Ministry of Defence

Army Equipment Support Publication

TRUCK UTILITY LIGHT (TUL) HS, TRUCK UTILITY MEDIUM (TUM) HS AND (TUM) BATTLEFIELD AMBULANCE HS, ALL VARIANTS

This publication contains information covering the requirement of Category 524 at level 4.

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PREFACE

Sponsor:	Operational Support Vehicles Programme (OSVP)
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INTRODUCTION

1 Users should forward any comments on this publication in accordance with Army Equipment Support Publication (AESP) 0100-P-011-013. All comments are only to be submitted using the electronic and interactive Form 10 which can be accessed and downloaded from the Joint Asset Management and Engineering Solutions (JAMES) Portal (via Hot Topic – Forms) or from DR TDOL (F10).

2 All electronic Form 10s are to be completed and forwarded to the Form 10 cell using the instructions accompanying the form in its template location. Security procedures are to be observed in accordance with Joint Services Publication (JSP) 440.

3 The Form 10 procedure is only to be used for the purpose of commenting on the content of an individual AESP and must not be used:

3.1 In place of the Equipment Failure Reporting (EFR) procedure outlined in The Land Equipment Unit Maintenance Standards (LEUMS).

3.2 For subjects which are the concern of the Technical Staff Suggestions outlined in Army General and Administrative Instructions (AGAI):

4 AESPs are issued under United Kingdom (UK) Ministry Of Defence (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.

5 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 contracts any portion of this publication it is to be taken as the overriding authority.

EQUIPMENT IDENTITY

6 The equipment identity details are listed in Table 1.

TABLE 1 EQUIPMENT IDENTITY

Serial (1)	Nomenclature (2)	NSN (3)	Asset Code (4)
1	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (Non EEGR)	2310-99-893-9746	NB 1047 3100
2	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (EEGR)	2310-99-893-9971	NB 1047 3101
3	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (Non EEGR) with Bowman NH	2310-99-908-6890	NB 1047 3160
4	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman NH	2310-99-908-6891	NB 1047 3161
5	Ambulance Battlefield (HS) 4 Stretcher LHD 4x4 Land Rover 2.5 Tdi (EEGR)	2310-99-893-9970	NB 1047 8100
6	Ambulance Battlefield (HS) 4 Stretcher LHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman NH	2310-99-908-6892	NB 1047 8160
7	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (EEGR) Semi Water (Proofed for 600mm Depth)	2310-99-908-5445	NB 1048 3100
8	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (EEGR) Semi Water (Proofed for 600mm Depth) with Bowman NH	2310-99-908-6893	NB 1048 3160
9	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (EEGR) Tropical	2310-99-908-5446	NB 1049 3100
10	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (EEGR) Tropical with Medical Monitoring IK	2310-99-908-6497	NB 1049 3101
11	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (Non EEGR) Tropical with Medical Monitoring IK	2310-99-908-6550	NB 1049 3102
12	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (EEGR) Desert with Medical Monitoring IK	2310-99-908-6705	NB 1049 3103
13	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (Non EEGR) Desert with Medical Monitoring IK	2310-99-908-6706	NB 1049 3104
14	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (EEGR) Tropical with Bowman NH	2310-99-908-6894	NB 1049 3160
15	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (EEGR) Tropical with Bowman NH & Medical Monitoring IK	2310-99-908-6895	NB 1049 3161
16	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (Non EEGR)Tropical With Bowman NH & Medical Monitoring IK	2310-99-908-6896	NB 1049 3162
17	Truck Utility Light (HS) GS (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter/Water	2320-99-893-9933	NB 4219 3100

(continued)

TABLE 1 EQUIPMENT IDENTITY (continued)

Serial (1)	Nomenclature (2)	NSN (3)	Asset Code (4)
18	Truck Utility Light (HS) GS (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9741	NB 4220 3100
19	Truck Utility Light (HS) GS (Soft Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9964	NB 4220 8100
20	Truck Utility Light (HS) GS (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter	2320-99-908-5441	RB 4224 3100
21	Truck Utility Light (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9742	NB 4225 3100
22	Truck Utility Light (HS) FFR (Hard Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9965	NB 4225 8100
23	Truck Utility Light (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter/Water	2320-99-893-9935	NB 4226 3100
24	Truck Utility Light (HS) FFR (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9936	NB 4228 3100
25	Truck Utility Light (HS) FFR (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Air Dropable	2320-99-908-5442	NB 4232 3100
26	Truck Utility Medium (HS) GS (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Heli Support	2320-99-908-5449	RB 5006 3100
27	Truck Utility Medium (HS) GS (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter/Water	2320-99-893-9938	NB 5008 3100
28	Truck Utility Medium (HS) GS (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter/Water	2320-99-893-9939	NB 5009 3100
29	Truck Utility Medium (HS) GS (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter / Water with Bowman NH	2320-99-908-6924	NB 5009 3160
30	Truck Utility Medium (HS) GS (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (Non EEGR)	2320-99-893-9743	NB 5010 3100
31	Truck Utility Medium (HS) GS (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9963	NB 5010 3101
32	Truck Utility Medium (HS) GS (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (Non EEGR) with Bowman NH	2320-99-908-6904	NB 5010 3161
33	Truck Utility Medium (HS) GS (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (Non EEGR) with BOWMAN SH	2320-99-908-6905	NB 5010 3171
34	Truck Utility Medium (HS) GS (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (Non EEGR) Trial Vehicle	2320-99-908-5511	NB 5010 3199
35	Truck Utility Medium (HS) GS (Soft Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9966	NB 5010 8100
36	Truck Utility Medium (HS) GS (Soft Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman NH	2320-99-908-6906	NB 5010 8160
37	Truck Utility Medium (HS) GS (Soft Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman SH	2320-99-908-6907	NB 5010 8170
38	Truck Utility Medium (HS) GS (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9940	NB 5017 3100
39	Truck Utility Medium (HS) GS (Hard Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9967	NB 5017 8100

(continued)

TABLE 1 EQUIPMENT IDENTITY (continued)

Serial (1)	Nomenclature (2)	NSN (3)	Asset Code (4)
40	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9744	NB 5020 3100
41	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with ODETTE DF IK	2320-99-908-5944	NB 5020 3101
42	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with ODETTE IC IK	2320-99-908-5945	NB 5020 3102
43	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with ODETTE TCAD IK	2320-99-908-5946	NB 5020 3103
44	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with WILDCAT IK	2320-99-908-6066	NB 5020 3104
45	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with SPICE IK	2320-99-908-6417	NB 5020 3107
46	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman NH	2320-99-908-6913	NB 5020 3160
47	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman SH	2320-99-908-6914	NB 5020 3170
48	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with BOWMAN BF LAS	2320-99-908-6911	NB 5020 3180
49	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with BOWMAN FF LAS	2320-99-908-6912	NB 5020 3190
50	Truck Utility Medium (HS) FFR (Hard Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9968	NB 5020 8100
51	Truck Utility Medium (HS) FFR (Hard Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR) with NBC Support	2320-99-908-6492	NB 5020 8104
52	Truck Utility Medium (HS) FFR (Hard Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman NH	2320-99-908-6918	NB 5020 8160
53	Truck Utility Medium (HS) FFR (Hard Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman SH	2320-99-908-6919	NB 5020 8170
54	Truck Utility Medium (HS) FFR (Hard Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman BF LAS	2320-99-908-6916	NB 5020 8180
55	Truck Utility Medium (HS) FFR (Hard Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman FF LAS	2320-99-908-6917	NB 5020 8190
56	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter/Water	2320-99-893-9941	NB 5021 3100
57	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter/Water with Bowman NH	2320-99-908-6926	NB 5021 3160
58	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter/Water with Bowman SH	2320-99-908-6927	NB 5021 3170
59	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter/Water with Bowman BF LAS	2320-99-908-6928	NB 5021 3180
60	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter/Water with Bowman FF LAS	2320-99-908-6920	NB 5021 3190

(continued)

TABLE 1 EQUIPMENT IDENTITY (continued)

Serial (1)	Nomenclature (2)	NSN (3)	Asset Code (4)
61	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with Commander's IK	2320-99-908-5720	NB 5022 3100
62	Truck Utility Medium (HS) FFR (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9745	NB 5031 3100
63	Truck Utility Medium (HS) FFR (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman NH	2320-99-908-6922	NB 5031 3160
64	Truck Utility Medium (HS) FFR (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman SH	2320-99-908-6923	NB 5031 3170
65	Truck Utility Medium (HS) FFR (Soft Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9969	NB 5031 8100
66	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) (SIGS)	2320-99-908-5272	NB 5035 3100
67	Truck Utility Medium (HS) GS (S/Wagon) RHD 4x4 Land Rover 2.5 Tdi (EEGR) 110 Media Operations Support Vehicle	2320-99-908-6976	NB 5040 3100
68	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter Heli Support vehicle	2320-99-908-5450	RB 5042 3100
69	Truck Utility Medium (HS) FFR 4x4 Land Rover 2.5 TDi (w/EEGR) Scout	2320-99-908-7633	NB 5033 3100
70	Truck Utility Medium (HS) GS (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) TETHYS IK FES	2320-99-490-5237	NB 5037 3100
71	Truck Utility Medium (HS) 4x4 GS (Hard Top) Land Rover 130 2.5 Tdi Double Cab Pickup (DCPU)	2320-99-908-7750	NB 5045 3100
72	Truck Utility Medium (HS) 4x4 GS (Soft Top) Land Rover 130 2.5 Tdi Double Cab Pickup (DCPU)	2320-99-908-7876	NB 5046 3100

7 Manufacturer:

7.1 Rover Group Ltd, Solihull, England.

RELATED AND ASSOCIATED PUBLICATIONS

Related Publications

8 The AESP Octad for the subject equipment consists of the publications shown below. All references are prefixed with the first eight digits of this publication.

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 Directives	111	111	111	111
	2	Cancellation Instructions	*	*	*	*
2	0	Operating Information	201	201	201	201
	1	Aide-Memoire	211	211	*	*
	2	Training Aids	*	*	*	*
3		Technical Description	302	*	*	*
4	1	Installation Instructions	411	411	411	411
	2	Preparation for Special Environments	421	421	421	421
5	1	Failure Diagnosis	*	512	512	512
	2	Maintenance Instructions	*	522	523	524
	3	Inspection Standards	*	532	533	533
	4	Calibration Procedures	*	*	524	524
6		Maintenance Schedules	601	601	601	601
7	1	Illustrated Parts Catalogues	711	711	711	711
	2	Commercial Parts Lists	*	721	721	721
	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)	*	*	*	*

* Category/sub-category not published

Associated Publications

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

Reference	Title
AESP 2610-B-100-013	Pneumatic, Solid And Cushioned Tyres, Tubes And Associated Road Wheels
AP 3260 Book 1	Mechanical Transport Maintenance Regulations for the Royal Air Force
JSP 800 Vol 5	Road Transport Regulations

WARNINGS AND CAUTIONS

WARNINGS

10 The following WARNINGS are used in this document:

(1) COOLING. THE HEATER UNIT OPERATES AT EXTREMELY HIGH TEMPERATURES. ENSURE THE HEATER AND EXHAUST SYSTEM HAVE COOLED DOWN SUFFICIENTLY BEFORE ATTEMPTING TO CARRY OUT ANY MAINTENANCE WORK.

(2) EYE CONTACT. ANTI-CORROSION LIQUID, MIST OR VAPOUR WILL CAUSE CONJUNTIVAL IRRITATION. CONTACT LENSES SHOULD BE REMOVED, AND IF CONTACT MADE, IRRIGATE WITH CLEAN FRESH WATER FOR AT LEAST 10 MINUTES HOLDING EYELIDS APART. SEEK MEDICAL ATTENTION IMMEDIATELY.

(3) FUEL. ENSURE ALL DISCONNECTED FUEL LINES ARE PLUGGED OR CLAMPED TO PREVENT THE ESCAPE OF HAZARDOUS FUEL.

(4) INGESTION. THE SWALLOWING OF ANTI-CORROSION MATERIAL CAN CAUSE VOMITING AND ABDOMINAL PAIN. IF INGESTED MEDICAL ATTENTION MUST BE SOUGHT IMMEDIATELY.

(5) INHALATION. INHALATION OF ANTI-CORROSION MATERIAL CAN CAUSE IRRITATION OF THE NOSE, THROAT AND RESPIRATORY TRACT, DROWSINESS AND HEADACHE. GOOD VENTILATION AND A FILTER TYPE RESPIRATOR MASK MUST BE USED AT ALL TIMES. IF INHALATED THE SUBJECT MUST BE REMOVED FROM EXPOSURE AND MEDICAL ATTENTION SOUGHT IMMEDIATELY.

(6) PROTECTIVE CLOTHING. ENSURE SUITABLE PROTECTIVE CLOTHING IS WORN BEFORE USING ANTI-CORROSION MATERIAL. ALWAYS WEAR SUITABLE PROTECTIVE OVERALLS, A FILTER TYPE RESPIRATOR, SAFETY GLASSES, GLOVES AND HEAD PROTECTION.

(7) PROTECTIVE CLOTHING. R134A IS A HAZARDOUS LIQUID AND WHEN HANDLED INCORRECTLY CAN CAUSE SERIOUS INJURY. SUITABLE PROTECTIVE CLOTHING MUST BE WORN WHEN CARRYING OUT SERVICING OPERATIONS ON THE AIR CONDITIONING SYSTEM.

(8) REFRIGERANT RECOVERY. THE REFRIGERANT USED IN AN AIR CONDITIONING SYSTEM MUST BE RECLAIMED IN ACCORDANCE WITH THE RECOMMENDATIONS GIVEN WITH A REFRIGERANT RECOVERY RECYCLING RECHARGING STATION.

(9) REFRIGERANT. THE REFRIGERANT USED IN THE AIR CONDITIONING SYSTEM IS HFC (HYDRO FLUOROCARBON) R134A.

(10) SKIN CONTACT. PROLONGED CONTACT WITH THE SKIN SHOULD BE AVOIDED AS IT CAN LEAD TO DEGREASING OF THE SKIN AND IRRITATION. WASH THOROUGHLY IN SOAP AND WATER OR USE A PROPRIETY SKIN CLEANER. SOLVENTS MUST NOT BE USED TO CLEAN THE SKIN. PROTECT EXPOSED SKIN WITH VASELINE PETROLEUM JELLY.

(11) SKIN CONTACT. R134A SPLASHED ON ANY PART OF THE BODY WILL CAUSE IMMEDIATE FREEZING OF THAT AREA. ALSO REFRIGERANT CYLINDERS AND REPLENISHMENT TROLLEYS WHEN DISCHARGING WILL FREEZE SKIN TO THEM IF CONTACT IS MADE.

(12) SMOKING. DO NOT SMOKE OR WELD IN AREAS WHERE R134A IS IN USE. INHALATION OF CONCENTRATIONS OF THE VAPOUR CAN CAUSE DIZZINESS, DISORIENTATION, NARCOSIS, NAUSEA OR VOMITING.

(continued)

WARNINGS (continued)

(13) SPONTANEOUS COMBUSTION. DO NOT ALLOW FLUIDS OTHER THAN R134A OR COMPRESSOR LUBRICANT TO ENTER THE AIR CONDITIONING SYSTEM. SPONTANEOUS COMBUSTION MAY OCCUR.

(14) TESTING. ENSURE ALL TEST RUNNING OF THE HEATER IS CARRIED OUT IN A WELL VENTILATED AREA.

(15) TOXIC GASES. R134A IS ODOURLESS AND COLOURLESS. DO NOT HANDLE OR DISCHARGE IN AN ENCLOSED AREA, OR IN ANY AREA WHERE THE VAPOUR OR LIQUID CAN COME IN CONTACT WITH NAKED FLAME OR HOT METAL. R134A IS NOT FLAMMABLE, BUT CAN FORM A HIGHLY TOXIC GAS.

(16) VENTILATION. ENSURE ALL WORK IS CARRIED OUT IN A WELL VENTILATED AREA.

CAUTIONS

12 The following CAUTIONS are used in this document:

(1) COMPONENT DAMAGE. A round nose tool must be used for this operation to avoid splitting the collar of the nut.

(2) DRILLING. The drilling of any part of the chassis structure is strictly prohibited.

(3) DRYING TIME. Allow adequate time for the vehicle to dry thoroughly prior to commencing re-treatment.

(4) NON-REPLACEABLE BEARING. Do not remove sector shaft bearings from casing. Replacement parts are not available. If sector shaft bearings are worn fit a new steering box.

(5) OVER SPRAYING. Avoid spraying propshaft and universal joints with solution.

(6) POWER STEERING FLUID. This is harmful to paintwork. Should any fluid seep onto body, chassis or any other components immediately wipe clean. It is most important that fluid drained from the system is not re-used

(7) PROPSHAFT. Do not apply product to the propshaft.

(8) SEAL DAMAGE. When reshimming valve and worm, extreme caution must be exercised to prevent seal damage during reassembly.

(9) SPRAY EQUIPMENT. High pressure spray equipment can be dangerous. Observe safety procedures at all times.

(10) STEAM CLEANING. The wax products are air drying and formulated to ensure flexibility of the coating when cured. Steam cleaning and ultra-high pressure washing can degrade them.

(11) TEMPERATURE. Cold water pressure washing is the preferred method for cleaning the chassis and surfaces underside of vehicle. In any event, water temperature should not exceed 60 °C.

(12) TORQUE SETTINGS. Wax treated surfaces can allow nuts and bolts to be overtightened. Always ensure nuts and bolts are cleaned free of wax with white spirit before tightening to the correct torque.

(13) WATER PRESSURE. Pressure of water should not exceed 1200 lb/in2. Ensure a distance of approximately 30 cms between the nozzle of the lance and surfaces in order to avoid accidentally damaging the original coating.

ABBREVIATIONS AND SYMBOLS

ABBREVIATIONS

13 The following abbreviations are used in this category:

Abbreviation	Definition
AESP	Army Equipment Support Publication
Amdt	Amendment
C	Celsius/Centigrade
CES	Complete Equipment Schedule
DA	Design Authority
DE&S	Defence Equipment and Support
DIN	Defence Instructions and Notice
DMC	Domestic Management Code
EEGR	Electric Exhaust Gas Recirculation
EMC	Electronic Magnetic Compatibility
ES	Equipment Support
ESPD	Equipment Support Policy Directive
FFR	Fitted For Radio
GS	General Service
HS	High Specification
IK	Installation Kit
IPT	Integrated Project Team
JSP	Joint Service Publication
kg	kilogramme(s)
km	kilometre(s)
kW	kilowatt(s)
LAD	Light Aid Detachment
lbf/ft	Pounds per Foot
lb/in^2	Pounds per Square Inch
LHD	Left Hand Drive
m	metre(s)
min	minute

(continued)

ABBREVIATIONS (continued)

Abbreviation	Definition
mm	millimetre(s)
MOD	Ministry of Defence
NATO	North Atlantic Treaty Organisation
Nm	Newton Metres
No.	Number
NSN	NATO Stock Number
Para	Paragraph
PCB	Printed Circuit Board
POC	Point of Contact
RAF	Royal Air Force
REME	Royal Electrical and Mechanical Engineers
RHD	Right Hand Drive
TDOL	Technical Documents On-Line
TUL	Truck Utility Light
TUM	Truck Utility Medium
UK	United Kingdom
W	Watts

SYMBOLS

14 The following symbol is used in this category:

Symbol	Definition
±	Plus or minus

CHAPTER 1

2.5 LITRE 300 TDI DIRECT INJECTED DIESEL ENGINE

CONTENTS

(continued)

CONTENTS (continued)

INTRODUCTION

1 This Chapter details the Base Repairs for Truck Utility Light (TUL) High Specification (HS), Truck Utility Medium (TUM) HS, and (TUM) Battlefield Ambulance HS vehicles fitted with the 2.5 litre 300Tdi direct injected turbocharged diesel engine, with the exception of the engine fuel and cooling systems which are dealt within Chapters 11 and 12 respectively.

NOTE

When receiving a new engine albeit Electric Exhaust Gas Recirculation (EEGR) or Non-EEGR, use the existing ancilliaries to dress the new engine to its original configuration (FFR only).

ENGINE REMOVAL FROM VEHICLE

2 Remove the engine from the vehicle (refer to Cat 523 Chap 1).

ANCILLARIES REMOVAL

3 Remove the engine ancillaries as follows:

3.1 Mount the engine on a suitable work stand.

3.2 Remove the 24 Volt alternator from the auxiliary mounting bracket (refer to Cat 522 Chap 13-1).

3.3 Remove the starter motor (refer to Cat 522 Chap 13-1).

3.4 Remove the inlet and exhaust manifolds (Cat 522 Chap 11-1).

3.5 Remove the fan and viscous coupling assembly (refer to Cat 522 Chap 12-1).

3.6 Remove the auto-tensioner and the main drive belt (refer to Cat 522 Chap 1-1).

3.7 Remove the power steering pump (refer to Cat 522 Chap 7-1).

3.8 Remove the water pump (refer to Cat 522 Chap 12-1).

3.9 Disconnect and remove the fuel supply pipes from the fuel injection pump (refer to Cat 522 Chap 11-1).

3.10 Remove the fuel lift pump (refer to Cat 522 Chap 11-1).

3.11 Remove the brake servo vacuum pump (refer to Cat 522 Chap 10-1).

3.12 Remove the oil filter assembly from the cylinder block. Unscrew the element and discard.

3.13 Remove the crankshaft pulley (refer to Cat 523 Chap 1).

3.14 Remove the clutch assembly from the flywheel (refer to Cat 522 Chap 2).

3.15 Remove the dipstick and oil sump (refer to Cat 522 Chap 1-1).

ENGINE

4 Table 1 details the sealants, adhesives and lubricants to be used.

TABLE 1 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	OMD 80	9150-99-335-3822	Engine oil
2	RTV	8030-99-224-6527	Silicon sealant

Dismantling

Cylinder head assembly

5 Remove, dismantle and overhaul cylinder head assembly (refer to Cat 522 Chap 1-1).

Timing covers, gears, belt, and pulleys

6 Remove and refit timing cover, gears, belt and pulleys (refer to Cat 523 Chap 1).

Cam follower assemblies

7 Remove and refit cam follower assemblies (refer to Cat 523 Chap 1).

Flywheel

8 Remove the flywheel (refer to Cat 523 Chap 1).

Crankshaft rear oil seal housing

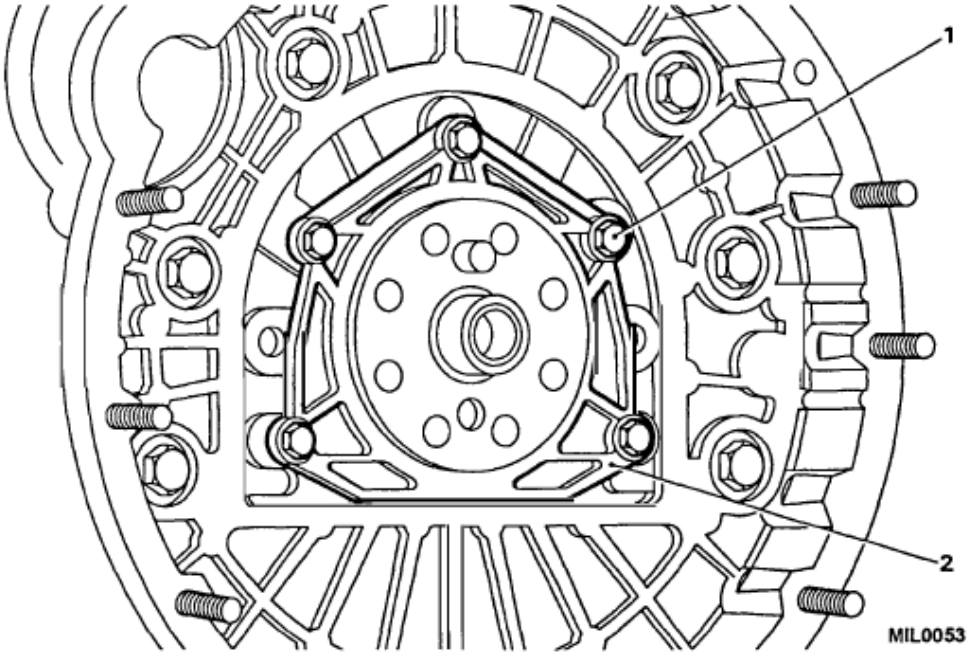
9 Remove the five retaining bolts (Fig 1 (1)) and withdraw the seal housing (2) and seal assembly complete with gasket.

Flywheel housing

10 To remove the flywheel housing proceed as follows:

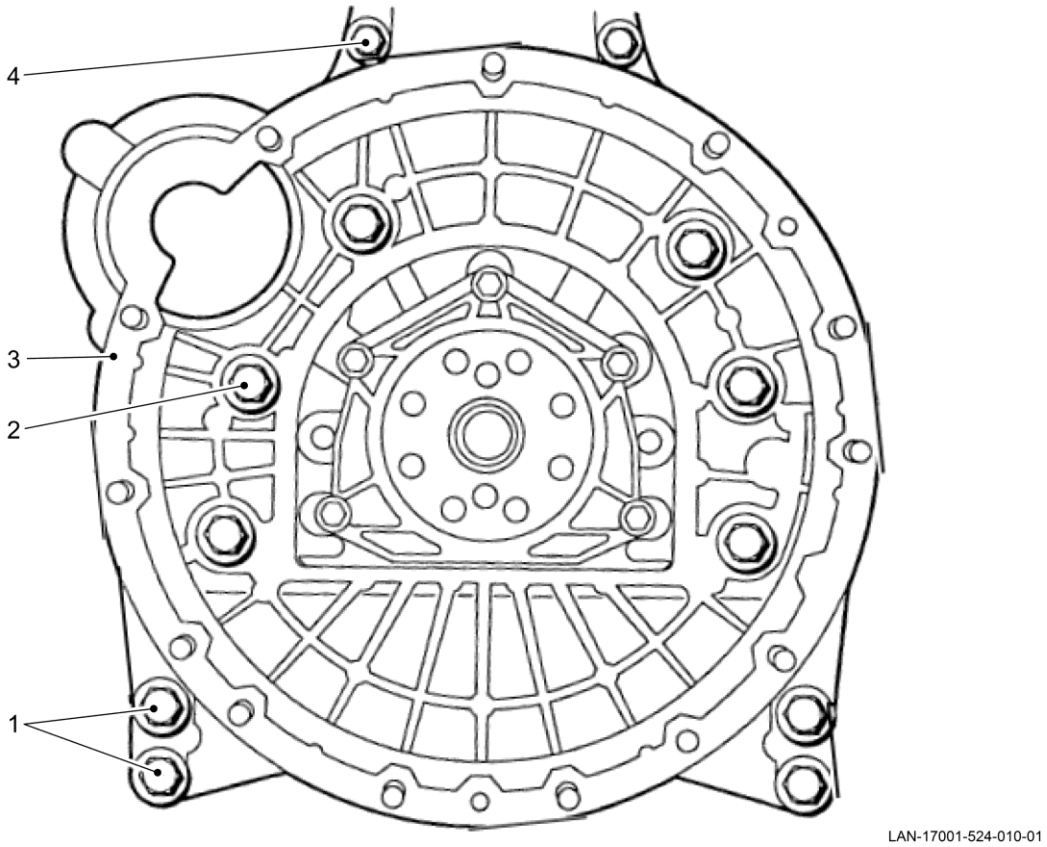
10.1 Remove the two bolts (Fig 2 (4)) securing the top of the flywheel housing to the cylinder block and the four bottom bolts (1) securing the flywheel housing to the engine mounting brackets.

10.2 Remove the six inner flywheel housing retaining bolts (2) and lift off the flywheel housing (3).



1 Retaining bolts 2 Seal housing

Fig 1 Crankshaft rear oil seal removal



1 Flywheel to mounting bracket bolts
2 Inner retaining bolts
3 Flywheel housing
4 Flywheel to engine block bolts

Fig 2 Flywheel housing removal

Auxiliary mounting bracket

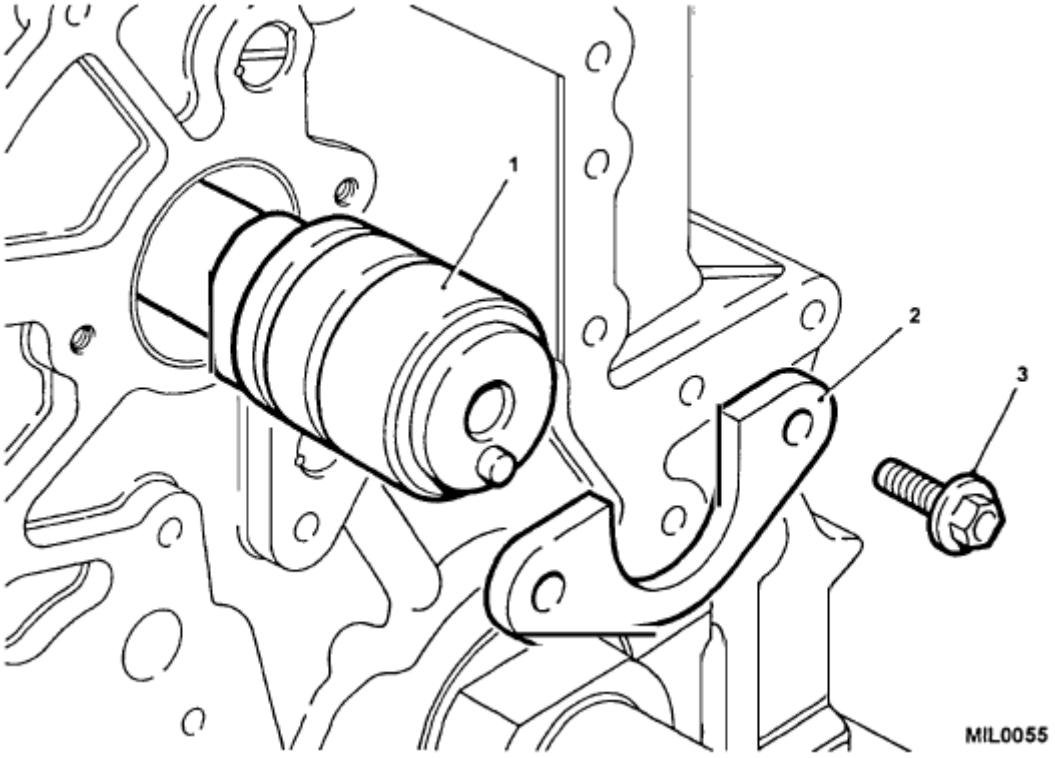
11 Remove the auxiliary mounting bracket (refer to Cat 522 Chap 12-1).

Camshaft

12 To remove the camshaft proceed as follows:

12.1 Remove the two securing screws (Fig 3 (3)) and remove the camshaft thrust plate (2).

12.2 Carefully withdraw the camshaft (1) taking care not to allow the end of the camshaft to drop onto the bearings as it is removed.



1 Camshaft 3 Bolt
2 Thrust plate

Fig 3 Camshaft removal

Connecting-rods and pistons

13 To remove the connecting-rods and pistons proceed as follows:

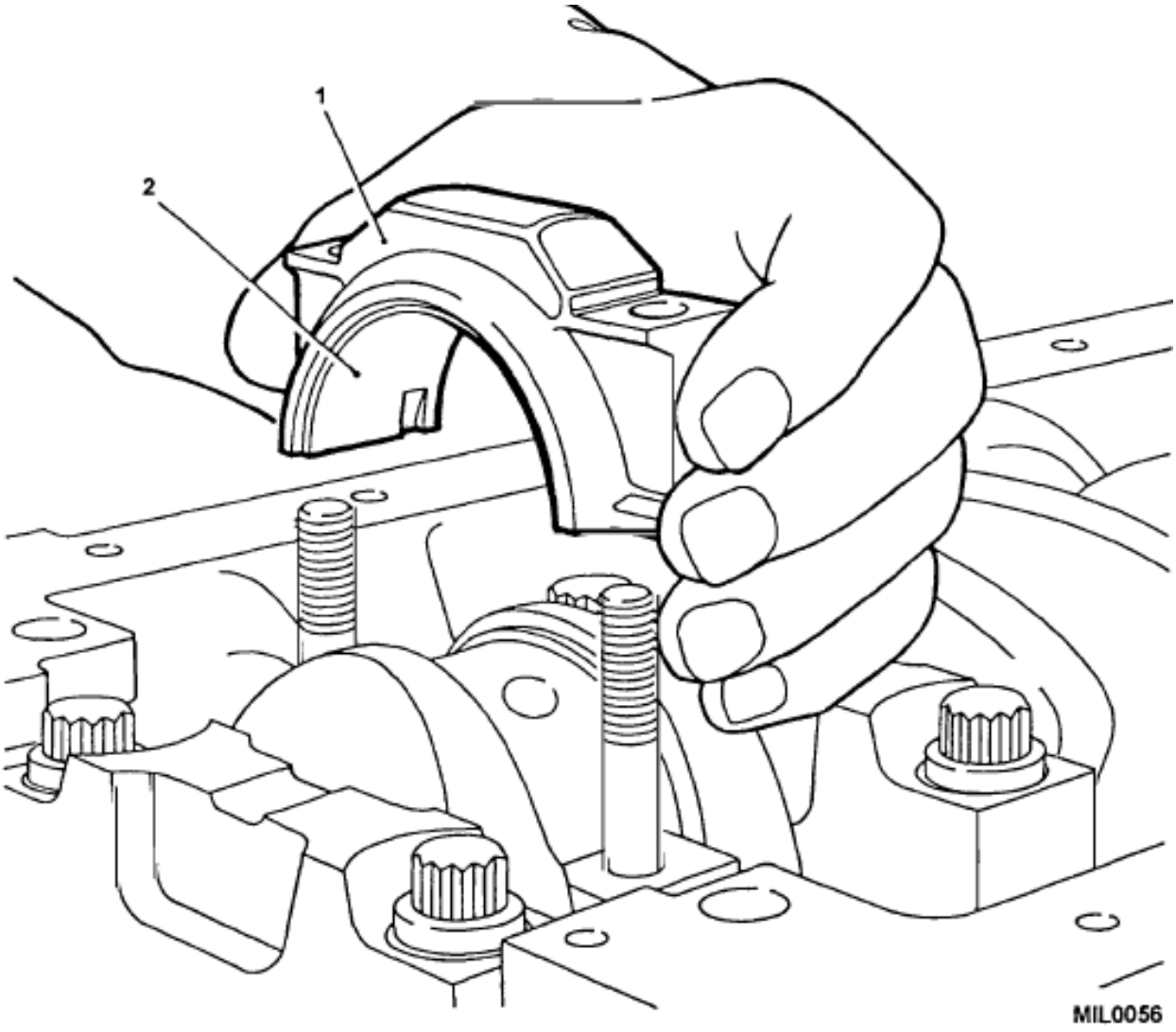
NOTE

Until it is decided if new components are required all parts must be kept in their related sets and position of each piston to its connecting-rod should be noted.

13.1 Turn the crankshaft to bring the connecting-rod caps (Fig 4 (1)) to an accessible position and slacken the nuts.

13.2 Remove the connecting-rod nuts and the caps in turn complete with the lower bearing halves (2). Note that the connecting-rod caps are numbered one to four.

13.3 Before removing the piston assemblies, number the corresponding piston to the bore and its relative end cap.



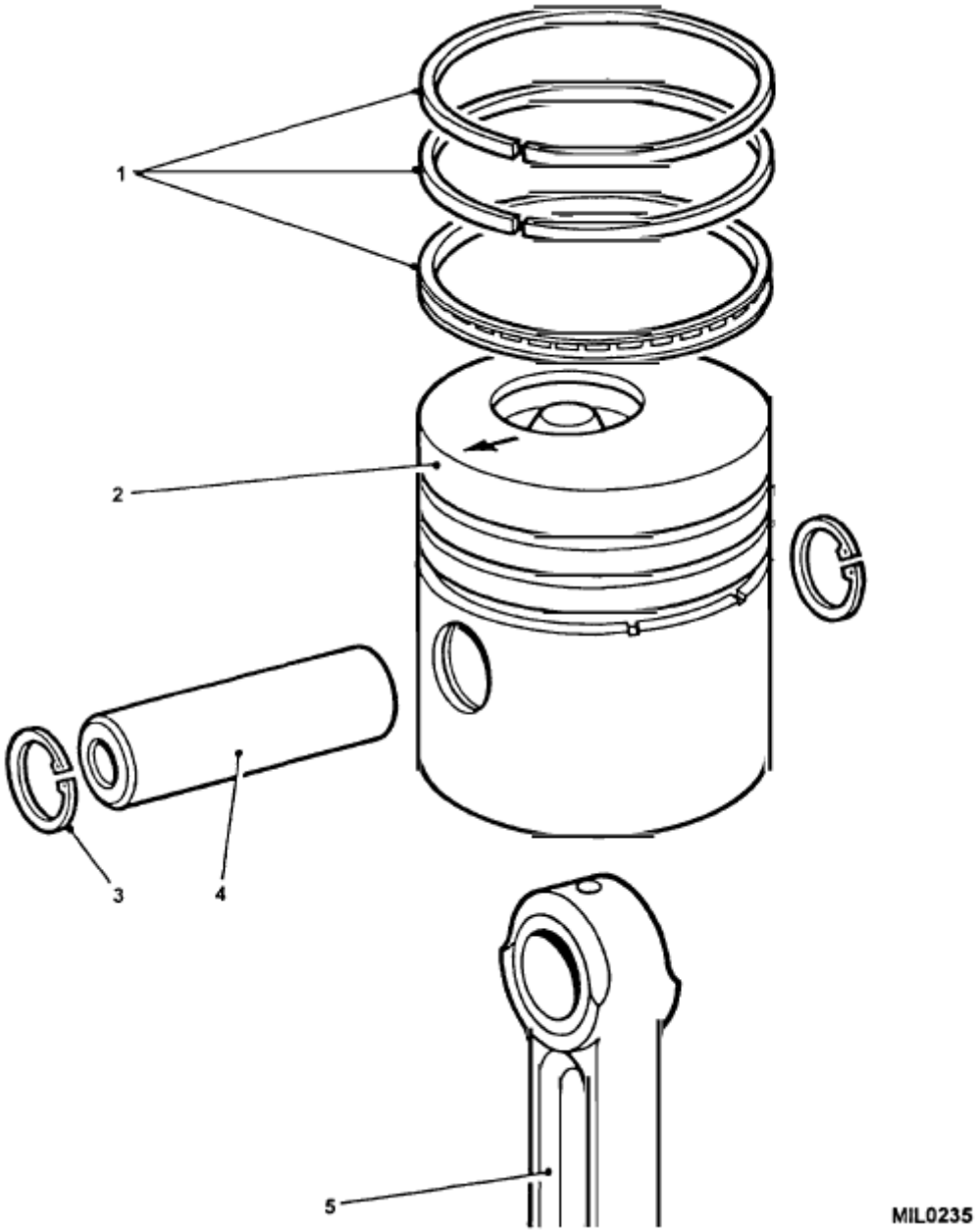
1 Connecting rod caps 2 Lower bearing halves

Fig 4 Connecting-rod caps removal

13.4 Taking care not to damage the bore, in turn push each piston assembly up the bore and withdraw from the cylinder block.

13.5 Remove the circlips (Fig 5 (3)) and gudgeon pin (4) from each piston (2) and detach connecting-rods (5).

13.6 Remove the piston rings (1) and retain with their respective pistons.



1 Piston rings
2 Piston
3 Circlip
4 Gudgeon pin
5 Connecting-rod

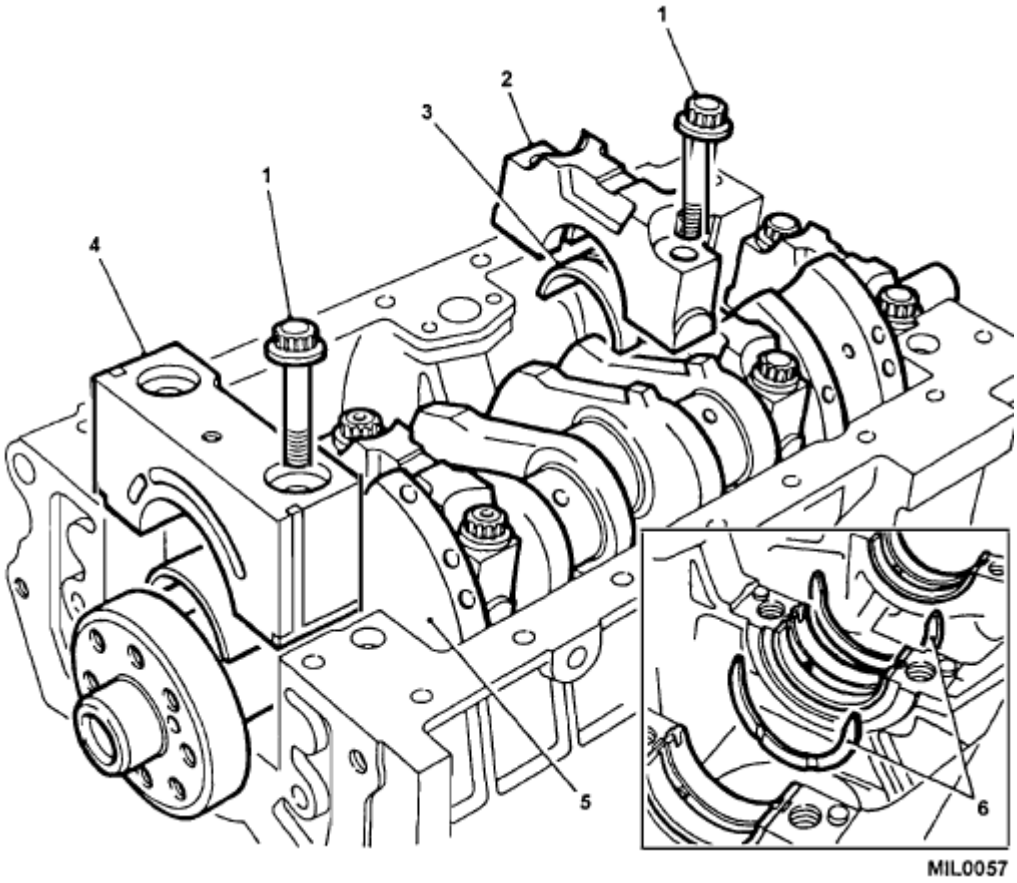
Fig 5 Piston and connecting-rod

Crankshaft

14 To remove the crankshaft proceed as follows:

14.1 Remove the bolts (Fig 6 (1)) securing the main bearing caps (2) and remove the caps and lower bearing shells (3).

14.2 Lift out the crankshaft (5), remove the main bearing upper shells from the saddles and the thrust washers (6) from the centre bearing location.



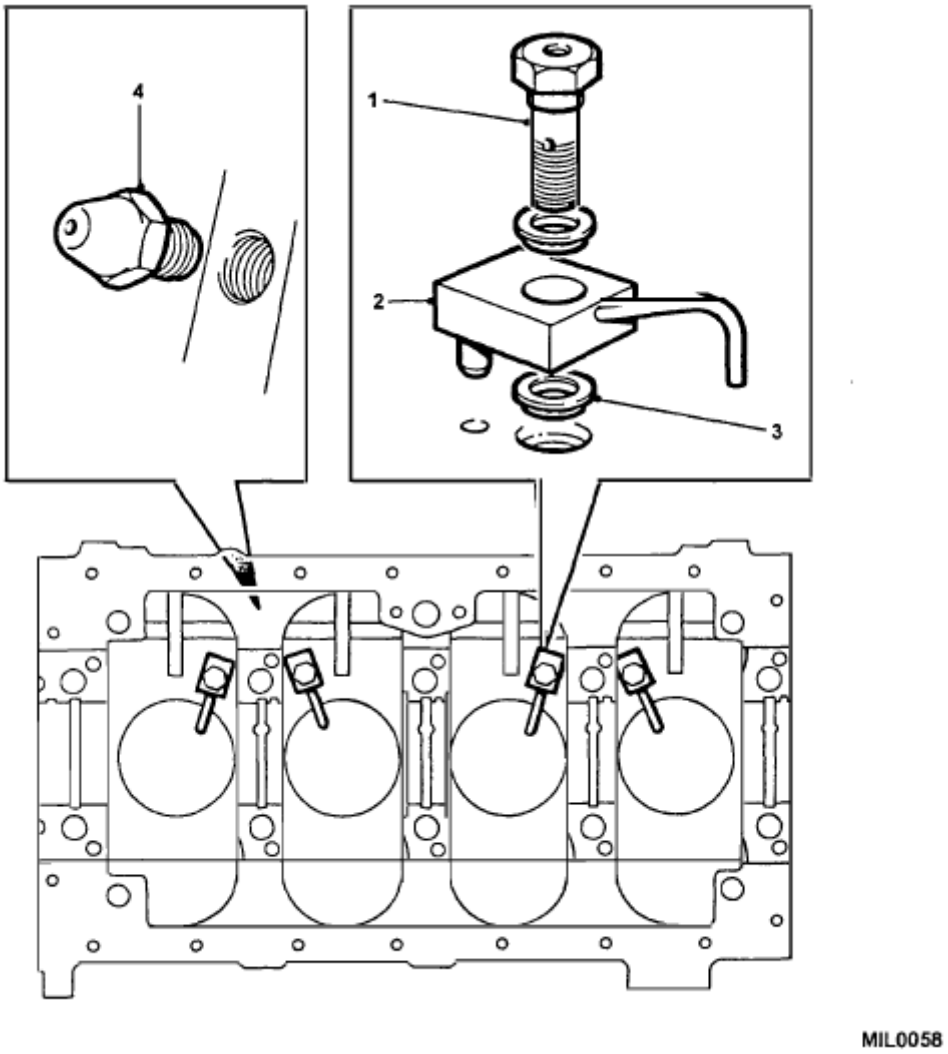
1	Bolts	4	No. 5 bearing cap
2	Main bearing caps	5	Crankshaft
3	Lower bearing shells	6	Thrust washers

Fig 6 Crankshaft removal

Oil jet tube assemblies

15 Remove the bolts (Fig 7 (1)) securing the jet tube assemblies to the cylinder block. Withdraw the jet tubes (2) and identify to the locations from which they were removed. Ensure that the washers (3), fitted under the jet tube bodies are retrieved from the recesses in the cylinder block.

15.1 Remove the vacuum pump cam oil squirt jet (4) the cam shaft chamber in the cylinder block.



1 Bolts 3 Washers
2 Jet tubes 4 Oil squirt jet

Fig 7 Oil jet tube assemblies

Oil pump

16 Remove the oil pump (refer to Cat 523 Chap 1).

Cleaning

17 Thoroughly clean and degrease all components ensuring that oil lubrication drillings and assage ways are clear. Remove all carbon deposits from the pistons.

Examination

Cylinder block

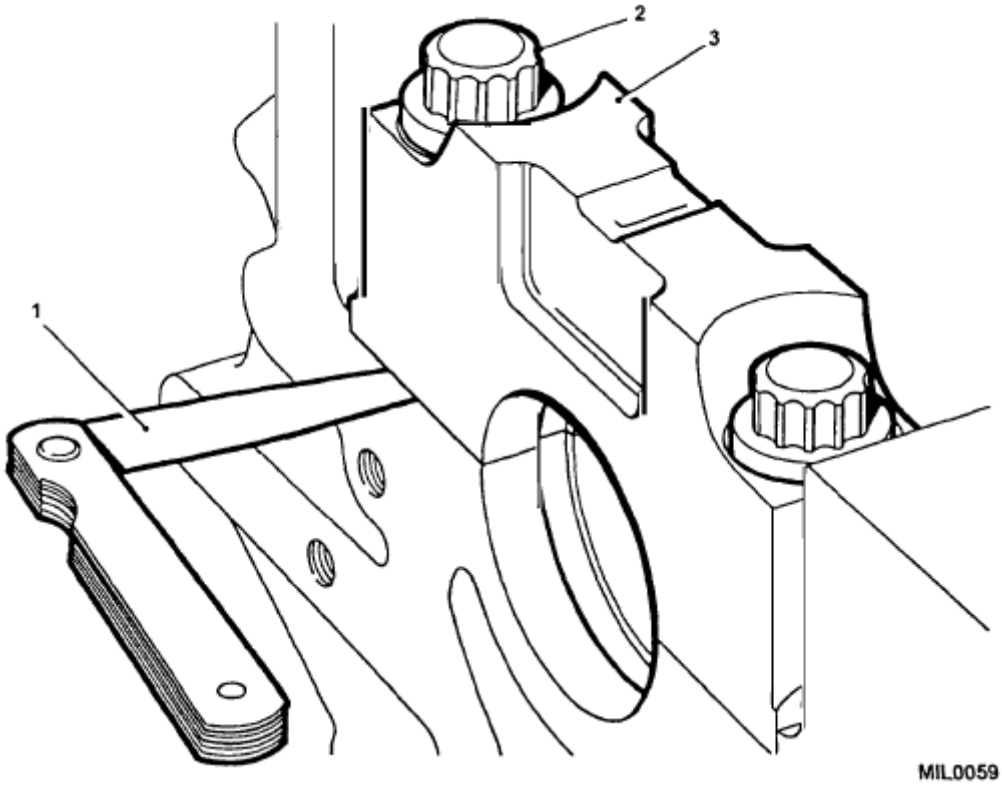
18 Examine the cylinder block as follows:

18.1 Visually examine for cracks, stripped threads and general damage.

18.2 Check the main bearing caps and cylinder block saddles for distortion.

18.2.1 Fit the main bearing caps (Fig 8 (3)) without the bearing shells, fit the securing bolts (2) and tighten to a torque of 133 Nm (98 lbf/ft).

18.2.2 Slacken the bolt on one side of each bearing cap and check, with feeler gauge (1), that no clearance exists at the joint face between the cap and saddle.



1 Feeler gauge 3 Bearing cap
2 Bolt

Fig 8 Checking main bearing caps

18.3 Examine the cylinder bores as follows:

18.3.1 Measure the bores for ovality using an internal micrometer. Check the ovality of each bore by taking a measurement at the top of the bore at two points diametrically opposite. The difference between the two figures is the ovality of the top of the bore.

18.3.2 Take similar measurements at approximately 50 mm (2.0 in.) from the bottom of the bore so that the overall ovality may be determined. Maximum permissible ovality 0.127 mm (0.006 in.).

18.3.3 Check the taper of each bore using a cylinder gauge by taking a measurement at the top and bottom of the bore at right angles to the gudgeon pin line. The difference between the two measurements is the taper. Maximum permissible taper 0.254 mm (0.01 in.).

18.3.4 Check the bores for maximum overall wear by taking measurements at as many points as possible down the bore at right angles to the gudgeon pin line. The largest dimension recorded is the maximum wear and should be compared with the original diameter of the cylinder bore. Maximum permissible wear 0.177 mm (0.007 in.).

18.3.5 If any of the above limits are exceeded the cylinders must be rebored.

18.3.6 If the overall wear, taper and ovality are within the acceptable limits and the original pistons are serviceable, new piston rings may be fitted. It is important however that the bores are deglazed, with a hone, to give a cross-hatched finish to provide a seating for the new rings. It is vital to thoroughly wash the bores to remove all traces of abrasive material after honing.

18.4 Check the camshaft bearings as follows:

18.4.1 Check the camshaft bearings for pitting or scoring, If damage is evident they must be renewed.

18.4.2 Measure the internal diameter of each bearing at several points using an internal micrometer. A comparison of the bearing diameters with those of the respective camshaft journals will give the amount of clearance. The bearings should be renewed if the clearance exceeds 0.0508 mm (0.002 in.).

Crankcase main bearings

19 To examine the crankcase main bearing shells proceed as follows:

19.1 Check the bearing shells for pitting, scoring or excessive wear. If damage is evident they must be renewed.

19.2 Assemble the bearing shells to the locations from which they were removed from the crankcase, fit the bearing caps and tighten to the correct torque (133 Nm (98 Ibf/ft)).

19.3 Using an internal micrometer, measure each bearing at several points noting the greatest diameter recorded. The maximum wear is the difference between this figure and the smallest dimension taken from the corresponding crankshaft journal. Acceptable main bearing running diametrical clearance is between 0.0792 mm and 0.0307 mm (0.003 in. and 0.0012 in.).

Crankshaft

20 To examine the crankshaft proceed as follows:

20.1 Visually examine the main bearing journals and crankpins for obvious wear, scores, grooves and overheating. Ensure that all oilways are clear. If it is considered that the shaft is worth more detailed examination, with a micrometer measure and note the ovality and taper of each main bearing journal and crankpin as follows:

20.1.1 Measure the ovality by taking two readings at right angles to each other at various intervals. The maximum ovality must not exceed 0.040 mm (0.0016 in.).

20.1.2 Measure the taper by taking two readings parallel to each other at both ends of the main bearing journal and crankpin. The maximum permissible taper must not exceed 0.025 mm (0.001 in.).

20.1.3 Measure the straightness by supporting the front and rear main bearing journals in Wee" blocks (Fig 9) and position a dial indicator to check the run-out at the centre main bearing journal. Run-out must not exceed 0.076 mm (0.003 in.) taking into account any ovality in the centre journal.

20.1.4 The overall allowable wear limits should not exceed 0.114 mm (0.0045 in.) for main bearing journals and 0.088 mm (0.0035 in.) for crankpins. Crankshafts worn beyond the limits of maximum taper, ovality and overall wear can be ground undersize, for which bearing shells are available. Crankshafts exceeding the limits of straightness must be scrapped, no attempt should be made to straighten them.

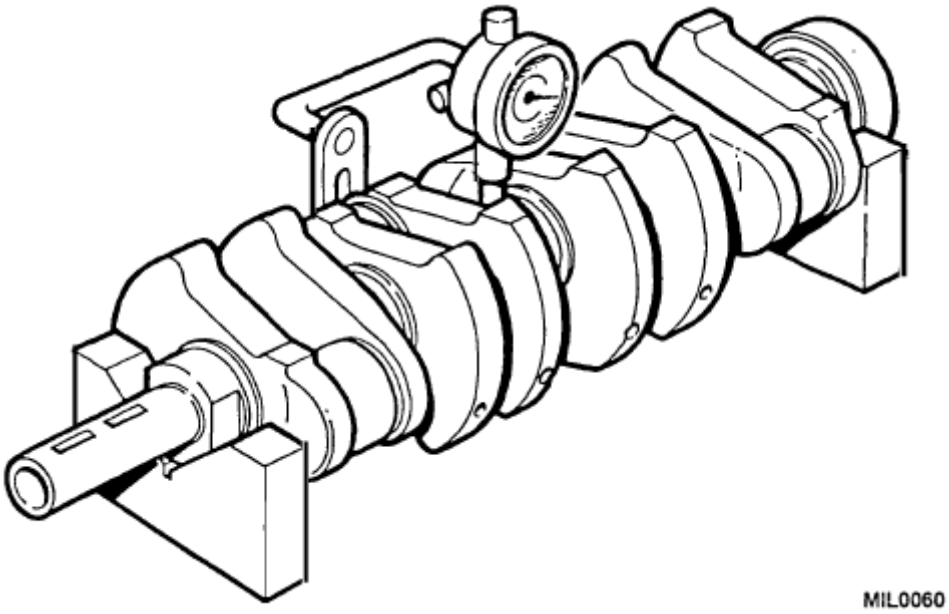


Fig 9 Checking the crankshaft for straightness

Camshaft

21 Examine the camshaft for scored, worn, pitted or chipped cams. Worn, corroded and discoloured bearing journals. If any of the foregoing are evident the camshaft must be renewed.

Pistons and connecting-rods

22 To examine the pistons, piston rings, gudgeon pins and connecting-rods proceed as follows:

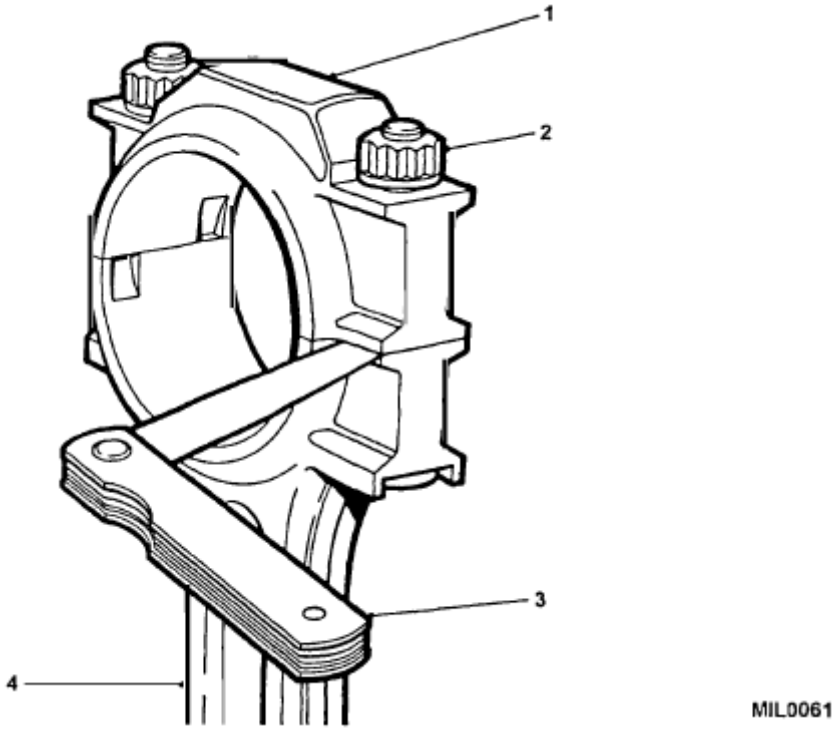
22.1 Carry out a visual examination of the pistons and rings, discard any that are considered to be unserviceable. Pistons which appear to be serviceable should be subjected to a more detailed examination described under New pistons" (refer to Para 28).

22.2 Check the gudgeon pins for wear, cracks, scores and overheating. The fit in the piston must be a tight push fit at a temperature of 20º C. Check the gudgeon pin for ovality and taper using a micrometer.

22.3 Check the connecting-rods and caps for distortion as follows:

22.3.1 Fit the connecting-rod caps (Fig 10 (1)) less the bearing shells to their respective connecting-rods (4) as denoted by the number stamped near the joint faces. Tighten the nuts (2) to a torque of 59 Nm (43 lbf/ft), then release one nut on each cap. Using feeler gauges (3), check that no clearance exists between the joint faces. If there is a gap the connecting-rod is distorted and must be renewed.

22.3.2 Check the rods for bend and twist. The maximum allowable for both conditions must not exceed 0.127 mm per 25.4 mm (0.005 in. per 1.00 in.) between bore centres.



1 Connecting rod caps
2 Nuts
3 Feeler gauge
4 Connecting rod

Fig 10 Checking connecting-rod caps for distortion

22.3.3 Examine and check the small-end bearing for wear, if necessary renew the bush. The correct clearance of the gudgeon pin in the small-end bush is 0.0157 mm to 0.003 mm (0.0001 in. to 0.0006 in.).

22.3.4 Connecting-rod bearings that are worn, pitted or scored and show signs of overheating must be discarded. If more than one of the bearings show these signs they must all be renewed. When fitting new or used bearings to serviceable crankpins the clearances must be checked.

Oil pump

23 To examine the oil pump carry out the following:

23.1 Inspect the components and renew as necessary.

23.2 Examine the gears for wear, scores and pitting.

23.3 Examine the gear thrust face on the pump cover for scores and scratches.

23.4 Examine the oil pump gallery in the timing case housing for wear and severe scoring.

23.5 Examine the relief valve spring and plunger for wear and scores.

Repair and replacement

Cylinder bores

24 Worn cylinder bores may only be reclaimed by reboring to a maximum of 0.50 mm (0.2 in.) depending on the condition of the bores and the amount of wear.

NOTE

It is not permissible to reclaim the cylinder block by fitting cylinder liners.

24.1 Hone the bore to accommodate the new pistons with the required clearances.

Camshaft bearings renew

General

25 The special tools required to carry out the overhaul operation are no longer available from the manufacturers. The work should be entrusted to line-boring specialists.

Crankshaft

Regrinding

26 Crankshaft main bearing and crankpin journals may be ground undersize and undersize shell bearings fitted.

27 It is vital to thoroughly wash the crankshaft after machining to remove all traces of abrasive material, ensuring all oil galleries are clean.

New pistons

General

28 Original pistons fitted to new engines at the factory are specially graded to facilitate assembly. The grade letter on the piston crown should be ignored when ordering new pistons. Service standard size pistons (ERR 2412) are fitted to production engines.

28.1 When fitting new pistons to a standard size cylinder block the bores must be honed to accommodate the pistons with the correct clearances. In addition, new pistons are available 0.254 mm (0.010 in.) - STC 298210 and 0.508 mm (0.020 in.) - STC 298220 oversize for fitting to rebored cylinder blocks.

28.2 For clearance limits for new standard size pistons in a standard cylinder bore measured at right angles to the gudgeon pin refer to (Cat 532 Chap 1).

Checking clearances

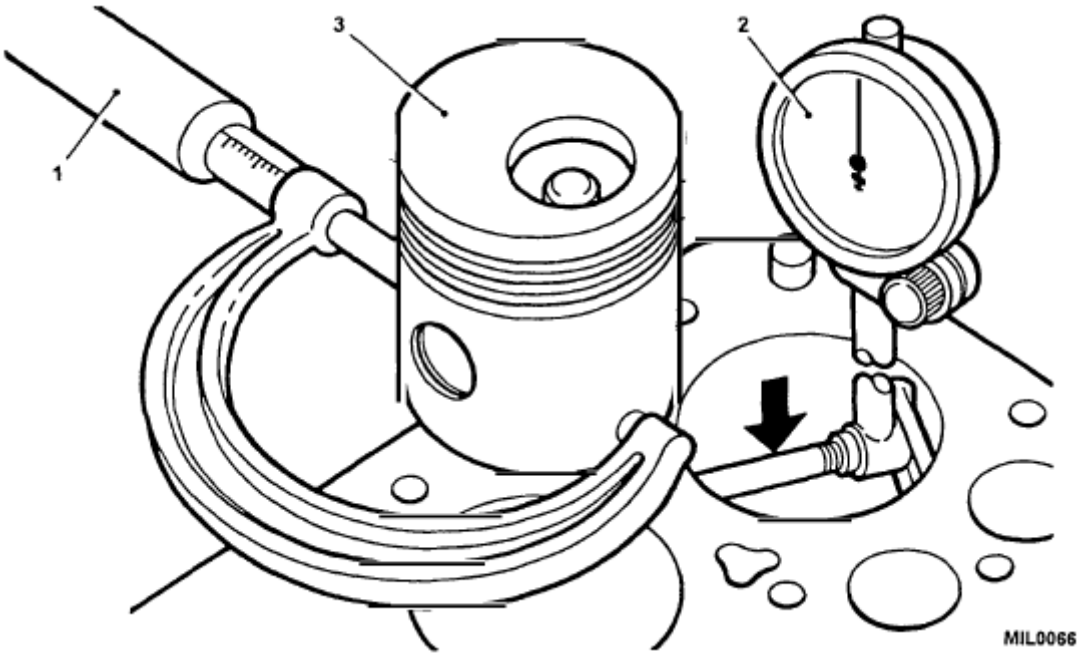
29 When checking clearances the cylinder block and pistons must be at the same temperature to ensure accuracy. To check the clearances carry out the following:

29.1 Using a suitable micrometer (Fig 11 (1)) or vernier measure the pistons (3) at the bottom of the skirt at right angles to the gudgeon pin.

29.2 With cylinder gauge (2) measure the bore at approximately half-way down and note the reading.

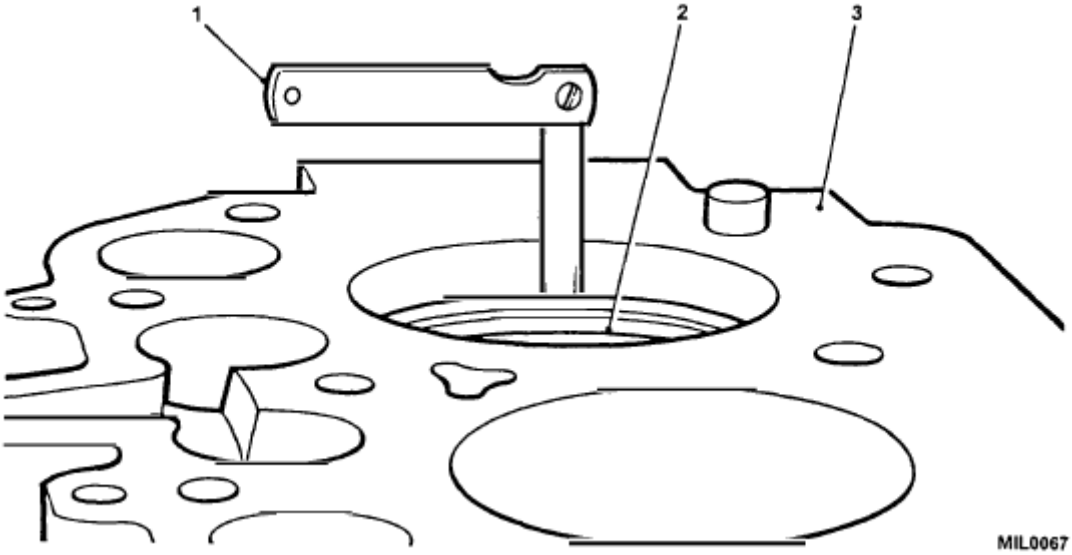
29.3 The clearance is determined by subtracting the piston diameter from the bore diameter.

29.4 Alternatively a feeler guage (Fig 12 (1)) can be used to measure the clearance.



1 Micrometer
2 Cylinder gauge
3 Piston

Fig 11 Checking piston to bore clearance



1 Feeler gauge
2 Piston
3 Engine block

Fig 12 Alternative method of checking piston to bore clearance

Piston rings

General

30 Normally when an engine is being overhauled the piston rings are discarded unless the pistons have been removed for a different purpose and the engine has only completed a small mileage. Before refitting the pistons the rings should be examined for wear and damage. In addition the rings must be checked for side clearance in the pistons and gap in the bores. These checks must also be carried out when fitting new rings to new and used pistons.

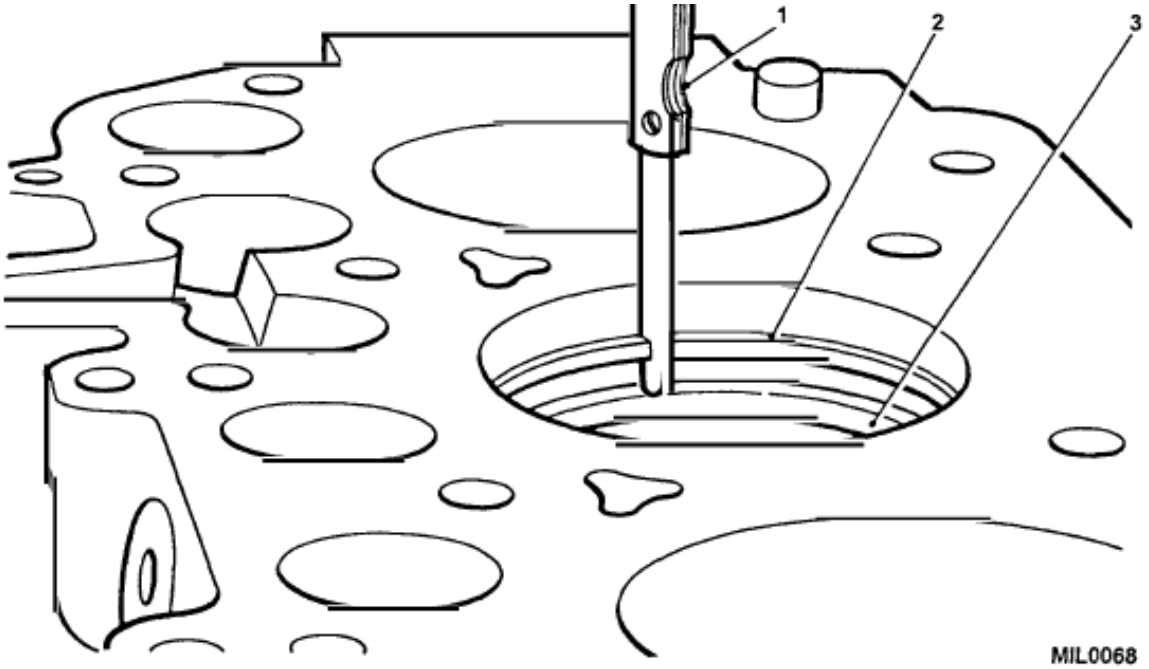
Checking gaps

31 When checking the piston ring gap in worn bores which are within the acceptable taper and ovality limits, the ring must be inserted squarely into the bottom of the cylinder bore at the lowest point of the piston travel. To ensure squareness push the ring down the bore to the correct position using a piston. With newly machined bores, the ring may be inserted squarely into any position in the bore. To check the gaps proceed as follows:

31.1 Using an appropriate feeler gauge (Fig 13 (1)) check the gaps of all the rings (2), in turn, including the oil control ring assembly (3).

31.2 For the correct gaps refer to (Cat 532 Chap 1).

31.3 Once the rings have been selected for a particular cylinder and piston ensure that they are retained as a set.



1 Feeler gauge 3 Oil control ring assembly
2 Piston ring

Fig 13 Checking piston ring gap

Checking groove clearance

32 It is important that the groove clearances are correct. Rings that are too tight may bind or fracture when hot and cause loss of compression. Excessive clearance allows the rings to rock in the groove and may result in a pumping action and excessive oil consumption. To check the piston ring groove clearance carry out the following:

32.1 Fit the oil control ring expander to the bottom groove. Fit the oil control ring ensuring that it fits over the expander. Fit the second, narrow, compression ring with the word "TOP" uppermost. Likewise fit the first compression ring to the top groove, word "TOP" uppermost. M1L0069

32.2 After fitting slide each ring around the groove to ensure that it is free and does not bind.

32.3 Using an appropriate feeler gauge check the groove clearance between the rings and the piston (Fig 14). For acceptable clearances (refer to Cat 532 Chap 1). Clearances in excess of the limits are unacceptable and the ring and or the pistons should be renewed.

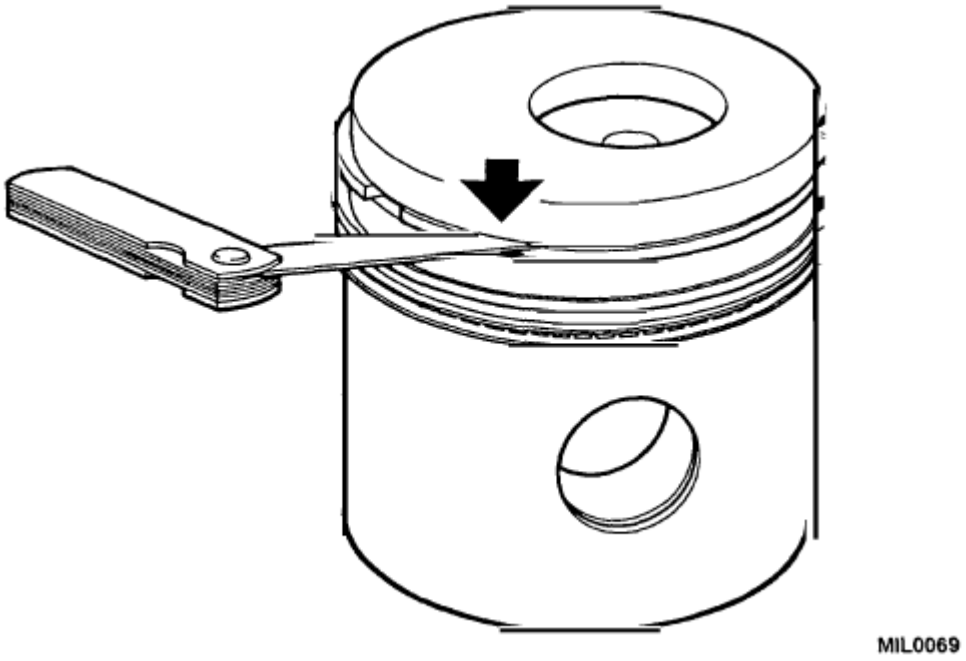


Fig 14 Checking the piston ring groove clearance

Oil pump

Displacement gears

33 If either of the pump displacement gears are worn they should be replaced as a pair (refer to Cat 523 Chap 1).

NOTE

There is no repair procedure for the oil pump assembly, if either the pump gears, thrust plate or pump housing are seriously worn, scratched or pitted the whole timing case rear housing and oil pump assembly must be replaced.

Reassembly

Oil jet tube assemblies

NOTE

The oil jet tube assemblies are "Handed" and can only be fitted one way. It is important to note that the jet retaining bolt contains a non-return valve and under no circumstances should an ordinary bolt be fitted.

34 Fit the jet tubes as illustrated (Fig 7) ensuring that the dowels locate in the holes in the cylinder block, and that the large diameter washer is fitted under the bolt head.

34.1 Before tightening the retaining bolts ensure that the jet pipes do not foul the crankshaft or pistons. When the crankshaft and pistons have been fitted slowly turn the crankshaft and check that no fouling occurs. Tighten the bolts to a torque of 17 Nm (13 lbf/ft).

34.2 Fit the vacuum cam oil squirt jet to the cylinder block cam shaft chamber and tighten to a torque of 7 Nm (5 lbf/ft).

Crankshaft

Main bearing nip and clearance

NOTE

New main bearing shells are supplied with a protective coating and must be degreased before being fitted.

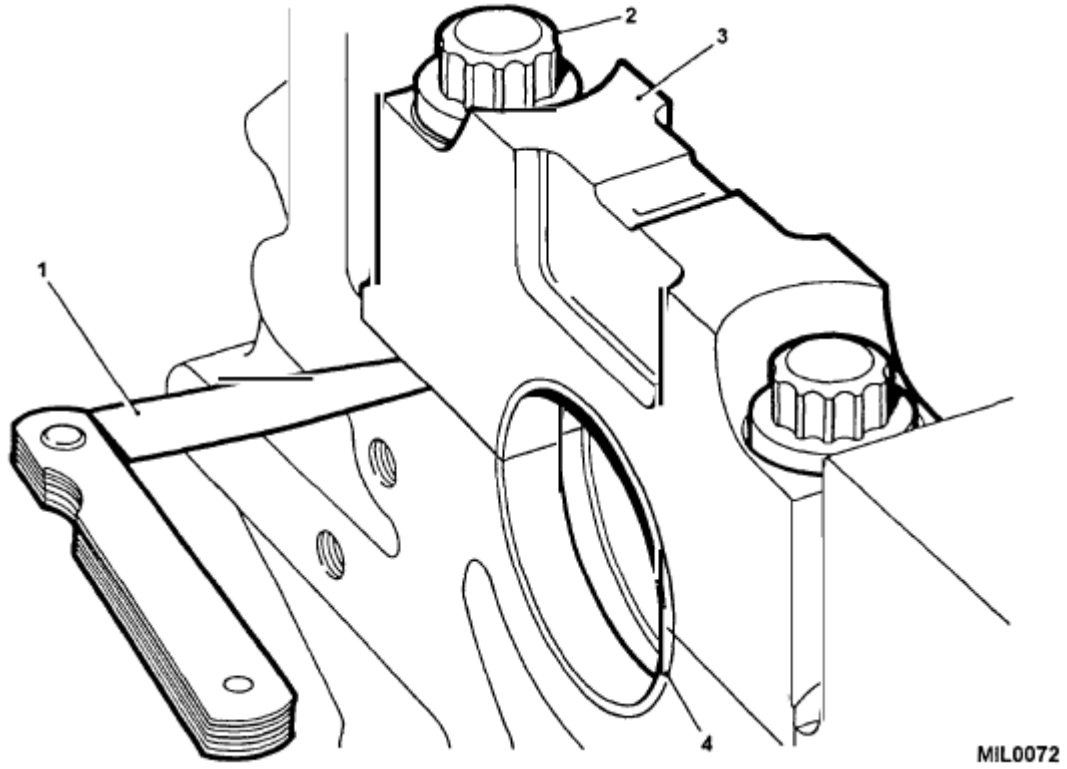
35 Check the main bearing nip and clearance as follows:

35.1 Fit the bearing halves (Fig 15 (4)) to the cylinder block ensuring full engagement of the location tags.

35.2 Fit the other half shells into the main bearing caps (3), again ensuring that the tags locate correctly.

35.3 Fit all the main bearing caps to their original locations tightening the bolts (2) to the correct torque (refer to Para 35.7), then release one bolt on each cap.

35.4 Check the gap between the joint faces (Fig 15). The clearance or nip must be within 0.10 mm to 0.15 mm (0.004 in. to 0.006 in.) to ensure that the bearings are correctly clamped.



1	Feeler gauge	3	Main bearing cap
2	Bolt	4	Bearing shells

Fig 15 Checking main bearing nip

35.5 The bearing nip can be adjusted by selective assembly of the bearing halves, available in varying thicknesses. Do not file or machine the caps or saddles to achieve the correct clearance. Note that the rear bearings are wider than the remaining four.

35.6 To make a final check that the clearance is correct, leave the bearing halves in the cylinder block and carefully lower the crankshaft into position.

35.7 Check each bearing in turn by inserting a 0.063 mm (0.0025 in.) shim paper (1) between the bearing cap and crankshaft journal and tighten the bolts to a torque of 39 Nm (29 lbf/ft). If the clearance is correct, there should be a slight increase in the resistance to rotation of the crankshaft.

35.8 As an alternative "Plastigauge" may be used to check the clearance.

Crankshaft end-float

36 To adjust the crankshaft end-float proceed as follows:

36.1 Lift out the crankshaft and insert a standard size thrust washer (refer to Fig 16) both sides of the centre main bearing saddle with the grooves towards the crankshaft.

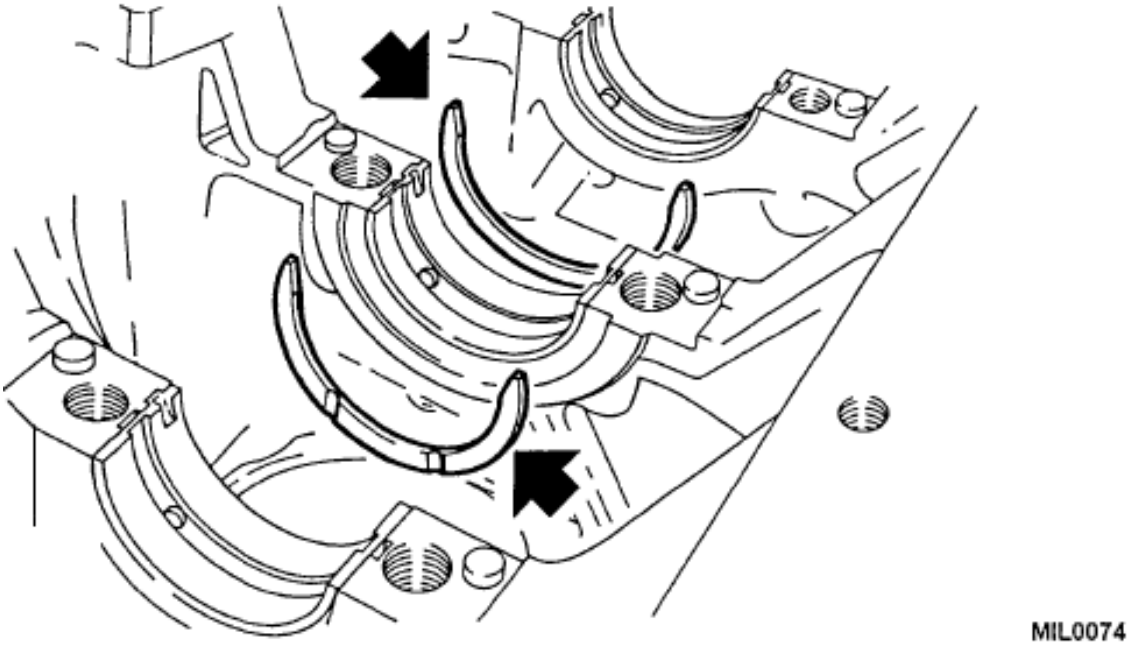
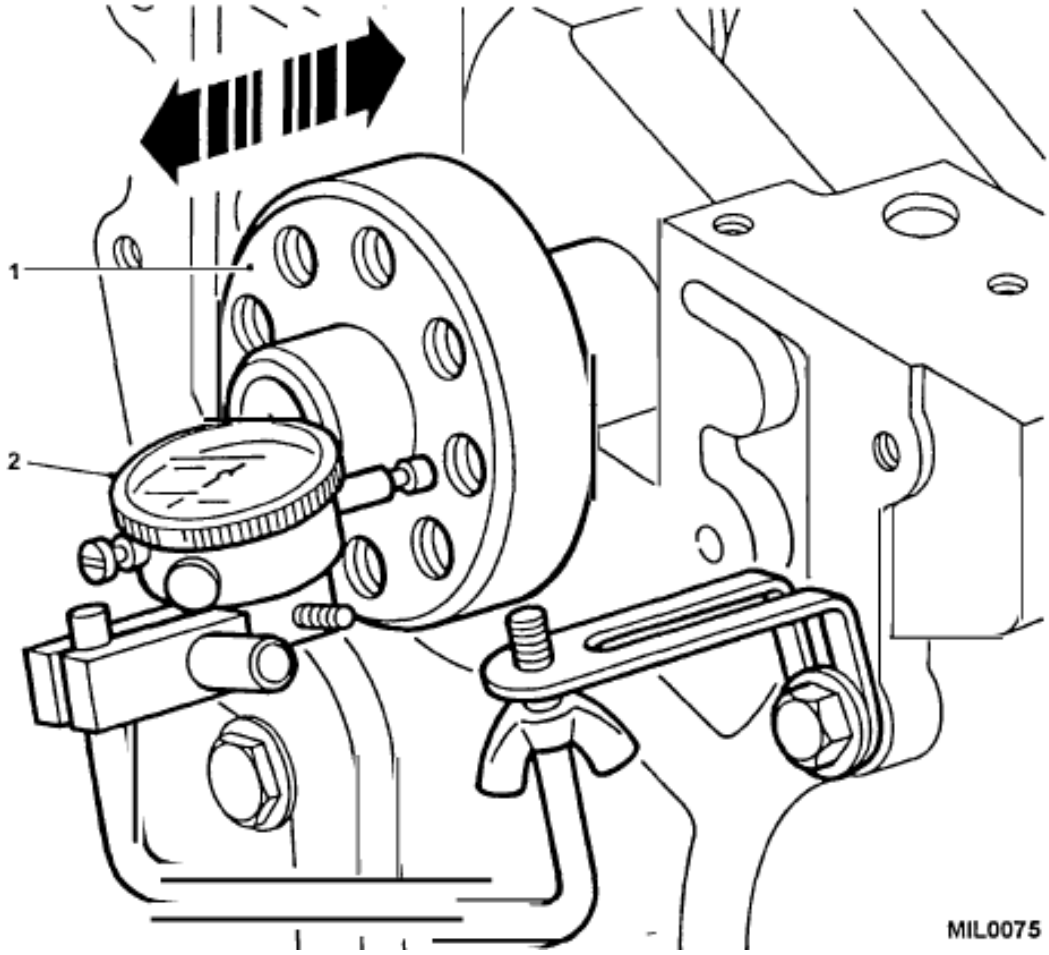


Fig 16 Fitting thrust washers to centre bearing saddle

36.2 Lubricate the cylinder block bearing shells and place the crankshaft (Fig 17 (1)) in position and mount a dial test indicator (2) to read off the end of the crankshaft.

36.3 Determine the end-float by moving the crankshaft away from the indicator and zero the dial, then move the crankshaft in the opposite direction and note the indicator reading. The end-float should be 0.05 mm to 0.15 mm (0.002 in. to 0.006 in.).

36.4 Alternatively measure the clearance with a feeler gauge. If adjustment is required substitute with oversize thrust washers. Variation of thrust washer thicknesses at each side of the crankshaft journal must not exceed 0.08 mm (0.003 in.) to ensure that the crankshaft remains centralised.



1 Crankshaft 2 Dial test indicator

Fig 17 Checking crankshaft end-float

Main bearing caps

37 To fit the main bearing caps proceed as follows:

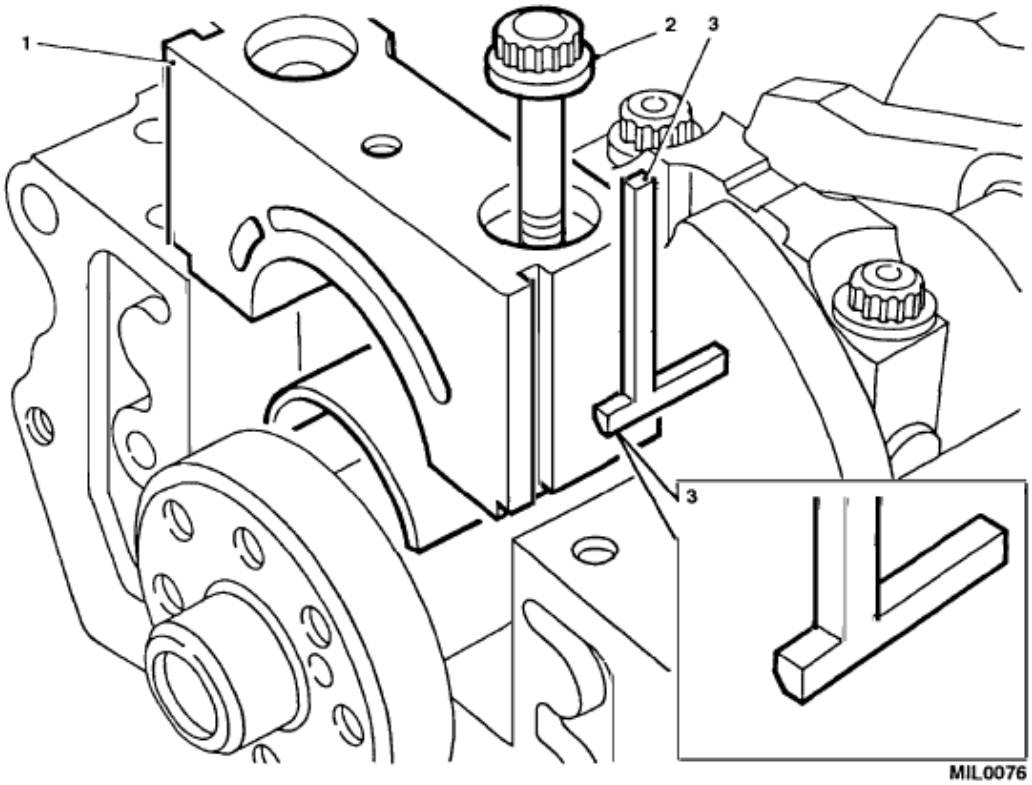
37.1 Lubricate the crankshaft main bearing journals with clean engine oil (refer to Table 1, Serial 1) and fit the centre main bearing cap, tighten the bolts to a torque of 133 Nm (98 lbf/ft) and ensure that the shaft is free to rotate before fitting the next bearing cap.

37.2 Fit No. 1, No. 2 and No. 4 main bearing caps checking that the shaft is free to rotate after tightening the bolts for each.

NOTE

The retaining bolts for No. 4 main bearing cap have threaded heads, these double as the mounting for the oil pick up strainer assembly so should not be replaced in any other position.

37.3 Ensure that No. 5 main bearing cap (Fig 18 (1)) is clean and free from old seal material.



1 No. 5 main bearing cap
2 Bolt
3 Sealing material

Fig 18 Fitting No. 5 main bearing cap

37.4 To prevent any seal material (3) becoming trapped between the bearing cap and crankcase, chamfer the inner edge of the seal 0.40 mm to 0.80 mm (0.016 in. to 0.03 in.) wide.

37.5 Smear the seals with clean engine oil (refer to Table 1, Serial 1) and fit them to the bearing cap (1). Fit the bearing cap complete with new bolts (2) and tighten to a torque of 133 Nm (98 lbf/ft). Remove seal guides and check that the shaft is free to rotate.

37.6 To allow for shrinkage after fitting leave the seals standing proud of the crankcase face then using a sharp blade, trim the seals off to approximately 0.80 mm (0.03 in.) above the crankcase face (refer to Fig 19).

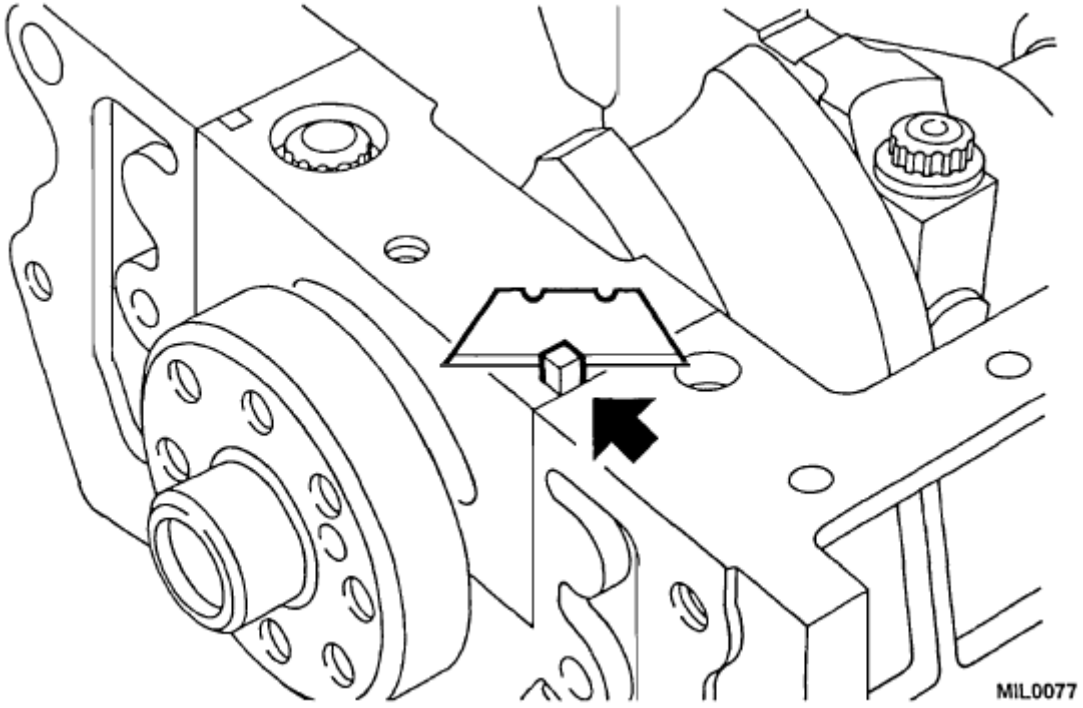


Fig 19 Trimming No. 5 main bearing cap seals

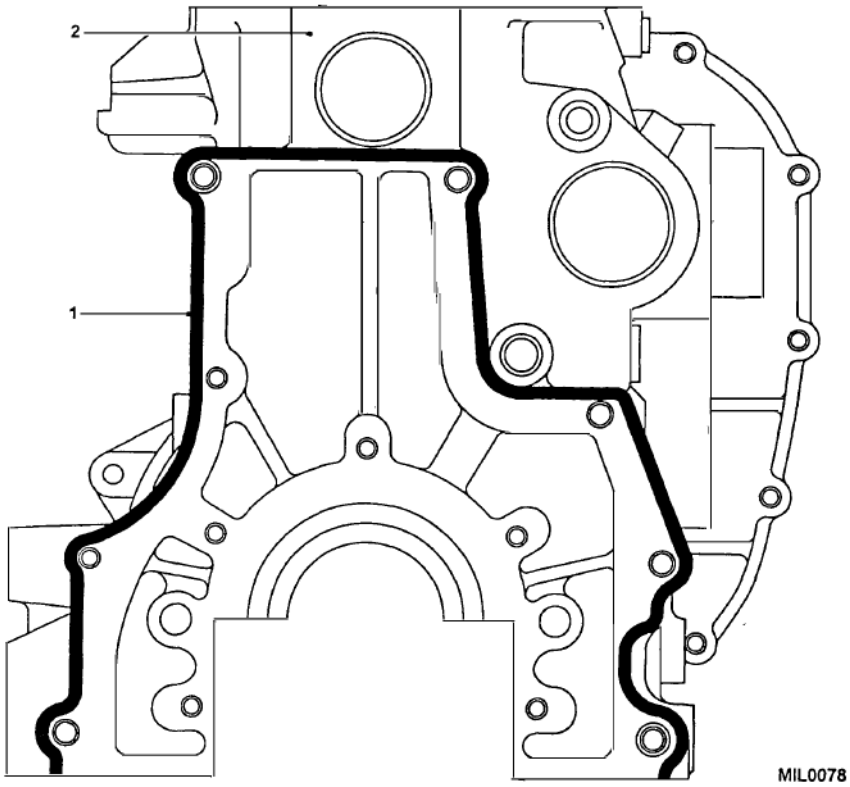
Flywheel housing

38 To fit the flywheel housing proceed as follows:

38.1 Clean the rear face of the flywheel housing and the mating face on the cylinder block, ensuring all old sealant is removed.

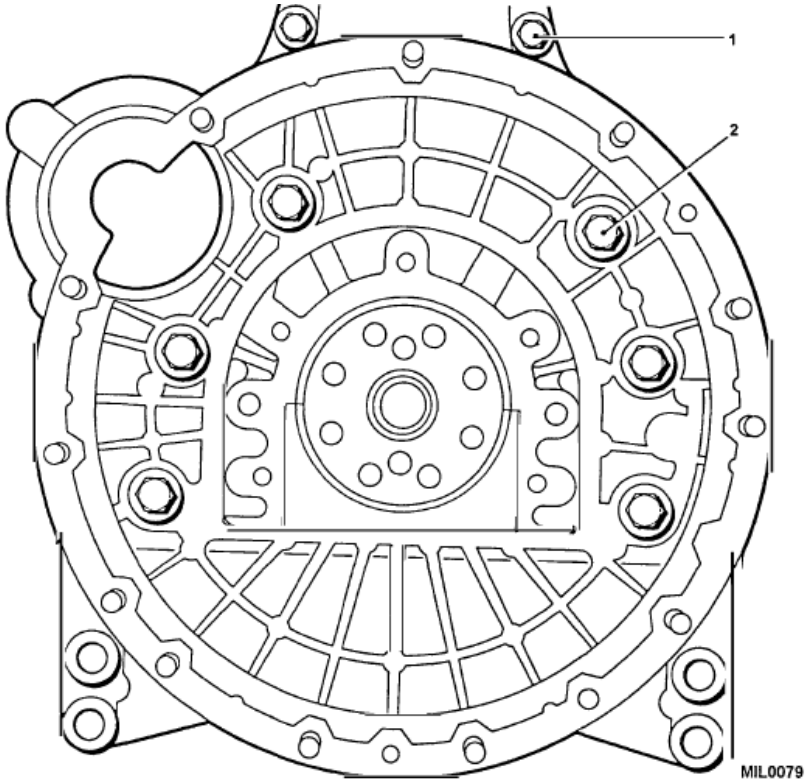
38.2 Apply sealant (refer to Table 1, Serial 2) (Fig 20 (1)) to the flywheel housing mating face on the cylinder block (2).

38.3 Fit the housing to the cylinder block, secure with bolts (Fig 21 (1 & 2)) tighten to a torque of 45 Nm (33 lbf/ft) and remove surplus sealant from the cylinder block.



1 Sealant 2 Engine block

Fig 20 Flywheel housing sealant application



1 Flywheel housing bolt 2 Flywheel housing bolt

Fig 21 Fitting flywheel housing

Crankshaft rear oil seal housing

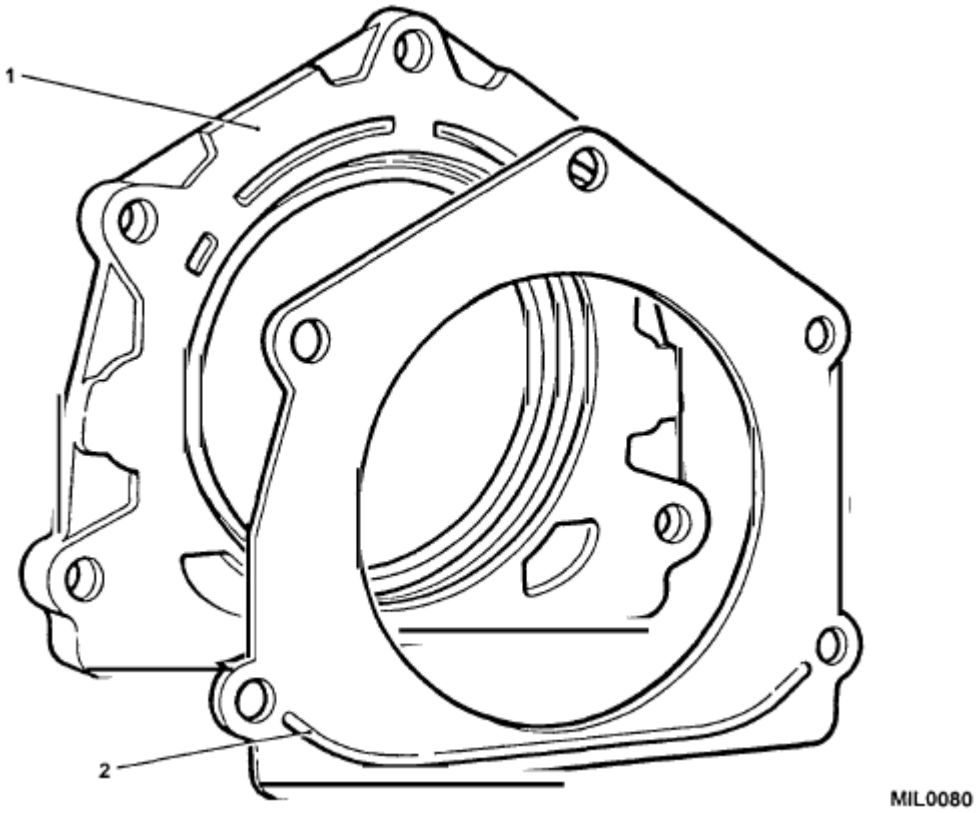
NOTE

The crankshaft rear oil seal (Fig 22 (1)) is retained in its own housing, if the seal requires replacing the housing and seal assembly must be renewed complete with the housing seal. The housing and seal assemblies are supplied with their own former/seal guide already fitted. This former must not be removed before fitting the assembly to the engine. If a seal and housing is obtained without a former/guide fitted it must be returned to the supplier. Used formers/guides must be discarded immediately after use, under no circumstances should they be reused on other assemblies.

39 To fit the crankshaft rear oil seal housing proceed as follows:

39.1 Insert slave studs to the seal housing mounting face.

39.2 Position the new seal housing gasket (2) over the slave studs and crankshaft flange onto the cylinder block.



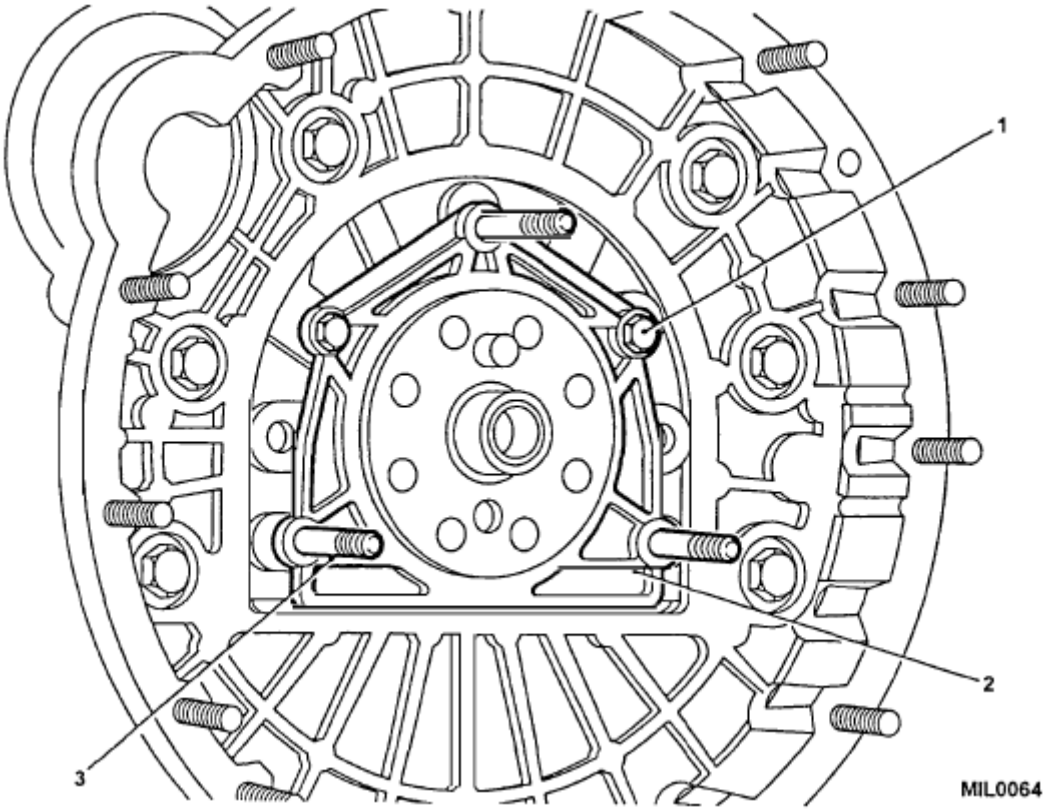
1 Rear oil seal housing 2 Seal housing gasket

Fig 22 Crankshaft rear oil seal

39.3 Ensure housing seal is correctly seated in its groove in the new housing and seal assembly.

39.4 Fit new assembly (Fig 23 (2)), with former/guide in position over crankshaft flange, this action will eject the former/guide and secure to cylinder block with retaining bolts (1).

39.5 Remove the slave studs (3) individually and insert bolts, tighten all retaining bolts to a torque of 25 Nm (18 lbf/ft).



1 Retaining bolt
2 Housing assembly
3 Slave studs

Fig 23 Fitting crankshaft rear oil seal

Connecting-rod bearing nip and clearance

NOTE

New bearing shells are supplied with a protective coating and must be degreased before fitting.

40 To check the connecting-rod bearing nip and clearance proceed as follows:

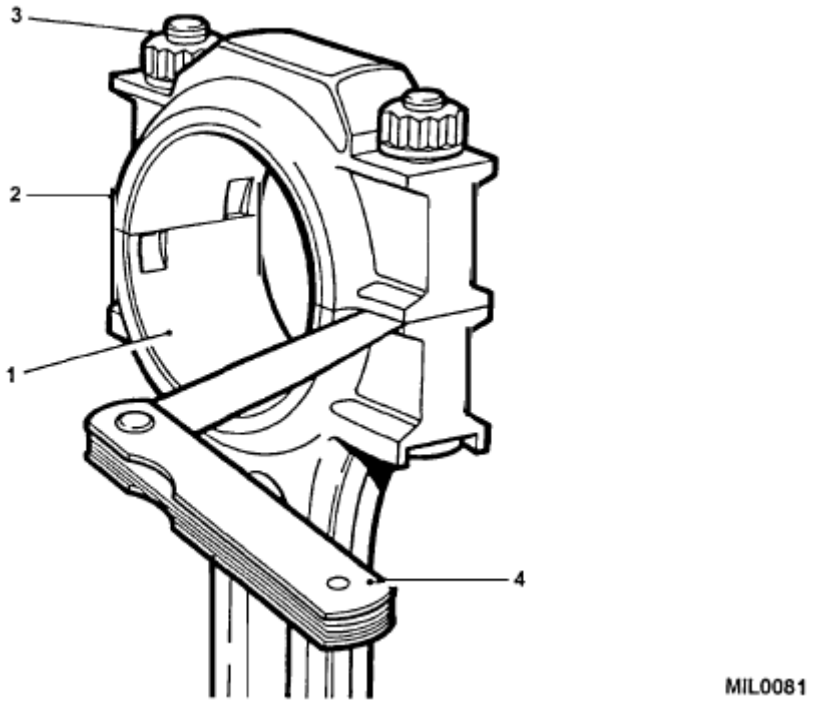
40.1 Fit the bearing shells (Fig 24 (1)) to the connecting-rod and cap (2) ensuring the location tags are correctly seated and aligned. Fit the nuts (3) and bolts and tighten to a torque of 59 Nm (43 lbf/ft).

40.2 Slacken the nut on one side only and check the clearance between the joint faces, using feeler gauges (4). The clearance should be 0.10 mm to 0.20 mm.

40.3 The bearing nip can adjusted by selective assembly of the bearing shells which are available in slightly varying thicknesses. Do not file or machine the caps or rods to vary the bearing nip.

40.4 Make a final check to prove the clearance by inserting a 0.063 mm shim paper between the crankpin and one half of the bearing and tighten to the correct torque. The connecting-rod should resist rotation with the shim paper fitted and move freely with it removed.

40.5 As an alternative, "Plastigauge" connecting may be used to determine the bearing clearances.



1 Bearing shells 3 Nuts
2 Connecting cap 4 Feeler gauge

Fig 24 Checking -rod bearing nip

Connecting-rod end float

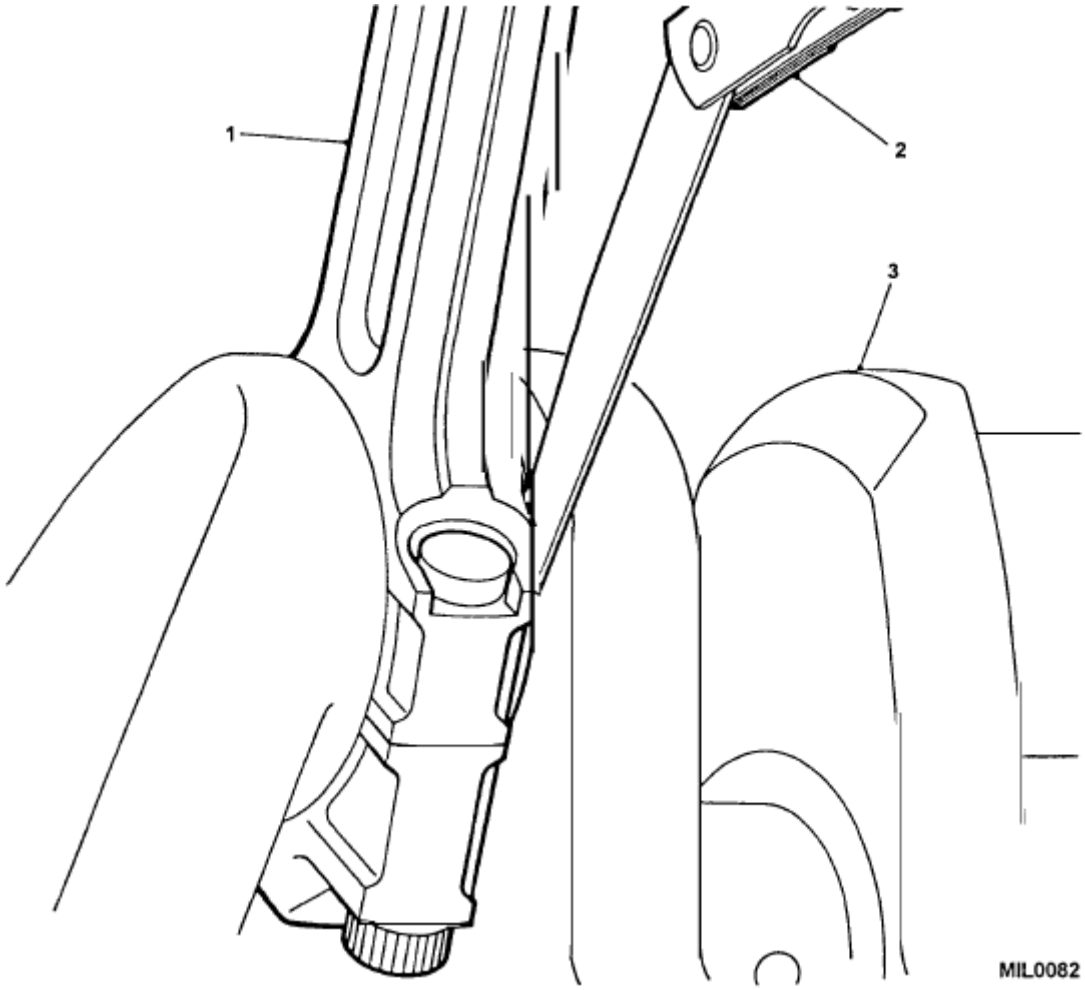
41 Fit the connecting-rods, complete with bearings, to their respective crankpins. Move the connecting-rod (Fig 25 (1)) to one side and check the clearance on the opposite side, using feeler gauges (2). The clearance should be 0.15 mm to 0.356 mm (0.006 in. to 0.014 in.). When the check is completed remove the connecting-rods from the crankshaft (3).

Pistons to connecting-rods

NOTE

The pistons must be assembled to the connecting-rods so that the arrow on the piston crown points to the front of the engine and the off-set combustion chamber, bearing shell tags and connecting-rod number are all on the same, right hand side of the cylinder block viewed from the rear of the engine.

42 Insert a circlip in one side of the gudgeon pin boss and assemble the piston to the connecting-rod with the gudgeon pin. Secure the assembly with a circlip on the opposite side of the piston.



1 Connecting rod
2 Feeler gauge
3 Crankshaft

Fig 25 Checking connecting-rod end float

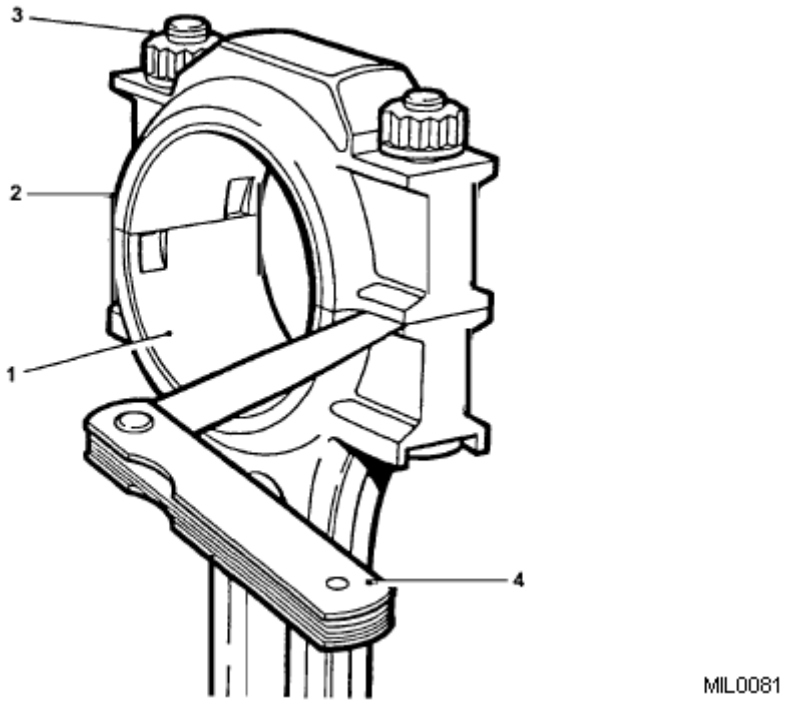
Piston and connecting-rod assemblies

43 To fit the piston and connecting-rod assemblies to the cylinder block and crankshaft proceed as follows:

43.1 Ensure that the eccentric headed big end bolts and shell bearings are correctly located in the connecting-rods and as a precaution against possible damage to the crankshaft journals during installation of the pistons, cover the bolt threads with a plastic sleeve or a layer of adhesive tape.

43.2 Check that the number on the connecting-rod is the same as the piston and cylinder and that they are correctly orientated.

43.3 With the cylinder block (Fig 26 (3)) vertical, and No. 2 and No. 3 crankshaft journals at Bottom Dead Centre (BDC) lubricate and install No. 2 and No. 3 piston connecting-rod assemblies, so that the piston rings are resting on the block face.



1 Gudgeon pin
2 Compression tool
3 Engine block

Fig 26 Fitting piston assemblies

43.4 Stagger the piston rings on both pistons so as the gaps of the compression rings are equidistantly spaced round the piston but, so arranged, so that no gap is positioned on the thrust side of the piston i.e. opposite the camshaft. Turn the oil control ring so that the gap is in line with the gudgeon pin (1).

43.5 Using a suitable tool (2) compress the piston rings and gently push each piston into the cylinder bore.

43.6 Pull both connecting-rod big ends on to the crankshaft journals and fit the caps ensuring the numbers match and orientation is correct. Retain the caps with new nuts but do not tighten at this stage.

43.7 Turn the crankshaft so that No. 1 and No. 4 journals are at BDC and install the pistons as previously described.

43.8 Tighten both nuts on one connecting-rod to a torque of 59 Nm (43 lbf/ft) and check that the crankshaft is free to rotate before securing the next connecting-rod cap nuts.

43.9 Investigate and rectify any big end bearing which when tightened restricts the freedom of the cr ankshaft.

Camshaft

44 To fit the camshaft proceed as follows:

44.1 Lubricate the camshaft bearings and journals with clean engine oil (refer to Table 1, Serial 1) and with care, insert the camshaft (Fig 27 (1)) into the cylinder block. Temporarily fit a new thrust plate (2) and secure with the two bolts (3) and tighten to a torque of 9 Nm (7 lbf/ft)..

44.2 Check the camshaft end-float, temporarily fit the camshaft gear (Fig 28 (1)) and mount a dial test indicator (2) so that the stylus rests in a loaded condition upon the machined face of the gear.

44.3 Zero the dial and move the camshaft back and forward and note the reading. The end-float should be within 0.06 mm to 0.13 mm (0.002 in. to 0.005 in.).

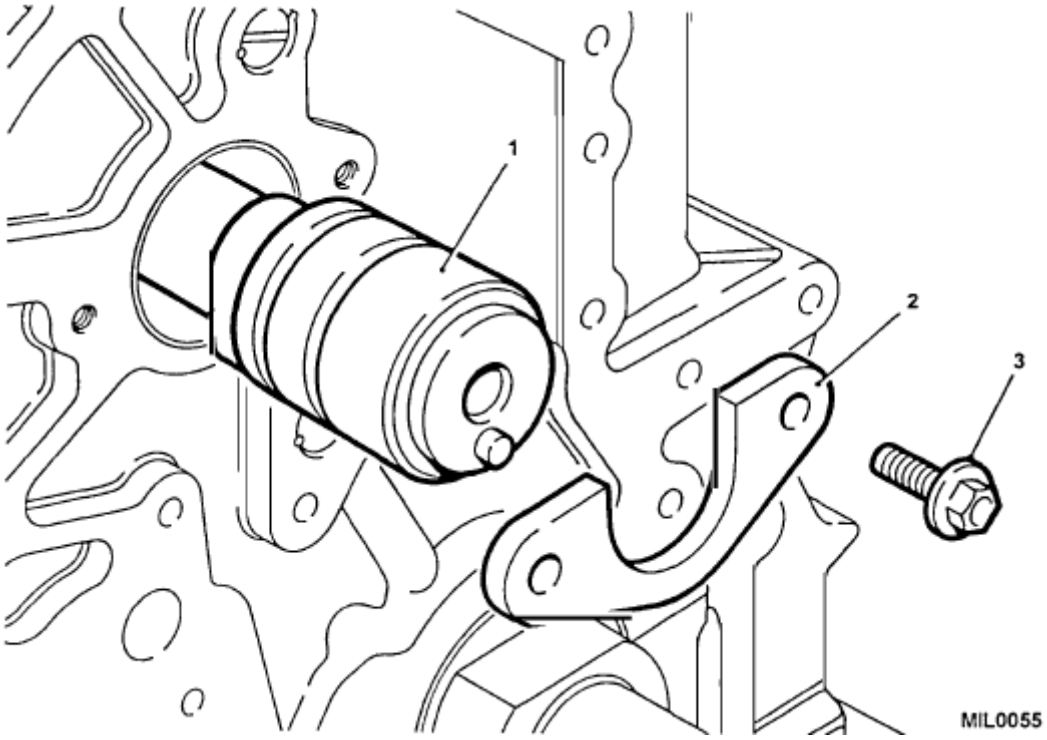
44.4 If the end-float is outside these limits, fit another thrust plate to achieve the correct endfloat.

Cam followers

45 Fit the cam follower assemblies (refer to Cat 523 Chap 1).

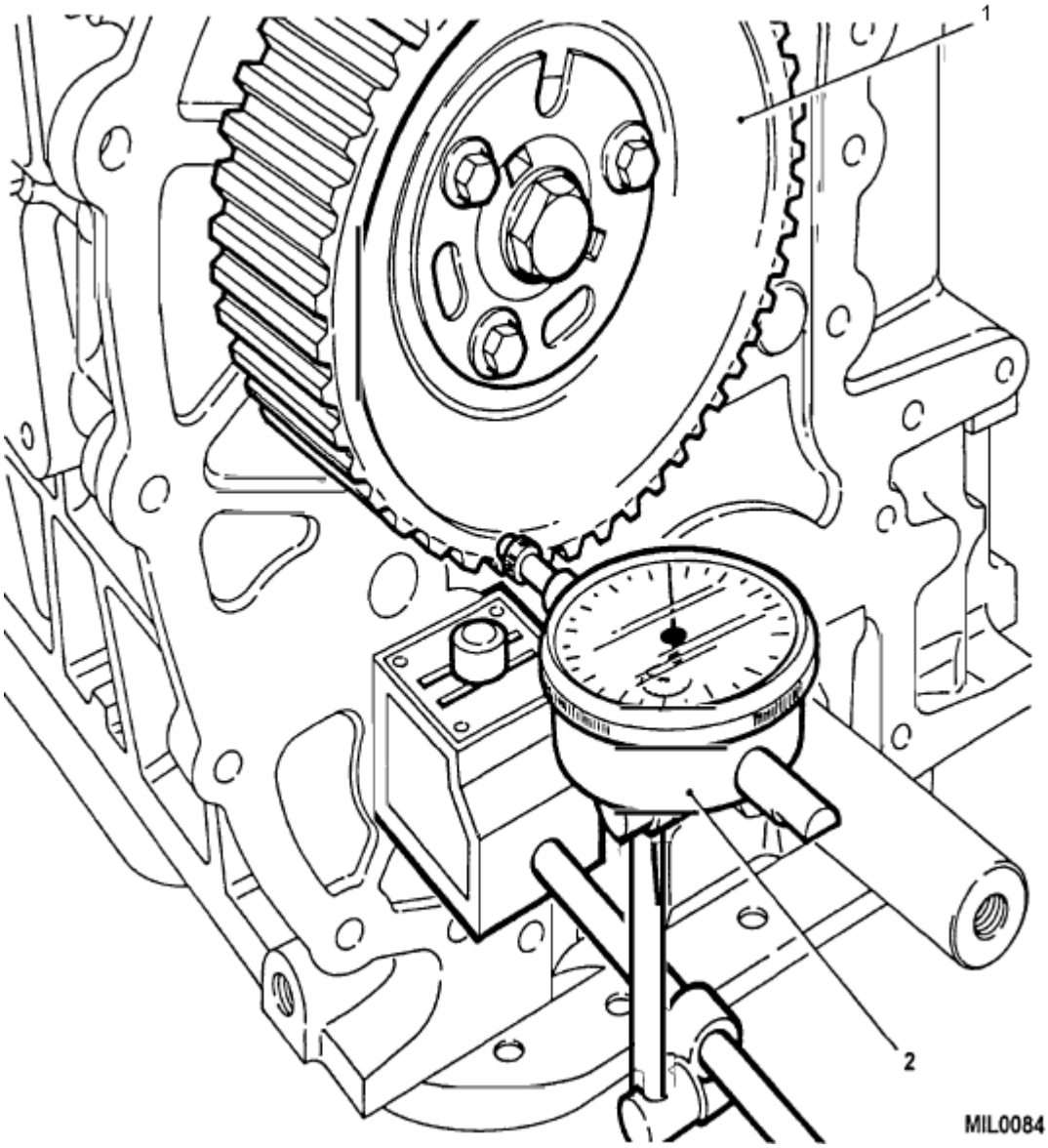
Timing covers, gears, belts and pulleys

46 Fit the timing covers, gears, belts and pulleys (refer to.Cat 523 Chap 1).



1 Camshaft
2 Thrust plate
3 Bolt

Fig 27 Fitting camshaft



1 Camshaft gear 2 Dial test indicator

Fig 28 Checking camshaft end-float

Cylinder head assembly

47 Fit the cylinder head assembly (refer to Cat 522 Chap 1-1).

Ancillaries

48 Refit the engine ancillaries in reverse order to removal (refer to Para 3).

Reface flywheel

49 To reface the flywheel proceed as follows:

49.1 Remove the clutch cover locating dowels.

49.2 Machine the flywheel over the entire clutch face, removing only the minimum material necessary to obtain a smooth flat surface parallel with the crankshaft mating face and within the allowable refacing dimensions (refer to Cat 533).

49.3 Fit new clutch location dowels.

REFIT ENGINE TO VEHICLE

50 Refit the engine to the vehicle (refer to Cat 522 Chap 1-1).

ENGINE OIL PRESSURE TEST

51 Check that engine lubriacant is to the correct level.

52 Place the vehicle on a ramp.

53 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

54 Remove oil pressure switch and connect a suitable pressure test guage (refer to Fig 29).

55 Reconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

56 Start and run the engine to normal operating temperature.

57 With the engine running at idle the engine oil pressure should be 1,76 Bar (14.5 lbf/in^2).

58 If the pressure is low refer to Cat 512 Chap 1 for possible causes and any action that needs to be taken.

59 Excessive pressure can be caused by the following:

59.1 Over filling the engine with lubricant.

59.2 Sticking oil pressure relief valve.

59.3 A blockage in the breather system.

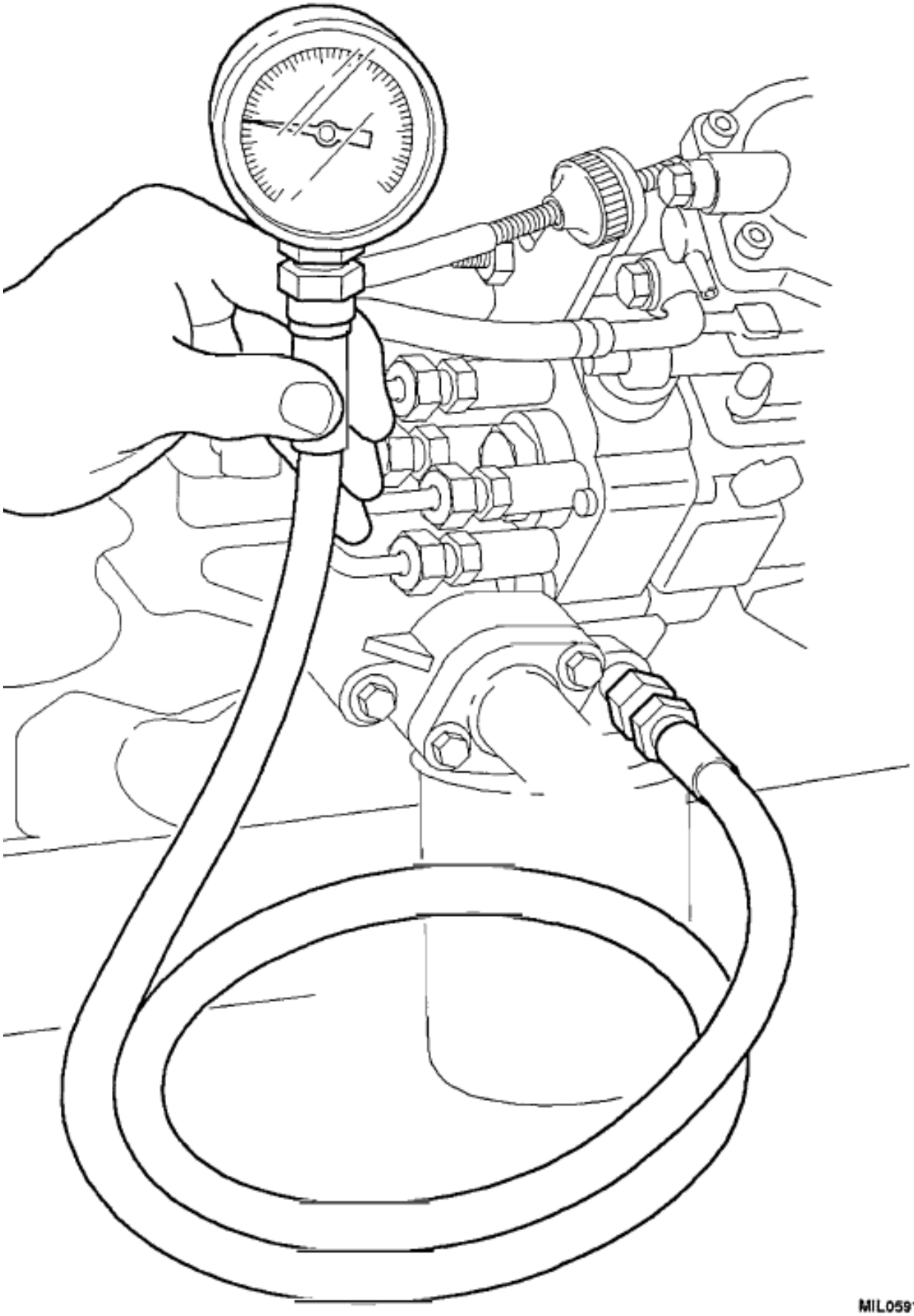


Fig 29 Engine oil pressure test

CYLINDER COMPRESSION TEST

60 Start and run the engine to normal operating temperature.

61 Disconnect the spill return hose and fuel pipe from number one injector.

NOTE

Fuel delivery to the injectors must be prevented by disconnecting the electrical lead from the fuel cut-off solenoid at the injector pump.

62 Remove the retaininmg nut, release the clamp and withdraw the injector from the cylinder head.

63 Ensure the injector port is clean, if necessary, crank the engine a few revolutions to remove any loose carbon.

64 Fit the dummy injector into the cylinder head and clamp securely in position (refer to Fig 30).

65 Connect flexible pressure hose and guage to dummy injector.

66 Crank the engine for 10 to 20 seconds and note the reading on the guage.

67 The guage will indicate the compression of the cylinder and maintain the reading until the pressure relief valve is depressed. Use the red pointer on the dial to record the pressure indicated to enable a comparison to be made with the other cylinders.

68 Expected reading of a crank test, with the battery fully charged, with a compression ratio of 19.5:1 of 24 bar (348 lbf/in2).

69 Repeat the test procedure for each of the remaining cylinders in turn.

70 A variation in compression readings between cylinders is often a better indication of an engine problem than the absolute values of compression.

71 If compression is appreciably less than the correct figure, or varies by more than 10%, piston rings or valves may be faulty.

72 Low pressures in adjoining cylinders may indicate a faulty head gasket.

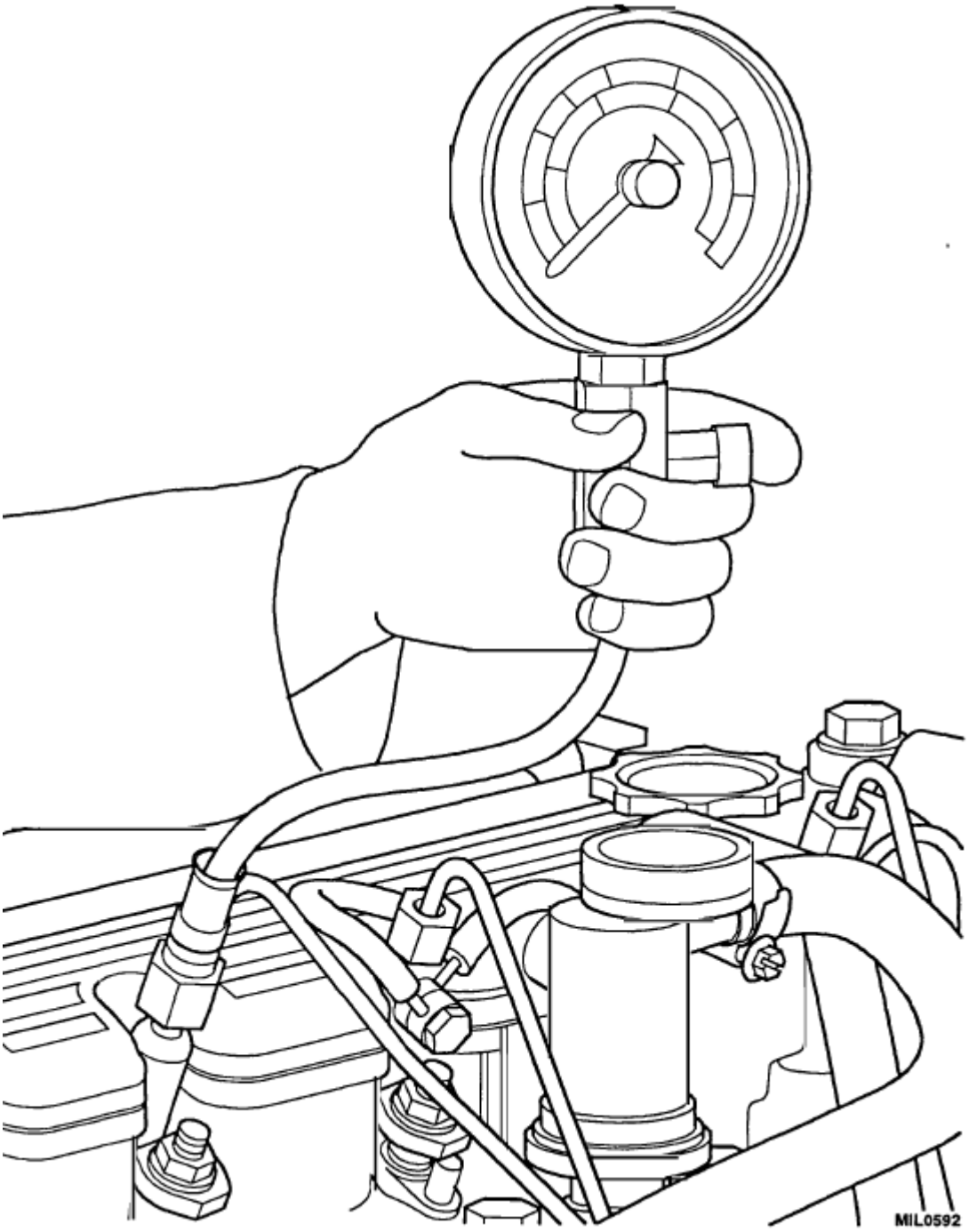


Fig 30 Cylinder compression test

CHAPTER 3

FIVE SPEED MANUAL GEARBOX

CONTENTS

INTRODUCTION

1 This Chapter details the Base repair for the manual gearbox systems as fitted to Truck Utility Light (TUL) High Specification (HS), Truck Utility Medium (TUM) HS and (TUM) Battlefield Ambulance HS vehicles.

General

2 This Chapter has been sub-chaptered to allow for the various types of vehicle heating and ventilation as detailed below:

Chapter 3-1 Five speed manual gearbox.

Chapter 3-2 Uprated gearbox.

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CHAPTER 3-1

FIVE SPEED MANUAL GEARBOX

CONTENTS

(continued)

CONTENTS (continued)

INTRODUCTION

1 This chapter details the Base repairs for Truck Utility Light (TUL) High Specification (HS), and Truck Utility Medium (TUM) HS and (TUM) Battlefield Ambulance HS vehicles fitted with the five speed manual gearbox and the 2.5 litre 300 Tdi direct injected turbocharged diesel engines.

NOTE

The special tools and accessories listed in the following tables will be referred to in the text, where used, by their serial number shown in column 1.

TABLE 1 SPECIAL TOOLS

Serial (1)	Manufacturers Part Number (2)	NSN/Part Number where applicable (3)	Designation (4)
1	LRT-37-023	6MT2/5120-99-037-0562	Layshaft gear retainer
2	LRT-37-024	6MT2/5120-99-063-0231	Adapter, remover layshaft bearing track
3	LRT-37-002	6MT2/5120-99-611-3333	Adapter- primary shaft bearing remover
4	LRT-37-019	6MT2/5120-99-051-9950	Bearing centre remover centralise
5	LRT-37-021	6MT2/5120-99-449-4201	Replacer, mainshaft rear bearing track
6	LRT-37-022	6MT2/5120-99-257-9857	Remover, layshaft bearings

TABLE 2 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	Loctite	518 8040-99-701-8040	Sealing compound
2	Loctite	270 8030-99-224-8707	Sealing compound

TABLE 3 HUBS AND SLEEVES

Serial (1)	Assembly (2)	Hub (3)	Sleeve (4)	Against Gear (5)
1	1st/2nd		1 Notch	1st
2		2nd gear side		2nd
3	3rd/4th		3 Notches	3rd
4				4th
5	4th/5th		5 Notches	5th

LOCALLY MANUFACTURED TOOL

2 The locally manufactured tool (Fig 1) is also recommended to assist in the gearbox repair.

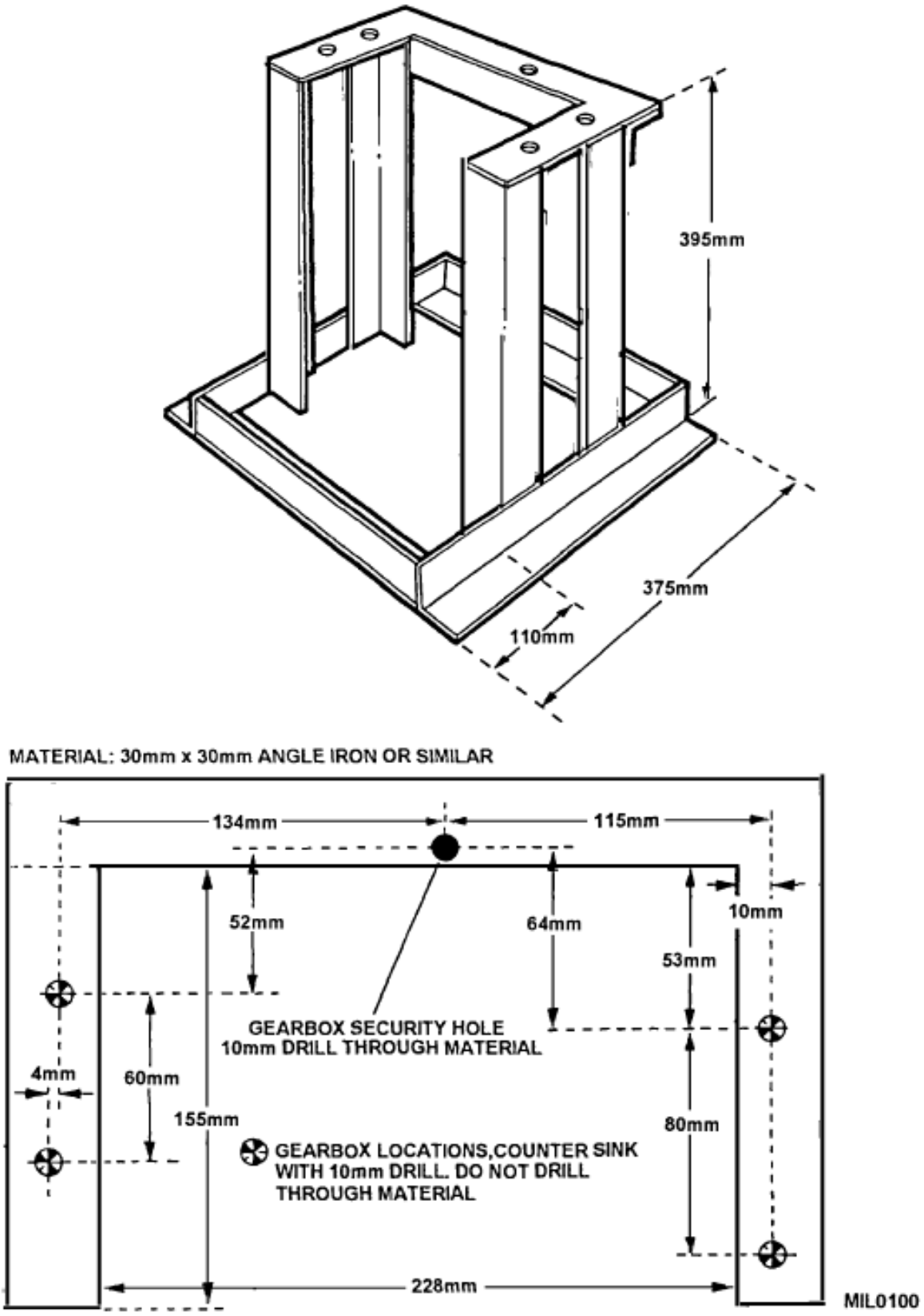


Fig 1 Gearbox support stand

MAIN GEARBOX AND TRANSFER BOX ASSEMBLY

Removal

3 To remove of the gearbox from the vehicle (refer to Cat 523 Chap 3-1).

Dismantling

4 Place the gearbox on a suitable work bench with the transfer box removed (refer to Cat 523 Chap 3-1) ensuring that the oil has been drained.

Clutch bell housing

5 Remove the clutch bell housing and clutch release lever (refer to Cat 523 Chap 2).

Transfer box selector housing

6 Remove the transfer box selector housing (refer to Cat 523 Chap 3-1).

Main gear selector and remote housing

7 Remove the main gear selector and remote housing (refer to Cat 523 Chap 3-1).

Selector quadrant fork

8 Remove the selector quadrant fork (refer to Cat 523 Chap 3-1).

EXTENSION HOUSING

Removal

9 To remove the extension housing (refer to Cat 523 Chap 3-1).

MAIN GEARBOX

Dismantling

5th and reverse gear

10 To dismantle the 5th and reverse gear carry out the following:

10.1 Using a suitable two legged puller, remove the 5th gear layshaft support bearing track (Fig 2 (1)) from the end of layshaft.

10.2 Using special tool (refer to Table 1, Serial 1) (20) to hold the 5th laygear, remove the 5th laygear nut (2).

10.3 Remove thrust collar segments retaining ring (3) and segments (4).

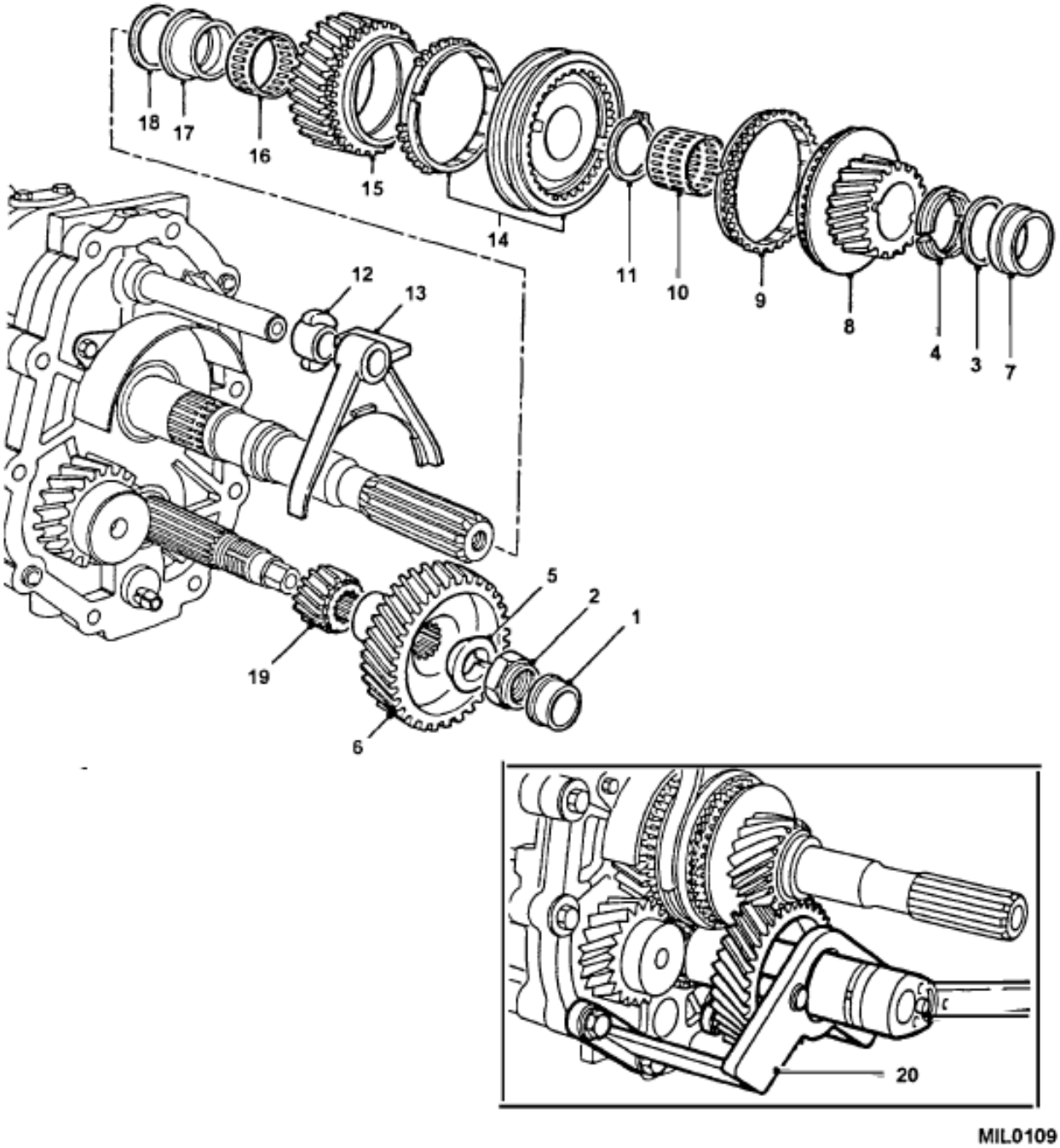
10.4 Remove 5th laygear (6) and split conical washer (5).

10.5 Remove mainshaft rear support bearing track (7) using a suitable tool with the special tool (refer to Table 1, Serial 2).

10.6 Remove 12 mm bolt from end of mainshaft.

10.7 Remove mainshaft 5th gear (8) with synchromesh baulk ring (9).

10.8 Remove mainshaft 5th gear split needle roller bearing (10).



1	Layshaft support bearing track	11	Circlip
2	5th gear laygear nut	12	Selector spool
3	Retaining ring	13	Selector fork
4	Thrust collar segments	14	Synchromesh hub
5	Split conical washer	15	Mainshaft reverse gear
6	5th laygear	16	Needle bearing
7	Mainshaft support bearing track	17	Bush
8	Mainshaft 5th gear	18	Selectable spacer
9	Synchromesh baulk ring	19	Layshaft reverse gear
10	Needle bearing	20	Special tool (refer to Table 1, Serial 1)

Fig 2 Removing 5th and reverse gear

10.9 Remove circlip (11) securing 5th gear synchromesh hub.

10.10 Rotate selector spool (12) clear of selector fork (13) and remove 5th and reverse synchro hub assembly (14) complete with fork and spool.

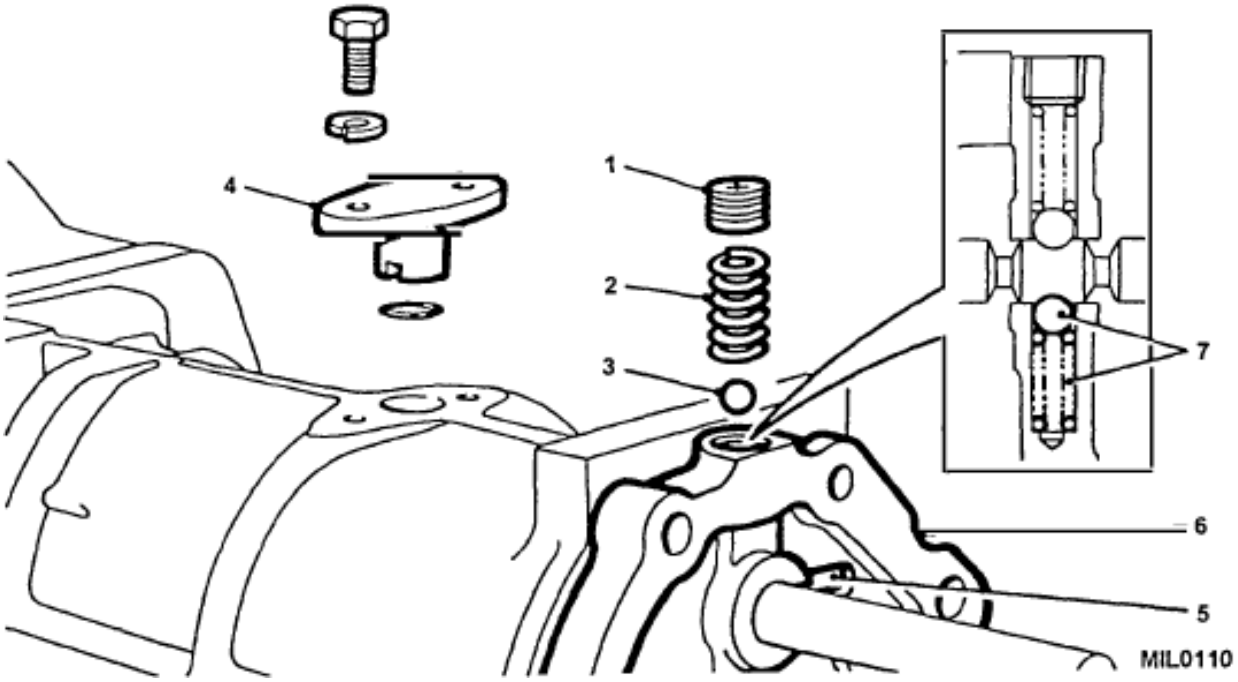
10.11 Remove mainshaft reverse gear (15) complete with needle roller bearing (16) and bush (17) noting the selectable spacer (18) between the reverse gear bush and centre plate bearing.

10.12 Remove layshaft reverse gear (19).

10.13 Remove centre plate detent plug (Fig 3 (1)), spring (2) and ball (3).

10.14 Remove maincase spool retainer (4).

10.15 Remove 'slave' bolts (refer to Cat 523 Chap 3-1).



1 Detent plug
2 Spring
3 Ball
4 Spool retainer
5 Selector shaft pin
6 Centre plate
7 Detent ball and spring

Fig 3 Removing centre plate

Mainshaft and layshaft removal

11 To remove the mainshaft and layshaft carry out the following:

11.1 Align selector shaft pin (Fig 3 (5)) with slot in centre plate and using wooden blocks and hide mallet, drive off centre plate (6).

11.2 Collect detent balls and springs (7), remove bearing tracks and shims.

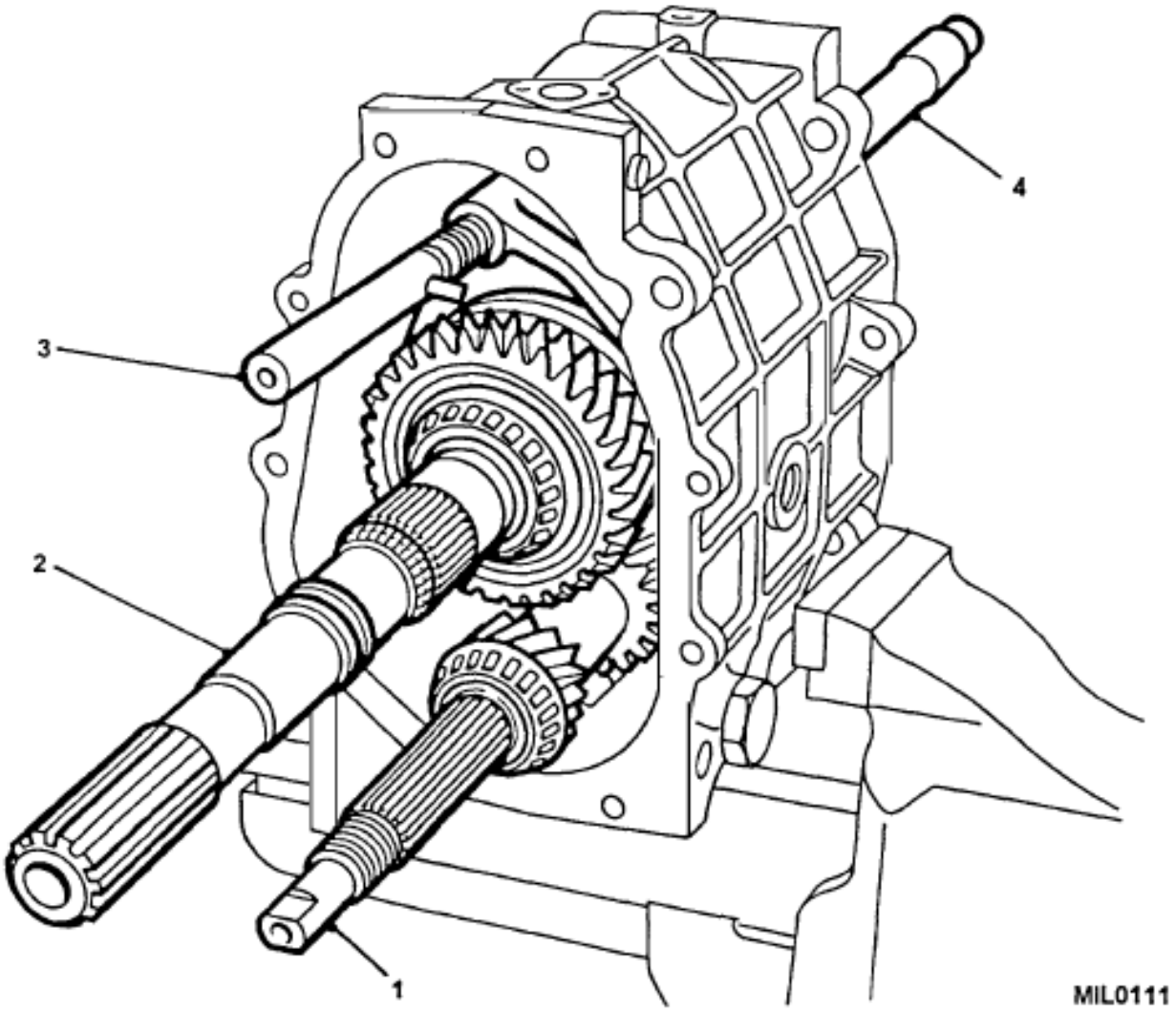
11.3 Remove layshaft (Fig 4 (1)), mainshaft (2) and selector shaft (3) from casing as complete unit.

11.4 Remove input shaft (4), and 4th gear baulk ring (If not already removed with mainshaft).

Mainshaft

12 To dismantle the mainshaft proceed as follows:

12.1 Using a suitable tool and support bars under 1st gear, press 1st gear and mainshaft support bearing from mainshaft (Fig 5).



1 Layshaft 3 Selector shaft
2 Mainshaft 4 Input shaft

Fig 4 Removing mainshaft and layshaft

12.2 Remove 1st gear (Fig 6 (4)), bush (2) needle bearing (3) and three synchromesh baulk rings (5).

12.3 Remove 1st/2nd gear synchromesh hub (6), 2nd gear synchromesh baulk rings (7), second gear (8) and needle bearing (9).

12.4 Invert mainshaft and using a suitable tool and support bars under 3rd gear, press off pilot bearing (Fig 7).

12.5 Remove spacer (Fig 6 (11)), 3rd/4th gear synchromesh hub (12), three synchromesh baulk rings (13), 3rd gear (14) and needle bearing (15).

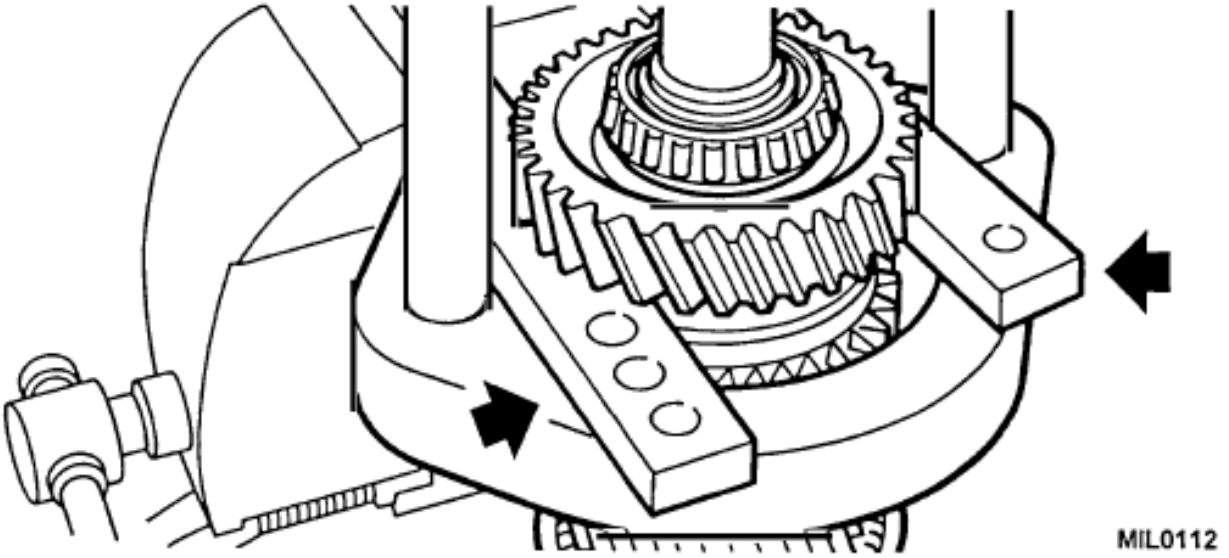
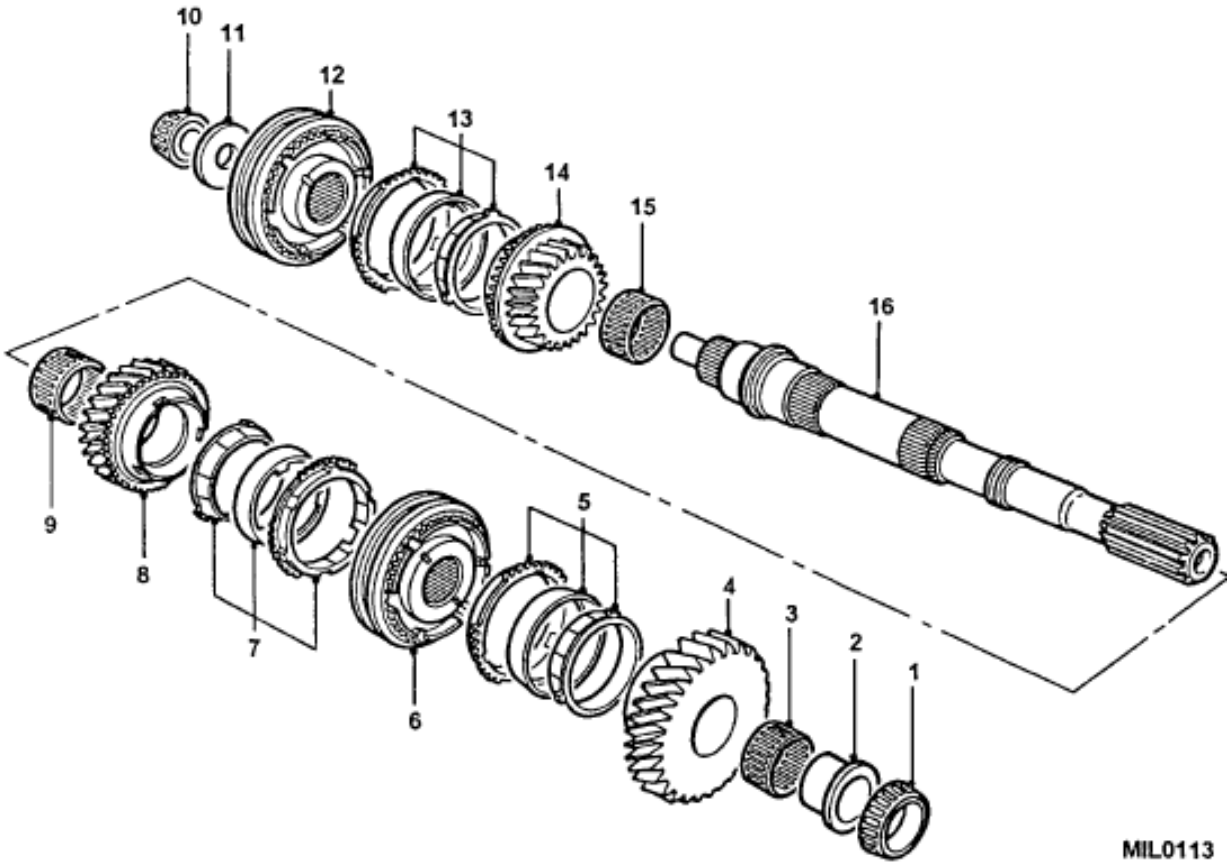


Fig 5 Removing support bearings from mainshaft



1	Mainshaft support bearing	9	Needle bearing
2	Bush	10	Pilot bearing
3	Needle bearing	11	Spacer
4	1 st gear	12	3rd/4th gear synchromesh hub
5	Synchromesh baulk rings	13	Synchromesh baulk rings
6	1st/2nd gear synchromesh hub	14	3rd gear
7	2nd gear synchromesh baulk rings	15	Needle bearing
8	2nd gear	16	Mainshaft

Fig 6 Dismantling the mainshaft

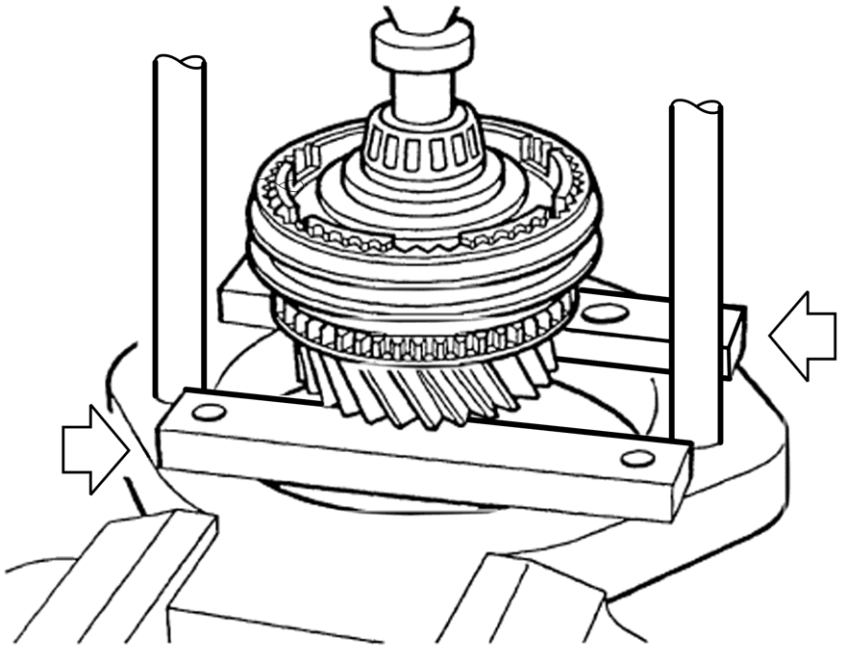


Fig 7 Removing pilot bearing

Synchromesh assemblies

13 Dismantle the synchromesh assemblies as follows:

13.1 Remove spring clips (Fig 8 (1)) from both sides of the assembly.

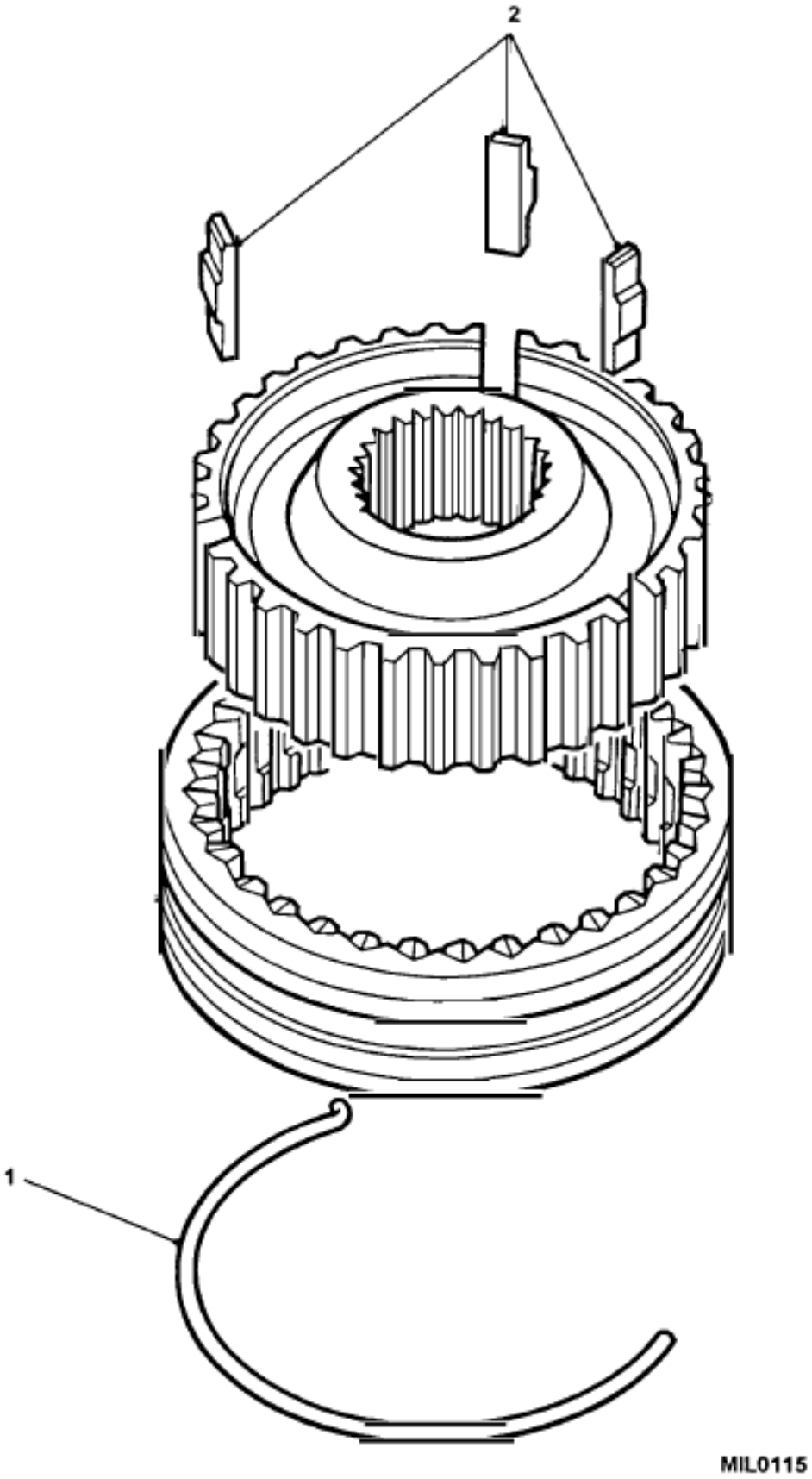
13.2 Remove slippers (2) and separate the hub from the sleeve.

13.3 Examine all parts for damage and wear including spring clips for tension.

13.4 Check no excessive radial movement exist between inner members and mainshaft splines.

13.5 Examine inner and outer splines for wear.

13.6 Examine the dog teeth on all gears for wear and damage.



1 Spring clips 2 Slippers

Fig 8 Synchromesh assemblies

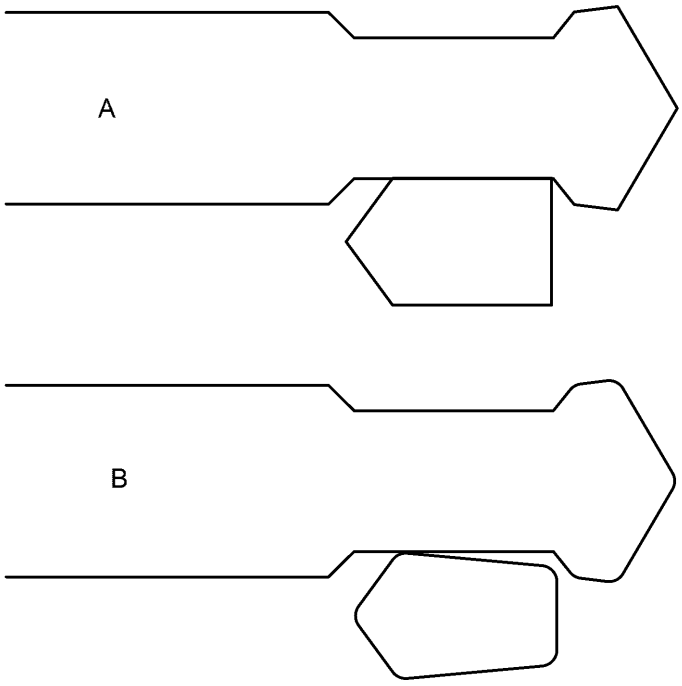


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Fig 9 Checking synchromesh dog teeth

NOTE

In Fig 9 example 'A' shows a tooth in good condition. Example 'B' shows the rounded corners of a worn tooth.

13.7 Replace unit if excessively worn.

Reassembly

14 Refit inner hub to sleeve.

NOTE

Hubs and sleeves have a master spline combination and can only be assembled one way. The sleeves are further identified with a series of half moon notches, which clearly identify which side of the assembly faces, which gear. Ensure the slot in the hub aligns with the centre notch on the sleeve (refer to Table 3).

14.1 Fit slippers and secure with a spring each side of the synchromesh.

Checking baulk ring clearances

15 Check clearance of all baulk rings and gears by pressing the baulk rings against the gear and measuring the gap (Fig 10). The minimum clearance should be 0.38 mm (0.015 in.).

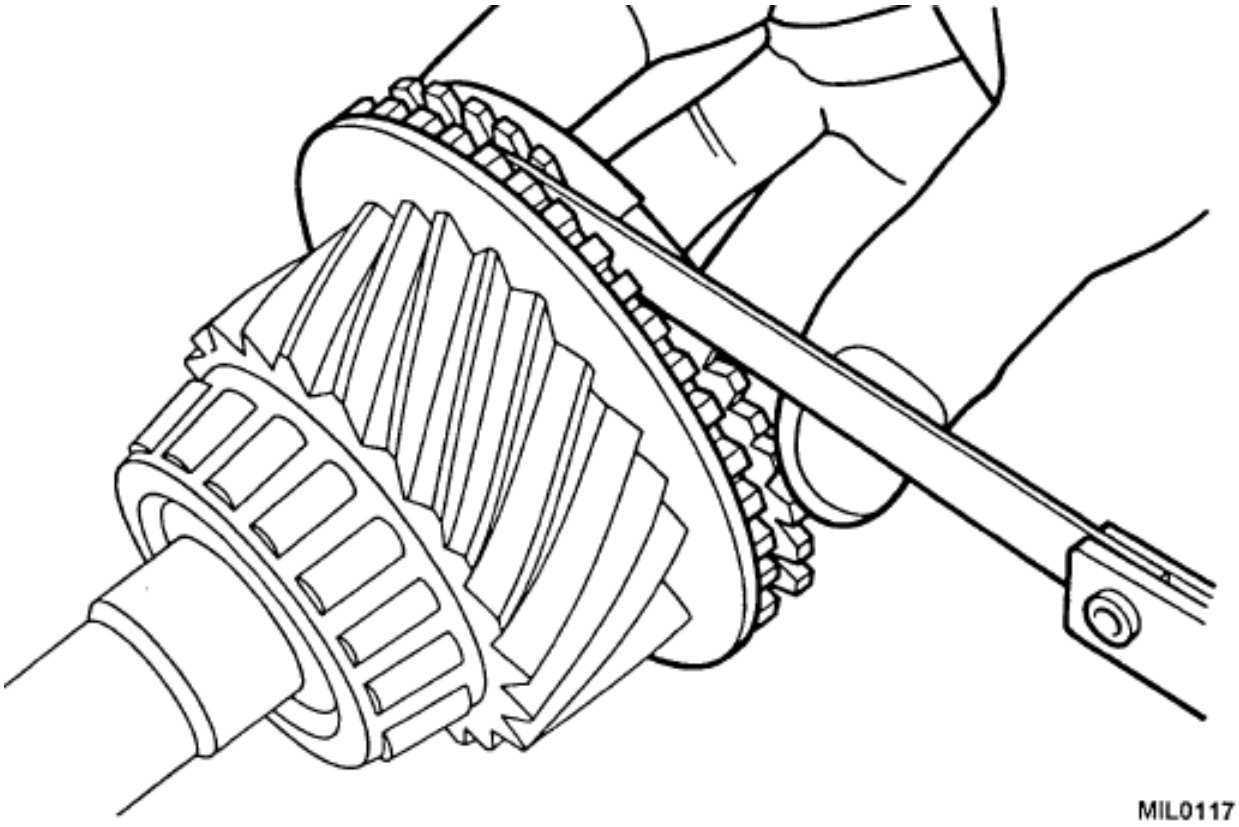


Fig 10 Checking baulk ring clearances

Input shaft assembly

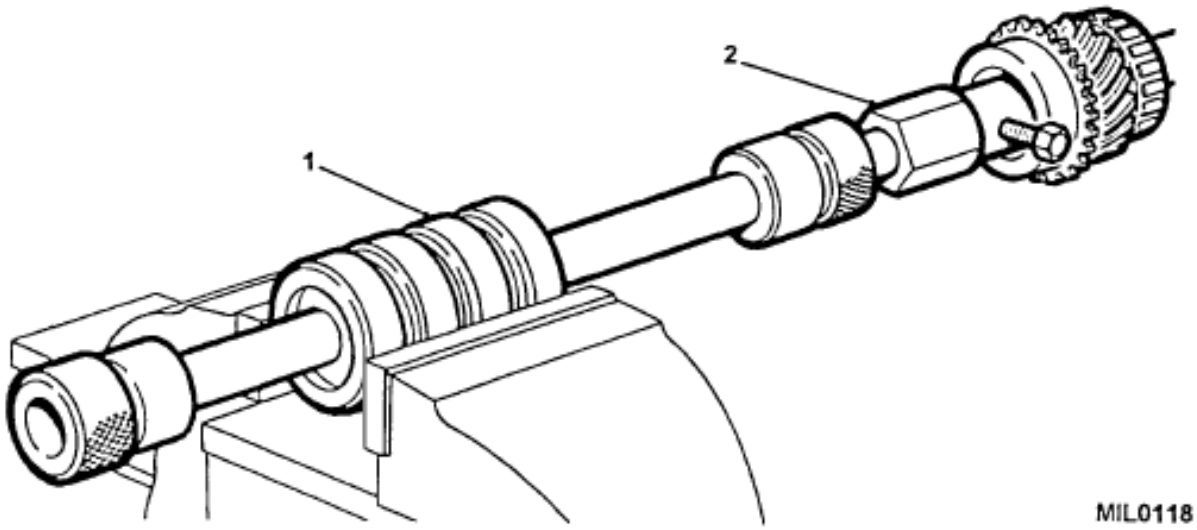
16 Dismantle the input shaft as follows:

16.1 Using suitable tools remove pilot bearing track (Fig 11).

16.2 Using suitable tools remove taper roller bearing (Fig 12).

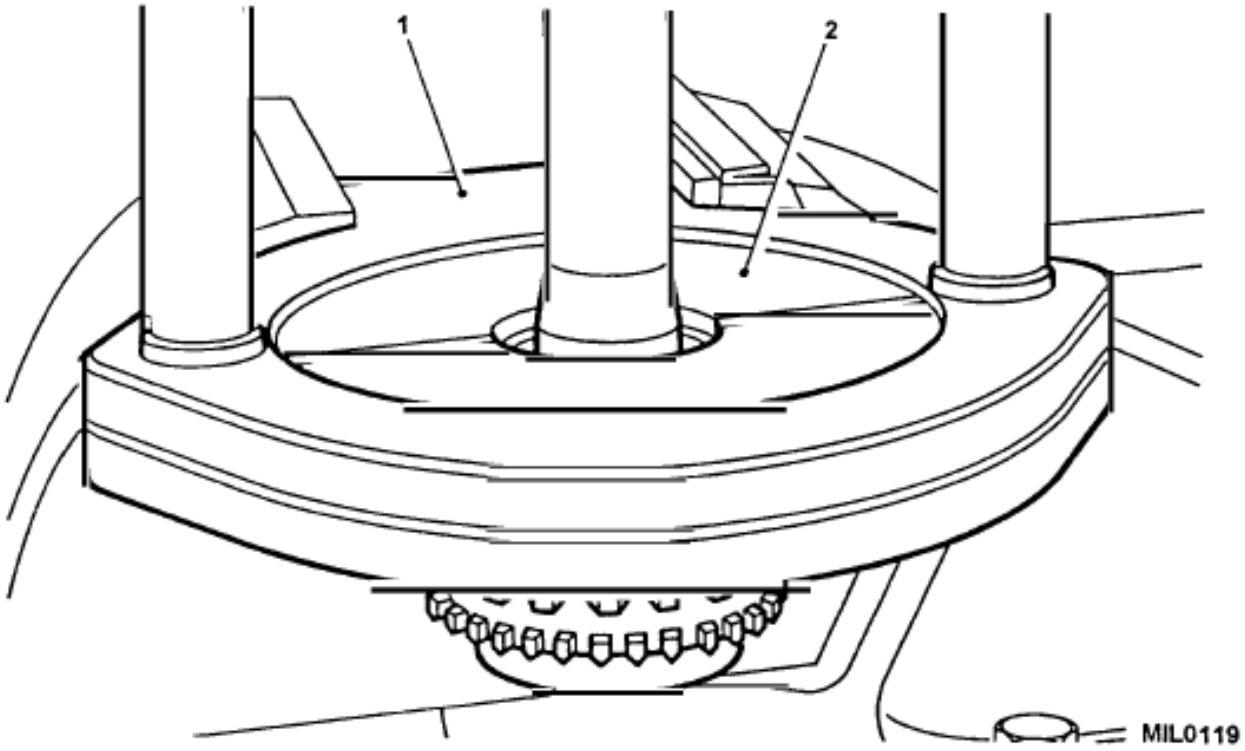
16.3 Support the shaft under the tool and press in a new pilot bearing track.

16.4 Using the suitable tools with the special tool (refer to Table 1, Serial 3) fit a new taper bearing (Fig 13).



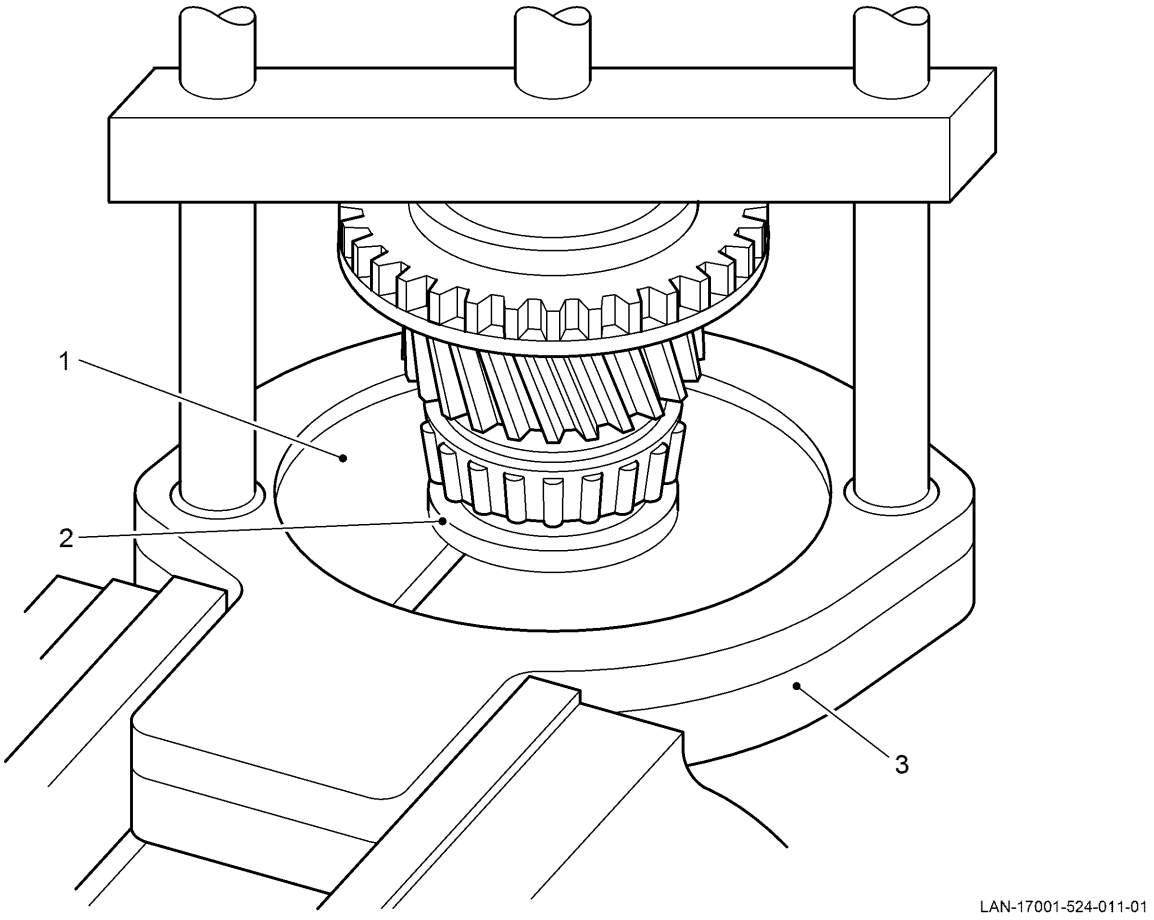
1 Impulse extractor 2 Adaptor

Fig 11 Removing pilot bearing track



1 Hand press 2 Bearing adaptor

Fig 12 Removing taper roller bearings



1 Layshaft bearing remover
2 Adaptor - primary shaft bearing remover
3 Hand press

Fig 13 Refitting taper roller bearing

Layshaft

17 Dismantle the layshaft as follows:

17.1 Using a suitable tool with the special tool (refer to Table 1, Serial 6) withdraw the layshaft bearings.

17.2 Examine the layshaft for signs of wear or damage.

Gearbox casing

18 Degrease and clean all components. Inspect casing for damage, cracks and stripped threads.

18.1 Fit new level plug.

18.2 Fit new copper washer to drain plug.

Front Cover

19 To dismantle the front cover proceed as follows:

19.1 Remove the front cover from the casing and remove bearing tracks. Check that the circlips are intact.

19.2 Remove oil seal from cover (Fig 14). Do not fit new seal at this stage.

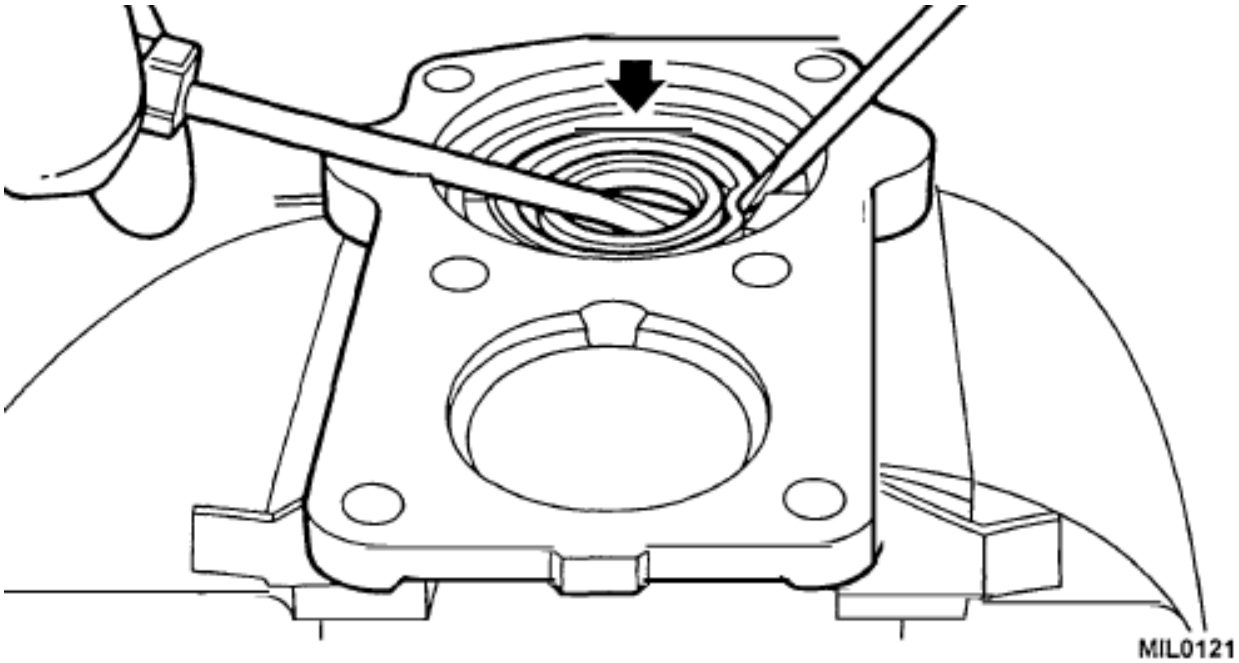


Fig 14 Dismantling front cover

Centre plate

20 To dismantle the centre plate proceed as follows:

20.1 Remove bearing tracks and shims.

20.2 Inspect the plate for damage and the selector rail bore for wear.

20.3 Remove splash shield (Fig 15 (1)) if required.

20.4 Press out reverse idler gear shaft (2) using suitable press.

20.5 Remove idler gear (4), needle bearing (3) and spacer (5). Check for wear and damage.

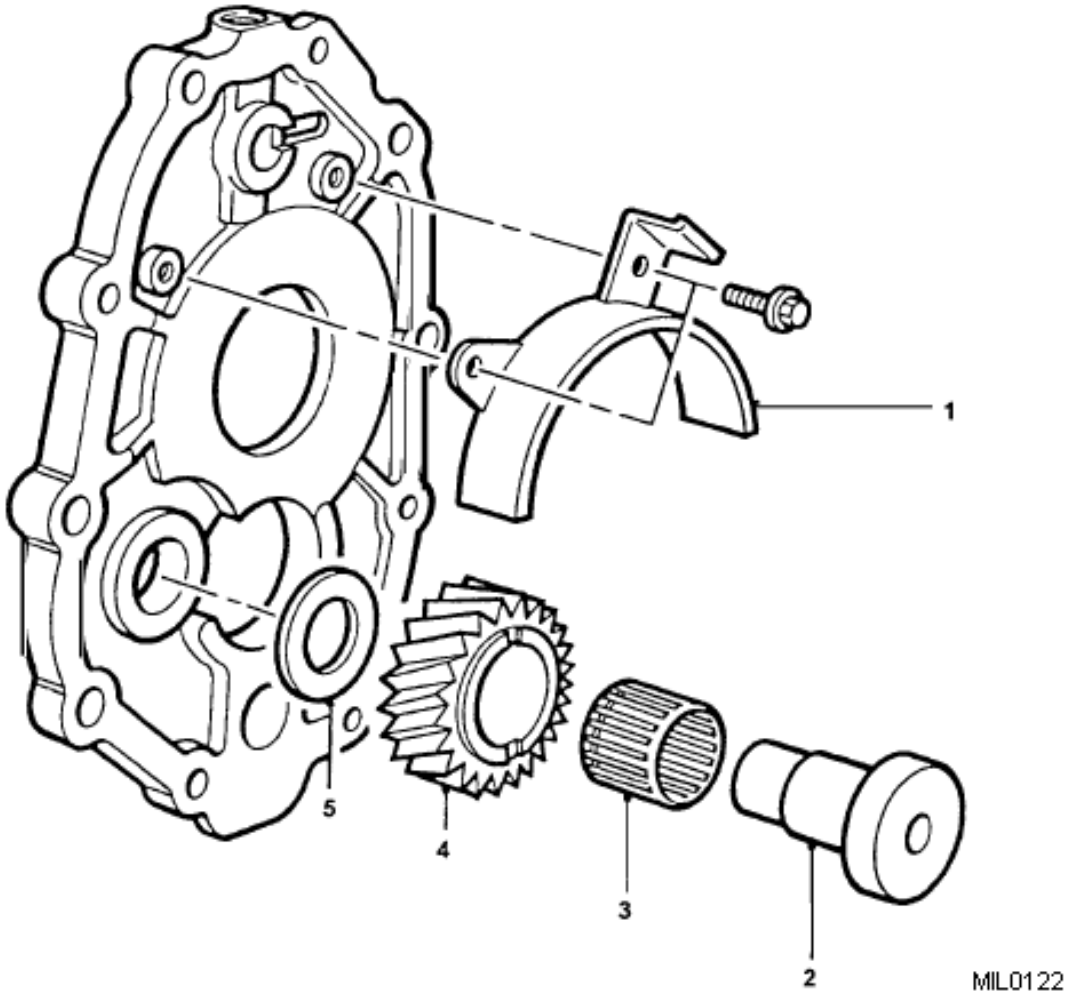
Cleaning

21 Clean all components thoroughly using a suitable solvent. Ensure all lubrication drillings are clear of sludge or contamination.

Examination

22 Examine the components as follows.

22.1 Examine the casings for cracks, stripped threads in bolt holes and the machined mating faces for burrs, nicks or any condition that would render the casing unfit for further service.



1 Splash shield
2 Reverse idler gear shaft
3 Needle bearing
4 Idler gear
5 Spacer

Fig 15 Dismantling centre plate

22.2 Inspect all gears for chipped or broken teeth, and for signs of excessive wear, inspect all spline teeth on the synchromesh assemblies.

22.3 Check synchromesh slippers and slipper rings for wear and breakage.

22.4 Check the wear between all synchromesh baulk rings and gears by pushing the baulk ring against the gear and measuring the gap between the ring and gear. The minimum permissible gap is 0.5 mm (0.02 in.). If this clearance is not obtained, new baulk rings must be fitted.

22.5 Inspect all circlip grooves. Remove any burrs or rough edges with a fine abrasive stone.

22.6 Generally examine all other components for wear or damage, fitting new components as necessary.

Repairs and replacement

23 It is recommended that all seals, gaskets, circlips, lockwashers, needle and roller bearings are renewed at overhaul.

Reassembly

24 Reassemble the gearbox as follows;

Mainshaft

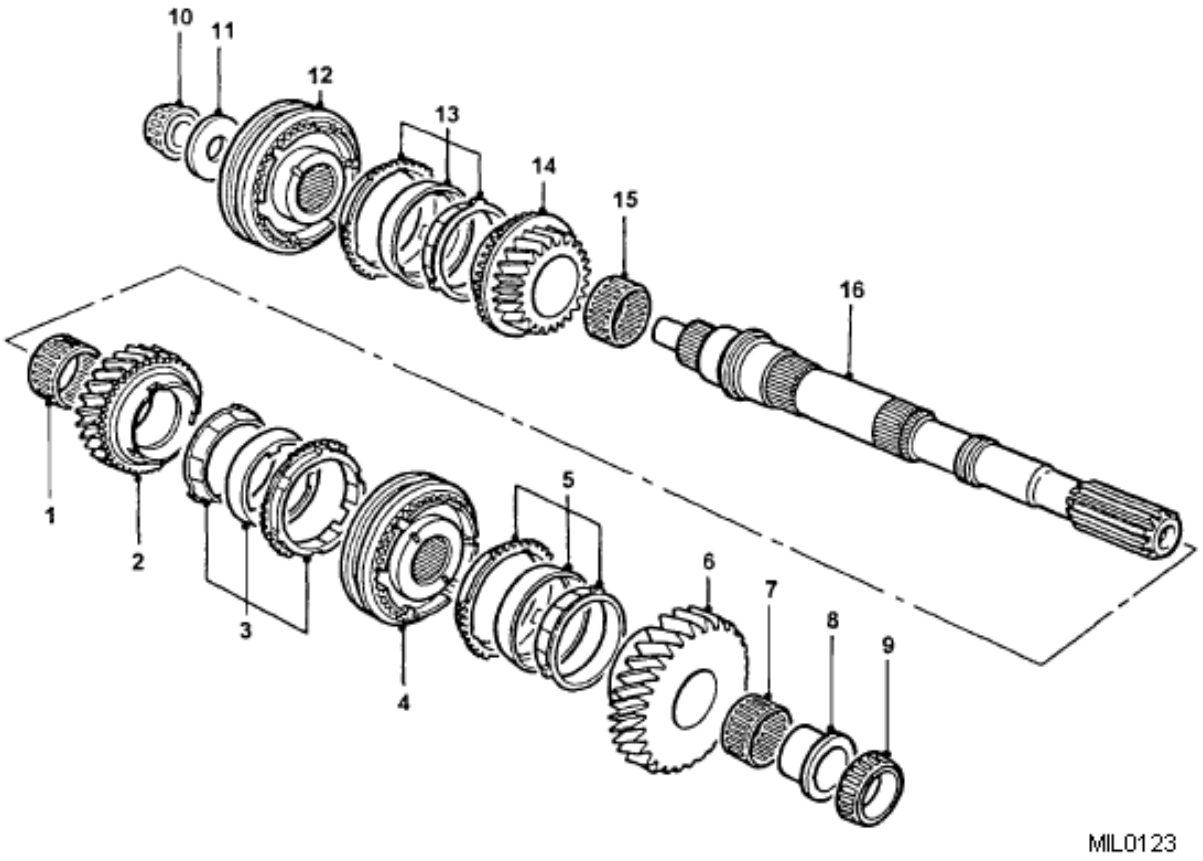
25 Reassemble the mainshaft as follows:

25.1 Clamp mainshaft in protected vice jaws, output end upwards.

25.2 Fit needle roller bearing (Fig 16 (1)), 2nd gear (2) and three synchromesh baulk rings (3) onto mainshaft (16) and press against shoulder.

NOTE

Rotate each baulk ring to ensure they locate onto each other.



1	Needle roller bearing	9	Taper roller bearing
2	2nd gear	10	Pilot bearing
3	Synchromesh baulk rings	11	Spacer
4	1st/2nd gear synchromesh hub	12	3rd/4th gear synchromesh hub
5	1st gear synchromesh baulk rings	13	Synchromesh baulk rings
6	1st gear	14	3rd gear
7	Needle roller bearing	15	3rd gear needle roller bearing
8	Bush	16	Mainshaft

Fig 16 Mainshaft reassembly

25.3 Assemble the 1st/2nd synchromesh hub (4) onto mainshaft spline, (note 2nd speed side marking). Ensure that the baulk rings (3) have located correctly inside the hub - rotate the ring slightly as the hub is lowered).

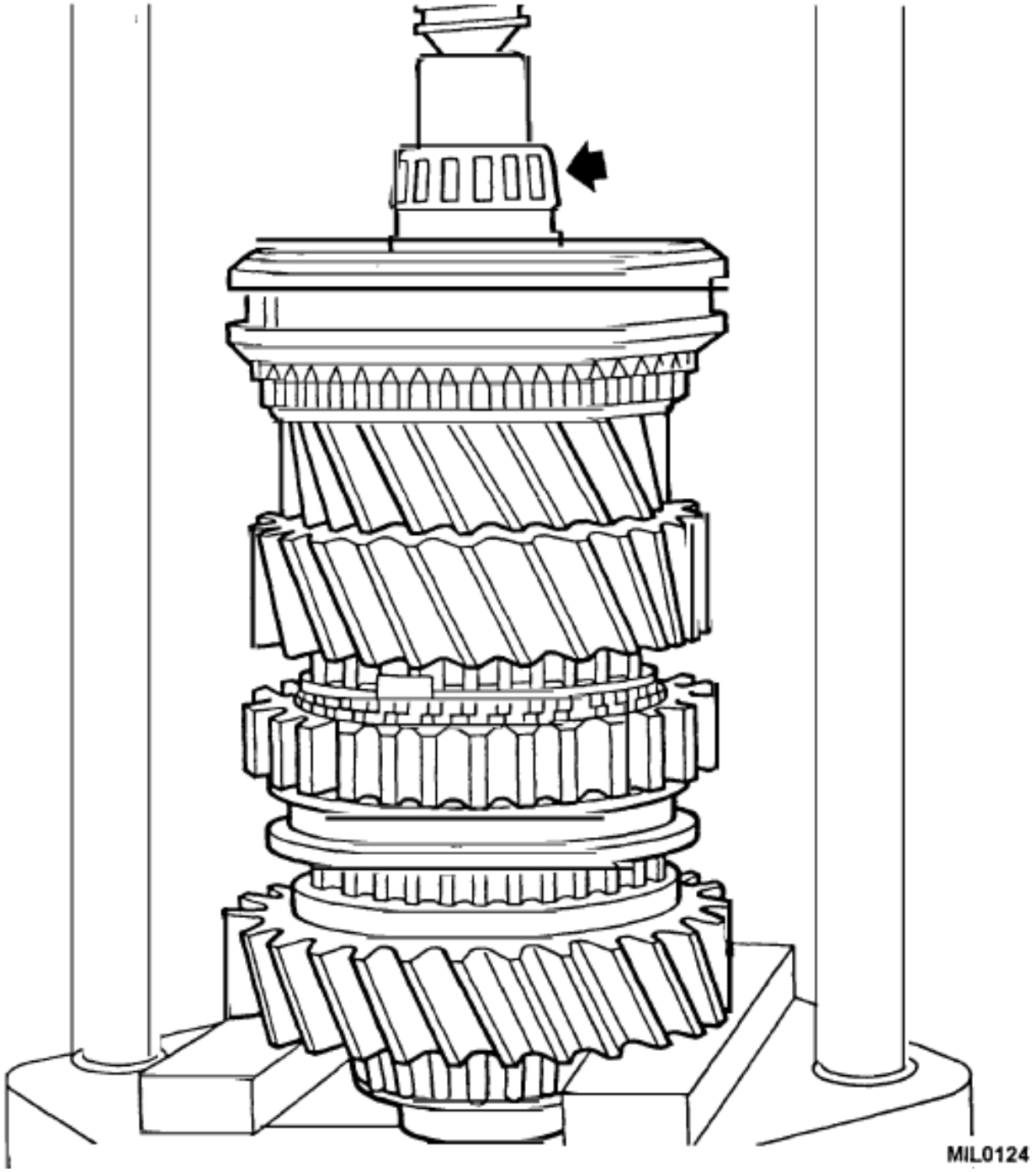


Fig 17 Fitting pilot bearing

25.4 Fit 1st gear synchromesh baulk rings (5), needle roller bearing (7), 1st gear (6) and bush (8) onto mainshaft ensuring baulk rings locate correctly inside hub.

25.5 Using suitable tools with the special tools (refer to Table 1, Serial 3 and 4) fit the mainshaft taper roller bearing (9) taking care not to disturb the synchromesh baulk rings and gears.

25.6 Check the end float of the mainshaft assembly using a feeler gauge between the 1st gear and mainshaft bearing. Minimum clearance should be 0.05 mm with a tolerance of 0.15 mm (0.002 in. with a tolerance of 0.006 in.) for 1st gear and 0.04 to 0.2 mm (0.0016 to 0.008 in.) for 2nd gear.

25.7 Invert the mainshaft in the vice and fit 3rd gear needle roller bearing (15), 3rd gear (14) and three synchromesh baulk rings (13) and press them firm against the mainshaft collar.

25.8 Assemble the 3rd/4th gear synchromesh hub (12) (note 3rd speed side markings) onto its splines taking care to locate the baulk rings into the recesses in the selector hub.

25.9 Fit spacer (11).

25.10 Using a suitable tool press on pilot bearing (Fig 17). Check end float of 3rd gear assembly (refer to Para 25.6). Minimum clearance 0.11 mm with a tolerance of 0.10 mm (0.004 in. with a tolerance of 0.004 in.).

Input shaft

26 Support the shaft under a suitable tool and press on a new pilot bearing track.

26.1 Using suitable tools with the special tool (refer to Table 1, Serial 3) fit a new taper bearing.

Layshaft

27 Using a suitable tool and support bars fit new taper roller bearings (Fig 18).

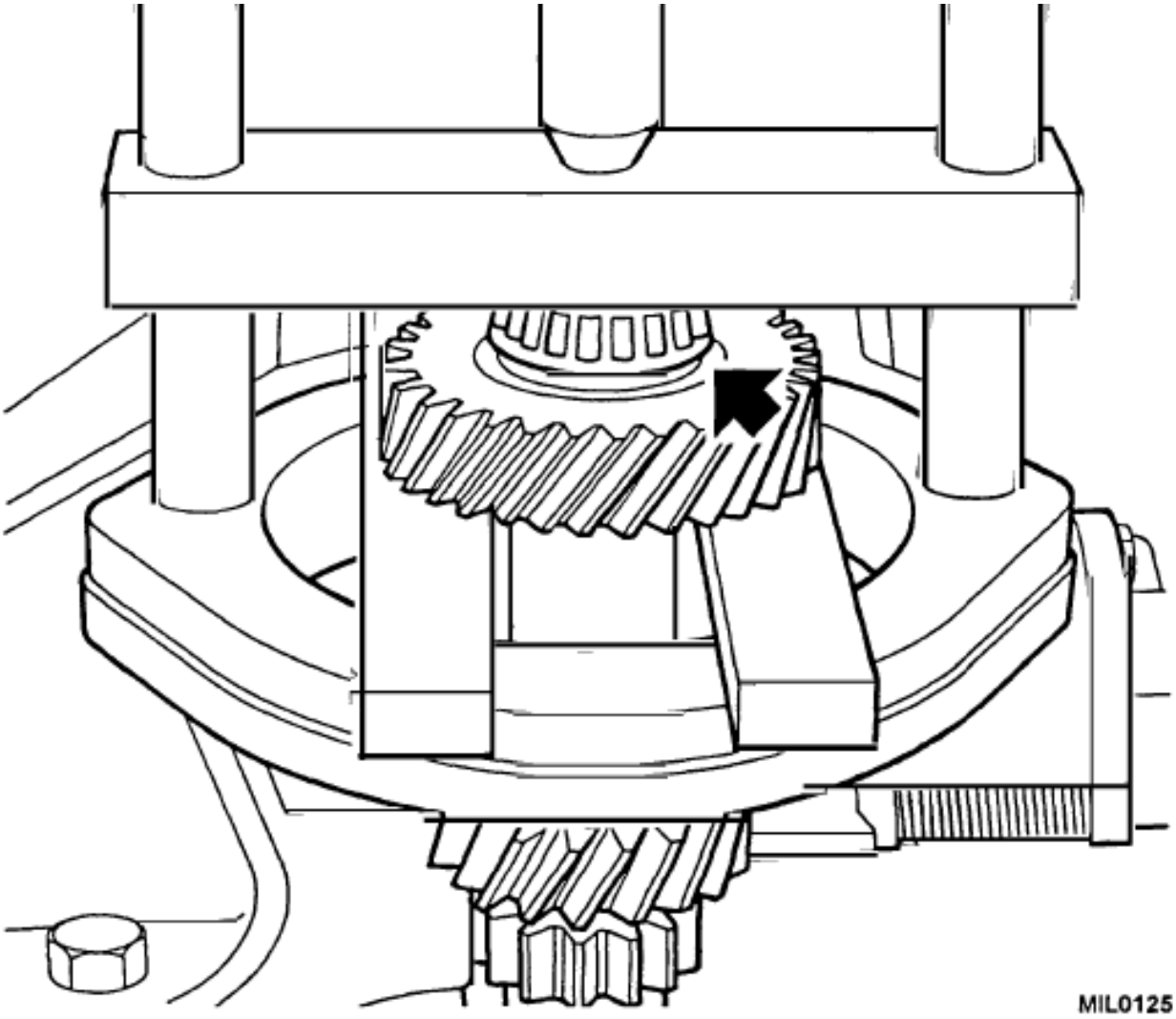


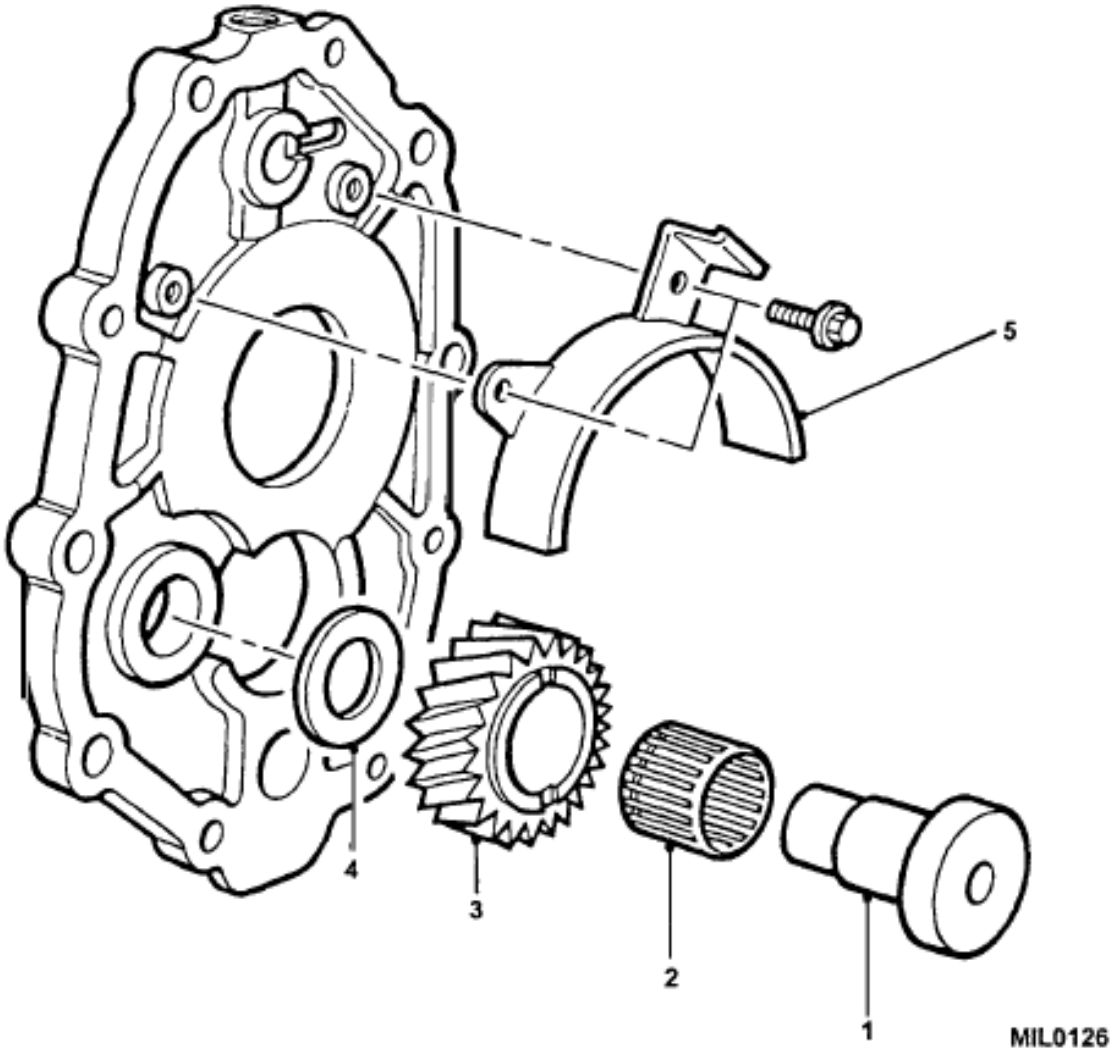
Fig 18 Fitting taper roller bearing

Reverse idler gear

28 Examine components for wear and damage.

28.1 Assemble reverse idle gear needle roller bearing (Fig 19 (2)), idler gear (3), spacer (4) and shaft (1) and using suitable tool, press into centre plate. Minimum clearance: 0.04 mm with a tolerance of 0.34 mm (0.0016 with a tolerance of 0.013 in.).

28.2 Fit splash shield (5) if removed.



1 Shaft
2 Needle roller bearing
3 Idler gear
4 Spacer
5 Splash shield

Fig 19 Reverse idler gear assembly

Selectors

29 Examine selector rail and pins for wear and damage.

29.1 Examine selector forks for wear and damage.

NOTE

The selector rail and fork is only supplied as a complete assembly.

29.2 Examine interlock spools for wear and damage.

29.3 Remove snap ring and examine selector yoke assembly.

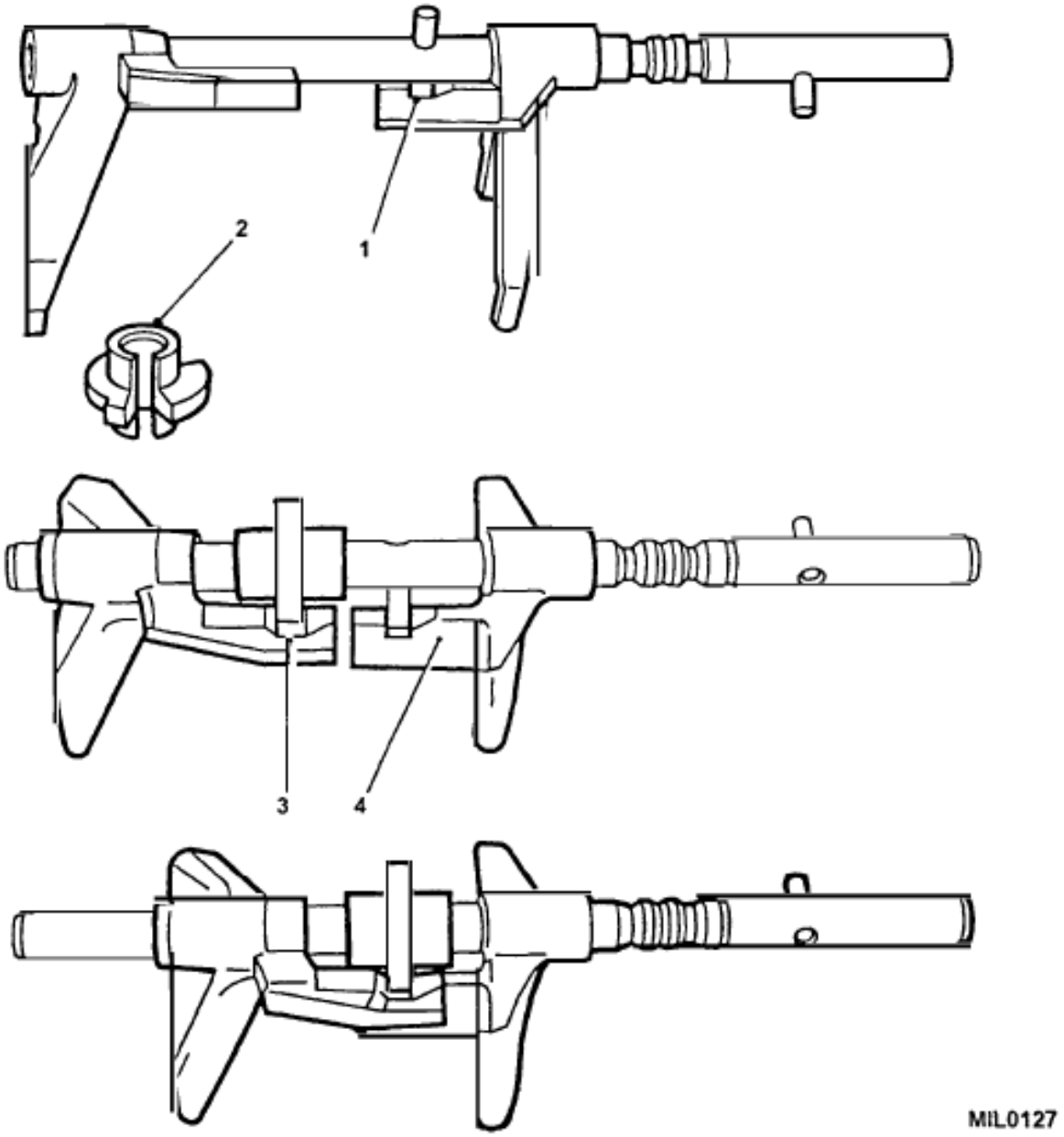
Assembling selectors

30 Assemble the selectors as follows:

30.1 Rest 1st/2nd fork (Fig 20 (3)) and shaft assembly on bench and locate pin (1) in jaw of fork.

30.2 Fit interlock spool (2) and 3rd/4th fork (4) and re-engage spool in jaw of fork (3).

30.3 Slide spool and fork towards 1st/2nd selector until slot in spool locates over pin keeping the spool engaged in 3rd/4th fork jaw (4).



1 Pin
2 Interlock spool
3 1st/2nd Fork
4 3rd/4th Fork

Fig 20 Assembling the selectors

Mainshaft and layshaft end float

31 The end float for both the mainshaft and the layshaft has to be determined before the gearbox can be reassembled. This is achieved by clamping the mainshaft and layshaft separately between the centre plate and main casing and measuring the movement on each shaft with a dial test indicator. The end float setting for the mainshaft and layshaft is 0.01 to 0.06 mm (0.0004 to 0.0024 in.).

31.1 Shims to make up the required clearances are placed under the bearing tracks of the centre plate.

Shimming

32 To shim the mainshaft and layshaft proceed as follows;

32.1 Fit bearing tracks to main casing front cover.

32.2 Fit front cover to casing without oil seal.

32.3 Clamp casing in vice with front cover downwards.

32.4 Fit input shaft. Do not fit 4th gear baulk ring.

32.5 Fit mainshaft assembly to input shaft.

32.6 Fit mainshaft bearing existing shim and track to centre plate.

32.7 Fit centre plate and bolt down using eight 'slave' bolts (Fig 21 (1)).

32.8 Fit large ball bearing to rear of mainshaft (2).

32.9 Mount dial test indicator (3).

32.10 Rotate mainshaft to settle bearings.

32.11 Lift mainshaft and note reading.

32.12 Dismantle and substitute shims if reading incorrect.

32.13 Repeat procedure.

32.14 Remove mainshaft assembly and repeat procedure for layshaft.

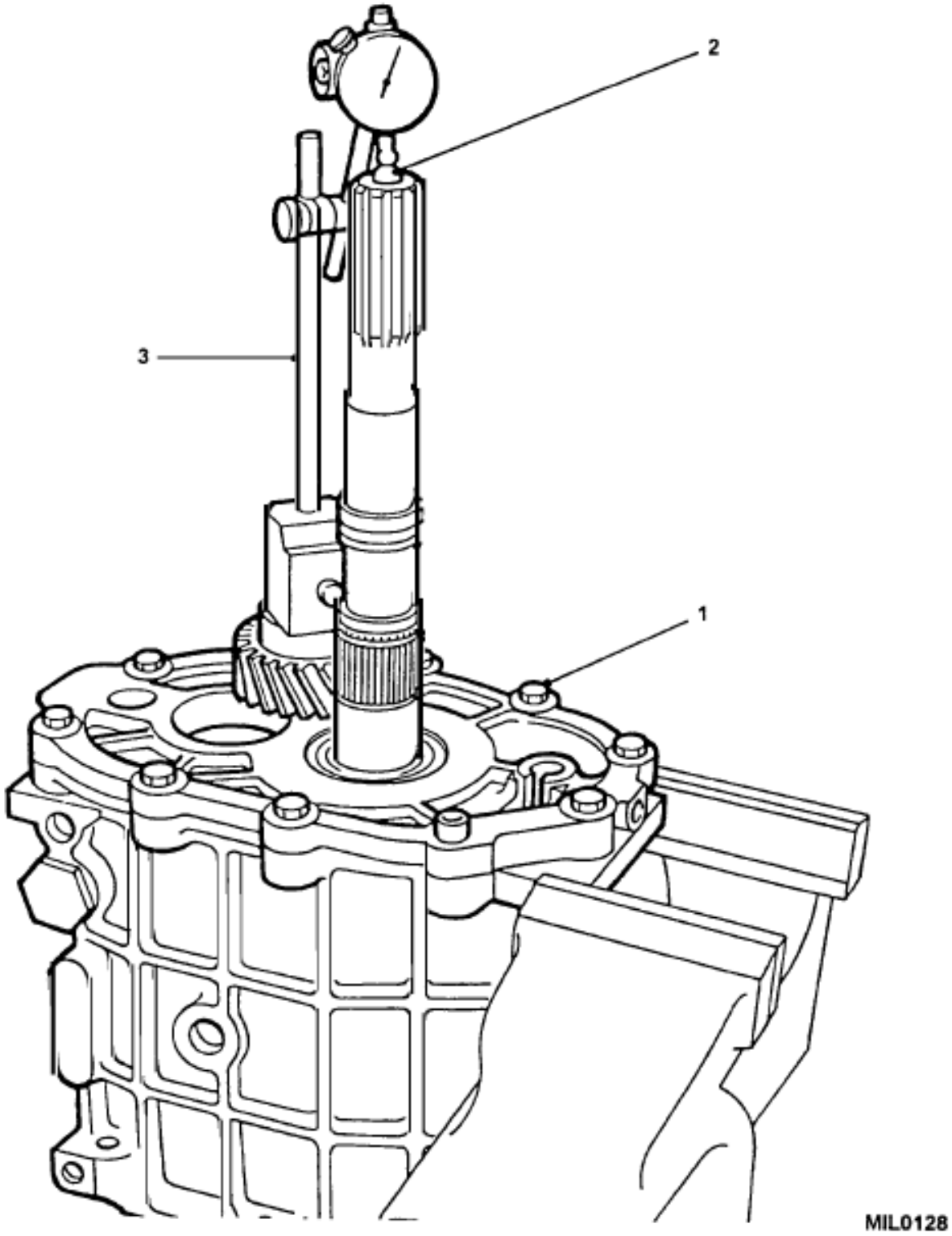
32.15 Dismantle assembly in preparation for reassembly on stand.

Assembling mainshaft and layshaft to centre plate

33 To assemble mainshaft and layshaft to centre plate proceed as follows:

33.1 Secure centre plate to workstand.

33.2 Fit selectable and bearing tracks. Check circlips are seated.

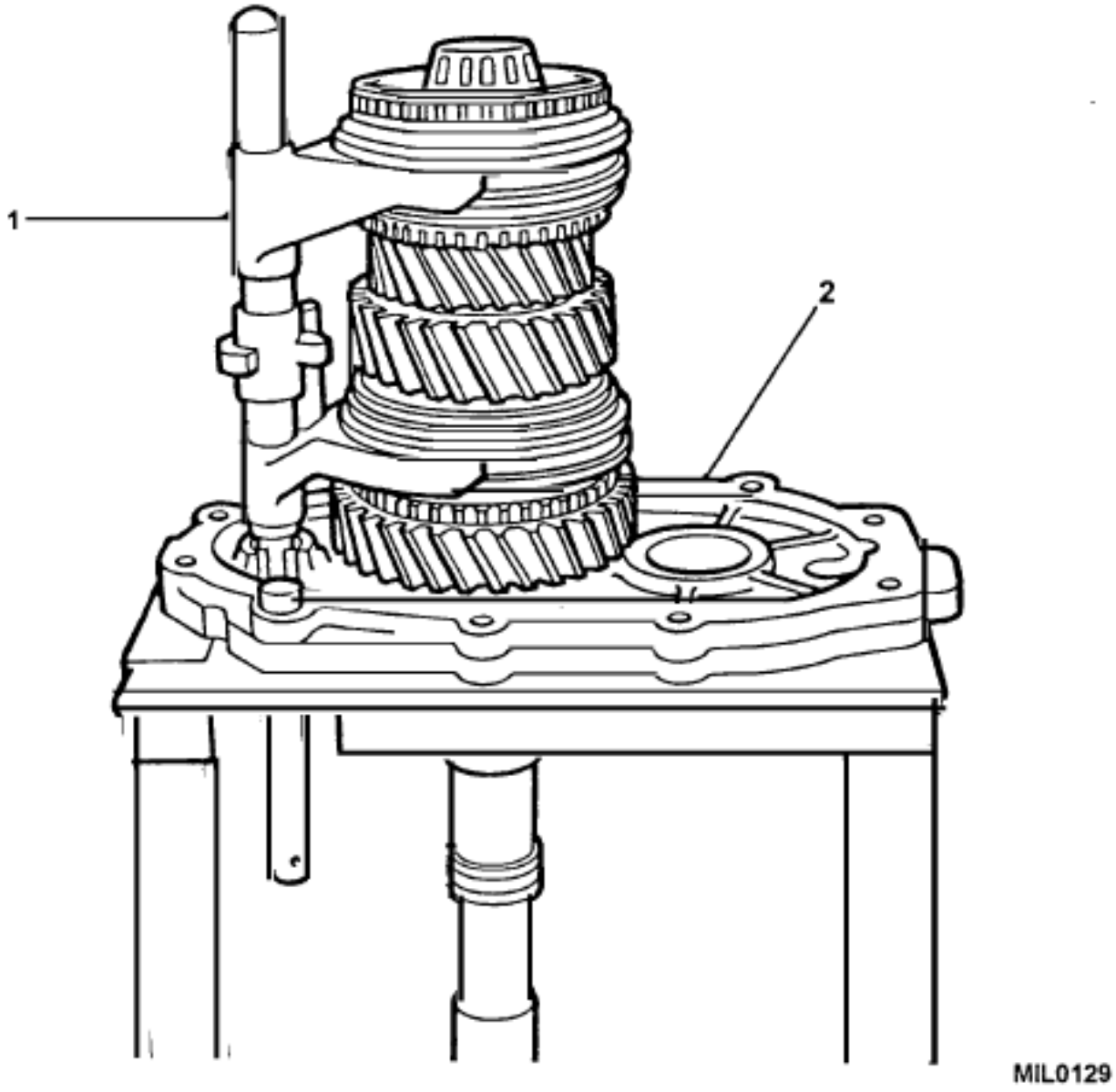


1 Slave bolts 3 Dial test indicator
2 Mainshaft

Fig 21 Shimming the mainshaft and layshaft

33.3 Fit inboard detent ball and spring, use a dummy bar to temporarily hold the ball in place.

33.4 Check both synchromesh units are in neutral and fit selector shaft assembly (Fig 22 (1)).



1 Selector shaft assembly 2 Centre plate

Fig 22 Assembling mainshaft to centre plate

33.5 Fit mainshaft and selectors to centre plate (2) aligning pin with slot in plate.

33.6 Fit layshaft (Fig 23 (1)) whilst lifting mainshaft to clear layshaft rear bearing.

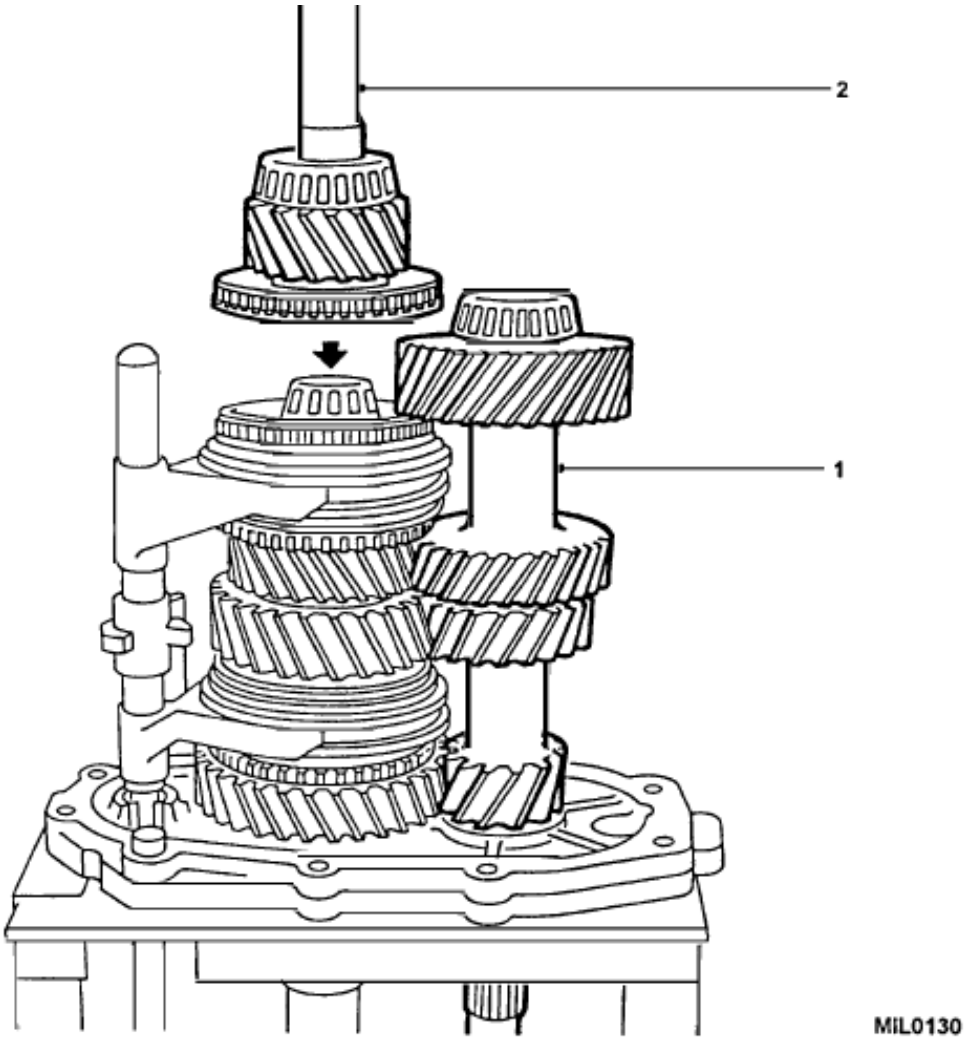
33.7 Lubricate pilot bearing and fit input shaft (2).

Front cover

34 Fit oil seal to front cover, ensure seal is fitted down to the shoulder.

34.1 Apply sealing compound (refer to Table 2, Serial 1) in a continuous bead as shown in Fig 24.

34.2 Fit front cover to main casing and secure.



1 Layshaft 2 Input shaft

Fig 23 Assembling primary shaft and layshaft to centre plate

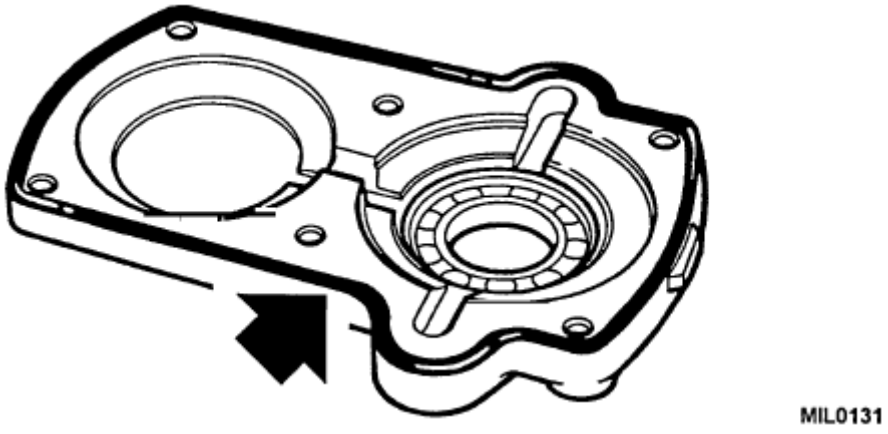


Fig 24 Assembling front cover

34.3 Fit bearing tracks and clips to main casing and fit front seal fixings with sealing compound (refer to Table 2, Serial 2).

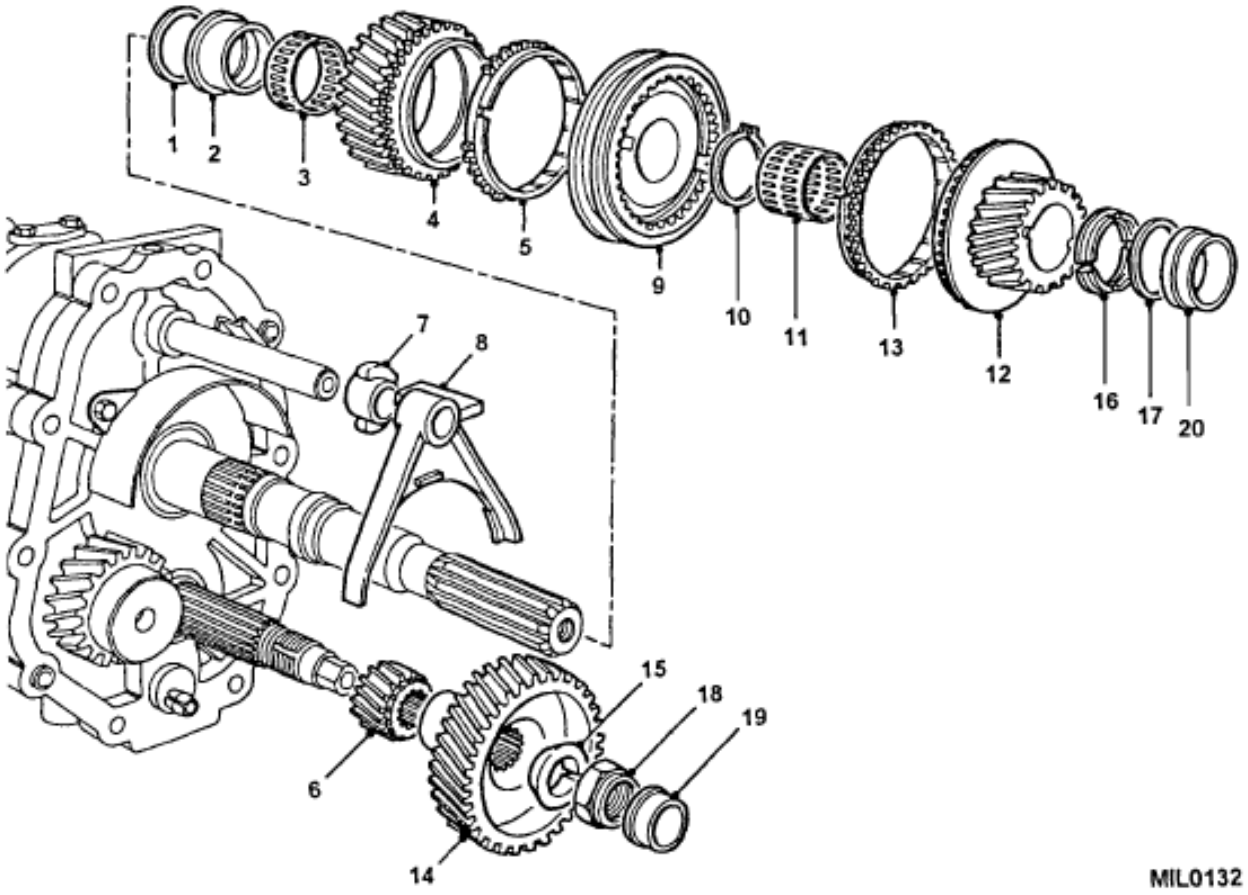
34.4 Apply sealing compound (refer to Table 2, Serial 1) and fit main casing to centre plate.

34.5 Bolt casing and centre plate together using two or three 'slave' bolts.

34.6 Fit new 'O' ring and fit spool retainer.

34.7 Fit outer detent ball and spring to centre plate and retain with grub screw.

34.8 Remove casing from stand and clamp in vice, centre plate upper most.



1	Selectable washer	11	Split needle bearing
2	Bush	12	5th gear
3	Needle roller bearing	13	5th gear synchromesh baulk rings
4	Reverse gear	14	Layshaft 5th gear
5	Synchromesh baulk ring	15	Split conical washer
6	Layshaft reverse gear	16	5th gear segments
7	Spool	17	Retaining ring
8	Selector fork	18	Nut
9	Reverse/5th gear synchromesh HUB	19	Rear support bearing
10	Circlip	20	Bearing track

Fig 25 Assembling 5th and reverse gear

Assembly of reverse and 5th gear

35 To assemble reverse and 5th gear proceed as follows:

35.1 Fit mainshaft reverse gear selectable washer (Fig 25 (1)), bush (2) and needle bearing (3).

35.2 Fit mainshaft reverse gear (4) and synchromesh baulk ring (5).

35.3 Fit layshaft reverse gear (6).

35.4 Assemble selector spool (7), selector fork (8) and reverse/5th gear synchromesh hub (9) and fit as one assembly to mainshaft splines and selector shaft. Ensure synchromesh baulk ring locates inside hub.

35.5 Fit new circlip (10).

NOTE

The selectable washer behind the reverse gear controls the fit of the circlip. Adjust to 0.005 to 0.055 mm (0.0002 to 0.0021 in.).

35.6 Fit 5th gear split needle bearing (11).

35.7 Fit 5th gear (12) and 5th gear synchromesh baulk rings (13) to mainshaft.

35.8 Fit layshaft 5th gear (14) and the split conical washer (15).

35.9 Fit and locate 5th gear segments (16) and retaining ring (17).

35.10 Using the special tool (refer to Table 1, Serial 1) to hold layshaft 5th gear (Fig 26) tighten the layshaft 5th gear nut to 375 Nm (276 lbf/ft).

35.11 Stake layshaft 5th gear nut (Fig 25 (18)).

35.12 Using a suitable tool with the special tool (refer to Table 1, Serial 5) press mainshaft rear support bearing track (20) to collar on mainshaft (Fig 27).

35.13 Apply small amount of heat and fit layshaft rear support bearing (Fig 25 (19)).

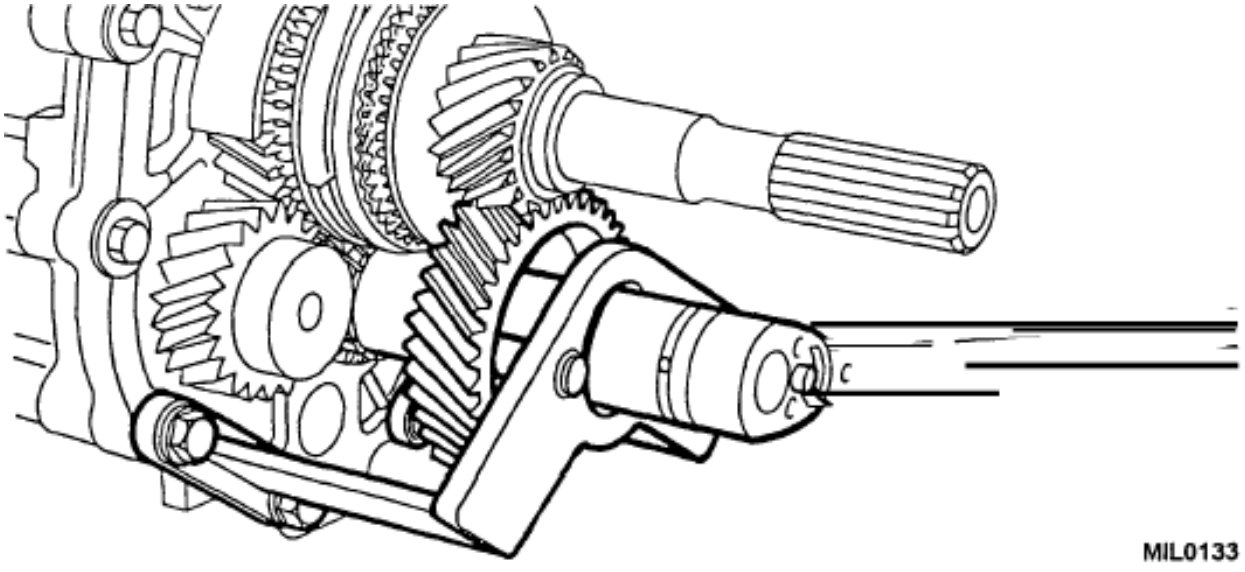


Fig 26 Fitting layshaft nut

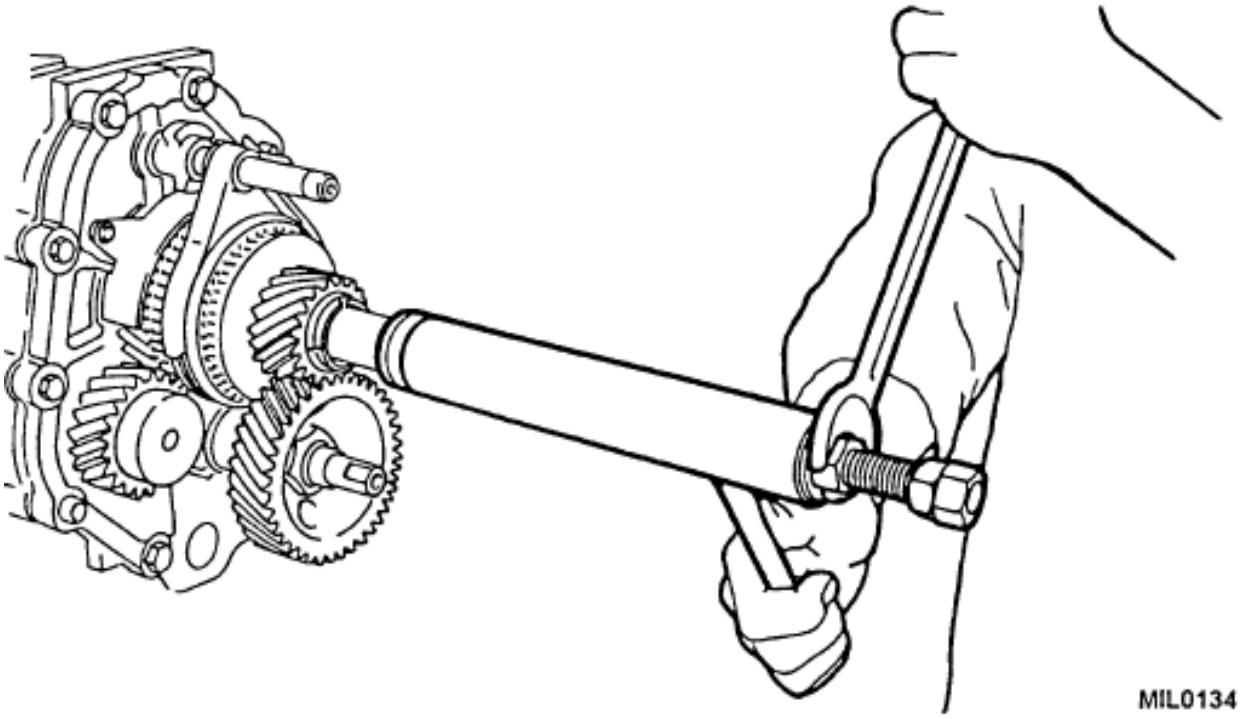


Fig 27 Fitting support bearing track

Refitting

Extension housing

36 To refit the extension housing (refer to Cat 523 Chap 3-1).

Selector quadrant fork

37 Refit the selector quadrant fork (refer to Cat 523 Chap 3-1).

Main gear selector and remote housing

38 Refit the main gear selector and remote housing (refer to Cat 523 Chap 3-1).

Transfer box selector housing

39 Refit the transfer box selector housing (refer to Cat 523 Chap 3-1).

Clutch housing

40 Refit the clutch housing and clutch release lever (refer to Cat 523 Chap 2).

Gearbox and transfer box assembly

41 Refit the gearbox and transfer box assembly to the vehicle (refer to Cat 523 Chap 3-1).

CHAPTER 3-2

UPRATED GEARBOX

CONTENTS

(continued)

CONTENTS (continued)

Table Page

Fig Page

INTRODUCTION

1 This chapter details the Base repairs for Truck Utility Light (TUL) High Specification (HS), and Truck Utility Medium (TUM) HS and (TUM) Ambulance HS vehicles fitted with the up-rated five speed manual gearbox and the 2.5 litre 300 Tdi direct injected turbocharged diesel engines.

NOTE

The special tools listed in the following table will be referred to in the text, where used, by their serial number shown in the table.

TABLE 1 SPECIAL TOOLS

Serial (1)	Manufacturers Part Number (2)	NSN/Part Number where applicable (3)	Designation (4)
1	LRT-37-002	6MT2/5120-99-611-3333	Adapter- primary shaft bearing remover
2	LRT-37-019	6MT2/5120-99-051-9950	Bearing centre remover centralise
3	LRT-37-021	6MT2/5120-99-449-4201	Replacer, mainshaft rear bearing track
4	LRT-37-022	6MT2/5120-99-257-9857	Remover, layshaft bearings
5	LRT-37-023	6MT2/5120-99-037-0562	Layshaft gear retainer
6	LRT-37-024	6MT2/5120-99-063-0231	Adapter, remover layshaft bearing track
7	LRT-37-043	TBA	Adapter
8	LRT-37-044	TBA	Adapter - layshaft bearing removal

TABLE 2 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	Loctite	518 8040-99-701-8040	Sealing compound
2	Loctite	270 8030-99-224-8707	Sealing compound

TABLE 3 HUBS AND SLEEVES

Serial (1)	Assembly (2)	Hub (3)	Sleeve (4)	Against Gear (5)
1	1st / 2nd		1 Notch	1st
2		2nd gear side		2nd
3	3rd / 4th		3 Notches	3rd
4				4th
5	4th / 5th		5 Notches	5th

LOCALLY MANUFACTURED TOOL

2 The locally manufactured tool (Fig 1) is also recommended to assist in the gearbox repair.

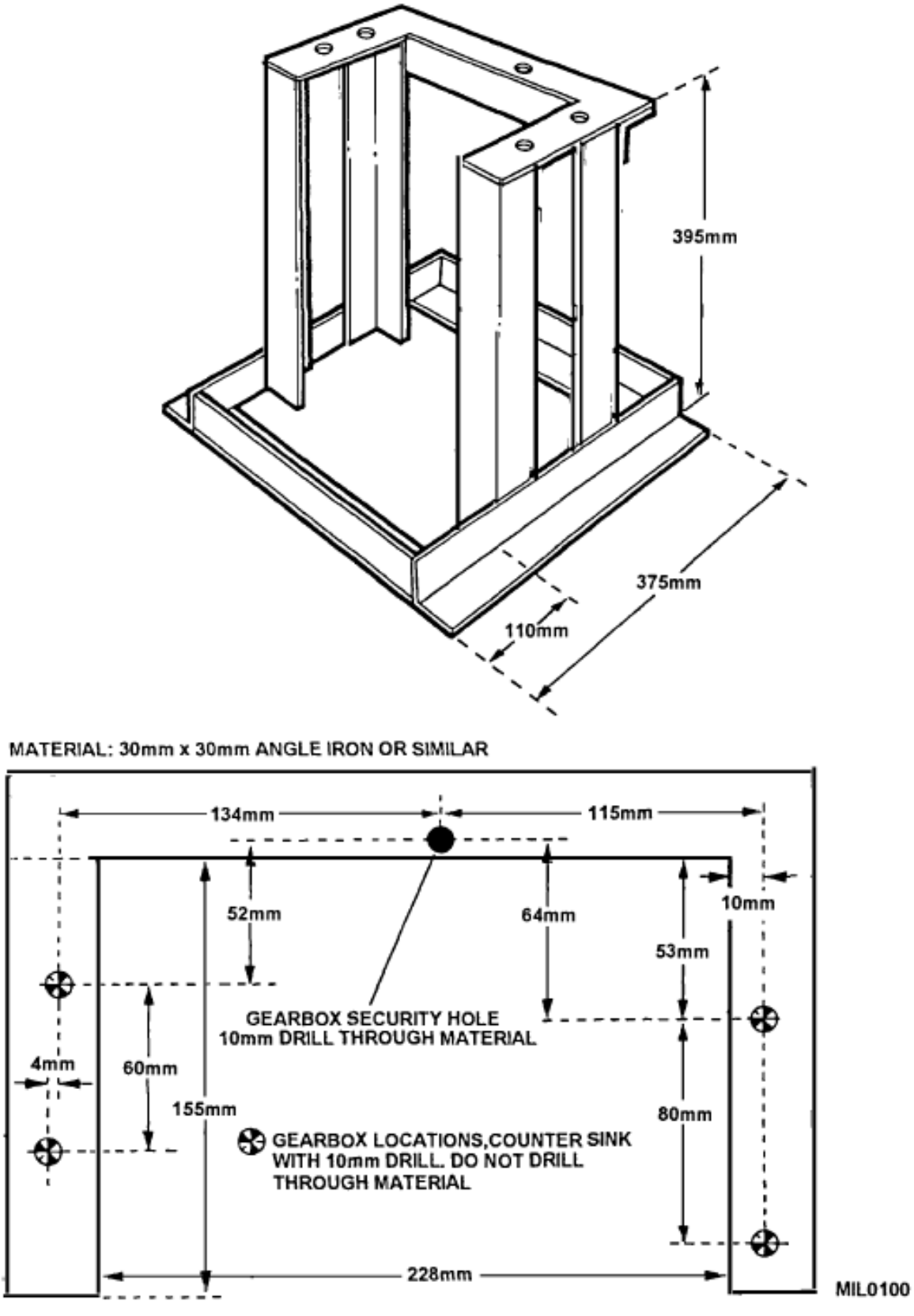


Fig 1 Gearbox support stand

MAIN GEARBOX AND TRANSFER BOX ASSEMBLY

Removal

3 Remove the gearbox from the vehicle (refer to Cat 523 Chap 3-2).

Dismantling

4 Place the gearbox on a suitable work bench with the transfer box removed (refer to Cat 523 Chap 3-2) ensuring that the oil has been drained.

Clutch housing

5 Remove the clutch housing and clutch release lever (refer to Cat 523 Chap 2).

Transfer box selector housing

6 Remove the transfer box selector housing (refer to Cat 523 Chap 3-2).

Main gear selector and remote housing

7 Remove the main gear selector and remote housing (refer to Cat 523 Chap 3-2).

Selector quadrant fork

8 Remove the selector quadrant fork (refer to Cat 523 Chap 3-2).

EXTENSION HOUSING

Removal

9 To remove the extension housing (refer to Cat 523 Chap 3-2).

MAIN GEARBOX

DISMANTLING

5th and reverse gear

10 To dismantle the 5th and reverse gear carry out the following:

10.1 Using a suitable two legged puller, remove the 5th gear layshaft support bearing track (Fig 2 (1)) from the end of layshaft.

10.2 Using special tool (refer to Table 1, Serial 5) (20) to hold the 5th laygear, remove the 5th laygear stake nut (2).

10.3 Remove thrust collar segments retaining ring (3) and segments (4).

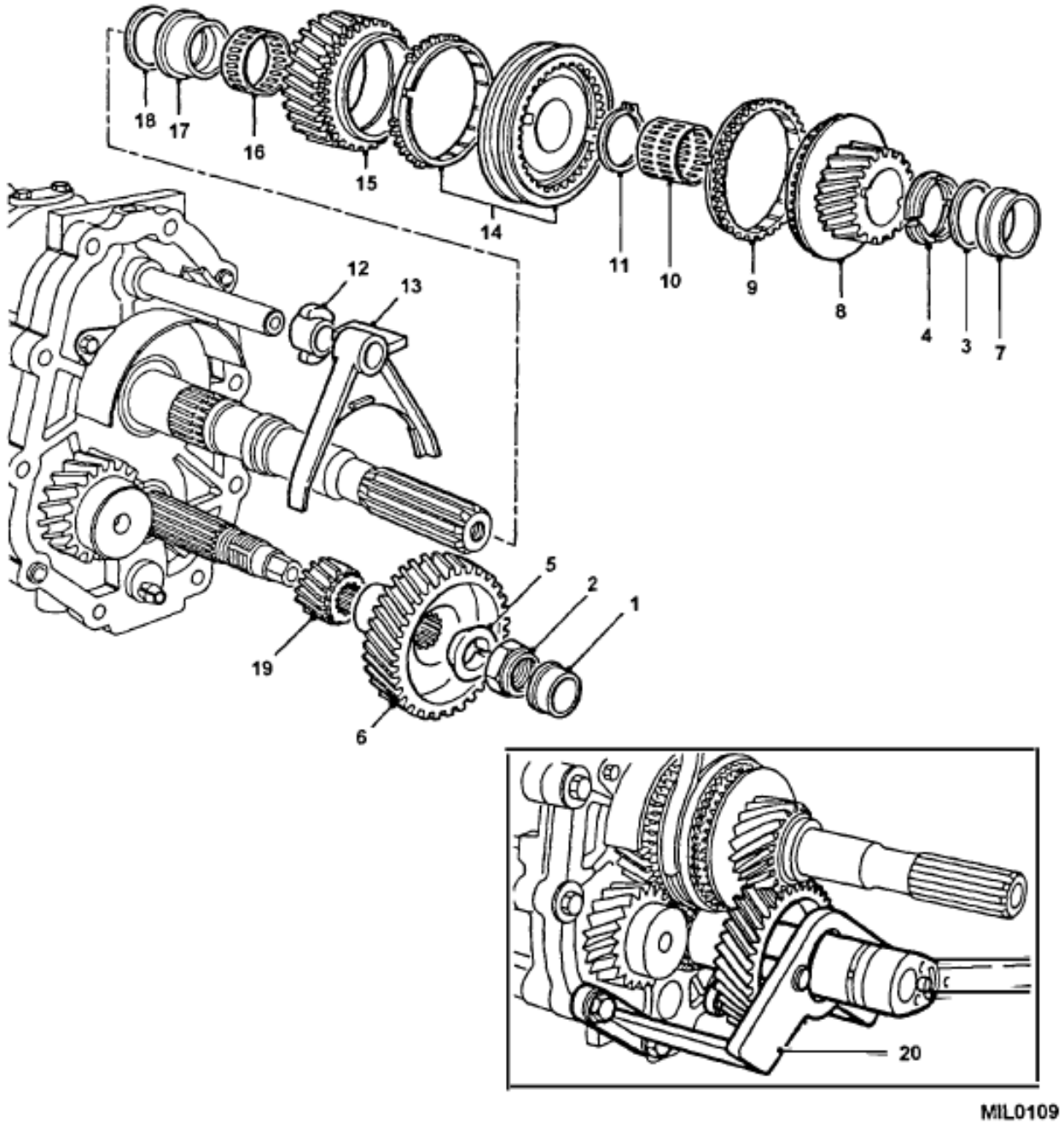
10.4 Remove 5th laygear (6) and split conical washer (5).

10.5 Remove mainshaft rear support bearing track (7) using special tools (refer to Table 1, Serials 6).

10.6 Remove mainshaft 5th gear (8) with synchromesh baulk ring (9).

10.7 Remove mainshaft 5th gear split needle roller bearing (10).

10.8 Remove circlip (11) securing 5th gear synchromesh hub.



1	Layshaft support bearing track	11	Circlip
2	5th gear laygear stake nut	12	Selector spool
3	Retaining ring	13	Selector fork
4	Thrust collar segments	14	Synchromesh hub
5	Split conical washer	15	Mainshaft reverse gear
6	5th laygear	16	Needle bearing
7	Mainshaft support bearing track	17	Bush
8	Mainshaft 5th gear	18	Selectable spacer
9	Synchromesh baulk ring	19	Layshaft reverse gear
10	Needle bearing	20	Special tool (refer to Table 1, Serial 5)

Fig 2 Removing 5th and reverse gear

10.9 Rotate selector spool Fig 2 (12) clear of selector fork (13) and remove 5th and reverse synchro hub assembly (14) complete with fork and spool.

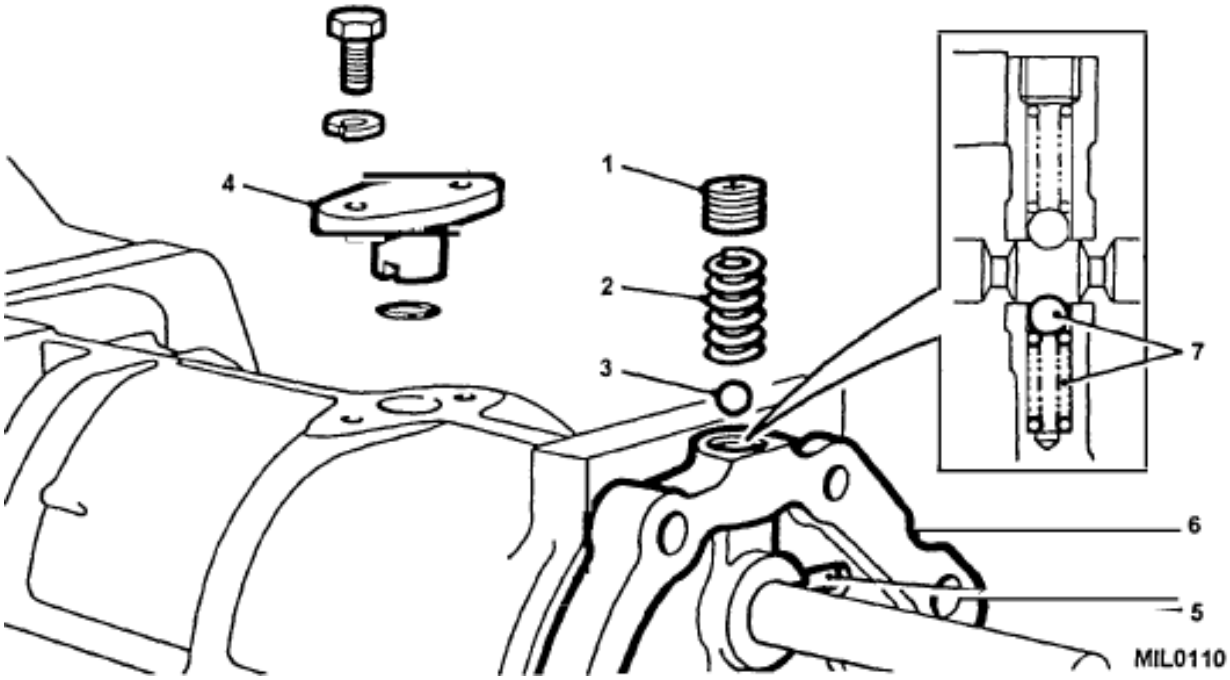
10.10 Remove mainshaft reverse gear (15) complete with needle roller bearing (16) and bush (17) noting the selectable spacer (18) between the reverse gear bush and centre plate bearing.

10.11 Remove layshaft reverse gear (19).

10.12 Remove centre plate detent plug (Fig 3 (1)), spring (2) and ball (3).

10.13 Remove maincase spool retainer (4).

10.14 Remove'slave' bolts (refer to Cat 523 Chap 3-2).



1 Detent plug
2 Spring
3 Ball
4 Spool retainer
5 Selector shaft pin
6 Centre plate
7 Detent ball and spring

Fig 3 Removing centre plate

Mainshaft and layshaft removal

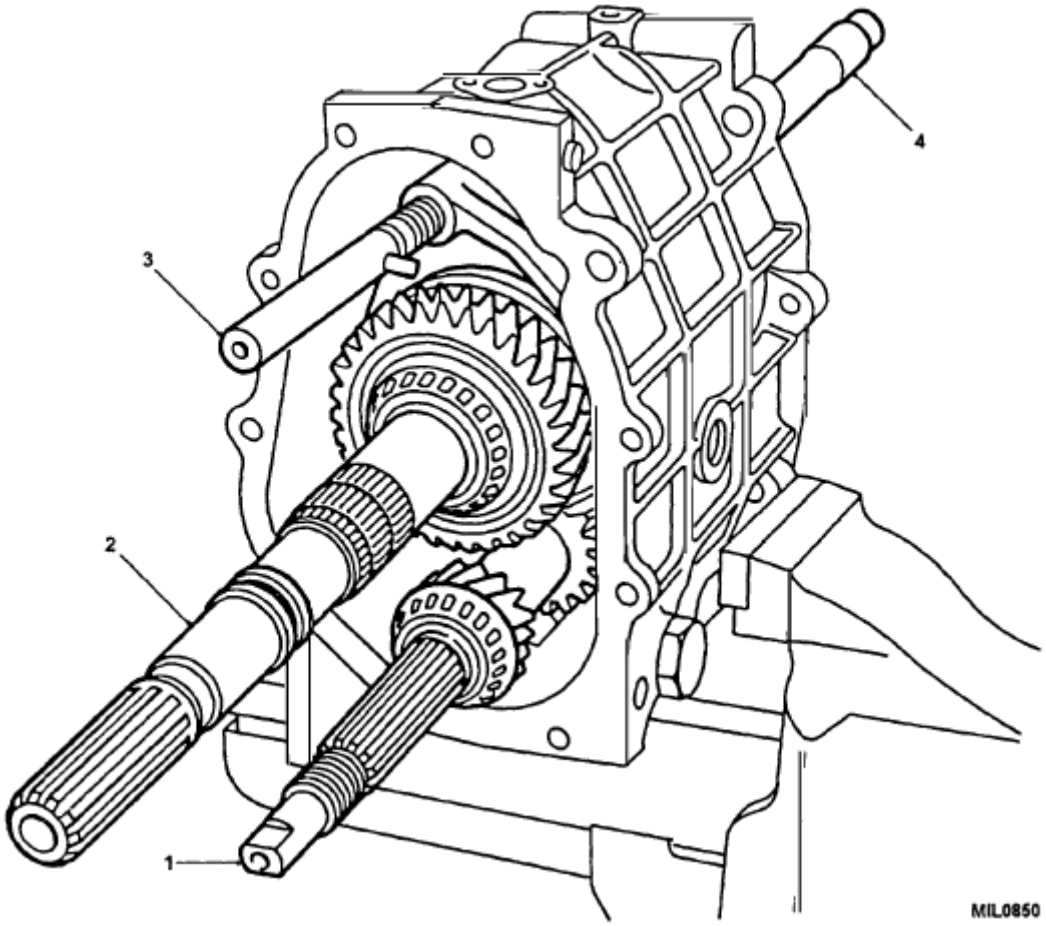
11 To remove the mainshaft and layshaft carry out the following:

11.1 Align selector shaft pin (Fig 3 (5)) with slot in centre plate and using wooden blocks and hide mallet, drive off centre plate (6).

11.2 Collect detent balls and springs (7), remove bearing tracks and shims.

11.3 Remove layshaft (Fig 4 (1)), mainshaft (2) and selector shaft (3) from casing as complete unit.

11.4 Remove input shaft (4), and 4th gear baulk ring (If not already removed with mainshaft).



1 Layshaft 3 Selector shaft
2 Mainshaft 4 Input shaft

Fig 4 Removing mainshaft and layshaft

Mainshaft

12 To dismantle the mainshaft proceed as follows:

12.1 Using a suitable tool and support bars under 1st gear, press 1st gear and mainshaft support bearing from mainshaft (Fig 5).

12.2 Remove 1st gear (Fig 6 (6)), bush (8) needle bearing (7) and three synchromesh baulk rings (5).

12.3 Remove 1st/2nd gear synchromesh hub (4), 2nd gear synchromesh baulk rings (3), second gear (2) and needle bearing (1).

12.4 Invert mainshaft and using special tool (refer to Table 1, Serial 15) and support bars under 3rd gear, press off pilot bearing (10) (refer to Fig 7).

12.5 Remove spacer (Fig 6 (11)), 3rd/4th gear synchromesh hub (12), 3 synchromesh baulk rings (13), 3rd gear (14) and needle bearing (15).

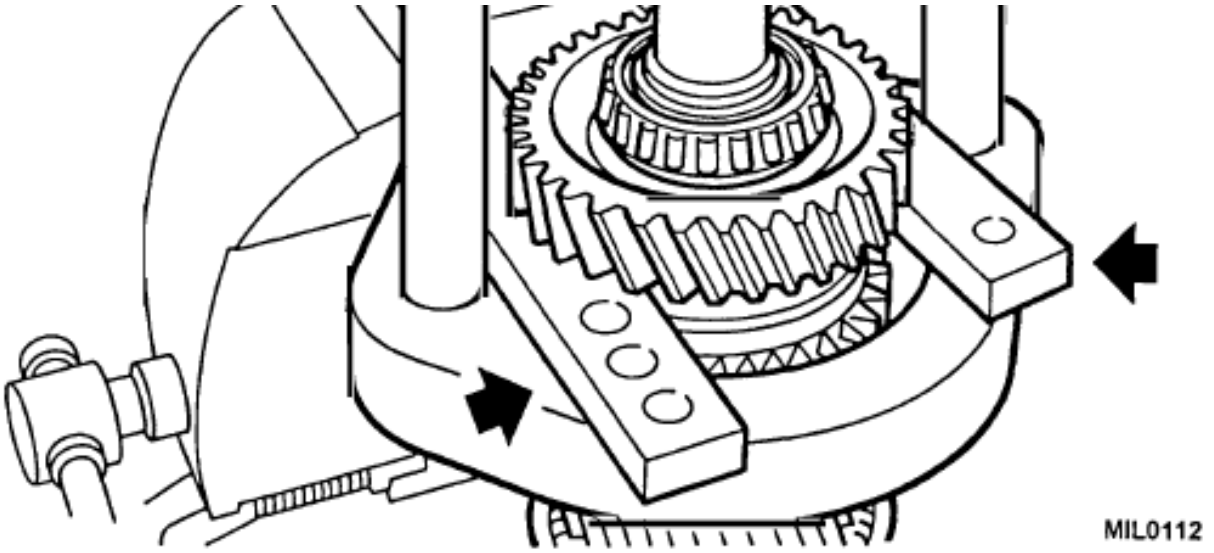
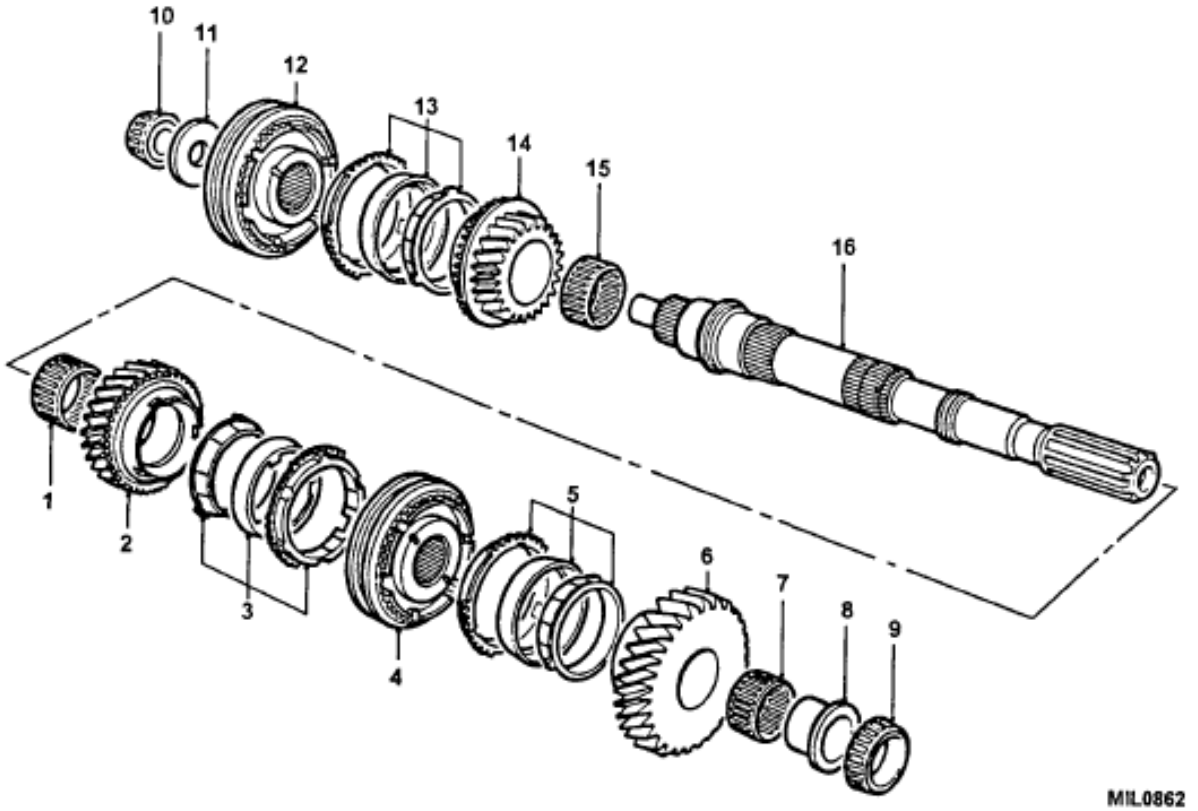


Fig 5 Removing support bearings from mainshaft



1	Needle bearing	9	Mainshaft support bearing
2	2nd gear	10	Pilot bearing
3	2nd gear synchromesh baulk rings	11	Spacer
4	1st/2nd gear synchromesh hub	12	3rd/4th gear synchromesh hub
5	Synchromesh baulk rings	13	Synchromesh baulk rings
6	1st gear	14	3rd gear
7	Needle bearing	15	Needle bearing
8	Bush	16	Mainshaft

Fig 6 Dismantling the mainshaft

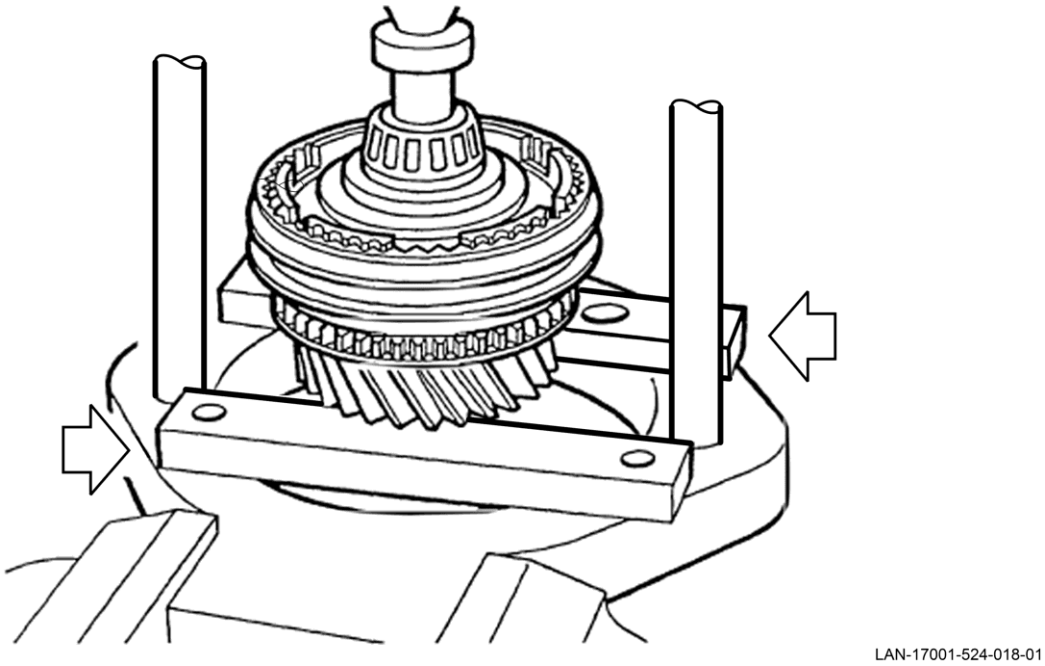


Fig 7 Removing pilot bearing

Synchromesh assemblies

13 Dismantle the synchromesh assemblies as follows:

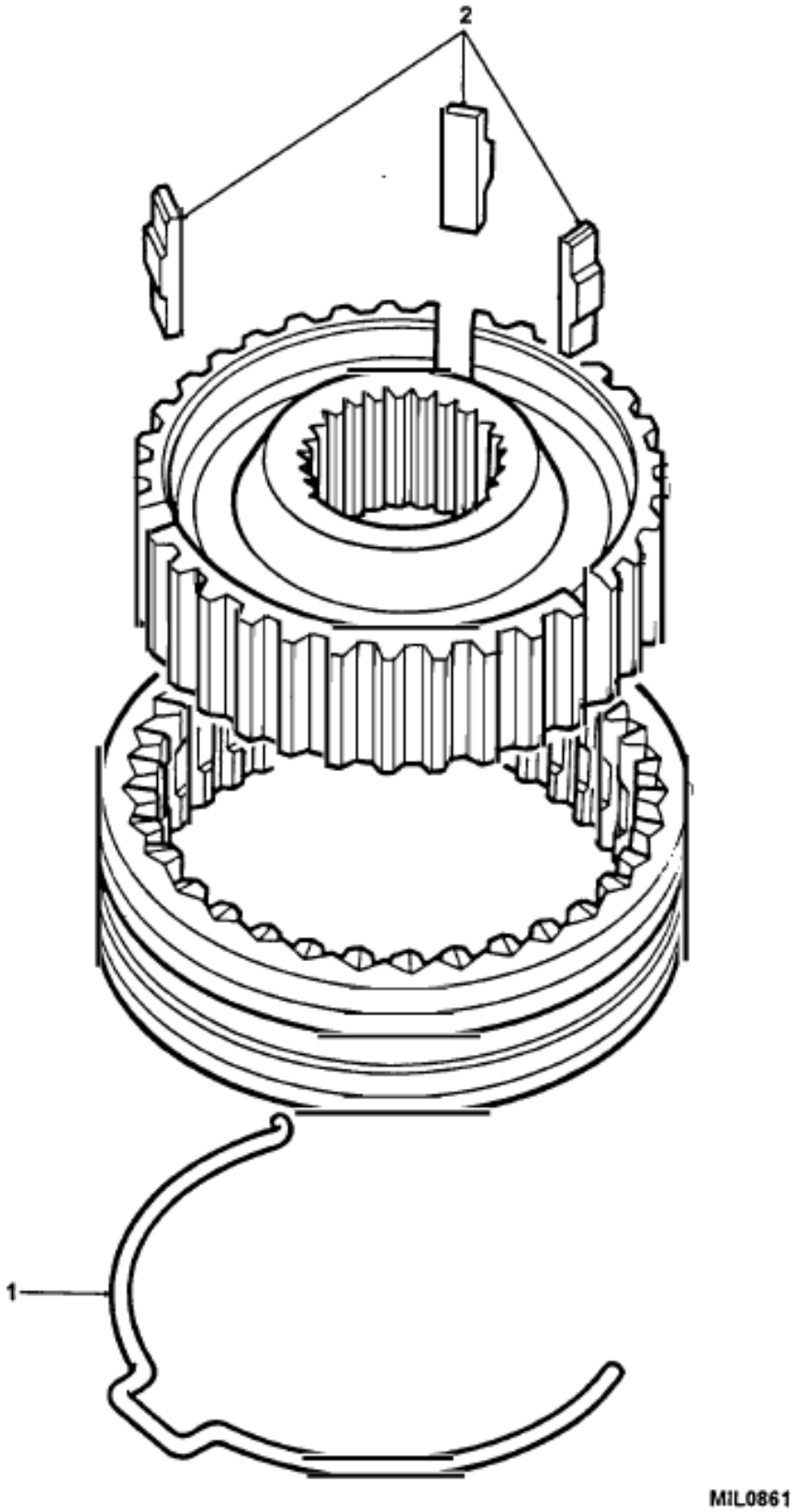
13.1 Remove spring clips (Fig 8 (1)) from both sides of the assembly.

13.2 Remove slippers (2) and separate the hub from the sleeve.

13.3 Examine all parts for damage and wear including spring clips for tension.

13.4 Check no excessive radial movement exist between inner members and mainshaft splines.

13.5 Examine inner and outer splines for wear.



1 Spring clips 2 Slippers

Fig 8 Synchromesh assemblies

13.6 Examine the dog teeth (Fig 9) on all gears for wear and damage.

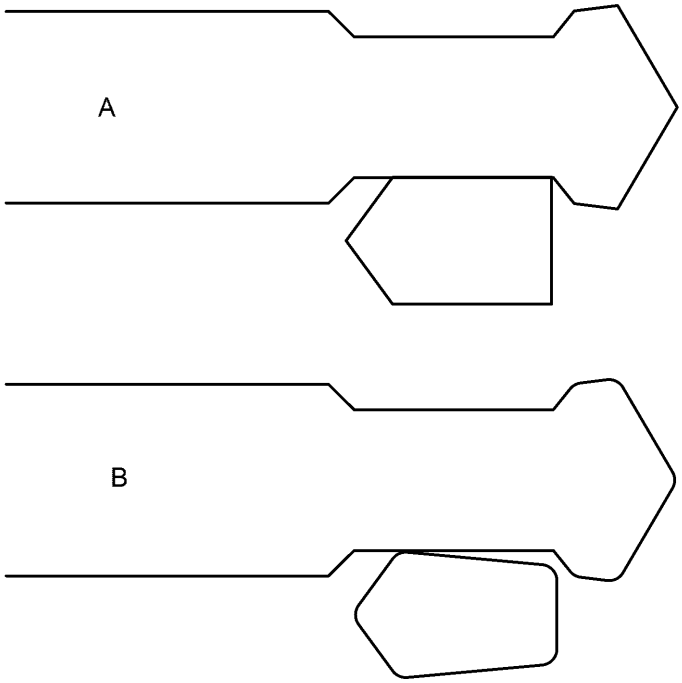


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Fig 9 Checking synchromesh dog teeth

13.7 Replace unit if excessively worn.

NOTE

In Fig 9 example 'A' shows a tooth in good condition. Example 'B' shows the rounded corners of a worn tooth.

REASSEMBLY

14 Refit inner hub to sleeve.

NOTE

Hubs and sleeves have a master spline combination and can only be assembled one way. The sleeves are further identified with a series of half moon notches which clearly identify which side of the assembly faces which gear. Ensure the slot in the hub aligns with the centre notch on the sleeve (refer to Table 3).

14.1 Fit slippers and secure with a spring each side of the synchromesh.

Checking baulk ring clearances.

15 Check clearance of all baulk rings and gears by pressing the baulk rings against the gear and measuring the gap (Fig 10). The minimum clearance should be 0.5 mm (0.02 in.).

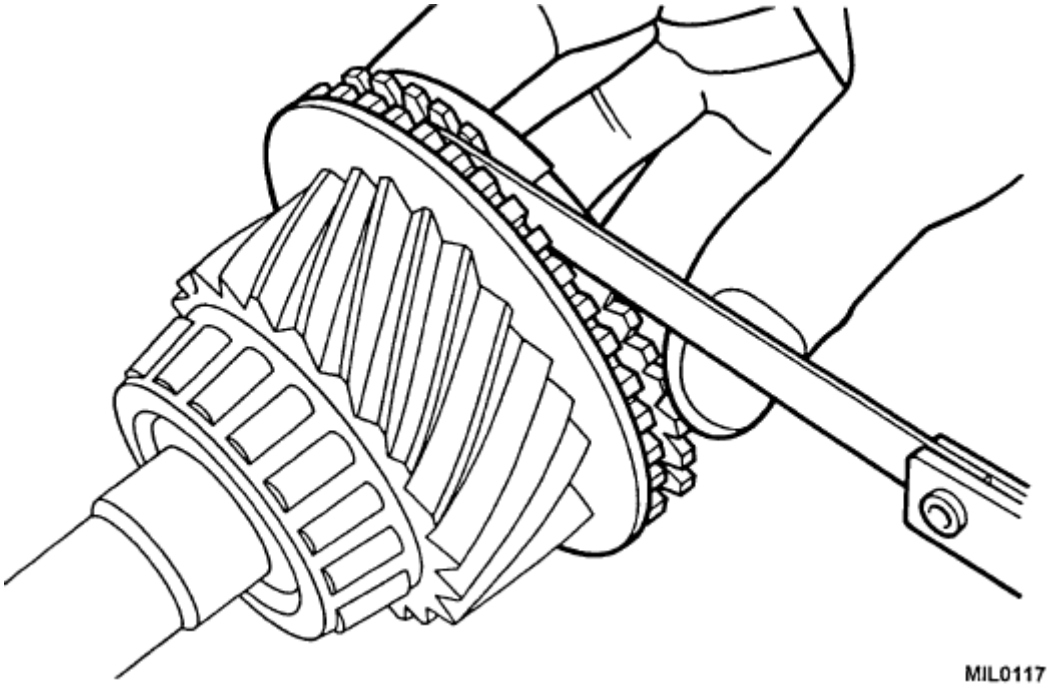
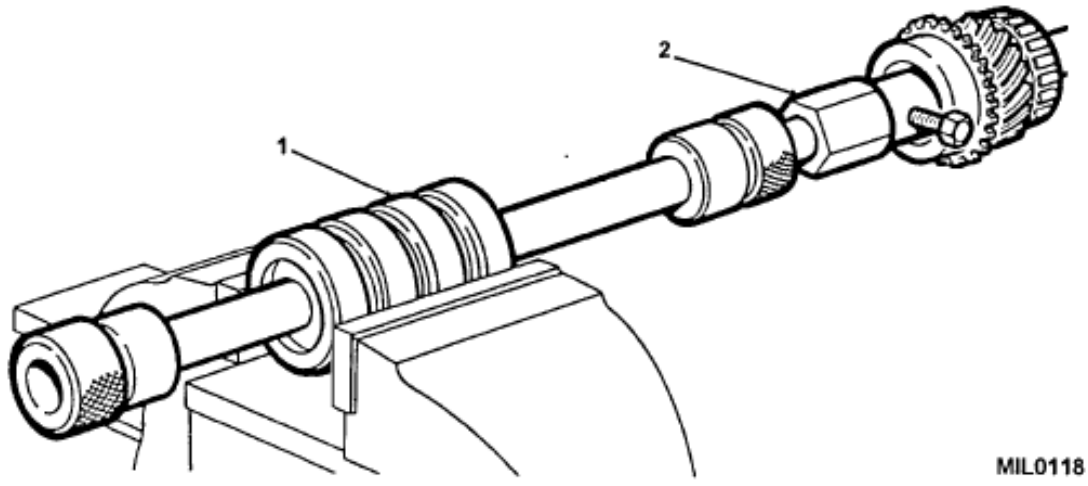


Fig 10 Checking baulk ring clearances

Input shaft assembly

16 Dismantle the input shaft as follows:

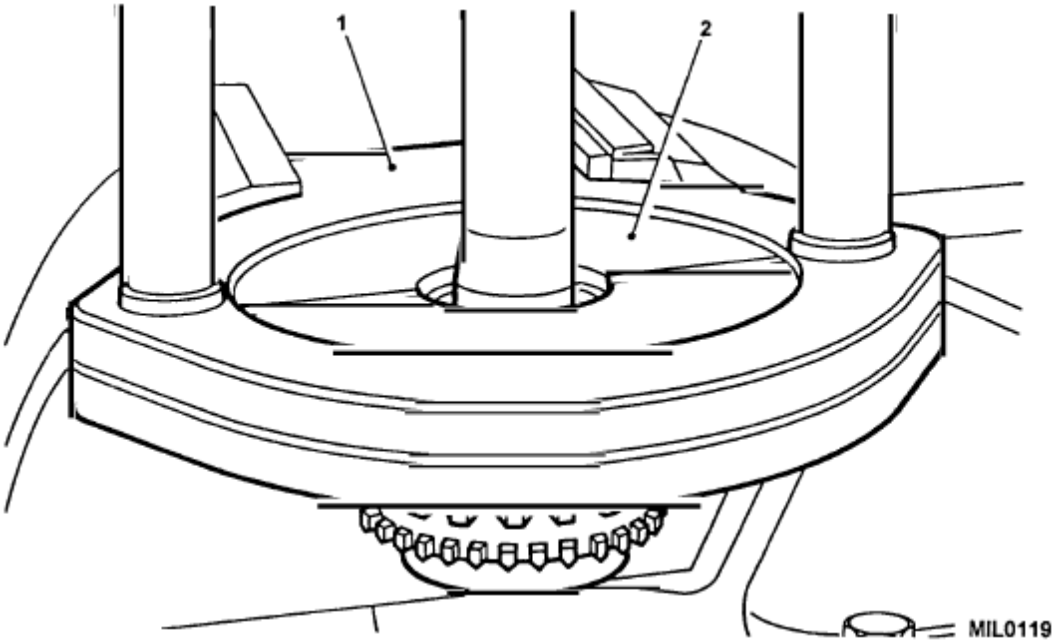
16.1 Using special tools (refer to Table 1, Serial 3 and 16) remove pilot bearing track (refer to Fig 11).



1 Impulse extractor 2 Adapter

Fig 11 Removing pilot bearing track

16.2 Using special tools (refer to Table 1, Serial 1 and 15) remove taper roller bearing (refer to Fig 12).

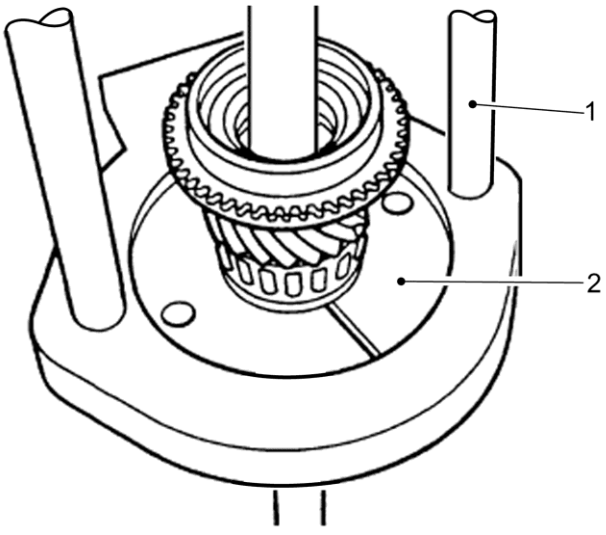


1 Hand press 2 Adapter

Fig 12 Removing taper roller bearings

16.3 Support the shaft under special tool (refer to Table 1, Serial 15) and press in a new pilot bearing track.

16.4 Using special tools (refer to Table 1, Serial 1, 2 and 15) fit a new taper bearing (Fig 13).



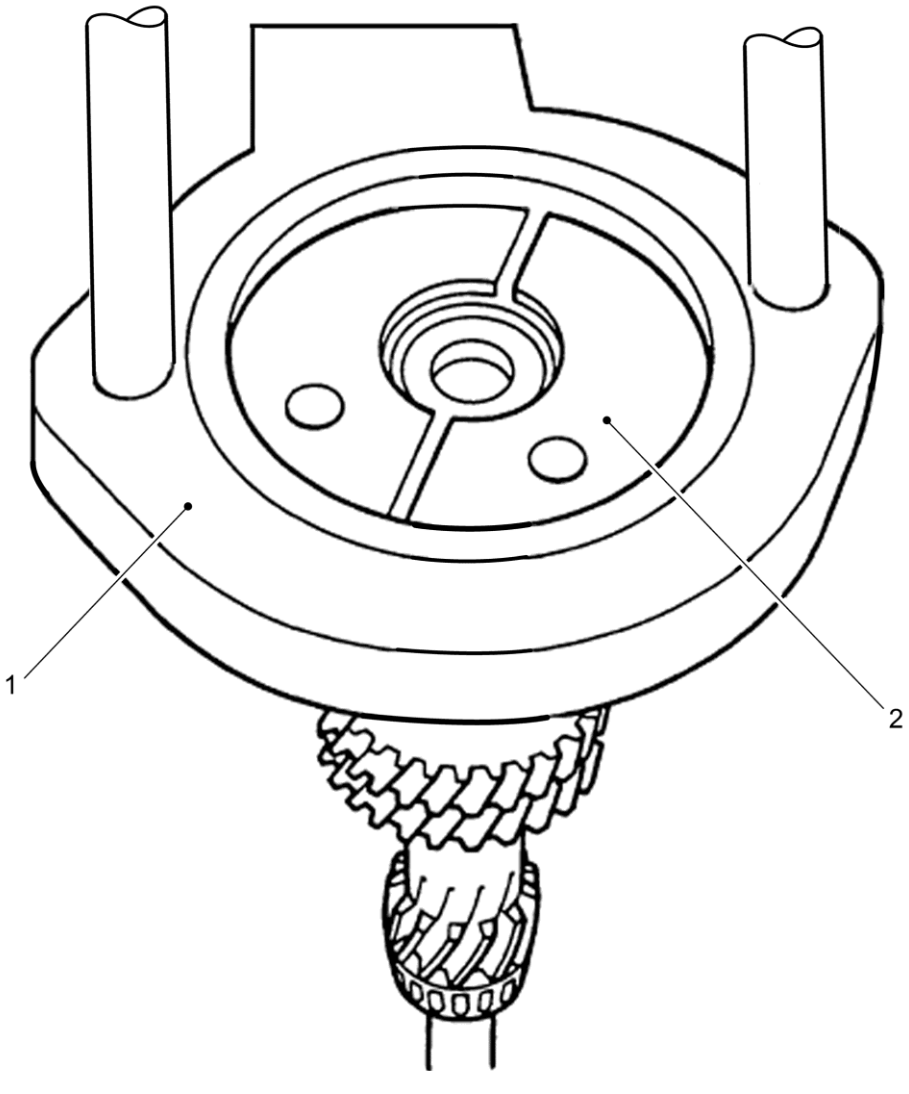
1 Hand press 2 Adapter

Fig 13 Refitting taper roller bearing

Layshaft

17 Dismantle the layshaft as follows:

17.1 Using special tools (refer to Table 1, Serials 10 and 15) remove the bearing from 4th gear end of layshaft (refer to Fig 14).

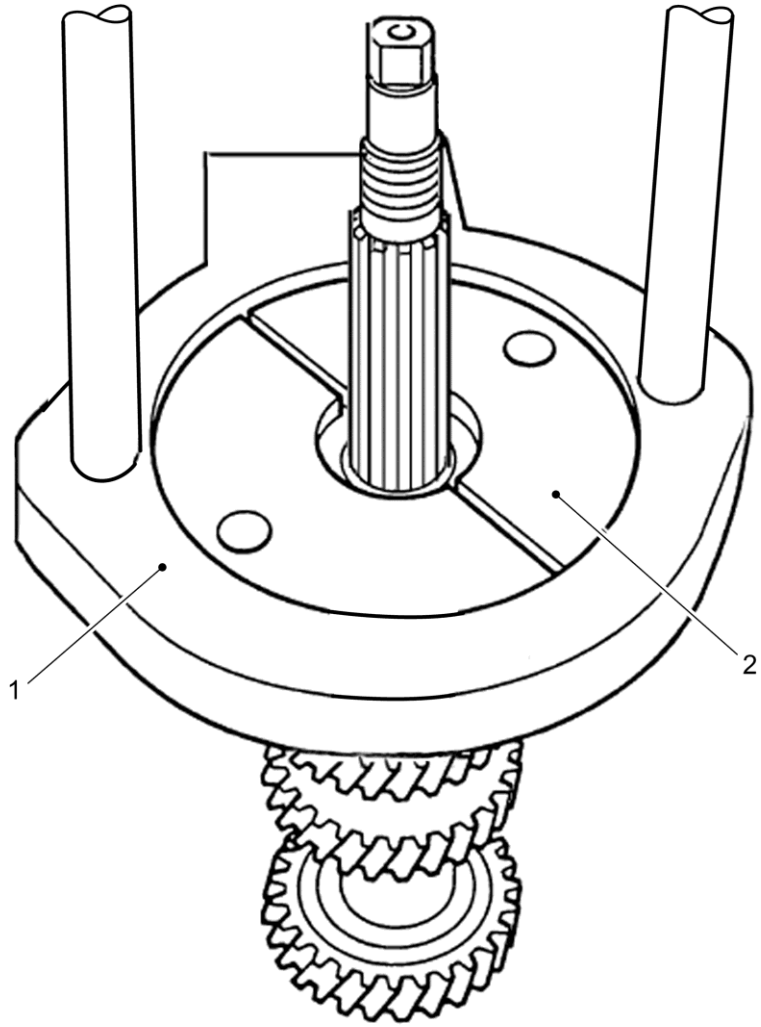


1 Hand press 2 Adapter

Fig 14 Removing layshaft taper roller bearings (1)

17.2 Using special tools (refer to Table 1, Serials 14 and 15) remove bearing from splined end of layshaft (refer to Fig 15).

17.3 Examine the layshaft for signs of wear or damage.



1 Hand press 2 Adapter

Fig 15 Removing layshaft taper roller bearings (2)

Gearbox casing

18 Degrease and clean all components. Inspect casing for damage, cracks and stripped threads.

18.1 Fit new level plug.

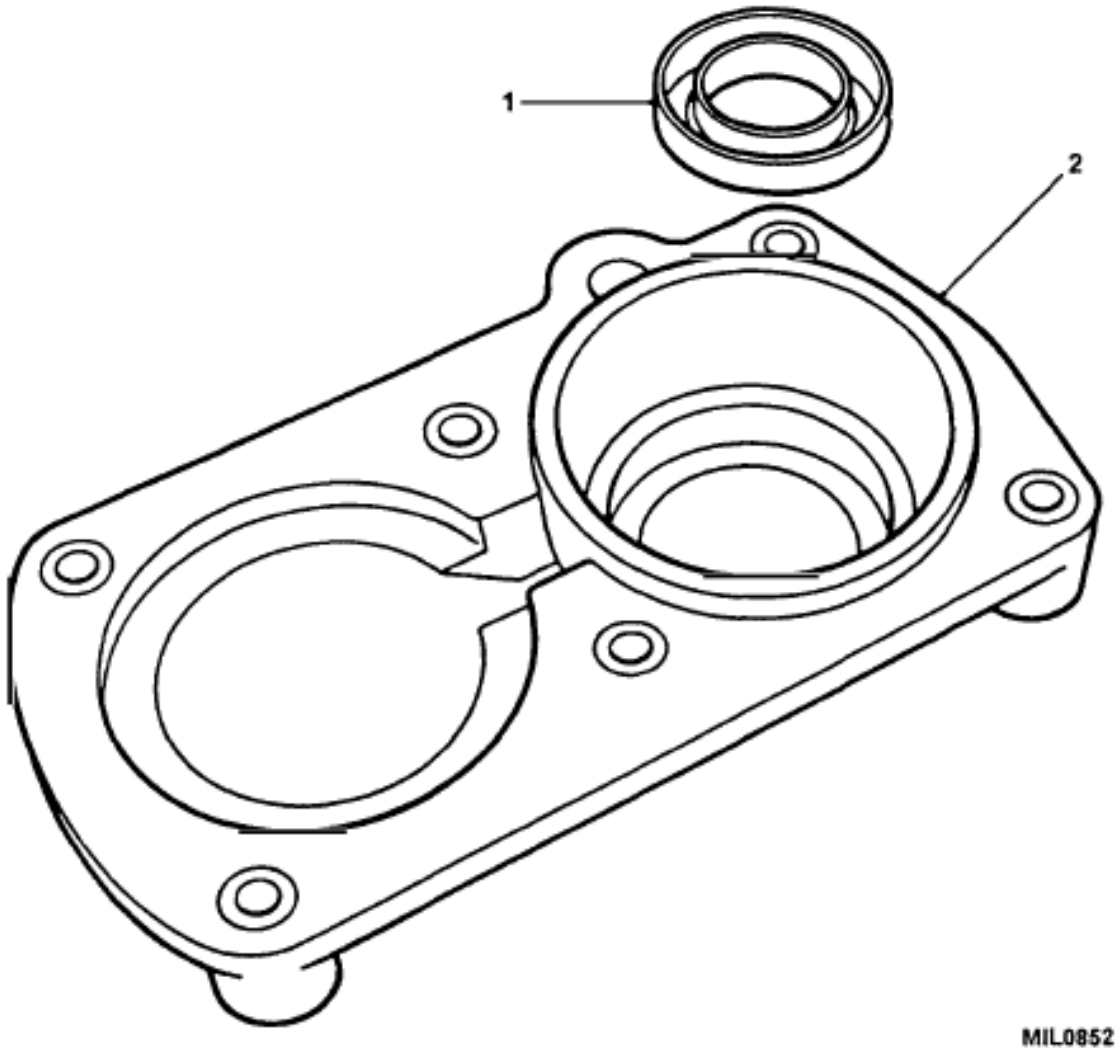
18.2 Fit new copper washer to drain plug.

Front cover

19 To dismantle the front cover proceed as follows:

19.1 Remove the front cover from the casing and remove bearing tracks. Check that the circlips are intact.

19.2 Remove oil seal from cover (Fig 16 (1)). Do not fit new seal at this stage.



1 Oil seal 2 Cover

Fig 16 Dismantling front cover

Centre plate

20 To dismantle the centre plate proceed as follows:

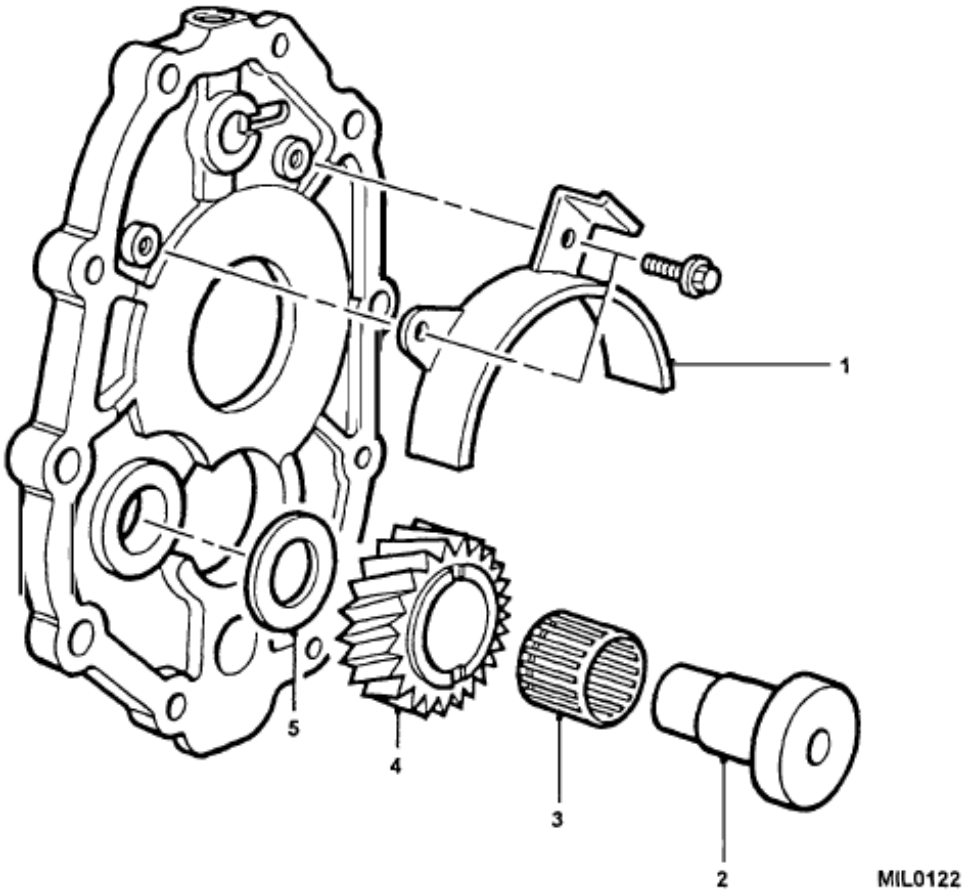
20.1 Remove bearing tracks and shims.

20.2 Inspect the plate for damage and the selector rail bore for wear.

20.3 Remove splash shield (Fig 17 (1)) if required.

20.4 Press out reverse idler gear shaft (2) using suitable press.

20.5 Remove idler gear (4), needle bearing (3) and spacer (5). Check for wear and damage.



1 Splash shield
2 Reverse idler gear shaft
3 Needle bearing
4 Idler gear
5 Spacer

Fig 17 Dismantling centre plate

CLEANING

21 Clean all components thoroughly using a suitable solvent. Ensure all lubrication drillings are clear of sludge or contamination.

EXAMINATION

22 Examine the components as follows:

22.1 Examine the casings for cracks, stripped threads in bolt holes and the machined mating faces for burrs, nicks or any condition that would render the casing unfit for further service.

22.2 Inspect all gears for chipped or broken teeth, and for signs of excessive wear, inspect all spline teeth on the synchromesh assemblies.

22.3 Check synchromesh slippers and slipper rings for wear and breakage.

22.4 Check the wear between all synchromesh baulk rings and gears by pushing the baulk ring against the gear and measuring the gap between the ring and gear. The minimum permissible gap is 0.5 mm (0.02 in.). If this clearance is not obtained, new baulk rings must be fitted.

22.5 Inspect all circlip grooves. Remove any burrs or rough edges with a fine abrasive stone.

22.6 Examine all other components for wear or damage, fitting new components as necessary.

REPAIRS AND REPLACEMENT

23 It is recommended that all seals, gaskets, circlips, lockwashers, needle and roller bearings are renewed at overhaul.

REASSEMBLY

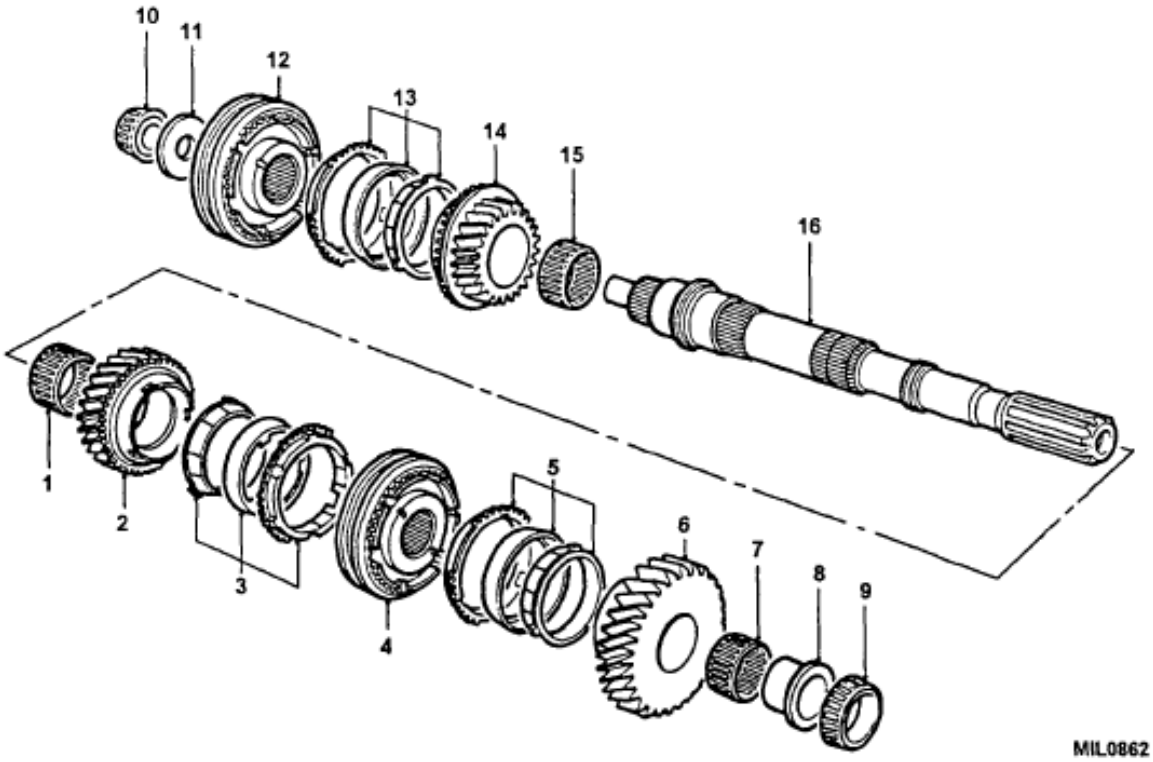
24 Reassemble the gearbox as follows:

Mainshaft

25 Reassemble the mainshaft as follows:

25.1 Clamp mainshaft in protected vice jaws, output end upwards.

25.2 Fit needle roller bearing (Fig 18 (1)), 2nd gear (2) and synchromesh baulk rings (3) onto mainshaft (16) and press against shoulder.



1	Needle roller bearing	9	Taper roller bearing
2	2nd gear	10	Pilot bearing
3	Synchromesh baulk rings	11	Spacer
4	1st/2nd gear synchromesh hub	12	3rd/4th gear synchromesh hub
5	1st gear synchromesh baulk rings	13	Synchromesh baulk rings
6	1st gear	14	3rd gear
7	Needle roller bearing	15	3rd gear needle roller bearing
8	Bush	16	Mainshaft

Fig 18 Mainshaft reassembly

NOTE

Rotate each baulk ring to ensure they locate onto each other.

25.3 Assemble the 1st/2nd synchromesh hub (4) onto mainshaft spline, (note 2nd speed side marking). Ensure that the baulk rings (3) have located correctly inside the hub - rotate the ring slightly as the hub is lowered).

25.4 Using special tools (refer to Table 1, Serial 1, 14 and 15) press on the mainshaft taper roller bearing (9).

25.5 Check the end float of 1st gear between gear and collar flange. Clearance should be 0.05 mm - 0.20 mm (0.002 in. - 0.008 in.).

25.6 Invert the mainshaft in the vice and fit 3rd gear needle roller bearing (15), third gear (14) and synchromesh baulk rings (13) and press them firm against the mainshaft collar.

25.7 Assemble the 3rd/4th gear synchromesh hub (12) (note 3rd speed side markings) onto its splines taking care to locate the baulk rings into the recesses in the selector hub.

25.8 Fit spacer (11).

25.9 Remove mainshaft from vice.

25.10 Using special tool (refer to Table 1, Serial 15) press on pilot bearing (Fig 19).

25.11 Check end float of 3rd gear between gear and flange on mainshaft. Clearance should be 0.11 mm - 0.21 mm (0.004 in. - 0.0083 in.).

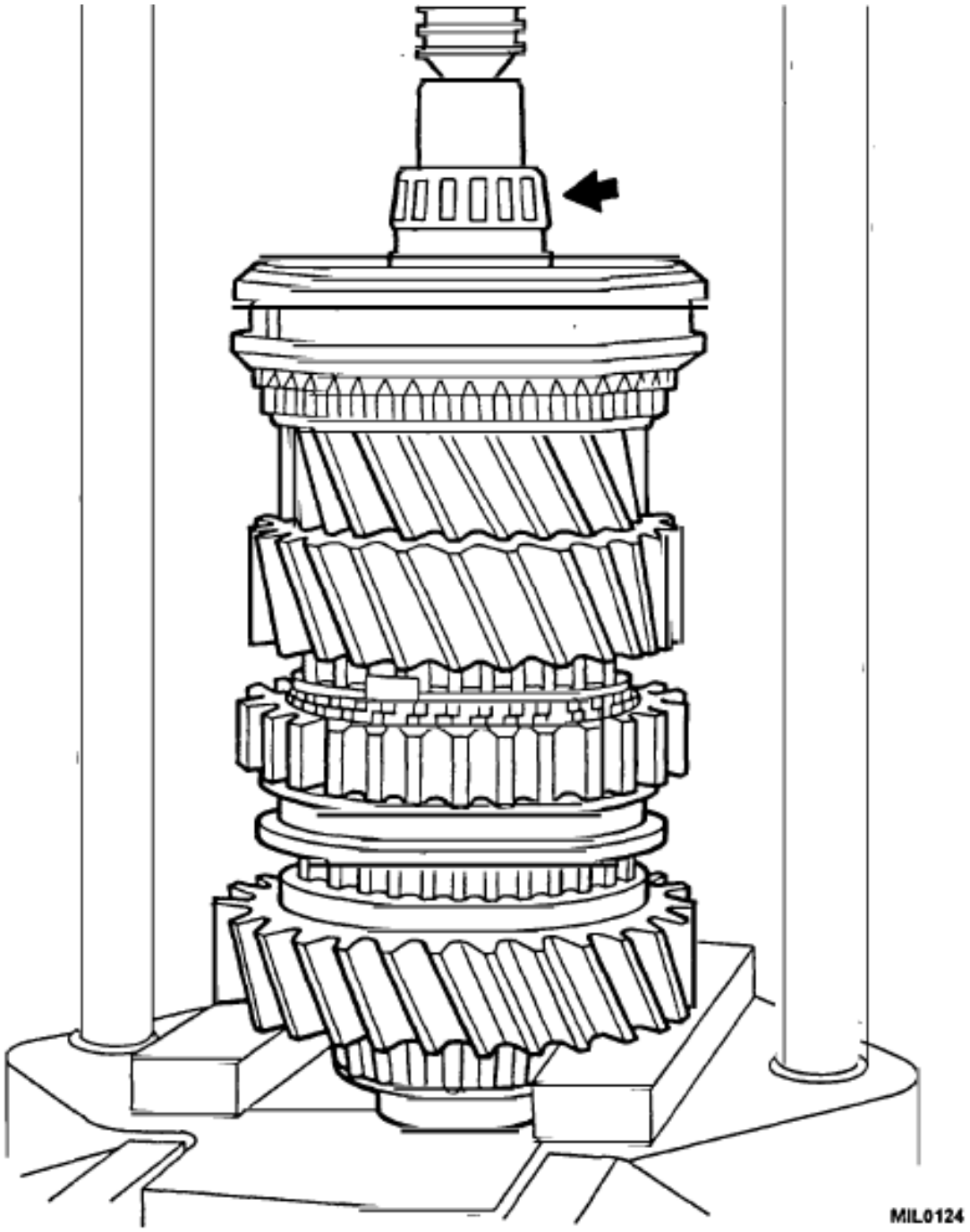


Fig 19 Fitting pilot bearing

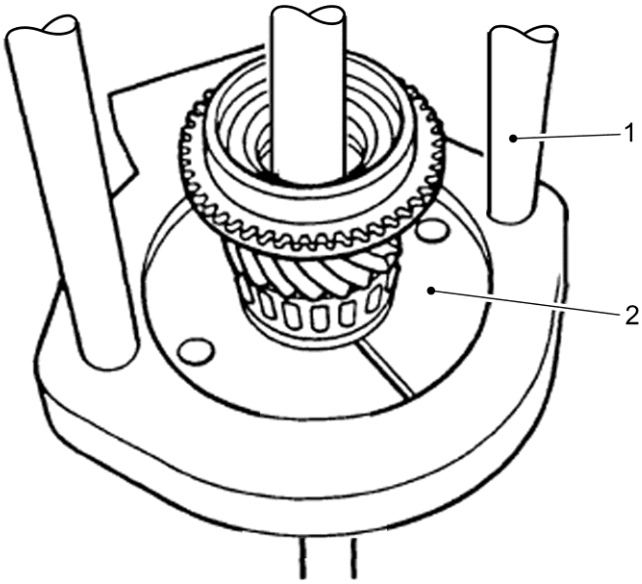
25.12 Fit 1st gear synchromesh baulk rings (5), needle roller bearing (7), 1st gear (6) and bush (8) onto mainshaft ensuring baulk rings locate correctly inside hub.

25.13 Remove mainshaft from vice.

Input shaft

26 Using special tool (refer to Table 1, Serial 14) and a suitable mandrel, press on a new pilot bearing outer track.

26.1 Using special tools (refer to Table 1, Serial 13 and 15) fit a new taper bearing (refer to Fig 20).



1 Hand press 2 Adapter

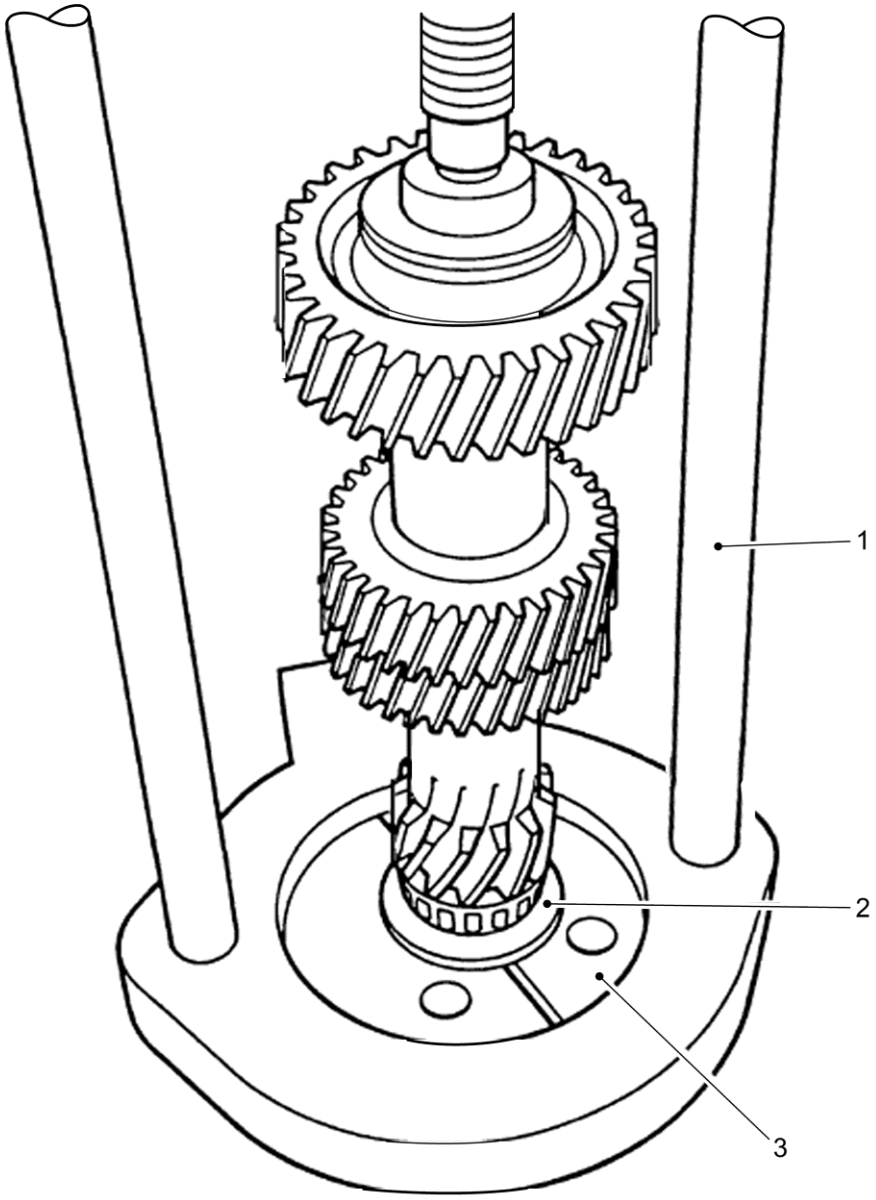
Fig 20 Fitting input shaft taper roller bearing

Layshaft

27 Examine component for wear and damage.

27.1 Clean layshaft bearing surfaces.

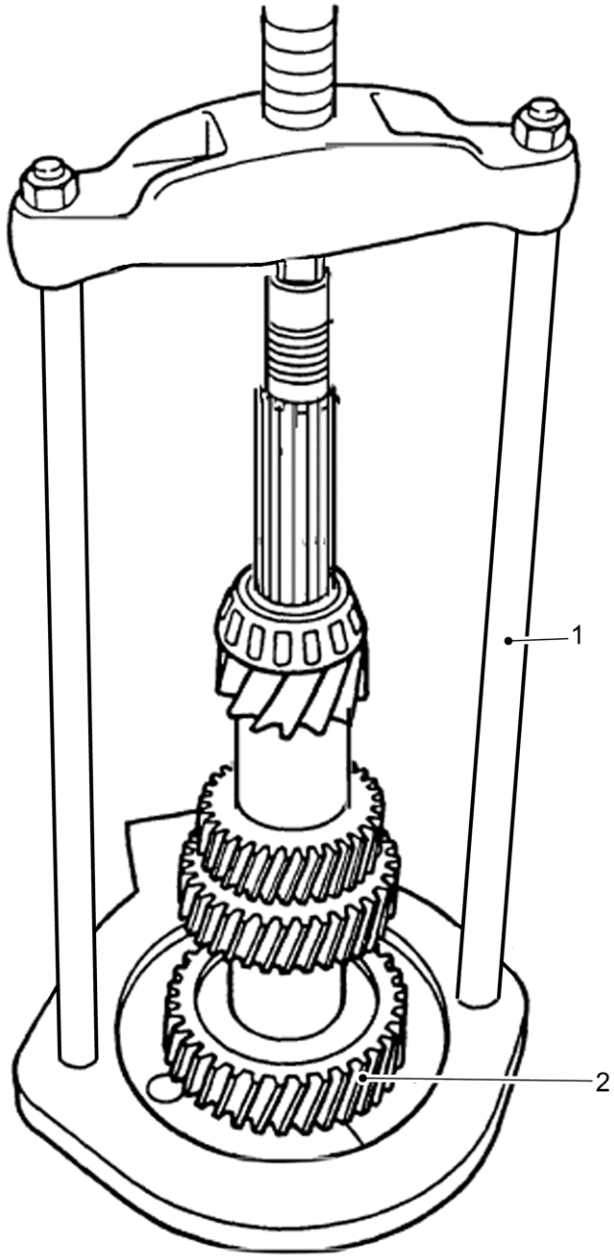
27.2 Using special tools (refer to Table 1, Serials 10, 14 and 15) press new taper roller bearings onto splined end of layshaft (Fig 21).



1 Hand press
2 Remover
3 Adapter

Fig 21 Fitting layshaft taper roller bearing (1)

27.3 Using special tools (refer to Table 1, Serials 10 and 15) press new bearing onto 4th gear end of layshaft (refer to Fig 22).



1 Hand press 2 Adapter

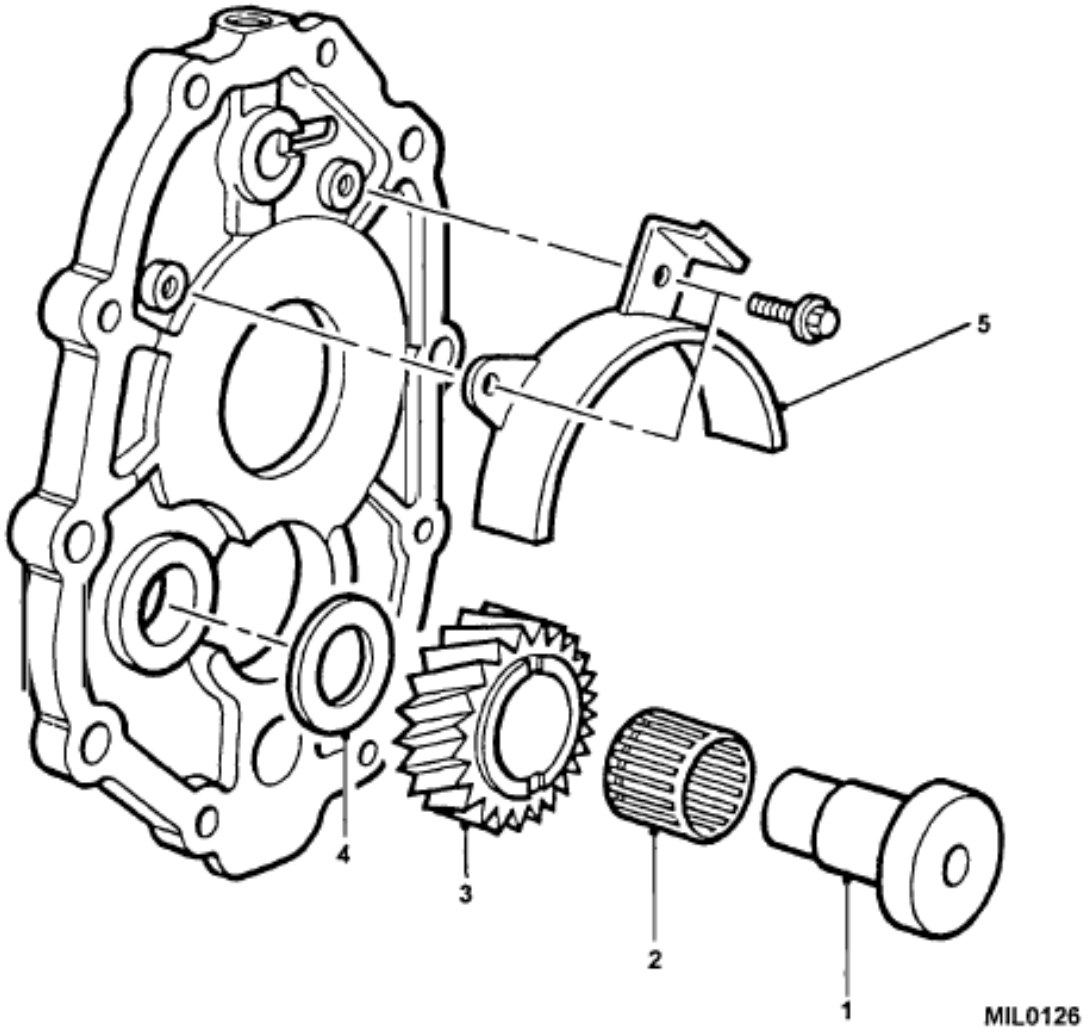
Fig 22 Fitting layshaft taper roller bearing (2)

Reverse idler gear

28 Examine components for wear and damage.

28.1 Assemble reverse idle gear needle roller bearing (Fig 23 (2)), idler gear (3), spacer (4) and shaft (1) and using suitable tool, press into centre plate. Clearance: 0.04 mm - 0.38 mm (0.0016 - 0.015 in.).

28.2 Fit splash shield (5) if removed.



1	Shaft	4	Spacer
2	Needle roller bearing	5	Splash shield
3	Idler gear		

Fig 23 Reverse idler gear assembly

Selectors

29 Examine selector rail and pins for wear and damage.

29.1 Examine selector forks for wear and damage.

NOTE

The selector rail and fork is only supplied as a complete assembly.

29.2 Examine interlock spools for wear and damage.

29.3 Remove snap ring and examine selector yoke assembly.

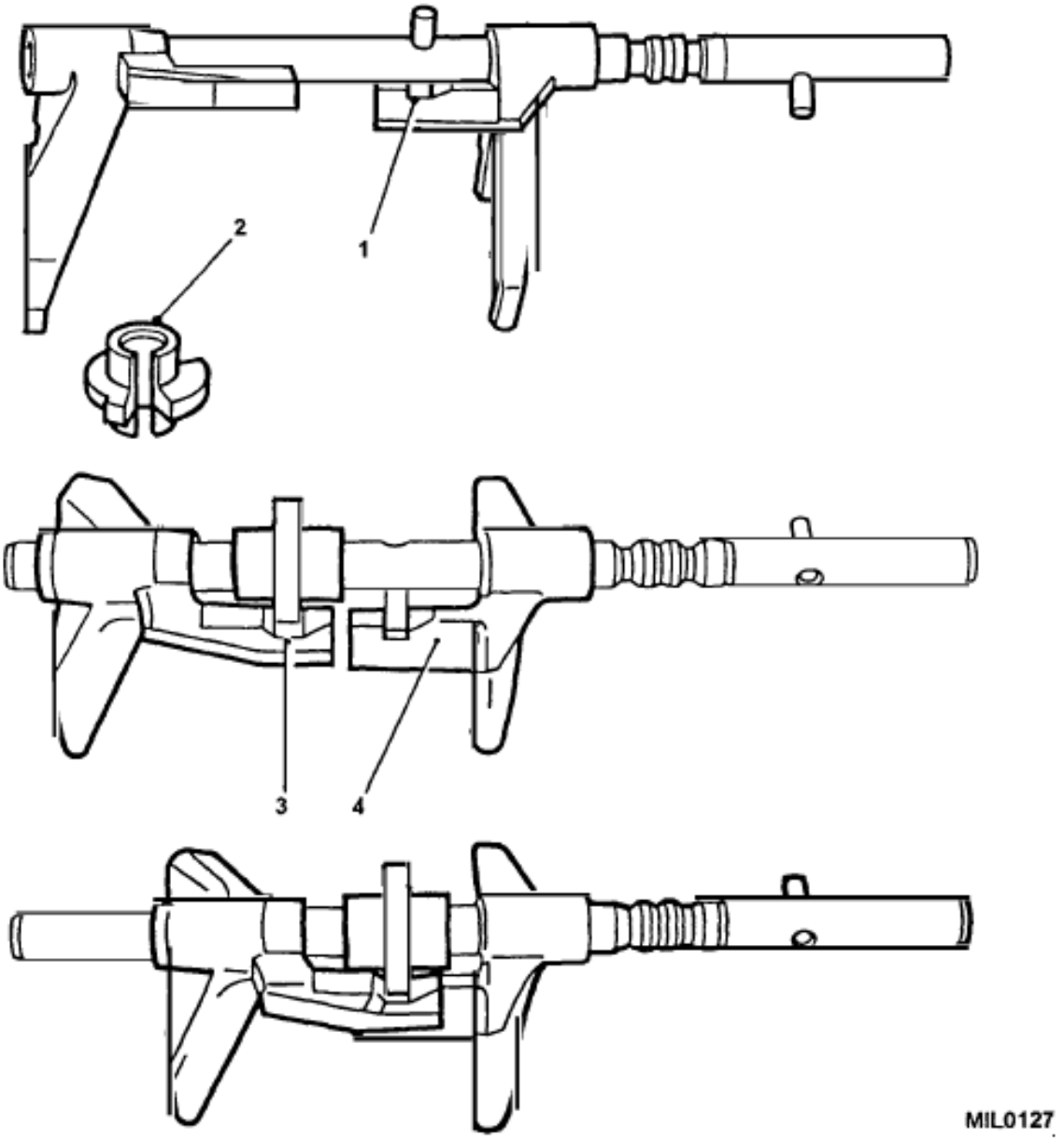
Assembling selectors

30 Assemble the selectors as follows:

30.1 Rest 1st/2nd fork (Fig 24 (3)) and shaft assembly on bench and locate pin (1) in jaw of fork.

30.2 Fit interlock spool (2) and 3rd/4th fork (4) and re-engage spool in jaw of fork (3).

30.3 Slide spool and fork towards 1st/2nd selector until slot in spool locates over pin keeping the spool engaged in 3rd/4th fork jaw (4).



1 Pin
2 Interlock spool
3 1st/2nd Fork
4 3rd/4th Fork

Fig 24 Assembling the selectors

Mainshaft and layshaft end float

31 The end float for both the mainshaft and the layshaft has to be determined before the gearbox can be reassembled. This is achieved by clamping the mainshaft and layshaft separately between the centre plate and main casing and measuring the movement on each shaft with a dial test indicator. The end float setting for the mainshaft and layshaft is 0.0 to 0.05 mm (0.0 to 0.002 in.).

31.1 Shims to make up the required clearances are placed under the bearing tracks of the centre plate.

Shimming

32 To shim the mainshaft and layshaft proceed as follows;

32.1 Fit bearing tracks to main casing front cover.

32.2 Fit front cover to casing without oil seal.

32.3 Clamp casing in vice with front cover downwards.

32.4 Fit input shaft. Do not fit 4th gear baulk ring.

32.5 Fit mainshaft assembly to input shaft.

32.6 Fit mainshaft bearing existing shim and track to centre plate.

32.7 Fit centre plate and bolt down using eight'slave' bolts (Fig 25 (2)).

32.8 Fit a suitable large ball bearing to rear of mainshaft (1).

32.9 Mount dial test indicator (3).

32.10 Rotate mainshaft to settle bearings.

32.11 Lift mainshaft and note reading.

32.12 Dismantle and substitute shims if reading incorrect.

32.13 Repeat procedure.

32.14 Remove mainshaft assembly and repeat procedure for layshaft.

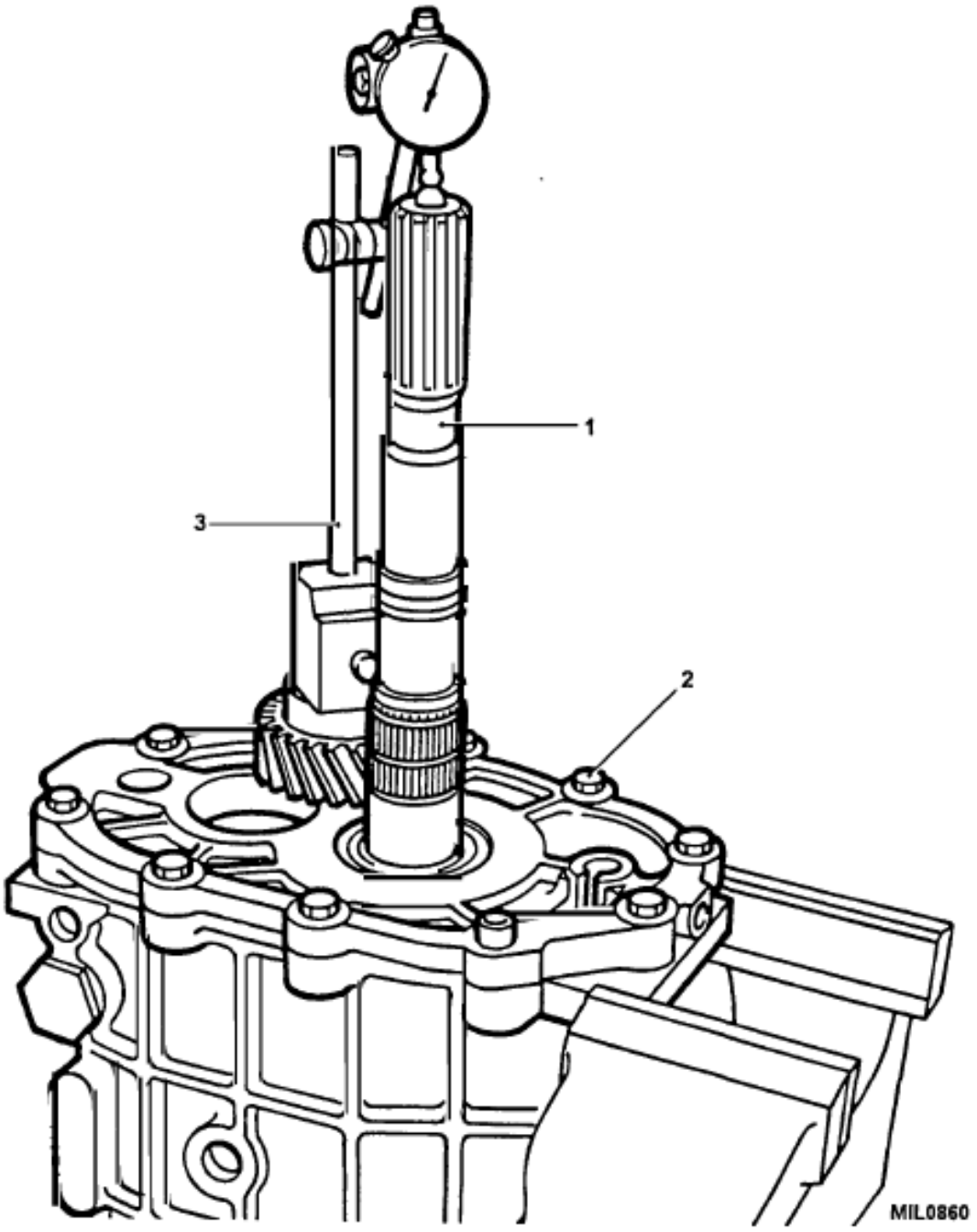
32.15 Dismantle assembly in preparation for reassembly on stand.

Assembling mainshaft and layshaft to centre plate

33 To assemble mainshaft and layshaft to centre plate proceed as follows:

33.1 Secure centre plate to workstand.

33.2 Fit selectable shims and bearing tracks. Check circlips are seated.

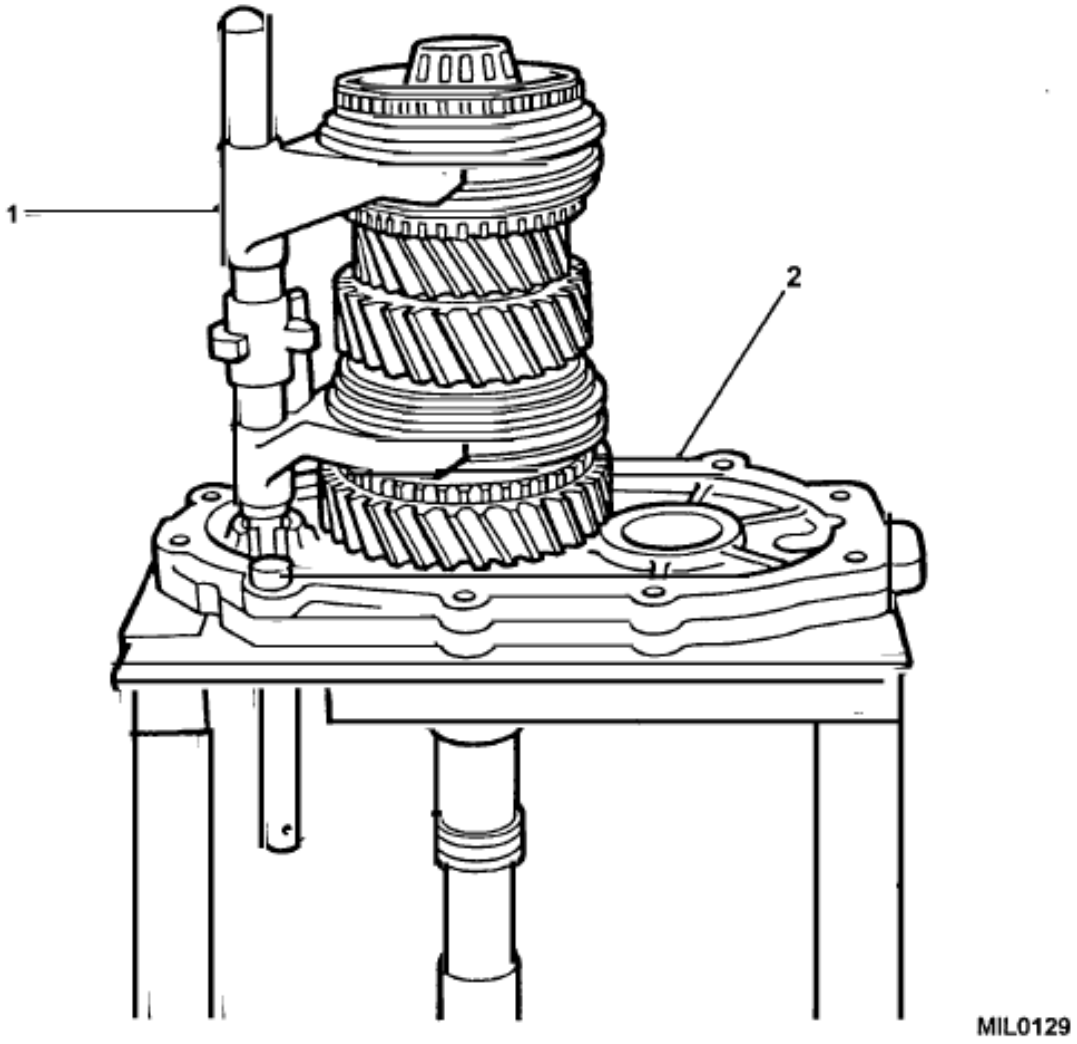


1 Slave bolts 3 Dial test indicator
2 Mainshaft

Fig 25 Shimming the mainshaft and layshaft

33.3 Fit inboard detent ball and spring, use a dummy bar to temporarily hold the ball in place.

33.4 Check both synchromesh units are in neutral and fit selector shaft assembly (Fig 26 (1)).



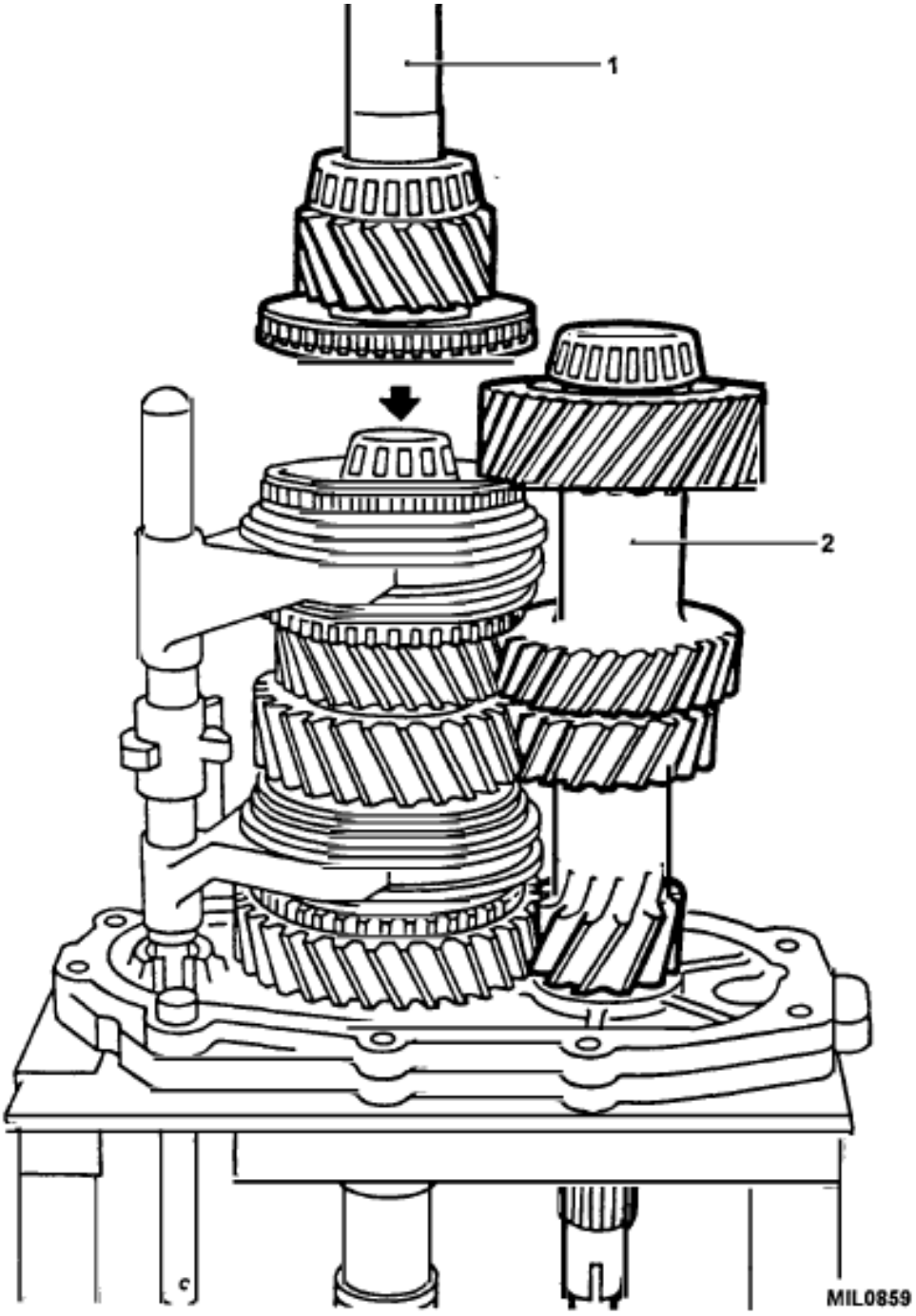
1 Selector shaft assembly 2 Centre plate

Fig 26 Assembling mainshaft to centre plate

33.5 Fit mainshaft and selectors to centre plate (2) aligning pin with slot in plate.

33.6 Fit layshaft (Fig 27 (1)) whilst lifting mainshaft to clear layshaft rear bearing.

33.7 Lubricate pilot bearing and fit input shaft (2).



1 Layshaft 2 Input shaft

Fig 27 Assembling primary shaft and layshaft to centre plate

Front cover

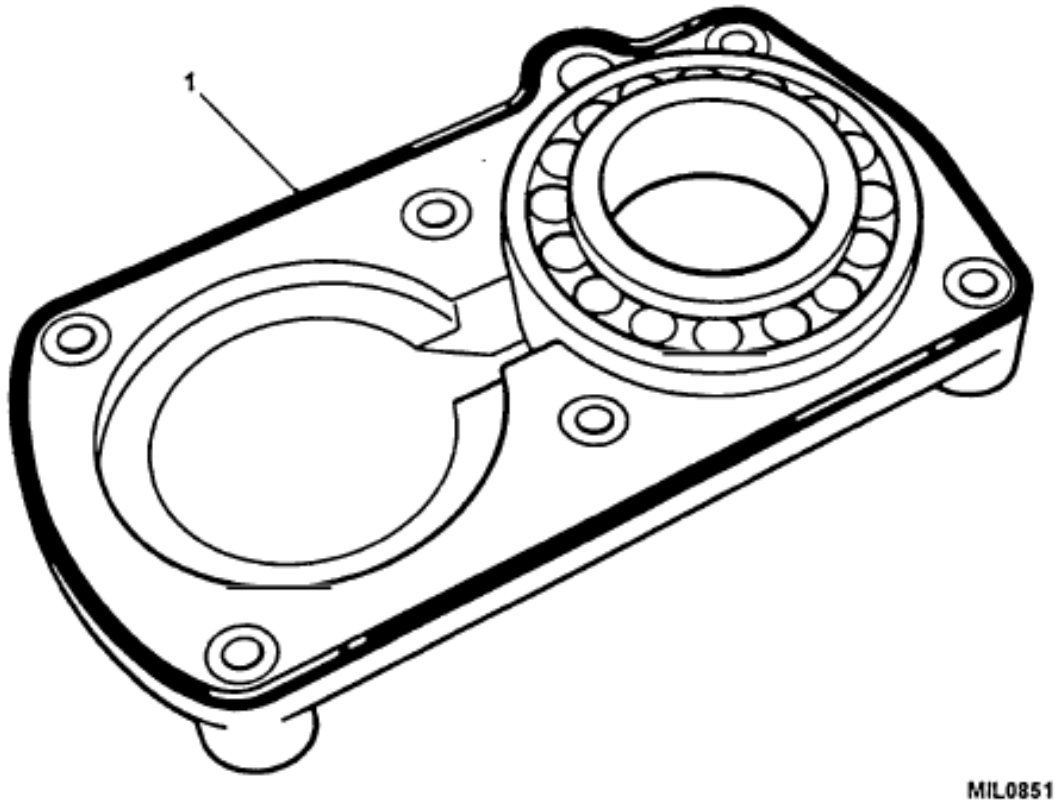
34 Fit oil seal to front cover, ensure seal is fitted down to the shoulder.

34.1 Apply silicon sealant (refer to Table 2 Serial 1) in a continuous bead as shown in

1 Silicone bead

34.2 Fig 28 (1).

34.3 Fit front cover to main casing and secure.



1 Silicone bead

Fig 28 Assembling front cover

34.4 Fit bearing tracks and clips to main casing and fit front seal fixings with sealing compound (refer to Table 2 Serial 2).

34.5 Apply silicon sealant (refer to Table 2 Serial 1) and fit main casing to centre plate.

34.6 Bolt casing and centre plate together using two or three 'slave' bolts.

34.7 Fit new 'O' ring and fit spool retainer.

34.8 Fit outer detent ball and spring to centre plate and retain with grub screw.

34.9 Remove casing from stand and clamp in vice, centre plate upper most.

Assembly of reverse and 5th gear

35 To assemble reverse and 5th gear proceed as follows:

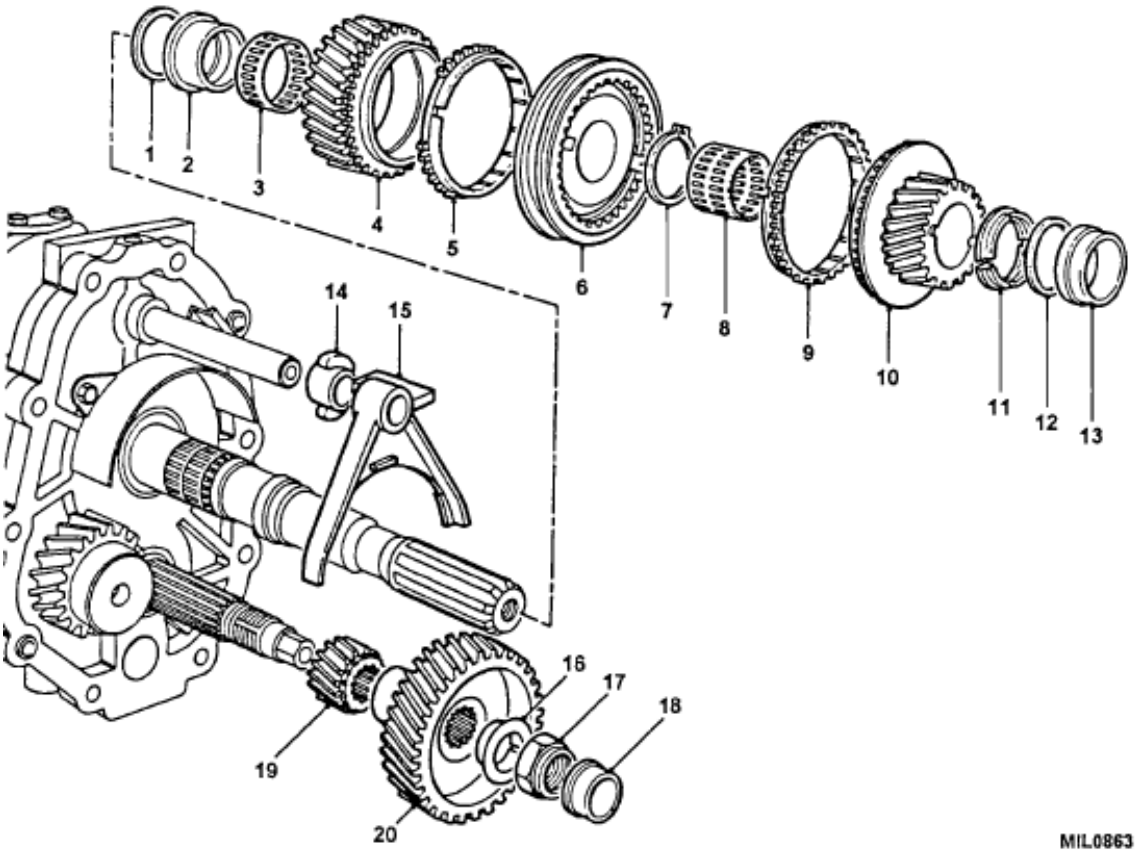
35.1 Fit mainshaft reverse gear selectable washer (Fig 29 (1)), bush (2) and needle bearing (3).

35.2 Fit mainshaft reverse gear (4) and synchromesh baulk ring (5).

35.3 Fit layshaft reverse gear (19).

35.4 Assemble selector spool (14), selector fork (15) and reverse/5th gear synchromesh hub (6) and fit as one assembly to mainshaft splines and selector shaft. Ensure synchromesh baulk ring locates inside hub.

35.5 Fit new circlip (7).



1	Selectable washer	11	5th Gear segments
2	Bush	12	Retaining ring
3	Needle roller bearing	13	Bearing track
4	Reverse gear	14	Spool
5	Synchromesh baulk ring	15	Selector fork
6	Reverse/5th gear synchromesh hub	16	Split conical washer
7	Circlip	17	Nut
8	Split needle bearing	18	Rear support bearing
9	5th gear synchromesh baulk	19	Layshaft reverse gear
10	5th gear	20	Layshaft 5th gear

Fig 29 Assembling 5th and reverse gear

NOTE

The selectable washer behind the reverse gear controls the fit of the circlip. Adjust to 0.005 to 0.055 mm (0.0002 to 0.0021 in.).

35.6 Fit 5th gear split needle bearing (8).

35.7 Fit 5th gear (10) and 5th gear synchromesh baulk ring (9) to mainshaft.

35.8 Fit layshaft 5th gear (20) and the split conical washer (16).

35.9 Fit and locate 5th gear segments (11) and retaining ring (12).

35.10 Using the special tool (refer to Table 1, Serial 11) to hold layshaft 5th gear (refer to Fig 30) tighten the layshaft 5th gear nut to 350 Nm (258 lbft/ft).

35.11 Stake layshaft 5th gear nut (Fig 29 (17)).

35.12 Using a suitable tool with the special tool (refer to Table 1,Serials 7 and 9) press mainshaft rear support bearing track (13) to collar on mainshaft (Fig 31).

35.13 Apply small amount of heat and fit layshaft rear support bearing (Fig 29 (18)).

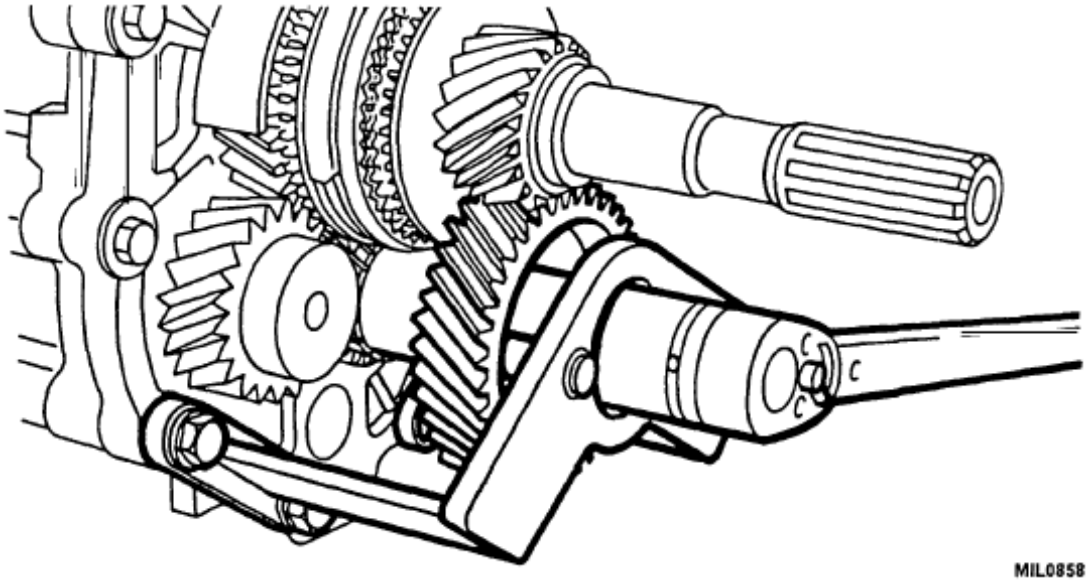


Fig 30 Fitting layshaft nut

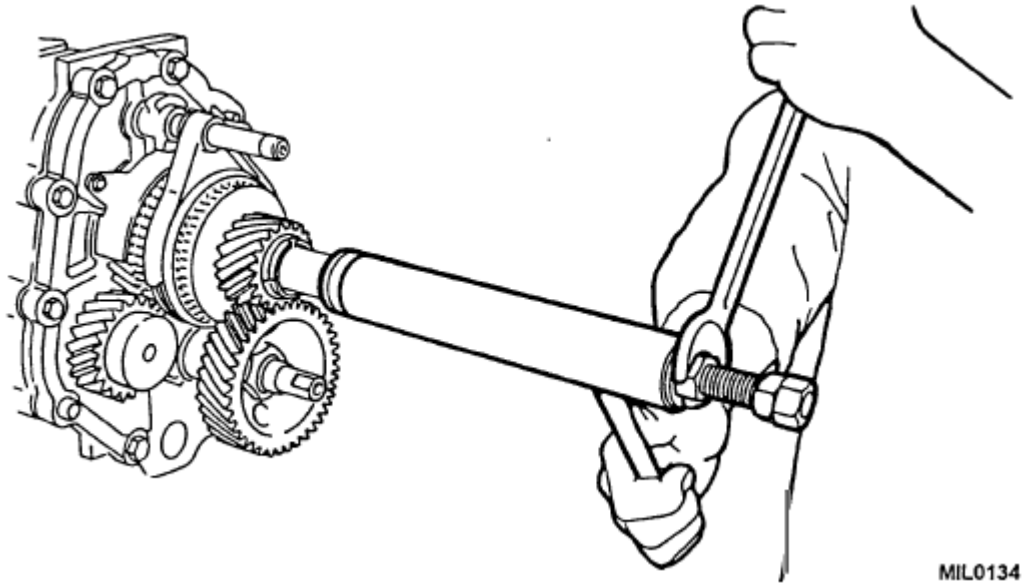


Fig 31 Fitting support bearing track

REFITTING

Extension housing

36 To refit the extension housing (refer to Cat 523 Chap 3-2).

Selector quadrant fork

37 Refit the selector quadrant fork (refer to Cat 523 Chap 3-2).

Main gear selector and remote housing

38 Refit the main gear selector and remote housing (refer to Cat 523 Chap 3-2).

Transfer box selector housing

39 Refit the transfer box selector housing (refer to Cat 523 Chap 3-2).

Clutch housing

40 Refit the clutch housing and clutch release lever (refer to Cat 522 Chap 2).

Gearbox and transfer box assembly

41 Refit the gearbox and transfer box assembly to the vehicle (refer to Cat 523 Chap 3-2).

CHAPTER 4

LT230T TRANSFER GEARBOX AND PROPELLER SHAFTS

CONTENTS

(continued)

CONTENTS (continued)

INTRODUCTION

1 This chapter details the Base repairs for Truck Utility Light (TUL) HS Truck Utility Medium (TUM) HS and (TUM) Ambulance HS vehicles fitted with the LT230T transfer gearbox and propeller shafts.

GENERAL

2 The transfer gearbox, which is mounted on the rear of the manual gearbox, can be removed independently of the gearbox.

TRANSFER BOX

Removal

3 To remove the transfer gearbox from the vehicle refer to (refer to Cat 523 Chap 4).

4 Table 1 details the sealants, adhesives and lubricants to be used.

TABLE 1 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	Loctite 270	8030-99-224-9318	Sealing compound
2	OEP 220	9150-99-220-1477	Transfer gearbox oil
3	XG279	9150-99-220-2418	Multipurpose grease
4	RTV	8030-99-224-6527	Silicon sealant

DISMANTLING

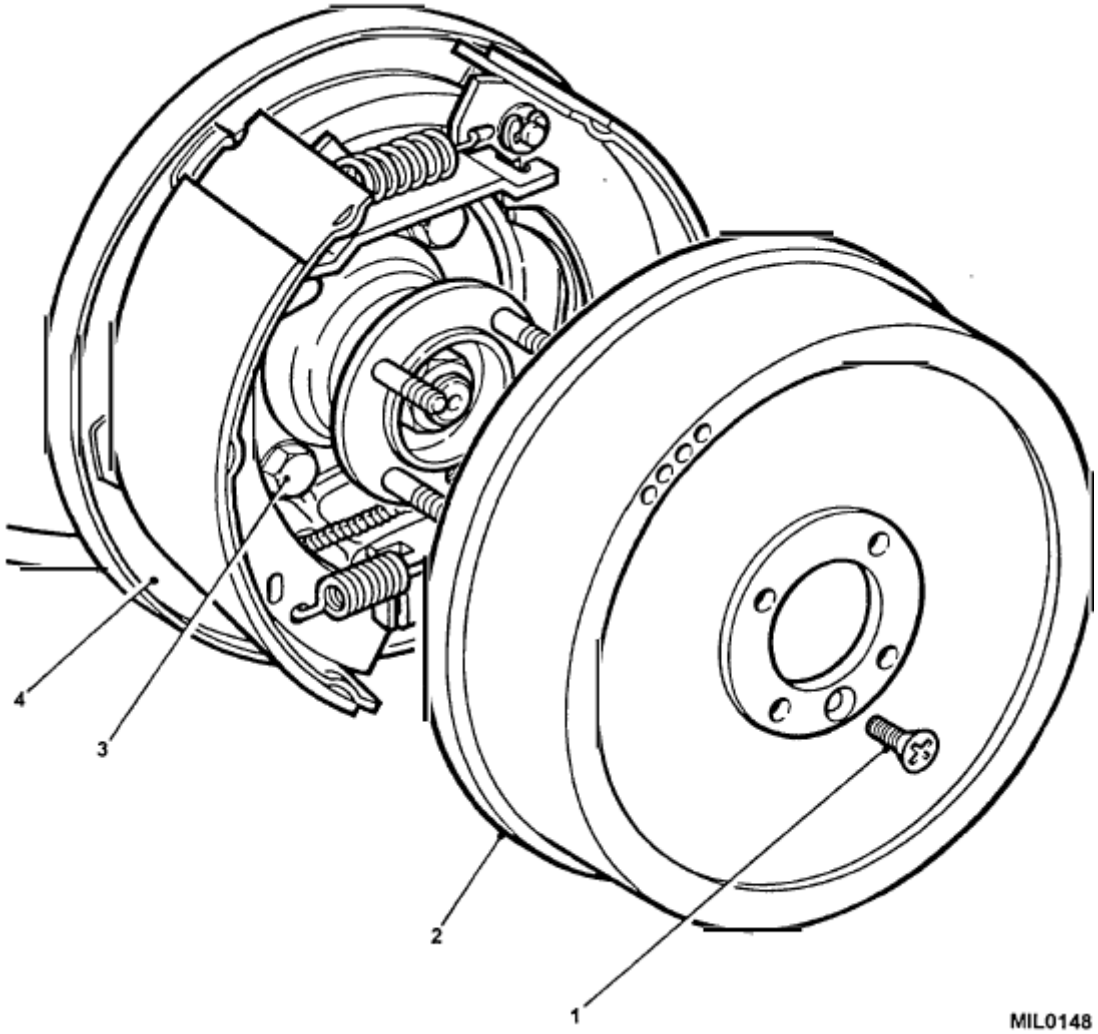
Transmission brake

5 To remove the transmission brake carry out the following:

5.1 Remove the countersunk screw (Fig 1 (1)) and withdraw the brake drum (2).

5.2 Remove four bolts (3) securing the assembled back-plate (4) and shoes. Withdraw the backplate from the transfer box.

5.3 To overhaul the transmission brake refer to Cat 522 Chap 10-1.

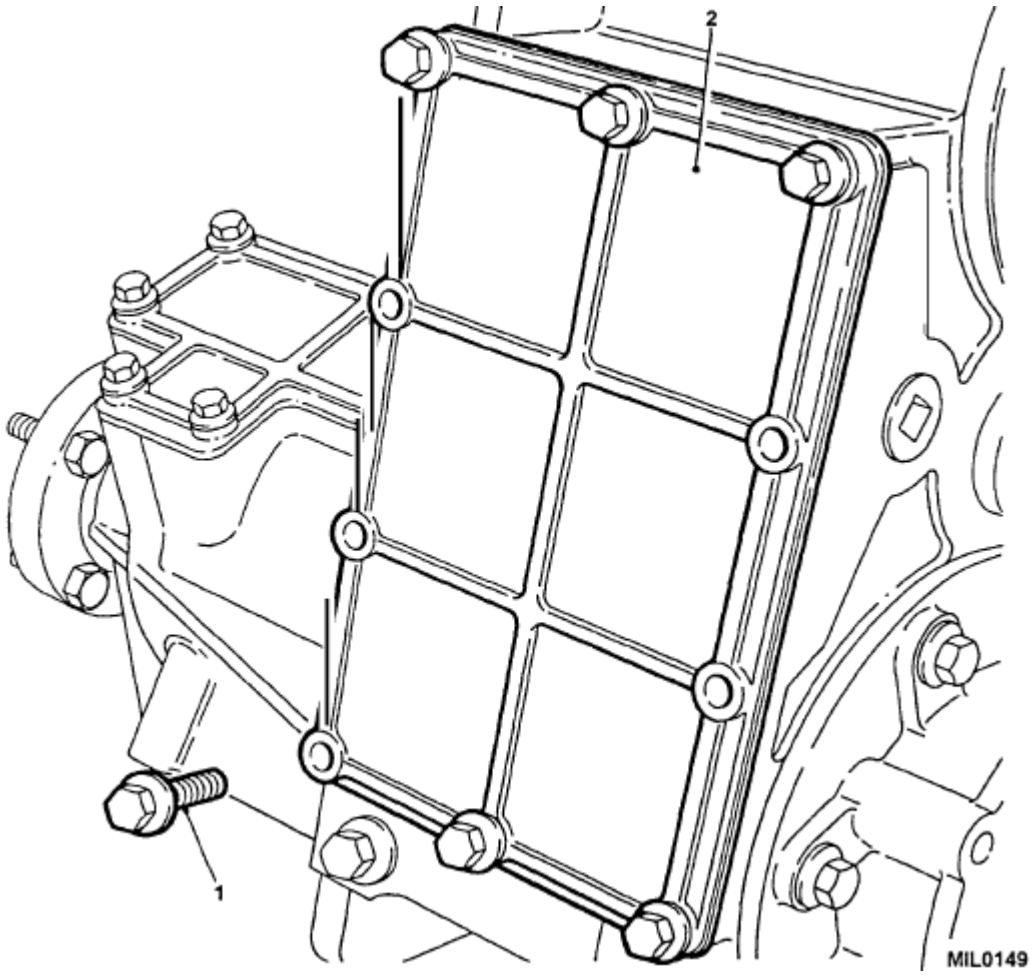


1 Countersunk screw 3 Securing bolt
2 Brake drum 4 Back plate

Fig 1 Transmission brake

Bottom cover

6 Unscrew the remaining six bolts (Fig 2 (1)) and remove the bottom cover (2).



1 Fixing bolt 2 Bottom cover

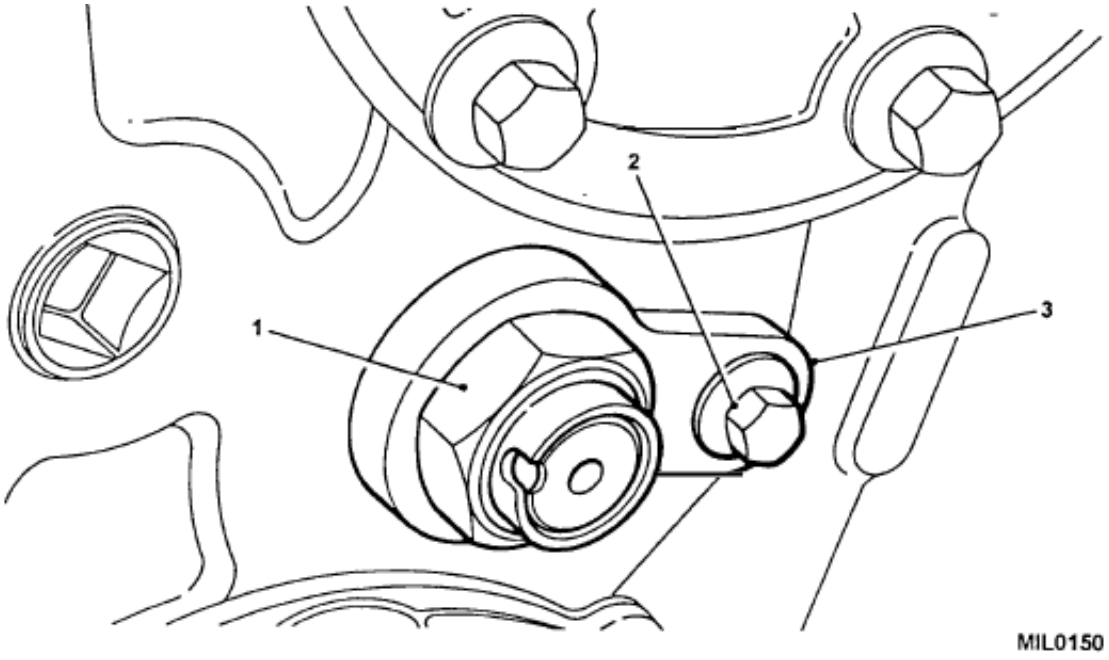
Fig 2 Bottom cover

Intermediate shaft and gear cluster

7 To remove and dismantle the intermediate shaft and gear cluster carry out the following:

7.1 Release stake nut (Fig 3 (1)) from recess in intermediate shaft, remove stake nut and discard.

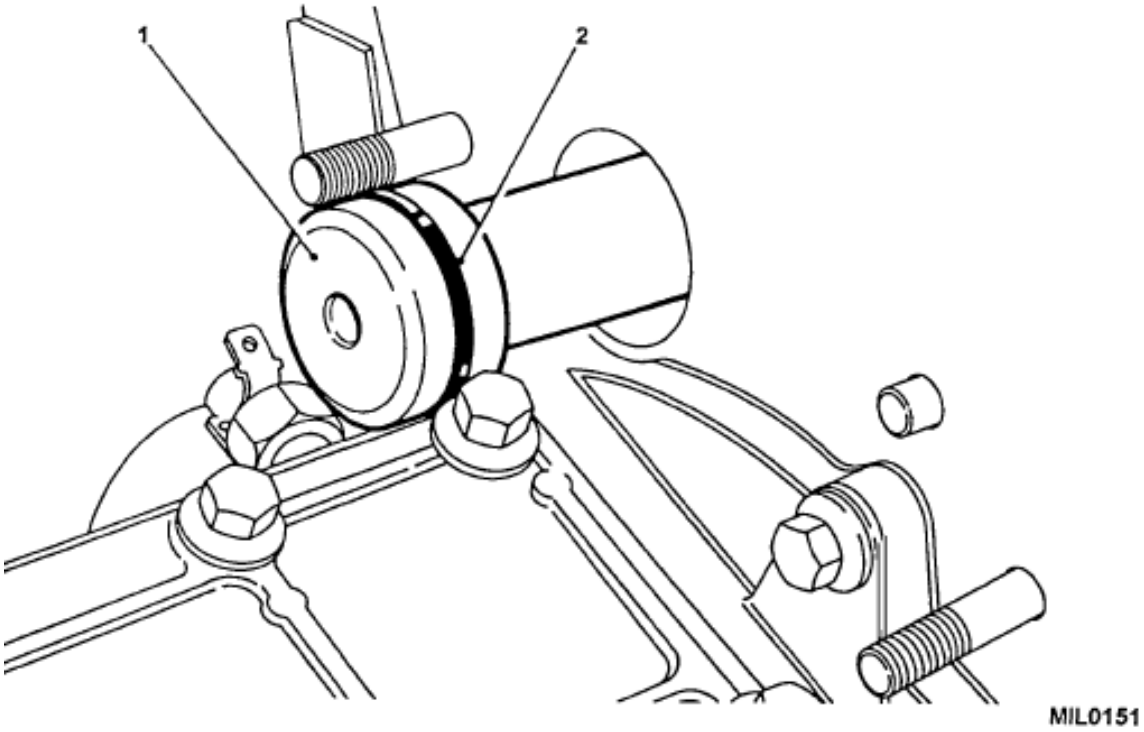
7.2 Unscrew the single bolt (2) and remove anti-rotation plate (3) at the rear face of the transfer box.



1 Stake nut 3 Anti-rotation plate
2 Bolt

Fig 3 Intermediate shaft stake nut and anti-rotation plate

7.3 Tap the intermediate gear shaft (Fig 4 (1)) from the transfer box and, remove the 'O' ring seal (2).



1 Intermediate gear shaft 2 'O' ring

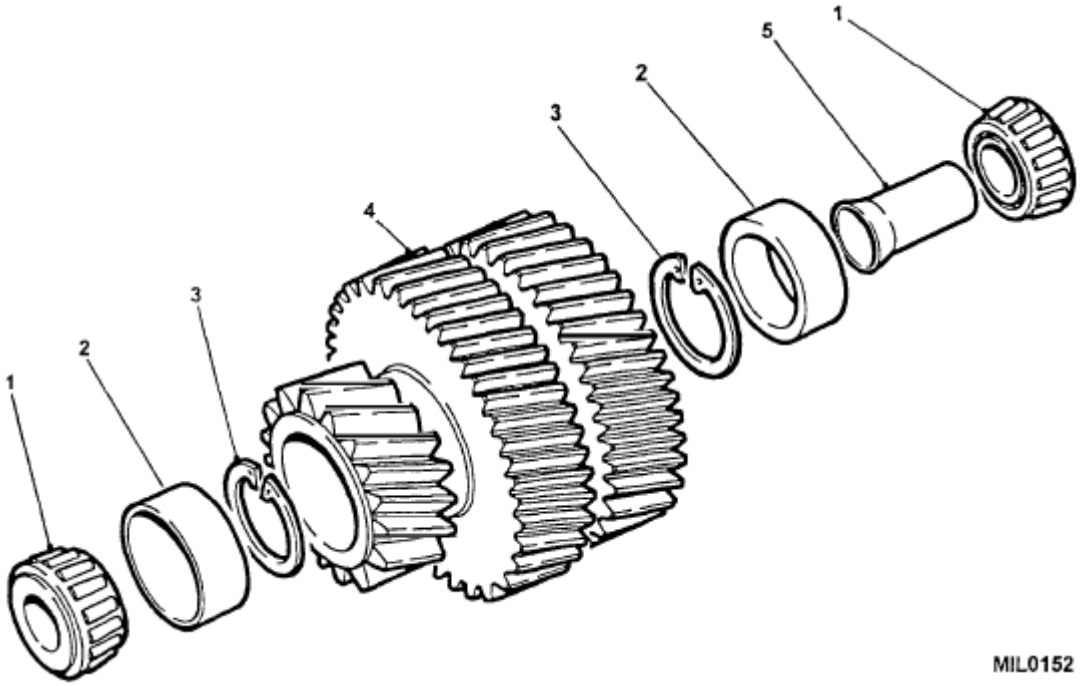
Fig 4 Intermediate shaft removal

7.4 Lift out the intermediate gear cluster and bearing assembly.

7.5 Remove the 'O' ring from inside the transfer case and discard.

7.6 Remove the taper roller bearings (Fig 5 (1)) and bearing spacer (5) from the intermediate gear cluster assembly (4).

7.7 Drive out the bearing tracks (2). The circlips (3) need only be removed if replacement is necessary.



1 Taper roller bearings
2 Bearing tracks
3 Circlips
4 Intermediate gear cluster
5 Bearing spacer

Fig 5 Intermediate gear cluster and bearings

Power take-off cover

8 To remove the power take-off cover carry out the following:

8.1 Remove five bolts (Fig 6 (1)) retaining the power take-off cover (2).

8.2 Remove the retaining nut (9) spring washer (10) securing the brake cable support bracket (8) (left hand drive only).

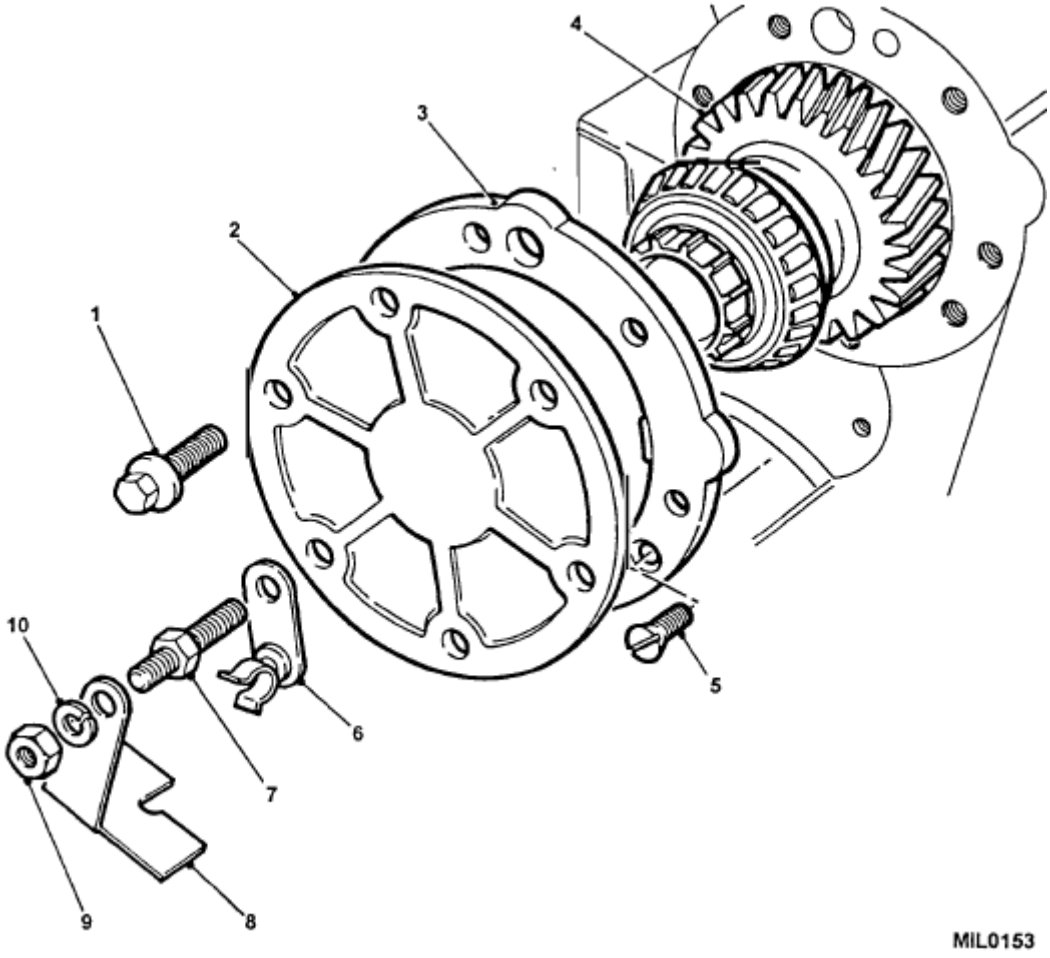
8.3 Remove the stud bolt (7) securing the speedo cable support plate (6) and withdraw the cover.

Input gear

9 To remove the input gear carry out the following:

9.1 Remove the two countersunk screws (Fig 6 (5)) and detach the bearing housing (3).

9.2 Withdraw the input gear assembly (4).



1	Retaining bolt	6	Speedo cable support plate
2	Power take-off cover	7	Stud bolt
3	Bearing housing	8	Brake cable support
4	Input gear assembly	9	Retaining nut
5	Countersunk screw	10	Spring washer

Fig 6 Power take-off cover and input bearing housing

9.3 Clean the input gear assembly and examine for wear or damage. Remove the bearings only if they are to be renewed. To remove the bearings proceed as follows:

9.3.1 Secure a suitable tool in the vice and using a suitable tool remove the rear taper roller bearing (Fig 7) from the input gear assembly.

9.3.2 Invert the input gear assembly in the hand press and remove the front taper roller bearing.

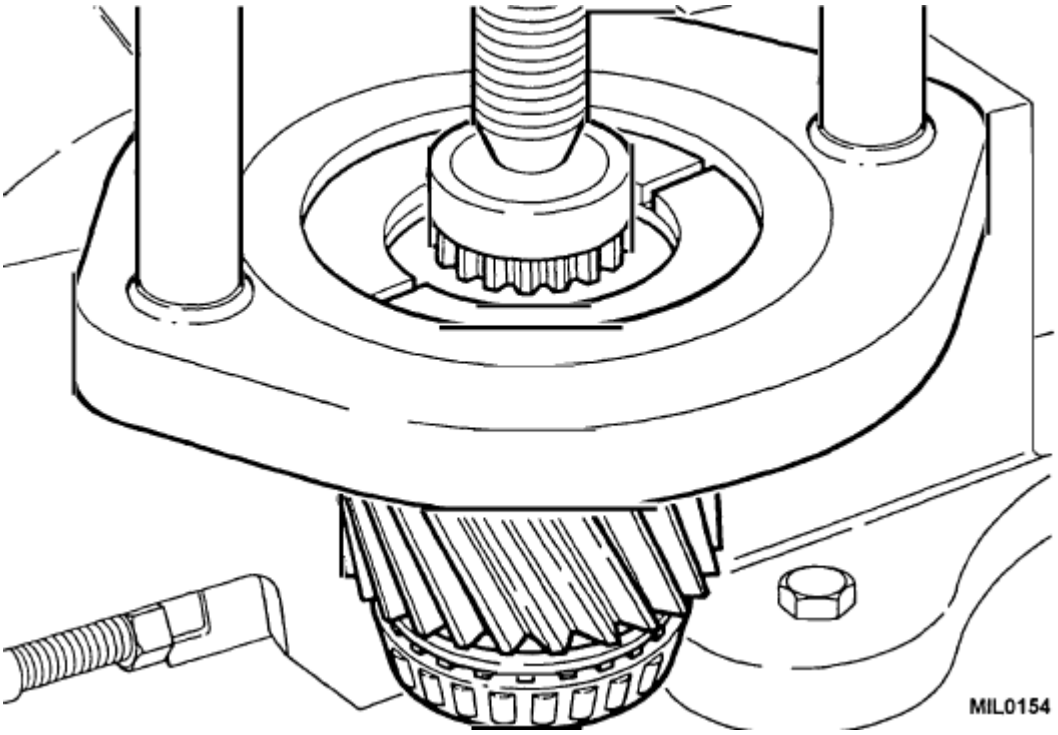


Fig 7 Removing bearings from input gear

9.4 Secure the housing in a soft jawed vice. Drive out the input gear bearing track (Fig 8).

9.5 Remove the shim, measure and note thickness of shim for assembly purposes.

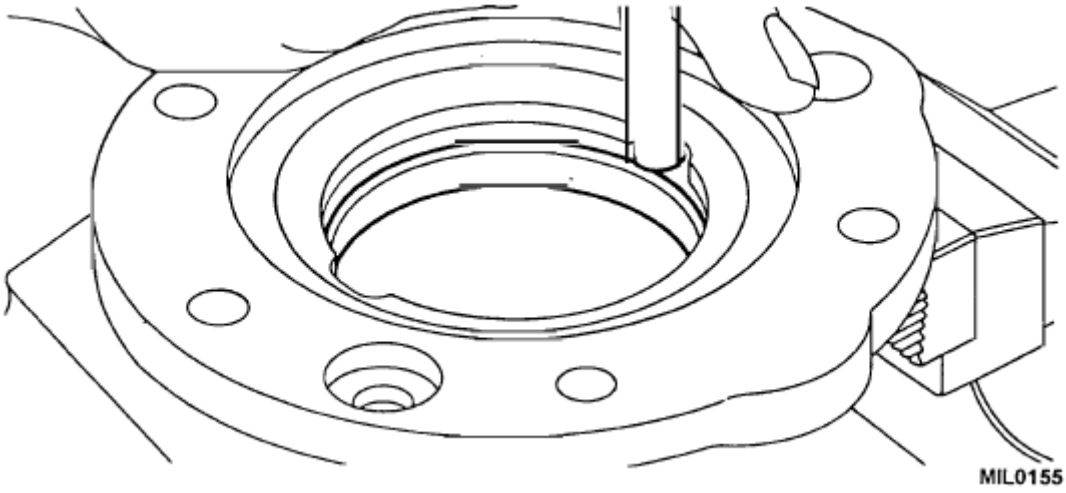
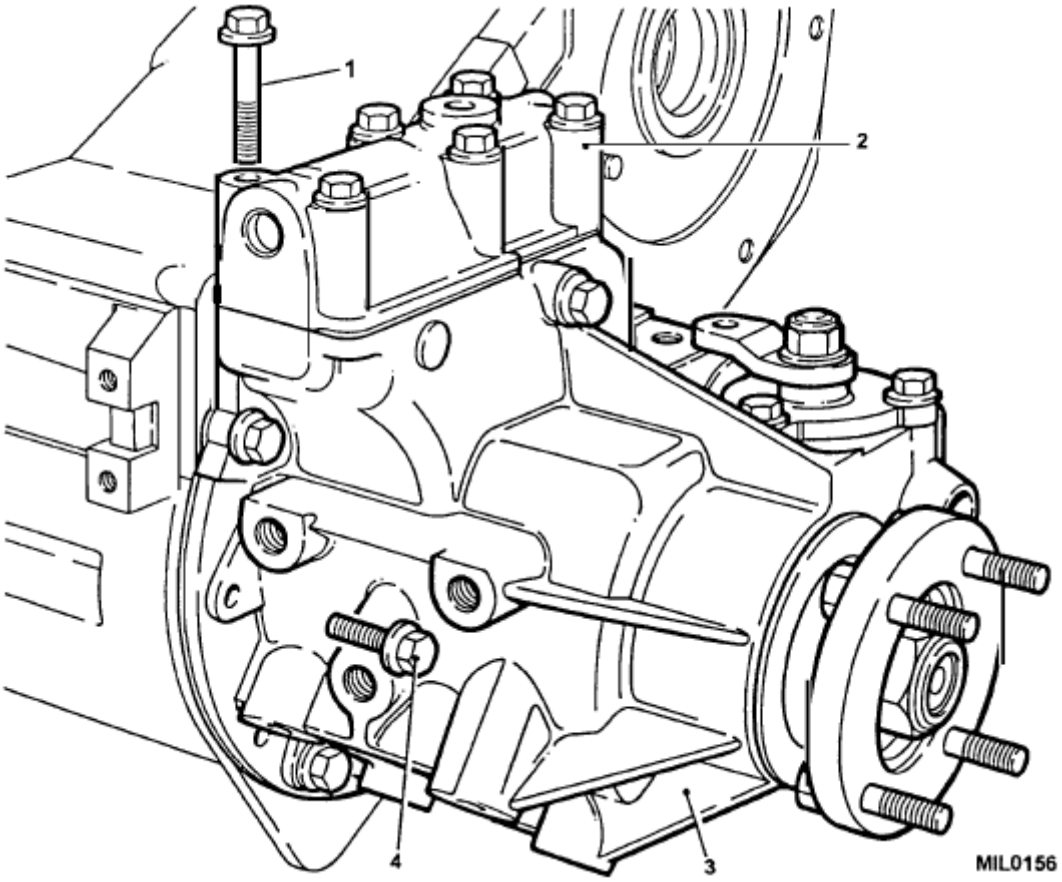


Fig 8 Removing input gear bearing track

High/low cross-shaft housing

10 To remove and dismantle the high/low cross-shaft housing carry out the following:

10.1 Remove the six bolts (Fig 9 (1)) securing the housing (2) to the front output housing and remove.



1 Bolt
2 Cross-shaft housing
3 Output housing
4 Bolt

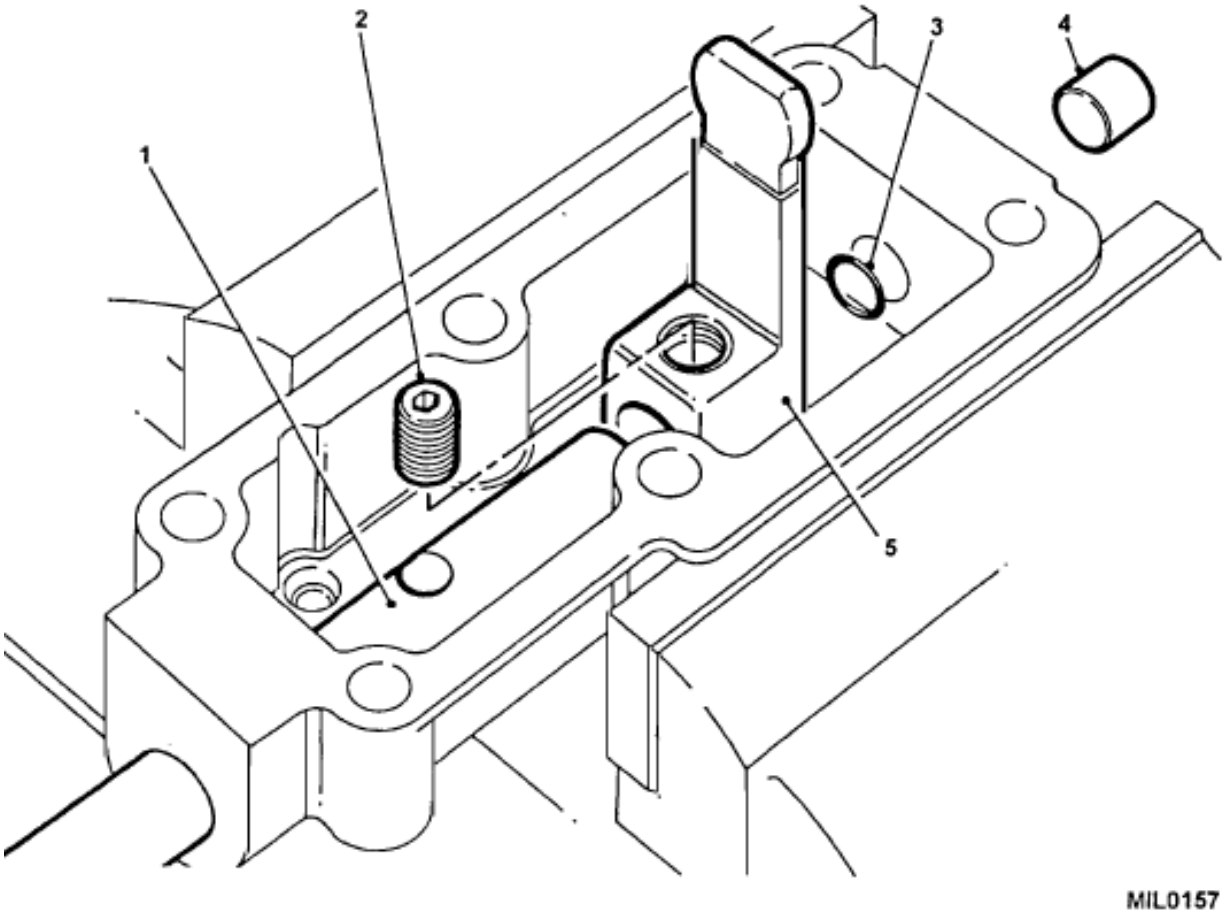
Fig 9 Front output housing

10.2 With the housing secured in an inverted position, remove the grub screw (Fig 10 (2)) securing the selector finger (5). Withdraw the cross-shaft (1) and remove the finger.

10.3 Remove the 'O' ring (3) from the cross-shaft.

10.4 Drift out selector housing cup plug if necessary.

10.5 Clean components and replace if damaged.



1 Cross-shaft
2 Grub screw
3 'O' ring
4 Selector housing cup plug
5 Selector finger

Fig 10 High/low cross-shaft

Front output housing

11 To remove and dismantle the front output housing carry out the following:

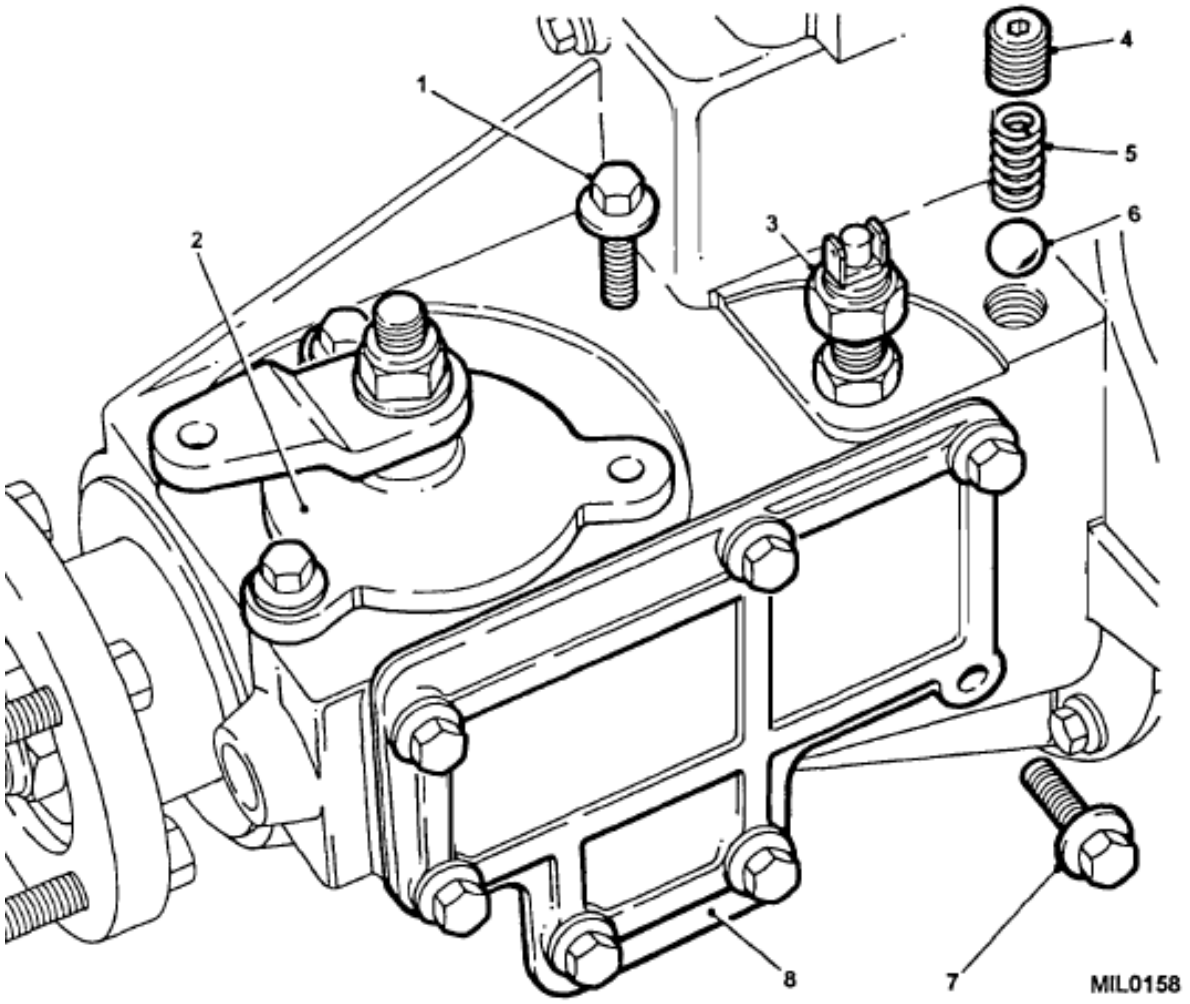
11.1 Remove the eight bolts (Fig 9 (4)) and detach the output housing (3) from the transfer box casing, taking care not to mislay the dowel.

11.2 Unscrew the seven retaining bolts (Fig 11 (7)) and remove the differential lock selector side cover (8).

11.3 Unscrew the three retaining bolts (1) and lift the differential lock finger housing (2) and actuator assembly from the front output housing.

11.4 Slacken the locknut and unscrew the differential lock warning light switch (3).

11.5 Undo the detent grub screw (4), and remove the spring (5) and ball (6) using a suitable magnet.



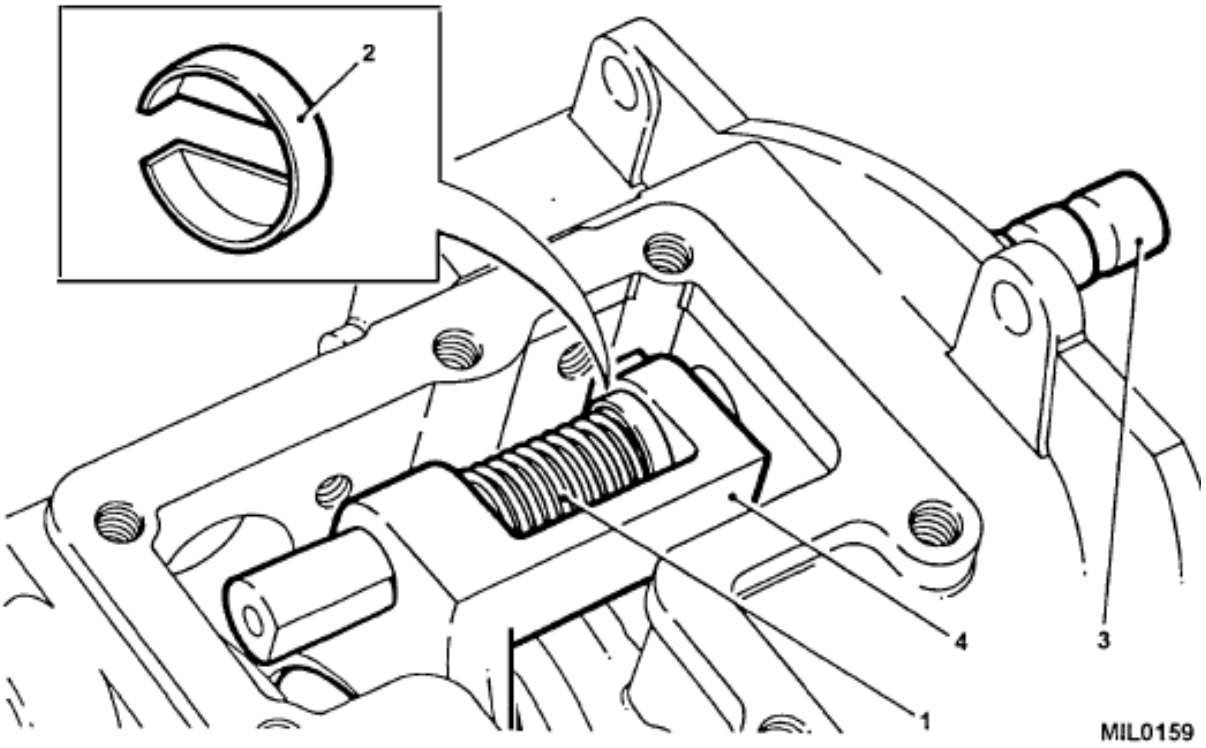
1	Retaining bolts	5	Spring
2	Differential lock finger housing	6	Ball
3	Warning light switch	7	Retaining bolts
4	Detent grub screw	8	Side cover

Fig 11 Differential lock finger housing

11.6 Compress the spring (Fig 12 (1)) and remove the two spring retaining caps (2).

11.7 Withdraw the selector shaft (3) from the rear of the output housing.

11.8 Remove the selector fork (4) and spring through the side cover aperture.



1 Selector fork spring 3 Selector shaft
2 Spring retaining cap 4 Selector fork

Fig 12 Removing selector shaft, fork spring and spring caps

11.9 Remove the lock-up sleeve from the rear of the output housing.

11.10 Using a suitable tool and socket wrench and ensuring that flange bolts are fully engaged in the wrench, remove the flange nut (Fig 13), followed by the steel and felt washers.

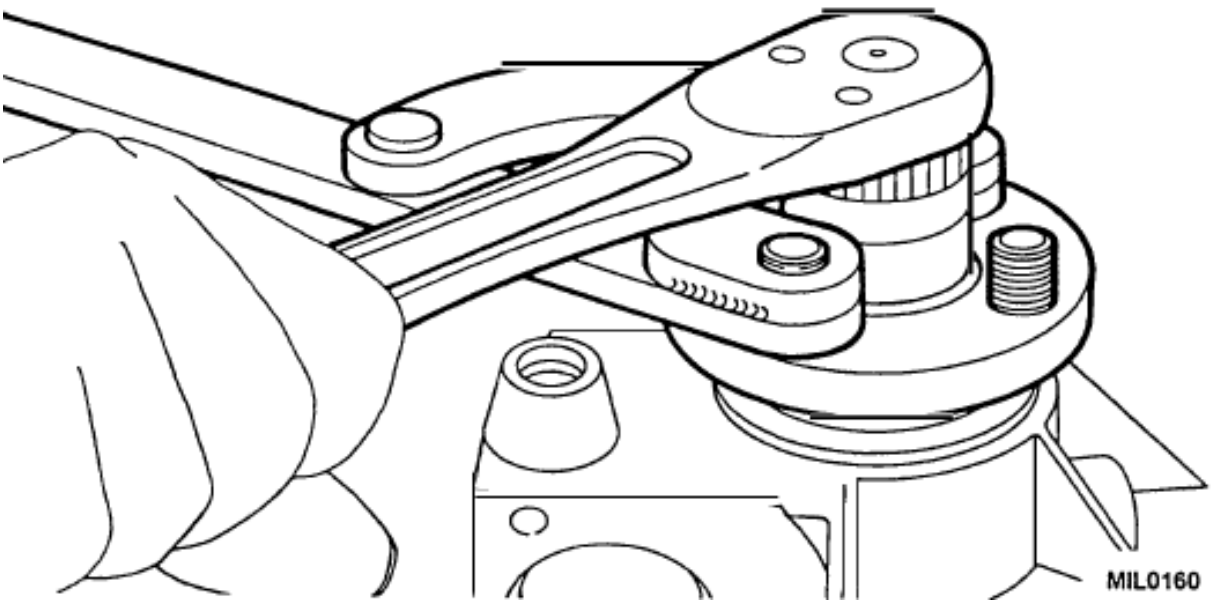


Fig 13 Flange nut removal

11.11 Remove the output flange and oil seal shield. These parts need not be separated unless the flange bolts are to be renewed.

11.12 Drift the output shaft rearwards from housing using a soft headed mallet.

11.13 Slide off the collar from the output shaft.

11.14 Prise out and discard the oil seal from the output housing using a suitable tool (Fig 14).

11.15 Remove the circlip with suitable circlip pliers.

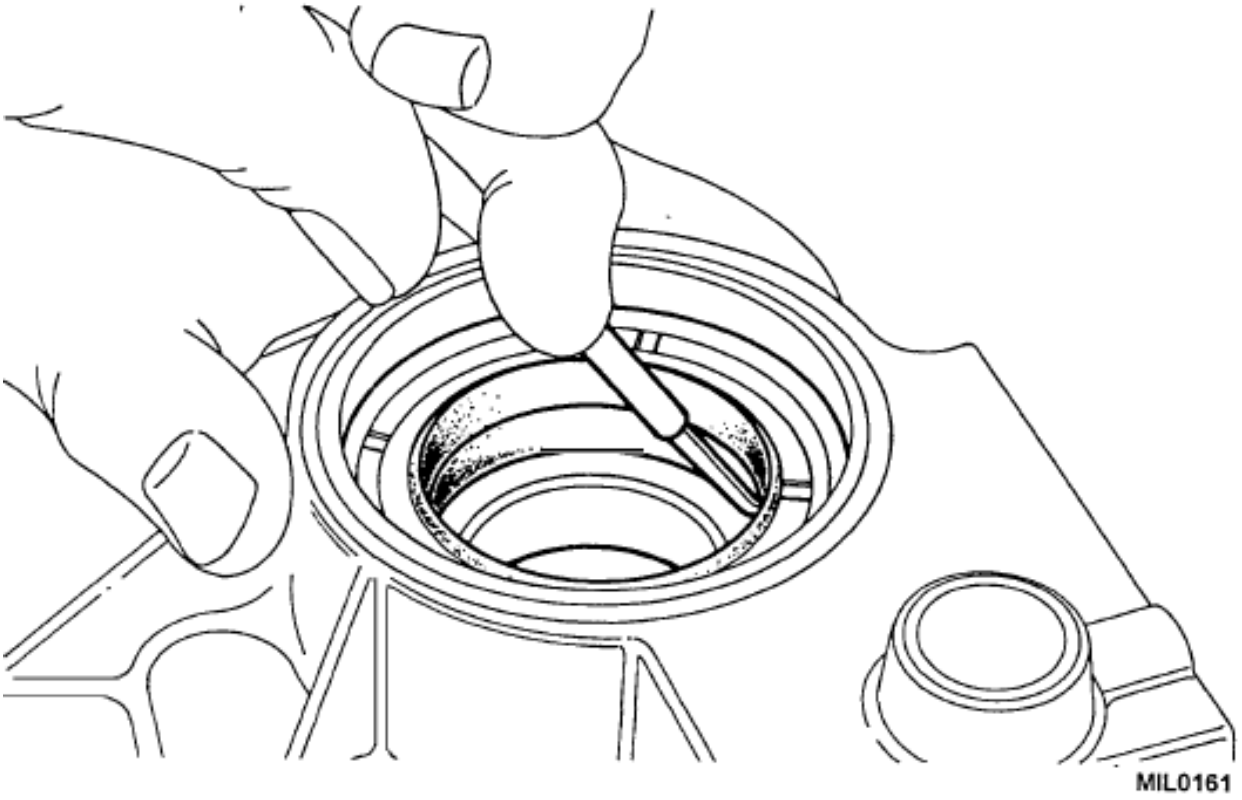


Fig 14 Front output housing oil seal removal

11.16 Invert the housing and drift out the bearing from inside the case (Fig 15).

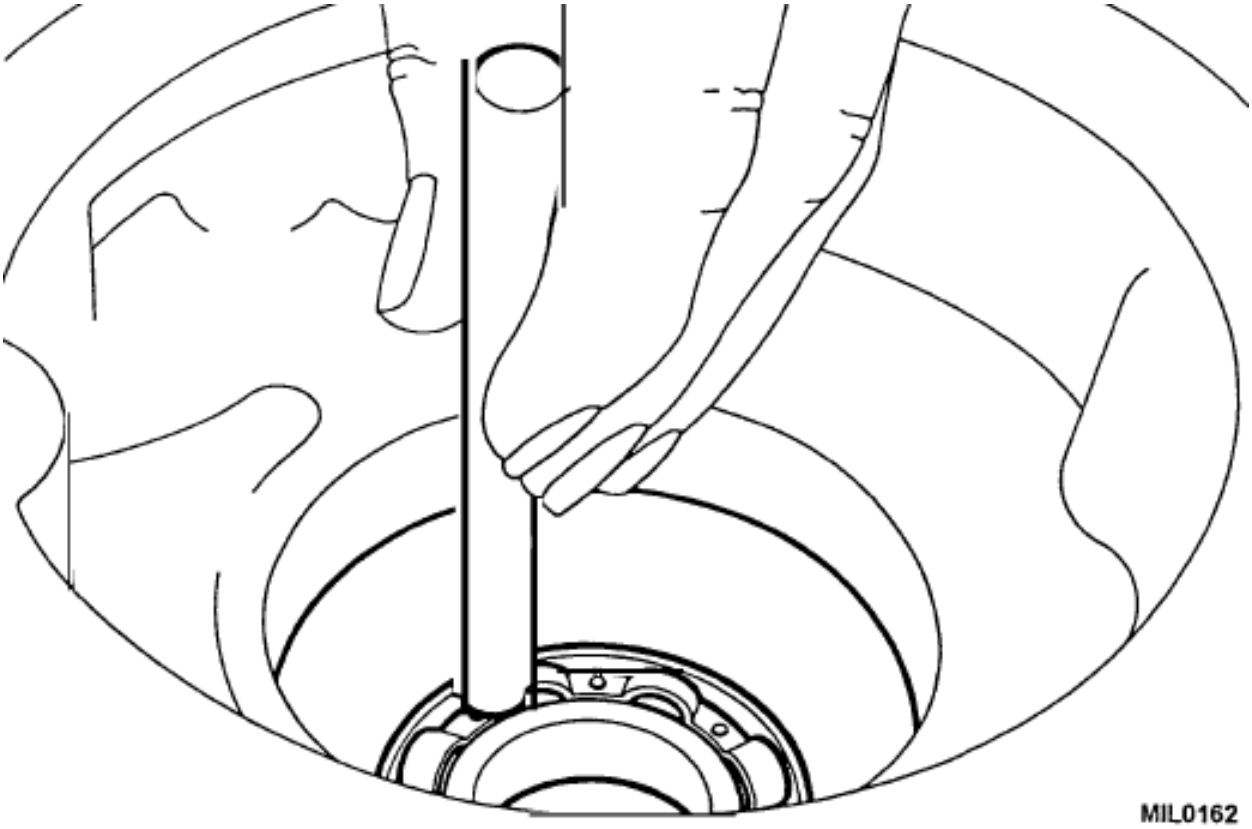
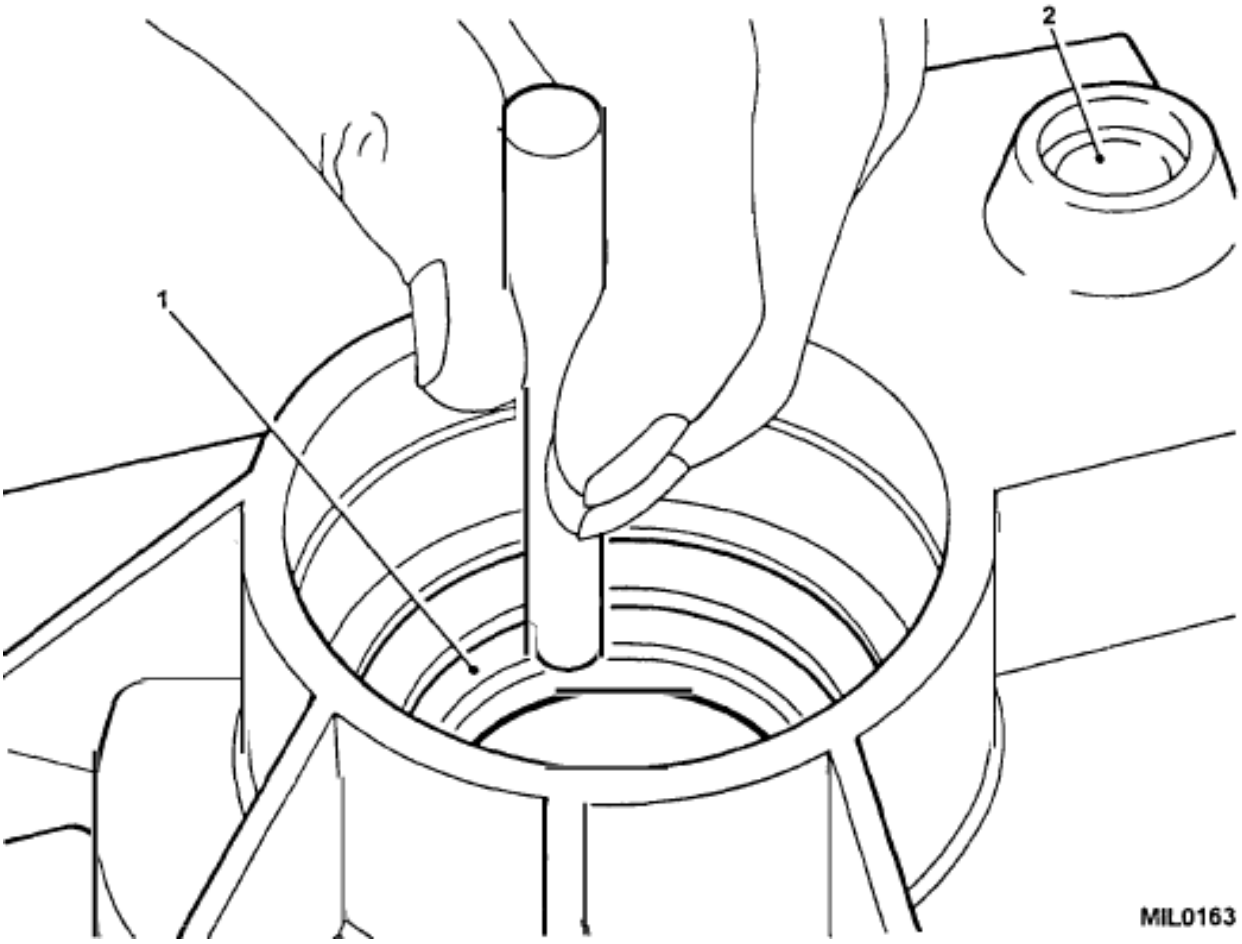


Fig 15 Front output bearing removal

11.17 Drift out the centre differential front taper roller bearing track (Fig 16 (1)) and shim; measure and note the shim thickness for use at reassembly.

11.18 Drift out the selector shaft cup plug (2) from housing.



1 Taper roller bearing track 2 Selector shaft cup plug

Fig 16 Removing differential bearing track and selector shaft cup plug

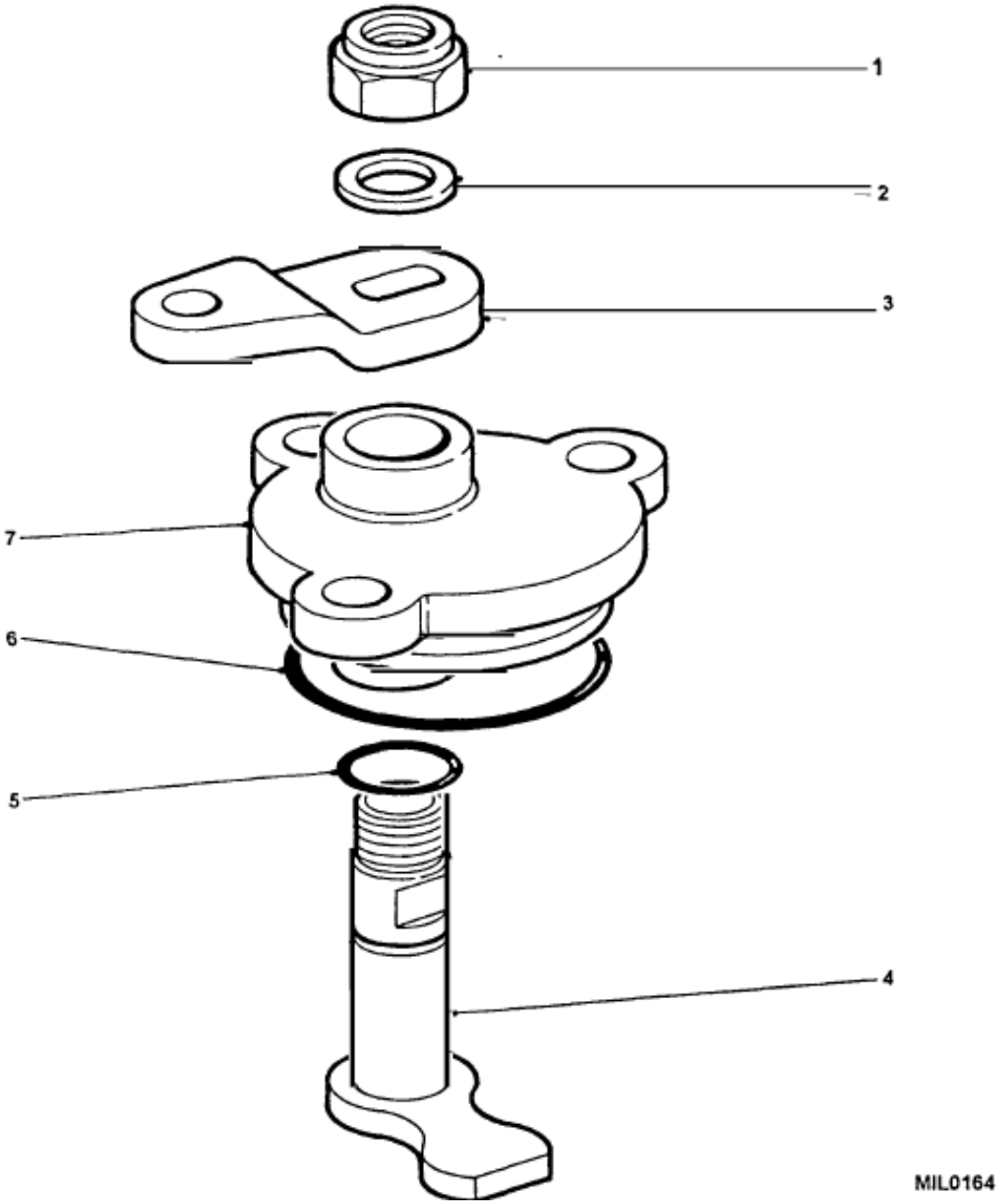
Differential lock finger housing

12 Dismantle the differential lock finger housing as follows:

12.1 Unscrew and discard the self-locking nut (Fig 17 (1)), remove the washer (2) and operating lever (3).

12.2 Remove the pivot shaft (4) from the finger housing (7).

12.3 Remove the 'O' rings (5) and (6) from the pivot shaft and finger housing and discard.



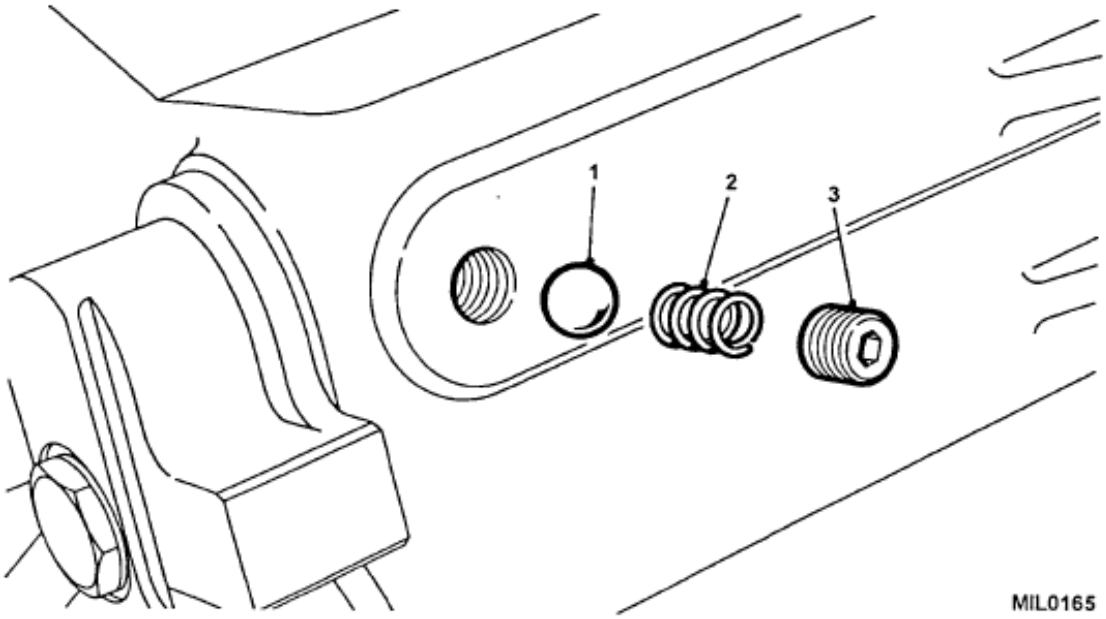
1	Self-locking nut	5	'O' ring
2	Washer	6	'O' ring
3	Operating lever	7	Finger housing
4	Pivot shaft		

Fig 17 Differential lock finger housing assembly

Centre differential unit

13 To remove and dismantle the centre differential unit proceed as follows:

13.1 Remove high/low selector shaft detent plug (Fig 18 (3)), spring (2) and retrieve the ball (1) with a suitable magnet, then withdraw the centre differential and selector shaft/fork assembly (Fig 19).



1 Ball
2 Spring
3 Detent plug

Fig 18 High/low selector shaft detent plug, ball and spring

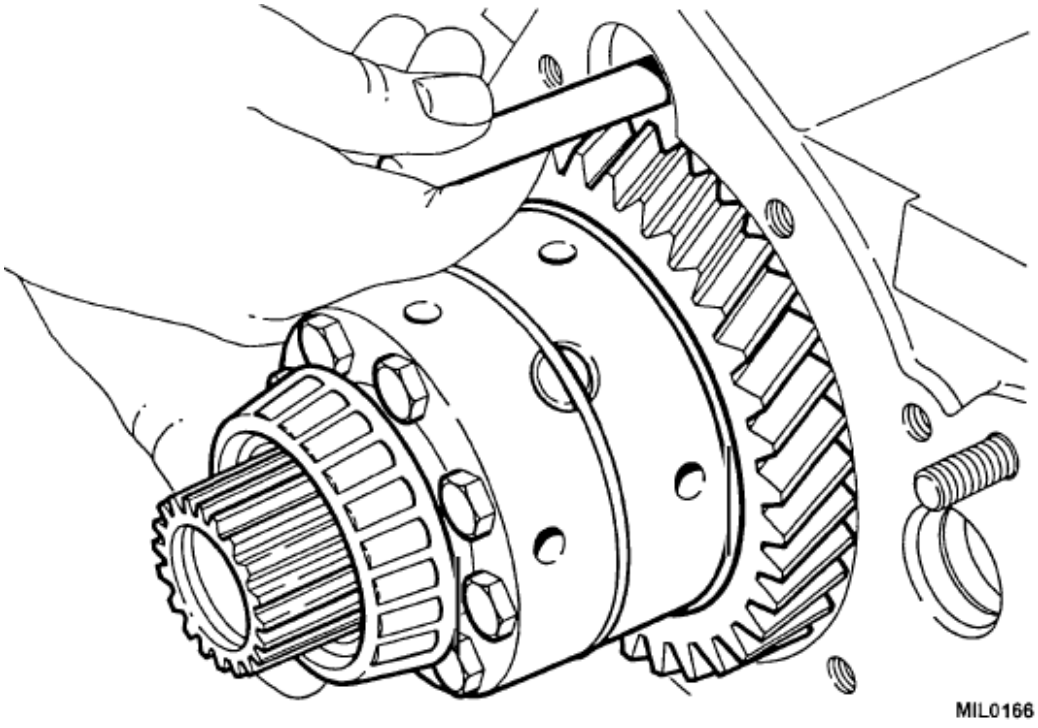


Fig 19 Removing the centre differential and selector shaft assembly

13.2 Secure the centre differential unit to a vice fitted with soft jaws, release stake nut from recess.

13.3 Using a suitable tool and socket wrench remove and discard the stake nut (Fig 20).

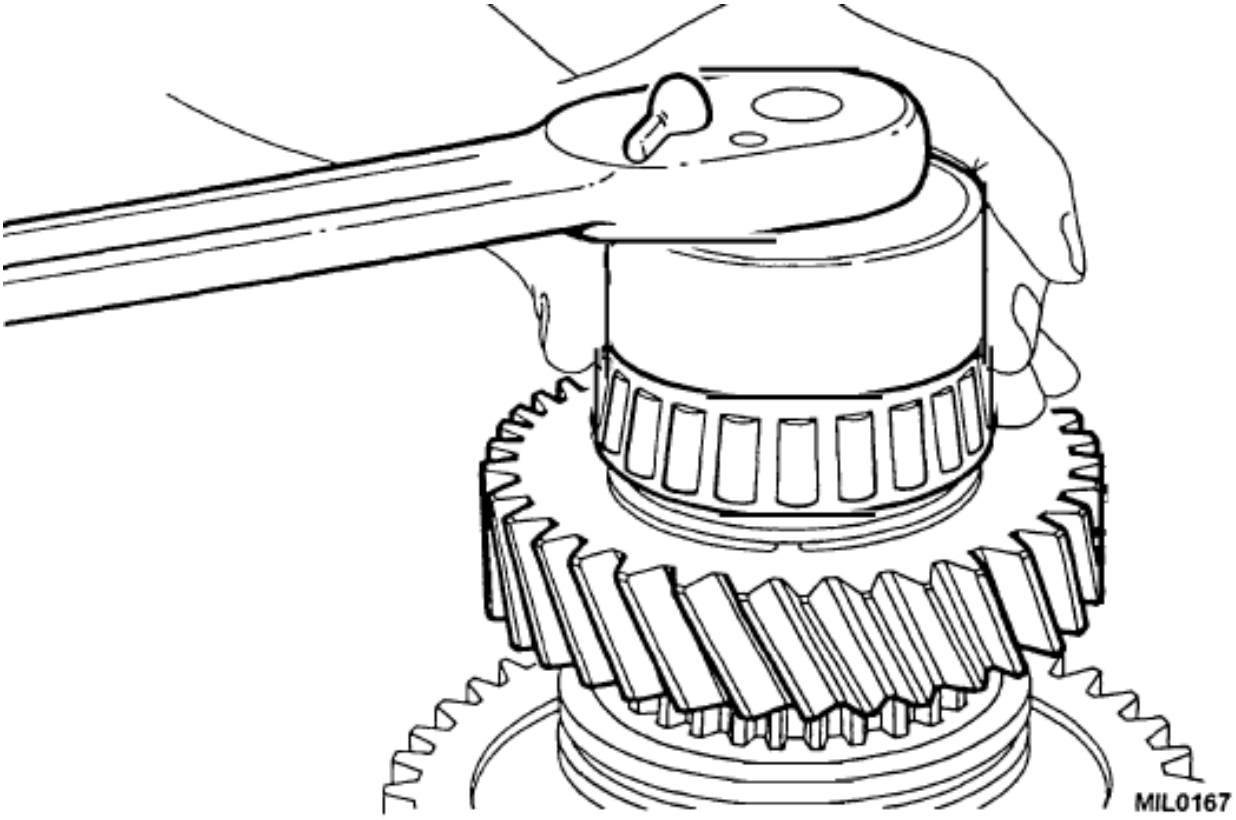


Fig 20 Removing stake nut from differential

13.4 Remove the differential unit from the vice.

13.5 Secure a suitable tool in the vice, and remove the rear taper bearing and collars (Fig 21).

13.6 Remove the high range gear (Fig 22 (2)) and bush (1), taking care not to disturb the high/low sleeve (3).

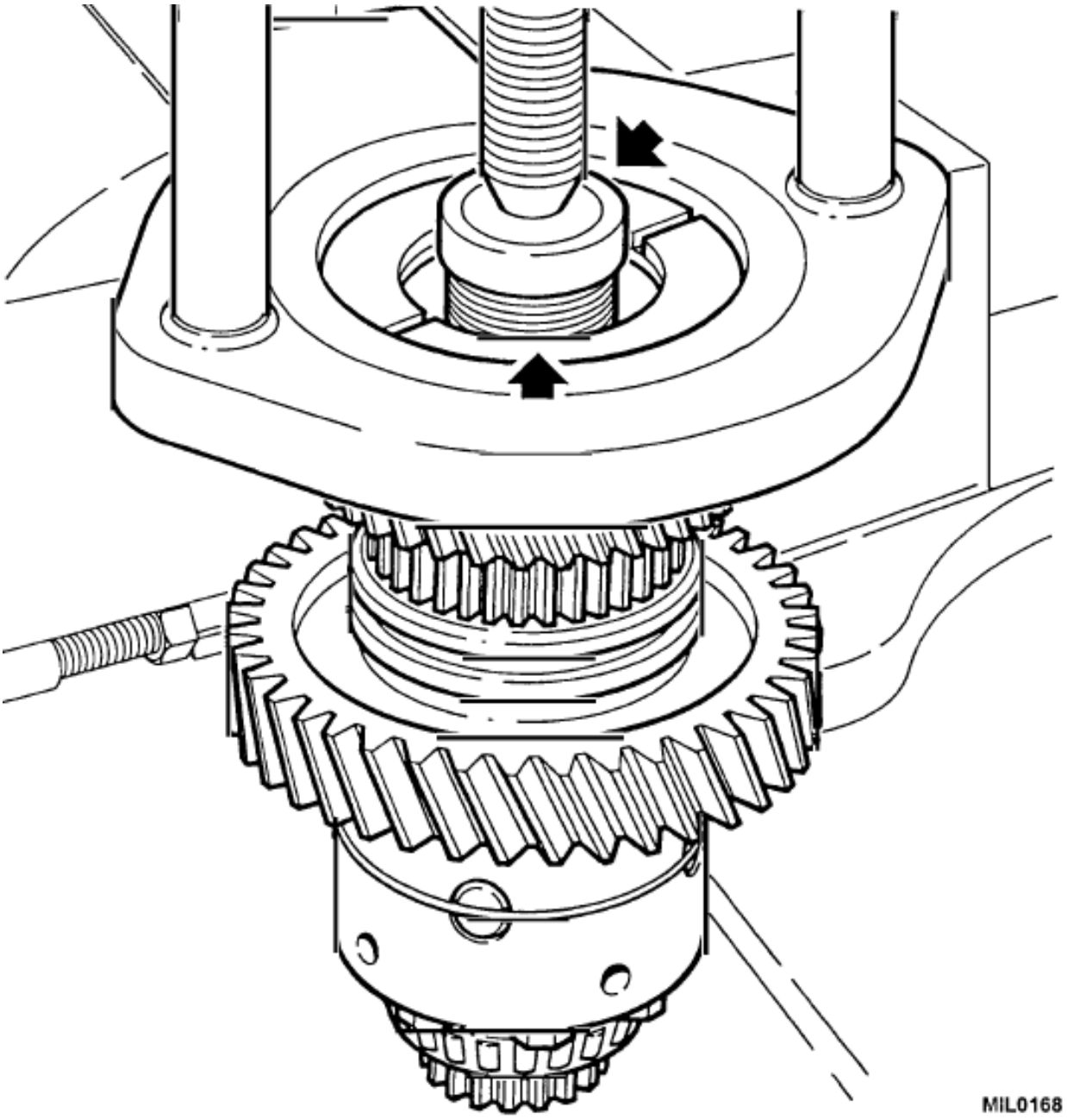


Fig 21 Removing differential rear taper bearing

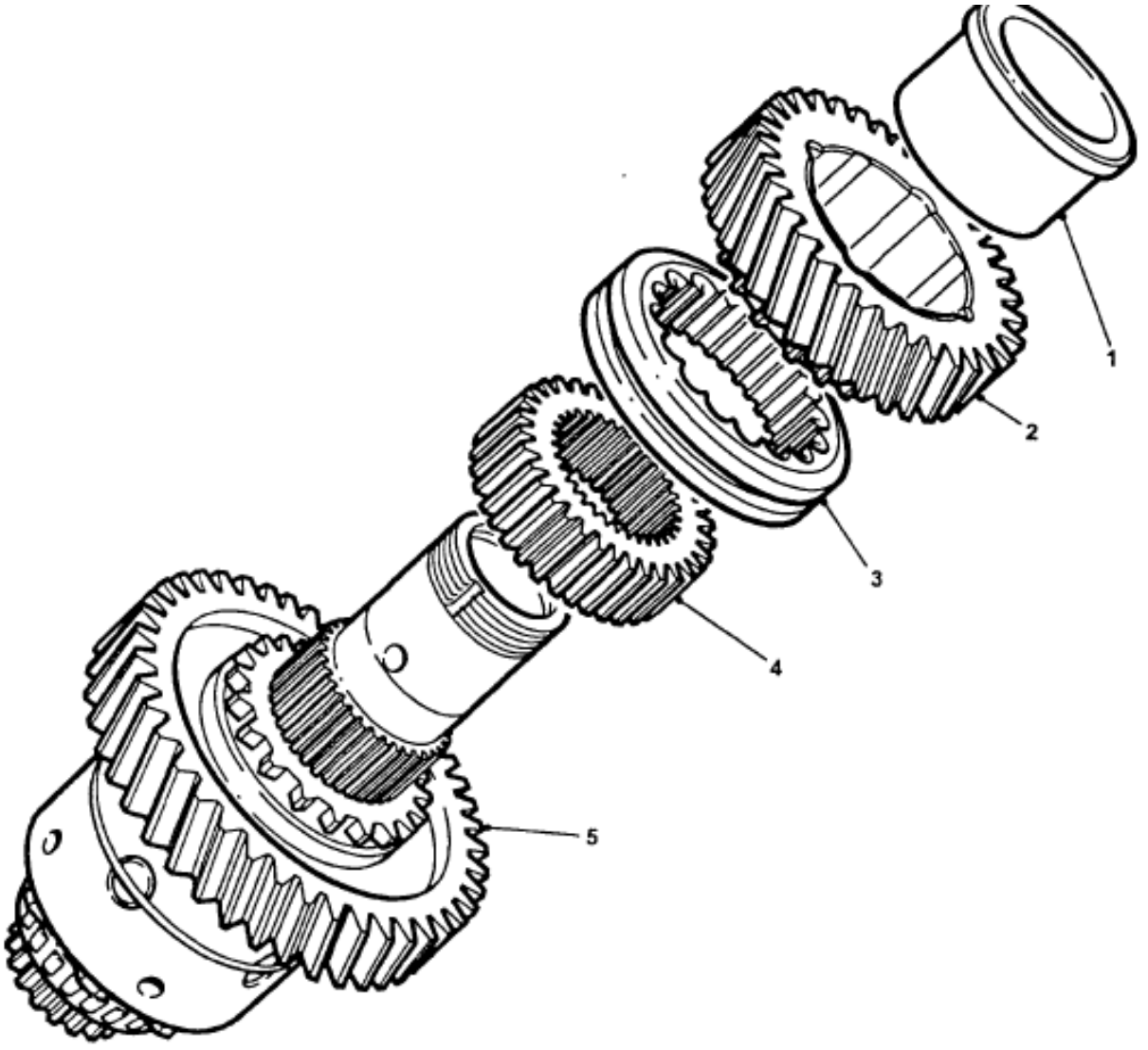
13.7 Mark the relationship of the high/low sleeve (3) to the high/low hub (4) and then remove the sleeve.

13.8 Using a suitable press behind the low range gear carefully remove the high/low hub and low range gear (5).

13.9 Remove tool from the hand press. Remove the front taper roller bearing.

13.10 Remove hand press from the vice.

13.11 Using soft jaws secure the differential unit in the vice by gripping the hub splines.



1 Bush
2 High range gear
3 High/low sleeve
4 High/low hub
5 Low range gear

Fig 22 High and low range gears

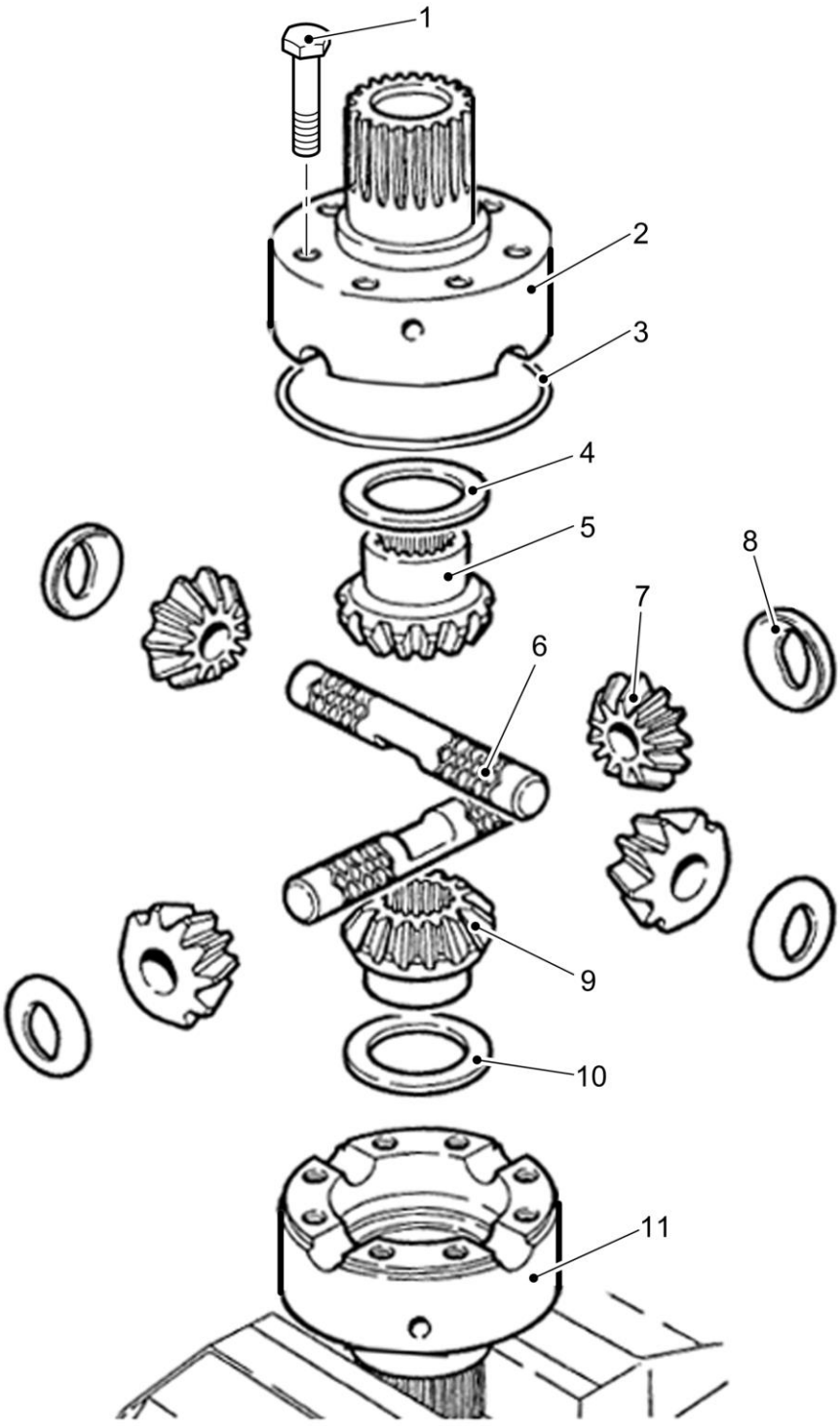
13.12 Remove the eight retaining bolts (Fig 23 (1)) and lift off the front differential case half (2).

13.13 Release the retaining ring (3) and remove the front upper bevel gear (5) and thrust washer (4).

13.14 Remove the pinion gears (7), dished washers (8) along with the cross shafts (6).

13.15 Remove the rear lower bevel gear (9) and thrust washer (10) from the rear differential case half (11).

13.16 Remove the rear differential case half from the vice.



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1	Retaining bolt	7	Pinion gears
2	Front differential case half	8	Dished washer
3	Retaining ring	9	Lower bevel gear
4	Thrust washer	10	Thrust washer
5	Upper bevel gear	11	Rear differential case half
6	Cross shaft		

Fig 23 Exploded view of differential

Rear output housing

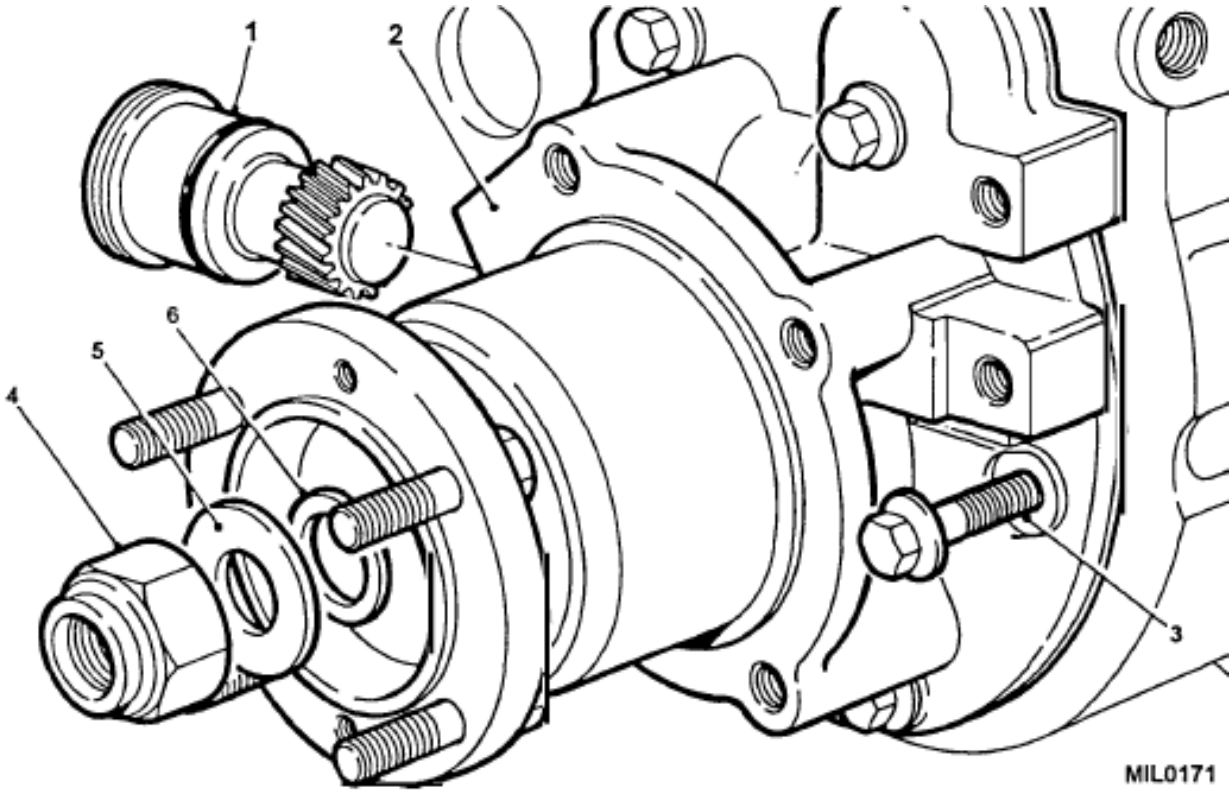
14 To remove and dismantle the rear output housing carry out the following:

14.1 Remove the six bolts (Fig 24 (3)) and detach the rear output housing and shaft assembly (2) from the transfer casing.

14.2 Using a suitable tool and socket wrench, remove the flange nut (4), steel washer (5) and felt washer (6), ensure flange bolts are fully engaged in the wrench.

14.3 Remove output flange with circlip attached. If necessary, use a two-legged puller. The circlip need only be released if the flange bolts require renewing.

14.4 Remove the speedometer drive housing (1) (refer to Cat 523 Chap 4).



1	Speedometer drive housing	4	Flange nut
2	Rear output housing and shaft assembly	5	Steel washer
3	Retaining bolt	6	Felt washer

Fig 24 Rear output housing

14.5 Carefully prise the oil catch ring off the output housing using a screwdriver in the slot provided.

14.6 Prise out and discard the seal from the output housing using a suitable tool (Fig 25).

14.7 Using suitable circlip pliers, remove the circlip retaining the bearing, and drive out the bearing from the rear of the housing (Fig 26).

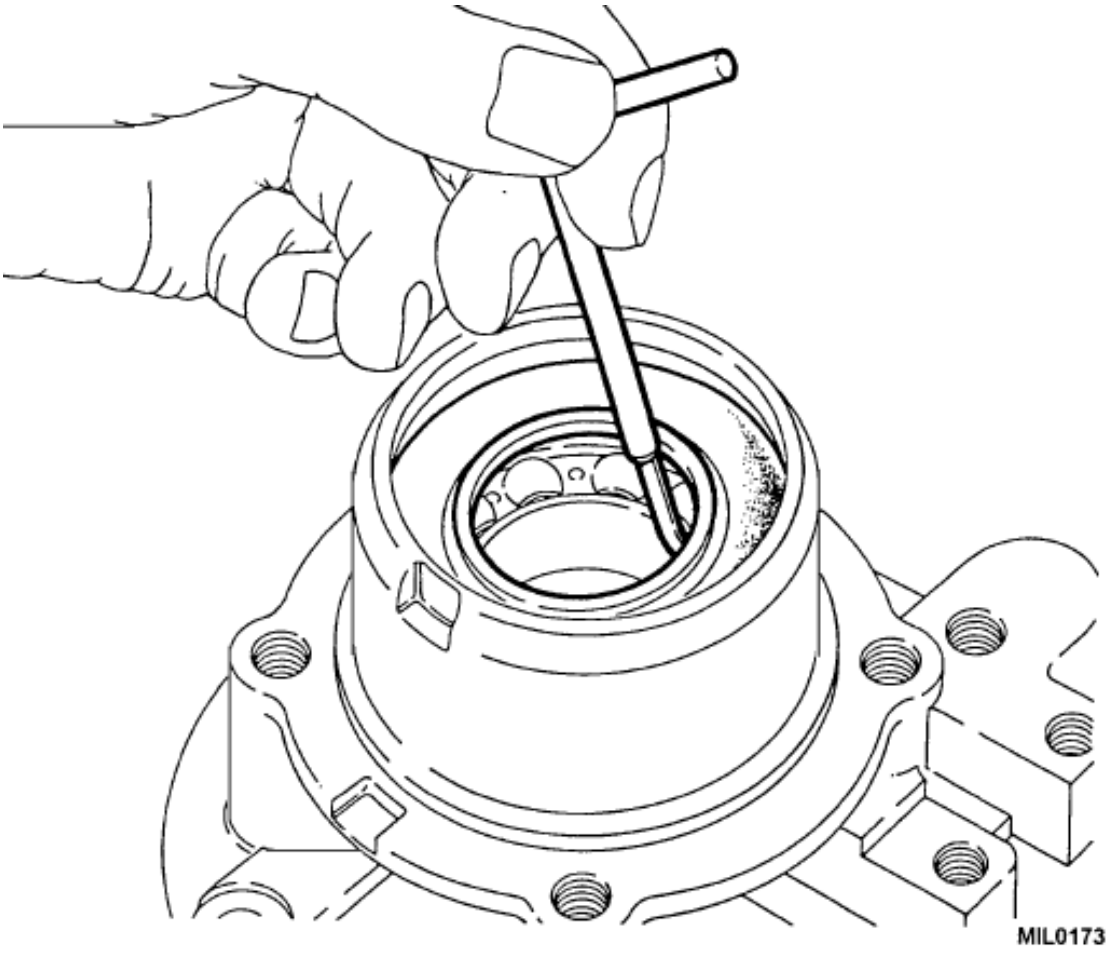


Fig 25 Removing oil seal from rear output housing

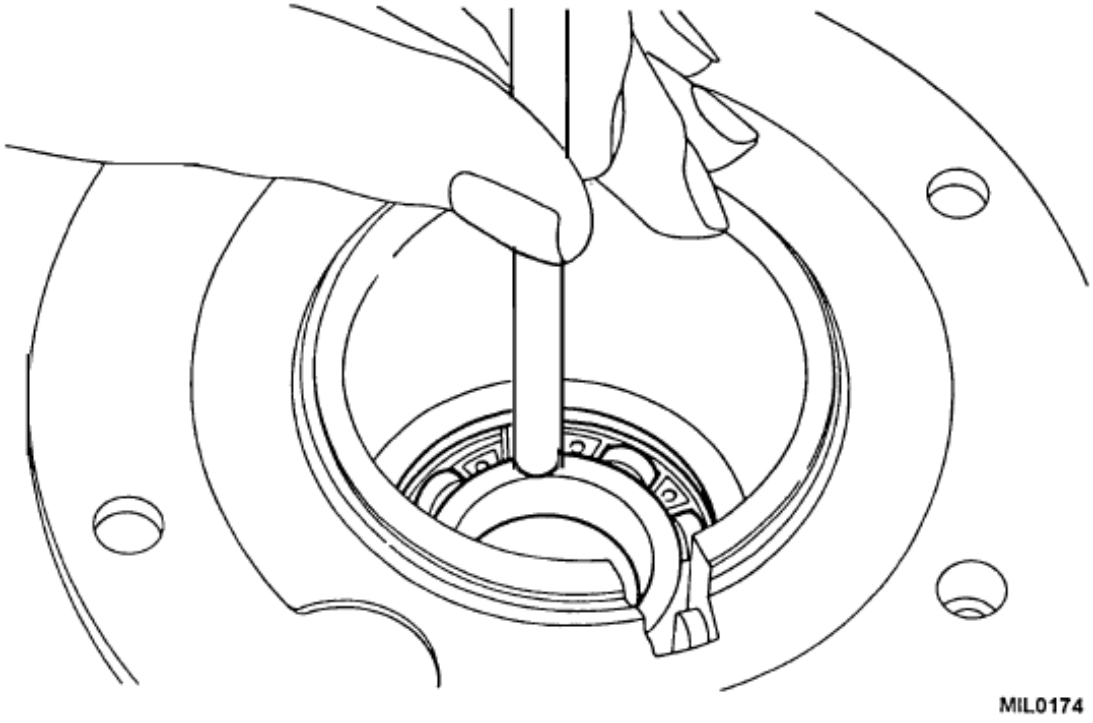


Fig 26 Removing bearing from rear output housing

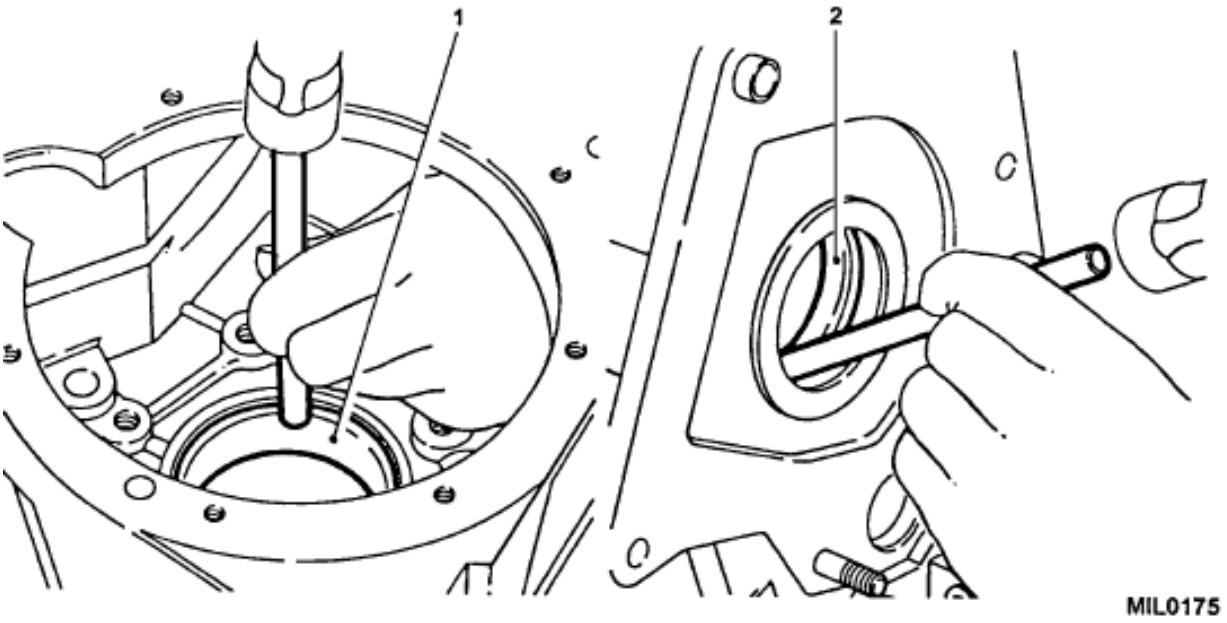
Transfer case

15 To dismantle the transfer case carry out the following:

15.1 Remove the magnetic drain plug, copper washer and filler/level plug. Discard the copper washer.

15.2 Prise out and discard the oil seal at the front of the casing using a suitable tool.

15.3 Drift out the differential rear bearing track (Fig 27 (1)) and the input gear front bearing track



1 Rear bearing track 2 Front bearing track

Fig 27 Removing bearing tracks from transfer case

CLEANING

16 Thoroughly clean all components ensuring removal of all sealing/locking compounds from mating faces and threads.

EXAMINATION

17 Examine all casings for cracks and damaged threads, inspect bearings and bearing tracks for wear and damage. Closely examine all gears and splines for wear and damage.

REPAIRS AND REPLACEMENT

18 Renew all seals, 'O' rings, self locking nuts and staked nuts.

REASSEMBLY

Centre differential unit

19 To reassemble the centre differential unit carry out the following:

19.1 Using soft jaws secure the rear differential case half (refer to Fig 23 (11)) in the vice by gripping the hub splines.

19.2 Lubricate (with oil specified in Table 1, Serial 2) and install the cross shafts (6) and pinion gears (7) with new dished washers (8). Do not fit the lower bevel gear (9) at this stage.

19.3 Lubricate (with oil specified in Table 1, Serial 2) and fit the upper bevel gear (5) and from the range available the thinnest thrust washer (4).

19.4 Fit the front differential case half (2) ensuring that the two engraved arrows are aligned. Fit the securing bolts (1) and tighten to a torque of 55 to 64 Nm (40 to 47 lbf/ft).

19.5 Lubricate (with oil specified in Table 1, Serial 2) and insert the rear output shaft into the bevel gear and check that the gears are free to rotate.

19.6 Fit the handbrake drum to the output drive flange and check the torque required to rotate the gears. Tie a length of string around the brake drum, attach a spring balance to the string and carefully tension the string until a load to turn is obtained (Fig 28). Alternatively use a torque meter applied to the brake drum flange nut.

19.7 Rotate the drum slowly by hand to overcome the initial load when using either method.

NOTES

(1) Gears that have been run will rotate smoothly and will require a torque of 0.6 Nm (5 lbf/in.). Equivalent force using a spring balance: 0.5 kg (1 lb).

(2) New gears will rotate with a notchy feel and will require a torque of not more than 2 Nm (20 lbf/in.). Equivalent force using a spring balance: 2 kg (4 lb).

(3) Keep all components well lubricated when carrying out these adjustments.

19.8 If the torque reading is too low change the thrust washer for a thicker one from the range available.

19.9 When the correct thickness of thrust washer has been determined, dismantle the unit and place the front bevel gear and thrust washer to one side.

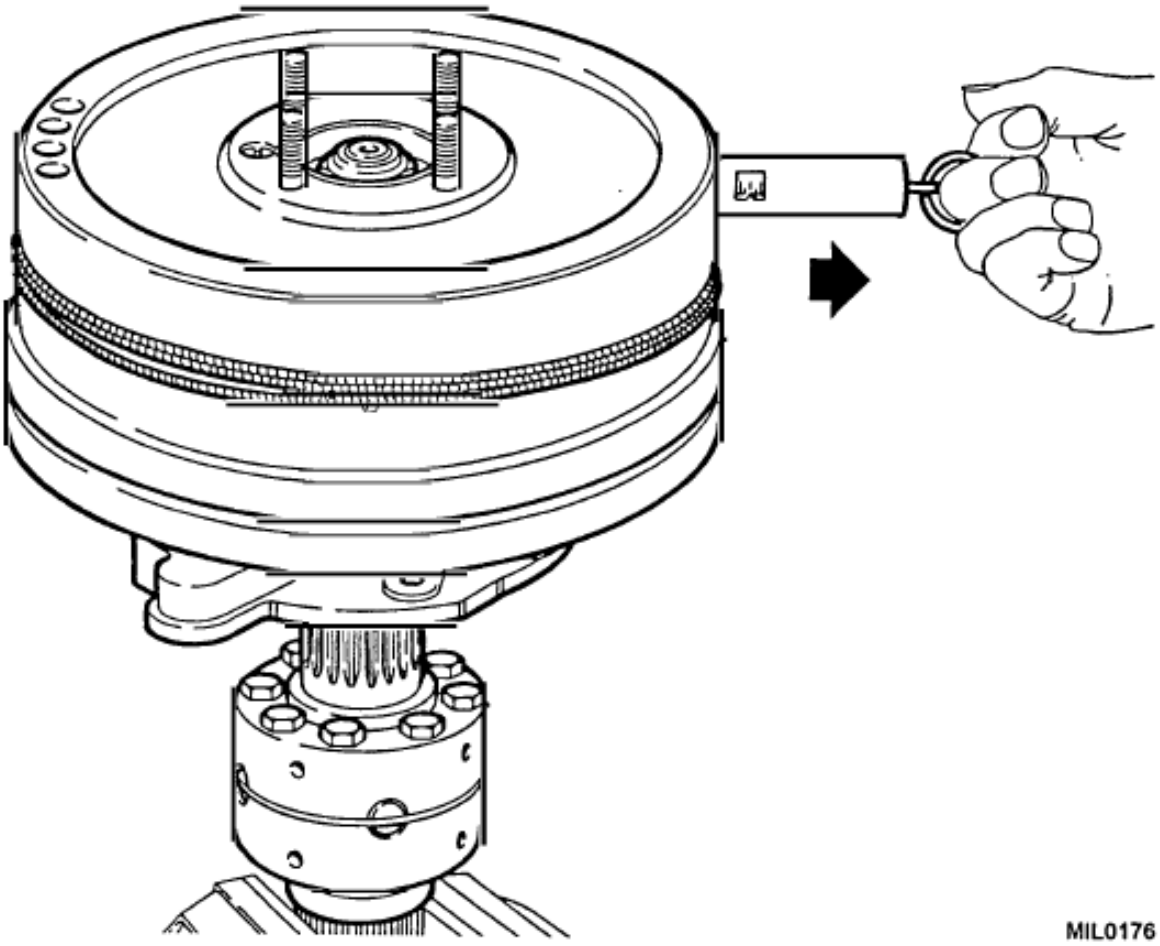


Fig 28 Checking torque required to rotate differential gears

19.10 Reassemble the unit with the rear bevel gear and thinnest thrust washer fitted.

19.11 Invert the assembly in the vice and repeat the foregoing procedure to obtain the correct thrust washer thickness for the rear bevel gear.

19.12 Dismantle the unit and fit the selected thrust washer and bevel gear to the rear differential half.

19.13 Fit the assembled cross shafts and pinions to the rear differential half and secure with the retaining ring.

19.14 Lubricate all the components with oil (refer to Table 1, Serial 2).

19.15 Fit the selected thrust washer and bevel gear to the front upper differential half.

19.16 Fit the front and rear differential case halves together, ensuring correct meshing of the gears and aligning the engraved arrows. Secure with the eight bolts tightened to a torque of 55 to 64 Nm (40 to 47 lbf/ft).

19.17 Check the overall torque required to turn the differential. This should be approximately equal to the resistance of both bevel gears added together.

19.18 Locate the front differential bearing onto the front shaft and press into position using a suitable tool (Fig 29).

19.19 Invert the differential unit and secure in the vice.

NOTE

During the following operations all parts should be lubricated with light oil as they are fitted.

19.20 Fit the low range gear (refer to Fig 22 (5)), with its dogteeth away from the differential assembly.

19.21 Press the high/low hub (4) onto the differential splines.

19.22 Slide the high/low selector sleeve (3) onto the hub ensuring alignment of the marks mad during dismantling.

19.23 Fit the bush (1) into the high range gear (2) so that the flange is fitted on the opposite side of the gear to the dogteeth. Slide the bushed gear onto the differential assembly with the dog tooth down.

19.24 Locate the rear differential bearing onto the hub and press it into position using a suitable tool.

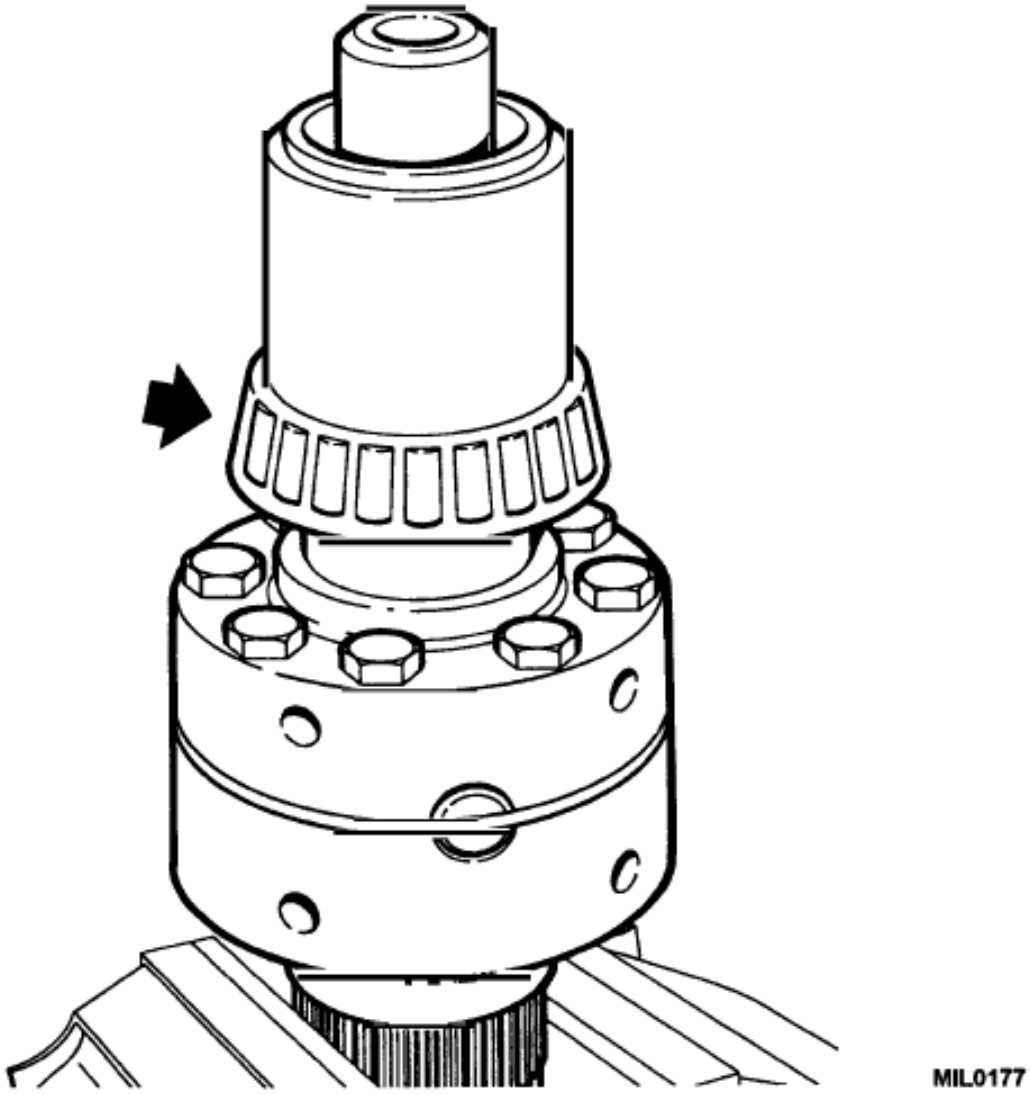


Fig 29 Fitting front differential bearing

19.25 Fit the stake nut and tighten to a torque of 66 to 80 Nm (50 to 59 lbf/ft) using a suitable tool.

NOTE

If the clearances vary from those specified in the following check, the assembly must be rebuilt using the relevant new parts.

19.26 Check the end float of the high and low range gears 0.05 to 0.15 mm (0.002 to 0.005 in.) (Fig 30).

CAUTION

COMPONENT DAMAGE. A round nose tool must be used for this operation to avoid splitting the collar of the nut.

19.27 Peen the stake nut collar by carefully forming the collar of the nut into the slot as illustrated (Fig 30).

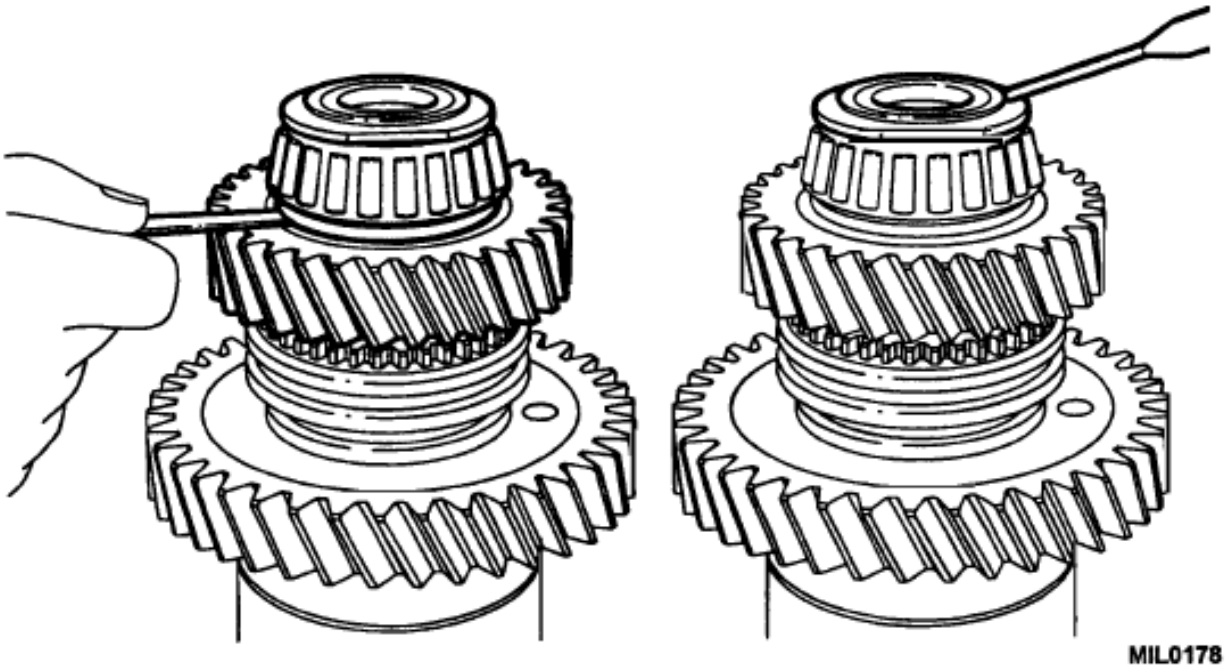


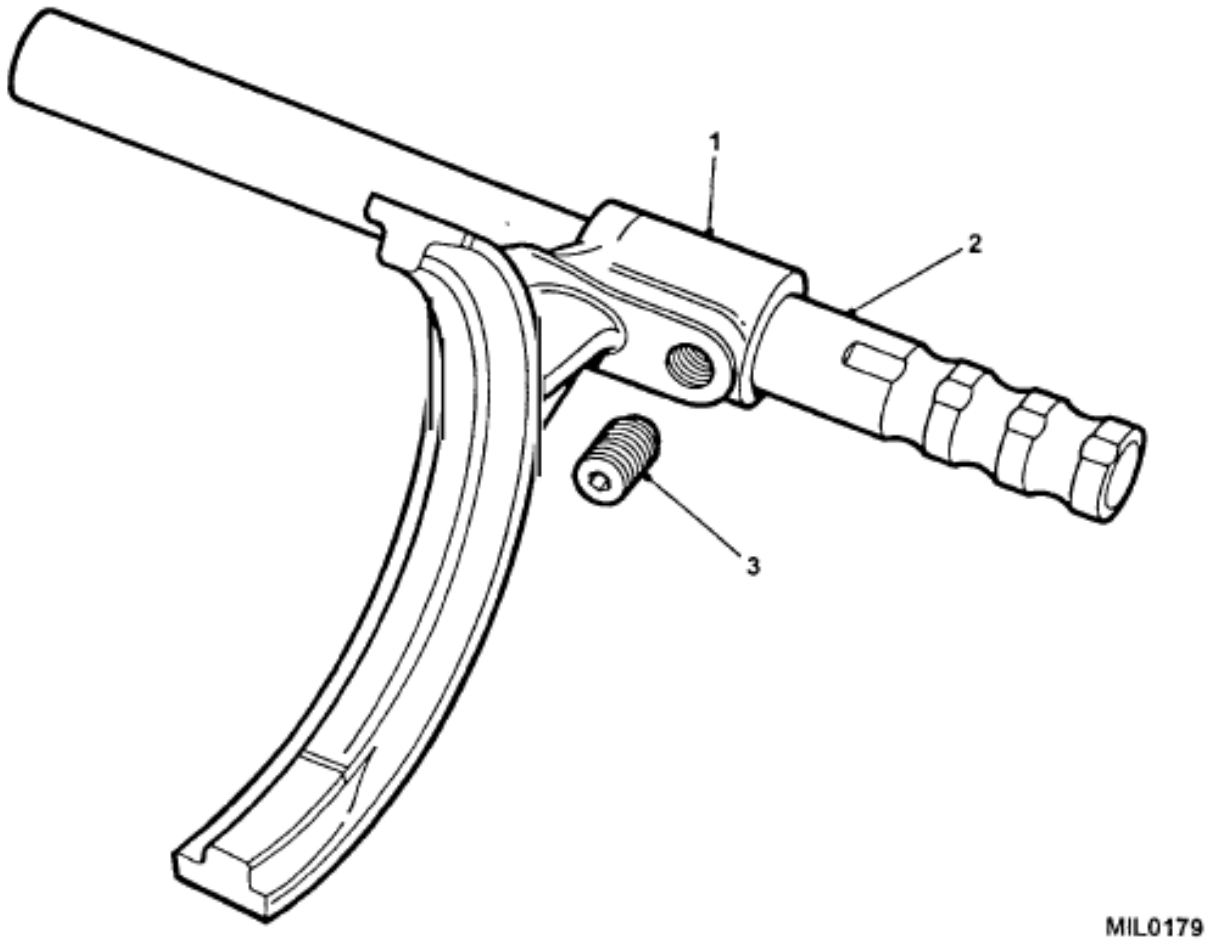
Fig 30 Checking end-float and peening stake nut

Selector fork assembly

20 If the selector fork assembly has been dismantled carry out the following:

20.1 Fit the selector fork (Fig 31 (1)) to the shaft (2) with its boss towards the three detent grooves. Align the tapped hole in the fork boss with the detent in the shaft nearest to the detent grooves.

20.2 Apply sealing compound (refer to Table 1, Serial 1) to the grub screw threads, fit the grub screw (3) and tighten to a torque of 22 to 28 Nm (16 to 21 lbf/ft).



1 Selector fork 3 Grub screw
2 Shaft

Fig 31 Selector fork assembly

Transfer case

21 Assemble the components to the transfer case as follows:

21.1 Fit the differential rear bearing track 1.00 mm (0.039 in.) below the outer face of the casing using a suitable tool (Fig 32).

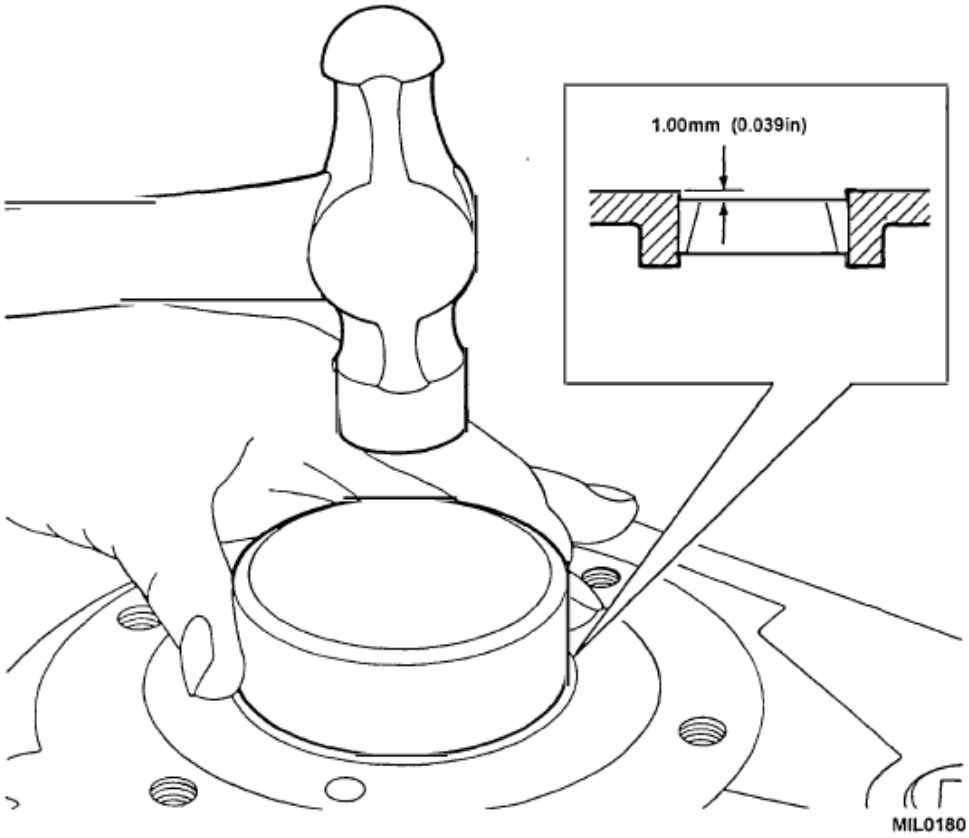


Fig 32 Fitting differential rear bearing track

21.2 Support the transfer case on the bench with the rear face uppermost and drive in the front taper bearing track (Fig 33).

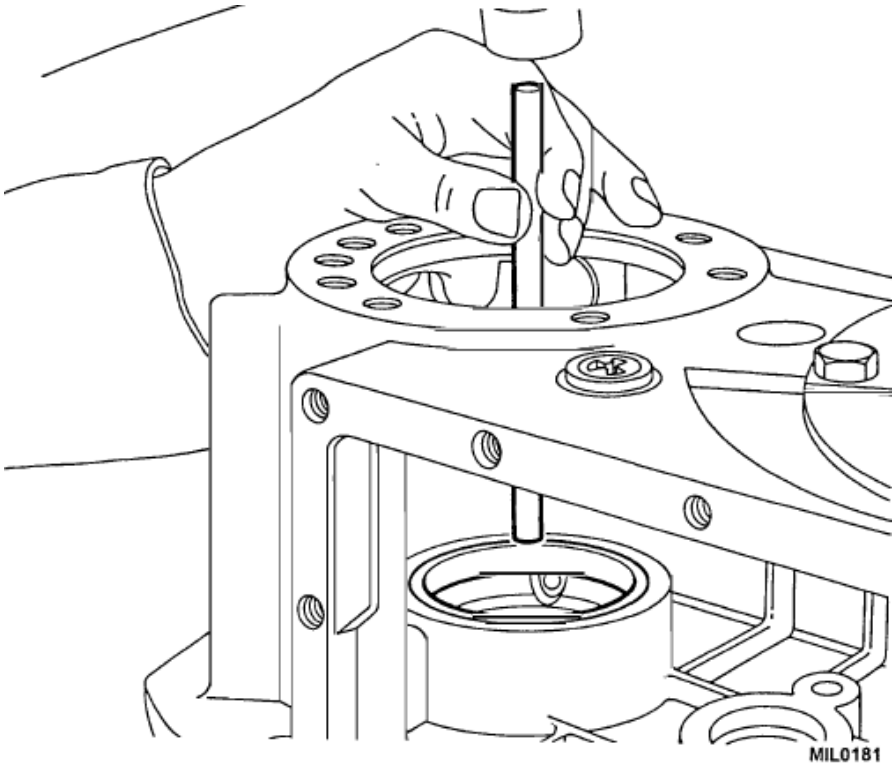


Fig 33 Fitting front taper bearing track

21.3 Reposition the casing so that the front face is uppermost and fit the oil seal (Fig 34), open side inwards, using a suitable tool.

21.4 If removed, refit the studs and dowels to the front face of the casing, ensuring that the radial dowel blade is set in line with the circle formed by the front output housing fixing holes. Also ensure, when fitting studs that the torque does not exceed the maximum quoted for the associated nut.

21.5 Fit the magnetic drain plug and tighten to a torque of 25 to 35 Nm (19 to 26 lbf/ft). Loosely fit the filler level plug.

Fig 34 Fitting oil seal to transfer case

Rear output housing

22 To assemble the rear output housing proceed as follows:

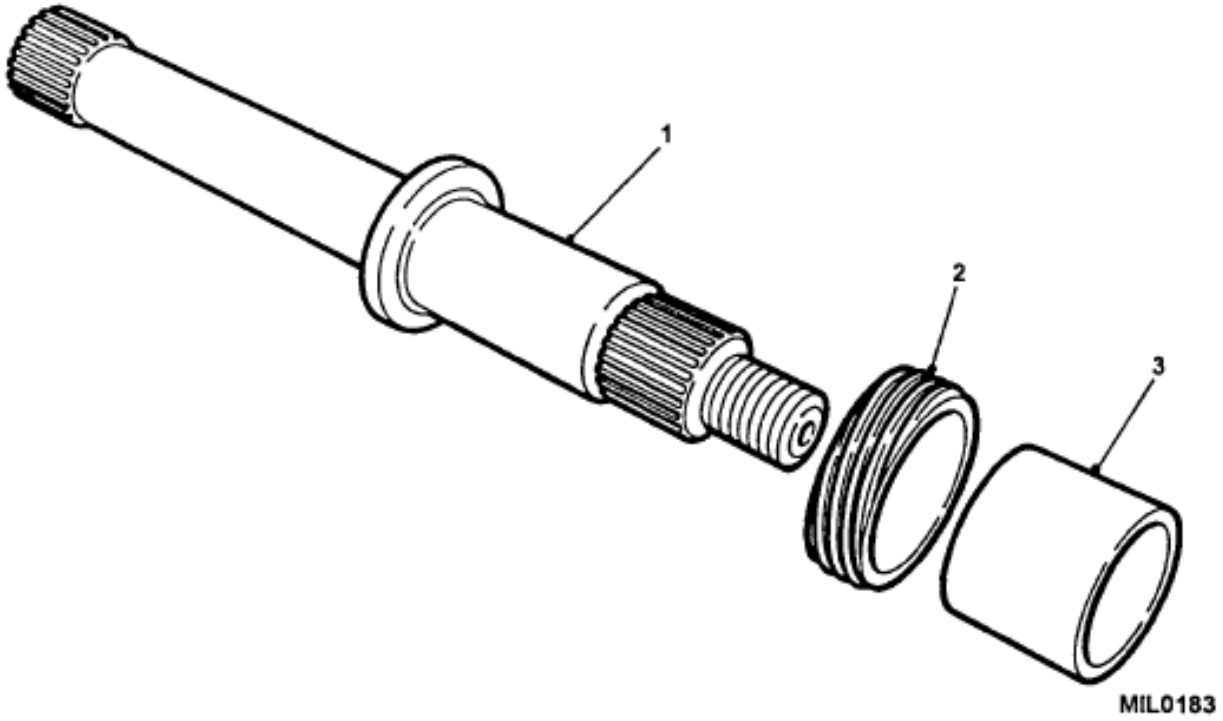
22.1 Press the output bearing into the housing. Do not use excessive force. To facilitate fitting the bearing, heat the output housing case to a maximum temperature of 100º C (212° F).

22.2 Fit the circlip to retain the bearing, using suitable circlip pliers.

22.3 Pre-grease (refer to Table 1, Serial 3) between the seal lips and fit new seal, open side inwards, using a suitable tool. The seal should just make contact with the bearing circlip.

22.4 Carefully charge the lips of the seal with clean grease (refer to Table 1, Serial 3) and refit the oil catch ring to the output housing.

22.5 Slide the speedometer drive gear (Fig 35 (2)) and spacer (3) onto the output shaft (1).



1 Output shaft
2 Speedometer drive gear
3 Spacer

Fig 35 Fitting speedometer drive gear and spacer to output shaft

22.6 Locate the output shaft into the bearing in the housing and drive into position.

22.7 Fit speedometer housing into output housing (refer to Cat 523 Chap 4).

22.8 Apply sealant (refer to Table 1, Serial 4) to the output housing joint face, ensuring the sealant bead is continuous.

22.9 Smear sealing compound (refer to Table 1, Serial 1) on the threads of the six output housing bolts. Fit the output housing to the transfer box casing and tighten the bolts evenly to a torque of 40 to 50 Nm (29 to 37 lbf/ft), which will pull the rear bearing track into position.

Centre differential assembly refit

23 To fit the centre differential assembly carry out the following:

23.1 Fit the selector fork/shaft assembly to the high/low selector sleeve on the differential assembly, with detent groove to the rear of the differential assembly.

23.2 Locate the differential assembly, complete with selector fork, into the transfer case (Fig 36), with the selector shaft positioned in the aperture as shown. It may be necessary to rotate the output shaft to ease fitment.

23.3 Fit the selector shaft detent ball and spring through the side of the transfer case (refer to Fig 18). Fit a new 'micro-encapsulated' detent plug and carefully screw home, ensuring the head of the plug finishes flush with the face of the transfer casing. Finally, peen over the head of the detent plug.

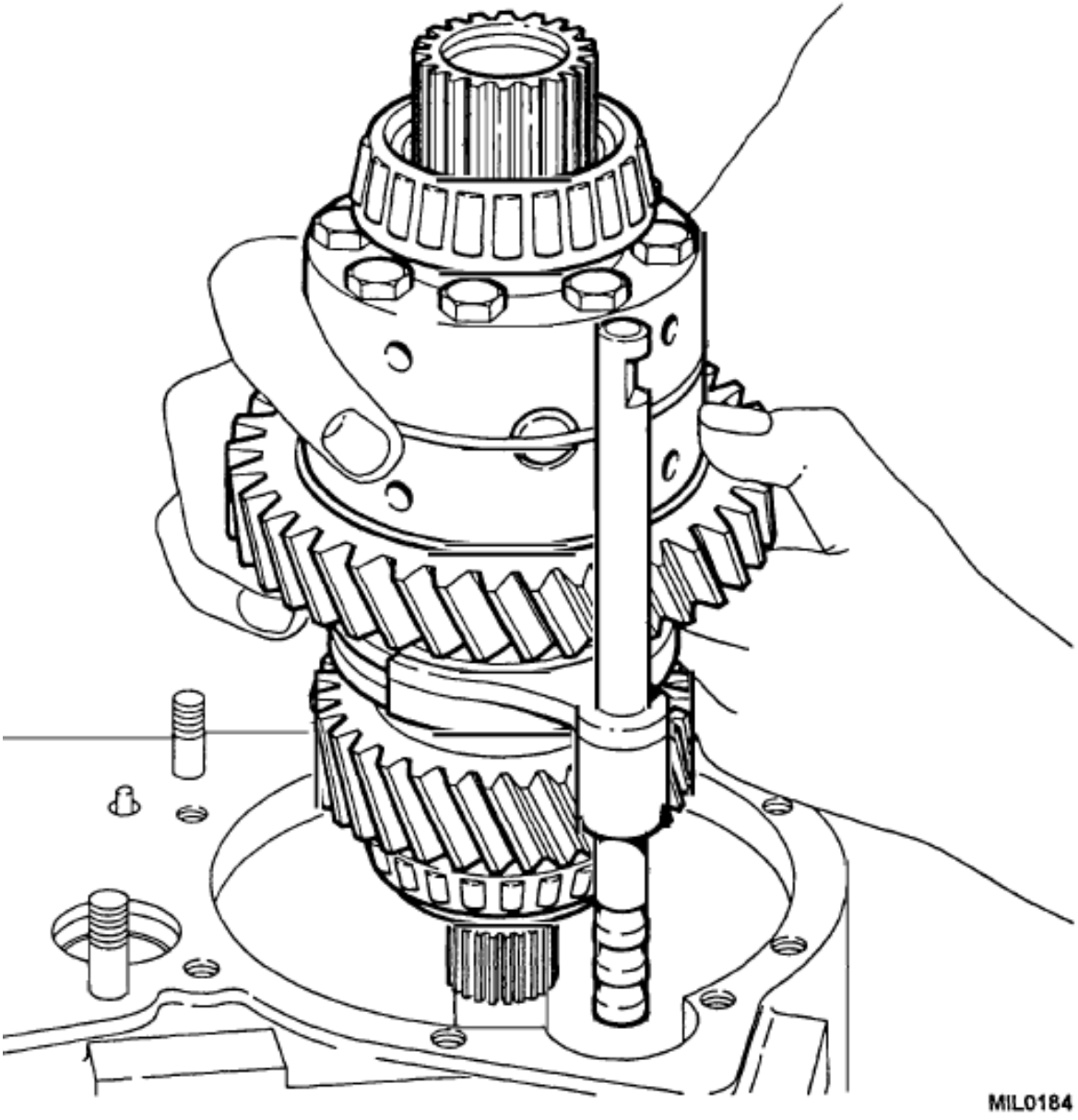


Fig 36 Fitting centre differential and selector shaft assembly

Front output housing

24 To assemble the front output housing carry out the following:

24.1 Press the output bearing into the housing. Do not use excessive force. To facilitate fitting the bearing, heat the front output housing to a maximum temperature of 100° C (212°F).

24.2 Fit the circlip to retain the bearing, using suitable circlip pliers.

24.3 Pre-grease between the lips and fit a new oil seal, open side inwards, using a suitable tool. The seal should just make contact with the bearing circlip.

24.4 Carefully charge the lips of the seal with clean grease.

24.5 Slide the collar onto the output shaft, with its chamfered edge towards the drive flange.

24.6 Fit the output shaft through the bearing and drive home.

Adjusting front differential bearing preload

25 To adjust the front differential bearing preload carry out the following:

25.1 Fit the original differential front bearing track shim, or one of the same thickness, noted during dismantling, in the front output housing.

25.2 Fit the differential front bearing track in the housing using a soft drift (Fig 37).

25.3 Locate the front output housing on the transfer case.

25.4 Secure housing with the eight retaining bolts and washers, the upper middle bolt being longer than the rest. Do not fully tighten the bolts at this stage.

25.5 Engage high or low gear.

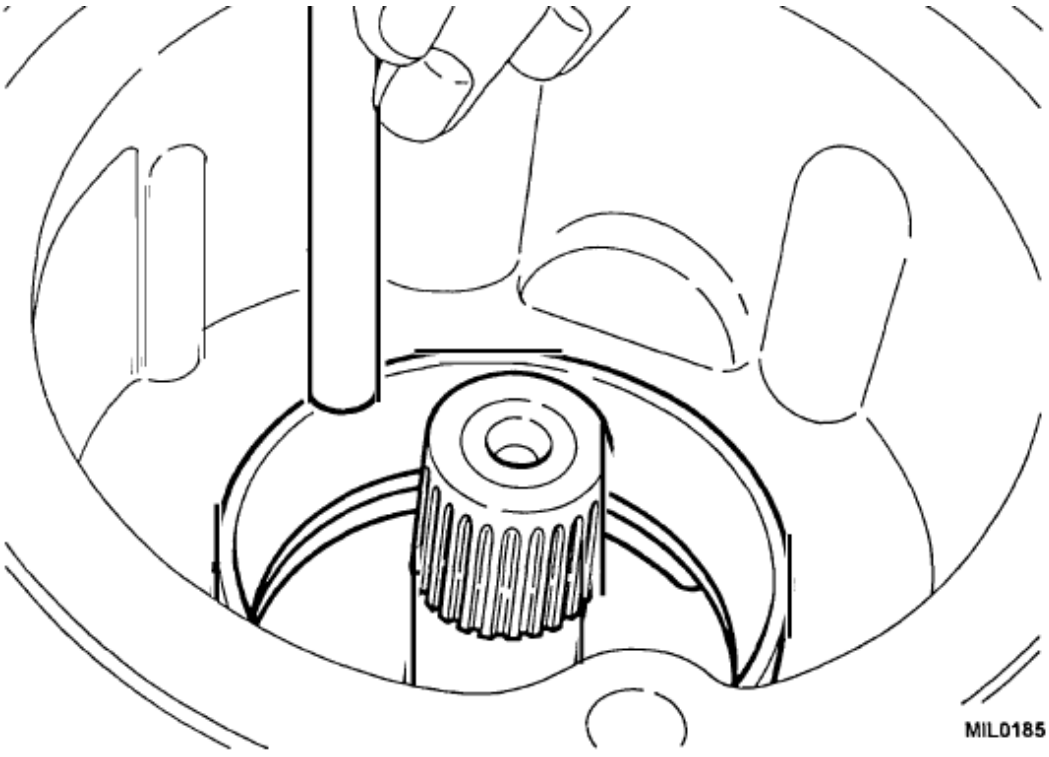


Fig 37 Fitting differential front bearing track to housing

25.6 Check the rolling resistance of the differential using a spring balance and a length of string wound around the exposed splines of the high/low hub (Fig 38). Alternatively a suitable torque meter may be used.

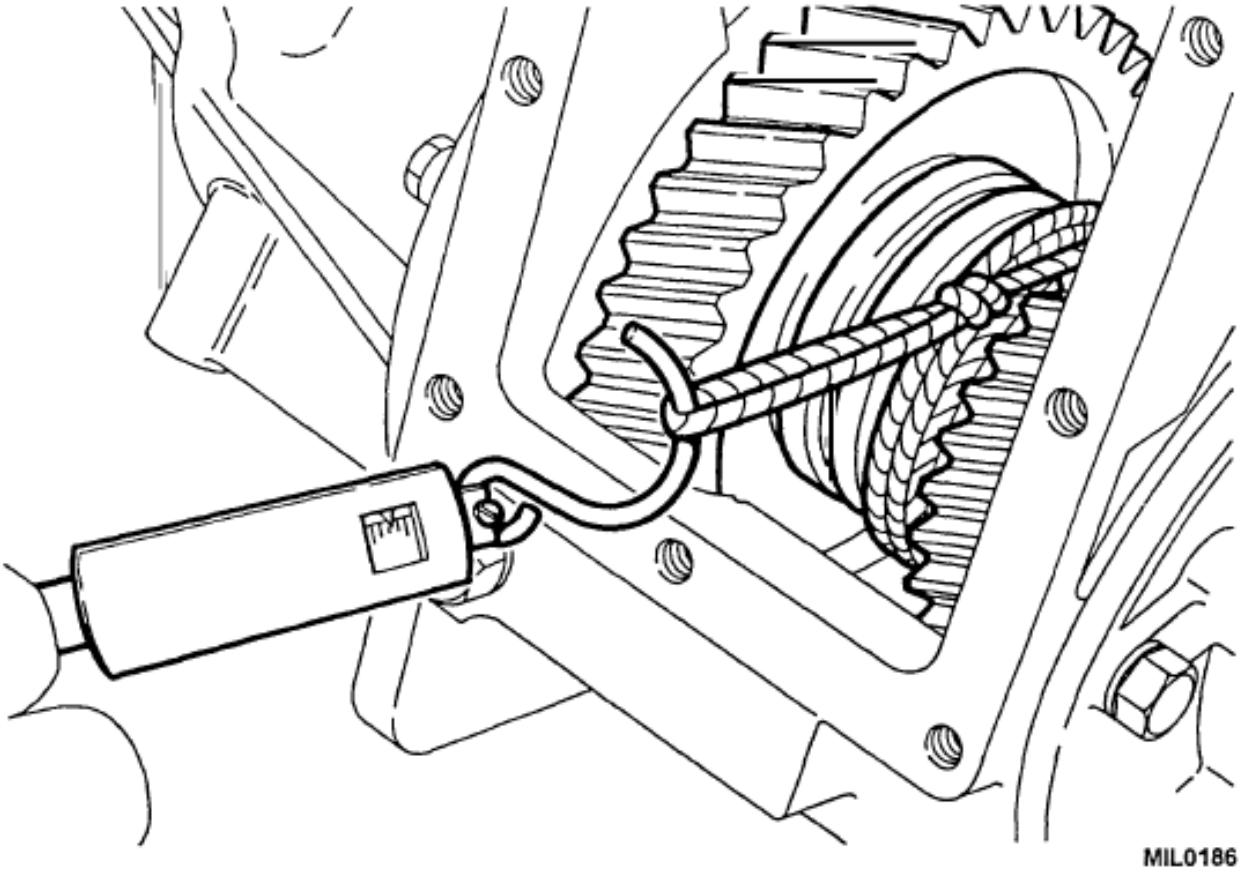


Fig 38 Checking differential rolling resistance

25.7 With the correct shim fitted the load to turn using a spring balance should be 1.36 kg to 4.53 kg (3 lb to 10 lb). Using a torque meter the reading should be 0.56 to 1.69 Nm (5 to 15 lbf/in.). These figures apply to new or used bearings. New bearings will register at the top end of the scale and used bearings will register at the lower end.

25.8 If the reading is in excess of the above measurements, remove the front output housing assembly from the transfer case.

NOTE

A thicker shim will increase the rolling resistance and a thinner one will reduce it.

25.9 Using a suitable extractor, withdraw the centre differential bearing track and change the shim for one of a suitable thickness from the range available (refer to Cat 711), to increase or decrease the resistance, as required.

25.10 Fit the new shim and drive the differential bearing track back into its housing until fully home, again using a suitable soft drift.

25.11 Having obtained the correct load to turn, place the transfer box on the bench with the front face uppermost. Apply sealant (refer to Table 1, Serial 4) to the joint face of the front output housing, ensuring the sealant bead is continuous.

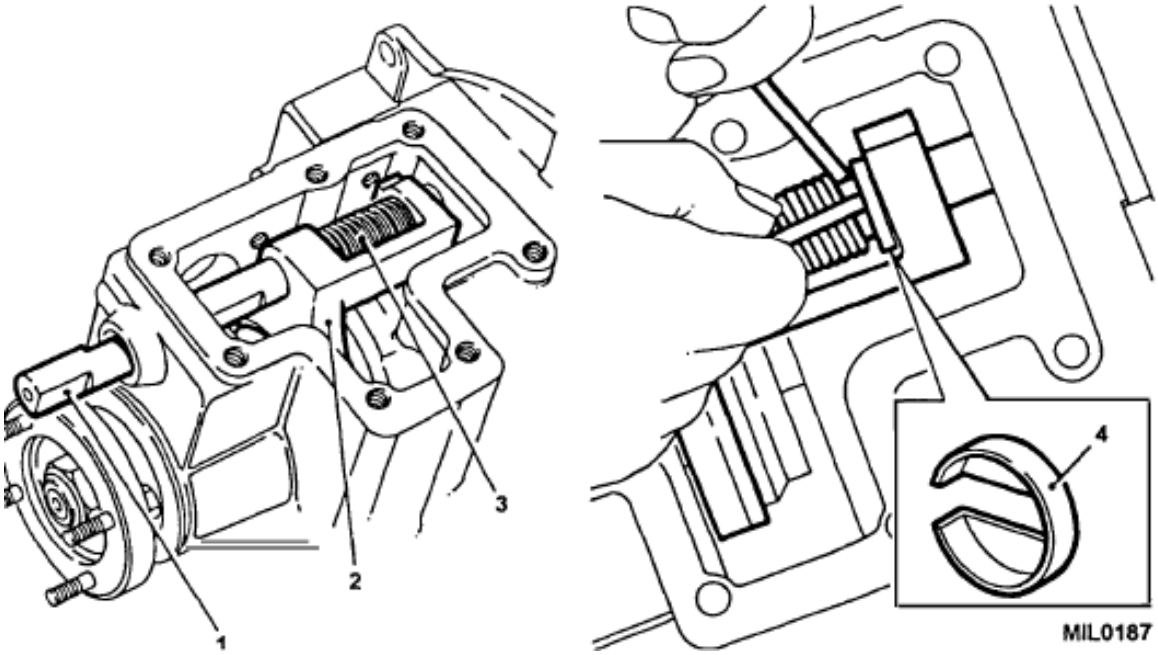
25.12 Apply jointing compound (refer to Table 1, Serial 1) to the threads of the front output housing retaining bolts. Fit the front output housing on the transfer box and secure with retaining bolts, tightening to a torque of 22 to 28 Nm (16 to 21 lbf/ft).

25.13 Fit the front output flange, felt washer, steel washer and a new flange nut.

25.14 Using a suitable tool and torque wrench and ensuring that the flange bolts are fully engaged in the wrench, tighten the flange nut to a torque of 146 to 179 Nm (108 to 132 Ibf/ft). This will pull the output shaft up to the correct position. Check that the oil seal shield does not foul the housing.

25.15 Repeat the previous operation for the rear output flange.

25.16 Compress the selector shaft spring (Fig 39 (3)) and fit to the selector fork (2).



1 Selector shaft
2 Selector fork
3 Spring
4 Spring cap

Fig 39 Fitting selector fork, shaft, spring and spring caps

25.17 Locate the selector fork through the front output housing side cover aperture, ensuring that the fork engages in the groove of the lock-up sleeve.

25.18 Fit the selector shaft (1) through the aperture in the front of the housing, pass it through the lugs in the selector fork and the spring into the rear part of the housing.

25.19 Rotate the selector shaft until the two flats for the spring retaining caps (4) are at right angles to the side cover plate face.

25.20 Compress the spring between the fork lugs and slide the retaining caps onto the shaft ensuring the spring is seated within the 'cupped' side of the caps.

25.21 Apply sealant to a new selector shaft cup plug and drive into position.

25.22 Fit the selector shaft detent ball (refer to Fig 11 (6)) and spring (5) in the tapped hole on top of the output housing. Fit a new micro-encapsulated detent grub screw (4) and carefully screw home, ensuring the head of the grub screw finishes flush with the face of the output housing.

25.23 Finally, peen over the head of the detent plug.

Differential lock finger housing

26 To assemble and fit the differential lock finger housing carry out the following:

26.1 Fit new 'O' ring seals (refer to Fig 17 (5)) and (6) to the pivot shaft (4) and finger housing (7) and lubricate with oil.

26.2 Locate the pivot shaft in the housing, fit the operating lever (3) over the pivot shaft with the lever facing forward and the bend uppermost. Secure the lever with a plain washer and new self locking nut.

26.3 Fit the assembled housing to its seating on the front output housing, ensuring that the selector finger is located in the flat of the selector shaft.

26.4 Apply sealing compound (refer to Table 1, Serial 1) to the bolt threads, secure the housing, tightening the bolts to a torque of 22 to 28 Nm (16 to 21 lbf/ft).

High/low cross-shaft housing

27 To assemble and refit the high/low cross shaft housing carry out the following:

27.1 Apply sealant to a new cup plug (refer to Fig 10 (4)) and fit so that the cup is just below the chamfer for the cross-shaft bore.

27.2 Fit a new 'O' ring seal (3) to the cross-shaft (1).

27.3 Lubricate the shaft and insert into the housing.

27.4 Fit the selector finger (5) ensuring that it aligns with the recess in the cross-shaft.

27.5 Apply sealing compound (refer to Table 1, Serial 1) to the grub screw (2), secure the selector finger to the cross-shaft and tighten the screw to a torque of 22 to 28 Nm (16 to 21 lbf/ft).

27.6 Apply a continuous bead of sealant (refer to Table 1, Serial 4) to the assembled housing joint face. Ensuring that the selector finger locates in the slot of the selector shaft, secure the housing to the transfer box with the six bolts and tighten to a torque of 22 to 28 Nm (16 to 21 lbf/ft).

Input gear

28 To assemble and fit the input gear carry out the following:

28.1 If new bearings are being fitted proceed as follows:

28.1.1 Position the rear taper roller bearing on the input gear and secure using a suitable tool (Fig 40).

28.1.2 Invert the input gear and fit the front taper roller bearing using the tool as above.

28.2 Lubricate both bearings with clean oil (refer to Table 1, Serial 2).

28.3 Fit the input gear assembly into the transfer case with the dogteeth uppermost.

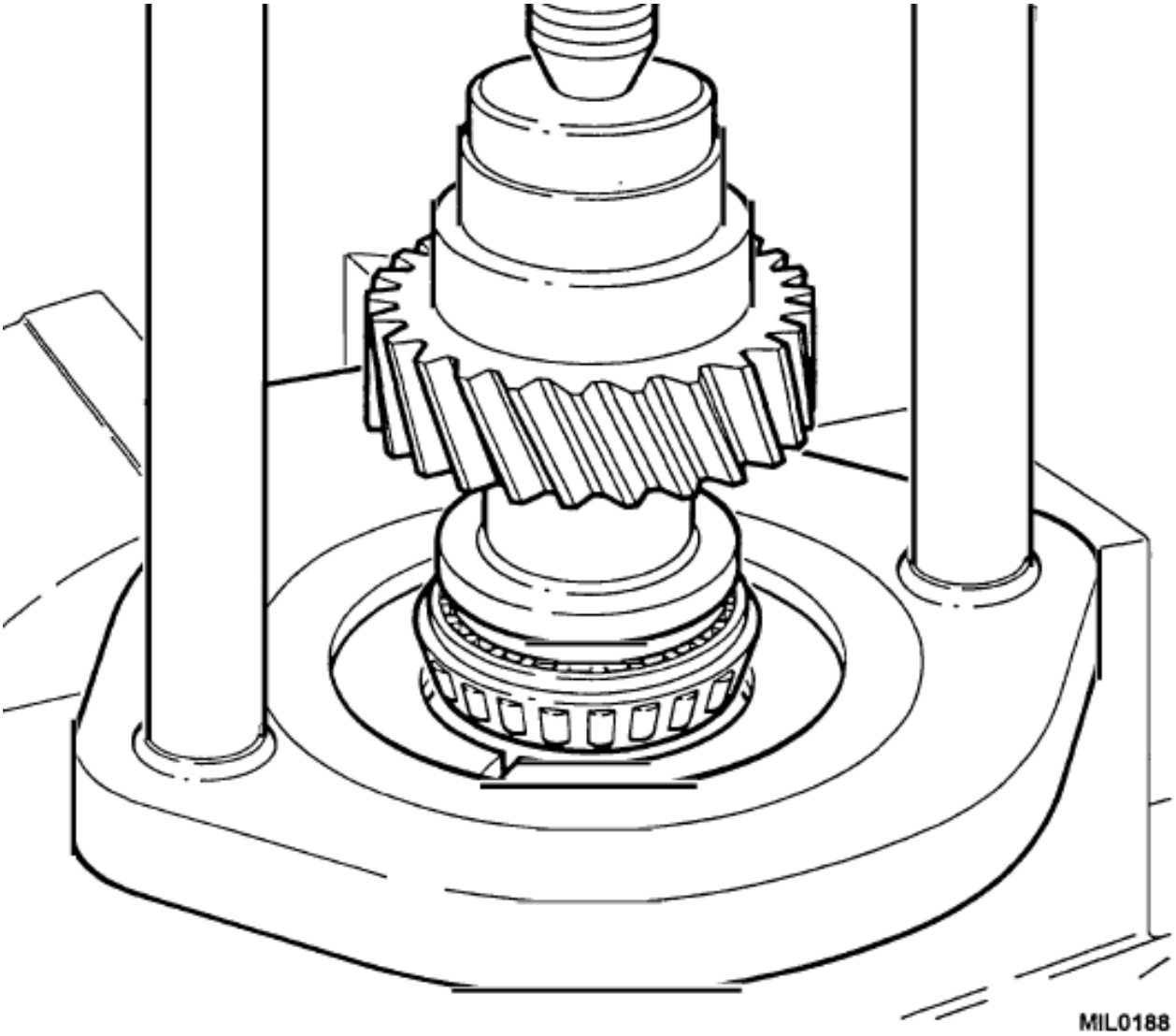


Fig 40 Fitting taper roller bearings to input shaft

Checking input gear bearing preload

29 To check the input gear bearing preload carry out the following:

29.1 Secure bearing housing in the vice. Fit the original shim or one of the same thickness, noted during dismantling (refer to Para 9.4).

29.2 Locate the bearing track in the support plate and press fully home.

29.3 Fit the bearing housing to the transfer case and secure with the five bolts and single retaining nut, do not fully tighten the bolts at this stage.

29.4 Fit a suitable tool to the input gear.

29.5 Tie a length of string to a split pin and fit it to the tool as shown (Fig 41).

29.6 Attach a spring balance to the string and carefully tension the spring until a load to turn the input gear is obtained. A pull of 2.26 kg to 9 kg (5 lb to 20 lb) is required. Alternatively engaging it with the nut on the service tool using a suitable torque meter. If this method is used the torque to turn should be 0.56 to 2.25 Nm (5 to 20 lbf/ft).

29.7 If the reading obtained is outside the above limits, repeat the foregoing operations and re-shim until the correct preload is obtained, note the final reading obtained for use when the intermediate gear torque to turn.

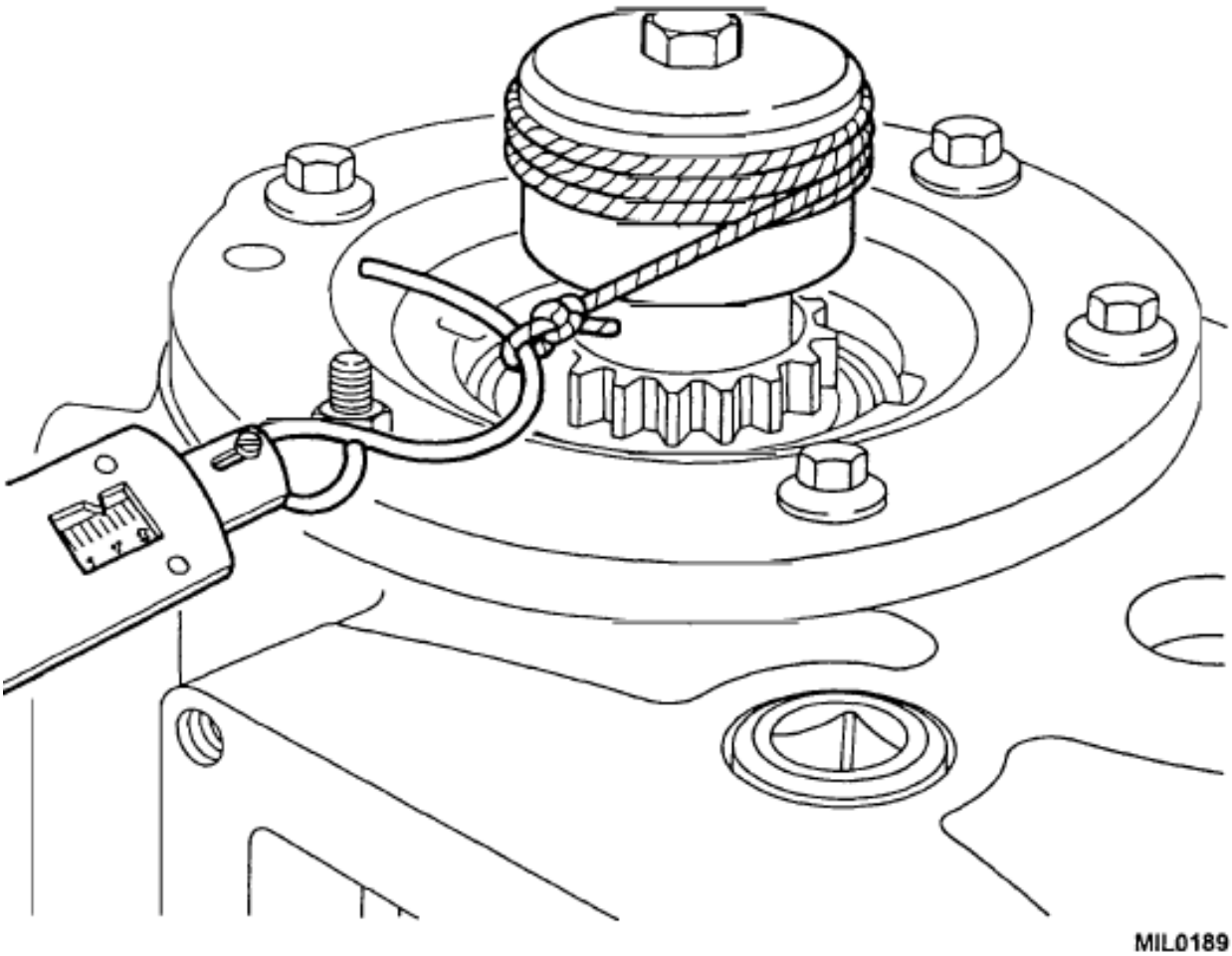


Fig 41 Checking the input gear load to turn

Intermediate gear

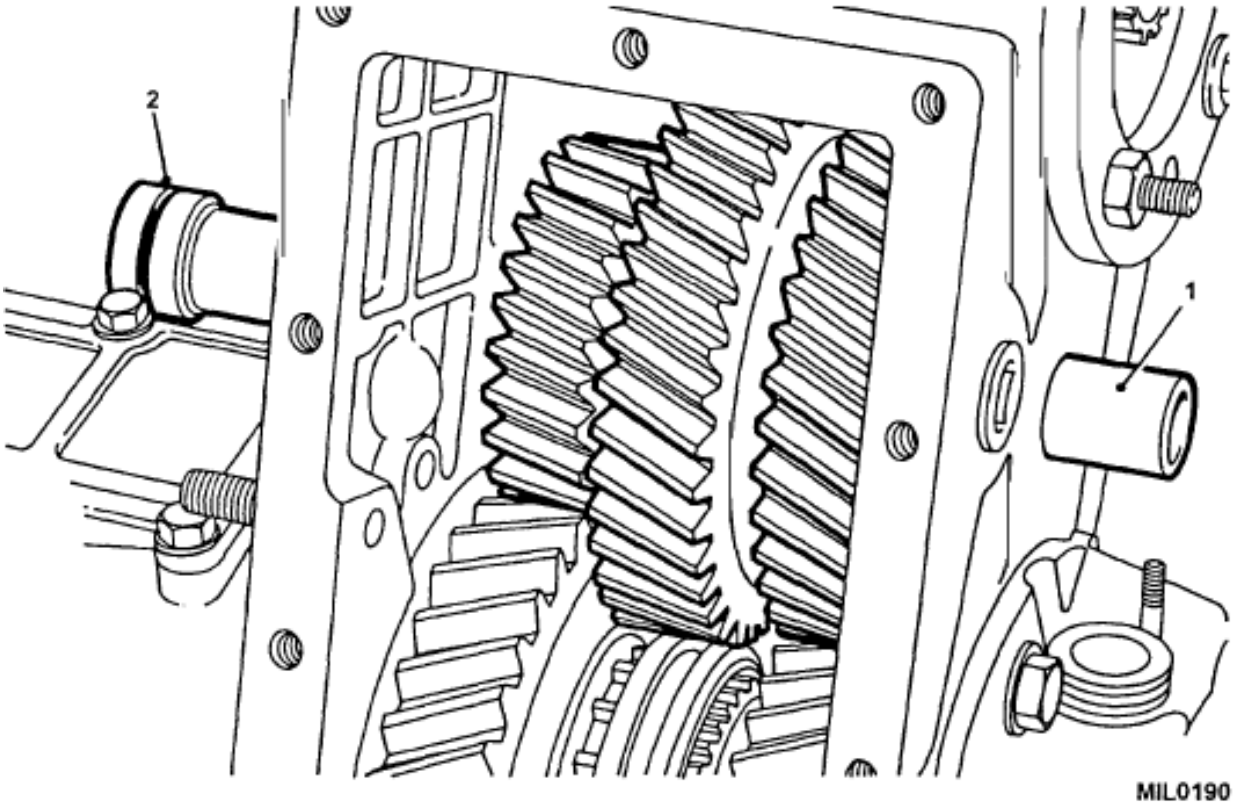
30 To assemble and fit the intermediate gear carry out the following:

30.1 Fit new circlips (refer to Fig 5 (3)) in the intermediate gear cluster (4).

30.2 Using suitable tools fit the bearing tracks (2) in the intermediate gear cluster.

30.3 Insert a new bearing spacer (5) to the gear assembly, followed by the taper roller bearings (1).

30.4 Fit a dummy shaft (Fig 42 (1)) into the intermediate gear cluster.



1 Dummy shaft 2 Intermediate shaft

Fig 42 Fitting the intermediate gear assembly

30.5 Fit a new 'O' ring seal to the intermediate shaft and in the intermediate shaft bore at the front of the transfer case.

30.6 Lubricate the taper roller bearings and intermediate gear shaft.

30.7 Locate the gear assembly into the transfer case from the bottom cover aperture.

30.8 Insert the intermediate shaft (2) from the front of the transfer case, pushing the dummy shaft (1) right through and remove. Ensure that the intermediate gear cluster meshes with the input gear and high and low range gears.

30.9 Turn the intermediate shaft to allow fitting of the anti-rotation plate. Fit the plate and secure with the bolt, tightening to a torque of 22 to 28 Nm (16 to 21 lbf/ft).

30.10 Fit the intermediate gear shaft stake nut. Do not tighten at this stage.

Adjusting intermediate gear torque-to-turn

31 Adjust the intermediate gear torque-to-turn as follows:

31.1 Select neutral.

31.2 Fit a suitable tool to the input gear.

31.3 Tie a length of string to a split pin and fit to the tool. Attach the spring balance to the string.

31.4 To obtain the correct figures and to collapse the spacer within the intermediate gear cluster, tighten the intermediate shaft nut (Fig 43) until the load-to-turn has increased by 3.7 kg (7 lb.) ± 1.63 kg (± 3 lb.) on that noted when setting the input shaft load-to-turn.

31.5 Using a suitable round nosed tool, to avoid splitting the collar, peen the stake nut by carefully forming the collar of the nut into the intermediate shaft recess.

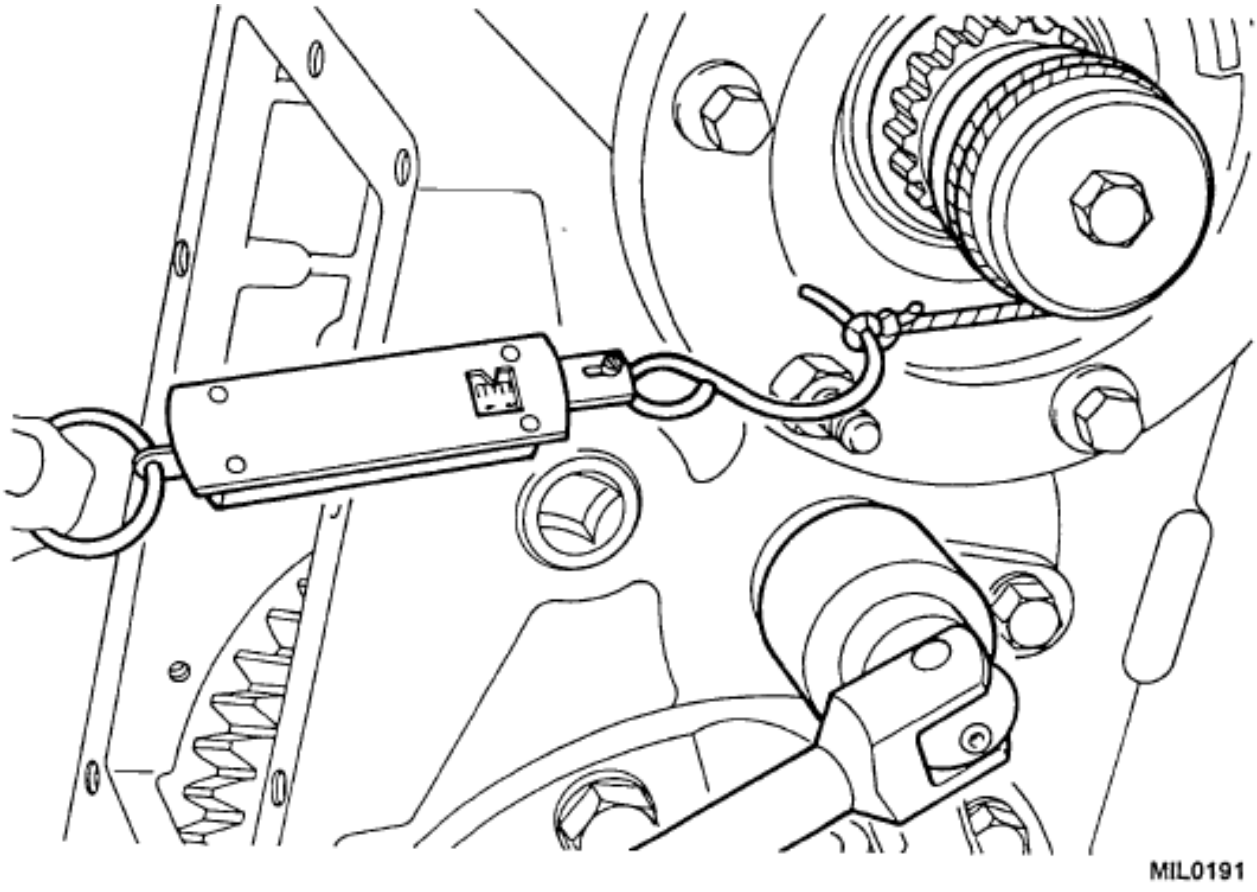


Fig 43 Checking intermediate gear torque and tightening stake nut

Power take-off cover

32 Fit the power take-off cover as follows:

32.1 Unscrew the five bolts and retaining nut and remove the input bearing housing.

32.2 Apply a continuous bead of sealant (refer to Table 1, Serial 4) to the joint face of the bearing housing.

32.3 Locate the bearing housing on the transfer box casing and secure with the two countersunk screws, tightening to a torque of 22 to 28 Nm (16 to 21 lbf/ft).

32.4 Apply sealant (refer to Table 1, Serial 4) to the joint face of the power take-off cover and then position cover on the bearing housing.

32.5 Fit the speedo cable support plate on the locating stud and secure with retaining nut.

32.6 Apply jointing compound (refer to Table 1, Serial 1) to the five bolt threads and secure the power take-off cover, tightening the bolts to a torque of 40 to 50 Nm (29 to 37 lbf/ft).

Bottom cover

33 Fit the bottom cover as follows:

33.1 Apply sealant (refer to Table 1, Serial 4) to the joint face of the bottom cover.

33.2 Apply jointing compound (refer to Table 1, Serial 1) to the bolt threads and secure the bottom cover to the transfer box with six bolts, tightening the bolts to a torque of 22 to 28 Nm (16 to 21 lbf/ft).

Differential lock switch

34 Fit and adjust the differential lock switch as follows:

34.1 Select the differential locked position by moving the lock lever towards the right hand side of the transfer box casing.

34.2 Apply sealant to the differential lock warning light switch and fit to the top of the front output housing (Fig 44).

34.3 Connect a test lamp circuit to the differential lock switch.

34.4 Screw in the lock switch until the bulb is illuminated.

34.5 Turn in the switch another half a turn and tighten the locknut against the housing.

34.6 Disconnect the test lamp and move the differential lock lever to the left to disengage the differential lock.

34.7 Apply a continuous bead of sealant (refer to Table 1, Serial 4) to the joint face of the side cover.

34.8 Apply jointing compound (refer to Table 1, Serial 1) to bolt threads, fit the side cover and secure with the seven bolts, tightening to a torque of 22 to 28 Nm (16 to 21 lbf/ft).

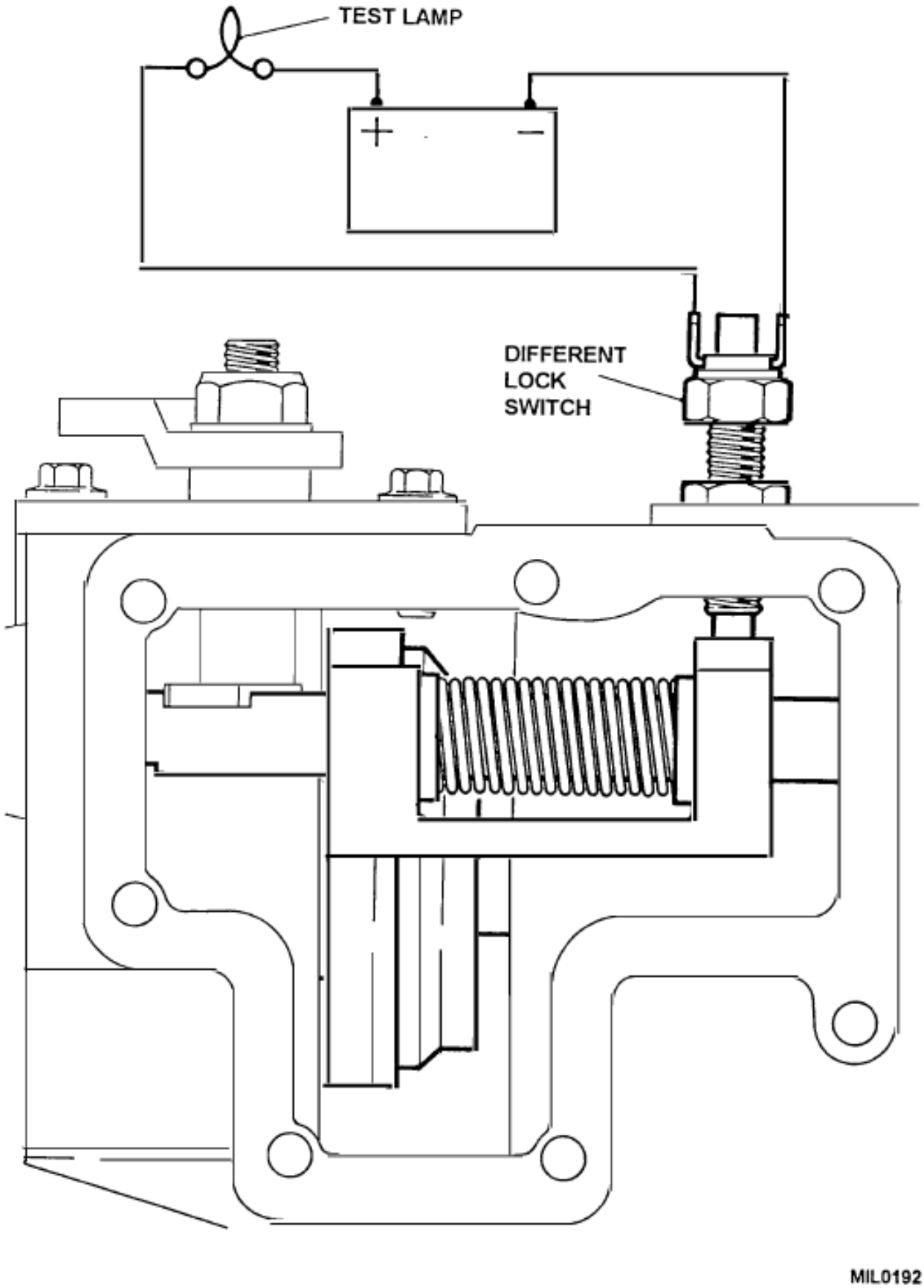


Fig 44 Fitting and setting the differential lock switch

Transmission brake

35 Fit the transmission brake as follows:

35.1 Clean the brake backplate.

35.2 Locate the assembled brake backplate and shoes on the rear output housing with the brake operating cable on the left hand side of the transfer box casing.

35.3 Secure the backplate with the four bolts and tighten to a torque of 65 to 80 Nm (48 to 59 lbf/ft).

35.4 Clean and fit brake drum and secure with single countersunk screw to a torque of 22 to 28 Nm (16 to 21 lbf/ft). Adjust the brake (refer to Cat 522 Chap 10-1).

REFITTING

36 To refit the transfer gearbox to the vehicle (refer to Cat 523 Chap 4).

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CHAPTER 7

POWER ASSISTED STEERING SYSTEM

CONTENTS

INTRODUCTION

1 This Chapter details the Base repairs for Truck Utility Light (TUL) High Specification (HS), Truck Utility Medium (TUM) HS and (TUM) Battlefield Ambulance HS vehicles fitted with power steering.

STEERING BOX

Removal

2 Remove the steering box from the vehicle (refer to Cat 522 Chap 7).

CAUTION

POWER STEERING FLUID. This is harmful to paintwork. Should any fluid seep onto body, chassis or any other components immediately wipe clean. It is most important that fluid drained from the system is not re-used.

NOTE

The items listed in Table 1 will be referred to in the text, where used, by the serial number shown in column (1).

TABLE 1 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	Loctite 270	8030-99-224-9318	Sealing compound
2	XG279	9150-99-220-2418	Multipurpose grease

Dismantling

3 To dismantle the steering box proceed as follows:

3.1 Using a suitable tool withdraw the drop arm (Fig 1 (3)) and remove dirt excluder (4).

KEY TO FIG 1

1 Sector shaft nut
2 Tab washer
3 Drop-arm
4 Dirt excluder
5 Circlip
6 Dirt seal
7 Extrusion washer
8 Sector shaft seal
9 Dirt excluder
10 Housing
11 Input shaft seal
12 Circlip
13 Fluid line
14 Sector shaft & follower assy
15 Seal
16 Sector shaft cover
17 Self locking screws - 4 off
18 Locknut
19 Bleed screw
20 Shims
21 Inner bearing track
22 Inner bearing cage and balls
23 Torsion bar
24 Input shaft
25 Teflon rings - 3 off
26 Worm
27 Outer bearing cage and balls
28 Outer bearing track
29 Seal
30 Worm adjusting screw
31 Locknut
32 Rack adjuster
33 Rack adjusting screw seal
34 Thrust pad
35 Grub screw
36 Piston & rack
37 Piston ring
38 Piston 'Teflon' seal (white)
39 Cylinder cover seal
40 Cylinder cover
41 Cylinder cover retaining ring
42 Circlip

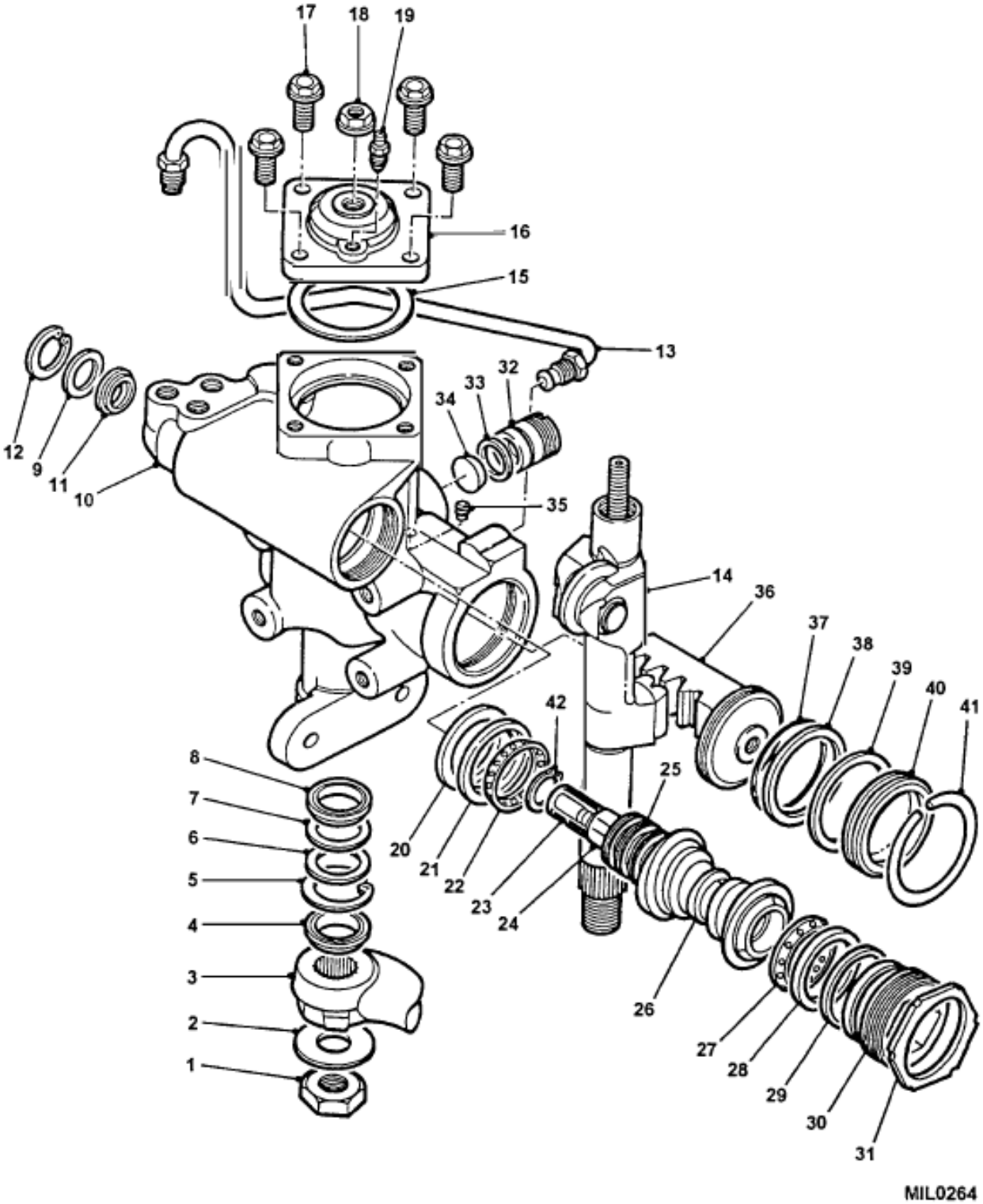


Fig 1 Power steering box

3.2 Drain oil, remove blanking plugs and bleed screw (19). Hold steering box over a suitable container, turn input shaft from lock to lock until oil is drained. Refit bleed screw.

3.3 Rotate the cover retaining ring (41), as necessary, until one end is approximately 12 mm (0.500 in.) from the extractor hole.

3.4 Lift the cover retaining ring from the groove in the cylinder bore, using a suitable pointed drift applied through the hole provided in the cylinder wall.

3.5 Complete the removal of the cover retaining ring, using a screwdriver.

3.6 Turn on right lock until the piston pushes out the cylinder cover (40).

3.7 Slacken the grub screw (35) retaining the rack adjuster (32).

3.8 Remove the rack adjuster (32) and thrust pad (34).

3.9 Remove the sector shaft adjuster locknut (18).

3.10 Remove the four self locking screws (17) securing the sector shaft cover (16).

3.11 Screw in the sector shaft adjuster until the sector shaft cover is removed.

NOTE

Sealant (refer to Table 1, Serial 1) is applied to hexagon socket to 'tamper proof sector shaft adjuster.

3.12 Slide out the sector shaft (14).

3.13 Withdraw the piston and rack (36), using a suitable bolt screwed into the tapped hole in the piston.

3.14 Remove the worm adjuster locknut (31) using a suitable tool.

3.15 Remove the worm adjusting screw (30) using a suitable tool.

3.16 Tap the splined end of the shaft (24) to free the bearing.

3.17 Withdraw the outer bearing cage and balls (27) and bearing track (28) assembly.

3.18 Withdraw the valve and worm (26) assembly.

3.19 Withdraw the inner bearing ball race (21 and 22) using a suitable extractor. Retain the shims (20).

NOTE

Should difficulty be experienced at this stage, warm the casing and the bearing assembly. Cool the bearing track and using a suitable mandrel and jar the steering box on the bench.

Steering box seals

4 To remove the steering box seals proceed as follows:

CAUTION

NON-REPLACEABLE BEARING. Do not remove sector shaft bearings from casing. Replacement parts are not available. If sector shaft bearings are worn fit a new steering box.

4.1 Remove the circlip (Fig 1 (5)), dirt seal (6), extrusion washer (7) and sector shaft seal (8) from the sector shaft housing bore.

4.2 Remove the circlip (12) and seals (9) and (11) from the input shaft housing bore.

Cleaning and examination

5 To clean and examine the components proceed as follows:

5.1 Degrease all parts and thoroughly check all parts for signs of excessive wear or damage.

5.2 Provide replacement parts as necessary.

Reassembly

6 To reassemble the steering box proceed as follows:

NOTE

During the following operations cleanliness is essential. Discard all rubber seals and provide replacements. When fitting replacement oil seals, these must be lubricated with recommended fluid. Replace bearings as a set where appropriate.

Sector shaft oil seal

7 To fit the seals proceed as follows:

7.1 Fit the sector shaft oil seal (Fig 1 (8)), lipped side first.

7.2 Fit the extrusion washer (7).

7.3 Fit the dirt seal (6), lipped side last.

7.4 Fit the circlip (5).

Valve and worm assembly

8 To assemble proceed as follows:

8.1 The Teflon rings (Fig 1 (25)) should be a loose fit in the valve grooves.

8.2 If required, fit replacement Teflon rings (25), using a suitable tool. Both rings and tool may be warmed using hot water and then inserted into the tool to cool.

8.3 No free movement should exist between the input shaft (24) and the worm (26).

NOTE

Any sign of wear makes it essential that the complete valve and worm assembly is renewed.

8.4 Refit the original shims (20) and the inner bearing track (21). Smear with grease (refer to Table 1, Serial 2) as an aid to assembling the bearings.

NOTE

If the original shims are not available fit shim(s) of 0.76 mm (0.030 in) nominal thickness.

8.5 Fit the inner bearing cage and balls (22) assembly.

8.6 Fit the valve and worm assembly (26).

8.7 Fit the outer cage bearing cage and balls (27).

8.8 Fit the outer bearing track (28).

8.9 Renew the worm adjuster sealing ring (29) and loosely screw the adjuster (30) into the casing. Fit the locknut (31), but do not tighten.

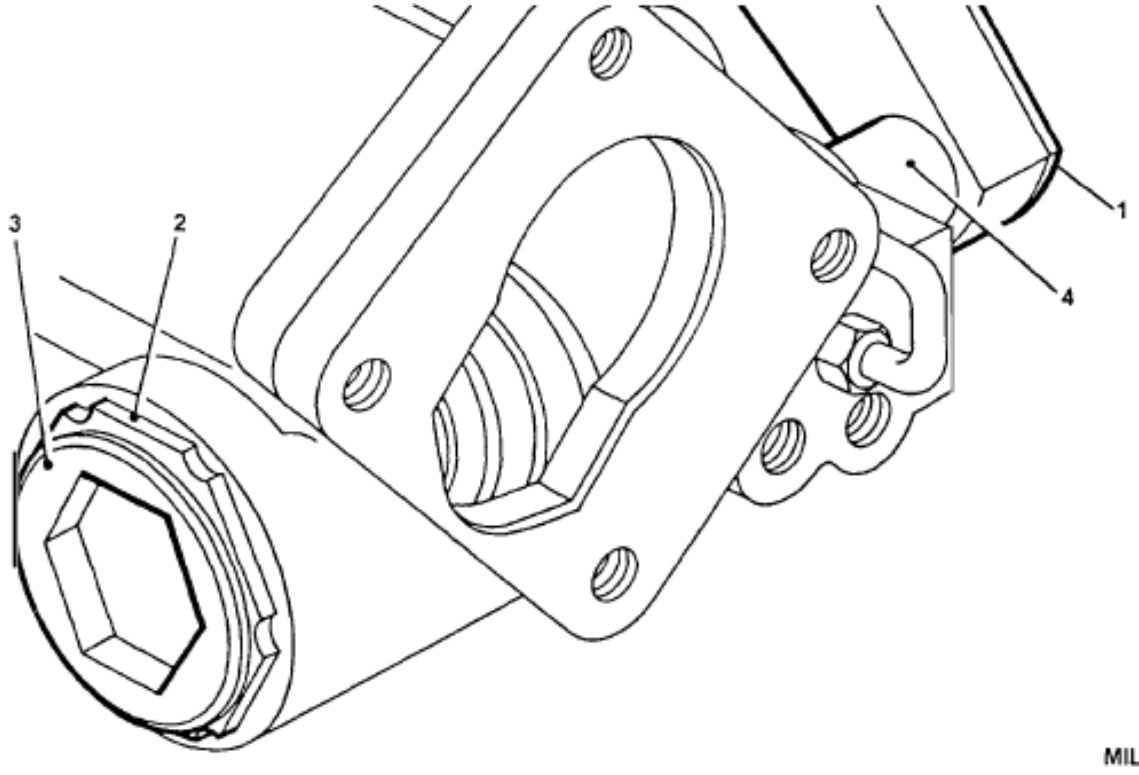
Adjustment

9 Turn in worm adjuster until end float is almost eliminated. Ensure bearing cages are seated correctly.

9.1 Measure maximum rolling torque value of valve and worm assembly, using torque wrench and a suitable tool (Fig 2 (1)).

9.2 Turn in worm adjuster (3) while rotating shaft to increase figure as measured (refer to Para 9.1) to 0.56 Nm (0.4 Ibf/ft)

9.3 Back off worm adjuster a quarter turn. Turn in worm adjuster to increase reading at Para 9.1 by 0.21 to 0.34 Nm (0.15 to 0.32 Ibf/ft) with locknut (2) tightened to 100 Nm (74 Ibf/ft).



1 Torque wrench 3 Worm adjuster
2 Lock nut 4 Torque setting tool

Fig 2 Worm adjustment

Piston

10 Fit a new piston ring (Fig 1 (37)) to the piston. Warm the Teflon seal (38) and fit this to the piston. Slide the piston assembly into the cylinder with the rack tube outwards. Allow to cool.

10.1 Screw a suitable bolt into the piston head (36) for use as an assembly tool.

10.2 Fit the piston and rack assembly so that the piston is 70 mm (2.8 in.) approximately from the outer end of the bore.

Fitting sector shaft

11 Feed in the sector shaft (Fig 1 (14)) using a suitable tool. Align the centre gear pitch on the rack with the centre gear tooth on the sector shaft, push in the sector shaft, and at the same time rotate the input shaft about a small arc to allow the sector roller to engage the worm.

11.1 Fit the sealing ring (33) to the rack adjuster (32).

11.2 Fit the rack adjuster (32) and thrust pad (34) to engage the rack. Back off a half turn on the adjuster.

11.3 Loosely fit the nylon pad and adjuster grub screw (35) assembly to engage the rack adjuster.

11.4 Fit the seal (15) to the sector shaft cover (16).

11.5 Screw the sector shaft cover assembly (16) fully on to the sector shaft adjuster screw.

NOTE

The sector shaft cover (16) and seal (15) are supplied as a complete assembly for replacement purposes.

11.6 Position the cover on to the casing and tap home. If necessary back off on the sector shaft adjuster screw to allow the cover to joint fully with the casing.

NOTE

Before tightening the fixings, rotate the input shaft about a small arc to ensure that the sector shaft (14) roller is free to move in the valve worm.

11.7 Fit and tighten the cover screws (17) to 75 Nm (54 lbf/ft).

NOTE

The locknut (18) also functions as a fluid seal and must be replaced at overhaul.

Cylinder cover

12 To fit the cylinder cover proceed as follows:

12.1 Fit the square section seal (Fig 1 (39)) to the cover (40).

12.2 Remove the assembly aid bolt and press the cover (40) into the cylinder just sufficient to clear the retainer ring groove.

12.3 Fit the retaining ring (41) to the groove with one end of the ring positioned 12 mm (0.5 in) approximately from the extractor hole.

Sector shaft adjustment

NOTE

Refit drop arm and tighten nut sufficiently to ensure that no backlash exists between drop arm and sector shaft.

13 To adjust the sector shaft proceed as follows:

NOTE

Centralise the steering before making any adjustments.

13.1 Set the worm on centre by rotating the input shaft to full inner-lock (full left lock for a right hand drive vehicle). Rotate input shaft back towards centre two full turns.

13.2 Rotate the sector shaft adjusting screw (Fig 3 (5)) counter-clockwise to obtain backlash between the input shaft and the sector shaft (4).

13.3 Rotate the sector shaft adjusting screw clockwise until the backlash is just eliminated.

13.4 Measure and record the maximum rolling resistance at the input shaft, using a torque wrench (3) and a suitable socket. Rotate adjuster screw to obtain across centre torque of 0.34 Nm (0.24 lbf/ft) at one and a quarter turns.

13.5 Hold still the sector shaft adjuster screw and loosely fit a new locknut (6).

13.6 Tighten adjuster locknut to 60 Nm (43 lbf/ft).

Rack adjuster

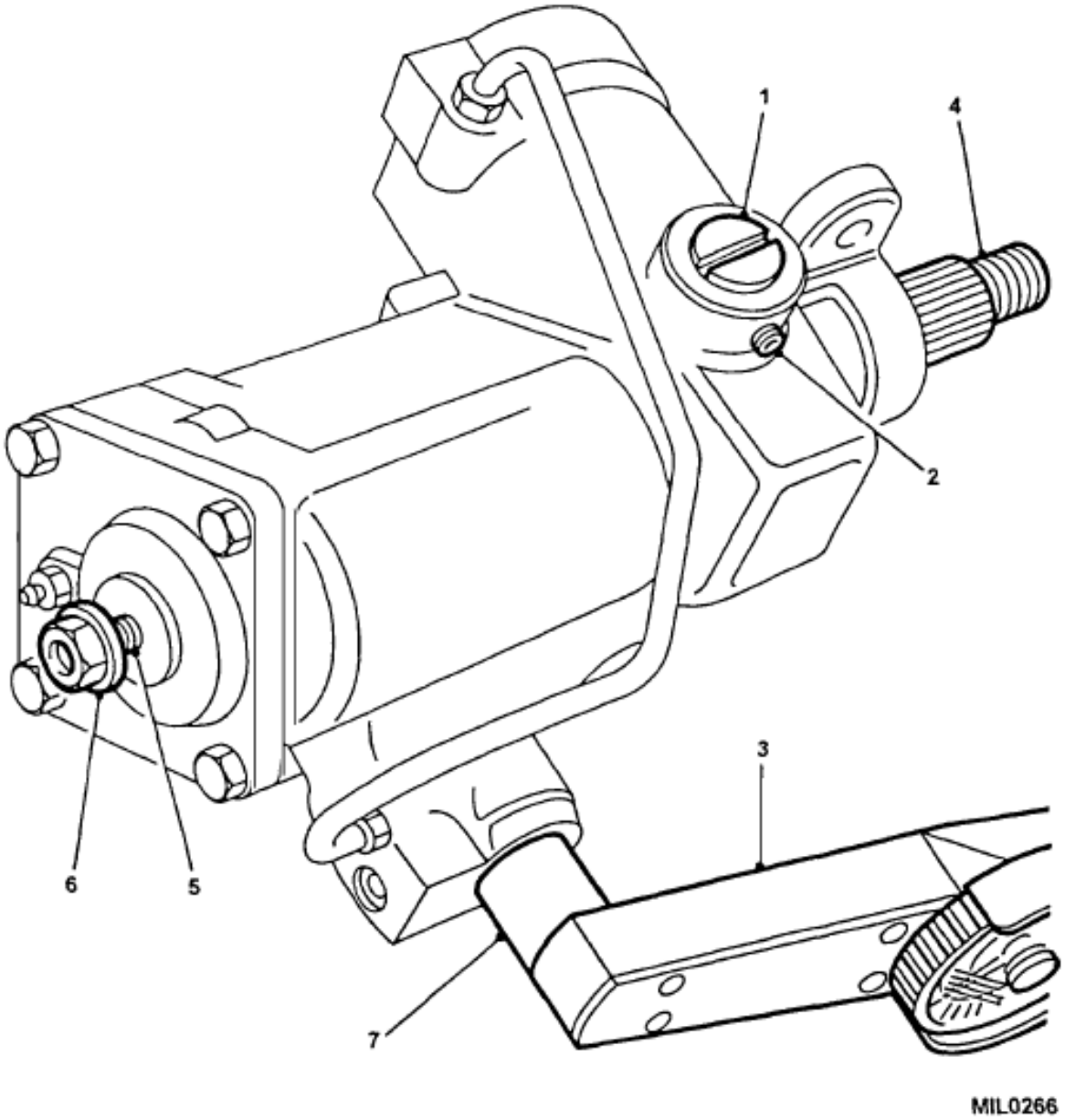
14 To adjust the rack adjuster proceed as follows:

14.1 Turn in the rack adjuster (Fig 3 (1)) to increase the figure recorded in Para 13.4 by 0.23 to 0.34 Nm (0.16 to 0.24 lbf/ft).

NOTE

The final figure may be less than but must not exceed 1.3 Nm (0.94 lbf/ft).

14.2 Lock the rack adjuster in position with the grub screw (2).



1	Rack adjuster	5	Adjuster screw
2	Grub screw	6	Locknut
3	Torque wrench	7	Torque setting tool
4	Sector shaft		

Fig 3 Sector shaft adjustment

Input shaft oil seal

15 Fit input shaft oil seal as follows:

15.1 Fit seal (Fig 1 (11)), lip side first, into housing (10). Seal is fitted to a depth of 4.75 to 5.0 mm (0.19 to 0.20 in.) from face of box.

15.2 Secure seal with dirt excluder (9) and circlip (12).

15.3 With input shaft on centre, centralise steering box. Fit drop arm to steering box using a new tab washer. Tighten to 176 Nm (129 lbf/ft) and bend over tab.

Refitting steering box

16 Refit the steering box (refer to Cat 522 Chap 7).

Torque peak check

17 To check the torque peak proceed as follows:

17.1 With the input shaft rotated from lock-to-lock, the rolling torque figures should be greatest across the centre position and equally disposed about the centre position.

NOTE

The condition depends on the value of shimming fitted between the valve and worm assembly inner bearing track and the casing. The original shim washer value will give the correct torque peak position unless major components have been replaced.

17.2 With the input coupling (sector) shaft (Fig 4 (2)) toward the operator, turn the shaft fully anti-clockwise.

17.3 Check the torque figures obtained from lock-to-lock using a torque wrench (1) and a suitable tool (3).

17.4 Note where the greatest figures are recorded relative to the steering position. If the greatest figures are not recorded across the centre of travel (i.e. steering straight-ahead position), adjust as follows:

CAUTION

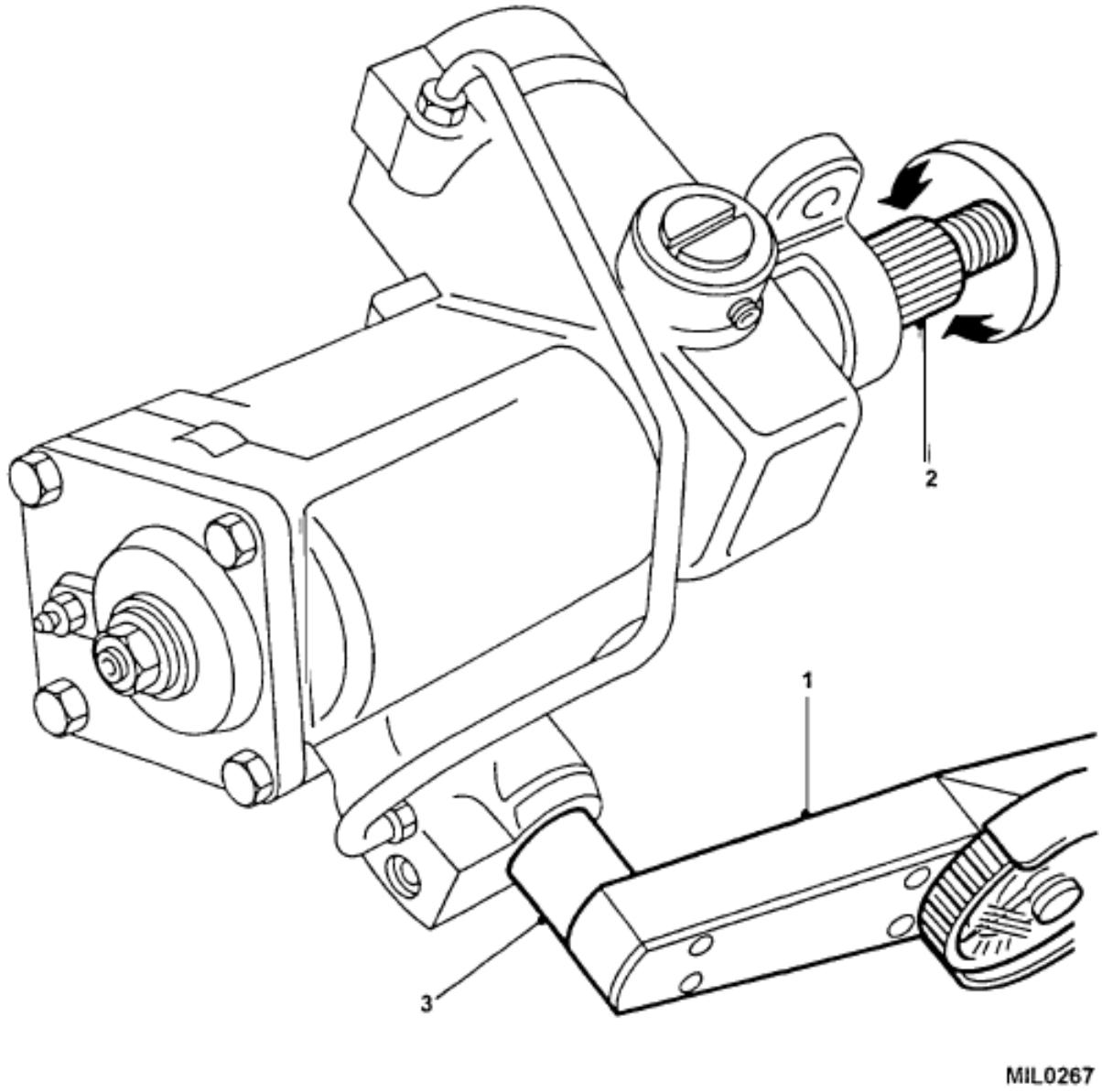
SEAL DAMAGE. When reshimming valve and worm, extreme caution must be exercised to prevent seal damage during reassembly.

17.4.1 For right hand steering models. If the torque peak occurs before the centre position, add to shim washer value; if the torque peak occurs after the centre position, subtract from the shim washer value.

NOTES

(1) Shim washers are available as follows: 0.03 mm, 0.07 mm, 0.12 mm and 0.24 mm (0.0015 in. 0.003 in. 0.005 in. and 0.010 in.).

(2) Adjustment of 0.07 mm (0.003 in) to the shim value will move the torque peak area by 1/2 turn approximately on the shaft.



1 Torque wrench 3 Torque setting tool
2 Sector shaft

Fig 4 Torque peak check

STEERING PUMP

Removal

18 Remove the pump from the vehicle (refer to Cat 522 Chap 7).

Dismantling

19 The power steering pump is a non serviceable item, in the event of pump failure the unit must be renewed.

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CHAPTER 16

WINTERISED/WATERPROOFED

CONTENTS

(continued)

CONTENTS (continued)

INTRODUCTION

1 This Chapter details the Base repairs and anti-corrosion treatment for the body and chassis fitted to Truck Utility Light (TUL) High Specification (HS) and Truck Utility Medium (TUM) HS winterised/waterproofed vehicles.

2 The procedures are applicable to both left and right hand drive vehicles.

TABLE 1 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
	TUL		
1	Dinitrol 3654 cavity wax (4 litres)		Anti-corrosion solution
2	Dinitrol 3125 Penetrant and anti corrosion wax (2 litres)		Anti-corrosion solution
3	Dinitrol 4941 underbody wax (7 Litres)		Anti-corrosion solution
	TUM		
4	Dinitrol 3654 cavity wax (4 litres)		Anti-corrosion solution
5	Dinitrol 3125 Penetrant and anti corrosion wax (2 litres)		Anti-corrosion solution
6	Dinitrol 4941 underbody wax (7 Litres)		Anti-corrosion solution

TABLE 2 SPECIAL TOOLS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	Dinol		High pressure spray pump and air mix gun fitted with a one metre x 6mm x 360° spray jet and flexible lance.
2	Dinol		Hook nozzle (360°)
3	Dinol		Cone cut drill bit
4	Ljungmans		22:1 airless spray unit
5	Polymask		Yellow plastic sheet

BODYWORK ANTI-CORROSION TREATMENT

WARNINGS

(1) INGESTION. THE SWALLOWING OF ANTI-CORROSION MATERIAL CAN CAUSE VOMITING AND ABDOMINAL PAIN. IF INGESTED MEDICAL ATTENTION MUST BE SOUGHT IMMEDIATELY.

(2) INHALATION. INHALATION OF ANTI-CORROSION MATERIAL CAN CAUSE IRRITATION OF THE NOSE, THROAT AND RESPIRATORY TRACT, DROWSINESS AND HEADACHE. GOOD VENTILATION AND A FILTER TYPE RESPIRATOR MASK MUST BE USED AT ALL TIMES. IF INHALATED THE SUBJECT MUST BE REMOVED FROM EXPOSURE AND MEDICAL ATTENTION SOUGHT IMMEDIATELY.

(3) EYE CONTACT. ANTI-CORROSION LIQUID, MIST OR VAPOUR WILL CAUSE CONJUNTIVAL IRRITATION. CONTACT LENSES SHOULD BE REMOVED, AND IF CONTACT MADE, IRRIGATE WITH CLEAN FRESH WATER FOR AT LEAST 10 MINUTES HOLDING EYELIDS APART. SEEK MEDICAL ATTENTION IMMEDIATELY.

(4) SKIN CONTACT. PROLONGED CONTACT WITH THE SKIN SHOULD BE AVOIDED AS IT CAN LEAD TO DEGREASING OF THE SKIN AND IRRITATION. WASH THOROUGHLY IN SOAP AND WATER OR USE A PROPRIETY SKIN CLEANER. SOLVENTS MUST NOT BE USED TO CLEAN THE SKIN. PROTECT EXPOSED SKIN WITH VASELINE PETROLEUM JELLY.

(5) PROTECTIVE CLOTHING. ENSURE SUITABLE PROTECTIVE CLOTHING IS WORN BEFORE USING ANTI-CORROSION MATERIAL. ALWAYS WEAR SUITABLE PROTECTIVE OVERALLS, A FILTER TYPE RESPIRATOR, SAFETY GLASSES, GLOVES AND HEAD PROTECTION.

Initial treatment procedure

Equipment

3 Use the recommended equipment (refer to Table 2, Serial 1 and 4) to treat the vehicle with anticorrosion solution (refer to Table 1).

CAUTIONS

(1) SPRAY EQUIPMENT. High pressure spray equipment can be dangerous. Observe safety procedures at all times.

(2) DRILLING. The drilling of any part of the chassis structure is strictly prohibited.

(3) OVER SPRAYING. Avoid spraying propshaft and universal joints with solution.

Site preparation

4 To prepare the site for spraying carry out the following:

4.1 Lightly scatter water over the surface of the working area.

4.2 Apply plastic sheet (refer to Table 2, Serial 5) to the work area.

Initial preparation of the vehicle

5 To prepare the vehicle carry out the following:

5.1 Ensure the vehicle is clean and dry.

5.2 Raise the bonnet.

5.3 Mask off brake discs, callipers, convoy lamp and engine bay.

5.4 Remove trim casings. (refer to Cat 522 Chap 16-4).

5.5 Drill 10 mm diameter holes using tool (refer to Table 2, Serial 3) in the following areas:

5.5.1 In the scuttle face (refer to Fig 1 (1)).

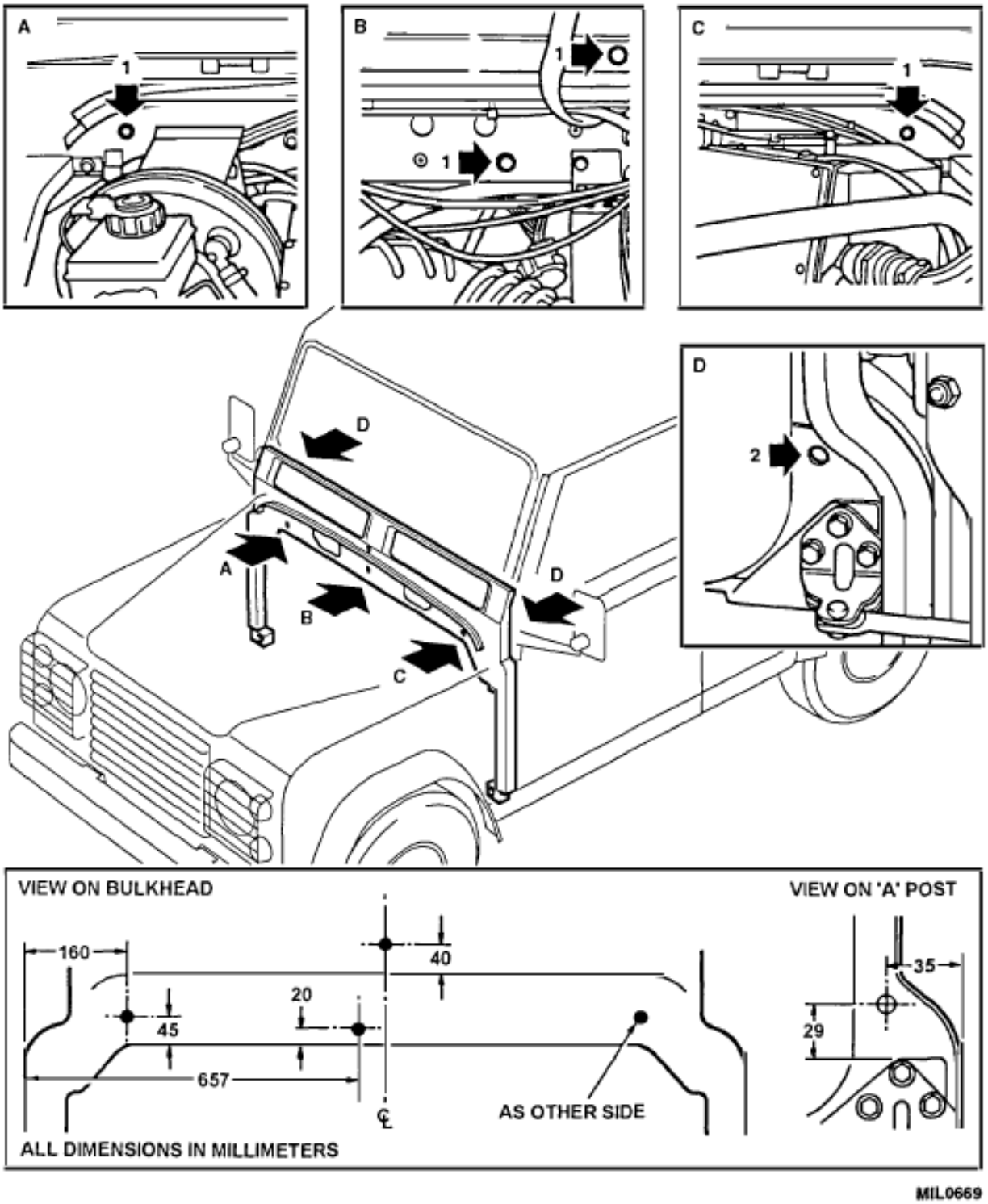
5.5.2 In the 'A' pillar adjacent to the check strap anchorage (2).

5.5.3 Two holes in the underside (one at each corner) of rear door frame (refer to Fig 2 (1)).

5.5.4 Front door upper channel (2).

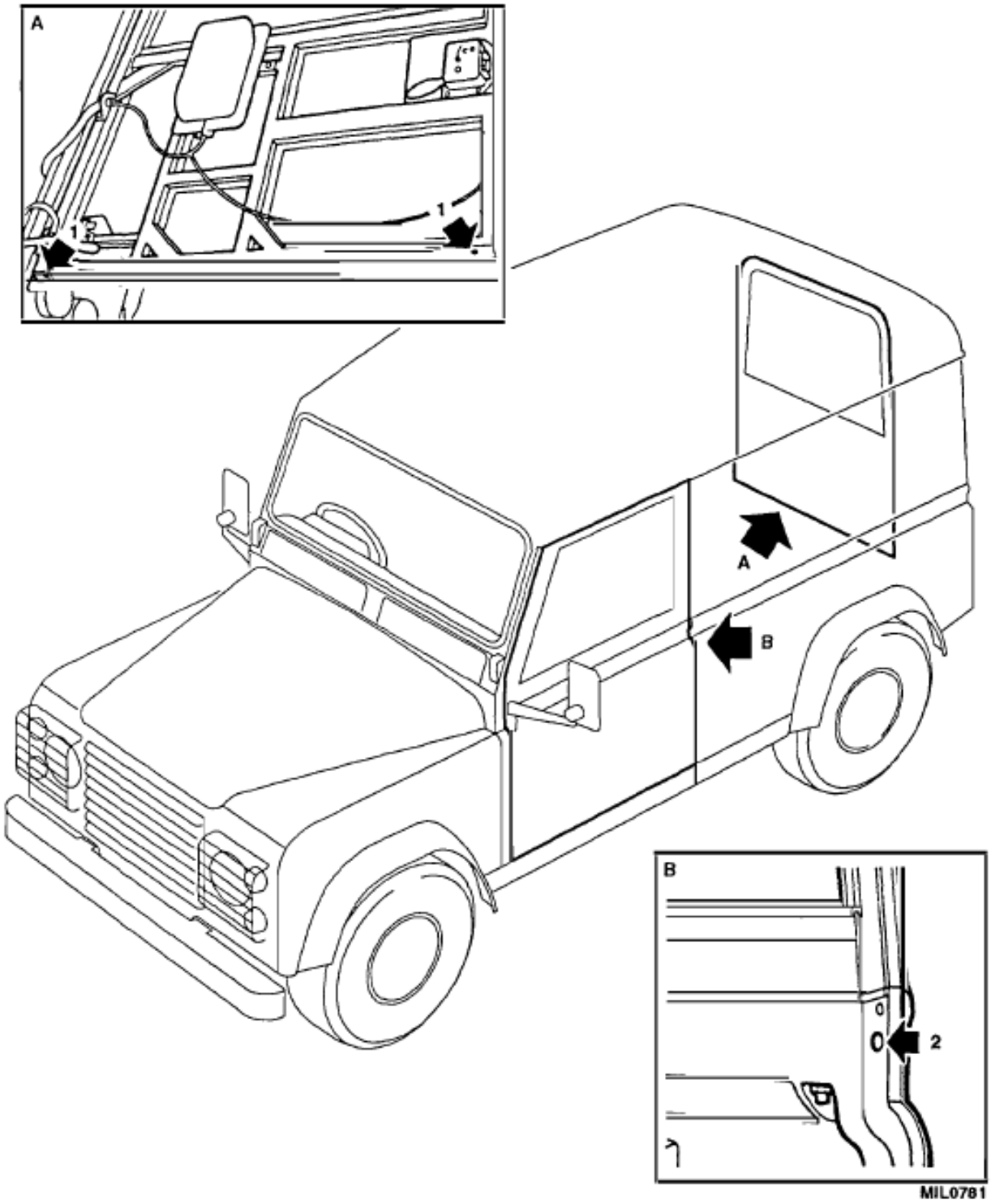
5.5.5 Remove swarf using a suitable vacuum cleaner.

5.5.6 Place the vehicle on a suitable ramp or over a pit to give access to the chassis and body underside.



1 Rear door drilling positions 2 'A' post access holes

Fig 1 Scuttle and 'A' post drilling positions



1 Bulkhead access holes 2 Passenger door drilling position

Fig 2 Passenger and rear door frame drilling positions

Application

6 Apply the anti corrosion treatment as follows:

NOTE

The spray flexible lance (refer to Table 2, Serial 1) must be fed all the way in to an access hole (in both directions) until it stops then withdrawn slowly allowing the spray to saturate the area with the wax treatment.

Chassis and underbody

7 Apply anti-corrosion wax solution (refer to Table 1, Serial 1 and 4) to the following areas:

7.1 The internal surfaces of the main chassis members using all access points along the chassis, both sides (refer to Fig 3 (3)).

7.2 Internal surface of the front bumper and the front chassis member in the area around the jate rings (1).

7.3 The internal surfaces of the 'A' post (2).

7.4 The internal surfaces the front chassis cross member (5).

7.5 Internal surfaces of the centre cross member (8).

7.6 Internal surfaces of all outriggers (6).

7.7 Internal surfaces of all jacking points (9).

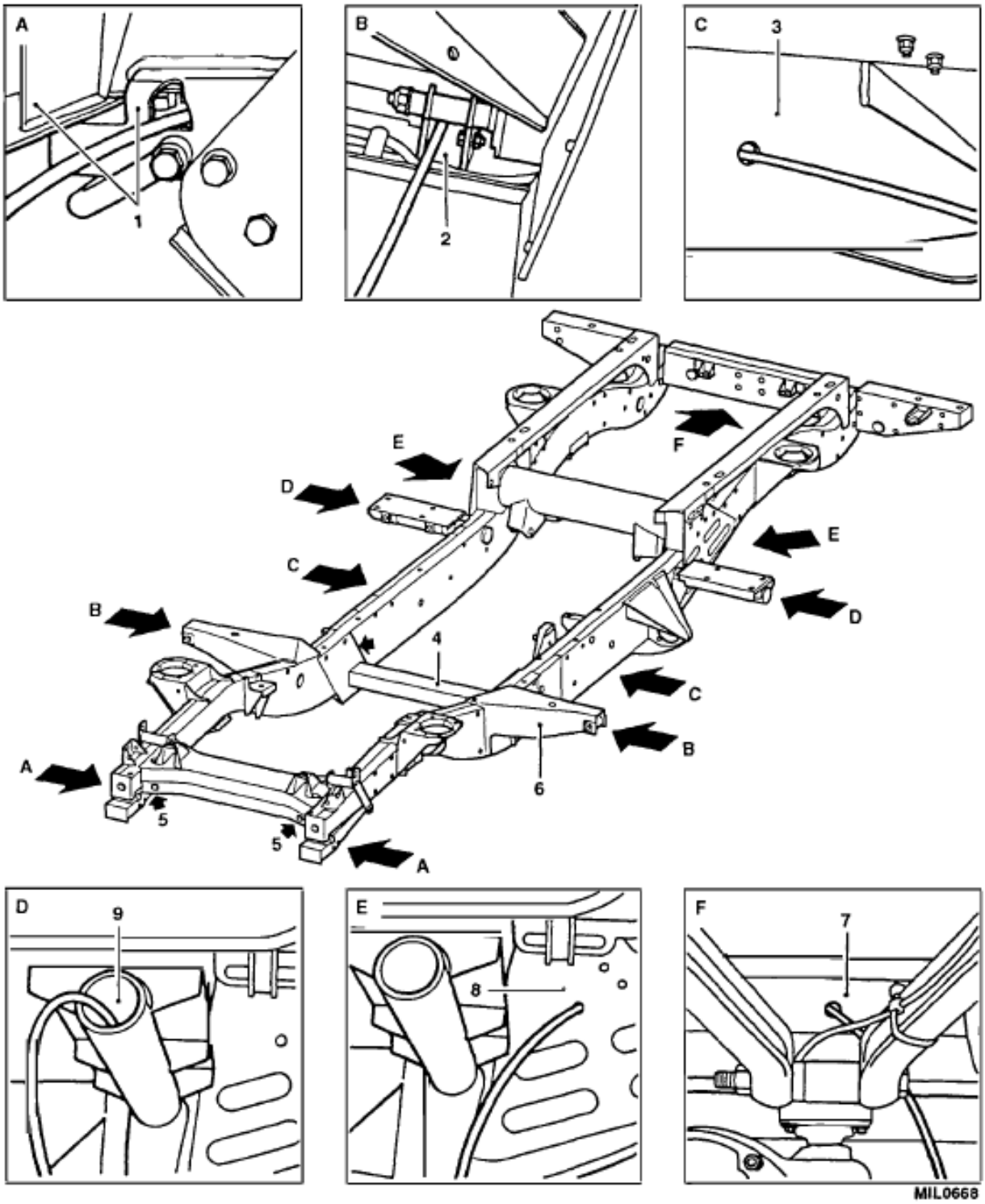
7.8 The internal surfaces of the rear cross member (7).

7.9 The internal surfaces of all other chassis members and body stiffeners (refer to Fig 4 (2)) using the existing openings.

8 Apply a thin film of wax solution (refer to Table 1, Serial 2 and 5) to seams in the under body of the vehicle, chassis, axles and propshaft. The dry film thickness should be 30 microns.

8.1 Take care to direct spray between the mating surfaces of the detachable cross member (4) and longitudinal section of the chassis.

8.2 Finish with an application of wax solution (refer to Table 1, Serial 3 and 6) on all surfaces of the vehicle (underbody and chassis) to a dry film of 300 microns.



1 Front bumper and chassis
2 'A' post
3 Main chassis members
4 Detachable cross member
5 Front chassis cross member
6 Outrigger
7 Rear cross member
8 Centre cross member
9 Jacking point

Fig 3 Chassis and underbody treatment areas

Bodywork and structure

9 Apply wax solution (refer to Table 1, Serial 1 and 4) to internal surfaces of body panels and structure as follows:

9.1 Scuttle. Insert the flexible lance (refer to Table 2, Serial 1) into the scuttle, left and right from each 10 mm diameter access hole (refer to Fig 1 (1)). Apply product whilst withdrawing lance.

9.1.1 Close access holes with 10 mm coloured plugs.

9.2 'A' Pillar. Insert the flexible lance into the 10 mm diameter hole (2), ensuring maximum travel in each direction.

9.2.1 Spray coat each section whilst slowly withdrawing lance.

9.2.2 Close access holes with 10 mm coloured plugs.

9.3 Bonnet. Apply wax solution to internal surfaces via existing openings (refer to Fig 4 (6)) using hook nozzle (refer to Table 2, Serial 2). Take care to spray into clinched fold of leading section of bonnet (7). Allow time for drippage.

9.3.1 Remove masking material and close bonnet.

9.3.2 Revisit and clean off during final inspection to ensure cleanliness of surfaces.

9.4 Front door frame. Locate existing opening at each corner in the underside of the lower frame (1) and the holes drilled in the front door upper channel (refer to Fig 2 (2)). Apply wax solution to all internal surfaces of the frame (vertically and horizontally) using the flexible lance.

9.4.1 Spray coat seams inside door where door panel is fixed to frame.

9.4.2 Close doors, and allow for drippage.

9.4.3 Revisit and clean off during final inspection to ensure cleanliness of surfaces.

9.5 Rear door frame. Locate the new 10 mm diameter holes positioned at each corner underside of the lower frame (refer to Fig 4 (5)). Apply wax solution (vertically and horizontally) using flexible lance.

9.5.1 Spray coat seams inside door where the door panel (3) is fixed to frame (4).

9.5.2 Spray coat channel at waist level and seams.

9.5.3 Close doors and allow for drippage.

9.5.4 Revisit and clean off during final inspection to ensure cleanliness of surfaces.

Preparation of vehicle for hand-over

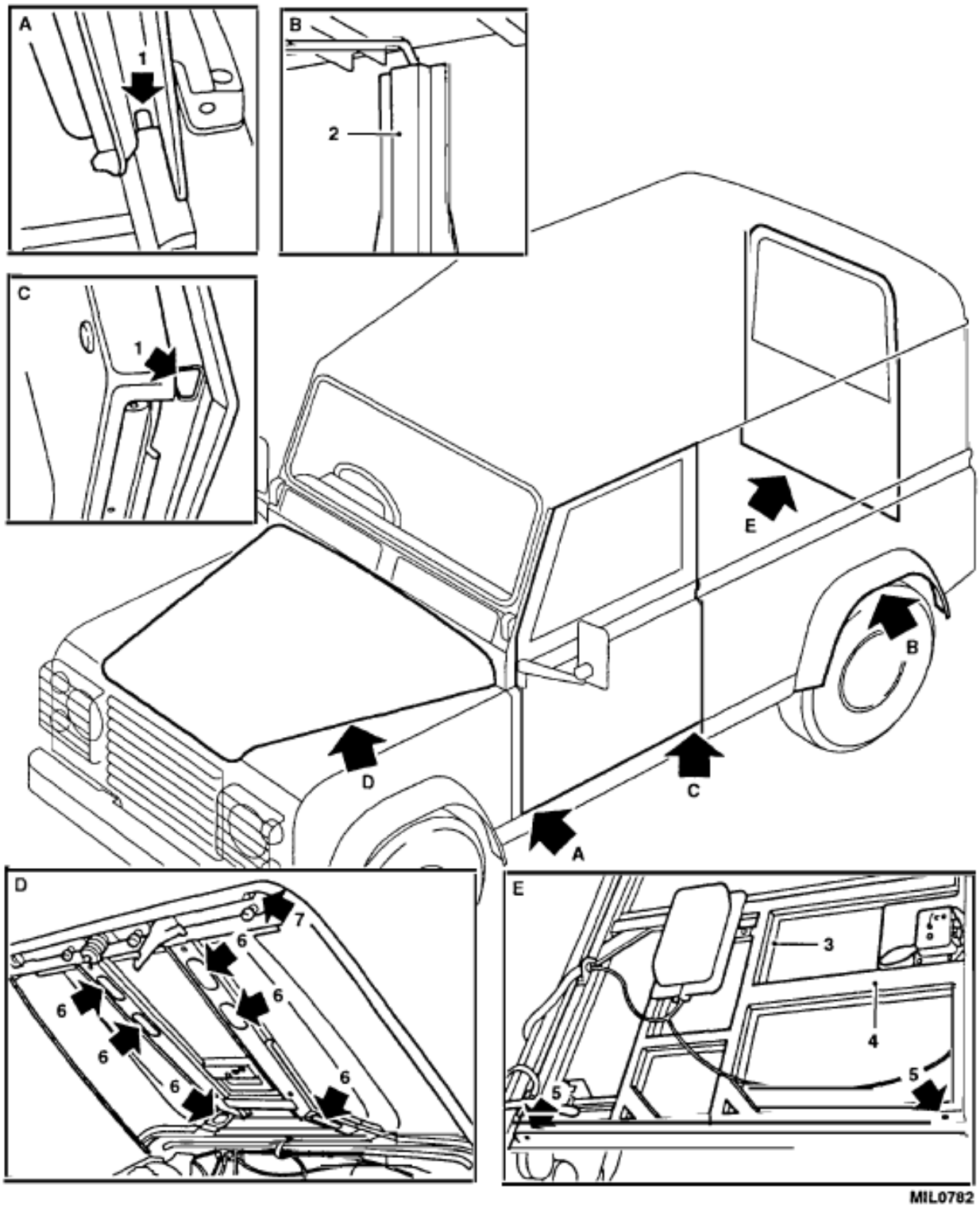
10 On completion of the wax treatment carry out the following:

10.1 Refit door trims (refer to Cat 522 Chap 16-4).

10.2 Remove all masking material.

10.3 Check that untreated surfaces are clean and free of wax over spray.

10.4 Revisit the vehicle immediately prior to hand-over to ensure the removal of any after treatment drippage from drain holes in doors.



1 Front door lower frame opening
2 Body stiffeners (rear wheel arch
3 Rear door panel
4 Rear door frame
5 Rear door lower frame holes
6 Bonnet stiffeners
7 Clinched fold

Fig 4 Body work and structure treatment areas

In service maintenance programme

Routine re-treatment

11 An annual standard service and re-treatment with anti-corrosion products of TUL/TUM body panels and chassis structure is required. This should start 12 months from the date of initial acceptance into service of the vehicle. This treatment should be completed within 30 days either side of the anniversary date of the initial acceptance of the vehicle.

12 The unit responsible for the vehicle must ensure the work is completed on time.

13 Personnel engaged in the standard re-treatment of TUL/TUM vehicles should be Land Rover/Dinol approved.

NOTE

In the event of any body panel (initially protected against corrosion) or part of the chassis structure and cross member being removed, replaced or repaired, those parts must be retreated with the appropriate products to original specification. Treatment must be within fourteen days of completion of such replacement or repair and undertaken by Land Rover/Dinol approved personnel only.

Products and approximate usage per vehicle

14 For products and approximate usage per vehicle (refer to Table 1).

Application - equipment and re-treatment method

Equipment

15 For required equipment (refer to Table 2).

Preparation

16 Connect the spray gun (refer to Table 2, Serial 1) directly to an airline supplying an approximate pressure of 90 lb/in^2. The gun operates at 28-145 lb/in^2.

17 After use, clean equipment with white spirit by placing a small quantity of white spirit in the spray container. Then attach to the gun and lightly depress trigger whilst pointing the hook nozzle into a waste bin. This will ensure cleansing of the working sections of the gun. Release residual pressure in gun on completion.

18 Waxes are packaged in one litre tins for direct insertion into the 1.2 litre spray container of the Compact Service Spray Gun.

19 Cavity Waxes (refer to Table 1, Serial 1 and 2) are low viscosity products and can be applied with relative ease. (Recommended dry film thickness is approximately that of thin paper).

20 Underbody Wax (refer to Table 1, Serial 3) is a high viscosity wax and requires heating for ease of application.

21 Recommended dry film thickness of the finished coating is approximately 300 microns which can be achieved by some 4 passes with the spray gun.)

Workshop preparation

22 Lightly scatter water over the surface of the working area.

23 Apply sheet (refer to Table 2, Serial 5) to the work area.

Treatment procedures

CAUTIONS

(1) STEAM CLEANING. The wax products are air drying and formulated to ensure flexibility of the coating when cured. Steam cleaning and ultra-high pressure washing can degrade them.

(2) TEMPERATURE. Cold water pressure washing is the preferred method for cleaning the chassis and surfaces underside of vehicle. In any event, water temperature should not exceed 60 °C.

(3) WATER PRESSURE. Pressure of water should not exceed 1200 lb/in^2. Ensure a distance of approximately 30 cms between the nozzle of the lance and surfaces in order to avoid accidentally damaging the original coating.

(4) DRYING TIME. Allow adequate time for the vehicle to dry thoroughly prior to commencing re-treatment.

Initial preparation of vehicle

24 Prepare the vehicle as follows:

24.1 Pressure wash the vehicle.

24.2 Ensure vehicle is dry.

24.3 Raise bonnet.

24.4 Mask-off brake discs, callipers, convoy lamp and engine bay.

24.5 Position vehicle over pit/ramp.

Re-treatment

Scuttle and 'A' pillar

25 Raise the bonnet, open the front doors fully and carry out the following:

26 Locate the 10 mm diameter coloured plugs in scuttle face and in 'A' pillar (refer to Fig 1), adjacent to check strap anchorage, and remove them.

27 Apply Cavity Wax (refer to Table 1, Serial 1 and 4) as follows:

27.1 Insert the flexible lance (refer to Table 2, Serial 1) into the scuttle, left and right from each 10 mm diameter access hole.

27.2 Apply wax generously whilst withdrawing the lance.

27.3 Close holes with replacement 10 mm coloured plugs.

NOTE

The 'A' pillar forms an integral part of the scuttle assembly.

27.4 Insert the flexible lance (refer to Table 2, Serial 1) into the 10 mm diameter hole, ensuring maximum travel in each direction.

27.5 Generously spray coat the upper section of the pillar and lightly spray coat the lower section.

27.6 Apply product when withdrawing the lance.

27.7 Close holes with replacement 10 mm coloured plugs.

Bonnet

28 Raise bonnet and carry out the following:

28.1 Mask the engine bay off for protection against possible wax contamination.

28.2 Apply Cavity Wax (refer to Table 1, Serial 1 and 4) to internal surfaces of frame via existing openings using the hook nozzle (refer to Table 2, Serial 2).

NOTE

Take care to direct spray into clinched fold of leading section of bonnet

28.3 Allow time for possible wax drippage, remove masking material and close bonnet.

28.4 Re-inspect to check for any further drippage from front of bonnet and remove as necessary.

Front door frame

29 Open door to the fully open position and carry out the following:

29.1 Locate the existing opening at each comer in the underside of the lower doorframe and the 10 mm hole in the outer edge of top frame.

29.2 Apply Cavity Wax (refer to Table 1, Serial 1 and 4) to the full length of all the internal channels of the frame (vertically and horizontally) using the flexible lance.

29.3 Close doors, allow for wax drippage and revisit to check for cleanliness of surfaces of doorsills immediately beneath each access hole in doors.

Rear door frame

30 Open door to the fully open position.

30.1 Locate existing 10 mm diameter hole positioned at each corner underside of the whole lower section of frame (refer to Fig 4). Some manipulation of door trim may be necessary to ensure access.

30.2 Apply Cavity Wax (refer to Table 1, Serial 1 and 4) to the full length of the channel (vertically and horizontally) using the flexible lance.

30.3 Close door and allow for wax drippage and revisit to check for cleanliness of surfaces of door sill immediately beneath each access hole in door.

Chassis and underbody of vehicle

31 With the vehicle positioned on lift/ramp or over a pit carry out the following:

31.1 Inspect for cleanliness of surfaces in proximity to wheel arches.

31.2 Inspect surfaces of the chassis for damage, surface corrosion and adhesion of original protective coatings.

31.3 Mask-off brake discs, callipers and convoy lamp.

31.4 Remove loose coatings and surface corrosion using wire brush.

31.5 Blow clean residual matter with compressed air.

CAUTION

PROPSHAFT. Do not apply product to the propshaft.

31.6 Using the flexible lance (refer to Table 2, Serial 1), apply Cavity Wax (refer to Table 1, Serial 1 and 4) to internal surfaces of the chassis via existing openings.

31.7 Apply Penetrant wax (refer to Table 1, Serial 2 and 5) to seams in the underbody of the vehicle, chassis, axles, propshaft and any part of the chassis sustaining surface corrosion to a dry film thickness of thin paper, i.e. 30 microns.

NOTE

Direct spray to provide for maximum penetration between the mating surfaces of the detachable cross member and longitudinal section of chassis (Fig 3).

32 Finish treatment with the application of Underbody Wax (refer to Table 1, Serial 3 and 6) to the vehicle chassis and underbody.

Cleanliness of vehicle surfaces for hand over

33 On completion of the re-treatment:

33.1 Inspect for cleanliness of surfaces in proximity to wheel arches.

33.2 Check that all livery, screens and mirrors are clean and free of wax over spray.

33.3 Re-inspect the vehicle immediately prior to delivery to check for after treatment drippage from drain holes in bonnet and doors. Remove as necessary.

Re-treatment following repair of accident damage or removal of components

CAUTION

TORQUE SETTINGS. Wax treated surfaces can allow nuts and bolts to be overtightened. Always ensure nuts and bolts are cleaned free of wax with white spirit before tightening to the correct torque.

Introduction

34 If any body panel (initially protected against corrosion) or part of the chassis structure and cross member is removed, replaced or repaired, those parts must be retreated with the appropriate product.

35 Treatment must be within fourteen days of completion of such replacement or repair and undertaken by Land Rover/Dinol approved personnel.

Procedure

36 All surfaces intended for treatment should be clean and dry.

36.1 Mask-off all the brake discs, callipers, convoy lamp and engine bay as necessary.

36.2 Replacement of scuttle and rear door is to include the drilling of 10 mm diameter access holes (refer to Fig 1).

Equipment and products required

37 Refer to Table 1 and Table 2 for equipment and products required.

37.1 Connect the spray gun (refer to Table 2, Serial 1) directly to an airline supplying an approximate pressure of 90 lb/in^2. The gun operates at 28-145 lb/in^2.

37.2 After use, clean equipment with white spirit by placing a small quantity of white spirit in the spray container.

37.3 Attach to the gun and lightly depress trigger whilst pointing the hook nozzle into a waste bin. This will ensure cleansing of the working sections of the gun.

37.4 Release residual pressure in gun on completion.

Anti-corrosion waxes

38 For a list of anti-corrosion waxes refer to Table 1.

38.1 Cavity and penetrant waxes (refer to Table 1, Serial 1 and 2) are low viscosity products and can be applied with relative ease.

38.2 Recommended dry film thickness is approximately that of heavy paper. Underbody Wax (refer to Table 1, Serial 3 and 6) is a high viscosity wax and requires heating for ease of application.

38.3 Recommended dry film thickness of the coating is that achieved by some four passes with the spray gun.

38.4 Waxes are packaged in one litre tins for direct insertion into the 1.2 Titre spray container of the Compact Service Spray Gun.

Re-treatment method

39 Inject with cavity wax (refer to Table 1, Serial 1 and 4) through existing or new holes.

40 After re-treatment, close 10 mm diameter holes in scuttle and A' Pillar with coloured plugs.

Treatment of new/repaired areas

Underbody and Chassis

41 Apply penetrant wax (refer to Table 1, Serial 2 and 5) to new areas and seams of overlapping panels of the underbody structure.

41.1 Lightly spray coat surfaces of chassis where applicable.

41.2 Conclude with an application of Underbody Wax (refer to Table 1, Serial 3 and 6) to all repaired areas.

Internal surfaces

42 Apply wax (refer to Table 1, Serial 1 and 4) to internal surfaces of body panels and structure as follows:

Scuttle and 'A' pillar

43 Insert the flexible lance (refer to Table 2, Serial 1) into the scuttle working left and right from each 10mm diameter access hole.

43.1 Apply product whilst withdrawing the lance.

43.2 Close holes with 10 mm coloured plugs.

NOTE

The' A'pillar forms an integral part of the scuttle assembly.

43.3 Insert the flexible lance (refer to Table 2, Serial 1) into the 10mm diameter hole, ensuring maximum travel in each direction.

43.4 Spray coat each section whilst slowly withdrawing the lance.

43.5 Close access holes with 10 mm diameter coloured plug.

Bonnet

44 Apply product to internal surfaces via existing openings using the hook nozzle (refer to Table 2, Serial 2).

44.1 Take care to direct spray into clinched fold of leading section of bonnet.

44.2 Allow time for drippage.

44.3 Remove masking material and close bonnet.

44.4 Revisit during final inspection to ensure cleanliness of surfaces.

Front door frame

45 Locate an existing opening at each corner in the underside of the lower door frame and the holes drilled in the front door upper channel.

45.1 Apply wax (refer to Table 1, Serial 1 and 4) to the internal surfaces of the frame (vertically and horizontally) using the flexible lance.

45.2 Spray coat seams inside door where door panel is affixed to frame.

45.3 Close doors.

45.4 Expect a small amount of drippage; revisit and clean-off during final inspection to ensure cleanliness of surfaces.

Rear door frame

46 Locate the new 10 mm diameter holes positioned at each corner underside of the lower frame (refer to Fig 4).

46.1 Apply wax (refer to Table 1, Serial 1 and 4) (vertically and horizontally) using the flexible lance.

46.2 Spray coat seams inside door where door panel is affixed to frame. Also, spray coat channel at waist level and seams.

46.3 Close doors.

46.4 Expect a small amount of drippage; revisit and clean-off during final inspection to ensure cleanliness of surfaces.

Protection of floor in spray area

47 Occasional re-treatment of a vehicle is unlikely to result in any major contamination from product fall-out when spraying the waxes. Low viscosity wax drips can be removed using cleaning cloths.

47.1 High viscosity wax will build on the floor of the spray area particularly when volume re-treatment of vehicles is taking place.

47.2 The use of a plastic sheet (refer to Table 2, Serial 5) is recommended to protect the floor area against this condition.

47.3 Lightly scatter water over the surface of the working area from a bucket or can.

47.4 Apply plastic sheet (refer to Table 2, Serial 5) to the work area.

47.5 Water will provide adhesion of the plastic sheet to the floor preventing it from 'picking up'.

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CHAPTER 18

HEATING AND VENTILATION

CONTENTS

INTRODUCTION

1 This Chapter details the Unit repair for the heating and ventilation systems as fitted to Truck Utility Light (TUL) High Specification (HS), Truck Utility Medium (TUM) HS and (TUM) Battlefield Ambulance HS vehicles.

General

2 This Chapter has been sub-chaptered to allow for the various types of vehicle heating and ventilation as detailed below.

Chapter 18-1 Eberspacher heater

Chapter 18-2 Webasto heater

Chapter 18-3 Air conditioning system

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CHAPTER 18-1

EBERSPACHER HEATER

CONTENTS

INTRODUCTION

1 This chapter details the Base repairs for the Eberspacher heater unit fitted to the Truck Utility Medium (TUM) Battlefield Ambulance High Specification (HS).

2 The information given is applicable to both right and left hand drive vehicles.

GENERAL

3 The Eberspacher D5L diesel fired air heater system fitted to this vehicle operates independently to the standard heating equipment supplied in the driver's cab. It is capable of producing between 1800 Watts to 4800 Watts of heat using an average of 0.42 litres of fuel per hour.

WARNINGS

(1) COOLING. THE HEATER UNIT OPERATES AT EXTREMELY HIGH TEMPERATURES. ENSURE THE HEATER AND EXHAUST SYSTEM HAS COOLED DOWN SUFFICIENTLY BEFORE ATTEMPTING TO CARRY OUT ANY MAINTENANCE WORK.

(2) FUEL. ENSURE ALL DISCONNECTED FUEL LINES ARE PLUGGED OR CLAMPED TO PREVENT THE ESCAPE OF HAZARDOUS FUEL.

(3) VENTILATION. ENSURE ALL WORK IS CARRIED OUT IN A WELL VENTILATED AREA.

(4) TESTING. ENSURE ALL TEST RUNNING OF THE HEATER IS CARRIED OUT IN A WELL VENTILATED AREA.

HEATER UNIT

Dismantle

4 To dismantle the heater unit carry out the following:

4.1 Remove the heater unit from the vehicle (refer to Cat 522 Chap 18-2).

Cable harness plus cap

5 To remove the cable harness plus cap proceed as follows:

5.1 Undo the screw (Fig 1 (1)) from the cap (2) and detach from the heater unit.

5.2 Remove the PCB harness (7) from the PCB (6) and glow plug (31).

KEY FOR FIG 1

1	Screw	19	Harness	37	Grommet
2	Cap	20	Seal	38	Washer
3	Upper half casing	21	Cover	39	Nut
4	Grommet	22	Seal	40	Stud
5	Screw	23	'O' ring	41	Cap
6	PCB	24	Thermal cutout switch	42	Screw
7	PCB harness	25	Clips	43	Inlet end piece
8	Locking ring	26	Strainer	44	Seal
9	Blower fan	27	Seal	45	Carrier
10	Screw	28	Clip	46	Screw
11	Cover	29	Intermediate piece	47	Screw
12	Lining	30	Flame sensor	48	Lower casing half
13	Seal	31	Glow plug	49	Flange seal
14	Screw	32	Clip	50	Seal
15	Clamp	33	Heat shield	51	Outlet end piece
16	Regulating plug	34	Heat shield	52	Screw
17	Blower motor assembly	35	Clip		
18	Plug	36	Heat exchanger		

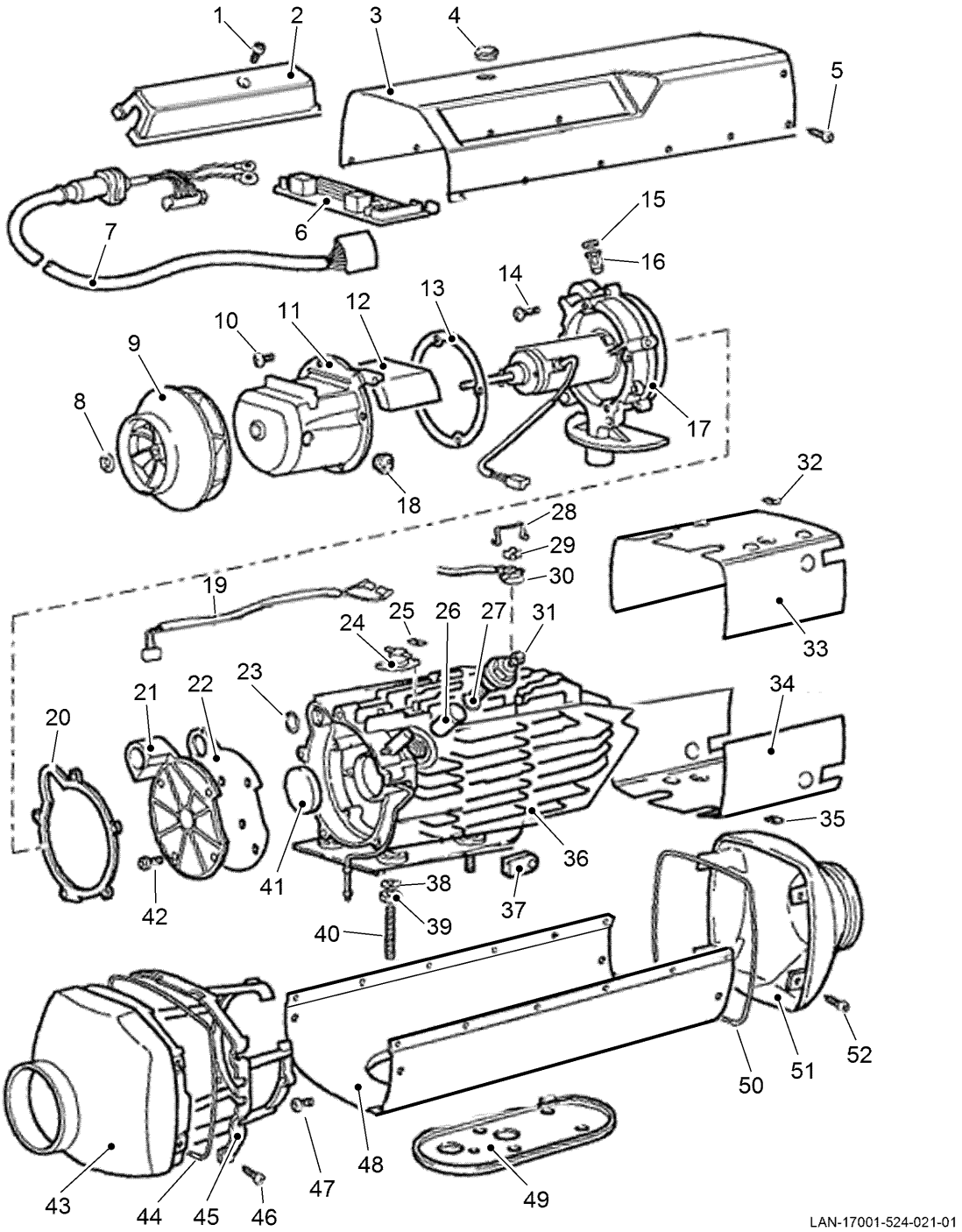


Fig 1 Heater unit

Glow plug

6 To remove the the glow plug:

6.1 Unscrew the glow plug connector.

6.2 Unscrew and remove the glow plug.

Glow plug strainer

7 To remove the glow plug strainer:

7.1 Remove the strainer (Fig 1 (26)) and seal (27) from the glow plug recess using a pair of pliers.

PCB

8 To remove the PCB:

8.1 Detach the plug connectors from the PCB.

8.2 Press the PCB downwards and pull it out. (refer to Fig 2).

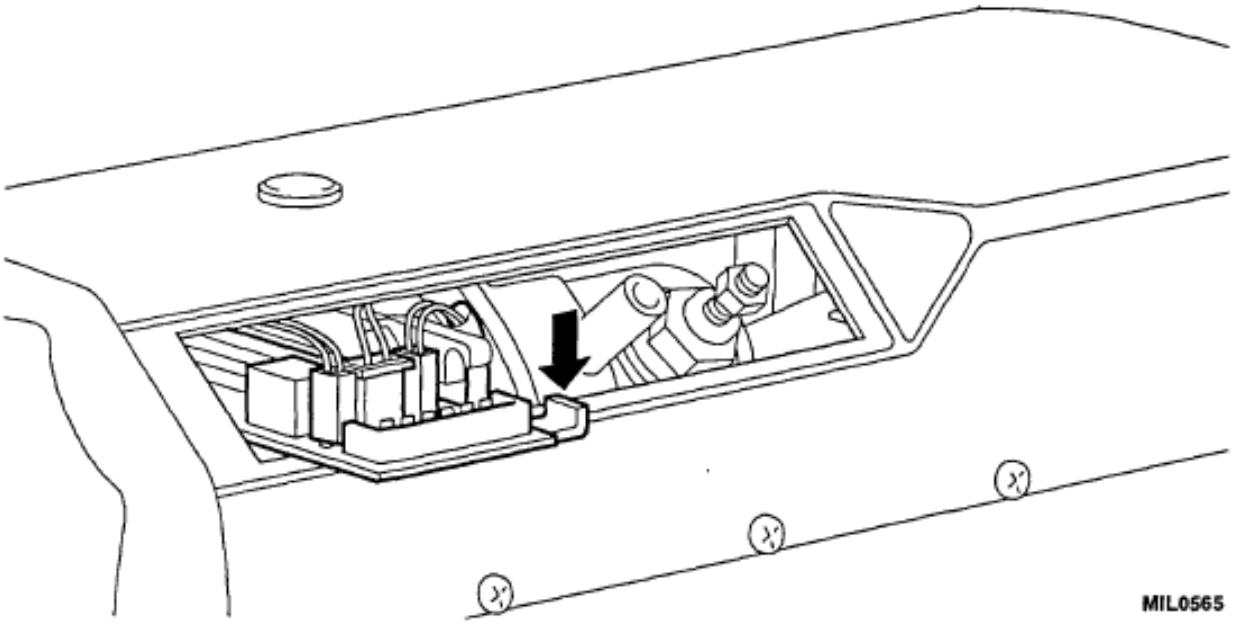


Fig 2 Removal of the PCB

8.3 Unscrew the four fastening screws (Fig 1 (52)) securing the outlet end piece and remove the outlet end piece (51). Collect seal (50).

8.4 Remove the fastening screws (5) of the uppercasing half and remove the casing half (3).

8.5 Remove both securing clips (32) from the heat protection shield and remove the heat protection shield (33).

Thermal cutout switch

9 To remove the thermal cutout switch:

9.1 Detach the harness (Fig 1 (19)) from the safety thermal cutout switch (24).

9.2 Remove both thermal securing clips (25) from the safety thermal cutout switch (refer to Fig 3).

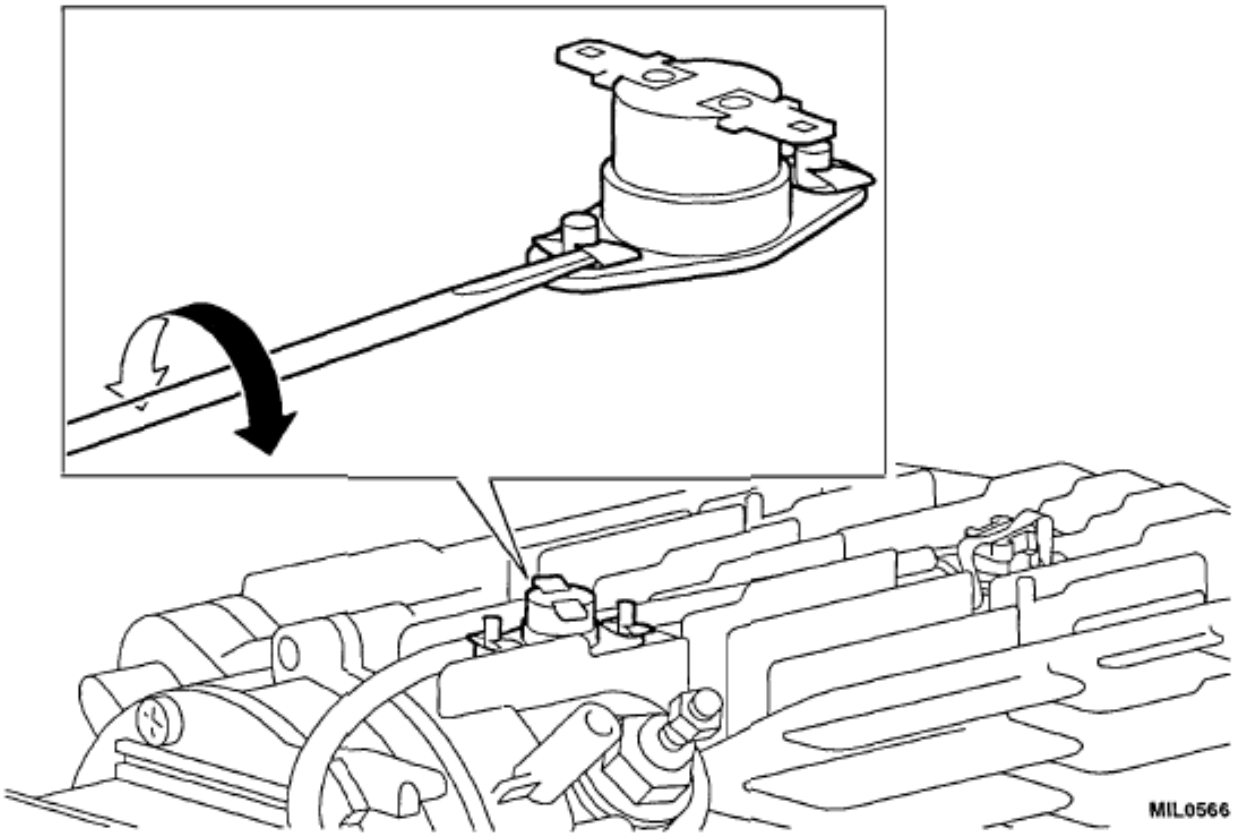


Fig 3 Removal of thermal cutout switch

9.3 Remove the safety thermal cutout switch.

Flame sensor

10 To remove the flame sensor:

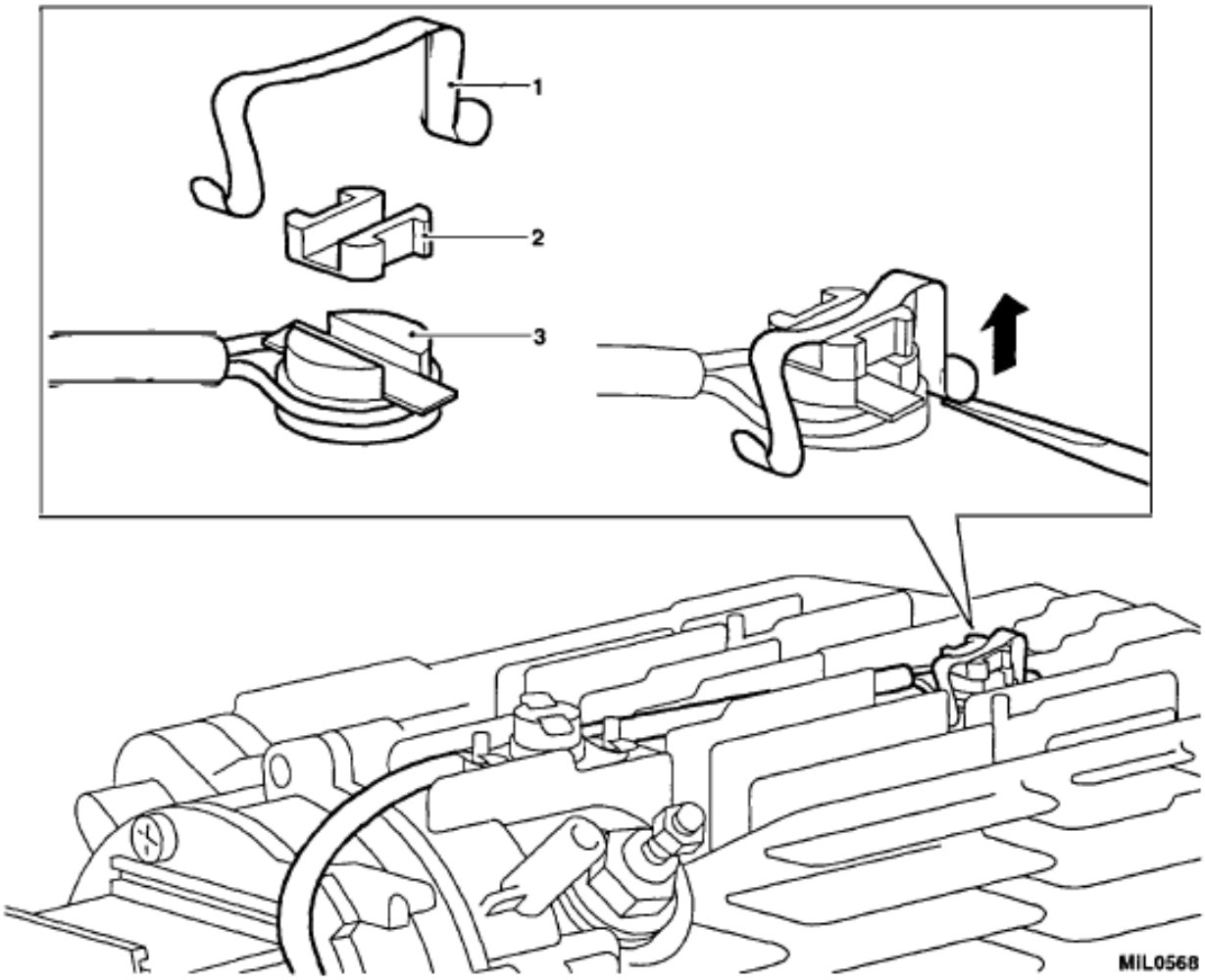
10.1 Remove the retaining spring (Fig 4 (1)) with a screwdriver.

10.2 Remove the flame sensor (3) with the intermediate piece (2).

10.3 Remove the screws (Fig 1 (46)) securing the inlet end piece (43) and remove the end piece.

10.4 Remove the Flange seal (49) and lower casing half (48).

10.5 Collect seal (44).



1 Clip
2 Intermediate piece
3 Flame sensor

Fig 4 Removal of flame sensor

Blower motor assembly

11 To remove the blower motor assembly:

11.1 Remove screws (Fig 1 (47)) and remove carrier support (45) from the blower motor casing (17).

11.2 Remove the screws (14) and remove the blower assembly from the heat exchanger and clear the heat exchanger and blower of sealing residues.

11.3 Collect the seal (20).

Blower fan

12 To remove the blower fan:

12.1 Remove the locking ring (Fig 1 (8)) from the blower fan (9) using a screwdriver (refer to Fig 5).

12.2 Pull the blower fan off the shaft of the blower motor.

12.3 Unscrew the fastening screws (10) from the cover (11) and remove the seal (13) and cover (11).

12.4 Remove the lining (12).

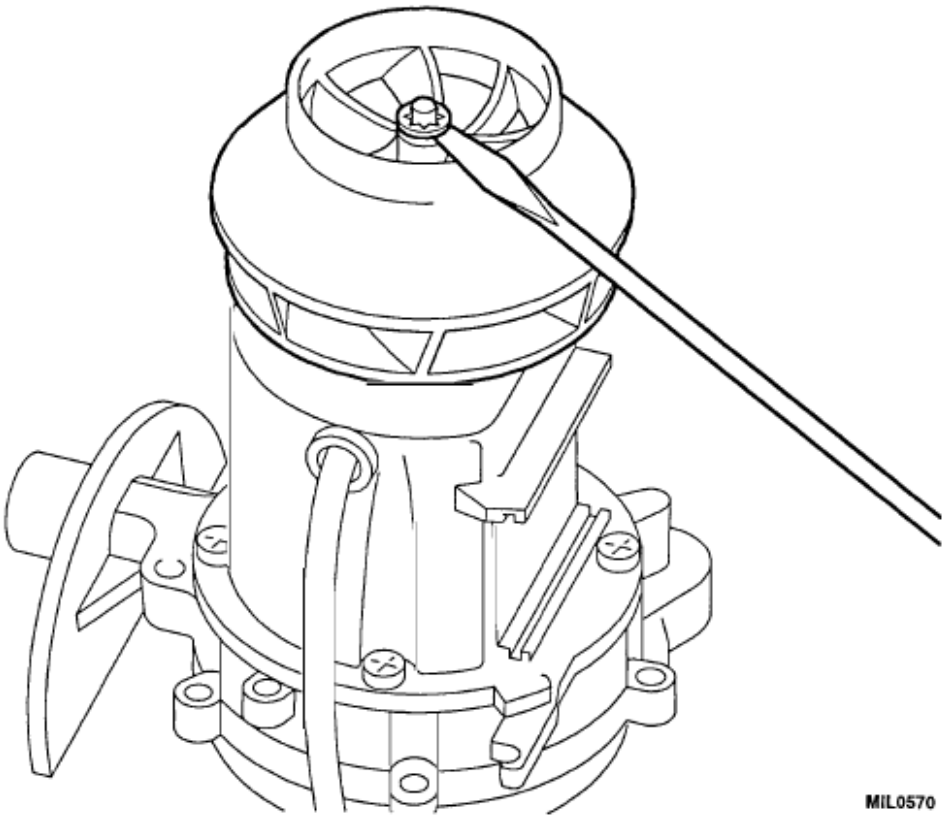


Fig 5 Removal of blower fan

Removal of the cover from the heat exchanger

13 To remove the cover from the heat exchanger:

13.1 Unscrew the fastening screws (Fig 1 (42)) from the cover (21). Lift the cover off the heat exchanger using an angled hook through the exhaust connection.

13.2 Remove the seals (22) and (23).

Inspection and replacement

14 Inspect all components for wear and damage and renew as necessary.

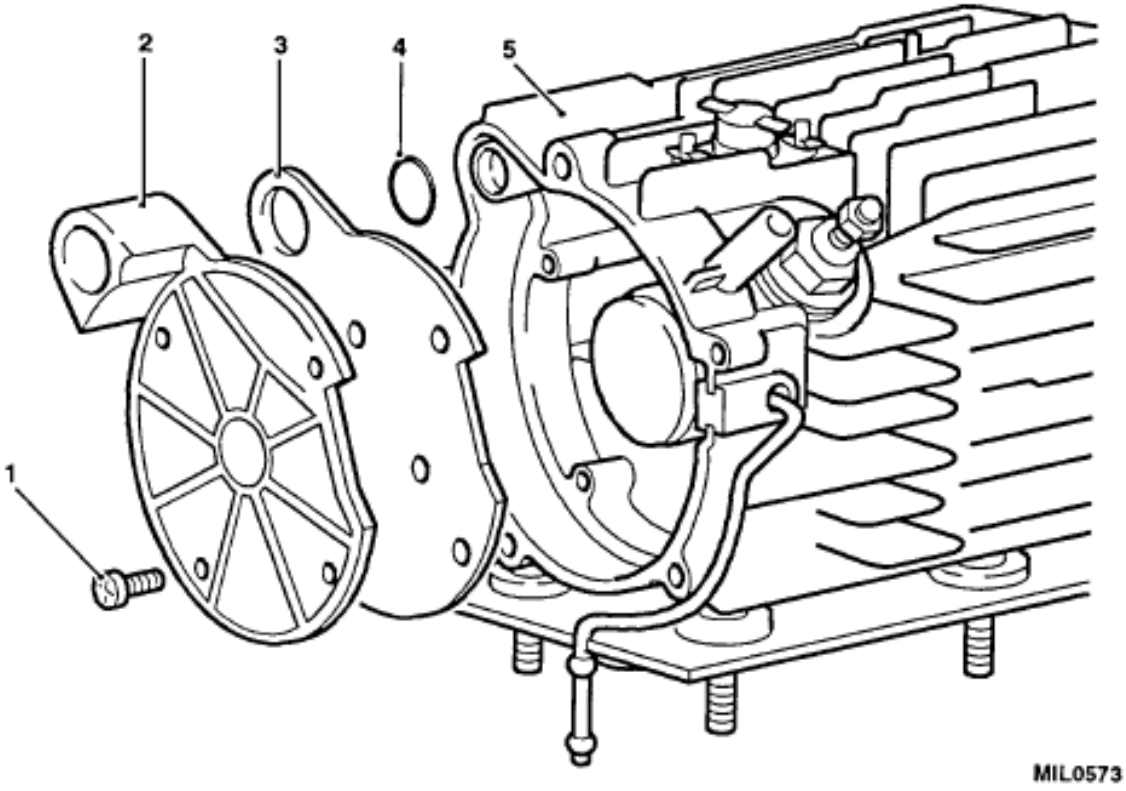
Reassembly

15 To reassemble the heater unit carry out the following:

15.1 Fit new seal (Fig 6 (3)) and 'O' ring (4) and refit the cover (2) to the heat exchanger (5). Secure with screws (1).

NOTE

Ensure the cover is located correctly over the combustion air system pipe and use only the original fixing screws or new ones.



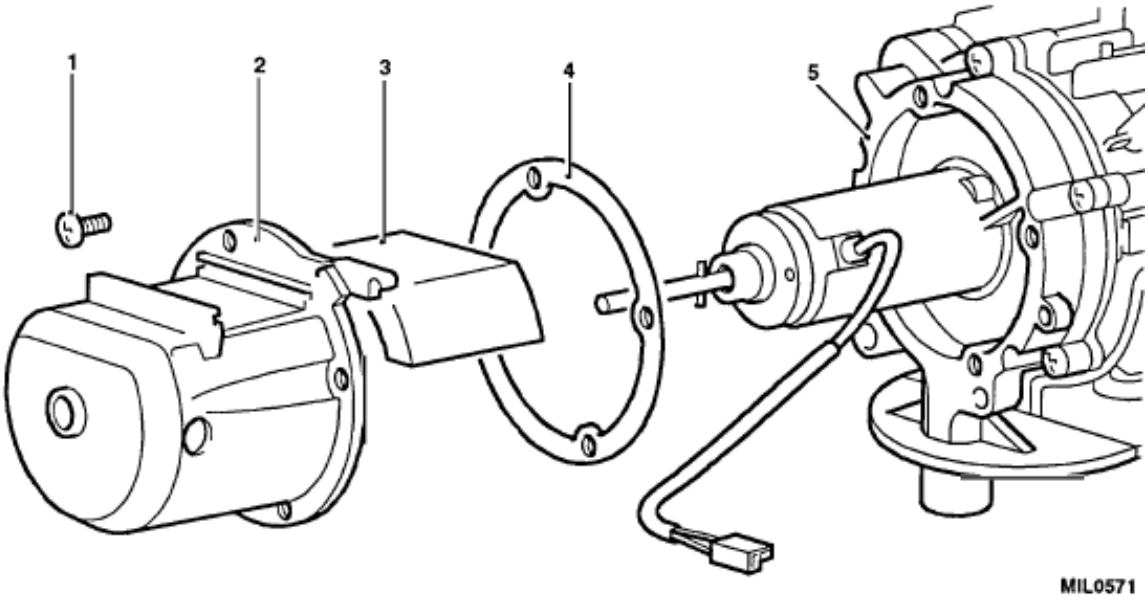
1 Screw
2 Cover
3 Seal
4 'O' ring
5 Heat exchanger

Fig 6 Refitting the heat exchanger cover

15.2 Fit a new lining (Fig 7 (3) and a new seal (4) and refit the cover (2) over the blower motor (5). Secure with screws (1).

NOTE

When refitting the cap ensure the original screws or new ones are fitted.

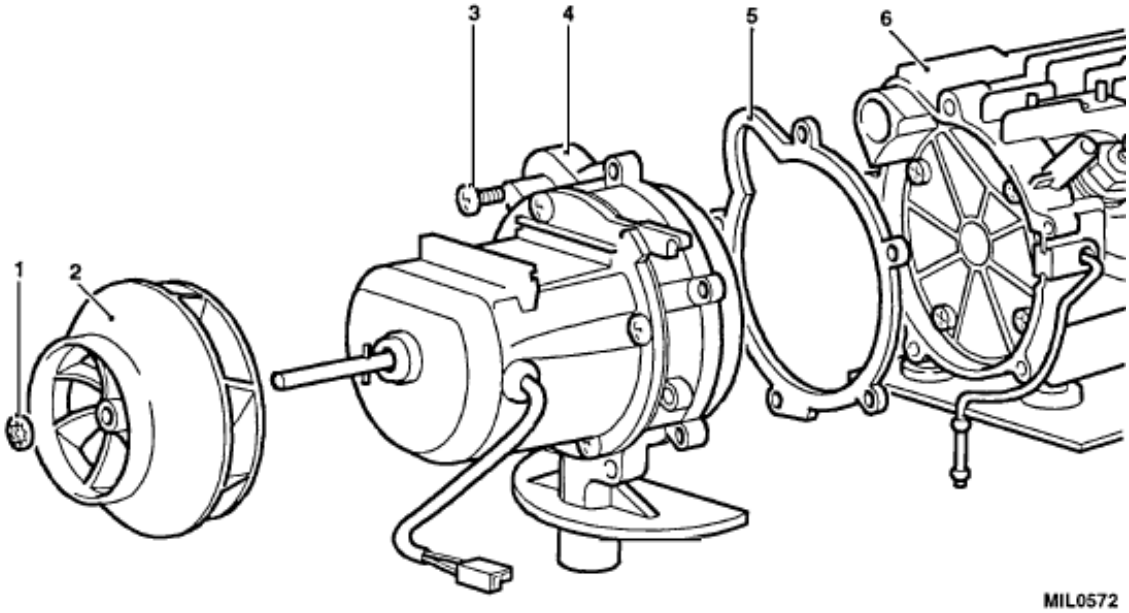


1 Screw
2 Cover
3 Lining
4 Seal
5 Heat exchanger

Fig 7 Fitting a new lining

15.3 Refit the blower fan (Fig 8 (2)) to the shaft of the blower motor (4) and locking ring (1). secure with a new

15.4 Fit a new seal (5) and refit the blower assembly (4) to the heat exchanger (6). Secure with screws (3).



1 Locking ring
2 Fan
3 Screw
4 Blower motor assembly
5 Seal
6 Heat exchanger

Fig 8 Refitting the blower assembly to the heat exchanger

15.5 Refit the carrier support (Fig 1 (45)) to the blower motor casing (17) and secure with screws (47).

15.6 Refit the lower casing half (48) and the inlet end piece (43) ensuring a new seal (44) is fitted. Secure with screws (46).

15.7 Refit the flange seal (49).

15.8 Refit the flame sensor (30) and intermediate piece (29) and secure with retaining spring (28) using two screwdrivers (refer to Fig 9).

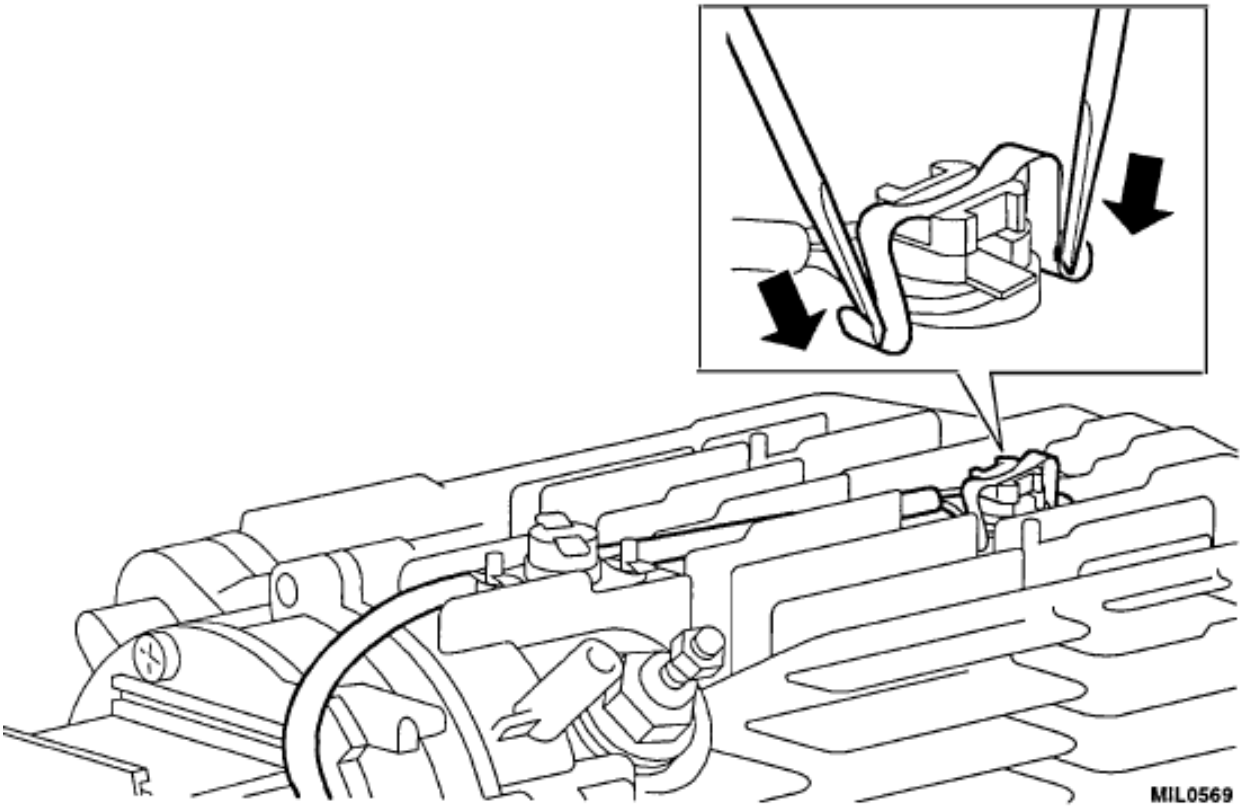


Fig 9 Refitting the flame sensor

15.9 Refit the safety thermal cutout switch (24) and secure with new clips (25) (refer to Fig 10).

15.10 Reconnect the plug connector harness (19) to the PCB (6) and the thermal safety cutout switch (24).

15.11 Refit the heat protection shield (33) and secure in position with new clips (32).

15.12 Refit the upper casing half (3) and secure with fastening screws (5).

15.13 Fit a new seal (50) and the outlet end piece (51) and secure with the four fastening screws (52).

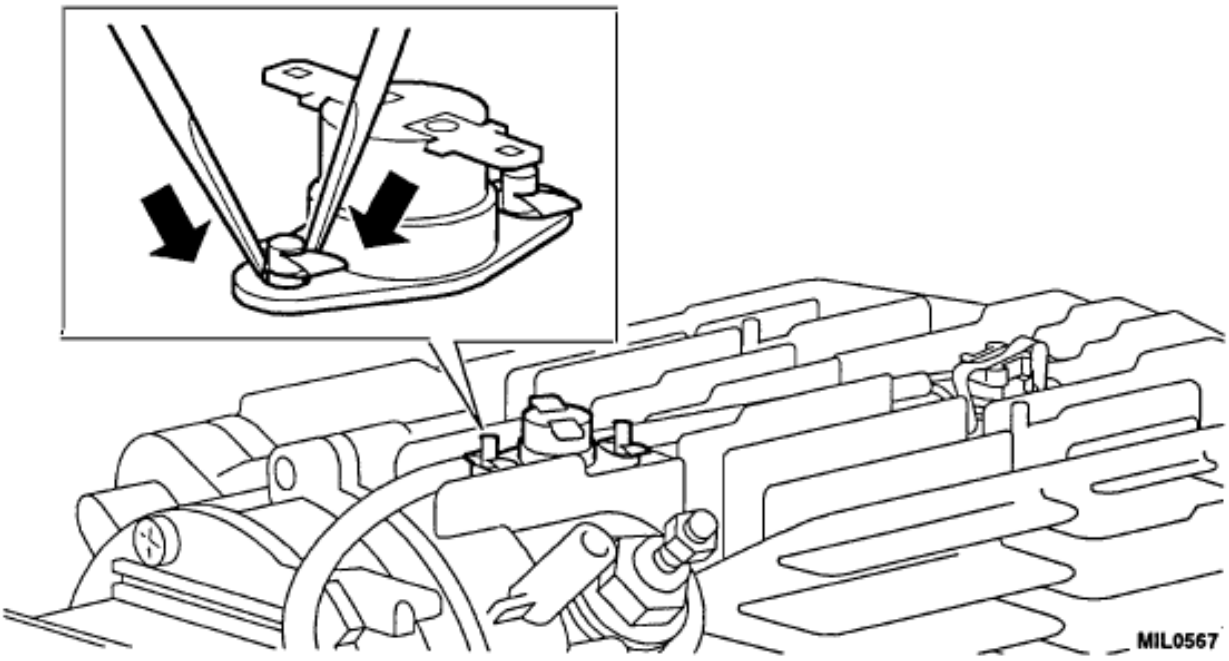


Fig 10 Refitting the safety thermal cutout switch

15.14 Refit the PCB (6) and reconnect the harness (7).

15.15 Clean and refit the plug strainer (26) (replace if necessary).

NOTE

When fitting the plug strainer, ensure that the nose is in the correct position. Slide in the plug strainer carefully as far as it will go (Fig 11).

15.16 Refit the glow plug (31).

15.17 Refit the plug connector (7) to the PCB (8) and glow plug.

15.18 Refit the cap (2) and secure with the screw (1).

15.19 Refit the heater unit into the vehicle (refer to Cat 522 Chap 18-2).

15.20 Switch on and test the unit is working correctly (refer to Cat 522 Chap 18-2).

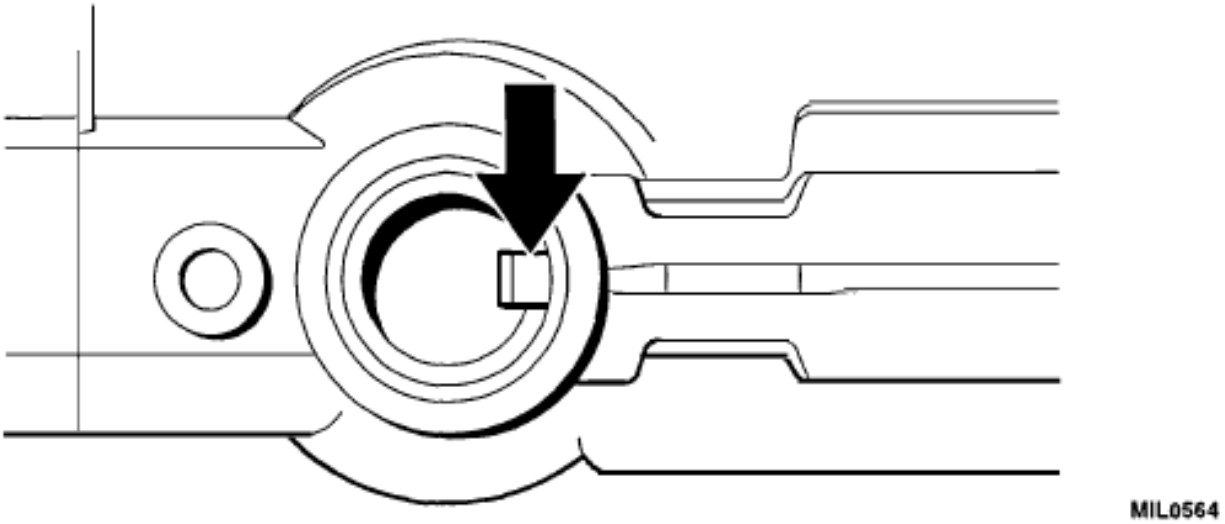


Fig 11 Refitting the glow plug strainer

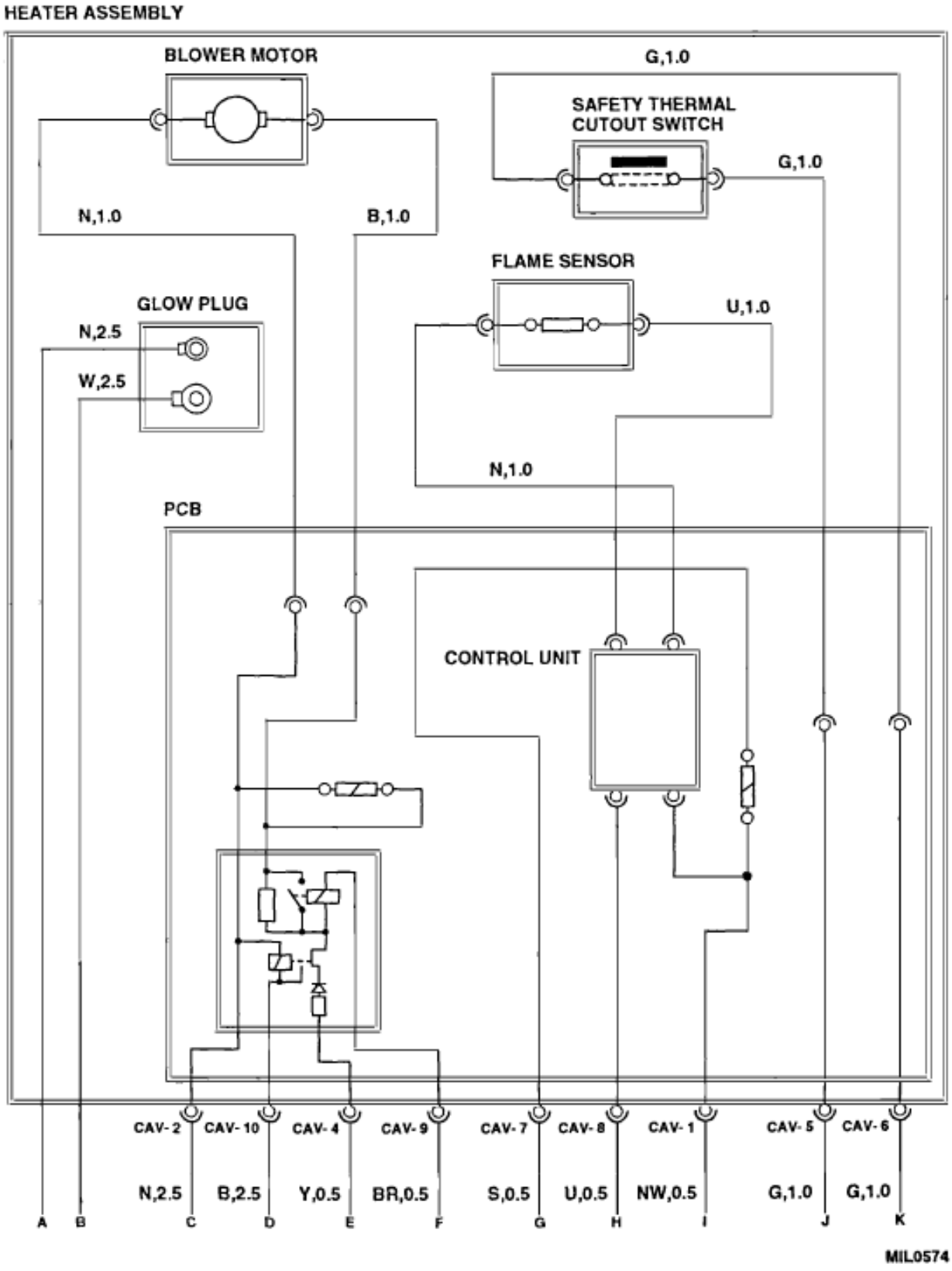


Fig 12 Wiring diagram I

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CHAPTER 18-2

WEBASTO HEATER

CONTENTS

(continued)

CONTENTS (continued)

INTRODUCTION

1 This Chapter details the Base repair procedures for the heating system fitted to Truck Utility Light (TUL) HS, Truck Utility Medium (TUM) High Specification (HS) Winterised/Waterproofed and (TUL) Battlefield Ambulance HS winterised vehicles.

2 The information given is applicable to both left and right hand vehicles. Throughout the Chapter the following terms are used to describe the location of components in the vehicles.

2.1 Left and right hand sides - The sides viewed from the driver's seat.

GENERAL

3 The Webasto auxiliary water heater system fitted to winterised/waterproofed vehicles provides preheated water to both the engine and vehicle interior radiators to maintain comfortable operational conditions inside the vehicle and aid engine starting in sub zero climates.

4 Table 1 details the sealants, adhesives and lubricants to be used.

TABLE 1 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	Drybond 1209	TBA	Sealant

DISCONNECTION AND RECONNECTION OF EMC 14-WAY PLUG CONNECTIONS.

NOTE

All electrical components in the water heater unit are wired through the 14-way electrical connector mounted on the top of the heater unit. Prior to removal of a component the relevant connections have to be disconnected.

Disconnection

5 To disconnect a component from the 14-way connector plug, carry out the following:

5.1 Disconnect the vehicle batteries (refer to Cat 522 Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Cat 522 Chap 13-2).

5.2 Disconnect the 14-way plug connector from the heater unit.

5.3 Remove the plug clamp (Fig 1 (2)).

5.4 Unscrew the rear cover (1) (counter-clockwise).

5.5 Carefully pull the relevant braiding sleeve (3) backwards to expose the component cables from the cable end.

5.6 Insert the special tool (6) into the plug seal (4). (The cable (5) should lay into the groove of the tool).

5.7 Push the tool into the seal as far as possible (7).

5.8 Gently push on the terminal pin and extract the tool. The locating peg inside the plug should now allow cable removal (8).

5.9 Withdraw the cables from the braided sleeve.

KEY TO FIG 1

1	Rear cover	6	Special tool
2	Plug clamp	7	Tool insertion
3	Braiding sleeve	8	Cable removal
4	Plug seal	9	Cable location
5	Cable	10	Positive locking

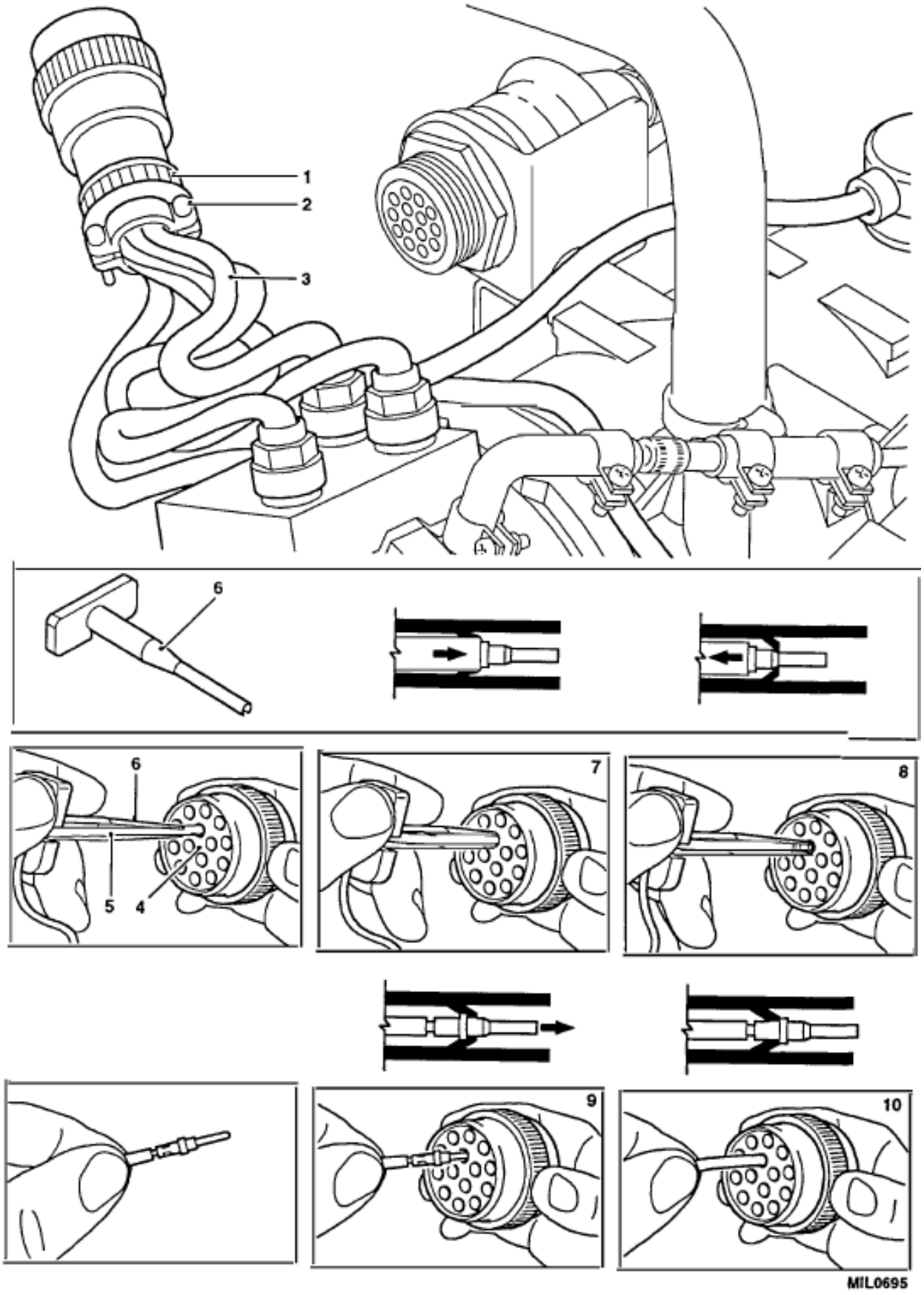


Fig 1 Disconnection and reconnection of plug connections

Reconnection

6 To reconnect the terminals carry out the following:

6.1 After fitting a new component, insert the cables into the braided sleeve. Taping the terminals pins together will assist assembly.

6.2 Enter the cables and braid through the rear cover nut.

6.3 Insert the pins into the correct location in the plug (Fig 1 (9)). Check the location (refer to Fig 2).

6.4 The locations are numbered at terminal entry and exit. A deliberate click should be felt when the pin is correctly located. Push on the terminal pin with a blunt instrument. The pin should not push out of the housing (10).

6.5 Refit the rear cover nut (1) and tighten.

6.6 Refit the cable clamp (2). Ensure all the braiding sleeve ends are pushed as far as possible inside the back shell and just clear of the rear seal of the plug.

6.7 Tighten the rear cover clamp screws.

6.8 Reconnect the plug to the heater.

6.9 Reconnect the vehicle batteries (refer to Cat 522 Chap 13-1) and on FFR vehicles the radio batteries (refer to Cat 522 Chap 13-2).

KEY TO FIG 2

Pin A	Yellow Glow pin	Pin G	Violet Overheat switch
Pin B	Brown Glow pin	Pin H	Brown Overheat switch
Pin C	Brown Combustion air fan	Pin J	Grey Flame detector
Pin D	Blue Combustion air fan	Pin K	Brown Flame detector
Pin E	Brown Water pump	Pin L	Brown Temperature sensor
Pin F	Black Water pump	Pin M	Green Temperature sensor

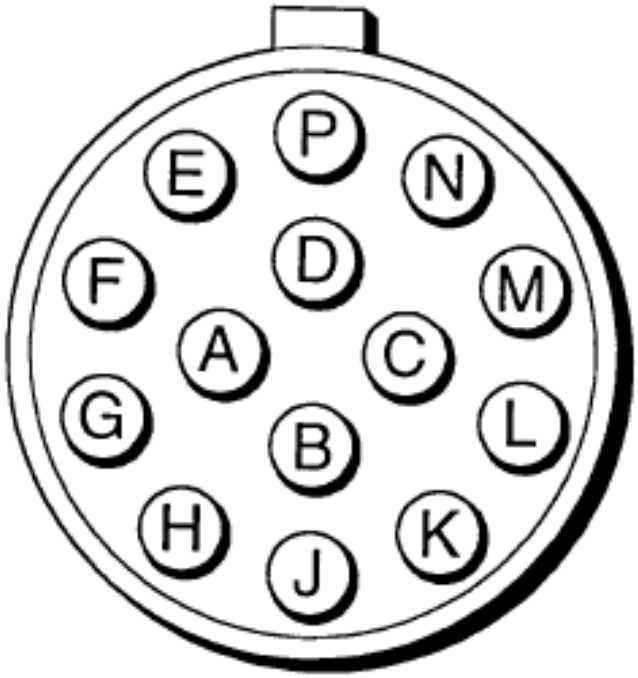


Fig 2 Plug pin assignment

WATER HEATER

Remove/refit

7 For the remove/refit of the water heater refer to Cat 522 Chap 18-3.

WATER PUMP

Remove

8 To remove the water pump carry out the following:

8.1 Disconnect the vehicle batteries (refer to Cat 522 Chap 13-1) and on FFR vehicles the radio batteries (refer to Cat 522 Chap 13-2).

8.2 Drain the cooling system (refer to Cat 522 Chap 12-2).

8.3 Remove the heater unit from the vehicle (refer to Para 7).

8.4 Remove the clamp (Fig 3 (3)) securing the screening braid (4) to the 14-pin connector plug (1). Unscrew the rear cover of connector (2) to expose the wires and using the special tool (11), (a spare is supplied and located in the control box) release the pump cable connectors from the 14-way plug (pins F and E). (refer to Para 5).

8.5 Remove the six screws and washers (7) securing the suppression cover (6) to the base plate and remove the suppression cover.

8.6 Unscrew the gland nut and remove the gland (10) from the suppression cover (6) and pull the cable out through the braid and free of the gland.

8.7 Remove the clamp (8) securing the pump to the heater unit, remove the pump (9). And collect the 'O' ring (5).

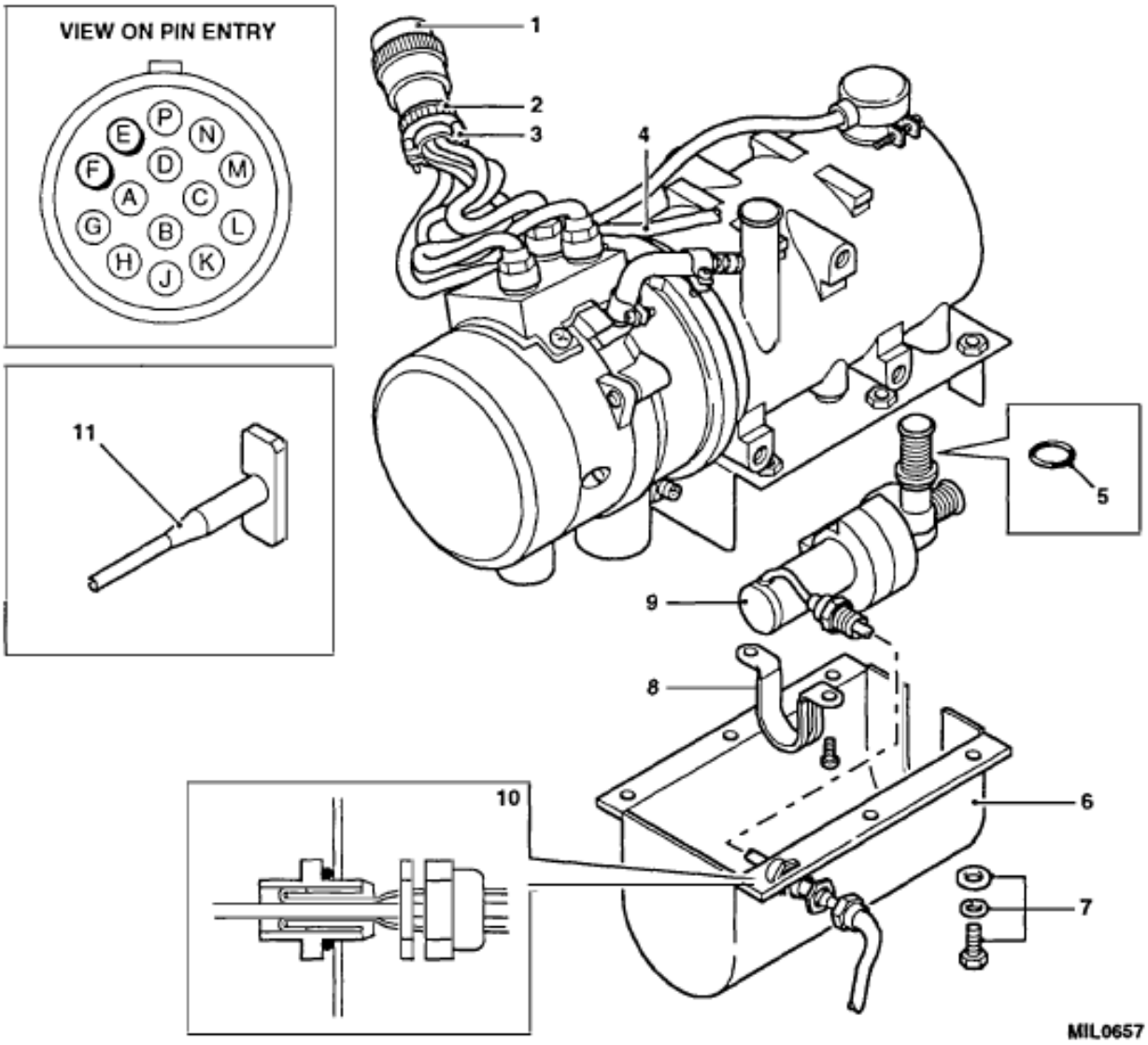
Refit

9 To refit the water pump carry out the following:

9.1 Fit a new 'O' ring (Fig 3 (5)) and locate the pump (9) through the base plate into the heater unit inlet.

9.2 Fit the pump clamp (8) and locate fixings through the base plate into heater unit mountings. Tighten fixings to 3 Nm (2.2 lbf/ft).

9.3 Feed the electrical cable from the pump through the suppression cover and through the gland (10) and screening braid (4).



1	14-pin connector plug	7	Screws and washers
2	Rear cover	8	Clamp
3	Clamp	9	Pump
4	Screening braid	10	Gland
5	'O' ring	11	Special tool
6	Suppression cover		

Fig 3 Water pump removal

9.4 Locate the gland into the suppression cover and loosely tighten. Locate the suppression cover (6) over the base and secure using the six screws and washers (7).

9.5 Fit the connections into the 14-way plug (1), refit the back of the connector and secure the cable and braid with the clamp (3).

9.6 Secure the gland (10) to the suppression cover (6) ensuring braid is fitted correctly.

9.7 Refit the heater unit to the vehicle (refer to Cat 522 Chap 18-3).

9.8 Reconnect the vehicle batteries (refer to Cat 522 Chap 13-1) and on FFR vehicles the radio batteries (refer to Cat 522 Chap 13-2).

9.9 Top up the system with the correct grade of coolant and bleed the system. (refer to Cat 522 Chap 12-2).

9.10 Start the heater unit and visually check for leaks.

BURNER CARTRIDGE

Remove

10 To remove the burner cartridge carry out the following:

10.1 Disconnect the vehicle batteries (refer to Cat 522 Chap 13-1) and on FFR vehicles the radio batteries (refer to Cat 522 Chap 13-2).

10.2 With the heater in situ, remove the three screws (Fig 4 (4)) securing the Electronic Magnetic Compatibility (EMC) box (3) to the heater and move aside the box and gasket (2).

NOTE

It is not necessary to disconnect the wiring to the plug connector. The EMC box, once released from the heater unit can be pushed back along the wires towards the connector plug to allow room.

10.3 Disconnect the quick release fuel pipe (6) from the top of the unit.

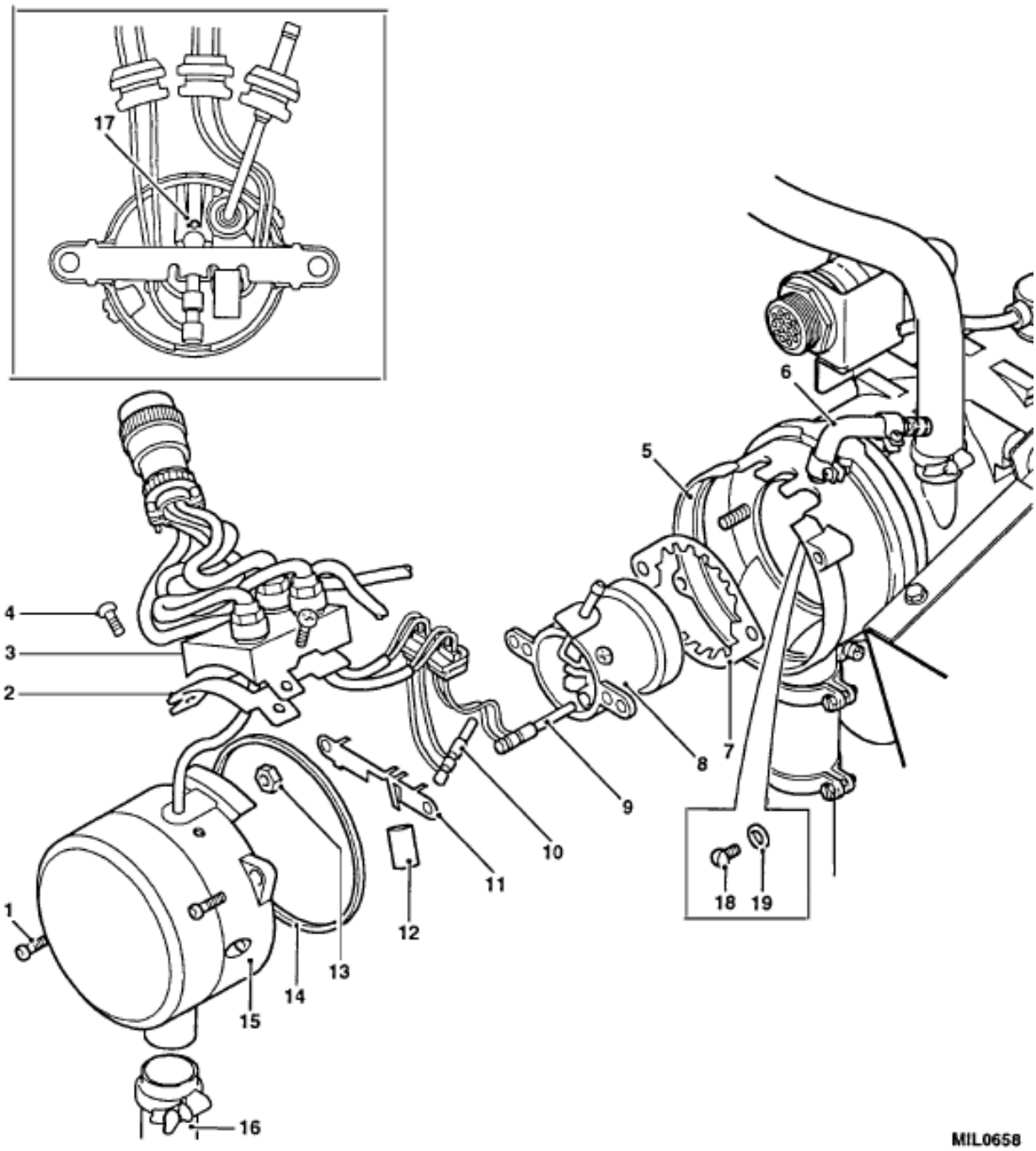
10.4 Disconnect the air intake (16).

10.5 Remove the two screws (1) securing the combustion air fan and motor (15) to the heater unit and remove the fan/motor from the heater. Support the fan/motor unit and place aside. Collect the 'O' ring (14).

10.6 Remove screw (18) and washer (19) securing fuel pipe.

10.7 Remove the two nuts (13) securing the burner cartridge (8) to the burner tube (5) and remove the support (11) and insulation sleeve (12). Withdraw the wiring grommets from the slots in combustion tube, remove the flame detector (9) and place aside.

10.8 Withdraw the burner cartridge (8) and swirl plate (7) and remove the glow pin (10).



1	Screw	8	Burner cartridge	15	Air fan and motor
2	Gasket	9	Flame detector	16	Air intake
3	EMC box	10	Glow pin	17	Air bore
4	Screw	11	Support	18	Screw
5	Burner tube	12	Sleeve	19	Washer
6	Fuel pipe	13	Nut		
7	Swirl plate	14	'O' ring		

Fig 4 Burner cartridge removal

Examination

11 Clean all components, remove sealant from mating faces and examine for signs of damage and wear. Ensure the starting air bore (Fig 4 (17)) and all other air bores are clear and pay particular attention to dents. Renew if required.

NOTES

(1) A combustion chamber with dents will impair the efficiency of the heater and cause excessive coking. Coke deposits on the evaporator surface (except for the pilot flame exit bore) are usual and need not be removed. When the load changes from full to part load and vice versa the burner is normally self cleaning.

(2) When refitting ensure the cables of the glow pin and flame sensor are routed as shown in the inset in Fig 2.

Refit

12 To refit the burner cartridge, carry out the following:

12.1 Locate the swirl plate (Fig 4 (7)) on the studs in the burner tube (5) and fit the burner cartridge (8). Ensure fuel pipe grommet is located correctly in the burner tube.

12.2 Fit the glow pin (10) and flame detector (9) to the cartridge.

12.3 Fit the support (11) and insulation sleeve (12) and secure the assembly with the two nuts (13). Tighten to 3 Nm (lbf/ft).

12.4 Secure fuel line with screw (18) and washer (19).

12.5 Ensure all wiring grommets are located correctly in the burner tube.

12.6 Apply sealant to the mating surfaces (refer to Table 1, Serial 1), fit a new 'O' ring (14) and fit combustion air fan (15) to heater unit, secure with two screws (1).

12.7 Apply sealant to the mating surfaces and the threads of the screws, refit the EMC box (3) and gasket (2) to the heater unit and secure with the screws (4).

12.8 Ensure combustion air fan air screw is plugged with sealant (refer to Table 1, Serial 1).

12.9 Reconnect the air intake (16).

12.10 Reconnect the vehicle batteries (refer to Cat 522 Chap 13-1) and on FFR vehicles the radio batteries (refer to Cat 522 Chap 13-2).

GLOW PIN AND FLAME DETECTOR

Remove

13 To remove the glow pin and the flame detector, carry out the following:

13.1 Disconnect the vehicle batteries (refer to Cat 522 Chap 13-1) and on FFR vehicles the radio batteries (refer to Cat 522 Chap 13-2).

13.2 With the heater in situ, remove the three screws (Fig 5 (4)) securing the EMC box (3) to the heater and move aside the box and gasket (2). Clean off sealant from mating faces.

13.3 Disconnect the quick release fuel pipe (9) from the top of the unit.

13.4 Disconnect the air intake (19).

13.5 Remove the two screws (1) securing the combustion air fan and motor (18) to the heater unit and remove the fan/motor from the heater. Support the air fan and motor unit and place aside.

13.6 Collect the 'O' ring (17) and clean off sealant from mating surfaces.

13.7 Remove the two nuts (16) securing the burner cartridge (11) to the burner tube (10) and remove the support (14) and sleeve (15).

13.8 Withdraw the glow pin (13) or flame detector (12) and place aside. (The flame detector can be removed with the burner tube in situ. Remove the burner to allow glow pin removal).

13.9 Disconnect the 14-way connector (7).

13.10 Remove the clamp (5) and unscrew the rear cover (6) to expose the wires.

13.11 Using the special tool (20) provided (a spare is supplied and located in the control box) release the terminal pins from the plug.

NOTE

Pins A and B supply the glow pin; Pins J and K supply the flame detector.

13.12 Pull the free ends of the wire through the braid and out via the EMC box.

13.13 Release the gland from the heater unit and remove the glow pin/flame detector.

Refit

14 To refit the glow pin/flame detector carry out the following:

14.1 Using the special tool (Fig 5 (20)) provided, feed the wire connectors through the braid from the EMC box end and locate the pins into the 14-pin plug.

14.2 Screw on the rear cover of the connector (6) and secure the braid with the clamp (5).

14.3 Locate the glow pin/flame detector in the burner cartridge (11), fit the support (14) and sleeve (15) noting the fork to locate the glow pin and secure with the two nuts (16). Ensure glands are located correctly.

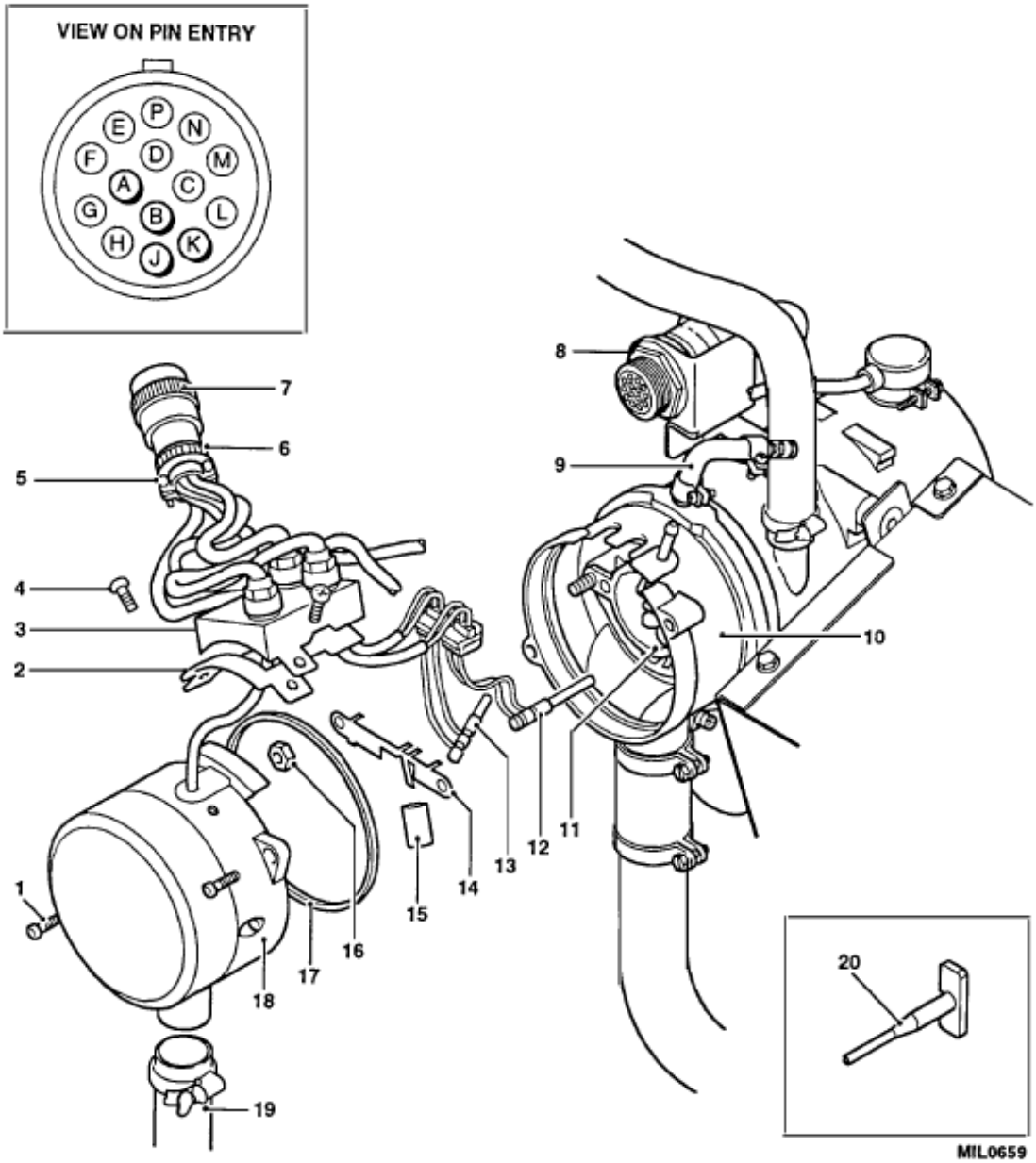
14.4 Apply sealant (refer to Table 1, Serial 1) to the mating surfaces, fit a new 'O' ring (17) and secure the air fan and motor (18) to the heater with the two screws (1).

14.5 Apply sealant (refer to Table 1, Serial 1) to the mating surfaces and screw threads, fit the EMC box (3) and gasket (2) and secure with the three screws (4).

14.6 Reconnect the fuel pipe (9).

14.7 Reconnect the air intake (19).

14.8 Reconnect the vehicle batteries (refer to Cat 522 Chap 13-1) and on FFR vehicles the radio batteries (refer to Cat 522 Chap 13-2).



1	Screw	8	14-way connector	15	Sleeve
2	Gasket	9	Fuel pipe	16	Nut
3	EMC box	10	Burner tube	17	'O' ring
4	Screw	11	Burner cartridge	18	Air fan and motor
5	Clamp	12	Flame detector	19	Air intake
6	Rear cover	13	Glow pin	20	Special tool
7	14-way connector plug	14	Support		

Fig 5 Glow pin and flame detector removal

TEMPERATURE SENSOR

Remove

15 To remove the temperature sensor carry out the following:

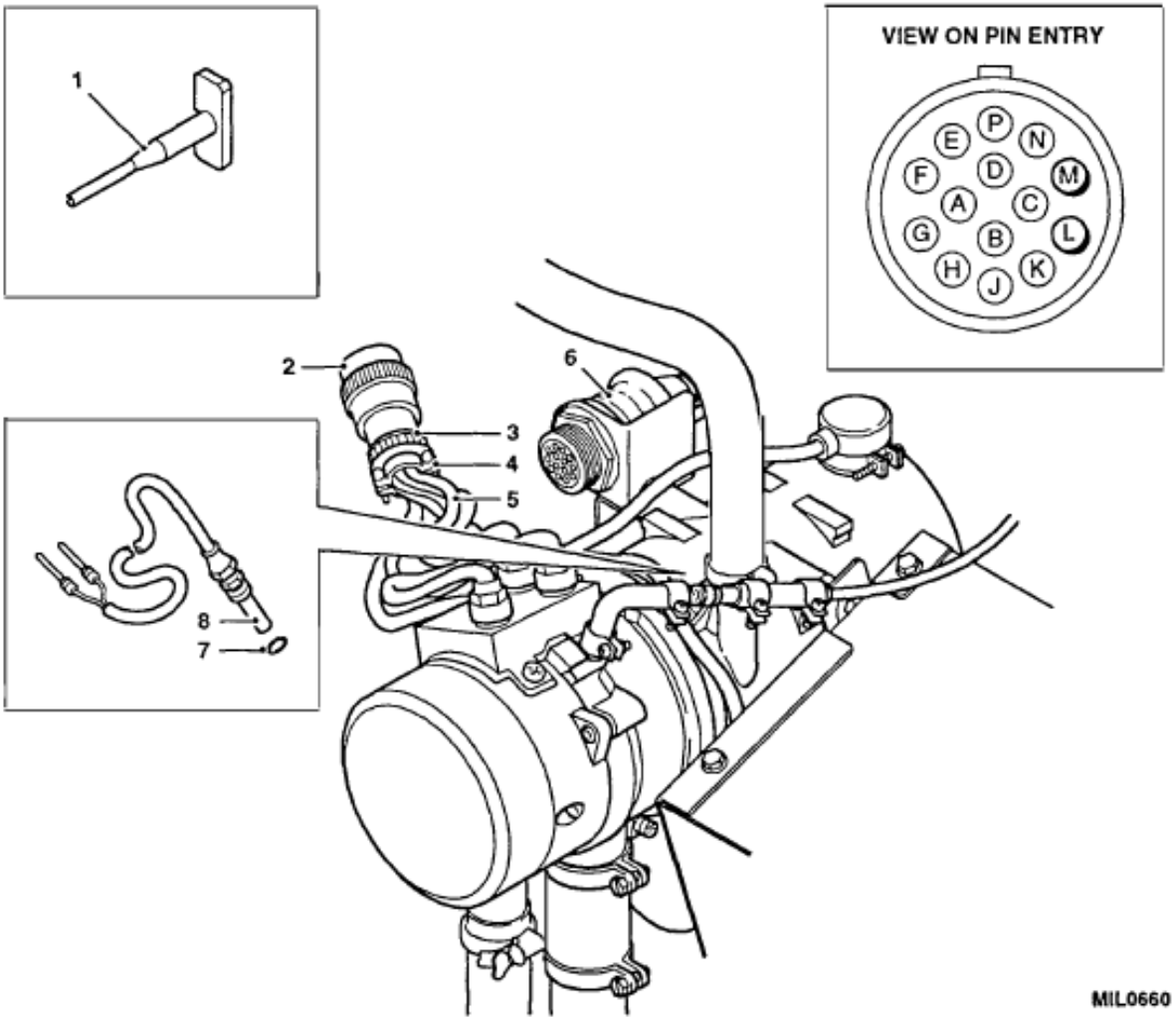
15.1 Disconnect the vehicle batteries (refer to Cat 522 Chap 13-1) and on FFR vehicles the radio batteries (refer to Cat 522 Chap 13-2).

15.2 Drain the cooling system sufficiently to allow the removal of the temperature sensor (refer to Cat 522 Chap 12-2).

15.3 Disconnect the 14-way connector plug (Fig 6 (2)).

15.4 Remove the clamp (4) and unscrew the rear cover (3) to expose the wires.

15.5 Using the special tool (1) provided (a spare is located in the control box) release the terminal pins L and M from the plug.



1	Special tool	5	Screened braid
2	14-way connector plug	6	14-way connector
3	Rear cover	7	'O' ring
4	Clamp	8	Temperature sensor

Fig 6 Temperature sensor removal

15.6 Pull screening braid (5) and wire free of connector.

15.7 Remove temperature sensor (8) and 'O' ring (7) from heater unit complete with screening braid.

Refit

16 Fit a new sensor and 'O' ring in the reverse order of removal.

16.1 Bleed the cooling system (refer to Cat 522 Chap 12-2).

16.2 Reconnect the vehicle batteries (refer to Cat 522 Chap 13-1) and on FFR vehicles the radio batteries (refer to Cat 522 Chap 13-2).

OVERHEAT SWITCH

Remove

17 To remove the overheat switch, carry out the following:

17.1 Disconnect the vehicle batteries (refer to Cat 522 Chap 13-1) and on FFR vehicles the radio batteries (refer to Cat 522 Chap 13-2).

17.2 Disconnect the 14-way connector plug (Fig 7 (2))

17.3 Remove the clamp (8) and unscrew the rear cover (9) to expose the wires.

17.4 Using the special tool (1) provided (a spare is located in the control box) release the terminal pins G and H from the plug.

17.5 Pull screening braid (3) and wire free of connector.

17.6 Remove the clamp (5) and withdraw protective cap (4).

17.7 Using a screwdriver, lever off retaining clip (6) and remove overheat switch (7) from the heater unit complete with screening braid and protective cap.

Refit

18 To refit the overheat switch carryout the following:

18.1 Insert a new overheat switch (7) into the heat exchanger and fit the retaining clip (6).

NOTE

It is important that the overheat switch is located properly, the retaining clip should be heard to click into place when fitted. If the click is not audible check the following:

18.2 Clean the seat of the overheat switch on the heat exchanger.

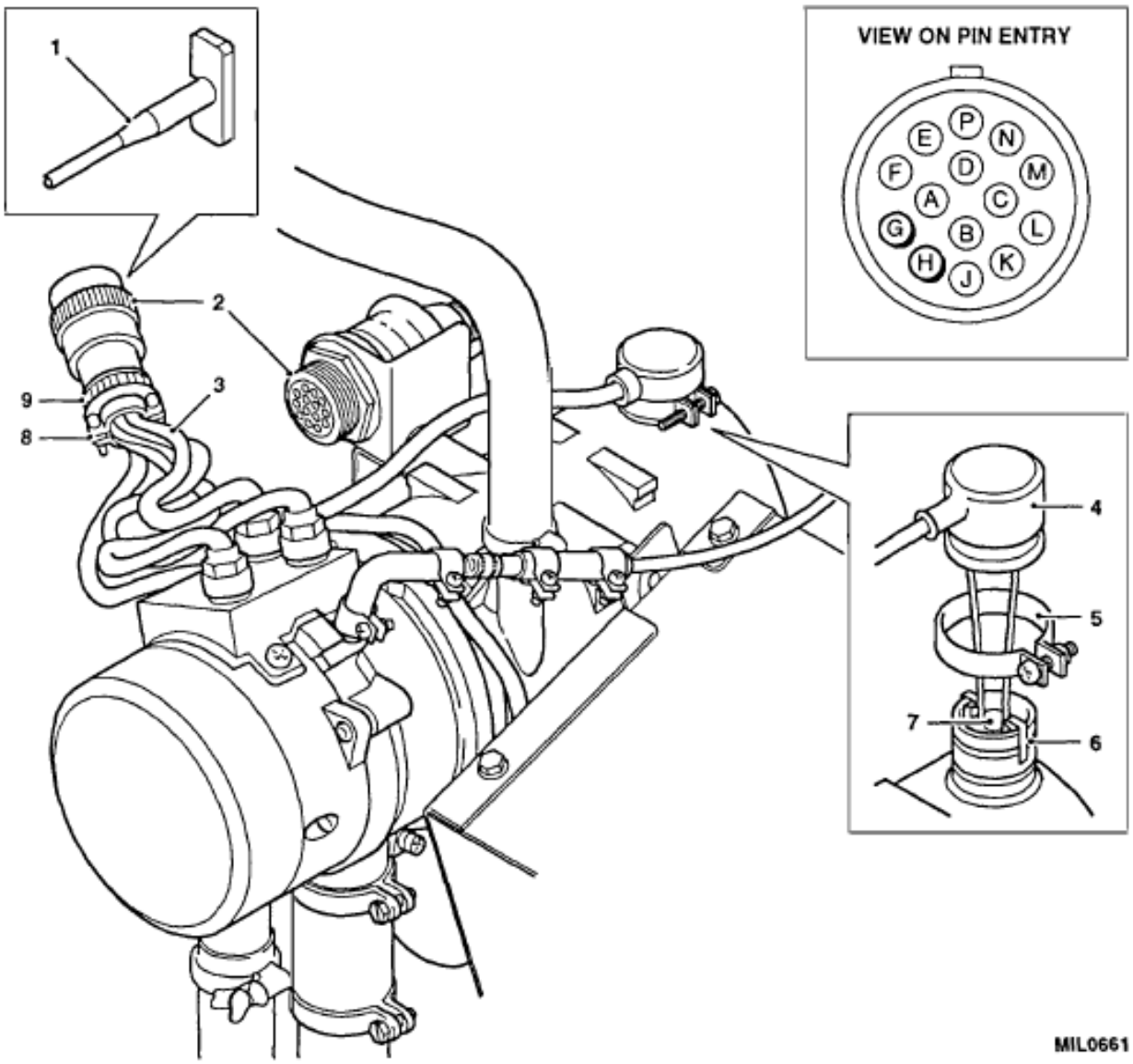
18.3 Clean groove on heat exchanger.

18.4 Ensure locking cams are present on both sides of the clip.

18.5 Fit protective cap (4) and secure with clamp (5).

18.6 Refit electrical connection.

18.7 Reconnect the vehicle batteries (refer to Cat 522 Chap 13-1) and on FFR vehicles the radio batteries (refer to Cat 522 Chap 13-2).



1	Special tool	6	Retaining clip
2	14-way connector plug	7	Overheat switch
3	Screening braid	8	Clamp
4	Protective cap	9	Rear cover
5	Clamp		

Fig 7 Overheat switch removal

COMBUSTION AIR FAN

Remove

19 To remove the combustion air fan, carry out the following:

19.1 Disconnect the vehicle batteries (refer to Cat 522 Chap 13-1) and on FFR vehicles the radio batteries (refer to Cat 522 Chap 13-2).

19.2 With the heater in situ, remove the three screws (Fig 8 (3)) securing the EMC box (2) to the heater and move aside the cover and gasket (1). Clean off sealant from mating faces.

19.3 Disconnect the 14-way connector plug (6)

19.4 Remove the clamp (4) and unscrew the rear cover (5) to expose the wires.

19.5 Using the special tool (7) provided (a spare is located in the control box) release the terminal pins C and D from the plug.

19.6 Pull the free ends of the wire through the screening braid (8) and out via the EMC box.

19.7 Disconnect the air intake (12) from the heater.

19.8 Remove the two screws (14) securing the combustion air fan and motor to the heater unit and remove the fan/motor (13). Clean off sealant from mating surfaces.

19.9 Retrieve the 'O' ring (10).

Refit

20 Refit the combustion air fan and motor as follows:

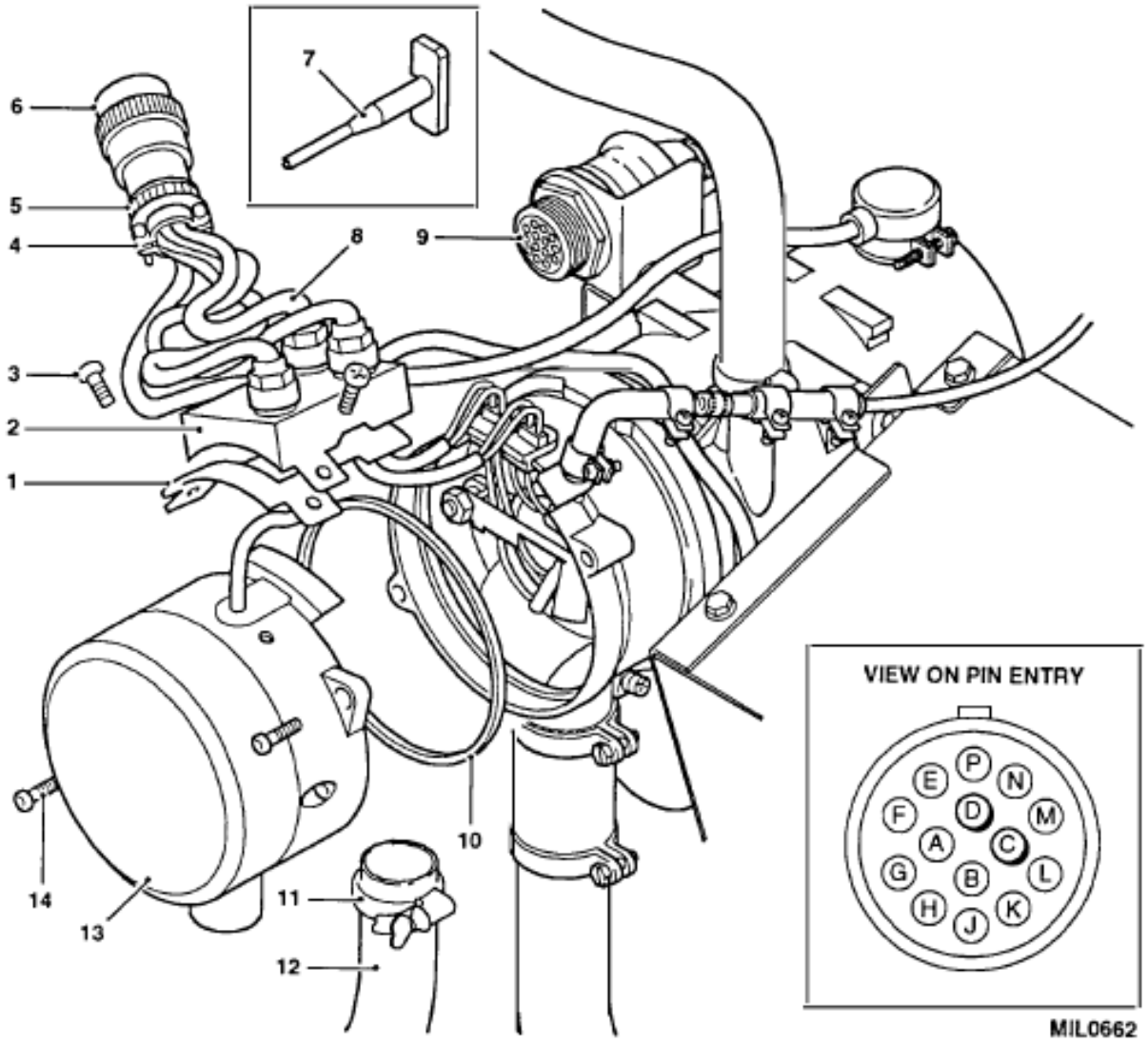
20.1 Apply sealant (refer to Table 1, Serial 1) to the mating surfaces, fit a new 'O' ring (10) and secure the air fan/motor (13) to the heater with the two screws (14).

20.2 Refit electrical connection to 14-way connector plug (6).

20.3 Apply sealant (refer to Table 1, Serial 1) to the mating surfaces and screw threads, fit the EMC box (3) and gasket (2) and secure with the three screws (4).

20.4 Reconnect the air intake (12).

20.5 Reconnect the vehicle batteries (refer to Cat 522 Chap 13-1) and on FFR vehicles the radio batteries (refer to Cat 522 Chap 13-2).



1	Gasket	8	Screening braid
2	EMC box	9	14-way connector
3	Screw	10	'O' ring
4	Clamp	11	Clamp
5	Rear cover	12	Air intake
6	14-way connector plug	13	Air fan and motor
7	Special tool	14	Screw

Fig 8 Combustion air fan removal

HEAT EXCHANGER

Remove

21 To remove the heat exchanger carry out the following:

21.1 Disconnect the vehicle batteries (refer to Cat 522 Chap 13-1) and on FFR vehicles the radio batteries (refer to Cat 522 Chap 13-2).

21.2 Remove the water heater from the vehicle (refer to Cat 522 Chap 18-3).

21.3 Remove the water pump (refer to Para 8).

21.4 Remove the temperature sensor (refer to Para 15).

21.5 Remove the overheat switch (refer to Para 17).

21.6 Remove the clamp (Fig 9 (3)) securing the combustion air fan and burner tube assembly (1) to the heat exchanger (4).

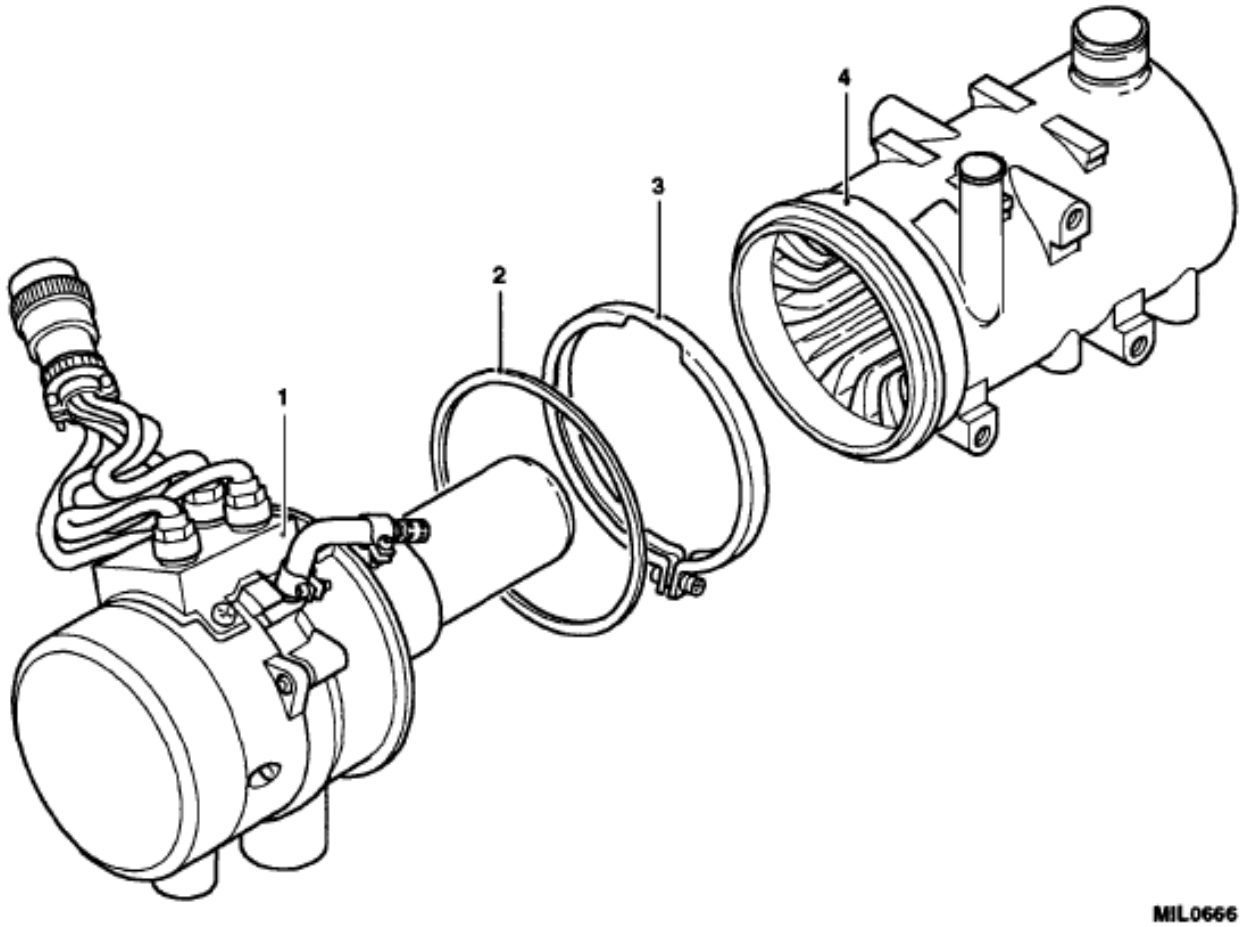
21.7 Separate the heat exchanger (4) from the combustion air fan and burner tube assembly (1) and retrieve the gasket (2).

Cleaning and examination

22 Remove any coke deposits with a wire brush and examine the heat exchanger for signs of damage or wear. Replace if necessary.

Refit

23 Refit the heat in the reverse order of removal ensuring a new gasket is fitted between the heat exchanger and the burner tube assembly.



1 Burner tube assembly
2 Gasket
3 Clamp
4 Heat exchanger

Fig 9 Heat exchanger removal

EXHAUST PIPE AND SILENCER

Remove

24 To remove the exhaust pipe and silencer, carry out the following:

24.1 Disconnect the vehicle batteries (refer to Cat 522 Chap 13-1) and on FFR vehicles the radio batteries (refer to Cat 522 Chap 13-2).

24.2 Loosen the exhaust clamp (Fig 10 (1)) from the heater unit.

24.3 Remove the bolt (8) securing the clip (3).

24.4 Loosen clamp (7) and disconnect the exhaust pipe (2) from the silencer (4).

24.5 Remove the bolt (5) nut and washer (6), securing the silencer (4) to the chassis and remove the silencer.

24.6 With draw the exhaust pipe from the vehicle.

Refit

25 Refit the exhaust pipe and silencer in the reverse order of removal.

AIR INLET PIPE

Remove

26 To remove the air inlet pipe carry out the following:

26.1 Disconnect the vehicle batteries (refer to Cat 522 Chap 13-1) and on FFR vehicles the radio batteries (refer to Cat 522 Chap 13-2).

26.2 Loosen the clamp (Fig 10 (11)) securing the air intake pipe to the heater unit.

26.3 Remove clip (9) securing the air inlet pipe and remove the pipe from the vehicle.

Refit

27 Refit the air inlet pipe in the reverse order of removal.

Adjustment of CO_2 content

28 If required adjust the CO_2 content (refer to Cat 522 Chap 18-3).

KEY TO FIG 10

1	Clamps	7	Clamp
2	Exhaust pipe	8	Bolt
3	Clip	9	Clip
4	Silencer	10	Air intake pipe
5	Bolt	11	Clamp
6	Nut and washer		

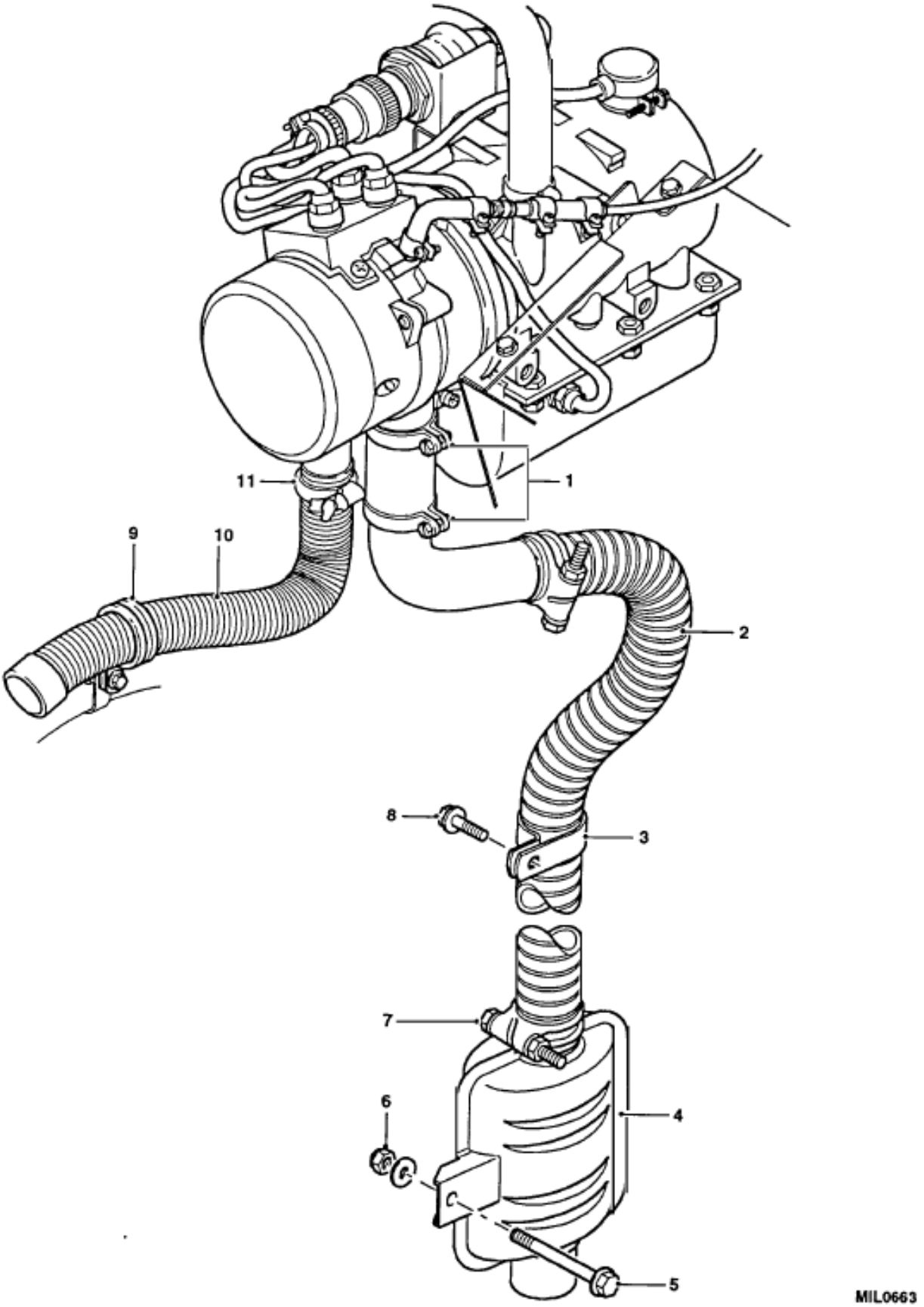


Fig 10 Exhaust pipe, air intake pipe and silencer removal

CHAPTER 18-3

AIR CONDITIONING SYSTEM

CONTENTS

INTRODUCTION

1 This Chapter details the Base repairs for the air conditioning system fitted to the Track Utility Medium (TUM) Battlefield Ambulance High Specification (HS).

WARNINGS

(1) REFRIGERANT. THE REFRIGERANT USED IN THE AIR CONDITIONING SYSTEM IS HFC (HYDRO FLUOROCARBON) R134A.

(2) PROTECTIVE CLOTHING. R134A IS A HAZARDOUS LIQUID AND WHEN HANDLED INCORRECTLY CAN CAUSE SERIOUS INJURY. SUITABLE PROTECTIVE CLOTHING MUST BE WORN WHEN CARRYING OUT SERVICING OPERATIONS ON THE AIR CONDITIONING SYSTEM.

(3) TOXIC GASES. R134A IS ODOURLESS AND COLOURLESS. DO NOT HANDLE OR DISCHARGE IN AN ENCLOSED AREA, OR IN ANY AREA WHERE THE VAPOUR OR LIQUID CAN COME IN CONTACT WITH NAKED FLAME OR HOT METAL. R134A IS NOT FLAMMABLE, BUT CAN FORM A HIGHLY TOXIC GAS.

(4) SMOKING. DO NOT SMOKE OR WELD IN AREAS WHERE R134A IS IN USE. INHALATION OF CONCENTRATIONS OF THE VAPOUR CAN CAUSE DIZZINESS, DISORIENTATION, NARCOSIS, NAUSEA OR VOMITING.

(5) SPONTANEOUS COMBUSTION. DO NOT ALLOW FLUIDS OTHER THAN R134A OR COMPRESSOR LUBRICANT TO ENTER THE AIR CONDITIONING SYSTEM. SPONTANEOUS COMBUSTION MAY OCCUR.

(6) SKIN CONTACT. R134A SPLASHED ON ANY PART OF THE BODY WILL CAUSE IMMEDIATE FREEZING OF THAT AREA. ALSO REFRIGERANT CYLINDERS AND REPLENISHMENT TROLLEYS WHEN DISCHARGING WILL FREEZE SKIN TO THEM IF CONTACT IS MADE.

(7) REFRIGERANT RECOVERY. THE REFRIGERANT USED IN AN AIR CONDITIONING SYSTEM MUST BE RECLAIMED IN ACCORDANCE WITH THE RECOMMENDATIONS GIVEN WITH A REFRIGERANT RECOVERY RECYCLING RECHARGING STATION.

NOTE

Suitable protective clothing comprises of wrap around safety glasses or helmet, heatproof gloves, rubber apron or waterproof overalls and rubber boots.

REMEDIAL ACTIONS

2 For remedial actions (refer to Cat 522 Chap 18-5).

SERVICING

3 For servicing (refer to Cat 522, Chap 18-5).

REFRIGERANT RECOVERY, RECYCLING, RECHARGING

4 For Refrigerant recovery, recycling and recharging (refer to Cat 522, Chap 18-5).

LEAK TEST SYSTEM

5 For leak test system (refer to Cat 522, Chap 18-5).

PERFORMANCE TEST

6 For performance test (refer to Cat 522, Chap 18-5).

SYSTEM TEST

7 For system test (refer to Cat 522, Chap 18-5).

HANDLING REFRIGERANT LINES

8 For handling refrigerant lines (refer to Cat 522, Chap 18-5).

PERIODIC MAINTENANCE

9 For periodic maintenance (refer to Cat 522, Chap 18-5).

EVAPORATOR UNIT

10 Table 1 details the sealants, adhesives and lubricants to be used.

TABLE 1 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	R 134A	TBA	Refrigerant

Evaporator matrix

Remove

11 To remove the evaporator carry out the following:

11.1 Remove the evaporator unit from the vehicle (refer to Cat 522 Chap 18-5).

11.2 Support the unit on a bench to prevent damage to matrix pipes.

11.3 Remove the fixings securing the top cover (Fig 1 (1)) to the evaporator unit and separate cover from casing.

11.4 Remove the fixings securing the outlet duct (8) and remove plate.

11.5 Remove the fixings securing the side air vents (5) and remove the vents from the casing.

11.6 Remove the fixings securing the fan mounting plate (6) to the casing and remove complete with fan units (14) and thermostat (3) ensuring probe is carefully removed from matrix.

11.7 Remove the foam seals from around the evaporator.

11.8 Release high and low pressure pipe connections from the side casing and withdraw the evaporator matrix (9) from the casing (13). Remove any remaining foam seals.

11.9 If required remove expansion valve (10) (refer to Para 13).

11.10 Discard all pipe connection 'O' rings.

11.11 Clean any sealing material from all joints of main casing, top cover and outlet duct.

Refit

12 Refit the evaporator as follows:

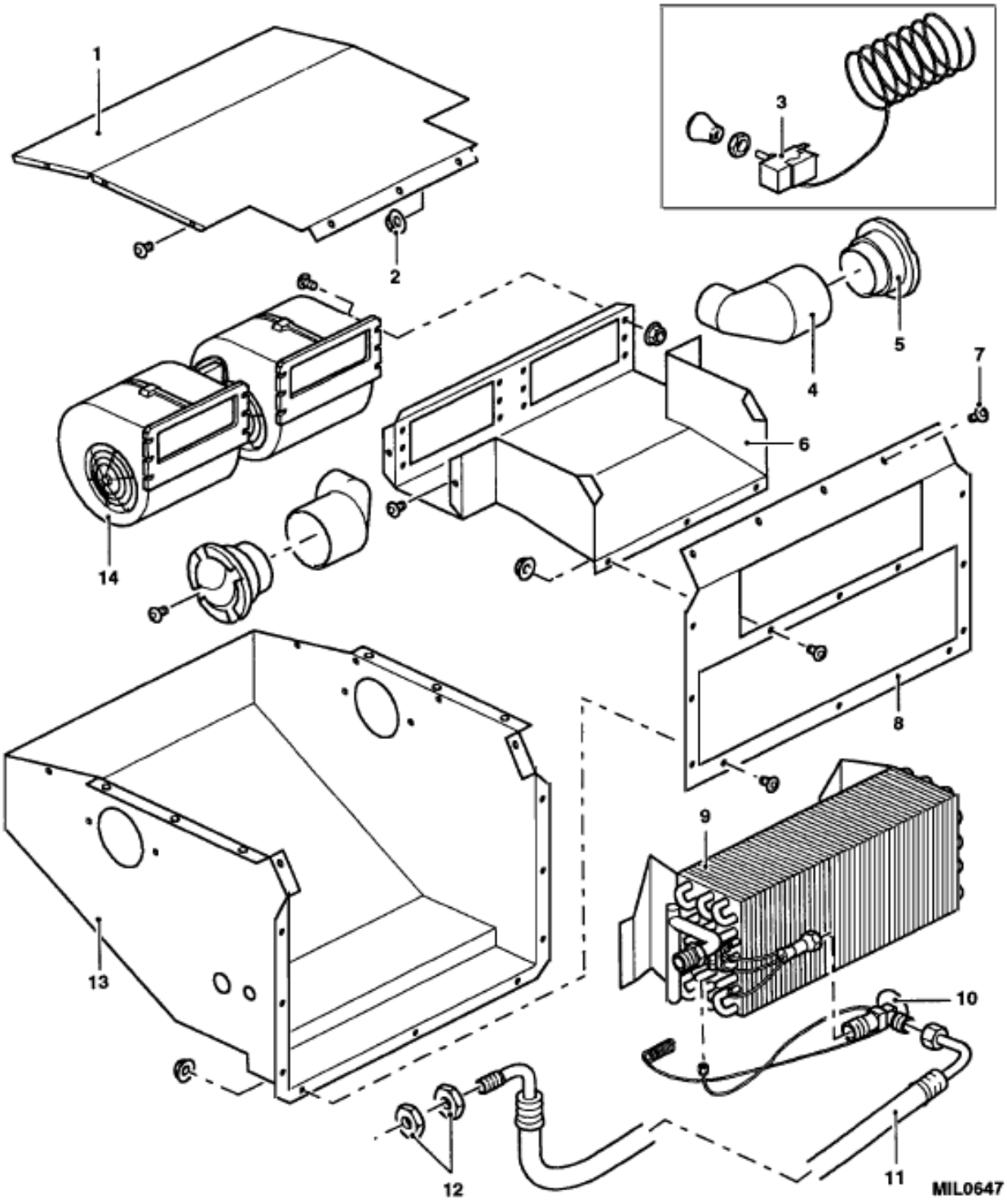
12.1 Coat unions, threads and new'O' rings with refrigerant prior to re assembly.

12.2 Fit expansion valve (refer to Para 14).

12.3 Locate evaporator matrix in casing ensuring foam seals are located around the matrix. Secure the high and low pressure connections to the side casing.

12.4 Fit foam seal to top of evaporator and fit fan mounting plate complete with fan units and thermostat ensuring probe is located in matrix.

12.5 Fit air vents to casing.



1	Top cover	8	Outlet duct
2	Nut	9	Evaporator matrix
3	Thermostat	10	Expansion valve
4	Elbow	11	High pressure pipe
5	Vent	12	Nuts
6	Fan mounting plate	13	Casing
7	Screw	14	Fan

Fig 1 Evaporator unit

12.6 Fit outlet duct plate.

12.7 Fit top cover.

12.8 Fit evaporator unit to vehicle (refer to Cat 522, Chap 18-5).

Expansion valve

Remove

13 To remove the expansion valve carry out the following:

13.1 Remove the evaporator unit from the vehicle (refer to Cat 522, Chap 18-5).

13.2 Remove evaporator from casing (refer to Para 11).

13.3 Remove clips securing expansion valve sensor and lagging to low pressure pipe.

13.4 Unscrew union securing expansion valve (10) to evaporator high pressure pipe.

13.5 Remove expansion valve complete with high pressure pipe (11).

13.6 Disconnect high pressure pipe (11) from expansion valve.

13.7 Discard all pipe connection 'O' rings.

Refit

14 Refit the expansion valve as follows:

15 Coat unions, threads and new 'O' rings with refrigerant (refer to Table 1)

15.1 , Serial 1) prior to reassembly.

15.2 Fit high pressure pipe to new expansion valve.

15.3 Fit expansion valve to evaporator pipe connector.

15.4 Position valve sensor at low pressure pipe and secure with lagging and clips.

15.5 Refit evaporator (refer to Para 12).

15.6 Fit evaporator unit to vehicle (refer to Cat 522).

Blower motor assembly

Remove

16 To remove the blower motor assembly carry out the following:

16.1 Remove the evaporator unit from the vehicle. (refer to Cat 522, Chap 18-5).

16.2 Support the unit on a bench to prevent damage to matrix pipes.

16.3 Remove the fixings securing the top cover (Fig 1 (1)) to the evaporator unit, break sealant and separate cover from casing.

16.4 Remove the fixings securing the outlet duct (8) break sealant and remove plate.

16.5 Remove the blower mounting plate (6) complete with blower assembly (14) and thermostat (3) taking care to remove the probe from the matrix.

16.6 Separate the blower assembly from the mounting plate.

Refit

17 Refit the blower motor assembly in the reverse order of removal.