300 SERIES TRACTOR WORKSHOP MANUAL

Publication No 1856 558 M8
Volume 1

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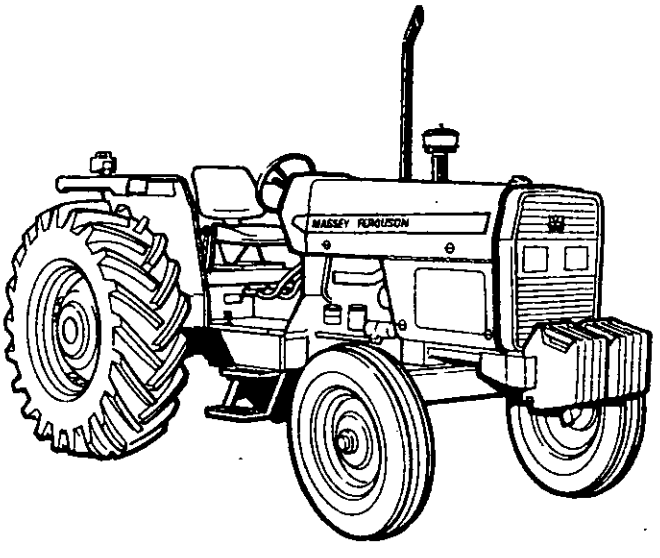

Published by:
Massey Ferguson (United Kingdom) Limited,
Banner Lane,
Coventry
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Introduction

The purpose of this manual is to assist Dealers and Distributors in the efficient repair and maintenance of Massey-Ferguson farm machinery. Carrying out the procedures as detailed, together with the use of special tools where appropriate, will enable the operations to be completed within the time stated in the repair time schedule.

To assist with locating information, each division of the manual is preceded by a contents page listing the operations. Each instruction within an operation has a sequence number, and to complete the operation in the minimum time it is essential that these instructions are performed in numerical sequence commencing at 1 unless otherwise stated. When applicable, these sequence numbers identify the components in the appropriate illustration. Where an operation requires the use of a special tool, the tool number is quoted under the operation heading and is repeated in, or following, the instruction involving its use.

Indexing

For convenience the manual is divided into parts and sections, each page bearing a part and section number. The sections are subdivided into numbered operations. Example: 7A-01 would be Section 7, Part A, Operation 01. This simplifies cross referencing and enables the subject to be found easily.

Definition of Terms

The operation descriptions generally used throughout the schedules may be defined as follows:-

Removal and Refitment
- Remove and refit an original part or assembly, or a new part or assembly which does not involve additional operations or time.

Install
- Install a part or component not previously fitted eg accessories.

Overhaul
- Remove a part or assembly, dismantle, inspect and recondition, re-assemble, and re-install making all necessary adjustments.

Disassembly and Reassembly
- The term indicates the orderly taking apart of an asssembly into individual parts and rebuilt into the original assembly.

Adjust
- Make necessary adjustments to restore specified setting or performance.

Check
- Ascertains if a setting or condition is within limits of *acceptability, either as defined in the manufacturers* specifications or, where a dimension is not specified, in the judgement of the mechanic. The checking of fixings, eg nuts and bolts, includes tightening to the specified torque figures listed in this Manual.

Servicing
- All technical work to maintain the machine in working order.

Special Tools

Where the use of a special tool is specified in an operation the tool number will be shown under the operation heading and also following the instruction requiring its use.

The use of the special tools mentioned in the text contributes to a safe, efficient and profitable repair. Some operations are impracticable without their use, eg the refitment of the differential unit. Distributors and Dealers are therefore urged to check their tools against the list provided. Where necessary, tools may be ordered from: V L Churchill & Co Ltd, London Road, Daventry, Northants, England, NN11 4NF. Telephone 0327 704461.

For further details refer to the special tool catalogue for this range of tractors, Publication Reference A1038.

Repairs and Replacements

When service parts are required it is essential that only genuine Massey-Ferguson replacements are used.

Attention is particularly drawn to the following points concerning repairs and the fitting of replacement parts and accessories.

Safety features embodied in the tractor may be impaired if other than genuine parts are fitted.

In certain territories, legislation prohibits the fitting of parts not to the tractor manufacturers specification. Torque wrench setting figures given in the Workshop Manual must be strictly adhered to. Locking devices where specified must be fitted. If the efficiency of a locking device is impaired during removal it must be renewed.

The tractor warranty may be invalidated by the fitting of other than genuine Massey-Ferguson parts. All Massey-Ferguson replacements have the full backing of the manufacturers warranty. Massey-Ferguson Distributors and Dealers are obliged to supply only genuine service parts.

Repair of the Tractor

Follow these important points:

TROUBLE-SHOOT AND CLEAN TRACTOR BEFORE DISASSEMBLY.

If possible, make a complete diagnosis to determine extent of repair required. Take precautions, as necessary, to prevent dirt or other foreign material entering hydraulic, fuel and air systems.

DO NOT MIX PARTS.

Make particular note of special parts which should not be interchanged.

DURING DISASSEMBLY, CLEAN PARTS THOROUGHLY AND INSPECT THEM FOR WEAR, DAMAGE, ETC.

LABEL PARTS. PROTECT PRECISION OR MACHINED SURFACES.

Repair Time Schedule

The operations listed in the Repair Time Schedule refer to those described in this manual. The time set against each operation in the schedule is established by performing the actual operations on standard machines using special tools where applicable. The Repair Time Schedule for use with this manual is issued as a separate publication.

Note: Repair Time Schedules are issued to Massey-Ferguson Distributors and Dealers only and are not for general circulation.

Amendments

Under normal conditions revised pages are issued carrying the same number as the existing pages requiring amendment. The new pages are inserted in place of the existing ones. The old pages should then be destroyed.

The issue number is printed on the bottom of each page, eg Issue 1, 2 or 3 etc.

In some cases aditional pages or completely new sections may be issued. These pages are to be inserted immediately following the page carrying the next lowest page number, or section number as appropriate.

Where new pages are required to be positioned between existing pages, the new page numbers will contain a suffix letter - Example:- New page number 7A-16a. This page is inserted after existing page number 7A-16 and before page number 7A-17. Correspondingly a further new page numbered 7A-16b would be positioned after 7A-16a but before 7A-17.

To ensure that a record of amendments to this manual is readily available, the list of amendments will be re-issued with each set of revised pages, quoting the amendment number, date of issue, appropriate instrucitons and revised page numbers.

Note: Service Bulletins and Amendment Sheets are issued to the Massey-Ferguson Distributors and Dealers only and are not for general circulation.

Safety Precautions

Make sure that all personnel are in a safe position before starting the engine, or operating ANY of the controls.

Always stop the engine before leaving the operator's platform.

Wait for all moving parts to stop COMPLETELY before starting any work on the tractor.

Before starting service procedures . . . attached equipment should be resting on the ground and all hydraulic control levers operated back and forth several times with the engine stopped.

If it becomes necessary to go under a raised attachment (eg loader) to perform adjustments etc, safety stands must be used to support the attachment.

Make sure the battery earth cables are disconnected before working on the electical system.

Keep hands, feet and clothing a safe distance away from moving belts, pulleys and other moving parts . . . and make sure all safety shields are installed.

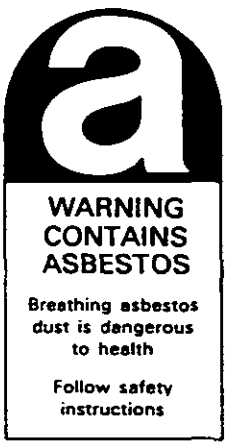
Be extra careful when performing any checks, inspection, adjustments or tests that require operating the engine, the hydraulic controls, or with the machine in motion.

Make sure dependable jacks of adequate lifting capacity and suitable stands (or wooden blocking) are used to securely block up the machine when removing any of the wheels or axles.

Before any attempt is made to disconnect or remove any hydraulic component, make sure the hydraulic pressure within the system is relieved . . . and the engine is stopped.

Carry out the repair procedures in a "common sense" manner. Safety procedures cannot be over-emphasised when working on, or around machinery . . . especially when working on engine driven and/or hydraulically actuated equipment.

Safety also depends upon the skill of the serviceman in the use of tools and other workshop equipment while performing the recommended service procedures.



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Warning

Some components on the tractor, such as gaskets and friction surfaces (brake linings, clutch linings, etc.), may contain asbestos. Breathing asbestos dust is dangerous to your health. When service operations are to be undertaken on parts containing asbestos, the essential precautions listed below must be observed:

***Work out of doors or in well ventilated area.**

***Dust found on the tractor or produced during work on the tractor must be removed by extraction and NOT by blowing.**

***Dust waste should be dampened, placed in a sealed container and marked to ensure safe disposal.**

***If any cutting, drilling etc. is attempted on materials containing asbestos, the item must be dampened and only hand tools or low speed power tools used.**

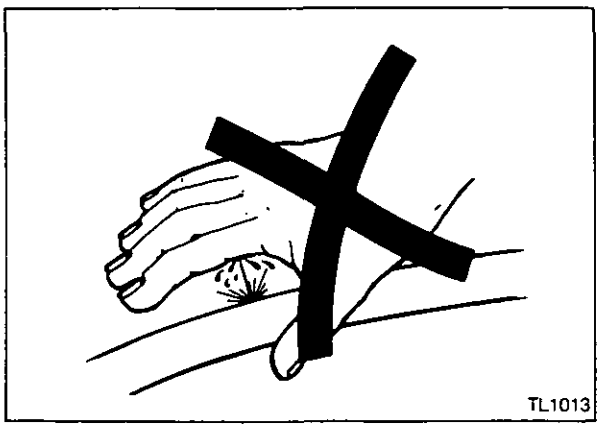
Roll Over Protective Structures (ROPS) and/or Safety Frames and Cabs

ALWAYS observe the following points – these are IMPORTANT. TIGHTEN ALL BOLTS progressively and evenly to their recommended torques. Install all bolts which project through inside edges and/or faces of frames, or cab so that threaded end of bolt (ie nut side) is outside frame. Use only bolts and other hardware supplied with ROPS (or cab frame) . . . do not substitute these fasteners. Use a flat washer over slotted holes. Use lockwasher to secure nuts . . . except self-locking type nut.	DO NOT do any of the following. Drill the frame structure to accept equipment such as extra mirrors or flashing indicators. Weld anything to the frame. Straighten a bent frame. Interchange components with other frame structures even of identical type. Modify the frame structure in any way without prior approval of Massey-Ferguson. Attach other implements, or fittings to Tractor by means of the frame structure (or its attachment points) unless such attachments are approved by Massey-Ferguson.

PERSONAL INJURY MAY RESULT IF THESE PRECAUTIONS ARE NOT FOLLOWED.

Look for this symbol to point out important safety precautions. It means - ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED.

Fluids



Fluids escaping from a very small hole can be almost invisible, they can penetrate the skin causing serious injury. Keep hands and body away from pin holes and nozzles which eject fluids under high pressure. When checking for leaks always use a piece of cardboard or wood, never use your hands to find a pressure lead.

If ANY fluid is injected into the skin, it must be attended to by a doctor immediately.

All fluids must be handled with care. If you are injured by or swallow any fluid seek medical attention immediately and show the label on the product.

Take note of the following instructions when handling fluids:

Antifreeze

When handling antifreeze observe the following safety precautions:

Warning: It is very important that you read the label on the container before you add antifreeze to the cooling system. The safety precautions are as follows:

1. Keep locked up and out of reach of children.
2. Keep only in the original container.
3. Avoid contact with the skin and eyes.
4. Wear suitable protective clothing and gloves.
5. Harmful by inhalation and if swallowed.
6. If swallowed, seek medical advice immediately and show the label or container.

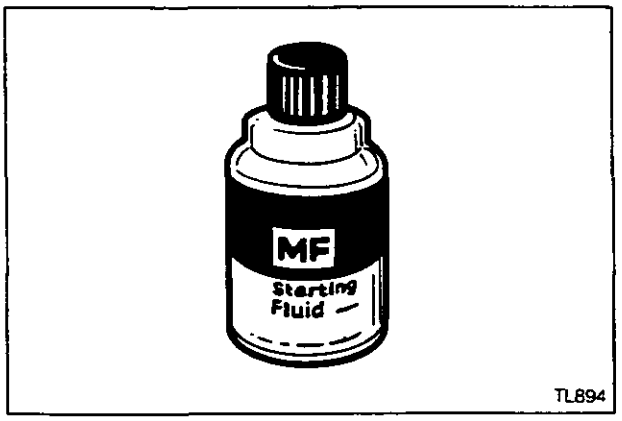
If you have any queries please contact the supplier.

Engine and transmission oils

Warning: When changing oil it is important you follow some basic rules on personal hygiene, these are as follows:

1. Before changing the oil use a suitable barrier cream on your hands
2. Wear protective clothing, overalls, PVC gloves etc.
3. Wash off with soap and water any dirty oil which you come into contact as soon as soon as you have finished changing the oil.
4. Contaminated clothing must be removed and cleaned.

Prolonged contact with dirty oil may affect your health and it is important you follow the above instructions.



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Starting fluid

Handle starting fluid safely. Starting fluid must only be used when an ether-start aid is fitted as original equipment by the manufacturer or when installed by a Dealer as an accessory. In cases of tractors being fitted with glow plugs or Thermostart, these MUST be removed prior to installation of an ether-starting aid.

Warning: It is very important that you read the label on the can before using, the safety precautions are as follows:

1. Starting fluid gives off a heavy flammable vapour.
2. DO NOT smoke.
3. DO NOT use near fire or flame.
4. Keep away from sources of ignition, store in a cool place.
5. The container is pressuried, DO NOT expose to heat or puncture, even if empty.
6. Keep out of reach of children.
7. Avoid contact with the skin and eyes.
8. Harmful by inhalation and if swallowed.
9. If swallowed or had contact with the eyes seek medical advice immediately and show the label or container.

Brake fluid

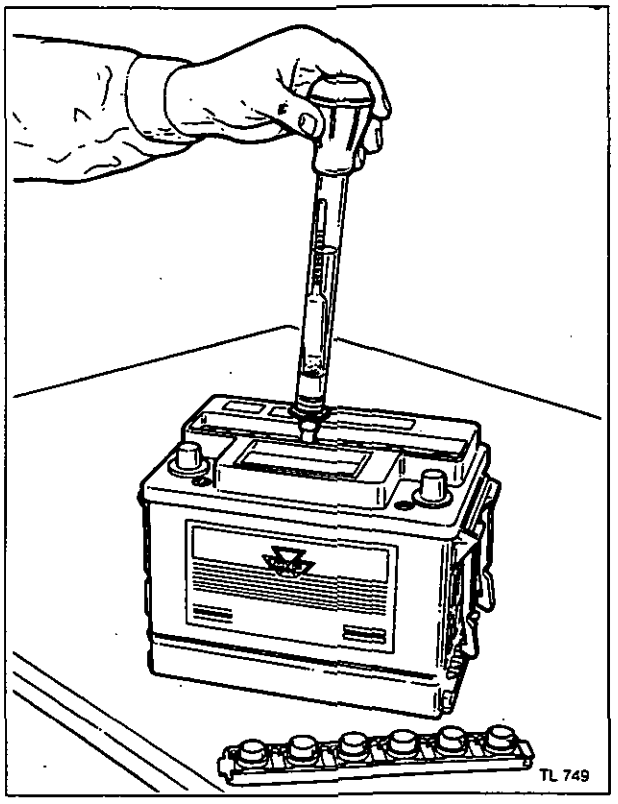
Warning: It is very important that the following safety precautions are observed in relation to brake fluid:

1. Keep only in the original container.
2. Keep out of reach of children.
3. Do not mix with other liquids or oils, keep the container tightly closed.
4. Avoid contact with the skin and eyes.
5. Wear suitable protective clothing and gloves.
6. In the event of eye contact, wash immediately with copious quantities of water then seek medical advice.
7. In the event of skin contact, thoroughly wash the affected parts, remove any contaminated clothing, and apply a conditioning cream if the skin has a tendency towards dryness.
8. If swallowed, do not induce vomiting, seek medical advice, show label or container.
9. Keep brake system mineral oil clean, contamination with dust or other materials may result in brake failure or costly repair.
10. Mineral brake oil is NOT COMPATIBLE with rubber components of other brake systems.

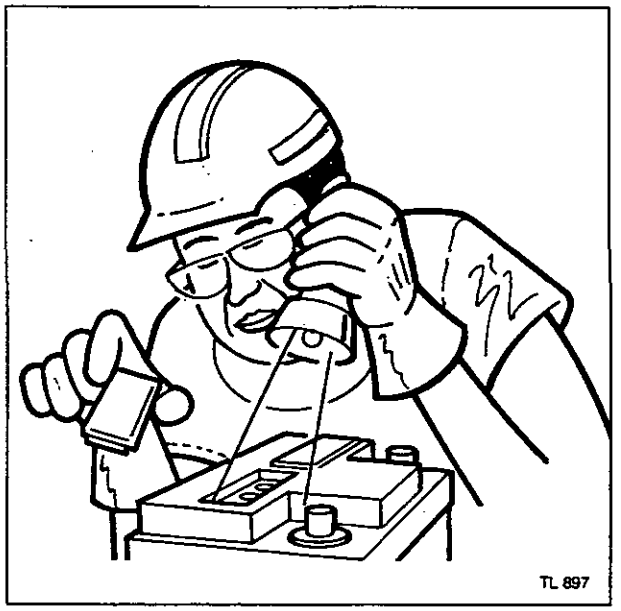
Battery

WARNING: The battery contains a sulphuric acid electrolyte which is a corrosive substance and must be treated with great care:

1. Corrosive substance.
2. Irritating to eyes and skin.
3. Keep out of reach of children.
4. Avoid contact with skin and eyes.
5. Wear suitable protective clothing, gloves and eye protection.
6. In the case of contact with eyes, rinse immediately with plenty of water and seek medical attention.
7. When charging the battery, charge in a well ventilated place and ALWAYS switch off at the mains before disconnecting the terminals.
8. If swallowed seek medical advice immediately and show the label.



9. DO NOT use a naked flame to check the electrolyte level, always use a voltmeter or hydrometer to check the state of charge.



10. Keep sparks, flames and cigarettes away, use a flashlight to check the battery electrolyte level if necessary.
11. DO NOT produce sparks with cable clamps when charging the battery or starting the tractor engine with a slave battery.
12. Ensure vent plugs are correctly installed and tight.
13. Always remove the negative (-) cable first.

Cooling System

WARNING: High pressure steam and hot water. Remove the filler cap with extreme care. DO NOT check or fill when the engine is hot or running.

Handle Fuel Safely

1. Diesel fuel is flammable and must be handled with care.
2. Never refuel or service the fuel system on the tractor while smoking or when near open flames or sparks.
3. Never refuel the tractor while the engine is running.
4. DO NOT use cans unless necessary.
5. Always clean up any spilled fuel.

Safety Guards

ALWAYS replace guards after repair, it is a legal requirement that they are fitted.

SERIAL NUMBERS – TRACTOR

The serial number of the tractor is located in two positions, on the serial number plate located on the right hand side of the tractor (See Fig.1), and stamped on the rear axle casting (See Fig.2).

From the launch of the 300 series tractorin August 1986, a new format serial number was introduced on all UK production. The tractors are numbered systematically and the number gives information on the machine type, year of manufacture and when it was built, as follows:

Example:

Year of manufacture — Tractor built in week of

5008 N 32121

Machine type — Week of manufacture

5008	=	390 2WD
N	=	1988
32	=	32nd week (week 1 = 1st week in January from 1991. Was 1st week in February up to 1990).
121	=	121st tractor built in that week.

Machine type and machine serial number (MSN):-

MF 340	2WD	5812
MF 342	2WD	9203
MF 350H	2WD	9000
MF 350	2WD	5000
MF 352	2WD	9205
MF 355	2WD	5309
MF 360	2WD	5221
MF 362	2WD	5726
MF 362H	2WD	9001
MF 362N	2WD	9153
MF 372	2WD	5998
MF 372N	2WD	9137
MF 365	2WD	5270
MF 375	2WD	5006
MF 375H	2WD	9003
MF 383	2WD	5266
MF 390	2WD	5008
MF 390H	2WD	9163
MF 390T	2WD	5723
MF 393	2WD	9131
MF 396	2WD	9129
MF 398	2WD	5010
MF 399	2WD	5012
MF 340	4WD	5747
MF 342	4WD	9204
MF 350	4WD	5001
MF 352	4WD	9206
MF 355	4WD	5310
MF 360	4WD	5222
MF 362	4WD (wide)	5727
MF 362N	4WD (narrow)	9154
MF 362H	4WD	9002
MF 365	4WD	5271
MF 372	4WD	5999
MF 372N	4WD	9138
MF 375	4WD	5007
MF 375H	4WD	9162
MF 382N	4WD	9140
MF 383	4WD	5742
MF 390	4WD	5009
MF 390H	4WD	9004
MF 390T	4WD	5724
MF 393	4WD	9132
MF 396	4WD	9130
MF 398	4WD	5011
MF 399	4WD	5013

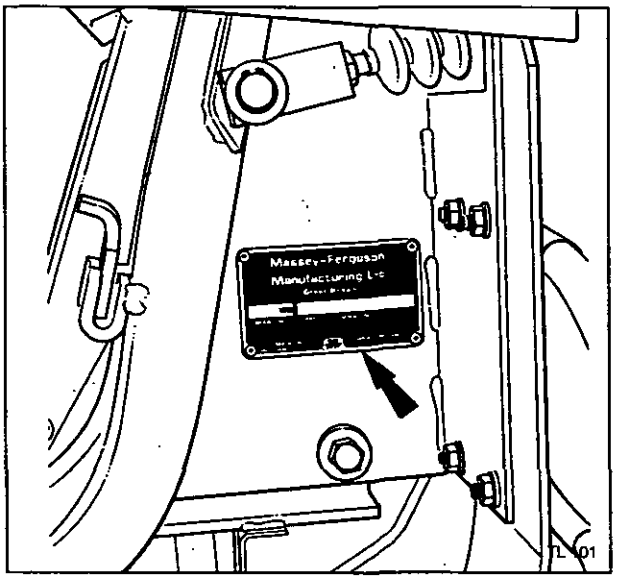


Fig.1

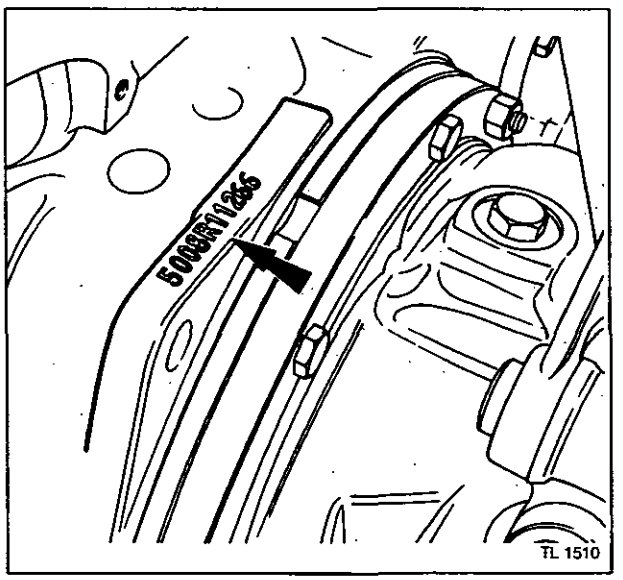


Fig.2

Year code letter:

U =	1986 - August	1986	to	January	1987.
V =	1987 - February	1987	to	January	1988.
N =	1988 - February	1988	to	January	1989.
P =	1989 - February	1989	to	January	1990.
R =	1990 - February	1990	to	December	1990.
S =	1991 - January	1991	to	December	1991.
A =	1992 - January	1992	to	December	1992.
B =	1993 - January	1993	to	December	1993.
C =	1994 - January	1994	to	December	1994.
D =	1995 - January	1995	to	December	1995.
E =	1996 - January	1996	to	December	1996.
F =	1997 January	1997	to	December	1997.
G =	1998 January	1998	to	December	1998.
H =	1999 January	1999	to	December	1999.
J =	2000 January	2000	to	December	2000.

Serial Numbers – Engine

The engine numbering system consists of up to thirteen letters and numbers giving details of build code, country of origin, serial number and year of manufacture. The positions of the serial numbers are as follows:

Figure 3 - 3 cylinder engines.
Figure 4 - 4 cylinder engines.
Figure 5 - 6 cylinder engines.

Example:

Country of manufacture — Year of manufacture

Engine family — LD31190U123456T

Build code — Serial number

LD	=	Engine family - 4.236
31190	=	Build code
U	=	United Kingdom Manufactured
123456	=	Engine serial number
T	=	1989

Engine family codes:-

CE	=	D3.152.
CN	=	T3.1524.
LD	=	4.236.
LF	=	4.248.
LJ	=	T4.236.
TW	=	6.3544.

Country of manufacture:-

A	=	Argentina
B	=	Brazil
C	=	Australia
D	=	Germany
E	=	Spain
F	=	France
G	=	Greece
J	=	Japan
K	=	Korea
L	=	Italy
M	=	Mexico
N	=	U.S.A.
P	=	Poland
S	=	India
T	=	Turkey
U	=	United Kingdom
W	=	Iran
X	=	Peru
Y	=	Yugoslavia

Year of manufacture:-

N	=	1986
P	=	1987
S	=	1988
T	=	1989
U	=	1990
V	=	1991
W	=	1992
X	=	1993
Y	=	1994
A	=	1995
B	=	1996
C	=	1997
D	=	1998
E	=	1999
F	=	2000

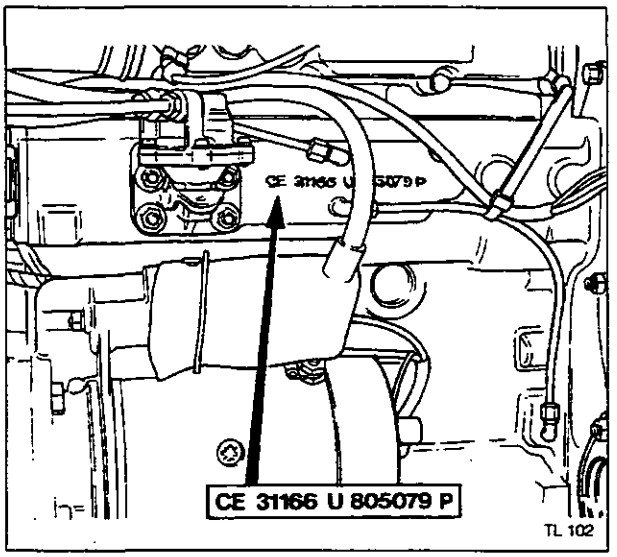


Fig.3

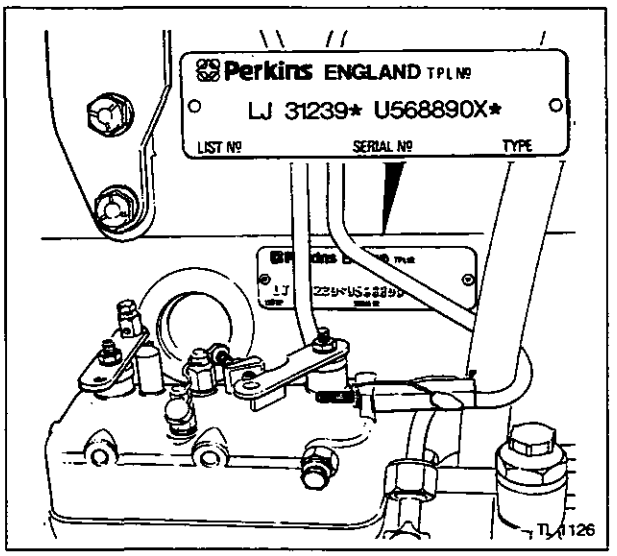


Fig.4

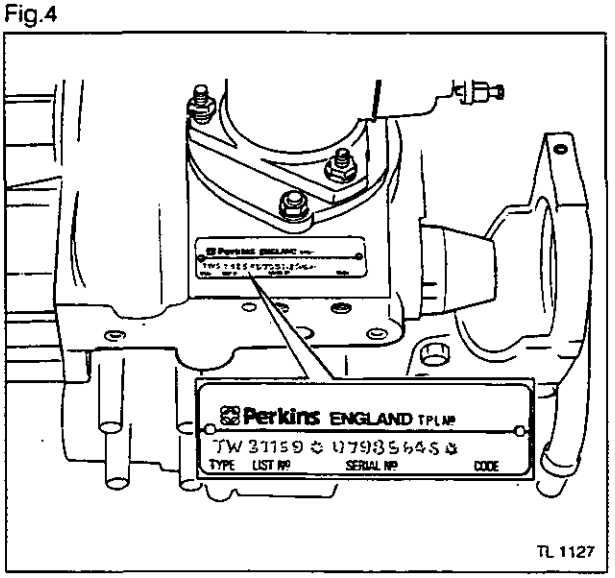


Fig.5

Transmission Identification

Rear Axle Ratio

The ratio of the crownwheel and pinion fitted to the tractor can be indentified by a letter stamping on the centre housing casing (see figure 6).

Marking	Ratio	No. of teeth
S	3.889:1	9 x 35
X	3.454:1	11 x 38
No mark	4.375:1	8 x 35

Epicyclic Ratio

The rear axle epicyclic ratios can be intentified by an either an X stamped on the drive hub of early models or a groove machined into the ring gear from 1990 onwards as follows (see figure 7).

Marking	Ratio	Type	Size 'A'
X or groove	3.75:1	Normal duty	309 mm (12 in)
No mark	3.14:1	Normal duty	309 mm (12 in)
X or groove	4.80:1	Heavy duty	338 mm (13 in)

Transmission Gearbox

All gearboxes are stamped with a unit number adjacent to the safety start switch (see figure 8). This number identifies the build of the gearbox in respect of constant mesh ratio, PTO ratio, normal or heavy duty epicyclic unit and whether the box is fitted with a long or short PTO shaft. Long shafts are fitted to tractors with four wheel drive drop-box or spacer, short shafts to non-spacer footstep tractors only.

The attached chart lists all the builds of gearbox by type and unit number giving the ratios and the number of teeth on the constant mesh gears in driver x driven order.

Additional information is given in respect of the models of tractor to which the box is fitted. It will be noted that there are a number of different builds of gearbox for any model of tractor. This is due to the different sizes of tyres related to the maximum speed of the tractor e.g. 25, 30 or 40 kph.

The purpose of this chart is to enable mechanics to identify the correct constant mesh gears for the gearbox they are overhauling.

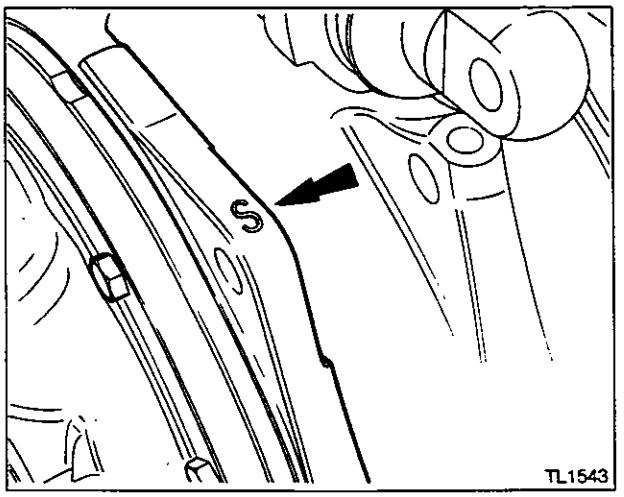


Fig. 6

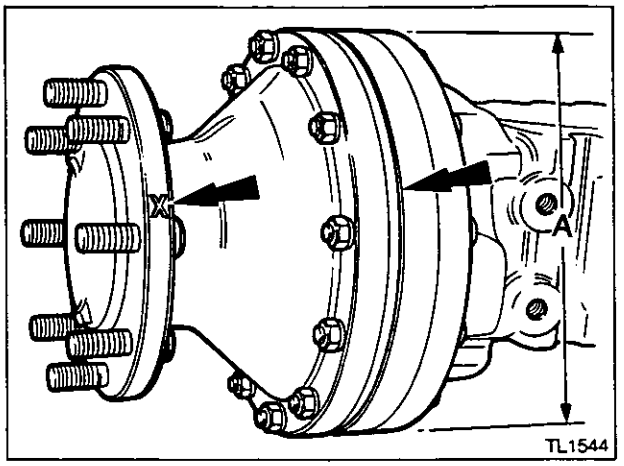


Fig. 7

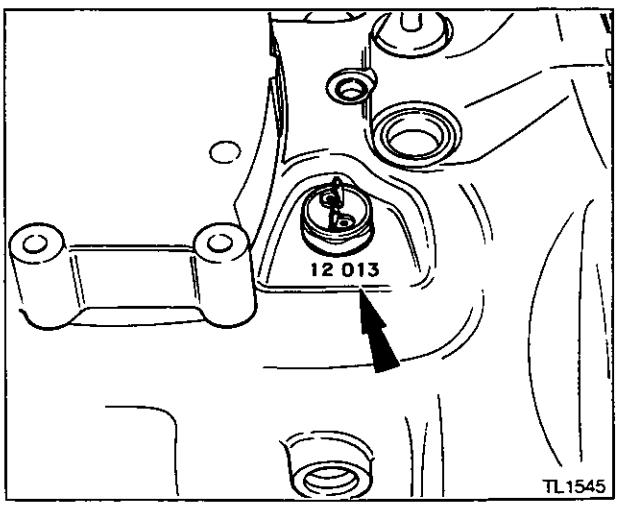


Fig. 8

GEARBOX SPECIFICATION LISTING

Gearbox Unit No.	High Range Constant-mesh ratio	High Range No. of teeth on gears	Low Range Constant-mesh ratio	Low Range No. of teeth on gears	Power Take Off Constant-mesh ratio	Power Take Off No. of teeth on gears	Type of Hyd. pump	Type of Epicyc	Long or short PTO shaft fitted	Models applicable
8 Speed standard gearbox										
12001	1.000:1	35T x 35T	-	-	3.312:1	16T x 53T	Std. flow	Normal duty	Short	M-F 350, 355, 365
12002	1.225:1	31T x 38T	-	-	3.312:1	16T x 53T	Std. flow	Normal duty	Short	M-F 360, 362
12003	1.000:1	35T x 35T	-	-	3.312:1	16T x 53T	Std. flow	Normal duty	Long	M-F 350, 355, 360
12005	1.156:1	32T x 37T	-	-	3.312:1	16T x 53T	Std. flow	Normal duty	Long	M-F 355, 360, 362, 365
12006	1.413:1	29T x 41T	-	-	3.312:1	16T x 53T	Std. flow	Heavy duty	Short	M-F 375, 383, 390
12007	1.156:1	32T x 37T	-	-	1.900:1	20T x 38T	High flow	Heavy duty	Long	M-F 375, 390
12008	1.225:1	31T x 38T	-	-	3.312:1	16T x 53T	Std. flow	Normal duty	Long	M-F 360, 362
12012	1.156:1	32T x 37T	-	-	1.900:1	20T x 38T	High flow	Normal duty	Long	M-F 365
12013	1.156:1	32T x 37T	-	-	3.312:1	16T x 53T	Std. flow	Heavy duty	Long	M-F 375, 390
12017	1.156:1	32T x 37T	-	-	3.312:1	16T x 53T	Std. flow	Heavy duty	Short	M-F 375
12018	1.156:1	32T x 37T	-	-	3.312:1	16T x 53T	Std. flow	Normal duty	Short	M-F 365
12021	1.156:1	32T x 37T	-	-	1.900:1	20T x 38T	High flow	Normal duty	Short	M-F 365
12024	1.000:1	35T x 35T	-	-	1.900:1	20T x 38T	High flow	Normal duty	Long	M-F 355
12026	1.156:1	32T x 37T	-	-	1.900:1	20T x 38T	High flow	Heavy duty	Short	M-F 390
12029	1.413:1	29T x 41T	-	-	3.312:1	16T x 53T	Std. flow	Heavy duty	Long	M-F 375, 383, 390
12030	1.225:1	31T x 38T	-	-	1.900:1	20T x 38T	High flow	Heavy duty	Short	M-F 390
12031	1.225:1	31T x 38T	-	-	1.900:1	20T x 38T	High flow	Heavy duty	Long	M-F 390
8 Speed synchromesh gearbox										
12009	1.000:1	35T x 35T	-	-	3.312:1	16T x 53T	Std. flow	Normal duty	Long	M-F 350, 355, 360
12010	1.156:1	32T x 37T	-	-	3.312:1	16T x 53T	Std. flow	Normal duty	Long	M-F 350, 355, 360, 365
12014	1.156:1	32T x 37T	-	-	3.312:1	16T x 53T	Std. flow	Heavy duty	Long	M-F 375, 390
12015	1.156:1	32T x 37T	-	-	1.900:1	20T x 38T	High flow	Heavy duty	Long	M-F 375, 390
12016	1.156:1	32T x 37T	-	-	1.900:1	20T x 38T	High flow	Normal duty	Long	M-F 365
12020	1.156:1	32T x 37T	-	-	3.312:1	16T x 53T	Std. flow	Normal duty	Short	M-F 362
12022	1.000:1	35T x 35T	-	-	1.900:1	20T x 38T	High flow	Normal duty	Long	M-F 355, 360
12023	1.000:1	35T x 35T	-	-	3.312:1	16T x 53T	Std. flow	Normal duty	Short	M-F 355
12032	2.740:1	19T x 52T	-	-	3.312:1	16T x 53T	Std. flow	Normal duty	Long	M-F 340
12033	2.740:1	19T x 52T	-	-	3.312:1	16T x 53T	Std. flow	Normal duty	Long	M-F 340, Hyd. pipes fitted
12 Speed synchromesh gearbox										
12200	1.000:1	35T x 35T	1.266:1	30T x 38T	3.312:1	16T x 53T	Std. flow	Normal duty	Long	M-F 350, 355, 360
12201	1.156:1	32T x 37T	1.464:1	28T x 41T	1.900:1	20T x 38T	High flow	Normal duty	Long	M-F 355, 360, 362, 365
12202.	1.156:1	32T x 37T	1.464:1	28T x 41T	3.312:1	16T x 53T	Std. flow	Heavy duty	Long	M-F 375, 390
12203	1.156:1	32T x 37T	1.464:1	28T x 41T	1.900:1	20T x 38T	High flow	Heavy duty	Long	M-F 375, 390
12204	1.069:1	29T x 31T	1.360:1	25T x 34T	1.900:1	20T x 38T	High flow	Heavy duty	Long	M-F 390, 398, 399
12206	1.156:1	32T x 37T	1.464:1	28T x 41T	3.312:1	16T x 53T	Std. flow	Normal duty	Long	M-F 355, 360, 362, 365
12207	1.156:1	32T x 37T	1.464:1	28T x 41T	3.312:1	16T x 53T	Std. flow	Heavy duty	Short	M-F 375, 390
12208	1.156:1	32T x 37T	1.464:1	28T x 41T	1.900:1	20T x 38T	High flow	Heavy duty	Short	M-F 375, 390
12209	1.069:1	29T x 31T	1.360:1	25T x 34T	1.900:1	20T x 38T	High flow	Heavy duty	Short	M-F 390, 398
12210	0.864:1	37T x 32T	1.125:1	32T x 36T	1.900:1	20T x 38T	High flow	Heavy duty	Long	M-F 390, 399
12211	1.156:1	32T x 37T	1.464:1	28T x 41T	1.900:1	20T x 38T	High flow	Normal duty	Short	M-F 365
12212	1.156:1	32T x 37T	1.464:1	28T x 41T	3.312:1	16T x 53T	Std. flow	Normal duty	Short	M-F 355, 360, 365
12214	1.000:1	35T x 35T	1.266:1	30T x 38T	1.900:1	20T x 38T	High flow	Normal duty	Long	M-F 340, 355, 360
12215	1.000:1	35T x 35T	1.266:1	30T x 38T	3.312:1	16T x 53T	Std. flow	Normal duty	Short	M-F 355
12 Speed Multi-Power gearbox										
12402	1.156:1	32T x 37T	1.464:1	28T x 41T	1.900:1	20T x 38T	High flow	Heavy duty	Short	M-F 375, 390
12403	1.156:1	32T x 37T	1.464:1	28T x 41T	1.900:1	20T x 38T	High flow	Heavy duty	Long	M-F 375, 390
12404	1.069:1	29T x 30T	1.360:1	25T x 34T	1.900:1	20T x 38T	High flow	Heavy duty	Short	M-F 398
12405	1.069:1	29T x 30T	1.360:1	25T x 34T	1.900:1	20T x 38T	High flow	Heavy duty	Long	M-F 398, 399
12406	1.156:1	32T x 37T	1.464:1	28T x 41T	1.900:1	20T x 38T	High flow	Normal duty	Long	M-F 365
12407	1.156:1	32T x 37T	1.464:1	28T x 41T	3.312:1	16T x 53T	Std. flow	Heavy duty	Short	M-F 375, 390
6 Speed manual shuttle										
12500	2.000:1	20T x 40T	-	-	3.117:1	25T x 53T	Std. flow	Normal duty	Short	M-F 360
12501	2.000:1	20T x 40T	-	-	3.117:1	25T x 53T	Std. flow	Normal duty	Long	M-F 360
8 Speed manual shuttle										
12513	1.681:1	22T x 37T	-	-	1.900:1	20T x 38T	High flow	Normal duty	Long	M-F 355, 360, 362, 365
12517	1.681:1	22T x 37T	-	-	1.900:1	20T x 38T	High flow	Heavy duty	Long	M-F 375, 390
12518	1.400:1	25T x 35T	-	-	3.312:1	16T x 53T	Std. flow	Normal duty	Short	M-F 360, 362
12520	1.400:1	25T x 35T	-	-	3.312:1	16T x 53T	Std. flow	Normal duty	Long	M-F 350, 355, 360
12521	1.400:1	25T x 35T	-	-	1.900:1	20T x 38T	High flow	Normal duty	Long	M-F 355
12522	1.400:1	25T x 35T	-	-	3.312:1	16T x 53T	Std. flow	Heavy duty	Short	M-F 375, 390
12525	1.400:1	25T x 35T	-	-	1.900:1	20T x 38T	High flow	Heavy duty	Long	M-F 375, 390

Continued . . .

GEARBOX SPECIFICATION LISTING continued

Gearbox Unit No.	Transmission		Power Take-off			Type of Hyd. Pump	Rear axle Epicyc. Ratio	Trans-mission Speed	Models Applicable
	Constant-mesh ratio	No. of teeth on gears	Constant-mesh ratio	No. of teeth on gears	Type of PTO				
12 Speed manual shuttle									
12600	0.944:1	36T x 34T	2.00:1	20T x 40T	540/1000 PTO	High flow	4.8:1	40 km/hr	M-F 398, 399
12601	1.193:1	31T x 37T	2.00:1	20T x 40T	540/1000 PTO	High flow	4.8:1	30 km/hr	M-F 398, 399
12601	1.193:1	31T x 37T	2.00:1	20T x 40T	540/1000 PTO	High flow	3.75:1	40 km/hr	M-F 365, 375, 390, 390T
12602	1.193:1	31T x 37T	2.632:1	19T x 50T	540 Economy PTO	Int. flow	3.75:1	40 km/hr	M-F 365, 375, 390, 390T
12603	1.464:1	28T x 41T	2.00:1	20T x 40T	540/1000 PTO	High flow	3.75:1	30 km/hr	M-F 365, 375, 390, 390T
12604	1.464:1	28T x 41T	2.632:1	19T x 50T	540 Economy PTO	Int. flow	3.75:1	30 km/hr	M-F 365, 375, 390, 390T

4WD Transfer Gearbox

From 1990 onwards the 4WD transfer gearbox is identified by the last six digits of the part number being stamped on the side of the box (see figure 9) e.g. 1693 607 M93 reads 607 M93.

The following chart gives details of the various boxes fitted, for further details see page 7F-02.

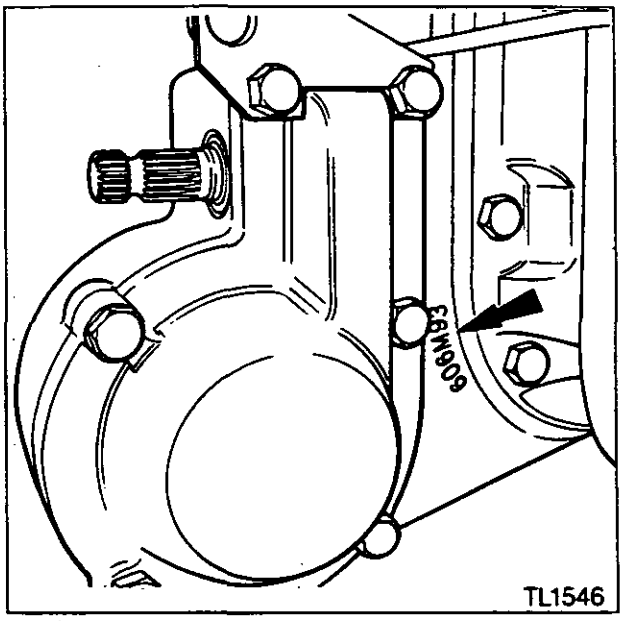


Fig. 9

Part number 3612 661 M91
*3698 711 M91
Type ..... Normal duty
Model application ..... M-F 340
Ratio 0.373:1

Part number 1693 607 M93
*3613 187 M91
Type ..... Normal duty
Model application ..... M-F 350 to 365 (excluding 8 speed shuttle gearbox)
Ratio 0.66:1

Part number 1693 606 M93
*3613 186 M91
Type ..... Heavy duty
Model application ..... M-F 375 to 399 (excluding 8 speed shuttle gearbox)
Ratio 0.66:1

Part number 3612 090 M91
*3613 933 M91
Type ..... Normal duty
Model application ..... M-F 350 to 365 (Fitted with 8 speed shuttle gearbox only)
Ratio 0.526:1

Part number 3612 089 M91
*3613 932 M91
Type ..... Heavy duty
Model application ..... M-F 375 to 390 (Fitted with 8 speed shuttle gearbox only)
Ratio 0.526:1

Part number *3613 935 M91
Type ..... Normal duty
Model application ..... M-F 340 (Fitted with 8 speed shuttle gearbox only)
Ratio 0.371:1

* Gearbox part numbers introduced from July 1991.

4WD Front Axle

The front axles are identified by the part number and serial number being stamped on the right-hand axle casing, see figure 10.

Example:

Part number

3428063M L0819

Serial number

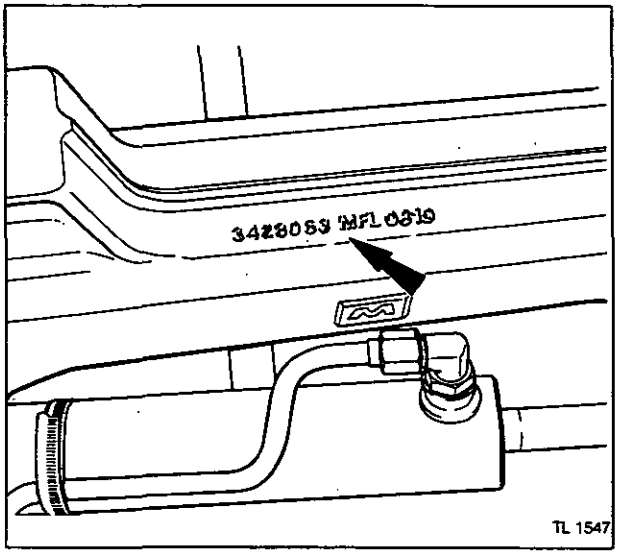


Fig.10

Part number	Type	Category	Build type
Axles with Standard differential			
3428 057 M91	NG100/SDN	Category 1 narrow	MF 340 only
3426 356 M92	NG100SDN	Category 1 narrow	Sealed unit
3428 054 M91	NG100/SDN	Category 1 narrow	Standard unit
Axles with No-spin differential			
3426 358 M92	NG100SDN	Category 1 narrow	Sealed unit
3428 053 M91	NG100/SDN	Category 1 narrow	Standard unit
3426 362 M92	NG100/SD	Category 1 wide	Sealed unit
3426 058 M91	NG100/SD	Category 1 wide	Standard unit
3426 366 M92	NG200/SD	Category 2	Sealed unit
3428 061 M91	NG200/SD	Category 2	Standard unit
3426 378 M92	NG250/SD	Category 2.5	Sealed unit
Axles with Hydrolock differential			
3426 942 M91	NG100/SDN	Category 1 narrow	Sealed unit
3428 055 M91	NG100/SDN	Category 1 narrow	Standard unit
3426 943 M91	NG100/SD	Category 1 wide	Sealed unit
3428 060 M91	NG100/SD	Category 1 wide	Standard unit
3426 944 M91	NG200/SD	Category 2	Sealed unit
3428 063 M91	NG200/SD	Category 2	Standard unit
3426 945 M91	NG250/SD	Category 2.5	Sealed unit

NOTE: Build type, 'Standard Unit' is an axle for operating in normal working conditions. 'Sealed Unit' for operating in severe conditions such as paddy fields. See section 10, page 10C–02 for model application.

4WD Front Axle Serial Number Plate

A serial number plate was introduced in 1991. It is divided into five sections, each section giving information as follows:-

1. **Axle = Axle type.**
   AG 65 SD - Type 65 side drive.
   342 and 352 tractors.
   AG 66 SD - Type 66 side drive.
   362, 372 and 382 tractors.
   NG 100 SDN - type 100 side drive narrow.
   340, 350, 355, 360 and 362 tractors.
   NG 100 SDW - type 100 side drive wide.
   365 and 375 tractors.
   NG 200 SD - type 200 side drive
   383, 390 and 390T tractors.
   NG 250 SD - type 250 side drive.
   398 and 399 tractors.
2. **Diff = Differential type.**
   NS = No-spin (autolock).
   ST = Standard (no differential lock).
   HY = Hydrolock.
3. **Total ratio = The total ratio value of the axle from input to wheel.**
4. **Serial No. = Progressive serial number.** The last two letters of the number refer to the date of build.

The first letter denotes the month:-

A	= January	G	= July
B	= February	H	= August
C	= March	I	= September
D	= April	L	= October
E	= May	M	= November
F	= June	N	= December

The second letter denotes the year:-

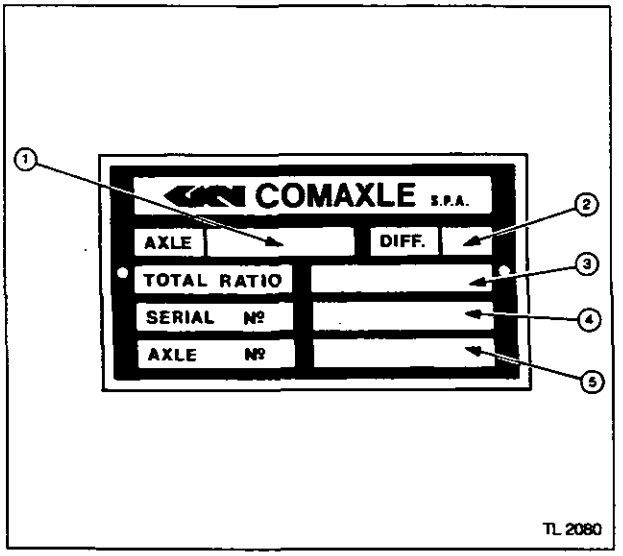
A	= 1991	E	= 1995
B	= 1992	F	= 1996
C	= 1993	G	= 1997
D	= 1994	H	= 1998

5. **Axle No. = Part number of the axle:–**
   The current part numbers used on four-wheel drive front axles are as follows:-

Axles with standard differential
3428 057 M91 . NG100/SDN 340
3426 356 M92 . NG100/SDN ..... sealed
3428 054 M91 . NG100/SDN ..... standard

Axles with No-Spin differential (Autolock)
3426 358 M92 . NG100/SDN ..... sealed
3428 053 M91 . NG100/SDN ..... standard
3426 362 M92 . NG100/SD ..... sealed
3428 058 M91 . NG100/SD ..... standard
3426 366 M92 . NG 200/SD ..... sealed
3428 061 M91 . NG 200/SD ..... standard
3426 378 M92 . NG 250/SD ..... sealed

Axles with Hydrolock differential
3426 942 M91 . NG100/SDN ..... sealed
3428 055 M91 . NG100/SDN ..... standard
3426 943 M91 . NG100/SD ..... sealed
3428 060 M91 . NG100/SD ..... standard
3426 944 M91 . NG 200/SD ..... sealed
3428 063 M91 . NG 200/SD ..... standard
3426 945 M91 . NG 250/SD ..... sealed



Standard unit is an axle for operating in normal working conditions. Sealed unit for operating in severe conditions such as paddy fields.

Axle part numbers

Tract model	Axle type	Axle part number	Differential type
342	AG 65	3429 737 M9 3429 745 M91	Hydralock No differential lock
352	AG 65	3429 725 M91 3429 655 M91	Hydralock No differential lock
362 372 382	AG 66N	3429 730 M91 narrow axle	Hydralock
362 372 382	AG 66W	3429 814 M91 3764 137 M91 wide axle	Hydralock Autolock
365 375	AG 75	3429 599 M91 3764 068 M91	Hydralock Autolock
383 390 390T 393 396	AG 85	3429 395 M91 3764 069 M91	Hydralock Autolock
398 399	AG 105	3429 396 M91 3764 070 M91	Hydralock Autolock

SPECIFICATIONS

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TRACTOR SPECIFICATIONS

Section 1 – Part A

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TRACTOR SPECIFICATIONS – CAB and FOOTSTEP **1A–01**

Engine:

Make	Perkins diesel to Massey Ferguson specification.
Type	Four stroke water cooled direct injection.
340, 342, 350	AD3.152.
352, 355, 360	AT3.152.4 - Turbocharged.
362, 365, 372, 375	A4.236.
382, 383, 390	A4.248.
390T, 393, 398	AT4.236 - Turbocharged.
396, 399	1006.6.

See Section 3 for full specification of all diesel engines.

Cooling System:

Type	Thermostat controlled with centrifugal pump to assist circulation. Four or six bladed fan driven by a single or double belt from the crankshaft pulley.
Radiator pressure cap rating	0,75 bar (10 lb/in^2).
Fan belt(s) deflection	10 mm (3/8 in) or 350 N (80 lbf).
Air conditioner compressor belt deflection	15mm (1/2 in).

Fuel System:

Fuel lift pump	Hand primed.
Fuel filter	CAV Filter with transparent sediment bowl.
Injection pump	CAV Distributor type with mechanical governor.
Injectors	CAV Nozzles and holders.
Starting aid	CAV Thermostart.
Air cleaner	Two stage dry element with warning light. Removable main and safety element or oil type.
Air intake pre-cleaner	Over-bonnet bowl type.

Clutch:

Type	Dual or split torque.
Size:	
340 to 390	305 mm (12 in).
390T to 399	330 mm (13 in).
PTO plate (Dual clutch)	254 mm (10 in).
Pedal free travel	
Rod operated clutches only:	
350 to 399 tractors	20-25 mm (3/4-1 in).
383 & 390 tractors with dual clutch	10-15 mm (3/8-5/8 in).
Clutch pedal height	
Cable operated clutches only:	
LoProfile cab	140 mm (5 1/2 in).
HiLine cab	130 mm (5 in).

Transmission:

Gearbox types:	
Eight speed gearbox (Standard or synchromesh)	The eight speed gearbox has eight forward and two reverse speeds. This is achieved by using a four forward and one reverse speed gearbox, compounded by an epicyclic unit.
Twelve speed synchromesh	The twelve speed gearbox has twelve forward and four reverse speeds. This is achieved by using a three forward and one reverse speed gearbox with synchromesh on second and third gears. This is compounded by a high/low manual shift range with synchromesh and a high/low epicyclic range.
Multi-Power gearbox	The Multi-Power gearbox has twelve forward and four reverse speeds. This is achieved by using a three forward and one reverse speed gearbox, compounded by an epicyclic unit and an additional set of high ratio constant mesh gears actuated by a hydraulic clutch.
Eight speed shuttle	Eight speeds forward and reverse. This is achieved by using a four speed gearbox, compounded by a two speed epicyclic unit to give eight speeds. A forward/reverse unit is fitted in the front of the gearbox.

Twelve-speed shuttle	Twelve speeds forward and reverse. This is achieved by using a four-speed gear box, compounded by a three-speed range unit to give the twelve speeds. A forward/reverse unit is situated in front of the gearbox and all gears are synchromesh. Creeper attachment available with this transmission.
18 Speedshift gearbox	The 18 speedshift has 18 forward and six reverse speeds. This is achieved by using a three forward and one reverse speed gearbox with synchromesh on all gears. This is compounded by a three-speed range change unit to give nine forward and three reverse speeds. At the front of the gearbox there is a electro/hydraulically operated Fast/Slow Speedshift unit which doubles the number of speeds to 18 forward and 6 reverse.

Final drive:	Bevel drive with epicyclic final reduction.		
Bevel drive (Standard):	Ratio	No. of teeth	Type
340, 342	6.167:1	6 x 37	Direct drive.
350 to 390, 390T, 393, 396	4.375:1	8 x 35	Normal duty.
390, 398, 399	3.889:1	9 x 35	Heavy duty.
352 - 8 speed shuttle gearbox	3.454:1	11 x 38	Epicyclic.
362, 372, 382	3.454:1	11 x 38	Epicyclic.
Bevel drive (40 km/hr):			
375 to 399	3.454:1	11 x 38	
Bevel drive (8 & 12 speed shuttle and 18 Speedshift gearbox):			
350 to 399	3.454:1	11 x 38	
Epicyclic ratio:			
350 to 390, 390T, 393, 396	3.75:1-Normal duty.		
390, 398, 399	4.80:1-Heavy duty.		
Rear axle maximum static load capacity:			
340, 342	3628 kg (7982 lb).		
350 to 390, 390T, 393, 396	4536 kg (10000 lb) - Normal duty.		
390, 398, 399	5443 kg (12000 lb) - Heavy duty.		
Differential lock clearance	1 mm (0.040 in).		

Brakes:

Foot brake	Oil immersed, hydraulically operated disc brakes, operated together or independently.
Parking brake	Operates on both rear wheels at the same time independent of the foot brakes.
Trailer brakes	Hydraulically operated by the tractor foot brake pedals.
Pedal free travel	5-10 mm (3/16-3/8 in).
MF Brake fluid part number	3405 389 M1.

Power Take–off (PTO):

Live PTO:	
340 to 390, 390T	Dual clutch, pedal operated.
Independent PTO:	
342, 350 to 399	Hydraulic clutch, operated by a single lever.
Standard PTO speeds:	
Standard pump	540 rev/min @ 1789 engine rev/min.
High flow pump	540 rev/min @ 1893 engine rev/min.
High flow pump	1000 rev/min @ 1900 engine rev/min.
Shiftable PTO speeds:	
540 rev/min	1902 engine rev/min.
1000 rev/min	2000 engine rev/min.
Economy PTO:	
Standard 540 rev/min	1979 engine rev/min.
Economy 540 rev/min	1421 engine rev/min.
PTO shaft:	
Diameter	35 mm (1.375 in).
Number of splines:	
540 rev shaft	6.
1000 rev shaft	21.
Ground speed ratio, rear wheel to PTO shaft:	
540 PTO only	13.816:1 (optional equipment).
Engine to PTO shaft ratio:	
Low flow pump	3.31:1.
High flow pump	1.90:1.

TRACTOR SPECIFICATIONS

Steering:

Type	Orbitrol hydrostatic power steering.
Pump	Engine mounted gear pump with reservoir or engine mounted auxiliary tandem pump.
Front wheel toe-in	0-5 mm (0-3/16 in).
Turns lock to lock:	
Two wheel drive:	
340, 350, 355, 360, 362	2.7.
342, 352, 362, 365 to 399	3.6.
Four wheel drive:	
340 to 390	4.1
362, 372, 382	4.1.
398, 399	4.3.
Steering wheel	Fixed or tilt adjustable.
Turning circles - Two wheel drive:	
With spacer:	
340	8,5 m (28 ft).
342, 352	6,8 m (22 ft).
362	7,9 m (26 ft).
350, 355, 360, 362	6,9 m (22.5 ft).
365 to 390	7,5 m (24.6 ft).
390T, 393, 398	7,6 m (24.9 ft).
396, 399	8,4 m (27.7 ft).
Without spacer:	
350, 355, 360, 362	6,4 m (21 ft).
365	7,1 m (23.2 ft).

Front Axle (Two–Wheel Drive):

Type	Three section with telescopic outer arms.	
Wheel camber/caster angles:	Camber angle	Caster angle
340, 350	3^0 30'	4^0 56'
342, 352, 362, 372, 382	4^0 30'	0^0
355, 360, 362	5^0	4^0 56'
365 to 399	4^0 30'	0^0
Maximum turning angle:		
340, 350, 355, 360, 362	55^0.	
342, 352, 362, 372, 382	55^0.	
365 to 399	52^0.	
Maximum static load capacity:		
340, 350, 355, 360, 362	2605 kg (5750 lb).	
342, 352, 362	2605 kg (5750 lb).	
365, to 390, 390T	3459 kg (7627 lb).	
398, 399	4357 kg (9607 lb).	

Front Axle (Four–Wheel Drive):

Type	Side drive mechanically or hydraulically engaged with or without Autolock or Hydralock differentials.
Maximum turning angle	50^0 (Adjustable stops to give 35^0, 40^0 and 50^0 turning angle)
Maximum turning angle (Series 2 cab)	55^0 with adjustable stops.
Turning circle - less brakes	
342, 352 (Series 2 cab)	7,8 m (26 ft).
350, 355, 360	7,9 m (310 in).
362 (Standard axle)	7,2 m (283 in)
362, 372, 382	10,0 m (394 in).
362, 372, 382 (Series 2 cab)	8,8 m (29 ft).
365, 375, 383, 390, 393	8,5 m (335 in).
396, 398, 399	9,4 m (370 in).
Maximum static load capacity:	
340, 350, 355, 360	3923 kgf (8660 lbf).
362, 372, 382	4000 kgf (8818 lbf).
365, 375, 383, 390, 390T, 393, 396	3923 kgf (8660 lbf).
398 and 399	4904 kgf (10825 lbf).
Maximum static load capacity (Series 2 cab)	4000 kgf (8818 lbf).

Wheel and Rim Nut and Bolt Torques:

Front axle - two wheel drive:
- 340, 342, 350, 352, 355, 360, 362 ..... 108 Nm (80 lbf ft).
- 362, 365 to 399 ..... 95 Nm (70 lbf ft).
- 9.00-16 and 10.00-16 tyres ..... 126 Nm (93 lbf ft).

Front axle - four wheel drive:
- Wheel nuts ..... 270 Nm (200 lbf ft).
- Rim to disc ..... 190 Nm (140 lbf ft).

Rear wheels - Pressed steel:
- Wheel nuts ..... 325 Nm (240 lbf ft).
- Rim to disc ..... 240 Nm (177 lbf ft).

Rear wheels - Cast centre:
- Wheel nuts ..... 325 Nm (240 lbf ft).
- Rim clamp nuts (PAVT) ..... 260 Nm (192 lbf ft).

Track Adjustments:

NOTE: For further details of the track settings see the Operator Instruction Book.

Front track (Two wheel drive):

340, 342, 350, 352, 355, 360, 362:
- 179 mm high axle ..... 1220-1830 mm (48-72 in).
- 231 mm high axle ..... 1220-1830 mm (48-72 in).
- 289 mm high axle ..... 1270-1880 mm (50-74 in).

365, 375, 383, 390, 390T, 393, 396:
- 234 mm high axle ..... 1220-1830 mm (48-72 in).
- 279 mm high axle ..... 1245-1855 mm (49-73 in).
- 348 mm high axle ..... 1270-1880 mm (50-74 in).

398:
- 279 mm high axle ..... 1245-1855 mm (49-73 in)
- 348 mm high axle ..... 1370-1980 mm (54-78 in).

399:
- ..... 1370-1980 mm (54-78 in).

Rowcrop:
- 383, 398, 399 ..... 1830-2440 mm (72-96 in).

Front track (Four wheel drive):
- 340 ..... 1425 mm (56 in).
- 342, 352, 362, 372, 382 (Series 2 cab) ..... 1314-1725 mm (52-68 in).
- 350, 355, 360, 362 ..... 1345-1700 mm (53-67 in).
- 362, 372, 382 ..... 1320-1880 mm (52-74 in).
- 365 to 390, 390T ..... 1370-1955 mm (54-77 in).
- 398, 399 ..... 1725-2110 mm (68-83 in).

Rear track (Pressed steel wheels):
- 340 ..... 1295-1905 mm (51-75 in).
- 342 (Series 2 cab) ..... 1425-1930 mm (56-76 in).
- 352, 362, 372, 382 (Series 2 cab) ..... 1425-1830 mm (56-72 in).
- 362, 372, 382 ..... 1320-1930 mm (52-76 in).
- 350 to 390, 390T ..... 1425-2130 mm (56-84 in).
- *390, 398, 399 ..... 1525-2235 mm (60-88 in).

Rear track (Cast centre wheels):
- 350 to 390, 390T ..... 1395-2210 mm (55-87 in).
- 390, 398 ..... 1425-2130 mm (56-84 in).

Rear track (PAVT wheels):
- 350 to 390, 390T, 393, 396 ..... 1395-2110 mm (55-83 in).
- *390, 398, 399 ..... 1525-2440 mm (60-96 in).

* Denotes 390 tractor with heavy duty rear axle.

TRACTOR SPECIFICATIONS

Electrical System:

Voltage	12 volt negative earth.
Battery:	
340, 350, 355, 360, 362	One 420 CCA.
362, 372, 382	One 570 CCA or two 420 CCA.
365 to 399	One 570 CCA or two 420 CCA.
Battery (Series 2 cab):	
342, 352 temperate climate	One 420 CCA battery.
342, 352 cold climate	One 570 CCA battery.
362, 372, 382 temperate climate	One 570 CCA battery.
362, 372, 382 cold climate	Two 420 CCA batteries.
Cold start performance	420 CCA or 570 CCA.
Reserve capacity:	
420 CCA battery	120 mins @ 25 amp.
570 CCA battery	220 mins @ 25 amp.
Starter motor:	
Type	Solenoid engaged pinion, safety device operated by gear and PTO lever.
Size:	
340, 342, 350, 352, 355, 360:	
Normal duty	1,8 kW.
Cold climate	2,2 kW.
362 to 399	2,2 kW.
Alternator:	
All models	45 amp, machine sensed.
Cab models	70 amp, machine sensed.
Regulating voltage	14.2 volts.

Light bulb sizes	Watts	Cap	Type
Headlights	45/40	P45t	UEC.
Plough & work light	55	PK22s	H3.
Side lights-footstep	5	BA15s	SCC.
Side lights-cab	5	SU8,5.8	Festoon.
Stop & rear lights	5/21	BAY15d	SBC index.
Flashers	21	BA15s	SCC.
No. plate light-footstep	5	SU8,5.8	Festoon.
No. plate light-cab	5	BA15s	SCC.
Range indicator lights	2	W2,1 x 9,5d	Wedge base (capless).
Instrument lights	2	W2,1 x 9,5d	Wedge base (capless).
Warning lights (Early type panel)			
Alternator	3	W2,9 x 9,5d	Wedge base (capless).
All others	2	Special	Special.
Warning lights (Later type panel)			
Alternator	2	W2,1 x 9,5d	Wedge base (capless).
All others	1.2	W2 x 4,6d	Wedge base (capless).
Cab interior light	5	SU8,5.8	Festoon.
Switch lights	1.2	W2 x 4,6d	Wedge base (capless).
Highway warning light	21	BA15d	SBC.
Red rear light	5	BA15s	SCC.

Trailer socket	7 Pin.
Cab air blower	Two speed blower drawing air through filter.
Fuses	Continental type.
Fuse size and colour	2 amp (clear), 5 amp (brown), 7,5 amp (brown), 10 amp (red), 15 amp (blue), 20 amp (yellow), 25 amp (natural white).

Hydraulic System:

Linkage pump	Four cylinder scotch yoke pump driven from the forward end of the PTO shaft supplying oil under pressure to the linkage ram cylinder and four external take off points.
Maximum pump output at 2200 engine rev/min:	
Standard pump	16,7 litre/min (3.7 gal/min) (4.4 US gal/min).
Standard pump with economy PTO	22,0 litre/min (4.8 gal/min) (5.8 US gal/min).
High flow pump	27,6 litre/min (6.0 gal/min) (7.2 US gal/min).
Pump maximum pressure	221-231 bar (3200-3350 lbf/in^2).
340 only	155 bar (2248 lbf/in^2).
Available power:	
Standard pump	4,7 kW (6.3 hp).
High flow pump	7,6 kW (10.2 hp).
Filtration	140 micron washable strainer.
Auxiliary hydraulics:	
Oil flow	35 litre/min (7.7 gal/min) (9.2 US gal/min).
Oil pressure	175 bar (2530 lbf/in^2).
Available power	9,1 kW (12.2 hp).
Filtration:	
Primary	140 micron washable strainer.
Secondary	20 micron throw away canister filter.
Return port:	
Size	7/8-14 x 37^0 JIC male.
Location	Left hand transmission side cover.
Combined pumps:	
Oil flow:	
Standard pump	52,6 litre/min (11.6 gal/min) (13.9 US gal/min).
Standard pump with economy PTO	58,6 litre/min (12.9 gal/min) (15.5 US gal/min).
High flow pump	63,6 litre/min (14 gal/min) (16.8 US gal/min).
Maximum pressure	175 bar (2530 lbf/in^2).
Available power:	
Standard pump	10,1 kW (13.6 hp).
High flow pump	16,0 kW (21.5 hp).
Amount of oil that can be removed from transmission:	
With spacer or 4WD	23 litre (5 gal) (6 US gal).
Without spacer	20 litre (4.5 gal) (5.4 US gal).

Drawbars and Linkage:

Swinging drawbar capacity (auto-hitch type):	
Normal duty:	
Inner position	1000 kg (2205 lb).
Outer position	775 kg (1710 lb).
Heavy duty:	
Inner position	1633 kg (3600 lb).
Outer position	1180 kg (2600 lb).
Automatic hitch	2268 kg (5000 lb).
Distance drawbar clevis to PTO shaft:	
Inner position	254 mm (10 in).
Outer position	356 mm (14 in).
North America:	
Inner position	356 mm (14 in).
Outer position	410 mm (16 in).

Drawbar off-set:		
Normal duty:	Inner position	Outer position
Position 1	57 mm (2.3 in)	68 mm (2.7 in).
Position 2	114 mm (4.6 in)	135 mm (5.3 in).
Position 3	221 mm (8.7 in)	239 mm (10.2 in).
Heavy duty:		
Position 1	9 mm (2.3 in)	68 mm (2.7 in).
Position 2	171 mm (6.7 in)	200 mm (7.8 in).

Nuts - drawbar frame to transmission case:	
Nut torque	420 Nm (310 lbf ft).

TRACTOR SPECIFICATIONS

Swinging drawbar capacity (standard type):	
Normal duty:	
Inner position	1000 kg (2205 lb).
Centre position	775 kg (1700 lb).
Outer position	775 kg (1700 lb).
Heavy duty:	
Inner position	1633 kg (3600 lb).
Centre position	1180 kg (2600 lb).
Outer position	1180 kg (2600 lb).
Distance drawbar clevis to PTO shaft:	
Inner position	241 mm (9.5 in).
Centre position	355 mm (14 in).
Outer position	400 mm (16 in).
Drawbar off-set:	
Normal duty	120 and 240 mm (4.7 and 9.5 in).
Heavy duty	194 mm (7.6 in).
Nut torques:	
Drawbar frame to transmission case	420 Nm (310 lbf ft).
Drawbar frame to PTO bracket	245 Nm (180 lbf ft).
Telescopic drawbar capacity:	
Inner position	2718 kg (5992 lb).
Intermediate position	2268 kg (5000 lb).
Outer position	2268 kg (5000 lb).
Clevis:	
Inner position	2268 kg (5000 lb).
Intermediate position	2268 kg (5000 lb).
Outer position	Not recommended.
Distance drawbar clevis to PTO shaft:	
Inner position	235 mm (9.3 in).
Intermediate position	400 mm (15 3/4 in).
Outer position	485 mm (19 in).
Maximum horizontal pull	6795 kg (14980 lb).
Nuts - drawbar frame to transmission case:	
Nut torque	420 Nm (310 lbf ft).
Trailer hitch (Lemoine)	
Trailer hitch adjustment	6 x 50 mm (6 x 2 in).
Drawbar maximum static load	2265 kg (4993 lb).
Centre tow pin maximum static load	2718 kg (5992 lb).
Lift linkage capacity:	
Interchangeable Cat. 1 & 2 ends	2145 kg (4730 lb).
Interchangeable ends with one assistor	2529 kg (5576 lb).
Cat. 2 Fixed ends	2586 kg (5702 lb).
Cat. 2 Fixed ends with one assistor	3059 kg (6744 lb).
Hook ends	2586 kg (5702 lb).
Hook ends with one assistor	3059 kg (6745 lb).
Hook ends with two assistor	3678 kg (7448 lb).
North America	
Interchangeable Cat. 1 & 2:	
360, 362	1765 kg (3890 lb).
Wrist action ends:	
375, 383, 390, 390T, 393	1928 kg (4250 lb).
Telescopic ends:	
396, 399	1968 kg (4340 lb).

Cab:

LoProfile	Factory fitted.
Noise level	Around 85dB(A).
Equipment	Front wind screen wiper and washer, rear view mirrors, large internal mirror, cab heater plus fresh air system, full lighting set including two plough lamps.
HiLine	As for LoProfile cab but around 82 dB(A) in-cab noise level and lighting set includes two front work lights. Air conditioning additional.
MF Screenwash part number	21820059.

Air Conditioning System (up to Oct 94):–

Refrigerant type	Freon 12 (F12).
Capacity	1,65 kg (3lb 12oz).
Operating pressure at 24-30^0 C - Low side	0,4 - 1 bar (6-15 lbf/in^2).
Operating pressure at 24-30^0 C - High side	10,6 - 13,4 bar (154-194 lbf/in^2).
Drive belt deflection	12 - 15 mm (1/2 - 5/8 in).

Air Conditioning System (Oct 94 on):–

Refrigerant type	R134a.
R134a identification	On pump body or inner gullwing
Capacity	1,4 kg (3lb 1oz).
Operating pressure at 24-30^0 C - Low side	0,6 - 1,2 bar (8-18 lbf/in^2).
Operating pressure at 24-30^0 C - High side	13,8 - 16,6 bar (200-240 lbf/in^2).
Lubricating oil to be used	IDEMITSU SP20.

Trailer Air Brake System:–

System	Single or two line
Operating pressure at 24-30^0 C (75-80^0 F)	4,8 - 7,6 bar (70 - 110 lbf/in^2).
Drive belt deflection	12 - 15 mm (1/2 - 5/8 in).

Capacities:–

Fuel tank:–	
340, 350, 355, 360	68 litre (15 gal) (18 US gal).
342, 352, 362, 372, 382	71,5 litre (15.7 gal) (18.8 US gal).
365 to 398	105 litre (23 gal) (28 US gal).
399 and HiLine models	118 litre (26 gal) (31 US gal).
HiLine models with air conditioning	114 litre (25 gal) (30 US gal).
Engine oil:–	
340, 350	5,7 litre (1.25 gal) (1.5 US gal).
342, 352, 355, 360	6,8 litre (1.5 gal) (1.8 US gal).
362 to 390	7,5 litre (1.7 gal) (2 US gal).
390T, 398	7,7 litre (1.7 gal) (2 US gal).
399	14,3 litre (3.1 gal) (3.8 US gal).
Oil bath air cleaner:–	
350, 355, 360	0,50 litre (1 pt) (1 US pt).
362 to 398	0,75 litre (1.3 pt) (1.3 US pt).
399	1 litre (1.8 pt) (1.8 US pt).
Cooling system:–	
340, 342, 350, 352, 355, 360	9,8 litre (2.2 gal) (2.6 US gal).
362, 372, 382	14.4 litre (3.2 gal) (3.8 US gal).
365 to 390	15,1 litre (3.3 gal) (4 US gal).
390T, 398	15,5 litre (3.4 gal) (4 US gal).
399 - 1006 series engine	23,0 litre (5.0 gal) (6.0 US gal).
Transmission/hydraulics:–	
With spacer	47,4 litre (10.4 gal) (12.5 US gal).
Without spacer	43,4 litre (9.5 gal) (11.5 US gal).
362, 372, 382	35,0 litre (7.7 gal) (9.2 US gal).
Power steering reservoir:–	
340, 350, 355, 360	0,7 litre (1.2 pt) (1.2 US pt).
362 to 398	1,2 litre (2.1 pt) (2.1 US pt).
Rear epicyclic hub (each side):–	
390 (heavy-duty rear axle), 398, 399	2,9 litre (5 pt) (5 US pt).
Front four–wheel drive axle (NG type):–	
Axle - 340, 350, 355, 360, 362	4,0 litre (6.7 pt) (1.1 US gal).
Axle - 342, 352, 362, 372, 382	3.8 litre (6.5 pt) (1 US gal).
Axle - 365 to 390, 390T	5,0 litre (1.1 gal) (1.3 US gal).
Axle - 398, 399	5,8 litre (1.3 gal) (1.5 US gal).
Epicyclic hubs (each side)-340 to 390, 390T	1,2 litre (2.1 pt) (2.3 US pt).
Epicyclic hubs (each side)-342, 352, 362, 372, 382	0,5 litre (1 pt) (1 US pt).
Epicyclic hubs (each side)-398 to 399	1,3 litre (2.2 pt) (2.6 US pt).
Front four–wheel drive axle (AG type):–	
Axle - 365, 375, 390, 390T	5,6 litre (1.25 gal) (1.5 US gal).
Axle - 398, 399	7,6 litre (1.7 gal) (2 US gal).
Epicyclic hubs (each side)-365, 375, 390, 390T	1,1 litre (2.0 pt) (2.0 US pt).
Epicyclic hubs (each side)-398, 399	1,2 litre (2.1 pt) (2.1 US pt).
Cab screen washer bottle	2,0 litre (3.5 pt) (3.5 US pt).

WEIGHTS AND DIMENSIONS

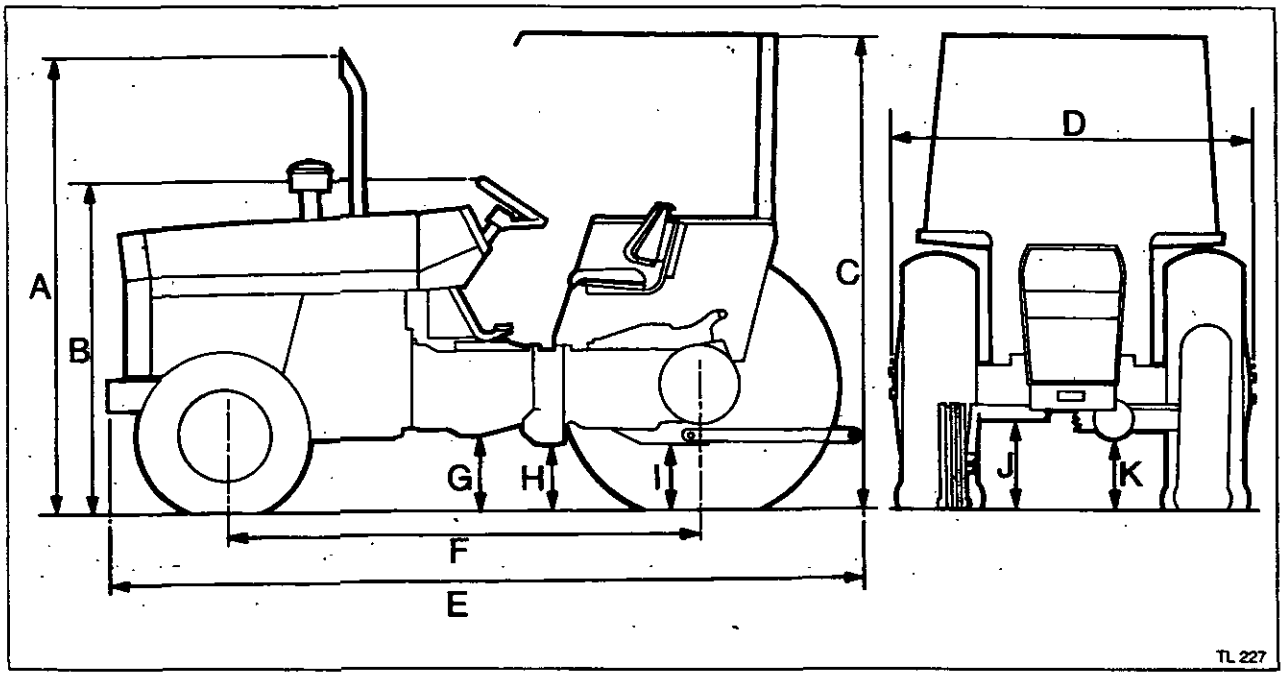

Fig.1

Dimensions 340, 350, 355, 360 and 362 tractors (Fig. 1)

	340	350, 355, 360	362
Overall height:			
A. Over exhaust	-	2362 mm (93 in)	2460 mm (97 in)
B. Over steering wheel	-	1653 mm (65 in)	1736 mm (68 in)
C. Over safety frame/cab:			
Two post (ROPS)	-	2421 mm (95 in)	2421 mm (95 in)
Four post	-	2485 mm (98 in)	2485 mm (98 in)
Over cab-LoProfile	2160 mm (85 in)	2420 mm (95 in)	2420 mm (95 in)
D. Overall width (minimum track).	1780 mm (70 in)	1871 mm (74 in)	1871 mm (74 in)
Overall length:			
E. With spacer	-	3446 mm (136 in)	3490 mm (137 in)
Without spacer	-	3296 mm (130 in)	3338 mm (131 in)
Four wheel drive	3240 mm (123 in)	3446 mm (136 in)	3660 mm (144 in)
Wheelbase:			
F. With spacer	-	2083 mm (83 in)	2183 mm (86 in)
Without spacer	-	1933 mm (76 in)	2033 mm (78 in)
Four wheel drive	2910 mm (86 in)	2117 mm (83 in)	2210 mm (87 in)
Ground clearance:			
G. Under gearbox	401 mm (16 in)	401 mm (16 in)	401 mm (16 in)
H. Under four wheel drive box	382 mm (15 in)	382 mm (15 in)	382 mm (15 in)
I. Under draw bar frame	286 in (11 in)	286 mm (11 in)	286 mm (11 in)
J. Under front axle (2WD)	-	602 mm (24 in)	602 mm (24 in)
K. Under 4WD differential	302 mm (12 in)	302 mm (12 in)	302 mm (12 in)

***NOTE:** These dimensions are for tractors fitted with front tyres 2WD 7.50–16, 4WD 8.30/8–24. Rear 14.9/13–28.*

Weights 340, 350, 355, 360 and 362 tractors

Weight of the tractor with full fuel, oil and water.	340	350, 355, 360	362
Footstep:			
2 Wheel drive:			
With spacer	-	2371 kg (5216 lb)	2398 kg (5287 lb)
Without spacer	-	2341 kg (5150 lb)	2368 kg (5220 lb)
4 Wheel drive	-	2525 kg (5555 lb)	2666 kg (5877 lb)
Cab:			
2 Wheel drive	-	2652 kg (5847 lb)	2670 kg (5886 lb)
4 Wheel drive	2370 kg (5225 lb)	2834 kg (6246 lb)	3009 kg (6634 lb)

Dimensions 365, 375, 383, 390, 390T and 393 tractors (Fig. 1)

	365, 375	383	390, 390T, 393
Overall height:			
A. Over exhaust	2485 mm (98 in)	2485 mm (98 in)	2485 mm (98 in)
B. Over steering wheel	1781 mm (70 in)	1781 mm (70 in)	1781 mm (70 in)
C. Over safety frame/cab:			
Two post (ROPS)	2524 mm (99 in)	2497 mm (98 in)	2524 mm (99 in)
Four post	2640 mm (104 in)	-	2640 mm (104 in)
Over cab -LoProfile	2510 mm (99 in)	-	2530 mm (100 in)
-HiLine	2630 mm (104 in)	2670 mm (105 in)	2650 mm (104 in)
-HiLine cab with air conditioning	2680 mm (106 in)	-	2680 mm (106 in)
D. Overall width (minimum track).	1871 mm (74 in)	2002 mm (79 in)	1871 mm (74 in)
Overall length:			
E. With spacer	3710 mm (146 in)	-	3761 mm (148 in)
Without spacer	3560 mm (140 in)	3668 mm (144 in)	3611 mm (142 in)
Four wheel drive	3940 mm (155 in)	3880 mm (153 in)	3990 mm (157 in)
Wheelbase:			
F. With spacer	2286 mm (90 in)	-	2286 mm (90 in)
Without spacer	2136 mm (84 in)	2136 mm (84 in)	2136 mm (84 in)
Four wheel drive	2350 mm (93 in)	2350 mm (93 in)	2350 mm (93 in)
Ground clearance:			
G. Under gearbox	470 mm (18 in)	470 mm (18 in)	470 mm (18 in)
H. Under four wheel drive box	480 mm (19 in)	480 mm (19 in)	480 mm (19 in)
I. Under drawbar frame	379 mm (15 in)	379 mm (15 in)	379 mm (15 in)
J. Under front axle (2WD)	530 mm (21 in)	530 mm (21 in)	530 mm (21 in)
K. Under 4WD differential	430 mm (17 in)	430 mm (17 in)	430 mm (17 in)

***NOTE:** These dimensions are for tractors fitted with front tyres 2WD 7.50–16, 4WD 12.4/11–24. Rear 18.4/15–30.*

Weights 365, 375, 383, 390, 390T and 393 tractors

Weight of the tractor with full fuel, oil and water.	365, 375	383	390, 390T, 393
Footstep:			
2 Wheel drive:			
With spacer	2732 kg (6023 lb)	-	2768 kg (6102 lb)
Without spacer	2702 kg (5956 lb)	2766 kg (6098 lb)	-
4 Wheel drive	2975 kg (6545 lb)	3056 kg (6738 lb)	3011 kg (6638 lb)
Cab:			
2 Wheel drive	3121 kg (6880 lb)	3180 kg (7010 lb)	3159 kg (6965 lb)
4 Wheel drive	3396 kg (7485 lb)	3737 kg (8250 lb)	3448 kg (7602 lb)

Dimensions 362, 372 and 382 tractors (Fig. 1)

	362, 372, 382	
Overall height:		
A. Over exhaust	2485 mm (98 in)	
C. Over cab	2570 mm (101 in)	
D. Overall width (minimum track)	1871 mm (74 in)	
E. Overall length	3495 mm (138 in)	
F. Wheelbase	2217 mm (87 in)	
Ground clearance:		
G. Under gearbox	470 mm (18 in)	
H. Under four wheel drive box	480 mm (19 in)	
I. Under drawbar frame	379 mm (15 in)	
J. Under front axle (2WD)	530 mm (21 in)	
K. Under 4WD differential	430 mm (17 in)	

Weights 362, 372, 382

Weight of the tractor with cab, full fuel, oil and water.	362, 372, 382	
2 Wheel drive:	2955 kg (6515 lb) 362 only	
4 Wheel drive :	3156 kg (6964 lb)	

WEIGHTS AND DIMENSIONS

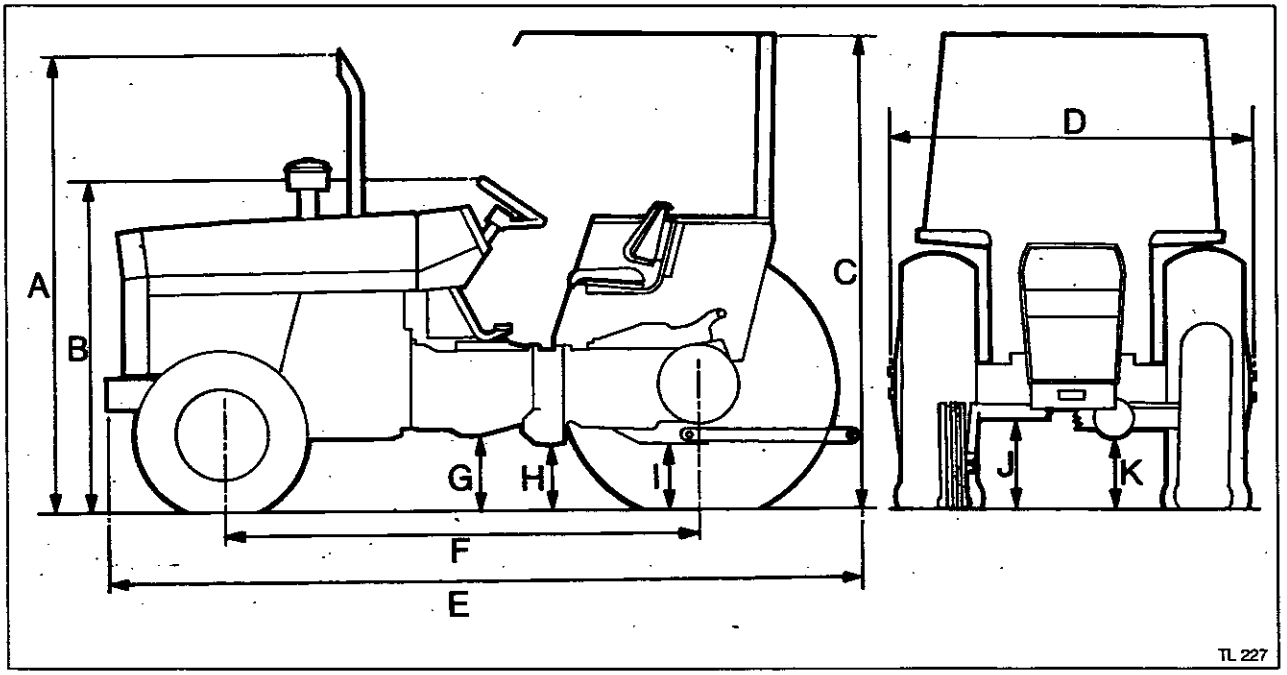

Fig.2

Dimensions 396, 398 and 399 tractors (Fig.2)

	396	398	399
Overall height:			
A. Over exhaust	2485 mm (98 in)	2550 mm (100 in)	2629 mm (104 in)
B. Over steering wheel	1781 mm (70 in)	1840 mm (72 in)	1906 mm (75 in)
C. Over safety frame/cab:			
Two post (ROPS)	2565 mm (101 in)	2570 mm (101 in)	2570 mm (101 in)
Four post	-	2750 mm (108 in)	2750 mm (108 in)
Over cab -LoProfile	-	2580 mm (102 in)	-
-HiLine	2730 mm (108 in)	2690 mm (106 in)	2690 mm (106 in)
-HiLine cab with air conditioning	-	2730 mm (108 in)	2730 mm (108 in)
D. Overall width (minimum track)	2060 mm (81 in)	1973 mm (78 in)	1973 mm (78 in)
E. Overall length:			
With spacer	4157 mm (163 in)	3761 mm (148 in)	4051 mm (160 in)
Without spacer	-	3611 mm (142 in)	-
Four wheel drive	4294 mm (169 in)	4040 mm (159 in)	4330 mm (170 in)
F. Wheelbase:			
With spacer	2580 mm (102 in)	2436 mm (96 in)	2436 mm (96 in)
Without spacer	-	2286 mm (90 in)	-
Four wheel drive	2634 mm (104 in)	2350 mm (93 in)	2640 mm (104 in)
Ground clearance:			
G. Under gearbox	560 mm (22 in)	560 mm (22 in)	560 mm (22 in)
H. Under four wheel drive box	540 mm (21 in)	540 mm (21 in)	540 mm (21 in)
I. Under draw bar frame	433 mm (17 in)	433 mm (17 in)	433 mm (17 in)
J. Under front axle (2WD)	580 mm (23 in)	580 mm (23 in)	580 mm (23 in)
K. Under 4WD differential	490 mm (19 in)	490 mm (19 in)	490 mm (19 in)

***NOTE:** These dimensions are for tractors fitted with front tyres 2WD 10.00–16, 4WD 13.6/12–28. Rear 16.9/14–38.*

Weights 396, 398 and 399 tractors

Weight of the tractor with full fuel, oil and water	396	398	399
Footstep:			
2 Wheel drive	3256 kg (7180 lb)	3174 kg (6983 lb)	3317 kg (7313 lb)
4 Wheel drive	3489 kg (7690 lb)	3690 kg (8135 lb)	3690 kg (8135 lb)
Cab:			
2 Wheel drive	3552 kg (7831 lb)	3199 kg (7053 lb)	3304 kg (7285 lb)
4 Wheel drive	3783 kg (8340 lb)	3460 kg (7628 lb)	3677 kg (8107 lb)

TRACTOR WEIGHTS AND DIMENSIONS

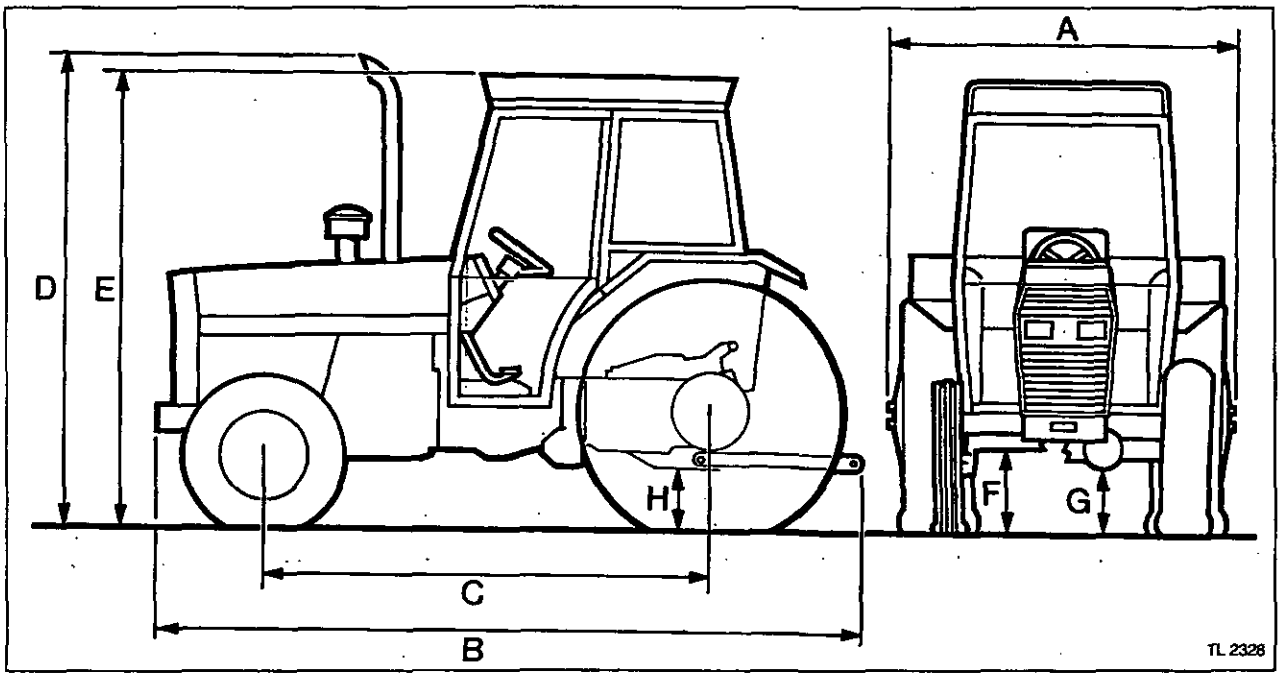

Fig.3

Dimensions 342 and 352 Series 2 cab tractor (Fig.3)

	342	352	
Overall width:			
A. minimum track	1809 mm (71 in)	1809 mm (71 in)	
Overall length:			
B. Two-wheel drive	3396 mm (134 in)	3396 mm (134 in)	
Four-wheel drive	3490 mm (138 in)	3490 mm (138 in)	
Wheelbase:			
C. Two-wheel drive	2083 mm (82 in)	2083 mm (82 in)	
Four-wheel drive	2124 mm (84 in)	2124 mm (84 in)	
Overall height:			
D. Over exhaust	2379 mm (94 in)	2422 mm (95 in)	
E Over cab	2389 mm (94 in)	2432 mm (96 in)	
Ground clearance:			
F. Under front axle	560 mm (22 in)	560 mm (22 in)	
G. Under 4WD differential	494 mm (19 in)	494 mm (19 in)	
H. Under drawbar frame	350 mm (14 in)	350 mm (14 in)	

***NOTE:** These dimensions are for 342 tractors fitted with front tyres 2WD 6.00–16, 4WD 10.5/80–18. Rear 14.9–24. For 352 tractors fitted with front tyres 2WD 7.50–16, 4WD 9.5R–20. Rear 14.9–28.*

Weights 342 and 352 Series 2 cab tractor

Weight of the tractor with full fuel, oil and water.	342	352	
Cab:			
Two-wheel drive	2382 kg (5251 lb)	2382 kg (5251 lb)	
Four-wheel drive	2620 kg (5776 lb)	2620 kg (5776 lb)	

TRACTOR WEIGHTS AND DIMENSIONS

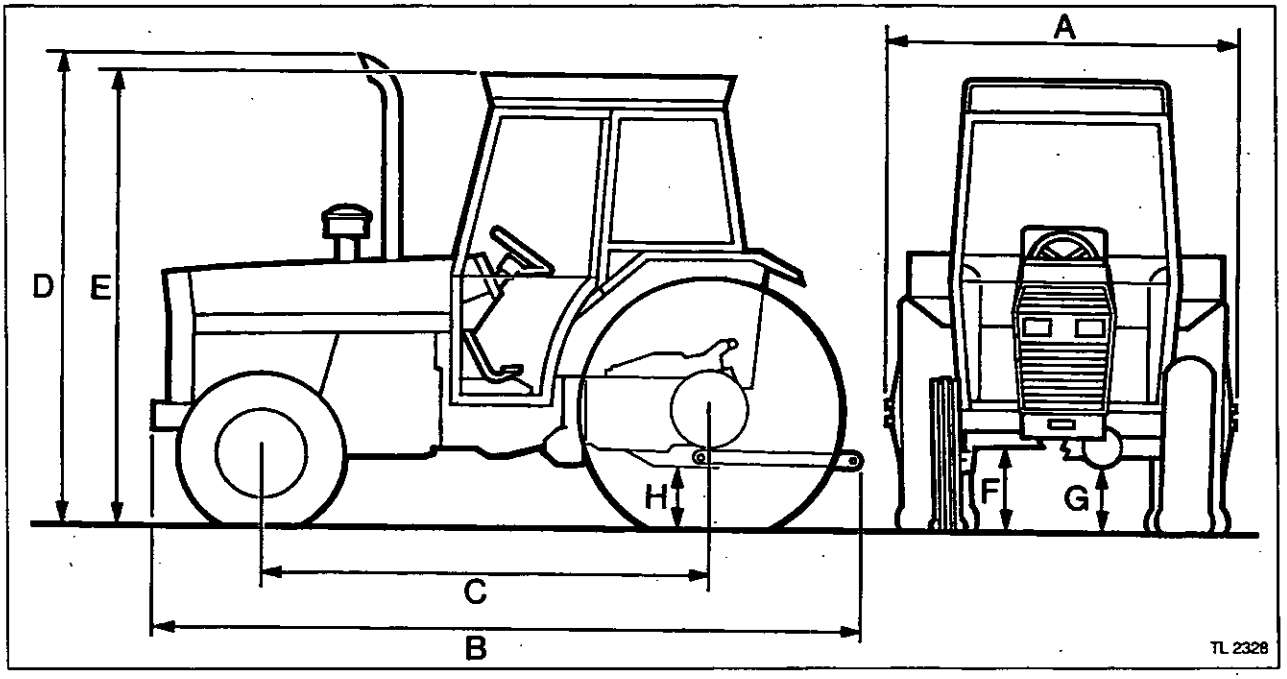

Fig.4

Dimensions 362, 372 and 382 Series 2 cab tractor (Fig.4)

	362 2WD	362 4WD	372, 382
Overall width:			
A. minimum track	1640 mm (64 in)	1640 mm (64 in)	1640 mm (64 in)
Overall length:			
B. Two-wheel drive	3532 mm (139 in)	--	--
Four-wheel drive	--	3532 mm (139 in)	3532 mm (139 in)
Wheelbase:			
C. Two-wheel drive	2180 mm (86 in)	--	--
Four-wheel drive	--	2217 mm (87 in)	2217 mm (87 in)
Overall height:			
D. Over exhaust	2398 mm (94 in)	2398 mm (94 in)	2398 mm (94 in)
E Over cab	2398 mm (94 in)	2398 mm (94 in)	2398 mm (94 in)
Ground clearance:			
F. Under front axle	530 mm (21 in)	--	--
G. Under 4WD differential	--	464 mm (18 in)	464 mm (18 in)
H. Under drawbar frame	345 mm (14 in)	345 mm (14 in)	345 mm (14 in)

***NOTE:** These dimensions are for tractors fitted with front tyres 2WD 7.50–16, 4WD 360/70–24. Rear 480/70R–30.*

Weights 362, 372 and 382 Series 2 cab tractor

Weight of the tractor with full fuel, oil and water.	362 2WD	362 4WD	372, 382
Cab:			
Two-wheel drive	2842 kg (6265 lb)	--	--
Four-wheel drive	--	3032 kg (6684 lb)	3062 kg (6756 lb)

MISCELLANEOUS DATA

Section 1 – Part B

Table of Contents

SEALANTS AND CHEMICALS

SEALANTS and CHEMICALS

The following sealants and chemicals quoted in this Workshop Service Manual are available from Massey Ferguson Parts Departments.

Description	Quantity	Part No
Hylomar Jointing and sealing compound.	100 g tube 280 g aerosol	1447 390 M1 3638 340 M91
640 Retainer Loctite 640 - for high strength retaining of cylinder liners.	50 ml	3630 513 M1
222 Screw Lock Loctite 222 - for lower strength thread locking allowing easy dismantling of parts.	10 ml	3405 380 M2
242 Lock 'n' Seal Loctite 242 - prevents small components from vibrating loose and provides an effective pipe thread seal against liquids or gases.	3 ml 24 ml	3405 350 M4 1633 266 M1
270 Studlock Loctite 270 - a heavy duty version of Lock and Seal for larger components which need less frequent stripping down. Highly resistant to industrial fluids and gases.	10 ml	3405 352 M4
271 Stud 'n' Bearing fit Loctite 271 - for high strength retaining of bearings liners, bushes, keys and splines. Designed to increase the reliability of slip fitted and light press fit parts, preventing fretting and corrosion whilst sealing against leakage.	3 ml	3930 275 M1
638 Retainer Loctite 638 - for high strength retaining of close fitting parts. Designed to retain slip fitted or to strengthen press fitted parts, shafts bushes, pulleys etc.	3 ml	3930 274 M91
574 Multi Gasket Loctite 574 - forms a strong, flexible gasket which provides a gas-tight, water-tight, oil-tight seal up to 200° C (392° F). Does not shrink,crack, tear or perish.	50 ml	3900 613 M1
515 Multi Gasket Loctite 515 - Forms a strong bond, very flexible and provides a oil tight seal up to 200°C. Does not shrink, crack or tare, sutiable for heavy duty applications. This gasket material used between the four wheel drive pod and the Range Change gearbox on 12 Speed Shuttle and 18 Speedshift gearboxes.	6 ml 50 ml	3405 354 M2 3405 355 M3
Superclean Solvent An all-purpose solvent for removing grease and dirt.	300 ml aerosol	3405 359 M4

SEALANTS AND CHEMICALS

Description	Quantity	Part No
409 Instant Adhesive Gel Instant bonding for metals, plastics,rubber and ceramics.	3 g 20 g	3405 422 M2 3405 395 M2
Superflex Silicone Clear A clear, tough, flexible and waterproof seal for metal, rubber, glass and plastics.	80 g 310 ml	3405 357 M4 3405 423 M1
Dismantling Spray A highly effective multi- purpose, moisture dispersant and dismantling spray.	300 ml aerosol	3405 376 M3
Anti-freeze Ethylene-glycol based, designed for protection down to minus 33° C (minus 27° F). Suitable for all types of engines, including those with aluminium cylinder heads.	1 litre 5 litre 25 litre 205 litre	1894 799 M2 1891 780 M2 1891 781 M2 1891 782 M2
Brake Fluid (Green) Specially developed for braking systems requiring a mineral fluid.	0,5 litre	3405 389 M1
De-Icer Used to clear ice from the windscreen of the tractor.	400 ml	3405 367 M3
Screenwash A special formulation to prevent freezing in cold weather and smearing.	1 litre 5 litre	3930 399 M1 3930 500 M1
Anti-Squark additive Specially developed to be added to the transmission oil to prevent noise from wet brake installations.	1 litre	1889 891 M2
703 Quick Clean A solvent used to remove dirt and grease prior to using instant adhesives. It also speeds the cure.	400 ml aerosol	3600 440 M1

SPECIAL TOOLS

300 SERIES TRACTOR SPECIAL TOOLS

Front Axle and Steering:–

MS.62B	'O' ring and seal fitting tool.
MS.63	Spring fitting tool.
MF.195C	Bearing puller (main tool).
MF.263A	Front axle and steering bush remover (main tool).
MF.263-2	Steering bush remover/replacer 1 1/2 inch diameter.
MF.263-3	Front axle and steering bush remover/replacer - 1 7/8 inch diameter.
MF.263-5	Steering bush remover/replacer - 1 3/4 inch diameter.
MF.264	Steering bush reamer (maintool).
MF.264-1	Reamer and pilot - 1 1/2 inch diameter.
MF.264-2	Reamer and pilot - 1 7/8 inch diameter.
MF.264-8	Reamer and pilot - 1 3/4 inch diameter.
MF.332	Hydraulic pump oil seal protector.
MF.444	Axle pivot pin remover.
MF.451B	4WD axle pivot pin bearing remover.
MF.454A	Steering ram end cap remover/replacer.
MF.471	Hydralock spring compressor.
MF.480	4WD axle pinion nut wrench (AG65 and AG 66).
MF.481	4WD axle hub nut wrench (AG 65).
MF.482	4WD axle steering cylinder wrench.
MF.483	4WD axle hub nut wrench (AG 66).
MF.485	4WD axle pivot pin installer.
MF.486	4WD axle pinion nut wrench (AG 75, AG 85 and AG 105).
MF.487	4WD axle hub nut wrench (AG 75, AG 85 and AG 105).
MF.488	4WD hub puller.
MF.493	Hub seal installer (AG 65 and AG 66).
MF.494	Hub seal installer (AG 75, AG 85 and AG 105).
MF.495	Planetary ring gear replacer (AG 65 and AG 66).
MF.496	Wear ring installer (AG65 and AG 66).
MF.497	Wear ring installer (AG 75, AG 85 and AG 105).
MF.498	Planetary ring gear replacer (AG 75, AG 85 and AG 105).
MS.550	Universal handle.
MF.472	Steering wheel puller.
FT.4062A	Bearing pre-load gauge.

Clutch:–

MF.159B	Clutch centraliser.
MF.215	Secondary clutch setting gauge.
MF.314	Release lever height setting gauge (12 inch).
MF.446	Release lever height setting gauge (13 inch).
MF.479	Clutch release bearing installer.

Gearbox:–

MF.218B	Front PTO housing replacer.
MF.255B	PTO input shaft oil seal replacer.
MF.256A	Multi-power main input shaft oil seal replacer.
MF.315A	PTO input shaft needle roller bearing remover/replacer.
MF.331	Input shaft oil seal remover.
MF.367A	Transmission case ring spanner and torque wrench.
MF.414A	Synchromesh setting pin.
MF.415	Synchromesh assembly tool.
MF.421	Input shaft oil seal and bearing replacer.
MF.422A	Input shaft oil seal and bearing remover.
MF.476	Bearing remover/replacer.
MF.477	Gear set support.
MF.478	Bearing pre-load kit.
MF.489	Seal, sleeve and bearing installer.
MS.550	Universal handle.
MF.177A	Input shaft oil seal protector.

Rear axle:–

------	Dial indicator gauge.
MF.26A	Wrench.
MF.245D	Differential bearing pre-load gauge.
MF.245D-1	Straight edge.
MF.265A	Epicyclic planetary carrier remover.
MF.267A	Epicyclic hub bearing pre-load gauge.
MF.267-1	Sleeve.
MF.267-2	Sleeve.
MF.295B	Wheel stud guide sleeves.
MF.366	PAVT wheel guide pegs.
MF.467	Brake pull rod seal protector.
MS.555	Adjustable puller (main tool).
MF.555-2A	Right hand differential bearing remover.
FT.4062A	Bearing pre-load gauge.

Power Take–Off (PTO):

MF.168	PTO shaft oil seal remover and bush replacer.
MF.195B	Bearing remover/replacer (main tool).
MF.195-5B	PTO needle bearing remover/replacer.
MF.195-6B	Two speed PTO needle bearing and bush remover/replacer.
MF.364A	PTO shaft oil seal replacer.
MF.474	Rear PTO shaft dust seal replacer.
MF.484	PTO cassette seal installer.

Hydraulics:

MF.163	Spring retainer nut wrench.
MF.272	Ram arm gauge fixture.
MF.273	Control lever setting gauge.
MF.333	Draft control rod gauge.
MF.355	Hydraulic pump overhaul kit comprising:-
MF.349	Valve facing cutter and coining tool set.
MF.350	Valve chamber circlip replacer.
MF.351	Valve chamber plug remover.
MF.352	Control valve spring retainer clip.
MF.353	Control valve body 'O' ring guide.
MF.354	Control valve body replacer.
MF.356C	Position and draft control setting gauge.
MF.418A	Lift cover remover/replacer.
MF.420	Hydraulic ram piston seal replacer 79 mm.
MF.445	Ram arm gauge fixture - intermix.
MF.453	Hydraulic ram piston seal replacer 93 mm.
MF.455	Pressure relief valve test capsule.
MF.3001	Pressure test kit.
MF.3002	Flow meter hose kit.
MF.3003	Hydraulic flow meter.
MF.3011	Pressure test point.

Engine:

PD.1C-4	Valve guide remover/replacer stop.
PD.1C-6	Valve guide remover/replacer stop.
PD.1D	Valve guide remover/replacer.
PD.1D-1A	Valve guide remover/adaptor.
No 8	Piston ring clamp.
PD.41D	Piston height and valve depth gauge (use with PD 208).
PD.67-2	Timing gauge adaptor.
PD.67-3	Timing gauge adaptor.
PD.140	Camshaft bush/fuel pump thrust collar remover/replacer.
PD.140-3	Fuel pump thrust collar remover/adaptor.
PD.145C	Crankshaft rear oil seal replacer.
PD.150B	Cylinder liner remover/replacer.
PD.150-1B	Cylinder liner remover/replacer adaptor.
PD.150-7B	Cylinder liner remover/replacer adaptor.
PD.155C	Puller (main tool).
PD.155-1	Puller adaptor bolts - water pump/camshaft - imperial.
PD.155B-5	Puller adaptor bolts - fuel pump/camshaft - metric.
PD.159	Timing cover centraliser.
PD.162A	Timing cover centraliser.
PD.170	Crankshaft front oil seal replacer (basic tool).
PD.170-1	Crankshaft front oil seal replacer (basic tool).
PD.170-2	Adaptor - 6 cylinder engines.
PD.170-3	Adaptor - 6 cylinder engines.
PD.170-4	Replacer - A6.3544 engines.
PD.170-5	Replacer - AD3.152 engines.
PD.170-6	Replacer - A4.236, A4.248 engines.
MF.200-26A	Water pump overhaul kit.
PD.208	Dial indicator gauge (use with PD41D).
370	Taper base.
PD.633A	Timing cover centraliser.
MS.2700B	Tractor splitting track.
PD.6118B	Valve spring compressor.
PD.6118-3	Valve spring compressor adaptor.
PD.6118-4	Valve spring compressor adaptor.

Electrical System:

------	Hydrometer.
------	Heavy duty battery discharge tester.
MF.3004A	Instrument panel testing unit.

1B–6
BOLT TORQUES

Bolt Torque Specifications (general guide for inch fasteners) 1B–03

Use the "Standard Torque" charts as a general guide when tightening fasteners that DO NOT HAVE SPECIFIC TIGHTENING RECOMMENDATIONS.

Inch fasteners Standard torque in Newton Metres (Foot Pounds)					
* Inch bolt size	SAE grade 5 ** mild steel below grade 5	SAE grade 8 ISO grade 8.8 BS grade S		ISO grade 10.9 BS grade V	
		*** Non-rigid joint	**** Rigid joint	*** Non-rigid joint	**** Rigid joint
1/4 inch	6-8 (4-6)	9-12 (7-9)	11-15 (8-11)	13-18 (10-13)	16-22 (12-16)
5/16 inch	12-16 (9-12)	18-24 (13-18)	22-30 (16-22)	25-34 (18-25)	31-43 (23-32)
3/8 inch	22-30 (16-22)	31-42 (23-31)	39-53 (29-39)	44-60 (32-44)	55-75 (41-55)
7/16 inch	35-47 (26-35)	51-69 (38-51)	64-86 (47-63)	72-96 (53-71)	90-120 (66-89)
1/2 inch	54-72 (40-53)	80-104 (59-77)	100-130 (74-96)	110-140 (81-103)	140-180 (103-133)
5/8 inch	110-140 (81-103)	160-210 (118-155)	200-260 (148-192)	220-300 (162-221)	280-370 (207-273)
3/4 inch	190-250 (140-184)	280-370 (207-273)	350-460 (258-339)	390-530 (287-391)	490-660 (361-487)
7/8 inch	310-410 (228-302)	450-610 (332-450)	560-760 (413-561)	640-850 (472-672)	800-1060 (590-782)
1 inch	460-620 (339-457)	670-900 (494-664)	840-1120 (620-826)	960-1280 (708-944)	1200-1600 (885-1180)

* ***NOTE:*** *The size is the diameter of the shank - not the head width.*

** ***NOTE:*** *Mild steel torque values to be used for SAE Grade 5 bolts when weld nuts, or other low strength nuts are used.*

*** ***NOTE:*** *Use these values when any of the following conditions exist:*

1. Possible damage to the joined members of the assembly may occur.
2. Thick and/or highly compressible gaskets are used between members.
3. Non-flat unmachined seating surfaces for bolt head (or nut) occurs.
4. Non-flat or non-parallel joint faces are encountered.

**** ***NOTE:*** *Use these values when ALL of the following conditions exist:*

1. Damage will not occur to the joined members of the assembly.
2. It is desirable to use this higher clamping force to ensure tightness.
3. Fastener thread is not lubricated prior to assembly.

BOLT TORQUE SPECIFICATIONS (GENERAL GUIDE FOR METRIC FASTENERS)

Use the "Standard Torque" charts as a general guide when tightening fasteners that DO NOT HAVE SPECIFIC TIGHTENING RECOMMENDATIONS.

Metric fasteners Standard torque in Newton Metres (Foot Pounds)					
* Metric bolt size	SAE grade 5 ** mild steel below grade 5	SAE grade 8 ISO grade 8.8 BS grade S		ISO grade 10.9 BS grade V	
		*** Non-rigid joint	**** Rigid joint	*** Non-rigid joint	**** Rigid joint
M6	4-5 (3-4)	8-11 (6-8)	10-14 (7-10)	12-16 (9-12)	14-20 (10-15)
M8	10-13 (7-10)	20-28 (15-21)	25-35 (18-26)	29-37 (21-27)	36-46 (27-34)
M10	19-25 (14-18)	40-56 (30-41)	50-70 (37-52)	57-77 (42-57)	72-96 (53-71)
M12	33-43 (24-32)	72-96 (53-71)	90-120 (66-89)	100-130 (74-96)	120-160 (89-118)
M16	84-110 (62-81)	160-210 (118-155)	200-260 (148-192)	240-320 (177-236)	300-400 (221-295)
M20	160-210 (118-155)	340-450 (251-332)	420-560 (310-413)	480-640 (354-472)	600-800 (443-590)

* ***NOTE:*** *The size is the diameter of the shank - not the head width.*

** ***NOTE:*** *Mild steel torque values to be used for SAE Grade 5 bolts when weld nuts, or other low strength nuts are used.*

*** ***NOTE:*** *Use these values when any of the following conditions exist:*

1. Possible damage to the joined members of the assembly may occur.
2. Thick and/or highly compressible gaskets are used between members.
3. Non-flat unmachined seating surfaces for bolt head (or nut) occurs.
4. Non-flat or non-parallel joint faces are encountered.

**** ***NOTE:*** *Use these values when ALL of the following conditions exist:*

1. Damage will not occur to the joined members of the assembly.
2. It is desirable to use this higher clamping force to ensure tightness.
3. Fastener thread is not lubricated prior to assembly.

TRACTOR STORAGE

TRACTOR STORAGE

General

When preparing a tractor for storage, comply with the following recommendations to ensure that the tractor is in good condition when required for use. Thoroughly clean the tractor, giving particular attention to the greasing points and oil filler plugs. Park the tractor in a dry, level and covered area away from the weather and livestock with easy exit in case of fire.

When the tractor has to be stored in the open air, park it on level ground in the shelter of a building or wall and completely cover it with a good tarpaulin.

Tyres

1. Jack up the tractor and position wooden blocks under the axles to relieve the tyres of all weight.
2. Inflate the tyres a little above the normal pressure and chalk that pressure on the tyre wall. Protect the tyres from direct sunlight.
3. When ballasted tyres are not filled with calcium chloride, deflate the tyres, empty out the water and re-inflate with air.
4. When wheel weights are fitted, remove, clean and paint any bare metal and refit.

Hydraulic lift system

1. Check and replenish the transmission oil level to the high mark on the dipstick.
2. Using the tractor hydraulics, with the Response Control in FAST, raise and lower the linkage several times.
3. Engage the PTO for a short period to obtain the maximum circulation of transmission oil around the centre housing.
4. Raise the linkage to the Transport Position and support the two lift arms in this position with wooden chocks.
5. Leave the two quadrant levers in the Transport Position i.e., the Draft Control (outer) lever past the UP and the Position Control (inner) lever in Transport Position. DO NOT MOVE the quadrant control levers from these positions.

Steering

1. Remove the filler plug from the reservoir, if fitted, and add the approved oil to the bottom of the oil filler plug hole. Refit the filler plug.
2. Clean and coat the exposed steering rams with grease.

Engine

1. Drain the engine sump oil, when hot if possible.
2. Change the filter element.
3. Refill the engine sump with an approved grade of oil.
4. Seal the crankcase breather, exhaust and air cleaner pipes with adhesive tape after running the engine.
5. Clean the dry air cleaner unit.
6. Clean the oil bath type air cleaner unit.

Cooling system

1. Drain the radiator and cylinder block, when hot if possible and leave the taps in the open position.
2. Rest the radiator cap on the filler neck.

Fuel system

1. Clean the fuel filter bowl, renew the elements and drain the fuel tank.
2. Add a rust inhibitor, refill the fuel tank and bleed the fuel system of air.
3. Start the engine and run at half speed for 15 minutes to circulate the fuel through the lift and distributor pumps, filters, pipe work and injectors.
4. Top up the fuel tank completely to prevent condensation forming on the unfilled portion of the tank, thus resulting in rust and water contaminating the fuel. Rust if permitted to form in any large quantity can cause filter blockage.
5. Remove the injectors and spray approximately 2 ml (0.65 fl oz) of engine oil into each cylinder bore. Using new joint washers, refit the injectors and slowly rotate the crankshaft one complete revolution. Do NOT bleed the fuel system of air.
6. Lubricate the foot and hand throttle control linkage.

Clutch

Fully depress the clutch pedal and hold down with a wooden chock. The clutch friction plates (main and PTO) will then not bond themselves to the flywheel or pressure plates.

Battery

1. Remove the battery from the tractor.
2. Check the electrolyte level and top up as necessary.
3. Clean the battery top and coat the terminals with petroleum jelly.
4. Fully charge the battery from an external source.
5. Repeat the external charge every month during the storage period and top up the electrolyte as necessary.
6. Store the battery in a cool, dry, dust free location but not directly on a concrete or metal surface. There must be no possibility of freezing.

Alternator and starter motor

1. Smear the alternator terminals with petroleum jelly.
2. Smear the starter motor and solenoid terminals with petroleum jelly.

Sheet metal, exposed castings and bright metal components

1. All rusty, scratched or bare patches of castings and/or sheet metal must be cleaned with abrasive papers and repainted. Matching colours are available for all Massey Ferguson tractors.
2. The bright metal components and surfaces must be cleaned and/or degreased and the protectives sprayed or brushed on.

Cab

1. Empty the windscreen washer bottle.
2. Remove and exclude the windscreen wiper blade from daylight.
3. Remove and store the rear view mirrors, free and lubricate all hinges and locking devices.
4. Close the cab side and rear windows.
5. Wash and dry the inside and outsides of the cab windscreen, side and rear windows with soap and water.
6. Cover the windscreen, side and rear windows.
7. Lock the cab door, note the number of the door key. Store the key in a known spot in case of fire.

PREPARING THE TRACTOR PRIOR TO RETURN TO WORK.

Cab

1. Remove the covers and wash the cab windscreen.
2. Refit the windscreen wiper blade.
3. Refit the rear view mirrors.
4. Fill the windscreen washer bottle.

Sheet metal and bright metal components

1. Clean off the protective from the bright metal parts and surrounding sheet metal.
2. Wash the sheet metal.

Alternator and starter motor.

1. Clean the petroleum jelly from the alternator terminals.
2. Clean the petroleum jelly from the starter motor and solenoid terminals.

Battery

1. Check that the battery is fully charged. Do not check the electrolyte strength immediately after adding distilled water.
2. Check that the electrolyte is at the correct level.
3. Clean the battery top and smear the terminals with petroleum jelly.
4. Refit the battery to the tractor.

Clutch

1. Remove the wooden chock from the clutch pedal linkage.

Fuel system

1. Check the level in the fuel tank, investigate any loss and eliminate the cause.
2. Bleed the fuel system of air.

Cooling system

1. Close the taps in the cylinder block and radiator.
2. Refill the cooling system slowly with clean rain-water or soft water.
3. In winter, refill the cooling system with an anti-freeze solution.
4. Check all connections and joints for leaks.
5. After the engine has been run for fifteen minutes, see 'Starting the engine', permit the radiator to cool, check the coolant level and replenish as necessary.

Engine

1. Remove the adhesive tape seals from the crankcase breather, exhaust and air cleaner pipes.
2. Check the engine oil level, investigate any loss of oil and eliminate the cause.

Steering

1. Check the steering reservoir oil level (if fitted), investigate any loss of oil and eliminate the cause.
2. Clean the steering rams of grease and leave clean and dry.

Hydraulic lift system

1. Check the centre housing transmission oil level, investigate any loss of oil and eliminate the cause.
2. Remove the two wooden chocks from the lift arms.

Tyres

1. Check the tyre pressures, investigate any loss of air and eliminate the cause.
2. Adjust the tyre pressures or deflate the tyres, replace the ballast as before and re-inflate as necessary.
3. Jack up the axles and remove the wooden chocks.

Fuel gauge and warning lights

Turn the starter key to '+' and check that the fuel gauge begins to register and all warning lights glow. Investigate any malfunction and eliminate the cause.

Starting the engine

1. Start the engine and run on a light load.
2. Check that the tachometer and fuel gauge register and all warning lights become extinguished. Investigate any malfunction and eliminate the cause.
3. Continue to run the engine for no more than 15 minutes, check all systems for correct function. Investigate any malfunction and eliminate the cause.

Road test

1. Road test the tractor checking all systems, electrical, hydraulic and mechanical.
2. Test the brakes and adjust if necessary.

TRACTOR WATERPROOFING

TRACTOR WATERPROOFING

General

Before working in water, such as in paddy fields or flooded areas, certain waterproofing modifications must be made to the tractor.

Ideally only tractors with disc brakes should be used in water as little can be done to ensure the efficiency of drum brakes when wet.

In addition, two extra maintenance services are required.

Starter motor and solenoid assembly

1. Remove the starter motor and solenoid assembly.
2. Thoroughly clean the exterior of the starter motor and solenoid assembly.
3. Blank off the drive end bracket.
4. Seal all the openings in the starter motor and solenoid assembly with suitable waterproof putty.
5. Apply a thick coating of grease to the starter motor and solenoid terminals and ensure that the drive end bracket is blanked off.
6. Coat the exterior of the starter motor and solenoid assembly with a water repellent spray.
7. Refit the starter motor and solenoid assembly to the engine.
8. Reconnect the wiring harness.

Electrical system wiring

Separate all the electrical connectors that are likely to come in contact with the water. Smear the terminals with petroleum jelly and reconnect.

Battery

1. Clean the battery top and smear the battery terminals with petroleum jelly.

Engine breather pipe

The engine breather pipe is of a critical length to prevent the ingress of dirt into the engine. DO NOT shorten the pipe, re-route it well clear of the water level and secure the end with a suitable clip to one of the engine bolts.

Engine dipstick

1. Remove the engine dipstick and store in the tool box.
2. Fit a tapered rubber plug to the engine dipstick tube.

or

3. Fit a sealing type dipstick obtainable from your local Massey Ferguson Dealer. Standard fit on tractors manufactured from October 1994.

Transmission

Clutch housing drain hole

1. Discard the split pin in the drain hole in the clutch housing.
2. Enlarge the drain hole, tap and fit a screwed plug.

PTO shaft

If the PTO is not being used:-

1. Remove the PTO cap.
2. Grease both threads.
3. Refit the cap and screw fully home.

If the PTO is to be used:-

4. Obtain from your Massey Ferguson Dealer a Heavy-duty PTO shaft and seal assembly. This is fitted with a special face type seal to prevent the ingress of water and dirt.

Centre housing dipstick

If the tractor has a centre housing dipstick mounted on the response cover and was manufactured before June 1994 it is not fitted with a sealed dipstick, proceed as follows:-

1. Remove the dipstick and store in the tool box.
2. Fit a tapered rubber plug to the dipstick tube in the response cover.

If the tractor has a remote dipstick and was manufactured before June 1994, ensure that the dipstick tube is securely fixed and sealed to the response cover.

Continuous working in deep water

If the tractor is to be worked continuously in deep water, i.e. higher than 50 mm (2 in) below the lowest point of the clutch housing, complete chassis sealing will be required in addition to the items listed above as follows:-

1. Remove and discard the two hole clutch housing cover plate.
2. Replace with a four hole clutch housing cover plate part number 1871 922 M1, gasket 180 481 M1 (or Hylomar) sealant and two bolts 354 441 X1
3. Split the tractor at the clutch housing and apply Hylomar sealant to the flange faces, reconnect.
4. Fit a clutch housing breather assembly comprising a Breather Fitting part number 3762 623 M1, Washer 390 735 X1, Nut 3009 696 X1 and Hose 3762 624 M1.
5. Remove the starter motor and seal the flange faces.
6. Fit the heavy-duty PTO (see PTO shaft above).
7. Fit the sealed type dipsticks (see centre housing dipstick above).

All these components are available from your Massey Ferguson Dealer.

Extra maintenance

Every 10 hours or daily

Charge all grease points with an approved grease until it exudes from the seals or shafts.

Every 50 hours or weekly

1. Remove the clutch housing drain plug, permit any water to drain away and refit the drain plug.
2. Ensure that the engine breather pipe is unobstructed.

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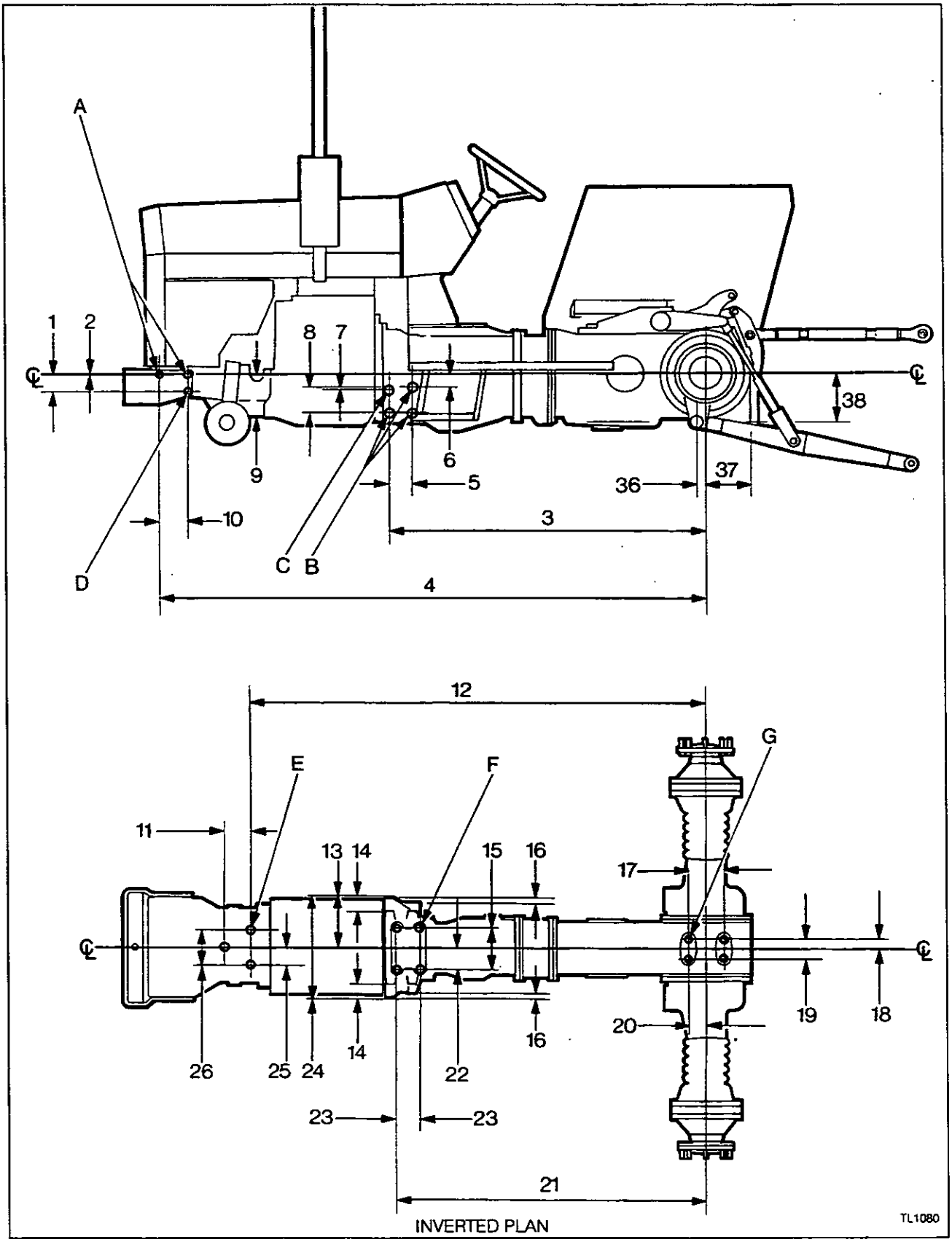
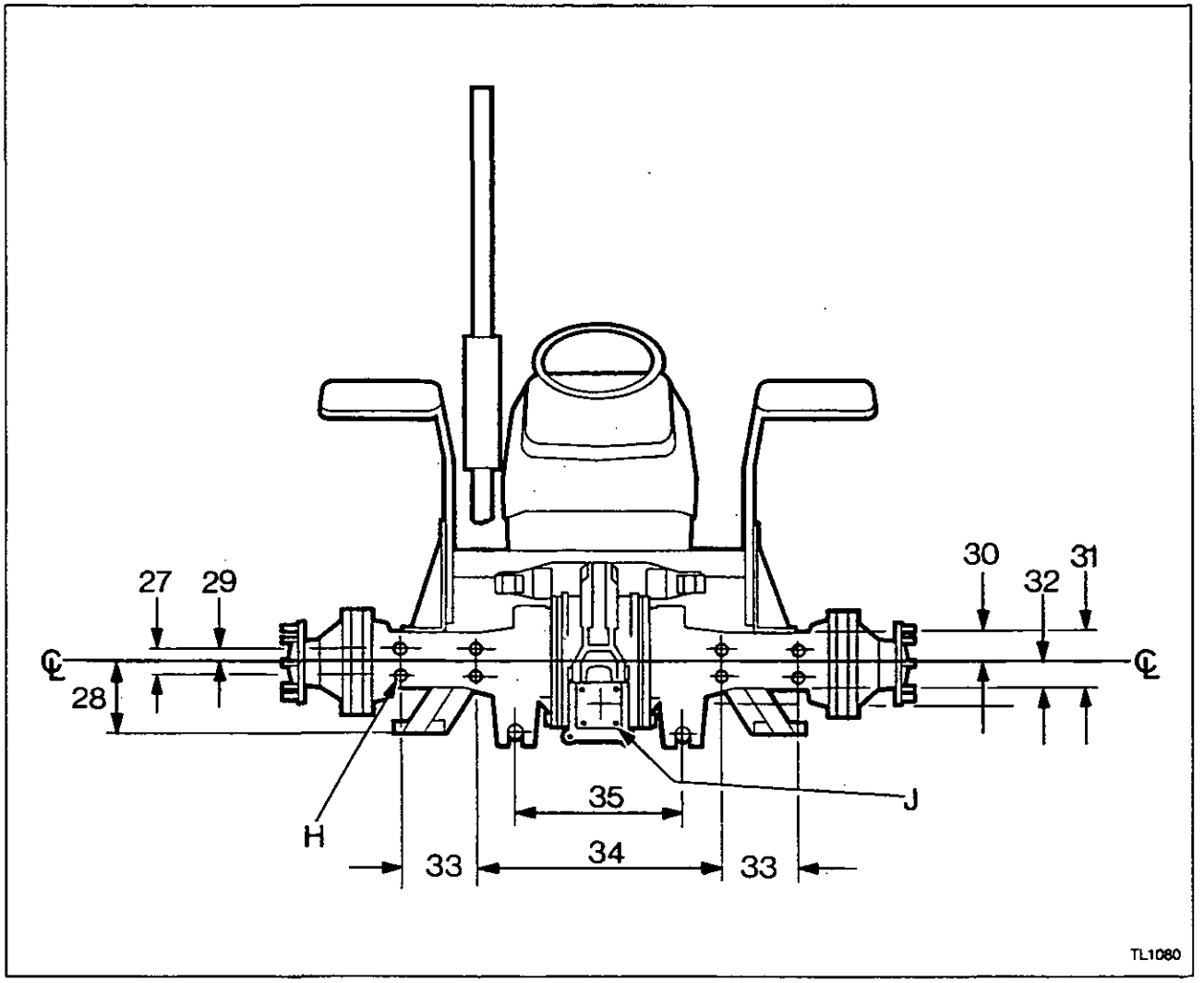
TRACTOR MOUNTING POINTS

TRACTOR MOUNTING POINTS



TRACTOR MOUNTING POINTS



350, 355 and 360 Tractors
All dimensions in millimeters.

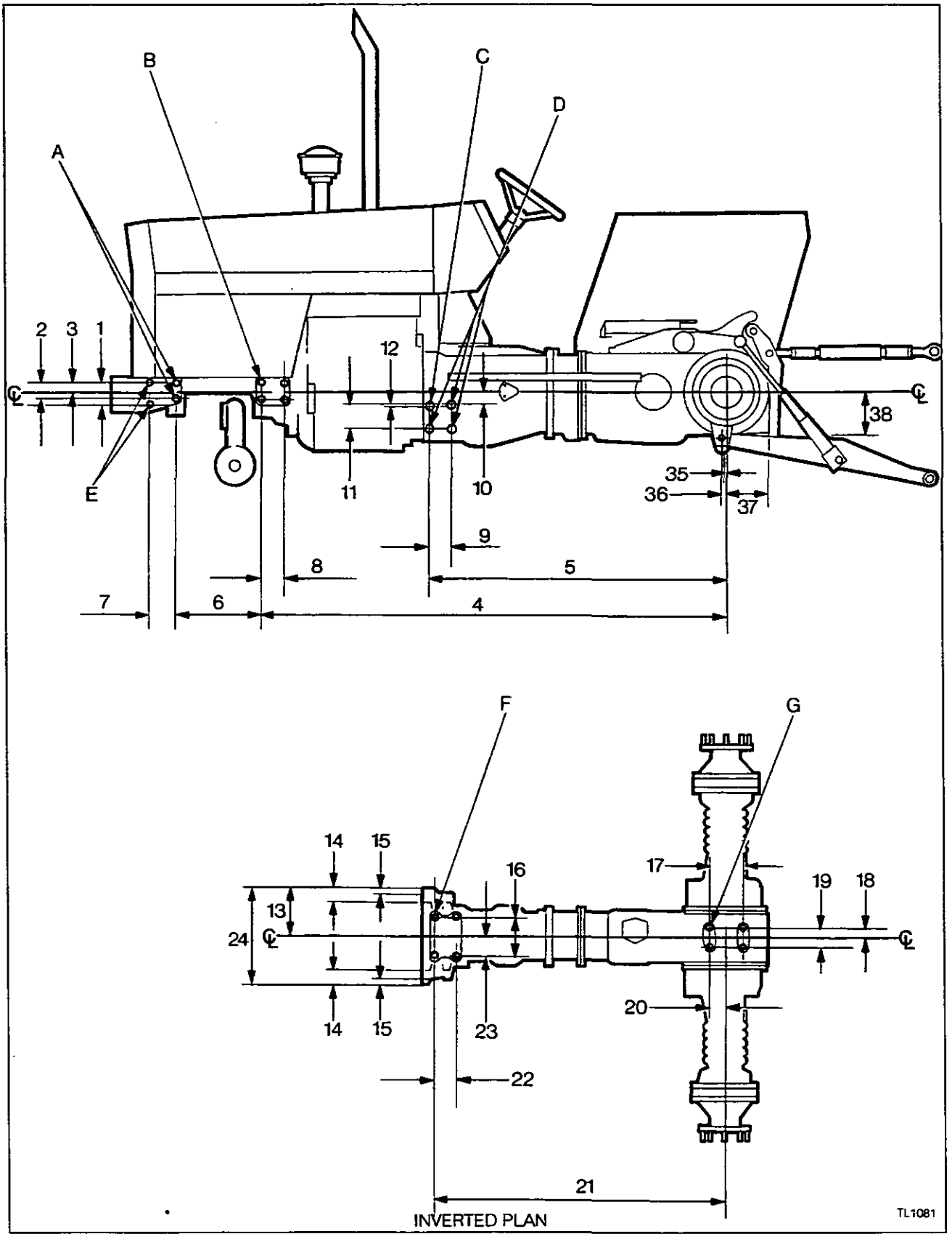
1.	75.00	13.	215,90	27.	80,00
2.	5,00	14.	57,15	28.	212,50
3.	1380,00 with spacer	15.	184,15	29.	40,00
3.	1230,00 without spacer	16.	19,05	30.	90,20
4.	2389,00 with spacer	17.	152,40	31.	161,54
4.	2239,20 without spacer	18.	42,88	32.	127,03
5.	101,60	19.	85,73	33.	220,00
6.	60,45	20.	76,20	34.	726,20
7.	9,65	21.	1345,20 with spacer	35.	492,00
8.	111,25	21	1195,20 without spacer	36.	31,75
9.	190,50	22.	92,07	37.	201,00
10.	130,00	23.	101,60	38.	194,74
11.	114,30	24.	431,80		
12.	1981,60	25.	76,20		
12.	1831,60	26.	152,40		

Hole sizes

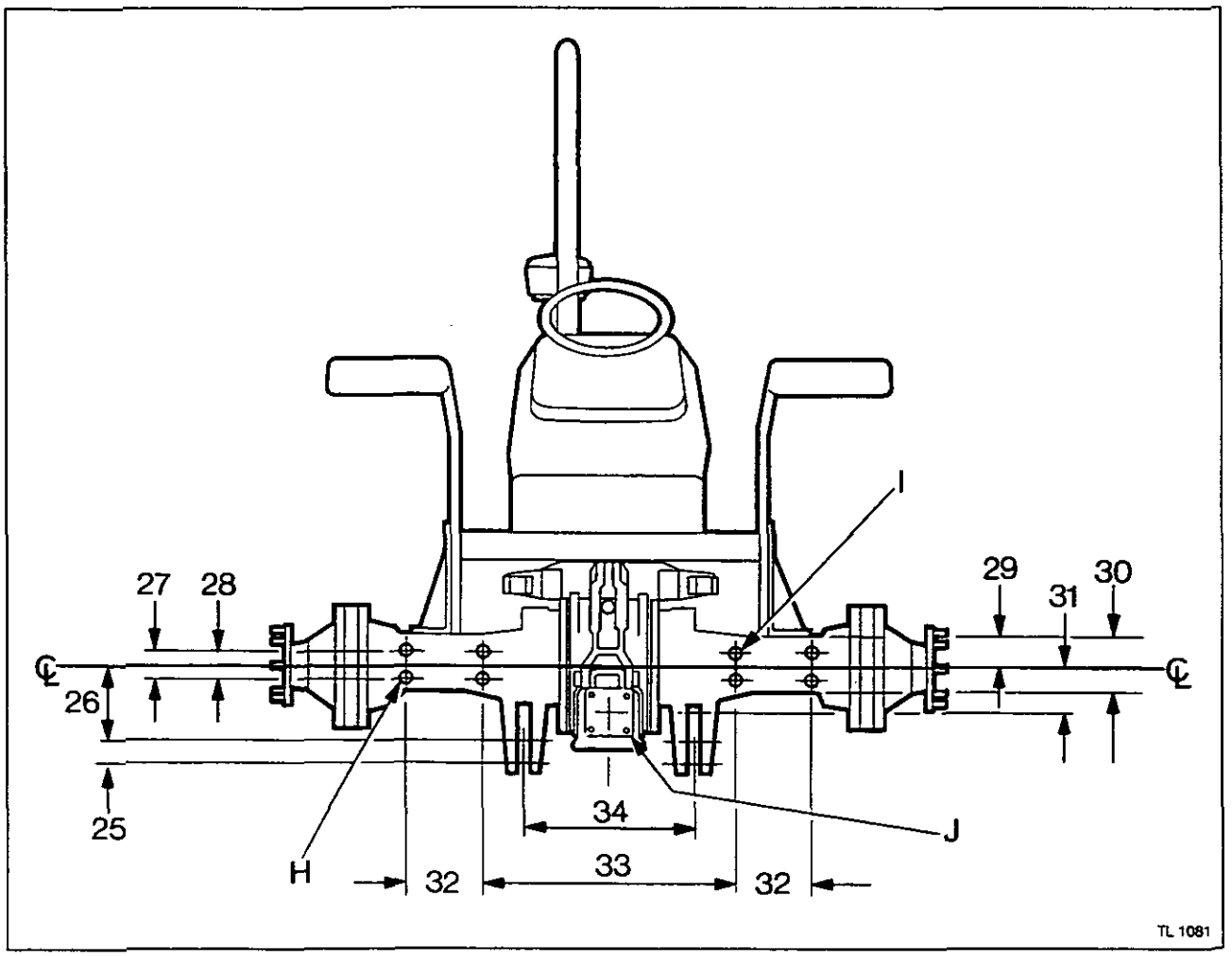
A.	4 holes 5/8 in-11 UNC through	D.	2 holes 5/8 in-11 UNC x 30 mm deep	G.	4 holes 3/4 in-10 UNC x 28 mm deep
B.	6 holes 5/8 in-11 UNC x 32 mm deep	E.	3 holes 5/8 in-11 UNC x 35 mm deep	H.	8 holes 5/8 in-11 UNC x 28 mm deep
C.	2 holes 5/8 in-11 UNC x 23 mm deep	F.	4 holes 5/8 in-11 UNC x 31 mm deep	I.	4 studs 1/2 in UNF on 149,35 mm PCD

TRACTOR MOUNTING POINTS

TRACTOR MOUNTING POINTS



TRACTOR MOUNTING POINTS



365, 375, 383, 390, 390T, 393, 396, 398 and 399 Tractors
Two-wheel drive - up to serial number C 49188.
Four-wheel drive - up to serial number C 45008.
All dimensions in millimeters.

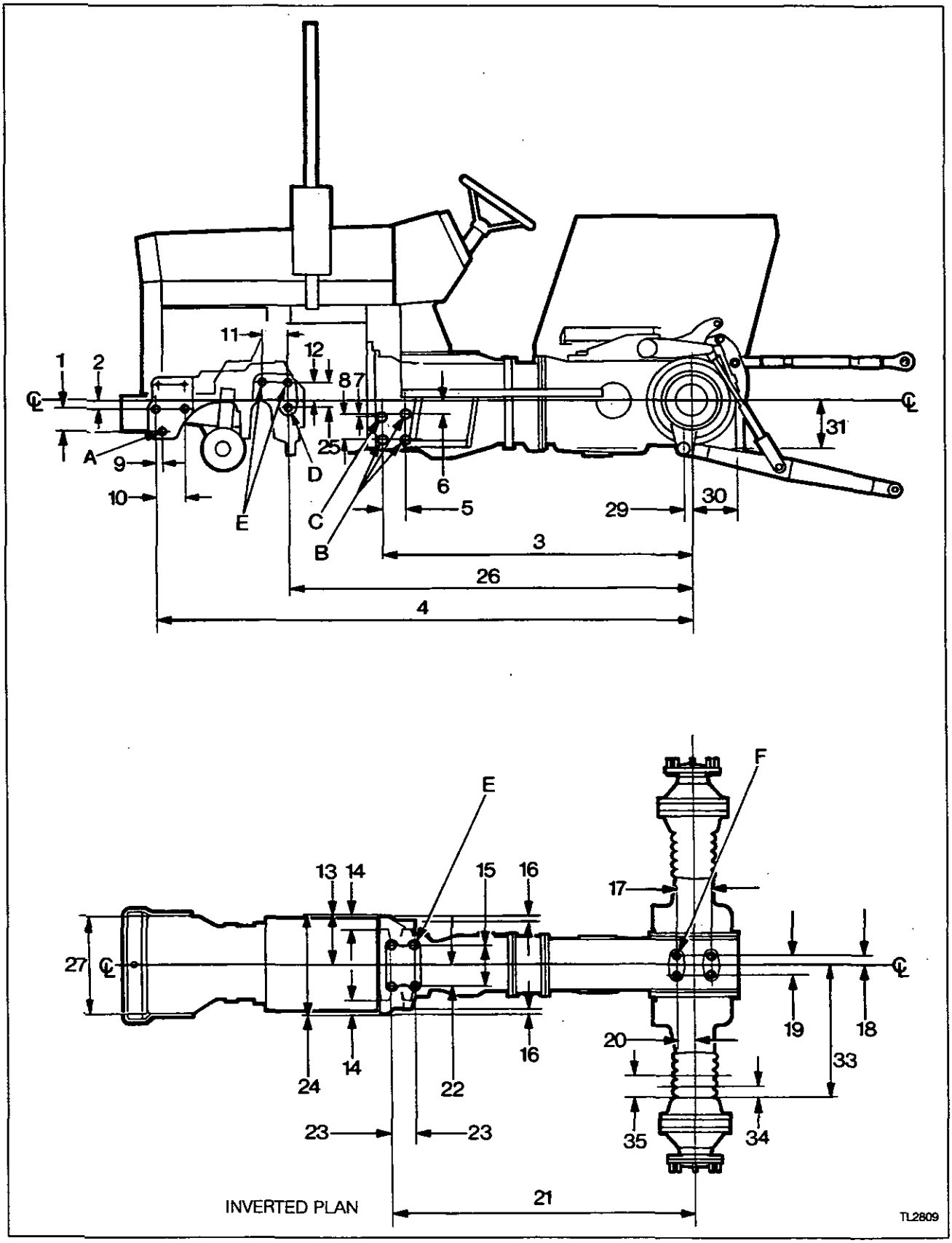
1.	95.00	12.	9,65	26.	212,50
2.	75,00	13.	215,90	27.	80,00
3.	46,50	14.	57,15	28.	40,80
4.	2155,00 with spacer	15.	19,05	29.	90,20
4.	2005,00 without spacer	16.	184,15	30.	161,54
4.	2412,00 - 399 with spacer	17.	152,40	31.	127,03
5.	1380,00 with spacer	18.	42,88	32.	220,00
5.	1230,00 without spacer	19.	85,73	33.	726,20
6.	403,00	20.	76,20	34.	492,00
7.	130,00	21	1345,20 with spacer	35.	6,35 heavy-duty axle
8.	101,60	21.	1195,20 without spacer	36.	31.75
9.	101,60	22.	101,60	37.	201,00
10.	60,45	23.	92,07	38.	197,74
11.	111,25	24.	431,80		
		25.	67,00 heavy-duty axle		

Hole sizes

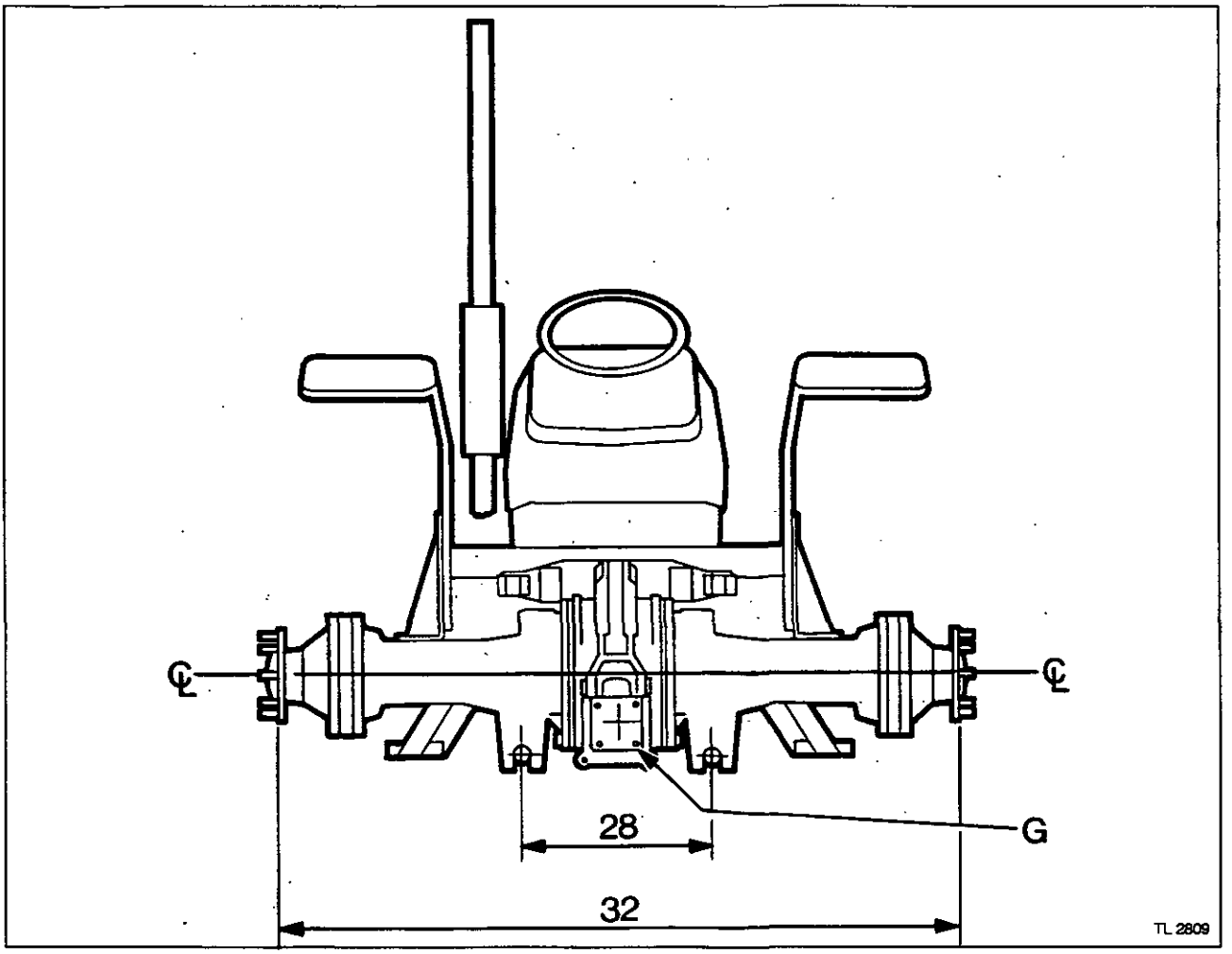
A.	4 holes 5/8 in-11 UNC x 32 mm deep	D.	6 holes 5/8 in-11 UNC x 32 mm deep	G.	4 holes 3/4 in-10 UNC x 28 mm deep
B.	8 holes 3/4 in-10 UNC x 32 mm deep	E.	4 holes 5/8 in-11 UNC through	H.	4 holes 5/8 in-11 UNC x 28 mm deep
C.	2 holes 5/8 in-11 UNC x 23 mm deep	F.	4 holes 5/8 in-11 UNC x 31 mm deep	I.	4 holes 5/8 in-11 UNC x 30 mm deep
				J.	4 studs 1/2 in UNF on 149,35 mm PCD

TRACTOR MOUNTING POINTS

TRACTOR MOUNTING POINTS



TRACTOR MOUNTING POINTS



342, 352, 362, 372 and 382 Tractors
All dimensions in millimeters.

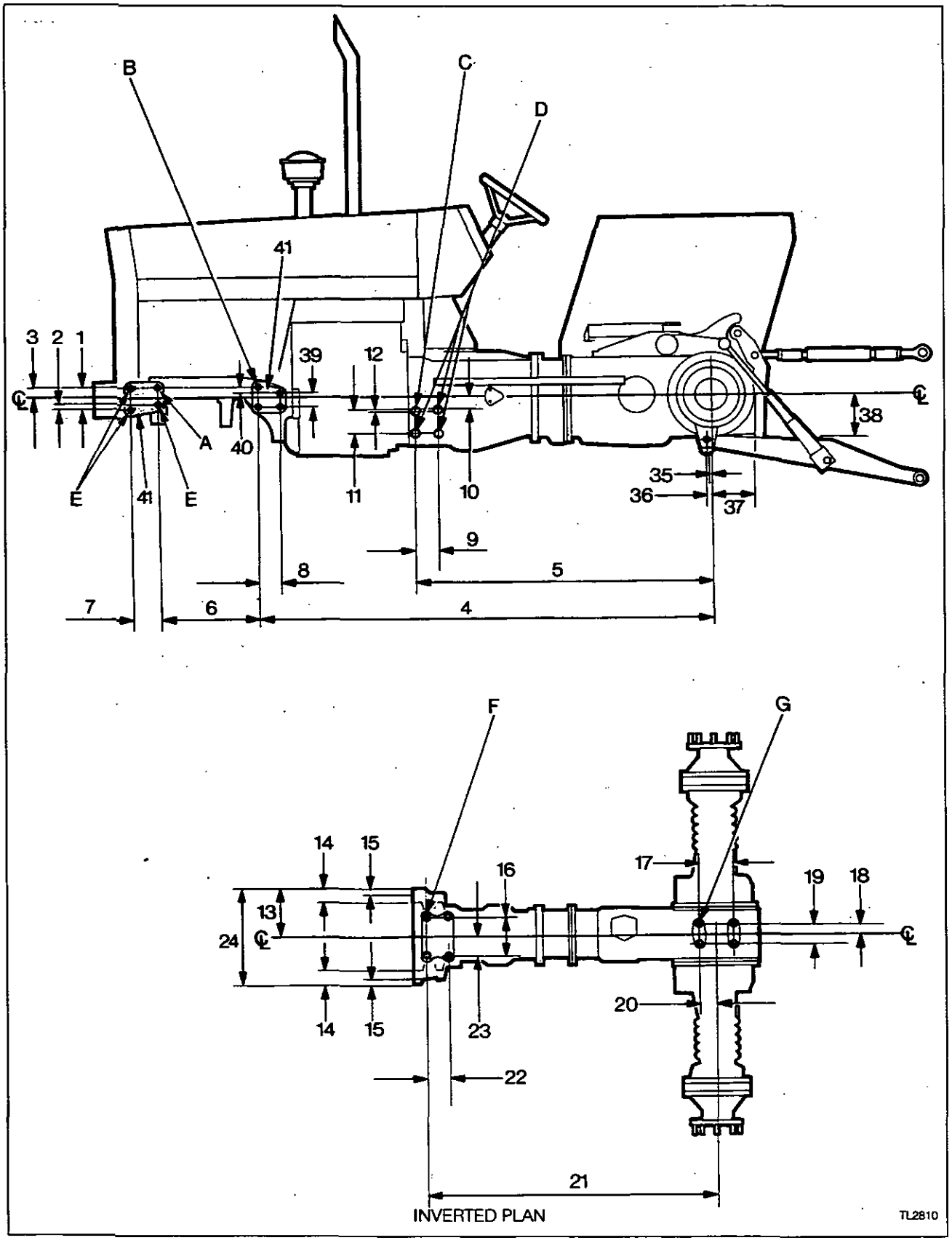
1.	75.00	13.	215,90	25.	80,00
2.	25,00	14.	57,15	26.	1943,00 - 342, 352
3.	1380,00	15.	184,15	26.	2035,00 - 362, 372, 382
4.	2390,00 - 342, 352	16.	19,05	27.	440,00 - across front pads
4.	2482,00 - 362, 372, 382	17.	152,40	27.	410,00 - across rear pads
5.	101,60	18.	42,88	28.	492,00
6.	60,45	19.	85,73	29.	31,75
7.	9,65	20.	76,20	30.	201,00
8.	111,25	21.	1345,20	31.	194,74
9.	20,00	22.	92,07	32.	1467,60
10.	100,00	23.	101,60	33.	427,80
11.	80,00	24.	431,80	34.	41,20
12.	60,00			35.	82,40

Hole sizes

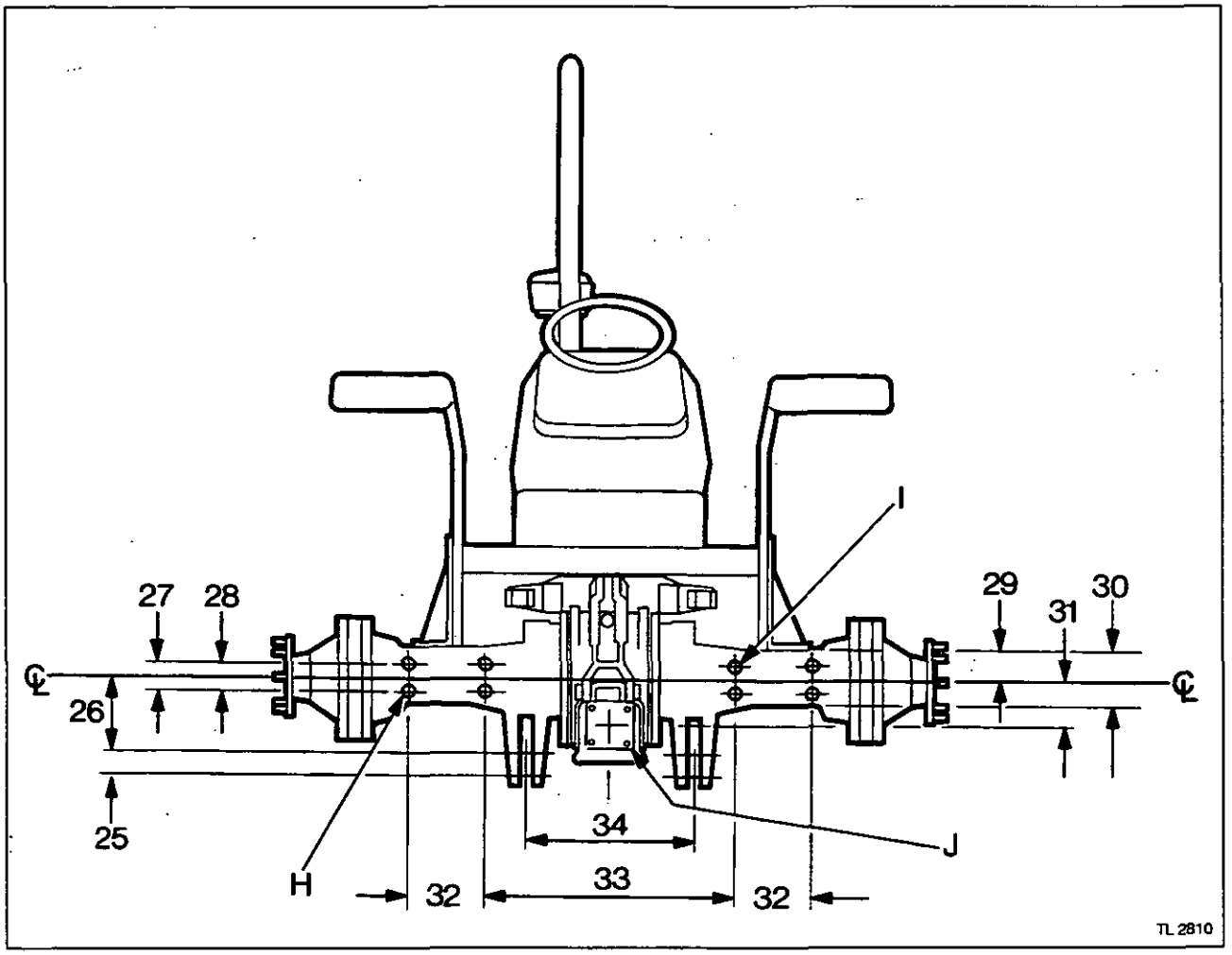
A.	4 holes 5/8 in-11 UNC through	D.	2 holes 5/8 in-11 UNC x 35 mm deep	F.	4 holes 3/4 in-10 UNC x 28 mm deep
B.	6 holes 5/8 in-11 UNC x 32 mm deep	E.	4 holes 5/8 in-11 UNC x 31 mm deep	G.	4 studs 1/2 in UNF on 149,35 mm PCD
C.	2 holes 5/8 in-11 UNC x 23 mm deep				

TRACTOR MOUNTING POINTS

TRACTOR MOUNTING POINTS



TRACTOR MOUNTING POINTS



365, 375, 383, 390, 390T, 393, 396, 398 and 399 Tractors
Two-wheel drive - serial number C 49189 onwards.
Four-wheel drive - serial number C 45009 onwards.
All dimensions in millimeters.

1.	95.00	14.	57,15	28.	40,80
2.	20,00	15.	19,05	29.	90,20
3.	46,50	16.	184,15	30.	161,54
4.	2086,50 - 4 cylinder engine	17.	152,40	31.	127,03
4.	2374,30 - 6 cylinder engine	18.	42,88	32.	220,00
5.	1380,00	19.	85,73	33.	726,20
6.	472,55	20.	76,20	34.	492,00
7.	130,00	21.	1345,20	35.	6,35 - heavy-duty axle
8.	90,00	22.	101,60	36.	31,75
9.	101,60	23.	92,07	37.	201,00
10.	60,45	24.	431,80	38.	197,74
11.	111,25	25.	67,00 - heavy-duty axle	39.	55,00
12.	9,65	26.	212,50	40.	30,00
13.	215,90	27.	80,00	41.	508,00 across mounting points

Hole sizes

A.	2 holes 5/8 in-11 UNC x 35 mm deep	E.	6 holes 5/8 in-11 UNC through	H.	4 holes 5/8 in-11 UNC x 28 mm deep
B.	8 holes 3/4 in-10 UNC x 40 mm deep	F.	4 holes 5/8 in-11 UNC x 31 mm deep	I.	4 holes 5/8 in-11 UNC x 30 mm deep
C.	2 holes 5/8 in-11 UNC x 23 mm deep	G.	4 holes 3/4 in-10 UNC x 28 mm deep	J.	4 studs 1/2 in UNF on 149,35 mm PCD
D.	6 holes 5/8 in-11 UNC x 32 mm deep				

PRE–DELIVERY, INSTALLATION AND SERVICES

Section 1 – Part C

Table of Contents

PRE–DELIVERY, INSTALLATION AND SERVICES

General

This section has been compiled to enable the reader to ascertain quickly what action is necessary to prepare a new tractor for sale, install it on the farm and carry out the 50 and 250 hour services, which should be rendered during the warranty period.

The timing of these two services has been calculated to provide maximum tractor efficiency throughout the warranty period thus safeguarding the subsequent life of the tractor.

Also detailed is the 'Running-in' procedure which will ensure that the engine will give a satisfactory performance through-out its life.

Pre–delivery

Check 1C–01

The following items must be checked by the Dealer before delivery to the Customer:

Before checking

1. Verify and record for future use the serial numbers of the tractor, engine, four-wheel drive front axle and cab if fitted.
2. Assemble all parts that have been removed for transport.

Checking levels

Check and top–up if necessary the following levels with their appropriate liquids:

3. Cooling system, water or anti-freeze.
4. Engine oil.
5. Engine air cleaner (oil bath type).
6. Transmission and rear axle.
7. Rear epicyclic hubs (heavy-duty axle only).
8. Power steering reservoir (if fitted).
9. Hydraulic brake reservoir.
10. Front axle (four-wheel drive).
11. Front axle epicyclic hubs (four-wheel drive).
12. Fuel tank.
13. Battery electrolyte.
14. Screen washer reservoir(s).

Lubrication

Lubricate the following points:

15. All grease nipples.
16. Four-wheel drive shaft.
17. Four-wheel drive front axle drive shafts.
18. Lightly oil the clutch linkage, throttle linkage hand and foot, all hinges, catches and door locks.

Adjustments

Make the following checks and adjust if necessary:

19. Alternator/fan belt tension.
20. Clutch linkage, free pedal clearance (when applicable).
21. Brake pedal, free pedal clearance.
22. Torque all wheel and rim nuts and bolts.
23. Tyre pressures.
24. Battery condition, charge if necessary. Clean the battery top and smear the terminals with petroleum jelly.

Checks before road test

Turn the starter switch to the 'Auxiliary' position, check the following, and if necessary rectify the fault:

25. All warning lights are 'On'.
26. Lights - head, side, direction indicator, work and interior.
27. Hazard warning and rotating beacon (if fitted).
28. Windscreen wiper(s) and washer.
29. Horn.
30. Cab heater, blower motor and louvre function.

Start the engine, check the following, rectify if necessary:

31. Safety start function on the high/low gear lever and PTO lever.
32. All warning lights extinguish.
33. Air cleaner restriction indicator by momentarily blanking off the air intake.
34. Fuel shut-off function.

Stop the engine:

35. Remove all traces of oil, fuel, and coolant from the tractor to permit a leak check after road test.

Road test

Restart the engine and warm–up the tractor. Drive forward and check the following, investigate and rectify any fault:

36. Gear selection is 'normal' for the model.
37. Balance and operation of the brakes.
38. Steering - feel and operation lock to lock.
39. Multi-Power or Speedshift function.
40. Differential lock function.
41. Four-wheel drive function.
42. Parking brake.
43. Operation of the cab heater.
44. Operation of all instruments, warning and indicator lights.
45. Operation of air conditioning.

After the road test

Check the hydraulic lift performance with a weight or implement fitted to the lower links:

46. Draft Control.
47. Position Control.
48. Transport - correct position.
49. Constant Pumping - correctly positioned.
50. Response Control - effective.
51. Selector valve - operation.

Final checks

Carry out these final checks:

52. Ensure that no leaks are apparent from areas previously cleaned.
53. Check that all safety guards and decals are in place and correctly fitted.

54. Clean off preservatives and remove labels.
55. Clean the tractor.
56. Ensure that the tool box content is correct and the Operator instruction Book, Maintenance Chart, and Tractor Service Record Book are with the tractor.

Tractor installation

Instruction 1C–02

These instructions are to be given to the Owner and/or Operator of the tractor, all items must be fully explained and where applicable, performed. Emphasis must be given to all safety precautions in the operation and servicing of the tractor and its implements.

Use the Operator Instruction Book and Maintenance Chart supplied with the tractor to assist in explaining the following:

1. Location and significance of tractor, engine and cab serial numbers.
2. All safety points and decals on the tractor and in the Operator Instruction Book.
3. The use of all instruments and controls.
4. Running-in procedure.
5. The operation of the throttle lever and foot pedal, use of the engine speed indicator, travel and PTO speed chart.
6. Use and adjustment of the clutch.
7. Differential lock, its engagement, disengagement and adjustment.
8. Four-wheel drive, its engagement and disengagement.
9. Brakes, latched and unlatched, method of adjustment.
10. The attachment of auxiliary hydraulic equipment.
11. The method of making wheel width adjustments, front wheel alignment and tyre pressures.
12. Drawbar and hitch positions.
13. Servicing of the tractor, explain the oil changes and services as detailed in the maintenance section of the instruction book. Point out the position of the drain plugs, filler plugs and dipsticks. Include the power steering reservoirs.

Draw attention to the recommended grades of lubricants and advise on engine and hydraulic filter replacement and cleaning.

14. Cooling system frost precautions and the fan belt adjustment.
15. Maintenance of the engine air cleaner.
16. Care and operation of the radio/cassette player and tapes (if fitted).

Demonstrate the following:

17. Engine starting and stopping procedure, when hot and cold.
18. How to remove the air from the fuel system, stress the importance of clean fuel.
19. Driving the tractor, starting and stopping, the use and sequence of gears, operation of clutches.
20. Operation of the PTO and the method of changing the speed.
21. How to use the hydraulic lift system, make adjustments and attach implements. Use of check chains, stabilizers and pick-up hitch (if fitted).

Carry out the following:

22. Complete the information on the Installation and Registration Certificate and request the Owner to sign.
23. Enter the serial numbers etc. in the front of the Operators Instruction Book and hand to the Owner.
24. Explain to the Owner his Warranty entitlement and the services due during the warranty period.

Running–in

Instruction 1C–03

The following precautions should be taken during the running–in period :

1. Experience has shown that the first 50 hours of tractor operation have a significant effect on the performance and life of the engine. From new, the tractor should be engaged in work which will load the engine as near as possible to full working conditions, emphasis should be given on varying the load to assist in the running-in.

Full load should not be applied until the engine has reached a temperature of at least 60°C (140°F).

2. Use low gear when pulling heavy loads.
3. During the running in period, check frequently the tightness of all wheel nuts and bolts.
4. To ensure proper clutch life, care must be taken to bed-in the friction plates properly.

NOTE: During the first 15 hours of the tractor's life, frequently, but carefully engage and disengage the clutch. During the first 50 hours a careful watch must be kept on the clutch pedal free travel (when applicable), which should be adjusted as soon as the pedal travel decreases. This is particularly important when a loader is fitted.

50 hour free service

Servicing 1C–04

The following operations are to be carried out after 50 hours running by the Dealer service engineer.

Engine

1. Change the engine oil.
2. Change the engine oil filter.
3. Check the tappets, and adjust if necessary.

Fuel system and air cleaner

4. Change the fuel filter element.
5. Check the air cleaner, change the oil or clean the filter if necessary.

Cooling system

6. Check the coolant level and replenish if necessary.
7. Check the alternator/fan belt tension and adjust if necessary.

Front axle and steering

8. Change the power steering pump oil and filter element (if fitted).
9. Check the front axle oil level (four-wheel drive only), top up if necessary..
10. Check the front axle epicyclic oil level (four-wheel drive only), top up if necessary.

Transmission and hydraulics

11. Check the transmission oil level and top-up if necessary.
12. Clean the lift hydraulic filter screen.
13. Check the oil in the rear epicyclic hubs (heavy-duty axle only), top-up if necessary.
14. Check the torque of all wheel and rim nuts and bolts.
15. Check tyre pressures and adjust if necessary.

Clutch and brakes

16. Check the clutch pedal free travel and adjust if necessary (when applicable).
17. Check the live PTO clutch setting and adjust if necessary (when applicable).
18. Check the foot brakes and adjust if necessary.
19. Check the parking brake and adjust if necessary.
20. Check the brake fluid level and top up if necessary.

Cab

21. Check the screen washer bottle fluid level and replenish if necessary.
22. Clean the cab air filter.

General

23. Lubricate all grease points.
24. Lightly oil the clutch linkage, throttle linkage both hand and foot, hinges, catches and door locks.
25. Road test the tractor, checking all instruments, lights and services for correct functioning, in the event of any fault being found this must be corrected.
26. After the road test, check for leaks in the oil, coolant and fuel systems.
27. Enquire if any operational difficulties are being experienced by the Owner, correct or demonstrate as necessary.
28. Complete the 1st Service record card.

250 hour free service

Servicing **1C–05**

The following operations are to be carried out after 250 hours running or before the end of the warranty period which ever is first by the Dealer service engineer:–

Engine

1. Change the engine oil.
2. Change the engine oil filter.

Fuel system and air cleaner

3. Check the air cleaner, change the oil or clean the filter if necessary.

Cooling system

4. Check the coolant level and replenish if necessary.
5. Check the alternator/fan belt tension and adjust if necessary.

Electrical system

6. Check the battery electrolyte level and replenish if necessary.
7. Check the operation of the safety start switches.

Front axle and steering

8. Check the power steering pump oil level and top-up if necessary (when applicable).
9. Check the front axle oil level (four-wheel drive only), top up if necessary.
10. Check the front axle epicyclic oil level (four-wheel drive only), top up if necessary.

Transmission and hydraulics

11. Check the transmission oil level and top-up if necessary.
12. Change the spin-on hydraulic oil filter.
13. Check the oil in the rear epicyclic hubs (heavy-duty axle only), top-up if necessary.
14. Check the torque of all wheel and rim nuts and bolts.
15. Check the tyre pressures and adjust if necessary.

Clutch and brakes

16. Check the clutch pedal free travel and adjust if necessary (when applicable).
17. Check the foot brakes and adjust if necessary.
18. Check the parking brake and adjust if necessary.
19. Check the brake fluid level and top up if necessary.

Cab

20. Check the screen washer bottle fluid level and replenish if necessary.
21. Clean the cab air filter.

General

22. Lubricate all grease points.
23. Lightly oil the clutch linkage, throttle linkage both hand and foot, hinges, catches and door locks.
24. Road test the tractor, checking all instruments, lights and services for correct functioning, in the event of any fault being found this must be corrected.
25. After the road test, check for leaks in the oil, coolant and fuel systems.
26. Enquire if any operational difficulties are being experienced by the Owner, correct or demonstrate as necessary.
27. Complete the 2nd Service record card.

Cab
33. Check the screen washer bottle washer level and and replenish if necessary.
34. Clean the cab air filter.

General
35. Check the drawbar for tightness.
36. Lubricate all grease points.
37. Lightly oil the clutch linkage, throttle linkage hand and foot, hinges, catches and door locks.
38. Road test the tractor, checking all instruments, lights and services for correct functioning, in the event of any fault being found this must be corrected.
39. After road test, check for leaks in oil, coolant and fuel systems.
40. Enquire if any operational difficulties are being experienced by the customer, correct or demonstrate as necessary.
41. Complete the 1st Service record card.

250 Hour free service

Servicing 1C-05

The following operations are to be carried our after 250 hours running or before the end of the warranty period whichever is first by the Dealer service engineer.

Engine
1. Change engine oil.
2. Change engine oil filter.

Fuel system and air cleaner.
3. Change the primary fuel filter element.
4. Check the air cleaner, change oil or clean filter if necessary.

Cooling system
5. Check the coolant level and replenish if necessary.
6. Check the alternator/fan belt tension and adjust if necessary.

Electrical system
7. Check the battery electrolyte level and replenish if necessary.
8. Check the tightness of the battery connections, ensure that the battery is clean and the terminals are covered with petroleum jelly.
9. Check the tightness of all cable clips and terminals and check all wiring for chafing.
10. Check the operation of the safety start switches.

Front axle and steering
11. Check the power steering pump oil level and top-up if necessary.
12. Check the front axle oil level (4WD only), top-up if necessary.
13. Check the front axle epicyclic oil level (4WD only), top-up if necessary.

Transmission and hydraulics
14. Check the transmission oil level, top-up if necessary.
15. Change the spin-on hydraulic oil filter (if necessary).
16. Check the oil in the rear epicyclic hubs (heavy duty axle only), top-up if necessary.
17. Check the torque of all wheel and rim nuts and bolts.
18. Check tyre pressures and adjust if necessary.

Clutch and brakes
19. Check the clutch pedal free travel and adjust if necessary.
20. Check the live PTO clutch setting and adjust if necessary.
21. Check the foot brakes and adjust if necessary.
22. Check the parking brake and adjust if necessary.
23. Check the brake fluid level and top-up if necessary.

Cab
24. Check the screen washer bottle level and replenish if necessary.
25. Clean the cab air filter.

General
26. Lubricate all grease points.
27. Lightly oil the clutch linkage, throttle linkage hand and foot, hinges, catches and door locks.
28. Road test the tractor, checking all instruments, lights and services for correct functioning, in the event of any fault being found this must be corrected.
29. After road test, check for leaks in oil, coolant and fuel systems.
30. Enquire if any operational difficulties are being experienced by the customer, correct or demonstrate as necessary.
31. Complete the 2nd Service record card.

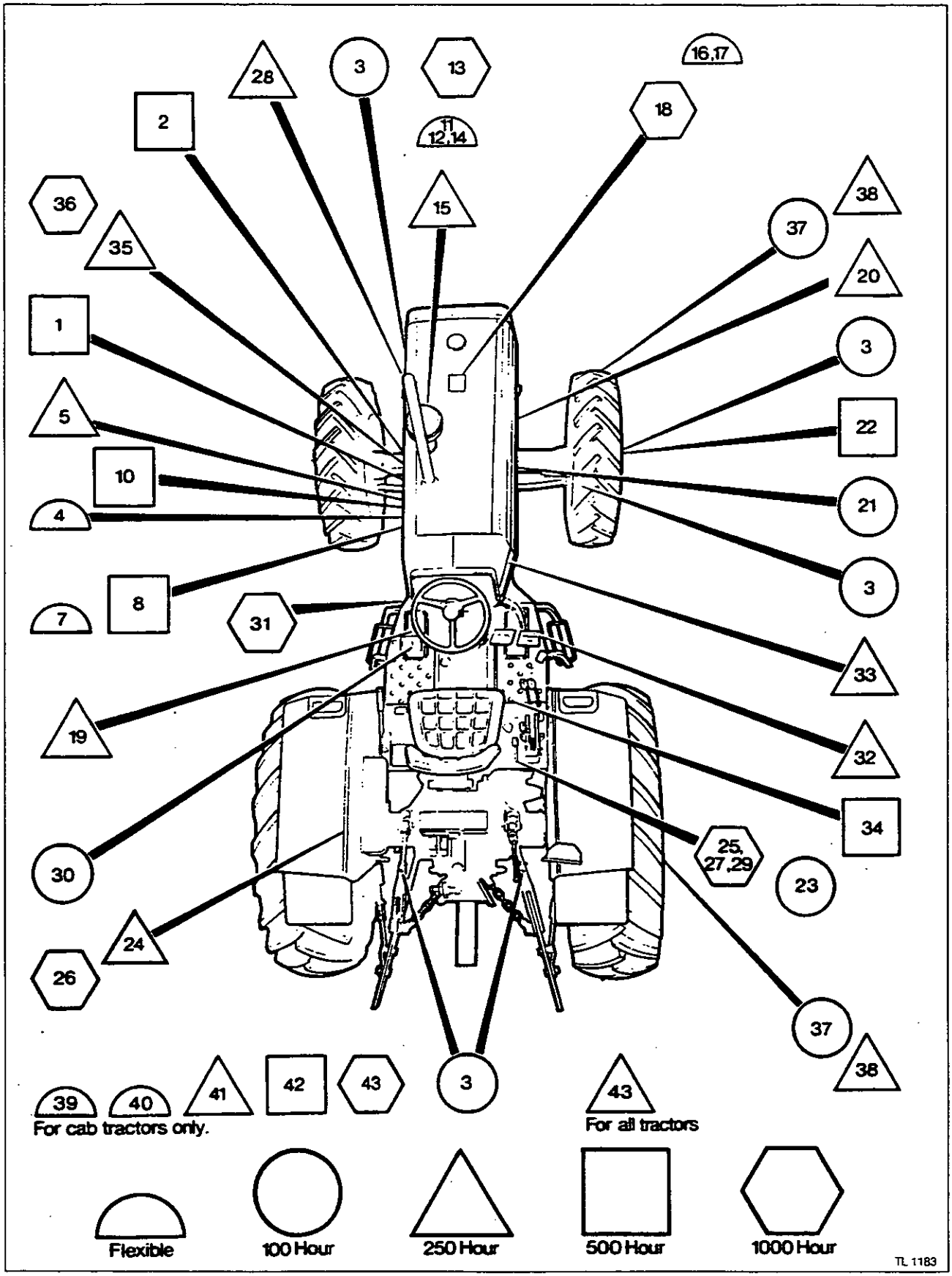
MAINTENANCE AND LUBRICATION

Section 1 – Part D

Table of Contents

MAINTENANCE CHART		EVERY				
		Flexible **	100 hours	250 hours	500 hours	1000 hours
GREASE POINTS	Grease four-wheel drive shaft universal joints and couplers.				1	
	Grease four-wheel drive front axle universal joints.				2	
	Grease all other grease nipples.		3			
ENGINE	Check the engine oil level and top up if necessary.	4				
	Change the engine oil and filter.			5		
	Check the valve tip clearance and adjust if necessary.	Every 2000 hours.				
FUEL SYSTEM	Drain the sediment from the fuel filter bowl(s).	7				
	Change the fuel filter element.				8	
	Service the fuel injectors.	Every 2000 hours.				
	Clean the fuel lift pump strainer.				10	
AIR CLEANER	Check the pre-cleaner.	11				
	Check and clean the dry air cleaner MAIN element.	12				
	Change the dry air cleaner MAIN element.					13
	Check the oil bath cleaner oil level and condition.	14				
	Service the oil bath air cleaner and pre-cleaner.			15		
COOLING SYSTEM	Check the radiator coolant level and top up if necessary.	16				
	Clean radiator, oil cooler fins and air conditioning condenser if fitted.	17				
	Drain, flush and refill the cooling system.					18
ELECTRICAL SYSTEM	Check battery condition and smear terminals with petroleum jelly.			19		
	Check the tension of the alternator/fan belt.			20		
STEERING	Check the power steering fluid level and top up if necessary.		21			
	Check the front wheel hub adjustment.				22	
TRANSMISSION AND HYDRAULICS	Check the transmission/hydraulic oil level and top up if necessary.		23			
	Check the rear epicyclic hub oil level and top up (heavy-duty only).			24		
	Change the transmission/hydraulic oil.					25
	Change the rear epicyclic oil (heavy-duty only).					26
	Clean the auxiliary pump oil strainer.					27
	Change the auxiliary pump oil filter element.			28		
	Clean the linkage pump oil strainer.					29
CLUTCH	Check the clutch pedal free travel and adjust if necessary (Rod operated clutches only). (Note running-in instructions).		30			
	Check and adjust the live PTO clutch.					31
BRAKES	Check the brakes and adjust if necessary.			32		
	Check the hydraulic brake fluid level and top up if necessary.			33		
	Change the brake fluid and check the condition of the brake pipes.	Every 2000 hours or two years whichever comes first				
DIFFERENTIAL LOCK	Check and adjust the differential lock (Mechanical type only).				34	
4WD FRONT AXLE	Check the 4WD front axle and epicyclic oil levels and top up.			35		
WHEELS AND TYRES	Check all tyre pressures.		37			
	Check wheel nut tightness.			38		
CAB	Check the windscreen washer bottle and top up if necessary.	39				
	Remove and clean the cab air filter.	40				
	Change the cab air filter element.					44
	Check operation of the air conditioning system.			41		
	Check air conditioning compressor belt tension.				42	
GENERAL	Oil can lubrication			43		

** Flexible Maintenance times vary according to individual conditions of operation. The owner must establish his own times for servicing flexible items. An average interval time for checking is at each fuel fill.



Tractor lubrication chart - see chart opposite

LUBRICATION

Engine crankcase

Use Massey Ferguson 'Vector' Super Tractor Universal Oil (STOU) or an STOU covered by Massey Ferguson specification M1139 to one of the viscosities listed in Table 1 below.

or

Massey Ferguson 'Vector' Super 500 multi-use oil or Massey Ferguson Multiguard oil.

or

One of the lubricants listed on page1D-6 in Table 3 or its equivalent.

Engine crankcase capacity:–

Three cylinder engines	6,8 litres (1.50 gal)(1.8 U.S.gal)
Four cylinder engines	7,5 litres (1.70 gal)(2.0 U.S.gal)
Four cylinder turbo engines	7,7 litres (1.70 gal)(2.0 U.S.gal)
Six cylinder engines	14,3 litres (3.1 gal)(3.8 U.S.gal)

Engine oil specification must meet one of the following minimum specifications:-

Naturally aspirated engine	API CC/CCMCD1
Turbocharged engines	API CD/CCMCD2

Engine oil viscosity

Ambient temperature range			Oil viscosity - SAE number
	Degree F	Degree C	
Cold	Below 41	Below 5	10W. 10W/20 10W/30
Temperate	25 to 81	-4 to +27	10W/30. 20W. 15W/30. 20W/30. 10W/40. 15W/40. 20W/50.
Hot	Above 64	Above 18	15W/40. 20W/30. 20W/40. 20W/50. 30.

Table 1

Transmission and hydraulics

Use Massey Ferguson 'Vector' Super Tractor Universal Oil (STOU) or an STOU covered by Massey Ferguson specification M1135 or M1139 to one of the viscosities listed in Table 2 below.

or

Massey Ferguson 'Vector' Super 500 multi-use oil or Massey Ferguson Permatran oil.

or

One of the lubricants listed on page1D-6 in Table 3 or its equivalent.

Transmission and hydraulic oil capacity:–

With spacer	47,4 litres (10.4 gal)(12.5 US gal)
Without spacer	43,4 litres (9.5 gal)(11.5 US gal)
With 12-speed shuttle or 18 Speedshift gearbox	45 litres (10 gal)(12 US gal)

Transmission and hydraulic oil viscosity

Ambient temperature range			Oil viscosity - SAE number
	Degree F	Degree C	
Cold	Below 41	Below 5	10W/20 10W/30.
Temperate	25 to 81	-4 to +27	10W/30. 15W/30. 20W/30. 10W/40. 15W/40. 20W/50.
Hot	Above 64	Above 18	15W/40. 20W/30. 20W/40. 20W/50.

Table 2

Four–wheel drive front axle

Use Massey Ferguson 'Vector' Super Tractor Universal Oil (STOU) or an STOU covered by Massey Ferguson specification M1139 to a viscosity of 10W/30 or 10W/40 at all temperatures.

or

Massey Ferguson 'Vector' Super 500 multi-use oil or 'Vector' Hi-Load Universal oil EP80W/90

or

Massey Ferguson Permatran oil.

or

EP90 GL5 gear oil.

or

One of the lubricants listed on page1D-6 in Table 3 or its equivalent.

Four-wheel drive front axle capacity:–

NG axle - early type:-

Axle - 350, 355, 360	5,0 litres (1.1 gal) (1.3 US gal)
Axle - 362, 365, 375, 383, 390, 390T, 393, 396	5,0 litres (1.1 gal) (1.3 US gal)
Axle - 398, 399	5,8 litres (1.3 gal) (1.5 US gal)
Epicyclic hubs (each side) 350, 355, 360	1,4 litres (2.5 pt) (2.5 US pt).
Epicyclic hubs (each side) 362, 375, 383, 390, 390T, 393, 396	1,2 litres (2.1 pt) (2.3 US pt).
Epicyclic hubs (each side) 398, 399	1,3 litres (2.2 pt) (2.6 US pt).

AG axle - later type:-

Axle - 342, 352, 362, 372, 382	5,5 litres (1.2 gal) (1.5 US gal)
Axle - 365, 375, 383, 390, 390T, 393, 396	5,6 litres (1.2 gal) (1.5 US gal)
Axle - 398, 399	7,6 litres (1.7 gal) (2.0 US gal)
Epicyclic hubs (each side) 342, 352, 362, 372, 382	0,8 litres (1,4 pt) (1,4 US pt).
Epicyclic hubs (each side) 365, 375, 383, 390, 390T, 393, 396	1,1 litres (2.0 pt) (2.3 US pt).
Epicyclic hubs (each side) 398, 399	1,2 litres (2.1 pt) (2.5 US pt).

Oil bath air cleaner

Use engine oil as listed on page1D-6 in Table 3 or its equivalent.

Oil bath capacity:-

Axle - 350, 355, 360	0,5 litres (1 pt) (1 US pt)
Axle - 365, 375, 390, 398	0,75 litres (1.3 pt) (1.3 US pt)
Axle - 399	1 litres (1.8 pt) (1.8 US pt)

Power steering reservoir

Use Massey Ferguson 'Vector' Automatic Transmission Fluid Dexron II.
or
Massey Ferguson 'Vector' Super Tractor Universal Oil (STOU) or an STOU covered by Massey Ferguson specification M1139 to a viscosity of 10W/30 or 10W/40 at all temperatures.
or
Massey Ferguson 'Vector' Super 500 multi-use oil or Massey Ferguson Permatran oil.
or
Use engine oil as listed on page1D-6 in Table 3 or its equivalent.

Power steering reservoir capacity:-

362, 365, 375, 390, 390T	1,2 litres (2.1 pts) (2.1 US pts)

Brake fluid

Use Massey Ferguson brake fluid part number 3405 389 M1.
or
Mineral type oil as specified in the recommended lubricants listed on page1D-6 in Table 3.

DO NOT use vegetable type fluid. The correct fluid is colour coded GREEN.

Grease Points

Use Massey Ferguson 'Vector' Multi Purpose Grease NLG1 EP2 or any multi-purpose lithium-based grease. Always clean the grease gun and fittings before and after use.

Grease points are located as follows:-

Front wheel hubs, two-wheel drive only	2 points.
Front axle king pins, two-wheel drive only	2 points.
Front axle pivot, two- & four-wheel drive	1 point.
Steering ram pivot pin, two-wheel drive only	1 point.
Lift rods and levelling box	3 points.
Four-wheel drive shaft - rear, universal joint and sliding coupling	2 points.
Four-wheel drive shaft - front, universal joint	1 point.
Front axle universal joints - NG axles only - early type	4 points.
Front axle universal joints - AG axles only - later type	2 points.
365, 375, 383, 390, 390T, 393, 396, 398, 399	2 points.
Four-wheel drive swivel pins - AG axles only - later type	4 points.

Oil can lubrication

With an oil can, lubricate throttle and control linkage, cab door hinges and locks, every 250 hours.

CAUTION: Severe working conditions.
Where tractors are operating arduous work cycles, or when working in areas where there are dusty conditions, paddy fields, deep water etc, coupled with a lack of maintenance care and low specification fuel and oil, the intervals of service should be halved, particularly for oil and filter changes.

WARNING: Tractor lubricants and greases:–
No significant hazard when properly used and in the application for which they were designed. Frequent and/or prolonged skin contact may give rise to skin irritations. Emergency treatment of acute effects:–

- Ingestion:- DO NOT induce vomiting. Administer 250 ml (1/2 pint) milk or 50 ml olive oil. Seek medical advice.
- Skin Contact:- Remove by wiping, wash with soap and water.
- Inhalation:- Saturated vapour non-toxic at room temperature. Remove from exposure.
- Eye contact:- Wash with copious amounts of warm water.

RECOMMENDED LUBRICANTS – ALL TERRITORIES

For engine oil viscosities and temperature - see Table 1 and Table 2 on page1D-4.

Unit	Temp.	BP	CALTEX	CASTROL	ESSO
Engine naturally aspirated	See page 1D-4	Vanellus M Terrac Extra	Delo 100 Delo 200 Delo 350 Delo 500 Super Tractor Oil Delo 350 Delo 500 Multigrade	Castrol Agri MP Castrol Agri MP Fortec Castrol CRF	Unifarm Super Tractor Oil Essolube DX-34+ Essolube MHX
Engine turbocharged	See page 1D-4	Vanellus C3 Terrac Extra BP Multigrade 15W-40	Delo 350 Delo 350 Multigrade Delo 500 Delo 500 Multigrade Super Tractor Oil Delo SMP Delo SMP Multigrade	Castrol Agri MP Castrol Agri MP Fortec Castrol Agri Trimax Castrol Agri Powermax Castrol RX Castrol RX Super Plus	Unifarm Super Tractor Oil Essolube MHX SAE 15W40 Essolube Cargo 15W40 Esso Super Diesel Oil TD
Transmission, hydraulics and 4WD front axle	Cold	Tractran 9 Terrac Extra 10W30	RPM Tractor Hydraulic Fluid	Castrol Agri MP Castrol Agri MP Fortec Castrol Agri Power Trans Castrol Agri Multi Trans	Torque Fluid 56 Unifarm AL 3100
	Temperate	Terrac Extra 10W30 Terrac Extra 10W40 Terrac 15 Tractran 8	Super Tractor Oil TDH Fluid HT RPM Tractor Hydraulic Fluid	Castrol Agri MP Castrol Agri MP Fortec Castrol Agri Power Trans Castrol Agri Multi Trans Castrol Agri AS Super	Torque Fluid 56 Torque Fluid 62 Unifarm AL 3100 Super Tractor Oil
	Hot	Terrac Extra 10W40 Terrac 15 Tractran 8	Super Tractor Oil TDH Fluid HT	Castrol Agri MP Castrol Agri MR Fortec Castrol Agri Power Trans Castrol Agri Multi Trans Castrol Agri AS Super	Unifarm Torque Fluid 62 AL 3100 Super Tractor Oil
Power steering reservoir	All temps.	Autran MBX Vanellus C3 10W Autran GM-MP	Texamatic Fluid Dexron IIE ATF HDA Delo 200 Delo 350 10W	Castrol RX Super 10 Agricastrol ATF Castrol TQ D	Essolube XD-3+SAE 10W
Brake fluid	All temps.	Hydraulic LHM	Rando HDZ 15	Castrol CHSMO Castrol LHM	LHM Fluid
	Over -20°C	Autran MBX Autran GM-MP Vanellus C3 10W	Rando HD 32 ATF HDA Delo 350 10W	Castrol TQ D Castrol RX Super 10 Castrol Agri ATF	Torque Fluid 10 ATF D ATF TAS A Essolube XD-3 SAE 10W
Grease	All temps.	Energrease LS-EP2	Molytex EP2	Castrol LM Castrol LMX	Esso Beacon 2 Esso Beacon EP2

Unit	Temp.	MOBIL	SHELL	TEXACO	TOTAL
Engine naturally aspirated	See page 1D-4	Mobil Super Universal Mobil Universal Delvac 1300 Delvac Super 1300	Rotella X Rimular X Rimular XT Harvella S Harvella TX Super Universal Farm Oil	Universal Tractor Oil Ursatex Super Universal Tractor Oil Super Universal Tractor Oil-Premium	Rubia S Rubia XT Multagri TM Multagri Super
Engine turbocharged	See page 1D-4	Mobiland Super Universal Delvac 1300 Delvac Super 1300 Delvac XHP	Harvella S Harvilla TX Super Universal Farm Oil Rimula X Rimula XT Rotella TX	Ursa Super LA Ursa Super TD Texfarm Super Universal Tractor Oil Super Universal Tractor Oil-Premium	Multagri Super Multagri TM Rubia XT
Transmission, hydraulics and 4WD front axle	Cold	Mobiland Super Universal Mobilfluid 423	Donax TD Harvella TX	TDH Oil Texfarm 10W30	Multagri Super 10W30 Transmission MP
	Temperate	Mobiland Super Universal	Donax TT Harvella Harvella TX Super Universal Farm Oil Farmecon Universal Oil	Texfarm Super Universal Tractor Oil Super Universal Tractor Oil-Premium	Multagri Super Multagri TM Transmission MP
	Hot	Mobiland Super Universal	Harvella 10W40 Harvella TX Donax TT	Super Universal Tractor Oil	Multagri Super Multagri TM Transmission MP
Power steering reservoir	All temps.	Delvac 1310 ATF 220	Rotella X 10W Rotella TX 10W Rimula X 10W Donax TM, TA or TX	Texamatic 9226 Texamatic 429 Ursa Super LA 10W Textran C3	Rubia S 10W Fluid ATX
Brake fluid	All temps.	Mobil DET II	Shell LHM.S	Rando HD 10	LHM Plus
	Over -20°C	Mobil ATF 200 Mobil ATF 220 Delvac 1310	Donax TA Donax TX Rimula X 10W Tellus T15	Texamatic 9226 Textran C3 Ursa Super LA 10W	Fluid ATX Azolla ZS 32 Robias 10W
Grease	All temps.	Mobilux EP2 Mobilgrease HP222	Farm Grease Universal Retinax LX	Multifak All Purpose EP2	Multis or Multis EP2

Table 3

***NOTE:** All engine oils recommended for turbocharged engines are suitable for use in naturally–aspirated engines after running in.*

SPLITTING THE TRACTOR

INDEX

SPLITTING THE TRACTOR – FOOTSTEP MODELS

Section 2 – Part A

Table of Contents

Specification

Shear tube end float ..... 0,4 to 2,5 mm (0.015–0.100 in)

Bolt Torques

Front axle support casting retaining bolts (3 cylinder tractors) ..... 280 Nm (207 lbf ft)
Front axle support casting retaining bolts (4 & 6 cylinder tractors) ..... 280 Nm (207 lbf ft)
Engine to gearbox retaining bolts ..... 100–130 Nm (74–96 lbf ft)
Gearbox to spacer housing ..... *102–122 Nm (75–90 lbf ft)*
Spacer housing to centre housing ..... 102–122 Nm (75–90 lbf ft)

SPLITTING THE TRACTOR – FOOTSTEP MODELS

Splitting the Tractor Between the Front Axle and the Engine (3 Cylinder Engine Tractors)

Splitting Procedure 2A-01

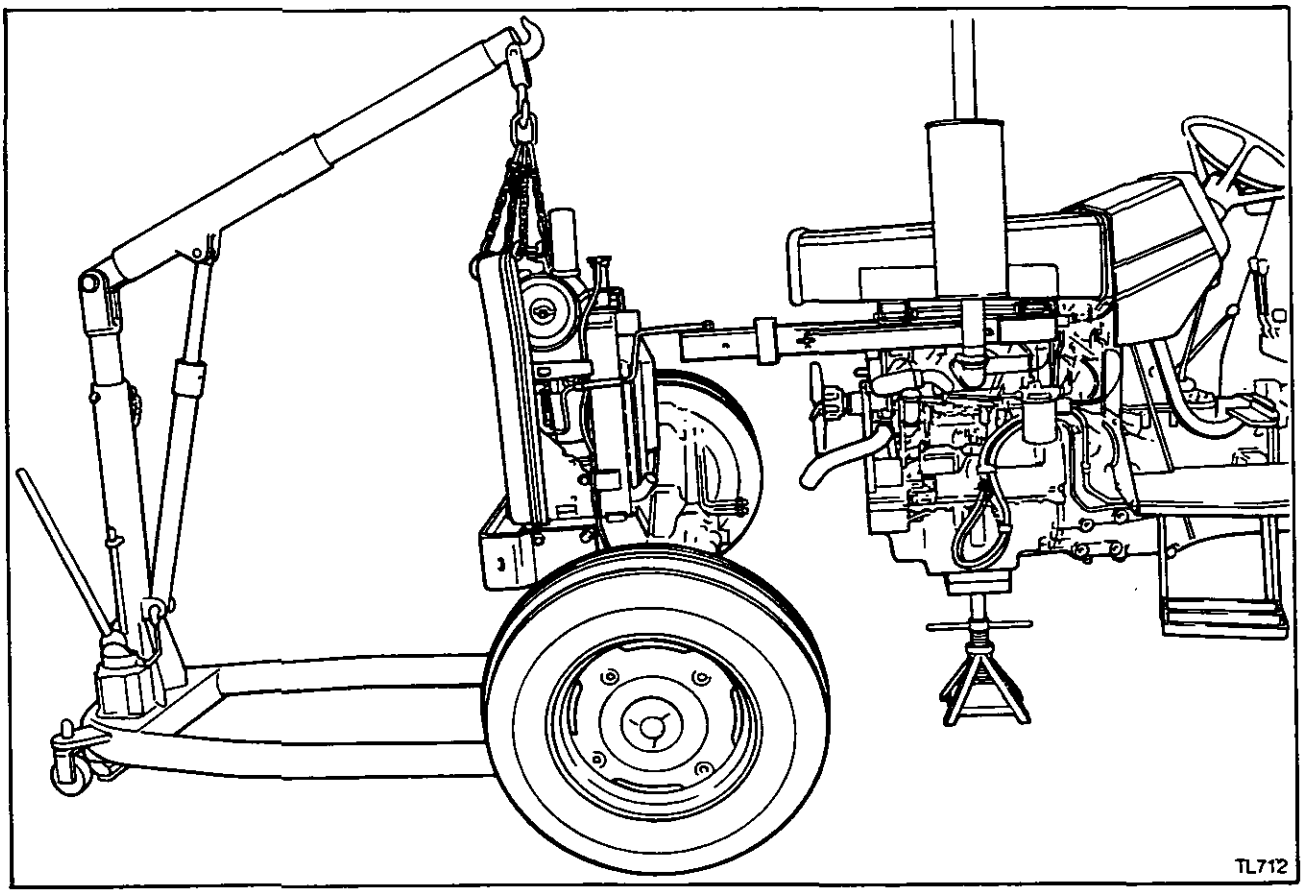
Disassembly

1. Apply the tractor parking brake and fit wedges to hold the rear wheels and remove the front weights if fitted.
2. Remove the hood, front grille and side panels.
3. Remove the radiator cap and drain the cooling system via the drain tap on the radiator and the plug on the engine block.
4. Disconnect the battery negative (−) cable at the battery.
5. Disconnect the battery positive (+) cable and thread it away so that it stays with the engine.
6. Disconnect the wiring harness and thread it back through so that it is left on top of the engine.
7. If necessary, drain the fuel tank.
8. Disconnect and plug the fuel feed and return pipes.
9. Remove both fuel tank side support members and lift off the fuel tank.
10. Disconnect the top and bottom radiator hoses.
11. Disconnect hydraulic pipes to and from the oil cooler and filter.
12. Disconnect the hose between the air cleaner and the inlet manifold.
13. Disconnect the pipe to the turbocharger if fitted.
14. Disconnect hoses to the power steering ram(s).
15. Disconnect the 4WD drive shaft, if fitted, at the axle end.
16. Fit hard wood wedges between the front axle support casting and the axle beam on both sides to prevent the assembly from tilting.
17. Support the nose assembly using a jib crane and chain.
18. Support the tractor under the sump using a suitable jack.
19. Remove the bolts and nuts holding the front axle support casting to the engine.
20. Carefully wheel the front axle assembly and jib crane forwards, away from the engine.

Caution: Take care to keep the front axle assembly vertical once it has been withdrawn from the engine, otherwise it could overbalance and cause injury.

Reassembly

21. Reverse procedures 1 to 19 except:
    a. Tighten the front axle retaining bolts and nuts to a torque of 280 Nm (207 lbf ft).
    b. Check the power steering reservoir oil level, if fitted.



SPLITTING THE TRACTOR – FOOTSTEP MODELS

Splitting the Tractor Between the Front Axle and the Engine 4 and 6 Cylinder Engine Tractors

Splitting Procedure 2A-02

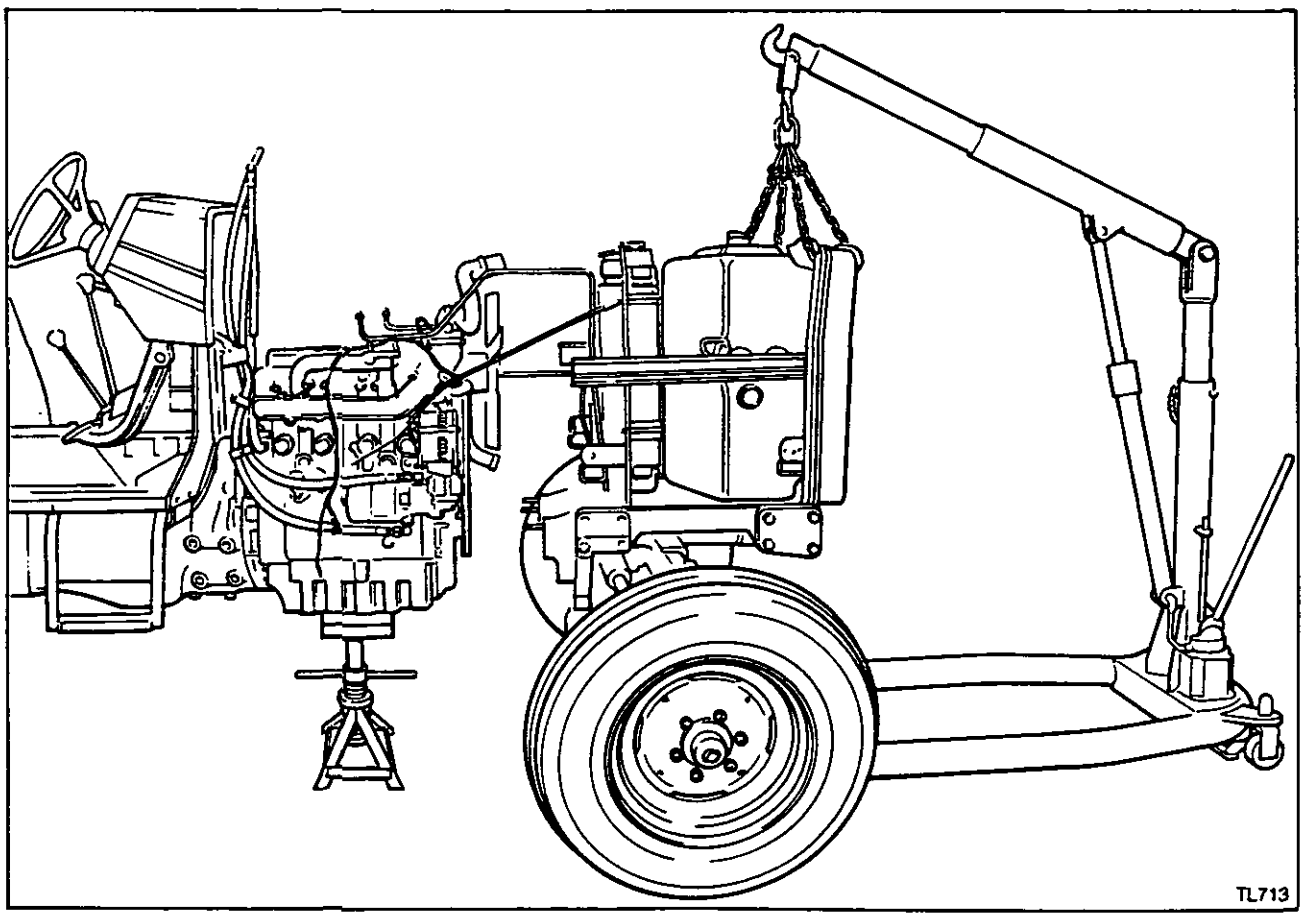
Disassembly

1. Apply the tractor parking brake and fit wedges to hold the rear wheels and remove the front weights if fitted.
2. Remove the radiator cap and drain the cooling system via the drain tap on the radiator and the drain plug on the engine block.
3. Remove the hood, air cleaner and exhaust.
4. Remove the front grille and front side panels.
5. Disconnect the wires to the headlights, horn and fuel tank.
6. Disconnect the pipes to the power steering ram.
7. Disconnect the drive shaft at the axle on 4WD models.
8. Disconnect hydraulic pipes to and from the oil cooler.
9. Check the fuel level in the tank, disconnect the fuel supply and return pipe and plug the pipes with wooden plugs to prevent loss of fuel from the tank if over half full.
10. Disconnect the radiator upper and lower hoses.
11. Disconnect the grease tube to the front axle pivot pin.
12. Fit hard wood wedges between the front axle support casting and the axle beam on both sides to prevent the front assembly tilting.
13. Support the tractor under the engine sump using a suitable jack.
14. Support the nose assembly using a jib crane and chain.
15. Remove the bolts and nuts securing the axle support casting to the engine.
16. Carefully wheel the front assembly away from the engine on its front wheels and the jib crane.

Caution: Take care to keep the front axle assembly vertical once it has been withdrawn from the engine, otherwise it could overbalance and cause injury.

Reassembly

17. Reverse procedures 1 to 16 except:
    a. Tighten the front axle support casting to engine bolts and nuts to a torque of 280 Nm (207 lbf ft).
    b. Check power steering pump oil level if fitted.



SPLITTING THE TRACTOR – FOOTSTEP MODELS

Splitting the Tractor Between the Engine and Gearbox

Splitting Procedure 2A-03

Special Tools:
MS 2700B Tractor Splitting Track
10 mm A/F Hexagon socket

Disassembly

1. Apply the tractor parking brake and fit wedges to hold the rear wheels.
2. *Disconnect the negative cable (-) from the battery on* 3 cylinder tractors and both batteries on 4 and 6 cylinder tractors.
3. Disconnect the positive battery cable (+) from the starter motor solenoid.
4. Disconnect the wiring harness at the block connectors.
5. Disconnect the throttle cable at the fuel injection pump and remove the connection block for hand and foot throttle cables from the support bracket.
6. Disconnect the stop control cable at the fuel injection *pump.*
7. Disconnect all hydraulic pipes which run from the front to the rear of the tractor.
8. Disconnect hydraulic hoses to power steering ram. Plug the ends and mark them for refitment.
9. Disconnect the drive shaft at the axle on 4WD tractors.
10. Disconnect pipes to the power steering valve. Plug the ends and mark them for refitment.
11. *Fit hard wood wedges between the front axle support* casting and the axle beam on both sides to prevent the front assembly pivoting about the front axle.
12. Assemble the MS 2700B tractor splitting track, place it under the tractor, positioning the trolley under the engine sump, the fixed support under the gearbox.
13. Remove the bolts and nuts holding the engine to the gearbox case.
14. Withdraw the engine and front axle forward.

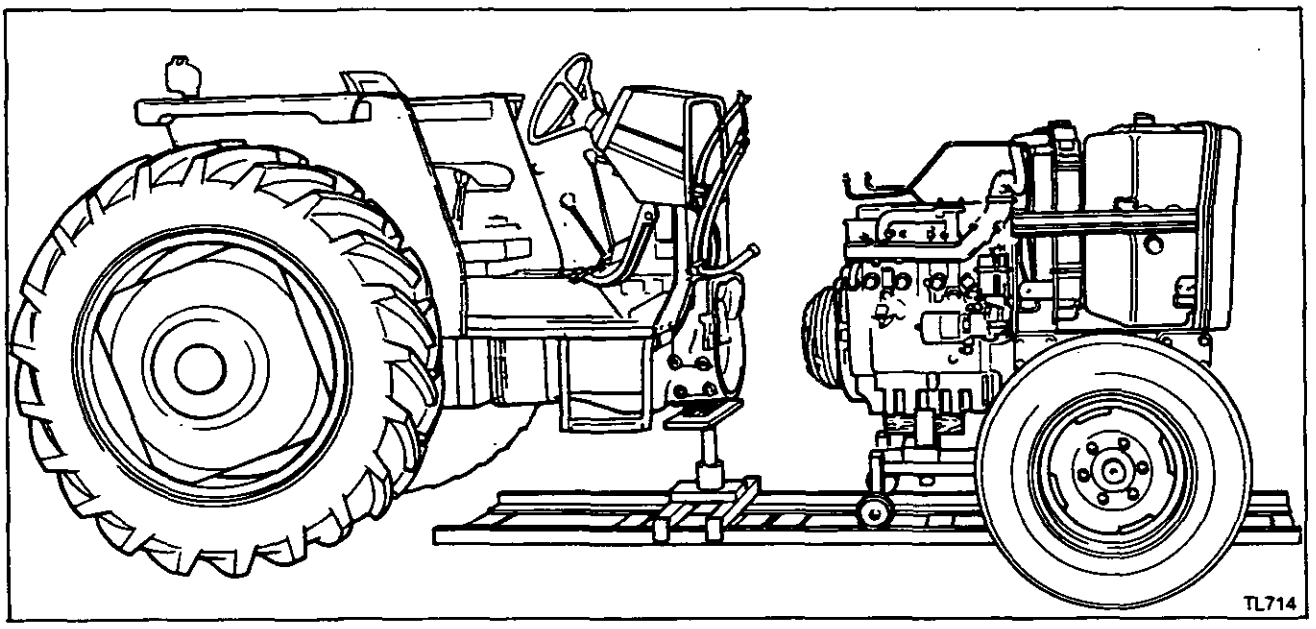
Reassembly

15. Align the engine with the gearbox, two guide studs will assist its alignment. These should be approximately 100 mm (4 in) long x M12.
16. Turn the flywheel and, at the same time, push the *engine and front axle towards the transmission.*

    Turning the flywheel align the clutch plate splines with the gearbox and PTO input shaft. Continue pushing and turning until the engine flanges meet.

Note: Do not force, fit and tighten any of the bolts until the two flanges meet, or serious damage may occur to the transmission and clutch.

17. Fit some of the bolts, remove the guide studs if used, fit the remainder of the bolts and nuts, and tighten them to a torque of 115 Nm (85 lbf ft).
18. Reverse procedures 1 to 11.
19. *Adjust the clutch linkage, see operation* 6A-01.
20. Check power steering pump oil level if fitted.
21. Check coolant level if cab fitted.
22. Refit the gear lever trim plate if fitted.



SPLITTING THE TRACTOR – FOOTSTEP MODELS

Splitting the Tractor Between the Gearbox and the Centre Housing

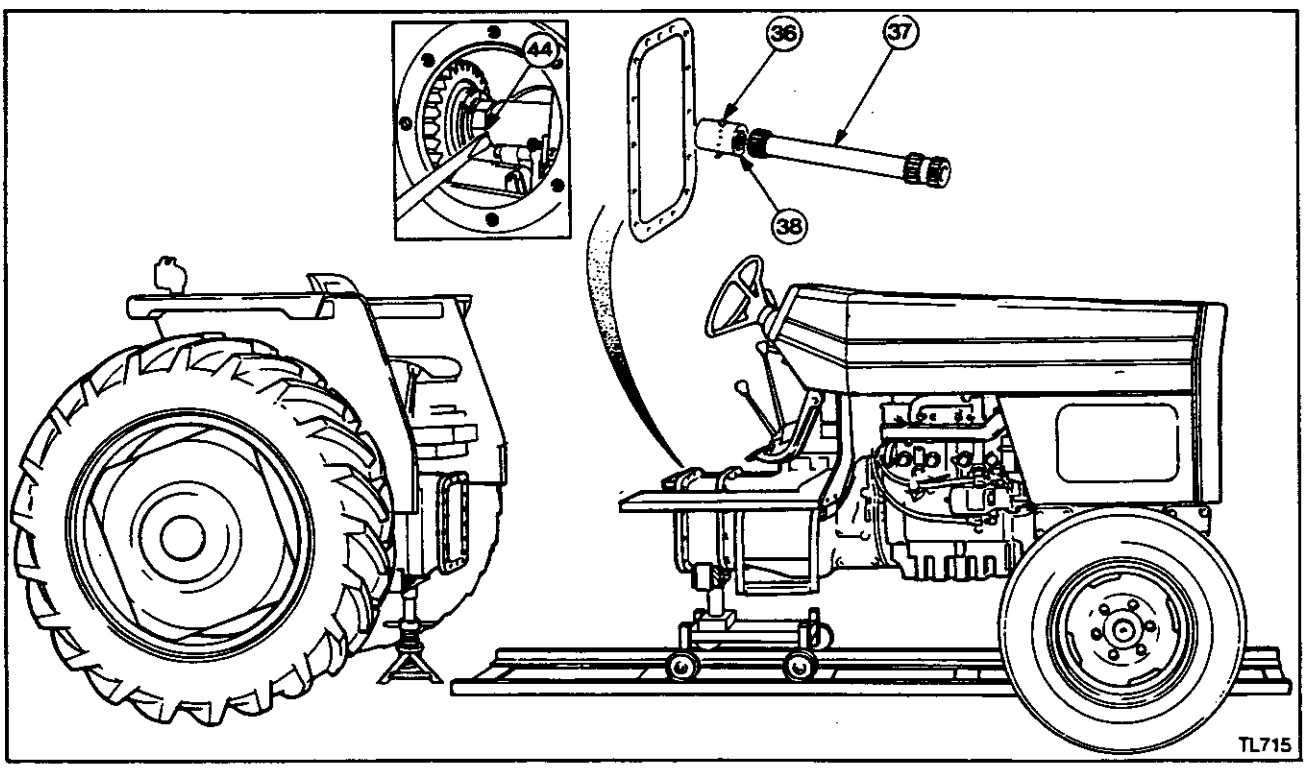
Splitting Procedure 2A-04

Special Tools:
MS 2700B Tractor splitting track

Disassembly

Note: This procedure is for the removal of the gearbox spacer, 4WD transfer gearbox or the centre housing. This is to be used as a guide. The amount of components removed from the tractor will depend on its specification and the repair to be carried out.

1. Apply the tractor parking brake and fit wedges to hold the rear wheels.
2. Disconnect the negative cable (-) from the battery/ies.
3. Disconnect the positive cables (+) and both batteries from tractors with 4 or 6 cylinder engines.
4. Drain the transmission oil via the drain plugs.
5. Remove the gearbox cover plate and both foot steps and battery boxes disconnecting the foot throttle.
6. Disconnect the hydraulic pipes on the left-hand side if fitted.
7. Disconnect the 4WD drive shaft if fitted.
8. Disconnect the 4WD selector lever if fitted.
9. Disconnect the wires from the 4WD indicator switch if fitted.
10. Disconnect the brake pipes and drain the system.
11. Disconnect the wiring harness at the junction blocks below the console on the right-hand side.
12. Disconnect the wires from the safety start switch.
13. Disconnect the hydraulic oil supply pipe on the right-hand side of the tractor.
14. Remove the hydraulic suction fitter assembly.
15. Place hard wood wedges between the front axle support casting and the front axle beam on both sides to prevent the tractor pivoting about the axle.
16. Assemble the tractor splitting track, MS 2700B, and place it under the tractor, positioning the trolley under the gearbox if the rear part is to be worked on. Under the engine if the gearbox is to be removed. Place the fixed support under the part which is not to be removed.
17. Depending upon the part to be worked on or the assembly to be removed, remove the bolts and nuts from around the transmission case or spacer.
18. Split the tractor, either moving the front part forward or the back part rearward.



SPLITTING THE TRACTOR – FOOTSTEP MODELS

Gearbox Removal

19. Disconnect the clutch operating rod from the clutch lever.
20. Disconnect and plug the hydraulic steering pipes to the steering unit. Mark for refitment.
21. Disconnect the throttle cable at the fuel injection pump and remove the cable junction block from the bracket.
22. Disconnect the stop control cable at the fuel injection pump.
23. Disconnect the wiring harness to the front of the tractor at the junction blocks.
24. Remove the bolts securing the instrument panel console to the top of the gearbox.
25. Lift off the instrument panel assembly.
26. Take the weight of the gearbox on a jib crane.
27. Remove the bolts around the engine bell housing and remove the gearbox.

Centre Housing Removal

19. Remove the Selector valve control lever.
20. Remove the 4WD control lever.
21. Disconnect the PTO control lever.
22. Disconnect the draft and position control rods.
23. Remove the differential lock pedal pad.
24. Disconnect the auxiliary hydraulic control rods at the valve end.
25. Disconnect the response control rod.
26. Disconnect the Selector valve control rod.
27. Disconnect the wiring harness to the lights on the fenders.
28. Disconnect the wires to the differential lock switch.
29. Disconnect both parking brake cables at the brake actuators.
30. Disconnect the supply and return hydraulic pipes to the auxiliary control valve.
31. Remove the auxiliary control valve mounting bolts and the valve assembly.
32. Remove both the left and right-hand fenders.
33. Lift off the seat panel assembly with the seat and all the controls.

    Access can now be gained to the centre housing, axles, crown wheel and pinion, PTO and lift hydraulics.

Reassembly

Gearbox

Reverse procedures 1 to 27.

Centre Housing

Reverse procedures 1 to 33.

General

34. When reconnecting the tractor the following must be observed.
35. Fit new gaskets between the gearbox/spacer/centre housing.
36. If the split pin has been removed from the shear tube, refit it in the centre of the five holes.
37. Fit the rear drive shaft into the epicyclic high/low coupler, with the high/low gear lever in low gear, and the main gear lever in the third gear position.
38. Fit the shear tube on to the pinion with the holes around the tube towards the front.
39. Remove the left-hand PTO shift lever and cover from the centre housing.
40. Fit two guide studs in to the top left and right hand sides of the transmission flange, using them to support a new dry gasket.
41. Push the rear half of the tractor into engagement with the gearbox, simultaneously aligning the shear tube splines on the rear axle pinion splines and the hydraulic pump drive gear splines onto the gearbox front PTO drive shaft. Alignment of the shear tube can be affected through the PTO lever aperture in the centre housing. Alignment of the hydraulic pump drive is facilitated by rotating the flywheel. This is affected by removal of the hexagon socket plug in the left hand side of the clutch housing.
42. Using a suitable lever turn the flywheel, align the guide studs on the transmission with the corresponding holes in the centre housing. Continue turning and pushing until the two flanges meet.

Note: Do not fit and tighten any of the bolts until the two flanges meet, or serious damage may occur to the PTO and main drive components. To assist reassembly, the spacer and the transmission flanges must be aligned as accurately as possible.

43. Secure the two flanges with a nut and bolt on each side.
44. Push the shear tube forwards (which will push the rear drive shaft against a spring). Continue pushing until the spring is fully compressed and measure the distance between the shear tube and locking collar. This measurement should be 0,4 to 2,5 mm (0.015 to 0.100 in).
45. If the end float is not within the specified limits, *remove the split pin and reposition it nearer the front* of the shear tube if the measurement is too large, or nearer the rear of the shear tube if the measurement is too small.
46. Remove the guide studs, fit the gearbox and spacer flange securing nuts and bolts, and tighten them to a torque of 112 Nm (83 lbf ft) starting with the bolt at the centre top and working in a clockwise direction (viewing the tractor from the rear). Two rotations around the flange are to be completed.

SPLITTING THE TRACTOR – CAB MODELS

Section 2 – Part B

Table of Contents

Specification

Shear tube end float ..... 0,4 to 2,5 mm (0.015 to 0.100 in).

Bolt Torques

Front axle support casting retaining bolts (3 cylinder tractors) ..... 280 Nm (207 lbf ft).
Front axle support casting retaining bolts (4 and 6 cylinder tractors) .... 280 Nm (207 lbf ft).
Engine to gearbox retaining bolts ..... 115 Nm (85 lbf ft).
Gearbox to spacer housing ..... 112 Nm (83 lbf ft).
Spacer housing to centre housing ..... 112 Nm (83 lbf ft).

SPLITTING THE TRACTOR – CAB MODELS

Splitting the Tractor Between the Front Axle and the Engine (3 cyl engine tractors)

Splitting Procedure 2B–01

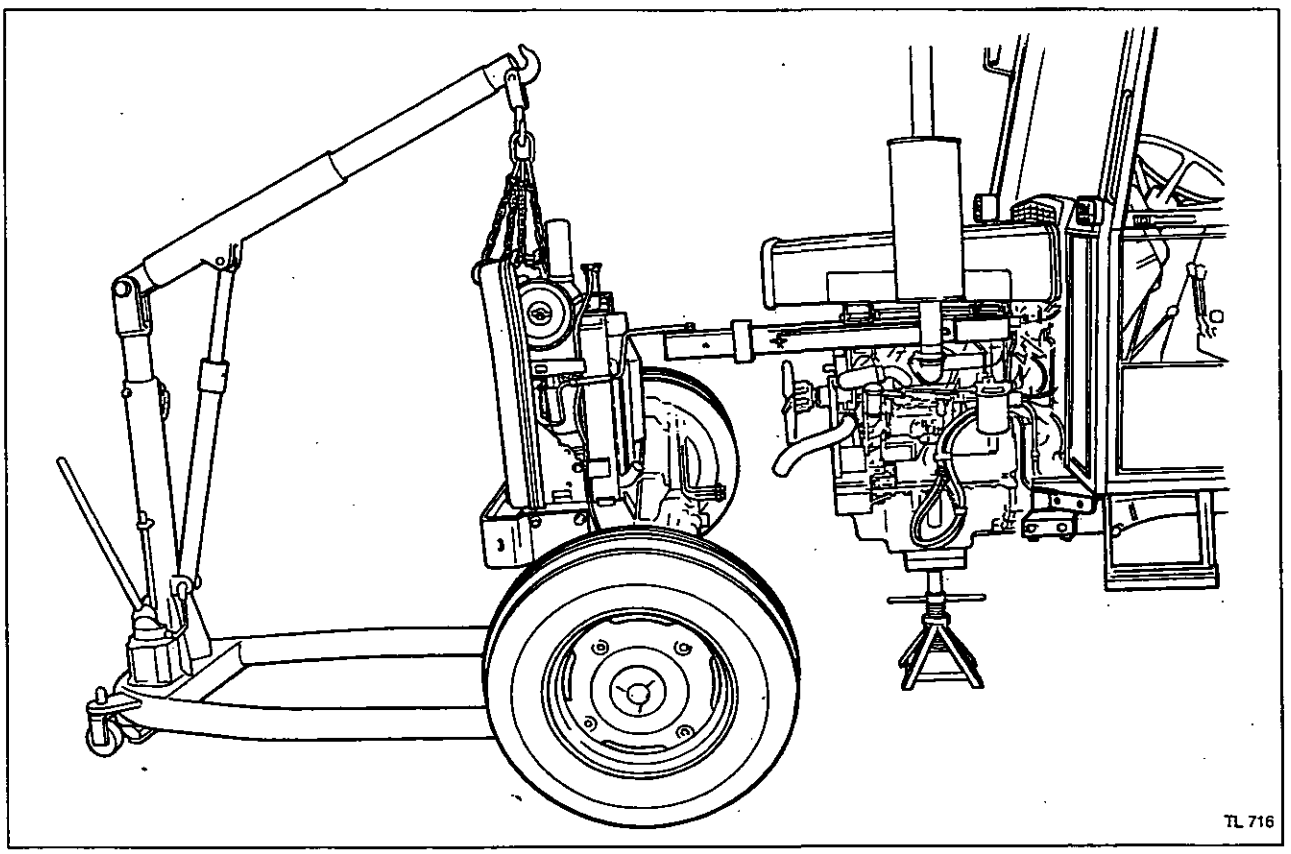
Disassembly

1. Apply the tractor parking brake and fit wedges to hold the rear wheels and remove the front weights if fitted.
2. Remove the hood, front grille and side panels
3. Remove the radiator cap and drain the cooling system via the drain tap on the radiator and the plug on the engine block.
4. Disconnect the battery negative (-) cable at the battery. Disconnect the battery positive (+) cable and thread it back so that it stays with the engine.
5. Disconnect the wiring harness and thread it back so that it is left on top of the engine.
6. Remove the fuel tank.
7. Remove both fuel tank side support members.
8. Disconnect the top and bottom radiator hoses.
9. Disconnect hydraulic pipes to and from the oil cooler and filter if fitted.
10. Disconnect the hose between the air cleaner and the inlet manifold.
11. Disconnect the pipe to the turbocharger if fitted.
12. Disconnect hoses to the power steering ram(s).
13. Disconnect the 4WD drive shaft, if fitted, at the axle end.
14. Fit hard wood wedges between the front axle support casting and the axle beam on both sides to prevent the assembly from pivoting about the axle.
15. Support the nose assembly using a jib crane and chain.
16. Support the tractor under the sump using a suitable jack stand.
17. Remove the bolts and nuts holding the support casting to the engine.
18. Carefully wheel the two front wheels, front axle and jib crane forwards away from the engine.

CAUTION: Take care to keep the front axle assembly vertical once it has been withdrawn from the engine, otherwise it could overbalance and cause injury.

Reassembly

19. Reverse procedures 1 to 18 except:
    a. Tighten the front axle retaining bolts and nuts to a torque of 280 Nm (207 lbf ft).
    b. Check the power steering reservoir if fitted.



SPLITTING THE TRACTOR – CAB MODELS

Splitting the Tractor Between the Front Axle and the Engine (4 & 6 Cylinder Tractors)

Splitting Procedure 2B-02

Disassembly

1. Apply the tractor parking brake and fit wedges to hold the rear wheels and remove the front weights if fitted.
2. Remove the radiator cap and drain the cooling system via the drain tap on the radiator and the drain plug on the engine block.
3. Remove the hood, air cleaner and exhaust assembly.
4. Remove the front grille and front side panels.
5. Disconnect the wires to the headlights, horn and fuel tank.
6. Disconnect the pipes from the power steering ram.
7. Disconnect the drive shaft at the axle on 4WD models.
8. Disconnect hydraulic pipes to and from the oil cooler.
9. Check the fuel level in the tank, disconnect the fuel supply and return pipe, plug the pipe with wooden plug to prevent loss of fuel from the tank if over half full.
10. Disconnect the radiator upper and lower hoses.
11. Disconnect the grease tube to the front axle pivot pin.
12. Fit hard wood wedges between the front axle support casting and the axle beam on both sides to prevent the front assembly pivoting about the axle beam.
13. Support the tractor under the engine sump using a suitable jack stand.
14. Support the nose assembly using a jib crane and chain.
15. Remove the bolts and nuts securing the axle support casting to the engine.
16. Carefully wheel the front assembly away from the engine on its front wheels and the jib crane.

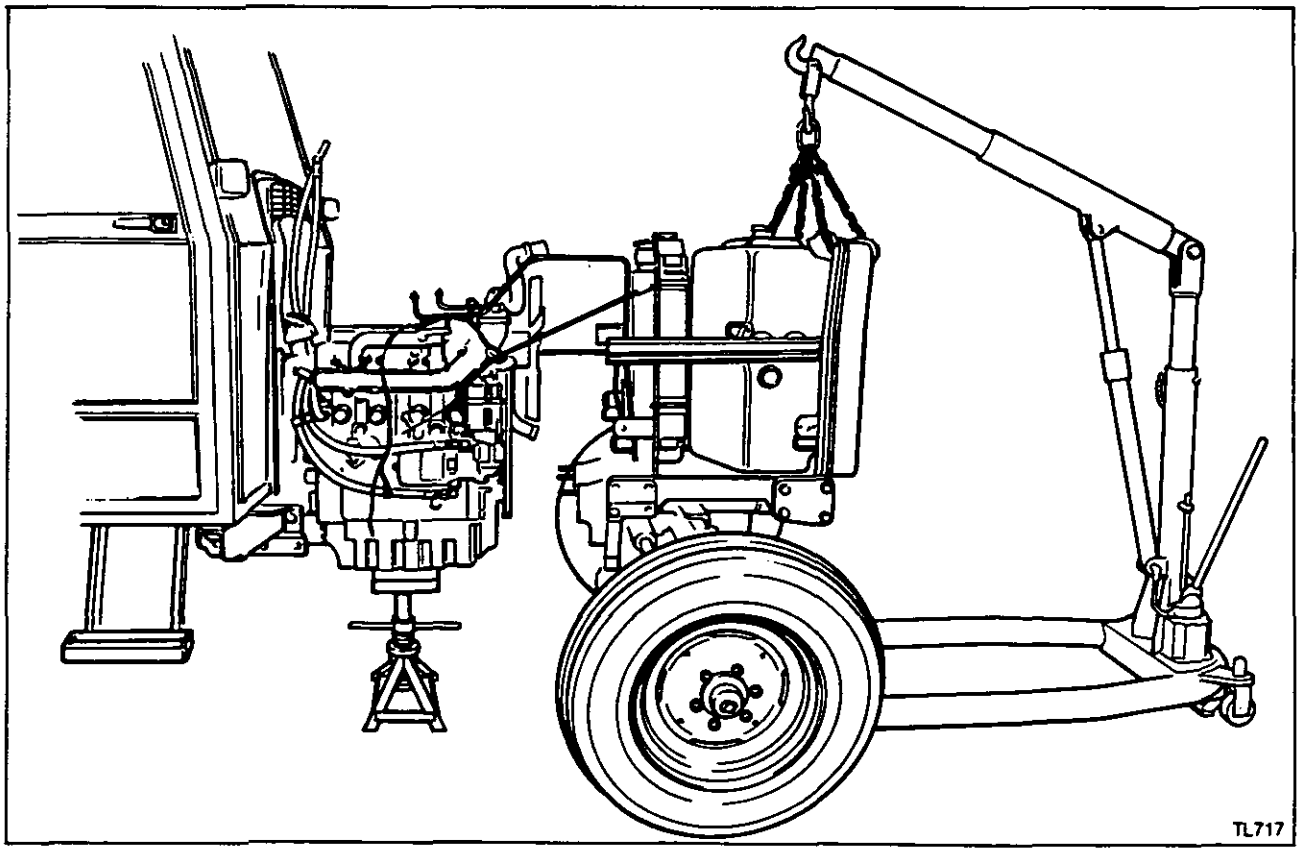
Caution: Take care to keep the front axle assembly vertical once it has been withdrawn from the engine, otherwise it could overbalance and cause injury.

Reassembly

17 Reverse procedures 1 to 16 except:

a. Tighten the front axle support casting to engine bolts and nuts to a torque of 280 Nm (207 lbf/ft).

b. Check power steering pump oil level if fitted.



SPLITTING THE TRACTOR – CAB MODELS

Splitting the Tractor Between the Engine and Gearbox

Splitting Procedure 2B-03

Special Tools:
MS 2700B Tractor Splitting Kit
10 mm A/F Hexagon Socket

Disassembly

1. Apply the tractor parking brake and fit wedges to hold the rear wheels.
2. Disconnect the negative cable (-) from the battery on 3 cylinder tractors, both batteries on 4 and 6 cylinder tractors.
3. Disconnect the positive battery cable (+) from the starter motor solenoid.
4. Disconnect the wiring harness at the block connectors.
5. Disconnect the throttle cable at the fuel injection pump and remove the connection block for hand and foot throttle cables from the support bracket.
6. Disconnect the stop control cable at the fuel injection pump.
7. Disconnect any hydraulic pipes which run from the front to the rear of the tractor. Supply pipe to the pump on the right-hand side, pressure pipes on the left-hand side if fitted.
8. Disconnect and plug the hydraulic hoses to the power steering ram. Mark for refitment.
9. Disconnect the cab heater hoses, if fitted, and plug to prevent loss of coolant.
10. Disconnect the drive shaft at the axle on 4WD tractors.
11. Disconnect pipes to the power steering valve and mark for refitment.
12. Fit hard wood wedges between the front axle support casting and the axle beam on both sides to prevent the front assembly pivoting about the front axle.
13. Assemble the MS 2700B tractor splitting track, and place it under the tractor, positioning the trolley under the engine sump, the fixed support under the gearbox.
14. Remove the gear lever trim plate and gear lever boot.
15. Remove the bolts and nuts holding the engine to the gearbox case. The socket screw securing the top centre of the gearbox requires use of the 10 mm hexagon socket.
16. Withdraw the engine and front axle forward.

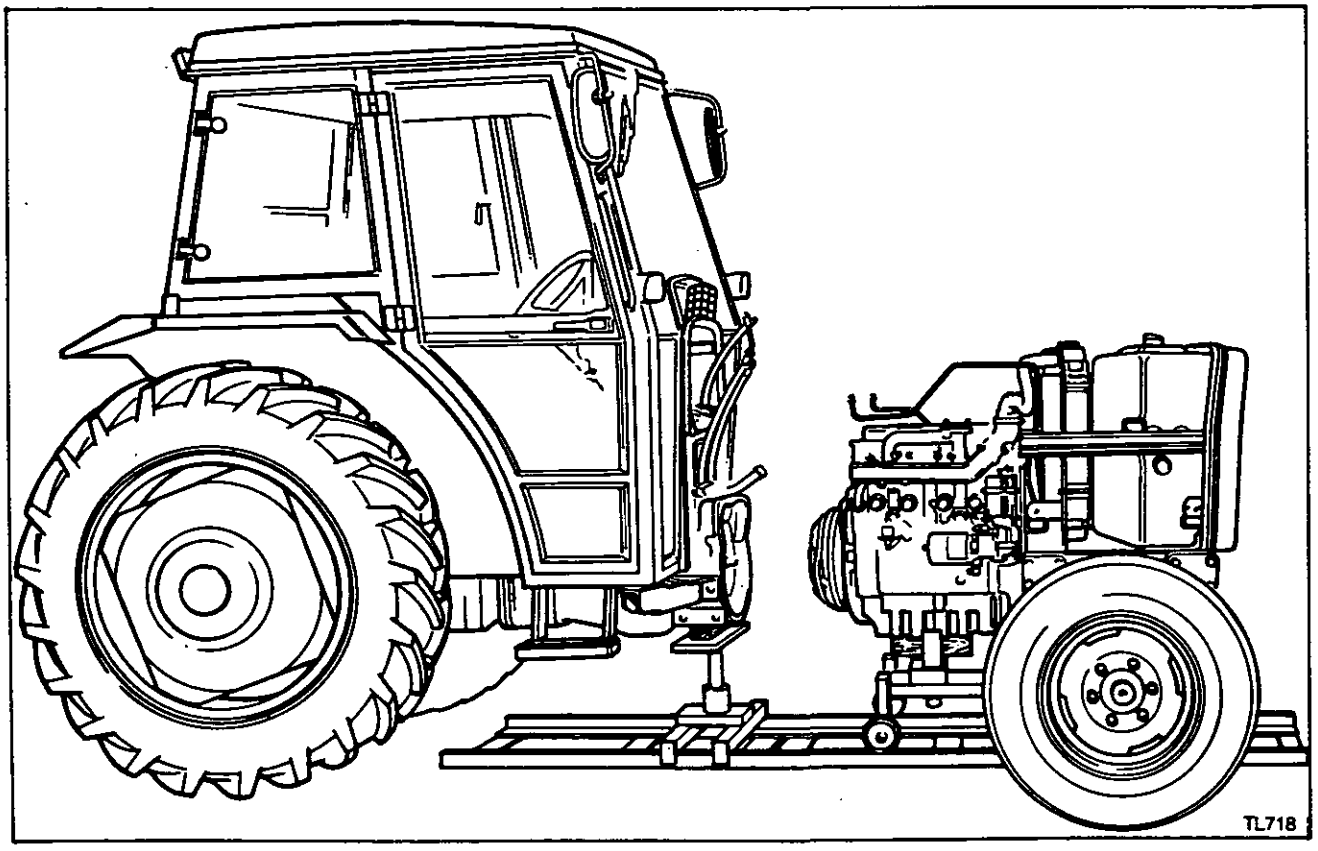
Reassembly

17. Align the engine with the gearbox. Two guide studs will assist its alignment. These should be approximately 100 mm (4 in) long x M12.
18. Turn the flywheel and, at the same time, push the engine and front axle towards the transmission.

    Turning the flywheel align the clutch plate splines with the gearbox and PTO input shaft. Continue pushing and turning until the engine flanges meet.

Note: Do not force, fit and tighten any of the bolts until the two flanges meet, or serious damage may occur to the transmission and clutch.

19. Fit some of the bolts, remove the guide studs if used, fit the remainder of the bolts and nuts, and tighten them to a torque of 115 Nm (85 lbf ft).
20. Reverse procedures 1 to 12.
21. Adjust the clutch linkage, see operation 6A-01.
22. Check power steering pump oil level if fitted.
23. Check coolant level if cab fitted.



SPLITTING THE TRACTOR – CAB MODELS

Splitting the Tractor Between the Gearbox and Spacer or 4WD Transfer Gearbox

Splitting Procedure 2B-04

Special Tools: MS 2700B Splitting kit

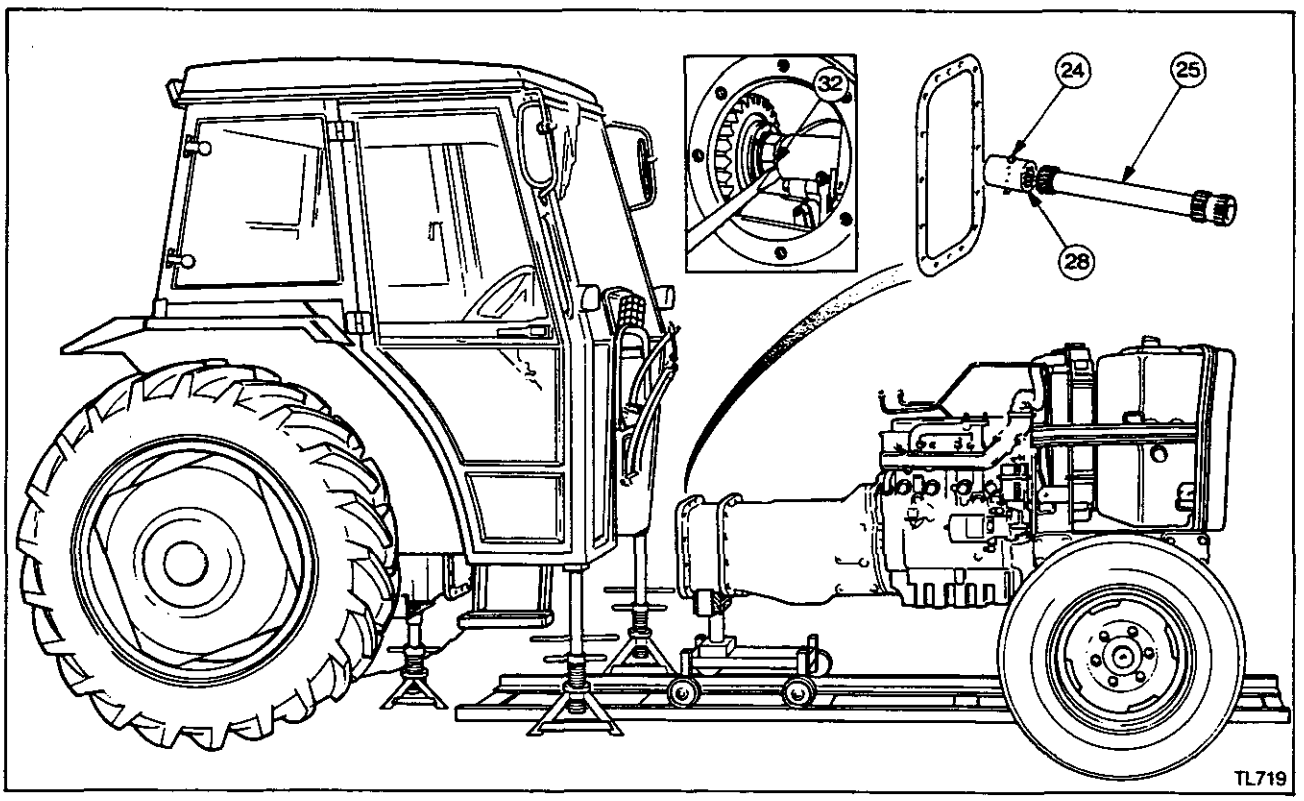
Disassembly

Note: This procedure is for the removal of the gearbox, spacer or 4WD transfer gearbox.

1. Follow the splitting procedure in section 2B-03, items 1 to 12.
2. Remove the cab floor mat and floor plates.
3. Disconnect the clutch linkage.
4. Disconnect the gearbox oil filler pipe.
5. Remove the gear lever cover, complete with the levers.
6. Remove the gear lever tower.
7. Disconnect the safety start switch wires.
8. Drain the transmission oil.
9. Disconnect the heater hoses if fitted and plug them to prevent coolant loss.
10. Support the cab on both sides with a cab support stand or a high axle stand.
11. Remove both front cab support brackets.
12. Disconnect both battery earth cables from the gearbox.
13. Disconnect the 4WD indicator switch wires, if fitted.
14. Remove the 4WD selector lever, if fitted.
15. Remove any pipe clips which would prevent the gearbox from moving forward.
16. Unclip the wiring harness.
17. Remove the oil feed pipe and filter housing from the right-hand side of the transmission case.

Note: On M-F 340 tractors only it will be necessary to remove the gearbox top and disconnect the hydraulic pipe which passes from the rear centre housing to the clutch housing.

18. Assemble the MS 2700B tractor splitting track, and place it under the tractor positioning the trolley under the gearbox and the fixed support under the centre housing.
19. Remove the bolts and nuts around the gearbox/ spacer/centre housing depending on where the split is to be made.
20. Withdraw the front axle, engine and gearbox forwards.
21. Discard the gasket.
22. Remove the split pin from the shear tube only if absolutely necessary.
23. The gearbox spacer may be removed from the engine as required.



26. Engage the high/low lever in low and the main gear lever in third.
27. Remove the right-hand brake actuator and right-hand side cover, see operation 8B-01.
28. Fit the shear tube onto the pinion with the holes around the tube towards the front.
29. Fit two guide studs to the spacer or gearbox to aid refitment.
30. Push the front axle, engine and transmission towards the centre housing, aligning the guide studs in the spacer with the corresponding holes in the centre housing. Turn the engine to align the splines and continue pushing until the two flanges meet.

Note: Do not fit and tighten any of the bolts until the two flanges meet, or serious damage may occur to the PTO and main drive components. To facilitate easy reassembly, the spacer and centre housing flanges must be aligned as near as possible.

31. Secure the two flanges with a nut and bolt on each side.
32. Push the shear tube forwards (which will push the rear drive shaft against a spring). Continue pushing until the spring is fully compressed and measure the distance between the shear tube and locking collar. This measurement should be 0,4 to 2,5 mm (0.015 to 0.100 in).
33. If the end float is not within the specified limits, remove the split pin and reposition it nearer the front of the shear tube if the measurement is too large, or nearer the rear of the shear tube if the measurement is too small.
34. Remove the guide studs, fit the nuts and bolts, and tighten them to a torque of 112 Nm (83 lbf ft) starting at the top centre bolt and working in a clockwise direction to the starting point (viewing the tractor from the rear). Two rotations around the flange are to be completed.
35. Refit the Response Control side cover.
36. Reverse procedures 1 to 16 except:
    a. Adjust the clutch linkage, see operation 6A-01.
    b. Check power steering pump oil level if fitted.
    c. Check the cooling system level if a heater is fitted.

Splitting the Tractor Between the Spacer Housing or 4WD Transfer Gearbox and the Centre Housing, Withdrawing the Centre Housing and Axle Rearwards

Splitting Procedure 2B-05

Special Tools:
MS 2700B Tractor Splitting Kit

Disassembly

Note: Ensure that the rear wheels are set to a wide track setting. If they are not, reverse the wheels so that the wheel disc is dished outwards.

1. Drain the transmission oil, via the drain plugs.
2. Disconnect the response control rod.
3. Disconnect the control rod from the Selector valve to the right- hand side cover.
4. Disconnect the auxiliary hydraulic control valve rods at the valve.
5. Disconnect both parking brake cables and remove the right-hand brake cable bracket to enable the brake pipe to come free.
6. Disconnect both brake pipes, collecting the fluid in a suitable container.
7. Disconnect the Position and Draft control rods from the lift cover.
8. Disconnect the external Position control linkage.
9. Remove the differential lock pedal foot pad.
10. Remove the Selector valve control lever.
11. Remove the PTO lever.
12. Disconnect the levelling box control rod.
13. Disconnect the hydraulic pipes on the left-hand side of the transmission.
14. Disconnect the supply pipe to the hydraulic pump on the right-hand side.
15. Disconnect the wiring harness and unclip as necessary.
16. Disconnect the wires to the differential lock switch.
17. Remove the cab floor mats and floor plates.
18. Place a cab stand under the cab on both sides just in front of the rear wheels.
19. Remove the centre bolt in the two rear cab mountings.
20. Raise the rear of the cab approximately 50 mm (2 in).
21. Fit hard wood wedges between the front axle support casting and the axle beam on both sides to prevent the front assembly pivoting about the front axle.
22. Assemble the MS 2700B, tractor splitting track, and place it under the tractor positioning the trolley under the centre housing, the fixed support under the gearbox.
23. Remove the bolts and nuts holding the centre housing to the spacer or transfer gearbox.
24. Withdraw the rear axle and centre housing rearwards.
25. Discard the gasket.
26. Remove the split pin from the shear tube only if absolutely necessary.

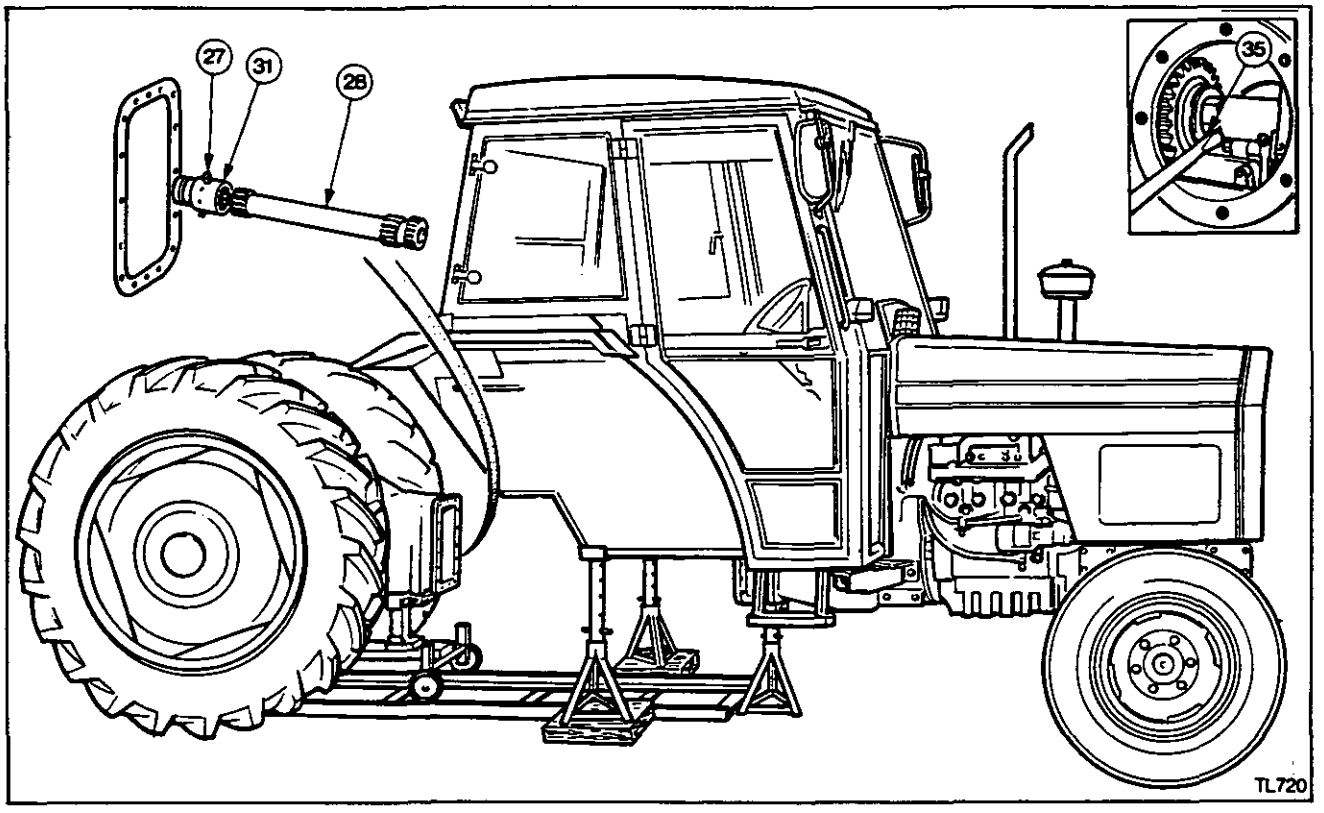
SPLITTING THE TRACTOR – CAB MODELS

Reassembly

27. If the split pin has been removed from the shear tube, refit it in the centre of the five pairs of holes.
28. Fit the rear drive shaft into the epicyclic high/low coupler or into the 4WD transfer gearbox coupler.
29. Engage the high/low lever in low and the main gear lever in third.
30. Remove the right-hand brake actuator and right-hand side cover, see operation 8B-01.
31. Fit the shear tube onto the pinion with the holes around the tube towards the front.
32. Fit the two guide studs to the spacer or gearbox to aid refitment.
33. Push the centre housing towards the engine and transmission, aligning the guide studs in the spacer with the corresponding holes in the centre housing. Turn the engine to align the splines and continue pushing until the two flanges meet.

Note: Do not fit and tighten any of the bolts until the two flanges meet, or serious damage may occur to the PTO and main drive components. To facilitate easy reassembly, the spacer and centre housing flanges must be aligned as near as possible.

34. Secure the two flanges with a nut and bolt on each side.
35. Push the shear tube forwards (which will push the rear drive shaft against a spring). Continue pushing until the spring is fully compressed and mesure the distance between the shear tube and locking collar. This mesaurement should be 0,4 to 2,5 mm (0.015 to 0.100 in).
36. If the end float is not within the specified limits, remove the split pin and reposition it nearer the front of the shear tube if the measurement is too large, or nearer the rear of the shear tube if the measurement is too small.
37. Remove the guide studs, fit the nuts and bolts, and tighten them to a torque of 112 Nm (83 lbf ft) starting at the top centre bolt and working in a clockwise direction (viewing the tractor from the rear) to the starting point, two rotations around the flange are to be completed.
38. Refit the Response Control side cover.
39. Reverse procedures 1 to 21 except:
    a. Adjust the clutch linkage, see operation 6A-01.
    b. Check power steering pump oil level if fitted.
    c. Check the cooling system level if a heater is fitted.

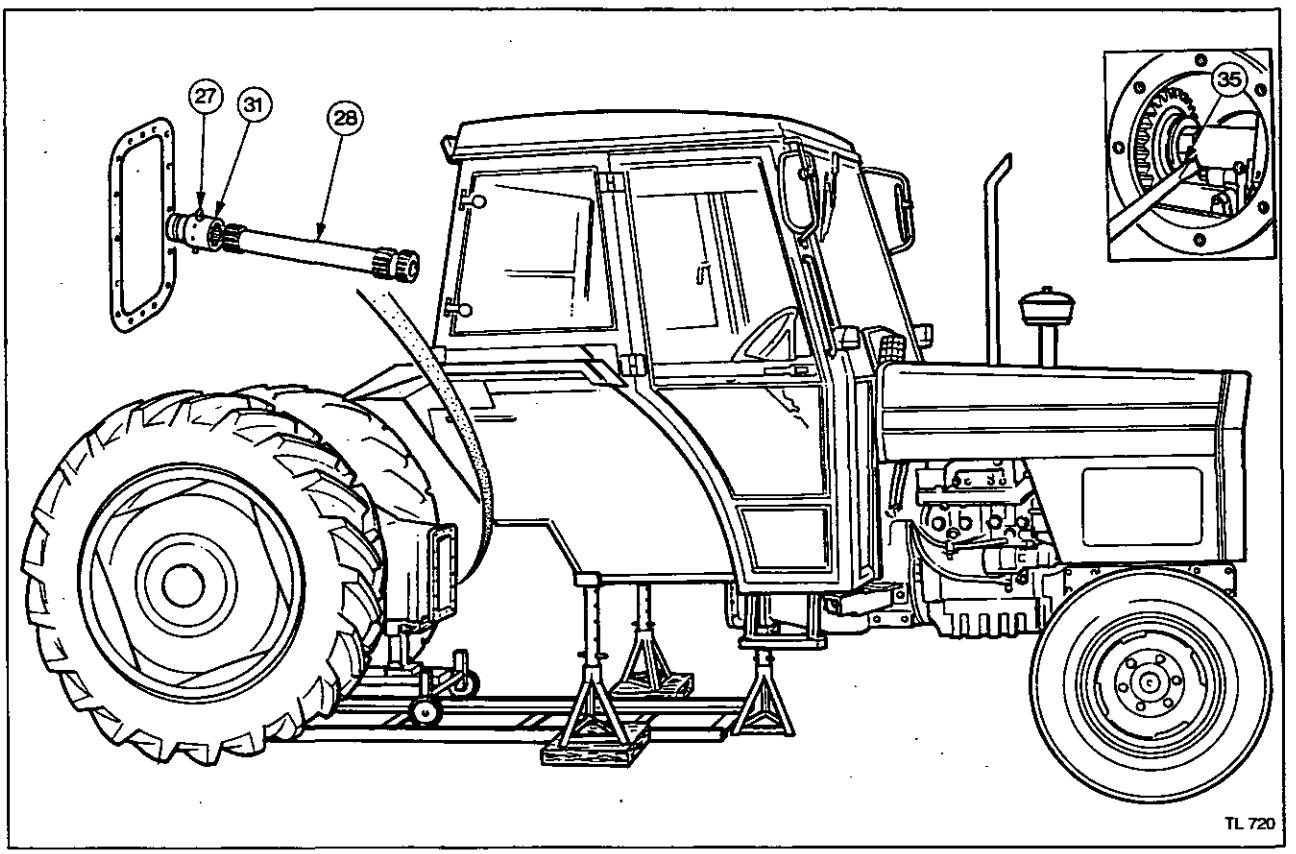


Reassembly

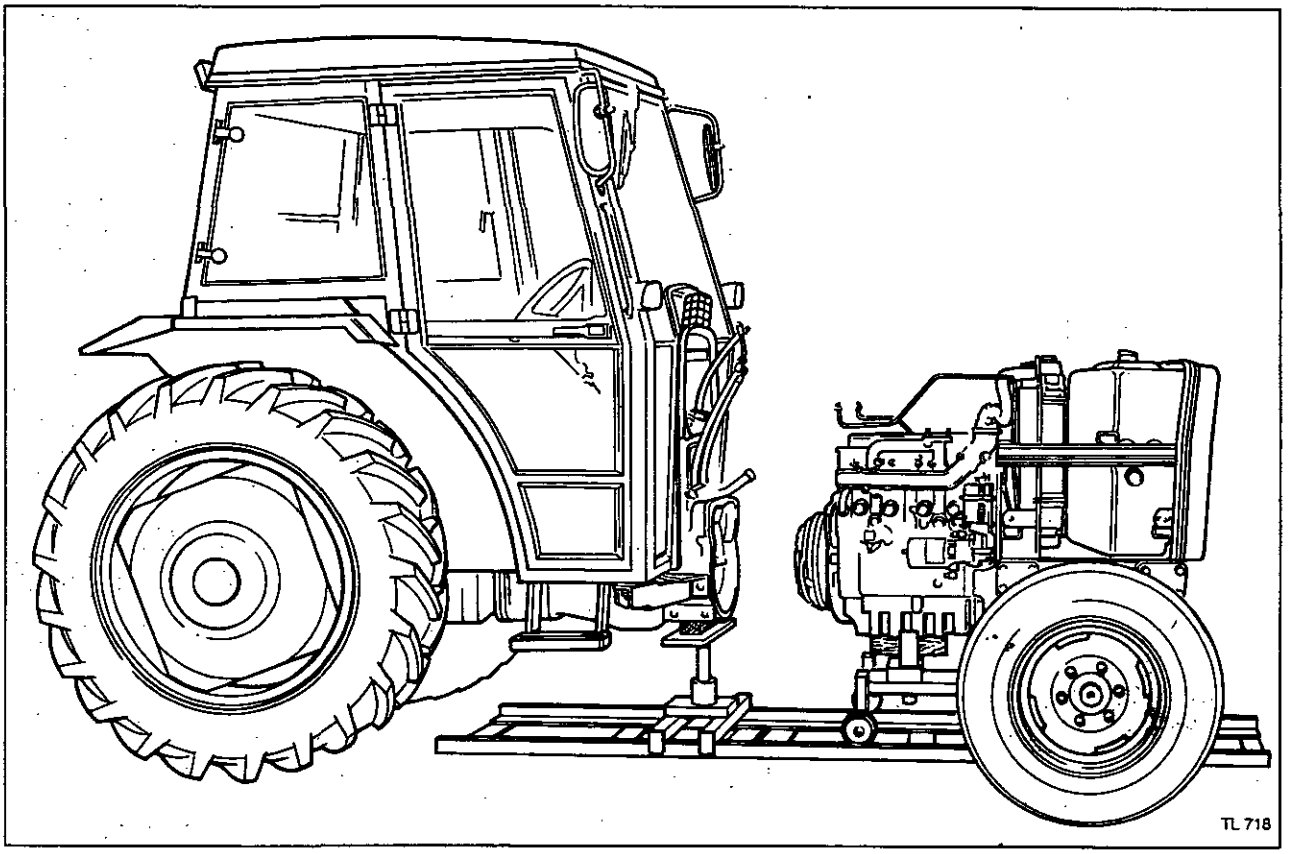
27. If the split pin has been removed from the shear tube, refit it in the centre of the five pairs of holes.
28. Fit the rear drive shaft into the epicyclic high/low coupler or into the 4WD transfer gearbox coupler.
29. Engage the high/low lever in low and the main gear lever in third.
30. Remove the right-hand brake actuator and right-hand side cover, see operation 8B-01.
31. Fit the shear tube onto the pinion with the holes around the tube towards the front.
32. Fit the two guide studs to the spacer or gearbox to aid refitment.
33. Push the centre housing towards the engine and transmission, aligning the guide studs in the spacer with the corresponding holes in the centre housing. Turn the engine to align the splines and continue pushing until the two flanges meet.

NOTE: DO NOT fit and tighten any bolts until the two flanges meet, or serious damage may occur to the PTO and main drive components. To facilitate easy reassembly, the spacer and centre housing flanges must be aligned as near as possible.

34. Secure the two flanges with a nut and bolt on each side.
35. Push the shear tube forwards (which will push the rear drive shaft against a spring). Continue pushing until the spring is fully compressed and measure the distance between the shear tube and the locking collar. This measurement should be 0,4 to 2,5 mm (0.015 to 0.010 in).
36. If the end float is not within the specified limits, remove the split pin and reposition it nearer the front of the shear tube if the measurement is too large, or nearer the rear of the shear tube if the measurement is too small.
37. Remove the guide studs, fit the nuts and bolts, and tighten them to a torque of 112 Nm (83 lbf ft) starting at the top centre bolt and working in a clockwise direction (viewing the tractor from the rear) to the starting point, two rotations around the flange are to be completed.
38. Refit the Response Control side cover.
39. Reverse procedure 1 to 21 except:
    a. Adjust the clutch linkage, see operation 6A-01.
    b. Check power steering pump oil level, if fitted.
    c. Check the cooling system level, if a heater is fitted.



SPLITTING THE TRACTOR – CAB MODELS



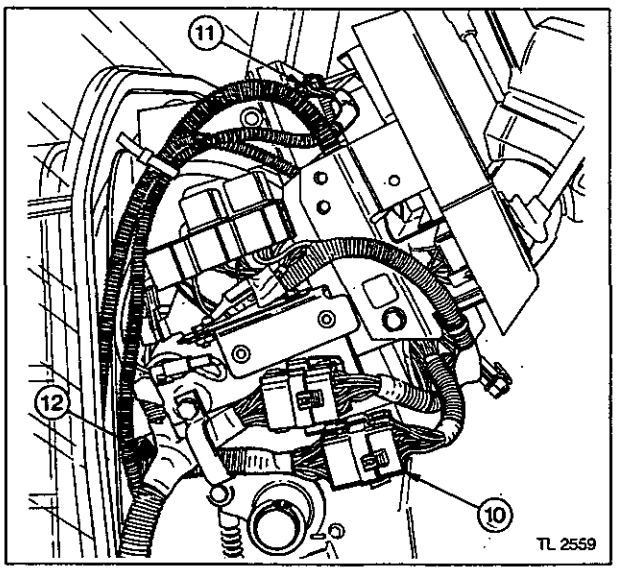
Splitting the Tractor Between the Engine and Gearbox

Special tools:
MF.3012 Tractor Splitting Track

This splitting procedure applies to cab tractors built after May 1993, serial number B18009 onwards.

Disassembly

1. Apply the tractor parking brake and fit wedges to hold the rear wheels.
2. Disconnect the negative cable (-) from the battery on three cylinder engines, both batteries on four and six cylinder engines.
3. Remove the wiring harness clamp.
4. Disconnect the positive battery cable (+) from the starter motor solenoid.
5. Disconnect the wiring harness from the starter solenoid.
6. Disconnect the wiring harness earth from the engine.
7. Remove the instrument panel left-hand and right-hand side covers.
8. Remove the central heater duct panel.
9. Disconnect and lower the lower panel.

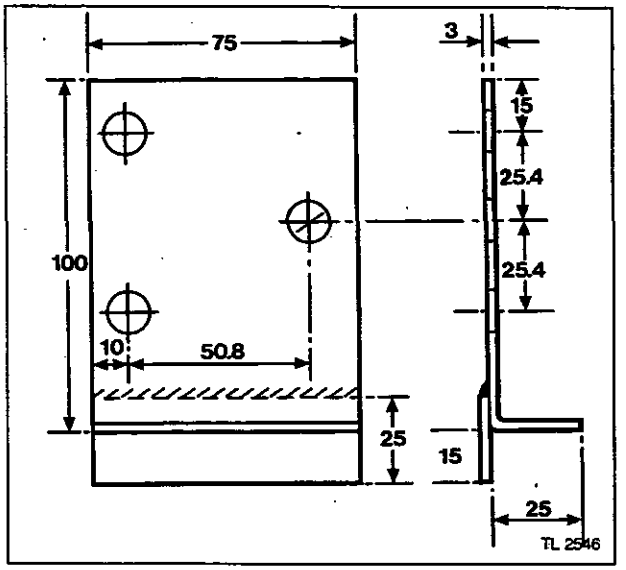


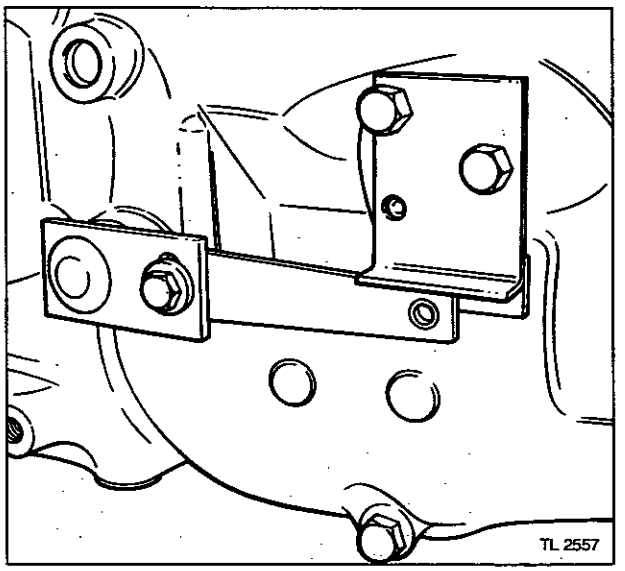
10. Disconnect the wiring harness at the red block connector.
11. Disconnect the wire from the tachometer.
12. Pull the wiring harness, with the rubber grommet, through the bulkhead into the engine compartment.
13. Disconnect the throttle cable at the fuel injection pump. Remove the connection block for hand and foot throttle cables from the support bracket.
14. Disconnect the stop control cable at the fuel injection pump, three and four cylinder engines only.
15. Disconnect any hydraulic pipes which run from the front to the rear of the tractor. This comprises the auxiliary hydraulic pump supply and pressure pipe on the right-hand side. Pressure pipes on the left-hand side to IPTO and auxiliary hydraulics.
16. Disconnect and plug the hydraulic hoses to the power steering cylinder. Mark for refitment.
17. Disconnect the pressure and return pipes on the power steering unit and mark for refitment.
18. Clamp to prevent loss of coolant and disconnect the cab heater hoses.
19. Disconnect the drive shaft at the front axle end on 4WD tractors.
20. Fit hard wood wedges between the front axle support casting and the axle beam on both sides to prevent the front assembly pivoting around the front axle.
21. Disconnect the clutch cable from the operating lever at the clutch end.
22. Remove the clutch cable anchor bracket from the side of the gearbox casing.
23. Manufacture a clutch lever support plate as shown in the illustration. This plate is used to prevent the clutch release bearing, which is spring-loaded against the clutch, from falling apart when the tractor is split.
24. Bolt the support plate to the side of the gearbox casing with the clutch lever under the projection.
25. Assemble the MF.3012 Tractor Splitting Track. Place it under the tractor and position the trolley under the engine sump, the fixed support under the gearbox.
26. Remove the nuts and bolts holding the engine to the gearbox case. The bolt at the top centre of the gearbox will require a 13 mm socket. To gain access remove the gear lever trim plate and boot.
27. Move the engine and front axle forward.

Reassembly

28. Ensure that the clutch release bearing is correctly fitted and that the clutch lever is correctly located under the support plate.
29. Align the engine with the gearbox. Two guide studs will assist its alignment.
30. Turn the flywheel, and at the same time, push the engine and front axle towards the transmission. Turning the flywheel aligns the clutch splines with the gearbox and PTO input shafts. Continue pushing and turning until the engine flange meets the transmission.

NOTE: DO NOT force, fit and tighten any of the bolts until the two flanges meet, or serious damage may occur to the transmission and clutch.





31. Fit some of the bolts, remove the guide studs if used, fit the remainder of the nuts and bolts and tighten them to a torque of 115 Nm (85 lbf ft).
32. Reverse procedures 1 to 23.
33. Adjust the clutch pedal height, see operation 6B-01 or 6B-03.
34. Check the transmission oil level.
35. Check coolant level.
36. The steering unit will not tolerate dirt ingress. Carry out the start-up procedure detailed in operation 11A-02 to remove any dirt from the system.
37. Finally, road test the tractor.

2B–10
SPLITTING THE TRACTOR – CAB MODELS

ENGINE DATA

INDEX

ENGINE DATA

Section 3 – Part A

Table of Contents

Preface

This section of the workshop manual gives the relevant technical specifications of the agricultural version of Perkins diesel engines fitted to the range of Massey Ferguson 300 series tractors.

For full technical specifications, repair and overhaul of this range of engines reference must be made to the Massey Ferguson diesel engine workshop service manual publication 1856 562 M1.

For the 1006 series engine refer to workshop service manual publication 1646 906 M1.

AD3.152 ENGINE DATA

AD3.152 TRACTOR ENGINE DATA **3A–01**

Specifications:

Make	Perkins diesel - naturally aspirated.
Type	Water cooled direct injection.
Engine Model No	AD3.152.
Engine build code :	
MF 340 tractor AD3.152S	CE 31237.
MF 342 and 350 tractor AD3.152S uprated	CE 31160.
Bore	91,44 mm (3.6 in).
Stroke	127,0 mm (5 in).
Cubic capacity	2,5 litre (152 cubic in).
No of cylinders	3.
Firing order	1, 2, 3.
Direction of engine rotation	Clockwise from front.
Compression ratio:	
MF 340 tractor	18.5:1.
MF 342 and 350 tractor	16.5:1.

Power ratings ±5%

	PS	hp	kW
MF 340 tractor:			
• Engine power at flywheel at 2250 rev/min	45	44	33.1.
• Power at PTO at engine rated speed	41.5	41	30.6.
• Maximum engine torque at 1300 rev/min	171 Nm (126 lbf ft).		
MF 342 and 350 tractor:			
• Engine power at flywheel at 2000 rev/min	47	46	34.6.
• Power at PTO at engine rated speed	42	41	30.9.
• Maximum engine torque at 1250 rev/min	171 Nm (126 lbf ft).		

• To DIN 70020 Standard.

Engine Speeds:

Low idle speed	750 rev/min.
Rated speed	2250 rev/min.
Maximum no-load speed	2470 rev/min.

Fuel injection pump:

MF 340 tractor:	
Make	CAV.
Type	DPA.
Fuel pump code - Standard	36963/SW/6/2470.
Fuel pump code - ISO	SW49L/500/6/2470.
Pump rotation	Clockwise.
Circlip timing mark letter	E.
No 1 cylinder outlet letter	W.
Engine checking angle at TDC	25^0.
Fuel pump checking angle	37^0.
Static timing BTDC	24^0.
Piston displacement	6,93 mm (0.273 in).
MF 342 and 350 tractor:	
Make	CAV.
Type	DPA.
Fuel pump code - Standard	2643B133/CW/6/2470.
Fuel pump code - ISO	CW50L/900/6/2470.
Pump rotation	Clockwise.
Circlip timing mark letter	E.
No 1 cylinder outlet letter	W.
Engine checking angle at TDC	27^0.
Fuel pump checking angle	35^0.
Static timing BTDC	16^0.
Piston displacement	3,15 mm (0.124 in).

Fuel injectors:

MF 340 tractor:	
Working pressure	175 bar (175 Atm) (2570 lbf/in^2).
Setting pressure new injectors	185 bar (185 Atm) (2720 lbf/in^2).
Identification code	GM.
MF 342 and 350 tractor:	
Working pressure	177 bar (175 Atm) (2571 lbf/in^2).
Setting pressure new injectors	192 bar (190 Atm) (2792 lbf/in^2).
Identification code	EE.

Valve tip clearance:

MF 340, 342 and 350 tractor:

Inlet	0,3 mm (0.012 in) cold.
Exhaust	0,3 mm (0.012 in) cold.

Valve guides:

MF 340, 342 and 350 - Stand-out above spring seating face:

Inlet and exhaust	14,73-15,09 mm (0.580-0.594 in).

Valves:

Valve face angle	35°.
Valve seat angle.	36°.

Valve recession:

MF 340, 342, and 350 - New inlet	1,32-1,63 mm (0.052-0.064 in).
MF 340, 342, 350 - New exhaust.	1,60-1,92 mm (0.063-0.075 in).
MF 340, 342 and 350 - Service inlet - maximum.	2,33 mm (0.092 in).
MF 340, 342 and 350 - Service exhaust - maximum	2,40 mm (0.043 in).
Valve seat inserts:	It is permissible to fit valve seat inserts to both inlet and exhaust valve seats of 3.152 engines where the original seat can not be corrected because of damage or the permissible service valve depth below the cylinder head is more than that already given. The valve seat insert recess dimensions are important and correct Perkins parts must be used.
Valve springs:	Double valve springs fitted on inlet and exhaust. Fit damper coil towards cylinder head.

Cylinder liners:

Type.	Dry - cast iron.
Location	Flange.
Maximum wear	0,18 mm (0.007 in).
Fit (service)	Transition ±0,025 mm (±0.001 in) .
Liner flange to cylinder block	0,10 mm (0.004 in) ABOVE to 0,10 mm (0.004 in) BELOW.

Pistons:

Assembly	Fit cavity towards fuel injection pump side of engine.
Gudgeon pin	Fully floating.
Piston height to cylinder block face MF 340, 342 and 350	0,10 mm (0.004 in) ABOVE to 0,03 mm (0.001 in) BELOW.

Piston ring layout:

No 1 compression	Tapered semi-inlay, chrome faced.
Gap	0,36-0,69 mm (0.014-0.027 in).
No 2 and 3 compression	Internally stepped.
Gap	0,28-0,61 mm (0.011-0.024 in).
No 4 oil control	Spring expanded oil control.
Gap	0,25-0,74 mm (0.010-0.029 in).

Connecting rods:

Big end bearing undersize	0,25 mm (0.010 in). 0,51 mm (0.020 in). 0,76 mm (0.030 in).
Small end bearing diameter	31,76-31,79 mm (1.2505-1.2515 in).

Crankshaft:

Regrind sizes	0,25 mm (0.010 in). 0,51 mm (0.020 in). 0,76 mm (0.030 in).
Number of main bearings	4
Method of hardening	Induction hardened.
End float	0,05-0,38 mm (0.002-0.015 in).

Oil pressure relief valve setting:

Working pressure	3,5-4,5 bar (50-65 lbf/in^2).
Minimum oil pressure	2,0 bar (30 lbf/in^2) - at maximum working speed and normal operating temperature.

AT3.1524 TRACTOR ENGINE DATA 3A–02

Specifications:

Make	Perkins diesel - turbocharged.
Type	Water cooled direct injection.
Engine Model No	AT3.1524.
Engine build code:	
MF 352 tractor	CN 31256.
MF 355 tractor	CN 31187.
MF 360 tractor	CN 31185.
Bore	91,44 mm (3.6 in).
Stroke	127,0 mm (5 in).
Cubic capacity	2,5 litre (152.7 cubic in).
No of cylinders	3.
Firing order	1, 2, 3.
Direction of engine rotation	Clockwise from front.
Compression ratio	15.5:1.

Power ratings ±5%	PS	hp	kW
MF 352 tractor:			
• Engine power at flywheel at 2250 rev/min	55	54	41.1.
• Power at PTO at engine rated speed	50	49	36.8.
• Maximum engine torque at 1500 rev/min	189 Nm (139 lbf ft).		
MF 355 tractor:			
• Engine power at flywheel at 2250 rev/min	53	54	39.0.
• Power at PTO at engine rated speed	47	49	34.6.
• Maximum engine torque at 1500 rev/min	186 Nm (137 lbf ft).		
MF 360 tractor:			
• Engine power at flywheel at 2250 rev/min	58	57	42.7.
• Power at PTO at engine rated speed	52	51	38.2.
• Maximum engine torque at 1500 rev/min	202 Nm (149 lbf ft).		

• To DIN 70020 Standard.

Engine Speeds:

Low idle speed	750 rev/min.
Rated speed	2250 rev/min.
Maximum no-load speed:	
MF 352 tractor	2470 rev/min.
MF 355 tractor up to engine serial No. U796441P	2370 rev/min.
MF 355 tractor engine serial No. U796442 onwards	2470 rev/min.

Fuel injection pump:

Make	CAV.
Type	DPA - mechanical governor.
MF 352 tractor:	
Fuel pump code	2643B141/DW/5/2470.
Pump rotation	Clockwise.
Circlip timing mark letter	E.
No 1 cylinder outlet letter	W.
Engine checking angle at TDC	26.5°.
Fuel pump checking angle	34°.
Static timing BTDC	17°.
Piston displacement	3,56 mm (0.140 in).
MF 355 tractor up to engine serial No. U796441P:	
Fuel pump code - Standard	2643B131BW/6/2370.
Fuel pump code - ISO	BW55L/900/6/2370.
Pump rotation	Clockwise.
Circlip timing mark letter	E.
No 1 cylinder outlet letter	W.
Engine checking angle at TDC	27°
Fuel pump checking angle	35°
Static timing BTDC	16°
Piston displacement	3,15 mm (0.124 in).

AT3.1524 ENGINE DATA

MF 355 tractor engine serial No. U796442 onwards:

Fuel pump code - Standard	2643B135DW/5/2470.
Fuel pump code - ISO	DW54L/1100/5/2470.
Pump rotation	Clockwise.
Circlip timing mark letter	E.
No 1 cylinder outlet letter	W.
Engine checking angle at TDC	26.5°
Fuel pump checking angle	34°
Static timing BTDC	17°
Piston displacement	3,56 mm (0.140 in).

MF 360 tractor:

Fuel pump code - Standard	2643B132DW/5/2470.
Fuel pump code - ISO	DW/61L/1100/5/2470.
Pump rotation	Clockwise.
Circlip timing mark letter	E.
No 1 cylinder outlet letter	W.
Engine checking angle at TDC	26.5°
Fuel pump checking angle	34°
Static timing BTDC	17°
Piston displacement	3,56 mm (0.140 in).

Fuel injectors:

MF 352 and 360 tractor:

Working pressure	213 bar (210 Atm) (3086 lbf/in^2).
Setting pressure new injectors	213 bar (210 Atm) (3086 lbf/in^2).
Identification code	HX.

MF 355 tractor up to engine serial No. U796441P:

Working pressure	253 bar (250 Atm) (3674 lbf/in^2).
Setting pressure new injectors	253 bar (250 Atm) (3674 lbf/in^2).
Identification code	HM.

MF 355 tractor engine serial No. U796442P onwards:

Working pressure	213 bar (210 Atm) (3086 lbf/in^2).
Setting pressure new injectors	213 bar (210 Atm) (3086 lbf/in^2).
Identification code	HX.

Turbocharger:

Make	Holset.
Type	HID.
Maximum pressure at 2250 rev/min engine speed	0,5 bar (7 lbf/in^2).

Valve tip clearance:

Inlet	0,2 mm (0.008 in) cold.
Exhaust	0,3 mm (0.012 in) cold.

Valve guides:

Stand-out above spring seating face:

Inlet	9,19-9,55 mm (0.362-0.376 in).
Exhaust	14,73-15,09 mm (0.580-0.594 in).

Valves:

Valve face angle MF 352 and 355 tractor	35°
Valve seat angle MF 352 and 355 tractor	36°
Valve face angle MF 360 tractor	35^0 inlet 45^0 exhaust.
Valve seat angle MF 360 tractor	36^0 inlet 46^0 exhaust.

Valve recession:

New inlet	1,32-1,63 mm (0.052-0.064 in).
New exhaust.	1,60-1,92 mm (0.063-0.075 in).
Service inlet - maximum.	2,26 mm (0.089 in).
Service exhaust - maximum	2,40 mm (0.088 in).
Valve seat inserts MF 352 and 355 tractor	Can be fitted to inlet and exhaust.
Valve seat inserts MF 360 tractor	Fitted to exhaust only. Can be fitted to inlet.
Valve springs	Double valve springs fitted on inlet and exhaust. Fit damper coil towards cylinder head.

Cylinder liners:

Type.	Dry.
Material	Cast iron.
Location	Parallel.
Maximum wear	0,18 mm (0.007 in).
Fit (service)	Interference and rebore .
Liner flange to cylinder block	0,05 mm (0.002 in) ABOVE to 0,10 mm (0.004 in) BELOW.

Pistons:

Assembly	Fit cavity towards fuel injection pump side of engine.
Gudgeon pin	Fully floating.
Piston height to cylinder block face	0,03 mm (0.001 in) BELOW to 0,15 mm (0.006 in) BELOW.

Piston ring layout:

No 1 compression	Tapered semi-inlay, chrome faced.
Gap	0,30-0,74 mm (0.012-0.030 in).
No 2 compression	Tapered face.
Gap	0,20-0,64 mm (0.008-0.025 in).
No 3 oil control	Spring loaded, laminated.
Gap	0,25-0,76 mm (0.010-0.030 in).

Connecting rods:

Big end bearing undersize	0,25 mm (0.010 in). 0,51 mm (0.020 in). 0,76 mm (0.030 in).
Small end bearing diameter	31,76-31,79 mm (1.2505-1.2515 in).

Crankshaft:

Regrind sizes	0,25 mm (0.010 in). 0,51 mm (0.020 in). 0,76 mm (0.030 in).
Number of main bearings	4.
Method of hardening	Tuftrided.
End float	0,05-0,38 mm (0.002-0.015 in).

Oil pressure relief valve setting:

Working pressure	3,5-4,5 bar (50-65 lbf/in^2).
Minimum oil pressure	2,0 bar (30 lbf/in^2) at maximum working speed and normal operating temperature.

Cooling system:

Fan belt deflection	10 mm (3/8 in).
Thermostat:	
Quantity	1.
Type	By-pass.
Opening temperature (nominal)	82° C (180° F).
Radiator pressure cap rating	0,75 bar (10 lbf/in^2) .

Capacities:

Cooling system	9,8 litre (2.2 imp gal) (2.6 US gal).
Engine sump	6,8 litre (1.5 imp gal) (1.8 US gal).

Bolt torques – see page 20

North America only:

Engines on tractors built up to December 1986 fitted with AT3.1524 to build list number CN31187. Fuel pump to ISO code BW55L/900/6/2370. Inlet and exhaust valve seats 35^0.

Engines on tractors built up to January 1987 onwards fitted with AT3.1524 to build list number CN31185. Fuel pump to ISO code DW61L/1100/5/2470. Inlet valves 35^0, exhaust valve 45^0 with inserts.

A4.236 ENGINE DATA

A4.236 TRACTOR ENGINE DATA 3A–03

Specifications:

Make	Perkins diesel - naturally aspirated.
Type	Water cooled direct injection.
Engine Model No	A4.236.
Engine build code:	
MF 362 tractor	LD 31234.
MF 365 tractor	LD 31190.
MF 372 tractor	LD 31259.
MF 375 tractor	LD 31140.
Bore	98,4 mm (3.875 in).
Stroke	127,0 mm (5 in).
Cubic capacity	3,86 litre (236 cubic in).
No of cylinders	4.
Firing order	1, 3, 4, 2.
Direction of engine rotation	Clockwise from front.
Compression ratio	16:1.

Power ratings ±5%	PS	hp	kW
MF 362 and 365 tractor:			
• Engine power at flywheel at 2200 rev/min	62	61	45.6.
• Power at PTO at engine rated speed	56	55	41.2.
• Maximum engine torque at 1400 rev/min	243 Nm (179 lbf ft).		
MF 372 tractor:			
• Engine power at flywheel at 2200 rev/min	71	70	52.3.
• Power at PTO at engine rated speed	64	63	47.1.
• Maximum engine torque at 1250 rev/min	268 Nm (198 lbf ft).		
MF 375 tractor up to engine serial No. U209015P:			
• Engine power at flywheel at 2250 rev/min	68	67	50.
• Power at PTO at engine rated speed	61	63	44.9.
• Maximum engine torque at 1250 rev/min	267 Nm (197 lbf ft).		
MF 375 tractor engine serial No. U209016P onwards:			
• Engine power at flywheel at 2250 rev/min	71	70	52.
• Power at PTO at engine rated speed	64	63	47.
• Maximum engine torque at 1250 rev/min	268 Nm (198 lbf ft).		

• To DIN 70020 Standard.

Engine Speeds:

MF 362 and 372 tractor:	
Low idle speed	750 rev/min.
Rated speed	2200 rev/min.
Maximum no-load speed	2310 rev/min.
MF 365 up to engine serial No. U261448S:	
Low idle speed	750 rev/min.
Rated speed	2200 rev/min.
Maximum no-load speed	2420 rev/min.
MF 365 tractor engine serial No. U261449S onwards ✳ - see page 22.	
Low idle speed	750 rev/min.
Rated speed	2200 rev/min.
Maximum no-load speed	2310 rev/min.
MF 375 tractor up to engine serial No. U209015P:	
Low idle speed	750 rev/min.
Rated speed	2200 rev/min.
Maximum no-load speed	2420 rev/min.
MF 375 tractor engine serial No. U209016P onwards ✳ - see page 22	
Low idle speed	750 rev/min.
Rated speed	2200 rev/min.
Maximum no-load speed	2310 rev/min.

Fuel injection pump:

Make	CAV.
Type	DPA - mechanical governor.
MF 362 tractor:	
Fuel pump code - Standard	2643C282LS/3/2310.
Fuel pump code - ISO	LS49L/900/3/2310.
MF 365 tractor up to engine serial No. U261448S:	
Fuel pump code - Standard	38313LS/2/2420.
Fuel pump code - ISO	LS49L/900/2/2420.
MF 365 tractor engine serial No. U261449S onwards * - see page 22.	
Fuel pump code - Standard	2643C282LS/3/2310.
Fuel pump code - ISO	LS49L/900/3/2310.
MF 372 tractor:	
Fuel pump code	2643C278/LS/3/2310.
MF 375 tractor up to engine serial No. U209015P:	
Fuel pump code - Standard	38377LS/2/2420.
Fuel pump code - ISO	LS57L/900/2/2420.
MF 375 tractor engine serial No. U209016P onwards * - see page 22.	
Fuel pump code - Standard	2643C278LS/3/23100.
Fuel pump code - ISO	LS57L/900/3/2310.
All tractor models:	
Pump rotation	Clockwise.
Circlip timing mark letter	C.
No 1 cylinder outlet letter	W.
Engine checking angle at TDC	284.5°
Fuel pump checking angle	296°
Static timing BTDC	23°
Piston displacement	6,45 mm (0.254 in).

Fuel injectors:

Working pressure	172 bar (170 Atm) (2498 lbf/in^2).
Setting pressure new injectors	177 bar (175 Atm) (2571 lbf/in^2).
Identification code	FY.

Valve tip clearance:

Inlet	0,3 mm (0.012 in) cold.
Exhaust	0,3 mm (0.012 in) cold.

Valve guides:

Stand-out above spring seating face:	
Inlet and exhaust	15,09 mm (0.594 in).

Valves:

Valve face angle	45°
Valve seat angle.	46°

Valve recession:

New inlet	0,89-1,14 mm (0.035-0.045 in).
New exhaust.	1,19-1,45 mm (0.047-0.057in).
Service inlet - maximum.	1,55 mm (0.061 in).
Service exhaust - maximum	1,85 mm (0.073 in).
Valve seat inserts:	Can be fitted to inlet and exhaust.
Valve springs:	Double valve springs fitted on inlet and exhaust. Fit damper coil towards cylinder head.

Cylinder liners:

Type.	Dry.
Material	Cast iron.
Location	Flange.
Maximum wear	0,20 mm (0.008 in).
Fit (service)	Transition ±0,025 mm (±0.001 in).
Relationship of liner flange to cylinder block face:	
Earlier 4.236 engines	0,10-0,25 mm (0.004-0.010 in) BELOW.
Current 4.236 engines	0,05 mm (0.002 in) ABOVE to 0,10 mm (0.004 in) BELOW.

A4.236 ENGINE DATA

Pistons:

Assembly	Fit cavity towards fuel injection pump side of engine.
Gudgeon pin	Fully floating.
Piston height to cylinder block face	0,41 mm (0.014 in) ABOVE to 0,61 mm (0.023 in) ABOVE.

Piston ring layout:

No 1 compression	Chrome insert.
Gap	0,41-0,86 mm (0.016-0.034 in).
No 2 compression	Internally stepped cast iron.
Gap	0,30-0,76 mm (0.012-0.030 in).
No 3 compression	Internally stepped cast iron.
Gap	0,30-0,76 mm (0.012-0.030 in).
No 4 oil control	Chrome spring loaded scraper.
Gap	0,30-0,43 mm (0.012-0.017 in).
No 5 oil control	Maxigroove scraper.
Gap	0,30-0,76 mm (0.012-0.030 in).

Connecting rods:

Big end bearing undersize	0,25 mm (0.010 in). 0,51 mm (0.020 in). 0,76 mm (0.030 in).
Small end bearing diameter	34,93-34,96 mm (1.3757-1.3765 in).

Crankshaft:

Regrind sizes	0,25 mm (0.010 in). 0,51 mm (0.020 in). 0,76 mm (0.030 in)
Number of main bearings	5
Method of hardening	Induction hardened.
End float	0,05-0,38 mm (0.002-0.015 in).

Oil pressure relief valve setting:

Working pressure	3,5-4,1 bar (50-60 lbf/in^2).
Minimum oil pressure	2,0 bar (30 lbf/in^2) at maximum working speed and normal operating temperature.

Cooling system:

Fan belt deflection	10 mm (3/8 in).
Thermostat:	
Quantity	1
Type (not MF 362)	By-pass blanking.
Opening temperature (nominal)	82° C (180° F).
Radiator pressure cap rating	0,75 bar (10 lbf/in^2).

Capacities:

Cooling system	14,4 litre (3.2 imp gal)(3.8 US gal).
Engine sump	7,5 litre (1.7 imp gal)(2 US gal).

Bolt torques – see page 20

A4.248 TRACTOR ENGINE DATA 3A–04

Specifications:

Make ..... Perkins diesel - naturally aspirated.
Type ..... Water cooled direct injection.
Engine Model No ..... A4.248.
Engine build code:
MF 382 tractor ..... LF 31258.
MF 383 and 390 tractor ..... LF 31141.
Bore ..... 100,96 mm (3.975 in).
Stroke ..... 127,0 mm (5 in).
Cubic capacity ..... 4,06 litre (248 cubic in).
No of cylinders ..... 4.
Firing order ..... 1, 3, 4, 2.
Direction of engine rotation ..... Clockwise from front.
Compression ratio 16:1

Power ratings ±5%	PS	hp	kW
MF 382 tractor:			
• Engine power at flywheel at 2200 rev/min	80	80.	58,9.
• Power at PTO at engine rated speed	73	72	53,7.
• Maximum engine torque at 1400 rev/min	283 Nm (209 lbf ft).		
MF 390 tractor up to engine serial No. U226834S and MF 383 tractor:			
• Engine power at flywheel at 2200 rev/min	77	76.	56,6.
• Power at PTO at engine rated speed	70	69	51,5.
• Maximum engine torque at 1400 rev/min	280 Nm (206 lbf ft).		
MF 390 tractor engine serial No. U226835S onwards ✳ - see page 22.			
• Engine power at flywheel at 2200 rev/min	80	79.	59.
• Power at PTO at engine rated speed	73	72	54.
• Maximum engine torque at 1400 rev/min	283 Nm (209 lbf ft).		

• To DIN 70020 Standard.

Engine Speeds:

MF 382 tractor:
Low idle speed ..... 750 rev/min.
Rated speed ..... 2200 rev/min.
Maximum no-load speed ..... 2310 rev/min.
MF 390 tractor up to engine serial No. U226834S and MF 383 tractor:
Low idle speed ..... 750 rev/min.
Rated speed ..... 2200 rev/min.
Maximum no-load speed ..... 2380 rev/min.
MF 390 tractor engine serial No. U226835S onwards:
Low idle speed ..... 750 rev/min.
Rated speed ..... 2200 rev/min.
Maximum no-load speed ..... 2310 rev/min.

Fuel injection pump:

Make ..... CAV.
Type ..... DPA - mechanical governor.
MF 382 tractor:
Fuel pump code ..... 2643C279/XS/3/2310.
MF 383 tractor:
Fuel pump code ..... XS65L/800/3/2310.
MF 390 tractor up to engine serial No. U226834S:
Fuel pump code- Standard ..... 38367/XS/8/2380.
Fuel pump code - ISO ..... XS59L/800/8/2380.
MF 390 tractor engine serial No. U226835S onwards:
Fuel pump code- Standard ..... 2643C279/XS/6/2310.
Fuel pump code - ISO ..... XS65L/800/6/2310.
All models:
Pump rotation ..... Clockwise.
Circlip timing mark letter ..... C.
No 1 cylinder outlet letter ..... W.
Engine checking angle at TDC ..... 280°
Fuel pump checking angle ..... 293°
Static timing BTDC ..... 26°
Piston displacement ..... 8,20 mm (0.323 in).

A4.248 ENGINE DATA

Fuel injectors:

Working pressure	172 bar (170 Atm) (2498 lbf/in^2).
Setting pressure new injectors	188 bar (185 Atm) (2719 lbf/in^2).
Identification code	FW.

Valve tip clearance:

Inlet	0,3 mm (0.012 in) cold.
Exhaust	0,3 mm (0.012 in) cold.

Valve guides:

Stand-out above spring seating face:	
Inlet and exhaust	15,09 mm (0.594 in).

Valves:

Valve face angle	45°
Valve seat angle.	46°

Valve recession:

New inlet	0,89-1,14 mm (0.035-0.045 in).
New exhaust.	1,19-1,45 mm (0.047-0.057in).
Service inlet - maximum.	1,55 mm (0.061 in).
Service exhaust - maximum	1,85 mm (0.073 in).
Valve seat inserts:	Can be fitted to inlet and exhaust.
Valve springs:	Double valve springs fitted on inlet and exhaust. Fit damper coil towards cylinder head.

Cylinder liners:

Type.	Dry.
Material	Cast iron.
Location	Flange.
Maximum wear	0,20 mm (0.008 in).
Fit (service)	Transition ±0,025 mm (±0.001 in).
Liner flange relationship to top face of cylinder block	0,05 mm (0.002 in) ABOVE to 0,10 mm (0.004 in) BELOW.

Pistons:

Assembly	Fit cavity towards fuel injection pump side of engine.
Gudgeon pin	Fully floating.
Piston height to cylinder block face	0,05 mm (0.0018 in) ABOVE to 0,25 mm (0.010 in) ABOVE.

Piston ring layout:

No 1 compression	Molybdenum barrel faced ring with top face internally stepped and externally chamfered.
Gap	0,41-0,86 mm (0.016-0.034 in).
No 2 compression	Tapered face cast iron ring with top face internally stepped and bottom face externally chamfered.
Gap	0,41-0,86 mm (0.016-0.034 in).
No 3 oil control	Coil spring loaded chrome scraper.
Gap	0,41-0,86 mm (0.016-0.034 in).

Connecting rods:

Big end bearing undersize	0,25 mm (0.010 in). 0,51 mm (0.020 in). 0,76 mm (0.030 in).
Small end bearing diameter	34,93-34,96 mm (1.3757-1.3765 in).

Crankshaft:

Regrind sizes	0,25 mm (0.010 in). 0,51 mm (0.020 in). 0,76 mm (0.030 in).
Number of main bearings	5.
Method of hardening	Tuftrided.
End float	0,05-0,38 mm (0.002-0.015 in).

Oil pressure relief valve setting:

Working pressure	3,5-4,1 bar (50-60 lbf/in^2).
Minimum oil pressure	2,0 bar (30 lbf/in^2) at maximum working speed and normal operating temperature.

Cooling system:

Fan belt deflection ..... 10 mm (3/8 in).
Thermostat:
- Quantity ..... 1.
- Type ..... By-pass blanking.
- Opening temperature (nominal) ..... 82° C (180° F).
- Radiator pressure cap rating ..... 0,75 bar (10 lbf/in^2) .

Capacities:

Cooling system ..... 14,4 litre (3.2 imp gal) (3.8 US gal).
Engine sump ..... 7,5 litre (1.7 imp gal) (2 US gal).

Bolt torques – see page 20

AT4.236 ENGINE DATA

AT4.236 TRACTOR ENGINE DATA 3A–05

Specifications:

Make	Perkins diesel - turbocharged.
Type	Water cooled direct injection.
Engine Model No	AT4.236.
Engine build code:	
MF 390T, 393 and 398 tractor	LJ 31142.
Bore	98,4 mm (3.875 in).
Stroke	127,0 mm (5 in).
Cubic capacity	3,86 litre (236 cubic in).
No of cylinders	4.
Firing order	1, 3, 4, 2.
Direction of engine rotation	Clockwise from front.
Compression ratio	15.5:1.

Power ratings ±5%

	PS	hp	kW
MF 390T, 393 and 398 tractor up to serial No.U219831S:			
• Engine power at flywheel at 2200 rev/min	90	89	66.2.
• Power at PTO at engine rated speed	83	82	61.0.
• Maximum engine torque at 1400 rev/min	341 Nm (252 lbf ft).		
MF 390T, 393 and 398 engine serial No. U219832S onwards:			
• Engine power at flywheel at 2250 rev/min	93	92	68.4.
• Power at PTO at engine rated speed	86	85	63.3.
• Maximum engine torque at 1250 rev/min	349 Nm (258 lbf ft).		

• To DIN 70020 Standard.

Engine Speeds:

MF 390T, 393 and 398 tractor up to serial No.U219831S:	
Low idle speed	750 rev/min.
Rated speed	2200 rev/min.
Maximum no-load speed	2420 rev/min.
MF 390T, 393 and 398 engine serial No. U219832S onwards * - see page 24.	
Low idle speed	750 rev/min.
Rated speed	2200 rev/min.
Maximum no-load speed	2310 rev/min.

Fuel injection pump:

Make	CAV.
Type	DPA - mechanical governor.
MF 390T, 393 and 398 tractor up to serial No.U219831S:	
Fuel pump code - Standard	2643C188KT/5/2420.
Fuel pump code - ISO	KT68L/1000/5/2420.
MF 390T, 393 and 398 engine serial No. U219832S onwards:	
Fuel pump code - Standard	2643C280KT/8/2310.
Fuel pump code - ISO	KT68L/1000/8/2310.
All tractor models:	
Pump rotation	Clockwise.
Circlip timing mark letter	C.
No 1 cylinder outlet letter	W.
Engine checking angle at TDC	284°
Fuel pump checking angle	292°
Static timing BTDC	16°
Piston displacement	3,15 mm (0.124 in).

Fuel injectors:

Working pressure	233 bar (230 Atm) (3380 lbf/in^2).
Setting pressure new injectors	233 bar (230 Atm) (3380 lbf/in^2).
Identification code	HL.

Turbocharger:

Make	Garrett.
Type	Wastgate T3.
Maximum pressure	0,82 bar (11.8 lbf/in^2).
At engine speed	2200 rev/min.

Valve tip clearance:

Inlet	0,3 mm (0.012 in) cold.
Exhaust	0,3 mm (0.012 in) cold.

Valve guides:

Stand-out above spring seating face:
Inlet and exhaust ..... 15,09 mm (0.594 in).

Valves:

Valve face angle ..... 30°
Valve seat angle. ..... 31°

Valve recession:

New inlet ..... 0,89-1,14 mm (0.035-0.045 in).
New exhaust. ..... 1,19-1,45 mm (0.047-0.0757in).
Service inlet - maximum. ..... 1,55 mm (0.061 in).
Service exhaust - maximum ..... 1,85 mm (0.073 in).
Valve seat inserts: ..... Exhaust seats only.
Valve springs: ..... Double valve springs fitted on inlet and exhaust. Fit damper coil towards cylinder head.

Cylinder liners:

Type. ..... Dry.
Material ..... Cast iron.
Location ..... Flange.
Maximum wear ..... 0,20 mm (0.008 in).
Fit (service) ..... Transition ±0,025 mm (±0.001 in) .
Liner flange relationship to top face of cylinder block ..... 0,05 mm (0.002 in) ABOVE to 0,10 mm (0.004 in) BELOW.

Pistons:

Assembly ..... Fit cavity towards fuel injection pump side of engine.
Gudgeon pin ..... Fully floating.
Piston height to cylinder block face ..... 0,25 mm (0.010 in) ABOVE to 0,58 mm (0.023 in) ABOVE.

Piston ring layout:

No 1 compression ..... Molybdenum faced wedge.
Gap ..... 0,25-0,61 mm (0.010-0.024 in).
No 2 compression ..... Cast iron taper faced.
Gap ..... 0,25-0,66 mm (0.010-0.027 in).
No 3 compression ..... Chrome face spring loaded conformable.
Gap ..... 0,25-0,79 mm (0.010-0.031 in).

Connecting rods:

Big end bearing undersize ..... 0,25 mm (0.010 in).
0,51 mm (0.020 in).
0,76 mm (0.030 in).
Small end bearing diameter ..... 38,12-38,14 mm (1.5007-1.5015 in).

Crankshaft:

Regrind sizes ..... 0,25 mm (0.010 in).
0,51 mm (0.020 in).
0,76 mm (0.030 in).
Number of main bearings ..... 5.
Method of hardening ..... Tuftrided.
End float ..... 0,05-0,38 mm (0.002-0.015 in).

Oil pressure relief valve setting:

Working pressure ..... 3,5-4,1 bar (50-60 lbf/in^2).
Minimum oil pressure ..... 2,0 bar (30 lbf/in^2) at maximum working speed and normal operating temperature.

Cooling system:

Fan belt deflection ..... 10 mm (3/8 in).
Thermostat:
Quantity ..... 1.
Type ..... By-pass blanking.
Opening temperature (nominal) ..... 82° C (180° F).
Radiator pressure cap rating ..... 0,75 bar (10 lbf/in^2).

Capacities:

Cooling system ..... 15,5 litre (3.41 imp gal) (4.09 US gal).
Engine sump ..... 7,7 litre (15 imp pt) (8.1 US qt).

Bolt torques – see page 21

A6.3544 ENGINE DATA

A6.3544 TRACTOR ENGINE DATA 3A–06

Specifications:

Make	Perkins diesel - naturally aspirated.
Type	Water cooled direct injection.
Engine Model No	A6.3544.
Engine build code:	
MF 399 tractor	TW 31159.
Bore	98,4 mm (3.875 in).
Stroke	127,0 mm (5 in).
Cubic capacity	5,8 litre (354 cubic in).
No of cylinders	6.
Firing order	1, 5, 3, 6, 2, 4.
Direction of engine rotation	Clockwise from front.
Compression ratio	16:1.

Power ratings ±5%

	PS	hp	kW
MF 399 tractor up to serial No.U793030P:			
• Engine power at flywheel at 2200 rev/min	97	96	71.3.
• Power at PTO at engine rated speed	90	89	66.2.
• Maximum engine torque at 1200 rev/min	372 Nm (274 lbf ft).		
MF 399 engine serial No. U793031P onwards:			
• Engine power at flywheel at 2250 rev/min	102	101	75.
• Power at PTO at engine rated speed	95	94	70.
• Maximum engine torque at 1300 rev/min	376 Nm (277 lbf ft).		

• To DIN 70020 Standard.

Engine Speeds:

MF 399 tractor up to serial No.U793030P:	
Low idle speed	750 rev/min.
Rated speed	2200 rev/min.
Maximum no-load speed	2420 rev/min.
MF 399 engine serial No. U793031P onwards:	
Low idle speed	750 rev/min.
Rated speed	2200 rev/min.
Maximum no-load speed	2310 rev/min.

Fuel injection pump:

Make	CAV.
Type	DPA - mechanical governor.
MF 399 tractor up to serial No. U793030P:	
Fuel pump code - Standard	2643D180/TY/3/2420.
Fuel pump code - ISO	TY51L/900/3/2420.
MF 399 engine serial No. U793031P onwards ✻ - see page 24.	
Fuel pump code - Standard	2643D188/TY/5/2310.
Fuel pump code - ISO	TY5L900/5/2310.
All tractor models:	
Pump rotation	Clockwise.
Circlip timing mark letter	F.
No 1 cylinder outlet letter	X.
Engine checking angle at TDC	153°
Fuel pump checking angle	141°
Static timing BTDC	23°
Piston displacement	6,35 mm (0.250 in).

Fuel injectors:

Working pressure	223 bar (220 Atm) (3233 lbf/in^2).
Setting pressure new injectors	223 bar (220 Atm) (3233 lbf/in^2).
Identification code	HU.

Valve tip clearance:

Inlet	0,2 mm	(0.008 in) cold.
Exhaust	0,45 mm	(0.018 in) cold.

Valve guides:

Stand-out above spring seating face:	
Inlet and exhaust	15,09 mm (0.594 in).

Valves:

Valve face angle	45°
Valve seat angle.	46°

Valve recession:

New inlet and exhaust	1,02-1,27mm (0.040-0.050 in).
Service inlet and exhaust - maximum.	1,52 mm (0.060 in).
Valve seat inserts:	Exhaust seats only.
Valve springs:	Double valve springs fitted on inlet and exhaust. Fit damper coil towards cylinder head.

Cylinder liners:

Type.	Dry.
Material	Cast iron.
Location	Flange.
Maximum wear	0,20 mm (0.008 in).
Fit (service)	Transition ±0,025 mm (±0.001 in) .
Liner flange relationship to top face of cylinder block	0,05 mm (0.002 in) ABOVE to 0,10 mm (0.004 in) BELOW.

Pistons:

Assembly	Fit cavity towards fuel injection pump side of engine.
Gudgeon pin	Fully floating.
Piston height to cylinder block face	0,18 mm (0.007 in) ABOVE to 0,mm (0 in) ZERO.

Piston ring layout:

No 1 compression	Chrome barrel faced, internal chamfer.
Gap	0,25-0,71 mm (0.010-0.028 in).
No 2 compression	Chrome face tapered.
Gap	0,20-0,61 mm (0.008-0.024 in).
No 3 compression	Chrome face spring loaded conformable.
Gap	0,25-0,84 mm (0.010-0.033 in).

Connecting rods:

Big end bearing undersize	0,25 mm (0.010 in). 0,51 mm (0.020 in). 0,76 mm (0.030 in).
Small end bearing diameter	34,93-34,96 mm (1.3757-1.3765 in).

Crankshaft:

Regrind sizes	0,25 mm (0.010 in). 0,51 mm (0.020 in). 0,76 mm (0.030 in).
Number of main bearings	7
Method of hardening	Induction hardened.
End float	0,05-0,38 mm (0.002-0.015 in).

Oil pressure relief valve setting:

Working pressure	3,5-4,1 bar (50-60 lbf/in^2).
Minimum oil pressure	2,0 bar (30 lbf/in^2) at maximum working speed and normal operating temperature.

Cooling system:

Fan belt deflection	10 mm (3/8 in)
Thermostat:	
Quantity	2
Type	By-pass blanking
Opening temperature (nominal)	82° C (180° F)

Capacities:

Cooling system	20,1 litre (4.42 imp gal)(5.39 US gal)
Engine sump	15,4 litre (3.38 imp gal)(4.06 US gal))

Bolt torques – see page 21

1006 SERIES TRACTOR ENGINE DATA 3A–07

Specifications:

Make	Perkins diesel - naturally aspirated.
Type	Water cooled direct injection.
Engine Model No	1006.6.
Engine build code:	
MF 396 tractor	YA 31251.
MF 399 tractor	YA 31240.
Bore	100 mm (3.937 in).
Stroke	127,0 mm (5 in).
Cubic capacity	6,0 litre (365 cubic in).
No of cylinders	6 in-line.
Firing order	1, 5, 3, 6, 2, 4.
Direction of engine rotation	Clockwise from front.
Compression ratio	16.5:1.

Power ratings ±5%

	PS	hp	kW
MF 396 tractor:			
• Engine power at flywheel at 2200 rev/min	100	98.6	73.5.
• Power at PTO at engine rated speed	89	87.8	65.5.
• Maximum engine torque at 1200 rev/min	388 Nm (286 lbf ft).		
MF 399 tractor:			
• Engine power at flywheel at 2200 rev/min	104	102.6	76.5.
• Power at PTO at engine rated speed	92	91	67.9.
• Maximum engine torque at 1200 rev/min	430 Nm (317 lbf ft).		

• To DIN 70020 Standard.

Engine Speeds:

MF 396 and 399 tractor:	
Low idle speed	750 rev/min.
Rated speed	2200 rev/min.
Maximum no-load speed	2310 rev/min.

Fuel injection pump:

Make	CAV.
Type	DPA - self-vent.
Fuel pump code - Standard (MF 396)	2643D629/LK/3/2310.
Fuel pump code - Standard (MF 399)	2643D804/UK/2/2310.
Pump rotation (MF 396 and 399)	Clockwise.
No 1 cylinder outlet letter (MF 396 and 399)	Y.
Governor spring position code (MF 396)	3.
Governor spring position code (MF 399)	2.
Engine checking angle at TDC (MF 396)	326.5°
Engine checking angle at TDC (MF 399)	325.5°
Fuel pump checking angle (MF 396)	337.5°
Fuel pump checking angle (MF 399)	334°
Static timing BTDC (MF 396)	22°
Static timing BTDC (MF 399)	17°

Fuel injectors:

Make	CAV.
Code	JU.
Holder	LRB 67014.
Nozzle	JB 6801106.
Set and re-set pressure	223 bar (3234 lbf/in^2).

Valve tip clearance:

Inlet	0,2 mm (0.008 in) cold.
Exhaust	0,45 mm (0.018 in) cold.

Valve guides:

Stand-out above spring seating face:	
Inlet and exhaust	15,10 mm (0.594 in).

Valves:

Valve face angle	45°
Valve seat angle.	46°

Valve recession:

New inlet	1,27-1,60mm (0.050-0.063 in).
New exhaust	1,28-1,83mm (0.050-0.072 in).
Service inlet - maximum	1,85 mm (0.073 in).
Service exhaust - maximum	2,08 mm (0.082 in).
Valve seat inserts:	No.
Valve springs:	Single valve springs fitted on inlet and exhaust.

Cylinder liners:

Type - production	Dry, interference fit, flanged.
Type - service	Dry, transition fit, flanged.
Material	Cast iron.
Liner flange relationship to top face of cylinder block	0,10 mm (0.004 in) ABOVE to 0,10 mm (0.004 in) BELOW.

Pistons:

Type	'Quadram' combustion bowl, controlled expansion, inserted top ring groove.
Gudgeon pin	Fully floating.
Piston height above top face of cylinder block	0,14 mm (0.005 in) ABOVE to 0.36 mm (0.014 in) ABOVE.

Piston ring layout:

Top compression	Barrel face, molybdenum insert, with chamfer at the top of the inner face.
Gap	0,40-0,85 mm (0.016-0.033 in).
No 2 compression	Taper face, cast iron.
Gap	0,30-0,76 mm (0.012-0.030 in).
Oil scraper	Coil spring loaded, chrome face.
Gap	0,38-0,84 mm (0.015-0.033 in).

Connecting rods:

Type	'H' section, square shape small end.
Cap location	Serrated face.

Crankshaft assembly:

Regrind sizes	0,25 mm (0.010 in). 0,51 mm (0.020 in). 0,76 mm (0.030 in).
Method of hardening	Induction hardened.
End float	0,05-0,38 mm (0.002-0.015 in).
Maximum permissible end float	0,51 mm (0.020 in).

Lubricating oil pressure:

Minimum oil pressure at maximum engine speed	2,0 bar (30 lbf/in^2) at maximum working speed and normal operating temperature.

Cooling system:

Water pump type	Centrifugal, gear driven.
Fan belt deflection	10 mm (3/8 in) or 350 N (80 lbf).
Radiator pressure cap rating	0.75 bar (10 lbf/in^2).
Thermostat:	
Type	Twin, wax pellet, by-pass blanking.
Opening temperature (nominal)	82° C (180° F).
Fully open temperature (nominal)	95° C (203° F).
Valve lift - fully open	9,1 mm (0.358 in).

Capacities:

Cooling system	32,0 litre (5 imp gal) (6 US gal)
Engine sump	14,3 litre (3.1 imp gal) (3.8 US gal))

Bolt torques – see page 21

ENGINE BOLT TORQUES

Bolt Torques – AD3.152 engine:

Cylinder head nuts	81 Nm	(60 lbf ft).
Cylinder head nuts/setscrews	95 Nm	(70 lbf ft).
Connecting rod self locking nuts (Not plated)	95 Nm	(70 lbf ft).
Connecting rod nuts (Cadmium plated)	61 Nm	(45 lbf ft).
Connecting rod nuts (Phophated)	81 Nm	(60 lbf ft).
Main bearings	150 Nm	(110 lbf ft).
Flywheel	106 Nm	(78 lbf ft).
Crankshaft balance weights	75 Nm	(55 lbf ft).
Crankshaft pulley setscrew with 4,8 mm (3/16 in) thick washer	142 Nm	(105 lbf ft).
Crankshaft pulley setscrew with 8,9 mm (0.35 in) thick washer	325 Nm	(240 lbf ft).
Camshaft drive gear	28 Nm	(21 lbf ft).
Idler gear	68 Nm	(50 lbf ft).
Injector securing nuts/setscrews	16 Nm	(12 lbf ft).
Engine back plate	49 Nm	(36 lbf ft).

Bolt Torques – AT3.1524 engine:

Cylinder head (cold)	108 Nm	(80 lbf ft).
Connecting rod	81 Nm	(60 lbf ft).
Main bearings	150 Nm	(110 lbf ft).
Flywheel	100 Nm	(74 lbf ft).
Crankshaft balance weight	75 Nm	(55 lbf ft).
Crankshaft pulley setscrew with 8,9 mm (0.35 in) thick washer	325 Nm	(240 lbf ft).
Camshaft drive gear	28 Nm	(21 lbf ft).
Idler gear	68 Nm	(50 lbf ft).
Injector securing nuts/setscrews	16 Nm	(12 lbf ft).
Engine back plate	61 Nm	(45 lbf ft).

Bolt Torques – A4.236 engine:

Cylinder head (cold)	120 Nm	(88 lbf ft).
Connecting rod	129 Nm	(95 lbf ft).
Main bearings	244 Nm	(180 lbf ft).
Flywheel	100 Nm	(74 lbf ft).
Camshaft drive gear	60 Nm	(50 lbf ft).
Idler gear	40 Nm	(30 lbf ft).
Crankshaft pulley (single bolt and washer)	390 Nm	(285 lbf ft).
Crankshaft pulley (Three 7/16 in UNF screws)	90 Nm	(70 lbf ft).
Atomizer securing nuts	18 Nm	(14 lbf ft).
Atomizer clamp nuts	12 Nm	(9 lbf ft).
Balancer unit	49 Nm	(36 lbf ft).

Bolt Torques – A4.248 engine:

Cylinder head (cold)	136 Nm	(100 lbf ft).
Connecting rod	129 Nm	(95 lbf ft).
Main bearings	244 Nm	(180 lbf ft).
Flywheel	100 Nm	(74 lbf ft).
Camshaft drive gear	68 Nm	(50 lbf ft).
Idler gear	40 Nm	(30 lbf ft).
Crankshaft pulley (single bolt and washer)	390 Nm	(285 lbf ft).
Crankshaft pulley (Three 7/16 in UNF screws)	90 Nm	(70 lbf ft).
Atomizer securing nuts	18 Nm	(14 lbf ft).
Atomizer clamp nuts	12 Nm	(9 lbf ft).
Balancer unit	49 Nm	(36 lbf ft).

ENGINE BOLT TORQUES

Bolt Torques – AT4.236 engine:

Cylinder head (cold)	120 Nm	(88 lbf ft) plus 1/2 turn.
Connecting rod	129 Nm	(95 lbf ft).
Main bearings	244 Nm	(180 lbf ft).
Flywheel	100 Nm	(74 lbf ft).
Camshaft drive gear	60 Nm	(50 lbf ft).
Idler gear	40 Nm	(30 lbf ft).
Crankshaft pulley (single bolt and washer)	390 Nm	(285 lbf ft).
Crankshaft pulley (Three 7/16 in UNF screws)	90 Nm	(70 lbf ft).
Atomizer securing nuts	18 Nm	(14 lbf ft).
Atomizer clamp nuts	12 Nm	(9 lbf ft).
Balancer unit	50 Nm	(40 lbf ft).

Bolt Torques A6.3544 engine:

Cylinder head (large stud)	156 Nm	(115 lbf ft)
Cylinder head (12 point screws)	38 Nm	(28 lbf ft)
Connecting rod (phophated)	129 Nm	(95 lbf ft)
Main bearings	270 Nm	(200 lbf ft)
Flywheel	100 Nm	(74 lbf ft)
Crankshaft pulley (cadmium plated)	88 Nm	(65 lbf ft)
Crankshaft pulley (phosphated)	125 Nm	(92 lbf ft)
Camshaft drive gear	68 Nm	(50 lbf ft)
Idler gear	49 Nm	(36 lbf ft)
Injector securing nuts/setscrews	16 Nm	(12 lbf ft)
Auxiliary drive shaft gear bolts	30 Nm	(22 lbf ft)

Bolt Torques – 1006 series engine:

Cylinder head	See engine workshop service manual.	
Connecting rod nuts	125 Nm	(92 lbf ft).
Main bearings	265 Nm	(196 lbf ft).
Rear oil housing	22 Nm	(16 lbf ft).
Rear oil housing to bridge piece	18 Nm	(13 lbf ft).
Bridge piece to cylinder block	16 Nm	(12 lbf ft).
Flywheel	105 Nm	(77 lbf ft).
Crankshaft pulley	115 Nm	(85 lbf ft).
Camshaft drive gear	78 Nm	(58 lbf ft).
Idler gear hub	44 Nm	(33 lbf ft).
Fuel injection pump nut	80 Nm	(59 lbf ft).
Injector retaining nuts	12 Nm	(9 lbf ft).

GENERAL NOTES

The following notes refer to the A4.236 engine on page 3A-8.

* Engine serial number **U261449S** introduced into tractors as follows:

MF 362 tractor - first production.

MF 365 tractor - two-wheel drive - N2929 onwards, built 19th August 1988

MF 365 tractor - four-wheel drive - N29314 onwards, built 19th August 1988

* Engine serial number **U261449S** introduced into tractors as follows:

MF 372 tractor - first production.

MF 375 tractor - two-wheel drive - V49006 onwards, built 4th January 1988

MF 375 tractor - four-wheel drive - V49002 onwards, built 4th January 1988

The following notes refer to the A4.248 engine on page 3A-11.

* Engine serial number **U226835S** introduced into tractors as follows:

MF 382 and 383 tractor - first production.

MF 390 tractor - two-wheel drive - N05287 onwards, built 3rd March 1988.

MF 390 tractor - four-wheel drive - N05294 onwards, built 3rd March 1988.

The following notes refer to the AT4.236 engine on page 3A-14.

* Engine serial number **U219832S** introduced into tractors as follows:

MF 390T tractor - first production.

MF 398 tractor - two-wheel drive - N06042 onwards, built 7th March 1988.

MF 398 tractor - four-wheel drive - N05290 onwards, built 3rd March 1988.

The following notes refer to the A6.3544 engine on page 3A-16.

* Engine serial number **U793031P** introduced into tractors as follows:

MF 399 tractor - two-wheel drive - N03471 onwards, built 19th February 1988.

MF 399 tractor - four-wheel drive - N04024 onwards, built 22nd February 1988.

Also MF 399 tractor - two-wheel drive serial number V52163 and MF 399 four-wheel drive tractor serial number VF52177 both built on 27th January 1988 and despatched to North America.

COOLING SYSTEM

INDEX

COOLING SYSTEM

Section 4 – Part A

Table of Contents

4A–02
COOLING SYSTEM

Specification

Capacities
- M-F 340, 350, 355, 360 ..... 9,8 litre (2.2 gal) (2.6 US gal)
- M-F 362 ..... 14,4 litre (3.17 gal) (3.8 US gal)
- M-F 365, 375, 383, 390 ..... 15,1 litre (3.32 gal) (3.9 US gal)
- M-F 390T, 398 ..... 15,5 litre (3.41 gal) (4.09 US gal)
- M-F 399 ..... 20,1 litre (4.42 gal) (5.3 US gal)
- M-F 399-1006 series engine ..... 23 litre (5.0 gal) (6.0 US gal)

Radiator cap pressure rating ..... 0,75 bar (10 lbf/in^2)

Thermostat
- M-F 340 to 398
  - Quantity 1
  - Type ..... Bypass
  - Opening temperature (Nominal) ..... 82°C (180°F)
- M-F 399
  - Quantity 2
  - Type ..... Bypass blanking
  - Opening temperature (Nominal) ..... 82°C (180°F)

Fan belt deflection
- M-F 340 to 398 ..... 19 mm (0.75 in)
- M-F 399 ..... 10 mm (0.375 in)

Fault Diagnosis

The faults listed are cooling system faults only and do not cover engine defects which may contribute towards overheating.

FAULT	POSSIBLE CAUSE	SUGGESTED REMEDY
Overheating	Engine racing or pulling hard	Select the correct gear to suit conditions
	Radiator water level	Fill to the correct level, check for leaks at joints and hoses, rectify as necessary
	Loose fan belt	Adjust the fan belt tension
	Radiator cap leaking or valve spring defective	Replace the radiator cap
	Radiator matrix blocked	Clean the radiator using a reverse flow of air or water
	Water flow restricted	Check the thermostat operation and replace if necessary Reverse flush the cooling system Service or renew the water pump
Engine runs cool	Operating conditions (cold head winds)	Blank off a portion of the radiator
	Thermostat stuck open	Replace the thermostat

Frost Precautions

There are three main methods of protecting the cooling system during frost conditions:

1. Draining the cooling system after each days work.

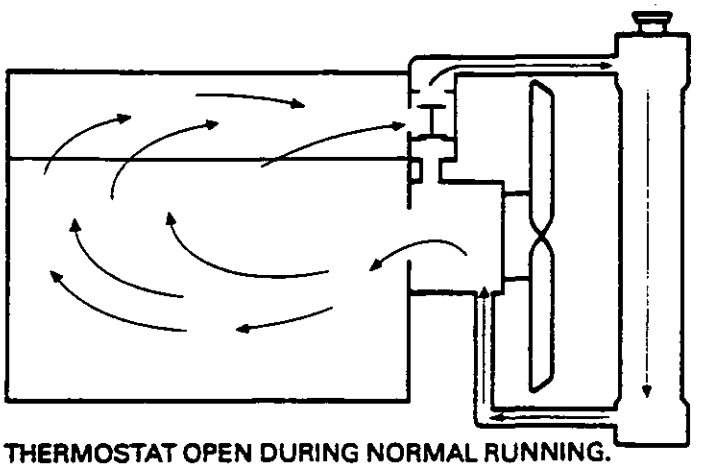
   This method leaves the system unprotected in the idle periods during the day, and in extreme conditions the cooling may freeze while the engine is running. Erosion of the water pump impellor may be accelerated in hard water conditions due to the frequent draining and refilling of the system.

2. Use of heated premises, engine or sump heaters.

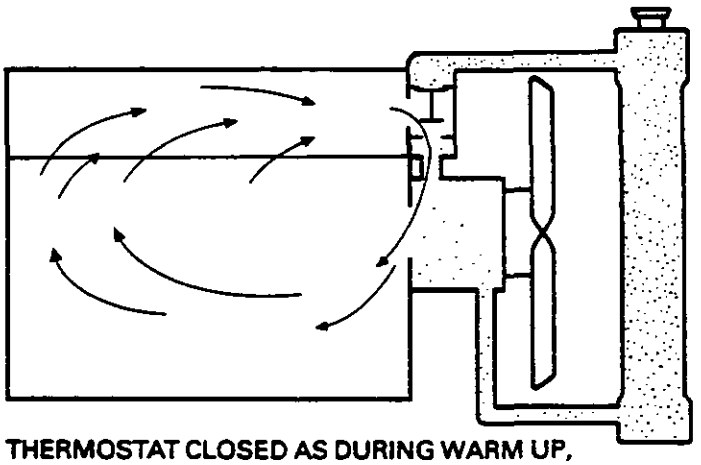
   This method also leaves the engine unprotected during the idle periods of the day and extremely cold conditions.

3. Anti-Freeze Solutions.

   Generally the most efficient method of protecting cooling systems but, due to the penetrating properties of the solution, all hoses and joints should be in good condition. A cooling system which is normally free of leaks may well develop them when filled with anti-freeze. Leakage may not occur immediately after initial filling of the system but may develop shortly afterwards. This should be considered and the necessary checks carried out.



THERMOSTAT OPEN DURING NORMAL RUNNING.



THERMOSTAT CLOSED AS DURING WARM UP, IN COLD AMBIENTS OR UNDER PART LOAD.

TL480

General Description

The coolant is circulated by thermo-syphon action assisted by a centrifugal type pump. The system is controlled by a thermostat which prevents the coolant from flowing through the radiator until the correct working temperature has been achieved, and a pressure-sensitive radiator cap, which, by allowing the radiator to pressurise, raises the temperature at which the coolant will boil. A fan attached to the front of the engine assists cooling by drawing air through the radiator.

The water pump and cooling fan are driven by a belt, which is driven by a pulley splined to the front of the crankshaft.

The thermostat fitted to the engine is a by-pass blanking type. These can be identified by the valve disc at its base. This type of thermostat regulates the flow of water through the radiator or by-pass port.

When cold the by-pass port is fully open and the connection to the radiator is closed; when hot the by-pass port is closed and the connection to the radiator is open. If the blanking by-pass thermostat is removed, the greater water flow will be through the by-pass and not the radiator, resulting in severe overheating and consequential damage. Do not run the engine without the thermostat.

Repair information on the water pump and thermostat will be found in the Engine Workshop Manual.

Radiator – 3 Cylinder Engines

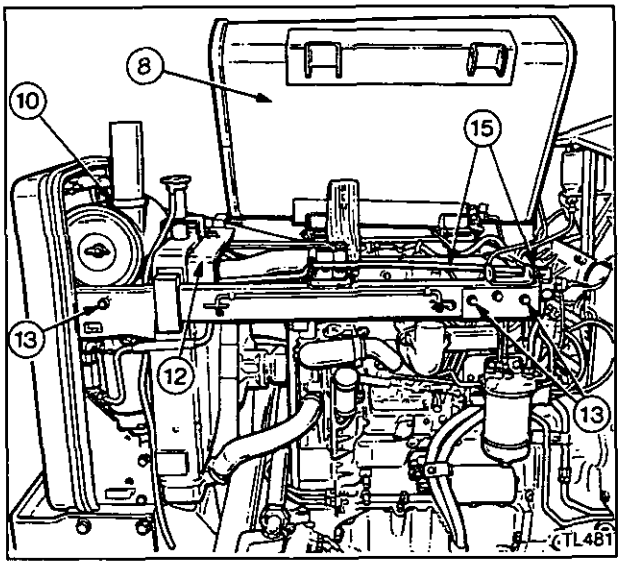
Removal and Refitment 4A-01

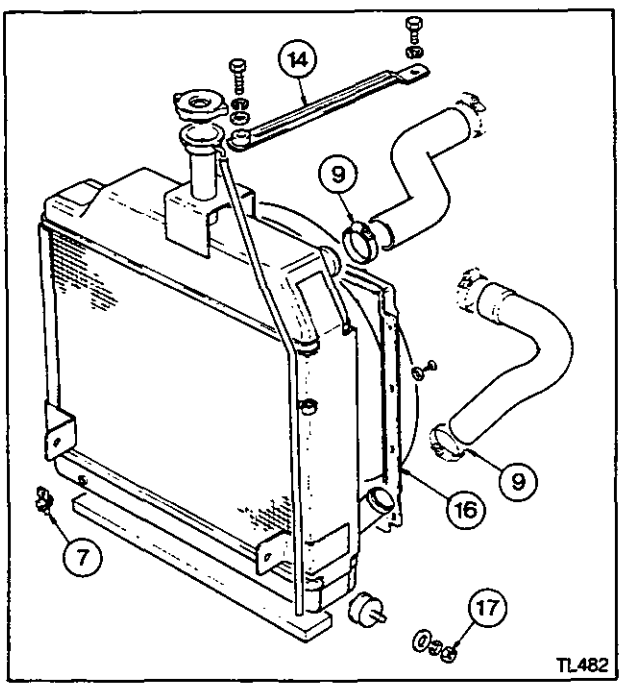
Removal

1. Remove the jubilee clip and centrifugal pre-cleaner.
2. Remove the bonnet.
3. Remove both lower side panels.
4. Disconnect the headlights.
5. Remove the front grille.
6. Remove the battery. (Disconnect the negative (-) terminal first.)
7. Drain the radiator. (Ensure a suitable size container is available.)
8. Raise the fuel tank on its left hand side and support it so that it does not block the removal of the radiator.
9. Disconnect the top and bottom hoses.
10. Disconnect the air cleaner hose at the air cleaner end.
11. Remove the upper section of the exhaust pipe.
12. Remove the cross member bracket supporting front of fuel tank.
13. Remove the bolts from the side support rail and lift the rail away.
14. Remove the top radiator stay.
15. Remove the hydraulic pipe, oil filter to rear of tractor.
16. Unscrew and place the fan shroud over the water pump.
17. Slacken the two lower securing nuts and lift the radiator away to the left-hand side.

Refitment

18. Reverse procedures 1 to 17.
19. Refill the radiator with the original solution of water and anti-freeze or with a fresh solution. Always use M-F Anti-Freeze.





Radiator – 4 & 6 Cylinder Engines

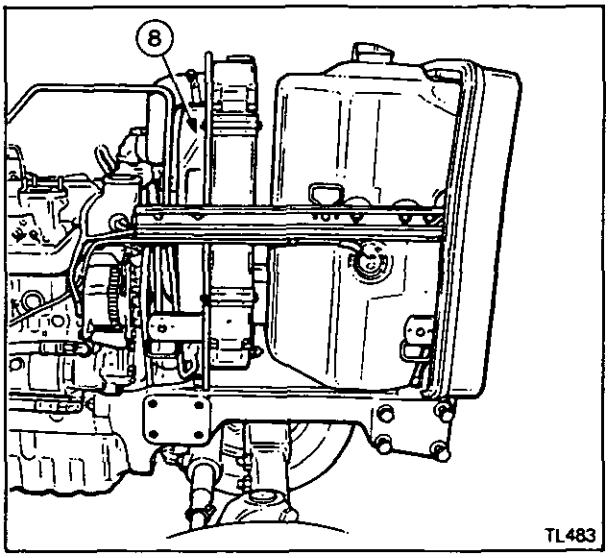
Removal and Refitment 4A-02

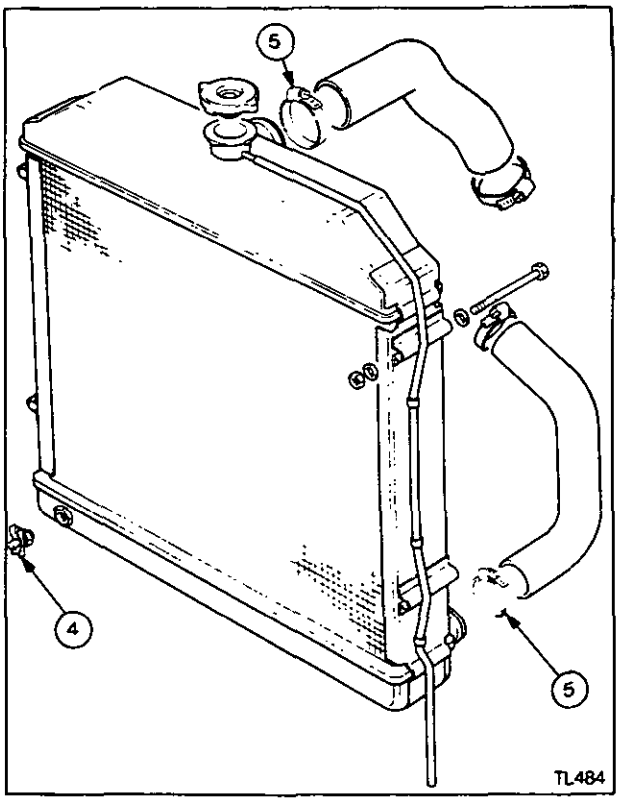
Removal

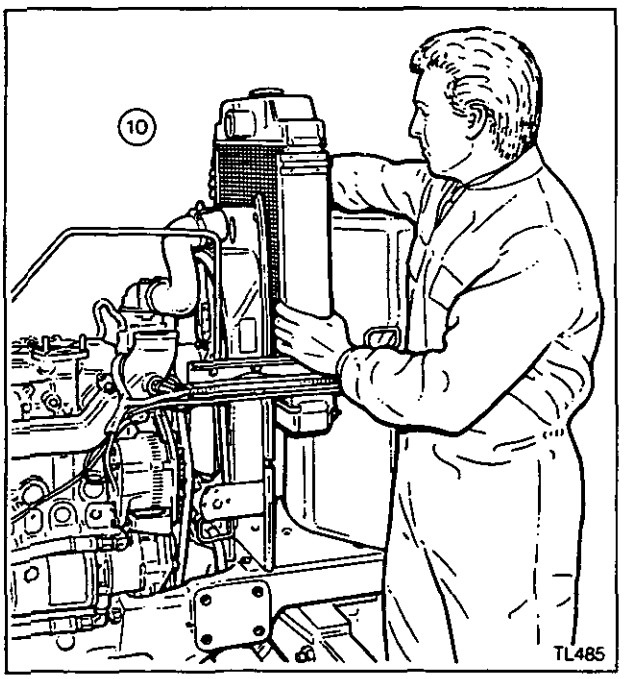
1. Remove the jubilee clip and centrifugal pre-cleaner.
2. Remove the bonnet, complete with the silencer, exhaust pipe and air cleaner.
3. Remove both lower side panels.
4. Drain the radiator. (Ensure a suitable size container is available.)
5. Disconnect the top and bottom hoses.
6. Disconnect the oil cooler supply and return pipes, if fitted.
7. Remove the oil cooler and plug the pipes.
8. Unscrew and place the fan shroud over the water pump.
9. Remove the four radiator securing bolts.
10. Lift the radiator up and out between the fuel tank and the fan shroud.

Refitment

11. Reverse procedures 1 to 10.
12. Refill the radiator with the original solution of water and anti-freeze or with a new solution. Always use M-F Anti-Freeze.







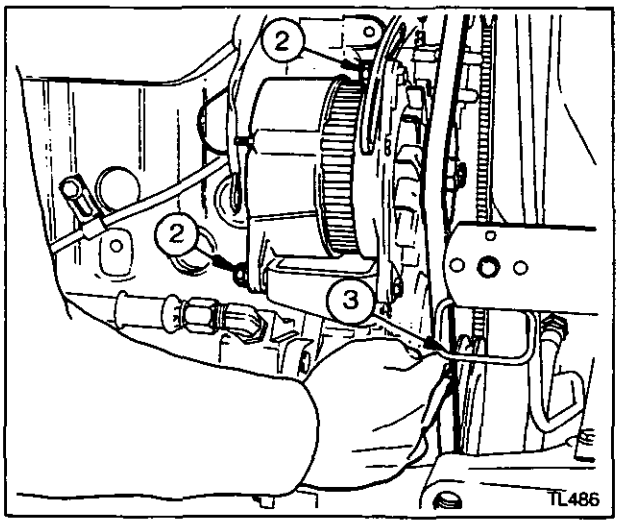
Fan Belt

Adjust 4A-03

Adjust

1. Remove the right-hand bonnet lower side panel.
2. Slacken the nuts and bolts on the alternator securing bracket.
3. Set the fan belt deflection between the crankshaft and alternator pulleys to 19 mm (0.75 in) for M-F 350 to 398 tractors and 10 mm (0.375 in) for M-F 399 tractors.
4. Retighten the alternator securing nuts and bolts to the bracket.
5. Replace the lower side panel.

Note: On M-F 399 the fan belts are fitted in pairs. If one belt is worn a new pair of belts should be fitted.



FUEL AND AIR SYSTEM

INDEX

AIR SYSTEM

Section 5 – Part A

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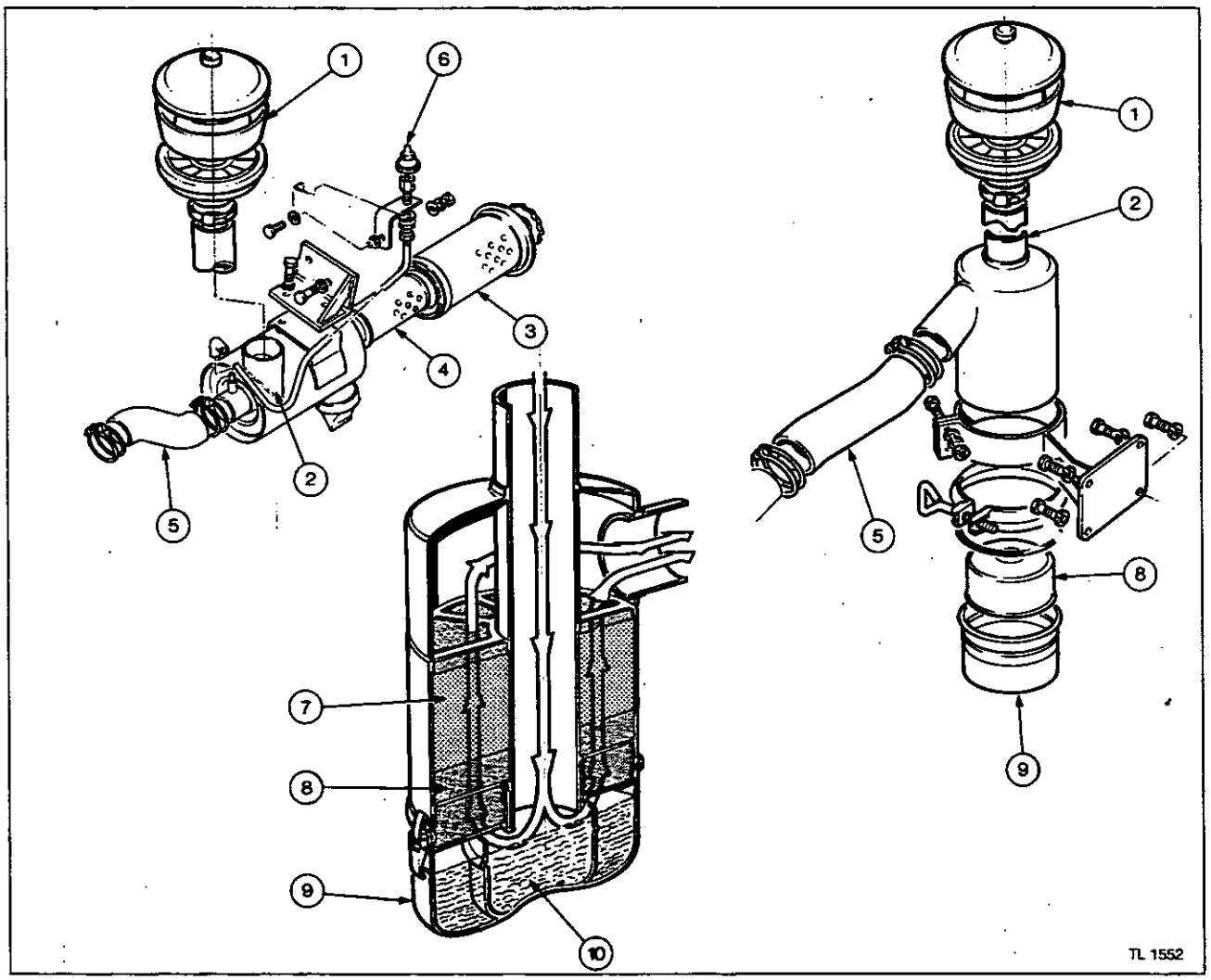


1. Pre-cleaner
2. Intake pipe
3. Main filter element
4. Safety filter element
5. Pipe to engine inlet manifold
6. Filter restriction indicator
7. Filter gauze
8. Removable filter gauze
9. Oil bowl
10. Lubricating oil

GENERAL DESCRIPTION

The air intake system consists of a pre-cleaner and a dry type air cleaner with a safety element or an oil bath type air cleaner in place of the dry type.

The air pre-cleaner uses the centrifugal principle, forcing intake air into a circular motion. Larger particles of dirt are flung out and collected in a detachable transparent dust bowl.

Dry air cleaner

Under the influence of the suction generated by the engine, the intake air flows through the intake pipe from the pre-cleaner into the cleaner body. The air passes through the main filter element and a safety element before being sucked in by the engine.

A restriction indicator switch, in conjunction with an air cleaner indicator light located in the instrument cluster, shows when the air cleaner element requires cleaning.

The main element may be washed up to a maximum of six times. ***The safety element must not be washed.***

Oil bath air cleaner

Air is drawn into the cleaner from the pre-cleaner down the central tube into the removable base. The base of the cleaner is fitted with lubricating oil to collect and retain the dirt. The change in direction that the air has to make to pass up through the filter gauze causes the heavy particles of dust and dirt to fall out into the oil.

The lower section of the gauze filter is removable for cleaning.

Cleaned air, after passing through the filter, is sucked in by the engine through the intake manifold. No restriction indicator is fitted to this type of cleaner.

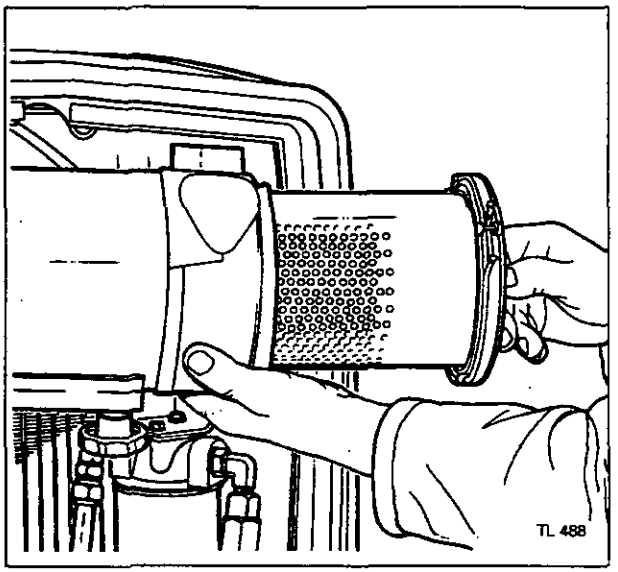
Dry Air Cleaner

Servicing 5A–01

Procedure

3 cylinder engine tractors

1. Disconnect the headlights and remove the front grille.
2. Loosen the hand knob and swing out the air cleaner for access.



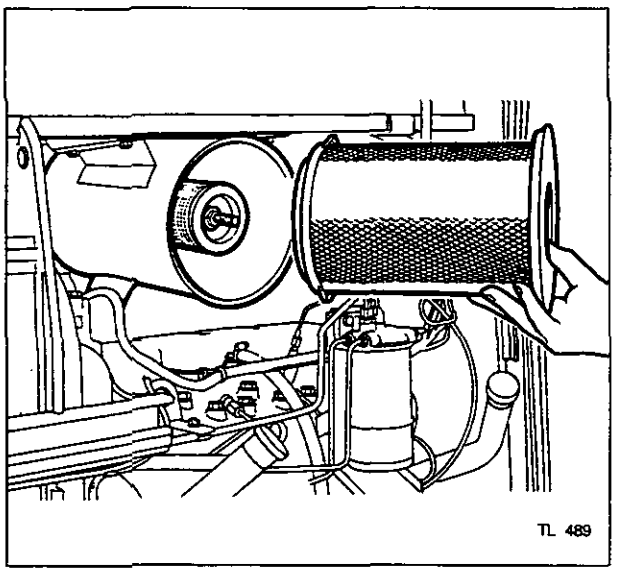
4 & 6 cylinder engine tractors

1. Raise the left-hand bonnet side panel.
2. Clip the bonnet in position.

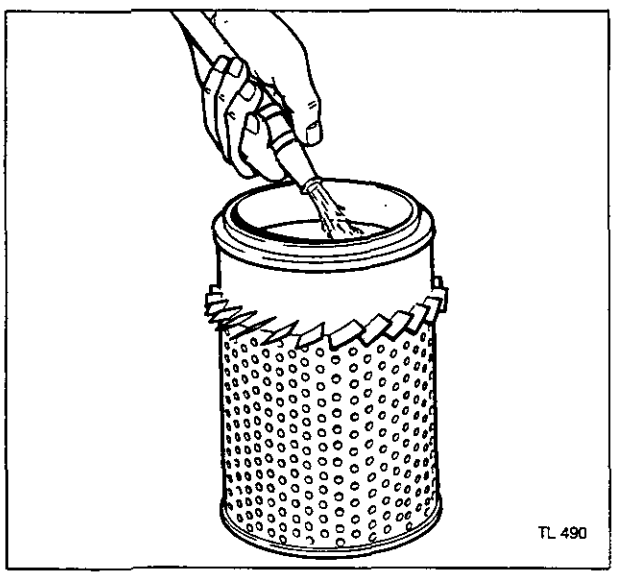
All models

3. Remove the retaining screw, then carefully slide out the main element.

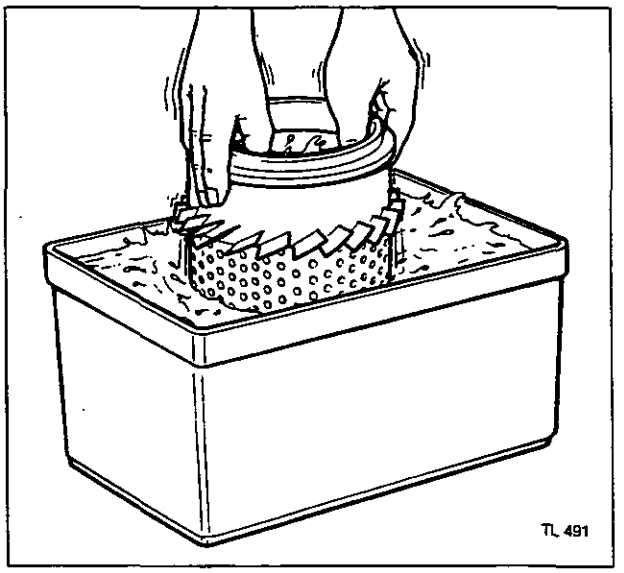
NOTE: Damaged elements must not be washed and reused. DO NOT attempt to clean the inner SAFETY element.



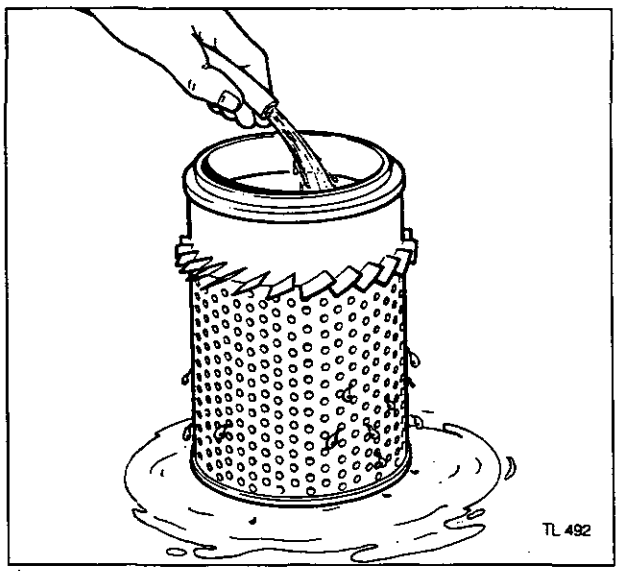
4. Remove all the loose dirt from the element with compressed air or water:
   a. Compressed air at 7 bar (100 lbf in^2) maximum with the nozzle held at least 25 mm (1 in) away from the element.
   b. Water hose at 3 bar (40 lbf in^2) maximum without a nozzle.
5. Mix 30g (1 oz) (2 tablespoons) of automatic washing machine detergent per 10 litre (2 gal) (2.5 US gal) of water (approximately half a cup per 16 litre (6 gal) (7US gal). Stronger solution costs more and is not needed.
6. Soak the element in the solution for 15 minutes. Do not soak for more than 24 hours.



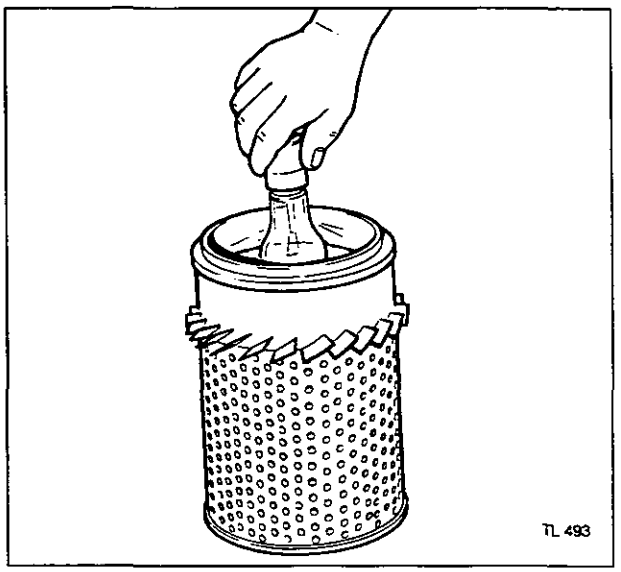
7. Swish the element around in the solution to help remove the dirt.



8. Rinse the element from the 'clean' side to the 'dirty' side with a gentle stream of water (less than 3 bar (40 lbf in^2)) to remove all the suds and dirt. If the clean side *has been contaminated with dirty water during the* soak cycle, rinsing from both sides will be necessary.
9. Dry the element before reuse. Warm air must be circulated at less than 70^{0}C (160^{0}F). DO NOT use a light bulb to dry the element. The element can be dried in an electric oven.



10. Inspect the element for holes or tears by looking through it towards a bright light. Check for damaged gaskets or dented metal parts. DO NOT reuse a damaged element.
11. Protect the element from dust and damage during drying and storage.
12. Before refitting the element, wipe out the air cleaner body with a damp cloth to remove any loose dust.
13. Slide the cleaned element back into place and secure with the retaining screw.
14. If the warning light comes on after a very short interval of working, the main element is unfit for service and must be replaced.
    However, if after replacement of the main element, the warning light stays on, the safety element must also be replaced - DO NOT attempt to clean it.
15. The inner safety element must be changed every three main element changes.
16. Change the elements after six washings or when damage or inefficiency becomes apparent.



NOTE:

- **Always keep at least one spare main element and inner safety element available ready for use to prevent excessive out of service time.**
- **Store the spare elements in a cool dry place and protect them from dust and damage.**
- **Mark the main element end plate after each washing – DO NOT wash the main element more than six times.**
- **DO NOT attempt to blow the main element clean using the tractor exhaust gases.**
- **Never add oil to the dry air cleaner.**
- **Never use petrol (gasoline), paraffin or cleaning solvents to clean the element.**

17. Replace the air cleaner element.

Oil Bath Air Cleaner

Servicing 5A–02

Procedure

3 cylinder engine tractors

1. Disconnect the headlights and remove the front grille for access.

4 & 6 cylinder engine tractors

1. Raise the left-hand bonnet side panel for access.

All models

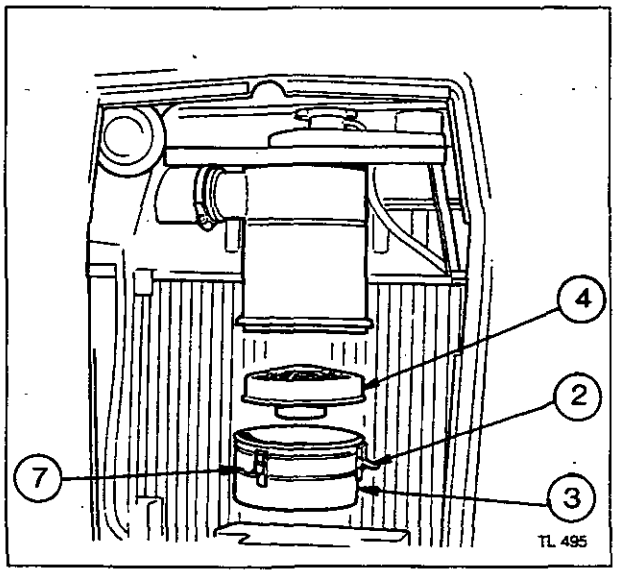
2. Release the three clamp fasteners.
3. Remove the bowl.
4. Remove the filter element.
5. Drain the bowl and carefully clean it.
6. Wash the element in paraffin or diesel fuel, and dry off.
7. Refill the bowl with clean engine oil to the level indicated but no higher.
8. Refit the element in the oil bath.
9. Refit the oil bath to the air cleaner, ensuring that the oil seal is correctly seated and the clamp fastener is properly engaged and secure.

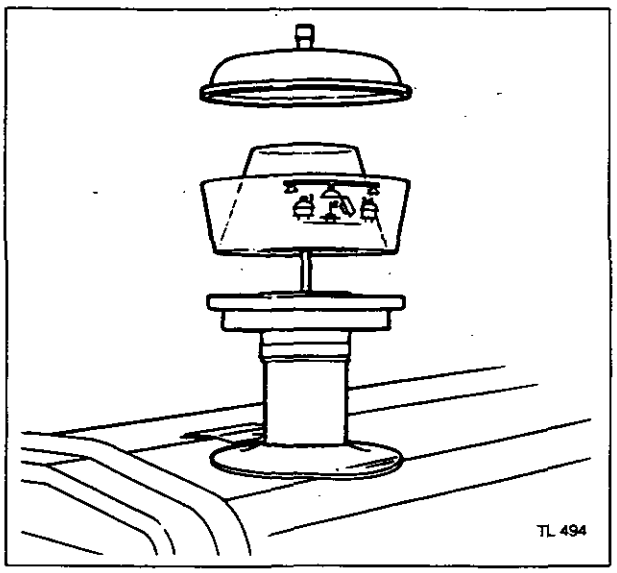
Air Pre-Cleaner

Servicing 5A–03

Procedure

1. Remove the central nut on the pre-cleaner and remove the top cover and bowl.
2. Clean out all dust and dirt and re-assemble.





FUEL SYSTEM

Section 5 – Part B

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5B–02
FUEL SYSTEM

Specification

Fuel tank capacities
- M-F 340, 350, 355, 360 ..... 68 litre (15 gal) (18 US gal)
- M-F 362 ..... 75 litre (16.5 gal) (19.8 US gal)
- M-F 365 to 398 ..... 108 litre (24 gal) (28½ US gal)
- M-F 399 and Hiline ..... 118 litre (26 gal) (31 US gal)

Hiline models with
air conditioning ..... 114 litre (25 gal) (30 US gal)

General Description

The fuel tank is located over the engine on tractors with 3 cylinder engines and in front of the radiator, between the front grille and two side panels on 4 and 6 cylinder engines.

The fuel tanks are fitted with a fuel gauge sending unit attached to the top of the tank on 3 cylinder engines and on the right-hand side on 4 and 6 cylinder engines.

The fuel filler cap is vented for safety.

The fuel transfer pump is a diaphragm-type pump, driven by the engine camshaft and attached to the right-hand side of the engine.

The pump can be manualy operated, eg for removing air from the fuel system. Fuel is fed from the fuel tank through either a single of dual filter to the fuel injection pump.

The fuel filter(s) are equipped with a water trap below the filter element. A water drain plug is provided to drain off any water or sediment.

Tractors are equipped with "Thermostart" starting aid. Pressurised fuel is taken off the fuel filter to the burner located in the intake manifold through a fuel line. A filament inside the burner receives current from the battery and a heat-sensitive valve which opens during the cold starting procedure. The thermostart is controled by the key start switch when turned to the cold start or pre-heat position. By turning the key switch to the cold start position, the filament is heated, which, in turn, ignites the fuel, thus providing the engine with preheated air for easier starting.

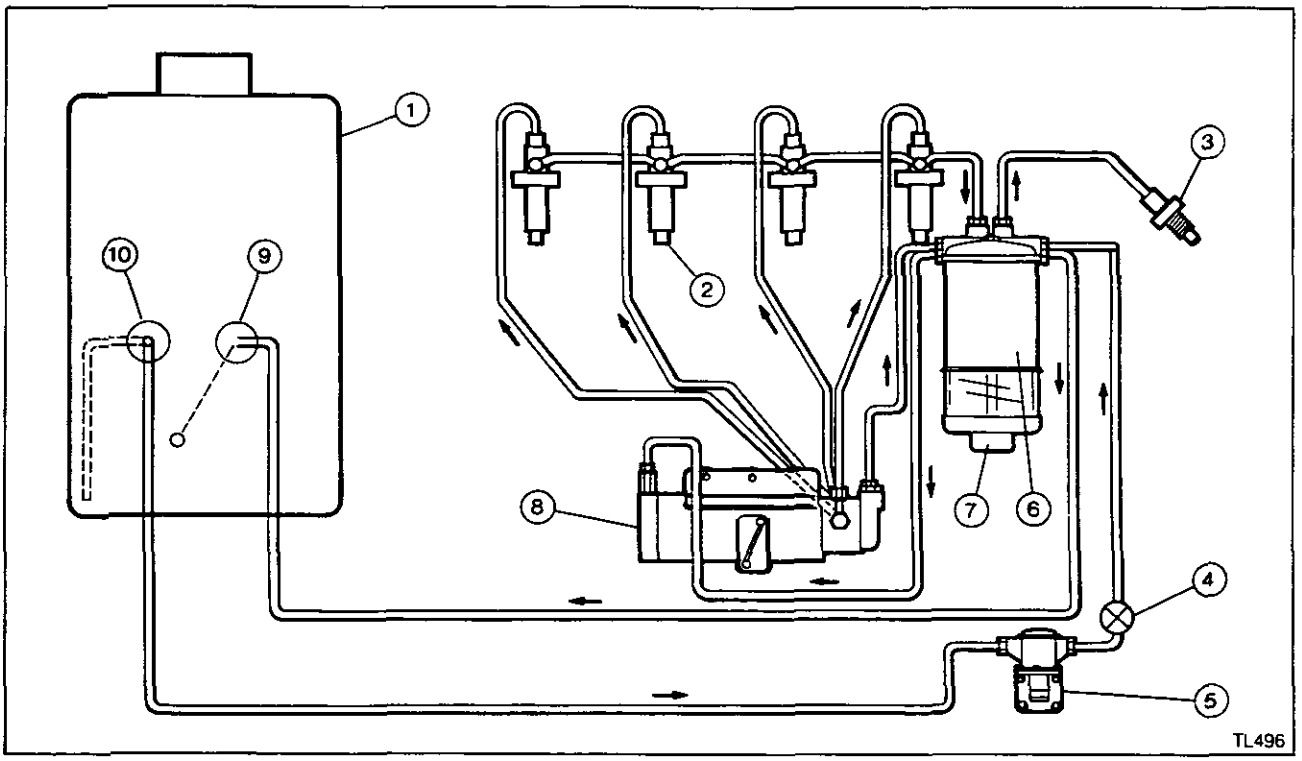
The desired speed is selected by means of a hand or foot throttle. The position of these levers controls, through the governor on the fuel injection pump, the amount of fuel being injected into the cylinders.

The hand throttle shaft is self-locking. Two spring-loaded friction discs keep the hand lever in the position selected.

Flexible control cables are used to convey the movement of the hand and foot throttle to the fuel injection pump.

With engine running at slow idle speed, the slow idle stop screw contacts the control lever. When the hand throttle is turned in a clockwise direction to its stop the engine speed is increased to its maximum.

The engine is stopped by means of a shut-off cable. One end of the cable is connected to the fuel injection pump stop lever, the other to a red knob on the tractor instrument panel.



1. Fuel tank
2. Fuel injectors
3. Thermostart
4. Fuel tap
5. Transfer pump
6. Fuel filter
7. Water trap
8. Fuel injection pump
9. Fuel tank sending unit
10. Fuel suction pipe

Fuel system 4 cylinder engine

Fuel Tank 3 Cylinder Engines

Removal and Refitment

Removal

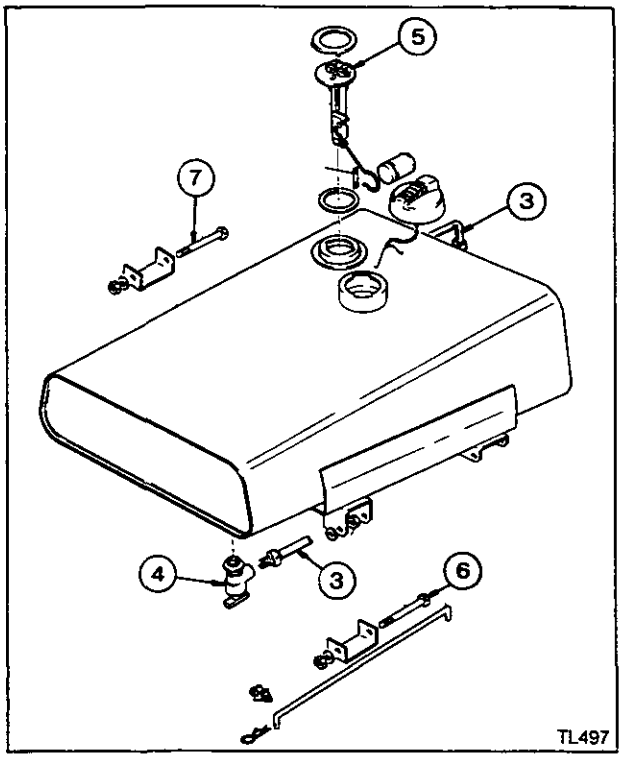
1. Loosen the jubilee clip and remove the centrifugal pre-cleaner.
2. Remove the bonnet.
3. Disconnect the two fuel lines.
4. Drain the fuel tank at the fuel tap.

Note: A container of 68 litre (15 gal) (18 US gal) maximum is required, if full.

5. Disconnect the tank sender unit. (Mark the three wires to assist refitment.)
6. Remove the nuts and bolts securing the left side of the fuel tank.
7. Remove the remaining nuts and bolts securing the fuel tank.
8. Lift the fuel tank away.

Refitment

9. Reverse procedures 1 to 8.
10. Refill the tank.



Fuel Tank 4 and 6 Cylinder Engines

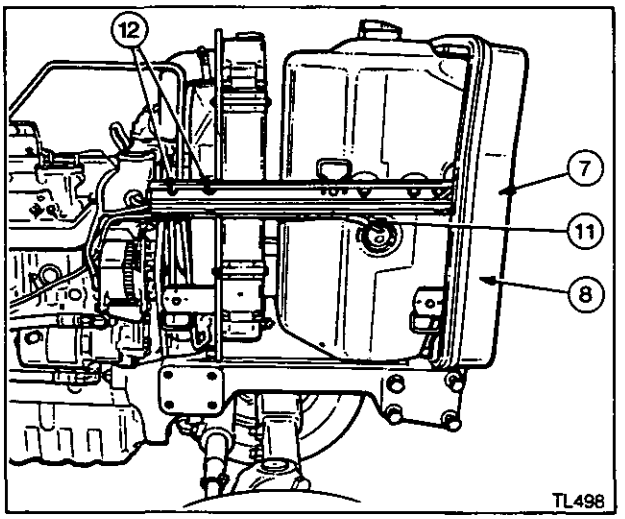
Removal and Refitment 5B-02

Removal

1. Remove the front weights.
2. Remove the front weight frame.
3. Remove the bonnet, complete with exhaust pipe and air cleaner.
4. Disconnect the headlights.
5. Remove the grille.
6. Remove the side panels.
7. Disconnect both side support rails at the front.
8. Remove the nose.
9. Disconnect the fuel sender unit. (Mark the three wires to assist refitment.)
10. Drain the tank using an electric pump.

Note: A container of 108/126 litres (24/28 gal) (28/33 US gal), depending upon model, is required, if full.

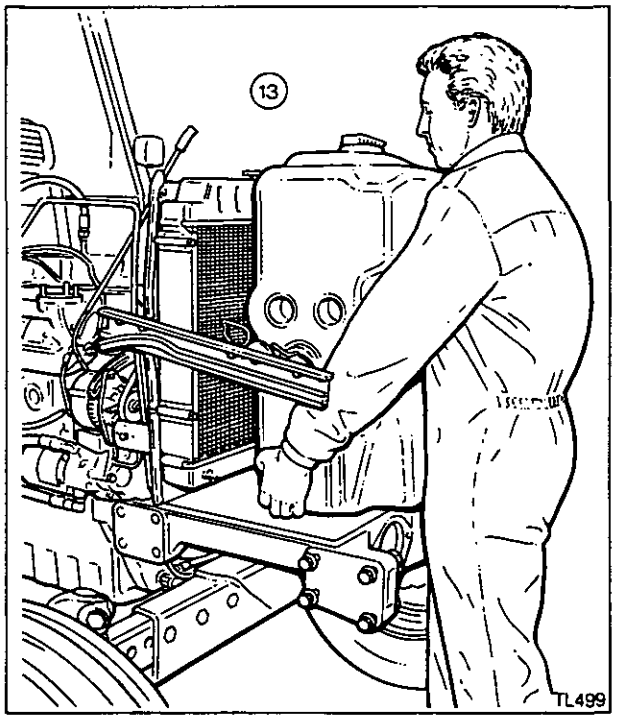
11. Disconnect the fuel lines.
12. Slacken the right-hand side rail at the rear to disengage the rubber mounts side rail to tank.



13. Remove the fuel tank.

Refitment

14. Reverse procedures 1 to 13 except: When refitting the fuel tank, ensure that the top of the front support casting and the bottom of the tank are clean.
15. Refill the fuel tank.



Fuel Gauge Sender Unit 3 Cylinder Engines

Removal and Refitment 5B-03

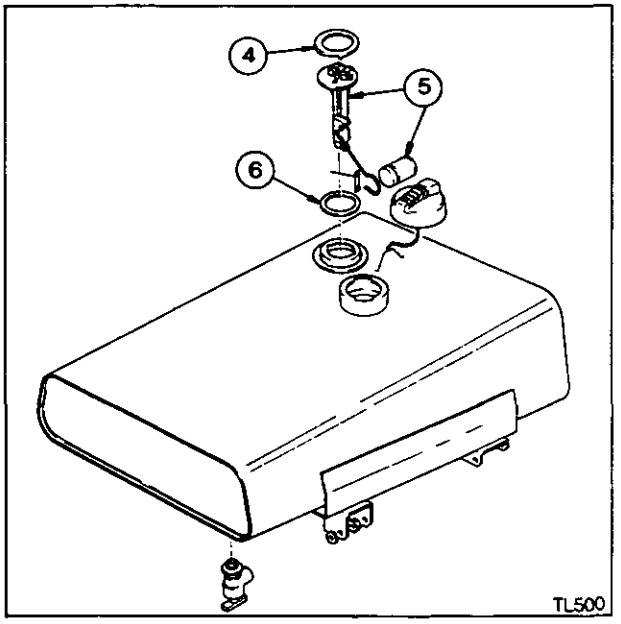
Removal

1. Remove the centrifugal pre-cleaner.
2. Remove the bonnet.
3. Disconnect the sender unit wires. (Mark the wires to assist refitment.)
4. Rotate the securing ring anti-clockwise until it comes free.
5. Lift out the sender unit and float.

Refitment

6. Reverse procedures 1 to 5.

Note: Ensure when refitting the fuel tank sender unit that a new rubber seal is used.



Fuel Gauge Sender Unit 4 and 6 Cylinder Engines

Removal and Refitment 5B-04

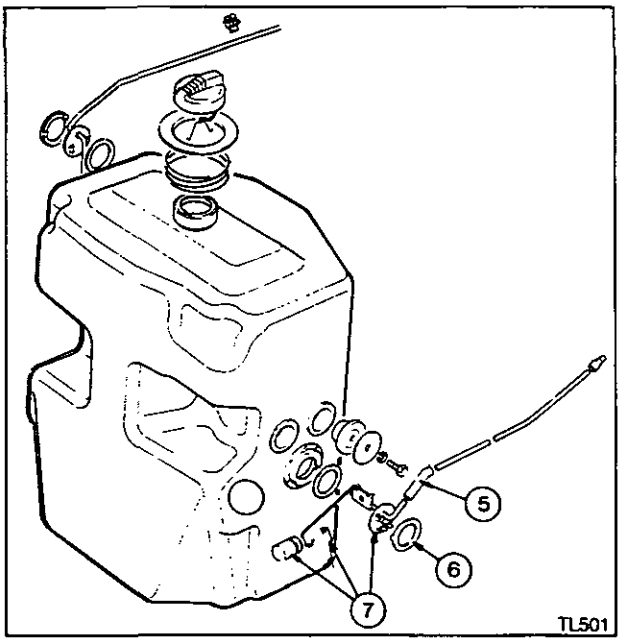
Removal

1. Raise the left hand bonnet side panel.
2. Remove the left hand lower side panel.
3. Drain the tank to below the sender unit using an electric pump.
4. Disconnect the sender unit wires. (Mark the wires to assist refitment.)
5. Disconnect the fuel line.
6. Rotate the securing ring anti-clockwise until it comes free.
7. Withdraw the sender unit and float.

Refitment

8. Reverse procedures 1 to 7.

Note: Ensure, when refitting the fuel tank sender unit, that a new rubber seal is used.



Throttle Control Cables

Removal and Refitment 5B-05

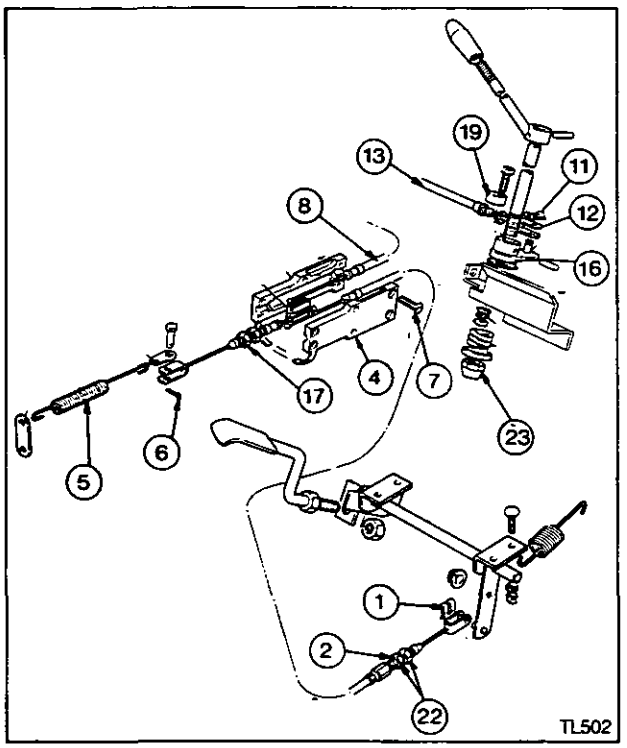
Removal

Foot Throttle Cable

1. Disconnect the throttle control cable at the foot control mechanism by under the right-hand fool plate by removing the spring clip.
2. Unscrew the adjusting nut and remove the cable from the bracket.
3. Pull the cable through from the left-hand side of the engine.
4. Remove the foot and hand throttle junction box from its bracket on the left-hand side of the engine.
5. Disconnect the spring on the fuel injection pump.
6. Remove the split pin and disconnect the control cable to the fuel injection pump.
7. Remove the four screws retaining the two halves of the junction box.
8. Split the junction box and remove the foot throttle control cable.

Hand Throttle Cable

9. Remove the instrument lower panel.
10. Disconnect the horn push and other switches, if fitted.
11. Remove the clip securing the cable end to the hand lever.
12. Remove the clevis from the pin and the cable from its retaining bracket.
13. Pull the cable through from the instrument panel side.



Refitment

Foot Throttle Cable

14. Reverse removal procedures 1 to 8.

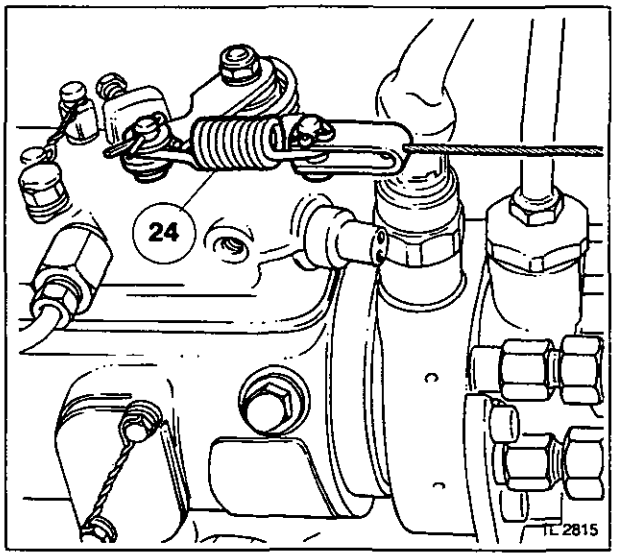
Hand Throttle Cable

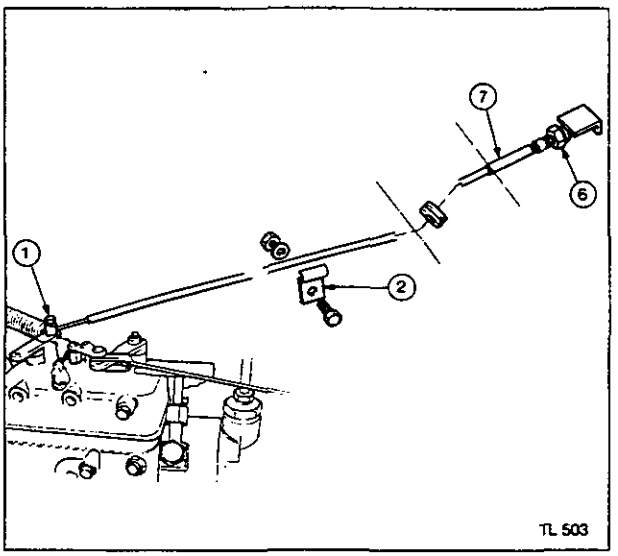
15. Reverse removal procedures 9 to 13 and 4 to 8.

NOTE: When fitting a new cable, ensure that there are no sharp bends.

Adjustment of cables

16. Open the hand throttle until the lever contacts the steering column.
17. Adjust the fuel pump operating cable until the pump lever contacts its maximum engine speed stop.
18. Close the hand throttle until the fuel pump lever contacts its minimum engine speed stop.
19. Slacken the bolt and adjust the minimum stop cam against the throttle lever (16).
20. Set the hand throttle in its maximum position.
21. Depress the foot pedal to its maximum down position.
22. Adjust the foot throttle cable with the two adjusting nuts.
23. Adjust the hand throttle lever friction by the self locking nut.
24. The illustration shows the later arrangement of connecting the throttle cable to the fuel pump with a spring. This was introduced in March 1994 and should be incorporated onto early tractors to prevent cable breakage.





Fuel Cut–off Cable – Stop Control

Removal and Refitment	5B–06

Removal

1. Loosen the securing screw on the fuel cut0off lever on top of the fuel injection pump.
2. Release the cable from its clamping bracket.
3. Pull the cable away from the fuel pump.
4. Remove the instrument side panels.
5. Remove the lower instrument panel to gain access to the nut behind the knob.
6. Remove the securing nut at the rear of the 'Pull to Stop' knob.
7. Pull the cable through from the instrument panel end.

Refitment

8. Reverse procedures 1 to 7 except:
   a. Loosen the securing screw and move the fuel shut-off lever to the 'ON' position. Retighten the screw.
   b. Start the engine and operate the fuel cut-off control cable to ensure the correct setting has been made and the engine stops.

Fuel Filters

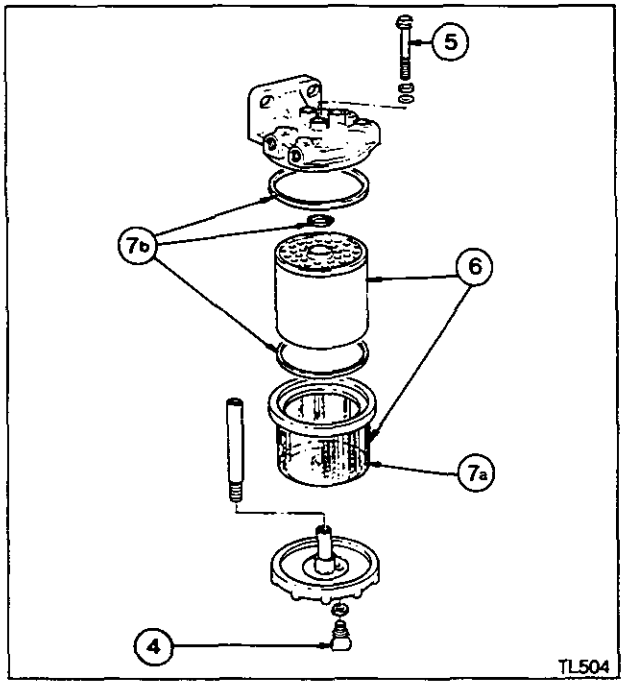
Servicing 5B-07

Procedure

1. Raise the left-hand bonnet side panel (on 3 cylinder models remove the bonnet).
2. Turn off the fuel supply at the tap next to the fuel lift pump.
3. Clean the outside of the filter assembly.
4. Drain the filter by unscrewing the drain plug.
5. Remove the centre bolt.
6. Remove the element and the bowl from the head and discard the element.

Note: On 6 cylinder models there are two filters.

7. Reverse procedures 1 to 6 except:
   a. Before putting a new element into position, clean the filter top and the sediment bowl.
   b. Ensure that the rubber joints are in good condition. If not, replace with new joints.
   c. Always fit a new element.
   d. Remove the air from the fuel system.



CLUTCHES

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CLUTCH

Section 6 – Part A

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6A–02
CLUTCH

Specification

Dual Clutch

Models Applicable ..... M-F 350, 355, 360, 365, 375, 383 and 390
Clutch diameter
- Primary plate ..... 305 mm (12 in)
- Secondary plate ..... 254 mm (10 in)

Clutch disc thickness
- Primary plate ..... 9,22 mm (0.363 in)
- Wear tolerance ..... 2,50 mm (0.098 in)

Secondary plate ..... 8 mm (0.315 in)
Wear tolerance ..... 2 mm (0.079 in)

Primary pressure plate coil springs:	*Quantity*	*Colour-Code*	*Clamp-Load*
M-F 340, 350	6	Red	442 kg (975 lb)
M-F 355	9	Green	749 kg (1650 lb)
M-F 360, 362	9	Green	749 kg (1650 lb)
M-F365	9	Green	749 kg (1650 lb)
M-F375	9	Green	749 kg (1650 lb)
M-F383	12	Red	885 kg (1950 lb)
M-F390	12	Red	885 kg (1950 lb)

Secondary pressure plate Belleville spring	*Colour-Code*	*Clamp-Load*
M-F 340, 350	Dark blue	568 kg (1250 lb)
M-F 355	Dark green	749 kg (1650 lb)
M-F 360, 362	Dark green	749 kg (1650 lb)
M-F365	Dark green	749 kg (1650 lb)
M-F375	Dark green	749 kg (1650 lb)
M-F383	Orange	749 kg (1950 lb)
M-F390	Orange	885 kg (1950 lb)

Release lever height
305 mm (12 in) clutch ..... 82,31-82,55 mm (3.25-3.28 in)
PTO clutch adjustment
Stop bolt adjustment ..... 2 mm (0.079 in)

Split-Torque Clutch

Clutch diameter:
- M-F 340, 350 ..... 305 mm (12 in)
- M-F 355 ..... 305 mm (12 in)
- M-F 360, 362 ..... 305 mm (12 in)
- M-F 365 ..... 305 mm (12 in)
- M-F 375 ..... 305 mm (12 in)
- M-F 390 ..... 305 mm (12 in)
- M-F 390T and 398 ..... 330 mm (13 in)
- M-F 399 ..... 330 mm (13 in)

Clutch disc thickness:
- 305 mm (12 in) ..... 9,22 mm (0.363 in)
- Wear tolerance ..... 2,50 mm (0.098 in)
- 330 mm (13 in) ..... 9,22 mm (0.0363 in)
- Wear tolerance ..... 2,50 mm (0.098 in)

Primary pressure plate coil springs	*Quantity*	*Colour-Code*	*Clamp-Load*
M-F 340, 350	6	Red	442 kg (975 lb)
M-F 355	9	Green	749 kg (1650 lb)
M-F 360, 362	9	Green	749 kg (1650 lb)
M-F 365	9	Green	749 kg (1650 lb)
M-F 375	9	Green	749 kg (1650 lb)
M-F 390	12	Red	885 kg (1950 lb)
M-F 390T and 398	12	Green	998 kg (2200 lb)
M-F 399	12	Green	998 kg (2200 lb)
305 mm (12 in) five blade type cerametallic	9	Red	664 kg (1464 lb)
330 mm (13 in) five blade type cerametallic	12	Red	885 kg (1950 lb)

Release lever height:
- 305 mm (12 in) clutch ..... 82,31-82,55 mm (3.25-3.28 in)
- 330 mm (13 in) clutch ..... 118,92-120,22 mm (4.682-4.733 in)

All Models

Clutch pedal free travel – All models	20-25 mm (¾-1 in)
– M-F 383 and 390 dual clutch	10-15 mm (⅜-⅝ in)
Flywheel machining	
Maximum permissible	1 mm (0.040 in)

Recommended Lubricants for clutch splines

Make	*Type*
Shell	Retinax DX
Mobil	Mobiltemp 1
Fina	Bentex 3
Gulf	High Temperature Grease No 3
Esso	Unirex N3
Duckhams	Admax B3
Castrol	BNS
Caltex/Texaco	Thermatex EPZ
BP	Energrease HTB2 or B2
Total	Extemp or Coloris 3

Special tools

MF 159B	Clutch centraliser
MF 215	Clutch setting gauge
MF 314	Release lever height gauge 305 mm (12 in)
MF 446	Release lever height gauge 330 mm (13 in)

Bolt torques

Clutch cover to flywheel (12 in)	27-34 Nm (20-25 lbf ft)
Clutch cover to flywheel (13 in)	36-54 Nm (26-40 lbf ft)
Flywheel to engine	100-110 Nm (74-80 lbf ft)
PTO drive plate to clutch cover	34-41 Nm (25-30 lbf ft)
Gearbox to engine	75 Nm (55 lbf ft)

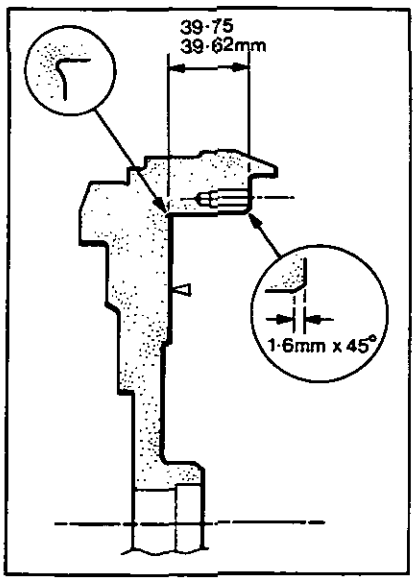


Fig. 1

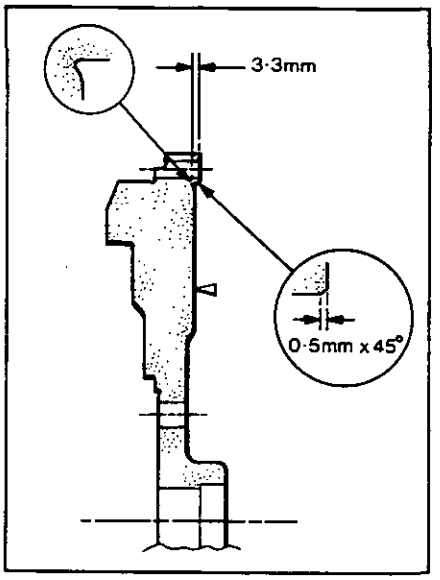


Fig. 2

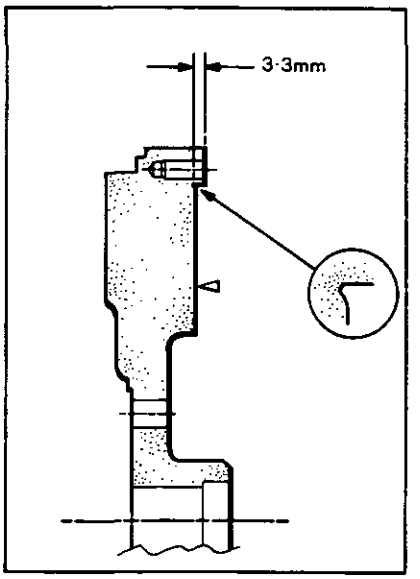


Fig. 3

Flywheel reclamation

The clutch surface of flywheels can be reclaimed by skimming in 0,25mm (0.010in) increments to a maximum of 1mm (0.040in) deep.

The ledge to which the clutch cover is bolted must also be skimmed to maintain the distance from the clutch face.

The following dimensions must always be maintained:

Figure 1, M-F 340 to 390 tractors with 305mm (12in) clutch, dual and split torque.

39, 75-39, 62mm (1.565–1.560in)

Figure 2, M-F 390T and 398 tractors with split torque 330mm (13in) clutch

3,3mm (0.130in)

Figure 3, M-F 399 tractors with split torque 330mm (13in) clutch.

3,3mm (0.130in)

Note: Never, under any cirumstance, attempt to skim either the clutch pressure plate or the false flywheel, as this will adversely affect the heat dissipating properties of these components.

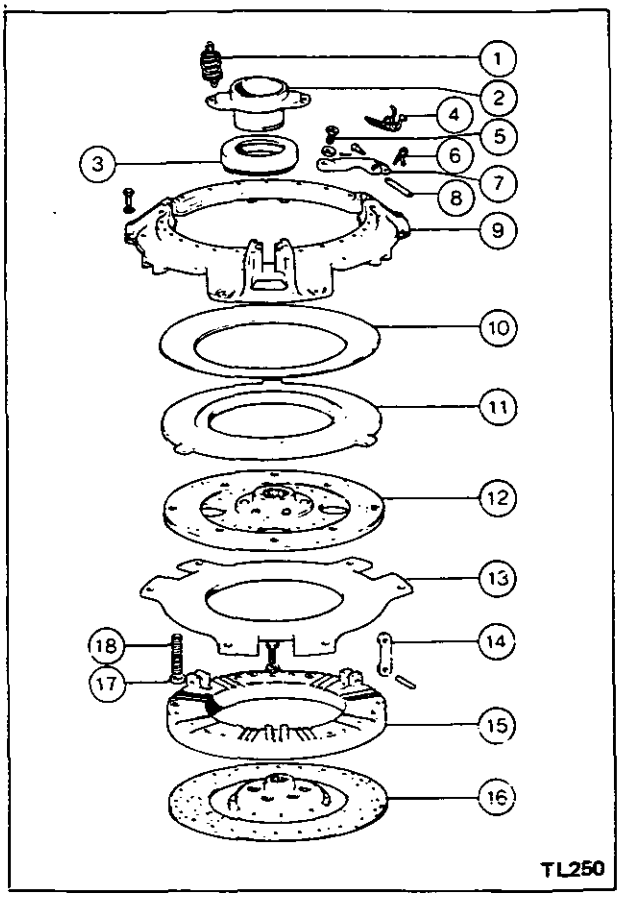
General Description

Dual Clutch – 305 mm (12 in)

The dual clutch enables the drive to the gearbox and rear wheels to be disconnected without interrupting the drive to the linkage pump and power take off which remains "live". The clutch second stage allows for disconnection of the drive to the PTO and hydraulics. During operation, the main friction disc (16) is held against the engine flywheel by the main pressure plate (15) under the force of twelve coil springs (18). The PTO friction disc (12) is held against a false flywheel (13) by the PTO pressure plate under the force of a Belleville spring disc (10).

Depressing the clutch pedal through its first stage of travel causes the release bearing to move three release levers pivot mounted to the clutch cover. Movement of these levers pulls the main pressure plate (15) rearwards against the force of coil springs and so disengages the drive from the main friction disc (16).

Depressing the clutch pedal into the second stage brings set-screws on the main pressure plate (15) into contact with the PTO pressure plate (11). Further pedal movement forces the PTO pressure plate (11) rearwards against the force of its Belleville spring and disengages the main drive from the PTO friction disc (12) to the pump and PTO.



Key to Illustration

1 Spring
2 Carrier
3 Bearing
4 Spring
5 Setscrew
6 Clip
7 Release Levers
8 Pin
9 Cover Plate
10 Belleville Spring Disc
11 PTO Pressure Plate
12 PTO Friction Disc
13 False Flywheel
14 Connecting Links
15 Main Pressure Plate
16 Main Friction Disc
17 Washer
18 Springs

General Description

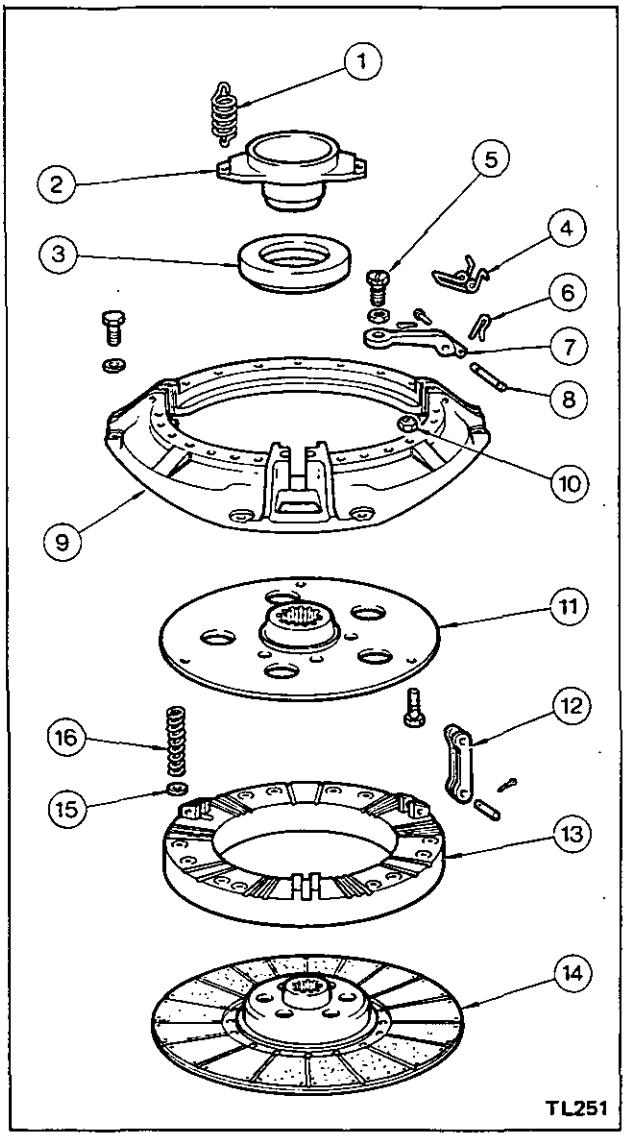
Split-Torque Clutch 305 mm (12 in) and 350 mm (13 in)

The split torque clutch differs from the dual clutch in that the drive to the Ferguson linkage pump and power take- off (PTO) is taken from the clutch cover and is always engaged when the engine is running. The clutch is therefore fitted to tractors with independent power take- off (IPTO) which employ a separate hydraulic clutch to engage or disengage the PTO. The drive to the gearbox and rear wheels is transmitted from either a 305 mm (12 in) or 330 mm (13 in) driven plate.

The friction disc (14) is operated by the pressure plate (13) against the flywheel. Pressure plate movement is obtained by three release levers (7), pivoted on the clutch cover plate (9). Release lever movement operating against the twelve coil springs (16) moves the pressure plate (13) rearwards and releases the friction disc (14). The clutch release levers (7) are operated by a release bearing (3) which is moved by the clutch pedal.

Key to Illustration

1 Spring
2 Carrier
3 Bearing
4 Spring
5 Screw
6 Retaining Clip
7 Levers
8 Pin
9 Cover Plate
10 Nut
11 PTO plate
12 Link
13 Pressure Plate
14 Friction Disc
15 Washer
16 Springs



Product changes

Spring centre main friction disc M-F350, 355, 360, 365, 375, 390 and 398

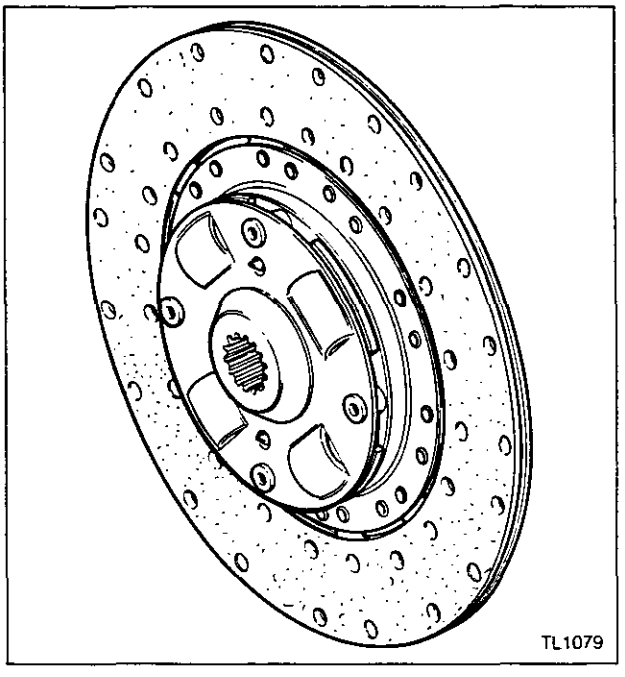
The main drive clutch on the above tractors has been progressively changed to a spring centre type friction plate (See illustration) in production during the period of May to December 1987. This has been done to provide torsional damping between the engine and transmission.

M-F 350, 355, and 360 tractors

At tractor serial number V16040 an interim version of the spring centre clutch cut-in, it had a friction plate similar to that used on the 330 mm (13 in) clutch but fitted with three springs. The pressure plate had its internal diameter increased to allow it to fit over the spring centre. The final version of the spring centre clutch friction plate will service the interim version.

On the interim version, if the pressure plate only is to be replaced, the friction plate must also be replaced with a later four spring type.

The final version of the clutch cut-in at tractor serial number V39421. This uses the new four spring type hub to provide damping and a modification to the original pressure plate.



(continued)

Product changes (continued)

M-F 365, 375, and 390 tractors

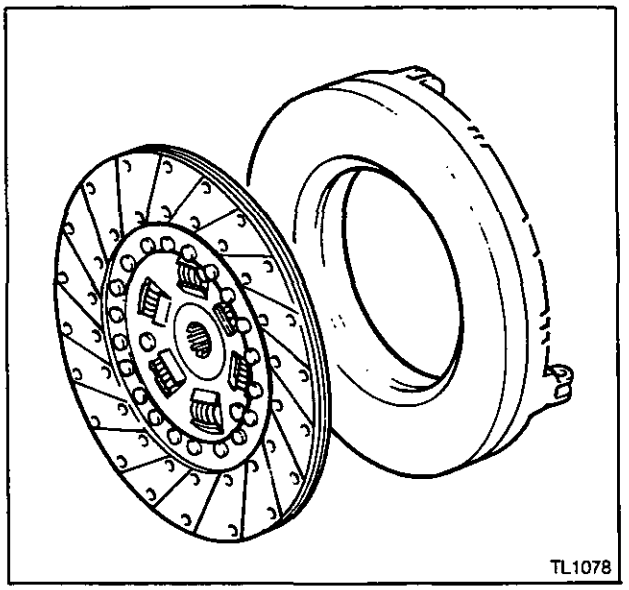
The spring centre friction plate for these tractors cut-in on 12 speed gearbox models only at serial number V46291.

The spring centre friction plate looks similar to the one fitted to the M-F 350, 355 and 360 tractors, although the springs in the hub are different. The plate has a dash of white paint on the spring housing to distinguish it from the M-F 350, 355 and 360 tractor version.

The machined-out pressure plate to take the spring centre friction plate was introduced from serial number V23100, therefore the later friction plate will fit without any need to change the pressure plate.

M-F 398 tractor

This tractor has had a spring centre clutch with a six spring hub fitted from serial number V14268. The clutch cover assembly which is fited with the new plate is the same cover assembly which has always been fitted to the M-F 399 tractor. (See illustration)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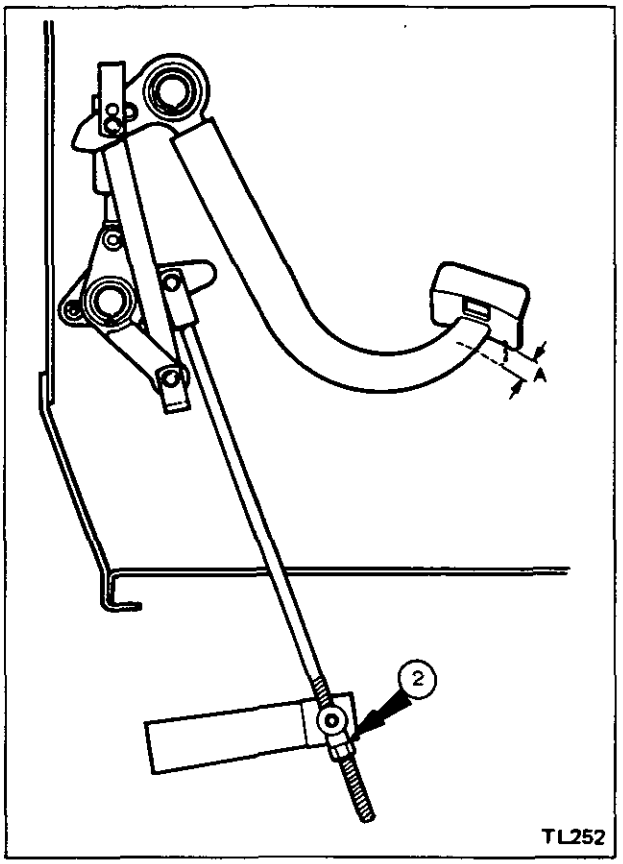
Fault Finding

SYMPTOM	CAUSE	REMEDY	REF
Clutch *not engaging*	Improper pedal adjustment	Adjust clutch pedal linkage	6A-01
	Damaged pressure plate in clutch cover	Replace defective part	6A-06 or 6A-08
	Friction plate hub binding on splined drive pinion	Clean up splines and smear with small quantity of a recommended grease	6A-05 or 6A-07
	Distorted friction plate broken facings on friction plate	Install new friction plate	6A-05 or 6A-07
	Dirt or foreign matter in clutch	Remove clutch from flywheel, clean and free off	6A-06 or 6A-08
Clutch slip	Oil or grease on friction plate	Install new friction plate	6A-05 or 6A-07
	Weak or soft pressure springs	Install new set of pressure springs	6A-06 or 6A-08
	Clutch pedal linkage sticking	Free bearings Grease with a recommended grease	6A-04
	Improper pedal adjustment preventing full engagement	Correct pedal adjustment	6A-01
	Clutch facing worn	Install new friction disc	6A-05 or 6A-07

Clutch Pedal

Adjust 6A-01

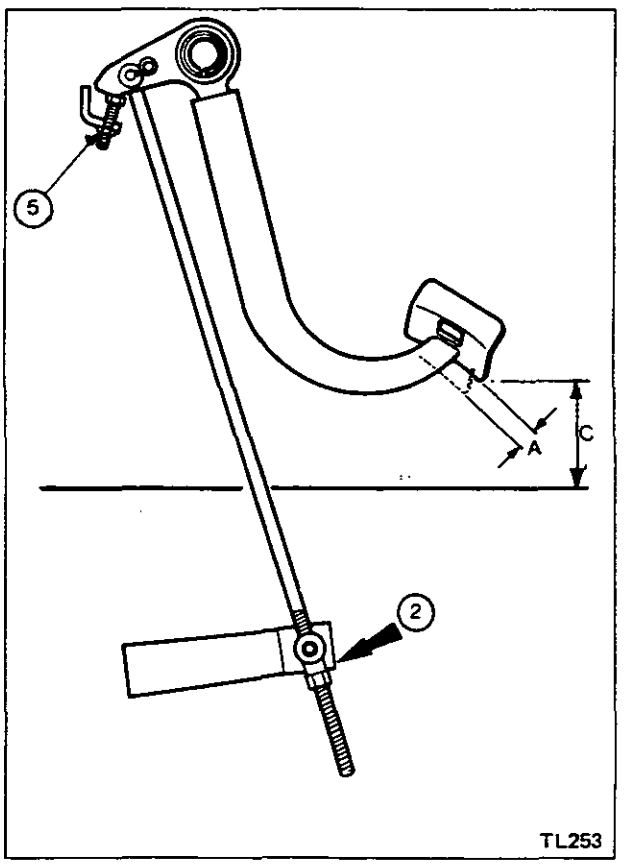
1. Press down the clutch pedal until the clutch release bearing contacts the clutch release fingers. This pedal clearance 'A' must be 20-25 mm (¾-1 in).
   On M-F 383 and 390 tractors with dual clutch and gas assistor cylinder, adjust to 10-15 mm (⅜-⅝ in).
2. To adjust the pedal clearance, turn the adjusting nut clockwise to reduce the clearance, anti-clockwise to increase the clearance.
3. Press the clutch pedal throughout its full travel a minimum of 5 times and recheck the pedal clearance. Re-adjust if necessary.



Clutch Pedal Height

4. This is a pre-set arrangement controlled by the main fixed link. The link has two position holes: (a) Lower hole 'A' for dual clutch (b) Upper hole 'B' for split-torque clutch. (See Operation 6A–02.)
5. For M-F350 (dual and split torque) set pedal height 'C' by rotating the stop bolt. Split Torque Clutch 120 mm (4.75 in) Dual Clutch 165 mm (6.50 in). On later tractors this adjustment was deleted.

Note: The type of clutch linkage illustrated opposite is fitted to the M-F350 tractor with dual or split torque clutches. It is fitted to M-F355, 360, 362, 365 and 375 tractor with split torque clutch only. All other models are fitted with the arrangement illustrated above.



CLUTCH

Clutch Pedal Linkage

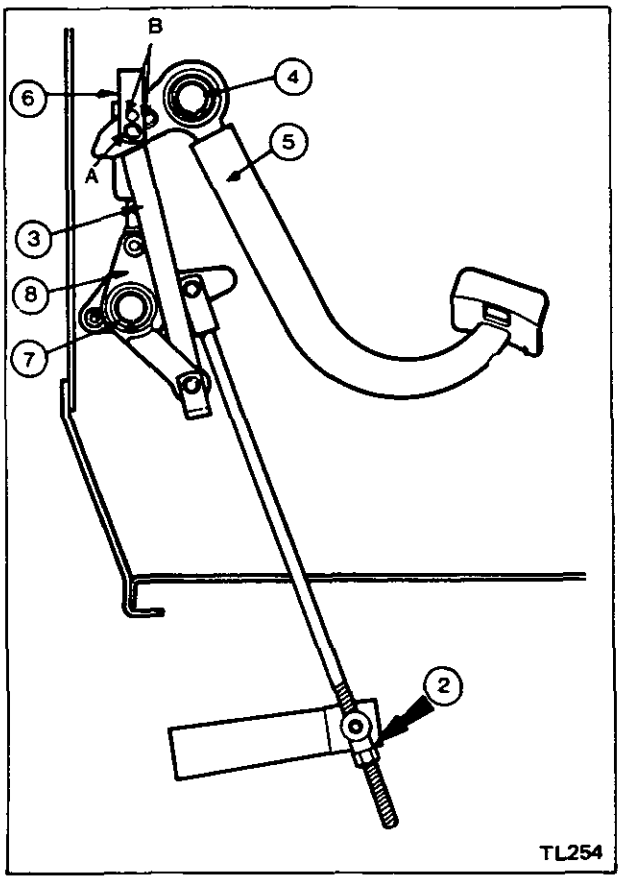
Removal and Refitment 6A-02

Removal

1. Remove the lower panel under the instrument panel to gain access to the clutch pedal shaft.
2. Slacken off the clutch pedal adjusting nut.
3. Remove the link between the pedal and bell-crank.
4. Remove the circlip from the end of the pedal shaft.
5. Withdraw the clutch pedal off the shaft.
6. Remove the upper split pin on the gas assister strut if fitted (M-F383 and M-F390 dual clutch only).
7. Remove the bell-crank pivot-shaft circlip.
8. Withdraw the bell-crank from the shaft, complete with the gas strut, links and rods.
9. Dismantle the bell-crank if necessary.
10. Inspect all parts, replace any if worn.

Refitment

11. Reverse procedures 1 to 10 except:
    a. Lubricate the pivot shafts with a Lithium-based grease.
    b. Ensure that the link between the bell-crank and the foot pedal is connected into the right hole: Position 'A' - Dual clutch Position 'B' – Split torque clutch.
    c. Ensure that the circlips are seated in their grooves.
12. Adjust the clutch pedal clearance, see operation 6A-01.



Clutch Release Bearing

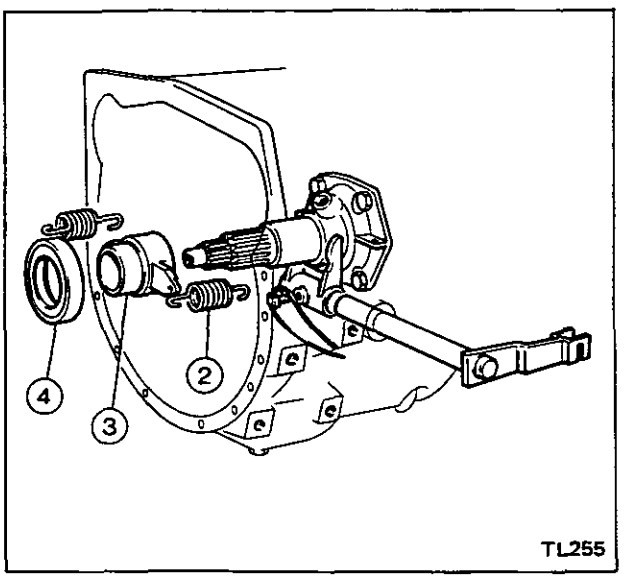
Removal and Refitment 6A-03

Removal

1. Split the tractor between the engine and gearbox, see section 2.
2. Release the two springs.
3. Remove the bearing and carrier assembly.
4. Drive the carrier from the bearing.

Refitment

5. Reverse procedures 1 to 4 except:
    a. Press a new bearing onto the carrier.
    b. Smear the input shaft splines and the release bearing carrier bore recess, with a Lithium-based grease.

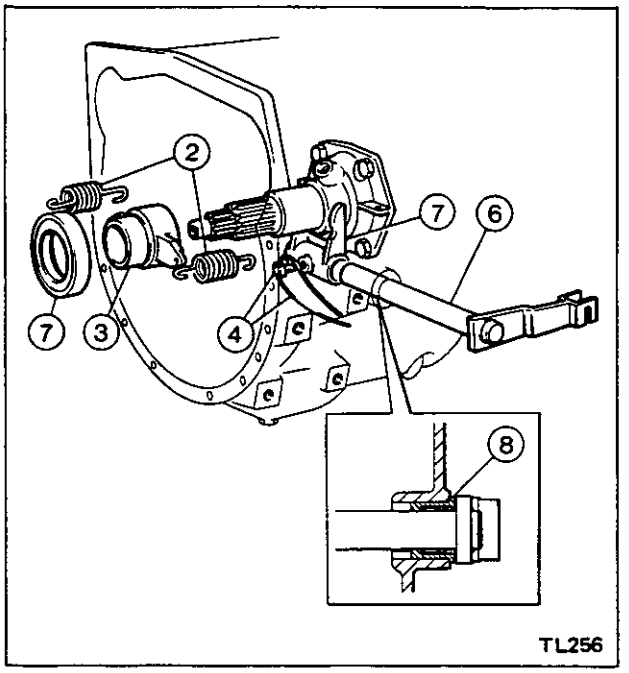


Clutch Release Mechanism

Removal and Refitment 6A-04

Removal

1. Split the tractor between the engine and gearbox, see section 2. On cab tractors, support the cab and remove the left-hand cab support bracket. On footstep tractors, remove the battery and battery box.
2. Remove the two springs.
3. Slide the carrier and release bearing off the input housing.
4. Remove the locking wire and the locking screw from the release fork.
5. Withdraw the clutch cross shaft from the gearbox casing.
6. Remove the clutch release fork.
7. Press the release bearing off the carrier.
8. If necessary remove the clutch cross shaft bearing and seal assemblies.



Refitment

9. Reverse procedures 1 to 8 except:
   a. Lubricate the input shaft splines, release bearing carrier bore and release shaft bearings with a Lithium-based grease.
   b. Ensure that the locking screw is located in the hole in the cross shaft.
   c. Adjust the clutch pedal clearance, see operation 6A-01.
   d. Apply Loctite 270 to clutch cross shaft bearing assemblies,if removed.
   e. Clutch release shaft seals are installed with inboard facing lip.

Dual Clutch Assembly

Removal and Refitment 6A-05

Special Tools:

MF 159B	*Clutch centraliser*
MF 215	*PTO clutch setting gauge*
MF 314	*Lever height setting gauge*

Caution: The following sequence of instructions must be followed carefully, as spring pressure will cause the clutch cover to fly apart if pressure is not released slowly and evenly.

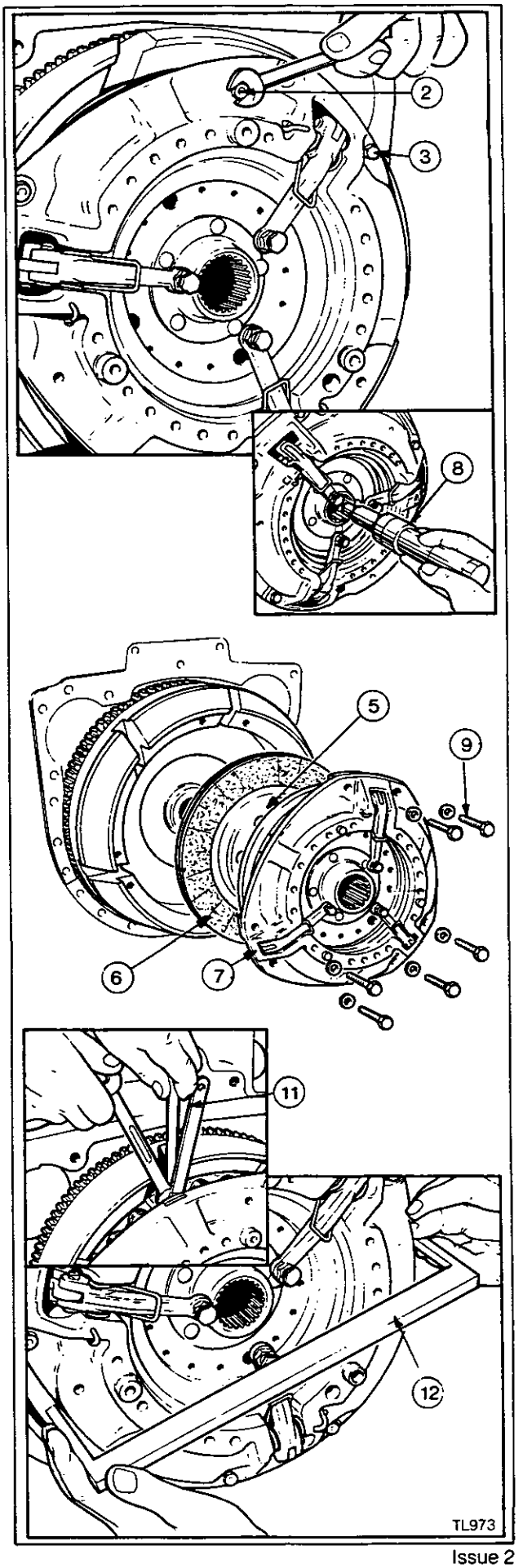
Removal

1. Split the tractor between the engine and the gearbox, see section 2.
2. Fit three slave bolts 1/4 UNC x 54 mm (2 1/8 in) to the three equi-spaced holes in the clutch cover.
3. Progressively slacken and remove the six bolts and washers.
4. Lift the clutch assembly clear of the flywheel. The main friction disc will remain separate from the clutch assembly.

Caution: The organic lining of the friction plate can contain asbestos. Use a face mask when cleaning the clutch and housing. DO NOT USE COMPRESSED AIR.

Refitment

5. Lightly smear the splines of the friction discs with a Bentone-based grease.
6. Locate the main friction disc in the flywheel.
7. Position the clutch assembly on the flywheel.
8. Using MF 159B, centralise the clutch and the main friction disc.
9. Refit the six bolts and washers. Torque to 27-34 Nm (20-25 lbf ft).
10. Remove the three slave bolts and then remove MF 159B.
11. Using MF 215, check the clearance between the PTO clutch adjusting setscrews and the PTO pressure plate. Adjust the setscrews as required to 2 mm (0.079 in). Re-tighten the locknuts.
12. Using MF 314, check the height of each release lever. The domed end of the release lever setscrew must just touch the gauge. Adjust the setscrews as required and re-tighten the locknuts.
13. Connect the engine to the rear half of the tractor, see section 2.
14. Adjust the clutch pedal free travel, see operation 6A-01.



Dual Clutch Assembly

Overhaul 6A-06

Special Tools:

MF 159B	*Clutch centraliser*
MF 215	*PTO clutch setting gauge*
MF 314	*Lever height setting gauge*
	Hydraulic press

Disassembly

1. Remove the clutch assembly, see operation 6A-05.
2. Mark all following components to permit their refitment in the same relative positions. Cover plate, PTO pressure plate, False flywheel, Main pressure plate.
3. Place the clutch assembly on a hydraulic press and locate a suitable bar on top of the cover.

Caution: Ensure that the clutch is located under the press correctly, that the bar will not slip and that the press has sufficient travel to allow the spring pressure to completely release. Release the pressure evenly and slowly.

4. Apply pressure until the three 1/4 UNC x 54 mm (2 1/8 in) slave bolts can be easily removed.
5. Remove the retaining clips from the pivot pins.
6. Remove the pivot pins.
7. Remove the lever springs.
8. Disconnect the release levers from the links.
9. Slowly release the pressure from the press until the springs are out of compression.
10. Lift off the cover plate.
11. Lift off the Belleville spring.
12. Lift off the PTO pressure plate.
13. Lift off the PTO friction disc.
14. Lift off the false flywheel.
15. Remove the springs and the fibre washers.
16. Remove the links.

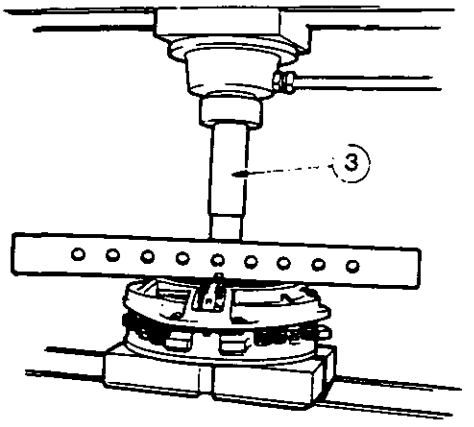
Examination

Inspect all components for wear, scoring, distortion, cracks, or signs of overheating. Check the coil springs for correct loading and pressure. Check condition of the Belleville springs.

If the tractor flywheel is scored, skimming is permissible in 0,254 mm (0.010 in) increments up to a maximum of 1,00 mm (0.040 in).

The ledge to which the clutch cover is bolted must be skimmed by the same amount to maintain the distance from the clutch face to 39,75 to 39,62 mm (1.565 to 1.560 in).

Note: Never, under any circumstances, skim either the false flywheel or the pressure plates as this will severely impair their heat dissipation characteristics.



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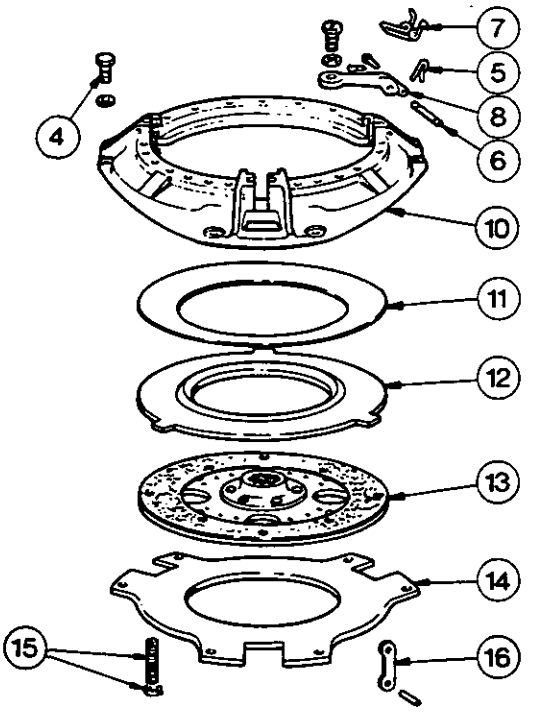

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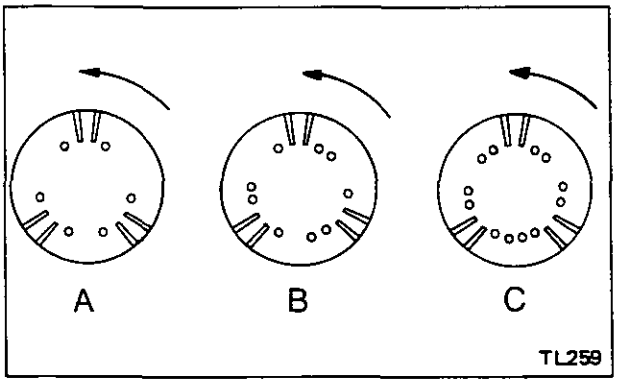
Reassembly

17. Reverse procedures 1 to 16 except: Fit new springs and fibre washers to the pressure plate as shown in the chart.

Model	No of Springs	Colour	Illustration
M-F 340	6	Red	A
M-F 350	6	Red	A
M-F 355	9	Green	B
M-F 360	9	Green	B
M-F 362	9	Green	B
M-F 365	9	Green	B
M-F 375	9	Green	B
M-F 383	12	Red	C
M-F 390	12	Red	C



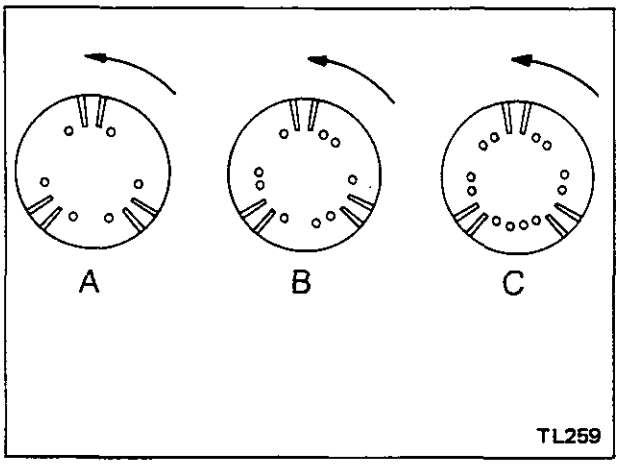
Tractors fitted with five blade type cerametallic friction plates, the nine red springs for a 305 mm (12 in) clutch are located as shown in illustration 'B'. On 330 mm (13 in) clutches the 12 red springs are located as shown in illustration 'C'.

Reassembly

14. Reverse procedures 1 to 13 except:
    a. Fit new springs and fibre washers.

Note: Fit springs (10) to the pressure plate as shown in the chart:

Model	No. of springs	Colour	Illustration
MF 350	6	Red	A
MF 355	9	Green	B
MF 360	9	Green	B
MF 365	9	Green	B
MF 375	9	Green	B
MF 390	12	Red	C
MF 390T	12	Green	C
MF 398	12	Green	C
MF 399	12	Green	C



Tractors fitted with five blade type cerametallic friction plates, the nine red springs for a 305 mm (12 in) clutch are located as shown in illustration 'B'. On 330 mm (13 in) clutches the 12 red springs are located as shown in illustration 'C'.

b. Refit the PTO plate (13) and torque the bolts to Nm 34-41 Nm (25-30 lbf ft).

Flywheel Pilot Bearing

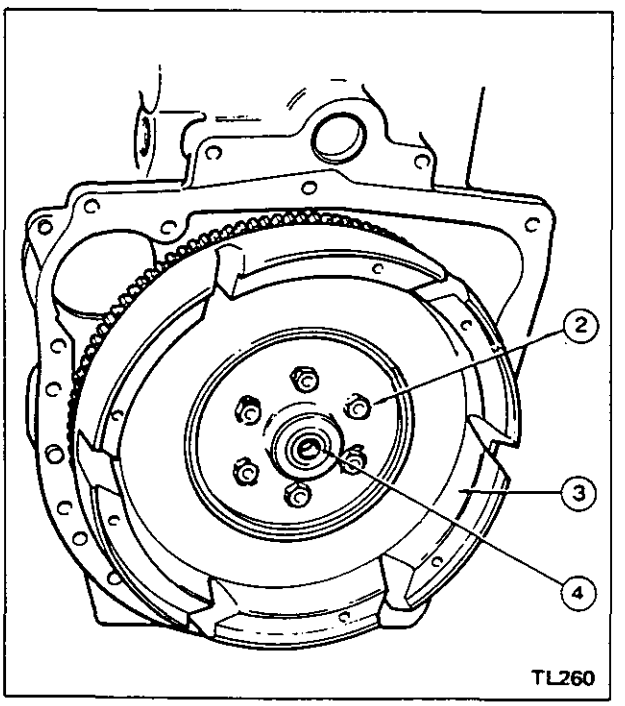
Removal and Refitment 6A-09

Removal

1. Remove the clutch assembly, see 6A-05 or 6A-07.
2. Remove the six bolts and washers.
3. Remove the flywheel.
4. Fill the pilot bearing bore with heavy grease, then insert a suitable length of 16,9 mm (0.668 in) diameter rod into the pilot bearing bore. Tap the rod sharply to hydraulically eject the bearing.

Refitment

5. Fit a new pilot bearing.
6. Locate the flywheel, aligning the untapped hole in the flange to the unused hole in the flywheel.
7. Fit the flywheel bolts, washers and torque to 100 Nm (75 lbf ft).
8. Refit the clutch.



Split Torque Clutch Assembly

Removal and refitment 6A-07

Special Tools:

MF159B	*Clutch centraliser*
MF314	*Lever height setting gauge*
MF446	*Lever height setting gauge*

Caution: The following sequence of instructions must be followed carefully, as spring pressure will cause the clutch cover to fly apart if pressure is not released slowly and evenly.

Removal

1. Split the tractor between the engine and the gearbox, see section 2.
2. Fit three slave bolts 1/4 UNC x 54 mm (2 1/8 in) to the three equi-spaced holes in the clutch cover.
3. Progressively slacken and remove the six bolts and washers.
4. Lift the clutch assembly clear of the flywheel. The main friction disc will remain separate from clutch assembly.

Caution: The organic lining of the friction plate can contain asbestos. Use a face mask when cleaning the clutch and housing. DO NOT USE COMPRESSED AIR.

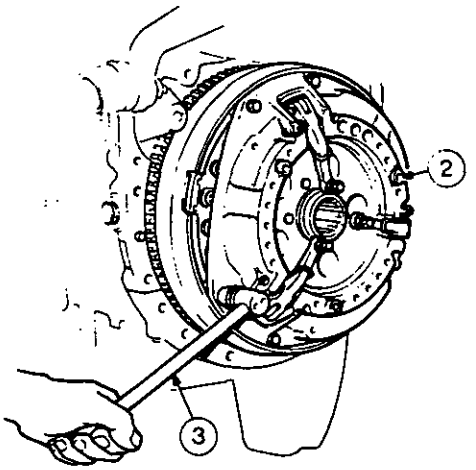
Refitment

5. Lightly smear the splines of the friction disc with a Bentone based grease.
6. Locate the main friction disc in the flywheel.
7. Position the clutch assembly onto the flywheel.
8. Using MF159B, centralise the clutch assembly and the friction disc.
9. Refit the six bolts and washers. Torque to 27-34 Nm (20-25 lbf ft).
10. Remove the three slave bolts and then remove MF159B.
11. Using the following release lever setting gauge check the adjustment of each release lever.

Tool No.	Tractor Model
M-F 314 M-F 446	M-F 340 to M-F 390 M-F 390T, 398, 399

The domed end of the release lever setscrew must be just touching the gauge. Adjust the setscrews as required and re-tighten the locknuts.

12. Reassemble the tractor, see section 2.
13. Adjust the clutch pedal free travel, see operation 6A-01.



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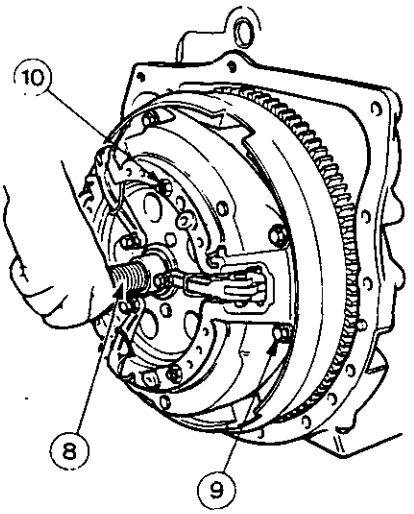

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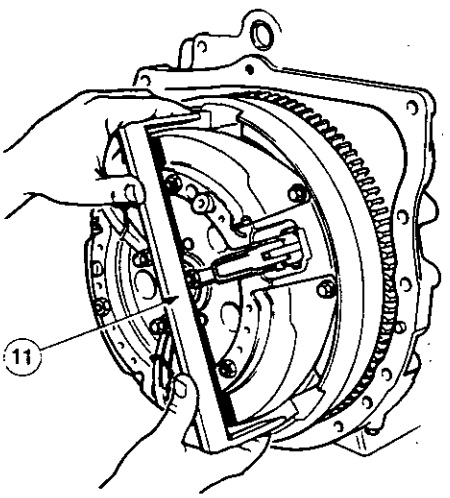

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Split Torque Clutch

Overhaul 6A-08

Special Tools:
MF159B Clutch centraliser
MF314 Lever height setting gauge
MF446 Lever height setting gauge
Hydraulic press

Disassembly

1. Remove the clutch assembly, see operation 6A-07.
2. Place the clutch assembly on the hydraulic press and locate a suitable bar across the top of the clutch cover.

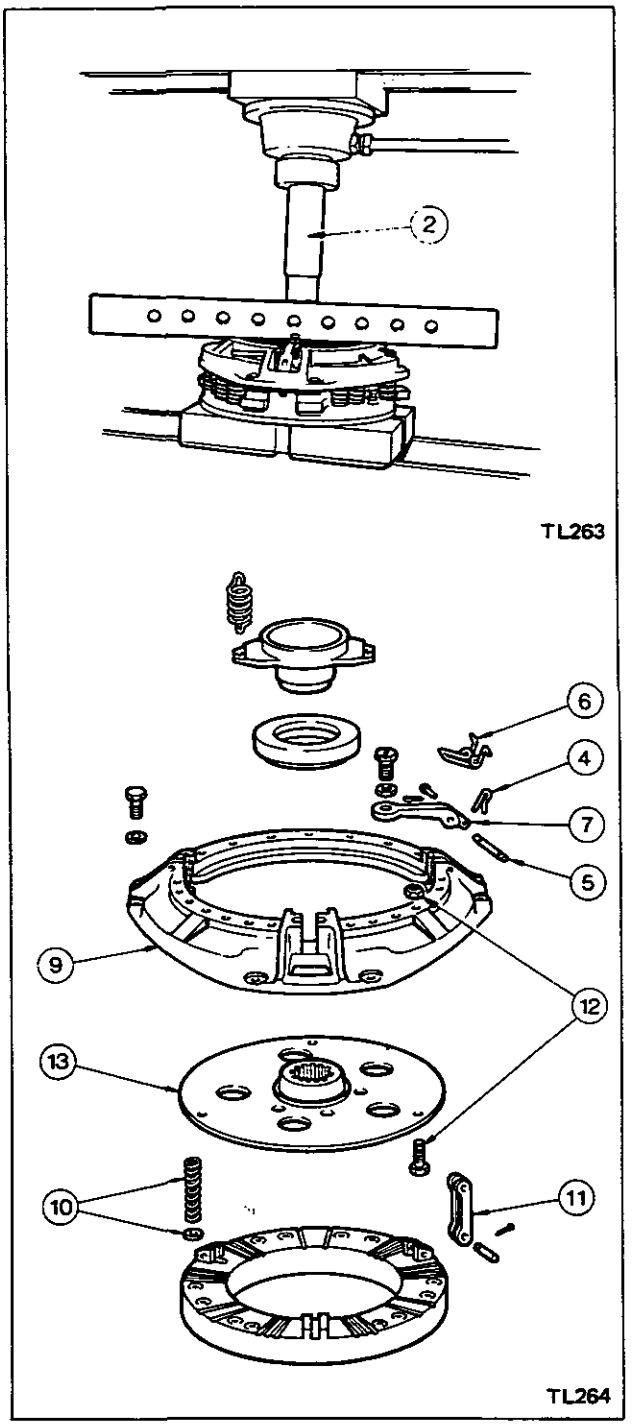
Caution: Ensure that the clutch is located under the press correctly, that the bar will not slip an dthat the press has sufficient travel to allow the spring pressure to come off. Release the pressure evenly and slowly.

3. **Apply pressure until the three 1/4 in bolts can be easily removed.**
4. **Removing the retaining clips from the pivot pins.**
5. **Remove the pivot pins.**
6. **Remove the lever springs.**
7. **Disconnect the release levers from the links.**
8. **Slowly release the pressure from the press until the springs are out of compression.**
9. **Lift off the cover plate assembly.**
10. **Remove the springs and the fibre washers.**
11. **Remove the links.**
12. **Remove the three bolts and nuts.**
13. **Remove the PTO plate.**

Examination

Inspect all components for wear, scoring, cracks, distortion or signs of overheating. Check the coil springs for correct loading and pressures as given in the Specification Section. If the tractor flywheel is scored, skimming is possible, in 0,254 mm (0.010 in) increments up to a maximum of 1,00 mm (0.040 in). The ledge to which the clutch cover is bolted must be skimmed by the same amount to maintain the distance from the clutch face of 39 mm (1.60 in) for 305 mm (12 in) clutches. 3.3 mm (0.130 in) for 330 mm (13 in clutches).

Note: Never, under any circumstances, skim the pressure plate, as this will severely impair its heat dissipation characteristics.



CLUTCH – CABLE/ROD OPERATED

Section 6 – Part B

Table of Contents

CLUTCH – CABLE/ROD OPERATED

Specification:

Application	All cab tractors and footstep tractors with 12 speed shuttle and 18 Speedshift gearbox.
Type:	
305 mm (12 in) diameter clutch	Split torque coil spring.
330 mm (12 in) diameter clutch	Split torque belleville spring.
Clutch diameter:	
342, 352, 362, 372, 382	305 mm (12 in) - coil spring type.
365, 375, 383, 390	305 mm (12 in) - coil spring type.
390T, 393, 398, 399	330 mm (13 in) - belleville spring type.
Pressure plate coil springs:	
305 mm (12 in) diameter clutch	12 red springs with clamp load of 664 kg (1464 lb).
Pressure plate belleville spring:	
330 mm (13 in) diameter clutch	885 kg (1950 lb) clamp load.
Release lever height:	
305 mm (12 in) clutch	82,31-82,55 mm (3.25-3.28 in).
330 mm (13 in) clutch	118,92-120,22 mm (4.682-4.733 in).
Clutch pedal height from cab floor:	
LoProfile cab models	140 mm (5.1/2 in).
HiLine cab models	130 mm (5 in).
Clutch pedal height - footstep tractors:	
365, 375, 390, 390T	145 mm (5.7 in).
398, 399	150 mm (5.9 in).
Routine clutch adjustment	None.
Flywheel machining limits	See page 6A-03.

Special Tools:

MF.159B	Clutch centralizer.
MF.314	Release lever height setting gauge 305 mm (12 in).
MF.446	Release lever height setting gauge 330 mm (13 in).
MF.479	Clutch release bearing installer.
MS.550	Universal handle.

Bolt Torques:

Clutch cover to flywheel (12 in)	30 Nm (23 lbf ft).
Clutch cover to flywheel (13 in)	45 Nm (33 lbf ft).
Release lever lock-nut	24 Nm (18 lbf ft).
PTO drive plate to clutch cover	45 Nm (33 lbf ft).
Flywheel to engine	105 Nm (77 lbf ft).
Cross shaft release lever adjusting screw	105 Nm (77 lbf ft).

General Description (Fig.1 and Fig.2)

The split torque clutch comprises two parts, the drive to the Ferguson linkage pump and power take-off (PTO) and the drive to the transmission. The drive to the linkage pump and PTO is always engaged when the engine is running and is taken from the clutch cover (14) by the PTO drive plate (7). An independent power take-off (IPTO) hydraulic clutch is employed to engage and disengage the PTO. The drive to the gearbox, rear axle and rear wheels is transmitted from either a 305 mm (12 in) clutch with coil springs (see Fig.1) or a 330 mm (13 in) clutch with a belleville type spring (see Fig.2)

The friction disc (10) is held engaged by the pressure plate (9) against the flywheel. Pressure plate movement is obtained by three release levers (5), pivoted on the clutch cover (14). Release lever movement operating against the twelve coil springs (12 Fig.1) or the belleville spring (12 Fig.2) moves the pressure plate rearwards and releases the friction disc (10). The clutch release levers (5) are operated by a release bearing (15) which is moved by the clutch pedal.

The clutch release bearing is operated from the clutch pedal by a flexible cable on cab tractors, rod on footstep tractors, cross shaft and fork. The release bearing is held in contact with the three release levers by a torsion spring on the cross shaft so that there is no need to carry out routine clutch adjustment. As the clutch friction plate wears there will be a need to readjust the clutch pedal height from the cab floor or footplate.

All the clutches are fitted with a five-blade type Cerametallic friction disc for its hard wearing and long life proprieties.

CLUTCH – CABLE/ROD OPERATED

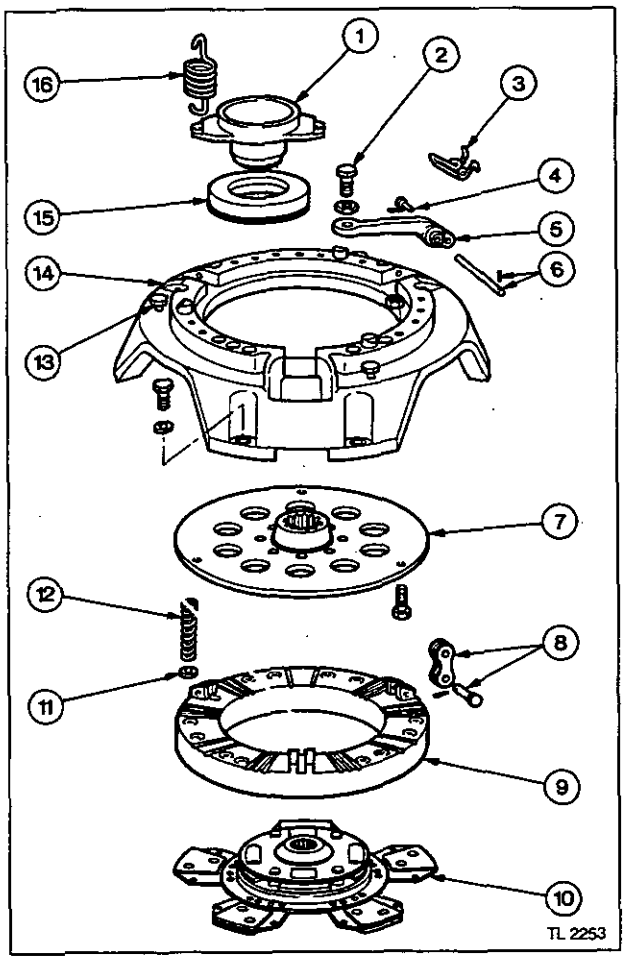


Fig.1 - 305 mm (12 inch) Clutch.

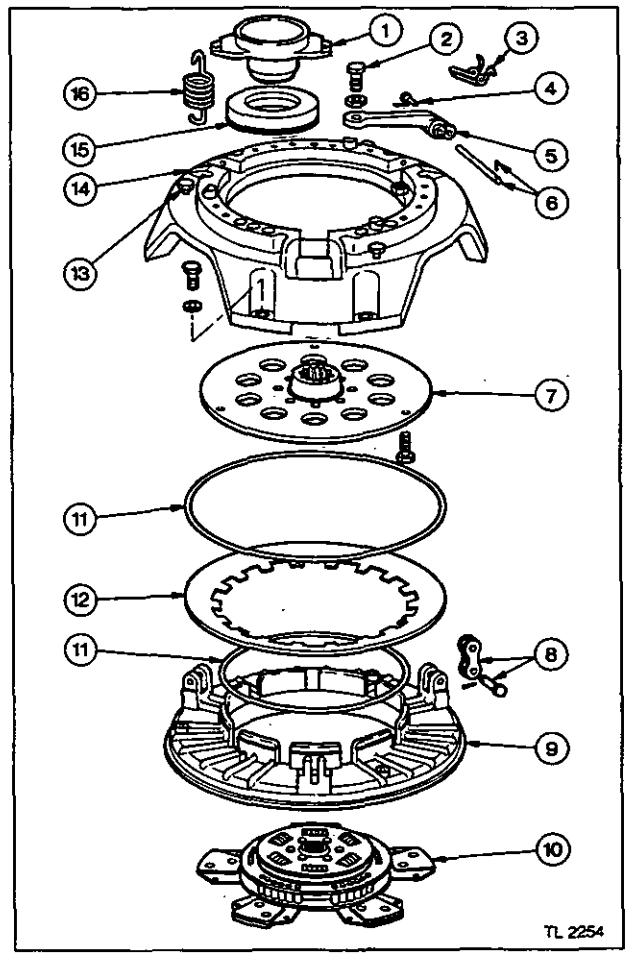


Fig.2 - 330 mm (13 inch) Clutch.

Key to illustration (Fig.1)

1. Bearing carrier
2. Adjusting screw
3. Release lever spring
4. Link pivot pin and split pin
5. Release lever
6. Release lever pivot pin and roll pin
7. PTO drive plate
8. Link and pivot pin
9. Pressure plate
10. Friction disc
11. Fibre washer
12. Coil spring
13. Assembly slave bolts
14. Clutch cover
15. Release bearing
16. Retaining spring

Key to illustration (Fig.2)

1. Bearing carrier
2. Adjusting screw
3. Release lever spring
4. Link pivot pin and split pin
5. Release lever
6. Release lever pivot pin and roll pin
7. PTO drive plate
8. Link and pivot pin
9. Pressure plate
10. Friction disc
11. Pivot rings
12. Belleville spring
13. Assembly slave bolts
14. Clutch cover
15. Release bearing
16. Retaining spring

CLUTCH – CABLE/ROD OPERATED

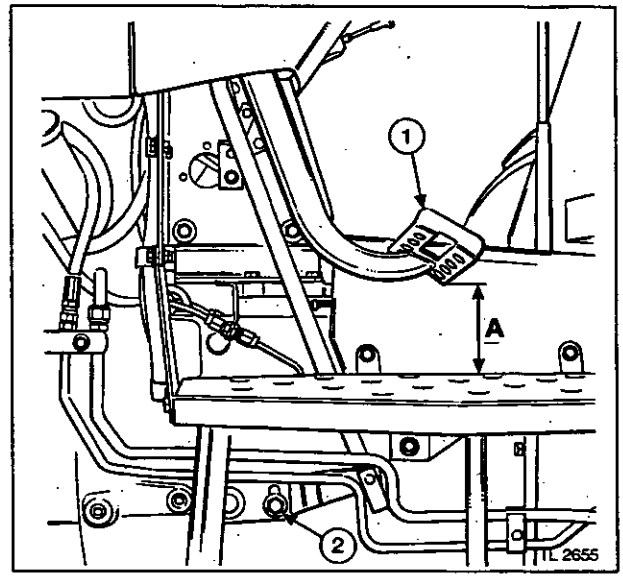
Clutch Pedal Height – Footstep Tractors

Adjust	6B–01

Procedure

Tractors fitted with 12 speed shuttle or 18 Speedshift gearboxes do not require routine adjustment, but the pedal will rise as the clutch wears. The pedal can be reset to an ergonomic height as follows:

1. Slacken the adjusting screw (2).
2. Reset the pedal (1) height **'A'**. In the factory it is set to 145 mm (5.7 in) on 365, 375, 390 and 390T tractors. It is set to 150 mm (5.9 in) on 398 and 399 tractors.
3. When set to the correct height, retighten the adjusting screw to a torque of 98 Nm (72 lbf ft).

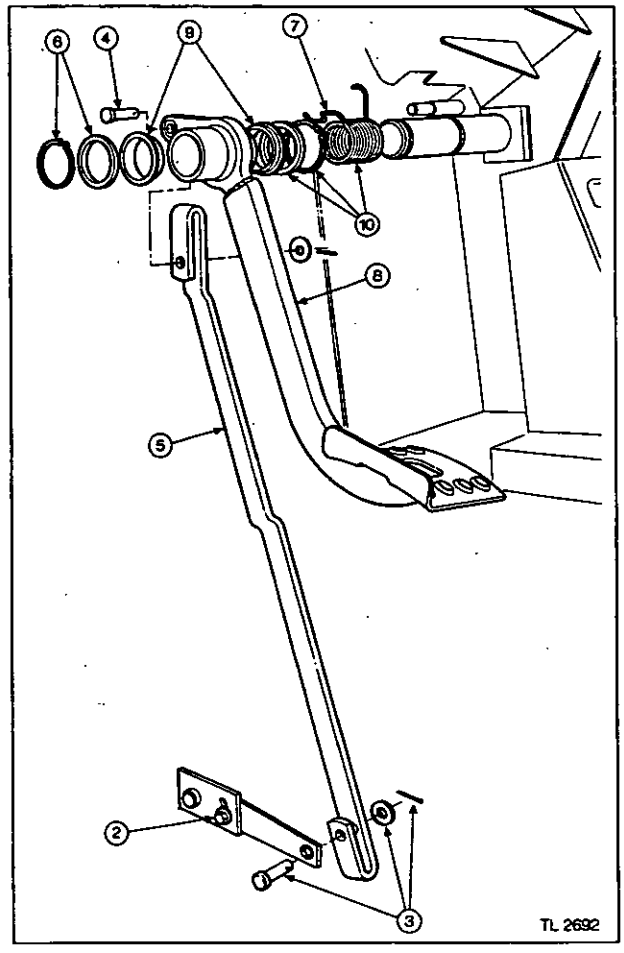


Clutch Pedal Linkage – Footstep Tractors

Removal and Refitment	6B–02

Removal

1. Remove the lower panel under the instrument panel to gain access to the clutch pedal shaft.
2. Slacken the clutch pedal adjusting bolt.
3. Remove the lower clutch rod split pin, washer and clevis pin.
4. Remove the upper clutch rod split pin, washer and clevis pin. Disconnecting the link between the pedal and the gear shift interlock.
5. Remove the clutch rod.
6. Remove the circlip and washer from the end of the pivot shaft.
7. Release the spring from the clutch pedal.
8. Slide the pedal from the shaft.
9. Remove the clutch pedal bushes.
10. Remove the inner washer, circlip and spring, if necessary.



Refitment

11. Reverse procedures 1 to 10 except:
    a. Lubricate the pivot shaft and bushes with a lithum based grease.
    b. Renew all circlips and split pins.
    c. Ensure that the circlips are seated in their grooves.
12. Adjust the clutch pedal height, see operation 6B-01.

Clutch Pedal Height – Cab Tractors

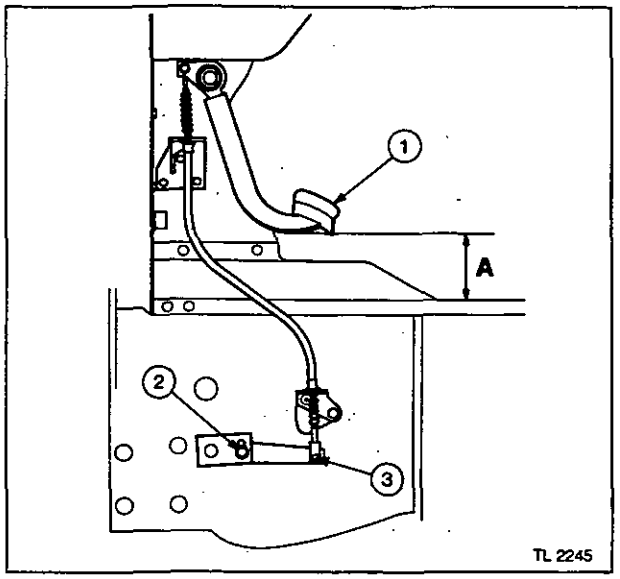
Adjust 6B–03

Procedure

Tractors fitted with cable operated clutches do not require routine adjustment, but the pedal will rise as the clutch wears. The pedal can be reset to an ergonomic height as follows:

1. Slacken the adjusting screw (2).
2. Rest the pedal on a block to hold it at the required height 'A'.
3. Pull the clutch release lever (3) down until the cable is taught and re-tighten the adjusting screw to a torque of 105 Nm (77 lbf ft).
4. The pedal should be set to one of the following heights off the floor mat:

   Low Profile cab models - 150 mm (6 in).
   HiLine cab models - 140 mm (5.1/2 in).
5. Massey Ferguson recommend that the clutch cable is renewed every 3000 hours.



Clutch Pedal Linkage – Cab Tractors

Removal and Refitment 6B–04

Removal

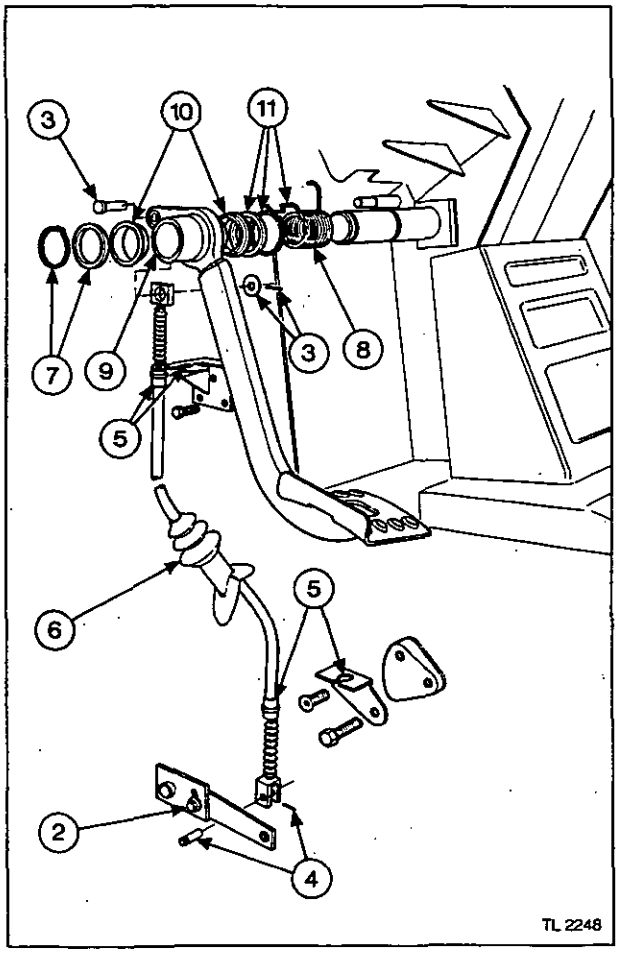
1. Remove the lower panel under the instrument panel to gain access to the clutch pedal shaft.

Clutch cable

2. Slacken the clutch pedal adjusting bolt.
3. Remove the upper clutch cable split pin, washer and clevis pin, disconnecting the link between the pedal and gear shift interlock, when fitted.
4. Drive the roll pin out of the lower clutch cable fork end, and remove the pivot pin.
5. Disconnect the cable from the upper and lower brackets.
6. Remove the cable from the tractor by releasing the cover from around the hole in the floor. Pull the cable out from under the cab floor.

Clutch pedal

7. Remove the circlip and washer from the end of the pivot shaft.
8. Release the spring from the clutch pedal.
9. Slide the pedal from the shaft.
10. Remove the clutch pedal bushes.
11. Remove the inner washer, circlip and spring, if necessary.



Refitment

12. Reverse procedures 1 to 11 except:
    d. Lubricate the pivot shaft and bushes with a lithium-based grease.
    e. Renew all circlips and roll pins.
    f. Ensure that the circlips are seated in their grooves.
13. Adjust the clutch pedal height, see operation 6B-03.

CLUTCH – CABLE/ROD OPERATED

Clutch Release Bearing

Removal and Refitment 6B–05

Special tools:
MF.479 Clutch Release Bearing Installer
MS.550 Universal Handle

Removal

1. Prior to splitting the tractor, disconnect the clutch cable at the lower end.
2. To prevent the cross shaft rotating against the tension of the torsion spring, the operating lever must be restrained.
3. Manufacture a bracket to the dimensions shown in the illustration in operation 2B-06.
4. Bolt the bracket to the side of the gearbox casing with the lever located under the projection.
5. Split the tractor between the engine and gearbox, see operation 2B-06.
6. Release the two retaining springs.

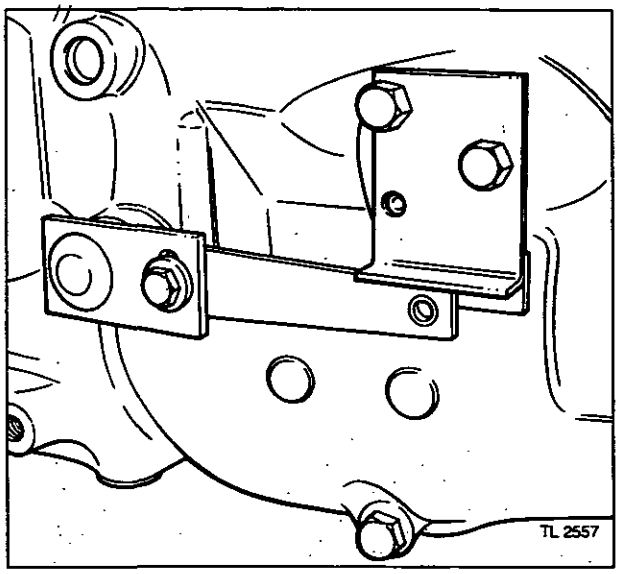
CAUTION: If the release bearing is not being replaced, the release bearing carrier MUST be marked 'TOP' so that it can be replaced in the same position. It will be found on later carriers that a small 'T' is cast onto the body to indicate top. Failure to carry out this instruction will result in premature failure of the bearing.

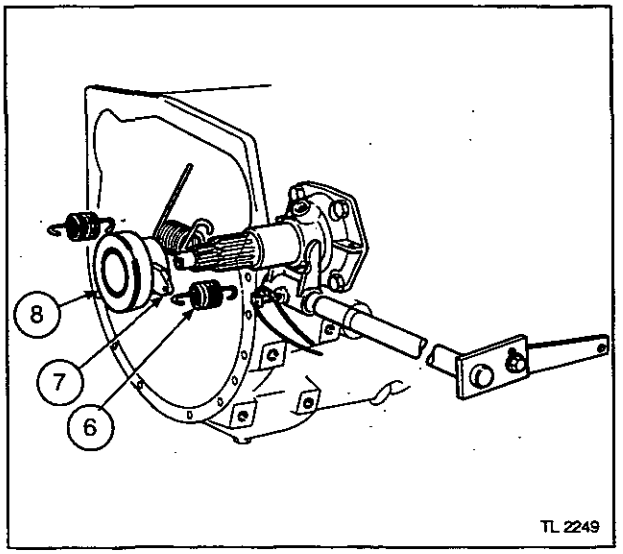
7. Remove the release bearing and carrier assembly.
8. Press the release bearing off the carrier.

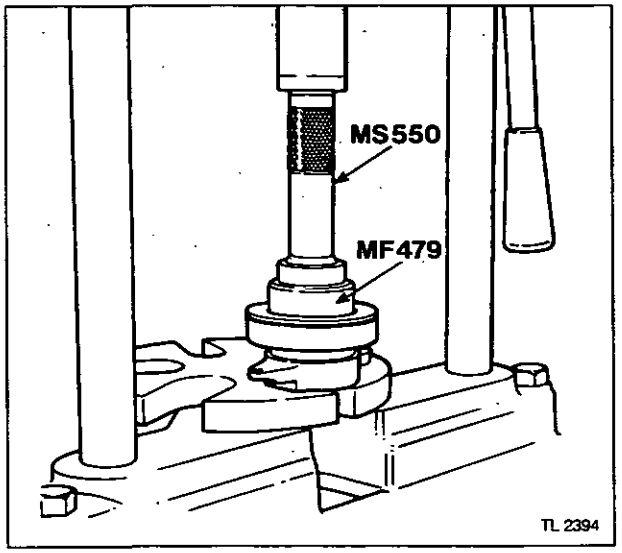
Refitment

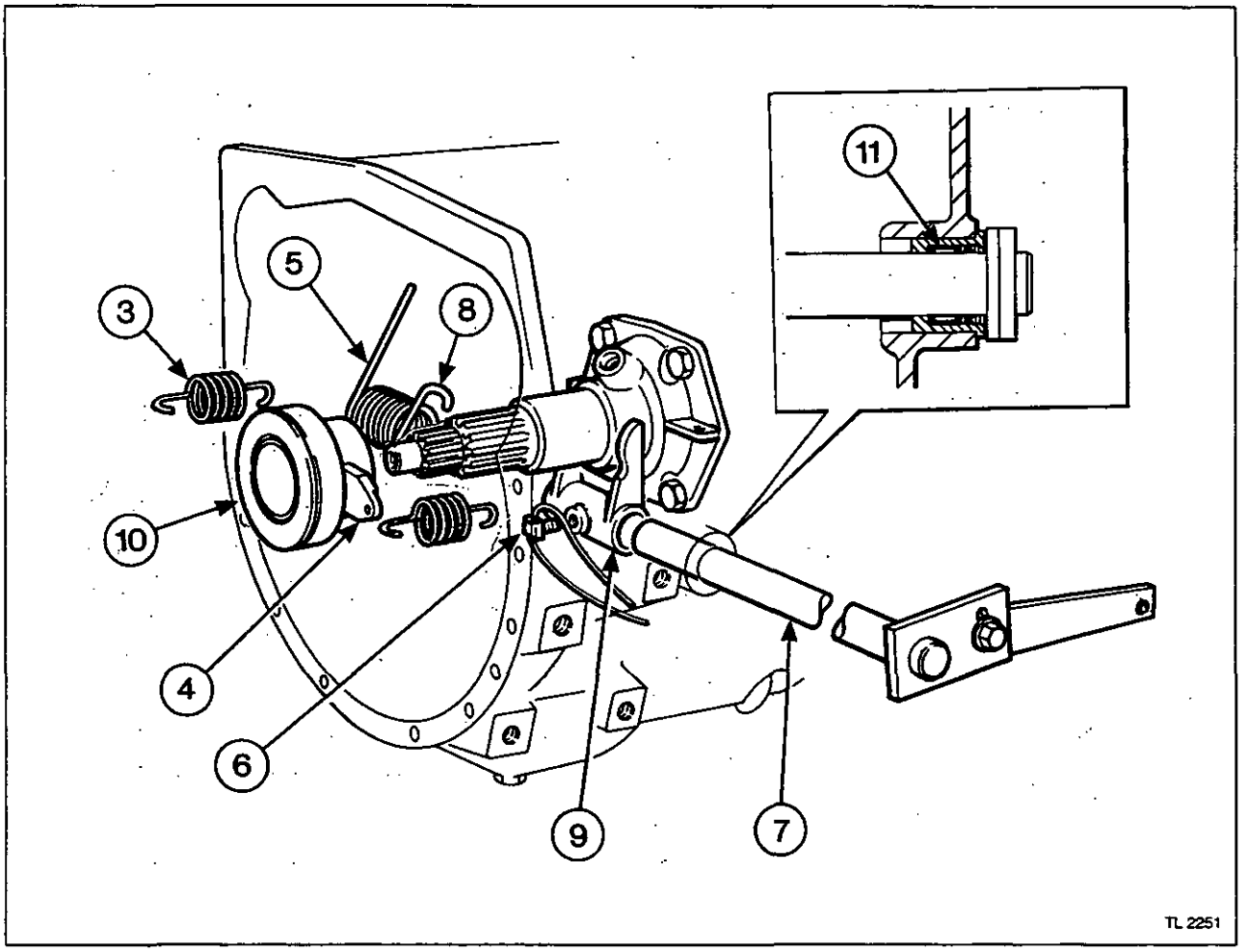
CAUTION: Special service tool MF.479 must be used to install the clutch release bearing to the carrier. Failure to carry out this operation using the special tool will result in damage to the bearing and premature failure.

9. Replace the release bearing using special tool MF.479 and Universal Handle MS.550 as shown in the illustration using a hand press.
10. Reverse procedures 1 to 8 except:
    a. Smear a light coating of lithium-based grease on the input shaft splines and the bore of the release bearing carrier.
    b. Ensure that the release fork is correctly located on the carrier.
    c. When refitting the gearbox to engine, rotate the clutch cross shaft clockwise to hold the release bearing away from the clutch during assembly. Secure the operating lever in this position.
    d. Release the cross shaft after the two halves of the tractor have been bolted together.
    e. Adjust the clutch pedal height, see operation 6B-01 or 6B-03.









Clutch Release Mechanism

Removal and Refitment 6B–06

Removal

1. Split the tractor between the engine and gearbox, see operation 2B-06.
2. Support the cab and remove the left-hand cab support bracket.
3. Release the two retaining springs.
4. Remove the release bearing and carrier assembly.
5. Release the torsion spring from the release fork.
6. Remove the locking wire and locking screw from the release fork.
7. Withdraw the clutch cross shaft from the gearbox casing.
8. Remove the torsion spring.
9. Remove the release fork.
10. Remove the release bearing assembly, see operation 6B-05.
11. If necessary, remove the clutch cross shaft bearing and seal assemblies.

Refitment

12. Reverse procedures 1 to 11 except:
    a. If the clutch cross shaft bushes have been removed, apply Massey Ferguson Studlock (Loctite 270) to the outside of the bearing.
    b. Install the cross shaft seals in the bearing with the lip of the seal facing the needle roller bearing.
    c. Smear a light coating of grease on the input shaft splines, cross shaft bushes and the release bearing carrier. Use a lithium-based grease.
    d. Ensure that the locking screw is located in the hole in the cross shaft.
    e. When refitting the gearbox to engine, rotate the clutch cross shaft clockwise to hold the release bearing away from the clutch during assembly. Secure the operating lever in this position.
    f. Release the cross shaft after the two halves of the tractor have been bolted together.
13. Adjust the clutch pedal height, see operation 6B-01 or 6B-03.

CLUTCH – CABLE/ROD OPERATED

Clutch Assembly

Removal and Refitment 6B–07

Special tools:
MF.159B Clutch Centralizer.
MF.314 Lever Height Setting Gauge
MF.446 Lever Height Setting Gauge

WARNING: The following sequence of instructions must be followed carefully, as spring pressure will cause the clutch cover to fly apart if the pressure is not released slowly and evenly.

Removal

1. Split the tractor between the engine and the gearbox, see section 2B-06.
2. Fit three slave bolts 1/4 UNC x 2.1/8 inches long to the three equi-spaced holes in the clutch cover.
3. Progressively slacken and remove the six bolts or cap screws and washers.
4. Lift the clutch assembly clear of the flywheel. The friction disc will remain separate from the clutch assembly.

Refitment

5. Lightly smear the splines of the friction disc with a Bentone-based grease (high melting point).
6. Locate the friction disc in the flywheel.
7. Position the clutch assembly onto the flywheel.
8. Using special tool MF.159B, centralize the clutch assembly and the friction disc.
9. Refit the six bolts or cap screws and washers. Tighten to the following torque:

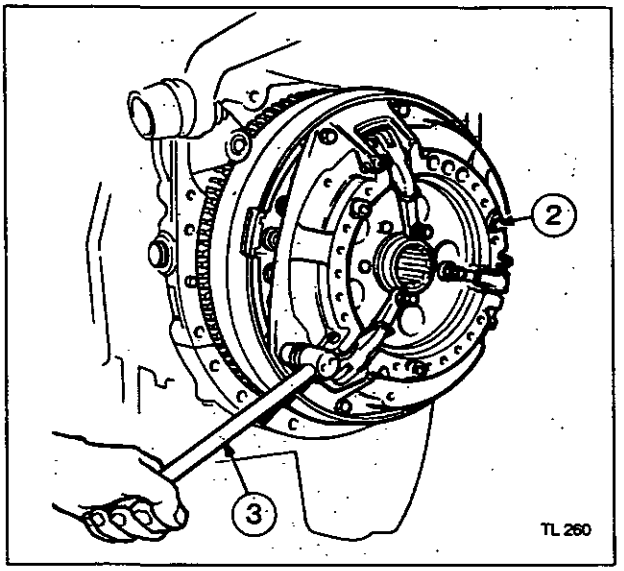
   305 mm (12 in) clutch - 30 Nm (23 lbf ft).
   330 mm (13 in) clutch - 45 Nm (33 lbf ft).

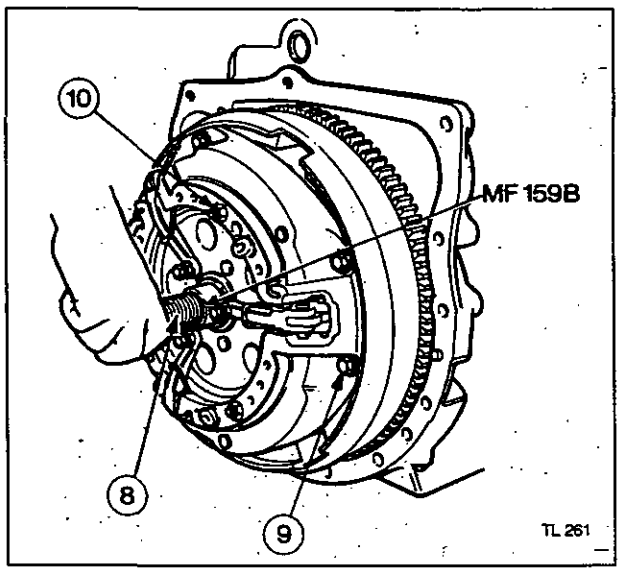
10. Remove the three slave bolts. Remove MF.159B.
11. Using one of the following release lever setting gauges check the adjustment of each release lever:

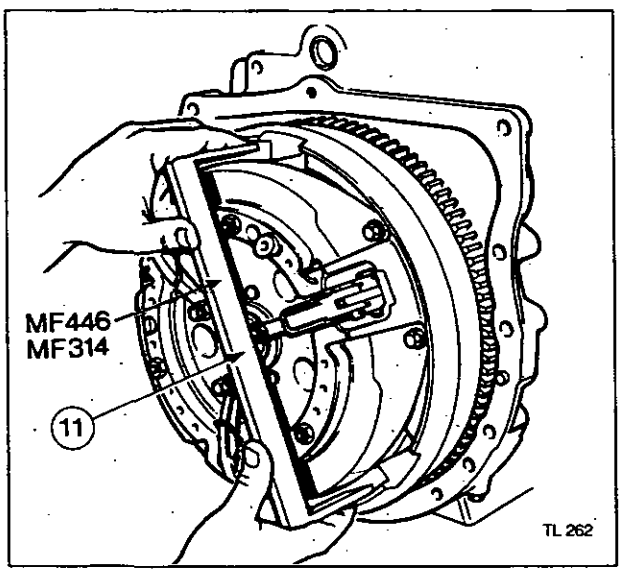
    305 mm (12 in) clutch - MF.314 Lever Height Setting Gauge.
    330 mm (13 in) clutch - MF.446 Lever Height Setting Gauge.

    The domed end of the release lever setscrew must be just touching the gauge. Apply Massey Ferguson Screwlock (Loctite 222) to the threads of the screws and adjust the setscrews as required. Tighten the lock-nuts to a torque of 24 Nm (18 lbf ft).

12. Reassemble the tractor except:
    a. When refitting the gearbox to engine, rotate the clutch cross shaft clockwise to hold the release bearing away from the clutch during assembly. Secure the operating lever in this position.
    b. Release the cross shaft after the two halves of the tractor have been bolted together.
13. Adjust the clutch pedal height, see operation 6B-01 or 6B-03.







Clutch Assembly – 305 mm (12 inch)

Overhaul 6B–08

Disassembly

1. Remove the clutch assembly and friction disc, see operation 6B-07.

WARNING: Ensure that the clutch is located under the press correctly, that the bar will not slip and that the press has sufficient travel to allow the spring pressure to come off. Release the pressure evenly and slowly.

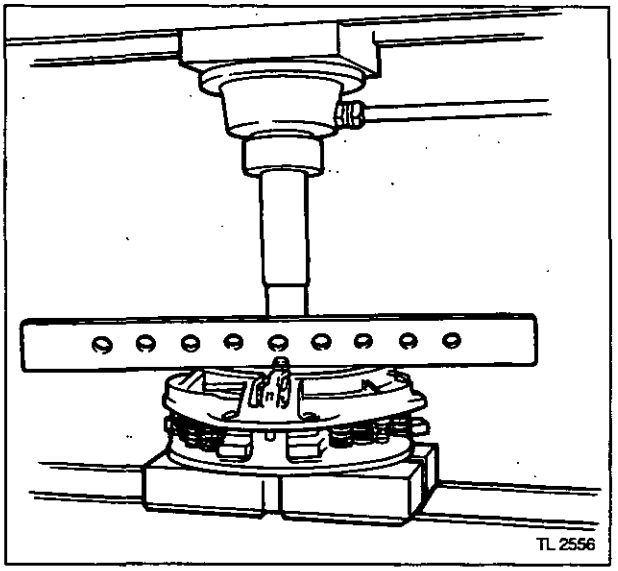
2. Place the clutch assembly on the hydraulic press and locate a suitable bar across the top of the clutch cover.
3. Apply pressure until the three 1/4 inch bolts can be easily removed.
4. Drive out the roll pins from the pivot pins.
5. Remove the three pivot pins.
6. Remove the release lever springs.
7. Slowly release the pressure from the press until the springs are out of compression.
8. Lift off the cover plate assembly.
9. Remove the springs and fibre washers.
10. Remove the split pins and pivot pins.
11. Remove the release levers.
12. Remove the lower split pins and pivot pins.
13. Remove the links.
14. Remove the three nuts and bolts.
15. Remove the PTO drive plate.

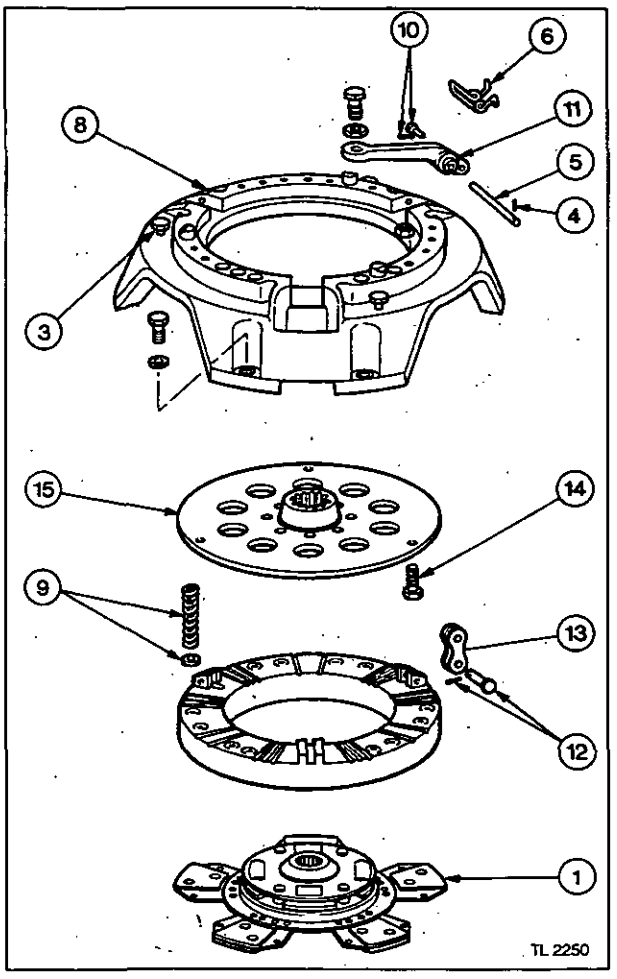
Examination

Inspect all components for wear, scoring, cracks, distortion or signs of overheating. Check the coil springs against a new spring for loss of tension. If the flywheel is scored, skimming is possible, see page 6A-03 for details. Never, under any circumstance, skim the pressure plate, as this will severely impair its heat dissipation characteristics.

Reassembly

16. Reverse procedures 1 to 13 except:
    a. Renew the springs and fibre washers.
    b. Renew all split pins and roll pins.
    c. Tighten the PTO drive plate nuts and bolts to a torque of 45 Nm (33 lbf ft).





CLUTCH – CABLE/ROD OPERATED

Clutch Assembly – 330 mm (13 inch)

Overhaul 6B–09

Disassembly

1. Remove the clutch assembly and friction disc, see operation 6B-07.

WARNING: Ensure that the clutch is located under the press correctly, that the bar will not slip and that the press has sufficient travel to allow the spring pressure to come off. Release the pressure evenly and slowly.

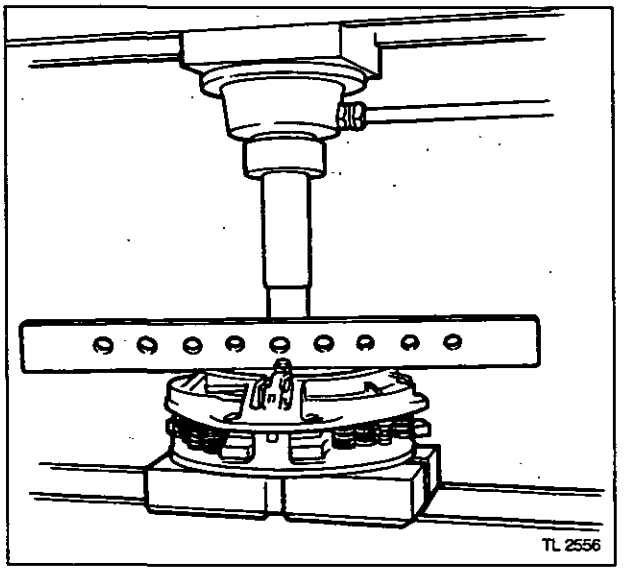
2. Place the clutch assembly on the hydraulic press and locate a suitable bar across the top of the clutch cover.
3. Apply pressure until the three 1/4 inch bolts can be easily removed.
4. Drive out the roll pins from the pivot pins.
5. Remove the three pivot pins.
6. Remove the release lever springs.
7. Slowly release the pressure from the press until the springs are out of compression.
8. Remove the clutch assembly from the press.
9. Lift off the cover plate assembly.
10. Remove the belleville spring and pivot rings.
11. Remove the split pins and pivot pins.
12. Remove the release levers.
13. Remove the lower split pins and pivot pins.
14. Remove the links.
15. If necessary, remove the three nuts and bolts.
16. Remove the PTO drive plate.

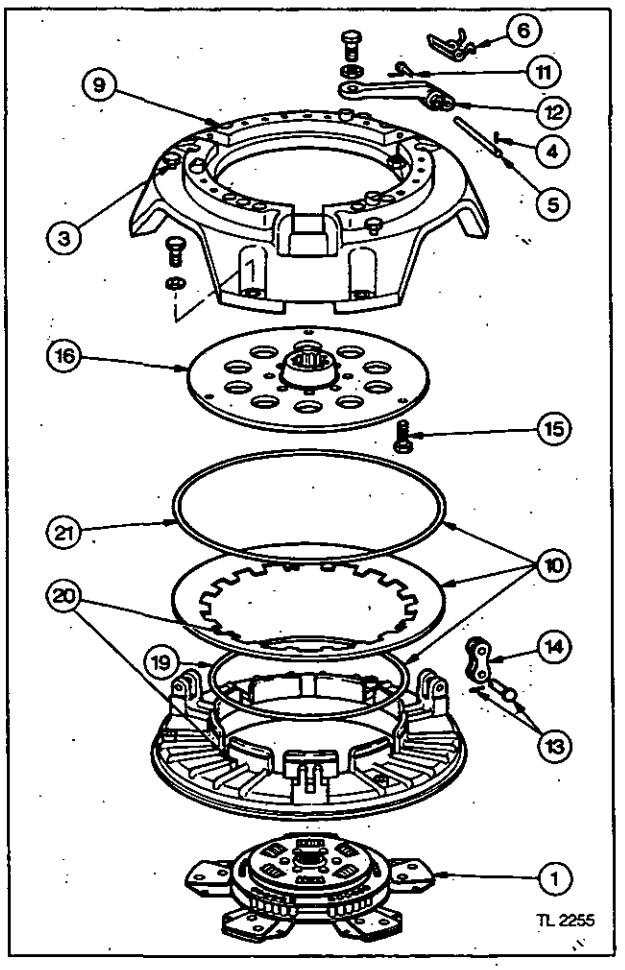
Examination

Inspect all components for wear, scoring, cracks, distortion or signs of overheating. If the flywheel is scored, skimming is possible, see page 6A-03 for details. Never, under any circumstance, skim the pressure plate, as this will severely impair its heat dissipation characteristics.

Reassembly

17. Replace the release levers, links and pivot pins.
18. If the PTO drive plate has been removed, replace it and tighten the nuts and bolts to a torque of 45 Nm (33 lbf ft).
19. Place the pressure plate on the bed of the hydraulic press. Position the smaller of the two pivot rings in the groove on the pressure plate locating the joint each side of the small roll pin.
20. Refit the belleville spring locating one of the small cut-outs in the fingers on the dowel pin in the pressure plate. The belleville spring is fitted with the dished-face upwards.
21. Position the larger of the two pivot rings in the groove in the cover plate.
22. Carefully place the cover plate over the pressure plate pulling the release levers through the holes in the cover. Ensure that pivot ring and belleville spring are correctly located.





23. Using the hydraulic press, bar and slave bolts reassemble the clutch.
24. Refit the release lever pivot pins and springs and renew the roll pins and split pins.

GEARBOXES

INDEX

8 SPEED MANUAL MKI STANDARD GEARBOX

Section 7 – Part A

Table of Contents

8 SPEED STANDARD GEARBOX

Specification

Model ..... 8 speed manual MKI

No of gears
Forward 8
Reverse 4

Epicyclic reduction ..... 4 :1 *(low range)*
Normal duty ..... M-F 350, 355, 360 and 365
Heavy duty ..... M-F 375, 383 and 390

Special tools

MF218A	PTO drive shaft puller
MF255B	PTO input shaft oil seal replacer
MF315A	Needle roller bearing remover/replacer
MF331	Input shaft oil seal replacer
KMF1004	Input shaft oil seal protector sleeve

Bolt Torques

Gear lever cover to shift tower ..... 50- 70 Nm (37-52 lbf ft)
Shift tower to gearbox top ..... 102-122 Nm (75-90 lbf ft)
Shifter Fork locking screws ..... 34- 52 Nm (25-38 lbf ft)
Interlock bolt to gearbox case ..... 40- 47 Nm (30-35 lbf ft)
Epicylic unit to gearbox case ..... 40- 47 Nm (30-35 lbf ft)
Input-shaft housing to gearbox case ..... 54- 61 Nm (40-45 lbf ft)
PTO drive shaft bearing housing to gearbox ..... 54- 61 Nm (40-45 lbf ft)
Gearbox to engine ..... 100-130 Nm (74-94 lbf ft)
Gearbox to rear transmission case ..... 102-122 Nm (75-90 lbf ft)

General Description

The gearbox has four forward speeds and one reverse, doubled by an epicyclic reduction unit to produce eight forward speeds and two reverse.

Main Transmission Drive

The input shaft is driven by the main transmission clutch plate and drives a pair of constant mesh gears. These, in turn, drive a hollow layshaft to which are attached the first, second, third and fourth ratio gears.

The mainshaft is located above the layshaft and has mounted on it three sliding gears, one of which is a compound gear having two sets of teeth. The sliding gears are operated by selector forks mounted on shifter rails which in turn are operated by the gear selector lever located directly above the gearbox.

The sliding gears mesh with the layshaft gears to give, from the front, third, first, fourth and second gears respectively depending upon the gear selected by the lever.

Epicyclic Reduction Unit

The epicyclic unit consists of a ring gear and three planetary pinions. It is mounted on the rear of the gearbox and driven by the mainshaft splined extension which acts as a sun gear.

To transmit the drive from the gearbox to the rear axle a driveshaft is connected by a coupler, either directly to the gearbox mainshaft (HIGH range) or the planetary pinion carrier where the speed of the gearbox is reduced by 4:1 (LOW range). The coupler is operated by a selector fork, rail and gearlever which is mounted alongside the main gear selector lever. As well as selecting either HIGH or LOW range, the lever also has a middle or neutral position which disengages the coupler splines from both the mainshaft and the planetary pinion carrier. In this neutral position an electrical switch completes the starting circuit and the danger of starting in gear is prevented.

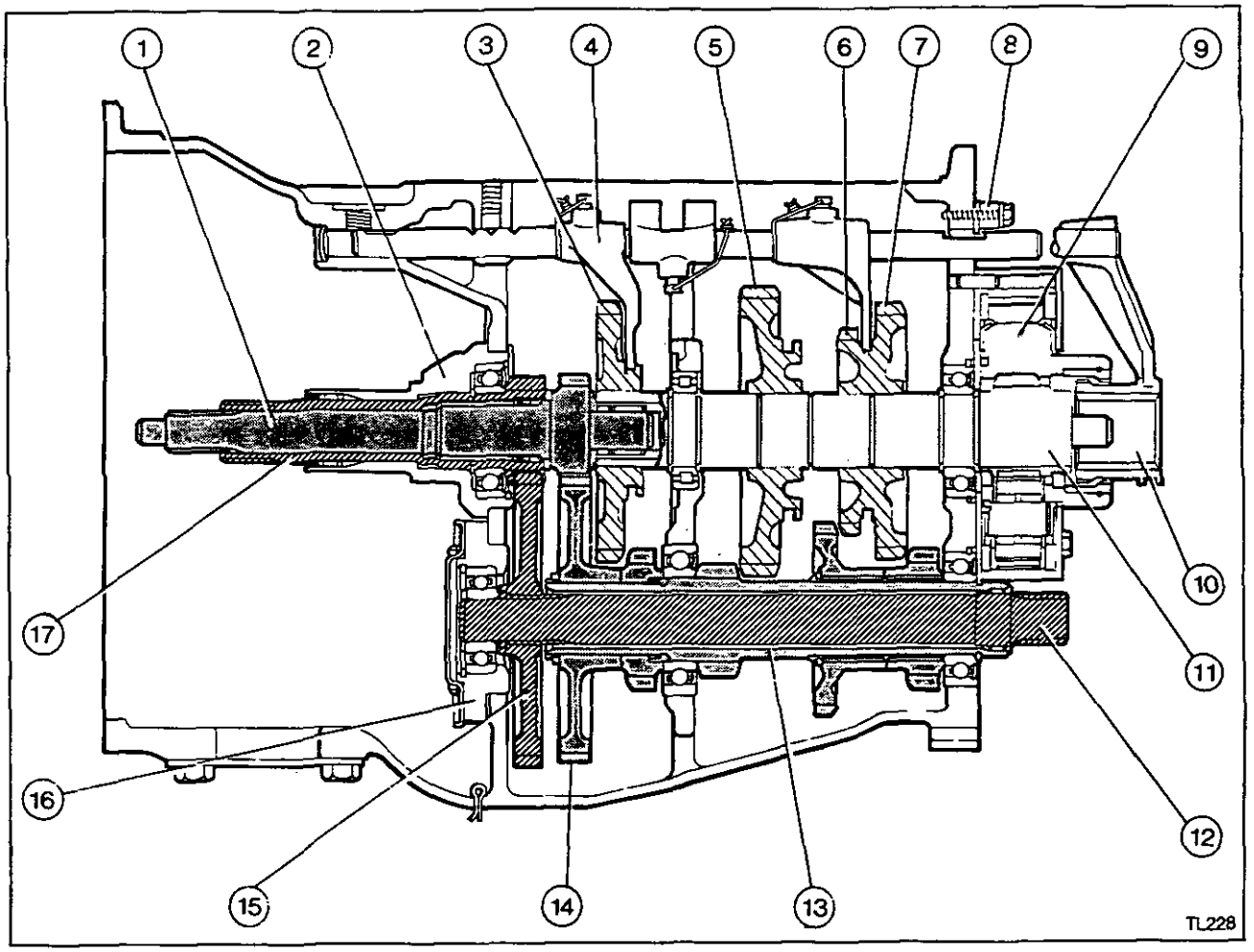
Reverse Drive

Reverse drive is achieved by the engagement of a compound gear cluster mounted in the left hand side of the gearbox. One of the gears is in constant mesh with the fourth gear pinion on the layshaft. The other gear is engaged by the sliding first gear on the mainshaft. This combination reverses the rotation of the mainshaft, reduction unit and final drive.

PTO Drive Shaft

The PTO input shaft driven by the secondary plate on the dual clutch, rotates a pair of constant mesh gears. These, in turn, drive the PTO shaft which projects rearwards through the hollow layshaft to drive the linkage pump and PTO.

8 SPEED STANDARD GEARBOX



1. Transmission input shaft and gear
2. Input shaft housing
3. Third gear
4. Selector rails and forks
5. First/reverse gear
6. Fourth gear
7. Second gear
8. Gear shift interlock
9. Epicyclic reduction unit
10. Sliding coupler
11. Main shaft
12. PTO shaft
13. Layshaft
14. Transmission constant mesh gear
15. PTO constant mesh gear
16. PTO front bearing housing
17. PTO input shaft and gear

8 SPEED STANDARD GEARBOX

Main Gear Shift Lever

Removal and refitment 7A-01

Removal

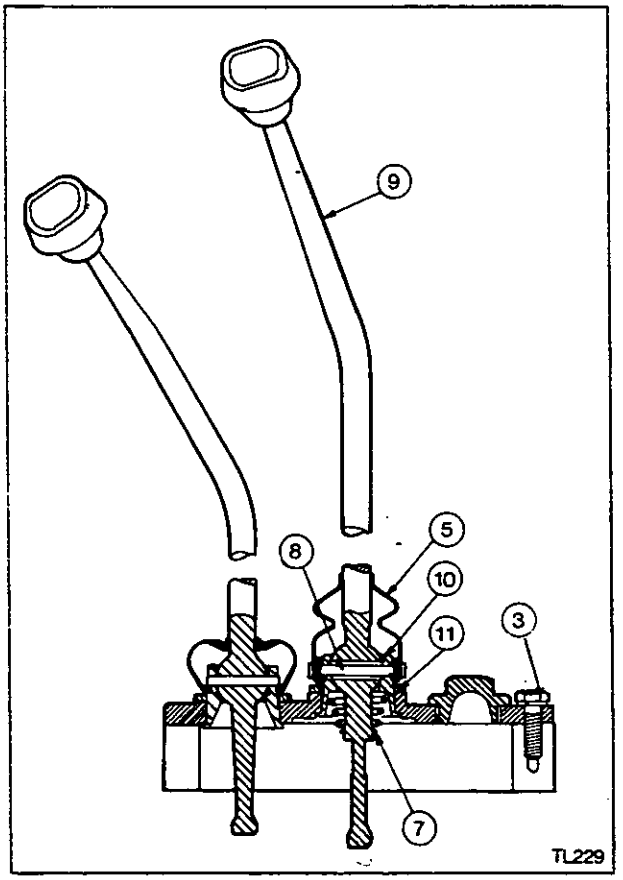
1. Remove the cab floor mat and/or access panels if fitted.
2. Move the gear levers to the neutral position.
3. Remove the five bolts holding the gearlever assembly to the shift tower on top of the gearbox.
4. Remove the gear lever assembly from the tractor.
5. Remove the gear lever rubber cover.

Caution: When removing the spring retaining clip (7) care must be taken to prevent the spring from flying out and causing possible injury or damage.

6. Place the gear lever assembly in a vice.
7. Press the spring retaining clip, towards the spring, slide sideways and remove. This will release the spring.
8. Press out the gear lever retaining clip.
9. Lift out the gear lever.
10. The gear lever cup may be removed from the cover if required.
11. Unscrew the retaining nut and press out the cup.

Refitment.

12. Reverse procedures 1 to 11 except:
    a. If the gear lever cup has been removed ensure that it is fitted with the gear lever retaining pin square with the axis of the tractor by lining up the flats on the cup.
    b. Ensure that the gear lever rubber cover is in good condition to prevent dirt getting into the transmission.
    c. Coat the underside of the gearlever cover with Loctite 515 and torque the cover bolts to 50-70 Nm (37-52 lbf ft).

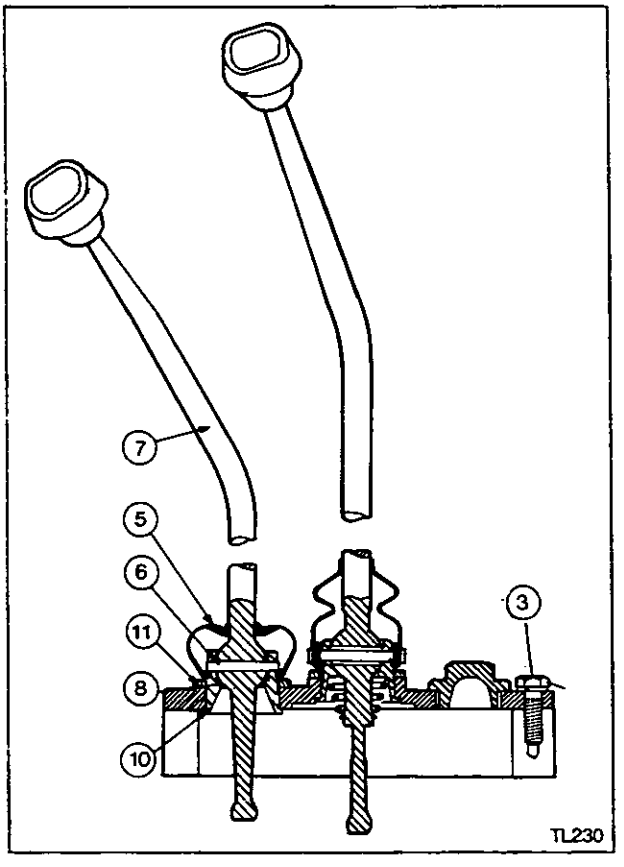


High/Low Shift Levers

Removal and Refitment 7A-02

Removal

1. Remove the cab floor mat and/or access panels if fitted.
2. Move the gear levers to the neutral position.
3. Remove the five bolts holding the gear lever assembly to the top of the gearbox.
4. Remove the gear lever assembly from the tractor.
5. Remove the gear lever rubber cover
6. Remove the gear lever retaining pin.
7. Lift out the gear levers.
8. Remove the 'O' ring.
9. The gear lever cup may be removed if required.
10. Unscrew the retaining nut and press-out the cup.



Refitment

11. Reverse proceedure 1 to 11 except:
    a. Renew the 'O' ring.
    b. If the gear lever cup has been removed make sure that it is fitted with the gear lever retaining pin square with the axis of the tractor by lining up the flats on the cup.
    c. Ensure that the gearlever rubber cover is in good condition to prevent dirt getting into the transmission.
    d. Coat the underside of the gearlever cover with Loctite 515 and torque the cover bolts to 50-70 Nm (37-52 lbf ft).

Selector Rail Mechanism

Removal and refitment 7A-03

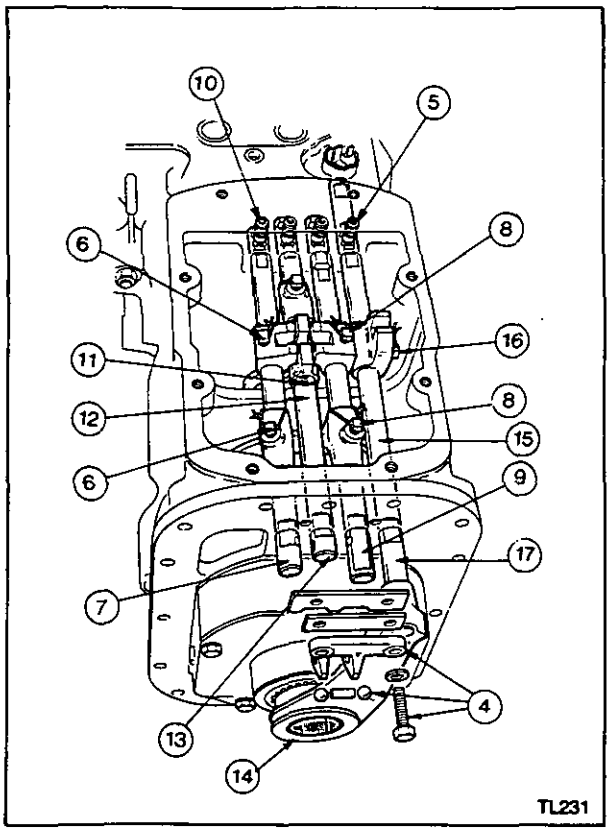
Removal

Caution: Beware of sharp edges around the top of the gearbox case.

1. Split the tractor between the gearbox and the spacer housing and remove the gearbox, see section 2.
2. Remove the gearbox top cover and the shift tower.
3. Release the locking wires.
4. Remove the bolts, fork, balls, peg, stop plate and plain plate of the gear shift locking mechanism.
5. Lift out the detent springs and plungers.
6. Remove the locking screws.
7. Slide the rail rearwards out of the housing.

Note: When removing the selector rails, retain the gear lever engagement dogs.

8. Remove the locking screws.
9. Slide the rail rearwards out of the housing.
10. Remove the locking screw.
11. Rotate the third gear selector rail through 180°.
12. Remove the third gear engagement block locking screw.
13. Slide the rail rearwards out of the housing.
14. Slide the High/Low rail rearwards and remove the coupler.
15. Rotate the High/Low rail through 90°.
16. Remove the locking screw.
17. Slide the rail rearwards out of the housing.
18. Remove the selector forks from the gearbox.



Refitment

19. Reverse procedured 1 to 18 except:
    a. Apply a few drops of oil to the selector rails before refitment.
    b. Tighten the inter-lock mechanism retaining bolts to a torque of 40-47 Nm (30-35 lbf ft).
    c. Tighten the shifter fork locking screws to a torque of 34-52 Nm (25-38 lbf ft).
    d. Wire-lock all shifter fork locking screws.
    e. On completion of the refitting procedure, place all the gears in the neutral position.

8 SPEED STANDARD GEARBOX

Normal and Heavy Duty Gearbox Epicyclic Unit

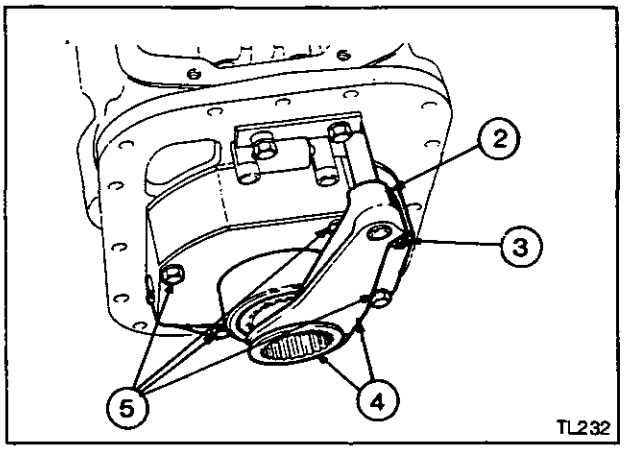
Removal and Refitment 7A-04

Removal

1. Split the tractor between the gearbox and the spacer or centre housing, see section 2.
2. Remove the locking wire.
3. Remove the locking screw.
4. Remove the selector fork and coupling.
5. Remove the bolts.
6. Remove the complete assembly.

Refitment

7. Reverse procedures 1 to 6 except:
   a. Ensure that the front and rear thrust rings are correctly located before refitment.
   b. Ensure that the dowels are correctly located in the gearbox casing.
   c. Locate the cover plate with the cut out, to the bottom left- hand corner for heavy duty, and the bottom right hand corner for normal duty epicyclics.
   d. Fit a lockwasher to the lower right hand retaining bolt, on normal duty epicyclic only.
   e. Tighten the retaining bolts progressively and evenly to a torque of 40-47 Nm (30-35 lbf ft).



Normal Duty Gearbox Epicyclic Unit

Overhaul 7A-05

Disassembly

1. Remove the gearbox epicyclic unit, see operation 7D-04.
2. Remove the cover plate.
3. Remove the rear thrust ring.
4. Remove the planetary pinion carrier.
5. Remove the front thrust ring.
6. Remove the shim.
7. Remove the front plate.
8. If necessary, remove the dowel pins from the ring gear.

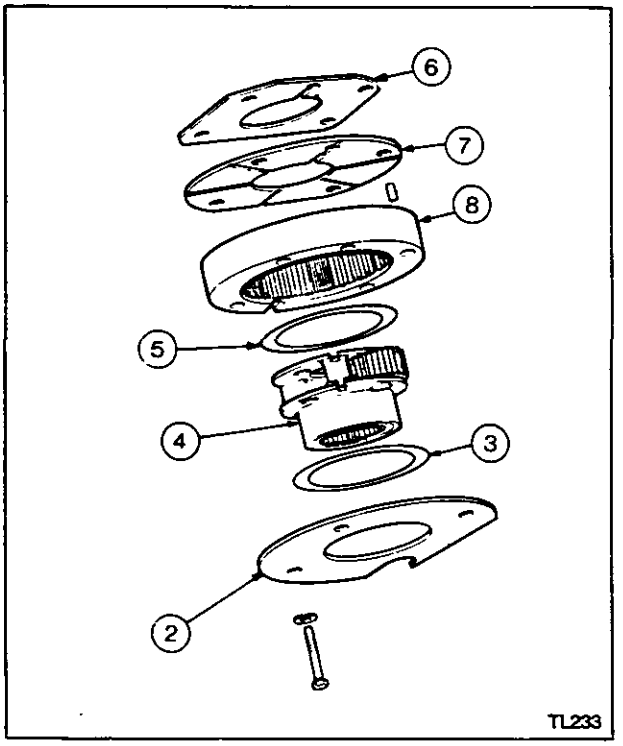
Note: The planetary pinion carrier cannot be serviced, and must be replaced as a complete assembly if found to be defective.

9. To remove pinions and needle rollers follow items 11, 12 and 13 in operation 7A-06.

Note: Spacers are fitted either side and between the needle rollers.

Reassembly

10. Reverse procedures 1 to 9 except:
    a. When replacing the rollers in the pinions, a smear of petroleum jelly (not grease) will help retain them. Do not omit the spacer between the two runs of rollers. Each run consists of 27 rollers, see item 9.
    b. The front plate and the cover plate must be positioned with the oil grooves towards the pinion carrier.
    c. Always fit the same thickness of shims as those removed.



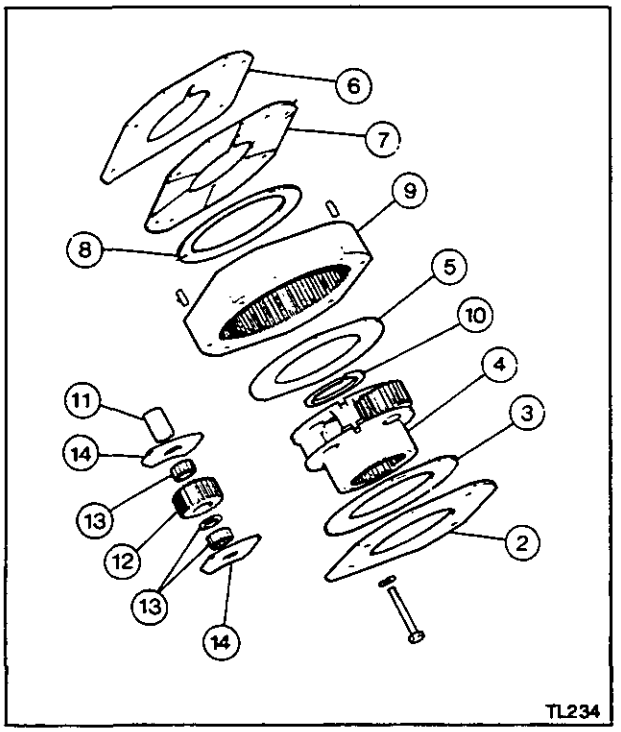
d. To assist assembly of the front and rear thrust rings on the pinion carrier, smear them with petroleum jelly (not grease). Ensure that the tabs on the thrust rings locate in the pinion carrier cut-outs, and that the brass faces are away from the pinion carrier.

Heavy Duty Gearbox Epicyclic Unit

Overhaul 7A-06

Disassembly

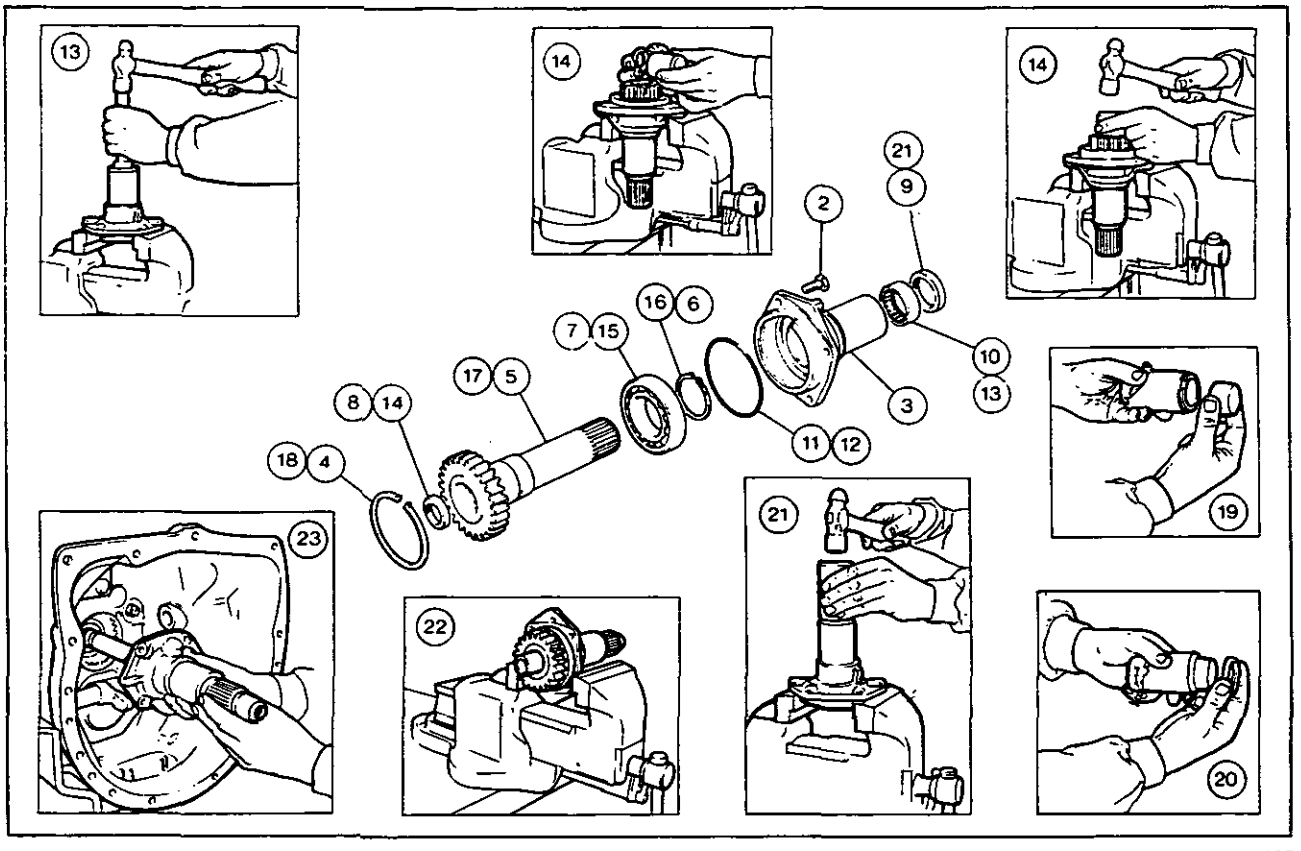
1. Remove the gearbox epicyclic unit, see operation 7A-04.
2. Remove the cover plate.
3. Remove the rear thrust ring.
4. Remove the planetary pinion carrier.
5. Remove the front thrust ring.
6. Remove the shim.
7. Remove the front plate.
8. Remove the Belleville spring disc.
9. If necessary, remove the dowels from the planetary ring gear.
10. Remove the external snap ring.
11. Gently tap out the three pinion shafts towards the front.
12. Remove the planetary pinions.
13. Remove the two sets of rollers and spacer from each pinion.
14. Remove the wear plates from each side of each pinion.



Reassembly

15. Reverse procedures 1 to 14, except:
    a. When replacing the rollers in the pinions, a smear of petroleum jelly (not grease) will help retain them. Do not omit the spacer from between the two runs of rollers. Each run consists of 16 rollers.
    b. Ensure the Belleville spring disc is located correctly in the epicyclic ring gear with the concave face rearwards.
    c. The front plate and the cover plate must be positioned with the oil grooves towards the pinion carrier.
    d. Ensure that the pinion wear plates are refitted with the flats positioned innermost to the centre of the pinion carrier.
    e. Ensure the gap of the snap ring is located midway between the planetary pinion shafts.
    f. Always fit the same thickness of shims as those removed.
    g. To assist assembly of the front and rear thrust rings on the pinion carrier, smear them with petroleum jelly (not grease). Ensure that the tabs on the thrust rings locate in the pinion carrier cut-outs, and that the brass faces are away from the pinion carrier.

8 SPEED STANDARD GEARBOX



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Input Shafts and Housing

Removal and Refitment 7A-07

Special tools:

MF255B	*PTO input shaft oil seal replacer*
MF315A	*Needle roller bearing remover/ replacer*
MF331	*Main input shaft oil seal replacer*
KMF1004	*Input shaft oil seal protector sleeve*

Removal

1. Remove the clutch release mechanism, see operation 6A-04.
2. Remove the four bolts.
3. Withdraw the input housing complete with PTO input shaft.
4. Remove the large internal circlip.
5. Push the PTO input shaft complete with bearing rearwards out of the housing.
6. If necessary remove the circlip.
7. If necessary press the bearing off the shaft.
8. Lever the PTO shaft seal out.
9. Lever the main shaft seal out.
10. Using MF315A remove the needle roller bearing.
11. Remove the 'O' ring (PTO input shaft housing).

Refitment

12. Fit a new 'O' ring (PTO input shaft).
13. Using MF315A refit the needle roller bearing.
14. Using MF331 fit a new seal, with the lip of the seal facing the tool.
15. Refit the bearing with the shield towards the gear teeth.
16. Refit the circlip (check that it is properly seated).
17. Refit the PTO input shaft and bearing into the input housing.
18. Refit the circlip. (Check that it is properly seated.).
19. Place the nylon cone adaptor on special tool MF255B.
20. Place the seal over the nylon cone and onto the tool with the seal lip facing away from the tool and remove the nylon cone.
21. Place the tool over the PTO input shaft and tap the seal into place.
22. Place KMF1004 into the input housing assembly.
23. Slide the housing over the input shaft.
24. Reverse procedures 1 to 7, except:
    a. Use petroleum jelly (not grease) to lubricate all seals and the needle roller bearing when refitting.
    b. Lightly coat the bolt thread with Hylomar sealant when refitting and tighten the bolts to a torque of 54-61 Nm (40-45 lbf ft).

PTO Driveshaft Front Bearing

Removal and Refitment 7A-08

Special Tools: MF218A PTO Drive Shaft Puller.

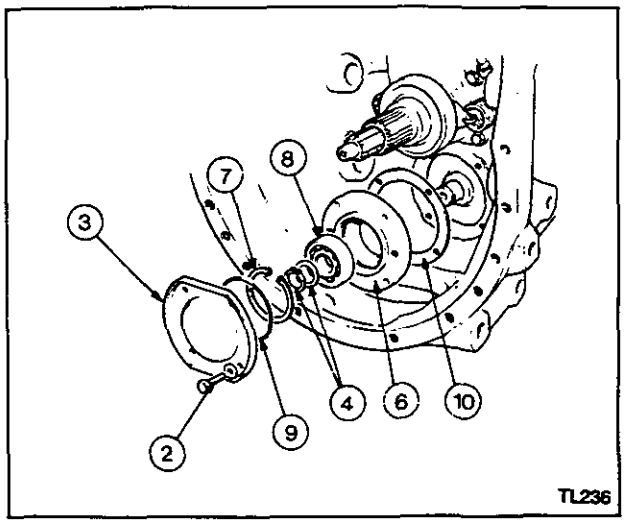
Removal

With the gearbox removed from the tractor:

1. Remove the clutch cross shaft and lever, see operation 6A-04.
2. Remove the four bolts and washers.
3. Remove the cover plate.
4. Remove the external circlip and washer.
5. Screw two 3/8 UNC x 75 mm (3 in) bolts into the bearing housing and tighten them evenly to draw the housing from the case and shaft.
6. Remove the housing.
7. Remove the circlip.
8. Press out the bearing.
9. Discard the 'O' ring.
10. Discard the gasket.

Refitment

11. Reverse procedures 7 to 10 except:
    a. Fit a new 'O' ring gasket and circlip.
    b. Lightly coat the gasket with Hylomar sealant.
12. Using MF218A pull the bearing and housing assembly onto the front end of the PTO drive shaft ensuring that the splines on the shaft locate with those in the PTO constant mesh gear.
13. Fit a new circlip and washer.
14. Reverse procedures 1 to 6 except:
    a. Lightly coat the securing bolt threads with Hylomar sealant.
    b. Tighten the bolts to a torque of 54-61 Nm (40-45 lbf ft).



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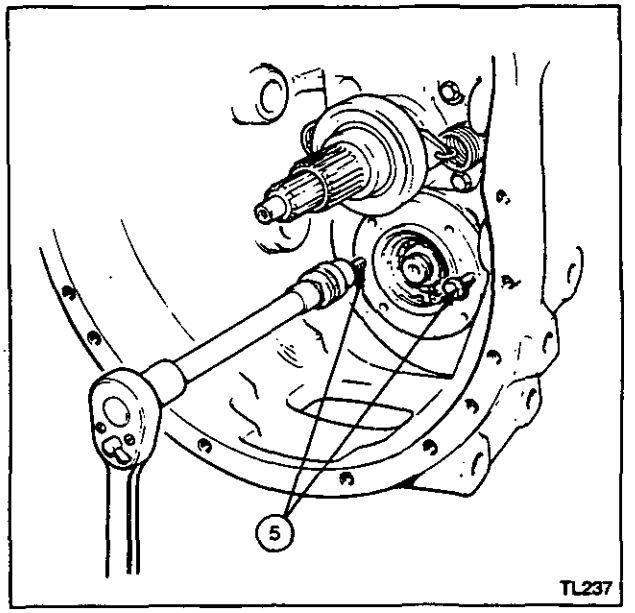

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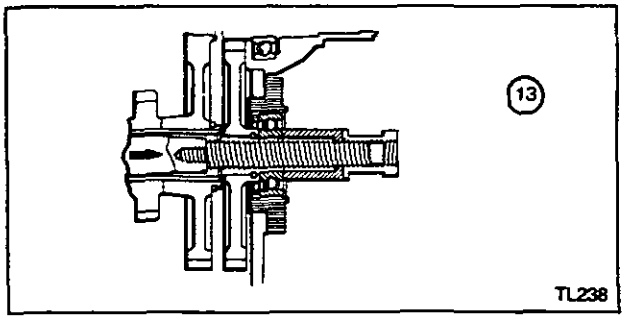

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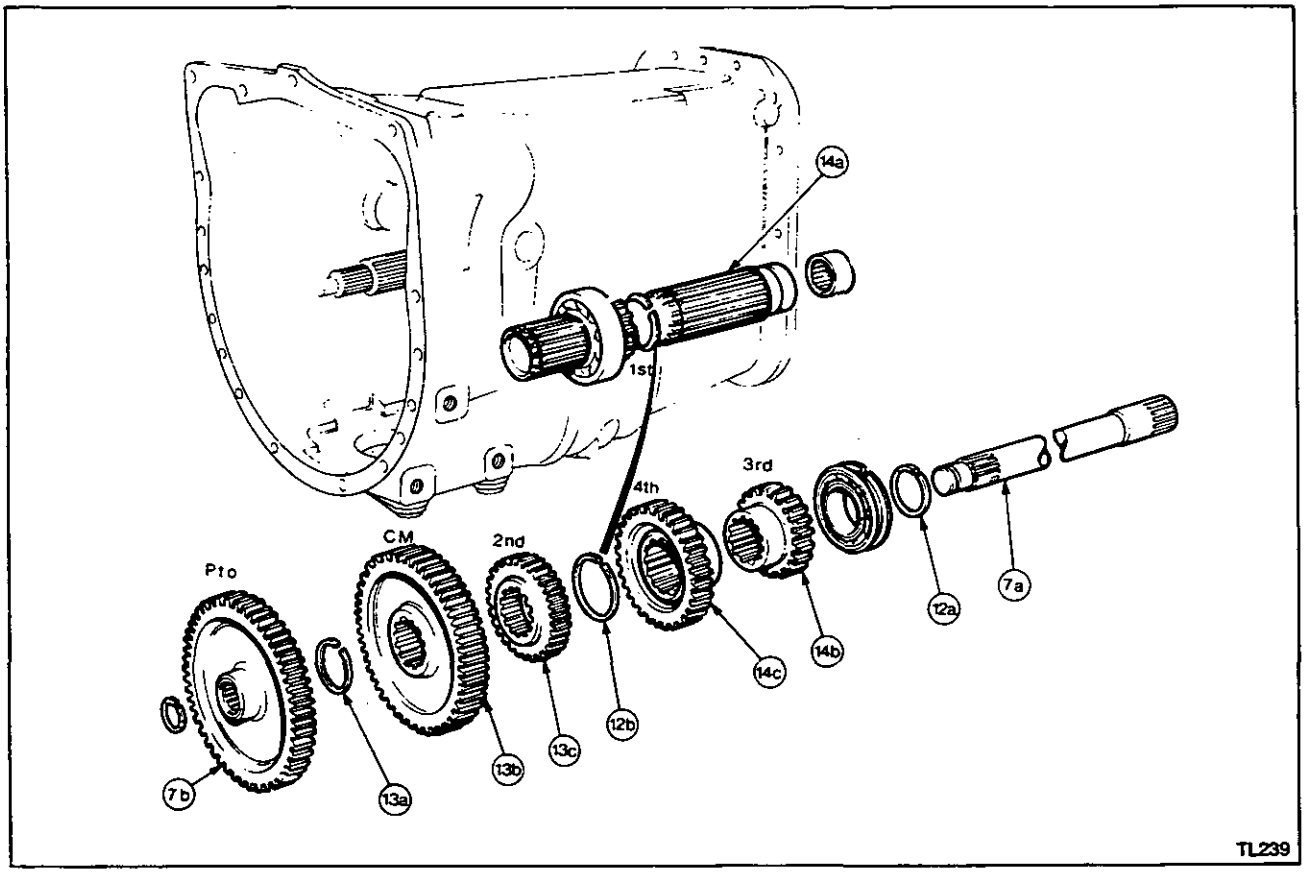
8 SPEED STANDARD GEARBOX



Layshaft, Mainshaft, PTO Shaft and Gears

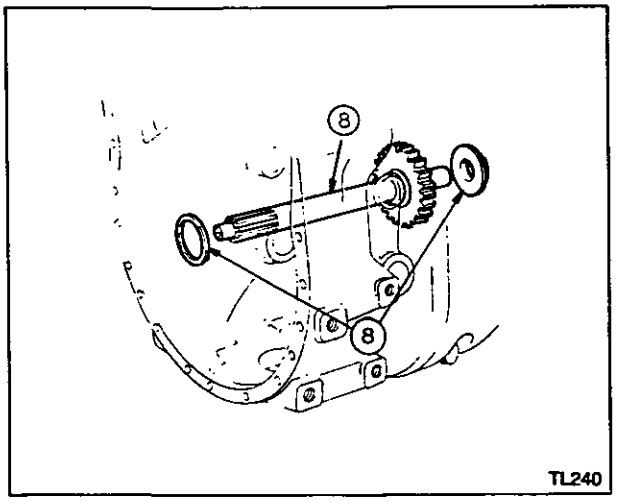
Overhaul 7A-09

Disassembly

1. Remove the gearbox from the tractor, see section 2.
2. Remove the thrust bearing and clutch cross-shaft, see operation 6A-04.
3. Remove the shifter rails and forks, see operation 7A-03.
4. Remove the epicyclic reduction unit, see operation 7A-04.
5. Remove the input shafts and housing, see operation 7A-07.
6. Remove the PTO drive shaft front bearing, see operation 7A-08. Withdraw the PTO shaft.

Input shaft

7. Withdraw the PTO shaft (7A) rearwards to allow the PTO constant mesh gear (7B) to drop into the housing.
8. Remove the main drive input shaft complete with the thrust washer. Lift out the PTO constant mesh gear.



Mainshaft

9. Drive the mainshaft (9A) rearwards and remove the third speed sliding gear (9B).
10. Remove the front circlip (10A) holding the front mainshaft bearing (10B) and drive the mainshaft rearwards through the bearing. Remove the circlip (10C) from behind the front mainshaft bearing.
11. Withdraw the mainshaft rearwards, removing 1st and reverse sliding gear (11A) and 2nd and 4th sliding gears (11B). Remove circlip (11C), bearing (11D) and circlip (11E).

Layshaft

12. Remove the rear circlip (12A) on the layshaft and tap the shaft forward sufficiently to uncover the circlip (12B) in front of the 4th speed gear. Move the circlip onto the unsplined portion of the shaft.
13. Remove the circlip (13A) from the front of the layshaft and remove the constant mesh (13B) and second speed gears (13C). The layshaft must be driven rearwards to accomplish this.
14. Drive the layshaft (14A) out through the front, removing the third (14B) and fourth (14C) gears.

Reverse Idler

15. Obtain a length of steel bar 25 mm dia x 55 mm long (1 in dia x 2.3/16 in long) to make up a dummy shaft for the removal of the reverse idler.
16. Release the locking washer.
17. Remove the bolt and locating tab.
18. Slide the dummy shaft in from the front of the reverse gear shaft towards the rear. This will push out the reverse gear shaft, and prevent the needle rollers from dropping into the gearbox case.
19. Remove the idler gear cluster complete with the needle rollers and spacers on the dummy shaft.
20. Withdraw the dummy shaft from the idler gear and release the needle rollers and spacers to drop out onto a clean work surface.

Reassembly

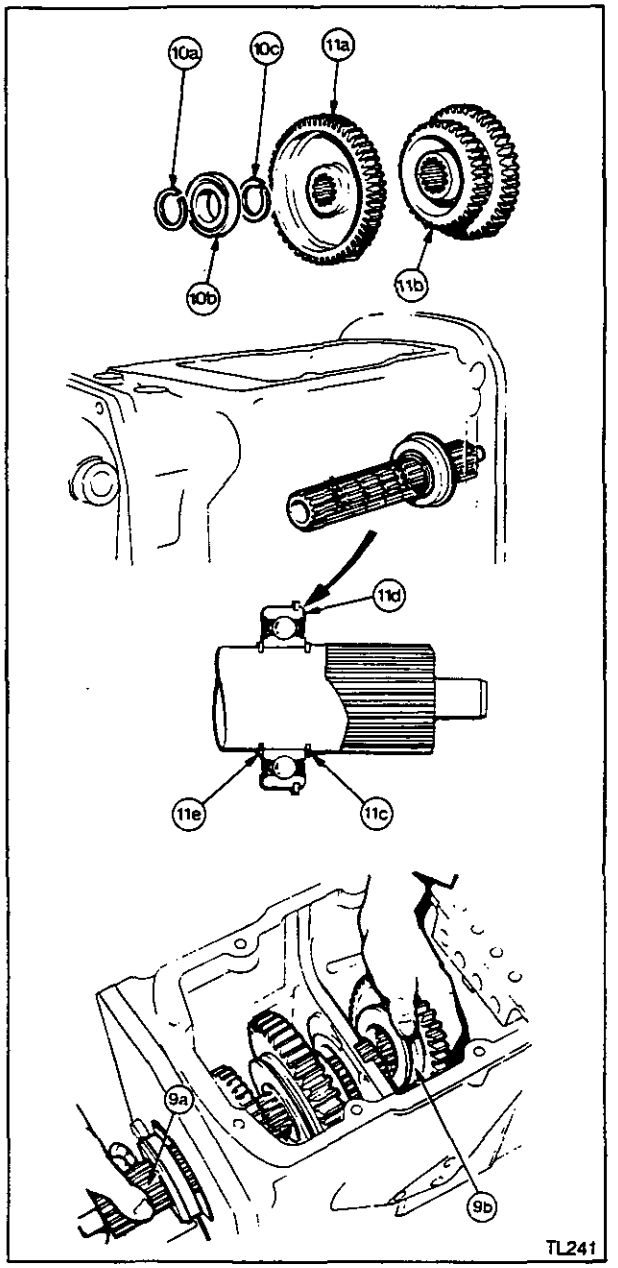
Note: All snap rings must be renewed. Ensure that they are all correctly located in their grooves.

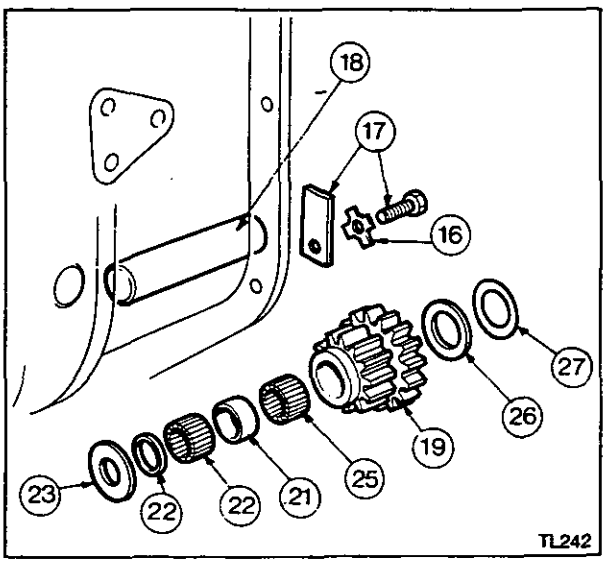
Reverse Idler

21. Fit the centre spacer into the reverse gear cluster.
22. Refit the first set of 28 rollers.

Note: Smear the rollers in petroleum jelly (not grease) to assist reassembly.

23. Refit the spacer to the end of the reverse idler with the needle rollers assembled.
24. Refit the thrust washer.
25. Refit the second set of rollers.
26. Refit the second spacer.
27. Refit the second thrust washer.
28. Slide the dummy shaft into the reverse gear cluster to hold the rollers in place.
29. Slide the distance piece over the dummy shaft on the rear end of the reverse gear cluster. Reverse procedures 16-19.





30. Fit a new lock washer to lock the retaining bolt.

Layshaft

31. Reverse procedures 12 to 14.

Mainshaft

32. Reverse procedures 9 to 11.

Input shaft

33. Reverse procedures 7 to 8. Ensure that the thrust washer, with oil grooves is placed on the rear of the main input shaft with the oil grooves facing the rear of the gearbox and that it is lightly oiled.
34. Refit the PTO drive shaft and the PTO front bearing, see operation 7A-08.
35. Refit the input shafts and housing, see operation 7A-07.
36. Refit the epicyclic reduction unit, see operation 7A-04.
37. Refit the shifter rails and forks, see operation 7A-03.
38. Refit the clutch release mechanism, see operation 6A-04.
39. Refit the gearbox to the tractor.

8 SPEED MANUAL MKI ZF SYNCHROMESH GEARBOX

Section 7 – Part B

Table of Contents

7B–2

8 SPEED SYNCHROMESH GEARBOX

Specification

Model	8 speed manual MKI Synchromesh
No of gears	
Forward	8
Reverse	2
Synchromesh type	ZF
Epicyclic reduction unit	4.1 (Low range)
Normal duty	M-F 340, 350, 355, 360, 362 and 365
Heavy duty	M-F 375 and 390

Settings Required

Synchromesh neutral	See procedure 7B-03
Synchromesh ring to coupler clearance	0,8 mm (0.030 in) minimum

Special tools

MF218A	PTO drive shaft puller
MF255B	PTO input shaft oil seal replacer
MF315A	Needle roller bearing remover/replacer
MF331	Input-shaft oil seal replacer
MF414	Synchromesh centralising pin
MF415	Synchromesh hub assembly tool
MS550	Drive handle
KMF1004	Input shaft oil seal protector sleeve

Bolt Torques

Gear lever cover to shift tower	50- 70 Nm (37-52 lbf ft)
Shift tower to gearbox top	102-122 Nm (75-90 lbf ft)
Shifter Fork locking screws	34- 52 Nm (25-38 lbf ft)
Interlock bolt to gearbox case	40- 47 Nm (30-35 lbf ft)
Epicyclic unit to gearbox case	40- 47 Nm (30-35 lbf ft)
Input shaft housing to gearbox case	54- 61 Nm (40-45 lbf ft)
PTO drive shaft bearing housing to gearbox	54- 61 Nm (40-45 lbf ft)
Gearbox to engine	100-130 Nm (74-94 lbf ft)
Gearbox to rear transmission case	102-122 Nm (75-90 lbf ft)

General Description

This gearbox is similar to the MK 1 eight speed standard gearbox described in section 7A, having four forward and one reverse gearbox, doubled by an epicyclic reduction unit to give eight forward and two reverse gears.

The gearbox differs by having a synchromesh gear change on the top two gears, 3rd and 4th. This arrangement makes three synchronised gear changes available as follows:

1. From 2nd to 3rd ratio.
2. From 3rd to 4th ratio.
3. From 4th to 3rd ratio.

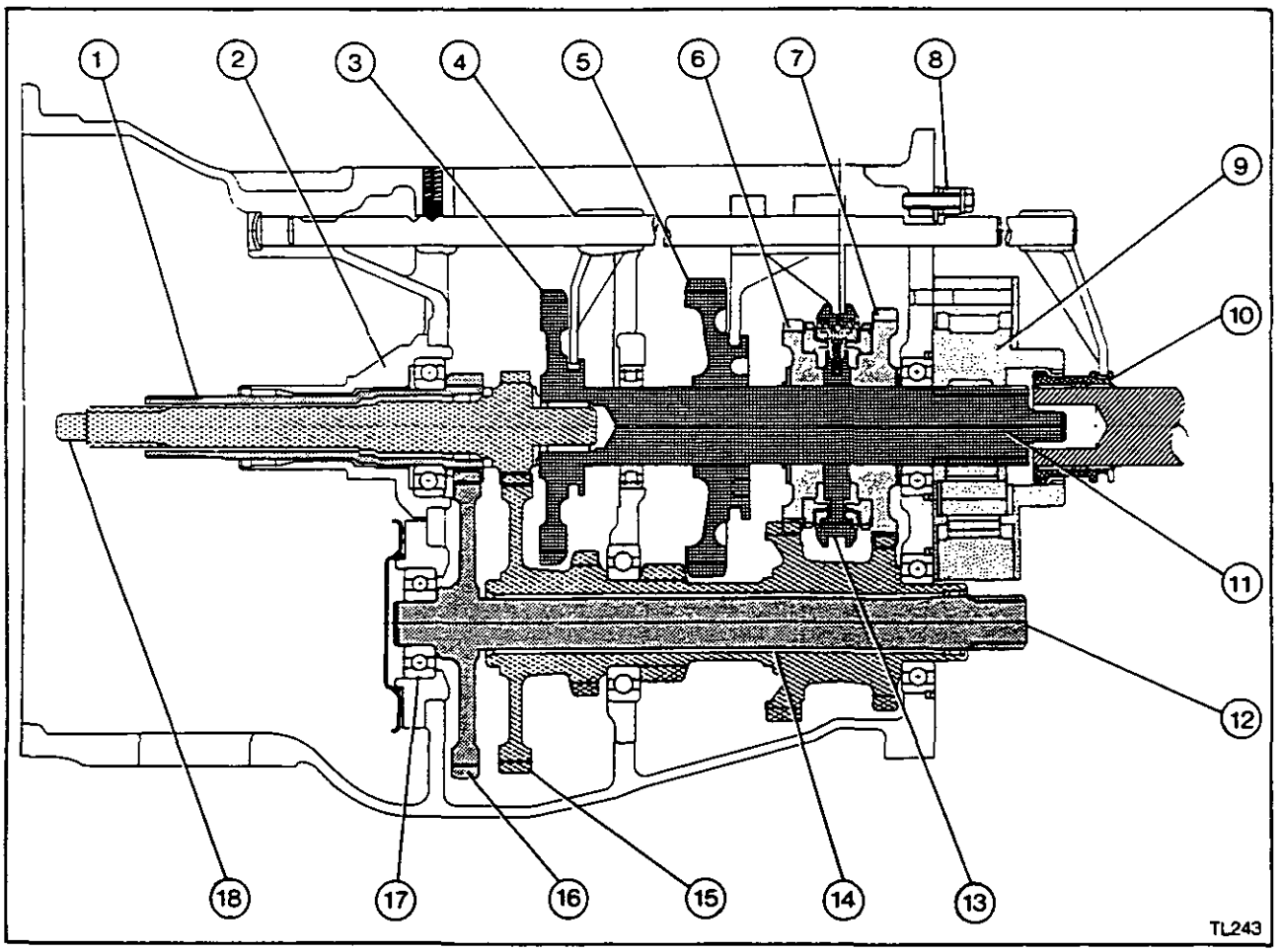
An additional advantage of the arrangement is the very logical sequence of gear changing it makes possible.

The main difference in the construction of the gearbox is that the mainshaft has two free running gears (3rd and 4th ratios). These free running gears are in constant mesh with their corresponding gears on the layshaft and are brought into engagement with the mainshaft by means of a ZF synchromesh engagement mechanism.

The synchromesh mechanism synchronises (equalises) the speed of the selected free-running gear with the main shaft before drive engagement. This is of great benefit to the driver since fast, easy gear changes can be made on the move without the need to stop the tractor.

The remaining gears, 1st – reverse and 2nd ratios are engaged by sliding gears the same as the standard type MK 1 gearbox.

8 SPEED SYNCHROMESH GEARBOX



1. PTO input shaft and gear
2. Input shaft housing
3. Second gear
4. Selector rails and forks
5. First/reverse gear
6. Fourth gear
7. Third gear
8. Gear shift interlock
9. Epicyclic reduction unit
10. Sliding coupler
11. Mainshaft
12. PTO shaft
13. Synchromesh mechanism and sliding coupler
14. Layshaft
15. Transmission constant mesh gear
16. PTO constant mesh gear
17. PTO front bearing housing
18. Transmission input shaft and gear

8 SPEED SYNCHROMESH GEARBOX

Main Gear Shift Lever

Removal and refitment 7B-01

Removal

1. Remove the cab floor mat and/or access panels if fitted.
2. Move the gear levers to the neutral position.
3. Remove the five bolts holding the gearlever assembly to the shift tower on top of the gearbox.
4. Remove the gear lever assembly from the tractor.
5. Remove the gear lever rubber cover.

Caution: When removing the spring retaining clip (7) care must be taken to prevent the spring from flying out and causing possible injury or damage.

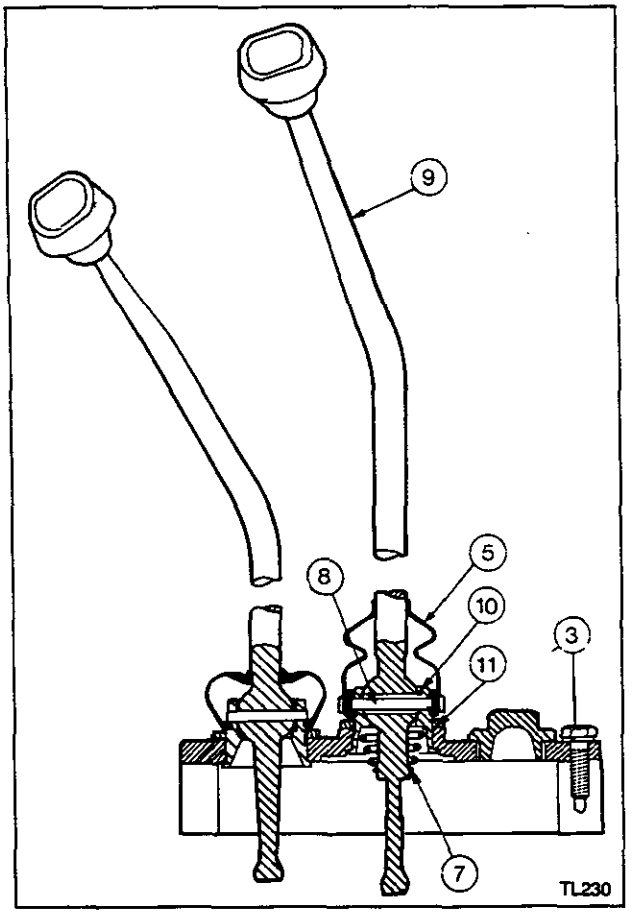
6. Place the gear lever assembly in a vice.
7. Press the spring retainer clip towards the spring, slide sideways and remove. This will release the spring.
8. Press out the gear lever retaining clip.
9. Lift out the gear lever.
10. The gear lever cup may be removed from the cover if required.
11. Unscrew the retaining nut and press out the cup.

Refitment.

12. Reverse procedure 1 to 11 except:
    a. If the gear lever cup has been removed ensure that it is fitted with the gear lever retaining pin square with the axis of the tractor by lining up the flats on the cup.

b. Ensure that the gear lever rubber cover is in good condition to prevent dirt getting into the transmission.

c. Coat the underside of the gearlever cover with Loctite 515 and torque the cover bolts to 50-70 Nm (37-52 lbf ft).

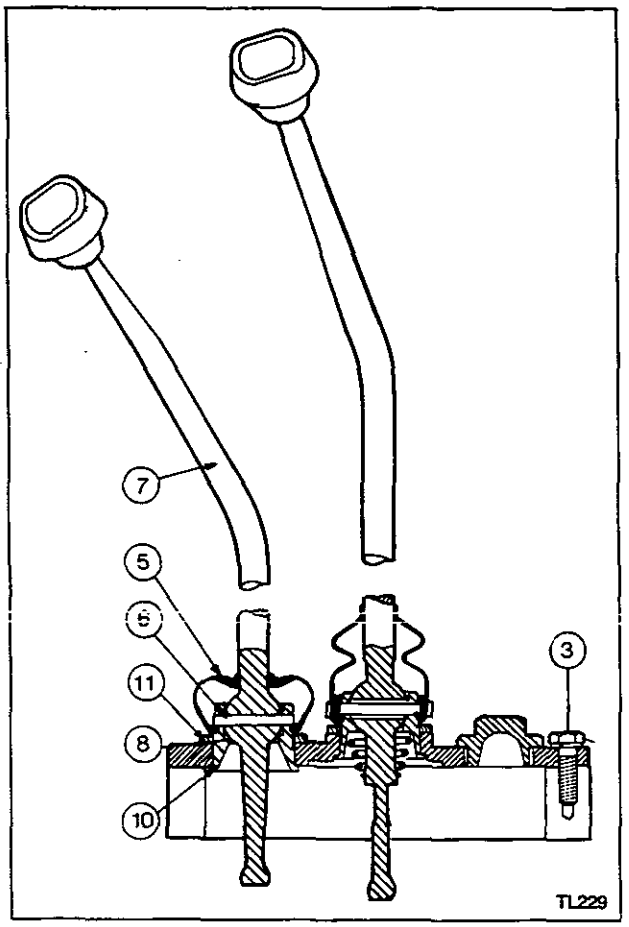


High/Low Shift Levers

Removal and Refitment 7B-02

Removal

1. Remove the cab floor mat and/or access panels if fitted.
2. Move the gear levers to the neutral position.
3. Remove the five bolts holding the gear lever assembly to the top of the gearbox.
4. Remove the gear lever assembly from the tractor.
5. Remove the gear lever rubber cover.
6. Remove the gear lever retaining pin.
7. Lift out the gear levers.
8. Remove the 'O' ring.
9. The gear lever clip may be removed if required.
10. Unscrew the retaining nut and press-out the cup.



Refitment

11. Reverse proceedure 1 to 11 except:
    a. Renew the 'O' ring.
    b. If the gear lever cup has been removed make sure that it is fitted with the gear lever retaining pin square with the axis of the tractor by lining up the flats on the cup.
    c. Ensure that the gearlever rubber cover is in good condition to prevent dirt getting into the transmission.
    d. Coat the underside of the gearlever cover with Loctite 515 and torque the cover bolts to 50-70 Nm (37-52 lbf ft).

Selector Rails and Forks

Removal and Refitment 7B-03

Special Tools: MF414 Centralising pin and locating peg

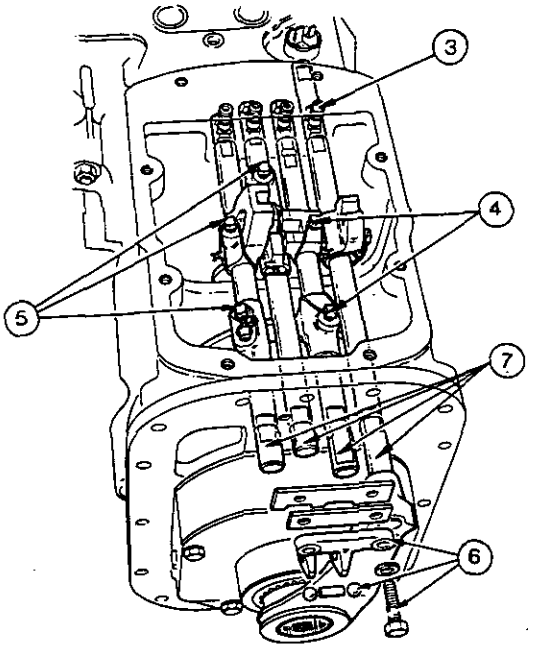
Removal

Caution: Beware of sharp edges around the top of the gearbox case.

1. Split the tractor between the gearbox and the spacer or centre housing, see section 2.
2. Remove the gearbox top cover and shift tower, see operation 7B-01.
3. Lift out the detent springs and plungers.
4. Remove the locking wires.
5. Loosen the locking screws.
6. Remove the bolts, fork, balls, peg, stop plate and plain plate of the gear shift interlock.
7. Slide the rails rearwards out of the casing retaining the gear lever engagement dogs and selector forks on each rail.
8. Lift out the selector forks.

Refitment

9. Reverse procedures 1 to 8 except:
    a. Apply a few drops of oil to the selector rails before refitment.
    b. Tighten the interlocking screws to a torque of 40-47 Nm (30-35 lbf ft).
    c. Tighten all selector fork locking screws to a torque of 34-52 Nm (25-38 lbf ft).
    d. On completion of the refitting procedure, place all the gears in the neutral position.
    e. Set the synchromesh selector fork to the neutral position by locating the selector rail with locating peg MF414/3 clamped to the gearbox casting with bolt MF414/2. Insert centralising pin MF414/1 into hole in top of the selector fork, aligning it with the hole in the sliding coupler.
    f. Tighten each locking screw in turn to the correct torque and ensure that the centralising pin MF414/1 rotates freely when the locking screws are tight.
    g. Secure all the locking screws with locking wire.



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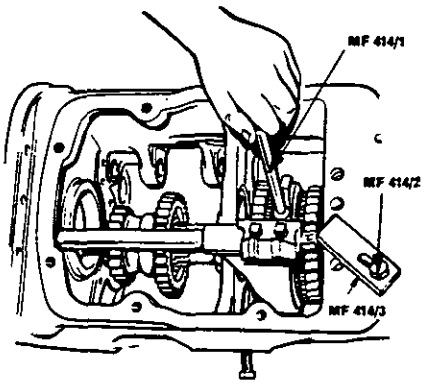


TL244

8 SPEED SYNCHROMESH GEARBOX

Normal and Heavy Duty Gearbox Epicyclic Unit

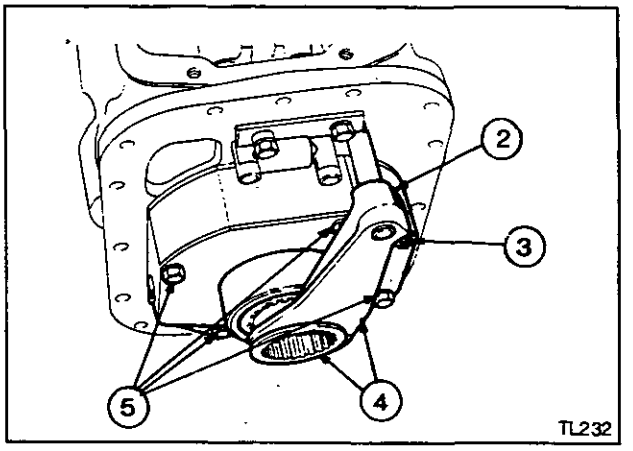
Removal and Refitment 7B-04

Removal

1. Split the tractor between the gearbox and the spacer or centre housing, see section 2.
2. Remove the locking wire.
3. Remove the locking screw.
4. Remove the selector fork and coupling.
5. Remove the bolts.
6. Remove the complete assembly.

Refitment

7. Reverse procedures 1 to 6 except:
   a. Ensure that the front and rear thrust rings are correctly located before refitment.
   b. Ensure that the dowels are correctly located in the gearbox casing.
   c. Locate the cover plate with the cut out in the bottom left hand corner for heavy duty, and the bottom right hand corner for normal duty epicyclics.
   d. Fit a lockwasher to the lower right hand retaining bolt, on normal duty epicyclic only.
   e. Tighten the retaining bolts progressively and evenly to a torque of 40-47 Nm (30-35 lbf ft).



TL232

Normal Duty Gearbox Epicyclic Unit

Overhaul 7B-05

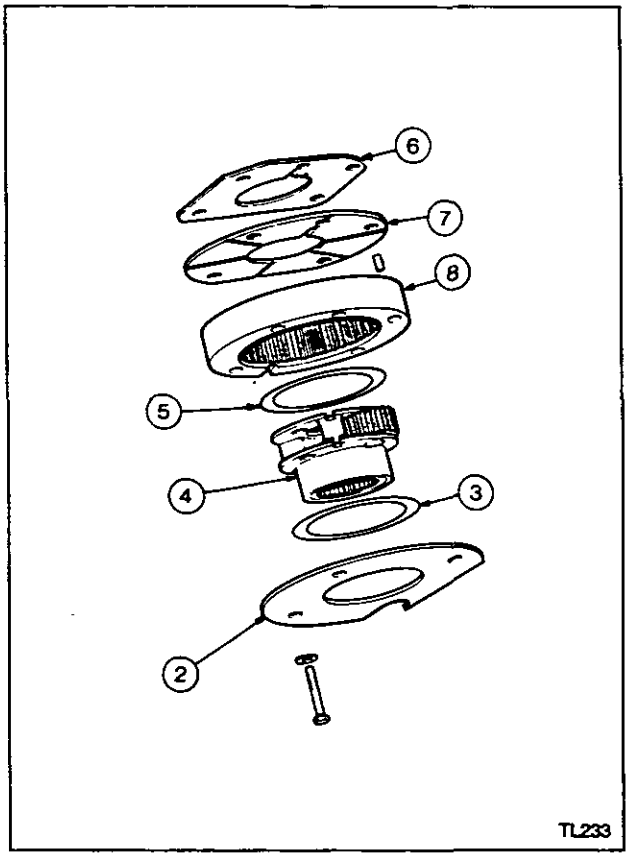
Disassembly

1. Remove the gearbox epicyclic unit, see operation 7B-04.
2. Remove the cover plate.
3. Remove the rear thrust ring.
4. Remove the planetary pinion carrier.
5. Remove the front thrust ring.
6. Remove the shim.
7. Remove the front plate.
8. If necessary, remove the dowel pins from the ring gear.

Note: The planetary pinion carrier cannot be serviced, and must be replaced as a complete assembly if found to be defective.

9. To remove pinions and needle rollers follow items 11, 12 and 13 in operation 7B-06.

Note: Spacers are fitted either side and between the needle rollers.



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Reassembly

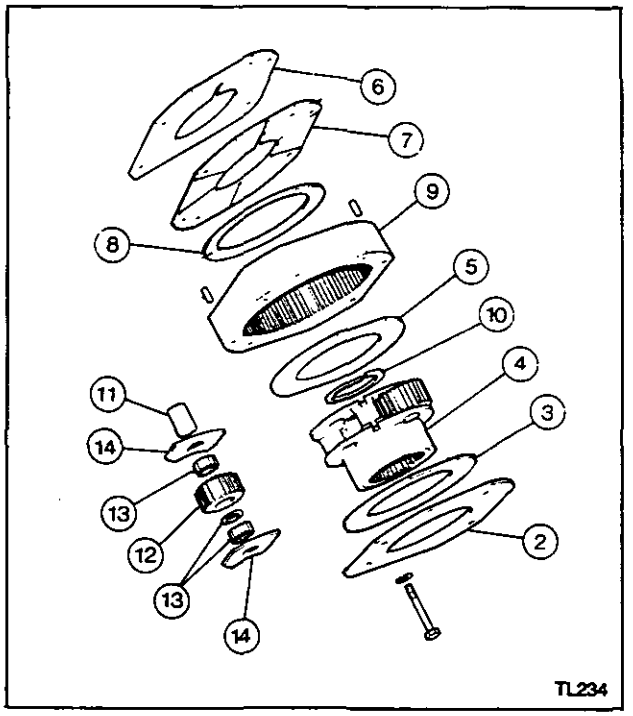
10. Reverse procedures 1 to 9 except:
    a. When replacing the rollers in the pinions, a smear of petroleum jelly (not grease) will help retain them. Do not omit the spacer from between the two runs of rollers. Each run consists of 27 rollers, see item 9.
    b. The front plate and the cover plate must be positioned with the oil grooves towards the pinion carrier.
    c. Always fit the same thickness of shims as those removed.
    d. To assist assembly of the front and rear thrust rings on the pinion carrier, smear them with petroleum jelly (not grease). Ensure that the tabs on the thrust rings locate in the pinion carrier cut-outs, and that the brass faces are away from the pinion carrier.

Heavy Duty Gearbox Epicyclic Unit

Overhaul 7B-06

Disassembly

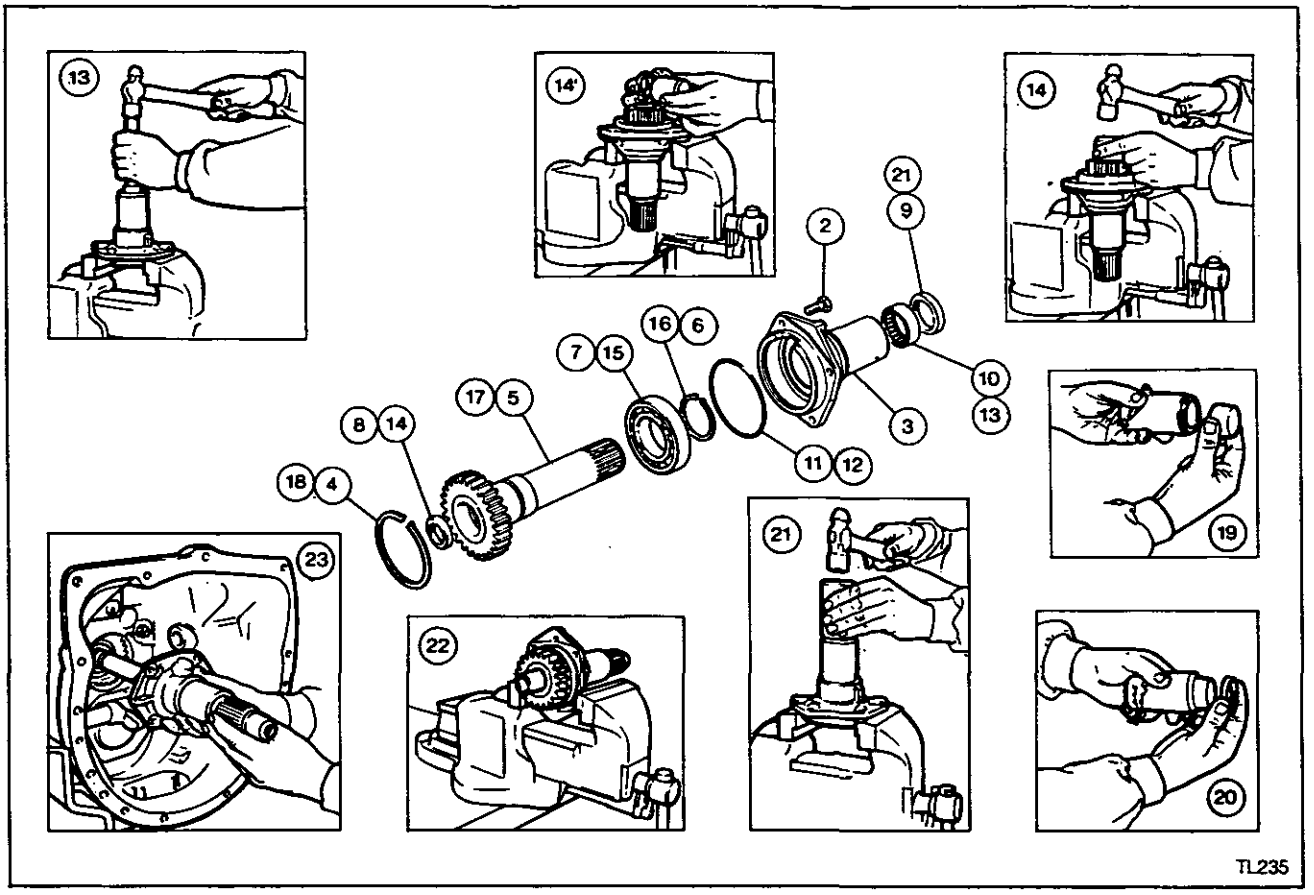
1. Remove the gearbox epicyclic, see operation 7B-04.
2. Remove the cover plate.
3. Remove the rear thrust ring.
4. Remove the planetary pinion carrier.
5. Remove the front thrust ring.
6. Remove the shim.
7. Remove the front plate.
8. Remove the Belleville spring disc.
9. If necessary, remove the dowels from the planetary ring gear.
10. Remove the external snap ring.
11. Gently tap out the three pinion shafts towards the front.
12. Remove the planetary pinions.
13. Remove the two sets of rollers and spacer from each pinion.
14. Remove the wear plates from each side of each pinion.



Reassembly

15. Reverse procedures 1 to 14, except:
    a. When replacing the rollers in the pinions, a smear of petroleum jelly (not grease) will help retain them. Do not omit the spacer from between the two runs of rollers. Each run consists of 16 rollers.
    b. Ensure the Belleville spring disc is located correctly in the epicyclic ring gear with the concave face rearwards.
    c. The front plate and the cover plate must be positioned with the oil grooves towards the pinion carrier.
    d. Ensure that the pinion wear plates are refitted with the flats positioned innermost to the centre of the pinion carrier.
    e. Ensure the gap of snap ring is located midway between the planetary pinion shafts.
    f. Always fit the same thickness of shims as those removed.
    g. To assist assembly of the front and rear thrust rings on the pinion carrier, smear them with petroleum jelly (not grease). Ensure that the tabs on the thrust rings locate in the pinion carrier cut-outs, and that the brass faces are away from the pinion carrier.

8 SPEED SYNCHROMESH GEARBOX



Input Shafts and Housing

Removal and Refitment 7B-07

Special Tools:

MF255B	*PTO input shaft oil seal replacer*
MF315A	*Needle roller bearing remover/ replacer*
MF421	*Needle roller bearing and seal replacer*
MF422	*Needle roller bearing and oil seal remover*
KMF1004	*Input shaft oil seal protector sleeve*

Removal

1. Remove the clutch release mechanism, see operation 6A-04.
2. Remove the four bolts.
3. Withdraw the input housing complete, leaving the PTO input-shaft in position.
4. Remove the large internal circlip.
5. Push the PTO input shaft complete with bearing rearwards out of the housing.
6. If necessary, remove the circlip.
7. If necessary, press the bearing off the shaft.
8. Lever the seal out of the front of the housing.
9. Using MF315A, remove the needle roller bearing from the front of the housing.
10. Remove the 'O' Ring from the housing.
11. Using MF422 carefully remove the needle roller bearing from the inside of the input shaft.
12. Using MF422 remove the oil seal from the input shaft.

Refitment

13. Fit a new 'O' ring into the housing.
14. Using MF315A, replace the needle roller bearing in the housing.
15. Using MF421, fit a new seal into the input shaft with the lip of the seal facing the tool.
16. Using MF421, refit needle roller bearing into the input shaft with the round end of the cage to the bottom of the recess.
17. Refit the bearing onto the outside of the shaft with the shield towards the gear teeth.
18. Refit the circlip. (Check that it is properly seated.)
19. Refit the PTO input shaft and bearing into the input housing.
20. Refit the circlip. (Check that it is properly seated.)
21. Place the nylon cone adaptor MF255B/2 on the seal replacer MF255B/1.
22. Place the seal over the cone and onto the tool with the seal lip facing away from the tool and remove the nylon cone.
23. Place the tool over the PTO input shaft and tap the seal into place.

24. Carefully push guide KMF1004/2 into the rear end of the PTO input shaft. Carefully insert the tapered end of the protector sleeve KMF1004/1 through the guide. Remove the guide leaving the sleeve in position.
25. Carefully refit the input housing over the input shaft and withdraw the protector sleeve when the housing is in place.
26. *Refit the clutch release mechanism, see operation* 6A-04.

Note:

a. **Use petroleum jelly (not grease) to lubricate all seals and the needle roller bearing when refitting.**
b. **Lightly coat the bolt threads in Hylomar sealant when refitting, and tighten the bolts to a torque of 54-61 Nm (40-45 lbf ft).**

PTO Driveshaft Front Bearing

Removal and Refitment 7B-08

Special Tools: MF218A PTO drive shaft puller

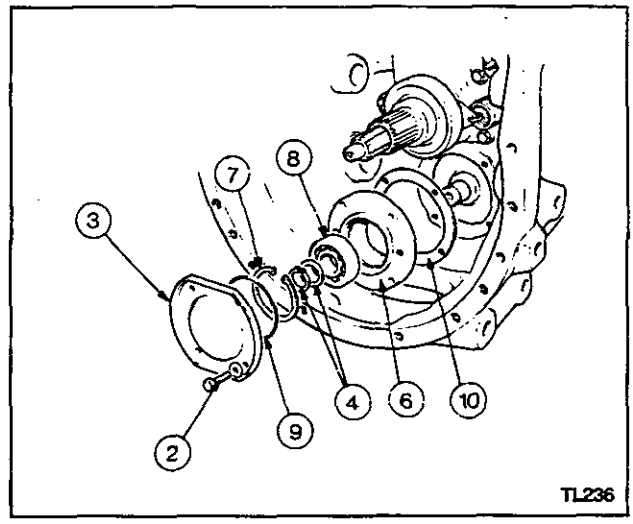
Removal

With the gearbox removed from the tractor:

1. Remove the cross shaft and lever, see operation 6A-04.
2. Remove the four bolts and washers.
3. Remove the cover plate.
4. Remove the external circlip and washer.
5. Screw two 3/8 UNC x 75 mm (3 in) bolts into the bearing housing and tighten them evenly to draw the housing from the case and shaft.
6. Remove the housing.
7. Remove the circlip.
8. Press out the bearing.
9. Discard the 'O' ring.
10. Discard the gasket.

Refitment

11. Reverse procedures 7 to 10, except:
    a. Fit a new 'O' ring gasket and circlip.
    b. Lightly coat the gasket with Hylomar sealant.
12. Using MF218A pull the bearing and housing assembly on the front end of the PTO drive shaft ensuring that the splines on the shaft locate with those in the PTO constant mesh gear.
13. Fit a new circlip and washer.
14. Reverse procedures 1 to 6 except:
    a. Lightly coat the securing bolt threads with Hylomar sealant.
    b. Tighten the bolts to a torque of 54-61 Nm (40-45 lbf ft).



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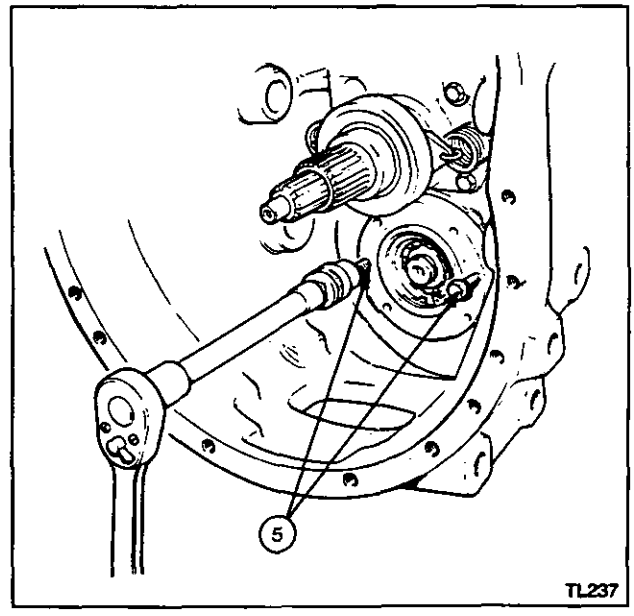

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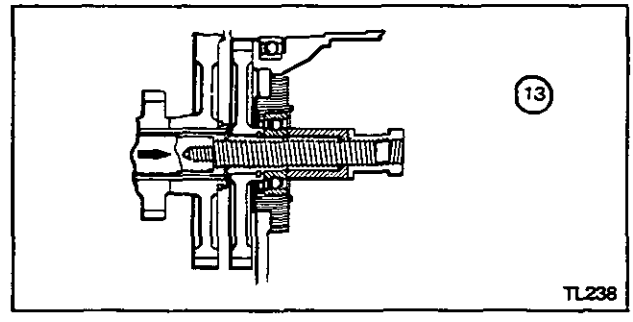

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8 SPEED SYNCHROMESH GEARBOX

Layshaft, Mainshaft, PTO Shaft and Gears

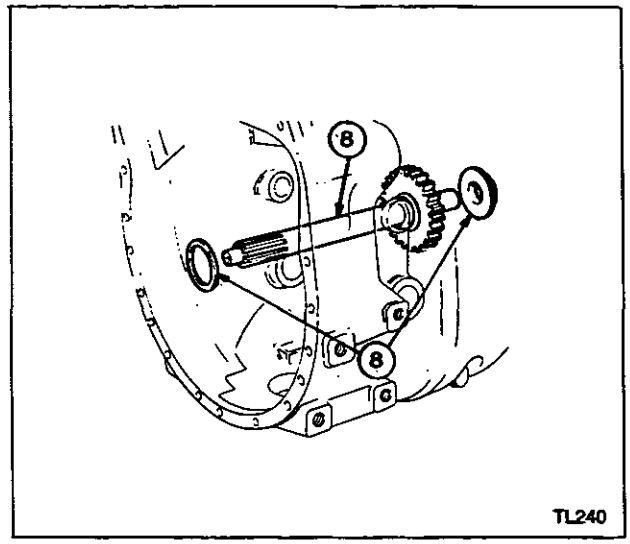
Overhaul	7B-09

Special Tools:

MF415	*Synchromesh hub assembly tool*
MS550	*Drive handle*

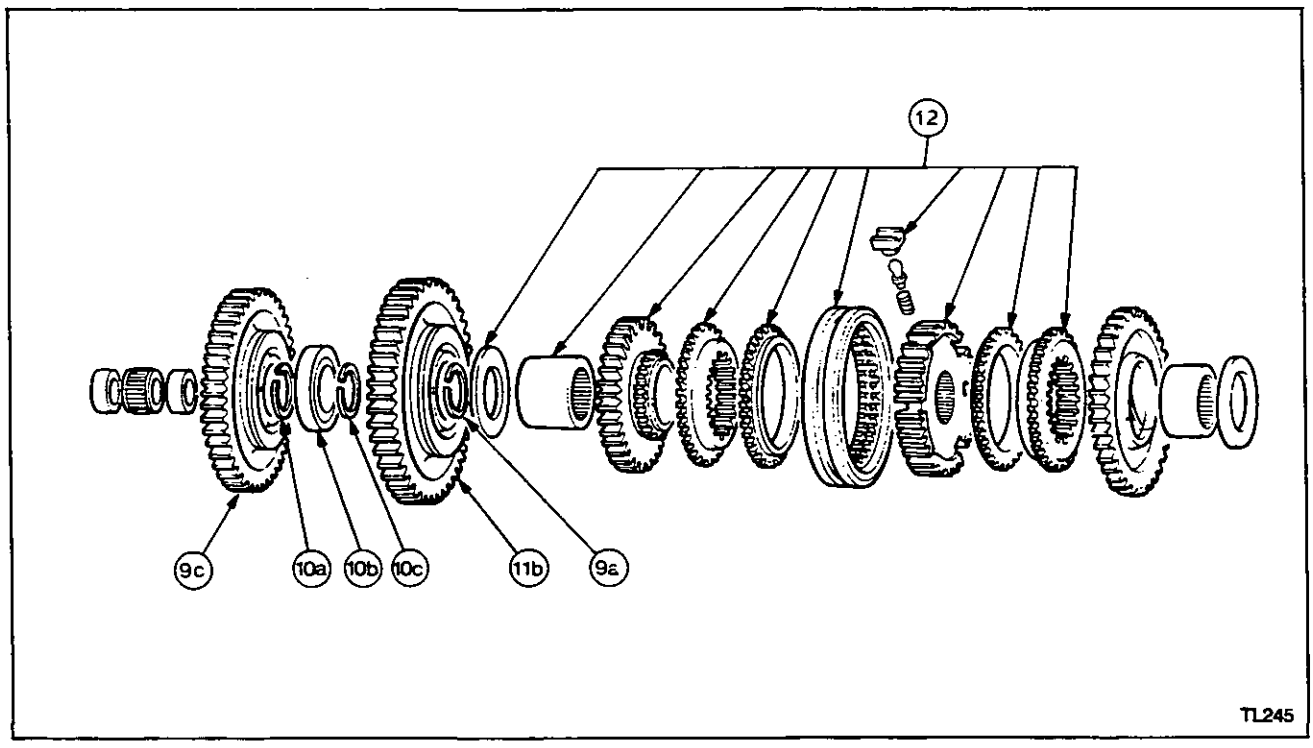
Disassembly

1. Remove gearbox from tractor, see section 2.
2. Remove clutch release mechanism, see operation 6A-04.
3. Remove shifter rails and forks, see operation 7B-03.
4. Remove epicyclic reduction unit, see operation 7B-04.
5. Remove input shafts and housing, see section 7B-07.
6. Remove the PTO drive shaft front bearing, see operation 7B-08. Withdraw the PTO drive shaft.

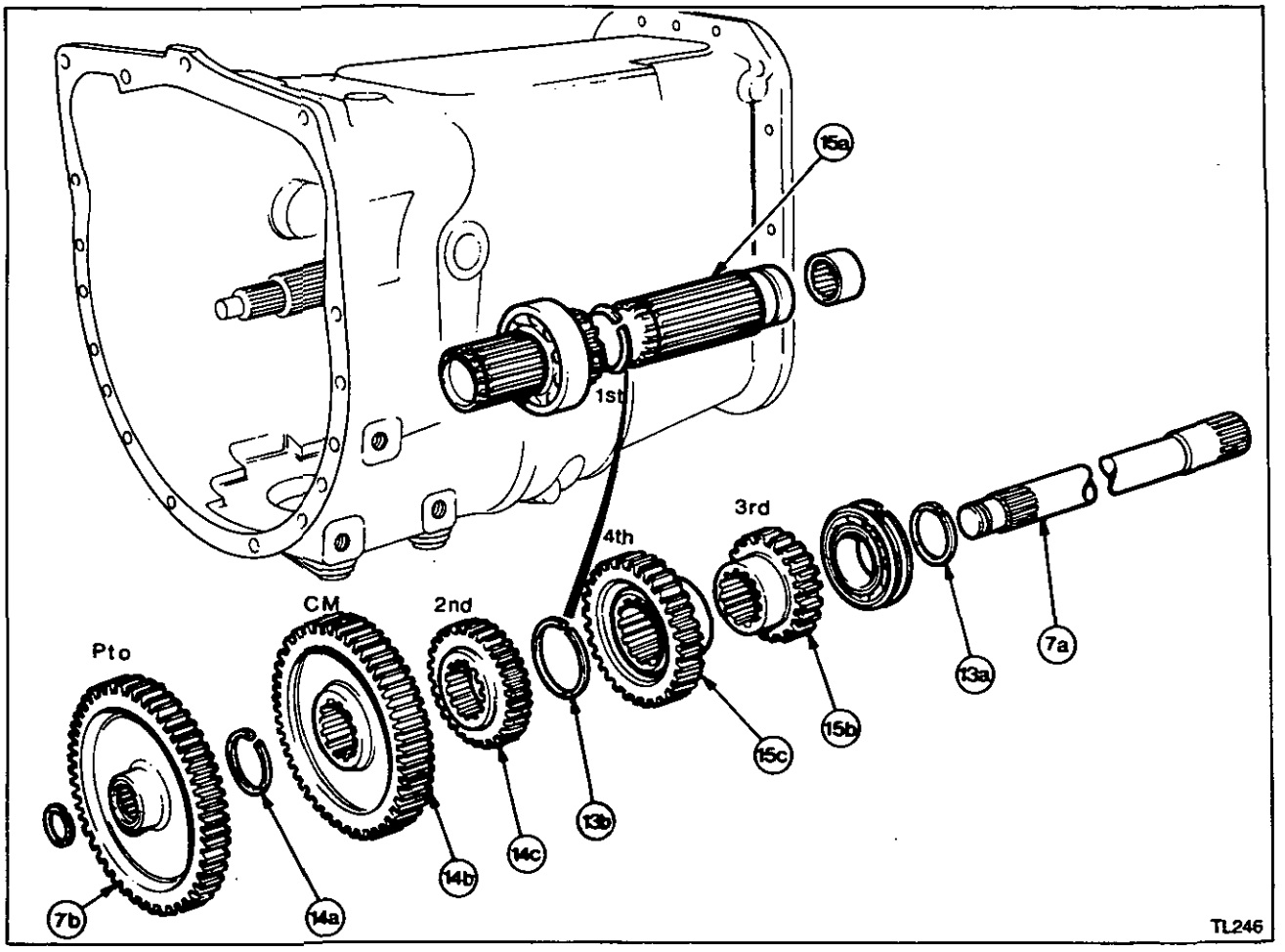


Input shaft and PTO gears.

7. Withdraw the PTO shaft (7A) rearwards to allow the PTO constant mesh gear (7B) to drop into the housing.
8. Remove the main drive input shaft complete with two thrust washers. Lift out the PTO constant mesh gear.



8 SPEED SYNCHROMESH GEARBOX



Mainshaft

9. Move snap ring (9A) in front of the 4th gear forwards along the mainshaft (9B). Draw the shaft rearwards and remove 2nd gear (9C).
10. Remove the snap ring (10A) from in front of the forward mainshaft support bearing (10B). Draw the bearing off the shaft and remove the second snap ring (10C).
11. Draw the mainshaft (11A) rearwards, progressively moving the snap ring forwards as necessary until the 1st gear (11B) can be removed.
12. Remove the snap ring (9A), withdraw the mainshaft and lift out 3rd and 4th gear and the synchromesh hub assembly.

Layshaft

13. Remove the rear snap ring (13A) on the layshaft and tap the shaft forward sufficiently to uncover the snap ring (13B) in front of the 4th gear. Move the snap ring onto the unsplined portion of the shaft.
14. Remove the snap ring (14A) from the front of the layshaft and remove the constant mesh and second speed gears. The layshaft must be driven rearwards to accomplish this.
15. Drive the layshaft (15A) out through the front, removing third (15B) and fourth gears (15C).

8 SPEED SYNCHROMESH GEARBOX

Reverse idler

16. Obtain a length of steel bar 25 mm dia x 55 mm long (1 in dia x 2 3/16 in long) to make up a dummy shaft for the removal of the reverse idler.
17. Release the tabwasher.
18. Remove the bolt and locating tab.
19. Slide in the dummy shaft from the front of the reverse gear shaft towards the rear. This will push out the reverse gear shaft, and prevent the needle rollers from dropping into the gearbox case and allow the idler gear to be removed.
20. Remove the idler gear cluster, complete with all parts and the dummy shaft inside.
21. Withdraw the dummy shaft from the idler gears, and allow all parts to drop out, onto a clean work surface.

Synchromesh hub assembly

22. Remove the two synchroniser rings.
23. Remove the drive hub complete with the sliding coupler.
24. Wrap the hub and coupler in a cloth.
25. Remove the sliding coupler, taking care not to lose the pressure springs, plungers and blocks.
26. Remove the three pressure blocks.
27. Remove the three plungers.
28. Remove the three springs.
29. Thoroughly clean all the components and check their condition.
30. Using a feeler gauge, measure the clearance between the synchroniser ring and the coupler on the gear at several points. The synchroniser ring must be correctly positioned on the tapered part of the splined ring. If the clearance is less than 0,5 mm (0.020 in) replace the synchroniser ring. If the clearance is checked with the gearbox assembled, replace the synchroniser ring if the clearance is found to be less than 0,8 mm (0.030 in).

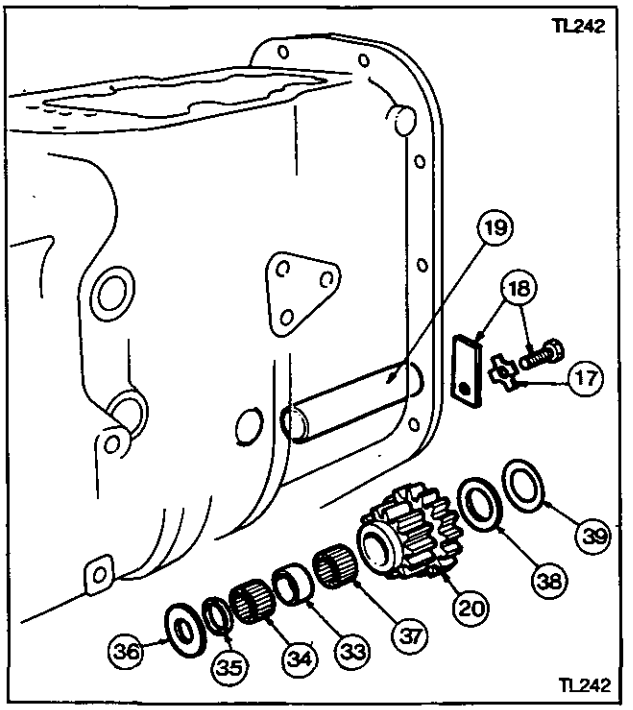
Reassembly

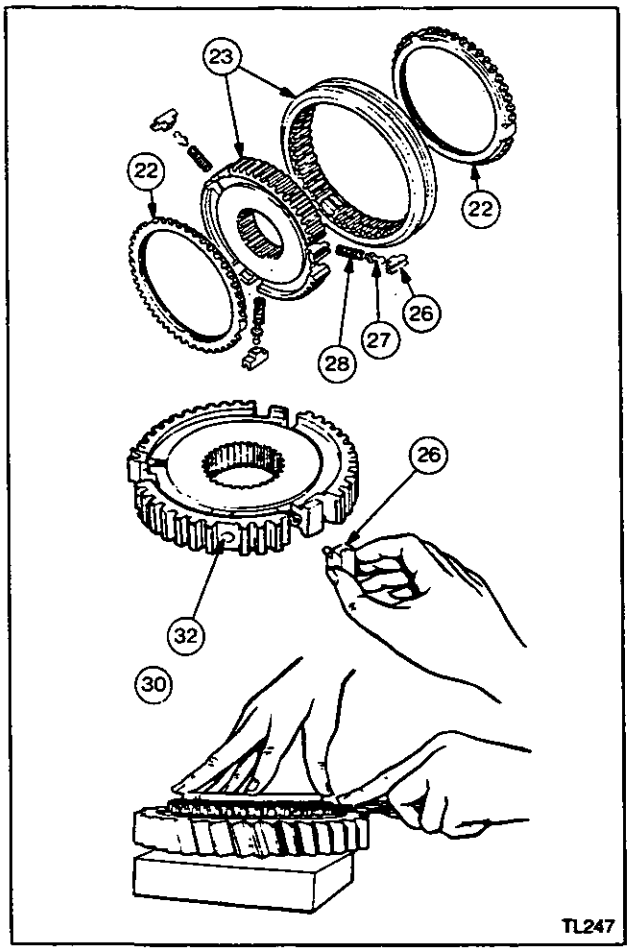
Note: Renew all snap rings. When refitting ensure that they are correctly located in their grooves.

Synchromesh hub assembly

31. Reverse procedures 22-30.
32. When replacing pressure springs, plungers and blocks in the coupler ring, special service tool MF415 and MS550 must be used to locate the hub in the sliding coupler.

Note: Ensure that the centralisation holes in the hub and coupler are aligned.





Reverse idler

33. Fit the spacer in the reverse gear cluster.
34. Refit the first set of rollers. Each run consists of 28 rollers.

Note: Smear the rollers in petroleum jelly (not grease) to help reassembly.

35. Refit the retaining ring.
36. Refit the thrust washer.
37. Refit the second set of rollers.
38. Refit the retaining ring.
39. Refit the thrust washer.
40. Slide the dummy shaft into the reverse gear cluster rollers.
41. Slide the distance piece over the dummy shaft on the rear end of the reverse gear cluster.
42. Reverse procedures 17 to 20.
43. Fit a new tab washer to lock the retaining bolt.

Layshaft

44. Place 3rd and 4th gears in the bottom of the gearbox and refit the layshaft from the front.
45. Drive the layshaft rearward and replace 2nd gear and the transmission constant mesh gear. Drive the layshaft forward and replace the snap ring holding 3rd and 4th gears in place.
46. Move the layshaft rearward and replace the snap ring at the front end retaining 2nd gear and constant mesh gear. Refit the rear bearing and snap ring.

Mainshaft

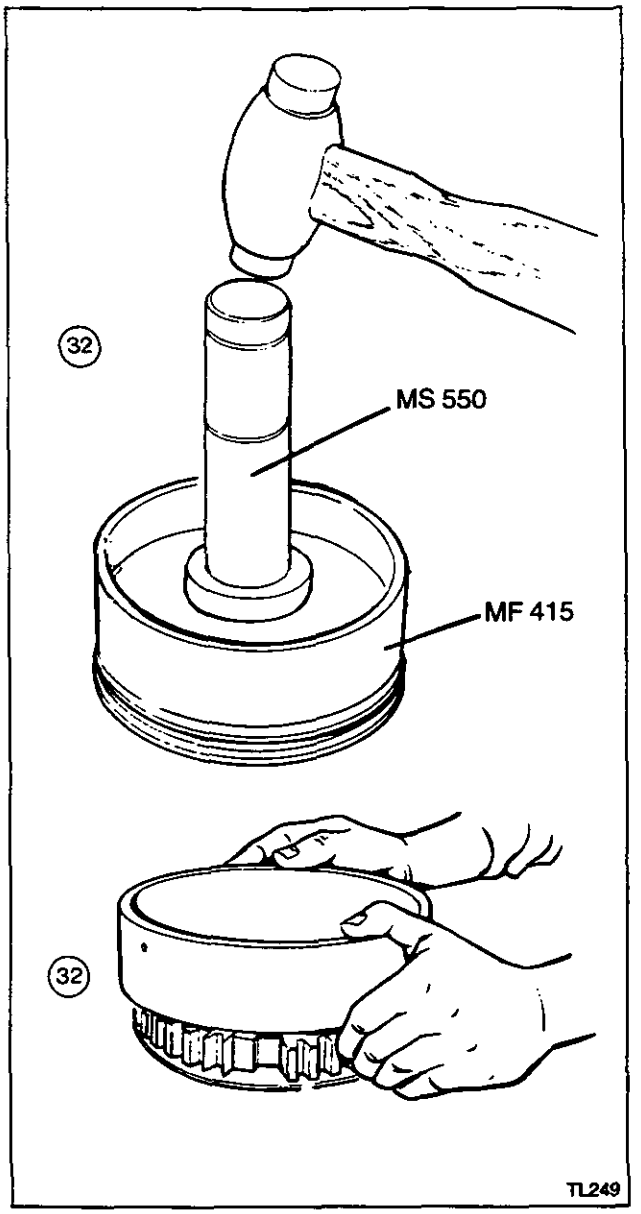
47. Slide the mainshaft through the rear of the gearbox, progressively fitting in order: Steel reversible thrust washer Third gear with the long bush Synchromesh hub assembly Fourth gear with the short bush Steel reversible thrust washer Snap ring First gear Snap ring Bearing Snap ring Second gear.

Note: Ensure first and second gears are fitted before finally locating snap rings:

a. In front of fourth gear
b. In front of mainshaft support bearing.

Input shaft and PTO gears

48. Place the PTO constant mesh gear in the bottom of gearbox and refit the main drive input shaft with its two thrust washers.
49. Refit the PTO shaft from the rear.
50. Refit the PTO drive shaft front bearing, see operation 7B-08.
51. Refit the input housing and shaft, see operation 7B-07.
52. Refit the epicyclic reduction unit, see operation 7B-04.
53. Refit the shifter rails and forks, see operation 7B-03.
54. Refit the clutch release mechanism, see operation 6A-04.
55. Refit the gearbox to the tractor.



6 SPEED MANUAL SHUTTLE GEARBOX

Section 7 – Part C

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7C–2

6 SPEED SHUTTLE GEARBOX

Specification

Model	6 Speed manual shuttle gearbox
No of gears	
Forward	6
Reverse	6
Setting Required:	
Inputshaft end float	0,25-0,50 mm (0.010-0.020 in)
Model application	M-F 360 North America only

Special tools

MF218A	PTO drive shaft puller
MF255B	PTO input shaft oil seal replacer
MF315A	Needle roller bearing remover/replacer
MF421	Needle roller bearing and seal replacer
MF422	Needle roller bearing and seal remover
KMF1004	Input shaft oil seal protector sleeve

Bolt Torques

Gearlever cover to shift tower	50- 70 Nm (37-52 lbf ft)
Shift tower to gearbox top	102-122 Nm (75-90 lbf ft)
Shifter fork locking screws	34- 52 Nm (25-38 lbf ft)
Interlock bolts to gearbox case	40- 47 Nm (30-35 lbf ft)
Epicyclic housing to gearbox case	40- 47 Nm (30-35 lbf ft)
Input shaft housing to gearbox case	54- 61 Nm (40-45 lbf ft)
PTO drive shaft bearing housing to gearbox	54- 61 Nm (40-45 lbf ft)
Engine to gearbox	100-130 Nm (74-94 lbf ft)
Gearbox to rear transmission case	102-122 Nm (75-90 lbf ft)

General Description

The gearbox has three forward and reverse gears which are doubled by a planetary unit to give six forward and six reverse.

The input shaft is driven by the main clutch plate and drives a central coupler mounted between two sets of free running gears in the front of the gearbox. The rear free running gear is the forward gear and meshes with the constant mesh gear on the layshaft.

The front free running gear meshes with the layshaft constant mesh gear through a reverse idler to give reverse.

The central coupler is moved by the forward/reverse gearlever to select either forward or reverse gear. It is held in either the engaged or neutral position by a spring loaded detent in the centre of the coupler hub.

The mainshaft is located above the layshaft and has mounted on it two sliding gears, one of which is a compound gear having two sets of teeth selecting 2nd and 3rd. The other gear selects 1st.

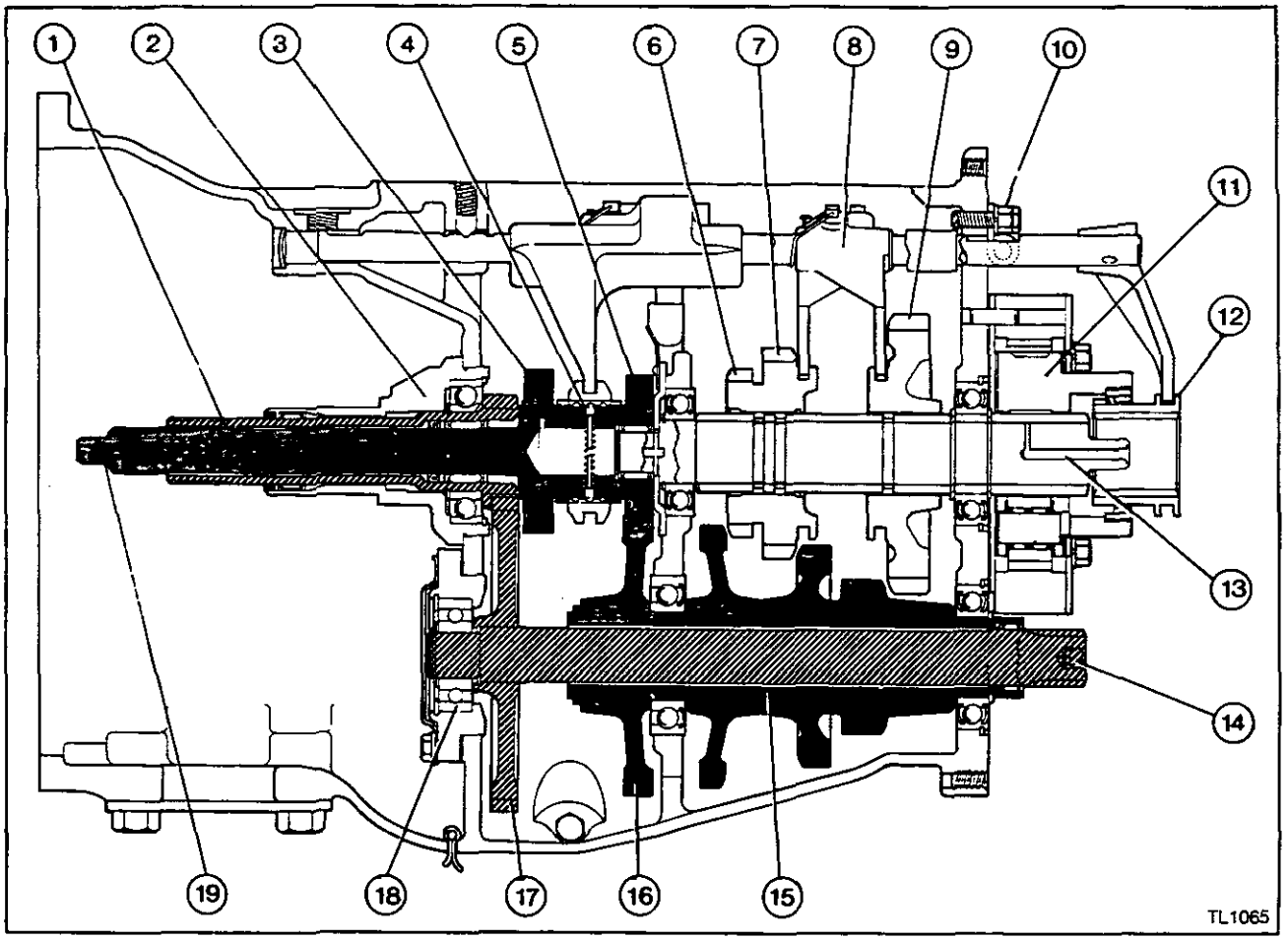
The sliding gears are operated by selector forks mounted on shifter rails which in turn are operated by a gear selector lever located directly above the gearbox.

The sliding gears mesh with the layshaft gears to give from the front, 1st, 3rd and 2nd gears respectively depending on the gear selected by the lever.

The epicyclic reduction unit is mounted on the back of the gearbox and is driven by the mainshaft. Low or High range is selected by a coupler, operated by a fork which in turn is operated by a three position selector lever. This is mounted alongside the forward/reverse lever. As well as selecting either high or low range,the lever also has a middle position or neutral which disengages the drive from the mainshaft to the rear axle drive pinion. In this neutral position an electrical contact is completed for starting. Thus engine starting in gear is prevented.

The PTO input shaft driven from the main clutch rotates a pair of constant mesh gears in the front of the gearbox. These in turn drive the PTO shaft which projects rearwards through the hollow layshaft to drive the linkage pump and PTO.

6 SPEED SHUTTLE GEARBOX



1. PTO input shaft and gear
2. Input shaft housing
3. Reverse constant mesh gear
4. Forward/reverse coupler
5. Forward constant mesh gear
6. Third gear
7. Second gear
8. Selector rails and forks
9. First gear
10. Gear shift interlock
11. Epicyclic reduction unit
12. Sliding coupler
13. Main shaft
14. PTO shaft
15. Layshaft
16. Transmission constant mesh gear
17. PTO constant mesh gear
18. PTO front bearing housing
19. Transmission input shaft

6 SPEED SHUTTLE GEARBOX

Main Gear Shift Lever

Removal and refitment 7C-01

Removal

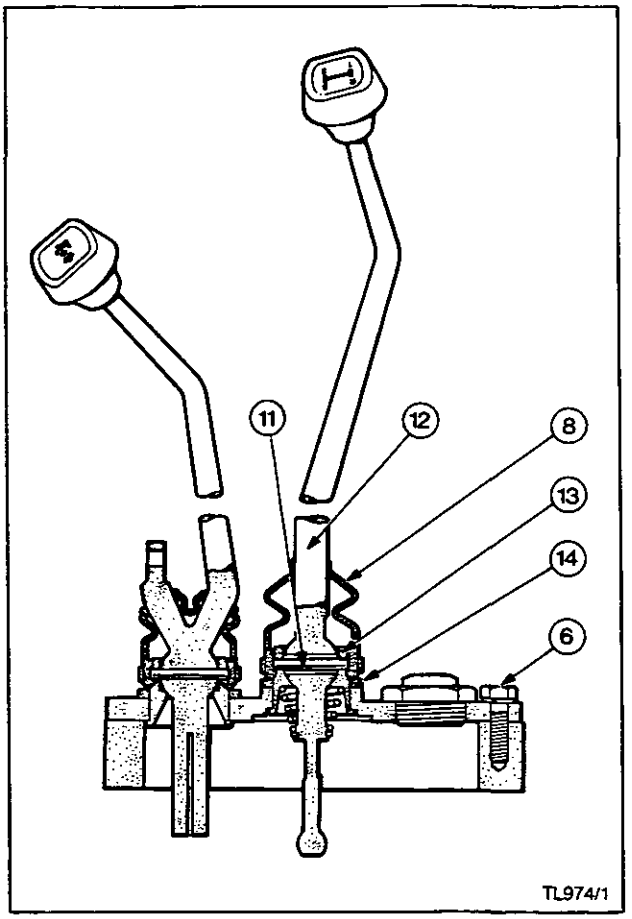
1. Remove the cab floor mat and/or access panels if fitted.
2. Move the gear levers to the neutral position.
3. Remove the split pin and pivot pin and disconnect the forward/reverse shift lever.
4. Remove the forward/reverse shift lever bracket bolts.
5. Remove the forward/reverse shift lever assembly.
6. Remove the five bolts holding the gearlever assembly to the shift tower on top of the gearbox.
7. Remove the gear lever assembly from the tractor.
8. Remove the gear lever rubber cover.

Caution: When removing the spring retaining clip (7) care must be taken to prevent the spring from flying out and causing possible injury or damage.

9. Place the gearlever assembly in a vice.
10. Press the spring retaining clip towards the spring, slide sideways and remove. This will release the spring.
11. Press out the gear lever retaining clip.
12. Lift out the gear lever.
13. The gear lever cup may be removed from the cover if required.
14. Unscrew the retaining nut and press out the cup.

Refitment.

15. Reverse procedure 1 to 14 except:
    a. If the gear lever cup has been removed ensure that it is fitted with the gear lever retaining pin square with the axis of the tractor by lining up the flats on the cup.
    b. Ensure that the gear lever rubber cover is in good condition to prevent dirt getting into the transmission.
    c. Coat the underside of the gearlever cover with Loctite 515 and torque the cover bolts to 50-70 Nm (37-52 lbf ft).



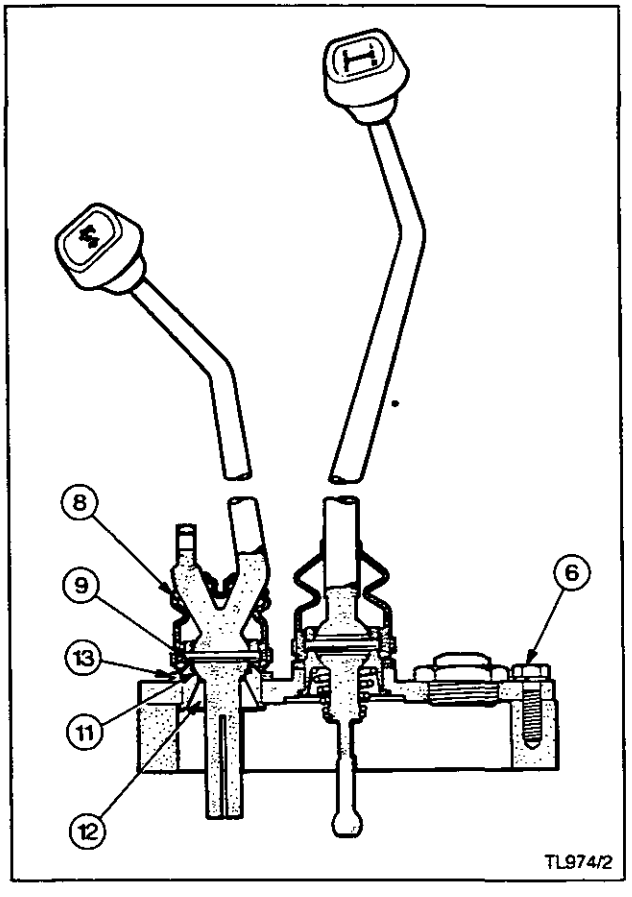
TL974/1

High/Low, Forward/Reverse Shift Levers

Removal and Refitment 7C-02

Removal

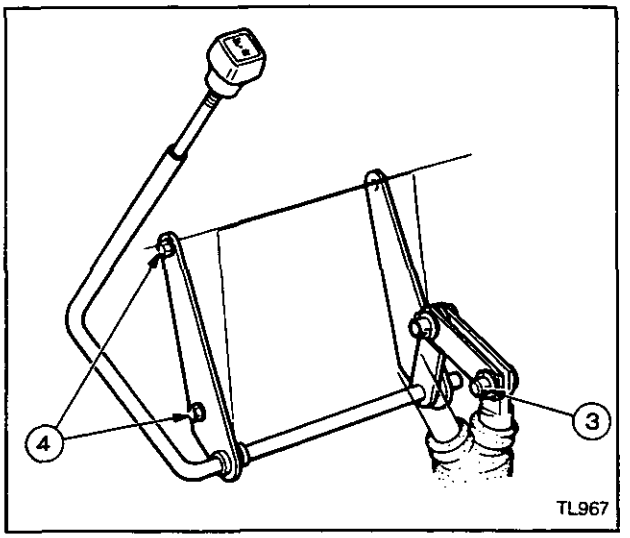
1. Remove the cab floor mat and/or access panels if fitted.
2. Move the gear levers to the neutral position.
3. Remove the split pin and pivot pin and disconnect the forward/reverse shift lever.
4. Remove the forward/reverse shift lever bracket bolts.
5. Remove the forward/reverse shift lever assembly.
6. Remove the five bolts holding the gear lever assembly to the top of the gearbox.
7. Remove the gear lever assembly from the tractor.
8. Remove the gear lever rubber cover.
9. Remove the gear lever retaining pin.
10. Lift out the gear levers.
11. Remove the 'O' ring.
12. The gear lever cup may be removed if required.
13. Unscrew the retaining nut and press-out the cup.



TL974/2

Refitment

14. Reverse the proceedure 1 to 13 except:
    a. Renew the 'O' ring.
    b. If the gear lever cup has been removed make sure that it is fitted with the gear lever retaining pin square with the axis of the tractor by lining up the flats on the cup.
    c. Ensure that the gearlever rubber cover is in good condition to prevent dirt getting into the transmission.
    d. Coat the underside of the gearlever cover with Loctite 515 and torque the cover bolts to 50-70 Nm (37-52 lbf ft).



Selector Rails and Forks

Removal and Refitment 7C-03

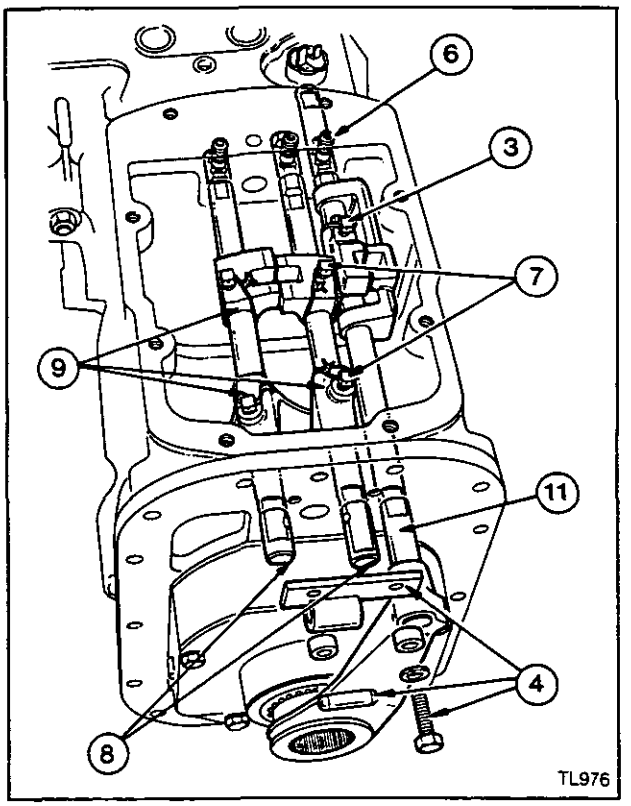
Removal

Caution: Beware of the sharp edges around the top of the gearbox case.

1. Split the tractor between the gearbox and the spacer housing or centre housing, and remove the gearbox, see section 2.
2. Remove the gearbox top cover and shift tower, see operation 7C-01.
3. Release the locking wires.
4. Remove the bolts, stop plate and peg of the gear shift interlock mechanism.
5. Disconnect and remove the spring and latch assembly (if fitted).
6. Lift out the detent springs and plungers.
7. Remove the locking screws.
8. Slide the rails rearward out of the housing.
9. Remove the selector forks from the gearbox.

Note: The position of both selector forks before removal. The thicker section of the selector forks goes to the rear of the gearbox when refitted.

10. Slide the High/Low rail rearwards and remove the coupling.
11. Rotate the High/Low rail through 90 degrees.
12. Remove the locking wire.
13. Remove the locking screw.
14. Slide the rail rearwards out of the housing, and remove the High/Low gear lever engagement forks and forward and reverse selector.



Refitment

15. Reverse procedures 1 to 14 except:
    a. Apply a few drops of oil to the selector rails before refitment.
    b. Tighten the interlock mechanism bolts to a torque of 40-47 Nm (30-35 lbf ft).
    c. Tighten all locking screws to a torque of 34-52 Nm (25-38 lbf ft).
    d. On completion of the refitting procedure, place all the gears in the neutral position.

6 SPEED SHUTTLE GEARBOX

Heavy Duty Gearbox Epicyclic

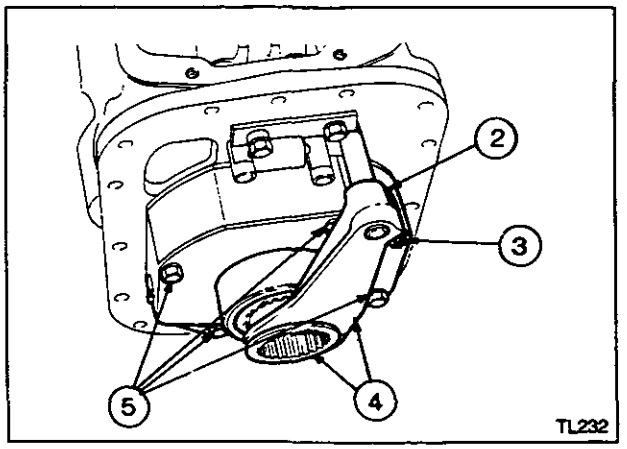
Removal and Refitment 7C-04

Removal

1. Split the tractor between the transmission and the centre housing, see section 2.
2. Remove the locking wire.
3. Remove the locking screw.
4. Remove the selector fork and coupling.
5. Remove the bolts.
6. Remove the complete assembly.

Refitment

7. Reverse the procedures 1 to 6 except;
   a. Ensure that the front and rear thrust rings are correctly located before refitment.
   b. Ensure that the dowels are correctly located in the gearbox casing.
   c. Locate the cover plate with the cut out in the bottom left hand corner.
   d. Tighten the retaining bolts progressively and evenly to a torque of 40-47 Nm (30-35 lbf ft).



Heavy Duty Gearbox Epicyclic Unit

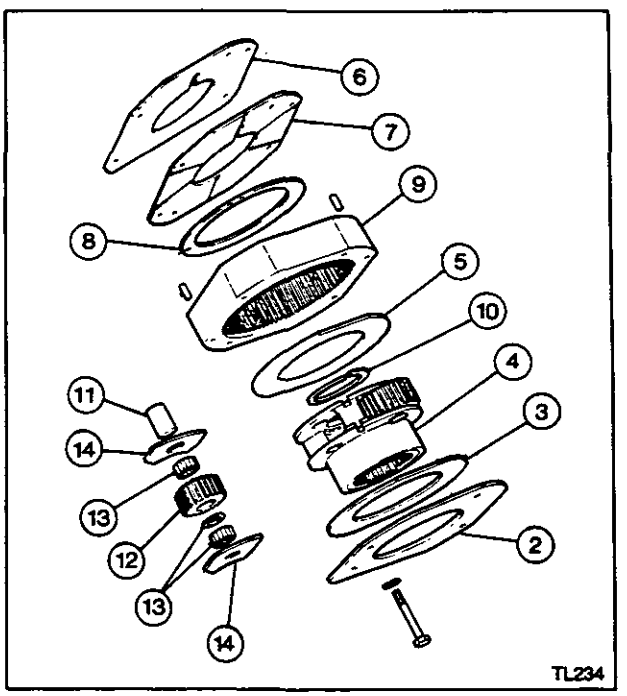
Overhaul 7C-05

Disassembly

1. Remove the gearbox epicyclic unit, see operation 7C-04.
2. Remove the cover plate.
3. Remove the rear thrust ring.
4. Remove the planetary pinion carrier.
5. Remove the front thrust ring.
6. Remove the shim.
7. Remove the front plate.
8. Remove the Belleville spring.
9. If necessary, remove the dowels from the planetary ring gear.
10. Remove the external snap ring.
11. Gently tap out the three pinion shafts towards the front.
12. Remove the planetary pinions.
13. Remove the two sets of rollers and spacer from each pinion.
14. Remove the wear plates from each side of each pinion.

Reassembly

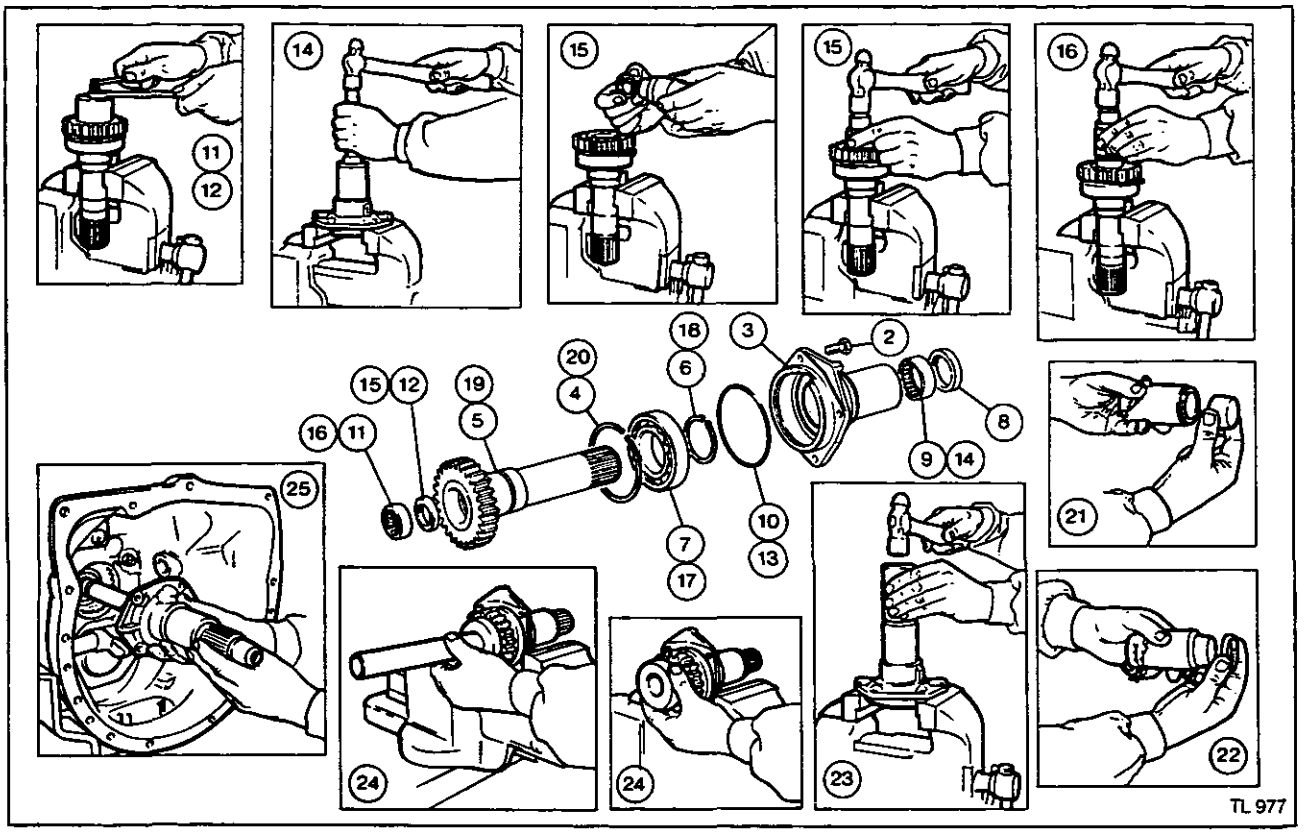
15. Reverse procedures 1 to 14, except:
    a. When replacing the rollers in the pinions, a smear of petroleum jelly (not grease) will help retain them. Do not omit the spacer from between the two runs of rollers. Each run consists of 16 rollers.
    b. Ensure the Belleville spring disc is located correctly in the epicyclic ring gear with the concave face rearwards.
    c. The front plate and the cover plate must be positioned with the oil grooves towards the pinion carrier.



d. Ensure that the pinion wear plates are refitted with the flats positioned innermost to the centre of the pinion carrier.
e. Ensure the gap of snap ring is located midway between the planetary pinion shafts.
f. Always fit the same thickness of shims as those removed.
g. To assist assembly of the front and rear thrust rings on the pinion carrier, smear them with petroleum jelly (not grease). Ensure that the tabs on the thrust rings locate in the pinion carrier cut-outs, and that the brass faces are away from the pinion carrier.

Note: On certain transmission builds, a ring is fitted between items 2 and 3 of the heavy duty epicyclic units.

6 SPEED SHUTTLE GEARBOX



Input Shafts and Housing

Removal and Refitment 7C-06

Special Tools:

MF255B	*PTO input shaft oil seal replacer*
MF315A	*Needle roller bearing remover/ replacer*
MF421	*Needle roller bearing and seal replacer*
MF422	*Roller bearing oil seal remover*
KMF1004	*Input shaft oil seal protector sleeve*

Removal

1. Remove the clutch release mechanism, see operation 6A-04.
2. Remove the four bolts.
3. Withdraw the input shaft complete with bearing rearwards out of the housing.
4. Remove the large internal circlip.
5. Push the PTO input shaft complete with bearing rearwards out of the housing.
6. If necessary, remove the circlip.
7. If necessary, press the bearing off the shaft.
8. Lever the seal out of the front of the housing.
9. Using MF315A, remove the needle roller bearing from the front of the housing.
10. Remove the 'O' Ring from the housing.
11. Using MF422, carefully remove the needle roller bearing from the inside of the input shaft.
12. Using MF422, remove the oil seal from the input shaft.

Refitment

13. Fit a new 'O' ring into the housing.
14. Using MF315A, replace the needle roller bearing in the housing.
15. Using MF421, fit a new seal into the input shaft with the lip of the seal facing the tool.
16. Using MF421, refit the needle roller bearing into the input shaft with the round end of the cage to the bottom of the recess.
17. Refit the bearing onto the outside of the shaft with the shield towards the gear teeth.
18. Refit the circlip. (Check that it is properly seated.)
19. Refit the PTO input shaft and bearing into the input housing.
20. Refit the circlip. (Check that it is properly seated.)
21. Place the nylon cone adaptor MF255B/2 on the seal replacer MF255B/1.
22. Place the seal over the cone and onto the tool with the seal toe facing away from the tool and remove the nylon cone.
23. Place the tool over the PTO input shaft and tap the seal into place.

24. Carefully push guide KMF1004/2 into the rear end of the PTO input shaft. Carefully insert the tapered end of protector sleeve KMF1004/1 through guide. Remove the guide leaving the sleeve in position.
25. Carefully refit the input housing over the input shaft and withdraw the protector sleeve when the housing is in place.
26. Refit the clutch release mechanism, see operation 6A-04.

Note:
a. **Use petroleum jelly (not grease) to lubricate all seals and the needle roller bearing when refitting.**
b. **Lightly coat the bolt threads with Hylomar sealant when refitting, and tighten the bolts to a torque of 54-61 Nm (40-45 lbf ft).**

PTO Driveshaft Front Bearing

Removal and Refitment 7C-07

Special Tools: MF218A PTO drive shaft puller.

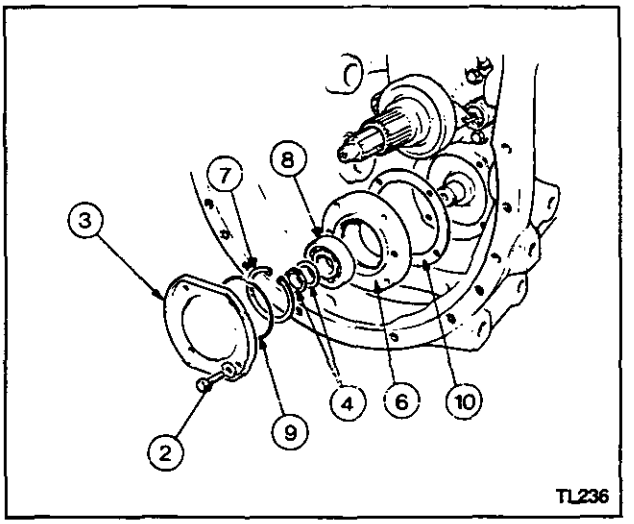
Removal

With the gearbox removed from the tractor:

1. Remove the clutch cross shaft and lever, see operation 6A-04.
2. Remove the four bolts and washers.
3. Remove the cover plate.
4. Remove the external circlip and washer.
5. Screw two 3/8 UNC x 75 mm (3 in) bolts into the bearing housing and tighten them evenly to draw the housing from the case and shaft.
6. Remove the housing.
7. Remove the circlip.
8. Press out the bearing.
9. Discard the 'O' ring.
10. Discard the gasket.

Refitment

11. Reverse procedures 7 to 10 except:
    a. Fit a new 'O' ring gasket and circlip.
    b. Lightly coat the gasket with Hylomar sealant.
12. Using MF218A, pull the bearing and housing assembly on the front end of the PTO drive shaft ensuring that the splines on the shaft locate with those in the PTO constant mesh gear.
13. Fit a new circlip and washer.
14. Reverse procedures 1 to 6 except:
    a. Lightly coat the securing bolt threads with Hylomar sealant.
    b. Tighten the bolts to a torque of 54-61 Nm (40-45 lbf ft).



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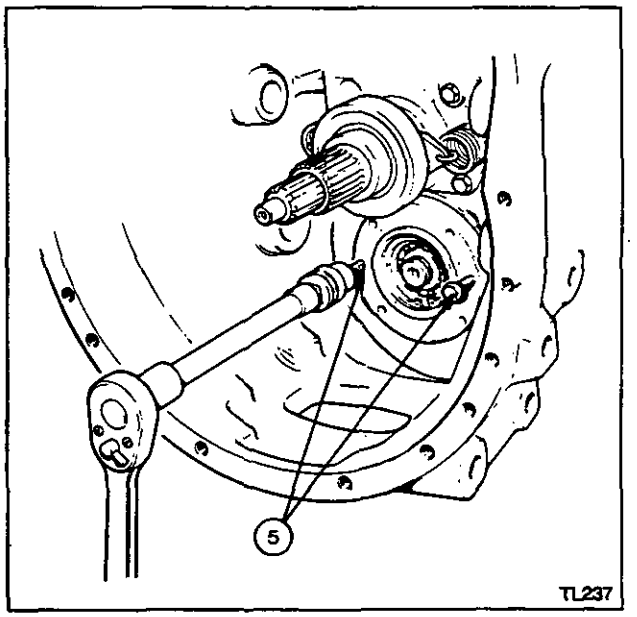

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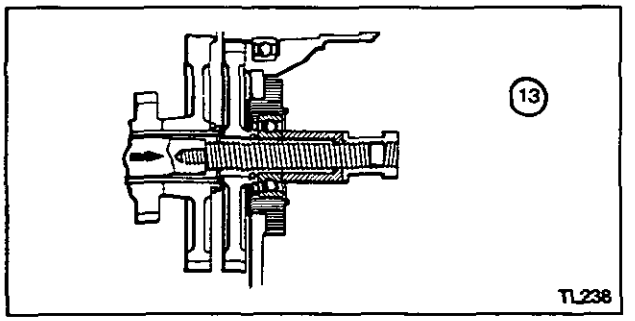

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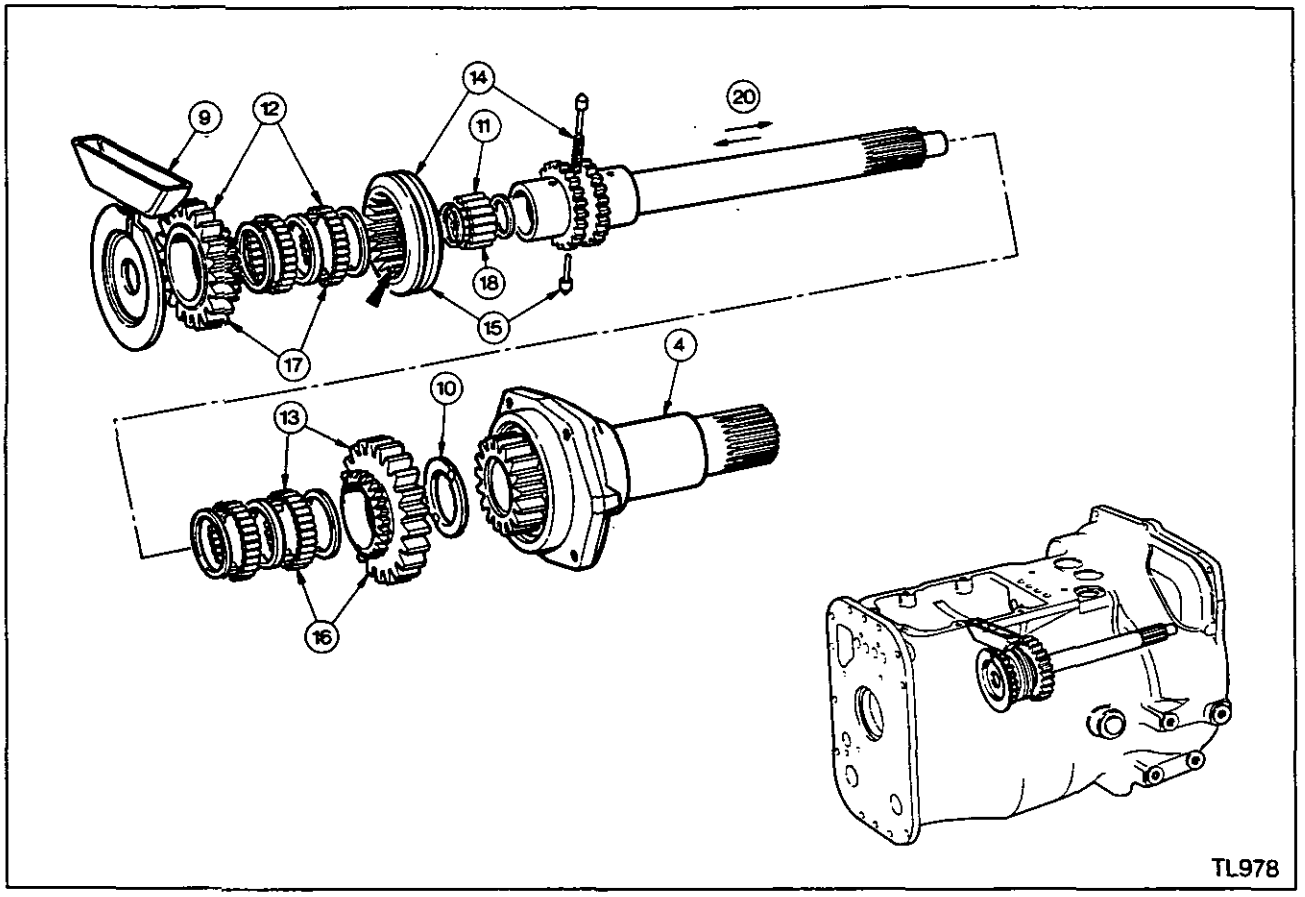
6 SPEED SHUTTLE GEARBOX



Input Shaft and Forward/Reverse Gear Cluster

Removal and Refitment 7C-08

Removal

1. Remove the gearbox from the tractor, see section 2.
2. Remove the clutch release mechanism, see operation 6A-04.
3. Remove the shifter rails and forks, see operation 7C-03.
4. Remove the PTO input shaft and housing, see operation 7C-06, do not remove the main input shaft assembly.
5. Remove the PTO driveshaft front bearing, see operation 7C-07.
6. Drive the PTO shaft rearwards to allow the PTO constant mesh gear to drop into the gearbox case.
7. Move the PTO constant mesh gear to a position in the bottom of the gearbox to allow the main input shaft and gears to be removed.
8. Carefully remove the main input shaft and gear assembly from the gearbox.

Note: Care must be exercised in removing the input shaft assembly, hold the forward and reverse gears in place to prevent loss of the 240 roller bearings. The spigot bearing between the mainshaft and input shaft also contains 23 loose roller bearings.

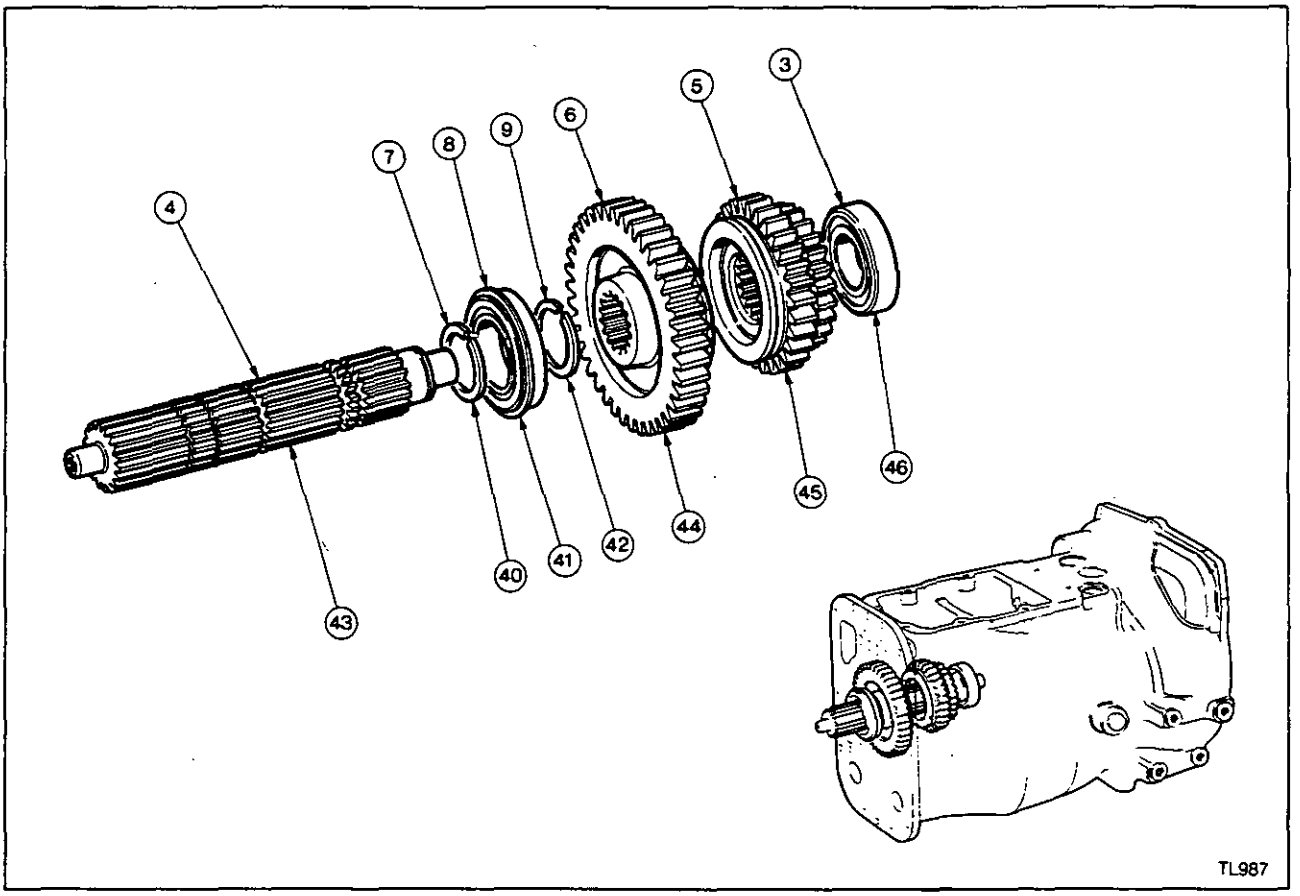
9. Remove the rear thrust washer and oil cup.
10. Remove the front measured thrust washer.
11. Tip the spigot bearing rollers into a clean tin.
12. With the main input shaft and gear assembly held over a clean tray slide the forward gear off the shaft allowing the roller bearings and spacers to drop into the tray.
13. Repeat the procedure for the reverse gear.
14. Wrap the input shaft and selector collar in some cloth and slide the collar off the shaft. The cloth is to catch the detents and spring.

Examination

Clean and thoroughly inspect all parts for signs of wear or damage and replace if necessary. Renew all snap rings, when refitting ensure that they are correctly located in their grooves.

Refitment

15. Refit the selector collar to the main shaft inserting the two detents and spring. The collar must be fitted with the four small indents on the internal splines (indicated by an arrow) in-line with the spring loaded detent.
16. Reassemble the reverse gear (22T), use petroleum jelly to hold the needle rollers in place. There are two rows of 60 rollers, assembled with a centre spacer ring and a spacer at each end. Fit to the front of the input shaft.
17. Reassemble the forward gear (20T) using the same procedure as above, fitting to the rear of the shaft.



18. Reassemble the needle roller bearing in the rear end of the input shaft. Fit a spacer first, 23 rollers held in with petroleum jelly and then the final spacer.
19. Reverse procedure 4 to 10.
20. With the aid of a dial gauge or feeler gauge measure the end float of the main input shaft. The correct end float is 0,25-0,50 mm (0.010-0.020 in) controlled by the measured spacer (9). In the event of the end float not being within limits, select one of the thrust washers from the chart below and fit in place of the existing washer.

Part No.	mm	inches
189 901 M2	1,50-1,57	0.059-0.062
194 224 M1	1,75-1,82	0.069-0.072
194 225 M1	2,00-2,08	0.079-0.082
194 226 M1	2,26-2,33	0.089-0.092
194 227 M1	2,51-2,59	0.099-0.102
194 228 M1	2,76-2,84	0.109-0.112

21. Reverse procedure 1 to 3.

Mainshaft, Layshaft and Gears

Overhaul 7C-09

Disassembly

1. Remove the input shaft and forward/reverse gear cluster, see operation 7C-08.
2. Remove the epicyclic reduction unit, see operation 7C-04.

Mainshaft

3. Carefully drive the mainshaft rearwards to release the front bearing from the centre web of the gearbox, remove the bearing from the main shaft.
4. Withdraw the mainshaft rearwards out of the gearbox.
5. Remove the second/third gear cluster.
6. Remove the first gear.
7. Remove the snap ring.
8. Press the rear bearing off the shaft.

Note: Do not attempt to press the rear bearing off the rear end of the main shaft. The epicyclic gear teeth are of a larger diameter than the mainshaft splines.

9. Remove the snap ring.

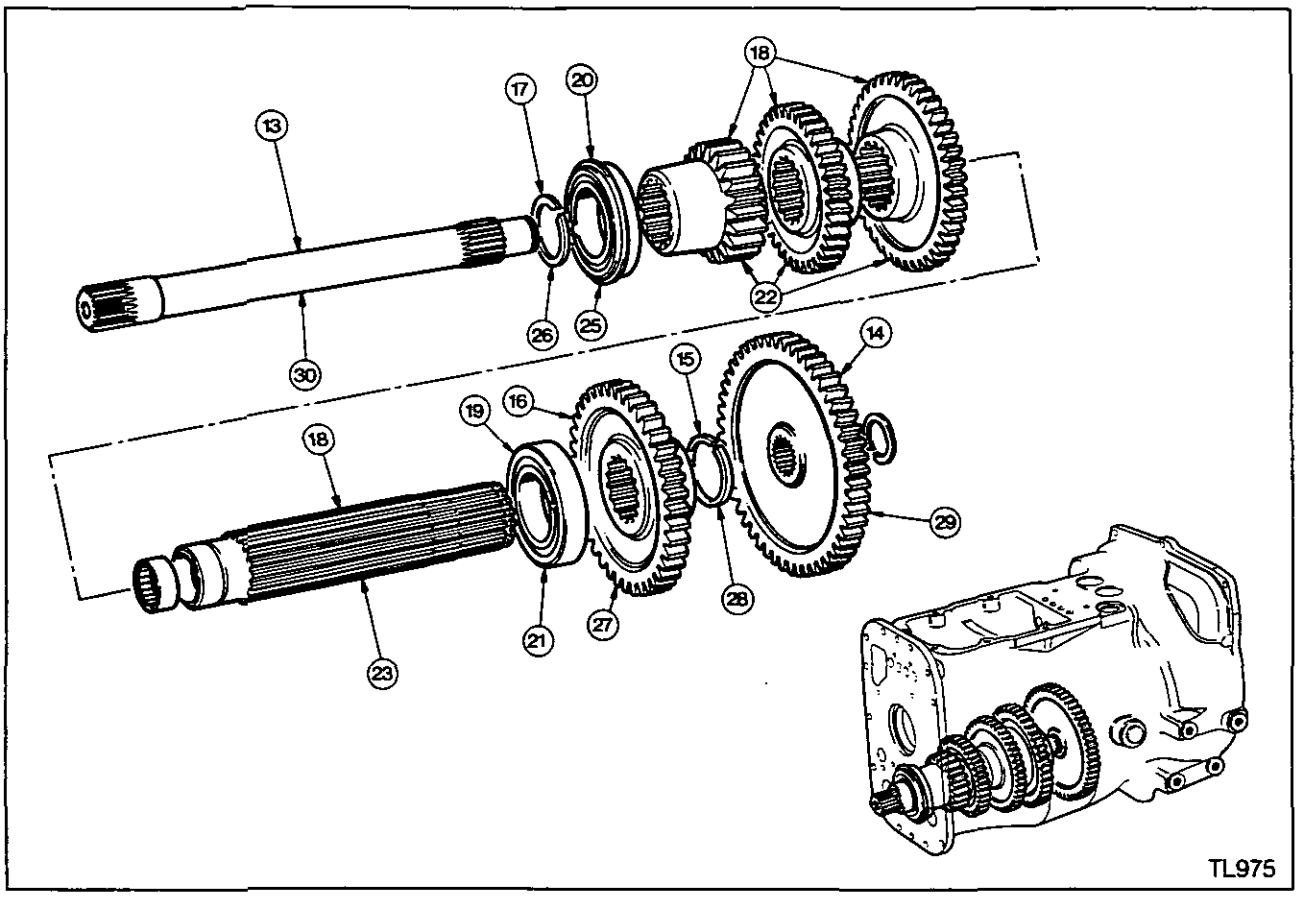
Reverse idler gear.

10. From the inside of the main part of the gearbox push the reverse idler shaft out of the housing..
11. Lift out the reverse idler gear assembly.

Note: Exercise care, the reverse idler contains two sets of loose roller bearings.

12. Allow the spacers and rollers to to drop out into a clean container.

6 SPEED SHUTTLE GEARBOX



Layshaft

13. Withdraw the PTO shaft rearwards out of the layshaft.
14. Remove the PTO constant mesh gear.
15. Remove the snap ring from the front of the layshaft.
16. Tap the layshaft rearwards and remove the constant mesh gear.
17. Remove the snap ring from the rear of the layshaft.
18. Drive the shaft forwards out of the rear bearing and lift out the first, second and third gears.
19. Press the front bearing off the layshaft.
20. Remove the rear bearing from the gearbox casing.

Reassembly

Layshaft

21. Press the front bearing onto the layshaft with the bearing shield facing the long portion of splined shaft.
22. Place the third (42T), second (36T) and first (20T) gears into the bottom of the gearbox.
23. Pass the layshaft with the bearing through the front of the gearbox and the centre web.
24. Fit the three gears onto the shaft in the above order, continue to drive the shaft through the box so that the rear bearing can be fitted.
25. Fit the rear bearing.
26. Fit the rear snap ring.
27. Fit the constant mesh gear and drive the shaft forward so that it locates in its correct running position.
28. Fit the front snap ring.
29. Place the PTO constant mesh gear in the bottom of the gear box so that the input shaft assembly can be refitted.
30. Place the PTO shaft in the layshaft.

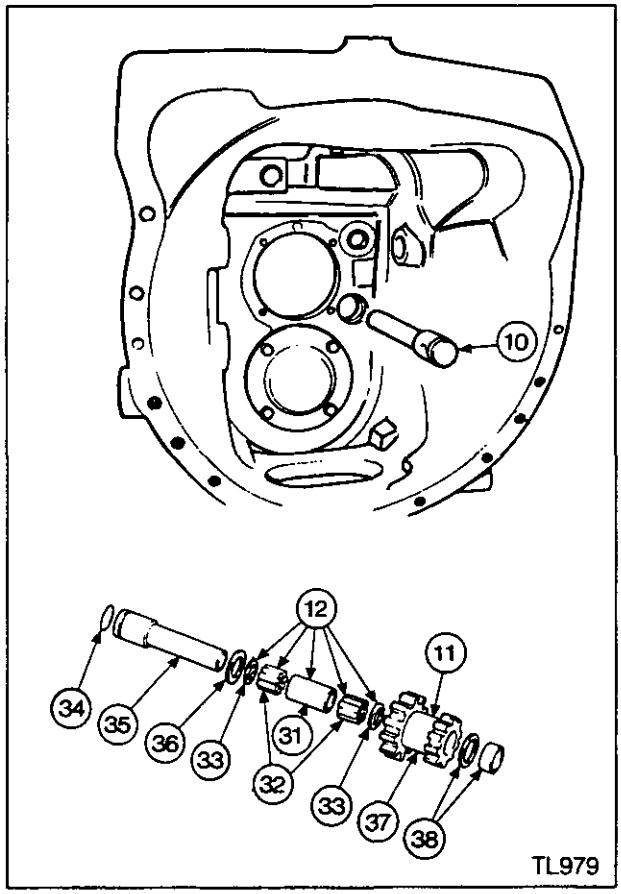
Reverse idler gear

31. Fit the wide spacer into the reverse idler with petroleum jelly.
32. Refit the two sets of roller bearings with petroleum jelly, there are two rows of 28 rollers.
33. Fit the two narrow spacers each side of the bearings.
34. Fit a new 'O' ring to the idler shaft.
35. With care, pass the idler shaft through the gearbox casing and reverse idler in the following order:
36. Thrust washer.

37. Reverse idler assembly.
38. Thrust Washer and spacer.
39. Align the cut away portion on the front of the reverse idler shaft to allow fitment of the input housing.

Mainshaft

40. Refit the snap ring.
41. Press the rear bearing onto the mainshaft from the front end up to the snap ring.
42. Replace the snap ring.
43. Refit the mainshaft to the gearbox from the rear.
44. Fit the 1st gear.
45. Fit the 2nd/3rd gear.
46. Refit the front bearing to the shaft.
47. Enter both bearings into the casing and drive the shaft forward into its running position.
48. Refit the input shaft and forward/reverse gear cluster, see operation 7C-08.
49. Refit the epicyclic reduction unit, see operation 7C-04.
50. Refit the gearbox to the tractor.



12 SPEED MANUAL MK11 SYNCHROMESH GEARBOX

Section 7 – Part D

Table of Contents

7D–2

12 SPEED SYNCHROMESH GEARBOX

Specification

Model	12 Speed Manual MKII Synchromesh
No of gears:	
Forward	12
Reverse	4
Synchromesh Type	ZF
Epicyclic Unit reduction	4:1
Normal duty	M-F 350, 355, 360, 362 and 365
Heavy duty	M-F 375, 390, 390T, 398 and 399

Settings Required

Mainshaft end float	0,080-0,30 mm (0.003-0.012 in)
Type of adjustment	Variable thickness thrust washer
Synchromesh ring to coupler clearance	0,8 mm (0.03 in)
Synchromesh neutral setting	See procedure 7D-03

Special tools

MF218A	PTO Drive shaft puller
MF255B	PTO input shaft oil seal replacer
MF315A	Needle roller bearing and seal remover/replacer
MF414	Synchro centralising pin
MF415	Synchro hub assembly tool
MF421	Needle roller bearing and seal replacer
MF422	Needle roller bearing and seal remover
MS550	Drive handle
KMF1004	Input shaft oil seal protector sleeve

Bolt Torques

Gear lever cover to shift tower	50- 70 Nm (37-52 lbf ft)
Shift tower to gearbox top	102-122 Nm (75-90 lbf ft)
Shifter Fork locking screws	34- 52 Nm (25-38 lbf ft)
Interlock bolt to gearbox case	40- 47 Nm (30-35 lbf ft)
Epicyclic unit-to gearbox case	40- 47 Nm (30-35 lbf ft)
Input-shaft housing to gearbox case	54- 61 Nm (40-45 lbf ft)
PTO drive shaft bearing housing to gearbox	54- 61 Nm (40-45 lbf ft)
Engine to gearbox	100-130 Nm (74-94 lbf ft)
Gearbox to rear transmission case	102-122 Nm (75-90 lbf ft)

General Description

The twelve speed manual MKII Synchromesh gearbox provides 12 forward gears. It provides full engine braking on over-run and enables the tractor to be towed to start the engine.

Drive arrangement

From the constructional view point the gearbox has three sections. The front section consists of the high and low ratio gears providing the choice of an alternative input ratio.

The centre section comprises constant mesh gearsets giving three basic forward speeds with ZF synchromesh engagement for 2nd and 3rd ratios whilst the rear section consists of an epicyclic gear reduction unit offering an alternative low range output drive ratio.

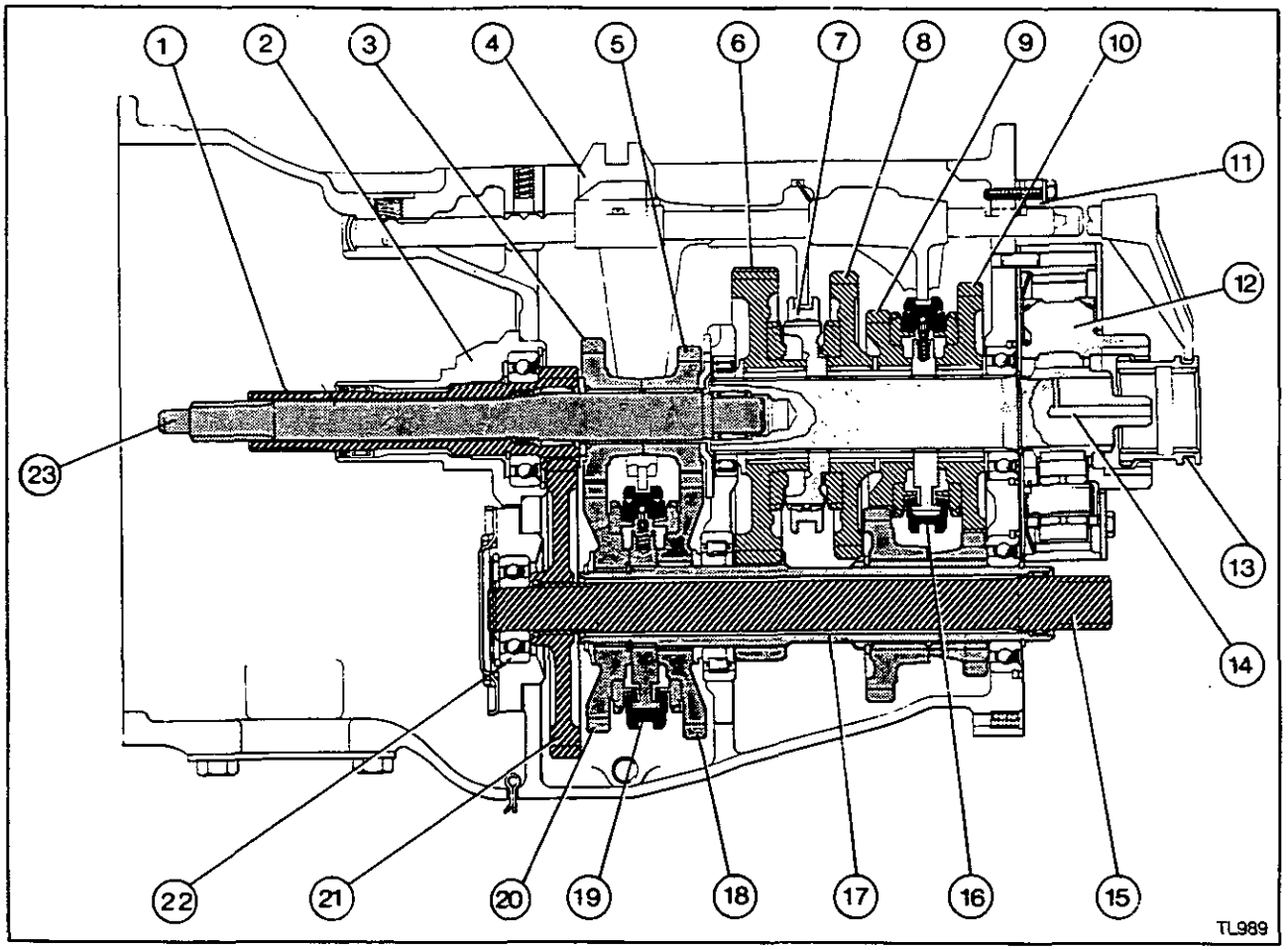
The three basic forward speeds and single reverse are doubled by the ability of the epicyclic unit to provide the additional output ratio. This feature, together with the alternative input ratio offered by the gears in the front section, which further doubles the number of speeds available, gives the gearbox a total of twelve forward speeds and four reverse.

The gearbox mainshaft is located above the layshaft which is of hollow construction to accept the power take-off (PTO) drive shaft which runs within it. Drive from the engine enters the gearbox through the input shaft which is spigot mounted at its front end into the mainshaft. The high and low ratio gears are splined to the input shaft and are in constant mesh with corresponding free-running gears on the front of the layshaft. Drive through either of these free- running gears occurs when the one selected is engaged with the layshaft by the sliding coupler of the synchromesh mechanism.

The PTO drive enters the gearbox through a hollow shaft revolving on the outside of the gearbox input shaft. A spur gear pinion at the rear of the hollow PTO input shaft is permanently engaged with the gear splined to the PTO drive shaft.

The mainshaft carries four free-running gears, three of which are in constant mesh with corresponding fixed gears on the layshaft to give the basic 1st, 2nd and 3rd ratios. The remaining free-running gear gives reverse drive and is in constant mesh with a compound idler gearset permanently driven from the side of the layshaft 3rd ratio gear.

12 SPEED SYNCHROMESH GEARBOX



1. PTO input shaft and gear
2. Input shaft housing
3. High range constant mesh gear
4. Selector rails and forks
5. Low range constant mesh gear
6. First gear
7. Sliding coupler
8. Reverse gear
9. Third gear
10. Second gear
11. Gear shift interlock
12. Epicyclic reduction unit
13. Sliding coupler
14. Mainshaft
15. PTO shaft
16. Synchromesh mechanism and sliding coupler
17. Layshaft
18. Low range constant mesh gear
19. Synchromesh mechanism and sliding coupler
20. High range constant mesh gear
21. PTO constant mesh gear
22. PTO front bearing housing
23. Transmission input shaft

12 SPEED SYNCHROMESH GEARBOX

The 2nd and 3rd ratio and reverse gearsets are of the straight cut spur type. The 1st ratio gearset has helical teeth which have longer contact areas and are consequently capable of transmitting greater loads than straight cut gears of the same size. They are also quieter running. Drive through the 1st, 2nd and 3rd ratio and reverse free-running gears takes place when the selected gear is engaged with the mainshaft by a sliding coupler. The coupler located between 2nd and 3rd ratios forms part of the ZF synchromesh engagement mechanism. Roller bearings are used to support the main and layshaft at their front ends.

Gearbox Driveline

The order of drive through the gearbox, with the gears selected is as follows:

From the input shaft through the high or low ratio gearset to the layshaft.

From the layshaft to the selected free-running gear on the mainshaft.

From the free-running gear to the coupler.

From the coupler to the mainshaft via the coupler hub which is splined to the mainshaft.

From the mainshaft to the tractor's final drive arrangements via the epicyclic gear reduction unit in LOW range drive or directly in HIGH range.

Synchromesh mechanism

The synchromesh mechanism synchronises (equalises) the speed of the selected free-running gear with the appropriate driven shaft before drive engagement. This is of great benefit to the drive by preventing potential gear damage and allowing fast, easy gear changes to be made on the move without the need to stop the tractor. Engaging gear with the tractor stationary is also easier.

Sliding couplers

Sliding couplers have teeth specially shaped to give easier drive engagement. All the teeth on the coupler engage with corresponding teeth on the side of the appropriate gear at the same time. This means that any impact forces occuring during the process of initial engagement are distributed uniformly through all teeth, so minimising the risk of damage. Furthermore, in the unlikely event of damage being received it is restricted to the coupler area and in no way affects the smooth running and life of the gears themselves.

Epicyclic gear reduction unit

Up to this point only passing reference has been made to the epicyclic gear reduction unit at the rear of the gearbox. This is of heavy duty design and incorporates a Belleville spring arrangement to absorb the end thrust imposed on the mainshaft by the first speed helical gearset.

The rear end of the mainshaft is machined to form the sun gear which meshes with three planet gears, also in mesh with a fixed internal ring gear or "annulus" forming the circumference of the working components. When the mainshaft rotates, the planet gears and carrier revolve round the sun gear at a reduced speed compared with that of the mainshaft.

A sliding coupler with internal and external splines forms the connection between the gearbox and the gear shaft to the final drive. When moved forwards by its output lever, it couples the mainshaft directly to the output shaft to establish high range drive, giving the gearbox an additional set of speed ratios designed 4th, 5th and 6th and high reverse. When shifted fully rearwards the external splines on the coupler engage corresponding splines on the planet carrier to establish low range drive. In these circumstances, drive from the gearbox mainshaft to the output shaft is via the carrier and subject to a speed reduction giving 1st, 2nd and 3rd speed ratios and low reverse. The coupler may also be placed in a mid or neutral position free of the mainshaft and carrier to totally disconnect the drive from the gearbox – a feature forming the basis of Massey-Ferguson's safety starting arrangements.

Main Gear Shift Lever

Removal and refitment 7D-01

Removal

1. Remove the cab floor mat and/or access panels if fitted.
2. Move the gear levers to the neutral position.
3. Remove the five bolts holding the gearlever assembly to the shift tower on top of the gearbox.
4. Remove the gear lever assembly from the tractor.
5. Remove the gear lever rubber cover.

Caution: When removing the spring retaining clip (7), care must be taken to prevent the spring from flying out and causing possible injury or damage.

6. Place the gear lever assembly in a vice.
7. Press the spring retaining clip towards the spring, slide sideways and remove. This will release the spring.
8. Press out the gear lever retaining clip.
9. Lift out the gear lever.
10. The gear lever cup may be removed from the cover if required.
11. Unscrew the retaining nut and press out the cup.

Refitment.

12. Reverse procedure 1 to 11 except:
    a. If the gear lever cup has been removed, ensure that it is fitted with the gear lever retaining pin square with the axis of the tractor by lining up the flats on the cup.
    b. Ensure that the gear lever rubber cover is in good condition to prevent dirt getting into the transmission.
    c. Coat the underside of the gearlever cover with Loctite 515 and torque the cover bolts to 50-70 Nm (37-52 lbf ft).

High/Low Shift Levers

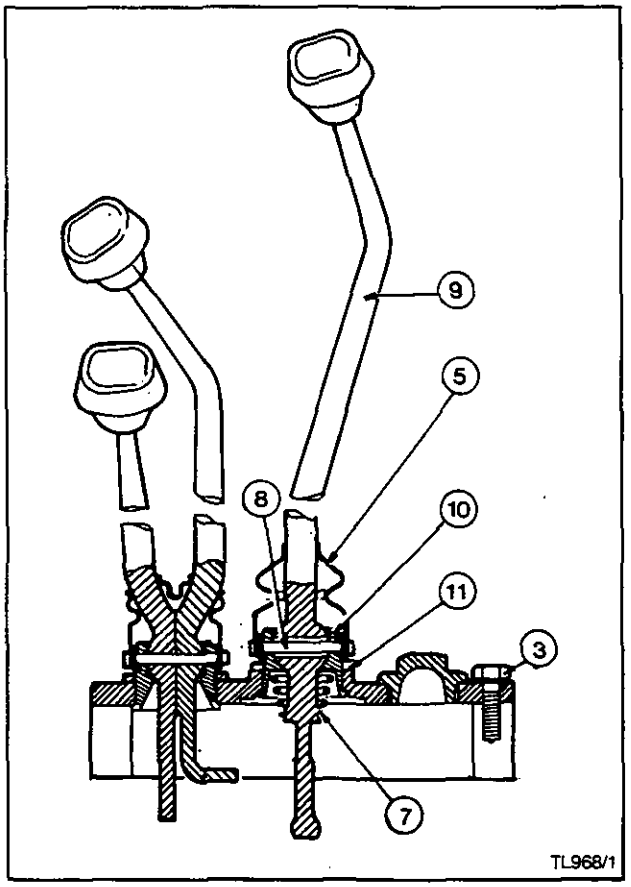
Removal and Refitment 7D-02

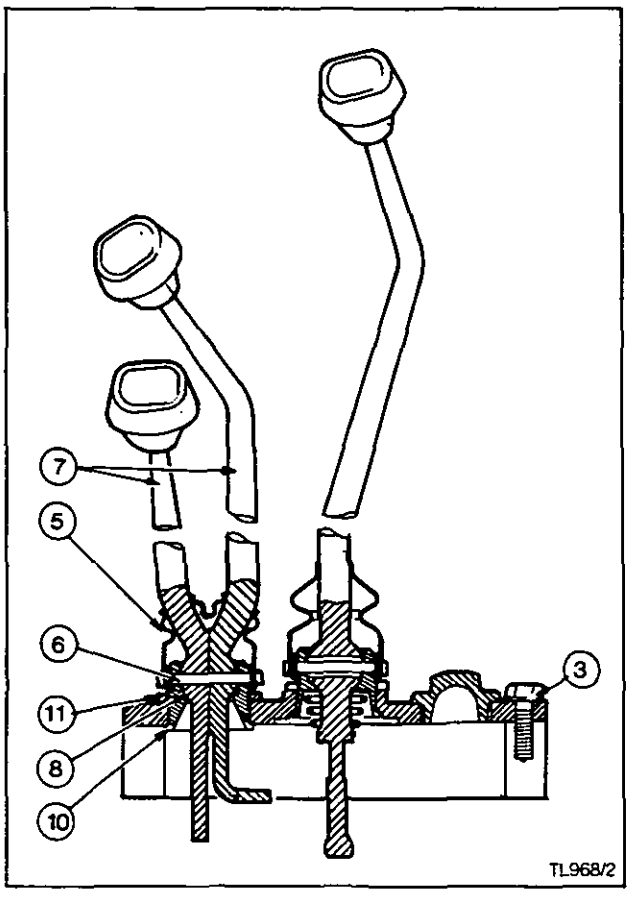
Removal

1. Remove the cab floor mat and/or access panels if fitted.
2. Move the gear levers to the neutral position.
3. Remove the five bolts holding the gear lever assembly to the top of the gearbox.
4. Remove the gear lever assembly from the tractor.
5. Remove the gear lever rubber cover.
6. Remove the gear lever retaining pin.
7. Lift out the gear levers.
8. Remove the 'O' ring.
9. The gear lever clip may be removed if required.
10. Unscrew the retaining nut and press out the cup.

Refitment

11. Reverse procedure 1 to 10 except:
    a. Renew the 'O' ring.
    b. If the gear lever cup has been removed ensure that it is fitted with the gear lever retaining pin square with the axis of the tractor by lining up the flats on the cup.
    c. Ensure that the gearlever rubber cover is in good condition to prevent dirt getting into the transmission.





    d. Coat the underside of the gearlever cover with Loctite 515 and torque the cover bolts to 50-70 Nm (37-52 lbf ft).

12 SPEED SYNCHROMESH GEARBOX

Selector Rails and Forks

Removal and Refitment 7D-03

Special Tools: MF414 Centralising pin and locating peg

Removal

Caution: Beware of sharp edges around the top of the gearbox case.

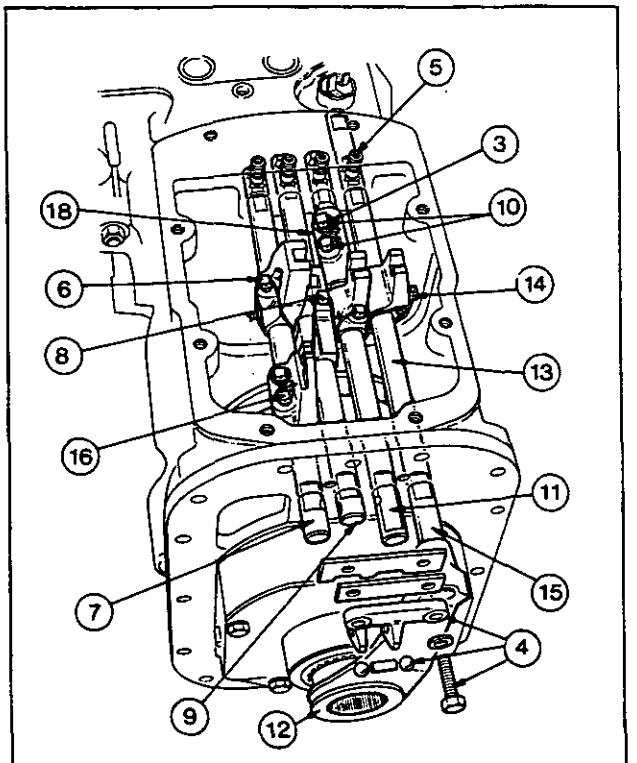
1. Split the tractor between the gearbox and the spacer housing or the centre housing and remove the gearbox, see section 2.
2. Remove the gearbox top cover, and the shift tower.
3. Release the locking wires.
4. Remove the bolts, forks, balls, peg, stop plate and plain plate of the gear shift interlock mechanism.
5. Lift out the detent springs and plungers.
6. Remove the locking screws.
7. Slide the rail rearwards out of the housing.

Note: When removing the selector rails, retain the gear lever engagement dogs.

8. Remove the locking screw.
9. Slide the rail rearwards out of the housing.
10. Remove the locking screw.
11. Slide the rail rearwards out of the housing.
12. Slide the high/low rail rearwards and remove the coupler.
13. Rotate the high/low rail through 90°.
14. Remove the locking screw.
15. Slide the rail rearwards out of the casting.
16. Remove first/reverse and second/third selector forks.
17. Remove main input shaft, see operation 7D-07.
18. Remove the locking screw.
19. Remove the high/low synchromesh selector fork.

Refitment

20. Reverse procedures 1 to 19 except:
    a. Apply a few drops of oil to the selector rails before refitment.
    b. Set both synchromesh selector forks and rails to the neutral position. Lock the selector rail using the plate and bolt (part of MF414). Insert the centralising pin, MF414, into the hole on the top of the selector fork, lining it up with the corresponding hole in the sliding coupler. Progressively lock up the two security screws on the selector fork to 34-52 Nm (25-38 lbf ft). Afterwards, check that the centralising pin MF414/1 can be removed freely. Wire-lock the screws.
    c. Tighten the remaining selector fork locking screws to a torque of 34-52 Nm (25-38 lbf ft).
    d. On completion of the refitting procedure, place all the gears in the neutral position.
    e. Torque the interlock retaining bolts (4) to 40-47 Nm (30-35 lbf ft)
21. Apply Loctite 515 or equivalent between the gearbox top and the shift tower and the gearlever assembly.
22. Torque the shift tower to gearbox bolts to 102-122 Nm (75-90 lbf ft), gearlever assembly to shift tower bolts to 50-70 Nm (37-52 lbf ft).



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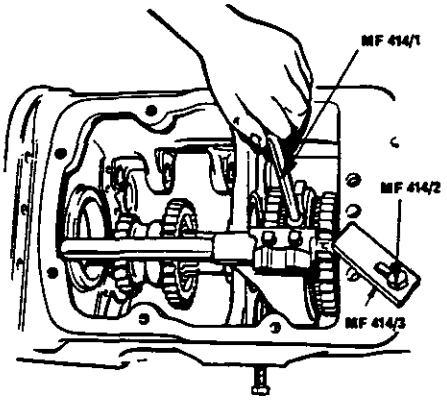

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Normal and Heavy Duty Gearbox Epicyclic Unit

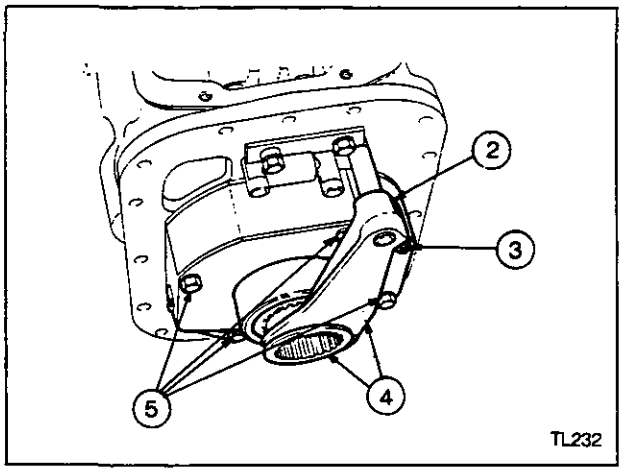
Removal and Refitment 7D-04

Removal

1. Split the tractor between the gearbox and the spacer housing or centre housing and the transmission, see section 2.
2. Remove the locking wire.
3. Remove the locking screw.
4. Remove the selector fork and coupling.
5. Remove the bolts.
6. Remove the complete assembly.

Refitment

7. Reverse procedures 1 to 6 except:
   a. Ensure that the front and rear thrust rings are correctly located before refitment.
   b. Ensure that the epicyclic dowels are correctly located in the gearbox casing.
   c. Locate the cover plate with the cut out in the bottom left hand corner for heavy duty, and the bottom right hand corner for normal duty epicyclics.
   d. Fit a lockwasher to the lower right hand retaining bolt, on normal duty epicyclics only.
   e. Tighten the retaining bolts progressively and evenly to a torque of 40-47 Nm (30-35 lbf ft).



Normal Duty Gearbox Epicyclic Unit

Overhaul 7D-05

Disassembly

1. Remove the gearbox epicyclic unit, see operation 7D-04.
2. Remove the cover plate.
3. Remove the rear thrust ring.
4. Remove the planetary pinion carrier.
5. Remove the front thrust ring.
6. Remove the shim.
7. Remove the front plate.
8. If necessary, remove the dowel pins from the ring gear.

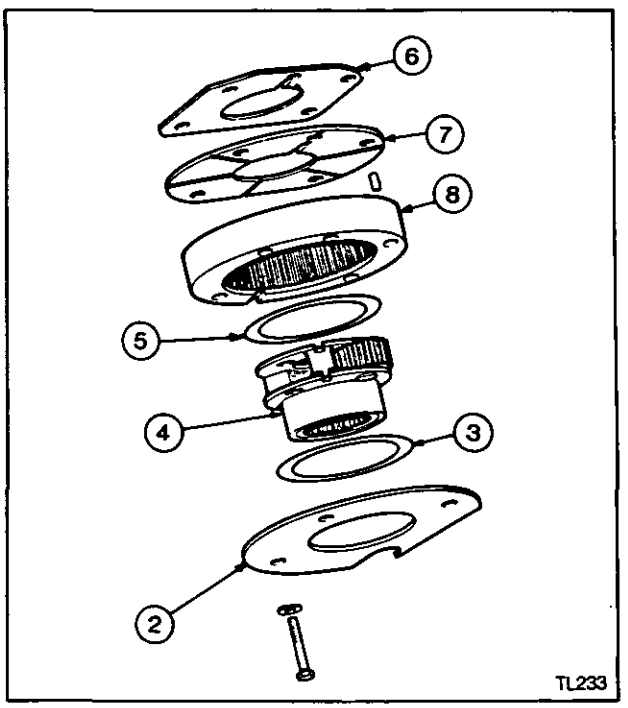
Note: The planetary pinion carrier cannot be serviced, and must be replaced as a complete assembly if found to be defective.

9. To remove pinions and needle rollers, follow items 11, 12 and 13 in operation 7D-06.

Note: Spacers are fitted either side and between the needle rollers.

Reassembly

10. Reverse procedures 1 to 9 except:
    a. When replacing the rollers in the pinions, a smear of petroleum jelly (not grease) will help retain them. Do not omit the spacer from between the two runs of rollers. Each run consists of 27 rollers, see item 9.
    b. The front plate and the cover plate must be positioned with the oil grooves towards the pinion carrier.



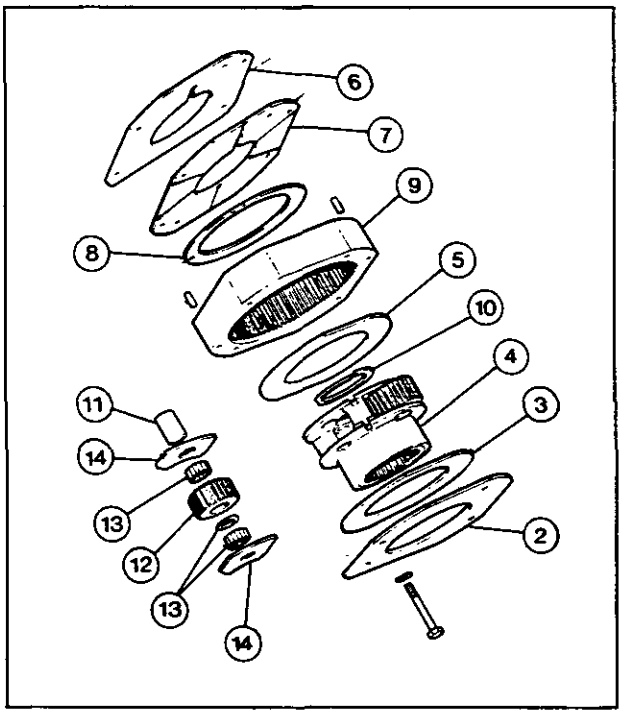
    c. Always fit the same thickness of shims as those removed.
    d. To assist assembly of the front and rear thrust rings on the pinion carrier, smear them with petroleum jelly (not grease). Ensure that the tabs on the thrust rings locate in the pinion carrier cut-outs, and that the brass faces are away from the pinion carrier.

12 SPEED SYNCHROMESH GEARBOX

Heavy Duty Gearbox Epicyclic Unit

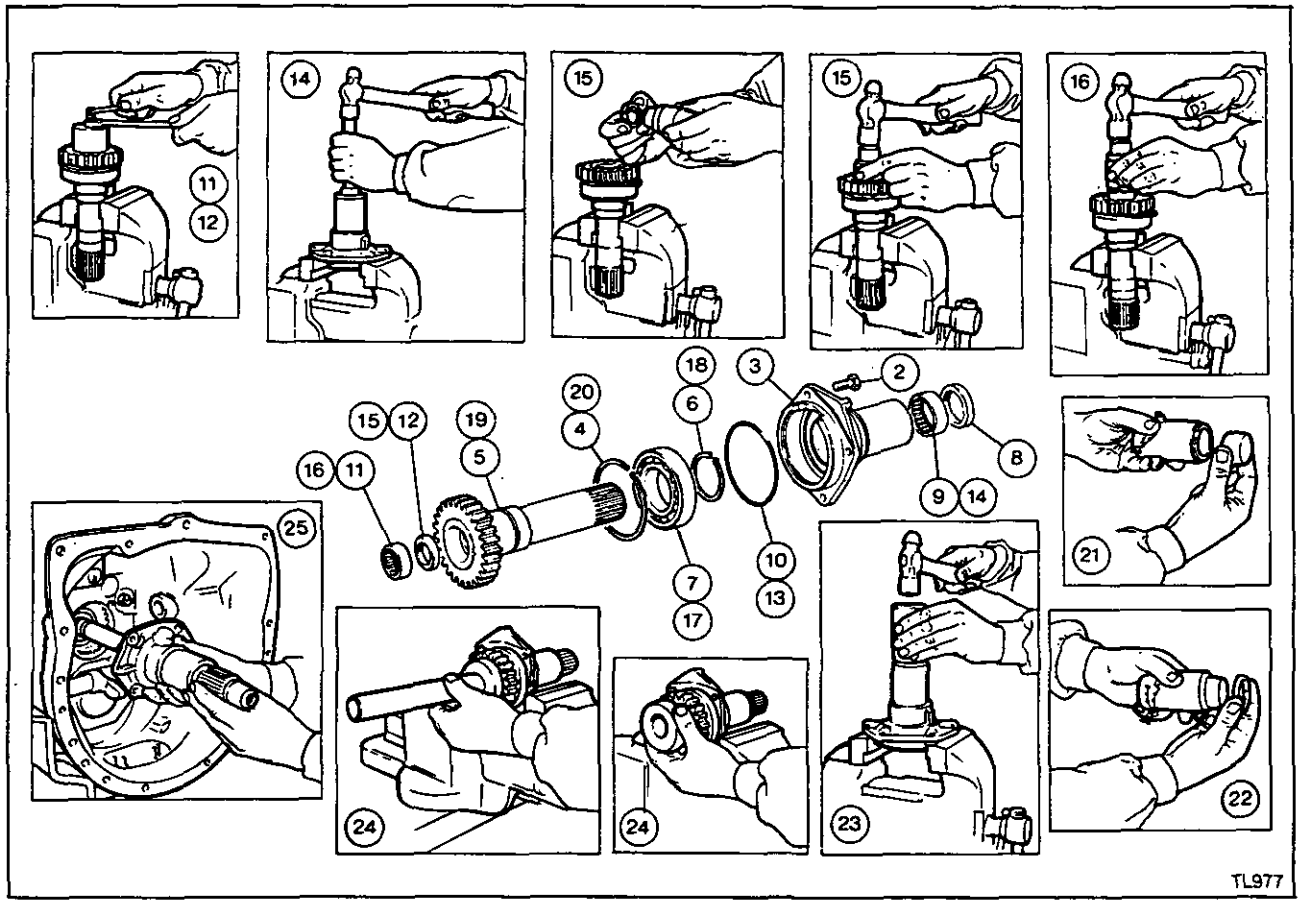
Disassembly

1. Remove the gearbox epicyclic, see operation 7D-04.
2. Remove the cover plate.
3. Remove the rear thrust ring.
4. Remove the planetary pinion carrier.
5. Remove the front thrust ring.
6. Remove the shim.
7. Remove the front plate.
8. Remove the Belleville spring disc.
9. If necessary, remove the dowels from the planetary ring gear.
10. Remove the external snap ring.
11. Gently tap out the three pinion shafts towards the front.
12. Remove the planetary pinions.
13. Remove the two sets of rollers and spacer from each pinion.
14. Remove the wear plates from each side of each pinion.



Reassembly

15. Reverse procedures 1 to 14 except:
    a. When replacing the rollers in the pinions, a smear of petroleum jelly (not grease) will help retain them. Do not omit the spacer from between the two runs of rollers. Each run consists of 16 rollers.
    b. Ensure that the Belleville spring disc is located correctly in the epicyclic ring gear with the concave face rearwards.
    c. The front plate and the cover plate must be positioned with the oil grooves towards the pinion carrier.
    d. Ensure that the pinion wear plates are refitted with the flats positioned innermost to the centre of the pinion carrier.
    e. Ensure that the gap of the snap ring is located midway between the planetary pinion shafts.
    f. Always fit the same thickness of shims as those removed.
    g. To assist assembly of the front and rear thrust rings on the pinion carrier, smear them with petroleum jelly (not grease). Ensure that the tabs on the thrust rings locate in the pinion carrier cut-outs, and that the brass faces are away from the pinion carrier.



Input Shafts and Housing

Removal and Refitment 7D-07

Special Tools:

MF255B	*PTO input shaft oil seal replacer*
MF315A	*Needle roller bearing remover/ replacer*
MF421	*Needle roller bearing and seal replacer*
MF422	*Needle roller bearing and oil seal remover*
KMF1004	*Input shaft oil seal protector sleeve*

Removal

1. Remove the clutch release mechanism, see operation 6A-04.
2. Remove the four bolts.
3. Withdraw the input housing complete leaving the PTO input shaft in position.
4. Remove the large internal circlip.
5. Push the PTO input shaft, complete with bearing, rearwards out of the housing.
6. If necessary, remove the circlip.
7. If necessary, press the bearing off the shaft.
8. Lever the seal out of the front of the housing.
9. Using MF315A, remove the needle roller bearing from the front of the housing.
10. Remove the 'O' Ring from the housing.
11. Using MF422, carefully remove the needle roller bearing from the inside of the input shaft.
12. Using MF422, remove the oil seal from the input shaft.

Refitment

13. Fit a new 'O' ring into the housing.
14. Using MF315A, replace the needle roller bearing in the housing.
15. Using MF421, fit a new seal into the input shaft with the lip of the seal facing the tool.
16. Using MF421, refit needle roller bearing into the input shaft with the round end of the cage to the bottom of the recess.
17. Refit the bearing onto the outside of the shaft with the shield towards the gear teeth.
18. Refit the circlip. (Check that it is properly seated.)
19. Refit the PTO input shaft and bearing into the input housing.
20. Refit the circlip. (Check that it is properly seated.)
21. Place the nylon cone adaptor, MF255B/2, on the seal replacer, MF255B/1.

22. Place the seal over the cone and onto the tool with the seal lip facing away from the tool and remove the nylon cone.
23. Place the tool over the PTO input shaft and tap the seal into place.
24. Carefully push guide KMF1004/2 into the rear end of the PTO input shaft. Carefully insert the tapered end of the protector sleeve, KMF1004/1, through the guide. Remove the guide leaving the sleeve in position.
25. Carefully refit the input housing over the input shaft and withdraw the protector sleeve when the housing is in place.
26. Refit the clutch release mechanism, see operation 6A-04.

Note:

a. **Use petroleum jelly (not grease) to lubricate all seals and the needle roller bearing when refitting.**
b. **Lightly coat the bolt threads in Hylomar sealant when refitting, and tighten the bolts to a torque of 54-61 Nm (40-45 lbf ft).**

PTO Driveshaft Front Bearing

Removal and Refitment 7D-08

Special Tools: MF218A PTO drive shaft puller

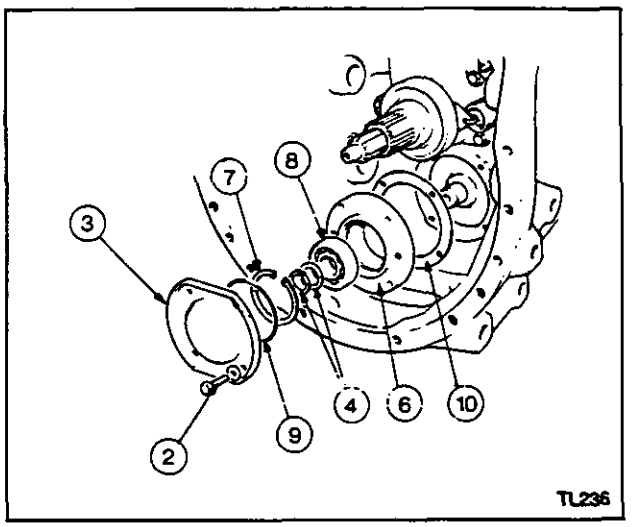
Removal

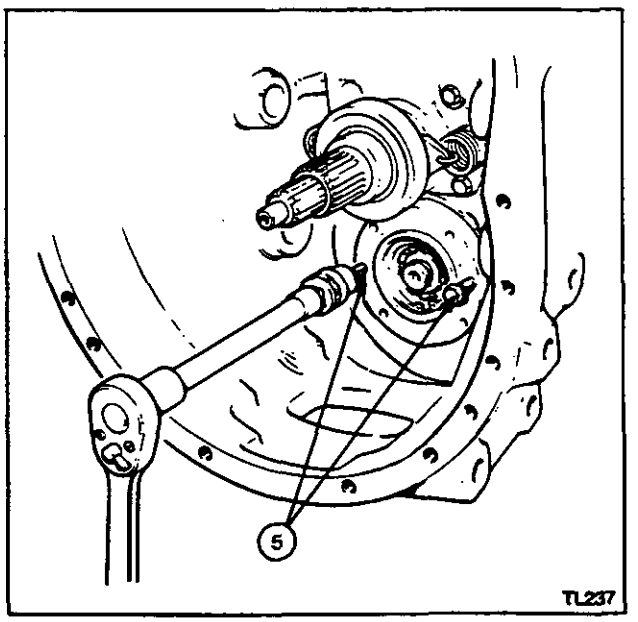
With the gearbox removed from the tractor:

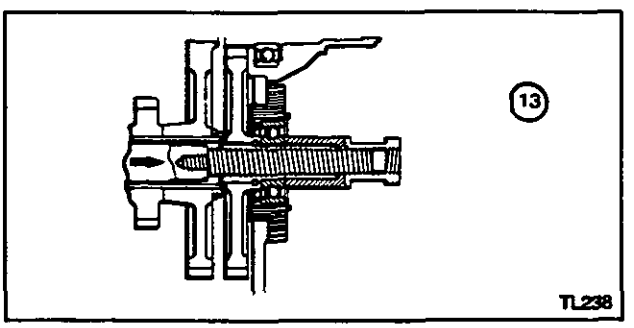
1. Remove the cross shaft and lever, see operation 6A-04.
2. Remove the four bolts and washers.
3. Remove the cover plate.
4. Remove the external circlip and washer.
5. Screw two 3/8 UNC x 75 mm (3 in) bolts into the bearing housing and tighten them evenly to draw the housing from the case and shaft.
6. Remove the housing.
7. Remove the circlip.
8. Press out the bearing.
9. Discard the 'O' ring.
10. Discard the gasket.

Refitment

11. Reverse procedures 7 to 10, except:
    a. Fit a new 'O' ring, gasket and circlip.
    b. Lightly coat the gasket with Hylomar sealant.
12. Using MF218A, refit the bearing and housing assembly on the front end of the PTO drive shaft ensuring that the splines on the shaft locate with those in the PTO constant mesh gear.
13. Fit a new circlip and washer.
14. Reverse procedures 1 to 6 except:
    a. Lightly coat the securing bolt threads with Hylomar sealant.
    b. Tighten the bolts to a torque of 54-61 Nm (40-45 lbf ft).







12 SPEED SYNCHROMESH GEARBOX

Layshaft, Mainshaft, PTO Shaft and Gears

Overhaul 7D-09

Special Tools:
MF415 Synchro hub assembly tool
MS550 Drive handle.

Disassembly

With the gearbox removed from the tractor:

1. Remove the clutch release mechanism, see operation 6A-04.
2. Remove the selector rails and forks, see operation 7D-03.

Note: The layshaft selector fork cannot be removed at this stage.

Mainshaft

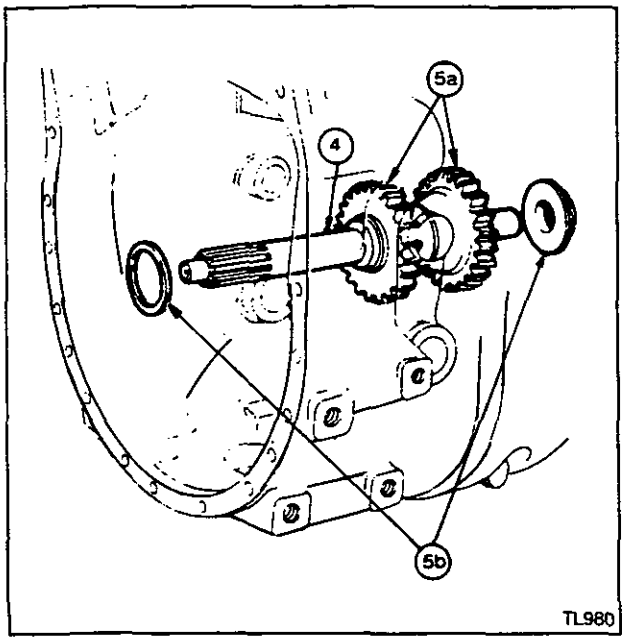
3. Remove the input housing, see operation 7D-07.
4. Withdraw the main input shaft.
5. Lift out the high and low constant mesh gears (5A) and the thrust washers (5B).

Note: A snap ring is fitted between the first thrust *washer and the front constant mesh gear.*

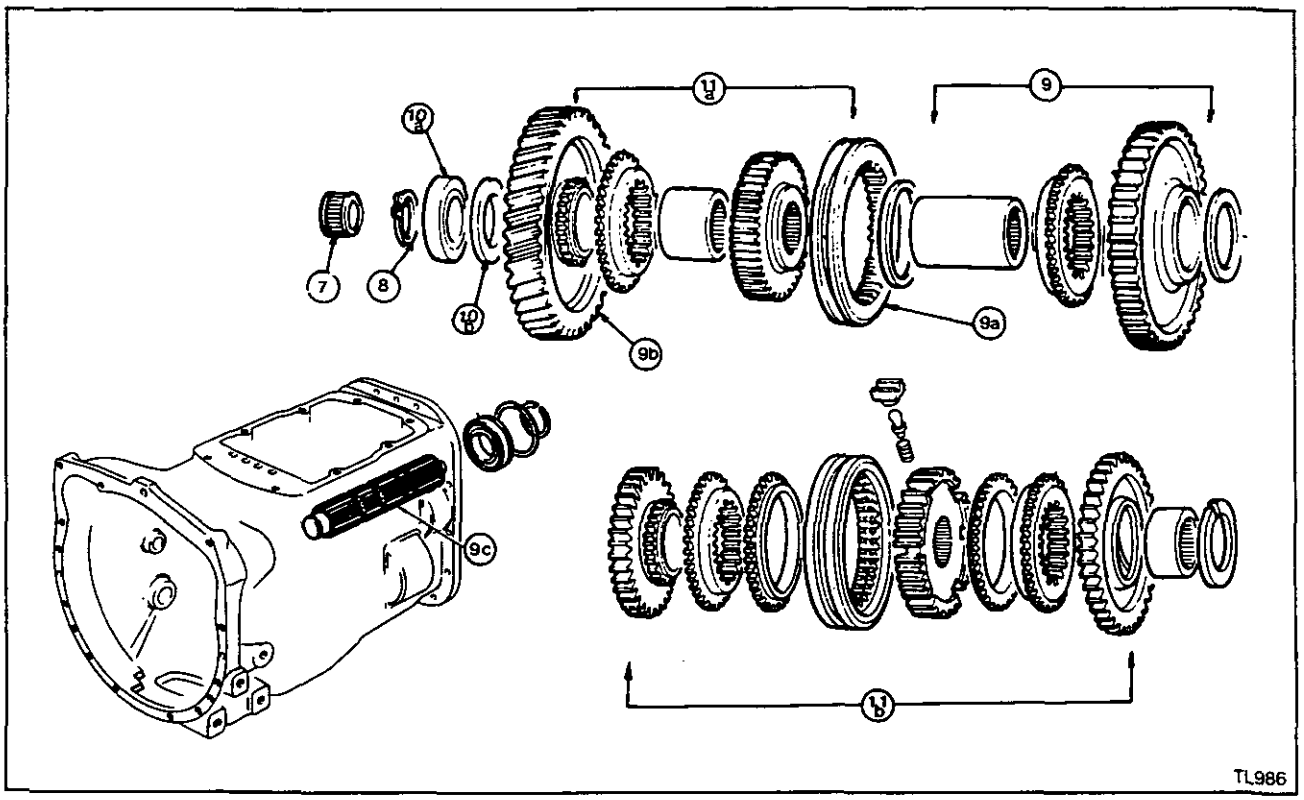
6. Remove the epicyclic reduction unit from the rear of the gearbox, see operation 7D-04.
7. Remove the needle roller bearing.
8. Remove the snap ring from the front of the mainshaft.
9. Engage the coupler (9A) with the first gear (9B) and withdraw the main shaft (9C) through the rear of the gearbox. Remove the rear bearing (9D) if necessary.
10. Remove the front mainshaft support bearing (10A) and thrust washer (10B) from the gearbox centre web.
11. Lift the first gear and first/reverse hub and coupler assembly (11A) together from the gearbox followed by the remainder of the mainshaft gear and synchromesh hub assembly (11B).

Layshaft

12. Remove the PTO drive shaft front bearing, see operation 7D-08.
13. Lift out the PTO constant mesh gear.
14. Remove the snap ring from the rear of the layshaft.
15. Carefully drive the layshaft forward to uncover the snap ring in front of the third gear and move it to the unsplined portion of the shaft.
16. Drive the layshaft fully rearwards and remove the snap ring (16A) and thrust washer (16B) from the front of the layshaft.
17. Slide the high ratio transmission constant mesh gear (17A) forwards and move the circlip (17B) from the front of the synchromesh hub as far forward along the layshaft as possible.
18. Slide the layshaft rearwards and lift the high ratio gear out through the top of the gearbox.
19. Remove the circlip (17B), synchromesh hub assembly (19A), low ratio gear and thrust washer (19B).
20. Remove the layshaft (20A) through the front of the gearbox and lift out the second and third gears (20B). Remove the rear bearing (20C).



12 SPEED SYNCHROMESH GEARBOX



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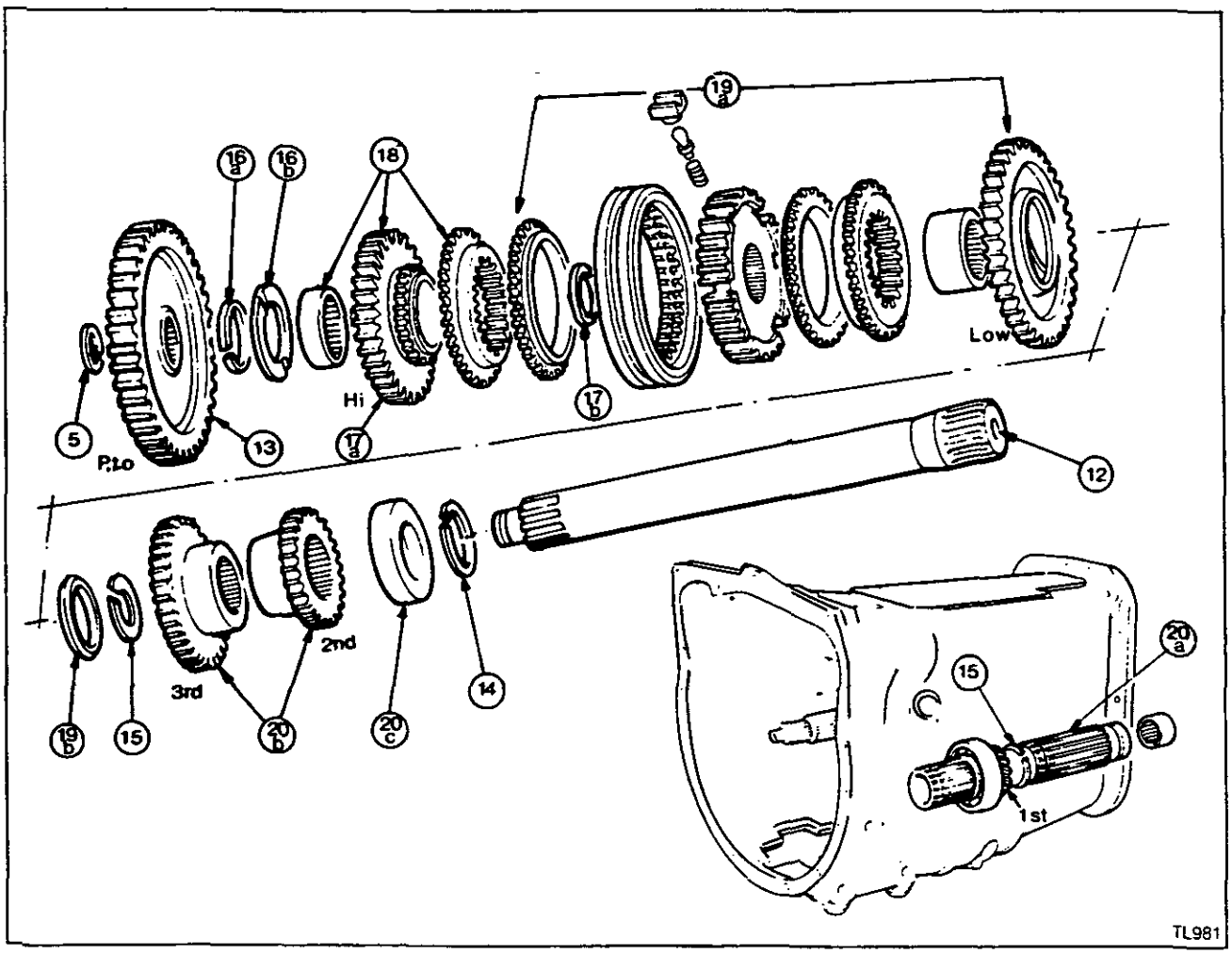

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12 SPEED SYNCHROMESH GEARBOX

Reverse idler

21. Obtain a length of steel bar 25 mm dia x 55 mm long (1 in dia x 2.3/16 in long) for use as a dummy shaft to aid removal of the reverse idler.
22. Release the tab washer.
23. Remove the bolt and locking tab.
24. Slide the dummy shaft (item 21 above) in from the front of the reverse gear shaft towards the rear. This will push out the reverse gear shaft and prevent the needle rollers from dropping into the transmission case and allow the idler gear to be removed.
25. Remove the idler gear cluster complete with all parts and the dummy shaft inside.
26. Withdraw the dummy shaft from the idler gear and allow all parts to drop out onto a clean work surface.

Synchromesh hub assemblies

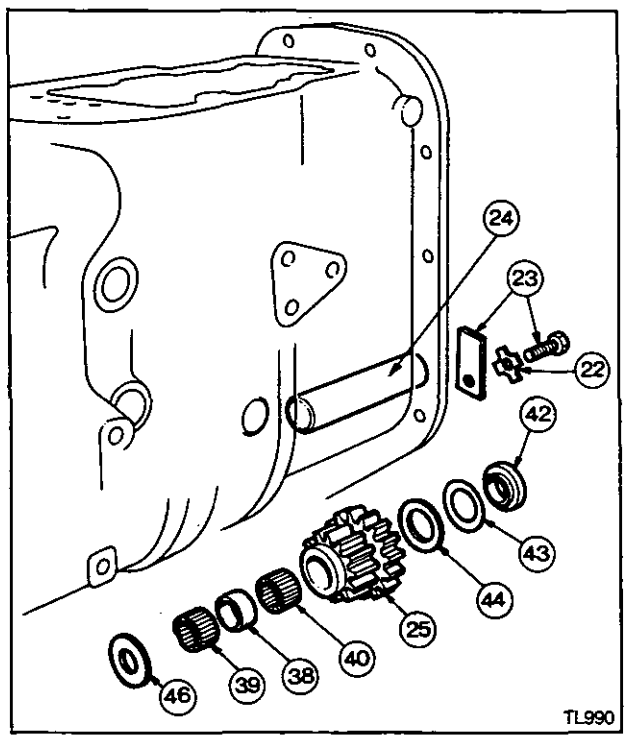
27. Remove the two synchroniser rings.
28. Remove the drive hub complete with the sliding coupler.
29. Wrap the hub and coupler in a cloth.
30. Remove the sliding coupler, taking care not to lose pressure springs, plunger and blocks.
31. Remove the three pressure blocks.
32. Remove the three pressure plungers.
33. Remove the three pressure springs.
34. Thoroughly clean all the components and check their condition.
35. Using a feeler gauge, measure the clearance between the synchroniser ring and the coupler on the gear at several points. The synchroniser ring must be correctly positioned on the tapered part of the splined ring. If the clearance is less than 0.5 mm (0.020 in), replace the synchroniser ring. If the clearance is checked with the gearbox assembled replace the synchroniser ring if the clearance is found to be less than 0,8 mm (0.030 in).

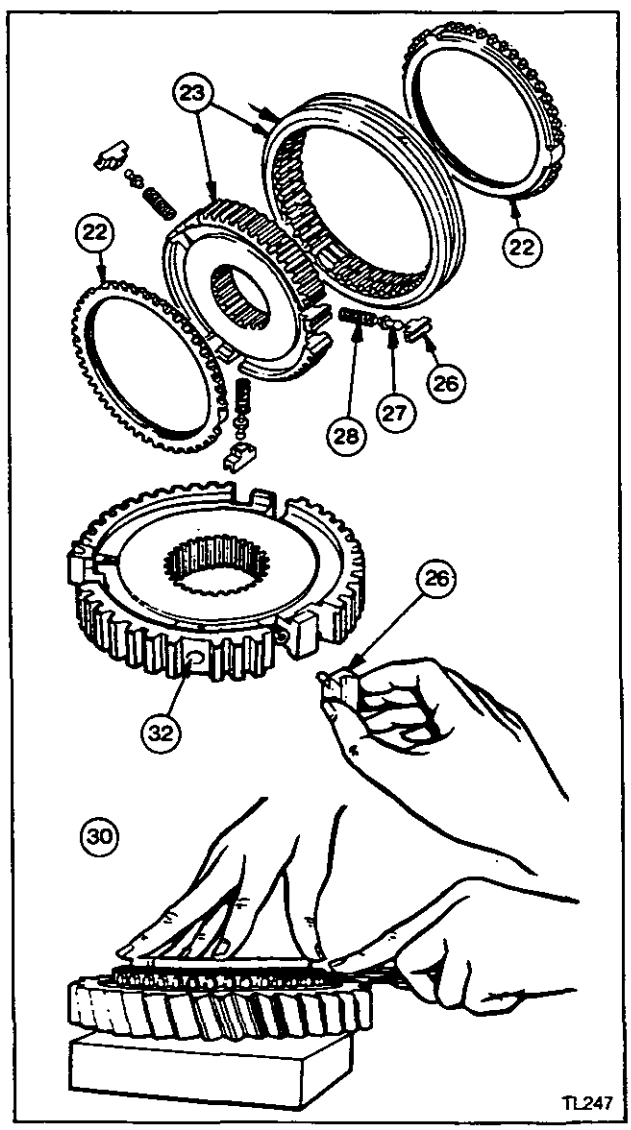
Reassembly

Synchromesh hub assemblies

36. Reverse procedures 27 to 33.
37. On replacing pressure springs, plunger and blocks into the coupler ring, special service tool MF 415 and handle MS 550 must be used to locate the hub back in the sliding coupler.

Note: Ensure that the hole 'A' in the coupler is fitted in line with the hole in the hub.





Reverse Idler

38. Fit the spacer in the reverse gear cluster.
39. Refit the first set of rollers. Each set consists of 28 rollers.
40. Fit the second set of rollers.
41. Insert the steel bar to hold the rollers in place.
42. Replace the collar.
43. Replace the disc spring.
44. Fit the friction plate as shown to the rear of the reverse gear cluster.
45. Fit the small spacer to the front of the reverse gear cluster.
46. Fit the thrust washer.
47. Reverse procedures 22 to 25.
48. Fit a new tab washer to lock the retaining bolt.

Layshaft

Note: All snap rings must be renewed. Ensure that they are correctly located in their grooves.

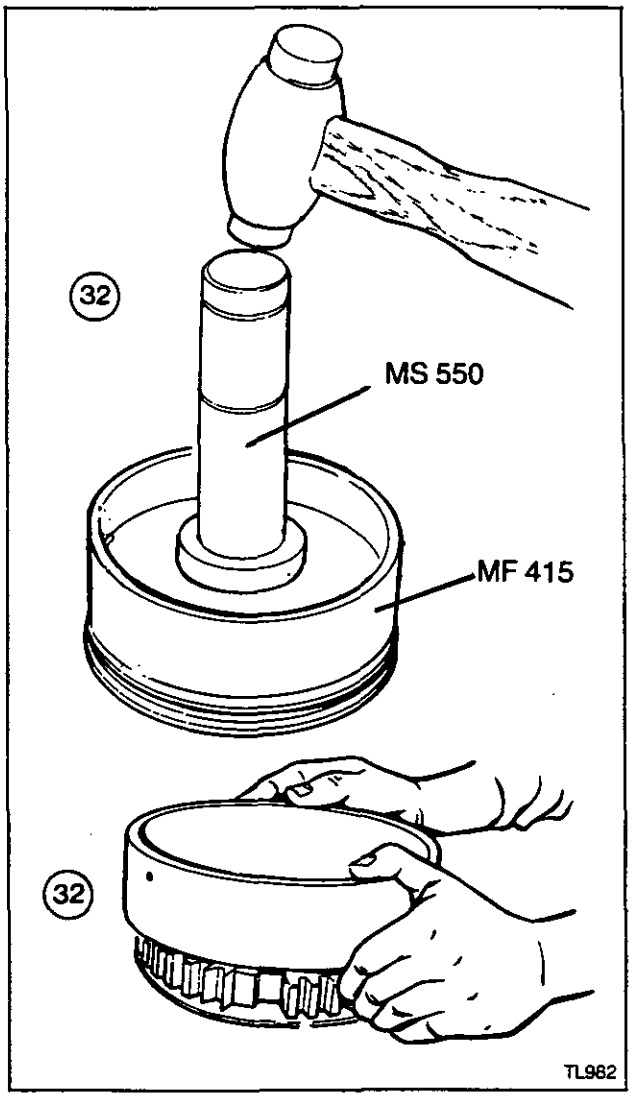
49. Place the second and third gears in the bottom of the gearbox and replace the layshaft through the front of the gearbox, sliding it fully rearward.
50. Refit the thrust washer at the front of the shaft with the step towards the bearing, low ratio gear and synchromesh hub assembly. Place the circlip on the unsplined portion of the shaft.
51. Refit high ratio gear and, while holding it in place, drive the layshaft forwards to push the circlip into its groove.
52. Refit the thrust washer with the flat face towards the high ratio gear and replace snapring.
53. Move the layshaft forwards and refit the snap ring in front of the third gear. Move layshaft rearwards and refit rear support bearing and snap ring.
54. Place the PTO constant mesh gear in the bottom of the gearbox and refit the PTO shaft from the rear of the gearbox.
55. Refit the PTO front bearing housing, see operation 7D-08.

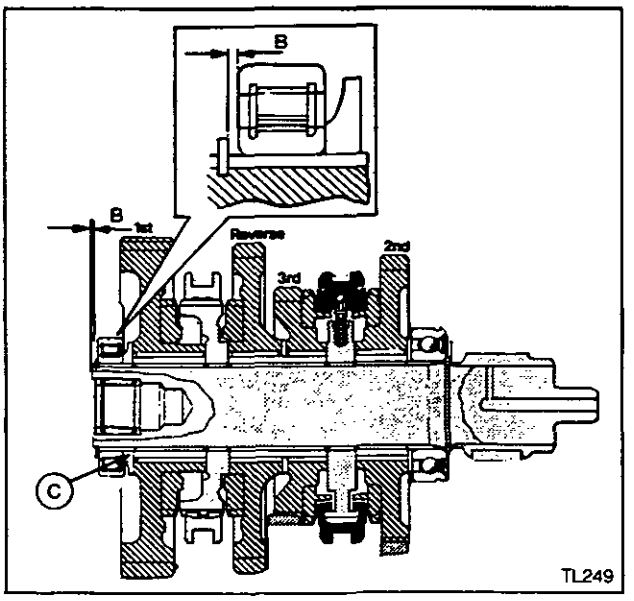
Mainshaft

56. Assemble the mainshaft complete with all hubs, gears, bushes, bearing and thrust washers. Refit circlip. Measure the gap 'B' between the front bearing and the circlip. The gap (end float) should be between 0,080 mm (0.003 in) and 0,30 mm (0.012 in). If your measurement falls outside the set limits, replace the calibrated thrust washer 'C', which sits between the bearing and first gear, with one of a choice of varying thickness thrust washers to achieve the desired end float. Calibrated thrust washer part numbers are as follows:

Thrust Washer Chart		
MF Part No	Thickness mm	Thickness in
1671 888 M2	4,14-4,19	0.163-0.165
1671 889 M1	4,39-4,44	0.173-0.175
1671 890 M2	4,62-4,67	0.182-0.184
1671 891 M2	4,85-4,90	0.191-0.193

57. Slide the mainshaft through the rear of the gearbox, progressively fitting in order, the steel reversible thrust washer, second gear with short bush, second/third gear synchromesh hub assembly, long bush together with third gear, steel reversible thrust washer, and reverse gear. Engage the first/reverse coupler with first gear on the medium length bush and locate the needle thrust face on rear of hub using petroleum jelly. Lower it into the gearbox and push the mainshaft fully forwards.





58. Fit the preselected calibrated thrust washer with flat side towards first gear, bearing and circlip.
59. Locate the tagged thrust washer in the gearbox centre web with the belled side facing forwards. Refit needle roller bearing into the front of the mainshaft.
60. Locate the layshaft selector fork into the coupler of the layshaft synchromesh assembly.
61. Hold the high and low ratio constant mesh gears in the gearbox and refit the transmission input shaft. Refit reversible steel thrust washer to the front of the high ratio gear.
62. Refit the input housing assembly, see operation 7D-07.
63. Refit the epicyclic reduction unit, see operation 7D-05.
64. Refit the selector forks and rails, see operation 7D-03.
65. Refit the clutch release mechanism, see operation 6A-04.
66. Refit the gearbox to the tractor, see section 2.

12 SPEED MULTI-POWER MK II ZF SYNCHROMESH GEARBOX

Section 7 – Part E

Table of Contents

7E–2

12 SPEED MULTI-POWER GEARBOX

Specification

Model	12 speed Multi-Power Mk II ZF Synchromesh
Number of gears:	
Forward	12
Reverse	4
Synchromesh Type	ZF
Epicyclic Unit Reduction	4:1 (Low range)
Normal duty	M-F 365
Heavy duty	M-F 375, 390 and 398

Settings Required

Mainshaft end float	0,08-0,30 mm (0.003-0.012 in)
Type of adjustment	Variable thickness thrust washer
Inputshaft and float	0,64-1,65 mm (0.025-0.065 in)
Type of adjustment	Variable thickness thrust washer
Synchromesh ring to coupler clearance	0,8 mm (0.030 in) minimum
Synchromesh neutral setting	See procedure 7E-04
Multi-Power Clutch Unit Number of Friction plates	3
Thickness	2,41-2,59 mm (0.095-0.102 in)
Maximum Height (permissible distortion)	2,92 mm (0.115 in)
Groove depth	0,38-0,63 mm (0.015-0.025 in)
Number of steel plates	3
Maximum Dish	0,25 mm (0.010 in)
Maximum height (permissible distortion)	2,21 mm (0.088 in)
Number of Coil Springs	6
Free length	17,8 mm (0.700 in)
Load at Working length	2,98-3,64 kg (6.75-8.03 lb)
Operating pressure	19-22 bar (275-319 lbf/in^2)

Special Tools

MF 255B	PTO input shaft oil seal replacer
MF 256A	Multi-Power input shaft oil seal replacer
MF 315A	Needle roller bearing remover/replacer
MF 414	Synchro centralising pin
MF 415	Synchro hub assembly tool
MS 550	Drive handle
KMF 1004	Input shaft oil seal protector
MF 2001	Pressure test set

Bolt Torques

Gear lever cover to shift tower	50- 70 Nm (37-52 lbf ft)
Shift tower to gearbox top	102-122 Nm (75-90 lbf ft)
Shifter fork locking screws	34- 52 Nm (25-38 lbf ft)
Interlock bolt to gearbox case	40- 47 Nm (30-35 lbf ft)
Epicycle unit to gearbox case	40- 47 Nm (30-35 lbf ft)
Input shaft housing to gearbox case	54- 61 Nm (40-45 lbf ft)
PTO drive shaft housing to gearbox	54- 61 Nm (40-45 lbf ft)
Engine to gearbox	100-130 Nm (74-94 lbf ft)
Gearbox to rear transmission case	102-122 Nm (75-90 lbf ft)

12 SPEED MULTI-POWER GEARBOX

General Description

The Multi-Power gearbox makes available twelve forward and four reverse speeds. It is based on a six-speed gearbox with a high-low epicyclic unit, ZF Synchromesh engagement, for second and third ratio gears, constant mesh gears for first and reverse. A hydraulic clutch is provided to give a "high/low power-shift" or change-on-the-move facility.

The gearbox has three sections:

The front section consists of the Multi-Power hydraulic clutch, associated gearing and drive arrangements. The power take-off input drive is also contained within this section.

The centre section comprises constant mesh gearsets giving three basic forward speeds and single reverse with ZF synchromesh engagement for second and third ratios as previously mentioned.

The rear section consists of an epicyclic gear reduction unit offering an alternative low range output drive ratio. The three basic forward speeds and single reverse are doubled by the ability of the epicyclic unit to provide the additional output ratio. This feature, together with the alternative input ratio offered by the Multi-Power in the front section, further doubles the number of speeds available and gives the gearbox a total of twelve forward speeds and four reverse.

The gearbox layshaft is located below the mainshaft and is of hollow construction to accept the power take-off (PTO) drive shaft which runs inside it.

Roller bearings are used to support the main and layshafts at their front ends. Throughout its design the gearbox offers a superior performance in terms of reliability and extended service life.

The Front Section of the Gearbox

Drive from the engine enters the gearbox via the input shaft which is supported by a spigot located in the front end of the mainshaft. Part of the Multi-Power hydraulic clutch assembly, consisting of the casing and connected friction plates together with the operating piston, is splined to the input shaft. The remaining part of the clutch comprising the high ratio driving gear carrying a set of plates located between those fixed to the casing is free-running on the input shaft. The high ratio driving gear is in constant mesh with a driven gear splined to the layshaft.

The Multi-Power low ratio driving gear is splined to the input shaft and is in constant mesh with a driven gear, free-running on the layshaft. The drive connection between the driven gear and the layshaft is made through a dog tooth coupling. The coupling has teeth for engagement with corresponding ones on the side of the driven gear and is connected by helical splines to the layshaft. It is spring loaded into engagement with the driven gear but has the ability to slide out of engagement automatically whenever Multi-Power high ratio is selected. How this occurs will be described shortly.

Multi-Power Low Ratio Drive

This passes from the gearbox input shaft to the layshaft through the constant mesh gearset and spring loaded coupling.

Multi-Power High Ratio Drive

Selection of Multi-Power high ratio causes the hydraulically operated piston within the clutch to force together the plates fixed to the casing and the high range driving gear. This action causes the gear to rotate with the clutch as a single assembly and the drive is delivered through the high ratio driven gear to the layshaft.

Engagement of the clutch plates immediately accelerates the speed of the layshaft by about 30% above that previously imparted to it by the low ratio gears. When this occurs the spring loaded coupling engaging the slower running low ratio gear is subjected to a side force by the helical splines on the layshaft and moves out of engagement with the gear. In this way the low ratio is instantly disengaged when the high ratio gears are switched in.

Unless the Multi-Power clutch is engaged the drive will always pass through the low ratio gearset and spring loaded coupling in the way previously explained. In these circumstances the high ratio driven gear rotates the driving gear which is now running free on the mainshaft.

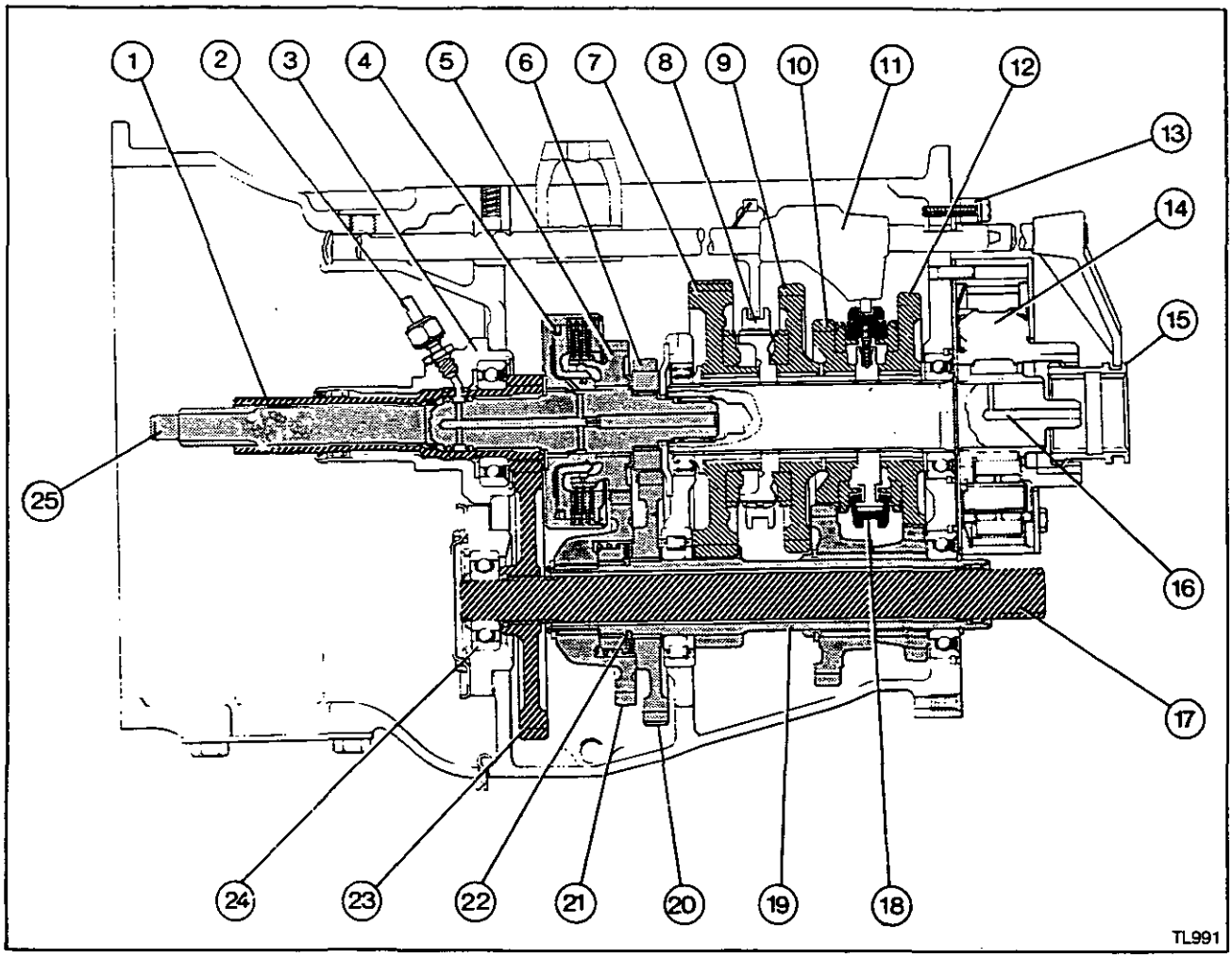
Multi-Power Gearbox Characteristics

1. In Multi-Power HIGH ratio there is a permanent mechanical connection between the engine and wheel when the engine is pulling and on the over-run. Engine braking is available.
2. In Multi-Power LOW ratio the connection between the engine and wheels is broken on the over-run and there is no engine braking. This happens because the wheels drive the countershaft and coupling faster than the LOW ratio gears. The coupling is therefore forced out of mesh with the driven gear and connection with the engine is disconnected.
3. Tractors with Multi-Power cannot be towed to start the engine because this is equivalent to driving the coupling faster than the LOW ratio gear set.
4. When driving the tractor and load up an incline in Multi-Power HIGH ratio, depression of the clutch pedal sufficiently to disengage the main clutch causes the transmission to lock as the tractor starts to roll back. This gives the operator a means of holding the tractor stationary, on an upward slope, without use of the brakes. The feature is known as "hill hold".

The reason for "hill hold" is that as soon as the tractor moves back, the countershaft is turned backwards and a reverse drive is imparted to the HIGH and LOW ratio gear sets. Since these gear sets with different ratios are coupled to the same input shaft, rotation is impossible and the transmission locks.

Note: If the Multi-Power control switch is moved to LOW during the "hill hold" the feature becomes ineffective because the high ratio driving gear runs free on the input shaft.

12 SPEED MULTI-POWER GEARBOX



1. PTO input gear and shaft
2. Hydraulic supply to clutch pack
3. Input shaft housing
4. Multi-Power clutch pack
5. High range gear
6. Low range gear
7. First/reverse gear
8. Sliding coupler
9. Reverse gear
10. Third gear
11. Selector rails and forks
12. Second gear
13. Gear shift interlock
14. Epicyclic reduction unit
15. Sliding coupler
16. Mainshaft
17. PTO shaft
18. Synchromesh mechanism and sliding coupler
19. Layshaft
20. Low range constant mesh gear
21. High range constant mesh gear
22. Spring loaded coupler
23. PTO constant mesh gear
24. PTO front bearing housing
25. Transmission input shaft

The power take-off drive

This enters the gearbox through a hollow shaft revolving on the outside of the gearbox input shaft. A spur gear pinion at the rear of this hollow shaft is permanently engaged with a gear splined to the PTO drive shaft running within the gearbox layshaft.

The Centre Section of the Gearbox

The mainshaft carries four free-running gears, three of which are in constant mesh with corresponding fixed gears on the layshaft to give the basic first, second and third ratios. The remaining free-running gear gives reverse drive and is in constant mesh with a compound idler gearset permanently driven from the side of the layshaft third gear.

The second, third and reverse gear are of the straight cut spur type. The first gear has helical teeth which have longer contact areas and are consequently capable of transmitting greater loads than straight cut gears of the same size. They are also quieter running.

Drive through the first, second, third and reverse free-running gears takes place when the selected gear is engaged with the mainshaft by a sliding coupler. The coupler located between the second and third ratios forms part of the ZF synchromesh mechanism.

Sliding couplers have teeth specially shaped to give easier drive engagement. All the teeth on the coupler engage with corresponding teeth on the side of the appropriate gear at the same time. This means that any impact forces occurring during the process of initial engagement are distributed uniformly through all teeth so minimising the risk of damage. Furthermore, in the unlikely event of damage occurring it is restricted to the coupler area and in no way affects the smooth running and life of the gears themselves.

The Rear Section of the Gearbox

This consists of the epicyclic gear reduction unit of heavy duty design incorporating a Belleville spring arrangement to absorb the end-thrust imposed on the mainshaft by the first speed helical gear set.

The rear end of the mainshaft is machined to form the sun gear which meshes with three planet gears also in mesh with a fixed internal ring gear forming the circumference of the working components. When the mainshaft rotates the planet gears and carrier revolve round the sun gear at a reduced speed compared with that of the mainshaft.

A sliding coupler with internal and external splines forms the connection between the gearbox and the output shaft to the final drive. When moved by its operating lever it couples the mainshaft directly to the output shaft to establish High range drive giving the gearbox an additional set of speed ratios designated fourth, fifth and sixth and high reverse. When shifted fully rearwards the external splines on the coupler engage corresponding splines on the planet carrier to establish Low range drive. In these circumstances, drive from the gearbox mainshaft to the output shaft is via the carrier and subject to a speed reduction giving first, second and third speed ratios and low reverse. The coupler may also be placed in a mid or neutral position free of the mainshaft and carrier to totally disconnect the drive from the gearbox – a feature forming the basis of MF's safety starting arrangements.

Hydraulic System

The hydraulic oil for operation of the Multi-Power clutch is supplied from the steering system. It is regulated to a pressure of 19-22 bar (275-319 lbf/in^2) by the pressure maintaining valve (PMV) mounted on the manifold in the engine compartment.

Hydraulic oil is taken from the PMV manifold through an electrical solenoid valve, controlled by a switch on the instrument panel, to the Multi-Power clutch.

A pressure test point is provided on the PMV manifold to check the hydraulic oil pressure.

12 SPEED MULTI-POWER GEARBOX

Diagnosis

With the Multi-Power clutch there are only two types of fault, mechanical or hydraulic. If a mechanical failure occurs the tractor will need to be split between the engine and the gearbox and remove the Multi-Power clutch unit for repair. Before any repairs are made, either mechanical or hydraulic, the following test must be carried out to determine the condition of the hydraulic system.

Multi-Power Pressure Test

Check 7E-01

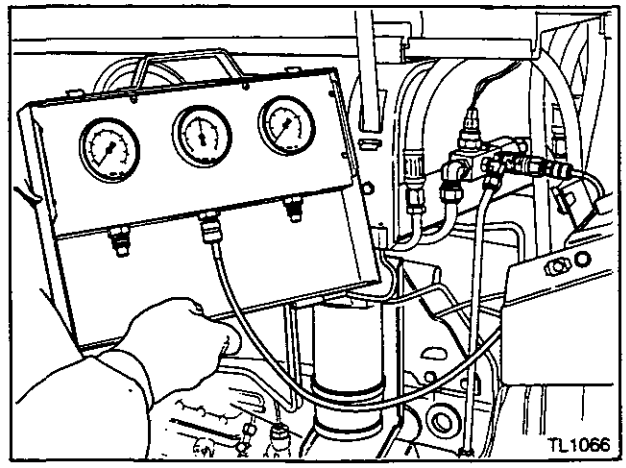
Special tools: MF 3001 Pressure test-set

Note: Before carrying out a hydraulic test, ensure that the transmission is up to the full mark, the oil is clean and the hydraulic oil filters are clean. The oil must be raised to 50-60°C (120-140°F) by running the hydraulic system under load. This is important as excessively cold or hot transmission oil can affect the pressure readings

1. Remove the test point plug on the PMV manifold.
2. Install the M14 male quick release diagnostic coupling.
3. Connect up the 30 bar (400 lbf/in^2) pressure gauge and pipe.
4. Start the engine to raise the transmission oil temperature to 50-60°C (122-140°F).
5. Set the engine speed to 1200 rev/min.
6. With the transmission oil temperature at the specified temperature the pressure gauge should read 19-22 bar (275-319 lbf/in^2).
7. Engage Multi-Power. The pressure reading must be as shown in item 6.
8. Stop the engine. Remove the gauge and refit the plug.
9. Check operation of the solenoid valve, remove the pipe from the solenoid valve to the clutch and connect the pressure gauge direct to the solenoid valve.
10. Start engine and increase speed to 1200 rev/min.
11. Switch the Multi-Power on and off. The pressure gauge will then indicate if the solenoid valve is working.
12. Stop engine, remove gauge and refit pipe.

Result

1. If the pressure is below the stated figure, check the pressure maintaining valve setting, see section 12.
2. If the pressure reading is correct at 19-22bar (275-319 lbf/in^2), the hydraulic system is satisfactory and the problem is mechanical within the clutch assembly.
3. Further, more detailed hydraulic tests will be found in section 12B dealing with flow testing the hydraulic pump and testing the PMV.
4. If the Multi-Power clutch does not drive, the following points should be looked for when the clutch is removed:
   a. Distorted and overheated clutch plates.
   b. Leaking seals on the piston and shafts.
   c. Mechanical failure.



Main Gear Shift Lever

Removal and refitment 7E-02

Removal

1. Remove the cab floor mat and/or access panels if fitted.
2. Move the gear levers to the neutral position.
3. Remove the five bolts holding the gear lever assembly to the shift tower on top of the gearbox.
4. Remove the gear lever assembly from the tractor.
5. Remove the gear lever rubber cover.

Caution: When removing the spring retaining clip (7), care must be taken to prevent the spring from flying out and causing possible injury or damage.

6. Place the gear lever assembly in a vice.
7. Press the spring retaining clip towards the spring, slide sideways and remove. This will release the spring.
8. Press out the gear lever retaining clip.
9. Lift out the gear lever.
10. The gear lever cup may be removed from the cover if required.
11. Unscrew the retaining nut and press out the cup.

Refitment.

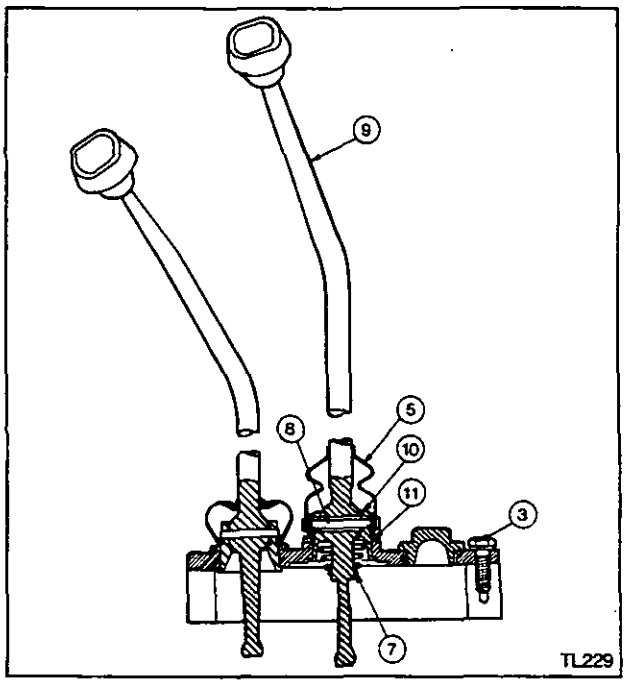
12. Reverse procedure 1 to 11 except:
    a. If the gear lever cup has been removed ensure that it is fitted with the gear lever retaining pin square with the axis of the tractor by lining up the flats on the cup.
    b. Ensure that the gear lever rubber cover is in good condition to prevent dirt getting into the transmission.
    c. Coat the underside of the gear lever cover with Loctite 515 and torque the cover bolts to 50-70 Nm (37-52 lbf ft).

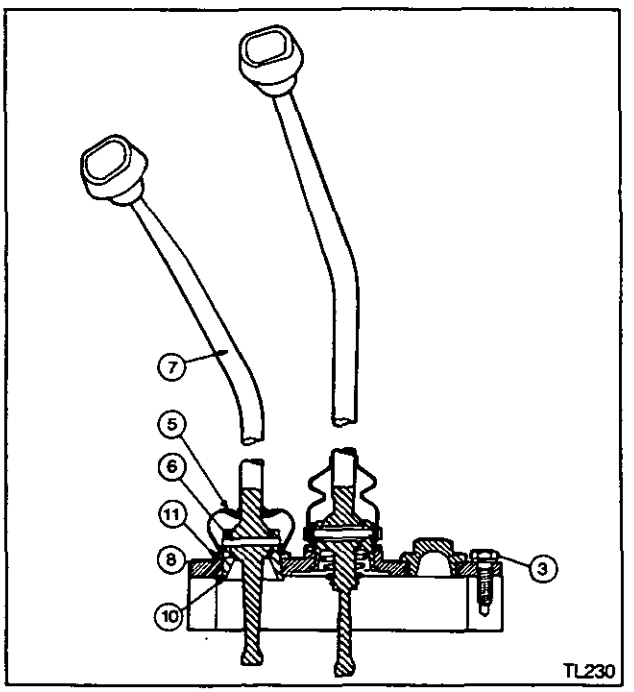
High/Low Shift Lever

Removal and Refitment 7E-03

Removal

1. Remove the cab floor mat and/or access panels if fitted.
2. Move the gear levers to the neutral position.
3. Remove the five bolts holding the gear lever assembly to the top of the gearbox.
4. Remove the gear lever assembly from the tractor.
5. Remove the gear lever rubber cover.
6. Remove the gear lever retaining pin.
7. Lift out the gear levers.
8. Remove the 'O' ring.
9. The gear lever cup may be removed if required.
10. Unscrew the retaining nut and press-out the cup.





Refitment

11. Reverse procedure 1 to 11 except:
    a. Renew the 'O' ring.
    b. If the gear lever cup has been removed, ensure that it is fitted with the gear lever retaining pin square with the axis of the tractor by lining up the flats on the cup.
    c. Ensure that the gearlever rubber cover is in good condition to prevent dirt getting into the transmission.
    d. Coat the underside of the gearlever cover with Loctite 515 and torque the cover bolts to 50-70 Nm (37-52 lbf ft).

12 SPEED MULTI-POWER GEARBOX

Selector Rails and Forks

Removal and Refitment 7E-04

Special Tools: MF 414 Centralising pin and locating peg

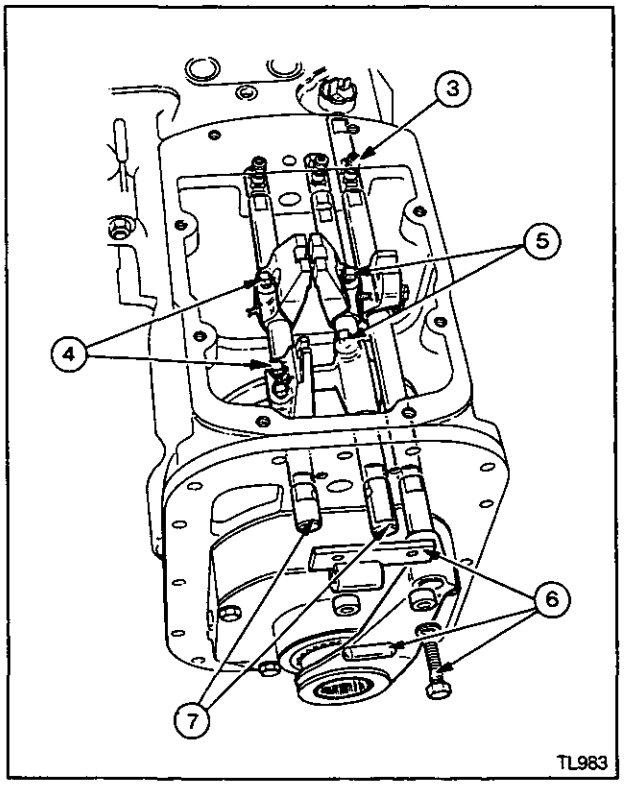
Removal

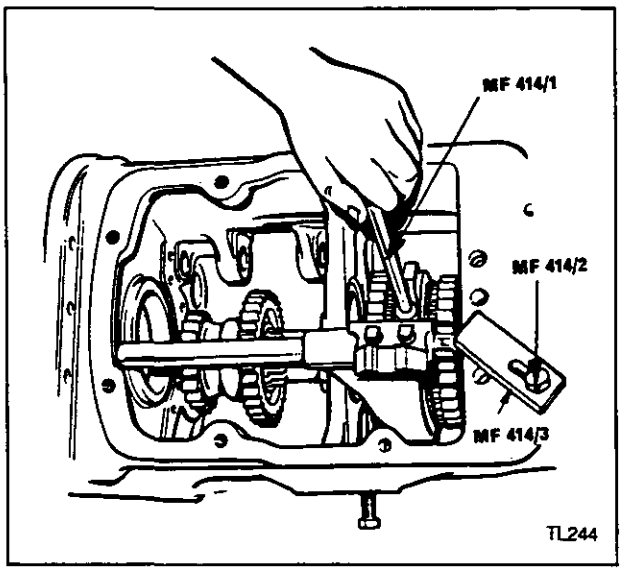
Caution: Beware of sharp edges around the top of the gearbox case.

1. Split the tractor between the gearbox and the spacer housing or centre housing, see section 2.
2. Remove the gearbox top cover and the shift tower.
3. Lift out the detent springs and plungers.
4. Remove the locking wires.
5. Loosen the locking screws.
6. Remove the bolts, forks, bails, peg, stop plate and plain plate of the gear shift interlock mechanism.
7. Slide the rails rearwards out of the casting, retaining the gear lever engagement dogs and the selector forks on each rail.

Refitment

8. Reverse procedures 1 to 7 except:
   a. Apply a few drops of oil to the selector rails before refitment.
   b. Tighten interlock plate bolts to a torque of 40-47 Nm (30-35 lbf ft).
   c. Tighten all locking screws to a torque of 34-52 Nm (25-38 lbf ft).
   d. On completion of the refitting procedure, place all the gears in the neutral position.
   e. Set the synchromesh selector fork to the neutral position by locating the selector rail with locating peg MF 414/3 clamped to casting with bolt MF 414/2. Insert centralising pin MF 414/1 into hole in top of the selector fork, lining it up with the hole in the sliding coupler. Progressively tighten the two locking screws on the selector fork to 34-52 Nm (25-38 lbf ft). Afterwards check that the centralising pin MF 414/1 can be removed freely. Wire the locking screws.





Normal and Heavy Duty Epicyclic Unit

Removal and Refitment 7E-05

Removal

1. Split the tractor between the gearbox and the spacer housing or the centre housing, see section 2.
2. Remove the locking wire.
3. Remove the locking screw.
4. Remove the selector fork and coupling.
5. Remove the bolts.
6. Remove the complete assembly.

Refitment

7. Reverse procedures 1 to 6 except:
   a. Ensure that the front and rear thrust rings are correctly located before refitment.
   b. Ensure that the dowels are correctly located in the gearbox casing.
   c. Locate the cover plate with the cut out in the bottom left hand corner for heavy duty, and the bottom right hand corner for normal duty epicyclic.
   d. Fit a lockwasher to the lower right hand retaining bolt, on normal duty epicyclics only.
   e. Tighten the retaining bolts progressively and evenly to a torque of 40-47 Nm (30-35 lbf ft).

Normal Duty Epicyclic Unit

Overhaul 7E-06

Disassembly

1. Remove the gearbox epicyclic unit, see operation 7D-05.
2. Remove the cover plate.
3. Remove the rear thrust ring.
4. Remove the planetary pinion carrier.
5. Remove the front thrust ring.
6. Remove the shim.
7. Remove the front plate.
8. If necessary, remove the dowels from the ring gear.

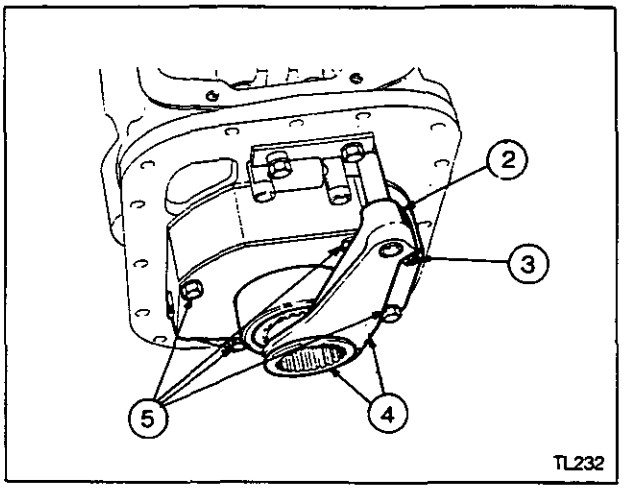
Note: The planetary pinion carrier cannot be serviced, and must be replaced as a complete assembly if found to be defective.

9. To remove pinions and needle rollers, follow items 11, 12 and 13 in operation 7D-07.

Note: Spacers are fitted either side and between the needle rollers.

Reassembly

10. Reverse procedures 1 to 9 except:
    a. When replacing the rollers in the pinions, a smear of petroleum jelly (not grease) will help retain them. Do not omit the spacer from between the two runs of rollers. Each run consists of 27 rollers, see item 9.



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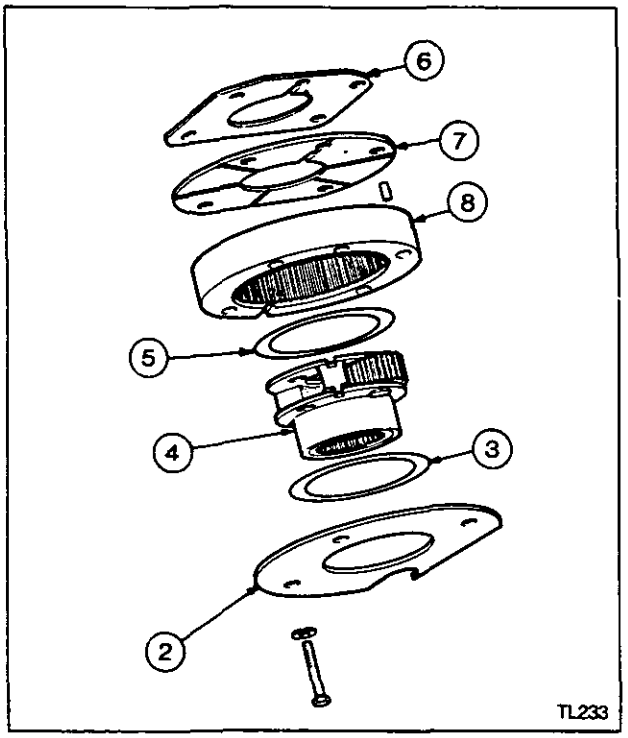


TL233

    b. The front plate and the cover plate must be positioned with the oil grooves towards the pinion carrier.
    c. Always fit the same thickness of shims as those removed.
    d. To assist assembly of the front and rear thrust rings on the pinion carrier, smear them with petroleum jelly (not grease). Ensure that the tabs on the thrust rings locate in the pinion carrier cut-outs, and that the brass faces are away from the pinion carrier.

12 SPEED MULTI-POWER GEARBOX

Heavy Duty Epicyclic Unit

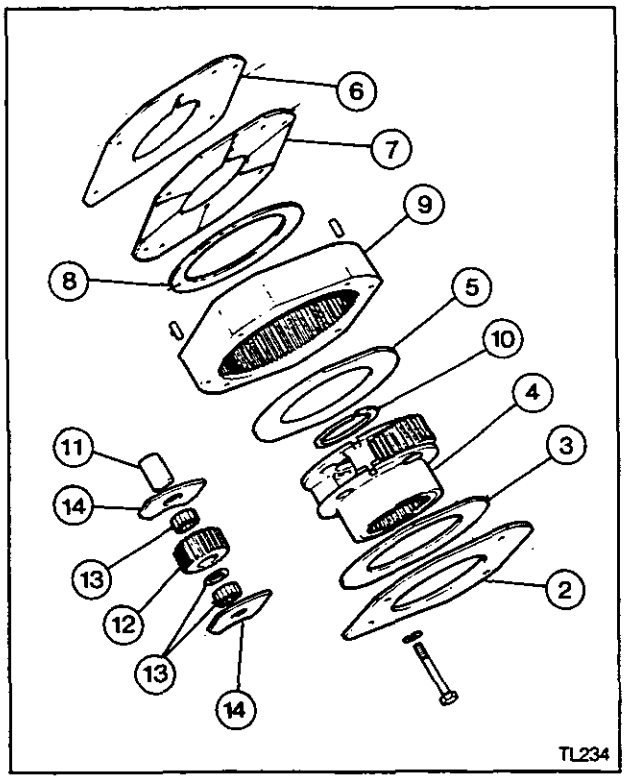
Overhaul 7E-07

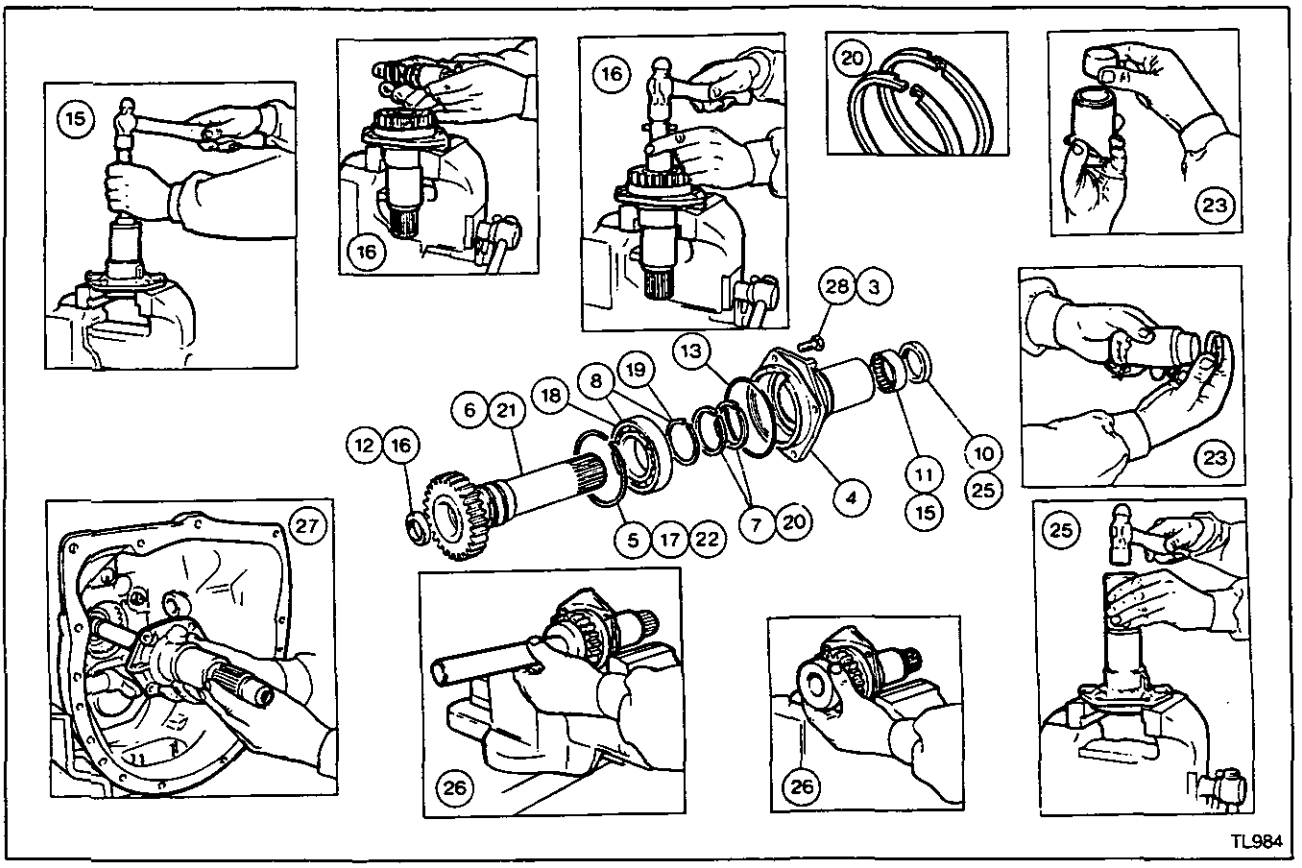
Disassembly

1. Remove the gearbox epicyclic, see operation 7E-05
2. Remove the cover plate.
3. Remove the rear thrust ring.
4. Remove the planetary pinion carrier.
5. Remove the front thrust ring.
6. Remove the shim.
7. Remove the front plate.
8. Remove the Belleville spring disc.
9. If necessary, remove the dowels from the planetary ring gear.
10. Remove the external snap ring.
11. Gently tap out the three pinion shafts towards the front.
12. Remove the planetary pinions.
13. Remove the two sets of rollers and spacer from each pinion.
14. Remove the wear plates from each side of each pinion.

Reassembly

15. Reverse procedures 1 to 14, except:
    a. When replacing the rollers in the pinions, a smear of petroleum jelly (not grease) will help retain them. Do not omit the spacer from between the two runs of rollers. Each run consists of 16 rollers.
    b. Ensure that the Belleville spring disc is located correctly in the epicyclic ring gear with the concave face rearwards.
    c. The front plate and the cover plate must be positioned with the oil grooves towards the pinion carrier.
    d. Ensure that the pinion wear plates are refitted with the flats positioned innermost to the centre of the pinion carrier.
    e. Ensure that the gap of snap ring is located midway between the planetary pinion shafts.
    f. Always fit the same thickness of shims as those removed.
    g. To assist assembly of the front and rear thrust rings on the pinion carrier, smear them with petroleum jelly (not grease). Ensure that the tabs on the thrust rings locate in the pinion carrier cut-outs, and that the brass faces are away from the pinion carrier.





Input Shafts and Housing

Removal and Refitment	7E-08

Special Tools:

MF 255B	*PTO input shaft oil seal replacer*
MF 256A	*Multi-Power input shaft oil seal replacer*
MF 315A	*Needle roller bearing remover/ replacer*
KMF 1004	*Input shaft oil seal protector sleeve*

Removal

1. Remove the clutch release mechanism, see operation 6A-04.
2. Disconnect the pipe to the input housing.
3. Remove the four bolts holding the housing to the gearbox case.
4. Withdraw the input housing complete with the PTO shaft.
5. Remove the large internal circlip from the input housing groove.
6. Push the PTO shaft complete with bearing rearwards out of the housing.
7. Unclip and remove the two sealing rings.
8. If necessary, remove the circlip and press the bearing off the front of the shaft.
9. Remove the circlip.
10. Lever the seal out.
11. Using MF 315A, remove the needle roller bearing.
12. Remove the seal.
13. Remove the 'O' ring (input shaft housing).

Examine the bore of the PTO input shaft and the input housing for wear where the sealing rings locate. If any of the above parts show signs of wear or damage, they must be replaced. Check (and if necessary, replace) the ball and needle roller bearings.

Refitment

Note: Use petroleum jelly (not grease) to lubricate all seals and the needle roller bearing when refitting.

14. Fit a new 'O' ring to the input shaft housing.
15. Using MF 315A, replace the needle roller bearing.
16. Using MF 256A, fit a new seal, with the lip of the seal facing the tool.
17. Refit the circlip on the shaft.
18. Refit the bearing with the shield towards the gear teeth.
19. Refit the circlip. (Check that it is properly seated.)
20. Fit two new cast iron sealing rings on the PTO input shaft and ensure that they are correctly clipped together, then lubricate the shaft with clean transmission oil.

21. Carefully refit the PTO shaft and bearing into the input housing, ensuring that the cast rings are not damaged.
22. Re-locate the circlip in the input housing. (Check that it is properly seated.)
23. Place the cone adaptor MF 255B/2 onto seal replacer MF 255B/1.
24. Place a new seal over the cone and onto the tool, with the lip of the seal facing away from the tool and remove the cone.
25. Place the tool over the PTO shaft and tap the seal into place.
26. Carefully push guide KMF 1004/2 into the rear end of the PTO input shaft. Carefully insert tapered end of protector sleeve KMF 1004/1 through guide. Remove the guide leaving the sleeve in position.
27. Carefully refit the input housing over the input shaft, and withdraw the protector sleeve when the housing is in place.
28. Lightly coat the bolt threads in a Hylomar sealant, refit and tighten them to a torque of 54-61 Nm (40-45 lbf ft).
29. Refit the pipe.
30. Refit the clutch release mechanism, see operation 6A-04.

PTO Driveshaft Front Bearing

Removal and Refitment 7E-09

Special Tools: MF218A PTO driveshaft puller.

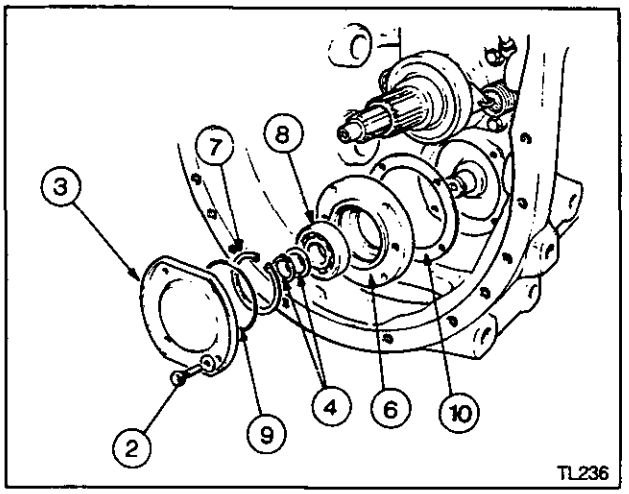
Removal

With the gearbox removed from the tractor:

1. Remove the clutch cross shaft and lever, see operation 6A-04.
2. Remove the four bolts and washers.
3. Remove the cover plate.
4. Remove the external circlip and washer.
5. Screw two 3/8 UNC x 75 mm (3in) bolts into the bearing housing and tighten them evenly to draw the housing from the case and shaft.
6. Remove the housing.
7. Remove the circlip.
8. Press out the bearing.
9. Discard the 'O' ring.
10. Discard the gasket.

Refitment

11. Reverse procedures 7 to 10 except:
    a. Fit a new 'O' ring, gasket and circlip.
    b. Lightly coat the gasket with Hylomar sealant.
12. Using MF218A refit the bearing and housing assembly on the front end of the PTO drive shaft ensuring that the splines on the shaft locate with those in the PTO constant mesh gear.
13. Fit a new circlip and washer.
14. Reverse procedures 1 to 6 except:
    a. Lightly coat the securing bolt threads with Hylomar sealant.
    b. Tighten the bolts to a torque of 54-61 Nm (40-45 lbf ft).



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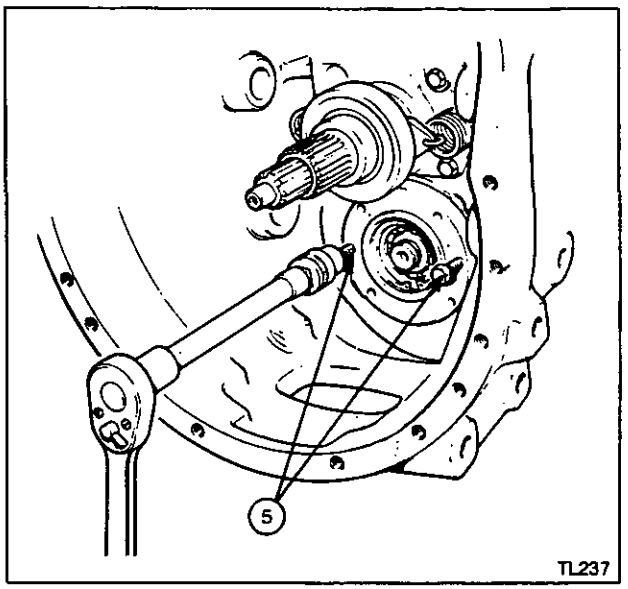

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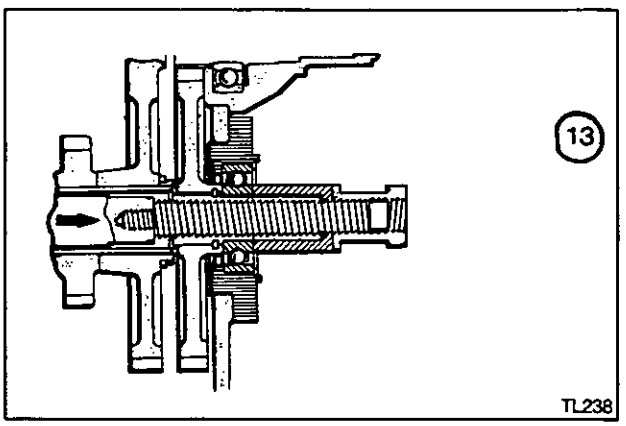

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Main Input Shaft and Multi-Power Clutch Unit

Removal and Refitment 7E-10

Removal

1. Remove the selector rail mechanism, see operation 7E-04.
2. Remove the clutch release mechanism, see operation 6A-04.
3. Using a feeler gauge, measure the gap between the front thrust washer and the PTO input shaft pinion. If it exceeds 1,65 mm (0.065 in) record the dimension for later use.
4. Remove the input shafts and housing, see operation 7E-08.
5. Remove the Multi-Power clutch front thrust washer.
6. Withdraw the main input shaft forwards out of the gearbox casing and simultaneously support the Multi-Power clutch, main input overdrive pinion and the main drive pinion whilst the splines are disengaged.

Note: Ensure that the Multi-Power clutch rear thrust washer does not fall into the bottom of the transmission casing.

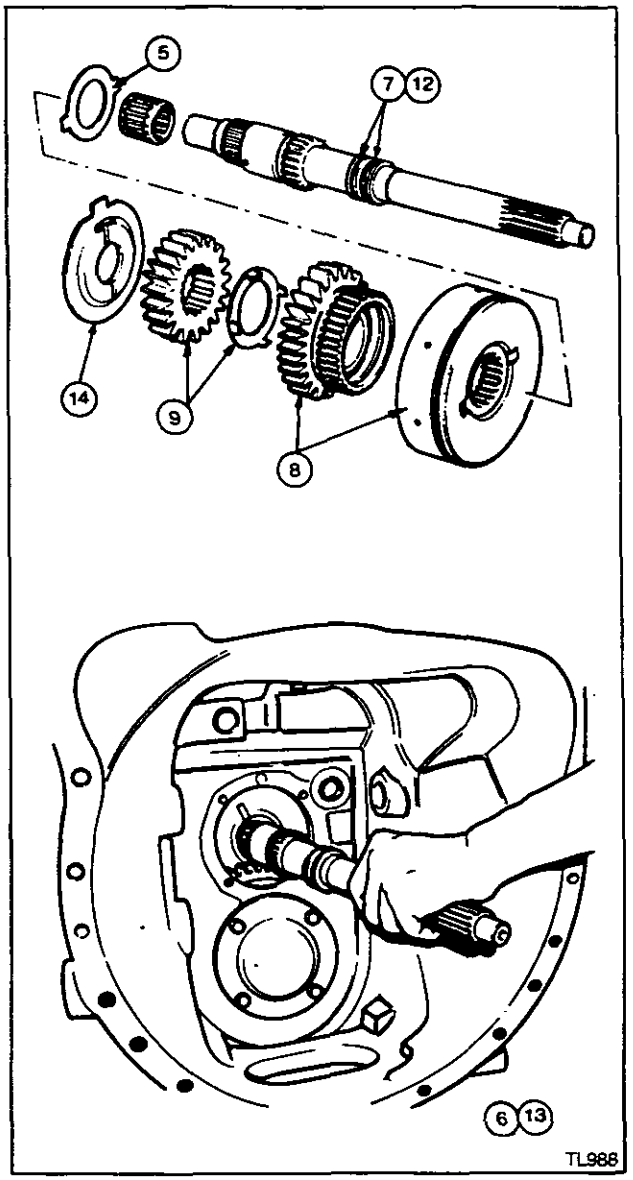
7. Unclip and remove the sealing rings.
8. Remove the clutch unit and main input overdrive pinion.
9. Remove the Multi-Power clutch rear thrust washer and the main drive pinion.
10. Examine the bore of the input PTO shaft for wear where the sealing rings locate and replace the shaft if any scoring or grooves are found. If excessive wear or scoring is found, the input housing and PTO input shaft assembly must be serviced as in operation 7E-08, procedures 8 to 30.

Refitment

11. Place the Multi-Power clutch, main input overdrive pinion, rear thrust washer and the main drive pinion forward of the centre web in the transmission casing, locating the gears with the overdrive and main drive layshaft gears.

Note: Lightly smear the rear thrust washer with petroleum jelly (to help refitment) and fit the tabs facing forwards and located correctly on the rear boss of the main input overdrive pinion.

12. Fit two new sealing rings to the main input shaft and ensure they are properly clipped together.
13. Carefully push the shaft rearwards into the front of the Multi-Power clutch unit and on into mesh with the main drive pinion. Ensure that the Multi-Power clutch unit and the main drive pinion are both located on the main input shaft splines and that the main input shaft is correctly located in the mainshaft needle roller bearing.
14. If the gap between the front thrust washer and the PTO input shaft pinion exceeds 1,65 mm (0.065 in) it must be replaced with one from the following chart, to give a gap of 0,63 mm (0.025 in) minimum, 1,65 mm (0.065 in) maximum.



Part No	Thickness mm	Thickness in
1661 951 M1	2,36-2,29	0.093-0.090
1667 607 M1	3,00-2,92	0.118-0.115
1667 608 M1	3,50-3,43	0,138-0,135

Refit the Multi-Power clutch unit front thrust washer and ensure that the two tabs are correctly located in the cut-outs on the clutch unit.

15. Lubricate the main input shaft with clean transmission oil and refit the input shaft housing and PTO input shaft, see operation 7E-08, procedures 26 to 29.
16. Reverse procedures 1 and 2.

Multi-Power Clutch Unit

Overhaul 7E-11

Disassembly

1. Remove the Multi-Power clutch, see operation 7E-10, procedures 1-8.
2. Place the clutch on a flat surface, push down the retainer plate the remove the snap ring.
3. Remove the retainer plate.
4. Remove the six springs.
5. Remove the three steel plates and the three friction discs.
6. Slide the piston out of the clutch housing.
7. If necessary, remove the piston rings.

Check

Check the condition of all components for signs of wear, scoring, damage, distortion or overheating. Check the friction plates for the following dimensional tolerances:
Thickness 2,41 to 2,59 mm (0.095 to 0.102 in).
Maximum height (permissible distortion) 2,92 mm (0.115 in).
Groove depth 0,38 to 0,63 mm (0.015 to 0.025 in).

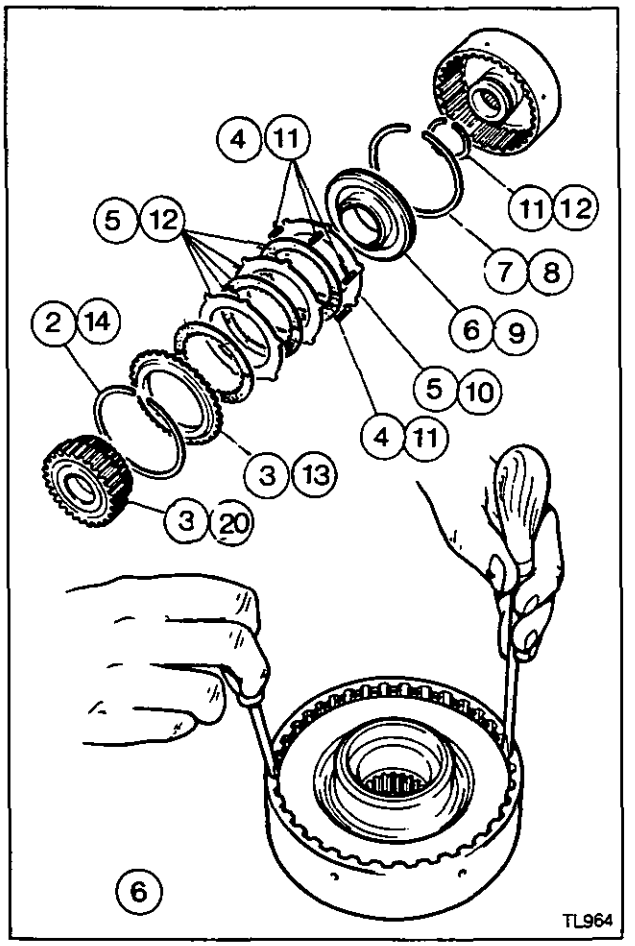
Check the steel plates as follows:
Thickness 1,67 to 1,75 mm (0.66 to 0.69 in).
Maximum dish 0,25 mm (0.010 in).
Maximum height (permissible distortion) 2,21 mm (0.0875 in).

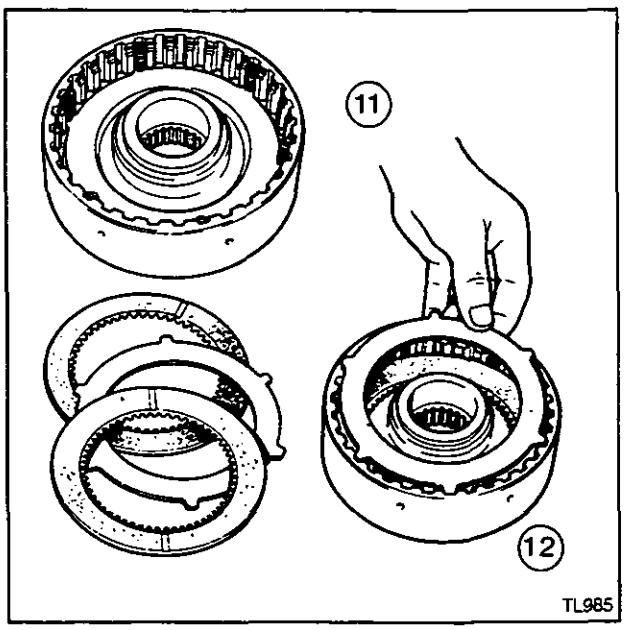
Check the six coil springs as follows:
Free length 17,8 mm (0.70 in).
Working length 12,7 mm (0.50 in).
Load at working length 2,98 to 3,64 kg (6.75 to 8.03 lb).

Replace any worn or damaged components, as required.

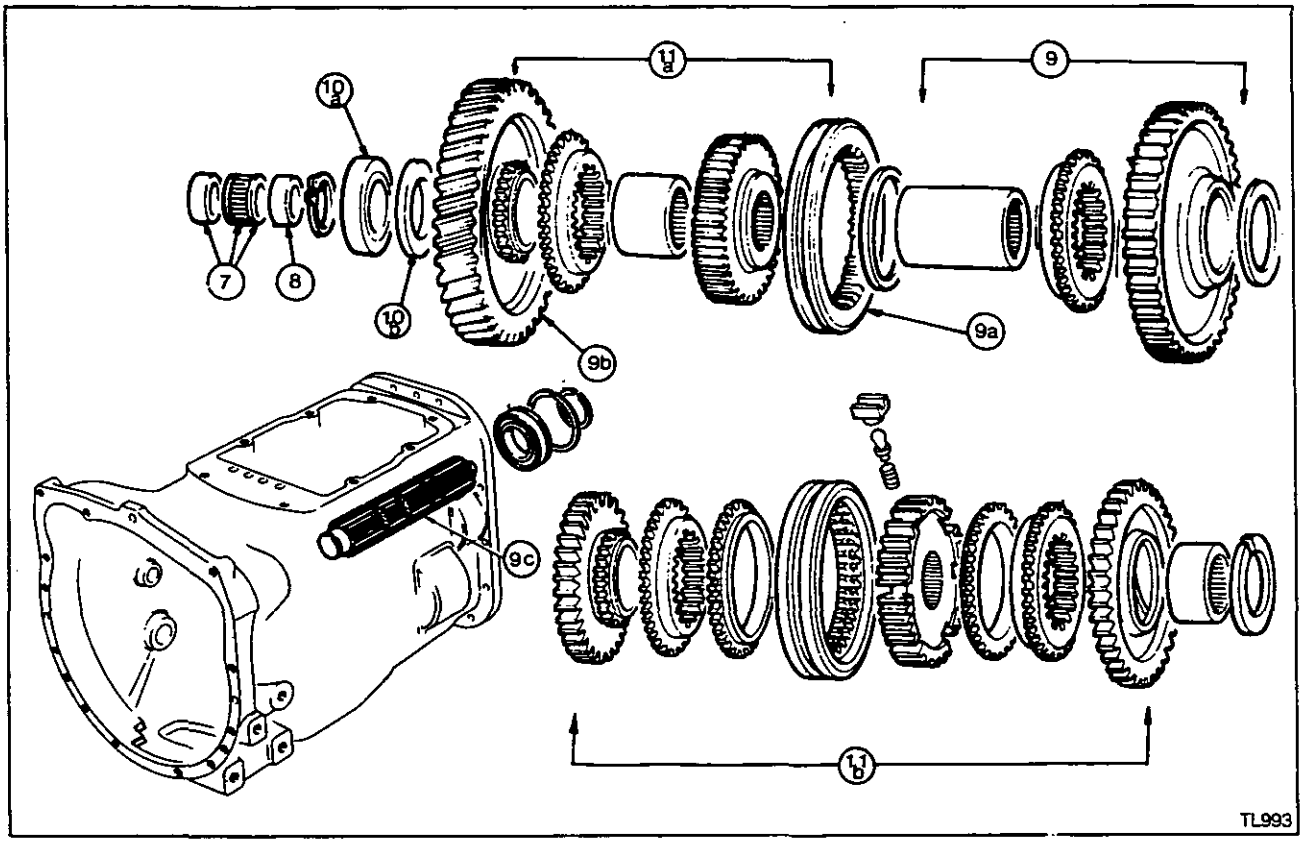
Reassembly

8. If necessary, refit the piston rings.
9. Compressing the piston ring, carefully refit the piston into the housing.
10. Fit one steel plate to the clutch housing, with the lugs on the steel plate located in the housing splines immediately to the right of the six holes in the housing.
11. Refit the six springs, placing one spring onto each lug of the first steel plate.
12. Refit the three friction plates and the remaining two steel plates alternately, locating the lugs on each steel plate one spline further to the right of one previously fitted.
13. Refit the retainer plate.
14. Refit the snap ring, and ensure it is located correctly.
15. Refit the Multi-Power clutch, see operation 7E-10, procedures 11-16.





12 SPEED MULTI-POWER GEARBOX



Layshaft, Mainshaft, PTO Shaft and Gears

Overhaul	7E-12

Special Tools:

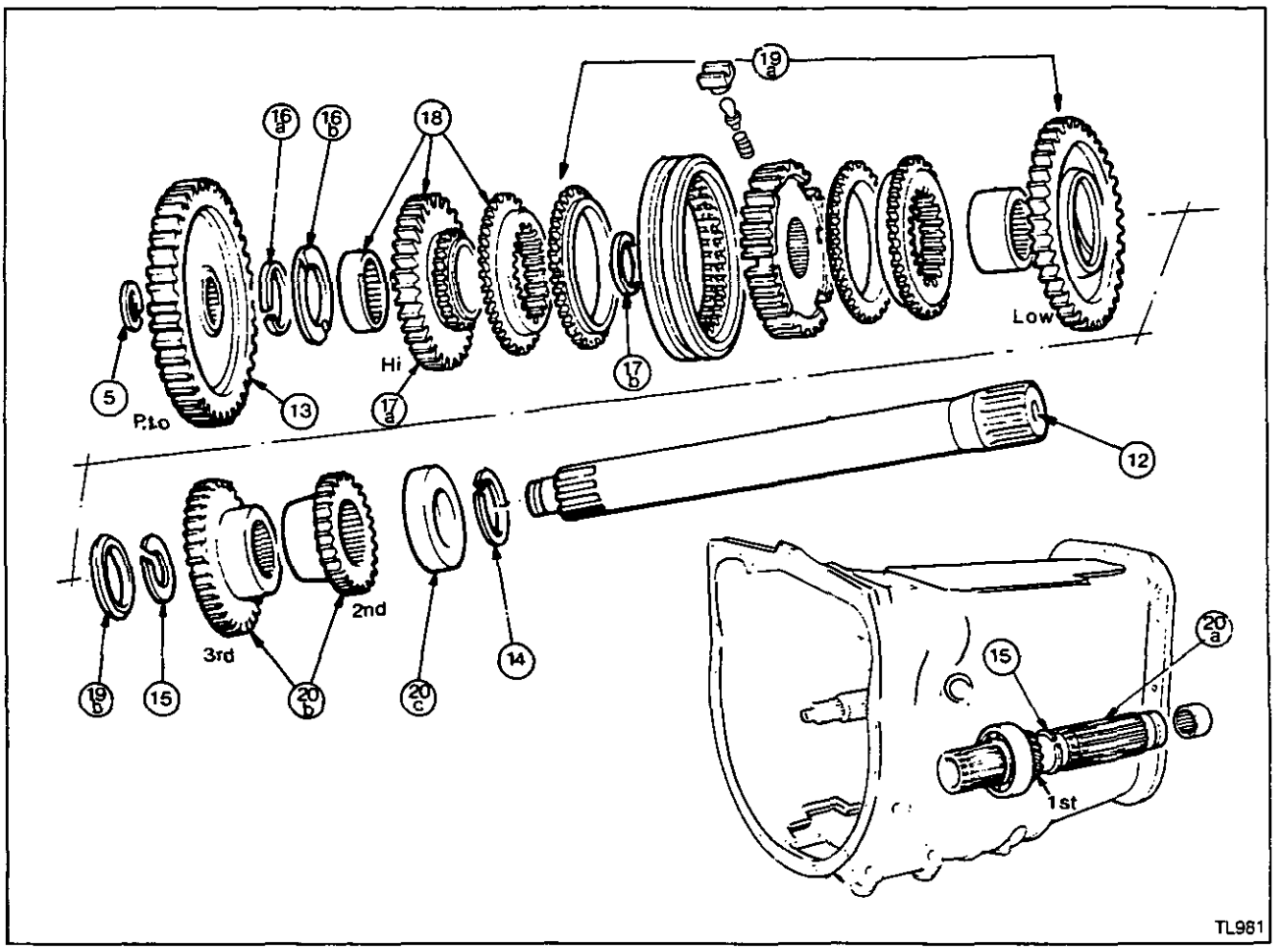
MF 415	*Synchro hub assembly tool*
MS 550	*Drive handle*

Disassembly

1. Remove the gearbox from the tractor, see section 2.
2. Remove the clutch release mechanism, see operation 6A-04.
3. Remove the selector rails and forks, see operation 7E-04.
4. Remove the epicyclic unit, see operation 7E-05.
5. Remove the input housing, see operation 7E-08.
6. Remove the PTO drive shaft housing, see operation 7E-09. Withdraw the PTO shaft.
7. Remove the clutch pack, high and low input constant mesh gears and the "belt type" thrust washer through the gearbox top.

Mainshaft

8. Remove the snap ring from the front of the mainshaft bearing.
9. Engage the coupler (9A) with the first gear (9B) and withdraw the main shaft (9C) through the rear of the gearbox.
10. Remove the front mainshaft support bearing (10A) and thrust washer (10B) from the gearbox centre web.
11. Lift first gear, first/reverse hub and coupler assembly (11A) from the gearbox followed by the remainder of the mainshaft gear and synchromesh hub assembly (11B).
12. Lift the PTO constant mesh gear out of the gearbox.



Layshaft

13. Remove the rear circlip on the layshaft.
14. Tap the layshaft (14A) forward to allow the removal of the snap ring in front of the third gear. Move the snap ring (14B) onto the unsplined portion of the shaft.
15. Remove the front snap ring (15A) and tap the layshaft rearwards sufficiently to remove the Multi-Power high (15B) and the low constant mesh gears (15C) and the spring-loaded coupler assembly (15D).
16. Drive the layshaft forwards, removing second (16A) and third gears, (16B) and the layshaft. Remove the front (16C) and rear (16D) bearing if necessary.

Reverse Idler

16A. Obtain a length of steel bar 25 mm dia x 55 mm long (1 in dia x 2 3/16 in long) to make a dummy shaft to aid removal of the reverse idler.

17. Release the tab-washer.
18. Remove the bolt and locking tabs.
19. Slide the dummy shaft (item 16A above) in from the front of the reverse gear shaft towards the rear. This will push out the reverse gear shaft and prevent the needle rollers from dropping into the transmission case and allow the idler gear to be removed.
20. Remove the idler gear cluster complete with all parts and the dummy shaft.
21. Withdraw the dummy shaft from the idler gear and allow all parts to drop out onto a clean work surface.
22. Clean and inspect all components.

Synchromesh hub assembly

23. Remove the two synchroniser rings.
24. Remove the drive hub complete with the sliding coupler.
25. Wrap the hub and coupler in a cloth.
26. Remove the sliding coupler, taking care not to lose the pressure springs, plungers and blocks.
27. Remove the three pressure blocks.
28. Remove the three plungers.
29. Remove the three springs.
30. Thoroughly clean all the components and check their condition.
31. Using a feeler gauge, measure the clearance between the synchroniser ring and the coupler on the gear at several points. The synchroniser ring must be correctly positioned on the tapered part of the splined ring. If the clearance is less than 0,5 mm (0.02 in) replace the synchroniser ring. If the clearance is checked with the gearbox assembled, replace the synchroniser ring if the clearance is found to be less than 0,8 mm (0.030 in).

Reassembly

Synchromesh hub assembly

32. Reverse procedures 22-28. On replacing pressure springs, plungers and blocks special service tool MF 415 and handle MS 550 must be used to locate the hub in the sliding coupler.

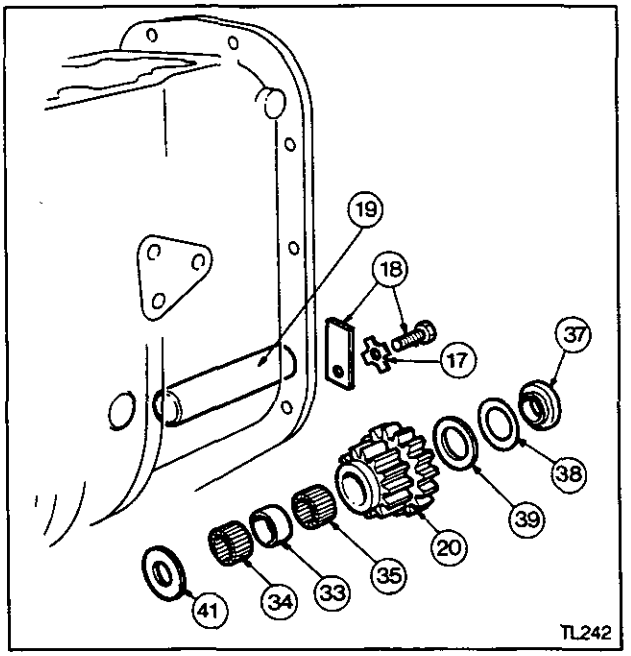
Note: Ensure that the centralisation holes 'A' in the hub and coupler are aligned.

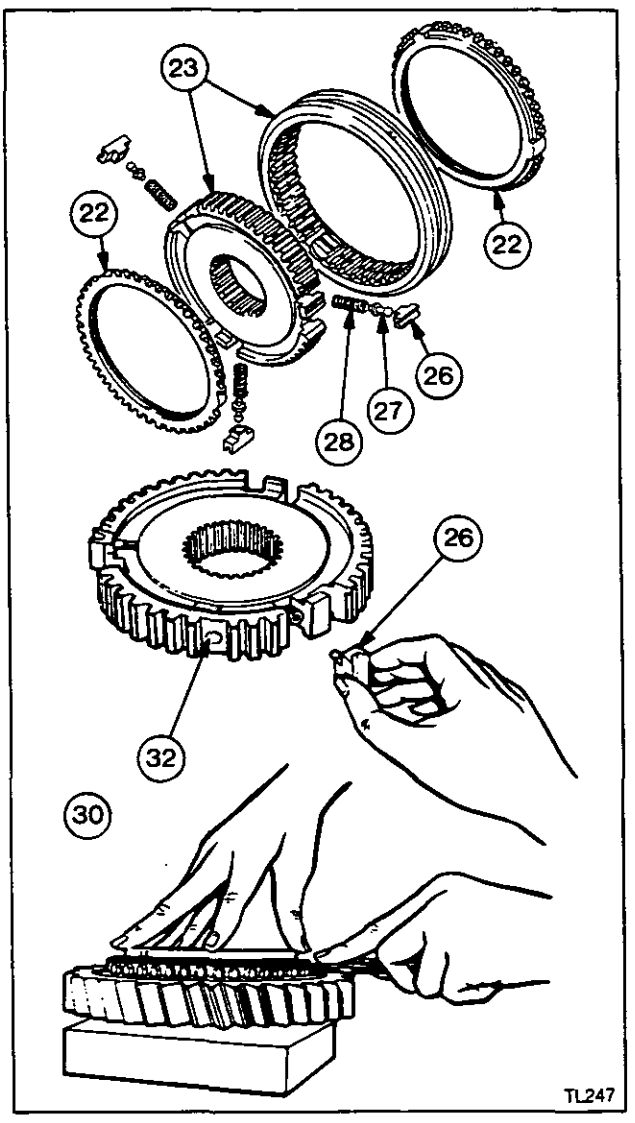
Reverse idler

33. Fit the spacer in the reverse gear cluster.
34. Refit the first set of rollers, each row consists of 28 rollers.

Note: Smear the rollers with petroleum jelly (not grease) to assist reassembly.

35. Fit the second row of rollers.
36. Insert the dummy shaft to hold the rollers in place.
37. Assemble the collar.
38. Replace the Belleville washer.





39. Fit the friction plate as shown to the rear of the reverse gear cluster.
40. To the front of the reverse gear cluster fit the small spacer.
41. Fit the thrust washer.
42. Reverse procedures 16-19.
43. Fit a new tab washer to lock the retaining bolt.

Layshaft

Note: All snap rings must be renewed and ensure that they are correctly located in their grooves.

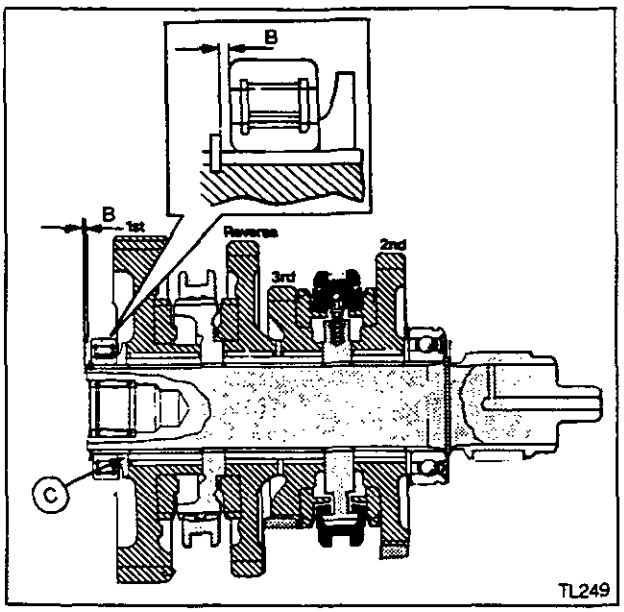
44. Refit the layshaft through the front of the gearbox and refit second and third gears.
45. Tap the layshaft rearwards and replace the thrust washer, constant mesh gears and dog clutch mechanism. Fit the front snap ring.
46. Refit the mainshaft into the casing from the rear, gears and replace the snap ring at back of layshaft.
47. Drop the PTO constant mesh gear into position in bottom of gearbox.

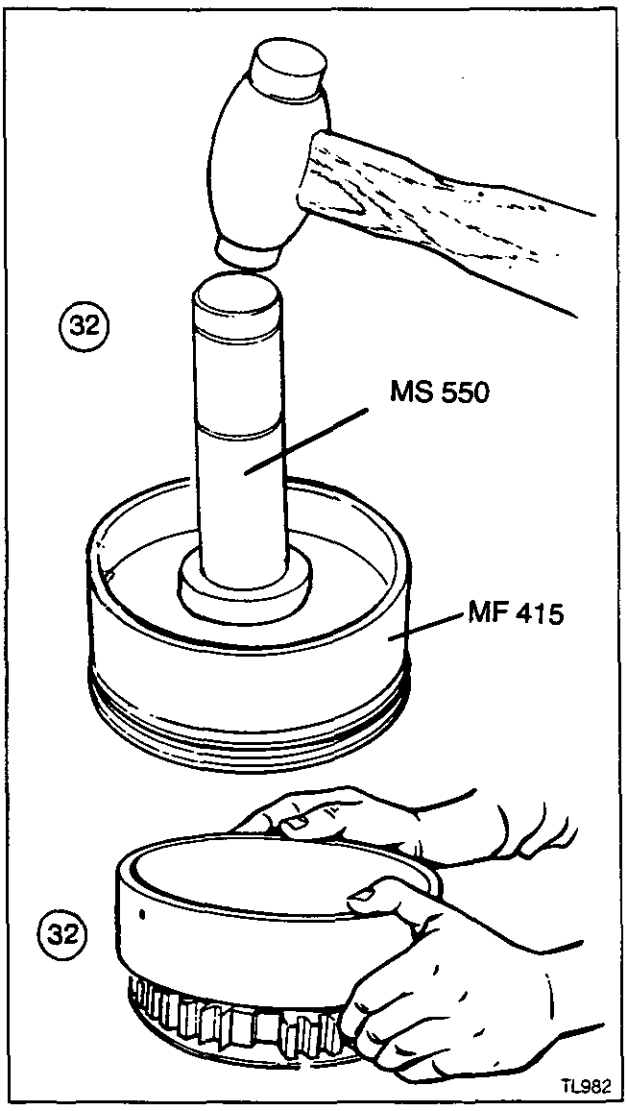
Mainshaft

48. Assemble the mainshaft complete, on the bench, with all thrust washers, bushes, gears and bearings and secure the components with the front snap ring.
49. Measure the gap 'B', between the front bearing and the circlip. The gap (end float) should be between 0,080 mm (0.003 in) and 0,30 mm (0.012 in). If the measurement falls outside the above limits, replace the calibrated thrust washer 'C', which sits between the bearing and first gear, with one of a suitable thickness to achieve the desired end float. Calibrated thrust washer part numbers are as follows:

Thrust Washer Chart		
Part No	Thickness mm	Thickness in
1671 888 M2	4,14-4,19	0.163-0.165
1671 889 M1	4,39-4,44	0.173-0.175
1671 890 M2	4,62-4,67	0.182-0.184
1671 891 M2	4,85-4,90	0.191-0.193

50. Refit the front mainshaft bearing and secure with the snapring.
    a. Flat thrust washer.
    b. 2nd gear and short bush.
    c. 2nd/3rd drive hub and synchromesh mechanism.
    d. 3rd gear and long bush.
    e. Flat thrust washer and reverse gear.
    f. Thrust needle roller bearing.
    g. 1st/reverse drive hub and coupler, with 1st gear and medium length bush.
    h. Front lipped thrust washer, the correct one having been determined from the bench check.
51. Refit the front mainshaft bearing and secure with the snap ring.





52. Replace needle roller bearing in front of mainshaft, and replacing Multi-Power clutch pack and constant mesh gears with the following thrust washers:
    a. Bell-shaped washer in front of mainshaft bearing.
    b. Steel washer (with right angled four tabs) between high and low constant mesh gears.
53. Slide the main input shaft and clutch unit in from the front. Check the PTO input shaft clearance, see operation 7E-10.
54. Refit the PTO drive shaft and front housing, see operation 7E-09.
55. Refit the input shaft and housing, see operation 7E-08.
56. Refit the epicyclic unit, see operation 7E-05.
57. Refit the selector rails and forks, see operation 7E-04.
58. Refit the clutch release mechanism, see operation 6A-04.
59. Refit the gearbox to the tractor, see section 2.

SPACER, 4WD TRANSFER BOX AND DRIVE SHAFT

Section 7 – Part F

Table of Contents

TRANSFER BOX AND DRIVE SHAFT

Specification

Type	Normal-duty
Model application	M-F 340
Part number	3612 661 M91
Ratio	0.373:1
Number of gear teeth	42T (2), 17-25T (4-12), 33T (5), 23T (10)
Type	Normal-duty
Model application	M-F 350 to 365 (excluding 8 speed shuttle gearbox)
Part number	1693 607 M93
Ratio	0.66:1
Number of gear teeth	36T (2), 24-24T (4-12), 33T (5), 24T (10)
Type	Heavy-duty
Model application	M-F 375 to 399 (excluding 8 speed shuttle gearbox)
Part number	1693 606 M93
Ratio	0.66:1
Number of gear teeth	36T (2), 24-24T (4-12), 33T (5), 24T (10)
Type	Normal-duty
Model application	M-F 350 to 365 (Fitted with 8 speed shuttle gearbox)
Part number	3612 090 M91
Ratio	0.526:1
Number of gear teeth	38T (2), 20-24T (4-12), 33T (5), 24T (10)
Type	Heavy-duty
Model application	M-F 375 to 390 (Fitted with 8 speed shuttle gearbox)
Part number	3612 089 M91
Ratio	0.526:1
Number of gear teeth	38T (2), 20-24T (4-12), 33T (5), 24T (10)

NOTE: Numbers in brackets indicate the gear illustrated in figure 2.

Idler shaft end float	0,10–0,20 mm (0.004–0.008 in)

Special Tools

MF.490	4WD cassette seal installer

Bolt Torques

Drive coupling to drive shaft bolt	60 Nm (44 lbf ft)
Drive coupling to drive shaft nuts and bolts	55-75 Nm (40-55 lbf ft)

General Description

The Spacer, figure 1, or Four Wheel Drive (4WD) Transfer Gearbox, figure 2, is fitted between the the gearbox and rear centre housing.

The spacer is used to increase the wheelbase of the tractor. It is a simple housing through which the main drive shafts to the rear axle and the PTO pass to the back of the tractor.

The 4WD transfer gearbox takes the drive from the rear of the main gearbox through the top shaft, second shaft and idler shaft to a drive shaft projecting from the front left-hand side of the gearbox. The drive is then transmitted to the front axle by a guarded universal drive shaft.

The main input shaft is supported by a ball bearing in the transfer case and needle roller bearing on the end of the gearbox main shaft.

All the gears are straight cut and mesh through to the drive shaft. A sliding collar on the drive shaft is actuated by the 4WD selector lever which engages the drive shaft through to the input shaft.

1. High/Low selector rail and fork
2. Epicyclic reduction unit
3. Gearbox main shaft
4. PTO drive shaft
5. Lift pump drive shaft
6. Sliding coupler
7. Drive to rear axle
8. Spacer casing

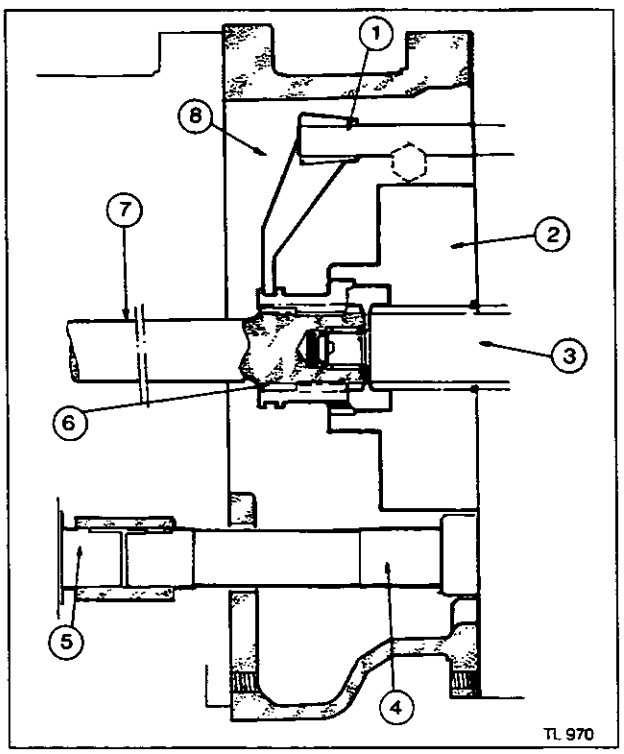


Fig.1 Spacer unit

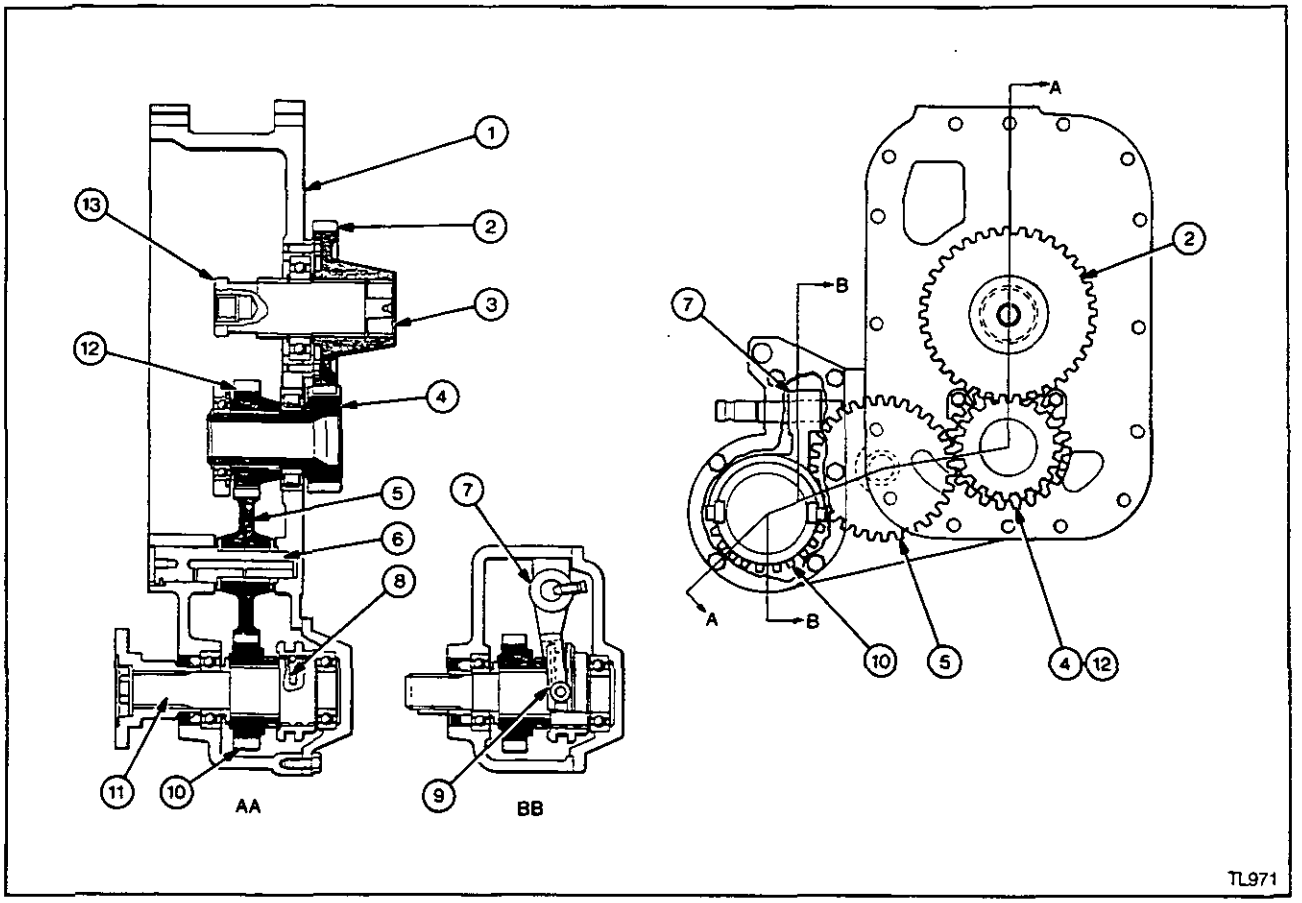
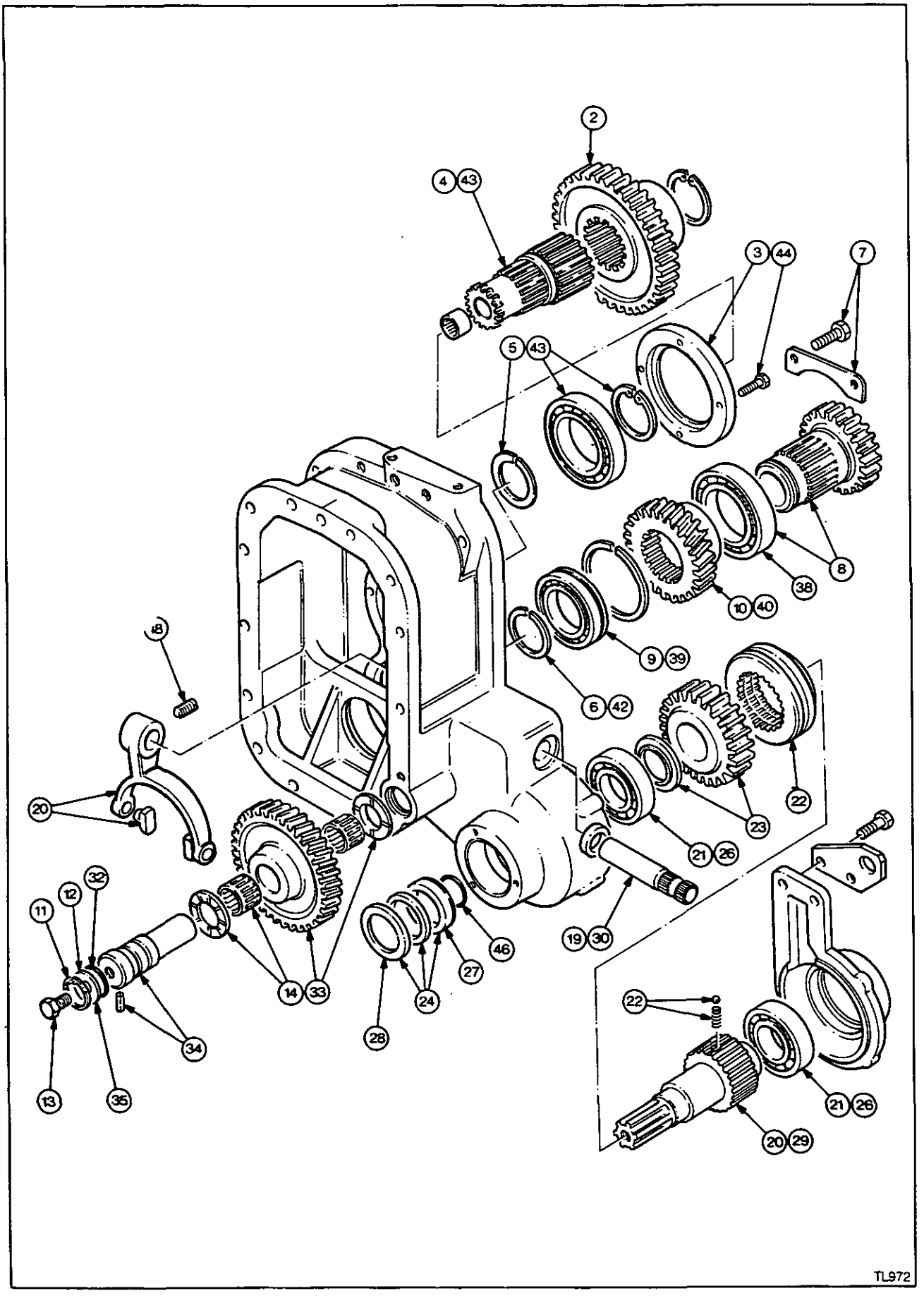


Fig. 2. Four wheel drive transfer gearbox.

1. Transfer gearbox casing.
2. Input shaft gear.
3. Input shaft.
4. Second shaft.
5. Idler gear.
6. Idler gear shaft.
7. Selector fork.
8. Selector detent.
9. Sliding coupling.
10. Output gear.
11. Output shaft.
12. Transfer gear.
13. Drive shaft to rear axle.

TRANSFER BOX AND DRIVE SHAFT



4WD Transfer Gearbox

Removal and Refitment 7F-01

Removal

1. Split the tractor between the transfer gearbox and the centre housing and withdraw engine, gearbox and transfer gearbox forward out of the tractor, see section 2.
2. Remove the drive shaft from the gearbox.
3. Remove the transfer gearbox from the main gearbox.

Refitment

4. Reverse procedure 1 to 3 except:
   a. Remove the left-hand brake actuator and left-hand transmission side cover to aid refitment of torque tube.
   b. Torque the drive shaft to coupling bolts to 75 Nm (55 lbf ft).

4WD Transfer Gearbox

Overhaul 7F-02

Disassembly

1. Remove the transfer gearbox from the tractor, see operation 7F–07.
2. Remove the input gear.
3. Remove the four bolts and the bearing retainer.
4. Drive the shaft and bearing from the housing.
5. Remove the circlips and bearing from the shaft if required.
6. Remove the circlip from the second shaft.
7. Remove the two bolts and the bearing retainer.
8. Drive out the second shaft and bearing from the front to the back of the gearbox.
9. Remove the second shaft bearing.
10. Lift out the second shaft gear
11. Remove the circlip from the idler gear shaft.
12. Extract the shim/shims and retain for reassembly.
13. Screw a 12 mm bolt (one removed during procedure 3 is suitable) into the end of the idler shaft and pull it out of the housing.
14. Lift out the gear assembly and thrust washers.
15. Remove the centre bolt and the univesal drive shaft coupling.
16. Remove the drive shaft guard.
17. Remove the six bolts and the output shaft cover.
18. Remove the retaining screw from the selector fork.
19. Remove the selector shaft.
20. Remove the output shaft assembly from the gearbox complete with the two bearings, at the same time removing the selector fork.
21. Remove the bearings.
22. Remove the selector ring, detent ball and spring.
23. Remove the gear and thrust washer.
24. Remove the felt dirt seal, lip seal and 0 ring from the housing.

Examination

Examine all of the gearbox components and replace any that are worn or damaged.

Clean all parts and replace all seals and O rings.

Reassembly

25. To the output shaft refit the gear, detent spring and ball, selecting ring and thrust washer.
26. Refit the two bearings to the shaft.
27. Coat the lip seal with Loctite 601 and press it into the housing. The lip of the seal must face inwards leaving a gap of 0,25 mm to 0,50 mm (0.10 to 0.20 in) between the oil seal and the bearing.
28. Replace the felt seal followed by the felt seal retainer.
29. Refit the output shaft assembly and selector fork.
30. Refit the selector fork shaft, coating the retaining screw in the fork with Loctite 270.
31. Refit the output shaft cover using Loctite 515 for the face joint seal.
32. Replace the O ring on the idler shaft.
33. Place the idler gear and needle bearing assembly and thrust washers into position.
34. Slide the idler shaft into position ensuring that the peg in the shaft locates in the housing correctly.
35. Refit the shim/shims removed and the circlip.
36. Pull the shaft bnack hard against the circlip.
37. Set the end float of the idler gear by inserting a feeler gauge between the thrust washer and gear. The running clearance must be 0,10 to 0,20 mm (0.004 to 0.008 in). Add the shims to reduce the clearance, remove to increase.

Shims available:

Part number	Shim thickness
1693 598 M1	0,10 mm (0.004 in)
1693 599 M1	0,20 mm (0.008 in)

38. Refit the roller bearing to the second shaft if it has been removed. If the bearing has been removed it is essential that it is refitted the same way round as the factory fit retain its thrust capabilities. (i.e. with the inner bearing lip towards the transfer gear).
39. Refit the ball bearing to the housing.
40. Hold the second shaft gear in position and slide the second shaft into position.
41. Attach and fasten the retaining plate with the two bolts.
42. Refit the circlip on the second shaft.
43. Slide the input shaft and bearing into the housing.
44. Refit the bearing retainer and fasten four bolts.
45. Refit the drive shaft guard.
46. Replace the O ring on the output shaft.
47. Refit the drive coupling, coating the splines with Hylomar sealing compound.
48. *Refit the centre bolt to the drive coupling using Loctite* 270 and tighten to a torque of 125 Nm (92 lbf ft).

Drive shaft oil seal replacement

The drive shaft oil seal may be replaced without removing the gearbox from the tractor:

1. Drain the oil from the transmission.
2. Disconnect the drive shaft.
3. Remove the shaft procedures 15 to 20 and 24.
4. Reassemble using procedures 27 to 31 and 45 to 48.
5. Reconnect the drive shaft and safety guard, see operation 7F–03.

4WD Axle Drive Shaft

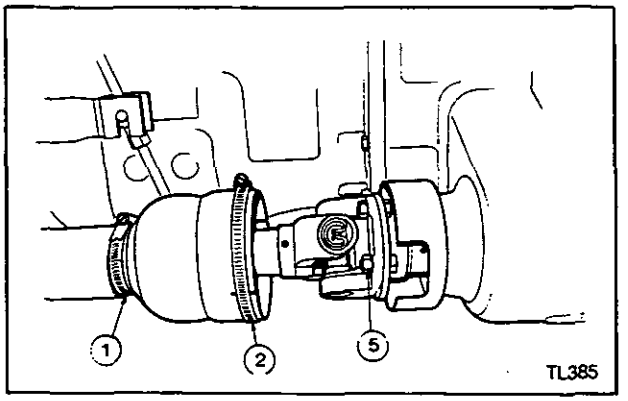
Removal and Refitment 7F-03

Removal

1. Slacken the two clips on the guard.
2. Slacken the clip from the guard at the transfer gearbox end.
3. Remove the spring clip from the guard at the axle end.
4. Slide the guard at both ends towards the centre to gain access to the couplings.
5. Remove the four bolts from each coupling and lift the drive shaft clear of the tractor.
6. Slide the rear part of the cover back to expose the sliding joint in the shaft.
7. Unscrew the retaining ring.
8. Slide the rear part of the coupling off the shaft.
9. The guards can now be removed from the shaft.

Refitment

10. Reverse procedures 1 to 9 except:
    a. Lubricate both universal joints and the sliding spline with grease.
    b. The drain hole in guard fitted to axle end must be at the bottom.
    c. The arrows on the drive shaft must be in line.
    d. The clips must be positioned directly over the grooves in the two end sections. On tractors with six cylinder engines the clip must be located 90 mm (3.5 in) from the front, dimension 'A'.
    e. Coat the threads with Loctite 270 and torque both sets of coupling bolts (5) to 55-75 Nm (40-55 lbf ft).
    f. Position the front guard approxiamately 45 mm (2.3 in) from the step in the differential housing, dimension 'B'.



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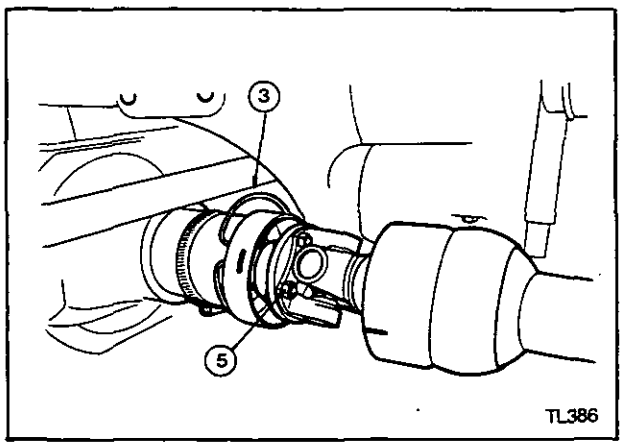

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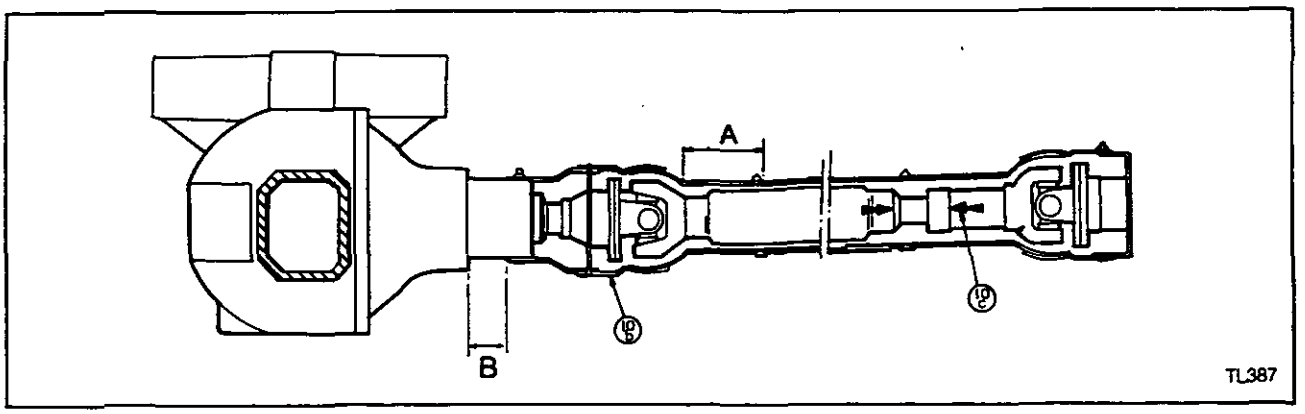

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4WD Transfer gearbox – July 1991 onwards

Specification

Type	Normal duty – 8 speed synchromesh gearbox
Model application	MF 340
Part number	3698 711 M91
Ratio	0.371:1
Number of gear teeth	42T, 17T–24, 33T, 22T

Type	Normal duty – direct drive, 8 speed shuttle gearbox
Model application	MF 340
Part number	3613 935 M91
Ratio	0.371:1
Number of gear teeth	42T, 17T–24, 33T, 22T

Type	Normal duty – excluding 8 speed shuttle gearbox
Model application	MF 350 to 365
Part number	3613 187 M91
Ratio	0.66:1
Number of gear teeth	36T, 24T–24T, 33T, 24T

Type	Heavy duty – excluding 8 speed shuttle gearbox
Model application	MF 375 to 399
Part number	3613 186 M91
Ratio	0.66:1
Number of gear teeth	36T, 24T–24T, 33T, 24T

Type	Normal duty – fitted with 8 speed shuttle gearbox
Model application	MF 350 to 365
Part number	3613 933 M91
Ratio	0.526:1
Number of gear teeth	38T, 20T–24T, 33T, 24T

Type	Heavy duty – fitted with 8 speed shuttle gearbox
Model application	MF 375 to 390
Part number	3613 932 M91
Ratio	0.526:1
Number of gear teeth	38T, 20T–24T, 33T, 24T

Idler shaft end float	0,10–0,20 mm (0.004–0.008 in)

Bolt torque

Drive coupling bolt	125 Nm (92 lbf ft)

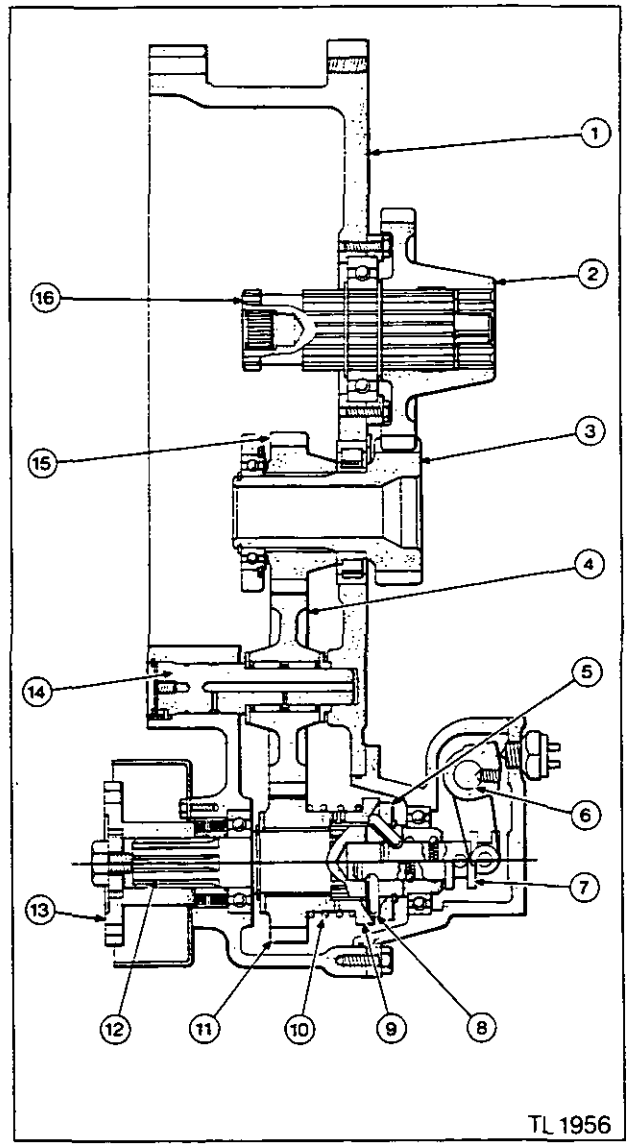
7F–08
TRANSFER BOX AND DRIVE SHAFT

General description

From July 1991 a new type of four wheel drive transfer box was progressively introduced with an improved drive engagement that can be engaged and disengaged on the move. This is similar to the hydraulic type introduced with the 12 x 12 shuttle gearbox but with mechanical operation.

The drive is taken from the rear of the main gearbox, through a set of intermediate gears to the output shaft in the pod on the side of the case, it is identical to the previous gearbox, the difference being in the engagement. The output gear is free to rotate on the front of the output shaft, the rear face of the gear is fitted with a simple tooth type coupling. Engaging with the gear and splined to the output shaft is a sliding coupler with a light spring between the gear and coupler to assist in disengagement. Behind the sliding coupler is an abutment ring held in place on the shaft by a circlip, between the abutment ring and the coupler there are three radial toggle pins which pass through to the centre of the shaft and engage in a groove in the actuator shaft.

The actuator shaft is controlled through linkage from the operators cab, when moved to the forward position, as shown in the lower half of the illustration, the three toggle pins are forced up into the vertical position moving the sliding coupler forward against the abutment ring into the engaged position. Moving the actuator shaft to the rear, as shown in the upper half of the illustration, moves the toggle pins down into the shaft and allows the sliding coupler to disengage under pressure from the return spring. The teeth on the gear and coupler are shaped to allow engagement and disengagement under load.

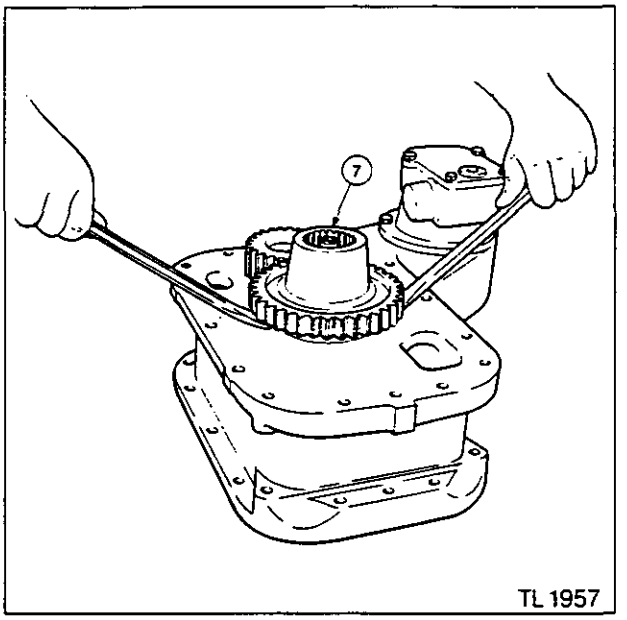


Four wheel drive transfer gearbox

1. Gearbox casing
2. Input gear
3. Second gear and shaft
4. Intermediate gear
5. Abutment ring
6. Operating shaft and fork
7. Actuator shaft
8. Toggle pins
9. Sliding coupler
10. Return spring
11. Output gear
12. Output shaft
13. Coupling to front axle
14. Intermediate shaft
15. Second gear
16. Input shaft

Introduction

There are two types of transfer gearbox, the one shown in the main illustration is for tractors with epicyclic reduction units fitted to the rear axle. The alternative drive arrangement shown in the box is for tractors with a direct drive rear axle, no epicyclic reduction.



4WD Transfer Gearbox

Overhaul 7F–04

Disassembly

1. Remove the transfer gearbox from the tractor, see operation 7F–07.
2. Remove the input gear.
3. Remove the four bolts and the bearing retainer.
4. Drive the input shaft and bearing from the casing.
5. Remove the circlips and bearing from the shaft, if necessary.
6. On tractors with normal duty gearboxes, up to MF 365, there is a spacer between the circlip and bearing (5).

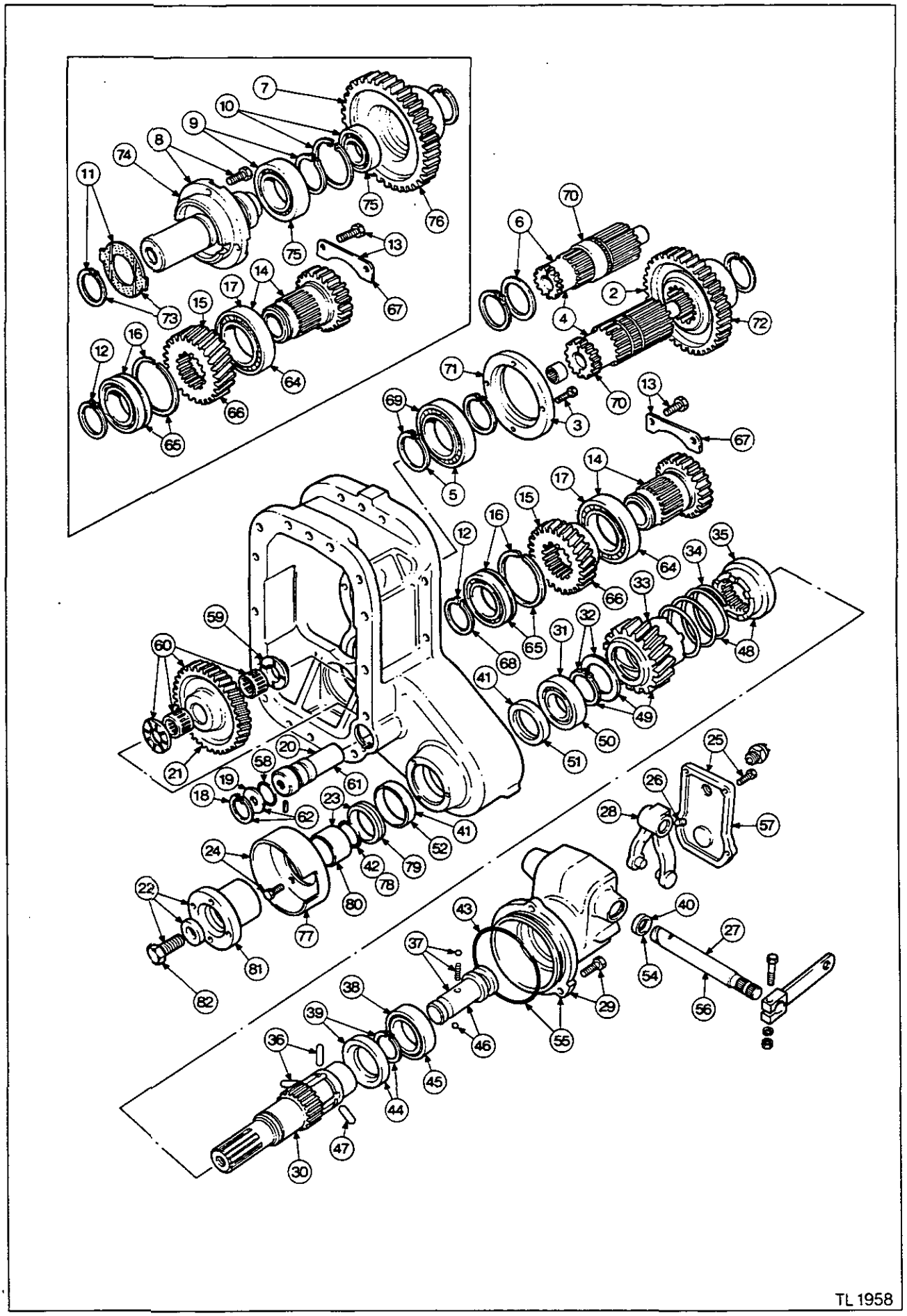
Tractors with direct drive axle

7. Using two pry bars each side of the input gear remove it from the stub shaft complete with the two bearings.
8. Remove the four bolts and the stub shaft.
9. Remove the circlip and roller bearing, if necessary.
10. Remove the circlip and ball bearing from the gear, if necessary.
11. Remove the circlip and thrust washer.

All models

12. Remove the circlip from the second shaft.
13. Remove the two bolts and the bearing retainer.
14. Drive out the second shaft and bearing assembly from the front of the gearbox.
15. Lift out the second shaft gear.
16. Remove the ball bearing from the casing.
17. Remove the second shaft roller bearing, if necessary.
18. Remove the circlip from the idler gear shaft.
19. Extract the shims and retain for reassembly.

TRANSFER BOX AND DRIVE SHAFT



20. Screw a 12 mm bolt (one removed during procedure 3 is suitable) into the end of the idler shaft and pull it out of the housing.

21. Lift out the gear assembly and thrust washers.

22. Remove the centre bolt and the drive shaft coupling.

23. Remove the dirt seal and seal sleeve.

24. Remove the four bolts and the drive shaft guard.

25. Remove the four bolts and the rear cover plate.

26. Remove the lock screw from the operating fork.

27. Pull the operating shaft from the housing.

28. Remove the operating fork.

29. Remove the four bolts and the rear housing.

30. Remove the output shaft assembly from the casing by tapping the coupling end with a hide hammer.

31. Using a hydraulic press and a bearing separator plate remove the front bearing from the shaft.

32. Remove the circlip and thrust washer.

33. Remove the output gear.

34. Remove the spring.

35. Slide the coupler off the splined shaft.

36. Remove the three toggle pins.

37. If necessary, very carefully pull the actuator shaft out of the main shaft, there are two spring loaded balls inside.

38. If necessary, remove the rear bearing from the shaft using a hydraulic press.

39. Remove the circlip and abutment ring.

40. Remove the operating shaft oil seal.

41. Remove the main shaft oil seal and wear sleeve.

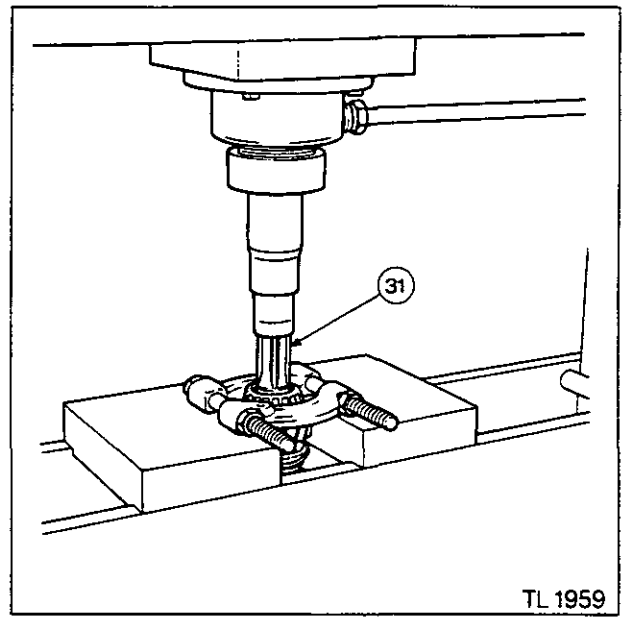
42. Discard the main shaft 'O' ring.

43. Discard the rear housing 'O' ring.

Examination

Examine all of the gearbox components and replace any that are worn or damaged.

Clean all parts and replace all seals and 'O' rings.



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Reassembly

44. Refit the abutment ring with the curved face facing forward to the main shaft with the circlip.

45. Reinstall the ball bearing.

46. Insert the two balls and spring in the cross drilling in the actuator shaft and fit it to the main shaft, set the actuator in the first, disengaged, position.

47. Fit the three toggle pins so that they locate in the groove in the actuator shaft.

48. Refit the coupler and spring.

49. Slide the gear onto the shaft and refit the thrust washer and circlip.

50. Press the ball race onto the shaft.

51. Coat the outside of the main shaft oil seal with Loctite Seal Retainer and press into the housing from the inside of the case so that the seal is 0,25–0,50 mm (0.010–0.020 in) below the face. The lip of the seal faces inwards.

52. Press the wear sleeve in from the front of the box flush with the case with the rolled edge inwards.

53. Lubricate the lip of the seal with petroleum jelly and install the main shaft assembly.

54. Replace the operating shaft oil seal, installing it with a coating of Loctite Seal Retainer and the lip facing inwards.

55. Replace the 'O' ring and fit the rear housing to the case. Check that the main shaft is free to rotate.

56. Fit the operating shaft and fork, coat the locking screw with Loctite 242 and tighten.

57. Apply Loctite 515 to the face of the cover plate and fit to the gearbox. Check operation of the control and switch.

58. Replace the 'O' ring on the idler shaft.

59. Place the rear thrust washer in the casing holding it in place with some petroleum jelly.

60. Hold the idler gear and needle bearing assembly in place and slide the plain thrust washers into position.

61. Install the idler shaft ensuring that the peg in the shaft locates in the housing correctly.

62. Refit the shim/shims removed and the circlip.

63. Pull the shaft hard back against the circlip. Set the end float by inserting a feeler gauge between the thrust washer and gear. The running clearance must be 0,10–0,20 mm (0.004–0.008 in). Add shims to reduce the clearance, remove to increase.

Shims available:

Part number	*Shim thickness*
1693 598 M1	0,10 mm (0.004 in)
1693 599 M1	0,20 mm (0.008 in)

64. Refit the roller bearing to the second shaft if it has been removed. If the bearing has been removed it is essential that it is refitted the same way round as the factory to retain its thrust capabilities. (i.e. with the inner bearing lip towards the transfer gear).

65. Refit the ball bearing to the housing.

66. Hold the second shaft gear in position and slide the shaft into position.

67. Attach and fasten the retaining plate with the two bolts coated with Loctite 242.

68. Refit the circlip on the second shaft.

69. Refit the ball bearing and second circlip, on normal *duty shafts fit the spacer.*

70. Slide the input shaft and bearing assembly into the housing.

71. Refit the bearing retainer and tighten the four bolts.

72. Slide the input gear on to the shaft.

Tractors with direct drive axle

73. Refit the thrust washer to the stub shaft with the thrust face facing outwards as shown in the illustration.

74. Refit the stub shaft to the gearbox casing so that the grooves in the thrust washer face are vertical. Tighten the four bolts.

75. Refit the ball and roller bearings if they have been removed.

76. Refit the input gear, it is a light drive fit onto the stub shaft, ensure that the bearings are fully seated.

All models

77. Refit the drive shaft guard.

78. Replace the 'O' ring on to the output shaft.

79. *Press a new dirt seal onto the seal spacer ensuring* that it is fitted to the end without the recess for the shaft 'O' ring.

80. Refit the seal spacer and seal, coating the splines of the shaft with Hylomar sealing compound, and the dirt seal with a liberal amount of general purpose grease.

81. Refit the drive coupling.

82. Refit the centre bolt to the drive coupling using Loctite 270 and tighten to a torque of 125 Nm (92 lbf ft).

83. Check the operation of the selector and that the gears and shafts run freely.

84. Refit the transfer box to the tractor.

Cassette Seal Installation

Removal and Refitment 7F–05

Special tools:
MF.490 4WD Cassette seal installer

The new output shaft cassette seal was introduced into production from tractor serial number C45000, manufactured November 1994.

This new type of seal can be fitted to all transfer box output shafts. On tractors built before July 1991, serial number S27159, it will be necessary to replace the drive coupling and obtain a new sleeve.

Removal

1. Drain the oil from the transmission.
2. Slacken the two clips on the guard.
3. Slacken the clip around the guard at the transfer gearbox end.
4. Slide the guard to the left to gain access to the coupling.
5. Remove the four bolts from the coupling and lower the shaft to the ground

Tractors built up to July 1991

6. Remove the the drive shaft and seal as described in operation 7F-02 paragraphs 15 to 20, 24 and 40 to 43 inclusive.
7. Check that the new seal will pass freely through the rear guard, if not, open out the guard centre hole to give 0,5 mm clearance all round the seal.
8. Discard the combined coupling and sleeve and replace with:-

   3611 319 M2 Sleeve

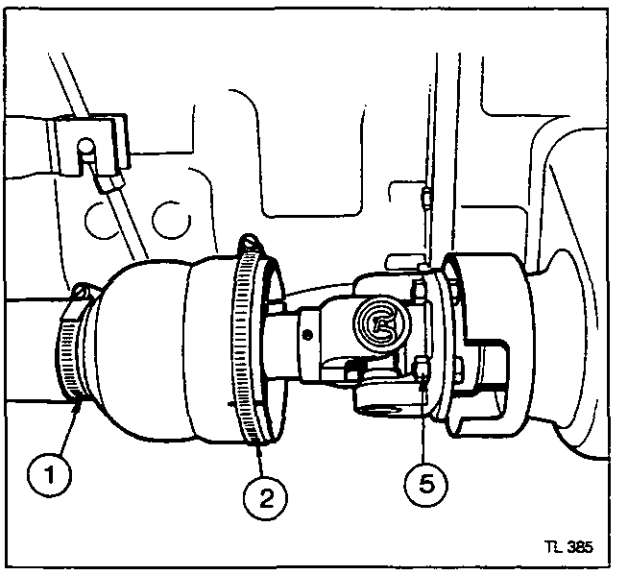
   3599 678 M2 Coupling
9. Replace the drive shaft as described in paragraphs 29 to 31 and 45 to 46 inclusive.

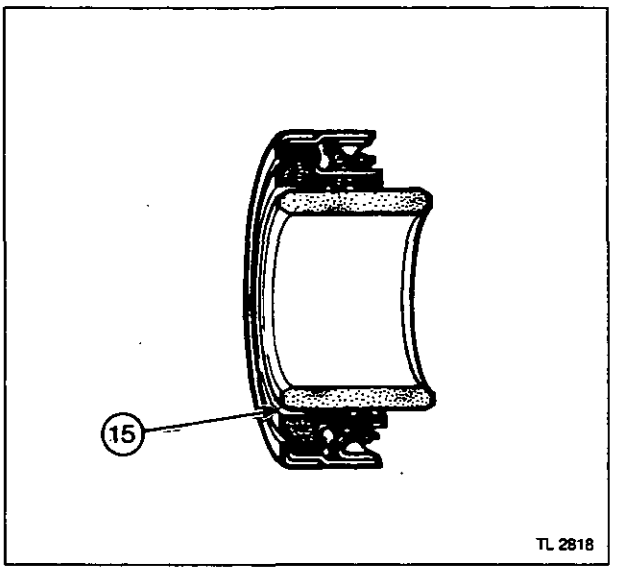
Tractors built after July 1991

10. Remove the the drive shaft and seal as described in operation 7F-04 paragraphs 22 to 30 and 40 to 43 inclusive.
11. Check that the new seal will pass freely through the rear guard, if not, open out the guard centre hole to give 0,5 mm clearance all round the seal.
12. Replace the drive shaft as described in paragraphs 54 to 57 inclusive.
13. Renew the 'O' ring.

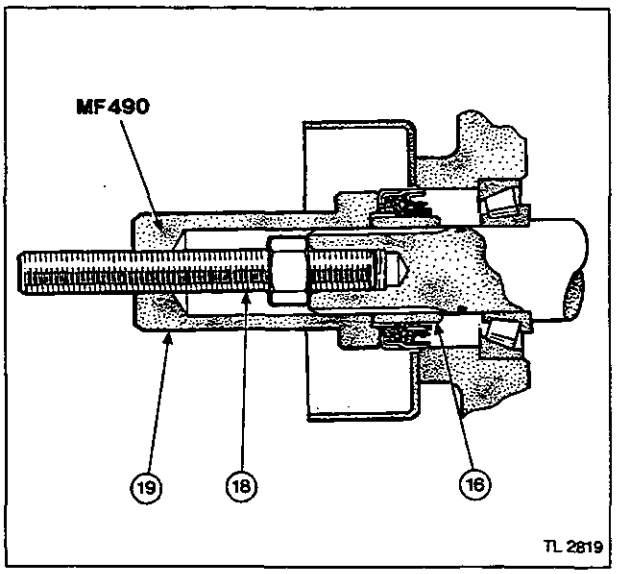
Installing the new seal

14. Liberally coat the inside of the seal with petroleum jelly.
15. Press the sleeve into the seal so that the front (flat) face of the seal is flush with the end of the sleeve.

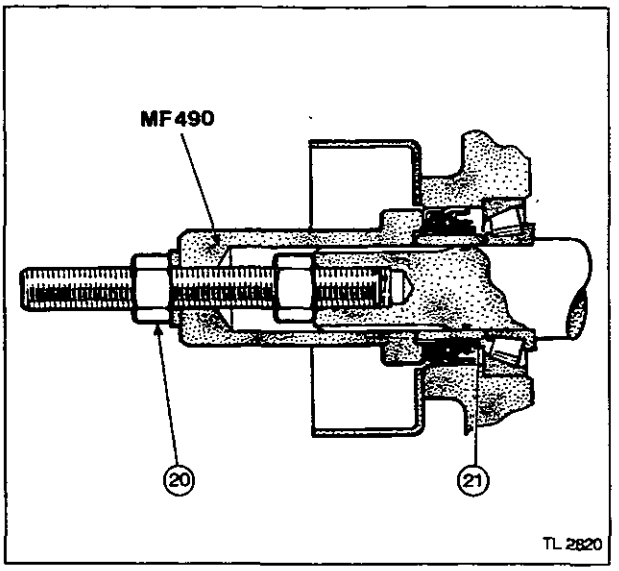




16. Slide the sleeve over the output shaft as shown until the seal is just entering the housing.
17. Special tool MF.490 has been designed to install the seal to the correct depth in relation to the housing and sleeve. It also presses the seal in the correct location.
18. Screw the stud of special tool MF.490 into the end of the output shaft.
19. Slide the assembly tool over the stud and shaft.



20. Fit the nut and washer.
21. Screw the nut up the stud until the tool pushes the sleeve hard against the bearing. The seal is now in the correct position.
22. Remove the tool.
23. Coat the splines of the output shaft with Hylomar sealant.
24. Refit the drive coupling, drive shaft and guard as described in operation 7F-04 paragraph 81 to 83 inclusive.
25. Apply Massey Ferguson studlock (Loctite 270) to the central bolt and tighten to a torque of 125 Nm (92 lbf ft).
26. Apply Massey Ferguson studlock (Loctite 270) to the coupling bolts and tighten to a torque of 65 Nm (50 lbf ft).



8 SPEED ZF SYNCHROMESH SHUTTLE GEARBOX

Section 7 – Part G

Table of Contents

7G-02
8 SPEED SYNCHROMESH SHUTTLE GEARBOX

Specification

Model	8 Speed Synchromesh shuttle gearbox
No of gears:	
Forward	8
Reverse	8
Synchromesh type	Strut type
Epicyclic unit reduction	4:1
Normal duty	MF 340, 350, 355, 362, and 365
Heavy duty	MF 375 and 390

Settings Required

Mainshaft end float	0,080-0,30 mm (0.003-0.012 in)
Type of adjustment	Variable thickness thrust washer
Synchromesh ring to coupler clearance:	
Installed	0,8 mm (0.030 in)
Removed	0,5 mm (0.020 in)
Synchromesh neutral setting	See procedure 7G-04

Special Tools

MF.177A	Input shaft oil seal protector sleeve
MF.218A	PTO Drive shaft puller
MF.255B	PTO input shaft oil seal replacer
MF.315A	Needle roller bearing and seal remover/replacer
MF.414	Synchromesh centralising pin
MF.415	Synchromesh hub assembly tool
MF.421	Needle roller bearing and seal replacer
MF.422	Needle roller bearing and seal replacer
MS.550	Drive handle

Bolt Torques

Gear lever cove to shift tower	50-70 Nm (37-52 lbf ft)
Shift tower to gearbox top	102-122 Nm (25-38 lbf ft)
Interlock to gearbox case	40-47 Nm (30-35 lbf ft)
Epicyclic unit to gearbox case	40-47 Nm (30-35 lbf ft)
Input housing to gearbox case	54-61 Nm (40-45 lbf ft)
PTO Bearing housing to gearbox	54-61 Nm (40-45 lbf ft)
Engine to gearbox	100-130 Nm (74-94 lbf ft)
Gearbox to rear transmission case	102-122 Nm (75-90 lbf ft)

General Description

The Eight Speed Synchromesh Shuttle Gearbox has eight forward and eight reverse gears; the forward reverse selection being controlled by a lever on the instrument panel adjacent to the steering wheel. It provides full engine braking on over-run and enables the tractor to be towed to start the engine.

Drive Arrangements

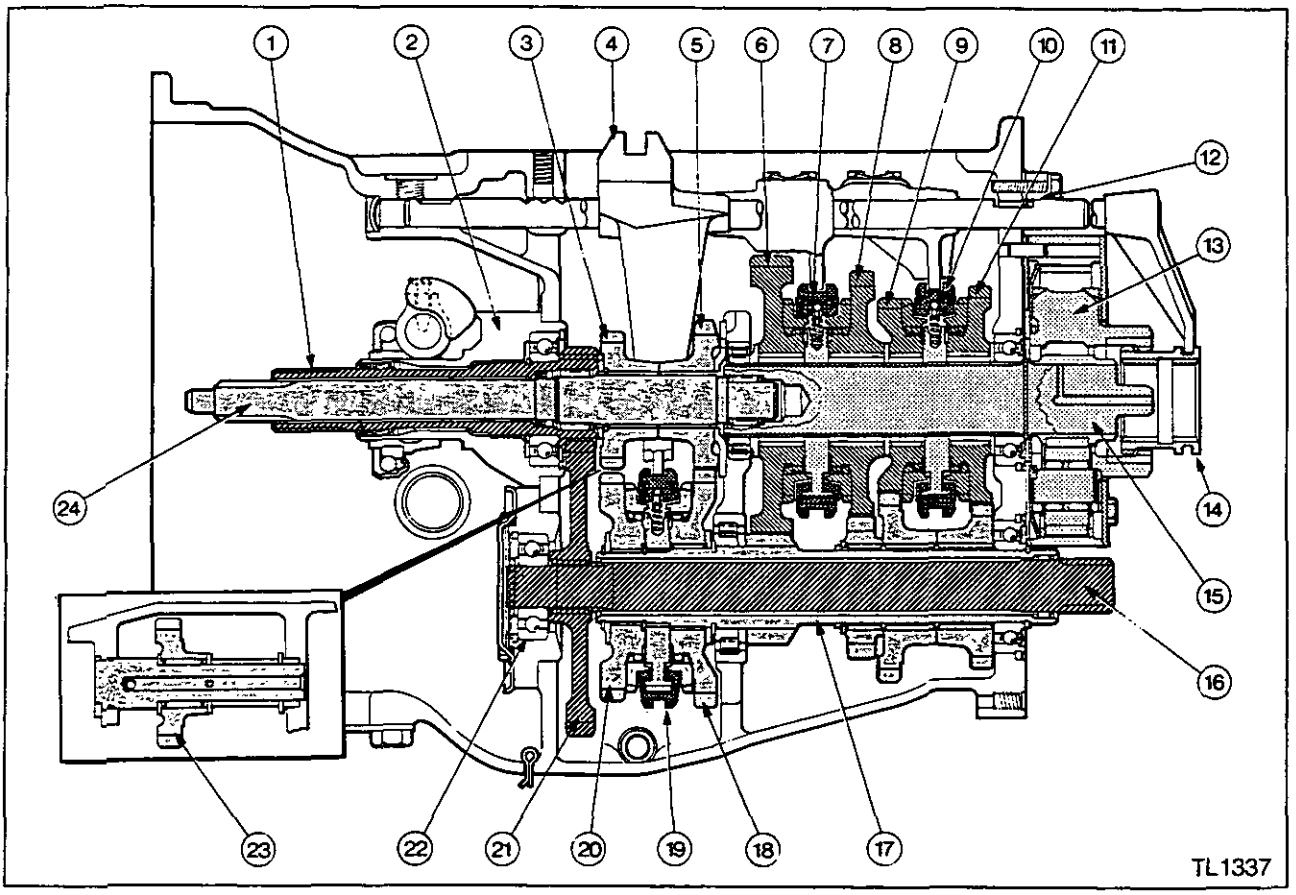
From a constructional view point the gearbox has three sections. The front section consists of the forward and reverse gears with synchromesh coupler.

The centre section comprises constant mesh gear sets giving four basic forward and reverse speeds with synchromesh engagement on all gears. The rear section consists of an epicyclic gear reduction unit offering an alternative low range output drive ratio.

The four basic forward and reverse speeds are doubled by the ability of the epicyclic unit to provide the additional output ratio. This feature, doubles the number of speeds available and gives the gearbox a total of eight forward and eight reverse.

The gearbox mainshaft is located above the layshaft which is of hollow construction to accept the Power Take-off (PTO) drive shaft which runs within it. Drive from the engine enters the gearbox through the input shaft which is spigot mounted at its front end into the mainshaft. The forward and reverse gears are splined to the input shaft and are in constant mesh with corresponding free-running gears on the front of the layshaft. The front or reverse gears drive through an idler gear to give the reverse motion. Drive through either of these free-running gears occurs when the one selected is engaged with the layshaft by the sliding coupler of the synchromesh mechanism.

8 SPEED SYNCHROMESH SHUTTLE GEARBOX



1. PTO input shaft and gear
2. Input shaft housing
3. Reverse constant mesh gear
4. Selector rails and forks
5. Forward constant mesh gear
6. First gear
7. 1st/2nd synchromesh coupler
8. Second gear
9. Fourth gear
10. 3rd/4th synchromesh coupler
11. Third gear
12. Gear shift inter lock
13. Epicyclic reduction unit
14. Sliding coupler
15. Mainshaft
16. PTO shaft
17. Layshaft
18. Forward constant mesh gear - layshaft
19. Forward/reverse synchromesh coupler
20. Reverse constant mesh gear - layshaft
21. PTO constant mesh gear - layshaft
22. PTO front bearing housing
23. Reverse idler gear
24. Transmission input shaft

Eight speed ZF synchromesh shuttle gearbox

The PTO drive enters the gearbox through a hollow shaft revolving on the outside of the gearbox input shaft. A spur gear pinion at the rear of the hollow PTO input shaft is permanently engaged with the gear splined to the PTO drive shaft.

The mainshaft carries four free-running gears, all of which are in constant mesh with corresponding fixed gears on the layshaft to give the basic 1st, 2nd, 3rd and 4th ratios.

The 2nd, 3rd and 4th ratio, forward and reverse gear sets are of the straight cut spur type. The 1st ratio gear set has helical teeth which have longer contact areas and are consequently capable of transmitting greater loads than straight cut gears of the same size. They are also quieter running.

Drive through the 1st, 2nd, 3rd and 4th ratio free-running gears takes place when the selected gear is engaged with the mainshaft by a sliding coupler. The coupler located between the pairs of gears forms

part of the ZF synchromesh engagement mechanism. Ball and roller bearings are used to support the main and layshaft.

Gearbox Driveline

The order of drive through the gearbox, with the gears selected is as follows:

From the input shaft through the forward or reverse gearset to the layshaft.

From the layshaft to the selected free-running gear on the mainshaft.

From the free-running gear to the coupler.

From the coupler to the mainshaft via the coupler hub which is splined to the mainshaft.

From the mainshaft to the tractor's final drive arrangements via the epicyclic gear reduction unit in LOW range drive or directly in HIGH range.

Synchromesh mechanism

The synchromesh mechanism synchronises (equalises) the speed of the selected free-running gear with the appropriate driven shaft before drive engagement. This is of great benefit to the drive by preventing potential gear damage and allowing fast, easy gear changes to be made on the move without the need to stop the tractor. Engaging gear with the tractor stationary is also easier.

Caution: The tractor MUST come to rest before changing direction from forward to reverse or reverse to forward.

Epicyclic gear reduction unit

Up to this point only passing reference has been made to the epicyclic gear reduction unit at the rear of the gearbox. This is of heavy duty design and incorporates a Belleville spring arrangement to absorb the end thrust imposed on the mainshaft by the first speed helical gearset.

The rear end of the mainshaft is machined to form the sun gear which meshes with three planet gears, also in mesh with a fixed internal ring gear or "annulus" forming the circumference of the working components. When the mainshaft rotates, the planet gears and carrier revolve round the sun gear at a reduced speed compared with that of the mainshaft.

A sliding coupler with internal and external splines forms the connection between the gearbox and the drive shaft to the final drive. When moved forwards by its output lever, it couples the mainshaft directly to the output shaft to establish high range drive, giving the gearbox an additional set of speed ratios 5th, 6th, 7th, 8th and high reverse.

When shifted fully rearwards the external splines on the coupler engage corresponding splines on the planet carrier to establish low range drive. In these circumstances, drive from the gearbox mainshaft to the output shaft is via the carrier and subject to a speed reduction giving 1st, 2nd, 3rd and 4th speed ratios and low reverse. The coupler may also be placed in a mid or neutral position free of the mainshaft and carrier to totally disconnect the drive from the gearbox - a feature forming the basis of Massey-Ferguson's safety starting arrangements.

Main Gear Shift Lever

Removal and Refitment 7G-01

Removal

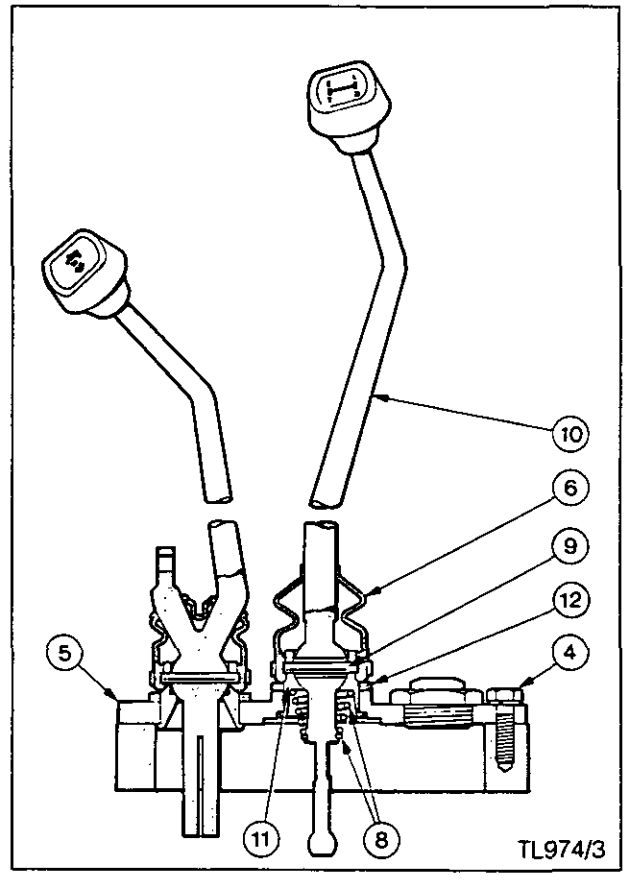
1. Remove the cab floor mat and/or access panels if fitted.
2. Move the gear levers to the neutral position.
3. Turn back the rubber boot, remove the split pin and pivot pin and disconnect the forward/reverse shift rod.
4. Remove the five bolts holding the gear lever assembly to the shift tower on top of the gearbox.
5. Remove the gear lever assembly from the tractor.
6. Remove the gear lever rubber cover.
7. Place the gear lever assembly in a vice.

Caution: When removing the spring retaining clip (8), care must be taken to prevent the spring from flying out and causing possible injury or damage.

8. Press the spring retaining clip towards the spring, slide sideways and remove. This will release the spring.
9. Press out the gear lever retaining pin.
10. Lift out the gear lever.
11. The gear lever cup may be removed from the cover if required.
12. Unscrew the retaining nut and press out the cup.

Refitment.

13. Reverse procedure 1 to 12 except:
    a. If the gear lever cup has been removed, ensure that it is fitted with the gear lever retaining pin square with the axis of the tractor by lining up the flats on the cup.
    b. Ensure that the gear lever rubber cover is in good condition to prevent dirt getting into the transmission.
    c. Coat the underside of the gear lever cover with Loctite 515 and torque the cover bolts to 50-70 Nm (37-52 lbf ft).

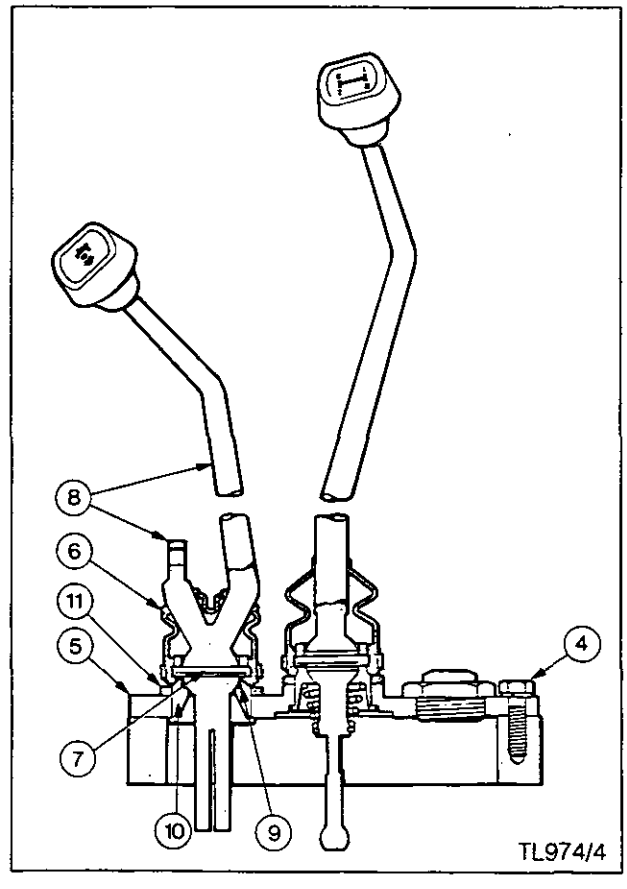


High/Low, Forward/Reverse Shift Levers

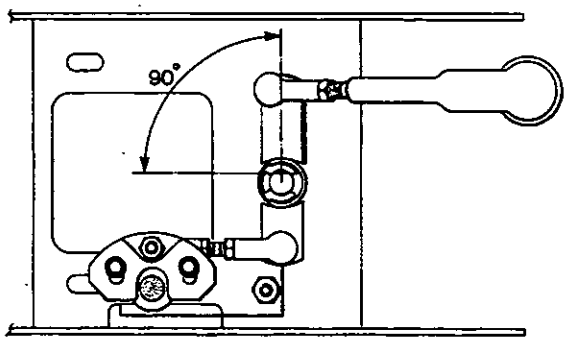
Removal and Refitment 7G-02

Removal

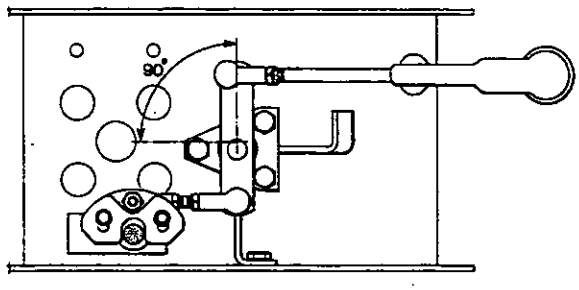
1. Remove the cab floor mat and/or access panels if fitted.
2. Move the gear levers to the neutral position.
3. Turn back the rubber boot, remove the split pin and pivot pin and disconnect the forward/reverse shift rod.
4. Remove the five bolts holding the gear lever assembly to the top of the gearbox.
5. Remove the gear lever assembly from the tractor.
6. Remove the gear lever rubber cover.
7. Remove the gear lever retaining pin.
8. Lift out the gear levers.



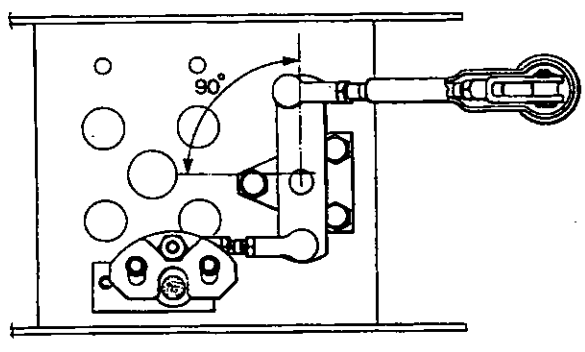
8 SPEED SYNCHROMESH SHUTTLE GEARBOX



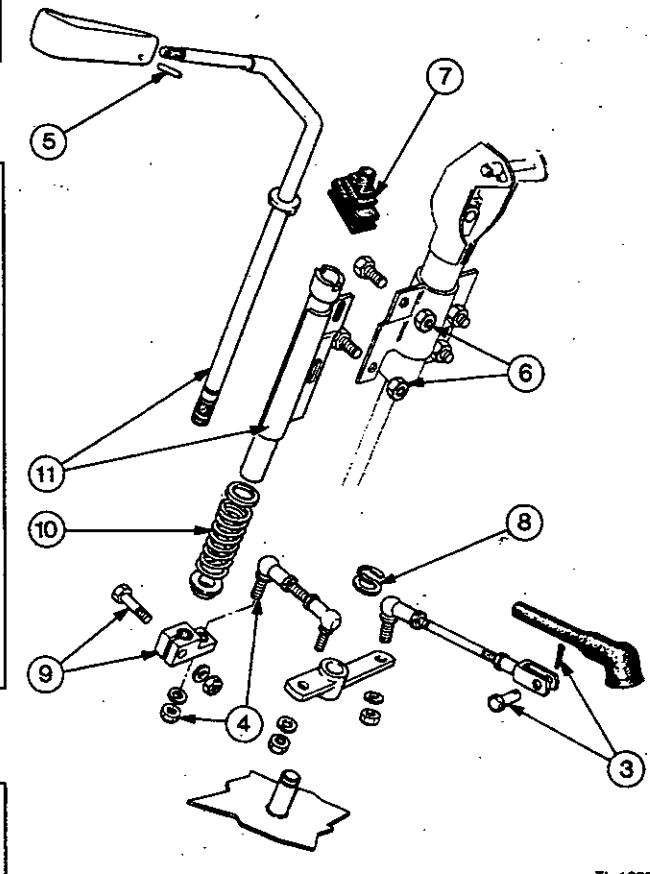
Footstep TL 2579



HiLine cab TL 2581



Standard cab TL 2580



TL 1338

9. Remove the 'O' ring.
10. The gear lever cup may be removed if required.
11. Unscrew the retaining nut and press out the cup.

Refitment

12. Reverse proceedure 1 to 11 except:
    a. Renew the 'O' ring.
    b. If the gear lever cup has been removed ensure that it is fitted with the gear lever retaining pin square with the axis of the tractor by lining up the flats on the cup.
    c. Ensure that the gear lever rubber cover is in good condition to prevent dirt getting into the transmission.
    d. Coat the underside of the gear lever cover with Loctite 515 and torque the cover bolts to 50-70 Nm (37-52 lbf ft).

Forward/Reverse Control Lever

Disassembly

1. Remove the cab floor mat and/or access panels if fitted.
2. Remove the lower instrument panel and the panel covering the lower end of the steering column.
3. Turn back the rubber boot, remove the split pin and pivot pin and disconnect the forward/reverse shift rod on top of the gearbox.
4. Remove the nut from the ball joint at the base of the shift lever column and disconnect the joint.
5. Drive out the roll pin holding the handle to the shift lever and remove the handle.
6. Remove the two nuts securing the shift column to the steering column support bracket.
7. Remove the shift lever column assembly by pulling away the bottom end and feeding the handle through the rubber grommet in the instrument panel.
8. The relay lever can be removed by removing the spring clip and lifting it off the pivot pin.
9. Remove the clamp bolt and lever at the base of the shift lever.
10. Remove the spring.
11. Draw the shift lever out of the tube.

Note: On Hiline tractors due to a high floor level the relay lever is in two parts passing through a bearing assembly with the lower lever splined to the shaft with a clamp bolt.

Reassembly

12. Reverse procedure 1 to 12 except:
    a. Lubricate the shift lever bearings and thrust faces with general purpose grease when fitting to the tube.
    b. Ensure that no electrical wiring or harness rubs or touches any moving part of the linkage.
    c. When refitting the relay lever shims are provided to remove any end float.
    d. When refitting the linkage between the shift lever and gearbox the following points must be observed:
    e. Put the gearbox forward/reverse lever in neutral.
    f. Place the shift lever in neutral.
    g. Ensure that the lever at the base of the shift lever is positioned as shown in the illustration, at 180° to the hand lever. There may be a small angular mis-alignment due to the positioning of the splines.
    h. Adjust the length of the rods to ensure that the relay lever is at 90° as shown in the illustration.

8 SPEED SYNCHROMESH SHUTTLE GEARBOX

Selector Rails and Forks

Removal and Refitment 7G-04

Special Tools:
MF414 Centralising pin and locating peg

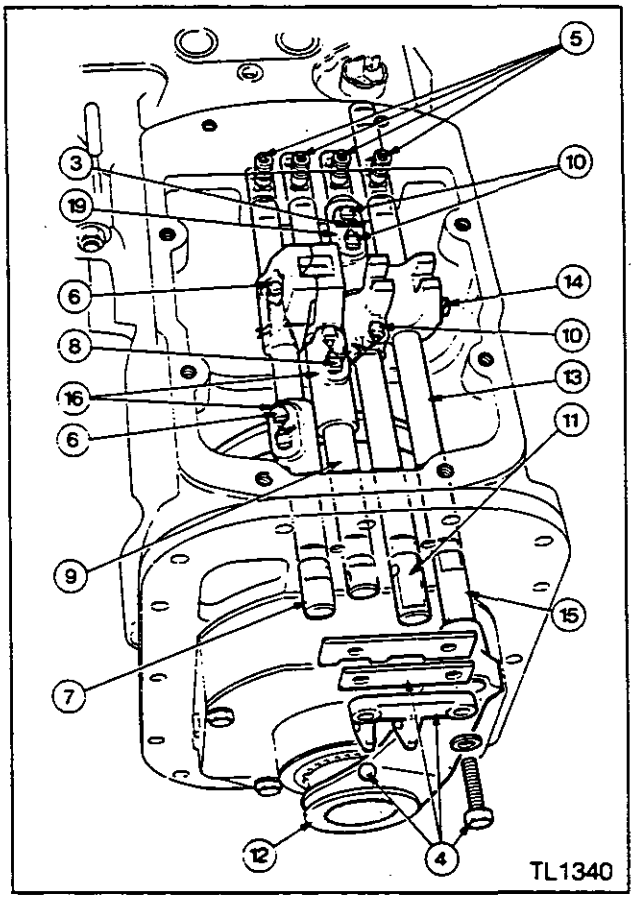
Removal

Caution: Beware of sharp edges around the top of the gearbox case.

1. Split the tractor between the gearbox and the spacer housing or the centre housing and remove the gearbox, see section 2.
2. Remove the gearbox top cover, and the shift tower.
3. Release the locking wires.
4. Remove the bolts, ball, spacer, and stop plate of the gear shift interlock mechanism.
5. Lift out the detent springs and plungers.
6. Remove the locking screws.
7. Slide the 3rd/4th rail rearwards out of the housing.

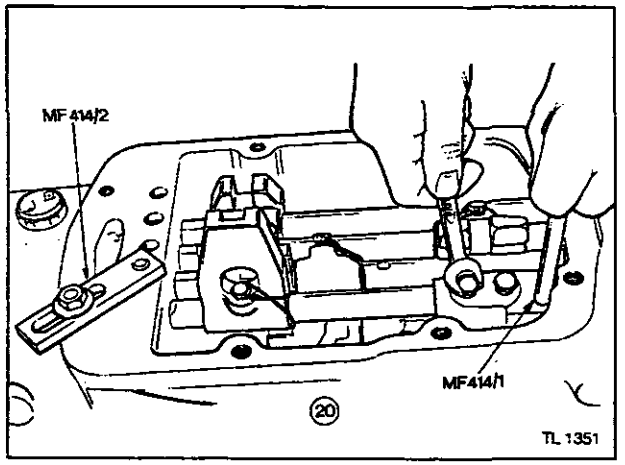
Note: When removing the selector rails, retain the gear lever engagement blocks.

8. Remove the locking screw.
9. Slide the 1st/2nd rail rearwards out of the housing.
10. Remove the locking screw.
11. Slide the forward/reverse rail rearwards out of the housing.
12. Slide the high/low rail rearwards and remove the coupler.
13. Rotate the high/low rail through 90°.
14. Remove the locking screw.
15. Slide the rail rearwards out of the casting.
16. Remove 1st/2nd and 3rd/4th selector forks.
17. Remove main input shaft, see operation 7G-08.
18. Remove the reverse idler assembly, see operation 7G-10 paragraph 9.
19. Remove the forward/reverse synchromesh selector fork.



Refitment

20. Reverse procedures 1 to 19 except:
    a. Apply a few drops of oil to the selector rails before refitment.
    b. Set each synchromesh selector fork and rail to the neutral position. Lock the selector rail using the plate and bolt MF414/2 (part of tool MF414). Insert the centralising pin, MF414/1, into the hole on the top of the selector fork, lining it up with the corresponding hole in the sliding coupler and hub. Progressively lock up the two security screws on the selector fork to 34-52 Nm (25-38 lbf ft). Afterwards, check that the centralising pin MF414/1 can be removed freely. Wire-lock the screws.
    c. Tighten the high/low selector fork and selector block screws to a torque of 34-52 Nm (25-38 lbf ft).



    d. On completion of the refitting procedure, place all the gears in the neutral position.
    e. Torque the interlock retaining bolts (4) to 40-47 Nm (30-35 lbf ft)
21. Apply Loctite 515 or equivalent between the gearbox top and the shift tower and the gear lever assembly.
22. Torque the shift tower to gearbox bolts to 102-122 Nm (75-90 lbf ft), gear lever assembly to shift tower bolts to 50-70 Nm (37-52 lbf ft).

Normal and Heavy Duty Gearbox Epicyclic Unit

Removal and Refitment 7G-05

Removal

1. Split the tractor between the gearbox and the spacer housing or centre housing and the transmission, see section 2.
2. Remove the locking wire.
3. Remove the locking screw.
4. Remove the selector fork and coupling.
5. Remove the bolts.
6. Remove the complete assembly.

Refitment

7. Reverse procedures 1 to 6 except:
   a. Ensure that the front and rear thrust rings are correctly located before refitment.
   b. Ensure that the epicyclic dowels are correctly located in the gearbox casing.
   c. Locate the cover plate with the cut out in the bottom left hand corner for heavy duty, and the bottom right hand corner for normal duty epicyclics.
   d. Fit a lockwasher to the lower right hand retaining bolt, on normal duty epicyclics only.
   e. Tighten the retaining bolts progressively and evenly to a torque of 40-47 Nm (30-35 lbf ft).

Normal Duty Gearbox Epicyclic Unit

Overhaul 7G-06

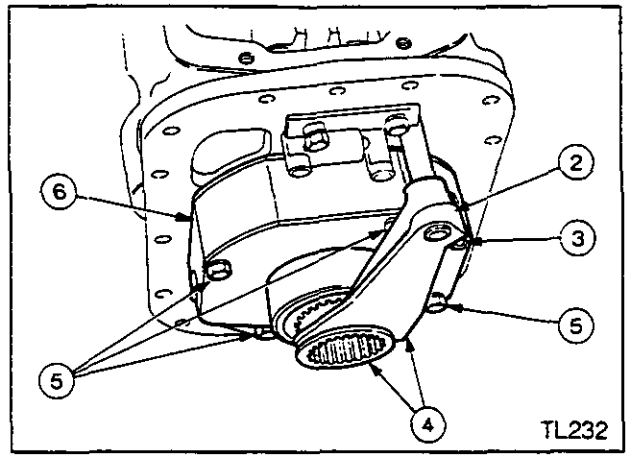
Disassembly

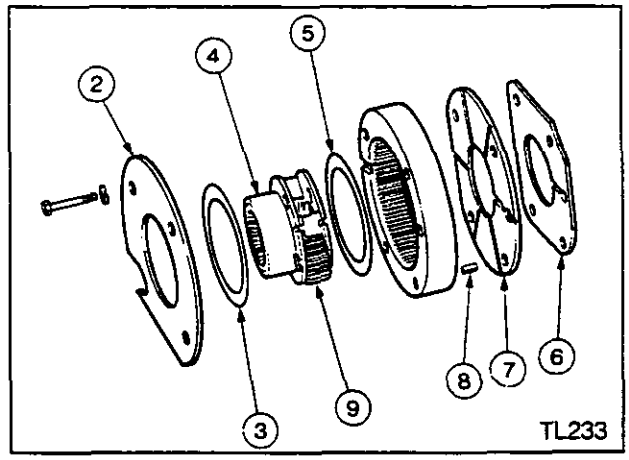
1. Remove the gearbox epicyclic unit, see operation 7G-05.
2. Remove the cover plate.
3. Remove the rear thrust ring.
4. Remove the planetary pinion carrier.
5. Remove the front thrust ring.
6. Remove the shim.
7. Remove the front plate.
8. If necessary, remove the dowel pins from the ring gear.

Note: The planetary pinion carrier cannot be serviced, and must be replaced as a complete assembly if found to be defective.

9. To remove pinions and needle rollers, follow items 11, 12 and 13 in operation 7G-07.

Note: Spacers are fitted either side and between the needle rollers.





Reassembly

10. Reverse procedures 1 to 9 except:
    a. When replacing the rollers in the pinions, a smear of petroleum jelly (not grease) will help retain them. Do not omit the spacer from between the two runs of rollers. Each run consists of 27 rollers, see item 9.
    b. The front plate and the cover plate must be positioned with the oil grooves towards the pinion carrier.
    c. Always fit the same thickness of shims as those removed.
    d. To assist assembly of the front and rear thrust rings on the pinion carrier, smear them with petroleum jelly (not grease). Ensure that the tabs on the thrust rings locate in the pinion carrier cut-outs, and that the brass faces are away from the pinion carrier.

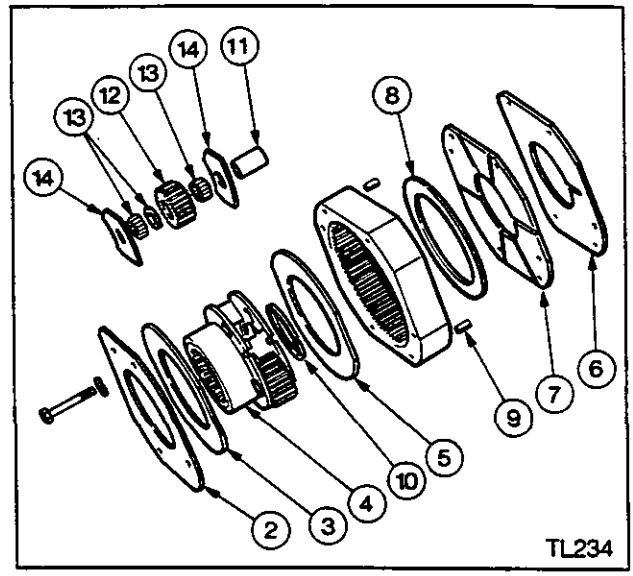
8 SPEED SYNCHROMESH SHUTTLE GEARBOX

Heavy Duty Gearbox Epicyclic Unit

Overhaul 7G-07

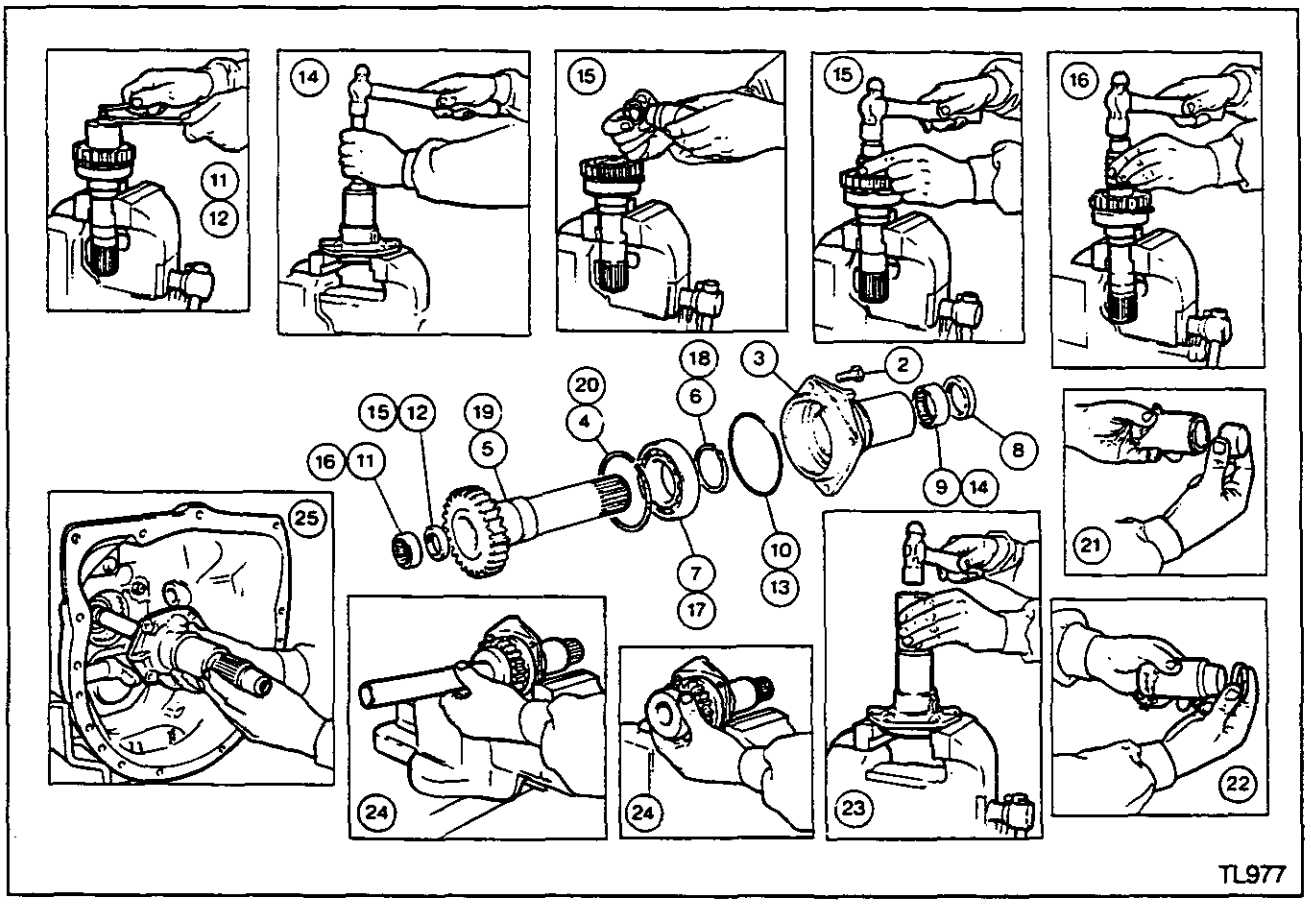
Disassembly

1. Remove the gearbox epicyclic, see operation 7G-05.
2. Remove the cover plate.
3. Remove the rear thrust ring.
4. Remove the planetary pinion carrier.
5. Remove the front thrust ring.
6. Remove the shim.
7. Remove the front plate.
8. Remove the Belleville spring disc.
9. If necessary, remove the dowels from the planetary ring gear.
10. Remove the external snap ring.
11. Gently tap out the three pinion shafts towards the front.
12. Remove the planetary pinions.
13. Remove the two sets of rollers and spacer from each pinion.
14. Remove the wear plates from each side of each pinion.



Reassembly

15. Reverse procedures 1 to 14 except:
    a. When replacing the rollers in the pinions, a smear of petroleum jelly (not grease) will help retain them. Do not omit the spacer from between the two runs of rollers. Each run consists of 16 rollers.
    b. Ensure that the Belleville spring disc is located correctly in the epicyclic ring gear with the concave face rearwards.
    c. The front plate and the cover plate must be positioned with the oil grooves towards the pinion carrier.
    d. Ensure that the pinion wear plates are refitted with the flats positioned innermost to the centre of the pinion carrier.
    e. Ensure that the gap of the snap ring is located midway between the planetary pinion shafts.
    f. Always fit the same thickness of shims as those removed.
    g. To assist assembly of the front and rear thrust rings on the pinion carrier, smear them with petroleum jelly (not grease). Ensure that the tabs on the thrust rings locate in the pinion carrier cut-outs, and that the brass faces are away from the pinion carrier.



Input Shafts and Housing

Removal and Refitment 7G-08

Special Tools:

MF255B PTO input shaft oil seal replacer
MF315A Needle roller bearing remover/replacer
MF421 Needle roller bearing and seal replacer
MF422 Needle roller bearing and oil seal remover
MF177A or KMF1004 Input shaft oil seal protector sleeve

Removal

1. Remove the clutch release mechanism, see operation 6A-04.
2. Remove the four bolts.
3. Withdraw the input housing complete leaving the main input shaft in position.
4. Remove the large internal circlip.
5. Push the PTO input shaft, complete with bearing, rearwards out of the housing.
6. If necessary, remove the circlip.
7. If necessary, press the bearing off the shaft.
8. Lever the seal out of the front of the housing.
9. Using MF315A, drive the needle roller bearing from the front of the housing.
10. Remove the 'O' ring from the housing.
11. Using MF422, carefully remove the needle roller bearing from the inside of the PTO input shaft.
12. Using MF422, remove the oil seal from the PTO input shaft.

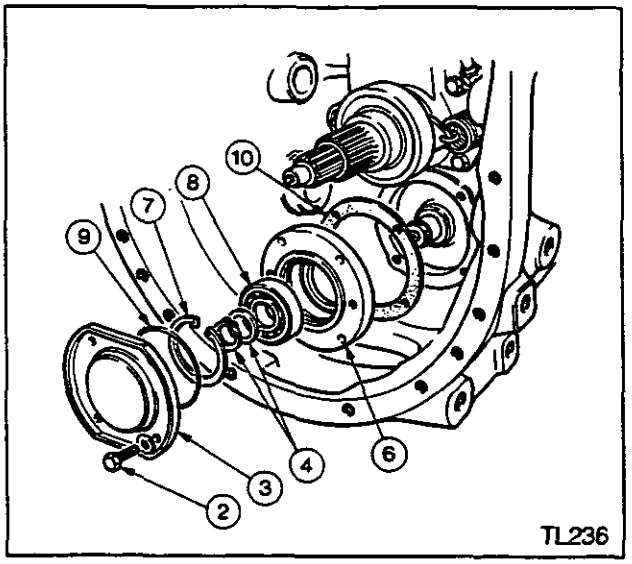
Refitment

13. Fit a new 'O' ring into the housing.
14. Using MF315A, replace the needle roller bearing in the housing.
15. Using MF421, fit a new seal into the input shaft with the lip of the seal facing the tool.
16. Using MF421, refit the needle roller bearing into the input shaft with the round end of the cage to the bottom of the recess.
17. Refit the bearing onto the outside of the shaft with the shield towards the gear teeth.
18. Refit the circlip. (Check that it is properly seated.)
19. Refit the PTO input shaft and bearing into the input housing.
20. Refit the circlip. (Check that it is properly seated.)
21. Place the nylon cone adaptor, MF255B/2, on the seal replacer, MF255B/1.

22. Place the seal over the cone and onto the tool with the seal lip facing away from the tool and remove the nylon cone.
23. Place the tool over the PTO input shaft and tap the seal into place.
24. Place seal protector sleeve MF177A or KMF1004 over the main input shaft on the gear box.
25. Carefully refit the input housing over the input shaft and withdraw the protector sleeve when the housing is in place.
26. Refit the clutch release mechanism, see operation 6A-04.

Note:

a. **Use petroleum jelly (not grease) to lubricate all seals and the needle roller bearing when refitting.**
b. **Lightly coat the bolt threads in Hylomar sealant when refitting, and tighten to a torque of 54-61 Nm (40-45 lbf ft).**



PTO Driveshaft Front Bearing

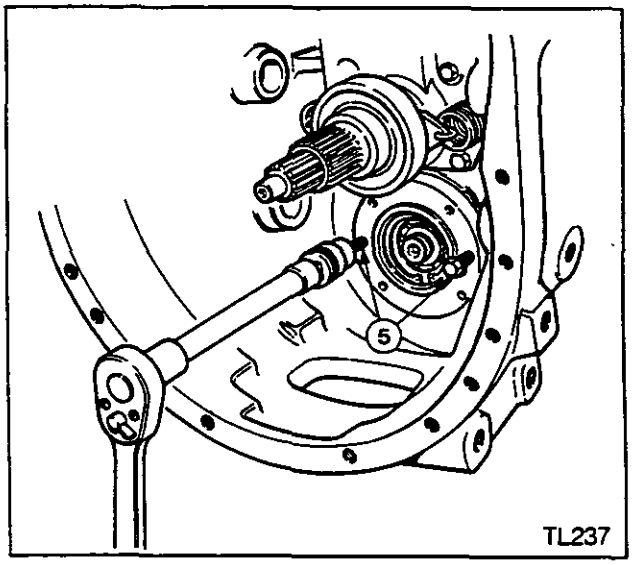
Removal and Refitment 7G-09

Special Tools:

MF218A PTO drive shaft puller

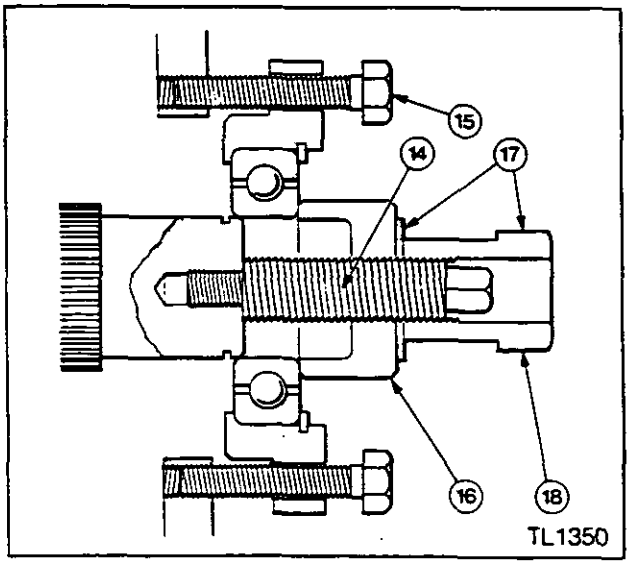
Removal

1. Remove the cross shaft and lever, see operation 6A-04.
2. Remove the four bolts and washers.
3. Remove the cover plate.
4. Remove the external circlip and washer.
5. Screw two 3/8 UNC x 75 mm (3 in) bolts (part of special tool MF218A) into the bearing housing and tighten them evenly to draw the housing from the case and shaft.
6. Remove the housing.
7. Discard the circlip.
8. Press out the bearing.
9. Discard the 'O' ring.
10. Discard the gasket.

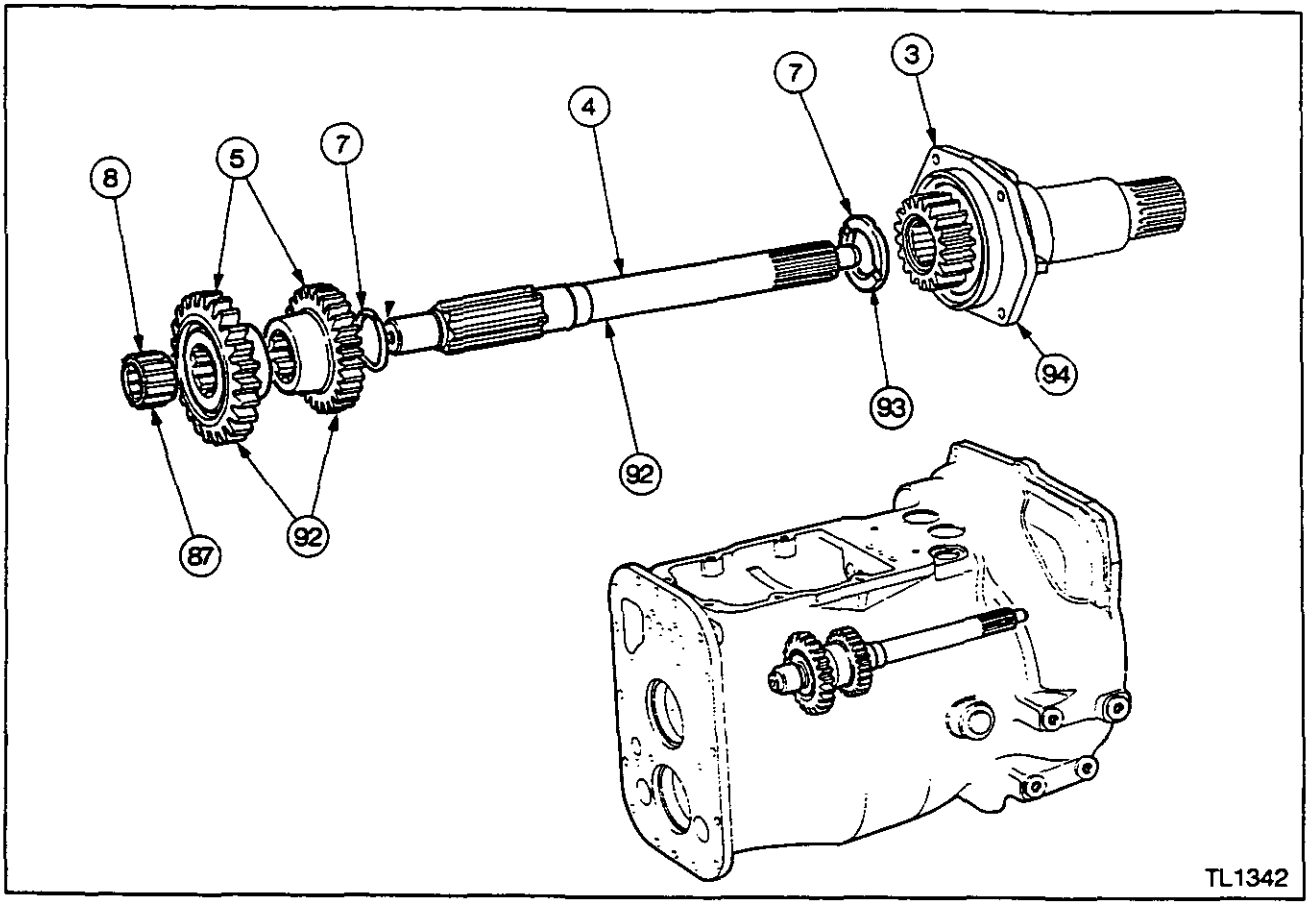


Refitment

11. Lightly coat the new gasket with Hylomar sealant.
12. Using MF218A, refit the bearing and housing assembly.
13. Check that the PTO drive shaft splines locate with those in the PTO constant mesh gear.
14. Screw the centre screw into the end of the PTO shaft with the aid of a 9/16 in. A/F spanner.
15. Locate the bearing and housing assembly on the end of the PTO shaft and to the housing with the two long bolts provided with MF218A through the unthreaded holes.
16. Place the adaptor onto the centre screw with the hollow face against the bearing.
17. Place the washer on the centre screw and screw on the nut.



8 SPEED SYNCHROMESH SHUTTLE GEARBOX



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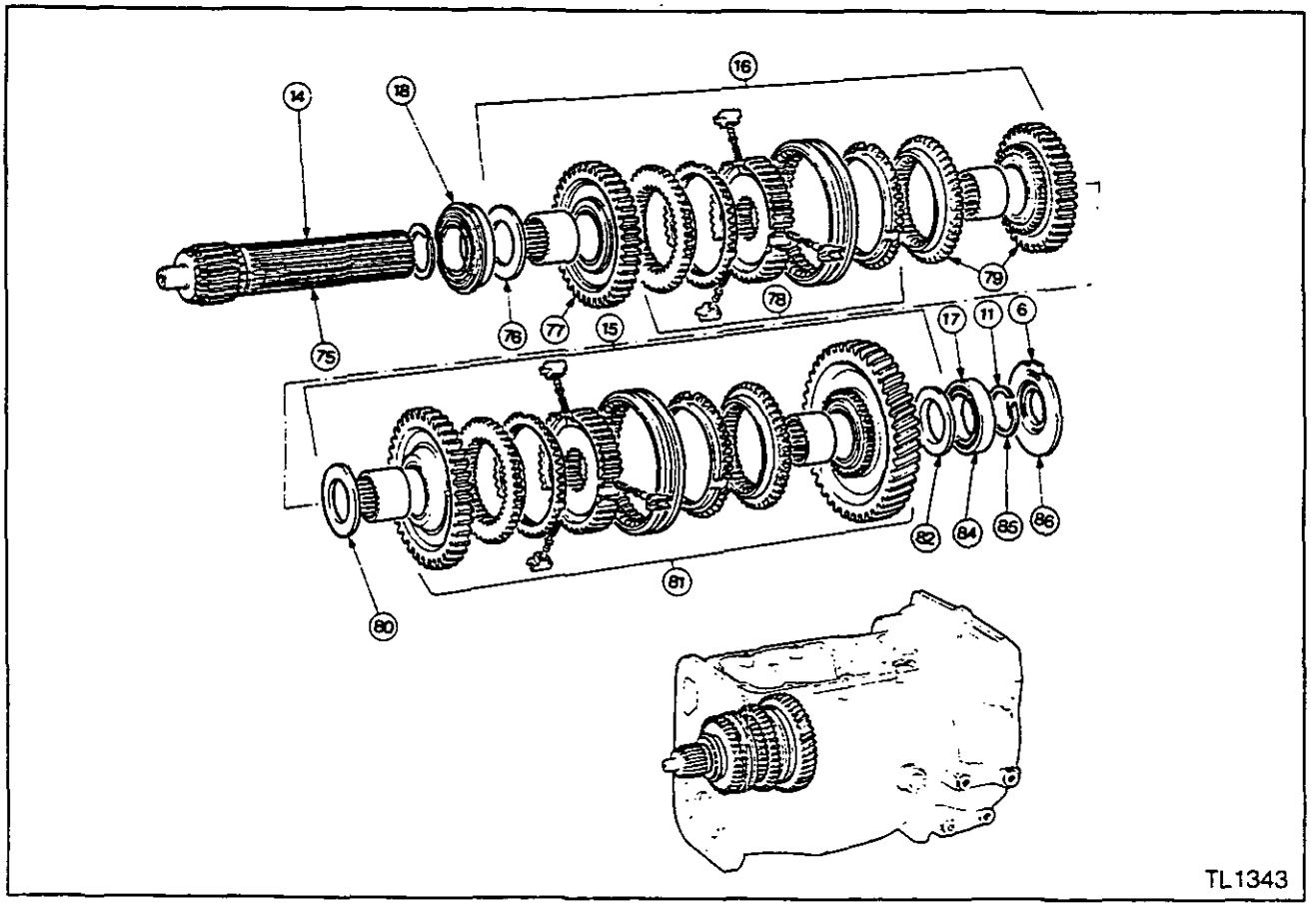


TL1343

18. Tighten the nut with an 1 1/8 in. A/F spanner until the housing is pushed home and the PTO shaft is drawn through the ball bearing sufficiently to enable the washer and circlip to be fitted.
19. Fit a new circlip and washer.
20. Replace the cover with a new 'O' ring.
21. Lightly coat the securing bolt threads with Hylomar sealant.
22. Tighten the bolts to a torque of 54-61 Nm (40-45 lbf ft).

Layshaft, Mainshaft, PTO Shaft and Gears

Overhaul 7G-10

Special Tools:

MF415 Synchromesh hub assembly tool
MS550 Drive handle.

Disassembly

With the gearbox removed from the tractor:

1. Remove the clutch release mechanism, see operation 6A-04.
2. Remove the selector rails and forks, see operation 7G-04.

Note: The layshaft selector fork cannot be removed at this stage.

Input shafts and housing

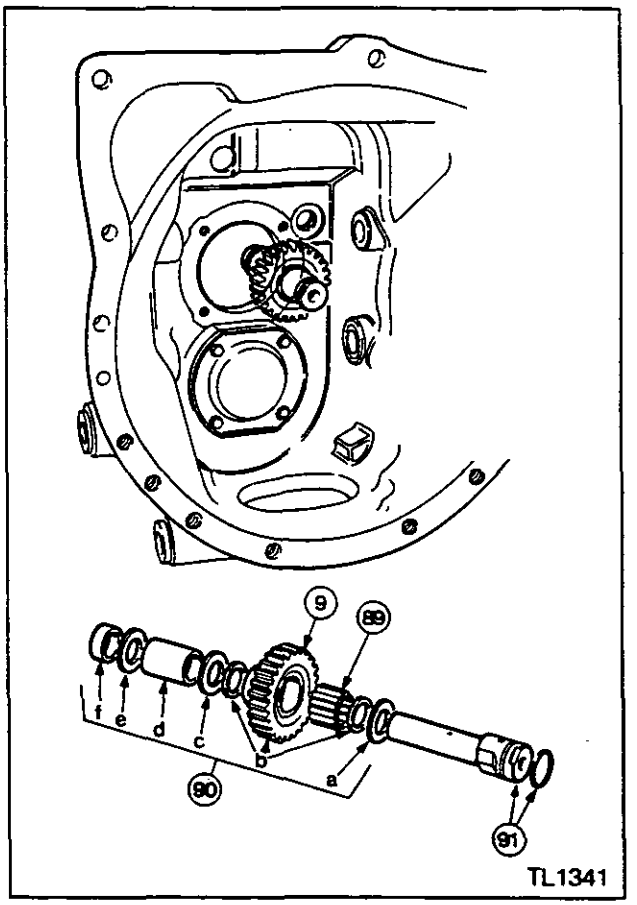
3. Remove the input shaft and housing, see operation 7G-08.
4. Withdraw the main input shaft.
5. Lift out the forward and reverse constant mesh gears.
6. Remove the main thrust washer.
7. Remove the snap ring and thrust washer from the main input shaft, if necessary.
8. Remove the needle roller bearing from inside the main shaft.

Reverse Idler

9. Remove the reverse idler shaft by easing it out of the front of the gear box with a screwdriver between the inner spacer and the casing, be careful, the idler gear contains loose needle roller bearings. Retain the components in a clean container.

Mainshaft

10. Lightly drive the front roller bearing to the rear with a punch to facilitate removal of the main shaft snap ring.
11. Remove the snap ring from the front of the main shaft.
12. Remove the epicyclic reduction unit from the rear of the gearbox, see operation 7G-05.
13. Push the front main shaft bearing forward to give clearance to the 1st/2nd gear set assembly.
14. Pull the main shaft out of the gearbox to the rear.
15. Lift out the 1st gear and the measured thrust washer, then 2nd gear and the synchromesh hub.

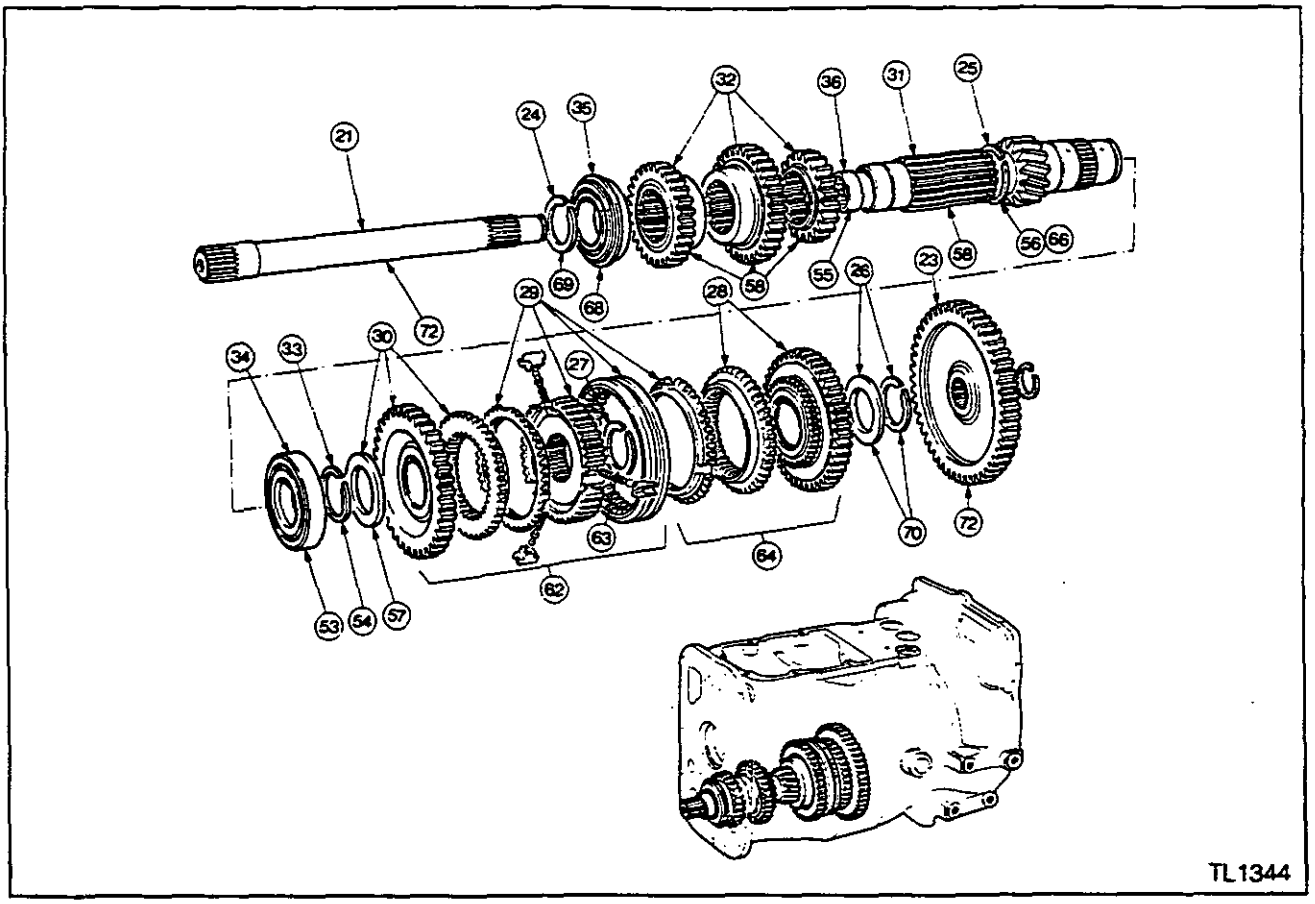


16. Lift out the rear 3rd/4th gear set assembly and thrust washers.
17. Remove the front roller bearing from the gearbox case.
18. Press the rear ball bearing off the front of the shaft.

Layshaft

19. Remove the PTO drive shaft front bearing cover.
20. Remove the the PTO shaft circlip and thrust washer.
21. Screw a 7/16 in. UNF bolt approximatley 75 - 100 mm (3 - 4 in.) long into the end of the PTO shaft and drive it out of the bearing.

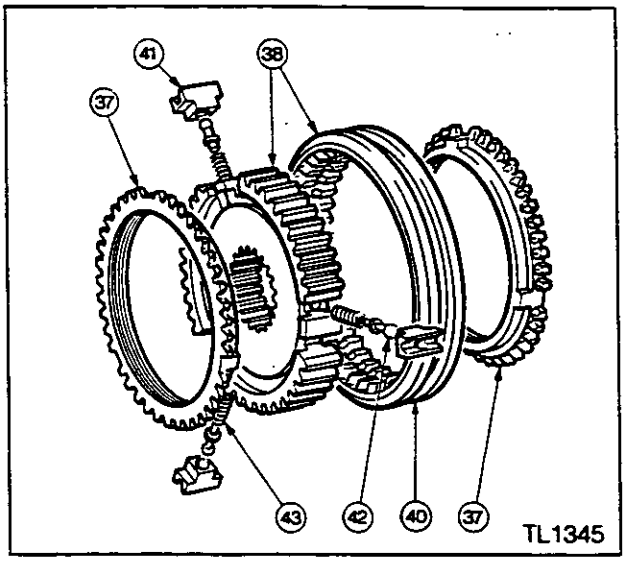
8 SPEED SYNCHROMESH SHUTTLE GEARBOX



22. Remove the PTO drive shaft front bearing, see operation 7G-09.
23. Lift out the PTO constant mesh gear.
24. Remove the snap ring from the rear of the layshaft.
25. Carefully drive the layshaft forward to ease removal of the snap ring in front of the second gear, move it to the unsplined portion of the shaft.
26. Remove the snap ring and thrust washer from the front of the layshaft and then drive the layshaft fully rearwards.
27. Slide the reverse constant mesh gear fully forward. Remove the circlip with a pair of right angled circlip pliers from the front of the synchromesh hub. Slide the circlip as far forward along the layshaft as possible.
28. Drive the layshaft rearwards so that roller bearing is in the rear section of the gearbox. Lift the reverse ratio gear out through the top of the gearbox.
29. Remove the circlip and the synchromesh hub assembly.
30. Remove the forward ratio gear and thrust washer.
31. Relocate the bearing in the centre web and drive the layshaft forward, remove it through the front of the gearbox.
32. Lift out the second, third gears and fourth gears.
33. Remove the snap ring.
34. Press the front layshaft bearing off the shaft.
35. Remove the rear bearing from the casing.
36. Remove the PTO rear support bearing.

Synchromesh hub assemblies

37. Remove the two synchroniser rings.
38. Remove the drive hub complete with the sliding coupler.
39. Wrap the hub and coupler in a cloth.
40. Remove the sliding coupler, taking care not to lose pressure springs, plungers and blocks.
41. Remove the three pressure blocks.
42. Remove the three pressure plungers.
43. Remove the three pressure springs.
44. Thoroughly clean all the components and check their condition.
45. Using a feeler gauge, measure the clearance between the synchroniser ring and the coupler on the gear at several points. The synchroniser ring must be correctly positioned on the tapered part of the splined ring. If the clearance is less than 0,5 mm (0.020 in), replace the synchroniser ring. If the clearance is checked with the gearbox assembled replace the synchroniser ring if the clearance is found to be less than 0,8 mm (0.030 in).



Examination

46. Clean and thoroughly inspect all parts for signs of wear or damage and replace if necessary. Renew all snap rings, when refitting ensure that they are correctly located in their grooves.

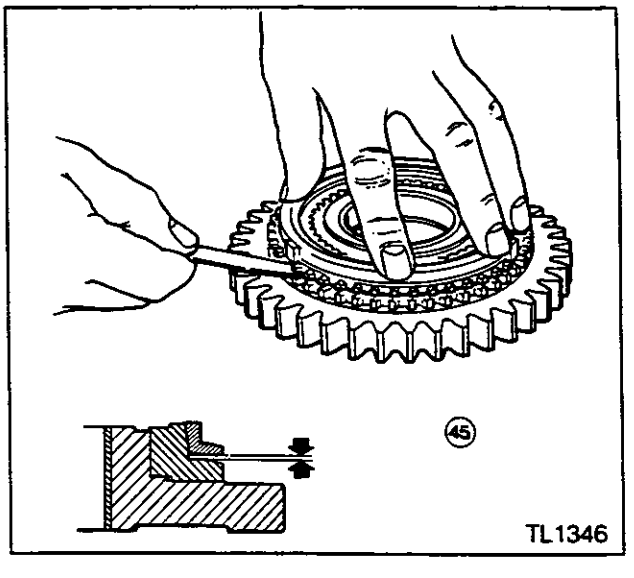
Reassembly

Synchromesh hub assemblies

47. Reverse procedures 37 to 43.
48. On replacing pressure springs, plunger and blocks into the coupler ring, special service tool MF 415 and handle MS 550 must be used to locate the hub back in the sliding coupler.
49. Place the hub on the work bench and insert the three springs, plungers and blocks.
50. Carefully place the hub assembly into the ring of MF415 ensuring that hole 'A' in the hub is inline with the hole 'A' in the side of MF415. Press the hub down into the tool compressing the blocks, plungers and springs.
51. Place the hub and tool over the coupler checking that the hole in the tool and hub aligns with the hole in coupler, also check that it is concentric.

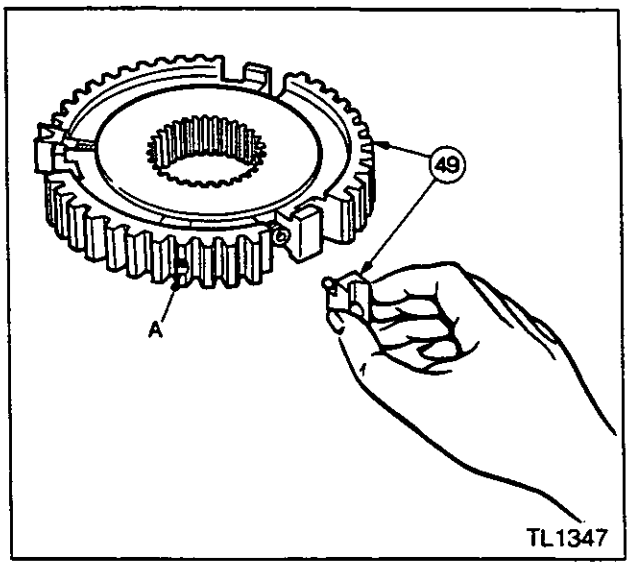
Note: Ensure that the hole 'A' in the coupler is fitted in line with the hole in the hub, it is used to align the selector fork to the rail.

52. Fit handle MS550 to the round plate of MF415 and use it to tap the hub into the coupler.



Layshaft

53. Press the front roller bearing onto the shaft.
54. Fit the roller bearing circlip.
55. Fit the rear PTO shaft support bearing.
56. Place the circlip on the unsplined portion of the shaft.
57. Refit the thrust washer at the front of the shaft.



58. Place the second (20T), fourth (29T) and third (28T) gears in the bottom of the gearbox.
59. Pass the layshaft through the front of the gearbox so that the roller bearing is in the first section.
60. Fit the layshaft gears in the above order.
61. Drive the layshaft rearwards so that the roller bearing is in the rear section.
62. Refit the the forward gear and synchromesh hub assembly.
63. Place the circlip on the unsplined portion of the shaft close up to the synchromesh hub.
64. Refit the reverse gear assembly.
65. Enter the roller bearing into the centre web. Drive the layshaft forward holding the reverse gear set so that it pushes the circlip between the reverse gear and hub into its grove.

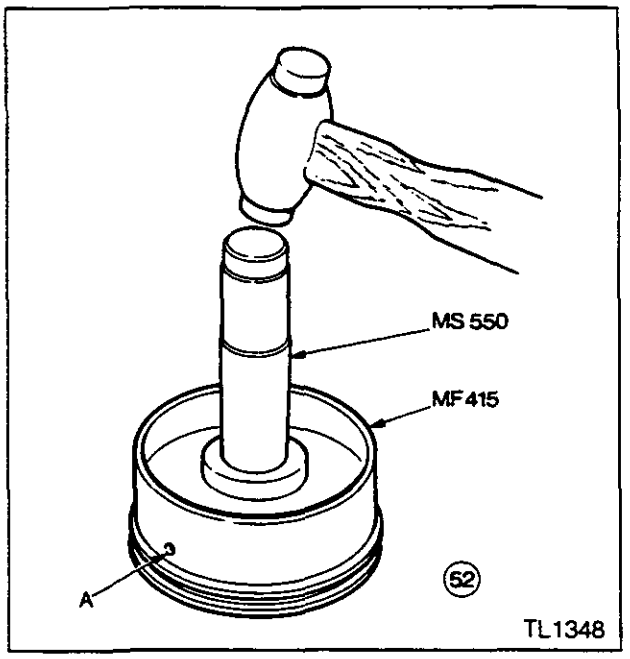
Caution: Check that the circlip between the reverse gear and the synchromesh hub is correctly seated in its groove.

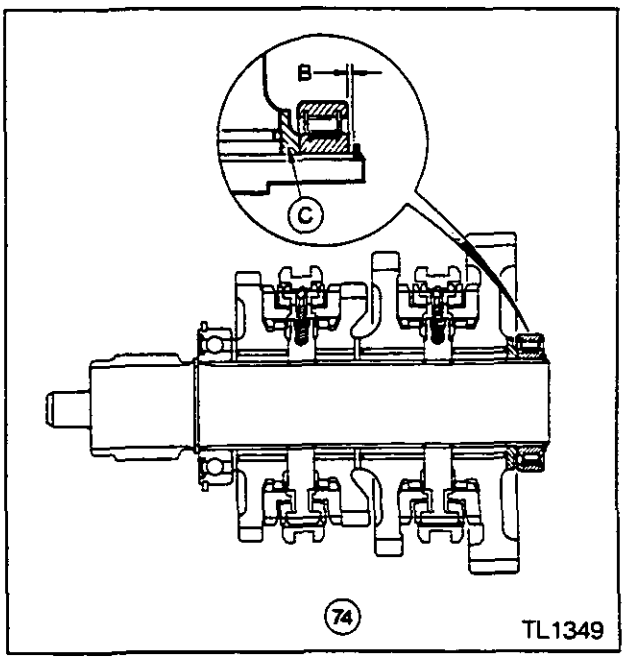
66. Refit the circlip from the unsplined portion of the shaft into its groove in front of 2nd gear.
67. Place a block between the front of the layshaft and the gearbox casing in the front section.
68. Drive the rear roller bearing onto the end of the shaft and into the gearbox casing.
69. Remove the block and replace the rear snap ring.
70. Refit the thrust washer with the flat face towards the reverse gear and replace the snap ring.
71. Ensure that the shaft is fully forward and check that the layshaft turns freely.
72. Place the PTO constant mesh gear in the bottom of the gearbox and refit the PTO shaft from the rear of the gearbox.
73. Refit the PTO front bearing housing, see operation 7G-09.

Mainshaft

74. Assemble the mainshaft complete with all hubs, gears, bushes, bearing and thrust washers. Refit circlip. Measure the gap 'B' between the front bearing and the circlip. The gap (end float) should be between 0,080 mm (0.003 in) and 0,30 mm (0.012 in). If your measurement falls outside the set limits, replace the calibrated thrust washer 'C', which sits between the bearing and first gear, with one of a choice of varying thickness thrust washers to achieve the desired end float. Calibrated thrust washer part numbers and sizes are as follows:

Thrust Washer Chart		
MF Part No	Thickness mm	Thickness in
1671 888 M2	4,14-4,19	0.163-0.165
1671 889 M1	4,39-4,44	0.173-0.175
1671 890 M2	4,62-4,67	0.182-0.184
1671 891 M2	4,85-4,90	0.191-0.193





75. Slide the mainshaft through the rear of the gearbox, progressively fitting in the following order:
76. Steel thrust washer.
77. Third gear (35T) with steel bush and synchro cone.
78. Synchromesh hub assembly and bulk ring.
79. Fourth gear (40T) with steel bush and synchro cone.

80. Steel thrust washer.
81. Assemble the second (40T) and first (42T helical) gear pack with the synchromesh hub and steel bushes. Lower the assembly down into the box and slide the main shaft through the assembly.
82. Fit the preselected calibrated thrust washer with flat side towards first gear.
83. Refit the epicyclic reduction unit, see operation 7G-05.
84. Drive the front roller bearing on to the mainshaft and into the centre web of the gearbox.
85. Replace the circlip.
86. Locate the tagged thrust washer in the gearbox centre web with the convex side facing forwards.
87. Refit the needle roller bearing into the front of the mainshaft.
88. Locate the forward/reverse selector fork into the coupler of the layshaft synchromesh assembly.
89. Replace the rollers in the reverse idler pinion, a smear of petroleum jelly (not grease) will help retain them. There is a single row of 23 rollers with a spacer ring each side.
90. Refit the reverse idler to the gearbox, the order of assembly is as follows:
    a. Thrust washer
    b. Pinion
    c. Thrust washer
    d. Long spacer
    e. Thrust washer
    f. Short spacer
91. Renew the 'O' ring on the idler shaft and enter from the bell housing end, align the cut away portion on the front of the idler shaft to allow fitment of the input housing.
92. Hold the forward and reverse constant mesh gears in the gearbox and refit the transmission input shaft.
93. Refit reversible steel thrust washer to the front of the reverse ratio gear.
94. Refit the input housing assembly, see operation 7G-08.
95. Refit the selector forks and rails, see operation 7G-04.
96. Refit the clutch release mechanism, see operation 6A-04.
97. Refit the gearbox to the tractor, see section 2.

12 SPEED SHUTTLE GEARBOX

Section 7 – Part H

Table of Contents

7H–2
12 SPEED SHUTTLE GEARBOX

Specification

Model	12 Speed synchromesh shuttle gearbox
Number of gears forward	12
Number of gears reverse	12
Synchromesh type	Strut type

Settings Required

Main shaft end float	0,08-0,03 mm (0.003-0.012 in)
Type of adjustment	Variable thickness thrust washer
Range change unit:	
Top bearing pre-load	0,05-0,06 mm (0.0002-0.0025 in)
Bottom bearing pre-load	0,05-0,10 mm (0.002-0.004 in)
Method of adjustment	Shims or spacer rings
Synchromesh ring to coupler clearance:	
Installed	0,8 mm (0.030 in)
Removed	0,5 mm (0.020 in)
Synchromesh neutral setting	See procedure 7H-05

Special Tools

MF.177A	*Input shaft oil seal protector sleeve*
MF.218A	PTO Drive shaft puller
MF.255B	PTO input shaft oil seal replacer
MF.315A	Needle roller bearing and seal remover/replacer
MF.414	Synchromesh centralising pin
MF.415	Synchromesh hub assembly tool
MF.421	Needle roller bearing and seal replacer
MF.422	Needle roller bearing and seal replacer
MF.476	Bearing remover/replacer
MF.477	Gear set support tool
MF.478	Bearing pre-load tool
MS.550	Drive handle

Bolt Torques

Gear lever to shift tower	50-70 Nm (37-52 lbf ft)
Gearbox top cover	*102-122 Nm (75-90 lbf ft)*
Oil filler pipe to top cover	50-70 Nm (37-52 lbf ft)
Shifter fork locking screws	34-52 Nm (25-38 lbf ft)
Rear gear shift selector bracket	54-61 Nm (40-45 lbf ft)
Input shaft housing to gearbox	54-61 Nm (40-45 lbf ft)
PTO Drive bearing housing	54-61 Nm (40-45 lbf ft)
Engine to gearbox	100-130 Nm (74-94 lbf ft)
Gearbox to rear transmission	102-122 Nm (75-90 lbf ft)
Range change unit	
Selector rail support plates	25-35 Nm (18-26 lbf ft)
Range selector detent spring plug	50-70 Nm (38-52 lbf ft)
Upper bearing housing bolts	25-35 Nm (18-26 lbf ft)
Lower bearing housing bolts	25-35 Nm (18-26 lbf ft)
Range selector switch bolts	25-35 Nm (18-26 lbf ft)
Side cover plate (2WD) bolts	120-160 Nm (88-118 lbf ft)
4WD housing bolts	120-160 Nm (88-118 lbf ft)
Gear shift lever housing bolts	50-70 Nm (38-52 lbf ft)

General Description

The twelve speed synchromesh shuttle gear box has twelve forward and twelve reverse gears; the forward reverse selection being controlled by a lever on the instrument panel adjacent to the steering wheel. All speed gears are controlled by a single gear lever to the right of the driver. Full engine braking is provided on over-run and the tractor can be towed to start the engine.

Drive Arrangements

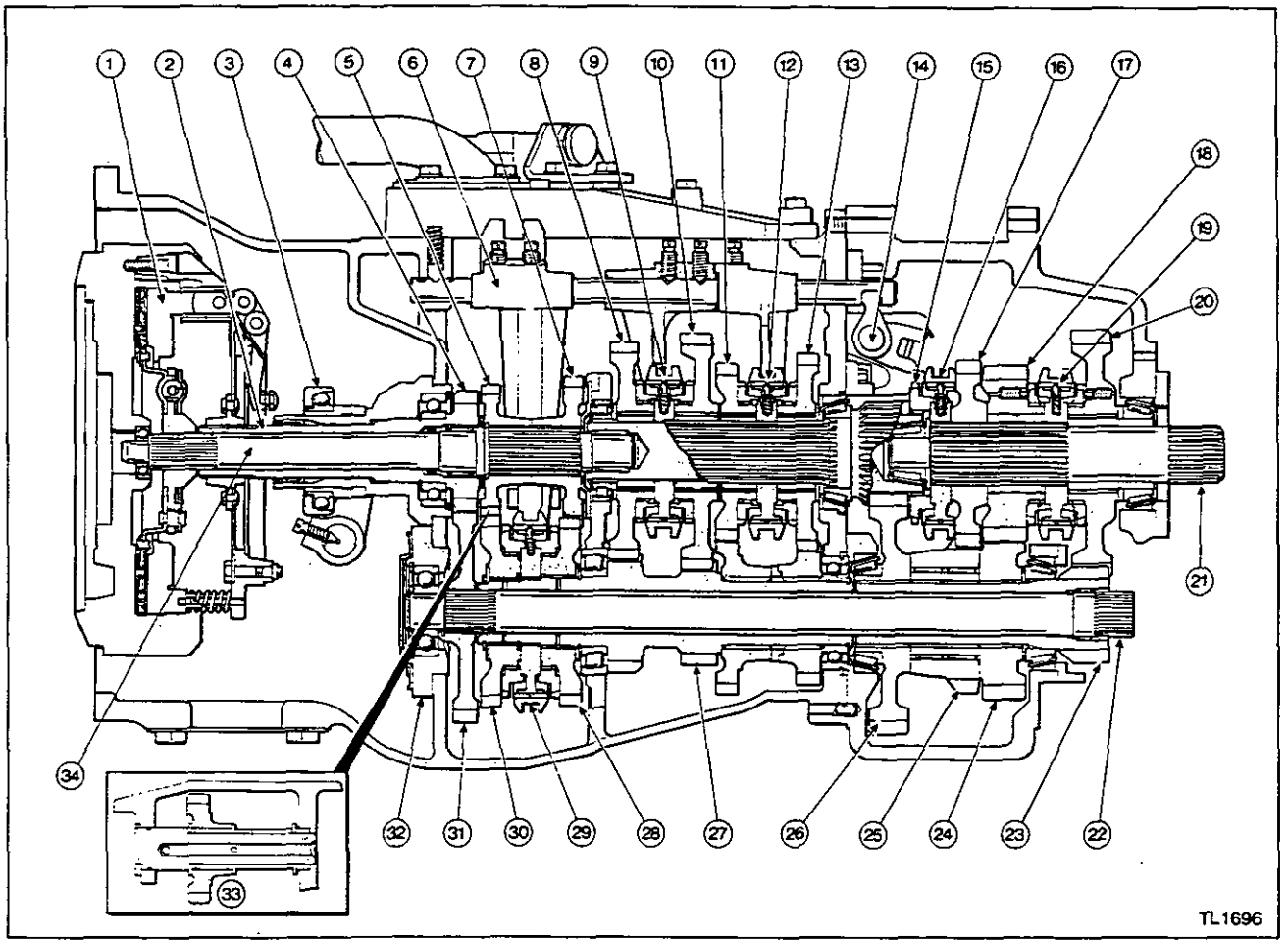
From the constructional view point the gearbox has three sections. The front section consists of the forward and reverse gears with synchromesh coupler.

The centre section comprises constant mesh gear sets giving four basic forward and revers speeds. The rear section consists of a three speed range unit offering an alternative low range, medium range and high range. Synchromesh engagement is provided on all gears.

The four basic forward and reverse speeds are tripled by the ability of the range unit to provide the additional ratios. This feature, gives the gearbox a total of twelve forward speeds and twelve reverse.

The gearbox mainshaft is located above the layshaft which is of hollow construction to accept the Power Take-off (PTO) drive shaft which runs within it. Drive from

12 SPEED SHUTTLE GEARBOX



1. Main split torque transmission clutch
2. PTO input shaft
3. Clutch release mechanism
4. PTO drive gear
5. Reverse constant mesh gear
6. Selector rails and forks
7. Forward constant mesh gear
8. Second gear
9. 1st/2nd synchromesh coupler
10. First gear
11. Fourth gear
12. 3rd/4th synchromesh coupler
13. Third gear
14. Selector mechanism
15. High range synchromesh cone
16. High range synchromesh coupler
17. Four wheel drive drive gear
18. Medium range gear
19. Medium/low range synchromesh coupler
20. Low range gear
21. Upper shaft – drive to rear axle
22. PTO drive shaft
23. Lower shaft
24. Medium range gear
25. Four wheel drive intermediate gear
26. Lower shaft drive gear
27. Lay shaft
28. Forward constant mesh gear – layshaft
29. Forward/reverse synchromesh coupler
30. Reverse constant mesh gear – layshaft
31. PTO constant mesh gear – layshaft
32. PTO front bearing housing
33. Reverse idler gear
34. Transmission input shaft

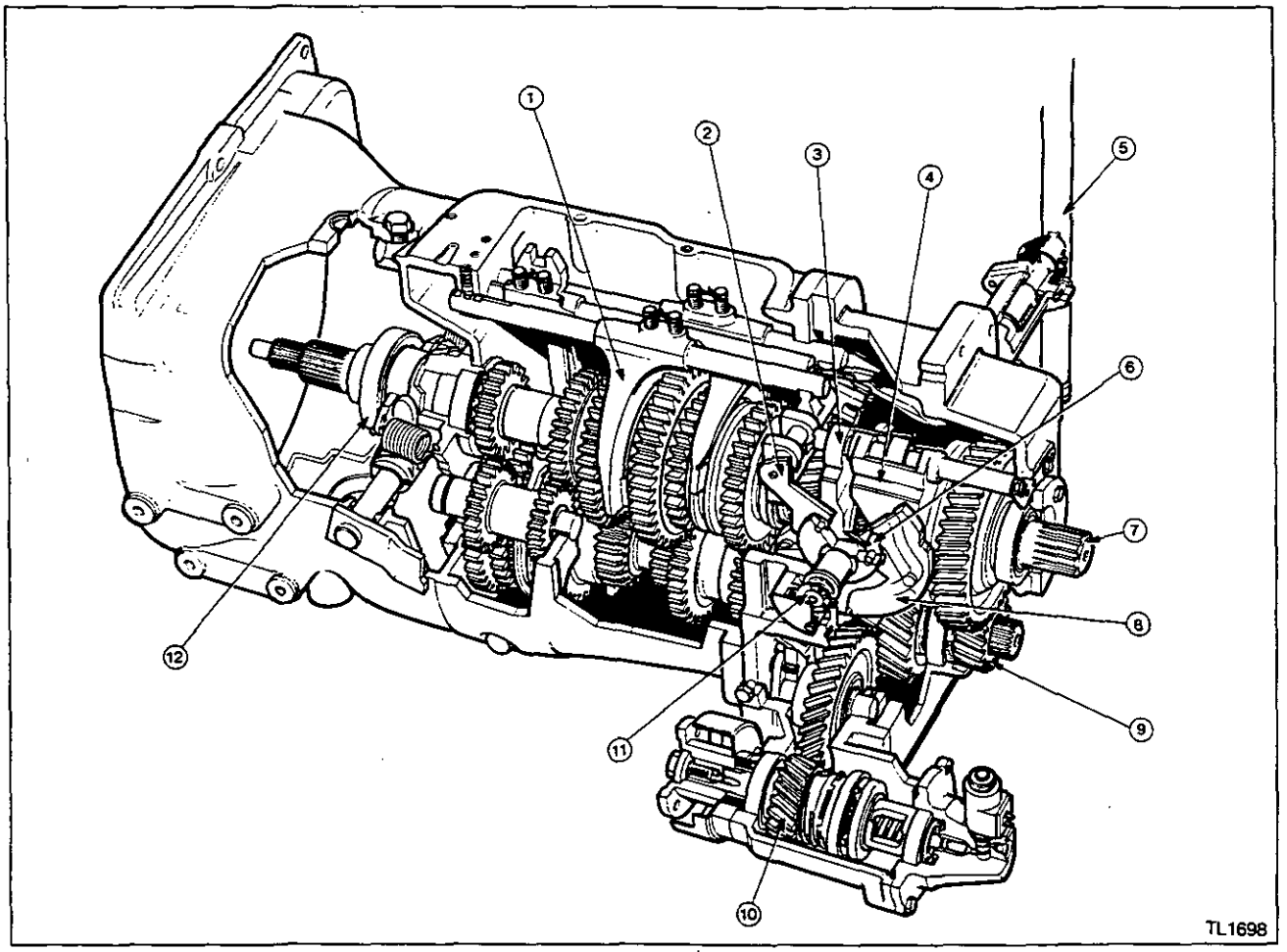
Figure 1. 12 Speed ZF synchromesh shuttle gearbox

the engine enters the gearbox through the input shaft which is spigot mounted into the front end of the mainshaft. The forward and reverse gears are splined to the input shaft and are in constant mesh with corresponding free-running gears on the front of the layshaft. The front or reverse gears drive through an idler gear to give the reverse motion. Drive through either of these free-running gears occurs when the one selected is engaged with the layshaft by the sliding coupler of the synchromesh mechanism.

There are two types of reverse idler fitted, the single gear type is fitted to tractors up to M-F 390 with 30 km/hr transmission. The double idler gear is fitted to M-F 398 and 399 tractors with 30 km/hr transmission and all models with 40 km/hr transmission.

The PTO drive enters the gearbox through a hollow shaft revolving on the outside of the gearbox input shaft. A spur gear pinion at the rear of the hollow PTO input shaft is permanently engaged with the gear splined to the PTO drive shaft.

12 SPEED SHUTTLE GEARBOX



1. Main gearbox
2. Range selector lever
3. High range selector fork
4. Low/medium range selector fork
5. Main gear lever
6. Selector ratchet
7. Upper shaft
8. Face cam
9. Lower shaft plate
10. Four wheel drive unit
11. Range selector rotary switch
12. Clutch release mechanism

Figure 2. Gearbox, range change unit and selector mechanism

The mainshaft carries four free-running gears, all of which are in constant mesh with corresponding fixed gears on the layshaft to give the basic 1st, 2nd, 3rd and 4th ratios.

All the gear sets are of the straight cut spur type, 1st and 2nd being wider than 3rd and 4th to cope with the higher torque that has to be transmitted.

Drive through the 1st, 2nd, 3rd and 4th ratio free-running gears takes place when the selected gear is engaged with the mainshaft by a sliding coupler. The coupler located between the pairs of gears forms part of the ZF synchromesh engagement mechanism. Roller and taper roller bearings are used to support the main and layshaft.

Gearbox Driveline

The order of drive through the gearbox, with the gears selected is as follows:

From the input shaft through the forward or reverse gearset to the layshaft.

From the layshaft to the selected free-running gear on the mainshaft.

From the free-running gear to the coupler.

From the coupler to the mainshaft via the coupler hub which is splined to the mainshaft.

From the mainshaft to the tractor's final drive arrangements via the range change unit.

Synchromesh Mechanism

The synchromesh mechanism synchronises (equalises) the speed of the selected free-running gear with the appropriate driven shaft before drive engagement. This is of great benefit to the drive by preventing potential gear damage and allowing fast, easy gear changes to be made on the move without the need to stop the tractor. Engaging gear with the tractor stationary is also easier.

Range Change Unit

The range change unit is directly bolted to the rear of the main gearbox and forms an integral part of the main transmission assembly. Bolted to the right hand side of the casing is the main gear shift lever, this single lever operates both sections of the gearbox excluding the forward/reverse mechanism which is operated from the lever adjacent to the steering wheel.

The range change unit comprises of two shafts, the upper and lower, the upper shaft carries the driven gears and synchromesh couplers. The lower shaft carries the constant mesh gears and the front axle drive gear. The PTO shaft runs through the centre of this shaft. The two synchromesh units are operated by selector forks actuated by a face cam having a scroll type track cut into its face. Rotation of the cam moves either selector fork or both together depending on which coupler is being moved and gear being selected.

The high range selector has only two positions, neutral, or shifted forward to select high range when the input and output shafts are locked together to provide a drive straight through the box.

The medium and low range selector has three positions, central neutral position; shifted forward to select medium range; shifted to the rear for low range. When either of these ranges are selected the drive train operates through the front constant mesh gear onto the lower shaft, from the lower shaft to the selected free-running gear on the top shaft. From the free running gear through the coupler to the main output shaft to the tractor's final drive.

The front four wheel drive unit is driven off the free-running running gear on the lower shaft, which is driven by the the gear splined to the upper shaft.

Both shafts are mounted on taper roller bearings, adjustable by shim packs to the rear of the box.

Gear Selection

The forward/reverse lever is simple in operation, depress the clutch and move the lever forward to go forward, back for reverse from the central neutral position. This operates the forward/reverse selector fork and coupler in the front of the gearbox. The lever can only be moved when the clutch pedal is fully depressed and must be in the central neutral position to start the engine. A safety start switch prevents starting the engine if the lever is engaged.

The 12 speeds are selected by a single lever, this lever operates the two sections of the gearbox. The first section contains four gears, 1st, 2nd, 3rd and 4th working in a gate as in any conventional gearbox, the lever is spring loaded when in neutral opposite 3rd and 4th gears. On the end of the gear lever cross shaft is a vertical lever which engages either of the two selector rails moving the selector fork and coupler.

The three speed range section is arranged in sequence from neutral (N) to low (L), medium (M) and high (H), and back through the range. The range selected is indicated by the appropriate indicator light on the right hand side of the instrument panel.

The range shift works on a ratchet system, moving the lever forward will select the next higher range and the lever will then return to the central position for selection of the main gears, leaving the range selected.

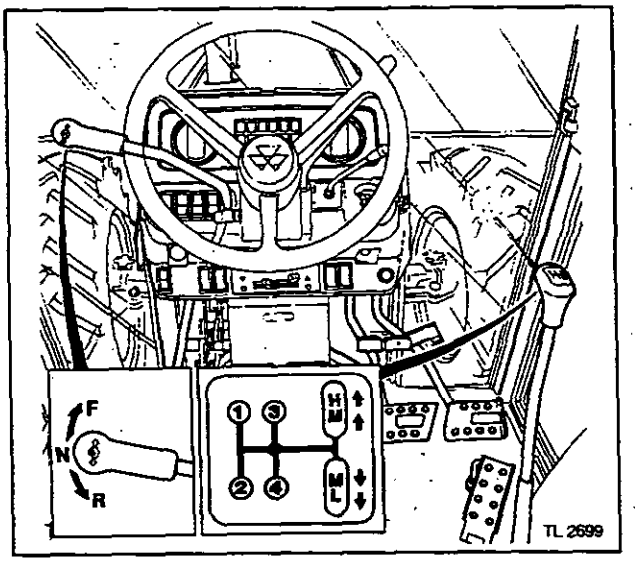


Fig.74

Figure 3 Gear shift positions

Moving the lever back will select the next lower range and the lever will again return to the centre. If a double shift is required the lever must be moved in the appropriate direction twice.

The range gear is selected by moving the main gear lever fully to the right of the gate and moving it either forwards or backwards to its limit, depending whether a change up or down is being made. One movement of the lever changes one range.

When the main gear lever is moved to the right, the vertical lever on the end of the cross shaft engages with the range selector lever, this in turn rotates the cam plate through a ratchet system and moves the appropriate selector fork and coupler. Rotation of the cam operates a rotary switch to illuminate one of the indicator lights to show that the gear has been selected.

After selection of the range gear the main gear lever is then used to select the required main gear. The range unit can be left in gear, it is not necessary to select neutral.

12 SPEED SHUTTLE GEARBOX

Gearbox

Removal and Refitment 7H-01

Removal

In addition to the instructions given in section 2 of this publication regarding the removal of the gearbox assembly, the following instructions must be followed:

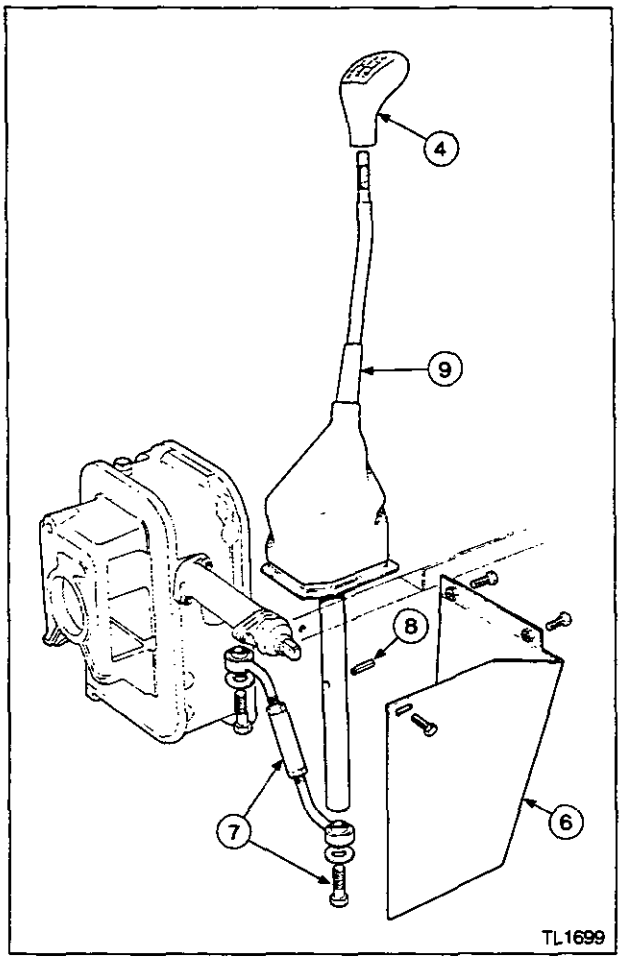
1. The gearbox and range change unit must be removed and replaced in the tractor as one unit. DO NOT split between the gearbox and range change unit.
2. Drain the transmission of oil.
3. Disconnect the clutch linkage and remove the foot throttle pedal.
4. Remove the main gear lever knob.
5. Remove the floor mats and floor panels.
6. Remove the gear lever guard.
7. Disconnect the bottom strut from the gear lever.
8. Remove the gear lever pivot roll pin.
9. Withdraw the gear lever up through the cab floor.
10. Slide back the four wheel drive shaft cover and disconnect the drive shaft at the rear.
11. Unscrew the knurled nut on top of the four wheel drive unit solenoid and remove the coil still connected to the wiring.
12. Disconnect the hydraulic pipe to the four wheel drive unit.
13. Remove the three bolts from the range indicator switch and remove the switch assembly still connected to the wiring, a small amount of oil may be present.
14. Disconnect the safety start switch.
15. Disconnect the forward/reverse lever linkage.
16. Support the cab on stands and remove the bolts from the cab mounts.

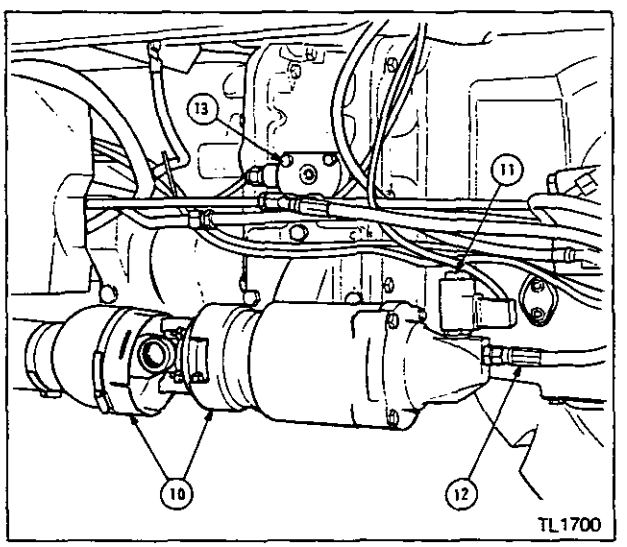
Note: On tractors with dual batteries, it will be necessary to remove the gear shift lever extension bolted to the range change housing.

17. Disconnect the tractor in the normal way between the range change unit and the rear axle.
18. Using a splitting track, move the engine forward complete with transmission clear of the tractor.
19. With a hand crane, remove the gearbox assembly from the engine. Ensure at all times that the engine, rear axle and transmission is correctly supported to prevent damage.
20. Place the gearbox on a low work bench standing on the clutch bell housing.
21. Remove the four wheel drive unit, see operation 10C-14.
22. Remove the main gear shift lever, see operation 7H-03.
23. Split the transmission between the gearbox and the range change unit.

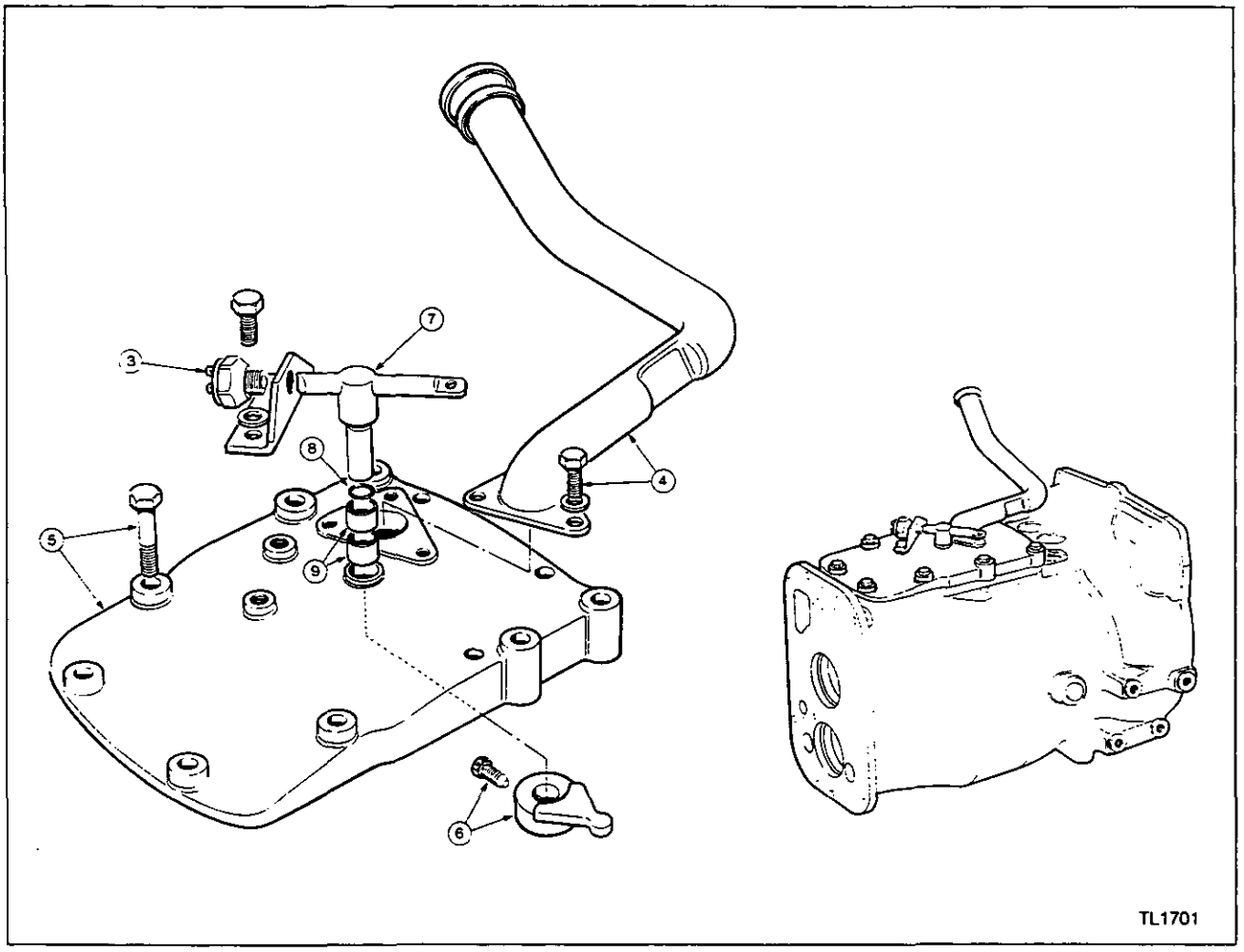
Refitment

24. Reverse procedure 1 to 19 except:
    a. A new gasket must be fitted between the gearbox and the range change box, and between the range change box and the rear axle.





    b. Apply Hylomar to the bottom 12 bolts holding the range change unit to the gearbox and rear axle casing.
    c. Tighten the engine to clutch housing bolts to a torque of 100-130 Nm (74-94 lbf ft)
    d. Tighten the range change unit to rear axle bolts to a torque of 102-122 Nm (75-90 lbf ft)



Gearbox Top Cover

Removal and Refitment 7H-02

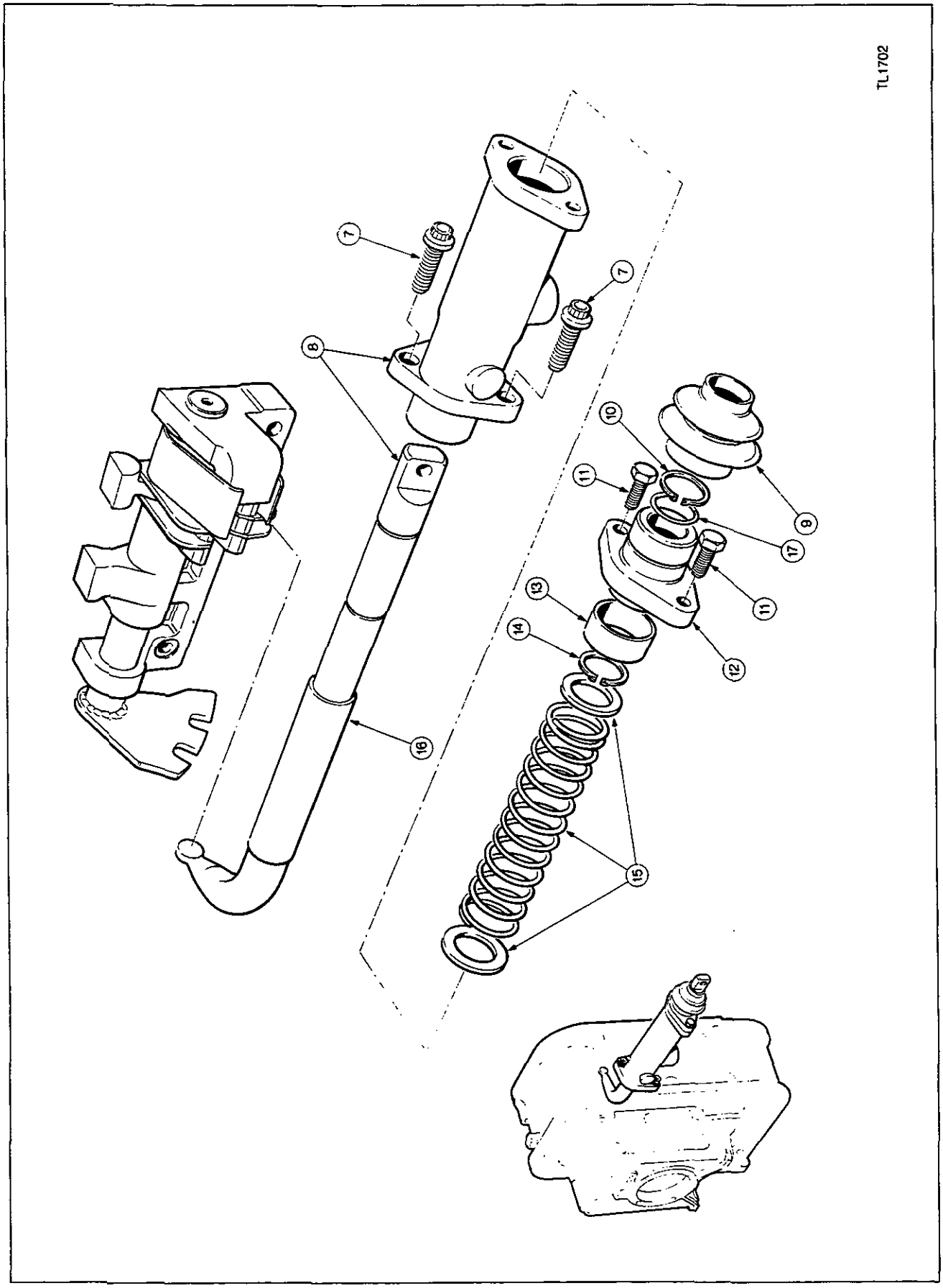
Removal

1. Remove the cab floor or foot plates.
2. Disconnect the forward/reverse lever linkage.
3. Disconnect the safety start switch.
4. Cab tractors – remove the three bolts from the oil filler tube and remove the tube.
5. Remove the top cover bolts and remove the top.
6. Unscrew the locking bolt in the selector lever and remove the lever from the shaft.
7. Withdraw the shaft from the cover.
8. Remove and discard the 'O' ring seal.
9. If necessary remove and replace the bushes in the top cover.
10. Clean all components.

Refitment

11. Reverse procedure except:
    a. Replace the shaft with a new 'O' ring.
    b. Apply Loctite 270 to the lever locking bolt.
    c. Apply Loctite 515 to the underside of the top cover and tighten the bolts to a torque of 101-122 Nm (75-90 lbf ft).
    d. Apply Loctite 515 to the underside of the oil filler pipe and tighten the bolts to a torque of 50-70 Nm (38-52 lbf ft).
    e. Check and ensure that the safety start switch operates.

12 SPEED SHUTTLE GEARBOX



Main Gear Shift Lever

Removal and Refitment 7H–03

Removal

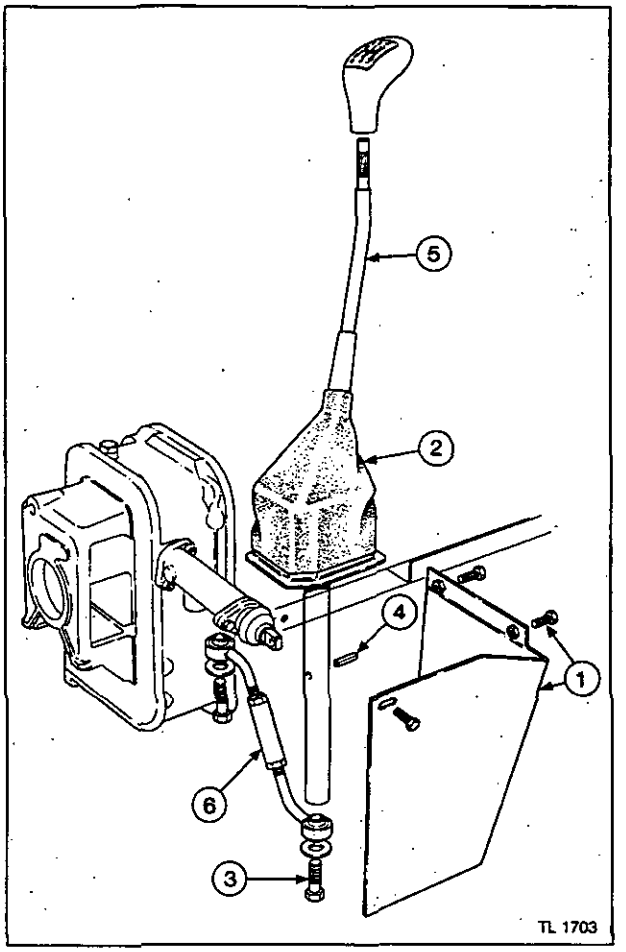
1. Remove the three bolts and the gear lever cover.
2. Remove the cab floor to release the cover around the gear lever.
3. Disconnect the bottom strut from the gear lever.
4. Remove the gear lever pivot roll pin.
5. Withdraw the gear lever up through the cab floor.
6. If necessary, remove the bottom strut.
7. Remove the two 12 point cap screws holding the lever assembly to the range change unit.
8. Remove the lever assembly.
9. Remove the rubber boot.
10. Remove the circlip.
11. Unscrew the two bolts holding the end cover in place.
12. Remove the end cover.
13. Remove the spacer.

WARNING: Spring under compression.

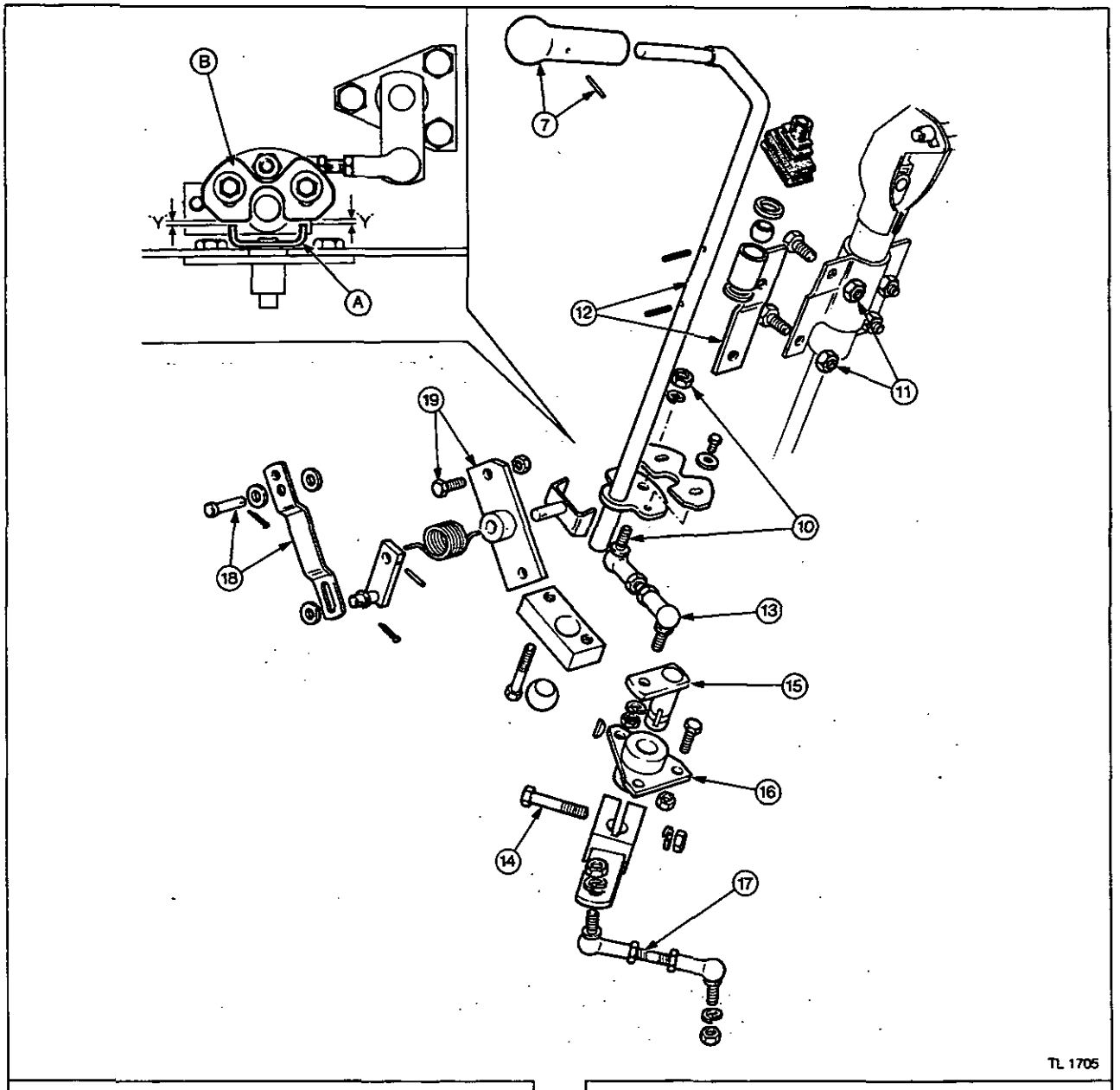
14. Remove the circlip.
15. Remove the two spacers and spring.
16. Remove the selector shaft from the housing.

Refitment

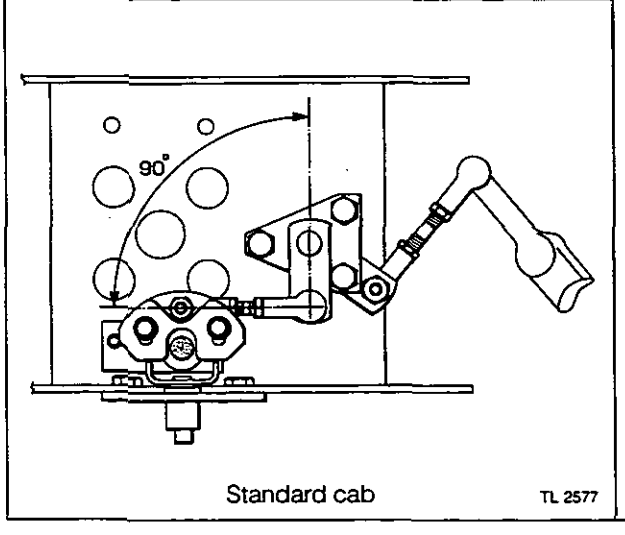
17. Reverse procedure 1 to 12, except:
    a. Replace the 'O' ring in the end cover.
    b. Replace all circlips.
    c. Lubricate the component parts during assembly with transmission oil.
    d. Ensure that the end of the selector shaft engages correctly in the jaws of the selector mechanism.
    e. Apply Massey Ferguson Instant Gasket (Loctite 515) to the face of the end cap and housing. Tighten the 12 point cap screws to a torque of 50-70 Nm (38-52 lbf ft).



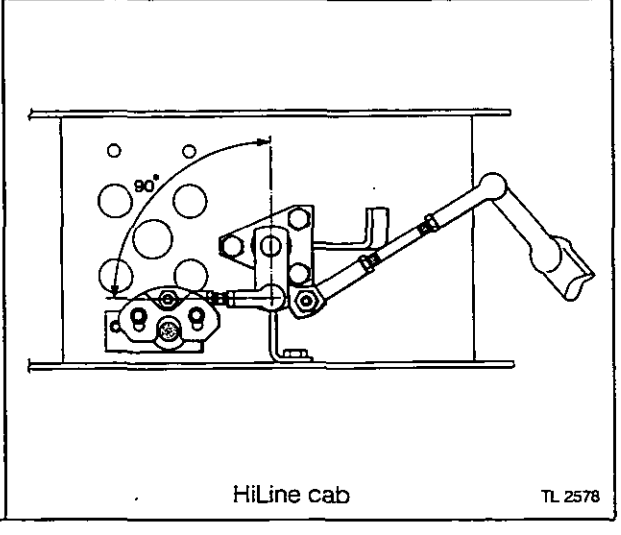
12 SPEED SHUTTLE GEARBOX



TL 1705



Standard cab TL 2577



HiLine cab TL 2578

Forward/Reverse Control Lever

Overhaul 7H–04

Disassembly

1. Disconnect and remove the operating rod between the clutch pedal operating lever and the side of the transmission.
2. Remove the foot throttle pedal and main gear lever knob.
3. Remove the cab floor mat and floor panels.
4. Remove the lower fuse panel and fuse holders below the steering column.
5. Remove the two instrument side panels disconnecting the range indicator lights.
6. Remove the steering column tilt locking lever.
7. Drive out the roll pin holding the handle to the shift lever and remove the handle.
8. Remove the two screws holding the left-hand switch panel in place. Disconnect the wiring from the switches behind the panel.
9. Remove the panel and the rubber cover by passing it up the gear lever.
10. Remove the nut from the ball joint at the base of the shift lever column and disconnect the joint.
11. Remove the two nuts securing the shift column to the steering column support bracket.
12. Remove the shift lever column assembly by lifting the column up out of the bottom bearing then feeding the handle down through the instrument panel support frame.

NOTE: The relay lever assembly may vary in layout from the unit shown in the illustrations due to the varying heights of the cab.

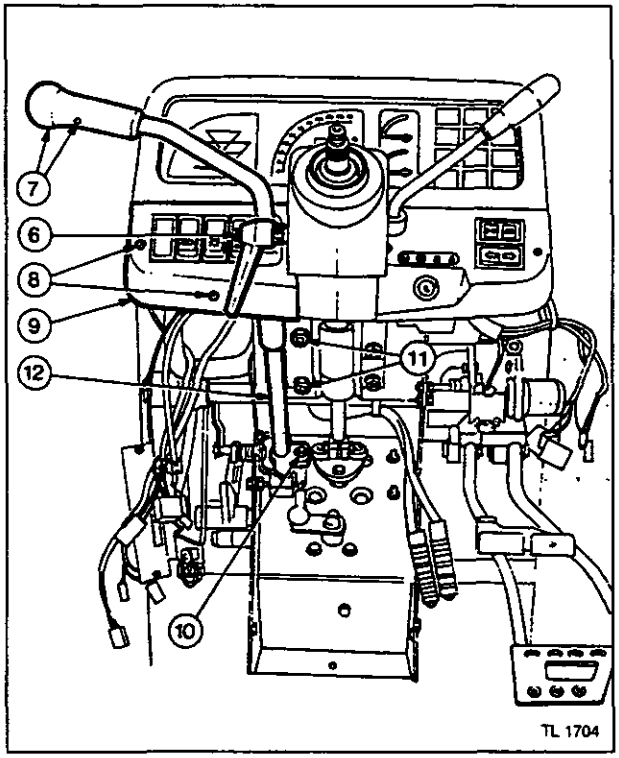
13. The relay lever can be removed by disconnecting the ball joint on top of the gearbox.
14. Remove the clamp bolt and lever at the base of the relay lever and remove.
15. Remove the relay lever.
16. Remove the bearing housing.
17. Remove the ball joints as necessary.

Clutch Interlock

18. Remove the split pins and the link between the clutch pedal and the interlock.
19. Remove the two bolts and the interlock assembly from the instrument panel support frame.

Reassembly

20. Reverse procedures 1 to 12 except:-
    a. Lubricate the shift lever bearings with engine oil.
    b. Ensure that no electrical wiring or harness rubs or touches any moving part of the linkage.
    c. When refitting the linkage between the shift lever and gearbox the following points must be observed:-
21. Put the gearbox forward/reverse lever in neutral.
22. Place the shift lever in neutral.

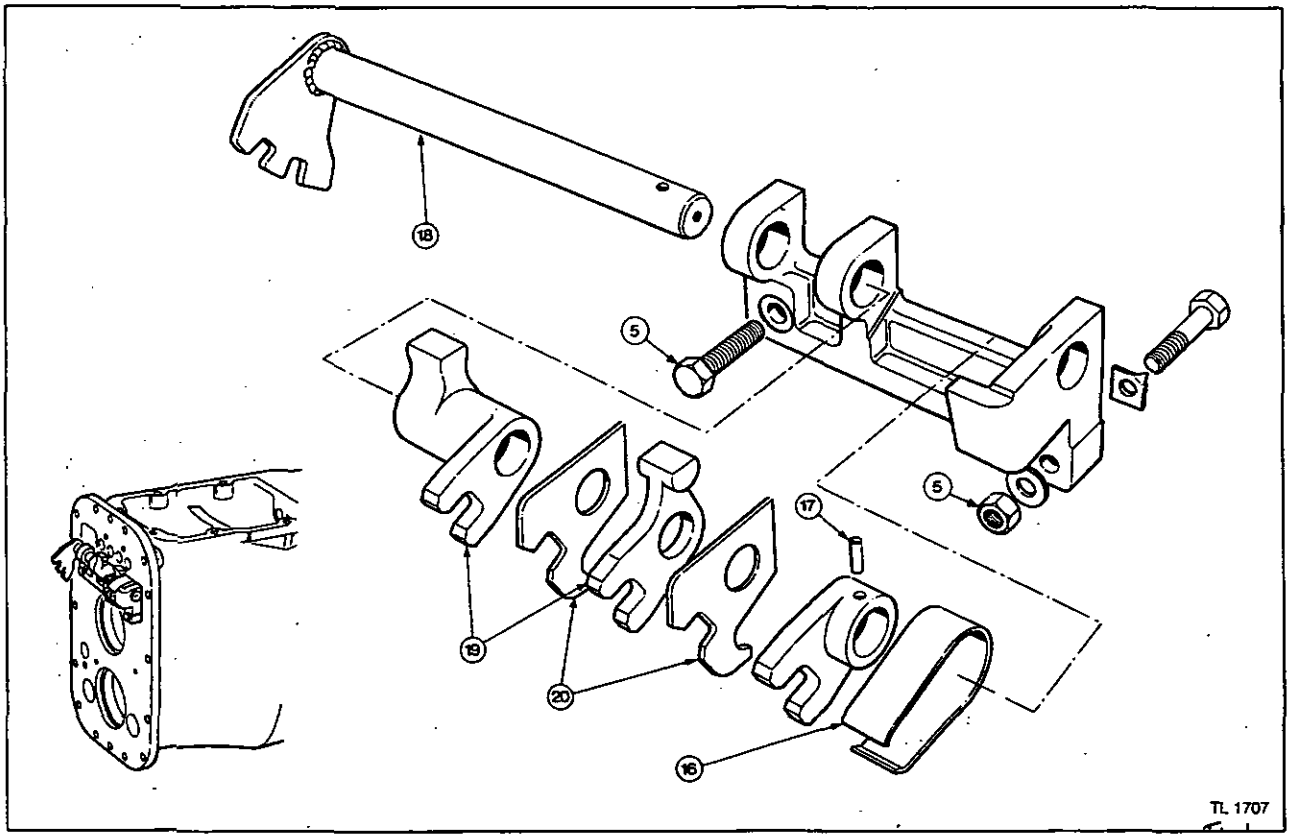


23. Ensure that the lever at the base of the shift lever is positioned as shown in the illustration, at 180^0 to the hand lever. There may be a small angular misalignment due to the positioning of the splines.
24. Adjust the length of the rods to ensure that the relay lever is at 90^0 as shown in the illustration.

Clutch interlock adjustment (see opposite page)

25. Place the forward/reverse lever in the neutral position.
26. Disengage and engage the clutch pedal. Check that the shaft assembly (A) rotates freely. If not, carry out any necessary remedial action to ensure that it operates correctly.
27. Slacken the two nuts securing the plate (B). Adjust the position of the plate (B) to a gap **'Y'** of 0,5 to 1,5 mm (0.020 to 0.060 in).
28. When the clutch pedal is in the engaged (released) position the edge of the plate (B) must be in the centre of the shaft (A). A slight misalignment is acceptable, with a minimum overlap of the shaft (A) by 3 mm (1/8 in).

12 SPEED SHUTTLE GEARBOX



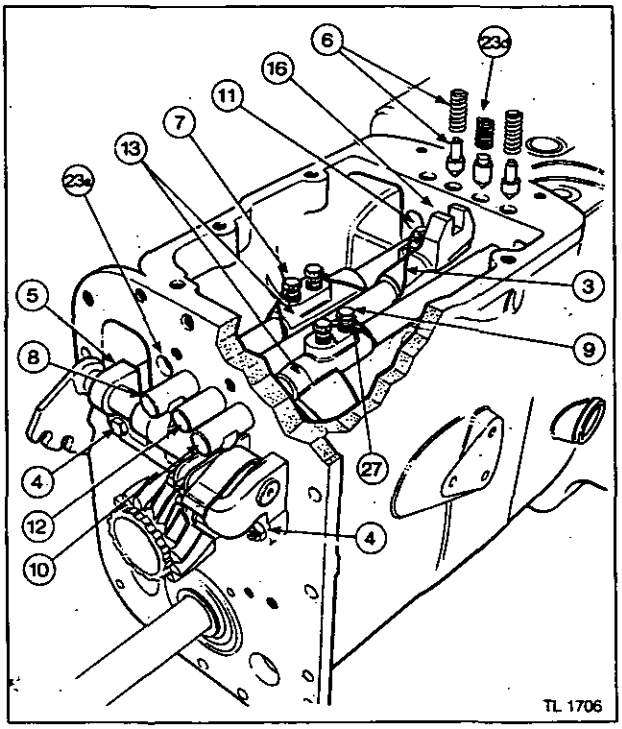
Selector Rails and Forks

Removal and Refitment 7H–05

Special tools:
MF.414 Centralising Pin and Locating Peg

Removal

1. *Remove the gearbox assembly from the tractor, see* operation 7H-01.
2. Remove the gearbox top cover, see operation 7H-02.
3. Release the locking wires.
4. Remove the bolt and nut from the rear selector mechanism.
5. Remove the selector mechanism assembly.
6. Lift out the detent springs and plungers.
7. Loosen the two locking screws.
8. Slide the 1st/2nd rail rearwards out of the housing.
9. Loosen the two locking screws.
10. Slide out the 3rd/4th rail rearwards out of the housing.
11. Loosen the two locking screws.
12. Slide the forward/reverse rail rearwards out of the housing.
13. Remove 1st/2nd and 3rd/4th selector forks.



Note: The forward/reverse selector fork can only be removed after removal of the input shaft and housing, and the reverse idler gear assembly.

To remove the forward/reverse selector fork:

14. Remove main input shaft, see operation 7H-06.
15. Remove the reverse idler assembly, see operation 7H-08, paragraph.
16. Remove the forward/reverse synchromesh selector fork.
17. If it is necessary to dismantle the selector mechanism proceed as follows:
18. Remove the selector return spring.
19. Drive out the roll pin.
20. Withdraw the range selector shaft.
21. Remove the selector levers.
22. Remove the spacer plates.

Refitment

23. Reverse procedures 1 to 20 except:
    a. The first selector shaft hole, working from left to right, in the gearbox casing is not used.
    b. Tighten the selector mechanism bolt and nut to a torque of 54-61 Nm (40-45 lbf ft).
    c. Apply a few drops of oil to the selector rails before refitment.
    d. When refitting the detent springs and plungers, the light spring and special plunger is fitted to the centre forward/reverse rail.

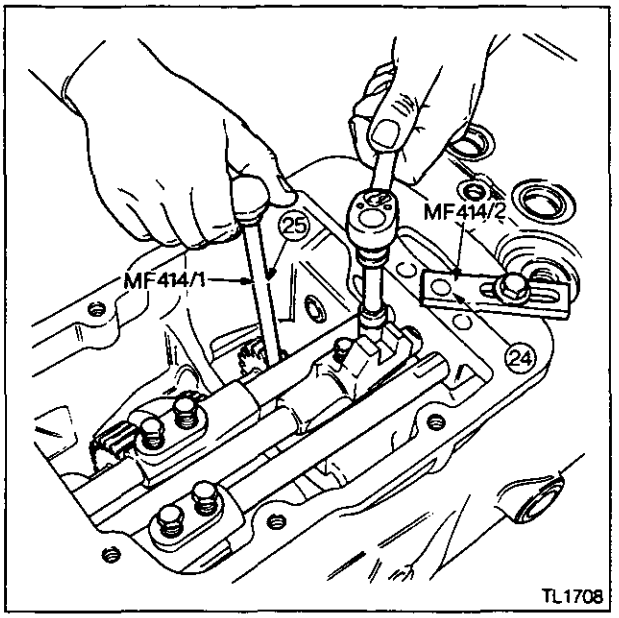
Note: The selector fork adjustment can not be carried out until the range change unit is bolted to the rear of the gearbox.

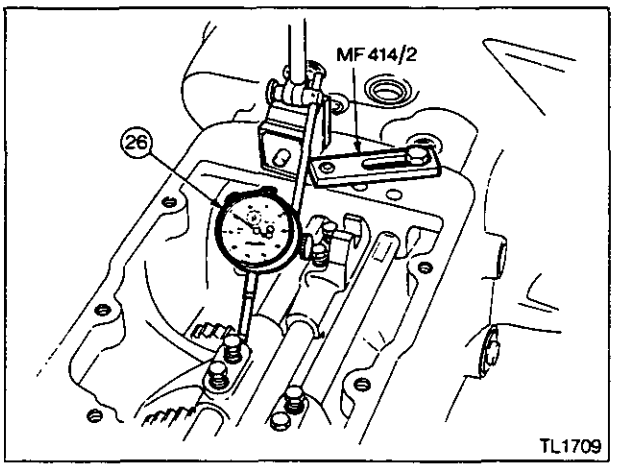
24. Set each synchromesh selector fork and rail to the neutral position. Lock the selector rails in place during the setting procedure using the plate and bolt MF414/2 (part of tool MF414).
25. Forward/reverse selector fork adjustment:

    Insert the centralising pin, MF414/1, into the hole on the top of the selector fork, lining it up with the corresponding hole in the sliding coupler and hub. Progressively lock up the two security screws on the selector fork to a torque of 34-52 Nm (25-38 lbf ft). Afterwards, check that the centralising pin MF414/1 can be removed freely. Wire-lock the security screws.
26. First/second and third/forth selector fork adjustment:

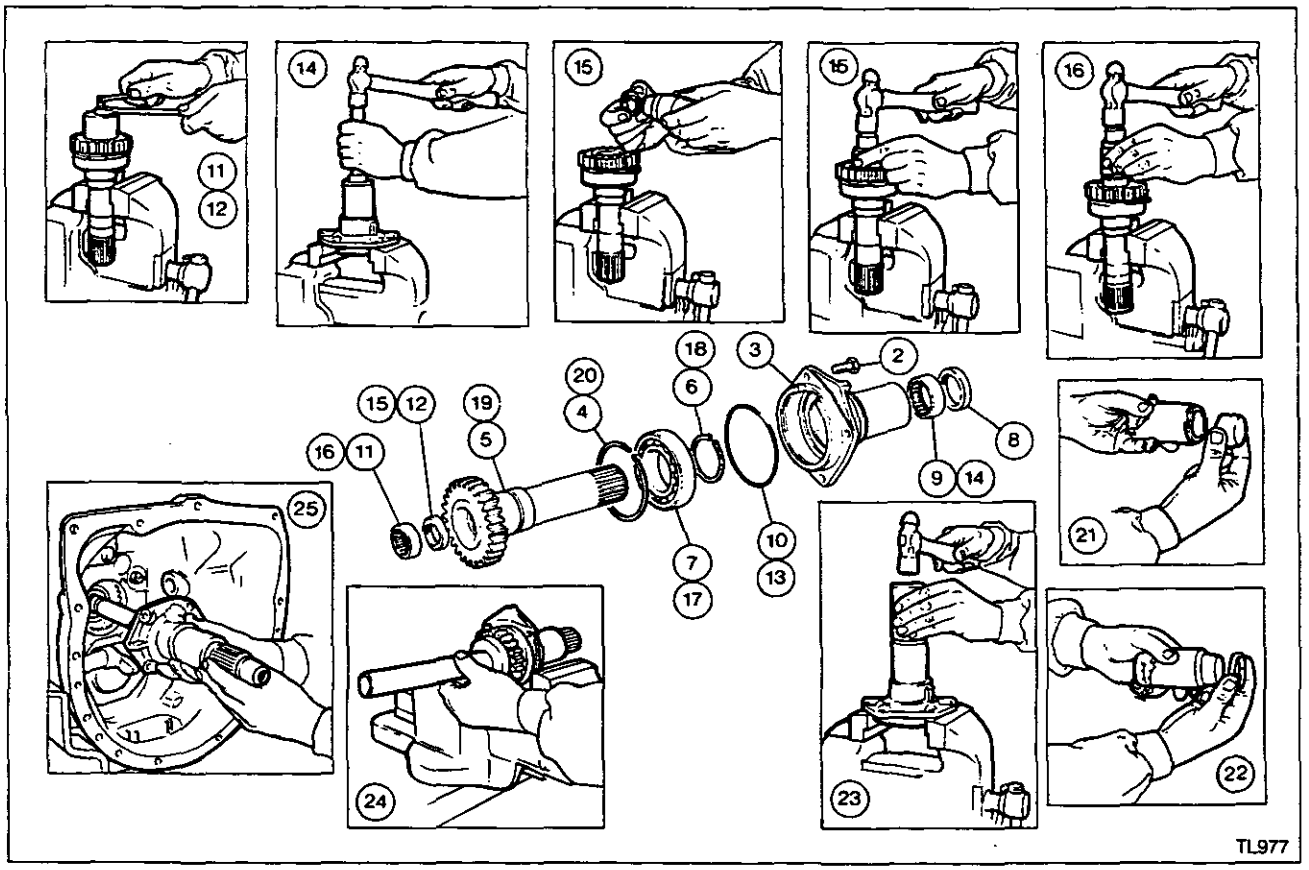
    Set up magnetic base and dial indicator, as illustrated, with the plunger located against the selector fork. With fingers pressure only slide the selector fork to the rear taking up any clearance. DO NOT engage gear. Zero the indicator gauge; slide the selector fork fully forward, taking up any clearance again and note the reading on the dial indicator.

    Halve the reading obtained and progressively lock up the two security screws on the selector fork to a torque of 34-52 Nm (25-38 lbf ft) ensuring that the selector fork is positioned to give the half reading on the dial indicator. The setting must be within 0,25 mm (0.010 in).
27. Wire-lock all the security screws.





12 SPEED SHUTTLE GEARBOX



Input Shafts and Housing

Removal and Refitment 7H-06

Special tools:

MF255B	*PTO input shaft oil seal replacer*
MF315A	*Needle roller bearing remover/replacer*
MF421	*Needle roller bearing and seal replacer*
MF422	*Needle roller bearing and oil seal remover*
MF177A or KMF1004	*Input shaft oil seal protector sleeve*

Removal

1. Remove the clutch release mechanism, see operation 6A-04.
2. Remove the four bolts.
3. Withdraw the input housing complete leaving the main input shaft in position.
4. Remove the large internal circlip.
5. Push the PTO input shaft, complete with bearing, rearwards out of the housing.
6. If necessary, remove the circlip.
7. If necessary, press the bearing off the shaft.
8. Lever the seal out of the front of the housing.
9. Using MF315A, drive the needle roller bearing from the front of the housing.
10. Remove the 'O' ring from the housing.
11. Using MF422, carefully remove the needle roller bearing from the inside of the PTO input shaft.
12. Using MF422, remove the oil seal from the PTO input shaft.

Refitment

13. Fit a new 'O' ring into the housing.
14. Using MF315A, replace the needle roller bearing in the housing.
15. Using MF421, fit a new seal into the input shaft with the lip of the seal facing the tool.
16. Using MF421, refit the needle roller bearing into the input shaft with the round end of the cage to the bottom of the recess.
17. Refit the bearing onto the outside of the shaft with the shield towards the gear teeth.
18. Refit the circlip. (Check that it is properly seated.)
19. Refit the PTO input shaft and bearing into the input housing.
20. Refit the circlip. (Check that it is properly seated.)
21. Place the nylon cone adaptor, MF255B/2, on the seal replacer, MF255B/1.
22. Place the seal over the cone and onto the tool with the seal lip facing away from the tool, remove the nylon cone.

23. Place the tool over the PTO input shaft and tap the seal into place.
24. Place seal protector sleeve MF177A or KMF1004 over the main input shaft on the gear box.
25. Carefully refit the input housing over the input shaft and withdraw the protector sleeve when the housing is in place.
26. Use petroleum jelly (not grease) to lubricate all seals and the needle roller bearing when refitting.
27. Lightly coat the bolt threads in Hylomar sealant when refitting, and tighten to a torque of 54-61 Nm (40-45 lbf ft).
28. Refit the clutch release mechanism, see operation 6A-04.

PTO Drive Shaft Front Bearing

Removal and Refitment 7H-07

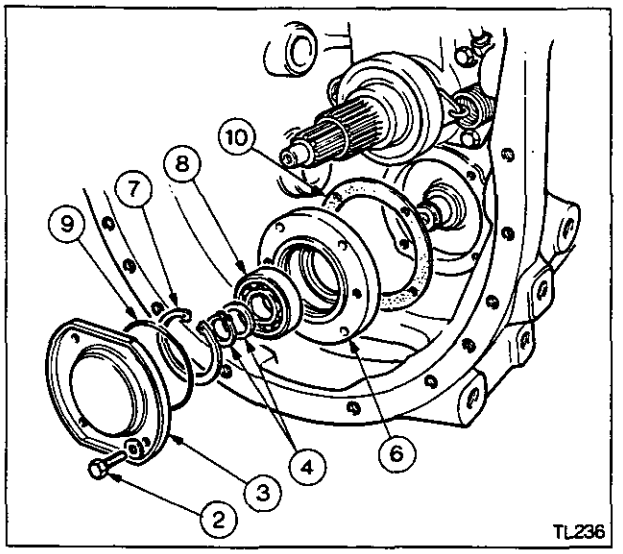
Special tools:
MF218A PTO drive shaft puller

Removal

1. Remove the cross shaft and lever, see operation 6A-04.
2. Remove the four bolts and washers.
3. Remove the cover plate.
4. Remove the external circlip and washer.
5. Screw two 3/8 UNC x 75 mm (3 in) bolts (part of special tool MF 218A) into the bearing housing and tighten them evenly to draw the housing from the case and shaft.
6. Remove the housing.
7. Discard the circlip.
8. Press out the bearing.
9. Discard the 'O' ring.
10. Discard the gasket.
11. If the gearbox has been removed and it is necessary to remove the PTO shaft, insert a 7/16 in UNF bolt approximately 75-100 mm (3-4 in) long into the shaft to protect it and drive it out of the PTO constant mesh gear.

Refitment

12. Lightly coat the gasket with Hylomar sealant.
13. Using MF218A, refit the bearing and housing assembly.
14. Check that the PTO drive shaft splines locate with those in the PTO constant mesh gear, if the shaft has been removed.
15. Screw the centre screw into the end of the PTO shaft with the aid of a 9/16 in. A/F spanner.
16. Locate the bearing and housing assembly on the end of the PTO shaft and to the housing with the two long bolts provided with MF218A through the unthreaded holes.
17. Place the adaptor onto the centre screw with the hollow face against the bearing.
18. Place the washer on the centre screw and screw on the nut.
19. Tighten the nut with an 1 1/8 in. A/F spanner until the housing is pushed home and the PTO shaft is drawn through the gear and ball bearing sufficiently to enable the washer and circlip to be fitted.



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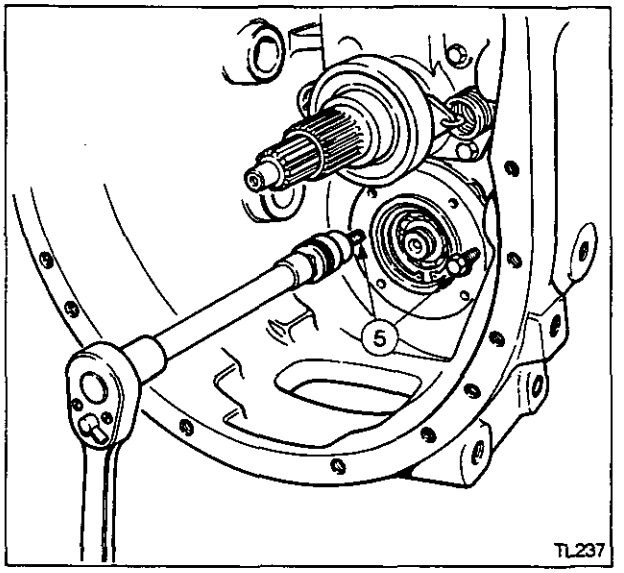

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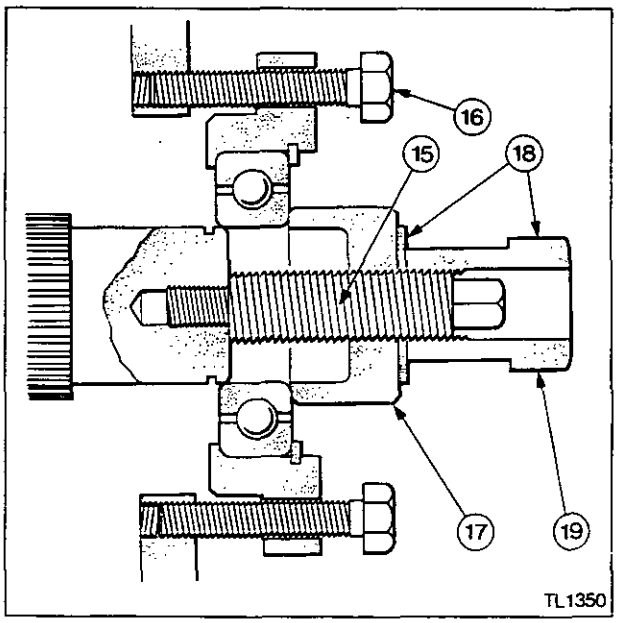

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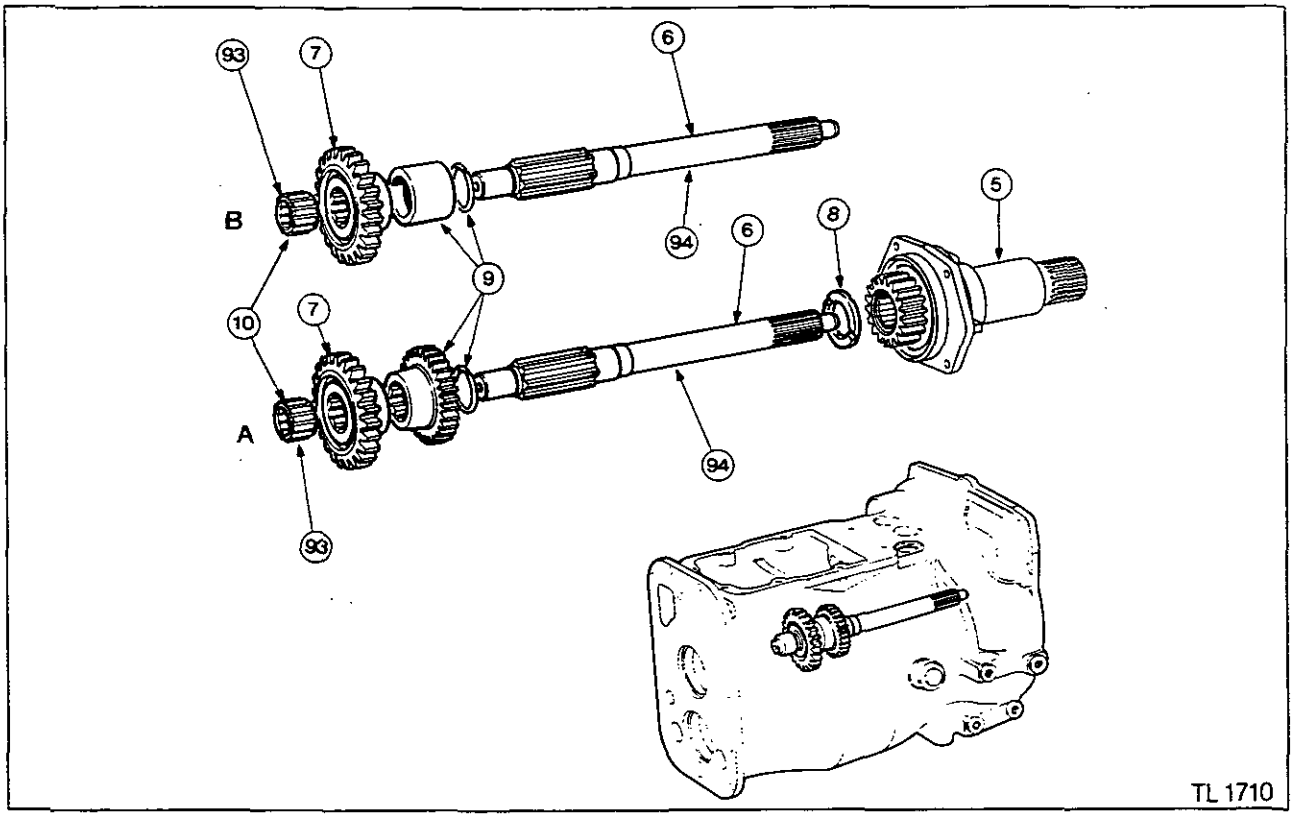
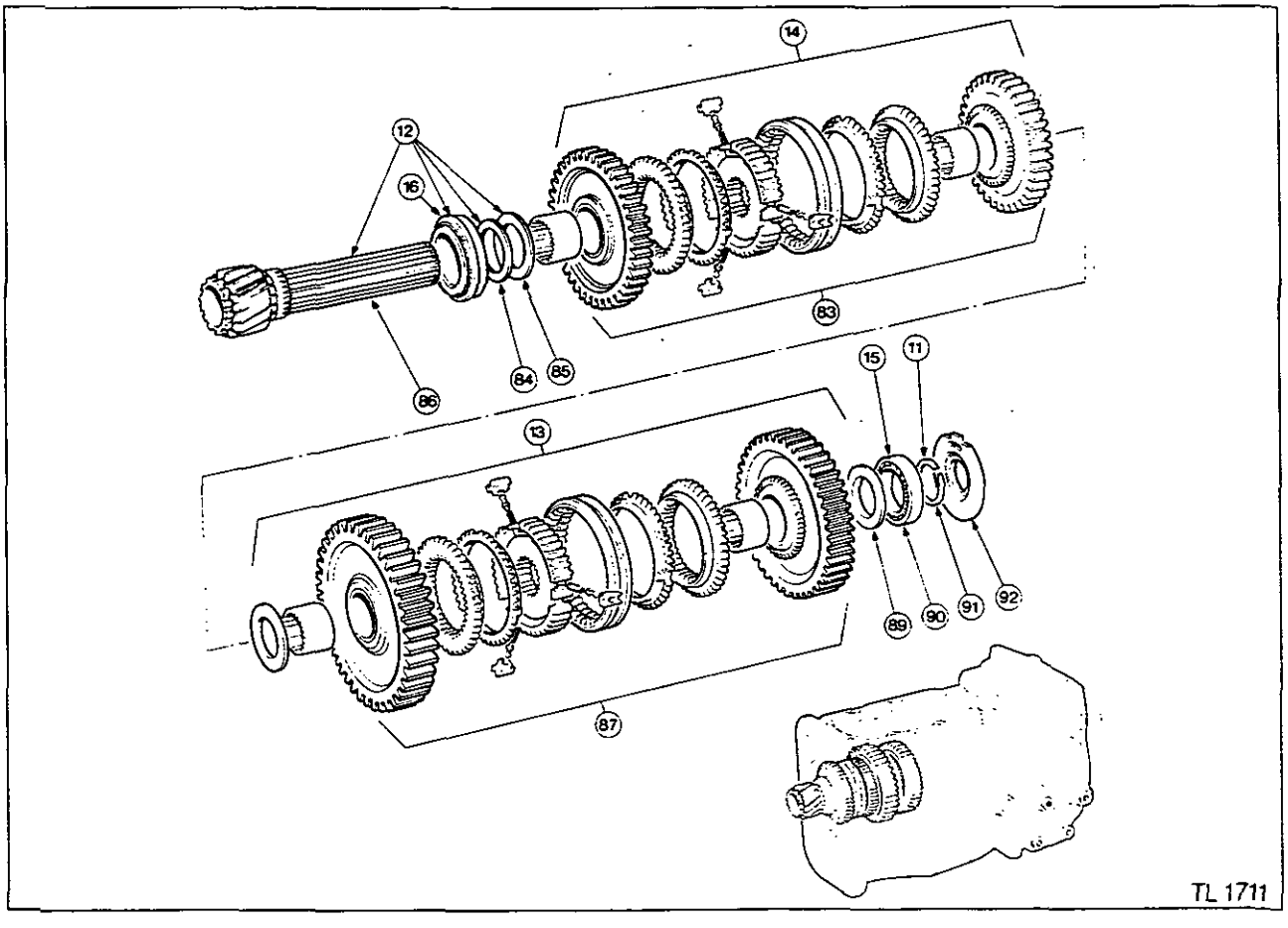
12 SPEED SHUTTLE GEARBOX





20. Fit a new circlip and washer.
21. Replace the cover with a new 'O'ring.
22. Lightly coat the securing bolt threads with Hylomar sealant.
23. Tighten the bolts to a torque of 54-61 Nm (40-45 lbf ft).

Layshaft, Mainshaft, PTO Shaft and Gears

Overhaul 7H–10

Disassembly

1. Remove the gearbox and range change unit assembly from the tractor, see operation 7H-01.
2. Split the transmission between the gearbox and range change unit, see operation 7H-01.
3. Remove the clutch release mechanism, see operation 6A-04.
4. Remove the selector rails and forks, see operation 7H-05.

Note: The layshaft selector fork (forward/reverse) cannot be removed at this stage.

Input Shafts and Housing

5. Remove the input shaft and housing assembly, see operation 7H-06.

Note: There are two types of input shaft and reverse idler assembly that can be fitted to this gearbox, either with a double input shaft gear and a single reverse gear type 'A', for tractors up to M-F 390 with 30 km/hr transmission. Or a single input shaft gear and double reverse gear arrangement type 'B', this is used on M-F 398 and 399 tractors with 30 km/hr transmission and all models with 40 km/hr transmission.

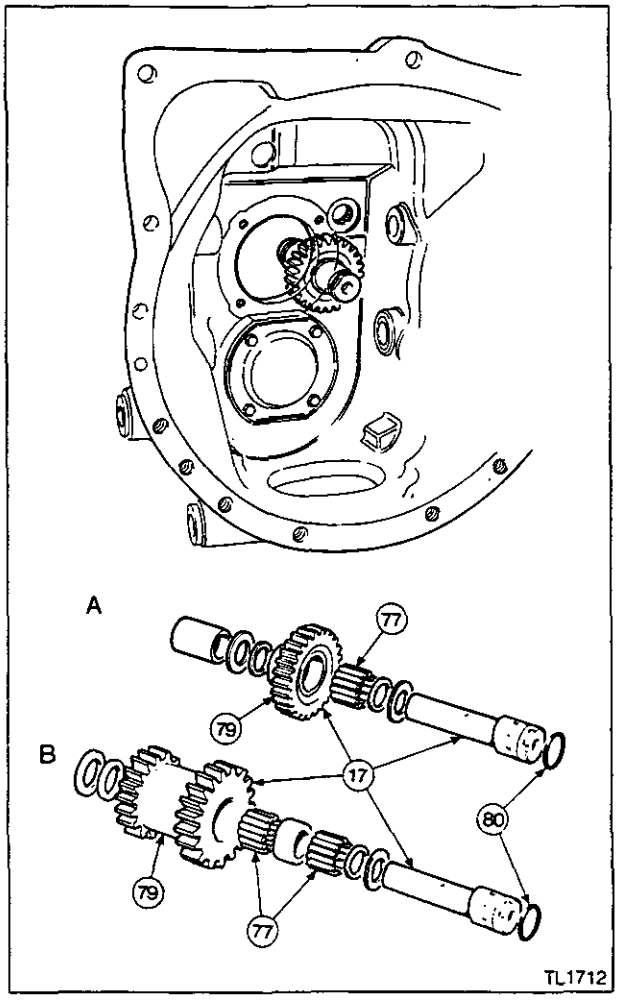
6. Withdraw the main input shaft and housing assembly leaving the forward gear in the gearbox.
7. Lift out the forward constant mesh gear.
8. Remove the main thrust washer, if necessary.
9. Remove the snap ring, thrust washer and reverse gear or spacer from the main input shaft, if necessary.
10. Remove the needle roller bearing from inside the main shaft.

Mainshaft

11. Remove the circlip from the front of the main shaft.
12. Pull the main shaft out of the gearbox to the rear with the rear thrust washer and spacer.
13. Lift out the 1st/2nd gear set and the measured thrust washer.
14. Lift out the rear 3rd/4th gear set assembly.
15. Remove the front roller bearing from the gearbox case.
16. Press the rear taper roller bearing off the main shaft, if necessary.

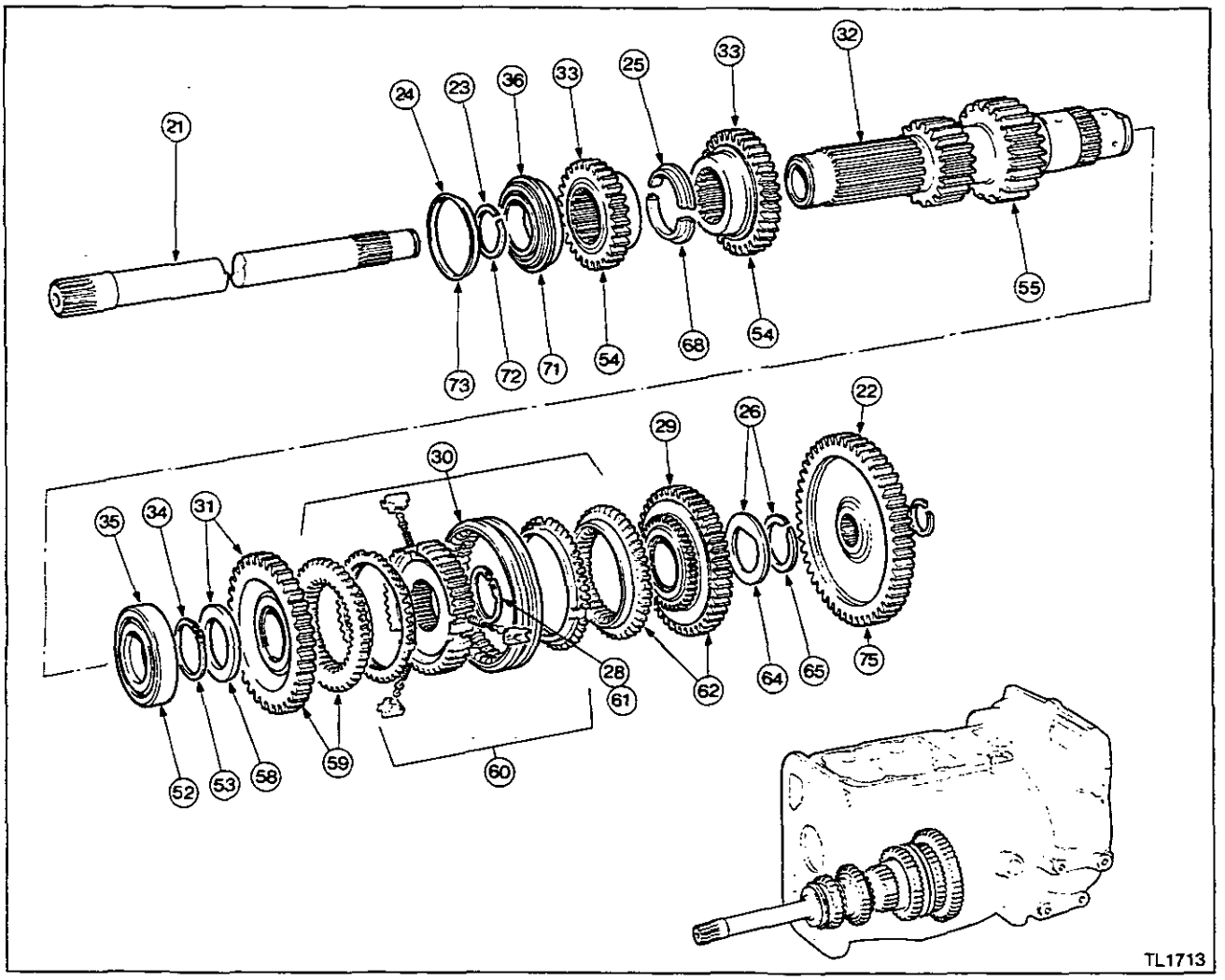
Reverse Idler

17. Remove the reverse idler shaft by tapping the shaft forward from the inside of the gearbox and lifting out the gear, thrust washers and spacers. Be careful, the idler gear contains loose needle roller bearings. Retain the components in a clean container.



Layshaft

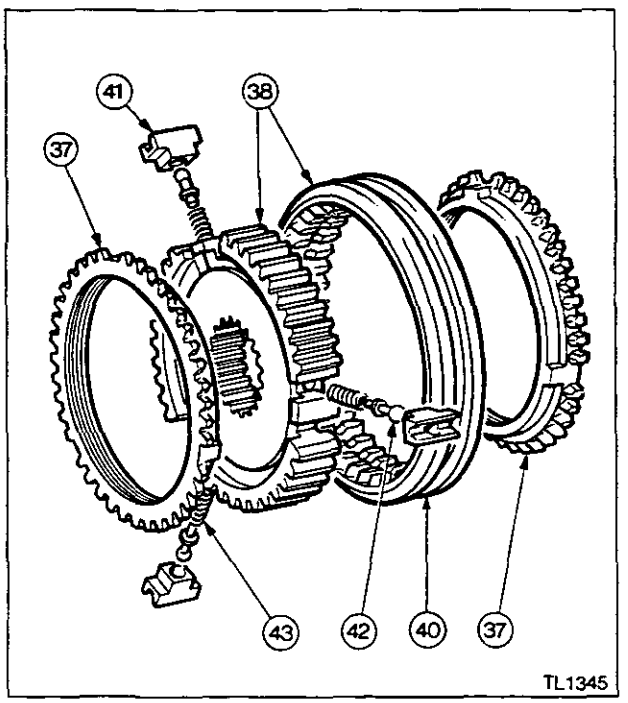
18. Remove the PTO drive shaft front bearing cover.
19. Remove the the PTO shaft circlip and thrust washer.
20. Remove the PTO drive shaft front bearing, see operation 7H-07.
21. Screw a 7/16 in. UNF bolt approximately 75-100 mm (3-4 in.) long into the end of the PTO shaft to protect it and drive it out of the PTO constant mesh gear and layshaft.
22. Lift out the PTO constant mesh gear.
23. Remove the snap ring from the rear of the layshaft.
24. Remove the spring ring from the rear layshaft bearing.
25. Drive the layshaft forwards and remove the two split rings between 3rd and 4th gear.
26. Remove the snap ring and thrust washer from the front of the layshaft.
27. Push the layshaft rearwards as far as possible.
28. Slide the reverse constant mesh gear fully forward. Remove the circlip with a pair of right angled circlip pliers from the front of the synchromesh hub. Slide the circlip as far forward along the layshaft as possible.
29. Push the layshaft rearwards as far as it will go and lift the reverse gear out through the top of the gearbox leaving the brass baulk ring on the synchromesh hub.



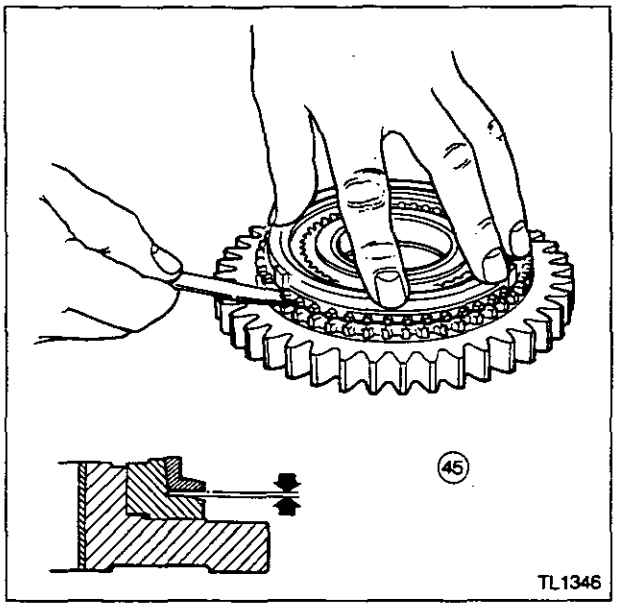
30. Remove the circlip and the synchromesh hub assembly with the two brass baulk rings.
31. Remove the forward gear and thrust washer.
32. Remove the layshaft by pushing it out through the front of the gearbox.
33. Lift out the fourth and third gears.
34. Remove the circlip.
35. Press the front layshaft bearing off the shaft, if necessary.
36. Remove the rear bearing from the casing.

Synchromesh Hub Assemblies

37. Remove the two baulk rings.
38. Remove the drive hub complete with the sliding coupler.
39. Wrap the hub and coupler in a cloth.
40. Remove the sliding coupler, taking care not to lose pressure springs, ball pins and blocks.
41. Remove the three pressure blocks.
42. Remove the three ball pins.
43. Remove the three pressure springs.
44. Thoroughly clean all the components and check their condition.



45. Using a feeler gauge, measure the clearance between the baulk ring and the synchro cone at several points. The baulk ring must be correctly positioned on the tapered part of the synchro cone. If the average clearance is less than 0,5 mm (0.020 in), replace the brass baulk ring. If the clearance is checked with the gearbox assembled, replace the baulk ring if the clearance is found to be less than 0,8 mm (0.30 in).



Examination

46. Clean and thoroughly inspect all parts for signs of wear or damage and replace if necessary. Renew all snap rings, circlips and 'O' rings; when refitting ensure that they are correctly located in their grooves.

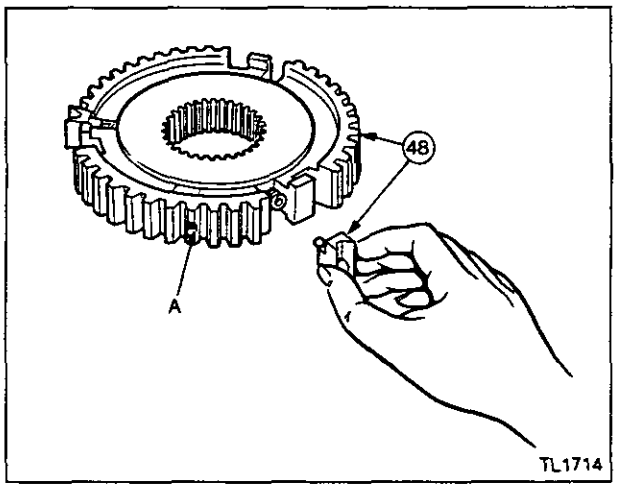
Reassembly

Synchromesh Hub Assemblies

47. Reverse procedures 37 to 43.
48. Place the hub on the work bench and insert the three springs, ball pins and pressure blocks.
49. Place the sliding coupler over the hub ensuring that the double width splines in the coupler are opposite the slots in the hub.

Note: On the forward/reverse synchromesh assembly ensure that the hole 'A' in the coupler is fitted in line with the hole in the hub, it is used to align the selector fork to the selector rail.

50. Press the coupler down into place easing the spring loaded blocks into position.
51. Position the brass baulk rings so that the locating blocks fit into the slots in the hub. Use petroleum jelly to retain the components in position.



Layshaft

52. Press the front roller bearing onto the shaft, if removed.
53. Fit the front roller bearing circlip.
54. Place the fourth (33T) and third (28T) gears in the bottom of the gearbox, the smaller gear is fitted to the rear.
55. Pass the layshaft through the front of the gearbox so that the roller bearing is in the first section.
56. Fit the forth and third layshaft gears.
57. Push the layshaft rearwards so that the roller bearing is in the centre web and the shaft is fully rearwards.
58. Refit the thrust washer at the front of the shaft.
59. Refit the the forward gear and synchro cone.
60. Refit the synchromesh hub complete with brass baulk rings.
61. Place the circlip on the unsplined portion of the shaft close up to the synchromesh hub.

Note: Circlips must be fitted the correct way round to aid in removal. The two holes in the clip are tapered, the small side must be on the outside.

62. Refit the reverse gear and synchro cone.
63. Push the layshaft forward holding the reverse gear set so that it pushes the circlip between the reverse gear and hub into its grove.

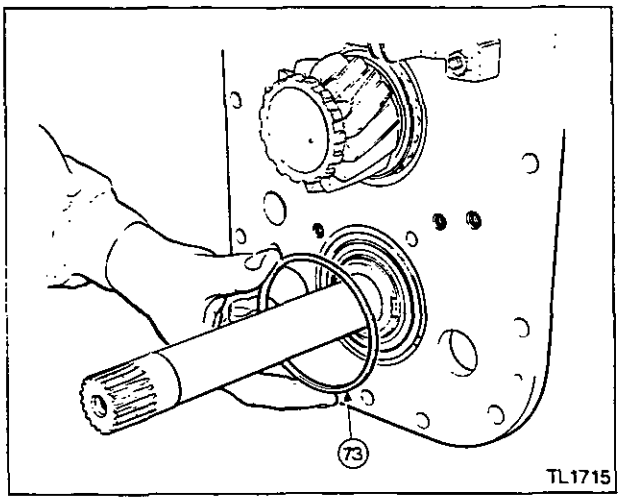
Caution: Check that the circlip between the reverse gear and the synchromesh hub is correctly seated in its groove.

64. Refit the thrust washer locating the internal flat on the flat on the shaft.
65. Replace the thick snap ring.

Note: Snap rings must be fitted the correct way round to aid removal. The cut ends are tapered, the narrow gap must face outwards.

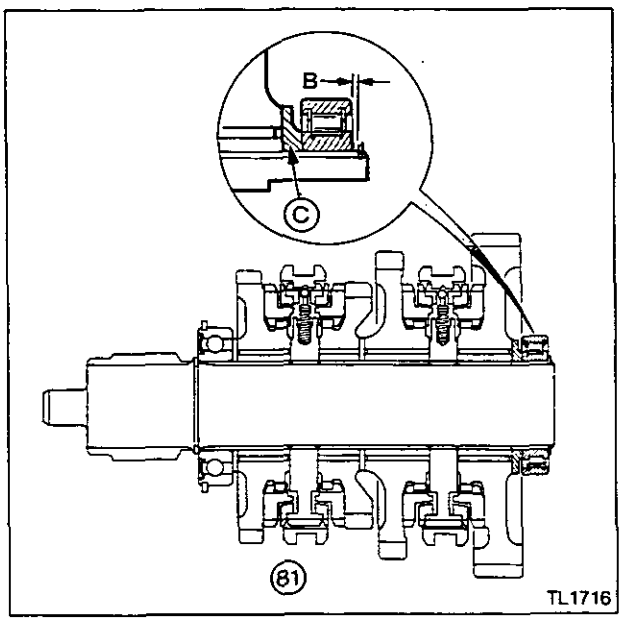
66. Check that both forward and reverse gears are free to rotate.
67. Move the shaft forward.
68. Refit the two split rings between 3rd and 4th gears using some petroleum jelly to hold them in place.
69. Move the shaft rearwards.

70. Place a block of wood between the front of the layshaft and the gearbox casing.
71. Drive the rear roller bearing onto the end of the shaft and into the gearbox casing.
72. Remove the block and replace the rear thin snap ring.
73. Fit the rear bearing retainer spring ring.
74. Ensure that the shaft is fully forward and check that the layshaft turns freely.
75. Place the PTO constant mesh gear in the bottom of the gearbox and refit the PTO shaft from the rear of the gearbox.
76. Refit the PTO front bearing housing, see operation 7G-09.
77. Locate the forward/reverse selector fork into the coupler of the layshaft synchromesh assembly.



Reverse Idler

78. Replace the rollers in the reverse idler pinion, a smear of petroleum jelly (not grease) will help retain them. There is a single or double row of 23 rollers with a spacer ring each side depending on the type of reverse idler fitted.
79. Refit the reverse idler into the gearbox with a thrust washer each side of the gear and a spacer in the case of the single gear arrangement.
80. Renew the 'O' ring on the idler shaft and enter from the bell housing end, align the cut away portion on the front of the idler shaft to allow fitment of the input housing. The oil hole will be at the top visible inside the case.

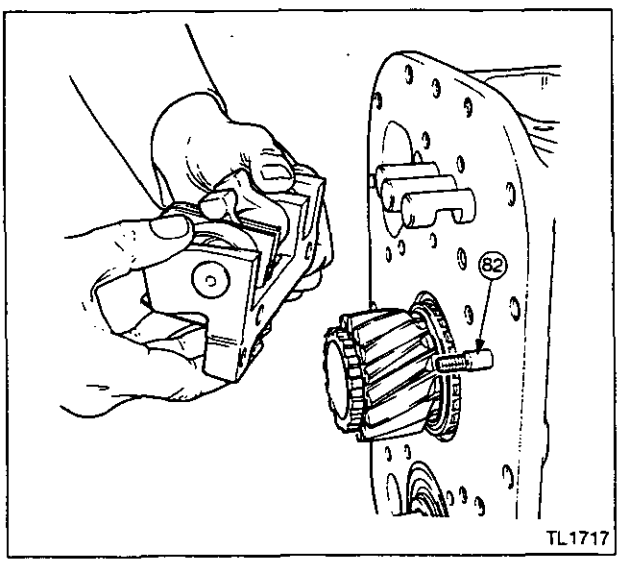


Mainshaft

81. Assemble the mainshaft complete with all hubs, gears, bushes, bearing and thrust washers. Refit circlip. Measure the gap 'B' between the front bearing and the circlip. The gap (end float) should be between 0,080 mm (0.003 in) and 0,30 mm (0.012 in). If your measurement falls outside the set limits, replace the calibrated thrust washer 'C', which sits between the bearing and first gear, with one of a choice of varying thickness thrust washers to achieve the desired end float. Calibrated thrust washer part numbers and sizes are as follows:

Thrust Washer Chart		
MF Part No	Thickness mm	Thickness in
3599 299 M1	3,38-3,43	0.133-0.135
3598 644 M1	3,63-3,68	0.143-0.145
3598 643 M1	3,89-3,94	0.153-0.155
1671 888 M2	4,14-4,19	0.163-0.165

82. Ensure that the selector mechanism dowel bolt is in place, use Loctite 222 to retain it.
83. Assemble the third (40T) and fourth (36T) gear pack with the synchromesh hub and steel bushes, lower the assembly down into the box with the third gear (largest) to the rear, rest the gear pack on the layshaft gears.
84. Place the steel spacer on the main shaft.

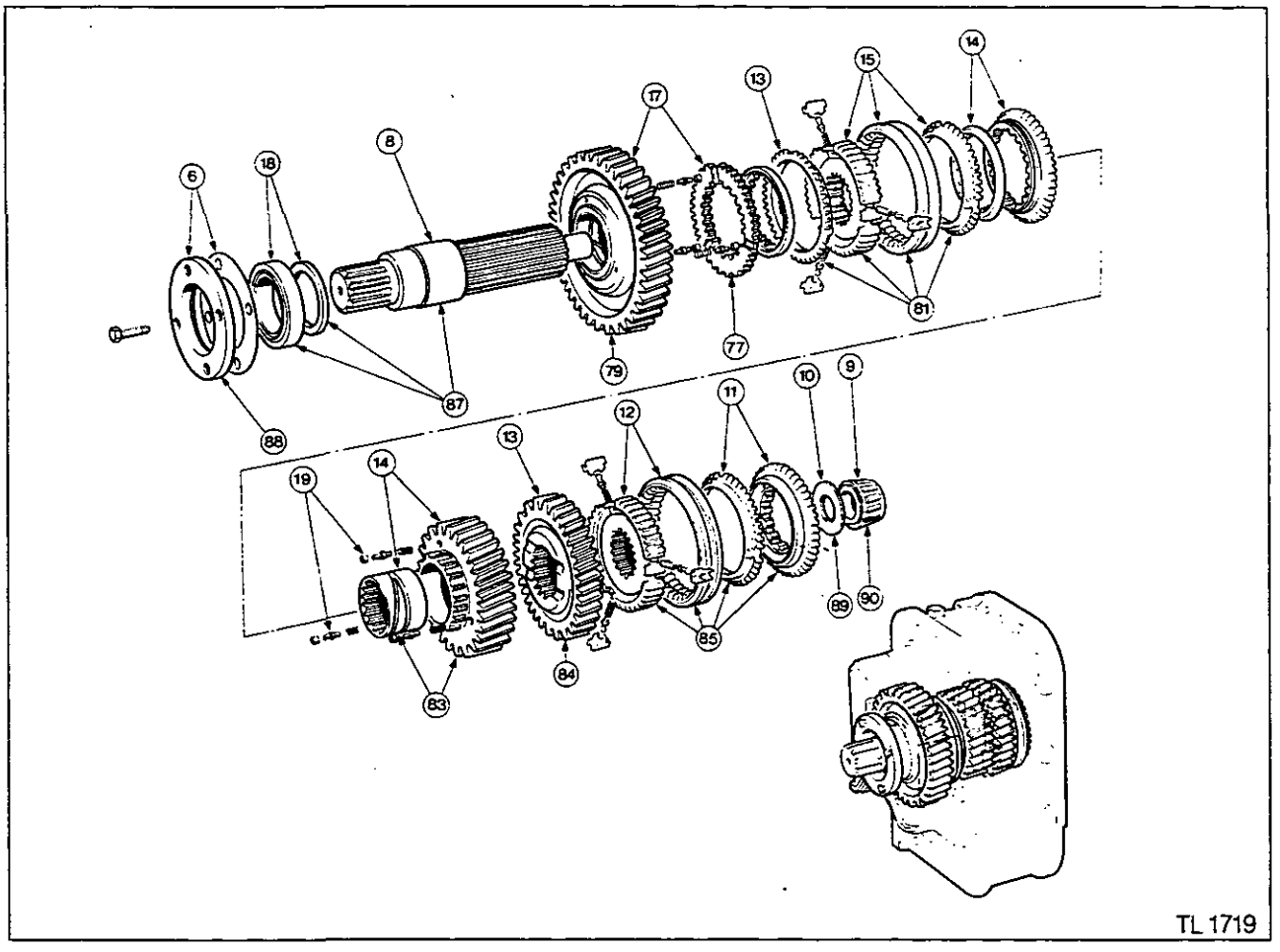


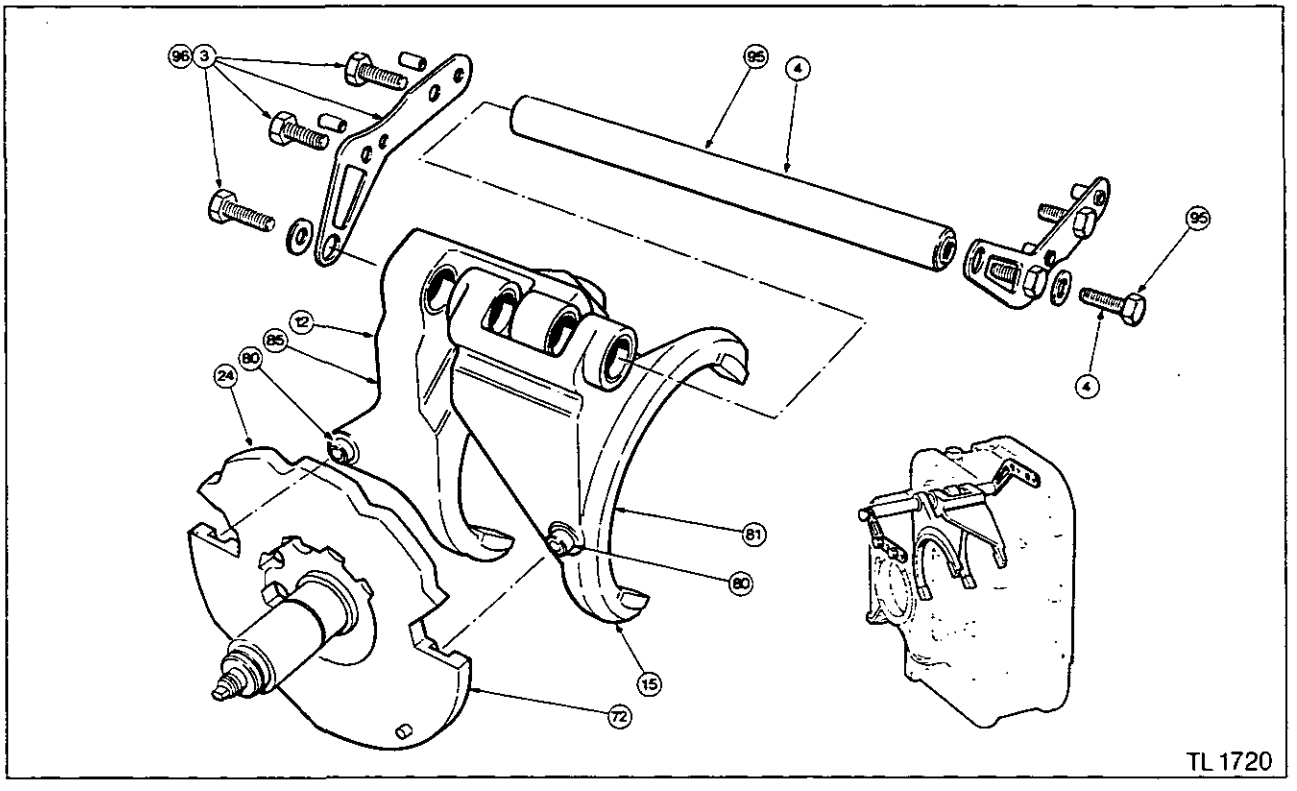
85. Place the thrust washer on the main shaft.
86. Slide the mainshaft through the rear of the gearbox and the third/forth gear pack.
87. Assemble the first (49T) and second (45T) gear pack with the synchromesh hub and steel bushes and lower the assembly down into the box with the first gear (largest) to the rear, rest the gear pack on the layshaft gears.
88. Push the shaft right through the 1st/2nd gear pack.
89. Fit the preselected calibrated thrust washer with the large flat side towards second gear.
90. Hold the mainshaft and drive the front roller bearing into position in the centre web of the gearbox.
91. Replace the circlip.
92. Locate the tagged thrust washer in the gearbox centre web with the convex side facing forwards.

Input Shafts and Housing

93. Refit the needle roller bearing into the front of the mainshaft.
94. Hold the forward constant mesh gear in the gearbox and refit the transmission input shaft and housing assembly complete with reverse gear or spacer, see operation 7H-06.
95. Refit the selector forks and rails, see operation 7H-05.
96. Refit the clutch release mechanism, see operation 6A-04.
97. Refit the range change gearbox and set the selector forks and main shaft preload settings as necessary.
98. If the main shaft and/or rear taper roller bearing have been changed it will be necessary to reset the upper range change unit bearing pre-load, see operation 7H-10.
99. Refit the gearbox to the tractor, see section 2 and operation 7H-01.

12 SPEED SHUTTLE GEARBOX





Range Change Unit Shafts & Gears

Overhaul 7H-09

Special tools:
MF476 Bearing remover/replacer
MF477 Gear set support tool

Disassembly

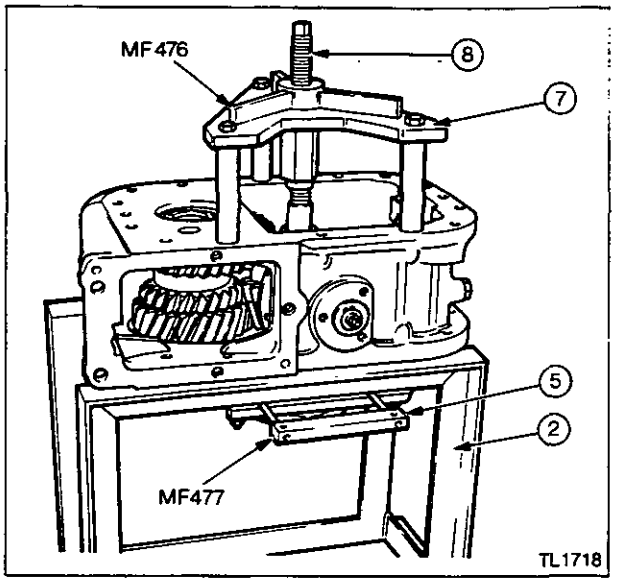
1. Remove the transmission from the tractor, see operation 7H-01.
2. Remove the range change unit from the gearbox and place on a suitable work bench. It would be beneficial to make a small stand to support the gearbox approximately 380 mm (15 in) high, 460 mm (18 in) long and 222 mm (8 3/4 in) wide between the supports as shown in the illustration.

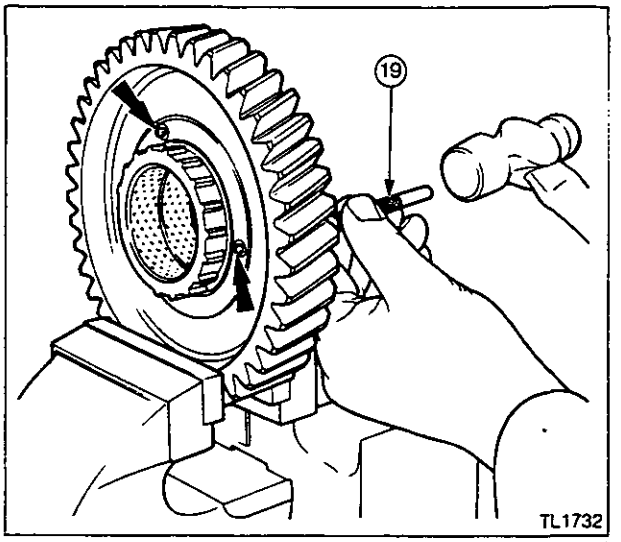
Upper Shaft and Selector Forks

3. Remove the three bolts from the front selector rail support bracket and remove the bracket.
4. Remove the bolt from the rear of the selector rail and withdraw the rail from the selector forks.
5. Place special tool MF477 between the rear casing and low range gear on the upper shaft. This tool will support the gears in their operating position and prevent damage to the selector fork roller and pin.
6. Remove the upper shaft rear bearing cap and shims.

Caution: Under no circumstance is the taper roller bearing item 9 to be removed or fitted to the upper shaft with a hammer and punch. Damage to the bearing will result in a seizure of the gearbox and extensive failure of many of the components. Special tool MF476 has been developed to make the dismantling and assembly of the range change unit safe, quick and easy.

7. *Bolt special tool MF476 over the upper shaft as* shown in the illustration.
8. Screw down the hand press onto the upper shaft and press the shaft out of the small taper roller bearing, DO NOT allow the shaft to fall onto the floor.
9. Remove the taper roller bearing.
10. Remove the thrust washer.
11. Remove the high range synchro cone and baulk ring.
12. Remove the high range synchromesh hub assembly and selector fork complete with guide roller.
13. Remove the four wheel drive pinion.
14. Remove the medium speed range gear complete with synchro cone and bush.
15. Remove the low/medium range synchromesh hub assembly and selector fork complete with guide roller.
16. Remove special tool MF477.
17. Remove the low range gear complete with synchro cone.



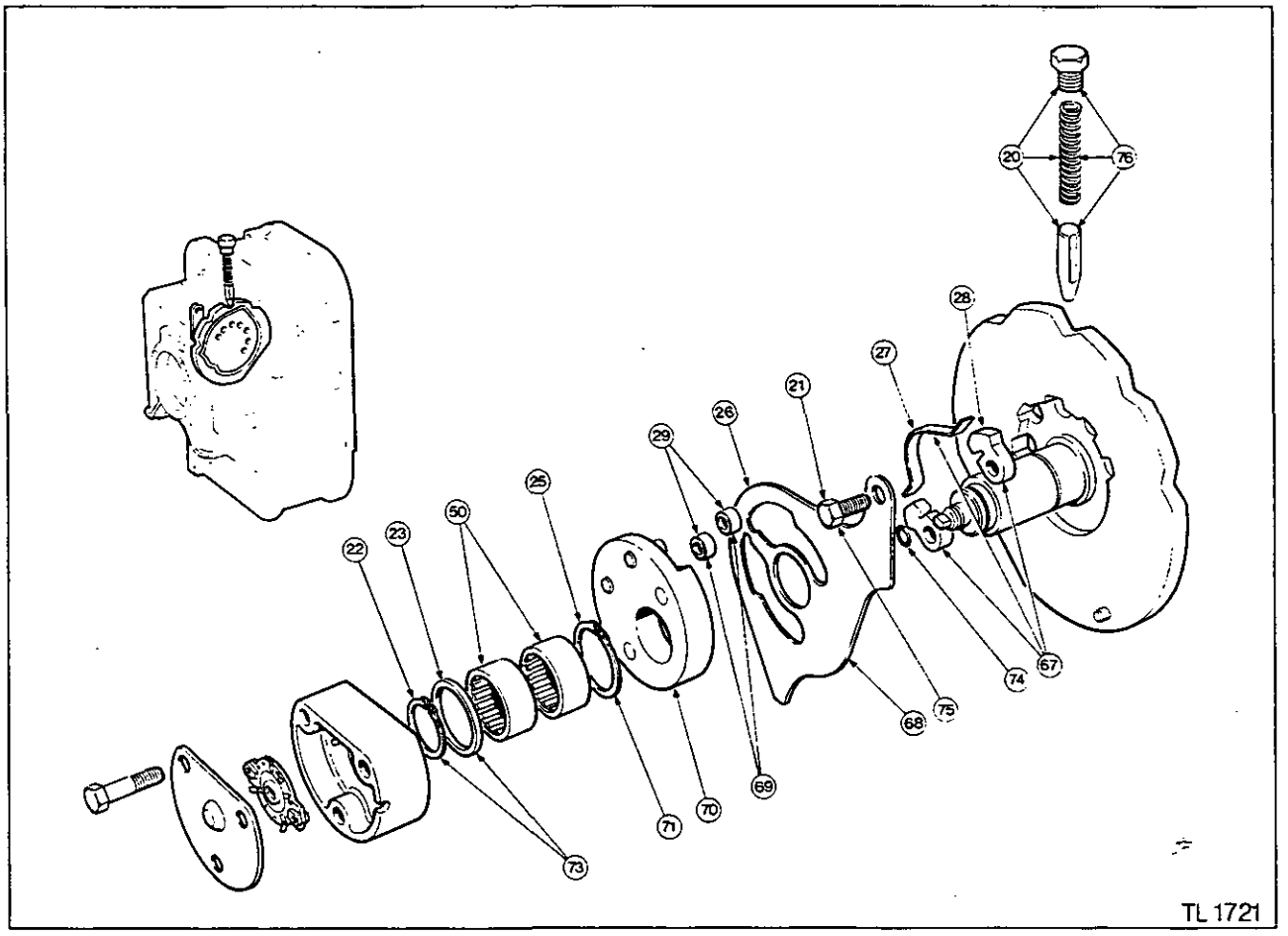


18. If necessary, the rear taper roller bearing and thrust washer can be pressed off the shaft.
19. Check the operation of the spring loaded synchro cone alignment pins, if damaged, they can be removed with a hammer and punch through the rear face of the gear. This applies to both medium and low gears.

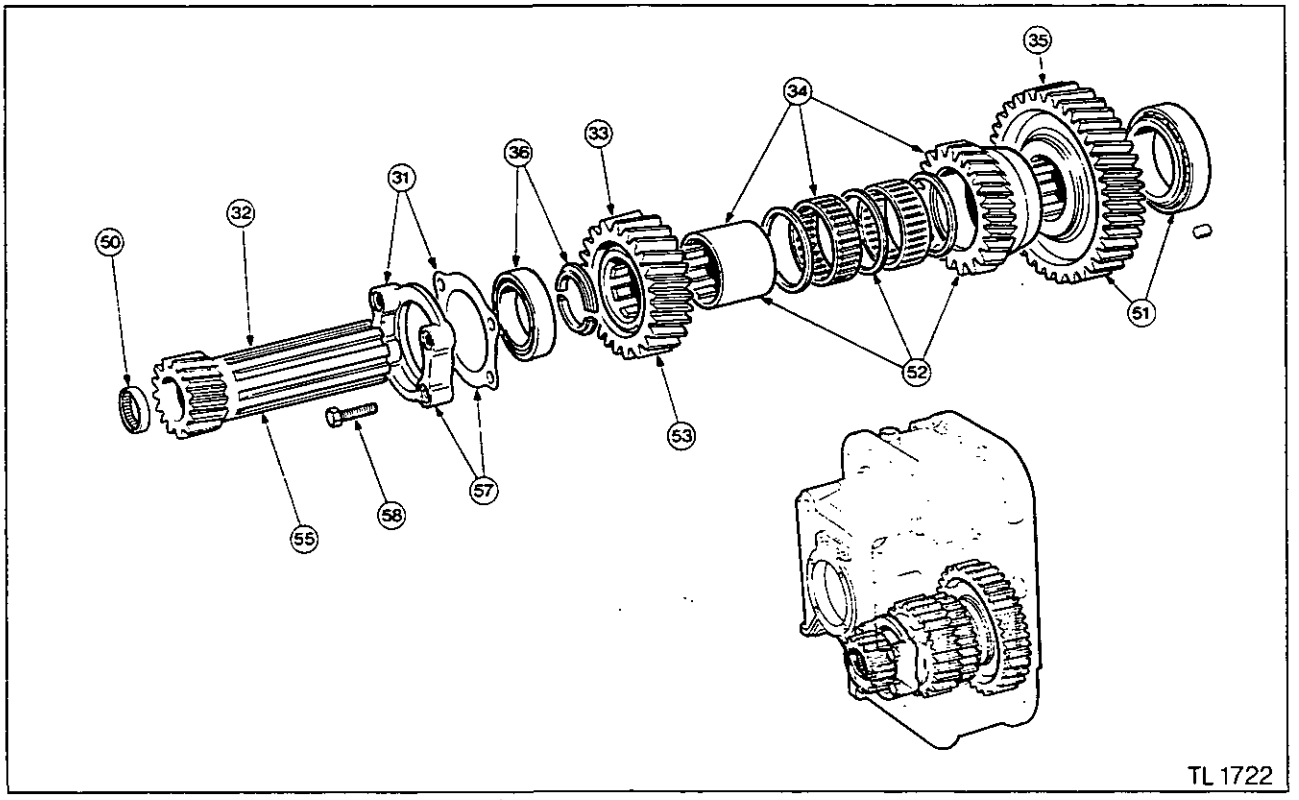
Selector Cam Assembly

20. Remove the cam plate detent plunger and spring.
21. Remove the bolt from the cam spring plate.
22. Remove the circlip.
23. Remove the thrust washer.
24. Remove the cam plate assembly from the inside of the box.
25. If necessary, remove the circlip and remove the cam ratchet assembly.
26. Remove the spring plate.
27. Remove the spring
28. Remove the pawls.
29. Remove the selector lever rollers.

12 SPEED SHUTTLE GEARBOX



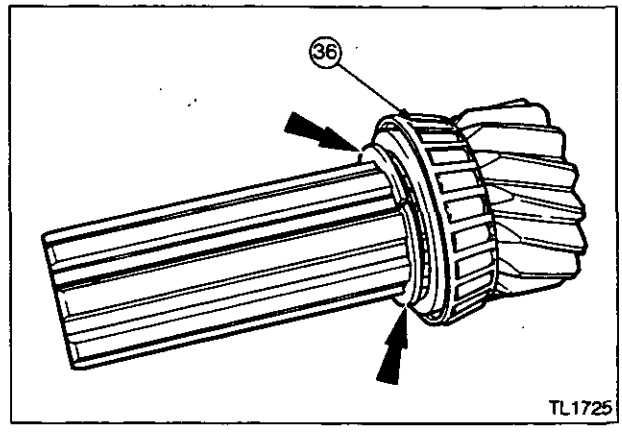
TL 1721



TL 1722

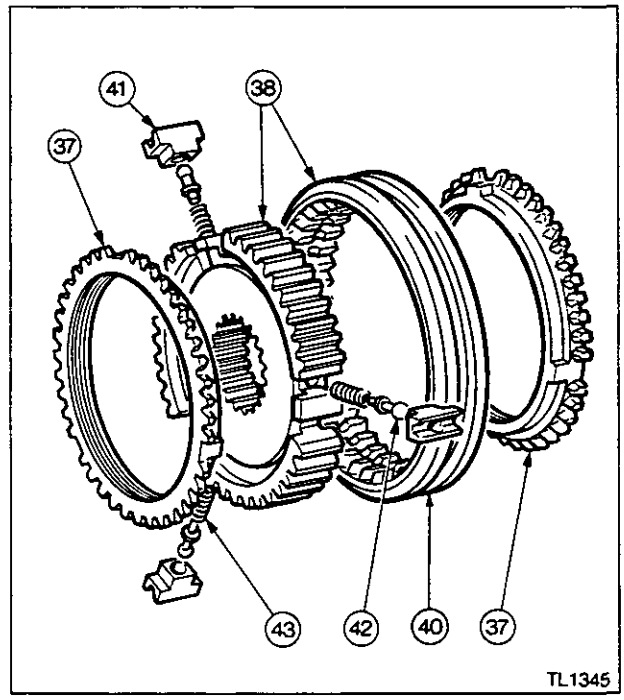
Lower Shaft

30. Turn the gearbox over.
31. Remove the lower shaft bearing cap bolts, cap and shims.
32. Pull the lower shaft and thrust washer out of the gearbox.
33. Remove the medium range gear.
34. Remove the four wheel drive gear complete with needle roller bearings and sleeve.
35. Remove the constant mesh gear.
36. Remove taper and needle roller bearings as necessary. To remove the taper roller bearing behind the low range gear it will be necessary to press the bearing towards the gear to remove the two split retaining rings.



Synchromesh Hub Assemblies

37. Remove the two baulk rings.
38. Remove the drive hub complete with the sliding coupler.
39. Wrap the hub and coupler in a cloth.
40. Remove the sliding coupler, taking care not to lose pressure springs, ball pins and blocks.
41. Remove the three pressure blocks.
42. Remove the three ball pins.
43. Remove the three pressure springs.
44. Thoroughly clean all the components and check their condition.
45. Using a feeler gauge, measure the clearance between the baulk ring and the synchro cone at several points. The bulk ring must be correctly positioned on the tapered part of the synchro cone. If the average clearance is less than 0,5 mm (0.020 in), replace the brass baulk ring.



Examination

Clean and carefully examine all the components, replace any that show signs of damage or wear. Replace all 'O' rings and circlips. Ensure that all circlips are fitted correctly in their grooves.

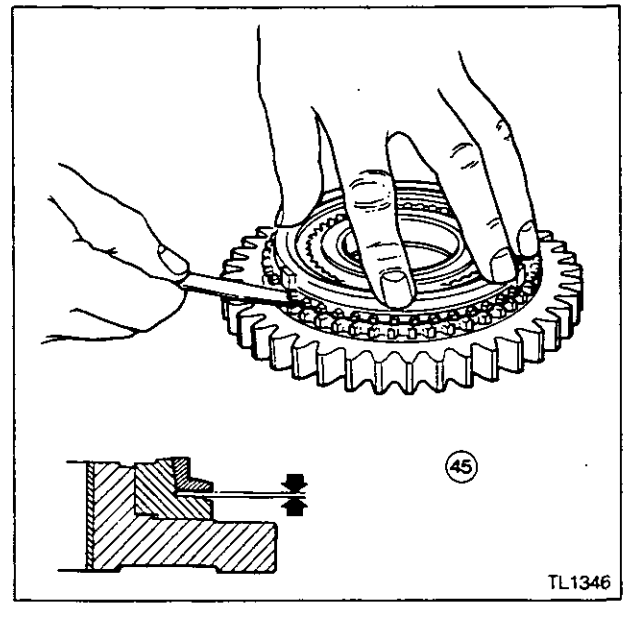
Reassembly

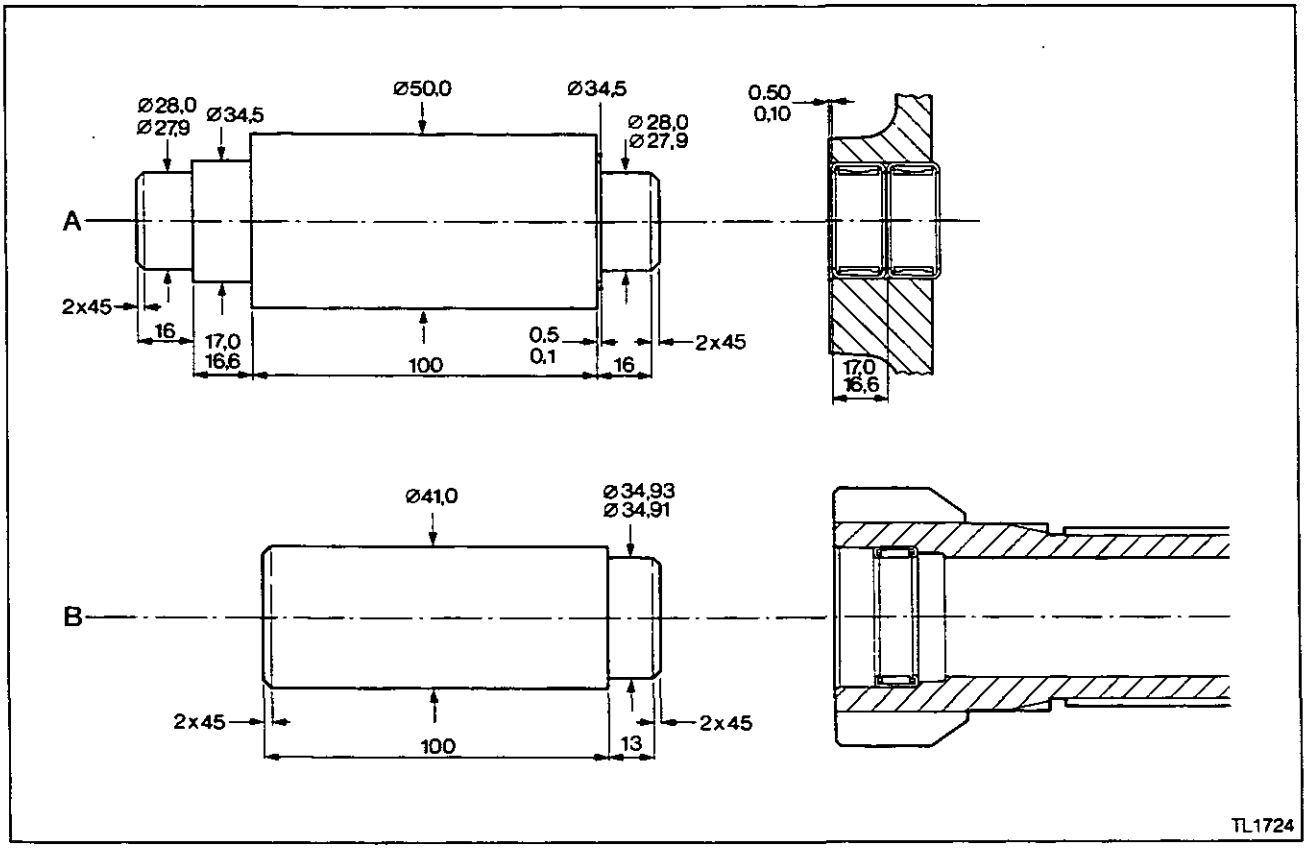
Synchromesh Hub Assemblies

46. Place the hub on the work bench and insert the three springs, ball pins and pressure blocks.
47. Place the sliding coupler over the hub ensuring that the double width splines in the coupler are opposite the slots in the hub.
48. Press the coupler down into place easing the spring loaded blocks into position.

Lower Shaft

49. Place the range change unit casing on the work stand, on it's front face with the lower shaft taper roller bearing cup in place.
50. Replace, if necessary, the needle roller bearings in the gearbox casing or the end of the lower shaft. Make a tool as shown in the illustration to install the bearings.

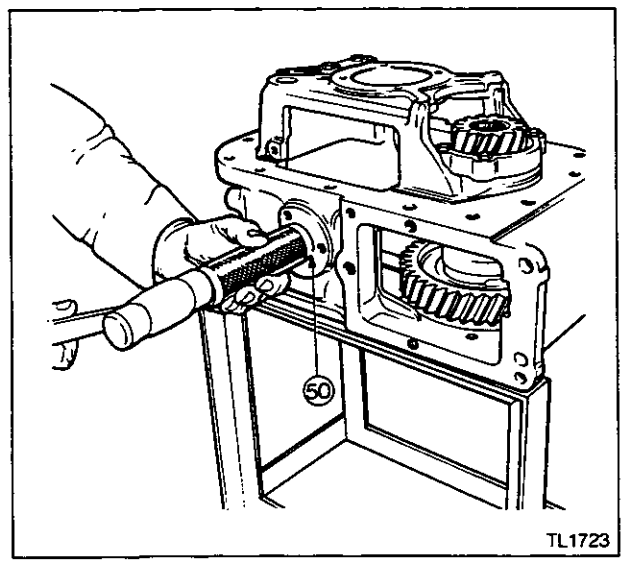




Camshaft bearing installer – Tool 'A'

Lower shaft bearing installer – Tool 'B'

51. Place the constant mesh gear complete with taper roller bearing in position in the gearbox.
52. Replace the four wheel drive gear assembly complete with needle roller bearings and steel bush with the thrust side facing down.
53. Position the medium range gear over four wheel drive gear with the thrust side facing downwards.
54. Carefully align the splines in all the gears.
55. Fit the lower shaft complete with bearing threading it through all the gears.
56. If all the original components are being refitted to the lower shaft there is no need to reset the bearing preload, ignore paragraphs 57 to 63.
57. Fit the bearing cap with shims to the value of 1 mm (0.039 in).
58. Fit the four cap bolts and tighten to a torque of 25-35 Nm (18-26 lbf ft).
59. Rotate the shaft and lightly tap each end to ensure that the bearings are fully seated and that the it rotates freely.



60. Set up a dial indicator gauge over the lower shaft with the plunger on the gauge resting on the low range gear.
61. With a pry bar lift the constant mesh gear up and down and take note of the deflection on the dial indicator gauge. Take several readings to ensure that you get the best reading with the greatest deflection.
62. From the reading obtained on the dial indicator deduct the thickness of the shim pack fitted under the cap and the pre-load required, the resultant figure is the value of shims to be fitted.

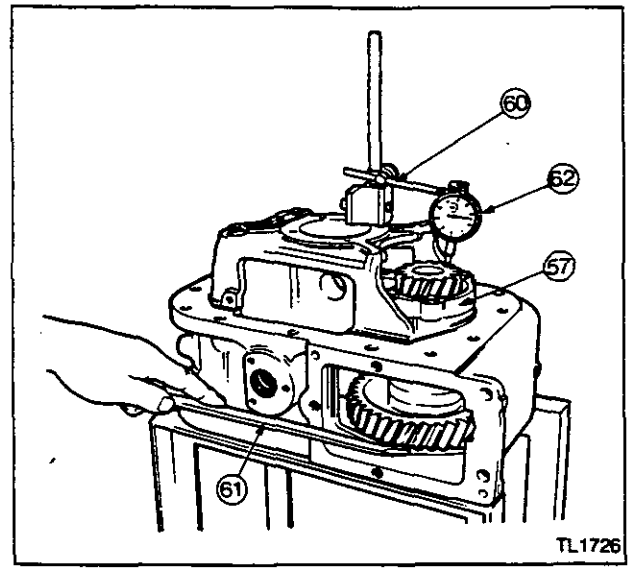
Example:

Shims = shim pack (1 mm) – (reading on dial indicator + pre-load)
= 1,00 mm – (0,35 mm + 0,05 mm)
= 0,60 mm

Use a pre-load of 0,10 mm (0.004 in) for new bearings
Use a pre-load of 0,05 mm (0.002 in) for used bearings
Shims are available in the following sizes:

Bearing cap shims		
Part number	Metric	Imperial
3610 549 M1	0,50 mm	0.020 in
3610 550 M1	0,20 mm	0.008 in
3610 551 M1	0,05 mm	0.002 in

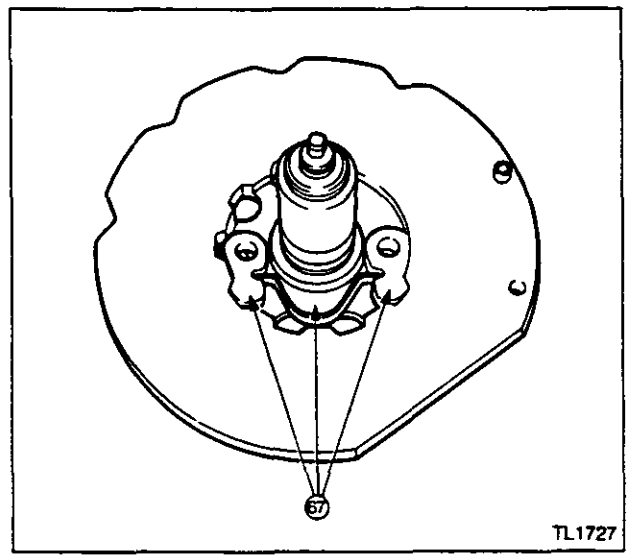
63. Remove the dial indicator gauge, bearing cap and shims.
64. Refit the bearing cap with the selected shims, apply Loctite 270 to the bolts and tighten to, a torque of 25-35 Nm (18-26 lbf ft).
65. Check the shaft for free rotation.
66. Turn the gearbox over.

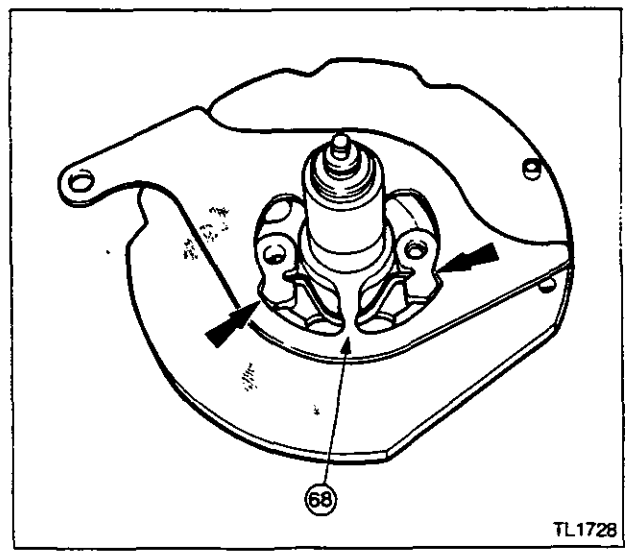


Selector Cam Assembly

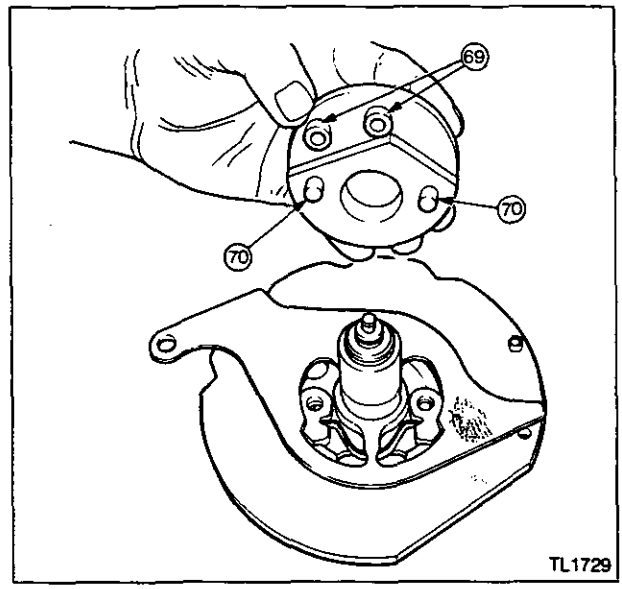
NOTE: These instructions on the assembly and setting of the selector cam are for tractors up to serial number B18008 manufactured up to May 1993. For tractors built after this date with no netural position, refer to page 7H-35.

67. Reassemble the cam ratchet assembly, position the two pawls and spring in the cam plate as shown in the illustration.
68. Place the spring plate over the two pawls ensuring that they locate in the two semi-circular slots in the plate.

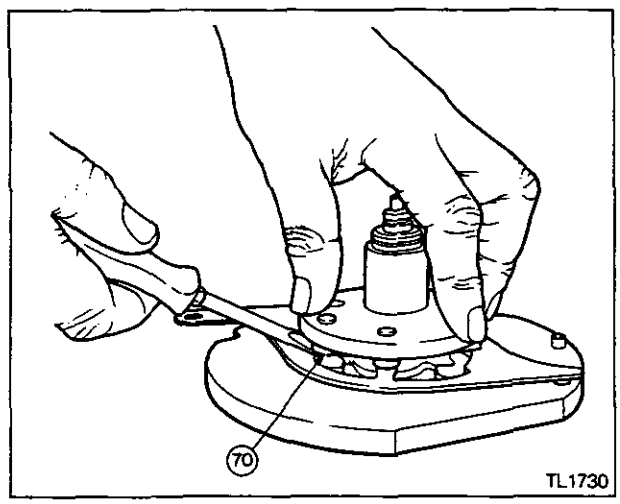




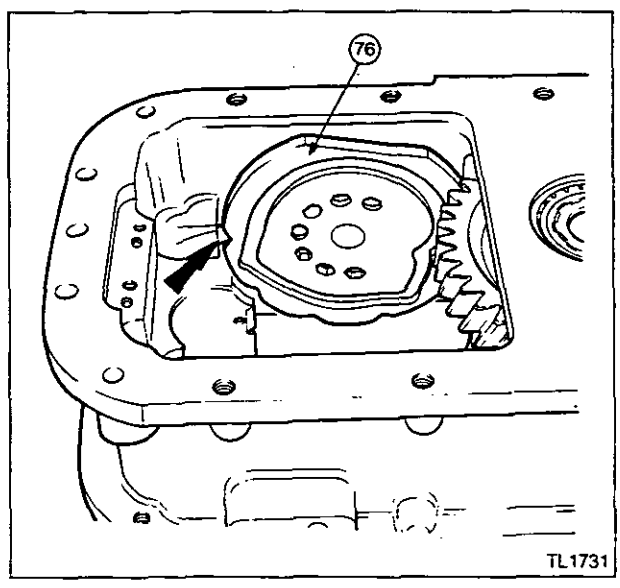
69. Position the two rollers on the pins of the cam block holding them in place with petroleum jelly.



70. Replace the cam block using a screwdriver to ease the pawls onto the pivot pins on the cam block.
71. Replace the circlip.
72. Refit the cam plate assembly to the gearbox in the neutral position.
73. Replace the the thrust washer and circlip.
74. Replace the seal ring.
75. Replace the bolt through the cam spring plate, apply Loctite 270 to the threads and tighten to a torque of 25-35 Nm (18-26 lbf ft).



76. Replace the detent plunger and spring ensuring that the cam plate is in neutral (see illustration), tighten the plug to a torque of 50-70 Nm (38-52 lbf ft).

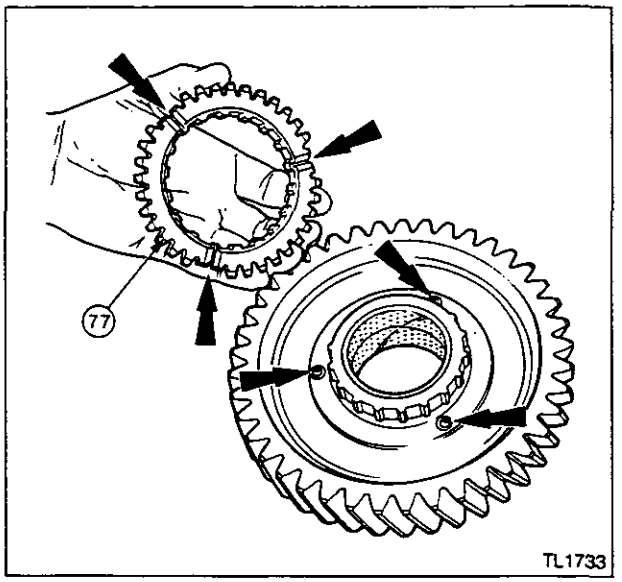


Upper Shaft

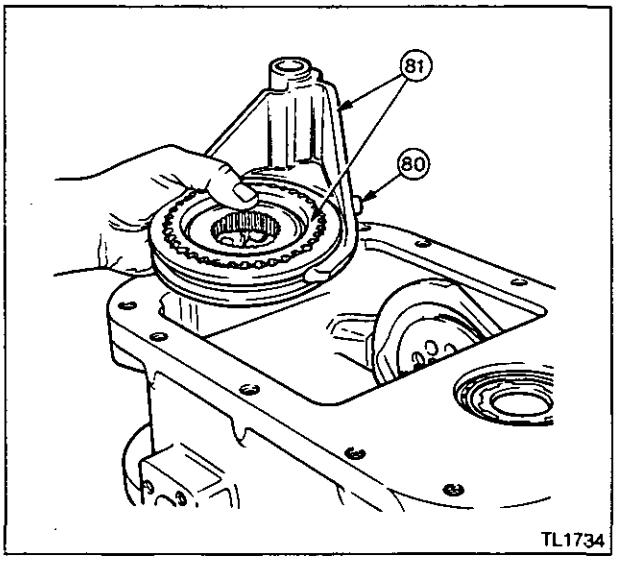
77. Fit the synchro ring to first gear ensuring that the synchro alignment pins are opposite the 'V' grove in the synchro cone hub.

Note: Use petroleum jelly to hold all the synchromesh cones, baulk rings and hubs in place during the assembly process.

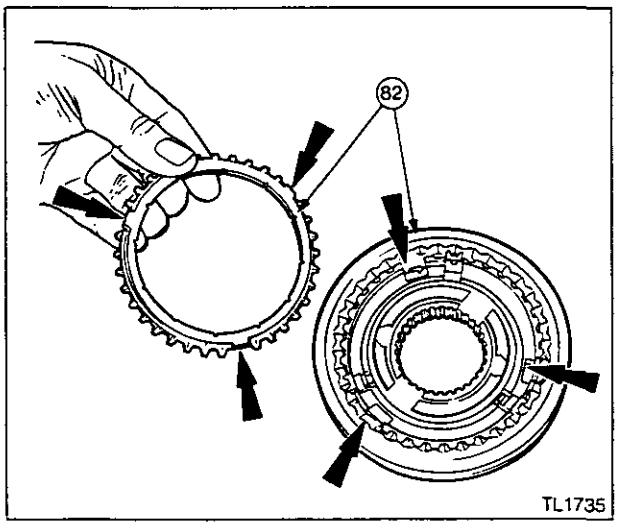
78. Place special tool MF 477 on the inner face of the rear web of the box. This is to hold all the gears in their running position during assembly.
79. Place the low range gear in position with the synchro cone uppermost.



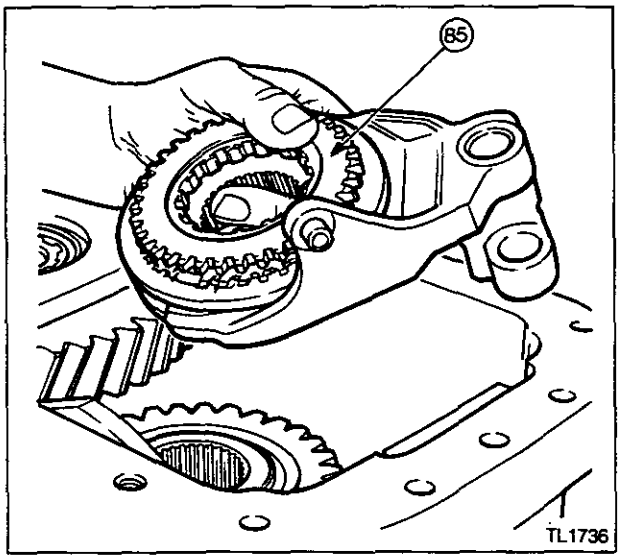
80. Fit the small rollers to the medium/low range and high range selector forks with some petroleum jelly.
81. Fit the selector fork to the synchromesh hub assembly and lower it into position in the box, simultaneously engaging the selector fork roller in the cam track.



82. Ensure that the locating blocks on the low range baulk ring are engaged in the slots of the hub.
83. Refit the medium range gear ensuring that the spring loaded plungers locate in the 'V' groves in the back of the synchro cone as described for the first range gear.
84. Replace the four wheel drive gear with the grooved thrust face downwards.

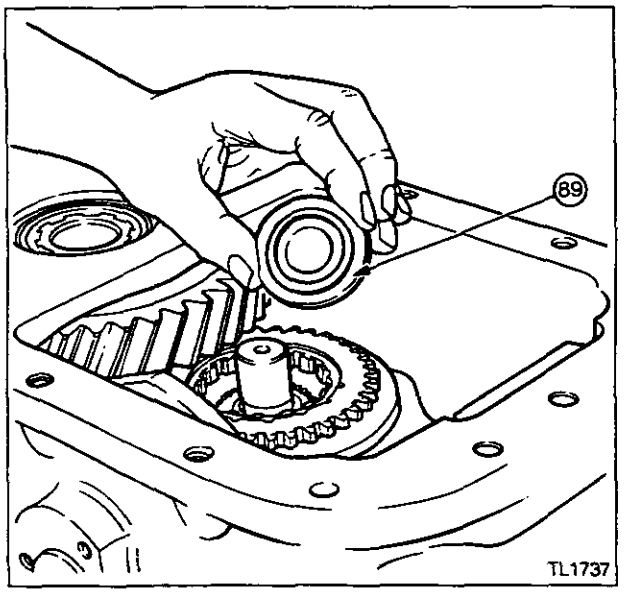


85. Fit the selector fork to the synchromesh hub, complete with baulk ring and synchro cone. Install with the flat face downwards, engaging the selector fork roller in the cam plate track.
86. Align the splines of all the gears and synchro hubs in the pack.
87. Take the upper shaft with the taper roller bearing cone, sleeve and thrust washer fitted. Pass it up through the gear pack carefully fitting all the gears and synchromesh hubs.
88. Fit the bearing cap without any shims to hold the shaft in place.

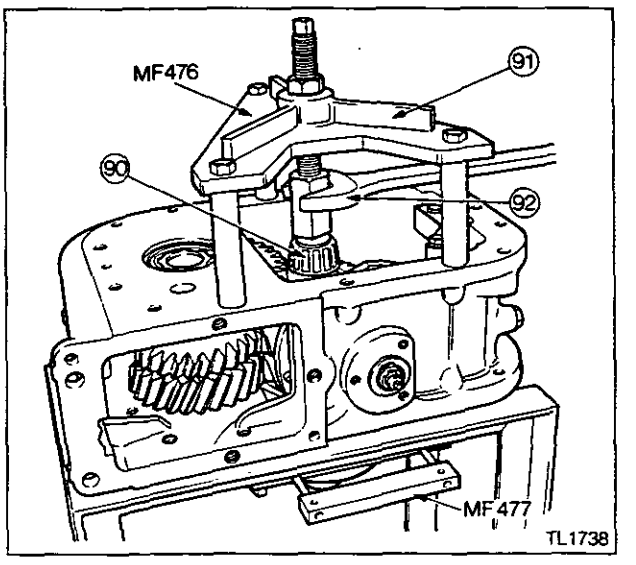


89. Place the thrust washer on the shaft with the reduced diameter facing upwards.

Caution: Under no circumstance is the taper roller bearing item 90 to be fitted to the upper shaft with a hammer and punch. Damage to the bearing will result in a seizure of the gearbox and extensive failure of many of the components.



90. Place the small taper roller bearing on the end of the screwed rod of special tool MF476.
91. Fit special tool MF476 over the upper shaft. Screw down the central screw until it locates in the end of the shaft. Tighten the locknut.
92. Screw down the large hexagon nut on MF476 to press the taper roller bearing into position.
93. Check that the bearing is pressed fully home by trying to turn the thrust washer under the bearing.
94. Remove special tool MF476 and MF477.
95. Replace the selector shaft, apply Loctite 270 to the threads of the bolt and tighten to a torque of 25-35 Nm (18-26 lbf ft).
96. Replace the selector shaft support plate, apply Loctite 270 to the threads of all the bolts an tighten to a torque of 25-35 Nm (18-26 lbf ft).
97. Rotate the shafts to ensure that all the gears are free to rotate.



Reinstalling the Range Change Unit

98. Stand the main gearbox up on end on its clutch housing. Ensure that all gears are in neutral.
99. Place a new gasket on the mounting face of the main gearbox.
100. Ensure that the dowel on the bottom of the range change unit is in place.
101. Lower the range change unit into position on the main gearbox. Check that the range selector fork engages correctly with the rollers in the back of the cam plate.
102. Apply Hylomar to the bottom six bolts securing the range change box to the gearbox.
103. Refit all the transmission case bolts, range change unit to gearbox, torque to 105 Nm (75 lbf ft).
104. Set the bearing preload setting, see operation 7H-10.

Range Change Unit Bearing Pre-load Setting

Adjust	7H-10

Special tools:
MF478 Bearing pre-load tool

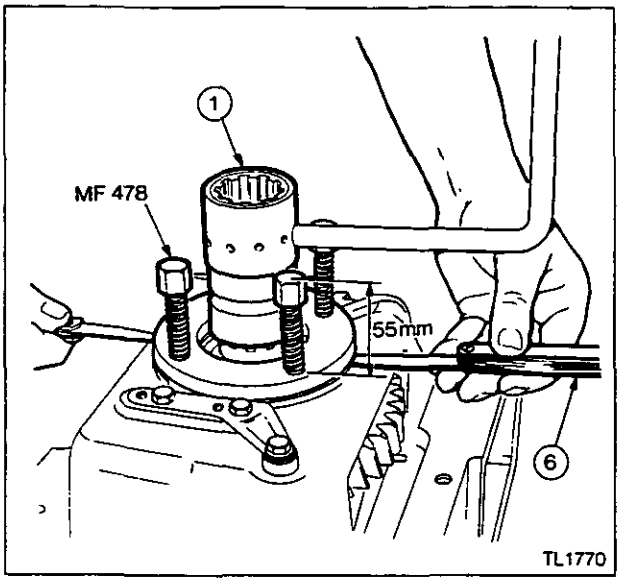
Adjust

Caution: The setting of the taper roller bearing pre-load is critical and MUST be carried out as described in this operation. Any deviation from the laid down procedure could have a serious effect on the performance of the gearbox.

1. From an old shear tube coupling make up a turning handle as shown in the illustration.
2. Remove the bearing cap bolts and clean out the threaded holes in the casing with an M6 tap.
3. Install special tool MF478. Fit the four springs to the four bolts and screw into the housing so that the height of the four bolts from the top face of the cap is 55 mm (2.167 in). This will preload the the taper roller bearings to approximately 45 kg (100 lbs).
4. Engage medium range (press the medium/low range coupler downwards).
5. Rotate the upper shaft at least 10 times with the handle, tap the end of the shaft with a soft hammer to ensure that all the bearings are fully seated in their cups.
6. With two feeler gauge sets very carefully measure the gap between the underside of the bearing cap and the casing. Both feeler gauges must be set to the same thickness because there is a tendency for the cap to tilt.

Note: This part of the operation is very important, you must get the most accurate reading you can, this measurement is critical to 0,0025 mm (0.001 in).

Check the clearance in two positions, 12 o'clock/6 o'clock and 3 o'clock/9 o'clock, when you are satisfied with the gauges selected add up the value on one gauge set.



7. Calculate the shims required:
   The taper roller bearing pre-load for both new and used bearings is 0,05 mm (0.002 in).
8. From the dimension taken under the bearing cap deduct the value of the preload required to obtain the thickness of the shim pack.

For example:

Shims required = Measured gap – bearing preload
= 0,37 mm – 0,05 mm
= 0,32 mm

9. From the available shims listed below make up a pack to the calculated value. Use a micrometer to check the thickness of the pack.

Bearing cap shims		
Part number	Metric	Imperial
3610 549 M1	0,50 mm	0.020 in
3610 550 M1	0,20 mm	0.008 in
3610 551 M1	0,05 mm	0.002 in

Select shims that will give the closest reading to that calculated, in the case of used bearings a slightly lighter pre-load will be satisfactory because the bearings do not have to wear-in.

10. Remove tool MF478, and the bearing cap.
11. Reassemble the bearing cap with the shim pack and apply Loctite 270 to the threads of the bolts. Tighten the bolts to a torque of 25-35 Nm (18-26 lbf ft).
12. Disengage the medium range gear and check the shafts for free rotation.
13. Lift the transmission back into the horizontel position.
14. Set the selector fork adjustment in the main gearbox, if necessary, see operation 7H-05

Range Change Indicator Light Switch

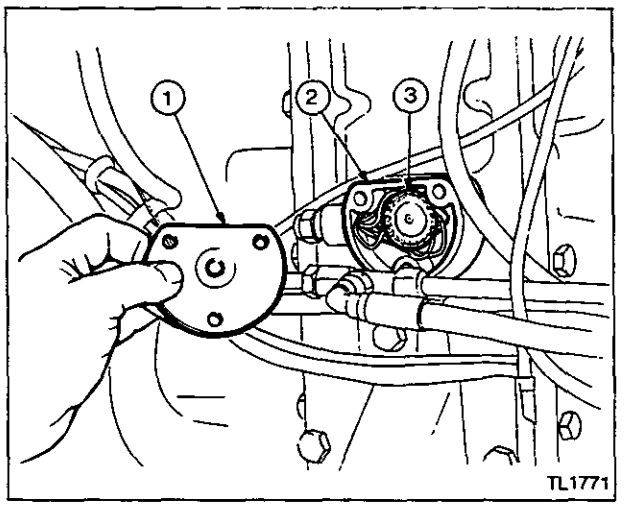
Removal and Refitment 7H-11

Removal

1. Remove the three retaining screws and the cover.
2. Carefully remove the switch assembly, there may be a small loss of oil when the switch is removed.
3. If necessary, disconnect the wiring.
4. Remove the switch from the housing.

Refitment

5. Reverse procedure, except:
   a. Renew the seal on the switch shaft.
   b. Lightly oil the seal
   c. Ensure that the cover seal is satisfactory.
   d. Coat the inner face of the switch housing and the mating face of the range box with Loctite 515.

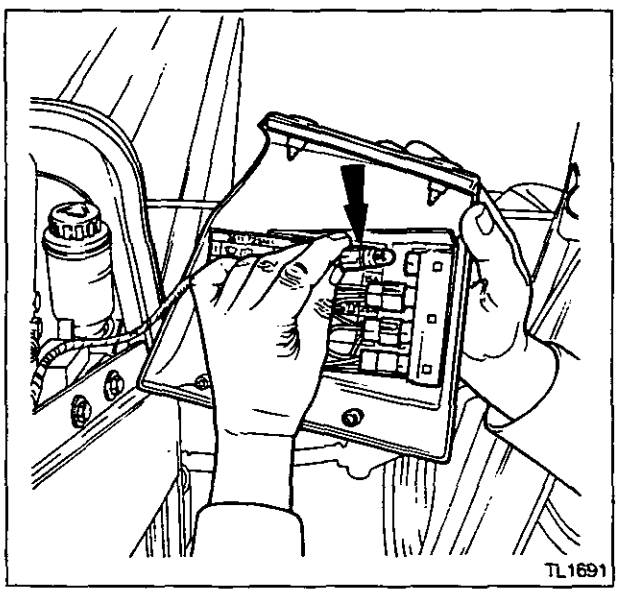


Range Change Indicator Light

Removal and Refitment 7H-12

Removal

1. Remove the right hand instrument panel side cover.
2. Pull the bulb holder out of the fitting.
3. Replace the failed capless bulb, not to exceed 2 watts.
4. Reassemble the light.



Bearing Pre–Loads

Adjust 7H–13

Special tools:
MF.478 Bearing Pre-load Tool

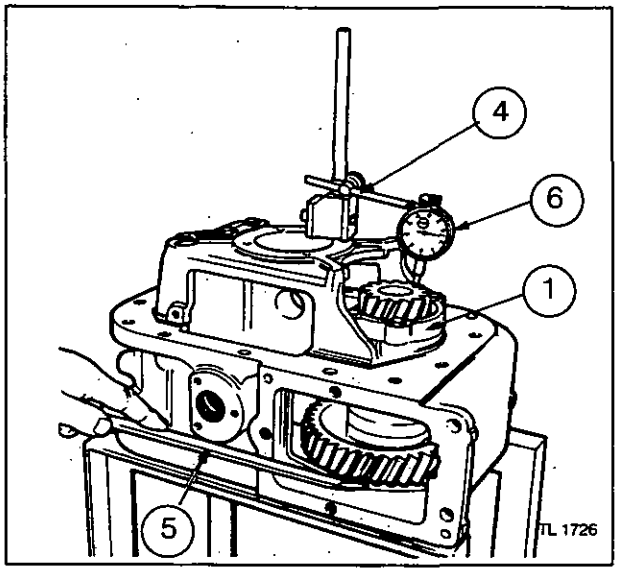
From tractor serial number S49116, December 1991, the method of setting the bearing pre-loads on the top and bottom shaft was changed to aid production in the factory and to ensure a more constant pre-load. The original design used thin metal shims, these have now been replaced by an accurately ground spacer ring in the following sizes:-

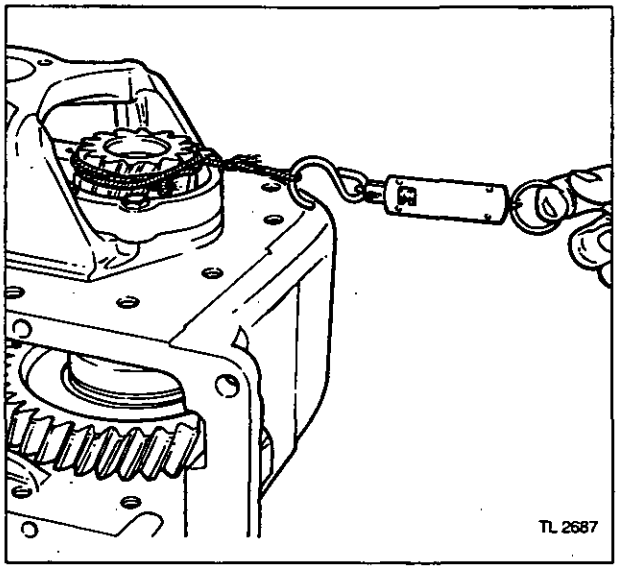
Spacer ring sizes		
Part number	Metric	Imperial
3697 520 M1	2,44 mm	0.096 in
3697 521 M1	2,48 mm	0.098 in
3697 522 M1	2,52 mm	0.099 in
3697 843 M1	2,56 mm	0.101 in
3697 844 M1	2,60 mm	0.102 in
3697 845 M1	2,64 mm	0.104 in
3697 846 M1	2,68 mm	0.106 in
3697 847 M1	2,72 mm	0.107 in
3697 848 M1	2,76 mm	0.109 in
3697 849 M1	2,80 mm	0.110 in
3697 850 M1	2,84 mm	0.112 in
3697 851 M1	2,88 mm	0.113 in
3697 852 M1	2,92 mm	0.115 in
3697 853 M1	2,96 mm	0.117 in

Procedure

Lower shaft

1. Before installing the bearing cap fit a spacer of sufficient thickness to give the shaft a small amount of end float.
2. Fit the four cap bolts and tighten to a torque of 30 Nm (22 lbf ft).
3. Rotate the shaft and lightly tap each end to ensure that the bearings are fully seated and that the shaft rotates freely.
4. Set up a dial indicator gauge over the lower shaft with the plunger of the gauge resting on the low range gear.
5. With a pry bar lift the constant mesh gear up and down and take note of the deflection on the dial indicator gauge. Take several readings to ensure that you get the most accurate reading with the greatest deflection.
6. From the reading obtained on the dial indicator add the thickness of the spacer ring and the bearing pre-load, the resultant figure will be the value of the spacer ring to be fitted.





Example:-

Spacer thickness = Thickness of spacer installed + dial indicator gauge reading + pre-load

2,44 mm + 0,25 mm + 0,05 mm

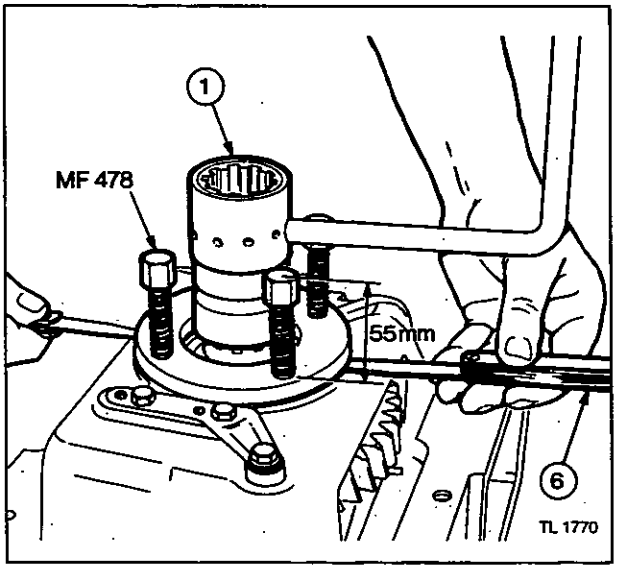
2,74 mm - Use spacer 2,76 mm

The taper roller bearing pre-load for both new and old bearings is 0,05 mm (0.002 in).

7. Remove the dial indicator gauge, bearing cap and spacer ring.
8. Refit the bearing cap with the selected spacer ring, apply Massey Ferguson Studlock (Loctite 270) to the bolts and tighten to a torque of 30 Nm (22 lbf ft).
9. Check the shaft for free rotation. Wrap string around the gear and check with a spring balance that the load required to turn the gear is between 1 and 2 Kgf (2 and 4 lbf).

12 SPEED SHUTTLE GEARBOX

Upper shaft



CAUTION: The setting of the taper roller bearing pre–load is critical and MUST be carried out as described in this operation. Any deviation from the laid down procedure could have a serious effect on the performance of the gearbox.

1. From an old shear tube coupling make up a turning handle as shown in the illustration.
2. Remove the bearing cap bolts and clean out the threaded holes in the casing with an M6 tap.
3. Install one of the thicker spacer rings between the cap and bearing so that when the cap is installed the gap between the cap and casing is minimal and easily measured with a feeler gauge.
4. Refit the bearing cap.
5. Install special tool MF.478. Fit the four springs to the four bolts and screw into the housing so that the height of the four bolts from the top face of the cap to the top of the bolt is 55 mm (2.167 in). This will pre-load the taper roller bearings to approximately 45 kg (100 lbs).
6. Engage medium range (press the medium /low range coupler downwards).
7. Rotate the upper shaft at least 5 times with the handle, tap the end of the shaft with a soft hammer to ensure that all the bearings are fully seated in their cups.
8. With two feeler gauge sets very carefully measure the gap between the underside of the bearing cap and the casing. Both feeler gauges must be set to the same thickness because there is a tendency for the cap to tilt.

NOTE: This part of the operation is very critical, you must obtain the most accurate reading you can to 0,0025 mm (0.001 in).

9. Check the clearance in two positions, 12 o'clock/6 o'clock and 3 o'clock/9 o'clock, when you are satisfied with the gauges selected, add up the value of one gauge set.
10. Calculate the spacer ring required as follows:-

    The taper roller bearing pre-load for both new and old bearings is 0,05 mm (0.002 in).

    Spacer thickness = Thickness of spacer installed - gap measured + pre-load

    = 2,92 mm - 0,20 mm + 0,05 mm

    =2,77 mm Use spacer ring 2,76 mm

Select a spacer ring that will give the closest reading to that calculated, in the case of used bearings a slightly lighter pre-load will be satisfactory because the bearings do not have to wear in.

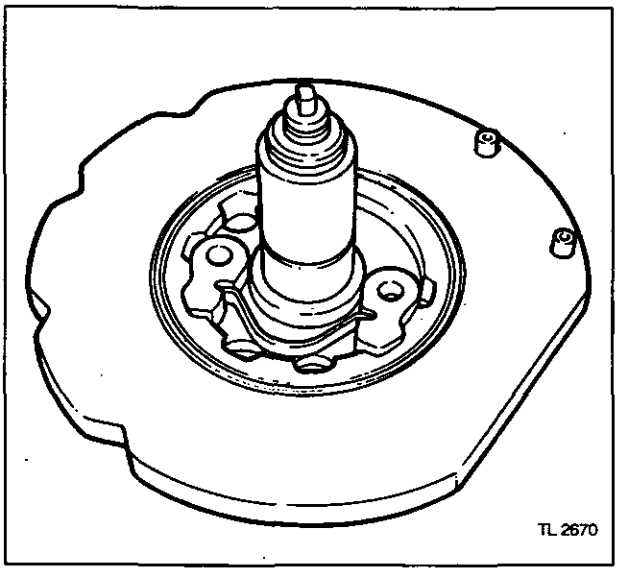
11. Remove tool MF.478, the bearing cap and the spacer ring used as a gauge.
12. Reassemble the bearing cap with the selected spacer ring and apply Massey Ferguson Studlock (Loctite 270) to the threads of the bolts. Tighten the bolts to a torque of 30 Nm (22 lbf ft).
13. Disengage the medium range gear and check the shafts for free rotation.

Selector Cam Assembly

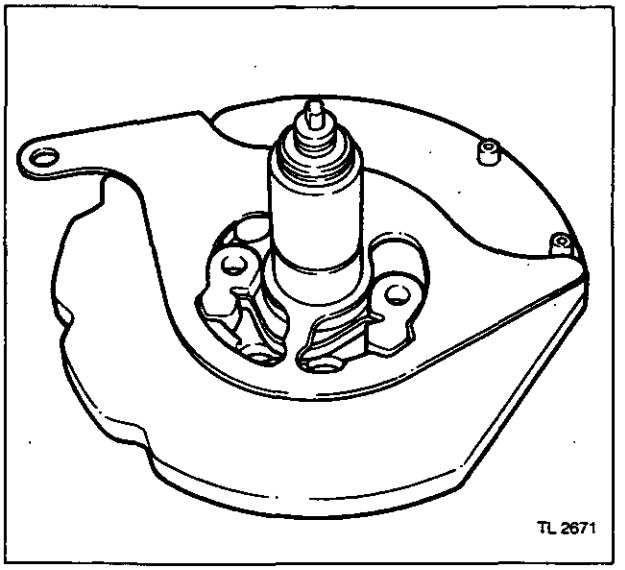
Refitment 7H–14

NOTE: These instructions are for tractors manufactured after serial number B18009, May 1993 with the neutral position deleted.

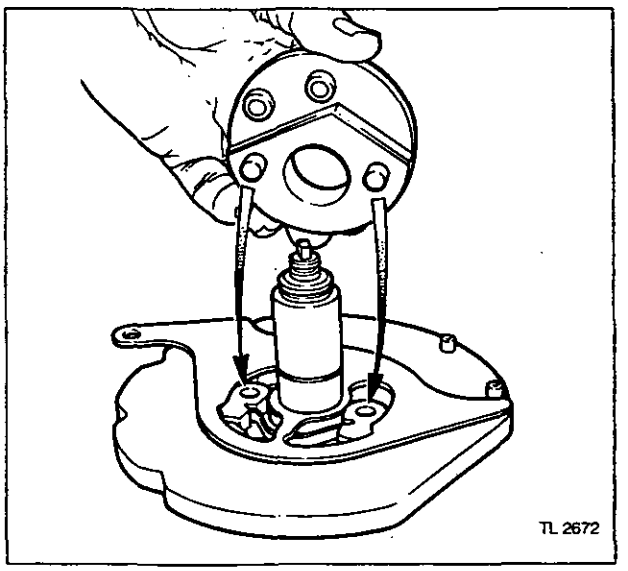
1. Reassemble the cam ratchet assembly, position the two pawls and spring in the cam plate as shown in the illustration.



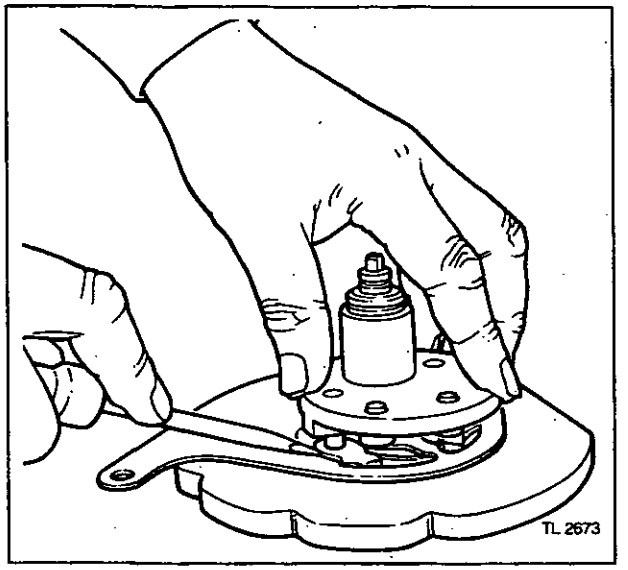
2. Place the spring plate over the two pawls ensuring that they locate in the two semi-circle slots in the plate.



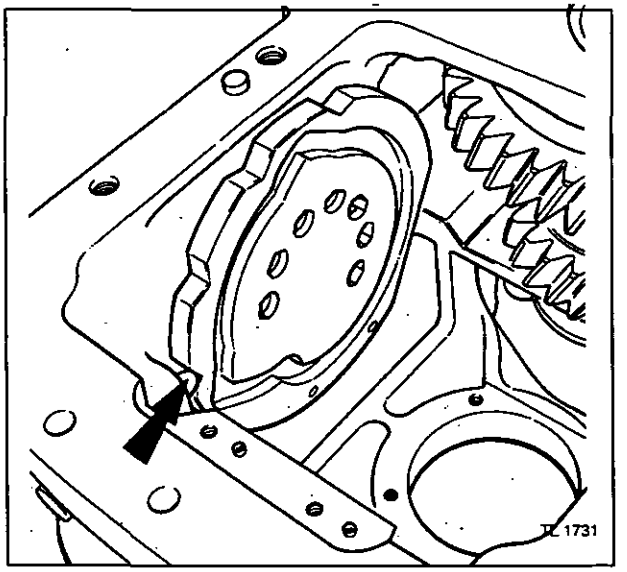
3. Position the two rollers on the pins of the cam block holding them in place with petroleum jelly.



4. Replace the cam block using a screwdriver to ease the pawls onto the pivot pins on the cam block.
5. Replace the circlip.
6. Refit the cam plate assembly into the gearbox in the high range position.
7. Replace the thrust washer and circlip.
8. Replace the seal ring.
9. Replace the bolt through the cam spring plate, apply Massey Ferguson Studlock (Loctite 270) to the threads and tighten to a torque of 25-35 Nm (18-26 lbf ft).



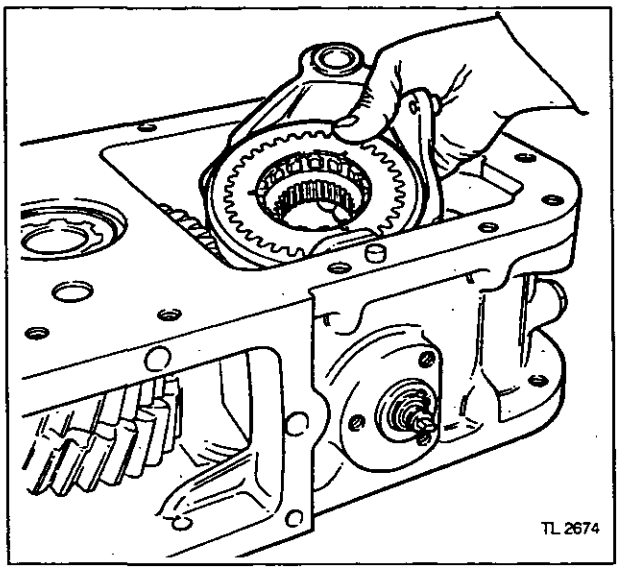
10. Replace the detent plunger and spring ensuring that the cam plate is in High Range (see illustration). Tighten the plug to a torque of 60 Nm (44 lbf ft).
11. Proceed with the assembly of the gearbox as detailed on page 7H-29.



Installing the High Range selector fork

Install the High Range selector fork and synchromesh hub in the following manner:-

1. Fit the High Range selector fork to the synchromesh hub, complete with baulk ring and synchromesh cone.
2. Pull the selector fork and coupler 'Up' to engage High Range with the baulk ring.
3. Install the coupler assembly with the flat face downwards, engaging the selector fork roller in the cam plate track.
4. Continue the assembly with procedure 86 on page 7H-30.



FOUR–WHEEL DRIVE UNIT

Section 7 – Part J

Table of Contents

7J–2
FOUR–WHEEL DRIVE UNIT

Specification

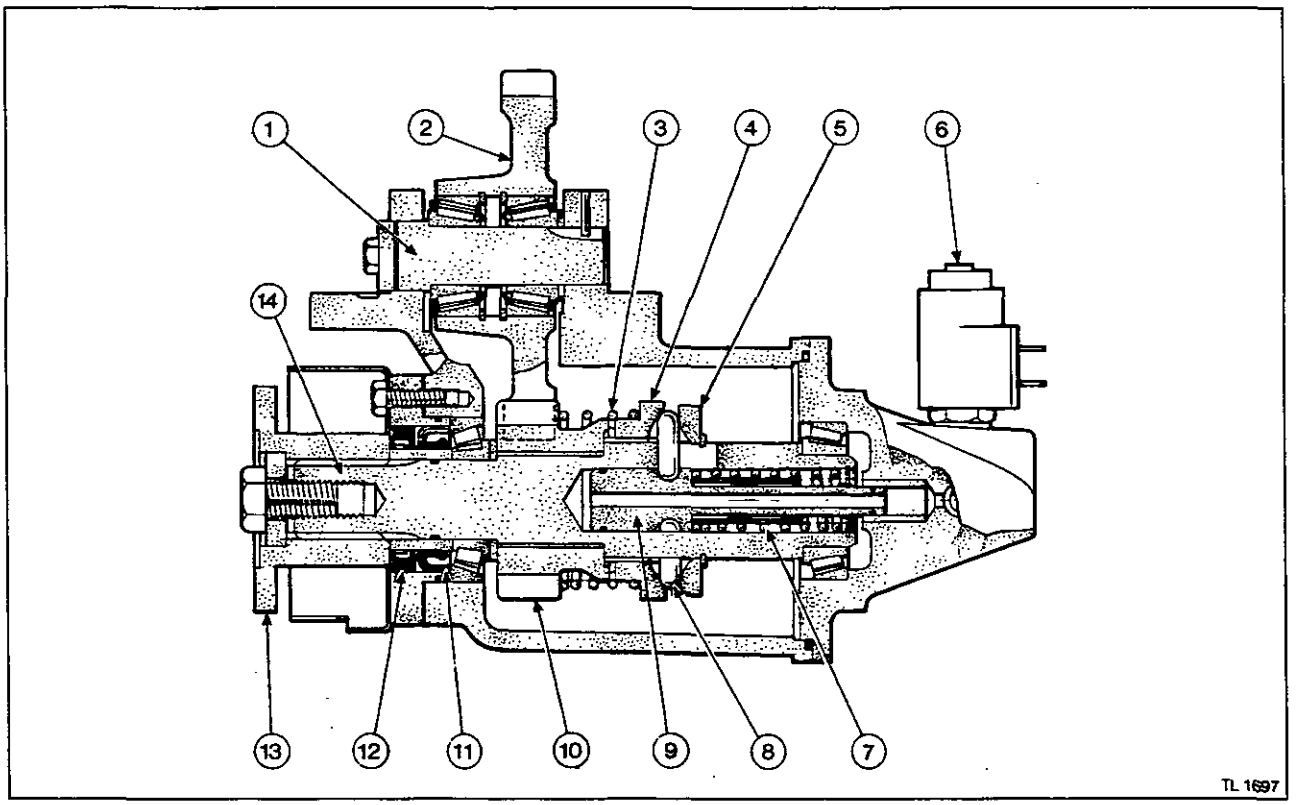
Intermediate gear pre-load ..... 0–0,05 mm (0–0.002 in)
Drive shaft pre–load ..... 0–0,07 mm (0–0.003 in)

Special Tools

MF.490 ..... 4WD axle cassette seal installer

Bolt Torques

Four wheel drive unit to range change unit ..... 120–160 Nm (88–118 lbf ft)
Drive coupling to output shaft bolt ..... 113–137 Nm (83–101 lbf ft)
Drive coupling to drive shaft nuts and bolts ..... 55–57 Nm (40–55 lbf ft)



Four-wheel drive unit

1. Intermediate shaft
2. Intermediate gear
3. Return spring
4. Clutch coupler
5. Abutment ring
6. Solenoid valve
7. Piston return spring
8. Toggle pins
9. Actuator piston
10. Drive gear
11. Oil seal
12. Dirt seal
13. Drive coupling to front axle
14. Output shaft

General Description

The Four Wheel Drive Unit is bolted on to the left-hand side of the Range Change Gearbox. The drive is obtained from the upper shaft in the range change box, through a series of intermediate gears to the out put shaft and clutch assembly, and finally to the front axle.

The engagement and disengagement of the unit is controlled by an electric solenoid valve operated by a switch under the drivers control. On cab tractors, the drive is also engaged when the foot or parking brake is applied to give four wheel braking. The four wheel drive unit is normally engaged, requiring energising to disengage.

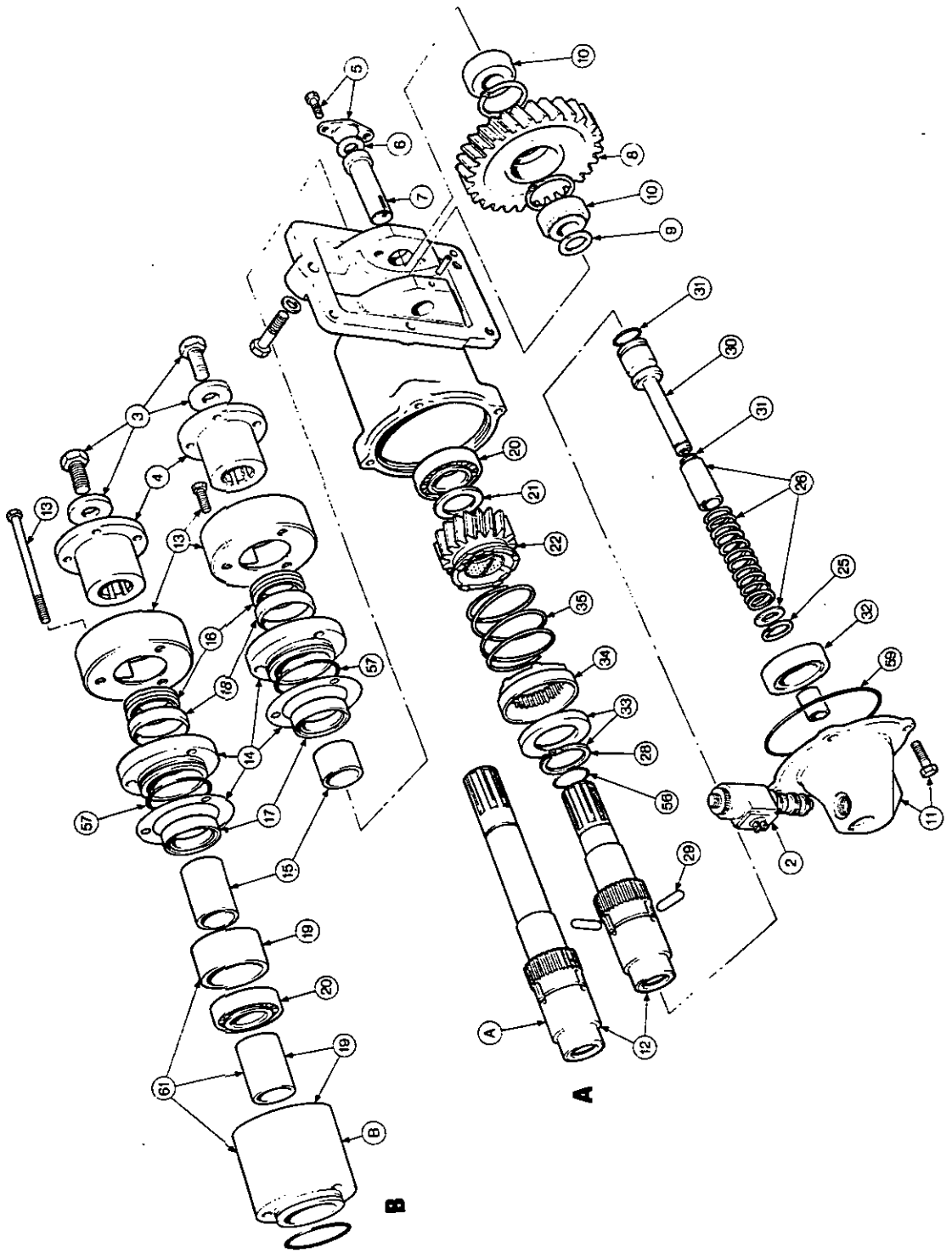
The drive shaft and clutch assembly is mounted on taper roller bearings and contains in the centre at the rear the hydraulic actuating piston and return spring. A free running gear is mounted on the front end of the shaft driven from the range change box, the rear face of the gear is equipped with a single tooth type clutch. Engaging with the gear and splined to the shaft is a sliding coupler with a light return spring between the gear and coupler. Behind the sliding coupler is an abutment ring held in place on the shaft by a circlip. Between the coupler and abutment ring there are three radial toggle pins which pass through the shaft and engage in a grove in the actuating piston in the centre of the shaft.

The hydraulic piston is spring loaded in the forward (engaged) position, operation of the solenoid valve will apply hydraulic pressure to the front of the piston, as piston moves back the toggle pins will move from the vertical position to an angle of 45°, the tips of the pins will move down the sloping face of the coupler allowing it to move rearwards under spring compression and disengage the coupler and the drive.

Engagement of the clutch is carried out in reverse, the solenoid is de-energised, the piston moves forward under compression of it's spring. The toggle pins move to the vertical position pushing the coupler into engagement as they pass up the sloping face. The rear abutment ring is shaped to guide and retain the toggle pins.

All the gears are helical cut and run on adjustable taper roller bearings, pre-load adjustment being by the introduction of shims between the bearing cap and casing. A double seal arrangement is fitted to the front of the drive shaft to prevent the ingress of dirt and the loss of oil.

FOUR WHEEL DRIVE UNIT



Four Wheel Drive Unit

Removal and Refitment 7J-01

Removal

1. Drain the oil from the transmission case.
2. Remove the clip and slide back the drive shaft cover.
3. Remove the drive shaft coupling nuts and bolts.
4. Disconnect the hydraulic supply pipe.
5. Disconnect the electrical wires from the solenoid valve.
6. Remove the bolts securing the four wheel drive unit to the range change box.
7. Remove the four wheel drive unit from the tractor.

Refitment

8. Clean the mating faces of the range change gearbox and four wheel drive unit.
9. Reverse procedure 1 to 7 except:
   a. Coat the mating face of the four wheel drive unit with Loctite 515 instant gasket.
   b. Tighten the mounting bolts to a torque of 120-160 Nm (88-118 lbf ft).
   c. Tighten the drive shaft coupling bolts to a torque of 55-75 Nm (40-55 lbf ft).

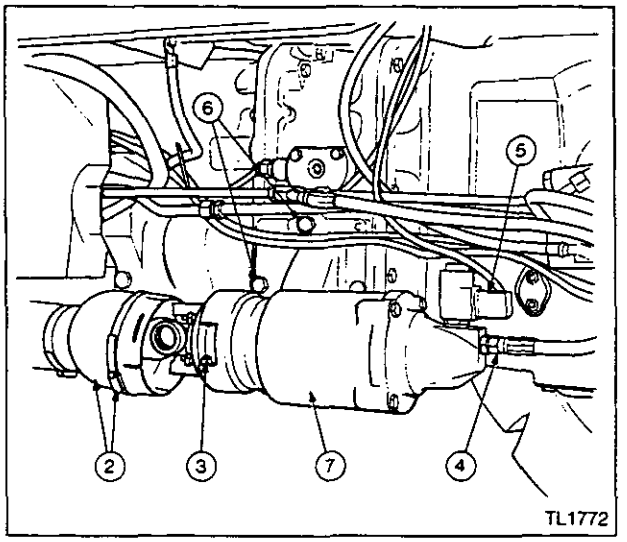
Four Wheel Drive Unit

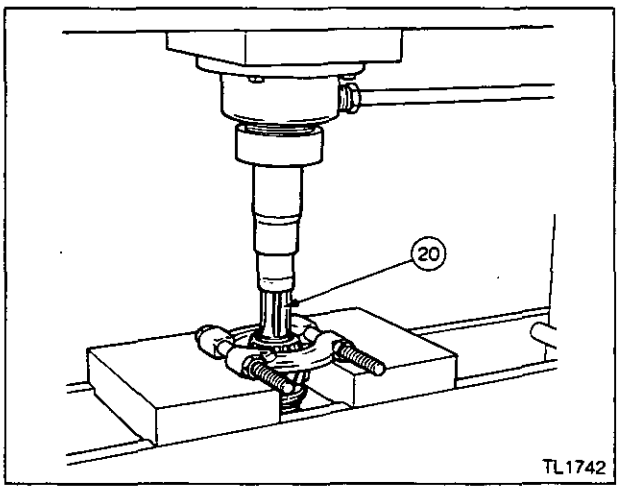
Overhaul 7J-02

Disassembly

Note: There are two types of four wheel drive unit, with or without extended drive shaft. The extended drive shaft is fitted to tractors with a 40 km/hr transmission, the major difference being the longer drive shaft `A' the housing extension `B' (see illustration). The standard length shaft is fitted to all other models.

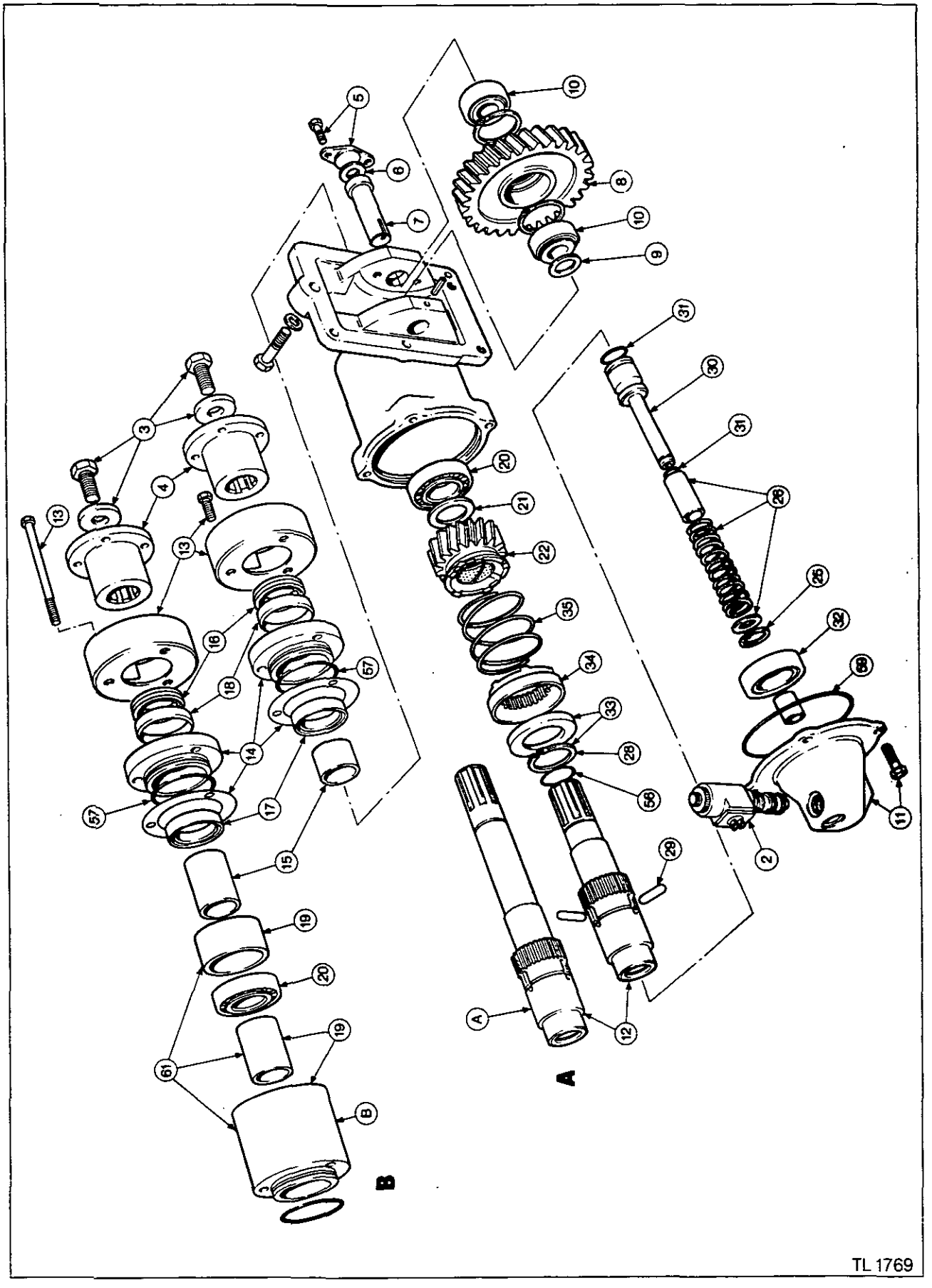
1. Remove the four wheel drive unit, see operation 7J-01.
2. Unscrew and remove the solenoid valve assembly.
3. Remove the central bolt and washer from the drive coupling.
4. Remove the drive coupling.
5. Remove the two bolts and the end cap on the intermediate gear shaft.
6. Remove and save the shims between the end cap and shaft.
7. Push the shaft out of the housing from the back.
8. Lift out the gear and taper roller bearings.
9. Retain the thrust washer between the gear and housing.
10. Remove the taper roller bearings from the intermediate gear, if necessary.
11. Remove the four bolts and the end cover.
12. Remove the drive shaft and clutch assembly from the housing.
13. Remove the four bolts and the rear guard.
14. Remove the end cap and shims.





15. Remove the oil seal sleeve.
16. Remove the dirt seal from the seal sleeve.
17. Press the oil seal out of the end cap.
18. Remove the dirt seal sleeve from the end cap.
19. On tractors with 40 km/hr transmissions, remove the additional extension and spacers.
20. Use a bearing separator plate and a hydraulic press to remove the front taper roller bearing.
21. Remove the thrust washer.
22. Remove the drive gear.

FOUR WHEEL DRIVE UNIT



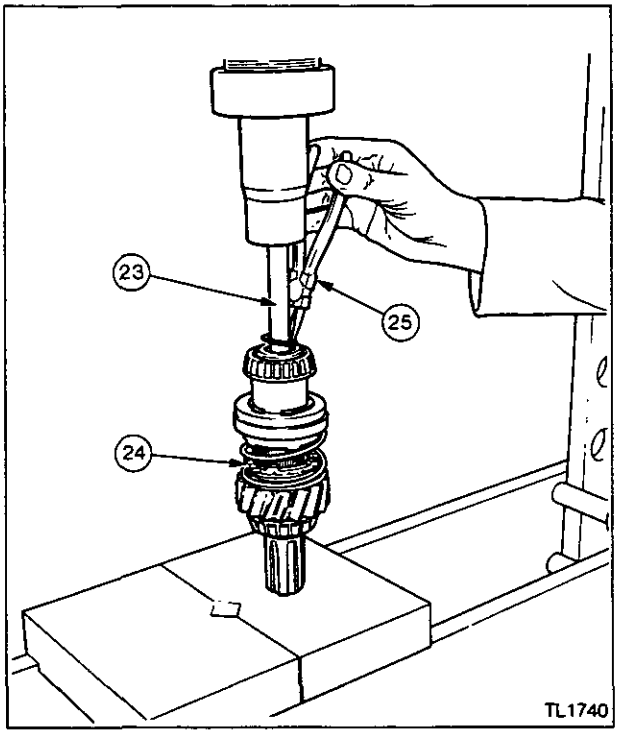
23. To remove the actuator piston cut a piece of tube approximately 16 mm (5/8 in) outside diameter, 13 mm (1/2 in) inside diameter and 100 mm (4 in) long that will pass over the end of the actuator piston rod projecting from the end of the shaft.
24. Place the shaft assembly under a hydraulic press and put the tube over the end of the rod and press down the washer against the spring pressure.
25. Remove the internal circlip.
26. Remove the washer, spring and stop tube.
27. Remove the shaft from the press.
28. To remove the clutch, first remove the circlip from its groove and slide it along the shaft towards the bearing.
29. Remove the three toggle pins from between the abutment ring and clutch coupler.
30. Pull the actuator piston out of the shaft.
31. Remove the actuator piston seals.
32. To remove the spring, clutch coupler, abutment ring and circlip, remove the rear taper roller bearing using a bearing separator plate under a hydraulic press.
33. Remove the circlip and abutment ring.
34. Remove the clutch coupler.
35. Remove the spring.

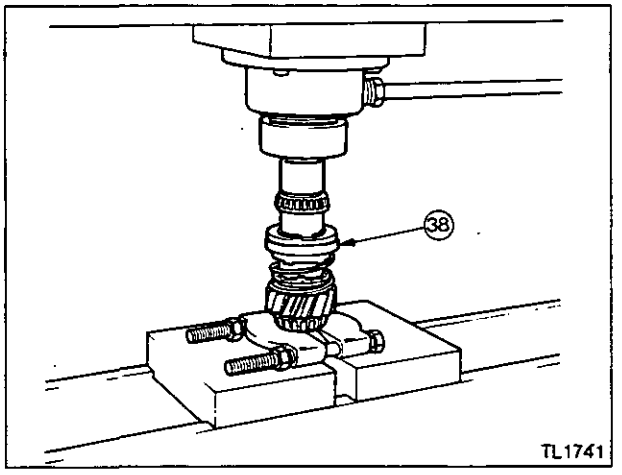
Examination

36. Clean and inspect all parts, pay particular attention the condition of the clutch.
37. Discard all 'O' rings, seals and circlips and replace with new.

Reassembly

38. Refit the drive gear and thrust washer onto the shaft and press the front taper roller bearing into place.
39. Place the spring, clutch coupler, abutment ring and circlip on to the shaft and press the rear taper roller bearing onto the shaft.
40. Replace the seals on the actuator piston and refit it into the end of the shaft.
41. Fit the three toggle pins between the abutment ring and clutch coupler, through the shaft and into the groove in the actuator piston.
42. To hold the toggle pins in place replace the shaft circlip into its groove.
43. Replace the stop tube, spring and washer.
44. Place the shaft assembly under a hydraulic press. Position the internal circlip on the washer and place the tube you used for dismantling over the end of the actuator piston.
45. Operate the hydraulic press and press the washer and spring down into the shaft, replace the circlip in its groove.
46. Replace the shaft assembly in the housing without the seals and drive coupling being fitted. Refit with the original shims removed.
47. The correct pre-load is 0,07 mm (0.003 in), this is obtained by adjusting the shim pack thickness between the end cap and the casing. Shims are available in the following sizes:





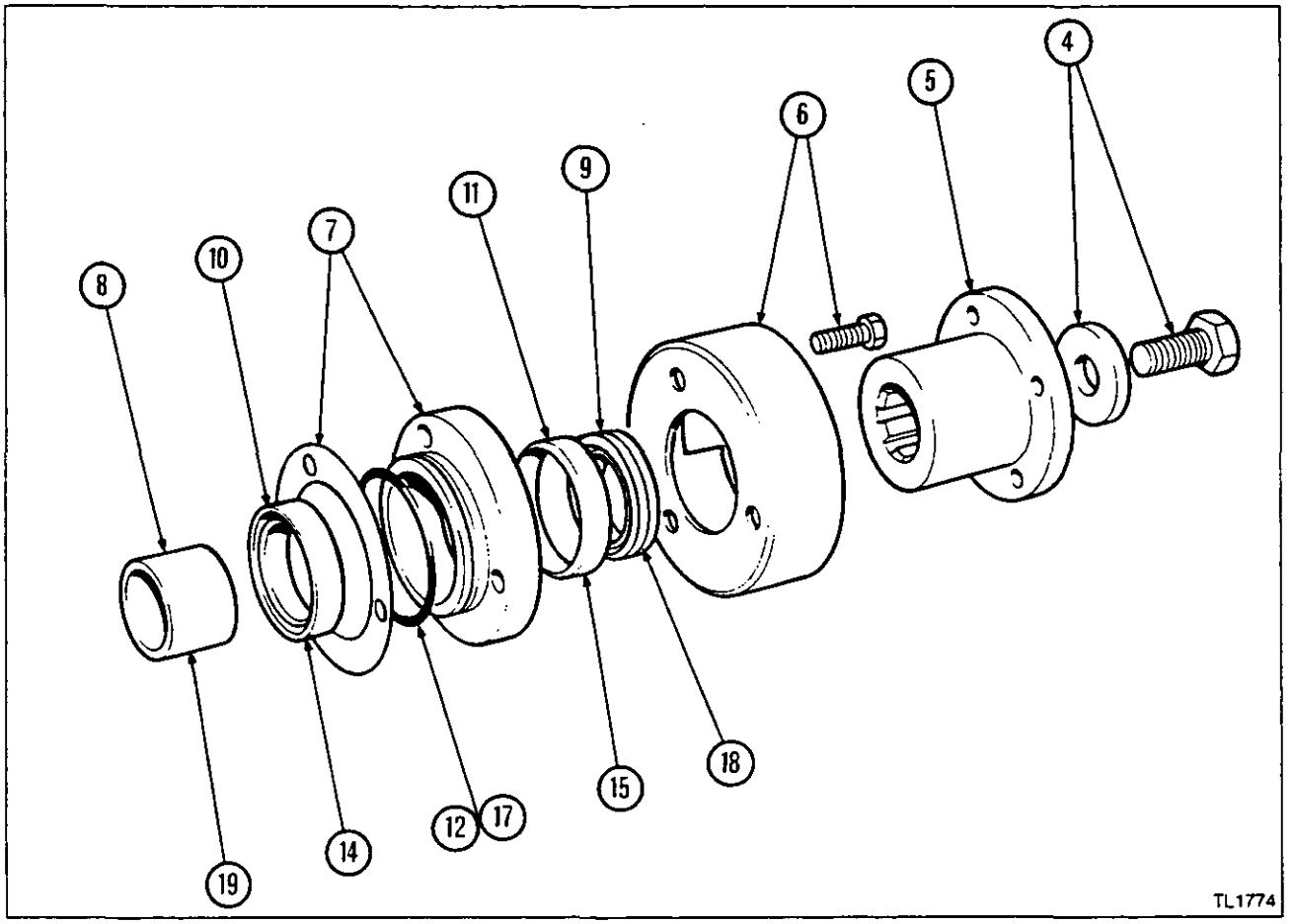
Drive shaft shims		
Part No.	Metric	Imperial
3611 066 M1	0,05 mm	0.002 in
3611 067 M1	0,20 mm	0.008 in
3611 068 M1	0,50 mm	0.010 in

48. Rotate the shaft by hand,when the pre-load is correct a slight drag on the rotation of the shaft should be felt, there must be no free play in the bearings, adjust the thickness of the pack to arrive at this condition.
49. Remove the drive shaft assembly from the case, retain the shims for reassembly.

50. Refit the intermediate gear assembly, pass the shaft through the front face of the housing, through the taper roller bearings in the gear and the thrust washer, ensure that the slot in the shaft locates in the pin in the housing.
51. The correct pre-load for this bearing is 0-0,05 mm (0-0.002 in). shims are available in the following sizes:

Intermediate shaft shims		
Part No.	Metric	Imperial
3612 631 M1	0,05 mm	0.002 in
3612 632 M1	0,10 mm	0.004 in
3612 633 M1	0,20 mm	0.008 in
3612 634 M1	0,30 mm	0.012 in
3612 635 M1	0,50 mm	0.020 in

52. Refit the shims removed and the end cap and check the bearing pre-load, there should be a slight resistance felt when rotating the gear.
53. After setting the pre-load remove the gear assembly and retain the shims for reassembly.
54. Press the oil seal into the end cap from the bearing end.
55. Press a new dirt seal wear sleeve into the end cap from the coupling end.
56. Fit a new 'O' ring to the drive shaft.
57. Fit a new 'O' ring to the end cap.
59. Fit a new 'O' ring to the end cover.
60. Reassemble the drive shaft assembly in the casing fitting the selected shims and rear guard, the slot in the rear guard faces outwards.
61. On tractors with 40 km/hr transmissions, reassemble with the extension piece, spacer and additional 'O' ring.
62. Press the dirt seal on to the seal sleeve and fill the dirt seal labyrinth with general purpose grease.
63. Install the seal sleeve and dirt seal onto the drive shaft.
64. Liberally coat the splines of the drive shaft with Hylomar and fit the drive coupling.
65. Degrease the threads of the central bolt, apply Loctite 270, refit with the washer and tighten to a torque of 113-137 Nm (83-101 lbf ft).
66. Reassemble the intermediate gear to the casing.
67. Refit the solenoid valve assembly.
68. Refit the four wheel drive unit to the range change gearbox, see operation 7J-01.



Drive Shaft Seal

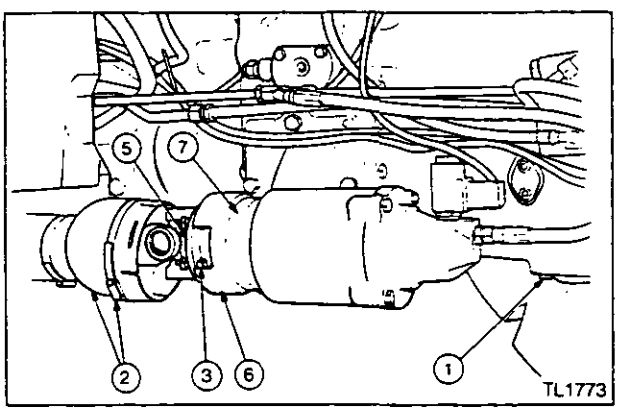
Removal and Refitment 7J-03

Removal

1. Drain the oil from the transmission case.
2. Remove the clip and slide back the drive shaft cover.
3. Remove the drive shaft coupling nuts and bolts.
4. Remove the drive coupling bolt and washer.
5. Remove the drive coupling.
6. Remove the four bolts and the rear guard.
7. Remove the end cap and shims.
8. Remove the oil seal sleeve.
9. Remove the dirt seal from the seal sleeve.
10. Press the oil seal out of the end cap.
11. Remove the dirt seal sleeve from the end cap.
12. Remove and discard the 'O' ring from the end cap and drive shaft.

Refitment

13. Clean all components.
14. Press the new oil seal into the end cap from the bearing end.
15. Press a new dirt seal wear sleeve into the end cap from the coupling end.
16. Fit a new 'O' ring to the drive shaft.
17. Fit a new 'O' ring to the end cap.



18. Press the new dirt seal on to the seal sleeve and fill the dirt seal labyrinth with general purpose grease.
19. Install the seal sleeve and dirt seal onto the drive shaft.
20. Liberally coat the splines of the drive shaft with Hylomar and fit the drive coupling.
21. Degrease the threads of the retaining bolt, apply Loctite 270 and tighten to a torque of 113-137 Nm (83-101 lbf ft).
22. Reconnect the drive shaft and tighten the drive shaft coupling bolts to a torque of 55-75 Nm (40-55 lbf ft).
23. Reconnect the drive shaft guard.
24. Refill the transmission with oil.

4WD Solenoid Valve

Removal and Refitment 7J–04

Removal

Solenoid Coil

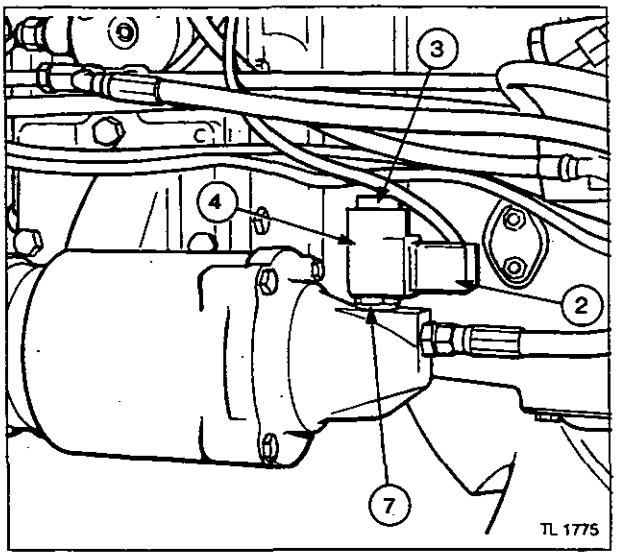
1. Test the electrical system first - with the key switch ON, the four wheel drive switch OFF, there should be a 12 volt supply at the solenoid terminals. If not, check the fuse and wiring system.
2. Remove the electrical system wires.
3. Remove the knurled nut on top of the solenoid.
4. Remove the coil taking care to retain the two 'O' rings each side of the coil.

Solenoid Valve Assembly

5. Ensure that the engine is stopped and allow a few minutes for the hydraulic pressure to subside.
6. Remove the electrical system wires.
7. Unscrew the solenoid valve assembly.
8. When refitting the unit ensure that the 'O' rings are in good condition.

Refitment

9. Reverse procedures 2 to 4 or 5 to 7, except:
   a. Apply Massey Ferguson Screw Lock (Loctite 222) to the knurled nut and tighten only finger tight.
   b. Tighten the solenoid valve body to a torque of 10 Nm (7 lbf ft). This is to prevent distortion of the valve body.

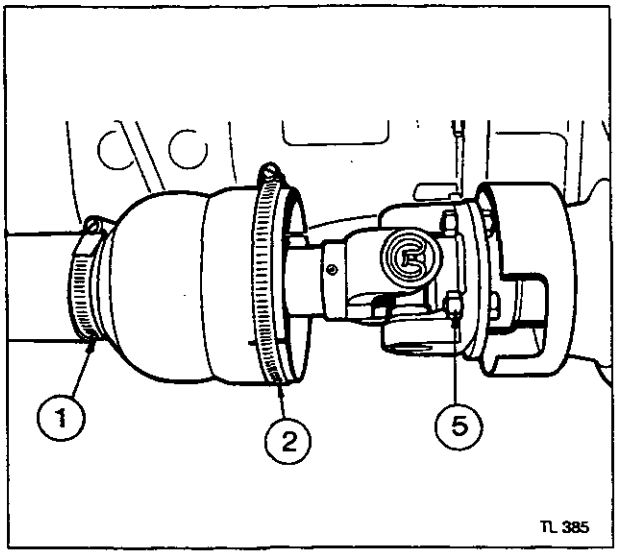


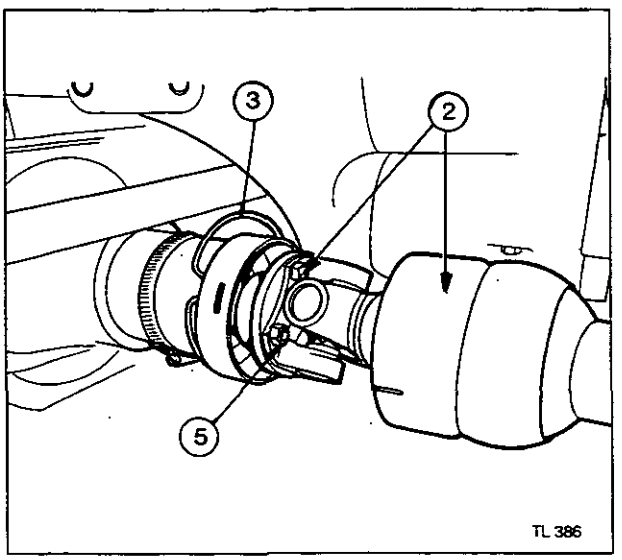
4WD Axle Drive Shaft

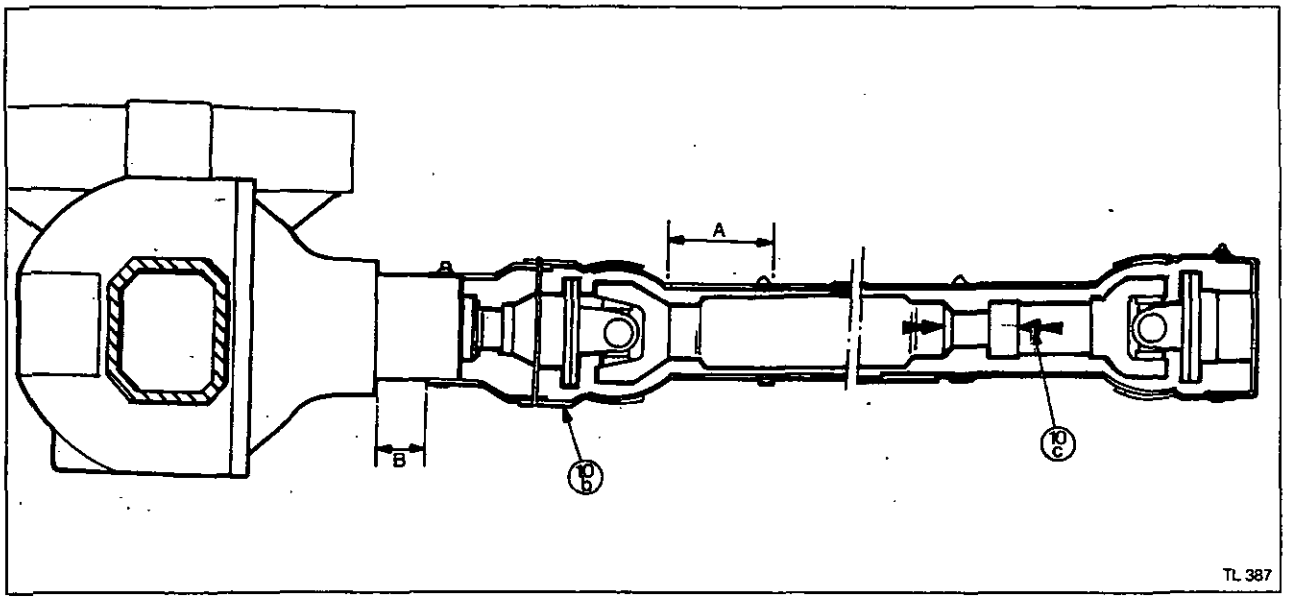
Removal and Refitment 7J–05

Removal

1. Slacken the two clips on the guard.
2. Slacken the clip from the guard at the transfer gearbox end.
3. Remove the spring clip from the guard at the axle end.
4. Slide the guard at both ends towards the centre to gain access to the couplings.
5. Remove the four bolts from each coupling and lift the drive shaft clear of the tractor.
6. Slide the rear part of the cover back to expose the sliding joint in the shaft.
7. Unscrew the retaining ring.
8. Slide the rear part of the coupling off the shaft.
9. The guards can now be removed from the shaft.







Refitment

10. Reverse procedures 1 to 9 except:

a. Lubricate both universal joints and the sliding spline with grease.

b. The drain hole in the guard must be at the axle end and be at the bottom.

c. The arrows on the drive shaft must be in line.

d. The clips must be positioned directly over the grooves in the two end sections. On tractors with six cylinder engines, the clip must be located 90 mm (3.5 in) from the front, dimension 'A'.

e. Apply Massey Ferguson Stud Lock (Loctite 270) to the threads of the coupling bolts and tighten to a torque of 55–75 Nm (40–55 lbf ft).

f. Position the front guard approximately 45 mm (2.3 in) from the step in the differential housing, dimension 'B'.

Cassette Seal Installation

Removal and Refitment 7J–06

Special tools:
MF.490 4WD Cassette seal installer

The new output shaft cassette seal was introduced into production from tractor serial number C45000, manufactured November 1994.

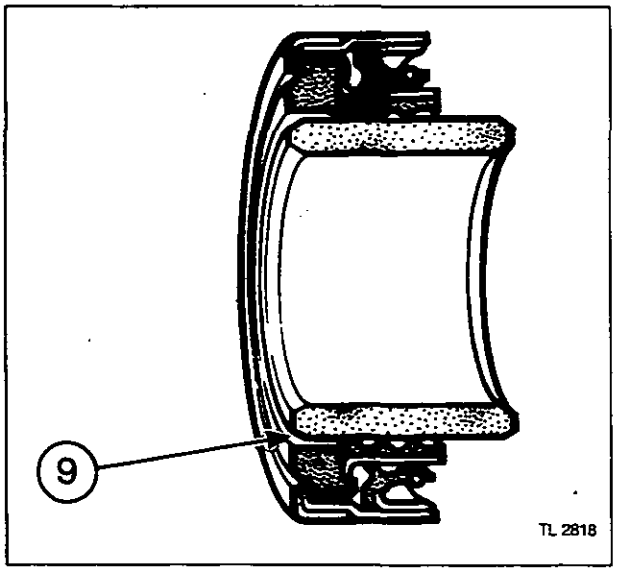
This new type of seal can be fitted to all four wheel drive output shafts

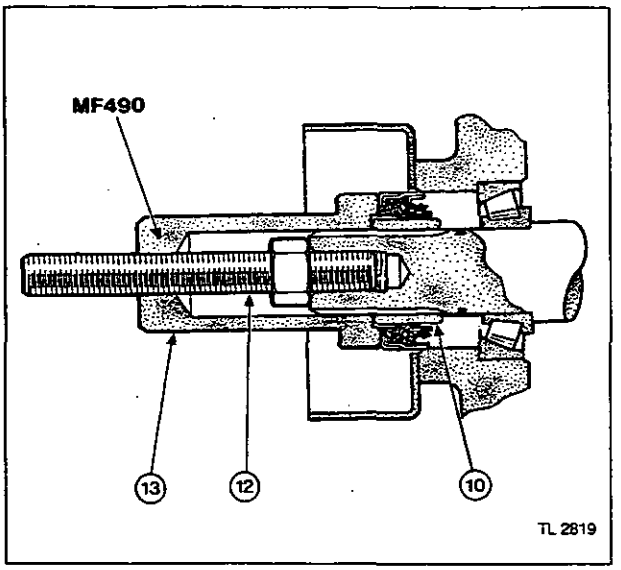
Removal

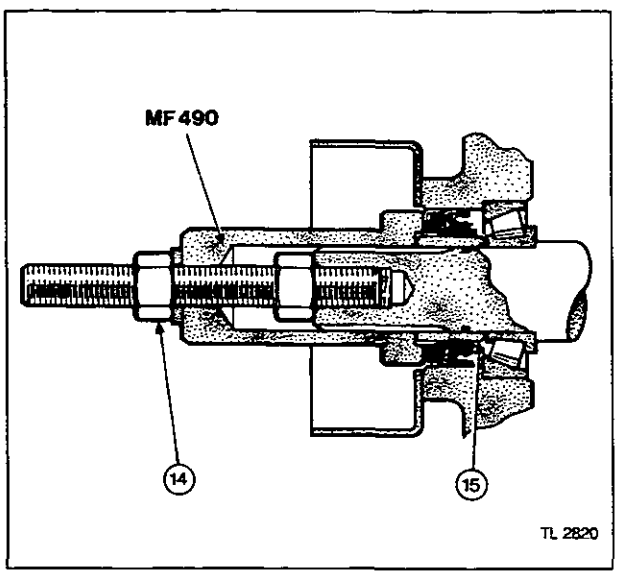
1. Drain the oil from the transmission.
2. Slide back the drive shaft guard and disconnect the drive shaft as described in operation 7J-05.
3. Remove the the drive shaft and seal as described in operation 7J-03 paragraphs 1 to 13,16 and 17 inclusive.
4. Refit the shims and end cap.
5. Check that the new seal will pass freely through the rear guard, if not, open out the guard centre hole to give 0,5 mm clearance all round the seal.
6. Replace the drive shaft as described in paragraphs 54 to 57 inclusive.
7. Renew the 'O' ring.

Installing the new seal

8. Liberally coat the inside of the seal with petroleum jelly.
9. Press the sleeve into the seal so that the front (flat) face of the seal is flush with the end of the sleeve.
10. Slide the seal/sleeve assembly over the output shaft as shown until the seal is just entering the housing.
11. Special tool MF.490 has been designed to install the seal to the correct depth in relation to the housing and sleeve. It also presses the seal in the correct location.
12. Screw the stud of special tool MF.490 into the end of the output shaft.
13. Slide the assembly tool over the stud and shaft.
14. Fit the washer and nut.
15. Screw the nut up the stud until the tool pushes the sleeve hard against the bearing. The seal is now in the correct position.
16. Remove the tool.
17. Coat the splines of the output shaft with Hylomar sealant.
18. Refit the drive coupling, drive shaft and guard as described in operation 7J-03 paragraph 20 to 24 inclusive.
19. Apply Massey Ferguson studlock (Loctite 270) to the central bolt and tighten to a torque of 125 Nm (92 lbf ft).
20. Apply Massey Ferguson studlock (Loctite 270) to the coupling bolts and tighten to a torque of 65 Nm (50 lbf ft).







CREEPER GEARBOX

Section 7 – Part K

Table of Contents

7K–2
CREEPER GEARBOX

Specification:

Model	Epicyclic creeper gearbox.
Reduction	4 : 1 (low range).
Tractor models	350 to 365 - 2WD only.

Bolt Torques:

Epicyclic unit to casing	43 Nm (32 lbf ft).
Creeper gearbox to transmission	112 Nm (83 lbf ft).

General Description

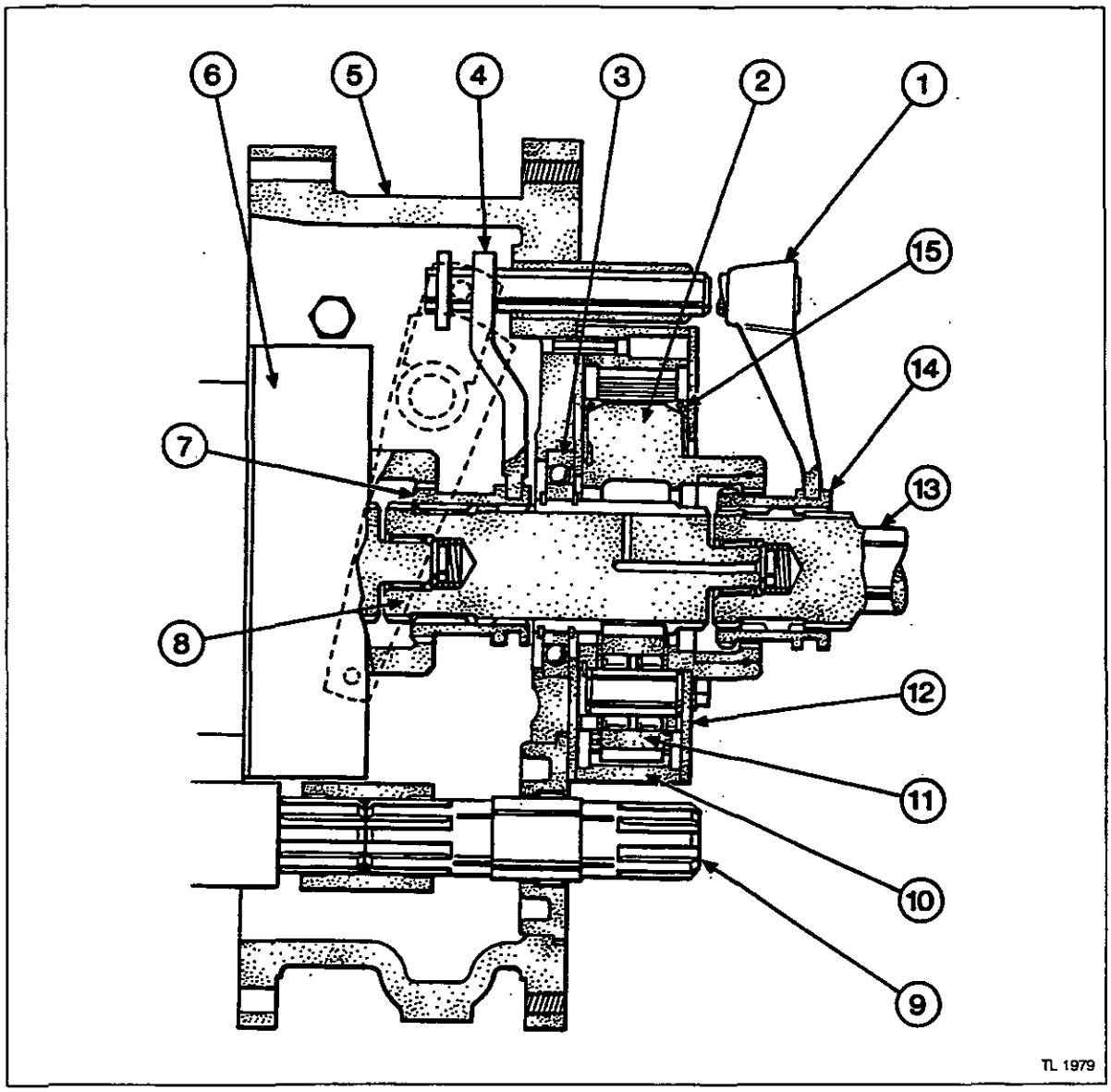
When the creeper gearbox is fitted to the tractor the epicyclic reduction on the back of the gearbox becomes the creeper unit operated by the control lever beside the drivers seat. The high/low gear lever on the gearbox top now operates the epicyclic reduction unit on the back face of the creeper gearbox casing. This is accomplished through an extension of the shifter rail and fork. The additional epicyclic gives a further 4:1 ratio reduction in speed. The epicyclic assembly fitted to the creeper gearbox is identical to the heavy duty epicyclic unit fitted to a standard gearbox. It consists of a ring gear and three planetary pinions mounted on the rear of the creeper gearbox casing. It is driven by the coupler on the main gearbox epicyclic unit through the drive shaft which acts as the sun gear for the epicyclic unit.

The drive is transmitted from the creeper gearbox to the rear axle by the rear axle drive shaft which is connected by a coupler, either directly to the creeper gearbox drive shaft (HIGH range) or the planetary pinion carrier where the output speed of the gearbox is reduced by a 4:1 ratio (LOW range).

The gearbox epicyclic (creeper range) is operated through a cable control where the hand control is located beside the drivers seat:

To engage, press the clutch pedal down and pull the control handle up (CREEPER range).

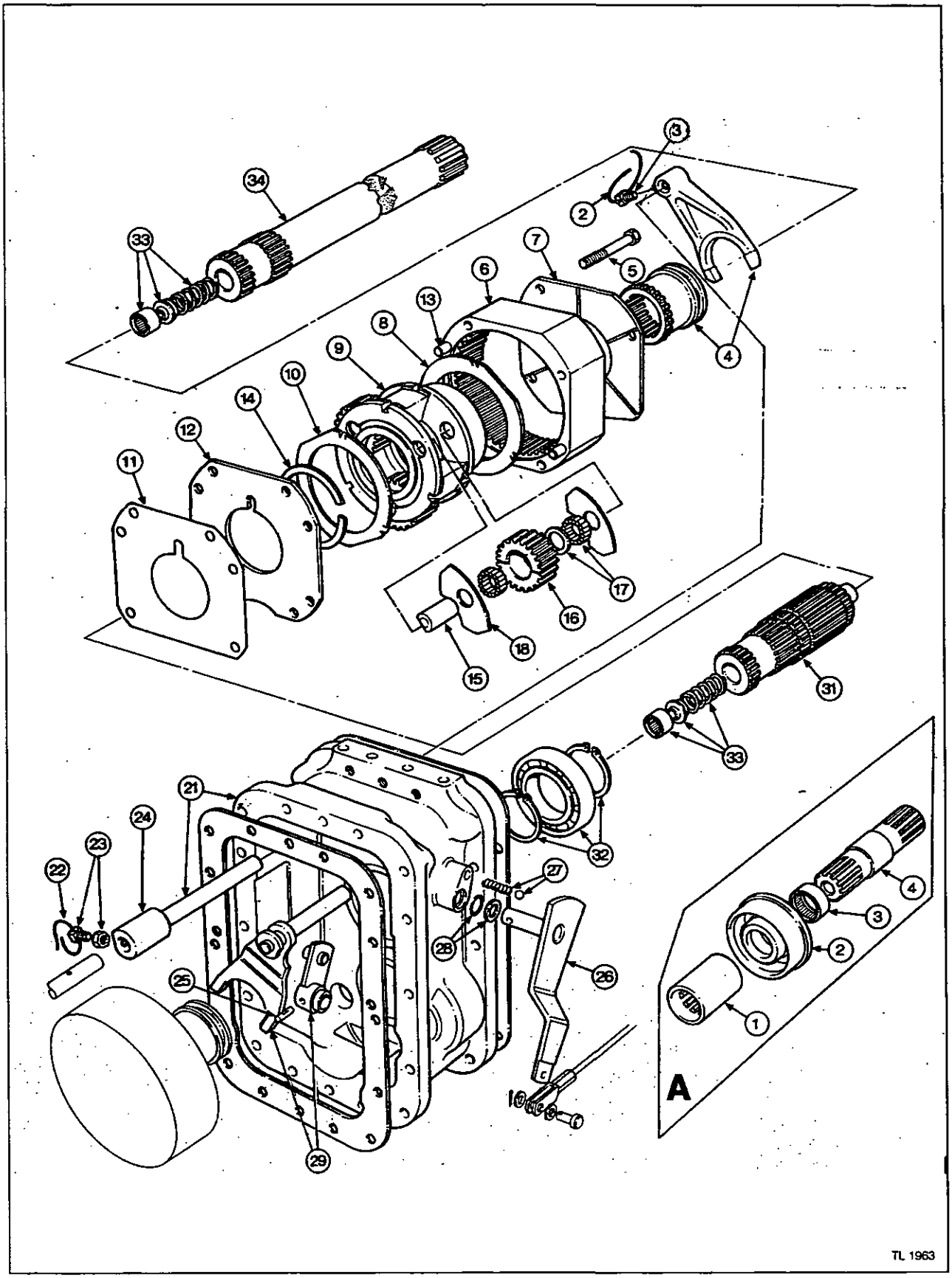
To disengage, press the clutch pedal down and push the control handle down (NORMAL range).



Epicyclic creeper gearbox

1. High/low selector fork.
2. Planetary carrier.
3. Drive shaft bearing.
4. Creeper selector fork.
5. Gearbox casing.
6. Main gearbox epicyclic unit.
7. Coupler.
8. Drive shaft.
9. PTO shaft.
10. Planetary ring gear.
11. Planetary pinions.
12. Cover plate.
13. Rear axle drive shaft.
14. Coupler.
15. Thrust ring.

CREEPER GEARBOX



Epicyclic Creeper Gearbox

Overhaul 7K–01

Dis–assembly

1. Disconnect the control cable and split the tractor between the creeper gearbox and the rear centre housing, see section 2.
2. Remove the locking wire.
3. Remove the locking screw.
4. Remove the selector fork and coupling.
5. Remove the bolts.
6. Remove the epicyclic assembly.
7. Remove the cover plate.
8. Remove the rear thrust ring.
9. Remove the planetary pinion carrier.
10. Remove the front thrust ring.
11. Remove the shim.
12. Remove the front plate.
13. If necessary, remove the two dowels from the planetary ring gear.
14. Remove the external snap ring.
15. Gently tap out the three pinion shafts towards the front.
16. Remove the planetary pinions.
17. Remove the two sets of rollers and spacer from each pinion.
18. Remove the wear plates from each side of each pinion.

Driveshaft and control linkage

19. Take the weight of the creeper gearbox casing on a small crane.
20. Remove the the nuts and bolts securing the casing to the main gearbox.
21. Very carefully slide the creeper gearbox off the selector rod and PTO shaft.

NOTE: If the creeper gearbox has been fitted in the field the PTO shaft will be in two parts and supported in a central bearing assembly as detailed in view 'A'. If factory fitted a one piece shaft will be used. (1) Coupling. (2) Bearing housing. (3) Needle roller bearing. (4) PTO shaft extension.

22. Remove the locking wire.
23. Slacken the locknut and remove the locking screw.
24. Remove the selector rod.
25. Remove the groove pin from the selector lever.
26. Remove the operating lever.
27. Retain the ball and spring.
28. Discard the 'O' ring and keep the washer.
29. Remove the selector fork and selector lever.
30. Remove gearbox coupler.
31. Remove the drive shaft from the casing by gently tapping it out from front to back with a soft hammer.
32. The two circlips and bearing may be removed from the shaft if necessary.
33. The internal needle roller bearing, thrust pad and spring may be removed if necessary.
34. Remove the rear axle drive shaft and replace the needle roller bearing, thrust pad and spring if necessary.

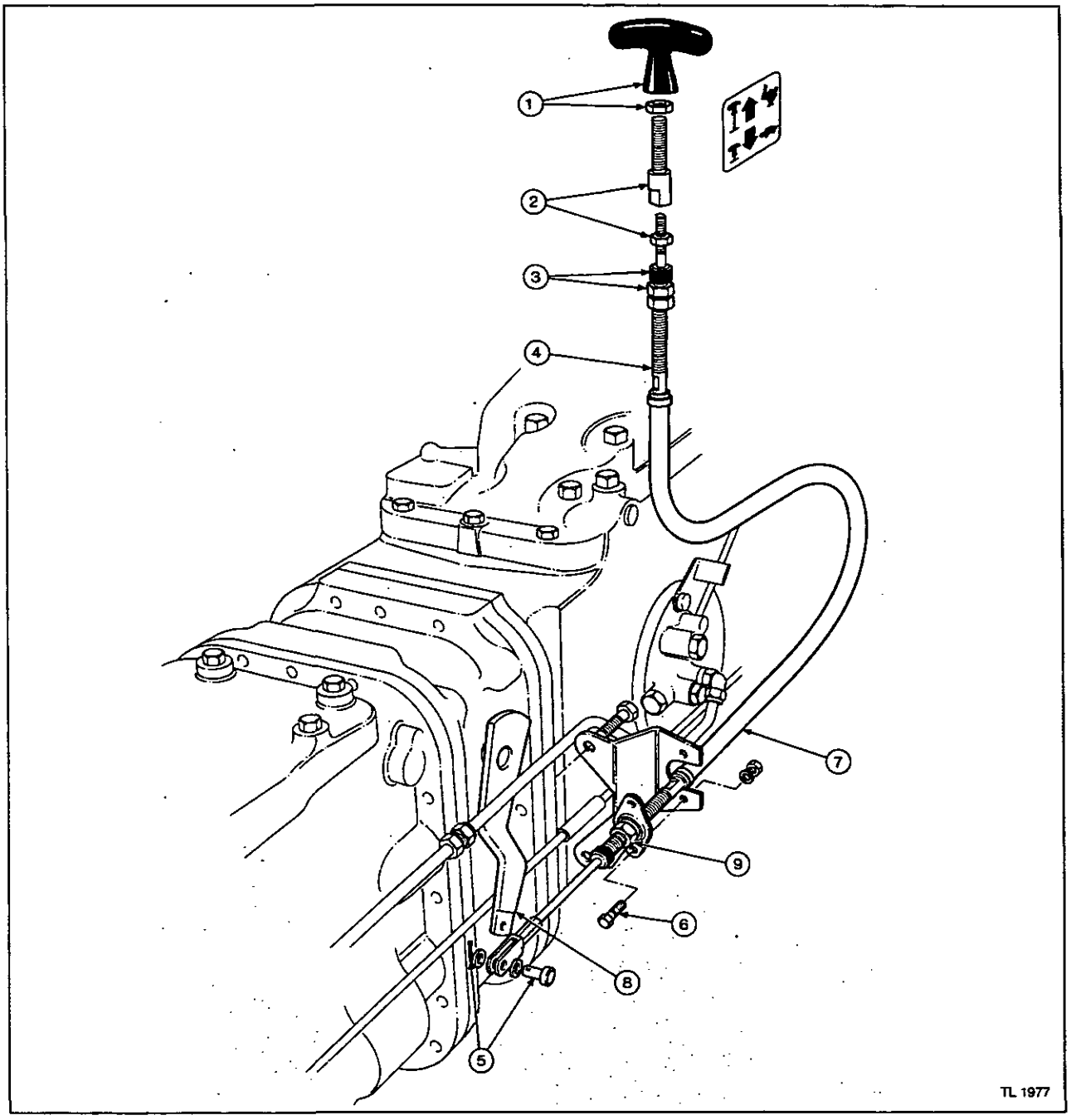
Re–assembly

35. Reverse procedures 1 to 18, except:
    a. When replacing the rollers in the pinions, a smear of petroleum jelly (not grease) will help to retain them. Do not omit the spacer from between the two rows of rollers. Each row consists of 16 rollers.
    b. The front plate and the cover plate must be positioned with the oil grooves towards the pinion carrier.
    c. Ensure that the pinion wear plates are refitted with the flats positioned innermost to the centre of the pinion carrier.
    d. Locate the cover plate with the cut out, to the bottom left-hand corner.
    e. Ensure the gap of the snap ring is located midway between the planetary pinion shafts.
    f. To assist assembly of the front and rear thrust rings on the pinion carrier, smear them with petroleum jelly (not grease). Ensure that the tabs on the thrust rings locate in the pinion carrier cut-outs, and that the brass faces are away from the pinion carrier.
    g. Tighten the retaining bolts progressively and evenly to a torque of 43 Nm (32 lbf ft).

Driveshaft and control linkage

36. Reverse procedures 19 to 33 except:
    a. Fit a new 'O' ring to the operating lever.
    b. Pack the ball and spring (27) with a small amount of grease.
    c. Fit a new groove pin (25).
    d. Tighten the selector locking screw (23) then turn back 1/3 to 1/2 turn and lock in position with the locknut. Replace the locking wire.
    e. If the needle roller bearing has been removed from the end of the drive shaft. Press the new bearing into the shaft so that it is 2.5 mm (0.100 in) below the front face of the shaft.
37. When re-assembling the transmission fit new gaskets dry between the main gearbox and creeper gearbox, and between the creeper gearbox and the rear centre housing. Torque tighten all the nuts and bolts to 112 Nm (83 lbf ft).

CREEPER GEARBOX



Creeper Gearbox Control Cable

Removal and Refitment 7K–02

Removal

1. Remove the control cable hand knob.
2. Remove the hand knob extension and locknut.
3. Remove the knurled sealing cap and cable retaining nut.
4. Pull the cable down through the seat deck.
5. Remove the clevis pin, washer and split pin and detach the cable from the operating lever.
6. Remove the two bolts from the cable bracket.
7. Remove the cable assembly.

Refitment

8. Reverse procedures 1 to 7. Ensure that the operating lever is able to operate through its full range.
9. Adjustment of cable length is made by moving the position of the two nuts each side of the self aligning bearing.

12 SPEED SHUTTLE CREEPER GEARBOX

Specification:

Application	Tractors fitted with 12 speed shuttle gearbox excluding 398 and 399 tractor with 40 km/hr transmission.
Speed reduction ratio	4.7 : 1.
Number of creeper speeds	4.
Speed range	0,37-0.83 km/hr at 2200 engine rev/min.
Total number speed ranges obtainable:	
362, 365, 372, 375, 382, 390 and 390T:	
30 km/hr transmission	16 forward x 12 reverse.
40 km/hr transmission	16 forward x 16 reverse.
398 and 399:	
30 km/hr transmission	16 forward x 16 reverse.
40 km/hr transmission	Creeper gear not fitted.

Bolt Torques

Selector lever lock screws	8 Nm (6 lbf ft).
Lower shaft lock screws	8 Nm (6 lbf ft).
Selector lever pivot bolt	10 Nm (7 lbf ft).
Gearbox cover bolts	112 Nm (82 lbf ft).
Creeper cover bolts	112 Nm (82 lbf ft).
Creeper cover nuts	60 Nm (44 lbf ft).

General Description (Figs. 1, 2 and 3)

The creeper reduction unit is a self contained set of gears mounted in the front section of the gearbox above the forward and reverse shuttle gears. It is only fitted to the 12 x 12 shuttle gearbox. Engagement of the creep gears is by means of a sliding gear in the creeper unit and a sliding collar on the input shaft operated by an interconnected selector fork. The selector fork is operated by an internal and external lever which in turn is connected by a control cable to the operating handle on the seat deck. A warning light on the tractor instrument panel indicates when the creeper gear is fully engaged. Built into the selector mechanism is an interlock device which prevents the creeper gears being selected in any range other than low. This protects the creeper gears from exposure to excessive loading in the higher speed ranges and prevents unnecessary duplication of speeds.

The creeper unit (see Figs. 1 and 2) consists of a simple train of five gears interposed between the input shaft and the main gearbox constant mesh gear to give a reduction of 4.7 : 1. The transmission input shaft assembly is different from the standard shaft fitted to this gearbox. In the centre of the shaft there is a sliding collar which connects to shaft with one of two gears. Moving the collar rearwards engages normal drive constant mesh gear. Moving it forwards engages creep.

There are two different types of reverse idler, simple or compound train that can be fitted to the gearbox. This results in two types of input shaft assembly. The simple train is shown in figure 1 and it will be noted that there are two constant mesh gears. The front gear, reverse, meshing through the idler to the layshaft gears. The rear gear, forward, is meshed directly with the layshaft gear (this does not show on the illustration due to it being laid out flat). The compound train shown in figure 2, there is only one input shaft constant mesh gear. This is engaged with both the reverse idler gear and the forward gear on the layshaft. The second gear on the reverse idle shaft engages with the layshaft reverse gear. Due to the different layout of reverse idler, tractors fitted with the simple gear train as shown in figure 1 will only have creep speeds in forward gear due to the reverse constant mesh gear being splined to the input shaft. With the compound gear train in figure 2, forward and reverse speeds are both taken off the rear constant mesh gear this results in creep speeds in both forward and reverse. Figure 3 shows the drive path through the gears for both types of gearbox.

When the creeper gear is engaged the transmission must first be placed in low range forward gear. The main engine clutch pedal is pressed down, the creep handle pushed down into the engaged position. Release the clutch pedal keeping pressure on the creep handle until the indicator light lights-up. Release the handle. Pushing the handle down into creep moves the sliding collar out of mesh with the main constant mesh gear (F) and into engagement with the first creep gear (A). At the same time the upper end of the selector lever engages gear (D) with gear (E) which is in mesh with the main constant mesh gear (F). The drive train is then completed through gears (A), (B), (C), (D) and (E). The constant mesh gears drive the forward and reverse shuttle gears and synchromesh units on the layshaft.

The creeper gearbox is available as a factory fit option only on two and four wheel drive tractors.

CREEPER GEARBOX

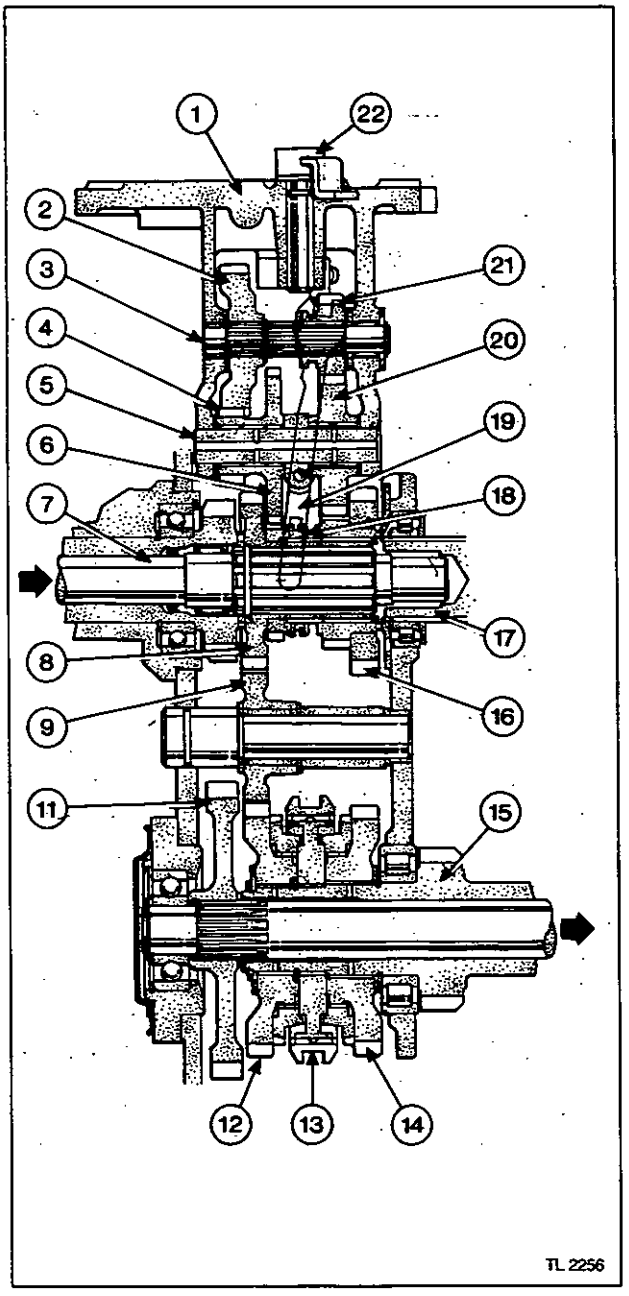


Fig.1 Creeper gearbox with simple reverse idler.

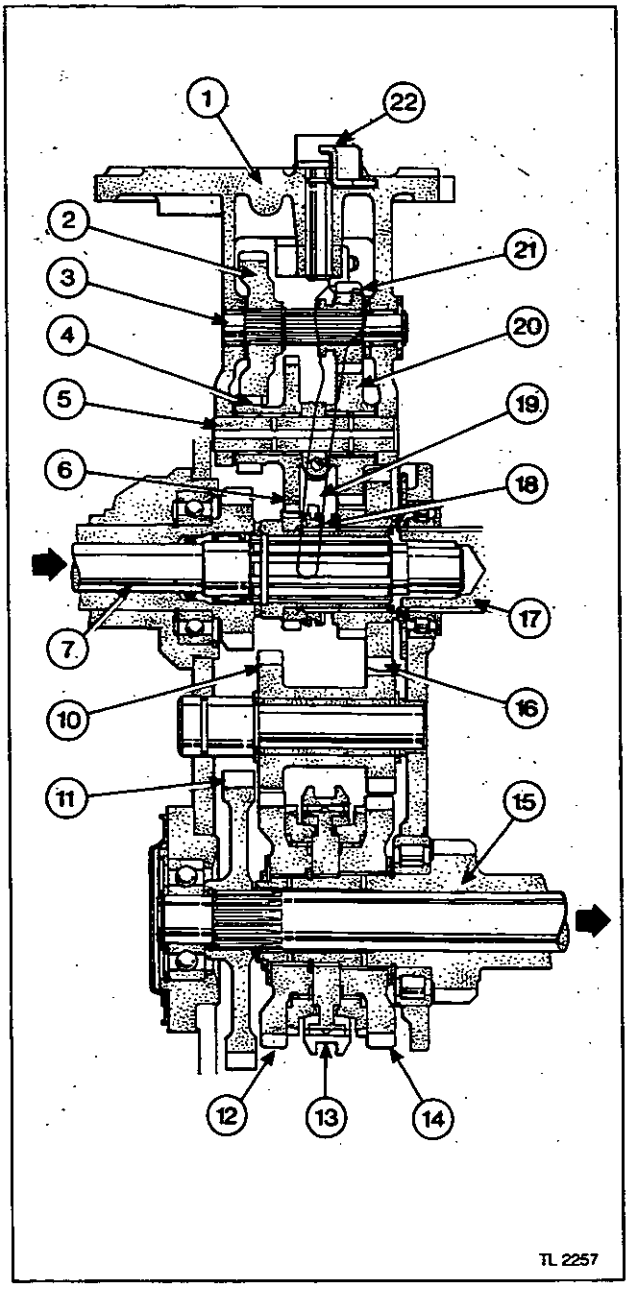
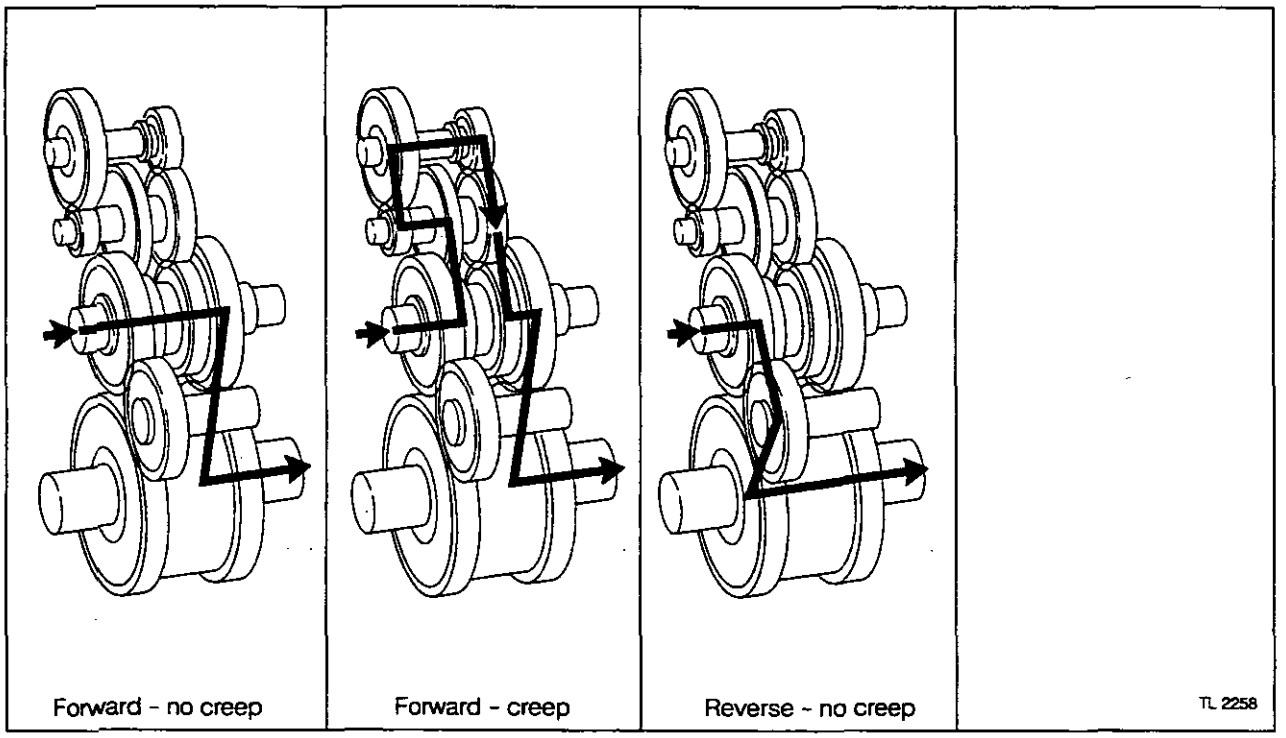


Fig.2 Creeper gearbox with compound reverse idler.

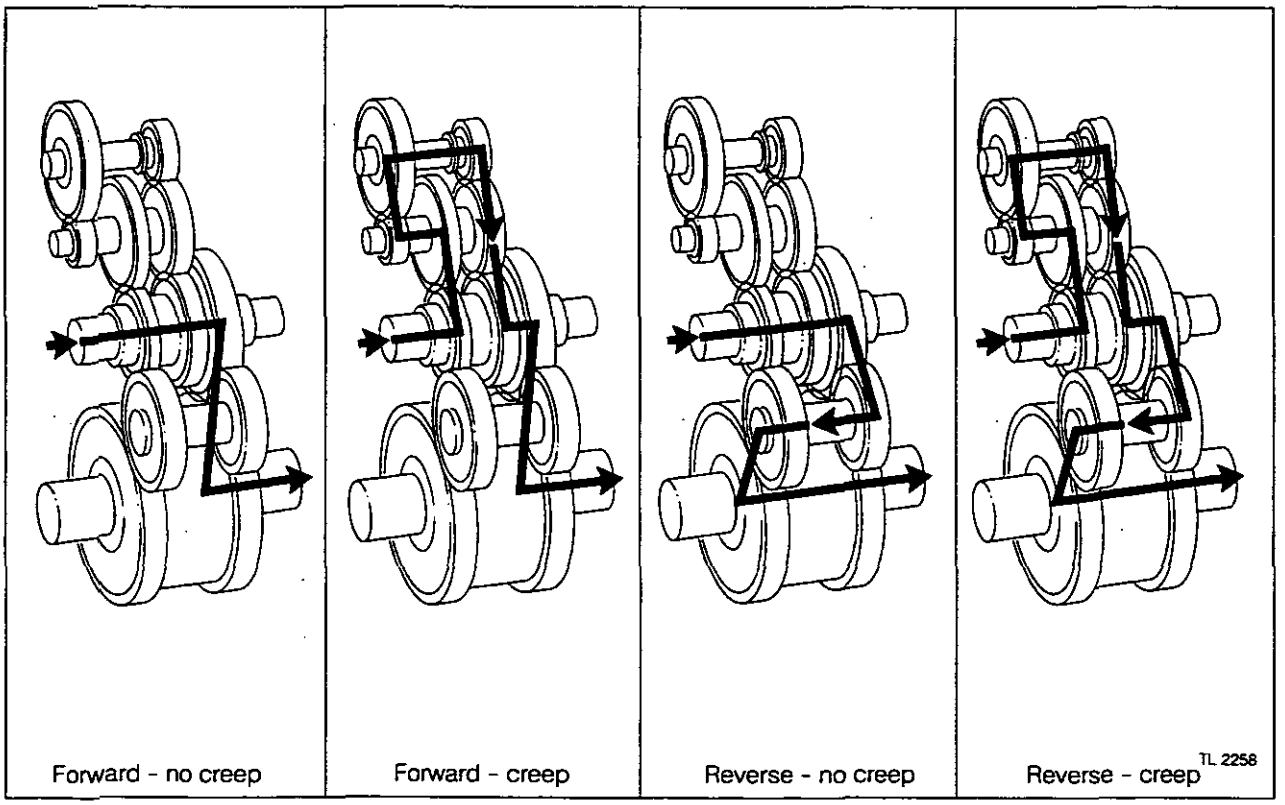
1. Creeper gearbox.
2. Intermediate gear (C).
3. Upper shaft.
4. Input driven gear (B).
5. Lower shaft.
6. Input driver gear (A).
7. Input shaft.
8. Reverse constant mesh gear.
9. Reverse idler gear - simple.
10. Reverse idler gear - compound.
11. PTO gears.
12. Reverse gear.
13. Synchromesh coupler.
14. Forward gear.
15. Lay shaft.
16. Forward constant mesh gear (F).
17. Main shaft.
18. Sliding collar.
19. Selector fork.
20. Output gear (E).
21. Sliding intermediate gear 18T (D).
22. Selector lever.

CREEPER UNIT GEAR TRAIN (Fig.3)

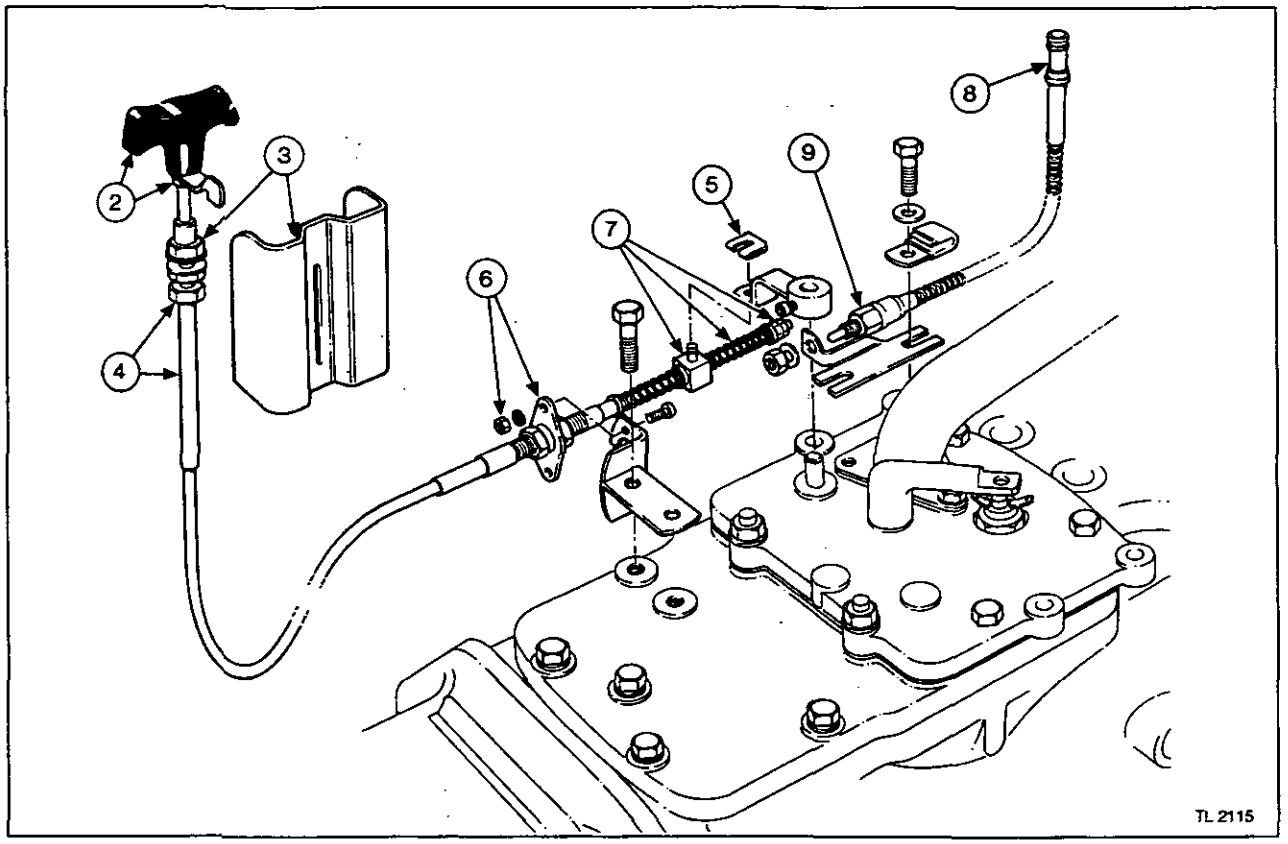
Simple reverse idler – 362, 365, 372, 382, 390 and 390T.



Compound reverse idler. 398 and 399.



CREEPER GEARBOX

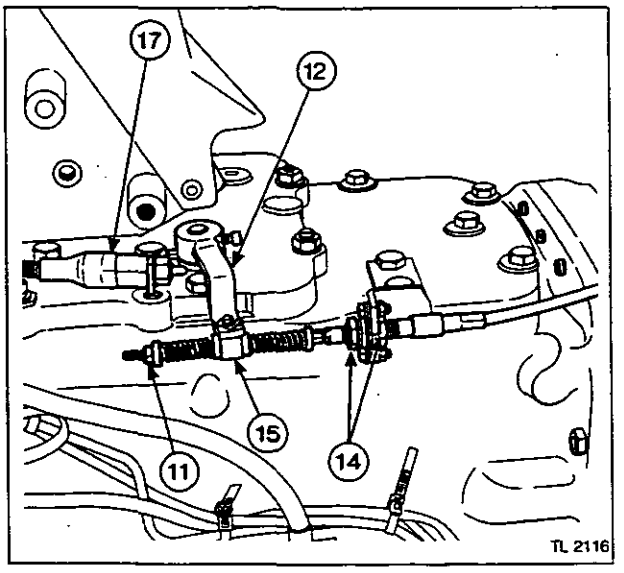


Creeper Control

Removal and Refitment 7K–03

Removal

1. Remove the floor mats and floor plates as necessary.
2. Slacken the locknut and remove operating knob, guide plate and locknut.
3. Remove the upper nut and guard.
4. Remove the second nut and the control cable from the seat deck.
5. Remove the spring clip from the lever on the gearbox top and disconnect the cable end.
6. Remove the two screws and disconnect the cable from the support bracket and remove it from the tractor.
7. If necessary, unscrew the locknut and remove the two springs and pivot block.
8. Disconnect the engaged light switch wiring at the plug.
9. Remove the nut and switch.



Refitment

10. Reverse procedure 1 to 8. Reset the linkage as follows:-
11. Tighten the locknut to the end of the thread so that the two springs are in compression.

12. Place the lever on the gearbox in the forward creep position (it may be necessary to rotate the gearbox to ensure full engagement)
13. With the gearbox end of the cable disconnected adjust the position of the 'T' handle so that there is 3 mm (1/8 in) clearance between the tab and the bottom of the slot when in the fully down position.
14. Adjust the end position of the outer cable using the two nuts either side of the gearbox bracket, so that with the 'T' handle fully down, the spigot on the pivot block is approximately 3 mm (1/8 in) past its locating hole in the creeper selector lever.
15. Fit the pivot block into the lever and fit the clip.
16. Check the operation of the engagement of the creeper gear. It may be necessary to run the engine to get engagement. When the 'T' handle is pushed fully downwards or pulled fully upwards and complete engagement of creeper or normal drive achieved, the amount of compression of the working springs should be approximately equal in both directions. If not, adjustment should be made using the two nuts either side of gearbox bracket.
17. Check the adjustment of the creeper engaged light. This should illuminate on full engagement only. If adjustment is necessary, this is carried out by slackening the two bracket bolts and moving the switch until the indicator light on the instrument panel just operates when engaged. Retighten the two bolt to a torque of 112 Nm (82 lbf ft).

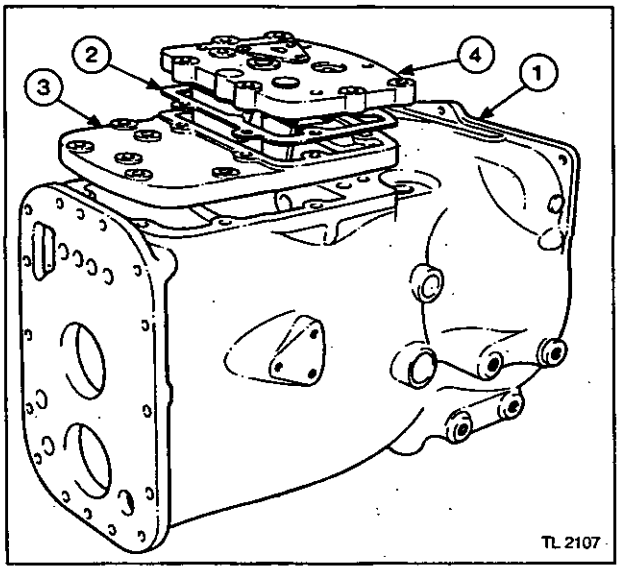
Creeper Unit

Removal and Refitment 7K–04

Removal

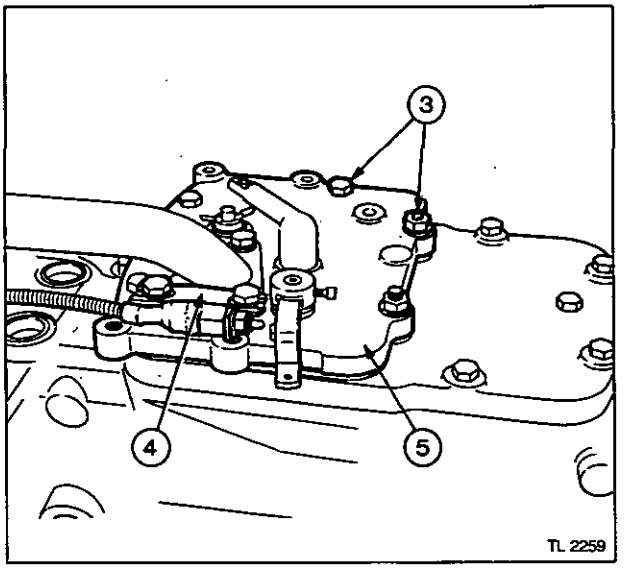
Important Instructions

The gearbox casing (1), steel shim (2) and gearbox cover (3) have been assembled in the factory as a matched set. They control the depth of mesh of the creeper unit gears with the gears on the input shaft. The steel shim (2) must NOT be changed or replaced when fitting a new creeper unit.

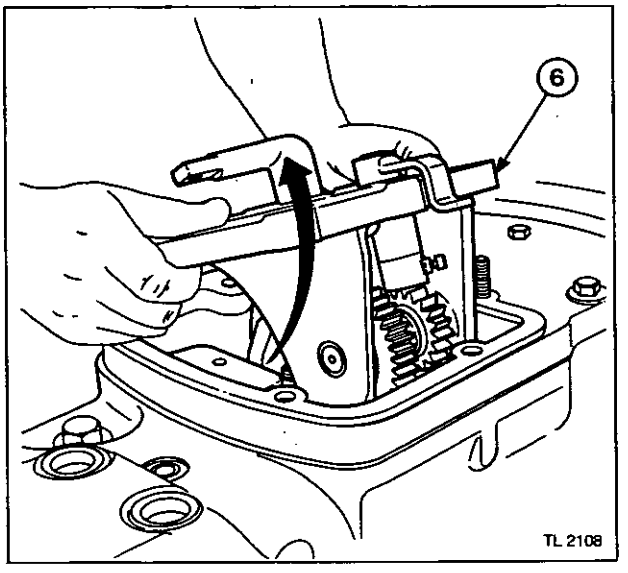


Removal

1. Disconnect the creep control cable, wiring to the engaged light switch and safety start switch.
2. Remove the gearbox and range change unit from the tractor as described in operation 7H-01.
3. Remove the four bolts and two nuts securing the creeper unit to the top cover.
4. Remove the engaged light switch bracket.
5. Break the joint between the creeper unit and the top cover by giving the cover a side tap with a hammer.



6. Standing on the right hand side of the gearbox lift the creeper unit up vertically then tilt it as shown in the illustration so that the selector fork clears the selector collar. Ease the unit out of the gearbox at an angle so that the lower gears clear the main gearbox selector rails.



Refitment

7. Ensure that the range unit is in LOW range and a forward main gear selected so that the gearbox can be rotated to assist in re-assembly.
8. Press the interlock back so that it contacts the selector forks.
9. Move the creeper selector collar on the input shaft forwards into the engaged position.
10. Move the selector fork on the creeper unit into the engaged position i.e. the upper 18 tooth sliding gear is in mesh.
11. Ensure that the two small bronze pivoting pads on the selector fork are in the vertical position.
12. Apply Massey Ferguson Instant Gasket (Loctite 515) to the top of the cover and the steel shim. Install the steel shim as shown in the illustration.
13. Position the shuttle lever in relation to the hole that takes the safety start switch as shown in the illustration.
14. With care install the creeper unit. It will fit back into the gearbox the same way it came out by a rolling action passing the gears round under the selector rails and then down into position. As the unit is finally lowered into place it may be necessary to slightly move the shuttle lever so that it engages with the jaw in the selector fork.
15. Fit the two dowel bolts first. Refit the remaining bolts and nuts, don't forget the switch bracket and wiring clips.
16. Check that the creeper and shuttle levers have engaged correctly. Turn the gearbox over and engage all gears in turn to ensure that it is correctly assembled.

CAUTION: This check and adjustment is very important. The creeper gear must only be allowed to be engaged in LOW range. Engagement in any other range will result in a very serious failure of the gearbox.

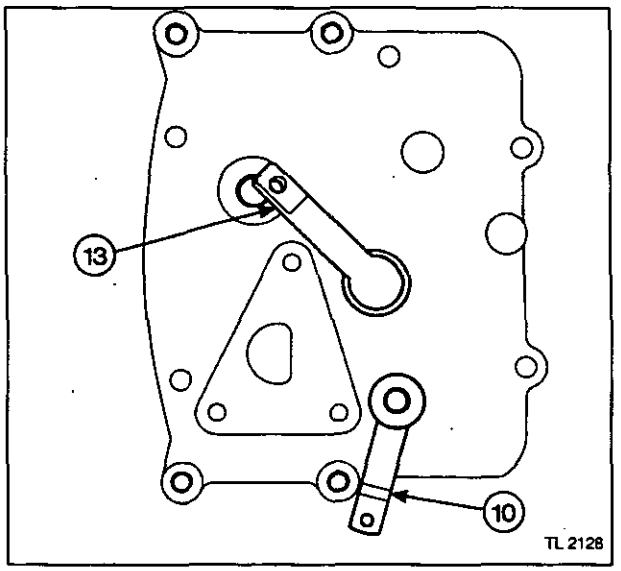
17. Check the operation of the creeper interlock, this prevents engagement of the creeper gear in any other range except LOW range as follows:

Range change check:

a. Select a LOW range.
b. Select 1st gear.
c. Select forward gear.
d. Engage creeper gear.
e. Move the range lever into MEDIUM range. The creeper gear should disengage. Check by rotating the gearbox input shaft. If dis-engagement does not take place the interlock rod length needs adjustment see operation 7K-05 procedures 68 to 71.

Creep gear engagement check:

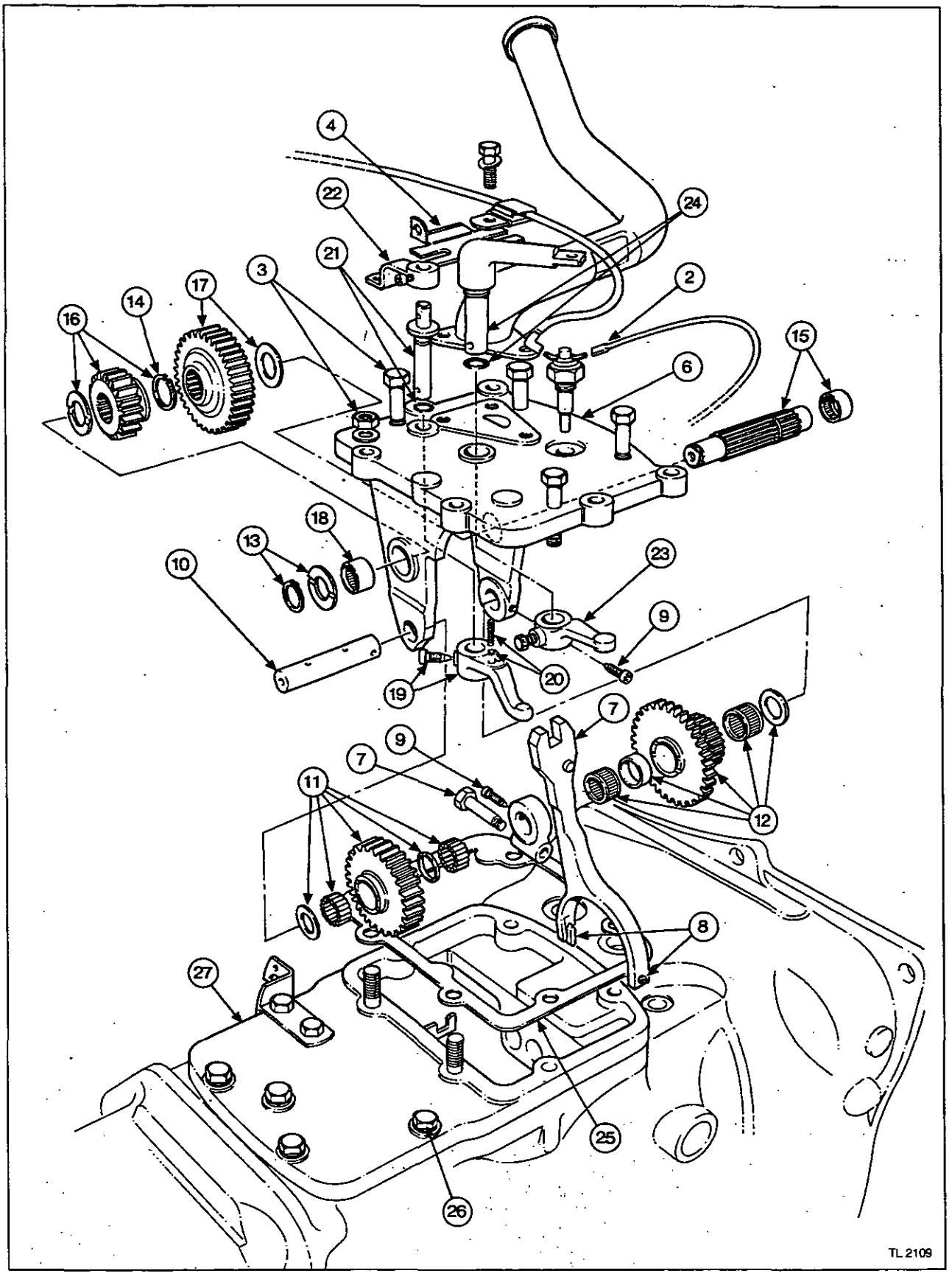
a. Select MEDIUM range.
b. Select 1st gear forward.
c. Creeper gear disengaged.
d. Try to select creeper or gear whilst rotating the input shaft. This must be prevented by the interlock. If engagement takes place the interlock rod length needs adjustment, see operation 7K-05 procedures 68 to 71.



e. Repeat the above check with a HIGH range, forward gear selected.

18. Tighten all the creeper unit and gearbox cover bolts to a torque of 112 Nm (82 lbf ft). Nuts to a torque of 60 Nm (44 lbf ft)
19. Install the gearbox assembly back into the tractor.
20. Reconnect the creeper operating cable and adjust as described in operation 7K-03.

CREEPER GEARBOX



Creeper Unit

Overhaul 7K–05

Important Instructions

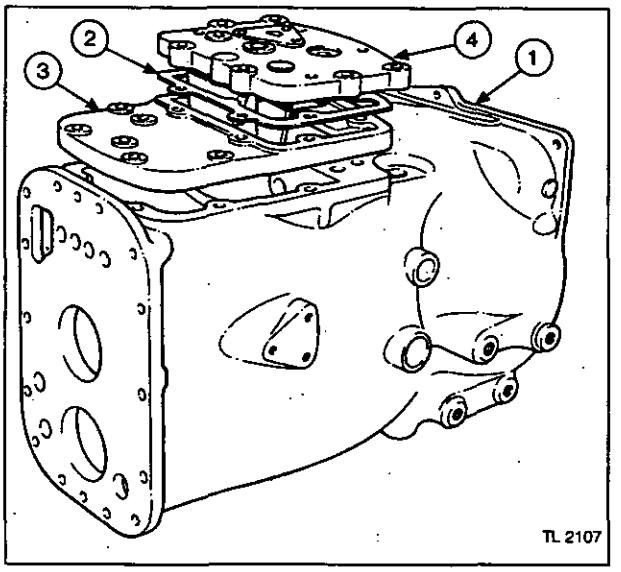
The gearbox casing (1), steel shim (2) and gearbox cover (3) have been assembled in the factory as a matched set. They control the depth of mesh of the creeper unit gears with the gears on the input shaft. These three components must NOT be changed or replaced. In the event of a serious failure which involves the changing of the gearbox casing or the gearbox cover contact the Massey Ferguson Tractors Limited, Product Service Department, Banner Lane, Coventry, England, CV4 9GF, who will provide a matched set.

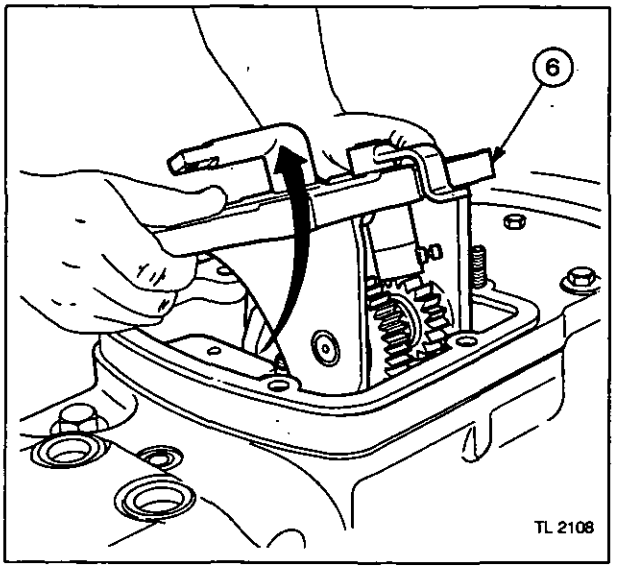
Dis–assembly

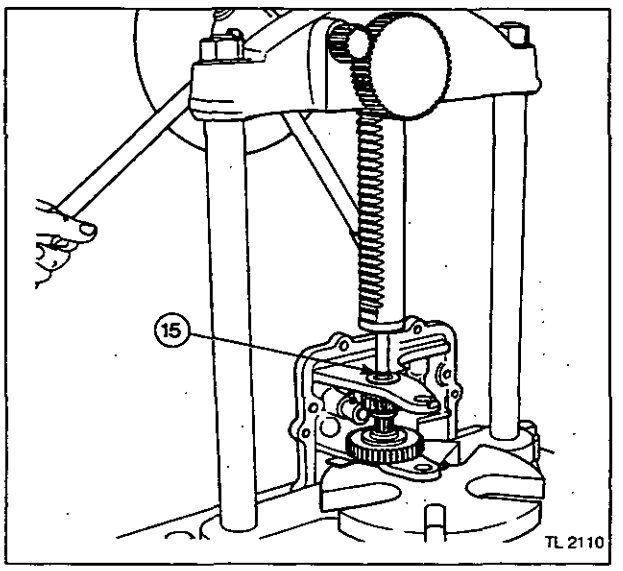
1. Remove the gearbox and range change unit from the tractor as described in operation 7H-01.
2. Disconnect the creep control cable, wiring to the engaged light switch and safety start switch.

Creeper Unit

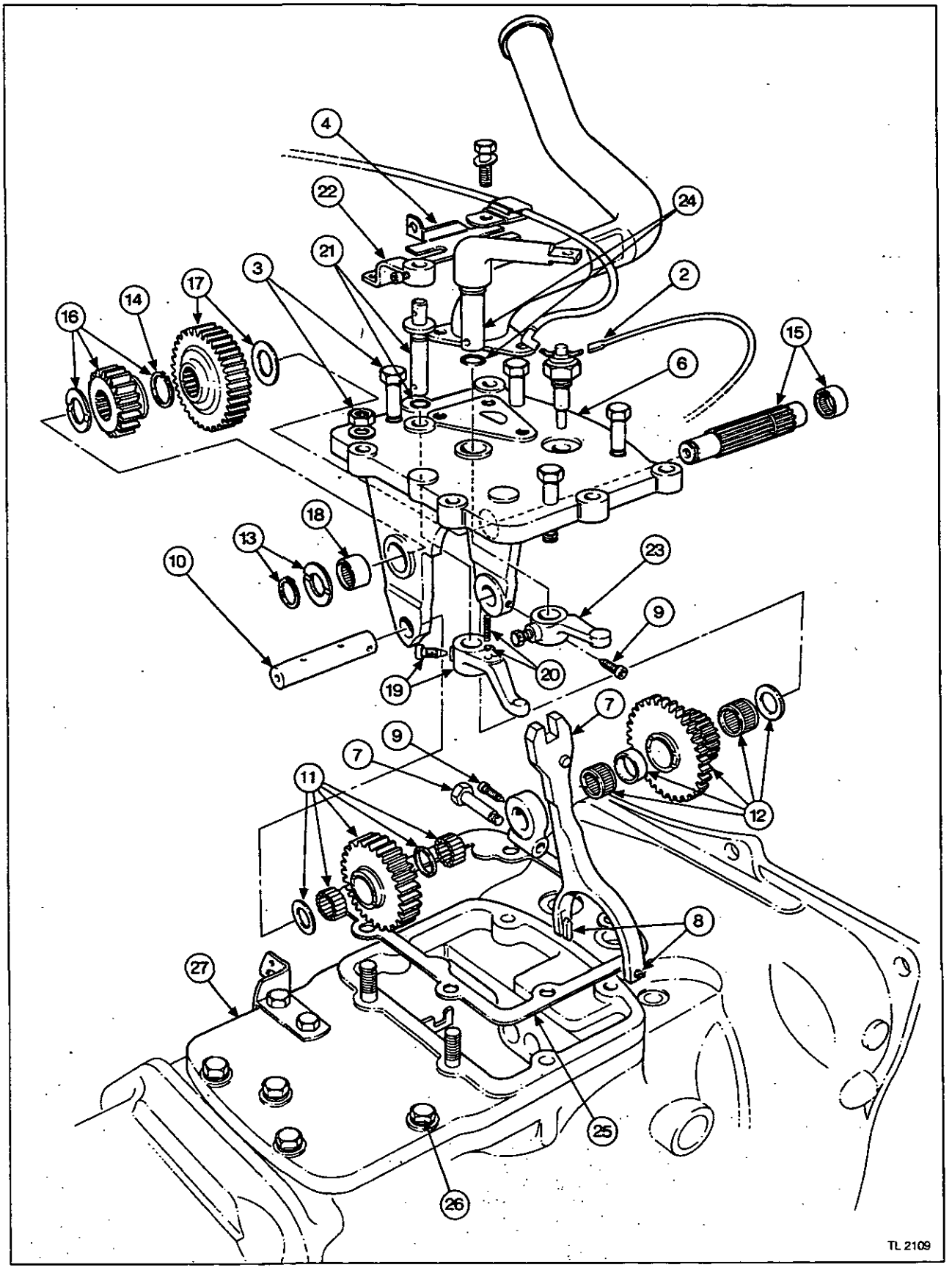
3. Remove the four bolts and two nuts securing the creeper unit to the top cover.
4. Remove the engaged light switch bracket.
5. Break the joint between the creeper unit and the top cover by giving the cover a side tap with a hammer.
6. Standing on the right hand side of the gearbox lift the creeper unit up vertically then tilt it as shown in the illustration so that the selector fork clears the selector collar. Ease the unit out of the gearbox at an angle so that the lower gears clear the main gearbox selector rails.
7. With the unit on a work bench, remove the selector fork pivot bolt and fork assembly.
8. If necessary, remove the two spring clips and the two bronze pivoting pads.
9. Remove the locking screws from the pivot bearing and casting.
10. Slide the lower shaft out of the gears, pivot bearing and housing. Carry out this task carefully, the single gear contains two sets of uncaged needle roller bearings.
11. Remove the output gear, bearings, spacer and thrust washer. Empty the washers and roller bearings into a clean container.
12. Remove the input gear, caged needle roller bearings, spacers and thrust washer.
13. Remove the intermediate shaft circlip and thrust washer.
14. Open-up the central circlip and slide it along the shaft towards the small sliding gear.
15. Place the creeper unit on its side under a hand press. Gently press the shaft from the back to the front (left to right looking at the illustration). This will enable the shaft to press the front caged needle roller bearing out of the casting. This bearing must be renewed on re-assembly.

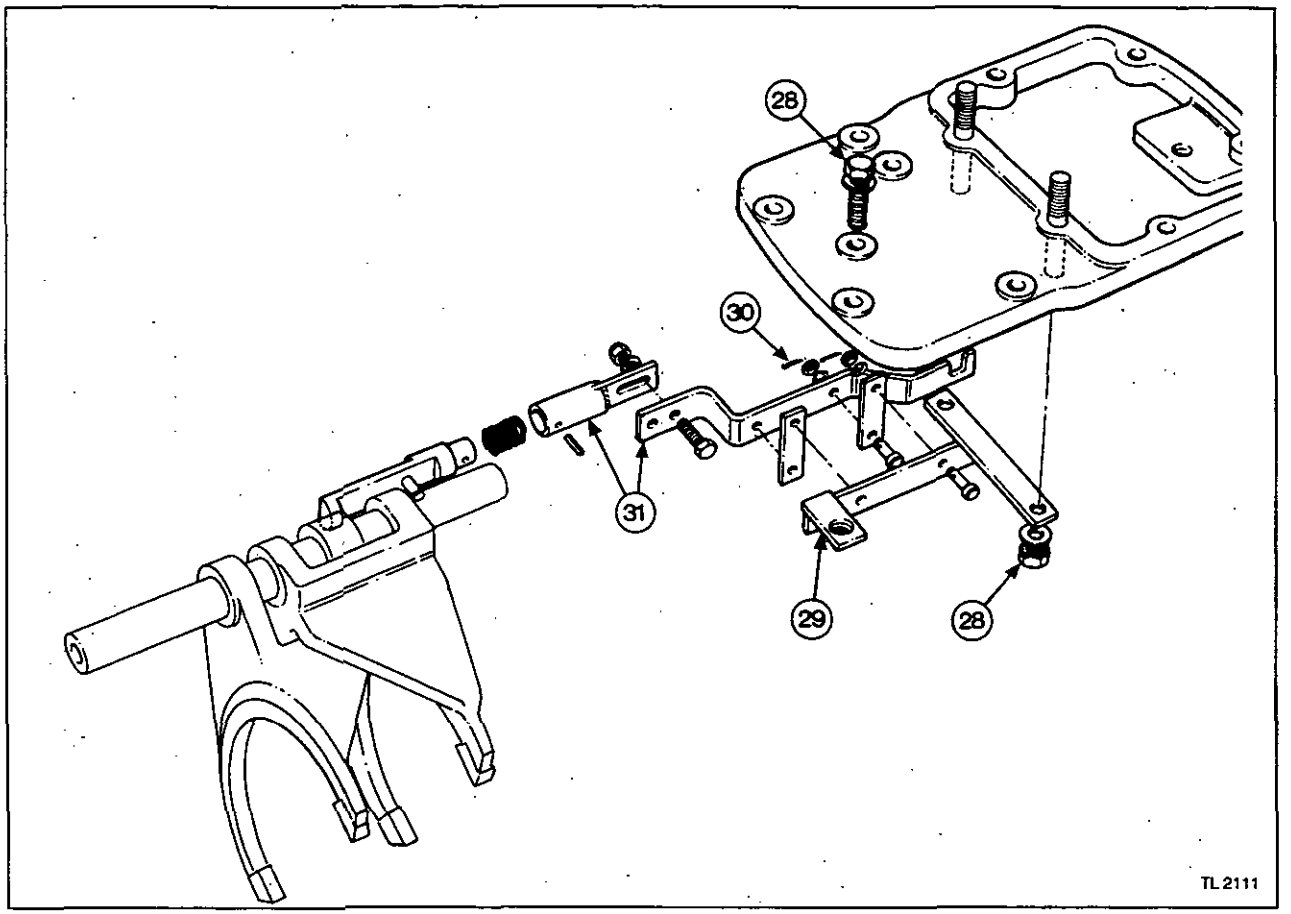






CREEPER GEARBOX





16. Remove the sliding intermediate gear, thrust washer and circlip.
17. Remove the intermediate fixed gear and thrust washer.
18. If necessary, remove the rear needle roller bearing. If this bearing is removed it must be renewed on re-assembly.
19. Remove the lower selector lever lock screw and lever.
20. Remove the ball and spring.
21. Remove the creeper selector shaft and 'O' ring. Discard the 'O' ring.
22. If necessary, remove the upper selector lever lock screw and lever.
23. If necessary, remove the shuttle lever lock screw and lever.
24. Remove the selector shaft and 'O' ring. Discard the 'O' ring.

Gearbox top cover

25. Remove the steel shim and retain.
26. Remove the remaining top cover bolts.
27. Lift the cover up and forwards so that the interlock rod which passes into the range unit can be withdrawn.

Interlock

The interlock prevents the creeper unit being engaged in any other gear except LOW range. A rod passes from the creep selector fork to the range unit selector forks. This rod has been set in the factory and should not require any attention. DO NOT alter the length adjustment unless new parts are being fitted.

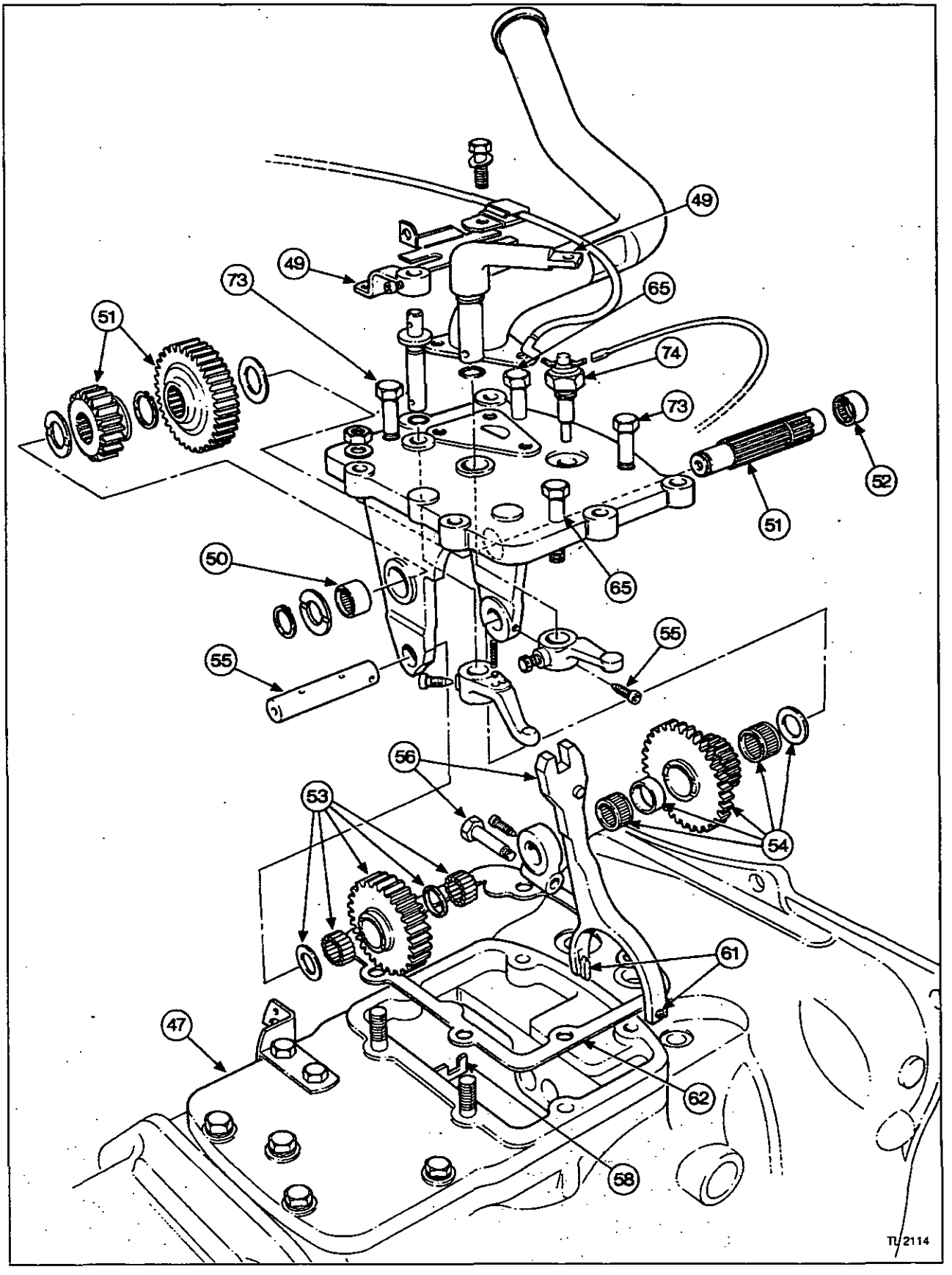
28. Remove the two nuts and washers, and the single bolt.
29. Remove the assembly from the cover.
30. If necessary, remove the split pins, plain washers, spring washers and clevis pins .
31. Dismantle the linkage.

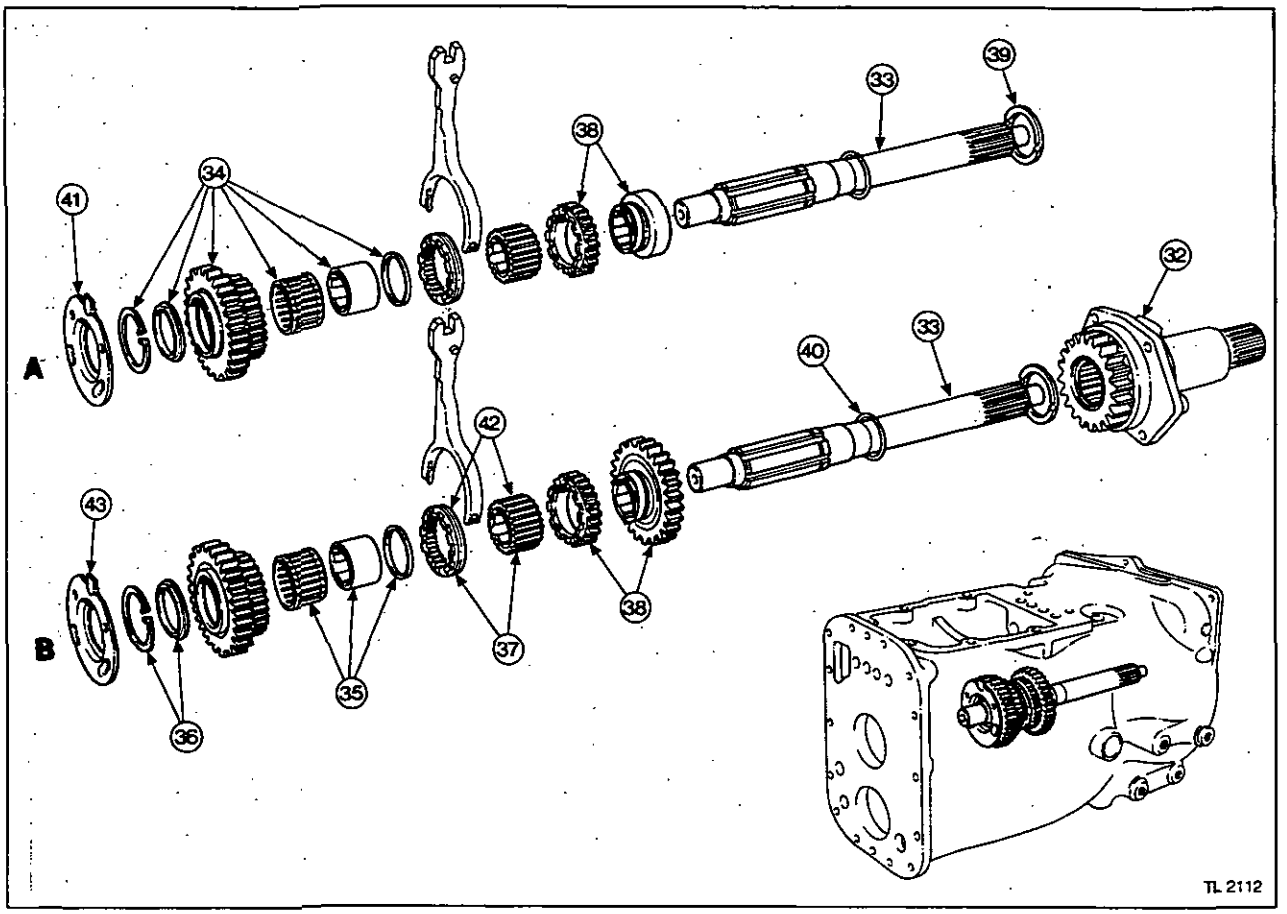
Input shaft

There are two types of input shaft. Type 'A' used with gearboxes with a compound reverse idler gear train. Type 'B' with a simple reverse idler gear train. The repair procedure is identical for both types.

32. Remove the input housing, see operation 7H-06.
33. Remove the input shaft by holding the input gears and lifting them out of the gearbox one at a time.
34. Remove the compound gear assembly complete with bearing. sleeve and washers.
35. Remove the needle roller bearing, sleeve and ring.
36. Remove the circlip and stepped ring.
37. Lift out the selector collar and splined sleeve.

CREEPER GEARBOX





38. Finally, lift out the drive gear and collar or reverse gear depending on the type of gearbox.
39. Remove the thrust washer.
40. If necessary, remove the snap ring.
41. Remove the main thrust washer.

Examination

Clean and carefully examine all the components, especially those subject to movement, and replace any that show signs of damage or wear. Renew all circlips, snap rings and 'O' rings. When re-assembling the gearbox ensure that all circlips are correctly located in their grooves.

Re–assembly

The re-assembly of the creeper unit is a reverse procedure of its dis-assembly. The following instructions are a further guide with details on any particular instructions that may apply.

Input shaft

42. Ensure that the selector collar slides freely on the splined sleeve.
43. Hold the main thrust washer in place during assembly with petroleum jelly, NOT GREASE.
44. When refitting the input housing ensure that the machined flat on the reverse idler shaft locates correctly on the housing.

Interlock

45. If the interlock, range change selector fork, creeper unit, input shaft (or its associated components) or range change unit output shaft components are being replaced or there is a need to re-adjust the interlock rod then proceed as follows. If this does not apply then replace the unaltered interlock assembly and continue on procedure 47.
46. Set the length of the rod to its minimum setting by making the adjustment at the slotted part of the linkage. This is the starting point and you may have to make further adjustments later when all the components of the creeper unit are assembled.
47. Install the gearbox cover and steel shim.
48. Replace the cover bolts but do not tighten, leave them loose so the cover can move.

Creeper unit

49. Install the shuttle and creeper levers with new 'O' rings, apply Massey Ferguson Studlock (Loctite 270) to the locking screws and tighten to a torque of 8 Nm (6 lbf ft). DO NOT forget the ball and spring on the creeper lever.

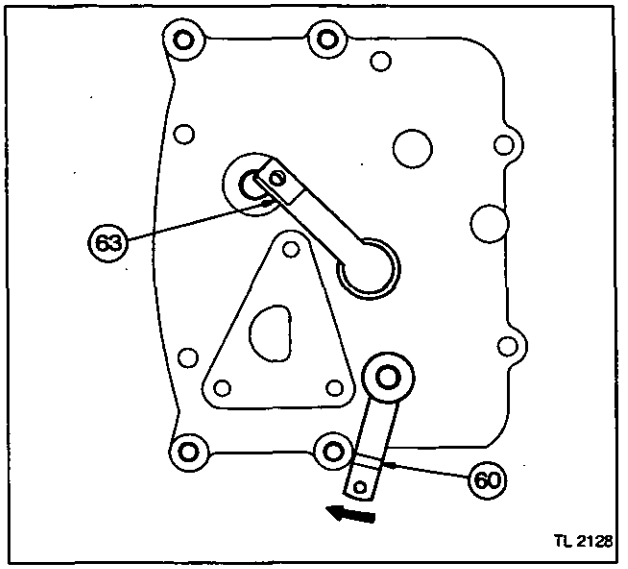
50. If the old bearing has been removed then press a new rear upper shaft needle roller bearing into the casting ensuring that it does not project on either side. DO NOT use a hammer to install, the bearings are susceptible to damage.

NOTE: Press the bearing on the flat/part number end of the bearing cup, NOT the rounded end.

51. Install the upper shaft, gears, thrust washers and circlips.
52. Press a new front needle roller bearing into place, pressing on the flat/part number end of the bearing cup.
53. Coat the inside of the output gear with petroleum jelly, NOT GREASE. Install the spacer and two rows of needle rollers, 21 rollers in each row.
54. Install the two needle roller bearings and spacer and thin thrust washers into the input gear. A little petroleum jelly will help to retain them.
55. Install the shaft, gears, thrust washers and selector fork pivot block. Apply Massey Ferguson Studlock (Loctite 270) to the lock screw in the casting and the pivot block. Tighten to a torque of 8 Nm (6 lbf ft).
56. Refit the selector fork ensuring the peg locates in the groove of the 18 tooth sliding gear, apply Massey Ferguson Studlock (Loctite 270) to the thread on the pivot bolt and tighten to a torque of 10 Nm (7 lbf ft).

Installing the creeper unit

57. Ensure that the range unit is in LOW range and a forward main gear selected so that the gearbox can be rotated to assist in re-assembly.
58. Press the interlock back so that it contacts the selector forks.
59. Move the creeper selector collar on the input shaft forwards into the engaged position.
60. Move the selector fork on the creeper unit into the engaged position i.e. the upper 18 tooth sliding gear is in mesh.
61. Ensure that the two small brass pivoting pads on the selector fork are in the vertical position.
62. Install the steel shim as shown in the illustration.
63. Position the shuttle lever in relation to the hole that takes the safety start switch as shown in the illustration.
64. With care install the creeper unit. It will fit back into the gearbox the same way it came out by a rolling action passing the gears round under the selector rails and then down into position. As the unit is finally lowered into place it may be necessary to slightly move the shuttle lever so that it engages with the jaw of the selector fork.
65. Fit the two dowel bolts first. Refit the other remaining bolts and nuts.
66. Check that the creeper and shuttle levers have engaged correctly. Turn the gearbox by the input shaft and engage all gears in turn to ensure that it is correctly assembled.



Interlock check

CAUTION: This check and adjustment is very important. The creeper gear must only be allowed to be engaged in LOW range. Engagement in any other range will result in a very serious failure of the gearbox.

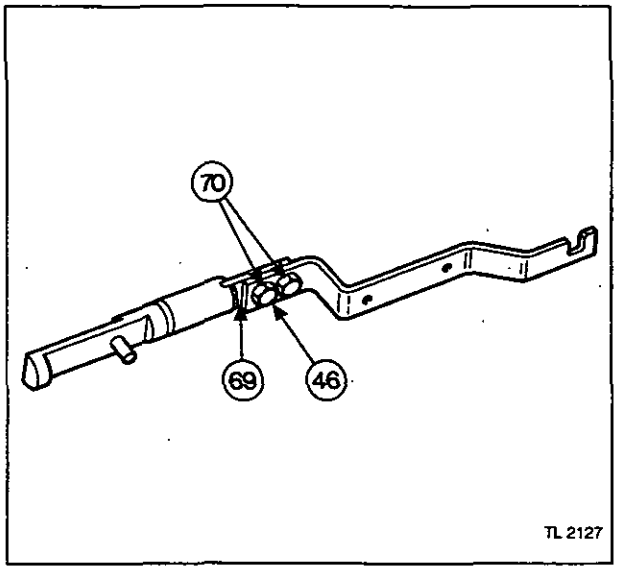
67. Check the operation of the creeper interlock, this prevents engagement of the creeper gear in any other range except LOW range as follows:

Range change check:

a. Select a LOW range.
b. Select 1st gear.
c. Select forward gear.
d. Engage creeper gear.
e. Move the range lever into MEDIUM range. The creeper gear should disengage. Check by rotating the gearbox input shaft. If dis-engagement does not take place the interlock rod length needs adjustment, see procedures 68 to 71.

Creep gear engagement check:

a. Select MEDIUM range.
b. Select 1st gear forward.
c. Creeper gear disengaged.
d. Try to select creeper or gear whilst rotating the input shaft. This must be prevented by the interlock. If engagement takes place the interlock rod length needs adjustment, see procedures 68 to 71.
e. Repeat the above check with a HIGH range, forward gear selected.



Interlock adjustment

68. Remove the creeper unit, and top cover.
69. Scribe a line on the linkage at the end of the adjustable section as indicated in the illustration.
70. Slacken the two bolts and lengthen the rod by 2 mm, this should be sufficient to overcome the problem. Retighten the nuts and re-install the unit and check its operation as described in procedure 66 and 67.

NOTE: This procedure must be followed as incorrect setting of the interlock rod could result in only partial engagement of the creeper gear.

71. Repeat the adjustment procedure until the correct adjustment has been obtained.
72. Apply Massey Ferguson Instant Gasket (Loctite 515) to the joint between the gearbox cover, shim and creeper unit.
73. Tighten all the creeper unit and gearbox cover bolts to a torque of 112 Nm (82 lbf ft) and nuts to 60 Nm (44 lbf ft), don't forget the switch bracket, wiring clips and cable control bracket.
74. Refit the safety start switch and light switch.
75. Install the gearbox assembly back into the tractor.
76. Reconnect the creeper operating cable and light switch, adjust as described in operation 7K-03.

18 SPEEDSHIFT GEARBOX

Section 7 – Part L

Table of Contents

18 SPEEDSHIFT GEARBOX

Specification

Model	18 Speedshift gearbox.
No of gears	
Forward	18.
Reverse	6.
Synchromesh type	Strut type.

Settings required

Mainshaft end float	0,080–0,30 mm (0.003–0.012 in).
Type of adjustment	Variable thickness thrust washer.
Range change unit	
Top bearing pre-load	0,05–0,06 mm (0.002–0.0025 in).
Bottom bearing pre-load	0,05–0,10 mm (0.002–0.004 in).
Method of adjustment	Variable thickness spacer rings.
Selector fork setting tolerance	0,25 mm (0.010 in).
Input shaft to clutch pack clearance	0,20–0,45 mm (0.008–0.018 in).
Type of adjustment	Variable thickness thrust washer.
Clutch pack clearance	0,30–0,45 mm (0.012–0.018 in).
Type of adjustment	Variable thickness thrust washer.
Speedshift clutch operating pressure (at 1200 engine rev/min)	22–24 bar (319–348 lbf in^2).

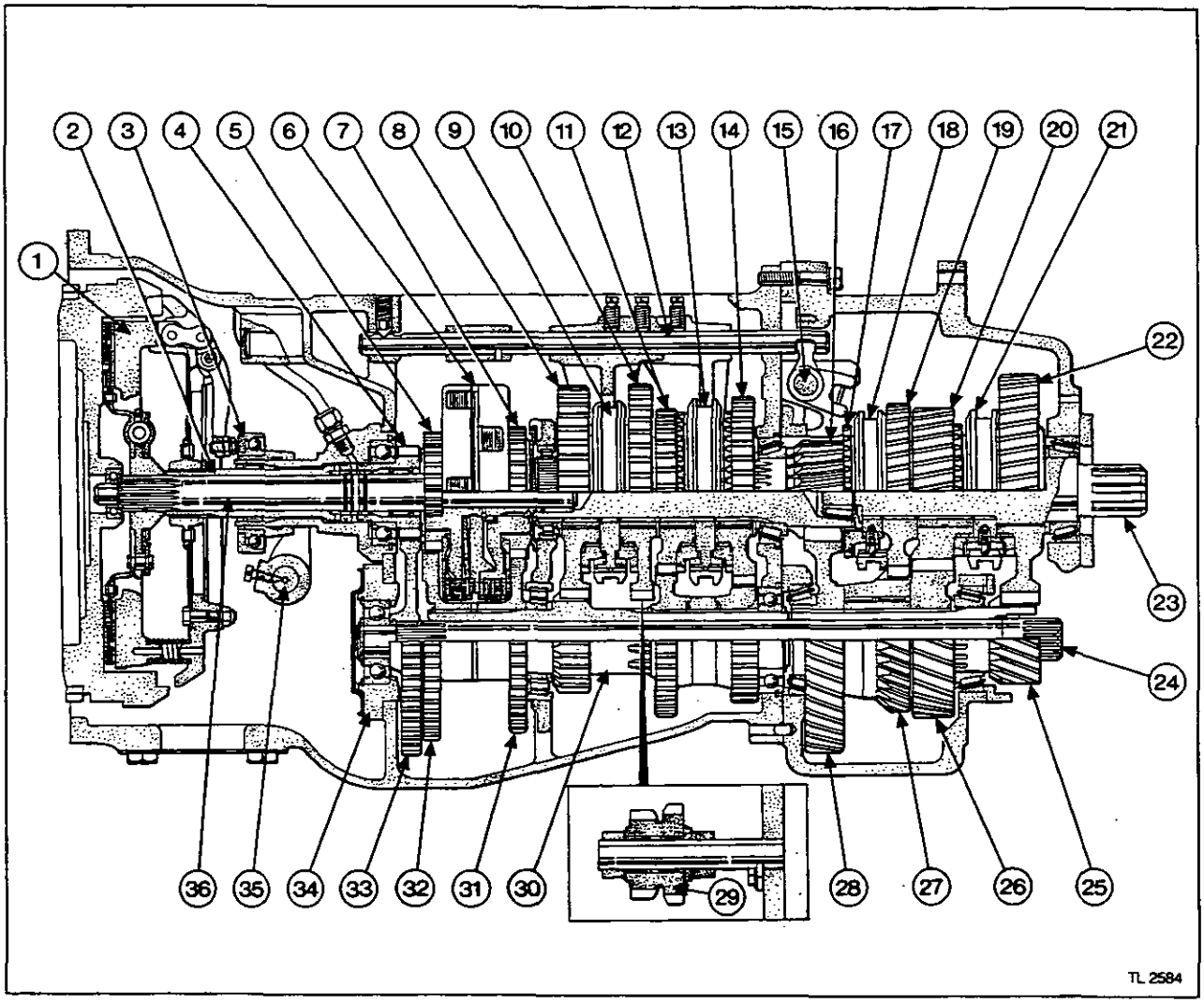
Special Tools

MF.177A	Input shaft oil seal protector.
MF.218	PTO drive shaft puller.
MF.255B	PTO input shaft oil seal replacer.
MF.315A	Needle roller bearing remover/replacer.
MF.414	Selector rail locating peg.
MF.422A	Bearing and sleeve remover.
MF.476	Bearing remover/replacer.
MF.477	Gear set support tool.
MF.478	Bearing pre-load tool.
MF.489	Bearing, sleeve and oil seal replacer.
MF.3012	Tractor splitting track.
MF.3013	Tractor cab stands.

Bolt Torques

Housings	
Engine to clutch housing bolts	115 Nm (85 lbf ft).
Range change unit to centre housing bolts	112 Nm (83 lbf ft).
Range change unit to gearbox bolts	112 Nm (83 lbf ft).
4WD housing to range change unit bolts	140 Nm (103 lbf ft).
Gearbox	
Rear selector mechanism bolt	60 Nm (44 lbf ft).
Rear selector mechanism nut	30 Nm (22 lbf ft).
Selector fork screws	43 Nm (32 lbf ft).
Safety start switch dummy rail screws	43 Nm (32 lbf ft).
Gear lever extension 12 point screw	60 Nm (44 lbf ft).
Gearbox top cover bolts	112 Nm (83 lbf ft).
Oil filler pipe bolts	60 Nm (44 lbf ft).
Input housing bolts	60 Nm (44 lbf ft).
PTO bearing housing bolts	60 Nm (44 lbf ft).
Gear lever knob screw	3 Nm (2 lbf ft).
Gear lever knob cover screw	12 Nm (9 lbf ft).
Range change unit	
Selector fork rail support plate bolts	30 Nm (22 lbf ft).
Range selector detent spring plug	60 Nm (44 lbf ft).
Rear upper bearing housing bolts	30 Nm (22 lbf ft).
Rear lower bearing housing bolts	30 Nm (22 lbf ft).
Range selector switch housing bolts	30 Nm (22 lbf ft).
Detent plunger plug	60 Nm (44 lbf ft).

18 SPEEDSHIFT GEARBOX



General arrangement of 18 speedshift gearbox

1. Main transmission clutch
2. PTO input shaft
3. Clutch release mechanism
4. PTO drive gear
5. Slow speed gear (low)
6. Speedshift clutch pack
7. Fast speed gear (high)
8. First gear
9. 1st/Rev synchromesh coupler
10. Reverse gear
11. Third gear
12. Selector rails and forks
13. 2nd/3rd synchromesh coupler
14. Second gear
15. Selector mechanism
16. Main shaft
17. High range synchromesh cone
18. High range synchromesh coupler
19. Four-wheel drive gear
20. Medium range gear
21. Medium/low range synchromesh coupler
22. Low range gear
23. Upper shaft - drive to rear axle
24. PTO drive shaft
25. Lower shaft
26. Medium range gear
27. Four wheel drive intermediate gear
28. Lower shaft drive gear
29. Reverse idler
30. Lay shaft
31. Fast speed - layshaft gear
32. Slow speed - layshaft gear
33. PTO constant mesh gear
34. PTO front bearing housing
35. Clutch release mechanism
36. Transmission input shaft

18 SPEEDSHIFT GEARBOX

General Description

The 18 Speedshift gearbox makes available 18 forward speeds and six reverse. It is based on a three-speed gearbox with a three-speed range change unit giving High, Medium and Low speeds. A hydraulic clutch pack is provided to give a Fast/Slow powershift change -on-the-move facility.

The gearbox has three sections, the front section consists of the Speedshift hydraulic clutch pack and drive arrangement. The Power Take-Off (PTO) input drive is also contained within this section.

The centre section comprises constant mesh gear set giving three basic forward speeds and a single reverse, all fitted with synchromesh engagement.

The rear section, the range change unit, comprises a three-speed unit giving High - transport speed, Medium - working speed and Low - special low speed for planting etc. The three speeds are again fitted with synchronized engagement.

The gears are all operated by a single gear lever within a gate designed to allow independent operation of the conventional gearbox or the range change unit. A push button on the gear lever operates the Speedshift in sequence. An additional button is provided on cab tractors adjacent to the hydraulic lift quadrant.

The gears from 1 to 18 have been arranged logically in three groups, 'Low', 'Medium' and 'High'. In each range there are six speeds 1st Slow/Fast, 2nd Slow/Fast and 3rd Slow/Fast.

To select a gear the lever is moved to the right of the gate and then firmly forward, or rearward to select the range required. The indicator light on the instrument panel will show which range has been selected. On releasing the gear lever it will position itself opposite 2nd and 3rd gear.

Depressing the clutch, 1st, 2nd or 3rd gear can then be selected. Speedshift can be selected at any time by pressing the button, an indicator light will show the speed selected 'Fast' or 'Slow". Engine braking is provided in all gears, including Speedshift 'Fast' and 'Slow'. The tractor can be tow started.

The Speedshift clutch pack is hydraulically controlled by a solenoid valve located on a valve block situated behind the engine. When the clutch pack is in its non-energized condition, 'Fast' (high) speed is engaged by the pressure exerted by a large Belleville spring compressing the clutch plates.

When 'Slow' (low) speed is selected, hydraulic pressure is applied to the piston which overcomes the pressure of the large Belleville spring, this releases the 'Fast' speed clutch and engages the 'Slow' speed clutch. The clutch plates for both speeds are compressed through additional Belleville springs so as to control the rate to give a smooth engagement. The selection of 'Fast' speed shuts off the supply of oil, the large Belleville spring takes over releasing one clutch and engaging the other. Oil inside the clutch is returned to the transmission.

The hydraulic oil under pressure is regulated by a pressure maintaining valve to a pressure of 24 bar (348 lbf in^2). It passes through a non-return valve to the solenoid valve operated by the push button. On the up-stream side of the non-return valve a 400 cc accumulator is fitted to maintain pressure to the Speedshift system during other demands on the hydraulic system i.e. engagement of the independent PTO.

The system is fitted with a low pressure cut-out switch. This protects the clutch from slippage when in slow speed, due to low hydraulic pressure. If low pressure occurs the clutch is automatically shifted to 'Fast' to prevent over-heating and damage.

The centre section, with the three forward and one reverse gear, is a conventional constant mesh gearbox with straight cut gears. Selection being through couplers and synchronizers.

The PTO drive is taken from the split torque clutch, through a set of constant mesh gears to the layshaft, here it passes to the rear of the tractor, lift pump and PTO shaft.

The range change unit is directly bolted to the rear of the main gearbox forming an integral unit. It is identical to the unit fitted to the 12-speed shuttle gearbox. It can be fitted with a four-wheel drive unit on the left-hand side to drive a front axle. The unit is similar to a conventional gearbox with a main and lay shaft. Three gears provide a direct drive 'High' gear and reduction gears for 'Medium' and 'Low' through the layshaft. All gear selections are through synchromesh couplers.

Gear selection is through selector forks which are controlled by a rotating cam plate operated by a ratchet from the main gear lever. In the face of the cam plate there is a circular track which engages with rollers on the selector forks. The track is designed to give the selector forks the right movement to select the gears in sequence. Moving the gear lever forward rotates the cam plate clockwise and selects a higher gear. Pulling the lever back rotates it anti-clockwise and selects a lower gear.

18 SPEEDSHIFT GEARBOX

Diagnosis

The Speedshift hydraulic system is controlled by a valve block located behind or alongside the engine, see illustration. The major components are:-

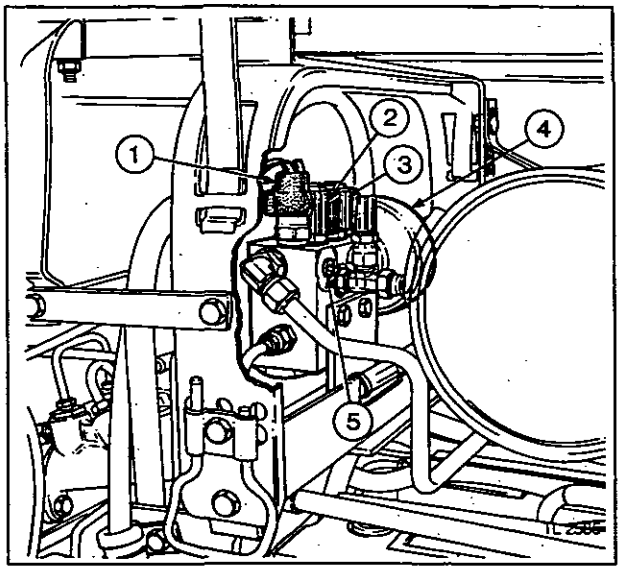
1. Low hydraulic pressure warning light switch.
2. Differential lock solenoid.
3. Speedshift solenoid.
4. Speedshift hydraulic accumulator.
5. Pressure test point.

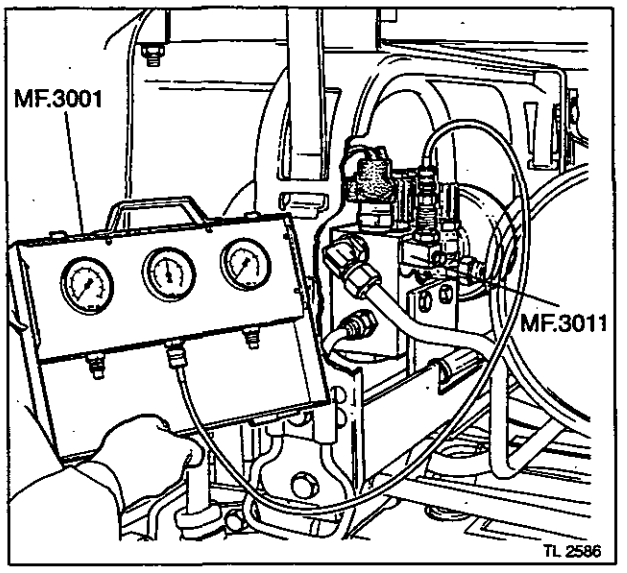
Non-operation of the Speedshift can only result in three types of failure; mechanical, electrical or hydraulic. Before any repairs are made, either mechanical or hydraulic, the following test should be carried out to determine the condition of the hydraulic system.

Speedshift Pressure Test

Check	7L–01

Special tools:
MF.3001 Pressure Test Kit
MF.3011 Pressure Test Point





Test

1. Check the transmission oil level, top up if necessary.
2. The hydraulic system, the hydraulic filter and strainer must be clean. If in doubt, change the filter element.
3. Start the engine and operate the auxiliary hydraulics to raise the oil temperature to 50-60°C (122-140°F). This is important, cold oil will give a false pressure reading.
4. Stop the engine when the oil is warm.
5. Remove the test point plug, a 1/8 in. hexagon key will be required and install MF.3011 Pressure Test Point.
6. Connect up the centre pressure gauge, 30 bar (400 lbf/in^2) in the MF.3001 Pressure Test Kit.
7. Start the engine and set the engine speed to 1200 rev/min.
8. The pressure reading at the above temperature should be 22-24 bar (319-348 lbf/in^2).
9. Engaging and disengaging Speedshift should not have any effect on the pressure reading.
10. Stop the engine. Remove the gauge and fittings, and replace the plug.
11. To check the operation of the solenoid valve and feed to the clutch; stop the engine, operate the clutch several times and turn the starter switch to OFF. This will exhaust the hydraulic accumulator and remove the pressure.
12. Disconnect the hose-pipe marked '18 SP' from the valve block to clutch and install the test tee (part of MF.3001) in the circuit.
13. Connect the pressure gauge to the test tee.
14. Start the engine and set the speed to 1200 rev/min.
15. Switch the Speedshift between 'Fast' and 'Slow'. The pressure gauge should show the pressure reading given in procedure 8 when 'Slow' speed is selected.
16. No pressure reading will indicate a faulty solenoid valve, switch, fuse or wiring.

Result

17. If the pressure is below the stated figure in procedure 8, check the following:-

- Pressure maintaining valve, see operation 12B-31.
- Hydraulic pump output flow and pressure, see operation 12B-01.
- Check and clean if necessary the hydraulic suction strainer, see operation 12B-08.
- Change the hydraulic filter element, see operation 12B-12.

18. If the clutch does not drive, the following points should be checked when the clutch is removed:-

- Distorted and overheated clutch plates.
- Leaking seals on the piston, shaft and hubs.
- Mechanical failure.

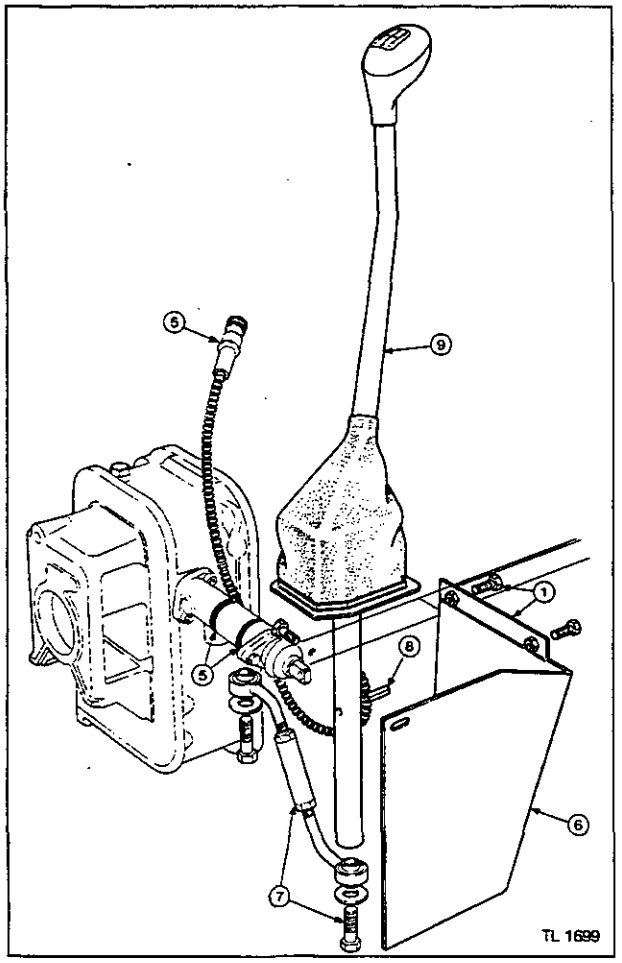
Gearbox

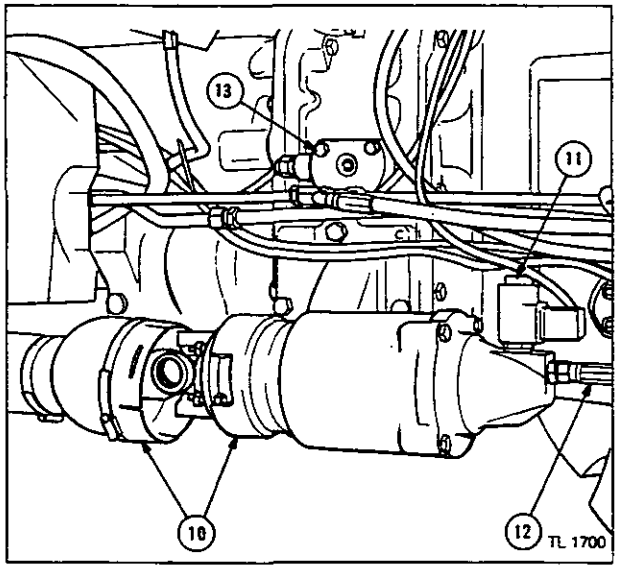
Removal and Refitment 7L–02

Special tools:
MF.3012 Tractor Splitting Track
MF.3013 Tractor Cab Stands

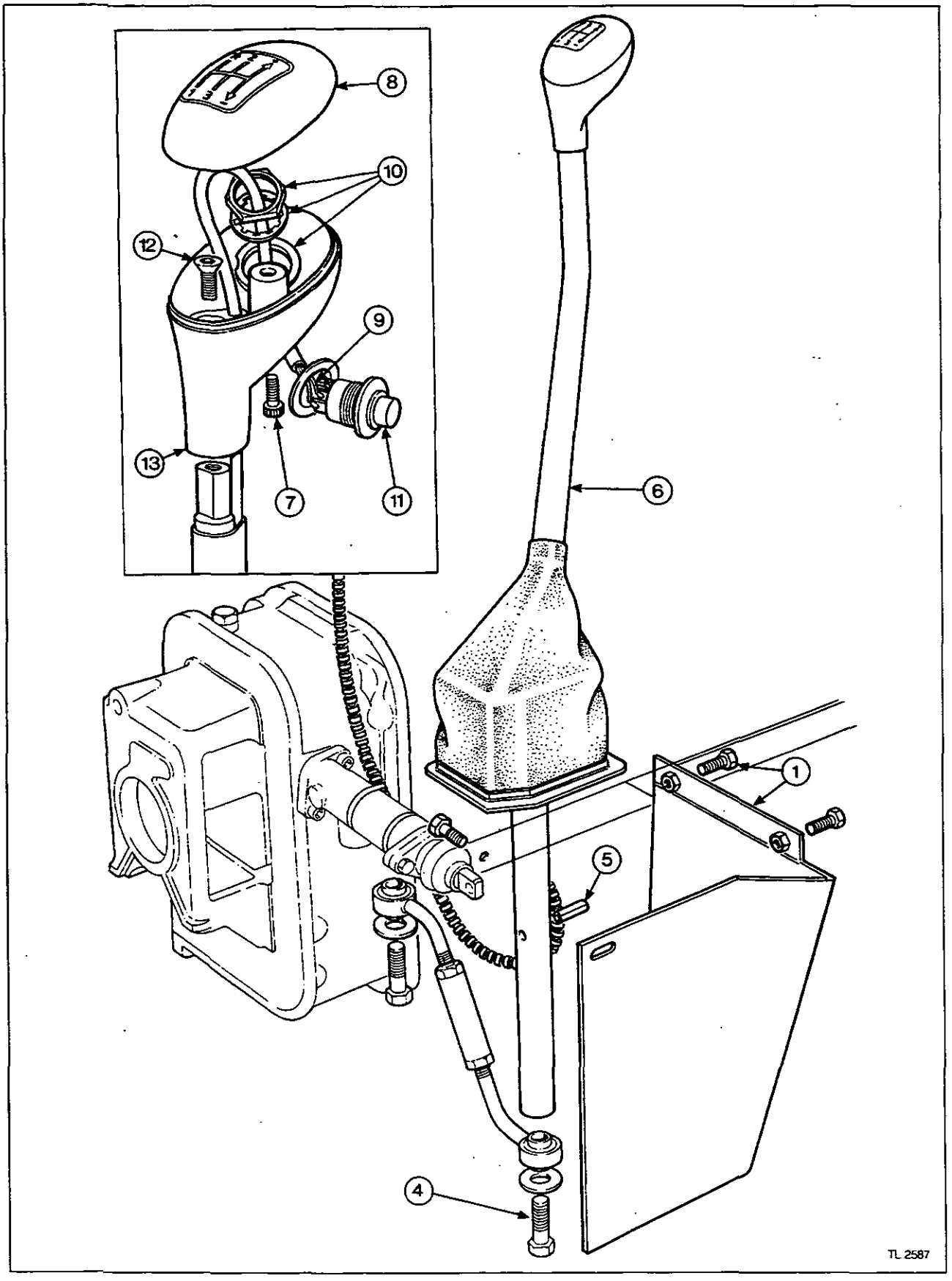
In addition to the instructions given in Section 2 of this publication regarding the removal of the gearbox assembly, the following instructions should be followed:

1. The gearbox and range change unit must be removed and replaced in the tractor as one unit. DO NOT split between the gearbox and the range change unit.
2. Drain the transmission oil.
3. Disconnect the clutch cable, see operation 2B-06 for details on securing the clutch lever.
4. Remove the floor mats and panels.
5. Remove the plastic tie and disconnect the wiring to the push button on the gear lever.
6. Remove the gear lever guard.
7. Disconnect the bottom strut from the gear lever.
8. Remove the gear lever pivot roll pin.
9. Withdraw the gear lever up through the cab floor with the cover.
10. Slide back the four-wheel drive shaft cover and disconnect the drive shaft at the rear.
11. Unscrew the knurled nut on top of the four-wheel drive unit solenoid, remove the coil still attached to the wiring harness.
12. Disconnect the hydraulic pipe to the four-wheel drive unit.
13. Remove the three bolts from the range indicator switch assembly. Remove the switch still attached to the wiring. A small amount of oil may be present.
14. Disconnect the safety start switch on the gearbox top.
15. Disconnect the pressure feed pipe to the Speedshift clutch pack.
16. Disconnect the drain pipe from the hydraulics.
17. Remove the the two 12 pointed screws and the gear lever extension bolted to the range change unit.
18. Support the cab on MF.3013 Tractor Cab Stands and remove the bolts from the cab mounts.
19. Jack up the cab using the cab stands to give sufficient clearance to the transmission.
20. Place the MF.3012 Tractor Splitting Track under the transmission. Arrange it so that the fixed part is under the front of the centre housing, the travelling part under the rear of the engine.
21. Place wedges in the front axle to prevent tilting sideways.
22. Disconnect the tractor in the normal way between the range change unit and the rear centre housing.
23. When disconnected, carefully move the engine forward, complete with the transmission, clear of the tractor.





18 SPEEDSHIFT GEARBOX



24. With a hand crane, remove the gearbox assembly from the engine. Ensure at all times that the engine, rear axle and transmission is correctly supported to prevent it from falling over and causing damage.
25. Place the gearbox on a low work bench, upended and standing on the clutch bell housing.
26. Remove the four-wheel drive unit, if necessary. See operation 10C–14.
27. Split the transmission between the gearbox and the range change unit.
28. Place the gearbox in its normal position on a work bench.

Refitment

29. Reverse procedures 1 to 27 except:
    a. If the rubber seal on the inside of the steel gasket (see illustration) is in good condition, the gasket may be reused.
    b. Apply Hylomar to the bottom 12 bolts holding the range change unit to the gearbox and rear centre housing.
    c. Tighten the range change unit to gearbox bolts to a torque of 112 Nm (83 lbf ft)
    d. Apply Massey Ferguson Multi-Gasket (Loctite 509) to the face of the four-wheel drive unit. Tighten the bolts to a torque of 140 Nm (103 lbf ft).
    e. Tighten the range change unit to rear centre housing bolts to a torque of 112 Nm (83 lbf ft).
    f. Tighten the engine to clutch housing bolts to a torque of 115 Nm (85 lbf ft).
    g. Apply Massey Ferguson Multi-Gasket (Loctite 574) to the face of the gear lever extension and tighten the two 12 pointed screws to a torque of 60 Nm (44 lbf ft).

Gearshift Lever and Knob

Removal and Refitment	7L–03

Removal

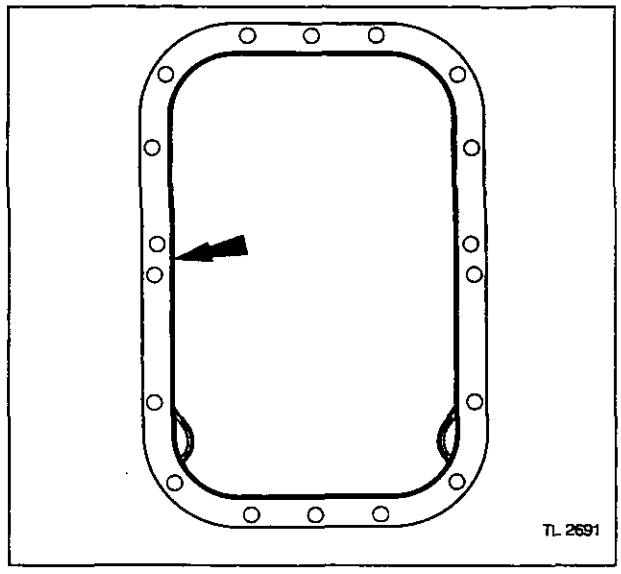
1. Remove the three bolts and the guard.
2. Disconnect the wiring to the push button at the multi-plug connector.
3. Remove the floor mat (cab tractors).
4. Remove the strut bolt.
5. Remove the pivot roll pin.
6. Lift the gear lever up through the floor.

Push Switch

7. Using a 3 mm hexagon key, remove the screw under the gear lever knob.
8. Remove the cap.
9. With the aid of a small electric soldering iron remove the three wires from the push switch.
10. Unscrew the nut and remove the two washers.
11. Remove the switch.

Knob

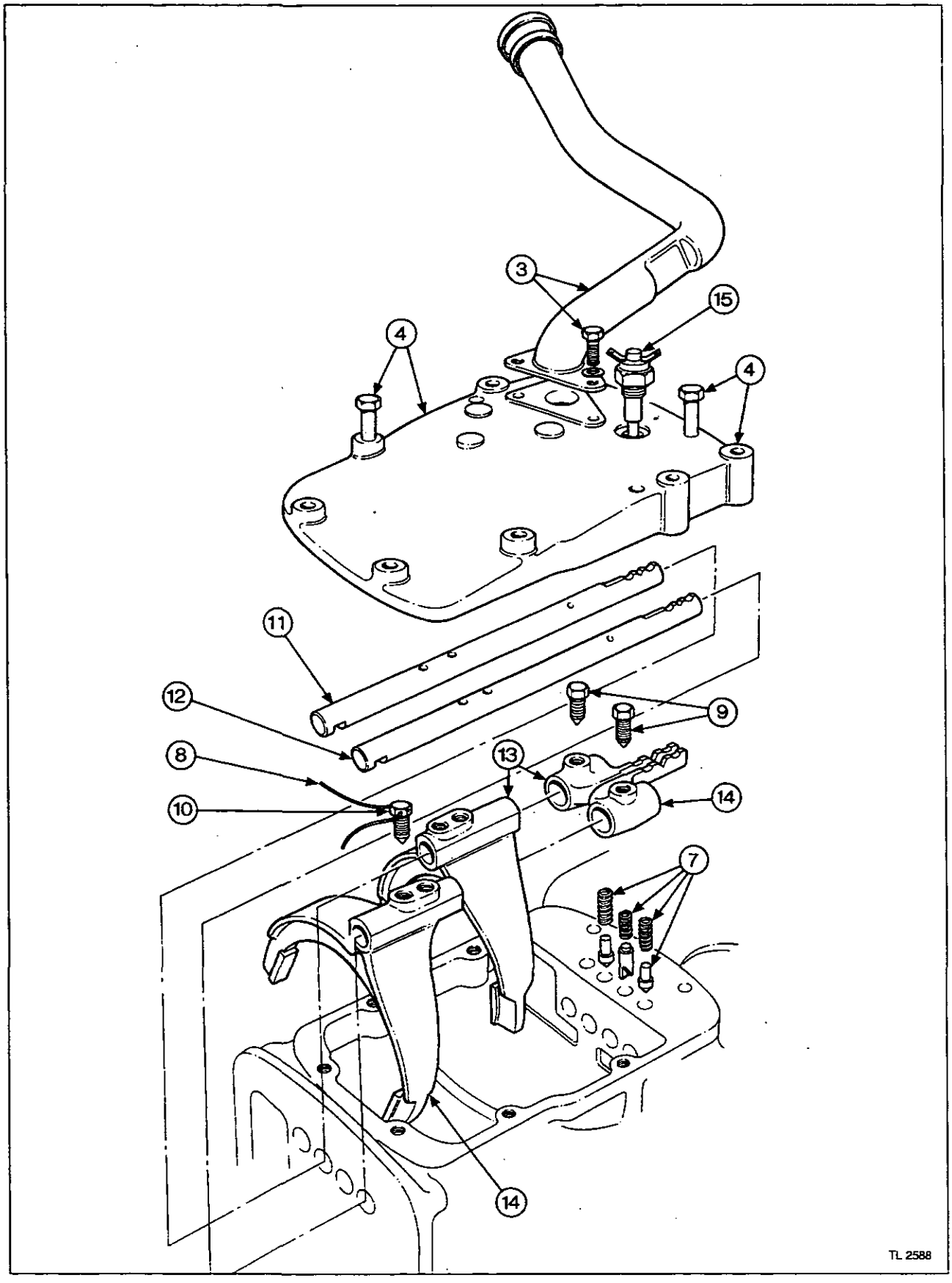
12. Remove the countersunk screw with a 4 mm hexagon key.
13. Remove the knob.

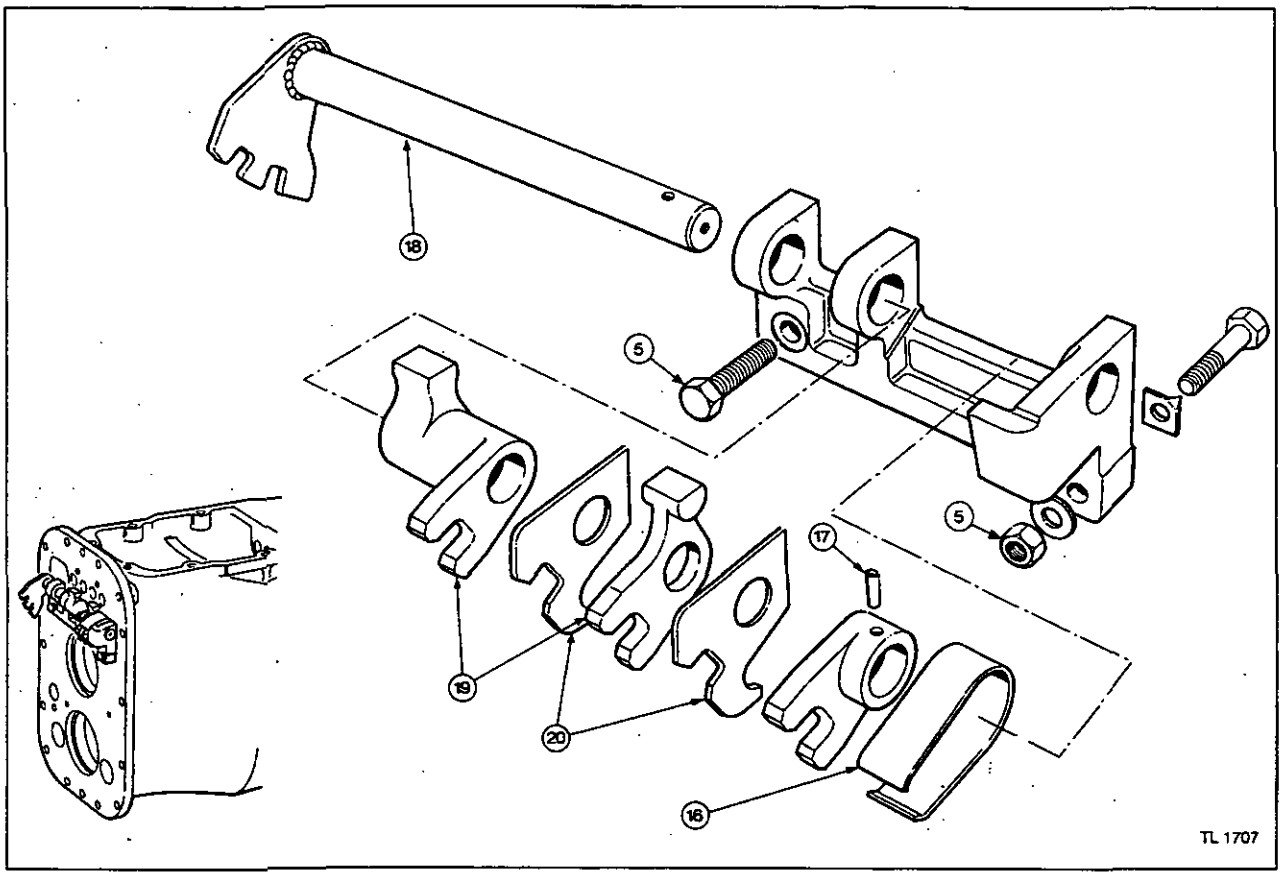


Refitment

14. Replace the knob, apply two or three drops of Massey Ferguson Lock 'n' Seal (Loctite 242) to the threads of the screw and tighten to a torque of 3 Nm (2 lbf ft)
15. Fit the push switch, fitting the plain washer, lock washer and nut.
16. Pass the wires through the hole in the knob and solder them on to the terminals of the switch. The red wire must be soldered to the central terminal.
17. Pack the wires into the knob ensuring that there will not be a short circuit.
18. Replace the cover and tighten the screw to 12 Nm (9 lbf ft).
19. Reverse procedures 1 to 6 fitting a new roll pin.

18 SPEEDSHIFT GEARBOX





Gearbox Top Cover and Selectors

Removal and Refitment 7L–04

Special tools:
MF.414 Locating Peg

Removal

1. Remove the gearbox assembly from the tractor, see operation 7L-01
2. Remove the range change unit, see operation 7L-01.
3. Remove the bolts and the oil filler pipe.
4. Remove the eight bolts and the gearbox top cover.
5. Remove the bolt and nut from the rear selector mechanism.
6. Remove the selector mechanism assembly.
7. Lift out the detent springs and plungers.
8. Cut and remove the locking wires.
9. Loosen the two locking screws on the safety start switch dummy rails.
10. Loosen the locking screws on the selector forks.
11. Slide out the 2nd/3rd rail rearwards and remove the right-hand dummy rail.
12. Slide out the 1st/reverse rail and remove the left-hand dummy rail.
13. Remove the 2nd/3rd selector fork.
14. Remove the 1st/reverse selector fork.
15. Remove the safety start switch, if necessary.

Rear Selector Mechanism

16. Remove the selector return spring.
17. Drive out the roll pin.
18. Withdraw the range selector shaft.
19. Remove the selector levers.
20. Remove the spacer plates.

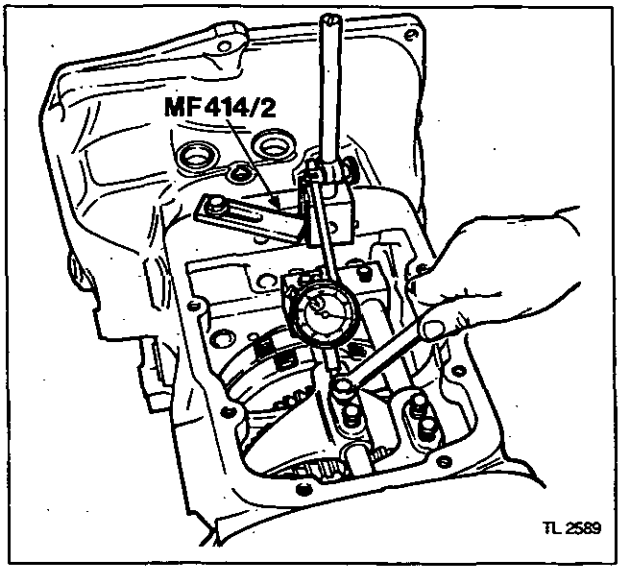
Refitment

21. Reverse procedures 1 to 19 except:
    a. Apply a few drops of oil to the selector rails before refitment.
    b. When refitting the detent springs and plungers, assemble them as shown in the illustration. Ensure that the safety start switch plunger is located on the operating plungers correctly.
    c. Apply Massey Ferguson Studlock (Loctite 270) to the threads and tighten the selector mechanism retaining bolt to a torque of 60 Nm (44 lbf ft). Tighten the retaining nut to a torque of 30 Nm (22 lbf ft).

Selector fork adjustment

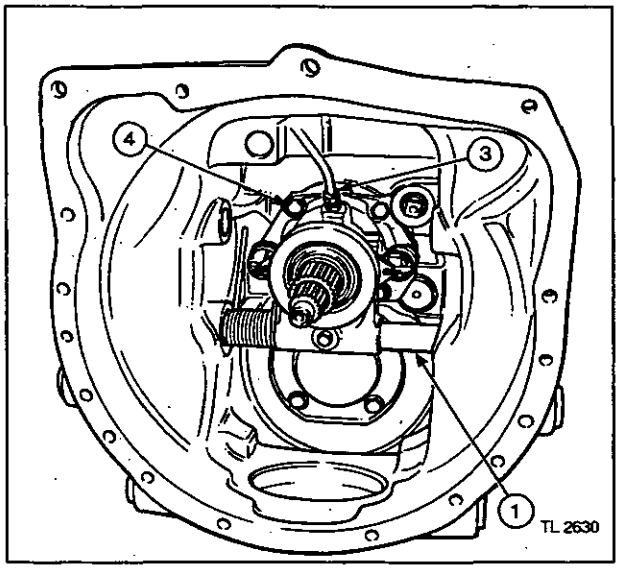
NOTE: This procedure must be carried out with the Range Change Unit in place.

22. Set each selector ring, selector fork and rail to the neutral position.
23. Lock the selector rail in place during the setting procedure using the plate and bolt MF.414/2 (part of tool MF.414).
24. Set up a magnetic base and dial indicator, as illustrated, with the plunger located against the selector fork.
25. Ensure that the locking screws are loose.
26. With finger pressure only, slide the selector fork to the rear taking up any clearance. DO NOT engage gear.
27. Zero the dial indicator and slide the fork fully forward taking up any clearance. Note the reading of movement on the dial indicator.
28. Halve the reading obtained and progressively tighten up the two locking screws to a torque of 43 Nm (32 lbf ft) ensuring that the selector fork is positioned to give the half reading on the dial indicator. The setting must be within 0,25 mm (0.010 in).



General

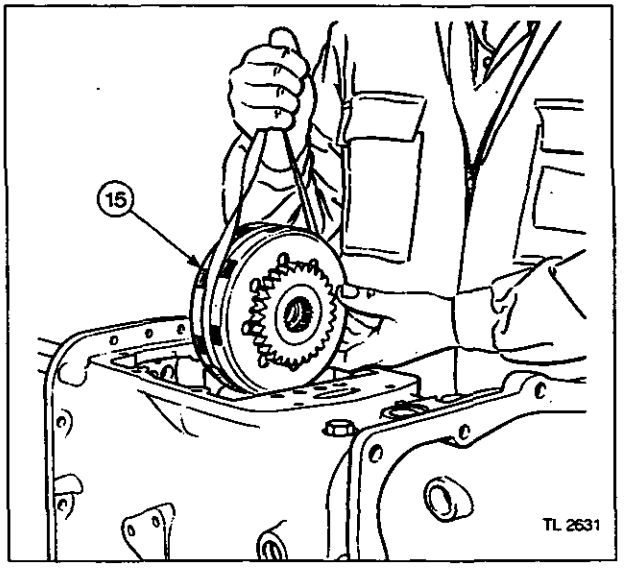
29. Tighten the screws on the safety start dummy rails to a torque of 43 Nm (32 lbf ft).
30. Wire-lock all locking screws.
31. Apply Massey Ferguson Multi-Gasket (Loctite 515) to the underside of the top cover and tighten the bolts to a torque of 112 Nm (83 lbf ft)
32. Apply Massey Ferguson Multi-Gasket (Loctite 515) to the underside of the oil filler pipe and tighten the bolts to a torque of 60 Nm (44 lbf ft).
33. Check and ensure that the safety start switch operates.



Input Housing and Clutch Pack

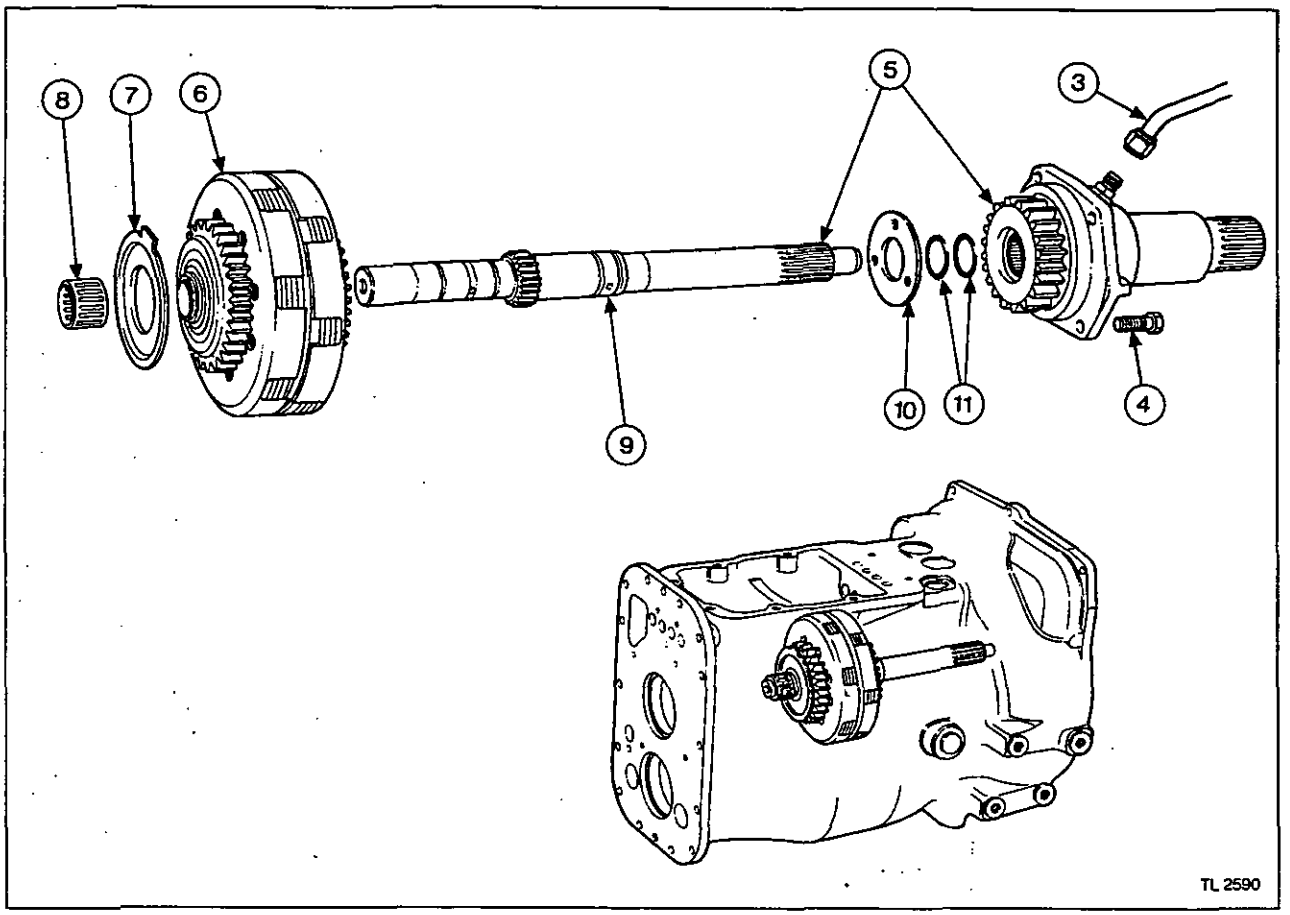
Removal and Refitment 7L–05

Special tools:
MF.177A Input Shaft Oil Seal Protector



Removal

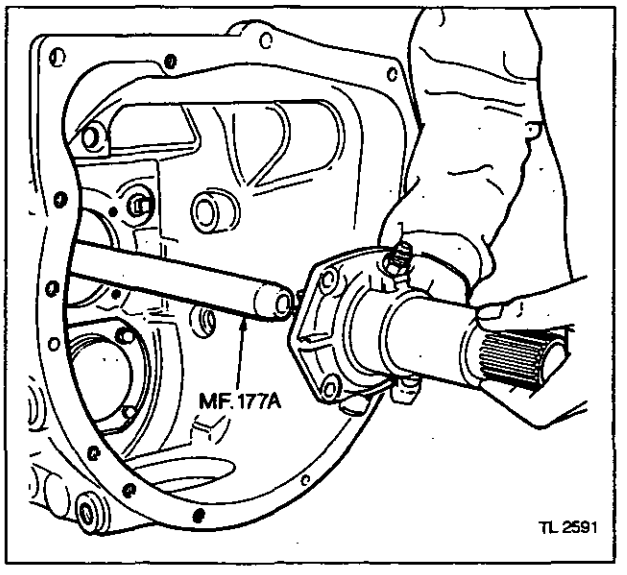
1. Remove the clutch release mechanism, see operation 6B-04.
2. Remove the gearbox top and selectors, see operation 7L-02.
3. Disconnect the oil supply pipe to the clutch pack.
4. Remove the four bolts.
5. Withdraw the input housing complete with the main input shaft.
6. Lift out the clutch pack assembly.
7. Remove the large thrust washer.
8. Remove the input shaft support bearing from inside the main shaft.
9. Remove the input shaft from the PTO pinion.
10. Remove the two sealing rings from the input shaft.
11. Remove the variable thrust washer from the input shaft.



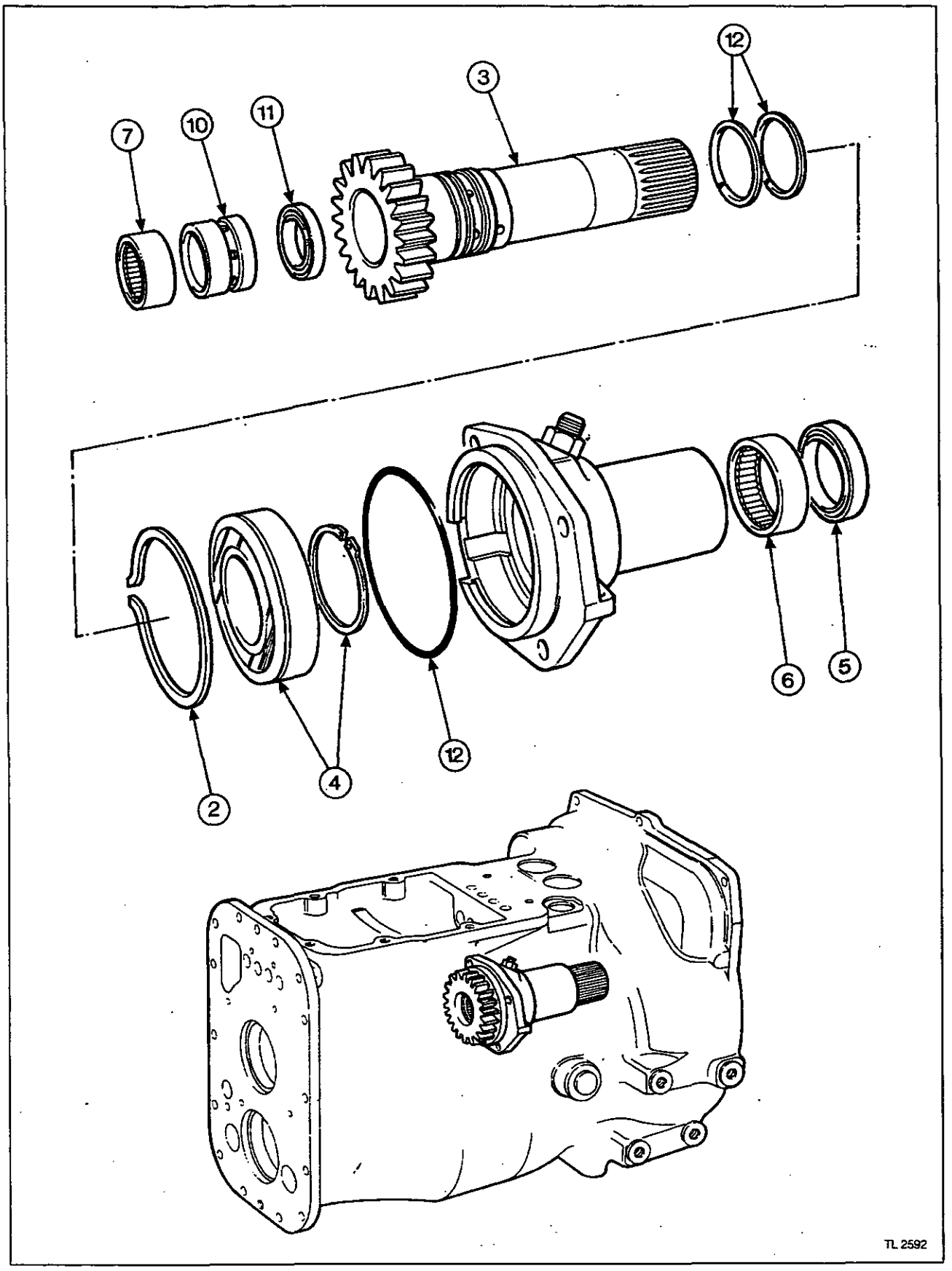
Refitment

If all the original components are being refitted it is not necessary to carry out the input shaft end float adjustment. When new components are fitted the procedure detailed in operation 7L-06 must be carried out.

12. Refit the needle roller bearing in the gearbox main shaft and the stepped thrust washer.
13. On to the input shaft fit the variable thrust washer with stepped face facing forward.
14. Fit two new seal rings to the shaft and lightly lubricate with clean transmission oil the rings and thrust washer.
15. Wrap some plastic banding around the clutch and lower into the gearbox. Install the thrust washers and input shaft.
16. Place special tool MF.177A Seal Protector Sleeve ,over the main transmission input shaft on the gear box. This is to protect the seal inside the PTO pinion from the splines on the shaft and prevent seal leakage.
17. Lightly oil the sleeve.
18. Carefully refit the input housing sliding it over the sleeve. Withdraw the sleeve when the housing is in place.
19. Lightly coat the threads of the bolts with Hylomar sealant and tighten to a torque of 60 Nm (44 lbf ft).
20. Reconnect the oil feed pipe.
21. Refit the clutch release mechanism, see operation 6B-04.



18 SPEEDSHIFT GEARBOX



Input Housing

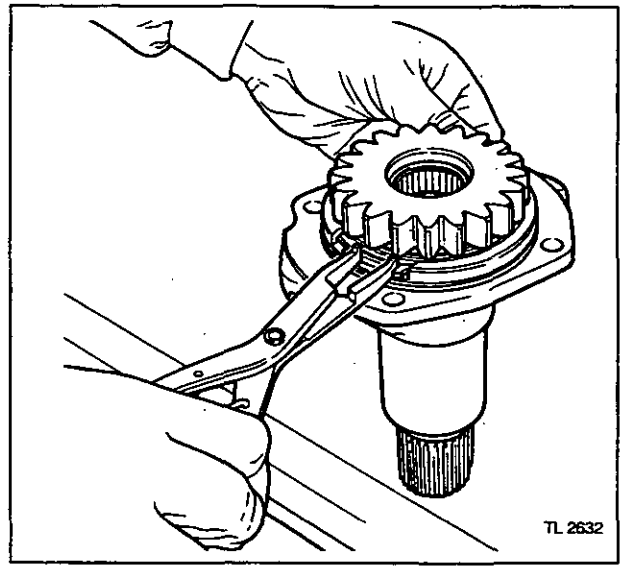
Overhaul	7L–06

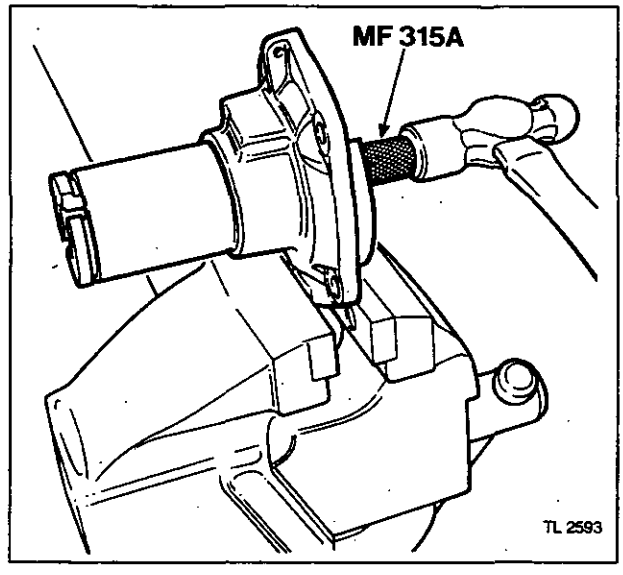
Special tools:

MF.177A	*Input Shaft Oil Seal Protector*
MF.255B	*Pto Input Shaft Oil Seal Replacer*
MF.315A	*Needle Roller Bearing Remover/Replacer*
MF.422A	*Bearing, Sleeve And Oil Seal Remover*
MF.489	*Bearing, Sleeve And Oil Seal Replacer*

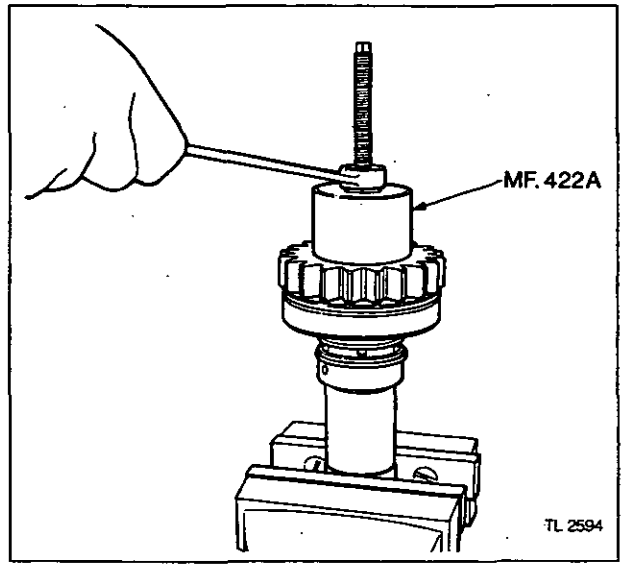
Disassembly

1. Remove the input housing, see operation 7L-05.
2. Open up the large circlip in its groove so that it is clear of the bearing.
3. Push the PTO input shaft, complete with ball-bearing, rearwards out of the housing.
4. If necessary, remove the circlip and ball-bearing after first removing the split ring seals.
5. Lever the seal out of the front of the housing.
6. Using special tool MF.315A, drive the needle roller bearing out of the housing.





7. Using special tool MF.422A remove the rear needle roller bearing. Carefully assemble the collets so that the step is located behind the bearing. Screw up the tapered nut so that the collets are held tight inside the bearing.
8. Fit the cap, lubricate the screw thread, fit the washer and nut.
9. Tighten the nut withdrawing the bearing from the shaft.
10. Repeat the operation using tool MF.422A to extract the sleeve. The step on the collets must be located fully behind the sleeve.
11. Lever out the inner oil seal.
12. Remove and discard the two sealing rings.
13. Remove and discard the 'O' ring.



Reassembly

14. If the ball-bearing has been removed from the PTO shaft, refit the bearing using a new circlip.

15. Using special tool MF.315A, press a new needle roller bearing into the input housing. The needle roller bearing must be installed with the tool pressing on the face which is engraved with the maker's name. This end of the bearing is designed to take the pressing forces.
16. Fit new seals to the PTO input shaft, lightly lubricate with clean transmission oil.
17. Place the large circlip into the groove in the housing.
18. Take care in carrying out this operation to prevent damage to the seals. Open up the circlip with one hand, and install the PTO shaft and bearing with the other. Push the shaft into the housing until the circlip locates in the groove in the bearing.

NOTE: If any of the major components of the input housing have been replaced, or the clutch pack has been overhauled, it will be necessary to carry out the following adjustment procedure:

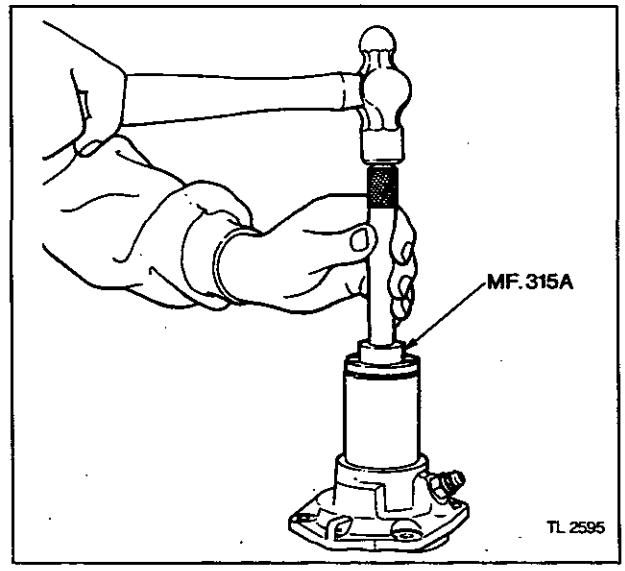
Input Shaft Adjustment

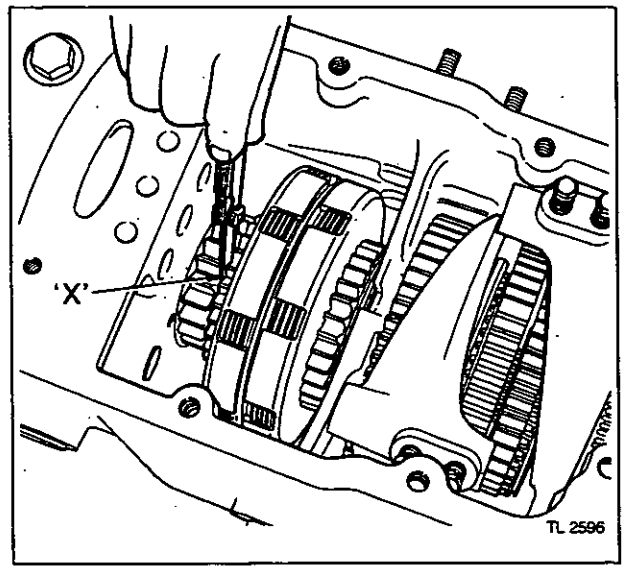
19. DO NOT install the inner seal, sleeve or needle roller bearing in the PTO input shaft.
20. Refit the needle roller bearing into the gearbox main shaft.
21. Install the large thrust washer between the clutch pack and main shaft.
22. Hold the clutch pack in position and refit the input shaft. DO NOT fit the seal rings or front thrust washer.
23. Refit the input shaft housing and bolt it into position.
24. Push the clutch pack rearward, push the PTO input shaft rearward.
25. With the aid of a set feeler gauges, measure the gap between the face of the PTO pinion and the face of the hub on the clutch pack.
26. From the chart below select a shim to give clearance **'X'** of 0,2-0,45 mm (0.008-0.018 in).

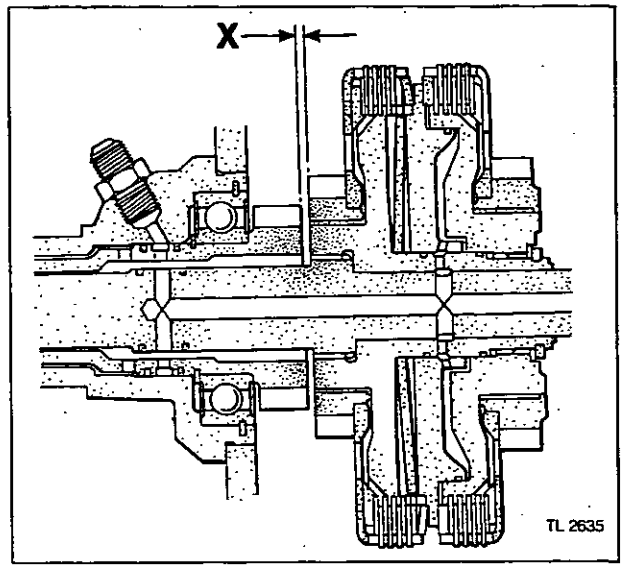
Thrust washer thickness chart		
Part No.	Metric	Imperial
3697 855 M1	2,0 mm	0.079 in
3697 856 M1	2,3 mm	0.091 in
3697 857 M1	2,5 mm	0.099 in
3760 548 M1	2,8 mm	0.110 in
3760 549 M1	3,0 mm	0.118 in

General

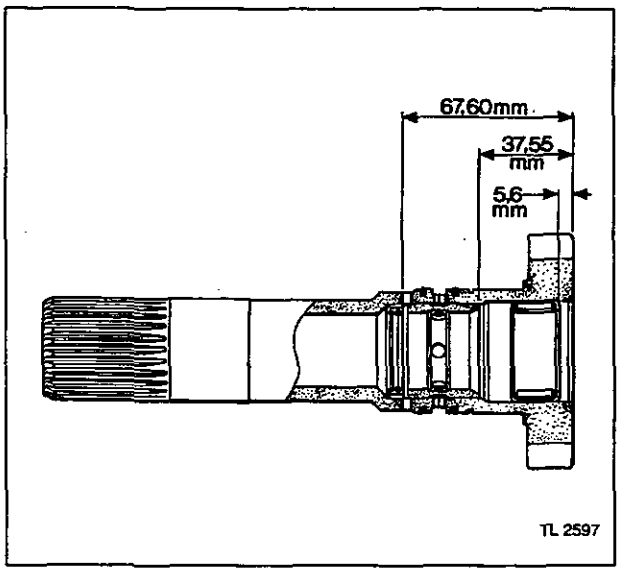
27. Remove the input housing and input shaft.
28. On to the input shaft fit the selected thrust washer with stepped face facing forward.
29. Fit two new seal rings to the shaft and lightly lubricate with clean transmission oil the rings and thrust washer.
30. Re-install the thrust washer and transmission input shaft into the gearbox.



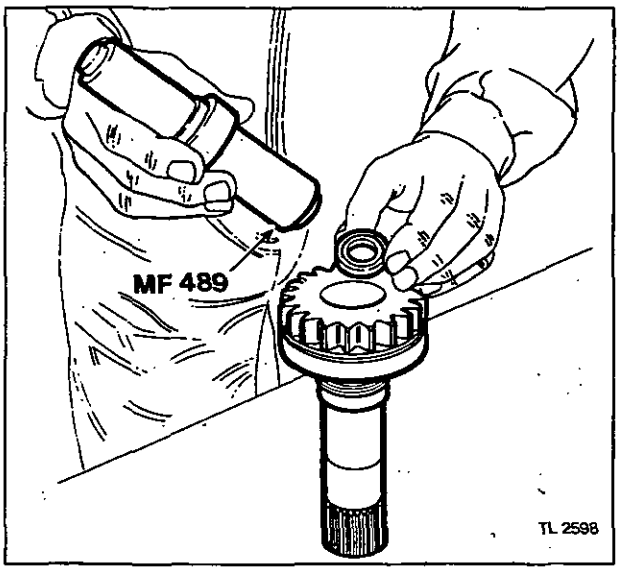




CAUTION: The oil seal, sleeve and needle roller bearing must be accurately positioned in the PTO input shaft. Special tool MF.489 has been designed to do this. In the event of a tool not being available set to the measurement given in the illustration.



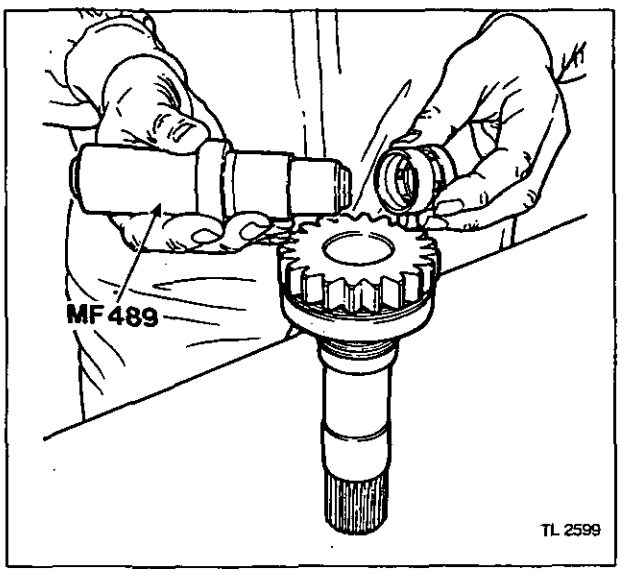
31. Pack the cavity of the small input shaft seal with petroleum jelly.
32. Using special tool MF.489, place the seal in the PTO shaft as shown in the illustration and press it into position until the flange on the tool touches the face of the gear.



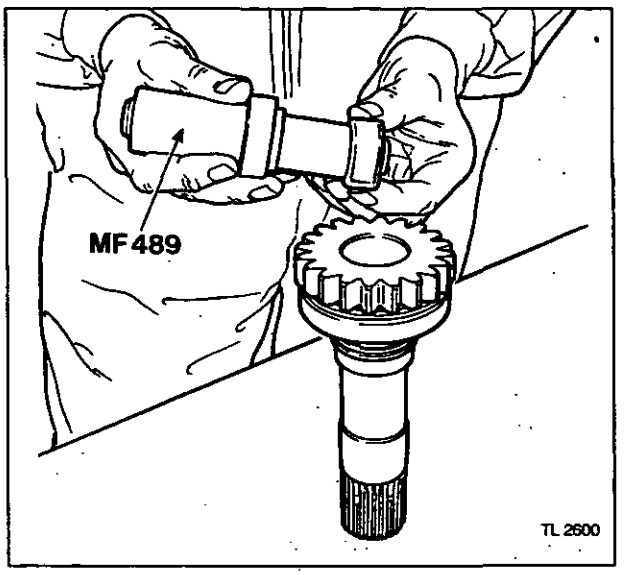
33. Turn the tool round, place the tool sleeve and the sleeve to be fitted on to the other end.

NOTE: The sleeve must be fitted with the internal chamfer facing to the rear.

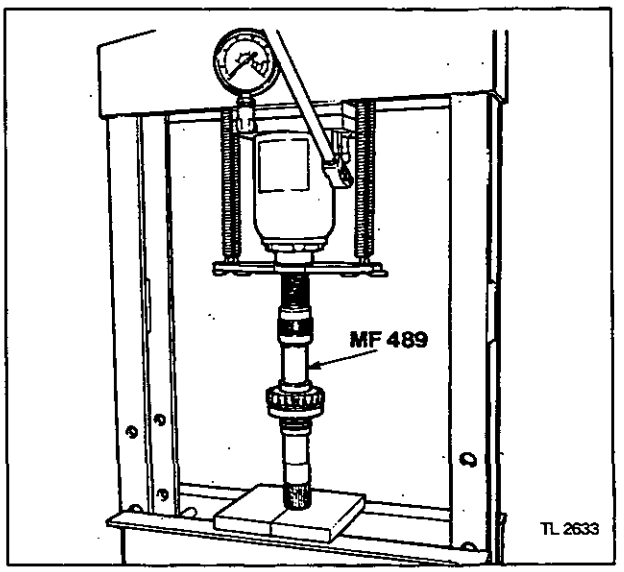
34. Press the sleeve into the PTO shaft until the flange on the tool touches the face of the gear.
35. Remove the tool and remove the tool sleeve.



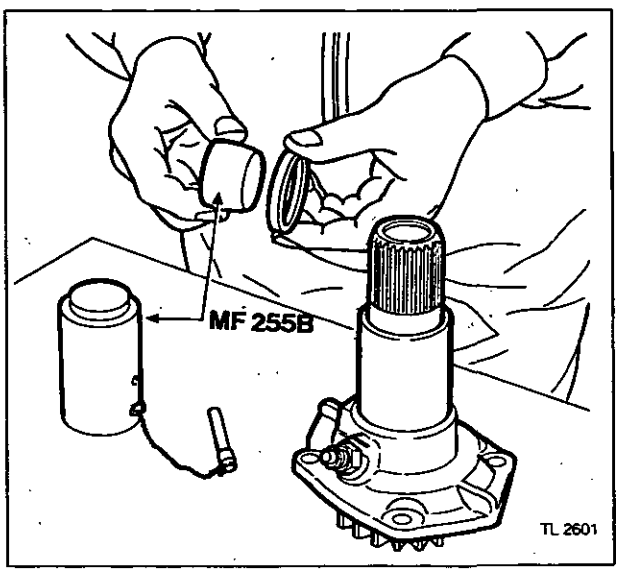
36. Place the needle roller bearing on the same end of the tool. The needle roller bearing must be installed with the tool pressing on the face which is engraved with the maker's name.



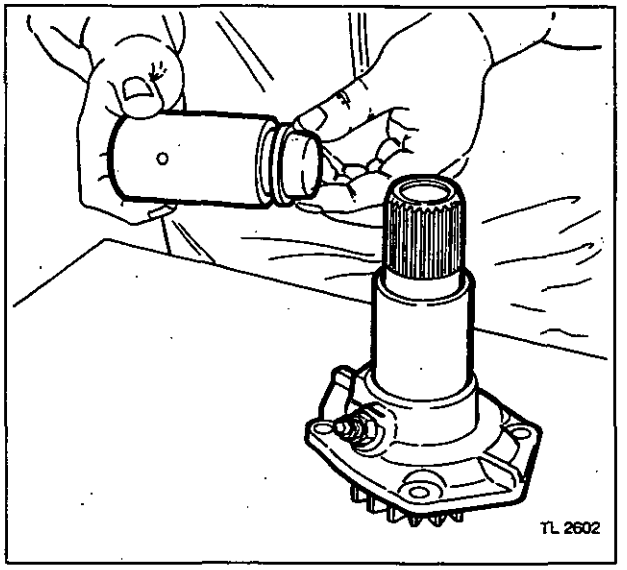
37. Press the bearing into position up to the flange on the tool.



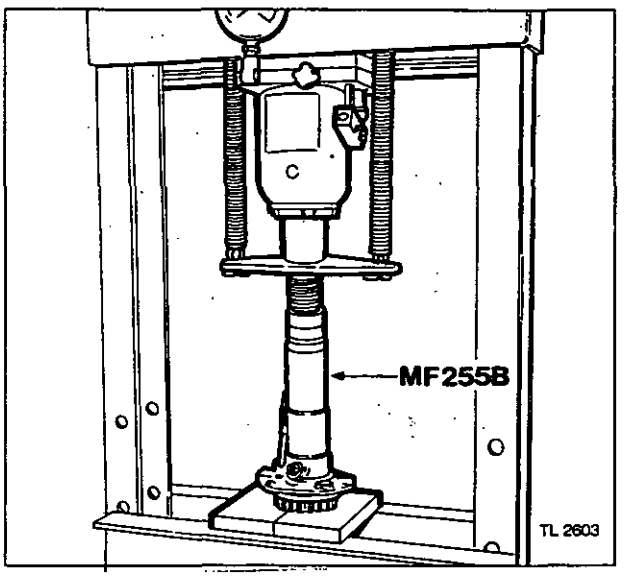
38. Pack the cavity of the large PTO shaft oil seal with petroleum jelly.
39. Install the seal using special tool MF.255B to prevent damage and oil leaks. Place the seal onto the cone adaptor with the seal lip facing away from the tool.



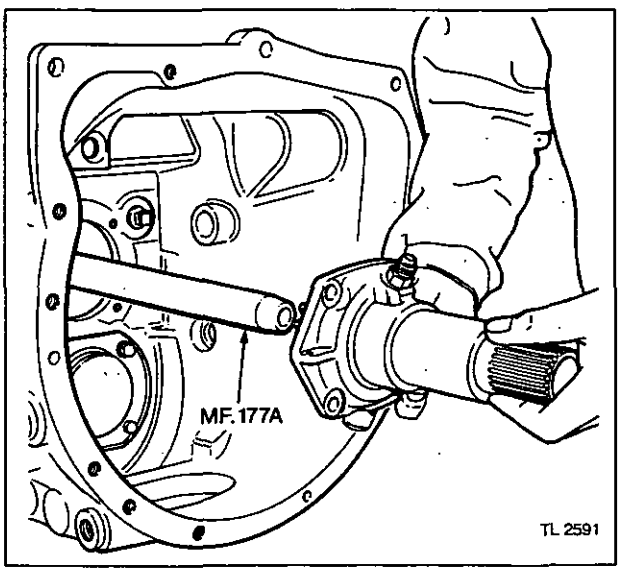
40. Fit the cone adaptor to the main body of the tool, slide the oil seal onto the tool. Remove the cone adaptor.



41. Place the input housing under a light press, place the tool with seal over the PTO input shaft and press the seal into place.
42. Replace the large 'O' ring on the housing.



43. Place special tool MF.177A Seal Protector Sleeve over the main transmission input shaft on the gear box. This is to protect the seal from the splines on the shaft and prevent seal leakage.
44. Lightly oil the sleeve.
45. Carefully refit the input housing sliding it over the sleeve. Withdraw the sleeve when the housing is in place.
46. Lightly coat the threads of the bolts with Hylomar sealant and tighten to a torque of 60 Nm (44 lbf ft).
47. Reconnect the oil feed pipe applying Massey Ferguson Studlock (Loctite 270).
48. Refit the clutch release mechanism, see operation 6B-04.



Clutch Pack Assembly

Overhaul 7L–07

Disassembly

1. Remove the clutch pack assembly, see operation 7L-05.
2. Manufacture a pressing tool as shown in the illustration.
3. Place the clutch pack under a hydraulic press with the rear face upwards.
4. Place the tool over the clutch resting on the face of the hub.
5. Apply hydraulic pressure so that the circlip inside the gear can be removed.
6. Release the pressure slowly, removing the shim.
7. Place the clutch on a clean work bench.
8. Lift off the fast speed gear, cover, piston and hub assembly and put to one side.
9. Remove the outer Belleville spring from the slow speed set.
10. Remove the inner Belleville spring.
11. Remove the cover and gear assembly from the hub.

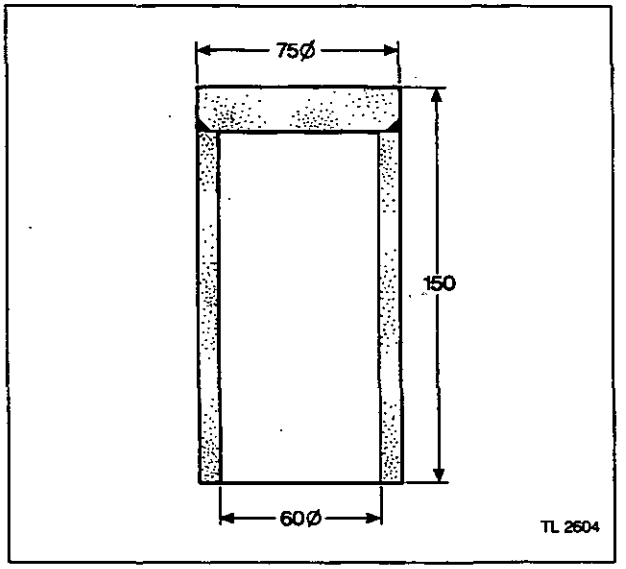
CAUTION: If the clutch plates are to be refitted to the clutch they must be kept in their respective sets and sequence. Note that the last steel plate to be fitted in the set is thicker than the others.

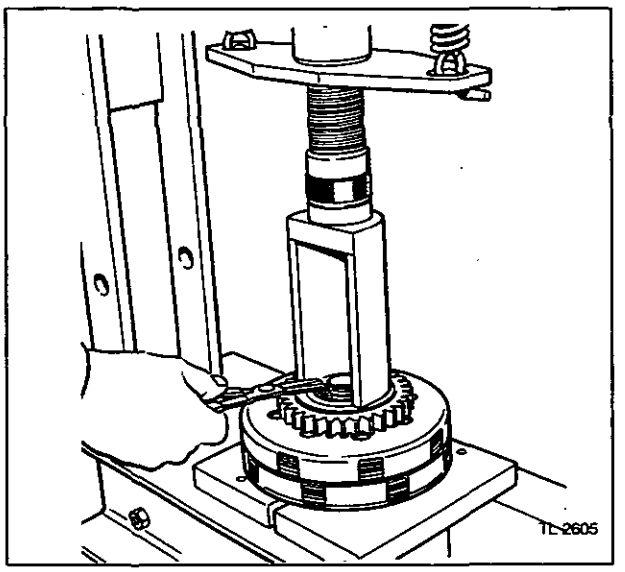
12. Remove the clutch plates.
13. Remove the two 'O' rings from the hub and discard.
14. Taking the fast speed set, carefully prise the piston out of the hub.
15. Remove and discard the 'O' ring.
16. Remove the outer Belleville spring.
17. Remove the cover and gear assembly from the hub.
18. Remove the clutch plates.

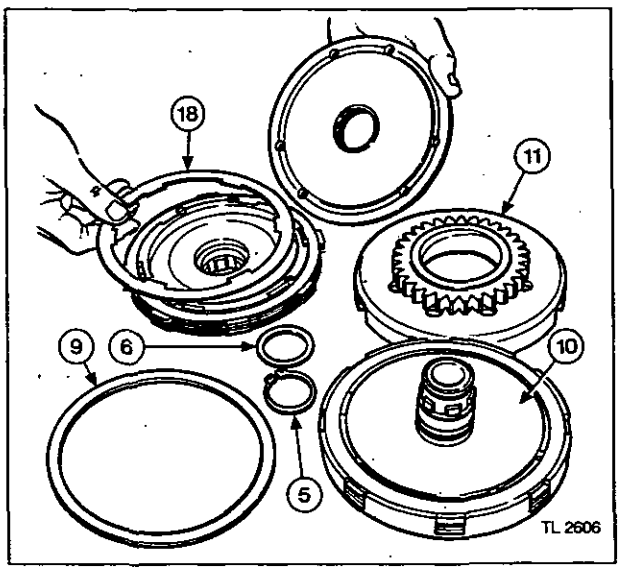
Examination

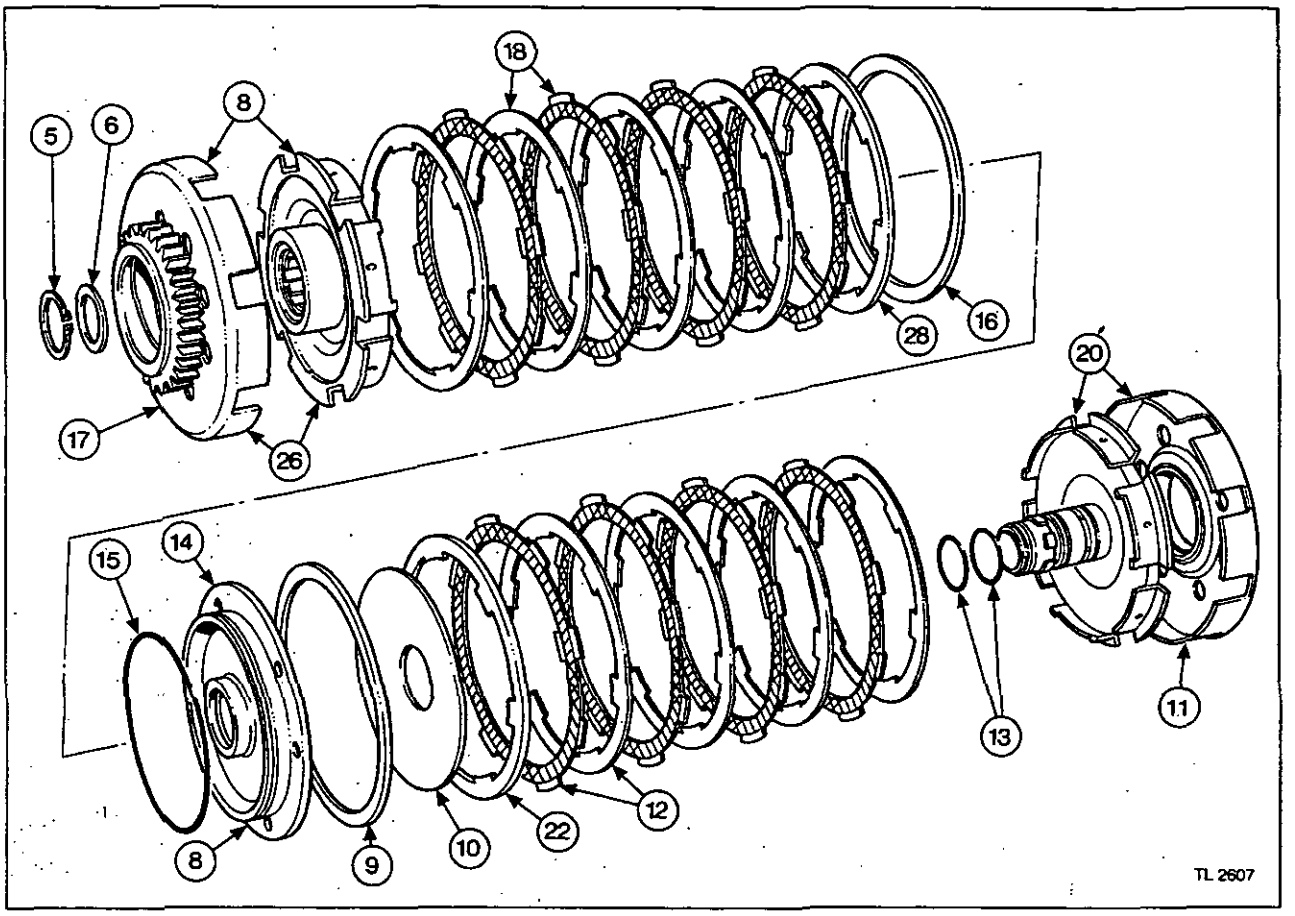
Examine all the components of the clutch, paying particular attention to the clutch plates. The plates should be flat, not deeply scored (light scuffing is acceptable) and the friction plates must show clear tangential oil grooves on their faces. Check the condition of the piston and its bore for signs of wear or damage.

Thoroughly clean all the components, lightly lubricate the parts during assembly. Replace all seal rings and circlips.



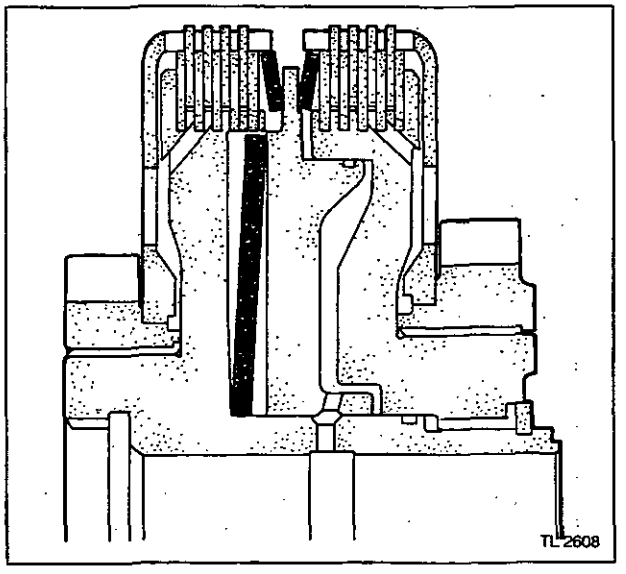






Reassembly

19. If new friction plates are to be fitted they should be immersed in transmission oil for 30 minutes before assembly.
20. Lubricate the bore of the front cover, slow speed (smallest gear) and fit the hub. Check that the face of the hub is proud of the gear.
21. Assemble the clutch plates starting with a steel plate, then friction until four sets have been fitted.
22. The final steel plate is thicker.
23. Fit the inner Belleville spring with it resting on its inner edge.
24. Fit the outer Belleville spring with it resting on its outer edge.
25. Carefully fit two new sealing rings to the hub.
26. Taking the rear cover, fast speed (largest gear), lubricate the bore and fit the hub. Check that the hub is proud of the gear.
27. Assemble the clutch plates starting with a steel plate, then friction until four sets have been fitted.
28. The final steel plate is thicker.



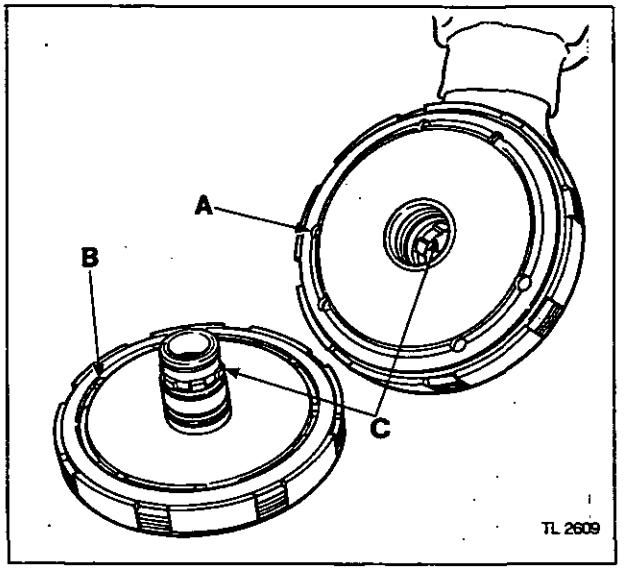
29. Fit the outer Belleville spring with it resting on its outer edge.
30. Replace the piston seal ring.
31. Lubricate the piston with clean transmission oil and locate the piston over the hub. The six projections on the hub must align with the six holes in the piston.
32. With hand pressure, press the piston down into the hub.
33. Lubricate the seals on the front hub with clean transmission oil.
34. Taking the rear clutch pack fit it to the front clutch pack by lowering over the hub. Take care not to damage the seals.
35. The six holes in the piston **'A'** must again align with the six pins on the front hub **'B'**. The hub has six splines **'C'** and the six pins are in three groups of two, there are three positions where the pins will be in line and three positions where they will not.
36. Check that the clutch is located properly and rotates freely.
37. Place the clutch under the press and position the tool on the hub.
38. Press the hub down until the shim and circlip can be fitted.
39. Fit the shim removed as a starting point.
40. Replace the circlip. A new clip must be fitted and it must be fitted with the sharp edge facing outwards.

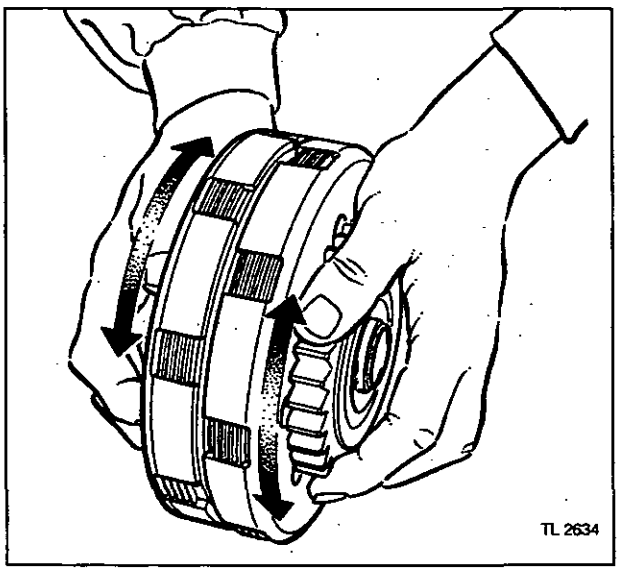
Clutch Adjustment

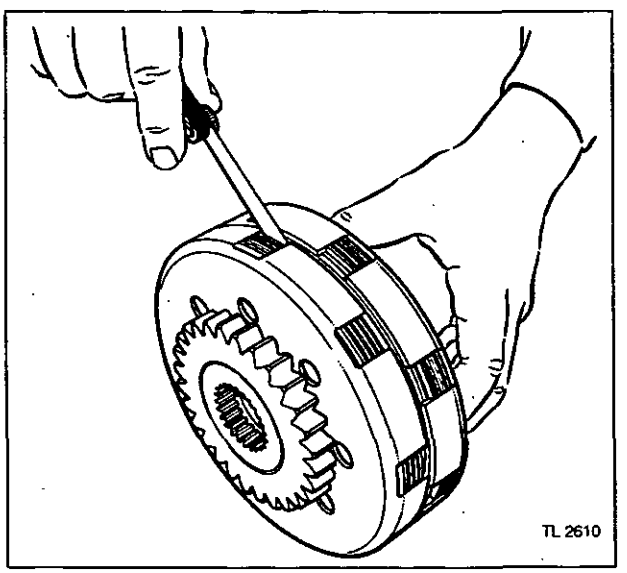
41. Remove the clutch from the press and check it for rotation.
42. Holding the clutch by the two gears try and rotate it. If the clutch is locked solid a thinner thrust washer is required.
43. If the clutch rotates freely a thicker thrust washer is required. The clutch should be able to be turned by hand, but it should be stiff. Thrust washers are available in the following sizes:

Shim thickness chart		
Part No.	Metric	Imperial
3760 658 M2	1,70 mm	0.067 in
3760 659 M2	1,85 mm	0.073 in
3760 660 M2	2,0 mm	0.079 in
3760 661 M2	2,15 mm	0.085 in
3760 662 M2	2,30 mm	0.091 in

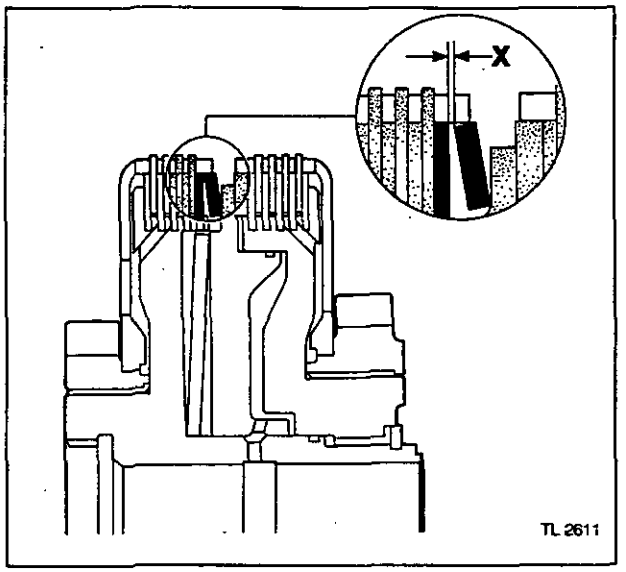
44. Check the clutch internal clearance by using a set of feeler gauges and measuring the gap between the outer Belleville spring and the first steel plate, dimension **'X'.**







45. Check the clearance **'X'** in at least eight positions around the clutch. Make a note of each reading, add the readings up and take an average. The average figure should be within 0,30-0,45 mm (0.012-0.018 in). If the reading is less than the tolerance a thinner shim is required, if greater a thicker one.
46. Re-install the clutch into the gearbox.



PTO Drive Shaft Front Bearing

Removal and Refitment 7L–08

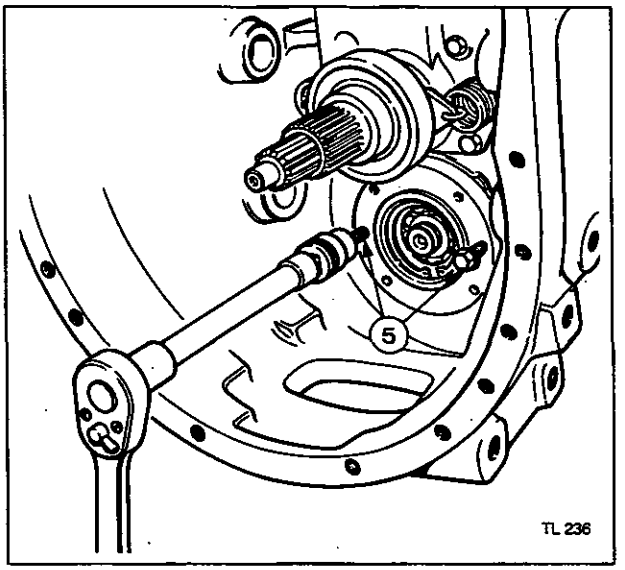
Special tools:
MF.218A PTO Drive Shaft Puller

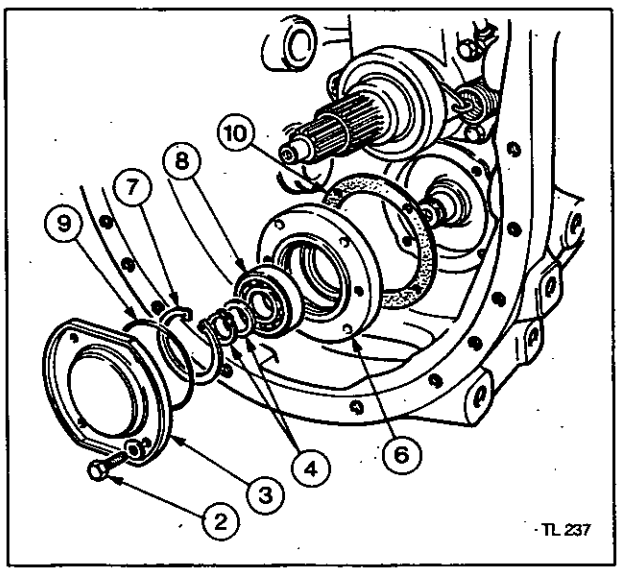
Removal

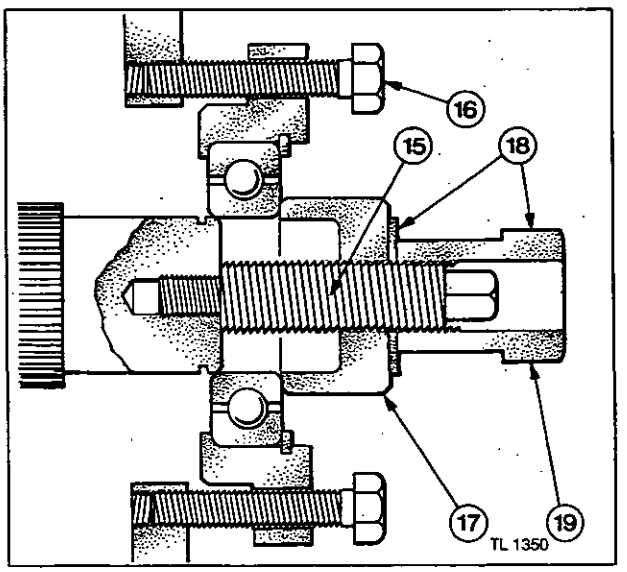
1. Remove the clutch cross shaft and lever, see operation 6B-04.
2. Remove the four bolts and washers.
3. Remove the cover plate.
4. Remove the external circlip and washer.
5. Screw two 3/8" UNC x 75 mm (3 in) bolts (part of Special Tool MF.218A) into the bearing housing and tighten them evenly to draw the housing from the case and shaft.
6. Remove the housing.
7. Discard the internal circlip.
8. Press out the bearing.
9. Discard the 'O' ring.
10. Discard the gasket.
11. If the gearbox has been removed for overhaul and it is necessary to remove the PTO shaft; screw a 7/16" UNF bolt approximately 75-100 mm (3-4 in) long into the end of the shaft. Drive the shaft out of the PTO constant mesh gear by striking the end of the bolt with a hammer.

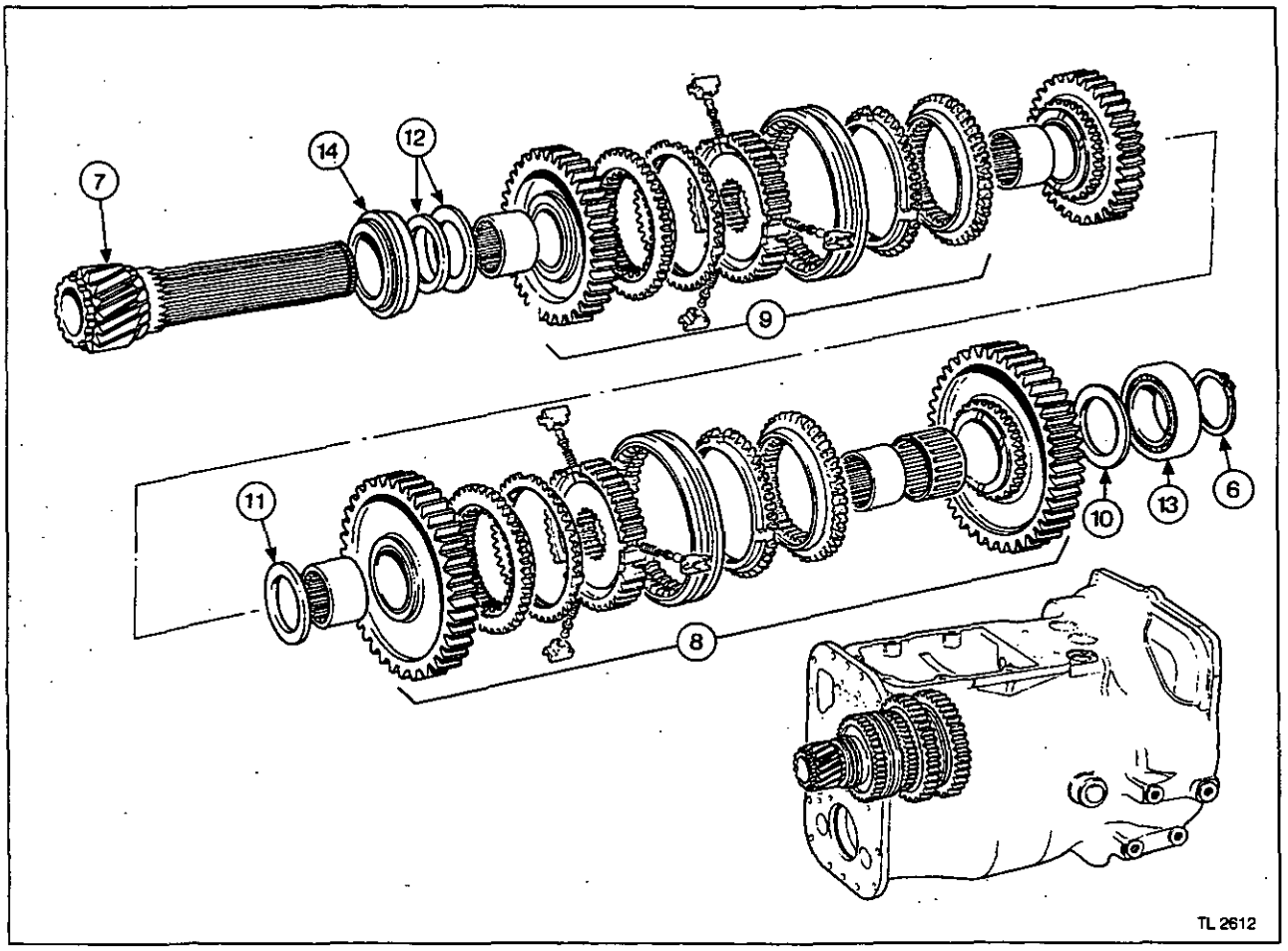
Refitment

12. Lightly coat the gasket with Hylomar sealant.
13. Using special tool MF.218A, pull the PTO shaft into the bearing and housing assembly as follows:
14. Check that the PTO shaft splines locate with those in the PTO constant mesh gear.
15. Screw the centre screw into the end of the PTO shaft with the aid of a 9/16 in A/F spanner.
16. Locate the bearing and housing assembly on the end of the PTO shaft. Locate the housing with the two long bolts provided with MF.218A through the unthreaded holes.
17. Lubricate the thread of the tool and place the adaptor onto the centre screw with the hollow face against the bearing.
18. Place the washer on the centre screw and screw on the nut
19. Tighten the nut with a 1,1/8 in A/F spanner until the housing is pushed home and the PTO shaft is drawn through the gear and ball-bearing up to the shoulder so that the washer and circlip can be fitted.
20. Fit the washer and a new circlip.
21. Refit the cover with a new 'O' ring.
22. Lightly coat the securing bolt threads with Hylomar sealant.
23. Tighten the bolts to a torque of 60 Nm (44 lbf ft).









Layshaft, Mainshaft, PTO and Gears

Overhaul	7L–09

Disassembly

1. Remove the gearbox and range change unit assembly from the tractor, see operation 7L-02.
2. Remove the range change unit from the gearbox, see operation 7L-02.
3. Remove the clutch release mechanism, see operation 6B-04.
4. Remove the top cover and selector rails and forks, see operation 7L-04.
5. Remove the input housing and clutch pack assembly, see operation 7L-05.

Mainshaft

6. Remove the circlip from the front of the main shaft.
7. Pull the main shaft out of the gearbox from the rear, complete with the rear thrust washer and spacer. Allow the gear sets to rest on the layshaft, the thrust washers will fall into the bottom of the box.
8. Lift out the 1st/reverse gear set .
9. Lift out the 3rd/2nd gear set.
10. Retrieve the measured thrust washer.
11. Retrieve the intermediate washer.
12. Remove the rear thrust washer and spacer.
13. Remove the front roller bearing from the gearbox casing.
14. If necessary, press the rear taper roller bearing off the mainshaft.

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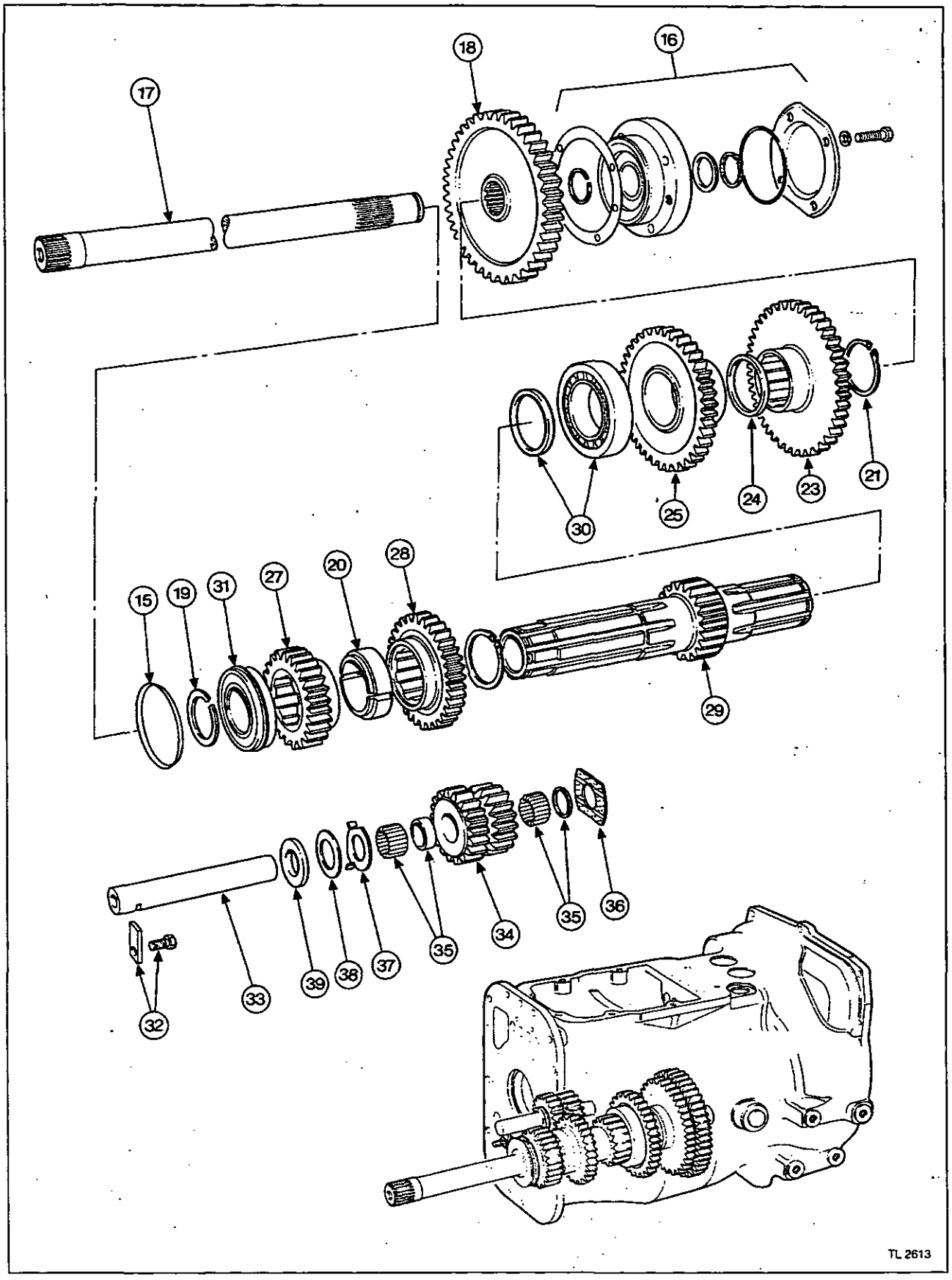
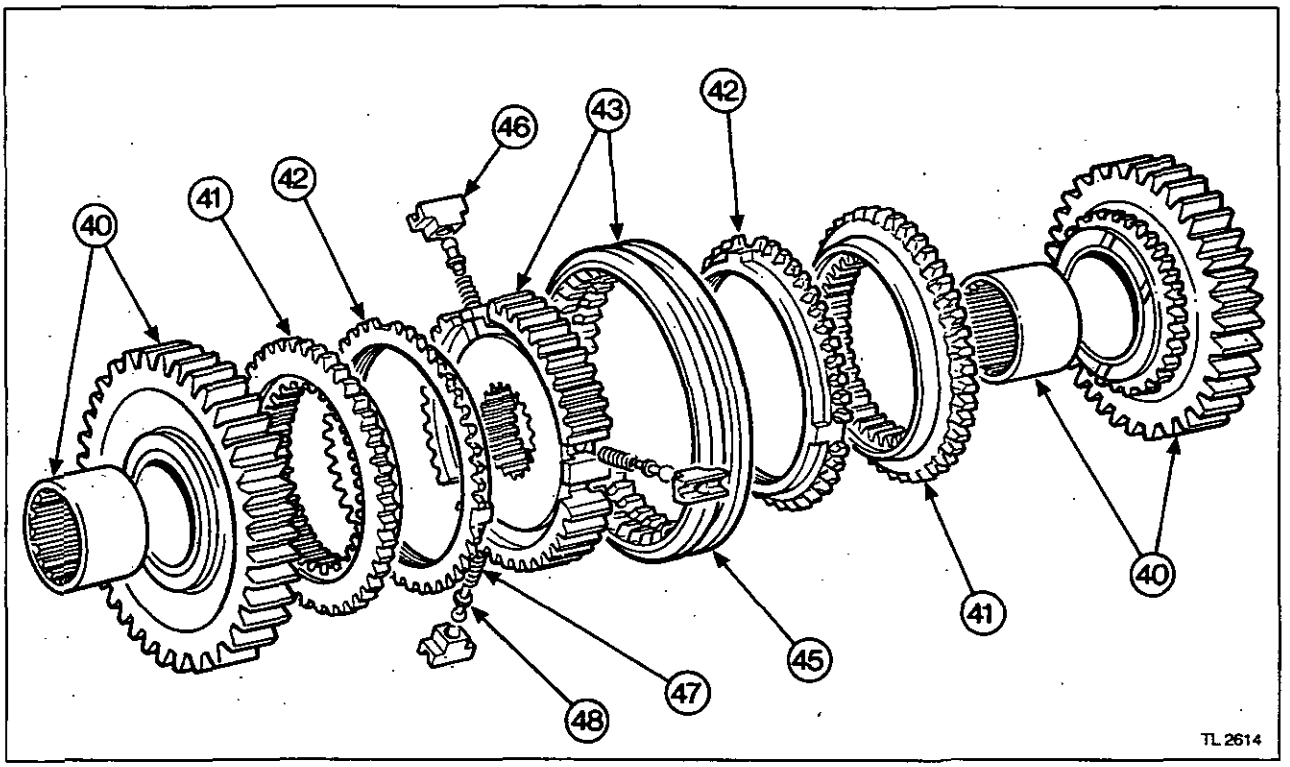
18 SPEEDSHIFT GEARBOX





Layshaft

15. Remove the compression ring from the rear bearing.
16. Remove the PTO drive shaft front bearing, see operation 7L-08.
17. Remove the PTO shaft.
18. Move the layshaft rearwards and lift out the PTO constant mesh gear.
19. Remove the rear circlip.
20. Drive the layshaft towards the front , separate 3rd and 2nd gear and lift out the two halves of the spacer.
21. Remove the front circlip.
22. Drive the layshaft to the rear to give sufficient clearance to lift out the Fast and Slow constant mesh gears.
23. Remove the slow speed gear.
24. Remove the spacer.
25. Remove the fast speed gear.
26. Drive the layshaft out of the gearbox casing from the rear.
27. Lift out 2nd gear.
28. Lift out 3rd gear.
29. Remove the shaft from the front of the box complete with the front roller bearing.
30. If necessary, remove the front bearing from the shaft with the spacer.
31. Remove the rear ball-bearing from the gearbox.

Reverse Idler

32. Remove the bolt and locking plate from the inside of the box.
33. Hold the gear cluster and carefully push out the shaft.
34. Remove the gear cluster.
35. Tip the 56 rollers and spacers into a clean container.
36. Remove the thrust washer.
37. Remove the tabbed thrust washer.
38. Remove the belleville spring washer.
39. Remove the collar.

Synchromesh assemblies

40. Remove the two gears and sleeves. In the case of 1st gear, the needle roller bearing.
41. Remove the two synchromesh cones.
42. Remove the two baulk rings.
43. Remove the drive hub complete with sliding coupler.
44. Wrap the hub and coupler in a cloth .
45. Remove the sliding coupler, taking care not to lose pressure springs, ball pins and blocks.
46. Remove the three pressure blocks.
47. Remove the three pressure springs.
48. Remove the three ball pins.
49. Thoroughly clean all the components and check their condition.

50. Using a feeler gauge, measure the clearance between the baulk ring and the synchromesh cone at several points. The baulk ring must be correctly positioned on the tapered part of the synchromesh cone. If the average clearance is less than 0,5 mm (0.020 in) replace the brass baulk ring.

Examination

51. Clean and thoroughly inspect all parts for signs of wear or damage and replace if necessary. Renew all snap rings, circlips and 'O' rings. When replacing snap rings and circlips ensure that they are correctly located in their grooves.

Reassembly

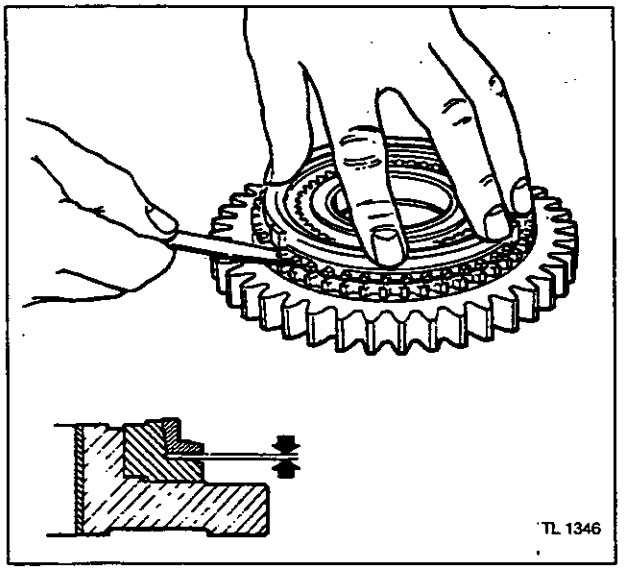
Synchromesh Hub Assemblies

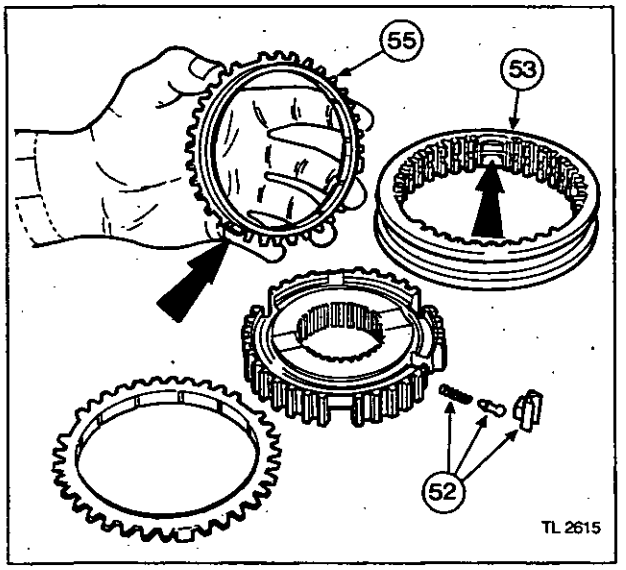
52. Place the hub on a work bench and insert the three springs, ball pins and pressure blocks.
53. Place the sliding coupler over the hub ensuring that the double width splines in the coupler are opposite the slots in the hub.
54. Press the coupler down into place easing the spring-loaded blocks into position.
55. Position the baulk rings so that the locating blocks fit into the slots in the hub.
56. Fit the synchromesh cones to the 1st (48T), 2nd (42T), 3rd (36T) and reverse (49T) gears.
57. Fit the sleeves to the gears.
58. Complete the two synchromesh assemblies by placing the gears each side of the hubs (1st/Rev - 3rd/2nd) ready for installation.

NOTE: 1st/rev synchromesh has the smaller outside diameter sliding coupler (53).

Reverse Idler

59. An assembly tool will greatly assist in fitting the reverse idler into the gearbox casing. Obtain a length of steel bar 25 mm diameter x 58 mm long. (1 in dia. x 2.5/16 in long).
60. Replace the rollers in the reverse idler pinion, a smear of petroleum jelly (not grease) will help to retain them. There is a double row of 28 rollers with the wide spacer between them.
61. The narrow spacer is fitted to the front in line with the small gear.
62. Insert the assembly tool into the gear to hold all the rollers in place.
63. Fit the Belleville spring washer to the collar with the dished face facing the tabbed thrust washer and gear.
64. Fit the front thrust washer with the brass face facing the gear.
65. Insert the idler assembly into the gearbox casing. Refit the shaft pushing out the assembly tool in the process.
66. Apply two or three drops of Massey Ferguson Lock 'n' Seal (Loctite 242) to the retaining bolt and fit the lock plate and washers.


TL 1346



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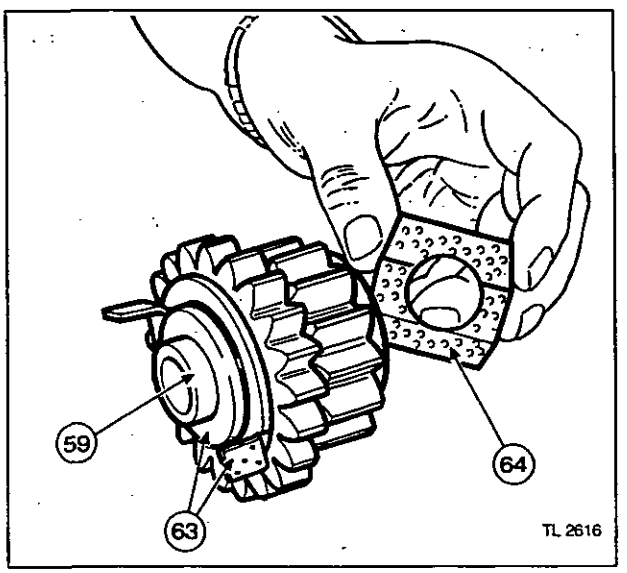


TL 2616

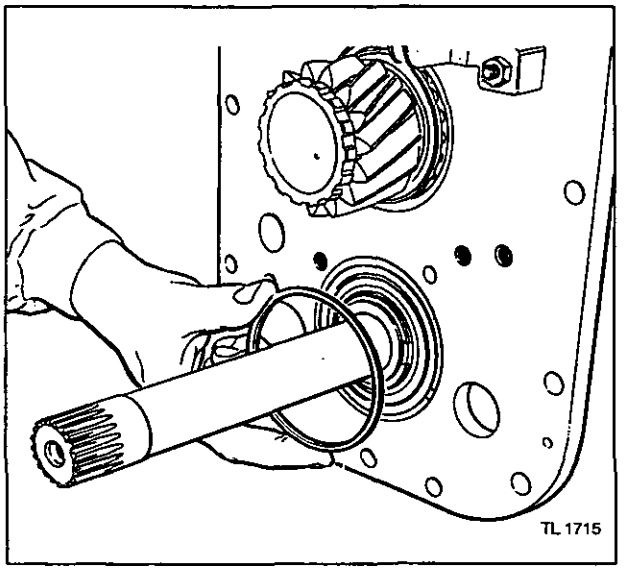
Layshaft

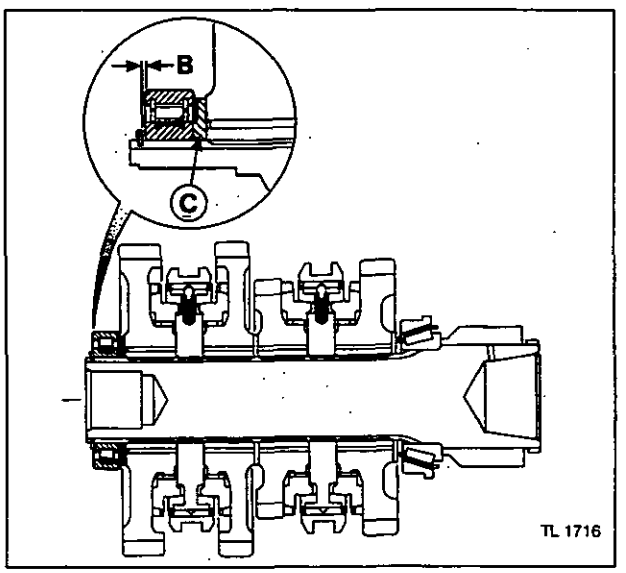
67. Replace the circlip in the centre of the shaft.
68. Fit the spacer (which is part of the bearing) to the shaft first. Press the front roller bearing onto the shaft, if removed.
69. Place the 3rd (33T) and 2nd (27T) gears in the bottom of the gearbox. The smaller gear to the rear.
70. Pass the layshaft through the front of the gearbox so that the roller bearing is in the first section.
71. Fit the 3rd and 2nd layshaft gears.
72. Push the layshaft rearwards so that the roller bearing is in the centre web and the shaft is fully rearwards.
73. Slide on the fast speed gear (the smallest of the two).
74. Fit the spacer.
75. Slide on the slow speed gear (the largest).
76. Replace the circlip on the front of the layshaft.
77. Move the layshaft forward so that the two gears 2nd and 3rd can be separated and the split spacer fitted.
78. Move the layshaft rearward again with the front roller bearing in its housing. Place a steel wedge, or suitable packing, between the front end of the layshaft and the inside of the gearbox casing.
79. Drive the rear roller bearing onto the end of the shaft and into the gearbox casing.
80. Remove the wedge or material from the front of the gearbox.
81. Replace the rear snap ring and ensure that the layshaft is fully forward.
82. Ensure that the layshaft turns freely.
83. Place the PTO constant mesh gear in place in the front of the box.
84. Refit the PTO shaft and bearing housing, see operation 7L-08.
85. Fit the rear bearing retainer spring ring.

Mainshaft End Float Adjustment

86. Assemble the mainshaft complete with all hubs, gears bearings and thrust washers.
87. Refit the circlip.
88. Measure gap **'B'** between the front bearing and the circlip. The gap (end float) should be 0,08-0,3 mm (0.003-0.012 in).
89. If your measurement falls outside these set limits replace the calibrated thrust washer **'C'** which sits between the bearing and first gear.
90. Select a suitable thrust washer from the chart below.

Thrust washer thickness chart		
Part No.	Metric	Imperial
3599 299 M1	3,4 mm	0.134 in
3598 644 M1	3.7 mm	0.146 in
3598 643 M1	3,9 mm	0.154 in
1671 888 M2	4,2 mm	0.164 in


TL 1715



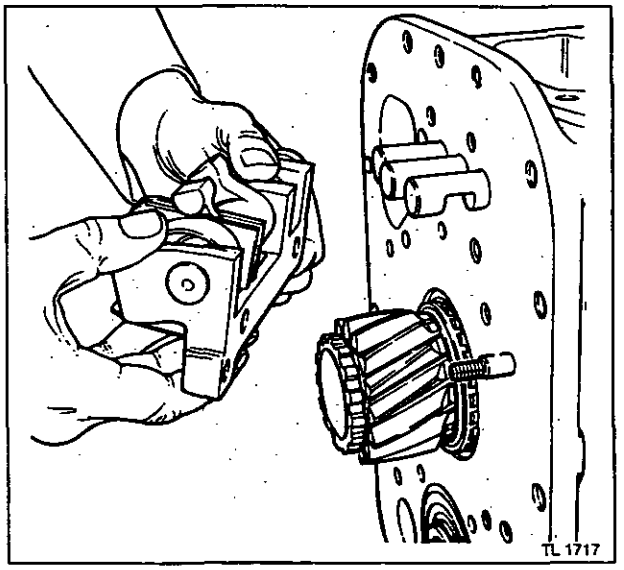
TL 1716

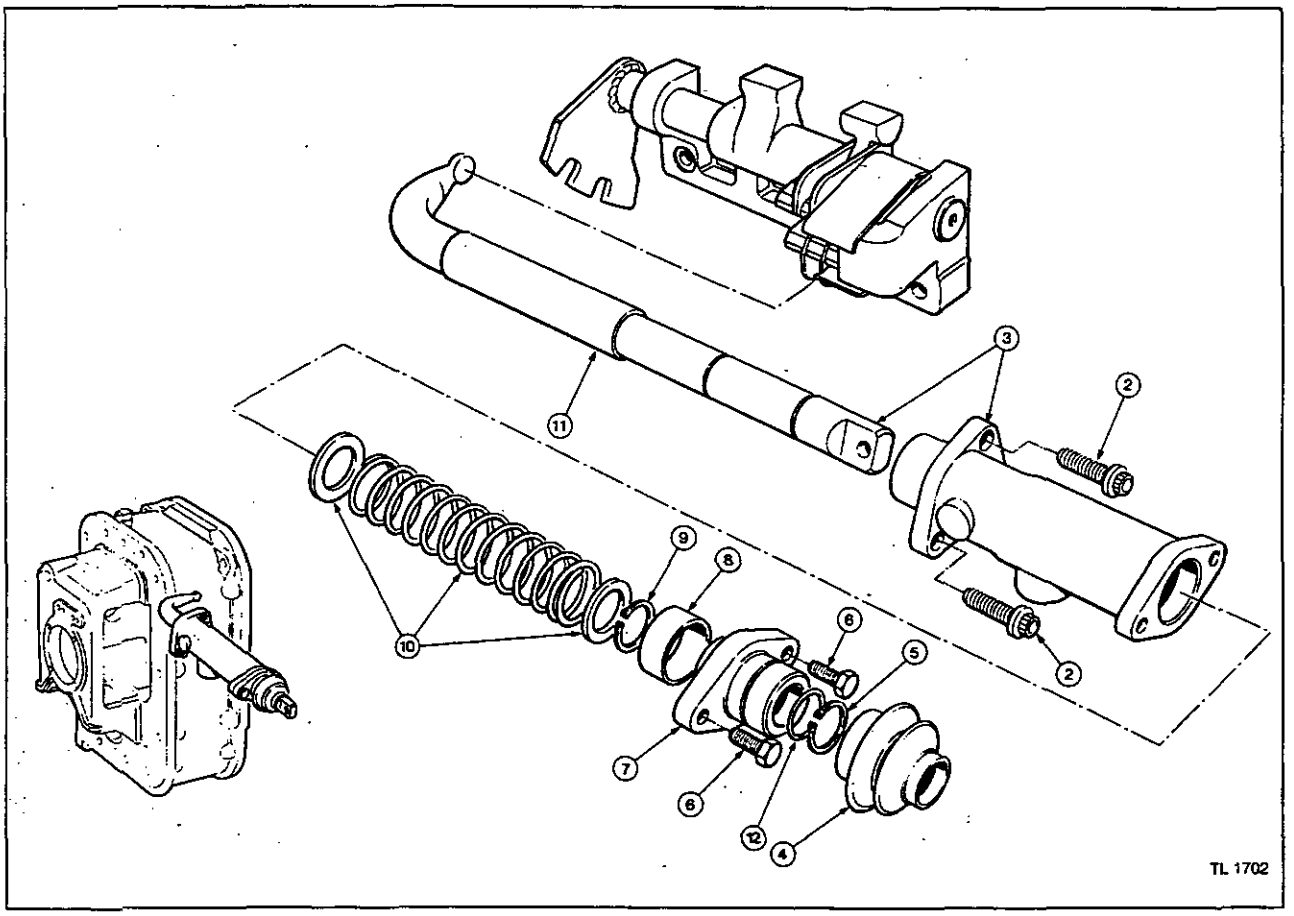
18 SPEEDSHIFT GEARBOX

General

91. Slide the mainshaft, complete with spacer and thrust washer through the rear of the gearbox, progressively fitting in the following order:
- 2nd/3rd synchromesh hub assembly with 2nd gear (largest 42T) to the rear.
- Central thrust washer.
- 1st/reverse synchromesh hub assembly with reverse (largest 49T) to the rear.
- Calibrated thrust washer with the larger face to the gear.
- Roller bearing.
- Circlip.

92. Locate the tagged thrust washer in the gearbox centre web with the belled side facing forwards.
93. Ensure that the needle roller bearing is fitted into the centre of the mainshaft.
94. Refit the input housing and clutch pack, see operation 7L-05.
95. Refit the selector forks, rails and top cover, see operation 7L-04.
96. Refit the clutch release mechanism, see operation 6B-04.
97. Refit the range change unit to the gearbox, see operation 7H-09 procedures 98 to 104 and operation 7H-10. Carry out all necessary bearing pre-load adjustments.
98. Refit the gearbox to the tractor.





Gear Shift Selector

Overhaul	7L–10

Disassembly

1. Remove the main gear shift lever assembly, see operation 7L-03.
2. Remove the two twelve-point cap screws holding the lever assembly to the range change unit.
3. Remove the lever assembly.
4. Remove the rubber boot.
5. Remove the circlip.
6. Unscrew the two bolts holding the end cover in place.
7. Remove the end cover.
8. Remove the spacer.

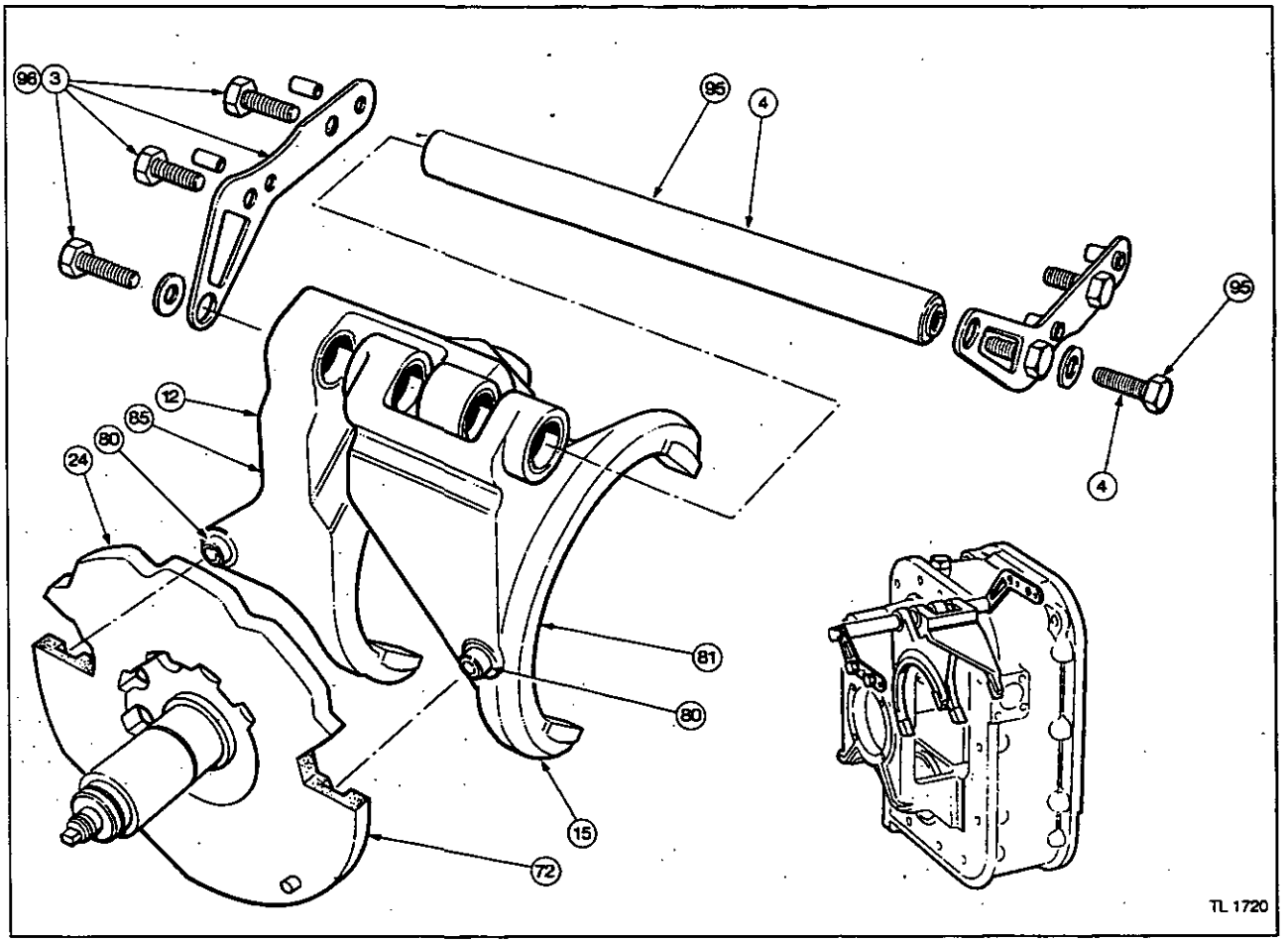
WARNING: Spring under compression.

9. Remove the circlip.
10. Remove the two spacers and spring.
11. Remove the selector shaft from the housing.

Reassembly

12. Reverse procedures 1 to 16 except:-
    a. Replace the 'O' ring in the end cover.
    b. Replace all circlips.
    c. Lubricate the component parts during assembly with transmission oil.
    d. Ensure that the end of the selector shaft engages correctly in the jaws of the selector mechanism.
    e. Apply Massey Ferguson Multi-Gasket (Loctite 574) to the face of the end cap and housing and tighten the twelve-point cap screws to a torque of 60 Nm (44 lbf ft).

18 SPEEDSHIFT GEARBOX



Range Change Unit Shafts and Gears

Overhaul	7L–11

Special tools:

MF.476 Bearing Remover/Replacer
MF.477 Gear Set Support Tool

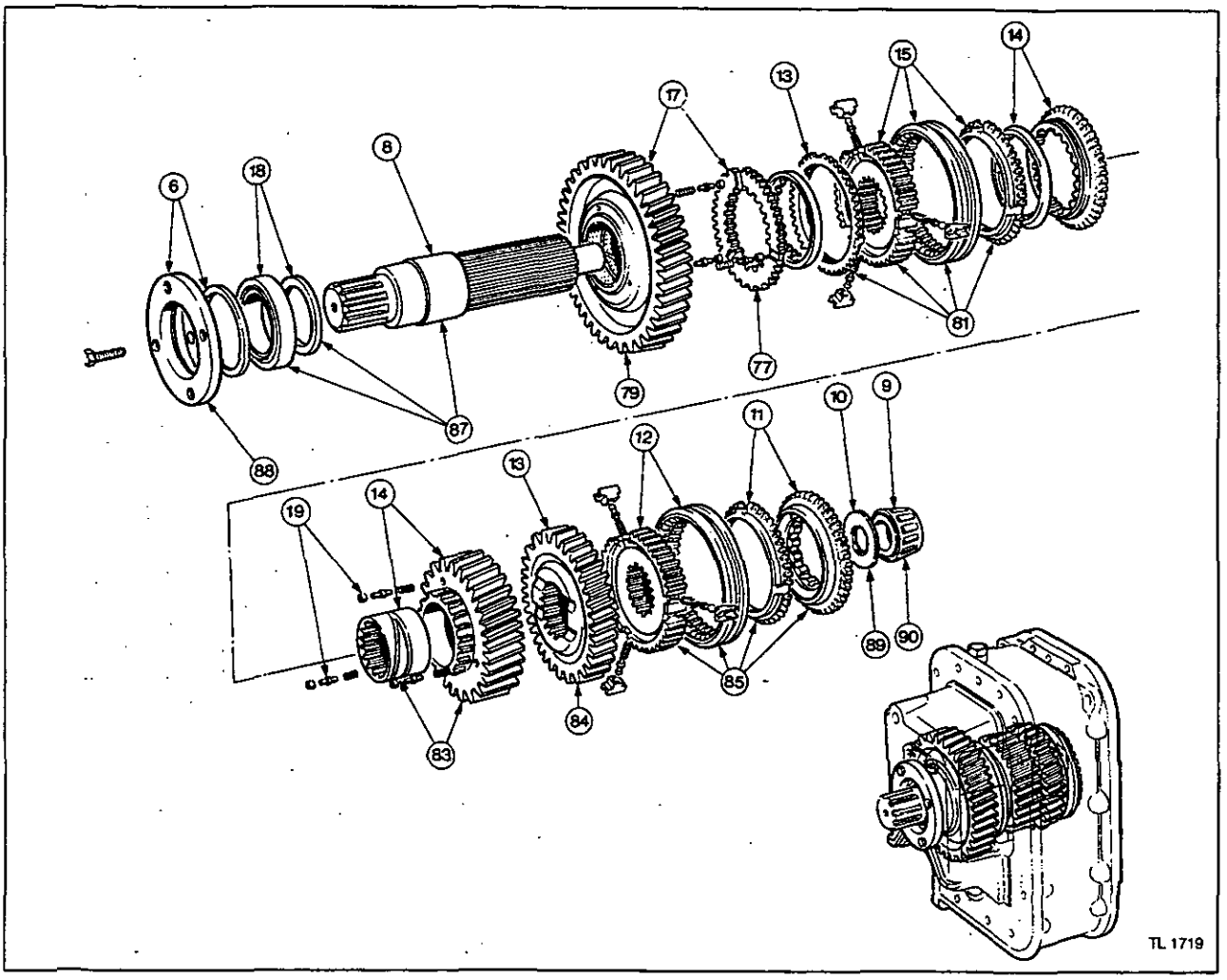
Disassembly

1. Remove the transmission from the tractor, see operation 7H-01.
2. Remove the range change unit from the gearbox and place on a suitable workbench. It would be beneficial to make a small stand to support the gearbox approximately 380 mm (15 in) high, 460 mm (18 in) long and 222 mm (8 3/4 in) wide between the supports as shown in the illustration on the next page.

Upper shaft and selector forks

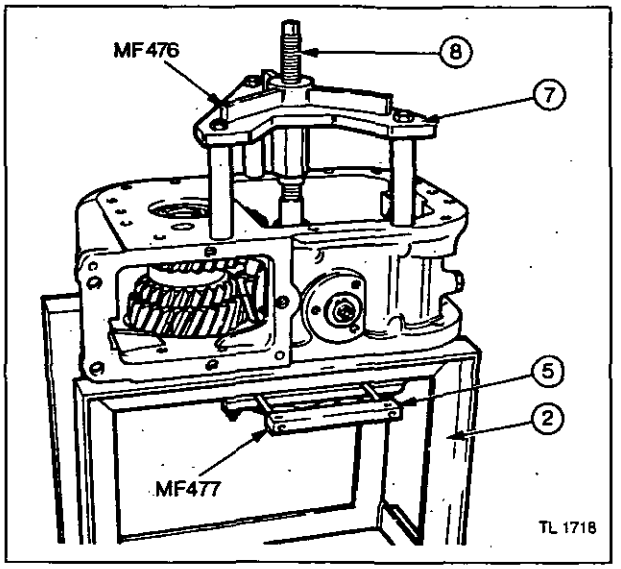
3. Remove the three bolts from the front selector rail support bracket and remove the bracket.
4. Remove the bolt from the rear of the selector rail and withdraw the rail from the selector forks.
5. Place special tool MF.477 between the rear casing and low range gear on the upper shaft. The tool will support the gears in their operating position and prevent damage to the selector fork roller and pin.
6. Remove the upper shaft rear bearing cap and spacer ring.

18 SPEEDSHIFT GEARBOX

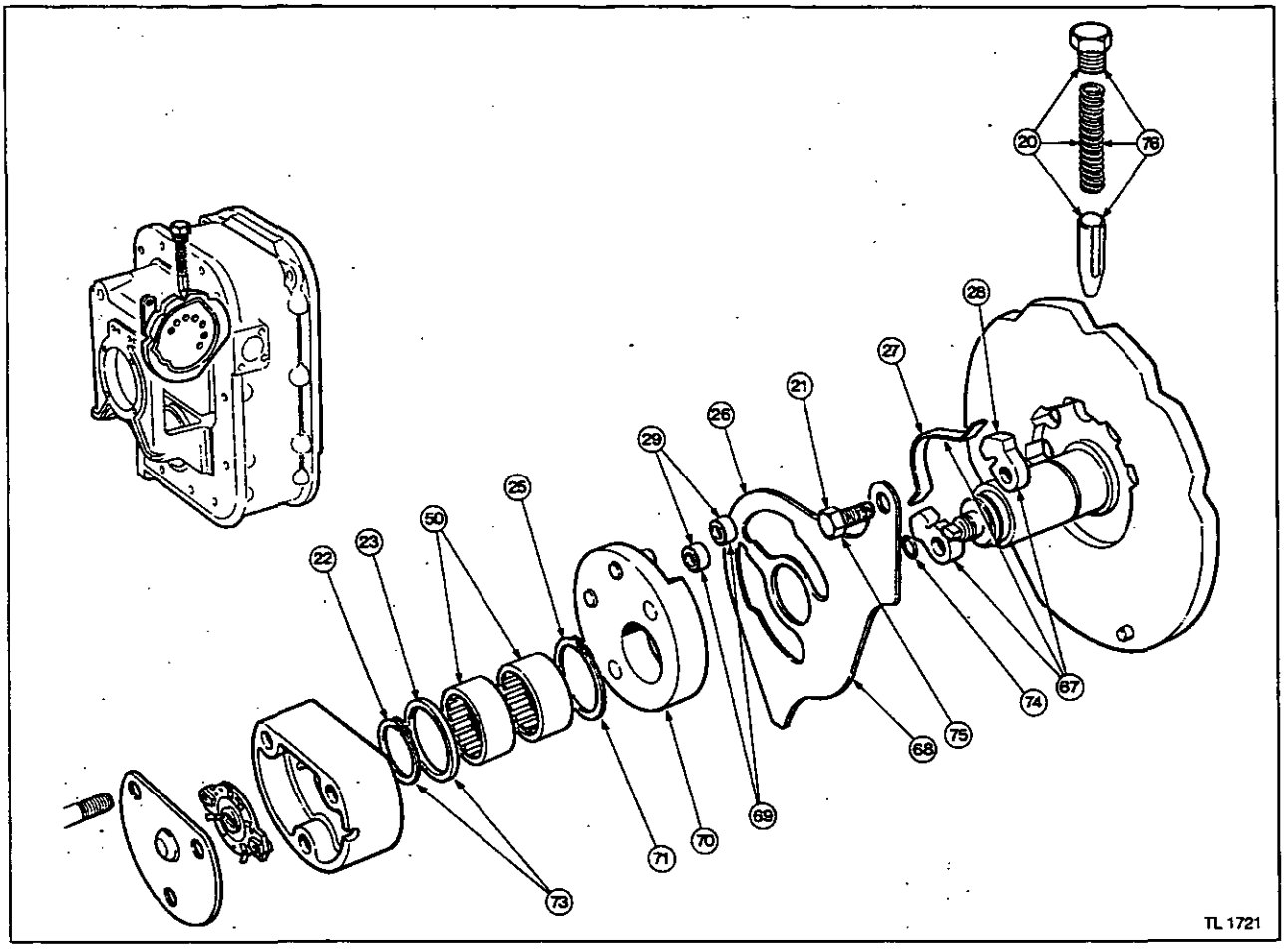


CAUTION: Under no circumstances is the taper roller bearing, item 9, to be removed or fitted to the upper shaft with a hammer and punch. Damage to the bearing will result in a seizure of the gearbox and extensive failure of many of the components. Special tool MF.476 has been developed to make the dismantling and assembly of the range change unit safe, quick and easy.

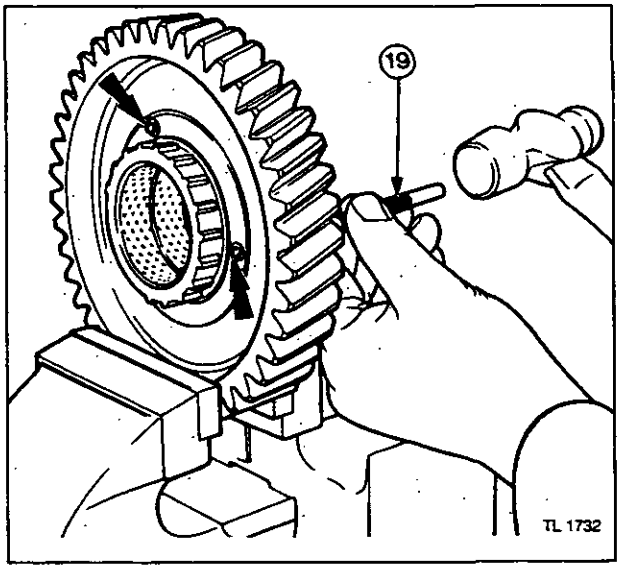
7. Bolt special tool MF.476 over the upper shaft as shown in the illustration.
8. Screw down the hand press onto the upper shaft and press the shaft out of the small taper roller bearing. DO NOT allow the shaft to fall onto the floor.
9. Remove the taper roller bearing.
10. Remove the thrust washer.
11. Remove the high range synchromesh cone and baulk ring.
12. Remove the high range synchromesh hub assembly and selector fork complete with guide roller.
13. Remove the four-wheel drive pinion.
14. Remove the medium speed range gear complete with synchromesh cone and bush.



18 SPEEDSHIFT GEARBOX

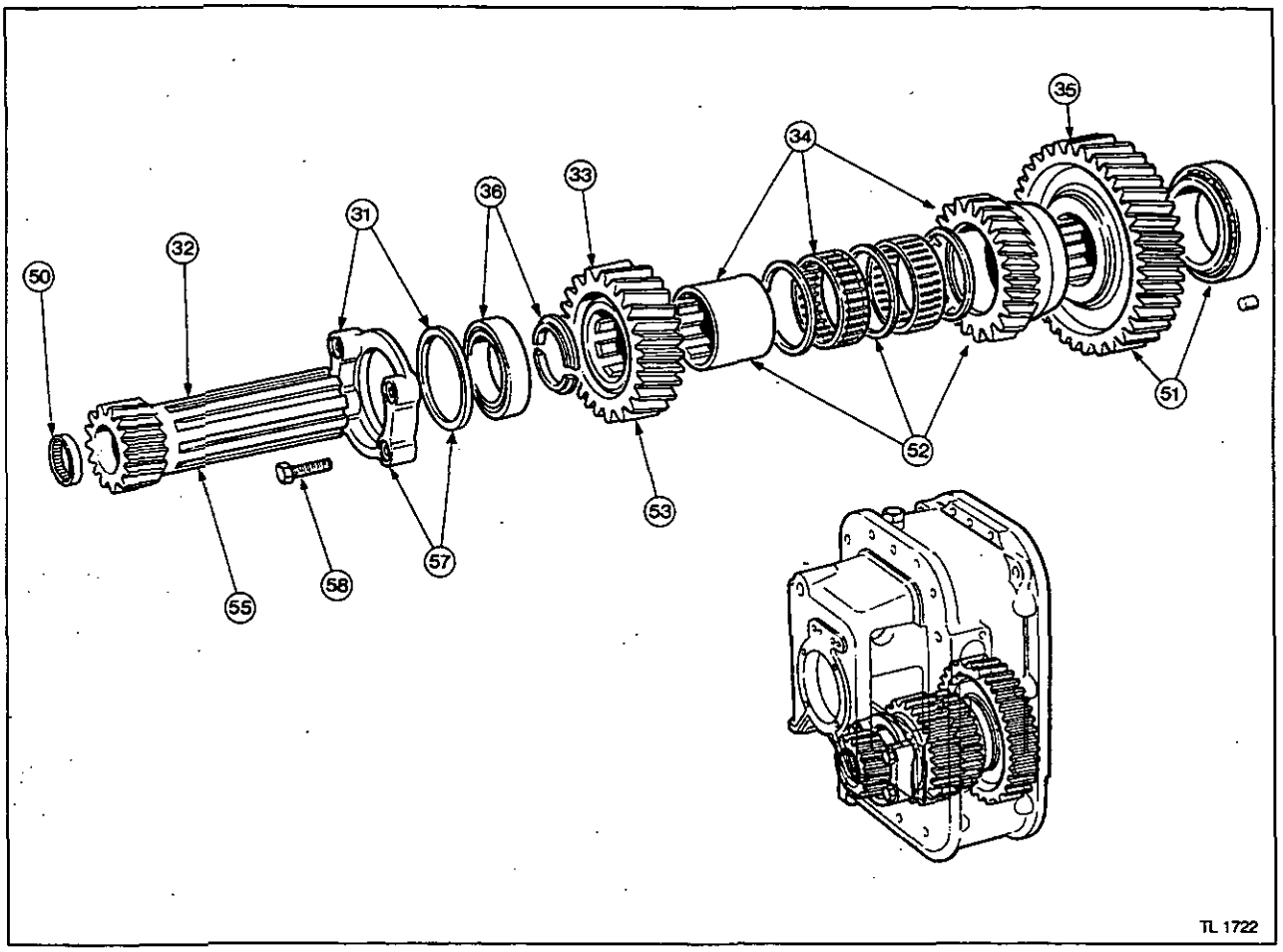


15. Remove the low/medium range synchromesh hub assembly and selector fork complete with guide roller.
16. Remove special tool MF.477.
17. Remove the low range gear complete with synchromesh cone.
18. If necessary, the rear taper roller bearing and thrust washer can be pressed off the shaft.
19. Check the operation of the spring-loaded synchromesh cone alignment pins. If damaged, they can be removed with a hammer and punch through the rear face of the gear. This applies to both medium and low gears.



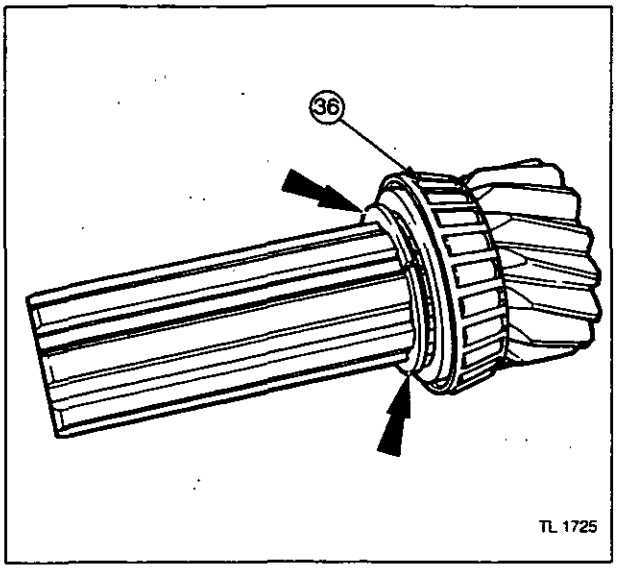
Selector cam assembly

20. Remove the cam plate detent plunger and spring.
21. Remove the bolt from the cam spring plate.
22. Remove the circlip.
23. Remove the thrust washer.
24. Remove the cam plate assembly from the inside of the box.
25. If necessary, remove the circlip and remove the cam ratchet assembly.
26. Remove the spring plate.
27. Remove the spring.
28. Remove the pawls.
29. Remove the selector lever rollers.



Lower shaft

30. Turn the gearbox over.
31. Remove the lower shaft bearing cap bolts, cap and spacer ring.
32. Pull the lower shaft and thrust washer out of the gearbox.
33. Remove the medium range gear.
34. Remove the four-wheel drive gear complete with needle roller bearings and sleeve.
35. Remove the constant mesh gear.
36. Remove the taper and needle roller bearings as necessary. To remove the taper roller bearing behind the low range gear it will be necessary to press the bearing towards the gear to remove the two split retaining rings.



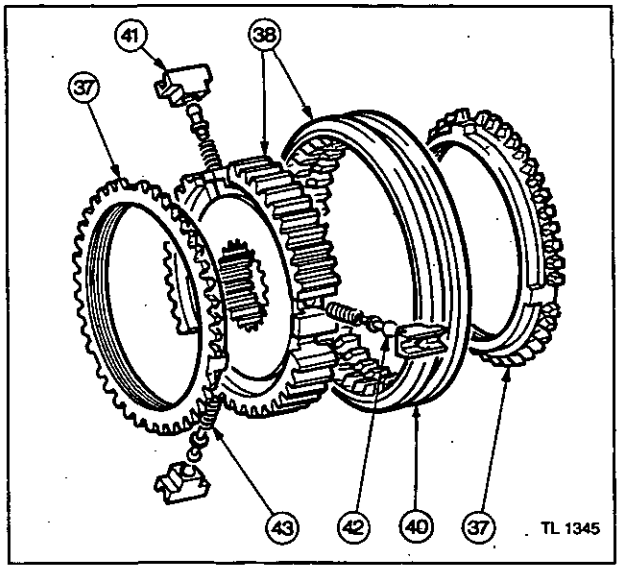
Synchromesh hub assemblies

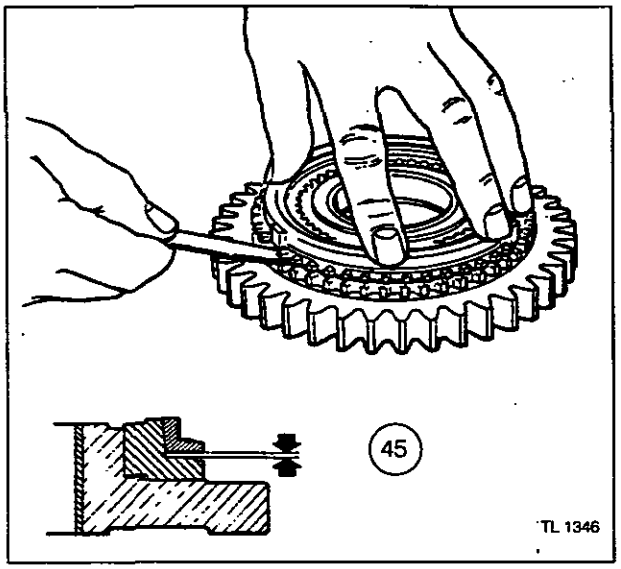
37. Remove the two baulk rings.
38. Remove the drive hub complete with the sliding coupler.
39. Wrap the hub and coupler in a cloth.
40. Remove the sliding coupler, taking care not to lose pressure springs, ball pins and blocks.
41. Remove the three pressure blocks.
42. Remove the three ball pins.
43. Remove the three pressure springs.
44. Thoroughly clean all the components and check their condition.

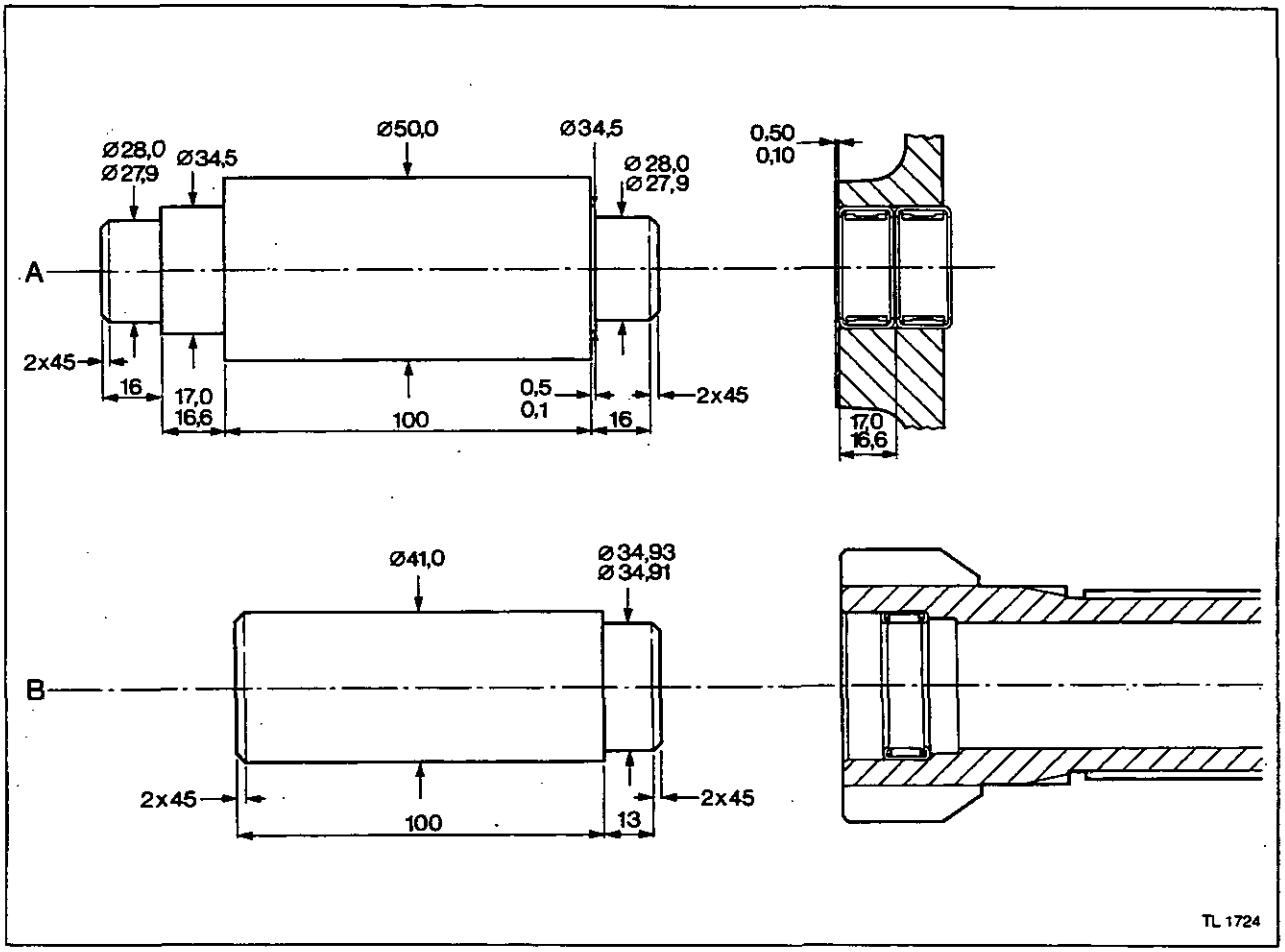
Examination

Clean and carefully examine all the components, replace any that show signs of damage or wear. Replace all 'O' rings and circlips. Ensure that all circlips are fitted correctly in their grooves.

45. Using a feeler gauge, measure the clearance between the baulk ring and the synchromesh cone at several points. The baulk ring must be correctly positioned on the tapered part of the synchromesh cone. If the average clearance is less than 0,5 mm (0.020 in), replace the brass baulk ring.







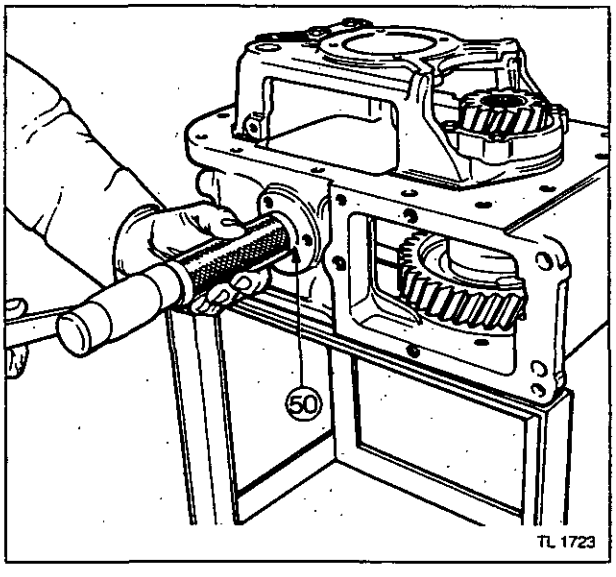
Reassembly

Synchromesh hub assemblies

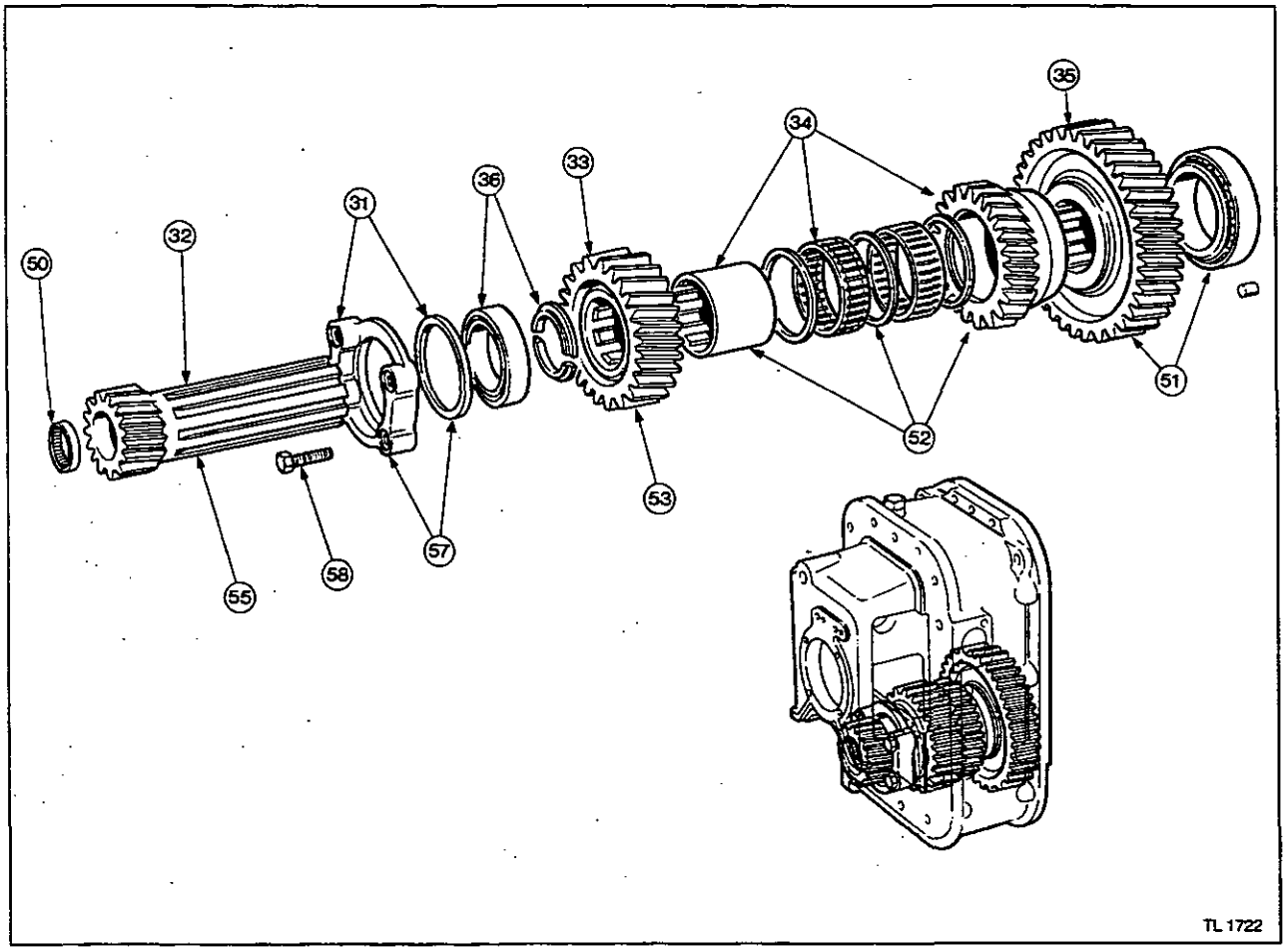
46. Place the hub on the work bench and insert the three springs, ball pins and pressure blocks.
47. Place the sliding coupler over the hub ensuring that the double width splines in the coupler are opposite the slots in the hub.
48. Press the coupler down into place easing the spring loaded blocks into position.

Lower shaft

49. Place the range change unit casing on the work stand, on its front face with the lower shaft taper roller bearing cup in place.
50. Replace, if necessary, the needle roller bearings in the gearbox casing or the end of the lower shaft. Make a tool as shown in the illustration to install the bearings.
    Camshaft bearing installer - Tool **'A'**.
    Lower shaft bearing installer - Tool **'B'**.



18 SPEEDSHIFT GEARBOX



51. Place the constant mesh gear, complete with taper roller bearing, in position in the gearbox.
52. Replace the four-wheel drive gear assembly complete with needle roller bearings and steel bush with the thrust side facing down.
53. Position the medium range gear over the four-wheel drive gear with the thrust side facing downwards.
54. Carefully align the splines in all the gears.
55. Fit the lower shaft complete with bearing, threading it through all the gears.
56. If all the original components are being refitted to the lower shaft there is no need to reset the bearing pre-load, ignore procedures 57 to 63.
57. Fit the bearing cap with a spacer ring of sufficient thickness to give the shaft a small amount of end float.
58. Fit the four cap bolts and tighten to a torque of 30 Nm (22 lbf ft).
59. Rotate the shaft and lightly tap each end to ensure that the bearings are fully seated and that it rotates freely.

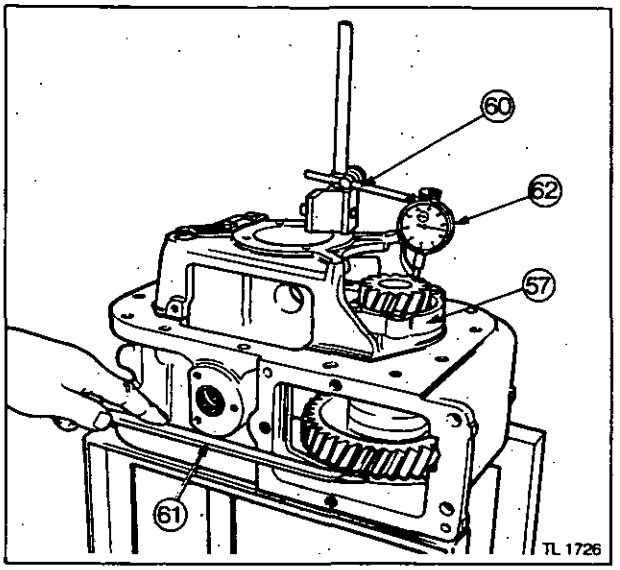
60. Set up a dial indicator gauge over the lower shaft with the plunger on the gauge resting on the low range gear.
61. With a pry bar lift the constant mesh gear up and down and take note of the deflection on the dial indicator gauge. Take several readings to ensure that you get the best reading with the greatest deflection.
62. From the reading obtained on the dial indicator add the thickness of the spacer ring and the bearing pre-load, the resultant figure will be the value of the spacer ring to be fitted.
    Example:-
    Spacer thickness = Thickness of spacer installed + dial indicator gauge reading + pre-load.
    2,44 mm + 0,25 mm + 0,05 mm.
    2,74 mm.
    Use spacer 2,76 mm (nearest).

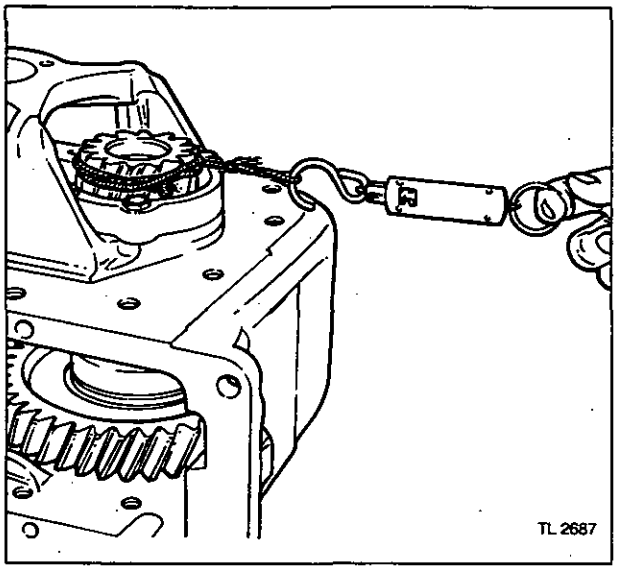
    The taper roller bearing pre-load for both new and old bearings is 0,05 mm (0.002 in).

    Spacer rings are available in the following sizes:-

Spacer ring sizes		
Part number	Metric	Imperial
3697 520 M1	2,44 mm	0.096 in
3697 521 M1	2,48 mm	0.098 in
3697 522 M1	2,52 mm	0.099 in
3697 843 M1	2,56 mm	0.101 in
3697 844 M1	2,60 mm	0.102 in
3697 845 M1	2,64 mm	0.104 in
3697 846 M1	2,68 mm	0.106 in
3697 847 M1	2,72 mm	0.107 in
3697 848 M1	2,76 mm	0.109 in
3697 849 M1	2,80 mm	0.110 in
3697 850 M1	2,84 mm	0.112 in
3697 851 M1	2,88 mm	0.113 in
3697 852 M1	2,92 mm	0.115 in
3697 853 M1	2,96 mm	0.117 in

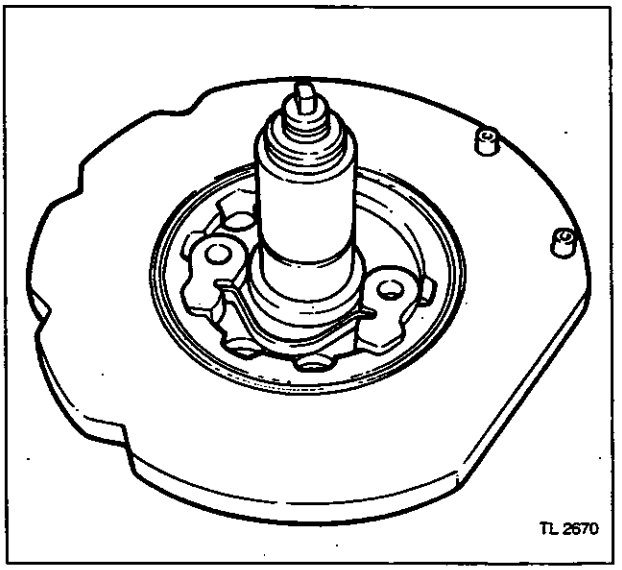
63. Remove the dial indicator gauge, bearing cap and spacer ring.
64. Refit the bearing cap with the selected spacer ring, apply Massey Ferguson Studlock (Loctite 270) to the bolts and tighten to a torque of 30 Nm (22 lbf ft).
65. Check the shaft for free rotation. Wrap string around the gear and check with a spring balance that the load required to turn the gear is between 1 and 2 kgf (2 to 4 lbf).
66. Turn the gearbox over.



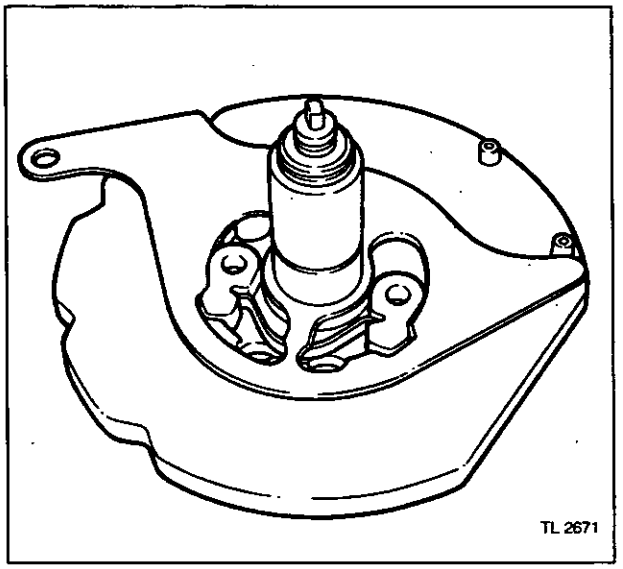


Selector cam assembly

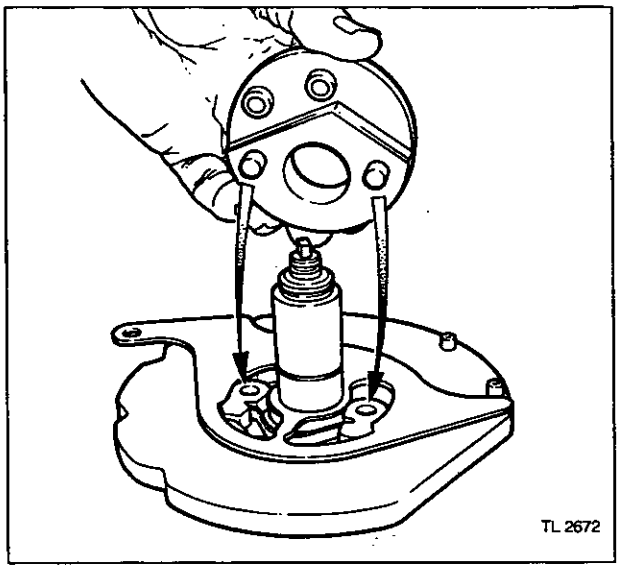
67. Reassemble the cam ratchet assembly, position the two pawls and spring in the cam plate as shown in the illustration.



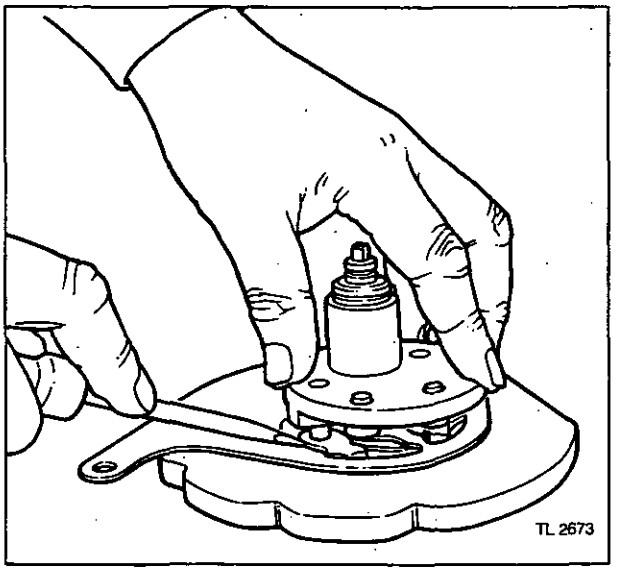
68. Place the spring plate over the two pawls ensuring that they locate in the two semi-circular slots in the plate.



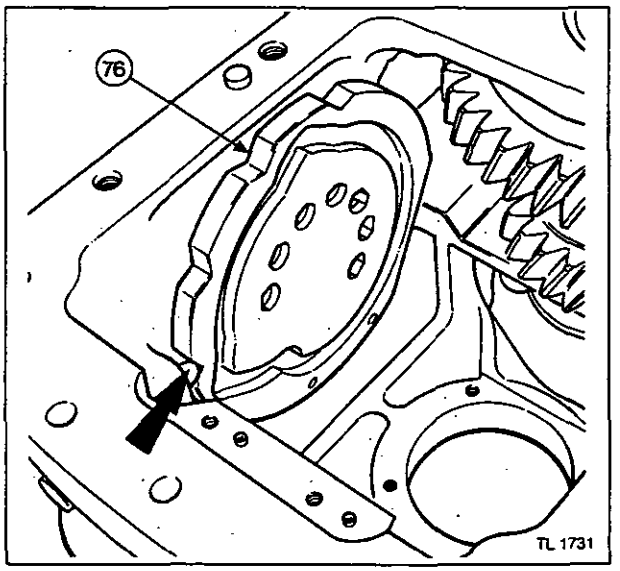
69. Position the two rollers on the pins of the cam block holding them in place with petroleum jelly.



70. Replace the cam block using a screwdriver to ease the pawls onto the pivot pins on the cam block.
71. Replace the circlip.
72. Refit the cam plate assembly to the gearbox in the high range position.
73. Replace the thrust washer and circlip.
74. Replace the seal ring.
75. Replace the bolt through the cam spring plate, apply Massey Ferguson Studlock (Loctite 270) to the threads and tighten to a torque of 30 Nm (22 lbf ft).



76. Replace the detent plunger and spring ensuring that the cam plate is in high range (see illustration), tighten the plug to a torque of 60 Nm (44 lbf ft).

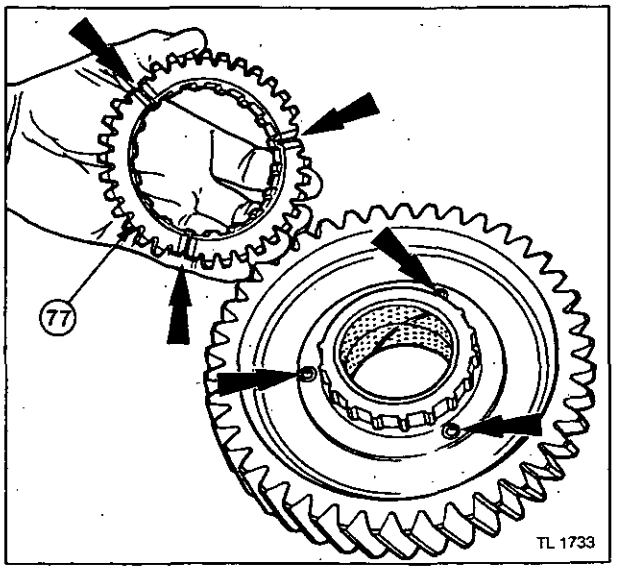


Upper shaft

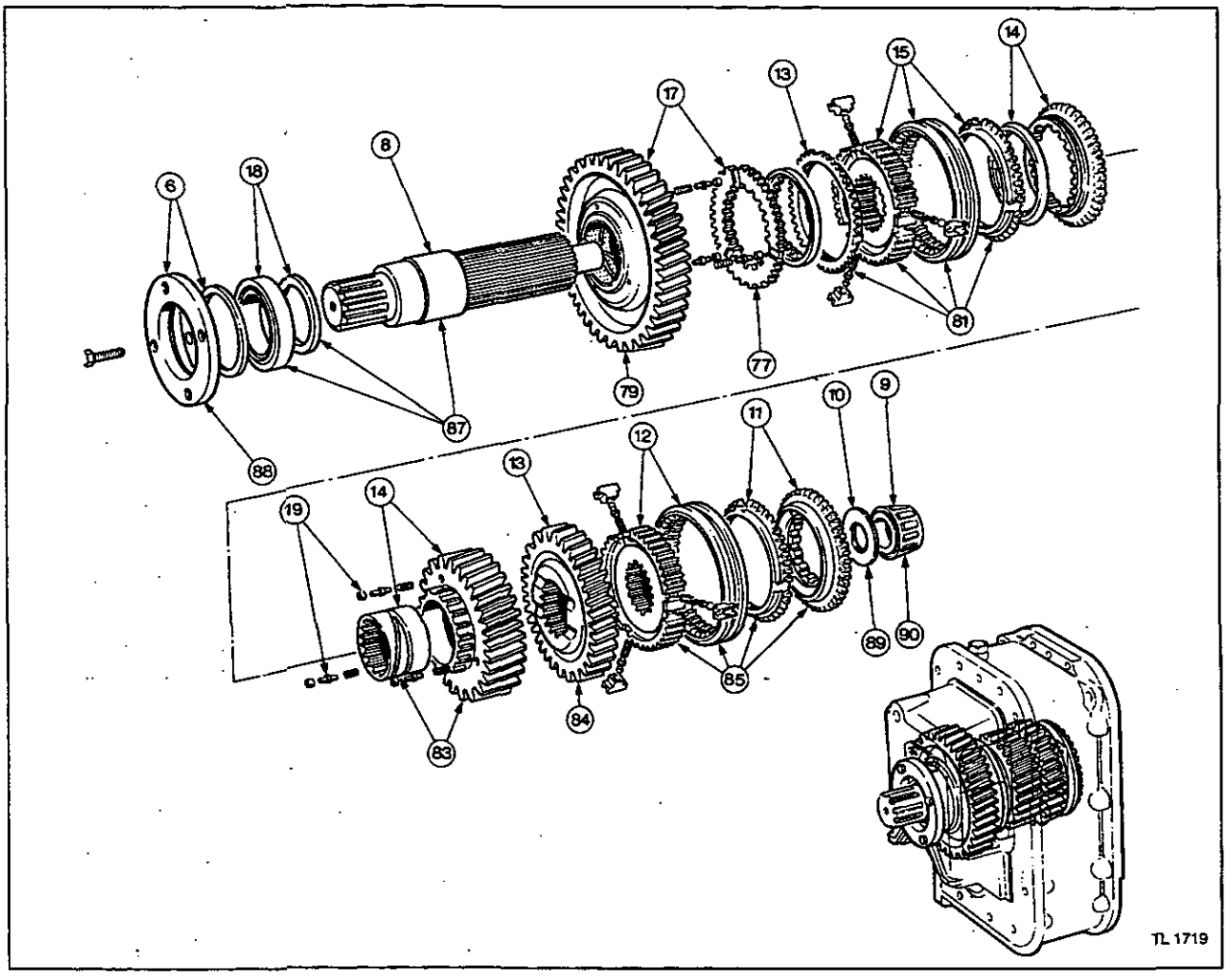
77. Fit the synchromesh ring on first gear ensuring that the synchromesh alignment pins are opposite the 'V' groove in the synchromesh cone hub.

NOTE: Use petroleum jelly to hold all the synchromesh cones, baulk rings and hubs in place during the assembly process.

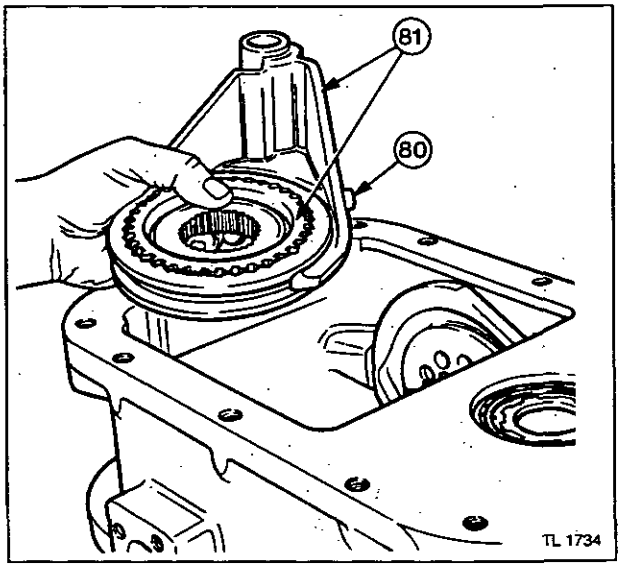
78. Place the special tool MF.477 on the inner face of the rear web of the box. This is to hold all the gears in their running position during assembly.
79. Place the low range gear in position with the synchromesh cone uppermost.



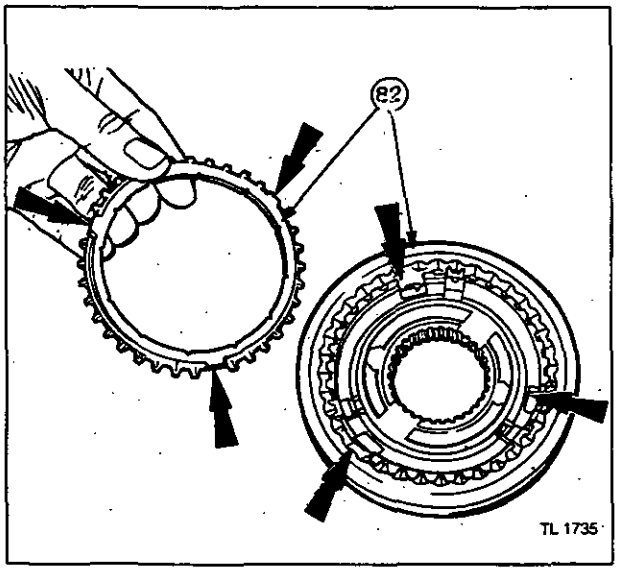
18 SPEEDSHIFT GEARBOX



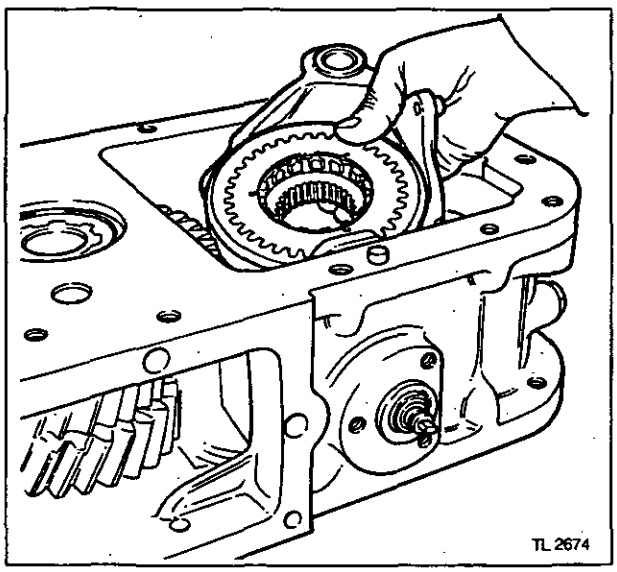
80. Fit the small rollers to the medium/low range and high range selector forks with some petroleum jelly.
81. Fit the selector fork to the synchromesh hub assembly and lower it into position in the box, simultaneously engaging the selector fork roller in the cam track.



82. Ensure that the locating blocks on the low range baulk ring are engaged in the slots of the hub.
83. Refit the medium range gear ensuring that the spring loaded plungers locate in the 'V' grooves in the back of the synchromesh cone, as described for the first range gear.
84. Replace the four-wheel drive gear with the grooved thrust face downwards.

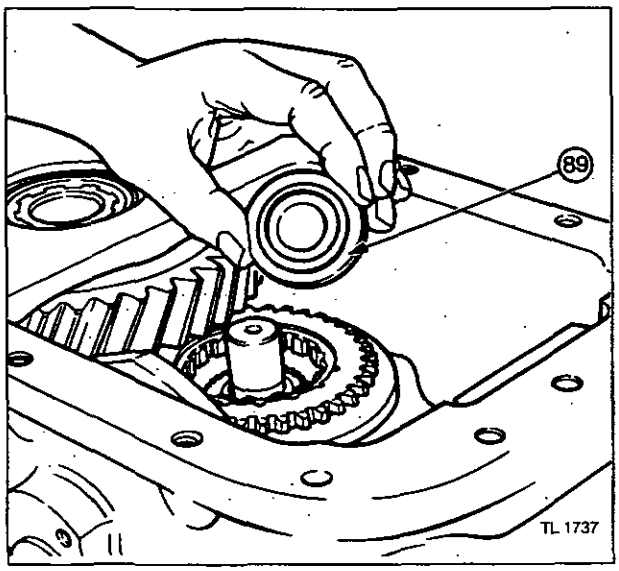


85. Fit the selector fork to the synchromesh hub, complete with baulk ring and synchromesh cone. Pull the selector fork and coupler 'up' to engage High range with the baulk ring. Install with the flat face downwards, engaging the selector fork roller in the cam plate track.
86. Align the splines of all the gears and synchromesh hubs in the pack.
87. Take the upper shaft with the taper roller bearing cone, sleeve and thrust washer fitted. Pass it up through the gear pack carefully fitting all the gears and synchromesh hubs.
88. Fit the bearing cap without any shims to hold the shaft in place.

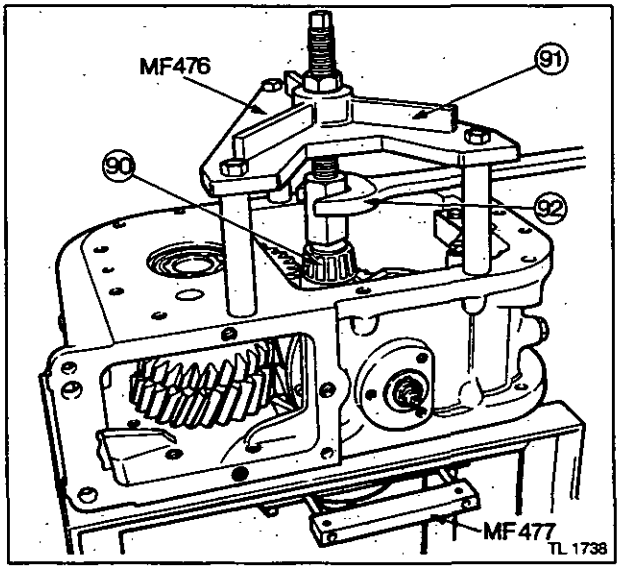


89. Place the thrust washer on the shaft with the reduced diameter facing upwards.

CAUTION: Under no circumstance is the roller bearing, item 90, to be fitted to the upper shaft with a hammer and punch. Damage to the bearing will result in a seizure of the gearbox and extensive failure of many of the components.



90. Place the small taper roller bearing on the end of the screwed rod of special tool MF.476.
91. Fit special tool MF.476 over the upper shaft. Screw down the central screw until it locates in the end of the shaft. Tighten the lock-nut.
92. Screw down the large hexagon nut on MF.476 to press the taper roller bearing into position.
93. Check that the bearing is pressed fully home by trying to turn the thrust washer under the bearing.
94. Remove special tools MF.476 and MF.477.
95. Replace the selector shaft, apply Massey Ferguson Studlock (Loctite 270) to the threads of the bolt and tighten to a torque of 30 Nm (22 lbf ft).
96. Replace the selector shaft support plate, apply Massey Ferguson Studlock (Loctite 270) to the threads of all the bolts and tighten to a torque of 30 Nm (22 lbf ft).
97. Rotate the shafts to ensure that all the gears are free to rotate.



Re–installing the range change unit

98. Stand the main gearbox up on end on its clutch housing. Ensure that all gears are in neutral.
99. Place the gasket on the mounting face of the main gearbox (only replace if damaged).
100. Ensure that the dowel on the bottom of the range change unit is in place.
101. Lower the range change unit into position on the main gearbox. Check that the range selector fork engages correctly with the rollers in the back of the cam plate.
102. Apply Hylomar to the bottom six bolts securing the range change box to the gearbox.
103. Refit the transmission case bolts, range change unit to gearbox, torque to 112 Nm (83 lbf ft).
104. Set the bearing pre-load setting.

Range Change Unit Bearing Pre–Load Setting

Adjust	7L–12

Special tools:
MF.478 Bearing Pre-load Tool

Adjust

CAUTION: The setting of the taper roller bearing pre–load is critical and MUST be carried out as described in this operation. Any deviation from the laid down procedure could have a serious effect on the performance of the gearbox.

1. From an old shear tube coupling make up a turning handle as shown in the illustration.
2. Remove the bearing cap bolts and clean out the threaded holes in the casing with an M6 tap.
3. Install one of the thicker spacer rings between the cap and bearing so that when the cap is installed the gap between the cap and casing is minimal and easily measured with a feeler gauge.
4. Refit the bearing cap.
5. Install special tool MF.478. Fit the four springs to the four bolts and screw into the housing so that the height of the four bolts from the top face of the cap to the top of the bolt is 55 mm (2.167 in). This will pre-load the taper roller bearings to approximately 45 kg (100 lbs).
6. Engage medium range (press the medium /low range coupler downwards).
7. Rotate the upper shaft at least 5 times both ways with the handle, tap the end of the shaft with a soft hammer to ensure that all the bearings are fully seated in their cups.
8. With two feeler gauge sets very carefully measure the gap between the underside of the bearing cap and the casing. Both feeler gauges must be set to the same thickness because there is a tendency for the cap to tilt.

NOTE: This part of the operation is very critical, you must obtain the most accurate reading you can to 0,0025 mm (0.001 in).

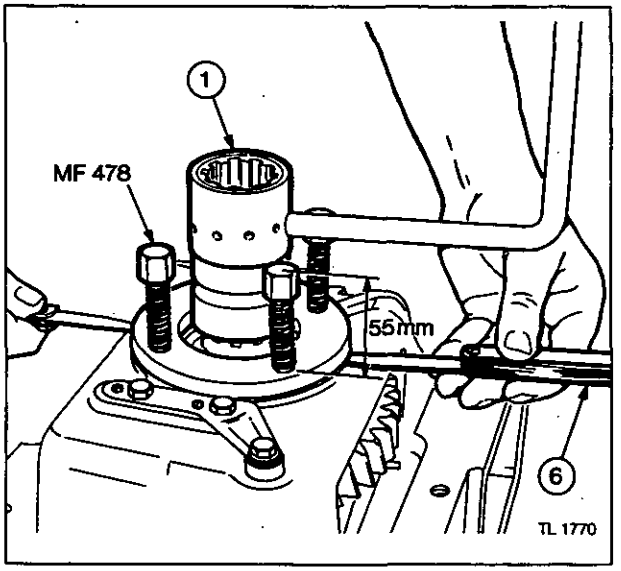
9. Check the clearance in two positions, 12 o'clock/6 o'clock and 3 o'clock/9 o'clock. When you are satisfied with the gauges selected, add up the value of one gauge set.
10. Calculate the spacer ring required as follows:-

    The taper roller bearing pre-load for both new and old bearings is 0,05 mm (0.002 in).

    Spacer thickness = Thickness of spacer installed - gap measured + pre-load

    = 2,92 mm - 0,20 mm + 0,05 mm

    =2,77 mm Use spacer ring 2,76 mm



Spacer ring sizes		
Part number	Metric	Imperial
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3697 852 M1	2,92 mm	0.115 in
3697 853 M1	2,96 mm	0.117 in

Select a spacer ring that will give the closest reading to that calculated. In the case of used bearings a slightly lighter pre-load will be satisfactory because the bearings do not have to wear in.

11. Remove tool MF.478, the bearing cap and the spacer ring used as a gauge.
12. Reassemble the bearing cap with the selected spacer ring and apply Massey Ferguson Studlock (Loctite 270) to the threads of the bolts. Tighten the bolts to a torque of 30 Nm (22 lbf ft).
13. Disengage the medium range gear and check the shafts for free rotation.

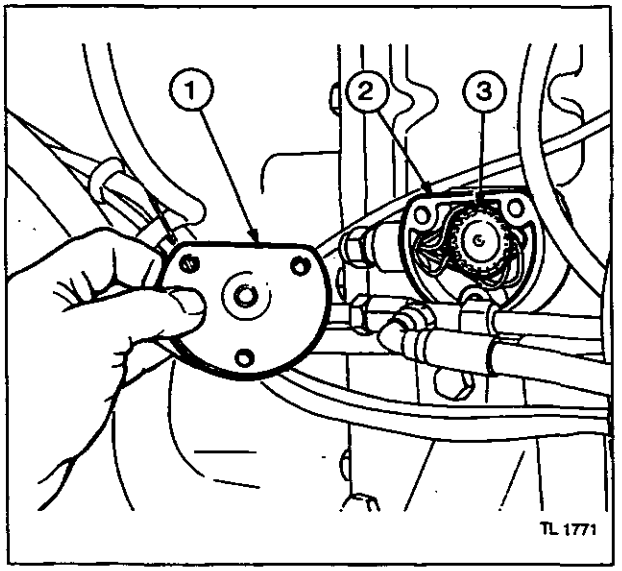
Range Change Indicator Light Switch

Removal

1. Remove the three retaining screws and the cover.
2. Carefully remove the switch assembly; there may be a small loss of oil when the switch is removed.
3. If necessary, disconnect the wiring.
4. Remove the switch from the housing.

Refitment

5. Reverse procedures 1 to 4, except:-
   a. Renew the seal on the switch shaft.
   b. Lightly oil the seal.
   c. Ensure that the cover seal is satisfactory.
   d. Coat the inner face of the switch housing and mating face of the range box with Massey Ferguson Multi-Gasket (Loctite 574).



REAR AXLE AND BRAKES

INDEX

REAR AXLE

Section 8 – Part A

Table of Contents

REAR AXLE

Specification:

Normal-duty epicyclic axle:	
Models	M-F 350, 352, 355, 360, 362, 365, 372, 375, 382, 390, 390T, 393 and 396 tractors.
Epicyclic ratio	3.75:1
Axle shaft oil seal	Fit 2 mm (0.080 in) proud of casting
Axle shaft end float	0 to 0,025 mm (0 to 0.001 in)
Heavy-duty epicyclic axle:	
Models	M-F 390, 398 and 399 tractors.
Epicyclic ratio	4.80:1
Axle shaft oil seal	Fit flush with casting
Direct drive axle:	
Models	M-F 340 and 342 tractors.
Axle shaft oil seal	Press to shoulder
Axle shaft end float (taper bearing type)	0,05 to 0,2 mm (0.002 to 0.008 in)
Method of adjustment	Shims

Special Tools:

------	Dial test indicator gauge
MF 265A	Epicyclic planetary carrier remover
MF 267A	Epicyclic pre-load gauge
MF 267-1	Sleeve - normal duty axle
MF 267-2	Sleeve - heavy duty axle
MF 366	PAVT wheel guide pegs

Bolt Torques:

Epicyclic unit housing bolts - normal-duty	70 Nm (52 lbf ft)
Epicyclic unit housing bolts - heavy-duty	105 Nm (77 lbf ft)
Rear wheel nuts	See Section 8D
Trumpet housing to centre housing	130 Nm (96 lbf ft)
Axle hub to trumpet housing (direct drive)	74 Nm (55 lbf ft)
Lower lift arm pivot (direct drive)	156 Nm (115 lbf ft)
Cab/ Fender/Stabilizer bracket bolts	230 Nm (170 lbf ft)

General Description – Indirect Drive Axle

There are two versions of the indirect drive epicyclic rear axle, normal- and heavy-duty depending on the size of the tractor (see Fig.1). The rear axles are fitted to each side of the centre housing which houses a bevel tooth crown wheel and pinion, driving through a differential unit to two fully floating half shafts with outboard epicyclic final speed reduction units. All these components run in common transmission oil.

The heavy-duty versions of the standard axle use larger epicyclic final speed reduction units. They have an increased reduction ratio to lessen the transmission torque loadings. These axles have their own self-contained oil supply for the final speed reduction units separated from the rest of the axle components by lip-type oil seals.

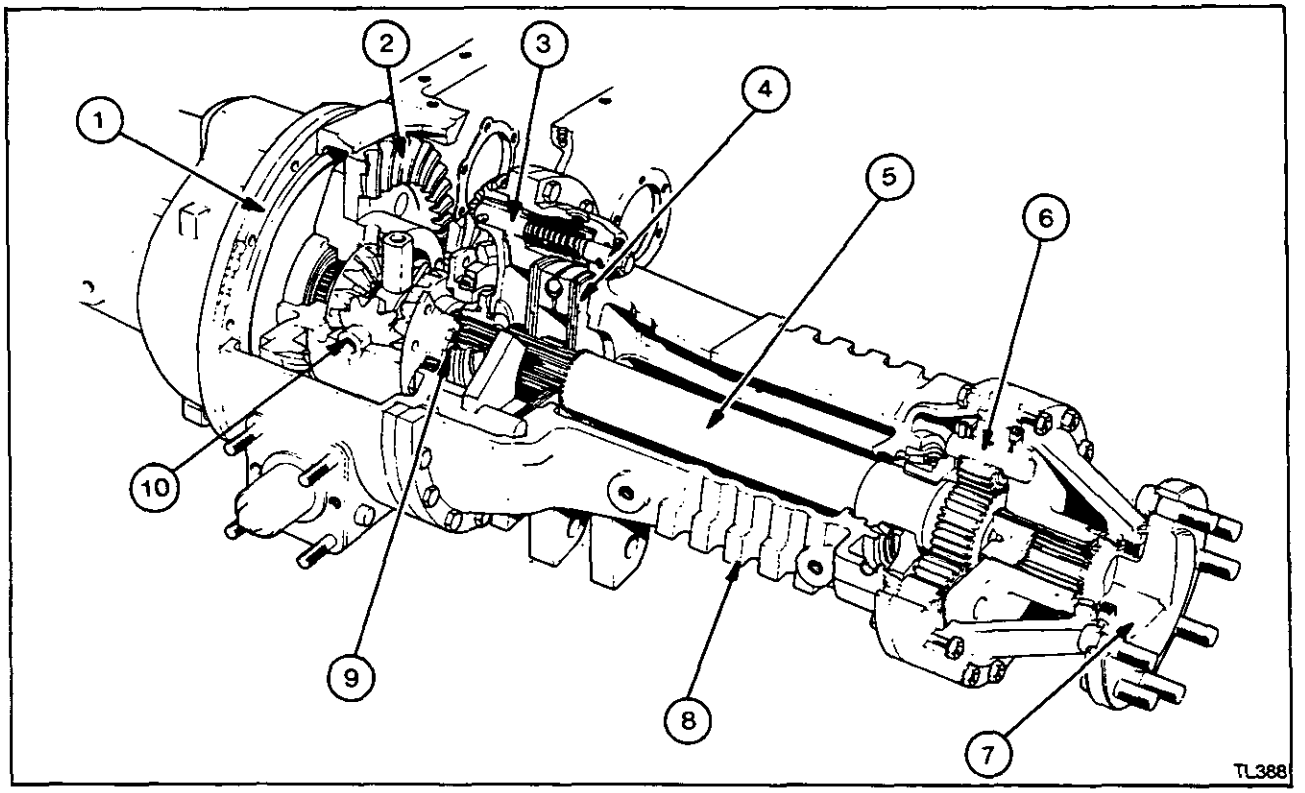
The half shafts are splined into the differential gears, and the outer ends are splined into the sun gear of the epicyclic unit.

The wheel axle is splined to the epicyclic carrier which is driven by the sun gear and planetary pinions.

The pre-load on the epicyclic taper roller bearings is set by the use of a special tool and fitting a shim behind the bearing cup in the trumpet housing.

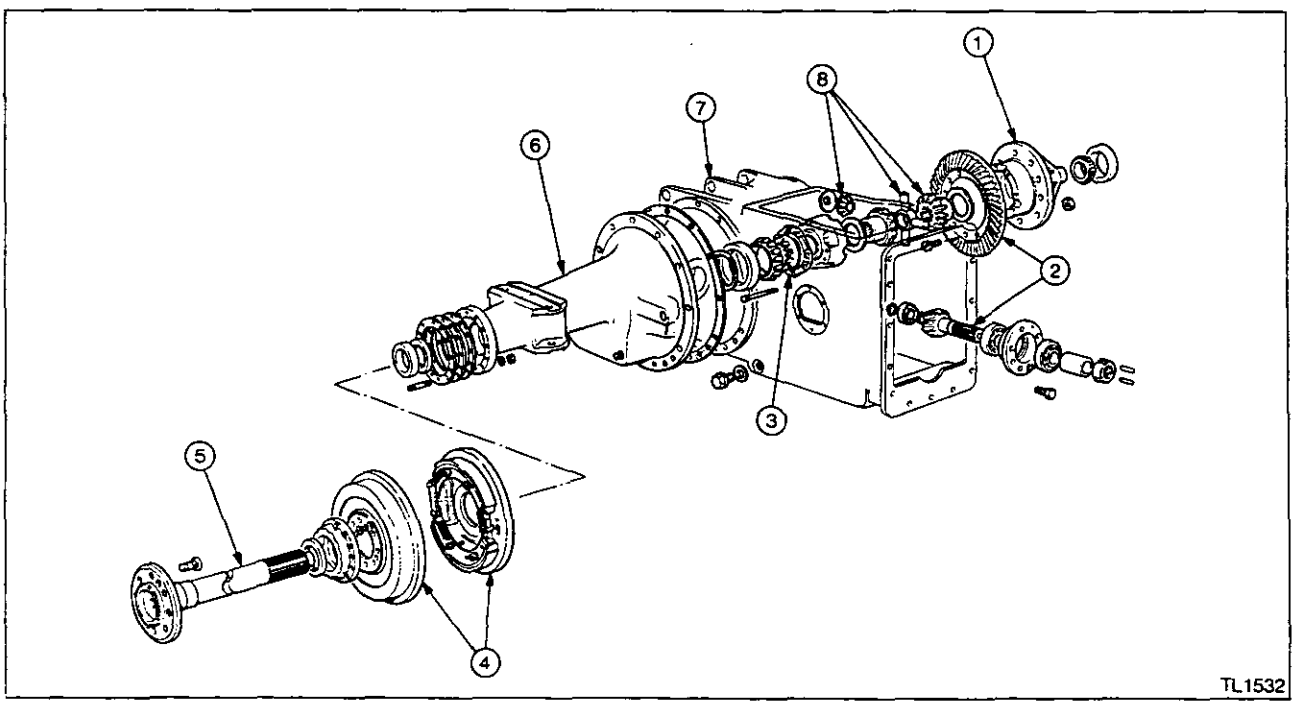
General Description – Direct Drive Axle

The direct drive rear axle (see Fig.2) is identical in construction without epicyclic reduction units. The axle shafts are splined directly into the differential gears.



1. Carrier
2. Crownwheel and pinion
3. Differential lock mechanism
4. Brakes
5. Half shaft
6. Epicyclic unit
7. Axle shaft
8. Trumpet housing
9. Differential lock
10. Differential

Figure 1. Epicyclic rear axle



1. Carrier
2. Crownwheel and pinion
3. Differential lock
4. Drum brake
5. Axle shaft
6. Trumpet housing
7. Centre housing
8. Differential

Figure 2. Direct drive rear axle

Rear Wheel Stud

Removal and Refitment	8A-01

Special Tools: MF 366 Guide sleeves, (PAVT wheels only)

Removal

1. Jack up the tractor.
2. Remove the rear wheel.

Note: PAVT wheels are extremely heavy and should only be removed with the assistance of a crane.

3. *Drive out the damaged stud. Examine the stud* hole,the other studs and the wheel disc for signs of fretting or damage.

Refitment

4. Locate a new stud in the wheel axle.
5. Tap the stud gently to locate the splines.
6. Fit a new wheel nut, with the flat side against the axle and pull the stud through the axle to its correct position.
7. Remove the nut.
8. Oil all the studs.
9. Fit a guide peg, MF 295B, to two of the wheel studs *(PAVT wheels only).*
10. Oil the threads of the wheel nuts.
11. Refit the rear wheel and nuts and tighten the nuts progressively and evenly. See section 8D for wheel torques.
12. Remove the jack.

Epicyclic Unit Ring Gear

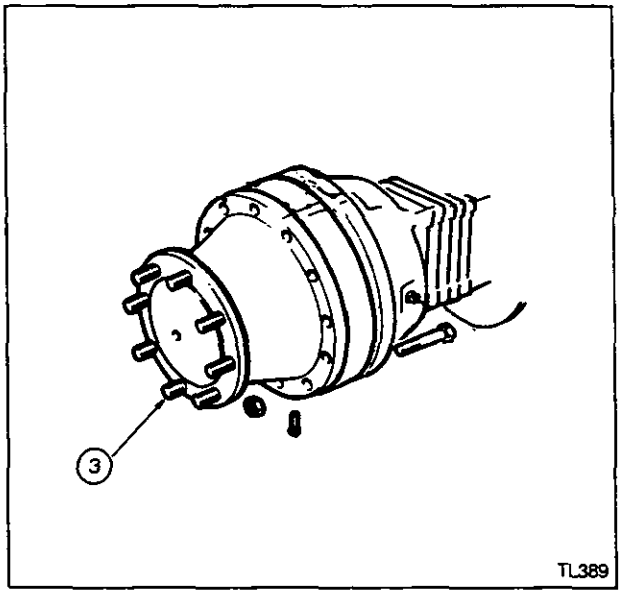
Removal and Refitment	8A-02

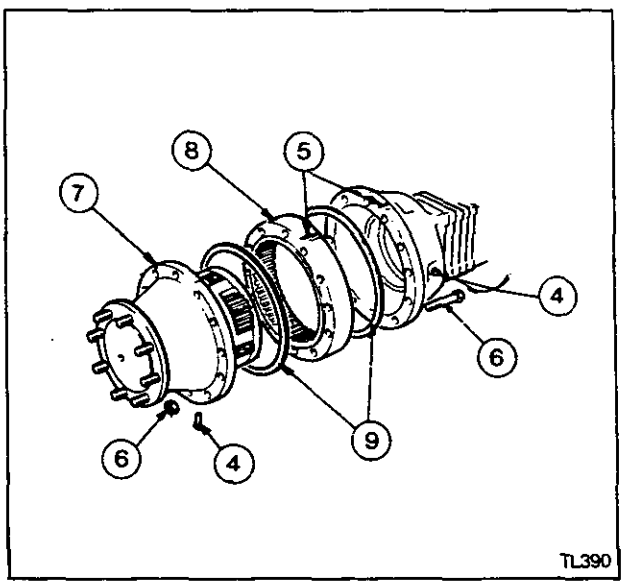
Removal

1. Apply the parking brake.
2. Jack up the tractor.
3. Remove the rear wheel.
4. Remove the drain and level plugs and drain the oil from the epicyclic unit.
5. Scribe a mark across the outer housing, ring gear, and trumpet housing to facilitate refitment. Also scribe a mark across the outer housing and ring gear only; this will ensure that the ring gear is replaced with the teeth in full engagement.
6. *Remove the nuts and bolts.*
7. Remove the outer housing and ring gear assembly.
8. Remove the ring gear.

Note: Do not withdraw the axle shaft.

9. Remove and discard the two cork gaskets. Clean the recesses in which the ring gear spigots are located and check that there is no burr or deformity which could cause leakage.





Refitment

10. Reverse procedures 1 to 9 except:
    a. Fit new cork gaskets.
    b. Ensure that the scribe marks are correctly aligned ensuring that the teeth of the ring gear are in full engagement OTHERWISE SEVERE DAMAGE CAN OCCUR.
    c. *Tighten the nuts and bolts to a torque of 68 to 74* Nm (50-55 lbf ft) on normal duty axles 90-120 Nm (66-89 lbf ft) on heavy duty axles.
    d. Refill to the correct level with an approved oil.

Epicyclic Planets and Sun Gear

Overhaul 8A-03

Special tools:
3/8 inch UNF bolt

Dis-assembly

1. Remove the outer housing assembly, *(see operation 8A-02)*. To service the sun gear remove only one planet gear.

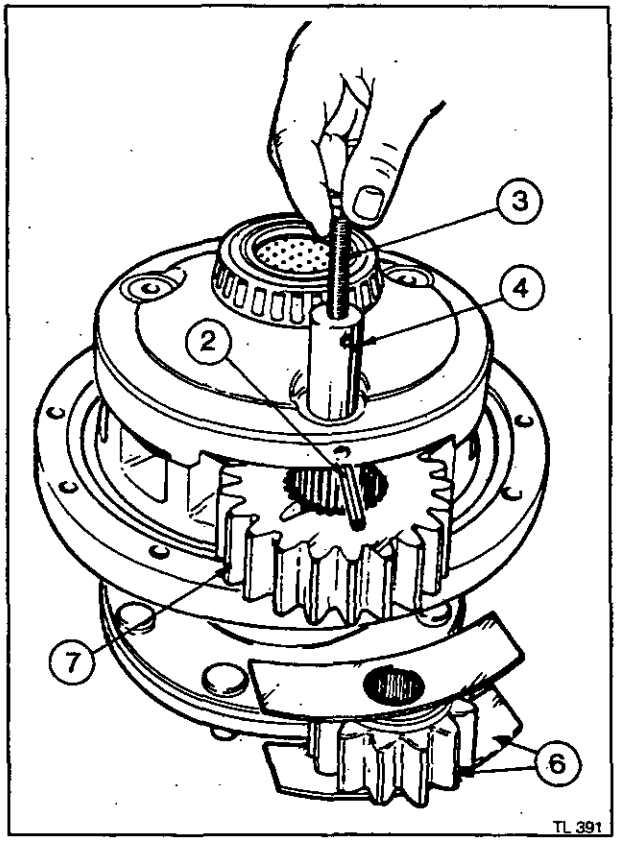
NOTE: The sun gear will only come out through one of the planet gear apertures, it is wider than the other two.

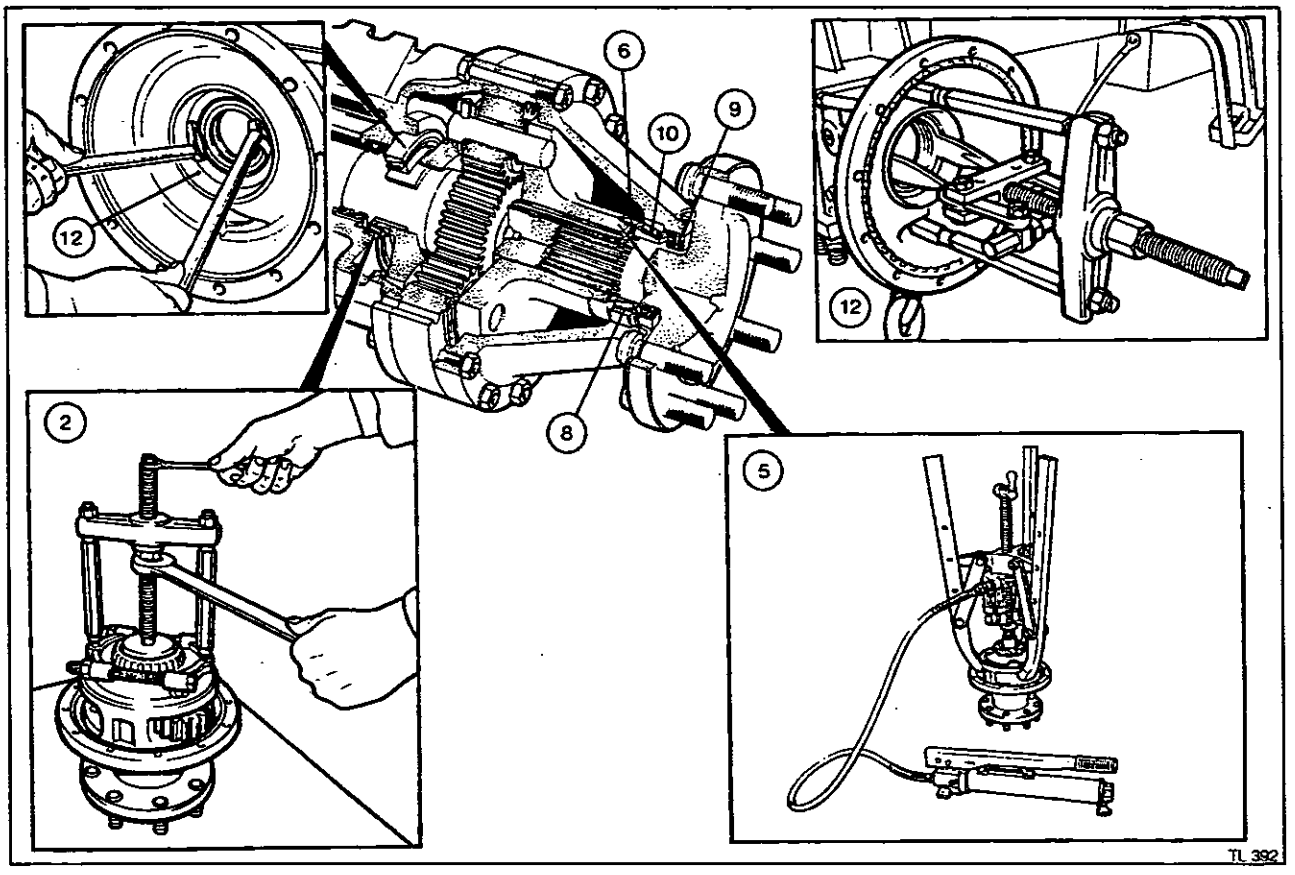
2. Drive out and discard the roll pin.
3. Fit a 3/8 inch UNF bolt into the planet gear shaft.
4. Withdraw the shaft trying not to dislodge the needle rollers.
5. Remove the 3/8 inch bolt.
6. Remove the thrust washers and the planet gear. Repeat procedures 2 to 5 only if the planetary hub is to be completely overhauled.
7. Withdraw the sun gear. Inspect all parts and replace any which show signs of wear or damage.

Re-assembly

8. Reverse procedures 1 to 7, except:
   a. If the needle rollers were dislodged, refit them using petroleum jelly, not grease. There are 58 needle rollers per planet gear (two rows of 29) plus a spacer washer on normal duty axles. There are 44 needle rollers per planet gear (two rows of 22, plus a spacer washer) on heavy duty axles.
   b. Ensure that the holes in the casting and shaft are aligned.
   c. Fit new roll pin.
   d. The wide aperture for the removal of the sun gear has special wide thrust washers, ensure that they are fitted to the correct planet gear.

NOTE: On normal duty axles only, the planet gears MUST be fitted with the large shoulder facing the centre of the axle.

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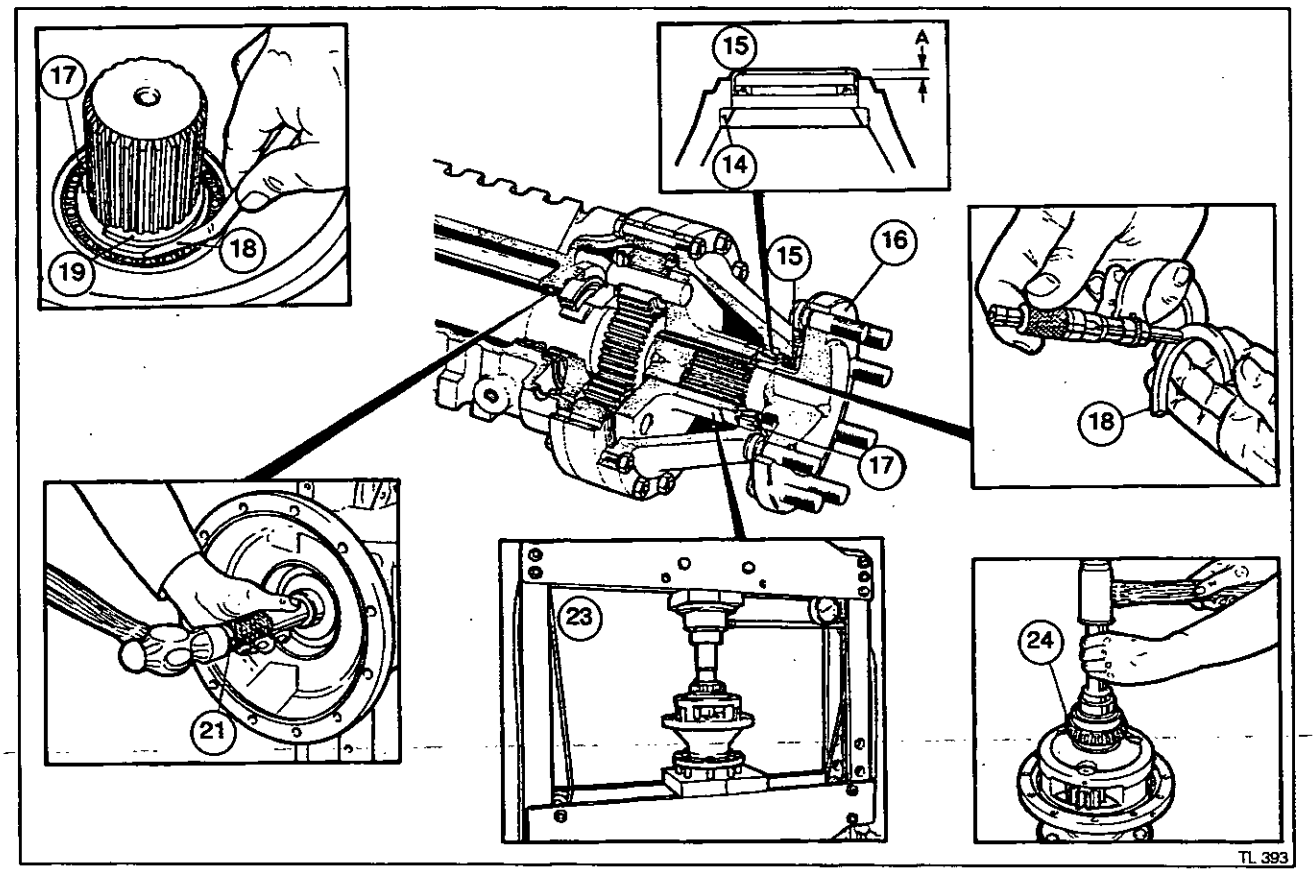
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Epicyclic Unit

Overhaul 8A–04

Special tools:
30 tonne Hydraulic Press or
30 tonne Hydraulic Puller

Dis-assembly

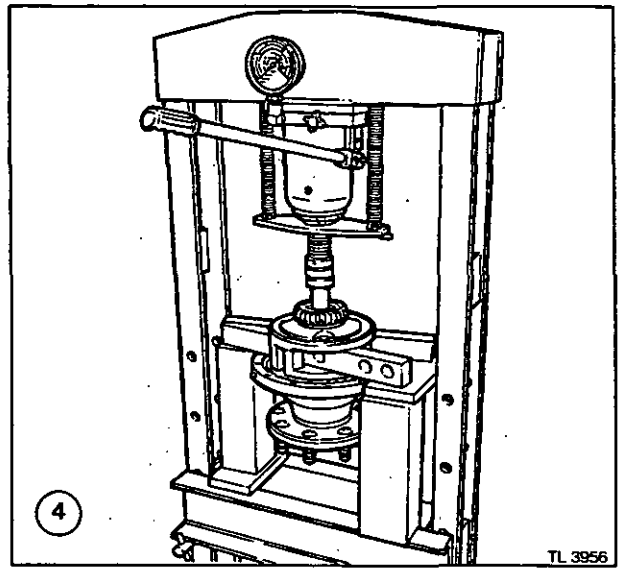
1. Remove the epicyclic gears and sun gear, *(see operation 8A-03).*
2. Remove the bearing cone using an external bearing puller from the epicyclic carrier.
3. There are two methods of removing the epicyclic carrier from the axle shaft. Using a hydraulic puller or a hydraulic press, these must have a minimum capacity of 30 tonne. It will require a pressure of approximately 20 to 25 ton to remove the carrier.
4. **Hydraulic press**, the illustration shows clearly the method of removal, it is recommended that the three pillars which support the cross bars are welded to a base plate. Allow a 100 mm (4 in) minimum clearance under the axle shaft for removal.
5. **Hydraulic puller**, position the puller so that the central rod is located in the centre of the axle shaft, It will take two pulls to remove due to the length of spline engaged.
6. Remove the two half rings on normal-duty axles, snap ring on heavy-duty axles.
7. Press the axle shaft out of the outer bearing cone and housing.
8. Lift out the bearing cone.
9. Remove the oil seal.
10. If necessary, remove the outer bearing cup.
11. To remove the half shaft, fully apply the parking brake to lock all the brake plates in position. Pull the half shaft out of the housing.
12. Using pry bars or an internal bearing puller, remove the inner bearing cup and shim from the axle housing.
13. Heavy-duty axles, remove the inner oil seal from the axle housing.

Examination

Inspect all parts and replace any which show signs of wear or damage. Replace all seals, gaskets and circlips.

Re-assembly

14. Refit the outer bearing cup, making sure it is fully seated.
15. Place the axle housing under a hydraulic press, apply a coating of Retainer Compound, Loctite 641, inside the bore and position the outer cassette oil seal with the lip facing inwards. Press the seal into the housing until it is 2mm (0.080 in) proud of the housing (dimension 'A') on normal-duty axles. Press the seal flush with the casing on heavy-duty axles.
16. Lubricate the inside of the seal with engine oil, carefully insert the wheel axle shaft through the outer seal.
17. Drive the bearing cone down the shaft seating the rollers in the cup.



Normal-Duty Axles

18. Refit the half rings removed and check the clearance with a feeler gauge between the half ring and the bearing which should be 0,00 to 0,025 mm (0.000 to 0.001 in). The ring most used is Ring No. 2, part number 882 603 M1.

Clearances and half rings					
Half ring + feeler gap		Half ring thickness		Part No.	Ring No.
mm	in	mm	in		
5,92 5,94	0.233 0.234	5,84 5,89	0.230 0.232	882 601 M1	0
5,95 5,99	0.234 0.236	5,90 5,94	0.230 0.234	882 602 M1	1
6,00 6,04	0.236 0.238	5,95 5,99	0.234 0.236	882 603 M1	2
6,05 6,09	0.238 0.240	6,00 6,04	0.236 0.238	882 604 M1	3
6,10 6,15	0.240 0.242	6,05 6,09	0.238 0.240	882 605 M1	4
6,15 6,19	0.242 0.244	6,10 6,14	0.240 0.242	882 606 M1	5
6,20 6,24	0.244 0.246	6,15 6,19	0.242 0.244	882 607 M1	6
6,25 6,30	0.246 0.248	6,20 6,24	0.244 0.246	882 608 M1	7
6,30 6,35	0.248 0.250	6,25 6,30	0.246 0.248	882 609 M1	8

If adjustment is required proceed as follows:

a. Using a micrometer, check the thickness of the half ring you have used to check the clearance.
b. To this measurement add the thickness of the feeler gauge measurement.
c. From the chart select the correct ring to be fitted to the shaft.

For example:

No. '2' measures 6,00 mm + feeler gauge thickness 0,10 mm = 6,1 mm

From chart select half ring No. 4 part number 882 605 M1, half ring + feeler gap = 6,10 mm

19. Fit the two half rings selected, ensuring that they are fully seated in the groove.

Heavy-Duty Axles

20. Fit a new snap ring. Using a suitable puller, pull the housing assembly and bearing back tightly onto the snap ring. No shims or setting is required.
21. Apply a thin coating of Hylomar sealant to the bore of the axle housing, then fit a new inner seal. The open side of the seal faces outwards. Smear the lips of the seal with petroleum jelly.

Both Axle Types

22. Check the condition of the axle shaft and carrier splines, they must be clean and not to contain any burrs or seizure marks. Remove any damage with a fine file or oil stone.
23. Apply lubricating oil to the spline and press the carrier onto the axle shaft. The minimum pressure is 10 tonne, maximum pressure 25 tonne.
24. Install the inner bearing cone onto the spigot of the epicyclic carrier.
25. Refit the axle half shaft.
26. Check the epicyclic pre-load, *(see operation 8A-05).*
27. Fit the selected shim(s) in the bearing cavity in the axle housing.
28. Refit the inner bearing cup.
29. Refit the ring gear and housing assembly, *(see operation 8A-02).*

Epicyclic Pre-Load

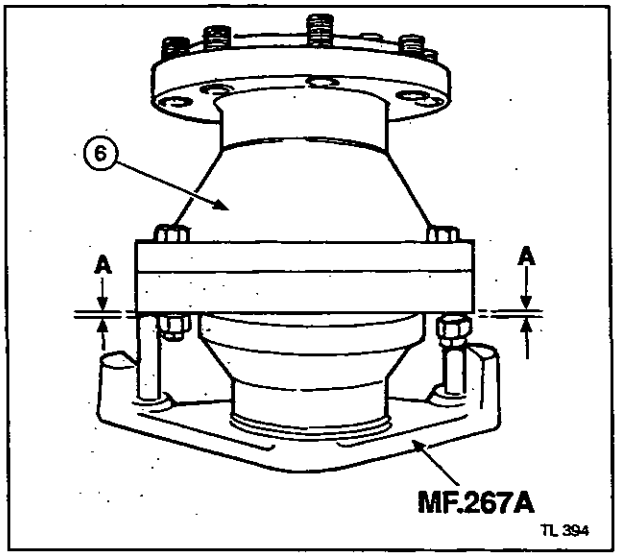
Check 8A-05

Special tools:
MF.267A Epicyclic Pre-load Gauge
MF.267-1 Sleeve - Normal-duty Axle
MF.267-2 Sleeve - Heavy-duty Axle

Procedure

Before refitting the epicyclic unit, check the bearing pre-load as follows:

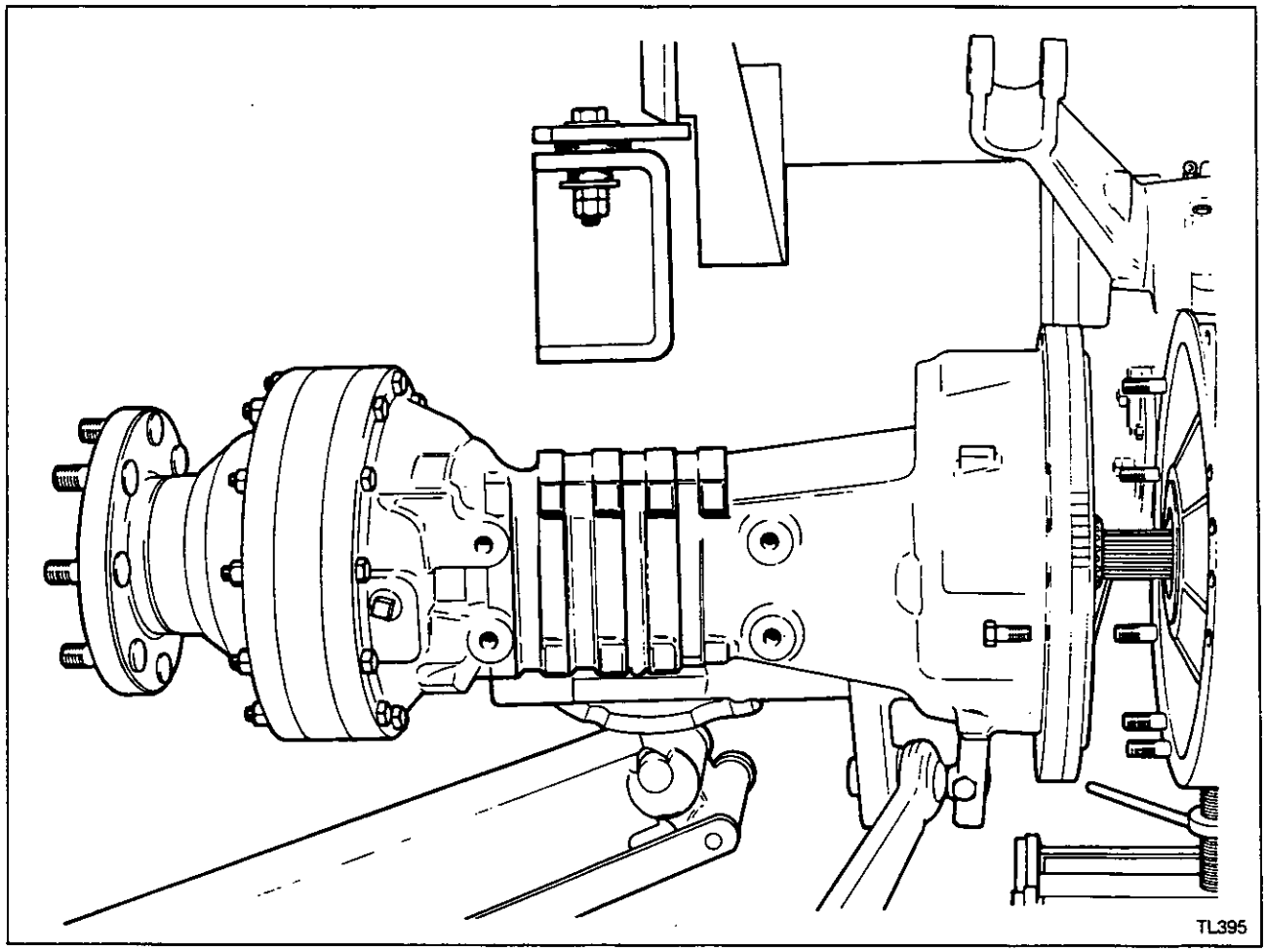
1. The inner bearing cup in the axle housing will have to be removed to enable the pre-load to be determined.
2. Remove the old shim(s) behind the bearing cup.
3. Bolt the ring gear to the outer housing using four bolts from the epicyclic unit with four wheel nuts as spacers. These bolts should be equally spaced around the ring gear.
4. Using special tool MF.267A, Epicyclic Pre-load Gauge, set the tool for either normal- or heavy-duty axle as follows:
   a. Normal-duty - fit sleeve MF.267-1 on the central locating pin and screw the two gauge posts into the inner positions.



Epicyclic pre-load table			
Gap measured by feeler gauges (both sides)		Shim thickness required	
mm	in	mm	in
0,025-0,127	0.001-0.005	0,889	0.035
0,152-0,254	0.006-0.010	0,762	0.030
0,279-0,381	0.011-0.015	0,635	0.025
0,406-0,508	0.016-0.020	0,508	0.020
0,533-0,635	0.021-0.025	0,381	0.015
0,660-0,762	0.026-0.030	0,254	0.010
0,787-0,889	0.031-0.035	0,127	0.005
0,914-1,016	0.036-0.040	0,000	0.000

Shims available		
Shim thickness		Part number
mm	in	
0,13	0.005	894 757 M1
0,25	0.010	894 758 M1
0,38	0.015	894 759 M1

   b. Heavy-duty - fit sleeve MF.267-2 on the central locating pin and screw the two gauge posts into the outer positions.
5. Place the bearing cup over the central locating pin on the gauge. DO NOT fit the shim(s).
6. Place the epicyclic unit on MF.267A so that the bearing cone fits the bearing cup and measure the gap at points **'A'** using two sets of feeler gauges.
7. Note the clearance, which must be equal at both sides, then select a shim or shims from the table opposite. The most common size is 0,381 mm (0.015 in).
8. Fit the shims into the cavity behind the bearing in the axle housing.
9. Refit the inner bearing cup, ensuring that it is fully seated.
10. Rebuild the axle as described *(see operation 8A-02).*



Trumpet Housing and Carrier Plate

Removal and Refitment 8A-06

Removal

1. Drain the transmission oil.
2. Disconnect the hydraulic brake feed pipe to the brake slave cylinder and drain the fluid into a clean receptacle. Mask off the pipes and unions with suitable plugs or masking tape to prevent dirt ingress.
3. Disconnect the trailer brake pipe from the slave cylinder, if fitted, and mask the connections.
4. Release the lift rod at the knuckle.
5. Release the check chain at the check chain anchor bracket.
6. Release the stabiliser bracket underneath the trumpet housing.
7. Release the forward end of the lower link from the trumpet housing bracket.
8. Remove the lift arm and lower link assembly complete.
9. Release the parking brake cable and the return spring.
10. Jack up the tractor under the trumpet housing being serviced.
11. Remove the rear wheel.
12. Place a substantial stand or support under the centre housing and lower the tractor until the jack is just taking the trumpet housing weight. Support the cab with a cab-support stand, if fitted.

Caution: The trumpet housing is heavy and awkward to handle Take care when both removing and refitting it.

13. Left-hand trumpet housing. Remove necessary pipe work and auxiliary manifold to enable the trumpet-housing to be withdrawn from the centre housing.
14. Right-hand trumpet housing. Remove the differential lock mechanism and disconnect the differential lock switch wiring.
15. Remove all of the nuts and bolts securing the trumpet housing to the centre housing.
16. Lower the trumpet housing slightly and withdraw it far enough to clear the half shaft from the differential splines.
17. Lower the trumpet housing further to clear the cab or fender.
18. Withdraw the trumpet housing completely.
19. Remove the 'O' ring from the flange on the carrier plate.

20. Manoeuvre the trumpet housing off the trolley jack and stand it on end.

Left hand carrier plate

21. Remove the two countersunk screws.
22. Withdraw the carrier plate from the trumpet housing.
23. Remove and discard the inner 'O' ring.

Right-hand carrier plate

24. Remove the differential lock adjustment bolt, locknut and rubber cover.
25. Remove the two countersunk screws.
26. Remove the carrier plate complete with the differential lock coupler fork and coupler.
27. Remove and discard the inner 'O' ring.
28. Remove the differential lock roll pin, coupler, fork and shaft assembly.

Refitment

29. Reverse procedures 22 to 26 or 29 to 21 except:
    a. Place a new 'O' ring in the recess in the trumpet housing using a smear of petroleum jelly for location. DO NOT attempt to fit the 'O' ring to the carrier plate.
    b. Secure each countersunk screw with a centre punch mark.

Right-hand carrier plate only

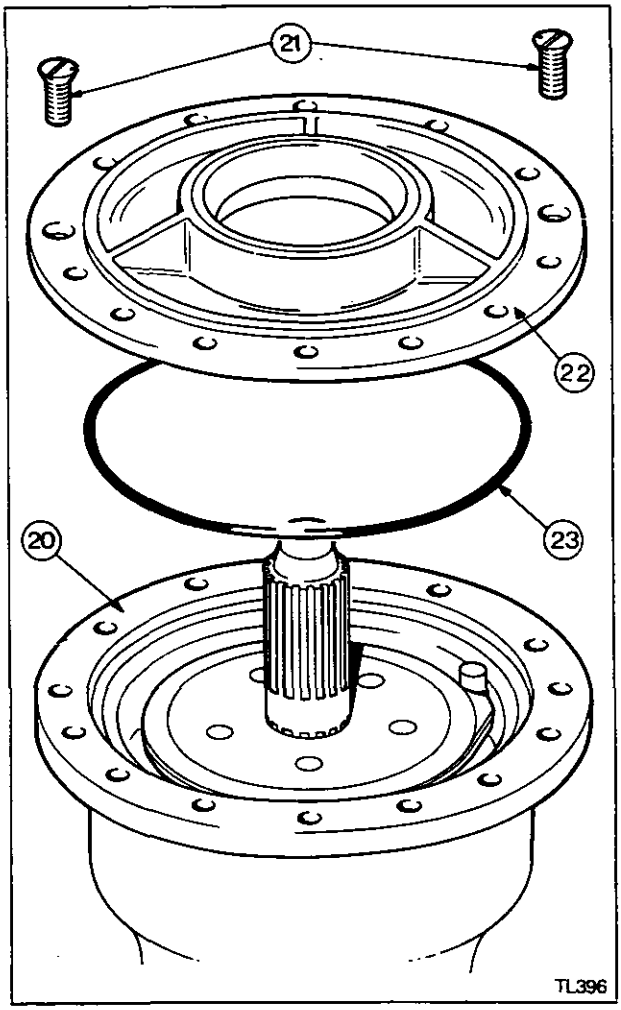
    c. Assemble the differential lock coupler fork, shaft and coupler to the carrier plate with a new roll pin.
    d. Refit the assembly, aligning the coupler splines on the axle shaft and the coupler shaft into the trumpet housing.
    e. Refit the differential lock adjustment bolt, locknut and rubber cover.

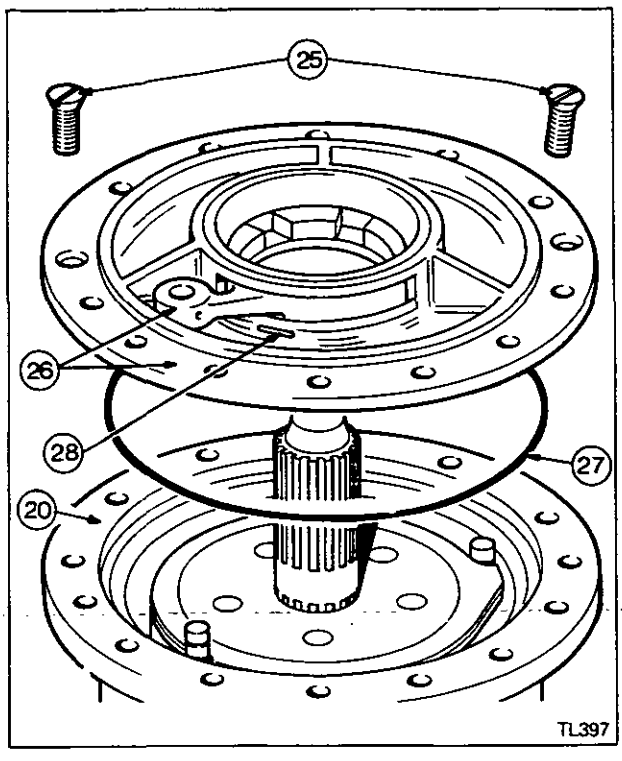
Both carrier plates

30. Reverse procedures 1 to 18 except:
    a. Fit a new 'O' ring, using petroleum jelly.
    b. When manoeuvering the trumpet housing assembly back into position, take care to align the axle shaft splines in the differential unit and the studs through their holes in the centre housing. Tighten the bolts and nuts to a torque of 104-156 Nm (77-115 lbf ft).
    c. Apply a few drops of loctite 270, then fit and tighten the cab or mud guard mounting bolts to a torque of 230 Nm (170 lbf ft).
    d. Brush the wheel stud threads clean.
    e. Refit the rear wheel and lightly oil the stud threads before fitting the wheel nuts.
    f. Tighten the nuts progressively and evenly to a torque of 325 Nm (240 lbf ft).

Note: The full quantity of oil, as stated in the specification will not be required as approximately 2,5 litre (4 Imp pt) will be trapped by the carrier plates in the trumpet housing.

31. Bleed the brake system in accordance with operation 8B-07.
32. Adjust and balance the brakes, see operation 8B-08.

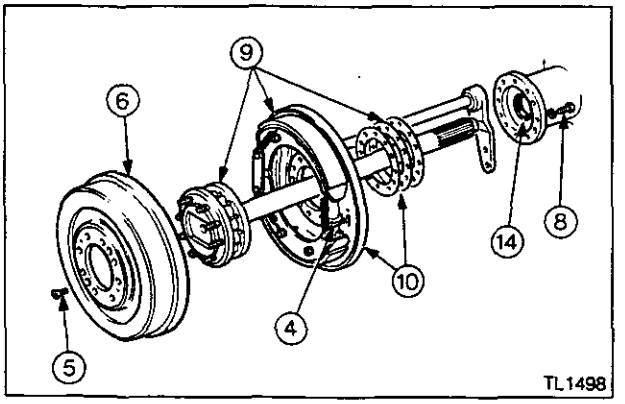




Axle Shaft (direct drive)

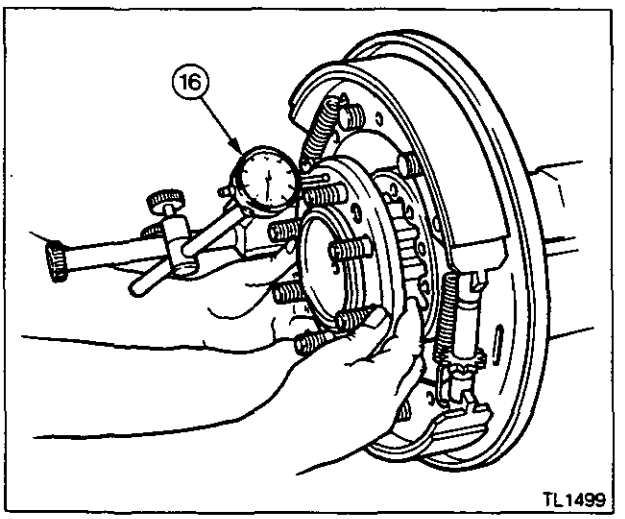
Removal and Refitment 8A-07

Special Tools:
Dial indicator gauge



Removal

1. Jack up the tractor under the trumpet housing to be serviced.
2. Drain the transmission.
3. Remove the rear wheel.
4. Slacken-off the brake adjuster.
5. Remove the two countersunk screws securing the brake drum.
6. Remove the brake drum.
7. Release the parking brake cable from the brake camshaft.
8. Remove the 12 bolts and spring washers securing the hub to the trumpet housing.
9. Withdraw the axle shaft complete with shims, hub and bearing assembly and brake assembly.
10. Remove the brake assembly and shims from the shaft.



Refitment

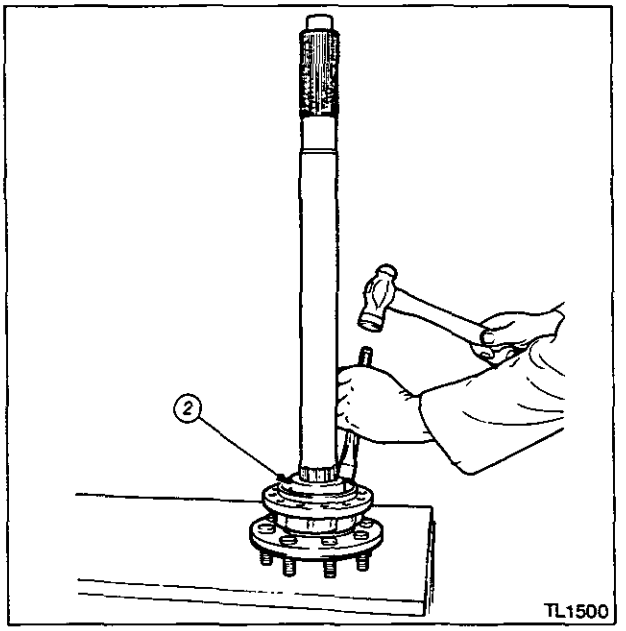
11. Smear the inside of the brake camshaft bush in the trumpet housing with a general purpose grease.
12. Check that the bearing cavity is full of grease.
13. Place the brake assembly and more shims than will be necessary on the axle shaft.
14. Taking care not to damage the oil seal, place the axle shaft into the trumpet housing, simultaneously locating the brake camshaft.
15. Secure the hub with three of the bolts and spring washers, equi-spaced and tighten to a torque of 74 Nm (55 lbf ft).
16. Check the axle end-float on the left hand trumpet housing, using a dial test indicator gauge. Remove shims as necessary to give an end float of 0,05 to 0,2 mm (0.002 to 0.008 in) between the axle ends.

Note: The right hand axle shaft must be in place to enable this setting to be accomplished. If both shafts have been removed assemble the right hand shaft with two shims to the value of 0,51 mm (0.020 in), then make your adjustments on the other side. Start with one 0,38 mm (0.015 in), two 0,51 mm (0.020 in) and two 0,13 mm (0.005 in) shims.

Shims are available in the following sizes:

Part number	Metric size	Imperial size
964 073 M1	0,05 mm	0.002 in
183 259 M1	0,13 mm	0.005 in
183 260 M1	0,38 mm	0.015 in
183 261 M1	0,51 mm	0.020 in

17. Refit the remaining bolts and spring washers and tighten to a torque of 74 Nm (55 lbf ft).
18. Reconnect the parking brake cable to the brake camshaft lever if removed.
19. Refit the brake drum.
20. Secure the brake drum with the two countersunk screws.
21. Refit the rear wheel and nuts, then tighten the nuts progressively and evenly to a torque of 270 Nm (200 lbf ft).
22. Refill the transmission with an approved oil to the correct level.
23. Adjust the brakes, see operation 8B-18

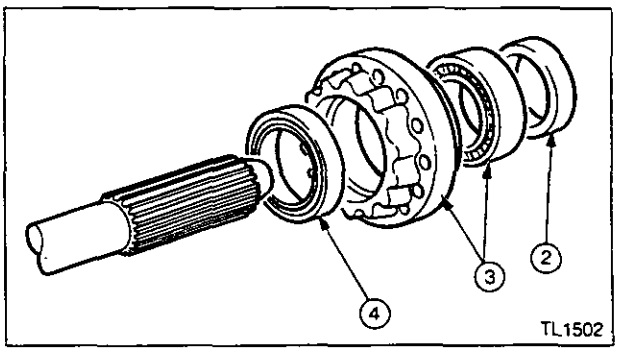


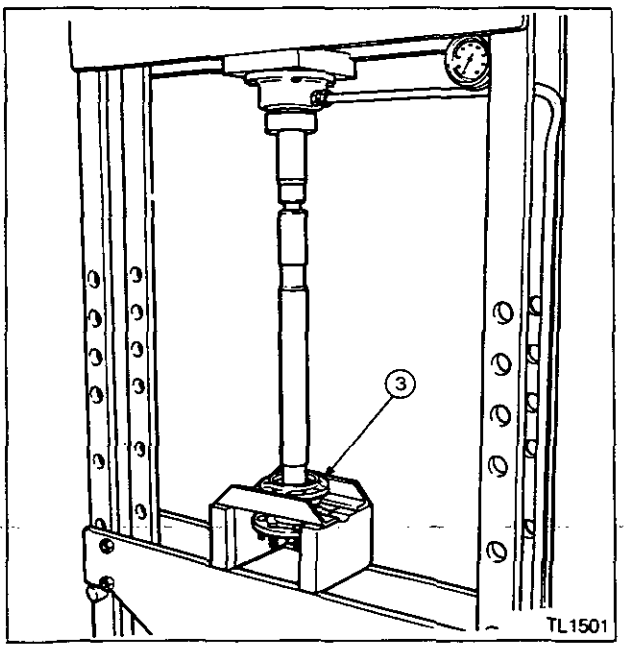
Axle Shaft (direct drive)

Overhaul	8A-08

Disassembly

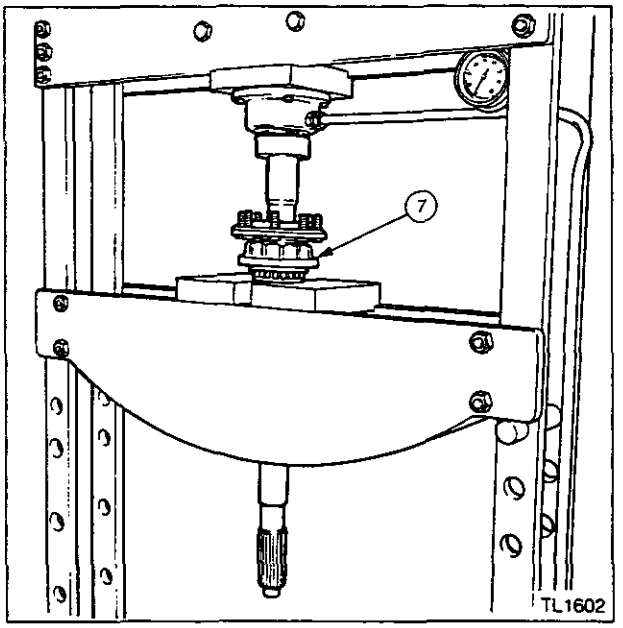
1. Remove the axle shaft, see operation 8A-07.
2. Drill into the side of the bearing retaining collar, then using a cold chisel, fracture the collar.
3. With a hydraulic press, press the seal and bearing assembly off the shaft. Only remove the bearing cup if necessary.
4. Remove and discard the hub oil seal.
5. Remove and discard the oil seal in the trumpet housing.



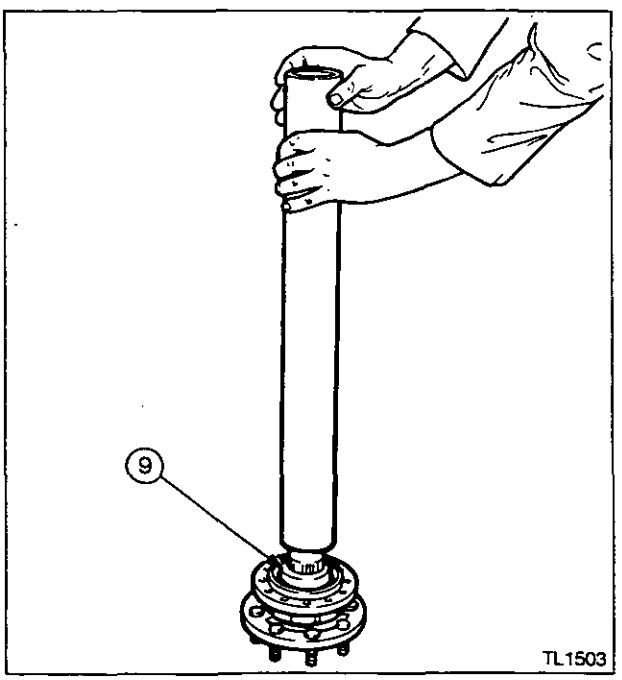


Reassembly

6. Coat the oil seal with Loctite 542 and press into the hub up to the shoulder (fit a new bearing cup if necessary).
7. Place a small quantity of high melting point grease between the oil seal and bearing. Position the axle shaft, seal and bearing assembly under a hydraulic press. Press the taper roller bearing cone into position.
8. Heat a new bearing retaining collar, until dull red, and place it in position on the axle shaft.



9. Quickly drive the bearing retaining collar into position with a length of steel tube so that the hub and bearing assembly is held tightly in position.
10. When cool, fill the bearing cavity with approximatly 85 g (3 oz) of high melting point bearing grease.
11. Replace the oil seal in the trumpet housing coating it first with Loctite 542, the lip of the seal faces towards the crownwheel and pinion.
12. Refit the axle shaft, see operation 8A-07.

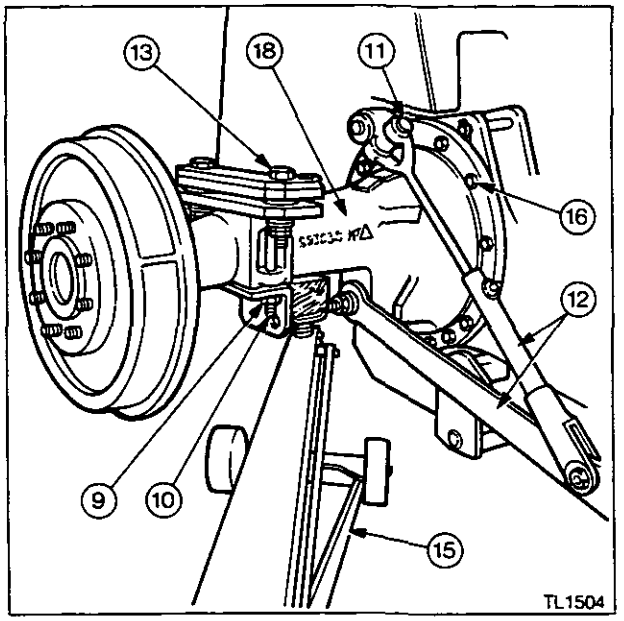


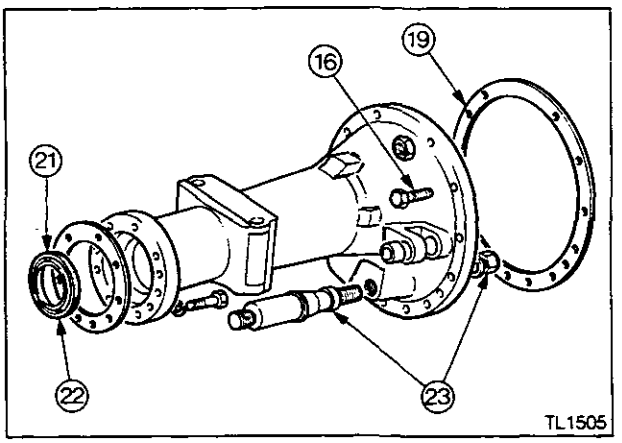
Trumpet Housing (direct drive)

Removal and Refitment 8A-09

Removal

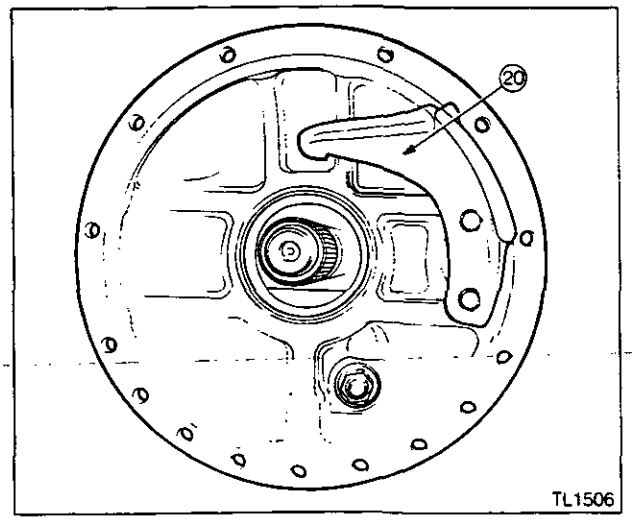
1. Drain the transmission oil.
2. Remove the split pin, nut and washer securing the lower link to the trumpet housing.
3. Jack up the tractor under the trumpet housing being serviced.
4. Remove the rear wheel.
5. Support the tractor on a suitable stand or splitting trolley under the transmission.
6. Release the parking brake cable from the brake cam shaft, and disconnect the hydraulic brake pipe. Cap the end of the pipe and the cylinder to prevent the ingress of dirt.
7. When removing the right hand trumpet housing, release or remove the differential lock pedal.
8. Release the check chain at the check chain anchor bracket.
9. Remove the two nuts securing the stabiliser bracket to the trumpet housing.
10. Remove the stabiliser bracket.
11. Release the lift rod at the lift arm knuckle.
12. Remove the lower link assembly complete.
13. Remove bolts from the fender or cab mounting plate.
14. Remove the fender assembly, or support the cab with a jack or cab stand.
15. Place a trolley jack under the centre of the trumpet housing being serviced, just supporting the housing.
16. Remove all the nuts and bolts securing the trumpet housing to the centre housing, and the hydraulic brake cylinder support bracket.
17. Lower the trumpet housing slightly on the trolley jack.
18. Withdraw the trumpet housing on the trolley jack.





Caution: When removing the left hand trumpet housing, the differential will need supporting to prevent it falling out.

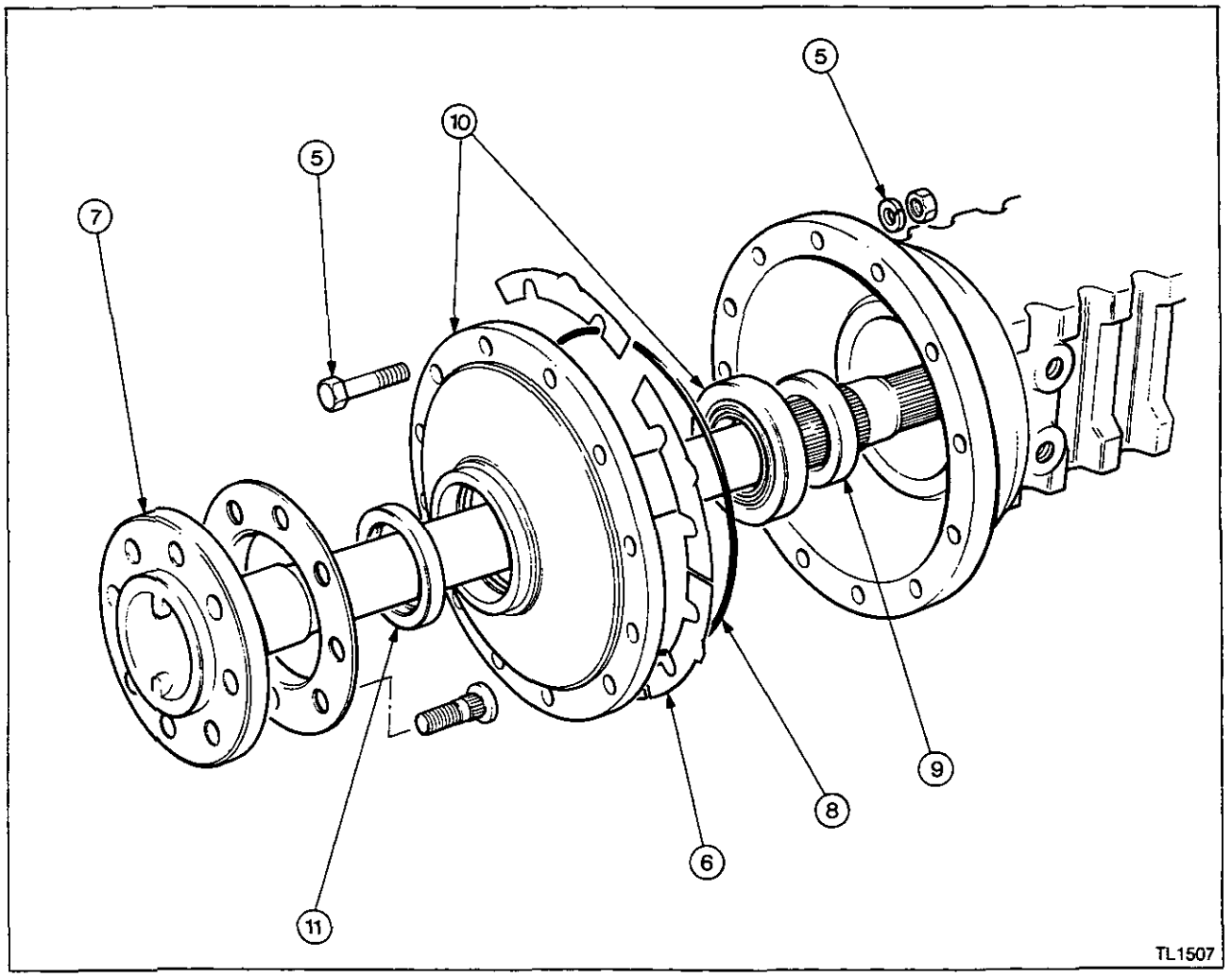
19. Remove the gasket from the centre housing.
20. Remove the oil trough from the left hand housing, if necessary.
21. Remove the oil seal.



Refitment

22. Replace the oil seal in the trumpet housing coating it first with Loctite 542, the lip of the seal faces towards the crownwheel and pinion.
23. If the lower lift arm pivot pin has been removed from the trumpet housing, when refitting tighten the nut to a torque of 149-163 Nm (110-120 lbf ft).

24. Reverse procedures 1 to 20 except:
    a. Fit a new gasket to the centre housing using petroleum jelly.
    b. When refitting the trumpet housing, take care to align the axle shaft splines in the differential unit and the studs through their holes in the trumpet housing.
    c. Do not forget to refit the differential lock return spring and attachment plate.
    d. Tighten the trumpet housing nuts and bolts to a torque of 115 Nm (85 lbf ft).
    e. Apply a few drops of Loctite 270, then fit and tighten the stabiliser bracket/fender/cab bolts to a torque of 230 Nm (170 lbf ft).
    f. Tighten the wheel nuts progressively and evenly to a torque of 270 Nm (200 lbf ft).
    g. Refill the transmission to the correct level with an approved oil.
    h. Remove the air from the brake system, see operation 8B-07.



Axle Shaft (direct drive - wet brakes)

Removal and Refitment 8A-10

Special Tools:

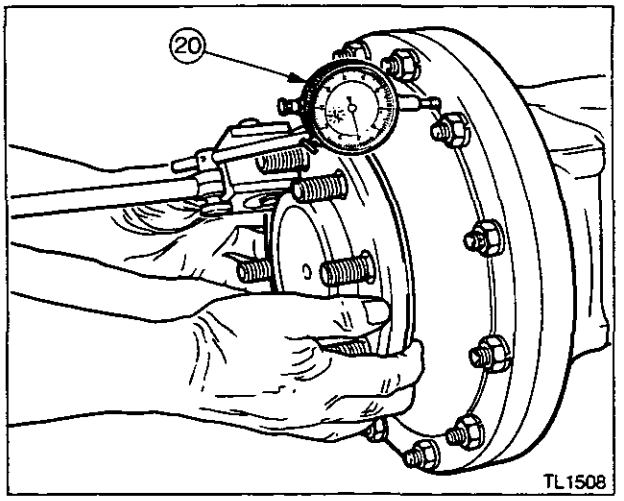
Dial indicator gauge

Removal

1. Jack up the tractor under the trumpet housing to be serviced.
2. Drain the transmission.
3. Remove the rear wheel.
4. Ensure that the parking brake is hard-on.
5. Remove the 12 nuts, bolts and spring washers.
6. Prise apart the axle housing, taking care to retain the shims between the two halves.
7. Remove the axle and hub assembly.
8. Remove the 'O' ring and discard.
9. Drill into the side of the bearing retaining collar, then using a cold chisel, fracture the collar, see operation 8A-08.
10. Remove the bearing and hub assembly off the axle shaft with a hydraulic press (remove the bearing cup only if necessary).
11. Remove and discard the oil seal.

Reassembly

12. Coat the oil seal with Loctite 542 and press into the hub up to the shoulder (fit a new bearing cup if necessary).
13. Place a small quantity of high melting point grease between the oil seal and the bearing. Position the axle shaft, seal and bearing assembly under a hydraulic press. Press the taper roller bearing cone into position.
14. Heat a new bearing retaining collar, until dull red, and place it in position on the axle shaft.
15. *Quickly drive the bearing retaining collar into* position so that the hub and bearing assembly is held tightly in position as shown in operation 8A-08.
16. Replace the 'O' ring.
17. Place the axle shaft into the trumpet housing carefully passing the shaft through the brake plates.
18. Place more shims than will be necessary between the hub and trumpet housing.



Caution: The shims are in segments, each pack of shims must be equal.

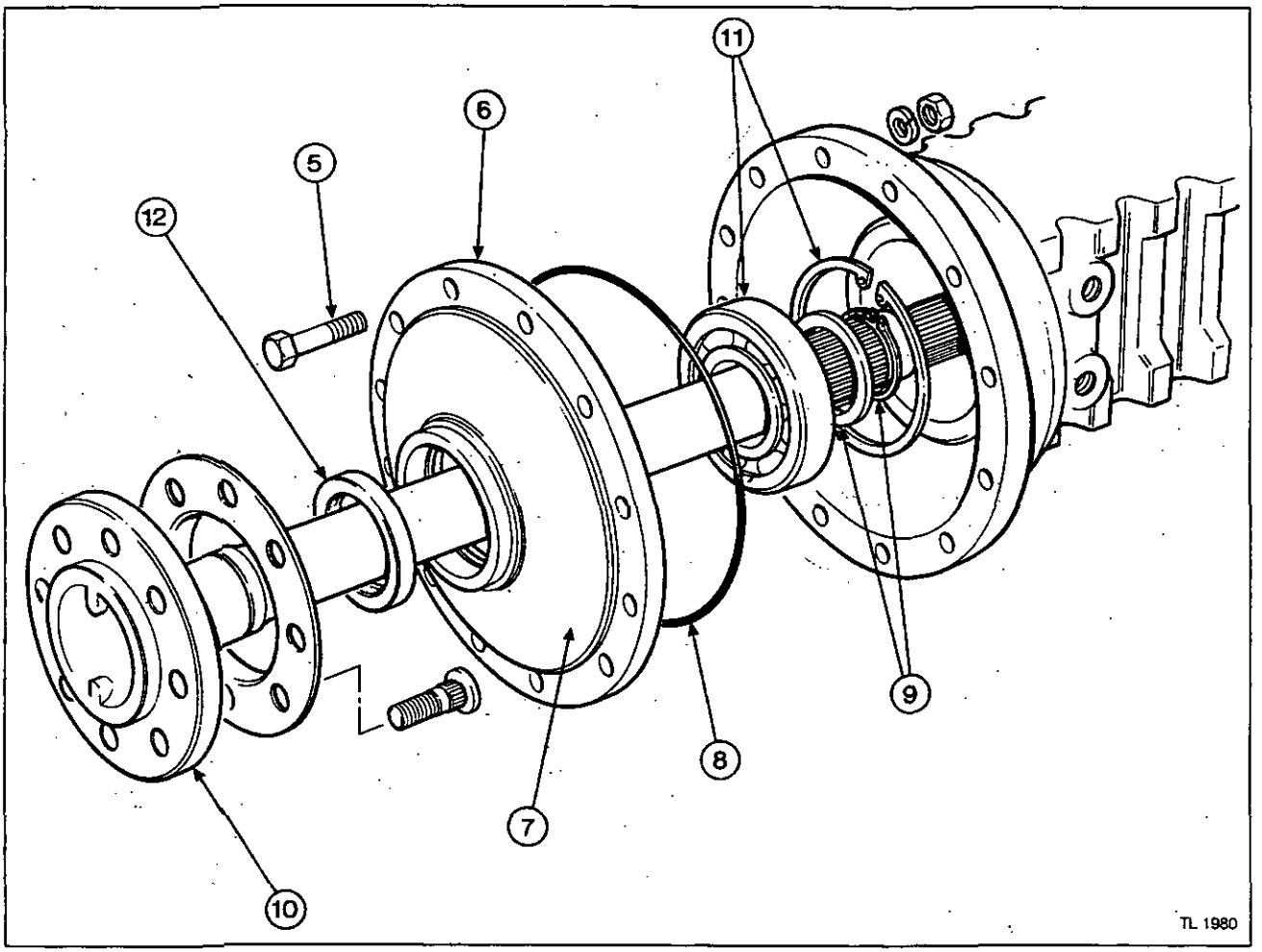
19. Secure the hub with three of the bolts and spring washers, equi-spaced and tighten to a torque of 74 Nm (55 lbf ft).
20. Check the axle end-float, using a dial test indicator gauge. Remove shims as necessary to give an end float of 0,05 to 0,2 mm (0.002 to 0.008 in) between the axle ends.

Note: The other axle shaft must be in place to enable this setting to be accomplished. If both shafts have been removed assemble the shaft on one side with shims to the value 0,5 mm (0.020 in), then make your adjustments on the other side.

Shims are available in the following sizes:

Part number	Metric size	Imperial size
1660 644 M1	0,10 mm	0.004 in
1660 645 M1	0,25 mm	0.010 in
1660 646 M1	0,50 mm	0.020 in

21. Refit the remaining bolts and spring washers and tighten to a torque of 74 Nm (55 lbf ft).
22. Refit the rear wheel and nuts, then tighten the nuts progressively and evenly to a torque of 270 Nm (200 lbf ft).
23. Refill the transmission with an approved oil to the correct level.
24. Adjust the brakes, see operation 8B-18



Axle Shaft – Wet Brakes – Direct Drive

Removal and Refitment 8A–11

Removal

NOTE: This axle shaft replaces the type shown in section 8A–10 which has a taper roller bearing retained by a shrink–fit collar. It can be identified by the large ball–bearing retained by a spacer and circlips.

1. Jack up the tractor under the trumpet housing to be serviced.
2. Drain the oil from the transmission.
3. Remove the rear wheel.
4. Ensure that the parking brake is hard on.
5. Remove the 12 nuts, bolts and spring washers.
6. Prise apart the axle housing between the end cover and trumpet housing.
7. Remove the axle and end cover assembly.
8. Remove the 'O' ring and discard.
9. Remove the external circlip and spacer.
10. Drive the axle shaft out of the bearing and cover assembly.
11. Remove the internal circlip and ball-bearing if necessary.
12. Remove and discard the oil seal.

Refitment

13. Coat the oil seal with Massey Ferguson Lock and Seal (Loctite 542) and press into the cover up to the shoulder.
14. Replace the ball-bearing if necessary.
15. Refit the axle shaft, spacer and circlip.
16. Replace the 'O' ring.
17. Place the axle shaft into the trumpet housing, carefully passing the shaft through the brake plates.
18. Refit the nuts and bolts tightening to a torque of 74 Nm (55 lbf ft).
19. Refit the rear wheel and nuts, then tighten the nuts progressively and evenly to a torque of 270 Nm (200 lbf ft).
20. Refill the transmission with an approved oil to the correct level.
21. Adjust the brakes, see operation 8B-02.

BRAKES

Section 8 – Part B

Table of Contents

8B–2
BRAKES

Specification

Type	Multi-disc oil immersed
Model	C.S. Brake (Concentric Slave) up to serial No. V39465 T.S. Brake (Tangential Slave) from serial No. V39466
Diameter	222 mm (8.75 in)
No. of plates - MF 340, 342	6 friction, 5 steel, each side
No. of plates - MF 350,355,360,362	3 friction, 2 steel, each side
No. of plates - All other models	4 friction, 3 steel, each side
Lining material (except MF 340 and 342)	Sintered bronze
Lining material MF 340, 342	Resin Bonded Fibre (RBF)
Depth of groove	0,3 mm (0.012 in)
Operation	Hydraulic independent
Parking brake	Cable operated, independent on both brakes
MF 340 Tractors only:	
Type	Outboard drum
Size	355 x 50 mm (14 x 2 in)
Actuation	Hydraulic
Trailer brake valve:	
Make	Bosch
Pressure ratio	4 : 1
Piston diameter	12 mm C.S. brake - 10 mm T.S. brake
Location	On auxiliary manifold (left-hand side cover)
Oil supply	First priority from auxiliary pump
Maximum braking pressure	120–150 bar (1740–2175 lbf/in^2)
Maximum flow to trailer brake	15 litre/min (3.3 gal/min)(4 US gal/min)
Master cylinder	Type CV
Quantity	2, one for each side
Piston diameter	17,8 mm (0.70 in) C.S. brake 15,9 mm (0.62 in) T.S. brake
Push rod to piston clearance	1 mm (0.040 in)
Pedal movement	5 to 10 mm (0.20 to 0.40 in)
Slave cylinder type	Hydro-mechanical
Quantity	2, one each side

Recommended grades of oils

Brake fluid type	Mineral based (Green)
Ambient temperature	-40°C to 60°C (-40°F to 140°F)
M-F part number	3405 389 M1
Lubricant suppliers recommendation:	
Castrol	CHSMO
Total	LHM
Shell	Tellus T15
Esso	Univis J13, Univis J36, Nuto H10
Mobil	DTE II
Petrofina	Fina Hydran 10
Texaco	Rando HDZ 15, Spintex 10
BP	Bartran HV15, Hydraulic LHM
Alternative grades of oil - ambient temperature	-20°C to 60°C (-4°F to 140°F)
Castrol	Hyspin AWS32, TQ Dexron II, Agricastrol ATF, RX Super 10
Total	Azolla AS32, Dexron II, HTF Type C3, Rubia S10W
BP	Energol HLP32, Autran GMMP, Autran DXII, Autran C3, Vanellus C3
Esso	Nuto H32, Torque Fluid 46, Essolube XD3/10W
Shell	Tellus T37, Dexron II, Rimula X10W
Texaco	Rando HD32, Rando HDZ32, Texamatic 9226 Torque Fluid C3, Ursa Super LA10W
Petrofina	Fina Hytran 32, Dexron II, Dexron DII, Transmission C3
Mobil	DTE 24, DTE Light, ATF 200, ATF 220, Delvac 1310
Caltex	Rando Oil HD 32, Texamatic Dextron II, RPM Delo 200 or 300 or 400 10W

Approved mineral based 20W engine oils for use in the braking system at temperatures above 0°C (+32°F):

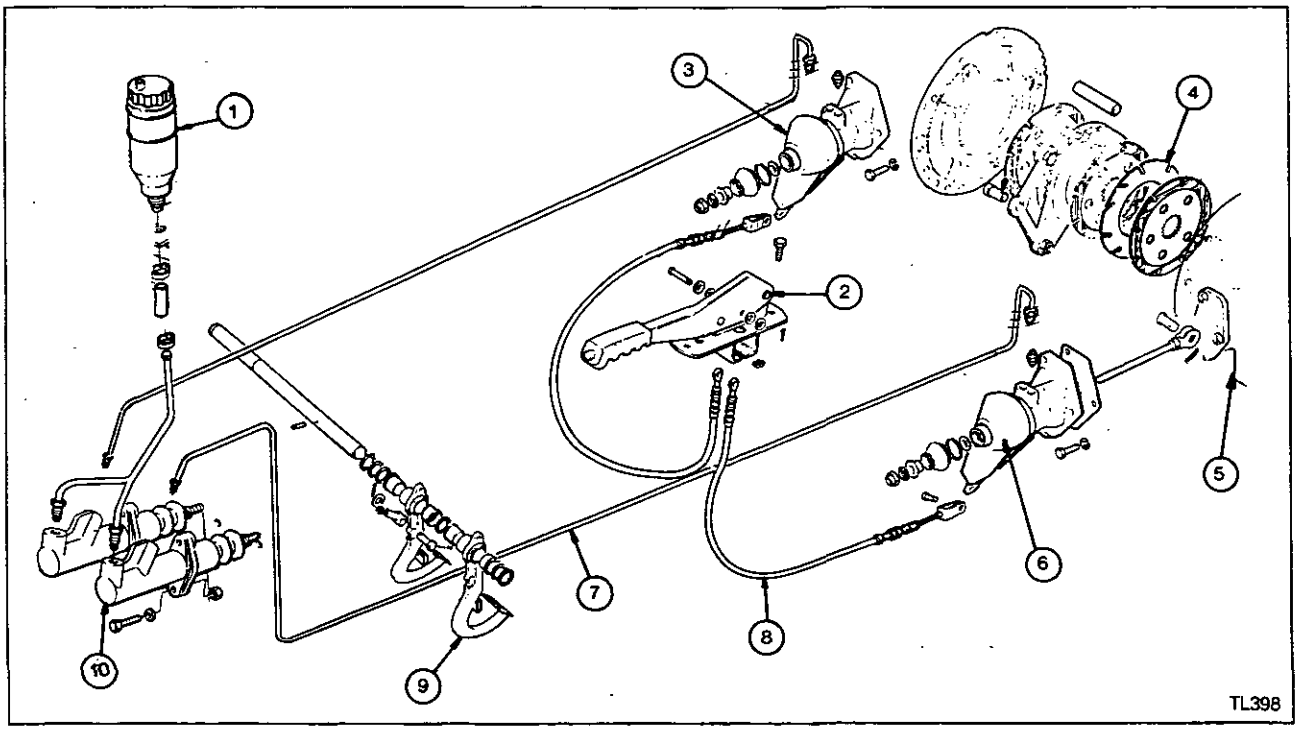
Castrol	CRI 20, or RX Super 20
Total	Rubia B or H or S 20W/20
BP	Vanellus M 20W or C3 20W, or Energol HD 20W
Esso	HDX 20W, or XD3+ 20W
Shell	Rotella X or SX 20/20W or Rimula X or CT 20/20W
Texaco	Ursa Super LA SAE 20/20W, or Ursatex 20/20W
Petrofina	Fina Delta SAE 20W/20
Mobil	Delvac 1220 or 1320 or 1420
Caltex	RPM Delo 100 or 200 or 300 SAE 20/20W
Duckhams	Fleetol HDX 20W, or Fleetol Series 3/20
Elf	Performance 3C 20W or 2B 20W

Special tools

MF 3001	Pressure test kit
MF467	Brake pull rod seal protector

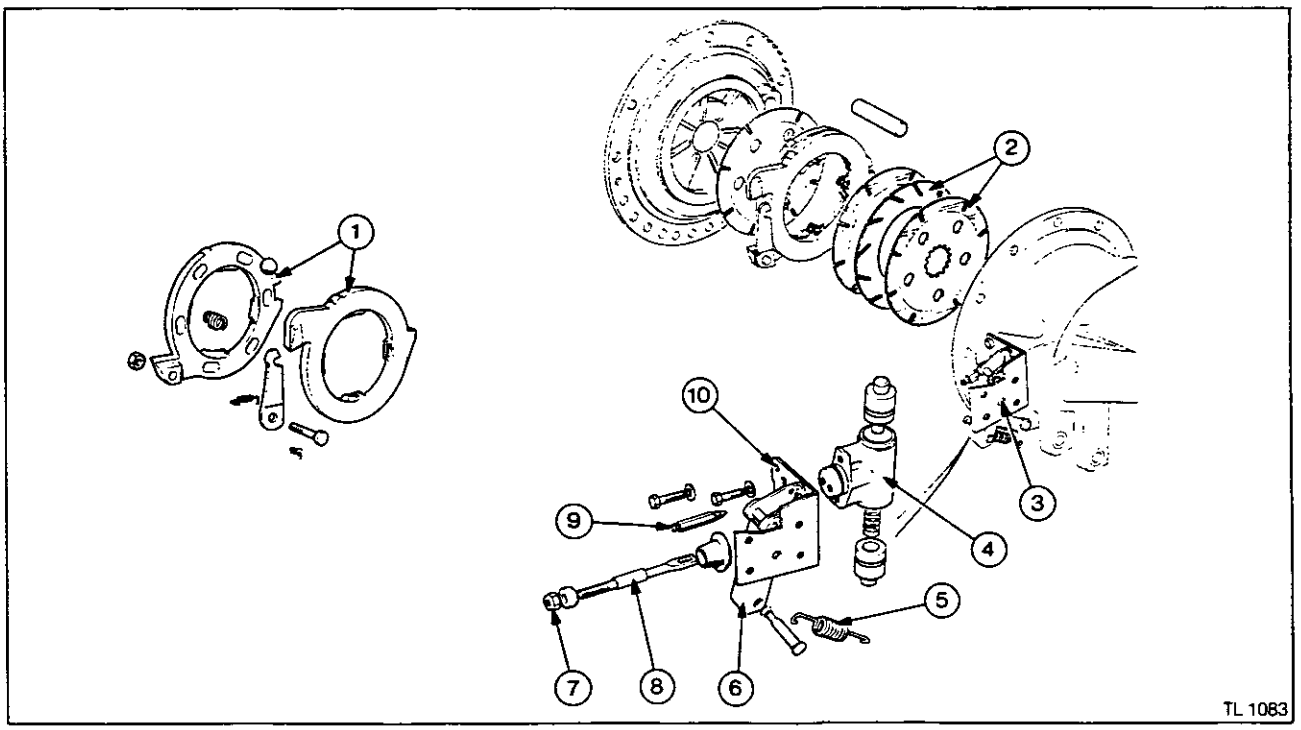
Bolt torques

Trailer brake valve to manifold	21-24 Nm (15-18 lbf ft)
Bleed nipple	19 Nm (14 lbf ft) maximum
Brake actuator to axle housing	12-16 Nm (9-12 lbf ft)
Anchor pins (drum brakes)	200 Nm (150 lbf ft)
Camshaft Lever (drum brakes)	1,4-3,4 Nm (12-30 lbf in)



1. Brake reservoir.
2. Parking brake.
3. R.H. slave cylinder.
4. Brake assembly.
5. Rear axle.
6. L.H. slave cylinder.
7. Brake pipes.
8. Parking brake cables.
9. Foot pedals.
10. Master cylinders.

Figure 1. Concentric Brake System



1. Expander plates.
2. Brake Discs.
3. Brake assembly.
4. Slave cylinder.
5. Return spring.
6. Parking brake lever.
7. Adjusting nut.
8. Pull rod.
9. Bleed nipple.
10. Mounting bracket.

Figure 2. Tangential Brake System.

General Description

The tractor is fitted with multi-disc oil cooled brakes fitted between the axle housing and the differential carrier plates adjacent to the centre housing.

The brakes are operated by two independent hydraulic master cylinders located under the instrument panel. They pressurise slave cylinders mounted on the trumpet housings.

The right pedal operates the right-hand brake and the left pedal operates the left-hand brake, to assist turning.

For highway use the brakes are used together by operating an interlocking latch which joins the two pedals.

Pressure on the brake pedal applies hydraulic pressure, which actuates the slave cylinders which are connected to an actuation assembly in contact with two rotating middle (friction) discs splined to each shaft, these in turn contact fixed friction faces provided in the axle housing and in the differential carrier plate fitted between the centre and axle housings. The mechanism of each brake consists of two cast iron actuating discs, held together by tension springs and separated by steel balls located in inclined ramps. Pressure on the brake pedal operates a hydraulic slave cylinder which pulls the operating rod, rotates one actuating disc relative to the other, and the steel balls ride up their inclined seats and so spread the actuating discs apart. These come into contact with the rotating (friction) discs, which are splined to the shaft being braked. The actuating assembly will move slightly in the direction of rotation until the torque ear of one actuating disc comes into contact with a shaft in the housing. The other actuating disc tends to rotate further, increasing the angular displacement between the discs, and assisting the braking action. When the brake pedal is released, the tension springs cause the discs to return to their normal position.

A parking brake is provided which operates both brakes together, independent of the foot brakes, mechanically through a cable control.

A hydraulic trailer braking system available on M-F 300 series tractor offers simultaneous operation of the tractor and trailer brakes controlled by movement of the tractor brake pedals.

This system eliminates the need for a separate mechanical or hydraulic trailer braking mechanism and enables the tractor and trailer to be braked safely as one unit.

Tractors fitted with this trailer braking system are equipped with an auxiliary pump to provide a pressurised oil supply to the TRAILER BRAKE VALVE (TBV) which is the principal component. The funcions of the TBV are as follows:-

1. To divert and regulate oil flow from the pump to the trailer.
2. To regulate the trailer brake pressure and therefore the braking force.
3. To limit the maximum brake pressure in the trailer brake line.
4. To prevent back flow of oil from the trailer brake line while the brakes are being held on.

Automatic operation of the TBV occurs when the operator presses or releases the tractor brake pedals.

Hydraulic oil for brake operation is taken from the auxiliary hydraulic system before it passes to the main auxiliary control valve. The TBV takes priority over the auxiliary control valve.

Hydraulic sensing of the brake circuit is carried out by pipe between the left-hand brake slave cylinder and the TBV.

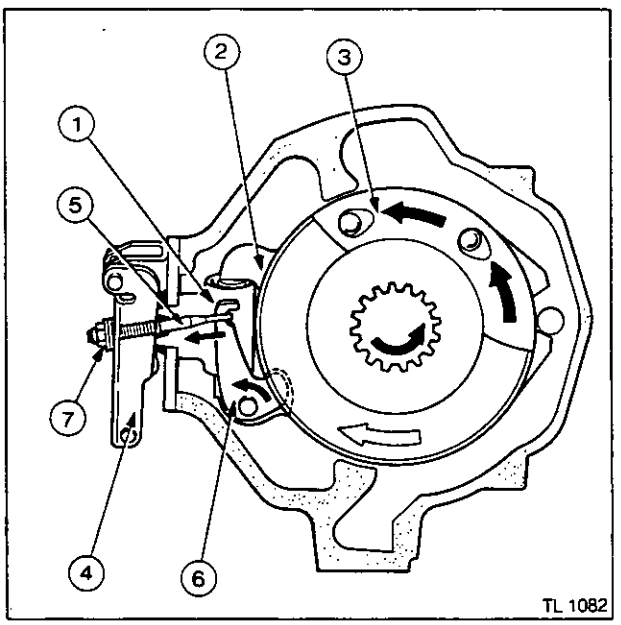


Figure 3.

Product Changes

Tangential Brakes

A new method of actuating the brakes was introduced into production on the 3rd November 1987 at tractor serial number V39466. This new arrangement is known as the Tangential Brake system. (See figure 2).

The tangential brake system operates in a similar way to the concentric brake system (figure 1), except that the slave cylinder (1 Fig. 3) is mounted inside the rear axle housing and operates directly on the lugs (2) of the expander unit (3) pushing them apart (rather than pulling them together as on the concentric system) and thus applying pressure on the brake plates, slowing the axle down.

A mechanical lever system is provided for adjustment of the brake and parking operation. When the parking brake is applied the lever (4) pulls the pull rod (5) which in turn operates the bellcrank (6) on one of the expander plates. As the bellcrank pivots it rotates the expander plate, the steel balls roll up the inclined seats and the brake is applied.

Adjustment is made by altering the effective length of the pull rod with the nyloc nut (7).

The brake master cylinders, reservoir, fluid lines and trailer brake valve remains unchanged.

Brake Actuator Assembly

Removal and Refitment 8B-01

Up to tractor serial No. V39465

Removal

1. Drain the transmission oil to below the MIN mark on the dipstick.
2. Disconnect the parking brake cable.
3. Remove the return spring.
4. Remove the brake adjusting nut.
5. Left-hand brake. Remove any pipes, fittings, auxiliary hydraulic manifold and trailer brake valve if fitted.
6. Right-hand brake. Disconnect and remove the differential lock mechanism.
7. Disconnect the hydraulic brake feed pipe and drain the fluid into a clean tin. Mask or plug the connectors to prevent dirt ingress.
8. Remove the three bolts securing the actuator to the trumpet housing.
9. Slide the actuator forward off the adjusting rod, leaving the seal between the actuator and the trumpet housing on the housing.

Refitment

10. Reverse procedures 1 to 9 except:
    a. Ensure that the rubber covers are in good condition.
    b. Ensure that the lip of the rubber covers are seated correctly and the retaining rings fitted.
    c. Ensure that the thread on the brake adjusting rod is clean.
    d. Always use a new locknut on the brake adjuster.
11. Remove air from the brake hydraulic system in accordance with operation 8B-07.
12. Balance and adjust the foot and parking brake in accordance with operation 8B-08.

Brake Actuator Assembly

Overhaul 8B-02

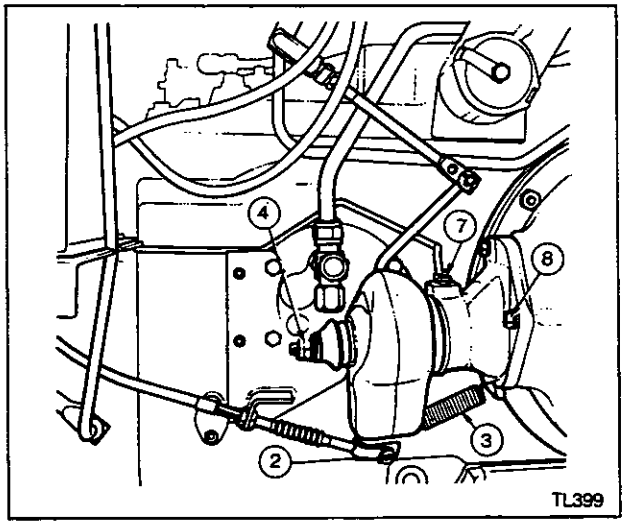
Up to tractor serial No. V39465

Disassembly

1. Remove the brake actuator, operation 8B-01.
2. Remove the large rubber cover over the handbrake lever, take care not to damage it.
3. Remove the clip and the top hand brake lever pivot pin.
4. Remove the handbrake lever assembly.
5. Remove the clip from the end of the slave cylinder piston.
6. Push out the slave cylinder piston from the brake end.
7. Remove the seals and spacer from the piston and the body of the actuator.

Cleaning and Inspection

8. Thoroughly clean all the parts by washing them in methylated spirit and drying with compressed air. Inspect the inside of the cylinder bore and the piston for any signs of scoring or abrasion. Replace any damaged parts.



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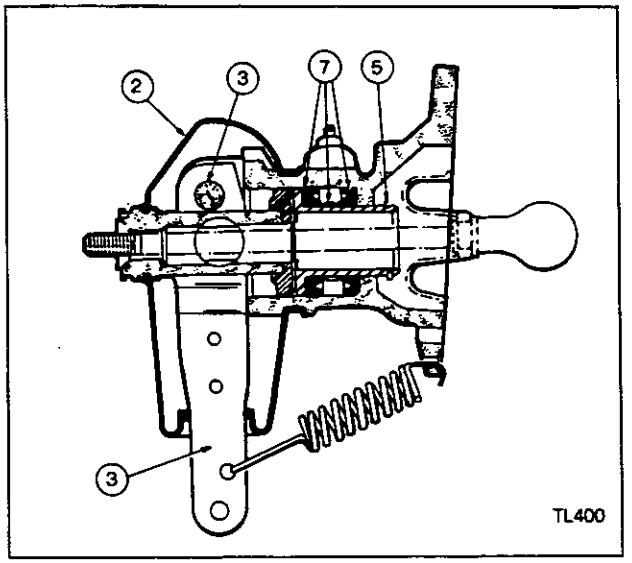


TL400

Reassembly

9. Lubricate the inside of the slave cylinder, piston and seals with a mineral type brake fluid.
10. Fit the two seals and spacer to the piston.
    Note The lips of the seals must face each other.
11. Ease the piston and seal assembly into the housing, taking care not to damage the lips of the seals.
12. Reverse procedures 1 to 5.

Right and Left-Hand Brakes

Removal and Refitment 8B-03

Up to tractor serial No. V39465

Removal

1. Remove the trumpet housing and carrier plate, see operation 8A-07.
2. Remove the brake actuator, see operation 8B-01.
3. Remove the rubber seal between the brake actuator and trumpet housing only is it is damaged.
4. Remove the brake stop rod from the housing.
5. Remove the brake components, turning each plate over and stacking in reverse order to ensure correct refitment.

Only if necessary, dismantle the expander unit as follows:

6. Release the four springs.
7. Remove the expander rod.
8. Remove the links and balls.

Examination

Friction plates: These have a minimum groove depth of 0,3 mm (0.012 in) when new. When the grooves begin to disappear, the plates must be replaced.

Steel plates: The interplates can generally be refitted, but should be replaced either when badly scored or worn more than 0,13 mm (0.005 in) per face. The steel plates should also be replaced when the friction plates are renewed.

Check all plates for signs of severe overheating or distortion.

Note: Never attempt to reclaim friction plates or steel plates by lapping or grinding.

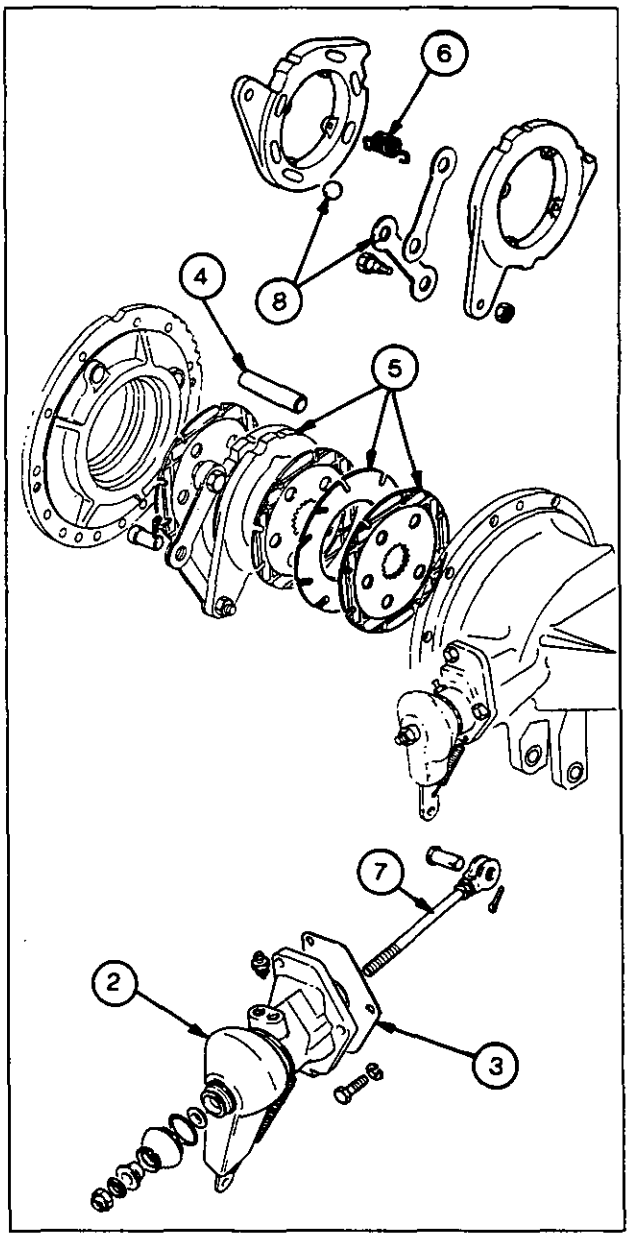
Actuator Plates: The actuator plates do not normally need replacing, but should be checked for severe scoring.

Thoroughly clean out the brake housing and remove any burrs or pieces of old gasket from the actuator and trumpet housings.

Refitment

Reverse procedures 1 to 5 or 1 to 7, depending on the extent of disassembly, except:

a. Dip each friction plate, steel plate and expander unit in clean transmission oil before fitting them into the housing. THIS IS VERY IMPORTANT Refit all plates in the order in which they were originally assembled.
b. Fit a new rubber seal between the trumpet housing and the brake actuator if removed. Use Hylomar jointing compound.
c. Smear the expander rod with petroleum jelly, then refit the expander assembly ensuring that the lip of the rubber seal seats correctly in the ridge on the rod of the expander.
d. If the brake plates have been mixed up or being replaced, they are fitted into the trumpet housing in the following order:



M-F 350, 355 and 360 tractors	All other tractors
3 friction discs per half axle	4 friction discs per half axle
Friction plate Steel plate Friction plate Expander unit Friction plate Carrier plate	Friction plate Steel plate Friction plate Expander unit Friction plate Steel plate Friction plate Carrier plate

9. Refit the trumpet housing and carrier plate, see operation 8A-07.
10. Refit the Brake actuator, see operation 8B-01.
11. Remove air from the brake system, see operation 8B-07.
12. Adjust the brakes, see operation 8B-08.

Parking Brake

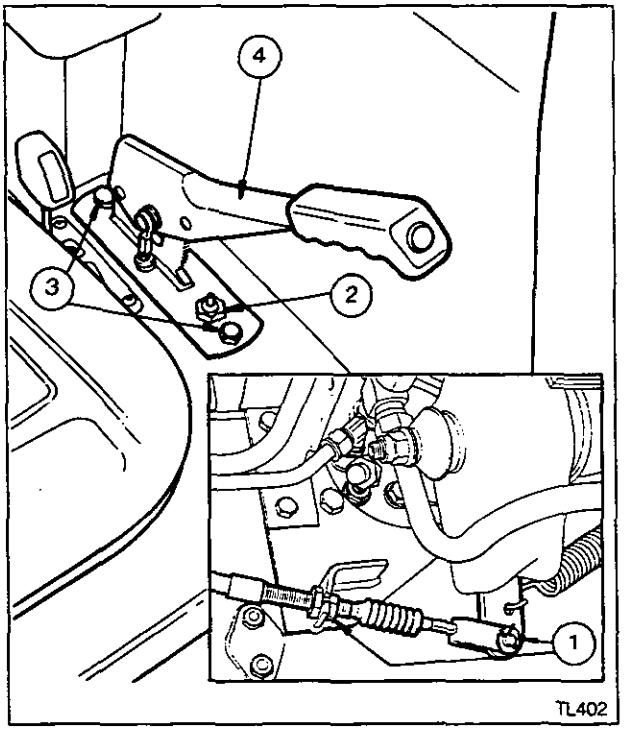
Removal and Refitment 8B-04

Removal

1. Disconnect the two parking brake cables from the rear brake actuators and at the anchor points on the side covers.
2. Disconnect the wires to parking brake warning light switch.
3. Remove the two bolts securing the parking brake assembly to the frame of the tractor.
4. Withdraw the parking brake assembly and the two cables.
5. Remove the cables if necessary.

Refitment

6. Reverse procedures 1 to 5 except:
   a. Route the right-hand brake cable over the transmission case, ensure that it has no sharp bends.
   b. Check that the brake operates freely and that the *warning light works after fitting.*
7. Adjust the brakes, see operation 8B-08.



Brake Pedals

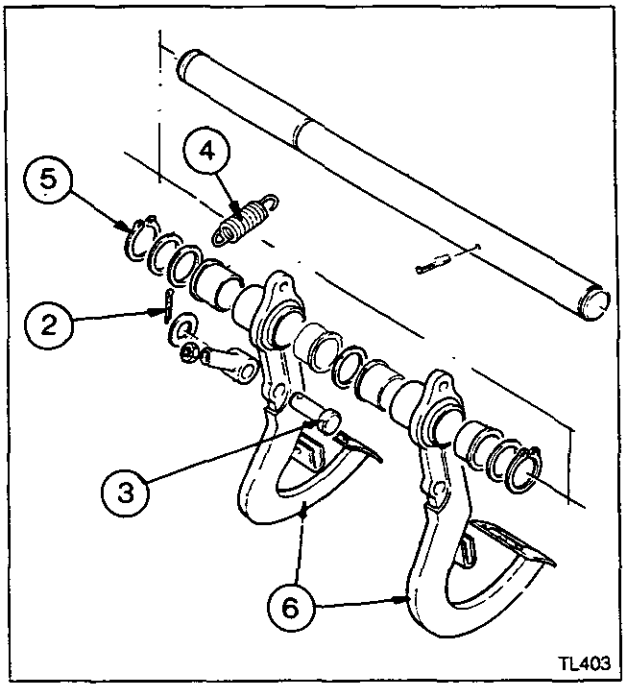
Removal and Refitment 8B-05

Removal

1. Remove the panel under the instrument panel.
2. Remove the split pins from the two clevis pins connecting the master cylinder push rods to the brake pedals.
3. Remove the clevis pins and ease the rubber cover off the master cylinder with the push rod.
4. Remove the two return springs.
5. Remove the circlip on the pivot shaft.
6. *Withdraw both pedals from the shaft.*

Refitment

7. Reverse procedure 1 to 6 except:
   a. Ensure that the rubber cover is in good condition.
   b. Check the brake pedal push rod to master cylinder adjustment, see operation 8B–08
   c. Lubricate the pivot shaft and bushes with a lithium-based grease.

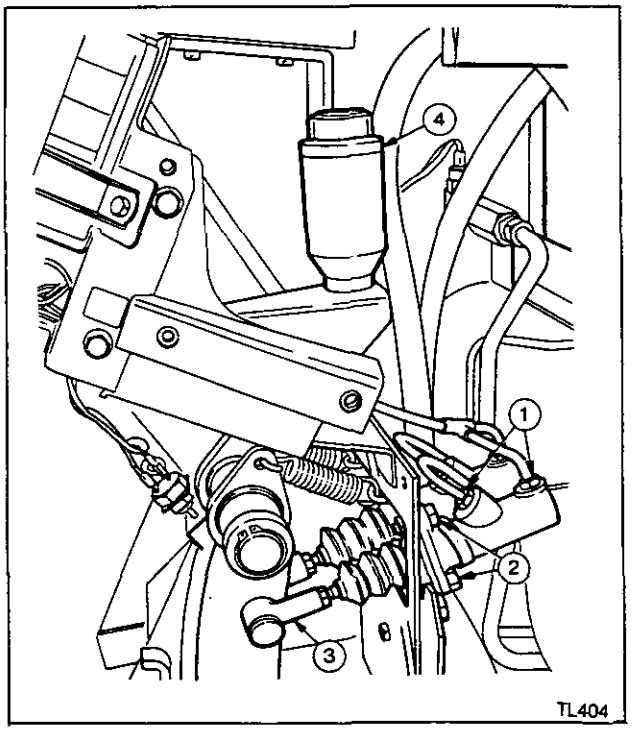


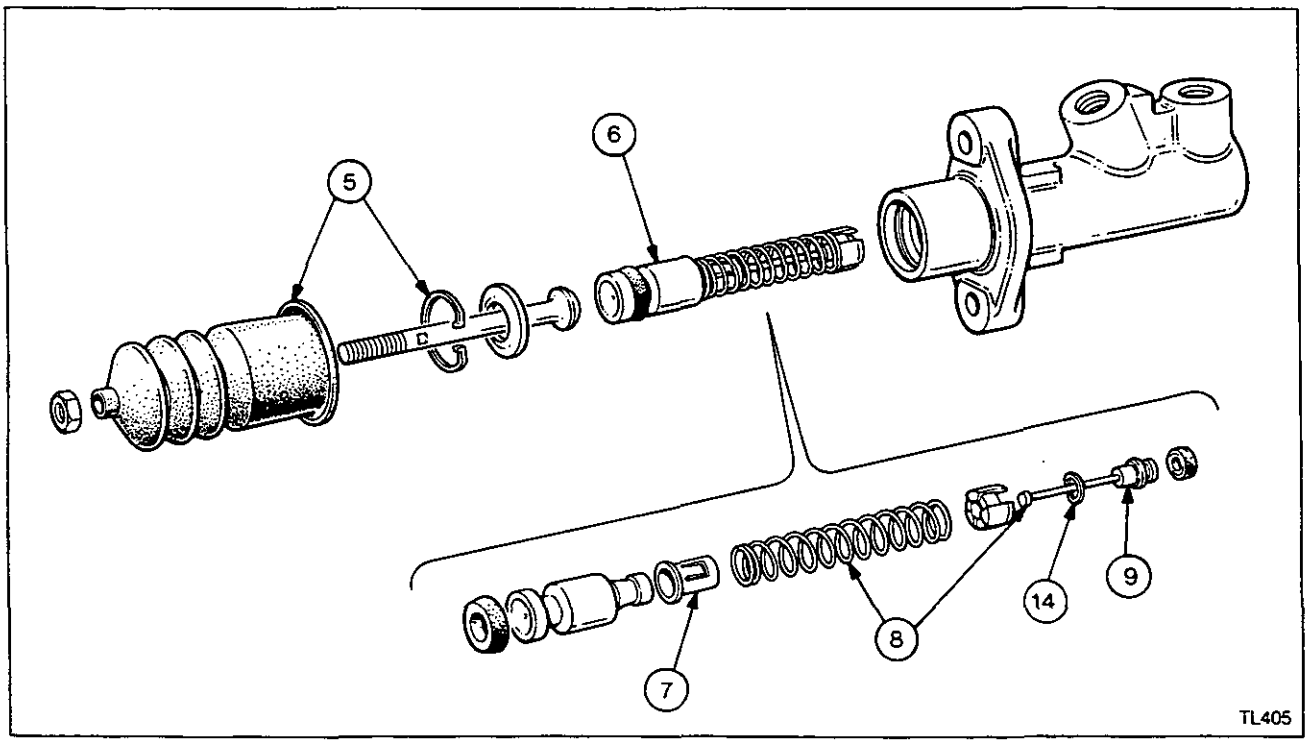
Brake Master Cylinder

Overhaul 8B-06

Disassembly

1. Disconnect the pipe work and oil reservoir from the master cylinder.
2. Unscrew the securing bolts holding the master cylinder to the bulkhead.
3. Disconnect the push rod from the foot pedal and remove the cylinder from its mounting.
4. Drain out any surplus fluid.
5. Pull back the rubber dust cover and remove the circlip with a pair of long-nosed pliers.
6. The plunger assembly can now be removed either by shaking the cylinder or by compressed air pressure.
7. Lift the leaf of the spring retainer and remove the spring assembly from the plunger.
8. Compress the spring to free the valve stem from the keyhole of the spring retainer, thus releasing the tension of the spring.
9. Remove the spring, valve spacer and spring washer from the valve stem and the valve seal from the valve head.





10. Select a small screw driver and round off and highly polish the end of the blade.

    Note: This is most important, for if the surface of the plunger is damaged in anyway, a new master cylinder must be fitted.

11. Squeeze the seal until the polished blade of the screw driver can be inserted then lever the seal as shown and remove from the plunger by pressing the seal off the plunger.

Inspection

If the seals are loose on the plungers and appear oversize suspect contamination. If contamination is suspected, the system must be thoroughly flushed out and all seals and hoses changed without delay.

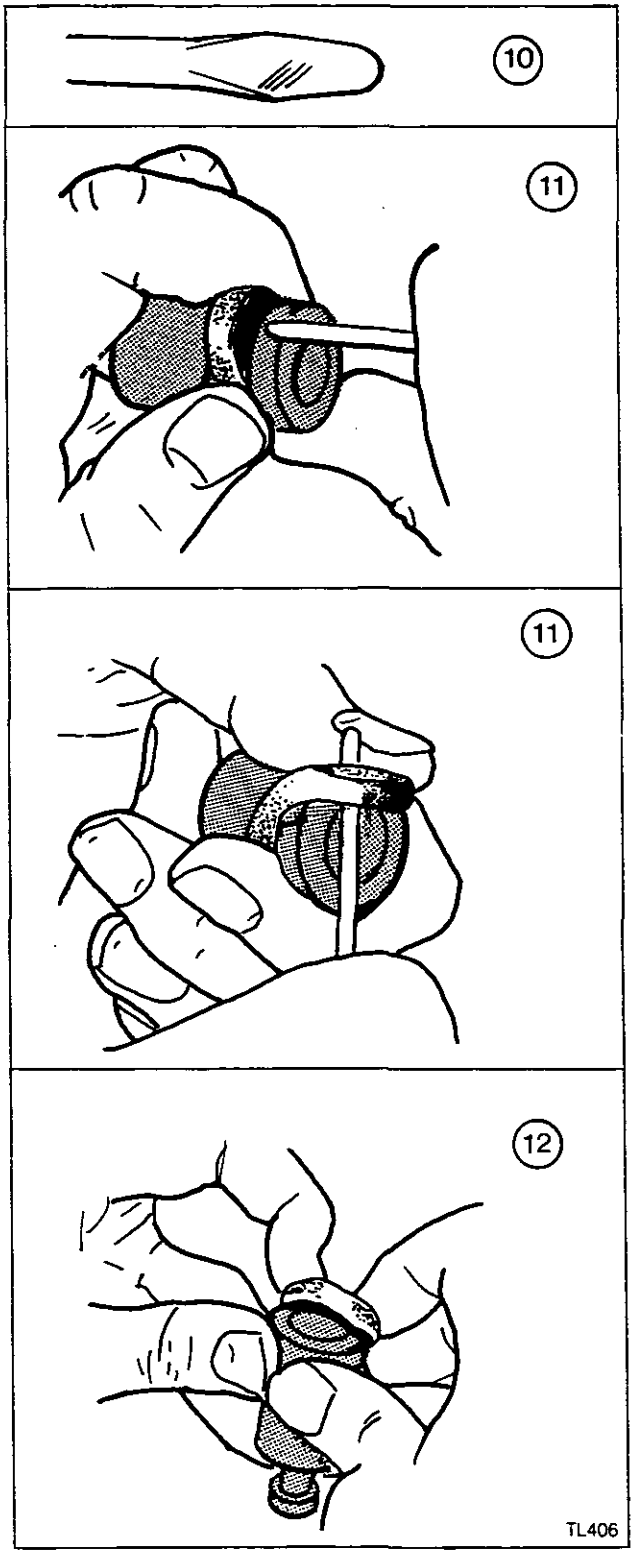
Comparison of the parts contained in the repair kit will indicate which parts must be discarded. Clean the remaining parts thoroughly with unused brake fluid and place them onto a clean sheet of paper.

Examine the plunger and cylinder bore for visible score marks, ridges and corrosion. Check that the bore is smooth to the touch. If there is the slightest doubt as to the condition of the part, a new master cylinder must be fitted. Inspect all other components to see that they are in good condition.

Reassembly

Warning: The brake system contains special synthetic rubber component requiring petroleum (mineral) based oil, use only the brake oil recommended in the specification part of this section.

12. Use the new parts from the repair kit when reassembling. Lubricate the inner diameter of the new plunger seal with unused brake fluid and fit the seal to the plunger as shown.
13. Fit the valve seal, smallest diameter leading, onto the valve head.
14. Position the spring washer on the valve stem so that it 'flares' away from the valve stem shoulder as illustrated.
15. Fit the valve spacer, legs first, and spring.
16. Fit the spring retainer to the spring and compress the spring until the valve stem passes through the keyhole in the spring retainer and engages in the centre.
17. Fit the spring sub-assembly immediately to the plunger and press home the leaf of the spring retainer to secure.
18. Liberally lubricate the plunger seal and cylinder bore with unused brake fluid.
19. Insert the plunger assembly fully into the cylinder, valve end leading, easing the entrance of the plunger seal.
20. Position the push rod and retaining washer and fit the circlip.
21. Smear the sealing areas of the rubber dust cover with rubber grease. The remainder of the grease in the repair kit should be used to pack the dust cover.



22. Position the dust cover on the cylinder body.
23. Reverse procedures 1 to 3.
24. Remove air from the system, see operation 8B-07.
25. Balance and adjust the brakes, see operation 8B-08.

Removing Air from the Brake System

Adjust 8B-07

Warning: The brake system contains special synthetic rubber component requiring petroleum (mineral) based oil, use only the brake oil recommended in the specification part of this section.

Due to the layout of the hydraulic system pipes, small pockets of air can form which will rise to the highest points in the system. Slow removal of the air and fluid will not purge the system although air will cease to come out with the fluid and give the appearance of complete purging.

To remove the air from this system, a high speed fluid flow which breaks up the air into minute bubbles which are carried out with the fluid is essential.

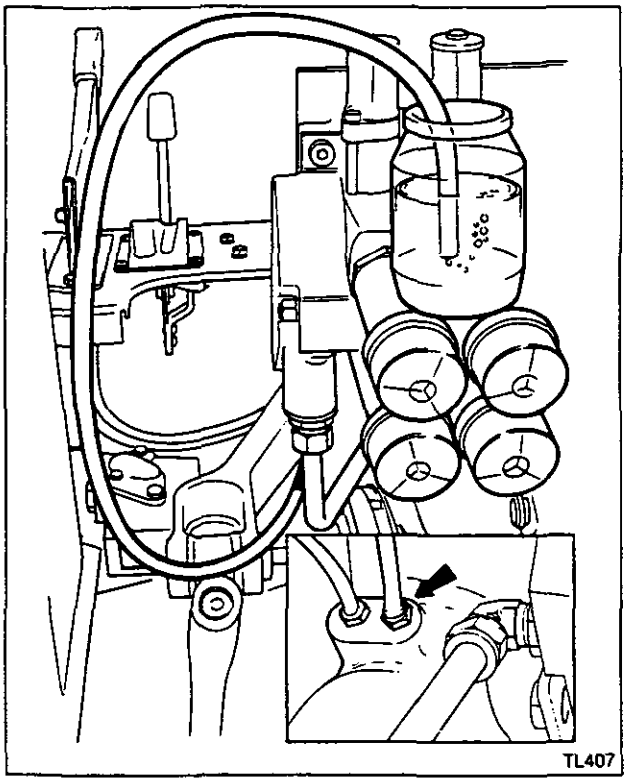
Where available, a proprietary pressurised or vacuum system should be used to remove the air from the system.

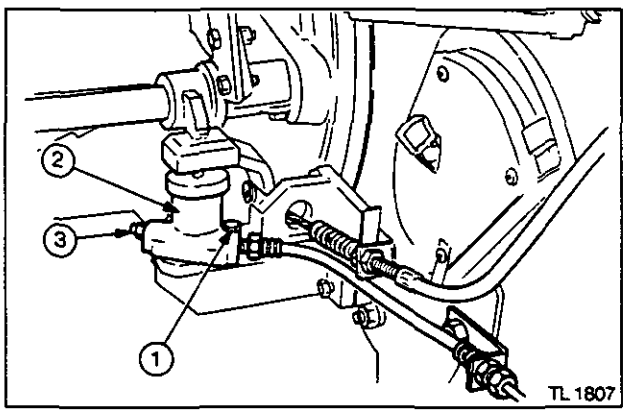
Where this is not available proceed as follows:-

1. If the tractor is fitted with a trailer brake valve remove the air from the left hand system by connecting the drain pipe to this valve and not the actuator.
2. Place a glass jar higher than the air vent screw on the brake actuator or trailer brake valve, to give a positive head of fluid to prevent air from being sucked in through the vent screw threads.
3. Fit a clear plastic tube from the vent screw and locate it in the bottom of the glass jar. A clear plastic tube of several metres length is helpful in showing the state of progress of the air removal.
4. Open the vent screw on the brake actuator and operate the pedal a few times until fluid in the jar covers the end of the tube then refill the reservoir.
5. Pump at the pedal quickly, without reaching the full pedal travel until the reservoir is nearly empty, then refill the reservoir with air-free fluid.
6. Repeat this cycle of operations until the clear tube confirms that no air remains. (Half a litre, or more, of fluid may have to pass through the system). The displaced fluid can be re-used after standing overnight provided that it is still clean and uncontaminated.
7. Close the vent screw. Check for sponginess by operating the pedal with the brake adjusting nut removed and the piston in the brake actuator against its circlip travel stop, not against the brake actuator lever.
8. On tractors manufactured from 1991 onwards with serial number prefix 'S', fitted with a 40 km/hr haulage gearbox. There is a balance pipe fitted between the two master cylinders close up to the bulkhead, this pipe ensures that both brakes are applied evenly. When removing air from the system it will be necessary to latch both the pedals together, and to carry out the above procedure to both brakes simultaneously to prevent the ingress of air.
9. Adjust and balance the brakes, see operation 8B-08.

M-F 340 tractor with drum brakes

On the M-F 340 tractor fitted with drum brakes, it will be noted that the brake slave cylinder vent screw is positioned





on the lower part of the cylinder. To ensure that all air is removed from the brake system the following procedure should be adopted:

1. Remove the two bolts securing the cylinder to the mounting bracket.
2. Remove the cylinder from the bracket, DO NOT disconnect the cylinder from the flexible pipe.
3. Hold the cylinder so that the vent screw is in the highest position so that any air trapped in the cylinder can escape.
4. Fit a clear plastic tube from the vent screw to a suitable container.
5. Remove the air in the normal manner as described in the previous section for internal brakes.
6. Close the vent screw and check for sponginess by operating the brake pedal.
7. Refit the brake cylinder, check all connections are tight, and readjust the brakes.

Brake Adjustment and Balancing

Adjust 8B–08

Brake Actuator

1. Ensure that all air is removed from the brake hydraulic system.
2. Disconnect the parking brake cable from the actuator.
3. Check that the return springs are fitted.
4. With the rear wheels clear of the ground screw up the adjustment nut on the pull rod until the brake has just locked and then back off to the condition where slight but perceptible drag is felt at the wheel, this will be approximately three flats of the nut.
5. Match this drag by adjusting the other brake. This will establish equality of adjustment.
6. The brake expander clearance is adjusted by unscrewing the adjuster nuts by the same amount. Number of flats back-off related to the number of friction plates fitted to one side of the axle, see table below:

Tractor model	No. of friction plates	Minimum No. of flats of nut back-off
M-F 340, 342	6	6
M-F 350,355, 360, 362	3	5
All other models	4	9

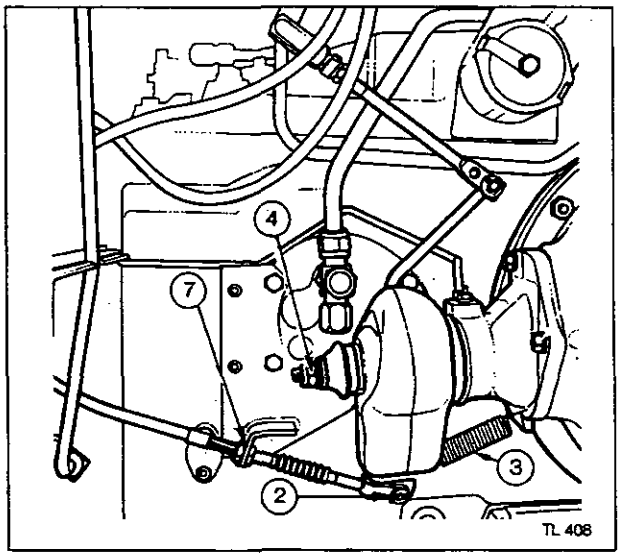
7. Re-connect the parking brake cable.

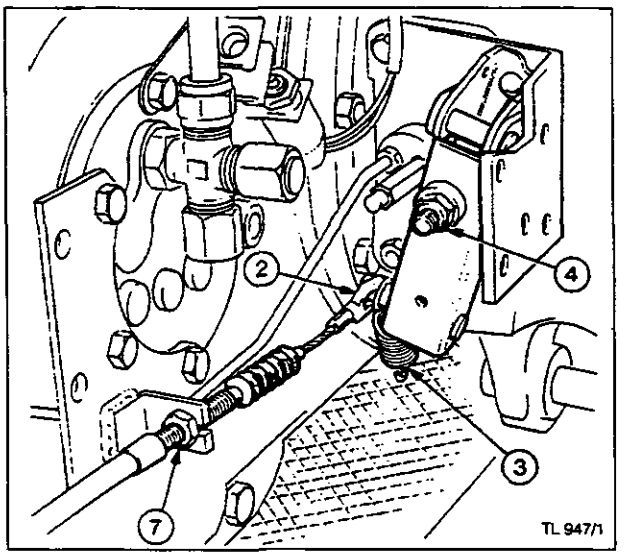
NOTE: On four wheel-drive tractors fitted with automatic four wheel drive engagement when the brakes are applied. It will be necessary to disconnect the electrical system.

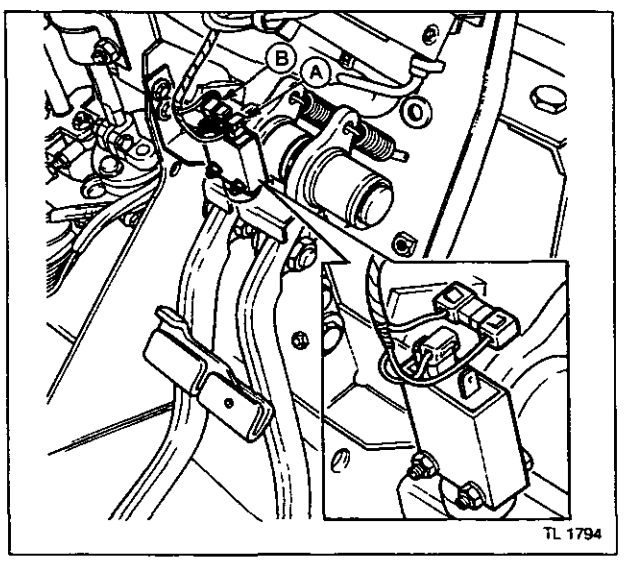
8. On tractors with automatic four wheel drive engagement remove the wire 'A' (light green) and wire 'B' (black/light green) from the brake switch mounted above the foot pedals and connect the two wires together. Switch the four wheel drive system OFF.

All models

9. Road test the tractor, check the brakes for binding or pulling to one side. Any tendency to pull to one side should be counteracted by slackening off the adjuster nut on the side to which the tractor pulls.
10. Finally, with the parking brake released, take-up any slack in the parking brake cable by turning the adjuster nuts (7). The brake should be fully applied when the hand lever has travelled no more than five clicks up the ratchet.
11. Re-connect the wires to the brake pedal switch if removed.



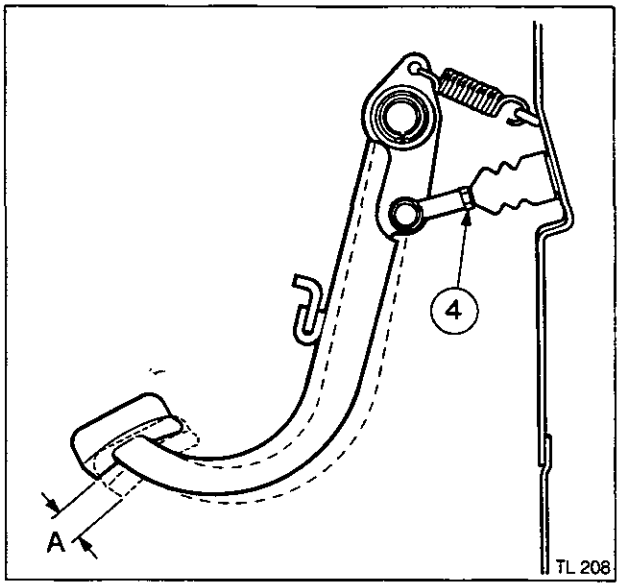




Pedal to Master Cylinder

1. Ensure that the pedals have free movement and that the return springs are fitted.
2. Check that both pedals are level and that the latch drops in, locking the two pedals together without fouling and forcing one of the pedals away from its stop position.
3. Ensure that both brake actuators are set correctly.
4. Adjust the push rods so that they are nearly, but not quite, contacting the master cylinder pistons inside the rubber covers. The clearance is 1 mm (0.040 in).

   This gap is inaccessable but it can be assumed as correct when the movement of the front end of the rod is just detectable to the fingers. The pedal travel 'A' should be approximately 5-10 mm (0.20-0.40 in).
5. Check that during operation of the brakes that both pedals remain level. If they don't, adjust the clearance of the higher pedal on the push rod.
6. Road test tractor and make final adjustments.



Trailer Brake Valve

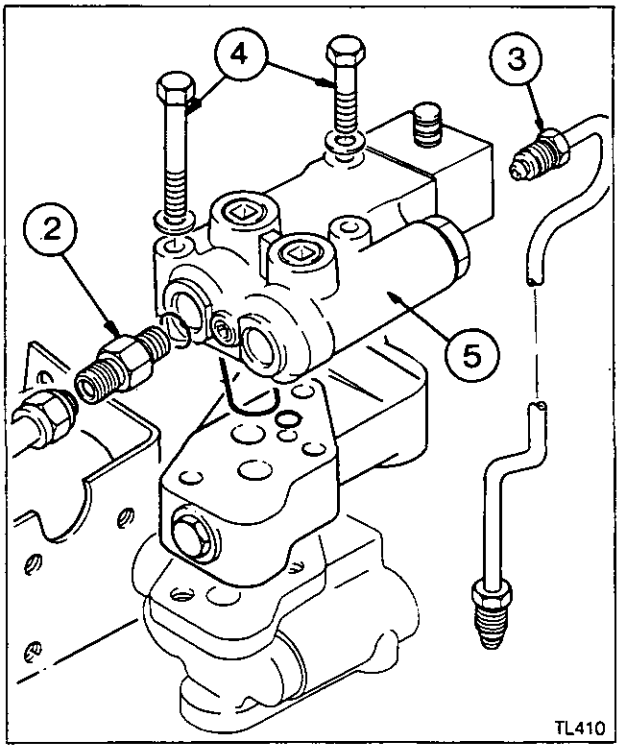
Removal and Refitment 8B-09

Removal

1. Clean the outside of the valve assembly.
2. Disconnect the hydraulic pipes and mask off the connections to prevent dirt ingress.
3. Disconnect the brake fluid pipe from the trailer brake valve and mask off the connections to prevent dirt ingress.
4. Remove the bolts.
5. Remove the trailer brake valve.

Refitment

6. Reverse procedures 1 to 5.
7. Tighten bolts to a torque of 21-24 Nm (15-18 lbf ft).
8. Remove the dust cap.
9. Remove the air from the spool valve pilot circuit by means of the screw.
10. Remove the air from the brake system, see operation 8B-07.



Trailer Brake Valve

Overhaul 8B-10

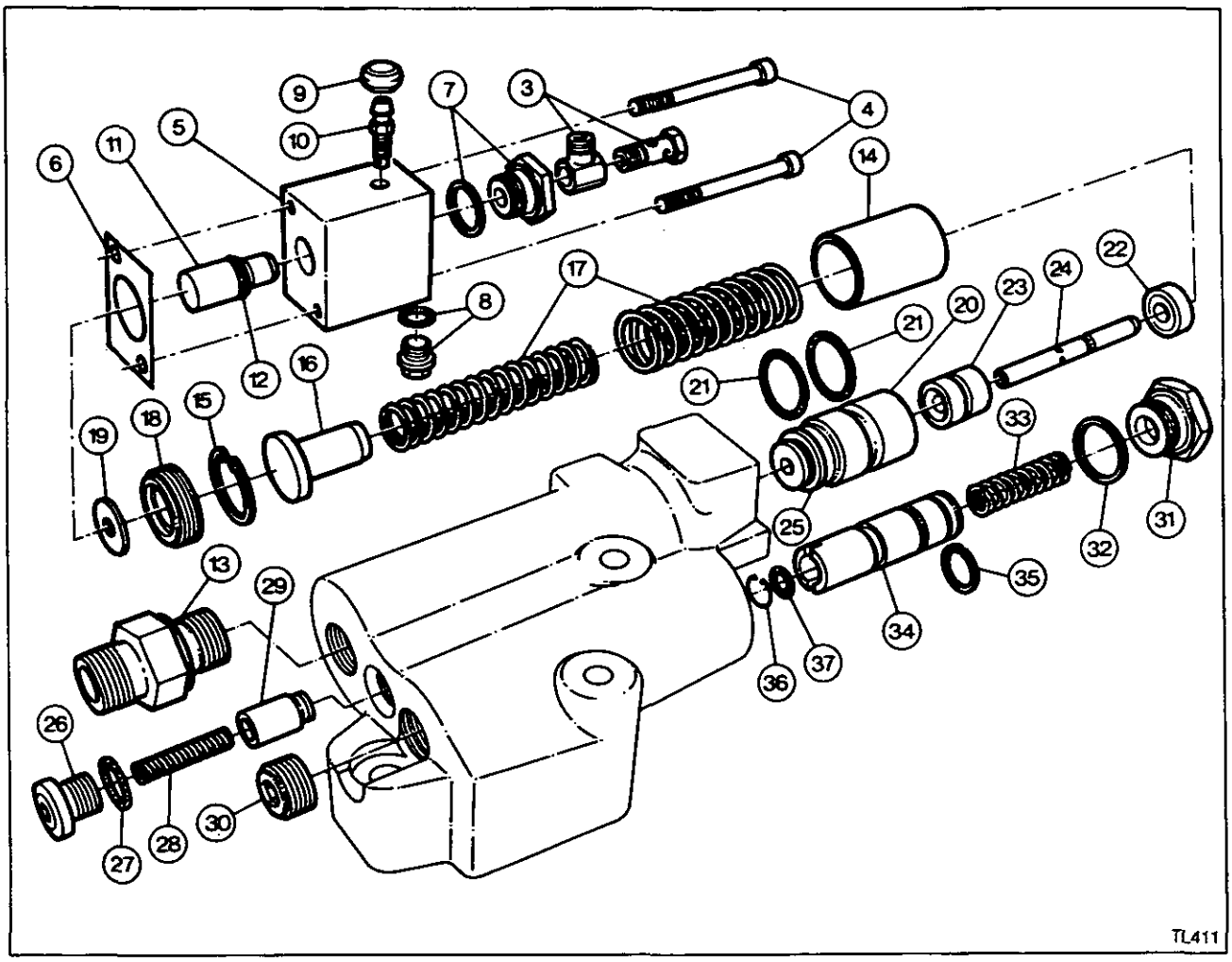
Before disassembling the trailer brake valve, check the trailer braking effort, see operation 8B-11.

Disassembly

1. Remove the trailer brake spool valve, see operation 8B-09.
2. Remove the three 'O' rings from the base of the valve.
3. Remove the union.
4. Remove the two hexagon socket screws.
5. Remove the pilot flow housing.
6. Remove and discard the gasket.
7. Remove the connector nut and its seal.
8. Remove the plug and its seal.
9. Remove the cap.
10. Remove the bleed screw.
11. Remove the piston.
12. Remove and discard the seal.
13. Remove the union.
14. Remove the housing.

Note: Use a press and take the necessary precautions when removing the two powerful springs contained in the housing.

15. Remove the circlip.
16. Remove the seat.
17. Remove the two springs.
18. Using a pipe union and a suitable socket, remove the hexagon socket screw.
19. Remove the washer.
20. Remove the spool valve assembly.
21. Remove the two 'O' rings from the valve body.
22. Remove the seal.
23. Remove the piston.
24. Remove the spool.
25. Remove the 'O' ring.
26. Remove the plug.
27. Remove the 'O' ring.



28. Remove the spring.
29. Remove the valve.
30. Remove the tapered plug.
31. Remove the plug.
32. Remove the seal.
33. Remove the spring.
34. Remove the spool.
35. Remove the circlip.
36. Remove the inner circlip.
37. Remove the washer, which has a calibrated hole.
38. Thoroughly clean all the components and dry with compressed air. Make sure that the machined parts in the various components are not blocked. Inspect the components for sign of wear, corrosion and scoring and replace all seals.

Reassembly

39. Lubricate all the components with clean oil.
40. Reverse procedures 1 to 37.

Trailer Brake Valve Test Procedure

Check 8B-11

Special tools: MF 3001 Pressure test kit

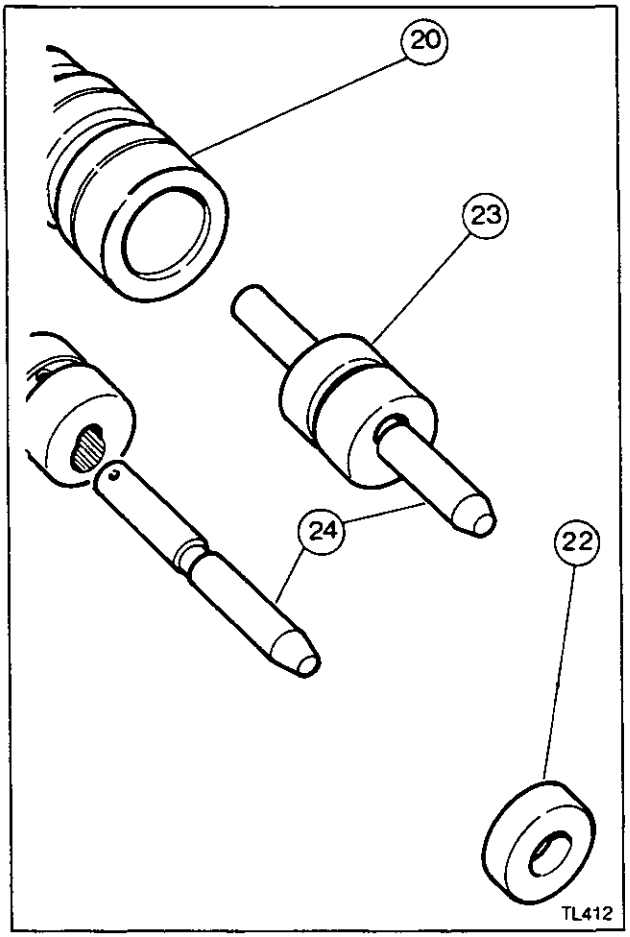
1. Balance the brake linkage.
2. Attach pressure test equipment to the trailer brake outlet coupling.

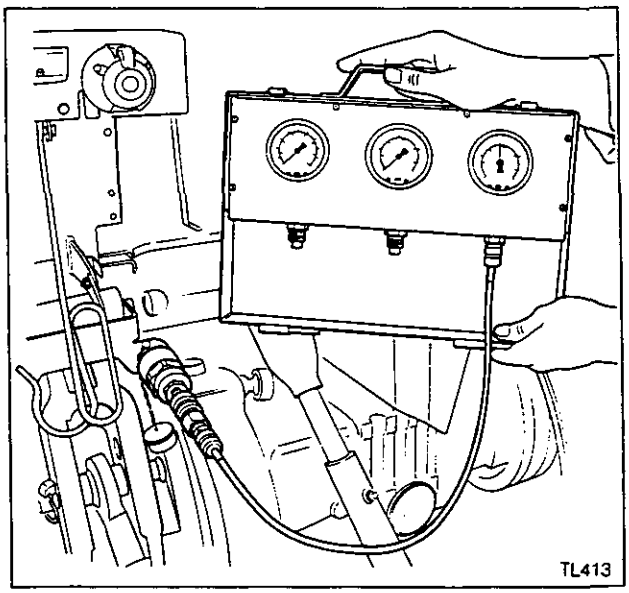
Note: The pressure gauge should have a 0-300 bar (0-4000 lbf/in^2) reading.

3. Start the tractor and set the engine to 1200 rev/min.
4. Unlatch the brake pedals.
5. From the seat press the left-hand pedal fully. Pressure in the trailer will build up to the maximum pressure of 120 to 150 bar (1740 to 2175 lbf/in^2).

Note: With the engine running and the brake pedal(s) depressed a rythmic oscillation of the pedal may be felt. This is due to pressure equalisation of the valve and is quite normal.

6. Latch the pedals together.
7. From the seat depress both pedals. Minimum pressure of 120 bar (1740 lbf/in^2) should be obtained from the coupler.
8. If 120 bar (1740 lbf/in^2) is not obtained, the brake pedals need equalising. Check the master cylinder push rod and brake adjustment.
9. If the required pressure is not obtained at the coupler carry out a test on the hydraulic systems, pressure and flow before taking apart or replacing the trailer brake valve, see section 12B.





Brake Actuator Assembly

Removal and Refitment 8B-12

Special Tools: MF 467 Brake pull rod seal protector

Tractor serial No. V39466 on.

Removal

1. Drain the transmission oil to below the MIN mark on the dipstick.
2. Disconnect the parking brake cable.
3. Remove the return spring.
4. Remove the brake adjusting nut, spherical washer and plastic sleeve.

Left-hand brake

5. Remove pipes, fittings, auxiliary hydraulic manifold and trailer brake valve as necessary.

Right-hand brake

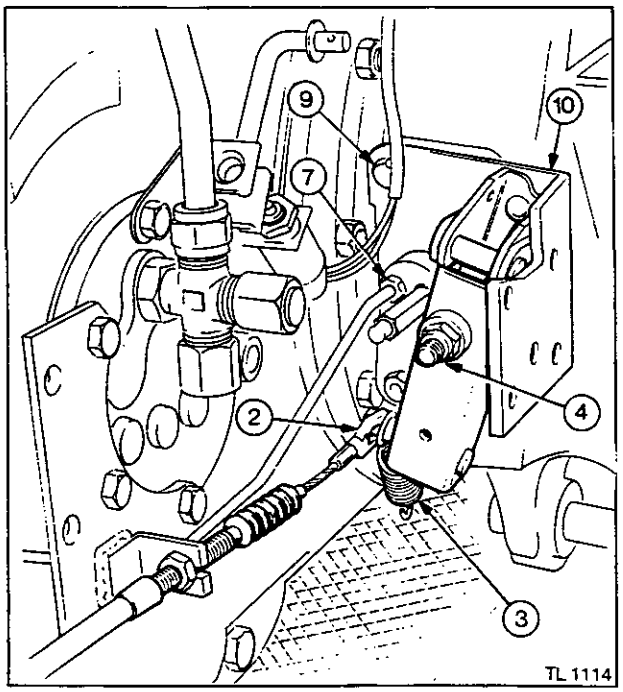
6. Disconnect and remove the differential lock mechanism.

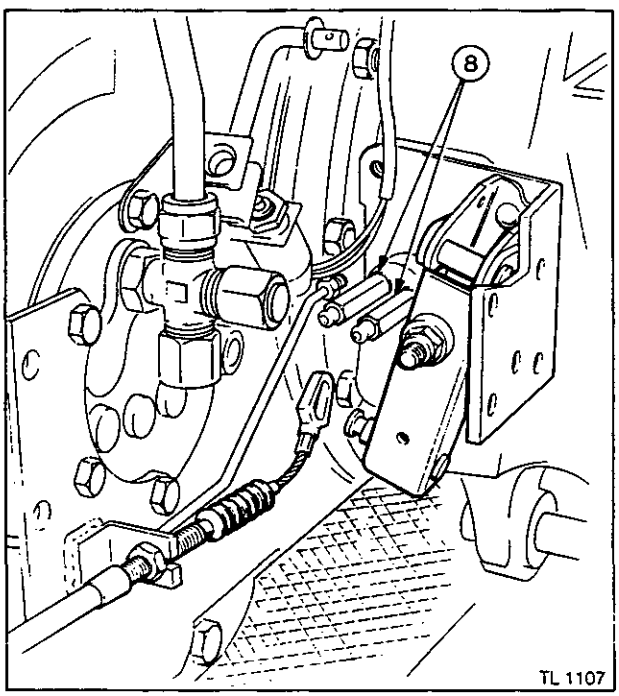
Either side:

7. Disconnect the hydraulic brake pipe and drain the fluid into a clean tin. Mask or plug the pipe to prevent dirt ingress.
8. Screw another bleed nipple (M-F part number 1694 259 M1) into the brake pipe port and tighten. The maximum tightening torque for the bleedscrew is 19 Nm (14 lbf ft). Check that the other bleed nipple is tight. This is to prevent the slave cylinder pistons being forced out of the brake cylinder by the internal spring when being removed from the trumpet housing.
9. Remove the three bolts securing the actuator to the trumpet housing.
10. Carefully slide the actuator forward off the adjusting rod taking care not to damage the rubber seal on the thread of the adjusting rod.

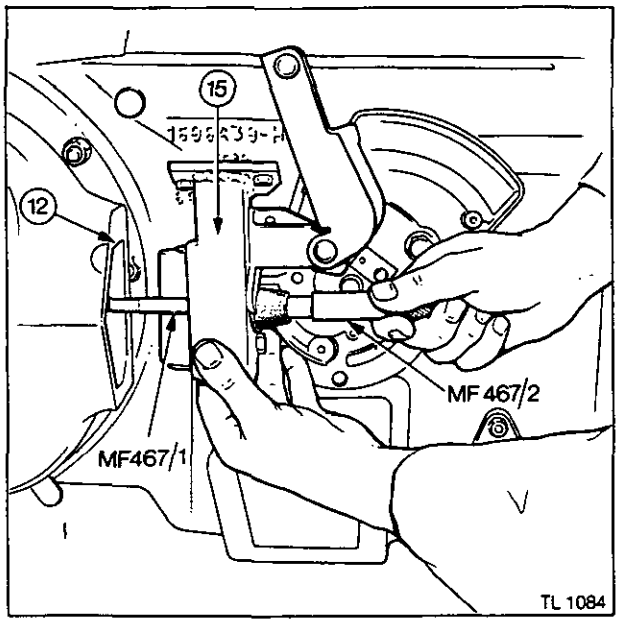
Refitment

11. Observe the following points:
    a. Ensure that the face of the mounting bracket and the trumpet housing are clean and flat.
    b. Ensure that the rubber seal on the actuator is not damaged internally and that the wrap spring is fitted.
    c. Ensure that the brake pull rod is clean and that the thread is not damaged.
    d. Always use a new nyloc nut on the brake adjusting rod.





12. Coat the bolting face of the trumpet housing with Loctite 518 (Powerpart No. 3405 396 M1).
13. Fit two bleed nipples to the brake slave cylinder and tighten one. Press the two slave cylinder pistons right into the cylinder and tighten the second nipple to retain the piston in place.
14. Slide the guide pilot MF467/1 over the thread of the pull rod so as not to damage the rubber seal when refitting.
15. Slide the actuator assembly onto the guide pilot, push the rubber seal and the actuator assembly down the pilot with the sleeve MF467/2. Ease the slave cylinder into the jaws of the expander unit, at the same time pushing the seal off the end of the guide pilot. The rubber seal is now correctly positioned.
16. Remove MF467/1 and 2, refit the three retaining bolts, tighten to a torque of 12-16 Nm (9-12 lbf ft).
17. Remove the bleed nipple from the pipe port in the slave cylinder.
18. Reverse procedures 1 to 7.
19. Remove air from the brake system in accordance with operation 8B-07.
20. Balance and adjust the foot and parking brake in accordance with operation 8B-08.



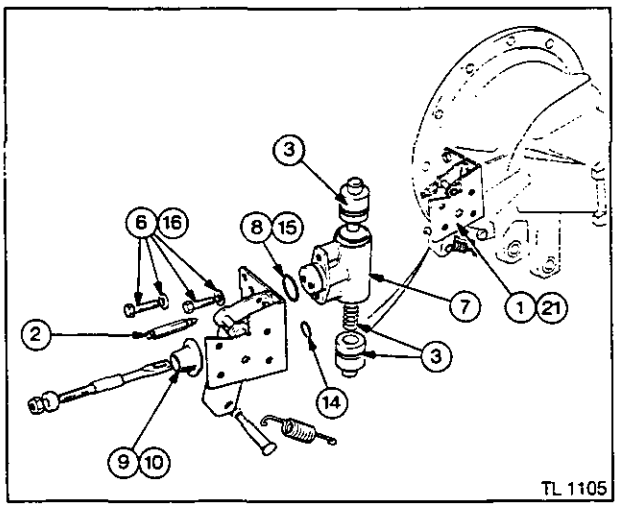
Brake Slave Cylinder

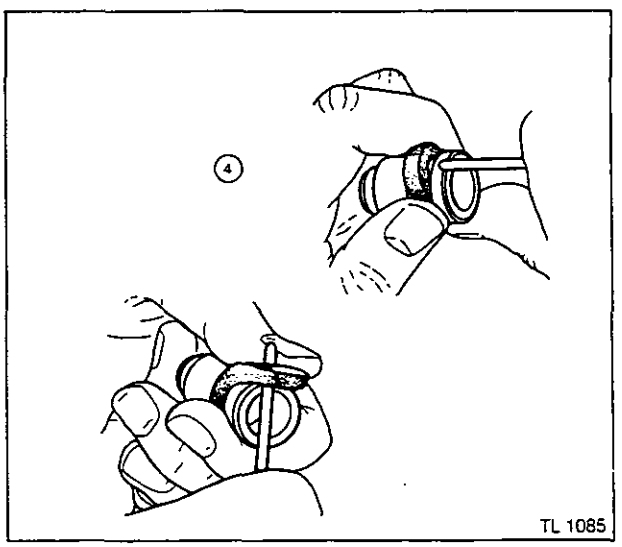
Overhaul	8B-13

Tractor serial No. V39466 on.

Disassembly

1. Remove the brake actuator, see operation 8B-12.
2. Unscrew one of the air bleed nipples allowing air into the cylinder, this will release the pistons in the slave cylinder.
3. Remove the pistons and spring from the bore of the slave cylinder.
4. Remove the seals from the pistons using a screwdriver, the tip of which has been rounded and polished to avoid scratching the piston seal groove.
6. Remove the two setcrews securing the slave cylinder to the mounting bracket.
7. Remove the slave cylinder.
8. Remove the 'O' ring seal from the cylinder turret.
9. Carefully drift the rubber seal from the mounting bracket. Avoid damage to the bracket.





Cleaning and Inspection

Thoroughly clean all parts by washing in a suitable fluid and drying with compressed air. Inspect the inside of the cylinder bore and the piston for any signs of scoring, abrasion or corrosion. No attempt must be made to clean up damaged or corroded parts.

Examine the operating lever and the bracket for signs of damage or wear. Pay particular attention to the pivot pin. The surface that bolts to the axle housing must be flat across its mounting face to ensure a good seal.

Ensure that the threads on the pull rod are undamaged and that the face of the spherical bearing is not worn or pitted.

Discard the rubber seal and nyloc nut, replace any worn components.

Reassembly

10. Fit the new 'O' ring seal to the slave cylinder turret. Ensure that it is correctly located in its groove.
11. Assemble the slave cylinder to the mounting bracket.
12. Fit the wrap spring into its groove on the underside of the rubber seal.
13. Coat the sealing face of the rubber seal with 'Hylosil' sealant.
14. Locate the seal in the mounting bracket.
15. Fit the clip from the service kit to retain the seal, secure it and the cylinder with the setscrews and two new gaskets.
16. Tighten the setscrews to a torque of 23-29 Nm (17-21 lbf ft).

Note: The flange of the rubber seal must lay flat on the face of the mounting plate.

17. Lubricate the inside of the slave cylinder, piston and seals with a mineral type brake fluid.
18. Fit the new seals from the service kit to the pistons taking care not to damage the seal lips.

Note: The lip of the seal must face the narrow land on the piston.

19. Ease the two piston and seal assemblies into the cylinder with the piston with the male locating spigot at the top, and the spring between the two pistons.
20. Press the two pistons fully into the cylinder, fit two bleed nipples into the ports and tighten (Max torque 19 Nm (14 lbf ft). This will hold the pistons in so that the cylinder will fit into the jaws of the expander unit.
21. Refit the brake actuator, see operation 8B-12.

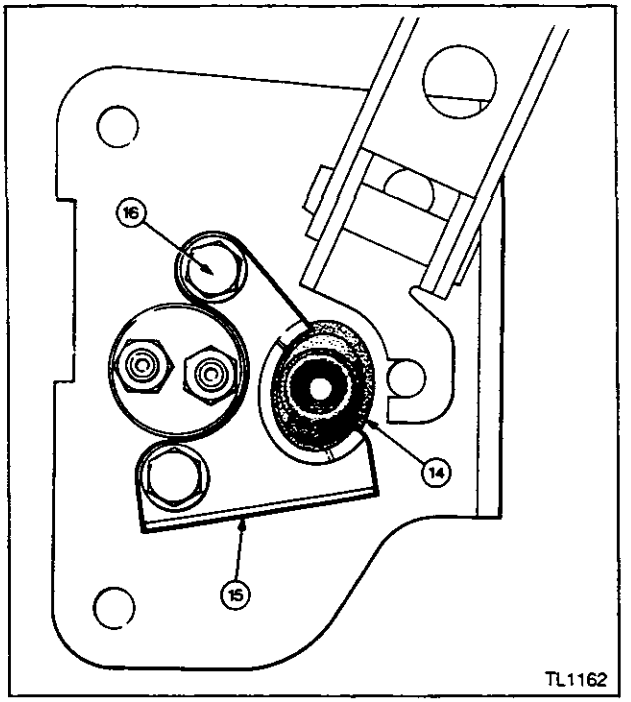
Seal Replacement

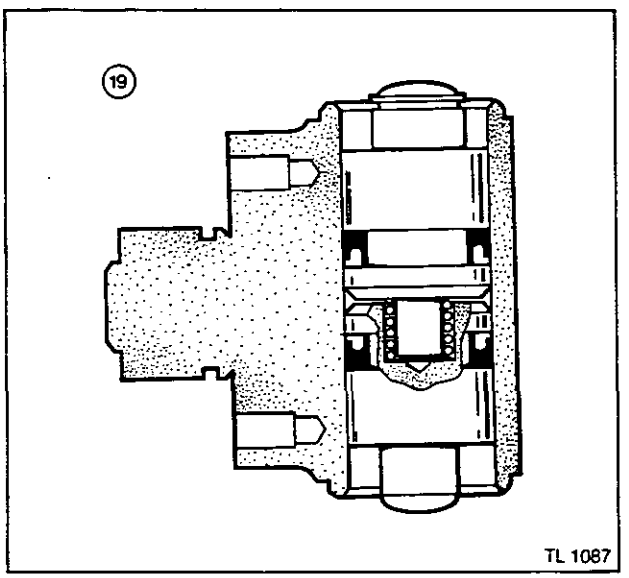
Note: The rubber seal on the brake pull rod can be replaced without removing the brake actuator assembly from the tractor as follows:

1. Disconnect the parking brake.
2. Remove the nyloc nut, spherical bearing and plastic sleeve.
3. Swing the lever up vertically.
4. With a screwdriver carefully drift the rubber seal from the mounting bracket.

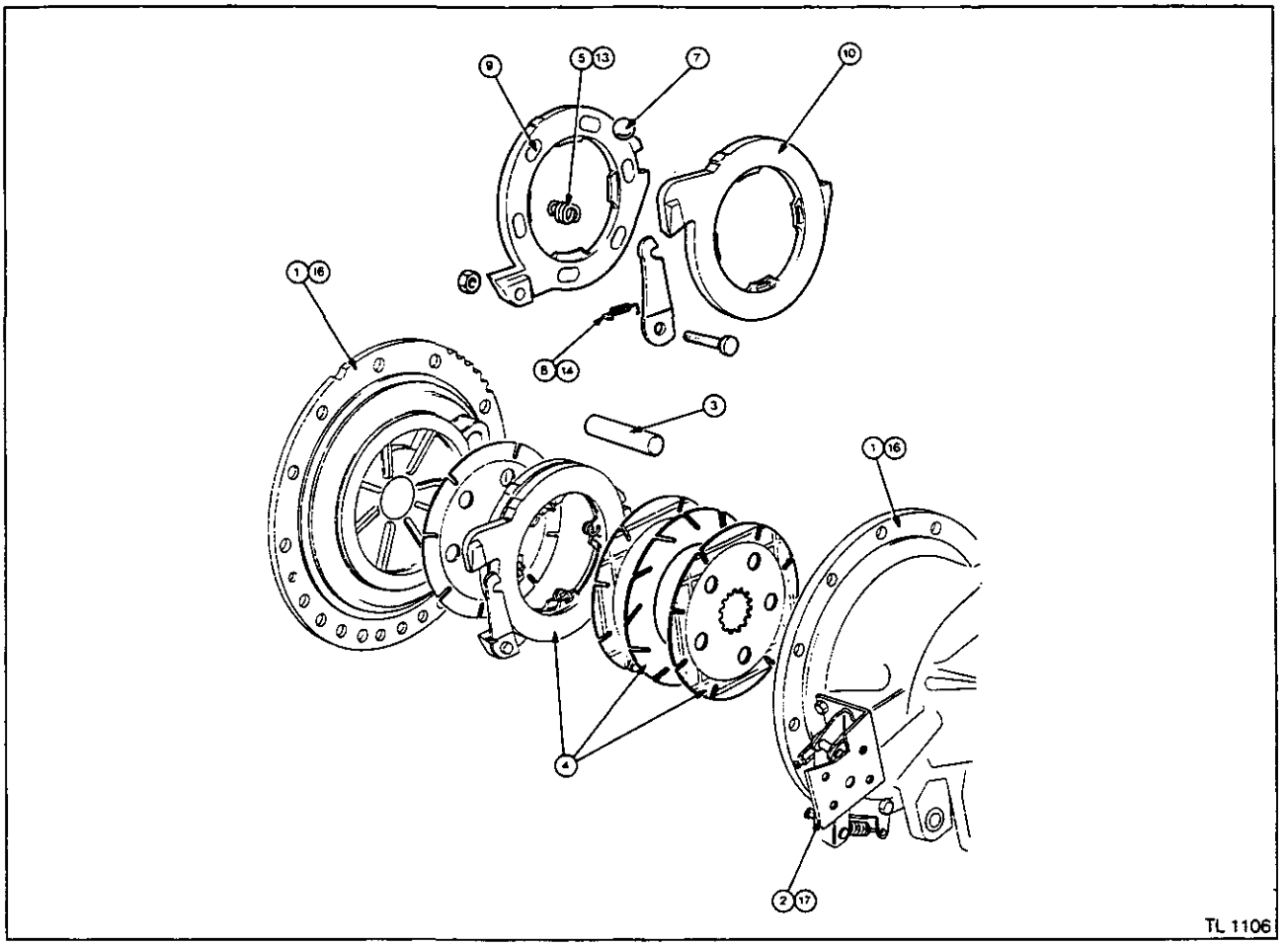
Caution: DO NOT damage the face of the mounting bracket, otherwise the seal will leak.

5. Fit the wrap spring into its groove on the inside of the seal.





6. Coat the sealing face of the rubber seal with 'Hylosil' sealant.
7. Using MF 467 brake pull rod seal protector, push the seal down the pull rod and into the mounting bracket. (See illustration on page 8B-17)
8. Remove the two setscrews and fit the clip supplied in the service kit to hold the seal in place.
9. Secure the clip and internal cylinder with the two setscrews and new gaskets. Tighten the setscrews to a torque of 23-29 Nm (17-21 lbf ft).
10. Reverse procedure 1 to 3.
11. Adjust the brakes, see operation 8B-08.



Right and Left-Hand Brakes

Removal and Refitment 8B-14

Tractor serial No. V39466 on.

Removal

1. Remove the trumpet housing and carrier plate, see operation 8A–07.
2. Remove the brake actuator, see operation 8B-12.
3. Remove the brake stop rod from the housing.
4. Remove the brake components, turning each plate over and stacking in reverse order to ensure correct refitment.
5. Release the four springs.
6. Remove the pull rod.
7. Remove the balls.
8. Remove the bellcrank return spring.

Examination

Friction plates:
These have a minimum groove depth of 0,3 mm (0.012 in) when new. When the grooves begin to disappear, the plates must be replaced. Ensure that the splines are not duly worn. Check that the discs slide easily over the length of the spline.

Steel plates:
The steel plates can generally be refitted, but should be replaced either when badly scored or worn more than 0,13 mm (0.005 in) per face. The steel plates should also be replaced when the friction plates are renewed.

Check all plates for signs of severe overheating or distortion.

Note: Never attempt to reclaim friction plates or steel plates by lapping or grinding.

Expander plates:
The expander plates do not normally need replacing, but should be checked for severe scoring.

Ensure that the threads on the pull rod are undamaged and that the slot in the opposite end shows no sign of excessive wear.

Thoroughly clean out the brake housing and remove any burrs.

Refitment

9. If dismantled, lay one expander plate down with the ball seats uppermost and place the balls in their seats.
10. Lay the other expander plate on top, ball seats downwards and with the lug on which the slave cylinder operates above the corresponding lug on the other plate. The illustration on previous page shows the correct assembly for the left-hand brake. The right-hand side will be the opposite hand.
11. Ensure that the balls are seated in the uppermost expander plate and both plates will then be correctly located in relation to one another.
12. Attach the pull rod to the bellcrank.
13. Hook on new pull-off springs.
14. Fit a new bellcrank return spring to the expander assembly. To do this hook it onto the expander casting, twist then hook the other end over the bellcrank lever.
15. Reverse procedures 1 to 4 except:
    a. Dip each friction plate, steel plate and expander unit in clean transmission oil before fitting them into the housing. IT IS VERY IMPORTANT to refit all plates in order in which they were originally assembled.
    b. If the brake plates have been mixed up or are being replaced, they are fitted into the trumpet housing in the following order:

M-F 340, 342 tractors	M-F 350, 355, 360, 362 tractors	All other models
6 friction discs per half axle	3 friction discs per half axle	4 friction discs per half axle
Friction plate Steel plate Friction plate **Expander unit** Friction plate Steel plate Friction plate Steel plate Friction plate Steel plate Friction plate **Carrier plate**	Friction plate Steel plate Friction plate **Expander unit** Friction plate **Carrier plate**	Friction plate Steel plate Friction plate **Expander unit** Friction plate Steel plate Friction plate **Carrier plate**

    c. Fit the expander unit to the axle with the pull rod and bellcrank facing towards the tractor wheel.
    d. Check that the small return spring is fitted between the bellcrank and the expander plate.
16. Refit the trumpet housing and carrier plate, see operation 8A-07.
17. Refit the brake actuator, see operation 8B-12.
18. Remove the air from the system, see operation 8B-07.
19. Adjust the brakes, see operation 8B-08.

Drum Brake

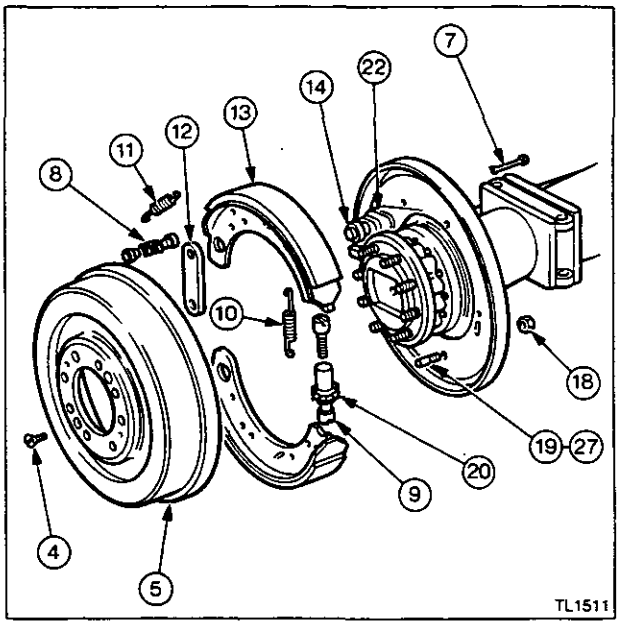
Removal and Replacement 8B-15

Removal

1. Jack up the tractor.
2. Remove the rear wheel.
3. Slacken-off the brake adjustment.
4. Remove the two countersunk screws.
5. Remove the brake drum.
6. Release the parking brake cable from the brake camshaft lever.
7. Remove the shoe hold-down spring assemblies, grip the pin with a pair of pliers.
8. Simultaneously, press and turn the dished washer until released, then remove the two washers and the spring. Repeat this procedure for the four sets of fixings.
9. Force apart the brake shoes at the adjuster end to allow the adjuster to drop out of position.
10. Remove the spring.
11. Remove the two springs by levering with a screwdriver between the springs and the anchor plate.
12. Remove the anchor plate.
13. Lift off the two brake shoes.
14. Remove the two spacer washers.
15. Clean off all parts, ensure that the adjuster threads are free to rotate.

Refitment

16. Lightly smear both ends of the new brake shoes and the flat end of the camshaft with Girling White Brake Grease.
17. Reverse procedures 6 to 14 except:
    a. To facilitate refitment of the springs, use a length of wire looped around the hook of the spring and pull the spring over the anchor pin.
    b. Ensure that the adjuster is fitted with the star wheel adjacent to the adjusting hole in the back plate.
18. Slacken the steady post nuts.
19. Screw the steady post well into the back plate.
20. Turn the adjuster to the fully 'off' position.
21. Refit the brake drum and secure it with the two countersunk screws.
22. Slacken the anchor pin nuts.
23. Using the adjuster, expand the brake shoes, then tap the anchor pin nuts to ensure that the shoes are seating correctly.



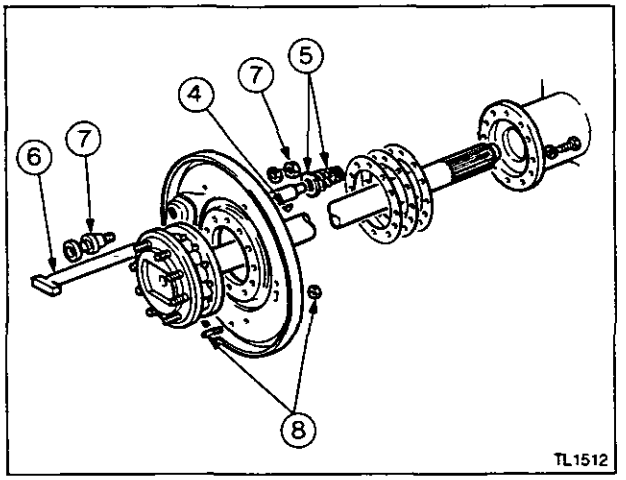
24. Repeat this procedure until the adjuster cannot be tightened any further.
25. Coat the threads of the anchor pins with grease and tighten to a torque of 200 Nm (150 lbf ft).
26. Slacken off the adjuster, remove the two countersunk screws and remove the brake drum.
27. Screw in the steady posts until they touch the brake shoe webs, then secure the posts with the nuts.
28. Refit the brake drum and secure it with the two countersunk screws.
29. Reconnect the parking brake cable.
30. Refit the rear wheel and tighten the nuts, progressively, and evenly to a torque of 270 Nm (200 lbf ft).
31. Adjust the brakes, see operation 8B-19

Drum Brake

Overhaul 8B-16

Disassembly

1. Dismantle the brake, see operation 8B-15.
2. Remove the axle shaft and brake assembly, see operation 8A-07.
3. Unscrew the grub screw in the camshaft lever.
4. Remove the camshaft lever and woodruff key.
5. Slide the washer and conical spring off the camshaft.
6. Remove the camshaft.
7. Remove the anchor pins, spring washers and nuts.
8. Remove the steady posts and nuts.



Examination

Clean and inspect all components, any showing signs of excess wear or damage must be replaced. Ensure that all threads are clean and free to turn, coat with Girling White Brake Grease.

Reassembly

9. Reverse procedure 1 to 8 except:
   a. Refit the washer first, then the conical spring (large diameter towards the back plate). Half compress the spring to load the camshaft.
   b. Position the brake lever on the camshaft with 6 mm (1/4 in) clearance from the trumpet housing. Tighten the grubscrew to a torque of 1,4-3,4 Nm (12-30 lbf in)
   c. Refit the anchor pins, spring washers and nuts but do not tighten until resetting the brakes.
   d. Refit the steady posts and nuts but do not adjust and tighten until the brakes are set.

Brake shoe relining

Overhaul 8B-17

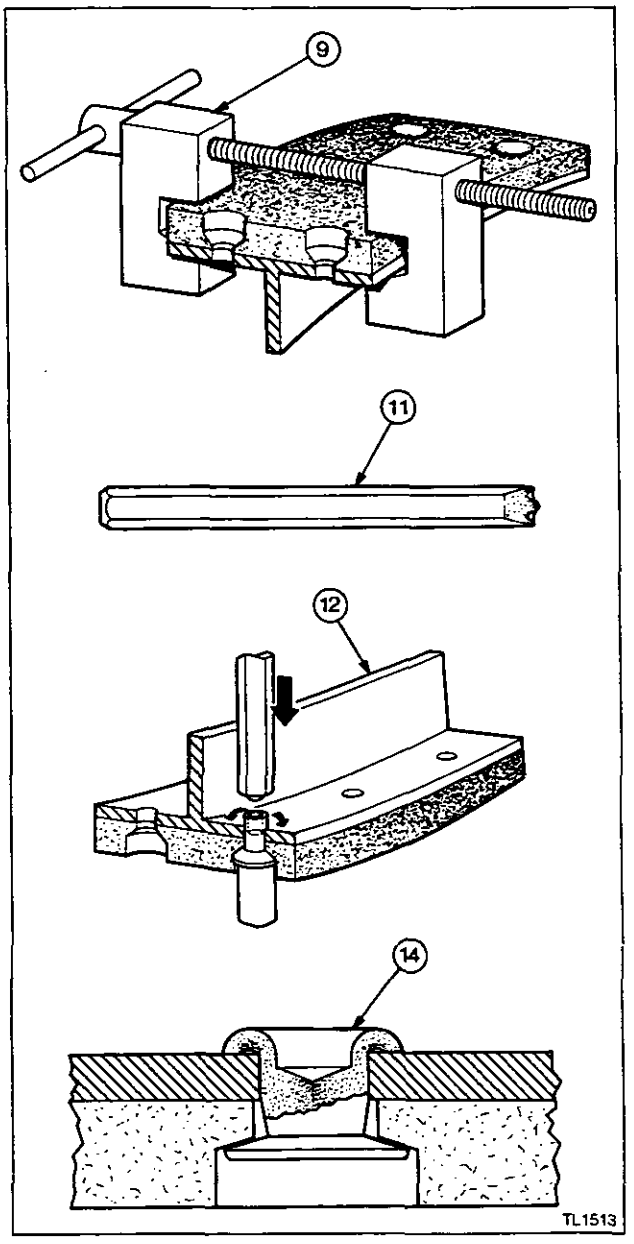
Special Tools:
Brake lining clamp (Qty 2)
Brake riveting anvil
Brake riveting punch

Disassembly

Caution: it is permissible to reline the brake shoes when genuine replacement shoes are not available, but it must be stressed that it is advisable to use genuine parts whenever possible.

Warning: The brake shoe lining may contain asbestos. Breathing asbestos dust is dangerous to your health, the following precautions listed below must be observed:

*** Work out doors or in a well ventilated area.**



*** Dust found when working on brakes must be removed by extraction and NOT by blowing.**

*** Dust waste should be dampened, placed in a sealed container and marked to ensure safe disposal.**

*** If any cutting, drilling etc. is attempted on the brake linings they must be dampened and only hand tools or low speed power tools used.**

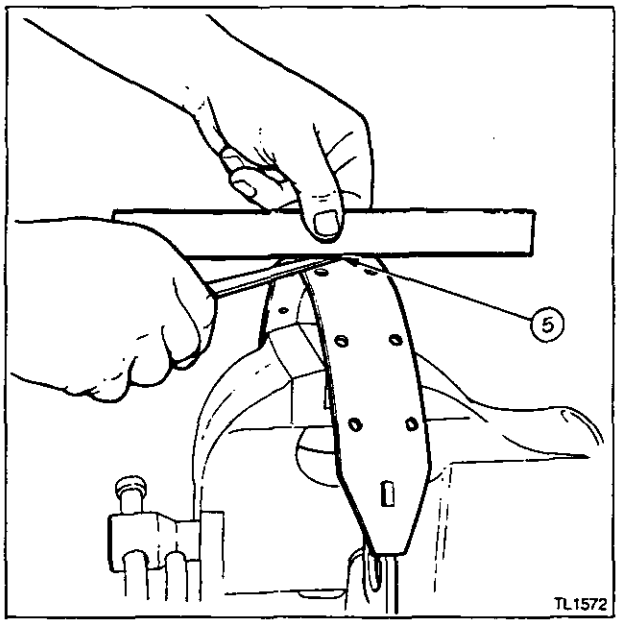
1. Remove the brake shoes, see operation 8B-15.
2. To remove the bonded linings from the shoes use one of the following methods:
   a. Place the brake shoes in an oven and heat to 600°C (1112°F); after about 15 minutes at this temperature the old linings will drop off.
   b. Manual stripping involves the use of a hammer and suitably sharp chisel to remove the lining and as much of the bond film as possible; abrasive methods (flexible belt, disc sander or hand sanding) must then be used to remove the remainder of the bond film, but taking great care to preserve the profile of the shoe platform. Eye protection and exhaust ventilation must be used.
3. Thoroughly clean the brake shoes, paying particular attention to the lining contact surface.
4. Ensure that all of the drillings are clear.
5. Check the concavety of the shoe platform. Place a straight edge across the shoe and with a feeler gauge check the gap in the centre of the shoe, it should not exceed 0,25 mm (0.010 in).
6. Paint the shoes with a quick drying black paint to prevent corrosion.

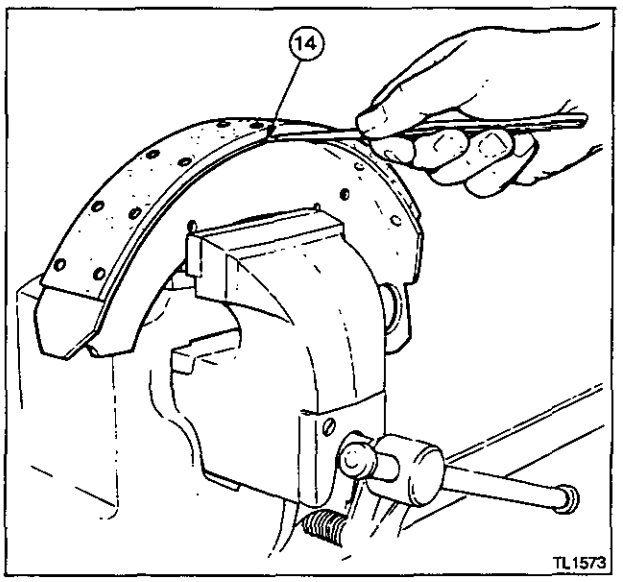
Reassembly

7. The shoes and linings are predrilled and do not require any preparation. Offer up the lining to the brake shoe and align the holes.
8. Locate the lining on the brake shoe by inserting two rivets at the centre of the lining.
9. Place the clamps each side of the two rivets and tighten them securely.
10. Select an anvil of the correct size, a little smaller than the counterbore in the lining.
11. For semi-tubular rivets it is important that a rim punch is used as shown in the illustration.
12. Using a hammer of moderate size and brake rivet punch clench up the rivet by using a series of taps, not by means of only one or two very heavy impacts which might cause damage to the lining.
13. Working alternately from the centre of the brake shoe, move the clamps, insert the rivets and secure them in position.
14. When the rivet is correctly fitted, it should fill the hole in the lining and the shoe and the tubular part of the rivet rolled over as shown in the illustration.

Note: The gap between the brake shoe and the lining must not exceed 0,1 mm (0.004 in).

15. Refit the brake shoes, see operation 8B-15.





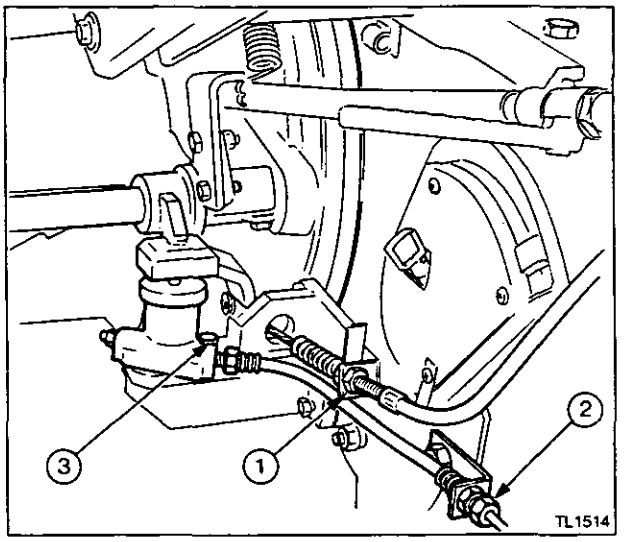
Drum Brake Slave Cylinder

Overhaul 8B-18

Disassembly

Warning: The brake system contains special synthetic rubber components requiring petroleum (mineral) based oil, use only the brake oil recommended in the specification part of this section.

1. Slacken-off the parking brake adjustment.
2. Disconnect the hydraulic brake pipe. Seal the end of the pipe to prevent the ingress of dirt.
3. Remove the two bolts securing the cylinder to the mounting bracket.
4. Remove the plunger from the cylinder.
5. Remove the rubber dust cover.
6. Remove the spring clip.
7. Remove the piston complete with oil seal.
8. Remove the spring.



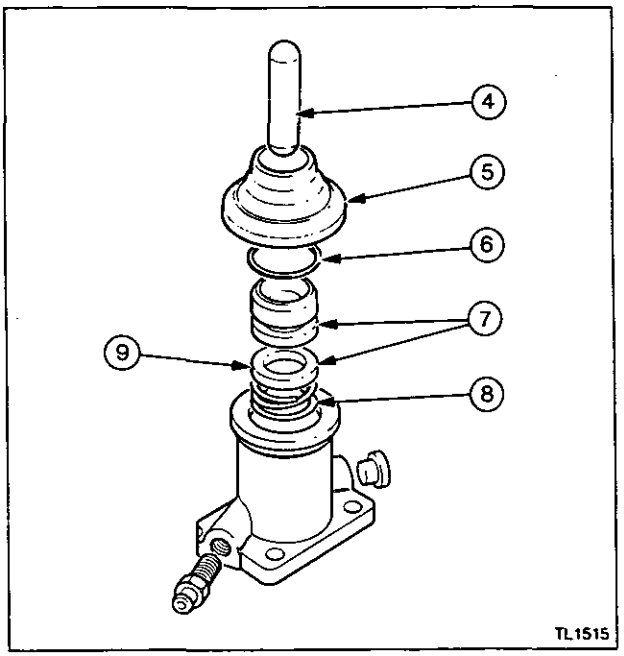
Examination

Thoroughly clean the dismantled parts by washing them in brake fluid and place them on a clean sheet of paper.

DO NOT USE PETROL, PARAFFIN, OR TRICHLORETHYLENE

Examine the piston and bore for visible score marks, ridges and corrosion. Check that the bore is smooth to the touch. If there is the slightest doubt as to the condition of the parts, then a new slave cylinder must be fitted. Inspect all the other components to see that they are in good working order.

Comparison of the parts in the service kit will indicate which used parts should be discarded.



Reassembly

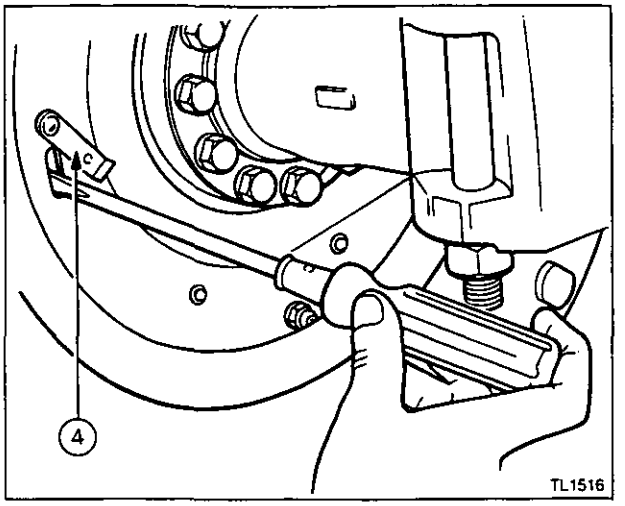
9. Use the new parts from the service kit when re-assembling. Lubricate the inner diameter of the seal with unused brake fluid and fit the seal to the piston.
10. Liberally lubricate the piston seal and cylinder bore with unused brake fluid.
11. Replace the spring.
12. Insert the piston assembly fully into the cylinder bore, lip of the seal leading. Replace the snap ring, dust cover and plunger.
13. Reverse procedures 1 to 3.
14. Remove the air from the system, see operation 8B-07.
15. Adjust and balance the brakes, see operation 8B-19.

Drum Brake Adjustment

Adjust 8B-19

Procedure

1. Chock the front wheels and jack the tractor rear wheels clear of the ground, release the parking brake.
2. Slacken the parking brake adjusters.
3. Unlatch the brake pedals.
4. Move back the cover plate on the brake backplate.
5. Insert a screwdriver through the slot in the backplate and lever the adjuster towards the front of the tractor until the wheel is locked.
6. Slacken the adjuster until the wheel rotates freely.
7. Repeat items 4 to 6 for the other brake.
8. Readjust the two parking brake adjusters so that the parking brake is effective at approximatley the third click.
9. Latch the two brake pedals together.
10. Road test the tractor, slacken the adjuster on the side to which the tractor pulls.



Changing the brake fluid

Servicing 8B-20

All models

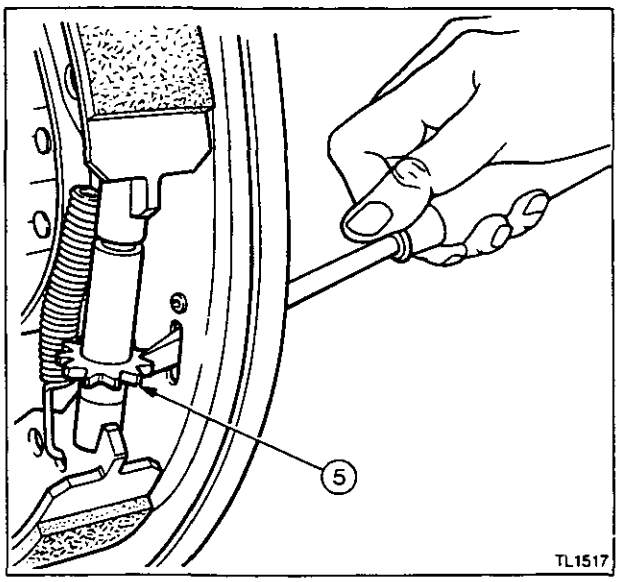
Procedure

Note: If the following procedure is adhered to, air will not enter the system and the time taken to change the fluid will be kept to a minimum.

1. Proceed in the same manner and order as for removing air from the system (see operation 8B-07) and attach a clear plastic tube together with a glass bottle to a bleed screw.
2. Pump out most, but not all, of the fluid in the reservoir.

Note: Do not allow the reservoir to empty.

3. Top up the reservoir with new unused fluid of the recommended type.
4. Ensure the reservoir is kept topped up and pump out the system until the old and discoloured fluid is ejected and the new fluid can be seen in the plastic tube.
5. Repeat the procedure for the other brake.
6. Top up the reservoir and road test the tractor.



CROWNWHEEL, PINION AND DIFFERENTIAL LOCK

Section 8 – Part C

Table of Contents

CROWNWHEEL, PINION AND DIFFERENTIAL LOCK

Specification:

	Ratio	No of teeth
Crownwheel and pinion ratio - Standard axle:		
M-F 350, 352, 360, 362, 365, 372, 375, 382, 383, 390, 393, 390T, 396 tractors	4.375:1	8 x 35
M-F 390, 398, 399	3.889:1	9 x 35
Crownwheel and pinion - 40 km/hr axle (2WD haulage tractors only):		
M-F 375, 390, 398, 399	3.454:1	11 x 38
Crownwheel and pinion - Direct drive:		
M-F 340, 342	6.167:1	6 x 37
Crownwheel and pinion - 8 and 12 speed shuttle gearboxes:		
M-F 350 to 399	3.454:1	11 x 38
Differential Lock Pedal clearance	1,0 mm (0.040 in)	
Pinion bearing pre-load	21-25 kg cm (18-22 lbf in)	
Differential pre-load	Use tool MF.245D	
Tighten MF.245D clamp bar	27 Nm (20 lbf ft)	
Massey Ferguson Stud Lock part number	3405 352 M4	
Massey Ferguson High Strength Retainer part number	3930 274 M91	

Special tools:

MF.245D	Differential bearing pre-load gauge
MF.245D-1	Straight edge
MS.555	Adjustable puller (main tool)
MF.555-2A	*Right-hand differential bearing remover*
FT.4062A	Bearing pre-load gauge

Bolt torques:

Differential case bolts	108 Nm (80 lbf ft)
Crownwheel bolts	160 Nm (120 lbf ft)
Trumpet housing bolts	130 Nm (96 lbf ft)
Pinion housing to centre housing bolts	108 Nm (80 lbf ft)
Differential lock pedal clamp bolt - drum brakes	115 Nm (85 lbf ft)
Differential lock pedal fork bolts - drum brakes	54 Nm (85 lbf ft)
Lower link pin - drum brakes	163 Nm (120 lbf ft)

General Description

The drive from the transmission mainshaft is transmitted through the rear drive shaft and shear tube to a spiral bevel gear driving the pinion and crownwheel, then through the axle shafts, either directly to the rear wheels or indirectly through epicyclic reduction units to the rear wheels.

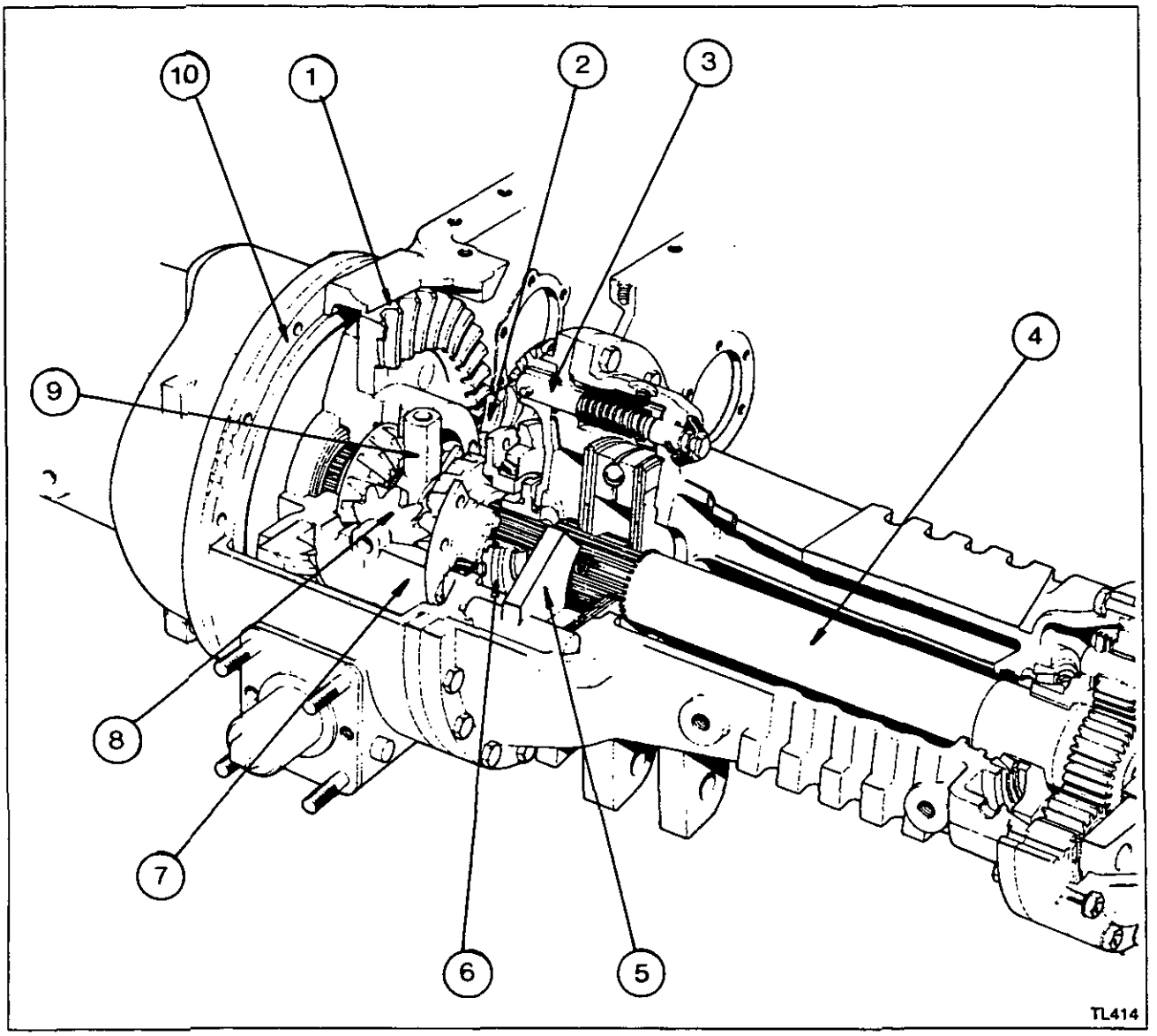
The driving pinion is supported in the centre housing by a straight roller pilot bearing and a pre-loaded housing assembly carrying two tapered roller bearings.

The crownwheel is attached to the split differential case, which is supported each side by a taper roller bearing. The differential pinions run on a cross joint and the thrust is taken by thrust washers behind the pinions.

A differential lock is fitted to the right-hand axle housing. When the pedal is pressed, a shaft engages a coupler, locking the differential case to the half shaft, thus locking the differential.

The pinion pre-load is set by tightening a screwed collar behind the two taper roller bearings. The differential bearing pre-load is set with the aid of a special tool and variable thickness bearing shields which are fitted behind the bearing cup of the right-hand carrier plate.

CROWNWHEEL, PINION AND DIFFERENTIAL LOCK



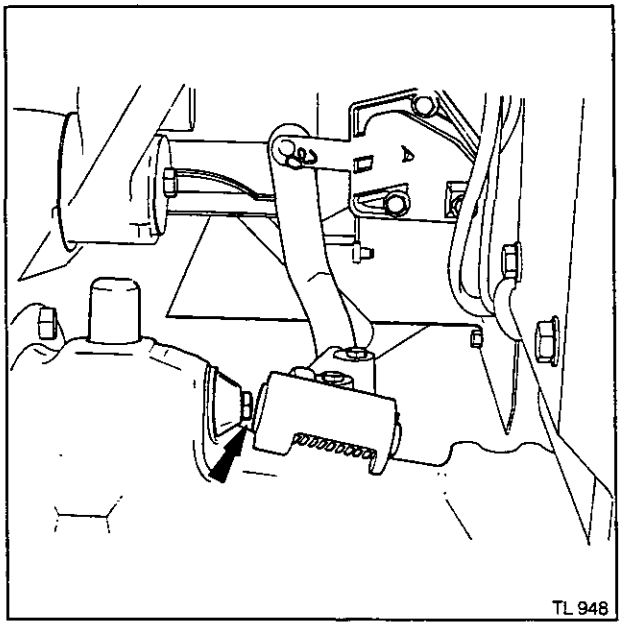
1. Crownwheel.
2. Pinion.
3. Differential lock.
4. Rear axle.
5. Brakes.
6. Differential lock coupler.
7. Differential case.
8. Differential pinions.
9. Cross joint.
10. Carrier plate.

CROWNWHEEL, PINION AND DIFFERENTIAL LOCK

Differential Lock

Adjustment 8C-01

1. Ensure that the pedal operates freely throughout its complete travel.
2. Check that the return spring is fitted and that the spring loaded plunger in the axle end of the pedal is free to move into its housing. If not, remove the pedal, the spring and plunger. Clean the components and refit to the tractor.
3. With the differential lock disengaged, the measurement between the face of spring loaded plunger and the adjusting screw, must be 1,0 mm (0.040 in).
4. If the setting is incorrect, lift back the rubber cover, slacken the locknut, then rotate the adjusting screw to the above dimension. Tighten the locknut and refit the rubber cover.


TL 948

Differential Lock

Removal and Refitment 8C-02

Special Tools

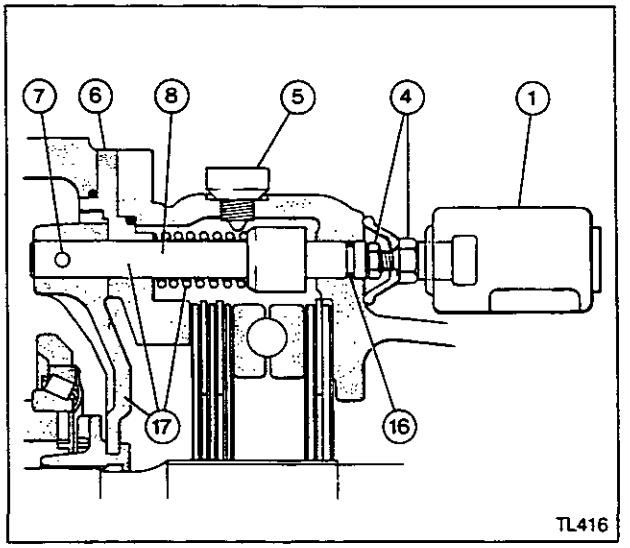
MF 555-2A	*Right-hand differential bearing remover*
MS 555	*Adjustable puller (main tool)*

Removal

1. Remove the differential lock operating lever assembly.
2. Remove the right-hand trumpet housing, see operation 8A-07.

Caution: The trumpet housing is heavy and awkward to handle. Take care when both removing and refitting it.

3. Manoeuvre the trumpet housing assembly off the trolley jack and stand it on end.
4. Lift up the rubber seal, release the locknut and screw the adjusting bolt, seal and locknut out of the operating rod.
5. Remove the differential lock warning switch.
6. Remove the carrier plate.
7. Drive the pin out of the fork. Remove it and the coupler.
8. Remove the shaft, complete with spring, cup washer, circlip and 'O' ring.
9. Using puller MS 555 and MF 555-2A, remove the differential bearing cone.
10. Remove the eight bolts.
11. Prise off the differential lock cap, taking care not to dislodge the case which would allow the differential gears to fall out.



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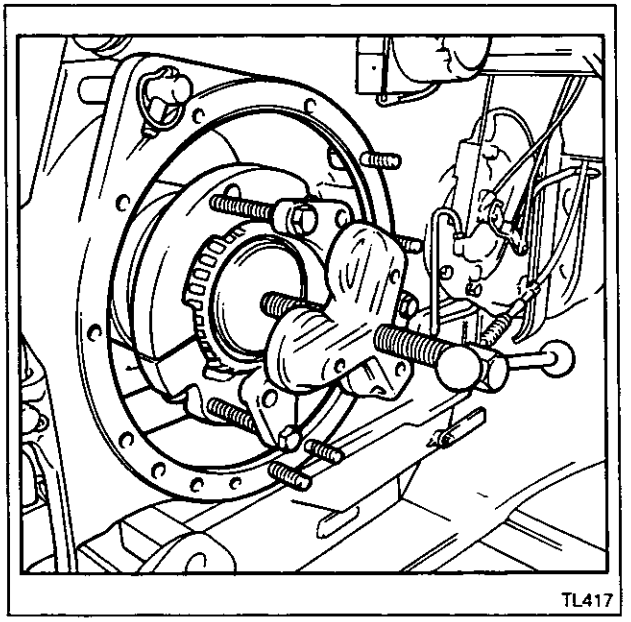

TL417

CROWNWHEEL, PINION AND DIFFERENTIAL LOCK

Examination

Examine the coupler, fork, cap and operating shaft for wear or scoring. Replace any worn parts.

Refitment

12. Fit the new coupler cap.
13. Insert and hand tighten the eight bolts.
14. Tighten the bolts progressively and evenly to a torque of 108 Nm (80 lbf ft).
15. Refit the bearing cone.
16. Fit a new 'O' ring to the shaft. If a new shaft is being fitted, a new washer and circlip should be fitted.
17. Refit the fork, shaft, spring coupler and pin to the carrier plate.
18. Refit the carrier plate to the trumpet housing, taking care not to damage the 'O' ring on the differential lock shaft.
19. Reverse procedure 1 to 5.
20. Refit the trumpet housing, see operation 8A-07.
21. Adjust the differential lock, see operation 8C-02.

Differential Unit

Overhaul	8C-03

Special Tools

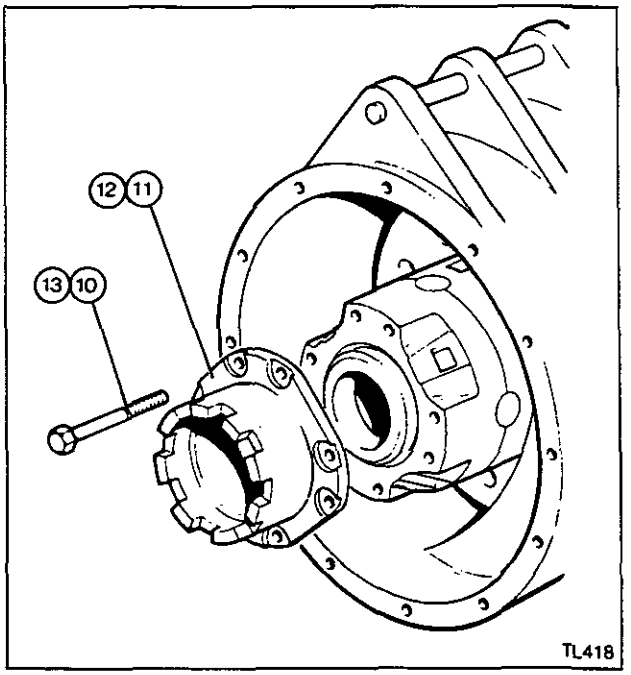
MF 555-2A	*Right-hand differential bearing remover*
MS 555	*Adjustable puller (main tool)*
FT 4062A	*Bearing pre-load gauge*

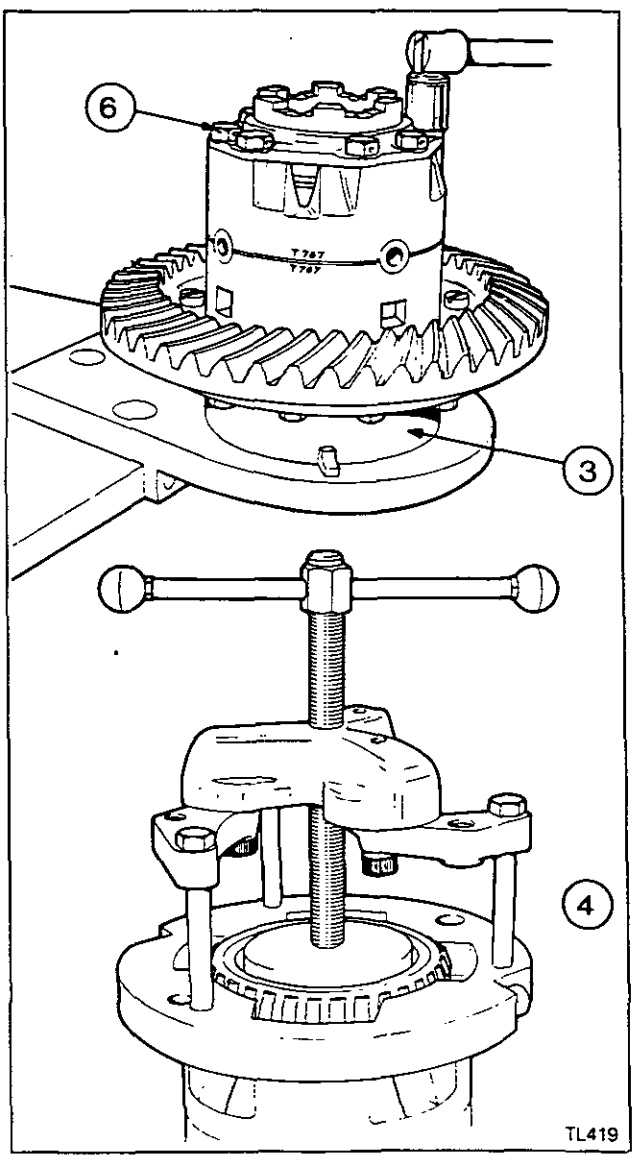
Disassembly

1. Remove the left-hand trumpet housing, see operation 8A-07.
2. Manoeuvre the differential assembly out of the centre housing.

Caution: The differential unit is heavy and awkward to handle. Take care when removing and refitting it.

3. Place the differential on a stand or in a vice.
4. Using puller MS 555 and MF 555-2A, remove the bearing right-hand cone.
5. Mark the two halves of the differential case to enable them to be assembled in the same relative positions.
6. Remove the eight bolts.
7. Remove the coupler cap and right hand half of the differential case.
8. Remove the cross and pinion assembly, complete with the thrust washers.
9. Remove the differential gears and their thrust washers.





CROWNWHEEL, PINION AND DIFFERENTIAL LOCK

Examination

Examine all of the differential components and replace any that are worn or damaged.

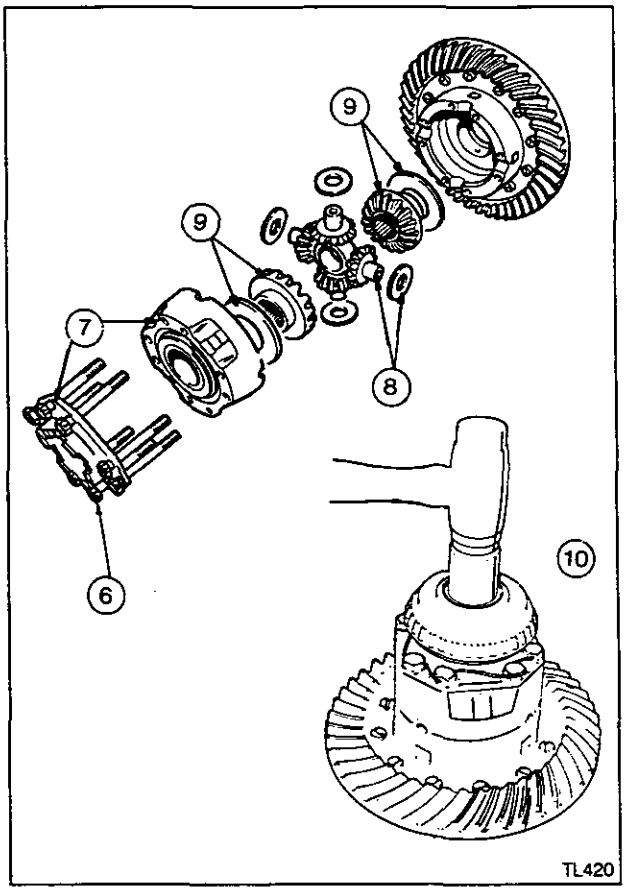
Note: If any of the spider gears are worn, a full set of four new gears must be fitted. In such circumstances, the differential gears may also need to be replaced.

Reassembly

10. Reverse procedures 2 to 9 except:
    a. Refit the right hand differential case with markings aligned.
    b. Tighten the eight bolts to a torque of 108 Nm (80 lbf ft).
    c. Refit the right-hand bearing cone.
    d. Refit the differential unit with care. It must engage with the splines on the right-hand axle shaft.

Note: If the differential bearings or case have been replaced, the pre-load must be checked, see operation 8C-05.

11. Refit the left hand trumpet housing, see operation 8A-07.



CROWNWHEEL, PINION AND DIFFERENTIAL LOCK

Crownwheel and Pinion

Overhaul 8C-04

Special Tools: FT4062A Bearing pre-load gauge

Disassembly

1. Split the tractor between the centre housing and the gearbox or spacer housing, see section 2.
2. Remove the lift cover, see operation 12A-03 or 04.
3. Remove the linkage pump and IPTO clutch if fitted.
4. Remove the differential unit, see operation 8C-03.
5. Place the differential unit on a bench with the teeth facing downwards.
6. Centre punch each of the rivet heads centrally.
7. Using a 13 mm (0.5 in) drill, drill out each of the rivet heads until they become detached from their shanks.
8. Drive out the rivets.
9. Drive off the crownwheel.

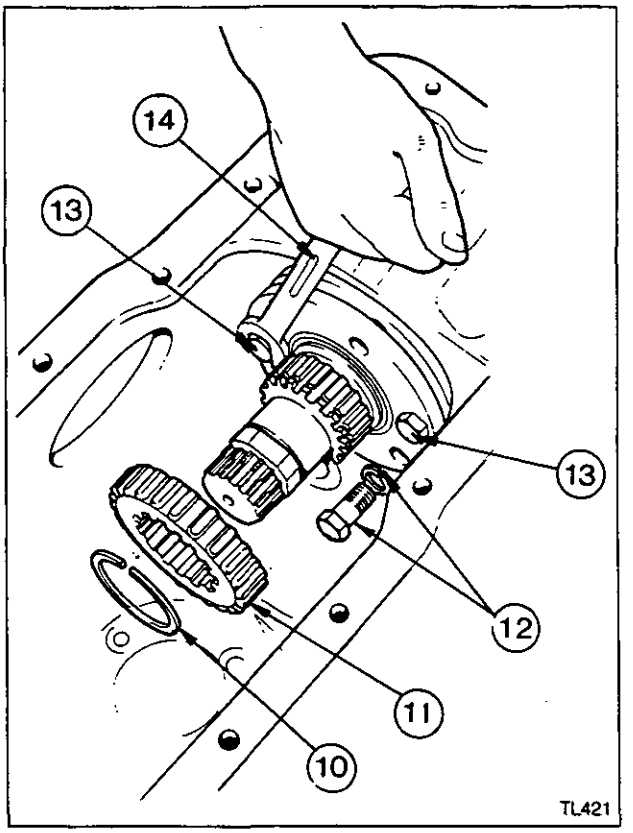
Note: Crownwheels and pinions are supplied as matched sets, therefore when fitting a new crownwheel, the pinion must also be replaced.

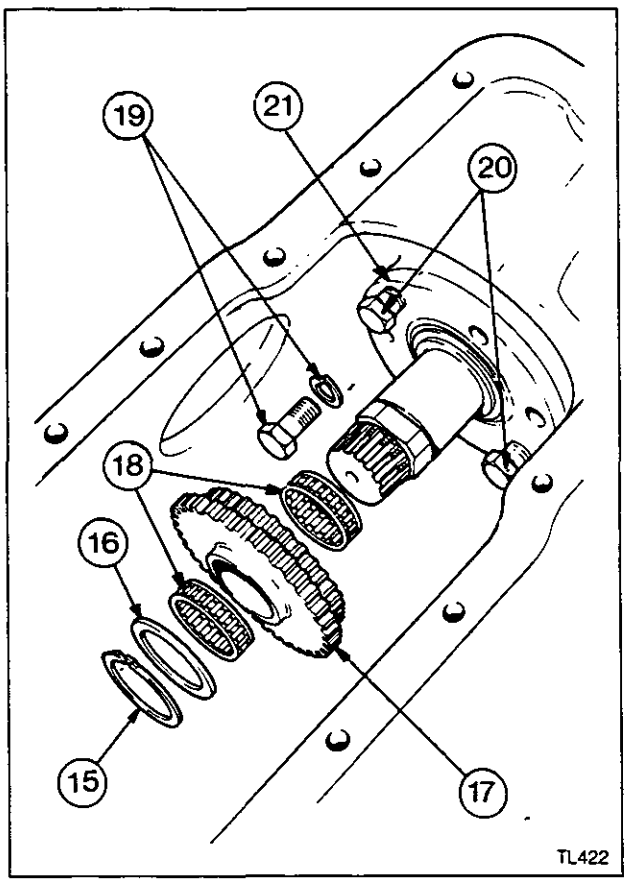
Pinion (single speed PTO)

10. Release the snap ring.
11. Slide off the gear.
12. Remove the six bolts and spring washers.
13. Screw one of the bolts into each of the two tapped holes.
14. Tighten the bolts, thus withdrawing the pinion assembly.

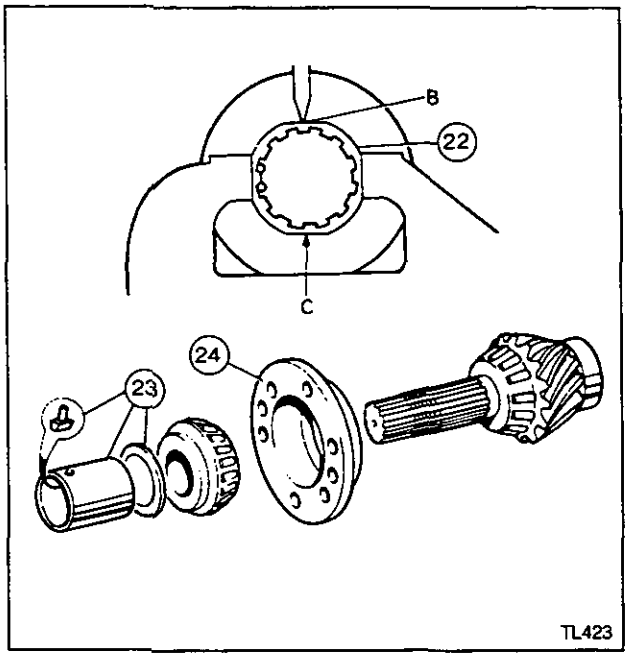
Pinion (two speed PTO)

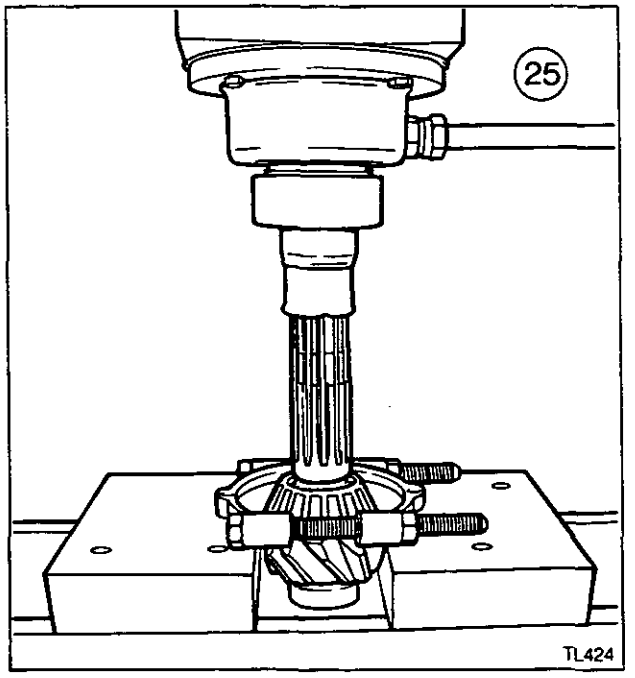
15. Release the circlip.
16. Remove the thrust washer.
17. Remove the gear cluster.
18. Slide the needle roller bearings off the bearing sleeve.
19. Remove the six bolts and spring washers.
20. Screw one of the bolts into each of the two tapped holes.
21. Tighten the bolts thus withdrawing the pinion assembly.

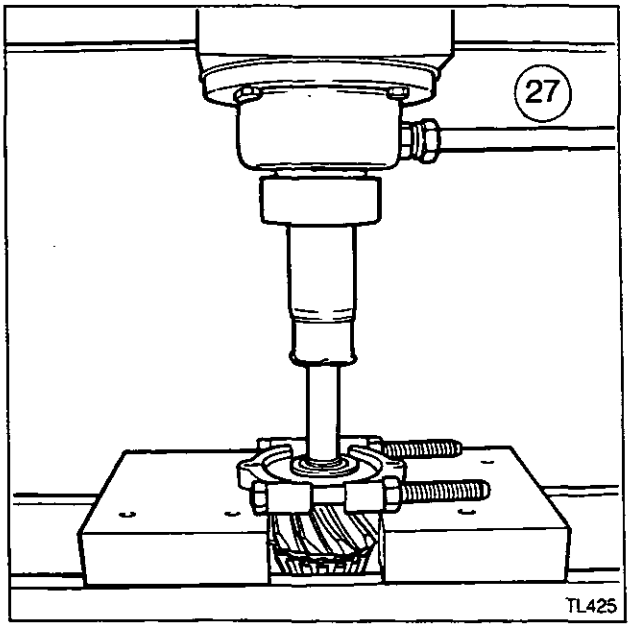




CROWNWHEEL, PINION AND DIFFERENTIAL LOCK







All models

22. Remove the locking ring as follows:
    a. Place the pinion in a vice with soft jaws, holding the flats, adjacent to the collar locking rollers.
    b. Using a cold chisel, cut one half to two thirds into the locking collar at points "B" and "C".
    c. Reposition the pinion in the vice and chisel down the splines into the cuts made at points "B" and "C". A few hefty blows will fracture the locking collar enabling it to be removed.

Note: Great care should be taken to avoid damaging the threads of the pinion if it is to be reused.

23. Remove the sleeve and the splined hub (single speed PTO) or the bearing sleeve, sleeve keeper and thrust washer (two speed PTO).
24. Remove the housing, complete with the front bearing cone.
25. Use a hand or hydraulic press and remove the two taper roller bearings.
26. Remove the snap ring securing the pilot bearing to the pinion.
27. Remove the pilot bearing in a press.

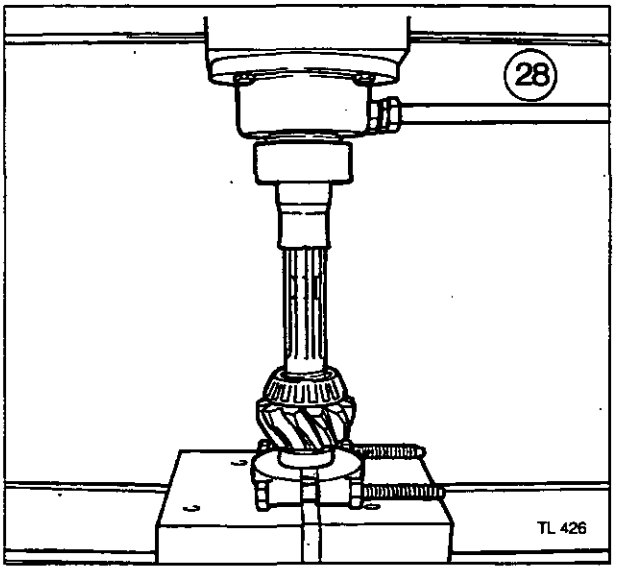
Examination

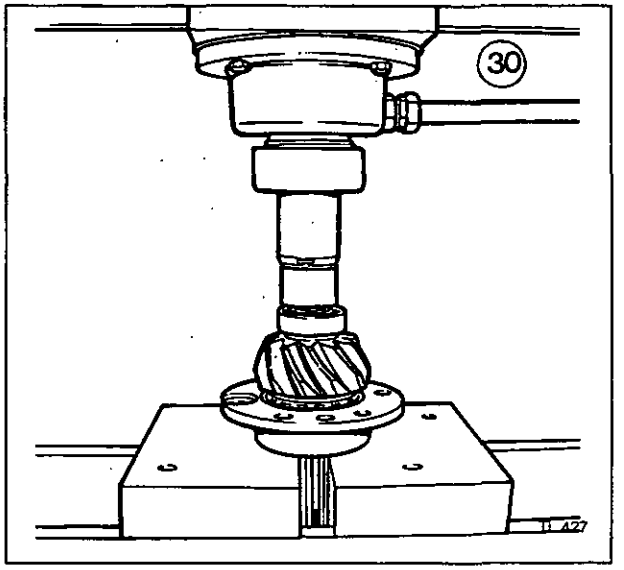
Examine all components for signs of wear, scoring or pitting. Any faulty or worn parts must be replaced.

Notes:

a. **If the pinion is damaged the crownwheel must also be replaced as these are only supplied in matched sets.**
b. **The taper roller bearings are serviced as a pair, assembled with the housing.**
c. **New snap rings should always be fitted.**

CROWNWHEEL, PINION AND DIFFERENTIAL LOCK





Reassembly

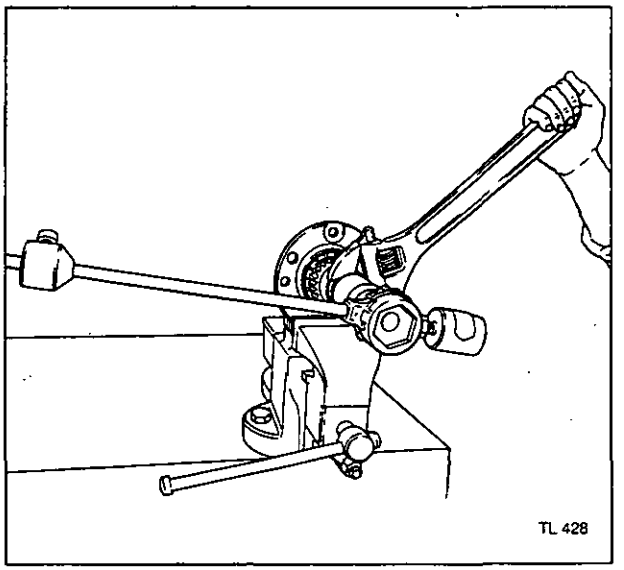
Pinion

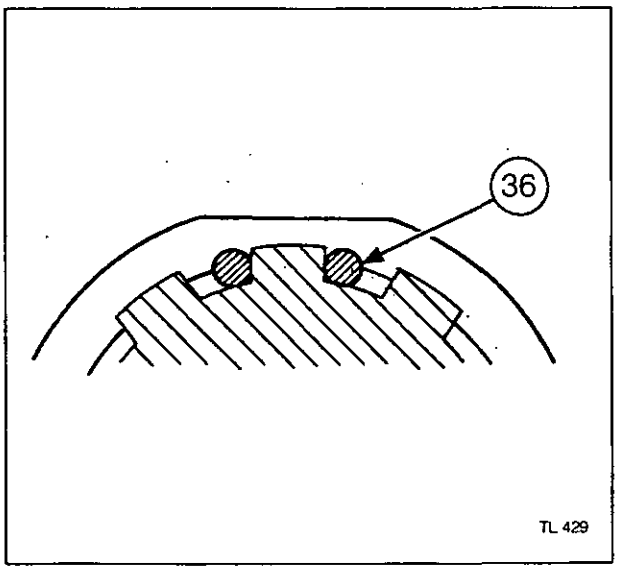
10. Press the pilot bearing onto the pinion.
11. Secure the pilot bearing with a new snap ring.
12. Press the taper roller bearing onto the pinion.
13. Locate the pinion in its housing and fit the front bearing cone.
14. Refit the sleeve and the splined hub (single speed PTO) or the thrust washer and bearing sleeve with the sleeve keeper (two speed PTO) and a new locking ring, hand tighten.
15. Hold the housing in a soft faced vice.
16. Fit the pre-load gauge FT.4062A to the pinion and tighten the locking ring to give a pre-load reading of 21-25 kgf cm (18-20 lbf ft). If a pre-load gauge is not available, wrap some string around the pinion shaft and attach the end to a spring balance. Pull the spring balance away from the shaft. The rolling resistance must be 10-11 kg (21-25 lbs) when the shaft is rotating. Adjust the tension by tightening or loosening the locking ring.
17. Remove the gauge, tap the pinion firmly to centralise the bearings, then re-check the pre-load.
18. Secure the locking ring by driving a locking roller down either side of one of the pinion splines.

NOTE: The locking rollers must be driven flush with the collar.

Before refitment, the pinion assembly should be freely lubricated with clean transmission oil.

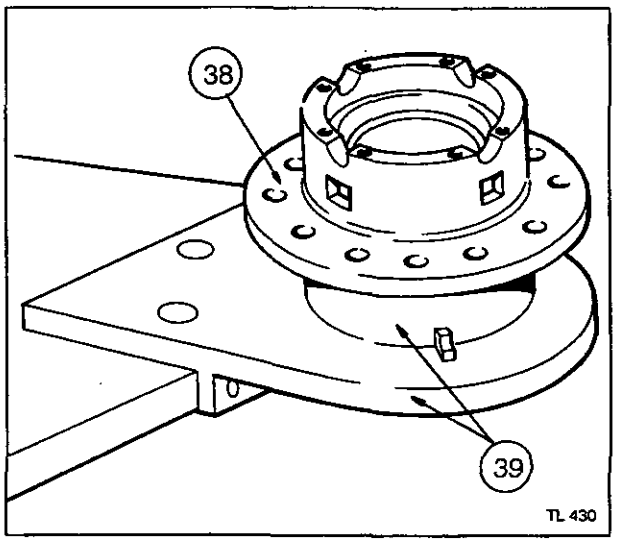
19. Reverse procedures 10 to 21 except:
    a. Ensure that the locating pin is aligned before pressing the housing into place.
    b. Tighten the six bolts to a torque of 108 Nm (80 lbf ft).
    c. When the thrust washer shows signs of wear it must be renewed (Two speed PTO)
    d. Fit a new circlip.





Crownwheel

38. Ensure that the mating faces of the differential case and the new crownwheel are perfectly flat.
39. Fit the left-hand differential case, with the mating face upwards in a stand or vice.



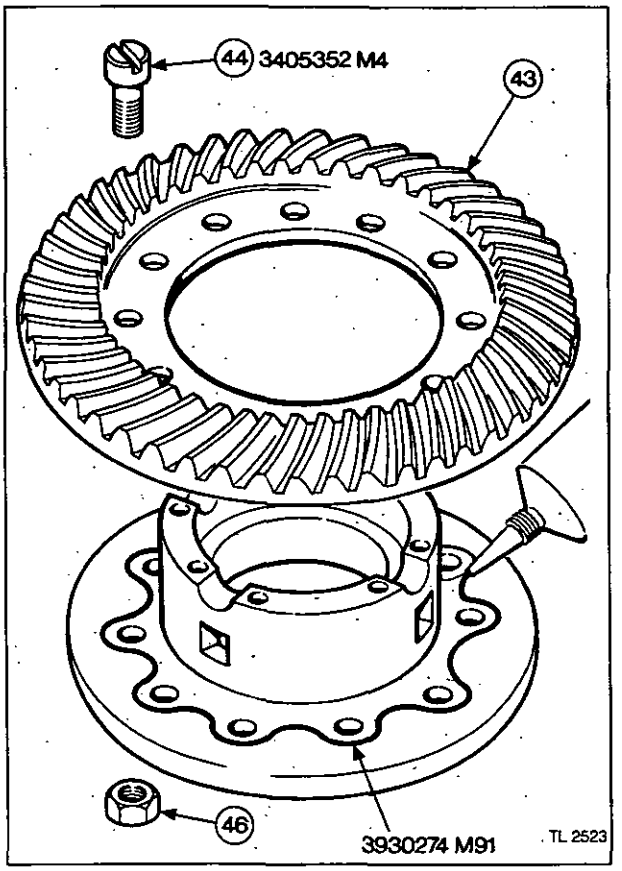
40. Degrease the crownwheel, left-hand differential case and the crownwheel retaining nuts and bolts. Use Massey Ferguson Superclean Solvent, trichloroethylene or equivalent.
41. Collect together all the items required for the assembly of the crownwheel to the differential case, the items are:

- A torque wrench.
- 3/4 inch across flats socket.
- Massey Ferguson High Strength Retainer (Loctite 638) part number 3930 274 M91.
- Massey Ferguson Studlock (Loctite 270) part number 3405 352 M4.

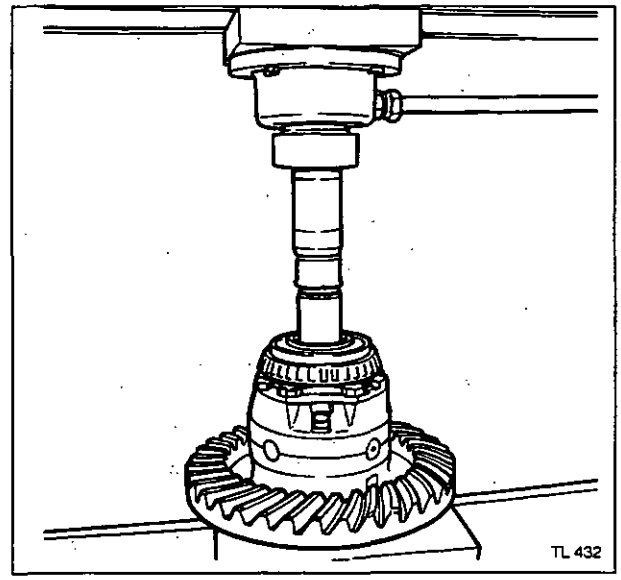
42. Apply the entire contents of the 3ml tube of Massey Ferguson High Strength Retainer evenly in a single bead to the flange of the differential case. DO NOT spread over the whole surface (see illustration).
43. Press the differential case onto the crownwheel. These two components are an interference fit and must, therefore, have their bolt holes aligned accurately before being fitted together.
44. Fit the 12 bolts with their heads nearest the crownwheel teeth.
45. Apply two drops of Massey Ferguson Studlock (Loctite 270) to the first thread of each bolt.
46. Fit the nuts and tighten them progressively and evenly to a torque of 160 Nm (120 lbf ft).

NOTE: Operations 42 to 46 must be completed without delay due to the curing of the Retainer and Stud Lock compound.

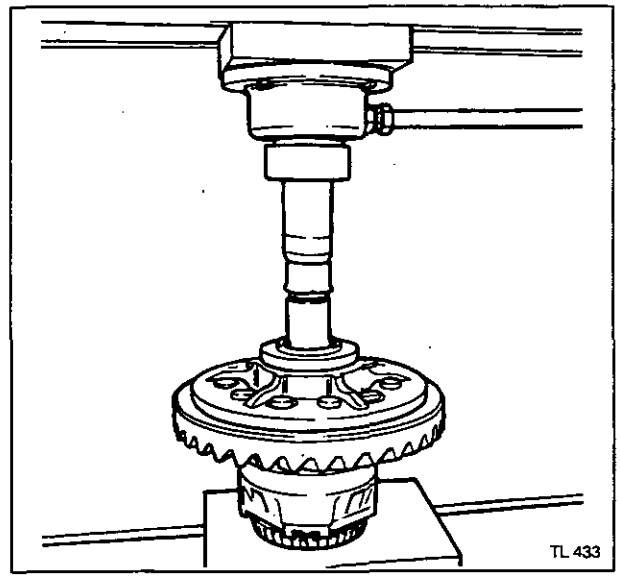
47. Refit the differential components, see operation 8C-03.



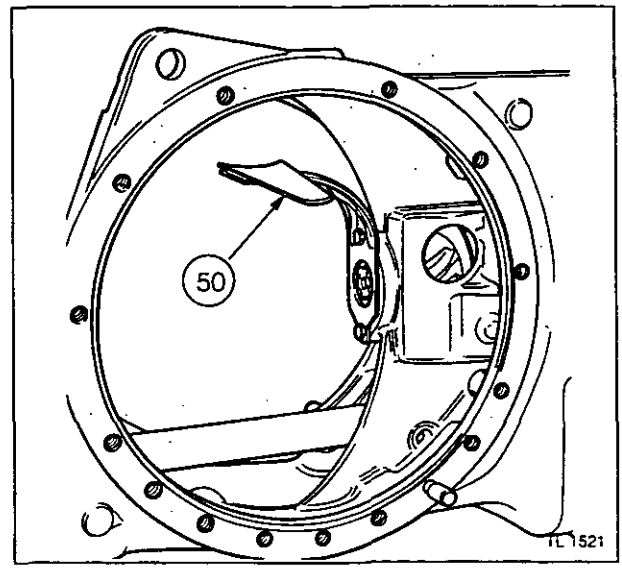
48. Press on the right-hand differential bearing cone.



49. Press on the left-hand differential bearing cup.



50. On direct drive axles ensure that the oil tray is bolted to the pinion bearing housing.
51. Refit the differential unit, see operation 8C-03.
52. Set the differential bearing pre-load, see operation 8C-05.
53. Refit the left-hand trumpet housing, see operation 8A-07 or 8A-09.
54. Refit the lift cover, see operation 12A-03 or 12A-04.
55. Reassemble the rest of the tractor.
56. Refill the transmission with the correct grade of oil.
57. Road test the tractor.



CROWNWHEEL, PINION AND DIFFERENTIAL LOCK

Differential Pre–load

Check 8C–05

Special tools:
MF.245D Pre-load Gauge
MF.245D-1 Straight Edge

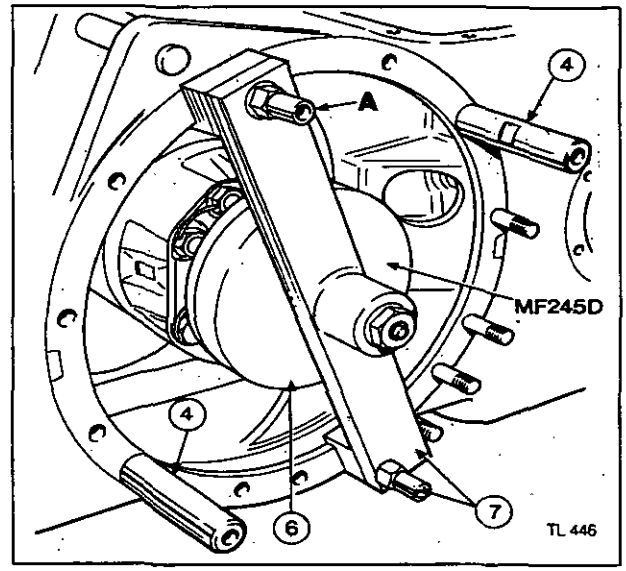
NOTE: This check must be carried out whenever the differential is disassembled, or if the bearings have been replaced.

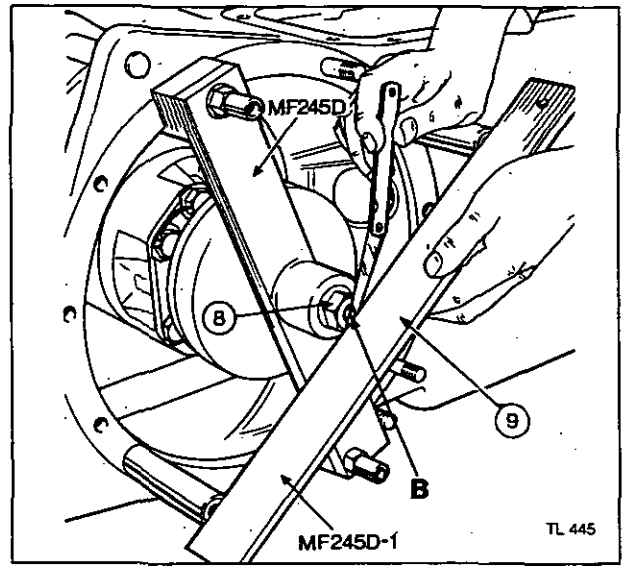
Procedure

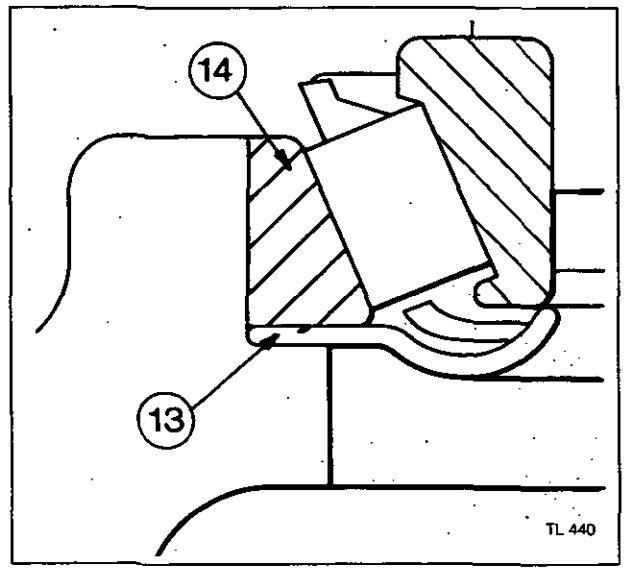
1. All pre-load checks are made on the right-hand side.
2. Assemble the left-hand side complete.
3. DO NOT fit the bearing cup to the right-hand carrier plate, or remove it and and the chip shield.
4. Screw a setting block (part of special tool MF.245D) to two diametrically opposite studs. Remove one stud from an adjacent location to fit the upper block.
5. Remove another stud from the centre housing and fit it in the tapped hole at position **'A'**.
6. Place the bearing cup on the bearing cone and fit the centraliser.
7. Position the clamp bar and secure it with the two tube nuts.
8. Torque the clamp bar nut to 27 Nm (20 lbf ft) whilst using a lever to turn the differential unit. This will ensure correct seating and location of the bearings.
9. Place the straight edge (MF.245D-1) in position, and measure the gap **'B'** using feeler gauges.
10. Using the table below to determine the correct chip shield.

Feeler gauge gap (*Equal shield thickness*)		Means of *identification*	Part *Number*
mm	in		
0,45-0,53	0.019-0.021	Eight dots	168 054 M1
0,61-0,66	0.024-0.026	Seven dots	521 401 M1
0,74-0,79	0.029-0.031	No dots	187 689 M1
0,86-0,91	0.034-0.036	One dot	892 173 M1
0,99-1,04	0.039-0.041	Two dots	892 172 M1
1,12-1,17	0.044-0.046	Three dots	892 171 M1
1,25-1,30	0.049-0.051	Four dots	892 170 M1
1,37-1,42	0.054-0.056	Five dots	191 124 M1

11. Remove MF.245D, tube nuts, clamp bar, centraliser and setting blocks.
12. Refit the two studs in their correct holes.
13. Place the new chip shield in the carrier plate, with the concave face towards the differential.
14. Refit the bearing cup, ensuring that it is fully seated.
15. Remove MF.245D, refitting the studs to the holes from which they were removed
16. Refit the carrier plate and the trumpet housing, see operation 8A-07.







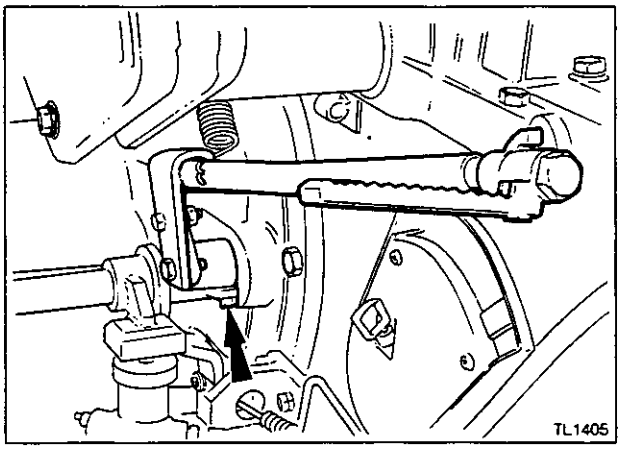
CROWNWHEEL, PINION AND DIFFERENTIAL LOCK

Differential lock (direct drive - drum brake)

Adjust 8C-06

Procedure

1. Ensure that the pedal operates freely throughout its complete travel.
2. Engage the differential lock.
3. Slacken the clamp bolt.
4. Move the pedal to the desired position to give a minimum clearance of 6 to 12 mm (1/4 to 1/2 in) between the pedal and the footstep or cab floor.
5. Tighten the clamp bolt to a torque of 115 Nm (85 lbf ft), check the clearance.

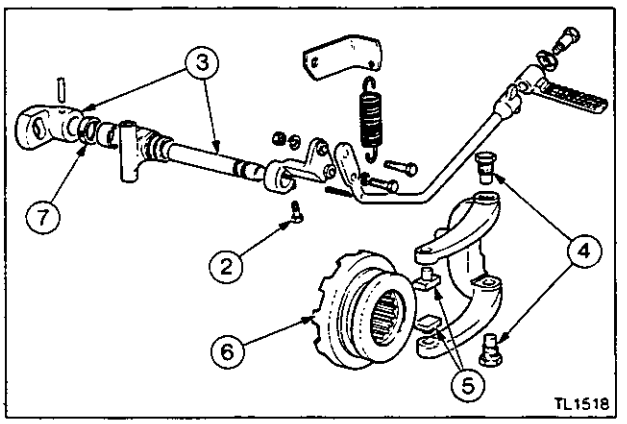


Differential lock (direct drive - drum brake)

Removal and Refitment 8C-07

Removal

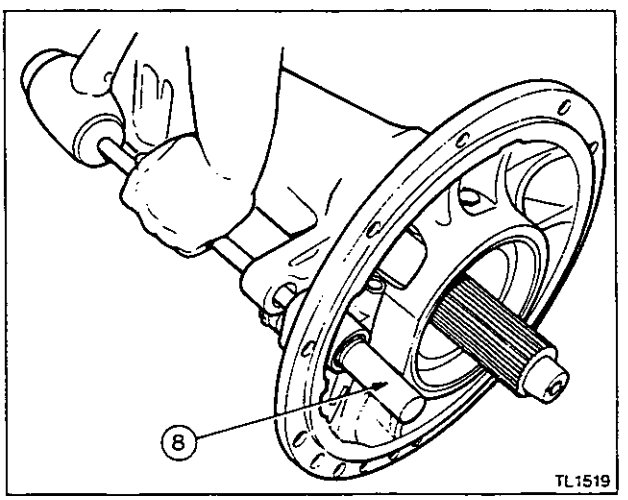
1. Remove the right hand trumpet housing, see operation 8A-09.
2. Remove the bolt securing the foot pedal lever to the actuating shaft.
3. Withdraw the cam and shaft.
4. Remove the two bolts securing the shifter fork.
5. Manoeuvre the shifter fork, with its two guide shoes out of the trumpet housing.
6. Slide the coupler off the axle shaft splines.
7. Remove the actuating shaft seal from the trumpet housing.



Bush Removal

If necessary, the actuating shaft bushes may be changed in the following manner:

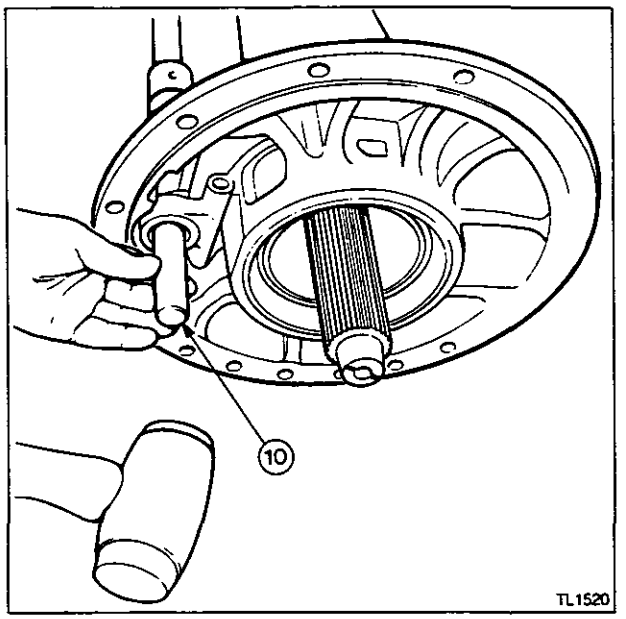
8. Using a suitable sized tap, cut a thread into the bush and screw in a piece of steel or bolt, then drive out the bolt and bush as shown using a suitable punch or drift.
9. Repeat the operation for the outer bush.

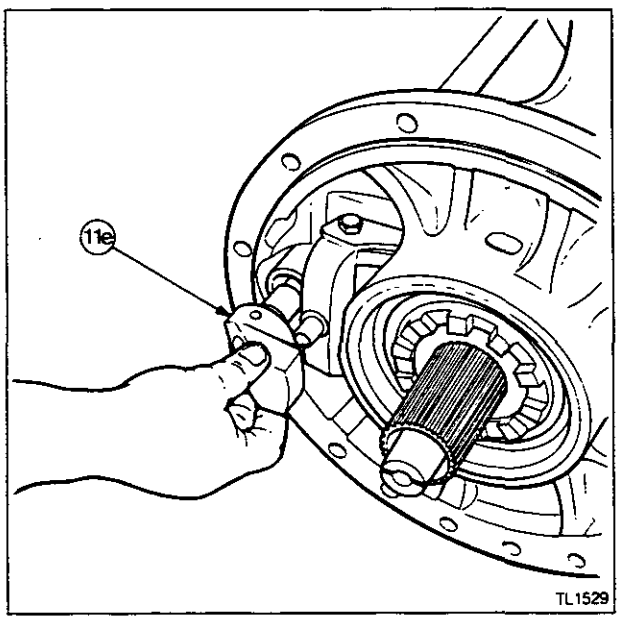


CROWNWHEEL, PINION AND DIFFERENTIAL LOCK

Refitment

10. Using a suitable mandrel, fit a new bushes into the trumpet housing, if removed.
11. Reverse procedures 1 to 7 except:
    a. Fit the new seal with the lip facing towards the differential.
    b. Slide the coupler onto the axle shaft with the teeth facing towards the differential.
    c. Clean and degrease the threads of the shifter fork securing bolts and their holes in shifter fork. When refitting the shifter fork, ensure that the shoe guides locate correctly on the coupler.
    d. Apply a small quantity of Loctite 270 to the threads of the bolts and secure the shifter fork to the trumpet housing, then tighten the bolts to a torque of 0,54 Nm (40 lbf ft).
    e. Smear the shaft bushes and oil seal lightly with engine oil. Carefully insert the shaft through the lip seal, simultaneously locating the lever on the shaft and the dowel pin on the shifter fork in the cam.
    f. Don't forget to replace the differential lock spring.
12. Adjust the differential lock pedal, see operation 8C-06.





WHEELS AND TYRES

Section 8 – Part D

Table of Contents

WHEELS AND TYRES

Wheel Nut and Bolt Torques

M-F 350, 355 and 360

Front wheels – Two wheel drive

Wheel nuts	81-108 Nm (60-80 lbf ft)
Wheel screws	95-120 Nm (70-88 lbf ft)

Front wheels – Four wheel drive

Wheel to hub screws	270 Nm (200 lbf ft)
Rim to disc nuts	190 Nm (140 lbf ft)

Rear wheels – Standard

Wheel to hub nuts	325 Nm (240 lbf ft)
Rim to disc nuts	240 Nm (178 lbf ft)

Rear wheels – PAVT

Wheel to hub nuts	325 Nm (240 lbf ft)
Clamp nuts – Stage 1	70 Nm (52 lbf ft)
– Stage 2	140 Nm (103 lbf ft)
– Stage 3	260 Nm (192 lbf ft)

M-F 365, 375, 383, 390, 398 and 399

Front wheels – Two wheel drive with pressed wheels

Wheel nuts	81-108 Nm (60-80 lbf ft)
Wheel screws	122-163 Nm (90-120 lbf ft)

Front wheels – Two wheel drive with disc wheels

Wheel nuts	108-144 Nm (80-106 lbf ft)
Wheel screws	163-244 Nm (120-180 lbf ft)

Front wheels – Four wheel drive

Wheel to hub screws	270 Nm (200 lbf ft)
Rim to disc nuts	190 Nm (140 lbf ft)

Rear wheels – Standard

Wheel to hub nuts	325 Nm (240 lbf ft)
Rim to disc	190 Nm (140 lbf ft)

Rear wheels – PAVT

Wheel to hub nuts	325 Nm (240 lbf ft)
Clamp nuts – Stage 1	70 Nm (52 lbf ft)
– Stage 2	140 Nm (103 lbf ft)
– Stage 3	260 Nm (192 lbf ft)

Inner Tube

Removal and Refitment 8D-01

Special Tools:
Bead-breaking tool
3 lb Hammer
Tyre Levers

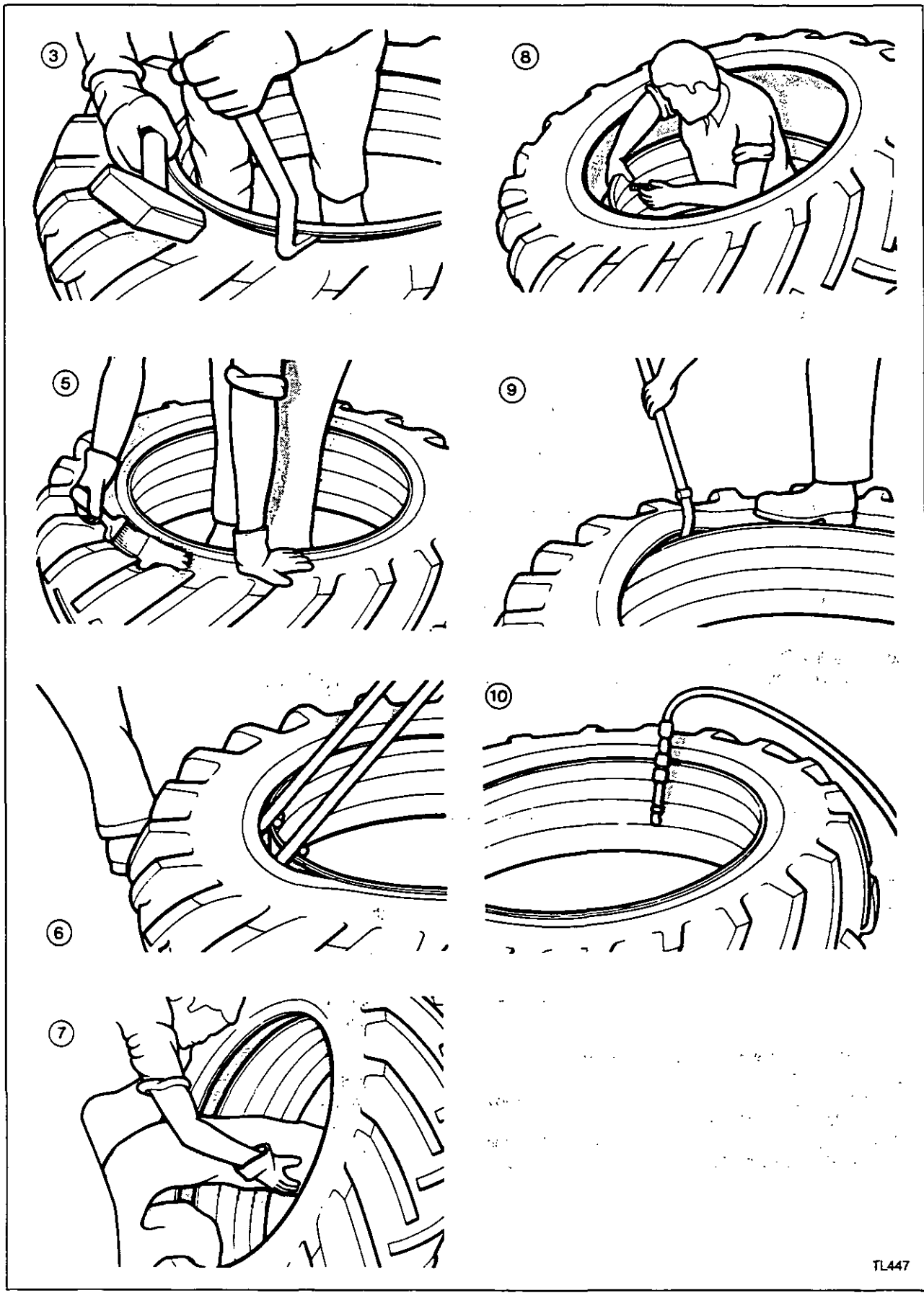
Removal

1. Lay the wheel on the ground with the valve uppermost.
2. Deflate the tyre by removing the valve core. Remove the valve retaining nut.
3. Drive the 'bead-breaking' tool between the tyre and rim, taking care not to damage the rim or the tyre.
4. After the bead has been released from the rim, invert the wheel and repeat procedure 3.
5. Lubricate the rim, tyre and base of the tube with a solution of soap and water or similar rubber lubricant.

Note: Never use petroleum or silicone base greases.

6. Starting at the valve location, pry the tyre off the rim, taking small bites with tyre levers, and ensuring that the bead on the opposite side is fully located in the mounting well.
7. With the wheel in a vertical position, pull the tyre forwards and remove the tube.

Examine the bead seating area of the rim. Remove any build-up of rust, corrosion or old rubber. Inspect inside the tyre casing for foreign matter or damage.


3
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TL447

Refitment

8. Inflate the tube until 'rounded out'. Place the tube in the tyre with the valve located in the valve hole. Refit the valve retaining nut finger tight.
9. Refit the tyre, starting opposite the valve location taking small bites with long tyre levers and keeping the fixed part of the bead fully located in the well.

   A solution of soap and water, or similar rubber lubricant, brushed on to the rim and bead will help refitment.

Note: Care must be taken not to pinch the tube when fitting.

10. Centre the tyre on the rim and inflate to approximately 2,5 kg/cm^2 (35 lb/in^2).

Caution: Never stand over the assembly when inflating. Remote control inflation equipment should be used.

11. Remove the valve core and completely deflate the tyre.
12. Refit the valve core and inflate to recommended pressure.

Caution: If beads fail to seat at 2,5 kg/cm^2 (35 lb/in^2) the tube may be pinched, do not increase the pressure but remove the valve core and release the tyre from the rim. Lubricate tyre, bead and rim and re-inflate to 2,5 kg/cm^2 (35 lb/in^2). Repeat process until both beads are properly seated.

Tyre

Removal and Refitment 8D-02

Special Tools: Bead-breaking tool
3 lb Hammer
Tyre levers

Removal

1. Remove inner tube as stated in operation 8D-01.
2. With the wheel in a vertical position, pry off the tyre taking small bites with the tyre levers. The use of rubber lubricant will help removal.

Refitment

3. Place the rim on the ground. Lubricate the bead and rim and place the tyre on rim.
4. Refit the tyre to the rim using long tyre levers.
5. Refit the inner tube.