

manual for:

PRM101



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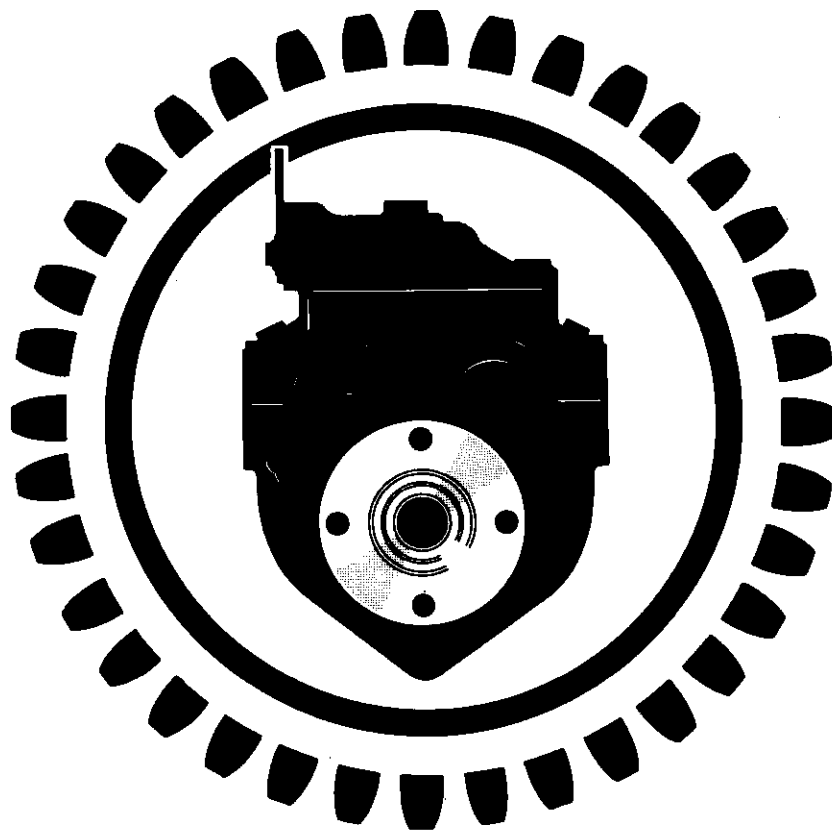
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NEWAGE PRM 101

DINTRA



WORKSHOP MANUAL

FOREWORD

The workshop manual has been prepared to assist the operator or user of PRM marine gearboxes and also to enable the skilled service engineer to undertake more detailed maintenance and overhaul.

GENERAL INFORMATION

PRM hydraulic marine gearboxes will give trouble-free service provided they are correctly installed, aligned and maintained. In the event of failure, the engine distributor who supplied the gearbox, or his local dealer, should be informed; where this is not possible, Newage Transmissions Limited, or the distributor for the area, should be notified. In all communications, verbal or otherwise, the model and serial number of the gearbox must be quoted in order to ensure correct identification and supply of parts.

CLAIMS UNDER WARRANTY

Claims for the replacement of parts under warranty must always be submitted to the distributor who supplied the gearbox; if this is not possible, application may be made to the nearest distributor or dealer, who must, however, be advised of the supplier's name and address.

SERVICE PARTS

The comprehensive illustrated parts list gives full information and ordering procedures.

PRICE £ 2.00 NETT.

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1. GENERAL DATA

| | | |
|--|---|--|
| Input Torque Capacity | — | 136 Nm (13.8 kg.m., 100 lb.ft) |
| Input Speeds | — | 3600 rpm continuous 4000 rpm intermittent |
| Input Rotation | — | Left hand (counter-clockwise) or right hand (clockwise) |
| Output Rotation (Ahead Drive) | — | Either right hand or left hand as required, irrespective of gear ratio |
| | | NOTE: When used with a right hand engine a left hand output rotation in ahead drive should be used |
| Reduction Ratio | — | 1.96 : 1 or 2.94 : 1 |
| Overall Dimensions | — | SEE PAGE 11 |
| Approximate Dry Weight | — | PRM101S 48 kg (106 lb) PRM101L 55 kg (121 lb) |
| Oil Capacity | — | Position VR : 1.4 litres (2.5 pints) Position HR/HL : 1.7 litres (3.0 pints) |
| Min. Oil pressure (working) | — | 1793 kN/m ² (260 p.s.i., 18.3 kg/cm ²) |
| Oil Temperature (working) | — | 50 ^o - 80 ^o c, depending on ambient temperature. Max permissible working temperature 90 ^o C |
| Thrust Capacity (Ahead, Astern) | — | 1.96:1 Pleasure 660 kp (1452 lbf) 1.96:1 Workboat 560 kp (1232 lbf) 2.94:1 Pleasure 756 kp (1664 lbf) 2.94:1 Workboat 660 kp (1452 lbf) |
| Input Shafts | — | 25.4 mm (1 in.) diameter, SAE 10 spline |
| Output Flange | — | 127 mm (5 in.) diameter with 4 holes 12 mm (0.453 in.) diameter on 108 mm (4.25 in.) p.c.d. |

2. INTRODUCTION

PRM marine gearboxes are oil operated gearboxes of the countershaft type and are capable of transmitting full engine power with a high degree of efficiency in both ahead and astern drive, continuously if required. Both clockwise (right-hand) and anti-clockwise (left-hand) rotating engines can be accommodated, and either left-hand or right-hand propeller rotation in 'ahead' drive can be provided. However, if used with a clockwise engine, the gearbox should not normally be used with a right-hand propeller.

Note: When describing engine rotation, face the end of the engine on which the transmission is to be mounted and describe the rotation accordingly. Similarly, describe the transmission output rotation as clockwise or anti-clockwise as seen when standing behind the gearbox output coupling facing towards the input or engine end of the transmission.

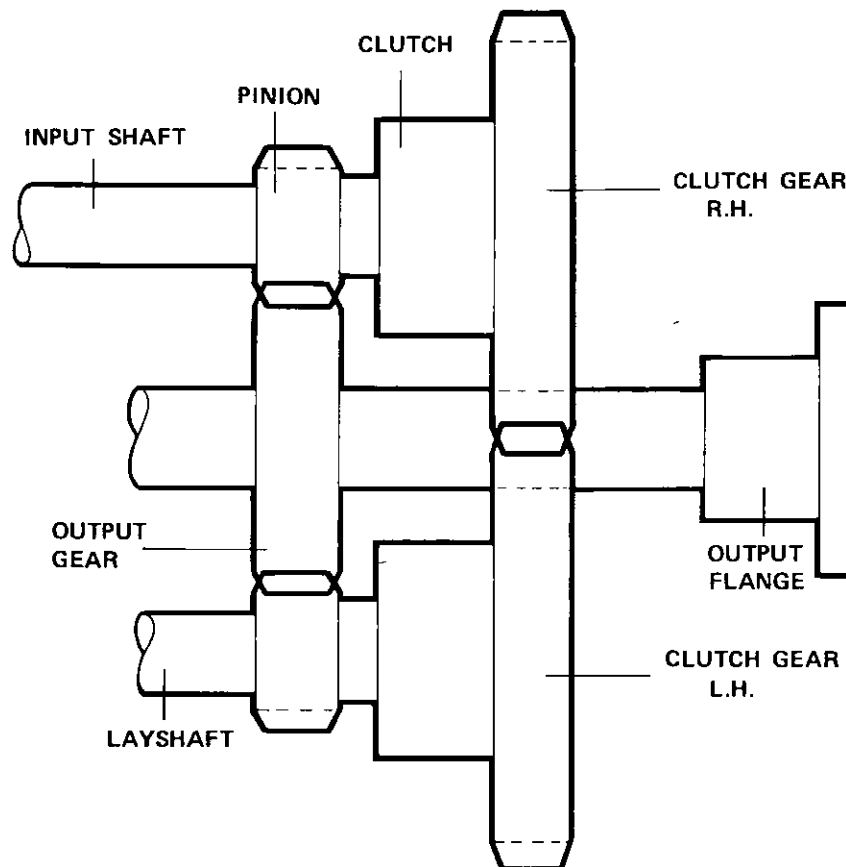


Fig.1 INTERNAL LAYOUT DIAGRAM - STANDARD BOX

3. OPERATION

With the control lever at the mid-point of travel or neutral position and the engine running, the splined input shaft and clutch gear rotate at engine speed. The clutch gear is in constant mesh with the clutch gear on the layshaft which is therefore also driven at engine speed, but in the opposite rotation. Since neither clutch is engaged, the drive pinions do not rotate.

When the control lever is moved to the "ahead" drive position, hydraulic action causes the clutch on the input shaft to engage and apply engine drive to the forward drive pinion. The pinion turns the gear on the output shaft and the propeller shaft and propeller rotate in the direction which corresponds with ahead movement of the vessel. Likewise when the control lever is operated to the "astern" drive position the clutch on the layshaft engages and engine drive is applied to the reverse pinion. The pinion turns the gear on the output shaft in the opposite direction and the propeller shaft and propeller rotate in the direction corresponding to astern movement of the vessel.

Hydraulic actuation

Oil is sucked from the gearbox sump through the internal supply pipe and delivered to the control valve, which incorporates a high pressure valve to ensure that the correct operating pressure is maintained.

When the operating lever is moved, oil is delivered under pressure to a feeder on either the input shaft or the layshaft and thence to a piston which actuates the corresponding clutch.

Oil in excess of that required for hydraulic actuation is used for lubricating the gearbox.

Lubrication

Oil for lubrication purposes is also delivered via the internal supply pipe to the control block. Whether the gearbox is in ahead or astern drive, or in neutral, oil is diverted from the discharge side of the pressure relief valve to an external oil cooler. On returning from the cooler the oil is directed through channels in the valve block to the feeders and thence through the layshaft and drive shaft to lubricate the clutch assemblies.

Oil surplus to clutch requirements is diverted back to the sump.

3.1 EMERGENCY OPERATION

A device is included in the gearbox which will permit the transmission to operate in "ahead" drive should hydraulic or clutch failure occur.

The method of operation is as follows:—

1. Remove the top cover, fitted behind the valve control block.
2. Rotate the appropriate* clutch shaft so that the dimple in the outer edge of the clutch end plate is uppermost.
3. Take one of the top cover screws and screw it into the threaded hole in the end plate. This is located between two ferrules, immediately below the dimple.
4. Tighten the screw in order to clamp the clutch, thereby effecting the drive.
5. Ensure that sufficient oil remains in order to avoid further damage, and refit the top cover.
6. Check that the dipstick does not foul against the bolt head, now fitted to the clutch end plate. If necessary, remove the dipstick and plug the hole with a clean rag.
7. Select neutral on the operating lever and disconnect the operating cable.
8. The gearbox can now be run up to 1/3rd throttle.

REMEMBER:

DRIVE WILL BE PERMANENTLY ENGAGED AND THERE WILL BE NO MEANS OF SLOWING THE BOAT.

FINALLY:

OBTAIN QUALIFIED ASSISTANCE BEFORE USING THE GEARBOX AGAIN.

*The majority of engines have a flywheel which rotates in an anti-clockwise direction when seen from the rear of the boat, and assuming that the gearbox has been mounted in the standard position of "vertical right hand", the correct clutch shaft to use is as follows.

For left-hand propellers, use the left hand shaft.

For right-hand propellers, use the right hand shaft.

WARNING:

Under no circumstances must the access to the "get-you-home" device be used to fill or top up the gearbox with oil. Before engaging the "get-you-home" device, ALWAYS disconnect the operating cable and ensure that the gearbox operating lever is in the neutral position.

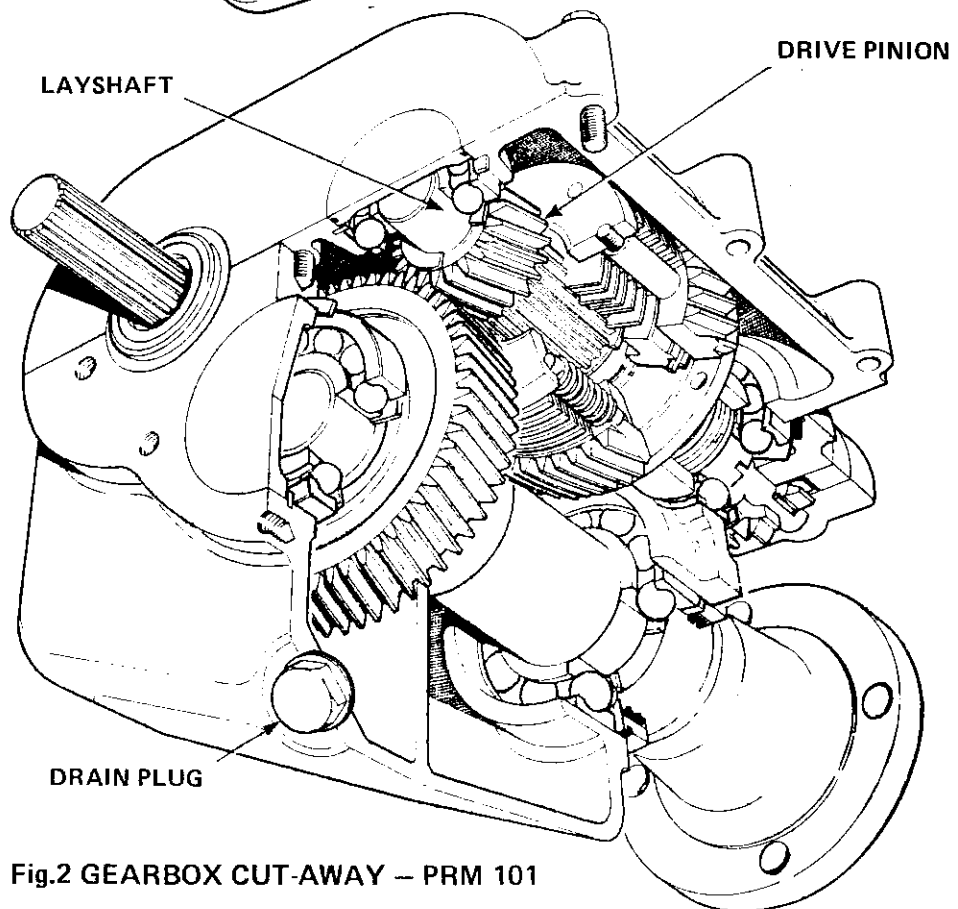
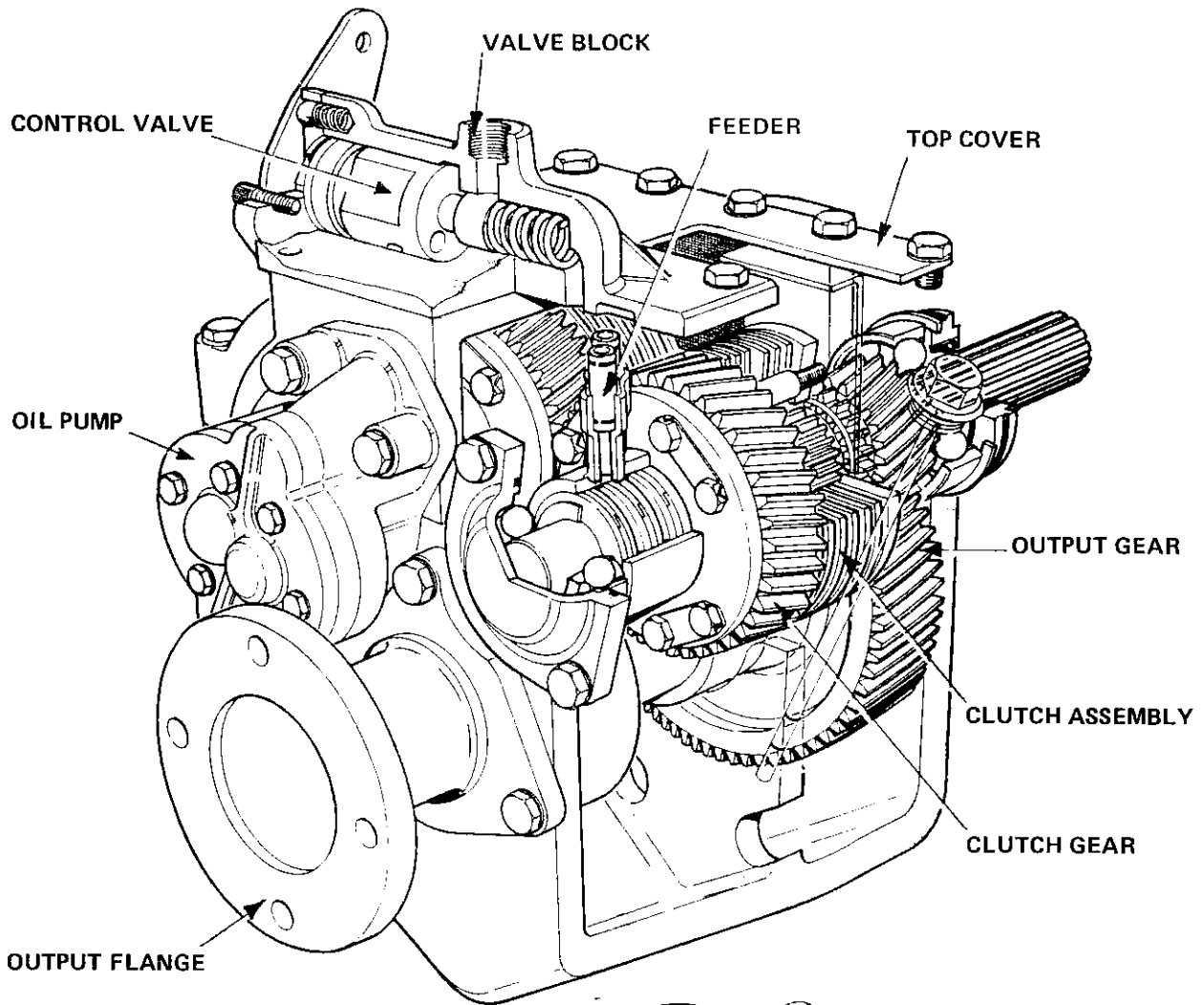


Fig.2 GEARBOX CUT-AWAY – PRM 101

4. CONSTRUCTION

The transmission comprises an input shaft assembly, a layshaft assembly and an output shaft assembly.

The input shaft, which is supported by a ball bearing at either end, incorporates a drive pinion of the required ratio (running on a special self-lubricating bearing), the forward drive clutch assembly, the clutch gear, and a hydraulically operated piston to actuate the clutch. The layshaft is similarly supported by ball bearings and also incorporates a drive pinion of the same ratio (also running on a self-lubricating bearing), the reverse drive clutch assembly, a clutch gear of opposite hand rotation to that on the input shaft, and a hydraulically operated piston to actuate the clutch.

The emergency drive acts on the layshaft assembly where the gearbox is fitted to an installation which includes an engine of left-hand crankshaft rotation and a left-hand propeller, or a right-hand rotating engine together with a right-hand propeller. With twin-engine installations which include one right-hand propeller, and one left-hand propeller, the drive acts on the input shaft in one gearbox and the layshaft in the other gearbox (see page 5 for method of engagement).

The output shaft runs on ball bearings. The bearings are so arranged as to enable propeller thrust to be absorbed, and the shafts carry an output gear of appropriate size and the output flange.

Sealing arrangements include a 54 millimetre bore seal, with 9½ millimetre retainers on the output shaft, and a 25 millimetre bore seal on the input shaft. A drain plug is fitted at the front of the gearbox casing; this can be removed for connection of suitable pipework to the two-way tap and the hand-operated sump drain pump provided on most engines.

The gearbox casing has been kept free from hydraulic pipes, cylinders and associated components, and the only items mounted externally are the oil pump, hydraulic control valve and operating lever.

Connections are provided on the valve block for the mandatory oil cooler and an optional oil pressure gauge.

Oil Pump

A cast iron gear-type pump externally mounted at the rear of the gear case and normally driven by the layshaft supplies oil at high pressure for actuation of the clutch assemblies. For continuous lubrication of the clutches and for circulation through the oil cooler, the pressure is reduced.

When the transmission is used with anti-clockwise engines the oil pump is mounted in a standard position whether a clockwise (right-hand) or anti-clockwise (left-hand) output rotation in ahead drive is required. If the transmission is to be used with clockwise rotating engines, the oil pump has to be mounted in a position 180° from normal.

Note: This is normally done in the factory when the gearbox is assembled.

Valve block

The valve block, located on top of the casing, contains the main control valve, integral with which is the high pressure valve, which controls the operation of the clutch assemblies. Oil which is surplus to clutch operation requirements is used for lubrication purposes.

The control valve is fitted with a spring-loaded neutral detent, which ensures positive selection of either the forward or reverse operating position and provides a positive neutral position.

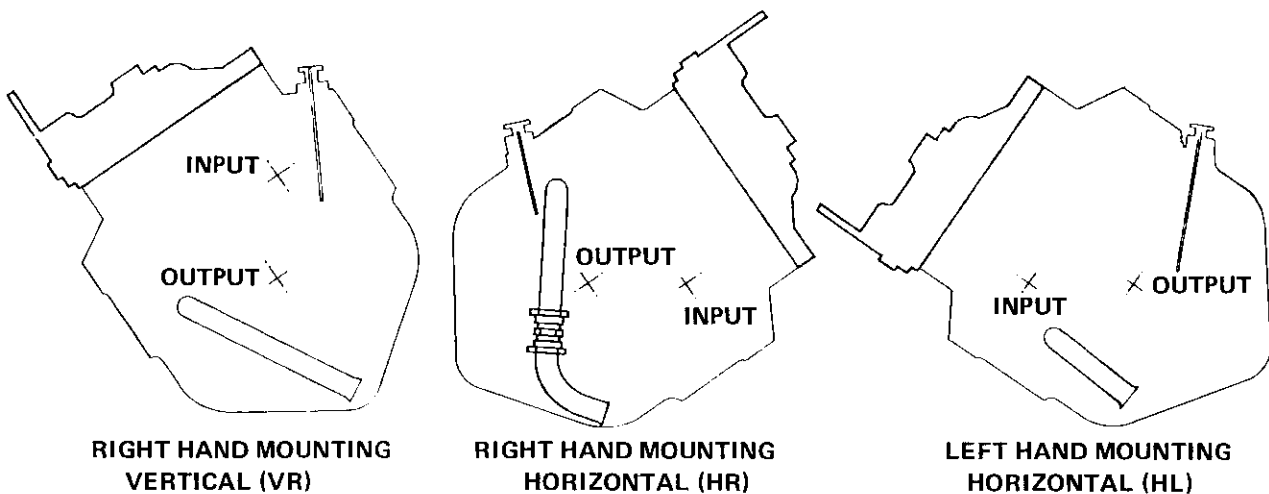
5. INSTALLATION DETAILS

5.1 INSTALLATION POSITIONS

In their standard versions PRM gearboxes are built so that the input shaft is the right-hand one of the two top shafts (as seen looking on the gearbox from behind). In order to provide a vertical offset between input and output shaft centres, the gearbox is mounted to the engine tilted at an angle to port; this is the standard installation position and is referred to as VR mounting. Unless we are specifically notified to the contrary when orders are placed all gearboxes are automatically built for VR mounting.

The PRM101 can also be arranged so that the output shaft is offset horizontally rather than vertically; this is known as HR mounting where the offset is to port, and HL mounting where the offset is to starboard.

In this case, the gearbox is mounted at an angle of tilt such that the required offset is achieved, and the dipstick is re-positioned on the port side of the gearcase.



5.2 INSTALLATION PROCEDURES

"S" version transmissions are usually mounted to the flywheel housing provided by the engine manufacturer by means of adaptor flanges. SAE4 and SAE5 are most often used with PRM101. However, special flywheel housings to which the gearbox can be fitted direct without the need for an adaptor can also be supplied for certain specific engines.

"L" version gearboxes are provided with a mounting flange already fitted.

Before installing the transmission, check that it is correct for the installation position required. The mounting position is stamped on the gearbox serial number plate, but the prudent installer will also make a visual check of the input shaft breather and dipstick by referring to the previous section, in case the gearbox has been modified after leaving the factory. Having done this, proceed as follows:—

PRM101S

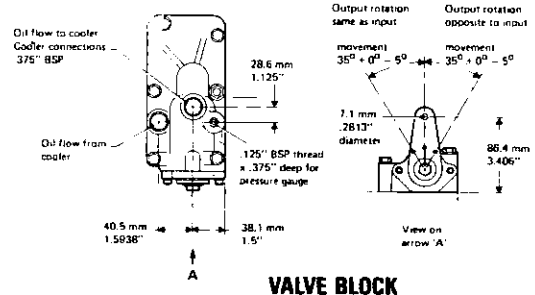
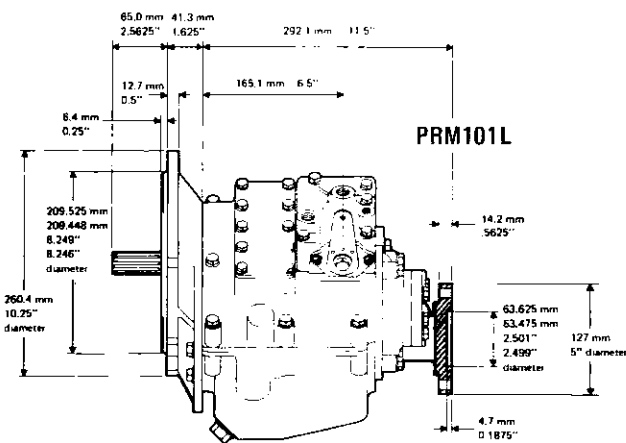
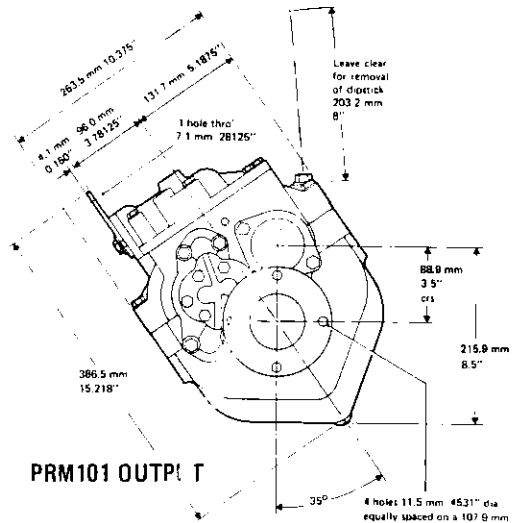
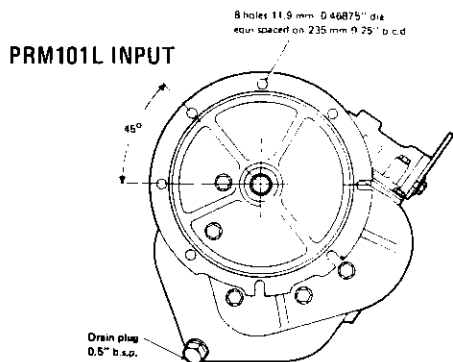
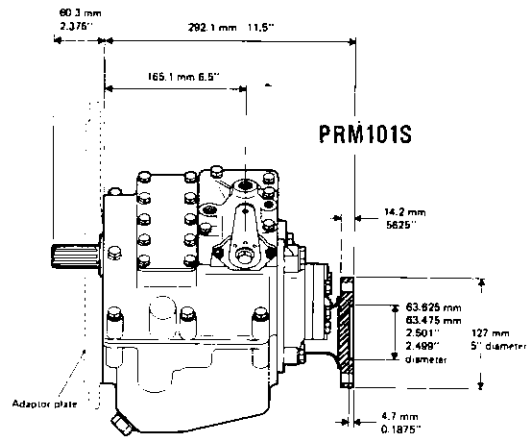
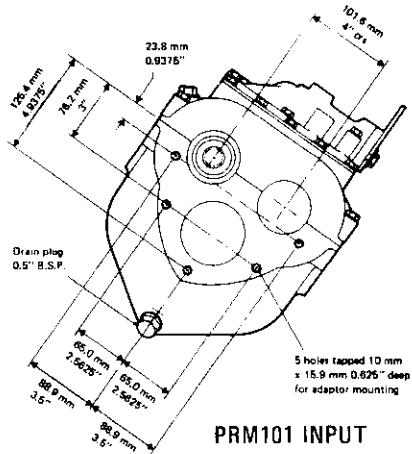
1. Mount the drive plate or flexible input coupling to the engine flywheel, using an alignment mandrel (if available) and secure. If a mandrel is not available, tighten the drive plate bolts just sufficiently to prevent free movement, assemble the gearbox to the drive plate and rotate the engine two or three revolutions by hand to line up the plate. Tighten two or three opposite bolts through the flywheel housing inspection cover.

2. Remove the gearbox and fully tighten the drive plate or flexible input coupling bolts.
3. Taking care to ensure correct alignment, mount the adaptor flange or flywheel housing to the front of gearbox.
4. Offer up the gearbox and adaptor (or gearbox and flywheel housing) assembly to the damping, or drive plate and engine flywheel housing (or back-plate) and enter the input shaft spline on the damping plate (it may be necessary to rock the gearbox slightly to ensure that the shaft enters). Press the assembly fully into position and bolt the adaptor to the flywheel housing (or the flywheel housing to the engine back-plate).
5. Mount an approved type oil cooler to the adaptor, remove the two "Redcap" plugs from the valve block and connect the cooler inlet and outlet oil connections to the back. Connect the appropriate water hoses, or pipes, to the cooler water connections, one at each end of the cooler.
6. If remote control of the gearbox is required, connect up the control equipment in accordance with manufacturer's instructions.
7. Connect the output flange via a suitable coupling to the propeller shaft.
8. If the oil pressure is to be indicated, an oil pressure gauge should be connected to the valve block by removing the pressure plug. Oil pressure 1793.2 kN/m^2 (260 p.s.i. 18.37 kg/cm^2) min.
9. Check the gearbox for oil, and if necessary, fill with one of the recommended lubricants to the 'High' mark on the dipstick. See list of recommended lubricants.
10. Set the control lever to the neutral position and run the engine to allow the oil to circulate through the oil cooler. Stop the engine and again check the level when the oil has settled.

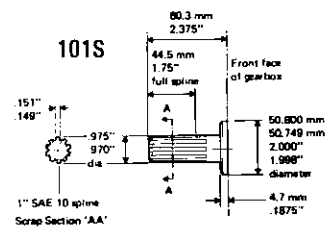
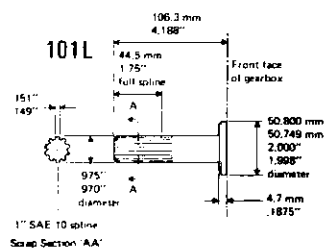
PRM101L

1. Mount the drive plate or flexible input coupling to the engine flywheel using an alignment mandrel (if available and secure. If a mandrel is not available, tighten the drive plate or flexible input coupling bolts just sufficiently to prevent free movement, assemble the gearbox to the drive plate and rotate the engine two or three revolutions by hand to line up the plate. Tighten two or three opposite bolts through the flywheel housing inspection cover.
2. Remove the gearbox and fully tighten the drive plate or flexible input coupling bolts.
3. Offer up the gearbox assembly to the drive plate or flexible input coupling and engine flywheel housing and enter the input shaft spline in the opposite spline on the drive plate (it may be necessary to rock the gearbox slightly to ensure that the shaft enters). Press the assembly fully into position and bolt the mounting flange to the flywheel housing.
4. Mount an approved type oil cooler to the adaptor, remove the two "Redcap" plugs from the valve block and connect the cooler inlet and outlet oil connections to the block. Connect the appropriate water hoses or pipes, to the cooler water connections, one at each end of the cooler.
5. If remote control of the gearbox is required, connect up the control equipment in accordance with the manufacturer's instructions.
6. Connect the output flange via a suitable coupling to the propeller shaft.
7. If the oil pressure is to be indicated, an oil pressure gauge should be connected to the valve block by removing the pressure plug. Oil pressure 1793.2 kN/m^2 (260 p.s.i. 18.37 kg/cm^2) min.
8. Check the gearbox for oil, and if necessary, fill with one of the recommended lubricants to the 'High' mark on the dipstick. See list of recommended lubricants.

9. Set the control lever to the neutral position and run the engine to allow the oil to circulate through the oil cooler. Stop the engine and again check the level when the oil has settled.
10. Check the gearbox for oil, and if necessary, fill with one of the recommended lubricants to the 'High' mark on the dipstick.
11. Set the control lever to the neutral position and run the engine to allow the oil to circulate through the oil cooler. Stop the engine and again check the level when the oil has settled. Check oil pressures ref. High pressure valve block.



INPUT SHAFT DETAILS

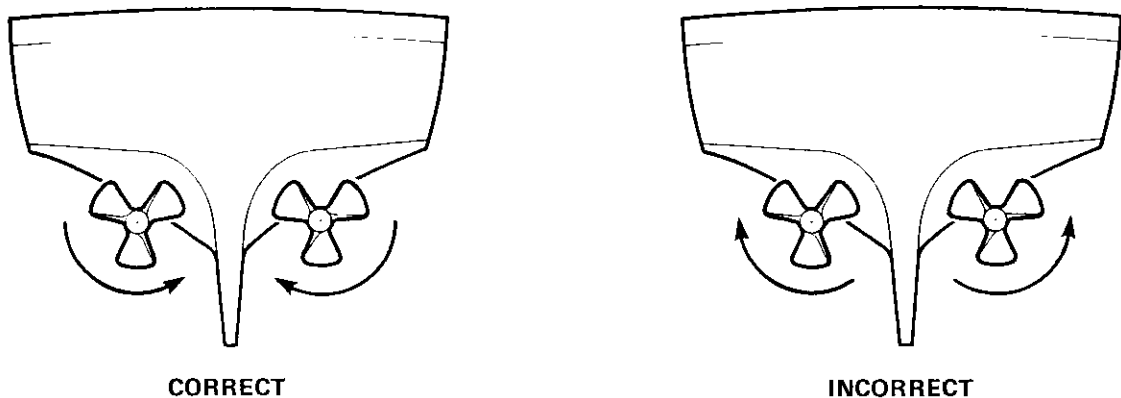


5.3 TWIN INSTALLATIONS

The rotating action of a propeller, even in a single installation, will have a slight "turning" effect on the handling of the boat, but this can be corrected by very small adjustments to the rudder.

In twin installations, the turning effect of the boat's handling will be much more pronounced if both propellers rotate in the same direction. It is therefore desirable that "handed" (i.e. counter-rotating) propellers be fitted, and it is for this reason that PRM gearboxes are capable of providing either hand of output rotation at any of the available gear ratios.

It is also preferable that the starboard (right-hand) propeller should rotate clockwise and the port (left-hand) propeller anti-clockwise rather than the other way about since, in the latter case, when the propeller blades are at the lowest point of their arc of rotation they tend to create a vacuum which acts on the other propeller by reducing the flow of water to it. Furthermore, when the boat is making a tight turn with one gearbox in "ahead" and the other in "astern", the thrust side of one propeller will be acting diametrically opposite to the other one, causing the boat to be deflected from the line which it ought to follow and thus delaying completion of the manoeuvre.



5.4 INSTALLATION ANGLE

The transmission and engine should normally be installed so that the maximum angle relative to the water line does not exceed 15° with the boat at rest, or 17° from all causes when under way. If installation angles greater than these are required our engineering department should be asked for its approval.

Note: Whenever possible, the engine and gearbox should be fitted whilst the hull is afloat, otherwise there is a danger of distorting the hull because of insufficient support being provided over its surface. If the engine and transmission are fitted before the hull is placed in the water, the installation should be very carefully re-checked for alignment after launching.

5.5 PROPELLER SHAFT COUPLINGS

It is generally considered preferable to couple the propeller shaft direct to the gearbox output flange by means of a rigid coupling, particularly in the majority of boats whose hulls have sufficient rigidity as not to allow flexing in heavy sea conditions, which could cause the engine and transmission to shift in relation to the propeller shaft.

Two of the main conditions when a flexible coupling should be used are:—

- (a) In boats whose hulls are insufficiently rigid to prevent the flexing referred to above and
- (b) in cases where the engine is mounted on flexible mounts.

In both instances, the flexible coupling will isolate engine vibration or other movement from the propeller shaft, thereby enabling the correct alignment of the propeller shaft and the stern tube to be maintained.

Whether a solid or a flexible coupling is used, it is extremely important that the following points are carefully checked:—

- (i) the coupling should be a light press fit on the shaft and the keyway accurately made to the correct size, and,
- (ii) the two halves of the coupling should be carefully aligned (this should be checked by feeler gauges above, below and on both sides of the coupling).

Coupling misalignment can cause vibration, gear noise and premature failure of oil seals or bearings. Since the propeller shaft line is normally fixed in the boat, alignment is usually obtained by adjusting engine mount shims or the mounts themselves.

5.6 INPUT COUPLINGS

To transmit the drive from the engine to the gearbox either a spring drive plate (damper plate) or a flexible input coupling must be used. Each incorporates a degree of flexibility in order to damp down engine torsional or cyclic vibrations and prevent them being passed on to the transmission.

The strongest engine vibrations are caused by firing the cylinders: Diesel engines, which have high compression ratios, usually generate stronger vibration pulses than petrol (gasoline) engines. It is often the case that when comparing engines of roughly equivalent size, the engine with the greater number of cylinders will tend to run more quietly and smoothly than the one with fewer cylinders, although this is by no means always the case.

Spring drive plates supplied for use with PRM gearboxes are adequate to cope with the vibrations normally likely to be created by the engine, but gear rattle can sometimes occur at very low speeds. If this does happen, raising the idling speed slightly will usually eliminate this vibration.

Flexible input couplings are normally reserved for use in installations where really heavy duty operation, such as trawling, tug work and so on, is to be encountered; however, because they have better vibration damping characteristics than spring drive plates, they may also be used to advantage where excessive vibration is experienced.

5.7 STARTING THE ENGINE

Before starting the engine **fill the gearbox to the correct level with a recommended oil and ensure that it is in neutral.** The neutral position is obtained when the operating lever is in the central position, which ensures that the flow of oil to the clutches is blocked at the control valve.

All PRM gearboxes are designed and tested to ensure that changes from "ahead" to "astern" or vice versa can be carried out at any engine speed up to the maximum recommended; however, transmission life will be increased if engine speed is brought down to approximately 1000 rev/min when direction is being changed.

In the case of left-hand (anti-clockwise) rotating engines right-hand propeller rotation is obtained by moving the gearbox operating lever to its extreme rear position, and left-hand propeller rotation obtained by moving the lever to its extreme forward position.

In the case of right-hand (clock-wise) rotating engines, the situation is reversed: left-hand propeller rotation is obtained when the lever is moved back, and right-hand rotation when it is forward.

(Anti-clockwise engines are by far the most common, and the standard gearbox build therefore assumes an anti-clockwise input; unless otherwise stated, the standard output rotation is right-hand).

All of the three positions for the operating lever, ahead, neutral and astern, are positively obtained by means of a spring loaded detent ball which enters a chamfered hole on the operating lever and gives a good "feel" to the operating mechanism.

5.8 TRAILING THE PROPELLER

PRM gearboxes are designed and tested to ensure that prolonged periods of trailing (free-wheeling) the propeller are permissible without any detrimental effect to the transmission. It is not therefore necessary to provide any propeller shaft locking device.

6. ROUTINE MAINTENANCE

Initial servicing – after 25 hours running

Drain all oil from the transmission and refill with one of the recommended lubricants to the high level mark on the dipstick and operate the engine and transmission to allow the oil to circulate. Stop the engine and recheck the oil level when the oil has settled.

Daily

1. Check gearbox oil level.
2. Make a quick visual inspection of the general conditions of the transmission and check for oil leakage at the output shaft oil seal, at gasket sealing surfaces or in the bell housing.
3. Listen for any unusual noises and check for their causes.

Annual

1. Check all oil cooler connections and hoses for leakage.
2. Check propeller shaft alignment.
3. Check that the remote control operating linkage (where fitted) is correctly adjusted to give correct amount of travel on the gearbox operating lever.

Winter storage

Drain water from the transmission oil cooler in order to avoid freezing or the collection of harmful deposits.

Other maintenance operations

1. Transmission oil should be changed at periods roughly corresponding with the intervals at which the engine oil is changed.
2. If the gearbox oil has suffered severe contamination by water, or if major mechanical damage has occurred, the oil should be changed.

Gear chatter

Engine vibrations, caused by firings in the cylinders, can occasionally be transmitted to the gearbox, resulting in gear rattle; other factors influencing this include the inertia of the flywheel, the weight of the propeller shaft, alignment of the input coupling or drive plate on the flywheel, propeller shaft coupling alignment, and size and design of propeller.

If excessive rattle is experienced, action should be taken in the following order:—

1. Slightly increase the idling speed of the engine; in most cases this will eliminate the problem.
2. Check the alignment of the propeller shaft coupling by using feeler gauges on all four sides; rectify if necessary by adjusting the shims under the engine mounts or by adjusting the engine mounts themselves.
3. Remove the propeller and check that the pitch, weight, diameter and balance of all the blades are equal, and rectify if necessary.
4. Remove the transmission and check that the flywheel face is flat and that the drive plate or flexible input coupling is correctly aligned.

5. Check the gearbox for mechanical damage.

The use of flexible couplings at both input and output side will almost certainly bring about an improvement.

Oil pressures

The minimum normal operating pressure of the hydraulic circuit is 1792.7 kN/m^2 (260 psi, 18.27 kg/cm^2). In order that this may be checked, connections are provided on the valve block to enable an oil pressure gauge to be fitted into the circuit.

Loss of oil pressure will result in the complete loss of drive through the gearbox, and if this does occur, the following checks should be made:—

1. Check for visible evidence of any oil leakage;
2. Check the oil level in the gearbox;
3. Remove the oil pump and check for damage, particularly to the pump spindle tang.

If these checks all prove negative, it is likely that the fault lies in the valve block. In this case, further advice should be sought from an authorised distributor or stockist.

7. SERVICING AND REPAIRS

The servicing or repair of components or assemblies on the input shaft or layshaft is simplified by the ease with which the shafts can be removed from the box without having to remove the complete unit from the installation.

This can be further simplified by fitting complete replacement shaft assemblies, and where skilled service personnel, of workshop facilities, or both, are not readily available, it may be found advantageous to adopt this procedure.

The maintenance of items on the output shaft will require that the gearbox is removed from the boat.

A cut-away arrangement of the gearbox is shown in Fig. 2.

7.1 REMOVING THE INPUT SHAFT AND LAYSHAFT ASSEMBLIES

1. Drain the gearbox oil into a suitable container.
2. Remove the four bolts securing the oil pump to the casing and remove the pump.
3. Remove the two bolts securing the drive shaft end plate.
4. Disconnect the oil cooler pipes and the cable or cables from the control lever or control equipment.
5. Unscrew and withdraw the seven bolts and the one nut on the valve block which secure the top half of the casing. Lift off the casing complete with valve block assembly and top cover.
6. Slacken the flywheel damping plate securing bolts to allow slight movement of the plates when withdrawing the input shaft spline. On units incorporating 3 : 1 reduction it is recommended that all bolts except one are removed from the damping plate and the plate pivoted on this one bolt to enable the shaft to be lifted clear of the gear on the output shaft.
7. Raise the shaft, and if necessary gyrate a little to withdraw the spline from the opposite spline on the damping plate.
8. Once the spline is clear, lift the complete shaft assembly from the casing. Lift and remove the layshaft assembly and the front end cover from the casing.

7.2 SERVICING THE CLUTCH SHAFT ASSEMBLIES

Input Clutch Shaft Oil Seal

In the event of an oil leak due to a damaged seal, remove the input end housing from the shaft, and with the aid of a hard wood drift and hammer force the seal from the housing.

Fit a new seal part no. MT165 in the housing and replace the housing.

Drive End Bearing

To renew a damaged or worn bearing proceed as follows:—

1. Support the shaft in a vice, and then remove the input housing and seal assembly.
2. Using circlip pliers remove the circlip in front of the bearing.
3. Withdraw the clutch pinion, spacer and bearing using pulley extractors with the jaws of the extractors located behind the pinion.
4. Refit the clutch pinion to the shaft.

5. Replace the pinion spacer, locate a new bearing, part no. 0540251 on the shaft and gently drive, with a hard wood drift and hammer, or handpress the bearing into position.
6. Refit the small circlip, part no. 0330250.
7. Replace the shaft, together with end housing and large circlip. Check that oil seal and 'O' ring are still in good condition. Replace if necessary.

Clutch Assembly

Clutch plates which are discoloured by overheating, or worn down to the extent of having lost their pattern of "criss-cross" grooves, will tend to slip. If either of these conditions arise, or if the plates are in some other damaged condition, the complete drive plate assembly will need to be replaced in the following way:—

1. Remove the drive pinion and bearing as described and unlock and remove the six clutch securing bolts, taking care not to lose any of the locating ferrules.
2. Withdraw the complete clutch from the shaft and observe the positions of the pull-off springs and pins.
3. Stand the shaft in an upright position and locate the retaining pins in the clutch gear.
4. Fit the clutch end plate (part no. MT117) over the pins and then starting with one of the driver clutch plates, build up the replacement clutch onto the end plate.
5. Place the ferrules in the spaces between the driven clutch plates and fit the pull off springs over the pins.
6. Replace the end cover onto the pins, locating them in the blind holes in the cover.
7. Re-fit the securing bolts and locating strips by feeding them through the flange on the clutch shaft, and lightly tighten.
8. Turn the shaft upside down and, ensuring that the pull-off pins are correctly located, tighten the bolts with a torque spanner set at 12.2 Nm (9 lb.ft. 1.24 kgm), and close the locking strips over the bolt heads.
9. Replace the drive pinion by turning it slightly as it is inserted into the driver clutch plates until it touches the bottom washer.
10. Replace the spacer, bearing and circlip as described.

Clutch Gear

To fit a new clutch gear, part no. MT333, remove the clutch as described and extract the piston retaining spacer and circlip, to allow the piston and clutch gear to be removed from the shaft.

Separate the gear from the piston, ensure that the inner and outer piston ring step joints are intact, then fit a new gear around the piston.

Refit the piston to the shaft. Replace the circlip and spacer and then re-assemble the clutch, drive pinion and bearing.

Note: To ensure quiet operation it is advisable to renew both clutch gears simultaneously.

Drive pinion

To renew a drive pinion, remove the drive end bearing and pinion with pulley extractors as described. As with the clutch gears, it is advisable to renew both pinions simultaneously.

To ensure that the correct ratio drive pinion is selected, please refer to the parts list at the back of this booklet. If a different ratio is required compared to that which was originally supplied, the output gear, as well as both pinions, will need to be changed.

Non-drive end bearing

Remove the circlip, part no. 0330250. Remove sufficient clutch securing and assembly bolts to permit light duty bearing pullers to be located behind the feeder, and pull off the bearing. Before refitting, examine the bearing carefully, and replace it if it exhibits any sign of damage.

Piston rings and feeder

Excessive wear or damage may necessitate renewal of the piston rings and feeder, and in this event the following procedure should be adopted:—

1. Remove the non-drive end bearing and withdraw the spacer and the feeder.
2. Use a special piston ring extractor or a piece of thin steel to remove the rings from the shaft.
3. Raise one end of the top ring out of the groove and insert the steel strip between the ring and the shaft. Rotate the strip around the shaft, applying slight forward pressure to the raised portion of the ring until it rests on the land above the groove. It can then be eased off the shaft. Do likewise with the other two rings.
4. Remove the new rings, part no. CP1192, from the packing and clean off any grease or inhibitor.
5. If available, fit a ring loading tool around the shaft, load the rings on the tool and locate in their approximate position. Gently withdraw the tool and allow the rings to locate in their grooves.
6. Where a loading tool is not available use a thin metal strip, long enough to lay along the shaft above the grooves. Expand each ring just sufficiently to allow them to be placed in approximate position over the strip. Gently remove the strip and locate the rings in their respective grooves.
7. Compress each ring in turn and carefully fit a new feeder, part no. MT315 and spacer.

7.3 REPLACING THE INPUT SHAFT AND LAYSHAFT ASSEMBLIES

1. Position the input shaft assembly in the casing, and ensure that the circlip, part no. 0250620 is correctly located in the lower half of the gearcase, and that the end housing is in position; engage the spline with the spline of the drive plate, and tighten the bolts which secure the plate to the flywheel.
2. Locate the layshaft in the casing and ensure that the end cover is correctly positioned.
3. Locate the gasket, fit the top half of the case and secure.
4. Refit the input shaft and plate, replacing the 'O' ring if damaged.
5. Refit the oil pump, replacing the 'O' rings if damaged.
6. Re-connect the oil cooler pipes and control cable or cables.
7. Refill with one of the recommended lubricants and check oil level.
8. Run the engine, shut down, and check oil level.

7.4 SERVICING THE OUTPUT SHAFT

Removing the Output Shaft

Removal of the output shaft will necessitate removing the gearbox from the installation in the following way:-

1. Drain the gearbox oil into a suitable container. Support the gearbox to take the weight off the drive shaft and the output shaft, remove the output flange coupling bolts and disconnect the propeller shaft coupling.
2. Disconnect the cable from the control lever.

3. Obtain access to the damping plate through the flywheel housing or inspection cover on the adaptor plate; slacken the engine damping plate securing bolts and then remove the engine adaptor plate mounting bolts. (If a one-piece flywheel housing is used instead of an adaptor plate, remove the bolts attaching the flywheel housing to the engine. In this case it will be impossible to slacken the damping plate securing bolts unless there is an inspection cover).
4. Withdraw the gearbox and adaptor plate (or flywheel housing) from the damping plate and remove the unit from the installation.
5. Remove the oil pump and input shaft end cover and then the top half of the casing as previously described.
6. Remove the input shaft and layshaft assemblies.
7. Remove output shaft end cover by applying a magnet and tapping the gearcase face with a soft hammer. In some cases, extreme corrosion will prevent the cover from moving. If all else fails, the cover must be drilled to provide extractor holes and a replacement cover fitted.
8. Remove circlip part no. 0030350.
9. Remove the three retaining bolts holding the end housing (part no. MT319).
10. Turn the gearcase on the end face with the output coupling face down. Using hardwood drift and hammer, knock the end of the shaft through the bearing and remove the output shaft assembly out of the case. The output gear will now be loose in gearcase.
11. Follow the next procedure for fitting a new rear bearing if the output shaft itself needs replacing.

REAR BEARING AND OIL SEAL

1. Having followed the procedure for removing the output shaft, it will now be free complete with nut, tab washer, bearing and housing with seal.
2. Bend back the tabs on tab washer to allow the locking nut to be unscrewed.
3. The bearing can now be removed from the shaft using a soft hammer or hand press.
4. If the bearing is defective, check that the gears have not been damaged by debris. Similarly, if a gear is defective, check that the bearing is undamaged.
5. Remove the rear housing with seal. Remove the small circlip 0330380 from the shaft. The output shaft will now be bare and can be removed if necessary.

RE-ASSEMBLING THE OUTPUT SHAFT

1. Check that the large circlip part no. CP1190 in the case bottom half is undamaged. Renew if necessary.
2. Remove 'O' ring part no. 003504 and oil seal part no. MT349 from the rear housing and replace with new parts. (It is advisable to renew these parts whenever the output shaft is stripped).
3. Fit the rear cover with 'O' ring and oil seal fitted to the output shaft.
4. Press on rear bearing.
5. Fit tab washer. Screw on locking nut. Bend back tabs to retain locknut.
6. Fit circlip part no. 0330380 to shaft.

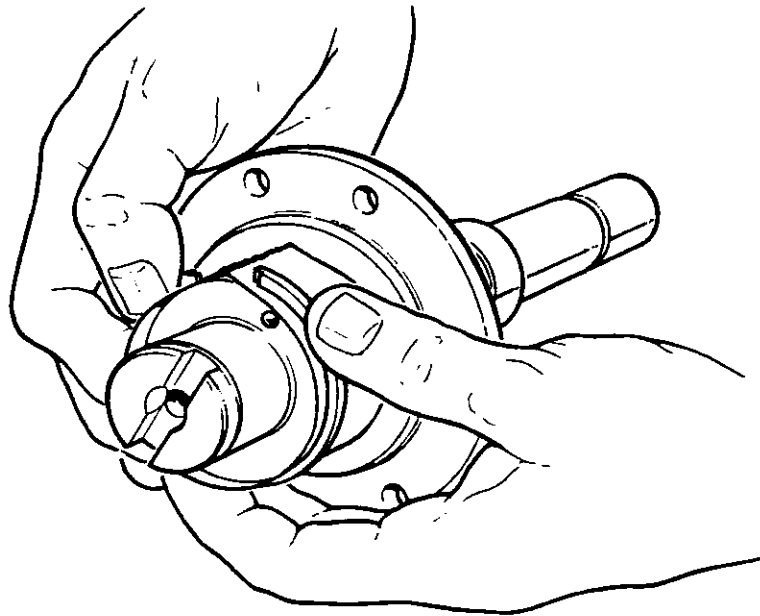
7. Align the output gear in the gearcase and press shaft assembly into the case, picking up the output gear at the same time. Ensure that the cut-out profile on the rear oil seal housing lines up with the profile of the oil pump on the rear case face.
8. Press in front bearing. Fit circlip part no. 0330350.
9. Fit new oil seal to front cover plate and refit.
10. Refit input and layshaft assemblies as previously described.

7.5 VALVE BLOCK

The complete valve block is easily removed for inspection: remove the five bolts and one nut which connect it to the gearcase.

To remove the control valve and high pressure valve, remove the two cap screws (part no. 0081220) and withdraw the valves from the valve body. Care should be taken not to lose or misplace the detent ball bearing and spring.

Inspect 'o' ring, part no. 000753 and bearing, part no. CP1307 and replace if worn, damaged or defective. Also check that valve spring, part no. MT 1194 has retained its correct free length 1.701 in. 43.2 mm), and if not replace it.



PISTON RINGS – FITTING PROCEDURE

8. FAULT FINDING

The fault finding chart below is designed to help diagnose some of the simpler problems encountered. It assumes that the installation and operating instructions in this manual have been followed and we advise that these are checked before proceeding to fault finding.

To avoid prejudicing warranty rights, no repair or other work should be done on the gearbox during the warranty period without first contacting NEWAGE TRANSMISSIONS LTD, COVENTRY, or authorised distributor or dealer, for advice.

| SYMPTOM | NOTICABLE EFFECT | CAUSE | REMEDY |
|-----------------------------------|---|---|---|
| No oil pressure | No drive ahead or astern | Damaged oil pump | Remove oil pump and examine. If possible replace gears and shafts with repair kit. If body damaged replace complete unit. |
| | | Broken input drive plate | Replace drive plate. |
| Low oil pressure to both clutches | Propeller speed does not increase with engine speed ahead and astern | Damaged or worn oil pump | Repair with kit or replace. |
| | | Remote control cable or linkage not allowing F-N-R lever to move correct distance | Remove cable and operate lever by hand. Adjust cable if necessary. |
| | | Pressure relief valve spring defective | Remove valve block and replace spring. |
| Low oil pressure to one clutch | Propeller speed does not increase with engine speed in one direction only | Piston rings worn. Feeder worn | Remove appropriate clutch shaft. Replace worn feeder or piston rings. |
| | | Damaged 'O' ring in hydraulic circuit | Check 'O' rings in feeder connectors and piston. |
| | | Blocked hydraulic passage in valve block | Remove valve block and examine. |
| | | Damaged clutch plates | Remove and examine clutch on appropriate shaft, replace if necessary |
| Gearbox noise | Excessive noise from gearbox | Input drive plate defective | Remove, examine and replace if necessary. |
| | | Gear rattle at low speed | Increase engine idling speed. |

| SYMPTOM | NOTICABLE EFFECT | CAUSE | REMEDY |
|------------------------------------|---|--|--|
| Gearbox noise | Excessive noise from gearbox | Defective bearing | Isolate defective bearing noise, remove and replace. |
| Excessive high oil Temperature | Gearcase too hot to touch | Defective oil cooler | Replace oil cooler. |
| | | Defective pressure relief valve | Remove and examine relief valve. Replace if necessary. |
| Gearbox oil consumption excessive | Oil level requiring constant topping up | Defective oil seal, gasket or 'O' ring | Clean the outside of the gearcase, particularly around the ends of shafts including the output shaft. Run the engine and observe the gearbox for leaks. Replace seals as required. |
| | | Defective oil cooler | Check for traces of water in the gearbox oil or oil in the cooling water system. Replace cooler if necessary. |
| | Escape of high pressure in gearbox when dipstick is removed | Defective breather. (causing leaks past oil seals) | Contact NEWAGE TRANSMISSIONS LTD, COVENTRY for advice. |
| Control lever on valve block stiff | Difficult to move single lever control | Defective valve or detent spring | Contact NEWAGE TRANSMISSIONS LTD, COVENTRY for advice. |

9. RECOMMENDED LUBRICANTS

| Company | Ambient Temperature Below 0°C | Ambient Temperature 0°C – 30°C | Ambient Temperature Above 30°C |
|-----------|--|--|--|
| BP | BP Vanellus M20-50 | BP Vanellus M20-50 | BP Vanellus M20-50 |
| Castrol | Castrol GTX or Deusol CRB 20W/50 | Castrol GTX or Deusol CRB 20W/50 | Castrol GTX or Deusol CRB 20W/50 |
| Century | Century Supreme 20W/50 or Centlube Supreme 10W/30 | Century Supreme 20W/50 or Centlube Supreme 10W/30 | Century Supreme 20W/50 |
| Chevron | Chevron Delo 100 10W or Chevron Delo 200 10W | Chevron Delo 100 20W/20 or Chevron Delo 200 20W/20 | Chevron Delo 100 30 or Chevron Delo 200 30 |
| Conoco | Conoco 20W/50 or Conoco HD 10W/30 | Conoco 20W/50 or Conoco HD 10W/30 | Conoco 20W/50 |
| Duckhams | Fleetol Multilite | Q Motor Oil or Fleetol Multi-V | Q Motor Oil or Fleetol Multi-V |
| Elf | Cougar 15W/30 | Cougar 15W/30 | Cougar 15W/30 |
| Esso | Esso Superlube or Essolube HDX Plus 10W-30 or Essolube XD-3 10W | Esso Superlube or Essolube HDX Plus 30 or Tromar HD30 | Essolube HDX Plus 30 or Tromar HD30 or Essolube XD-3 30 |
| Fina | Fina Dilano 20 or Fina 20W/50 | Fina Dilano 30 or Fina 20W/50 | Fina Dilano 40 or Fina 20W/50 |
| Gulf | G.M.O. XHD 10W/30 or G.M.O. XHD 10W | G.M.O. XHD 10W/30 or G.M.O. XHD 20W/20 | G.M.O. XHD 10W/30 or G.M.O. XHD 30 |
| Mobil | Mobil Super 15W-50 or Delvac Special 10W-30 or Delvac Super 15W-40 | Mobil Super 15W-50 or Delvac Special 10W-30 or Delvac Super 15W-40 | Mobil Super 15W-50 or Delvac Special 10W-30 or Delvac Super 15W-40 |
| Shell | Shell Super Motor Oil or Rotella TX 20W/40 | Shell Super Motor Oil or Rotella TX 20W/40 | Shell Super Motor Oil or Rotella TX 20W/40 |
| Silkolene | Chatsworth 10 Engine Oil or Permavisco 20W650 Engine Oil | Chatsworth 20 Engine Oil or Permavisco 20W/50 Engine Oil | Chatsworth 30 Engine Oil or Permavisco 20W/50 Engine Oil |
| Texaco | Ursatex 20W-50 or Ursa Extra Duty 20W-40 | Ursatex 20W-50 or Ursa Extra Duty 20W-40 | Ursatex 20W-50 or Ursa Extra Duty 20W-40 |
| Total | GTS or HD2.M 20W/50 | GTS or HD2.M 20W/50 | GTS or HD2.M 20W/50 |
| Valvoline | Super HPO 10W or HDS HDM 10W Grades | XLD 15W 50 | XLD 15W 50 or All Climate 20W-50 |

Customers wishing to use any oil not listed above should send the relevant details to Newage for prior approval. Failure to do so may result in the forfeiture of warranty cover since no claims under warranty will be entertained if oil of the wrong specification is used.

Any other queries relating to this list should be addressed to:

**Service Department, Newage Transmissions Limited, Barlow Road, Coventry CV2 2LD, England.
Telex No. 31333 (a/b Newage G) Telephone: (0203) 617141**

SPARE PARTS ORDERING

When ordering spare parts the following should be quoted:

- (a) Gearbox model and serial number
- (b) Description(s) and part number(s) of the component(s) required
- (c) Quantity required

NOTES

- 1 Individual items which form part of an assembly, or main components, are indented and may be supplied separately; if the assembly is ordered all components pertaining to that assembly are supplied. For example, if the 'clutch input shaft' assembly is ordered the shaft itself and every item called up and shown on the corresponding illustration will be supplied, with the exception of the end housing and oil seal. The same applies to the layshaft.
- 2 Clutch plate assemblies, i.e. end plates, driven plates and driver plates are supplied in sets.

Orders and enquiries for spare parts should be addressed to:

NEWAGE TRANSMISSIONS LIMITED
BARLOW ROAD
COVENTRY CV2 2LD
ENGLAND

Telephone: 0203 617141

Telex: 31333

Cables: 'SUPAGEARS' Coventry

METRIC DIMENSIONS

Where metric dimensions are shown in the description column, or without brackets in the remarks column, i.e. bearing dimensions, these are actual dimensions.

Where metric dimensions are shown within brackets in the remarks column, these are equivalent metric dimensions to imperial and are intended to assist identification of components only.

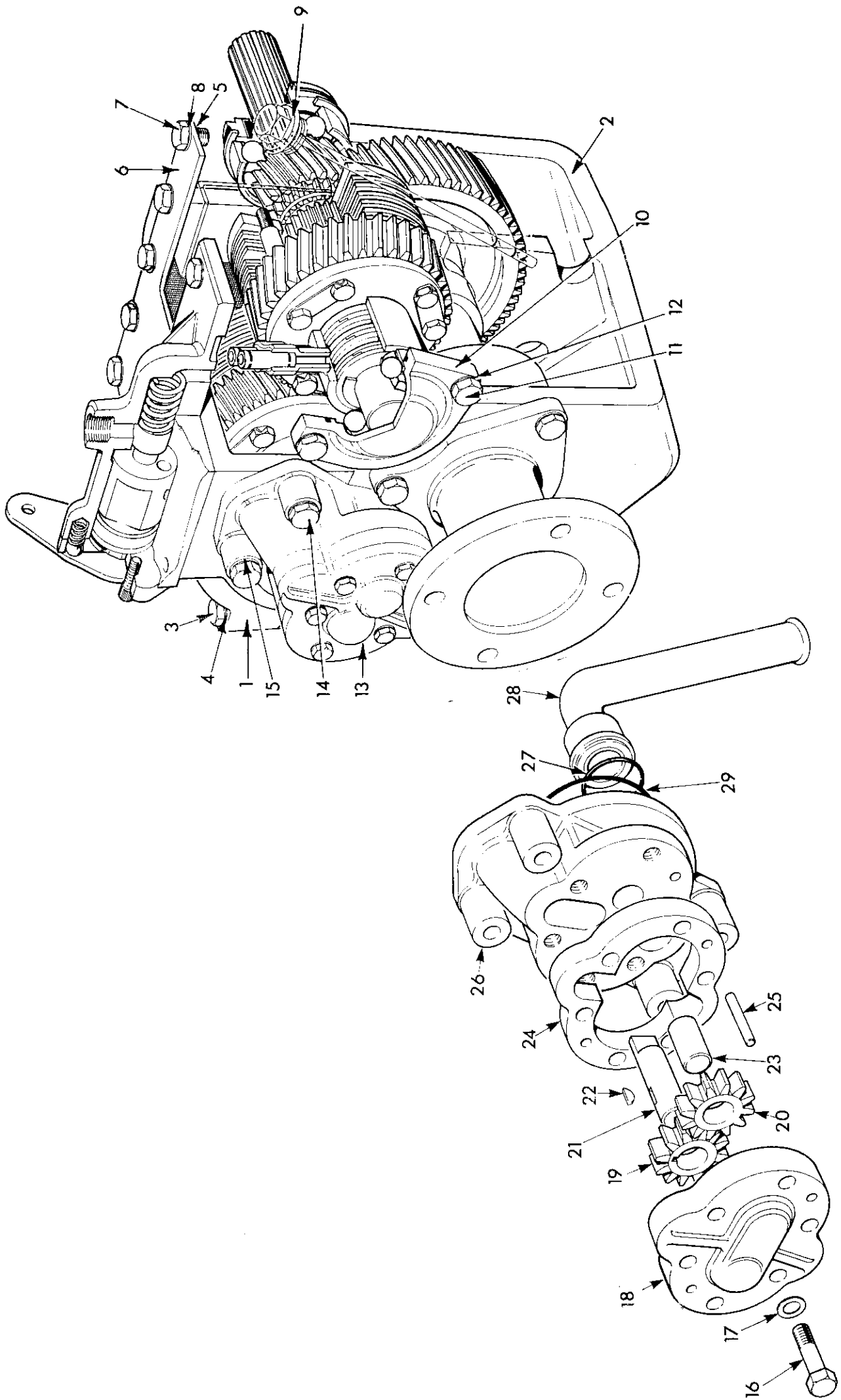


Fig.1 OIL PUMP and GEARBOX ASSEMBLY

| Plate Ref. | Description | PRM 101 Part No. | Qty. | Remarks |
|------------|---|------------------|------|------------------------------------|
| | <u>GEARCASE ASSEMBLY COMPRISING:</u> | | | |
| 1 | CASE SUB-ASSEMBLY | MT0080 | 1 | Supplied complete only |
| 2 | Gearcase - top | MT1119 | 1 | Not supplied separately |
| 3 | Gearcase - bottom | MT991 | 1 | Not supplied separately |
| 4 | Bolt 3/8" UNF x 2" | UBF113 | 6 | |
| 5 | Washer 3/8" (9.5mm) | W108 | 6 | |
| 6 | Gasket | MT343 | 1 | |
| 7 | Top cover | MT1121 | 1 | |
| 8 | Screw 5/16" UNF x 3/4" | USF32 | 10 | |
| 9 | Washer 5/16" (7.9mm) | CP1223 | 10 | |
| 10 | Oil level indicator - vertical | MT471 | 1 | |
| 11 | Oil level indicator - horizontal | MT1137 | 1 | |
| 12 | End cover | MT318 | 1 | |
| 13 | Screw 3/8" UNF x 3/4" | USF33 | 2 | Items not illustrated: |
| 14 | Washer 3/8" (9.5mm) | CP1124 | 2 | Gearcase breather - CP1116 - 1 off |
| 15 | Bolt 3/8" UNF x 1 1/2" | UBF93 | 4 | Drain plug - CP1189 - 1 off |
| | Washer | CP1224 | 4 | Seal washer - CP1068 - 1 off |
| | <u>OIL PUMP ASSEMBLY COMPRISING:</u> | | | |
| 16 | Bolt 5/16" UNF x 1 1/4" | MT479 | 1 | |
| 17 | Washer 5/16" (7.9mm) | UBF72 | 6 | |
| 18 | Pump cover | CP1223 | 6 | |
| 19 | Pump gear - driver | MT321 | 1 | |
| 20 | Pump gear - driven | MT322 | 1 | |
| 21 | Pump spindle | MT323 | 1 | |
| 22 | Woodruff Key | MT324 | 1 | |
| 23 | Pump spindle | CP1193 | 1 | |
| | Items 19 - 23 only supplied as pump repair kit S/A under part no. MT903 | MT325 | 1 | |
| 24 | Pump plate | MT320 | 1 | |
| 25 | Dowel | MT356 | 2 | |
| 26 | Adaptor | MT314 | 1 | |
| 27 | 'O' ring | 001254 | 2 | |
| 28 | Oil pipe - standard | MT736 | 1 | |
| 29 | 'O' ring | 002873 | 1 | |

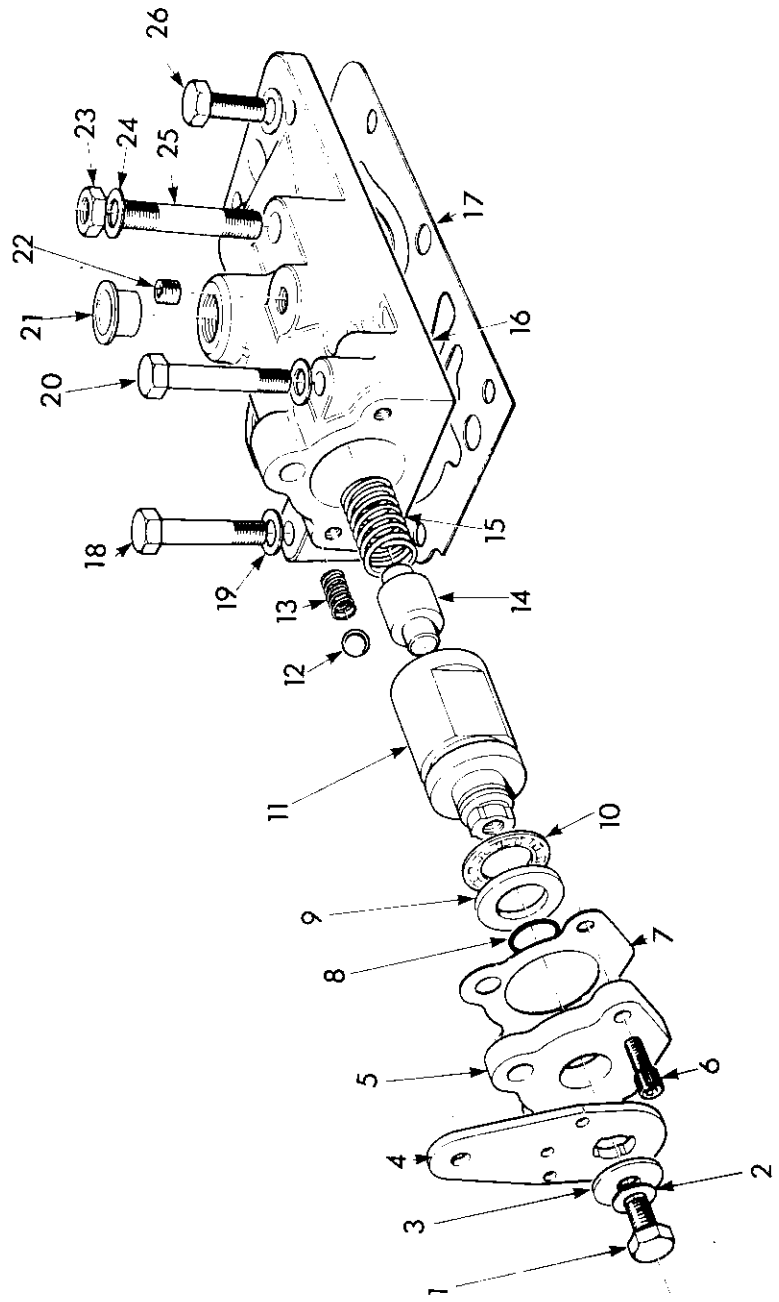


Fig.2 VALVE BLOCK ASSEMBLY

| Plate Ref. | Description | PRM 101 Part No. | Qty. | Remarks |
|------------|---|------------------|------|--------------------------------|
| | <u>INPUT SHAFT ASSEMBLY</u> | | | |
| | SHORT SPLINED SHAFT - 2:1 RATIO | MT0086/2 | 1 |) |
| | SHORT SPLINED SHAFT - 3:1 RATIO | MT0086/3 | 1 |) ORDER ACCORDING TO |
| | LONG SPLINED SHAFT - 2:1 RATIO | MT0082/2 | 1 |) GEARBOX SPECIFICATION |
| | LONG SPLINED SHAFT - 3:1 RATIO | MT0082/3 | 1 |) |
| | EACH ASSEMBLY COMPRISES: | | | |
| 1 | Circlip | 00330250 | 1 | |
| 2 | Bearing (25mm bore, 62mm O/D 17mm wide) | AM161 | 1 | |
| 3 | Spacer | MT350 | 1 | |
| | PINION AND BUSH SUB ASSEMBLY: 2:1 RATIO | MT733 | 1 | Supplied as S/A only |
| 4 | Bush | MT361 | 2 | Not supplied separately |
| 5 | Pinion (27 teeth) | MT328 | 1 | Not supplied separately |
| | PINION AND BUSH SUB ASSEMBLY: 3:1 RATIO | MT732 | 1 | Supplied as S/A only |
| 4 | Bush | MT361 | 2 | Not supplied separately |
| 5 | Pinion (17 teeth) | MT326 | 1 | Not supplied separately |
| | CLUTCH PACK SUB ASSEMBLY | MT0089 | 1 | Supplied complete only |
| 6 | Clutch end cover | MT1113 | 1 |) |
| 7 | Clutch plate - driver | MT731 | 6 |) |
| 8 | Ferrule | MT1156 | 6 |) |
| 9 | Clutch plate - driven | MT116 | 5 |) |
| 10 | Clutch end plate | MT117 | 1 |) These items are not supplied |
| 11 | Spacer | MT344 | 1 |) separately |
| 12 | Circlip | CP1102 | 1 |) |
| 16 | Spring | MT1157 | 3 |) |
| 17 | Pin | MT1155 | 3 |) |
| 24 | Tap strip | MT351 | 3 |) |
| 25 | Bolt | UBF141 | 6 |) |

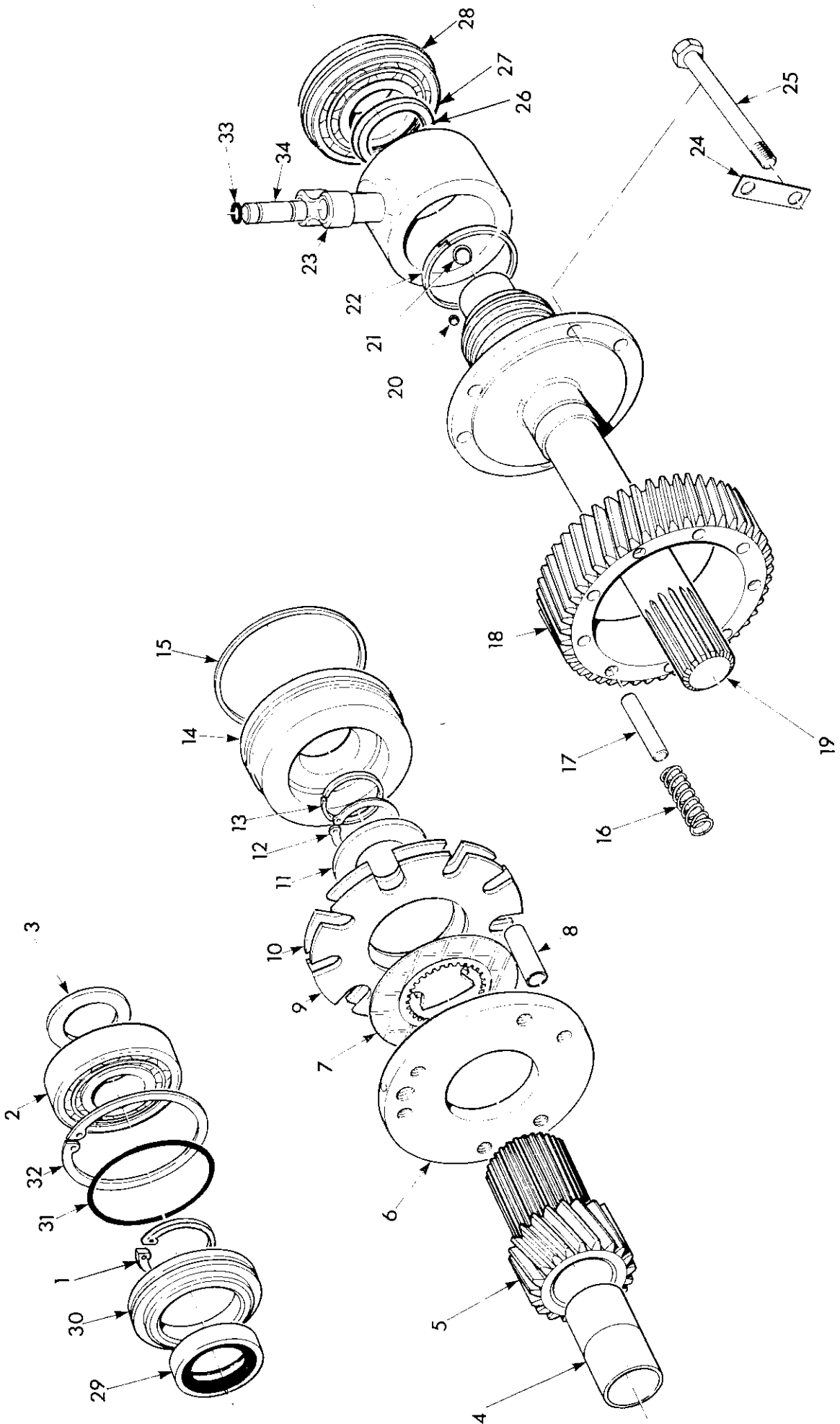


Fig.3 INPUT SHAFT ASSEMBLY

| Plate Ref. | Description | PRM 101 Part No. | Qty. | Remarks |
|------------|----------------------------|------------------|------|---------------------|
| 13 | Piston Ring | MT358 | 1 | |
| 14 | Piston | MT345 | 1 | |
| 15 | Piston ring | MT359 | 1 | |
| 18 | Clutch gear | MT333 | 1 | |
| 19 | Input shaft - short spline | MT1154 | 1 | Use with MT0086/2-3 |
| | Input shaft - long spline | MT1152 | 1 | Use with MT0082/2-3 |
| 20 | Ball | CP1180 | 1 | |
| 21 | Ball | CP1191 | 1 | |
| 22 | Piston ring | CP1192 | 3 | |
| 23 | Feeder | MT315 | 1 | |
| 26 | Spacer | MT1158 | 1 | |
| 27 | Bearing | MT160 | 1 | |
| 28 | Circlip | 0.330250 | 1 | |
| 29 | Input shaft oil seal | MT165 | 1 | |
| 30 | Input shaft end cover | MT981 | 1 | |
| 31 | 'O' ring | 002433 | 1 | |
| 32 | Circlip | 0250620 | 1 | |
| 33 | 'O' ring | 000372 | 4 | |
| 34 | Connector | MT1057 | 2 | |

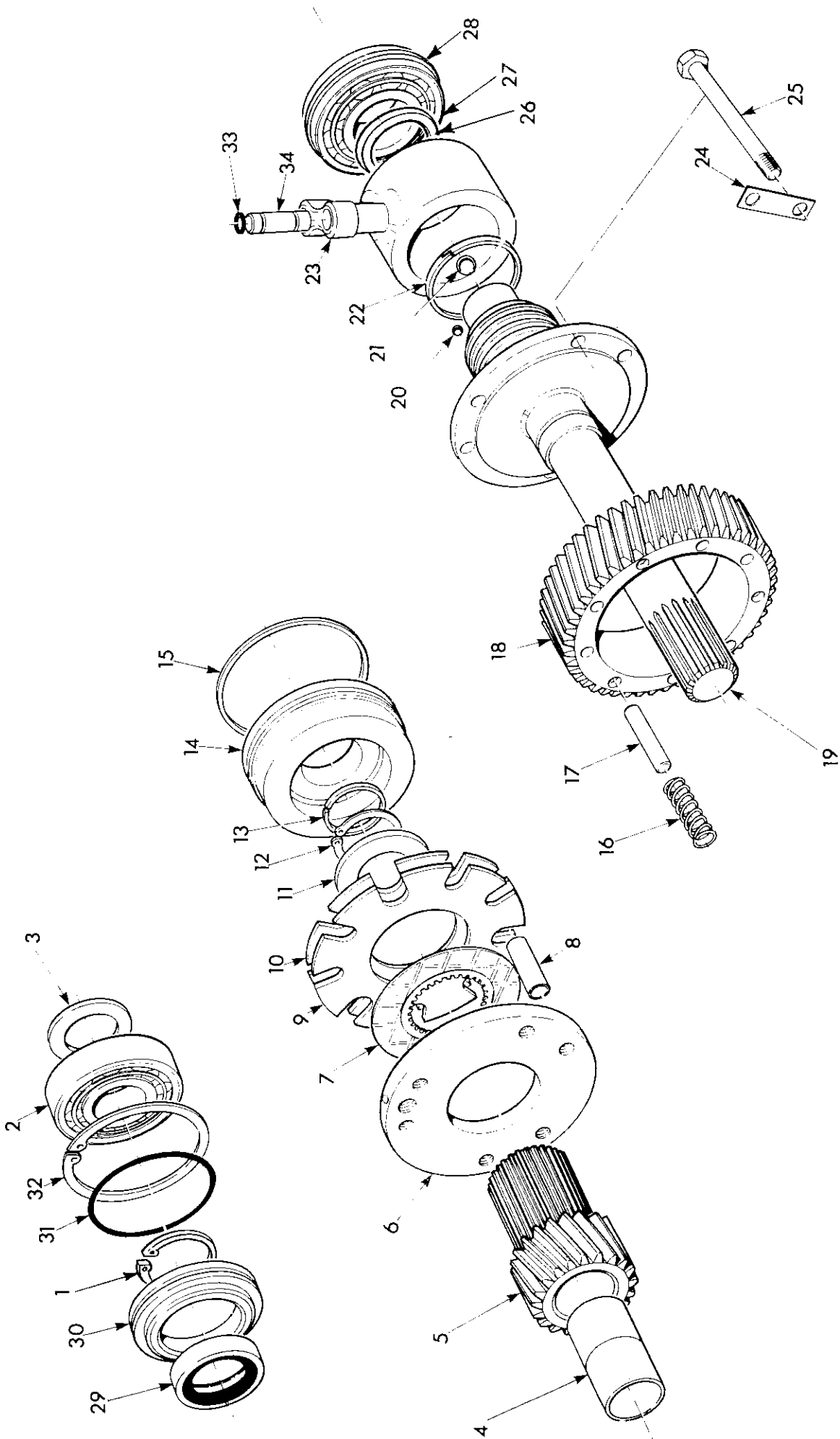


Fig.3 INPUT SHAFT ASSEMBLY

| Plate Ref. | Description | PRM 101 Part No. | Qty. | Remarks |
|------------|---|------------------|------|-------------------------|
| | <u>LAYSHAFT ASSEMBLY</u> | | | |
| | 2:1 REDUCTION | MT0081/2 | 1 | |
| | 3:1 REDUCTION | MT0081/3 | 1 | |
| | EACH ASSEMBLY COMPRISES: | | | |
| 1 | Circlip | O330250 | 1 | |
| 2 | Bearing (25mm I/D, 62mm O/D, 17mm wide) | AML61 | 1 | |
| 3 | Spacer | MT350 | 1 | |
| | PINION AND BUSH SUB ASSEMBLY 2:1 RATIO | MT733 | 1 | Supplied as S/A only |
| 4 | Bush | MT361 | 2 | Not supplied separately |
| 5 | Pinion (27 teeth) | MT328 | 1 | Not supplied separately |
| | PINION AND BUSH SUB ASSEMBLY 3:1 RATIO | MT732 | 1 | Supplied as S/A only |
| 4 | Bush | MT361 | 2 | Not supplied separately |
| 5 | Pinion (17 teeth) | MT326 | 1 | Not supplied separately |
| | CLUTCH PACK SUB ASSEMBLY | MT0089 | 1 | |
| 6 | Clutch end cover | MT1113 | 1 |) |
| 7 | Clutch plate - driver | MT731 | 6 |) |
| 8 | Ferrule | MT1156 | 6 |) |
| 9 | Clutch plate - driven | MT116 | 5 |) |
| 10 | Clutch end plate | MT117 | 1 |) |
| 11 | Spacer | MT344 | 1 |) |
| 12 | Circlip | CP1102 | 1 |) |
| 16 | Spring | MT1157 | 3 |) |
| 17 | Pin | MT1155 | 3 |) |
| 27 | Tab strip | MT351 | 3 |) |
| 28 | Bolt | UBF141 | 6 |) |

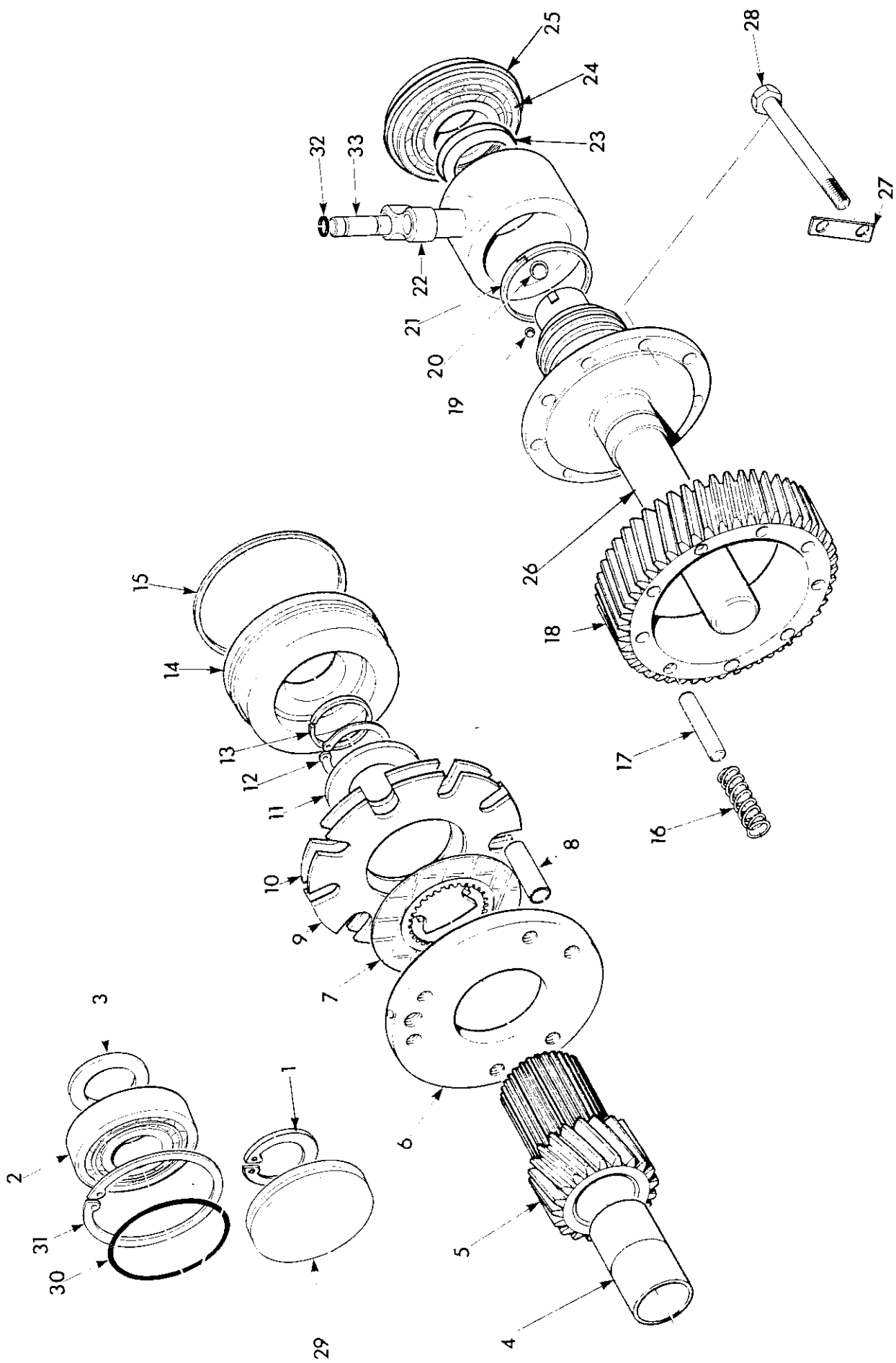


Fig.4 LAYSHAFT ASSEMBLY

| Plate Ref. | Description | PRM 101 Part No. | Qty. | Remarks |
|------------|---|------------------|------|-----------------------|
| 13 | Piston ring | MT358 | 1 | |
| 14 | Piston | MT345 | 1 | |
| 15 | Piston ring | MT359 | 1 | |
| 18 | Clutch gear | MT332 | 1 | |
| 19 | Ball | CP1180 | 1 | |
| 20 | Ball | CP1191 | 1 | |
| 21 | Piston ring | CP1192 | 3 | |
| 22 | Feeder | MT315 | 1 | |
| 23 | Spacer | MT1158 | 1 | |
| 24 | Bearing (25mm I/D, 62mm O/D, 17mm wide) | MT160 | 1 | With snap ring groove |
| 25 | Circlip | O330250 | 1 | |
| 26 | Layshaft | MT1153 | 1 | |
| 29 | Layshaft end cover | MT999 | 1 | |
| 30 | 'O' ring | 002433 | 1 | |
| 31 | Circlip | 0250620 | 1 | |
| 32 | 'O' ring connector | 000372 | 4 | |
| 33 | Connector | MT1057 | 2 | |

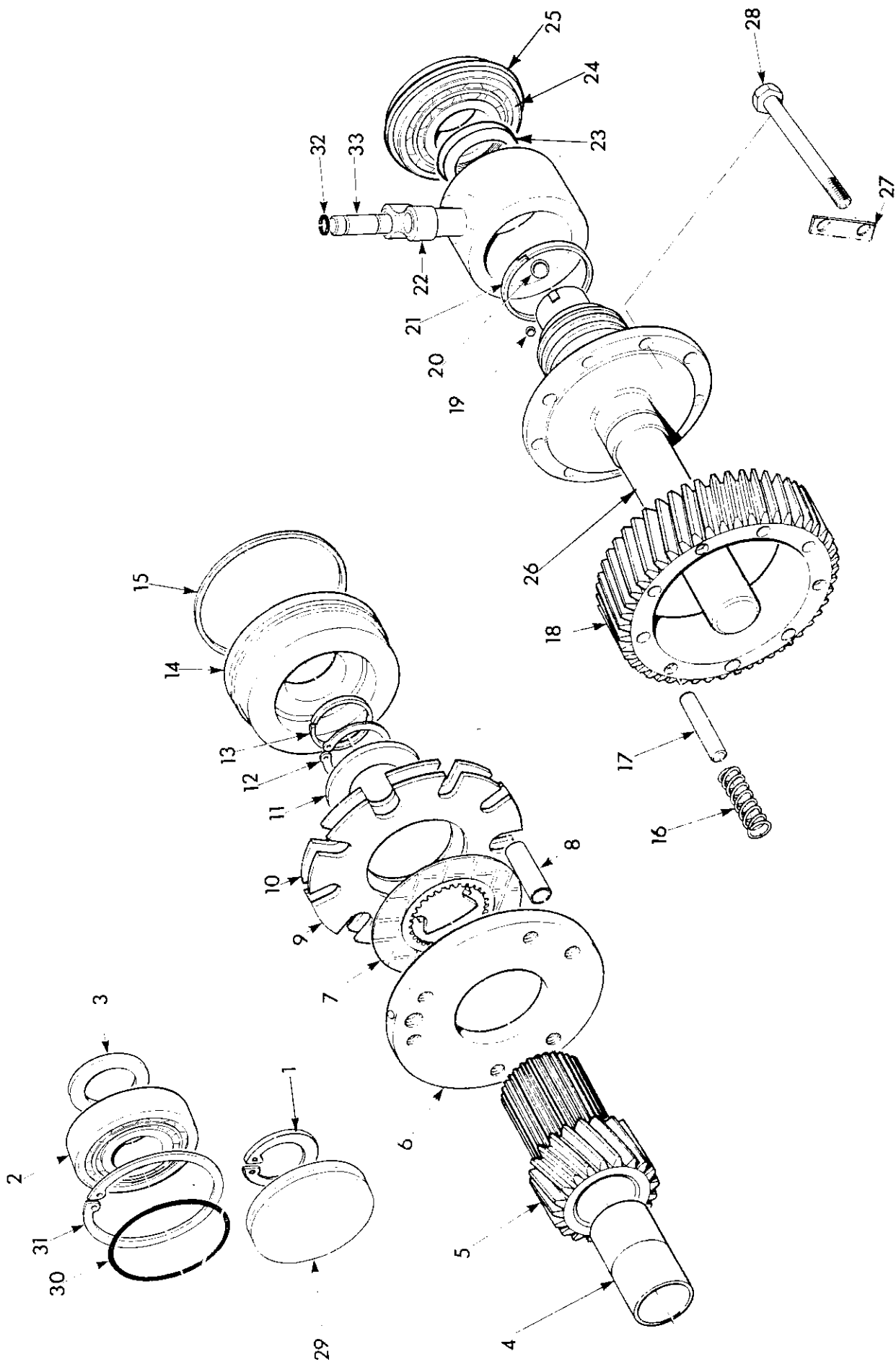


Fig.4 LAYSHAFT ASSEMBLY

| Plate Ref. | Description | PRM 101 Part No. | Qty. | Remarks |
|------------|---|------------------|------|---------|
| 1 | <u>OUTPUT SHAFT</u> | | | |
| 2 | End cover | MT1101 | 1 | |
| 3 | 'O' ring | 003124 | 1 | |
| 4 | Circlip | 0330350 | 1 | |
| 5 | Bearing (35mm I/D, 80mm O/D, 21mm wide) | 0513530 | 1 | |
| 6 | Spacer | MT1111 | 1 | |
| 7 | Output gear 2:1 ratio | MT1100 | 1 | |
| 8 | Output gear 3:1 ratio | MT1098 | 1 | |
| 9 | Circlip | 0330380 | 1 | |
| 10 | Output shaft | MT1151 | 1 | |
| 11 | Locknut | 010N401 | 1 | |
| 12 | Lockwasher | 010W401 | 1 | |
| 13 | Circlip | CP1190 | 1 | |
| 14 | Ball bearing | 0514030 | 1 | |
| 15 | 'O' ring | 003504 | 1 | |
| 16 | End housing | MT319 | 1 | |
| 17 | Oil seal | MT349 | 1 | |
| 18 | Bolt | UBF53 | 3 | |
| 19 | Washer | W108 | 3 | |

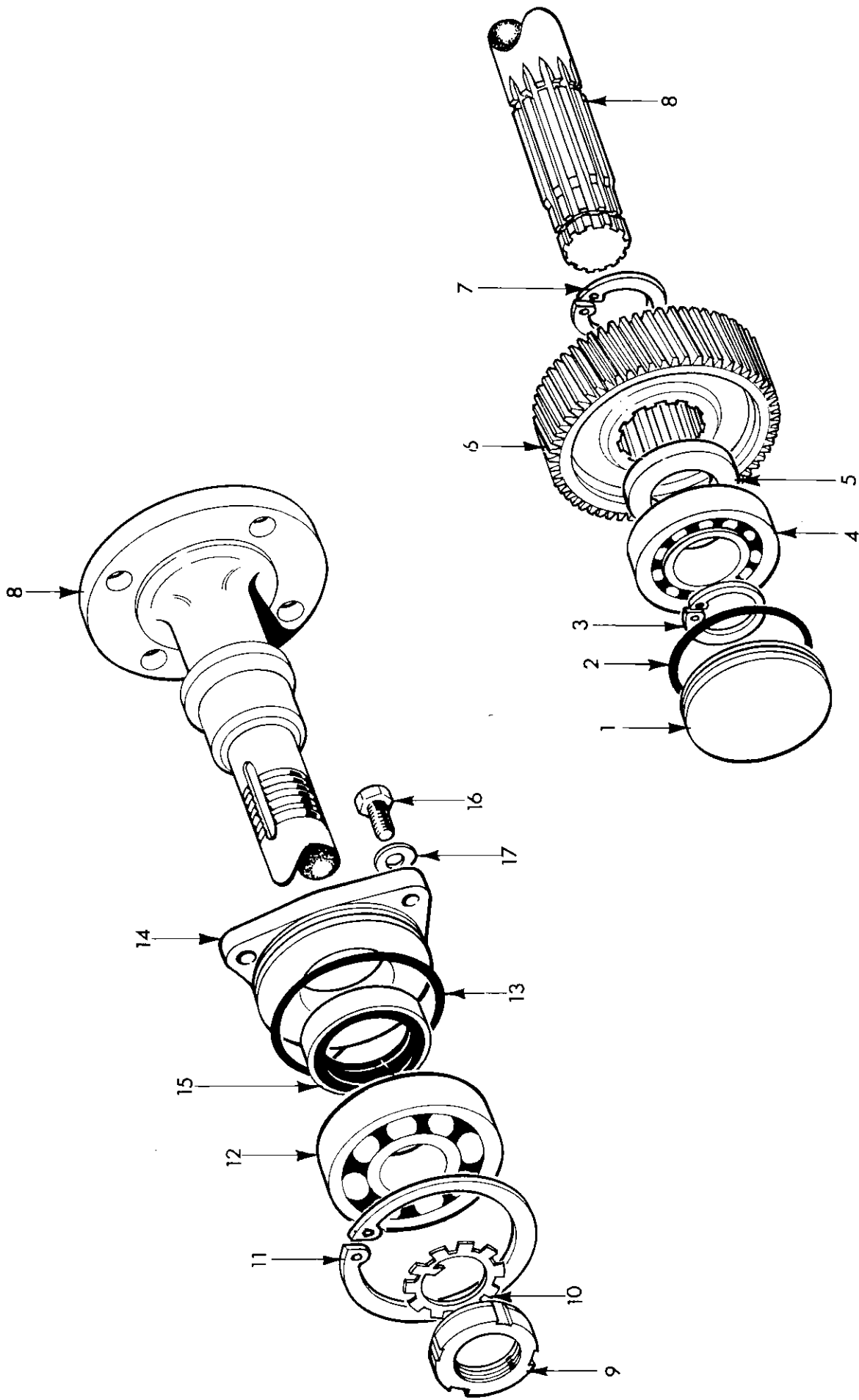


Fig.5 OUTPUT SHAFT ASSEMBLY

| Plate Ref. | Description | PRM 101 Part No. | Qty. | Remarks |
|------------|--|---|----------------------------|---------|
| | RATIO CHANGE KIT 2:1 RATIO COMPRISING: Pinion and bush sub assembly Output gear 'O' ring kit | MT0065 MT733 MT1058 MT0025 | 1 2 1 1 | |
| | RATIO CHANGE KIT 3:1 RATIO COMPRISING: Pinion and bush sub assembly Output gear 'O' ring kit | MT0066 MT732 MT972 MT0025 | 1 2 1 1 | |
| | OIL PUMP REPAIR KIT COMPRISING Pump gear driver Pump gear driven Pump spindle Woodruff key Pump spindle | MT903 MT322 MT323 MT324 CP1193 MT325 | 1 1 1 1 1 1 | |

| Plate Ref. | Description | PRM 101 Part No. | Qty. | Remarks |
|------------|---|--|--|---------|
| | <p><u>SERVICE KITS OF PARTS</u></p> <p>'O' RING KIT COMPRISING:</p> <p>'O' ring feeder connection 'O' ring control valve 'O' ring oil pump 'O' ring output shaft 'O' ring end cover 'O' ring oil pump 'O' ring end cover</p> <p>Gasket valve block Gasket valve end plate Oil seal - input shaft Gasket - top cover Oil seal output shaft</p> | <p>MT0025</p> <p>000372 000753 001254 003504 002433 002873 003124</p> <p>MT1073 MT1081 MT165 MT343 MT349</p> | <p>1</p> <p>8 1 2 1 2 2 1</p> <p>1 1 1 1 1</p> | |
| | <p>CLUTCH PACK KIT COMPRISING:</p> <p>Clutch plate - driver Ferrule Clutch plate - driven Clutch end plate Spacer Circlip Spring Pin End plate Tab washer Bolt</p> | <p>MT0089</p> <p>MT731 MT1156 MT116 MT117 MT344 CP1102 MT1157 MT1155 MT1113 MT351 UBF141</p> | <p>1</p> <p>6 6 5 1 1 1 3 3 1 3 6</p> | |

