PRM 101/160 BY NEWAGE

WORKSHOP MANUAL

NEWAGE

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NS 5048

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PRM GEARBOXES BY NEWAGE

PRM 101/160 SERVICE MANUAL

CONTENTS

LIST OF ILLUSTRATIONS – PRM 101/160 SERVICE MANUAL

1. GENERAL DATA

1.1 Specifications

PRM101

Power rating:
Up to 1.9hp per 100 rev/min, depending on ratio and application.

Input speed
Up to 3600 rev/min continuous, 4000 rev/min intermittent.

Input rotation
Either hand.

Output rotation
Either hand as required.

Gear ratios
1.96:1 or 2.94:1

Approximate dry weight
PRM101S: 471N(48kg,106lb).
PRM101L: 539N(55kg,121lb).

Oil capacity
Position VR: 1.4 litres (2.5 pints)
Position HR/HL: 1.7 litres (3.0 pints)

Working oil pressure
1790kN/m² (260lb/in², 1.83kg/cm²)

Working oil temperature
50° – 80°; maximum permissible temperature 90°.

Transmission cooling
Transmission cooler must be fitted; provision made for connecting unit to operating valve block. Factory supplied cooler available.

PRM160

Power rating
Up to 3.43hp per 100 rev/min, depending on ratio and application.

Input speed
Up to 3600 rev/min continuous, 4000 rev/min intermittent.

Input rotation
Either hand.

Output rotation
Either hand as required.

Gear ratios
1.96:1 or 2.94:1

Approximate dry weight
PRM160S: 471N(48kg,106lb).
PRM160L: 539N(55kg,121lb).

Oil capacity
Position VR: 1.4 litres (2.5 pints)
Position HR/HL: 1.7 litres (3.0 pints)

Working oil pressure
1790kN/m² (260lb/in², 1.83kg/cm²)

Working oil temperature
50° – 80°C; maximum permissible temperature 90°C.

Transmission cooling
Transmission cooler must be fitted; provision made for connecting unit to operating valve block. Factory supplied cooler available.

Engine mounting adaptors
SAE3, SAE4 and SAE5 flywheel housing adaptor flanges available; mounting pads provided enabling support feet to be fitted if required.

PRM101L incorporates mounting flange to Borg Warner pattern.

Input drive couplings
Spring centre damper plate, alternatively flexible drive couplings to suit flywheels of a nominal 6½in, 7½in, 8in, 10in and 11½in diameter to SAEJ620C.

Gearcase
Heavy duty cast iron constructed in two halves for ease of servicing; ribbed internally for rigidity and strength.

Input shaft
25.4mm (1in) diameter, SAE10 spline.

Output flange
127mm (5in) diameter, with 4 holes 12mm (0.453in) diameter on 108mm (4.25in) p.c.d.

Engine mounting adaptors
SAE3, SAE4, and SAE5 flywheel housing adaptor flanges available; mounting pads provided enabling support feet to be fitted if required.

PRM160L incorporates mounting flange to Borg Warner pattern.

Input drive couplings
Flexible drive couplings to suit flywheels of nominal 6½in, 7½in, 8in, 10in and 11½in diameter to SAEJ620C.

Gearcase
Heavy duty cast iron constructed in two halves for ease of servicing; ribbed internally for rigidity and strength.

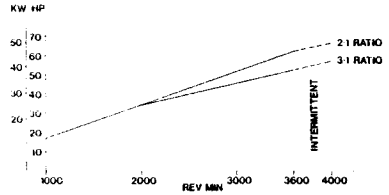
Input shaft
25.4mm (1in) diameter, SAE10 spline.

Output flange
127mm (5in) diameter with 4 holes 12mm (0.453in) diameter on 108mm (4.25in) p.c.d.

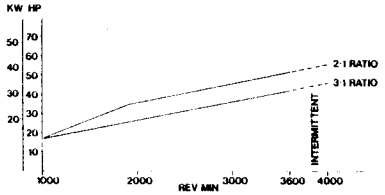
1.2 Application details

PRM101

Pleasure boats

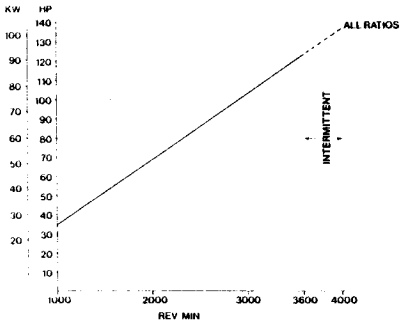


Workboats

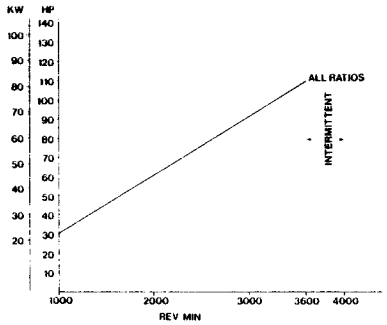


PRM160

Pleasure boats



Workboats

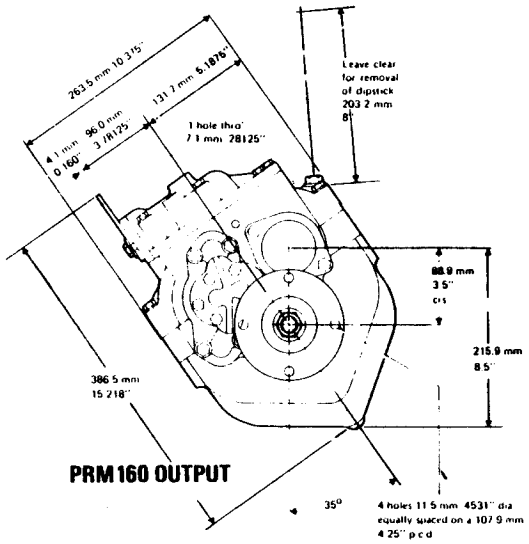


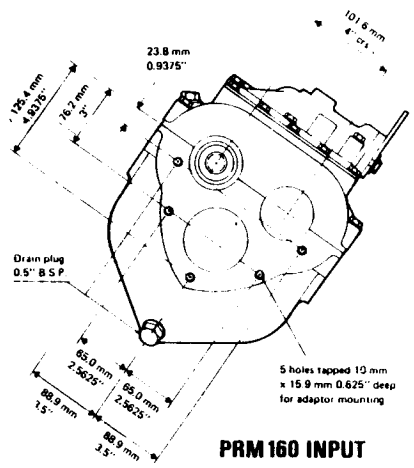
Note: pleasure boat ratings are generally also acceptable for light commercial boat applications up to 1500 hours per year. However, all ratings are given for general guidance; if in any doubt or for special application requirements please refer to factory or distributor.

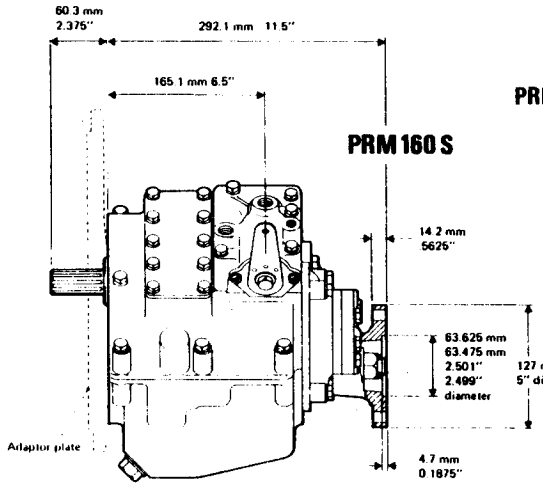
Classifying Societies

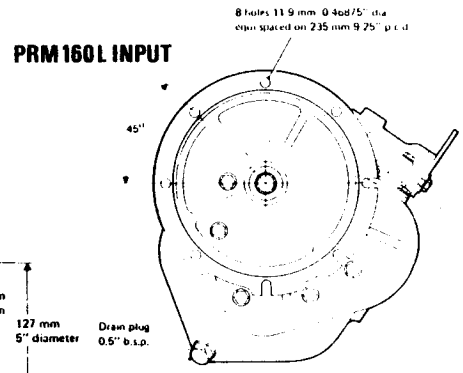
Please refer to factory for details of Classifying Society approvals.

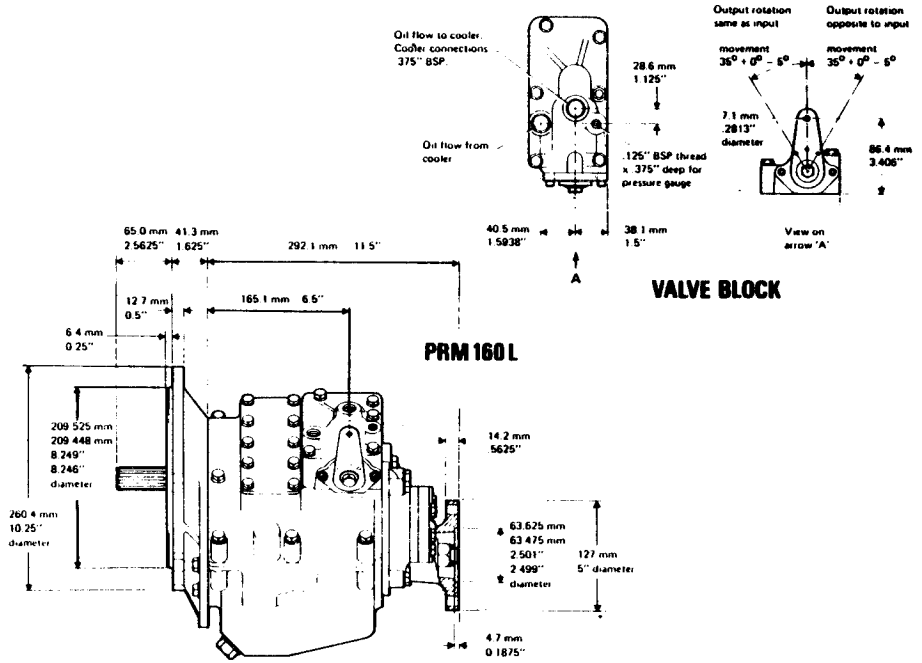
1.3 Installation details



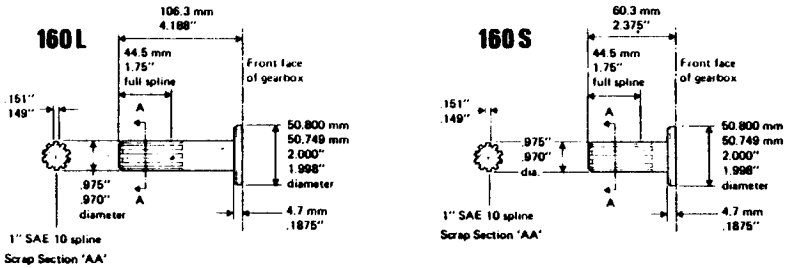








INPUT SHAFT DETAILS



2. INTRODUCTION

PRM marine transmissions are oil-operated gearboxes of the countershaft type with separate oil-operated multi-disc clutches (which need no adjustment) for both ahead and astern drive. This design permits full power to be transmitted in astern as well as ahead, and also allows right-hand or left-hand propeller rotation in ahead drive, with identical ratios in ahead and astern.

Both left-hand (anti-clockwise) and right-hand (clockwise) rotating engines can be accommodated; however, if used with a clockwise engine, it is recommended that neither the PRM101 nor the PRM160 should be used with a right-hand propeller.

Note: **when describing engine rotations, 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 anticlockwise as seen when standing behind the gearbox output coupling facing towards the input or engine end of the transmission.**

3. CONSTRUCTION

3.1 Gearcase

The gearcase has been kept free from hydraulic pipes, cylinders and associated components, and the only items mounted externally are oil pumps, hydraulic control block and operating lever.

A magnetic drain plug is provided at the front of the gearcase; this can be removed if required to allow suitable pipework to be connected to a hand-operated drain pump.

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

3.2 Gear train

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

The input shaft, which is supported by a bearing at either end, incorporates a drive pinion of the required ratio (running on a special self-lubricating bearing), the forward (when used with a right hand propeller) drive clutch assembly, the clutch gear and a hydraulically actuated piston to operate the clutch.

The layshaft is similarly supported by bearings and also incorporates a drive pinion of the same ratio (again running on a special self-lubricating bearing), the reverse (when used with a right-hand propeller) drive clutch assembly, a clutch gear of opposite hand rotation to that on the input shaft, and a hydraulically actuated piston to operate the clutch.

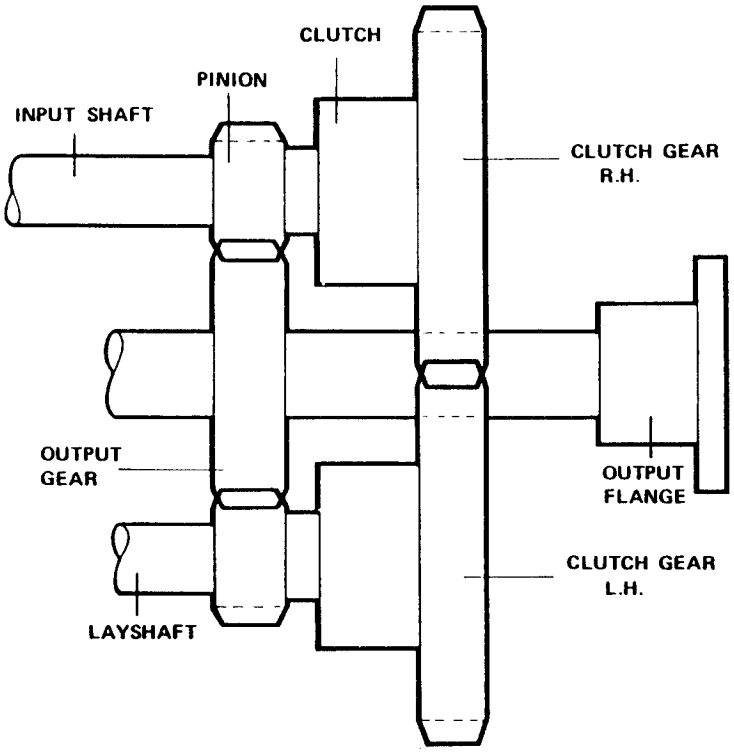


Fig. 1. internal layout

The output shaft runs on amply proportioned bearings, arranged in such a way that propeller thrust can be satisfactorily absorbed; it also carries the output gear and the output flange.

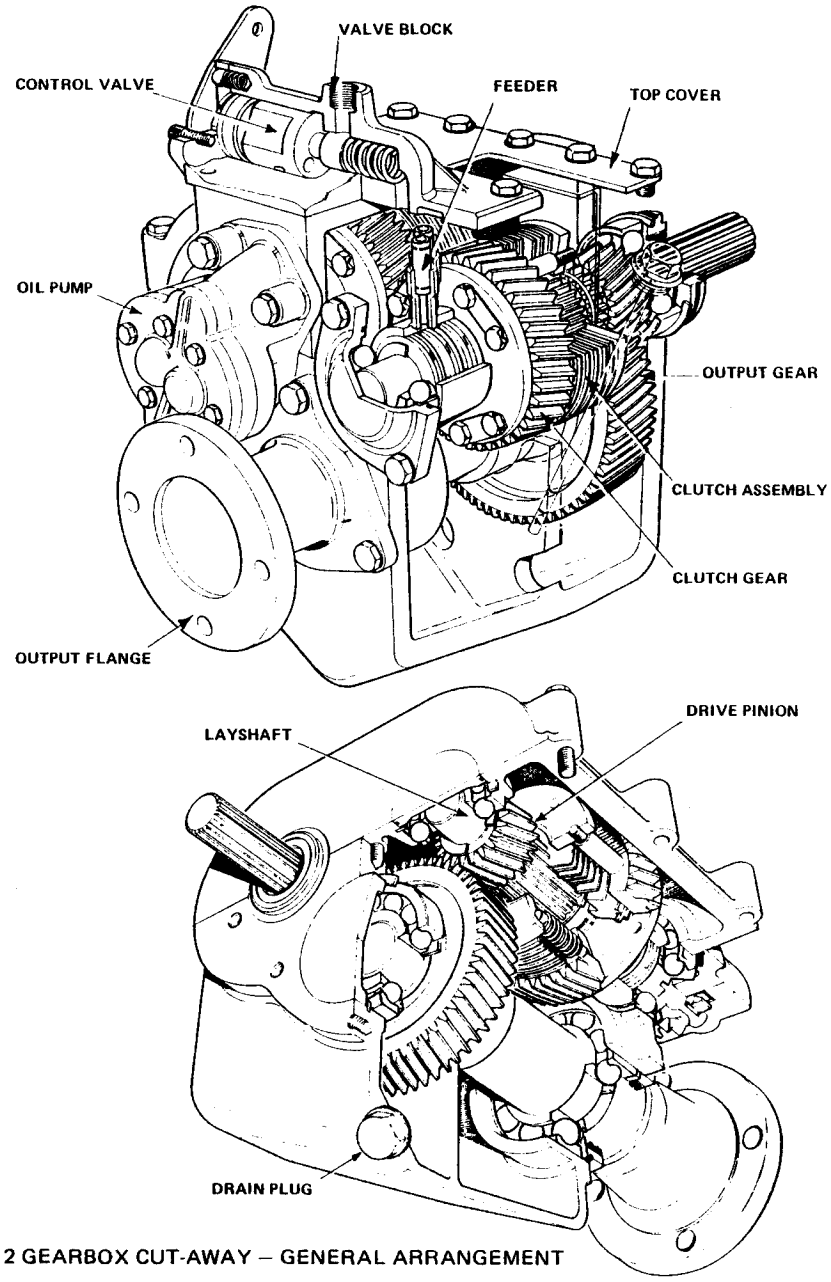


Fig. 2 GEARBOX CUT-AWAY – GENERAL ARRANGEMENT

3.3 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 the actuation of the clutch assemblies, and at lower pressure for lubrication and cooling circuits.

When the transmission is used with anti-clockwise engines the oil pump is mounted in its standard position, whether a right-hand or left-hand propeller is used. If the transmission is used with clockwise engines, the oil pump has to be mounted in a position 180° from the normal.

3.4 Valve Block

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

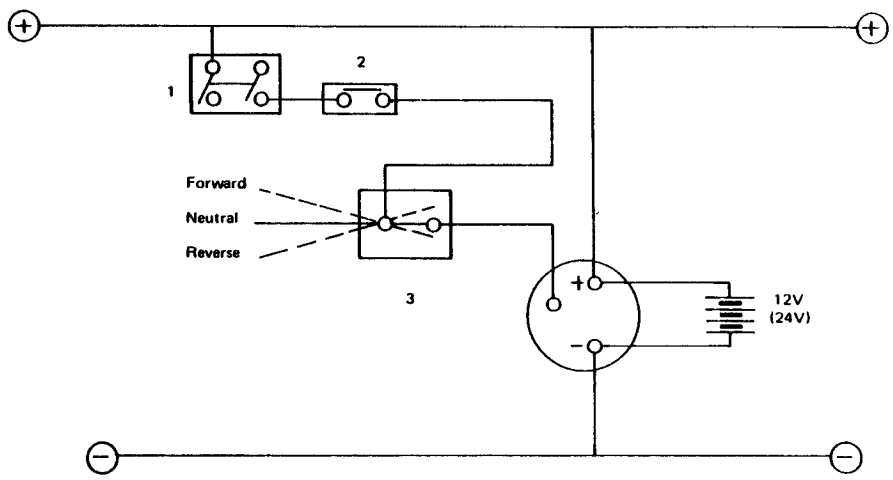
The control valve is fitted with a spring-loaded neutral detent; this provides a positive neutral position and ensures positive selection of either ahead or astern drive.

3.5 Neutral safety switch

A neutral safety start switch, which ensures that the engine to which the gearbox is fitted cannot be started unless the gearbox is in neutral, is available as an optional extra.

This device is of obvious benefit, since it will help prevent accident or damage caused by a boat moving ahead or astern on engine start-up in a crowed marina or other area.

When used, the switch is located on the valve block (see item C on the parts list) and should be wired into the starter circuit as shown in Fig. 3.



1. Start key switch
2. Starter push switch
3. Neutral safety switch
4. Solenoid/starter motor

Fig. 3 wiring diagram - neutral safety start switch

4. OPERATING SYSTEM

4.1 Output rotations

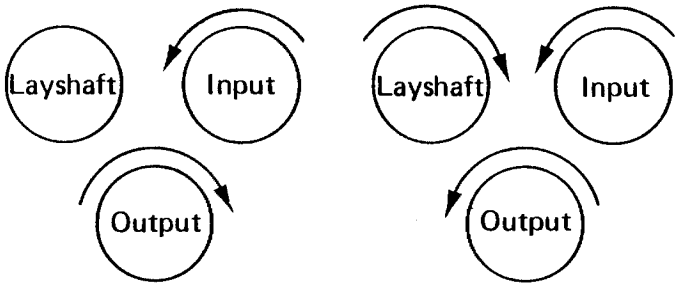
With the control lever at the mid-point of travel or neutral position and the engine running, the splined input shaft and the clutch gear rotate at engine speed. The clutch gear is in constant mesh with the clutch gear on the layshaft which is therefore also driven at engine-speed, but in the opposite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

When the control lever is moved to the 'ahead' position, the hydraulic system is actuated and oil is directed at high pressure to the clutch on the input shaft; the clutch engages and engine drive is directed to the forward drive pinion. The pinion turns the gear on the output shaft and the propeller shaft and propeller are rotated in the direction corresponding to ahead movement of the vessel.

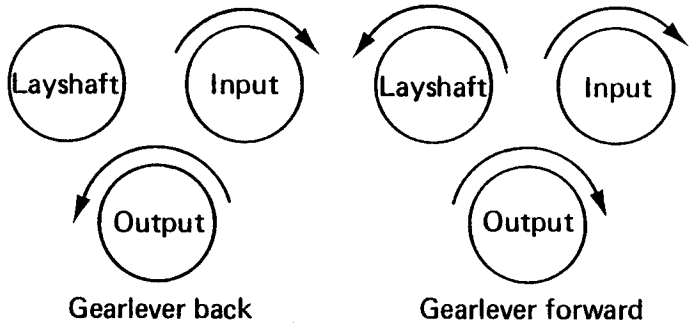
Similarly, when the control lever is moved to the 'astern' position, the clutch on the layshaft is engaged and drive applied to the reverse pinion. This turns the output shaft gear in the opposite direction; and the propeller shaft and propeller rotate in the direction corresponding to astern movement of the vessel.

Fig. 4. operating lever positions and rotations obtained

A. anti-clockwise engines (standard)



B. clockwise engines (uncommon)



Note: (i) Rotations are as seen looking from the propeller forward to the gearbox.

(ii) Anti-clockwise engines are by far the most common, and the standard gearbox build therefore assumes an anti-clockwise input.

4.2 Hydraulic system

Oil is pumped from the gearbox sump through the internal supply pipe and is delivered to the control block, 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 layshaft and thence to a piston which actuates the appropriate clutch for either ahead or astern drive.

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

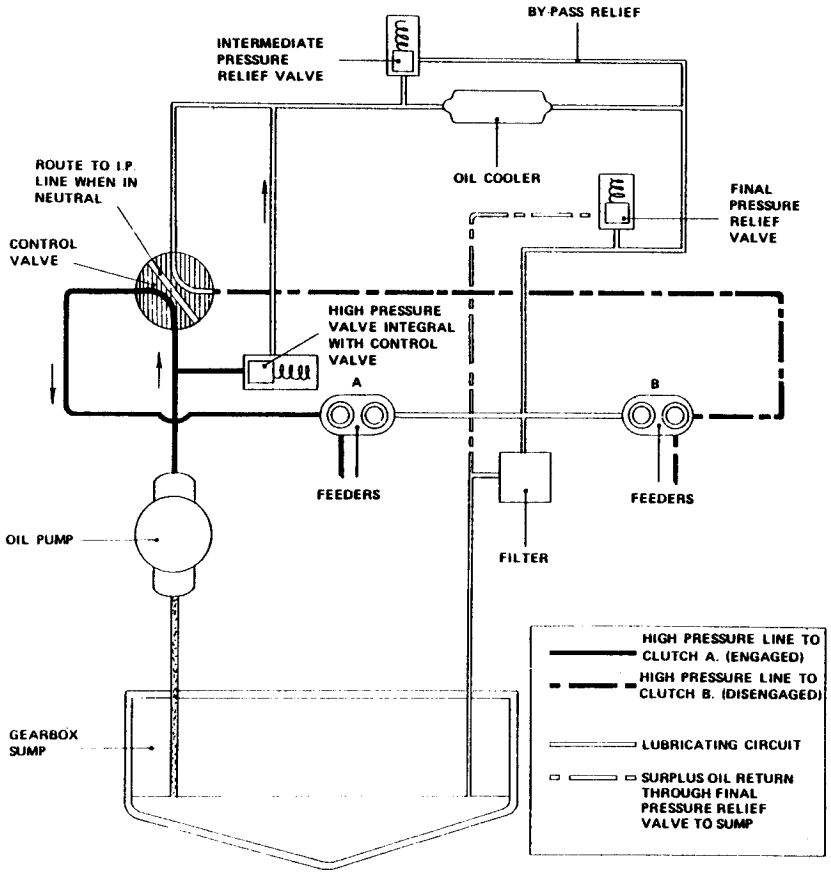


Fig. 5. Hydraulic and lubricating oil circuits

4.3 Lubrication

Oil for lubrication purposes is also delivered via the internal supply pipe to the control block. Irrespective of whether ahead or astern is engaged, oil is diverted from the discharge side of the pressure relief valve to an external oil cooler. After passing through the cooler, the oil is directed through channels on the valve block to the feeders and thence through the layshaft and drive shaft to lubricate the clutch assemblies.

4.4 Approved oils

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 10/W30	Century Supreme 20W/50 or Centilube 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 Fleetal 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

Company	Ambient Temperature Below 0°C	Ambient Temperature 0°C -- 30°C	Ambient Temperature Above 30°C
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 20W40
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	Ursatx 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 warrenty cover since no claims under warrenty will be entertained if oil of the wrong specification is used.

5. INSTALLATION

5.1 General

Drive is usually transmitted from the engine to the gearbox by means of either a spring centre drive plate (damper plate) or a flexible input coupling. These bolt to the engine flywheel with the gearbox input shaft inserted into their centre.

Each of these components enjoys a degree of torsional flexibility, the purpose of which is to damp down the engine torsional or cyclic vibrations and prevent them being passed on to the transmission, provided that they are correctly fitted.

The strongest engine vibrations are usually those caused by firing in the cylinders; diesel engines, which have high compression ratios, usually generate stronger vibration pulses than petrol (gasolene) engines; and it is often the case that of two engines of roughly equivalent size, the one having the greater number of cylinders will tend to run more smoothly than the one with fewer cylinders, although this is by no means always the case.

In all marine installations, correct alignment is of the utmost importance — misalignment can cause noise, vibration and premature failure — and we strongly recommend that all the procedures detailed in this manual are closely followed.

5.2 Checking the engine flywheel housing

Attach a dial test indicator, calibrated in units of 0.001in (0.025mm) or smaller, to the flywheel so that the measuring stylus of the indicator is perpendicular to the bore of the flywheel housing (item A on fig. 6). Rotate the flywheel and check the deviation on the indicator over one complete revolution: this should not exceed 0.006in (0.152mm) total indicator reading.

With the dial test indicator still attached to the flywheel, re-position the stylus so that it is perpendicular to the face of the flywheel housing (item B on fig. 6). Rotate the flywheel and check the deviation over one complete revolution, again, this should not exceed 0.006in (0.52mm) total indicator reading.

5.3 Checking the engine flywheel

Attach a dial test indicator, calibrated to 0.001in (0.025mm) or less, to the engine flywheel housing so that the measuring stylus of the indicator is perpendicular to the bore of the register in the flywheel (item C on fig. 6). Rotate the flywheel through one complete revolution and note the deviation: this should not exceed 0.005in (0.125mm) total indicator reading.

With the dial test indicator still attached to the flywheel housing, re-position the stylus so that it is perpendicular to the face of the flywheel register (D on fig. 6). Rotate the flywheel through one complete revolution and note the deviation; this should not exceed 0.005in (0.125mm) total indicator reading.

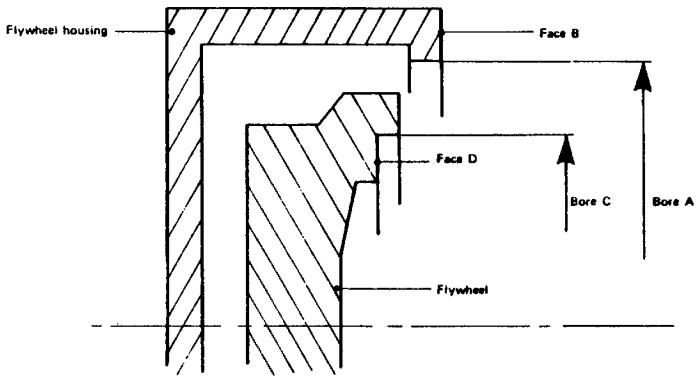


Fig. 6. checking trueness of flywheel and flywheel housing

5.4 Gearbox mounting positions

In their standard versions, the PRM101 and the PRM160 are so assembled that the input shaft is the right-hand of the two top shafts (looking on the rear of the gearcase 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 mounting 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 and PRM160 can also be built so that the output shaft is offset horizontally rather than vertically.

If the input shaft is the right-hand of the two top shafts and the gearbox is mounted at a degree of tilt to starboard so that the output shaft is offset horizontally to port, this is known as HR mounting.

If the input-shaft is the left-hand of the two top shafts and the gearbox is mounted at a degree of tilt to port so that the output shaft is offset horizontally to starboard, this is known as HL mounting.

Horizontal offsets are only normally required for special applications.

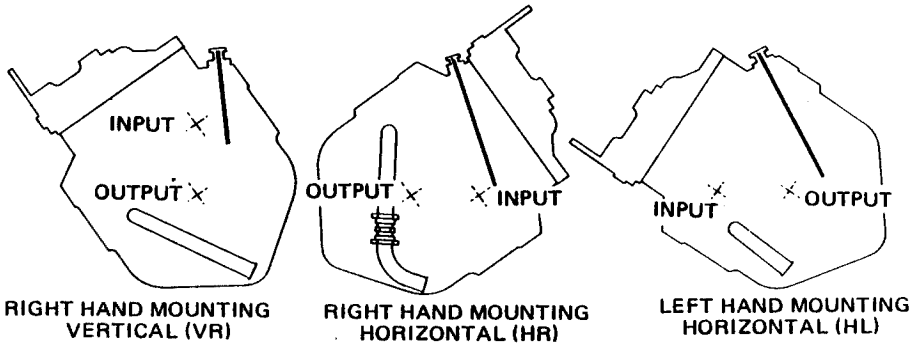


Fig. 7. gearbox mounting positions

Note: **it will be seen from this illustration that size and shape of internal oil suction pipe, and the position and length of the dipstick vary, according to the mouting position for which the gearbox has been built. It is not therefore possible to use a gearbox which has been built for one mounting position for any other position without modification.**

5.5 Mounting the gearbox to the engine

Before installing the gearbox, check carefully that it is correct for the mounting position required (see above). The mounting position is stamped on the gearbox serial number plate (see section 11), but the prudent installer will also make a visual check of the input shaft and dipstick positions, referring to Fig. 7, in case the gearbox has been modified after leaving the factory. Having done so proceed as follows:-

PRM101S and PRM160S

1. Mount the drive plate or flexible input coupling to the flywheel, using an alignment mandrel if available, and bolt it to the flywheel using the holes provided. Where components to SAE standard are used, the outside diameter of the drive plate or coupling should be a close fit in the register on the flywheel.

   If a mandrel is not available, tighten the mounting bolts just sufficiently to prevent free movement, assemble the gearbox to the drive plate or coupling, and rotate the engine two or three revolutions by hand to align the plate. Tighten up two or three opposite bolts, using the inspection window provided on the gearbox adaptor flange.
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 to the front of the gearbox.
4. Offer up the gearbox and adaptor to the drive plate or input coupling and engine flywheel housing at the correct angle of inclination to obtain the shaft offset required and insert the gearbox input shaft into the centre of the drive plate or coupling (it may be necessary to rock the shaft slightly to ensure that the shaft enters). Press the assembly fully into position, align the mounting holes in the adaptor flange with those on the flywheel housing and bolt securely.

PRM101L and PRM160L

Procedure for mounting these versions to the engine are exactly as given above, except that the adaptor flange is fitted to the gearbox at the factory.

5.6 Oil cooler

All PRM101 and PRM160 gearboxes must be fitted with an oil cooler to maintain correct working temperatures. To permit a suitable cooler to be fitted, two 3/8 in BSP connections are provided on the valve block, and these are blanked off with "Redcap" seals on delivery from the factory.

Remove the "Redcap" seals and connect via suitable hoses to the inlet and outlet connections on the cooler, which is then connected up to the cooling system on the engine. The cooler may be mounted on any convenient location; the adaptor flange or bulkhead of the boat are popular locations.

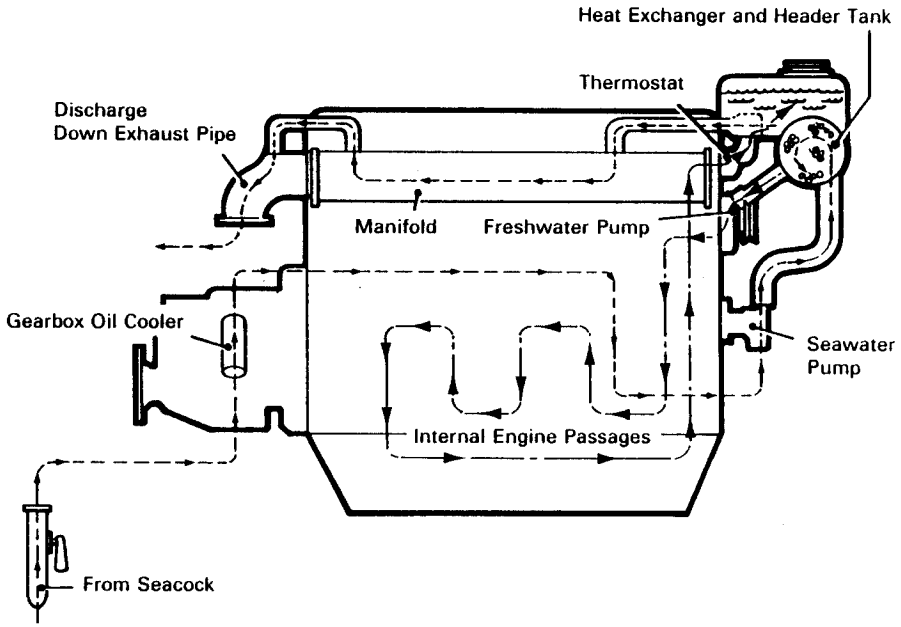


Fig. 8. gearbox and engine cooling circuit

5.7 Alignment to propeller shaft

Alignment between the propeller shaft flange and the mating flange

on the gearbox output flange is extremely important since excessive vibration and stress leading to damage and perhaps even failure can occur if correct alignment is not achieved.

The decision as to whether a flexible or a rigid propshaft coupling will be used will vary from boat to boat, although many people consider it preferable to use a rigid coupling, particularly in those boats whose hulls have sufficient rigidity not to allow flexing in heavy sea conditions, which could cause a shift of the engine and transmission relative to the propshaft.

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

(a) in boats whose hulls are not sufficiently rigid to prevent the flexing referred to above.

(b) in cases where the engine is mounted on flexible mounts.

In both cases, the flexible coupling will isolate engine vibration or other movement from the propshaft, thereby helping maintain correct alignment of the propshaft and stem tube.

It must be stressed that flexible couplings are not designed to take up misalignment, and 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 tight press fit on the shaft and the keyway accurately machined to the correct size; and

(ii) the two halves of the coupling must be carefully aligned. This should be done by bringing the two flanges sufficiently close together that a feeler gauge can be inserted to check the vertical and horizontal alignment. Since the propeller shaft line is normally fixed in the boat, alignment is usually achieved by adjusting engine mount shims, or the engine mounts themselves.

Note: **whenever possible the engine and gearbox should be installed whilst the boat is in the water, otherwise there is a danger of the hull distorting due to insufficient support being provided over a large enough surface area. If the engine and transmission are fitted before the hull is placed in the water, the whole installation should be very carefully re-checked for alignment after launching.**

5.8 Installation angle

The transmission should normally be installed so that the maximum fore and aft angle relative to the waterline does not exceed 15° with the boat at rest. Please consult factory if installation angles greater than this are required.

5.9 Twin installation

The rotation of a propeller, even in a single engine installation, tends to have a slight "turning" effect on the handling of the boat, but this can normally be corrected with very slight adjustments on the rudder.

In twin installations, the turning effect on the handling of the boat 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 gear-boxes are capable of providing either hand of output rotation at any of the available gear ratios.

It is also preferable for the starboard (right-hand) propeller to rotate clockwise and the port (left hand) anticlockwise rather than the other way about since in the latter case, when the propeller blades are at the lowest point of their rotational arc they tend to create a vacuum which affects 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 off line and thus delaying completion of the manoeuvre.

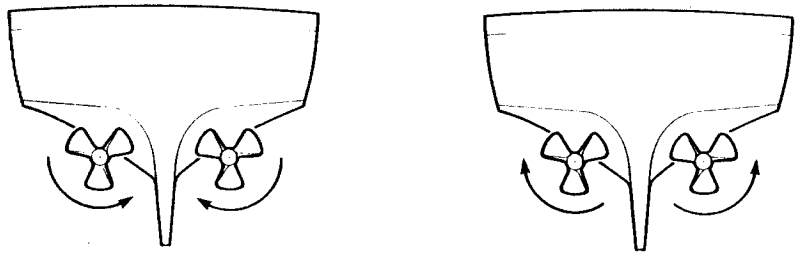


Fig. 9. propeller rotation – twin installations

When connecting remote control units for twin engine/gearbox installations, it should be remembered that forward operation of the gearbox operating lever will produce output rotation as engine (generally left-hand, or anticlockwise).

Therefore, in order to provide counter-rotation of the two propeller shafts in the correct direction for 'ahead' drive, with both the remote control operating levers in the 'ahead' position, the operating controls should be fitted so that the cable entry on the starboard gearbox is from in front of the transmission whilst on the port gearbox it is from behind it, as in fig.

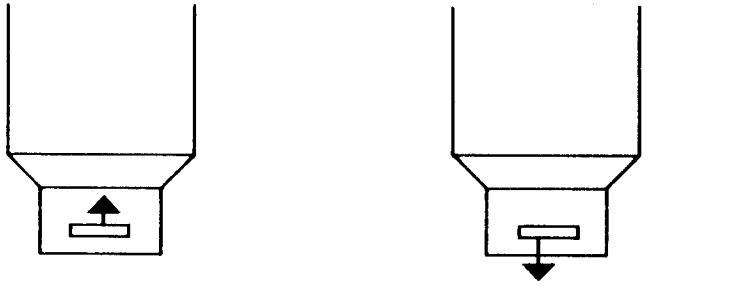


Fig. 10.twin installations – remote contol cable entry

5.10 Remote control operating systems

All PRM gearboxes can be used with remote control operating systems and indeed the use of the single lever type of remote control, which links the engine throttle to the gearbox operating lever, is highly recommended.

The following points should be noted:

(i) The gearbox operating lever is provided with a positive neutral position, which greatly assists the setting up of the remote control unit.

(ii) care should be taken to ensure that the cable moves the gearbox operating lever approximately 1/16" (2mm) short of its maximum forward or backward travel to prevent the lever being brought hard up against the end stop with every gear shift.

The contol equipment should in all cases be connected in accordance with the manufacturer's recommendations.

6. OPERATION

6.1 First-time usage

Before starting the engine the following operations should be carried out:-

(i) fill the gearbox with one of the recommended oils (see section 4.4) to the maximum level indicated on the dipstick (see section 1.1 for approximate capacity).

(ii) ensure that the gearbox is in neutral (it is also recommended that a neutral safety start device should be wired into the starter circuit as described in section 3.5).

6.2 Drive selection

Both the PRM101 and the PRM160 gearboxes have been designed and tested to ensure that shifts from "ahead" to "astern" can in emergencies be carried out at any engine speed up to the maximum recommended, and the gearbox will respond extremely rapidly in these circumstances.

However, full-power reversals do place an abnormal if short-lived loading on the gearbox, and transmission life will be increased if engine speed is brought down to approximately 1,000 rev/min when changing direction; it is for this reason that we recommend the fitment of a proprietary single-lever remote control operating system which links the engine throttle control to the gearbox operating lever.

6.3 Trailing (free-wheeling) the propeller

PRM gearboxes are designed and tested to ensure that prolonged trailing (free-wheeling) of the propeller is permissible for long periods without any detrimental effect on the transmission; this makes them

very well suited for use in auxiliary sailboats, motor sailers and multi-engine installations which may be used with one or more engines shutdown.

It is not therefore necessary to provide any propeller shaft locking device to protect the transmission, although in the case of racing yachts and other high performance sailboats fitted with two-bladed propellers it may be desirable to fit a propshaft lock so that the propeller can be locked behind the deadwood to reduce drag.

Where propellers are allowed to free-wheel they can be a useful source of free auxiliary power; if a flat pulley is fitted to the propeller shaft a small generator can be belt-driven for charging batteries (although care must be taken not to apply excessive side-load, which would cause vibration and misalignment)

6.4 Emergency operation

Included as standard in every PRM101 and PRM160 is a device which allows the gearbox to be locked mechanically in 'ahead' drive in the unlikely event of hydraulic failure occuring.

The method operation is as follows:-

(i) Remove the top cover, fitted behind the valve block.

(ii) Rotate the appropriate clutch shaft so that the dimple in the outer edge of the clutch end plate is uppermost.

(iii) Take one of the top cover bolts and screw it into the threaded hole in the clutch end plate (located immediately below the dimple, between two ferrules).

(iv) Tighten the screw, thereby clamping the clutch and providing drive engagement.

(v) Ensure that sufficient oil remains in the gearbox to avoid further damage, and refit the top cover.

(vi) Check that the dipstick does not foul the head of the bolt now fitted in the clutch end plate; if necessary, remove the dipstick and plug the hole with a clean rag.

(vii) Select neutral on the operating lever and disconnect the operating cable.

The engine can now be run: we recommend a maximum of 1/3 full throttle in order to avoid further possible damage to the transmission.

Notes: (A) Assuming an anti-clockwise rotating engine (by far the most common) the appropriate shaft to be rotated (see (ii) above) is

- for left hand rotating propellers, the left hand shaft;
- for right hand rotating propellers, the right hand shaft.

(B) When the emergency drive is in use, astern drive or neutral cannot be selected and there will be no means of stopping the boat;

(C) After emergency drive has been used, qualified assistance should be sought to give the transmission a thorough check before the gearbox is used again;

(D) Always disconnect the operating cable and ensure that the gearbox operating lever is in neutral before using the gearbox in emergency drive.

(E) Never use the top cover for topping-up with oil.

7. ROUTINE MAINTENANCE

7.1. Initial maintenance (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. Operate the engine and gearbox, allowing the oil to circulate; stop the engine and re-check the oil after the oil has settled.

7.2 Daily check

(i) Check gearbox oil level.

(ii) make a quick visual inspection of the general condition of the transmission and check for oil leakage especially at the output shaft oil seal and at gasket sealing surfaces.

(iii) listen for any unusual noises and check their cause.

7.3 Annual checks

(i) Check all oil cooler hoses and connections for leakage.

(ii) Check propeller shaft alignment.

(iii) Check that the remote control operating linkage is accurately adjusted to give the correct amount of travel on the gearbox operating lever.

7.4 Winter storage

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

7.5 Other maintenance operations

(i) The gearbox oil should be changed at periods which roughly correspond to the intervals at which engine oil changes are carried out.

(ii) The oil should also be changed if it has been contaminated by water, or if the gearbox has suffered major mechanical damage.

8. FAULT FINDING

The fault finding chart below is designed to help diagnose some of the problems which might be 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 warrenty rights, no repair or other work should be done on the gearbox during the warrenty period without first contacting NEWAGE TRANSMISSIONS LTD., COVENTRY, or authorised distributor or dealer, for advice.

SYMPTOM	NOTICEABLE 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.
		Oil leaks	Check for evidence of leakage and rectify
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 and replace if necessary.
Gearbox noise	Excessive noise from gearbox	Input coupling defective	Remove, examine and replace if necessary.
		Gear rattle at low speed	Increase engine idling speed.
		Propeller misalignment	Check the alignment of the propeller shaft coupling (see section 5.7); if necessary rectify by adjusting the shims under the engine mounts or the engine mounts themselves.
		Out-of-balance propeller	Remove the propeller and check that the pitch, weight, diameter and balance of all the blades are equal and rectify if necessary.
		Engine/gearbox misalignment	Remove the transmission and check that the flywheel face is flat and that the drive plate or flexible input coupling is correctly aligned.

SYMPTOM	NOTICEABLE EFFECT	CAUSE	REMEDY
Gearbox noise	Excessive noise from gearbox	Defective bearing	Isolate defective bearing noise, remove and replace.
Excessively 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 distributor or factory for advice.
Control lever on valve block stiff	Difficult to move single lever control	Defective valve or detent spring	Contact distributor or factory for advice.

9. SERVICING AND REPAIRS

The servicing, repair and replacement of components and assemblies on the input shaft and layshaft is made simply by the fact that the gearcase is constructed in two separate halves, the top half being easily removable to give access to the two top shafts.

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

A cut-away drawing showing the general arrangement of the gearbox is shown in fig. 2, and exploded views of all internal components are contained in the parts list. Many servicing operations can be carried out with the gearbox still mounted to the engine (provided, of course that there is sufficient space in the engine compartment to allow this); examples are the replacement or repair of valve block and oil pump. It may also be possible to work on the layshaft and even the output shaft. The repair and maintenance of items on the output shaft will require that the gearbox is removed from the boat.

N.B. The PRM 160 shafts are supported by taper roller bearings. It will be necessary to re-calculate the number of shims required to correctly load the bearings each time a shaft is stripped for examination, component repair or replacement. Shimming procedure is described in Section 10.8.

As the PRM101 uses ball bearings no shimming is required: they are retained by circlips.

9.1 Valve block

The complete valve block is easily removed for inspection and servicing with the gearbox still installed in the boat.

1. Disconnect the oil cooler pipes and the control cable or cables from the lever on the control equipment.
2. Disconnect the wiring from the neutral safety switch – if fitted.
3. Remove the 5 bolts and one nut which fix the valve block to the gearcase.

To remove the control valve and high pressure valve, simply remove the two cap screws (item no. C6) and withdraw the valves from the valve body. Care should be taken not to lose the detent ball and springs.

Inspect the O ring (item no. C8) and bearing (item no. C10): replace if worn, damaged or defective. Check that the pressure release valve spring (item no. C15) has retained its correct free length (mm, ins) and if not, replace.

To assemble and refit the valve blocks, simply reverse the above procedure.

9.2 Oil Pump

The oil pump assembly can also be easily removed with the gearbox in situ.

1. Note the position of the pump (for refitting).
2. Remove the 4 bolts securing the oil pump to the main case and withdraw the pump assembly complete with O Rings and (PRM160 only) shims.
3. Inspect O rings and replace if necessary. If in good condition carefully store until required for refitting.

   The pump can now be stripped by removing the 4 fixing bolts in the cover plate. The assembly splits into its three component parts exposing the pumps, gears and shafts.

   If the pump body is damaged, the complete pump assembly (item no. B) must be replaced. If the pump assembly is in good condition, the oil pump can be repaired using pump repair kit (item no. B4 to B8 inclusive).

N.B. With PRM160, the clutch shaft must be reshimmed if a replacement pump body or complete pump assembly is fitted. If the old pump casing is re-used, refitting the original shims will be adequate.

9.3 Removing the transmission from the boat

1. Ensure that the gearbox operating lever is in the neutral position and disconnect the operating cable or cables.
2. Drain the gearbox oil into a suitable container and disconnect oil cooler pipes.
3. Unscrew and withdraw the bolts connecting the gearbox output flange from the flexible coupling or mating half coupling on the propeller shaft.
4. Sling ropes around the gearbox to provide supports while it is being removed from the engine.
5. Unscrew and withdraw the bolts securing the adaptor flange to the engine flywheel housing.
6. Slacken the bolts which secure the damper plate or input coupling to the flywheel.
7. Withdraw the gearbox, if necessary by rocking the unit slightly in order to disengage the input shaft spline from the opposing spline in the damper plate or coupling.

9.4 Removing the input shaft and layshaft assembly

To remove with the gearbox still installed in the boat, proceed as follows:-

1. Drain the gearbox oil into a suitable container.
2. Disconnect oil cooler pipes and the cable from the control lever.
3. Remove the 4 bolts securing the oil pump to the gearcase and remove the pump.
4. Remove the two bolts securing the drive shaft end plate.
5. Unscrew the nut on the valve block and remove the 7 bolts that secure the top half of the gearcase to the lower half. Lift off the top half complete with the valve block assembly and top cover.
6. Slacken the bolts securing the damper plate or input coupling to the flywheel to allow slight movement. Withdraw the input shaft spline. (on units incorporating 3:1 ratio it is recommended that all bolts but one be removed so that the plate or coupling will pivot on the remaining bolt to permit the input shaft to be lifted with the gearbox case).
7. Lift the input shaft, if necessary rotating slightly so that the spline can be withdrawn from the damper plate or flexible

coupling.

8. Once the spline is cleared, lift the complete shaft assembly from the casing. Lift and remove the layshaft and front cover from the casing.

9.5 Servicing input shaft and layshaft assembly components

9.5.1

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 force the seal from the housing with the aid of a hardwood drift.

Fit a new oil seal (item no. D29) in the housing and replace the housing.

9.5.2

Drive end bearing

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

1. Support the shaft in a vice, and remove input housing and seal assembly.
2. For PRM101: using circlip pliers, remove the circlip from in front of the bearings. For PRM160 the bearing outer race will be loose; remove and discard.
3. Withdraw the clutch pinion, spacer and bearing by means of pulley extractors, with the jaws of the extractors positioned behind the pinion.
4. Refit the pinion to the shaft.
5. Replace the pinion spacer and locate a new bearing (item no. D2) on the shaft and either handpress or gently drive the bearing into position using the hardwood drift and a hammer.
6. PRM101: refit the small circlip (item no. D1).

   PRM160: fit the outer race from the replacement taper roller bearing.
7. Re position the end housing, complete with oil seal, O ring and large circlip, on the shaft (first check that the O ring and circlip are in good condition and replace if necessary).

9.5.3

Clutch assembly

Clutch plates which are discoloured by overheating or worn down to the extent that they have lost their criss cross pattern of grooves, will tend to slip. If either of these conditions occurs it is recommended that the entire clutch assembly is replaced as follows:-

1. Remove the drive pinion bearing as previously described.
2. Unlock and remove the 6 clutch securing bolts taking care not to lose any of the locating ferrules.
3. Withdraw the complete clutch from the shaft, noting the position of the pull-off springs and pins.
4. Stand the shaft in an upright position and locate the retaining pins in the clutch gear.
5. Fit the clutch end plate (item no. D10) over the pins and then, starting with one of the driver clutch plates (item no. D7), build up the replacement clutch on to the end plate.
6. Position the ferrules in the spaces between the driven clutch plates and fit the pull-off springs over the pins.
7. Replace the end cover onto the pins, locating them in the blind holes in the cover.
8. Refit the securing bolts and locating strips by feeding them through the flange on the clutch shaft and lightly tighten.
9. Turn the shaft upside down and ensuring that the pull-off springs are correctly located tighten the bolts with a torque spanner set at 12.2 Nm (9lbf.ft, 1.24 Kgm) and close the locking strips over the bolt head.
10. Replace the drive pinion, turning slightly so that it is inserted into the driver clutch plates until it touches the bottom washer.
11. Replace the thrust washer bearing and circlip as described.

N.B. for shimming procedures please refer to section 9.12.

9.5.4

Clutch gear

To fit a new clutch gear (item no. D18) first remove the clutch as described, then extract the piston retaining spacer and circlips, to allow the piston and clutch gear to be removed from the shaft. Separate the gear from the piston, check that the inner and outer piston ring step joints are intact, and fit a new gear around the piston. Refit the piston to the shaft replacing the circlip and spacer, and reassemble the clutch drive pinion and bearing as previously described.

N.B. It is advisable to renew both clutch gears simultaneously since damage to one will often result to damage to its mating gear.

9.5.5

Drive pinion

As with the clutch gears it is advisable to renew both drive pinions simultaneously. To ensure that the drive pinion of the correct ratio is used please refer to the parts list at the back of this manual. If it is required to fit a ratio which is different to that which was originally supplied, the output gear as well as both pinions will need to be changed.

To replace the drive pinion, follow the procedure set out in section 9.5.2

9.5.6

Non drive end bearings

PRM101: To remove the non drive end bearing remove the small retaining circlip. The bearing can now be removed using standard bearing pullers.

PRM160: Withdraw sufficient clutch securing bolts to permit light 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.

9.5.7

Piston rings and feeder

Excessive wear or damage may necessitate replacement of the piston rings and feeder in the following manner:-

1. Remove the non drive end bearing as described and remove the feeder and spacer.
2. Remove the piston rings from the shaft with the aid of a special piston ring extractor or a piece of thin steel. 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 and until it rests on the land above the groove, where it can be eased off. Repeat this with the other two rings.
3. Take out the new rings from the packing and clean off any grease or inhibitor.
4. If a ring loading tool is available, fit this around the shaft, load the rings onto the tool and locate in their approximate position. Gently withdraw the tool and allow the rings to locate in their respective grooves.

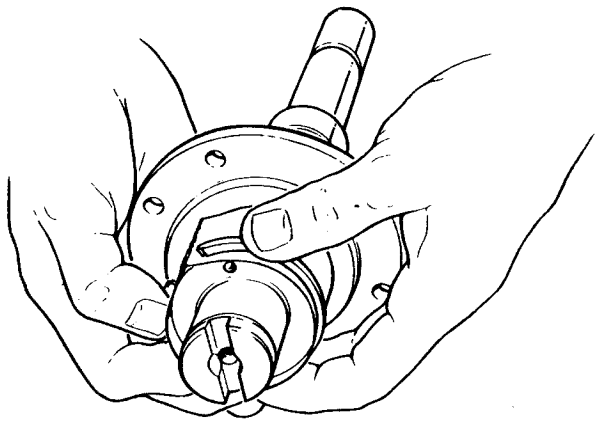


Fig. 11. piston rings – fitting procedure

5. 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 it to be placed in its approximate position over the strip. Gently withdraw the strip and locate the rings in their respective grooves. (see fig. 13).
6. Compress each ring in turn and carefully fit the new feeders and spacers.

9.6 Replacing the input shaft and layshaft assemblies

1. Position the input shaft assembly in the gearcase and ensure that the circlip is correctly located in the lower half of the gearcase, and that the end housing is in position. If the gearbox is still mounted to the engine engage the input shaft into the spline centre of the drive plate or input coupling.
2. Position the layshaft in the casing ensuring that the end cover is correctly located.
3. Ensure that the top and bottom mating faces for the two gearcase halves are clean and free of any metal burrs. Smear the bottom half case with a liquid gasket compound, fit the top half and secure with 7 bolts and one nut on the valve block.
4. PRM160 only: calculate the number of shims required and locate the correct number in the output shaft end cover.
5. Refit the input shaft end cover, replacing the O ring if damaged.
6. PRM160 only: recalculate the number of shims required and locate in the recess provided on the oil pump adaptor.
7. Refit the oil pump, replacing the O ring if damaged.
8. Tighten the bolts securing the drive plate or input coupling to the engine flywheel.
9. If the gearbox has been removed from the engine re-align and reconnect the propeller shaft coupling, oil cooler and operating system as described in sections 5.6, 5.7 and 5.10 (installation).

For shimming details please see section 9.12.

9.7 Removing PRM101 output shaft assembly

Removal of the output shaft necessitates the gearbox being taken out of the boat (see section 9.3). Then proceed as follows:-

(i) Remove input shaft and layshaft assemblies (see section 9.4).

(ii) Remove output shaft end cover by applying a magnet and lightly tapping the gearcase with a soft hammer. If the end cover is corroded in the bore and cannot be removed, it must be drilled to provide extractor holes (necessitating the fitment of a new cover).

(iii) Remove circlip (item no. F3).

(iv) Remove the three retaining bolts (item no. F16) holding the end housing.

(v) Turn the gearcase on end with the output coupling face down. Using a hardwood drift and hammer knock the end of the shaft through the bearing and remove the output shaft assembly from the case. The output gear, front bearing and spacer will now be left inside the case.

9.8 Servicing PRM101 output shaft assembly components

9.8.1

Front bearing and output gear

(i) Having removed the output shaft assembly from the gearbox (as described in 9.7) the output gear will be left loose inside the gearcase. The front bearing must be carefully removed from its bore using a press or a hardwood drift and hammer.

(ii) If the bearing is defective check that the gear has not been damaged by debris. Similarly, if the gear is defective, check that the bearing is undamaged.

(iii) For a new gear or front bearing to be fitted, align the output gear in the gearcase and press the shaft assembly through the rear bore, picking up the output gear at the same time. The shaft should be pressed until the rear bearing seats onto the large circlip in the rear bore. Ensure that the cut-out profile on the rear oil seal housing (item no. F14) lines up with the profile of the oil pump on the rear case face.

(iv) Turn the gearbox over so the coupling is facing downwards and fit the spacer (item no. F5) onto the shaft.

(v) Press the front bearing onto the shaft and into the front bore.

(vi) Fit the circlip (item no. F3).

(vii) Inspect 'O' ring (item no. F2) which seals the front cover and replace if damaged. Refit the front cover.

(viii) Refix the rear oil seal cover with three bolts.

(ix) Refit input shaft and layshaft assemblies as previously described.

9.8.2

Rear bearing and oil seal

(i) Remove the output shaft assembly as described in section 9.7. The shaft will now be free complete with nut, tab washer, bearing, and housing with seal.

(ii) Bend back the tabs on the washer to allow the locking nut to be unscrewed.

(iii) The bearing can now be removed from the shaft using a soft hammer or hand press.

(iv) If 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.

(v) Remove the rear housing with seal. If the seal is damaged, press out and replace.

(vi) Remove the circlip (item no. F7). The output shaft will now be bare and can be replaced if necessary.

9.9. Re-assembling the PRM101 output shaft

(i) Check that the large circlip (item no. F11) in the case bottom half is undamaged. Renew if necessary.

(ii) Remove the 'O' ring (item no. F13) and oil seal (item no. F15) from the rear housing and replace with new parts. (It is advisable to renew these parts whenever the output shaft is stripped).

(iii) Fit the rear cover, with 'O' ring and seal fitted, to the output shaft.

(iv) Press on rear bearing until it seats on the shoulder provided on the output shaft.

(v) Fit tub washer. Screw on locking nut. Bend back tabs to retain locknut.

(vi) Fit circlip (item no. F7).

(vii) Complete re-assembly as described in section 9.8.1, paras (iii) to (ix).

9.10 Removing PRM160 output shaft assembly

Only the rear oil seal (item no. F15) can be renewed without removing the gearbox from the engine/sterngear installation (assuming there is space in the engine compartment). For the servicing of all other items on the output shaft, first remove the transmission from the boat, then proceed as follows:-

(i) Remove input shaft and layshaft assemblies (see section 9.4).

(ii) Remove the output shaft end cover by applying a magnet and lightly tapping the gearcase with a soft hammer. If the end cover is corroded in the bore and cannot be removed, it must be drilled to provide extractor holes (necessitating the fitment of a new cover).

(iii) Remove the output coupling and seal housing. Carefully remove the shims located between the seal housing and bearing and store for re-assembly. Refit the coupling, washer and nut.

(iv) Place two small jacks between the coupling flange and the case. Operate the jacks so that the shaft and rear bearing are pulled from the case. The spacer, output gear, washer and front bearing inner race will now be loose in the case.

(v) Remove the large circlip (item no. F3) from the front bearing hole and press out the front bearing outer race.

9.11 Servicing the PRM160 output shaft assembly components

(i) Having removed the output shaft assembly from the gearbox (as described in 9.10) the output gear and front bearing can now be examined and replaced if necessary.

(ii) If the bearing is defective, check that the gears have not been damaged by debris. Similarly, if a gear is found to be defective, check that the bearing is undamaged.

(iii) For a new gear or front bearing to be fitted, first remove nut, washer, output coupling and bearing outer race from the output shaft. If the rear bearing is damaged remove the inner race from the shaft and press home the new part.

(vi) Press the outer race of the new bearing into the front bearing until it just clears the circlip groove in the bore.

(v) Fit the large circlip into the groove.

(vi) Align the spacer bush, output gear, thrust washer and front bearing inner race in the gearbox case.

(vii) Pass the output shaft through the rear bore, pick up the bush, gear, washer and front bearing and press the shaft home until the inner race is fully loaded onto the shaft and the outer race is seated onto the large circlip in the bore.

(viii) Locate the rear bearing outer race in the rear bore and press home.

(ix) Re-calculate the number of shims required (see section 9.12 describing shim procedure) and refit rear seal housing. It is advisable to fit a new 'O' ring and oil seal whenever the output shaft has been stripped.

(x) Replace the 'O' ring on the front cover if damaged (strongly recommended) and refit the cover into the front bore.

(xi) Refit the thrust washer, coupling, tab washer and nut. Tighten the nut to the torque figure specified in section 10.

9.12 Shimming procedures (PRM160 only)

9.12.1

Input shaft and layshaft

The allowable end float on the taper bearing is 0-0.05mm (0-0.002in) clearance: this should be checked with the aid of a depth micrometer as follows:-

(i) press the bearing outer cone firmly into position and measure between the face of the gearcase and the top of the bearing outer as shown in fig. 14.

(ii) measure the depth of the recess in the oil pump and in the output shaft end cover. Make up the difference with shims.

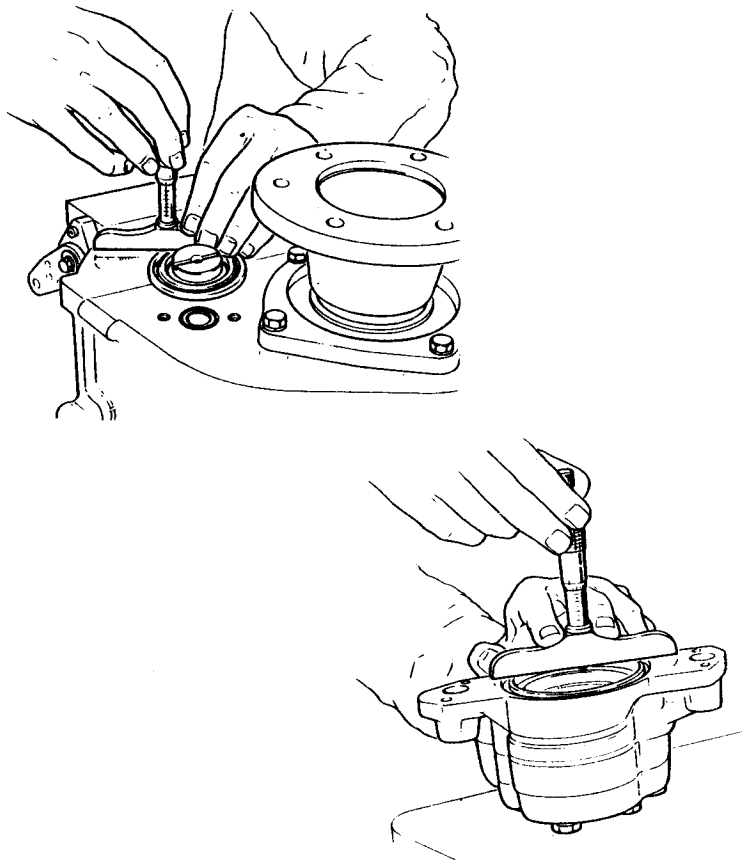


Fig. 12. shimming procedure

Where a depth micrometer is not available, the following method may be used:-

(i) remove the 'O' ring from the oil pump or end cover;

(ii) fit sufficient shims so that the oil pump or end cover stands proud of the gearbox.

(iii) rotate the input shaft or layshaft whilst slowly tightening the four securing bolts until the shaft starts to bind. **Note: care must be taken to ensure that the oil pump or end cover is tightened squarely on to the gearbox face: this can be checked by feeler gauges or shims around the pump or end cover to ensure a uniform gap.**

(iv) Now measure the gap with the aid of feeler gauges or shims. Deduct shims to this figure plus 0.050mm (0.002in) from the shims already installed.

(v) Remove the necessary number of shims, tighten the oil pump or end cover, and test by rotating the shaft.

(vi) Remove the oil pump or end cover and re-fit with the 'O' ring installed.

9.12.2

Output shaft

(i) When the output shaft is fitted in the gearcase and the bearing driven into position, press the bearing outer cone firmly into position and measure from the gearcase to the top of the bearing outer.

(ii) Measure the height of the spigot on the seal housing from the face which is fitted to the gearcase.

(iii) Make up the difference between the two dimensions with shims.

Note: **shims are available in two thicknesses, 0.254mm (0.010in) and 0.05mm (0.002in.). As an example of their use, if an end float reading of 0.548mm (0.023in) is obtained, two shims of 0.254mm (0.010in) and one of 0.05mm (0.010in) should be used, giving the final end float or clearance of 0.025mm (0.001in).**

10. TIGHTENING TORQUES

	lbf.ft	Nm	kgm
Upper to lower gearcase bolts	40	54.2	5.53
Valve block to upper gearcase	22	29.8	3.04
Operating lever to valve block	22	29.8	3.04
End cover to valve block (loctite)	40	54.2	5.53
Pump body to gearcase	40	54.2	5.53
End cover to gearcase	40	54.2	5.53
Pump cover to pump body	22	29.8	3.04
Coupling to output shaft (PRM160)	120	162.7	16.60
Top cover to upper gearcase	22	29.8	3.04
Oil seal housing to gearcase	40	54.2	5.53
Adaptor plate gearbox	43	58.3	5.95

11. IDENTIFICATION PLATE

Every PRM gearbox is fitted with an identification plate on the top half of the gearcase before it leaves the factory; fig. 13 shows an example of such a plate.

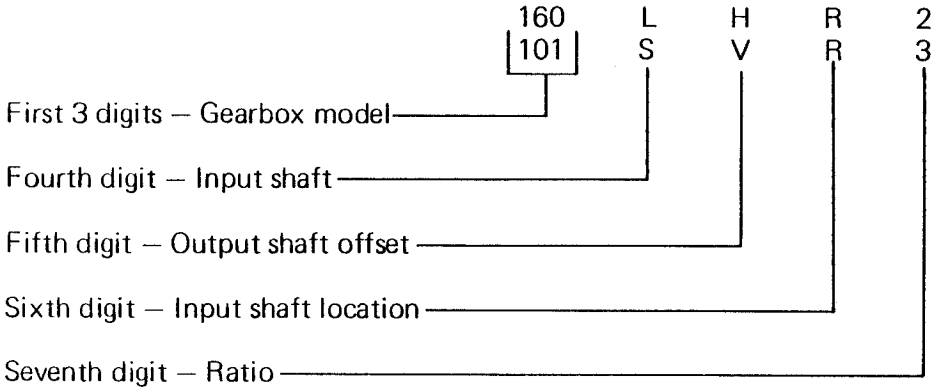
fig. 13. identification plate

Newage	Coventry
123456	A1234
101SVR3	
Use recommended lubricants only	

It will be noted that there are two lines of numbers.

The top line is the gearbox serial number, and should always be quoted when ordering spare parts; this enables the factory to trace the history of the gearbox right back to its date of manufacture and the components and materials used in its production, thus ensuring that the correct components can be supplied as spare parts.

The lower line is the gearbox specification; in the example given this translates as follows:-



(PRM101 or PRM160)
(S = standard, L = long)
(H = horizontal, V = vertical)
(R = right hand)
(2 = 1.96:1, 3 = 2.94:1)

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

Tel: 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.

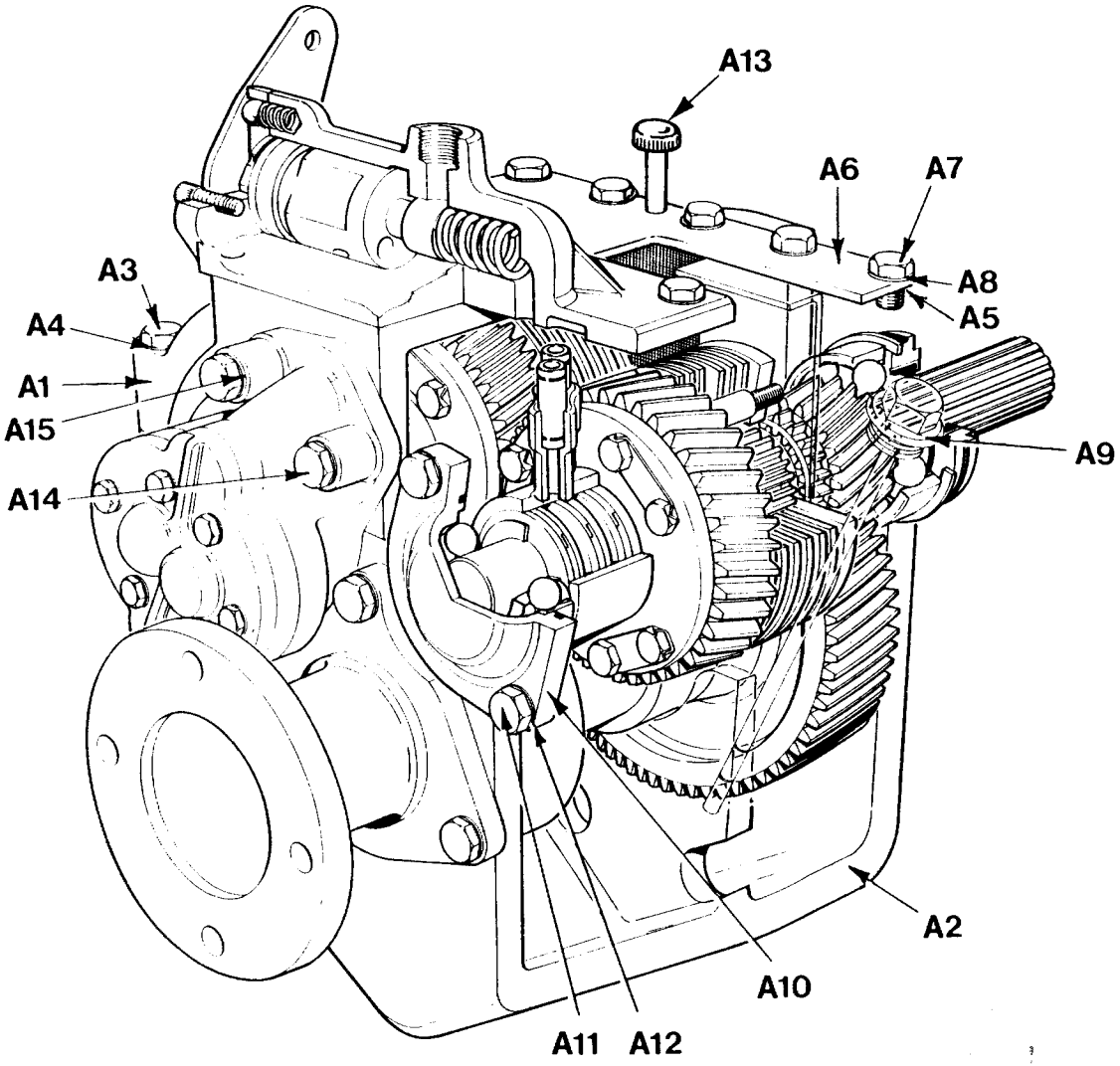

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PLATE REF	DESCRIPTION	PRM101 PART NO.	PRM160 PART NO.	Qty	REMARKS
A	Gearcase assembly comprising				
	Case sub-assembly	MT0018	MT0018	1	For vertical build
	Case sub-assembly	MT0036	MT0036	1	For horizontal build
A1	Gearcase – top	MT1119	MT1119	1	Not supplied seperately
A2	Gearcase – bottom	MT991	MT991	1	Not supplied seperately
A3	Bolt 3/8" UNF x 2"	UBF113	UBF113	6	9.5mm x 50.8mm
A4	Washer 3/8"	W108	W108	6	9.5mm
A5	Gasket	MT343	MT343	1	
A6	Top cover	MT1203	MT1203	1	
A7	Screw 5/16" UNF x ¾"	USF32	USF32	10	7.9mm x 19.1mm
A8	Washer 5/16" UNF	CP1223	CP1223	10	7.9mm
A9	Oil level indicator	MT471	MT471	1	For vertical build
	Oil level indicator	MT1137	MT1137	1	For horizontal build
A10	End cover	MT318	MT318	1	
A11	Screw 3/8" UNF x ¾"	USF33	USF33	2	9.5mm x 19.1mm
A12	Washer 3/8"	CP1124	CP1124	2	9.5mm
A13	Air filter	CP1057	CP1057	1	
A14	Bolt 3/8" UNF x 1½"	UBF93	UBF93	4	9.5mm x 38.1mm
A15	Washer 3/8"	CP1224	CP1224	4	9.5mm
	Items not illustrated				
	Drain plug	CP1189	CP1331	1	
	Washer drain plug	CP1068	CP1068	1	
	Washer dipstick	CP1068	CP1068	1	
	Case half bolt	UBF173	UBF173	1	
	End cover (MT318) O ring	002873	002873	1	

Mod 8300

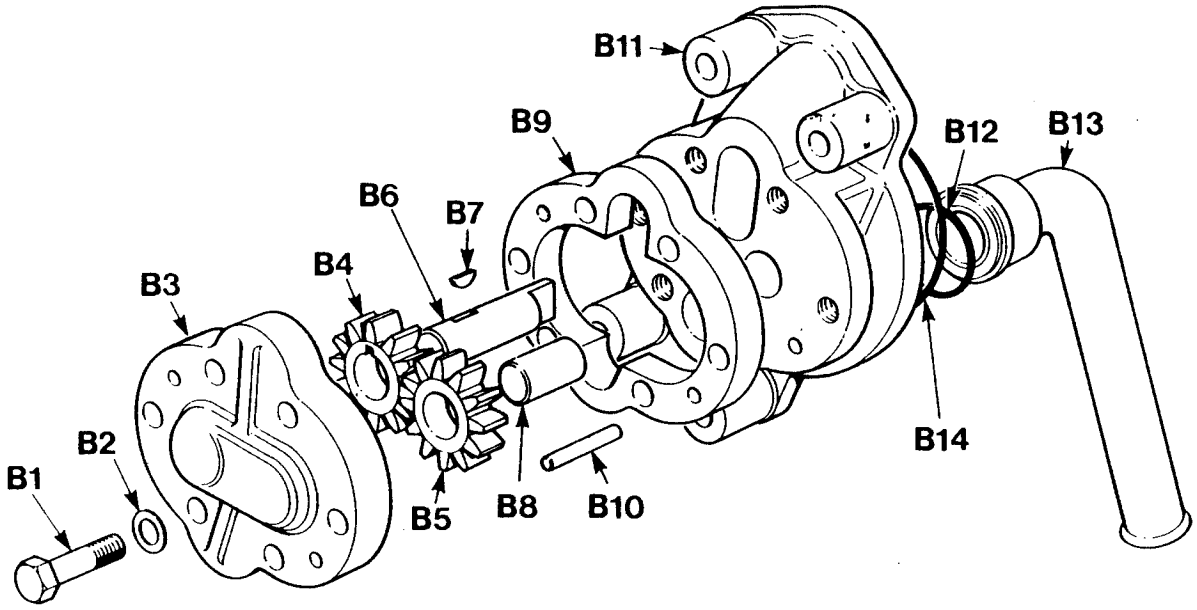
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PLATE REF	DESCRIPTION	PRM101 PART NO.	PRM160 PART NO.	Qty	REMARKS
B	Oil pump assembly comprising	MT479	MT0009		
B1	Bolt 5/16" UNF x 1¼"	UBF72	UBF72	6	
B2	Washer 5/16"	CP1223	CP1223	6	
B3	Pump cover	MT321	MT321	1	
	Pump repair kit comprising:	MT903	MT903	1	
B4	Pump gear driver	MT322	MT322	1	)
B5	Pump gear driven	MT323	MT323	1	) Only available as pump
B6	Pump spindle	MT324	MT324	1	) repair kit MT903
B7	Woodruff key	CP1193	CP1193	1	)
B8	Pump spindle	MT325	MT325	1	)
B9	Pump plate	MT320	MT320	1	
B10	Dowel	MT356	MT356	2	
B11	Adaptor	MT314	MT1053	1	
B12	O ring	001254	001254	2	
B13	Oil pipe	MT736	MT736	1	Standard build
B13	Oil pipe	—	MT737	1	Horizontal build
B14	O ring	002873	002873	2	

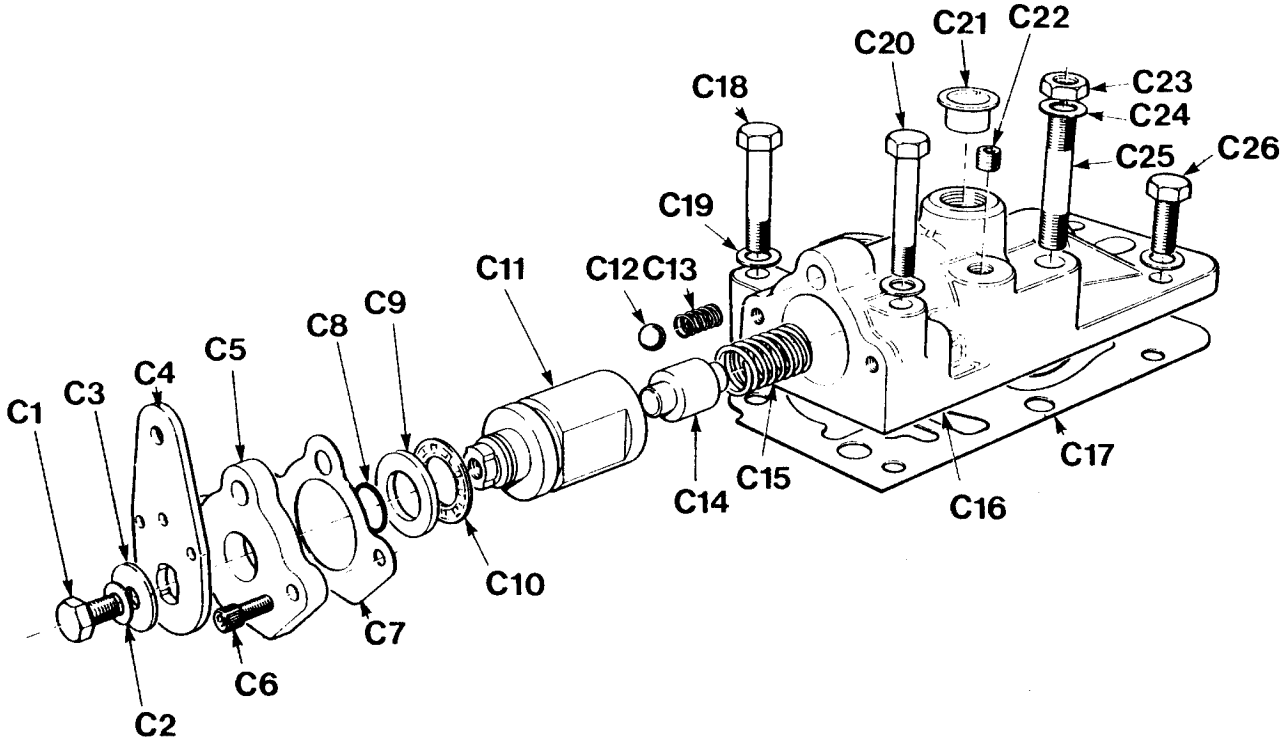
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PLATE REF	DESCRIPTION	PRM101 PART NO.	PRM160 PART NO.	Qty	REMARKS
C	VALVE BLOCK ASSEMBLY	MT0011	MT0011	1	
C1	Screw M8 x 16mm	0040806	0040806	1	
C2	Spring washer M8	0191105	0191105	1	
C3	Washer 1"	MT979	MT979	1	25.4mm
C4	Operating lever	MT977	MT977	1	
C5	End plate	MT978	MT978	1	
C6	Cap screw M5 x 20mm	0081220	0081220	2	
C7	Gasket	MT1081	MT1081	1	
C8	O ring	000753	000753	1	
C9	Spacer	CP1308	CP1308	1	
C10	Thrust bearing	CP1307	CP1307	1	
C11	Control valve	MT976	MT976	1	
C12	Detent ball	CP1077	CP1077	1	
C13	Detent spring	MT305	MT305	1	
C14	Relief valve	MT980	MT980	1	
C15	Valve spring	MT1194	MT1194	1	
C16	Valve block	MT4600	MT4600	1	Not supplied separately
C21	Redcap seal (transit only)	MT477	MT477	2	
C22	Pressure plug	MT311	MT311	1	3.17mm
C17	Gasket	MT1073	MT1073	1	
C18	Bolt 5/16" UNF x 1¾"	UBF102	UBF102	1	7.9mm x 44.4mm
C19	Washer 5/16"	CP1223	CP1223	5	7.9mm
C20	Bolt 5/16" UNF x 2¼"	UBF122	UBF122	1	7.9mm x 57.1mm
C23	Nut 3/8" UNF	UN505	UN505	1	9.5mm
C24	Washer 3/8"	W108	W108	1	9.5mm
C25	Stud 3/8" UNF x 5.11/16"	MT1079	MT1079	1	9.5mm x 144.46mm
C26	Screw 5/16" UNF x 1"	USF52	USF52	3	7.9mm x 25.4mm

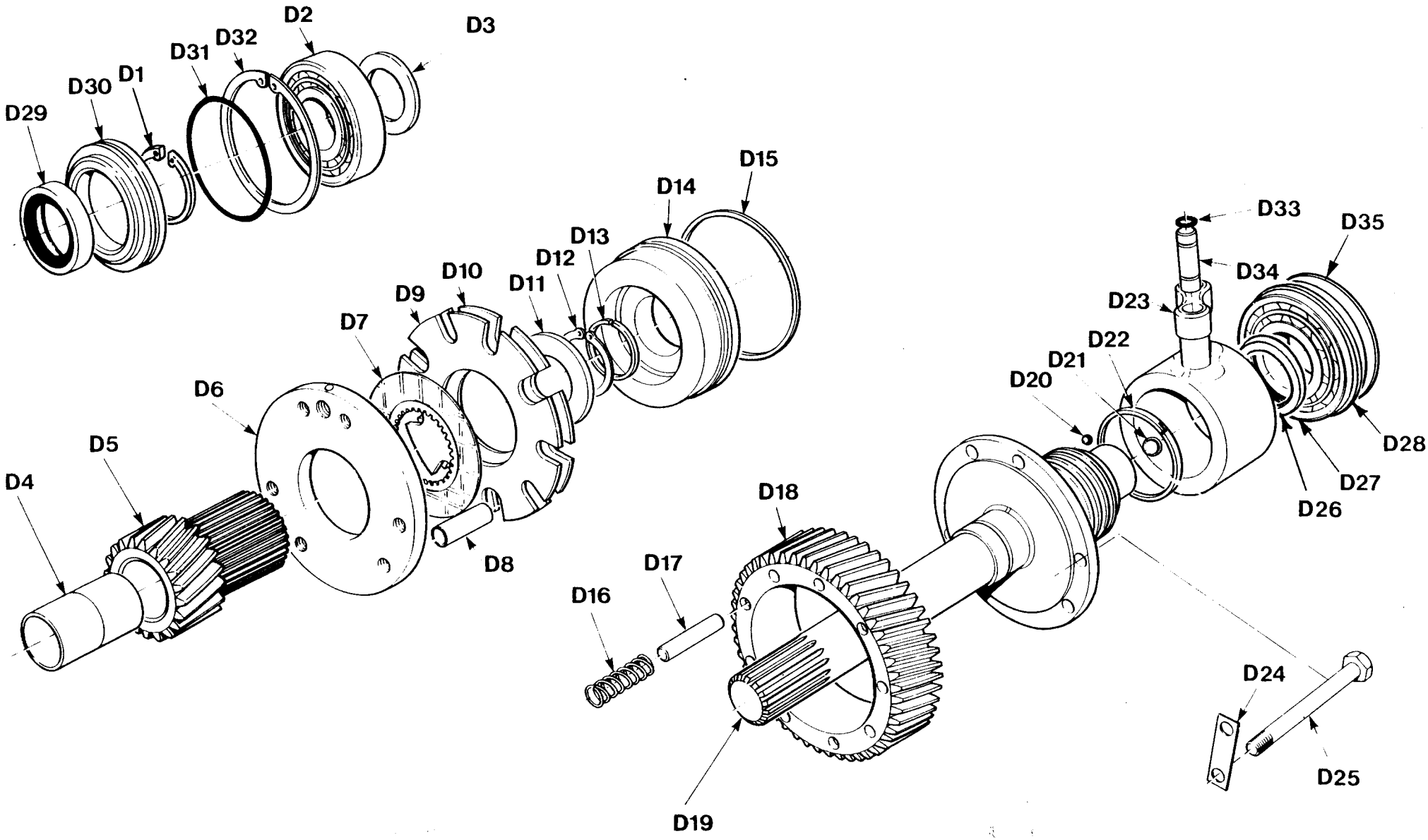
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PLATE REF	DESCRIPTION	PRM101 PART NO.	PRM160 PART NO.	Qty	REMARKS
D	INPUT SHAFT ASSEMBLY				
	Short splined shaft 2:1	MT0086/2	MT0041/2	1	Vertical
	Short splined shaft 3:1	MT0086/3	MT0041/3	1	Vertical
	Long splined shaft 2:1	MT0082/2	MT0043/2	1	Vertical
	Long splined shaft 3:1	MT0082/3	MT0043/3	1	Vertical
	Short splined shaft 2:1	—	MT0069/2	1	Horizontal
	Short splined shaft 3:1	—	MT0069/3	1	Horizontal
	Tapered shaft 2:1	—	MT0042/2	1	Vertical
	Tapered shaft 3:1	—	MT0042/3	1	Vertical
	Each assembly comprises:-				
D1	Circlip	0330250	—	1	
D2	Bearing	AM161	0540251	1	
D3	Spacer	MT350	MT1123	1	
	Pinion & bush sub assy.	MT733	MT0070/2	1	2:1 ratio
D4	Bush	MT361	—	2	Not supplied seperately
D4	Bush	—	MT1138	1	Not supplied seperately
D5	Pinion 27 teeth	MT328	MT1173	1	Not supplied seperately
	Pinion & bush sub assy.	MT732	MT0070/S	1	3:1 ratio
D4	Bush	MT361	—	2	Not supplied seperately
D4	Bush	—	MT1138	1	Not supplied seperately
D5	Pinion 17 teeth	MT326	MT1141	1	Not supplied seperately
	Clutch pack	MT0089	MT0079	1	
D6	Clutch end cover	MT1113	MT1113	1	Not supplied separately
D7	Clutch plate driver	MT731	—	6	Not supplied separately
D7	Clutch plate driver	—	MT731	8	Not supplied separately
D8	Ferrule	MT1156	MT730	6	
D9	Clutch plate driven	MT116	—	5	Not supplied separately
D9	Clutch plate driven	—	MT116	7	Not supplied separately
D10	Clutch end plate	MT117	MT117	1	Not supplied separately
D11	Spacer	MT344	MT344	1	
D12	Circlip	CP1102	CP1102	1	
D16	Spring	MT1157	MT120	3	
D17	Pin	MT1155	MT357	3	
D24	Tab strip	MT351	MT351	3	
D25	Bolt	UBF141	MT452	6	
D13	Piston ring	MT358	MT358	1	
D14	Piston	MT345	MT345	1	

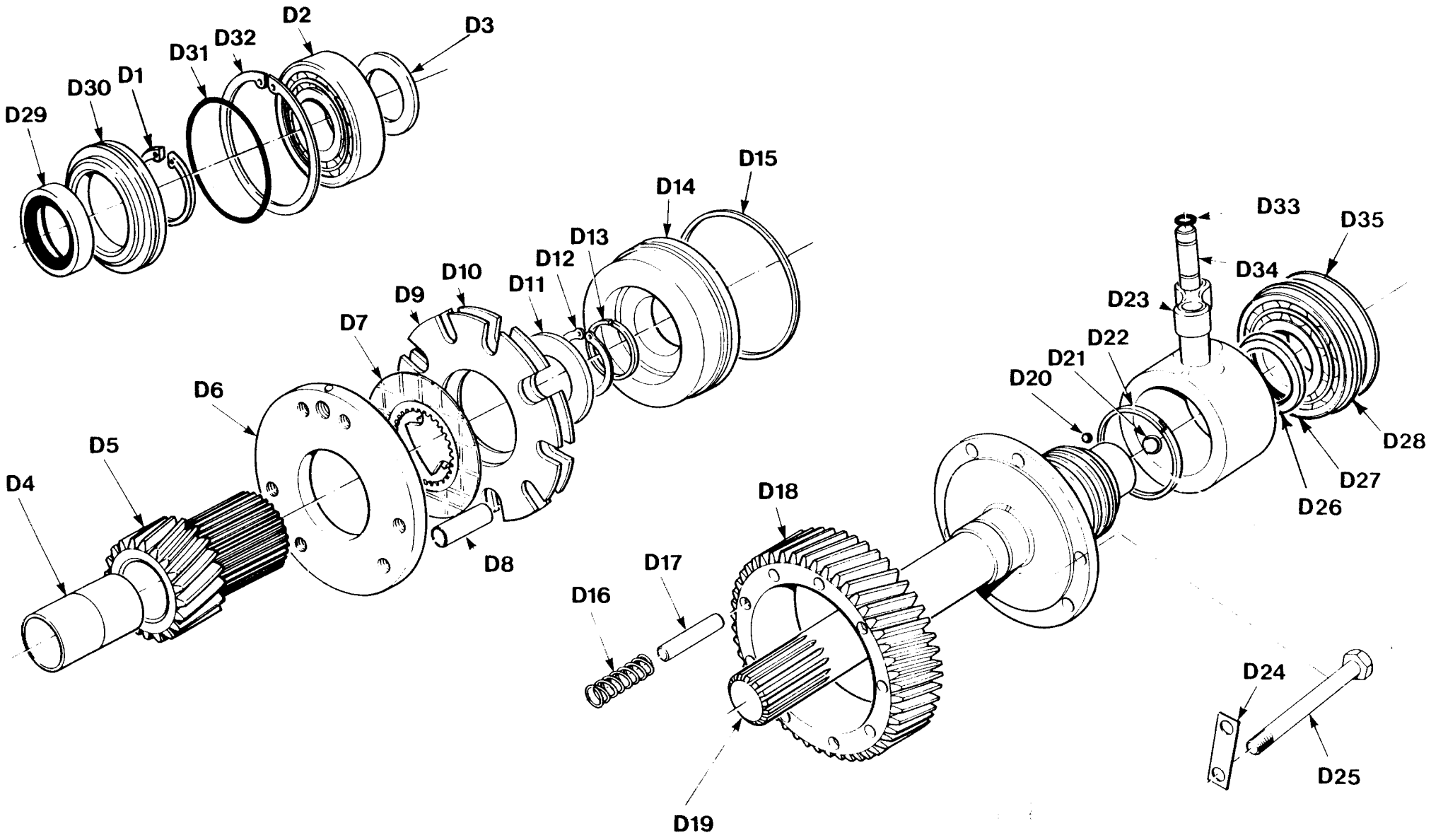
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PLATE REF	DESCRIPTION	PRM101 PARTNO.	PRM160 PART NO.	Qty	REMARKS
D15	Piston ring	MT359	MT359	1	
D18	Clutch gear	MT333	MT333	1	
D19	Input shaft short spline	MT1154	MT1126	1	Vertical build
D19	Input shaft long spline	MT1152	MT1128	1	Vertical build
D19	Input shaft short spline	—	MT1133	1	Horizontal build
D19	Input shaft tapered	—	MT1127	1	Vertical build
D20	Ball	CP1180	CP1180	1	
D21	Ball	CP1191	CP1191	1	
D22	Piston ring	CP1192	CP1192	3	
D23	Feeder	MT315	MT315	1	
D26	Spacer	MT1158	—	1	
D27	Bearing	MT160	0540251	1	
D28	Circlip	0330250	—	1	
D29	Input shaft oil seal	MT165	MT165	1	
D30	Input shaft end cover	MT981	MT981	1	
D31	O ring	002433	002433	1	
D32	Circlip	0250620	0250620	1	
D33	O ring	000372	000372	4	
D34	Connector	MT1057	MT1057	2	
D35	Shim	—	MT1075/02/ 10 AR		
	Nut 5/16" Nyloc	—	UN521	1	) Only used
	Washer	—	CP1289	1	) with
	Key	—	MT760	1	) MT1127

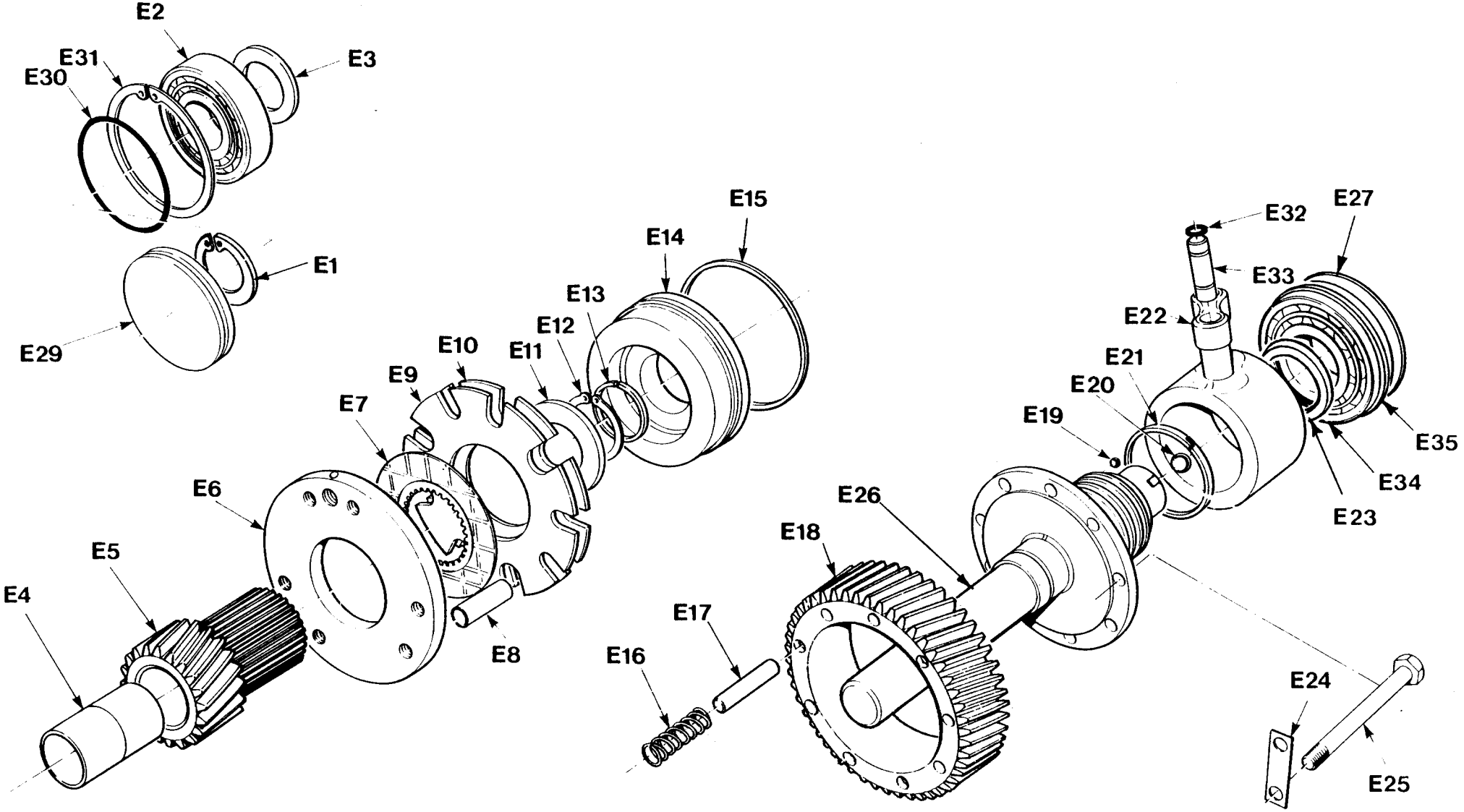
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PLATE REF	DESCRIPTION	PRM101 PART NO.	PRM160 PART NO.	Qty	REMARKS
E	LAYSHAFT ASSEMBLY				
	Layshaft assembly 2:1 ratio	MT0081/2	MT0040/2	1	
	Layshaft assembly 3:1 ratio	MT0081/3	MT0040/3	1	
	Each assembly comprises:				
E1	Circlip	0330250	—	1	
E2	Bearing	AM161	0540251	1	
E3	Spacer	MT350	MT1123	1	
	Pinion & bush subassy.	MT733	MT0070/2	1	2:1 ratio
E4	Bush	MT361	—	2	Not supplied seperately
E4	Bush	—	MT1138	1	Not supplied separately
E5	Pinion 27 teeth	MT328	MT1173	1	Not supplied separately
	Pinion & bush subassy.	MT732	MT0070S/A	1	3:1 ratio
E4	Bush	MT361	—	2	Not supplied separately
E4	Bush	—	MT1138	1	Not supplied separately
E5	Pinion 17 teeth	MT326	MT1141	1	Not supplied separately
	Clutch pack	MT0089	MT0079	1	
E6	Clutch end cover	MT1113	MT1113	1	Not supplied separately
E7	Clutch plate driver	MT731	—	6	Not supplied separately
E7	Clutch plate driver	—	MT731	8	Not supplied separately
E8	Ferrule	MT1156	MT730	6	
E9	Clutch plate driven	MT116	—	5	Not supplied separately
E9	Clutch plate driven	—	MT116	7	Not supplied separately
E10	Clutch end plate	MT117	MT117	1	Not supplied separately
E11	Spacer	MT344	MT344	1	
E12	Circlip	CP1102	CP1102	1	
E16	Spring	MT1157	MT1120	3	
E17	Pin	MT1155	MT357	3	
E24	Tab strip	MT351	MT351	3	
E25	Bolt	UBF141	MT452	6	
E13	Piston ring	MT358	MT358	1	
E14	Piston	MT345	MT345	1	
E15	Piston ring	MT359	MT359	1	
E18	Clutch gear	MT332	MT332	1	
E19	Ball	CP1180	CP1180	1	
E20	Ball	CP1191	CP1191	1	
E21	Piston ring	CP1192	CP1192	1	
E22	Feeder	MT315	MT315	1	
E23	Spacer	MT1158	—	1	

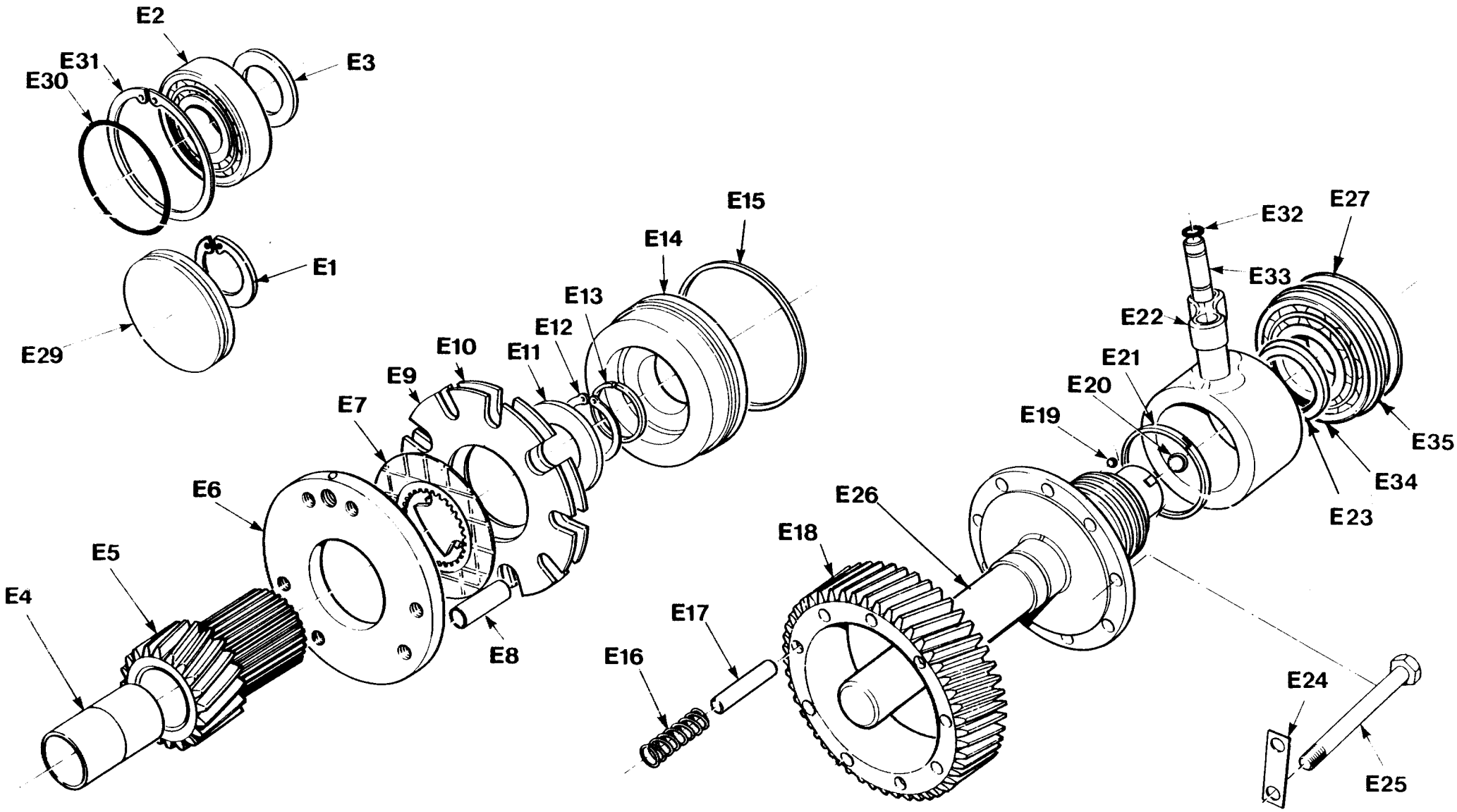
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PLATE REF	DESCRIPTION	PRM101 PART NO.	PRM160 PART NO.	Qty	REMARKS
E					
E34	Bearing	MT160	0540251	1	
E35	Circlip	0330250	—	1	
E26	Layshaft	MT1153	MT1125	1	
E27	Shims	—	MT1075/02	AR	.002 in thickness
			MT1075/10	AR	.010 in thickness
E29	Layshaft end cover	MT999	MT999	1	
E30	O ring	002433	002433	1	
E31	Circlip	0250620	0250620	1	
E32	O ring	000372	000372	4	
E33	Connector	MT1057	MT1057	2	

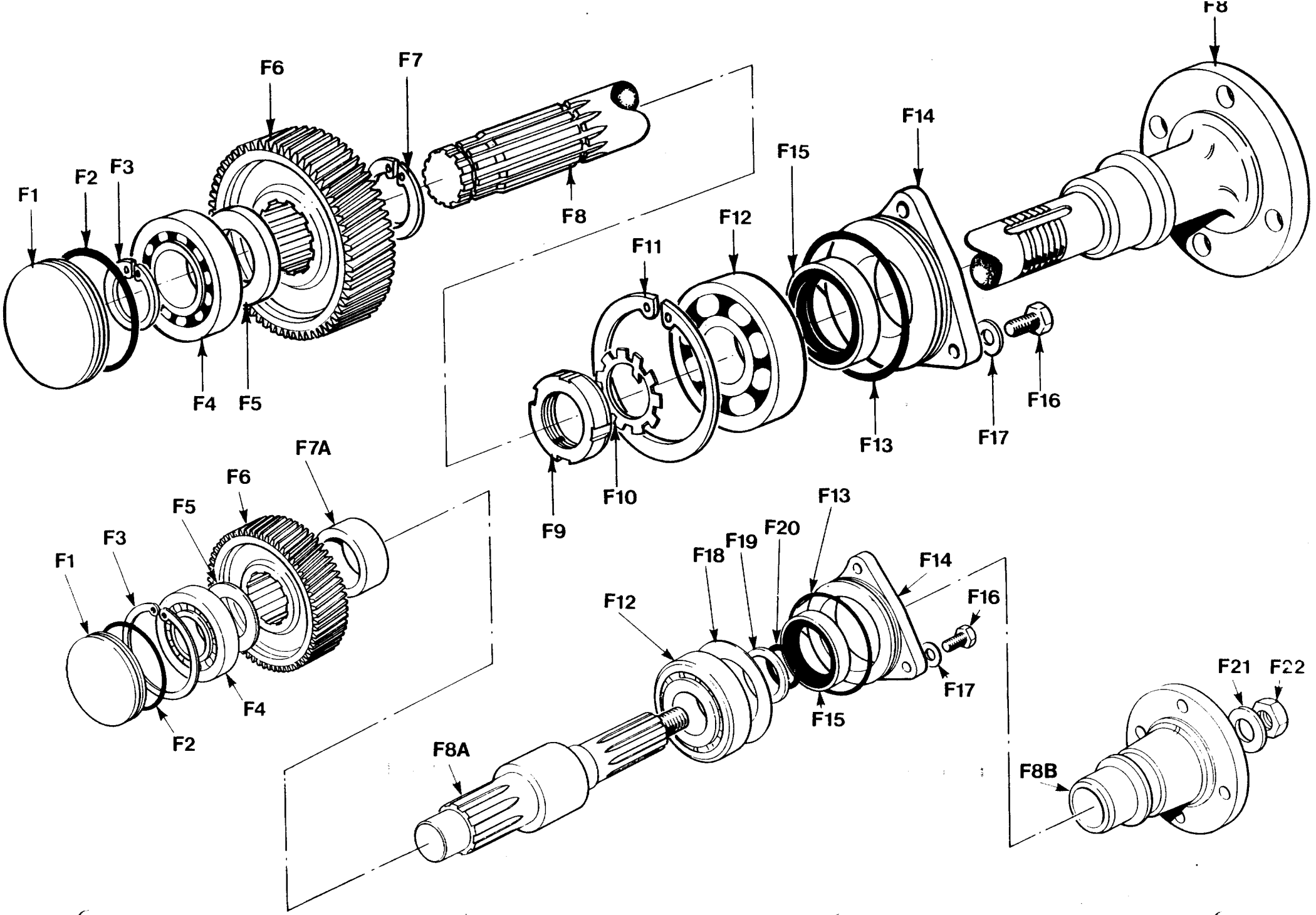
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PLATE REF	DESCRIPTION	PRM101 PART NO.	PRM160 PART NO.	Qty	REMARKS
F	OUTPUT SHAFT				
F1	End cover	MT1101	MT996	1	
F2	O ring	003124	003124	1	
F3	Circlip	0330350	0250800	1	
F4	Bearing	0513530	0540352	1	
F5	Spacer	MT1111	MT995	1	
F6	Output gear 2:1 ratio	MT1100	MT1100	1	53 teeth
F6	Output gear 3:1 ratio	MT1098	MT1098	1	50 teeth
F7	Circlip	0330380	—	1	
F7A	Spacer	—	MT1102	1	
F8	Output shaft/coupling	MT1151	—	1	
F8A	Output shaft	—	MT1097	1	
F8B	Coupling	—	MT753	1	
F9	Locknut	010N401	—	1	
F10	Lockwasher	010W401	—	1	
F11	Circlip	CP1190	—	1	
F12	Bearing	0514030	0540401	1	
F13	O ring	003504	003504	1	
F14	End housing	MT319	MT319	1	
F15	Oil seal	MT349	MT349	1	
F16	Bolt	USF53	USF53	3	
F17	Washer	W108	W108	3	
F18	Shim	—	MT1076/ 02/10	AR	
F19	Spacer	—	MT1082	1	
F20	O ring	—	001506	1	
F21	Washer	—	MT600	1	
F22	Nut	—	0061210	1	

PRM101 Kits of Parts

Description	Part No.	Qty
O Ring Kit	**MT0025**	
O ring feeder connection	000372	8
O ring control valve	000753	1
O ring oil pump	001254	2
O ring	001506	1
O ring output shaft	003504	1
O ring end cover	002433	2
O ring oil pump	002873	2
O ring end cover	003124	1
Gasket valve block	MT1073	1
Gasket valve end plate	MT1081	1
Oil seal – input shaft	MT165	1
Gasket – top cover	MT343	1
Oil seal output shaft	MT349	1
Clutch Pack Kit	**MT0089**	
Clutch plate – driver	MT731	6
Ferrule	MT1156	6
Clutch plate – driven	MT116	5
Clutch end plate	MT117	1
Spacer	MT344	1
Circlip	CP1102	1
Spring	MT1157	3
Pin	MT1155	3
End plate	MT1113	1
Tab washer	MT351	3
Bolt	UBF141	6

PRM160 Kits of Parts

Description	Part No.	Qty
O Ring Kit	**MT0025**	
O ring feeder connection	000372	8
O ring control valve	000753	1
O ring oil pump	001254	2
O ring output shaft	003504	1
O ring end cover	002433	2
O ring oil pump	002873	2
O ring end cover	003124	1
Gasket valve block	MT1073	1
Gasket valve end plate	MT1081	1
Oil seal – input shaft	MT165	1
Gasket – top cover	MT343	1
Oil seal output shaft	MT349	1
O ring output shaft	001506	1
Clutch Pack Kit	**MT0079**	
Circlip	CP1102	1
Clutch end cover	MT1113	1
Clutch plate – driven	MT116	7
Clutch end plate	MT117	1
Spring	MT120	3
Spacer	MT344	1
Tab washer	MT351	3
Pin	MT357/2	3
Ferrule	MT730	6
Clutch plate driver	MT731	8
Screw	USF32	1

PRM101 Kits of Parts

Description	Part No.	Qty.
Ratio Change Kit 2:1 ratio	**MT0065**	
Pinion and bush sub assembly	MT0070/2	2
Output gear	MT1058	1
O ring kit	MT0025	1
Ratio Change Kit 3:1 ratio	**MT0066**	
Pinion and bush sub assembly	MT0070S/A	2
Output gear	MT972	1
O ring kit	MT0025	1
Oil Pump Repair Kit	**MT903**	
Pump gear driven	MT322	1
Pump gear driven	MT323	1
Pump spindle	MT324	1
Woodroff key	CP1193	
Pump spindle	MT325	1

PRM160 Kits of Parts

Description	Part No.	Qty.
Ratio Change Kit 2:1 ratio	**MT0065**	
Required to convert PRM160 3:1 gearboxes **up to** S/N A0383/01 to 2:1 reduction		
Pinion and bush sub assy	MT0070/2	2
Output gear	MT0158	1
O ring kit	MT0025	1
Ratio Change Kit 2:1 ratio	**MT0065A**	
Required to convert PRM160 3:1 gearboxes from S/N A0383/01 to 2:1 reduction		
Pinion and bush sub assembly	MT0070/2	2
O ring kit	MT0025	1
Output gear	MT1100	1
Ratio Change Kit 3:1 ratio	**MT0066**	
Required to convert PRM160 2:1 up to S/N A0511/10 to 2:1 reduction		
Pinion and bush S/A	MT0070S/A	2
O ring kit	MT0025	1
Output gear	MT972	1

PRM101 Kits of Parts

Description	Part No.	Qty.
Strip and Inspection Kit	**MT0109**	
Circlip	CP1102	2
O ring kit	MT0025	1
Spring	MT120	6
Tab washer	MT351	6

PRM160 Kits of Parts

Description	Part No.	Qty.
Ratio Change Kit 3:1 ratio	**MT0066A**	
Required to convert PRM160 2:1 from S/N A0511/70 to 3:1 reduction		
Pinion and bush S/A	MT0070S/A	2
O ring kit	MT0025	1
Output gear	MT1098	1
Oil Pump Repair Kit	**MT903**	
Pump gear driver	MT322	
Pump gear driven	MT323	
Pump spindle	MT324	
Woodruff key	CP1193	
Pump spindle	MT325	
Strip and Inspection Kit	**MT0109**	
Circlip	CP1102	2
O ring kit	MT0025	1
Spring	MT120	6
Tab washer	MT351	6