



# J TYPE MARINE GEARBOX

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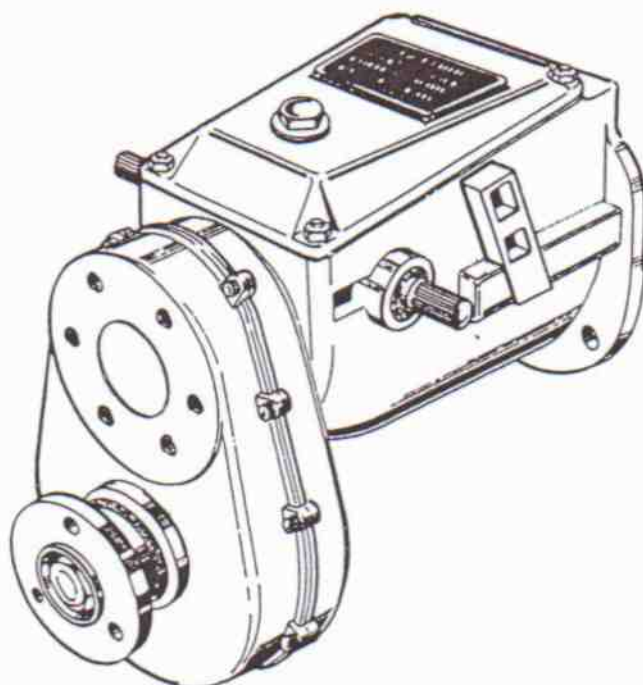
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# THE WATERMOTA MARINE REVERSE GEAR

This Marine Reverse Gear is manufactured in our Works to a specification based on JOES Type 505B Gear. Parts are similar to Joes, resulting in a World Wide Service for spare parts. The gear has been used for many years on many types of engines, with outstanding reliability. The information included in this booklet will facilitate the service of the gearbox, especially the ordering of spare parts from the illustrated Parts Lists.



## SPECIFICATION

O/A Length (Direct Drive)	. 10 in.
O/A Length (Reduction 2:1)	. 12 $\frac{3}{4}$ in.
Maximum Width	. 9 $\frac{3}{4}$ in.
Weight (Direct Drive)	. 28 $\frac{1}{2}$ lb.
Weight (Reduction 2:1)	. 41 $\frac{1}{2}$ lb.
H.P. Rating	. 1.5 h.p. per 100 r.p.m.
Torque Capacity	. 50 lb./ft. Diesel 80 lb./ft. Petrol
Maximum R.P.M.	. 4,000 r.p.m.
Astern Revolutions	. 79% of Ahead
Lubrication — Splash	. Oil as Engine
Oil Capacity:	
Direct Drive	. 1 pint
2:1 Reduction	. 1 $\frac{2}{3}$ pint

Note: Rotation of reduction output is same as direct drive.

## DESCRIPTION OF REVERSE GEAR

The Forward Drive is engaged by moving the gear lever forward which engages the double friction clutch. The operation takes place through a ball-bearing control operating a system of toggles which force home a set of plungers, thus clamping together a series of hardened steel friction discs which are interleaved, alternative plates being attached to the engine shaft and propeller shaft. Additionally, at the engine end a split cone clamps the engine shaft and frictionally locks the epicyclic gearing to it. The double clutch arrangement eliminates entirely the slight rattle at low speeds noticeable in the normal type of epicyclic gear.

The Neutral Position is obtained with the lever midway between forward and reverse, the forward and reverse drives are then released and permit the gearing to run idle.

The Reverse Drive is obtained by drawing the lever right back. This releases the forward drive and contracts a lined brake band by means of a cam, thus clamping the outer portion of the gear and causing a reverse motion of the propeller shaft through epicyclic gearing. The reverse drive is approximately 79% of the engine speed.

**IMPORTANT: See that oil level is maintained in the reverse gear and reduction drive, if fitted.**

Use one of the following grades: BP Energol SAE30; Castrol XL; Mobiloil A; Shell X-100 30; Essolube 30. Keep to 'Full' mark on dip-stick.

### ADJUSTMENT OF GEAR

First remove Inspection Cover of Gear Box.

#### AHEAD CLUTCH

Rotate the drum M4 until the locking tab M20 is observed. This tab locks the aft part of drum to the forward part and engages in castellations cut in the forward portion. Lock the drum by pulling the Gear Control Lever into reverse and slack off the set screw M22 securing locking tab. Take care not to slacken too far and drop the screw into the gearbox. Lift tab out of the slot. Tighten the Ahead Clutch by turning the aft portion clockwise one or two divisions. Do NOT overdo this, otherwise you may burst the drum since tremendous pressure can be exerted by the leverage obtained through the toggles. These toggles M23 must throw over dead centre and are thus self-locking in Ahead. There must be NO continual strain on the Operating Collar such as would be caused by constant pressure on the gear lever. The lever

is held lightly in position in neutral by means of a roller which engages the indent in the cam plate. See illustration on page 4.

### **REVERSE BAND**

If the gear slips in reverse, remove Inspection Cover. Tighten the hexagon lock nut M43 slightly so that drum is locked when lever is pulled right back. Do NOT overtighten or the reverse band will drag in Neutral and Ahead. This will cause overheating and loss of power. When the correct adjustment is found, replace top cover. If the lock nut is slack remove and give a sharp blow to the top locking portion and re-assemble.

### **REDUCTION GEAR**

The drive is by triple roller chain and all bearings are Ball Bearings. THERE ARE NO ADJUSTMENTS. Careful alignment with the Propellor Shaft is VERY IMPORTANT. The Gear Box and reduction gear have a common lubricating system.

CHANGE the oil once per season or every 500 hours, whichever is the more frequent. To DRAIN OIL, attach sump pump to tube on side of gearbox having first removed the hexagon plug M49.

RIGHT

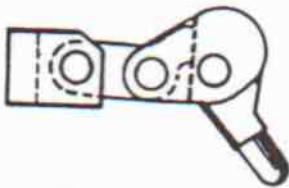


FIG 1

**IMPORTANT**

Ahead clutch must not be adjusted so tight that toggles will not close up with links at 'A' Fig. 2. Fig. 1 shows correct position with central pin just past dead centre and therefore locked in ahead without constant pressure on the control lever and operating collar.

WRONG

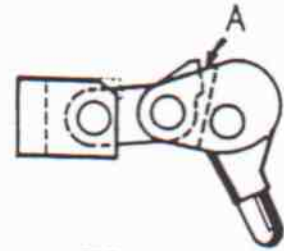
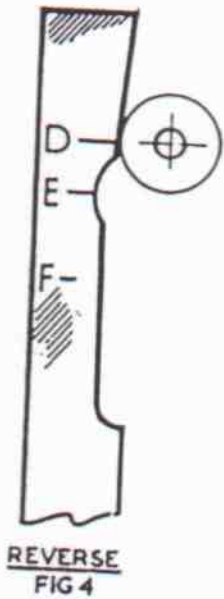


FIG 2



REVERSE  
FIG 4

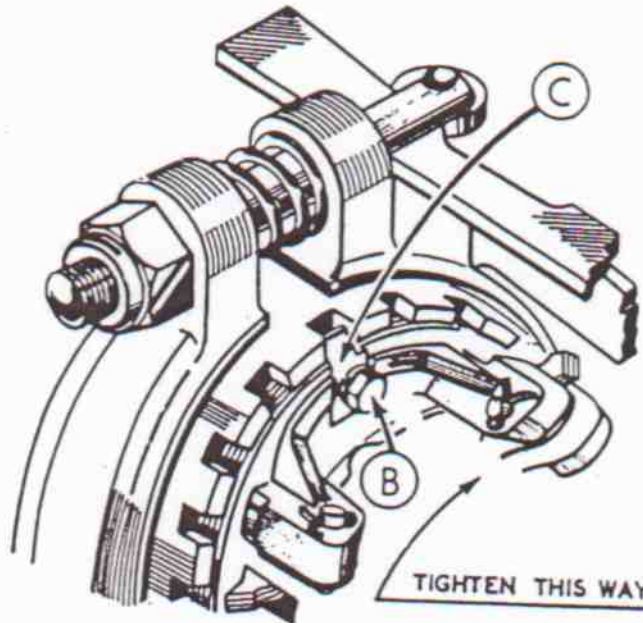
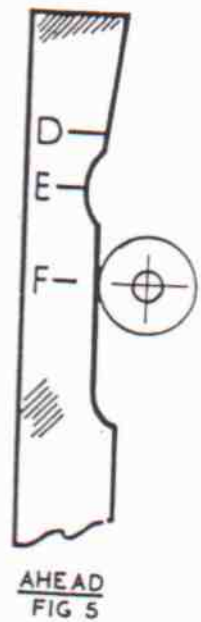


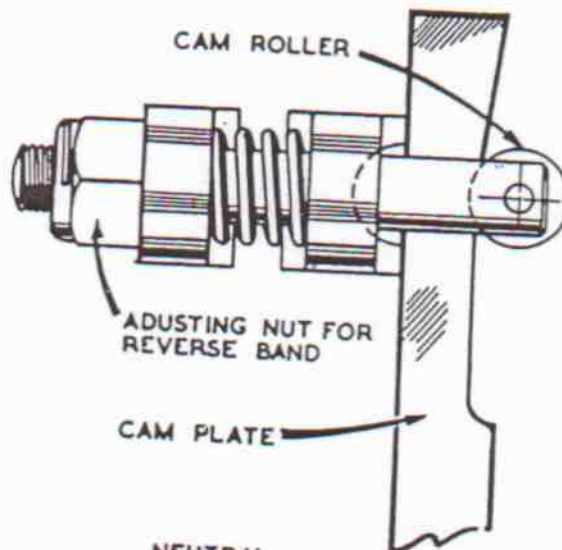
FIG 3



AHEAD  
FIG 5

**ADJUSTMENT OF REVERSE BAND**

Pull control lever aft until rollers rests on cam at 'D', see Fig. 4. Now tighten nut sufficiently to lock drum. Do not overtighten the nut so as to cause the band to pinch the drum as the roller rides out of neutral notch between 'E' and 'F'. Figures 4, 5, and 6 show relative positions of the cam roller and cam plate in reverse, ahead and neutral.

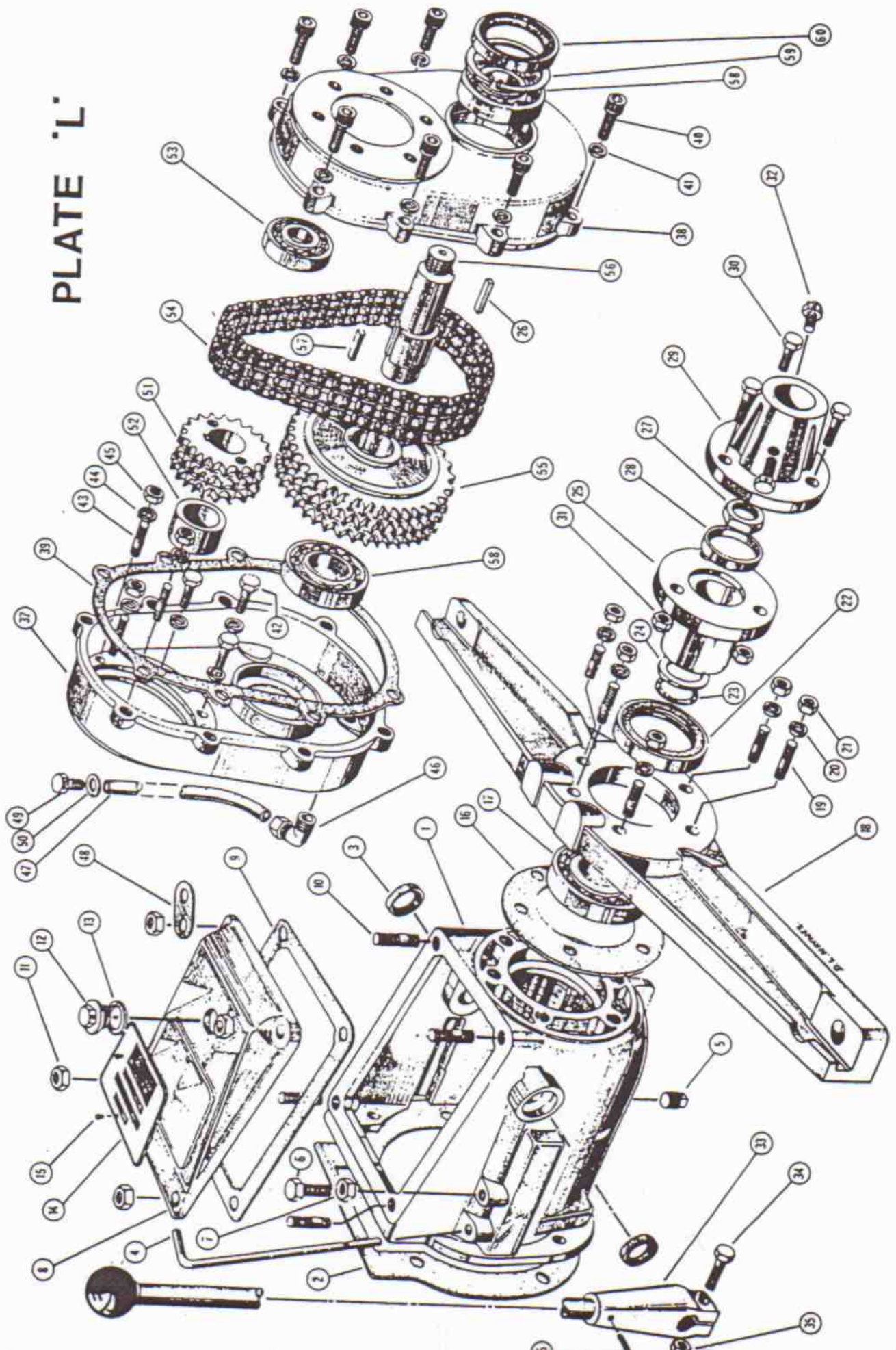


NEUTRAL  
FIG 6

**ADJUSTMENT OF AHEAD DRIVE**

Turn drum so that tab 'C' is at top position. See Fig. 3. Pull control lever aft so as to lock drum. Slack off screw 'B', lift tab 'C' out of slot. Tighten ahead clutch by turning clockwise aft portion that carries toggles. Correct adjustment is important. If too tight gear will not remain in ahead. See Fig. 2. If too slack the clutch will slip under load. A notch or two either way will make all the difference. Note the tab is offset and can be reversed for closer adjustment.

# PLATE 'L'



## SPARE PARTS LIST GEARBOX AND REDUCTION GEAR

Plate	Revised Part No.	Old Part No.	Description	Dates	Dates	Qty.
L1	L010	660R	Gearbox Mk. II		49-J-62	1
	L011	660R	Gearbox 'O' ring cross shaft	50-J-62	35567	1
	L012	660R	Gearbox unified oiling	R16866	35567	1
	L013	661	Gearbox Mk. III	35667		1
	L014		Gearbox			1
L2	L020	660RJ	Joint fwd.			1
L3	L030	W36	'O' ring	50-J-62	35567	2
	L031	W252	Seal	35667		2
L4	L040	660A	Dipstick			1
	L041	660AR	Dipstick			1
L5	L050	58B	Plug			1
L6	L060	G50S	Screw			1
	L061		Set screw			1
L7	L070	1/4 F	Nut			1
	N1780		Nut			1
L8	L080	652R	Cover Mk. II			1
L9	L090	652RJ	Joint Mk. II lid			1
L10	L100	FD422G	Screw		25567	4
	L101	W15	Stud	25667		4
L11	N1780	1/4 W	Nut	25667		4
L12	L120	490CR	Filler breather			1
	L121	490CR	Filler solid		16767	1
L13	L130	490J	Washer			1
L14	L140	653	Label			1
L15	L150	652B	Pins for label			2
L16	L160	651J	Joint aft.			1
L17	L170	412B	Bearing			1
L18	L180	W169	Bracket DD (16 1/2)			1
	L181		RG aft. bearer J (16 1/2)			1
L19	L190	491A	Bolt		35567	6
	L101		Stud	35667		6
L20	N5040	6W	Washer		35667	6
	N1490		Washer		35667	6
L21	N1780	516W	Nut	35667		6
L22	L220	454S	Seal DD coupling			1
L23	L230	4565R	'O' ring coupling	34167		1
L24	L240	456W	Washer	34167		1
L25	L250	456	1/2 bore coupling 1/4 key		R7668	1
	L251		1/2 'O' ring 1/4 key	34167	R7668	1
L26	L252		1/2 'O' ring 1/2 key	R7768	38068	1
	L253	456R	1" coupling 1/2 key	38168		1
L27	L260	455A	Woodruff key 1/4		R7668	1
	L261	J7C	Key 1/4	R7768		1
L28	L270	456C	Nut		34067	1
	L271		Circlip	34167	38068	1
L29	L270	456C	Nut	38168		1
	L280	456B	Register			1
L30	L290	56R	Coupling 1"			1
	L291		Coupling 25mm			1
L31	L292		Coupling 30mm			1
	L293		Tailshaft cplg. 1 1/2" J			1
L32	L300	59C	Bolt		19976	3
	L301		Bolt	20076		3
L33	L302		Coupling bolt M8 x 35			1
	L310	516s/1	s/1 nut		19976	3
L34	L311	516s/1	s/1 nut	20076		3
	L320	P126	Lock screw			2
L35	L321	W248	Lock screw			2
	L330	R23R	Gear lever assembly		22-J-65	1
L36	L331	W249	Gear lever splined assembly	23-J-65	36-JR-65	1
	L340	R22	Pin cotter	37-JR-65		1
L37	L300	59C	Bolt	23-J-65		1
	N3420		Bolt	37-JR-65	19976	1
L38	L310	516s/1	Nut	20076		1
	N5120	516s/1	Nut	23-J-65		1
L39	M470	HC41	Pin	37-JR-65	19976	1
	L370	670	Housing reduction	20076		1
					16766	1

Plate	Revised Part No.	Old Part No.	Description	Dates	Dates	Qty.
L37	L371	670R	Housing unified oil ring	16866	369R68	1
L38	L372	700	Housing Mk. II reduction	370R68		1
	L380	671	Cover reduction		369R68	1
	L381	701	Cover reduction	370R68		1
L39	L390	670J	Joint		369R68	1
	L391	702	Joint	370R68		1
L40	L400	671A	Screw		369R68	1
	L401	704	Screw	370R68		1
L41	N1490	5W	Washer	370R68		8
L42	L190	491A	Bolt	370R68		8
	N1330	74B	Bolt		369R68	3
L43	L190	491A	Bolt	370R68		3
	L101	W15	Stud		369R68	3
L44	N5040	6W	Washer	370R68		3
	N1490	5W	Washer		369R68	6
L45	N1780	516W	Nut	370R68		6
L46	N1420	W16	Elbow	370R68		6
L47	L470	W250	Pipe drain	16866		1
L48	L480	W250C	Clip	16866		1
L49	L490	W101S	Screw	16866		1
L50	N2710	W251	Washer	16866		1
L51	L510	493	Sprocket 19T			1
	L511	705	Sprocket 19T		369R68	1
L52	L520	707	Spacer	370R68		1
L53	L530	492B	Bearing top	370R68		1
	L531	706	Bearing top		369R68	1
L54	L540	496	Chain	370R68		1
L55	L550	494	Sprocket 38T			1
	L551	709	Sprocket 38T		369R68	1
L56	L560	495	Shaft $\frac{3}{4}$ " $\frac{1}{2}$ " reduction	370R68		1
	L561	495R	$\frac{1}{2}$ " key shaft reduction		R7768	1
	L562	708	Shaft reduction		369R68	1
L57	L260	455A	Woodruff key	370R68		1
	L261	J7C	Key		77R68	1
L58	L580	491B	Bearing lower	R7868		1
L59	L590	712	Circlip			2
L60	L220	454S	Seal	370R68		1
	L601	713	Seal		369R68	1
L25A	L610	S72	Coupling GB $\frac{1}{2}$ " flex	370R68		1
L33	L620	W29	Socket cotter			1
	L621	W29R	Socket splined	24-J-65	36-JR-65	1
L33A	L630		Lever	37JR65		1
L33B	L640		Knob			1
L33C	N6310	S155	Stub morse 64			1
	L650		Vetus coupling adaptor			1
L54A	L660	496S	Chain			1
L55A	L670	497	Sprocket 31T			1
	L671	709S	Sprocket 31T		369R68	1
L60A	L680	651	Cover aft. DD	370R68		1
L60B	L690	W169T	Bracket Tiger 16 $\frac{1}{2}$ "			1
L60C	L700	S28R	Bracket STBD Freeman			1
L60D	L710	W227	Elbow Freeman oil level			1
L60G	L720	W169R	Bracket DD 20"			1
	L721		Bracket R.G. 20"			1
	L722		Tiger aft. bearer SJ 20"			1
L60H	L730		Pipe water to pump			1
	L740		Vetus flex coupling 1"			1
	L750		Bolt M10 x 75 (Vetus)			1
	L760		RD flexible coupling			1
	L770		Gearbox coupling RD flex			1
L60E	H1530		Plug			1
L60F	H1540		Washer			1
M1	M010	J8	Cear stub shaft			1
M2	M020	J8A	Bush assembly pilot			1
M3	M030	J8C	Key			1
M4	M040	J1	Drum			1
M5	M050	J1B	Bush for drum			1
M6	M060	J4C	Cone split			1
M7	M070	J3C	Plate fwd. push			1
M8	M080	J3AB	Stud long pinion			1
	M081		Long pinion stud (oversize)			2
M9	M090	J3A	Stud short pinion			1
	M091		Short pinion stud (oversize)			2
M10	M100	J9	Pinion long			1
M11	M110	J9B	Bush long			2



# PLATE 'M'

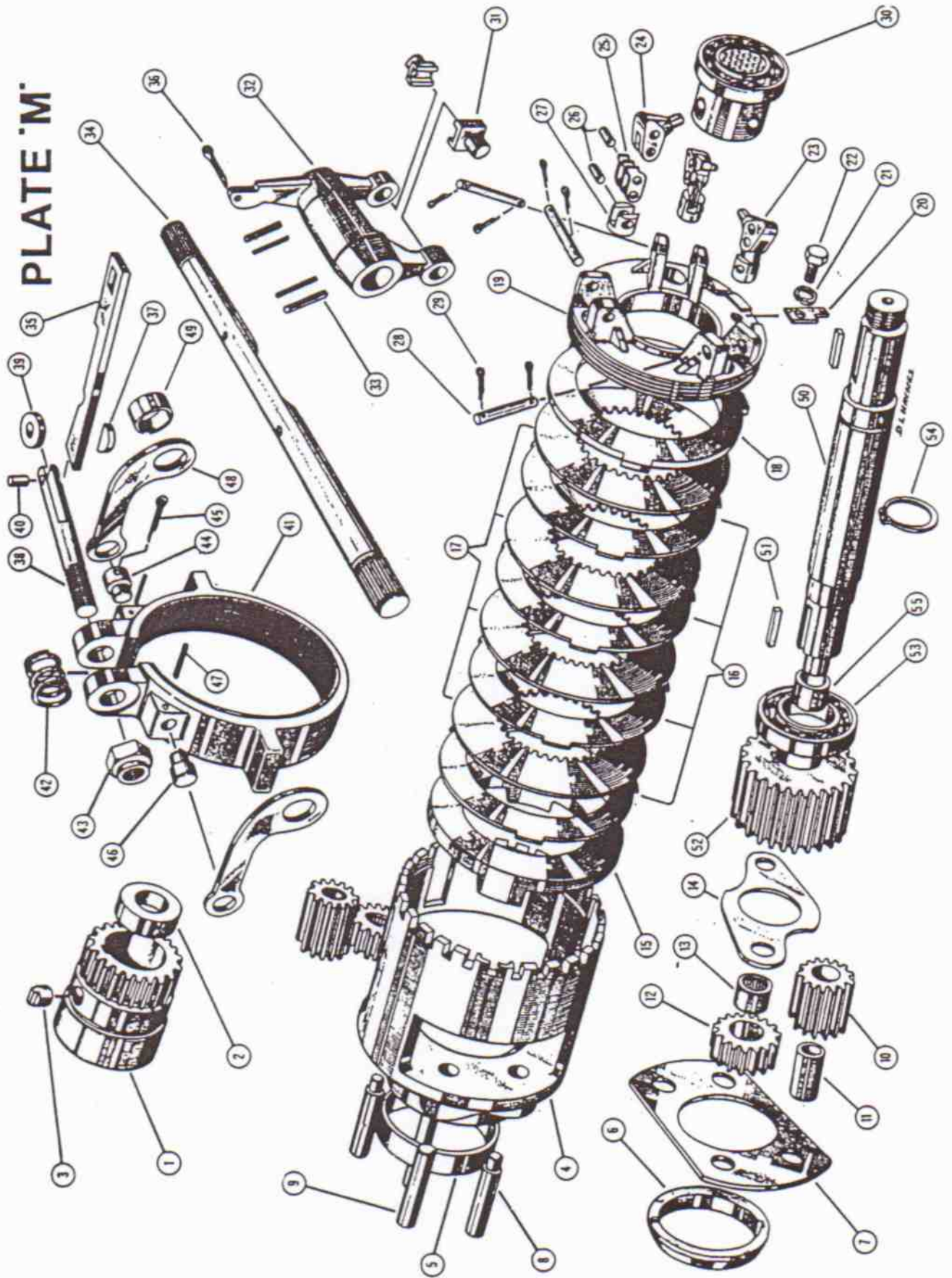
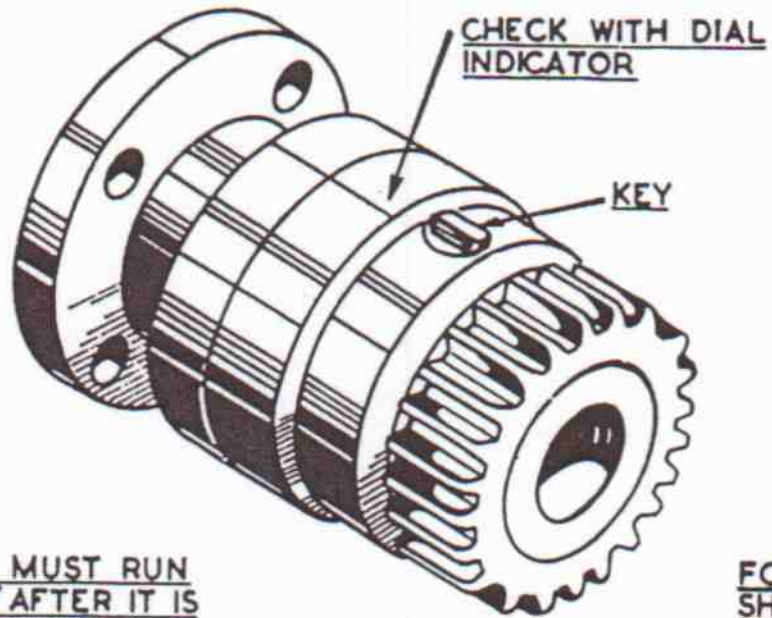


Plate	Revised Part No.	Old Part No.	Description	Dates	Dates	Qty.
M12	M120	J9A	Pinion short			2
M13	M130	J9C	Bush		15968	2
	M131	J9CR	Needleroller	16068		2
M14	M140	J17	Disc thrust			1
M15	M150	J3R	Head		33768	1
	M151	J3RT	Head	33868		1
M16	M160	J4A	Disc lugs		33768	3
		J4A	Disc lugs	33868		4
M17	M170	J4	Disc teeth		33768	3
		J4	Disc teeth	33868		4
M18	M180	J4B	Disc thick			1
M19	M190	J2	Plate d.a.			1
M20	M200	J24	Clip ad.			1
M21	M2280	4W	Washer			1
M22	M220	J24A	Screw			1
M23	M230	J13Y	Toggle assembly			3
M24	M240	J13	Toggle			3
M25	M250	J13A	Links (3)			3
M26	M260	J13C	1/2 pin link			6
M27	M270	J18	Plunger			3
M28	M280	J13B	Bolt			3
	M281	J13B	Pin pivot			3
M29	M290	J13N	Nut			3
	M291	J13P	Split pin			6
M30	M300	J16Y	Collar assembly		28-J-62 7-JR-62	1
	M301	J16RY	Collar assembly	29-J-62 8-JR-62		1
M31	M310	W38	Shoe	29-J-62 8-JR-62		2
M32	M320	J14/14F	Levers		28-J-62 7-JR-62	1
	M321	W37	Lever fork	29-J-62 8-JR-62		1
M33	M330	J27B	Keys		100-J-62	2
	M331	HC7	Pin transax outer	101-J-62		2
	M332	HC7A	Pin transax inner			2
M34	M340	J27A	Shaft cross		100-J-62	1
	M341	J27AR	Shaft (T pin) cross	101-J-62	22-J-65 37-JR-65	1
		W188	Shaft (spline) cross	38-JR-65 23-J-65		1
M35	M350	J10	Camplate			1
M36	M360	J5B	Pin split			1
M37	M370	J22A	Shoe cam			1
M38	M380	J15Y	Shaft assembly			1
M39	M390	J22	Roller			1
M40	M260	J22B	Pin for roller			1
M41	M410	J5Y	Band assembly		10-J-60	1
	M411	J5RY	Band assembly	11-J-60		1
M42	M420	J15C	Spring			1
M43	M430	J15A	Nut			1
	M431	J15AR	s/1. nut			1
M44	M440	J5A	Pin link starboard			1
M45	M360	J5B	Pin split			1
M46	M460	J5AR	Pin link port			1
M47	M470	HC41R	Pin transverse			1
M48	M480	J19	Plate link			2
M49	M490	J19C	Spacer for plate			2
M50	M500	655	Shaft (Woodruff) DD			1
	M501	655	Shaft (circlip) DD	34167	34067	1
	M502	655	Shaft 1/2 key DD	R7768	R7668	1
	M503	655D	Shaft Mk. II DD	38068	37968	1
M51	L261	J7C	Key			1
M52	M520	J7A	Gear main			2
M53	M530	J2A	Bearing d.a. plate			1
M54	M540	656	Bush adaptor		37969	1
	M541	655C	Circlip	38069		1
35	M550	655A	Bush shaftend			1
30A	M560	J16RYA	Body J16			1
	M561		Sleeve			1
30B	M570	J16RYC	Bearing J16			1
30	M580	J16RYB	Bush J16			1
38	M590	J15	Camshaft			1
41	M600	J5RYEX	Band assembly exchange			1
	M610	J5R	Band			1
41A	M620	J5L	Liner	11-J-60		1

<i>Plate</i>	<i>Revised Part No.</i>	<i>Old Part No.</i>	<i>Description</i>	<i>Dates</i>	<i>Dates</i>	<i>Qty.</i>
50A	M630	655	Shaft (Woodruff) Red.		R7768	1
	M631	655	Shaft $\frac{1}{2}$ Red.	R7768	369R68	1
	M632	655R	Shaft Mk. II Red.	370R68		1
64	M640		Book Mk I		1967	1
	M641		Book Mk. II	1968		1
	M650		Bush housing pilot			1
	M660		Bush $\frac{1}{2}$ bore oilite pilot			1
			<b>J.S. GEARBOX PARTS</b>			1
	M670		Cam lever			1
	M680		Cam			1
	M690		Clutch plates			1
	M700		Fork lever			1
	M710		Brake band			1
	M720		Link camshaft			1
	M730		Cam socket			1
	M740		Cam links			1
	M750		Pivot pin cam links			1
	M751		Pivot pin			1
	M760		Release spring brake band			1
	M770		Pressure spring brake band			1
	M780		Cam shaft			1
	M790		Cross shaft			1
	M800		Gear lever morse connection			1
	M810		Head plate			1
	M820		Fulcrum pin cam links			1
	M830		Label JS box			1
	M840		s/1 nut			1
	M850		Pin cam release			1
	M860		Spacer for cable clamp			1
	M870		Split pin for pivot pin			1
	M880		Plain washer			2



THIS SHAFT MUST RUN WITHIN .002" AFTER IT IS BOLTED TO FLYWHEEL

FORWARD STUB SHAFT & GEAR

FIG 7

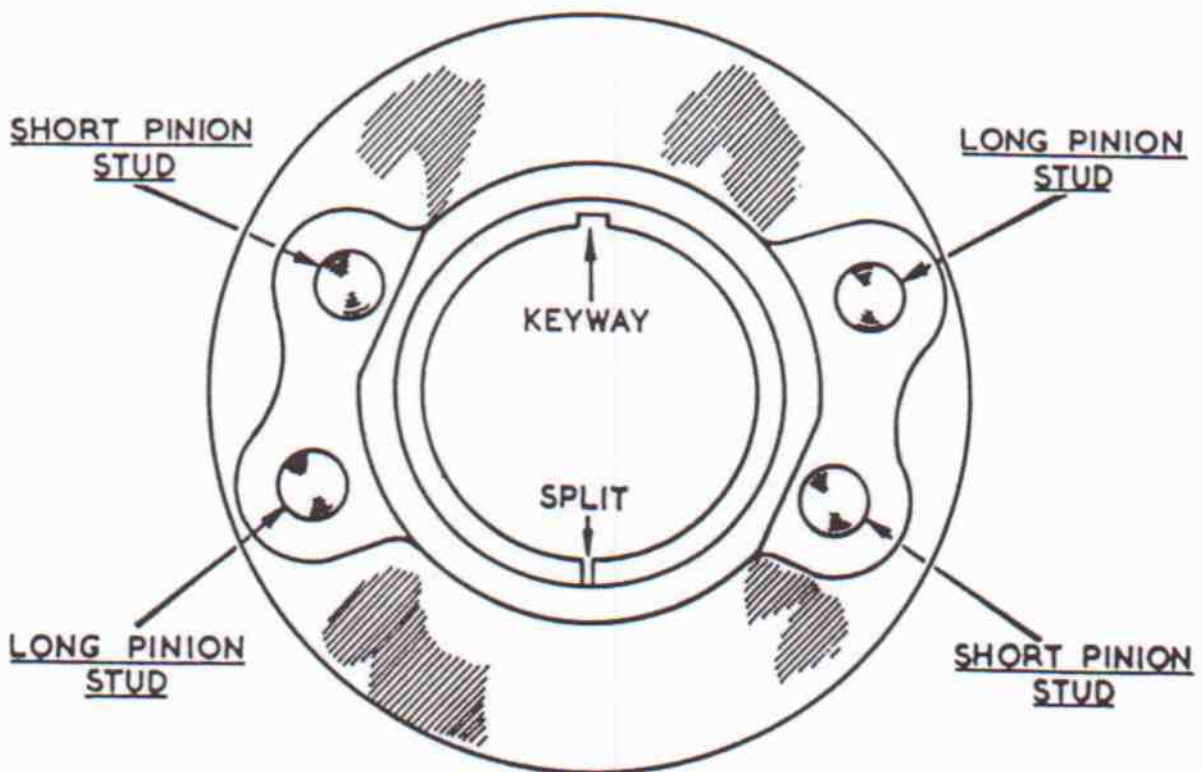


FIG.8  
DRUM  
VIEWED FROM FORWARD END

## SERVICE INSTRUCTIONS FOR REVERSE GEAR

Normal adjustments for the reverse gear are given on page 4, and particular attention is directed to notes on remote gear controls given below. 90% of all gear troubles can be traced to distant controls which are either badly designed, are too flimsy, or cause the cam roller to ride out of the indent in the camplate in Neutral. Do NOT use long or heavy levers and try to arrange that the remote lever is upright in the Neutral position, otherwise it may drag on the gear shift and cause the reverse band to bind in Neutral. It will also impose a constant load on the operating collar which will heat and then wear from undue friction when running in Ahead.

IF GEAR TROUBLES SHOULD DEVELOP, first make an examination and find if:

- (a) The controls have bends which will flex and weaken, or
- (b) Have elbows or joints which strike against the floor or bulkheads or adjacent parts, thus preventing full pressure and throw at the gear.
- (c) See that joints are not stiff or rusty and keep them lubricated.
- (d) See that control handle does not strike the dash or pull loose from the bracket so that full travel and pressure fail to reach the gear.
- (e) See that the controls do not cramp, rub or stick so as to maintain a constant pressure against the trunnions of the operating collar and so cause heat and wear from undue friction when running in Ahead.
- (f) Check the adjustments of both AHEAD and REVERSE to see that these are correct. Instructions for adjusting will be found on page 4.
- (g) Check for worn or unevenly adjusted Toggles and Toggle Links. These may have been replaced at some time and were not correctly adjusted to produce even pressure on the clutch plates through the plungers. Examine the links; they should all come into correct closed position at 'A' as shown in Sketch *Fig. 1*. Should one of the links close up and two remain open as in *Fig. 2*, then the link that shows correct should be filed slightly at 'A' until all bear equally at this point when closed. If two links show correct and the third open, then both closed ones must be filed slightly until this space is closed by all three toggles. As this is most important when fitting new toggles it is best to order three complete sets of toggle assem-

- blies comprising Parts Nos. J13, 13A, 13B, 13N, 13C, 18A and 18. When adjustment is fairly tight, the lever should throw in with a snap and require a sharp pull to disengage the toggles.
- (h) Check for badly worn Split Cone J4C. The gear may have been allowed to slip continuously in Ahead, due to neglect to adjust the clutch when it became necessary. This would cause wear on the split cone which later adjustment might fail to correct until a new split cone had been fitted. It is possible that the corresponding recess in the drum may also have become badly worn so that the drum requires replacing or re-bushing. Clutch plates may also become worn or the surface torn, which would necessitate renewal. In order to test for a split cone which might require replacement: Adjust the Ahead Clutch so that the toggles snap over dead centre by moderate pressure of the gear lever and without undue force, then the split cone should grip the sleeve of Gear J8 so that there is no end play of the Drum. Such end play can be observed when the Inspection Cover is removed and indicates that the cone is worn too much to still grip the sleeve. It must be replaced. When reassembling the gear it is important to see that the Key J8A engages the keyway in the cone and NOT the split in the cone. See *Figs. 7 and 8.*

## TO REMOVE THE REVERSE GEAR FROM ENGINE

Disconnect tail shaft coupling and slide well aft.

The gearbox is secured by two nuts outside and two similar nuts inside. Remove gearbox lid, undo nuts and slide gearbox off.

**CAUTION:** Observe the condition of the gear on the forward stub shaft and also the bronze pilot bush inside the gear. If either is worn the stub shaft must be removed. When replacing, it is very important that the shaft must run true within .002 in. after it is bolted to the flywheel. This should be checked by means of a dial indicator before finally fitting the reverse gear assembly.

REMEMBER ALSO WHEN PUSHING THE ASSEMBLED DRUM OVER THE GEAR J8, TO ENTER THE CONE KEY IN THE KEYWAY AND NOT THE SPLIT IN THE BRONZE SPLIT CONE J4C. See Figure 8. Another point: if it is intended to

completely dismantle the reverse gear, it is better to slack off the nut 456C which secures the coupling BEFORE commencing to remove the gearbox as it is then so much easier to lock the shaft 655 to prevent it from turning.

## TO DISMANTLE THE REVERSE GEAR

Clamp the gearbox firmly in a bench vice, gripping that portion at the bottom behind the drain plug; proceed as follows:

1. The Drum Assembly may be removed, after the adjusting clip J24 has been lifted clear of the notch, by unscrewing anti-clockwise away from the Drum Arm Plate J2. The clutch plates can then be removed and examined. See Item 5 for removal of gears, thrust plates, etc.
2. The Brake Band Assembly can now be removed after slacking the Nut J15A sufficiently to slide out the Cam Plate J10. It is not necessary to withdraw the cam plate from the assembly, but if this is done be careful not to lose the Cam Shoe J22A.
3. To remove Operating Collar Assembly. This necessitates removal of Main Shaft 655. Undo Nut 456C, draw off Coupling 456R with a coupling drawer and remove Key J7C. Move the Fork Lever so as to free the shoes off the Operating Collar J16RY. The shaft may now be driven out by means of a rubber hammer. Press off gear J7A and release J16RY. Take care not to lose the shoes W38.
4. The Ball Bearing should be driven out with a suitable brass punch from inside the box but the Aft End Cover must first be removed; six set screws secure this. If it is only required to replace the Oil Seal 454S, this cover can be removed after pulling the coupling. It is only necessary to disturb the keys if the shaft is to be driven out.

**CAUTION:** If Either the Coupling 456R or the Reduction Drive Sprocket 705 has been removed from the Shaft 655, great care must be taken in replacing; first that the Key J7C does not trip or fall into the reduction drive housing, and second, that something heavy like a block of lead or brass is held against the forward end of Shaft 655 to take the thrust when the coupling or sprocket is driven back into place. This operation must not be attempted when the gear is fully assembled or when the reverse gear is fitted to engine. After replacing the coupling or sprocket, check to see that the ball bearing is tight against the circlip on the shaft. If there is a gap here it means that Thrust Disc J17

will be pinched because the Gear J7A is too far forward. There should be  $\frac{1}{8}$  in. to  $\frac{1}{16}$  in. of end float on the Thrust Disc J17 between the two Gears J7A and J8 when correctly assembled.

5. To remove Cone J4C or Planet Gears J9 and J9A: proceed as Item 1, then, after lifting out the Clutch Plates J4, J4A, J4B, and Head J3R, the pinion studs should be pressed inwards when the gears will come free and the Cone also. If the Cone is worn or scored it must be replaced and the corresponding surface in the Drum should also be examined for similar wear. When the Cone and Forward Push Plate J3C are in position there should be  $\frac{1}{16}$  in. to  $\frac{1}{8}$  in. clearance between the Plate and the Drum to permit the Cone to be forced forward and close tightly on the Gear J8. When reassembling, the pinion studs are entered from the forward end of the Drum. Begin with the two short studs. These should enter the holes adjacent to the two flats on the forward boss. Turn the Drum over and place the Cone in position, followed by the Forward Push Plate J3C, then drop the two short pinions over the studs. Next press these short pinion studs home flush. Now enter the long pinion studs, small end first, hold the pinions in place and press these studs home. Assemble the Thrust Disc J17 and drop the Head in position over the ends of the pinion studs.

When reassembling Clutch Plates in the Drum the sequence is: Head J3R, Plate with Lugs J4A, Plate with Teeth J4 and alternately thereafter, finishing with Pressure Plate, i.e. Thick Plate with Lugs J4B. It will be found easier to assemble the drum into gearbox by tilting the box and entering the gear J7A into the splined plates, finally screwing home the Drum Arm Plate J2. When replacing the coupling 456R before fitting the key to the shaft slide the 'O' ring up to the bearing, having first checked there are no cuts in the ring. Next slide on the washer then fit the key. Slide the coupling on past the key then move the washer into the recess in the face of the coupling. A little grease placed in the recess helps to ensure that the washer will not be displaced when pushing the coupling home.

## **TO DISMANTLE REDUCTION DRIVE WHEN FITTED TO REVERSE GEAR**

1. Drain the oil by removing the bottom bolt holding the cover to the housing, or the drain plug, then remove the remaining cover bolts or drain with a sump pump.



2. Remove the nut securing the coupling to the lower shaft. Draw off the coupling with coupling drawer.
3. Warm the cover around the ball-race housings which should allow them to be drawn away from the housing. It may be necessary to tap the bolt bosses lightly with a rubber hammer by making a glancing blow in the direction the cover is required to go.
4. After removal of the cover, in order to remove the triple chain which is endless, it is necessary to remove both sprockets evenly and at the same time. The top sprocket is withdrawn by means of two bolts  $\frac{1}{4}$  whit. and length 2 in. to 3 in. The sprocket is already threaded for these bolts and will be forced off the shaft as both these bolts are screwed evenly home.
5. To remove the lower sprocket complete with shaft, warm forward ball-race, then ease the shaft from the case at the same time as the top sprocket is being withdrawn.
6. If it is desired to remove the housing from the gearbox, undo the six bolts or nuts which will allow it to come clear from the ball bearing which forms a spigot between the two castings.

## TO FIT REDUCTION DRIVE CASE TO REVERSE GEAR

1. Offer the top sprocket to the gearbox shaft and see that the key is fitting the keyway. Do NOT fit the sprocket just yet.
2. Bolt the reduction housing to the gearbox.
3. See that both the sprockets are perfectly clean and free from any burrs. Fit the ball-races to the lower shaft.
4. Fit the chain over both the sprockets and tap the top sprocket on to the gearbox shaft approximately two-thirds of the way when the ball-race on the lower sprocket will enter its housing, then tap both the sprockets home evenly. When home, sprockets should be  $\frac{1}{2}$  in. outside the face of the housing. See 'Caution', page 12. Fit the bearing 706 to the end of the 655R shaft.
5. Fit the oil seal to the cover and fit the cover to the housing. *NOTE:* Immersing the cover in hot water will cause the casting to expand and allow the cover to be tapped easily over the ball-races.

6. Screw up cover evenly and test to see that reduction drive turns freely. It is sometimes necessary to fit an extra joint between the faces of the housing and the cover to give perfect freeness. When replacing the coupling 456R before fitting the key to the shaft slide 'O' up to the bearing having first checked there are no cuts in the ring. Next slide on the washer then fit the key. Slide the coupling on past the keyway then move the washer into the recess in the face of the coupling. A little grease placed in the recess helps to ensure that the washer will not be displaced when pushing the coupling home.

*NOTE:* These Fitting Instructions are for Gearboxes which already have had a Reduction Drive fitted. If a Reduction Drive is to be fitted to a direct drive gearbox, the gearbox shaft must be changed for a 655R shaft before commencing the operation described above, and oil transfer holes must be drilled in the aft end of the gearbox case to correspond with those in the front face of the reduction case.

*REMINDER:* If you have not already done so, read notes of caution at foot of page 12. This is particularly important when re-fitting the top sprocket of the reduction drive.

## SUPPLEMENT FOR J.S. GEARBOX

This supplement should be read in conjunction with the standard J box instruction book.

### Description

The J.S. box incorporates a number of features which enable the gearbox operating lever pressure to be reduced and therefore the box is suitable for use with Morse or similar single lever control with a 33C or similar cable.

The principle features are the use of special friction clutch plates and eccentric spring loaded reverse mechanism. Both these features have the additional advantage of reducing the frequency of adjustment.

### Adjustment

Ahead adjustment remains the same as at present. The reverse adjustment is effected by tightening the hexagon lock nut on the brake band. Do not turn more than one flat and then re-check to see if adjustment is correct.

The gearbox should engage ahead or astern with a pressure of 20 to 23 lbs. on the end of the Morse stub lever fitted to the gearbox. A higher pressure will be unsatisfactory for the controls and a lower pressure may allow the gearbox to slip.

The following parts changes are made:

#### DELETIONS

M610 Brake band  
M440 Link Pin (1)  
M420 Spring  
M590 Camshaft  
M370 Camshoe  
M390 Cam roller  
M260 Cam roller pin  
M431 s/1 nut for camshaft  
M490 Link spacer  
M480 Link (1)  
M321 Fork lever  
M360 Split pin for  
M350 Cam plate  
M180 Clutch plate lugs thick  
M160 Clutch plate lugs (3)  
(note 1 still used)  
M151 Head plate  
L140 Label J Box

#### ADDITIONS

M670 Cam lever

M680 Cam  
M690 Clutch plates  
M700 Fork lever  
M710 Brake band  
M720 Link camshaft  
M730 Cam socket  
M740 Cam links  
M750 Pivot pin cam links  
M751 Pivot pin  
M760 Release spring brake band  
M770 Pressure spring brake band  
M780 Cam shaft  
M790 Cross shaft  
M800 Gear lever morse connection  
M810 Head plate  
M820 Fulcrum pin cam links  
M830 Label JS box  
M840 s/1 nut  
M850 Pin cam release  
M860 Spacer for cable clamp  
M870 Split pin for pivot pin  
M880 Plain washer

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