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TRUCK UTILITY HEAVY (TUH), 4x4  
REYNOLDS BOUGHTON - ALL VARIANTS

REPAIR INSTRUCTIONS

This publication contains information covering the  
requirements of Sub-Category 5-2 at information  
Level 4

BY COMMAND OF THE DEFENCE COUNCIL

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AMENDMENT RECORD

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15 Chassis frame and fittings	
16 Not taken up	
17 Winch (including PTO)	

PREFACE

1 Amendments are identified by marginal side lining.

2 Comments on this publication are to be forwarded in accordance with AESP 0100-P-011-013 to Vehicles and Weapons Branch REME, Chobham Lane, Chertsey, Surrey KT16 0EE.

ASSOCIATED PUBLICATIONS

EMER Wksp N 111	Preservation, Identification and Packaging of Assemblies (including engines)
EMER Wksp N 345	Split Shall Bearings, Assembly, Techniques using Plastigage Method
EMER T&M A 028 Chap 100	Testing Internal Combustion Engines
Equipment Table Scale No - NYK	Reynolds Boughton Special Tools
AESP 2920-C-102	Generator No 16, Mk 1, 28V, 90A (FV 1068364)
AESP 2815-F-641	Engine Diesel, PERKINS PHASER 1000 Series
AESP 2520-C-122	Gearbox, 5 Speed, T5-250 with T5-290 Supplement

Chapter 2

CLUTCH

CONTENTS

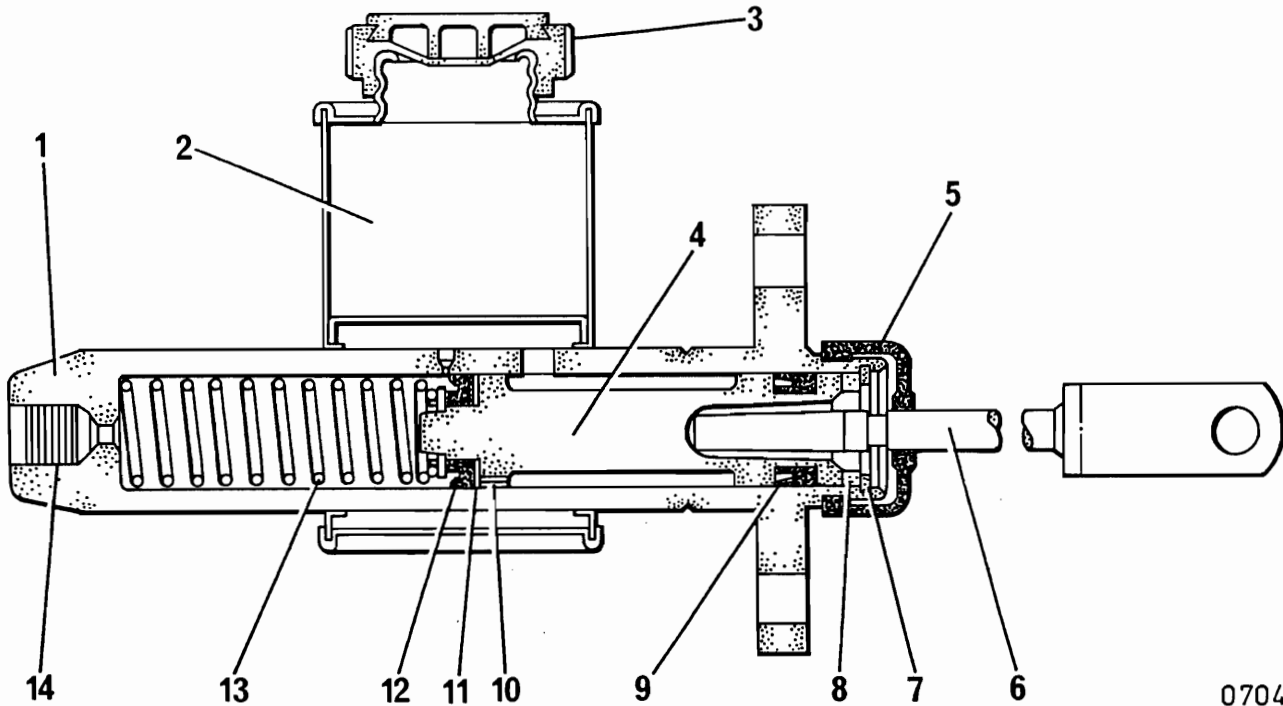
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- Clutch driven plate
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- Master Cylinder
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- 4 Inspection of parts
- 5 Re-assembling
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2	Reservoir	9	Secondary seal
3	Cap	10	Transfer parts
4	Piston	11	Washer
5	Rubber boot	12	Main seal
6	Push rod	13	Spring
7	Circlip	14	Outlet port

Fig 3 Sectional view of clutch master cylinder

3.6 Remove the main seal (12), washer (11) and secondary seal (9) from the piston (4) and discard the seals.

#### Inspection of parts

4 Thoroughly clean all parts and blow dry with compressed air.

4.1 Carefully examine the piston and cylinder bore. If any corrosion, scratches or scoring are evident, the relevant part is unserviceable and must be renewed.

4.2 Ensure that the transfer ports (10) in the piston head are clear.

4.3 Check the spring (13) for distortion and if distorted or coil bound renew spring.

4.4 Ensure that the ports in the cylinder are clear.

4.5 Examine the rubber boot (5) for cracks or holes.

4.6 Fit the rubber boot (5) in the groove on the cylinder body, if it is a slack fit, the boot has lost its elasticity and must be renewed.

### Re-assembling

5 Prior to re-assembly ensure that all parts are scrupulously clean and lubricate all parts with clean brake fluid of the grade specified in the Maintenance Schedule.

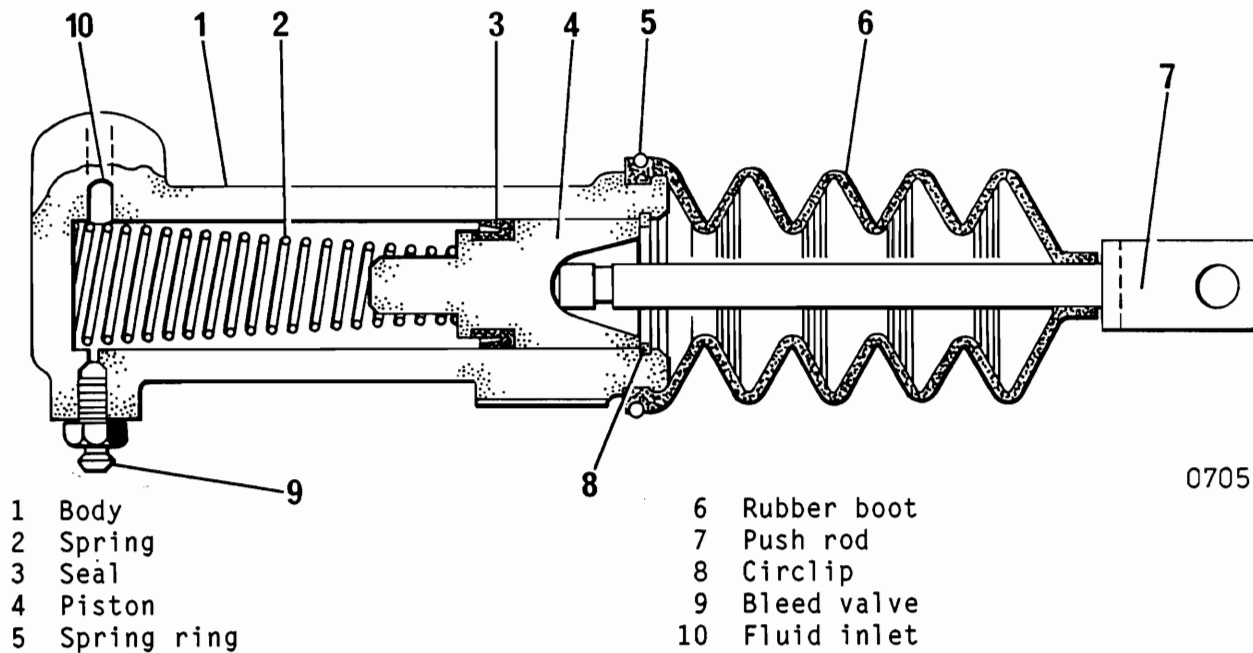
- 5.1 Fit a new washer (11) and main seal (12) to the front of the piston.
- 5.2 Fit a new secondary seal (9) to the rear of the piston.
- 5.3 Lubricate the cylinder bore with clean brake fluid and insert the spring (13) with the small end to the rear of the bore.
- 5.4 Fit the piston assembly into the cylinder bore, taking care not to damage the piston seal lips.
- 5.5 Fit the stop washer (8) and secure with circlip (7).
- 5.6 Smear the inside of the rubber boot (5) with copperslip grease (NATO Part No. HI 8030-99-224-6794).
- 5.7 Fit the boot to the cylinder body, ensuring that the inner lip engages firmly on the cylinder body.

### SLAVE CYLINDER

#### Dismantling

- 6 To dismantle the slave cylinder proceed as follows :-
- 6.1 Thoroughly clean the exterior of the slave cylinder.
  - 6.2 Remove the spring ring (Fig 4 (5)) securing the boot (6).
  - 6.3 Withdraw the boot and the push rod (7).
  - 6.4 Remove the circlip (8) securing the piston.
  - 6.5 Extract the piston assembly and spring (2) from the cylinder.
  - 6.6 Remove the seal (3) from the piston (4) and discard the seal.





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Fig 4 Sectional view of clutch slave cylinder

Inspection of parts

7 Thoroughly clean all parts and blow dry with compressed air.

7.1 Carefully examine the piston and cylinder bore. If any corrosion, scratches or scoring are evident, the relevant part is unserviceable and must be renewed.

7.2 Unscrew the bleed valve to ensure that no dirt is lodged behind the valve or in the threaded hole.

7.3 Check the spring (2) for distortion, and if the spring is distorted or coil bound renew the spring.

7.4 Renew the rubber boot (6) if it is cracked or perished.

Re-assembling

8 Prior to re-assembly ensure that all parts are scrupulously clean and lubricate all parts with clean brake fluid of the grade specified in the Maintenance Schedule.

8.1 Fit a new seal (3) to the piston (4) and ensure that the seal seats correctly in the groove.

8.2 Fit the small diameter of the conical spring (2) into the piston.

8.3 Lubricate the cylinder bore with clean brake fluid, and carefully fit the conical spring (2) with the piston assembly into the cylinder bore, taking care that the piston seal is not damaged.

8.4 Secure the piston with the circlip (8).

8.5 Smear the inside of the rubber boot and the push rod with copperslip grease (NATO No. HI 8030-99-224-6794).

8.6 Insert the push rod (7) in the boot (6) and then position the rod in the piston and fit the boot to the cylinder body, ensuring that the inner lip engages in the groove in the body.

8.7 Secure the boot with the spring ring (5).



Chapter 4

TRANSMISSION  
(TRANSFER BOX AND PROPELLER SHAFTS)

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- Transfer box
- 1 Dismantling
- 2 Inspection of parts
- 3 Re-assembling
- Propeller shaft universal joints
- 4 Dismantling
- 5 Re-assembling

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TRANSFER BOXDismantling

- 1 To dismantle the transfer box proceed as follows :-
  - 1.1 Drain the oil out of the transfer box (refer to Cat.2).
  - 1.2 Remove the PTO and pump (if fitted) as described in Chapter 17 of Cat. 522.
  - 1.3 Remove the oil pump as described in Cat. 522 Chapter 4 Para 17.
  - 1.4 Remove the rear axle output flange (36) and oil seal (35) by knocking the tab washer away from the side of the coupling flange nut (38) and gripping the coupling flange to prevent it from turning and remove the coupling flange bolt and tab washer.
  - 1.5 Pull the flange off the seal to reveal the outer face of the seal.
  - 1.6 Remove the three nuts (40) and washers retaining the output shaft bearing retainer/oil seal carrier (34).
  - 1.7 Place the oil seal carrier (34) with its oil seal downwards on a bench and support the rim of the carrier.
  - 1.8 Using a drift, tap the oil seal out of the carrier, taking care not to damage the carrier.
  - 1.9 Remove the differential lock selector and housing by undoing the setscrews and spring washers securing the selector housing to the rear output housing (42).
  - 1.10 Remove the speedo gear housing (31) complete with speedo driven gear and joint by removing the two setscrews and spring washers securing the housing.
  - 1.11 Remove the rear output housing (42) and the shims (30).
  - 1.12 Remove the input coupling flange (68) by knocking the tabwasher tab away from the coupling flange nut (67).
  - 1.13 Grip the coupling flange to prevent it from turning, and remove the coupling flange bolt (67) and tab washer.
  - 1.14 Pull the flange of the shaft to reveal the outer face of the seal (69).
  - 1.15 Remove the two bolts and nuts securing the outer flange of the gearchange cable support bracket to the left-hand lug of the unit casing.
  - 1.16 Remove the five screws (71) and washers retaining the input shaft bearing retainer/oil seal carrier (72) (one screw also retains the gearchange cable support bracket).

Key to Fig 1

1	Cover	25	Joint	49	Differential
2	Setscrew	26	Oil pump	50	Bearing
3	Joint	27	Key	51	Stud
4	Chain	28	Circlip	52	Nut
5	Chain wheel	29	Filter	53	Oilseal
6	Main case	30	Shims	54	Flange
7	Spacer	31	Speedo gear	55	Setscrew
8	Selector fork	32	Ball bearing	56	Mud flinger
9	Clutch	33	Joint	57	Bearing
10	Spacer	34	Housing	58	Carrier
11	Setscrew	35	Oil seal	59	Joint
12	Bush	36	Coupling flange	60	Bearing housing
13	Chain wheel	37	Output shaft	61	Shaft
14	Cover	38	Setscrew	62	Bush
15	Chain	39	Mud flinger	63	Bearing
16	Spacer	40	Nut	64	Spacer
17	P.T.O gear	41	Spacer	65	Mud flinger
18	Circlip	42	Rear housing	66	Input shaft
19	Joint	43	Speedo gear	67	Setscrew
20	Joint	44	Clutch	68	Flange
21	Capscrew	45	Drive flange	69	Oil seal
22	Bearing	46	Bearing	70	Circlip
23	Capscrew	47	Setscrew	71	Setscrew
24	Housing	48	Gear cluster	72	Housing
				73	Spacer

1.17 Place the oil seal carrier with its oil seal downwards on a bench, and support the rim of the carrier.

1.18 Using a drift, tap the oil seal out of the carrier, taking care not to damage the carrier.

1.19 Undo the 16 socket head setscrews (2) and plain washers securing the cover (1) to the housing (6).

1.20 Support the cover (1) on the front axle output flange and metal tube on the ball bearing (63) and lift off the main housing (6) leaving the shafts and gears in the main case cover (1).

1.21 Remove the PTO gear (17) and thrust washer (16) from the input shaft (66).

1.22 Remove the speedo spacer (41) and speedo drive gear (43) with rear output shaft (37) from the differential unit.

1.23 Turn the cover (1) complete with shaft through 90° so that shafts are laying on the workbench.

1.24 Fit 1/2in UNC setscrew into the hole in the input shaft for setscrew (67) and using a hide mallet hit the setscrew to knock the shaft out of the bearing. The differential (49) will be released at the same time.

- 1.25 Remove the drive chain.
- 1.26 Remove the drive chain (15) the second speed chain wheel (13) and bush (12).
- 1.27 Remove the selector fork (8) the 3rd/4th speed clutch (9) and the two thrust washers (7 & 10).
- 1.28 Remove the differential assembly complete with chain wheel (48) and chain (4).
- 1.29 If the differential assembly, the chain wheel (48) or the differential drive flange (45) require replacement the eight bolts (47) and plain washers must be removed to dismantle the assembly. Mark the two halves of the differential assembly so that they can be correctly aligned on re-assembly.
- 1.30 Remove the drive flange (45), the chain wheel (48) and the top half of the differential case.
- 1.31 Remove the upper side gear and thrust washer from the differential.
- 1.32 Lift out the differential cross shaft, 4 pinions and spherical thrust washers.
- 1.33 Withdraw the lower side gear and thrust washer from the lower differential case.
- 1.34 Remove the 1st speed chain wheel (5) with the bush (62), also the thrust washer (73).
- 1.35 Turn the cover with the front output flange facing upwards, support the cover on wooden blocks high enough to protect the front output flange.
- 1.36 Knock the tab washer tab away from the side of the coupling flange nut.
- 1.37 Grip the coupling flange to prevent it from turning, and remove the coupling flange bolt and tab washer.
- 1.38 Pull the flange (54) off the shaft (61) to reveal the outer face of the seal (53).
- 1.39 Remove the five nyloc nuts (52) and plain washers retaining the output shaft bearing retainer/oil seal carrier (58).
- 1.40 Place the oil seal carrier with its oil seal downwards on a bench, and support the rim of the carrier.
- 1.41 Using a drift, tap the oil seal out of the carrier, taking care not to damage the carrier.

### Inspection of parts

2 Prior to inspection all parts must be thoroughly cleaned. All seals must be washed in a soap solution and all other parts in Trichloroethylene or other cleaning solution.

2.1 Every part must be inspected for wear, corrosion or damage. Any part not considered suitable should be replaced.

2.2 The chains must be inspected for stretching and wear and replaced if necessary.

2.3 If any of the bearing surfaces show signs of wear the relevant bearings must be renewed when the parts are renewed.

2.4 The oil seals should be renewed.

2.5 Ensure that all clamping surfaces have been properly cleaned and that no sealant compound is adhering.

### Re-assembling

3 To re-assemble the transfer box proceed as follows :-

3.1 Before fitting the front axle output shaft oil seal (53) ensure that the oil seal carrier is free from dirt and debris.

3.2 Smear a new seal with a small amount of oil, and place it into the carrier (58), ensure that it is the correct way round (the sealing lip to the shaft should face inboard).

3.3 Using a flat block of hardwood or similar, tap the seal home until its outer edge is flush with the carrier (58).

3.4 Press the ball bearing (57) and the taper roller bearing (50) into the front bearing housing (60) then fit a new joint to the carrier and replace it on the maincase cover using a silicon gasket sealant (silastic 732 RTB Black).

3.5 Fit a new joint (59) to the oil seal carrier face and replace it on the front bearing housing (60) using silicon sealant (silastic 732 RTV Black).

3.6 Replace the five nuts (52) and washers, and tighten the nuts to a torque of 24-30 Nm (18-22 lbf ft).

3.7 Press the bearing (63) complete with snap ring into the main casing cover (1).

3.8 Fit the front output shaft (61) then replace the coupling flange (54) and retain it with the bolt (55) and a new tab washer. Tighten the bolt to a torque of 115-122 Nm (85-90 lbf ft).



3.9 Fit the lower side gear with thrustwasher into the lower differential case.

3.10 Fit the 4 pinions with spherical thrustwashers onto the differential cross shaft and fit the unit into the lower case.

3.11 Fit the upper side gear and thrust washer and then fit the upper case ensuring that the two halves are correctly aligned.

3.12 Fit the chain wheel (48) and the drive flange (45) onto the differential.

3.13 Secure the unit by eight bolts (47) with plain washers. Tighten the bolts to a torque of 41-47 Nm (30-35 lbf ft) and wire the heads for additional security.

3.14 Fit the bush (62) into the 1st chain wheel (5).

3.15 Place the thrust washer (73) on to the input shaft (66) then fit the 1st speed chain wheel complete with bush on to the shaft.

3.16 Fit the second thrust washer (7), the 3rd/4th speed clutch (9) followed by the third thrust washer (10) on to the shaft.

3.17 Fit the bush (12) into the 2nd speed chain wheel (13) and then fit this assembly on to the shaft (66).

3.18 Fit the last thrust washer (16) followed by the PTO gear (17) on to the shaft.

3.19 Feed the end of the input shaft and gear assembly partially into the cover bearing (63), but not so far that the shaft cannot move sideways.

3.20 Fit the chain (4) over the smaller gear of the differential unit (48) and 1st speed chain wheel (5).

3.21 Feed the shaft a bit further into the bearing but do not drive it home.

3.22 Fit the chain (15) over the larger gear of the differential unit and the 2nd speed gear wheel (13).

3.23 Using a hide faced mallet drive the input shaft home into the bearing (63).

3.24 Fit the rear output shaft (37) into the differential and the speedo gear (43) and speedo spacer (41) onto the rear output shaft.

3.25 Carefully fit the main casing (6) over the shafts and gears, fitting a joint (3) between the cover (1) and the main casing, also using gasket sealant silicon silastic 732 RTV Black, then secure the cover to the casing with 16 socket head screws (2) and washers. Tighten the screws to a torque of 20-24 Nm (15-18 lbf ft).

- 3.26 Fit the bearing (22) onto the bearing carrier and secure with circlip (18).
- 3.27 Fit circlip (28) to secure bearing housing to output shaft.
- 3.28 Refit oil pump as described in Cat. 522 Chapter 4.
- 3.29 Fit the taper roller bearing (46) into the main casing (6) and the dog clutch (44) onto the drive flange (45).
- 3.30 To establish the amount of shims (30) required to achieve a bearing preload of 0.004-006 in. measure the distance the taper roller bearing (46) protrudes from the main casing (6) and measure the depth of the bearing recess in the rear output housing (42). Subtract the second dimension from the first dimension to calculate the amount of shims required to achieve the preload and fit the shims (30) required.
- 3.31 Fit the rear output shaft (37) into the differential.
- 3.32 Fit the speedo drive gear (43) and the spacer (41) onto the rear output shaft.
- 3.33 Replace the rear output housing (42).
- 3.34 Fit the rear output roller bearing (32).
- 3.35 Ensure that the oil seal carrier (34) is free from dirt and debris before fitting oil seal (35).
- 3.36 Smear a new seal with a small amount of oil, and place it into the carrier, ensuring that it is the correct way round (the sealing lip to the shaft should face inboard).
- 3.37 Using a flat block of hardwood or similar, tap the seal home until its outer edge is flush with the carrier.
- 3.38 Clean the transfer box casing in the region of the removed seal carrier, then fit a new gasket to the carrier face, and replace it on the casing.
- 3.39 Replace the three nuts (40) and washer, and tighten the nuts to a torque of 24-30 Nm (19-22 lbf ft).
- 3.40 Refit the coupling flange (36), and retain it with the bolt (38) and a new tab-washer; tighten the bolt to a torque of 115-122 Nm (85-90 lbf ft).
- 3.41 Refit the speedo gear housing joint, speedo driven gear and shaft (31) and secure with two setscrews and spring washers. Tighten setscrews to a torque of 11-14 Nm (8-10 lbf ft).

3.42 Refit differential lock selector housing complete with selector, vacuum actuator, switch, and joint to rear output housing ensuring that selector engages in the selector groove in the clutch (44). Secure selector housing with four setscrews and spring washers and tighten setscrews to a torque of 20-24 Nm (15-18 lbf ft).

3.43 Ensure that the oil seal carrier is free from dirt and debris before installing input shaft oil seal (69).

3.44 Smear a new seal with a small amount of oil, and place it into the carrier, ensuring that it is the correct way round (the sealing lip to the shaft should face inboard).

3.45 Using a flat block of hardwood or similar, tap the seal home until its outer edge is flush with the carrier.

3.46 Clean the transfer box casing in the region of the removed seal carrier, and fit a new gasket to the carrier face, and replace it on the casing.

3.47 Replace the five screws and washers, and include the single-hole flange of the gearchange cable support bracket under the top screw nearest the gearchange operating shaft; tighten the screws to a torque of 20-25 Nm (15-18 lbf ft).

3.48 Replace the coupling flange, and retain it with the bolt and a new tab-washer; tighten the bolt to a torque of 115-122 Nm (85-90 lbf ft).

3.49 Replace the two bolts and nuts securing the gearchange cable support bracket to the unit casing lug.

3.50 Refit the PTO and pump (if required) as described in Cat 522 Chapter 17.

3.51 Refill the transfer box with clean oil as specified in the maintenance schedule. The final level must be adjusted as per Category 201 after installing in the vehicle.

## PROPELLER SHAFTS UNIVERSAL JOINTS

### Dismantling

4 To dismantle the universal joints proceed as follows :-

4.1 Rest the shaft on "V" blocks and clean away any paint or dirt from the circlip and bearing race.

4.2 Using suitable circlip pliers remove all the circlips from the joint commencing with the flange yoke. A tight clip may be eased by lightly tapping the bearing race end face using a soft faced mallet, to relieve any pressure exerted on the clip.

4.3 Retain the shaft firmly and with the bearing to be removed on top tap the yoke with a soft faced mallet. The bearing will begin to emerge until finally the shaft can be turned over and the bearing race removed.

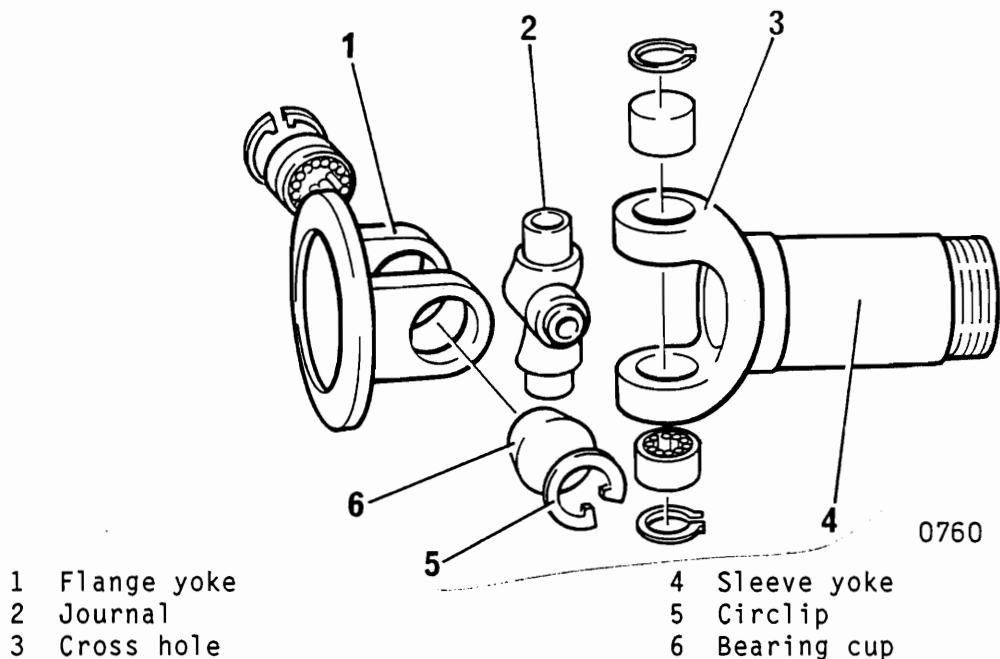


Fig 2 Exploded view of universal joint

4.4 The operation described in Para 4.3 must now be repeated for the opposite bearing. The unsecured flange yoke can now be removed from the joint.

4.5 Repeat the above procedure on the two remaining bearings.

#### Re-assembling

5 To re-assemble the universal joints proceed as follows :-

5.1 Insert the journal in the flange yoke cross holes and using a soft nosed drift, slightly smaller than the outside diameter of the bearing race, tap the race into position, taking care not to lose any of the needle rollers.

5.2 Secure the bearing cup in position with the circlip.

5.3 Turn the flange 180° and repeat the above procedure.

5.4 Then repeat this procedure for the two remaining bearings.

5.5 If the force required to articulate the joint is high tap the yokes lightly with a soft faced mallet; this will relieve any pressure of the bearings on the end of the journal.

5.6 Fill the joint with grease using XG 279 grease.



Chapter 7  
STEERING SYSTEM

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3 Re-assembling  
4 Testing  
WARNING  
CAUTION

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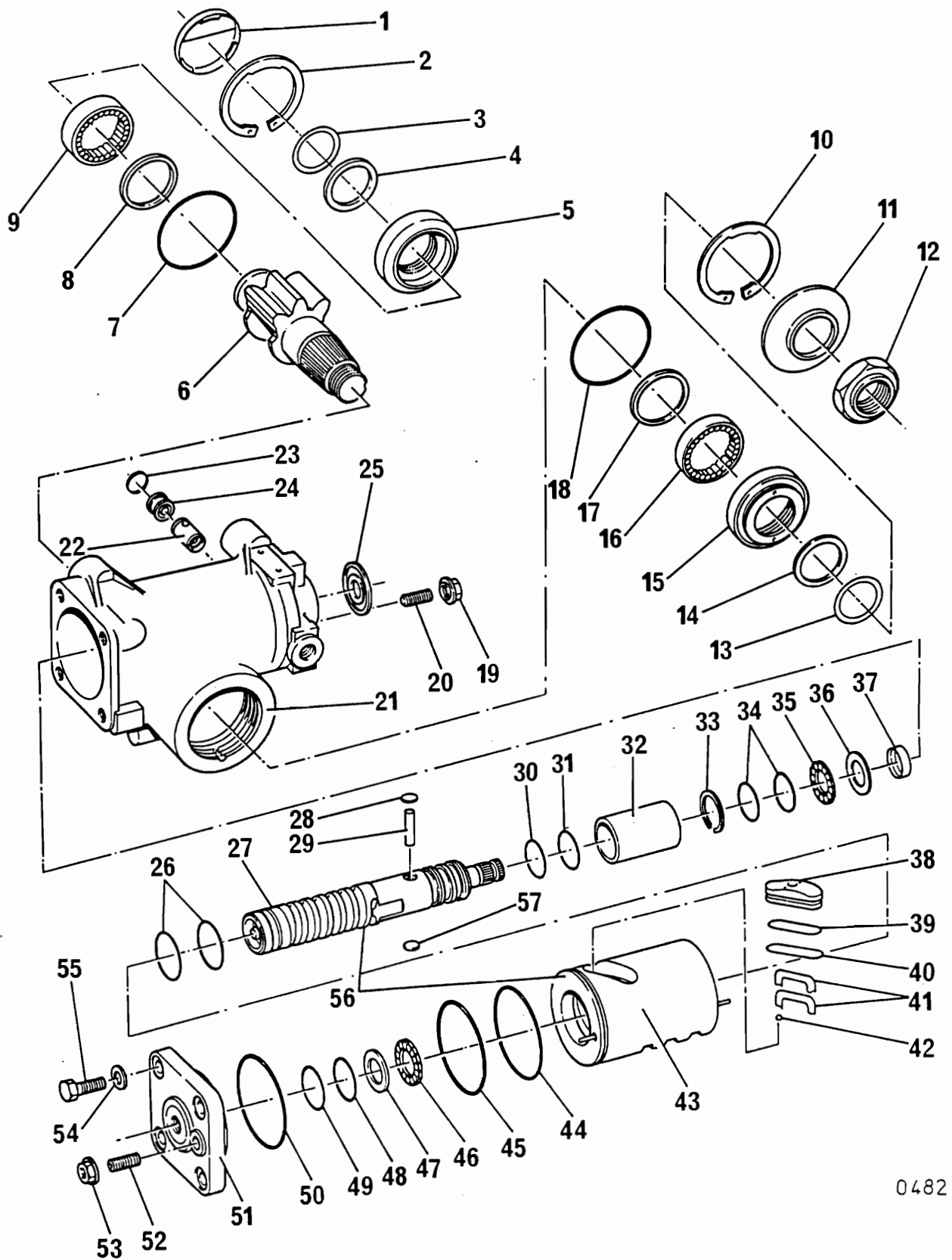
1	Special test equipment and tools	2
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TABLE 1 SPECIAL TEST EQUIPMENT AND TOOLS

Serial No	NSN/ Part No.	Designation
(1)	(2)	(3)
1	7470 798 703	Measuring tool
2	8052 798 552	Adaptor
3	8090 798 101	Clock adaptor
4	8052 798 552	Adaptor
5	8090 798 151	Adjusting tool
6	8090 798 551	Adaptors

## Key to Fig 1

1 Plug	20 Adjusting screw	39 "O" ring
2 Circlip	21 Housing	40 Seal
3 Support ring	22 Screw	41 Re-circulating tube
4 Seal	23 "O" ring	42 Set of balls
5 Cover	24 Valve	43 Piston
6 Sector shaft	25 Cap	44 "O" ring
7 "O" ring	26 "O" rings	45 "O" ring
8 Washer	27 Worm	46 Needle cage
9 Roller bearing	28 Cover	47 Washer
10 Circlip	29 Pin	48 Seal
11 Cap	30 "O" ring	49 "O" ring
12 Nut	31 "O" ring	50 "O" ring
13 Support ring	32 Sleeve	51 Cover
14 Seal	33 Circlip	52 Adjusting screw
15 Cover	34 "O" rings	53 Nut
16 Roller bearing	35 Needle case	54 Washer
17 Washer	36 Washer	55 Setscrew
18 "O" ring	37 Seal	56 Worm and piston
19 Nut	38 Plug	57 Plug



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Fig 1 Exploded view of steering box

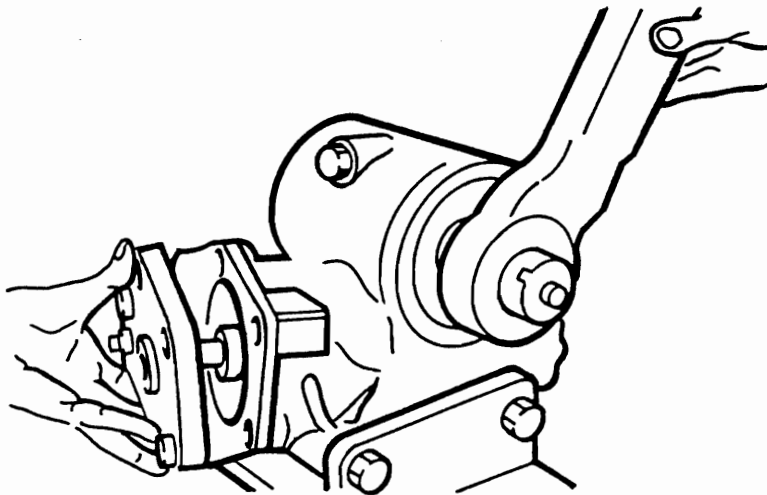


CAUTIONS ...

- 1 To ensure correct functioning of the steering box the dismantling and re-assembly must be carried out in clean conditions.
- 2 Excessive force must not be used during dismantling and re-assembly of the box as the resultant damage could cause partial or complete malfunction of the steering box.

STEERING BOXDismantling (See Fig 1)

- 1 To dismantle the steering box proceed as follows :-
  - 1.1 The steering box should be clamped in a soft jawed vice.
  - 1.2 Check that the steering shaft is marked for the central position of its travel. If necessary the protective cap (25) and shaft should be marked for relative position.
  - 1.3 Remove the protective cap (25).
  - 1.4 Undo the four setscrews (55) securing the cylinder cover (51) to the housing and remove setscrews.
  - 1.5 Lift the cylinder cover by turning the sector shaft (6) with the assistance of the drop arm. Take care not to damage the hydraulic limiter.



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Fig 2 Removal of cylinder cover

- 1.6 Remove needle roller cage (46) and washer (47) from the cover. Also remove the "O" ring (49) and seal (48).
- 1.7 Drive complete piston and worm assembly out of the housing using the provisionally fitted drop arm to turn the sector shaft.

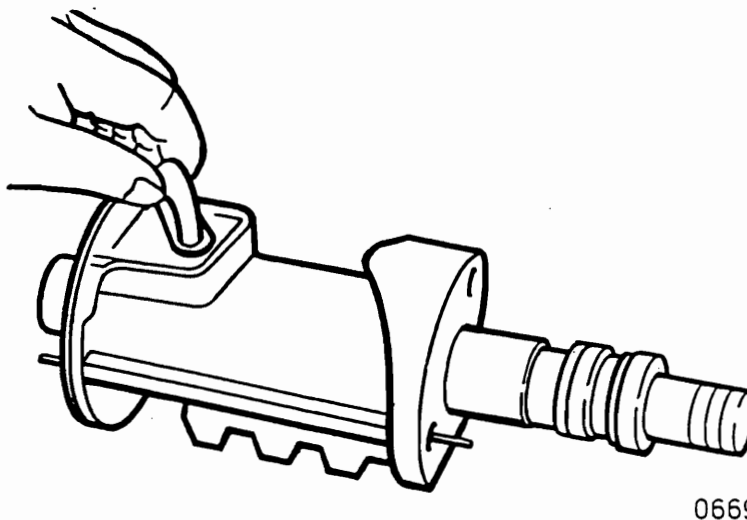


Fig 3 Removal of re-circulating tube

- 1.8 Remove the plug (38) and sealing rings (39 & 40) from the piston then lift the re-circulating tube (41) out of the piston.
- 1.9 Carefully remove the re-circulating balls (42) by turning the piston.
- 1.10 Remove the four sealing rings (26, 44 & 45) from the piston.
- 1.11 Remove the circlip (33) and the control sleeve (32) from the worm.
- 1.12 Remove the two plugs (28 & 57) from the worm to give access to the torsion pin (29) which can now be removed, using blunt nosed pliers.
- 1.13 Remove the sealing rings (30, 31 & 34) from the piston grooves.
- 1.14 The piston body should not be dismantled as it is very accurately adjusted at the works for hydraulic centering and fixed in this position with two pins, and even the removal of one pin could alter the fine adjustment.
- 1.15 Remove the dust cap (11) from the drop arm end of the sector shaft and the plug (1) from the opposite end.
- 1.16 Remove the two circlips (2 & 10) fitted at either end of the sector shaft.
- 1.17 If the grooves, in the housing, for the circlips have been slightly damaged the sector shaft should be pressed away from the groove using a piece of pipe, of fractionally smaller diameter than the diameter of the shaft, and a hand press. The groove can then be repaired with a scraper.
- 1.18 Mark the two housing covers for re-assembly on the correct side.

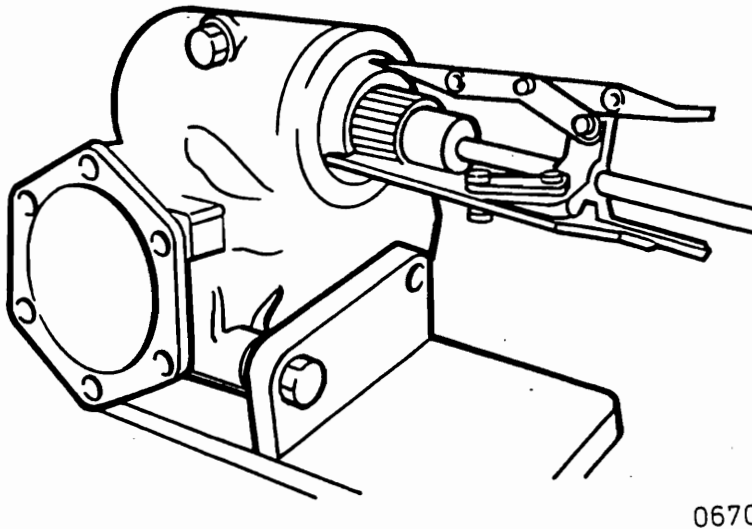


Fig 4 Removal of housing covers

1.19 Withdraw housing covers using a suitable withdrawal tool. The withdrawal spindle of the tool should not be placed centrally on the sector shaft as this could distort the covers because of the excentricity of the shaft. Use a pressure plate between the sector shaft and the withdrawal tool spindle.

NOTE ...

- (1) To avoid the edge of the housing covers being damaged use the largest possible claws on the withdrawal tool.
- (2) Ensure that each set of roller bearings (9 & 10) is kept with the relevant cover (5 & 15) as the roller bearings are selected for size at the time of the original assembly.

1.20 Remove the support rings (3 & 13) and seals (4 & 14) out of the grooves.

1.21 Remove washers from sector shaft. Mark position of sector shaft to assist re-assembly and remove sector shaft.

1.22 Remove needle cage (35) and washer (36) from the housing. Also remove seal (37) at top of worm from the housing.

1.23 Remove the screw (22), the valve insert (24) and the "O" ring (23) from the housing.

Inspection of parts

2 Prior to inspection all parts must be thoroughly cleaned. All seals and other rubber parts must be washed in a soap solution and all other parts in Trichloroethylene.

2.1 Every part must be inspected for wear, corrosion or damage. Any part not considered suitable should be replaced with a new part.

2.2 The piston bore in the housing should be inspected and any slight damage can be repaired by gentle scraping.

2.3 The circlip groove must be inspected and any slight damage can be gently scraped out.

2.4 Any threads must be checked for wear or deformation.

2.5 If any of the bearing surfaces show signs of wear the relevant bearings must be renewed when the parts are renewed.

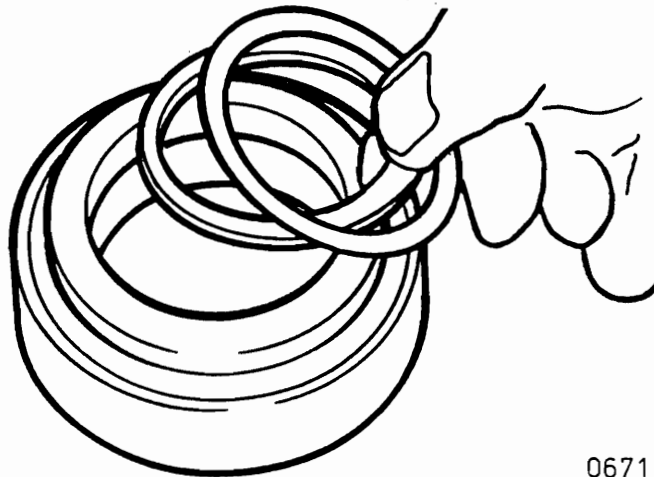
### Re-assembling

3 To re-assemble the steering proceed as follows :-

3.1 Ensure that all parts are perfectly clean. All parts should be lubricated prior to assembly. No excessive force must be used when re-assembling the steering as this might damage it.

3.2 Fit the oil seal into the housing using a tube which has a slightly smaller diameter than the seal. The seal must be fitted squarely into the housing.

3.3 Fit greased "O" ring (7 & 8) into each of the grooves of the housing and gently press the seal (37) into the housing.



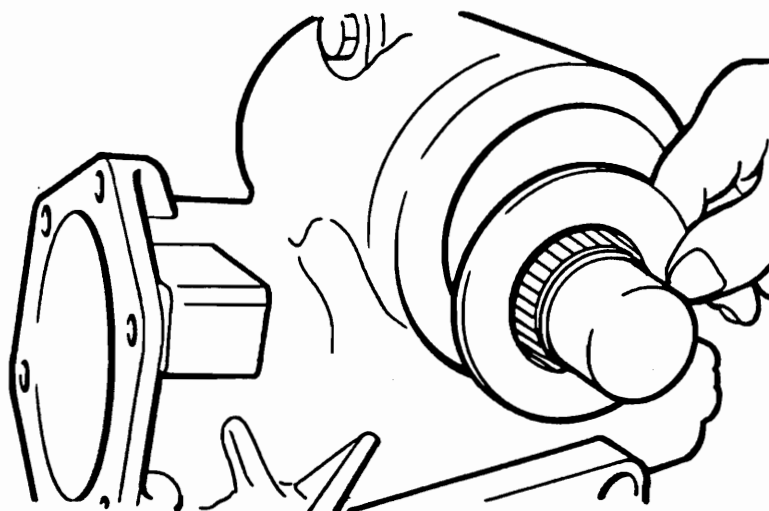
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Fig 5 Cover, "O" ring and back up ring

3.4 The seals (4 & 14) and back up ring (3 & 13) must be fitted in the grooves of the covers (5 & 15). Ensure that the chamfered edge of the back up ring is fitted next to the chamfered edge of the groove.

3.5 Fit the rollers (9 & 16) into the covers (5 & 15) using grease to keep them in place as each cover is fitted with the correct size roller bearing, ensure that the covers are not removed from side to side.

3.6 Position the roller bearings correctly in the covers (5 & 15) by pushing the sector shaft into the covers. this will assist in final assembly of the sector shaft with the "O" rings in position. Remove the sector shaft (6).



0672

Fig 6 Fitting of chamfered washer

3.7 Fit the sector shaft (6) into the housing ensuring that it is fitted the right way around for right hand or left hand steering. Fit one chamfered washer (8 & 17) to each side of the sector shaft with the chamfered side facing the inside of the housing.

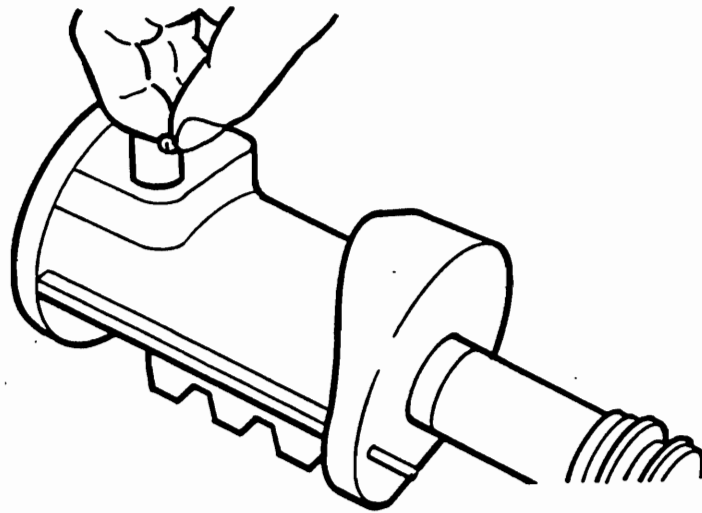
3.8 Place the housing with the drop arm side to the top on a flat surface and fit the pre-assembled cover and roller bearing into the housing using a suitable adaptor until the groove for the circlip (10) in the housing is completely uncovered.

3.9 To ensure that the covers are fitted in a different position relative to the housing it is advisable when re-fitting the old bearing/cover assemblies to change them from one side to the other ensuring the outside diameter of the cover is free of marks or damage to ensure a good seal.

3.10 If it is not intended to re-adjust the backlash between the worm and sector shaft it is important that the bearing/cover assemblies are fitted in the same position from which they have been removed.

3.11 Fit the circlip (10) with the gap facing the sector teeth.

3.12 Turn the housing over and fit the second bearing/cover assembly ensuring that the end of the sector shaft is not damaged. Fit the second circlip (2).



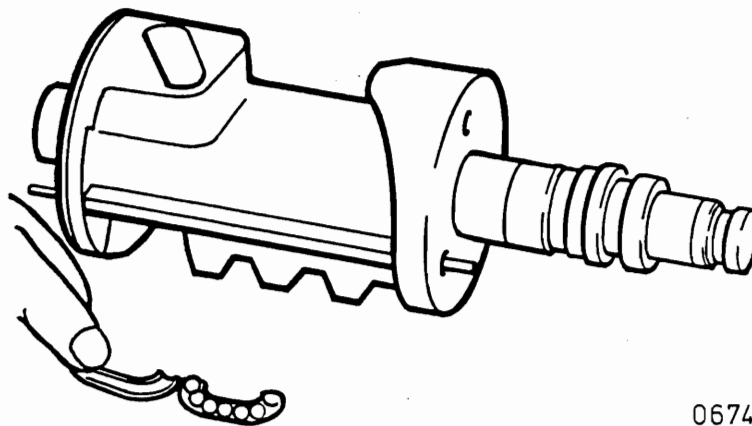
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Fig 7 Fitting balls into piston

3.13 Fit the worm (27) into the piston (43) until the first balls (42) can be fitted into the worm through the re-circulating tube opening in the piston.

3.14 Altogether 38 balls must be fitted and they must all be of the same size. The balls must be fitted one at a time while the worm is slowly rotated so that the balls can be fitted without any gaps.

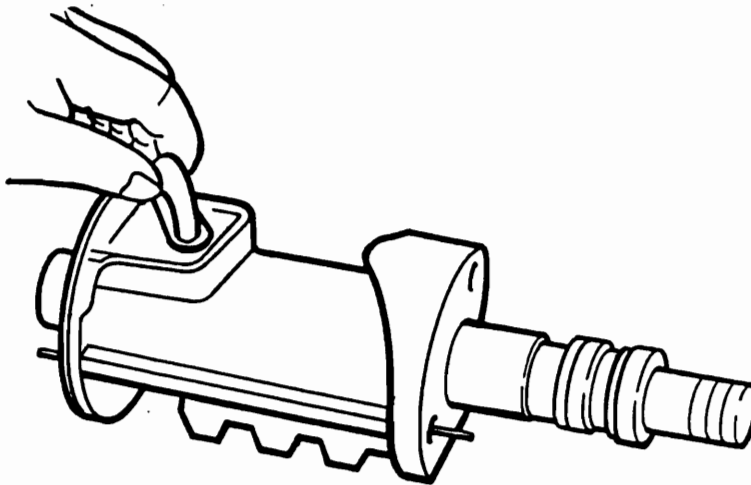
3.15 The ball circulating worm is filled when the first ball appears at the rear edge of the drilling for the re-circulating tube.



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Fig 8 Fitting balls in re-circulating tube

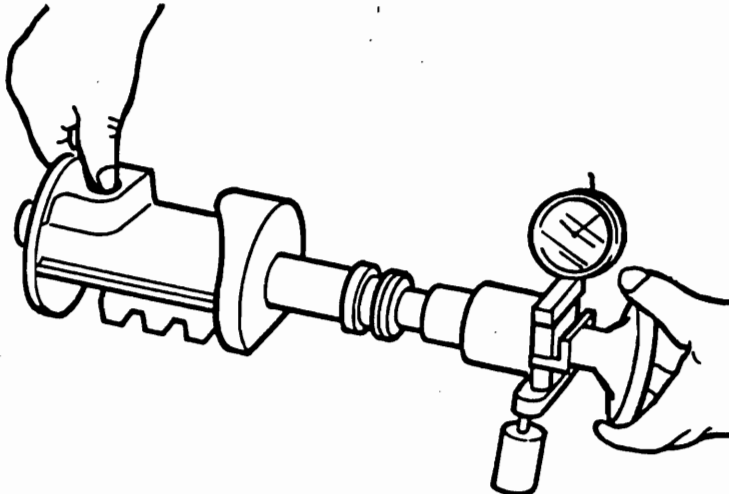
3.16 The remaining balls should be fitted in the re-circulating tube. To facilitate assembly use grease to locate balls in tube (Fig 8).



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Fig 9 Fitting re-circulating tube

3.17 Fit the filled re-circulating tube into the drilling (Fig 9)



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Fig 10 Measuring of ball bearing friction

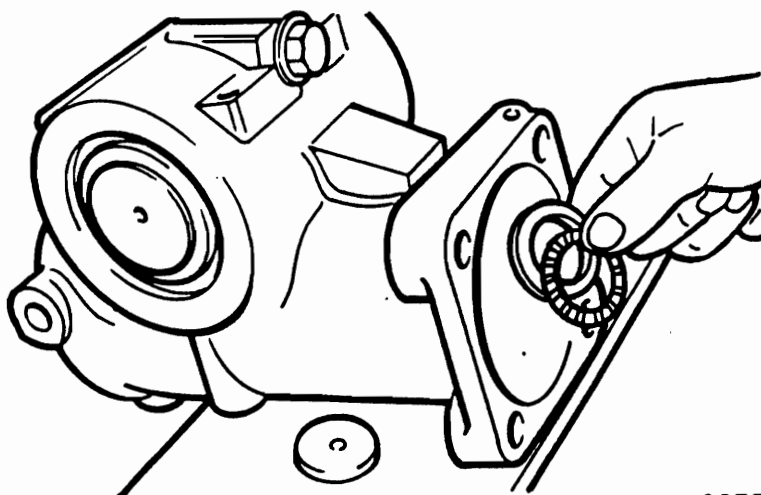
3.18 Check the friction of the ball bearings using the measuring instrument Part No. 7470 798 703 and the adaptor Part No. 8052 798 552 (Table 1 items 1 & 2).

3.19 The assembly should be placed horizontally and the worm should be rotated over  $90^{\circ}$ . The piston should not be clamped in a vice. The friction for a new steering should be zero to 20 Ncm (maximum) in the central position, in the extreme position the maximum friction could be up to 35 Ncm. The maximum permissible friction with a worn steering is 60 Ncm at the two extremes of travel.

3.20 Balls (42) are available in several sizes each tolerance group has balls the diameter of which do not vary in excess of 0.001 mm. If the friction is too high a complete set of balls of a small diameter must be fitted. If the friction is too low a set of larger balls must be fitted.

- 3.21 Under no circumstances must balls from more than one tolerance range be fitted.
- 3.22 When the correct size of balls have been selected the worm must be removed from the piston ensuring that the set of balls has been collected.
- 3.23 Fit the "O" ring (30) in the recess of the worm and then fit the sealing ring (31). To avoid any damage to the "O" ring and seal fit a piece of rubber hose (39 mm inside diameter) over the worm before fitting the "O" ring.
- 3.24 Fit the torsion pin (29) through the worm and then fit the two cover plugs (28 & 57) one either side of the pin.
- 3.25 Fit the sleeve (32) over the torsion pin plugs.
- 3.26 Fit the circlip (33). Check the axial movement of the sleeve; this movement must be 0-0.1 mm. This movement can be adjusted by fitting a circlip (33) of a different thickness.
- 3.27 Fit an "O" ring (34) in the front groove of the worm (27) and another "O" ring (34) in the rear groove of the worm.
- 3.28 Fit "O" ring (26) into the radial groove inside the piston bore and follow up by the second "O" ring (26).
- 3.29 Fit the "O" ring (44) in the outside groove of the piston followed by the second "O" ring (45).
- 3.30 Fit the worm into the piston again so that the previously selected balls can be fed into the worm and the re-circulating tube.
- 3.31 Fit the "O" rings (39 & 40) into the grooves of the plug (38).
- 3.32 To avoid damaging the plug and "O" rings when fitting it into the piston use a hand tool to remove any sharp edges in the recess in the piston for the plug a lead edge of up to 45° may be ground in.
- 3.33 Fit the plug into the piston.
- 3.34 The space in the dual seal (37) between the sealing lip and the dust seal should be filled with grease.



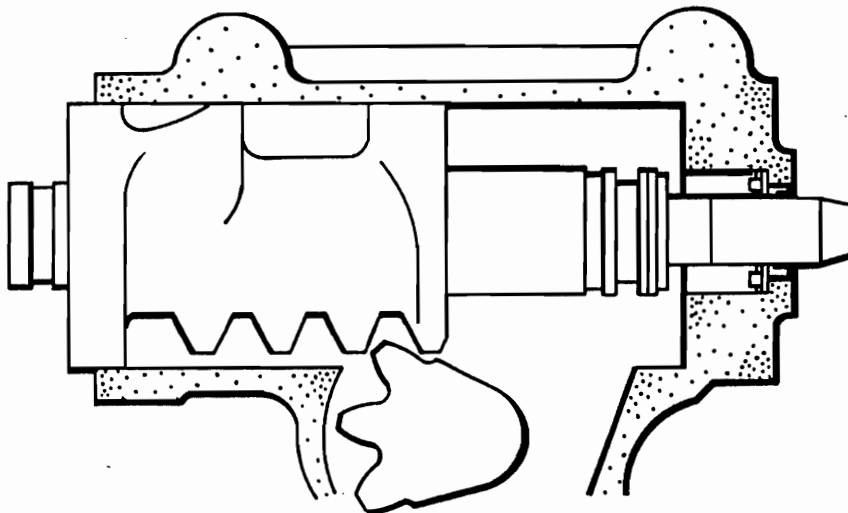


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Fig 11 Fitting washer and needle rollers

3.35 Fit the plain washer (36) and the needle rollers (35) into the recess of the housing.

3.36 The sector shaft should be rotated so that the teeth move in the direction of the cover.



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Fig 12 Position of worm and sector shaft

3.37 Feed the piston complete with worm into the housing so that the first tooth of the sector shaft when rotated engages with the first tooth in the piston.

3.38 Rotate the sector shaft with the assistance of a provisionally fitted drop arm to drive the piston into the housing.

3.39 Fit the washer (47) and the needle rollers (46) into the recess of the cover (51).

3.40 Fit the "O" ring (49) into the inside groove of the cover (51) followed by the seal (48).

3.41 Fit a greased "O" ring (50) into the outside groove of the cover (51).

3.42 Carefully fit the cover to the housing ensuring that the seals are not damaged during the fitting operation.

3.43 Secure the cover (51) with the four setscrews (55) and washers (54) and tighten the setscrews to a torque of 135 Nm (100 lbf ft).

Note ...

If either the housing, the worm or the cover have been renewed the washer behind the needle rollers may be of the wrong thickness. In this case the worm bearing adjustment must be checked as per Para 3.50. The setscrews should be tightened carefully whilst turning the steering spindle to ensure that there is no axial preload on the worm bearing.

3.44 To check the correct position of the sector shaft rotate the steering from full lock to full lock and count the number of rotations of the steering spindle. If the sector shaft is correctly positioned the marking on the outside face of the sector shaft should be at a right angle to the worm axis when the steering is in the central position.

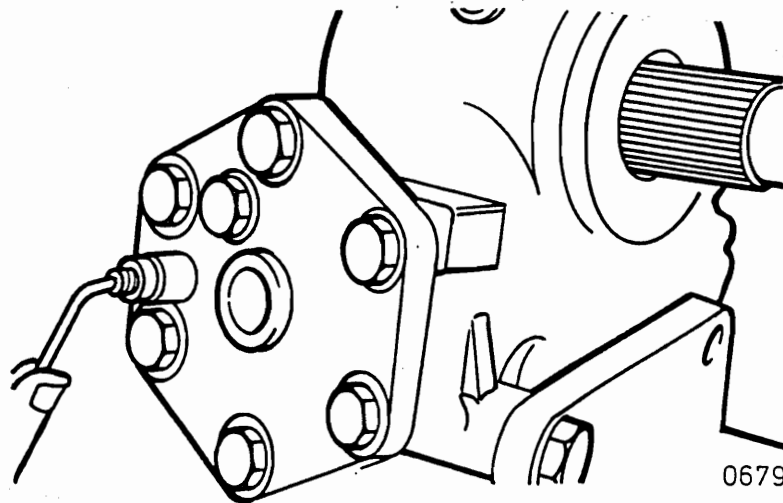


Fig 13 Tightening of the hydraulic limiting screw

3.45 The adjusting screw (20) for the hydraulic limiter must be tightened.

3.46 The drillings for the pressure and return lines must be plugged.

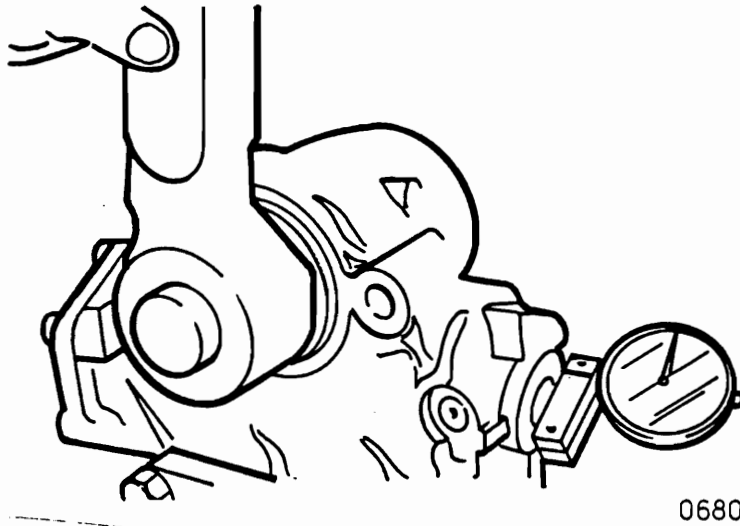
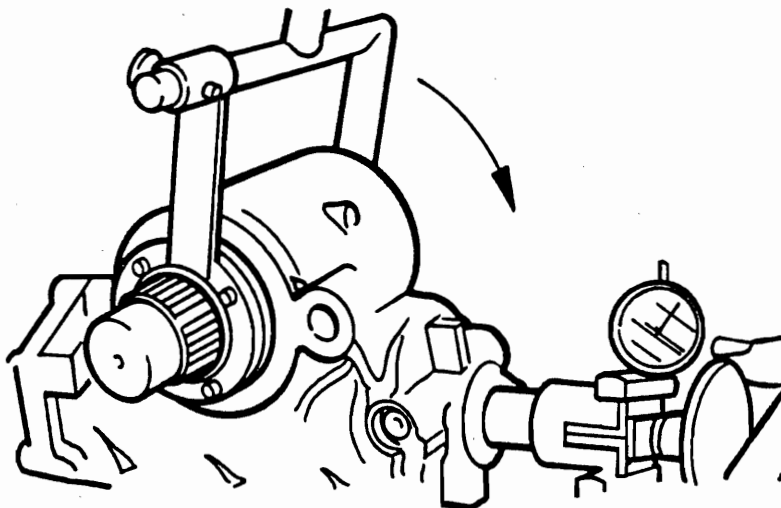


Fig 14 Checking of axial play of worm

3.48 Clean up the top of the steering box casing so that the housing is free of paint. Fit clock adaptor Part No. 8090 798 101 (Table 1 item 3) complete with standard measuring clock, calibrated in 1/1000mm, to worm shaft.

3.49 Turn the sector shaft as far as possible in one direction and "Zero" the measuring clock.

3.50 Turn the sector shaft as far as possible in the opposite direction, ensuring that the measuring clock adaptor does not rotate axially. The axial play must not exceed 0.015 mm at room temperature. If any adjustment is necessary this can be achieved by fitting an adjusting washer (47) of the correct thickness.



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1 Adjusting tool

2 Friction measuring tool

Fig 15 Checking of friction in complete steering box

3.51 Fit adaptor Part No.1 8052 798 552 (Table 1 item 4) with friction measuring installation Part No. 7470 798 703 (Table 1 item 1) onto the serrated shaft end of the worm. Turn steering into the central position.

3.52 Rotate the steering to one of the end positions and measure the friction in the complete steering box. The maximum friction should be 140 Ncm.

3.53 Check the friction of the steering in the straight ahead position. Turn the steering about 1/2 a turn to the right and to the left from the straight ahead position at the same time rotating the covers with the excentric bearings by means of the adjusting tool Part No. 8090 798 151 plus adaptors Part No. 8090 798 551 (Table 1 items 5 & 6) until the correct friction value has been achieved. It is advisable to set the friction near to the maximum permissible value ie. 140 Ncm.

### Testing

#### WARNING ...

ONLY USE CONNECTORS AND PIPES OR HOSES WHICH HAVE BEEN PASSED FOR THE MAXIMUM PRESSURE USED.

#### CAUTION ...

A repaired steering box must not be fitted into the vehicle until it has been thoroughly tested.

4 Fit the steering box into a steering test installation. Connect the feed and return lines to the steering box.

4.1 Bleed the hydraulic steering.

4.2 Adjust the test equipment to the correct maximum flow and pressure as given on the hydraulic pump fitted in the vehicle.

4.3 Block the steering box in the central position and attempt to turn the steering wheel using a force of 100-200 N this should register the maximum pressure.

4.4 Turn the steering wheel in the opposite direction to Para 4.3 and maximum pressure should again register. If the maximum pressure registered is not within the accepted tolerance there must be an excessive oil leak in the steering box.

4.5 To check the maximum oil leak in the steering box, run the pump and adjust the pressure to 30 bar below the maximum permissible pressure.

4.6 Turn the steering in both directions, with a blocked steering, apply a force of 100-200 N to the rim of the steering wheel. The maximum permissible leakage rate is 1 l/min.

Chapter 10

BRAKING SYSTEM

CONTENTS

Frame Para

- Vacuum servo
- 1 Dismantling
- 2 Inspection of parts
- 3 Re-assembling
- 4 Testing
- Load sensing valve
- 5 Dismantling
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- 7 Re-assembling
- 8 Testing

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| 3 | Retainer setting                    | 5  |
| 4 | Output pushrod setting              | 6  |
| 5 | Position of test points             | 7  |
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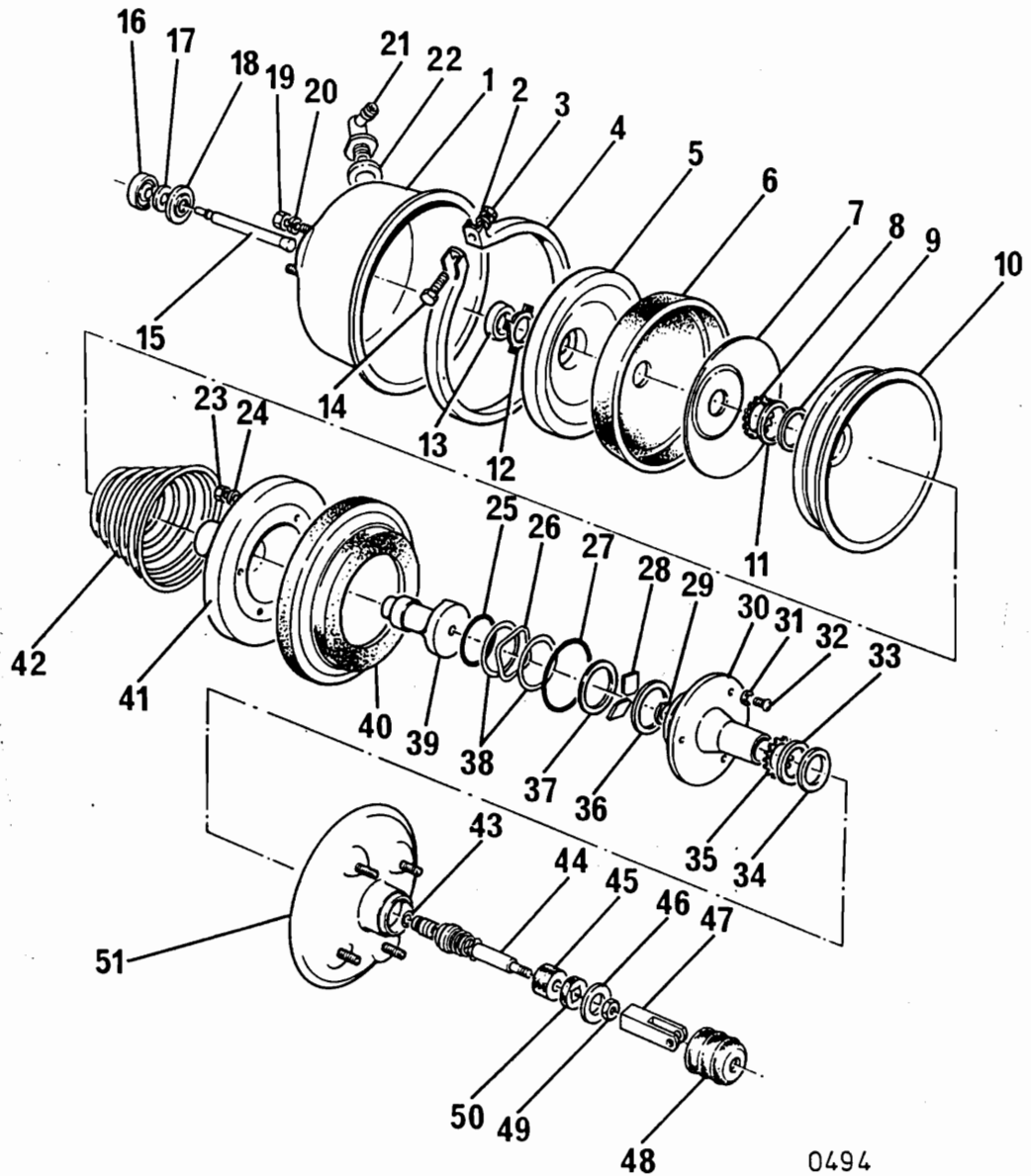
VACUUM SERVOCaution ...

Ensure that components do not come into contact with mineral lubricant (engine oil or grease).

Dismantling

- 1 To dismantle the vacuum servo proceed as follows :-
  - 1.1 Remove the gland seal (16), the seal retainer (18) and the output pushrod (15) from the unit.
  - 1.2 Note the relationship of the clamping screw (14) the cover (51) and the vacuum shell (1) to assist in re-assembly.
  - 1.3 Loosen the setscrew (14) on the clamp ring (4) and remove the ring.
  - 1.4 Remove the vacuum shell (1) from the diaphragm and end cover assembly complete with valve and push rod (44) sub assembly.
  - 1.5 Knock back the lock washer (12) tabs, and remove the retaining nut (13) slowly, holding the front diaphragm support plate (5) against the load of the spring (42). Gradually relax the load, allowing the spring to extend.
  - 1.6 Remove the diaphragm support plate (5), the diaphragm (6), the backing plate (7), the separator (10), and the spring (42).
  - 1.7 Dismantle the valve body (30), the reaction piston (39), the rear diaphragm (40) with the support plate (41) by removing the three nuts (23), washers (24) and screws (32) and fibre washers (31).
  - 1.8 Remove the support plate (41), the diaphragm (40), the reaction piston (39), the support rings (38) and waved washer (26), the retainer (37), the levers (28) and the bearing ring (29) from the valve body, noting the waved washer is between the two support rings (38).
  - 1.9 Remove the circlip (36) and the bolt retainer (46) and withdraw the valve and pushrod sub-assembly (44) from the valve body (30).
  - 1.10 Extract the rubber "O" ring (43) from the seal groove in the valve piston.
  - 1.11 Using a small screwdriver, prise out the bearing retainer (35) from the end cover (51), also prise out the bearing retainer (8) from the shell separator.
  - 1.12 The seals (9 & 34) and the bearings (11 & 33) can now be removed. Note the difference between the two bearings for re-assembly.

Inspection of parts



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- |    |               |    |                  |    |               |
|----|---------------|----|------------------|----|---------------|
| 1  | Shell         | 18 | Seal retainer    | 35 | Retainer      |
| 2  | Washer        | 19 | Nut              | 36 | Circlip       |
| 3  | Nut           | 20 | Washer           | 37 | Retainer      |
| 4  | Clamp         | 21 | Non-return valve | 38 | Support ring  |
| 5  | Support plate | 22 | Valve mount      | 39 | Piston        |
| 6  | Diaphragm     | 23 | Nut              | 40 | Diaphragm     |
| 7  | Backing plate | 24 | Washer           | 41 | Support plate |
| 8  | Retainer      | 25 | "O" ring         | 42 | Spring        |
| 9  | Seal          | 26 | Washer           | 43 | "O" ring      |
| 10 | Separator     | 27 | "O" ring         | 44 | Valve pushrod |
| 11 | Bearing       | 28 | Lever            | 45 | Filter        |
| 12 | Lock washer   | 29 | Bearing ring     | 46 | Retainer      |
| 13 | Nut           | 30 | Valve body       | 47 | Fork end      |
| 14 | Setscrew      | 31 | Fibre washer     | 48 | Rubber boot   |
| 15 | Pushrod       | 32 | Screw            | 49 | Locknut       |
| 16 | Seal          | 33 | Bearing          | 50 | Silencer      |
| 17 | Washer        | 34 | Seal             | 51 | End cover     |

Fig 1 Exploded view of vacuum servo

- 2.1 Carefully inspect all parts for faults, damage or wear.
- 2.2 All rubber parts and retainers should automatically be renewed.
- 2.3 If the valve and pushrod assembly is suspect it must be replaced as a complete assembly.

### Re-assembling

- 3 To re-assemble the vacuum servo proceed as follows :-
  - 3.1 Refit the rubber "O" ring (43) into the seal groove in the valve piston (39).
  - 3.2 Lightly coat the rubber seals of the new valve and pushrod sub-assembly with Lockheed disc brake lubricant and press fully into the bore of the valve body.
  - 3.3 Compress the springs so that the circlip groove in the valve body is exposed and fit the circlip (36).
  - 3.4 Push the boot retainer (46) onto the valve body (30).
  - 3.5 Lightly coat the new "O" ring (27) for the valve body (30) with the Lockheed disc brake lubricant and fit into the seal groove.
  - 3.6 Assemble the bearing ring (29), the levers (28), the retainer (37), the first support ring (38), the waved washer (26) into the end of the valve body (30). Grease the levers (28) before fitting and ensure that they are properly located with their chamfered ends in the valve piston groove.
  - 3.7 Apply lockheed disc brake lubricant to the "O" ring (25) for the reaction piston (39) and fit into the seal groove and push the assembly into the valve body (30) ensuring that the two projections on the reaction piston are located over the levers in the valve body.
  - 3.8 Place the new diaphragm (40) onto the valve body (30), convex side first, so that the inner diameter locates on the shoulder just outside the three screw holes. Do not grease the diaphragm.
  - 3.9 Fit the diaphragm support plate (41) lining up the indent on the support plate with the corresponding projection on the valve body. Fit the three securing screws (32) washers (31 & 24) and nuts (23) entering the screws from the valve body side. Tighten the nuts to a torque of 3.5 Nm (2.5 lbf ft).
  - 3.10 Coat the bearing (11) and the seal (9) for the separator shell (10) with Lockheed disc brake lubricant and press the seal into the shell, flat side first, followed by the bearing, noting that the chamfer in the bore of the bearing is adjacent to the seal.
  - 3.11 With the use of the setting tool (Fig 2), press in a new retainer, convex side first, until the largest shoulder of the tool meets the face of the shell (Fig 3).



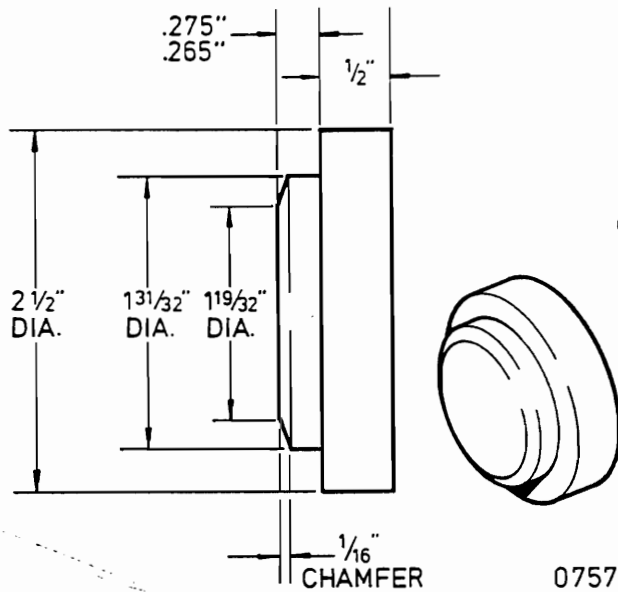


Fig 2 Setting tool for retainer

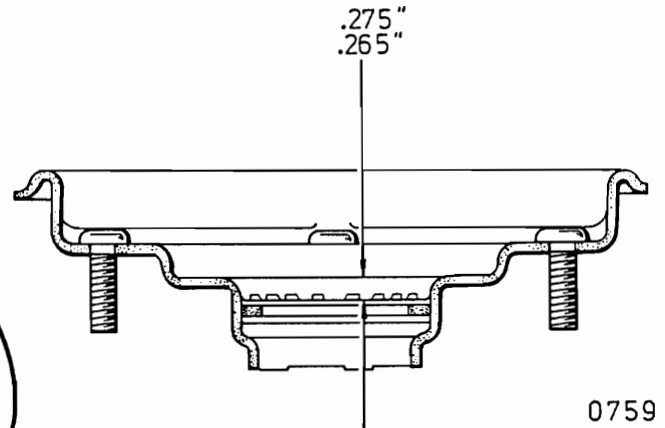


Fig 3 Retainer setting  
(Using tool as per Fig 2)

3.12 Pre-assemble the separator shell (10), the backing plate (7), the diaphragm (6) concave side first, and the support plate (5) and slide the assembly onto the tube, depressing the spring (42) and taking care not to damage the seal in the separator shell. Secure with the lockwasher (12) and nut (13). Tighten nut (13) to a torque of 16 Nm (12 lbf ft), and secure nut with tab on lockwasher.

3.13 Locate the outer edge of the front diaphragm (6) into the groove around the separator shell and push the assembly into the servo vacuum shell (1) ensuring that the diaphragm stays in position.

3.14 Coat the bearing (33) and seal (34) for the end cover (51) with Lockheed disc brake lubricant and press the shell into the cover, lips leading, followed by the bearing.

3.15 With the use of the setting tool (Fig 2) press in a new retainer (35), convex side first, until the largest shoulder of the tool meets the face of the cover (51) (see Fig 3).

3.16 Lightly grease the full length of the bearing surface of the valve body (30), using Lockheed disc brake lubricant, and slide on the end cover (51).

3.17 Locate the beaded edge of the rear diaphragm (40) between the end cover (51) and the separator shell (10) ensuring that the vacuum shell (1) and end cover are correctly aligned.

3.18 Fit the clamp ring (4) and secure with the setscrew (14), washer (2) and nut (3). Tighten the nut to a torque of 1.5 Nm (1.1 lbf ft) with the vacuum applied by connecting a vacuum line to the assembly (Nominal working vacuum is 28 mm).

3.19 Slide the boot (48) over the pushrod and locate the beaded edge of the boot over the flared end of the cover (51). Push the outer edge of the boot (interval groove) into the boot retainer (46).

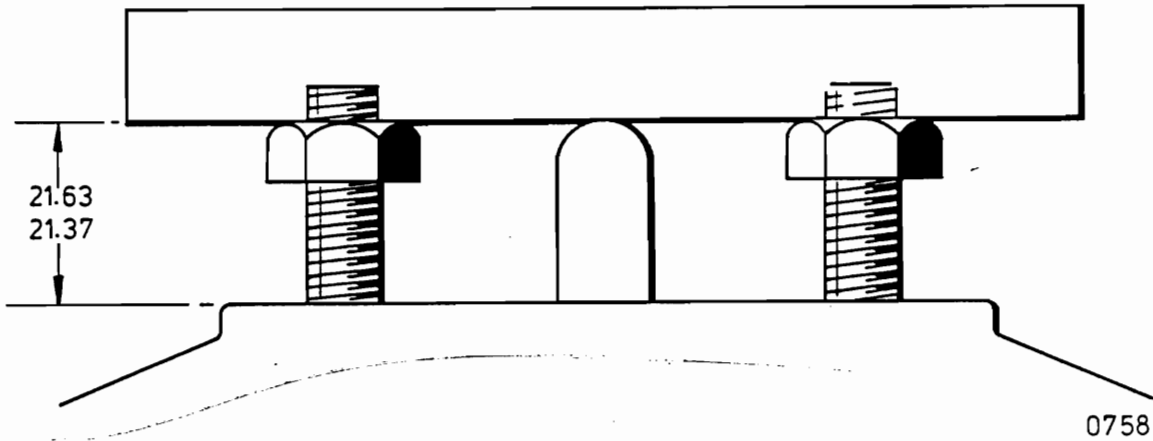


Fig 4 Output pushrod setting

3.20 The output pushrod adjustment must now be checked. The distance the end of the pushrod (15) protrudes at rest from the shell is critical and must be checked and set accurately. This dimension is 21.37-21.63 mm. To check this dimension lay a metal straight edge across two nuts, and run down the studs to the correct height. The pushrod must now be set to the correct dimension (see Fig 4).

3.21 If the output push rod and the fork end (47) have been dismantled, the dimension from the centre of the fork end clevis pin hole to the servo mounting face must be reset to 147-149 mm and the locknut (49) re-tightened to a torque of 23 Nm (17 lbf ft).

3.22 Lightly grease the outside diameter of the output pushrod (15) with Lockheed disc brake lubricant.

3.23 Fit the pushrod (15), the seal retainer (18) dished side inwards and the backing washer (17) into the vacuum shell (1).

3.24 Smear the seal (16) with Lockheed disc brake lubricant, slide over the end of the pushrod (15) and locate into the end of the vacuum shell (1).

### Testing

4 To test vacuum servo and tandem master cylinder as a unit proceed as follows :-

4.1 Remove the non-return valve (Fig 1 (21)).

4.2 Use the correct hydraulic fluid as specified in AESP 2320-E-200-601 in the master cylinder.

4.3 To check push rod setting remove filler cap and apply the following test.

4.3.1 Apply air pressure at 2.8 bar to master cylinder outlet "A" (see Fig 5) via a 0.53 mm dia restrictor x 4.8 mm long, pressure gauges must be fitted before and after the restrictor.

4.3.2 Move the push rod a maximum distance of 2 mm and then check that the pressure at outlet "A" (see Fig 5) does not exceed 2 bar.

4.3.3 Move the push rod a further 6.35 mm, which closes the venting ports.

4.3.4 Shut off the pressure source and check that the pressure does not drop below 2.7 bar in 5 seconds.

4.3.5 Release push rod.

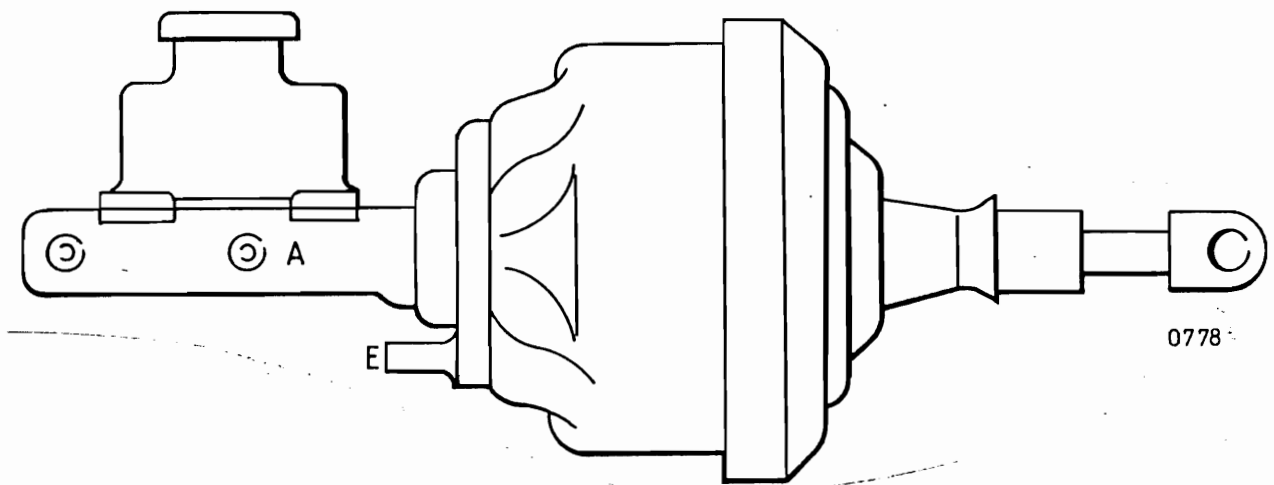


Fig 5 Position of test points

4.4 To check vacuum leakage in "Off" position proceed as follows :

4.4.1 Apply 0.68-0.75 bar of vacuum to connection "E" (see Fig 5) and shut off vacuum source. The leakage must not exceed 6.8 millibar in 10 seconds.

4.5 To test the performance of the unit proceed as follows :

4.5.1 Apply 0.75 bar of vacuum to connection "E" (see Fig 5) and move push rod for its full stroke after inserting a stop to prevent the stroke of the push rod exceeding 6.35 mm from its start position.

4.5.2 Apply a constant load of 1112 N to the push rod.

4.5.3 Apply hydraulic pressure at 110-112 bar to outlet "A" (see Fig 5) of the master cylinder. The push rod must return to the stop.

4.5.4 With the load of 1112 N still applied to the push rod reduce the pressure at "A" (see Fig 5) to 76-78 bar and the push rod must move from the stop. If this does not happen the unit is faulty.

- 4.5.5 Shut off the vacuum supply and check the unit for leakage. The leakage must not exceed 33.9 millibar vacuum in 15 seconds.
- 4.5.6 Release the hydraulic pressure at outlet "A" (see Fig 5).
- 4.5.7 Release input load and check that push rod returns to the fully off condition in 3 seconds.
- 4.5.8 Replace non-return valve.

## LOAD SENSING VALVE

### Dismantling

- 5 To dismantle the load sensing valve proceed as follows :-
  - 5.1 Ensure that the outside of the valve is clean and that the working area is also perfectly clean.
  - 5.2 Undo the four nuts (Fig 6)(2)) and remove with spring washers and bolts.
  - 5.3 Mark the top and bottom bodies to facilitate re-assembly in the same relative position.
  - 5.4 Gently remove the top body (1) complete with pistons and fork link (43) from the bottom body (25).
  - 5.5 Carefully note the relative positions of the parts prior to dismantling, particularly the position of the lever relative to the pointer, the order of assembly on the shaft and which sides of the lever and pointer face the valve.
  - 5.6 Remove the fulcrum block (36) complete with yokes (20 and 37) noting the relative position of yokes to the grooves in the shaft (23).
  - 5.7 Undo the clips (19 and 35) and remove the shaft and the yokes from the fulcrum block.
  - 5.8 Undo the two capscrews (40) securing the beam (21) to the bottom body (25). Remove the setscrews (40), spring washers (39) and beam from the body.
  - 5.9 Undo the nut (34) and dismantle the pointer (31) and lever (30) from the shaft (23) noting the remarks in Para 4.5.
  - 5.10 Remove the fork link (43) from piston rods, by removing the four clips securing the pins (18 and 42). Withdraw the pins and the fork link.
  - 5.11 Remove the two circlips (14 and 44), and withdraw the pistons and associated parts noting their relative positions.
  - 5.12 Unscrew the adaptor (6) and remove the spring (8) and the valve (9).

Inspection of parts

- 6 Wash all parts in cleaning solvent and blow dry prior to inspection.
  - 6.1 Ensure that all the passages in the body are clean.
  - 6.2 Visually inspect both bodies for cracks and damage.
  - 6.3 Visually inspect all sliding and working surfaces for scores and excessive wear.
  - 6.4 Check springs for corrosion and distortion.
  - 6.5 Examine the fork link and beam for cracks.
  - 6.6 Check all threads for damage.
  - 6.7 Ensure that the remaining parts, other than items to be renewed, are in good condition.

Re-assembling

- 7 Re-assembling is the reverse of dismantling noting the following points :-
  - 7.1 Take care to prevent any parts coming into contact with mineral oil or grease.
  - 7.2 Coat all moving parts with CDS 161 grease.
  - 7.3 Press in the shaft seal (28) after inserting the shaft (23).
  - 7.4 The fulcrum block (36) must be fitted with the small hole on one side facing away from the threaded end of the shaft.
  - 7.5 After assembling the parts in the bottom body, hold the fulcrum block down on the beam and move the block through its stroke.
  - 7.6 Ensure that the yoke (37) can oscillate freely and does not foul in the bottom body well, as this will restrict the full travel of the fulcrum block.
  - 7.7 The following torques should be applied :

Bleed Screw	13.56-20.34 Nm	(10-15 lbf/ft)
Securing Nuts	13.56-20.34 Nm	(10-15 lbf/ft)
Pointer securing nut	20.34-27.12 Nm	(15-20 lbf/ft)
Hydraulic Connections	33.90-40.68 Nm	(25-30 lbf/ft)

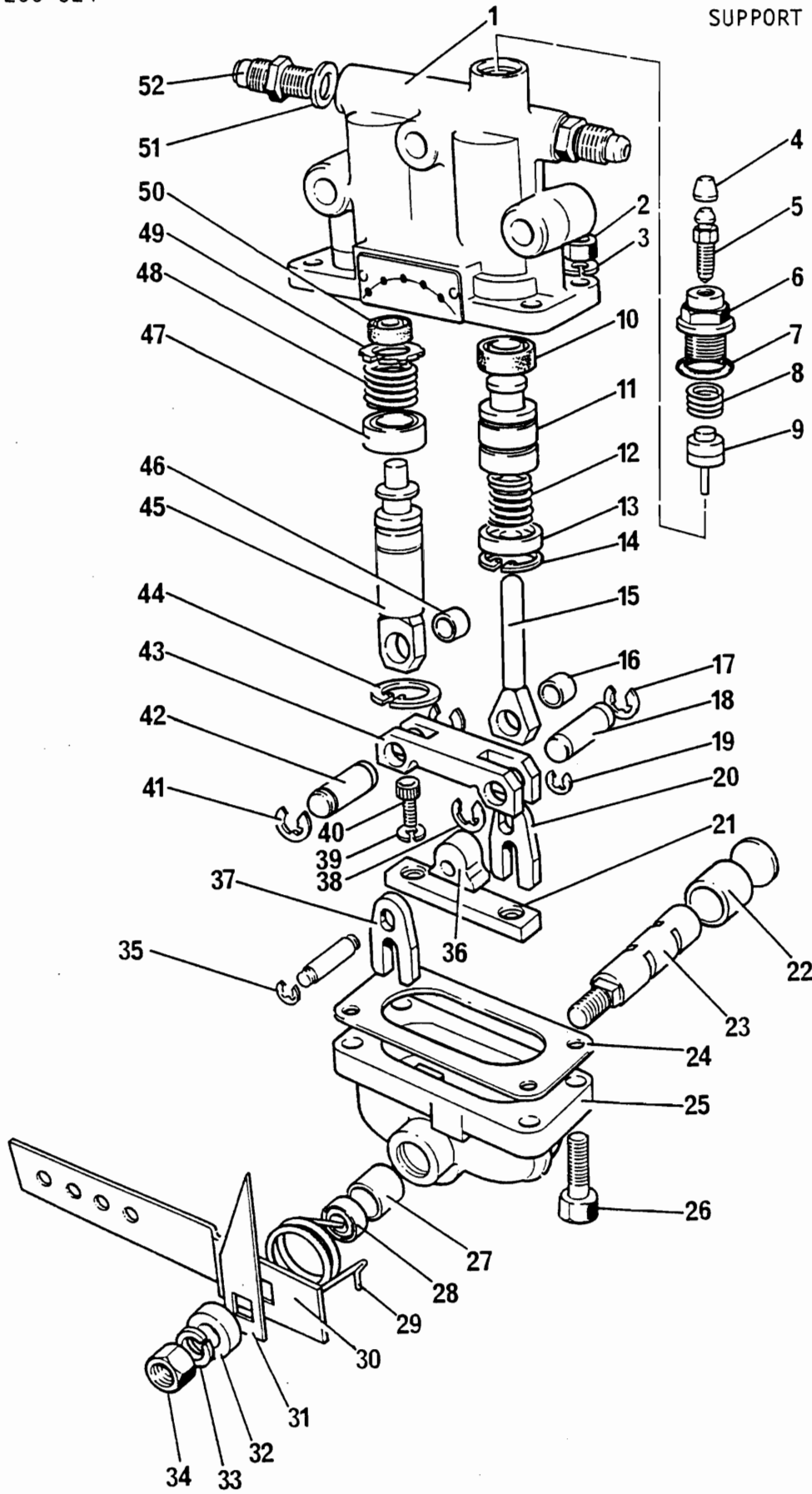


Fig 6 Exploded view of load sensing valve

KEY TO FIG.6

1	Body and bush	18	Pin	35	Clip
2	Nut	19	Clip	36	Fulcrum block
3	Spring washer	20	Yoke	37	Yoke
4	Dust cap	21	Beam	38	Clip
5	Bleed screw	22	Plug	39	Spring washer
6	Adaptor	23	Shaft	40	Capscrew
7	Sealing ring	24	Joint	41	Clip
8	Spring	25	Bottom body	42	Pin
9	Valve	26	Bolt	43	Fork link
10	Seal	27	Bush	44	Circlip
11	Balance piston	28	Seal	45	Piston
12	Spring	29	Spring	46	Bush
13	Retainer	30	Lever	47	Bush and retainer
14	Circlip	31	Pointer	48	Spring
15	Rod	32	Spacer	49	Circlip
16	Bush	33	Spring washer	50	Seal
17	Clip	34	Nut	51	Copper washer
				52	Connector

Testing

8 Install the valve into a test rig being able to apply hydraulic pressure up to 103 bar (1500 lbf/in<sup>2</sup>) and ensure that there is a pressure gauge reading 0-103 bar (0-1500 lbf/in<sup>2</sup>) fitted in the inlet line and a similar gauge in the outlet line.

8.1 Bleed the complete system before commencing the test. The initial position of the pointer (Fig 6 (31)) must be pointing to the 1:1 position.

8.2 The hydraulic pressure must be built up smoothly and at the same speed in all tests.

8.3 Apply a pressure of 103 bar (1500 lbf/in<sup>2</sup>) to the load sensing valve with the pointer at the 1:1 ratio position the input and output pressure should be identical.

8.4 With the pointer still in the 1:1 ratio position apply a hydraulic pressure of 21 bar (300 lbf/in<sup>2</sup>), the input and output pressures should again be identical.

8.5 With the pointer in the 4:1 ratio position apply a pressure of 103 bar (1500 lbf/in<sup>2</sup>) to the input port of the valve and keep this pressure steady. There must be no variation in the pressure recorded at the outlet port ie. 23.5-28 bar (340-410 lbf/in<sup>2</sup>). No leakage is permissible.

8.6 At the pressure ratio specified, smooth increases and decreases in the input pressure must be followed uniformly and without delay on the output side.

Chapter 11

FUEL AND EXHAUST SYSTEMS

CONTENTS

Frame Para

- 1 Fuel injection pump (microfiche)
- 2 Test plan
- Turbocharger
- 3 Dismantling
- 4 Inspection of parts
- 5 Re-assembling
- Start pilot pump
- 6 Filter cleaning or changing
- 7 Piston "O" rings replacing
- 8 Piston rod "O" rings replacing
- 9 Valve assembly replacing

Fig

Page

- 1 Sectional view of turbocharger
- 2 Sectional view of start pilot pump

7  
12



FUEL INJECTION PUMP

1 For information on the dismantling and re-assembling of the fuel injection pump see the following microfiche.

W - 400/000	-	Index	
W - 400/003	-	}	Information instructions
W - 400/007	-		
W - 400/008	-		
W - 400/014	-		
W - 400/016	-		
W - 460/100	-		
W - 460/303	-	New governor system VE Pumps	



## Low idle speed regulation :

Speed	1/min	:	300
Del. quantity	cm <sup>3</sup> /1000H	:	22 ... 26
Dispersion	cm <sup>3</sup> /1000H	:	Max 5.0

## Full load speed regulation :

Speed	1/min	:	1500
Charge press.	hPa	:	1000
Del. quantity	cm <sup>3</sup> /1000H	:	11 ... 19
Speed	1/min	:	100
Del. quantity min	cm <sup>3</sup> /1000H	:	82 ... 122

## Timing device characteristic :

1st speed	1/min	:	850
Charge press.	hPa	:	1000
TD travel	mm	:	0.3 ... 1.10

KSB solenoid operating value	volt	:	24
------------------------------	------	---	----

2nd speed	1/min	:	950
Charge press.	hPa	:	1000
TD travel	mm	:	1.5 ... 1.9

KSB solenoid operating value	volt	:	24
------------------------------	------	---	----

3rd speed	1/min	:	1100
Charge press.	hPa	:	1000
TD travel	mm	:	2.0 ... 2.8

KSB solenoid operating value	volt	:	24
------------------------------	------	---	----

4th speed	1/min	:	1300
Charge press.	hPa	:	1000
TD travel	mm	:	2.0 ... 2.8

## Supply pump pressure characteristic :

1st speed	1/min	:	500
Charge press.	hPa	:	0
Supply pump pressure	bar	:	2.7 ... 3.3

2nd speed	1/min	:	950
Charge press.	hPa	:	1000
Supply pump pressure	bar	:	4.6 ... 5.2

Overflow quantity at overflow valve :

1st speed	1/min	:	500
Charge press.	hPa	:	0
Overflow quantity	cm <sup>3</sup> /10s	:	15 ... 30
2nd speed	1/min	:	1300
Charge press.	hPa	:	1000
Overflow quantity	cm <sup>3</sup> /10s	:	20 ... 50

Delivery quantity & breakaway characteristic :

1st speed	1/min	:	1660
Charge-air pressure	hPa	:	1000
LDA stroke	mm	:	
Del. quantity	cm <sup>3</sup> /1000H	:	0 ... 2.6
2nd speed	1/min	:	1600
Charge press.	hPa	:	1000
Del. quantity	cm <sup>3</sup> /1000H	:	11 ... 19
3rd speed	1/min	:	1500
Charge press.	hPa	:	1000
Del. quantity	cm <sup>3</sup> /1000H	:	47 ... 53
4th speed	1/min	:	1300
Charge press.	hPa	:	1000
Del. quantity	cm <sup>3</sup> /1000H	:	85.5 ... 88.5
5th speed	1/min	:	1000
Charge press.	hPa	:	1000
Del. quantity	cm <sup>3</sup> /1000H	:	92.5 ... 93.5
6th speed	1/min	:	700
Charge press.	hPa	:	1000
Del. quantity	cm <sup>3</sup> /1000H	:	95 ... 98
7th speed	1/min	:	700
Charge press.	hPa	:	300
Del. quantity	cm <sup>3</sup> /1000H	:	88.5 ... 89.5
8th speed	1/min	:	700
Charge press.	hPa	:	0
Del. quantity	cm <sup>3</sup> /1000H	:	85 ... 86
9th speed	1/min	:	500
Charge press.	hPa	:	0
Del. quantity	cm <sup>3</sup> /1000H	:	76.5 ... 79.5
10th speed	1/min	:	
Charge press.	hPa	:	
Del. quantity	cm <sup>3</sup> /1000H	:	

Zero del. (stop) :

Mech. shutoff :

Speed	1/min	:	1300
Del. quantity	cm <sup>3</sup> /1000H	:	0 ... 3

Electronic shutoff :

Speed	1/min	:	300
KLAB	volt	:	0
Del quantity	cm <sup>3</sup> /1000H	:	0 ... 3

Idle delivery :

1st speed	1/min	:	300
Del. quantity	cm <sup>3</sup> /1000H	:	22 ... 26

2nd speed	1/min	:	350
Del. quantity	cm <sup>3</sup> /1000H	:	9 ... 15

3rd speed	1/min	:	400
Del. quantity	cm <sup>3</sup> /1000H	:	1 ... 2.6

Automatic starting fuel delivery :

1st speed	1/min	:	150
Del. quantity min	cm <sup>3</sup> /1000H	:	100 ... 140

2nd speed	1/min	:	250
Del. quantity ex	cm <sup>3</sup> /1000H	:	20 ... 70

## TURBOCHARGER

### Dismantling

3 To dismantle the turbocharger proceed as follows :-

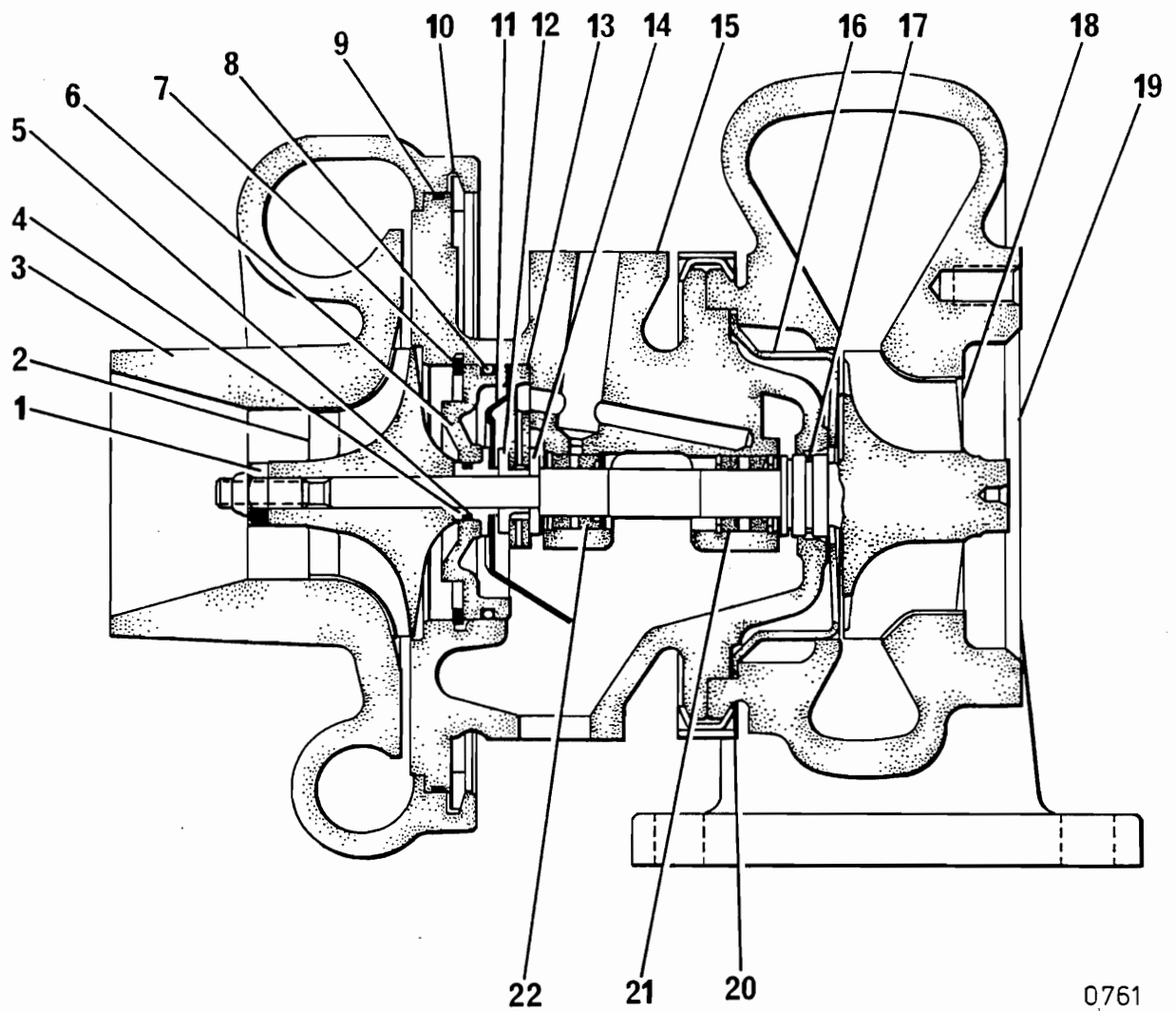
3.1 Mark the relative positions of the compressor cover (3) and the turbine housing (19) to the bearing housing (15).

3.2 Grip the turbine housing (19) in a soft jawed vice with the turbocharger shaft vertical.

3.3 Remove the large split ring (10).

3.4 Lift off the compressor cover.

3.5 Remove the clamp (20) securing the turbine housing (19).



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- |    |                  |    |                        |
|----|------------------|----|------------------------|
| 1  | Locknut          | 12 | Thrust collar          |
| 2  | Compressor wheel | 13 | Thrust bearing         |
| 3  | Compressor cover | 14 | Thrust ring            |
| 4  | Flinger sleeve   | 15 | Bearing hsg. assembly  |
| 5  | Piston ring      | 16 | Backplate              |
| 6  | Insert           | 17 | Piston ring            |
| 7  | Snap ring        | 18 | Shaft & wheel assembly |
| 8  | 'O' ring         | 19 | Turbine housing        |
| 9  | 'O' ring         | 20 | Vee clamp and locknut  |
| 10 | Snap ring        | 21 | Circlip                |
| 11 | Oil deflector    | 22 | Bearing                |

Fig 1 Sectional view of turbocharger

- 3.6 Lift the central core assembly out of the turbine housing.
- 3.7 Clamp a suitable 12 point socket wrench in the vice with the socket axis vertical.
- 3.8 Place the 12 point hub of the turbine shaft and wheel (18) into the socket. Hold the core assembly in one hand and release the compressor wheel locknut (1) using the correct size socket.
- 3.9 Remove the locknut (1) and remove the compressor wheel (2) from the turbine shaft (18).
- 3.10 Gently remove the turbine shaft (18) and wheel by tapping the compressor end of the shaft with a small soft faced mallet. Be careful not to bend the shaft.
- 3.11 Place the turbine backplate (16) with the bearing housing (15) on the bench and remove the insert (6) retaining snap ring (7).
- 3.12 Remove the insert (6) and oil flinger by simply prying the insert out with two screw drivers in the grooves provided in the insert.
- 3.13 Dismantle the insert assembly by pushing the flinger sleeve out of the insert (6).
- 3.14 Remove the oil deflector (11), the thrust bearing (13), the thrust ring (14) and the thrust collar (12).
- 3.15 Using suitable circlip pliers, remove the outer circlips from both ends of the bearing housing, remove the journal bearings (22) and inner circlips (21).

#### Inspection of parts

- 4 Prior to inspection soak all metal parts in a commercial non-caustic cleaning solvent.
  - 4.1 When all surfaces are clean they can be inspected.
  - 4.2 Inspect bearing and turbine end seal bore of the bearing housing for damage or wear.
  - 4.3 Visually inspect the compressor wheel for evidence of bent, burred, nicked or eroded blades and for evidence of scuffing on the back face. Very minor damage is acceptable. Do not attempt to straighten any bent blades. Reject and replace the wheel if the damage appears great enough to affect wheel balance.
  - 4.4 To inspect shaft and wheel assembly carry out the visual inspection as per Para 4.3 on the blades and then check the following :
    - 4.4.1 Check journal diameter for wear. Minimum diameter is 8,99 mm.
    - 4.4.2 Check seal groove width. Maximum width is 1,58 mm.

- 4.4.3 Measure eccentricity between large and small shaft diameter. The limit of eccentricity is 0.0076 mm.
- 4.4.4 Check balance of assembly in both places to 0.36 gm.mm.
- 4.5 Visually inspect compressor cover for contour damage and replace if damage is excessive.
- 4.6 Visually inspect turbine housing for contour damage and evidence of overheating damage such as cracking, pitting, warping and erosion. Replace housing if damage is excessive.
- 4.7 Replace turbine backplate if it is cracked or warped.
- 4.8 Check the flinger sleeve piston ring groove width (max 1,58 mm) and also check groove for signs of taper or other damage and replace part if worn.
- 4.9 Replace the thrust ring if the thrust surface is worn. In most cases these may be re-used by reversing the position so that the non worn side is in contact with the thrust bearing.
- 4.10 The thrust collar should not show any signs of surface disturbance or wear on the thrust face.

#### Re-assembling

5 To re-assemble the turbocharger proceed as follows :-

- 5.1 Do not use any defective parts.
- 5.2 All parts must be washed in clean solvent and dried with compressed air.
- 5.3 Fit the inbound circlips (21) to the bearing housing bore. Add a few drops of engine oil to the bore and fit the bearings (22) and the outboard snap rings (7).
- 5.4 Fit a new piston ring seal into the shaft and wheel assembly.
- 5.5 Fit the turbine backplate over the shaft section and rest on the back of the turbine wheel.
- 5.6 Fit the shaft and wheel assembly into the bearing housing assembly after lubricating both the shaft and the piston ring using engine oil. Be careful not to damage the piston ring when entering the sealing bore.
- 5.7 Place the above assembly onto the turbine housing (19) with the shaft vertical.
- 5.8 Fit the thrust ring (14) onto the shaft.
- 5.9 Fit the thrust bearing (13) into the bearing housing (15) and lubricate bearing surfaces with engine oil.



- 5.10 Fit the thrust collar (12) and oil deflector (11).
- 5.11 Fit a new "O" ring (8) in the insert.
- 5.12 Fit a new piston ring into the flinger sleeve (4).
- 5.13 Assemble the flinger sleeve assembly into the insert (6) taking care not to damage the piston ring (5).
- 5.14 Lubricate the "O" ring (9) using engine oil, and assemble the insert assembly into the bearing housing and shaft assembly and retain with the snap ring taking care the bevelled edge is uppermost.
- 5.15 Fit the compressor wheel (2) and locknut (1).
- 5.16 Clamp a suitable 12 point socket wrench into the vice with the socket axis vertical.
- 5.17 Place the 12 point hub of the turbine wheel into the socket.
- 5.18 Tighten the compressor locknut (1) to a torque of 10.17 Nm (7.5 lbf ft) and apply two drops of Loctite 601 to the threads.
- 5.19 Fit the core assembly into the compressor cover (3) after loosely assembling the circlip (10) over bearing housing flange (bevelled edge towards the turbine) and fit the circlip in the groove.
- 5.20 Fit the core assembly into the turbine housing (19) align the marks made on dismantling, fit the "V" clamp (20) and tighten the locknut to a torque of 3.7 Nm (5 lbf ft).

## START PILOT PUMP

### Filter cleaning or changing

- 6 To clean or change the filter (10) proceed as follows :-
  - 6.1 Remove the pump name plate (9) by levering from rubber handle (8).
  - 6.2 Using a pair of small flat nosed pliers grip rim of nylon filter and pull out.
  - 6.3 If the filter is not being renewed wash filter in paraffin, dry and replace.
  - 6.4 To replace filter reverse removal instructions.

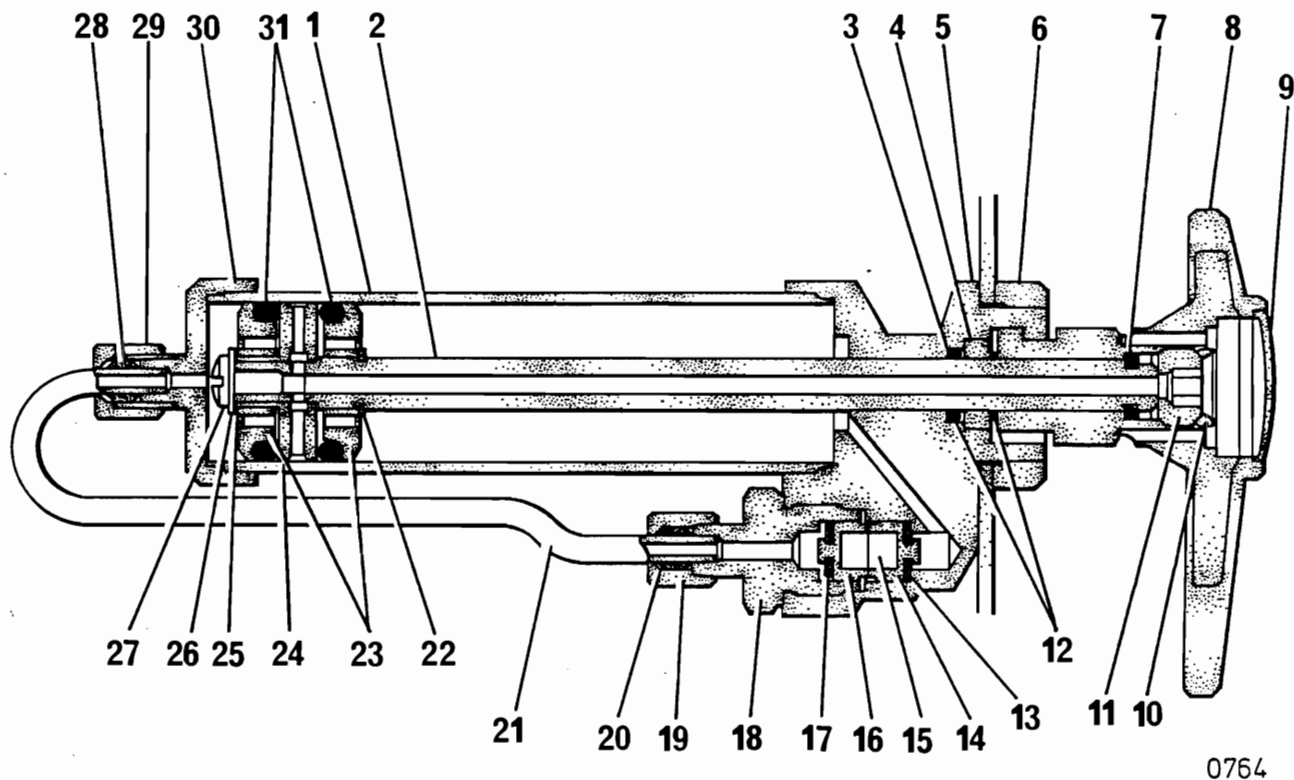
### Piston "O" rings replacing

- 7 To replace piston "O" rings proceed as follows :-
  - 7.1 Remove the pump name plate and filter as per Para 6.
  - 7.2 Remove male plug (11) using a socket wrench.

- 7.3 Push the handle back along the piston rod, when the circular key (7) will become accessible; it is a loose fit and will drop out.
- 7.4 Remove the external pipe (21) by undoing the nuts at either end.
- 7.5 Unscrew the cylinder (1) and end cap (30) by gripping the cylinder with a strap wrench.
- 7.6 Slide the cylinder from the piston rod. Inspect the "O" rings (31) for wear and renew if scored or deformed.
- 7.7 Lubricate the "O" rings with a few drops of low temperature (-40°C) mineral oil.
- 7.8 Refit the cylinder over the piston assembly taking care not to damage the "O" rings (31).
- 7.9 Screw the cylinder into the pump body using a PTFE sealant, and tighten the cylinder using a strap wrench.
- 7.10 Replace the external pipe.
- 7.11 Replace the handle and filter by reversing dismantling instructions in Para 7.1-7.3.

Piston rod "O" rings replacing

- 8 To replace the piston rod seal proceed as follows :-
  - 8.1 Remove the pump handle as per Para 7.1-7.3
  - 8.2 Remove the plug (11) using a socket wrench.
  - 8.3 Unscrew the cylinder (1) and end cap (30) by gripping the cylinder with a strap wrench.
  - 8.4 Slide the cylinder from the piston rod. Inspect the "O" rings (31) and renew if scored or deformed.
  - 8.5 Withdraw piston rod assembly.
  - 8.6 Remove seal (3) from groove taking care not to damage the bore, replace and lubricate.
  - 8.7 Replace all components in reverse order of dismantling.



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- |    |              |    |                |
|----|--------------|----|----------------|
| 1  | Cylinder     | 17 | Valve washer   |
| 2  | Piston rod   | 18 | Adaptor        |
| 3  | Seal         | 19 | Nut            |
| 4  | Insert bush  | 20 | Olive          |
| 5  | Pump body    | 21 | Pipe           |
| 6  | Nut          | 22 | Circlip        |
| 7  | Circlip      | 23 | Sliding piston |
| 8  | Handle       | 24 | Fixed flange   |
| 9  | Nameplate    | 25 | Brace          |
| 10 | Filter       | 26 | Washer         |
| 11 | Plug         | 27 | Setscrew       |
| 12 | "O" ring     | 28 | Olive          |
| 13 | Valve washer | 29 | Nut            |
| 14 | Valve        | 30 | End cap        |
| 15 | Spring       | 31 | "O" rings      |
| 16 | Valve        |    |                |

Fig 2 Sectional view of start pilot pump

Valve assembly replacement

9 To replace the valve assembly proceed as follows :

9.1 Remove the external pipe (21) by undoing the nuts (19 and 29).

9.2 Unscrew the adaptor (18) from the body.

9.3 The two halves of the valve with the spring (15) with the washers (13 and 17) may be withdrawn.

9.4 Inspect the washers (13 and 17) and replace if necessary.

9.5 Clean the valve seats in the body and the adaptor.

9.6 Relace the valve (14) with the washer (13) into the body.

9.7 Fit the spring (15) and the other valve (16) with the washer (17) and secure with the adaptor (18).

9.8 Replace the external pipe (21).

Chapter 17

WINCH (INCLUDING PTO)

CONTENTS

Frame Para

Winch

- 1 Dismantling
- 2 Inspection of parts
- 3 Re-assembling
- 4 Testing (WARNING)
- Hydraulic motor
- 5 Dismantling
- 6 Inspection of parts
- 7 Re-assembling
- 8 Testing (CAUTION)
- Hydraulic pump
- 9 Dismantling
- 10 Inspection of parts
- 11 Re-assembling
- 12 Running in and test procedure
- Power take-off
- 13 Dismantling (WARNING)
- 14 Inspection of parts
- 15 Re-assembling
- 16 Testing

Table

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- 1 Drum winch settings 7

Fig

- 1 Sectional view of winch and fairlead assembly 3/4
- 2 Danger Zone 7
- 3 Exploded view of hydraulic motor assembly 10
- 4 Exploded view of hydraulic pump 13/14
- 5 Assembling the lobe seal and backing washers 15
- 6 Arrangement of bushes in pump body 16
- 7 Exploded view of power take-off 20

WINCHDismantling

- 1 To dismantle the winch assembly proceed as follows :-
  - 1.1 Remove the fairleads, clutch and hydraulic motor as per AESP 2320-E-200-522.
  - 1.2 Remove the drum (Fig 1 (11)) from the shaft (8).
  - 1.3 Remove cover (17) and gasket as per AESP 2320-E-200-522.
  - 1.4 Remove the intermediate gear (5).
  - 1.5 Remove the gear (20) from the casing (1).
  - 1.6 Remove the large circlip (18) from the main shaft (8).
  - 1.7 Remove the gear (14) taking care not to lose the two keys (16).
  - 1.8 The main shaft (8) should then be removed from the gearcase (1).
  - 1.9 Remove all bearings.

Inspection of parts

- 2 Thoroughly clean all parts in a suitable cleaning solution.
  - 2.1 Visually inspect all gears for cracks, broken teeth or uneven wear over the width of the teeth.
  - 2.2 Inspect drum (11) for cracks or other damage.
  - 2.3 Visually inspect all shafts for excessive wear.
  - 2.4 Inspect casing (1) and cover (17) for cracks or other damage.
  - 2.5 Inspect ball and roller bearing in accordance with EMER TEST & MEASUREMENT A028 Chap 60.

Key to Fig 1

1 Gearcase	8 Main shaft	15 Setscrew
2 Bearing	9 End cover	16 Key
3 Hydraulic motor	10 Fairlead assembly	17 Cover
4 Bearing	11 Drum	18 Circlip
5 Intermediate gear	12 Spacer	19 Bearings
6 Oil seal	13 Bearing	20 Gear
7 'O' ring	14 Gear	21 Gasket

2.6 Remove the oil seal (6), spacer (12), the "O" ring (7) and the gasket (21) and discard. (Retain the spacer).

### Re-assembling

3 To re-assemble the winch assembly proceed as follows :-

3.1 Replace bearings as necessary.

3.2 Insert the two keys (16) in the keyways on the main shaft (8), press the drum gear (14) onto the main shaft and secure with the circlip (18).

3.3 Press the main shaft and journal into the bearing in the gearcase as shown in Fig 1.

3.4 Fit the intermediate gear (5) and the gear (20).

3.5 Refit the gearcase cover (17) and gasket as per AESP 2320-E-200-522.

3.6 Carefully pass the oil seal (6) over the main shaft and fit into the gearcase (1).

3.7 Pass the spacer (12) and "O" ring (7) over the main shaft, taking care not to damage the "O" ring. Tap the spacer home into the gearcase.

3.8 Fit the drum (11) onto the main shaft (8).

3.9 Refit the fairleads, clutch and hydraulic motor as per AESP 2320-E-200-522.

3.10 Refill the gearcase with oil as detailed in AESP 2320-E-200-522 and AESP 2320-E-200-601.

### Testing

#### WARNING

1 INDUSTRIAL GLOVES ARE TO BE WORN WHEN HANDLING THE WINCH ROPE. KEEP HANDS AND CLOTHING CLEAR OF THE WINCH AND FAIRLEADS WHEN THE WINCH IS IN OPERATION.

2 ALL PERSONNEL NOT DIRECTLY INVOLVED IN THE WINCH TEST ARE TO REMAIN OUTSIDE THE DANGER ZONE AS DEFINED IN FIGURE 1.

Note ...

EMER Test and Measurement A028 Chapter 157 must be read in reference to this test.

4 After renewal or major repairs to the winch assembly the installed winch is to be load tested to the following procedure;

4.1 The winch rope is to be examined and classified serviceable (EMER Test & Measurement A028 Chapter 157 refers).

4.2 Secure the vehicle chassis to a suitable ground anchor in a designated winch test area.

4.3 Spool out the winch rope leaving four full coils on the bottom lay.

4.4 Connect a calibrated load measuring device to the rope and apply a light load.

4.5 Clear all personnel not involved with the test from the danger zone as defined in Fig 2.

4.6 Engage winch P.T.O., start engine and set to a 1000 R.P.M.

4.7 Under the control of the person monitoring the load measuring device operate winch to 'winch in'

4.8 Immediately stop winching if the following occurs:

4.8.1 The controller indicates an overload.

4.8.2 The winch stalls.

Note ...

Release the load by winching out retaining a light load on the rope.

4.9 The following data is to be used

4.9.1 Immediately abort the test if the indicated load exceeds 4.08 tonne (4.01 ton).

4.9.2 The winch is classified serviceable if the winch at point of stall pulls 3.71 tonne -5% +zero (3.65 ton -5% +zero).

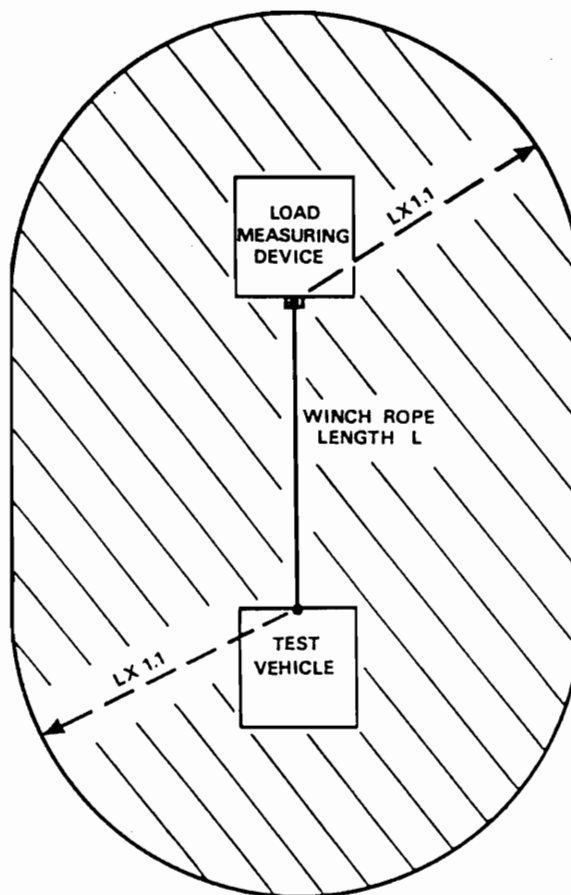
4.10 If the winch is above or below the specified tolerance (para 4.9.2) the cause is likely to be a maladjusted or worn hydraulic components. Refer to Cat 512 of this AESP.



TABLE 1 - DRUM WINCH SETTINGS (TONNES)

SYSTEM	SETTINGS FOR EACH DRUM LAYER				
	Bottom	2nd	3rd	4th	5th
CUT OUT	3.71	3.17	2.77	2.46	2.21
WARNING DEVICE	If applicable				

System Hydraulic Pressure Relief Valve setting 54 bar (783 lbf/in<sup>2</sup>)



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Fig 2 Danger Zone

HYDRAULIC MOTOR (Fig 3)Dismantling

5 To dismantle the hydraulic motor proceed as follows :-

5.1 Clamp the hydraulic motor in a vice using soft jaws or a holding fixture, with the end cover at the top.

5.2 Unscrew the six setscrews securing the end cover (8) to the housing (30), withdraw the setscrews and washers, and then remove the end cover sideways.

5.3 Lift out the gearwheel set (5) and remove the "O" rings (4 & 6).

5.4 Remove the distributor plate (3) and the "O" ring (2) from the groove in the housing.

5.5 Remove the shaft (1) out of the housing.

5.6 Remove the output shaft (29).

5.7 Turn over the motor housing in the vice or holding fixture so that the mounting flange is facing the top.

5.8 Remove the six setscrews (26) and washers (27).

5.9 Remove the spigot flange (23) from the housing.

5.10 The "O" ring (21) and the bearing (22) can now be removed from the spigot flange.

5.11 Remove the shaft seal (20) from the spigot flange.

5.12 Remove the sealing ring (24) and withdraw needle bearing (19).

Inspection of parts

6 Prior to inspection carefully clean all components in white spirit using lint free material.

6.1 Remove any burrs from the machined surfaces of the housing using fine stone. Protect bearings which have not been removed, from the ingress of swarf particles.

6.2 Renew bearings if they show signs of wear.

6.3 Renew gearwheel set if excessively worn.

6.4 Renew shaft if it shows signs of excessive scoring or corrosion.

6.5 Renew oil seals and "O" rings.

6.6 Examine all screw threads.

6.7 Clean up splines and keyways using a fine stone.

6.8 Prior to re-assembly lubricate all parts with winch hydraulic oil as specified in AESP 2320-E-200-601.

#### Re-assembling

7 To assemble the hydraulic motor proceed as follows :-

7.1 Fit the needle bearing (19) into the housing (30).

7.2 Place the shaft seal (20) in the spigot flange (23) and gently tap into place using a hide mallet.

7.3 Place the dust seal ring (24) into the spigot flange (23) using a hide mallet to tap the seal into position.

7.4 Fit the "O" ring (21) and bearing race (22) into the spigot flange.

7.5 Fit the spigot flange into housing (30).

7.6 Fit the six screws and washers through the spigot flange and tighten them to a torque of 5.0-8.0 Nm (45-70 lbf in).

7.7 Turn the motor over and fit the output shaft (29).

7.8 Fit the "O" ring (2) and the distributor plate (3) ensuring that the screw holes in the distributor plate align with the drillings in the housing.

7.9 Guide the shaft (1) into the motor housing supporting the shaft so that the gear teeth are above the housing.

7.10 Fit the "O" rings (4 and 6) in the rim of the gear wheel set (5).

7.11 Place the gearwheel set (5) onto the shaft (1) so that the top of an outer tooth in the rotor is vertically above the shaft (29) keyway.

7.12 Turn the gearwheel set 15 degrees anti-clockwise until the shaft (1) and rotor of the gearwheel set engage.

7.13 Turn the gearwheel set so that the holes for the bolts line up with the holes in the housing and distributor plate.

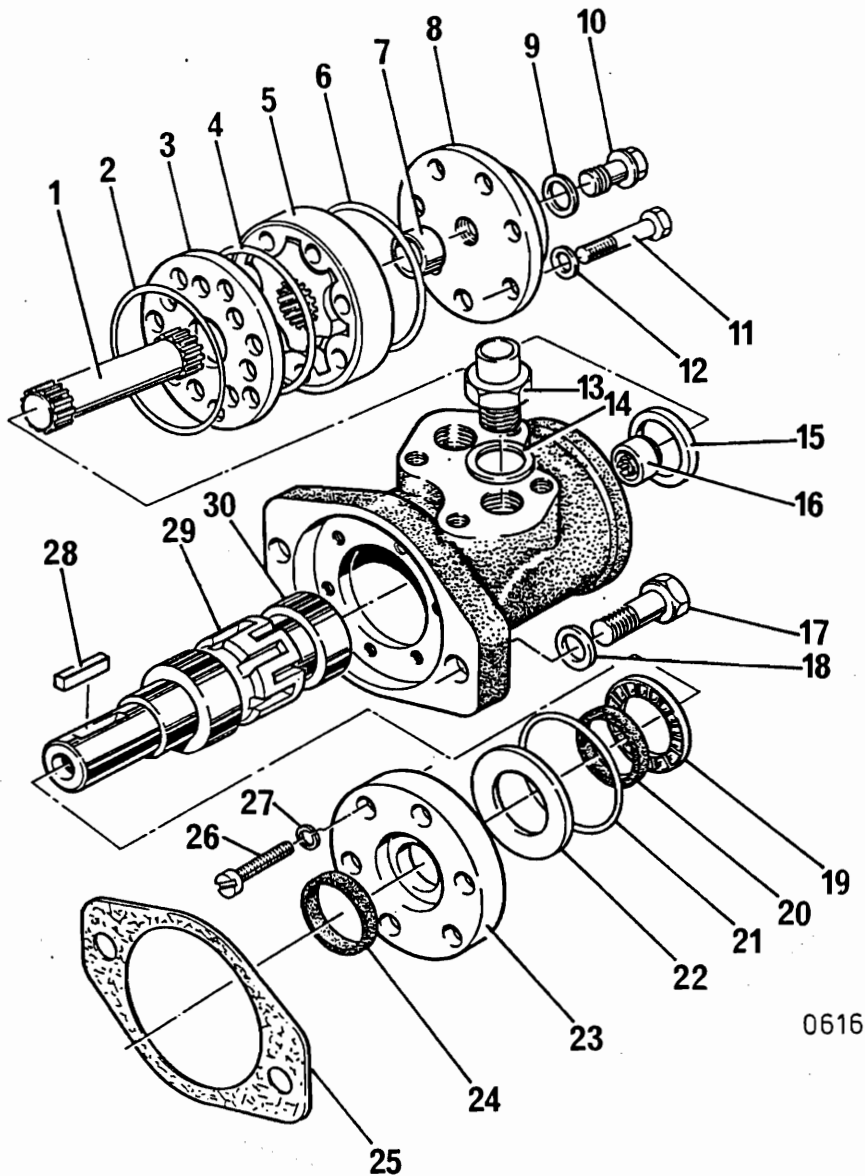
7.14 Place the spacer (7) in the gearwheel set.

7.15 Fit the end cover (8) ensuring that the bolt holes line up with the bolt holes in the gearwheel set, the distributor and the housing.

7.16 Fit the washers (12) on the setscrews (11) and screw them in loosely. Remove the support for the shaft fitted in Para 7.10.

7.17 Tighten the setscrews (11) to a torque of 300-350 Nm (220-260 lbf ft).

7.18 Fit the key (28) into the keyway in the output shaft.



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1	Shaft	11	Setscrew	21	O ring
2	O ring	12	Washer	22	Bearing
3	Distributor plate	13	Adaptor	23	Spigot flange
4	O ring	14	Sealing washer	24	Sealing ring
5	Gearwheel set	15	Thrust bearing	25	Gasket
6	O ring	16	Magnet	26	Screw
7	Spacer	17	Setscrew	27	Lockwasher
8	End cover	18	Lockwasher	28	Key
9	Copper washer	19	Needle bearing	29	Shaft
10	Drain plug	20	Shaft seal	30	Housing

Fig 3 Exploded view of hydraulic motor assembly

7.19 Screw in the drain plug (10) complete with copper washer (9).

7.20 Tape the key (28) in position and plug all the ports to prevent ingress of dirt.

## TESTING

8 Test data is as follows:

- 8.1 Flow 32l/min (8 gal/min) +/- 5 l/min (1.3 gal/min).
- 8.2 Pressure 70 bar (1000 lbf/in<sup>2</sup>).
- 8.3 Minimum Torque 245 Nm (180 lbf ft).
- 8.4 Speed 92 rev/min.
- 8.5 Oil temperature 40°C +/- 2°C

## Caution

The maximum speed rating of the motor is 200 rev/min this must not be exceeded.

Note ...

The maximum starting pressure of the motor is 5 bar (72 lbf/in<sup>2</sup>)

- 8.6 Mount the motor on the test bench and connect the inlet and outlet ports.
- 8.7 Start test bench and set a flow of 10l/min (2.6 gal/min) with no load. Run motor for 10 to 15 minutes.
- 8.8 There must be no leakage or overheating during running in.
- 8.9 Increase flow to 32l/min (8 gal/min) and slowly increase pressure to 70 bar (1000lbf/in<sup>2</sup>). Adjust flow as necessary.
- 8.10 Check and record output torque.
- 8.11 There must be no leakage or overheating during test.
- 8.12 Repeat test in the opposite direction.
- 8.13 Stop bench, remove motor and fit plastic sealing plugs to open ports.

## HYDRAULIC PUMP (Fig 4)

### Dismantling

9 To dismantle the hydraulic pump proceed as follows :-

- 9.1 Mark the position of the end cover (1), unscrew the eight setscrews (31) and remove the end cover (1).
- 9.2 Carefully lift out the two backing washers (5 and 30), the lobe seal (6) and the "O" ring (2).

9.3 Remove the circlip (17) from the shaft (21) and protect the end of the shaft before withdrawing the mounting flange (18).

9.4 Carefully lift out the "O" ring (15), the two backing washers (14 and 19) and the lobe seal (13).

9.5 Hold the pump body (22) vertically with the mounting flange end downwards and with one hand underneath to prevent the bushes dropping out. Tap the side of the body with a hide mallet to dislodge the lower bushes and slide these carefully out of the body. Keep the bushes (12 and 20) as a pair and place them on the mounting flange.

9.6 Invert the body and lift out the driver (21) and driven gears (11) after marking their relative positions.

9.7 Remove the remaining pair of bushes as already described in para 9.6 and place them on the end cover.

#### Inspection of parts

10 Prior to inspection wash all metal parts thoroughly in a proprietary cleaning fluid.

10.1 Visually inspect the body bores, if a pronounced step caused by the gears is felt, the body must be renewed.

10.2 Check the security of the two hollow dowels in the body.

10.3 Worn bushes should be renewed. Light scoring on the bush faces can be polished out on a lapping plate. If new bushes are to be fitted in an old body, check for the presence of a burr at the edges of the weartrack. If a burr is found it must be polished out otherwise it will hold the bush faces away from the gears and increase the internal leakage.

10.4 Examine the gears for discolouration, indicating overheating. Check the journals for scoring.

10.5 Ensure that the contact marks are evenly distributed across each tooth surface and also that none of the teeth are chipped.

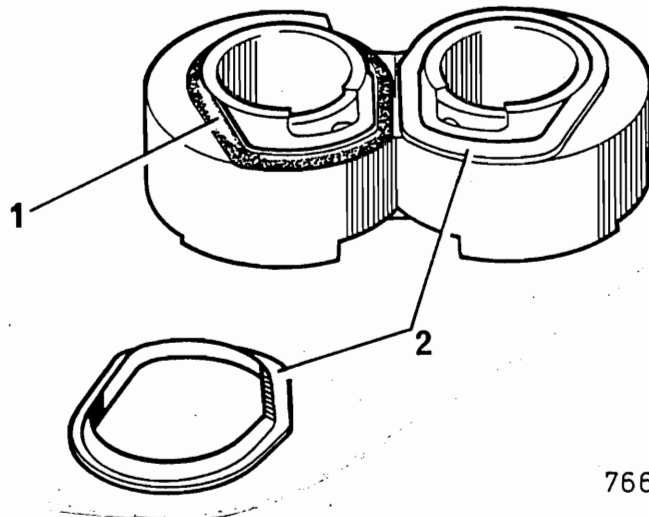
10.6 Bushes and gears are mated for width to within 0.005mm (0.0002 in) and can only be renewed in pairs.

10.7 Ensure that the flat inner surface of the cover is free from scoring or pitting.

10.8 Examine the mounting flange for damage.

10.9 All seals must be renewed.

10.10 Check the condition of the setscrew threads.



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1 Lobe seal

2 Backing washers

Fig 5 Assembling the lobe seal and backing washers

### Re-assembling

11 To re-assemble the hydraulic pump proceed as follows :-

11.1 Ensure that all parts are perfectly clean and lubricate with the hydraulic oil used in the system as per AESP 2320-E-200-601.

11.2 Refer to Fig 5 and prepare the bushes for the mounting flange end of the body for insertion.

11.3 Place the bushes on the bench with their lobes uppermost and the flats in contact. Lubricate the lobe seal with mineral base grease and fit around the bush lobes. Fit the two backing washers inside the "eye pieces" of the lobe seal. When fitted correctly the backing washers must be level and flush with the top surface of the bush lobes.

11.4 Prepare the bushes for the cover end of the body for insertion in a similar manner to the one described in Para's 11.2 - 11.3.

11.5 Pack the space between the lips of the oil seal (Fig 4 (16)) with high melting point mineral based grease.

11.6 Pick up the body and hold it with the hollow dowels uppermost and with the fingers of one hand inside ready to support the bushes.

11.7 Pick up the mounting flange bushes complete with lobe seal and backing washers, and slide them into the body bore with the lobes facing outwards and away from the flat formed by the removal of the cusp at the intersection of the body bores. The bushes must be entered squarely into the bore and must be kept square to each other. No force must be used; the bushes should slide in easily. If the bushes jam in the bore, remove them and examine for bruising. Light bruising can be stoned out with a fine-grit hand stone.

11.8 Lubricate the body seal (Fig 4 (2)) with mineral-base grease and place it in the body recess.

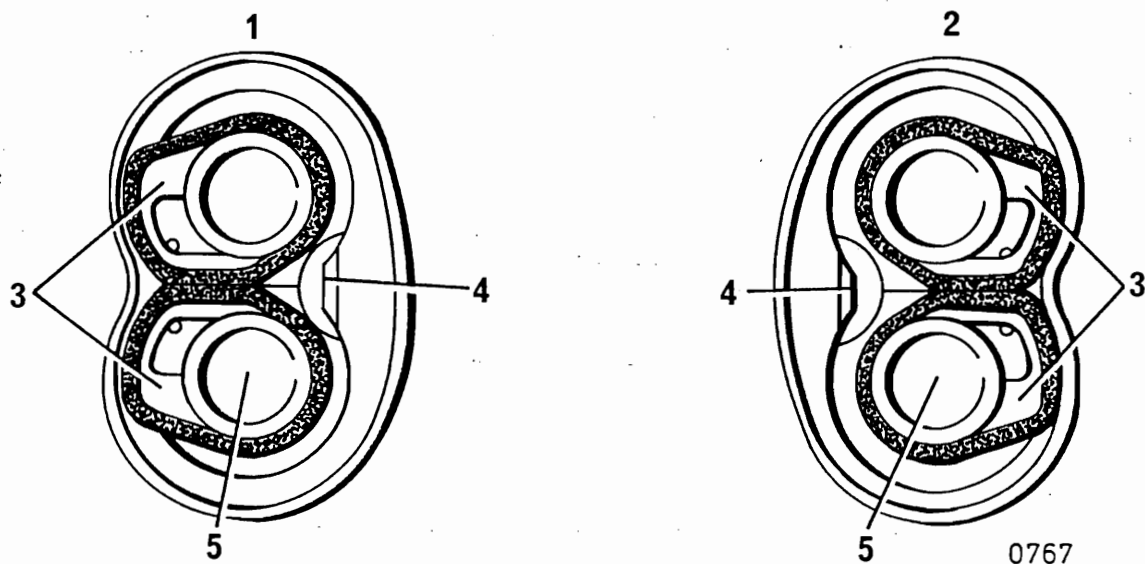
11.9 Position the drive gear for clockwise rotation as shown in Fig 6.

11.10 Lay the pump body in its side and slide the drive gear (Fig 4 (21)) through this bore so that the shaft protrudes from the hollow dowel end of the body.

11.11 Cover the splined end of the drive shaft so that the splines do not damage the mounting flange oil seal on assembly.

11.12 Hold the drive gear journal with one hand and slide the mounting flange squarely over the shaft on to the two hollow dowels ends flush against the pump body.

11.13 Clamp the mounting flange in a soft jawed vice with the pump body uppermost.



- |   |                     |   |                                  |
|---|---------------------|---|----------------------------------|
| 1 | Cover end           | 3 | Bush lobes                       |
| 2 | Mounting flange end | 4 | Cusp removed                     |
|   |                     | 5 | Assemble drive gear in this bore |

Fig 6 Arrangement of bushes in pump body

11.14 Check that the bushes are flush against the mounting flange face and that the lobe seal and backing washers have not become dislodged. Check that the arrow on the body adjacent to the word ROTATION indicates the direction of rotation required.

11.15 Mesh the driven gear (Fig 4 (11)) with the drive gear. If the original gears are being refitted, ensure that the marked sides of the teeth are in contact so that the bedded-in position is maintained.



11.16 Pick up the cover bushes, complete with lobe seal and backing washers and slide them over the gear journals with the lobes facing outwards and away from the removed cusp. Again the bushes must be entered squarely and without force.

11.17 Lubricate and fit the body seal (Fig 4 (2)) into its recess.

11.18 Place the end cover in position, aligning the marks previously made.

11.19 Feed the setscrews (Fig 4 (31)) through the end cover and body to engage the threads in the mounting flange and screw home finger tight.

11.20 Tighten the setscrews to a torque of 46-49 Nm (34-36 lbf ft).

11.21 Pour a small quantity of hydraulic oil, of the correct grade as specified in the maintenance schedule into the ports and check the pump for freedom of rotation.

11.22 Fit a new circlip into the shaft groove, and remove the spline protection.

11.23 The attachment bolts on the outlet connectors must be tightened to a torque of 34-47 Nm (25-35 lbf ft).

11.24 A pump that has been re-assembled with new gears, or body must be carefully run-in before it is subjected to full load working conditions.

#### Running in and test procedure

12 Run in and test pump as per the procedure described in AESP 4320-B-054-524. Using the data below.

12.1 Data for running procedure:

Speed: 1500 rev/min

Oil temperature: 50°C min

Duration: Stages 1-4 30s, stage 5 1 min

Pressure:	Stage 1	0	}
	Stage 2	35 bar ( 500 lbf/in <sup>2</sup> )	}
	Stage 3	90 bar (1300 lbf/in <sup>2</sup> )	} + 3.5 bar
	Stage 4	152 bar (2200 lbf/in <sup>2</sup> )	} (50 lbf/in <sup>2</sup> )
	Stage 5	207 bar (3000 lbf/in <sup>2</sup> )	}

12.2 Pump acceptance test data.

Speed: 1500 rev/min

Delivery rate: 66.4 l/min (14.6 gal/min)  
60.0 l/min (13.2 gal/min) acceptable on overhaul.

Pressure: 207 bar (3000 lbf/in<sup>2</sup>)

Temperature: 50°C min.

### POWER TAKE-OFF (Fig 7)

#### Dismantling

13 To dismantle the power take-off proceed as follows :-

13.1 Remove the four setscrews (4) from the shifter cover (11) and remove shifter cover, gaskets and spacer (18-20).

13.2 Remove the idler shaft lock screw (34) from the mounting flange of the housing.

13.3 Position the PTO on its side (output shaft up).

13.4 Using a suitable sized steel drift and hide faced mallet remove the idler shaft (33) from the housing by striking the drift with the mallet. The idler shaft will fall out.

13.5 The cluster gear (36), bearings (35 and 39) and spacer 40 can now be removed.

13.6 Remove the nuts (26) and washer (25) and then remove the flange (28) and gasket (29).

13.7 Remove the output shaft and gear assembly from the unit to be dismantled at a later stage.

13.8 Turn the PTO over and remove the four setscrews (46), the bearing cap (45) and the gasket (43).

13.9 Remove the two bearings (31 and 42) from the output shaft using a suitable bearing puller.

#### WARNING ...

EXTREME CAUTION SHOULD BE TAKEN WHEN REMOVING A CIRCLIP TO PREVENT IT SPRINGING OFF AND CAUSING INJURY

13.10 Remove the two circlips (23 and 41) from the shaft.

13.11 Remove the output gear (22) from the output shaft.

#### Inspection of parts

14 Thoroughly clean all parts in a suitable industrial solvent.

14.1 Visually inspect all parts for excessive wear, cracks, chips or other damage.

14.2 Renew all gaskets, shims and seals.

14.3 Clean all milled surfaces on the housing of any excess gasket material.

14.4 Bearings are to be inspected in accordance with EMER TEST & MEASUREMENT A 028 Chap 060.

#### Re-assembling

15 To re-assemble the power take-off proceed as follows :-

15.1 Fit the circlips (23) on the output end of the output shaft (32).

15.2 Then fit the output gear (22) onto the output shaft ensuring that it is fitted with selector groove facing the flange (28).

15.3 Fit the second circlip (41) on to the output shaft.

15.4 Install the tapered bearing (42) on to the internal end of the output shaft.

15.5 Install the other tapered bearing (31) on to the other end of the output shaft.

15.6 Fit the closed bearing cap (45), complete with cup (44) and at least one shim (43).

15.7 Secure cap with four setscrews (46). Tighten capscrews to a torque of 30-35 lbf ft (41-48 Nm).

15.8 Turn the housing (21) over and carefully install the assembled output shaft in the casing.

15.9 Fit the flange (28) complete with bearing cup (30) and at least one shim (29).

#### Note :

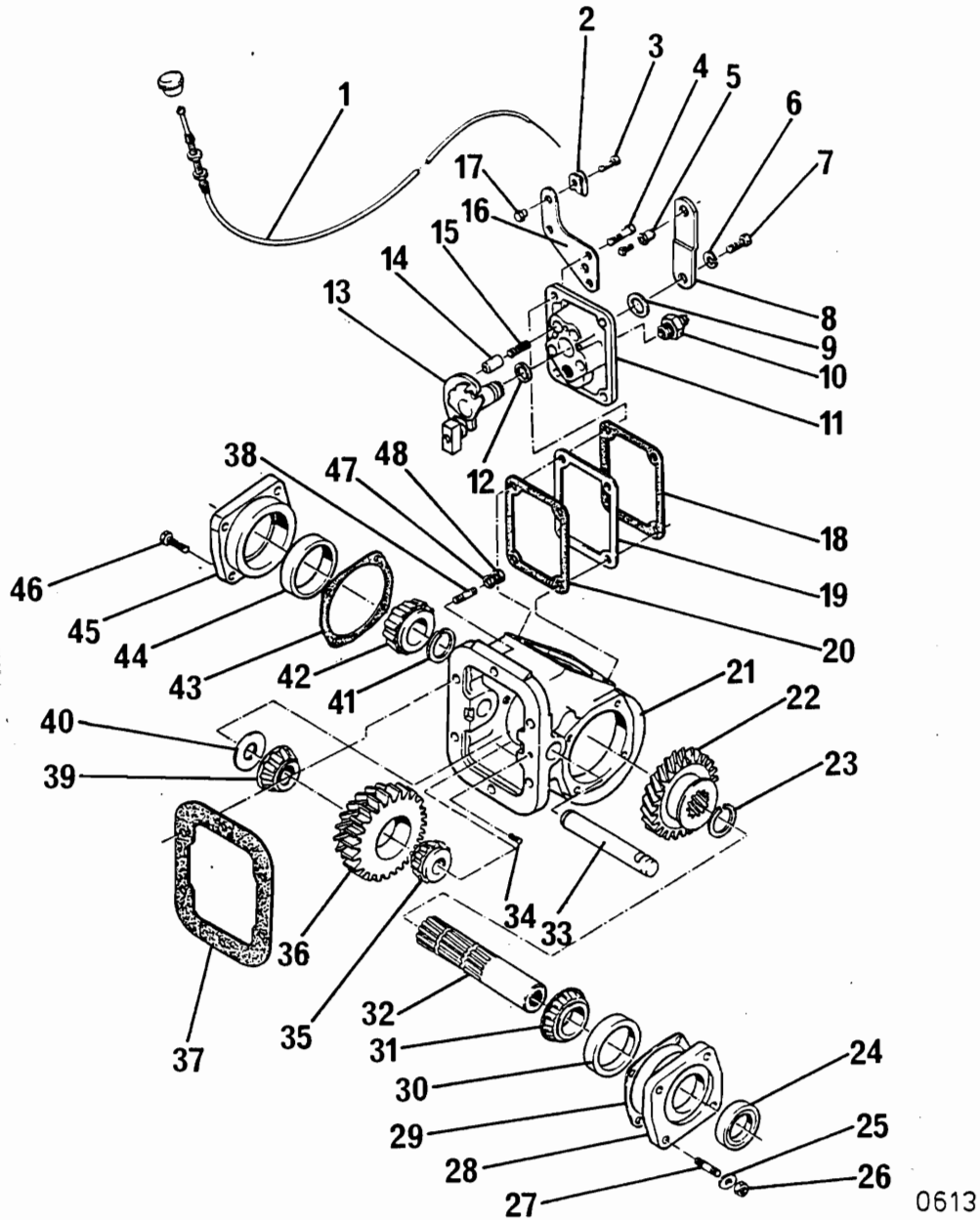
A minimum of one shim is required for each bearing cap, but in most cases at least .030 in to .040 in shim thickness will be necessary to achieve the correct adjustment.

15.10 Secure the cap with four nuts (26) and washers (25) and tighten the nuts to 41-48 Nm (30-35 lbf ft)

15.11 Strike the end of the output shaft with a hide faced mallet to seat the inner bearing.

15.12 Place a suitable tool over the output shaft and strike it using a hide faced mallet to seat the outer bearings.

15.13 Using a dial indicator check the end float of the output shaft. The maximum end float is 0.15 mm (.006 in). If this is exceeded or if the shaft does not rotate freely, add or subtract shims until the proper adjustment is achieved.



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- |                   |                 |                 |
|-------------------|-----------------|-----------------|
| 1 Control cable   | 17 Nut          | 33 Collar shaft |
| 2 Bolt bracket    | 18 Gasket       | 34 Screw        |
| 3 Bolt            | 19 Spacer       | 35 Bearing cone |
| 4 Screw           | 20 Gasket       | 36 Cluster gear |
| 5 Pivot pin       | 21 Housing      | 37 Shim gasket  |
| 6 Washer          | 22 Output gear  | 38 Stud         |
| 7 Bolt            | 23 Circlip      | 39 Bearing      |
| 8 Lever           | 24 Oil seal     | 40 Spacer       |
| 9 Washer          | 25 Washer       | 41 Circlip      |
| 10 Switch         | 26 Nut          | 42 Bearing      |
| 11 Cover          | 27 Stud         | 43 Shim         |
| 12 Sealing ring   | 28 Flange       | 44 Bearing cup  |
| 13 Post and plate | 29 Shim         | 45 Cap          |
| 14 Poppet         | 30 Bearing cup  | 46 Bolt         |
| 15 Spring         | 31 Bearing cone | 47 Washer       |
| 16 Bracket        | 32 Output shaft | 48 Nut          |

Fig 7 Exploded view of power take-off

15.14 Install the oil seal (24) in the bearing cap using a suitable tool. Position the seal until it is flush with the open bearing cap.

15.15 Place a tapered bearing in both tapered bores of the input gear cluster (36).

15.16 Install the spacer (40) opposite the large cluster of the input gear and fit the gear complete with bearings and spacer into the housing. Drive the idler shaft through the output gear until it is flush with the housing. Check that the idler gear rotates properly. If it is tight a tap with a hide faced mallet should free it.

15.17 With the housing on its side (set screw hole up) drive the idler shaft (33) into the top bore until it just protrudes through the inside wall of the housing. The groove in the idler shaft should line up with the set screw hole when fully installed.

Note :

The maximum end float should be 0.15 mm (.006 in). Change the combination of spacers until this end float is achieved.

15.18 Fit the setscrew (34), ensuring that it engages in the slot in the idler shaft and does not protrude from the bolting face.

15.19 Fit the shifter cover (11) complete with gasket (18), spacer (19) and second gasket (20) to the housing and secure with four setscrews (4). Tighten setscrews to a torque of 30-35 lbf ft (41-48 Nm). No adjustment of the shifter cover is necessary.

Testing

16 To test the power take-off screw the unit down on a flat plate.

16.1 Remove the indicator switch (Fig 7 (10)) and connect an air line to the unit.

16.2 To test the oil seals apply air pressure at 0.35 - 0.5 bar (5-7 lbf/in<sup>2</sup>) for 15 seconds. The maximum pressure drop shall not exceed 0.07 bar (1 lbf/in<sup>2</sup>).

16.3 Remove the air line and replace the indicator switch.

16.4 Manually test shifter to ensure proper engagement and disengagement.

16.5 Check shift indicator switch operation with a continuity checker.