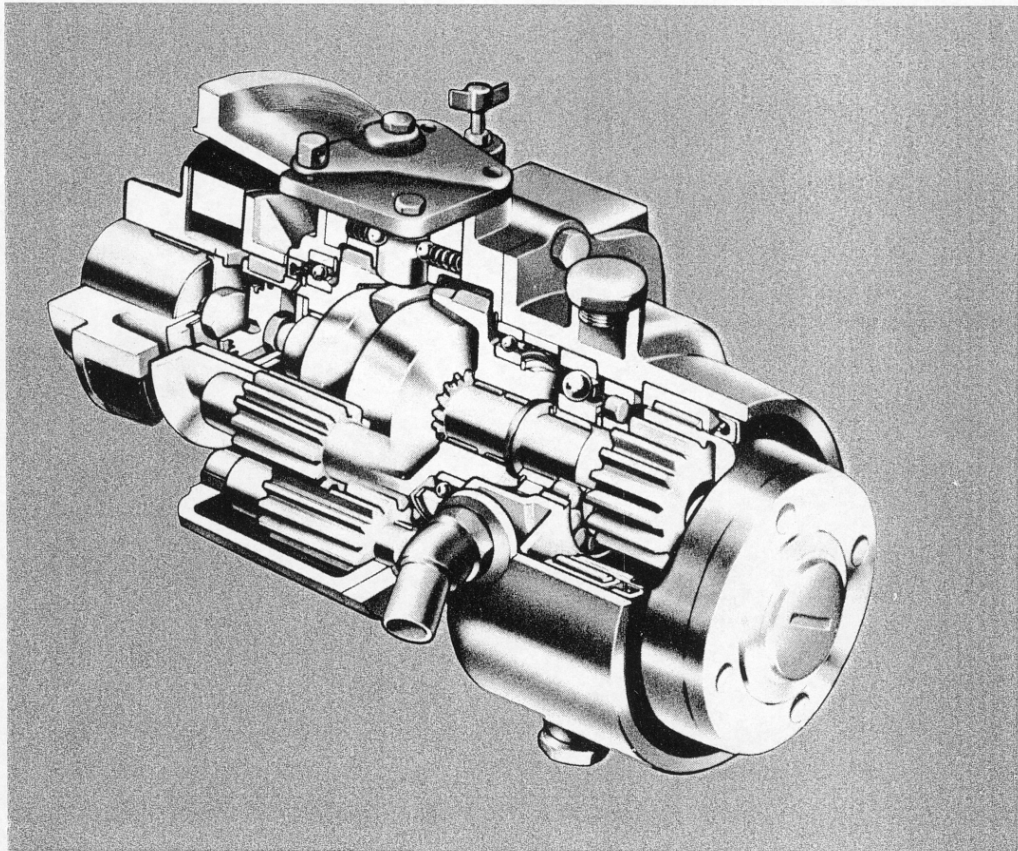


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**VOLVO
PENTA**

REVERSE GEAR MONO SHIFT MS AND MSB

VERHAUL INSTRUCTIONS



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REVERSE GEARS, TYPE MONO SHIFT, MS AND MSB

Description

The Volvo Penta reverse gear, type Mono Shift, has reduction 1:1 and an alternative version with a reduction gear with reduction 1.91:1 integrally built with the reverse gear.

Power transmission from the engine to the reverse gear is via a flange.

The Volvo Penta patented cone clutch is used for operating "Forward" and "Reverse". With this clutch, operation is both smooth and quiet.

The engaging power of the cone clutch is influenced by the amount of torque during the power transmission, and this makes for harder engagement with increased throttling.

Since the main components in the front housing and intermediate housing on the MS-reverse gear differ from those on the MSB-reverse gear, these components will be dealt with individually.

The essential difference is that the cones have been given a lining which makes smoother and quieter engagement possible.

The rear housing and the reduction gear for the MS- and MSB-reverse gears are jointly covered, since these are similar for both types of reverse gear units.

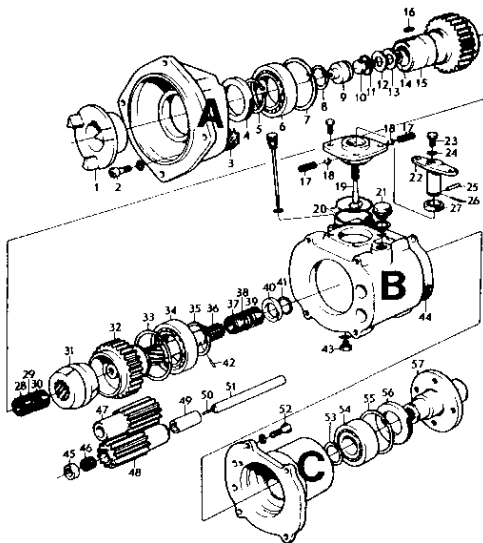


Fig. 1. Reverse gear type MS, without reduction gear

- A = Front housing
- B = Intermediate housing
- C = Rear housing

OVERHAUL INSTRUCTIONS

Disassembling the MS and MSB (Concerning special tools, see page 10.)

1. Clean the outside of the reverse gear.
2. Drain the oil in the reverse gear by unscrewing the oil drain plug (see 43, Fig. 1). Unscrew the oil dipstick and the oil filler plug. NOTE! The earlier reverse gears have a copper gasket. This must be scrapped and replaced by an aluminium one.
3. Remove the four bolts securing the control mechanism and raise the cover so much that your fingers can grip the slide cone (19). Then lift up the entire mechanism.
4. Place the reverse gear upright with the engine-connection side facing downwards. Remove the four bolts (52) and lift off the rear housing. NOTE! Take care of the shims on the rear housing on the MSB-reverse gear. If the reverse gear is fitted with a reduction gear, remove the reduction gear instead. Remove the gasket (44). Two shaft ends can be seen where the rear housing (or reduction gear) joins with the intermediate housing. Place a piece of tape or similar over these to prevent them from sliding out when the reverse gear is turned.
5. Turn the reverse gear and place it in a vice. Tool 884152 can be used for this purpose.
6. Remove the circlip (8) and pull out the sleeve (9) with the help of tool 884490. (Applies only to MS.)

NOTE! The MSB is not fitted with a groove ring. Remove the sleeve by carefully levering out with a screwdriver or similar. Pull off the flange (1) with the help of a puller.

7. Remove the four bolts (2) securing the intermediate housing to the front housing.
8. Slacken the screw (10) 2 to 3 turns.
9. Turn the reverse gear and place it on the front housing flange. Release the circlip (41) and remove the washer (40) on the MS, or the washers 46 and 47, Fig. 5, on the MSB: Pull the guide pin (42) out of the shaft (36) with a pair of pliers.
10. Carefully tap on the intermediate housing with a rubber mallet so that it releases from the front housing. Then carefully lift the intermediate housing straight upwards. Make sure that the shafts (51) do not fall out of the intermediate housing. Hold the shafts in position with a piece of tape across their ends. Take care of the needle bearings (37 and 39) as well as the spacer washer (38).
11. Lift off the engaging muff (31) from the shaft.

Inspect the four disassembled main components: front housing, intermediate housing, reduction gear or rear housing and the gear mechanism. With major operational disturbances in the reverse gear, the entire unit should be disassembled and thoroughly inspected. With minor faults, and when these can be localized to one of the four units, it is only necessary to disassemble the component concerned (see under the respective heading).

Front housing, MS

1. Remove the screw (10, see Fig. 2). NOTE! Keep an eye on the washers (12 and 13) and the shim (14).
2. Pull out the shaft (36, see Fig. 4). NOTE! Keep an eye on the needle bearings (28 and 30) as well as the spacer washer (29).
3. Remove the sealing ring (4, Fig. 2).
4. Inspect the bearing (6) and the gear wheel (15). If they have to be replaced, follow work operations 5 to 7. If the drive must be pressed out, the bearing should be replaced.
5. Remove the key (16) and the circlip (5).
6. Press the gear wheel out of the front housing. Use drift 884263.
7. Remove the circlip (7) and press out the bearing (6) with the help of drift 884265.

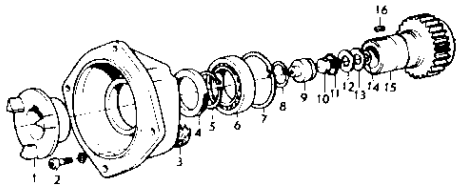


Fig. 2.

Front housing, MSB

1. Remove the screw (11, see Fig. 3). NOTE! Keep an eye on the washers (13, 14, 16) and the shim (15).
2. Pull out the shaft (36, Fig. 1). NOTE! Keep an eye on the needle bearings (28 and 30) as well as the spacer washer (29).
3. Remove the sealing ring (4, Fig. 3).
4. Inspect the bearing (7), the gear wheel (18) and the friction lining. If the lining is damaged, the entire gear must be replaced. Separate friction linings are available in stock. If the bearing and gear wheel have to be replaced, follow work operations 5 to 7. The bearing should be replaced if the drive is pressed out.
5. Remove the key (17) and the circlip (5). NOTE! Take care of the shim (6).
6. Press the gear wheel out of the front housing. Use drift 884263.
7. Remove the circlip (9). NOTE! Take care of the shim (8). Press out the bearing (7) with the help of drift 884265.

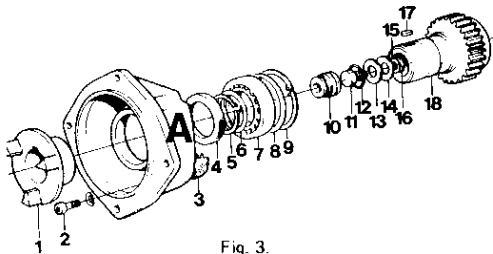


Fig. 3.

Intermediate housing, MS

1. Remove the pieces of tape over the shaft ends and press out the shafts (51) of the planetary gears (47 and 48, see Fig. 4). Remove the bearings (46) and the spacer sleeves (49).
2. Inspect all the bearings, bushings and gear wheels in the intermediate housing. If the gear wheels (32, 47 and 48) or the bearing (34) have to be replaced, carry out work operations 4–8 below. Since the bearing (34) is always exposed to lop-sided loading when being disassembled, it should be scrapped and replaced by a new one.
3. Re-fit in position the shafts (51) of the planetary gears, spacer sleeves (49), the bearing (46) and the bushings (45).
4. Remove the circlip (35).
5. Press out the gear wheel (32) with the help of drift 884263. Make sure that the teeth on the gear wheel fall into the teeth openings in the planetary gears.
6. Remove the circlip (33).
7. Tap out the bearing (34) with drift 884168.
8. Remove the bearings, spacer sleeves and shafts for the two planetary gears (47 and 48). The two gears can then be lifted out of the intermediate housing.

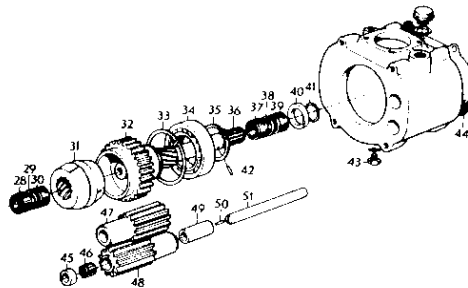


Fig. 4

Intermediate housing, MSB

1. Remove the pieces of tape over the ends of the shafts (56), and press out the planetary gears (52 and 53), see Fig. 5. Remove the bearings (51) and the spacer sleeves (54).
2. Inspect all the bearings, bushings and gear wheels in the intermediate housing. Check to make sure that the friction lining on the gear wheel (37) is not damaged. No friction linings are stocked separately so that the gear wheel must be replaced together with the lining. If the gear wheels (37, 52 and 53) or the bearing (39) have to be replaced, carry out work operations 4–8 below. Since the bearing (39) is always exposed to lop-sided loading during disassembling, it must be scrapped and replaced by a new one.
3. Re-fit in position the shafts (56) of the planetary gears, the spacer sleeves (54), the bearing (51) and the bushings (50).
4. Remove the circlip (41). NOTE! Take care of the shim (40).
5. Press out the gear wheel (37) with the help of drift 884263. Make sure that the teeth on the gear wheel fall into the teeth opening in the planetary gears.
6. Remove the circlip (38).
7. Tap out the bearing (39) with drift 884168. (NOTE! Take care of the shim 49.)
8. Remove the bearings, spacer sleeves and shafts from the two planetary gears (52 and 53). The two gears can then be lifted out of the intermediate housing.

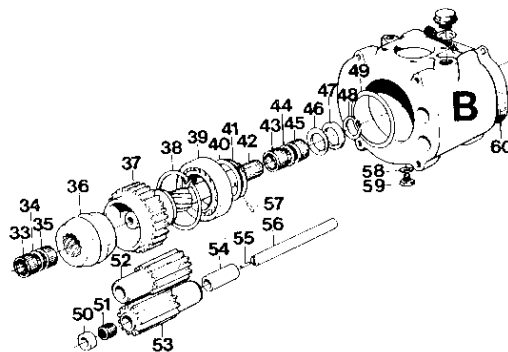


Fig. 5

Rear housing, MS and MSB

1. Clean the rear housing thoroughly. Inspect the bearing (54, see Fig. 6) and the sealing ring (56). If any of them has to be replaced, carry out work operations 2–5 below.
2. Remove the circlip (53).
3. Press the flange (57) out of the rear housing with the help of sleeve 884152.
4. Remove the sealing ring (56).
5. Remove the circlip (55) and press out the bearing with the help of drift 884263.

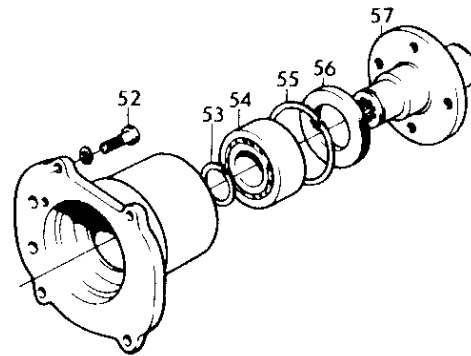


Fig. 6

Reduction gear (disassembling), MS and MSB

1. Remove the plug (89) and the screw (87) together with the washers (85 and 86) see Fig. 7. NOTE! Scrap the O-ring (88) on the plug.
2. Pull off the gear wheel (84) with the help of puller 884078 (place a spacer sleeve or such between the centre bolt of the puller and the threaded pin).
3. Carefully tap out the drive (77) together with the bearings (74 and 76), using a brass drift.
4. Pull off the sealing ring (81).
5. Lever loose the sealing ring (80).
6. Clean the parts thoroughly and inspect the bearings and gear wheels. If any of them has to be replaced, see the respective points below. NOTE! The bearing (83) in the large gear wheel (84) as well as the large bearing (79) must be replaced after removal. If it is desired to prevent the bearing (74) from being damaged when the gear wheel (77) is pressed out, a counterhold must be placed against the bearing inner ring.
7. Tap out the bearing (79) with the help of a drift.
8. Remove the circlip (72) and press out the drive (77) with drift 884266. Then remove the spacer washer and inner bearing. Carefully tap loose the bearing (76) inner ring with a slender brass drift.
9. Press out the bearing (83) with the help of a suitable sleeve or drift.

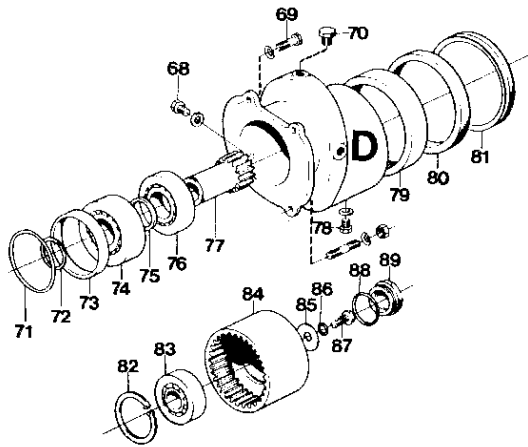


Fig. 7

Control mechanism (disassembling) MS and MSB

1. Knock out the tensioning pin (31, Fig. 8) and pull out the pin (30). Remove the lock wire, the springs (19) and the balls (20) (the earlier type of reverse gear has only one spring and ball). Pull out the eccentric plunger (29). Remove the sealing ring (32).
2. Clean and check the parts thoroughly. Replace worn parts.

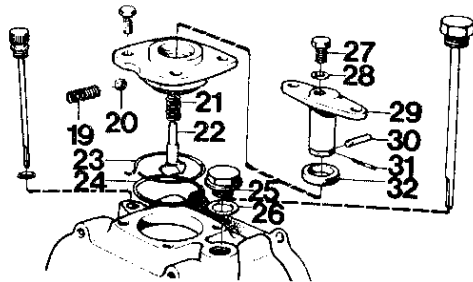


Fig. 8

ASSEMBLING

Control mechanism (Fig. 8) MS, MSB

1. Fit the sealing ring (32) in the cover, and make sure the side with the spring faces inwards. Always use a new ring.

2. Fit the eccentric plunger (29). Fit the pin (30) and lock it with the tensioning pin (31). Make sure that the tensioning pin is in the middle of the eccentric plunger.
3. Fit the balls (20) and the springs (19). Insert a lock wire in the cover groove and clamp it tight with the springs. Cut off the wire and bend down the end into the cover recess. The function of the lock wire is only to hold the springs in position while installing the control mechanism in the gear housing.

NOTE! ON THE LATE PROD. TYPE MSB REVERSE GEAR, THE BALL, SPRING AND LOCK WIRE FOR THE NEUTRAL POSITION HAVE BEEN REMOVED.

4. Fit the slide cone (22), the spring (21) and the O-ring (24).

Reduction gear (Fig. 9) MS, MSB

1. Press the large bearing (79) into the gear housing with drift 884488.
2. Apply a little grease to the sealing ring (80) and press the ring in with drift 884488.
3. Press the bearing (83) into the gear wheel (84) with the help of drift 884488. Carefully press the gear wheel through the sealing ring (80). Tap down the gear wheel with a rubber mallet so far that the screw (87) can be screwed in together with the flat washer and a new lock washer. Tighten to a torque of 55 Nm (5.5 kpm = 40 lbfft). Screw in the plug (89) after having changed the O-ring (88). Fit the large sealing ring (81) which is filled with grease.
4. Press the bearings (74 and 76) as well as the spacer ring (75) on the gear wheel (77) with the help of drift 884263. Do not fit the circlip until the entire assembly has been fitted in the housing. Turn the housing and press down the gear wheel together with the bearings with the help of drift 884500. Turn the gear wheel while pressing in so that it "meshes". Fit the circlip (72).
5. Place the spacer ring (73) and any shims (71) in the housing.

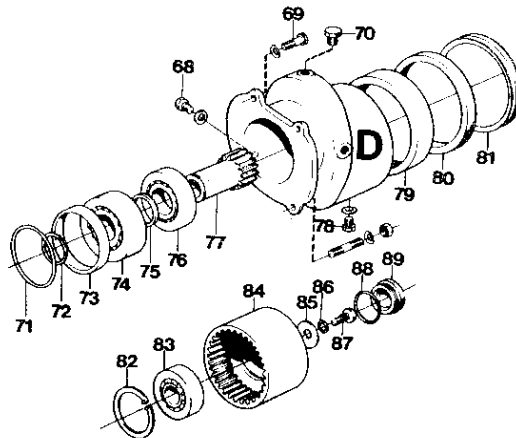


Fig. 9

Rear housing MS, MSB

1. Press the bearing (54, Fig 10) into the rear housing with the help of drift 884488.
2. Secure the bearing with the circlip (55).
3. Fit the sealing ring (56).
4. Apply a little grease to the sealing ring and press in the flange (57). NOTE! The counterhold (drift 884263) must be placed against the bearing inner race.
5. Secure the flange with the circlip (53).

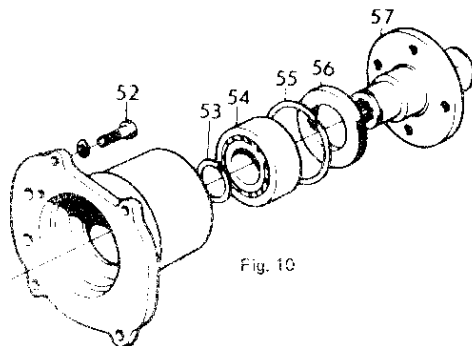


Fig. 10

Intermediate housing MS

1. Fit the circlip (33, Fig. 11) in the housing.
2. Press the bearing (34) into the housing with drift 884500.
3. Place the planetary gears (47 and 48) in their respective positions in the intermediate housing. Then fit their bushings, bearings, sleeves and shafts. Place a piece of tape over the shaft ends to prevent them from falling out.
4. Press the gear wheel (32) in the bearing (34) with drift 884263. NOTE! Counterhold 884488 must be placed against the bearing inner race. Make sure that the gear wheel teeth engage with the teeth on the planetary gears.
5. Secure the gear wheel with the lock ring (35).

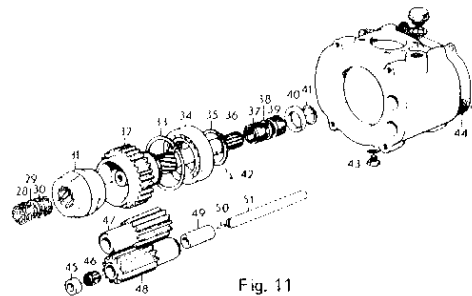


Fig. 11

Intermediate housing MSB

1. Fit the circlip (38, Fig. 12) in the housing.
2. Press the bearing (39) into the housing with drift 884500.
3. Place the planetary gears (52 and 53) in their respective positions in the intermediate housing. Then fit their housings, bearings, sleeves and shafts. Place a piece of tape over the shaft ends to prevent them from falling out.
4. Press the gear wheel (37) in the bearing (39) with drift 884263. NOTE! Counterhold 884488 must be placed against the bearing inner race. Make sure when doing so that the gear wheel teeth mesh with the teeth of the planetary gear.
5. Shims (40) are available in two thicknesses: 0.05 mm and 0.50 mm (0.002 and 0.02"). Add a sufficient number of shims to remove all clearance. Then remove a 0.05 mm (0.002") shim. Lock the gear wheel with the circlip (41).

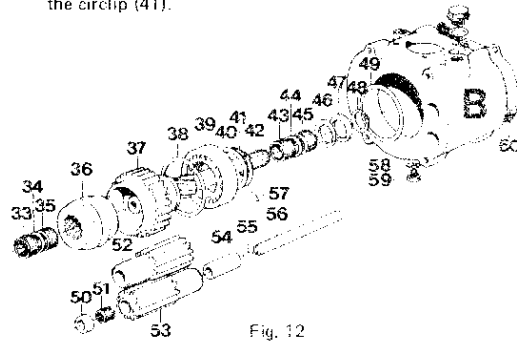


Fig. 12

Front housing MS

1. Knock the guide pin (55, Fig. 12) into the front housing so far that it projects about 2 mm (0.08") above the line separating the front housing from the intermediate housing.
2. Press the bearing (6, Fig. 13) into the front housing with the help of drift 884500.
3. Secure the bearing with the circlip (7).
4. Press the gear wheel (15) into the bearing with the help of drift 884263. NOTE! Counterhold (tool 884488) must be placed against the bearing inner ring.
5. Secure the gear wheel with the circlip (5).
6. To protect the sealing ring (4) when installing, first place sleeve 884487 on the shaft end of the gear wheel. Apply a little grease to the sealing ring and fit it (the side with the spring should face the bearing). NOTE! The sealing ring may only be pushed in so far that it is flush with the edge of the housing. Remove the sleeve and fit the key (16) securely.

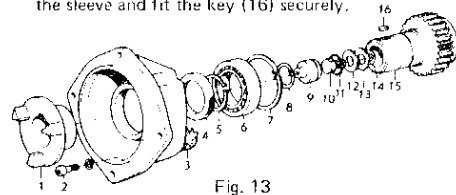


Fig. 13

Front housing MSB

1. Knock the guide pin (55, Fig. 12) into the front housing so far that it projects about 2 mm (0.08") above the line separating the front housing from the intermediate housing.
2. Press the bearing (7, Fig. 14) into the front housing with the help of drift 884500.
3. Fit the shim (8), which is available in two thicknesses: 0.05 and 0.10 mm (0.002 and 0.004"). Secure the bearing with the circlip (9). Select shim thickness so that max. clearance is 0.05 mm (0.002"). Fit a number of shims until there is no clearance. Then remove a shim with thickness 0.05 mm (0.002").
4. Press the gear wheel (18) into the bearing with the help of drift 884263. NOTE! The counterhold (tool 884488) must be placed against the bearing inner ring.
5. Check the thickness and number of shims (6). Add shims and secure the gear wheel with the circlip (5). Choose the shim thickness so that there is a max. clearance of 0.05 mm (0.002"). Add shims until there is no clearance left. Then remove a shim with thickness 0.05 mm (0.002").
6. To protect the sealing ring (4) when installing, first place sleeve 884486 on the shaft end of the gear wheel. Apply a little grease to the sealing ring and fit it (the side with the spring should face the bearing). NOTE! The sealing ring may only be pushed in so far that it is flush with the edge of the housing. Remove the sleeve and fit the key (17) securely.

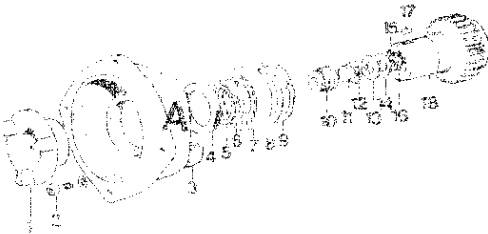


Fig. 14

Assembling the front housing and intermediate housing MS (Fig. 11 and 13)

1. Fit the needle bearings (28 and 30) as well as the spacer washer (29) on the shaft (36).
2. Fit the shaft in the front housing gear wheel. Screw in the screw (10) together with the steel washer (12), the brass washer (13) and the shims (14). Do not screw the screw in fully but only until there is 2 to 3 turns left before the bottom position.
3. Turn the front housing so that it stands on the connection flange, and then fit the engaging sleeve (31) on the shaft (36). Note! The drilling in one end of the engaging sleeve must face away from the front housing.

4. Place the needle bearings (37 and 39) as well as the spacer ring (38) on the shaft (36).
5. Place a new gasket (3) on the end of the front housing. Note! The holes for the guide pin (50) in the gasket must be opposite the pins.
6. Remove the piece of tape holding the planetary gear shafts in position in the intermediate housing.
7. Assemble the intermediate housing and front housing. Turn the intermediate gear shafts (51) with a screwdriver so that the lock pins (50) enter the grooves in the shaft ends.
8. Press the pin (42) into the shaft (36).
9. Fit the brass washer (40) on the shaft. The washer groove must be opposite the pin (42).
10. Secure the brass washer with the circlip (41). Note! Use a new circlip. This operation is made easier if the shaft is lifted upwards.
11. Invert the reverse gear entirely. Use tool No. 884152 which is fixed in a vice.
12. Screw tight the four bolts (2) together with their washers.
13. Tighten the bolt (10) to a torque of 100 Nm (72 lbf·ft). Measure the axial clearance for the shaft assembly (see Fig. 15). This clearance should be 0.2–0.3 mm (0.008–0.012"). Increase or decrease the number of shims until the correct clearance is obtained. Shims are available in two thicknesses: 0.1 and 0.5 mm (0.004 and 0.020").
14. Fit the O-ring (11) on the sleeve (31). Apply a little grease to the O-ring and press the sleeve into the gear wheel. Observe due care so as not to damage the O-ring.
15. Secure the sleeve with the circlip (6).

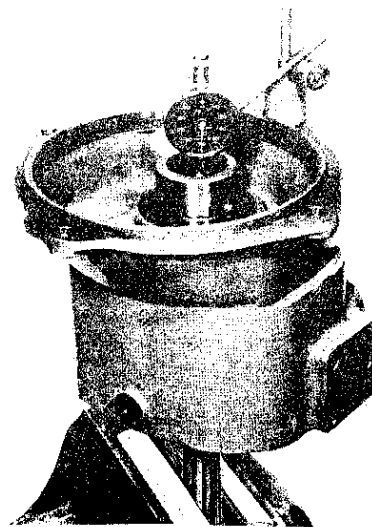


Fig. 15

Assembling the front housing and intermediate housing MSB (Figs. 12 and 14)

1. Fit the needle bearings (33 and 35) as well as the spacer washer (34) on the shaft (42).
2. Fit the shaft in the front housing gear wheel. Screw in the screw (11) together with the steel washer (13), the brass washer (14), the shims (15) and the small steel washer (16). Do not screw the screw fully to the bottom but only 2 to 3 turns from the bottom position.
3. Turn the front housing so that it stands on the connection flange. Then fit the engaging sleeve (36) on the shaft (42). Note! The drilling in one of the engaging sleeve ends must face away from the front housing.
4. Place the needle bearings (43 and 45) as well as the spacer ring (44) on the shaft (42).
5. Place a new gasket (3) on the front housing end. Note! The holes for the guide pins (55) in the gasket must be opposite the pins.
6. Remove the piece of tape holding the planetary gear shafts in position in the intermediate housing.
7. Assemble the intermediate housing and front housing. Turn the intermediate gear shafts (56) with a screwdriver so that the lock pins (55) enter the grooves on the shaft ends.
8. Press the pin (57) into the shaft (42).
9. Fit the brass washer (46) and the steel washer (47) on the shaft. The groove on the washers must be opposite the pin (57).
10. Secure the brass washer and steel washer with the circlip (48) NOTE! Use a new circlip. This operation is made easier if the shaft is raised.
11. Invert the reverse gear entirely. Use tool 884152 fixed in a vice.

12. Screw tight the four bolts (2) together with their washers.
13. Tighten the screw (11). The tightening torque is 100 Nm (10 kpm = 72 lbf·ft). Measure the axial clearance in the shaft assembly (see Fig. 15). The clearance should be 0.2–0.3 mm (0.008–0.012"). Increase or decrease the number of shims until correct clearance is obtained. Shims are available in two thicknesses: 0.1 and 0.5 mm (0.004 and 0.02").
14. Place the O-ring (12) on the sleeve (10). Apply a little grease to the O-ring and press the sleeve into the gear wheel. Take care not to damage the O-ring.

INSTALLING THE ASSEMBLED MS, MSB

1. Screw tight the control mechanism in the gear housing so that the bolt (27, Fig. 8) in the eccentric plunger is displaced towards starboard.
 2. Screw loose the bolt (27) and remove all the shims (28). Screw tight the bolt and place the mechanism in neutral. Try rotating the shaft (42). Note! To make sure that the engaging sleeve will rotate with the shaft, the output shaft then must be rotated. Remove one shim at a time until the shaft can be rotated without resistance. After the adjustment, apply sealing agent to the shims and bolt and then assemble.
- NOTE! ON THE LATE PROD. TYPE MSB REVERSE GEAR WITHOUT BALL AND SPRING FOR THE NEUTRAL POSITION, THE MECHANISM MUST BE PLACED BETWEEN "FORWARD" AND "NEUTRAL", OR BETWEEN "REVERSE" AND "NEUTRAL" WHEN SHIMMING.
3. Fit the key (17, Fig. 14) on the drive (18). Heat the flange (1) to about 150°C (302°F) and fit it.

Reverse gear without reduction gear MS, MSB

1. Turn the reverse gear and place it on the front housing flange. Remove the piece of tape holding the planetary gear shafts in position in the intermediate housing.
2. Measure on the intermediate housing the distance from the outer bearing race to the rear end of the housing (A, Fig. 16).
3. Measure the depth on the corresponding recess in the rear housing (B, Fig. 16). NOTE! The old gasket should be included in the measurement. Fit or remove a requisite number of shims so that there is a clearance of 0.1–0.2 mm (0.004–0.008").
4. With a screwdriver check that the shafts of the planetary gears cannot be rotated. Place a new gasket on the rear end of the intermediate housing and screw tight the rear housing.

Reverse gear with reduction gear MS, MSB

1. Measure on the intermediate housing the distance from the outer bearing race to the rear end of the housing (A, Fig. 16).
2. Measure the depth on the corresponding recess in the reduction gear (B, Fig. 16). Note! The old gasket must be included in the measurement.
3. Add or remove shims until a clearance of 0.1–0.2 mm (0.004–0.008") is obtained. Shims are available in three thicknesses: 0.05, 0.1 and 0.30 mm (0.002, 0.004 and 0.012"). The earlier shim thickness was 0.35 mm (0.14").
4. With a screwdriver check that the shafts on the planetary gears cannot be rotated. Place a new gasket on the rear end of the intermediate housing and screw tight the reduction gear.

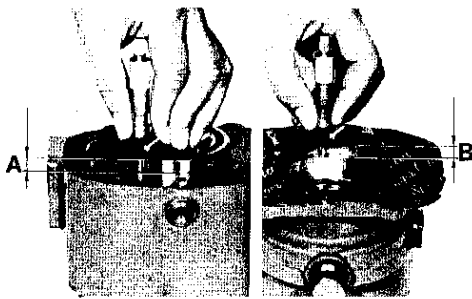


Fig. 16

Re-building the MS-reverse gear to the MSB-reverse gear

In the event the MS-reverse gear is re-built to the MSB type, a number of parts must be replaced by a new ones.

The following parts must be replaced:

1. Front housing A, Fig. 1.
2. Parts 9 to 16.
3. Parts 31 and 32, also 40.

The above are replaced by the following parts:

1. Front housing A, Fig. 17.
2. Parts 6 and 8 as well as 10 up to 18.
3. Parts 36, 37, 40, 46, 47 and 49.

Concerning the installation instructions, see the respective sections.

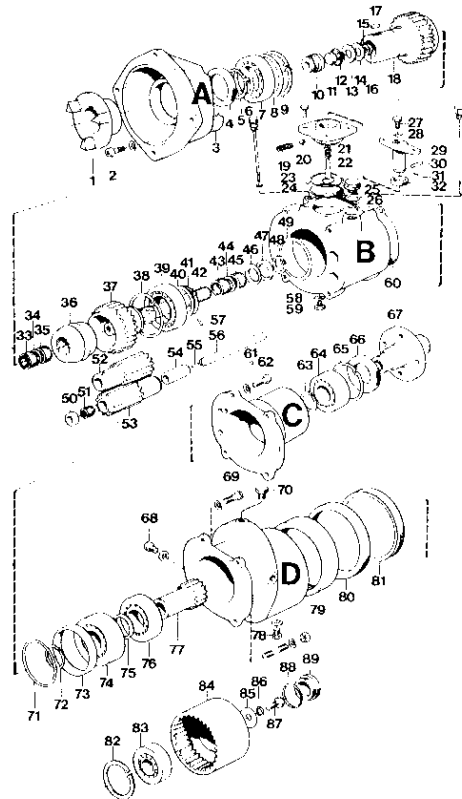


Fig. 17 Reverse gear MSB

- A = Front housing
- B = Intermediate housing
- C = Rear housing
- D = Reduction gear

All reverse gears

1. Screw in the oil drain plug (59, Fig. 12). NOTE! Use the aluminium washer.
2. Fill with oil to a suitable level according to the dipstick.
3. Screw tight the dipstick and the oil filler plug.

SPECIAL TOOLS

REVERSE GEAR, TYPES MS, MSB





Part No.	Description
884487	 Sleeve for fitting front sealing ring
884488	 Drift for fitting bearings
884490	 Extractor for sealing sleeve (only MS)
884500	 Drift for fitting bearings

Fig. 18

The overhaul instructions also refer to special tools for the outboard drives mod. 100, 250 and 270. These tools have the following part Nos.: 884152, 884168, 884263, 884265 and 884266.

