SERVICE MANUAL

CARS AND VANS

PV 444—445

Part 3

GEARBOX

(H1–H4)

Export Service Department

AKTIEBOLAGET

VOLVO

GÖTEBORG · SWEDEN

DESCRIPTION

The gearbox rests on two rubber cushions on a cross member attached to the frame by screws. (On PV 444 a mounting plate screwed to the body bottom plate). Three speeds forward and one reverse. Fig. 1 indicates gear positions. Power transmission in different speed gears is illustrated in fig. 2. 2nd and 3rd speed gears are synchronized. All speeds silent in H-3 and H-4 type gearboxes.

Gearbox housing (4), see fig. 3, is made in one piece of cast iron and fitted with a rear housing of aluminium. The main drive pinion and main shaft bearings are placed in the top part of gearbox housing. Counter gears and reverse gears are carried on the countershaft and the reverse shaft in the bottom part of gearbox housing.

Main drive pinion (1) is carried by a ball bearing (3) at the gearbox housing front end. Countershaft and reverse shaft are locked at gearbox housing ends. The main shaft front end is carried by a roller bearing (43) at the rear end of main drive pinion and by two ball bearings (28 and 19) in the rear housing. Speedometer drive cable is connected to a gear (24) at the rear end of main shaft. Rear housing is fitted with an oil seal (20).

Three types of gearboxes have been produced, namely: H-1, H-3 and H-4. The differences between the three types do not affect repair instructions given in this shop manual if not

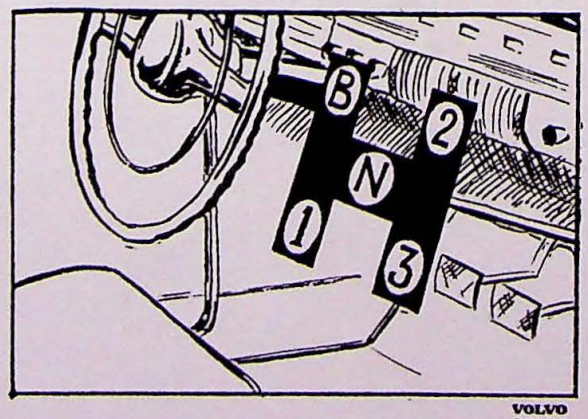
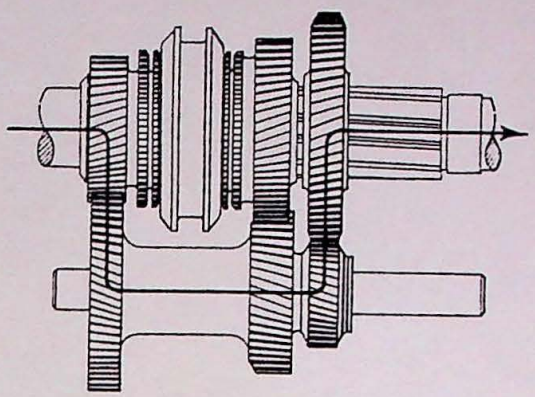
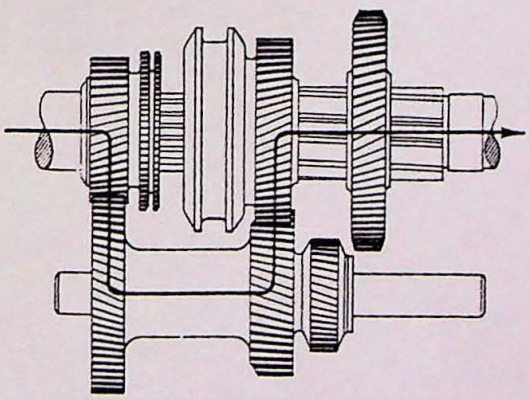


Fig. 1.

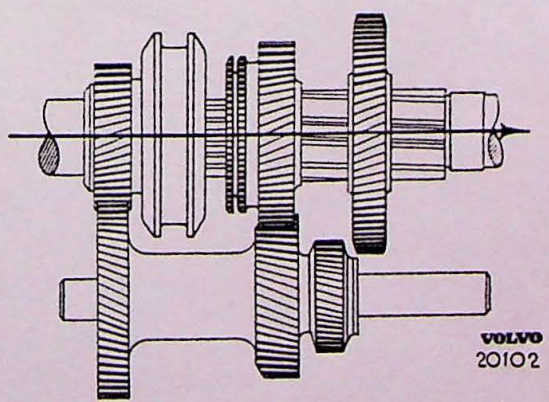
B = Reverse gear N = Neutral position



1st SPEED



2nd SPEED



3rd SPEED

Fig. 2.

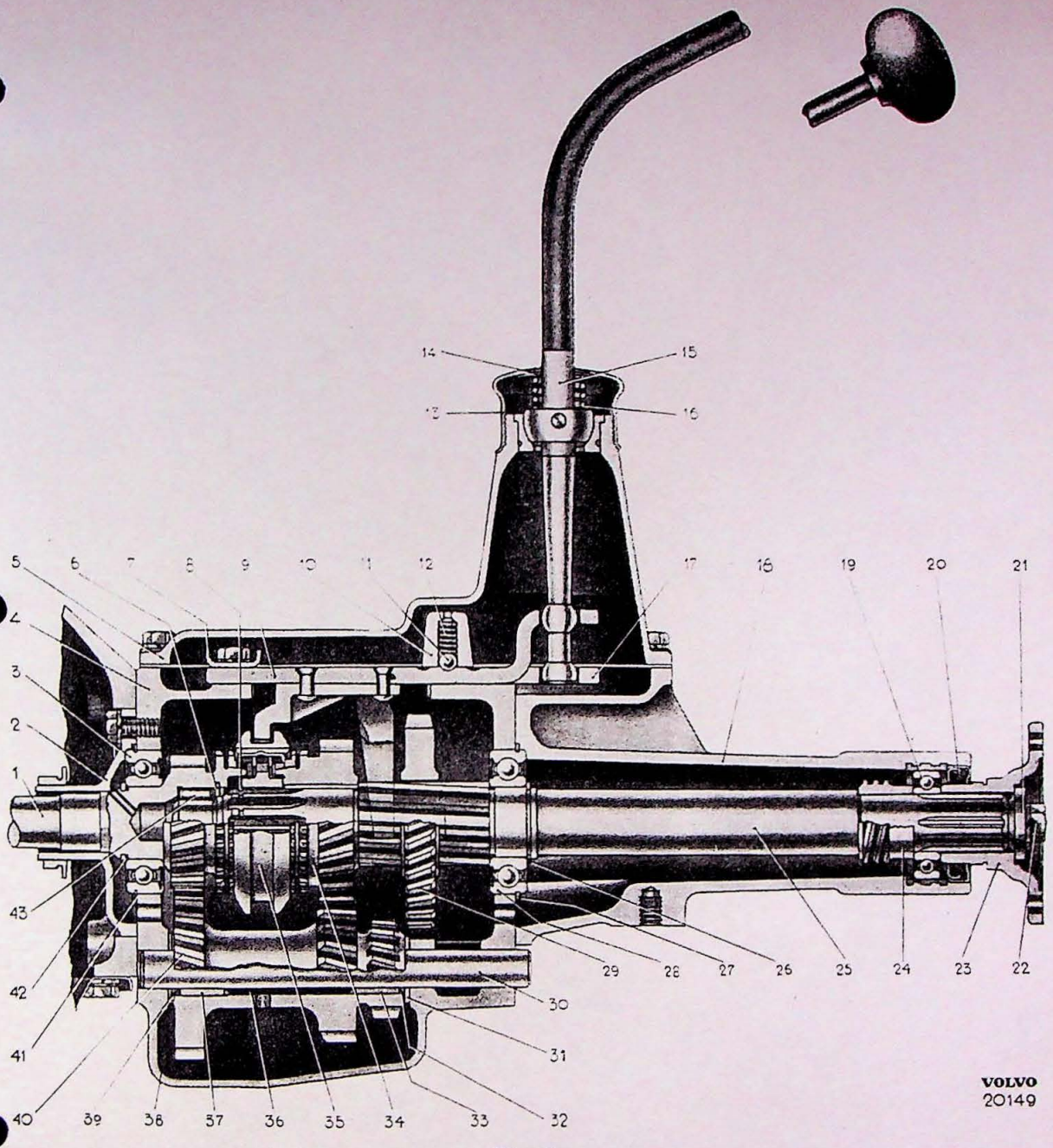


Fig. 3.

1. Main drive pinion.
2. Main drive pinion bearing cover.
3. Main drive pinion bearing.
4. Gearbox housing.
5. Gearbox cover.
6. Roller bearing lock ring (Not on H-4).
7. Gearshift rail cap.
8. Snap ring.
9. Gearshift rail (2nd and 3rd speed).
10. Rear gearshift rail cap.
11. Gearshift rail ball.
12. Ball spring.
13. Metal hood.
14. Washer.
15. Gearshift lever.
16. Spring.
17. Gearshift rail (1st speed and reverse).
18. Aluminium rear housing.
19. Rear main shaft bearing.
20. Oil seal.
21. Washer.
22. Screw.
23. Companion flange.
24. Speedometer drive gear.
25. Main shaft.
26. Main shaft snap ring.
27. Ball bearing snap ring.
28. Main shaft front bearing.
29. 1st and reverse speed sliding gear.
30. Countershaft.
31. Thrust washer.
32. Spacer.
33. Roller bearing.
34. 2nd speed sliding gear.
35. Sliding clutch gear (2nd and 3rd speed).
36. Counter gear spacer.
37. Roller bearing.
38. Spacer.
39. Thrust washer.
40. Counter gears.
41. Ball bearing snap ring.
42. Main drive pinion snap ring.
43. Roller bearing.

particularly stated in text. The type ensignation is stamped on the left hand side of the housing, but to make further identification possible we state features characterizing the different types.

H-1. The gears are helical except for 1st and reverse speeds which have spur gears. Ball bearing snap ring at rear end of drive pinion shaft.

H-3. Helical gears all through. Ball bearing snap ring at rear end of drive pinion shaft.

H-4. Helical gears all through. No ball bearing snap ring at rear end of drive pinion shaft.

PV 444 is fitted with gearbox type H-1 up to chassis No. 5077 with the exception of chassis No. 4806, 4807, 4827, 4864—4868, 4870, 4956, 4958—4965, 4995—5004, 5055, 5058, 5059, 5061, 5064, 5066, 5067 and 5075.

Chassis No. 5078 up to No. 11384 in addition to those mentioned above are fitted with gearbox type H-3.

Chassis No. 11385 and up and chassis No. 11302—11304, 11339, 11343, 11362, 11366, 11374 and 11382 are fitted with gearbox type H-4.

PV 444 B is fitted with gearbox type H-4.

PV 444 BS is fitted with gearbox type H-4.

PV 445 is fitted with gearbox type H-3 up to chassis No. 215 except on chassis No. 206 and with gearbox type H-4 on chassis No. 216 and up. Type H-4 on chassis No. 206.

REPAIR INSTRUCTIONS

Gearbox should preferably be removed from chassis when overhauling. Remove either gearbox together with engine or gearbox alone. method chosen depends on circumstances. If only gearbox overhaul necessary, it should be removed according to instructions given below. Should engine be overhauled too. we recommend lifting out engine and gearbox at the same time in accordance with the instructions given in part 1.

Inspection cover on PV 444 B and BS.

On PV 444 B and BS there is an inspection cover above the gearbox in the propeller shaft tunnel. Cover can be removed when inspecting gearshift forks and gears. Cover is attached to car body with screws from below.

Removal of gearbox.

1. Remove gearshift level (15) by screwing out threaded hood (13). fig. 4 and lift gearshift lever upwards.

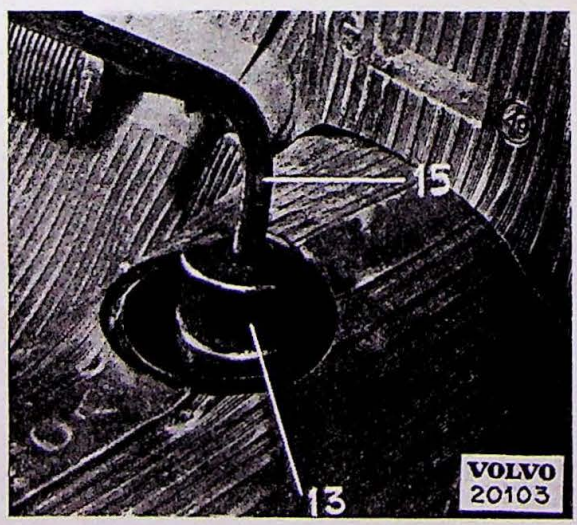


Fig. 4.

2. Disconnect exhaust pipe at exhaust manifold flange and negative cable terminal at battery and remove crankcase breather tube.

3. Drain radiator until radiator top hose can be removed.

4. Remove front universal joint at gearbox.

5. Disconnect clutch link. clutch return spring. brake pedal return spring and speedometer drive cable at gearbox.

6. Place jack under gearbox and remove the cross member (mounting plate on PV 444) to which gearbox is attached. fig. 5.

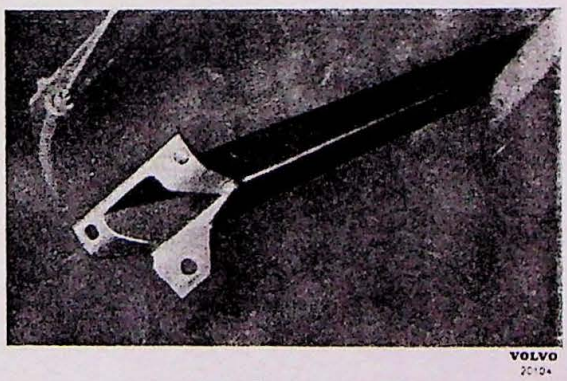


Fig. 5.

7. Loosen front engine supports but do not screw out nuts. Lower gearbox carefully and place a wood block between the engine rear end and the cowl (A. fig. 6).

8. Loosen the four bolts attaching gearbox to flywheel housing by means of tools SVO 4036 and SVO 1456. Pull gearbox so far backwards that main drive pinion can be withdrawn downwards.

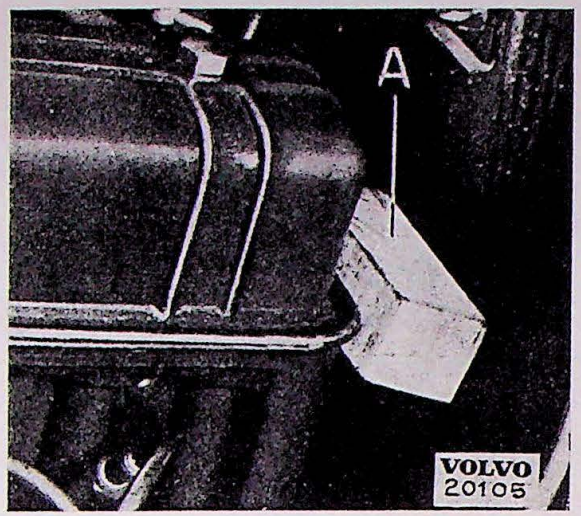


Fig. 6.

Disassembly of gearbox.

A complete disassembly of gearbox is carried out as follows:

I. Remove main shaft.

II Drive out countershaft.

III. Remove main drive pinion.

IV. Remove counter gears.

V. Remove reverse gear and shaft.

1. Place gearbox in fixture SVO 4111 (attached to support SVO 4108) and lift off gearbox cover.
2. Remove the two gearshift rail caps (7 and 10), fig. 3.
3. Lift up gearshift rail (9), (2nd and reverse speeds). The other gearshift rail will then come out too. Remove ball.
4. Remove the four screws holding the rear housing and loosen same together with main shaft eventually by means of a rubber headed hammer, fig. 7. Lift out the front synchronizing cone, which is by now loose.
5. Remove snap ring (8) by means of special pliers and withdraw main shaft. 2nd speed gear synchronizing device and the sliding gear for 1st and reverse speeds can then be removed.
6. Loosen reverse shaft and countershaft lock washers.

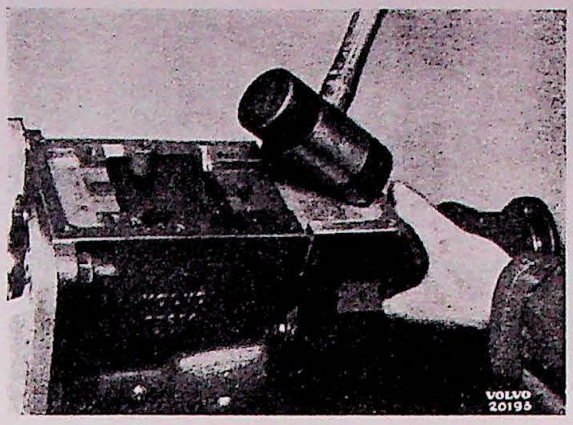


Fig. 7.

Drive out countershaft backwards by means of driver SVO 4021. Drive countershaft entirely out, allowing counter gears to fall to the bottom. This is necessary to make it possible to remove the main drive pinion.

7. Loosen bearing cover (2) at gearbox front end. Drive out main drive pinion (1) forwards by means of driver SVO 4135. Place tool SVO 4150 (use SVO 4151 for type H-4) at the shaft end supporting the driver.
   Lift the counter gear set out of gearbox housing. Be careful not to drop ball bearings (33 and 37).
8. Remove reverse shaft by means of tool SVO 4023. fig. 8, and lift reverse gears out.

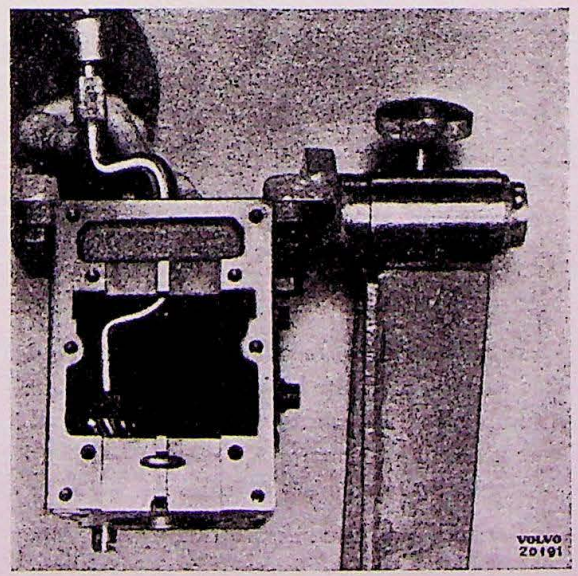


Fig. 8.

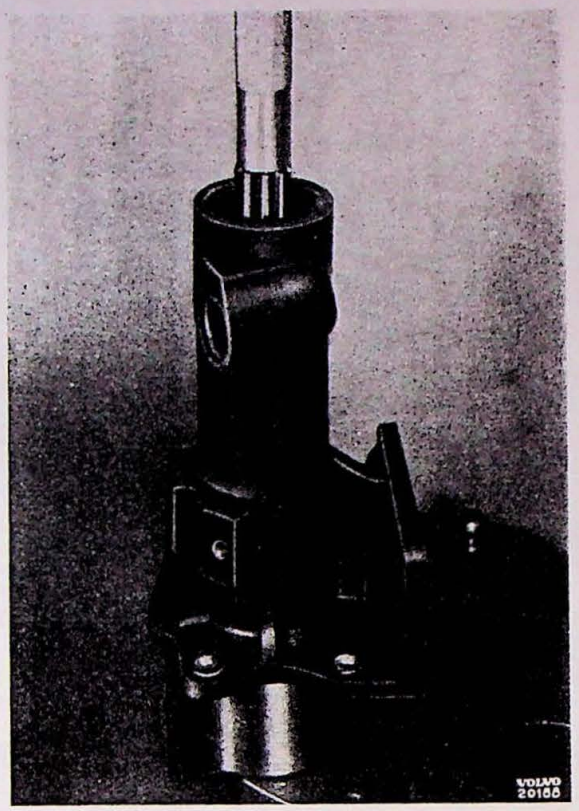


Fig. 9.

Removal of main shaft and bearings from rear housing.

1. Remove companion flange. Use companion flange tool SVO 4035 and puller SVO 4031.
2. Place rear housing assembly in a press and press out main shaft. Use tool SVO 4037 and SVO 4038, fig. 9. Pull rear bearing (19) and oil seal (20) out of rear housing by means of tool SVO 4030.
3. Remove the front ball bearing snap ring (26) and press off the bearing in a press. Support with SVO 4038, fig. 10.

Removal of main drive pinion bearings.

1. Remove roller bearing snap ring (6) by means of a pointed hack saw blade or similar tool (Only gearboxes type H-1 and H-3 are fitted with snap ring).
   Remove the rollers (14 rollers).
2. Remove ball bearing snap ring (42). Press off ball bearing. Place it into position in the housing and drive the shaft through by means of a copper headed hammer.

Disassembly of synchronizing device.

Remove the two lock springs (A, fig. 11) and push synchronizing hub (C) out of clutch sleeve (B).

Inspection.

After disassembling gearbox entirely or partly, depending on circumstances, inspect all parts, even those ones not disassembled. Clean carefully before inspecting. Check gear teeth first. Badly worn or damaged gears should always be replaced. The best way to ensure a good result is to replace also the gear working together with the damaged one.

Check reverse idler gear and 2nd speed gear bushings on main shaft. If excessive play found between gears and shaft, replace bushings and if necessary shaft too. The counter gear needle bearings should be investigated and renewed together with the shaft if wear or damage is

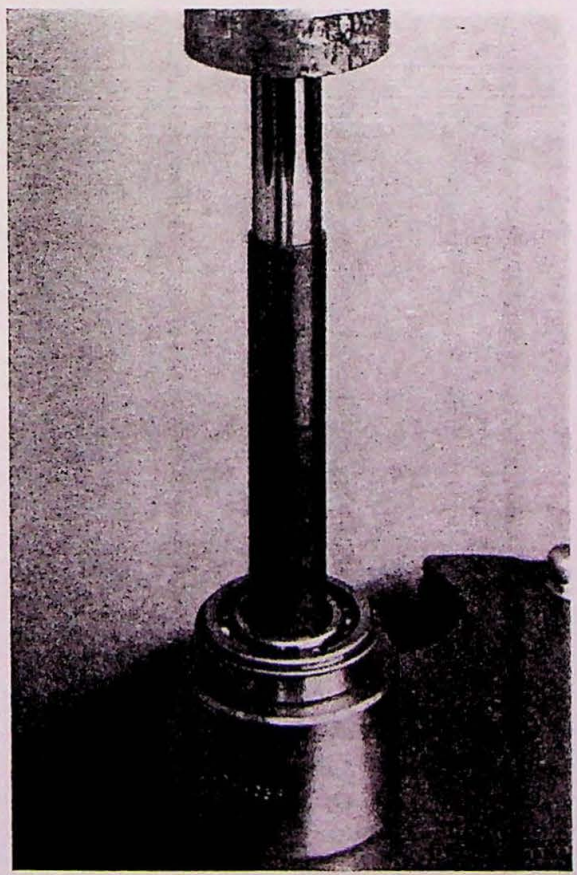


Fig. 10.

found. Check reverse and counter gear thrust washers in the same manner. Play must not exceed 0,1 mm (.004″).

Wash all ball bearings carefully and test them by making them rotate slowly. Renew bearings if they stick at any point, excessive play is found or if balls or rings are damaged. Check the fit between ball bearings and gearbox housing. If same is not tight, the whole housing should be replaced as a rule.

Check synchronizing device cones, hubs and clutch sleeve. Worn cones should be renewed. The whole synchronizing device should be renewed if there is excessive play between clutch sleeve and hub, or clutch sleeve sticks on hub.

Check that there is a close running fit between the sliding 1st gear, reverse gear and main shaft. Does gear stick on shaft, grind off any edges or renew gears and main shaft.

Check the main drive pinion with regard to splines, pilot bearing journal and roller bearing races at its rear end. Inspect gearshift rails for wear at ball grooves. If any ball has gnawed itself down into the gearshift rails, the rail should be renewed. Gearshift forks should be attached to gearshift rails. If loose, they should be riveted, if no other defects are found. Check that the tension of the ball springs is good. If not, replace the whole rear gearshift rail cap. Check the speedometer gear teeth. Renew speedometer gears, if badly worn or damaged.

The cylindrical part of the companion flange running in the oil seal at the rear housing end must not be worn or scratched. Replace companion flange together with oil seal, if worn, as the new oil seal otherwise will rapidly wear out.

Assembly of synchronizing device.

1. Match clutch sleeve (B) and synchronizing hub (C) in such a manner that they may be moved easily in relation to each other, fig. 11.
2. Place the three drivers (D) in position.
3. Fit the snap rings with their openings at the same latch. When fitted properly the rings should be placed as fig. 11 indicates, whichever side of the synchronizing device that may be turned upwards. Snap rings bent to a right angle only at one end should be fitted with their bent ends in the latch.

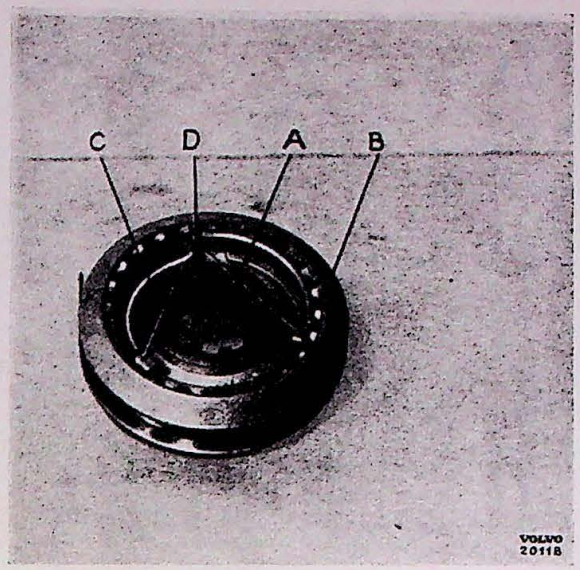


Fig. 11.

Fitting of main drive pinion bearing.

1. Press on the ball bearing (3) with the snap ring turned from the gear, fig. 12. Use driver SVO 4028 and support the shaft with thrust washer SVO 4150 (SVO 4151 for H-4).
2. Fit snap ring (42) of suitable thickness. Four different sizes are available: 2,00, 2,10, 2,15, 2,25 mm (.079″, .083″, .085″, .089″). Choose a snap ring fitting tightly in the groove.
3. Wash needle bearing rollers carefully. Lubricate the bearing race and fit the 14 rollers. Insert the last roller into position from above, fig. 13.
4. Fit snap ring (6) (not on gearbox type H-4).

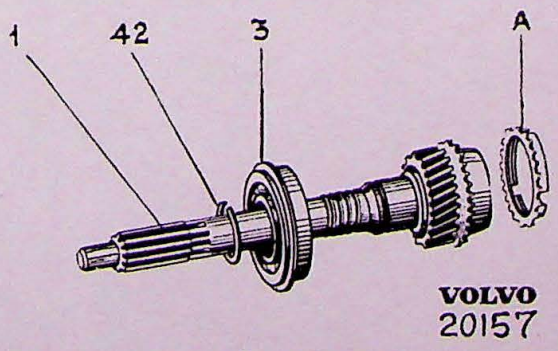


Fig. 12.

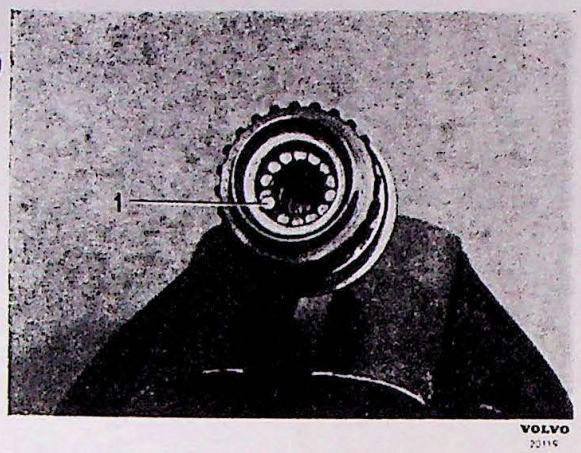


Fig. 13.

companion flange front surface is free from burrs. Fasten companion flange with screw (22).

5. Install main shaft and rear housing in vice and check the companion flange out-of-roundness. Max. permissible out-of-roundness is 0.07 mm. (.003″). fig. 14. Check side warp too. max permissible is 0.09 mm. (.004″).

6. Check that the sliding gear (29) for 1st speed and reverse fits easily on shaft. Check in the same way the 2nd speed sliding gear and the synchronizing device.

Installation of main shaft in rear housing.

1. Press on ball bearing (28, fig. 15) by means of driver SVO 4028.
   Fit a new snap ring of suitable thickness. It should fit tightly in the groove.

2. Fit the speedometer drive gear with the bevelled side facing backwards and install main shaft in rear housing.

3. Install rear bearing (19), fig. 18, by means of driver SVO 4113 and the oil seal (20) by means of driver SVO 4029 (text side facing inwards).

4. Drive on the companion flange (23), fig. 15 with driver SVO 4034. Check first that the

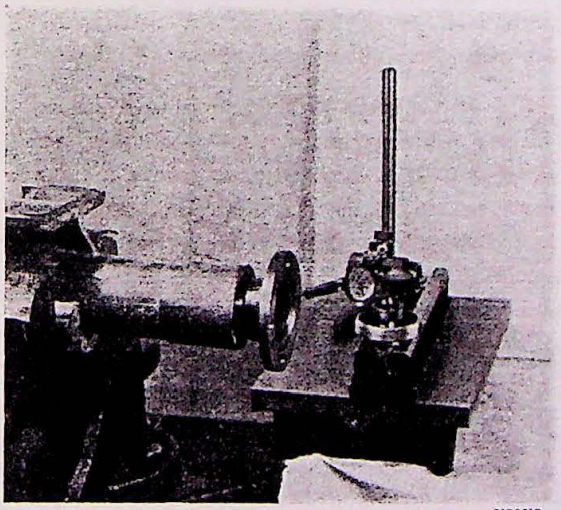


Fig. 14.

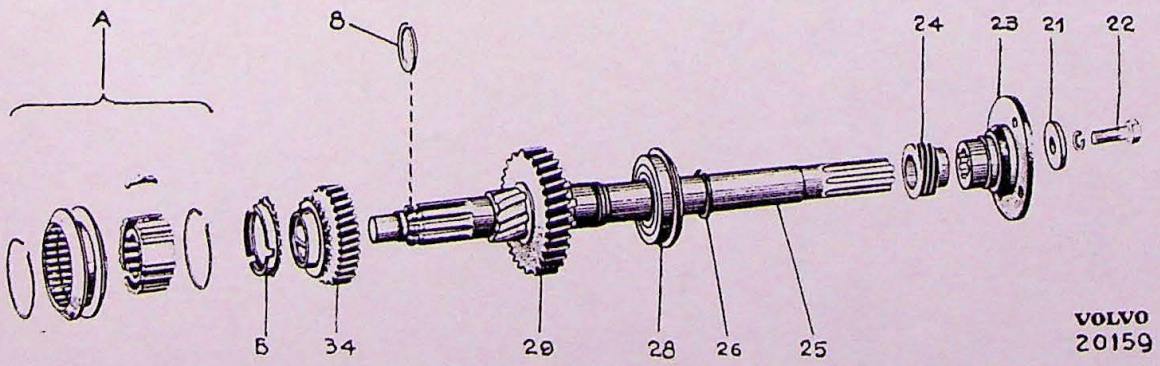


Fig. 15.

A. Synchronizing device. B. Synchronizing ring.

Rebushing of reverse gears.

Drive out old bushings and drive in new ones by means of driver SVO 4025. Use SVO 4027 as a pad. After being pressed into position the bushings should be turned in a lathe to a diameter of $15\ ^{+0,006}_{-0.024}$ mm ($.5905''\ ^{+.0002''}_{-.0009''}$)

Rebushing of main shaft 2nd speed gear.

Drive out the bushing and install new one with driver SVO 4026. Support with SVO 4027, fig. 16. Be careful to place bushing oil holes exactly opposite gear holes. After being pressed into position, the bushing should be turned in a lathe to a diameter of

$29{,}25\ ^{+0,007}_{-0,028}$ mm ($1{,}1515''\ ^{+.0003''}_{-.0011''}$)

Bushings should be trued up at teeth tops when turning. Be very careful when truing up to preclude gear from warping when fitted to main shaft.

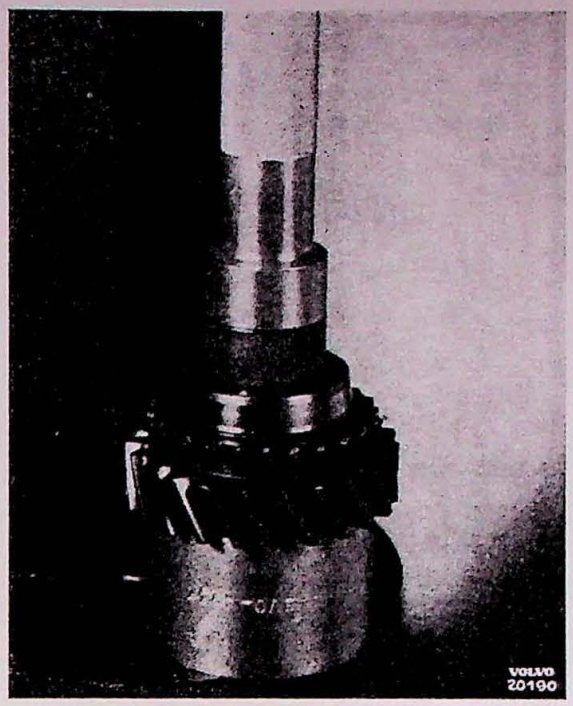


Fig. 16.

Assembly of gearbox.

A disassembled gearbox should be assembled as follows:

I. Fitting of reverse gears.
II. Fitting of counter gears.
III. Fitting of main drive pinion.
IV. Fitting of main shaft with gears and synchronizing device.
V. Fitting of countershaft.

Fitting of reverse gears.

1. If reverse gears have been disassembled, use driver SVO 4024 when re-fitting to make thrust washers remain in position. Fitting is facilitaced by fastening washers with grease. The large gear should be facing backwards.
2. Drive in reverse shaft, and driver SVO 4024 will be driven out at the same time (support slightly with your hand). The groove at the reverse shaft rear end should lie flush with the lock washer.

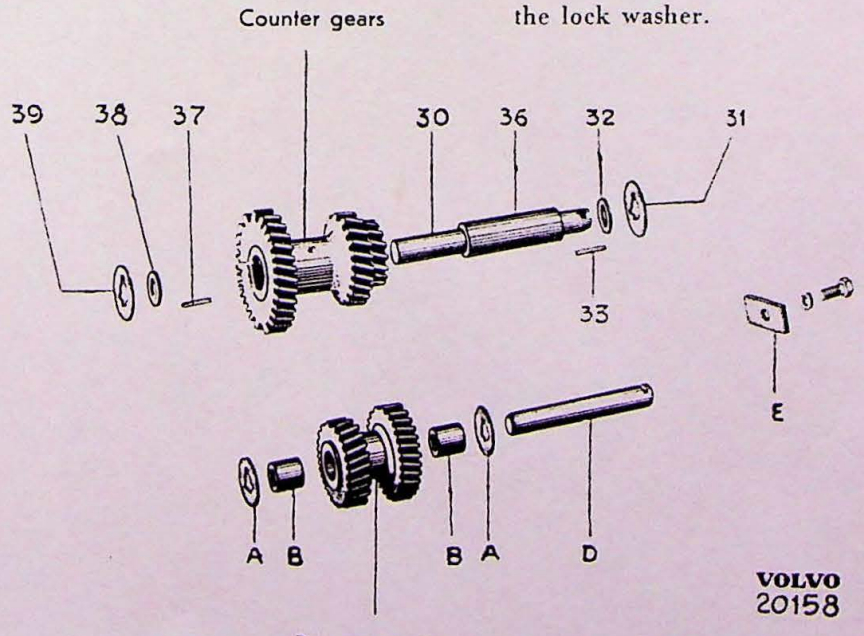


Fig. 17.

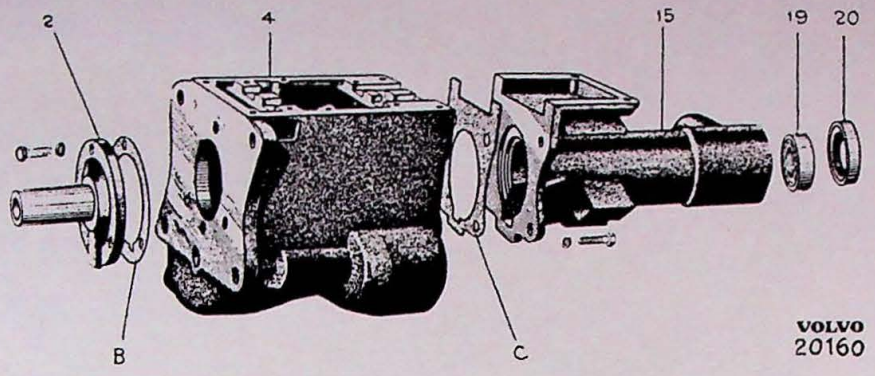


Fig. 18.

Installation of counter gears.

1. Place driver SVO 4022 with sleeve (36), fig. 17 reaching into the hub of counter gears and insert needle rollers (33) and (37), (24 rollers at each end), spacers (32) and (38) and thrust washers (31) and (39). Use grease when installing to make parts remain in position.
2. Place the set of counter gears at gearbox housing bottom but do not drive in countershaft (30) before main pinion shaft (1) and main shaft are installed. Be careful not to drop the driver. Check that the copper washers (31 and 39) come into position.

Fitting of main shaft and rear housing.

1. Fit gasket (C), fig. 18. on the front faying surface of rear housing.
2. Insert main shaft in gearbox housing and install as follows: 1st speed sliding gear (29), 2nd speed sliding gear (34), synchronizing cone (B) and synchronizing device (A), fig. 15.
   On gearbox type H-1 and H-3 the synchronizing device may be turned as you like. On H-4 it should be placed with the long neck facing forwards. Check that the three drivers are fitted into the synchronizing cone notches.
3. Fit the synchronizing device snap ring (8, fig. 15) on main shaft.
   Check the axial play between the 2nd speed gear and the main shaft shoulder. Max. axial play 0,05 mm (.002″). (See fig. 19). Axial play can be adjusted by means of the snap ring (8, fig. 15). Different thicknesses are available.

Installation of main drive pinion.

1. Install main drive pinion (1) complete with bearings in gearbox housing.
2. Fit gasket (B), fig. 18. and bearing cover (2). See that oil channel in cover is lined up with the drain plug hole in the gearbox front.
3. Fit 3rd speed gear synchronizing cone (A, fig. 12).
4. Drive in main shaft so far that the bearing comes into position at the gearbox rear end. Fasten rear housing with screws.
5. Turn gearbox upside down and drive in countershaft *from behind.* The countershaft groove should lie flush with the lock washer (E), fig. 17.
6. Lock counter gears and reverse gears by means of lock washer.

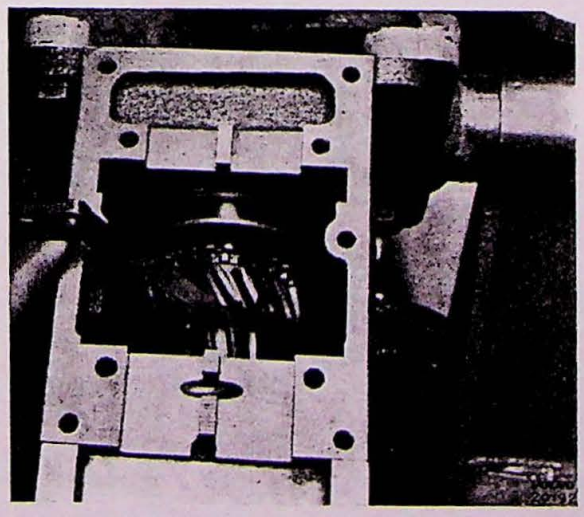


Fig. 19.

Fitting of gearbox cover and gearshift rails.

1. Change into 1st speed gear.
2. Fit gearshift rails.
3. Install ball between gearshift rails.
4. Move gears into neutral position.
5. Fit gearshift rail caps (7 and 10).
6. Check gear positions.
7. Fit a new cork gasket and the gearbox cover.
8. Fill 0,6 l. (1 Imp. pint) oil.
   Summer SAE 90, Winter SAE 80.

Installing gearbox in chassis.

1. If necessary center driven plate by means of a special driver (see part 2).
   Install gearbox and tighten screws with tool SVO 4036 and SVO 1456. Installation is facilitated by using dowel pins.
2. Place jack under gearbox and raise it high enough to fit cross member to frame (On PV 444 braket plate).
3. Lower gearbox and attach rear bracket to cross member (PV 445). Tighten nut until it contacts washer. Back off 1/2—1 turn and lock with cotter pin.
4. Fit gearshift lever and check that gear changing can be carried out properly in all positions.
5. Install propeller shaft, clutch link and return spring and brake pedal return spring. Connect speedometer drive cable.
6. Connect exhaust pipe and radiator top hose. Fit crankcase breather tube and connect negative cable terminal.
7. Fill radiator with water.

Renewing of rear oil seal.

When renewing rear oil seal, lower the gearbox rear end until companion flange will be available for removal (On PV 444 it is only necessary to loosen the mounting plate from body). See "Removal of gearbox".

1. Loosen companion flange screw and remove companion flange with tool SVO 4031.
2. Remove oil seal by means of puller SVO 4030. Before installing a new oil seal, check rear bearing (19 fig. 3). If there is excessive play, disassemble gearbox entirely and install a new bearing.
3. Install a new oil seal. Use driver SVO 4029 and drive on the companion flange by means of tool SVO 4034.
4. Tighten the screw and assemble the remaining parts in reverse order as when disassembling.

TRACING FAULTS

CAUSE	REMEDY
Difficult to change gear.	
Clutch does not release.	Adjust or repair clutch. See part 2.
	Check that a suitable lubricant is used.
Too heavy oil used.	Summer SAE 90, Winter SAE 80.
Synchronizing device worn.	Renew worn parts.
Bushings or gears worn.	Renew worn or damaged parts.
Gearshift rail or gears stick.	Renew worn or damaged parts.
Jumping out of gear.	
Worn bearings on shafts or gears.	Fit new bearings or bushings.
Worn latch in synchronizing device or gearbox cover.	Renew worn parts.
Gears badly worn.	Renew worn gears.
Gearbox inclined on flywheel housing.	Check flywheel housing with a dial indicator and adjust if necessary (see part 2).
	Clean contact surfaces.
Flywheel pilot bearing worn.	Replace bearing.
Noise.	
Oil level too low.	Fill oil. Summer SAE 90. Winter SAE 80.
Worn or damaged bearings on shafts or gears.	Replace bearings or bushings.
Badly worn gears.	Replace worn gears.
Oil leakage.	
Companion flange faying surface worn.	Fit new companion flange and oil seal.
Rear oil seal and bearing worn.	Install new bearing and new oil seal.
Leakage between gearbox housing and rear housing.	Fit new paper gasket. Clean return hole.
Leakage between gearbox housing and front bearing cover.	Fit new paper gasket. Clean return hole.
Leakage between gearbox housing and gearbox cover.	Fit new cork gasket.

TOOLS

The following special tools are necessary when repairing gearbox.

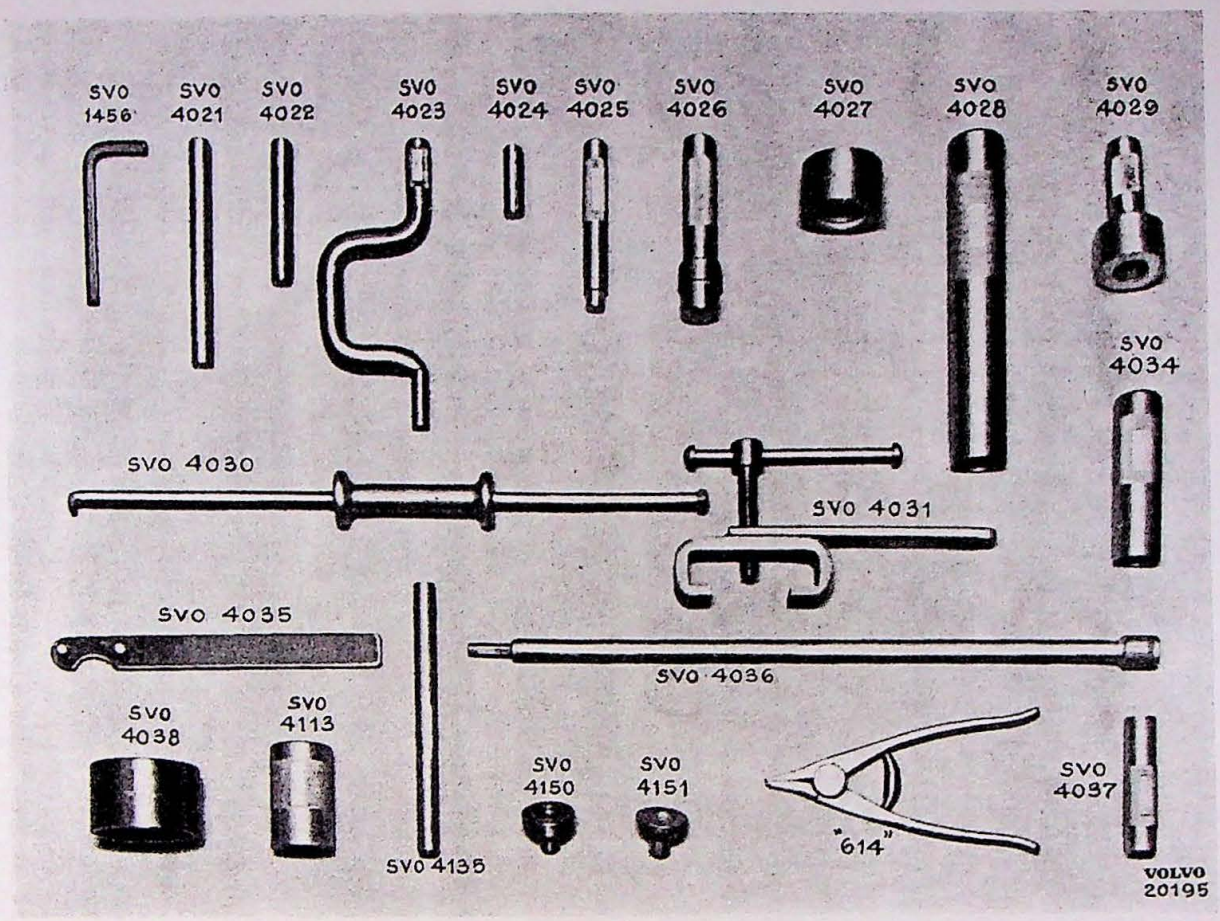


Fig. 21.

SVO 4027 Spacer for ditto.
SVO 4028 Sleeve for assembly of main drive pinion and main shaft bearings.
SVO 4029 Gearbox oil seal driver.
SVO 4030 Gearbox oil seal puller.
SVO 4031 Companion flange puller.
SVO 4034 Companion flange assembly sleeve.
SVO 4035 Companion flange wrench.
SVO 4036 Wrench for upper gearbox screws.
SVO 4037 Driver for pressing main shaft out of rear housing.
SVO 4038 Spacer ring for ditto.
SVO 4108 Gearbox and rear axle gear support.
SVO 4111 Gearbox fixture.
SVO 4113 Sleeve for assembly of main shaft rear bearing.
SVO 4135 Main drive pinion disassembly driver.
SVO 4150 Thrust washer for main drive pinion (H-1 and H-3).
SVO 4151 Thrust washer for main drive pinion (H-4).
"614" Special pliers for snap ring.

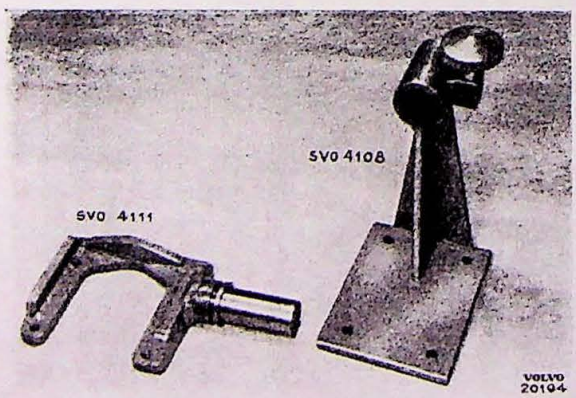


Fig. 20.

SVO 1456 Wrench for lower gearbox screws.
SVO 4021 Countershaft driver.
SVO 4022 Countershaft assembly driver.
SVO 4023 Reverse shaft disassembly driver.
SVO 4024 Reverse gear assembly driver.
SVO 4025 Driver for disassembly and assembly of reverse gear bushings.
SVO 4026 Driver for disassembly and assembly of 2nd speed gear bushings.

SPECIFICATIONS

Types ..... H-1—H-4

Type and number stamped on left hand side.

Ratios:

1st speed	3,23:1
2nd speed	1,62:1
3rd speed	1:1
Reverse	2,92:1

Number of teeth:

Main drive pinion	17 teeth

Countershaft:

Drive gear	24 teeth
1st speed gear	14 teeth
2nd speed gear	20 teet

Main shaft:

1st speed gear	32 teeth
2nd speed gear	23 teeth

Reverse gear ..... 18 and 20 teeth

Oil capacity ..... 0,6 lit. (1 Imp. pint)

Lubricant:

Summer	SAE 90
Winter	SAE 80