

Workshop manual

A
2(0)

**MS2, MS2B-A, MS2B-L, MS2A-D
MS2A-E, MS2L-D, MS2L-E, MS2V
120S, 120S-B, 120S-C, 120S-D, 120S-E**

Reverse gear

MS2, MS2B-A, MS2B-L, MS2A-D MS2A-E, MS2L-D, MS2L-E, MS2V

Sailboat drive

120S, 120S-B, 120S-C, 120S-D, 120S-E

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Safety information

Introduction

The workshop manual contains technical data, descriptions and repair instructions for products or product versions noted in the table of contents, supplied by Volvo Penta. Make sure you use the correct workshop literature.

Read the available safety information, “General information” and “Repair instructions” in the workshop manual before you start to do any service work.

Important!

The following special warning signs are found in the workshop manual and on the product.



WARNING! Warns for the risk of personal injury, major damage to product or property, or serious malfunctions if the instruction is ignored.



IMPORTANT! Is used to call attention to things which could cause damage or malfunctions to product or property.

NOTE! Is used to call attention to important information, to facilitate work processes or operation.

To give you a perspective on the risks which always need to be observed and precautions which always have to be taken, we have noted them below.



Make it impossible to start the engine by cutting system current with the main switch(es) and lock it (them) in the off position before starting service work. Fix a warning sign by the helmsman's seat.



All service work should normally be done on a stationary engine. Some work, such as adjustments, need the engine to be running, however. Going close to a running engine is a safety risk. Remember that loose clothes, long hair etc. can catch on rotating components and cause severe injury.

If work is done adjacent to a running engine, a careless movement or a dropped tool can lead to personal injury in the worst case. Be careful with hot surfaces (exhaust pipes, turbos, charge air pipes, starting heaters etc.) and hot fluids in pipes and hoses on an engine which is running or which has just stopped. Re-install all guards which have been removed during service work, before re-starting the engine.



Make sure that the warning or information labels on the product are always clearly visible. Replace labels which have been damaged or painted over.



Engines with turbocharger: Never start an engine without the air filter in place. The rotating compressor turbine in the turbocharger can cause severe injury. Foreign bodies in the inlet pipe can also cause severe mechanical damage.



Never use start spray or similar products as a starting aid. Explosions could occur in the inlet manifold. Danger of personal injury.



Avoid opening the coolant filling cap (on fresh water cooled engines) when the engine is hot. Steam or hot coolant could spray out. Open the filler cap carefully, and release the excess pressure in the cooling system. Be extremely careful if a tap, plug or coolant hose has to be removed from a hot engine. Steam or hot coolant can stream out in an unexpected direction.














Hot oil can cause burns. Avoid skin contact with hot oil. Make sure that the oil system is de-pressurized before doing any work on it. Never start or run the engine with the oil filler cap removed, because of the risk of oil spillage.




Stop the engine and close the sea cocks before doing any work on the cooling system.



Only start the engine in a well-ventilated area. When operated in a confined space, exhaust fumes and crankcase gases must be ventilated from the engine bay or workshop area.


-  Always use goggles when doing any work where there is any risk of splinters, grinding sparks, acid splash or other chemicals. Your eyes are extremely sensitive, injury could cause blindness!
-  Avoid skin contact with oil! Long-term or repeated skin contact with oil can make your skin dry out. The consequence is irritation, dry skin, eczema and other skin disorders. Used oil is more hazardous to health than new oil. Use protective gloves and avoid oil-soaked clothes and rags. Wash regularly, especially before meals. Use special skin cream to avoid drying and facilitate skin cleaning.
-  Most chemicals intended for the product (e.g. engine and transmission oils, glycol, petrol (gasoline) and diesel oil) or chemicals for workshop use (e.g. degreasers, paints and solvents) are hazardous. Read the instruction on the packages carefully! Always observe the safety advice (e.g. use of breathing protection, goggles, gloves etc.). Make sure that other personnel are not inadvertently exposed to hazardous substances, such as via the air they breathe. Ensure good ventilation. Handle used and surplus chemicals in the prescribed manner.
-  Be very careful when searching for leaks in the fuel system and testing fuel injectors. Use goggles. The jet from a fuel injector is under very high pressure, and has considerable penetration ability; fuel can force its way deep into body tissues and cause serious injury. Risk of blood poisoning (septicemia).
-  All fuels, and many chemicals, are flammable. Make sure that open flames or sparks can not set them alight. Petrol (gasoline), some thinners and hydrogen gas from batteries are extremely flammable and explosive when mixed with air in the correct ratio. Do not smoke! Provide good ventilation and take the necessary precautions before you start welding or grinding in the vicinity. Always have a fire extinguisher easily available near the workplace.
-  Make sure that oil and fuel soaked rags, and used fuel and oil filters are stored in a safe place. Oil soaked rags can self-ignite in certain circumstances. Used fuel and oil filters are polluting waste and must be handed to an approved waste management facility for destruction, together with used lubrication oil, contaminated fuel, paint residue, solvents, degreasers and wash residue.
-  Batteries must never be exposed to open flames or electric sparks. Do not smoke close to the batteries. The batteries generate hydrogen gas when charged, which forms an explosive gas when mixed with air. This gas is very flammable and highly explosive. A spark, which can be formed if the batteries are wrongly connected, is enough to make a battery explode and cause damage. Do not move the connections when you attempt to start the engine (risk of arcing), and do not stand and lean over one of the batteries.
-  Never mix up the battery positive and negative poles when the batteries are installed. If the batteries are wrongly connected, this can cause severe damage to the electrical equipment. Please check the wiring diagram!
-  Always use goggles when charging and handling batteries. Battery electrolyte contains highly corrosive sulfuric acid. If this comes into contact with your skin, wash at once with soap and a lot of water. If you get battery acid in your eyes, flush at once with a generous amount of water, and get medical assistance at once.
-  Stop the engine and cut the system current with the main switch(es) before doing any work on the electrical system.
-  The clutch must be adjusted with the engine shut off.

 The existing lugs on the engine/reverse gear should be used for lifting. Always check that the lifting devices are in good condition and that they have the correct capacity for the lift (the weight of the engine plus the reverse gear and extra equipment if installed).

The engine should be lifted with a customized or adjustable lifting boom for safe handling and to avoid damaging components on top of the engine. All chains or cables should be parallel to each other and should be as square as possible to the top of the engine.


If other equipment connected to the engine has altered its centre of gravity, special lifting devices may be needed to obtain the correct balance and safe handling.


Never do any work on an engine which just hangs from a lifting device.


 Never work alone when heavy components are to be dismantled, even when safe lifting devices such as lockable blocks & tackle are used. Even when lifting devices are used, two people are needed in most cases. One who operates


the lifting device and other who makes sure that components move freely and are not damaged during lifting.

When you work aboard a boat, always make sure that there is enough space for disassembly where you are working, with no risk for personal or material damage.

 Components in the electrical system, the ignition system (on petrol (gasoline) engines) and fuel systems on Volvo Penta products have been designed to minimize the risks of explosion and fire. The engine must not be operated in environments with adjacent explosive media.

 Remember the following when washing with a high pressure washer: Never aim the water jet at seals, rubber hoses or electrical components. Never use a high pressure washer for engine cleaning.

 **NOTE!** The fuel delivery pipes must not be bent, twisted or tampered with in other ways. Change damaged fuel delivery pipes.

 Only use the fuels recommended by Volvo Penta. Please refer to the instruction book. The use of fuel of inferior quality can damage the engine. In a diesel engine, poor fuel can cause the regulation rod to bind and the engine will over-rev, entailing a strong risk of personal injury and machinery damage. Poor fuel can also lead to higher maintenance costs.

General information

About the workshop manual

This workshop manual contains technical data, descriptions and repair instructions for the MS2 reverse gear, all versions, and sail boat drive 120S, all versions. The repair methods for the reverse gear and drive (upper gear) are essentially the same. Where they differ, this is noted.

In all correspondence, the product designation and serial number must be specified.

The workshop manual has been primarily prepared for Volvo Penta service workshops and their qualified personnel. This assumes that people who use the Manual have basic knowledge of marine drive systems and can do the tasks of a mechanical or electrical nature associated with the trade.

Volvo Penta constantly improves its products, so we reserve the right to make modifications without prior notification. All information in this manual is based on product data which was available up to the date on which the manual was printed. Any material changes introduced into the product or service methods after this date are notified by means of Service Bulletins.

Spare parts

Spare parts for electrical and fuel systems are subject to various national safety requirements such as the US Coast Guard Safety Regulations. Volvo Penta Original Spares comply with these requirements.

No damage whatever, occasioned by use of non-original Volvo Penta spares for the product, will be compensated by the warranty offered by Volvo Penta.

Repair instructions

The work methods described in the workshop manual apply to work in a workshop environment. For this reason, the reverse gear and drive are lifted out of the boat.

The warning signs which occur in the workshop manual (please refer to “Safety information” for their meanings)



NOTE!

are not comprehensive in any way, since we can not foresee everything, since service work is done in highly varying circumstances. For this reason, all we can do is to point out the risks which we believe could occur due to incorrect work in a well-equipped workshop, using work methods and tools tested by us.

In the workshop manual, all tasks for which there are Volvo Penta special tools, are done using these tools. Special tools are specially prepared to permit the safest and most rational work methods possible. For this reason, it is the responsibility of the person who uses other tools or other work methods than those recommended by us, to ensure that there is no risk of personal injury or material damage, and that they can not cause any malfunctions.

In some cases, special safety regulations and user instructions are available for the tools and chemicals mentioned in the workshop manual. These rules must always be observed, so there are no special instructions about this in the workshop manual.

The majority of risks can be prevented by taking certain elementary precautions and using common sense. A clean workplace and a clean engine eliminate many risks of both personal injury and malfunction.

Above all, when work on fuel systems, lubrication systems, induction systems, turbocharger, bearing caps and seals is done, it is extremely important that no dirt or other kinds of foreign particles are able to get in, since this would otherwise cause malfunctions or shortened repair life.

Our common responsibility

Each engine consists of a large number of collaborating systems and components. Any deviation of a component from its technical specification can dramatically increase the environmental impact of an otherwise good engine. For this reason, it is extremely important that specified wear tolerances are maintained, that systems with adjustment facilities are correctly adjusted and that Volvo Penta Original Spares are used for the engine. The times noted in the engine maintenance schedule must be observed.

Some systems, such as components in the fuel system, may require special competence and special test equipment. For environmental reasons etc., some components are sealed at the factory. It is only permissible to work on sealed components if you are authorized to do such work.

Remember that most chemical products, incorrectly used, damage the environment. Volvo Penta recommends the use of biodegradable degreasers whenever engine components are de-greased, unless otherwise specified in the workshop manual. When working aboard a boat, be careful to ensure that oils, wash residue etc. are processed for destruction, and are not inadvertently discharged with bilge water into the environment.

Tightening torque

The tightening torques for vital fasteners, which should be tightened with a torque wrench, are listed in "Specifications: Tightening torque" and noted in the job descriptions in the book. All torque specifications apply to clean screws, screw heads and mating faces. The torque specifications apply to lightly oiled or clean screws. If lubricants, locking fluids or sealants are needed on a fastener, the type of preparation to be used will be noted in the job description and in "Tightening Torques". Where a particular torque value is not specified for any fastener, the general tightening torques in the table below shall apply. The torque specification is a target value and the fastener does not need to be tightened with a torque wrench.

Dimension	Tightening torque	
	Nm	lbf ft
M5	6	4.4
M6	10	7.4
M8	25	18.4
M10	50	36.9
M12	80	59.0
M14	140	103.3

Torque-angle tightening

In torque/angle tightening, the fastener is tightened to the specified torque, and tightening then continues through a pre-determined angle. Example: for 90° angle tightening, the fastener is turned a further 1/4 turn in one sequence, after the specified tightening torque has been achieved.

Lock nuts

Disassembled locknuts shall not be re-used, they shall be replaced by new ones, since the locking properties are impaired or lost when the nut is used several times. On locknuts with plastic inserts, such as Nylock®, the tightening torque specified in the table must be reduced if the Nylock® nut has the same nut height as a standard fully metallic hexagonal nut. Reduce the tightening torque by 25% if the screw dimension is 8 mm or greater. On Nylock® nuts with higher nut height, where the fully metallic thread is as high as on a standard hexagonal nut, use the tightening torques in the table.

Strength classes

Screws and nuts are sub-divided into different strength classes. Classification is indicated by markings on the screw head. A marking with higher number indicates stronger material. For example, a screw marked 10-9 is stronger than one marked 8-8. For this reason, when fasteners are removed, it is important that the screws are put back in the correct places when they are re-installed. When you change screws, please check the spare parts catalogue to ensure that the correct versions are obtained.

Sealants

Several different types of sealant and locking fluids are used on the engine. The properties of the preparations differ, and they are intended for different strengths of fastener, temperature, resistance to oil and other chemicals, and for the different materials and gap thicknesses found in the engine.

It is therefore important that the correct types of sealant and locking fluids are used on the fasteners where needed, to give a fully acceptable service result.

In the workshop manual, the relevant chapters contain notes on the preparations used in our production.

In service work, the same preparations or preparations of corresponding properties, but of other makes, shall be used.

When sealants and locking fluids are used, it is important that the surfaces are free from oil, grease, paint and rust-protection, and that they are dry.

Always observe the manufacturer's instructions about temperatures of use, hardening times and other instructions for use of the product.

Various basic types of preparation are used, characteristics are as follows:

RTV preparations (Room Temperature Vulcanizing).

These are mostly used together with gaskets, such as sealing gasket joints, or are brushed on gaskets. RTV preparations are fully visible when the component has been disassembled; old RTV compound must be removed before the joint is sealed again.

The following RTV preparations are mentioned in the workshop manual: Volvo Penta part no. 840879-1, Loctite® 574; Volvo Penta part no. 1161099-5, Permatex® No.3. Remove old sealant with denatured alcohol in all cases.

Anaerobic preparations

These preparations harden in the absence of air.

These preparations are used when two solid components, such as two cast components, are fitted together without a gasket. Common uses are also to lock and seal plugs, stud threads, taps, oil pressure monitors etc. Hardened anaerobic preparations are glassy and for this reason, the preparations are colored to make them visible. Hardened anaerobic preparations are highly resistant to solvents, and old compound can not be removed. On re-installation, degrease carefully and then apply new sealant.

The following anaerobic preparations are mentioned in the workshop manual:

Volvo Penta part no. 1161053-2, Loctite® 243.

The following **polymer preparations** are mentioned in the workshop manual:


Volvo Penta part no. 1141570-0 (white)

NOTE! Loctite® is a registered trademark belonging to the Loctite Corporation, Permatex® is a registered trademark belonging to the Permatex Corporation.

Safety rules for fluorocarbon rubber

Fluorocarbon rubbers are commonly used materials in seal rings on shafts, O-rings etc.

When fluorocarbon rubber compounds are exposed to high temperatures (above 572°F), **hydrofluoric acid** can be formed, which is highly corrosive. Skin contact can cause severe chemical burns. If it splashes in your eyes, this can cause severe chemical burns. If you breathe the fumes, you can suffer lung and bronchial injury.

 **WARNING!** Be very careful when working on engines which have been exposed to high temperatures, such as overheating caused by a seizure or fire. Seals must never be cut with a flame torch during disassembly, or burned in uncontrolled circumstances afterwards.

- Always use chloroprene rubber gloves (gloves for chemicals handling) and goggles.
- Handle the removed seal in the same way as corrosive acid. All residues, including ash, can be strongly corrosive. Never use compressed air to blow components clean.
- Put the remains in a plastic container, seal it and apply a warning label. Wash the gloves under running water before you take them off.

The following seals are most probably made from fluorocarbon rubber:

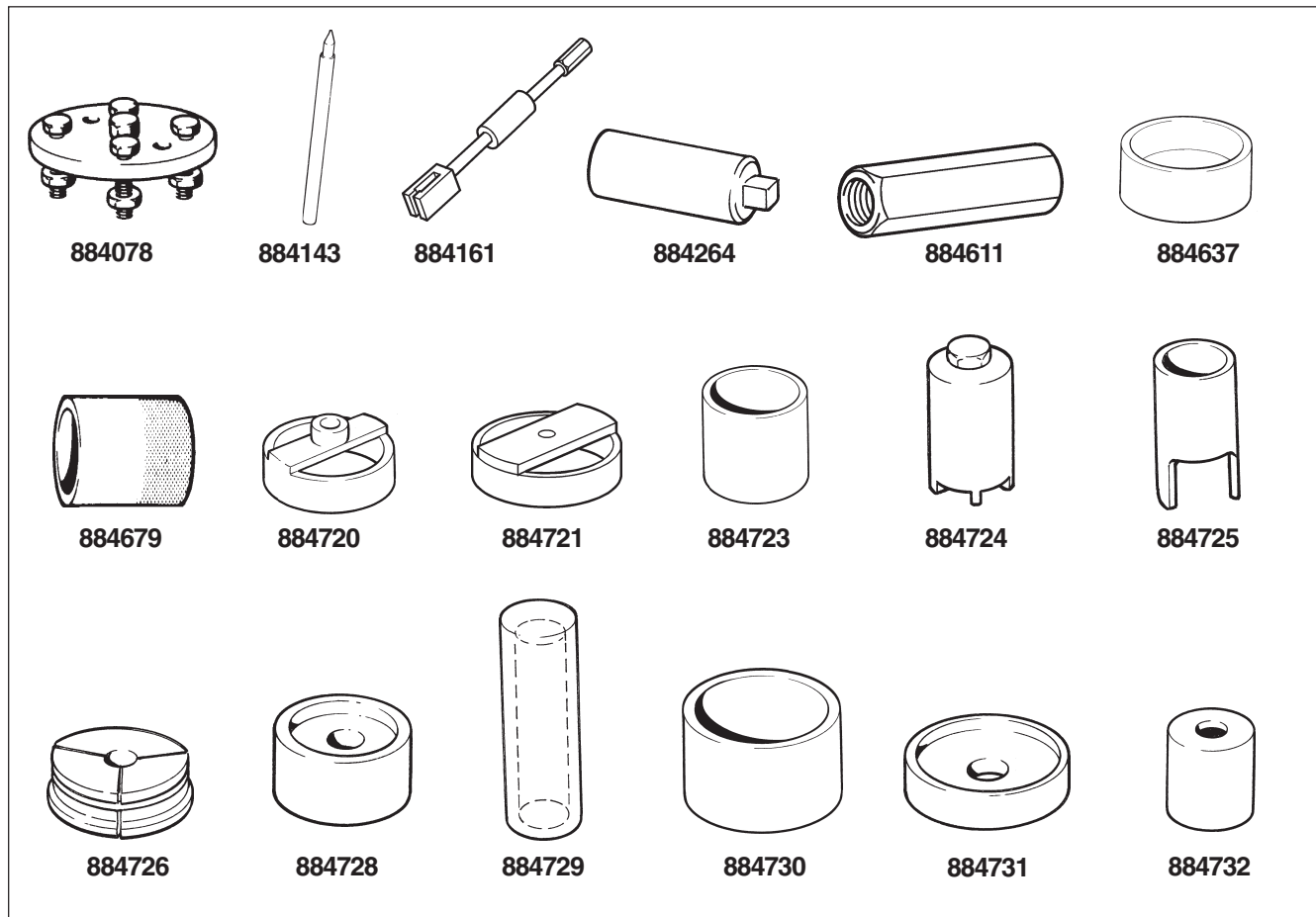
Seal rings for the crankshaft, camshaft, drive shafts.

O-rings, irrespective of where they are installed.

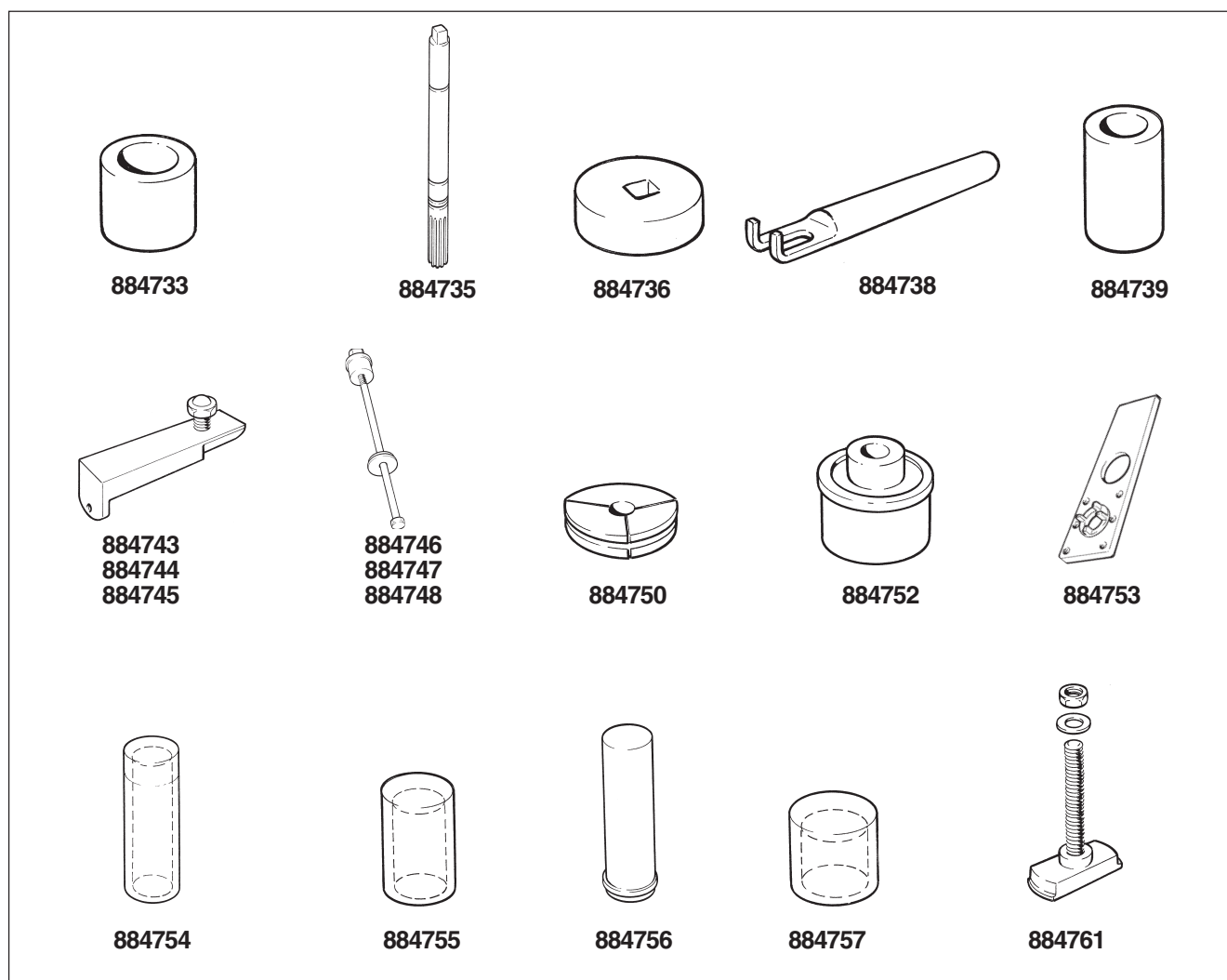
O-rings for cylinder liner sealing are almost always made of fluorocarbon rubber.

Please note that seals which have not been exposed to high temperature can be handled normally.

Special tools



884078-7	Extractor. Disassembly of output shaft	884724-6	Hook wrench. Removal, assembly of nuts.
884143-9	Shaft for expander 884750.	884725-3	Drift Removal, assembly of retention ring halves.
884161-1	Slide hammer. Removal of propeller shaft	884726-1	Expanding mandrel. Removal of outer bearing race.
884264-3	Sleeve for vertical shaft. Can be replaced by 884830	884728-7	Drift Removal of bearings, gear wheels.
884611-5	Extractor. Used together with 884161	884729-5	Drift Installation of bearing.
884637-0	Sleeve. Disassembly of tubular shaft MS2V	884730-3	Drift Disassembly of output bearing housing.
884679-2	Drift Installation of seal ring	884731-1	Drift Installation of bearing.
884720-4	Extractor. Removal of outer bearing race. Used together with 884761	884732-9	Drift Installation of bearing.
884721-2	Extractor. Removal of outer bearing race. Used together with 884761		
884723-8	Drift Splitting of rear bearing housing		



884733-7 Drift. Installation of bearings, removal of gear wheels.

884735-2 Tool. Checking of marking pattern.

884736-0 Wheel. For checking pre-load.

884738-6 Brake tool. Checking of marking pattern.

884739-4 Counterhold

884743-6 Removal of vertical shaft. Used together with 884744 and 884745

884746-9 Installation of needle roller bearing. Used together with 884747 and 884748

884750-1 Expanding mandrel. Removal of outer bearing race.

884752-7 Drift. Installation of seal rings in rear bearing housing.

884753-5 Fixture, 120S

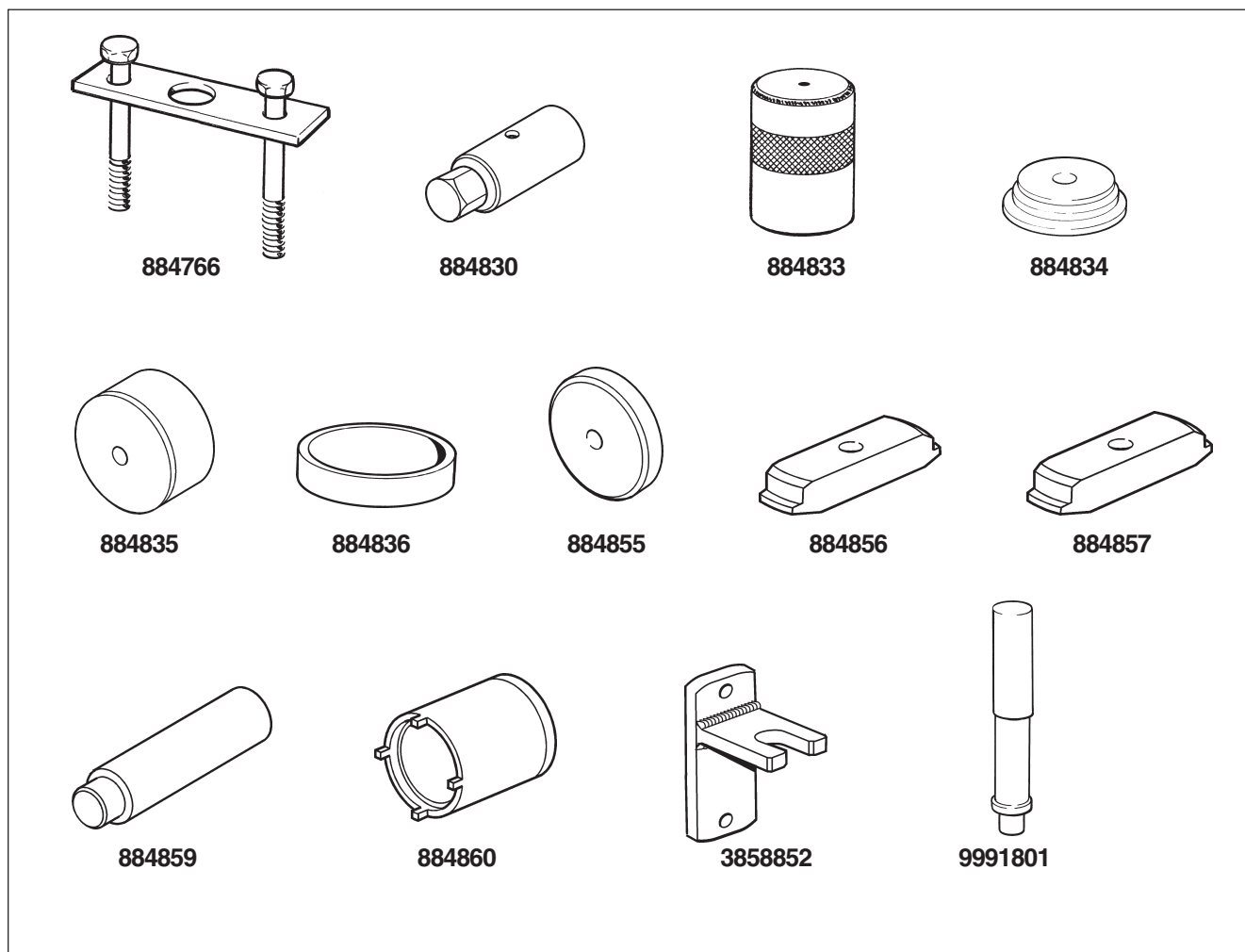
884754-3 Drift. Installation of bearing.

884755-0 Drift. Installation of roller bearing, lower gear housing.

884756-8 Drift. Installation of outer bearing race in rear bearing housing.

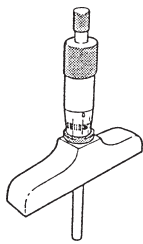
884757-6 Drift. Installation of outer bearing race in lower gear housing.

884761-8 Extractor. Used together with tool 884721



884766-7	Press. For pressing down the vertical shaft. Used together with 884753	884857-4	Plate. Removal of bearing race from cover, MS2V
884830-1	Sleeve for vertical shaft. Can be replaced by 884264	884859-0	Shaft, MS2V
884833-5	Drift. Installation of outer bearing race.	884860-8	Hook wrench. Installation, removal of nut on tubular shaft, MS2V
884833-5	Drift. Removal of bearing in cover, MS2V	3858852-1	Counterhold. Removal of pinion nuts. 120S
884834-3	Plate. Installation of bearing race and seal ring, MS2V	9991801-3	Standard shaft
884835-0	Sleeve. Installation of rolling bearing on tubular shaft, MS2V		
884836-8	Ring. Installation of rolling bearing on pinion, MS2V		
884855-8	Plate. Installation of bearing race in cover, MS2V		
884856-6	Plate. Removal of bearing race from gear housing, MS2V		

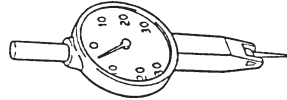
Other special equipment



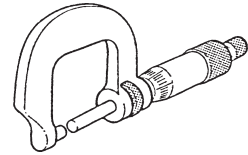
9985472



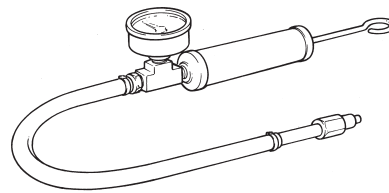
9985494



9999683



9999701



3810152

- 9985472-1 Depth micrometer
- 9985494-5 Spring balance
- 9999683 -7 Dial gauge
- 9999701-7 Micrometer
- 3810152-3 Equipment for pressure testing drives

Chemicals

RTV preparations:

Volvo Penta part no. 840879-1, Loctite® 574;

Volvo Penta part no. 1161099-5, Permatex® No. 3.

Anaerobic preparations:

Volvo Penta part no. 1161053-2, Loctite® 243.

Polymer preparations:

Volvo Penta part no. 1141570-0 (white)

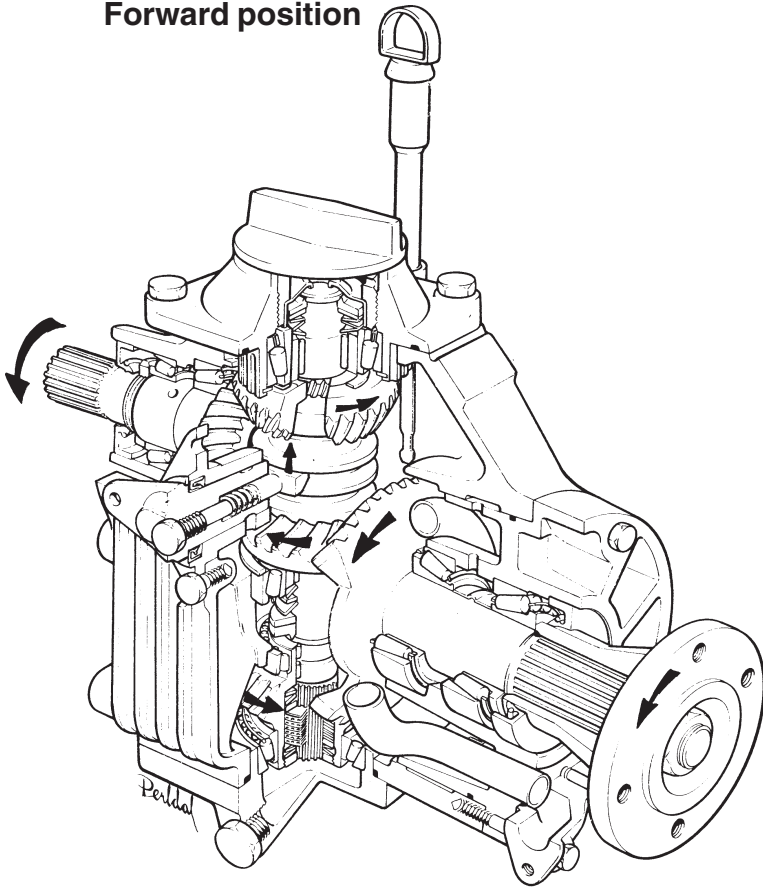
Water resistant grease:

Volvo Penta part no. 828250-1

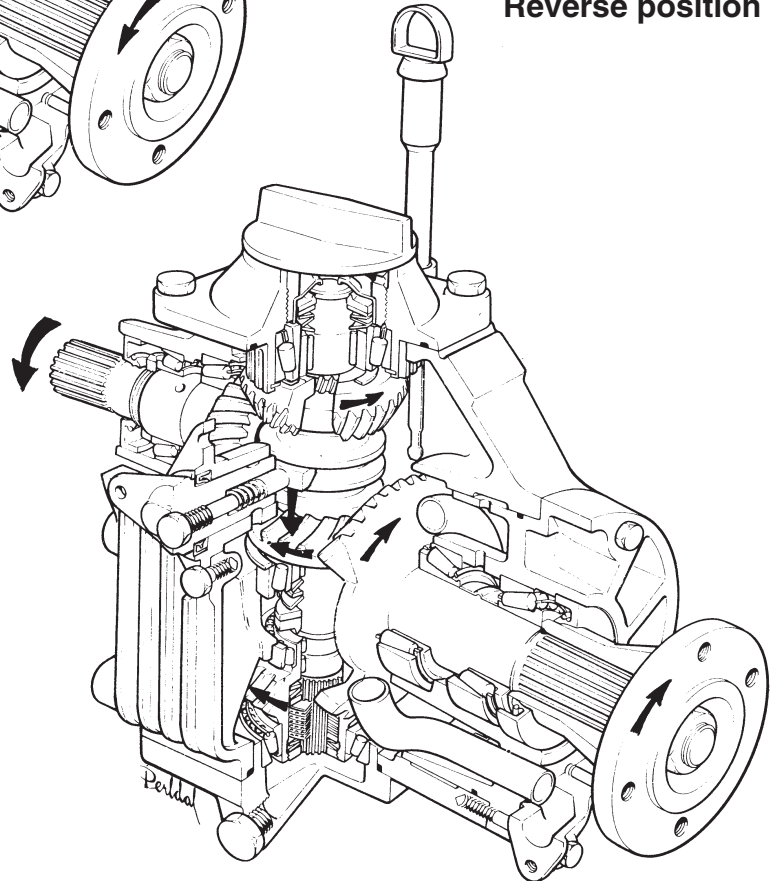
Design and function

Reverse gear MS2

Forward position

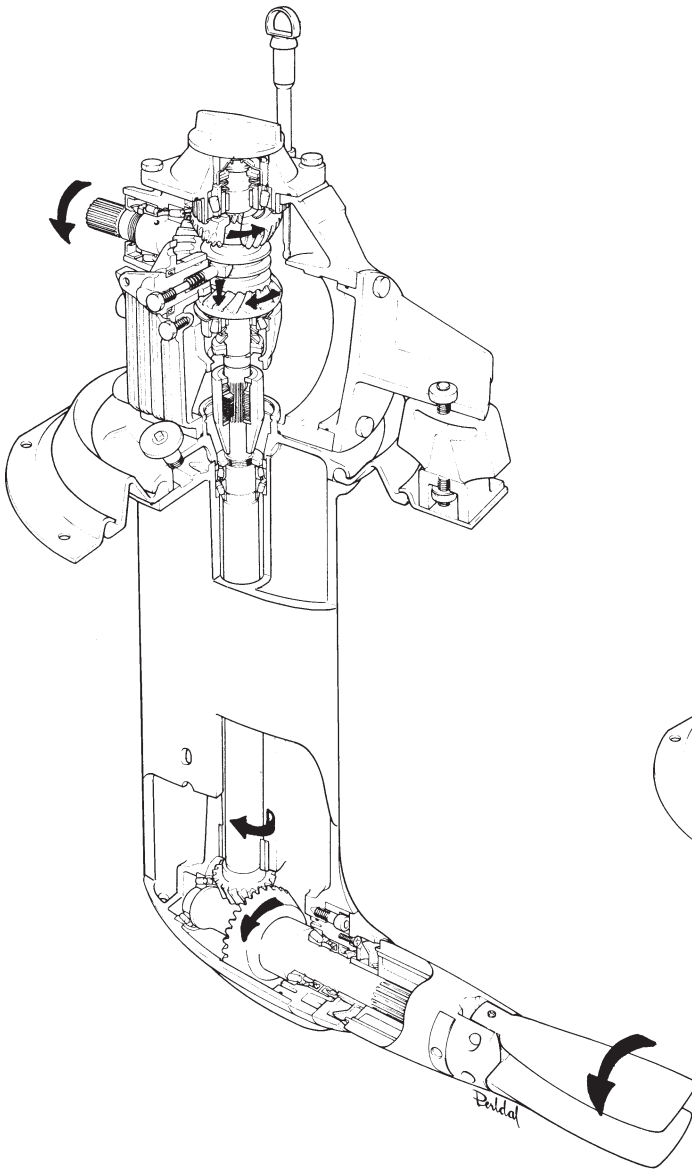


Reverse position

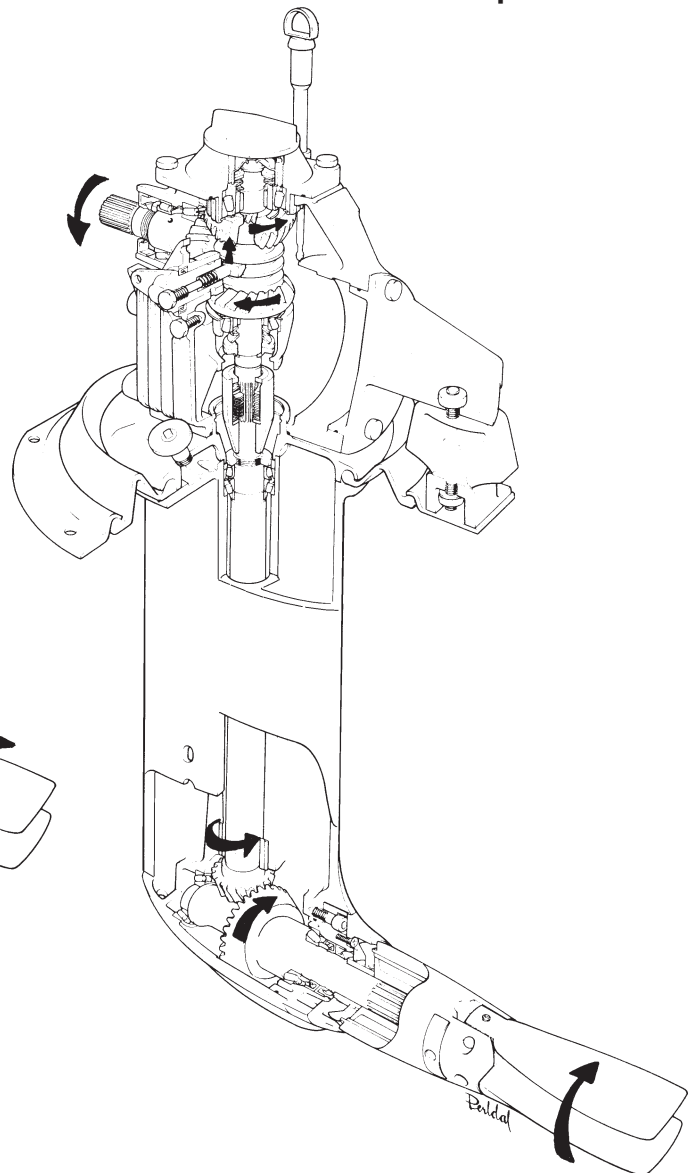


Sailboat drive 120S

Forward position

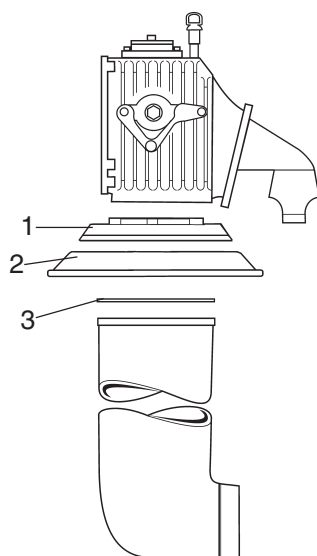


Reverse position



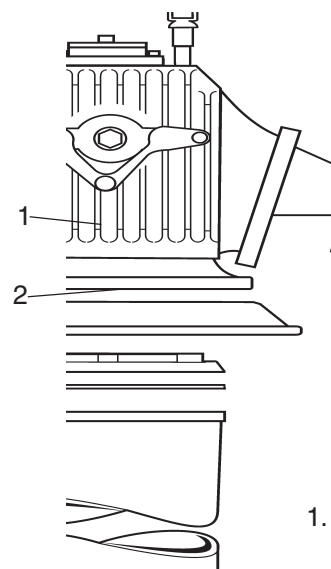
History, sail boat drives

Model 120S



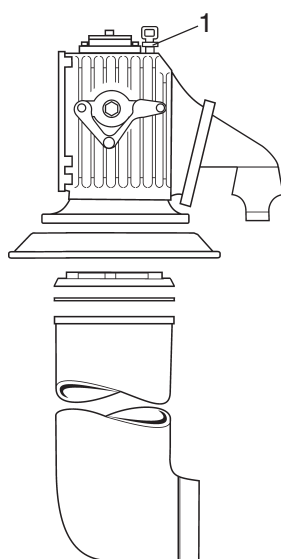
1. Adapter, loose
2. Rubber sleeve
3. Gasket

Model 120S-B



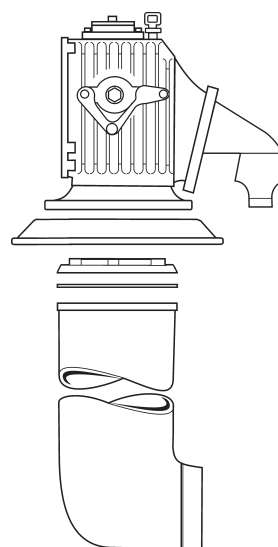
1. Adapter, integrated into gear housing
2. Adapter plate

Model 120S-C



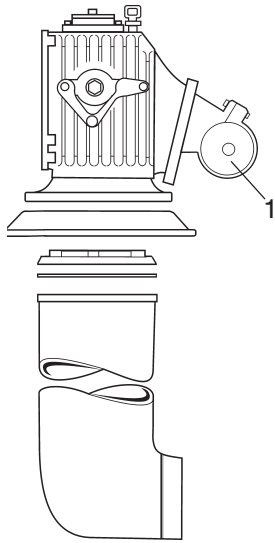
1. Dipstick, new version
Production rationalization changes

Model 120S-D



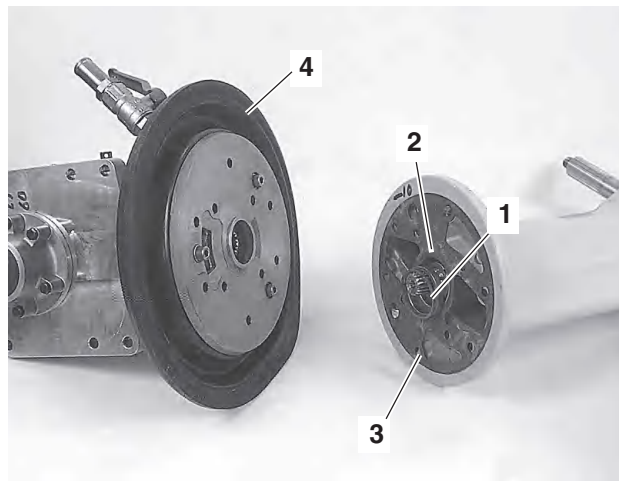
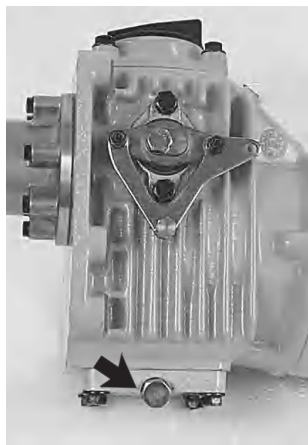
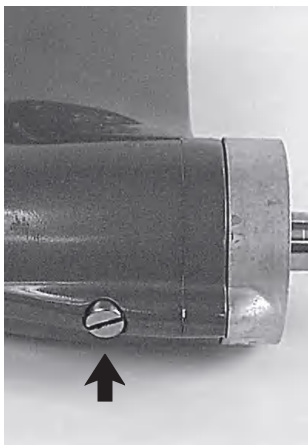
- New material in sliding sleeve
New color, gray

Model 120S-E



- 1. Rubber mounting, new version
- Shot blasted gear wheels
- Fully synthetic oil

Disassembly - upper and lower gear housings, sailboat drive



1. Clean the outside of the reverse gear and drive. Remove the drain plug and drain the oil. Remove the screws in the adapter section. Four socket cap screws on the inside and two on the outside.

3. Split the drive and save the spacer ring (1), shims, (2) and gasket (3).

Model 120S

Remove the rubber sleeve (4).

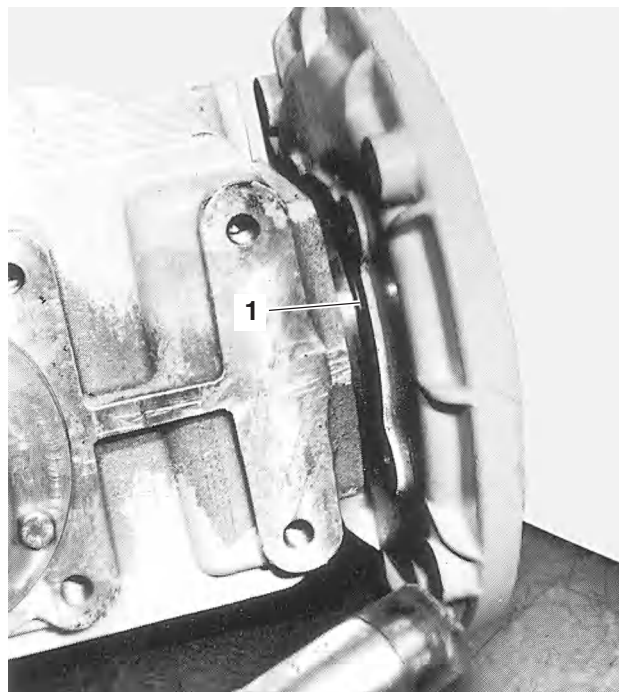
NOTE! The rubber sleeve must be changed every 5 years.



2. Remove the locking wire from the four screws. Then remove all the screws, 10 pcs below the division line of the drive.

Model 120S:

Also remove the four nuts on the front and rear of the upper gear.



4. Model 120S

Remove the adapter section. Tap carefully with a plastic or rubber faced mallet. Change the O-ring (1).



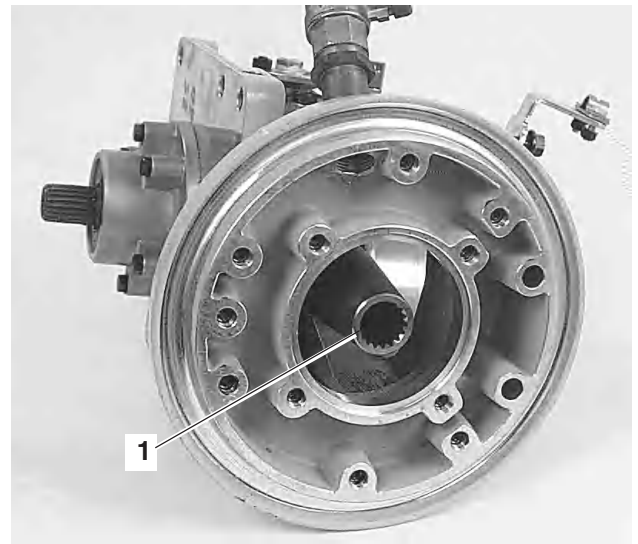
5. Models 120S-B, -C, -D, -E

Remove the adapter plate and remove the rubber sleeve.

Prize carefully. Use a tool with no sharp edges.

Remove and scrap the O-ring on the sleeve of the adapter plate.

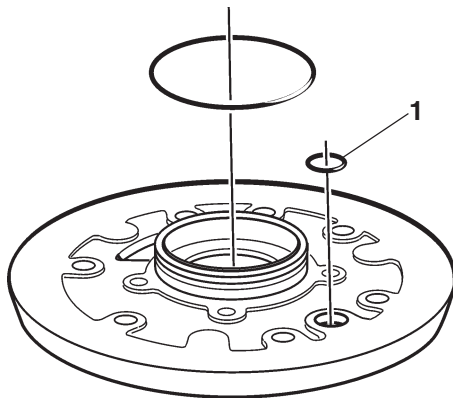
Repair of the lower gear housing, please refer to page 61.



6. Remove the slipping clutch (1).

Check that the clutch is not damaged.

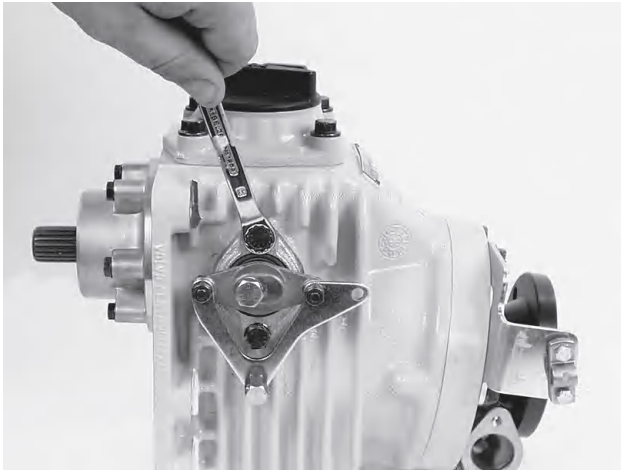
Reverse installed drive (180°)



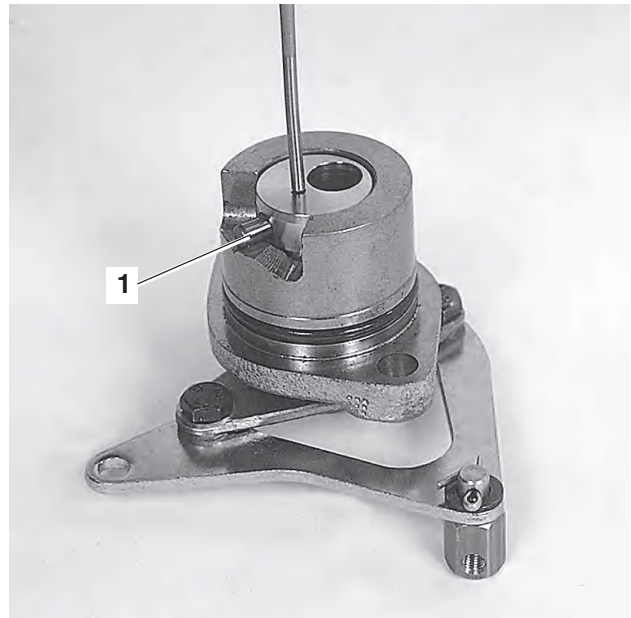
Remove and scrap the O-ring (1) on the adapter plate.

Repair - MS2 reverse gear and upper gear housing, sailboat drive

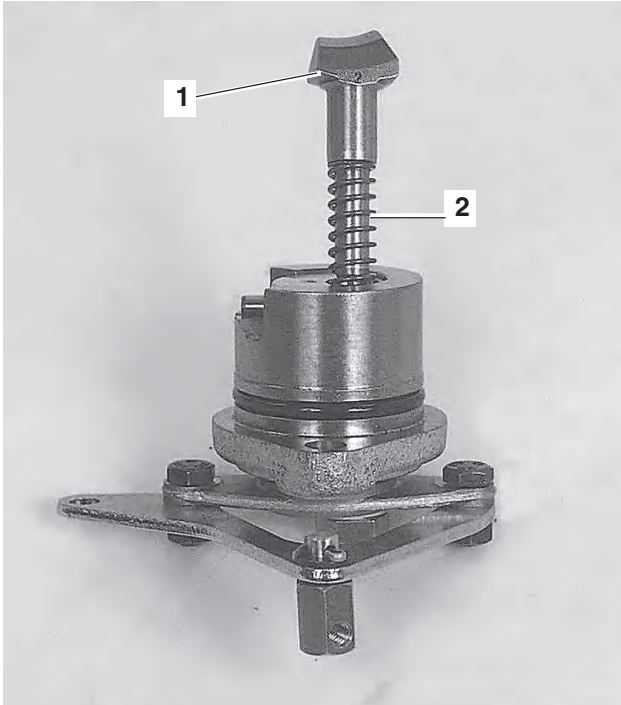
Gear shift mechanism, disassembly



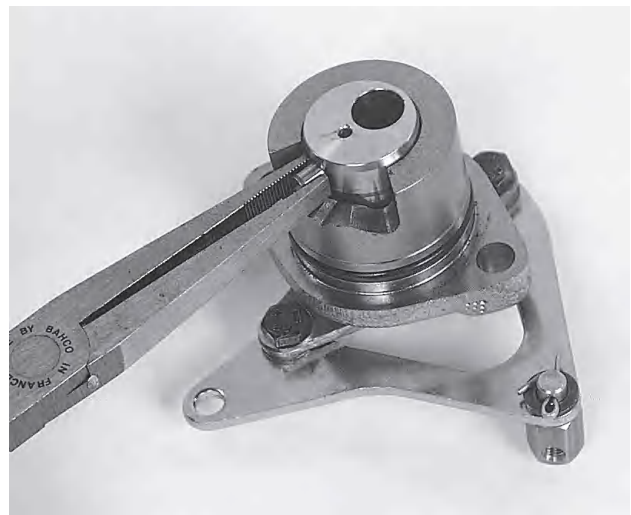
1. Disassemble the gear shift mechanism, 2 screws.



3. Drive in the spring pin so far that the pin (1) is released.



2. Remove the dog (1) and spring (2).



4. Pull the pin out.



5. Pull the eccentric piston out.

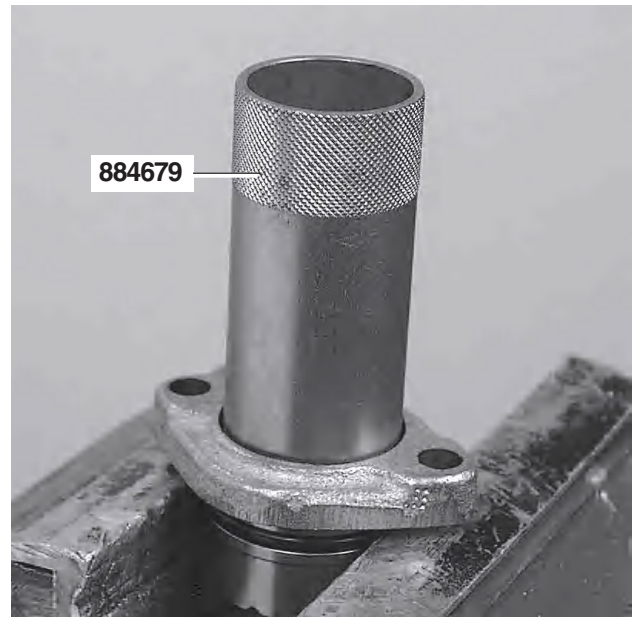


6. Shake the pin out of the eccentric piston.

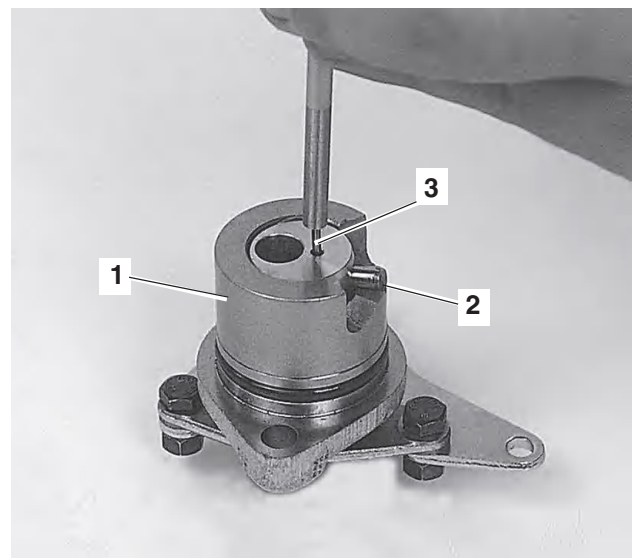


7. Remove the seal ring with a screwdriver. Clean all components of the gear shift mechanism and check for wear. Change components as necessary.

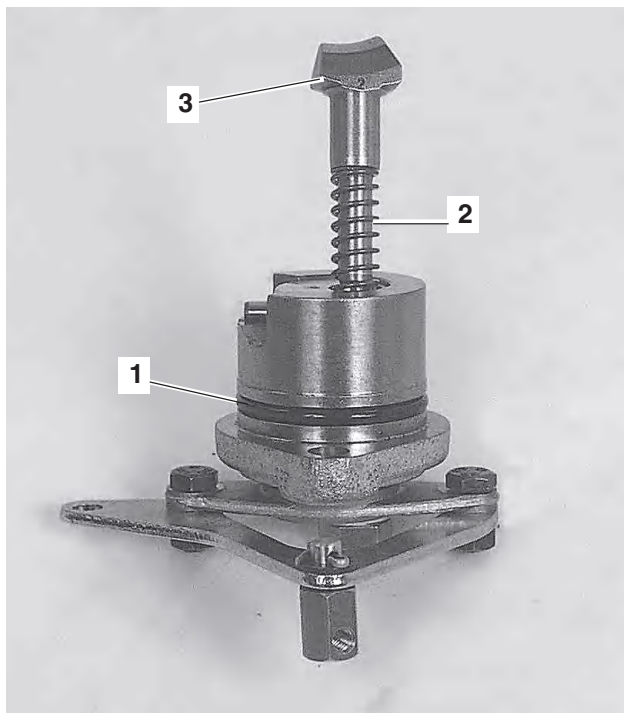
Gear shift mechanism, assembly



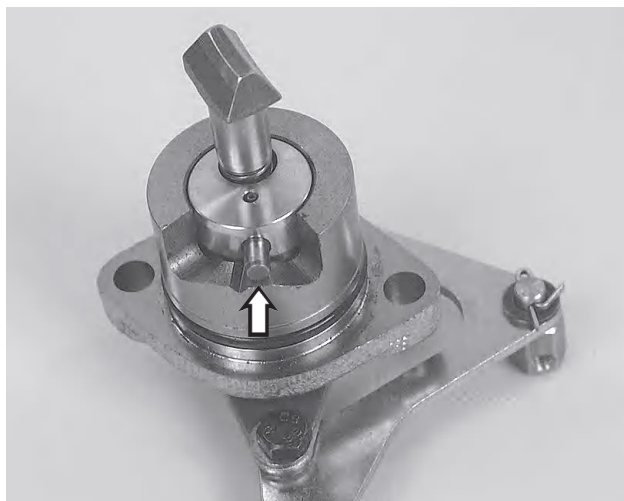
8. Oil all components before assembly starts. Install the seal ring. Align the side with the spring inwards. Use tool no. **884679** or a pipe whose diameter is slightly smaller than the outer diameter of the seal ring.



9. Install the eccentric piston (1) and press the pin (2) in. Lock it with the spring pin (3).



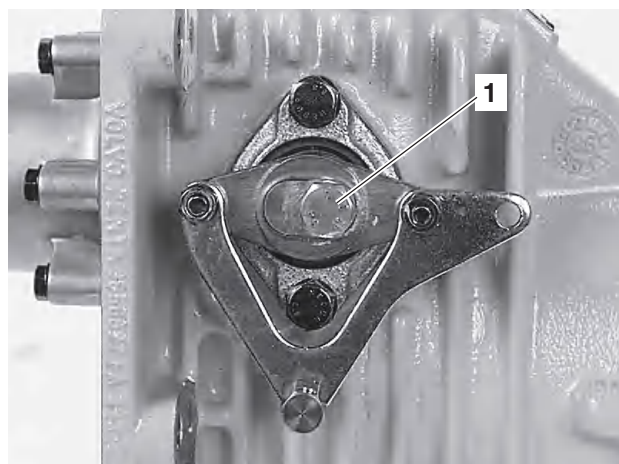
10. Put a new O-ring (1) on the gear shift mechanism. Install the spring (2) and dog (2).



11. Put the gear shift mechanism in a position between forwards and neutral. The pin should rest in one of the “notches”.



12. NOTE! During assembly, the dog must be aligned as shown in the illustration. The gear shift mechanism will not work if the dog is turned the other way round.



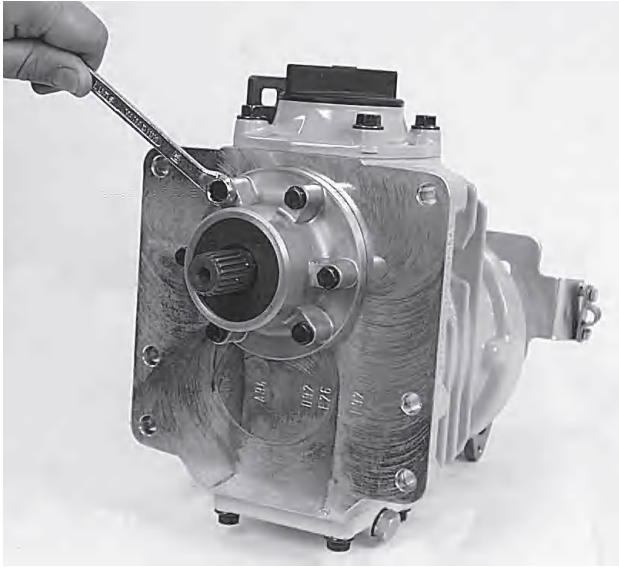
13. Undo screw (1) about 2 turns and install the gear shift mechanism in the housing. Check the position of the dog. The screw must be displaced backwards, i.e. to the right in the illustration.

Disassemble the screw, remove the shim and re-tighten the screw. It will now be impossible to turn the output shaft round.

Install one shim at a time until the shaft can be turned without resistance.

After adjustment, apply sealant with Volvo Penta part no. 1141570-0 to the shims and screw, then tighten the screw.

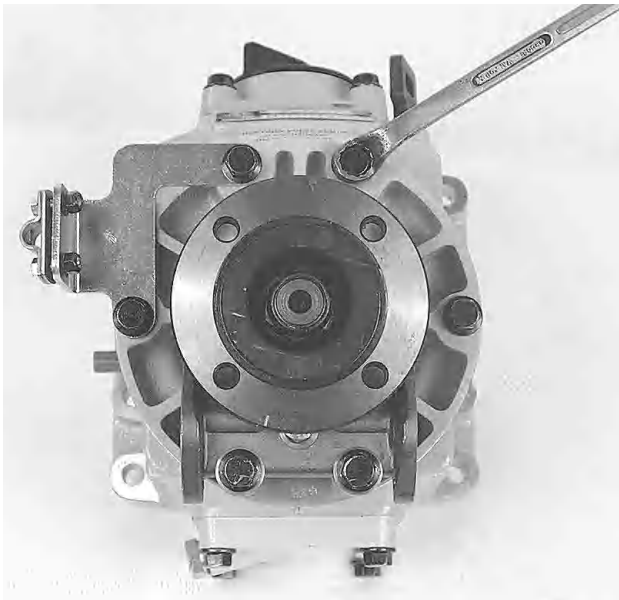
Reverse gear/upper gear housing, disassembly



14. Disassemble the double bearing seal housing, 6 screws.

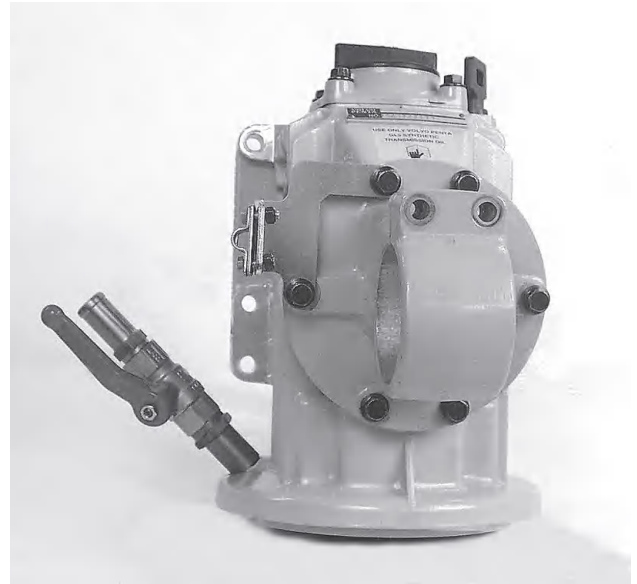
NOTE! Tap carefully with a plastic-faced mallet etc. Do not use a screwdriver to prize between the housing and the bearing seal housing. This can damage the sealing surface.

Save the shims.



15. Reverse gear MS2.

Disassemble the rear bearing housing. 6 screws. Also tap carefully here with a plastic-faced mallet, until the bearing housing comes away from the reverse gear. Save the shims.



16. Drive, 120S, 120S-B, -C, -D, -E

Remove the cooling water valve.

Remove the gear shift cable holder and the rear cover with rubber mounting.

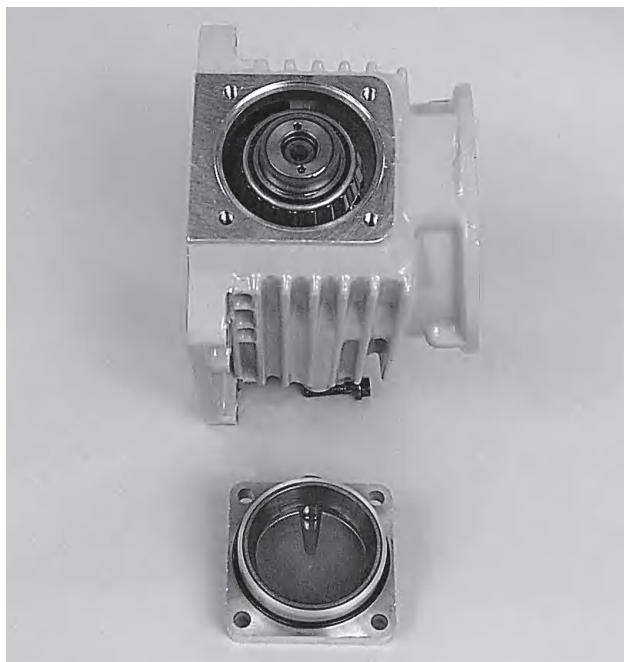
Change the O-ring on the cover.



17. Unscrew the oil filler cap and remove the dipstick and outer casing.

Model 120S

Also remove the throttle control bracket. The two front screws on the bearing cover are removed later.



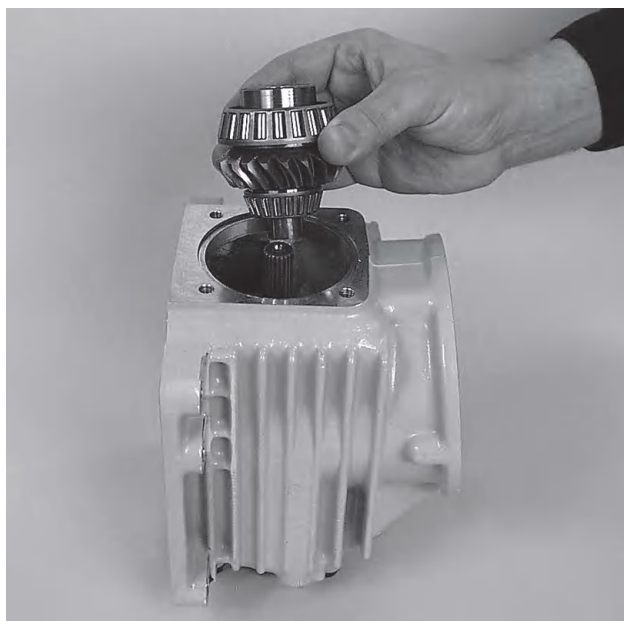
18. Reverse gear MS2.

Turn the reverse gear upside down and remove the bottom cover. 4 screws.

Scrap the O-ring.



20. Turn the reverse gear/upper bearing housing over and put it in a press. Put tool no. **884725** over the vertical shaft, so that it rests on the large washer. Press the washer down, to release the retention ring halves. Remove the halves.

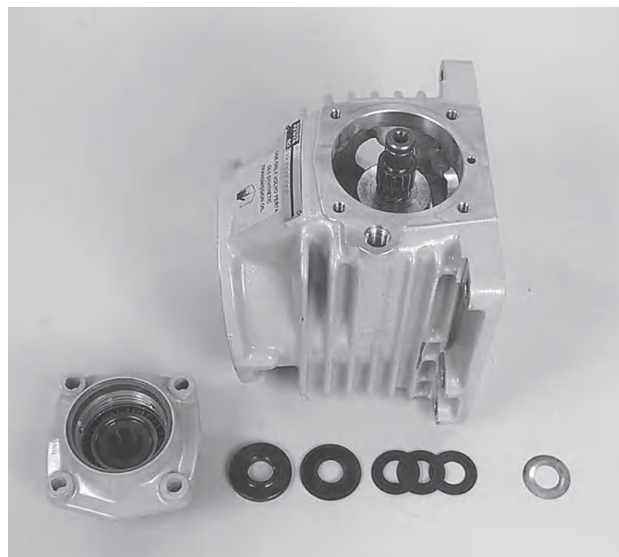


19. Reverse gear MS2.

Remove the slipping clutch. Remove the sleeve bearing from the vertical shaft. In some cases, the bearing might remain in the slipping clutch.

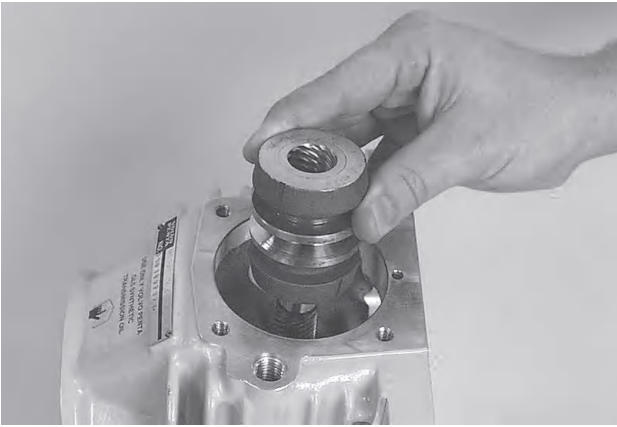
NOTE! If there is any fault in the slipping clutch, it must be replaced as a unit. The clutch is only available as a complete spare part.

Change the roller bearing as necessary. Please refer to items 73-83.



21. Remove the cover. A lock washer, a large spring washer, three small spring washers and possibly one or two spacers will come away with the cover. In addition, the ball bearing and gear wheel are fixed to the cover.

NOTE! Remove the needle roller bearing. The bearing might remain on the shaft.



22. Pull up the sliding sleeve with a turning motion.



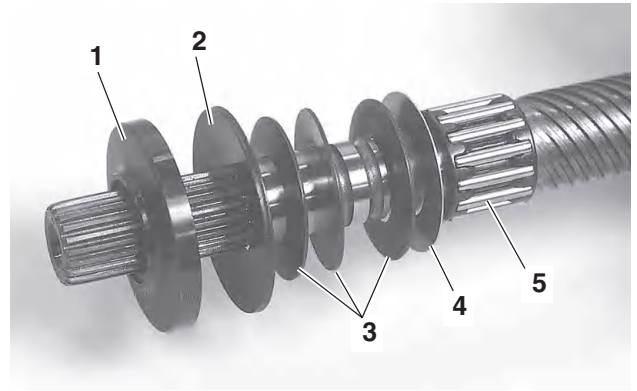
23. Reverse gear MS2

Press the outer bearing race out, using the vertical shaft. Keep hold of the vertical shaft, to prevent it from falling and being damaged. Save any shims beneath the bearing race.

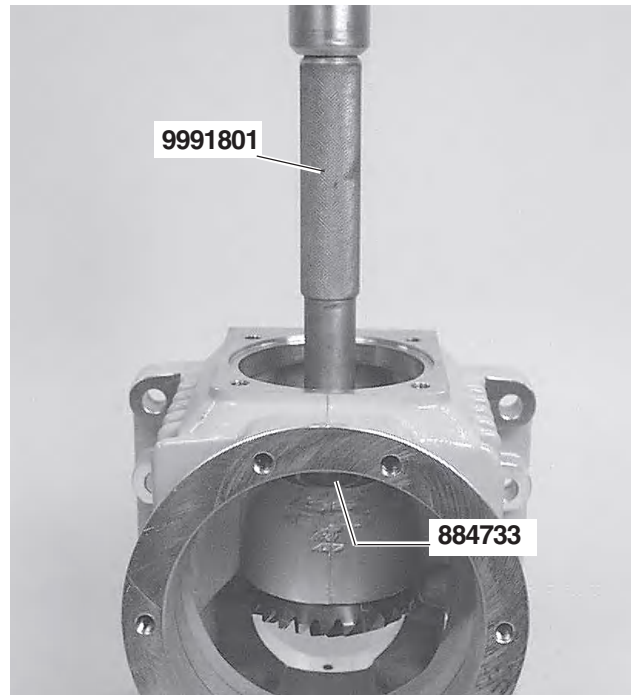
NOTE! On the sailboat drive, the shaft is loose since there are no bearings.



24. Put the vertical shaft in a press and press the large washer with tool no. **884725**, to release the retention ring halves. Remove the halves.



25. Remove the lock washer (1), the large domed washer (2), the three smaller domed washers (3), any spacer washers (4) and the needle roller bearing (5).

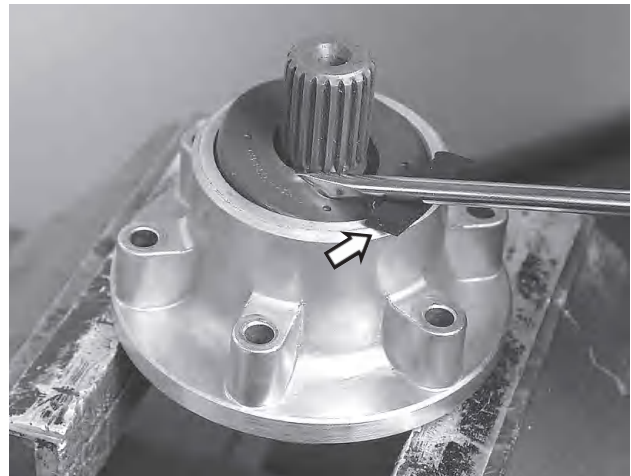


26. Press the gear wheel out. Use tool no. **884733** in combination with standard shaft **9991801**.

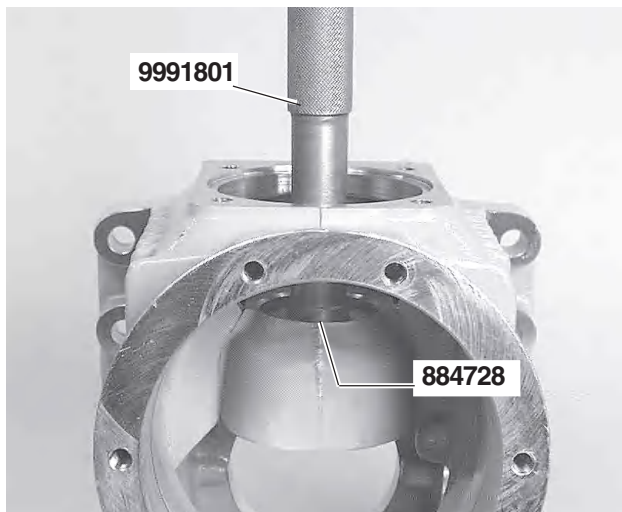


27. Remove the circlip, using circlip pliers.

Input bearing seal housing, disassembly



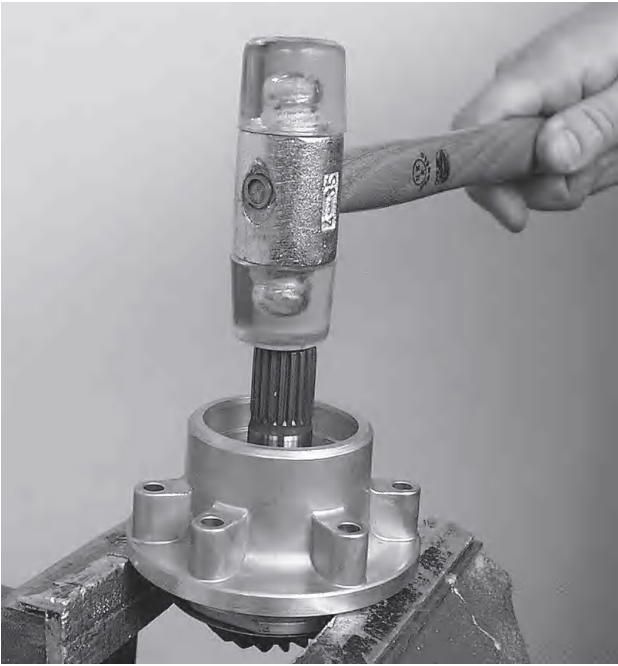
29. Fix the bearing housing in a vise. Press a screwdriver into the seal ring. Then place a thick piece of rubber or leather between the screwdriver and the bearing housing casting. Prize out the seal ring and scrap it.



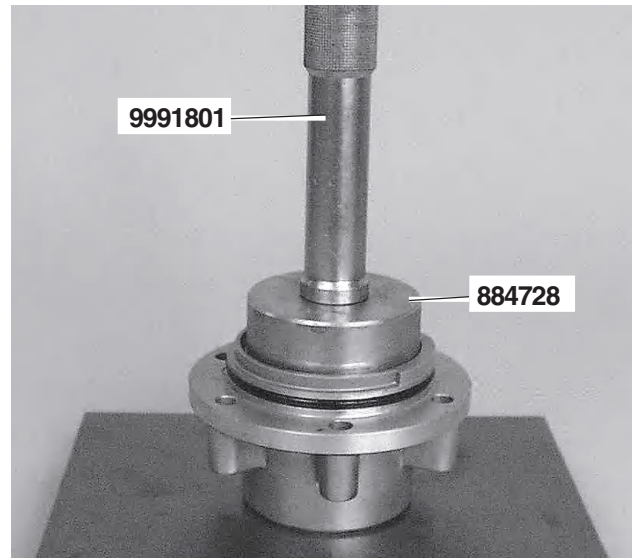
28. Press out the taper roller bearing. Use tool no. **884728** and standard shaft **9991801**. Then wash the gearbox housing out.



30. Fix the gear in a vise. Use soft facings on the vise jaws. Then disassemble hook nut with tool no. **884724**.

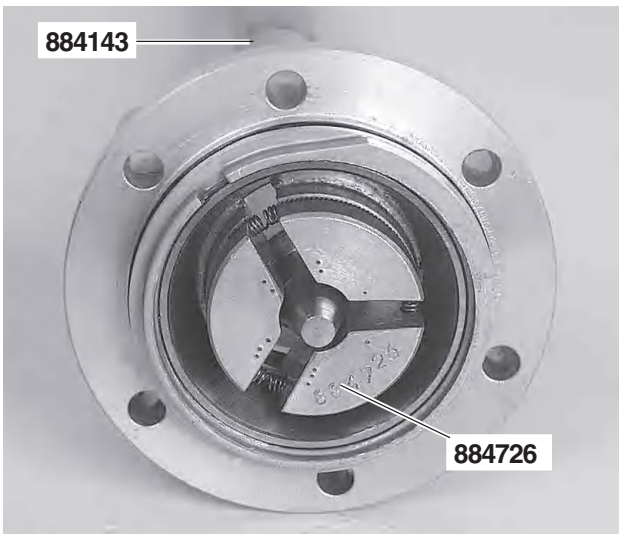


31. Drive or press the input shaft out of the bearing housing. Use a plastic-faced mallet or similar, to avoid damaging the end of the shaft and the splines.

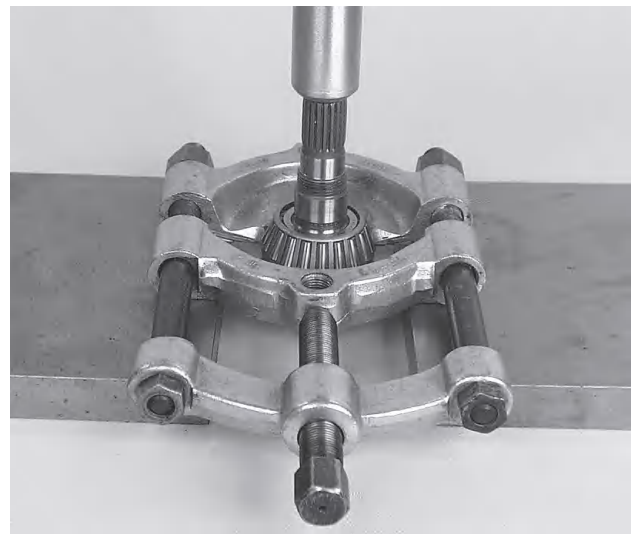


33. Drive out the small outer bearing race, using tool **884728** and shaft **9991801**.

NOTE! Be careful to offer up the tool against the bearing race.

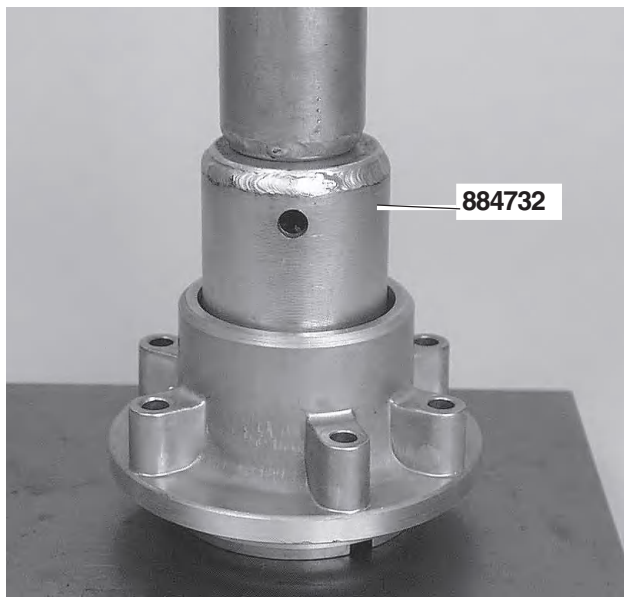


32. If the roller bearings are damaged, they must be changed. Remove the large outer bearing race from the bearing housing, using tool no. **884726** and shaft **884143**.

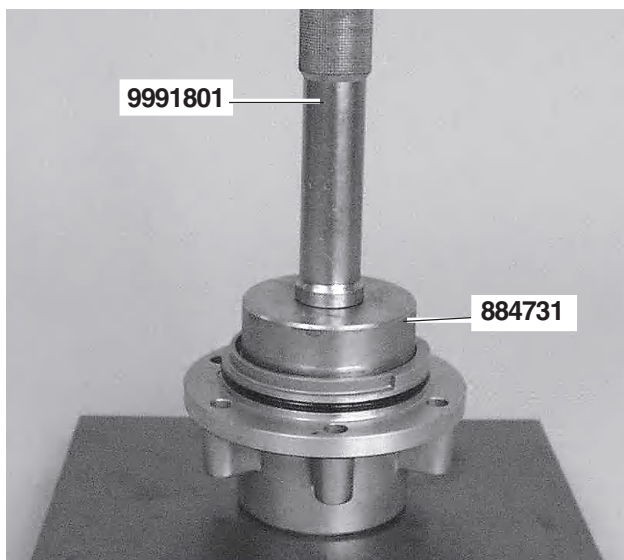


34. Remove the roller bearing from the input shaft, using a knife-type extractor. Then remove the washer. Clean the components and check for wear, replace worn and damaged components.

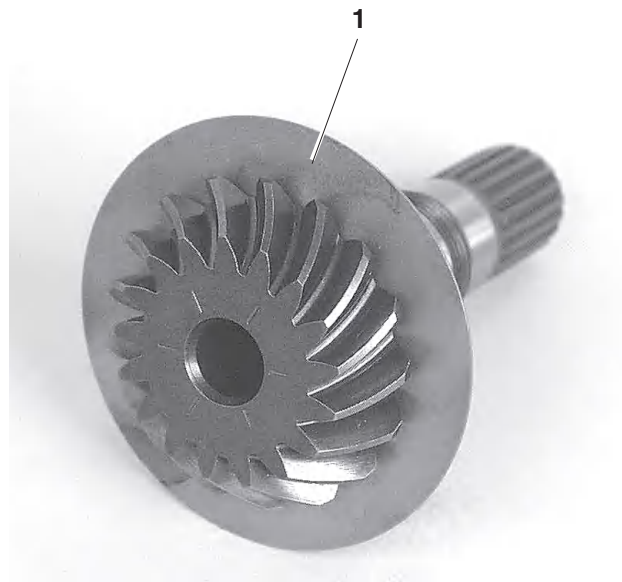
Input bearing housing, installation.



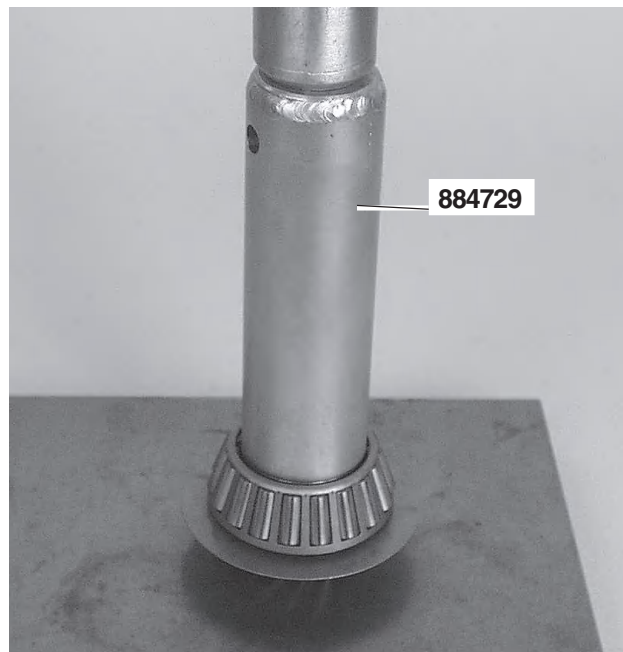
35. Press the small outer bearing race into the bearing housing. Use tool no. **884732**.



36. Press the large outer bearing race into the bearing housing. Use tool no. **884731** and shaft **9991801**.



37. Put the metal sheet (1) on the drive shaft.



38. Press the large roller bearing onto the drive shaft. Use tool no. **884729**.



39. Place the drive shaft in the bearing housing and press the small roller bearing on, using tool no. **884729**.

NOTE! Do not press the bearing until it bottoms. A certain amount of clearance must be left. When the nut is torqued to the correct value, the bearing housing is pre-loaded and the clearance disappears.



41. Test the pre-load with a spring balance. Fix the gear wheel or shaft in a vise with soft jaw pads. Wind a string round the bearing housing, and pull with spring balance no. **9985494**.

Pre-load: **10-18 N (2.25-4.05 lbf)**

Not enough pre-load: Increase the torque on the nut.

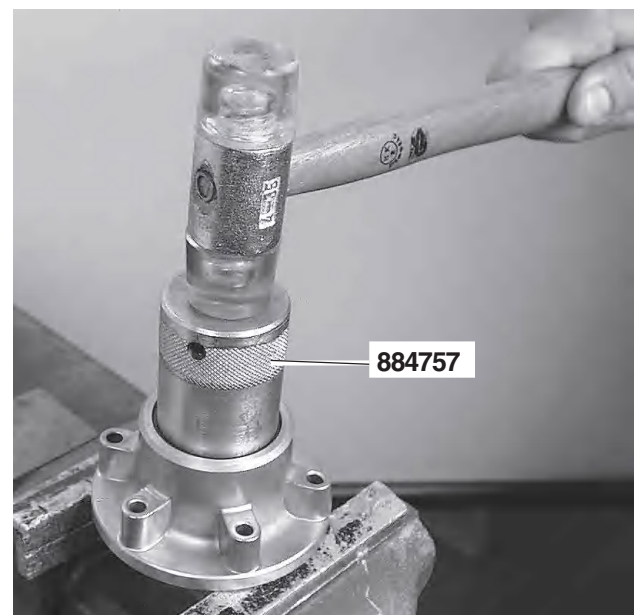
Too much pre-load: Reduce the torque on the nut.



40. Screw a new nut on. Turn the chamfer inwards.

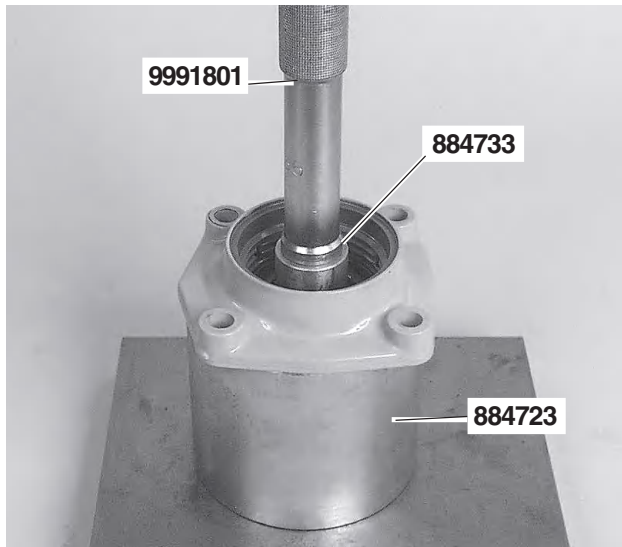
NOTE! The nut must always be changed.

Use tool no. **884724**. Start off with low torque. Please refer to the following chapter.

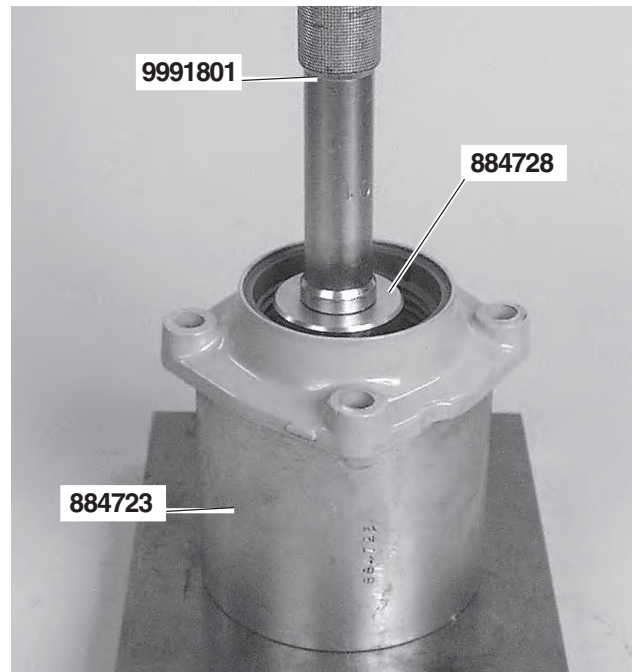


42. Oil and install the seal ring carefully, to avoid damage to the seal lip. Use tool no. **884757** to drive the ring in.

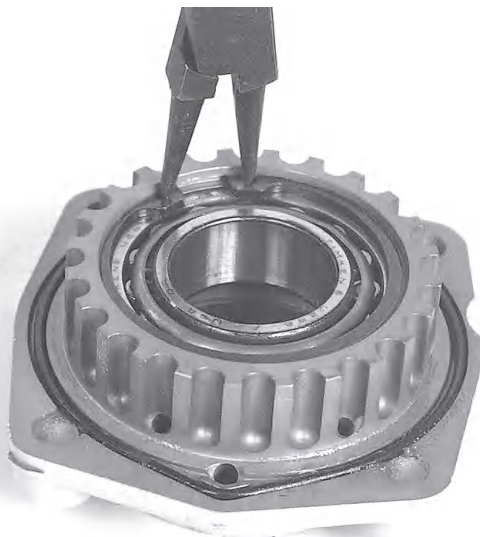
Upper bearing housing, disassembly



43. Put the bearing housing in tool no. **884723** and press the gear wheel out. Use tool no. **884733** and shaft **9991801**. Save any shims.

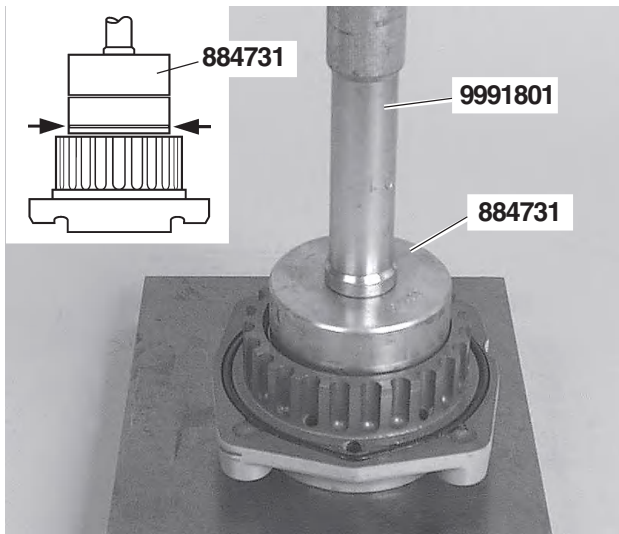


45. Put the bearing housing in tool no. **884723** and press roller bearing out of the bearing housing. Use tool no. **884728** and shaft **9991801**.



44. Remove the circlip, using circlip pliers.

Upper bearing housing, assembly

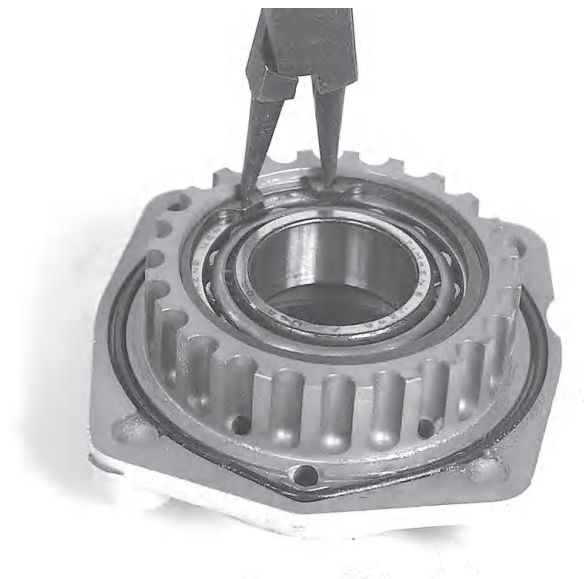


46. Press the upper roller bearing into the bearing housing. Use tool no. **884731** and shaft **9991801**.

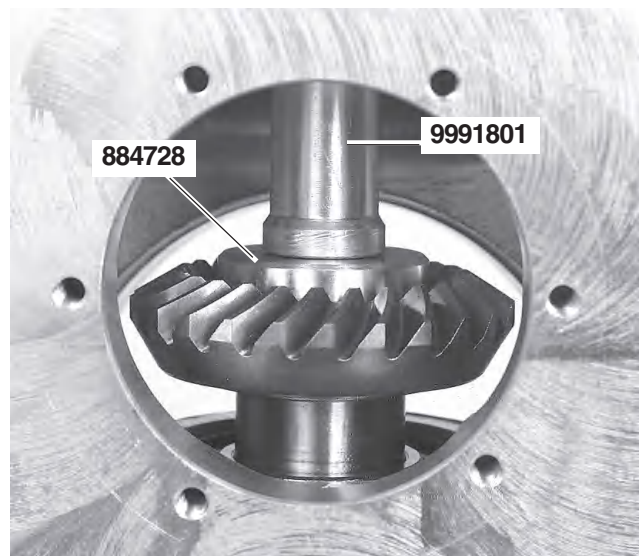
NOTE! The narrow ring on the bearing, at the arrow, should face the bearing housing. Make sure that the bearing does not go in crookedly.



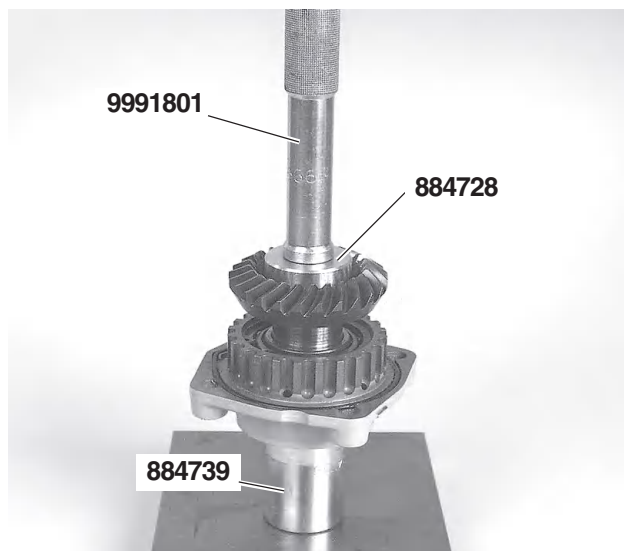
48. Put shims on the gear wheels for the upper bearing housing and gear housing. Start off with 0.50 mm for each gear wheel. This is a value which is based on experience.



47. Install the circlip, using circlip pliers. Turn the chamfered side down, towards the gear housing. Make sure that the circlip is securely seated in the groove.



49. Press the gear wheel into the gear housing. Use tool no. **884728**, shaft **9991801** and **884739** as a support for the inner race.

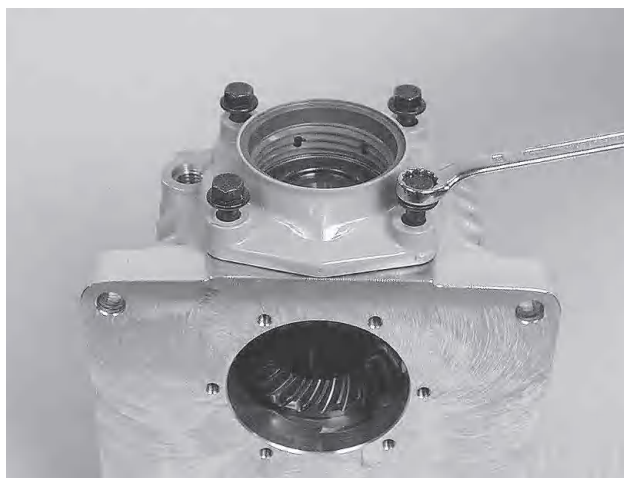


50. Press the gear wheel into the upper bearing housing. Use tool no. **884728**, shaft **9991801** and **884739** as a support for the inner race.

Reverse gear MS2 Output gear housing, disassembly



52. Remove the nut.
Socket size: **27 mm**

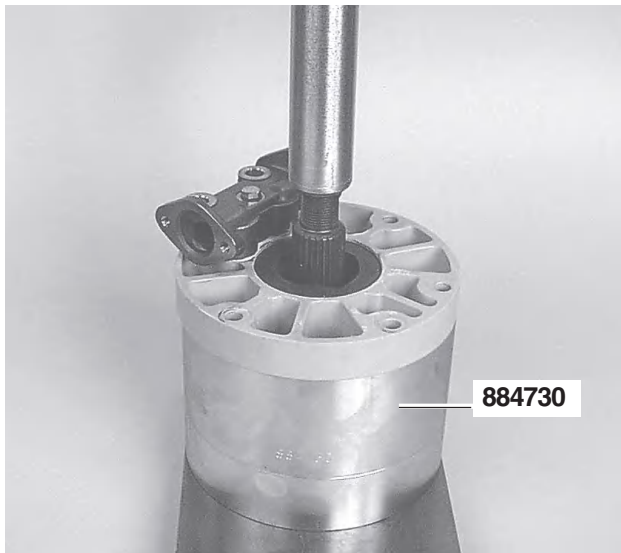


51. Install the upper bearing housing on the reverse gear.

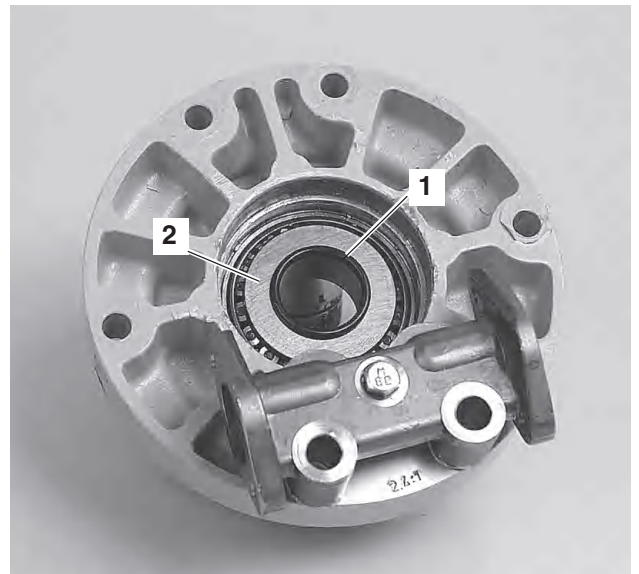


53. Disassemble the propeller shaft flange. Use tool no, **884078**, wrench dimension **19 mm**, or a claw puller.

Pull the seal ring off the propeller shaft flange.



54. Press the output shaft out of the bearing housing. Use tool no. **884730**.



56. Remove the O-ring (1) and ball bearing (2) from the bearing housing.



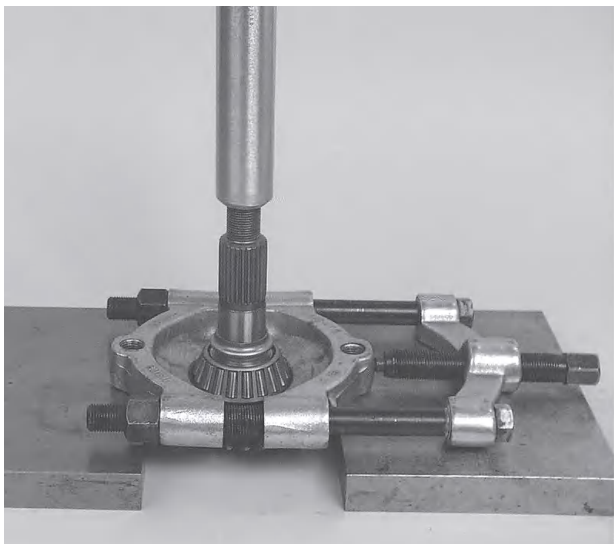
55. Remove the seal ring. Use a screwdriver or similar tool.

NOTE! Use rubber or leather to protect the edges of the bearing housing.

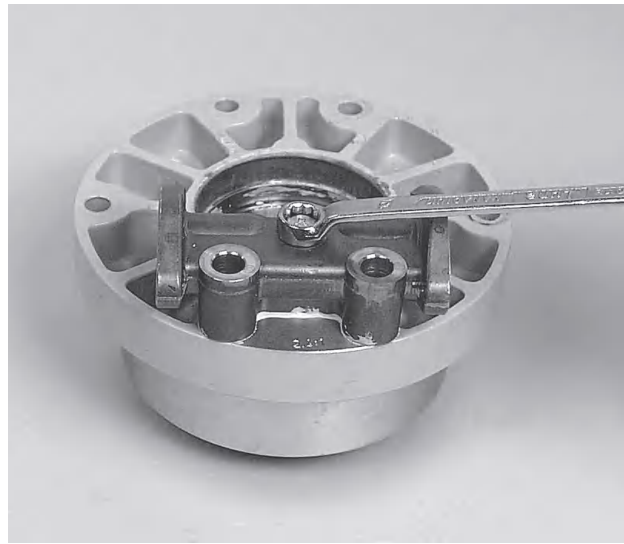
Clean off all traces of sealant.



57. Remove the ferrule (1) from the output shaft.



58. Press the shaft out from the roller bearing. Use a knife puller.



60. Check that the cooling water pipe is in good condition. Change as necessary.

Remove the screw and lift the manifold off.



59. Remove the outer bearing races from the output bearing housing. Use tool no. **884726** and shaft **884143**.

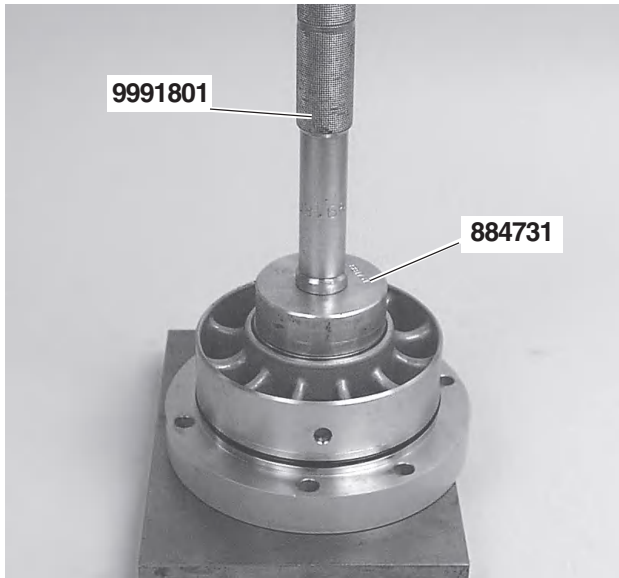


61. Remove the O-rings from around the cooling water pipe and screw hole. The O-ring for the screw hole is mounted on the screw.

Press the cooling water pipe out from the bearing housing.

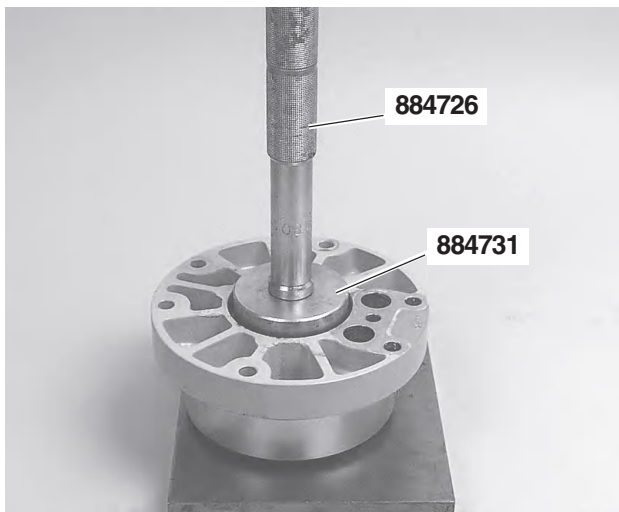
Clean off all traces of sealant.

Reverse gear MS2 Output gear housing, assembly

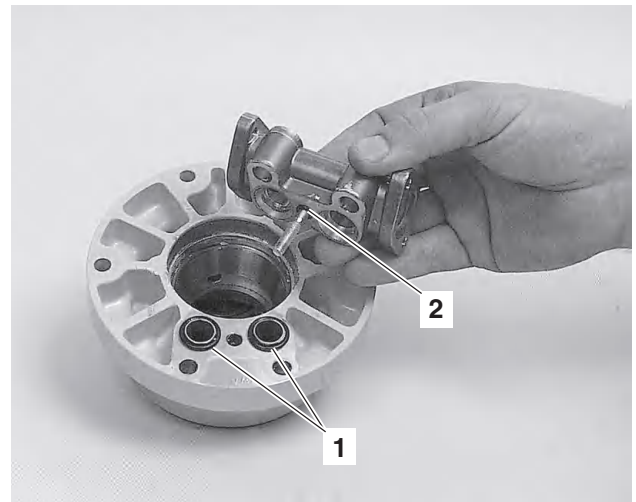


62. Install one of the outer bearing races in the bearing housing. Use tool no. **884731** and shaft **9991801**.

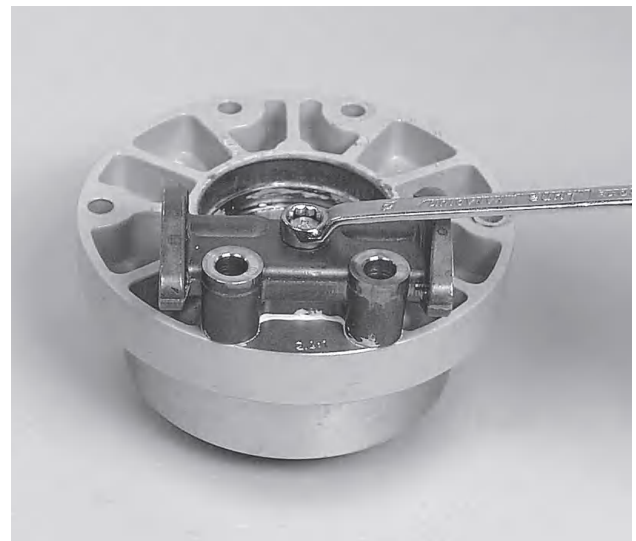
NOTE! Make sure that the bearing race does not go in crookedly.



63. Turn the bearing housing over and press in the other bearing race. Use tool no. **884731** and shaft **9991801**.

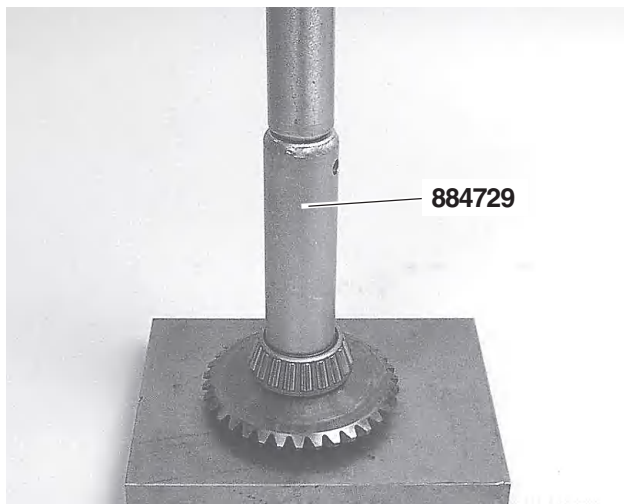


64. Install the cooling water pipe and install the two larger O-rings (1). Press the small O-ring (2) onto the screw.

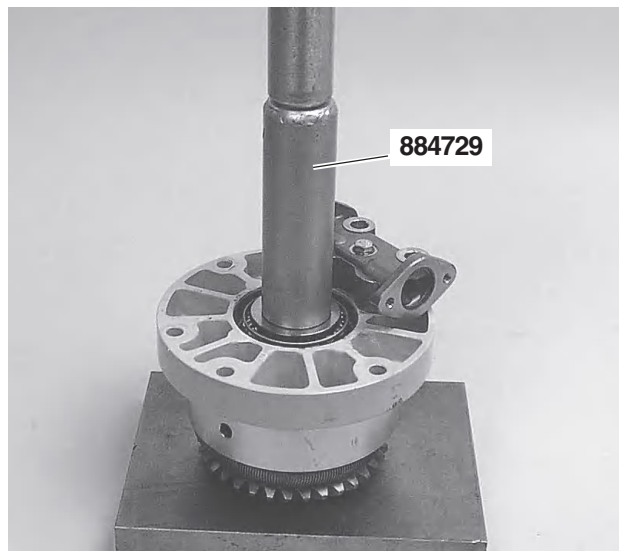


65. Apply sealant, Volvo Penta part. no. 840879-1 on the mating face against the bearing housing.

Install the cooling water union. Check that the O-ring is correctly aligned. Tighten the screw.



66. Press a roller bearing onto the output shaft. Use tool no. **884729**.



68. Place the drive shaft in the bearing housing and press the other roller bearing on, using tool no. **884729**.

NOTE! Do not press the bearing until it bottoms. Some clearance must be left. When the nut is torqued to the correct value, the bearing housing is pre-loaded and the clearance disappears.



67. Install a new ferrule (1).

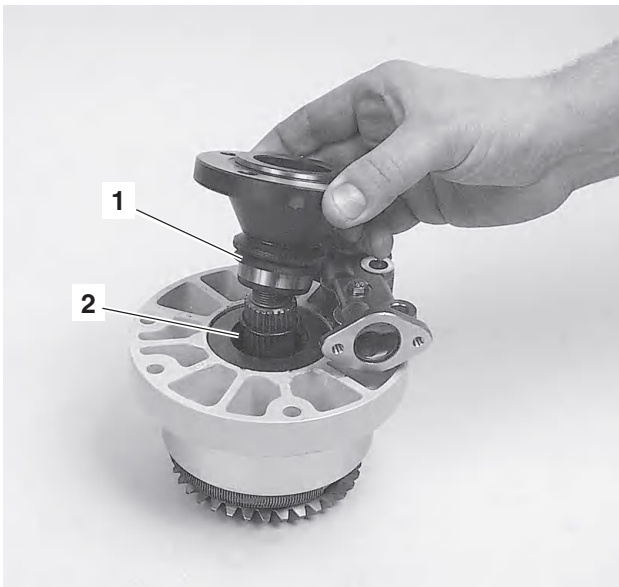
NOTE! Always use a new ferrule when the output shaft has been removed from the housing.



69. Apply sealant, Volvo Penta part. no. 840879-1 on the mating face of the seal ring against the bearing housing.

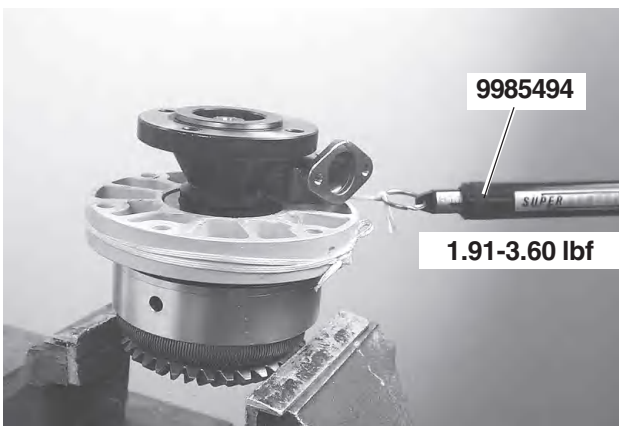
Install the seal ring in the bearing housing. Press the outer diameter of the seal with a mandrel.

Wipe some grease, Volvo Penta part no. 828250-1 on the ring.



70. Put on O-ring (1) and thread seal ring (2) on.
Install the propeller shaft flange and install **a new** nut.
Tighten the nut.

NOTE! Start off with low torque and check with a
spring balance. Please refer to item 71.

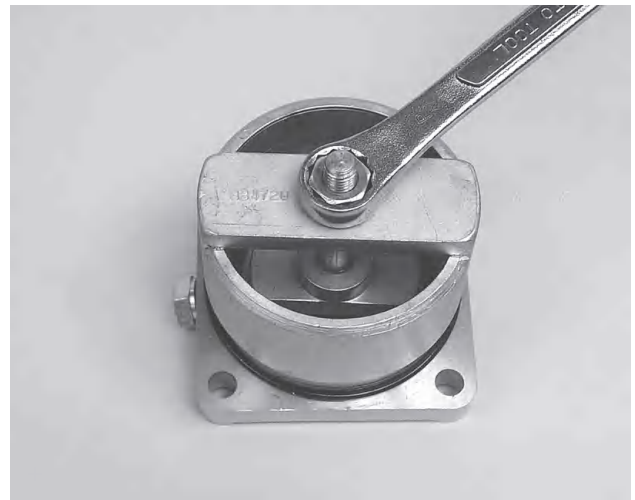


71. Use spring balance **9985494** to check that the cor-
rect pre-load has been obtained.

Pre-load: **8.5-16.0 N (1.91-3.60 lbf)**

Tighten the nut progressively until the correct pre-load
has been obtained.

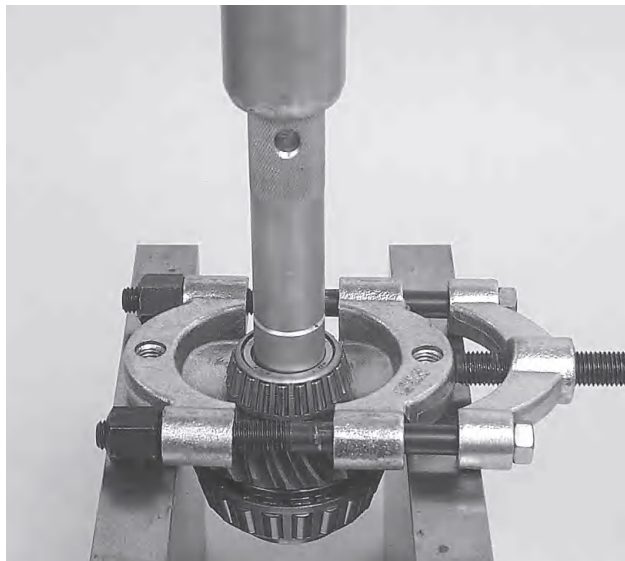
Reverse gear MS2 Lower bearing cover, disassembly



72. Disassemble the outer bearing race with tool no.
884720.

Remove the shim and the O-ring.

Reverse gear MS2 Slipping clutch, disassembly

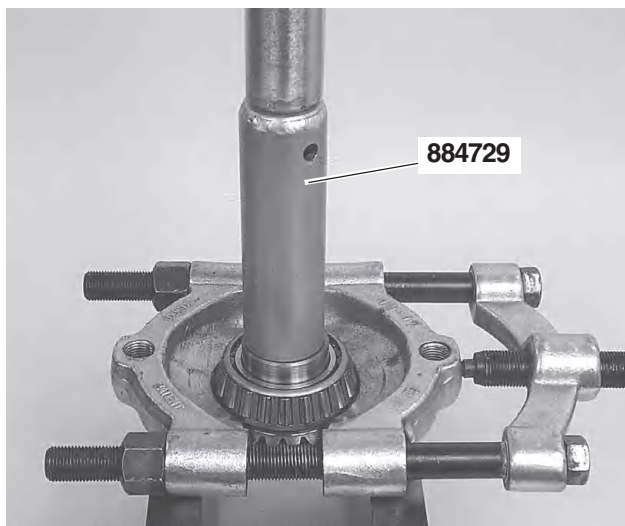


73. When the bearings need to be changed. Press the small ball bearing off the slipping clutch. Use a mandrel and knife extractor.

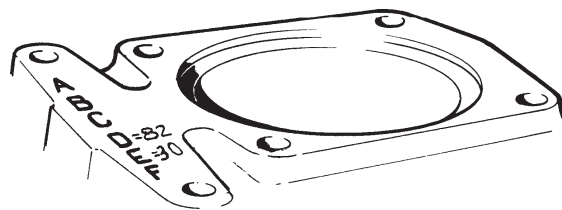
Reverse gear MS2. Slipping clutch/lower bearing cover, assembly



75. Press the small ball bearing onto the slipping clutch. Use tool no. **884733**.



74. Press the large ball bearing off the slipping clutch. Use a knife extractor and tool no. **884729**.



76. Preferably use the shims which were installed previously, if only new bearings have been installed. In other cases, the shim thickness can be calculated as in items 77–84.

Calculate the shim thickness for the small bearing race in the slipping clutch. The housing is stamped with a D dimension and an E dimension.

Let us assume that the D dimension = 88.82 mm and the E dimension = 61.30 mm.

NOTE! The D dimension is based on 88.00 and only the decimals are stamped. The E dimension is based on 61.00, to which the stamped value should be added.

Thus: $88 + 0.82 = 88.82$ and $61.00 + 0.30 = 61.30$.

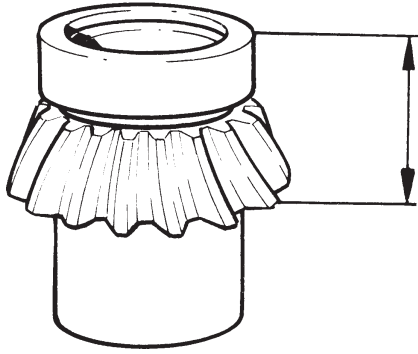
The example below shows how the shim thickness is calculated.

Example:

D = 88.82 **NOTE!** only 82 is stamped

E = 61.30 **NOTE!** only 30 is stamped

D-E = 27.52

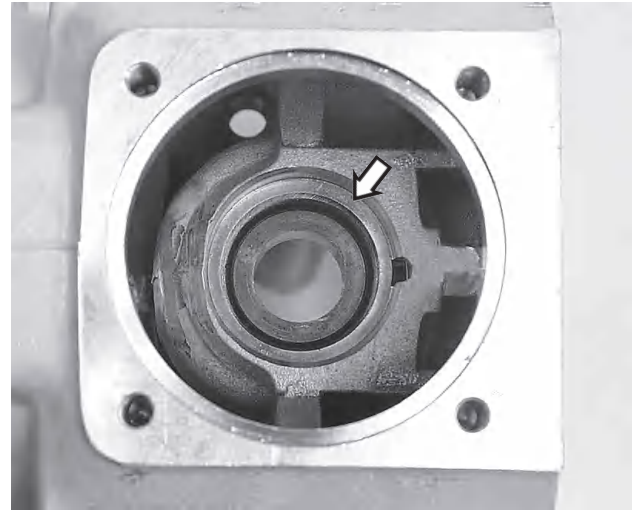


77. Assume that the marking on the gear wheel = 65.00 mm. Only 00 is stamped on the gear wheel.

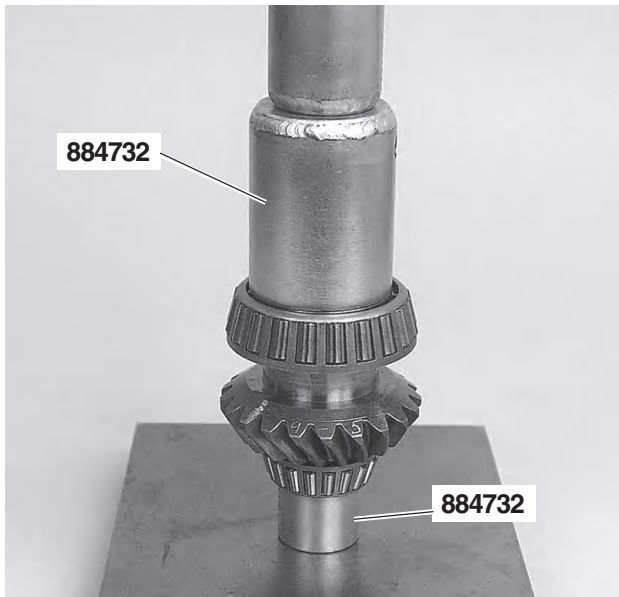
Put the outer bearing race on and measure the depth of the gear wheel and the small roller bearing, as shown in the illustration. For example, 37.10 mm.

The marking on the gear wheel is 65.00 mm and we have measured the gear wheel + bearing to 37.10 mm. This gives us $65.00 - 37.10 = 27.90$ mm.

Since $D - E = 27.52$ mm, this gives the shim thickness $27.90 - 27.52 = 0.38$ mm.

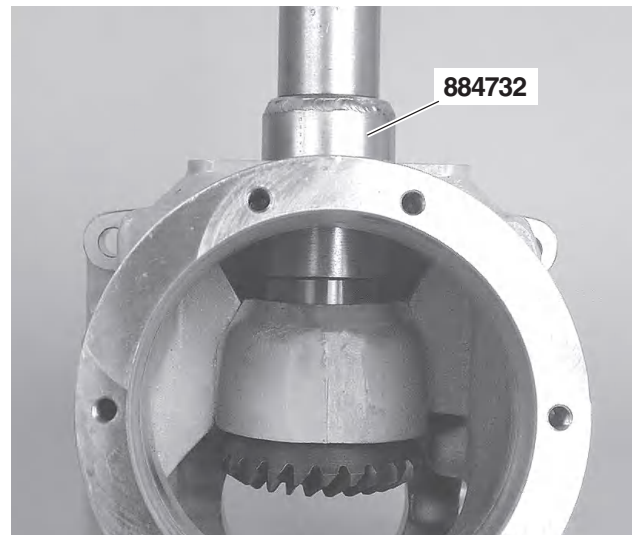


79. Place the shims, as calculated, in the housing. In this case, they are 0.40 mm.



78. Press the large ball bearing onto the slipping clutch. Use tool no. **884732** and tool no. **884733** under the small gear wheel.

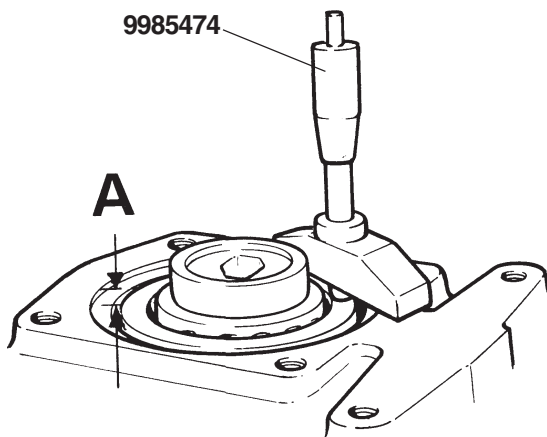
Use the original shims when only **new** ball bearings have been installed. In other cases, the shim thickness must be calculated as in items 76–77.



80. Press the small bearing race into the housing. Use tool no. **884732**.



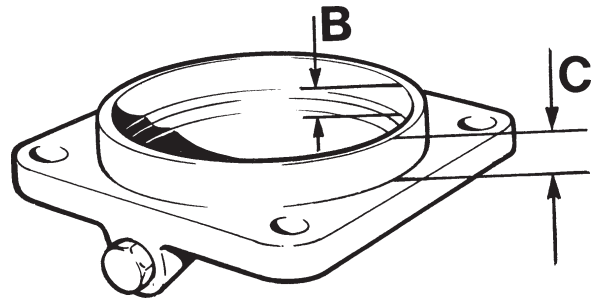
81. Put the slipping clutch into the housing and place the outer bearing race loose on top of the bearing.



82. Calculate the shim thickness as follows:

Press the outer bearing race with your fingers and turn the gear wheel (pinion) round about 10 turns, to remove any slack in the rollers.

Measure with a depth micrometer **9985474** from the housing plane, down to the bearing race (**A**).



83. Measure the cover on the inside (**B**) down to the shim seat. Then measure the cover on the outside (**C**).

Example:

$S = (C-B) - A$, where S is the shim thickness.

First press the bearing race, and turn the gear wheel about 10 turns. The ensuing measurement A becomes 2.5 mm, for example.

We now measure distance B , which becomes 16.05 mm, for example. We then measure distance C , which becomes 18.10 mm, for example.

This gives: $C - B = 18.10 - 16.05 = 2.05$ mm.

This should be subtracted from the A dimension, which we measured as 2.5 mm.

$2.50 - 2.05 = 0.45$ mm

NOTE! To obtain the correct pre-load, shims with a thickness of $0.45 + 0.05 = 0.50$ mm should be put in the cover.



84. Put in shims of the calculated thickness, plus a further 0.5 mm in the cover and install the bearing race. Put a plate on the bearing race and press.

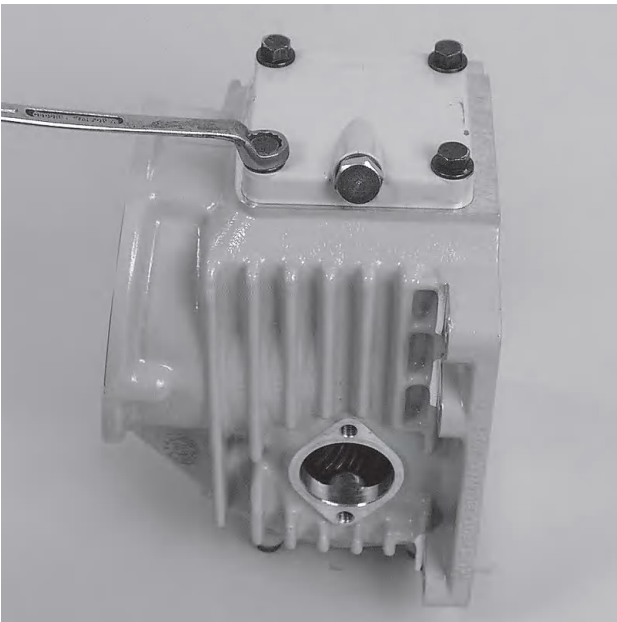
NOTE! Align the bearing race carefully, to ensure that it does not go in crookedly.

The extra shim thickness will be removed later, when the flank clearance has been tested.

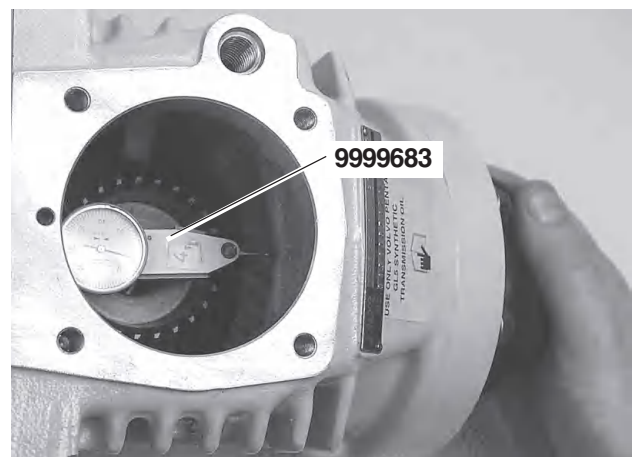
Reverse gear MS2 Flank clearance



86. Put an 0.20 mm shim on the outgoing bearing housing, and install it on the housing.



85. Install the cover on the housing, and tighten it with four screws.



87. Measure the flank clearance with a dial gauge and rocker **9999683**.

Flank clearance: **0.10-0.25 mm (0.004-0.010")**

Adjust the flank clearance if necessary.

Not enough clearance:.. Add more shims to the output bearing housing.

Not enough clearance:.. Reduce the shim thickness in the bearing housing.

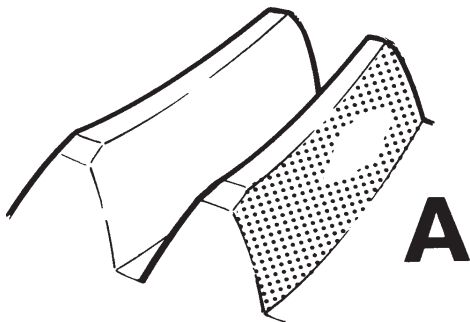
Reverse gear MS2

Marking pattern

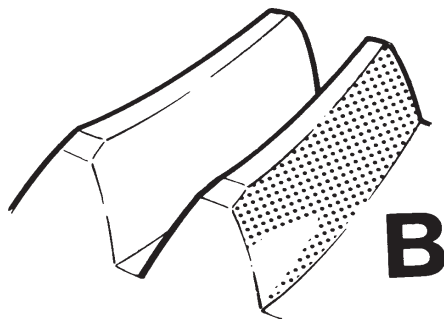


88. Remove the output bearing housing and apply a thin layer of marking dye to the lower gear and the gear wheel on the output shaft.

Install the bearing housing again and turn tool no. **884735** round in both directions, at the same time as the propeller shaft flange is braked.



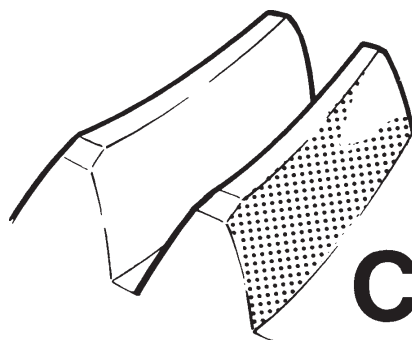
89. Remove the output bearing housing and check whether the marking pattern on the gear wheel corresponds with marking pattern **A**, which is correct. The pattern should be located at the centre of the tooth, in height, but displaced towards the small end.



90. If the marking pattern is similar to **B**, the output shaft must be moved inwards by removing shims from the bearing housing.

If the flank clearance is too small after this operation, the lower drive must be moved downwards by reducing the shim thickness underneath the bearing race in the cover.

NOTE! To retain the preload in the lower gear wheel bearing, the shim thickness for the upper bearing outer race must be increased to the same extent.



91. If the marking pattern is similar to **C**, move the output shaft and lower gear wheel in the opposite directions to what was specified in item 74.



92. When the correct flank clearance and marking pattern have been obtained, disassemble the output bearing housing, lower bearing cover and slipping clutch.

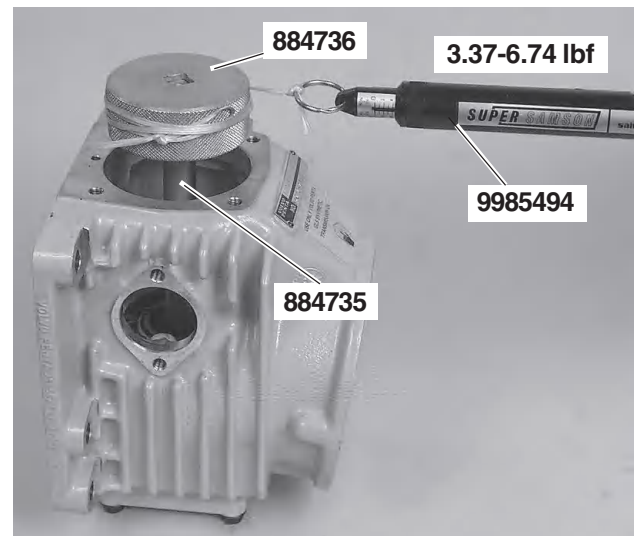
Wash off the marking dye. Then disassemble the outer bearing race in the cover, using tool no. **884720**.



93. Remove the extra 0.5 mm shim thickness which was installed in item 84.

Then put the calculated shim thickness in the lid and install the bearing race. Press, using tool no. **884833**.

Reverse gear MS2 Preload



94. Install the slipping clutch and tighten the cover.

Turn the housing over and install tools **884735** and **884736**. Turn the shaft round with tool no. 884735 in both directions, to make the bearing "seat" itself.

Wind a string round tool no. 884736 and measure the pre-load with a spring balance, **9985494**.

Preload, new bearings: **15-30 N (3.37-6.74 lbf)**.

Too much pre-load: Reduce the shim thickness in the upper cover.

Not enough pre-load: Increase the shim thickness in the upper cover.



95. When the correct pre-load has been obtained, remove the lower bearing cover, the slipping clutch and the small outer bearing in the gear housing.

Use tool no. **884728** and shaft **9991801**.

NOTE! Save the shims.

Gear housing



96. Install the lower roller bearing in the housing.

NOTE! Align the narrow ring by the arrow upwards. The ring has a sharp edge which would cut into the casting if it were installed crookedly. For this reason, be careful to ensure that the bearing is correctly aligned in the bearing seat.

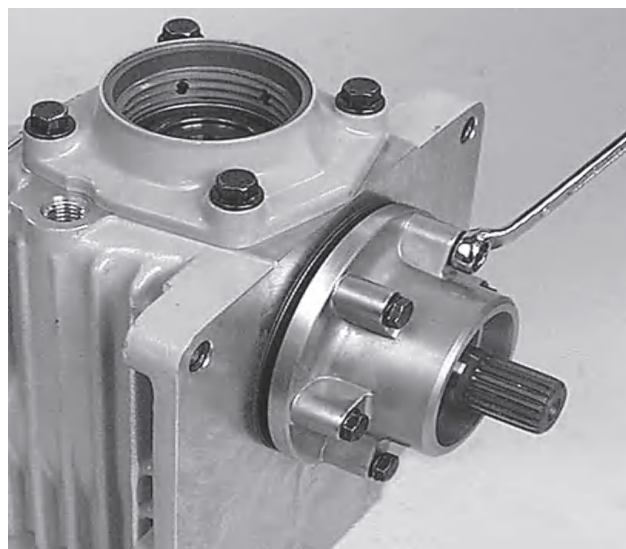
Use tool no. **884731** and shaft **9991801**.



97. Install the circlip, using circlip pliers.

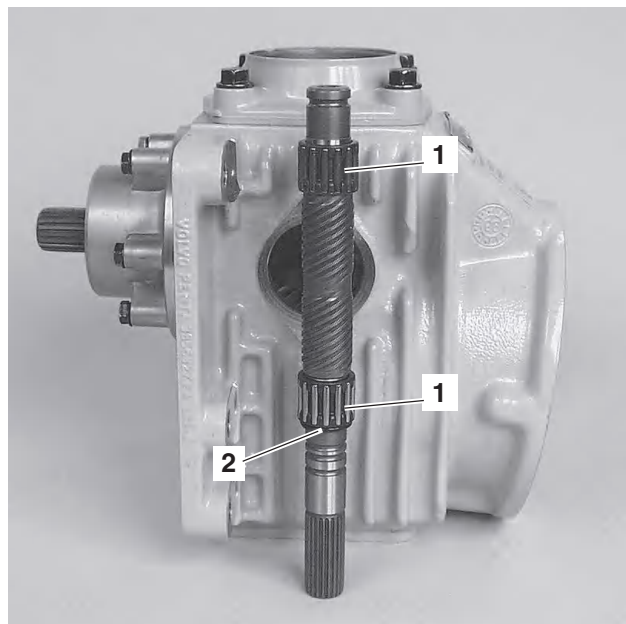
NOTE! The chamfered side must face upwards. Make sure that the circlip is securely seated in the groove.

Checking the marking pattern and gear flank clearance



98. Try installing an 0.40 mm shim in the input bearing housing.

Install the bearing housing on the housing.



99. Put the vertical shaft, with needle roller bearing, in the housing. The lower needle roller bearing is retained by a rubber band or O-ring.

The illustration shows the location of the bearing (1) and O-ring (2).



100. Measure the gear flank clearance on both gear wheels, using a dial gauge **9999683**. Press the gear wheel downwards.

The clearance should be **0.10-0.25 mm (0.004-0.010")**

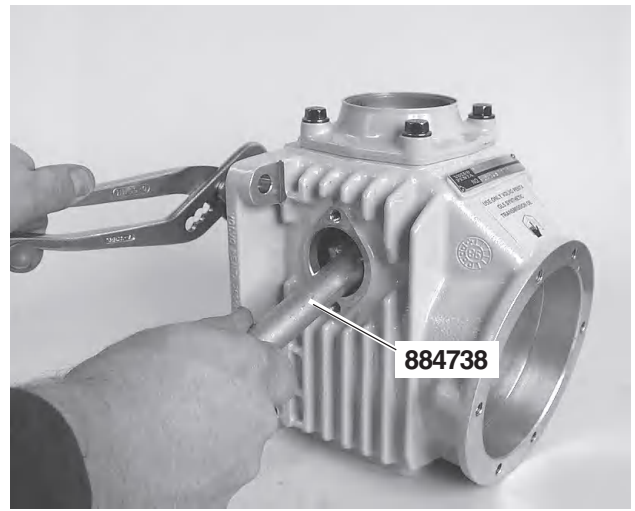
If the flank clearance is not enough, further shims should be added to the input bearing housing.

If the flank clearance is too great, reduce the thickness of the shims.

NOTE! It may be necessary to reduce the shim thickness below the gear wheel.

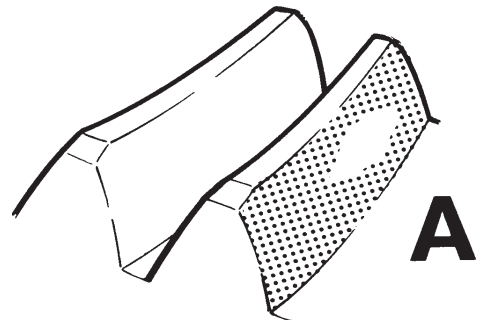


101. Turn the gear housing upside down. Press the other gear wheel down and do the same operations as in the previous item.



102. Apply marking dye to the gear wheel. Turn the input shaft round in the direction of engine rotation. Protect the splines on the input shaft with a rubber sheet etc.

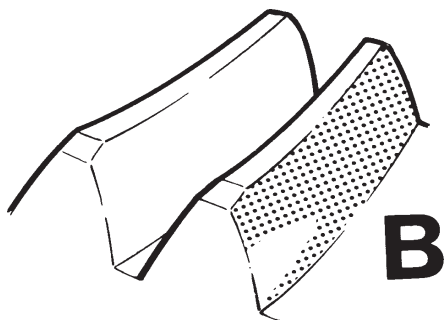
Brake with tool no. **884738**.



103. Check whether the marking pattern corresponds with marking pattern **A**, which is correct. The pattern should be located at the centre of the tooth, in height, but displaced towards the small end.

NOTE! Consideration can not be given to the marking pattern on the input pinion, since this is influenced by both gear wheels.

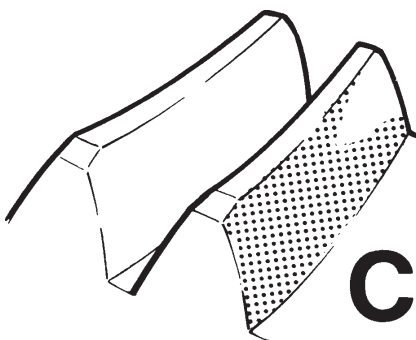
Final assembly



104. If the marking pattern resembles **B**, the shim thickness in the input bearing housing should be reduced. If the gear flank clearance becomes too small, the gear wheels must be disassembled.

Remove the shims from the gear wheels to the same extent, and re-install the gear wheels.

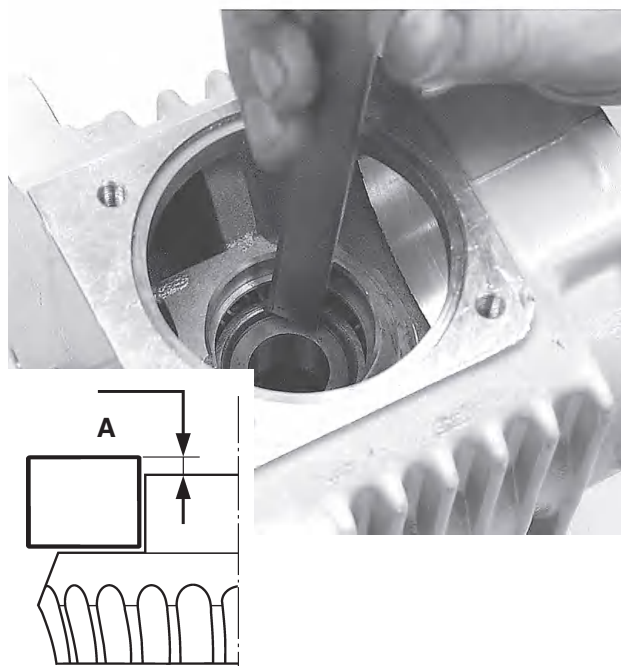
Apply marking dye to the gears again, turn them round and check the contact patches.



105. If the marking pattern is similar to **C**, move the input gear housing and gear wheel in the opposite directions to what was specified in item 104.

When the correct flank clearance and marking pattern have been obtained, the input gear housing and upper gear housing should be disassembled, and all marking dye washed off.

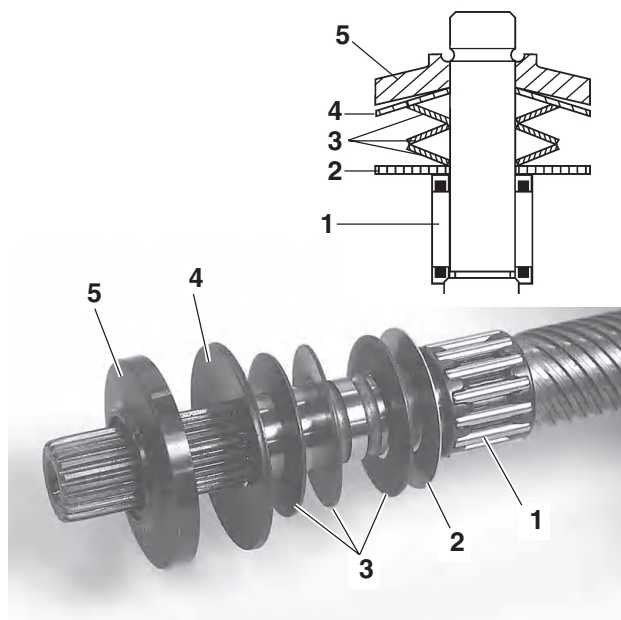
NOTE! Keep the reverse gear upside down when the lower gear wheel is washed clean, to prevent the dye from finding its way into the bearing.



106. Measure distance (A) between the bearing and gear wheel hub. This distance should be between 3.4 and 3.8 mm (0.13 and 0.15").

If the distance is 4.10 mm (0.161"), for example, a spacer washer must be inserted.

If the distance exceeds 4.20 mm (0.165"), two spacer washers must be inserted.



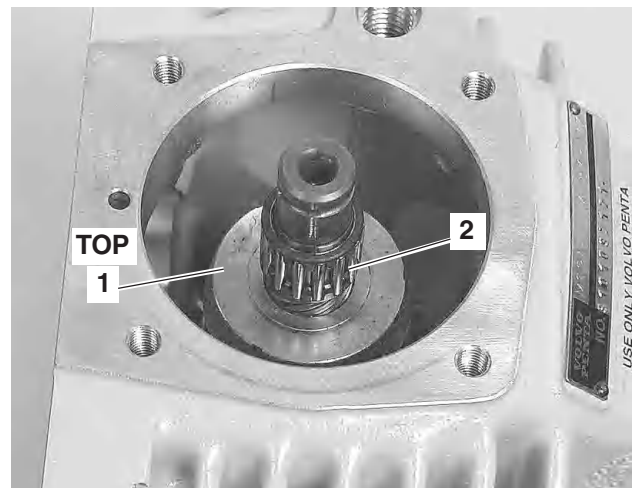
107. Put a needle roller bearing (1) on the vertical shaft.

Then put on the measured spacer washer (2), the three domed small washers (3), the large domed washer (4) and the lock washer (5).



108. Put the shaft in a press.

Use tool no. **884725** and press the lock washer down so far that the retaining ring halves can be put into the groove.



110. Align the “TOP” marking upwards, and install sliding sleeve (1) and needle roller bearing (2).

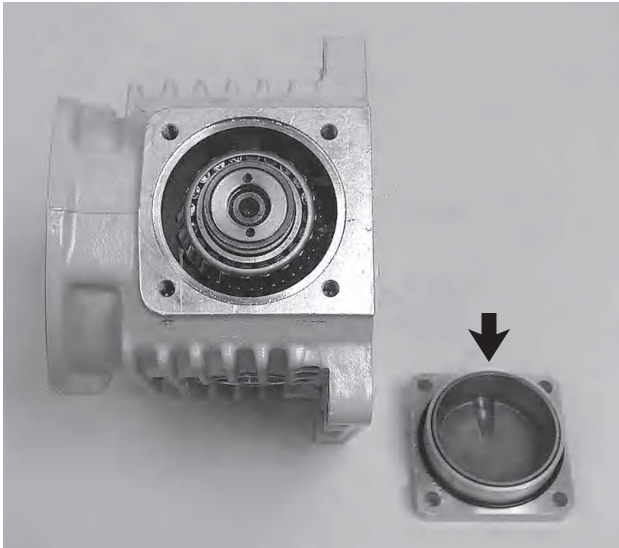


109. Reverse gear MS2

Put the shaft in the housing. Put the calculated thickness of shims on, followed by the outer bearing race. Press the outer bearing race on with tool no. **884732**.



111. Put a new O-ring in the groove in the upper bearing housing. Then install the bearing housing on the housing.



116. Reverse gear MS2

Put a new O-ring on the cover.

Make sure that the oil drain is correctly aligned. Screw the cover down onto the housing.



118. Drive, 120S, 120S-B, -C, -D, -E

Put on a new O-ring and install the rear cover and gear bracket on the upper gear.

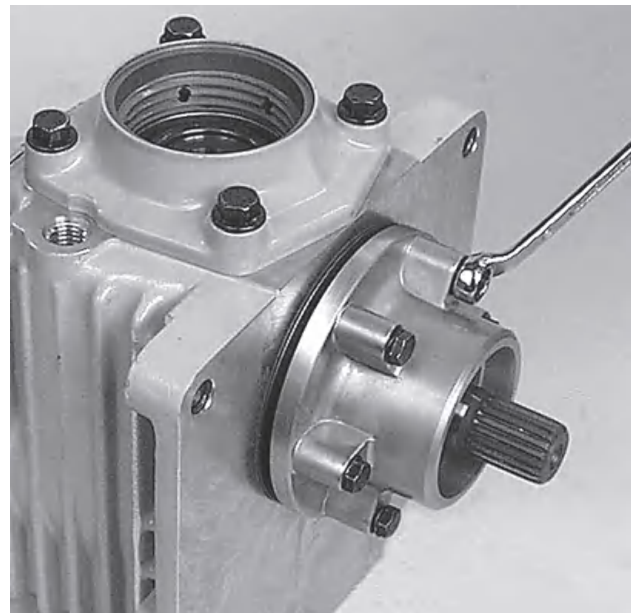
Install the sea water valve. Use sealant, Volvo Penta part no. 1141570 on the threads.



117. Reverse gear MS2

Put on a new O-ring, put the tested thickness of shims on the output bearing housing, and then fix it to the housing with screws.

Turn the shaft slightly, to allow the gear teeth to mesh. Install the gear bracket with two of the screws.



119. Put a new O-ring and the tested thickness of shims on the input bearing housing.

NOTE! The bearing housing can only be installed in one position, because of the hole pattern. Screw the bearing housing down onto the housing.

120. Install the gear change mechanism in the reverse gear housing. Please refer to items 10-13.



121. Reverse gear MS2

Install the dipstick. Fill up with oil.

Please refer to **Technical Data** for oil volume, grade and viscosity.

Check the oil level with the dipstick and install the oil filler cap.

125. Drive, 120S, 120S-B, -C, -D, -E

Install the dipstick and oil filler cap.

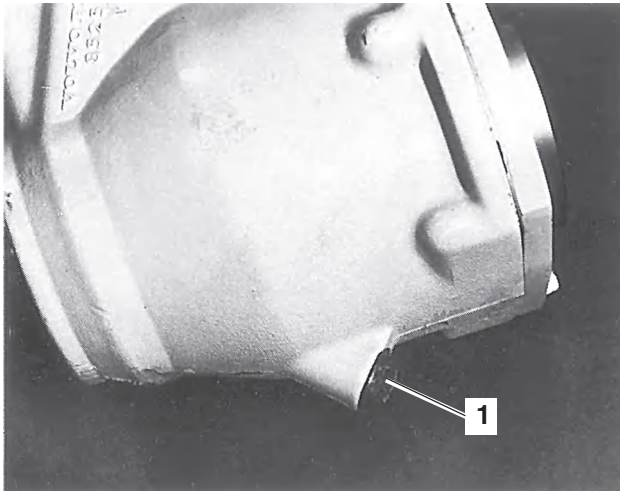
The lower gear must be installed before the oil is put in.

Please refer to **Technical Data** for oil volume, grade and viscosity.

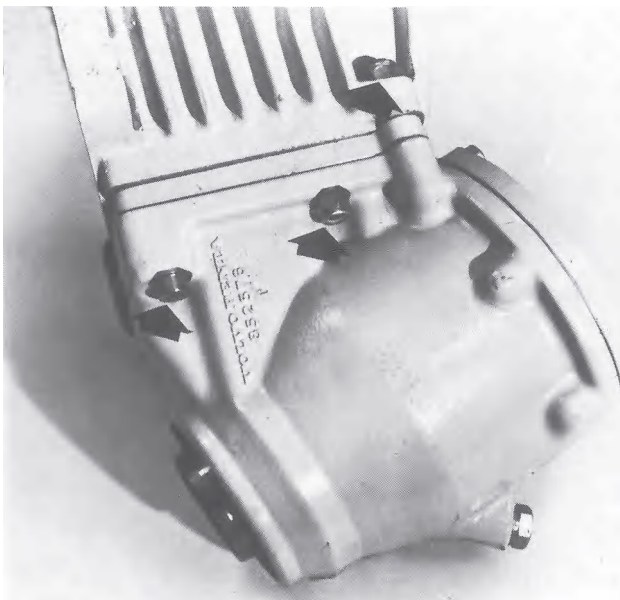
Repair of MS2V reverse gear, angle gear

This section only refers to repair of the angle gear and its sub-components. Please refer to the MS2 information for general information about the reverse gear.

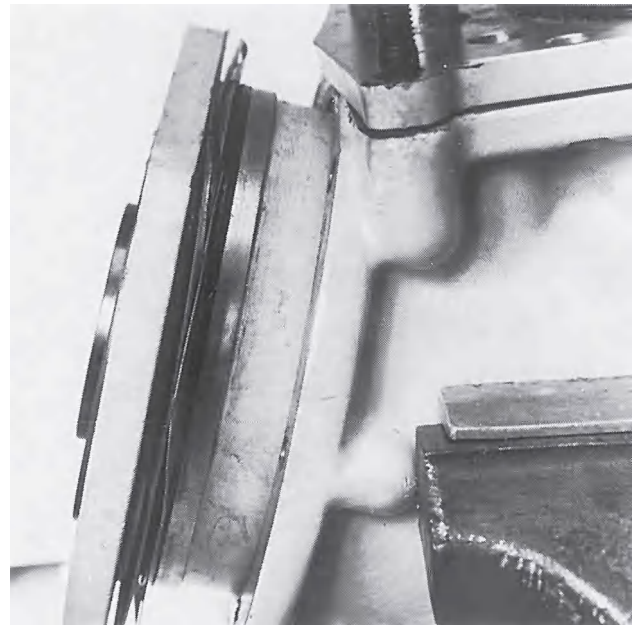
Tubular shaft, disassembly



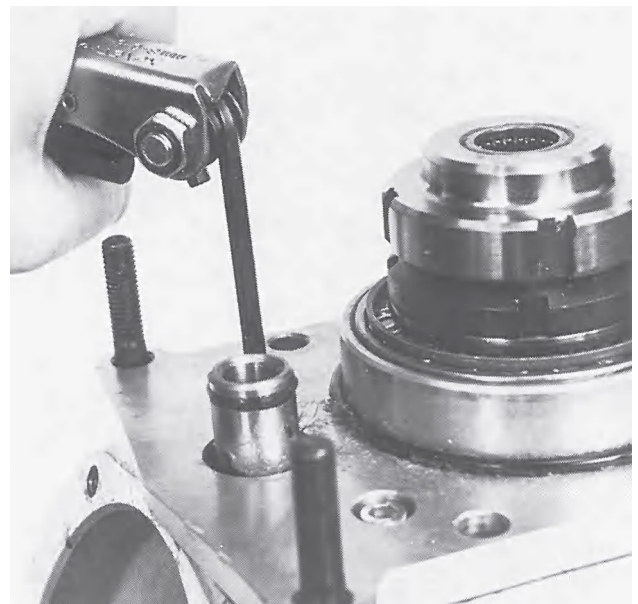
1. Clean the outside of the reverse gear. Remove the drain plug (1) and drain the oil.



2. Undo the 4 nuts, the 2 socket cap screws and remove the angle gear from the reverse gear.



3. Undo the six screws which hold the tubular shaft in the housing, and drive out the tubular shaft with a lead hammer etc. Save the shims between the cover and the gear housing.

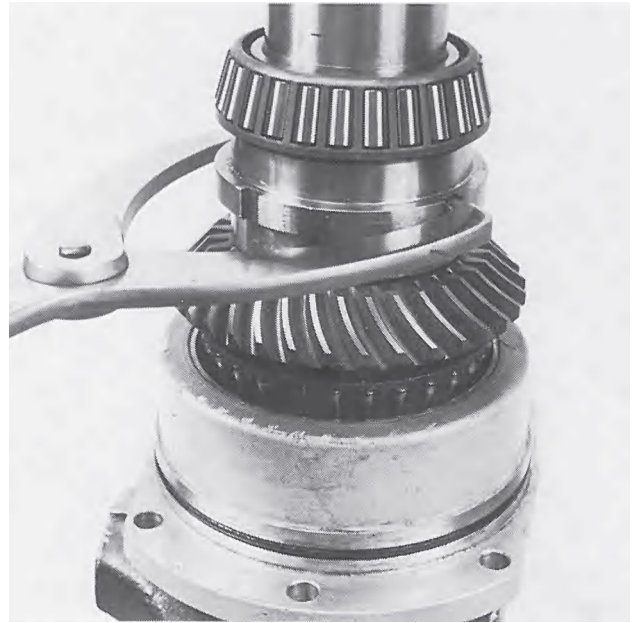


4. Undo the four socket cap screws which retain the pinion in the housing, and disassemble the pinion. Save the shims between the gear housing and the pinion.

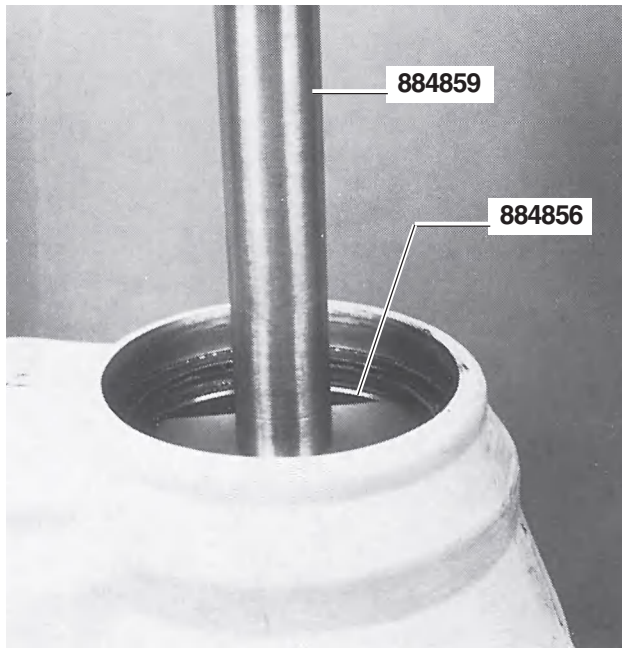


5. Remove the seal ring.

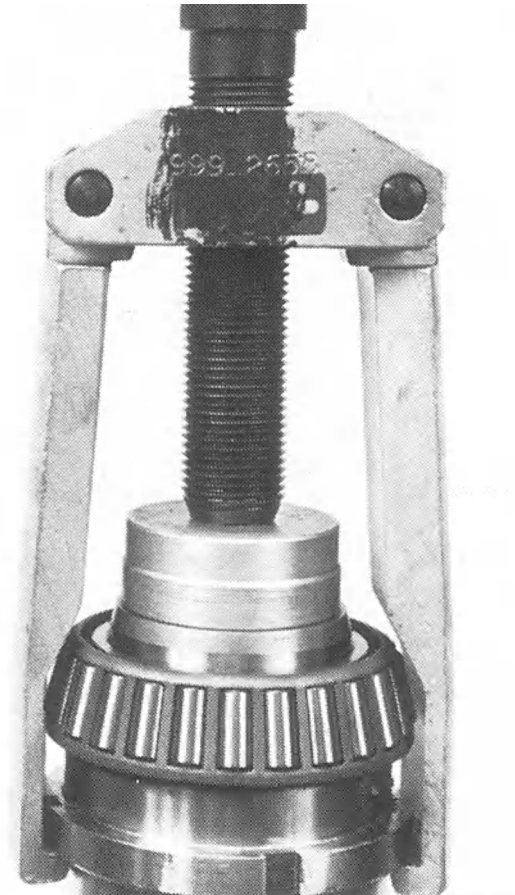
NOTE! The seal ring must always be replaced by a new one.



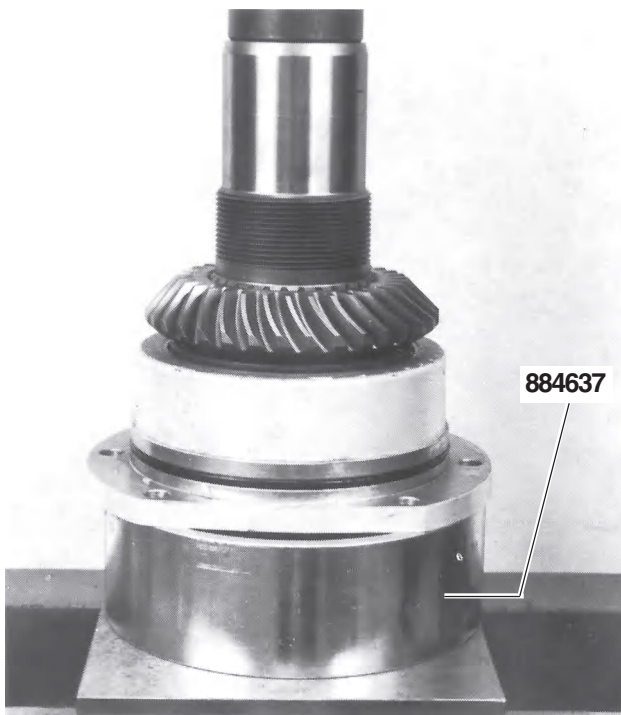
7. Screw two screws into the tubular shaft and fix it by putting the two screw heads in a vise. Undo the tubular nut with a hook wrench. When the tubular nut is removed, remove the outer ball bearing as well. Please refer to item 8.



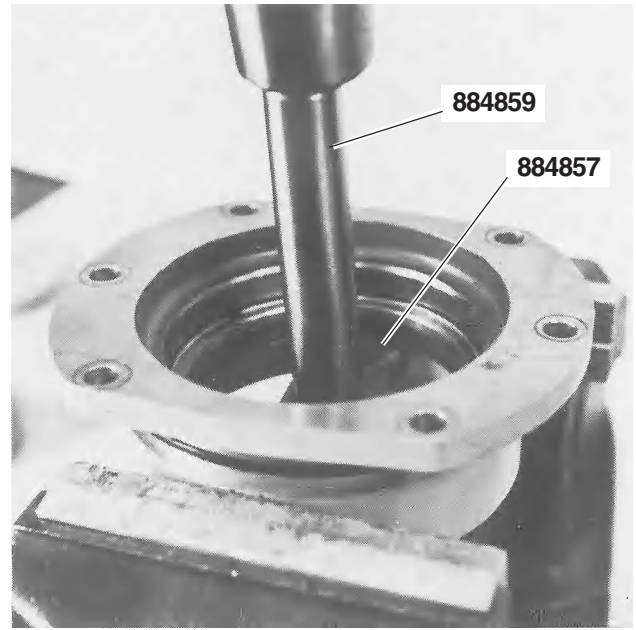
6. Press the bearing race out of the housing. Use tool no. **884856** and shaft **884859**. Save the shims beneath the bearing race.



8. A claw extractor must be used to free the bearing fully from the tubular shaft. Grip round the tubular nut.



9. Put the tubular shaft in sleeve **884637** and press out the tubular shaft, which also removes the crown wheel and the inner roller bearing.

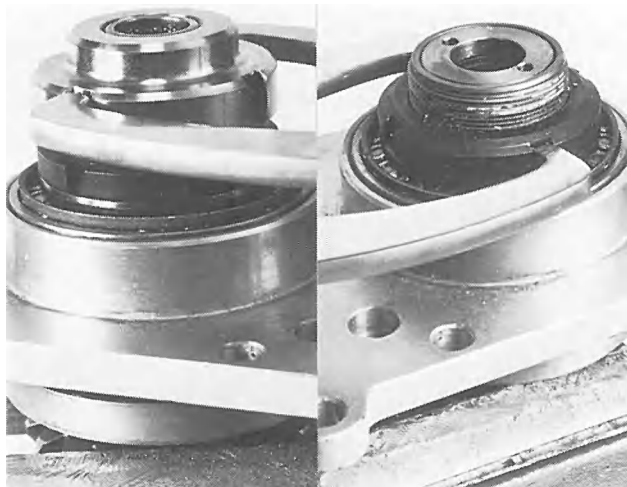


11. Remove the bearing race from the cover. Use tool no. **884857** and shaft **884859**.

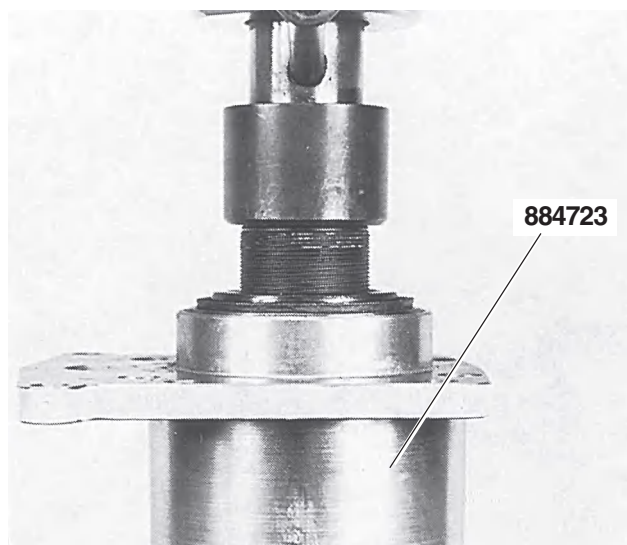


10. Remove the seal ring from the cover. The seal ring must always be replaced by a new one.

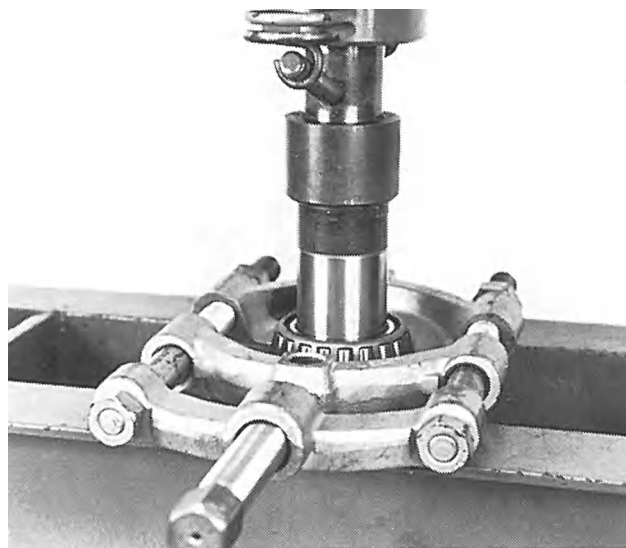
Pinion, disassembly



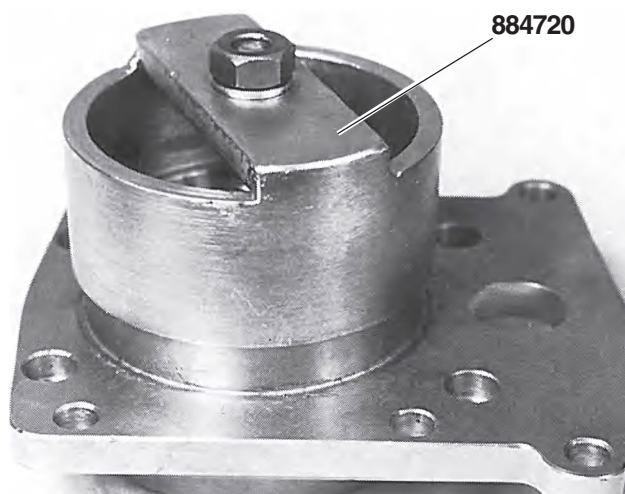
12. Fix the pinion in a vise and undo the two nuts with a hook wrench.



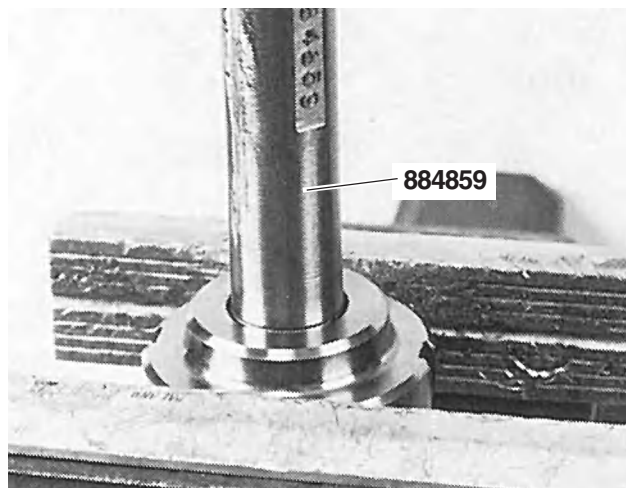
13. Put the pinion in sleeve **884723** and press out the pinion, which also removes upper roller bearing.



14. Remove the roller bearing from the pinion, using a knife extractor and press.

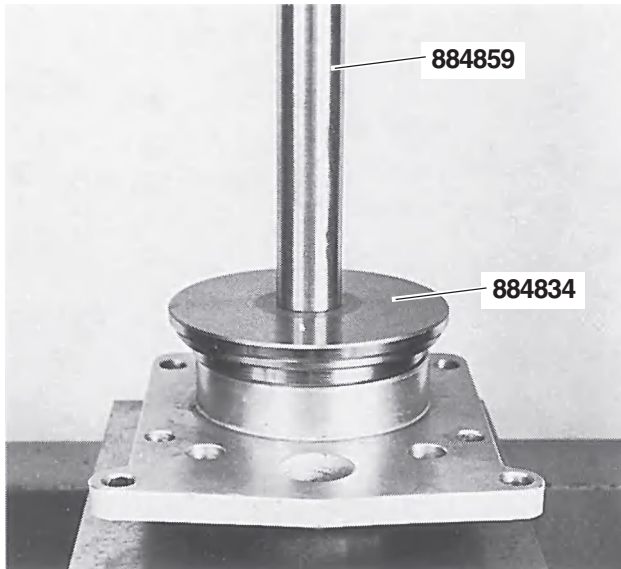


15. Remove the two bearing races in the pinion housing with tool no. **884720**.

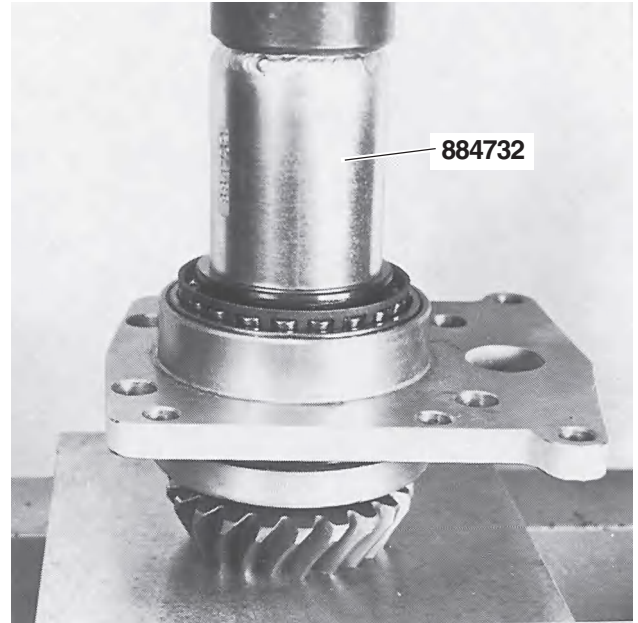


16. Remove the needle roller bearing in the pinion nut with mandrel **884859**.

Pinion, assembly

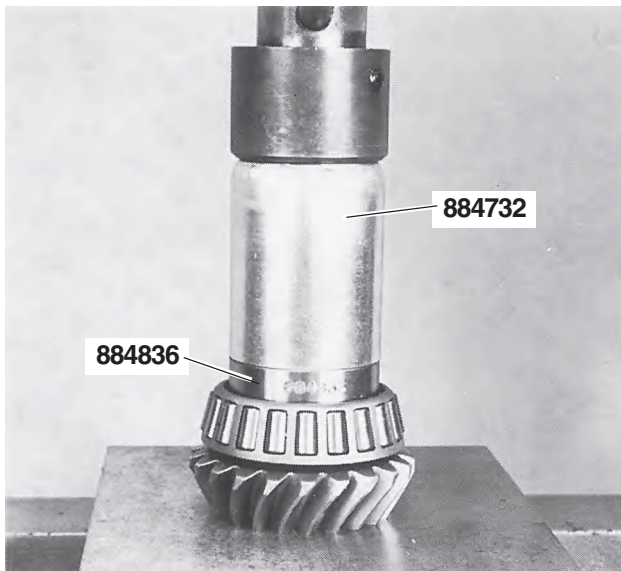


17. Install the bearing races in the pinion housing with tool **884834** and shaft **884859**.

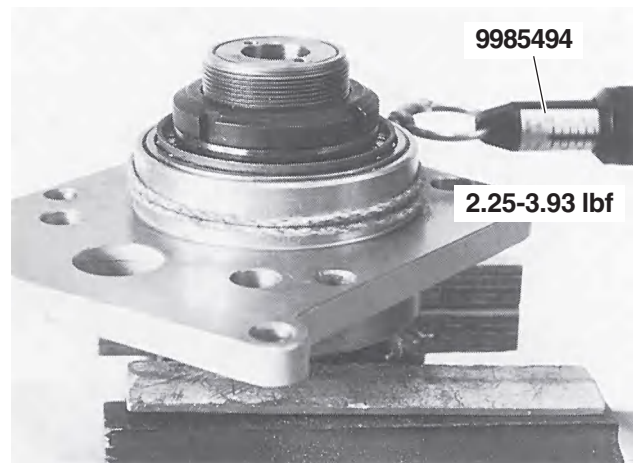


19. Place the pinion in the housing (turn the housing so that the recessed holes for the socket cap screws are on top). Press the other roller bearing on, using tool no. **884732**.

NOTE! Do not press the bearing until it bottoms. Some clearance must be left. When the nut is tightened, the bearing housing is pressed together and the clearance disappears.



18. Install the inner roller bearing on the pinion, use the two sleeves **884732** and **884836**.



20. Apply thread locking fluid, Volvo Penta part no. 1161053-2 on the threads of the nut and install it with the chamfered side upwards.

Start off with low torque and check the preload with a spring balance **9985494** and a piece of string wrapped round the bearing housing.

Pre-load: **10,0-17,5 N (2.25-3.93 lbf)**.



21. Install a new needle roller bearing in the pinion nut, using mandrel **884859**.

Apply thread locking fluid, Volvo Penta part no. 1161053-2, on the threads and install the nut.

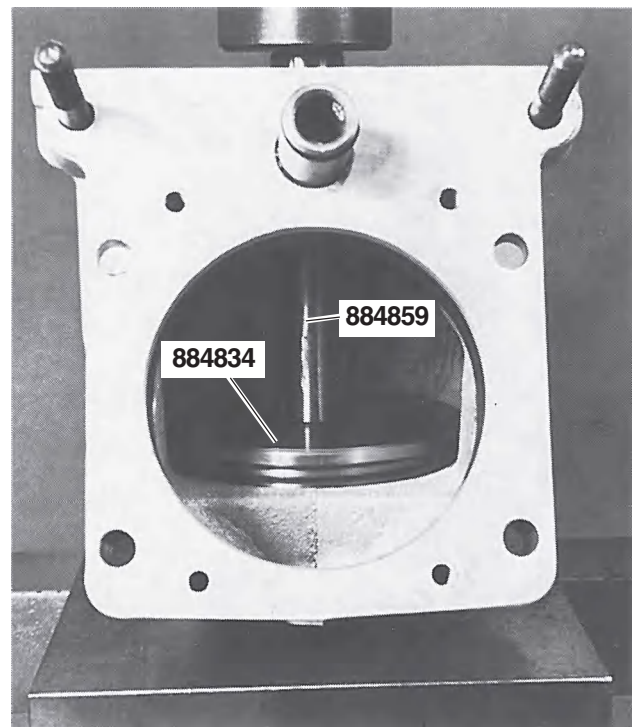
Tightening torque: **140 Nm (103.26 lbf ft)**

Bearing and tubular shaft, assembly

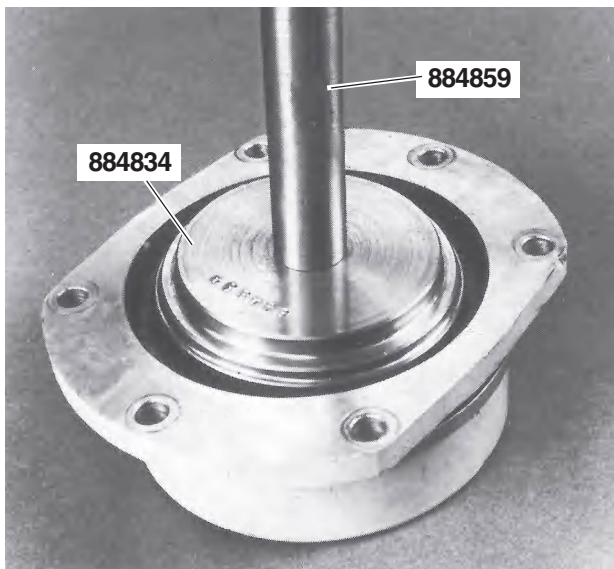


22. Apply sealant, Volvo Penta part no. 1161099-5 to the gearbox housing and install a new seal ring. Use tool no. **884834** and shaft **884859**.

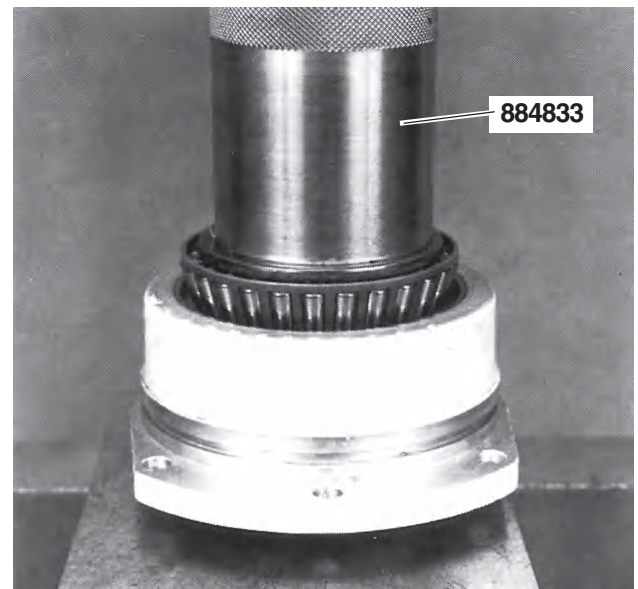
Wipe some grease, Volvo Penta part no. 828250-1 on the lip of the seal ring.



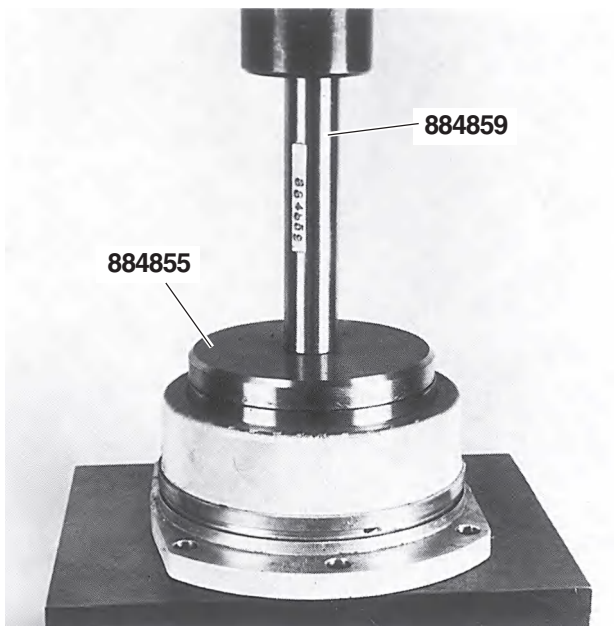
23. Put shims with a total thickness of 0.70 mm in the housing and install the bearing race with tool **884834** and shaft **884859**.



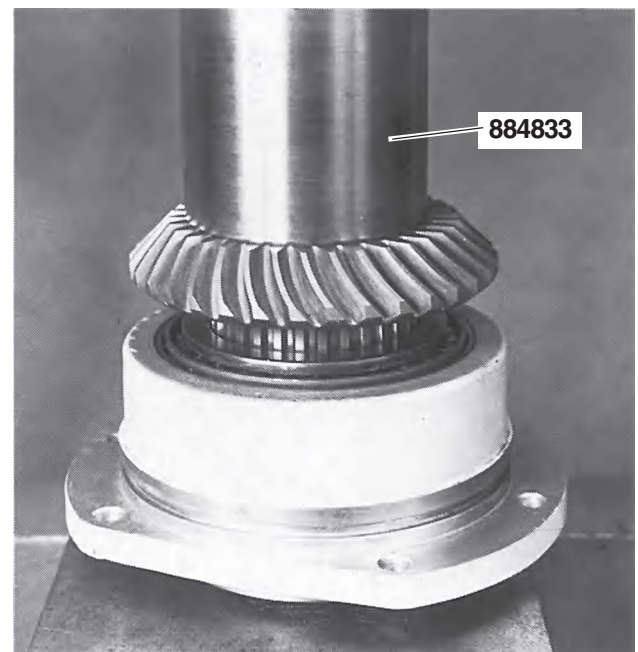
24. Apply sealant, Volvo Penta part no. 1161099-5 to the cover and install a new seal ring. Use tool no. **884834** and shaft **884859**. Wipe some grease, Volvo Penta part no. 828250-1 on the lip of the seal ring.



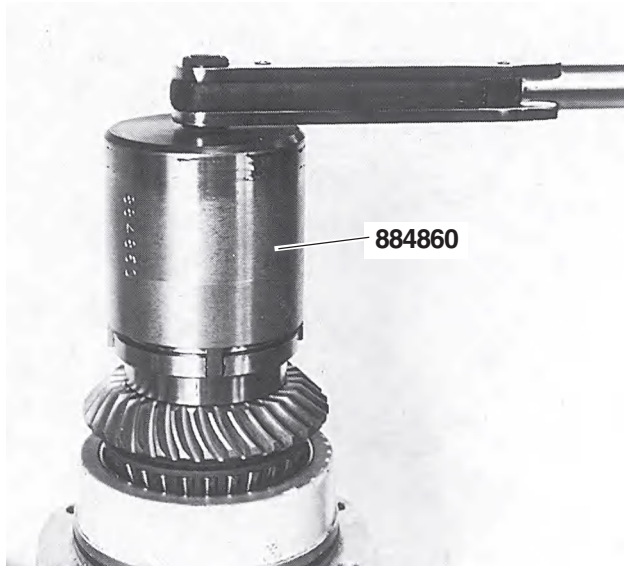
26. Put the cover in the tubular shaft and press the roller bearing on with sleeve no. **884833**. Press the bearing all the way down to the step on the shaft.



25. Install the bearing race in the cover with tool **884855** and shaft **884859**.



27. Press the crown wheel on with sleeve no. **884833**.

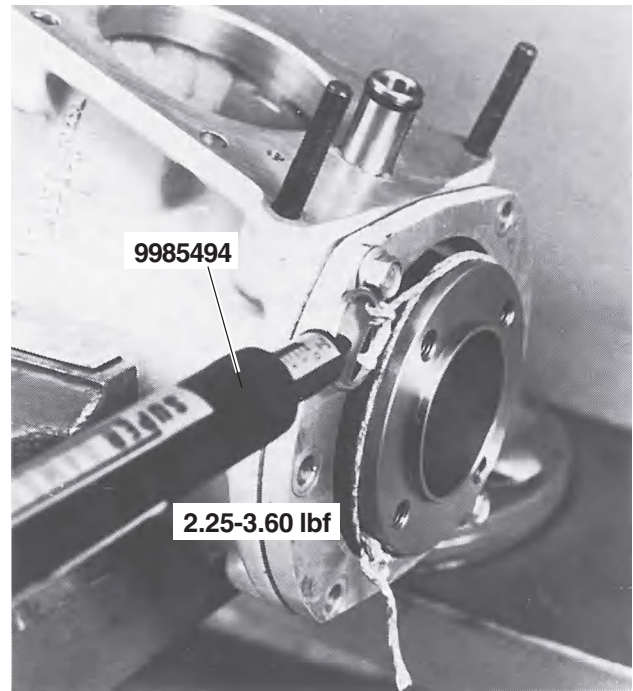


28. Screw two screws into the tubular shaft and fix it in a vise. Align the tubular nut with the un-threaded section towards the crown wheel and install it with tool no. **884860**.

Tightening torque: **140 Nm (103.26 lbf ft)**



29. Press the outer roller bearing on. Use sleeve **884835**.



30. Put shims with a total thickness of 0.70 mm between the cover and the housing.

Install the tubular shaft in the housing and fix it with two diagonally opposed screws.

Tightening torque: **25 Nm (18.44 lbf ft)**

Check the pre-load with a spring balance, **9985494** and a piece of string wound round the tubular shaft.

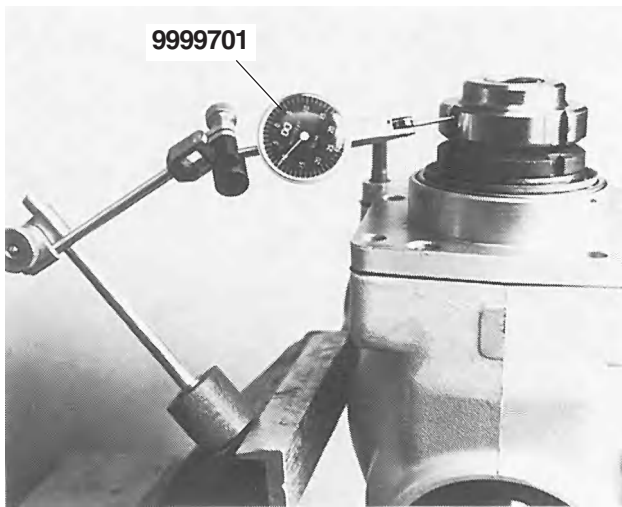
Pre-load: **10-16 N (2.25-3.60 lbf)**

Too low pre-load: Increase the shim thickness under the upper cover.

Too high pre-load: Reduce the shim thickness under the upper cover.

Check the pre-load again and continue until the correct pre-load has been obtained.

Flank clearance, checking



31. Install the pinion in the gearbox housing, without an O-ring and with a total shim thickness of 0.35 mm between the pinion and the gearbox housing.

Install two of the socket cap screws, diagonally opposed. Torque to **9 Nm (6.64 lbf ft)**.

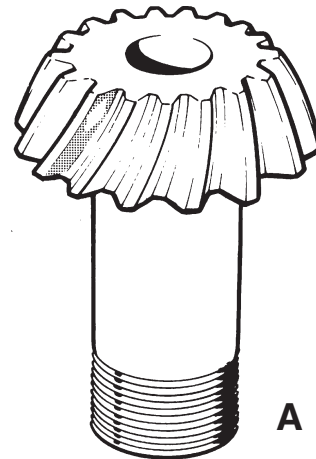
Check the flank clearance on the nut, as in the illustration. Use dial gauge **9999701** and a stand.

Flank clearance: **0.10-0.25 mm (0.004-0.010")**

Adjust the flank clearance if necessary, by adding or removing shims from between the pinion and the gearbox housing.

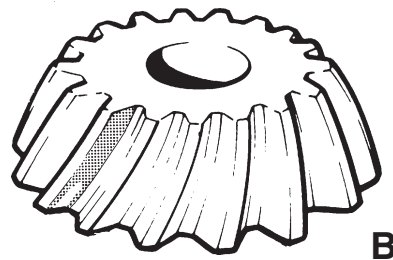
32. Remove the pinion and apply a thin layer of marker dye to the crown wheel and pinion.

Install the pinion again and turn it round in both directions. Brake the tubular shaft at the same time.



33. Remove the pinion and check whether the marking pattern on the pinion corresponds with illustration **A**, which is correct.

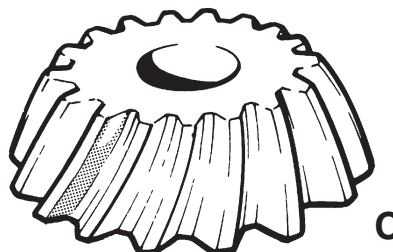
The pattern should be located at the centre of the tooth, in height, but displaced towards the narrower end.



34. If the marking pattern is similar to **B**, move the crown wheel down.

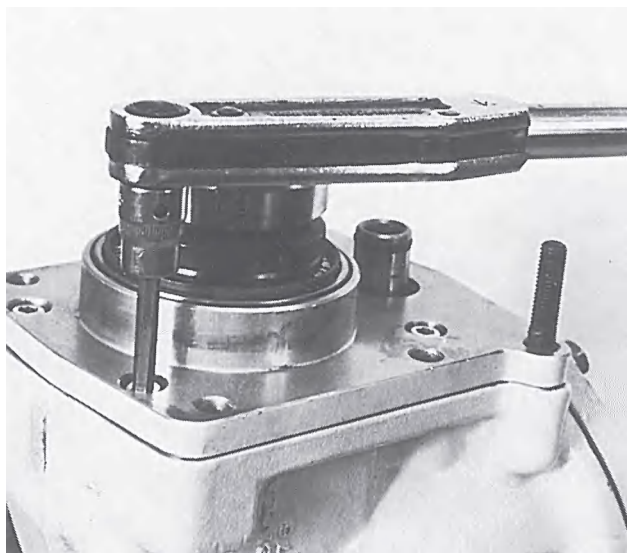
NOTE! To retain the pre-load on the tubular shaft, the thickness of shims between the cover and the gearbox housing must be reduced to the same extent.

If the flank clearance is too small after this operation, move the pinion upwards by increasing the thickness of the shims between the gearbox housing and the pinion.



35. If the marking pattern is similar to **C**, move the crown wheel and pinion in the opposite directions to what was specified in the previous item.

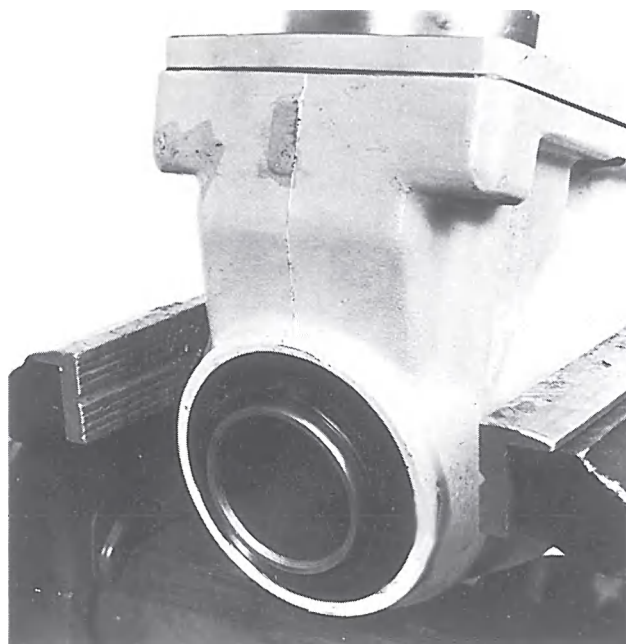
When the correct flank clearance and marking pattern has been obtained, wash off all marker dye from the crown wheel and pinion.



36. Install the pinion in the gearbox housing together with a new O-ring.

Tightening torque: **9 Nm (6.64 lbf ft)**

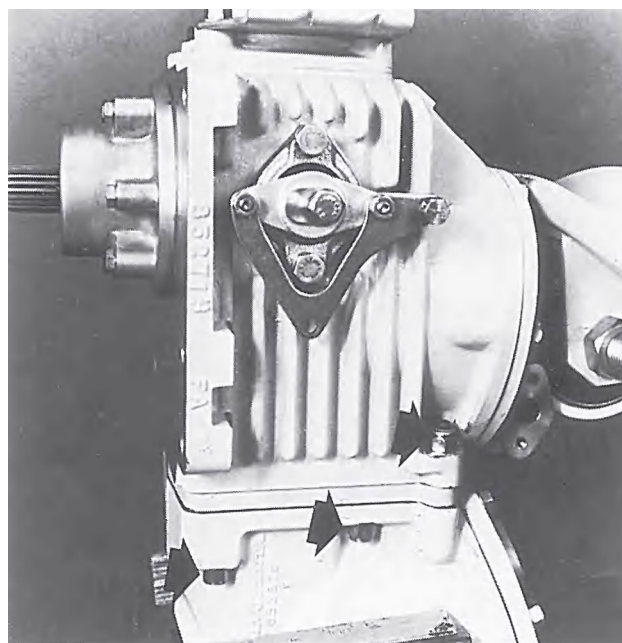
Angle drive, final assembly



37. Install the tubular shaft in the gearbox housing together with a new O-ring.

Tightening torque: **25 Nm (18.44 lbf ft)**

Install a new seal ring on the tubular shaft.



38. Assemble the angle drive and reverse gear.

Use a **new** O-ring.

Tightening torque: **28 Nm (20.65 lbf ft).**

Repair - lower gear housing, sailboat drive

Disassembly of the drive



1. Clean the outside of the drive. Remove the propeller and remove the fishing line cutter. Unscrew the drain plug and drain off the oil.



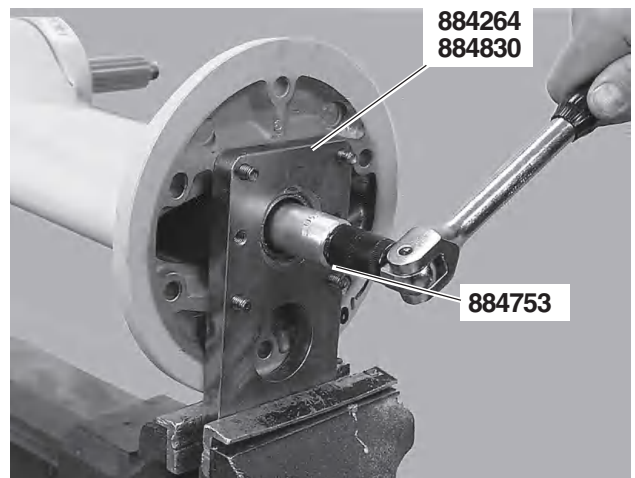
3. Separate the upper and lower gear housings. Remove and scrap the gasket at the division line. Remove the shims. Note the number of shims.

Remove the spacer ring (1). Tap the shaft lightly with a plastic-faced hammer.



2. Remove the locking wire from the four socket cap screws below the division line of the drive, two on each side. Throw the wire away.

Then remove all the (10) screws.

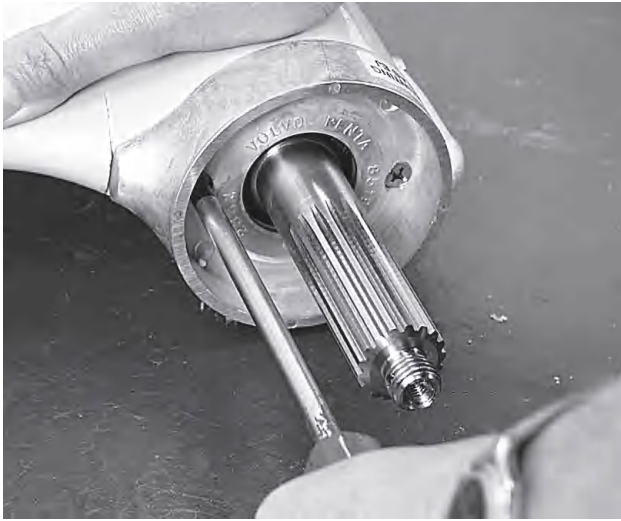


4. Fix fixture **884753** in a vise. Install the lower gear housing in the fixture, so that the four pins fit the cut-outs in the shaft nut. Fix the gear housing with four of the socket cap screws.

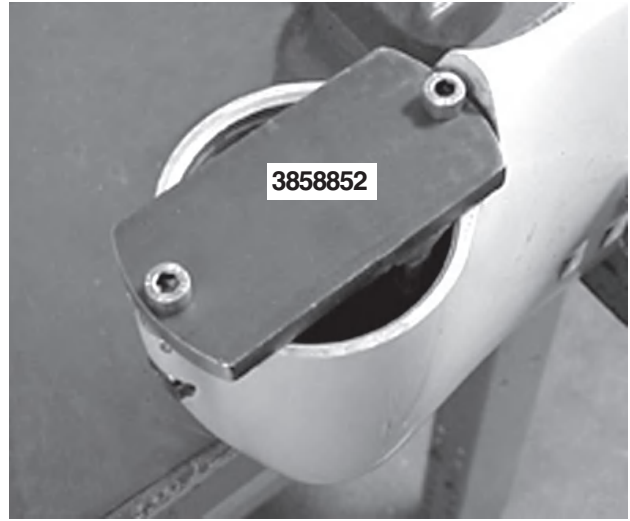
Install tool **884264** or **884830** on the shaft. Use a **17 mm** socket and undo the nut by turning the shaft clockwise.

NOTE! Only turn enough to make the nut just come into contact with the fixture.

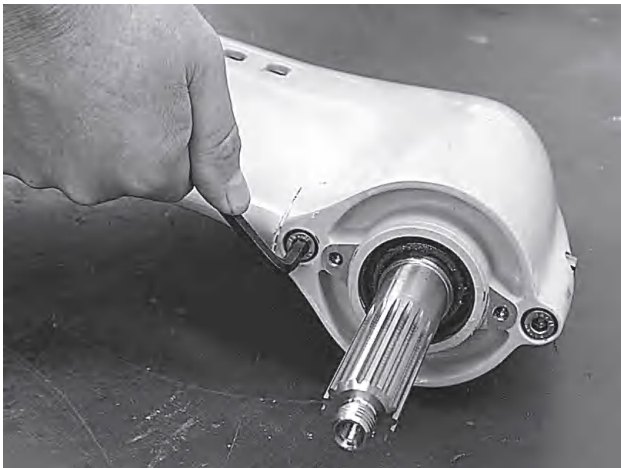
Remove the fixture from the lower gear and screw the nut off the shaft.



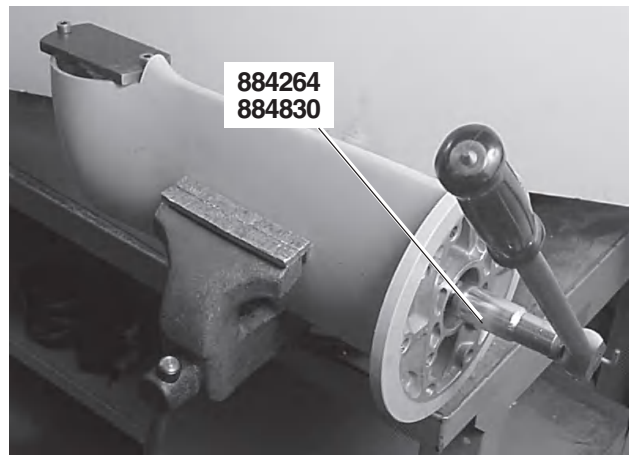
5. Remove the zinc ring.



8. Lock the pinion nut with tool no. **3858852**. Press the shaft down and make sure that the pinion nut engages in the tool. Fix the tool to the rear bearing housing, using socket cap screws.

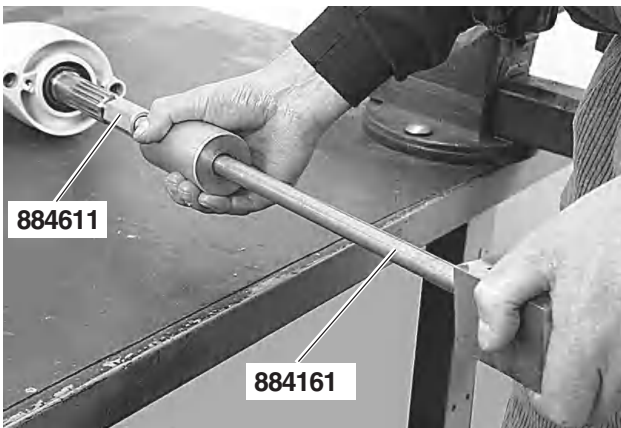


6. Remove the two socket cap screws in the bearing housing.

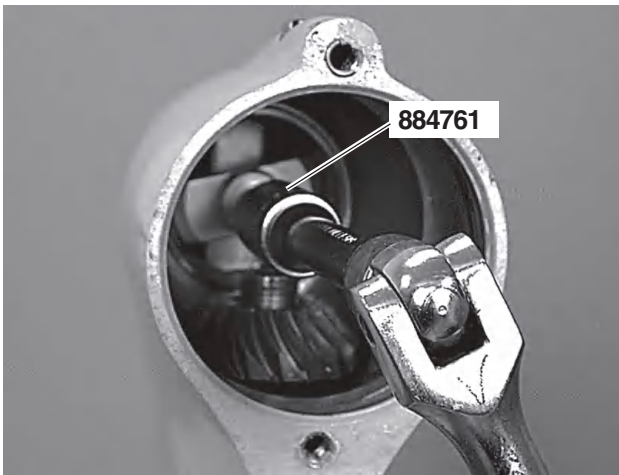


9. Install tool **884264** or **884830** on the vertical shaft. Unscrew the pinion nut.

Remove the pinion. If the pinion has got stuck, it will come loose when the shaft is pressed out later on, in item 11.

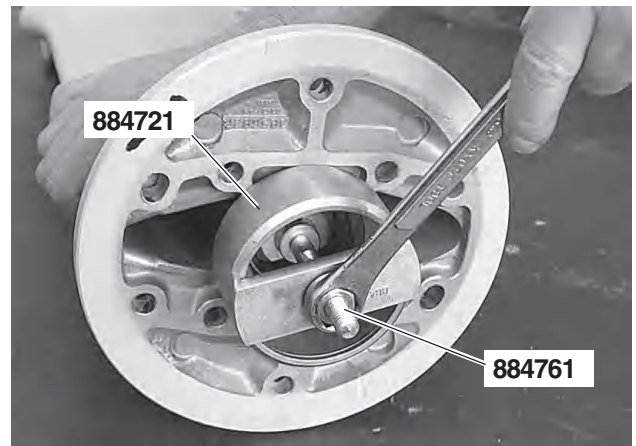


7. Remove the propeller shaft and bearing housing. Use slide hammer **884161** and extractor **884611**.

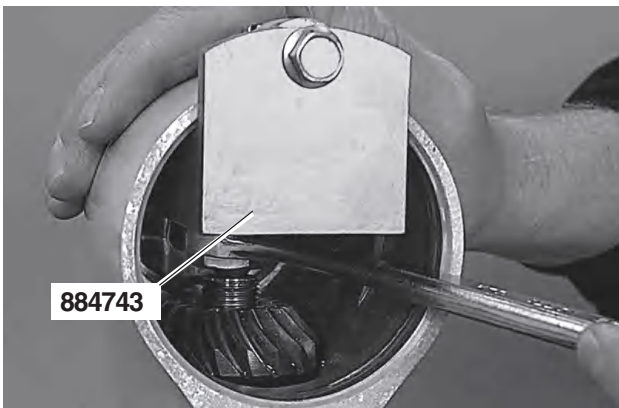


10. Disassemble the bearing race with tool no. **884761**.

NOTE! Note the number of shims between the bearing race and the gear.



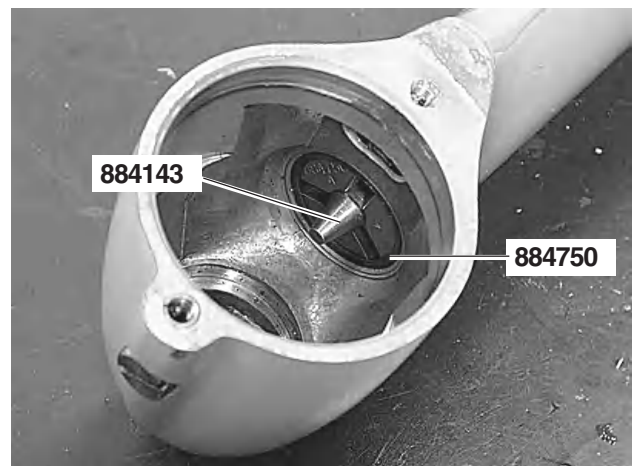
12. Disassemble the outer bearing race from the upper part of the gear housing, using tool no. **884761** in combination with tool no. **884721**.



11. Install tool no. **884743** in the lower gear housing. Use a 5/16" x 20 mm (3/4") screw. Alternatively, one of the drive fixing screws can be used together with a 5 mm thick washer.

Take out the loose needles (25 pcs) if the needle roller bearing needs to be changed.

Tighten the screw with the steel ball so that it presses the vertical shaft up. Wrench size **24 mm**. Then disassemble the tool.



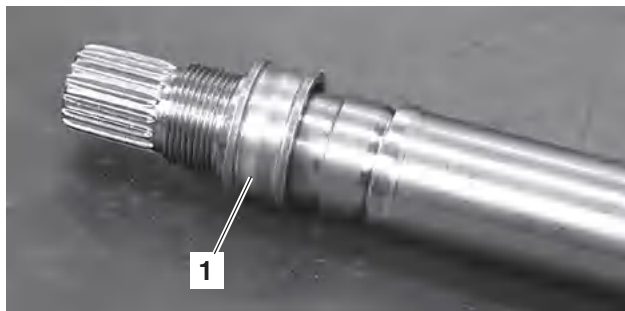
13. Remove the bearing race with expander **884750** and shaft **884143**.

The expander is inserted from underneath, and the shaft from above.

Vertical shaft, disassembly

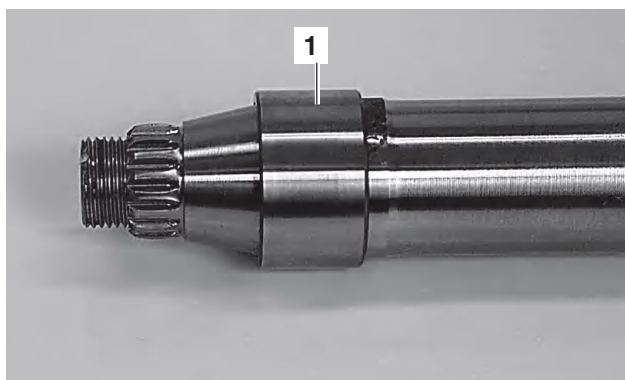


14. Remove the roller bearings with a knife extractor as counterhold. Use a hydraulic press together with a suitable mandrel.



15. Remove the ferrule (1). Use a knife puller as a counterhold.

NOTE! The ferrule must always be changed when the shaft has been removed or when the pinion has been changed.

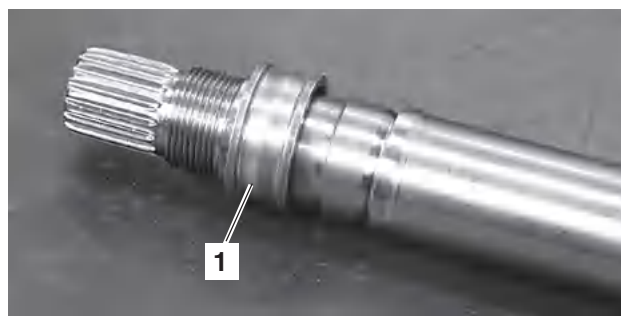


16. The ground needle roller bearing race on the vertical shaft should not be changed. If the roller bearing is damaged, the entire shaft must be changed.

Then clean all components. Change worn or damaged components.

Vertical shaft, assembly

NOTE! Oil all components before or during assembly.



17. Put a **new** ferrule (1) on the vertical shaft.



18. Install a new roller bearing with mandrel **884755**.

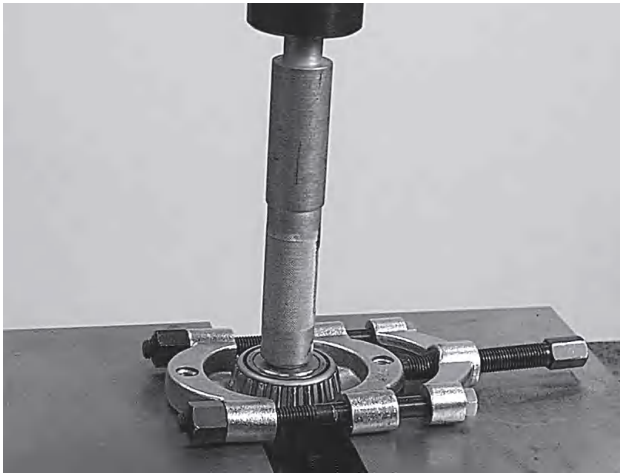
NOTE! Press until the bearing **touches** the ferrule.



19. Install the other roller bearing inverted, i.e. with the smaller end upwards. Use mandrel **884755**.

NOTE! Press so far that the bearings **touch** each other.

Propeller shaft, disassembly of bearings and drive



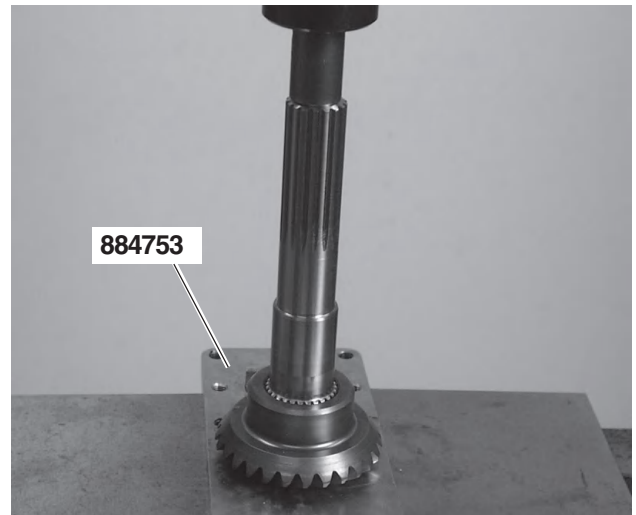
20. Remove the **front** roller bearing.

Use a knife extractor as a counterhold and press the bearing out with a hydraulic press and a suitable mandrel.



21. Remove the **rear** roller bearing. Use a knife extractor as a counterhold, with a **17 mm** socket on the shaft end.

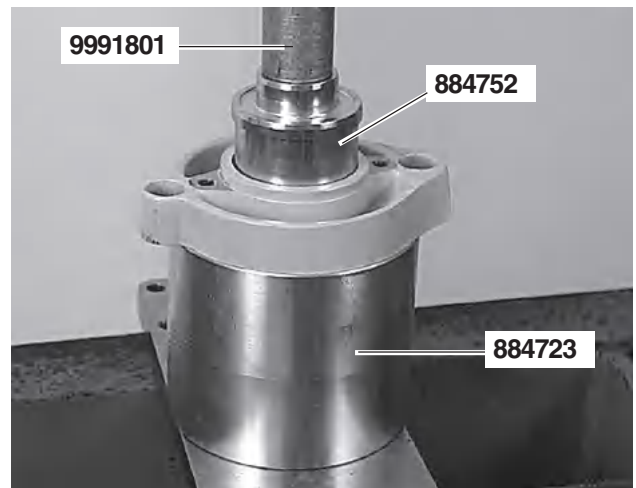
NOTE! If the gear wheel is going to be changed as well, the bearing can be pressed off at the same time. Please refer to item 22.



22. Remove the gear wheel with tool no. **884753**. Use a socket to protect the end of the shaft.

NOTE! The gear wheel and pinion are classed together and can only be changed as a complete unit.

Rear bearing housing, disassembly



23. When the seal rings are changed, the outer bearing race should also be changed.

Put the bearing housing on tool no. **884723**. Press out the seal rings with tool **884752** and shaft **9991801**. Press the outer bearing race out at the same time as the housing.

NOTE! Note the number of shims. Save the shims.

Propeller shaft, assembly of bearings and drive



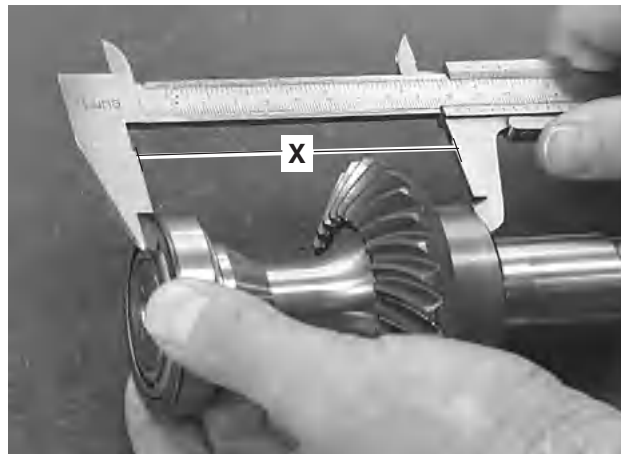
24. Press the gear wheel down to the step on the propeller shaft with tool no. **884753**. Make sure that it seats securely.



25. Install the front roller bearing with tool no. **884754**.

Propeller shaft, shimming

26. For when only new bearings have been installed. Use the previously installed shims in the first instance. In other cases, the shim thickness can be calculated as in items 27–29.

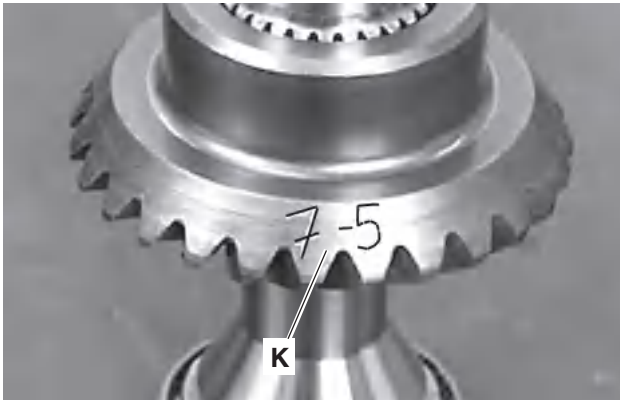


27. Put the outer bearing race on the front ball bearing. Press it hard against the bearing and measure distance (**X**) with a caliper gauge, between the rear plane of the gear wheel and the outer front plane of the bearing race.

In this case, the distance is 100.20 mm.



28. Dimension (**T**) is stamped on the starboard side of the gear housing division to permit the shim thickness under the front bearing race to be calculated, which is 17 in this case. The dimension of the division plane can vary between 0 and 30.



29. The illustration shows the **K** dimension (– 5) engraved on the gear wheel. The other engraved figure (7) shows the pinion which the gear wheel belongs together with. The pinion should have the same figure engraved on it.

Example:

T = Stamped dimension on the division plane (17)

K = Engraved dimension on the gear wheel (–5)

X = Dimension measured with caliper gauge (100,20)

101 = Constant

$$\text{Shim thickness} = 101 + \frac{(T + K)}{100} - X$$

$$\text{Shim thickness} = 101 + (0,17 + - 0,05) - 100,20$$

$$\text{Shim thickness} = 101 + 0,12 - 100,20$$

$$\text{Shim thickness} = 0,92 \text{ mm}$$



30. Put shims of the correct thickness in the lower gear housing. Add a further 0.05 – 0.10 mm. In this case, we put a total of 1.00 mm shims in the housing.

Shims are available in the following standard thicknesses: 0.10 mm, 0.15 mm, 0.35 mm, 0.50 mm.



31. Install the outer bearing race in the gear housing with mandrel **884756**. Use the rear bearing housing as a guide.



32. Press the rear roller bearing down onto the propeller shaft. Use mandrel **884754**.

Rear bearing housing, shimming

For when only new bearings have been installed. Use the previously installed shims in the first instance. When the gear housing or rear bearing housing is changed, the shim thickness should be calculated as below.



33. Shimming, alternative 1

Put the propeller shaft in the gear housing. Install the outer bearing race for the propeller shaft roller bearing. Press the bearing race hard and turn the shaft round, to take up any play in the bearing.

Then use a depth micrometer **9985472** to measure the distance between the rear plane of the gear housing and the rear outer bearing race for the propeller shaft. We call this dimension **Y**.



34. Shimming, alternative 2

Alternatively, we can add shims until the outer bearing race is flush with the gear housing. Clean off all traces of sealant from the mating surface of the gear housing against the bearing housing.

⚠ IMPORTANT! Make sure that the surface is not damaged. Do not use steel tools.

Use a steel rule or caliper gauge to check.



35. There is a dimension (**B**) punched on the rear bearing housing. This dimension is stamped underneath the bearing housing, and varies between 50-70. In this case, the distance is 65 mm.

Example: Y is measured to 1.05 mm in this case.

$$\text{Shim thickness} = \frac{Y - B}{100}$$

$$\text{Shim thickness} = 1,05 - \frac{65}{100}$$

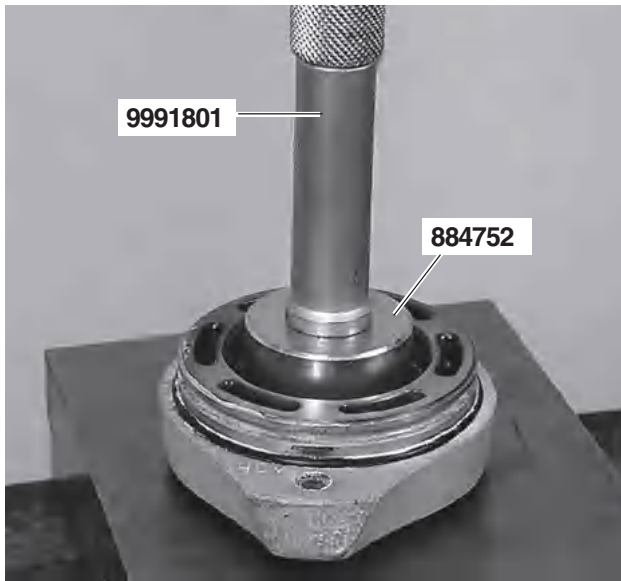
$$\text{Shim thickness} = 1,05 - 0,65 = 0,40$$

$$\text{Shim thickness} = 0,40 \text{ mm}$$

Shims are available in the following standard thicknesses: 0.10 mm, 0.15 mm, 0.35 mm, 0.50 mm.

Use shim thickness $0.35 + 0.10 = 0.45$ mm.

Rear bearing housing, assembly



36. Install a new seal ring in the bearing housing, using tool no. **884752** and shaft **9991801**. Apply sealant, Volvo Penta part no. 1161099-5, to the mating face between the seal and the bearing housing.

NOTE! Align the open side of the seal ring backwards (aft).

37. Install the other seal ring by using the same tool.

NOTE! Align the open side of the seal ring forwards (towards the bow). When the seal rings have been installed, the spring in the rings should face away from each other.

38. Apply some grease to the seal rings, Volvo Penta part no. 828250-1.



39. Put shims of the correct thickness in the bearing housing. In this case, they are 0.45 mm.



40. Assemble the outer bearing race with tool no. **884756**.

Oil and install new O-rings, 2 pcs.



41. Install the propeller shaft in the gear housing.

NOTE! Turn the shaft carefully, to avoid damaging the sealing lips on the seal rings.

Tightening torque: **30 Nm (22.13 lbf ft)**.

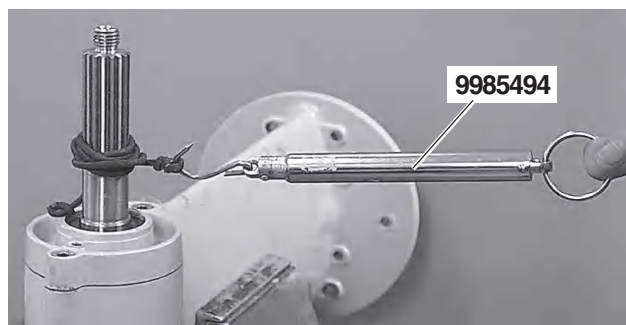
Check the preload. Please refer to item 42.

During final assembly:

Apply sealant, Volvo Penta part no. 1161231-4, to the mating face between the bearing housing and the drive.

Apply thread locking fluid, Volvo Penta part no. 1161231-4, to the screws and install the bearing housing on the drive.

Pre-load



42. Check that there is no slack in the propeller shaft
Check the preload in the shaft.

Method 1. Wind a piece of string round the shaft and pull with spring scale **9985494**. Please refer to the figure above.

Permissible preload: **0 (no slack) – 35 N (0–7.87 lbf)**.

Method 2. Install the propeller nut on the shaft. Turn the shaft with a torque wrench. Turn at an even speed, about 1 revolution/sec.

Permissible preload: **0.5 ± 0.3 Nm (0.37 ± 0.22 lbf ft)**.

When there is slack in the shaft, or the pre-load is incorrect, change the thickness of the shims underneath the bearing race in the rear bearing housing.

If preload is correct: Disassemble the bearing housing and remove the propeller shaft.



44. Install a new needle roller bearing. Use tool no. **884746**.

The tool consists of three sections. Please refer to the **Special Tools** section.

NOTE! The needle roller bearing has loose rollers. For this reason, the new bearing has a transport shield.

Press bearing retainer **884747** into the needle roller bearing. The transport shield (foam rubber) is then pressed out. Insert the screw with flange **884748** from above and the bearing retainer with needle roller bearing from below. Turn the screw round until the needle roller bearing is in place. Use a wrench on the bearing holder to keep it in place. Then disassemble the tool.

Vertical shaft

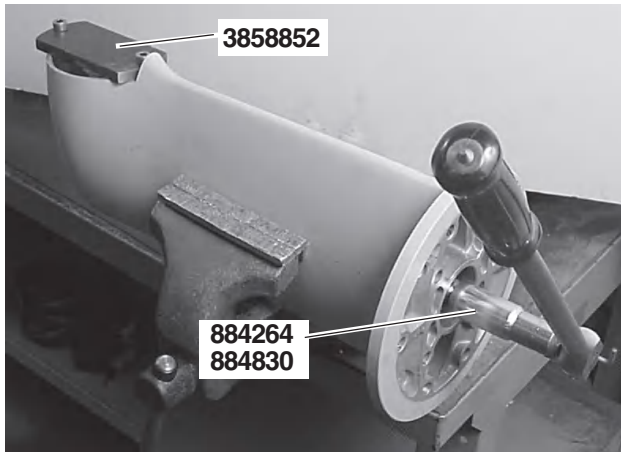


43. Install the lower one of the two bearing races. Use mandrel **884757**.



45. Install the vertical shaft in the housing. Be careful to ensure that the needle rollers do not fall out. Then install the pinion. Apply thread locking fluid, Volvo Penta part no. 1161075-5, on the threads and install the nut.

NOTE! One side of the nut has a chamfer which should face the pinion.

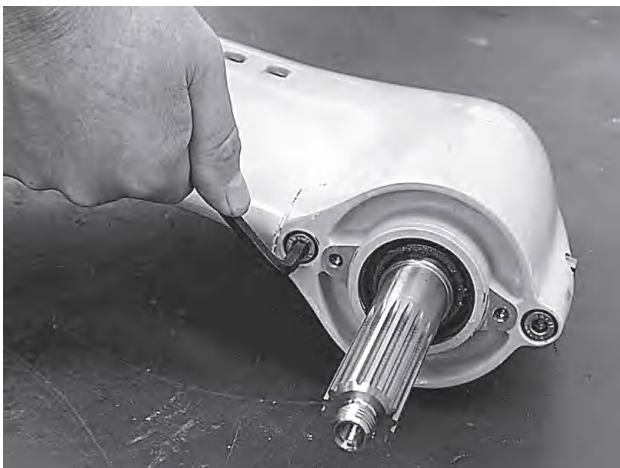


46. Lock the pinion nut with tool **3858852**. Press the shaft down and make sure that the pinion nut engages in the tool. Fix the tool to the rear bearing housing, using socket cap screws.

Install tool **884264** or **884830** on the vertical shaft. Tighten the pinion nut.

Wrench size: **17 mm**.

Tightening torque: **110 ± 10 Nm (81.13 ± 7.38 lbf ft)**.



47. Install the bearing housing on the propeller shaft.

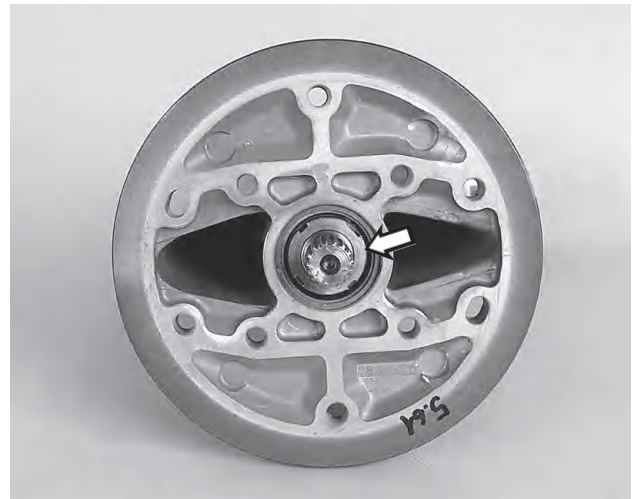
NOTE! Turn the shaft carefully, to avoid damaging the sealing lips on the seal rings.

Apply sealant, Volvo Penta part no. 1161231-4, to the mating face between the bearing housing and the drive.

Then install the propeller shaft and bearing housing on the gear housing.

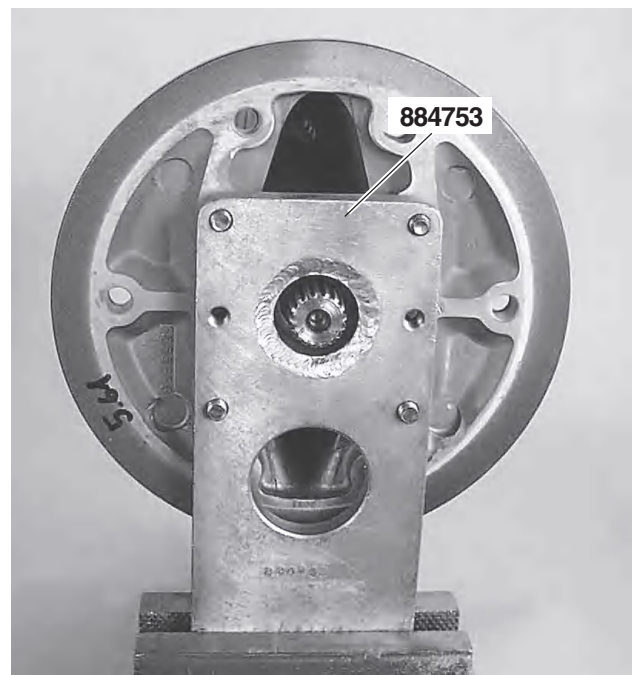
Apply thread locking fluid, Volvo Penta part no. 1161231-4, to the screws.

Tightening torque: **30 Nm (22.13 lbf ft)**.



48. Install the upper nut on the vertical shaft.

NOTE! The chamfered side of the nut must face downwards.



49. Then screw tool **884753** to the division plane, so that the “teeth” engage on the nut. Fix the tool, with the lower gear housing, in a vice.

NOTE! First tighten the nut by hand, so that the tool lies flush against the division plane.

Flank clearance



Install dial gauge **9999683** on the propeller shaft splines. Tap the vertical shaft from above, so that it comes as far down as possible. Turn the propeller shaft forwards and backwards.

Flank clearance: **0.04-0.10 mm (0.002-0.004")**

If the clearance is too small, the nut must be tightened a further turn. 1/4 turn is about 0.02–0.03 mm (0.0008–0.0012").

⚠ IMPORTANT! Only tighten a small amount at a time, and check the clearance each time.

If the flank clearance becomes too large, the vertical shaft must be disassembled and the ferrule changed, since it can only be used once.

50. Install tool **884264** or **884830** on the vertical shaft. Turn the shaft clockwise with a heavy wrench or torque wrench. Wrench size: **17 mm**.

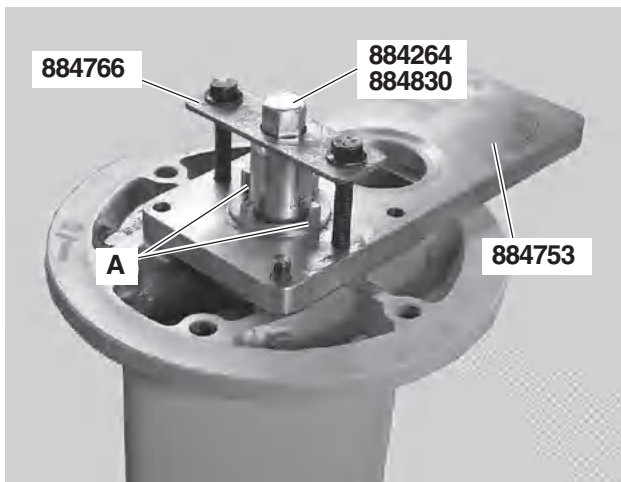
NOTE! The nut must be tightened so hard that the ferrule is deformed. The torque needed is about **230–250 Nm (169.64–184.40 lbf ft)**.

The flank clearance is zero (0) before the nut begins to nip up.



51. When the highest torque specified above has been reached, the gear housing should be removed from the vice and fixed vertically instead. Let the tool remain on the gear housing.

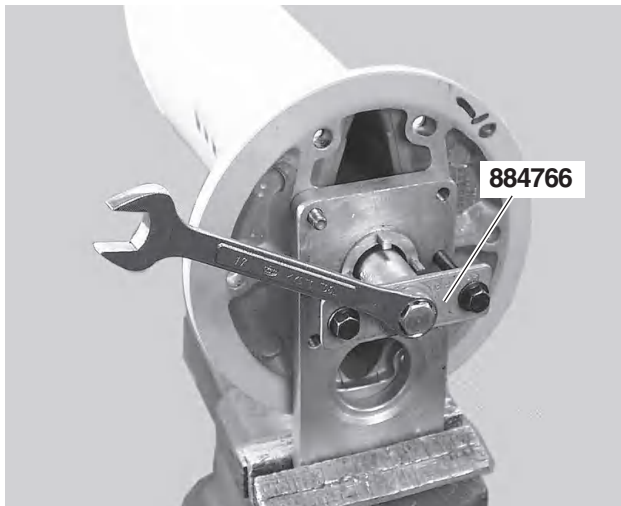
Marking pattern



52. When the correct gear flank clearance has been obtained, remove tool **884753** from the lower gear. Then turn the tool so that the “teeth” (**A**) face outwards. Fix the tool with two screws to the lower gear housing.

Press the vertical shaft in with tool no. **884766** which is screwed to the other tool. Leave tool **884264** or **884830** in place.

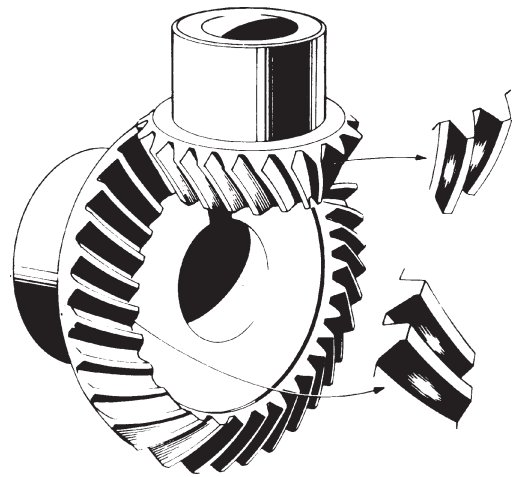
Then disassemble the propeller shaft and apply marker dye to the gear wheels.



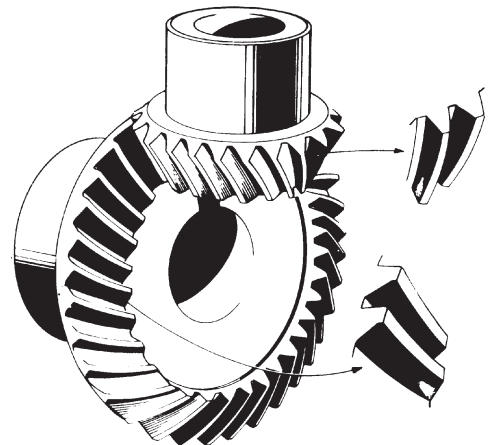
53. Install the propeller shaft again and turn it round in both directions.

Brake the propeller shaft strongly.

NOTE! Press the vertical shaft in with tool no. **884766** at the same time as it is turned round.



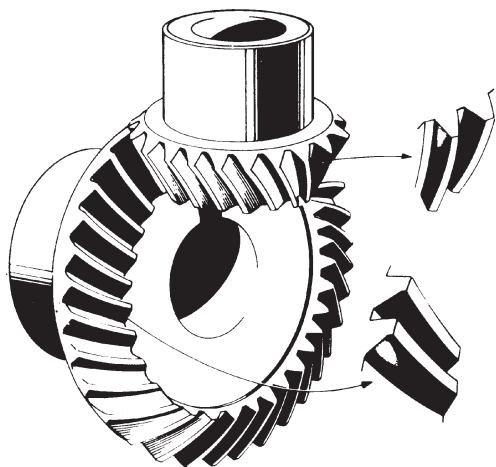
54. Disassemble the propeller shaft and check that the marking pattern on the gear teeth corresponds with the marking pattern in the illustration above or the figures in items 55 and 56.



55. If the marking pattern is displaced in relation to the figure above, the thickness of the shims underneath the front bearing race must be reduced and the thickness of the shims behind the bearing race in the rear bearing housing must be increased to the same extent. It is important that the preload is not changed.

NOTE! In this case, the propeller shaft is displaced forwards (towards the pinion), which reduces flank clearance. For this reason, it is necessary to install tool no. **884753** and tighten the upper nut a bit more until correct flank clearance has been obtained.

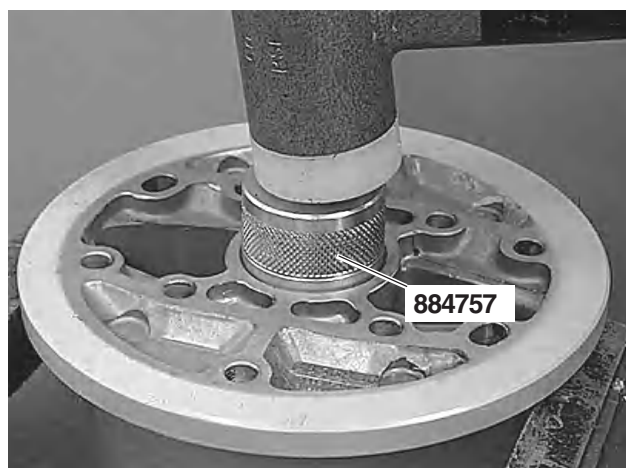
Please refer to items 50 and 51. Then check the contact patch again, as in items 52-54.



56. On the other hand, if the marking pattern is displaced in relation to the figure above, the thickness of the shims underneath the front bearing race must be increased and the thickness of the shims behind the bearing race in the rear bearing housing must be reduced to the same extent.

NOTE! In this case, the propeller shaft will be displaced backwards (away from the pinion), which means that the flank clearance will be too large. This can not be changed in any other way than by removing the vertical shaft, pressing off the roller bearings and changing the ferrule.

Install a new ferrule. Then re-install the bearings and put the shaft back in the gear housing. Turn round to establish the new flank clearance and check the marking pattern. Please refer to items 50-51.



57. When the correct flank clearance has been obtained, disassemble the tool and propeller shaft, and wash off all marker dye from the crown wheel and pinion.

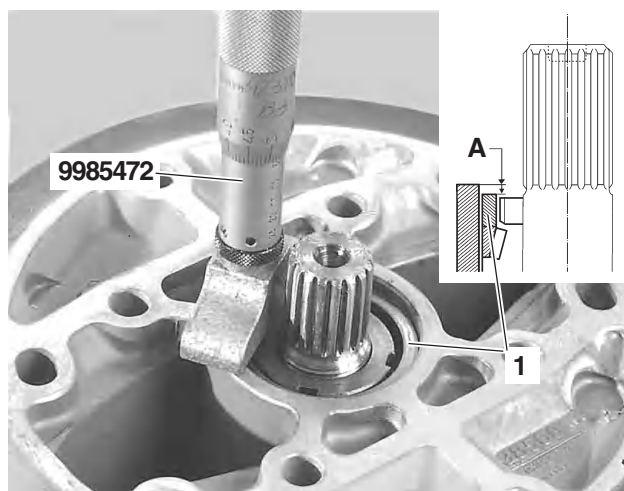
Re-install the propeller shaft and rear bearing housing. Please refer to item 47. Then install the upper, outer bearing race. Use tool no. **884757**.

Model 120S Installation, lower gear housing–adapter housing

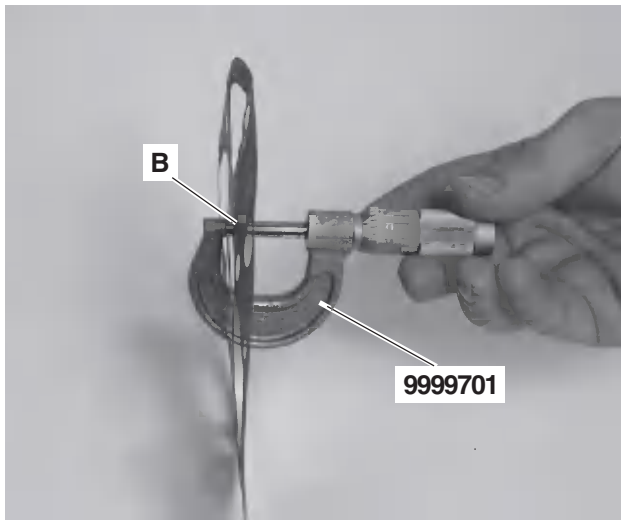
Preferably use the shims which were installed previously, if only new bearings have been installed. Shim thickness can also be measured as in the points below.



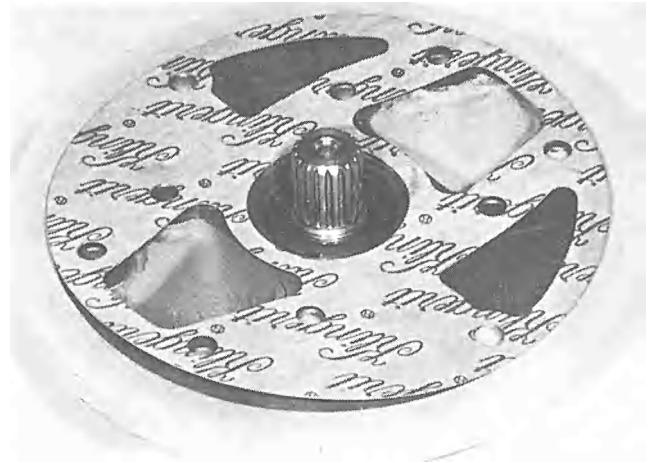
58. Check that there is no end float in the vertical shaft. Then install spacer ring (1).



59. Use a depth micrometer **9985472** to measure the distance (A) from the division plane down to the spacer ring (1).

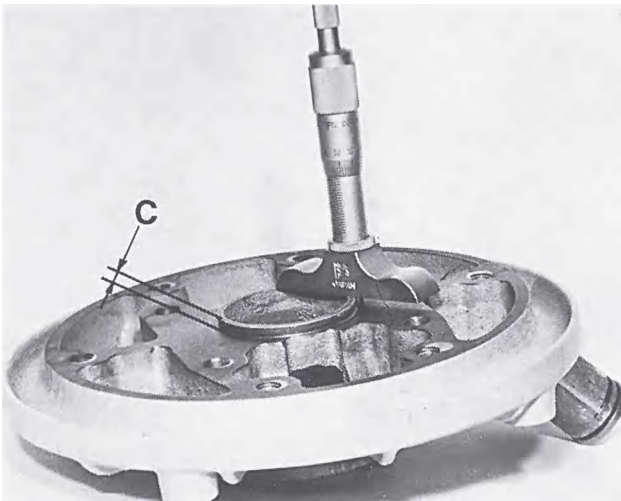


60. Measure the thickness of gasket (B) with micrometer 9999701.



62. Install the calculated thickness of shims and gasket on the division plane of the lower gear housing.

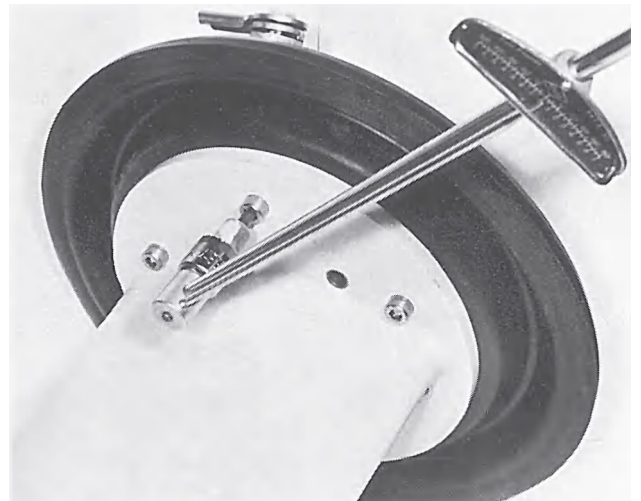
NOTE! The text on the gasket must face upwards. The hole pattern in the gasket only fits one way round.



61. Measure the height of flange (C) on the adapter housing.

Example:

- a) When distance (A) is measured, we obtain a distance of 5.70 mm in this case.
 - b) Gasket (B) thickness is measured as 0.30 mm.
 - c) Flange height (C) is measured as 3.85 mm.
- $A + B - C = \text{shim thickness}$
 $5.70 + 0.30 - 3.85 = 2.15$
 Shim thickness = 2.15 mm



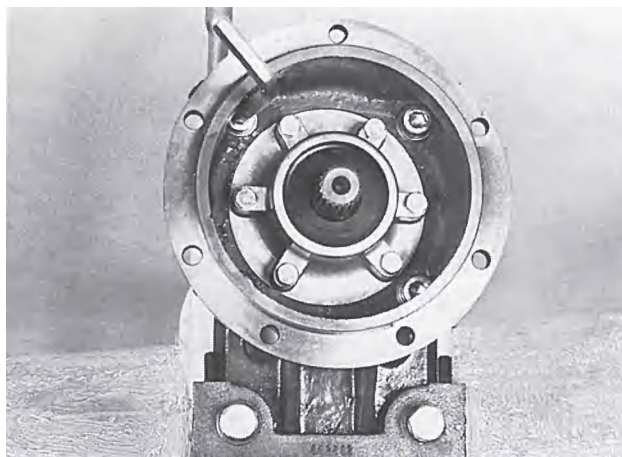
63. Install the adapter housing with rubber sleeve on the lower gearing housing. Apply MoS₂ based grease, Volvo Penta part no. 1161029-2 to the socket cap screws. Put washers on the six socket cap screws and use a torque wrench to tighten them.

Tightening torque: **30 Nm (22.13 lbf ft).**

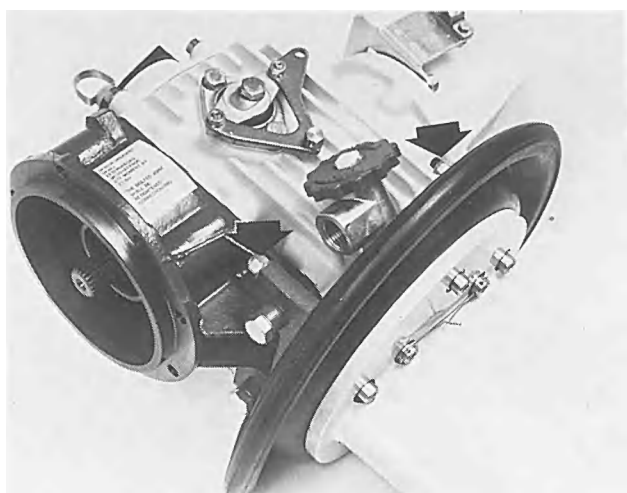
NOTE! Torque the screws diagonally, then re-check their tightening.

Install the cooling water tap on the port side. Apply sealant, Volvo Penta part no. 1141570-0 on the threads.

NOTE! Check that the adapter flange has entered the gear housing and presses the shims down, so that there is no end float in the vertical shaft. Also check the flank clearance.



64. Install the adapter section on the upper housing. Torque the socket cap screws alternately. Tightening torque: **40 Nm (29.50 lbf ft)**. Only tighten bracket **(1)** by hand.



65. Put a new O-ring on the adapter section neck. Check that the slipping clutch is in place in the upper gear housing and then fit the housings together.

NOTE! Put washers under the screw heads.

Tightening torque: **30 Nm (22.13 lbf ft)**.

Secure the four screws with locking wire. Tighten the four nuts.

Tightening torque: **23 Nm (16.96 lbf ft)**.

Tighten the two screws on the front bracket.

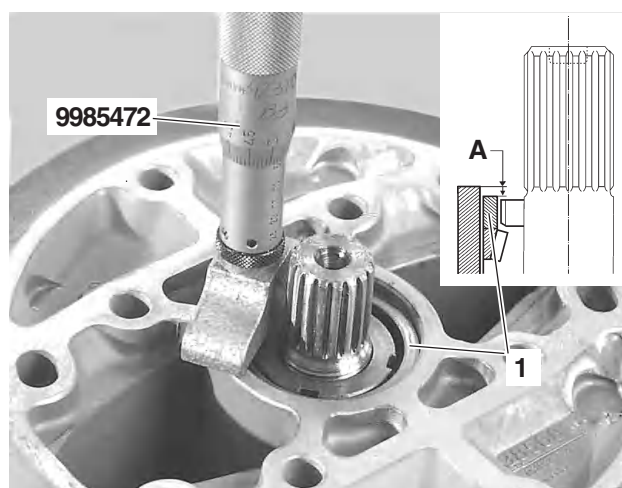
Tightening torque: **40 Nm (29.50 lbf ft)**.

Models 120S-B, -C, -D, -E Installation, lower gear housing–adapter plate.

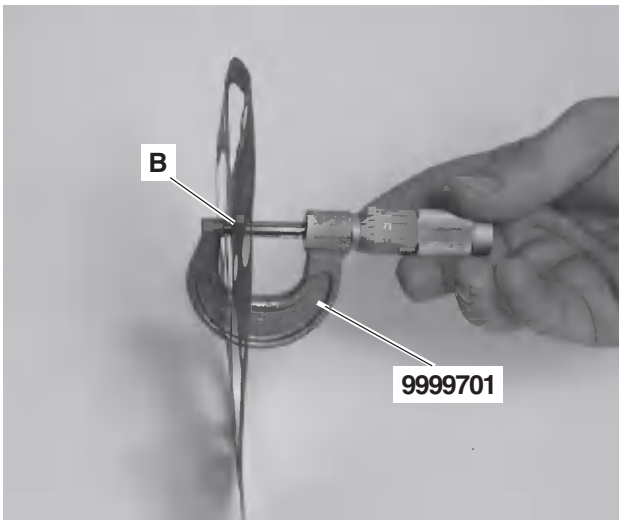
Preferably use the shims which were installed previously, if only new bearings have been installed. Shim thickness can also be measured as in the points below.



66. Check that there is no end float in the vertical shaft. Then install spacer ring **(1)**.



67. Use a depth micrometer **9985472** to measure the distance **(A)** from the division plane down to the spacer ring **(1)**.

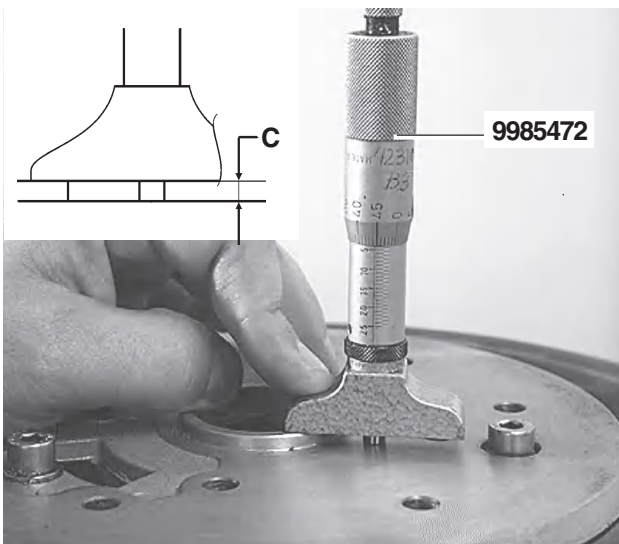


68. Measure the thickness of gasket (**B**) with micrometer **9999701**.



70. Install the calculated thickness of shims and gasket on the division plane of the lower gear housing.

NOTE! The text on the gasket must face upwards. The hole pattern in the gasket only fits one way round.



69. Measure flange (**C**) on the adapter plate with micrometer **9985472**.

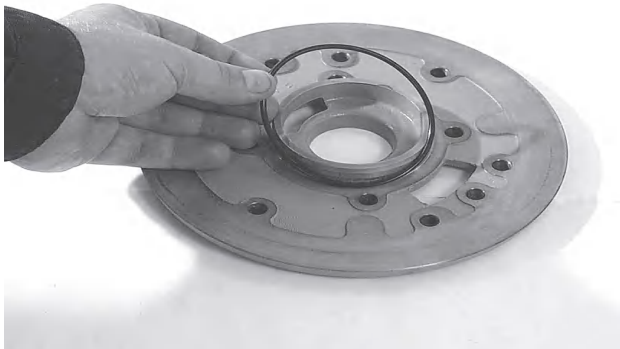
Example:

- a) When (**A**) is measured, we obtain a distance of 5.70 mm in this case.
 - b) Gasket (**B**) thickness is measured as 0.30 mm.
 - c) Flange height (**C**) is measured as 3.85 mm.
- $A + B - C = \text{shim thickness}$
 $5.70 + 0.30 - 3.85 = 2.15$
 Shim thickness = 2.15 mm



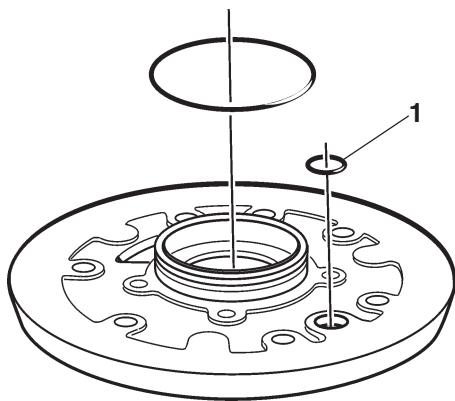
71. Put the rubber sleeve on the upper gear housing.

Install the cooling water tap. Apply sealant, Volvo Penta part no. 1141570-0 on the threads.

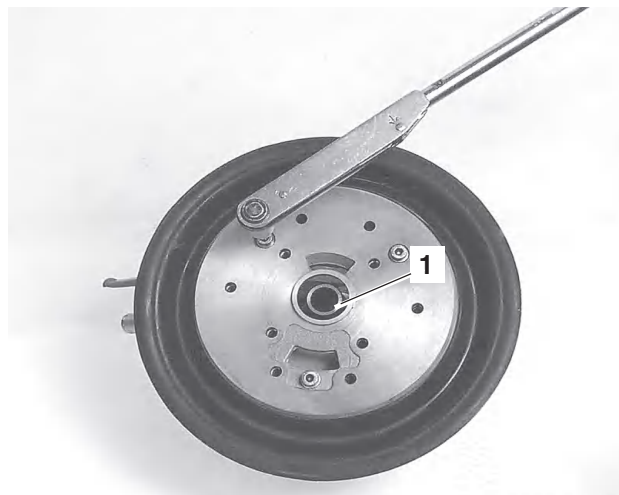


72. Oil and install a new O-ring on the adapter section neck.

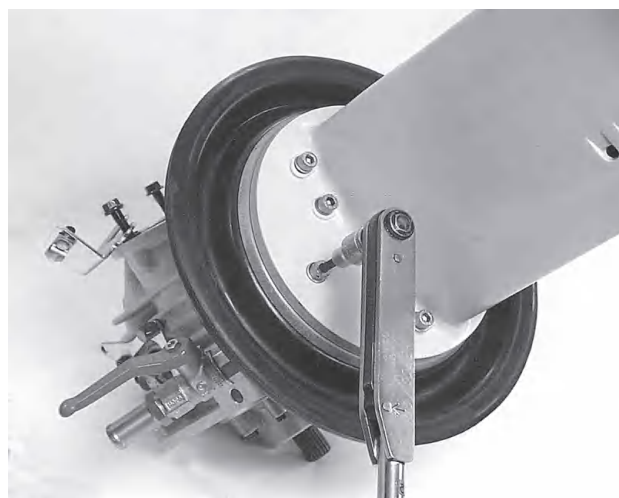
Reverse installed drive (180°)



Oil and install a new O-ring (1) in the cutout in the adapter plate.



73. Install the adapter plate on the upper gear housing. Apply MoS2 based grease, Volvo Penta part no. 1161029-2 to the three socket cap screws. Put washers on the socket cap screws and use a torque wrench to tighten them. Torque the screws alternately. Tightening torque: **30 Nm (22.13 lbf ft)**. Install the slipping clutch (1).



74. Fit the gear housings together. Apply MoS2 based grease, Volvo Penta part no. 1161029-2 to the socket cap screws. Install the screws, 10 pcs. The two long screws should be located by the rear edge. Put washers under the screw heads and distribute the screws with holes in the screw heads so that there are two on each side. Tightening torque: **30 Nm (22.13 lbf ft)**.

Other components, installation

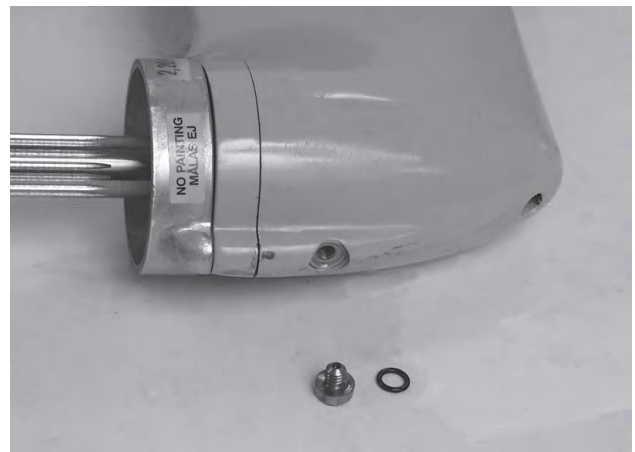


75. Secure four of the screws, the ones with holes in their heads, with locking wire, two screws on each side as in the illustration.



76. Install a new zinc ring.

Tightening torque: **12 Nm (8.85 lbf ft)**



77. Change the gasket on the oil drain plug.

⚠ IMPORTANT! The gasket must be allowed soak in oil for about 15 minutes before assembly. Leakage would otherwise occur.

Pressure test the drive, please refer to the **Pressure Testing** section.

Fill up with engine oil.

Please refer to **Technical Data** for oil volume, grade and viscosity.

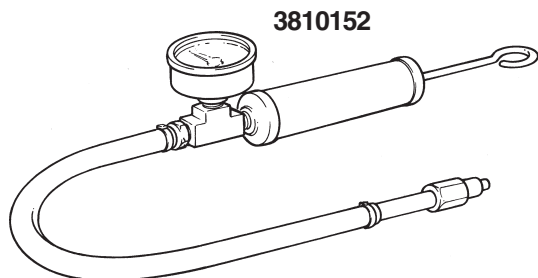
Check the oil level with the dipstick and install the oil filler cap.

⚠ IMPORTANT! When the drive is installed on the engine the screws must be dipped in oil (including the heads) and torqued.

Tightening torque: **20 Nm (14.75 lbf ft), alternately, diagonally. Also do an extra check of tightening.**

Pressure testing

When the drive has been removed, it must be pressure tested to check for any leakage. Use special tool **3810152**, which consists of a pressure gauge with union, and a hand pump.



78. Connect the pressure gauge to the oil drain hole. Pump the pressure up to a level not exceeding **78 kPa (11.31 psi)**.

Check that the pressure remains constant for 1 minute.

NOTE! Make sure that no air leakage can occur via the hand pump.

If the pressure falls, the leakage must be localized by using soapy water which is brushed over all joints on the outboard section.

Painting of the drive

Most countries have legislation which regulates the use of growth inhibiting paints. In some cases, their use is completely banned on pleasure boats. Ask your Volvo Penta Dealer for advice on alternative methods in this case.

⚠ IMPORTANT! Find out about current legislation for painting with growth inhibiting paints / anti-fouling paints.

The drive

The top coat is part of the corrosion protection of the drive, and it is important that any paint damage is repaired.

Sand metal surfaces lightly with 120 grit emery paper, and use finer paper on painted surfaces. Wash with cellulose thinners or an equivalent product. Pores must be filled and sanded.

Paint with Volvo Penta original primer plus a top coat. Give the paints time to harden.

The drive should be coated with Volvo Penta anti-fouling paint to prevent the growth of weed and barnacles. Apply in accordance with the directions on the package.

⚠ IMPORTANT! The protective anodes on the drive and propeller must not be painted over.

Technical data

Type designation

Drive	120S, 120S-B, 120S-C, 120S-D, 120S-E
Reverse gear	MS2, MS2B-L, MS2V

Gear ratio

Drive	2.2:1
Reverse gear	2.4:1 and 3.0:1

Flank clearance

Input gear - gear wheel, measured directly on the gear wheels	0.10–0.25 mm (0.004–0.010")
Output shaft - lower drive measured on the gear wheels. Only MS2, MS2B-A, MS2B-L, MS2A-D, MS2A-E, MS2L-D, MS2L-E	0.10–0.25 mm (0.004–0.010")
Pinion - crown wheel. Only MS2V	0.10–0.25 mm (0.004–0.010")
Propeller shaft - vertical shaft, measured on propeller shaft splines	0.04–0.10 mm (0.0016–0.004")

Preload, bearings:

Input shaft bearings	10–18 N (2.25–4.05 lbf)
Output shaft bearings	13–25 N (2.92–5.62 lbf)
Lower shaft bearings, slipping clutch	15–30 N (3.37–6.74 lbf)
Propeller shaft bearings	No slack up to 35 N (7.87 lbf), measured on propeller shaft
Pinion bearing. Only MS2BV	10.0–17.5 N (2.25–3.93 lbf)
Tubular shaft bearing Only MS2BV	10.0–16.0 N (2.25–3.60 lbf)

Lubrication system

Oil grade, MS2A-E, MS2L-E	API GL5/SAE 75W/90, synthetic
Oil grade 120S-E	API GL5/SAE 75W/90, synthetic
Oil grade, other reverse gears and drives	Engine oil for Service SE or CD
Viscosity, Service SE	Multigrade SAE 10W/40 *
Viscosity, Service CD	Over +10°C: SAE 20W/30 *
Viscosity, Service CD	Below +10°C: SAE10W *

Oil volume, drive.	2.8 l (0.74 US gallon)
With 2" extension, total	3.1 l (0.82 US gallon)
With 4" extension, total	3.3 l (0.87 US gallon)

Oil volume, reverse gear.	0.8 l (0.21 US gallon)
Oil volume, MS2V reverse gear	1.8 l (0.48 US gallon)

*) Or Volvo Penta oil for diesel engines, please refer to the handbook.

Tightening torque

Reverse gear MS2, MS2B-A, MS2B-L, MS2A-D, MS2A-E, MS2L-D, MS2L-E

Lower cover 23 Nm (16.96 lbf ft)

Reverse gear MS2V

Nut on pinion 140 Nm (103.26 lbf ft)

Nut on tubular shaft 140 Nm (103.26 lbf ft)

Cover for tubular shaft 25 Nm (18.44 lbf ft)

Adapter housing – gear housing 9 Nm (6.64 lbf ft)

Angle drive – gear housing 28 Nm (20.65 lbf ft)

Reverse gear and drive

Input bearing housing 8 Nm (5.90 lbf ft)

Upper bearing housing 23 Nm (16.96 lbf ft)

Screws for gear change mechanism 20 Nm (14.75 lbf ft)

Screw for eccentric piston, gear shift mechanism 12 Nm (8.85 lbf ft)

Rear bearing housing, reverse gear 23 Nm (16.96 lbf ft)

Upper gear housing – adapter housing, engine 40 Nm (29.50 lbf ft)

Oil drain plug 10 Nm (7.38 lbf ft)

Drive 120S, 120S-B, 120S-C, 120S-D, 120S-E

Lower nut, vertical shaft 160 Nm (118.00 lbf ft)

Propeller bearing housing 25 Nm (18.44 lbf ft)

Zinc ring 12 Nm (8.85 lbf ft)

Rubber pad, drive, old model 23 Nm (16.96 lbf ft)

Rubber mounting, 120S-E, M8 25 Nm (18.44 lbf ft)

Model 120S

Upper gear housing – adapter housing nut 23 Nm (16.96 lbf ft)

Lower gear housing – adapter housing 30 Nm (22.13 lbf ft)

Upper gear housing – adapter housing- lower gear housing 23 Nm (16.96 lbf ft)

Model 120S-B, 120S-C, 120S-D, 120S-E

Upper gear housing – adapter plate 30 Nm (22.13 lbf ft)

Upper gear housing – lower gear housing 30 Nm (22.13 lbf ft)

Group	No.	Date	Refers to
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