

Workshop manual

Sail boat drive

A
2(0)

MS25S, MS25SR

Sail boat drive MS25S-A MS25SR-A

Contents

Safety information	2
Introduction	2
Important	2
General information	5
About the workshop manual	5
Spare parts	5
Repair instructions	6
Our common responsibility	6
Tightening torque	7
Torque-angle tightening	7
Lock nuts	7
Strength classes	7
Sealants	8
Safety rules for fluorocarbon rubber	9
Special tools	10
Other special equipment	12
Chemicals	12
Design and function	13
Powertrain	13
Upper gear housing	14
Lower gear housing	15
Disassembly - upper and lower gear housings	16
Repair - upper gear housing	18
Repair - lower gear housing	38
Pressure testing	54
Painting of the drive	55
Technical data	56
References to Service Bulletins	60

Safety information

Introduction

This workshop manual contains technical data, descriptions and repair instructions for the Volvo Penta products or product versions noted in the table of contents. Make sure that 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 used 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 control station.



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 depressurized 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 damage. 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/reversing 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 reversing 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 control 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 M25S sailboat drive:

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 reversing 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)

 **WARNING!**

 **IMPORTANT!**

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 **Technical Data**, and are noted in the task descriptions in the manual. 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 Torque**.

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.

Tightening torque

Dimension	Nm	(lb.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 for sealing gasket joints, or are brushed on gaskets.

RTV preparations are fully visible once the component has been disassembled. Old RTV material must be removed before the joint is re-tightened.

The following RTV preparations are mentioned in the workshop manual: Volvo Penta part no. 840879-1, liquid gasket (or Loctite® 574)

Volvo Penta part no. 1161099-5, sealant (or 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, thread locking fluid (or Loctite® 243).

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

Volvo Penta part no. 1141570-0, sealant, 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 300°C, 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.

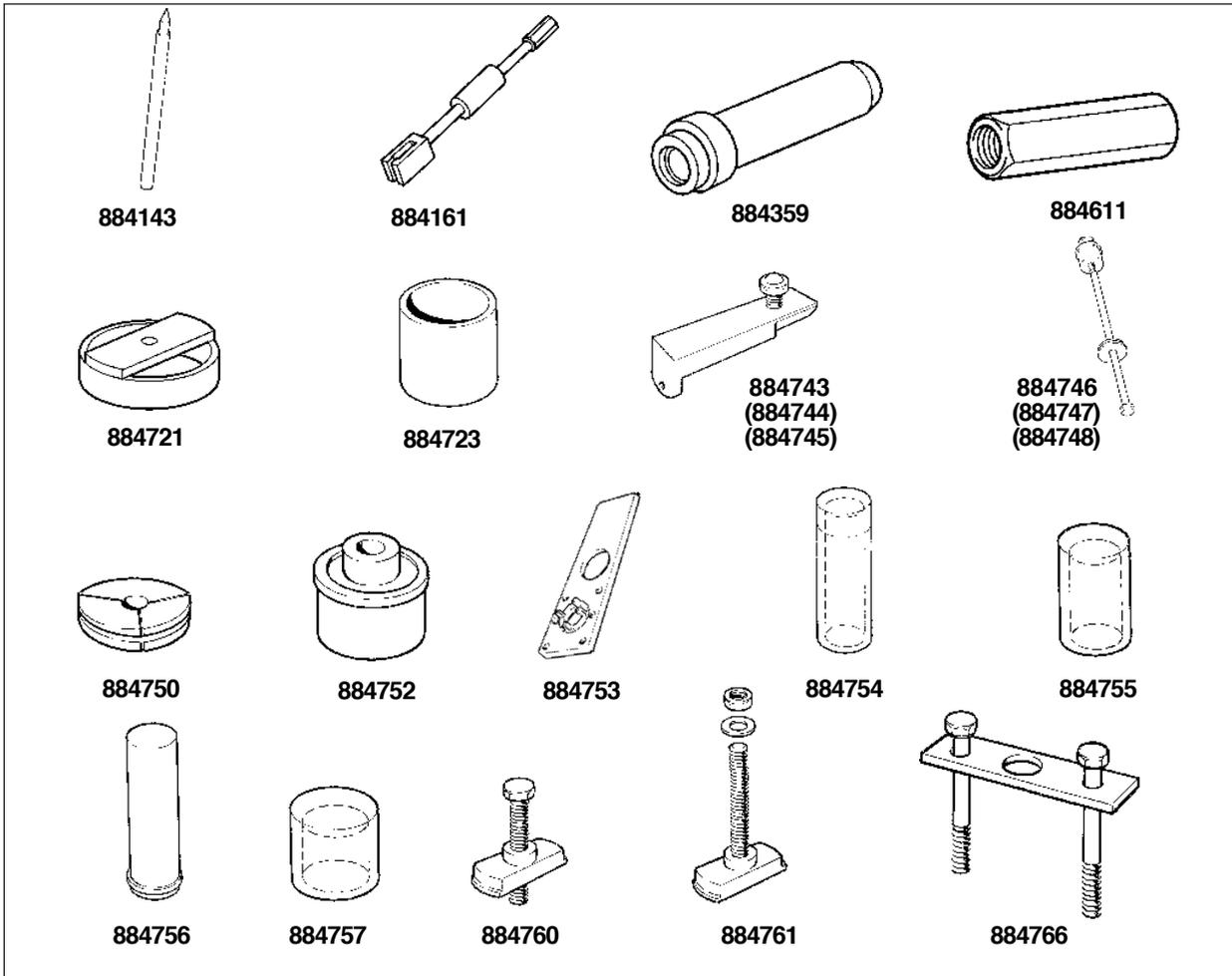
The following seals are most probably made from fluorocarbon rubber:

Seal rings for the crankshaft, camshaft, drive shafts.

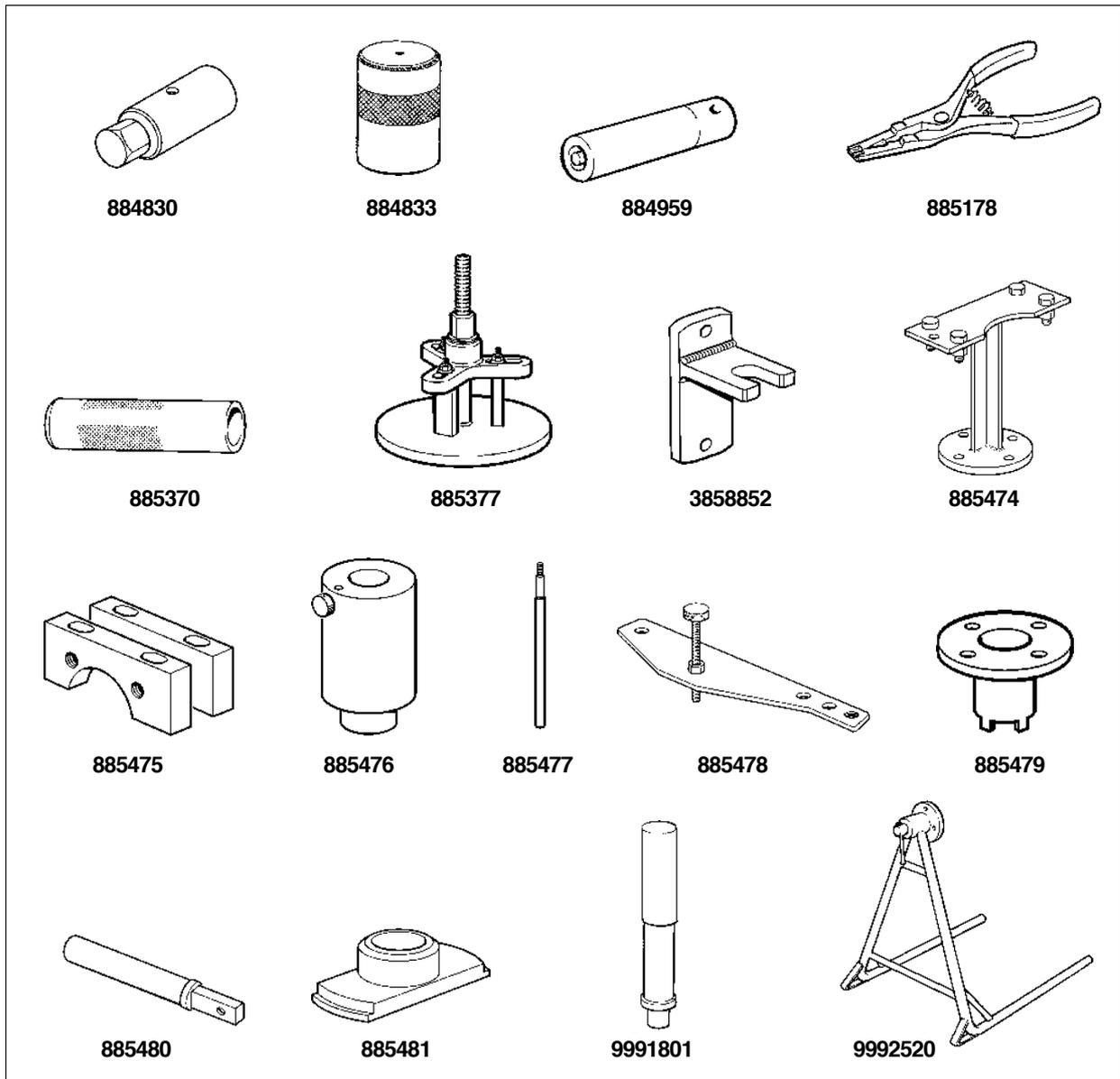
O-rings, irrespective of where they are installed. O-rings for cylinder liner sealing are almost always made of fluorocarbon rubber.

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

Special tools

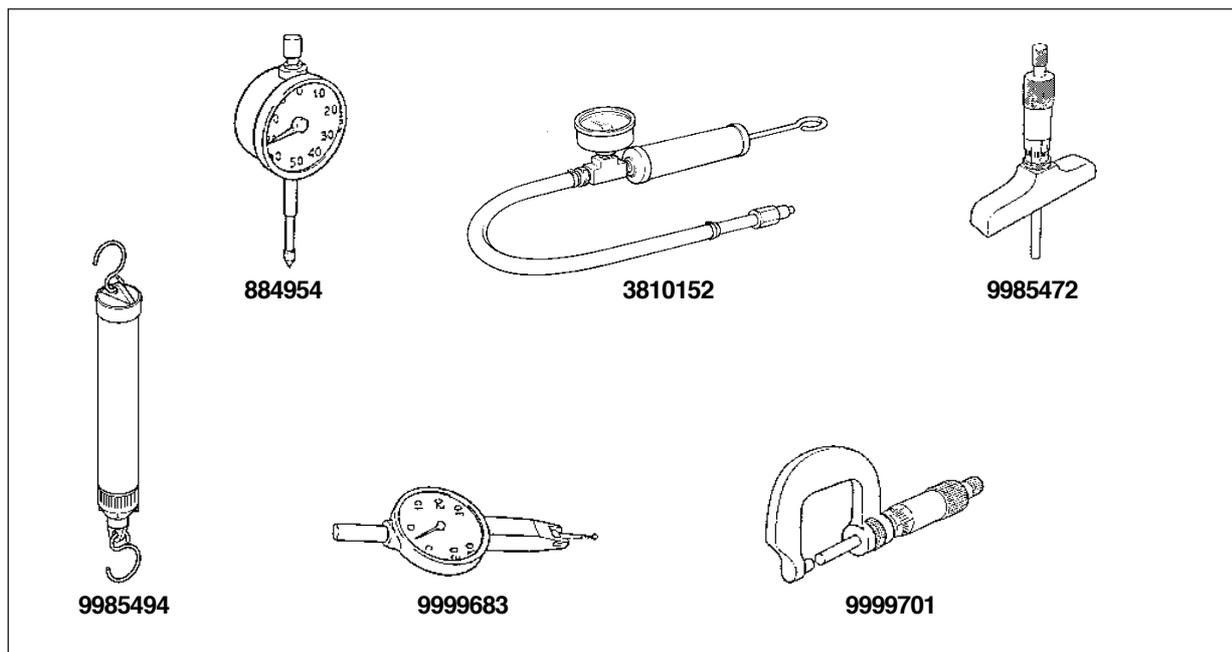


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|----------|--|----------|--|
| 884143-9 | Shaft for expander 884750. | 884752-7 | Mandrel. Installation of seal rings in rear bearing housing, lower gear. |
| 884161-1 | Slide hammer. Removal of propeller shaft | 884753-5 | Fixture, lower gear. |
| 884359-1 | Mandrel. Installation of upper bearing race, upper gear housing. | 884754-3 | Mandrel. Installation of bearing, lower gear housing. |
| 884611-5 | Extractor. Used together with 884161 | 884755-0 | Mandrel. Installation of roller bearing, lower gear housing. |
| 884721-2 | Extractor. Removal of outer bearing race, lower gear. Used together with 884761 | 884756-8 | Mandrel. Installation of outer bearing race in rear bearing housing. |
| 884723-8 | Mandrel. Disassembly of rear bearing housing, lower gear. | 884757-6 | Mandrel. Installation of outer bearing race, outer bearing, lower gear. |
| 884743-6 | Removal of vertical shaft. The complete tool also includes 884744 and 884745 | 884760-0 | Mandrel. Installation of outer bearing race, inner bearing, lower gear. |
| 884746-9 | Installation of needle roller bearing, lower gear housing. The complete tool also includes 884747 and 884748 | 884761-8 | Extractor. Used together with tool 884721 |
| 884750-1 | Expanding mandrel. Removal of outer bearing race, lower gear. | 884766-7 | Press. Installation of vertical shaft, lower gear housing. Used together with 884753 |



- | | | | |
|----------|---|-----------|--|
| 884830-1 | Sleeve for vertical shaft. Earlier tool 884264 can be used | 885477-0 | Extension. Used together with extension and gauge 885476 |
| 884833-5 | Mandrel. Installation of outer bearing race, lower gear | 885478-8 | Fixture for crown wheel/input shaft, upper gear housing |
| 884959-8 | Mandrel. Installation of seal ring, control arm | 885479-6 | Counterhold. Disassembly/assembly of ring nuts, output shaft, upper gear housing |
| 885178-4 | Circlip pliers. Flange - upper gear housing | 885480-4 | Measurement shaft for shim dimensioning |
| 885370-7 | Mandrel. Input shaft, upper gear housing | 885481-2 | Plate, disassembly of upper bearing race, output shaft, upper gear housing |
| 885377-2 | Press tool. Compression of disc springs, circlip installation | 3858852-1 | Counterhold. Removal of pinion nuts |
| 885474-7 | Fixture for upper gear housing | 9991801-3 | Standard extension |
| 885475-4 | Shaft clamp, 2:nd. For fixing input shaft, upper gear housing | 9992520-8 | Working stand |
| 885476-2 | Gauge. Used together with extension 885477 and dial gauge. | | |

Other special equipment



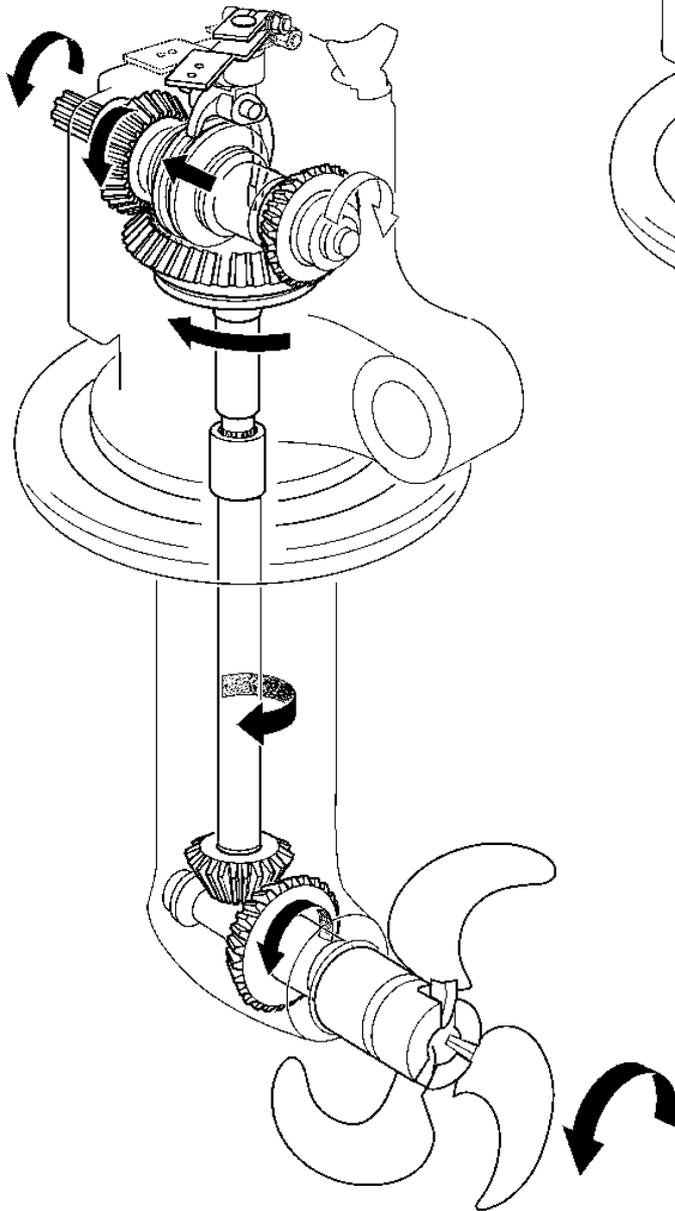
- 884954-9 Dial gauge. Used together with extension 885477 and gauge 885476.
- 3810152-3 Equipment for pressure testing drives
- 9985472-1 Depth micrometer
- 9985494-5 Spring balance
- 9999683-7 Dial gauge.
- 9999701-7 Micrometer

Chemicals

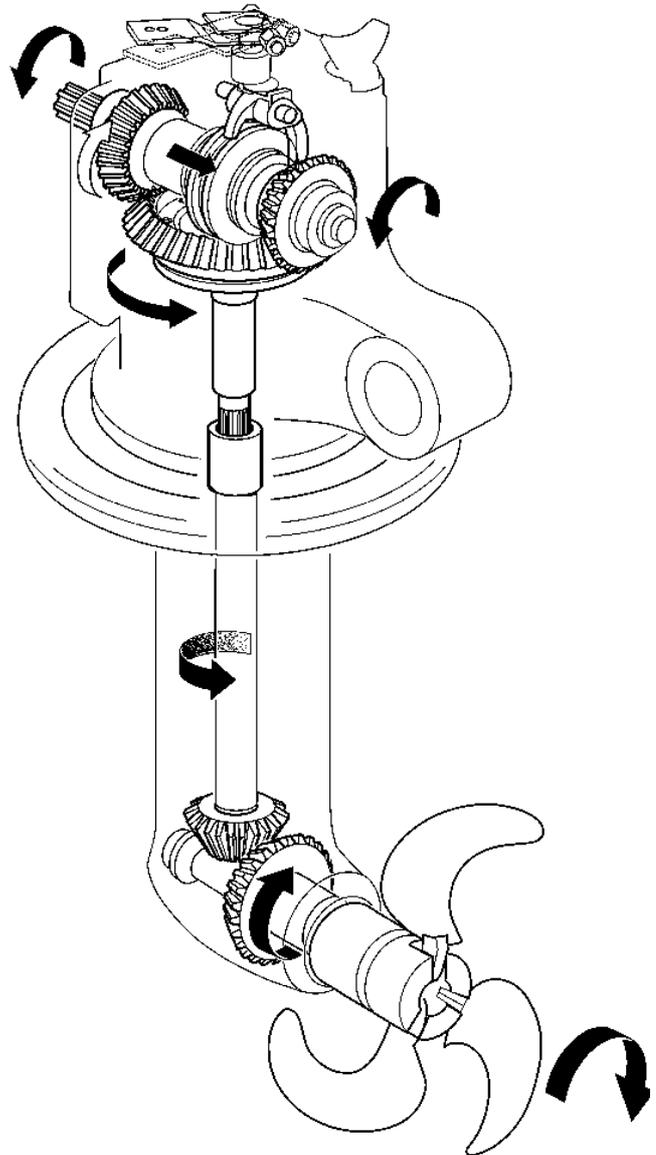
- RTV preparations:
Volvo Penta part no. 840879-1, Loctite® 574;
Volvo Penta part no. 1161099-5, Permatex® No. 3.
- Anaerobic preparations:
Volvo Penta part no. 1161053-2, Loctite® 243.
- Polymer preparations:
Volvo Penta part no. 1141570-0 (white)
- Water resistant grease:
Volvo Penta part no. 828250-1
- Assembly paste, MoS₂ :
Volvo Penta part no. 1161029-2,
1161397-0 (spray-can)

Design and function

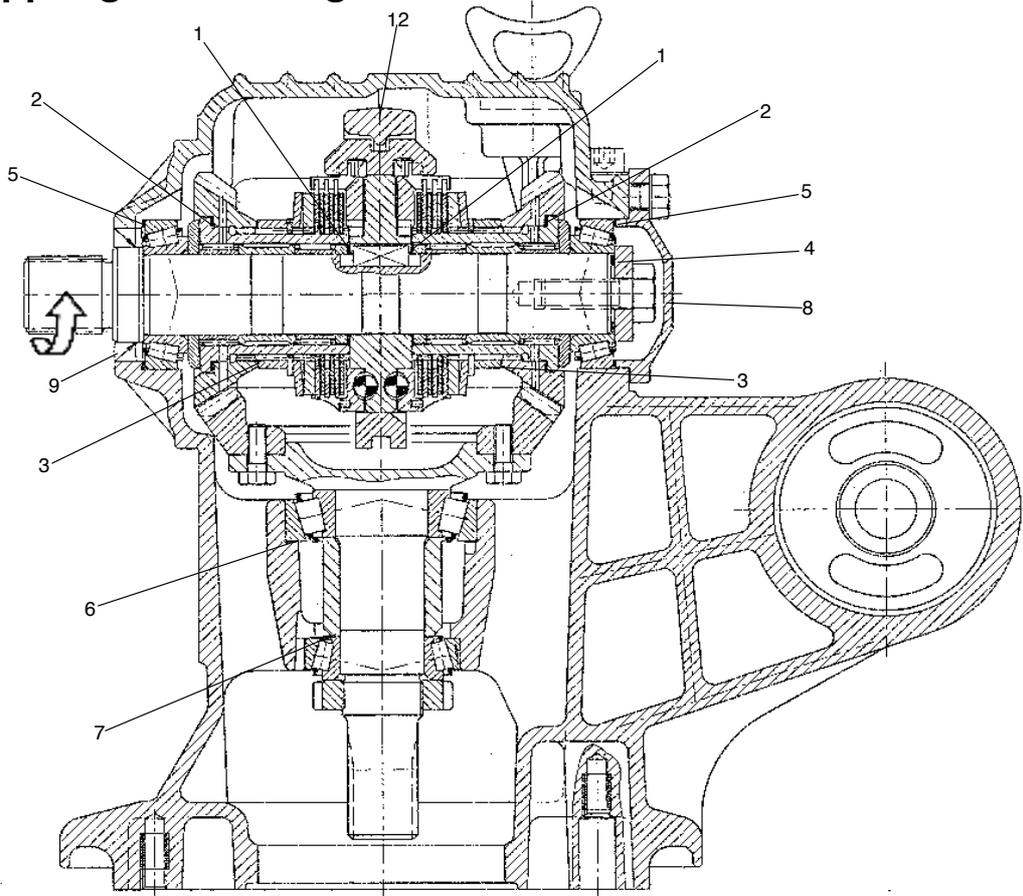
**FORWARD-position,
left hand rotating propeller**



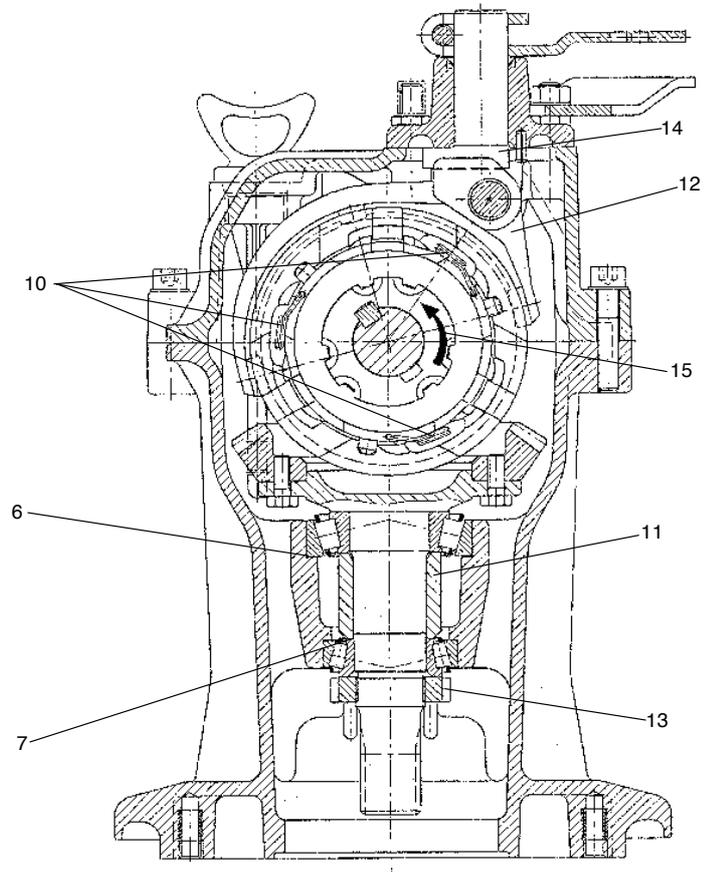
**REVERSE-position,
left hand rotating propeller**



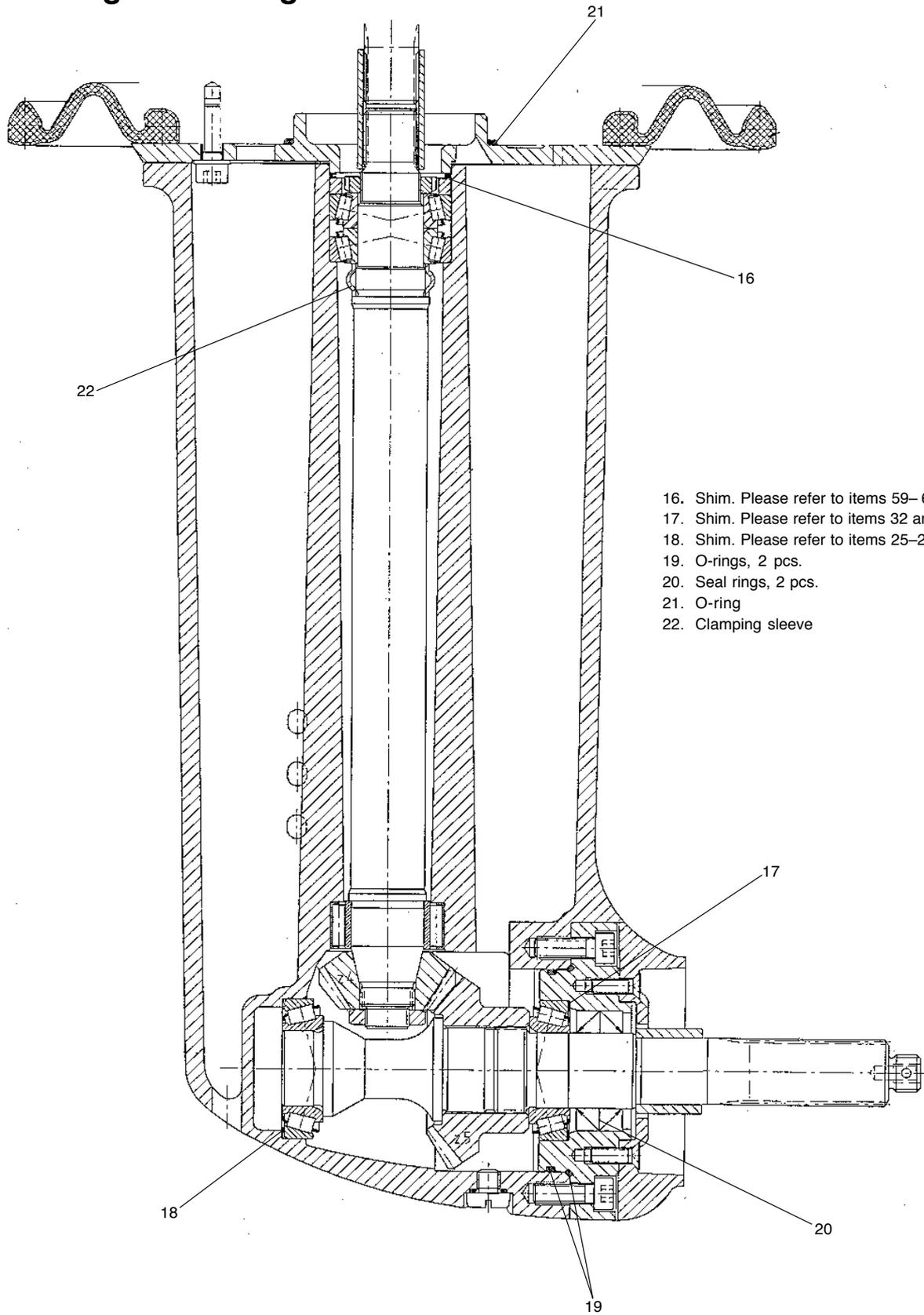
Upper gear housing



1. Shim. Please refer to items 16 and 24.
2. Shim. Please refer to items 18 and 20.
3. Shim. Please refer to item 21.
4. Shim. Please refer to item 35.
5. Shim. Please refer to items 41 and 44.
6. Shim. Please refer to item 58.
7. Shim. Please refer to item 64.
8. Cover.
9. Seal ring
10. Springs, 3 pcs. Please refer to item 27.
11. Spacer.
12. Gear selector fork
13. Ring nut
14. Eccentric plate
15. Direction of rotation of engine and input shaft.

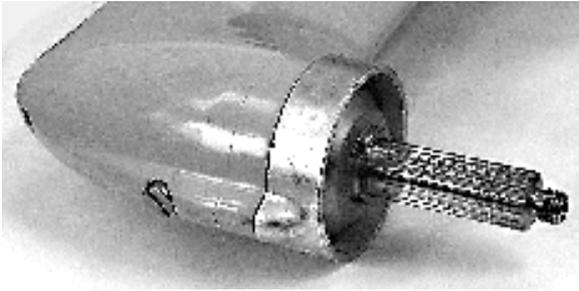


Lower gear housing



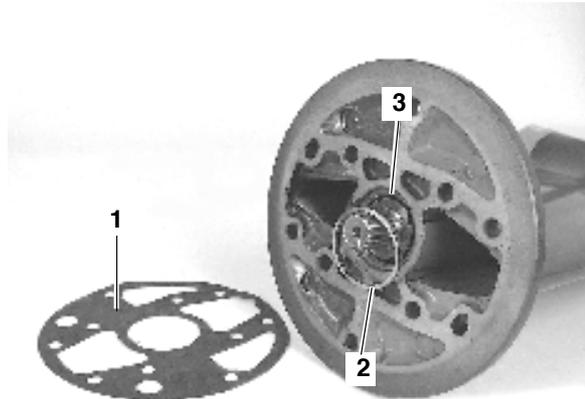
- 16. Shim. Please refer to items 59– 62.
- 17. Shim. Please refer to items 32 and 36.
- 18. Shim. Please refer to items 25–27.
- 19. O-rings, 2 pcs.
- 20. Seal rings, 2 pcs.
- 21. O-ring
- 22. Clamping sleeve

Disassembly – upper and lower gear housings



1. Clean the outside of the upper and lower gear housings.

Remove the propeller and remove the fishing line cutter.
Remove the drain plug and drain the oil.



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



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

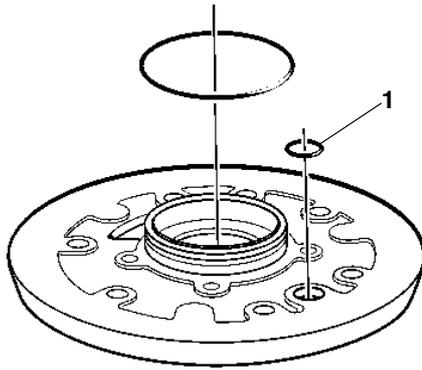


4. Remove the adapter plate and remove the rubber sleeve.

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

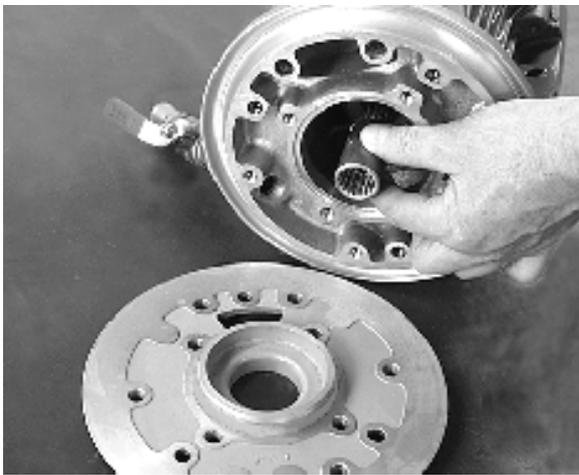
Prize carefully. Use a tool with no sharp edges.

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



5. Reverse installed drive (180°)

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



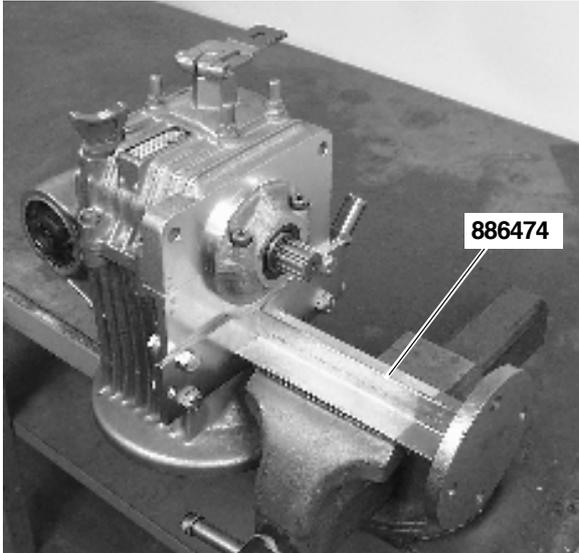
6. Remove the splined sleeve.

Check that the sleeve is not damaged.

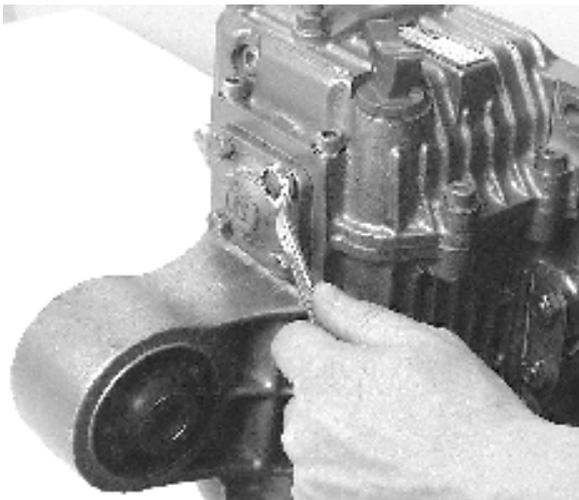
Repair – upper gear housing

Input shaft, disassembly

⚠ IMPORTANT! Mark the components when disassembled, to avoid mixing them up. Note the dimensions of all the shims in the gear housing when you are working.



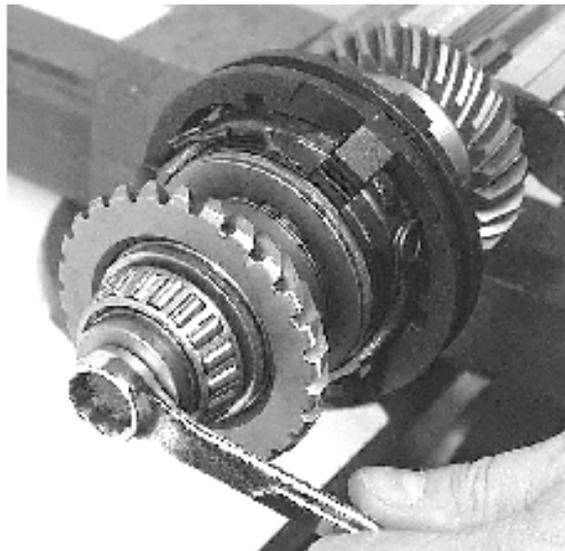
1. Install the bracket, special tool **885474** on the gear housing. Fix the bracket in a vise or working stand **9992520**.



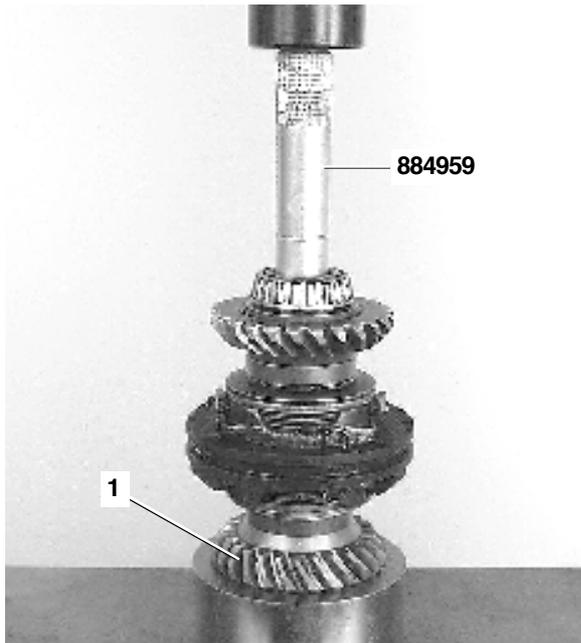
2. Remove the sealing cover and the upper section of the gear housing.



3. Lift the input shaft out and remove the seal ring, the outer bearing races and the shims on both sides. Scrap the seal ring.



4. Fix the input shaft in a vise. Use soft facings on the vise jaws. Remove the screws and washer and shims. Clean all traces of sealant off the threads.



5. Put the shaft in a press, with the splines facing down. Press all the components up to the gear wheel (1) off the shaft. Use mandrel **884959**.

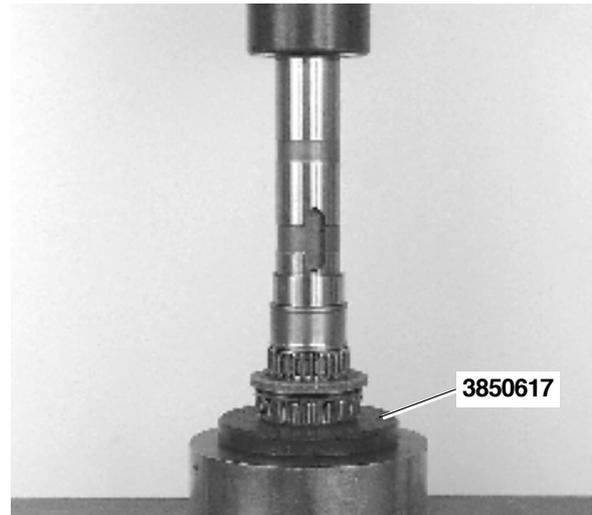
Remove the plates.



6. The bearing – sintered washer – needle roller bearing – spacer – needle roller bearing – spacer – shim and key are left on the shaft.

Remove the key from the shaft. Change the key if damaged.

NOTE! The key can sit tightly. Make sure not to damage the shims.

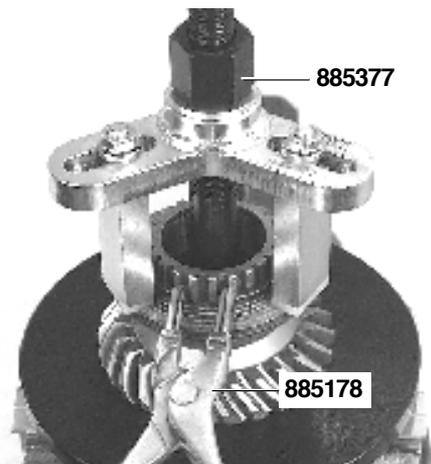


7. Remove the shims, the spacer and one of the needle roller bearings.

8. Press the other bearings off.

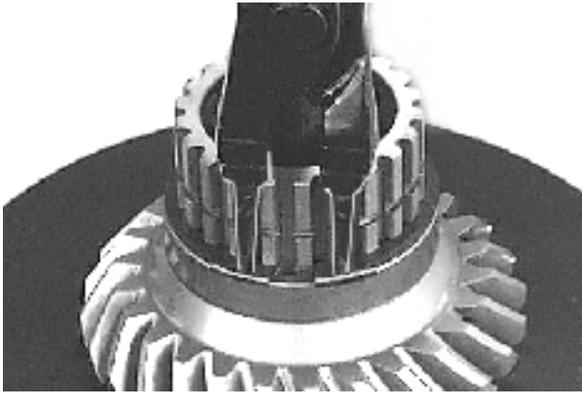
Use a tool no. **3850617** as a counterhold.

Refers to both sides, items 9–13.



9. Press the spring washer down. Use tool no. **885377**.

Undo the circlip with circlip pliers no. **885178** and remove the components from the shaft.



10. Remove the circlip, spacer and shims from the flange.

11. Tap the gear off the flange with a plastic faced hammer. Save the shims.



12. Measurement and inspection of sintered washers:

Check the sintered washers, 2 on the flanges and 2 on the shaft, by the gear wheels.

Min. dimension of the sintered washer, flange: **3.9 – 4.0 mm (0.153543 – 0.1575")**

Min. dimension of the sintered washer, gear wheel: **3.6 – 3.7 mm (0.141732 – 0.1457")**

The washers must not be worn bright, i.e. have a low coefficient of friction.

Change the washers as necessary.

⚠ IMPORTANT! When the sintered washers are changed, the complete package of plates must be changed.

13. Checking the plates:

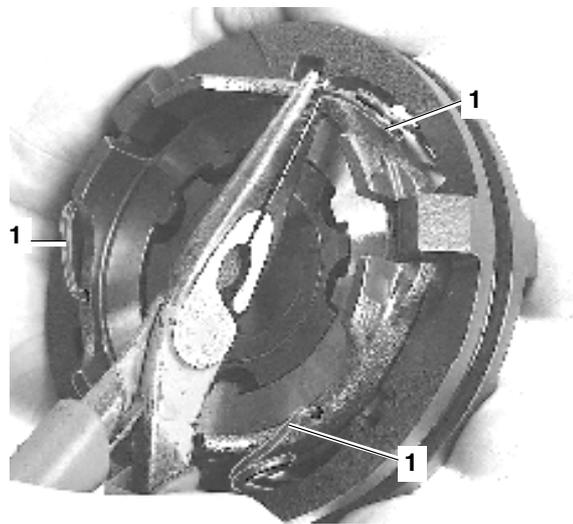
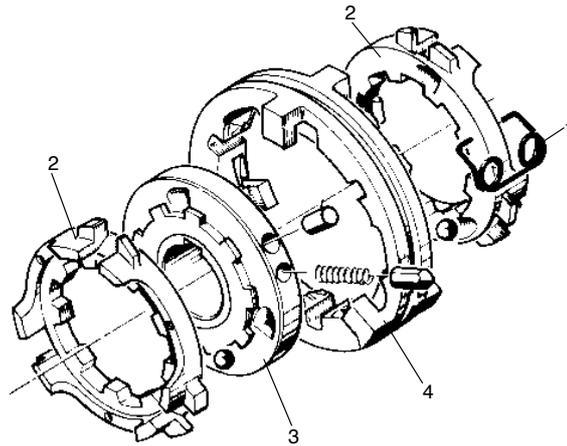
Minimum dimension of the sintered plates: **1.55 – 1.60 mm (0.0610 – 0.0630")**

Minimum dimension of the steel plates: **1.35 – 1.40 mm (0.0531 – 0.0551")**

The plates must not be worn so they are shiny.

Change the complete package of plates as necessary.

⚠ IMPORTANT! When the plates are changed, all four sintered washers must be changed.



14. Disassembly of gear selection plate and holder:

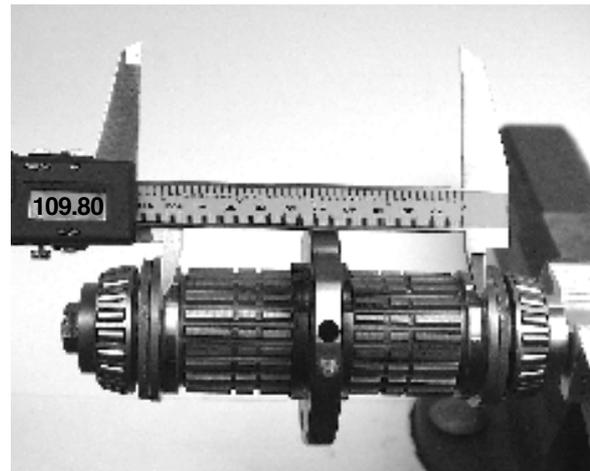
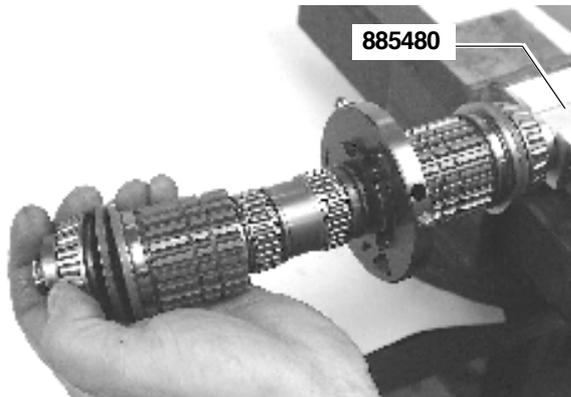
Remove the three springs (1) and the two holders (2). Be careful to save the balls, three in each holder.

Put the hub (3) and the gear selection plate (4) in a cloth etc. to catch any components which could come loose.

Carefully separate the hub and gear selection plate.

Save the pins, 3 pcs., and the springs, 3 pcs.

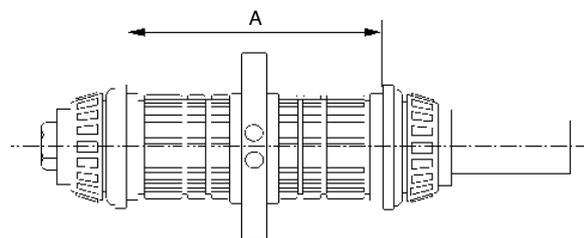
Shim calculation



15. Put the components on the “measurement shaft”, special tool **885480** as in the illustration. Bearing – sintered washer – needle roller bearing – spacer – needle roller bearing – spacer – shim – flange – hub – shim – spacer – needle roller bearing – spacer – needle roller bearing – flange – sintered washer – bearing – washer – screw.

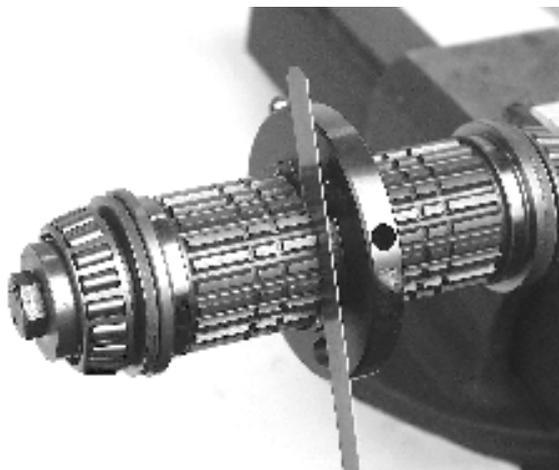
NOTE! Do not put any shims inside the washer and screw.

Tighten the screw. Tightening torque: **App. 10 Nm (7.3 lbf-ft)**.



17. Measure distance (**A**) between the flanges with a caliper gauge. Use a digital caliper gauge for easier reading. Note the value.

As an example, we have chosen the value of 109.80 mm (4.322826”).



18. Calculate the corresponding distance, starting from the two gear wheels. We call this dimension (**B**).



16. Measure the clearance between the flange on both sides. Use a feeler gauge.

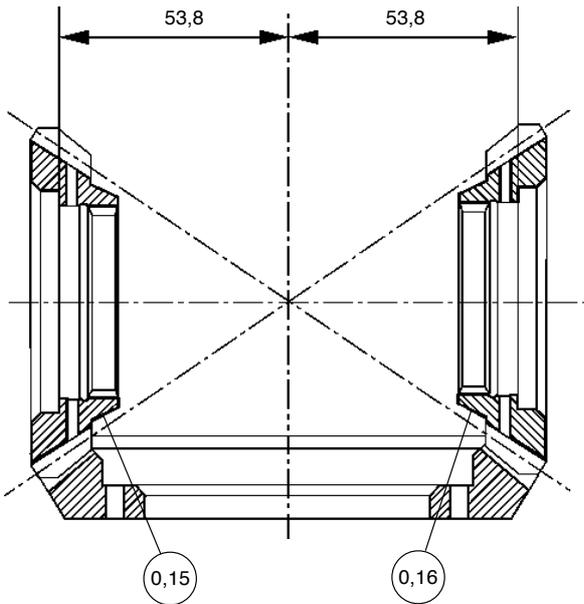
Clearance: **0.50–0.55 mm (0.0197–0.0217”)**

If the clearance is incorrect, correct the shims facing the hub.

Shims are available in the following thicknesses (mm):
0.15 - 0.20 - 0.30 - 0.40 - 0.50 - 0.60 - 0.70.
(1 mm = 0.03937”)

First check the marking on the gear wheels. The gear wheels in the example are marked **0.15** and **0.16** as in the illustration.

NOTE! The values are always positive.



53.8 is a constant value which applies to all gear wheels.

The B-dimension then becomes:

$$B = 53.8 + 0.15 + 53.8 + 0.16 = 107.91$$

The nominal shim thickness on each side becomes:

$$\frac{A - B}{2}$$

In the example:

$$\frac{109,80 - 107,91}{2} = 0,945 \text{ mm}$$

Nominal shim thickness: 0.945 mm (0.0372") on each side.

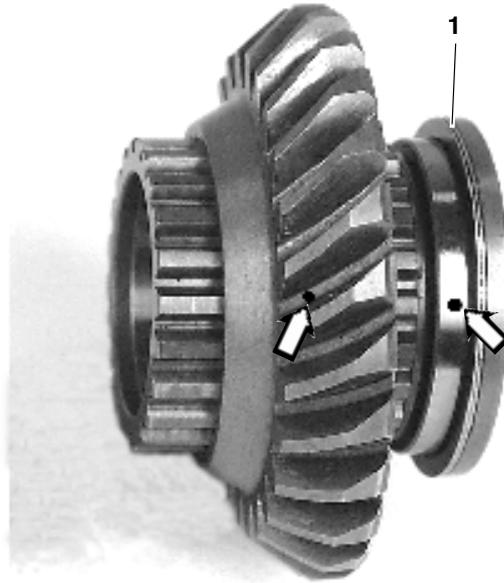
Choose shims which are as close as possible to standard thicknesses. Use the lowest number of shims possible. In this example, we will use shims of thickness 1.00 mm (0.0394").

Shims are available in the following thicknesses (mm): **0.10 - 0.20 - 0.30 - 0.50. (1 mm = 0.03937")**

19. Remove the components from the "measurement shaft", special tool **885480**.

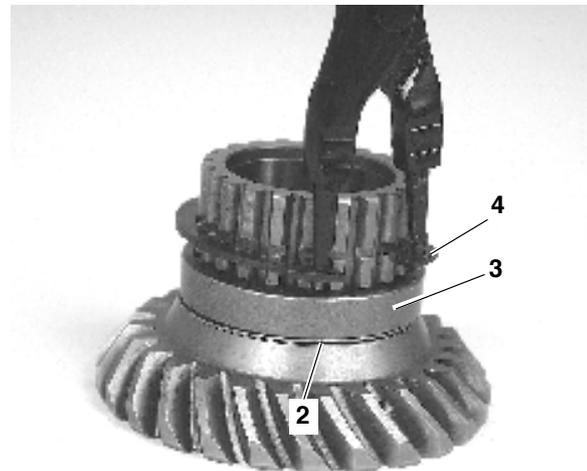
Flange, hub and gear selection plate, assembly.

Both flanges, items 20–22:



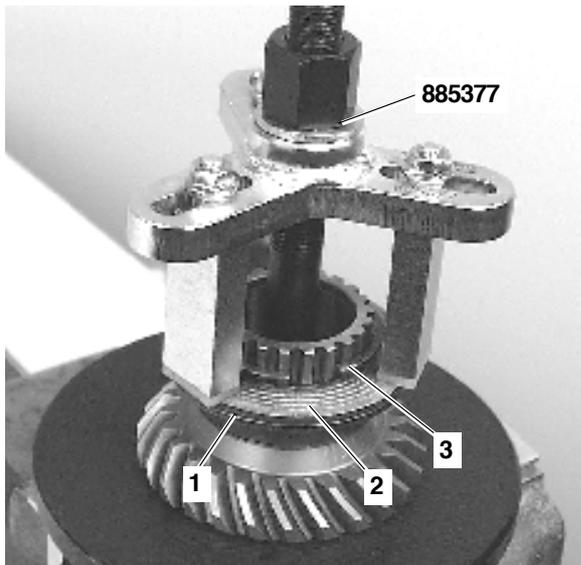
20. Install the shim (1) and gear wheel on the flange. Note that the holes on gear wheel and flange are positioned in line with each other.

The shims should have the thickness measured in the method described in items 17–18.

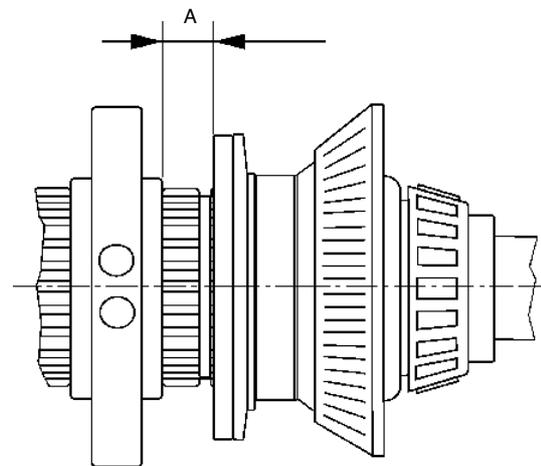
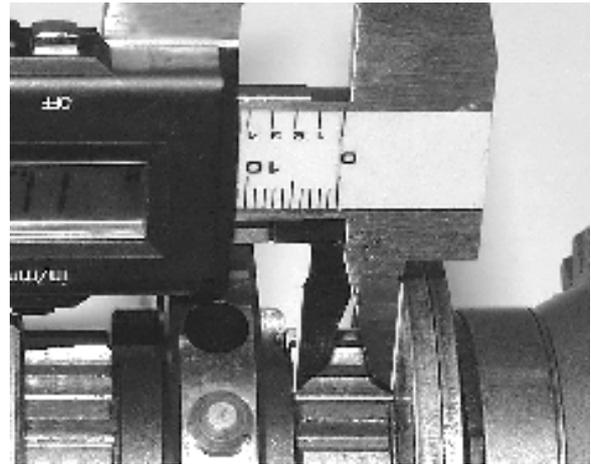


21. Install the shim (2), spacer (3) and circlip (4). Check that there is no slack between the circlip and gear wheel. Measure with a feeler gauge. If there is any slack, the shim thickness must be increased.

Shims are available in the following thicknesses (mm): **0.10 - 0.15 - 0.20 - 0.30 - 0.50. (1 mm = 0.03937")**

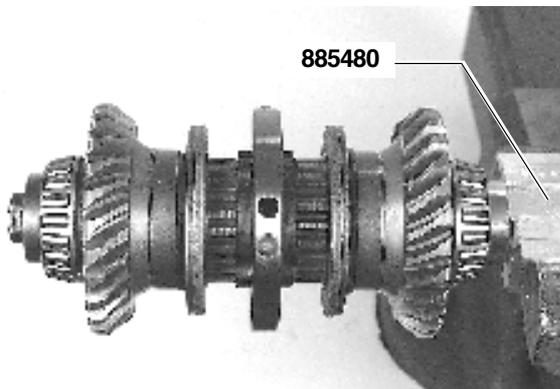


22. Install the spring washer (1) and the sintered washer (2). Press the washer down with tool no. **885377** and install the circlip (3). Make sure that the circlip is securely seated in the groove.



24. Measure distance (A) between the sintered washer and the hub. Please refer to the figure. Use a digital caliper gauge for greater accuracy.

Correct distance: **11.3 – 11.4 mm (0.4449– 0.4488")**



Check measurement, both sides

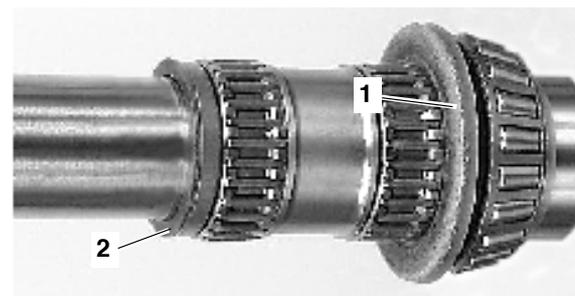
23. Install the following components on the “measurement shaft”, special tool **885480**.

The bearing – the sintered washer – needle roller with spacer – the other needle roller – flange complete with gear etc. – the spacer ring – shims and hub.

Install the screw and washer.

Tighten the screw.

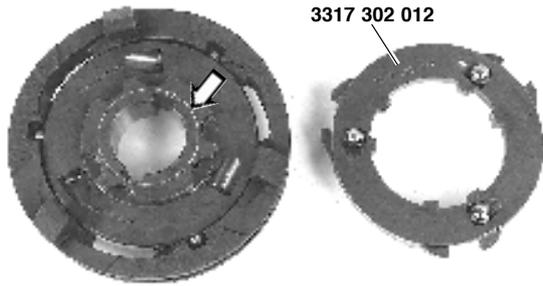
Tightening torque: **10 Nm (7.3 lbf-ft)**.



If the distance is incorrect:

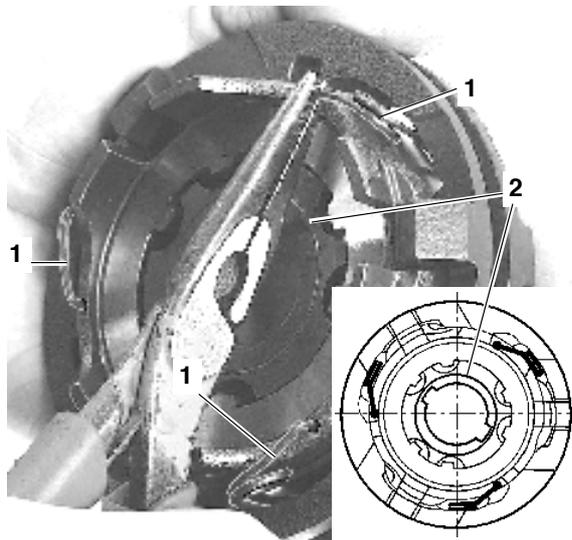
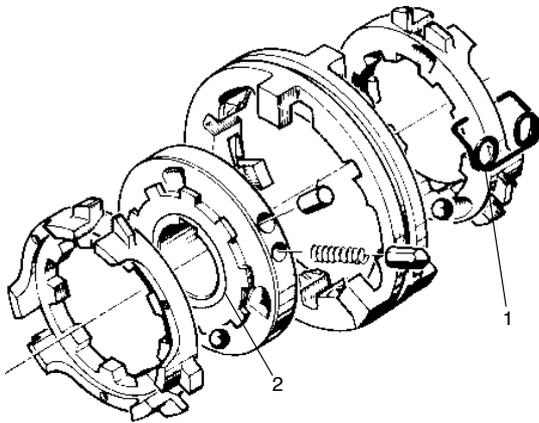
- Check the measurement of the sintered washer (1).
- Check the shimming (2) between the needle roller bearing and the hub.
- Check the clearance between the needle roller bearing and the hub as in item 16.

25. Remove the components from the “measurement shaft”.



26. Assemble the hub and the holders.

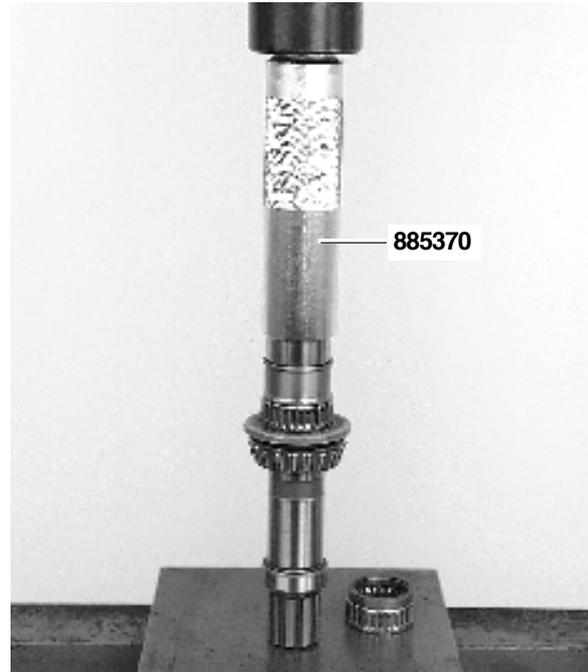
⚠ IMPORTANT! The groove on the inner section of the hub, by the arrow, should face the holder marked **3317 302 012**.



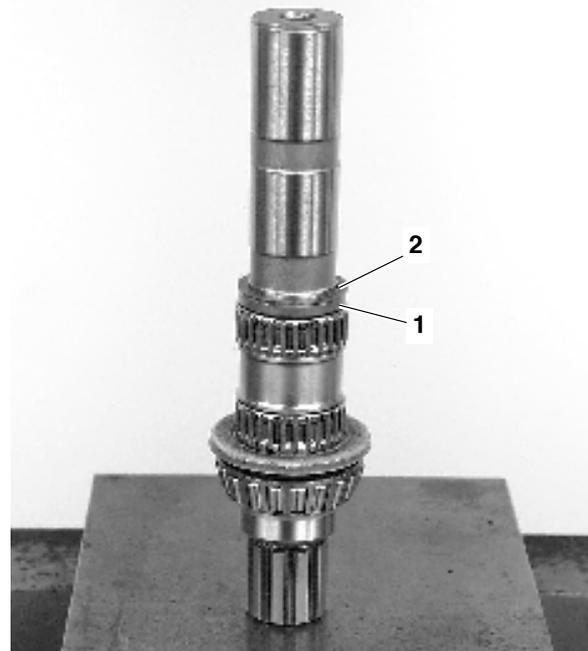
27. Install the screws (1), (3 pcs). Make sure that they are installed the correct way round.

NOTE! The groove (2) on the hub.

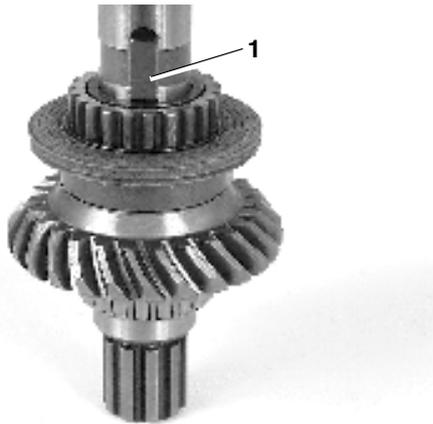
Input shaft, component assembly



28. Press the bearing – sintered washer – needle roller bearing – spacer – needle roller bearing race on. Use mandrel **885370**. Make sure that the components seat securely.



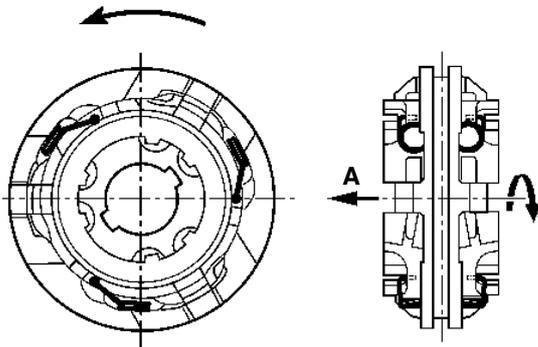
29. Install the spacer ring (2) and shim (2). Shim thickness is determined by the method shown in items 16 and 24.



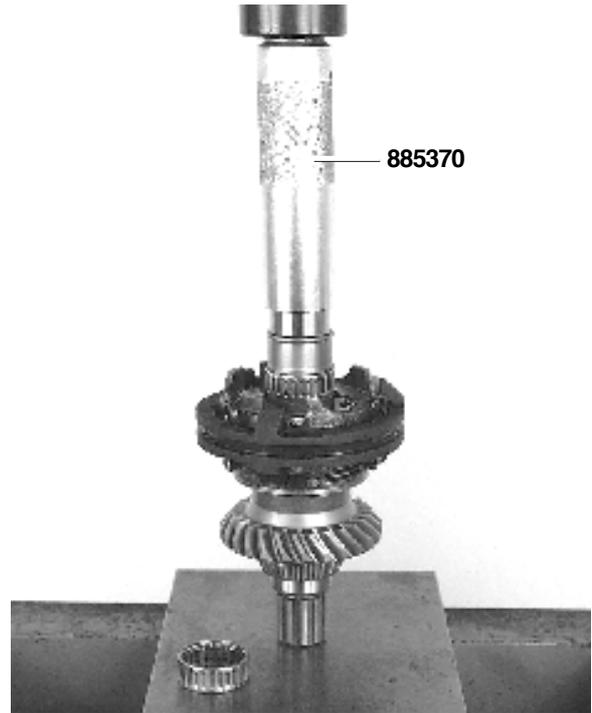
30. Install the flange, complete and key (1).



31. Thread one package of plates on
Install the complete hub with holder and gear selection plate. Align the points to face the steel plates. Thread the hub on carefully and observe the position of the plates.



⚠ IMPORTANT! Align the hub and gear selection plate correctly in relation to the direction of rotation. Note the position of the springs. The groove in the hub, see item 27 pos. (2), must be positioned towards the engine.
A = engine side.

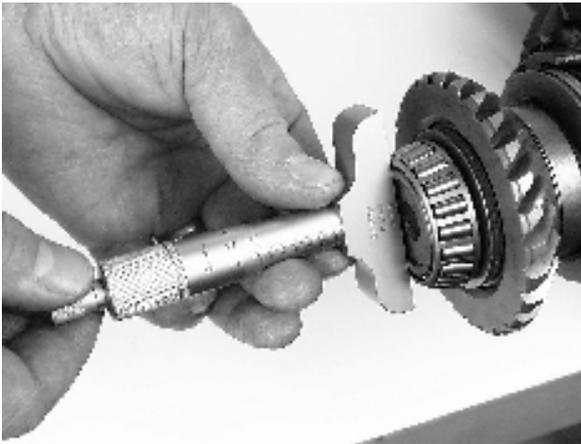


32. Install the shims calculated in the **Shim calculation** chapter, items 16 and 24, and then the spacer ring – needle roller bearing – spacer and needle roller bearing.

When pressing, use mandrel **885370**.

⚠ IMPORTANT! Make sure that the needle roller bearing is not pinched against the bearing race. Check that the components seat securely.

33. Continue with the gear selection plates and the other flange, complete.



34. Install the sintered washer and press the bearing on.

35. Measure the distance between the end of the shaft and the inner bearing race, using a depth micrometer.

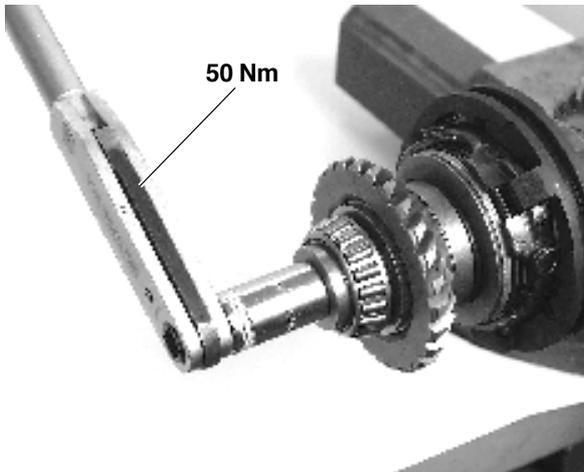
Install shims to make the pre-load against the shaft
0.05–0.10 mm (0.0020–0.0039")

Example:

Distance with micrometer = 1.80 mm (0.0709") gives shim thickness = 1.70 – 1.75 mm (0.0669 – 0.0689"), considering the pre-load.

Available shim thicknesses (mm):

0.10 - 0.20 - 0.50 - 1.00. (1 mm = 0.03937").

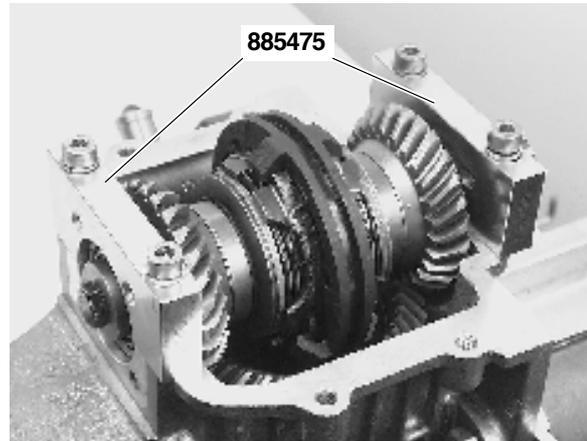


36. Apply thread locking fluid, Volvo Penta part no. 1161075-5, to the screw threads. Install the washer and screw.

Tighten the screw.

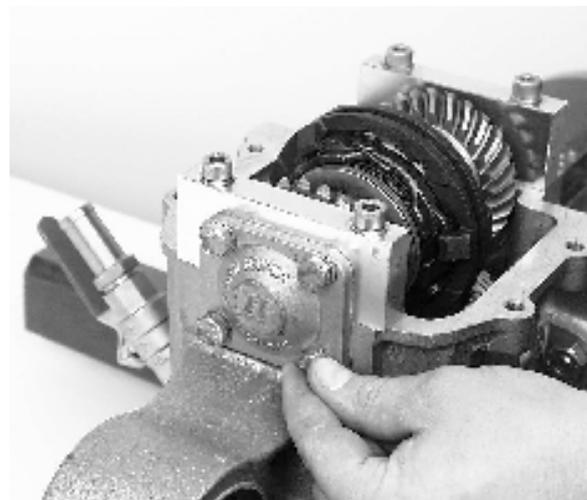
Tightening torque: **50 Nm (36.8 lbf-ft).**

Flank clearance and marking pattern, checking



37. Install the outer bearing race with shims in the gear housing. Put the input shaft in the housing.

Fix the shaft in the housing with the shaft clamps, special tool **885475**. Use the screws from the upper and lower bearing housings (M8x60). The screws must be clean and oiled. Tighten the screws alternately by hand, without using tools.

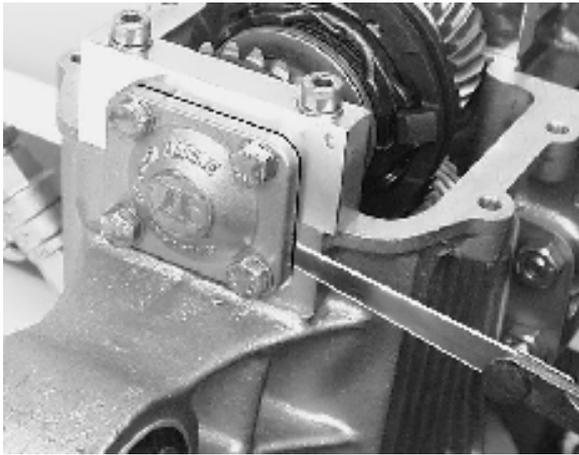


38. Press the bearing races into place by using the cover **without gasket** and **with shims** of the same thickness as the original ones.

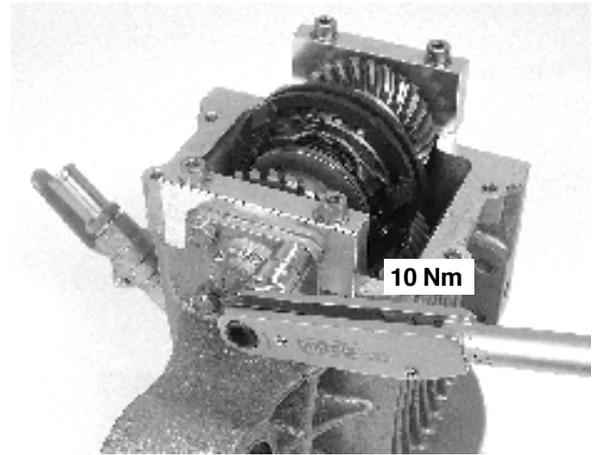
Tighten the screws **lightly, about 5 Nm (3.6 lbf-ft)**, wrench size 13 mm.

Undo the screws on the cover again and tighten them by hand, without using tools.

Torque the shaft clamp screws to **20 Nm (14.7 lbf-ft)**. Make sure that there is gear flank clearance on both sides.

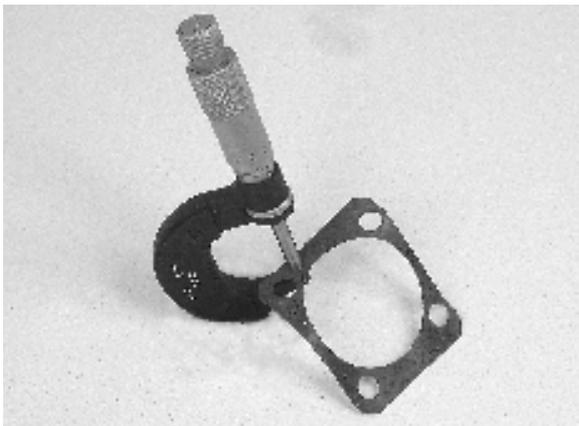


39. Measure the gap between the gear housing and the cover with a feeler gauge.



42. Put the gasket on the cover. Torque the screws alternately.

Tightening torque: **10 Nm (7.3 lbf-ft)**.



40. Measure the thickness of the gasket with a micrometer.

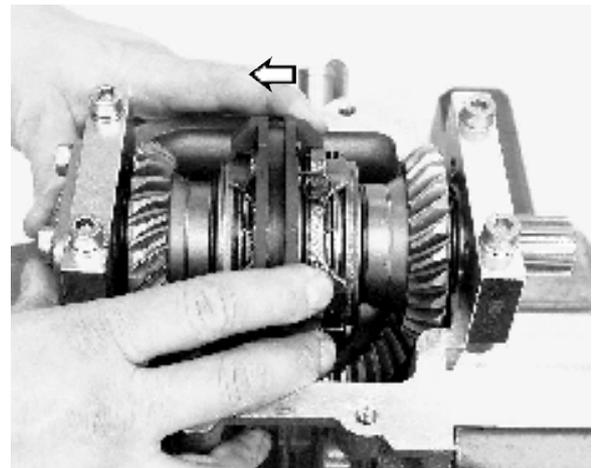
41. Compensate with shims, to make the pre-load **0.03 - 0.07 mm (0.0012 - 0.0028")**.

Available shim thicknesses (mm): **0.10 - 0.15 - 0.20 - 0.30 - 0.50 (1 mm = 0.03937")**.

Example:

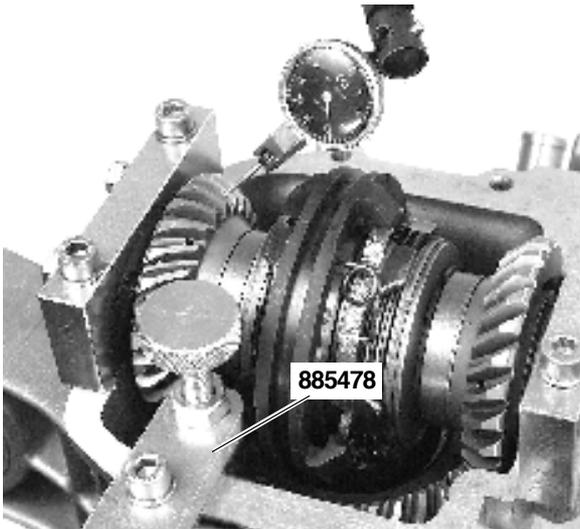
Gap measured with feeler gauge (A)	= 0.35 mm (0.0138")
Gasket thickness (B)	= 0.25 mm (0.0098")
Preload (B A):	= 0.10 mm (0.0039")

In this example, the pre-load would be too large (0.10 mm (0.0039")). Reduce the shim thickness by 0.05 mm (0.0020"). This makes gap (A) 0.30 mm (0.0118") and pre-load 0.05 mm (0.0020"), which is inside the tolerance limits of 0.03–0.08 mm (0.0012–0.0032").



43. Engage the gear position for the gear wheel to be checked, by sliding the gear selection plate towards the wheel as in the illustration.

The gear selection plate is in the FORWARDS direction in the illustration (left hand rotating propeller).



44. Install an dial gauge with rocker arm and stand.

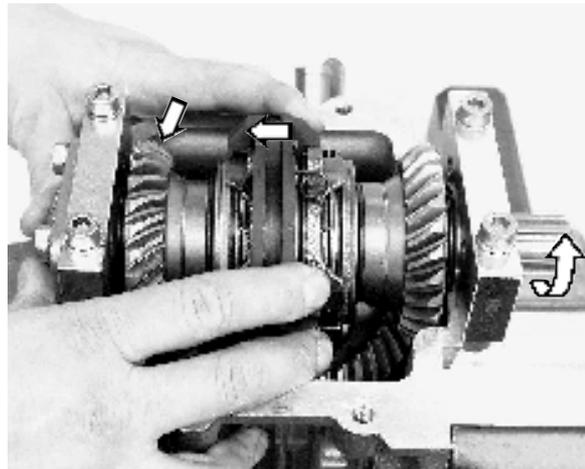
Lock the crown wheel/output shaft with special tool **885478** installed as in the illustration. Measure the flank clearance on the gear wheel.

Engage the gear position for the other gear wheel and measure the clearance.

Flank clearance: **0.12–0.27 mm (0.0047–0.0106")**.

The flank clearance should be as equal as possible on* each side.

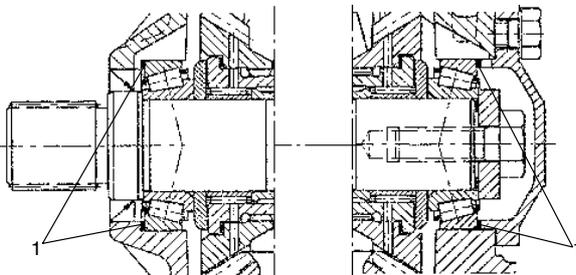
Adjust by centering the shaft against the crown wheel, using shims (1) by the outer bearing race.



45. Check the marking pattern.

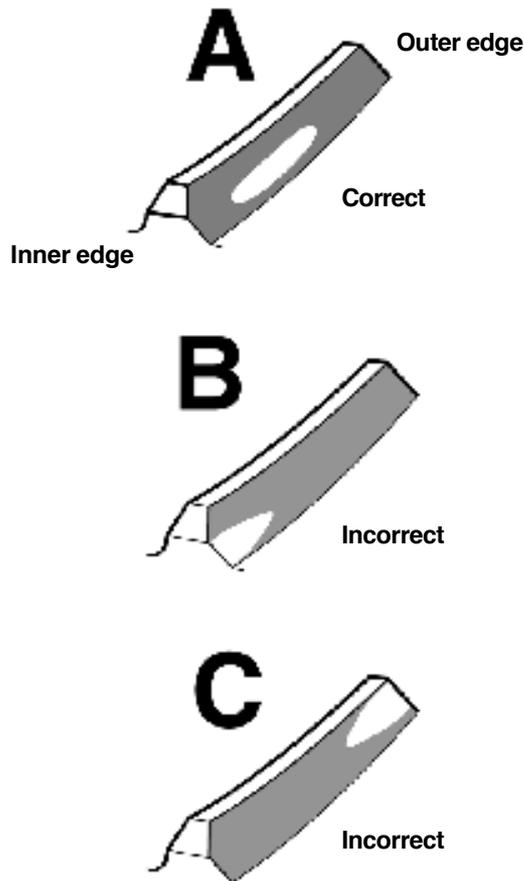
Engage the gear position for the gear wheel to be checked, by sliding the gear selection plate towards the wheel as in the illustration. The gear selection plate is in the FORWARDS direction in the illustration.

Wipe marker dye on the gear teeth and check them by turning the input shaft in the direction of rotation shown in the illustration. Brake the output shaft lightly during measurement.



Faulty flank clearance or incorrectly located marking picture.

If there is faulty flank clearance or an incorrectly located marking picture, the position of the input shaft must be adjusted by means of shims.



If we move the position of the input shaft /crown wheel upwards, the flank clearance is reduced and the marking position is displaced towards the center of the gear wheel (B). If the shaft is lowered, the marking position is displaced towards the outsides (C) and the flank clearance is increased. Figure (A) shows the correct marking picture.

NOTE! The flank clearance is changed by about half of the vertical shim adjustment height. This means that an increase of 0.25 mm (0.009842") shim thickness on the output shaft reduces the flank clearance by about 0.12 mm (0.004724"), and vice versa.

Adjusting the marking pattern and flank clearance

46. Remove the cover and shaft clamps. Save the shims and bearing races. Remove the input shaft from the gear housing.

47. Remove the output shaft and bearing.

Please refer to **Output shaft, disassembly**, items 52, 53 and 55.

48. Increase or reduce the shim thickness for the upper bearing, depending on the flank clearance.

Please refer to **Output shaft, shimming and assembly**, item 58.

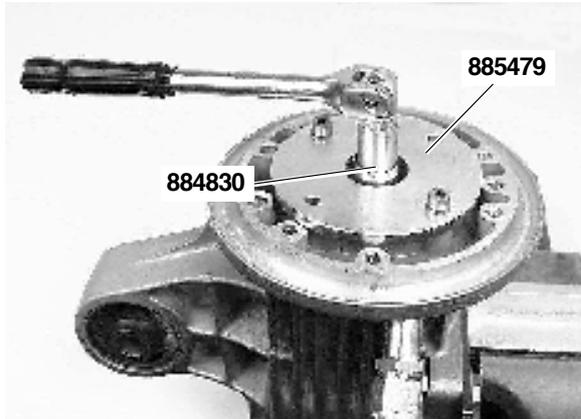
49. Install the shaft

Please refer to **Output shaft, shimming and assembly**, items 58–69.

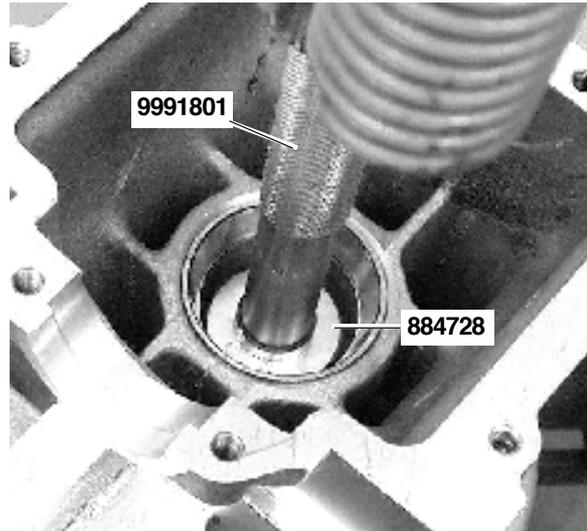
50. Check the flank clearance.

51. When the flank clearance is correct, do a final check on the marking pattern.

Output shaft, disassembly

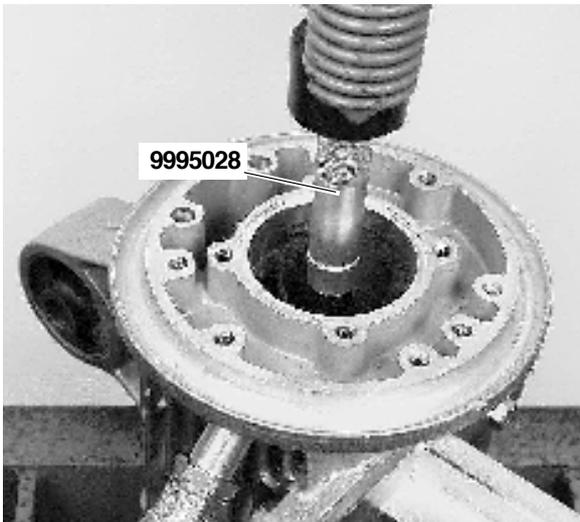


52. Lock the ring nut with counterhold **885479**. Use the screws from the gear housing. Turn the shaft clockwise, using socket **884830** and a 17 mm wrench.

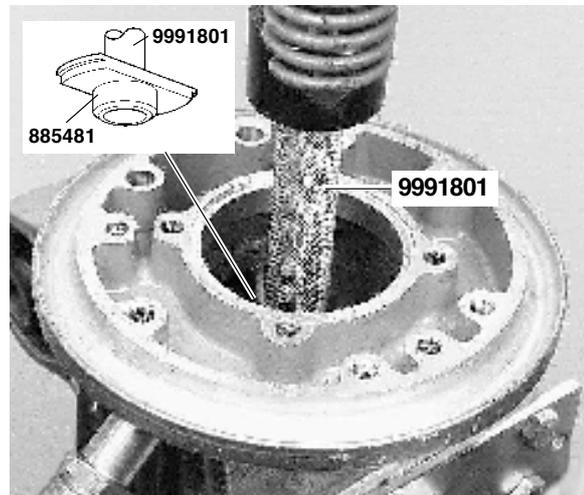


54. Turn the gear housing over and press the lower bearing race out with sleeve **884728** and extension **9991801**.

If only the pre-load and bearings are going to be checked, continue with **Output shaft, shimming and assembly**, items 58–69.



53. Remove counterhold and ring nut. Press out the shaft, using mandrel **9995028**. Save the lower bearing, shims and spacer sleeve.



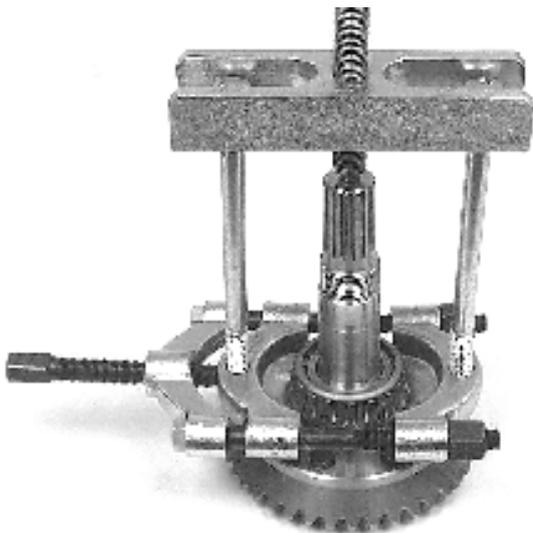
55. Turn the gear housing over and press the upper bearing race out. Use tool no. **885481** and shaft **9991801**.

Save the shims.

Checking wear

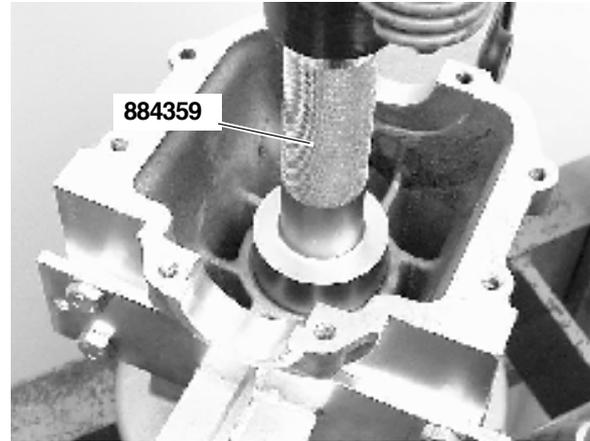


56. Check the bearing and bearing races for wear.
 57. If the upper bearing is changed, use a knife extractor.



Output shaft, shimming and assembly

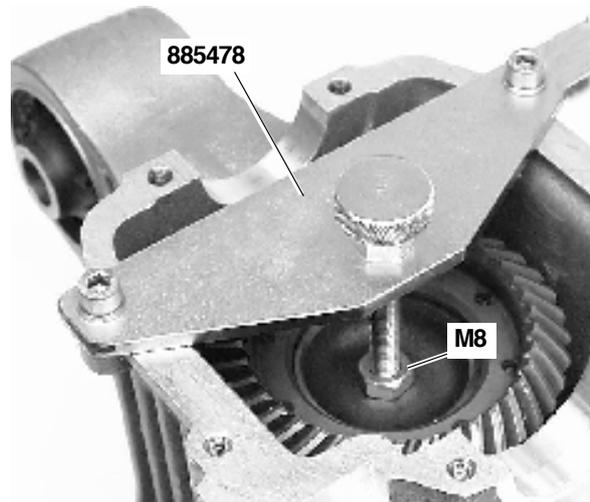
⚠ IMPORTANT! Clean the gear housing, bearing seats, bearing races and bearings before assembly.



58. Install the shims for the upper bearing race in the gear housing, with consideration given to the flank clearance and marking pattern.

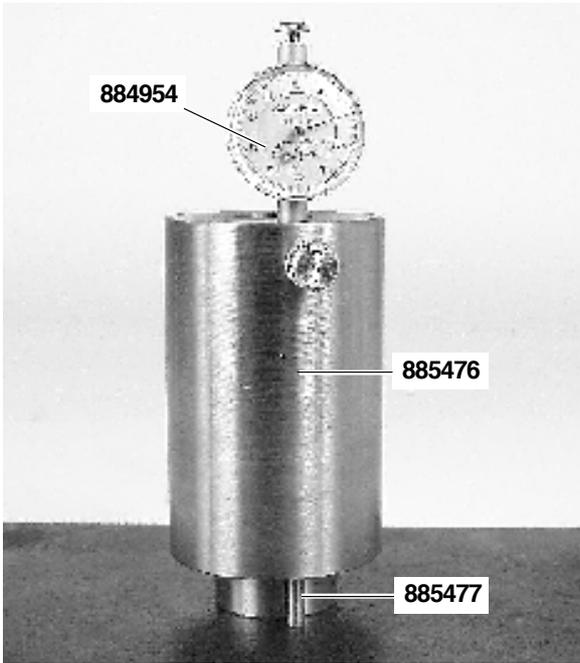
Shims are available in the following thicknesses (mm):
0.10 - 0.15 - 0.20 (1 mm = 0.03937").

Press the upper bearing race into the bearing housing. Use mandrel **884359**. Make sure that the bearing race does not come out of line when pressed in.

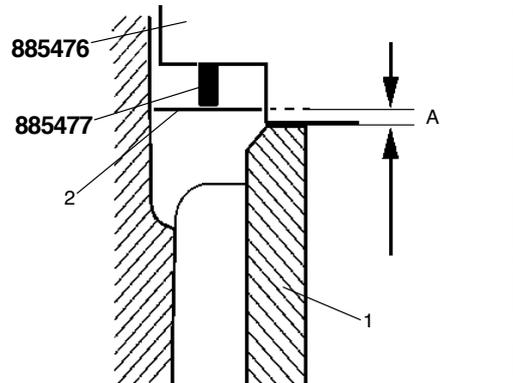
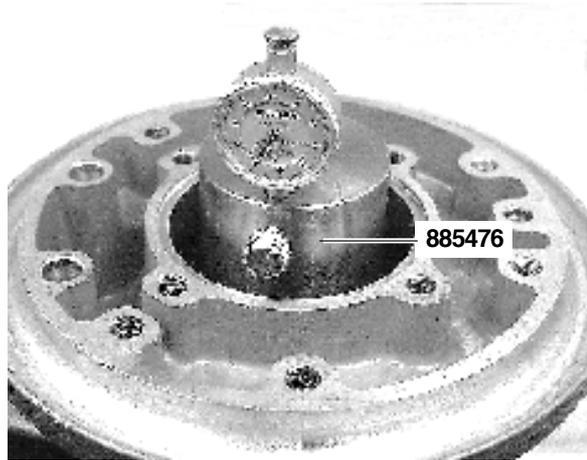


59. Insert the shaft into the gear housing and fix the crown wheel and shaft with tool no. **885478**.

NOTE! Put a nut (M8) as a spacer between the lock screw on the tool and the crown wheel.

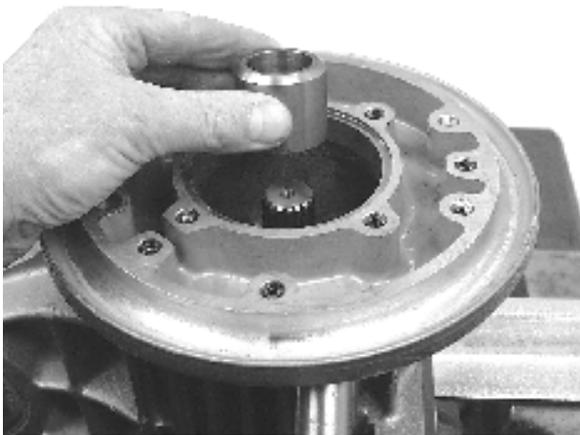


60. Install dial gauge **884954** with extension, special tool **885477**, in measurement gauge **885476**. Zero the dial gauge against a flat surface.

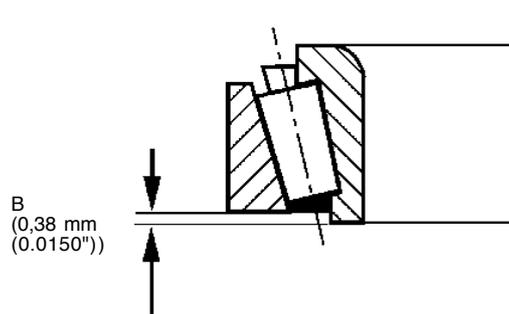


62. Place gauge no. **885476** against the spacer sleeve (1). Lower extension **885477** towards the lower bearing race seat (2) in the gear housing .

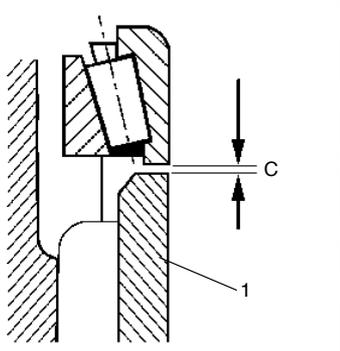
Read off distance (**A**) between the seat and the spacer sleeve on the dial gauge.



61. Install the spacer sleeve on the shaft, **without** shims.



63. Dimension (**B**) is the distance between the inner and outer bearing races = 0.38 mm (0.014960") (constant dimension).



64. The distance (C) between the spacer sleeve (1) and the inner bearing race is:

$$A - B = C$$

The clearance should be **0.01 – 0.03 mm (0.0004 – 0.0012")** to give correct pre-load when tightened.

Example:

$$A = 0.60 \text{ mm (0.0236")}$$

$$B = 0.38 \text{ mm (0.0150") (constant dimension)}$$

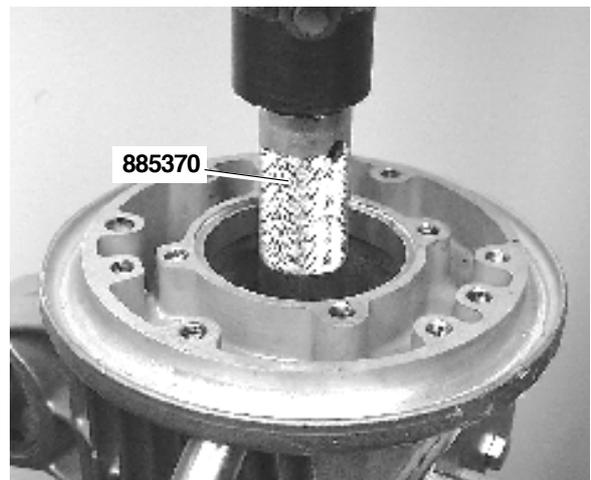
$$C = A - B = 0.22 \text{ mm (0.0087")}$$

To get the correct clearance, with consideration given to pre-load, we shim up 0.19 – 0.21 mm (0.0075 – 0.0083")
In this case, the shim thickness = 0.20 mm (0.0079").

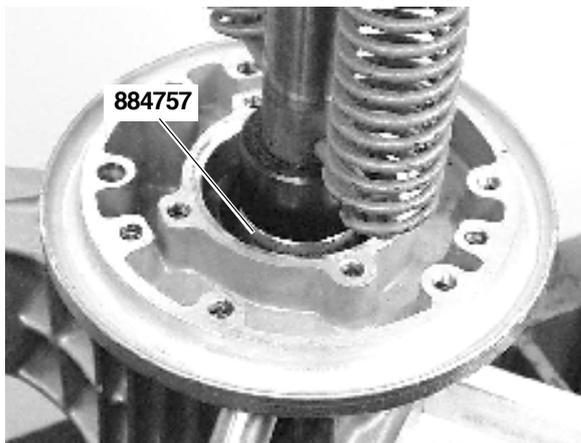
Shims are available in the following thicknesses (mm):
0.15 - 0.20 - 0.30 - 0.40 - 0.50 (1 mm = 0.03937").



66. Insert the shaft, spacer sleeve and shims with thickness calculated as in item 64.



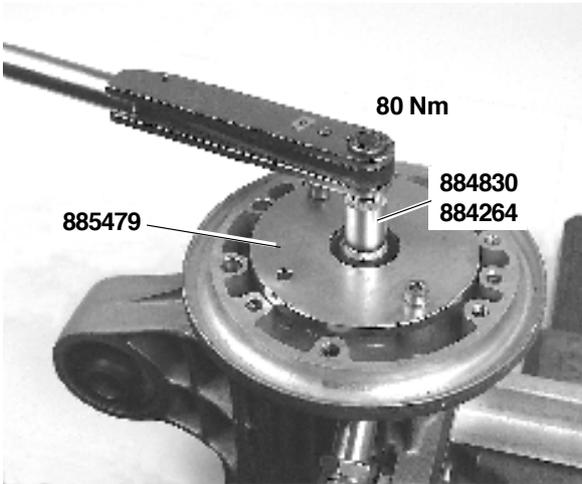
67. Press the bearing race in with tool no. **885370**.



65. Remove tool **885476** and the shaft. Press in the bearing race with mandrel **884757**. Make sure that the bearing race does not come out of line when pressed in.



68. Install the ring nut.
NOTE! Location of nut (edge).



69. Lock the nut with tool **885479**.
Use sleeve **884830** or **884264** and tighten the nut by turning the shaft anti-clockwise. Tightening torque: **80 Nm (59.0 lbf-ft)**.

Inspection

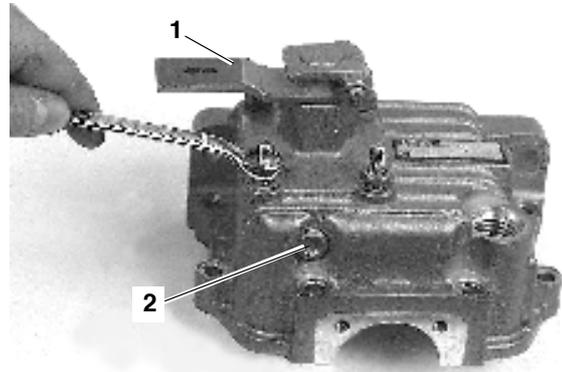
70. Install the input shaft, bearing races and shims. Fix the shaft with the shaft clamps, special tool **885475**.

71. Check the marking pattern and flank clearance. Please refer to items 37–51.

When the clearance and marking pattern is correct, remove the shaft clamps and install the gear housing cover. Please refer to items 84–87.

If the clearance and marking pattern is not correct, the output shaft should be the first one to be re-shimmed.

Gear selector fork, removal and inspection



72. **NOTE!** Always put the control lever (1) in neutral position.

Remove the rubber pads. Remove the nuts and spring washers, use a 13 mm wrench.

Remove the cover plate and sub-components together with the gasket, if fitted. Liquid gasket, Volvo Penta part number 840879-1, may have been used instead of a gasket.

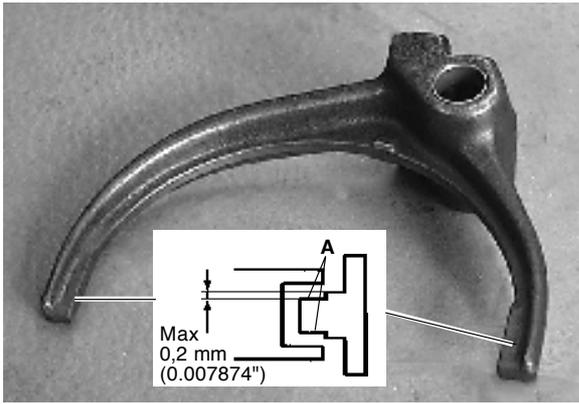
73. Remove the plug (2) on the gear selector fork shaft. Slide the shaft out of the gear housing.



74. Check the clearance between fork and shaft.

Fix the shaft in a vise with soft jaw pads. Install a stand and dial gauge. Let the dial gauge rest against the fork and rock the fork arm. Read off the clearance.

Maximum permissible clearance: **0.05 mm (0.0020")**.



75. If the clearance is too great, the fork must be changed. The bushing is built into the selector fork and can not be changed.

When the gear selector fork is new, the guide surfaces (**A**) have a molybdenum disulfide coating. If the coating is worn, apply a new coating, such as by spraying Volvo Penta Assembly Paste (MoS_2), part no. 1161397-0.

Maximum wear on guide surfaces: **0.2 mm (0.0079")**.

Gear selector fork, assembly



76. Press the gear selector fork into the gear housing. Please refer to the illustration.

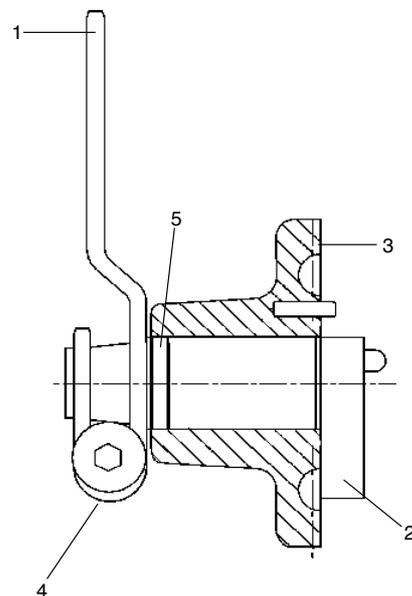
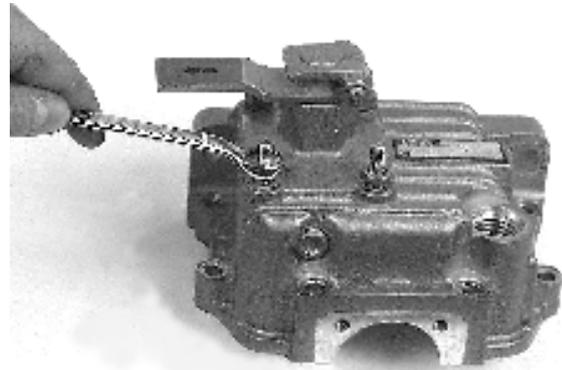
Insert the shaft through the hole in the housing and through the selector fork.

77. Install the shaft plug in the cover. Make sure that the clearance between the selector fork and the shaft is **at least** 0.5 mm (0.0197").

Seal the shaft plug with thread locking fluid, Volvo Penta part no. 1161053-2.

NOTE! Check that the selector fork can move easily.

Cover plate for gear selector shaft, disassembly



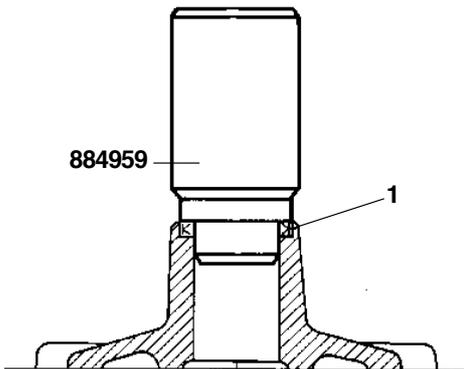
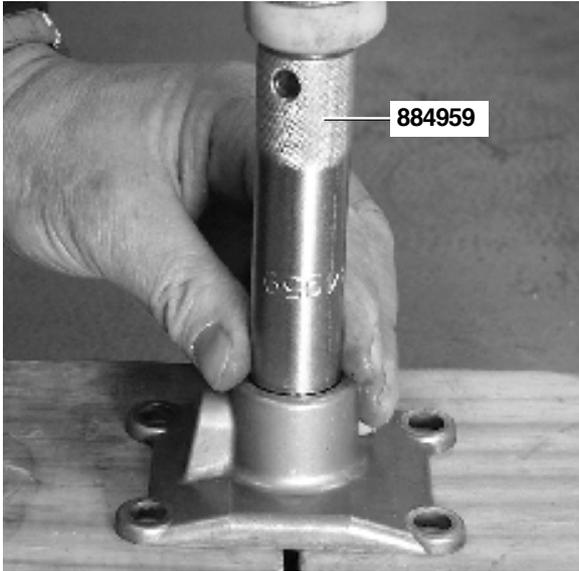
78. Remove the cover plate with sub-components. Control arm (1) and eccentric plate (2), gasket (3) if fitted. Liquid gasket, Volvo Penta part number 840879-1, may have been used instead of a gasket.

79. Remove the screw (4) for the control arm. Pull the arm off.

Remove the eccentric plate (2).

Remove the seal ring (5). Scrap the seal ring.

Cover plate for gear selector shaft, assembly

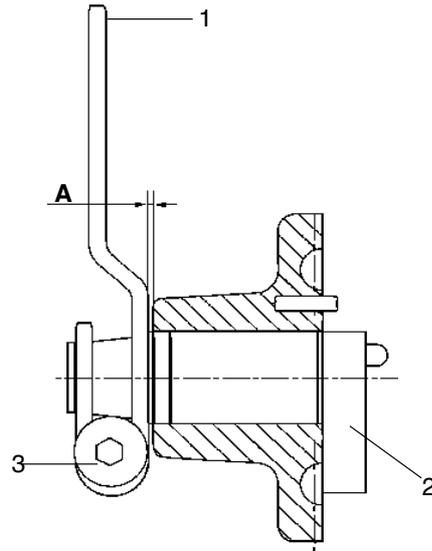


80. NOTE! Always install a new seal ring.

Use mandrel **884959**, diameter 20 mm (0.7874") to press the seal ring (1) into the cover plate.

⚠ IMPORTANT! Align the flat side of the seal ring outwards.

Apply sealant, Volvo Penta part no 1141570-0, between the lips of the seal.



81. Install the eccentric plate (2).

Install the control arm (1).

⚠ IMPORTANT! The clearance (A) between the control arm and cover plate must be **0.5 mm (0.019685")**.

Clamp the control arm with lock screw (3) and a 13 mm socket.

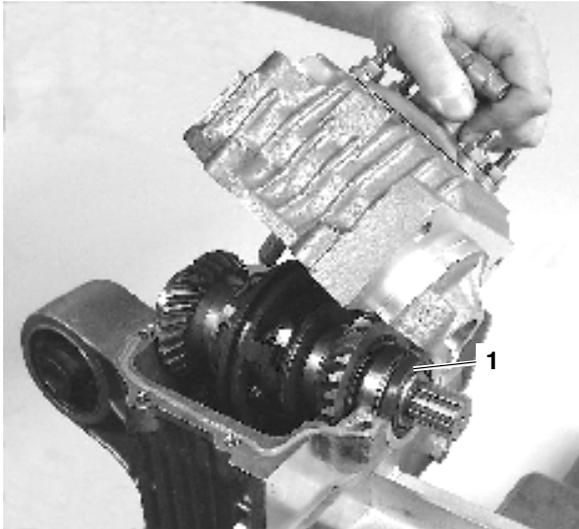
Tightening torque: **20 Nm (14.7 lbf-ft)**.

82. Install the gasket or apply liquid gasket, Volvo Penta part no. 840879-1, to the cover plate.

83. Install the cover plate on the gear housing.

84. Install the spring washers and nuts. Tighten the nuts **lightly**.

Gear housing, assembly

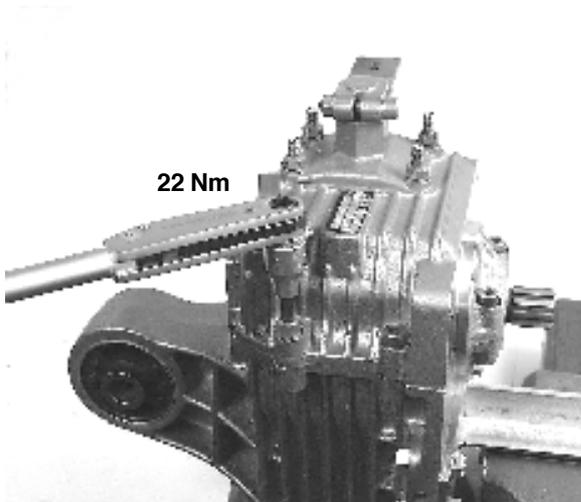


85. Install the shaft seal (1).

2. Install the upper gear housing cover. Apply liquid gasket, Volvo Penta part no. 840879-1, to the mating faces and around screw heads..

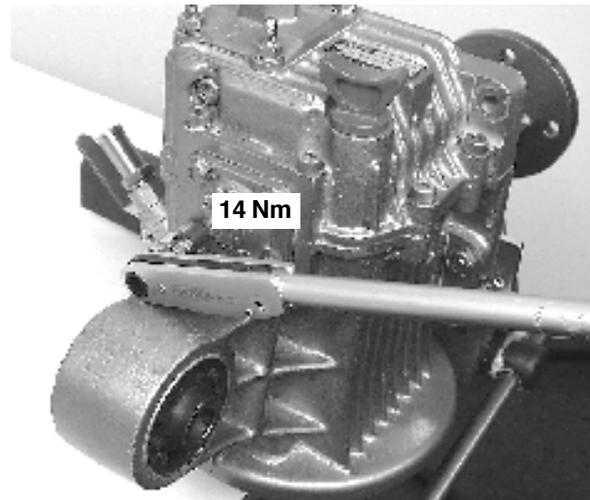
NOTE! The gear housing must be assembled with the gear selector fork in neutral (center position).

Check that the gear selector plate and gear selector fork engage in the correct manner.



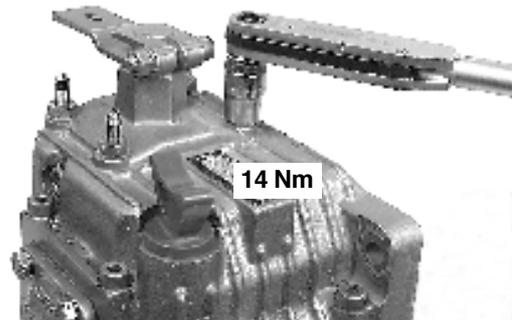
86. Tighten the screws.

Tightening torque: **22 Nm (16.2 lbf-ft)**.



87. Install the sealing cover with shims and new gasket. Tighten the screws.

Tightening torque: **14 Nm (10.3 lbf-ft)**.



88. Tighten the nuts on the cover plate with a 13 mm socket.

Tightening torque: **14 Nm (10.3 lbf-ft)**.

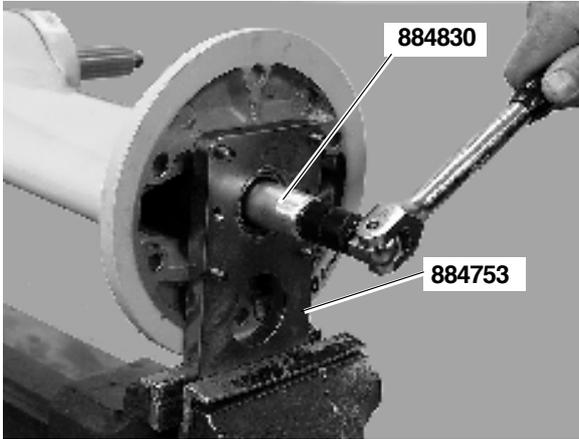
⚠ IMPORTANT! It is important to adjust the cover plate so that the gear selector fork is not loaded, to prevent the fork from pressing against the selector plate in neutral.

Put the valve rubber plugs on the screws.

89. Check that the control arm functions correctly.

Repair – lower gear housing

Lower gear housing, disassembly

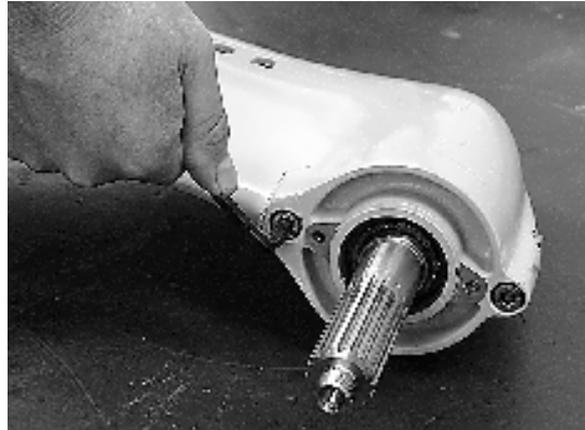


1. Fix fixture **884753** in a vise. Install the lower gear housing in the fixture, so that the four pins fit the cut-outs in the shaft nut. Fix the gear housing with four of the socket cap screws.

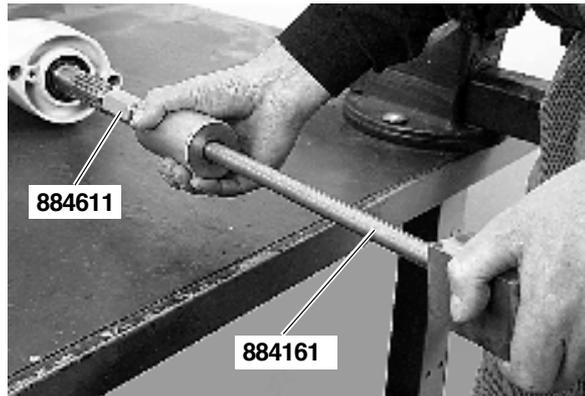
Install tool **884830** on the shaft. Use a **17 mm** socket and undo the nut by turning the shaft clockwise.

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

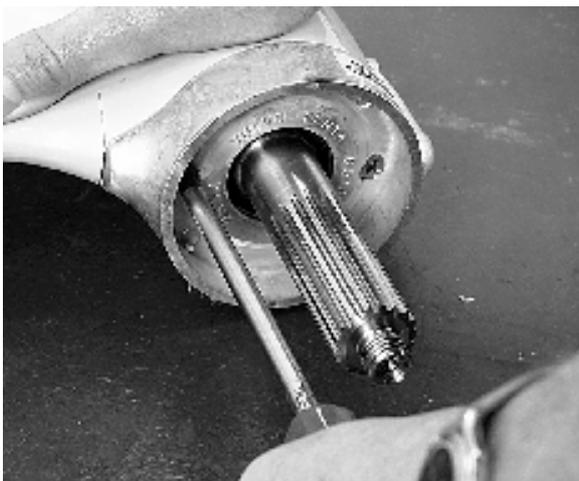
Remove the fixture from the lower gear and screw the nut off the shaft.



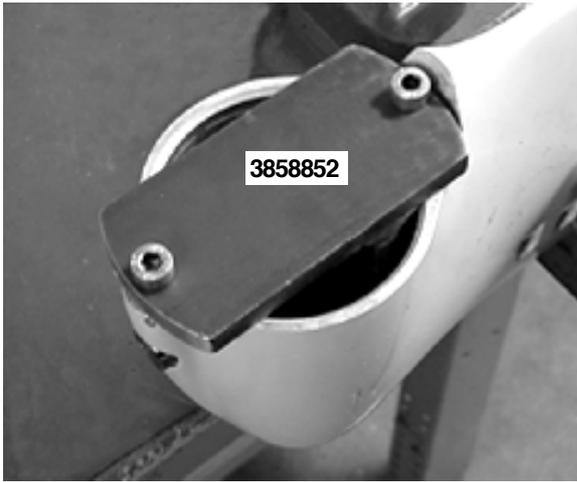
3. Remove the two socket cap screws in the bearing housing.



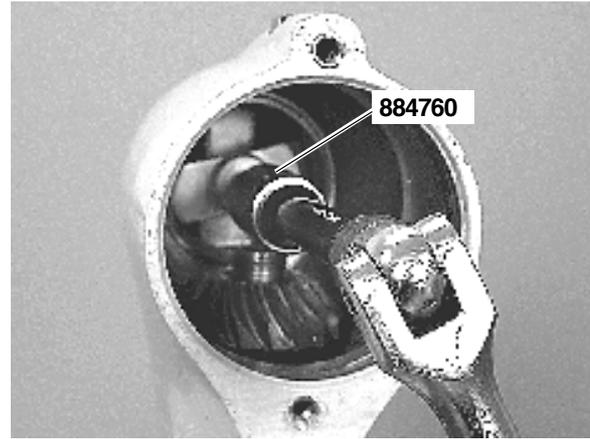
4. Remove the propeller shaft and bearing housing. Use slide hammer no. **884161** with extractor **884611**.



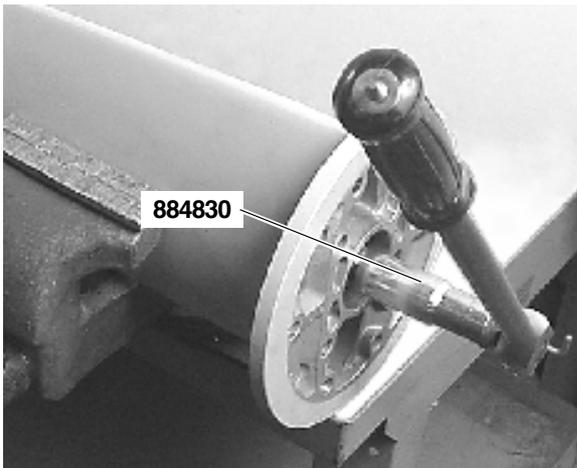
2. Remove the zinc ring.



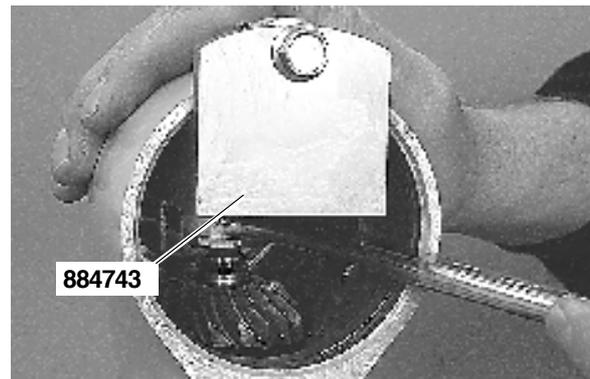
5. Lock the pinion nut with tool no. **3858852**. Press the shaft down and make sure that the pinion nut engages in the tool. Fix the tool to the rear bearing housing, using socket cap screws.



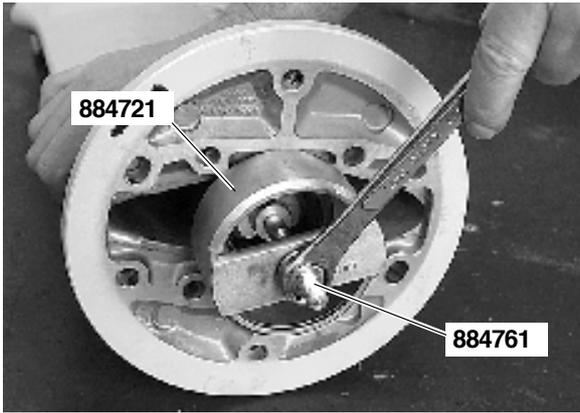
7. Disassemble the bearing race with tool no. **884760**.
NOTE! Note the number of shims between the bearing race and the gear.



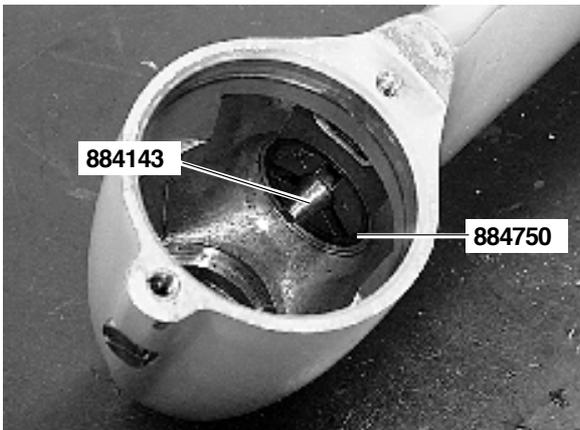
6. Install tool **884830** on the vertical shaft. Unscrew the pinion nut.
Remove the pinion. If the pinion has got stuck, it will come loose when the shaft is pressed out later on, in item 8.



8. 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 (0.20") 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.



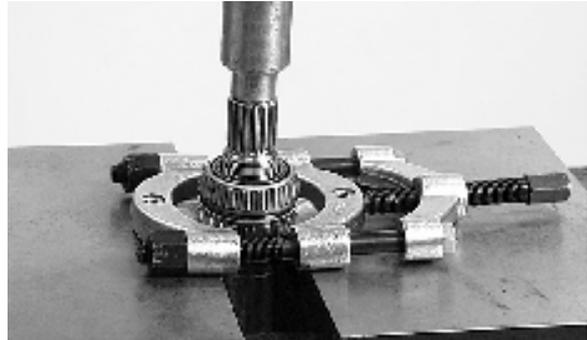
9. Disassemble the outer bearing race from the upper part of the gear housing, using tool no. **884761** in combination with tool no. **884721**.



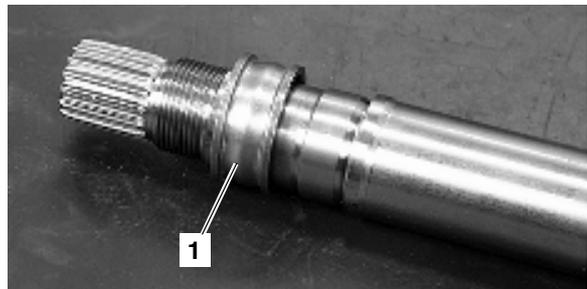
10. Remove the bearing race with expander **884750** and shaft **884143**.

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

Vertical shaft, disassembly

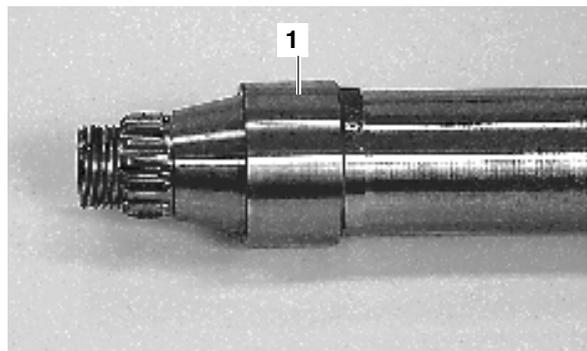


11. Remove the roller bearings with a knife extractor as counterhold. Use a hydraulic press together with a suitable mandrel.



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

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

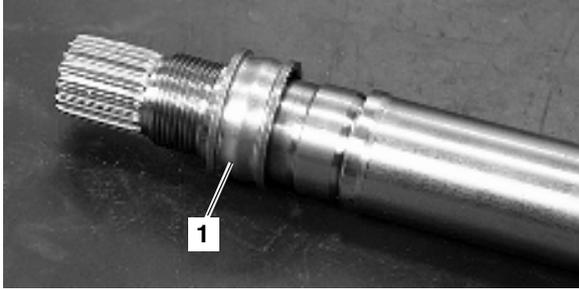


13. The ground needle roller bearing race (1) on the vertical shaft should not be changed. If the roller bearing is damaged, the entire shaft must be changed.

Then clean all components. Change worn or damaged components.

Vertical shaft, assembly

NOTE! Oil all components before or during assembly.



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

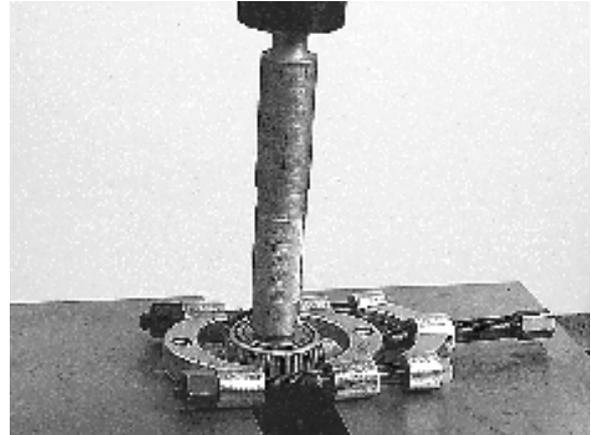


15. Install a new roller bearing with mandrel **884755**.
NOTE! Press until the bearing just **touches** the ferrule.

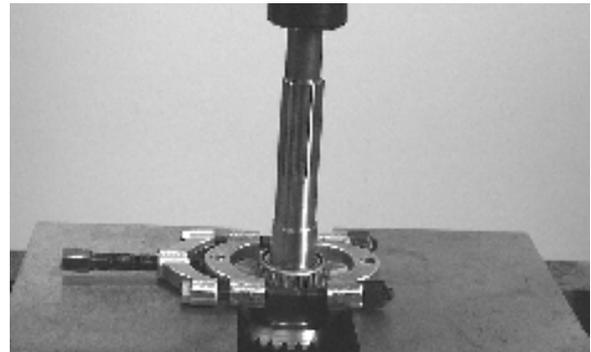


16. Install the other roller bearing inverted, i.e. with the smaller end upwards. Use mandrel **884755**.
NOTE! Press so far that the bearings just **touch** each other.

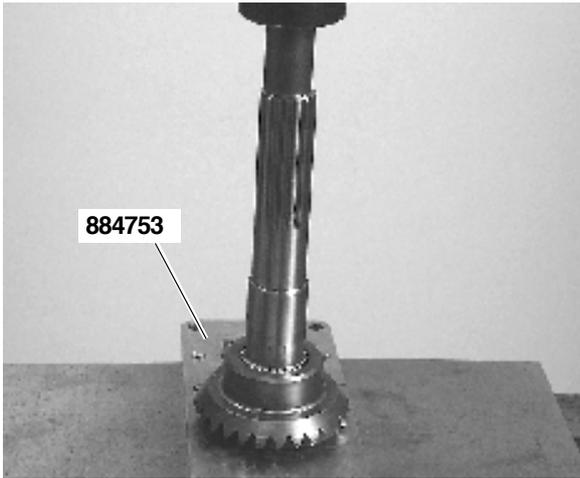
Propeller shaft, disassembly of bearings and drive



17. Remove the **inner** roller bearing.
Use a knife extractor as a counterhold and press the bearing out with a hydraulic press and a suitable mandrel.



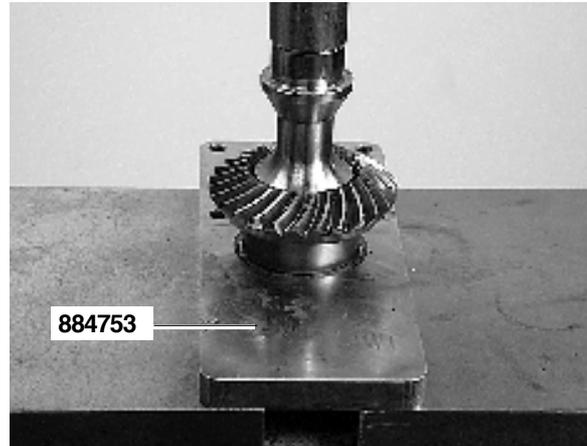
18. Remove the **outer** roller bearing. Use a knife extractor as a counterhold, with a **17 mm** socket on the shaft end.
NOTE! If the gear wheel is going to be changed as well, the bearing can be pressed off at the same time. Please refer to item 19.



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

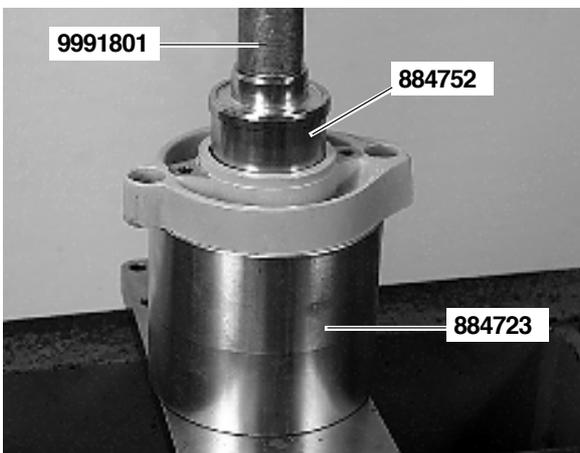
NOTE! The gear wheel and pinion are classed together and can only be changed as a complete unit.

Propeller shaft, assembly of bearings and drive



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

Rear bearing housing, disassembly



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

Put the bearing race 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.

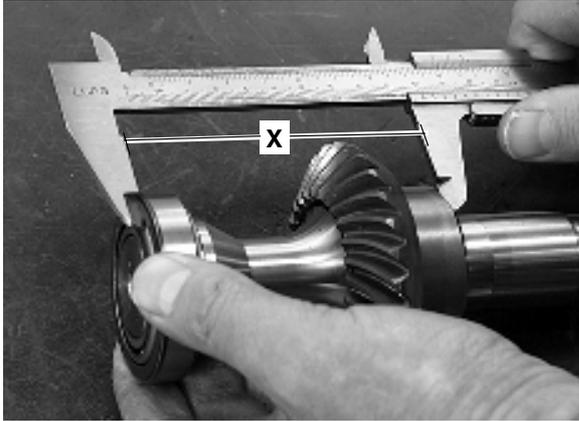
NOTE! Note the number of shims. Save the shims.



22. Install the inner roller bearing with tool no. **884754**.

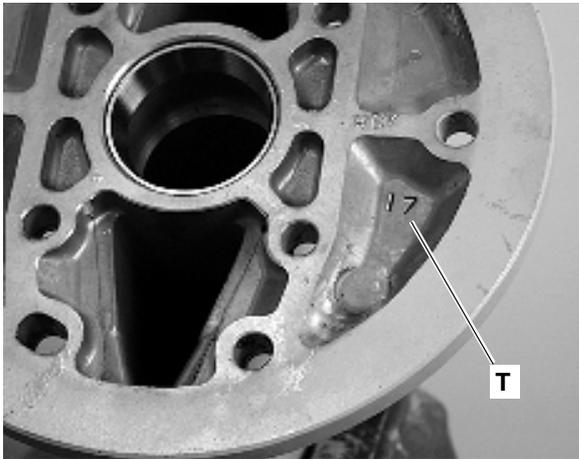
Propeller shaft, shimming

23. 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 24–26.

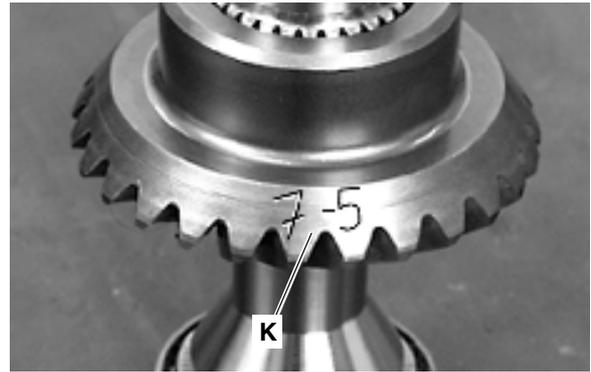


24. Put the bearing race on the inner ball bearing. Press it hard against the bearing and measure distance (X) with a caliper gauge, between the rear plane of the gear wheel and the outer front plane of the bearing race.

In this case, the distance is 100.20 mm (3.945").



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



26. 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

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

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

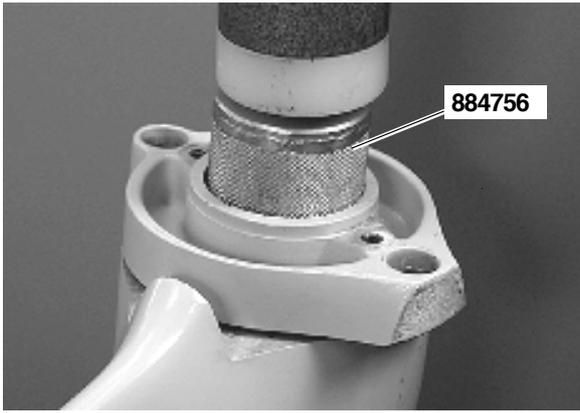
$$\text{Shim thickness} = 101 + 0,12 - 100,20$$

$$\text{Shim thickness} = 0,92 \text{ mm } (0.0362\text{"})$$

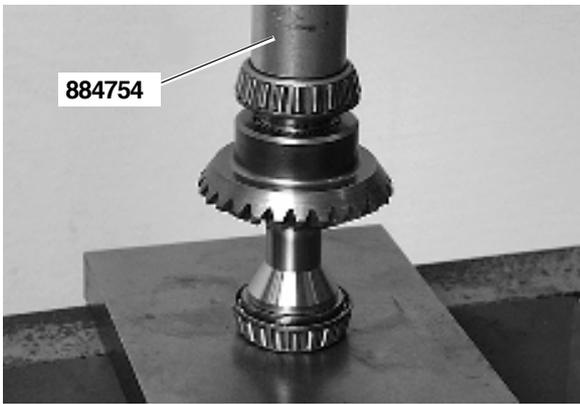


27. Put shims of the correct thickness in the lower gear housing. Add a further 0.05–0.10 mm (0.001968–0.003936"). In this case, we put a total of 1.00 mm (0.03937") shims in the housing.

Shims are available in the following standard thicknesses (mm): 0.10 - 0.15 - 0.35 - 0.50 (1 mm = 0.03937").



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



29. Press the outer 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.



30. 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.



31. 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.



32. 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 (2.5591").

Example: Y is measured to 1.05 mm (0.0413") in this case.

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

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

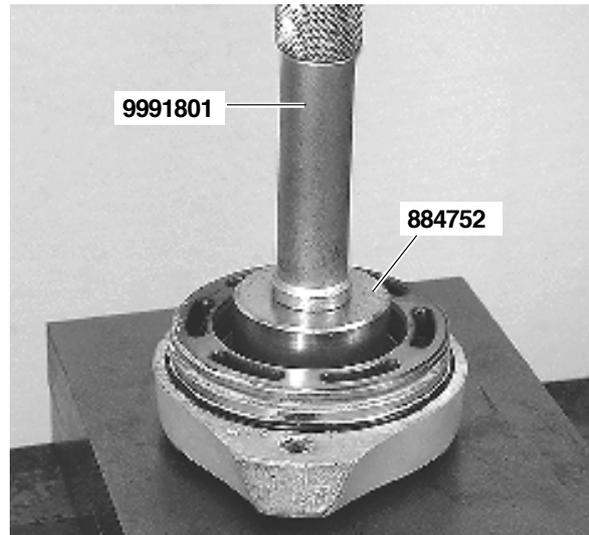
$$\text{Shim thickness} = 1,05 - 0,65 = 0,40$$

$$\text{Shim thickness} = 0,40 \text{ mm (0.0158")}$$

Shims are available in the following standard thicknesses (mm): **0.10 - 0.15 - 0.20 - 0.30 - 0.50 (1 mm = 0.03937")**.

Use shim thickness $0.35 + 0.10 = 0.45 \text{ mm (0.0177")}$.

Rear bearing housing, assembly



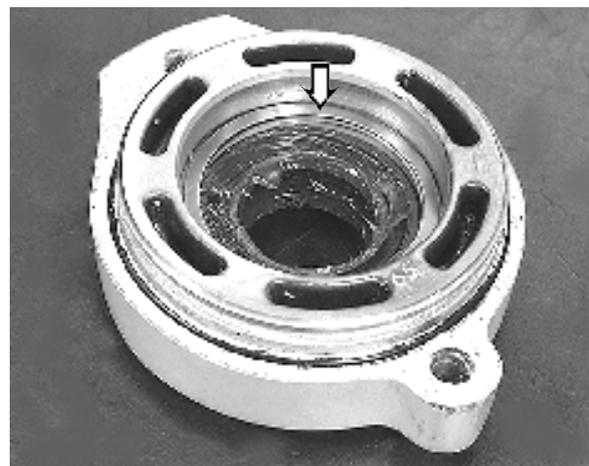
33. Install a new seal ring in the bearing housing, using tool no. **884752** and shaft **9991801**. Apply sealant, Volvo Penta part no. 1161099-5, to the mating face between the seal and the bearing housing.

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

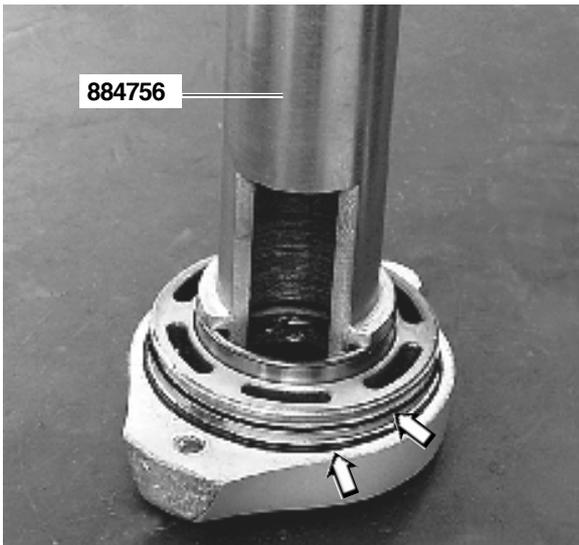
34. Install the other seal ring by using the same tool.

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.

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

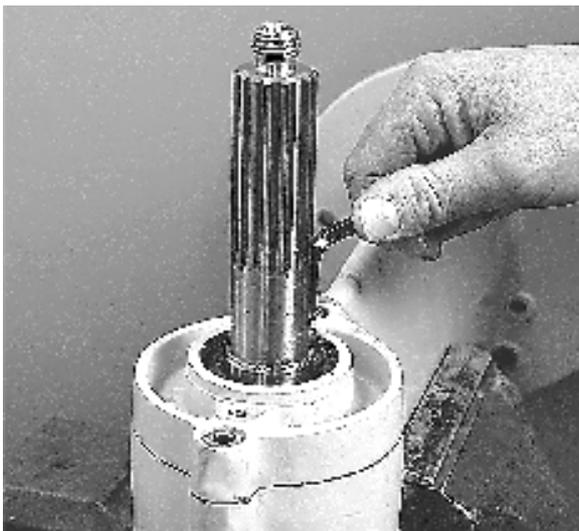


36. Put shims of the correct thickness in the bearing housing. In this case, they are 0.45 mm (0.0177") . Please refer to item 32.



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

Oil and install new O-rings, 2 pcs.



38. 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 (22.1 lbf-ft)**.

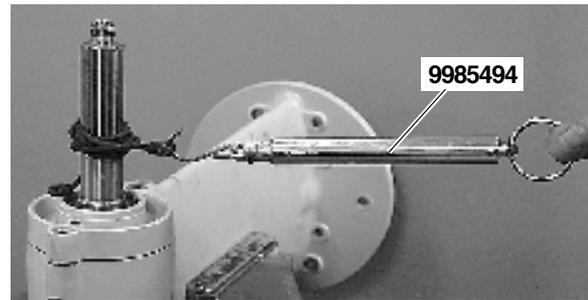
Check the preload. Please refer to item 39.

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:



39. 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**.

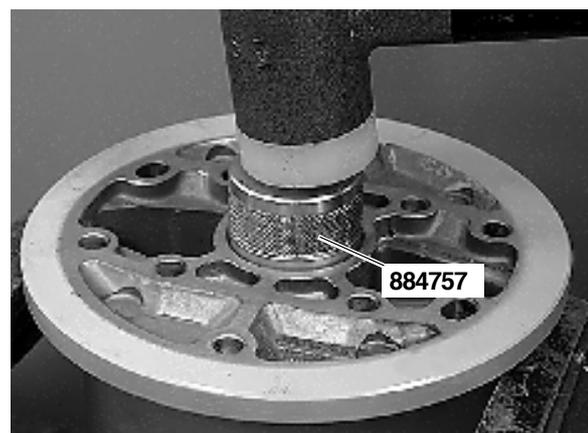
Method 2. Install the propeller nut on the shaft. Turn the shaft with a torque wrench. Turn at an even speed, about 1 revolution/sec.

Permissible preload: **0.5 ± 0.3 Nm (0.37±0.2 lbf-ft)**.

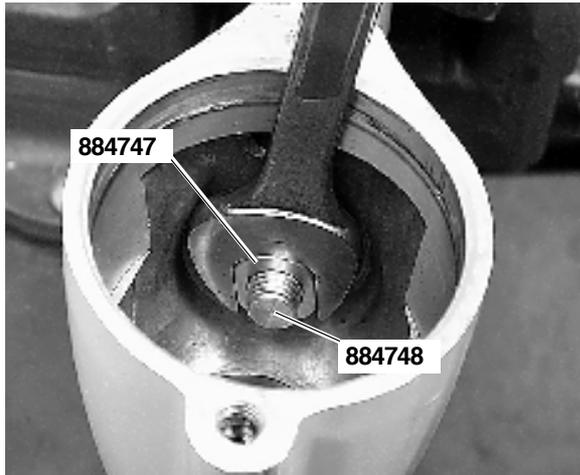
When there is slack in the shaft, or the pre-load is incorrect, change the thickness of the shims underneath the bearing race in the rear bearing housing.

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

Vertical shaft



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

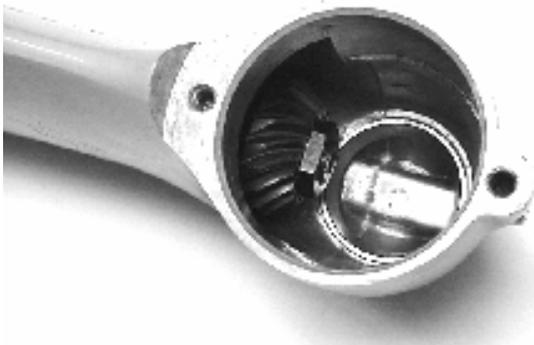


41. Install a new needle roller bearing. Use tool no. **884746**.

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

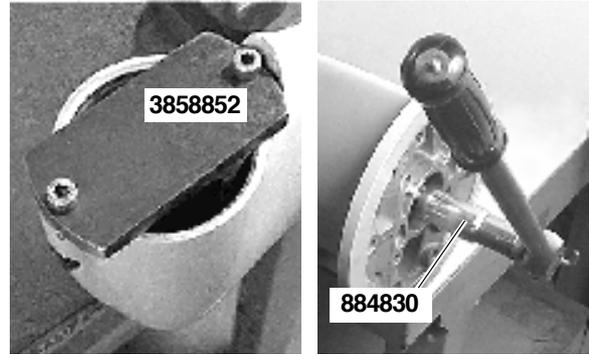
NOTE! The needle roller bearing has loose rollers. For this reason, the new bearing has a transport shield.

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.



42. 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.

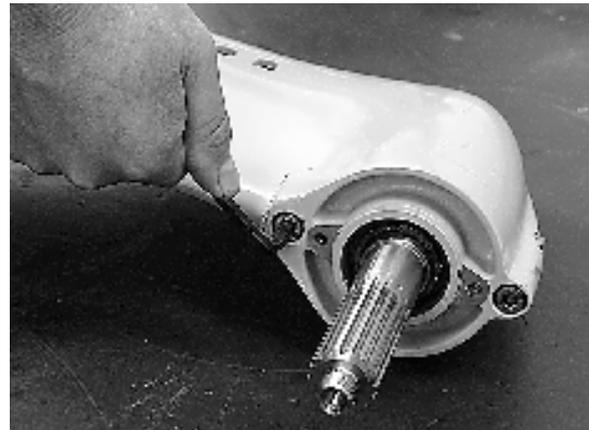


43. Lock the pinion nut with tool **385885**. Press the shaft down and make sure that the pinion nut engages in the tool. Fix the tool to the rear bearing housing, using socket cap screws.

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

Wrench size: **17 mm**.

Tightening torque: **110 ± 10 Nm (80±7.3 lbf-ft)**.



44. Install the bearing housing on the propeller shaft.

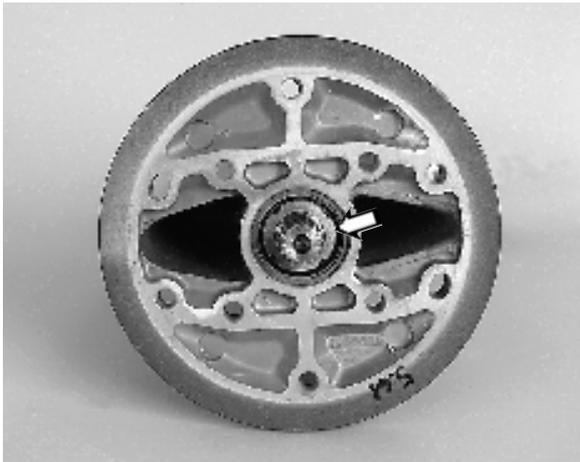
NOTE! Turn the shaft carefully, to avoid damaging the sealing lips on the seal rings.

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.

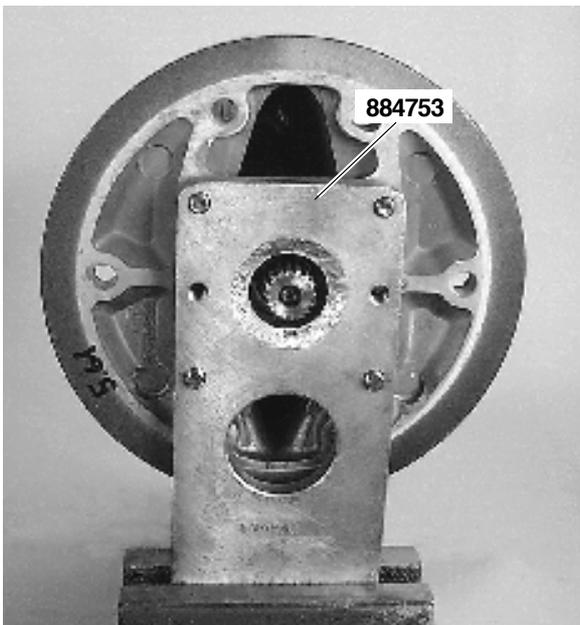
Apply thread locking fluid, Volvo Penta part no. 1161231-4, to the screws.

Tightening torque: **30 Nm (22.1 lbf-ft)**.



45. Install the upper nut on the vertical shaft.

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



46. 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



47. Install tool **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 ferule is deformed. The torque needed is about **230–250 Nm (170–184.3 lbf-ft)**.

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



48. 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.

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.

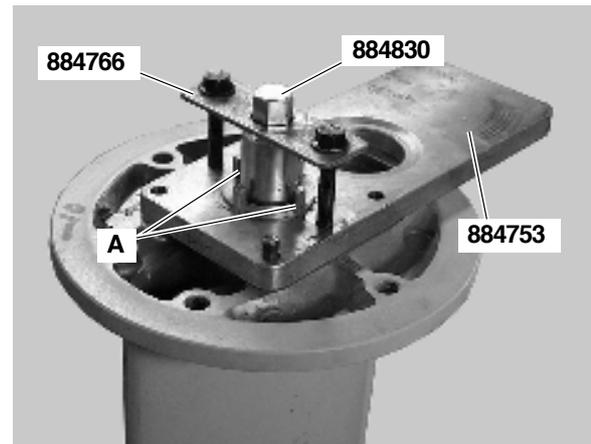
Flank clearance:

0.04– 0.10 mm (0.0016–0.0039").

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 ferule changed, since it can only be used once.

Marking pattern



49. 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.

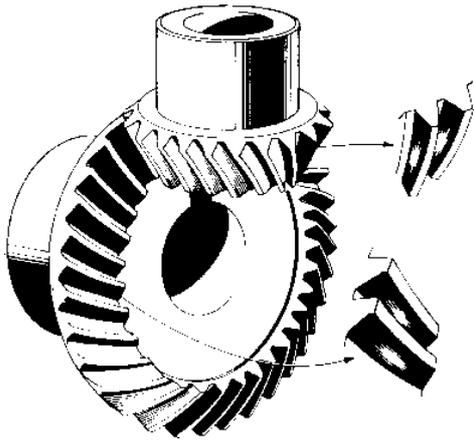
Press the vertical shaft in with tool no. **884766** which is screwed to the other tool. Leave tool **884830** behind.

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

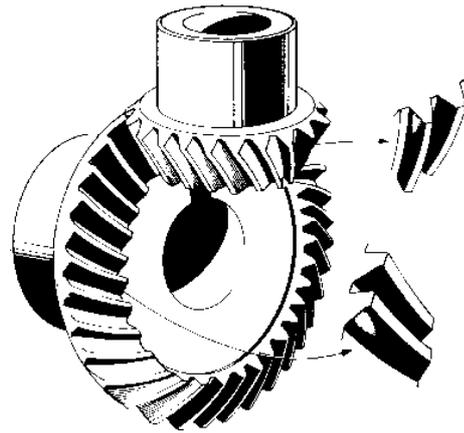


50. Install the propeller shaft again and turn it round in both directions. Brake the propeller shaft strongly.

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



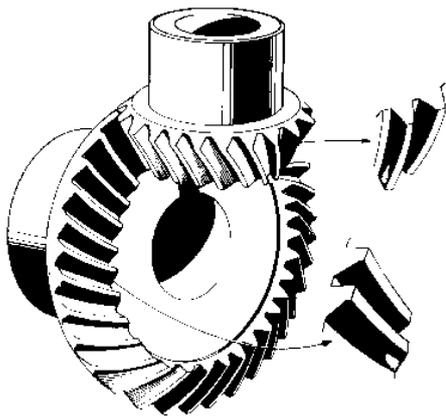
51. Disassemble the propeller shaft and check that the marking pattern on the gear teeth corresponds with the marking pattern in the illustration above or the figures in items 52 and 53.



53. 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.

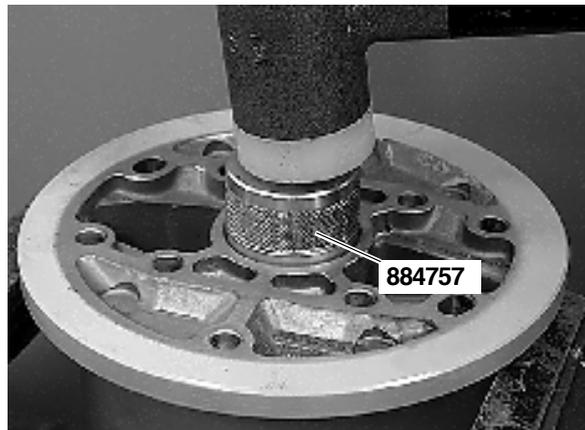
Install a new ferrule. Then re-install the bearings and put the shaft back in the gear housing. Turn round to establish the new flank clearance and check the marking pattern. Please refer to items 47–48.



52. 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 47 and 48. Then check the contact patch again, as in items 49–51.



54. 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.

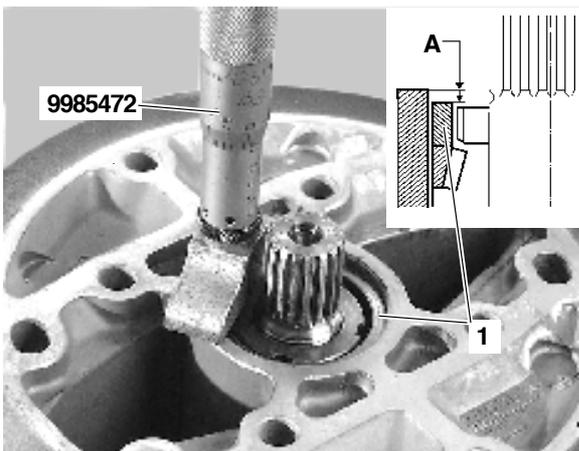
Re-install the propeller shaft and rear bearing housing. Please refer to item 44. Then install the upper, outer bearing race. Use tool no. **884757**.

Installation, lower gear housing – adapter plate.

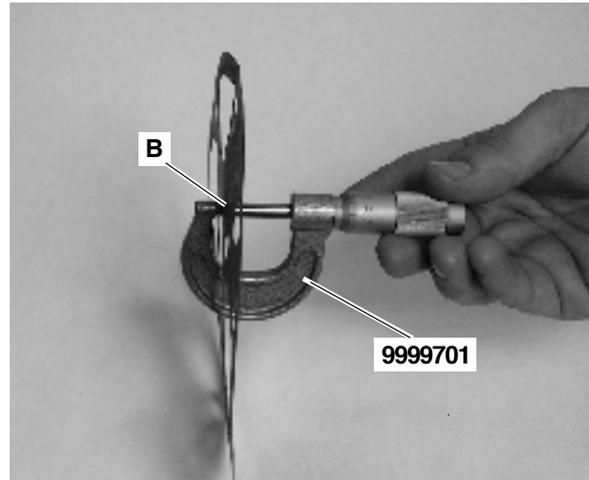
Preferably use the shims which were installed previously, if only new bearings have been installed. Shim thickness can also be measured as in the points below.



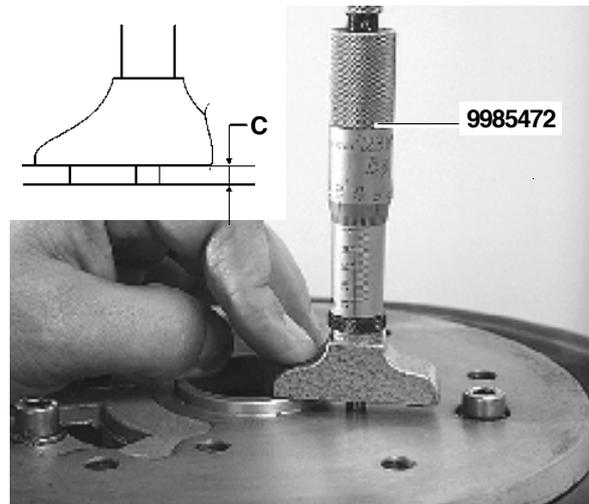
58. Check that there is no end float in the vertical shaft. Then install spacer ring (1).



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**.



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

Example:

- When (A) is measured, we obtain a distance of 5.70 mm (0.2244") in this case.
- Gasket (B) thickness is measured as 0.30 mm (0.0118").
- Flange height (C) is measured as 3.85 mm (0.1516").

$A + B - C = \text{shim thickness}$

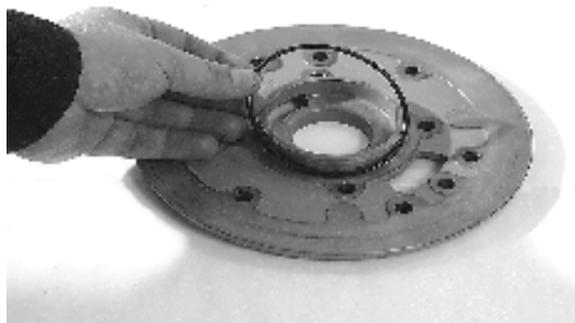
$$5.70 + 0.30 = 6.00$$

$$6.00 - 3.85 = 2.15 \text{ mm (0.0846")}$$

Shims are available in the following standard thicknesses (mm): **0.10 - 0.15 - 0.20 - 0.30 - 0.50** (1 mm = 0.03937").



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.

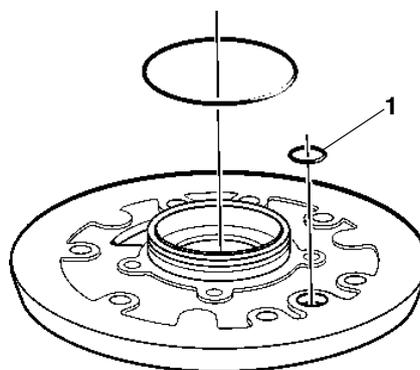


64. Oil and install a new O-ring on the adapter section neck.

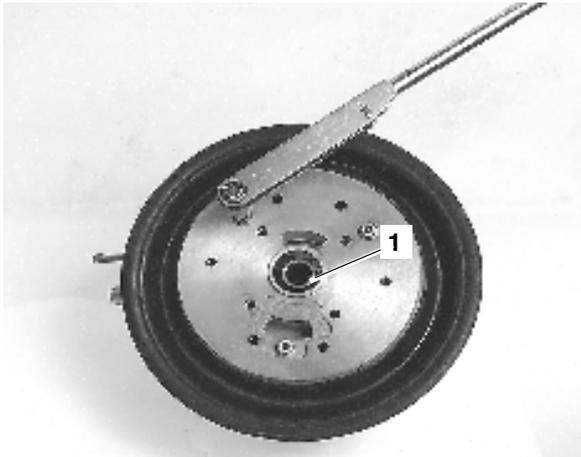
Reverse installed drive (180°)



63. 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.



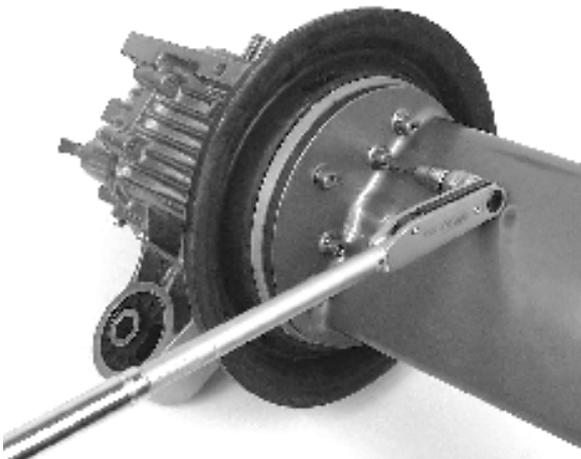
65. Oil and install a new O-ring (1) in the cutout in the adapter plate.



66. 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 (22.1 lbf-ft)**. Install the splined sleeve (1).



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



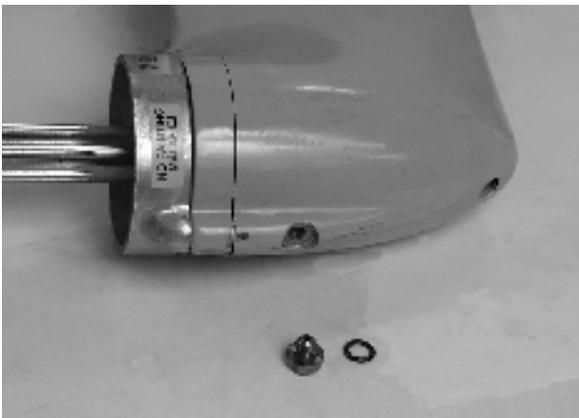
67. Fit the gear housings together. Apply MoS₂ based grease, Volvo Penta part no. 1161029-2 to the socket cap screws. Install the screws, 10 pcs. The two long screws should be located by the rear edge. Put washers under the screw heads and distribute the screws with holes in the screw heads so that there are two on each side. Tightening torque: **30 Nm (22.1 lbf-ft)**.

Other components, installation



69. Install a new zinc ring.

Tightening torque: **12 Nm (8.8 lbf-ft)**



70. Change the gasket on the oil drain plug.

⚠ IMPORTANT! The gasket must be allowed to 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.

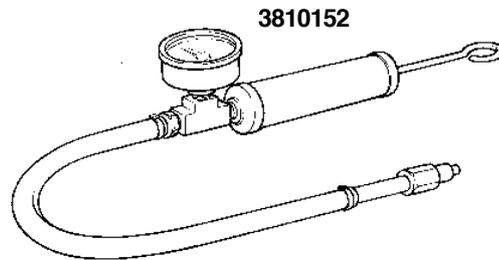
Check the oil level with the dipstick and install the oil filler cap.

⚠ 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 (14.7 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.



71. Connect the pressure gauge to the oil drain hole.

Pump the pressure up to a level not exceeding **78 kPa (11.3 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 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

Sail boat drive MS25S-A, MS25SR-A

Gear ratio

Lower gear 2.19:1, 2.47:1

Max permissible clearance, selector fork - shaft 0.05 mm (0.0020")

Max permissible wear, selector fork guide surfaces 0.2 mm (0.0079")

Gear flank clearance, upper gear

Input gear - crown wheel, measured directly on the gear wheels 0.12–0.27 mm (0.0047–0.0106")

Gear flank clearance, lower gear

Propeller shaft - vertical shaft, measured on propeller shaft splines . 0.04 –0.10 mm (0.0016–0.0039")

Gear preload, upper gear

Lower bearing, output shaft 0.01–0.03 mm (0.0004–0.0012")

Input shaft 0.05–0.10 mm (0.0020–0.0039")

Bearing, input shaft 0.03–0.08 mm (0.0012–0.0031")

Gear preload, lower gear

Propeller shaft bearings No slack up to 35 N (7.9 lbf.),
measured on propeller shaft

Lubrication system

Oil grade Same as engine

Oil volume, drive. 2.0 liter (2.1 US qts)

Pressure testing

Pressure when testing the drive 78 kPa (11.3 psi)

Tightening torque

Upper gear housing

Upper gear housing - adapter plate	30 Nm (22.1 lbf.ft)
Upper gear housing - engine, alternately, diagonally	20 Nm (14.7 lbf.ft)
Gear housing, dividing plane	22 Nm (16.2 lbf.ft)
Sealing cover	14 Nm (10.3 lbf.ft)
Cover plate, gear selector shaft	14 Nm (10.3 lbf.ft)
Lock screw, gear selector arm	20 Nm (14.7 lbf.ft)
Ring nut, output shaft	80 Nm (59.0 lbf.ft)
Screw, input shaft	50 Nm (36.8 lbf.ft)

Lower gear housing

Upper gear housing - lower gear housing	30 Nm (22.1 lbf.ft)
Pinjong nut, vertical shaft	110 ±10 Nm (81 ±7.4 lbf.ft)
Bearing housing	30 Nm (22.1 lbf.ft)
Zinc ring	12 Nm (8.8 lbf.ft)
Rubber mounting, M8	25 Nm (18.4 lbf.ft)
Oil drain plug	10 Nm (7.4 lbf.ft)

Notes

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Notes

A series of horizontal dotted lines for writing notes.

Report form

Do you have any comments or complaints about this manual? Please take a copy of this page, write your comments on it and send it to us. The address is at the bottom. We would appreciate it if you were to write in English or Swedish.

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