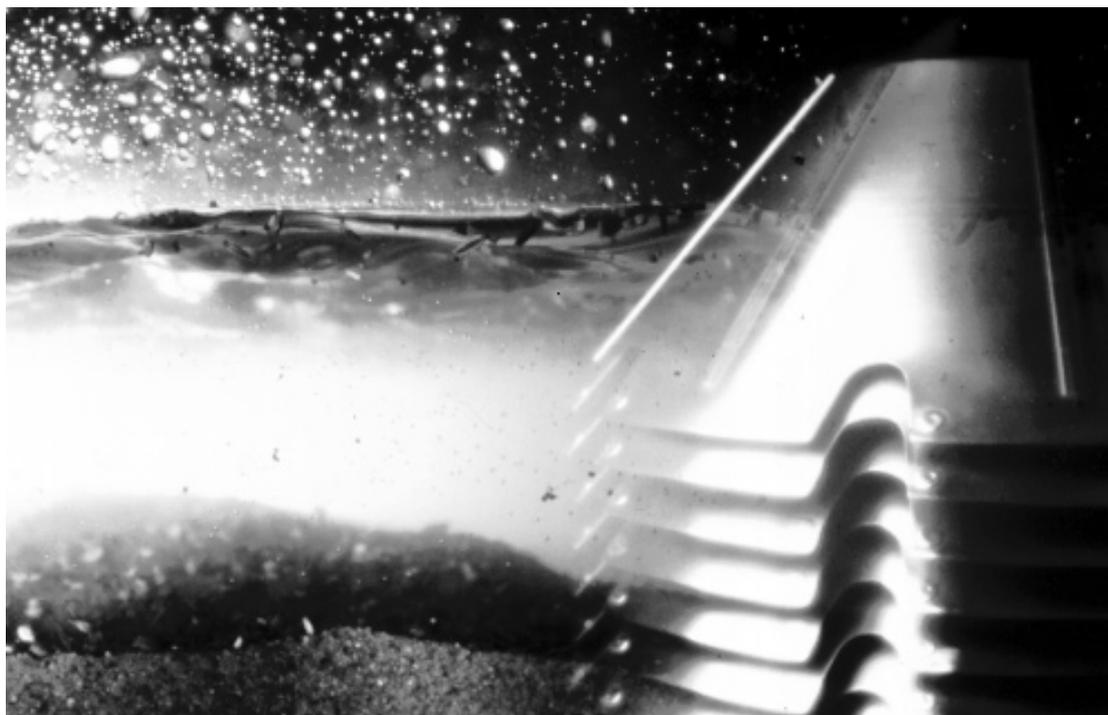


# FOPX 611TFD-24



## Separator Manual

Product No.  
Book No.

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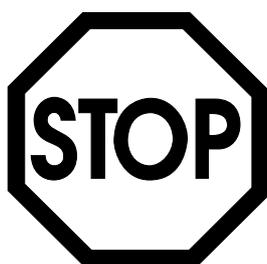
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**Study instruction manuals and observe the warnings before installation, operation, service and maintenance.**

**Not following the instructions can result in serious accidents.**

In order to make the information clear only foreseeable conditions have been considered. No warnings are given, therefore, for situations arising from the unintended usage of the machine and its tools.



---

# 1 *Read this first*

---

This manual is designed for operators and service engineers working with the Alfa Laval separator FOPX 611TFD-24.

For information concerning the function of the separator, see chapter “3 Separator Basics” on page 15 and chapter “8 Technical Reference” on page 173.

If the separator has been delivered and installed by Alfa Laval as part of a processing system, this manual is a part of the system documentation. In this case, study carefully all the instructions in the system documentation.

In addition to this Separator Manual a *Spare Parts Catalogue, SPC* is supplied.

This Separator Manual consists of:

## **Safety Instructions**

Pay special attention to the safety instructions for the separator. Not following the safety instructions can cause accidents resulting in damage to equipment and serious injury to personnel.

## **Separator Basics**

Read this chapter if you are not familiar with this type of separator.

## **Operating Instructions**

This chapter contains operating instructions for the separator only.



*Separator Manual and Spare Parts Catalogue*

SO068011

## **Service Instructions**

This chapter gives instructions for daily checks, cleaning, oil changes, servicing and check points.

## **Dismantling / Assembly**

This chapter contains step-by-step instructions for dismantling and assembly of the separator for service and repair.

## **Trouble-tracing**

Refer to this chapter if the separator functions abnormally.

If the separator has been installed as part of a processing system always refer to the Trouble-tracing part of the system documentation first.

## **Technical Reference**

This chapter contains technical data concerning the separator and drawings.

## **Index**

This chapter contains an alphabetical list of subjects, with page references.

## 2 Safety Instructions



The centrifugal separator includes parts that rotate at high speed. This means that:

- Kinetic energy is high
- Great forces are generated
- Stopping time is long

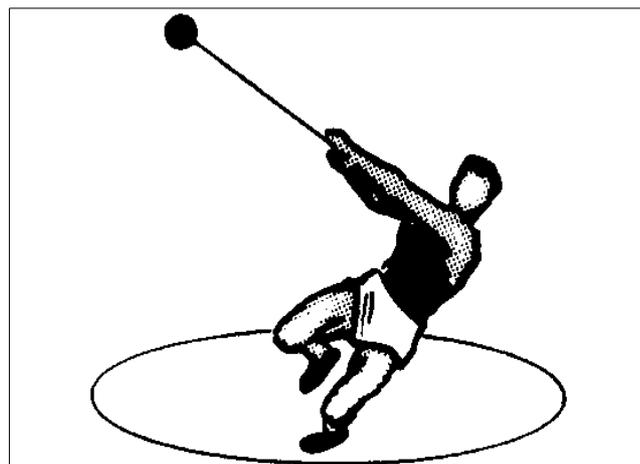
Manufacturing tolerances are extremely fine. Rotating parts are carefully balanced to reduce undesired vibrations that can cause a breakdown. Material properties have been considered carefully during design to withstand stress and fatigue.

The separator is designed and supplied for a specific separation duty (type of liquid, rotational speed, temperature, density etc.) and must not be used for any other purpose.

Incorrect operation and maintenance can result in unbalance due to build-up of sediment, reduction of material strength, etc., that subsequently could lead to serious damage and/or injury.

The following basic safety instructions therefore apply:

- **Use the separator only for the purpose and parameter range specified by Alfa Laval.**
- **Strictly follow the instructions for installation, operation and maintenance.**
- **Ensure that personnel are competent and have sufficient knowledge of maintenance and operation, especially concerning emergency stopping procedures.**
- **Use only Alfa Laval genuine spare parts and the special tools supplied.**

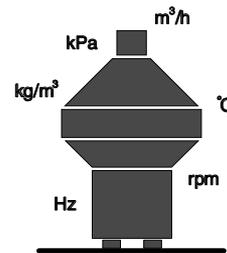




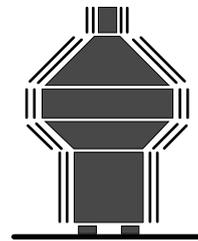
## DANGER

### Disintegration hazards

- Use the separator only for the purpose and parameter range specified by Alfa Laval.
- If excessive vibration occurs, **stop** separator and **keep bowl filled** with liquid during rundown.
- When power cables are connected, always check direction of motor rotation. If incorrect, vital rotating parts could unscrew.
- Check that the gear ratio is correct for power frequency used. If incorrect, subsequent overspeed may result in a serious break down.
- Welding or heating of parts that rotate can seriously affect material strength.
- Wear on the large lock ring thread must not exceed safety limit.  $\phi$ -mark on lock ring must not pass opposite  $\phi$ -mark by more than specified distance.
- Inspect regularly for **corrosion** and **erosion** damage. Inspect frequently if process liquid is corrosive or erosive.



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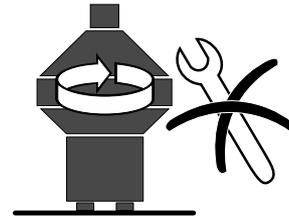
## DANGER

### Entrapment hazards

- Make sure that rotating parts have come to a **complete standstill** before starting **any** dismantling work.
- To avoid accidental start, switch off and lock power supply before starting **any** dismantling work.
- Assemble the machine **completely** before start. **All** covers and guards must be in place.

### Electrical hazards

- Follow local regulations for electrical installation and earthing (grounding).



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S0051011



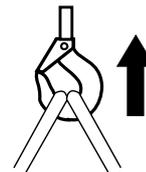
## WARNING

### Crush hazards

- Use correct lifting tools and follow lifting instructions.
- Do **not** work under a hanging load.

### Noise hazards

- Use ear protection in noisy environments.



S0051711

S0051611



**CAUTION**

**Burn hazards**

- Lubrication oil and various machine surfaces can be hot and cause burns.

**Cut hazards**

- Sharp edges on separator discs and lock ring threads can cause cuts.



S0055411



S0054311



## Warning signs in the text

Pay attention to the safety instructions in this manual. Below are definitions of the three grades of warning signs used in the text where there is a risk for injury to personnel.



### **DANGER**

Type of hazard

This type of safety instruction indicates a situation which, if not avoided, could result in **fatal injury** or fatal damage to health.



### **WARNING**

Type of hazard

This type of safety instruction indicates a situation which, if not avoided, could result in **disabling injury** or disabling damage to health.



### **CAUTION**

Type of hazard

This type of safety instruction indicates a situation which, if not avoided, could result in **light injury** or light damage to health.

### **NOTE**

This type of instruction indicates a situation which, if not avoided, could result in damage to the equipment.



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# 3 *Separator Basics*

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## Contents

<b>3.1 Basic principles of separation</b>	17
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## 3.1 Basic principles of separation

The purpose of separation can be:

- to free a liquid of solid particles,
- to separate two mutually insoluble liquids with different densities while removing any solids presents at the same time,
- to separate and concentrate solid particles from a liquid.

### Separation by gravity

A liquid mixture in a stationary bowl will clear slowly as the heavy particles in the liquid mixture sink to the bottom under the influence of gravity.

A lighter liquid rises while a heavier liquid and solids sink.

Continuous separation and sedimentation can be achieved in a settling tank having outlets arranged according to the difference in density of the liquids.

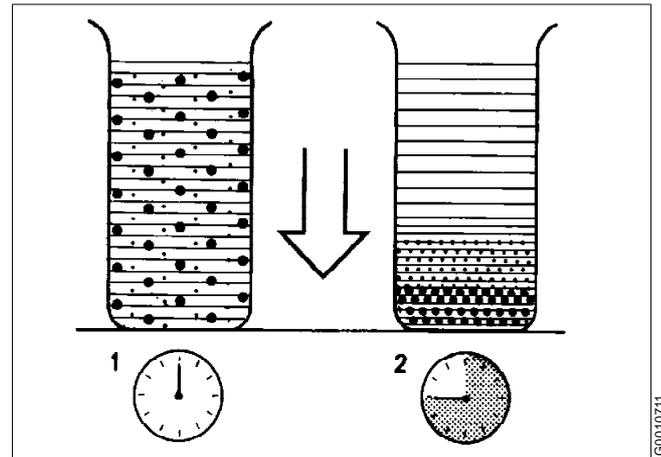
Heavier particles in the liquid mixture will settle and form a sediment layer on the tank bottom.

### Centrifugal separation

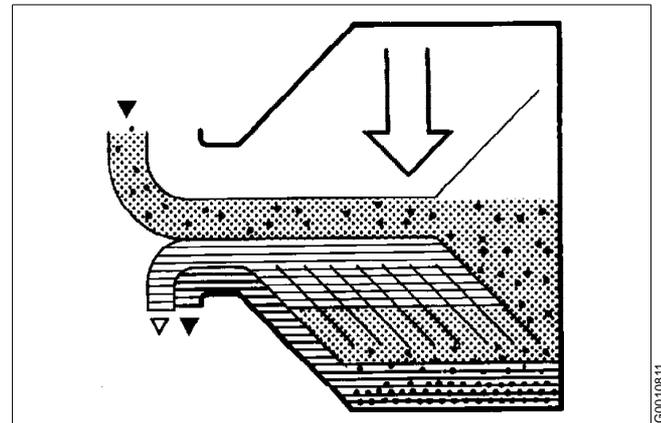
In a rapidly rotating bowl, the force of gravity is replaced by centrifugal force, which can be thousands of times greater.

Separation and sedimentation is continuous and happens very quickly.

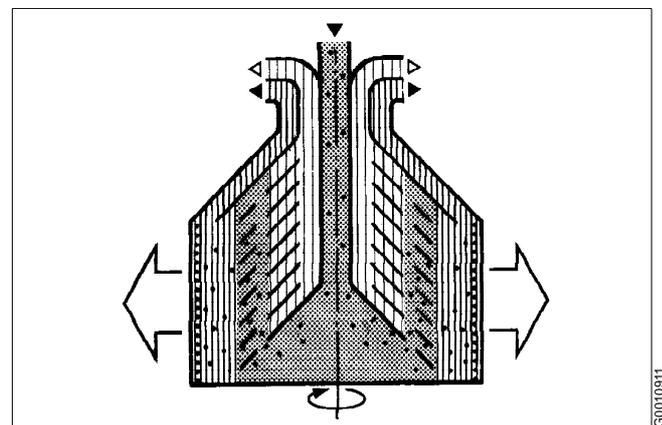
The centrifugal force in the separator bowl can achieve in a few seconds what takes many hours in a tank under influence of gravity.



*Sedimentation by gravity*



*Sedimentation in a settling tank, with outlets making it possible to separate the lighter liquid parts from the heavier*



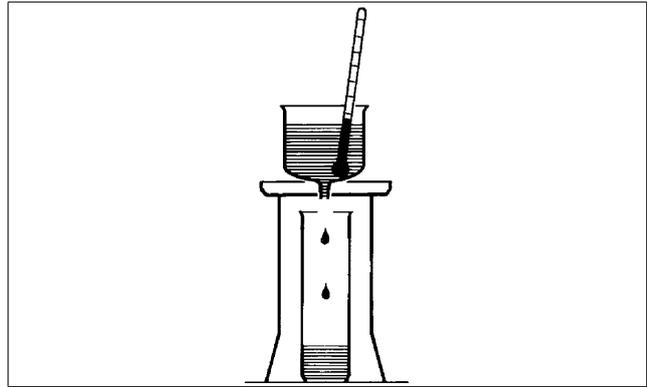
*The centrifugal solution*

### Separating temperatures

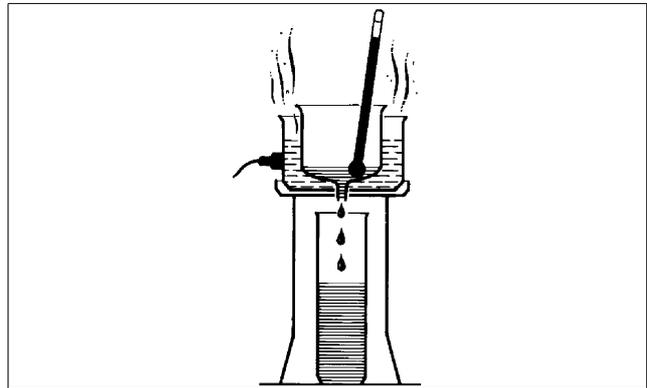
For some types of process liquids (e.g. mineral oils) a high separating temperature will normally increase the separation capacity. The temperature influences oil viscosity and density and should be kept constant throughout the separation.

### Viscosity

Low viscosity facilitates separation. Viscosity can be reduced by heating.



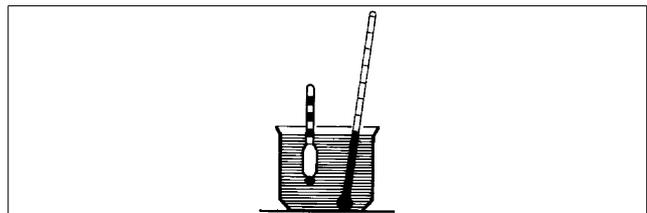
*High viscosity (with low temperature)*



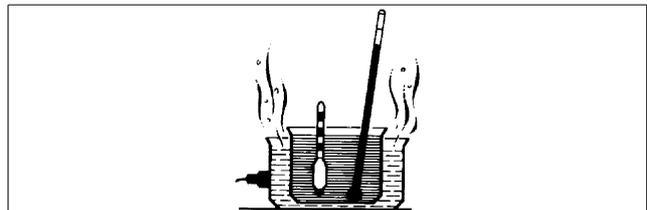
*Low viscosity (with high temperature)*

### Density difference

The greater the density difference between the two liquids, the easier the separation. The density difference can be increased by heating.



*High density (with low temperature)*



*Low density (with high temperature)*

## 3.2 Design and function

### 3.2.1 Overview

The separator comprises a processing part and a driving part. It is driven by an electric motor (9).

Mechanically, the separator machine frame is composed of a bottom part, a top part and a frame hood. The motor is flanged to the frame as shown in the illustration. The frame feet (6) are vibration damping.

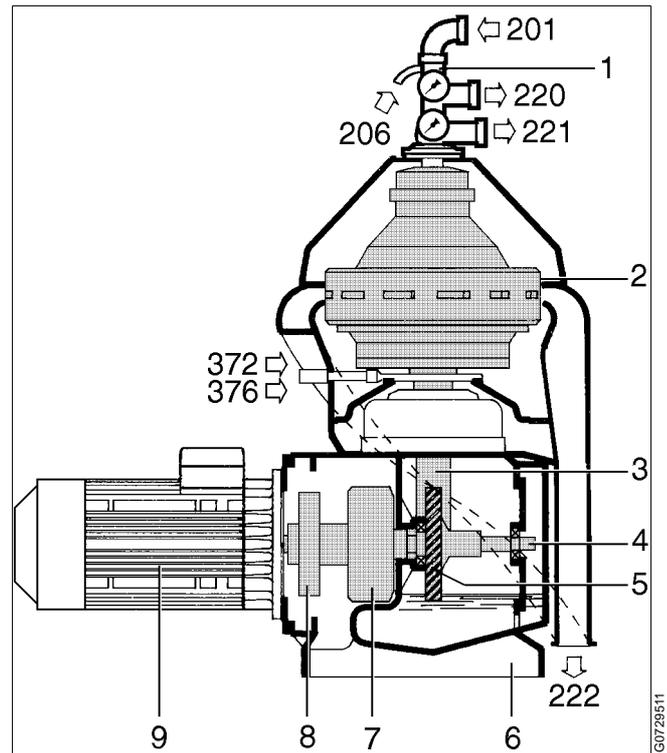
The bottom part of the separator contains the horizontal driving device (4), driving shaft with couplings (7, 8), a worm gear (5) and a vertical spindle (3).

The bottom part also contains an oil bath for the worm gear, a brake and a revolution counter.

The frame top part and the frame hood contain the processing parts of the separator, the inlet, outlets and piping (1).

The liquid is cleaned in the separator bowl (2). This is fitted on the upper part of the vertical spindle and rotates at high speed in the space formed by the frame top part and frame hood. The bowl also contains the discharge mechanism which empties the sludge from the bowl.

The main inlets and outlets are shown with connection numbers in the illustration. These numbers correspond with the numbers used in the connection list and the basic size drawing which can be found in chapter "8 Technical Reference" on page 173.



1. Inlet and outlet device
2. Bowl
3. Vertical driving device with bowl spindle
4. Horizontal driving device
5. Worm gear
6. Frame feet
7. Friction coupling
8. Elastic coupling
9. Electric motor

201. Unseparated oil inlet
206. Displacement/conditioning water inlet
220. Clean oil outlet
221. Water outlet
222. Sludge discharge outlet
372. Bowl opening water inlet
376. Bowl closing and make-up water inlet

### 3.2.2 Mechanical power transmission

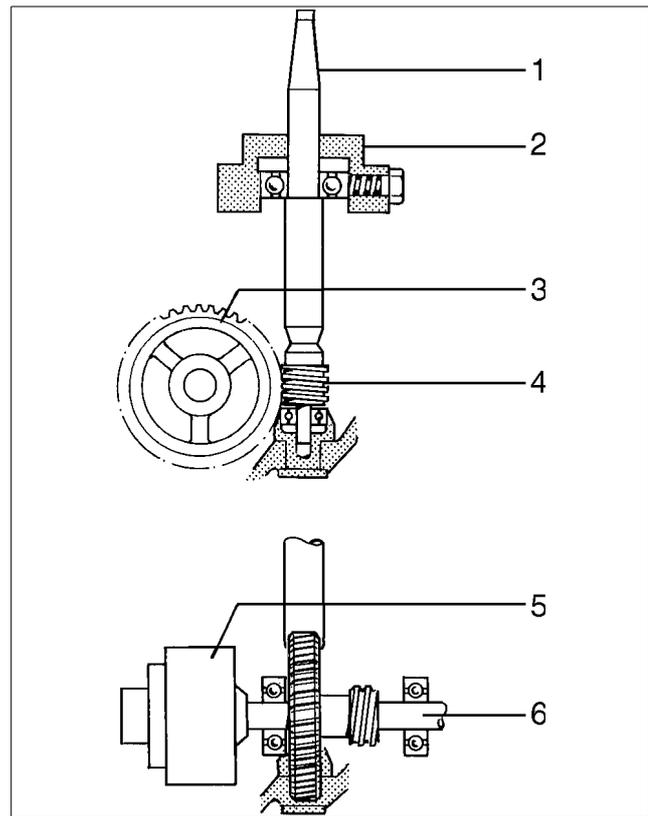
The main parts of the power transmission between motor and bowl are illustrated in the figure.

The friction coupling ensures a gentle start and acceleration and at the same time prevents overloading of the worm gear and motor.

The worm gear has a ratio which increases the bowl speed several times compared with the motor speed. For correct ratio see chapter "8.1 Technical data" on page 175.

To reduce bearing wear and the transmission of bowl vibrations to the frame and foundation, the top bearing of the bowl spindle is mounted in a spring casing.

The worm wheel runs in a lubricating oil bath. The bearings on the spindle and the worm wheel shaft are lubricated by the oil splash produced by the rotating worm wheel.

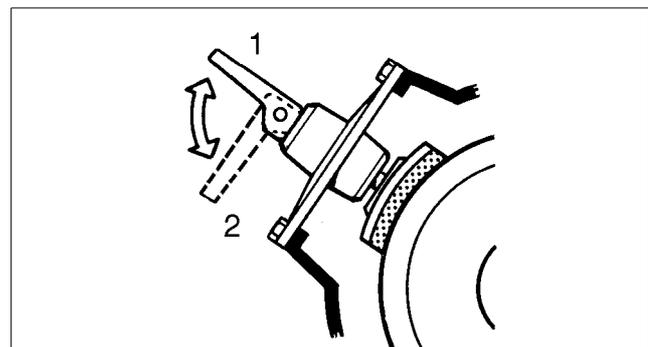


1. Bowl spindle
2. Top bearing and spring casing
3. Worm wheel
4. Worm
5. Friction coupling
6. Worm wheel shaft

### Brake

The separator is equipped with a brake to be used when stopping the separator. The use of the brake reduces the retardation time of the bowl and critical speeds will therefore be quickly passed.

The brake lining acts on the outside of the coupling pulley.



Applying (1) and releasing (2) of brake

### 3.2.3 Sensors and indicators

#### Back pressure gauge (1)

Correct limits for the back pressure in the clean oil outlet can be found in chapter “8.2.3 Connection list” on page 179.

Increasing back pressure in the clean oil outlet can be caused by:

- restriction in the outlet piping, e.g. a buckled or bent pipe,
- increased throughput,
- increased viscosity, decreased separating temperature.

#### Indicating pressure gauge (2)

During normal operation, the indicating pressure gauge in the water outlet will indicate pressure of less than 1 bar. If the pressure increases and exceeds 1 bar, this indicates abnormal operating conditions for the separator caused by:

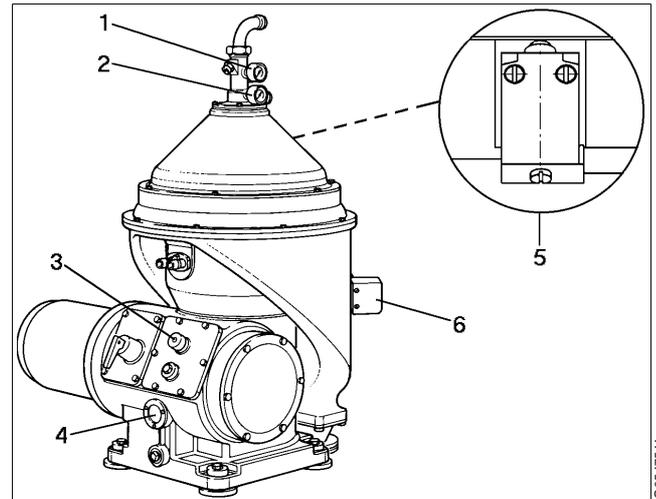
- increased back pressure in the clean oil outlet,
- clogged disc stack.

#### Revolution counter (3)

A revolution counter indicates the speed of the separator and is driven from the worm wheel shaft. The correct speed is needed to achieve the best separating results and for reasons of safety. The number of revolutions on the revolution counter for correct speed is shown in chapter “8 Technical Reference” on page 173. Refer to name plate for speed particulars.

#### Sight glass (4)

The sight glass shows the oil level in the worm gear housing.



1. Back pressure gauge
2. Indicating pressure gauge
3. Revolution counter
4. Sight glass
5. Cover interlocking switch (option)
6. Vibration switch (option)

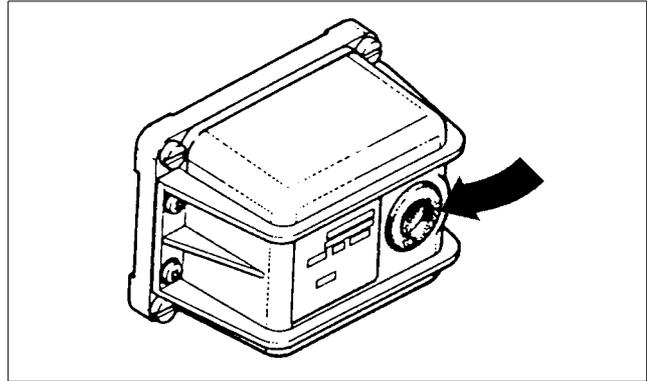
**Cover interlocking switch (5, option)**

When required, the cover interlocking switch should be connected to the starter equipment so that starting of the motor is prevented when the separator hood is not (completely) closed.

**Vibration switch (6, option)**

The vibration switch, properly adjusted, trips on a preset vibration level.

The vibration switch is sensitive to vibration in a direction perpendicular to its base. It contains a vibration detecting mechanism that actuates a snap-action switch when the selected level of vibration is exceeded. After the switch has tripped it must be reset manually by pressing the button on the switch.



*Reset push button on vibration switch*

### 3.2.4 Process main parts

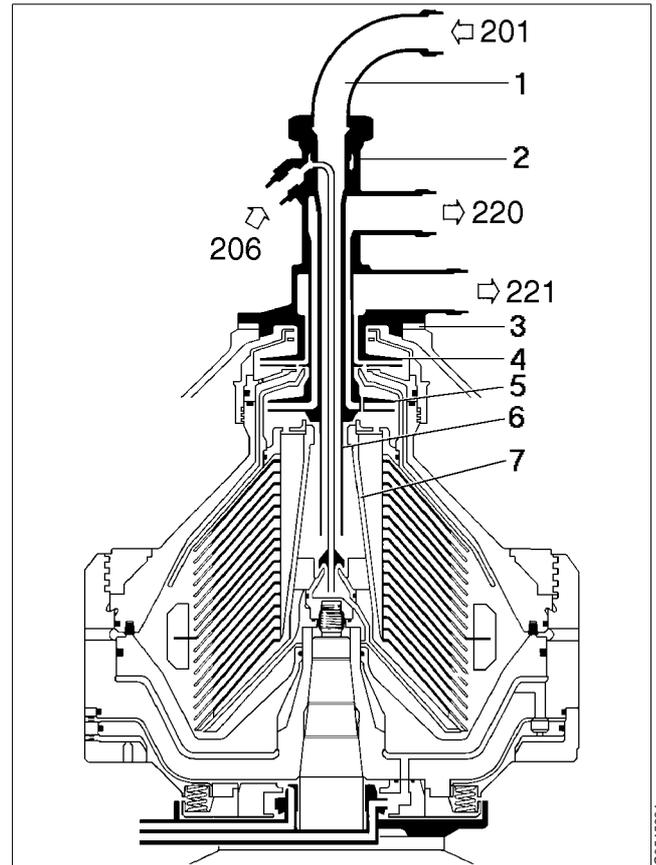
#### Inlet and outlet device

The inlet and outlet device consists of the following parts:

- The inlet (201). This comprises the inlet bend (1) and the long inlet pipe (6) which extends into the middle of the bowl.
- The outlets (220, 221). These comprise the discharge cover and the paring discs (4,5) which pump the separated oil and water out of the bowl. Each paring disc is located in a paring chamber in the top of the bowl.

The inlet and outlet device is held together by the inlet pipe threading which is fixed to the oil paring disc. O-rings and a seal ring seal the connections between the parts.

The connection housing (2) is fastened to the separator frame hood. Height adjusting rings (3) determine the height position of the paring discs in the paring chambers.



1. Inlet bend
2. Connection housing
3. Height adjusting rings
4. Upper (water) paring disc
5. Oil paring disc
6. Inlet pipe
7. Distributor

201. Unseparated oil inlet  
 206. Displacement/conditioning water  
 220. Clean oil outlet  
 221. Water outlet

### Separator bowl

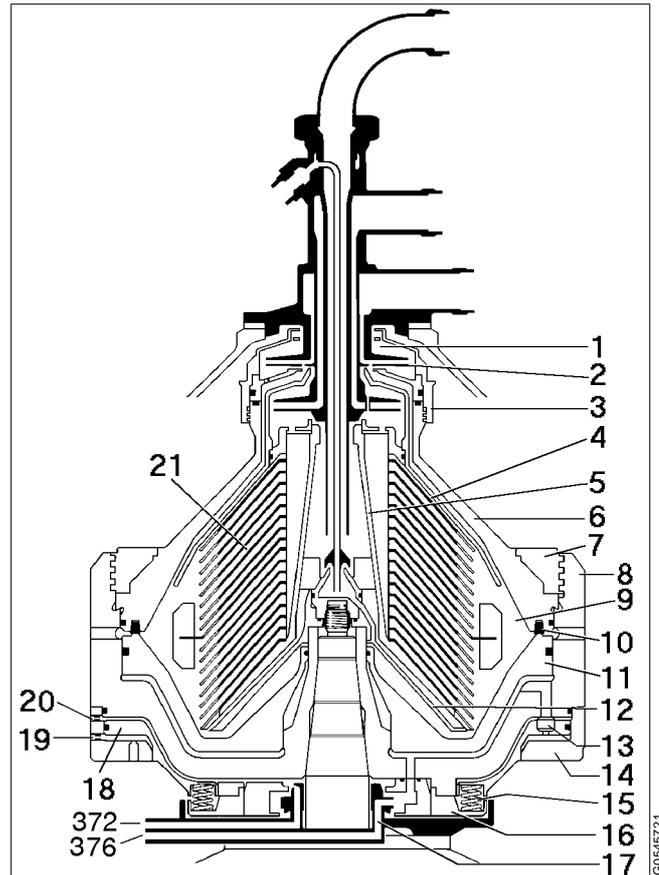
The separator bowl with its sludge discharge mechanism is built-up as follows:

The bowl body (8) and bowl hood (6) are held together by the large lock ring (7). Inside the bowl are the distributing cone (12), the distributor (5) and the disc stack (21). The disc stack is kept compressed by the hood. The sliding bowl bottom (11) forms an internal separate bottom in the bowl.

The bowl top is covered by the paring chamber cover (3). The space between this cover and the top disc (4) is the upper paring chamber (1). The oil paring chamber with its paring disc is located inside the upper part of the top disc.

The sludge space (9) is the space between the sliding bowl bottom and the bowl hood in the bowl periphery. It is kept closed by the sliding bowl bottom which seals against a seal ring (10) in the bowl hood.

At intervals decided by the operator, the sliding bowl bottom (11) drops to empty the bowl of sludge.



### Sludge discharge mechanism

The sludge discharge mechanism, which controls the sliding bowl bottom, comprises an operating slide (18) and an operating water device (17). Passive parts are the dosing ring (14), nozzles (19, 20) and drain valve plugs (13). The operating water device on the underside of the bowl supplies opening (372) and closing/make-up (376) water to the discharge mechanism.

1. Upper paring chamber
2. Upper (water) paring disc
3. Paring chamber cover (small lock ring)
4. Top disc
5. Distributor
6. Bowl hood
7. Lock ring
8. Bowl body
9. Sludge space
10. Seal ring
11. Sliding bowl bottom
12. Distributing cone
13. Drain valve plug
14. Dosing ring
15. Spring
16. Spring support
17. Operating device
18. Operating slide
19. Nozzle
20. Nozzle
21. Disc stack

372. Opening water inlet

376. Closing and make-up water inlet

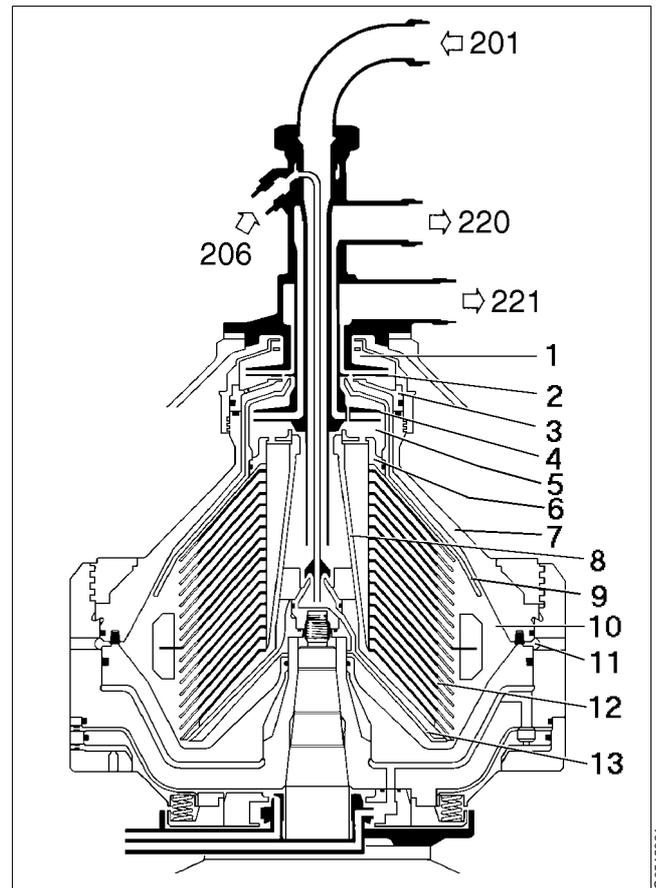
### 3.2.5 Separating function

Unseparated oil is fed into the bowl through the inlet (201) and is pumped via the distributor (8) towards the periphery of the bowl.

When the oil reaches slots of the distributor, it will rise through the channels formed by the disc stack (12) where it is evenly distributed.

The oil is continuously cleaned as it travels towards the center of the bowl. When the cleaned oil leaves the disc stack it rises upwards, flows over the level ring (6) and enters the oil paring chamber (5). From the latter it is pumped by the oil paring disc (4) and leaves the bowl through outlet (220). Separated water, sludge and solid particles, which are heavier than the oil, are forced towards the periphery of the bowl and collected in the sludge space (10).

The space between bowl hood (7) and top disc (9) and also the upper paring chamber are filled with oil, which is distributed over the entire circumference via the groove in the top disc.



1. Upper paring chamber
2. Upper (water) paring disc
3. Flow control disc
4. Oil paring disc
5. Oil paring chamber
6. Level ring
7. Bowl hood
8. Distributor
9. Top disc
10. Sludge space
11. Sludge port
12. Disc stack
13. Distributing cone

201. Unseparated oil inlet
206. Displacement/conditioning water inlet
220. Clean oil outlet
221. Water outlet

### 3.2.6 Sludge discharge cycle

The separator discharges a fixed volume of sludge and water. The discharge volume is approximately 100% of the space outside the disc stack, the so-called sludge space. The contents of the discharge can contain some emulsified oil.

#### Closed bowl (normal operation)

The sliding bowl bottom (2) is pressed upwards by force of the closing water in the closing water space (3) under the sliding bowl bottom which is greater than the force of the process liquid above the sliding bowl bottom.

The operating slide (6) is pressed upwards by the springs (7) and the valve plugs (5) then cover the drain channels (4).

#### Bowl opens for discharge

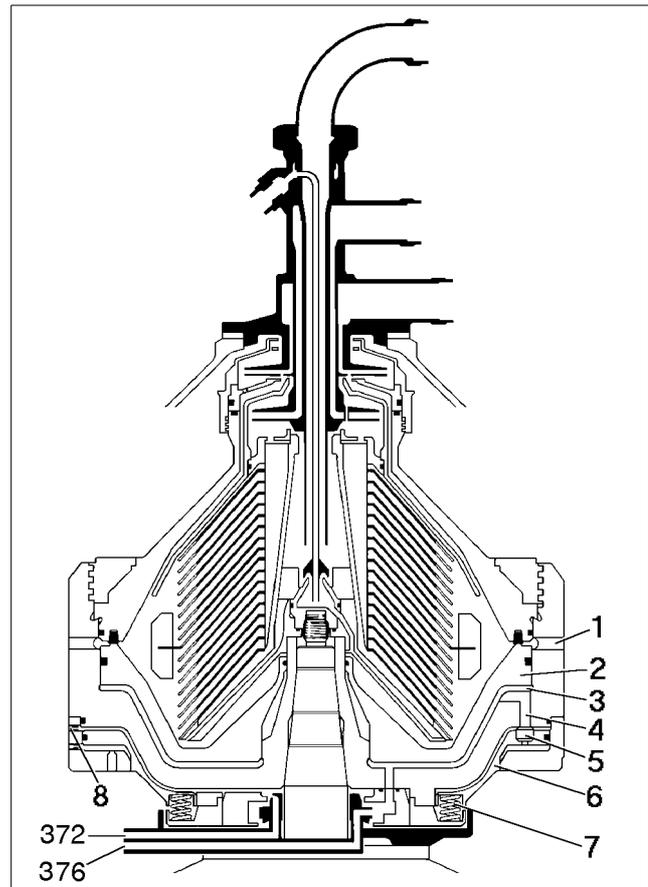
The opening water (372), which is supplied into the space above the operating slide (6), overcomes the force from the springs (7) and the operating slide is pressed downwards. The drain channels (4) open and the closing water drains out through the nozzle (8). This allows the force on the underside of the sliding bowl bottom (2) to become lower than the force on the upper side. The sliding bowl bottom moves downwards and the bowl opens for a discharge through the sludge ports (1).

#### Bowl closes after discharge

The supply of opening water stops. The springs (7) move the operating slide (6) upwards because the opening water is continuously drained through the nozzle (8).

The drain channels (4) are closed by the drain valve plugs (5) and the increasing force from the closing water (376) presses the sliding bowl bottom (2) upwards. The bowl closes and the sludge discharge cycle is complete.

Bowl closing water is supplied during the sludge discharge sequence and at intervals during the separation sequence to replace evaporated water.



1. Sludge port
2. Sliding bowl bottom
3. Closing water space
4. Drain channel
5. Drain valve plug
6. Operating slide
7. Spring
8. Drain nozzle

372. Opening water inlet  
376. Closing and make-up water inlet

### 3.3 Definitions

<b>Back pressure</b>	Pressure in the separator outlet.
<b>Clarification</b>	Liquid/solids separation with the intention of separating particles, normally solids, from a liquid (oil) having a lower density than the particles.
<b>Counter pressure</b>	See Back pressure.
<b>Density</b>	Mass per unit volume. Expressed in $\text{kg/m}^3$ at a specified temperature, normally at $+15\text{ }^\circ\text{C}$ .
<b>Gravity disc</b>	Disc in the bowl hood for positioning the interface between the disc stack and the outer edge of the top disc. This disc is only used in purifier mode.
<b>Interface</b>	Boundary layer between the heavy phase (water) and the light phase (oil) in a separator bowl.
<b>Intermediate Service (IS)</b>	Overhaul of separator bowl, inlet/outlet and operating water device. Renewal of seals in bowl inlet/outlet and operating water device.
<b>Major Service (MS)</b>	Overhaul of the complete separator, including bottom part (and activities included in an Intermediate Service, if any). Renewal of seals and bearings in bottom part.
<b>Purification</b>	Liquid/liquid/solids separation with the intention of separating two intermixed and mutually insoluble liquid phases of different densities. Solids having a higher density than the liquids can be removed at the same time. The <b>lighter</b> liquid phase (oil), which is the major part of the mixture, shall be purified as far as possible.
<b>Sediment (sludge)</b>	Solids separated from a liquid.
<b>Sludge discharge</b>	Ejection of sludge from the separator bowl.
<b>Throughput</b>	The feed of process liquid to the separator per unit time. Expressed in $\text{m}^3/\text{h}$ or $\text{lit}/\text{h}$ .
<b>Viscosity</b>	Fluid resistance against movement. Normally expressed in centistoke ( $\text{cSt} = \text{mm}^2/\text{s}$ ), at a specified temperature.
<b>Water seal</b>	Water in the solids space of the separator bowl to prevent the light phase (oil) from leaving the bowl through the heavy phase (water) outlet, in purifier mode.



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# 4 *Operating Instructions*

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## Contents

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## 4.1 Operating routine

These operating instructions are related only to the separator itself. If the separator is a part of a system or module follow also the instructions for the system.

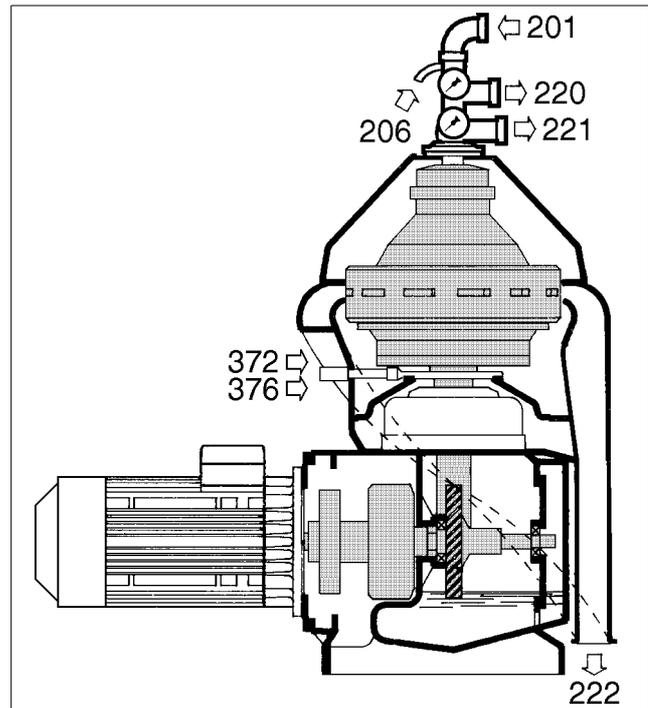
### 4.1.1 Before first start

Technical demands for connections and logical limitations for the separator is described in the chapter "8 Technical Reference" on page 173 in the documents:

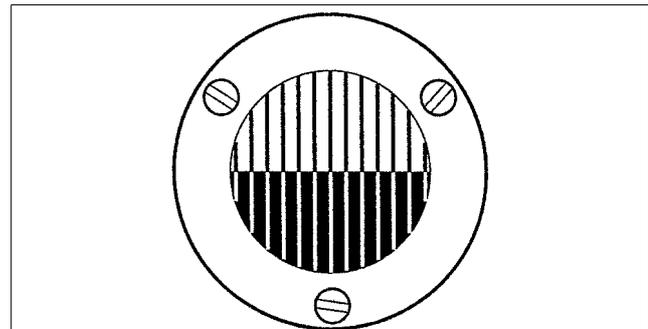
1. Technical data
2. Basic size drawing
3. Connection list
4. Interface description
5. Foundation drawing.

Before first start the following check points shall be checked:

- Ensure the machine is installed correctly and that feed-lines and drains have been flushed clean.
- Fill oil in the gear housing. Fill up exactly to the middle of the sightglass. Use the correct grade of oil. The separator is delivered without oil in the worm gear housing. For grade and quality, see "8.5 Lubricants" on page 186.
- Make sure the direction of rotation of the motor corresponds to the sign on the motor, see "8.6.3 Machine plates and safety labels" on page 198.



Explanations of the separator connections are given in "8.2.3 Connection list" on page 179



Fill oil in the gear housing

### 4.1.2 Ready for start

To achieve the best separation results the bowl should be in a clean condition.

1. Check that the bolts of the frame hood are fully tightened.
2. Check that all inlet and outlet connections have been correctly made and properly tightened.

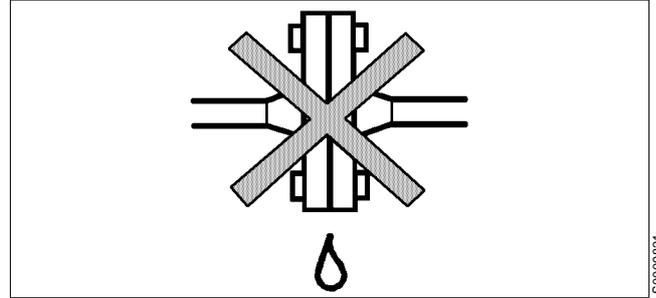


#### CAUTION

#### Burn hazards

Make sure that hose connections and flange couplings are properly assembled and tightened.

Escaping hot liquid can cause burns.



Check for leakages (not admitted)

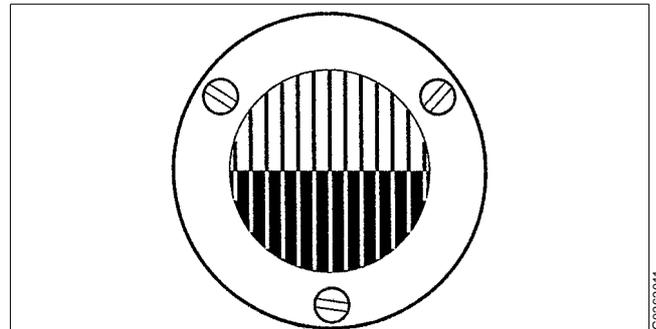
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3. Check that the oil level is exactly in the middle of the sight glass.

#### NOTE

During running the oil level should be slightly below the middle of the sight glass.

Too much or too little oil may damage the bearings.

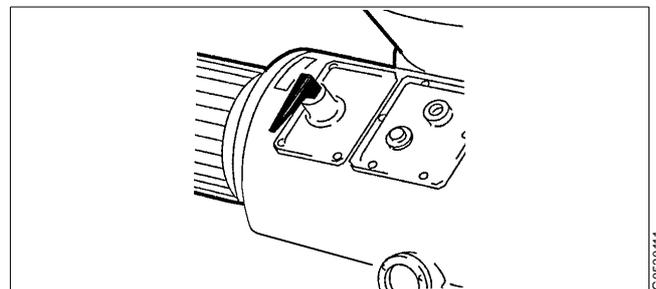


Check the oil level

G0262011

Fill if necessary. See chapter "8.5 Lubricants" on page 186, for a list of recommended oils.

4. Make sure that the brake is released.



Release the brake

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### 4.1.3 Start

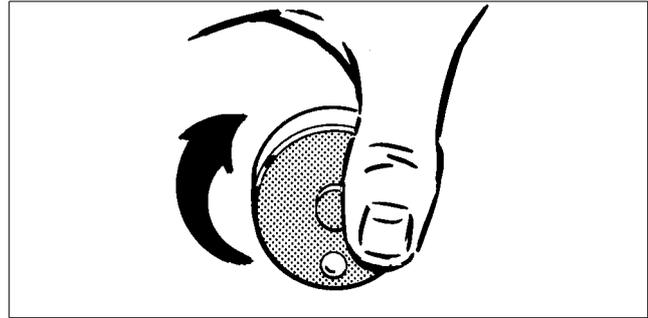
1. Start the separator.
2. Check the direction of rotation of the bowl.  
The revolution counter should turn clockwise.



**DANGER**

**Disintegration hazards**

When power cables have been connected, always check direction of rotation. If incorrect, vital rotating parts could unscrew.



*Check for correct direction of rotation*

3. Check the separator for vibration. Some vibration can occur for short periods during the starting cycle, when the separator passes through its critical speeds. This is normal and passes without danger. Try to learn the vibration characteristics of the critical speed pattern.

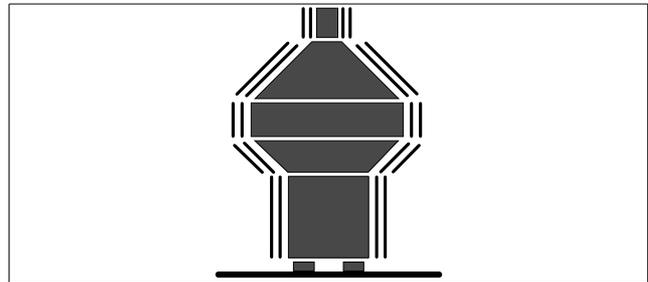


**DANGER**

**Disintegration hazards**

When excessive vibration occurs, **keep bowl filled** and **stop** separator.

The cause of the vibration must be identified and rectified before the separator is restarted. Excessive vibration may be due to incorrect assembly or insufficient cleaning of the bowl.



*Check for vibration*

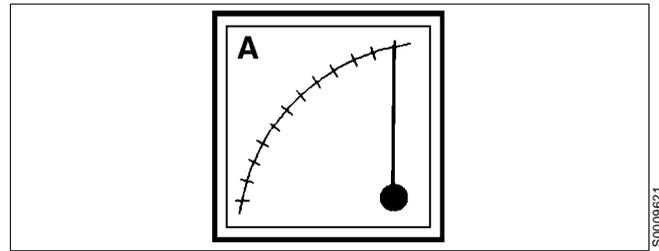
In the trouble-tracing chapter “7.1.1 Separator vibrates” on page 164, a number of causes are described that can create vibration.

4. Check, if possible, the current drawn by of the motor starter to ensure that the separator has reached full speed.

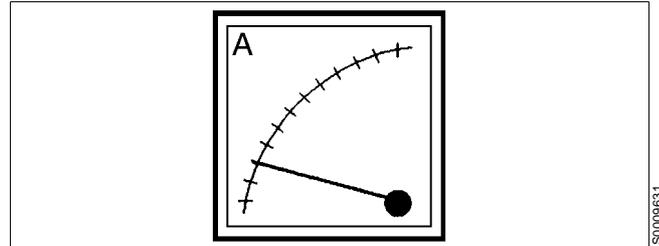
At full speed the starter ammeter reading has decreased from a high starting value to a low steady value.

The time to reach full speed may not exceed the limit given in chapter “8.1 Technical data” on page 175.

5. When running normally, open the closing water valve (connection 376) for approximately 5 seconds to close the bowl.



*Current increases when the coupling engages...*



*... to decrease to a stable value when full speed has been reached*

#### 4.1.4 Running

1. Check that the feed has the correct flow and temperature. See chapter “8 Technical Reference” on page 173 for correct values.
2. Adjust the oil outlet pressure to **1,5 bar**.
3. Discharge by opening the valve for opening water (connection 372) until a discharge is heard. For max. and min. time for discharge intervals, see chapter “8 Technical Reference” on page 173.



**DANGER**

**Disintegration hazards**

Ensure that correct discharge intervals and cleaning procedures are used.

Unbalance due to improper washing out of solids may lead to contact between rotating and non-rotating parts.

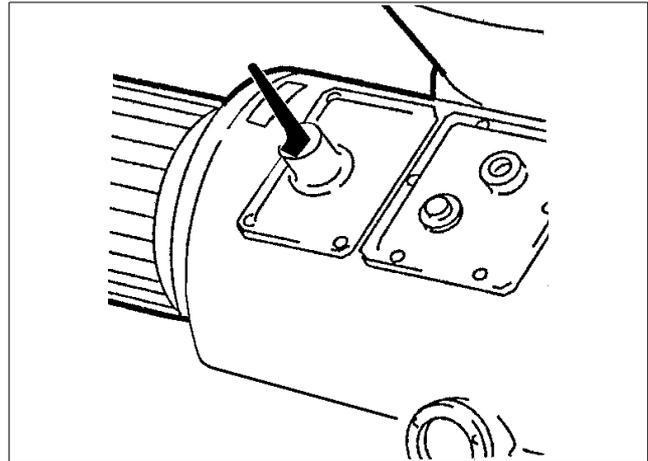
4. For daily condition checks, see “5.2.1 Daily checks” on page 43.

### 4.1.5 Normal stop

1. Carry out a sludge discharge before stopping the separator. Otherwise the bowl must be cleaned manually before the next start up.

The volume of the discharged sludge must be compensated for by additional feed.

2. After discharge, turn off the feed and stop the separator with the bowl filled with liquid.
3. Apply the brake.



*The final action, apply the brake*

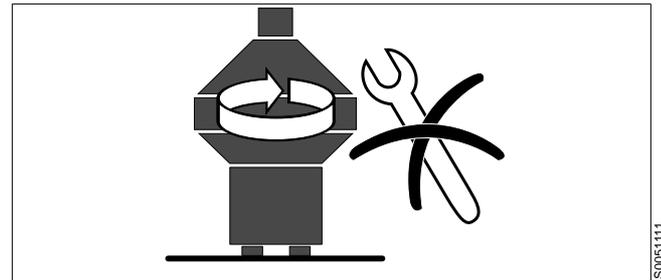
### 4.1.6 Emergency stop



**DANGER**

**Entrapment hazards**

Make sure that rotating parts have come to a **complete standstill** before starting **any** dismantling work. The revolution counter and the motor fan indicate if the separator parts are rotating or not.

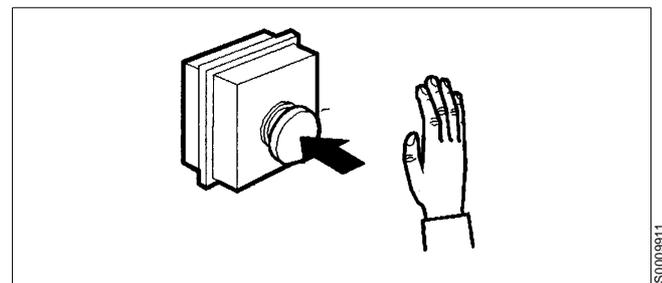


*The separator must not be dismantled until standstill*

1. If the separator begins to vibrate excessively during operation, stop it immediately by pushing the emergency stop; the separator motor is switched off.

Keep the bowl filled during the run-down to minimize excessive vibration.

2. Evacuate the room. The separator may be hazardous when passing its critical speeds during the run-down.



*Push the emergency stop if excessive vibration*



**DANGER**

**Disintegration hazards**

Do not discharge a vibrating separator.

Out-of-balance vibration can become worse if only part of the sediment is discharged.



**CAUTION**

**Disintegration hazards**

After a emergency stop the cause of the fault must be identified.

If all parts have been checked and the cause remains unclear, contact Alfa Laval for advice.



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# 5 Service Instructions

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## Contents

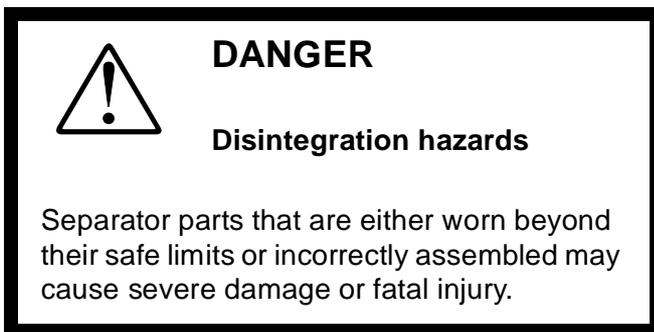
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## 5.1 Periodic maintenance

### 5.1.1 Introduction

Periodic (preventive) maintenance reduces the risk of unexpected stoppages and breakdowns. Follow the maintenance logs on the following pages in order to facilitate the periodic maintenance.



### 5.1.2 Maintenance intervals

The following directions for periodic maintenance give a brief description of which parts to be cleaned, checked and renewed at different maintenance intervals.

The maintenance logs for each maintenance interval later in this chapter give detailed enumeration of the check points that must be done.

Daily checks consist of minor check points to carry out for detecting abnormal operating conditions.

#### **Oil change**

The oil change interval is every **1000-1500 hours** or at least once every year if the total number of operating hours is less than **1000-1500 hours**.

When using a group D oil, time of operation between oil changes can be extended from the normal **1000-1500 hours to 2000 hours**.

**Intermediate Service (IS)**

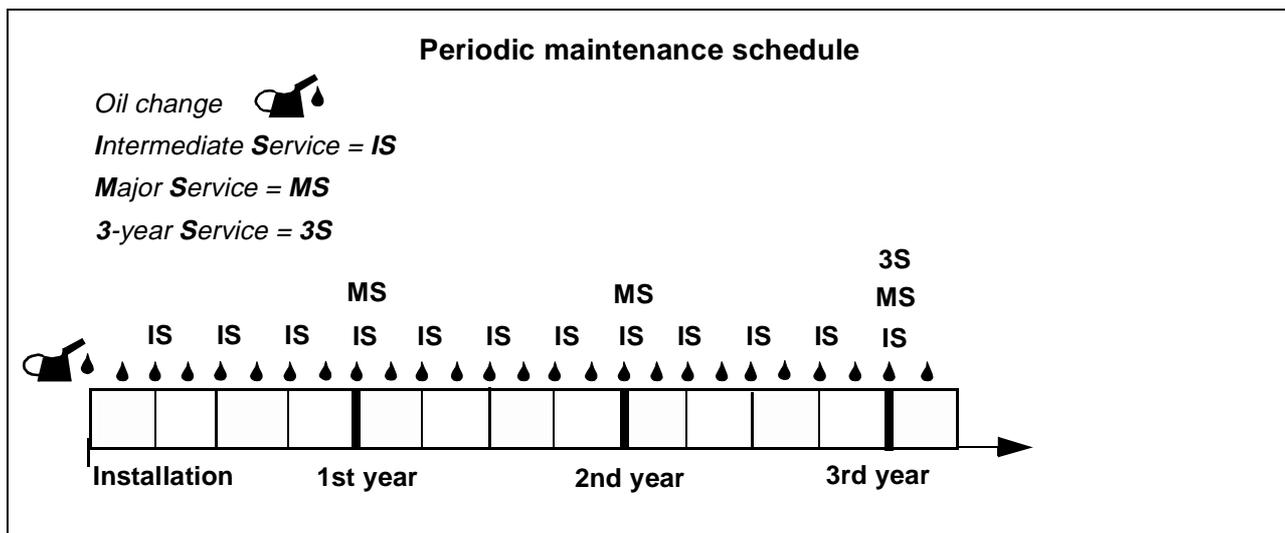
Intermediate Service consists of an overhaul of the separator bowl, inlet/outlet and operating device every **3 months or 2000 operating hours**. Seals in bowl and gaskets in inlet/outlet device are renewed.

**Major Service (MS)**

Major Service consists of an overhaul of the complete separator and includes an Intermediate Service every **12 months or 8000 operating hours**. Seals and bearings in the bottom part are renewed.

**3-year Service (3S)**

**3-year Service** consists of renewing the frame feet. The feet get harder with increased use and age. Intermediate and Major services are also carried out.



### 5.1.3 Maintenance procedure

At each Intermediate and Major Service, take a copy of the maintenance log and use it for notations during the service.

An Intermediate and Major Service should be carried out in the following manner:

1. Dismantle the parts as mentioned in the maintenance log and described in chapter “6 Dismantling/Assembly” on page 97.  
Place the separator parts on clean, soft surfaces such as pallets.
2. Inspect and clean the dismantled separator parts according to the maintenance log.
3. Fit all the parts delivered in the service kit while assembling the separator as described in chapter “6 Dismantling/Assembly” on page 97. The assembly instructions have references to check points which should be carried out before and during the assembly.

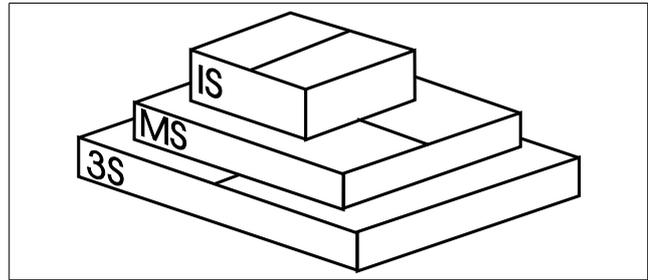
### 5.1.4 Service kits

Special service kits are available for Intermediate Service (IS) and Major Service (MS), as well as for servicing the frame feet (3S).

For other services the spare parts have to be ordered separately.

Note that the parts for IS are **not** included in the MS kit.

The contents of the service kits are described in the *Spare Parts Catalogue*.



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*Kits are available for Intermediate Service, Major Service and for servicing the frame feet*

#### NOTE

Always use Alfa Laval genuine parts as otherwise the warranty will become invalid.

Alfa Laval takes no responsibility for the safe operation of the equipment if non-genuine spare parts are used.



#### DANGER

##### Disintegration hazards

Use of imitation parts may cause severe damage.

## 5.2 Maintenance Logs

### 5.2.1 Daily checks

The following steps should be carried out daily.

Main component and activity	Part	Page	Notes
<b>Inlet and outlet</b> Check for leakage	Connecting housing If leakage through indicating hole (430) on housing, renew the O-rings inside.	177 179	
<b>Separator bowl</b> Check for vibration and noise		90	
<b>Horizontal driving device</b> Worm wheel shaft and gear casing Check for vibration and noise Check Electrical motor Check for heat, vibration and noise	Oil level in gear housing	90 31 1)	

1) See manufacturer's instruction

### 5.2.2 Oil change

The oil change and check of worm gear should be carried out every **1000-1500<sup>a)</sup> hours** of operation.

**Note:** In a new installation, or after replacement of gear, change the oil and clean the gear housing after **200 operating hours**.

Main component and activity	Part	Page	Notes
<b>Horizontal driving device</b> Worm wheel shaft and gear housing Check Renew	Worm wheel and worm Oil <sup>b)</sup> in gear housing	86 89	

When the separator is running for short periods, the lubricating oil must be changed every **12 months** even if the total number of operating hours is less than **1000-1500 hours (2000 h)**.

- a) When using a group D oil, time of operation between oil changes can be extended from the normal **1000-1500 hours to 2000 hours**.
- b) See chapter "8.5 Lubricants" on page 186 for further information.

**5.2.3 Intermediate Service (IS)**

Name of plant:

Local identification:

Separator: FOPX 611TFD-24

Manufacture No./Year:

Total running hours:

Product No: 881245-02-03

Date:

Signature:

<b>Main component and activity</b>	<b>Part</b>	<b>Page</b>	<b>Notes</b>
<b>Inlet and outlet</b>			
Clean and inspect	Threads of inlet pipe	61	
	Connecting housing	–	
<b>Separator bowl</b>			
Clean and check	Upper paring disc	–	
	Flow control disc	–	
	Lock ring	62	
	Bowl hood	50	
	Top disc	–	
	Oil paring disc	61	
	Level ring	61	
	Bowl discs	84	
	Distributor	–	
	Distributing cone	–	
	Sliding bowl bottom	64	
	Bowl body	–	
	Bowl spindle cone and bowl body nave	51	
	Operating mechanism	57, 63 64, 65	

Main component and activity	Part	Page	Notes
<b>Separator bowl, cont.</b>	Corrosion	51	
Check	Cracks	54	
	Erosion	57	
	Galling of guide surface	60	
	Disc stack pressure	55	
Renew	O-rings and sealings	–	
<b>Operating device</b>			
Clean and check	Operating paring disc	–	
Renew	O-rings	–	
<b>Horizontal driving device</b>			
Worm wheel shaft and gear housing			
Check	Worm wheel and worm	86	
Renew	Oil in gear housing	89	
Electrical motor			
Lubrication (if nipples are fitted)	See sign on motor	–	
<b>Signs and labels on separator</b>			
Check attachment and legibility	Safety label on hood	198	
	Direction of rotation arrow	199	
	Power supply frequency	175	
<b>Monitoring equipment (option)</b>			
Function check	Vibration switch	66	
	Cover interlocking switch	66	

**Note:** Renew all parts included in the Intermediate Service kit (IS).

**5.2.4 Major Service (MS)**

Name of plant:

Local identification:

Separator: FOPX 611TFD-24

Manufacture No./Year:

Total running hours:

Product No: 881245-02-03

Date:

Signature:

Main component and activity	Part	Page	Notes
<b>Inlet and outlet</b> Clean and inspect	Threads of inlet pipe	61	
	Connecting housing	–	
<b>Separator bowl</b> Clean and check	Upper paring disc	–	
	Flow control disc	–	
	Lock ring	75, 62	
	Bowl hood	50	
	Top disc	–	
	Oil paring disc	61	
	Level ring	61	
	Bowl discs	84	
	Distributor	–	
	Distributing cone	–	
	Sliding bowl bottom	64	
	Bowl body	–	
Bowl spindle cone and bowl body nave	51		
Operating mechanism	57, 63 63, 65		

Main component and activity	Part	Page	Notes
<b>Separator bowl, cont.</b>  Check      Renew	Corrosion	51	
	Cracks	54	
	Erosion	57	
	Galling of guide surface	60	
	Disc stack pressure	55	
	Height position of oil paring disc	78	
	O-rings and sealings	–	
<b>Operating device</b>  Clean and check  Check  Renew	Operating paring disc	–	
	Height position of operating paring disc	77	
	O-rings	–	
<b>Vertical driving device</b>  Clean and check      Renew	Bowl spindle	–	
	Wear of groove in worm	78	
	Buffer springs and ball bearing housing	69	
	Height position of bowl spindle	67	
	Radial wobble of bowl spindle	68	
	O-rings and sealings	137	
	Spindle bearings	137	
<b>Horizontal driving device</b> Worm wheel shaft and gear housing  Check    Renew  Brake  Clean and check	Worm wheel and worm	86	
	Radial wobble of worm wheel shaft	79	
	Axial play of flexible plate	73	
	Bearings,O-rings and sealings	151	
	Oil in gear housing	89	
	Spring and brake shoe	68	

Main component and activity	Part	Page	Notes
Friction coupling			
Clean and check	Worm wheel coupling	–	
Renew (if necessary)	Friction pads	71	
Electrical motor			
Lubrication (if nipples are fitted)	See sign on motor	–	
<b>Signs and labels on separator</b>			
Check attachment and legibility	Safety label on hood	198	
	Direction of rotation arrow	199	
	Power supply frequency	175	
<b>Monitoring equipment (option)</b>			
Function check	Vibration switch	66	
	Cover interlocking switch	66	

**Note:** Renew all parts included in the Intermediate Service kit (IS) and Major Service kit (MS)

### 5.2.5 3-year Service (3S)

The 3-year service should be carried out in conjunction with a Major Service (MS). The extent of the 3-year service is the same as for a major service plus renewing of parts included in the 3-year Service kit (3S).

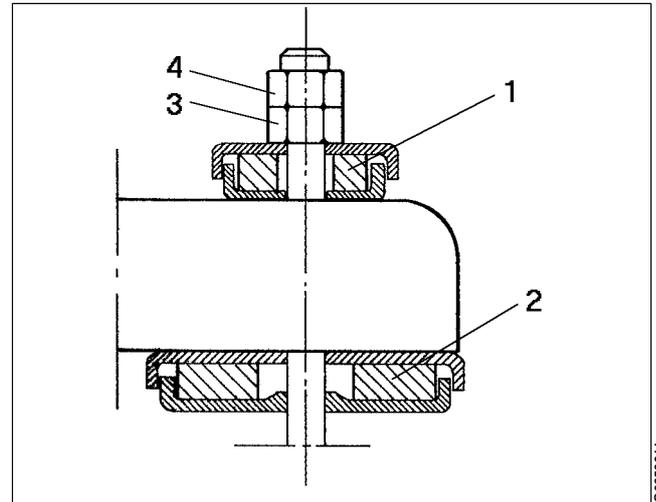
#### Frame feet, renewal

1. Disconnect pipes, hoses and cables connected to the separator.
2. Remove the nuts (3, 4).
3. Lift the separator.

#### NOTE

When lifting a separator it must always **hang securely**. See separate instruction in chapter "5.5 Lifting instructions" on page 80.

4. Renew the vibration dampers (1, 2).
5. Lower the frame. Check that the bolts do not press against the edges of the holes.
6. Tighten the nut (3) to **20 Nm**.
7. Hold the nut (3) firmly and secure with the lock nut (4).
8. Connect the previously disconnected pipes, hoses and cables.



1. *Vibration damper, upper*
2. *Vibration damper, lower*
3. *Nut*
4. *Lock nut*

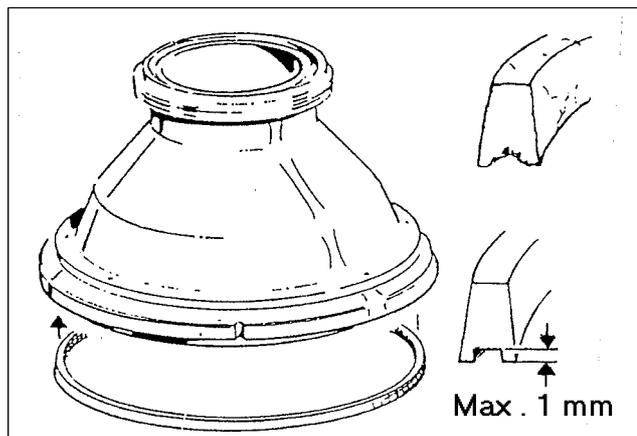
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## 5.3 Check points at Intermediate Service (IS)

### 5.3.1 Bowl hood seal ring

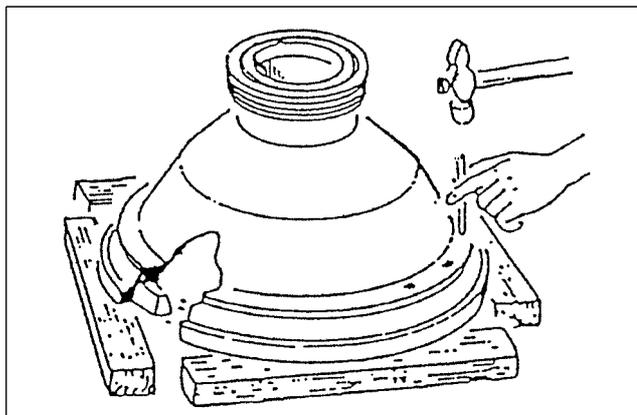
Poor sealing between the bowl hood seal ring and the sealing edge of the sliding bowl bottom will cause a leakage of process liquid from the bowl.

Renew the bowl hood seal ring at each Intermediate Service (IS).



Max. permitted indentation of the seal ring is 1 mm

Knock out the old ring by means of a pin inserted in the holes intended for this purpose.



Removal of the seal ring

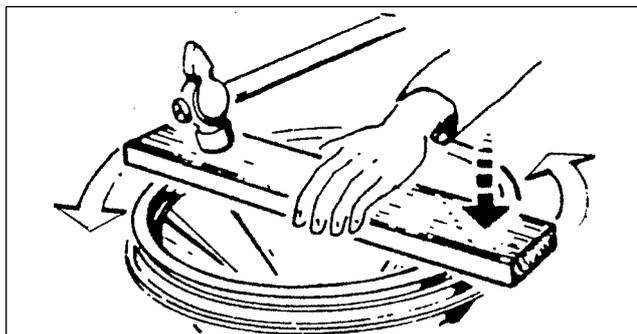
Fit the new ring as follows:

Press the ring into the groove with a straight wooden board placed across the ring.

#### NOTE

If the new ring is too narrow, place it in hot water (70-80 °C) for about 5 minutes.

If it is too wide, it will shrink after drying at 80-90 °C for about 24 hours.



Fitting of the seal ring

### 5.3.2 Bowl spindle cone and bowl body nave

Impact marks on the spindle cone or in the bowl body nave may cause poor fit and out-of-balance vibrations.

The bowl spindle and the nave should also be checked if the bowl spindle has been dismantled or if the bowl runs roughly.

Corrosion may cause the bowl to stick firmly to the spindle cone and cause difficulties during the next dismantling.

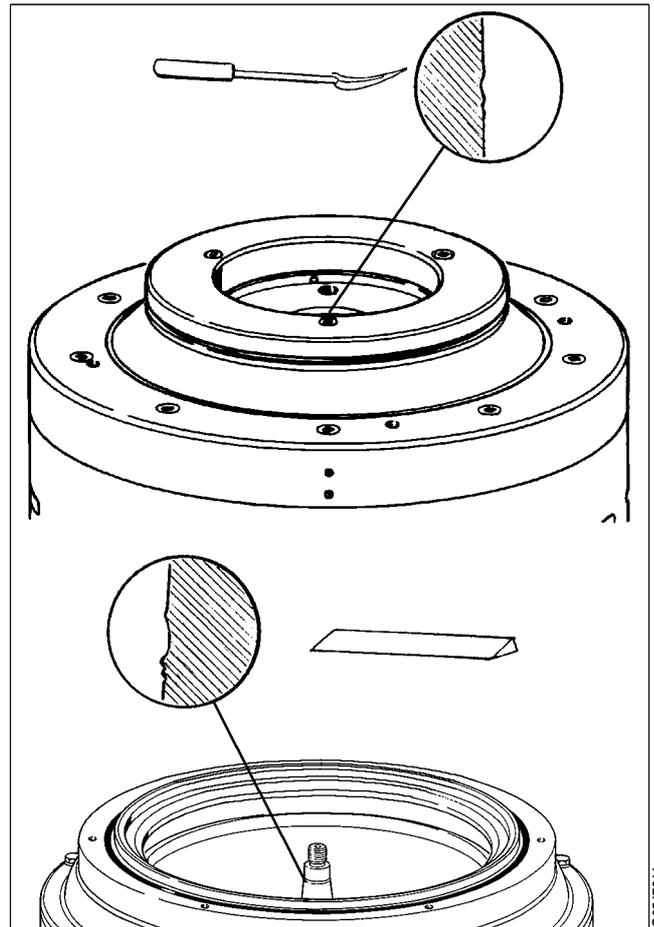
- Remove any impact marks with a scraper and/or whetstone.

Rust can be removed by using a fine-grain emery cloth (e.g. No. 320).

Finish with polishing paper (e.g. No. 600).

#### NOTE

Always use a scraper with great care. The cone shape must not be deformed.



Remove impact marks from the nave and cone

### 5.3.3 Corrosion

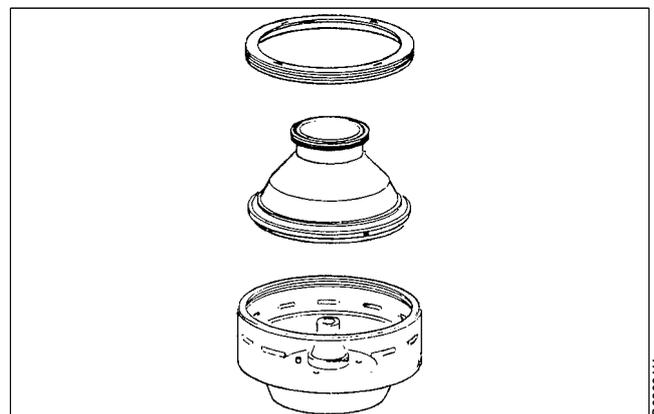
Evidence of corrosion attack should be looked for and rectified each time the separator is dismantled. Main bowl parts such as the bowl body, bowl hood and lock ring must be inspected with particular care for corrosion damage.



#### DANGER

#### Disintegration hazard

Inspect regularly for corrosion damage. Inspect frequently if the process liquid is corrosive.



Main bowl parts to check for corrosion

Always contact your Alfa Laval representative if you suspect that the largest depth of the corrosion damage exceeds 1,0 mm or if cracks have been found. Do not continue to use the separator until it has been inspected and given clearance for operation by Alfa Laval.

Cracks or damage forming a line should be considered as being particularly hazardous.

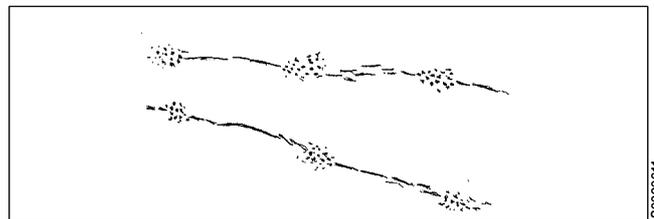
### Non-stainless steel and cast iron parts

Corrosion (rusting) can occur on unprotected surfaces of non-stainless steel and cast iron. Frame parts can corrode when exposed to an aggressive environment.

### Stainless steel

Stainless steel parts corrode when in contact with either chlorides or acidic solutions. Acidic solutions cause general corrosion. The chloride corrosion is characterised by local damage such as pitting, grooves or cracks. The risk of chloride corrosion is higher if the surface is:

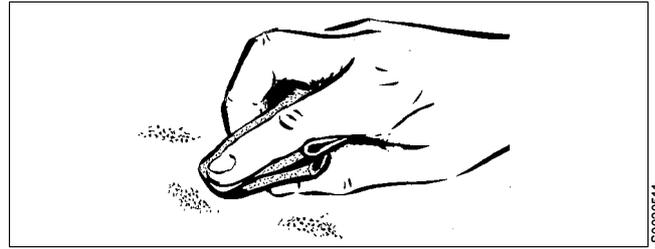
- Exposed to a stationary solution.
- In a crevice.
- Covered by deposits.
- Exposed to a solution that ofa low pH .



*Example of chloride corrosion in stainless steel*

Corrosion damage caused by chlorides on stainless steel begins as small dark spots that can be difficult to detect.

1. Inspect closely for all types of damage by corrosion and record these observations carefully.
2. Polish dark-coloured spots and other corrosion marks with a fine grain emery cloth. This may prevent further damage.



*Polish corrosion marks to prevent further damage*



## **DANGER**

### **Disintegration hazard**

Pits and spots forming a line may indicate cracks beneath the surface.

All forms of cracks are a potential danger and are totally unacceptable.

Renew the part if corrosion can be suspected of affecting its strength or function.

### **Other metal parts**

Separator parts made of materials other than steel, such as brass or other copper alloys, can also be damaged by corrosion when exposed to an aggressive environment. Possible corrosion damage can be in the form of pits and/or cracks.

### 5.3.4 Cracks

Cracks can initiate on the machine after a period of operation and propagate with time.

- Cracks often initiate in an area exposed to high cyclic material stresses. These are called fatigue cracks.
- Cracks can also initiate due to corrosion in an aggressive environment.
- Although very unlikely, cracks may also occur due to the low temperature embrittlement of certain materials.

The combination of an aggressive environment and cyclic stresses will speed-up the formation of cracks. Keeping the machine and its parts clean and free from deposits will help to prevent corrosion attacks.



**DANGER**

**Disintegration hazard**

All forms of cracks are potentially dangerous as they reduce the strength and functional ability of components.

Always replace a part if cracks are present.

It is particularly important to inspect for cracks in rotating parts and especially the pillars between the sludge ports in the bowl wall.

Always contact your Alfa Laval representative if you suspect that the largest depth of the damage exceeds 1,0 mm. Do not continue to use the separator until it has been inspected and cleared for operation by Alfa Laval.

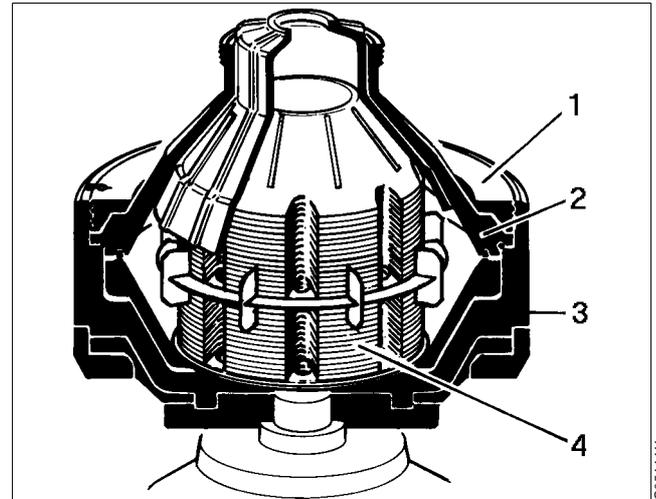
### 5.3.5 Disc stack pressure

#### NOTE

Ensure that the disc stack pressure is sufficient to maintain bowl balance.

Insufficient pressure in the disc stack can cause vibration and reduce lifetime of ball bearings.

The lock ring (1) should press the bowl hood (2) firmly against the bowl body (3). The hood in turn should exert a pressure on the disc stack (4), clamping it in place.



1. Lock ring
2. Bowl hood
3. Bowl body
4. Disc stack

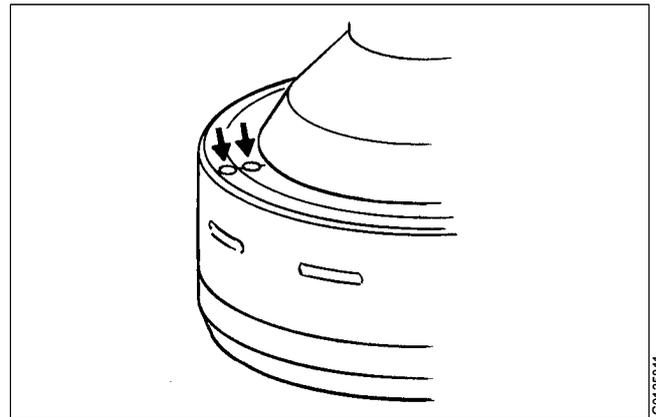
Compress the disc stack by tightening the lock ring, see chapter "6.3.3 Assembly" on page 114.

Correct pressure is obtained when it is possible to tighten the lock ring so far by hand that the  $\phi$ -mark on the lock ring is positioned 60° - 90° ahead of the mark on the bowl body.

To achieve this, add an appropriate number of discs to the top of the disc stack beneath the top disc.

Then advance the lock ring by giving the spanner handle some blows till the  $\phi$ -marks are passed and the bowl is fully assembled.

If the  $\phi$ -marks do not reach or pass each other, the reason could be an incorrectly assembled bowl or too many discs in the disc stack. Reassemble and check.



$\phi$ -marks on bowl body and lock ring in line

### Complementary check using the compressing tool

With the large lock ring correctly tightened and the compressing tool mounted on the separator bowl, turn the lever to position 1 for compression.

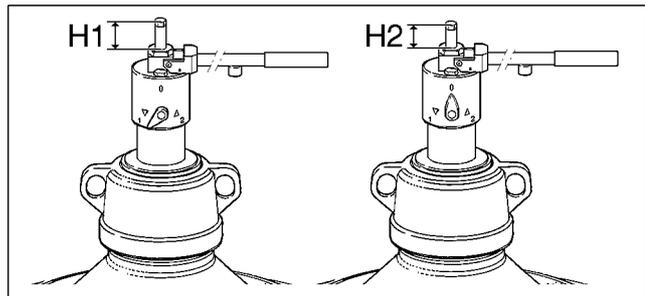
Compress the disc stack by pumping the horizontal handle arm until the oil pressure is released through the relief valve.

Measure the height (H1) of the piston rod (see illustration) with the slide calliper depth gauge. Make a note of the reading obtained.

Release the pressure in the compressing tool by turning the lever to position 0. The piston rod will now move downwards slightly when the disc set is released inside the bowl.

Measure once again the height (H2) of the piston rod with the slide calliper and make a note of the reading obtained.

If the difference between H1 and H2 is less than 1,5 mm, the disc stack pressure is correct. If it exceeds 1,5 mm, the number of discs is insufficient. Add one or more discs and repeat the above procedure until the correct disc stack pressure is obtained.



Measure of disc stack pressure with use of a compressing tool

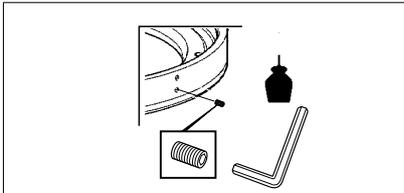
### NOTE

An insufficient number of discs will create an imbalance causing vibration.

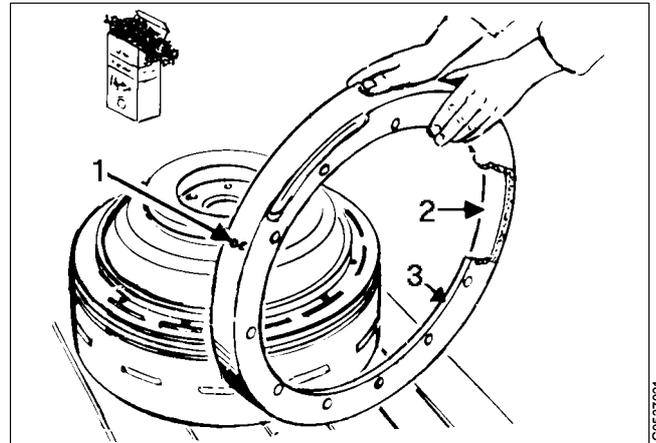
### 5.3.6 Dosing ring

Clean the nozzles (1) with a soft iron wire and polish the surface (2) with steel wool.

Inspect the surface (3) in contact with the operating slide. Remove any marks with a whetstone or fine emery cloth (grain size 240).



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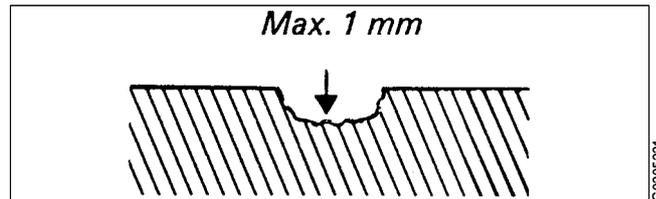


G0537021

1. Nozzles
2. Surface inside the dosing ring
3. Surface in contact with the operating slide

### 5.3.7 Erosion

Erosion can occur when particles suspended in the process liquid flow along or strike against a surface. Erosion can become intensified locally by flows of higher velocity.



G0205221

Max. permitted erosion



**DANGER**

**Disintegration hazard**

Inspect regularly for erosion damage. Inspect frequently if the process liquid is erosive.

Always contact your Alfa Laval representative if the largest depth of any erosion damage exceeds 1,0 mm. Valuable information as to the nature of the damage can be recorded using photographs, plaster impressions or hammered-in lead.

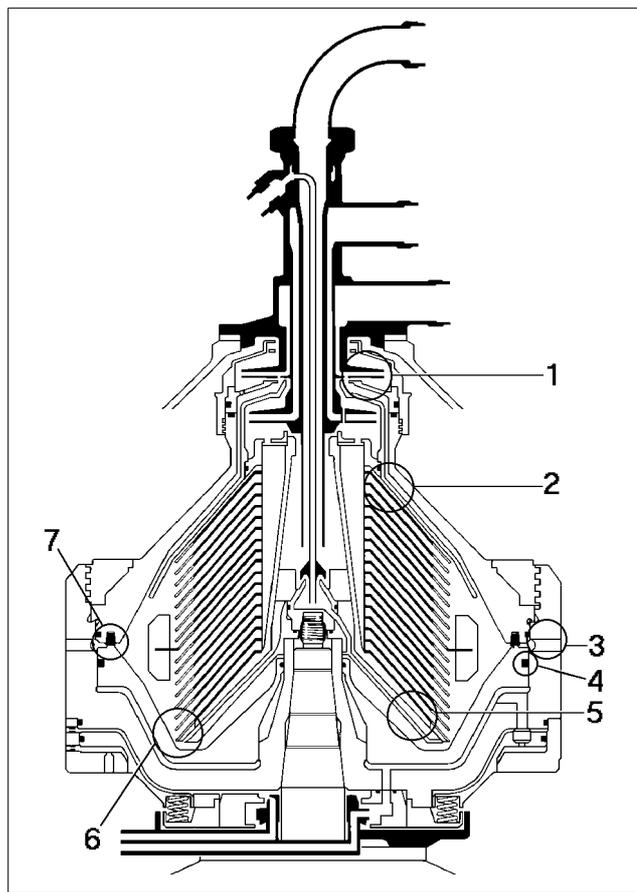
Erosion is characterised by:

- Burnished traces on the material.
- Dents and pits having a granular and shiny surface.

Surfaces particularly subjected to erosion are:

1. The upper paring disc.
2. The top disc.
3. The pillars between the sludge ports in the bowl wall.
4. The sealing edge of the sliding bowl bottom.
5. The underside of the distributor in the vicinity of the distribution holes and wings.
6. The surface of the sliding bowl bottom that faces the conical part of the distributor.
7. The sealing edge of the bowl body for the seal ring in the sliding bowl bottom.

Look carefully for any signs of erosion damage. Erosion damage can deepen rapidly and consequently weaken parts by reducing the thickness of the metal.



*Surfaces particularly subjected to erosion*



## **DANGER**

### **Disintegration hazard**

Erosion damage can weaken parts by reducing the thickness of the metal.

Pay special attention to the pillars between the sludge ports in the bowl wall.

Renew the part if erosion can be suspected of affecting its strength or function.

### 5.3.8 Guide surfaces

Check surfaces indicated (1 and 2) for burrs or galling. Rectify when necessary.

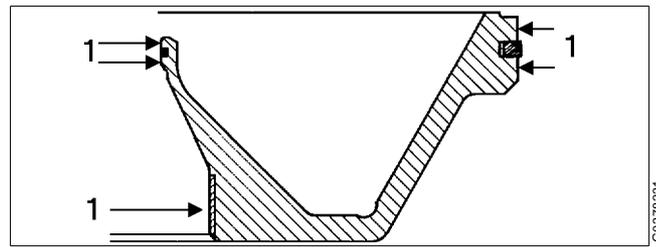
Repair of galling on guide surfaces; see following pages. Before fitting the sliding bowl bottom, clean (**do not** degrease) the contact surfaces (1). Apply Alfa Laval lubricating paste or Molykote 1000 Paste with a well-cleaned brush on surfaces (1 and 2).

**NOTE**

To avoid the risk of galling, the contact surfaces (1) should be primed with a slide lacquer at every Major Service (MS).

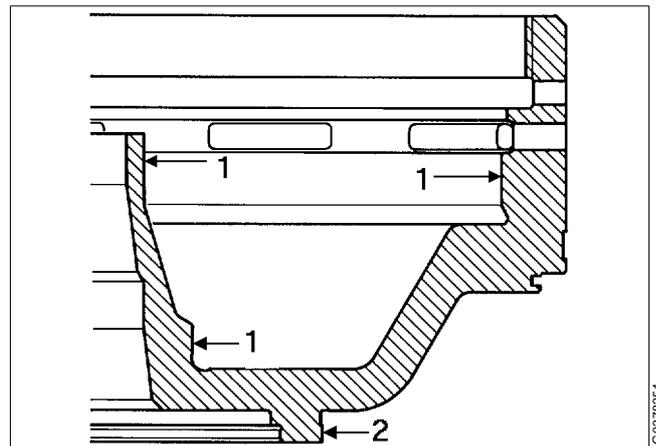
The slide-lacquered surfaces will be destroyed if the surfaces are degreased.

Lubricate the O-ring and the seal ring with silicone grease making sure they are not damaged and lie properly in their grooves.



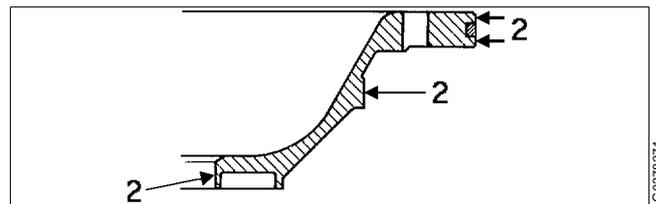
Sliding bowl bottom

G0378231



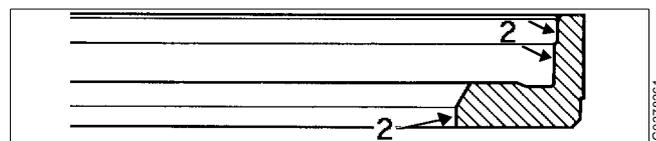
Bowl body

G0378251



Operating slide

G0378271



Dosing ring

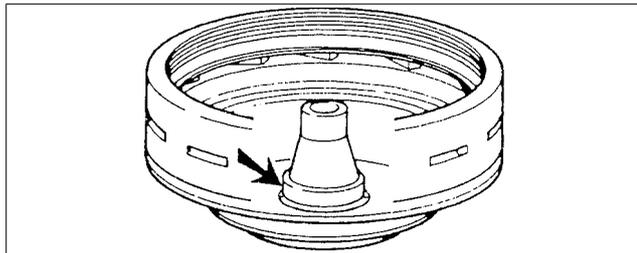
G0378281

1, 2 =  Alfa Laval lubricating paste or Molykote 1000 Paste.

### Repair of galling on guide surfaces

Galling (friction marks) may appear on guide surfaces in the operating system, the bowl body and the sliding bowl bottom. Surfaces subject to repair are indicated by an arrow.

The example below describes the repair of the lower guide surface of the bowl body nave.

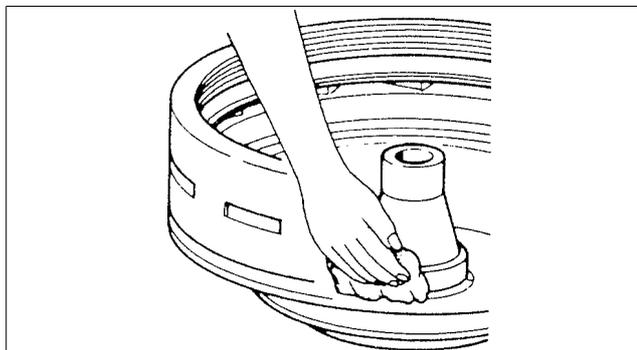


Guide surface in the bowl body

Recommended tools for correction of galling:

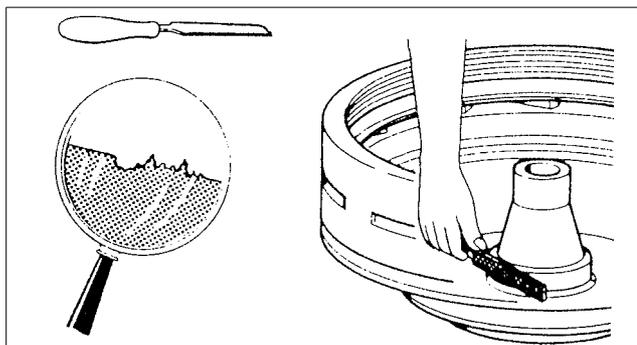
- Emery cloth, 240 grade.
- Small power drill
- Degreasing agent.
- Fibre brush, Ø 25mm.
- Fibre brush, Ø 50 mm.
- Very fine single-cut file.

1. Clean the surface thoroughly with a degreasing agent, i.e. white spirit. This is important.

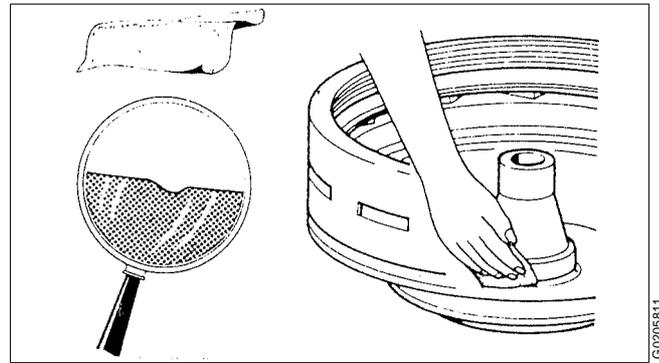


2. If the galling is excessive, first use the fine single-cut file. The file should be used with caution so that the damage is not made worse.

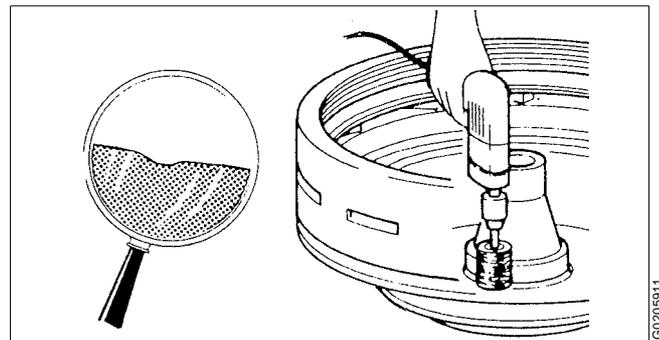
Remove the high spots on the surface. Do not use rotating files or similar. Remove the high spots only - not the undamaged material.



3. An emery cloth of 240 grade should be used to smooth the edges and to remove any burnt-in foreign matter.



4. Finish off by polishing the damaged spot with the fibre brushes and brush wax. It is recommended that the whole area where galling may occur is polished. Polishing will help smooth the whole of the damaged area, even in the deepest parts.

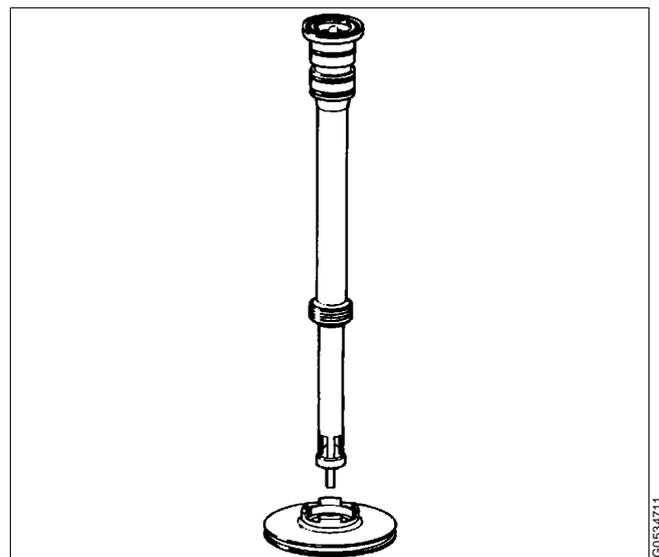


Prime the repaired area with lubricating spray Molykote 321 R. Read the correct procedure under checkpoint "5.4.17 Lock ring; priming" on page 75. Apply Alfa Laval lubricating paste or Molykote 1000 Paste to the surface after priming.

### 5.3.9 Inlet pipe and oil paring disc

Damage to the threads and the top surface of level ring may cause the paring disc to scrape against the paring chamber cover even if the height has been adjusted correctly.

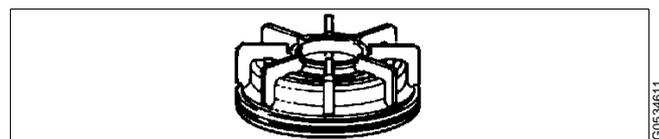
Screw the inlet pipe into the paring disc and check that the inlet pipe turns easily.



Check the threads of the inlet pipe and oil paring disc

### 5.3.10 Level ring

Remove any burrs on the surface of the level ring with a file as the paring disc rests on that surface during the height position check.



Check the level ring for burrs

### 5.3.11 Lock ring; wear and damage

Excessive wear or impact marks on threads, guide and contact surfaces of the lock ring, bowl hood and bowl body may cause hazardous galling.

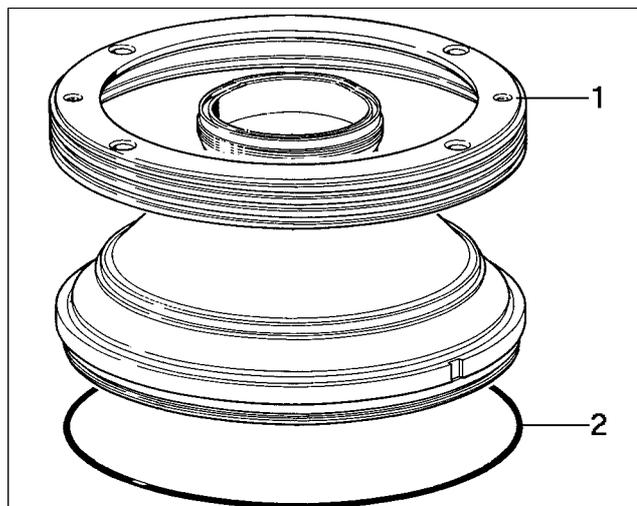
Check the thread condition by tightening the lock ring (1) after removing the disc stack and bowl hood O-ring (2) from the bowl.



**DANGER**

**Disintegration hazards**

**Wear** on large lock ring thread must not exceed safety limit. The  $\phi$ -mark on lock ring must not pass opposite  $\phi$ -mark by more than the specified distance.



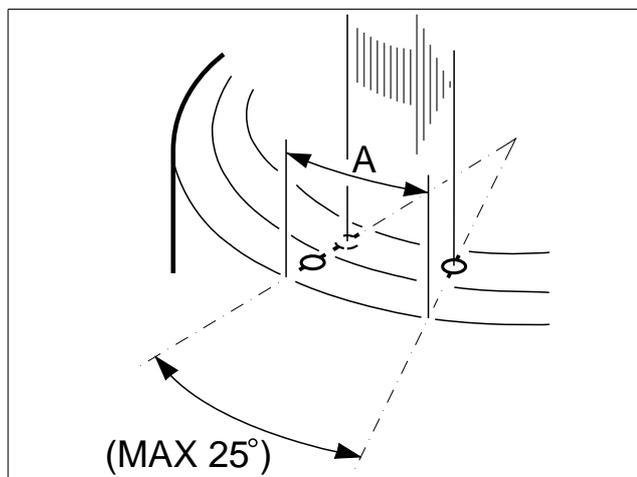
1. Lock ring
2. O-ring for the bowl hood

In a new bowl the alignment marks on the lock ring and the bowl body are exactly opposite each other.

If thread wear is observed, mark the lock ring at the new position of the alignment mark on the bowl body by punching in a new mark.

If the original  $\phi$ -mark on the lock ring passes the  $\phi$ -mark on the bowl body by more than  $25^\circ$  (which corresponds to **A=100 mm**, an Alfa Laval representative must be contacted immediately.

If the marks become illegible, an Alfa Laval representative should be contacted immediately to inspect thread wear and for determining the position of new alignment marks.



The  $\phi$ -mark on the lock ring must not pass the  $\phi$ -mark on the bowl body by more than  $25^\circ$

**Damage**

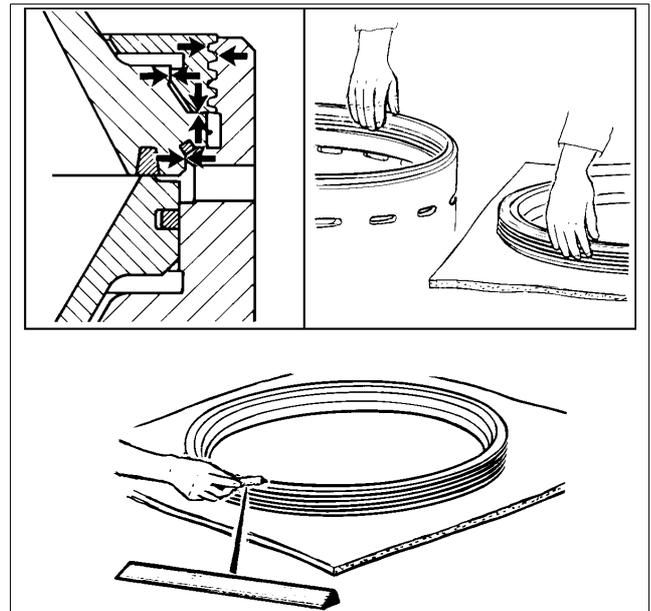
The position of the threads, contact and guide surfaces are indicated by arrows in the illustration.

Clean the threads, contact and guide surfaces with a suitable degreasing agent.

Check for burrs and protrusions caused by impact. Watch your fingers for sharp edges.

If damage is established, rectify using a whetstone or fine emery cloth (recommended grain size 240).

If the damage is considerable, use a fine single-cut file, followed by a whetstone.



Clean and check thread, contact and guide surfaces of the lock ring

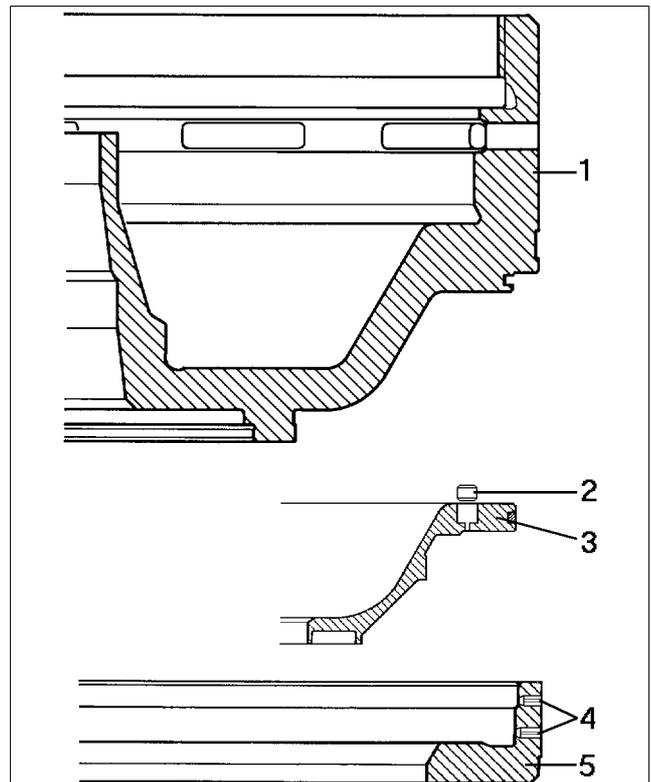
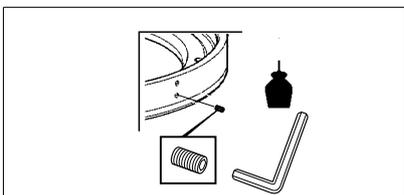
**5.3.12 Operating mechanism**

Dirt and lime deposits in the operating mechanism may cause poor discharge function or no function at all.

Clean and polish surfaces with steel wool if necessary.

**Reasons for dirt or deposits:**

- Hard or unclean operating water. Change water supply or install a water softener or a fine filter.
- Sludge has been sucked down into bowl casing and into the operating system. Check the installation and the venting system of both the sludge tank and bowl casing drain.



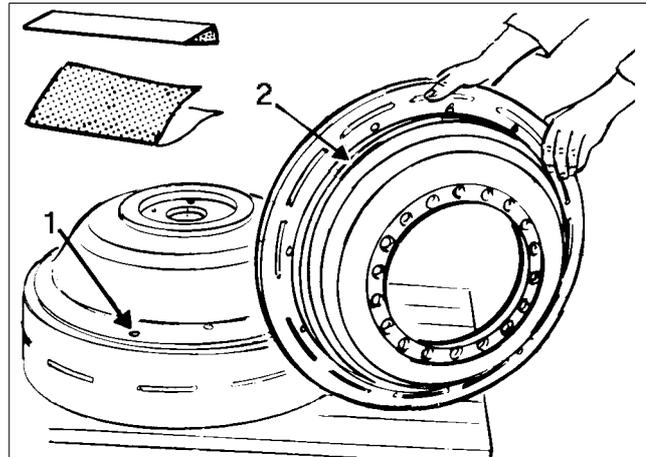
1. Bowl body
2. Valve plug
3. Operating slide
4. Nozzles
5. Dosing ring

### 5.3.13 Operating slide

Poor sealing between the valve plugs on the operating slide and bowl body may prevent complete closing of the bowl.

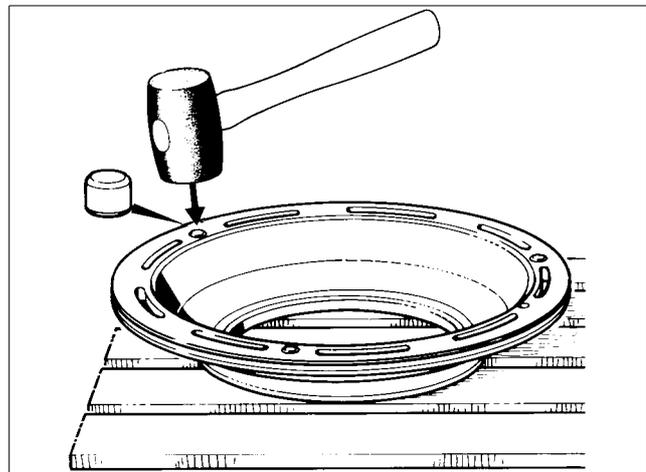
Examine the sealing surfaces (1) of the bowl body in contact with the valve plugs. Remove any marks and lime deposits with a very fine grain emery cloth.

Check the guiding surface (2) in contact with the dosing ring. Remove any marks with a whetstone (grain size 240).



1. Bowl body sealing surfaces in contact with the valve plugs
2. Operating slide guide surface in contact with the dosing ring

Remove all the valve plugs. Tap in the new plugs.  
Correct height of plugs: **13,8 mm**.



Tap in new valve plugs

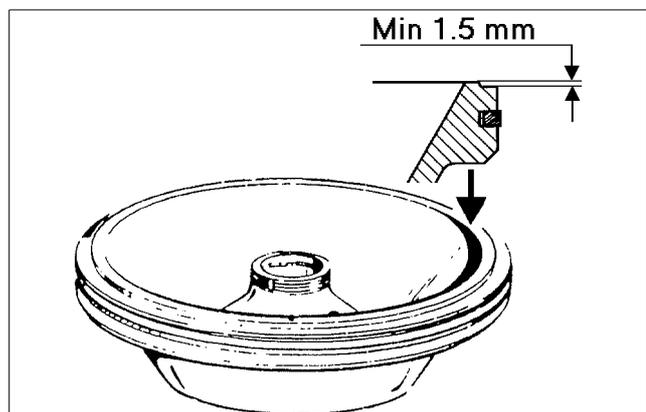
### 5.3.14 Sliding bowl bottom

Poor sealing between the bowl hood seal ring and the sealing edge of the sliding bowl bottom will cause a leakage of process liquid from the bowl

Check the sealing edge of the sliding bowl bottom. If damaged either through corrosion or erosion or other means, it can be rectified by turning in a lathe. Maximum permissible reduction of the original profile height (2,0 mm) is 0,5 mm.

#### NOTE

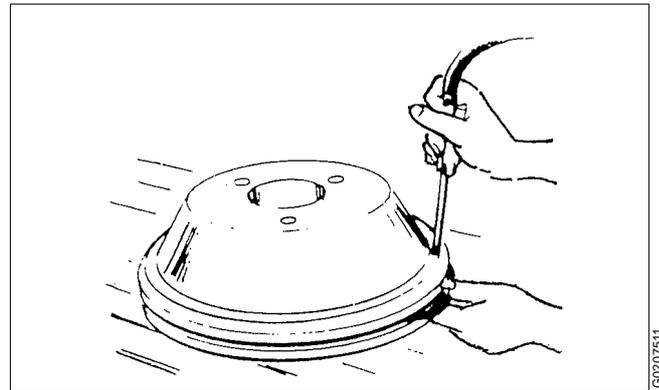
Never reduce the height outside the sealing edge to reach the minimum profile height.



Min. height of the profile on sliding bowl bottom

If the seal ring for the sliding bowl bottom is to be renewed, turn the sliding bowl bottom upside down and inject compressed air through the hole on the underside. This will press the ring outwards far enough to be gripped easily.

	<b>WARNING</b>
	<b>Risk for eye injury</b>
	Wear safety goggles.

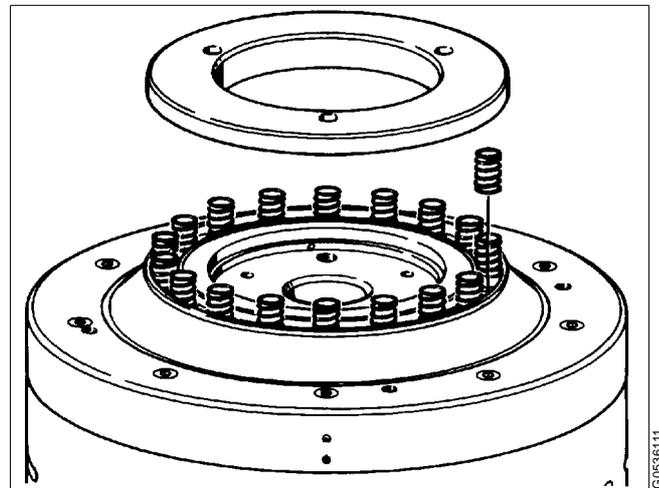


*Removal of the seal ring in sliding bowl bottom using compressed air*

### 5.3.15 Springs for operating mechanism

Defective or broken springs may prevent complete closing of the bowl.

Renew those springs which differ from other springs in regard to length or are defective in other respects.



*Check for defective or broken springs*

### 5.3.16 Worm wheel and worm; wear of teeth

Described in “5.7.1 Worm wheel and worm; wear of teeth” on page 86 in this chapter.

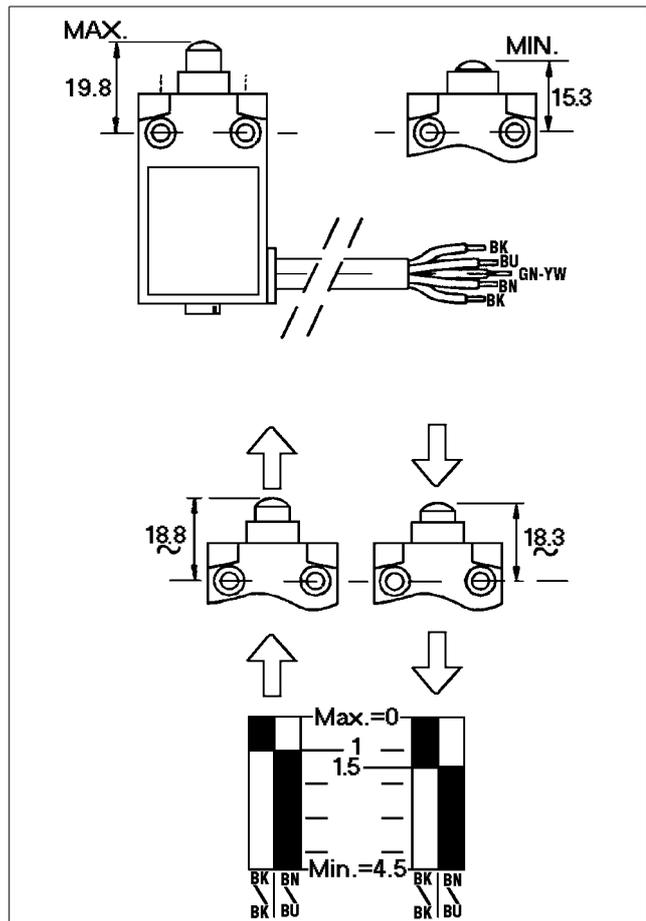
### 5.3.17 Cover interlocking switch (option)

When the button is pushed, check that the brown and blue wires are short-circuited and the two black wires are open circuit.

Check also the reverse when the button not pressed.

See the illustration for exact measurement when the button is operated.

- Contact closed
- Contact open
- BK Black
- BN Brown
- BU Blue
- GN-YW Green-Yellow



Measurements for operation range of the cover interlocking switch button

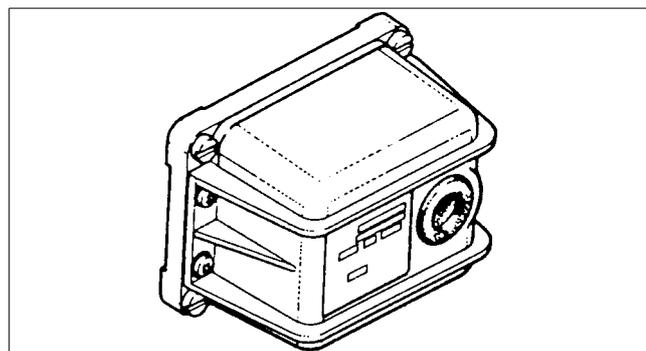
### 5.3.18 Vibration switch (option)

**NOTE**

Before carrying out the function check described below, check that a safety stop will not cause serious interruption of the operation.

Knock on the vibration switch cap a number of times within one second (the number is decided by the system parameter settings). If the switch functions correctly, the separator will perform a safety stop.

How to adjust the setpoint is described in chapter “5.8.2 Vibration switch (option)” on page 91.



Vibration switch

## 5.4 Check points at Major Service (MS)

### 5.4.1 Bowl hood seal ring

Described in “5.3.1 Bowl hood seal ring” on page 50.

### 5.4.2 Bowl spindle cone and bowl body nave

Described in “5.3.2 Bowl spindle cone and bowl body nave” on page 51.

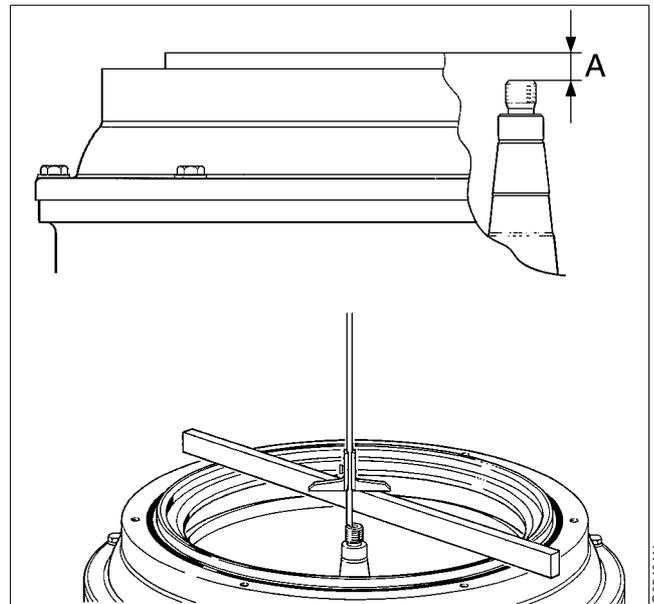
### 5.4.3 Bowl spindle; height position

If the bowl spindle has been removed, its height position relative to the frame ring must be checked.

- Place a steel rule across the frame ring. Measure the distance between the spindle top and the underside of the steel rule with a depth gauge or rule.
- The distance (A) should be  $24 \pm 1$  mm.
- The height position is adjusted by adding or removing height adjusting rings inside the bottom bearing housing.

#### NOTE

Before starting adjustment, tap the spindle top a few times with a soft hammer to ensure that the bottom bearing of the spindle is properly seated in the bottom bearing housing.



Measurement of the bowl spindle height (A)

G05-40111

### 5.4.4 Bowl spindle; radial wobble

The bowl spindle wobble should be checked if the bowl spindle has been dismantled or if rough bowl running (vibration) occurs.

#### NOTE

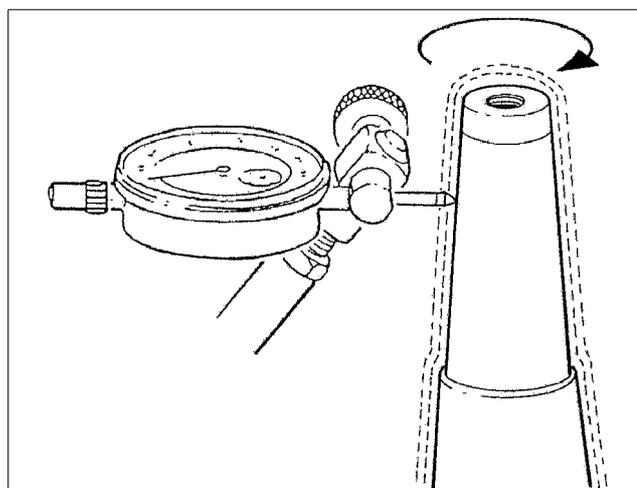
Spindle wobble will cause rough bowl running. This leads to vibration and reduces lifetime of ball bearings.

Check the wobble before mounting the bowl.

Before measuring, make sure that the buffer plugs are properly tightened.

- Fit a dial indicator in a support and fasten it to the frame.
- Remove the brake cover to get access to the coupling drum. Use the coupling drum to revolve the spindle manually.
- Measure the wobble at the top of the tapered end of the spindle. Permissible radial wobble is **maximum 0,04 mm**.
- If wobble is too large, renew all the ball bearings on the spindle.

Measure wobble after assembly. If it is still excessive, the spindle is probably damaged and must be renewed



Measurement of the radial wobble

### 5.4.5 Brake

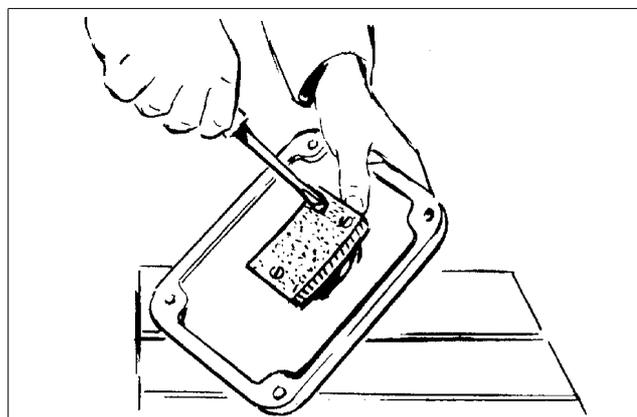
A worn or oily friction pad will lengthen the braking period.

If the friction pad is worn:

- Remove the screws and exchange the friction pad.

#### NOTE

The screws are slotted at both ends.



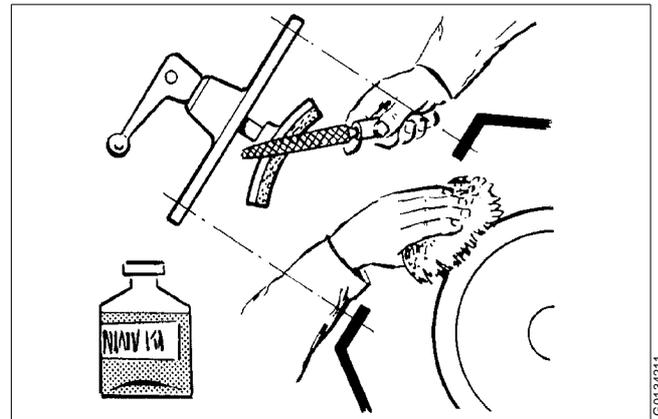
Brake lining is fastened with screws

f the friction pad is oily:

- Clean the friction pad and the coupling drum with a suitable degreasing agent.
- Roughen the friction surface of the friction pad with a coarse file.

**NOTE**

Identify the cause of oily friction pad. If oil is leaking from the gear housing, renew the sealing ring between the two parts.

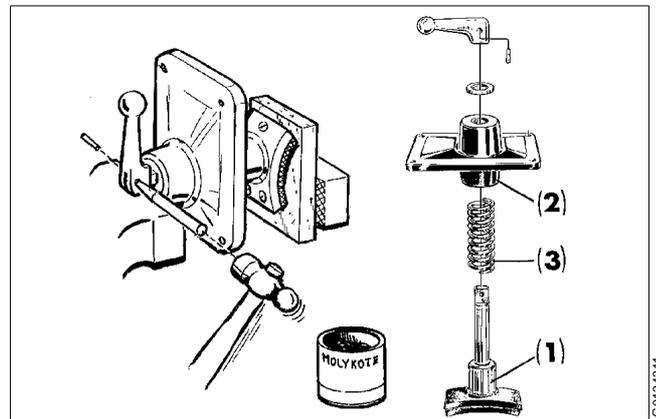


Actions when the friction pad is oily

**Checking of spring and brake shoe:**

Rust on brake parts may cause the brake to jam.

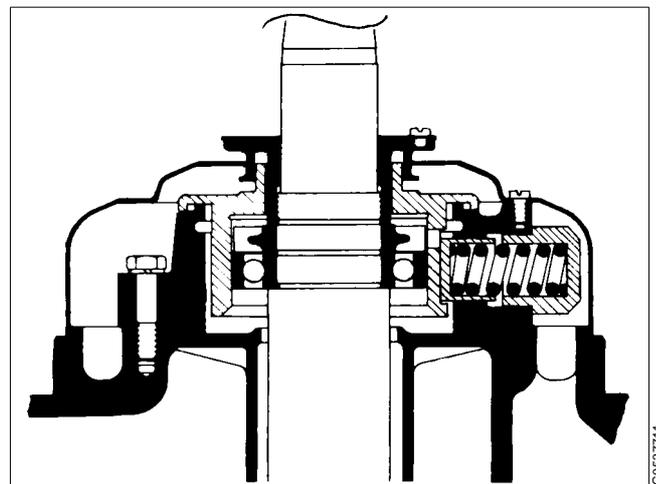
- Remove any rust from the surface (1) of the brake shoe and the corresponding guide surface in the cap (2).
- Rub in Molykote Paste on the surfaces.
- Renewplace the spring (3) if it has become weak. This is indicated by chattering of the spring when the brake is in released position.
- Oil the spring when assembling.



1. Contact surface on the brake shoe for the spring
2. Guide surface in the cap for the brake shoe
3. Spring

**5.4.6 Buffer springs and ball bearing housing**

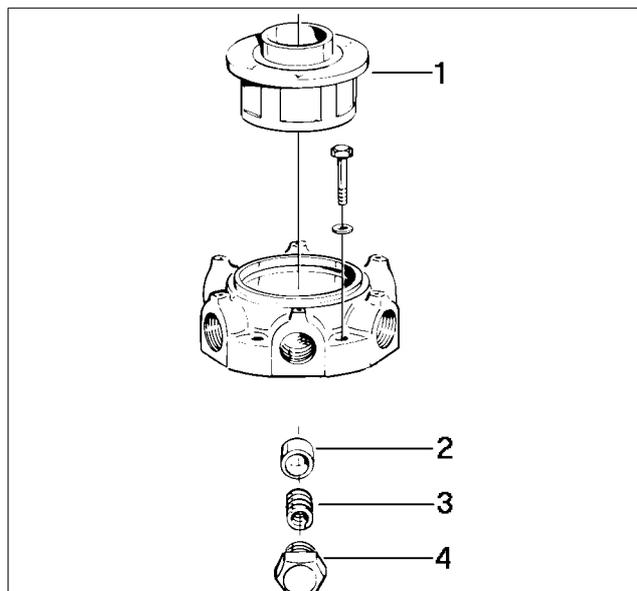
Weakened or broken buffer springs or defective contact surfaces for the buffers on the ball bearing housing may give rise to separator vibration (rough bowl running).



Sectional view of ball bearing housing

### Top bearing springs

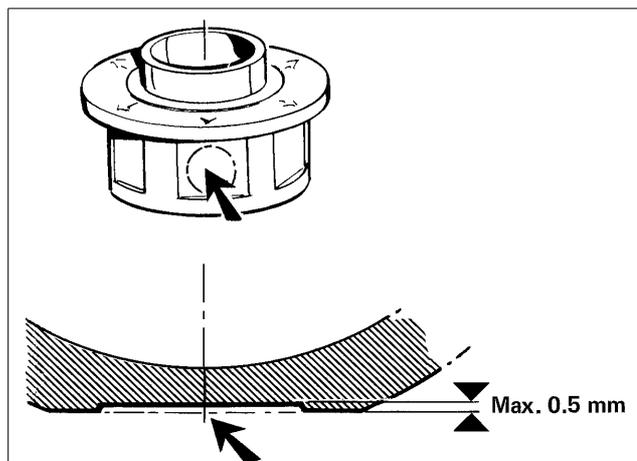
In case of spring failure, the complete set of springs should be renewed, even if only one spring is affected.



1. Ball bearing housing
2. Radial buffer
3. Buffer spring
4. Screw plug

### Ball bearing housing

Examine the contact surface for the buffers on the ball bearing housing. In case of defects (indentations deeper than **0,5 mm**), renew the housing as well as buffers and springs.



*Max. permitted indentations made by radial buffers*

### 5.4.7 Coupling friction pads

Worn or oily pads in the coupling will cause a long acceleration period.

If the separator does not attain full speed within about 10 minutes or if the bowl loses speed during operation, the friction pads of the coupling may be worn or oily.

Check the pads. If the pads are oily:

- Clean the pads and the inside of the coupling drum with a suitable degreasing agent. Roughen the friction surfaces of the pads with a coarse file.

If the pads are worn:

- Remove the screws and renew the pads.

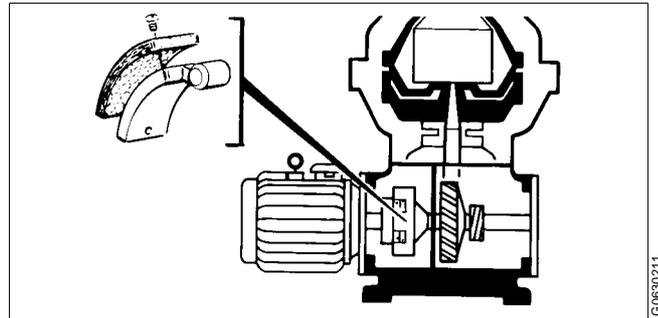
#### NOTE

The screws are slotted at both ends.

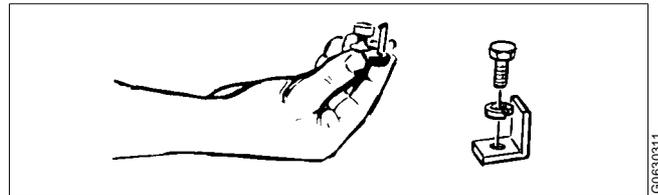
Renew all pads even if only one is worn.

How to renew friction pads without dismantling horizontal driving device:

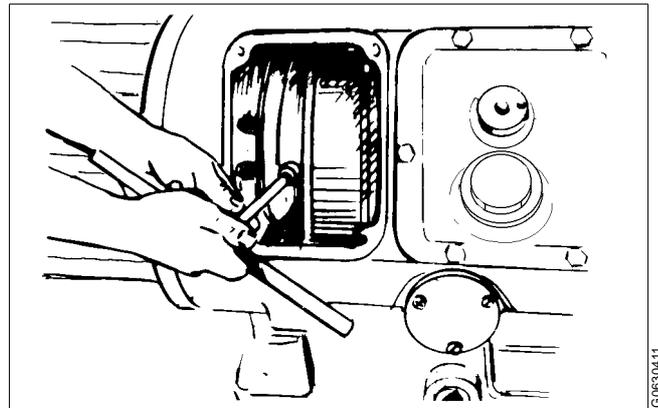
- Remove the brake cap.
- Undo the screws of the holding brackets.
- Remove the holding brackets and friction blocks.
- Remove the screws and renew the pads.



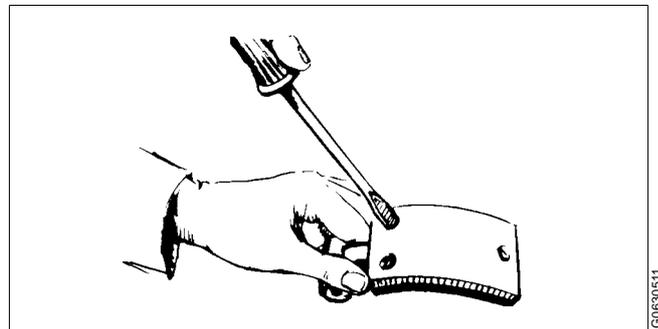
Location of coupling friction blocks



A friction block is fixed with screw, spring washer and holding bracket



Unscrew the holding bracket screws to remove the friction blocks



Three screws fix the friction pad to the friction block

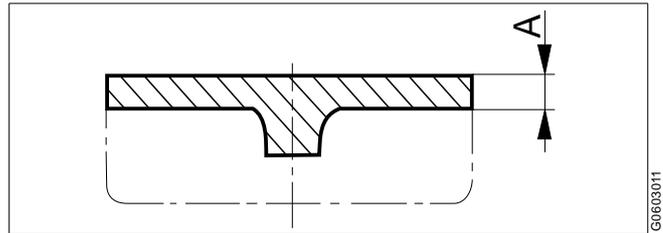
### Different friction blocks for different power supply frequencies

If fitting new friction blocks, check that the blocks are correct for the power supply frequency. The dimension A is different for 50 and 60 Hz separators.

50 Hz: A = **20 mm**

60 Hz: A = **5,5 mm**

The thickness does not include the friction pad.



*Dimension A is different for 50 and 60 Hz installations*

### 5.4.8 Corrosion

Described in “5.3.3 Corrosion” on page 51.

### 5.4.9 Cracks

Described in “5.3.4 Cracks” on page 54.

### 5.4.10 Disc stack pressure

Described in “5.3.5 Disc stack pressure” on page 55.

### 5.4.11 Dosing ring

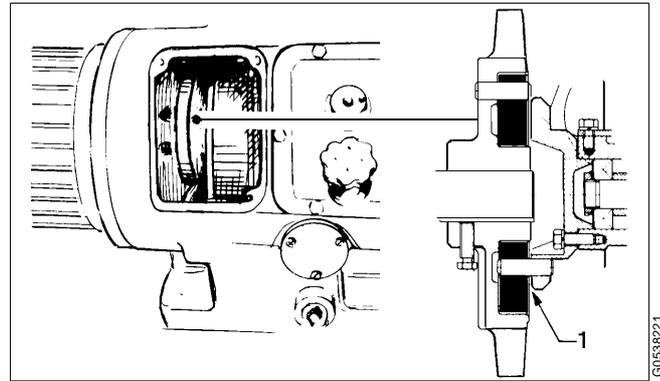
Described in “5.3.6 Dosing ring” on page 57.

### 5.4.12 Erosion

Described in “5.3.7 Erosion” on page 57.

### 5.4.13 Flexible plate in coupling

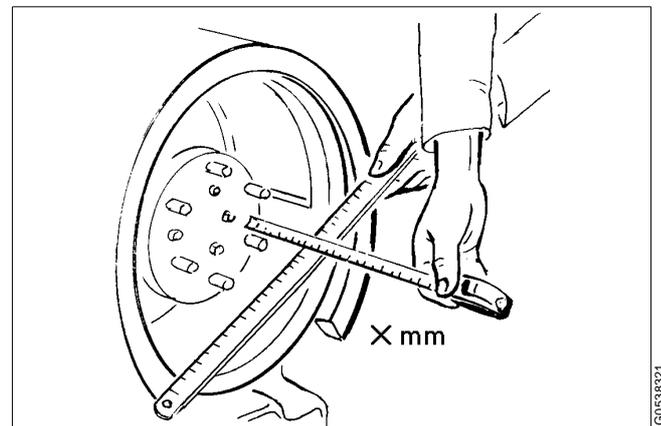
The axial play (1) of the flexible plate should be approximately 2 mm.



Location of the axial play (1) in the flexible coupling

Check the play as follows:

Measure the distance from the frame ring to the coupling disc of the separator.

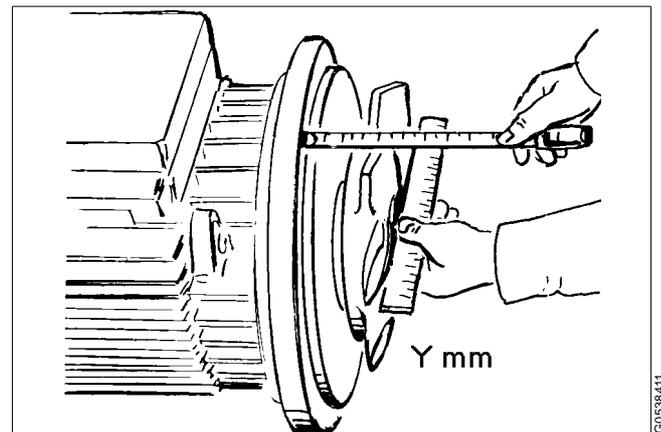


Measurement of distance for coupling in separator

Measure the distance from the motor coupling disc to the motor flange.

$X \text{ mm} - Y \text{ mm} = 2 \text{ mm}$ .

If required, adjust the position of the motor coupling disc.



Measurement of distance for coupling on motor

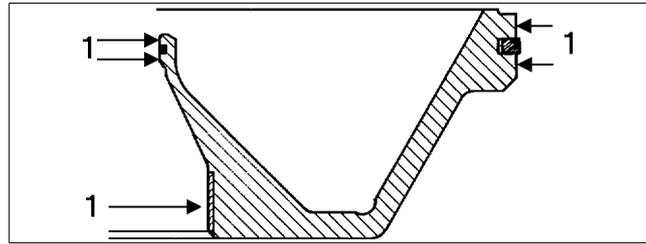
### 5.4.14 Guide surfaces

Check surfaces indicated (1) for burrs or galling. Rectify when necessary.

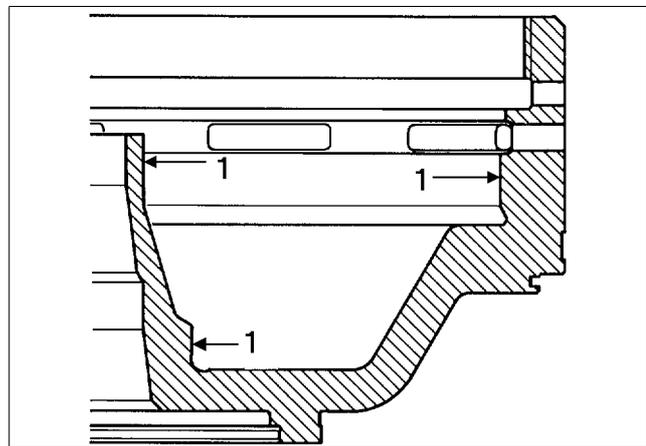
Repair of galling on guiding surfaces, see "5.3.8 Guide surfaces" on page 59.

Treat the guide surfaces with slide lacquer in the following way:

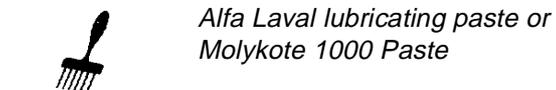
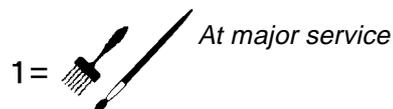
1. Mask the nave hole of the bowl body. Slide lacquer must not enter this hole.
2. Carefully degrease the contact surfaces (1) between the sliding bowl bottom and bowl body. Dry the surfaces well.
3. Apply slide lacquer Molykote D321R with a well cleaned brush. Protect the surfaces which should not be treated.
4. Air-cure the treated surfaces for 15 minutes.
5. Use a smooth fibre brush to polish to an even, homogeneous contact film.
6. Apply slide lacquer a second time.
7. Air-cure the lacquer for a further 15 minutes.
8. Polish the film to a shiny surface. The film should look like well-polished leather when properly finished.
9. Finish the treatment by lubricating the contact surfaces (A) with Alfa Laval lubricating paste or Molykote 1000 Paste. Use a well-cleaned brush. Rub it into the surface, do not leave any excess paste.
10. Lubricate the O-ring and the seal ring with silicone grease and check that they rest properly in their grooves.



Sliding bowl bottom



Bowl body



### 5.4.15 Inlet pipe and oil paring disc

Described in "5.3.9 Inlet pipe and oil paring disc" on page 61.

### 5.4.16 Level ring

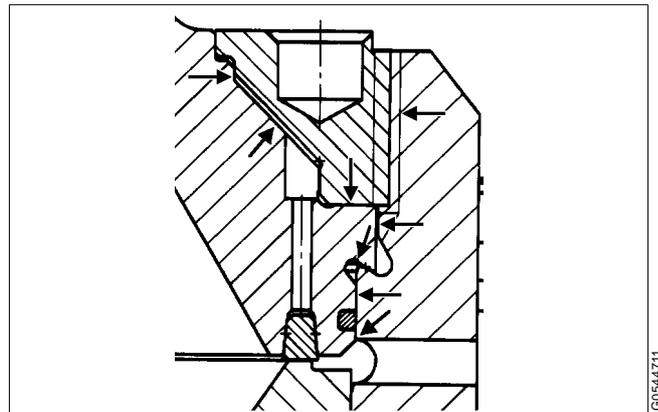
Described in section “5.3.10 Level ring” on page 61.

### 5.4.17 Lock ring; priming

The arrows indicate positions of threads, guide and contact surfaces to be primed.

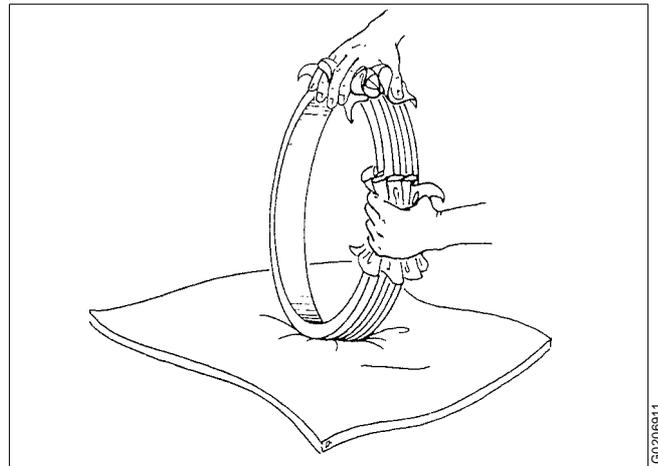
#### Recommended agents for priming procedure:

- Degreasing agent
- Lubricating spray Molykote 321 R
- Small power drill
- 2 fibre brushes

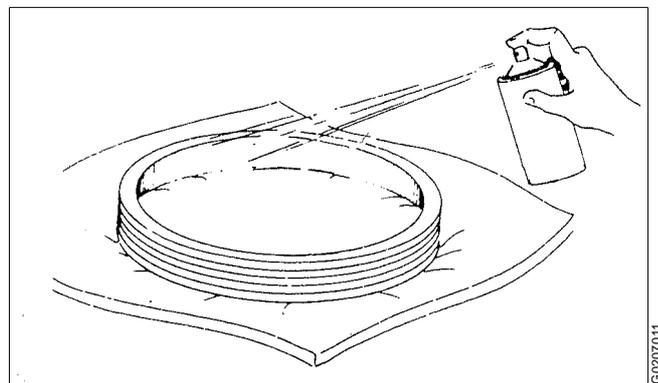


Threads, guide and contact surfaces to be primed

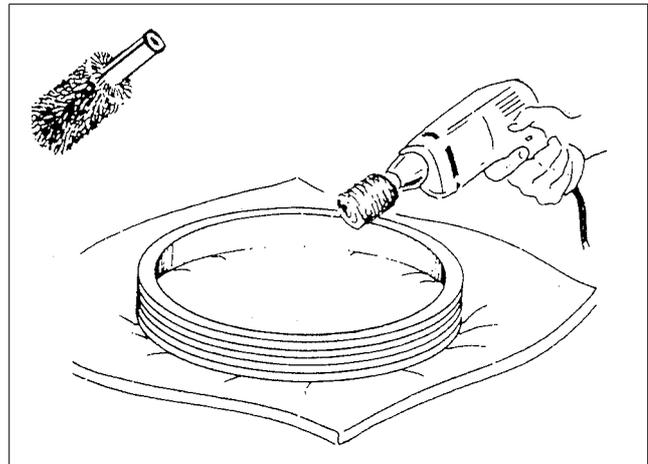
1. Clean the lock ring thoroughly with a degreasing agent and wipe it off.



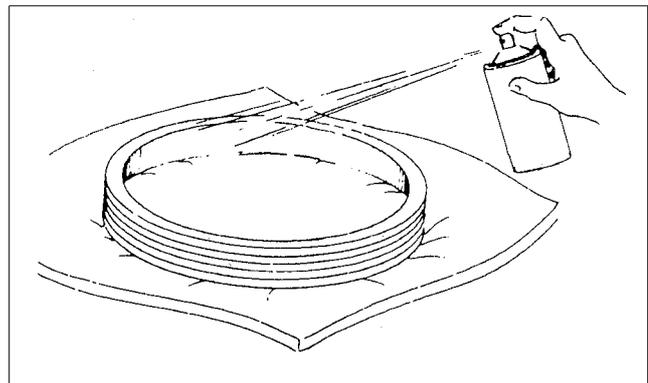
2. Spray the threads, guide and contact surfaces with slide lacquer Molykote 321 R. Let the lacquer air-cure for about 15 minutes.



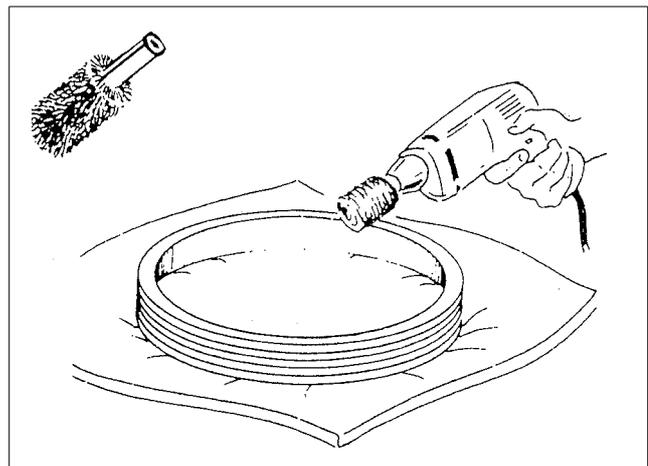
3. Use a fibre brush to polish the slide lacquer into the surface. The black spray will look like well-polished leather when properly finished.



4. Spray the lock ring a second time and let it dry for about 15 minutes.



5. Polish the slide lacquer to a black shiny surface which will now last about a year. Proceed in the same way with the threads of the bowl body and with the guide surfaces of the bowl hood and bowl body.



### 5.4.18 Lock ring; wear and damage

Described in section “5.3.11 Lock ring; wear and damage” on page 62.

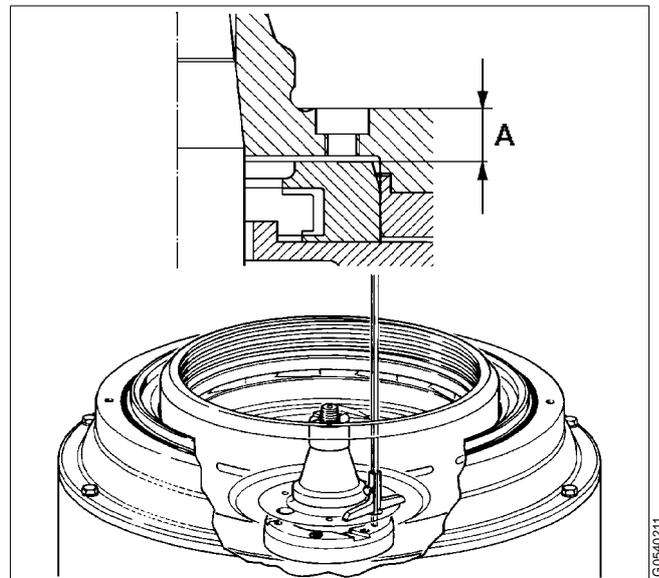
### 5.4.19 Operating mechanism

Same as described in section “5.3.12 Operating mechanism” on page 63.

### 5.4.20 Operating paring disc; height position

If the bowl spindle has been removed or the bowl has been replaced, the height position of the operating device relative to the bowl spindle top must be checked.

- Place a depth gauge at the bottom of the bowl body. Measure the distance between the surface (bottom) of the bowl body and the top surface of the distributing ring through one of the screw holes. The distance (A) should be **24,5 ±0,5 mm**.
- The height position is adjusted by adding or by removing height adjusting rings under the distributing cover.
- After adjustment rotate the spindle. If a scraping noise is heard, re-adjust.



Measurement of height position of operating paring disc

### 5.4.21 Operating slide

Described in section “5.3.13 Operating slide” on page 64.

### 5.4.22 Sliding bowl bottom

Same as described in section “5.3.14 Sliding bowl bottom” on page 64.

### 5.4.23 Springs for operating mechanism

Same as described in “5.3.15 Springs for operating mechanism” on page 65.

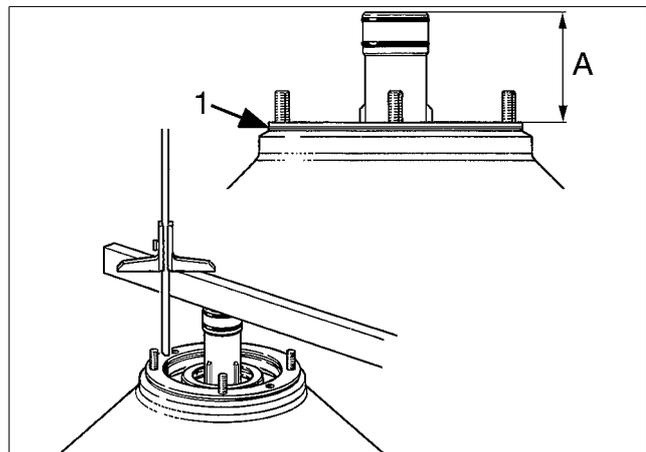
### 5.4.24 Upper paring disc; height position

The height position of the upper paring disc should be checked if the bowl spindle has been removed or the bowl has been replaced.

- Place a steel ruler across the top of the upper paring disc. Measure the distance between the top of the paring disc and the top of the frame hood with a depth gauge or a graduated ruler. The distance (A) should be **81,5 ±0,5 mm**.
- Adjust the distance by adding or removing height adjusting rings (1).

With inlet and outlet parts mounted:

- Revolve the worm wheel shaft by hand. If it turns heavily or if a scraping noise is heard, wrong height adjustment or wrong fitting of the inlet pipe may be the cause.

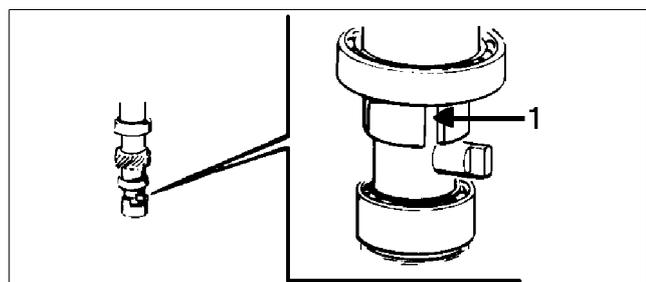


Measurement of distance A

### 5.4.25 Worm; wear of groove

Renew the worm if the wear in the groove (1) which receives the conveyor exceeds **3-4 mm**.

If renewing the worm, it is recommended to renew also the worm wheel, see “5.7.1 Worm wheel and worm; wear of teeth” on page 86.



Measurement of wear in groove (1)

### 5.4.26 Worm wheel and worm; wear of teeth

Same as described in section “5.7.1 Worm wheel and worm; wear of teeth” on page 86.

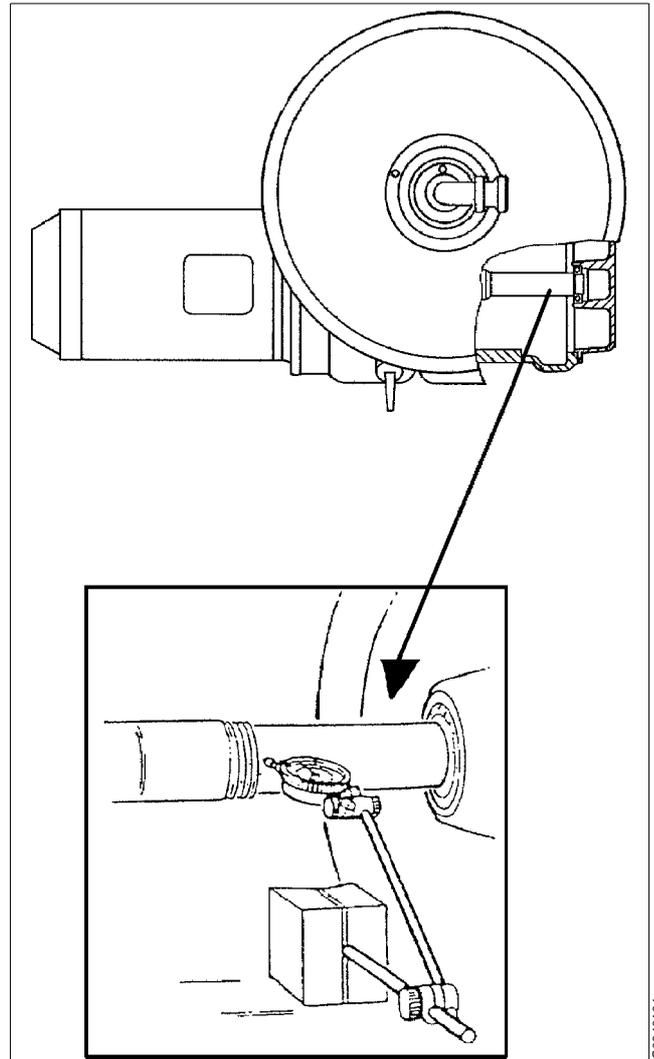
### 5.4.27 Worm wheel shaft; radial wobble

Excessive wobble on the worm wheel shaft may cause vibration and noise.

Clamp a dial indicator in a magnetic support and fasten it to the surface for the worm wheel guard. Turn the worm wheel shaft by hand.

Permissible radial wobble is **maximum 0,10 mm**.

If the wobble is greater, the worm wheel shaft must be removed from the frame for closer examination. Get in touch with your Alfa Laval representative as the worm wheel shaft may need to be renewed.



Measurement of the radial wobble

### 5.4.28 Cover interlocking switch (option)

Described in “5.3.17 Cover interlocking switch (option)” on page 66.

### 5.4.29 Vibration switch (option)

Described in “5.3.18 Vibration switch (option)” on page 66.

## 5.5 Lifting instructions

### 5.5.1 Separator

Attach three endless slings or cables to the lifting eyes (the screws must be tightened with spanner).

The circumference of each sling must be **min. 2 metres**.

#### NOTE

Machine weight without frame hood and bowl is approx. **850 kg**.

Do not lift the separator unless the frame hood and bowl have been removed.



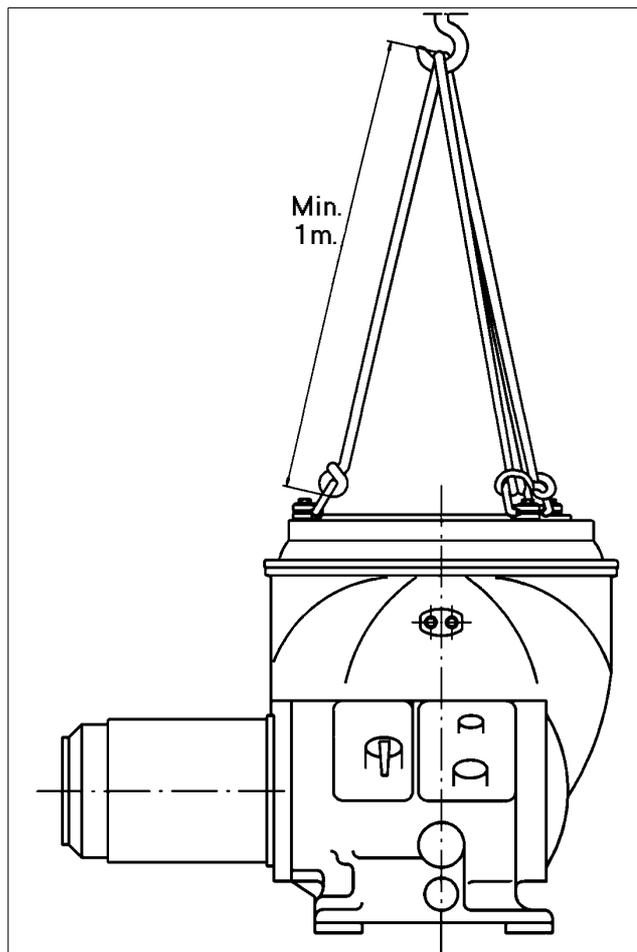
#### WARNING

##### Crush hazards

Use only the three **special lifting eyes** (M16) for lifting the machine. They are to be screwed into the special threaded holes normally covered by the frame hood.

Other holes are **not** dimensioned for lifting the machine.

A falling separator can cause accidents resulting in serious injury to persons and damage to equipment.



*Lift the separator with the frame hood and bowl removed*

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### 5.5.2 Bowl

When lifting the bowl, use the special lifting tool fastened on the bowl hood.

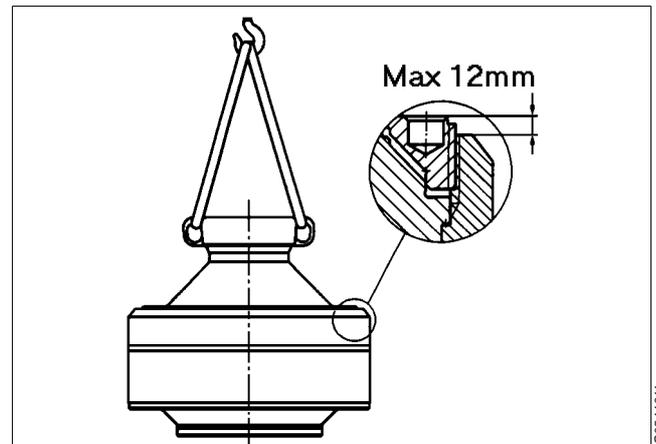
#### NOTE

Check that the lock ring is properly tightened.

The height of the lock ring above the bowl body must not exceed **12 mm**, see illustration.

Weight to lift is approx. **300 kg**.

When lifting the bowl out of the separator frame, the cap nut fixing the bowl to the bowl spindle and the screws fixing the bowl body to the operating water device must first be removed.



*The lock ring must be properly tightened when lifting the bowl*

### 5.5.3 Other parts

The frame hood and the heavy bowl parts must be lifted by means of a hoist. Position the hoist exactly above the bowl centre. Use endless lifting straps and a lifting hook with safety catch.

Special tools from the tool kit must be used for dismantling and assembly. The special tools are specified in the *Spare Parts Catalogue* and are shown as illustrations together with the dismantling/assembly instructions.

#### NOTE

When lifting parts without weight specifications, always use lifting straps with the capacity of at least **500 kg**.

## 5.6 Cleaning

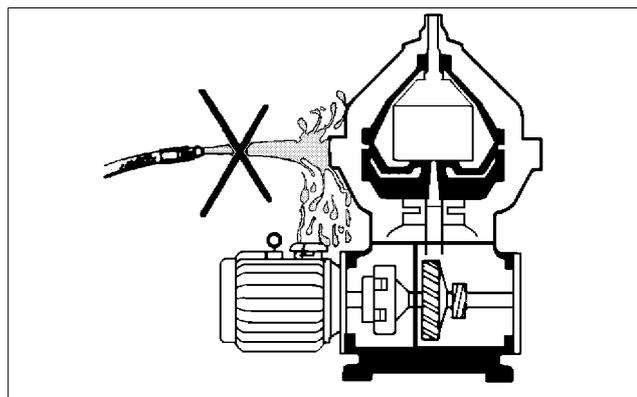
### 5.6.1 External cleaning

The external cleaning of the frame and motor should be restricted to brushing, sponging or wiping while the motor is running or is still hot.

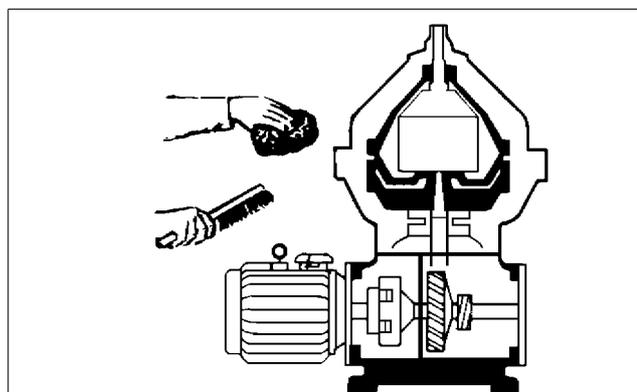
Never wash down a separator with a direct water stream. Totally enclosed motors can be damaged by direct hosing to the same extent as open motors and even more than those, because:

- Many operators believe that these motors are sealed, and normally they are not.
- A water jet played on these motors will produce an internal vacuum, which will suck the water between the metal-to-metal contact surfaces into the windings, and this water cannot escape.
- Water directed on a hot motor may cause condensation resulting in short-circuiting and internal corrosion.

Be careful even when the motor is equipped with a protecting hood. Never play a water jet on the ventilation grill of the hood.



*Never wash down a separator with a direct water stream or playing a water jet on the motor*



*Use a sponge or cloth and a brush when cleaning*

## 5.6.2 Cleaning agents

When using chemical cleaning agents, make sure you follow the general rules and suppliers' recommendations regarding ventilation, protection of personnel, etc.

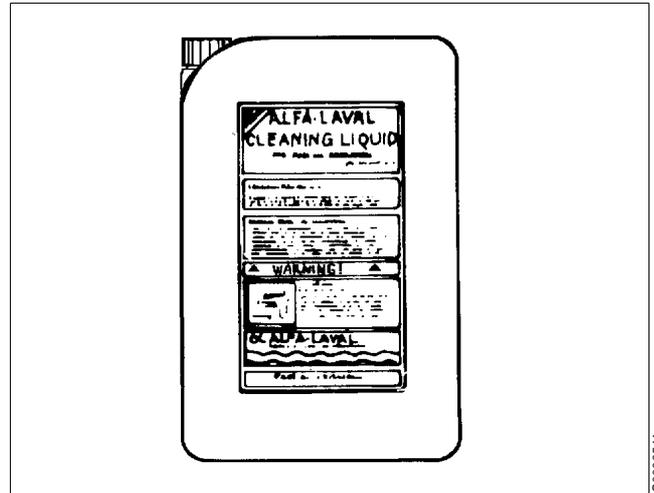
### For separator bowl, inlet and outlet

A chemical cleaning agent must dissolve the deposits quickly without attacking the material of the separator parts.

- **Fuel oil** sludge mainly consists of complex organic substances such as asphaltenes. The most important property of a cleaning liquid for the removal of fuel oil sludge is the ability to dissolve these asphaltenes.

**Alfa Laval cleaning liquid for fuel oil separators** has been developed for this purpose. The liquid is water soluble, non-flammable and does not cause corrosion of brass and steel. It is also gentle to rubber and nylon gaskets in the separator bowl.

Before use, dilute the liquid with water to a concentration of 3-5%. Recommended cleaning temperature is 50-70 °C.



*Alfa Laval cleaning liquid for lube and fuel oil separators*



### CAUTION

#### Skin irritation hazard

Read the instructions on the label of the plastic container before using the cleaning liquid.

Always wear safety goggles, gloves and protective clothing as the liquid is alkaline and dangerous to skin and eyes.

### For operating mechanism

Use 10% acetic acid solution to dissolve lime deposits. The acid should be heated to 80 °C.

### For parts of the driving devices

Use white spirit, cleaning-grade kerosene or diesel oil.

### Oiling (protect surfaces against corrosion)

Protect cleaned carbon steel parts against corrosion by oiling. Separator parts that are not assembled after cleaning must be wiped and coated with a thin layer of clean oil and protected from dust and dirt.

### 5.6.3 Cleaning of bowl discs

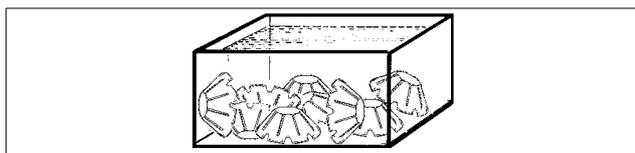
Handle the bowl discs carefully so as to avoid damage to the surfaces during cleaning.

#### NOTE

Mechanical cleaning is likely to scratch the disc surfaces causing deposits to form quicker and adhere more firmly.

A gentle chemical cleaning is therefore preferable to mechanical cleaning.

1. Remove the bowl discs from the distributor and lay them down, **one by one**, in the cleaning agent.
2. Let the discs remain in the cleaning agent until the deposits have been dissolved. This will normally take between two and four hours.
3. Finally clean the discs with a **soft** brush.



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*Put the discs one by one into the cleaning agent*

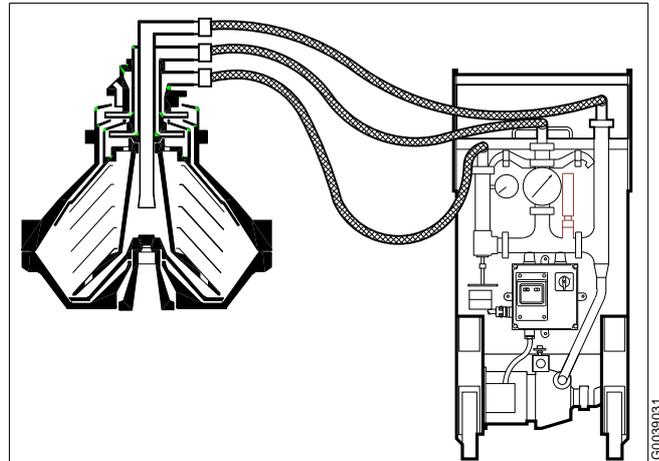


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*Clean the discs with a soft brush*

### 5.6.4 CIP-system

Alfa Laval has developed a CIP (Cleaning-In-Place) system specifically designed for cleaning the bowl and without the need of dismantling.



*CIP unit connected to separator*

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## 5.7 When changing oil

### 5.7.1 Worm wheel and worm; wear of teeth

#### Check at each oil change.

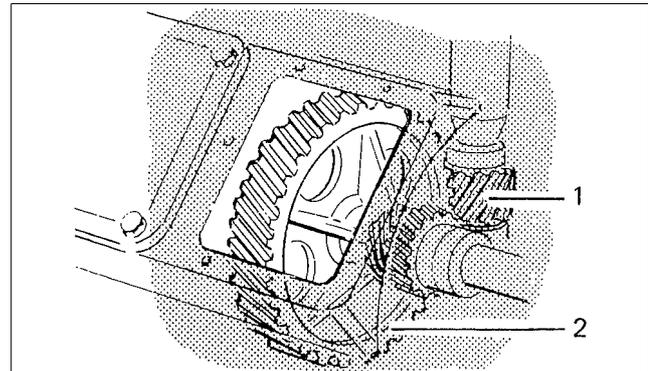
Check the teeth of both the worm wheel and worm for wear.

See the “Tooth appearance examples” on page 88. Examine the contact surfaces and compare the tooth profiles. The gear may operate satisfactorily even when worn to some degree.

- Replace both worm wheel and worm at the same time, even if only one of them is worn.
- To avoid damaging the teeth when lifting the bowl spindle: push the worm wheel to one side first.

Position the spindle in correct place before fitting the worm wheel.

When replacing the gear, always make sure that the new worm wheel and worm have the same number of teeth as the old ones. See chapter “8.1 Technical data” on page 175 for correct number of teeth.



1 Worm  
2 Worm wheel

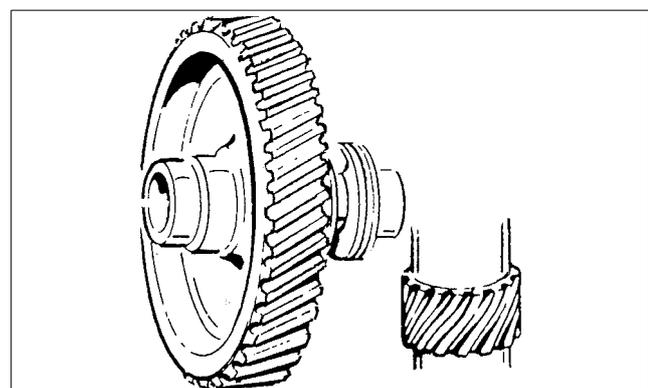
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**DANGER**

**Disintegration hazards**

Check that gear ratio is correct for power frequency used. If incorrect, subsequent overspeed may result in a serious breakdown.



Check the gear ratio (number of teeth) when replacing the gear

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**NOTE**

Presence of metal chips in the oil bath is an indication that the gear is wearing abnormally.

**Important!**

When using mineral-type oil in the worm gear housing, the presence of black deposits on the spindle parts is an indication that the oil base has deteriorated seriously or that some of the oil additives have precipitated. If pitting is found on the worm gear, the cause could be that the additives are not suitable for this purpose.

In all these cases it is imperative to change to a high-temperature oil.

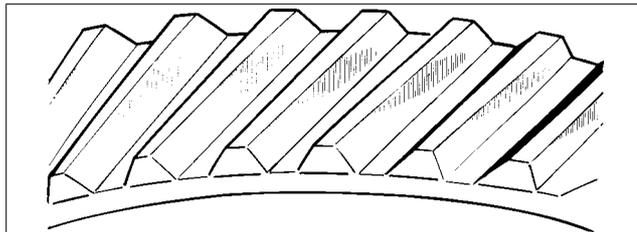
For further information, see chapter “8.5 Lubricants” on page 186.

## Tooth appearance examples

### Satisfactory teeth:

Uniform wear of contact surfaces. Surfaces are smooth.

Good contact surfaces will form on the teeth when the gear is subjected to only moderate load during its running-in period.

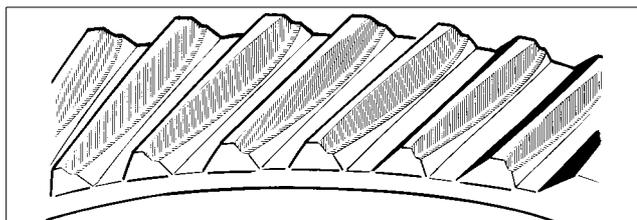


*Satisfactory teeth*

### Worn teeth:

Permissible wear is as a rule 1/3 of the thickness of the upper part of a tooth, provided that

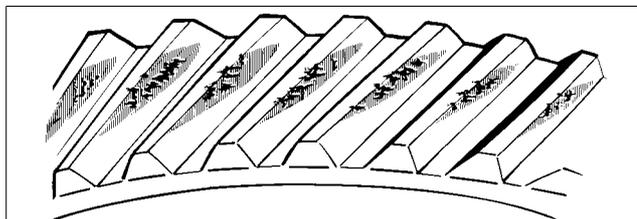
- the wear is uniform over the whole of the flank of a tooth
- and all teeth are worn in the same way.



*Worn teeth*

### Spalling:

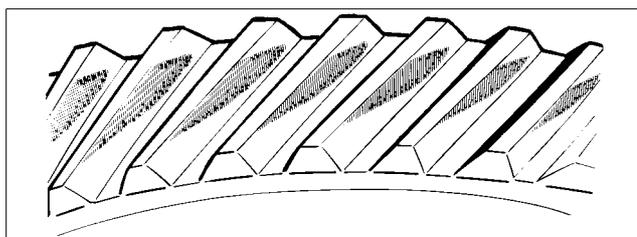
Small bits of the teeth have broken off, so-called spalling. This is generally caused by excessive load or improper lubrication. Damage of this type may not necessitate immediate replacement, but careful checking at short intervals is of imperative importance.



*Spalling*

### Pitting:

Small cavities in the teeth, so-called pitting, can occur through excessive load or improper lubrication. Damage of this type need not necessitate immediate replacement, but careful check at short intervals is of imperative importance.

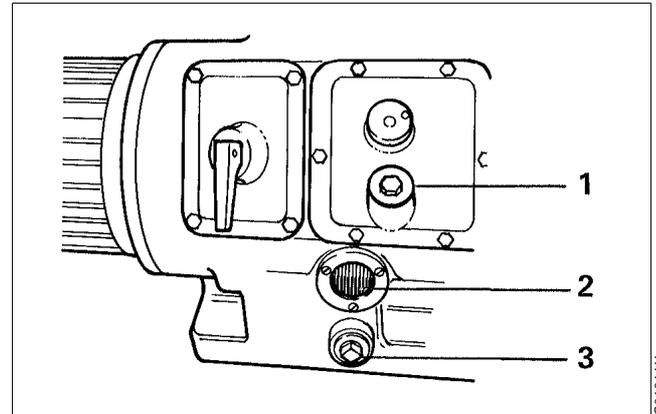


*Pitting*

## 5.7.2 Oil change procedure

### NOTE

Before adding or renewing lubricating oil in the worm gear housing, the information concerning different oil groups, handling of oils, oil change intervals etc. given in chapter "8.5 Lubricants" on page 186 must be well known.



1. Oil filling plug
2. Sight glass
3. Oil drain plug

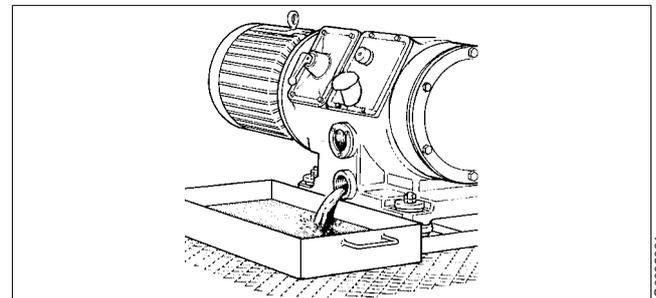
1. Place a collecting tray under the drain hole, remove the drain plug and drain off the oil.



### CAUTION

#### Burn hazards

Lubricating oil and various machine surfaces can be sufficiently hot to cause burns.



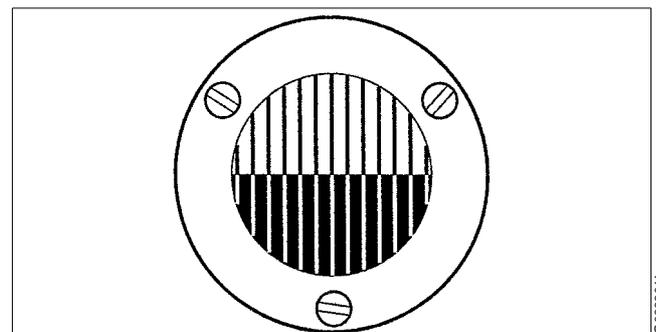
*Burn hazards: The drained oil may be hot*

2. Fill new oil in the worm gear housing. The oil level should be exactly in the middle of the sight glass:  
Oil volume: approx. **12 litres**.  
For oil brands see "8.5.3 Recommended oil brands" on page 189.

### NOTE

During operation the oil level must be slightly below the middle of the sight glass.

If the oil level is too high, the life of the rolling bearings will be reduced due to high temperature.



*The oil level must not be above the middle of the sight glass*

## 5.8 Vibration

### 5.8.1 Vibration analysis

Excessive vibration or noise indicates that something is incorrect. Stop the separator and identify the cause.

Use vibration analysis instrument to periodically check and record the level of vibration. See the illustration where to take measurements.

#### NOTE

The level of vibration should not exceed **11,2 mm/s** at full speed.

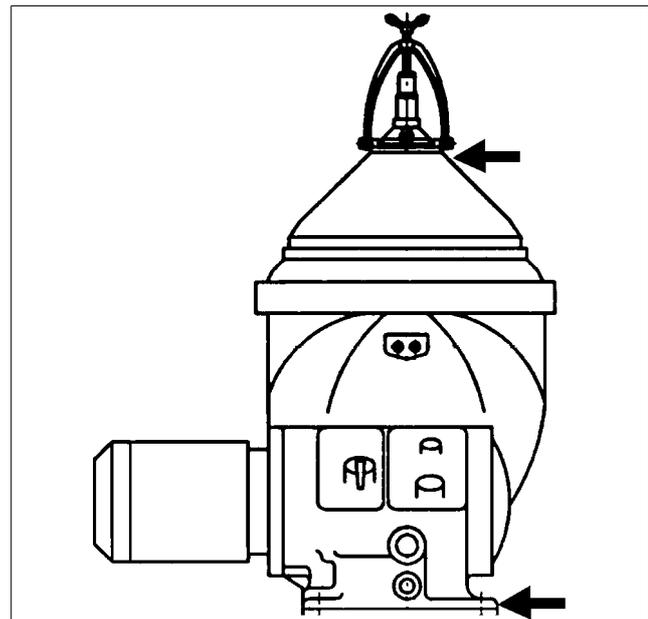


#### DANGER

##### Disintegration hazards

If excessive vibration occurs, **stop** separator and **keep bowl filled** with liquid during rundown.

The cause of the vibration must be identified and corrected before the separator is restarted. Excessive vibration can be due to incorrect assembly or poor cleaning of the bowl.



Measuring points for vibration analysis

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## 5.8.2 Vibration switch (option)

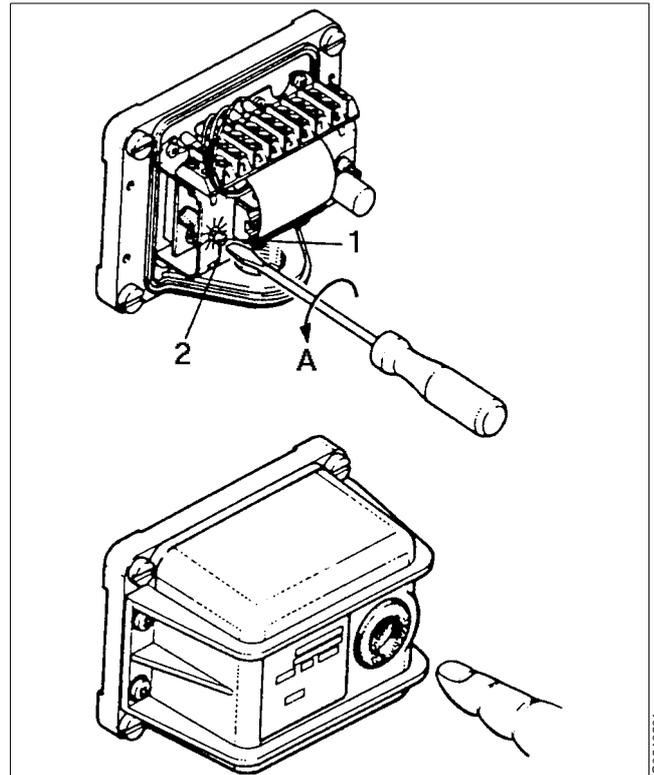
### Adjustment of setpoint

The vibration switch is adjusted with the separator in operation. The cover must be removed to gain access to the setpoint adjusting screw (1).

1. Back-off the setpoint adjusting screw counter-clockwise (A) two or three turns. Press the reset button. If the armature does not remain in the reset position, turn the adjusting screw another turn or two until the armature stays in position when the reset button is pressed.
2. Now turn the adjusting screw slowly clockwise until the armature rocks. Mark this position with a line immediately in front-of the adjusting screw pointer (2).
3. Back-off the adjusting screw counter-clockwise a three-quarter turn. Press the reset button. If the armature now rocks, turn the adjusting screw counter-clockwise another quarter turn and so on until the armature remains in the reset position.
4. Refit the cap and fasten with the screws.

### NOTE

Further adjustment may become necessary if alarm occurs due to vibration from surrounding equipment.



#### Setpoint adjustment

1. Adjusting screw
2. Pointer
- A. Direction of increased set point (admit higher vibration)

## 5.9 Common maintenance directions

### 5.9.1 Ball and roller bearings

#### Special-design bearings for the bowl spindle

The bearings used for the bowl spindle are specified to withstand the speed, vibration, temperature and load characteristics of high-speed separators.

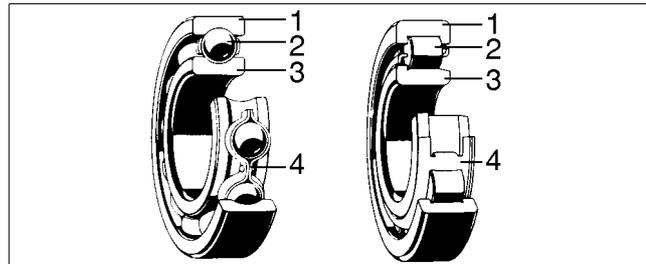
Only Alfa Laval genuine spare parts should be used.

A bearing appears equivalent to the genuine may differ considerably in various respects: inside clearances, design and tolerances of the cage and races as well as material and heat treatment.

#### NOTE

Using an incorrect bearing can cause a serious breakdown with damage to equipment as a result.

Do not re-fit a used bearing. Always replace it with a new.



1. Outer race
2. Ball/roller
3. Inner race
4. Cage

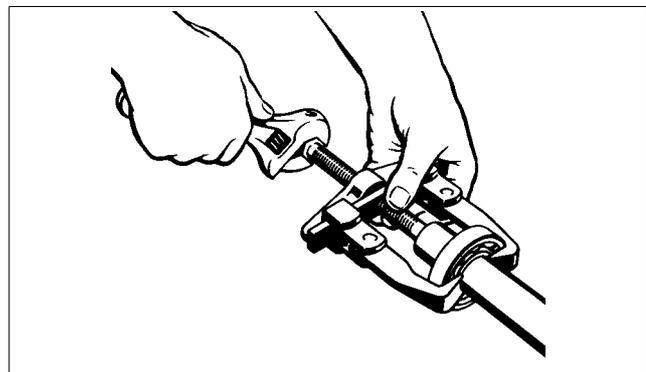
#### Dismantling

For bearings where no driving-off sleeve is included in the tool kit, remove the bearing from its seat by using a puller. If possible, let the puller engage the inner ring, then remove the bearing with a steady force until the bearing bore completely clears the entire length of the cylindrical seat.

The puller should be accurately centred during dismantling; otherwise, it is easy to damage the seating.

#### NOTE

Do not strike with a hammer directly on the bearing.



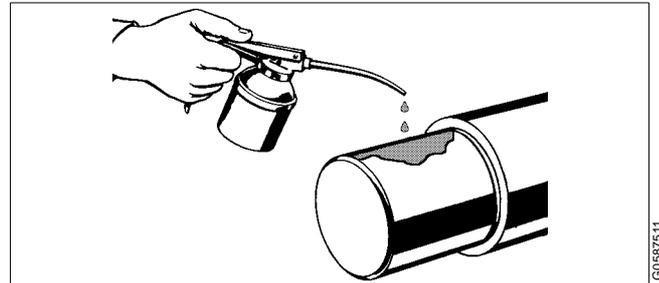
For bearings where no driving-off sleeve is included in the tool kit, use a puller when removing bearings

### Cleaning and inspection

Check shaft (spindle) end and/or bearing seat in the housing for damage indicating that the bearing has rotated on the shaft (spindle) and/or in the housing respectively. Replace the damaged part(s), if the faults cannot be remedied by polishing.

### Assembly

- Leave new bearings in original wrapping until ready to fit. The anti-rust agent protecting a new bearing should not be removed before use.
- Use the greatest cleanliness when handling the bearings.
- To facilitate assembly and also reduce the risk of damage, first clean and then lightly oil the bearing seating on shaft (spindle) or alternatively in housing, with a thin oil.



*Clean and oil the bearing seating before assembly*

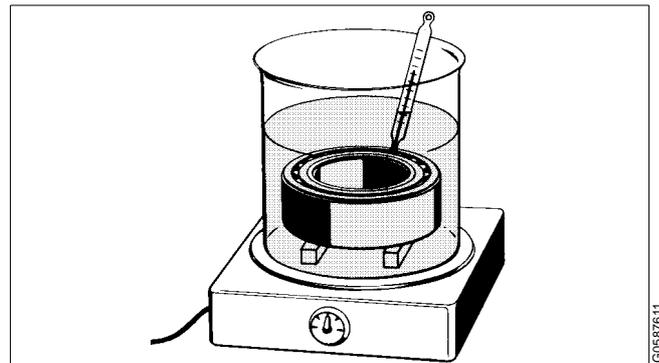
- When assembling ball bearings, the bearings must be heated in oil to **max. 125 °C**.

### NOTE

Heat the bearing in a clean container.

Use only clean oil with a flash point above 250 °C.

The bearing must be well covered by the oil and not be in direct contact with the sides or the bottom of the container. Place the bearing on some kind of support or suspended in the oil bath.

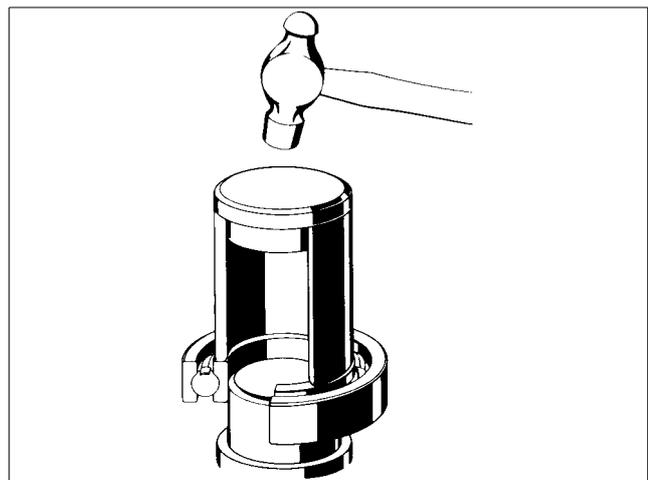


*The bearing must not be in direct contact with the container*

**WARNING****Burn hazards**

Use protective gloves when handling the heated bearings.

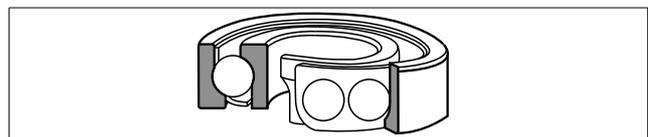
- There are several basic rules for assembling cylindrical bore bearings:
  - Never directly strike a bearing's rings, cage or rolling elements while assembling. A ring may crack or metal fragments break off.
  - Never apply pressure to one ring in order to assemble the other.
  - Use an ordinary hammer. Hammers with soft metal heads are unsuitable as fragments of the metal may break off and enter the bearing.
  - Make sure the bearing is assembled at a right angle to the shaft (spindle).
- If necessary use a driving-on sleeve that abuts the ring which is to be assembled with an interference fit, otherwise there is a risk that the rolling elements and raceways may be damaged and premature failure may follow.



Use a driving-on sleeve for bearings that are not heated

**Angular contact ball bearings**

Always fit single-row angular contact ball bearings with the wide shoulder of the inner race facing the axial load (upwards on a bowl spindle).



The wide shoulder of the inner race must face the axial load

## 5.9.2 Before shutdowns

Before the separator is shut-down for a period of time, the following must be carried out:

- Remove the bowl, according to instructions in chapter “6 Dismantling/Assembly” on page 97.

### NOTE

The bowl must not be left on the spindle during standstill for more than one week.

Vibration in foundations can be transmitted to the bowl and produce one-sided loading of the bearings. The resultant indentations in the ball bearing races can cause premature bearing failure.

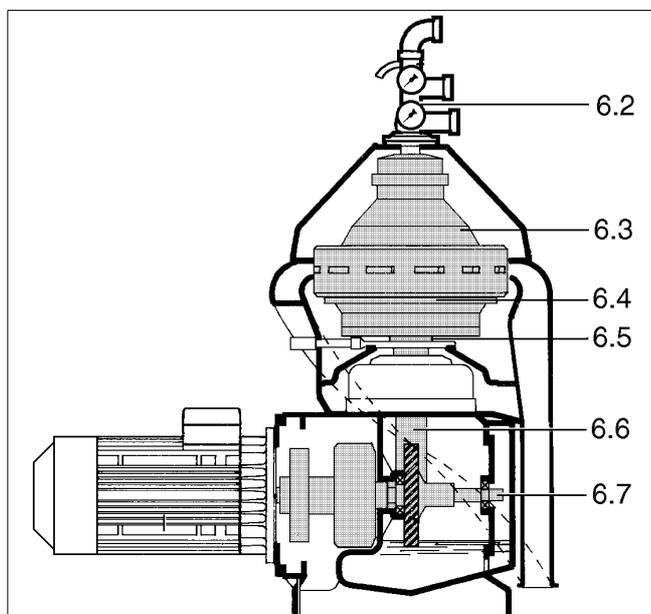
- Protect cleaned carbon steel parts against corrosion by oiling. Separator parts that are not assembled after cleaning must be wiped and protected against dust and dirt.
- If the separator has been shut-down for more than 3 months but less than 12 months, an Intermediate Service (IS) has to be made. If the shut-down period has been longer than 12 months, a Major Service (MS) should be carried out.



# 6 Dismantling/Assembly

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## 6.1 Introduction

### 6.1.1 General directions

The separator must be dismantled regularly for cleaning and inspection.

The recommended intervals are stated in chapter "5.1.2 Maintenance intervals" on page 39.

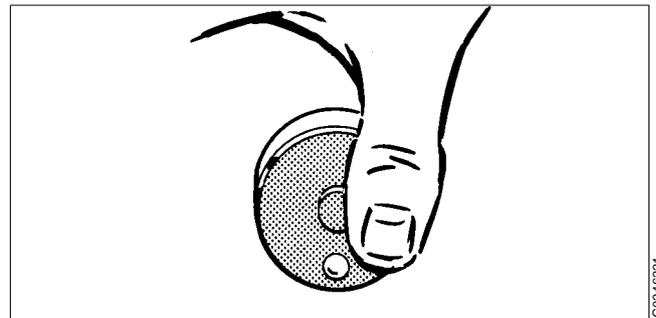


**DANGER**

**Entrapment hazard**

Make sure that rotating parts have come to a **complete standstill** before starting **any** dismantling work.

The revolution counter and the motor fan indicate if separator parts are rotating or not.



*The revolution counter indicates if the separator still is rotating*

The frame hood and heavy bowl parts must be lifted by a hoist. Position the hoist directly above the bowl centre. Use an endless sling and a lifting hook with catch.

These parts must be handled carefully.

Do not place parts directly on the floor, but on a clean rubber mat, fibreboard or a suitable pallet.

**NOTE**

**Never interchange bowl parts**

To prevent mixing of parts, e.g. in an installation comprising several machines of the same type, the major bowl parts carry the machine manufacturing number or its last three digits.

## 6.1.2 References to check points

In the text you will find references to the Check Point instructions in chapter 5. The references appear in the text as in the following example:

### ✓ Check point

“5.4.10 Disc stack pressure” on page 72.

In this example, look up check point Disc stack pressure in chapter 5 for further instructions.

## 6.1.3 Tools

Special tools from the tool box must be used for dismantling and assembly. The special tools are specified in the *Spare Parts Catalogue* and are shown as illustrations together with the dismantling/assembly instructions.

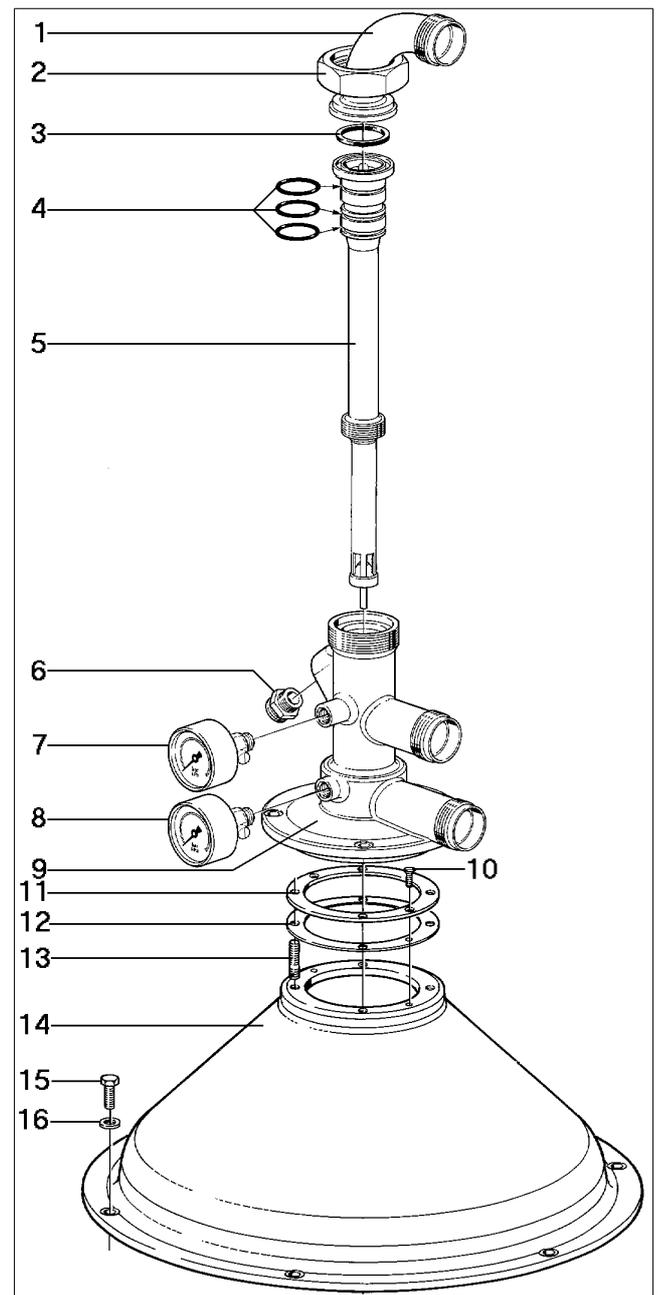
### **NOTE**

When lifting parts without weight specifications, always use lifting straps with the capacity of at least 500 kg.

## 6.2 Inlet/outlet, frame hood (IS)

### 6.2.1 Exploded view

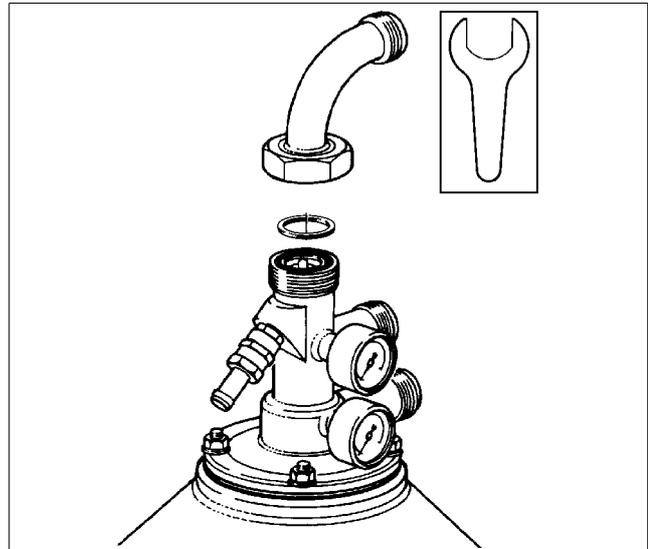
1. Inlet bend
2. Coupling nut
3. Rectangular ring
4. O-ring
5. Inlet pipe
6. Hexagon nipple
7. Pressure gauge with ball valve
8. Pressure gauge with ball valve
9. Connecting housing
10. Screw
11. Protecting washer
12. Height adjusting ring(s)
13. Stud bolt
14. Hood
15. Screw
16. Washer



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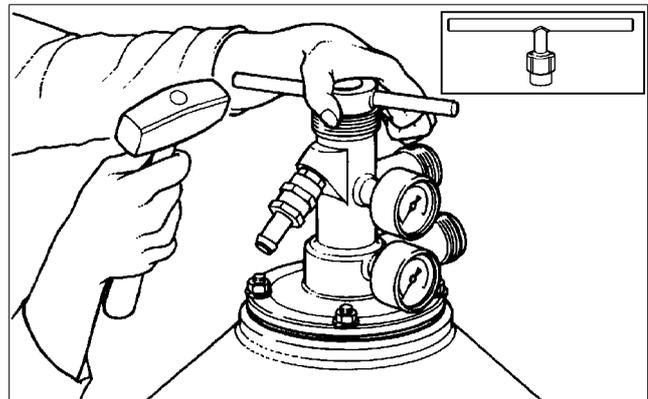
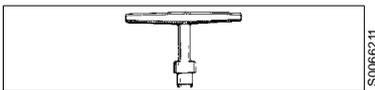
### 6.2.2 Dismantling

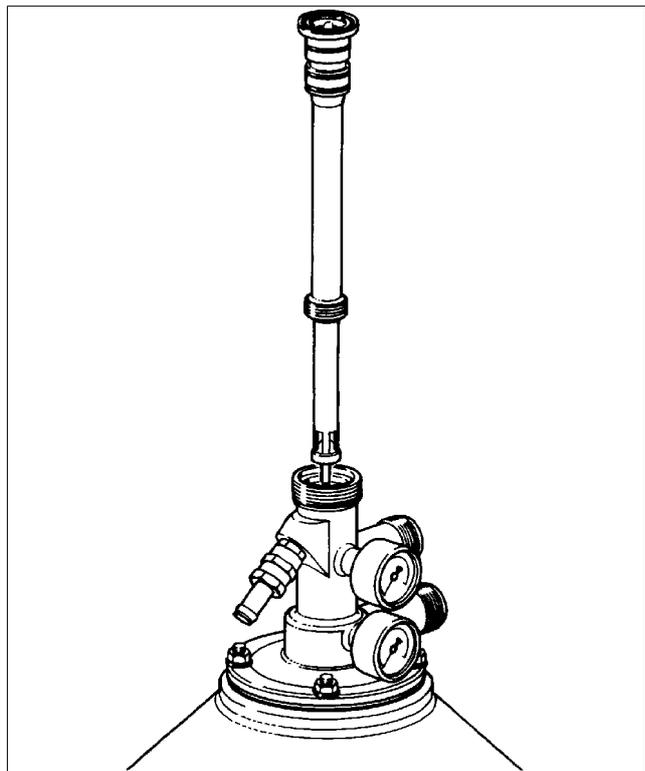
1. Unscrew the nuts for the oil inlet bend, outlet hoses and water inlet hose.



2. Unscrew and remove the inlet pipe using the pin spanner.

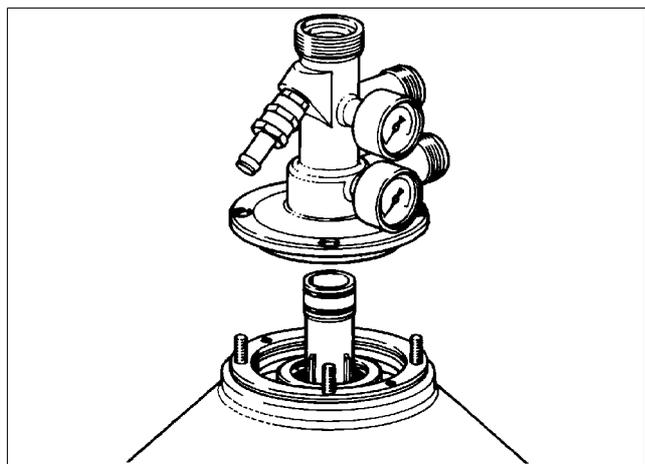
**Left-hand thread!**





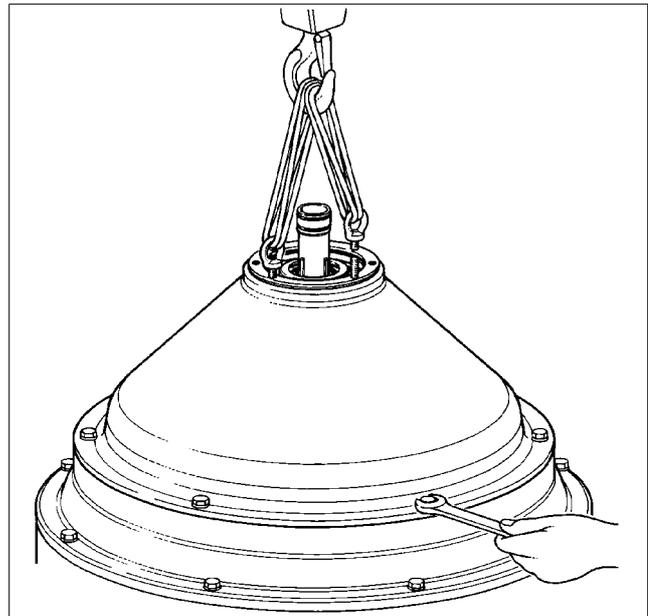
G0530811

3. Unscrew the four nuts for the connection housing and remove it.



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4. Remove the six screws holding the frame hood at lift it off.



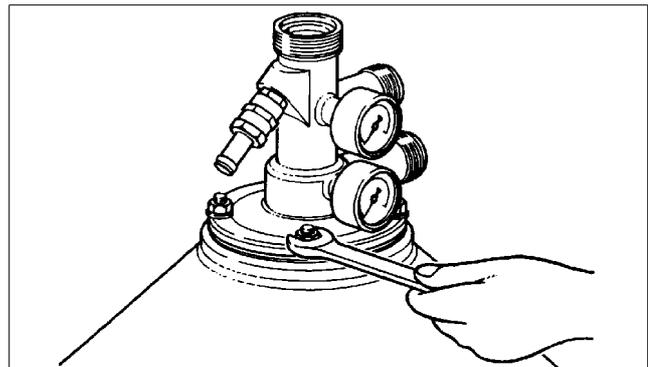
### 6.2.3 Assembly

1. Put the frame hood in place and tighten it with the six screws.

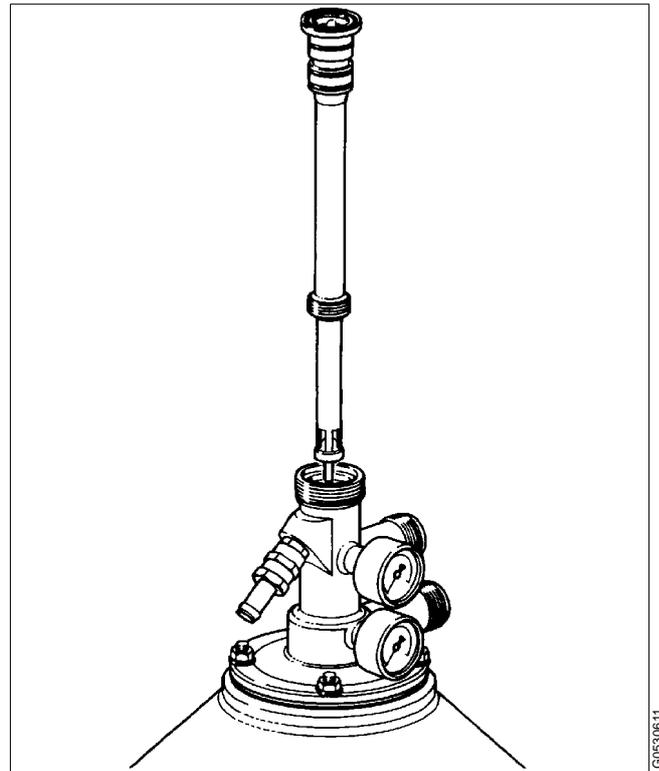
✓ **Check point**

“5.4.19 Operating mechanism” on page 77 (only when Major Service).

2. Fit the connection housing and tighten the four nuts.

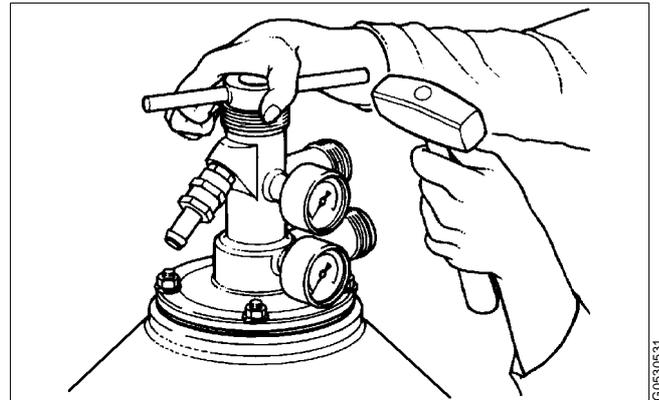


3. Fit the inlet pipe.

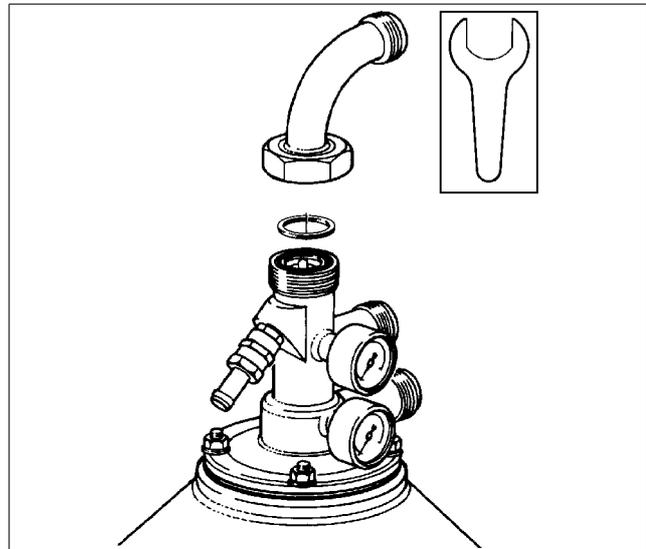


4. Tighten the inlet pipe properly. Knock with light blows.

**Left-hand thread!**



5. Fit and tighten the inlet and outlet connections. Do not forget the sealing rings.
6. Revolve the worm wheel shaft by hand to check the rotating parts in the separator for free rotation. If it turns heavily or if a scraping noise is heard, wrong height adjustment or wrong fitting of the inlet pipe may be the cause, which must be remedied.
7. After the separator has been assembled completely, see "4.1.2 Ready for start" on page 31.



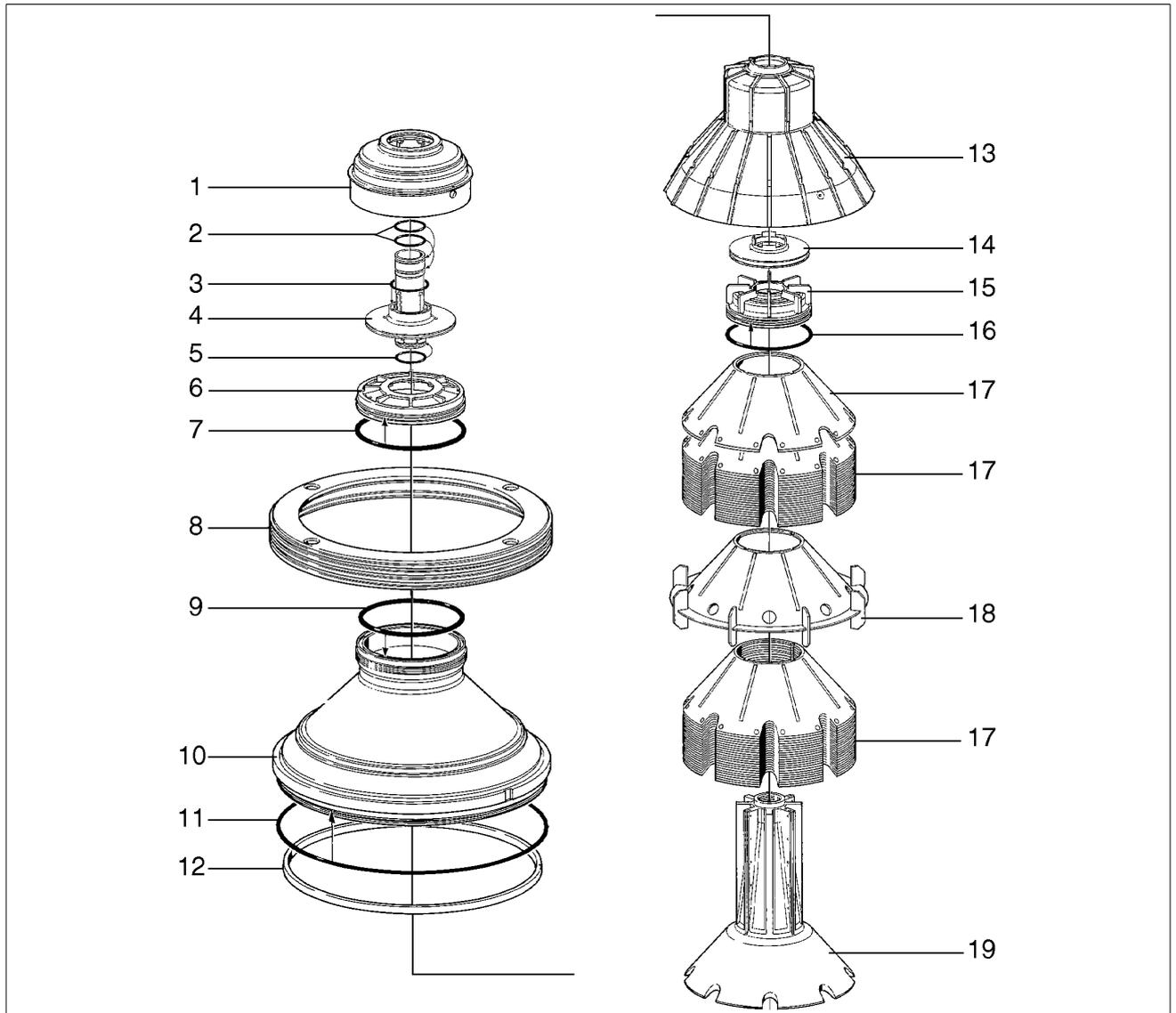
## DANGER

### Disintegration hazards

When power cables have been connected, always check direction of rotation, see "4.1.2 Ready for start" on page 31. If incorrect, vital rotating parts could unscrew causing disintegration of the machine.

## 6.3 Bowl hood and disc stack (IS)

### 6.3.1 Exploded view



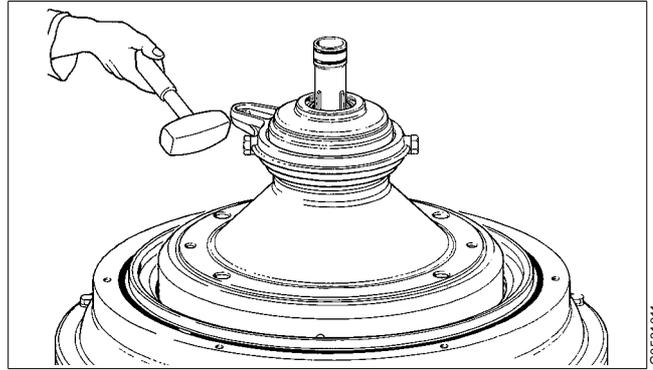
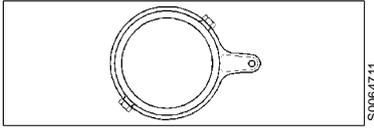
1. *Paring chamber cover (small lock ring)*
2. *O-ring*
3. *O-ring*
4. *Upper paring disc*
5. *O-ring*
6. *Flow control disc*
7. *O-ring*
8. *Lock ring*
9. *O-ring*

10. *Bowl hood*
11. *O-ring*
12. *Seal ring*
13. *Top disc*
14. *Oil paring disc*
15. *Level ring*
16. *O-ring*
17. *Bowl disc*
18. *Wing insert*
19. *Distributor*

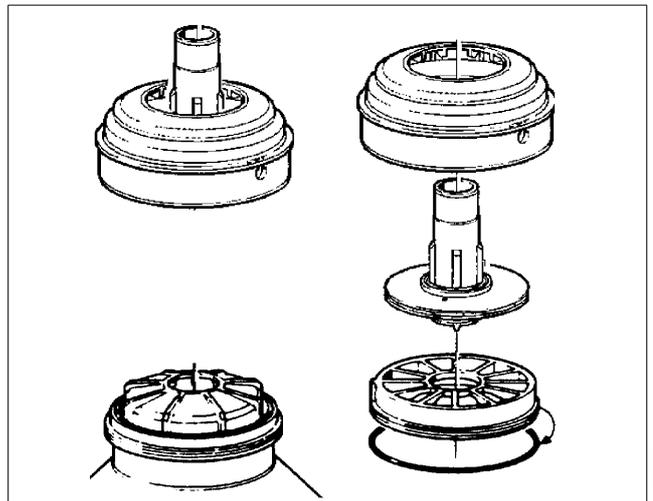
### 6.3.2 Dismantling

1. Unscrew the paring chamber cover using the spanner.

**Left-hand thread!**



2. Remove the paring chamber cover. Force out the flow control disc and the upper paring disc from the cover.



3. Apply the brake and unscrew the lock ring as described below.

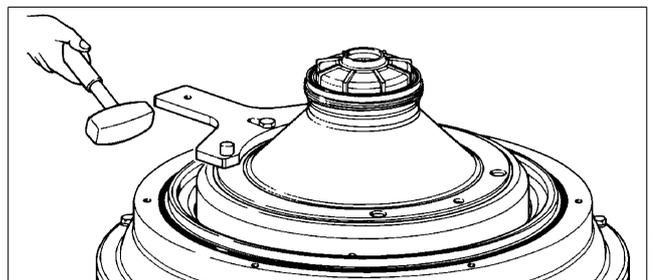
#### NOTE

Use an Alfa Laval compressing tool (optional) to reduce shocks to bearings and keep thread wear minimized when unscrewing the large lock ring.

#### Unscrewing lock ring without using a compressing tool

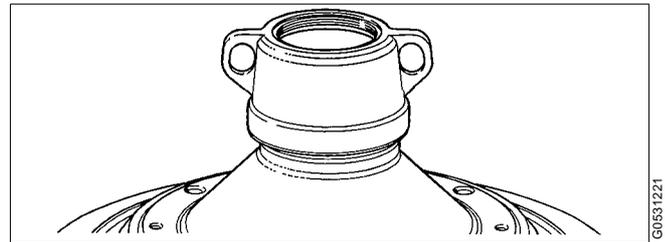
- a. Unscrew the lock ring using the spanner.

**Left-hand thread!**



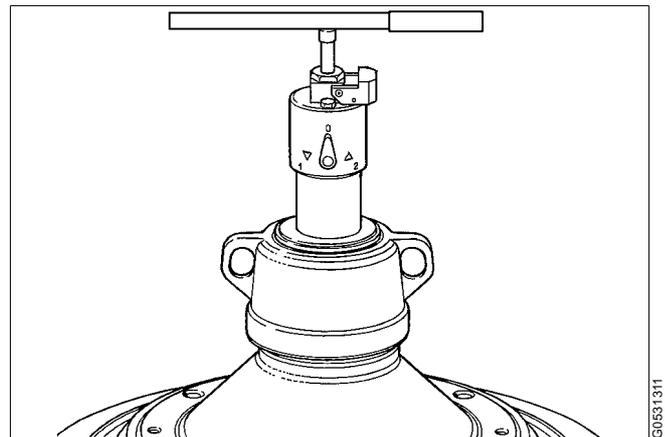
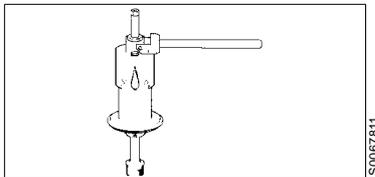
### Unscrewing lock ring by using a compressing tool

- a. Fit the lifting tool on the bowl hood.



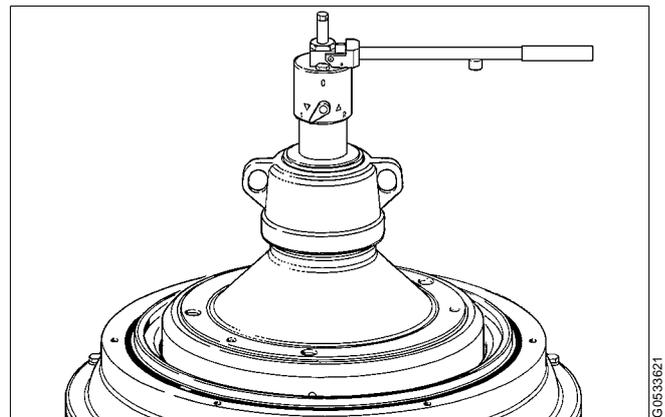
- b. Fit the compressing tool by screwing the pillar of the tool into the threads of the distributor using the horizontal handle.

The control lever on the compressing tool should be in position 0.



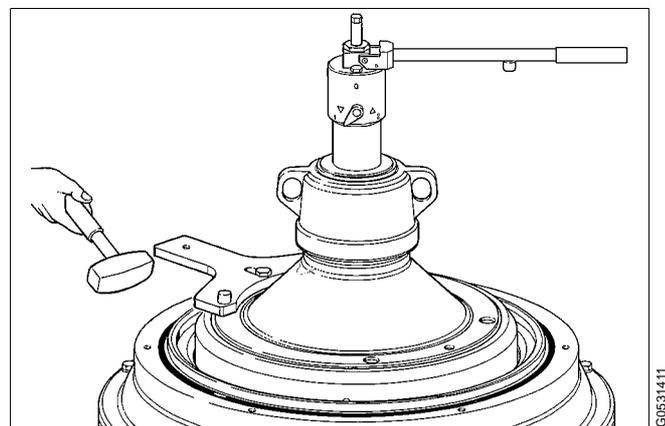
- c. Turn the control lever to position 1 for compression.

Compress the disc stack by pumping the horizontal handle until the oil pressure is released through the relief valve.

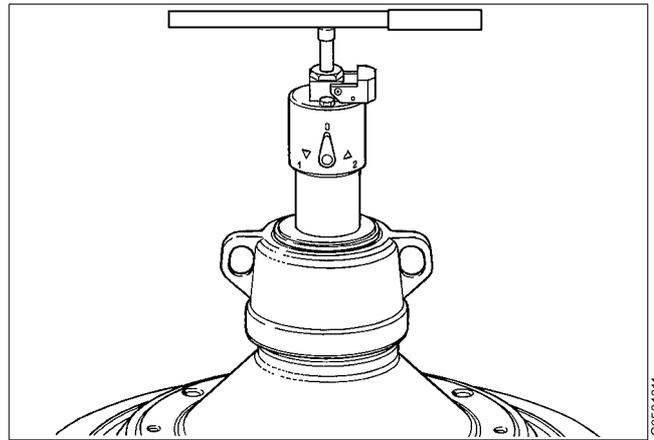


- d. Unscrew the large lock ring by using the spanner.

**Left-hand thread!**



- e. Release the pressure in the compressing tool and remove it from the lifting tool.

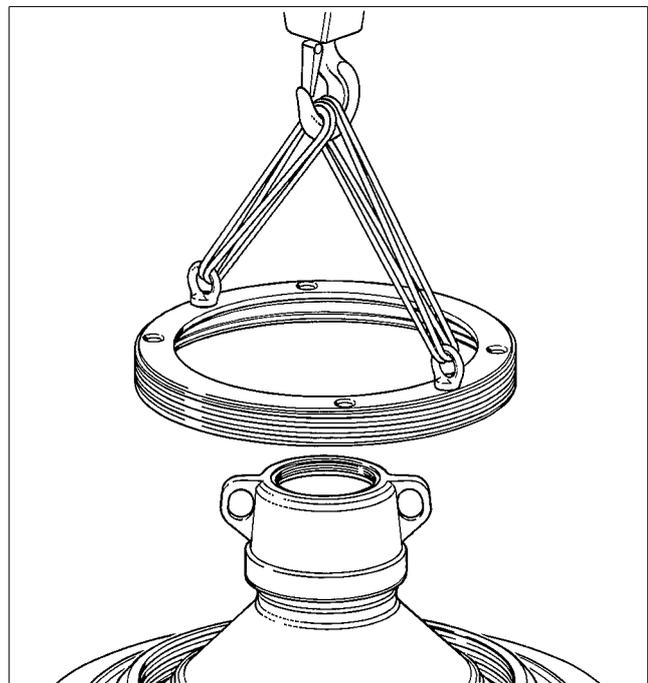


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4. Fit two eye bolts (M12) and remove the lock ring by a hoist.

### NOTE

The lock ring must be kept lying horizontally or it may become distorted. Even slightest distortion could make it impossible to refit.

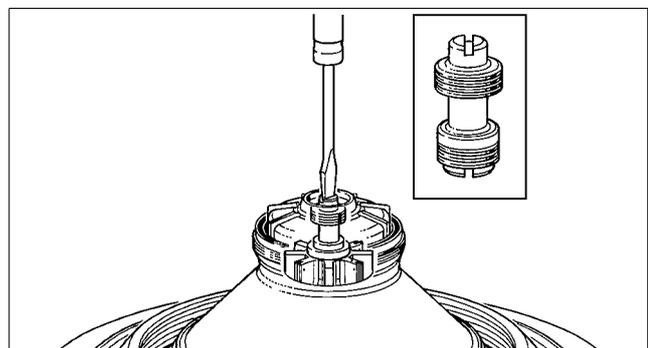


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5. Separate the bowl hood from the bowl body as described below before lifting off the bowl hood.

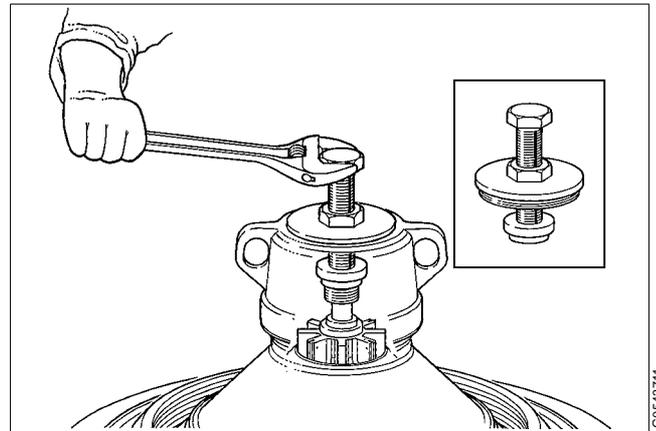
### Separating bowl hood without using a compressing tool

- a. Screw the smaller threaded end of the puller into the distributor. If necessary, remove the lifting tool to facilitate the mounting of the puller.



G0543811

- b. Screw the spindle plate into the lifting tool. Unscrew the spindle a few turns if the plate is not in contact with the lifting tool.
- c. Screw home the spindle until the bowl hood loosens from the bowl body.
- d. Remove the spindle plate from the lifting tool.



G0543711

### Separating bowl hood by using a compressing tool

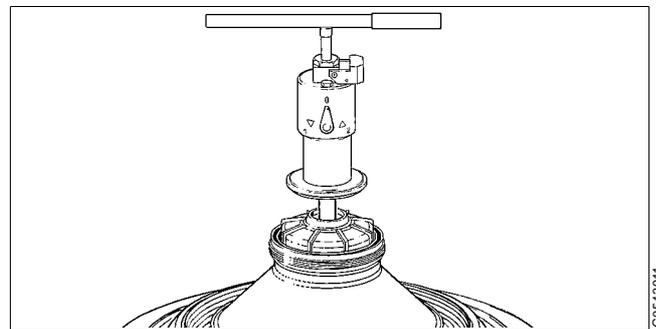
- a. Remove the lifting tool from the bowl hood.
- b. Fit the compressing tool by screwing the pole of the tool into the threads of the distributor using the horizontal handle.

The control lever on the compressing tool should be in position 0.

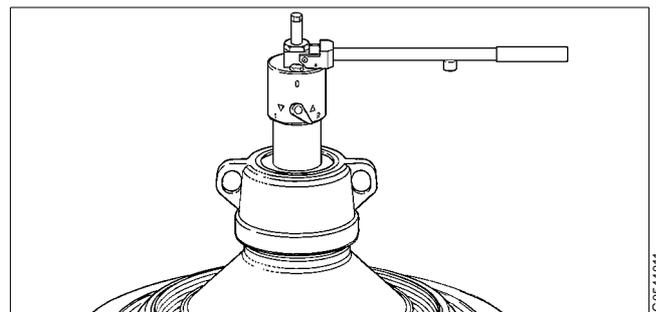
- c. Fit the lifting tool on the bowl hood.
- d. Turn the control lever to position 2 for expansion.

Separate the bowl hood from the bowl body by pumping the horizontal handle.

- e. Remove the lifting tool and the compressing tool. Then refit the lifting tool.



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G0544011

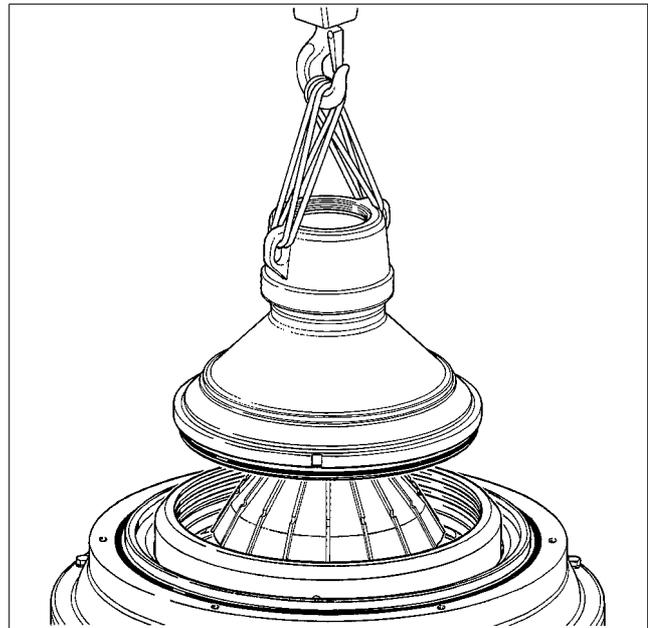
6. Lift off the bowl hood using a hoist. Be careful not to scratch the bowl hood seal ring.



### CAUTION

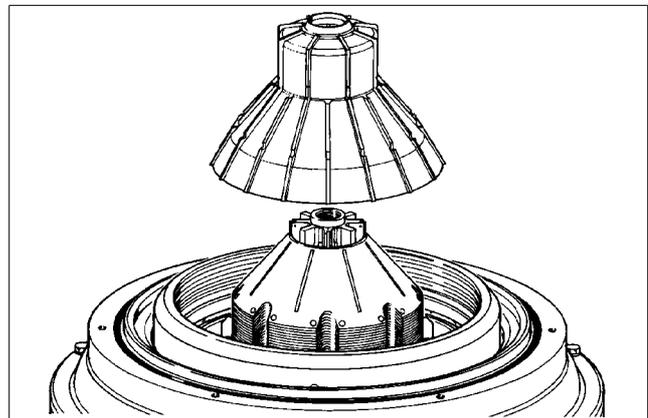
#### Crush hazards

If the top disc is stuck into the bowl hood, remove it now before it accidentally falls out.



G0539971

7. Remove the top disc.

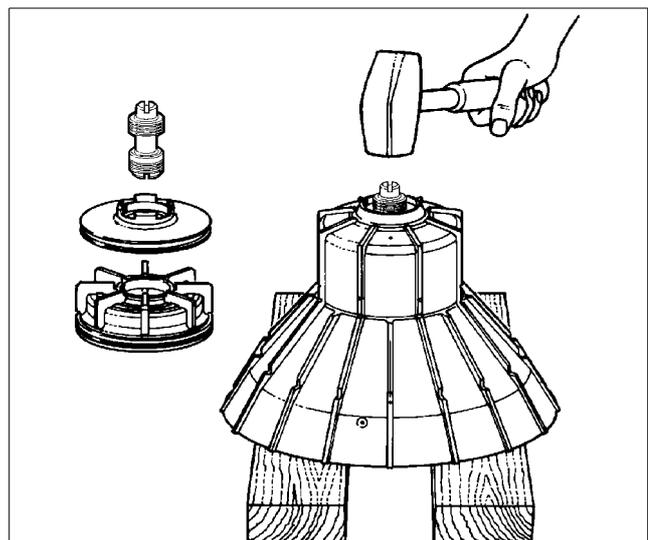


G0531791

8. Screw the larger threaded end of the puller into the paring disc located above the level ring inside the top disc.

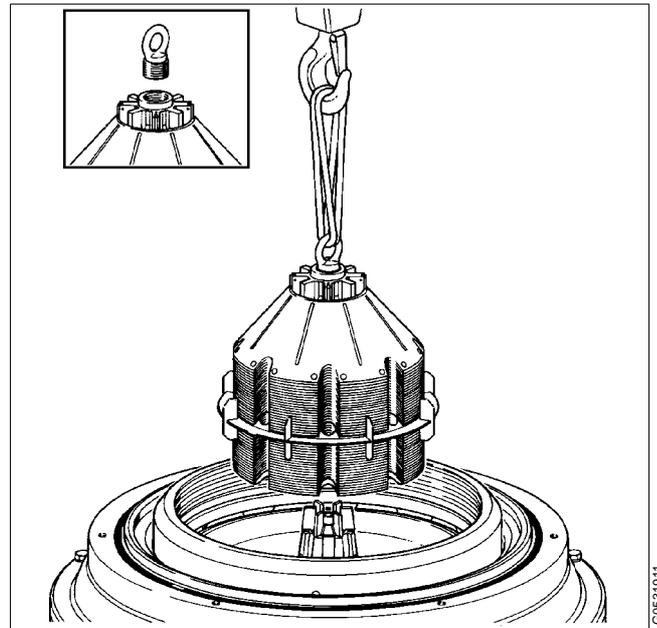
#### Left-hand thread!

Place the top disc onto wooden blocks to act as protection for the top disc edge and for falling level ring. Force out the level ring and the paring disc carefully from the top disc.



G0532021

9. Fit the lifting tool into the distributor and lift the distributor with disc stack out of the bowl body using a hoist.
10. Remove deposits and clean all parts thoroughly in a suitable cleaning agent. See chapter "5.6 Cleaning" on page 82.



### 6.3.3 Assembly

#### ✓ Check point

“5.3.3 Corrosion” on page 51,  
 “5.3.4 Cracks” on page 54,  
 “5.3.7 Erosion” on page 57,  
 “5.3.11 Lock ring; wear and damage” on page 62.

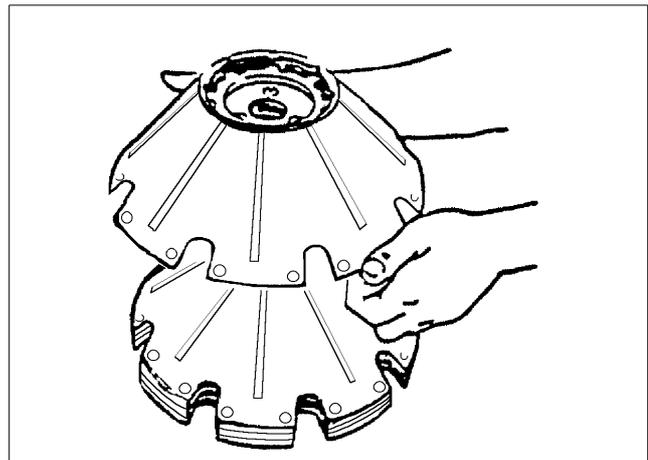
1. Assemble the discs one by one on the distributor. The distributor has one guide rib for the correct positioning of the discs.



#### CAUTION

Cut hazard

Sharp edges on the separator discs may cause cuts.



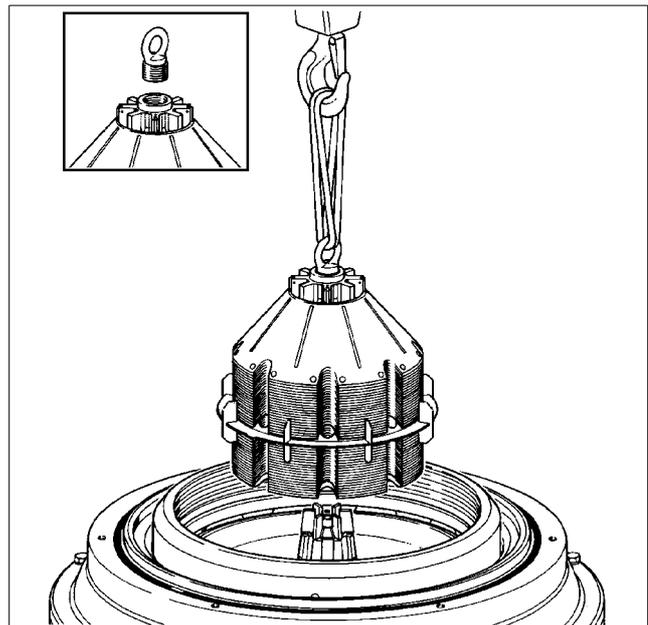
G0603111

For correct number of discs above and below the wing insert when the machine was new, see the *Spare Parts Catalogue*.

The number of bowl discs above the wing insert may be increased to adjust the disc stack pressure.

2. Fit the lifting tool to the distributor and lift the distributor with disc stack into the sliding bowl bottom using a hoist.

Check that the guide pins in the distributing cone fit into the recesses on the underside of the distributor.



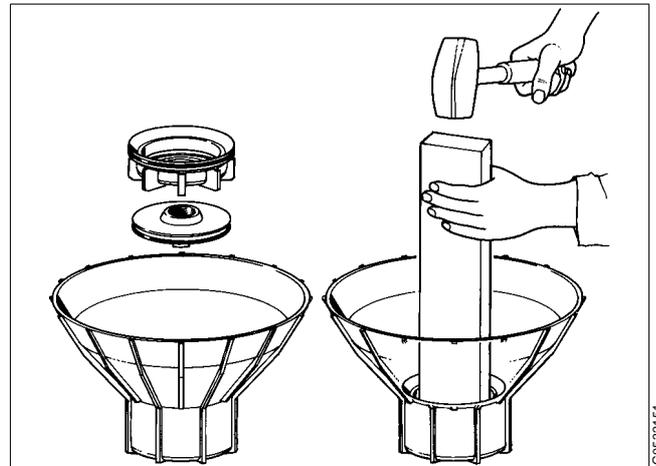
G0631911

✓ **Check point**

“5.3.10 Level ring” on page 61.

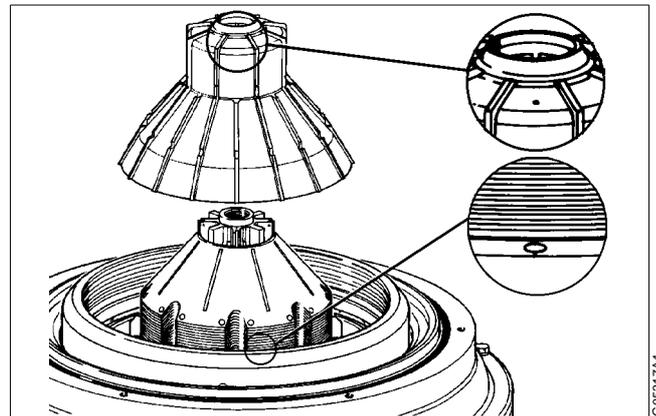
3. Fit the oil paring disc and level ring with the O-ring into the top disc.

Make sure that the paring disc is positioned in the right direction.



G0532151

4. Fit the top disc onto the distributor. The drilled assembly mark on the top disc must face the guide lug on the bowl body.



G05317A1

✓ **Check point**

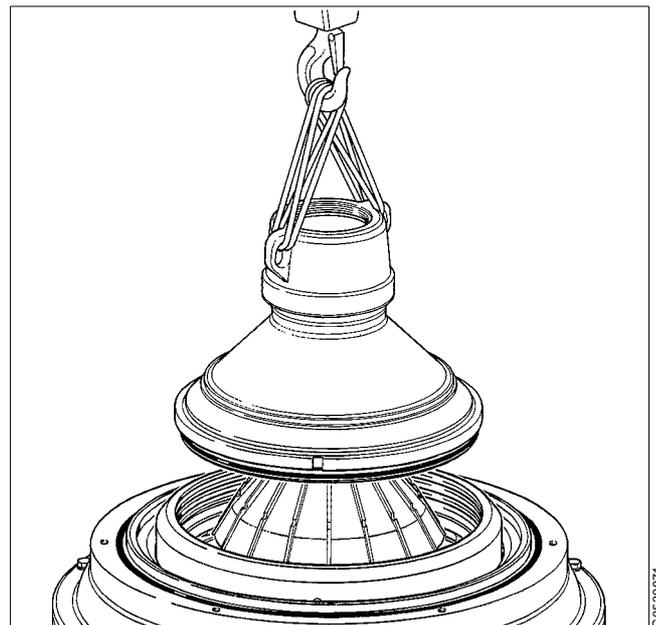
“5.3.1 Bowl hood seal ring” on page 50.

5. Fit the lifting tool to the bowl hood and lift it using a hoist. Check that the O-ring and the seal ring of the bowl hood are properly fitted and lubricated.

Lower the bowl hood straight down onto the disc stack, otherwise it may get stuck. Be careful not to scratch the bowl hood seal ring.



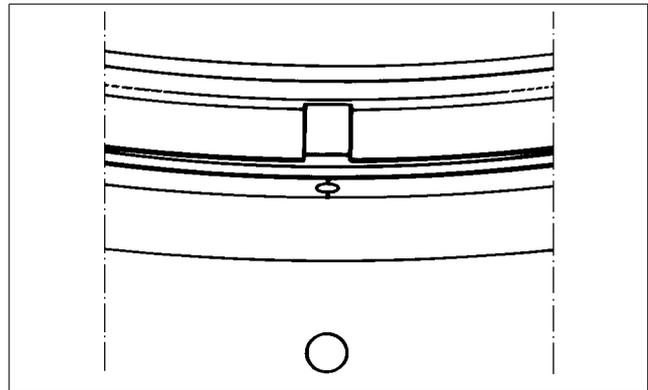
S0067611



G0539971

For correct position of bowl hood, see next illustration.

6. Check that the guide recess on the bowl hood enters the guide lug in the bowl body.

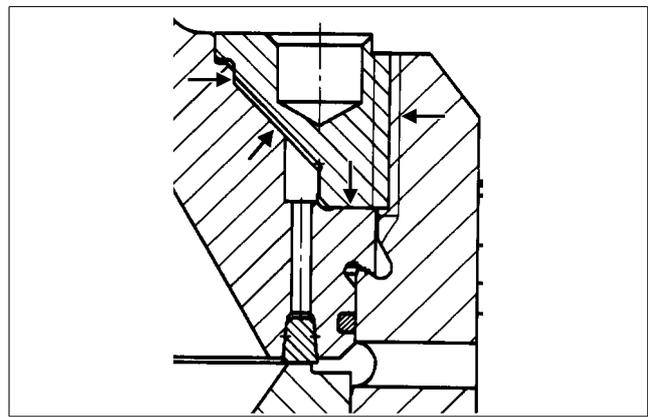


G0535621

7. Remove the lifting tool.
8. Lubricate the lock ring threads, contact and guide surfaces with lubricating paste.

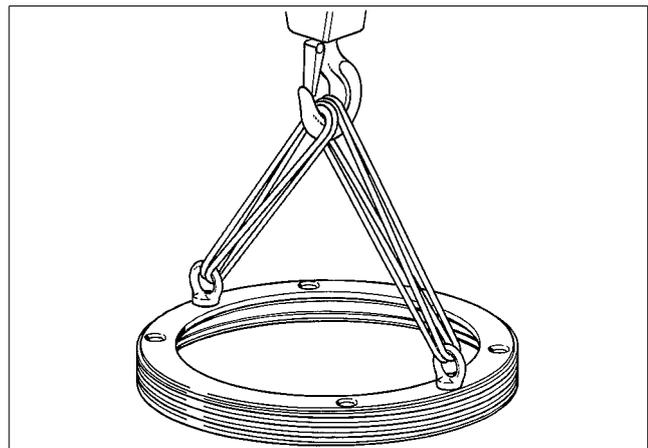
✓ **Check point**

“5.4.17 Lock ring; priming” on page 75 (only when Major Service).



G0544721

9. Fit two eye bolts and lift the lock ring by a hoist onto the bowl body.



G0531621

10. Tighten the lock ring.

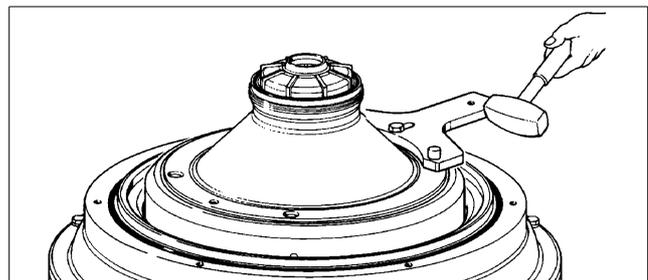
**NOTE**

Use an Alfa Laval compressing tool (optional) to reduce shocks to bearings and keep thread wear minimized when unscrewing the large lock ring.

**Tightening of lock ring without using a compressing tool**

- a. Tighten the lock ring using the spanner for lock ring.

**Left-hand thread!**



G0533411

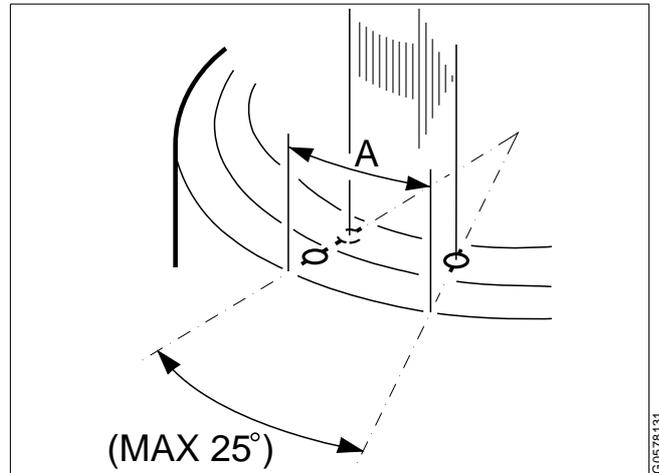
- b. Tighten until the assembly marks are at least in line.

✓ **Check point**

“5.3.5 Disc stack pressure” on page 55.

**NOTE**

The assembly marks must never pass each other more than  $25^\circ$  which corresponds to  $A=100\text{ mm}$ .



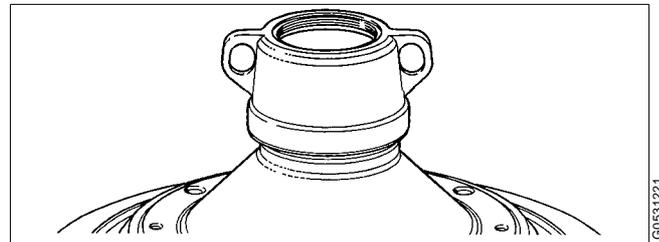
G0578131

**Tightening of lock ring using a compressing tool**

- a. Fit the lifting tool onto the bowl hood.



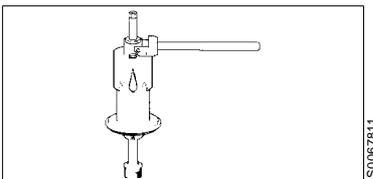
S0067811



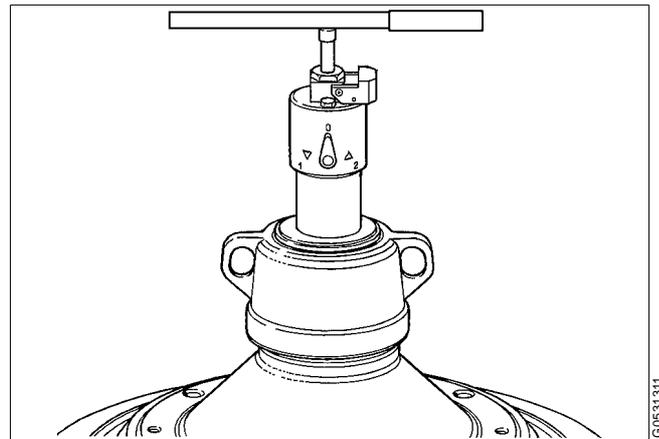
G0531221

- b. Fit the compressing tool by screwing the pole of the tool into the threads of the distributor by the horizontal handle.

The control lever on the compressing tool, should be in position 0.



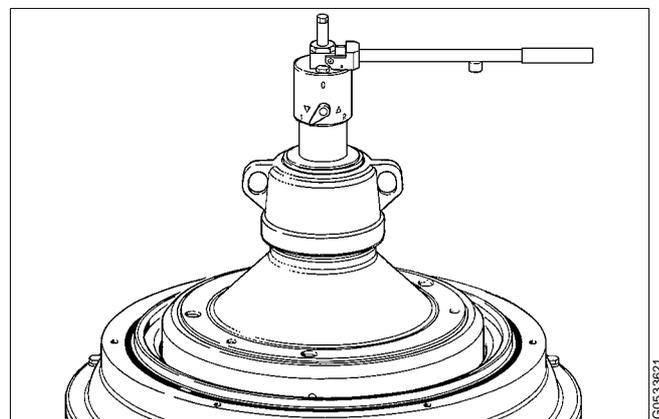
S0067811



G0531311

- c. Turn the control lever to position 1 for compression.

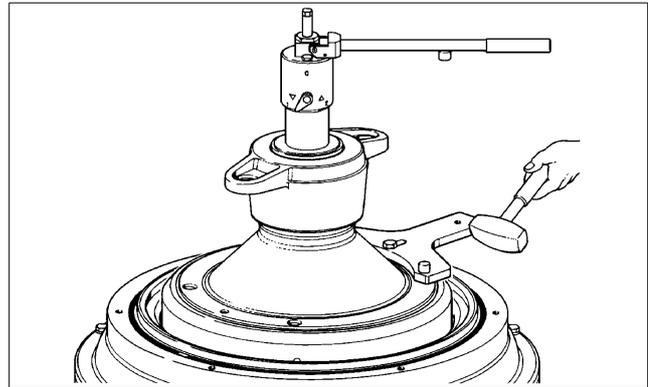
Compress the disc stack by pumping with the horizontal handle until the oil pressure is released through the relief valve.



G0533621

- d. Tighten the lock ring using the spanner for lock ring.

**Left-hand thread!**



G0653611

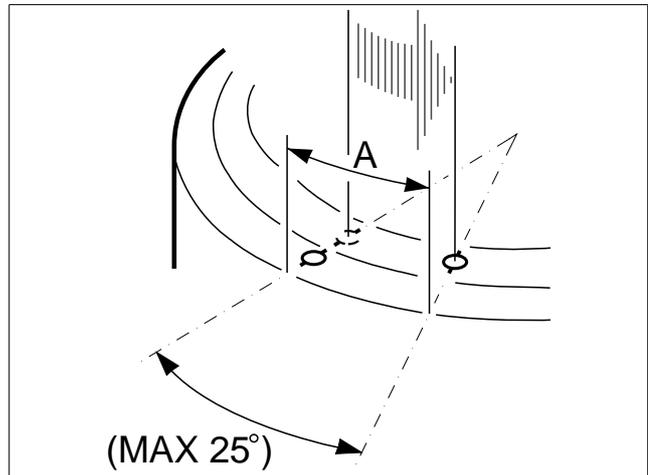
- e. Tighten until the assembly marks are at least in line.

✓ **Check point**

“5.3.5 Disc stack pressure” on page 55.

**NOTE**

The assembly marks must never pass each other more than  $25^\circ$  which corresponds to  $A=100\text{ mm}$ .



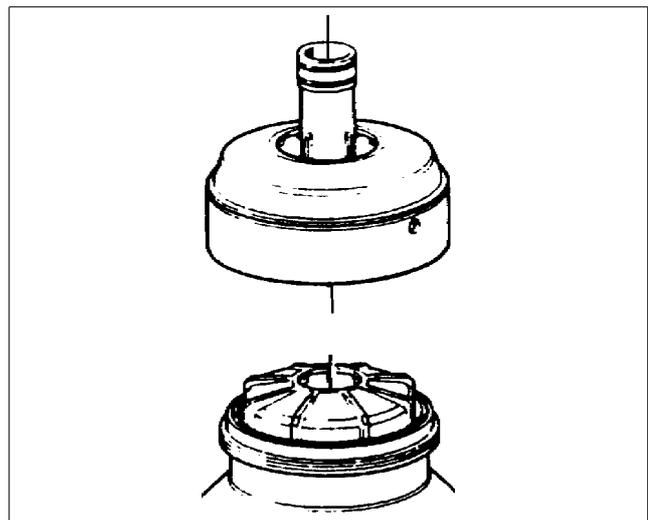
G0578131

- f. Release the pressure in the compressing tool by turning the control lever to position 0 and then remove the compressing and lifting tools.

11. Fit the upper paring disc and the flow control disc in the paring chamber.

✓ **Check point**

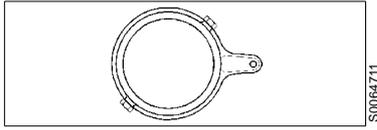
“5.3.9 Inlet pipe and oil paring disc” on page 61.



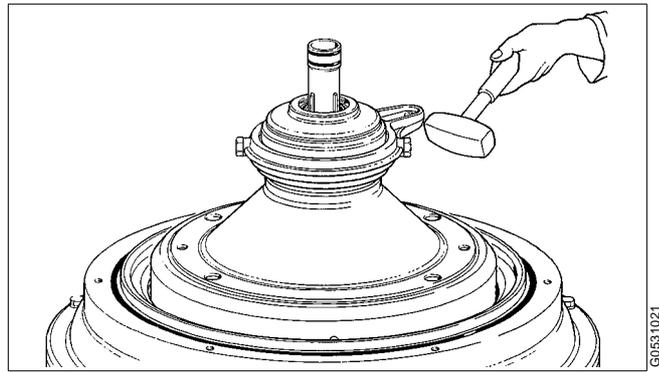
G07105D1

12. Fit and tighten the paring chamber cover by using the spanner.

**Left-hand thread!**



S10064711

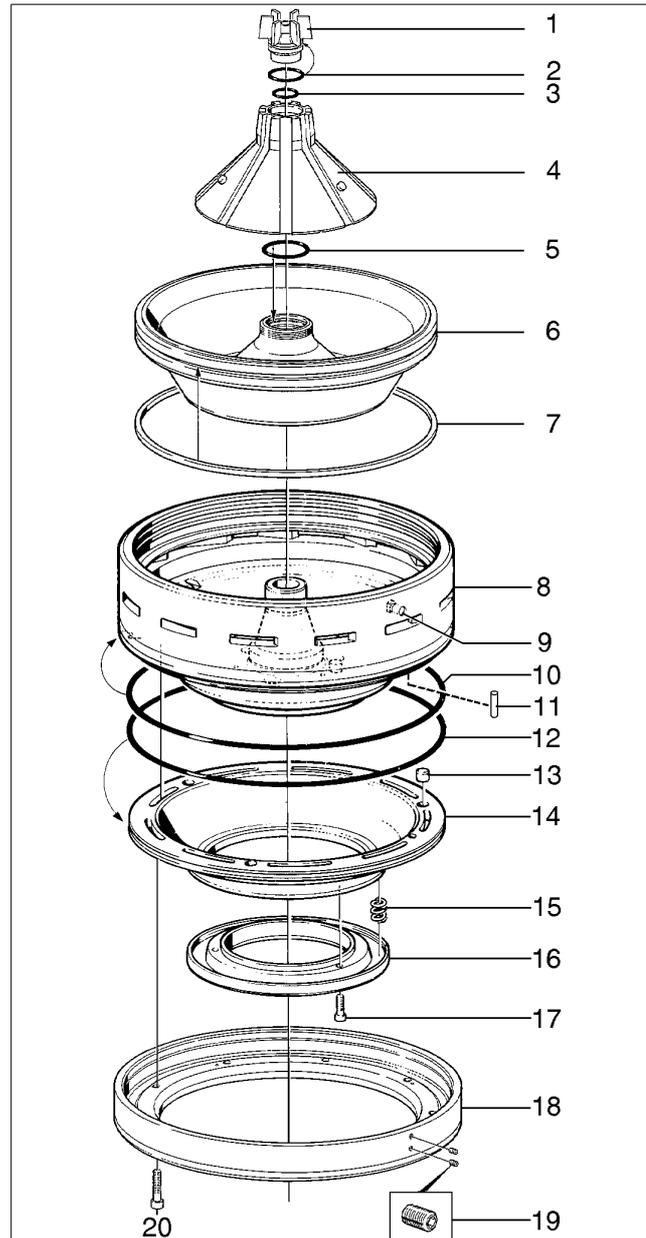


G0531021

## 6.4 Bowl body and operating mechanism (IS)

### 6.4.1 Exploded view

1. Cap nut
2. O-ring
3. O-ring
4. Distributing cone
5. O-ring
6. Sliding bowl bottom
7. Rectangular ring
8. Bowl body
9. Guide lug
10. O-ring
11. Cylindrical pin
12. O-ring
13. Valve drain plug
14. Operating slide
15. Spring
16. Spring support
17. Screw
18. Dosing ring
19. Nozzle \*)
20. Screw



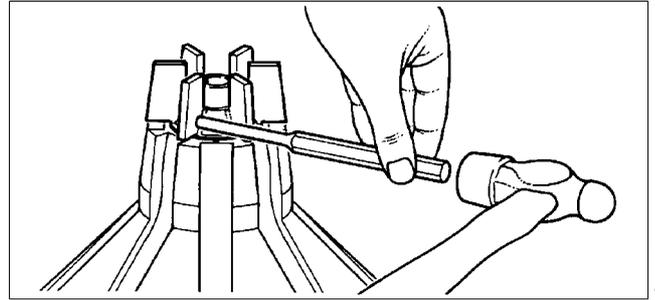
G0546261

\*) Secured with Loctite 242

### 6.4.2 Dismantling

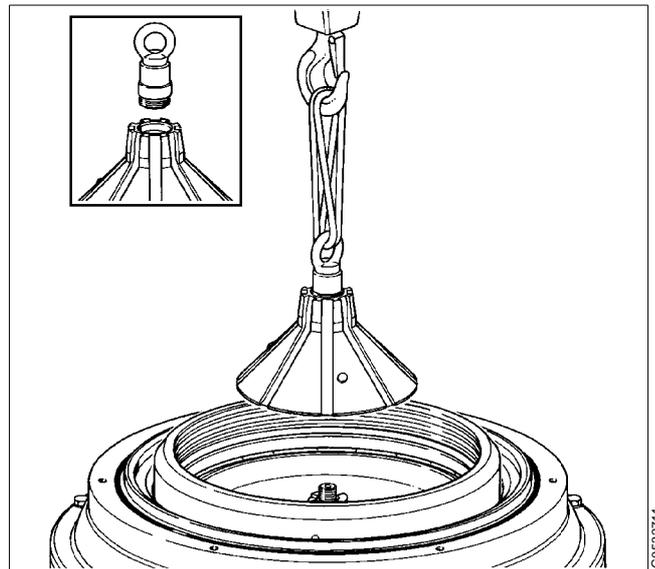
1. Unscrew and remove the cap nut. Hit with light blows on the inner part of the capnut wings with a drift and hammer.

**Left-hand thread!**



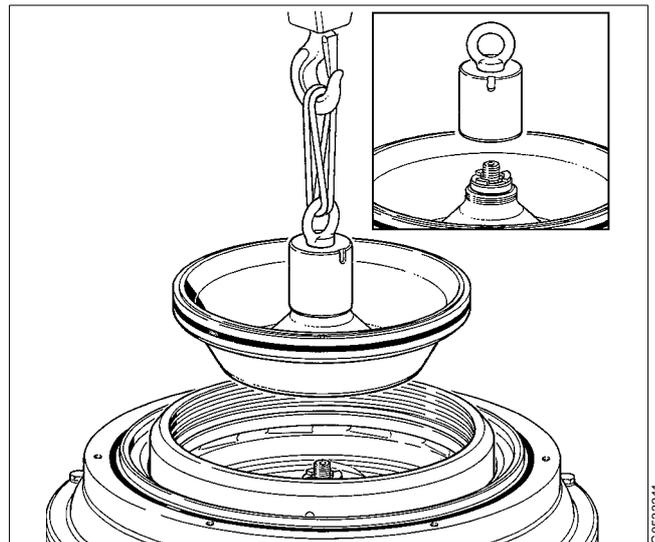
G0540011

2. Fit the lifting tool into the distributing cone and lift it out.



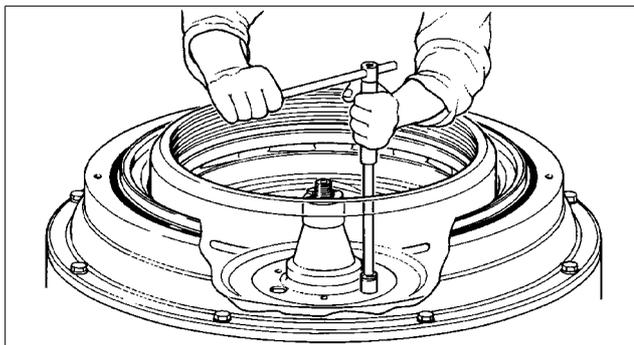
G0532711

3. Fit the lifting tool onto the sliding bowl bottom and lift it out by a hoist.



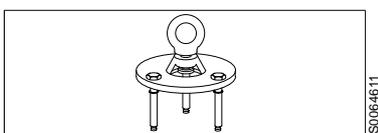
G0533211

4. Unscrew the three screws in the bottom of the bowl body.



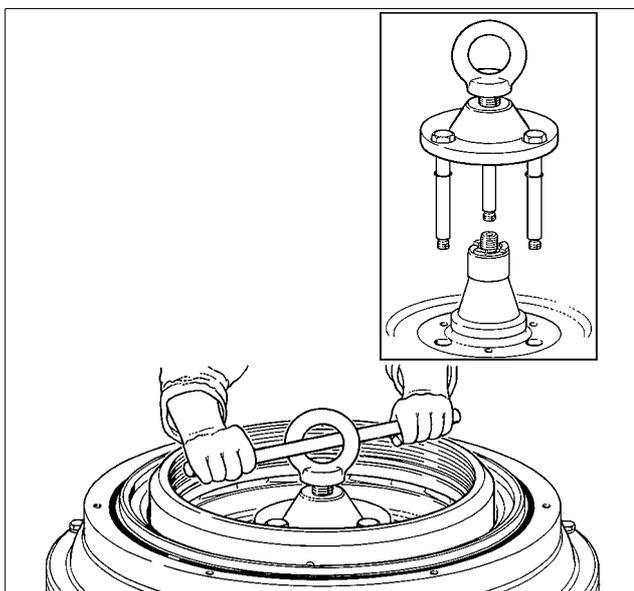
G0532811

5. Fit the lifting tool into the bowl body bottom with the three screws.



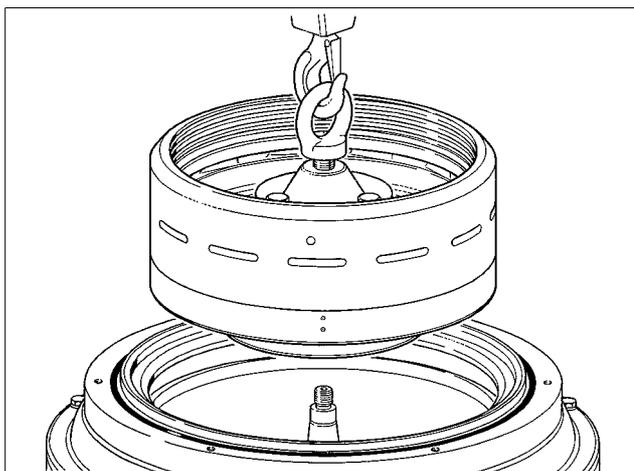
S0064611

Release the bowl body from the spindle by using the lifting tool as a puller. Turn the handle at top of the lifting tool until the bowl body comes loose from the spindle taper. Turn the handle two more turns in order to avoid damaging the paring disc device.



G0532911

6. Lift out the bowl body using a hoist.



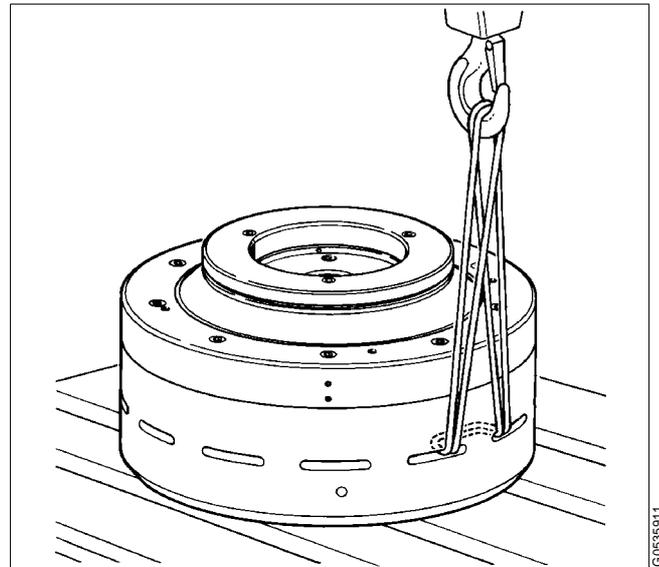
G0533311

7. Thread a strap through two sludge ports and turn the bowl body upside down using a hoist.

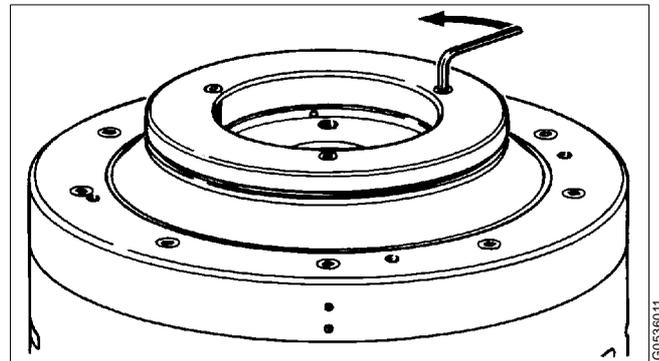
 **WARNING**

**Crush hazards**

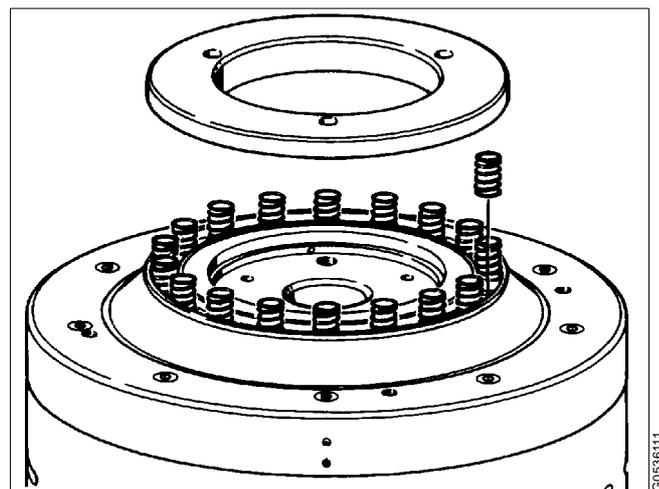
Support the bowl body when turning to prevent it from rolling.



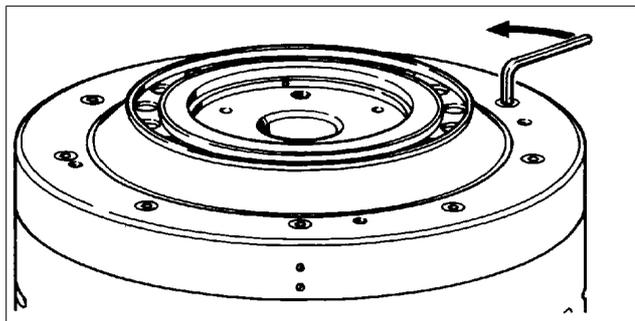
8. Loosen the screws for the spring support successively a little at a time. Remove the screws.



9. Remove the spring support and the springs.

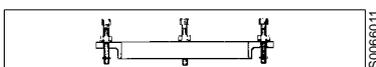


10. Unscrew the screws for the dosing ring.



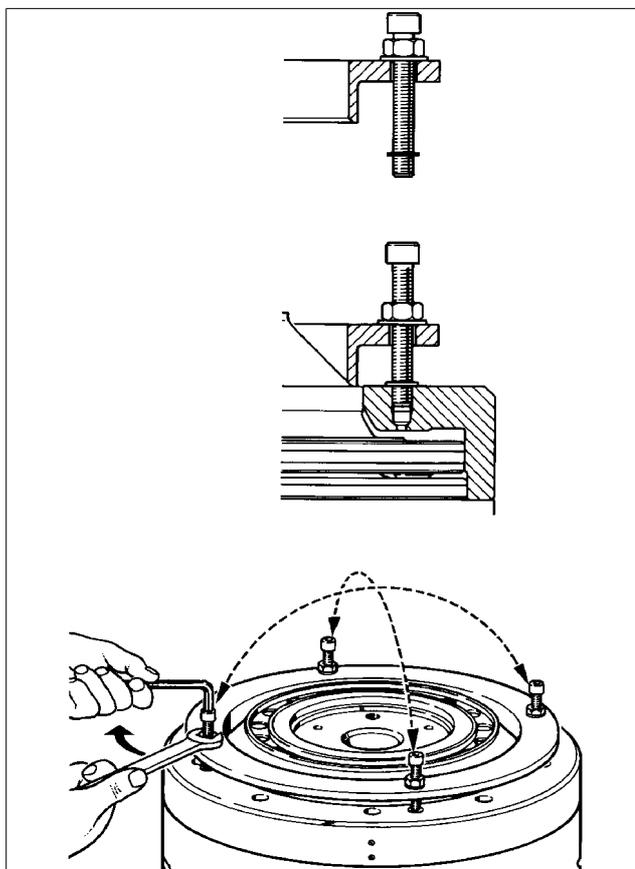
G0536211

11. Dismantle the dosing ring from the bowl body with the special puller.



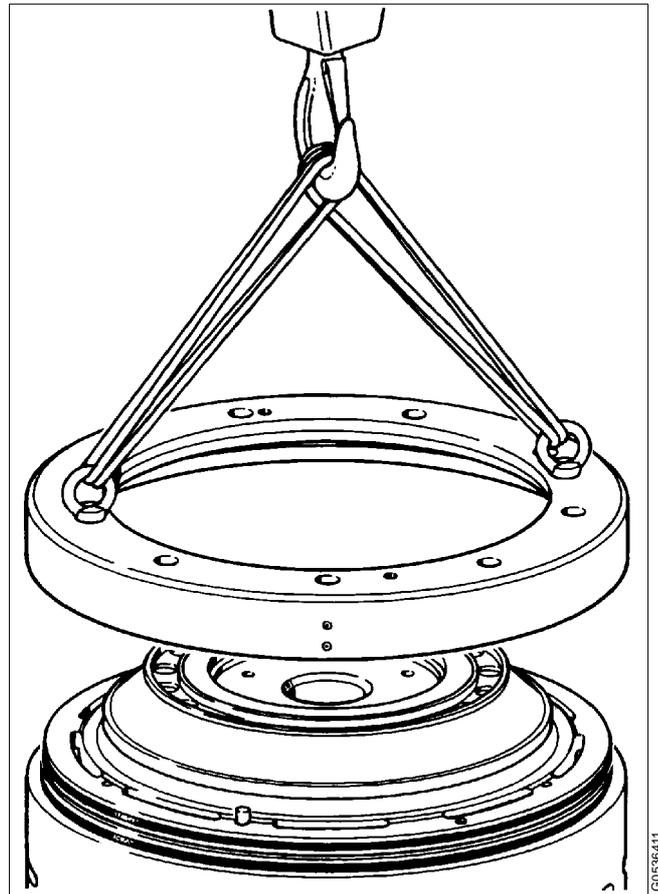
Proceed in the following way:

- a. Screw the nuts against the heads of the screws.
- b. Place the puller on the operating slide and screw the screws into the dosing ring.
- c. Force off the dosing ring by tightening the nuts crosswise. Remove the puller when the dosing ring is loose.

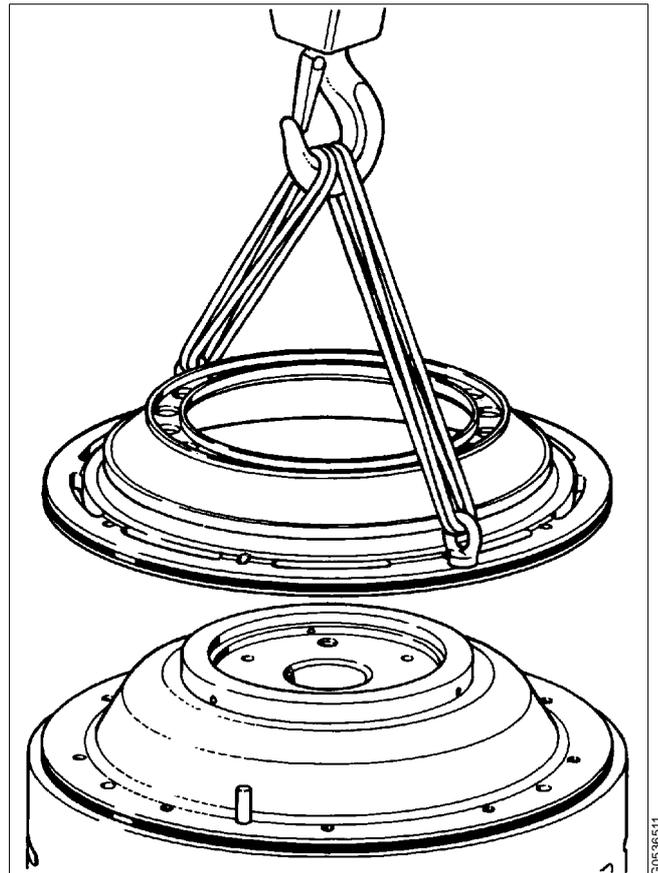


G0536311

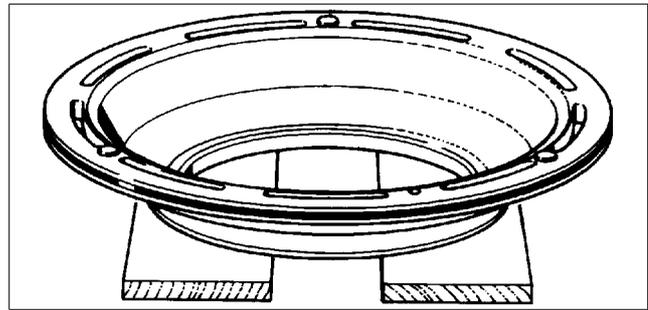
12. Fit two lifting eyes (M10) or two screws from the puller into the dosing ring and lift it off from the bowl body.



13. Fit two lifting eyes (M10) or two screws from the puller into the operating slide and lift it off from the bowl body.



14. Place the operating slide with the valve plugs facing upwards.
15. Remove any thick deposits in the bowl hood and clean all other parts thoroughly in a suitable cleaning agent. See chapter "5.6 Cleaning" on page 82.

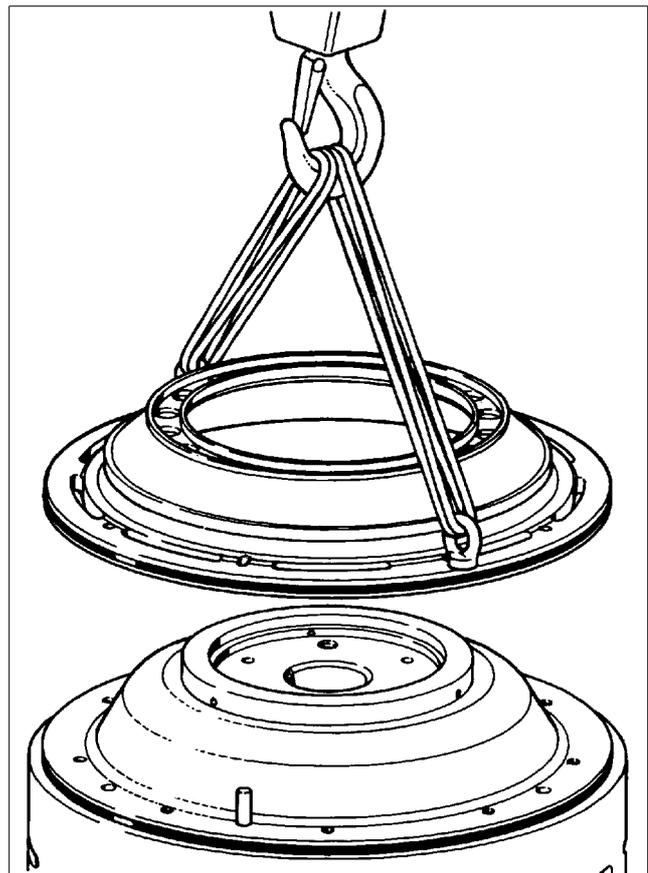


G0536611

### 6.4.3 Assembly

#### ✓ Check point

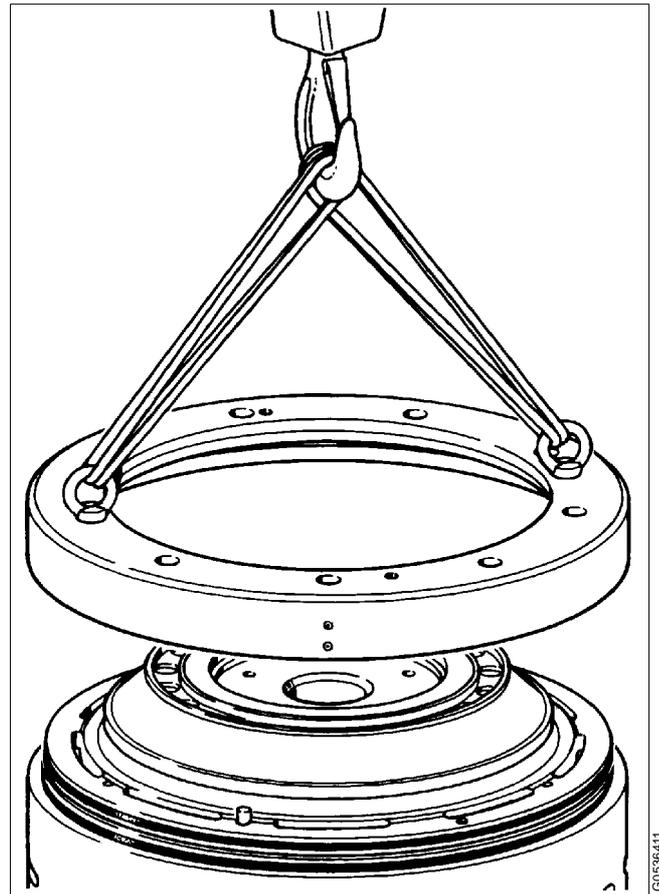
- "5.3.3 Corrosion" on page 51,
  - "5.3.4 Cracks" on page 54,
  - "5.3.6 Dosing ring" on page 57,
  - "5.3.7 Erosion" on page 57,
  - "5.3.8 Guide surfaces" on page 59,
  - "5.3.12 Operating mechanism" on page 63,
  - "5.3.13 Operating slide" on page 64,
  - "5.3.14 Sliding bowl bottom" on page 64,
  - "5.3.15 Springs for operating mechanism" on page 65.
1. Lubricate the guide surfaces of the bowl body, operating slide and dosing ring with lubricating paste. See chapter "8.5 Lubricants" on page 186.
  2. Fit the operating slide onto the bowl body. Check that the guide pin in the bowl body enters the hole in the operating slide.



G0536511

## 3. Fit the dosing ring.

Check that the guide pin in the bowl body enters the hole in the dosing ring.



G0636411

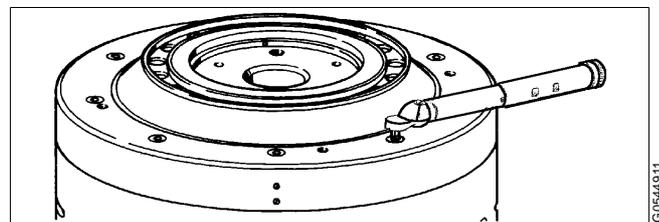
## 4. Apply only a thin film of lubricating paste on the screws for the dosing ring.

**NOTE**

If there is too much lubrication paste applied, the surplus will collect between the operating slide and bowl body with risk of malfunction.

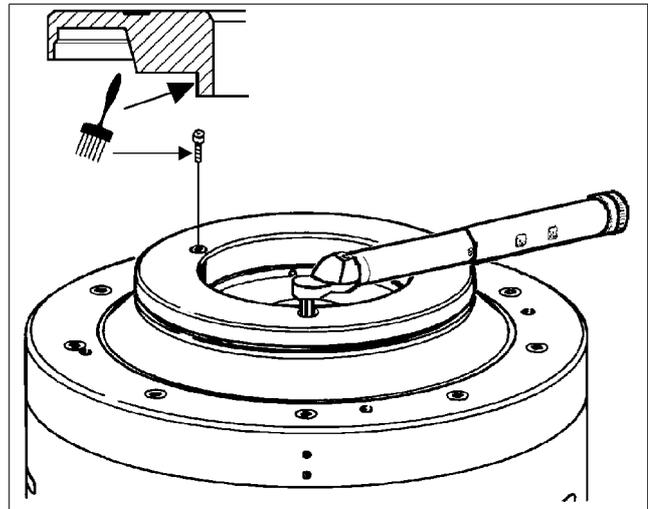
Tighten the dosing ring screws to a torque of **20 Nm**. The screws should first be tightened diametrically, then tightened symmetrically around the bowl.

If torque is too low, there is a risk that the bolts will loosen by themselves when the separator is in operation. If torque is too high, the dosing ring as well as the bolts will be deformed. This may lead to sticking of the operating slide which moves inside the dosing ring.



G0644911

5. Lubricate the guide surfaces of the spring support. See chapter "8.5 Lubricants" on page 186.  
Fit springs and support.
6. Tighten the three screws for the spring support successively by hand a little at a time.  
Finally tighten the screws to a torque of **25 Nm**.

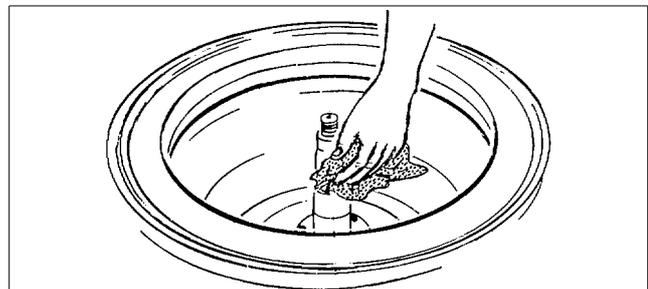


G0544821

7. Wipe off the spindle top and nave bore in the bowl body. Lubricate the tapered end of the spindle and wipe it off with a clean cloth.

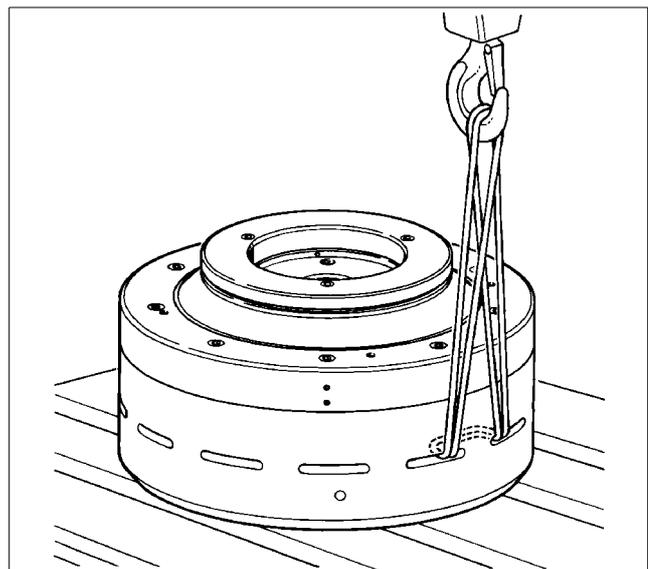
✓ **Check point**

"5.3.2 Bowl spindle cone and bowl body nave" on page 51.



G0522611

8. Turn the bowl body using a hoist to its up-right position with a strap threaded through two sludge ports.



G0535911



**WARNING**

**Crush hazards**

Support bowl body when turning to prevent it from rolling.

9. Fit the lifting tool into the bowl body bottom with the three screws.  
Turn the handle at the top of the lifting tool so that the central screw is home.



10. Lower the bowl body using a hoist until the central screw rests on the spindle top. Then screw up the central screw so that the bowl body sinks down onto the spindle.

Remove the tool.

11. Rotate the bowl body and align it so that the three screw holes in the bowl body bottom are exactly above the three holes in the distributing ring.

Tighten the three screws firmly.

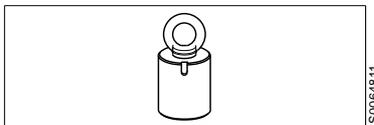
✓ **Check point**

“5.4.20 Operating paring disc; height position” on page 77

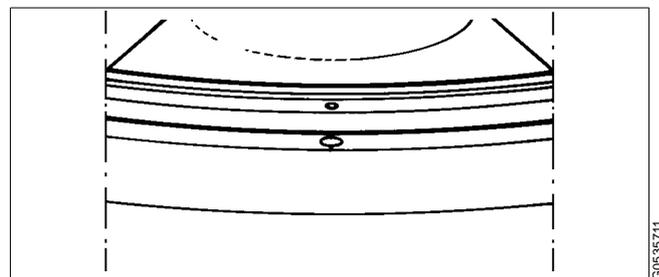
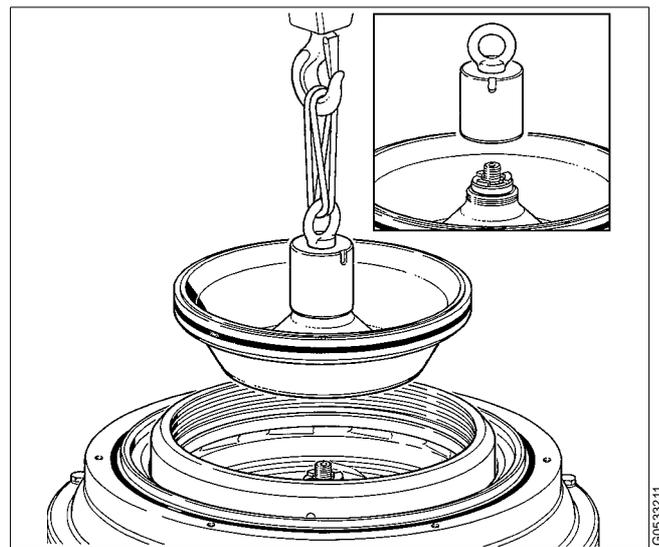
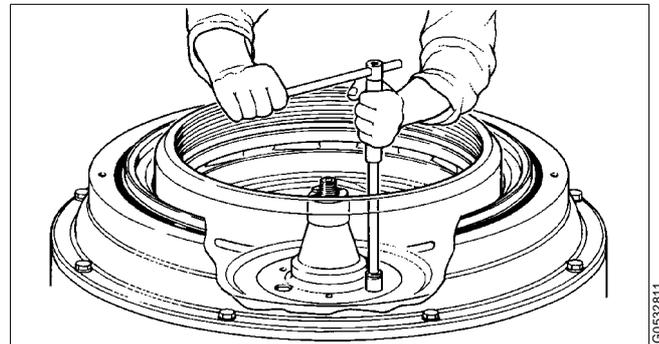
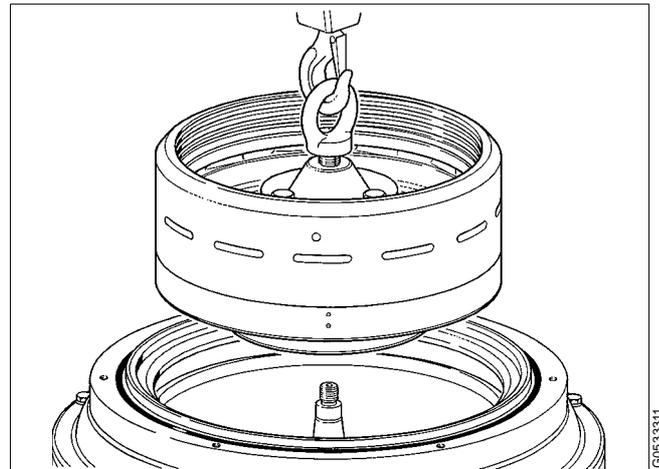
12. Lubricate the guide surfaces of the bowl body and sliding bowl bottom with lubricating paste. See chapter “8.5 Lubricants” on page 186.

13. Fit the lifting tool to the sliding bowl bottom and lift it into the bowl body using a hoist.

For correct position of the sliding bowl bottom, see below.



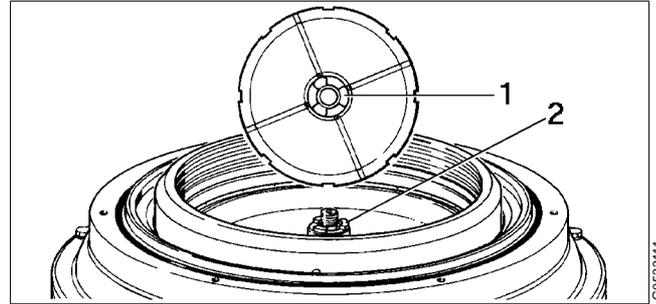
14. Bring the assembly mark on the sliding bowl bottom in line with the guide lug on the bowl body to ensure that the sliding bowl bottom enters into the correct position.





15. Fit the distributing cone onto the sliding bowl bottom.

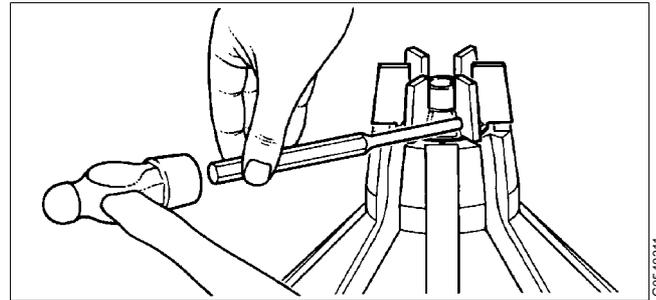
Check that the guide recesses (1) on the underside of the distributing cone enter the correct guide lugs (2) in the sliding bowl bottom. The relative sizes of the guides are different.



G0533111

16. Tighten the cap nut firmly.

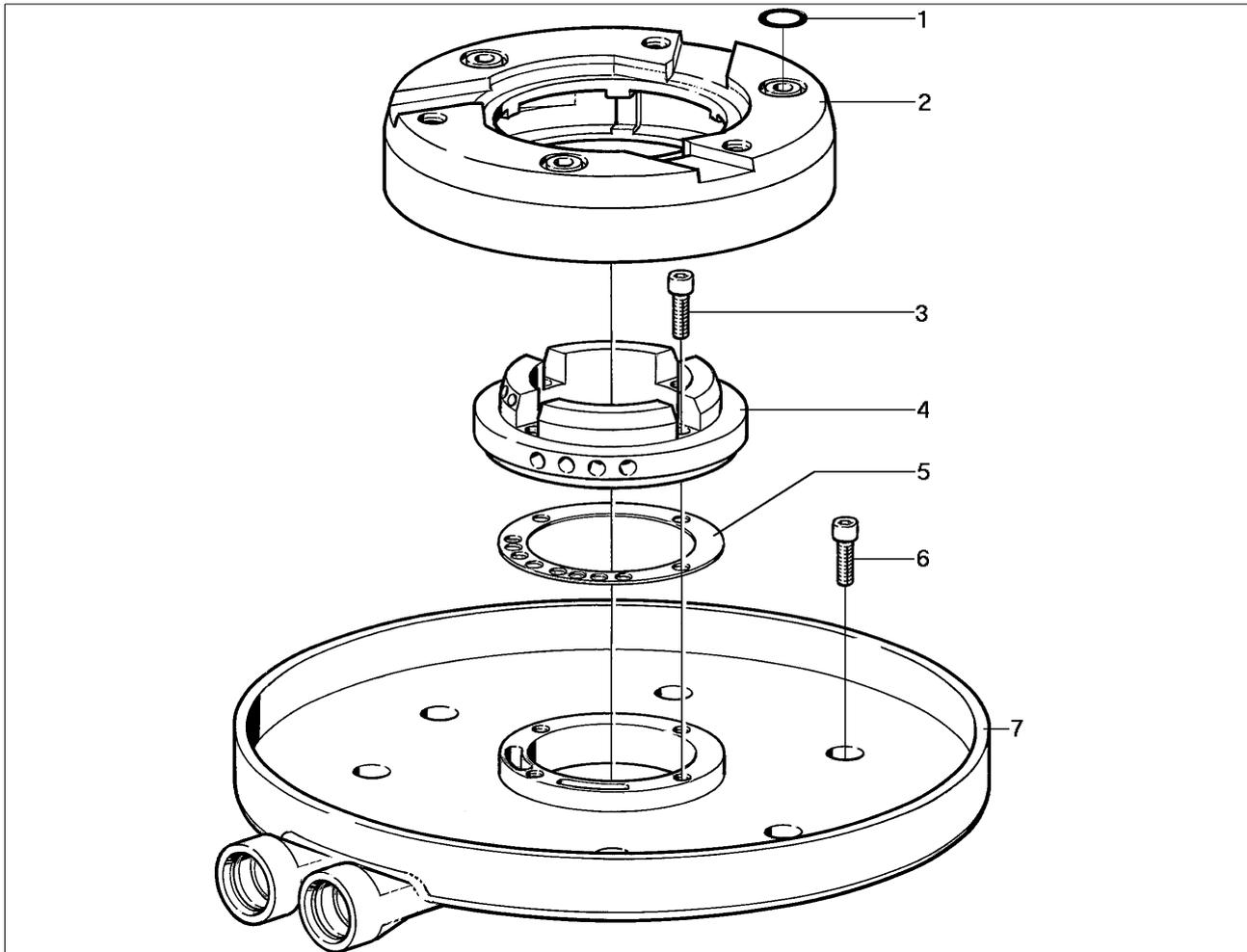
**Left-hand thread!**



G0540311

## 6.5 Operating water device (IS)

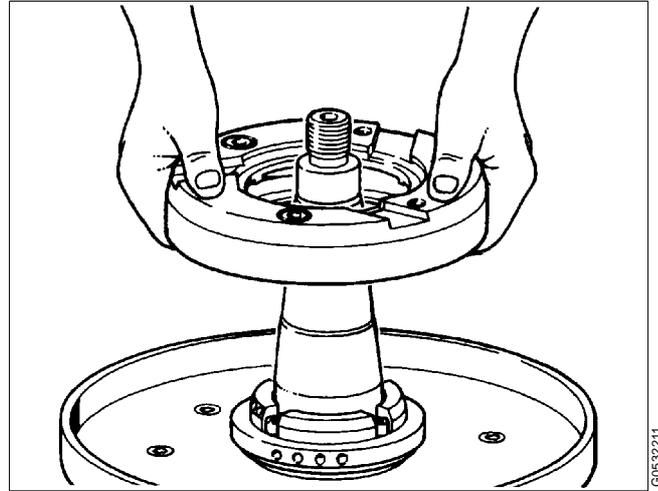
### 6.5.1 Exploded view



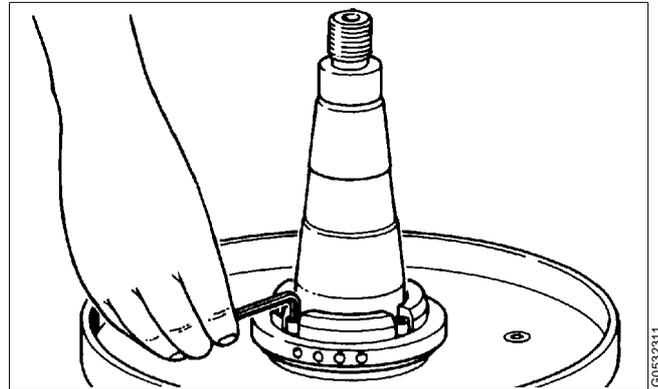
1. O-ring
2. Distributing ring
3. Screw
4. Operating paring disc
5. Gasket
6. Screw
7. Distributing cover

### 6.5.2 Dismantling

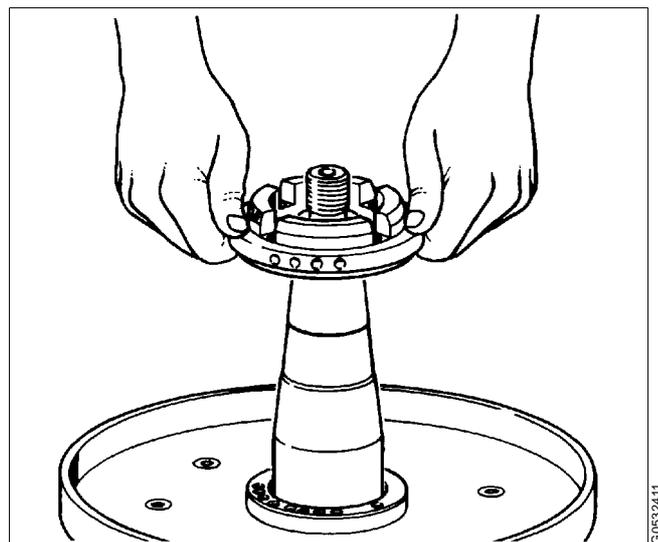
1. Lift out the distributing ring.



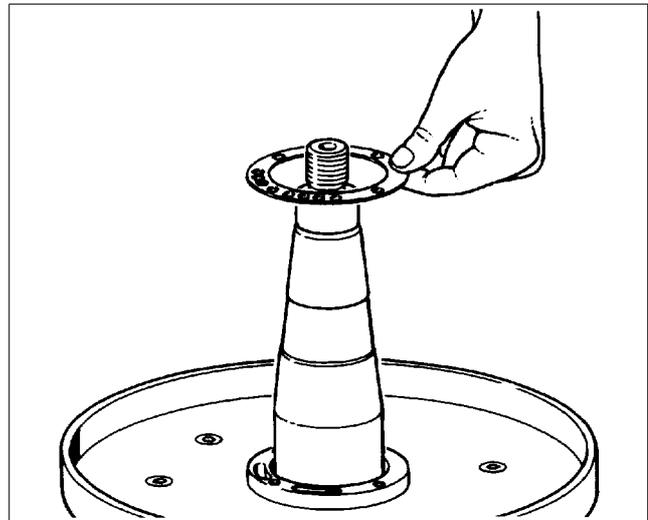
2. Unscrew the four screws for the operating paring disc.



3. Lift out the operating paring disc.



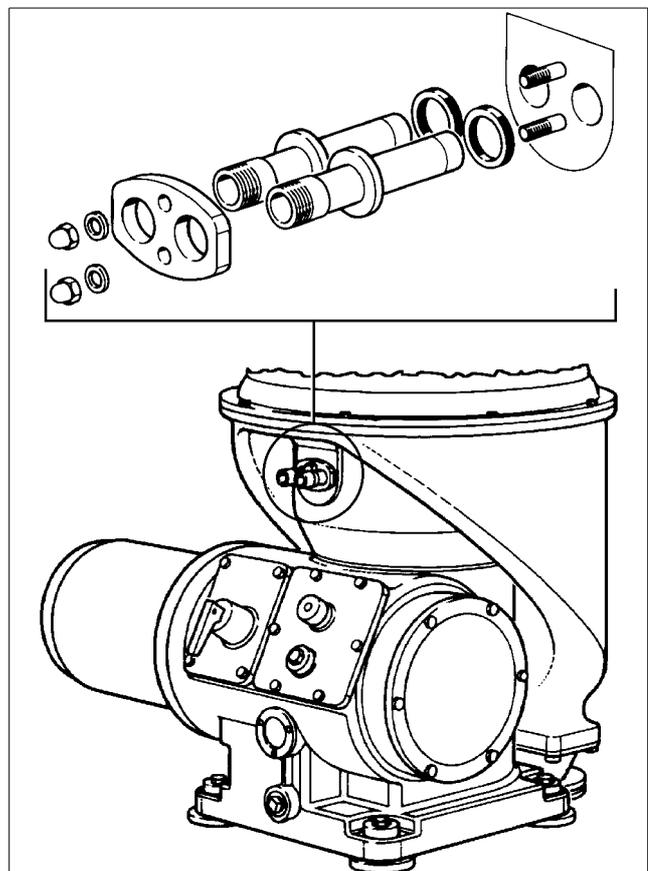
4. Remove the operating paring disc gasket.



G0532511

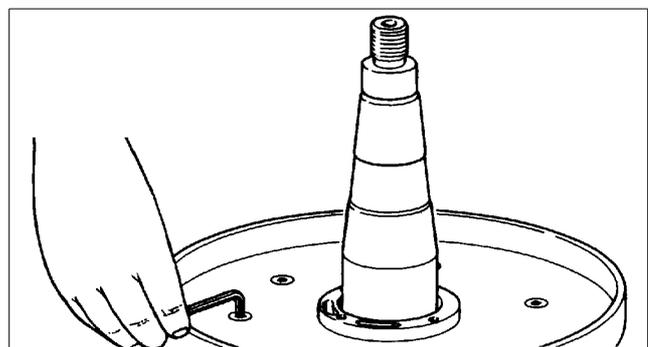
5. Disconnect the operating water hoses and then loosen and pull out the operating water inlet pipes.

To simplify the assembly, mark which hose that is connected to which inlet pipe.



G0540311

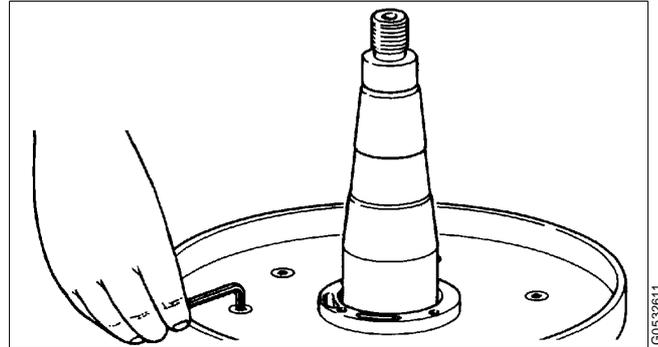
6. Unscrew the six screws for the distributing cover and lift it out.
7. Remove deposits and clean all parts thoroughly in a suitable cleaning agent. Pay special attention to the channels. See chapter "5.6 Cleaning" on page 82.
8. Check the parts for damage and corrosion.



G0532611

### 6.5.3 Assembly

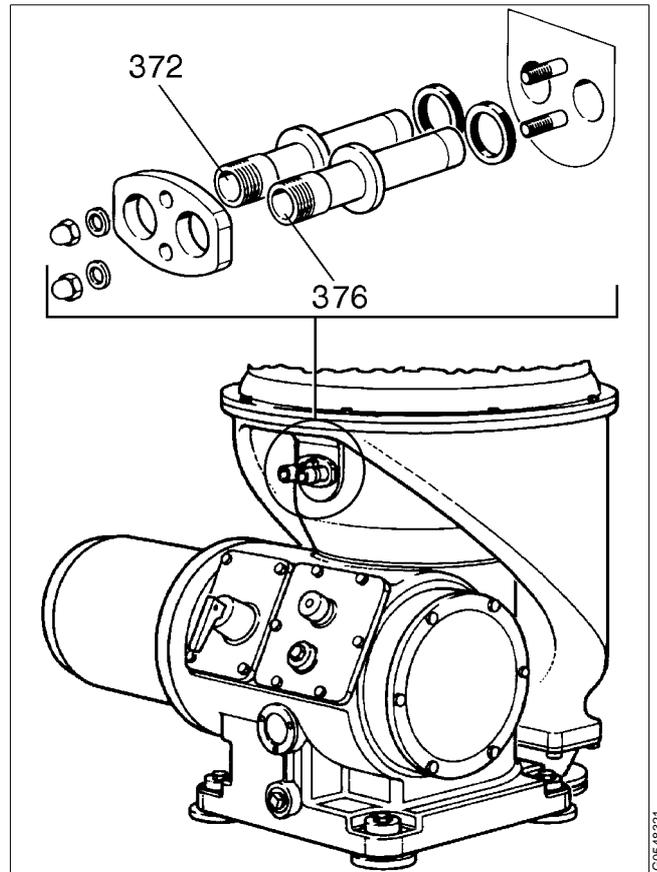
1. Fit the distributing cover and tighten the six screws.



G0532611

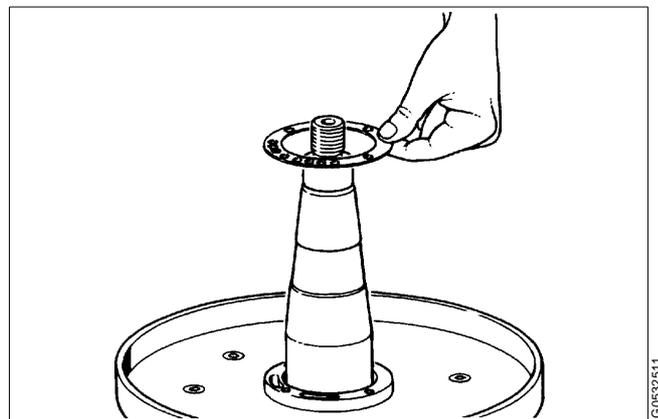
2. Fit the operating water inlet pipes into the distributing cover and connect the operating water hoses.

372. Bowl opening (discharge) water  
376. Bowl closing and make up water



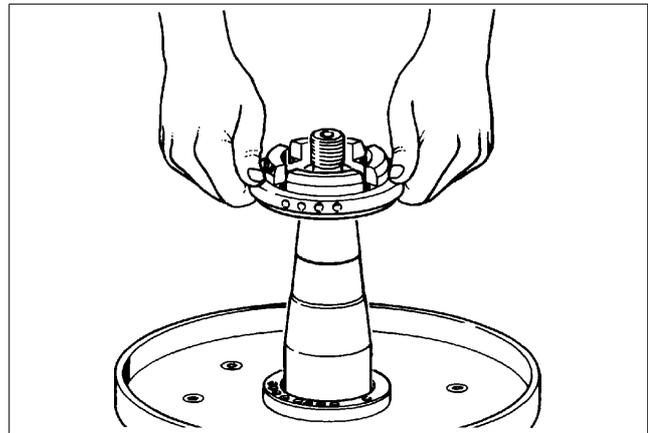
G0548321

3. Fit the operating paring disc gasket. Align the holes with those in the distributing cover.



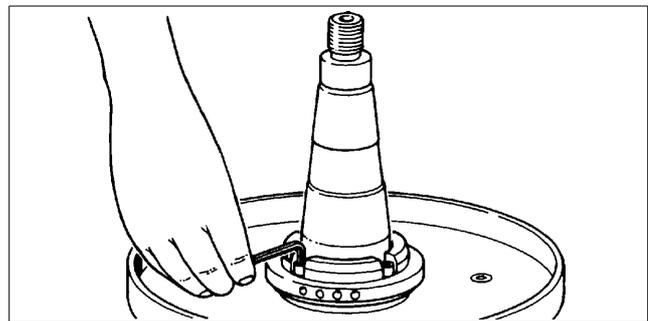
G0532511

4. Fit the operating paring disc.



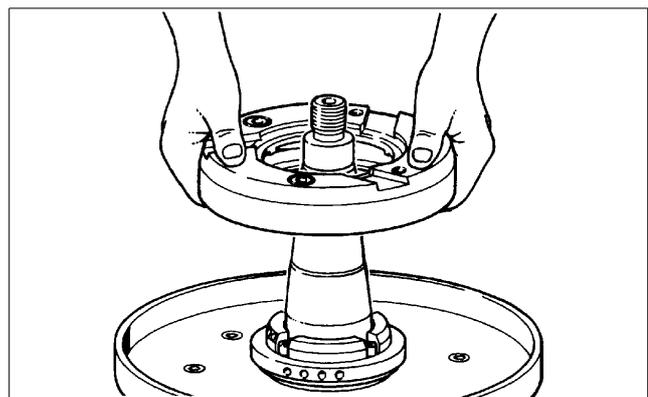
G0532411

5. Align the holes in the operating paring disc with the holes in the distributing cover and gasket. Tighten the four screws.



G0532311

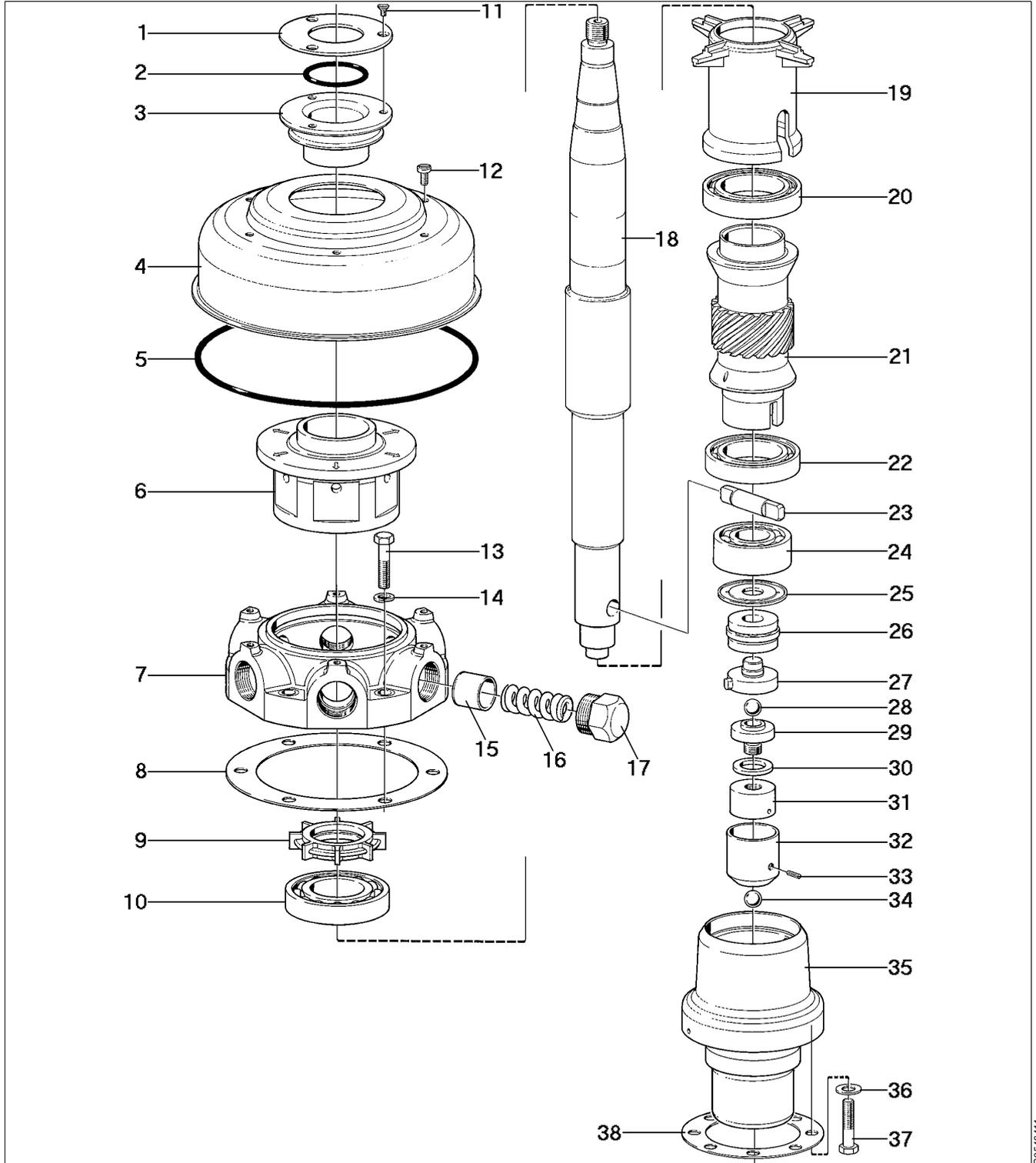
6. Fit the distributing ring. Try to place it in correct position.



G0532211

## 6.6 Vertical driving device (MS)

### 6.6.1 Exploded view



G0546411



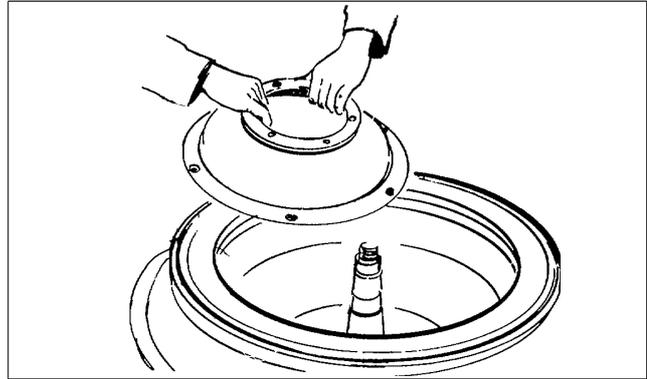
1. *Protecting plate*
2. *O-ring*
3. *Protecting collar*
4. *Guard*
5. *O-ring*
6. *Ball bearing housing*
7. *Spring casing*
8. *Gasket*
9. *Oil fan*
10. *Ball bearing*
11. *Screw*
12. *Screw*
13. *Screw*
14. *Spring washer*
15. *Buffer*
16. *Spring*
17. *Buffer plug*
18. *Bowl spindle*
19. *Stop sleeve*
20. *Ball bearing*
21. *Worm*
22. *Ball bearing*
23. *Conveyor*
24. *Ball bearing*
25. *Spacing washer*
26. *Ball bearing*
27. *Washer*
28. *Ball*
29. *Support ring*
30. *Height adjusting ring*
31. *Spacing sleeve*
32. *Bottom sleeve*
33. *Slotted pin*
34. *Ball*
35. *Bottom bearing housing*
36. *Washer*
37. *Screw*
38. *Gasket*

### 6.6.2 Dismantling

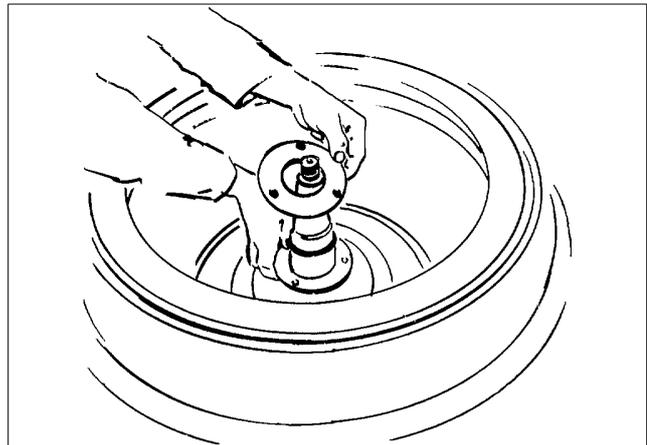
1. Unscrew the six screws and remove the hood and O-ring.

#### NOTE

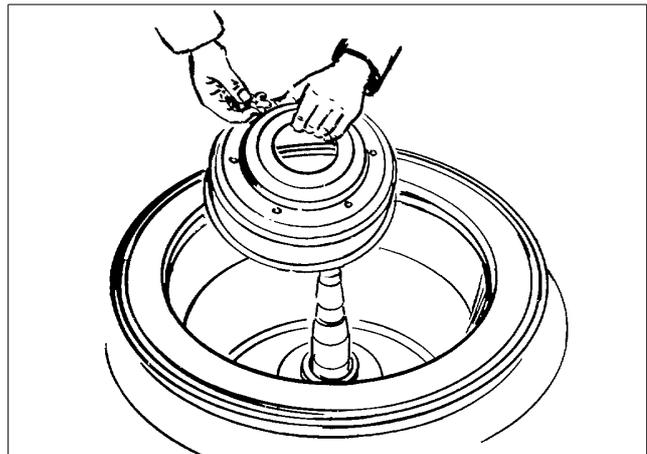
Clean the space in the bowl casing thoroughly before starting to dismantle the bowl spindle to prevent contaminations falling down into the oil gear housing.



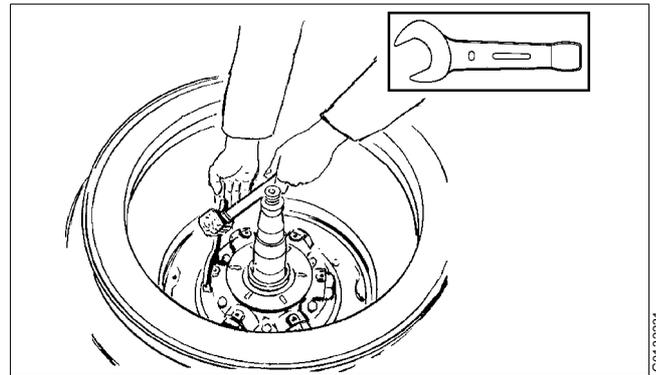
2. Unscrew the three screws and remove the protecting plate, O-ring and protecting collar.



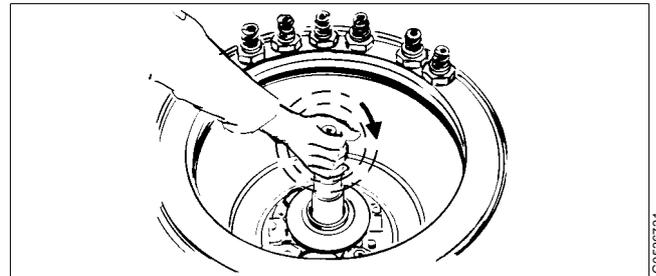
3. Unscrew the six screws and remove the guard and O-ring.



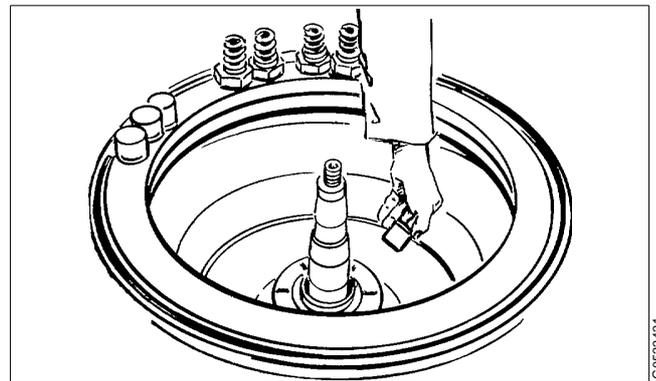
4. Loosen (but do not remove) the six screw plugs for the buffers with a spanner and a hammer.



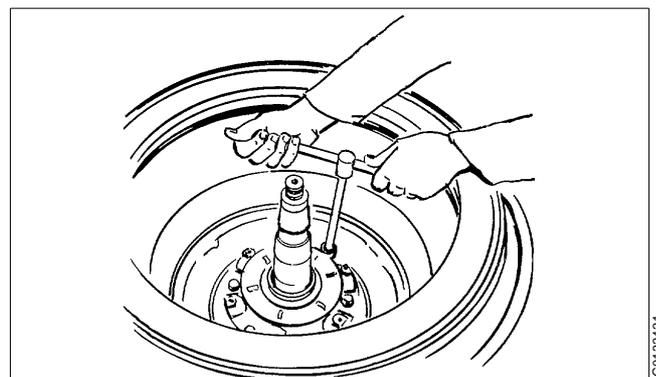
5. Unscrew the six screw plugs and remove the springs. Move the spindle top a few turns in a circle while pressing outwards. This will disengage buffers from the ball bearing housing.



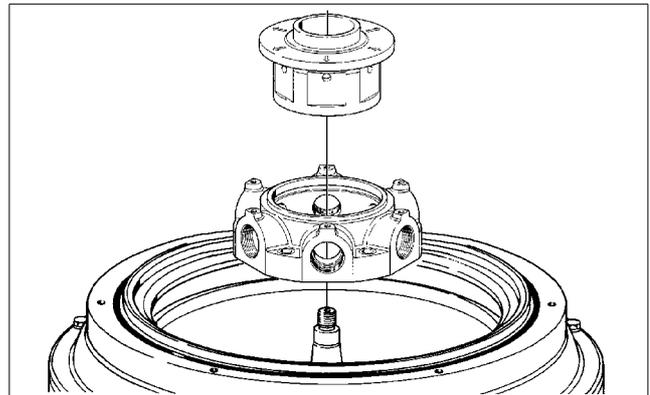
6. Remove the six buffers from the spring casing.



7. Unscrew the six screws holding the spring casing.



8. Prize out the ball bearing housing from the spring casing with a screw driver.
9. Remove the spring casing and gasket.



G00545011

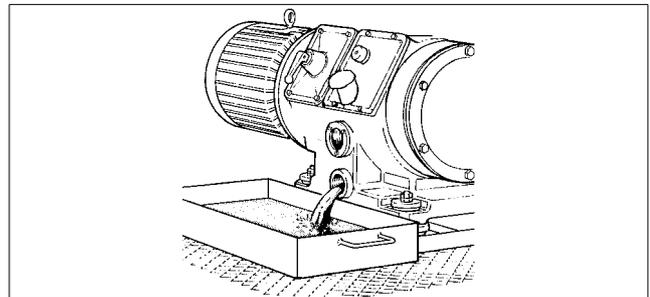
10. Drain the oil from the worm gear housing.



**CAUTION**

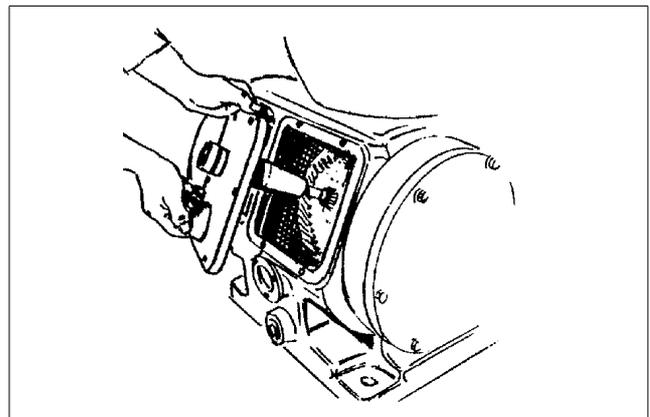
**Burn hazards**

Lubricating oil and various machine surfaces can be hot and cause burns.



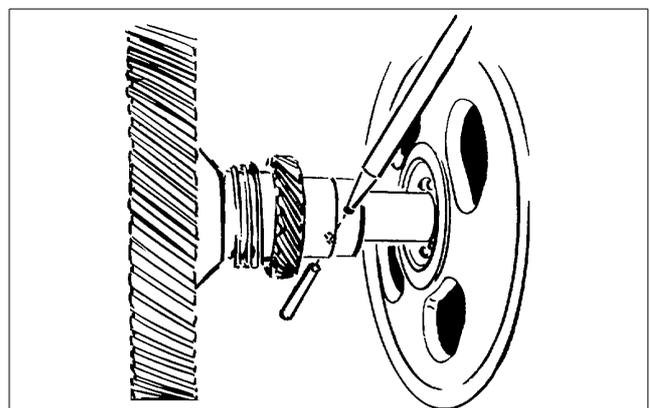
G0035921

11. Remove the brake cover and revolution counter cap and their gaskets.



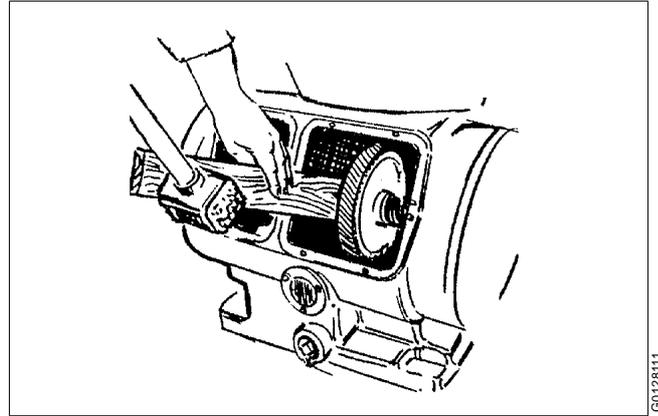
G0127911

12. Knock out the taper pin from the worm wheel stop ring.



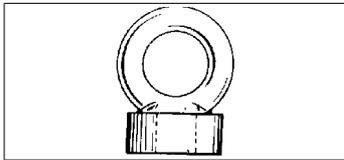
G0524511

13. Push the worm wheel to one side before removing the spindle. If worm wheel is stuck use a piece of wood to loosen it.

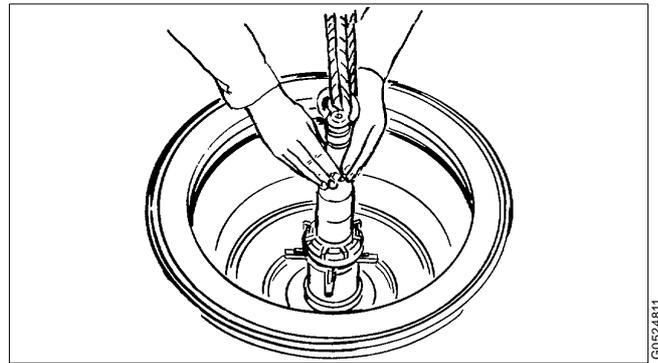


G0128111

14. Fit the lifting tool onto the spindle and lift out using the a hoist.



S0066811

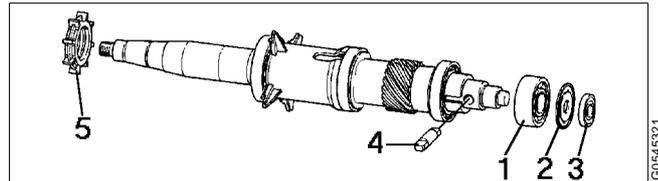


G0524811

15. Pull off the ball bearing (1) together with the spacing washer (2) and upper ball race (3) for the axial bottom ball bearing.

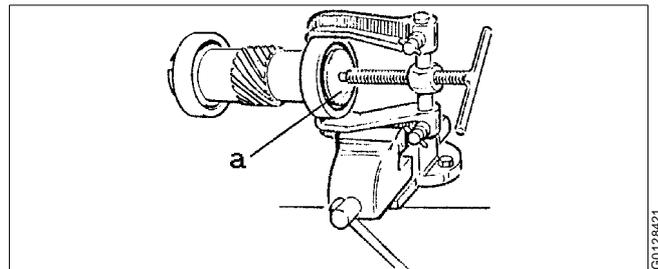
16. Remove the conveyor (4) for worm.

17. Remove the oil fan (5).



G0545321

18. Remove the worm and stop sleeve from the spindle. Pull off ball bearings from the worm. Use a washer (a) as a support for the puller.

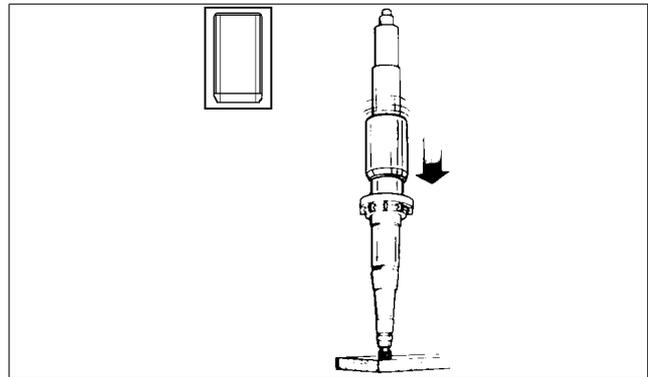


G0128421

19. Drive off the top ball bearing from the sleeve spindle with the driving-off sleeve. Use a wooden plank or similar as a soft base for the spindle top.

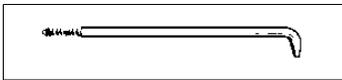


S0066611

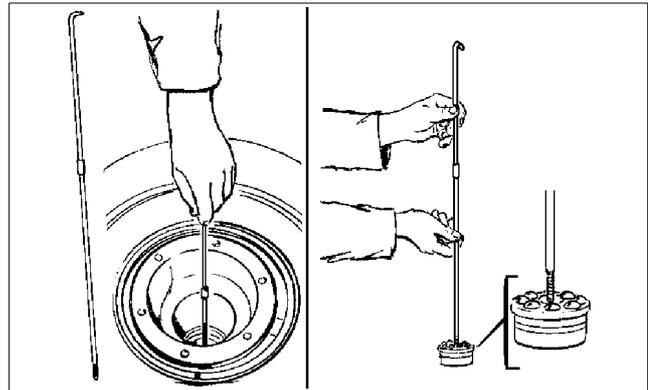


G0537511

20. Lift out the axial bottom ball bearing and the washer beneath using the lifting pin.

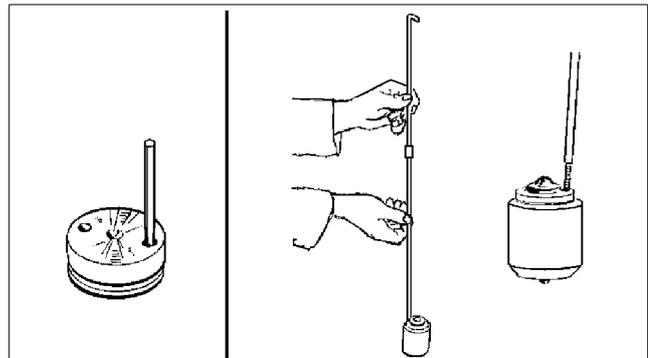


S0066711



G0138641

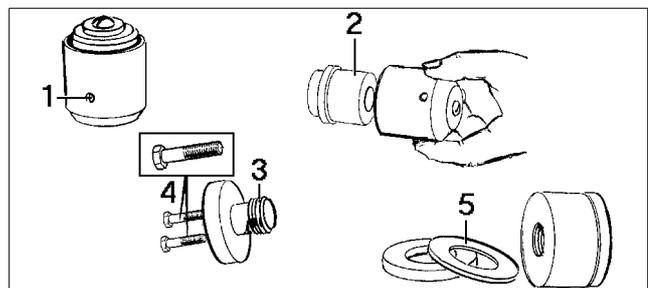
21. Lift out the bottom sleeve using the lifting pin.



G0138631

22. Knock out the slotted pin (1) from the spacing sleeve (2) and remove it. Unscrew support plug (3) using two screws (4) with threads  $\frac{1}{4}$ "-20 UNC to make height adjusting ring (5) accessible.

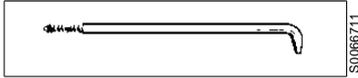
23. Remove deposits and clean all parts thoroughly in a suitable cleaning agent. See chapter "5.6 Cleaning" on page 82.



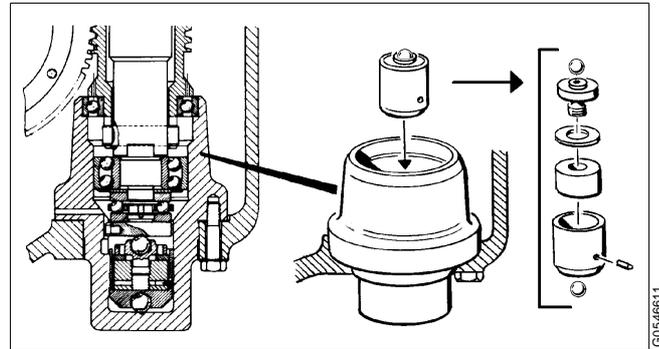
G0138631

### 6.6.3 Assembly

1. Fit the bottom sleeve with mounted parts (rings and sleeve) into the bottom bearing housing. Use the lifting pin.

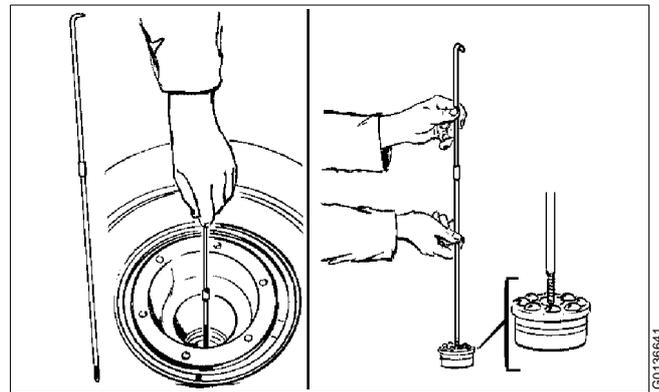


Check that one ball is fitted both on top and bottom of the bottom sleeve.



2. Fit the washer and the ball bearing onto the bottom sleeve.

When mounting ball bearings on the spindle and worm as described below, the bearings must be heated in oil to **max. 125 °C**.



#### WARNING

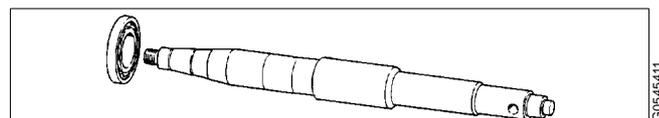
**Burn hazards**

Use protective gloves when handling the heated bearings.

#### NOTE

If in doubt how to mount roller bearings correctly, see the detailed description in chapter "5.9.1 Ball and roller bearings" on page 92.

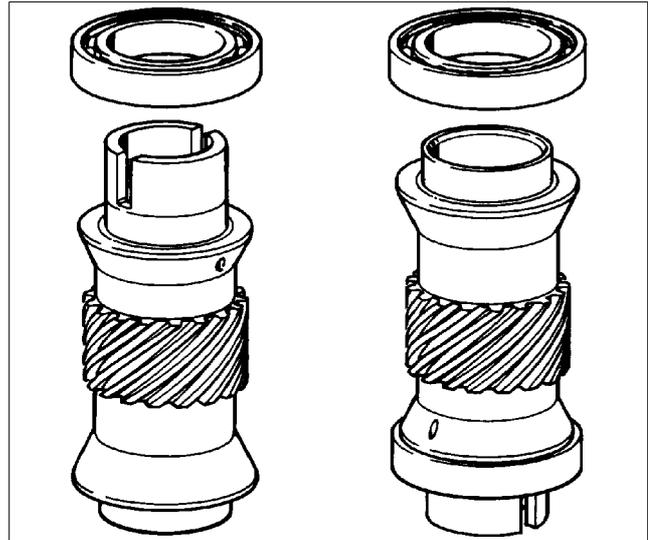
3. Heat the ball bearing and fit it on the spindle.



✓ **Check point**

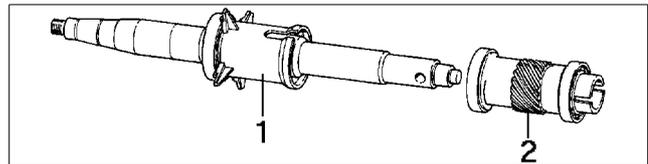
“5.4.25 Worm; wear of groove” on page 78.  
 “5.7.1 Worm wheel and worm; wear of teeth” on page 86

- Heat the two ball bearings and fit them on the worm.



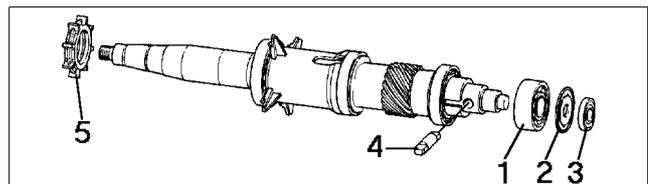
G 0545511

- Fit the stop sleeve (1) and the worm (2) on the spindle.



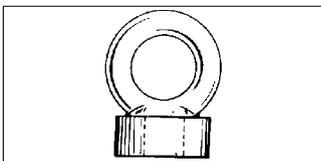
G 0545221

- Fit the ball bearing (1) on the spindle. Then fit the spacing washer (2) and upper ball race (3) for the axial bottom bearing. The ball race must be heated.

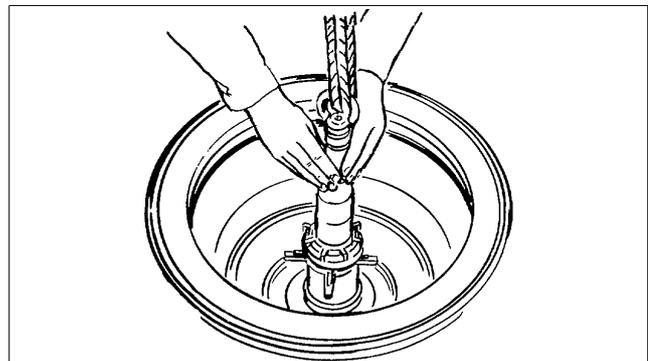


G 0545321

- Fit the conveyor (4) and the oil fan (5).
- Fit the lifting tool to the spindle and lift it using a hoist.

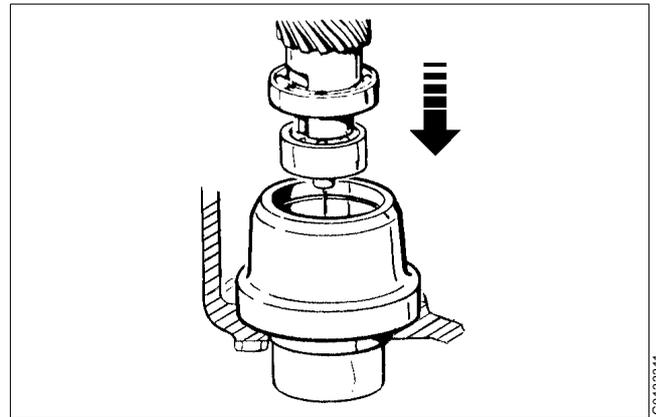


S 0066811



G 0524811

9. Carefully lower the spindle into the frame and guide the spindle into the correct position in the bottom bearing housing so the ball bearings enter their seats. If the ball bearings do not completely enter their seats, tap the spindle top gently with a soft hammer.

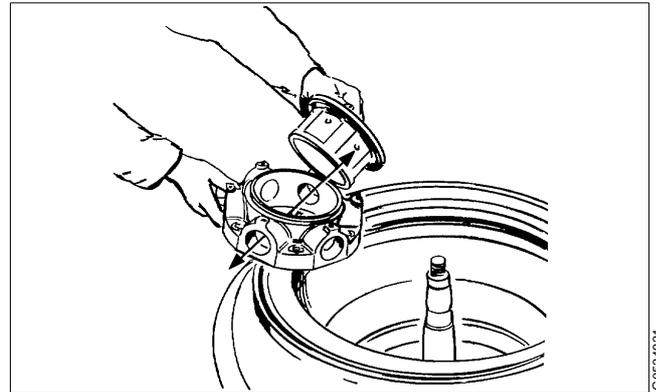


G0133311

✓ **Check point**

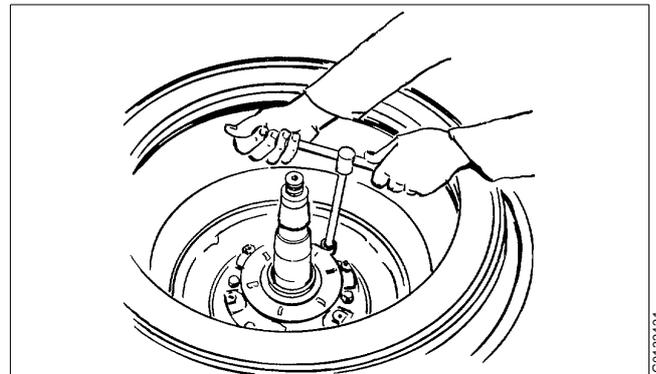
“5.4.6 Buffer springs and ball bearing housing” on page 69.

10. Fit the spring casing with gasket and ball bearing housing. Position the flat surfaces of the ball bearing housing in front of the buffer holes in the spring casing.



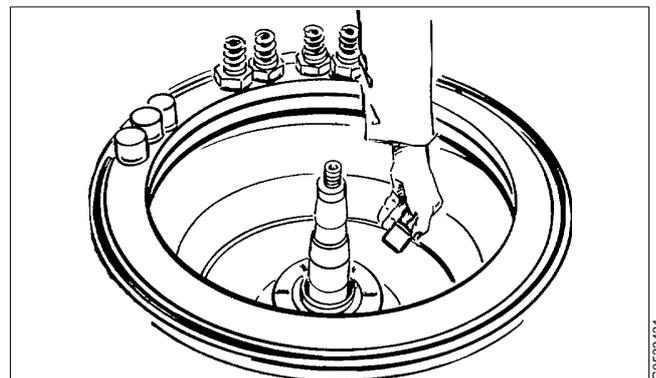
G0524921

11. Tighten the six screws for the spring casing.



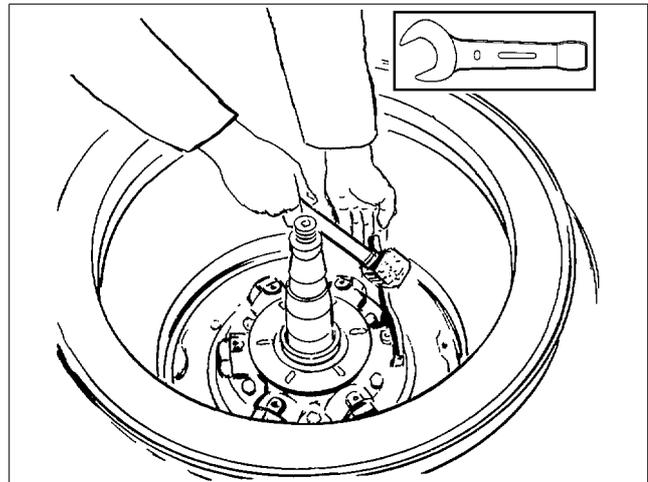
G0132421

12. Fit the buffers, springs and screw plugs.



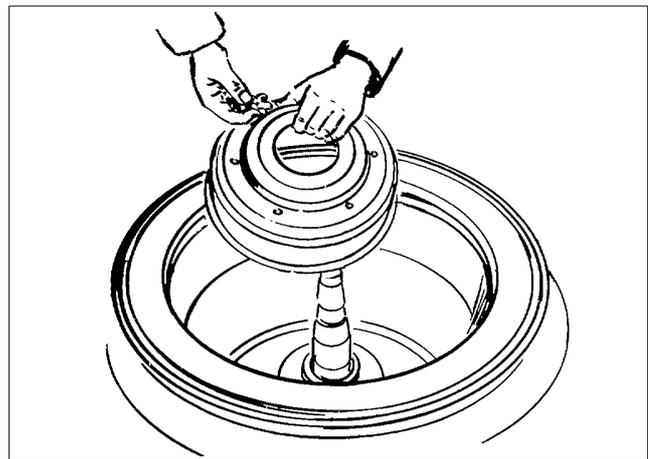
G0522421

13. Tighten the six screw plugs.



G0133431

14. Fit the guard with O-ring and tighten the six screws.



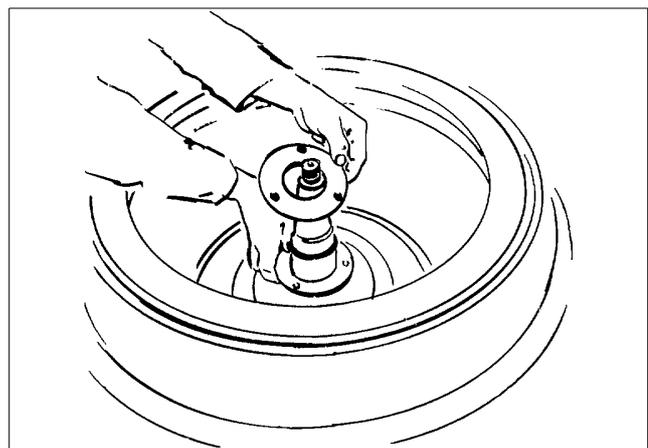
G0132741

15. Fit the protecting collar with O-ring and protecting plate.

**NOTE**

Check that the protecting collar is in the bottom position before tightening the protecting plate.

Tighten the three screws for the protecting plate.

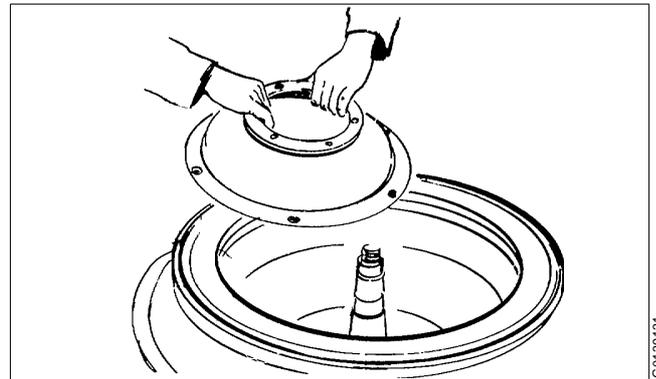


G0132031

16. Fit the hood with O-ring and tighten the six screws.

✓ **Check point**

“5.4.3 Bowl spindle; height position” on page 67.



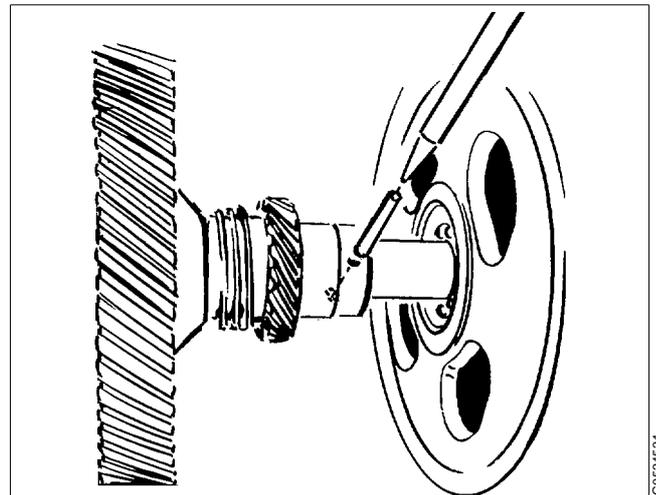
G0139131

17. Match the worm wheel with the teeth in the worm of the bowl spindle. Knock the taper pin into the worm wheel stop ring.

✓ **Check points**

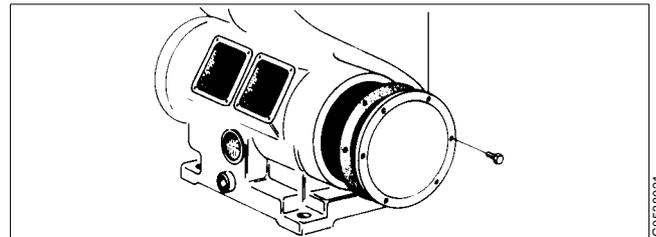
“5.4.27 Worm wheel shaft; radial wobble” on page 79.

“5.4.4 Bowl spindle; radial wobble” on page 68.



G0524521

18. Fit the protecting cover with gasket.

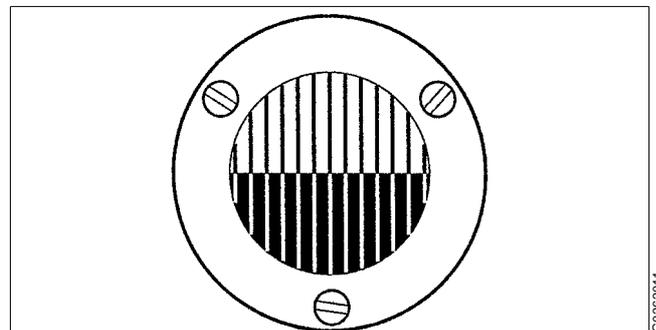


G0538021

19. Pour oil into worm gear housing. The oil level should be exactly in the middle of the sight glass.

Oil volume: Approx. **12 litres**

For correct oil volume and recommended oil brands, see chapter “8.1 Technical data” on page 175 and “8.5 Lubricants” on page 186.

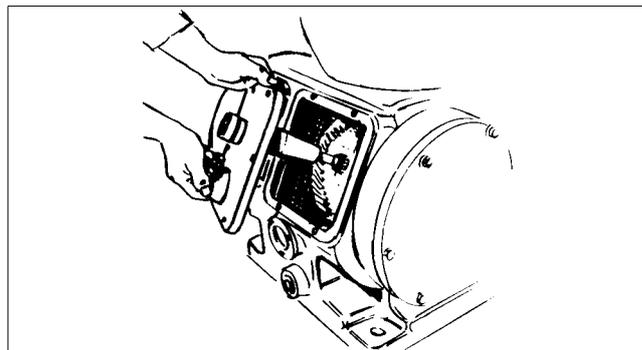


G0262011

✓ **Check point**

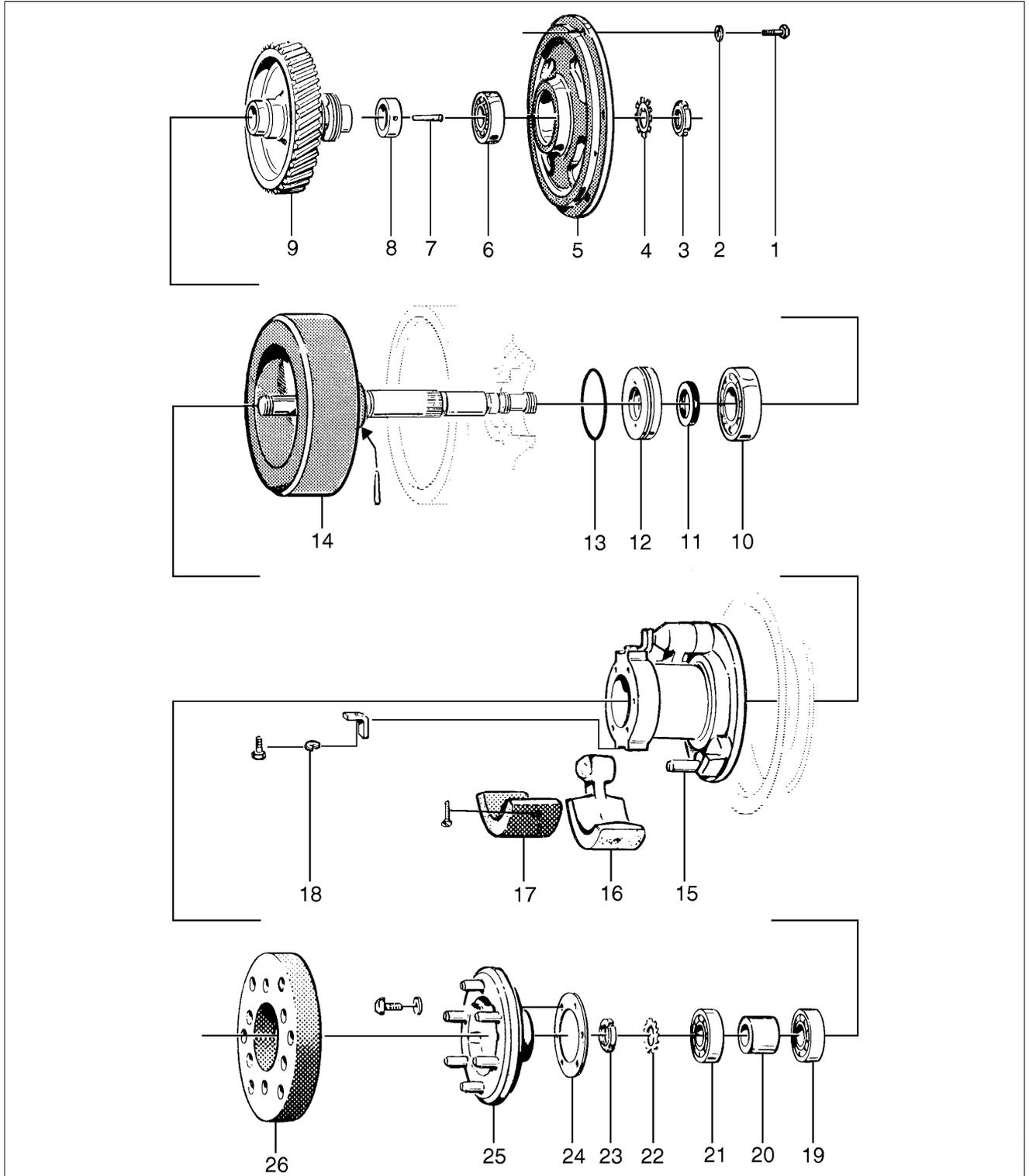
“5.4.5 Brake” on page 68.

20. Fit the brake cover and revolution counter cap and their gaskets.



# 6.7 Horizontal driving device (MS)

## 6.7.1 Exploded view



G0591231

1. *Screw*
2. *Spring washer*
3. *Round nut*
4. *Lock washer*
5. *Bearing shield*
6. *Ball bearing*
7. *Taper pin*
8. *Stop ring*
9. *Worm wheel*
10. *Ball bearing*
11. *Sealing ring*
12. *Sealing washer*
13. *O-ring*
14. *Worm-wheel shaft with coupling drum*
15. *Nave*
16. *Friction block*
17. *Friction pad*
18. *Holding bracket*
19. *Ball bearing*
20. *Spacing sleeve*
21. *Ball bearing*
22. *Lock washer*
23. *Round nut*
24. *Gasket*
25. *Coupling disc*
26. *Elastic plate*

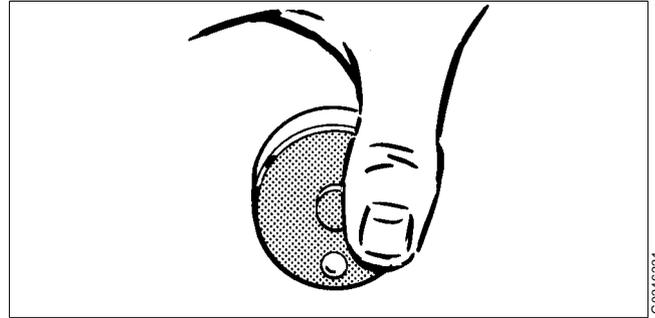
## 6.7.2 Dismantling



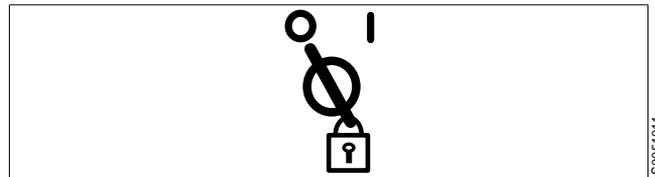
**DANGER**

**Entrapment hazards**

1. Make sure that rotating parts have come to a **complete standstill** before starting **any** dismantling work.  
  
The revolution counter and the motor fan indicates if separator parts are rotating or not.
2. To avoid accidental start, switch off and lock power supply before starting **any** dismantling work.



G0246221



S0051011

The parts must be handled carefully. Don't place parts directly on the floor, but on a clean rubber mat, fibreboard or a suitable pallet.

If the bowl spindle has been removed according to earlier description, points 1-5 below are already done. Proceed with point 6.

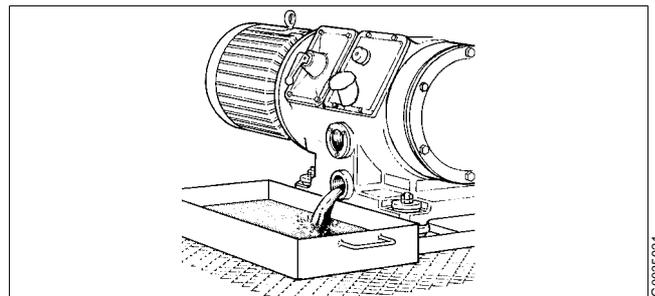
1. Drain the oil from the worm gear housing.



**CAUTION**

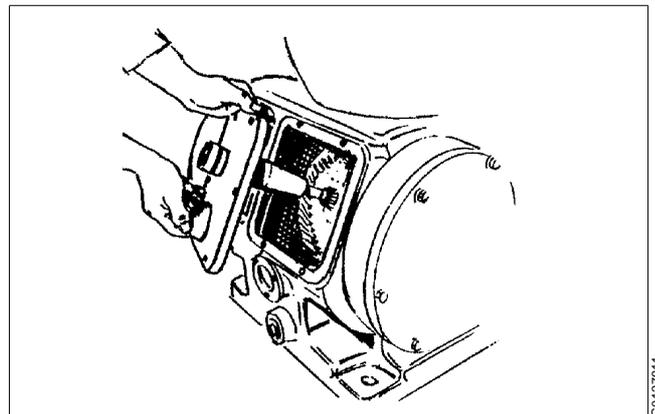
**Burn hazards**

Lubricating oil and various machine surfaces can be hot and cause burns.



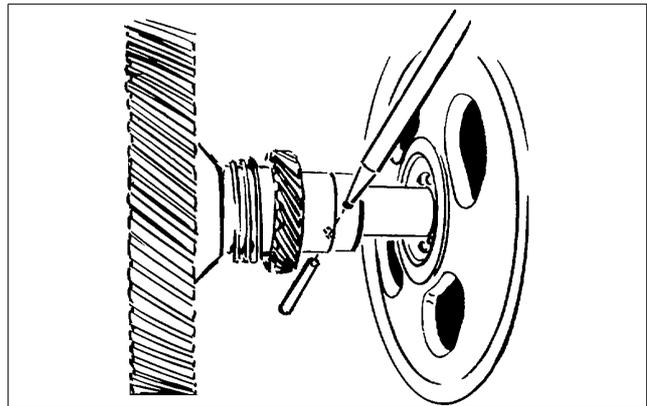
G0035921

2. Remove the brake cover and revolution counter cap and their gaskets.



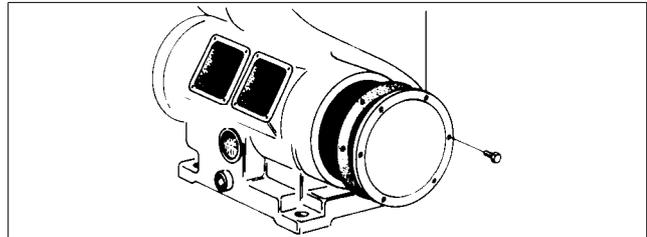
G0127911

3. Knock out the taper pin from the worm wheel stop ring.



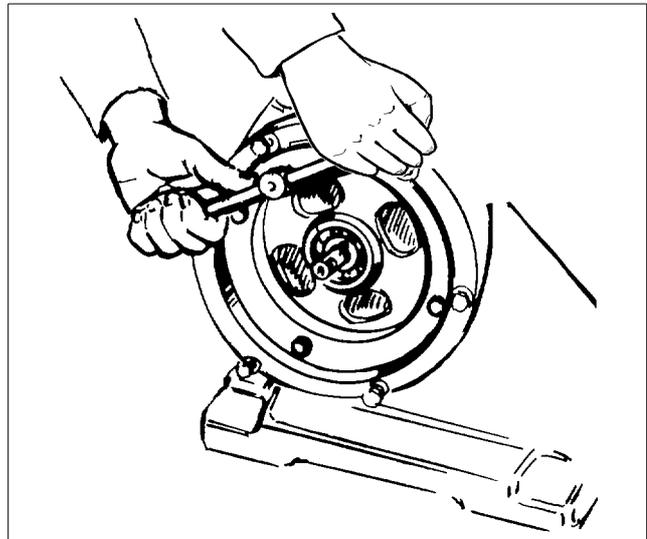
G0524511

4. Remove the protecting cover with gasket.



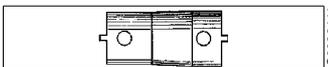
G0559021

5. Unscrew the four screws for the bearing shield and remove it.

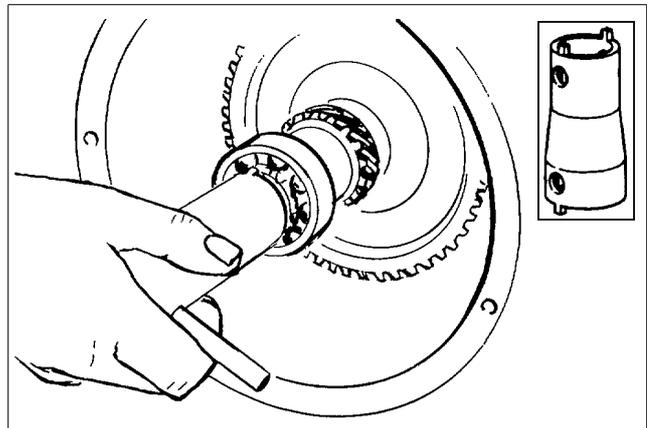


G0525521

6. Unscrew and remove the round nut and lock washer.

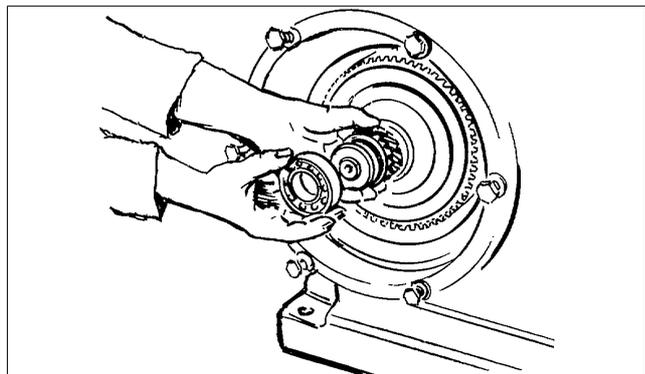


S0066411



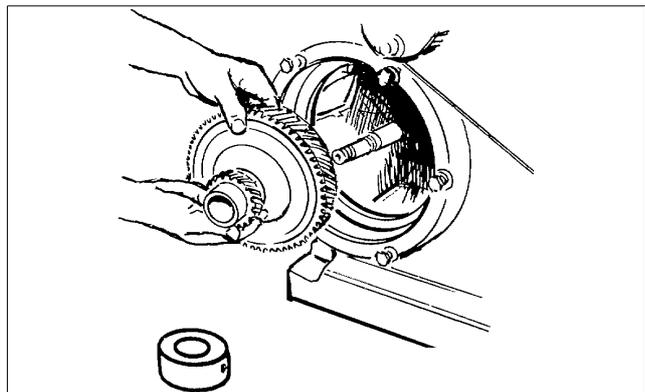
G0525421

7. Remove the ball bearing.



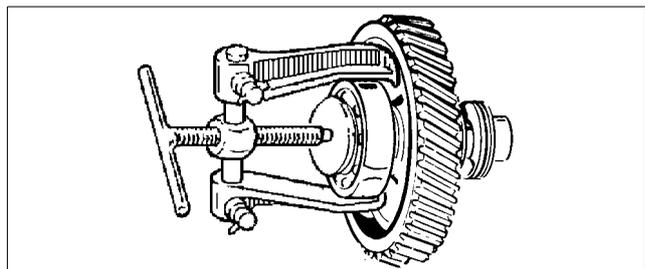
G0522311

8. Remove the stop ring and worm wheel with ball bearing.



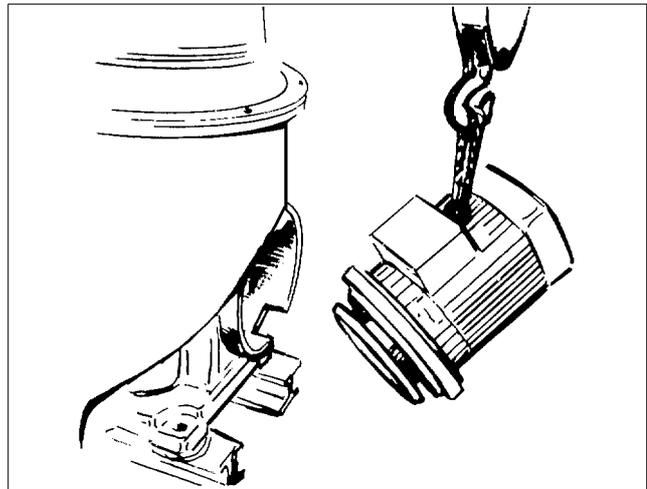
G0522211

9. Pull off the ball bearing from the worm wheel. Use a washer as a support for the puller.

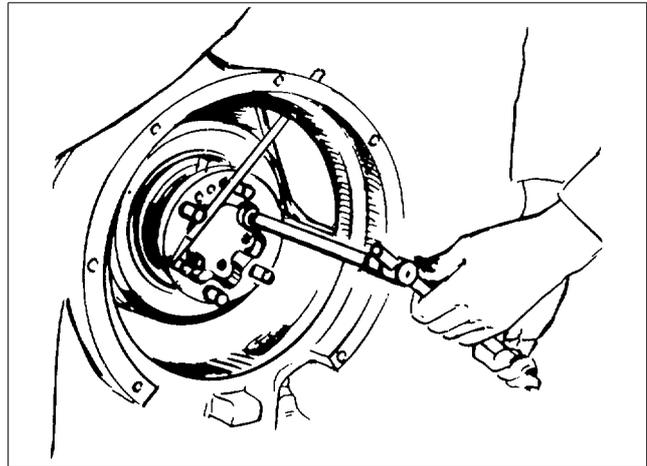


G0547611

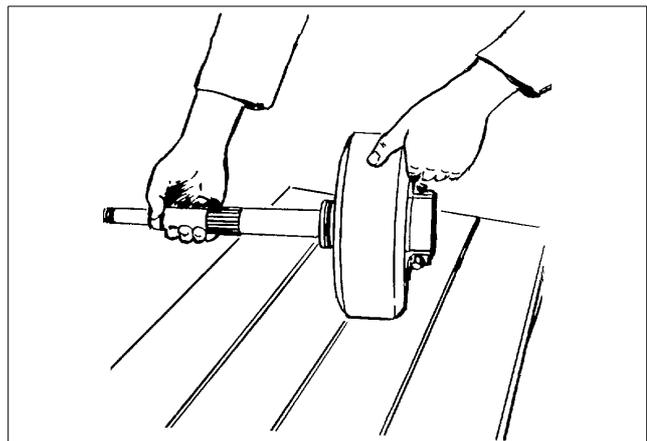
10. Disconnect the motor cables. Note the positions of cables in the terminal box to re-connect correctly (for correct direction of rotation).
11. Remove the electric motor using a hoist.



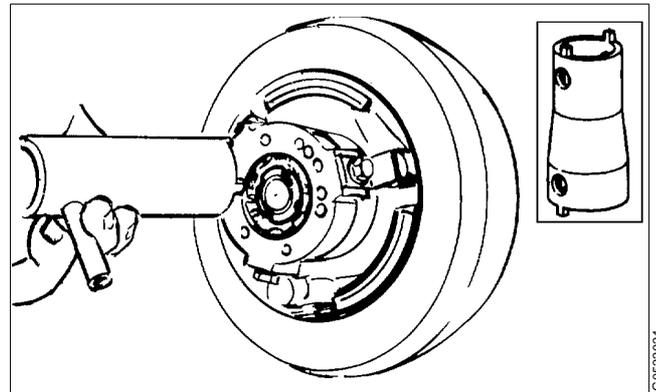
12. Remove the flexible plate and unscrew the six screws for the coupling disc and remove it.



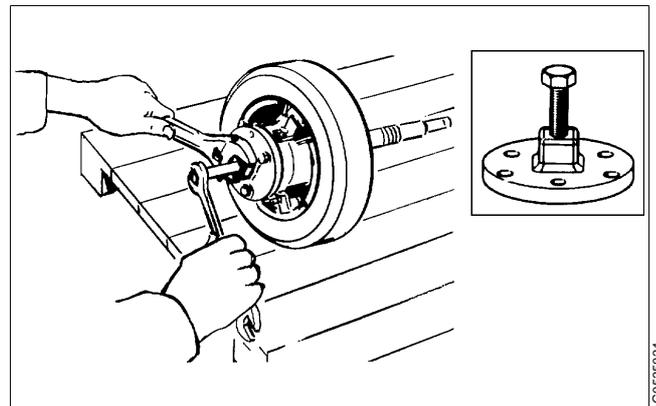
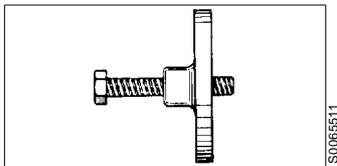
13. Remove the worm wheel shaft with friction clutch pulley.



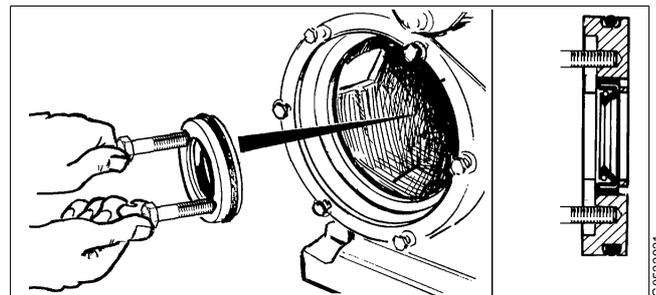
14. To dismantle the nave, unscrew the round nut with the pin spanner and remove the lock washer.



15. Pull off the nave with the puller and remove the friction blocks.

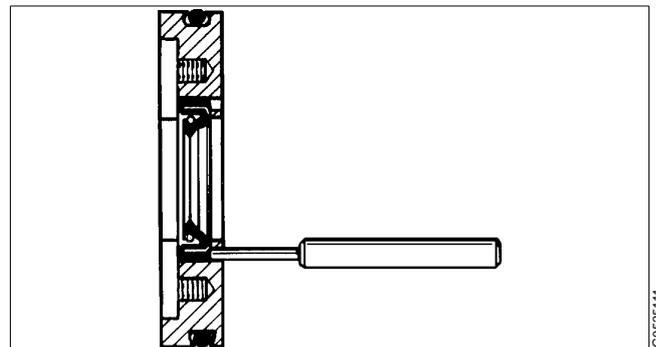


16. Remove the sealing washer using two screws with 1/4"-20 UNC threads.



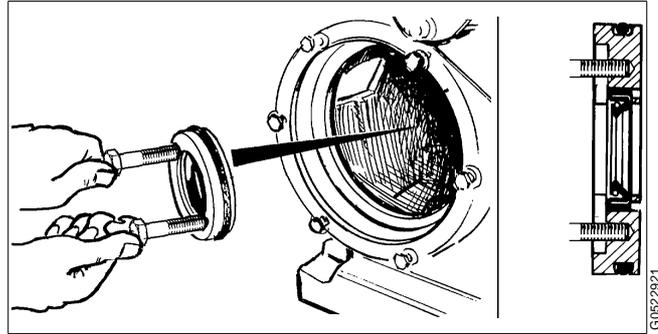
17. Remove the sealing ring from the sealing washer.

18. Remove deposits and clean all parts thoroughly in a suitable cleaning agent. See chapter "5.6 Cleaning" on page 82.



### 6.7.3 Assembly

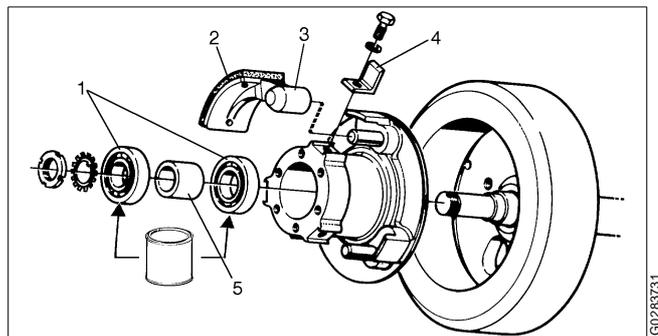
1. Lubricate the O-ring on the sealing washer periphery and the sealing ring with silicone grease. Fit the sealing washer in frame and check that the sealing ring is fitted in the correct direction, as illustrated.



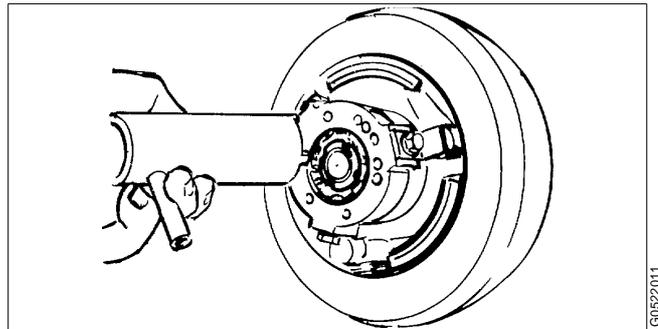
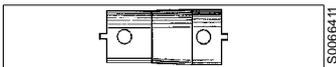
✓ **Check point**

“5.4.7 Coupling friction pads” on page 71.

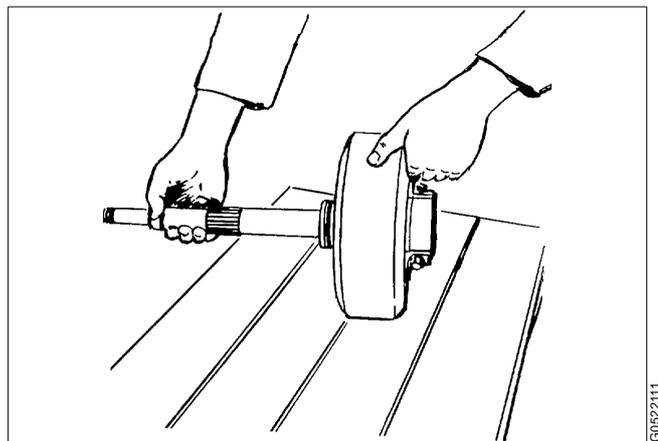
2. Fit the friction blocks (3) with pads (2) on the nave and lock them with holding brackets (4). Lubricate the ball bearings. For recommended lubricants, see chapter “8.5 Lubricants” on page 186.
3. Fit the ball bearings (1) and spacing sleeve (5) with the driving on sleeve tool to force the ball bearings into their correct positions.



4. Tighten the round nut with the pin spanner and secure it with the lock washer.



5. Fit the worm wheel shaft.

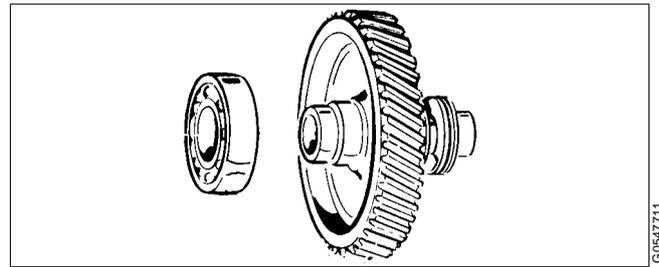


✓ **Check point**

“5.7.1 Worm wheel and worm; wear of teeth” on page 86.

6. Heat the ball bearing and fit it on the worm wheel.

When mounting the ball bearings on the worm wheel and shaft, the bearings must be heated in oil to **max. 125 °C**.



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**WARNING**

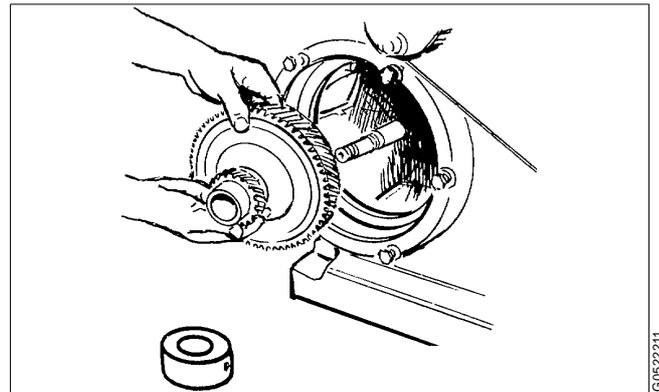
**Burn hazards**

Use protective gloves when handling the heated bearings.

**NOTE**

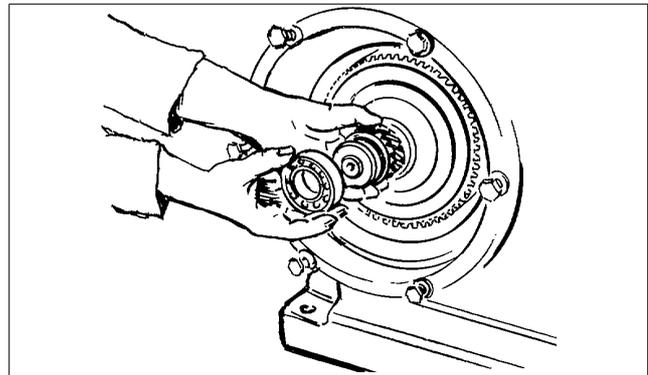
If any doubt how to mount roller bearings correctly, see the detailed description in chapter “5.9.1 Ball and roller bearings” on page 92.

7. Fit the worm wheel with the ball bearing and fit the stop ring.



G0522211

8. Fit the ball bearing.

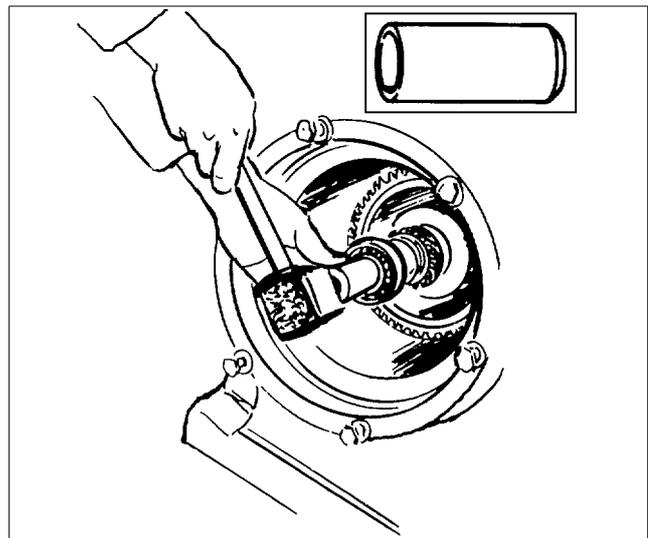


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9. Knock the ball bearing into its seat with the driving-on sleeve tool.

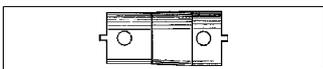


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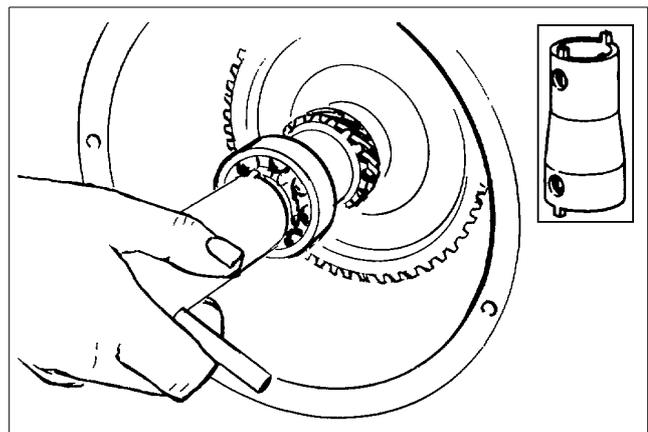


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10. Tighten the round nut with the pin spanner and secure it with the lock washer.

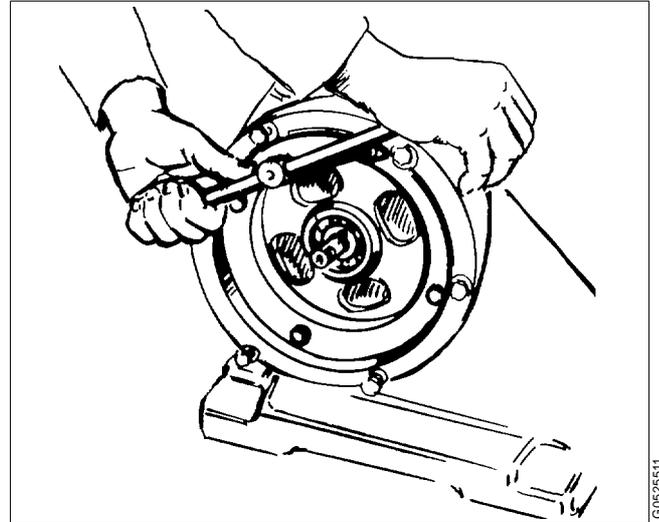


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11. Fit the bearing shield and tighten the four screws.



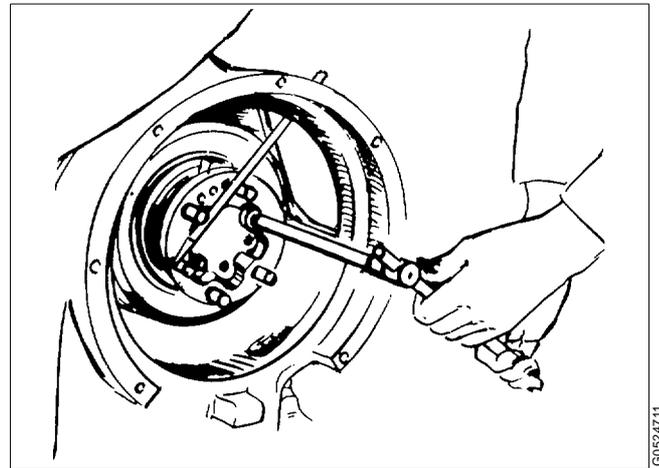
G0525511

12. Fit the coupling disc with gasket and tighten the six screws. If necessary, use the driving-on sleeve.

13. Fit the flexible plate.

✓ **Check point**

"5.4.13 Flexible plate in coupling" on page 73.



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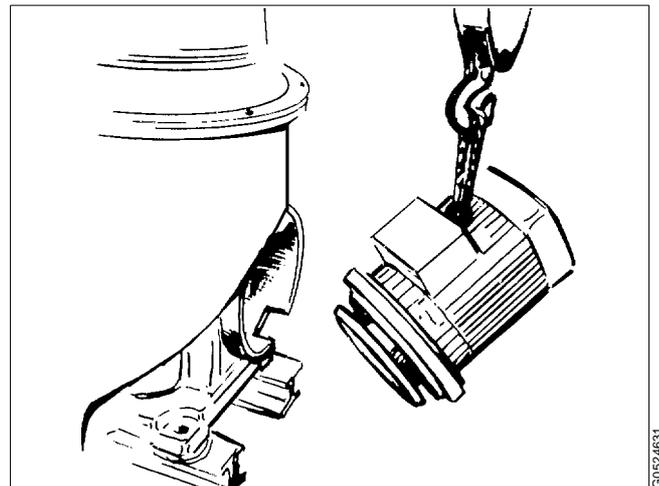
14. Fit the electric motor.



**DANGER**

**Disintegration hazards**

When power cables have been connected and the separator is completely assembled see "4.1.2 Ready for start" on page 31, always check direction of rotation. If incorrect, vital rotating parts could unscrew causing disintegration of the machine.



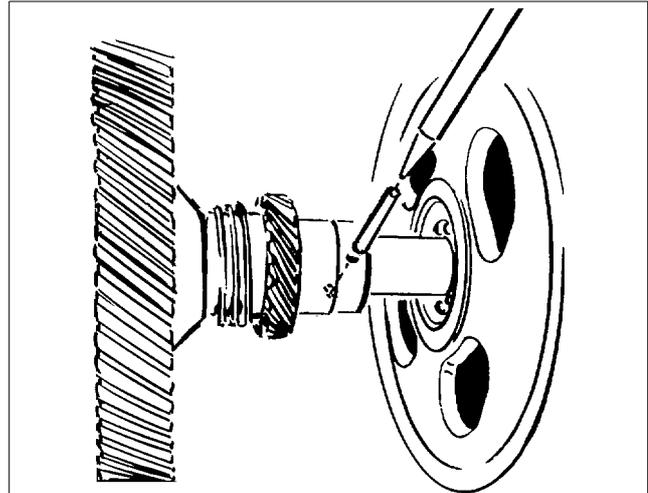
G0524631

The remaining description in this section implies that the bowl spindle is mounted in the frame. If not, proceed with the assembly instruction for the vertical driving device in chapter “6.6.3 Assembly” on page 145.

15. Match the worm wheel with the teeth in the worm of the bowl spindle. Knock the taper pin into the worm wheel stop ring.

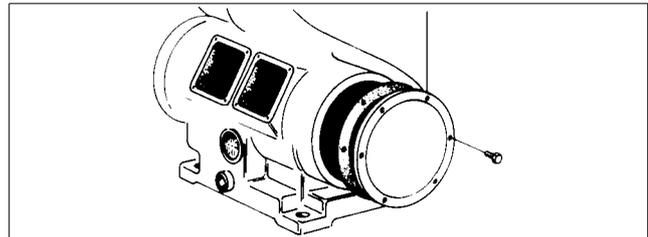
✓ **Check point**

“5.4.27 Worm wheel shaft; radial wobble” on page 79.



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16. Fit the protecting cover with gasket.



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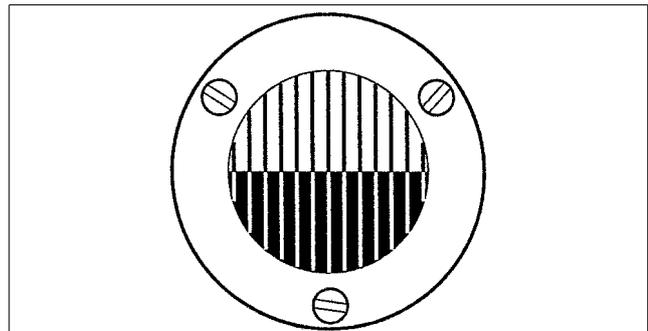
17. Pour oil into worm gear housing. The oil level should be exactly in the middle of the sight glass.

Oil volume: Approx. **12 litres**

For recommended oil brands see chapter “8.5 Lubricants” on page 186.

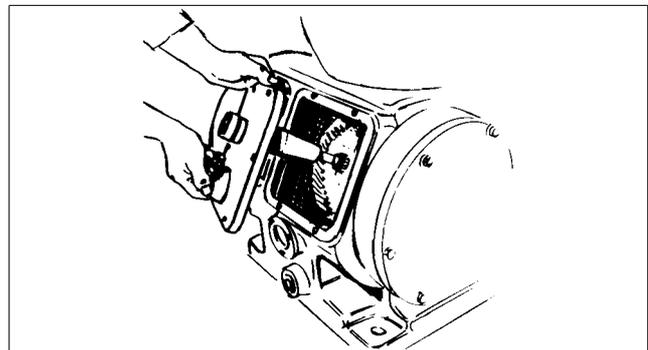
✓ **Check point**

“5.4.5 Brake” on page 68.



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18. Fit the brake cover and revolution counter cap and their gaskets.



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# 7 *Trouble-tracing*

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## 7.1 FOPX mechanical functions

### 7.1.1 Separator vibrates

#### NOTE

Some vibration is normal during the starting and stopping sequences when the separator passes through its critical speeds.



#### DANGER

##### Disintegration hazards

When excessive vibration occurs, **stop** separator and **keep bowl filled** with liquid during rundown.

The cause of the vibration must be identified and corrected before the separator is restarted. Excessive vibration may be due to incorrect assembly or poor cleaning of the bowl.

Cause	Corrective actions	Page
Bowl out of balance due to: - poor cleaning - incorrect assembly - incorrect disc stack compression - bowl assembled with parts from other separators	Dismantle the separator and check the assembly and cleaning	114
Uneven sludge deposits in the sludge space	Dismantle and clean the separator bowl	108
Height adjustment of the oil paring disc or bowl spindle is incorrect	Stop the separator, measure, and if necessary, adjust the height(s)	67, 78
Bowl spindle bent (max 0,04 mm)	Renew the bowl spindle	68
Bearing is damaged or worn	Renew all bearings	137, 151
Vibration damping rubber cushions are worn out	Renew all rubber cushions	49
Spindle top bearing spring is broken	Renew all springs	137

**7.1.2 Smell**

<b>Cause</b>	<b>Corrective actions</b>	<b>Page</b>
Normal occurrence during start while the friction blocks are slipping	None	–
Brake is applied	Release the brake	–
Oil level in gear housing is too low	Check oil level and add oil if necessary	31

**7.1.3 Noise**

<b>Cause</b>	<b>Corrective actions</b>	<b>Page</b>
Oil level in gear housing is too low	Check oil level and add oil if necessary	31
Height adjustment of the oil paring disc or bowl spindle is incorrect	Stop the separator, measure and adjust the height(s)	67, 78
Worm wheel and worm are worn	Renew worm wheel and worm	86
Bearing is damaged or worn	Renew all bearings	137, 151
Incorrect play between coupling pulley and elastic plate	Adjust the play	73

**7.1.4 Speed too low**

<b>Cause</b>	<b>Corrective actions</b>	<b>Page</b>
Brake is applied	Release the brake	–
Coupling pads are oily or worn	Clean or renew friction pads	71
Bowl is not closed or leaking	Dismantle the bowl and check	107
Motor failure	Repair the motor	–
Bearing is damaged	Renew all bearings	137, 151
Incorrect gear transmission (60 Hz gear for 50 Hz power supply)	Stop and change the gear transmission to suit the power supply frequency	86, 137, 151
Incorrect coupling friction blocks (60 Hz blocks for 50 Hz power supply)	Change the friction blocks to suit the power supply frequency	71

### 7.1.5 Starting power too high

Cause	Corrective actions	Page
Incorrect friction blocks (50 Hz blocks for 60 Hz power supply)	 <b>DANGER</b> Stop immediately and change the friction blocks to suit the power supply frequency	71
Wrong direction of rotation	Change electrical phase connections to the motor	–
Brake is applied	Release the brake	–

### 7.1.6 Starting power too low

Cause	Corrective actions	Page
Incorrect friction blocks (60 Hz blocks for 50 Hz power supply)	Stop immediately and change the friction blocks to suit the power supply frequency	71
Friction pads are oily or worn	Clean or renew friction pads	71
Motor failure	Repair the motor	–

### 7.1.7 Starting time too long

Cause	Corrective actions	Page
Brake is applied.	Release the brake.	–
Friction pads are oily or worn	Renew or clean friction pads	71
Height position of oil paring disc or operating device is incorrect	Stop, check and adjust the height	71, 77
Motor failure	Repair the motor	–
Bearing is damaged or worn	Renew all bearings	137, 151

### 7.1.8 Retardation time too long

Cause	Corrective actions	Page
Brake friction pad is worn or oily	Renew or clean brake friction pad	68

**7.1.9 Water in worm gear housing**

<b>Cause</b>	<b>Corrective actions</b>	<b>Page</b>
Bowl casing drain is obstructed.	Clean the casing and the drains properly. The drains have connection Nos. 462 and 463 on the <i>Basic size drawing</i> . Solve the reason for obstruction. Clean worm gear housing and change oil.	86
Leakage at the top bearing.	Renew seal ring and change oil.	137, 89
Condensation.	Clean worm gear housing and change oil.	89

## 7.2 FOPX separating functions

### 7.2.1 Liquid flows through the bowl casing drain and/or sludge outlet

Cause	Corrective actions	Page
Sludge discharge or water draining in progress	None (normal)	–
Strainer in operating water line is clogged or water pressure/flow is too low	Clean the strainer and check water pressure/flow: Closing water pressure, 20-30 kPa Closing water flow	–
Channels in operating water device are clogged	Clean the operating water device	132
O-rings at the flow control disc are defective	Renew the O-rings	107
Paring chamber cover (small lock ring) is defective	Renew the paring chamber cover	107
Seal ring in the bowl hood defective.	Renew the seal ring	107
Sealing edge of the sliding bowl bottom is defective	Smoothen sealing edge of the sliding bowl bottom or renew it	64
Valve plugs are defective	Renew all valve plugs	64
Bowl speed is too low	See section “7.1.4 Speed too low” on page 165 in this chapter	–

### 7.2.2 Bowl opens accidentally during operation

Cause	Corrective actions	Page
Strainer in the operating water supply is clogged	Clean the strainer	–
No water in the operating water system	Check the operating water system and make sure the valve(s) are open	–
Water connections to the separator are incorrectly fitted	Rectify	–
Upper nozzle in the dosing ring is clogged	Clean the nozzle. Carry out an Intermediate Service (IS)	57
Square-sectioned ring in sliding bowl bottom is defective	Renew the square-sectioned ring. Carry out an Intermediate Service (IS)	64
Valve plugs are defective	Renew all plugs. Carry out an Intermediate Service (IS)	64
Supply valve for opening water is leaking	Rectify the leak	–

### 7.2.3 Bowl fails to open for sludge discharge

Cause	Corrective actions	Page
Strainer in the operating water supply is clogged	Clean the strainer	–
Seal rings in operating water device are defectiv	Renew the seal rings	132
Operating water flow is too low	Check the opening water flow; 18 l/min	–
Dosing ring too firmly tightened	Check the tightening torque	127
Lower nozzle in the dosing ring is clogged	Clean the nozzle. Carry out an Intermediate Service (IS)	57
Seal ring in the operating slide is defective	Renew the seal ring. Carry out an Intermediate Service (IS)	120

### 7.2.4 Unsatisfactory sludge discharge

Cause	Corrective actions	Page
Dosing ring is too firmly tightened	Check the tightening torque	127
Valve plugs in the operating slide too are high	Renew with correct valve plugs	64
Sludge deposits in the operating system	Check and clean the operating system	120, 132

### 7.2.5 Unsatisfactory separation

Cause	Corrective actions	Page
Incorrect separation temperature	Adjust	–
Throughput is too high	Adjust	–
Disc stack is clogged	Clean disc stack	84
Sludge space in bowl is filled	Clean and reduce the time between sludge discharges	84
Bowl speed is too low	Examine the motor and power transmission including the gear ratio	86, 151

### 7.2.6 High pressure in oil outlet

Cause	Corrective actions	Page
Throughput is too high	Adjust	–
Valve(s) in the oil outlet line is closed	Open the valve(s)	–
Bowl disc stack is clogged	Clean disc stack	84

### 7.2.7 High pressure in water outlet

Cause	Corrective actions	Page
Increased back pressure in the clean oil outlet	See “7.2.6 High pressure in oil outlet” above	–
Bowl disc stack is clogged	Clean the disc stack	84

## 7.3 Vibration switch (option)

### 7.3.1 Vibration switch does not reset

Cause	Corrective actions	Page
Dirt or iron particles on magnets	Clean magnets	–
Leaf spring is broken	Return to Alfa Laval for repair	–
Reset coil is open	Check for continuity and proper coil resistance	–

### 7.3.2 Impossible to adjust setpoint to obtain tripping

Cause	Corrective actions	Page
Incorrect air gap between hold-down magnet (lower) and armature in switch	Readjust the air gap with the stop pin screw	–

### 7.3.3 Vibration switch does not reset

Cause	Corrective actions	Page
Defective switch	Renew and verify by manually moving the armature to the latched (tripped) position and listen for an audible click. Verify contact by performing a continuity check	–
Incorrect position	Check that the switch plunger is just free of the armature when in the set (un-tripped) position	–



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# 8 *Technical Reference*

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## 8.1 Technical data

Alfa Laval ref. 557115 rev. 1

### NOTE

The separator is a component operating in an integrated system including a monitoring system. If the technical data in the system description do not agree with the technical data in this instruction manual, the data in the system description shall apply.

<b>Product number</b>	881245-02-03	
<b>Separator type</b>	FOPX 611TFD-24	
<b>Application</b>	Continuous clarification of heavy fuel oil. Intended for both land and marine applications.  The flash point of the fuel oil to be separated must be min. 60 °C.	
<b>Density of operating water, max.</b>	1 000	kg/m <sup>3</sup>
<b>Density of sediment/feed, max.</b>	1 744/1 000	kg/m <sup>3</sup>
<b>Hydraulic capacity, max.</b>	23 000	litres/h
<b>Feed temperature, min./max.</b>	0/100	°C
<b>Ambient temperature, min./max.</b>	5-15/55	°C The min. temperature is dependent of the used oil type. See "8.5.2 Recommended lubricating oils" on page 188.
<b>Bowl speed, max.</b>	5824/5874	r/min, 50/60 Hz
<b>Motor shaft speed, max.</b>	1500/1800	r/min, 50/60 Hz
<b>Gear ratio, 50 Hz</b>	66:17	
<b>Gear ratio, 60 Hz</b>	62:19	
<b>Valve plugs, height</b>	13,8	mm
<b>Lubricating volume</b>	approx. 12	litres
<b>Motor power rating</b>	16/19	kW, 50/60 Hz
<b>Power consumption, max.</b>	20	kW (at starting up)
<b>Power consumption, normal</b>	6/14	kW (idling/at max. capacity)
<b>Discharge volume, nominal</b>	6	litres fixed discharge volume
<b>Discharge interval, min./max.</b>	1/240	minutes
<b>Bowl volume</b>	13,7	litres

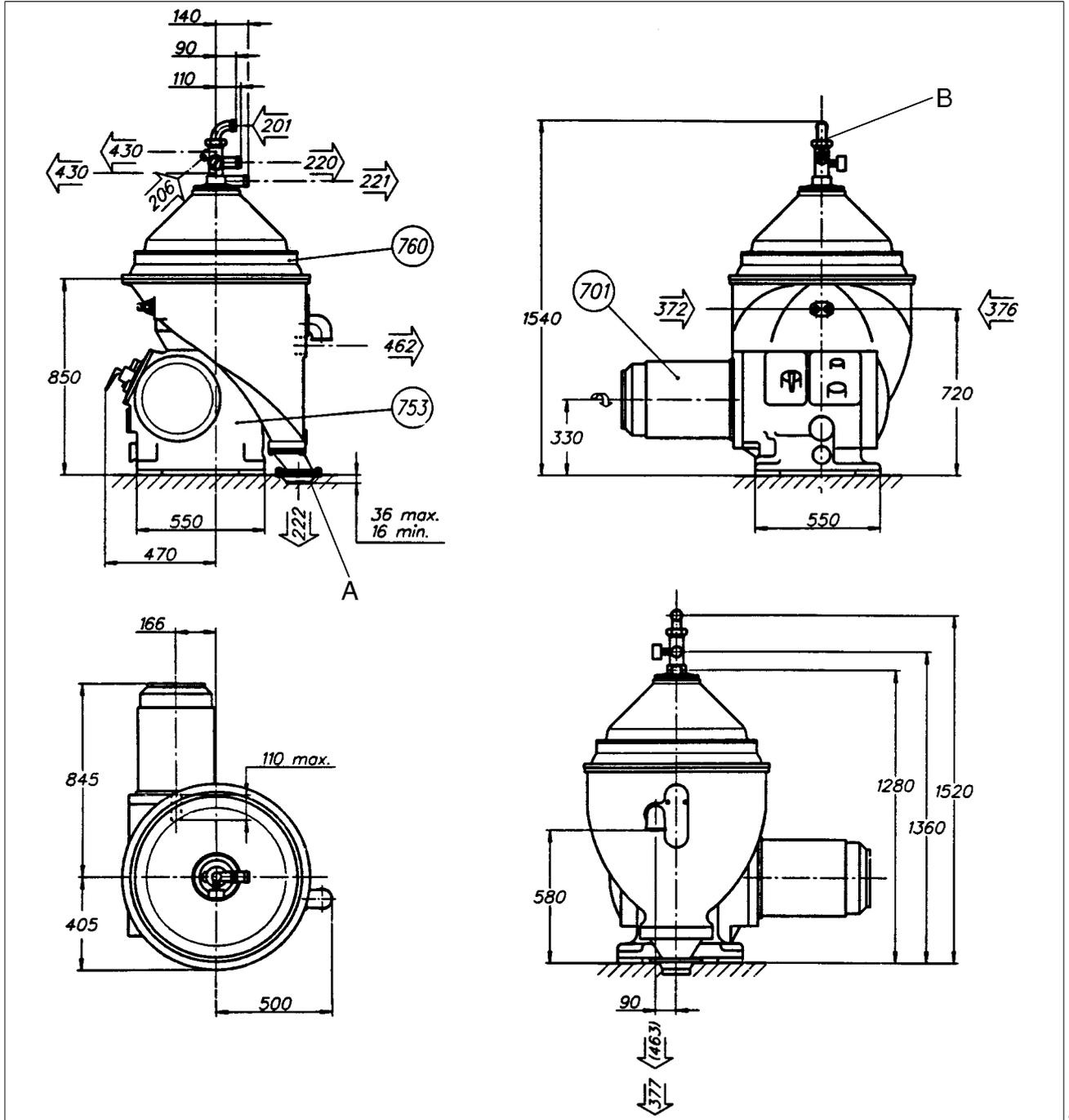
<b>Sediment space</b>	6	litres
<b>Starting time</b>	3-4	minutes
<b>Stopping time with brake, min./max.</b>	4-7	minutes
<b>Stopping time without brake</b>	50	minutes
<b>Max. running time without flow;</b>		
- empty bowl	180	minutes
- filled bowl	180	minutes
<b>Sound power level</b>	–	Bel(A)
<b>Sound pressure level</b>	81	dB(A)
<b>Vibration level, separator in use, max.</b>	11,2	mm/s (RMS)
<b>Weight of separator (without frame hood and bowl)</b>	1023	kg
<b>Weight of bowl</b>	276	kg

The materials in contact with process fluid (excluding seals and O-rings) are brass, bronze and stainless steel. Cast iron frame.

## 8.2 Connections and size

### 8.2.1 Basic size drawing

Alfa Laval ref. 558801 rev. 1

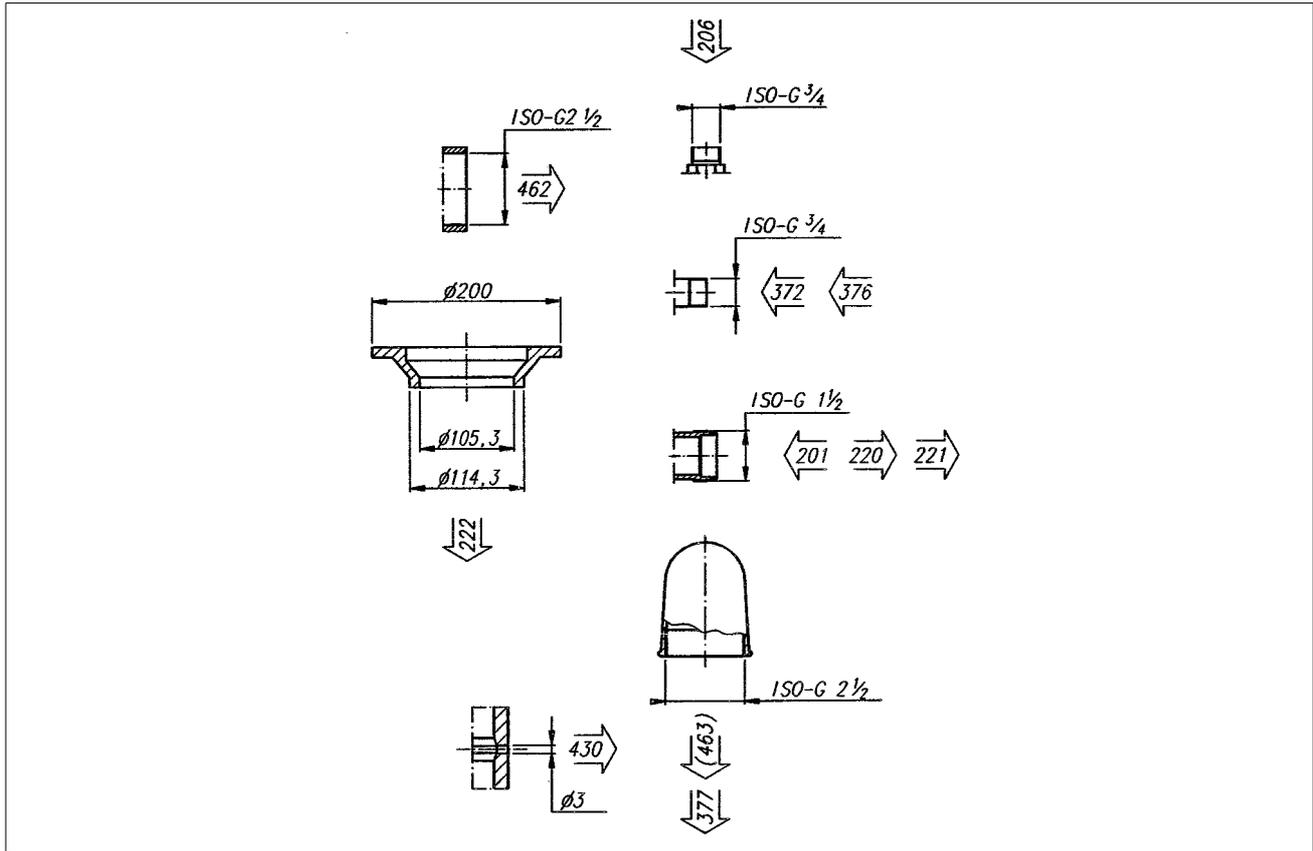


A. Maximum vertical displacement at the sludge connection during operation  $\pm 10$  mm.

B. Maximum horizontal displacement at the in/outlet connections during operation  $\pm 20$  mm.

### 8.2.2 Dimensions of connections

Alfa Laval ref. 558801 rev. 1



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Data for connections, see chapter "8.2.3 Connection list" on page 179.

Connections 220 and 221 are turnable 360° in 90° steps.

All connections to be installed non-loaded and flexible. Connection 201 is turnable 360°.

### 8.2.3 Connection list

Alfa Laval ref. 555486 rev. 3

Connection No.	Description	Requirements/limits
201	Inlet for product – Allowed temperature	Min. 0 °C, max. 100 °C
206	Inlet to liquid seal or displacement liquid, water. – Instantaneous flow – Pressure (Min./Max.)	Fresh water 2,8 litre/minute 200/600 kPa
220	Outlet for light phase (oil). – Counter pressure.	0 -350 kPa.
221	Outlet for heavy phase (water). – Counter pressure.	0 -200 kPa.
222	Outlet for solid phase.	The outlet after the separator should be installed in such a way that you can not fill the frame top part with sludge. (Guidance of sludge pump or open outlet)
372	Inlet of discharge liquid. – Instantaneous flow – Consumption – Time – Pressure (Min./Max.)	See demand in chapter “8.4 Water quality” on page 185 18 litres/minute 0,6 litre/discharge 3 seconds/discharge 200/600 kPa
376	Inlet for make-up liquid. – Instantaneous flow – Consumption – Pressure (Min./Max.)	See demand in chapter “8.4 Water quality” on page 185 18 litres/minute 1,5 litre/discharge 200/600 kPa

Connection No.	Description	Requirements/limits
377 (463)	Outlet for operating liquid (discharge and make-up liquid) Drain of frame top part, upper.	
462	Drain of frame top part, lower	
701	Motor for separator. – Max. deviation from nominal frequency.	± 5% (momentarily 10% during a period of maximum 5 seconds).
753	Unbalance sensor (delivered as option)  – Type – Vibration measurement range – Switch rating, resistive load max.  – Reset coil power supply max. 14 W	See “8.3 Interface description” on page 181 and “8.6.4 Vibration sensor (option)” on page 200  Mechanical switch  0 to 4,5 g from 0 to 300 Hz  5 A      12 V DC 2 A      24 V DC 1 A      48 V DC 0,5 A    120 V DC 7 A      460 V AC 50/60 Hz  48 V DC
760	Cover interlocking switch (delivered as option).  – Type – Switch rating, resistive load max.	See “8.3 Interface description”  Mechanical switch  3 A 500 V

## 8.3 Interface description

Alfa Laval ref. 557138 rev. 2

### 8.3.1 General

In addition to the Connection List this document describes limitations and conditions for safe control, monitoring and reliable operation.

At the end of the document a function graph and running limitations are found.

### 8.3.2 Definitions

#### Ready for start means:

- The machine is assembled correctly.
- All connections are installed according to Connection List, Interconnection Diagram and Interface Description.

#### Start means:

- The power to the separator is on.
- The acceleration is supervised to ensure that a certain speed has been reached within a certain time. See technical data.

The start procedure continues until full speed has been reached and a stabilization period has passed (about 1 minute).

#### Normal stop means:

- Stopping of the machine at any time with brake applied.
- The bowl must be kept filled.

**Safety stop means:**

The machine must be stopped in the quickest and safest way due to vibrations or process reasons.

Comply to following conditions:

- The bowl must be kept filled.
- Sludge ejection must not be made.
- The machine must not be restarted before the reason for the safety stop has been investigated and action has been taken.

In case of emergency condition in the plant, the machine must be stopped in a way that is described in EN 418.

### **8.3.3 Component description and signal processing**

#### **Separator motor 701**

The separator is equipped with a 3-phase DOL-started (direct on line) motor. The separator can also be started by a Y/D starter, but then the time in Y-position must be maximized to 5 seconds.

#### **Vibration sensor 753 (option)**

The vibration sensor is an acceleration sensitive instrument with a mechanical switch. It gives an open contact when the unbalance exceeds the preset value.

#### **Signal processing**

If to high vibration occur the machine must be stopped with automatic Safety Stop.

## **Cover interlocking switch 760 (option)**

The cover of the separator is equipped with an interlocking switch.

When the cover is closed the interlocking circuit in the control system is closed and the separator could be started.

### **Signal Processing**

The circuit is closed when the frame hood of the separator is closed.

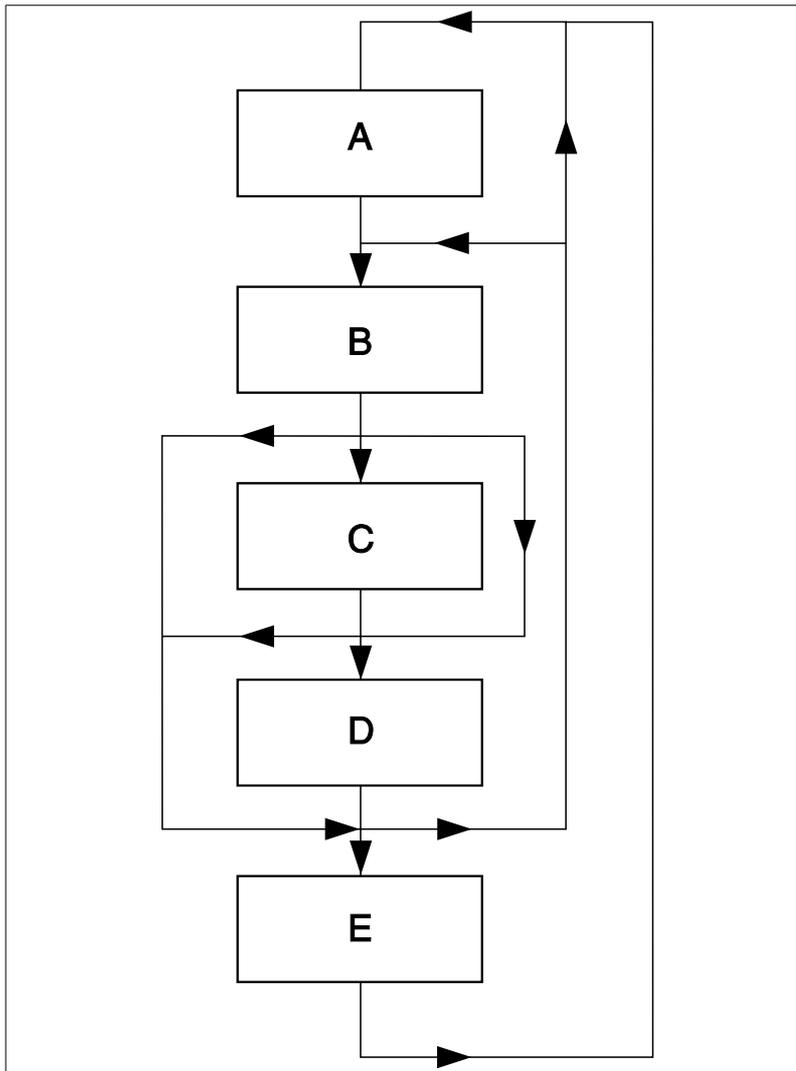
The interlocking switch should be connected so that starting of the motor is prevented when the separator hood is not closed.

### **Discharge signal processing**

The control system shall contain a memory function for registration of the number of initiated discharges.

At indication of the absence of a discharge, the operator or the control system must initiate a new discharge. At indication of the absence of two consecutive sludge discharges, an alarm must be given and action must be taken.

### 8.3.4 Function graph and running limitations



- A. *Stand still*
- B. *Starting mode*
- C. *Running mode*
- D. *Stop mode*
- E. *Safety stop mode*

## 8.4 Water quality

*Alfa Laval ref. 553406 rev.3*

### **Specific requirements regarding the quality of water**

Water is used in the separator for several different functions: Discharge-mechanisms, liquid seals, as cooling media and for flushing.

Bad quality of the water can with time cause erosion, corrosion and/or operating problems in the separator and must therefore be treated to meet certain demands.

### **The following requirements are of fundamental importance.**

1.1 Turbidity-free water, solids content < 0,001% of volume.

Deposits must not be allowed to form in certain areas in the separator.

1.2 Max particle size 50  $\mu$ m.

2. Total hardness  $\leq$  180 mg CaCO<sub>3</sub> per litre.

Chalk deposits can build-up if the water is hard (corresponds to 10 °dH or 12,5 °E). Increased operating temperature accelerates the chalk built-ups.

3. Chloride content  $\leq$  100 ppm NaCl (equivalent to 60mg Cl/l).

Chloride ions contribute to corrosion on the separator surfaces in contact with the operating water, including the spindle. Corrosion is a process that is accelerated by increased separating temperature, low pH, and high chloride ion concentration. A chloride concentration above 60 mg/l is not recommended.

4. pH > 6

Increasing acidity (lower pH) increases corrosion; this is accelerated by increased temperatures and high chloride ion content.

For test methods, contact any Alfa Laval representative.

If these demands cannot be met, the water should be pretreated according to Alfa Laval's recommendations.

*Alfa Laval accepts no liability for consequences arising from unsatisfactorily purified water supplied by the customer.*

## 8.5 Lubricants

### 8.5.1 Lubrication chart, general

Alfa Laval ref. 553216-01 rev. 5

Lubricating points	Lubricants
Bowl spindle ball bearings and buffers are lubricated by oil mist	Lubricating oil as specified in "8.5.2 Recommended lubricating oils" on page 188
Bowl spindle taper	Lubricating oil (only a few drops for rust protection)
Buffers of bowl spindle	Lubricating oil
Bowl: Sliding contact surfaces and pressure loaded surfaces such as lock rings, threads of lock rings, bowl hood, and cap nut	Pastes as specified in "8.5.4 Recommended lubricants" on page 192 If not specified otherwise, follow the supplier's recommendation about method of application
Rubber seal rings	Grease as specified in "8.5.4 Recommended lubricants" on page 192
Friction coupling ball bearings	The bearings are packed with grease and sealed and need no extra lubrication
Electric motor (if nipples are fitted)	Follow manufacturer's instructions

#### Alfa Laval Lubricating Oil Groups:

- **Group A oil:** a high quality gear oil on paraffin base with stable AW (anti wear) additives.
- **Group B oil:** a high quality gear oil on paraffin base with stable EP (extreme pressure) additives.
- **Group D oil:** a synthetic base oil with additives stable at high operating temperatures.

Do not mix different oil brands or oils from different oil groups.

Always use clean vessels when handling lubricating oil.

Great attention must be paid not to contaminate the lubricating oil. Of particular importance is to avoid mixing of different types of oil. Even a few drops of motor oil mixed into a synthetic oil may result in severe foaming.

Any presence of black deposits in a mineral type oil is an indication that the oil base has deteriorated seriously or that some of the oil additives have precipitated. Always investigate why black deposits occur.

If it is necessary to change from one group of oil brand to another it is recommended to do this in connection with an overhaul of the separator. Clean the gear housing and the spindle parts thoroughly and remove all deposits before filling the new oil.

**NOTE**

Always clean and dry parts (also tools) before lubricants are applied.

**NOTE**

Check the oil level before start. Top up when necessary. Oil volume see "4.1.2 Ready for start" on page 31.

It is of utmost importance to use the lubricants recommended in our documentation. This does not exclude, however, the use of other brands, provided they have equivalently high quality properties as the brands recommended. The use of oil brands and other lubricants than recommended, is done on the exclusive responsibility of the user or oil supplier.

**Applying, handling and storing of lubricants**

Always be sure to follow lubricants manufacturer's instructions.

## 8.5.2 Recommended lubricating oils

Alfa Laval ref. 553219-15 rev. 0

Two different groups of lubricating oils are approved for this separator.

They are designated as Alfa Laval lubricating oil groups A and D.

The numerical value after the letter states the viscosity grade.

The corresponding commercial oil brands are found in chapter "8.5.3 Recommended oil brands" on page 189.

Ambient temperature °C	Alfa Laval lubricating oil group	Time in operation Oil change interval
between +15 and +60	A/320	1 000 - 1 500 h
between -10 and +60	D/220	2 000 h
between ±0 and +60	D/320	2 000 h

### Note:

- In a new installation or after change of gear transmission, change oil after 200 operating hours.
- When the separator is operated for short periods, lubricating oil must be changed every 12 months even if the total number of operating hours is less than stated in the recommendations above.
- Check and prelubricate spindle bearings on separators which have been out of service for 6 months or longer.
- In seasonal operation: change oil before every operating period.

### 8.5.3 Recommended oil brands

#### Alfa Laval lubricating oil group A/320

Alfa Laval ref. 553218-11

Viscosity grade VG (ISO 3448/3104) 320

Viscosity index VI (ISO 2909) >95

Manufacturer	Designation
Alfa Laval	546099-80 20 litres 546099-81 4 litres 546099-82 208 litres 546099-83 1 litre
BP	Bartran 320
Castrol	Alpha ZN 320
Esso Standard Oil/ Svenska Statoil/Exxon	Nuto 320 Teresso 320 Terrestic 320
Lubmarine/Beijer (ELF Brand designation according to ELF)	Polytelis 320
Mobil	DTE Oil AA Gencirc TQ 320
Q8/Kuwait (Gulf)	Harmony AW 320
Shell	Tellus C 320 Vitrea 320 Tellus 320
Texaco/Caltex	Regal R&O 320 Paper Machine HD 320

**Alfa Laval lubricating oil group D/220***Alfa Laval ref. 553218-08 rev. 0*

Viscosity grade VG (ISO 3448/3104) 220

Viscosity index VI (ISO 2909) &gt; 130

<b>Manufacturer</b>	<b>Designation</b>
Alfa Laval	542690-80 20 litres
	542690-81 4 litres
	542690-82 208 litres
	542690-83 1 litres
BP	Energol HTX 220
Castrol	Alpha Syn T 220
Chevron	Ultragear 220
Esso/Exxon/Statoil	Terrestic SHP 220, Teresso SHP 220
Lubmarine/ELF	Epona SA 220
Mobile (Engen)	SHC 630
Q8/Kuwait /Gulf	Schumann 220
Shell	Paolina 220

**Alfa Laval lubricating oil group D/320**

Alfa Laval ref. 553218-06

Viscosity grade VG (ISO 3448/3104) 320

Viscosity index VI (ISO 2909) &gt;130

<b>Manufacturer</b>	<b>Designation</b>
Alfa Laval Separation AB	542690 - blue
Castrol	Alpha Syn T 320
Lubmarine/Beijer (ELF Brand designation according to ELF)	Epona SA 320
Optimol Ölwerke	Optigear HT 320
Q8/Kuwait	Schumann 320
Chevron	Ultragear 320
Esso/EXXON/Standard Oil/ Svenska Statoil	Terrestic SHP 320
Mobil	SHC 632
Shell	(Delima HT 320)* (Paolina 320)

( ) = available in a few countries

\* These oils must be used when the frame temperature is about 80 °C.

If you can't measure the temperature: about 80 °C is reached when you can touch the lower frame surface for a short time only.

### 8.5.4 Recommended lubricants

#### Pastes and bonded coatings for non-food applications

Alfa Laval ref. 553217-01 rev. 4

Manufacturer	Designation	Alfa Laval No.	Application
Gleitmolybdän	Gleitmo 705 K Gleitmo 805 K 805 K varnish 901 Gleitmo Paste G rapid	537086-04	All pressure loaded surfaces
Dow Corning	Molykote paste1000	537086-02	
Rocol	Antiscuffing paste (ASP)		
Klueber	Wolfracoat C paste		
Russian Standard	VNII NP 232 Gost 14068-90		

#### Silicone grease

Manufacturer	Designation	Alfa Laval No.
Dow Corning	Molykote 111 compound 100 g 25 g	539474-02 539474-03
Gleitmolybdän	Silicone paste 750	
Wacker	Silicone Paste P (vacuum paste)	

**Greases for ball and roller bearings**

Alfa Laval ref. 553217-01 rev.4

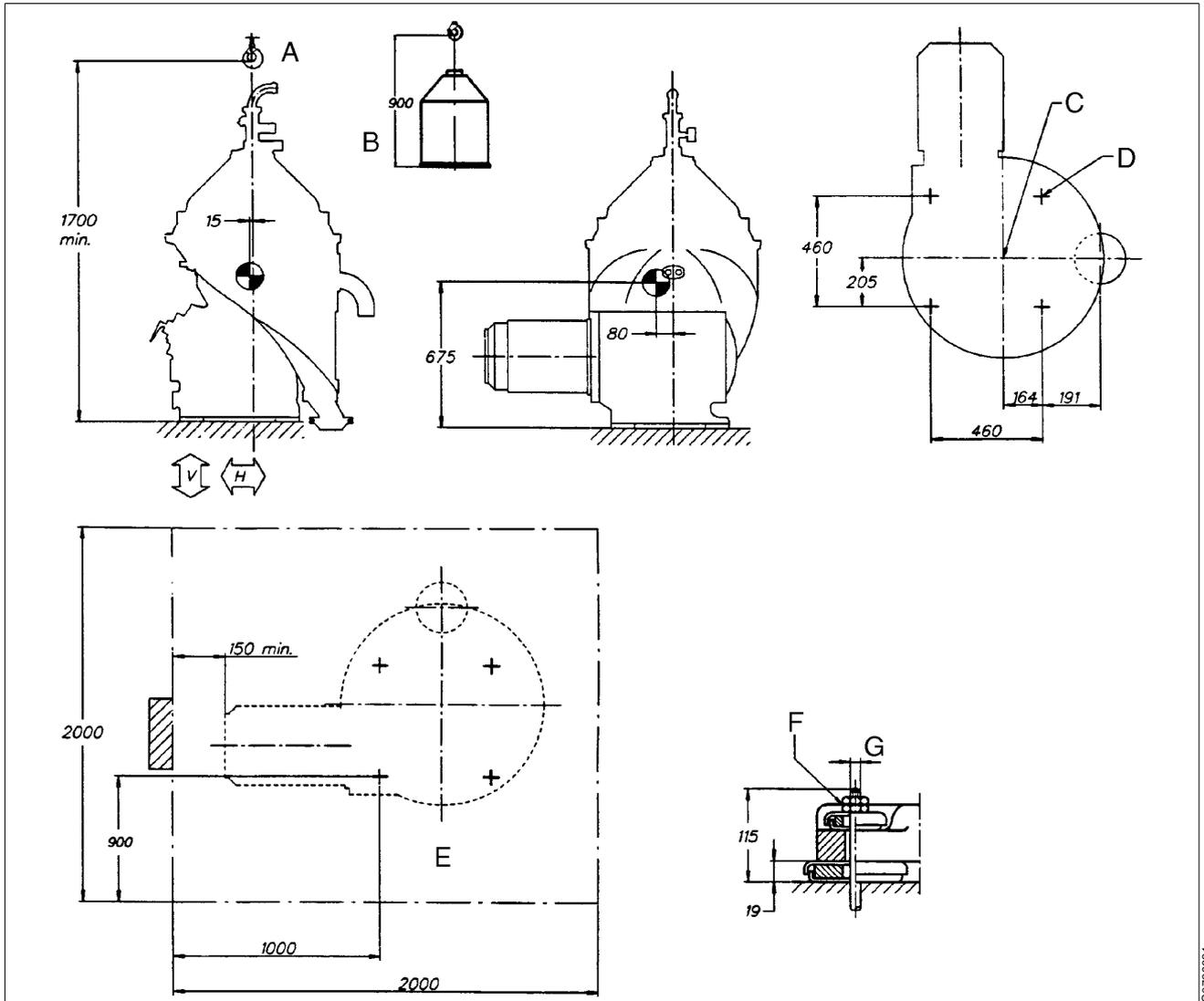
<b>Manufacturer</b>	<b>Designation</b>	<b>Alfa Laval No.</b>
BP	Energrease MMEP2 Energrease LS2	
Castrol	Spheerol SW2 EP Spheerol EPL2	
Chevron	Duralith grease EP2	
Exxon	Beacon EP2	
Mobil	Mobilith SHC 460 Mobilux EP2	
Gulf	Gulflex MP2	
Q8	Rembrandt EP2	
Shell	Cailithia EP Grease T2 Alvania EP Grease 2 or R.A	
SKF	LGEP2 or LGMT2	
Texaco	Multifak AF B2 Multifak premium 2,3	
Russian Standard	Fiol 2M, Litol 24 TU 38.201.188	



## 8.6 Drawings

### 8.6.1 Foundations

Alfa Laval ref. 555474, rev. 2



- A Min. lifting capacity 1000 kg
- B Max. height of largest component incl. lifting tool
- C Center of separator bowl
- D 4 holes  $\varnothing$  17 for anchorage
- E Service side
- F Tightening torque 20 Nm  
Locked with lock nut
- G M16 Minimum property class 8.8

— Recommended free floor space for unloading when doing service

- - - Min. access area for overhead hoist (no fixed piping within this area)

⊙ Center of gravity (without motor)

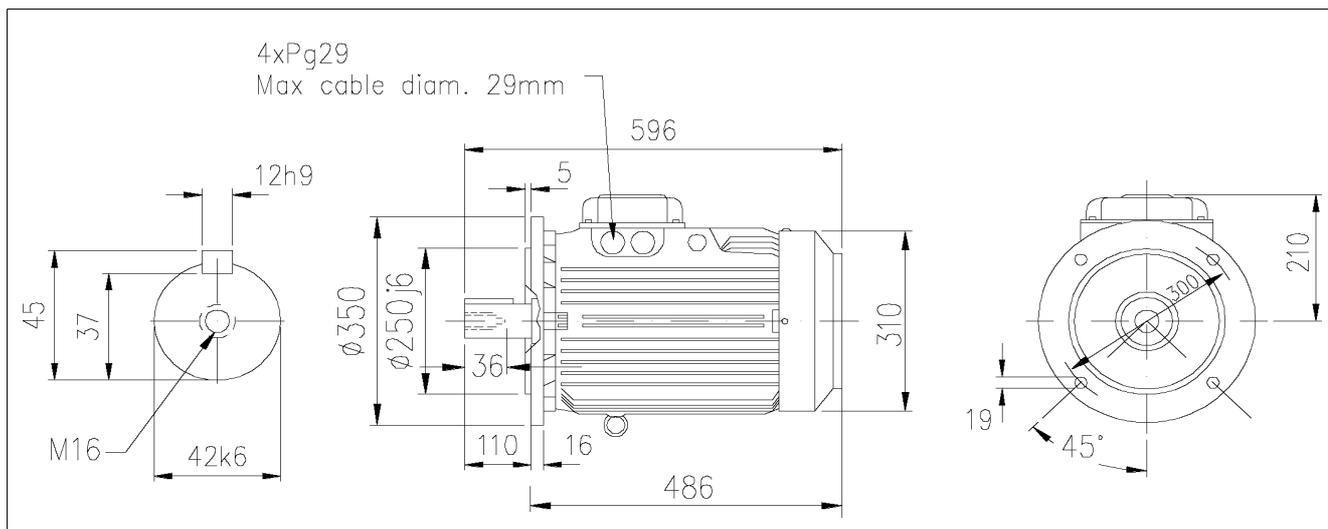
⬆ Vertical force not exceeding 20 kN/foot

⬅ Horizontal force not exceeding 20 kN/foot

G0729821

### 8.6.2 Electric motor

Alfa Laval ref. 552814 rev. 2



<b>Manufacturer</b>	ABB Motors
<b>Manufacturers drawing</b>	MK20-92S
<b>Standards</b>	IEC 34 series, 72, 79 and 85
<b>Size</b>	160L
<b>Type</b>	M2AA 160L-4
<b>Weight</b>	63 kg
<b>Poles</b>	4
<b>Insulation class</b>	F
<b>Bearings</b>	DE 6209-2Z/C3 – NDE 6209-2Z/C3
<b>Method of cooling</b>	IC 41 (IEC 34-6)
<b>Specification</b>	Totally enclosed three-phase motor for marine service <sup>3)</sup>

Type of mounting		Degree of protection
	IM 1001	
	IM 3001	IP 55
	IM 3011	IP 55
	IM 3031	IP 55

Article No	Output kW	Speed RPM	Freq Hz	Voltage V	Current A	Pow.fac cos j	$I_{st} / I$ <sup>1)</sup>	Therm <sup>2)</sup> °C	Note
552814-01	15,5	1445	50	200 D	58	0,85	6,5		
552814-02	15,5	1445	50	220 D	52,5	0,85	6,5		
552814-03	15,5	1445	50	380 D	30,5	0,85	6,5		
552814-04	15,5	1445	50	415 D	28	0,85	6,5		
552814-05	15,5	1445	50	440 D	26,5	0,85	6,5		
552814-06	15,5	1445	50	500 D	23	0,85	6,5		
552814-07	18	1750	60	220 D 440 D	61 30,5	0,85	6,5		D-par D-ser
552814-08	18	1750	60	230 D 460 D	58,5 29	0,85	6,5		D-par D-ser
552814-09	17	1750	60	575 D	23	0,84	6.7		CSA- plated
552814-10	15,5 18	1445 1750	50 60	380 D 440 D	30,5 30,5	0,85	6,5 6,5		
552814-11	15,5	1450	50	690Y 400D	16,8 29	0,85	6,5		
552814-12	18	1750	60	460	29	0,85	6,5		
552814-13	18	1750	60	480D	28	0,85	6,5		
552814-14	15	1452	50	660Y 380D	17 29,5	0,85	6,7		Stamped 15 kW
552814-15	15	1758	60	440D	26,5	0,83	7,5		Stamped 15 kW

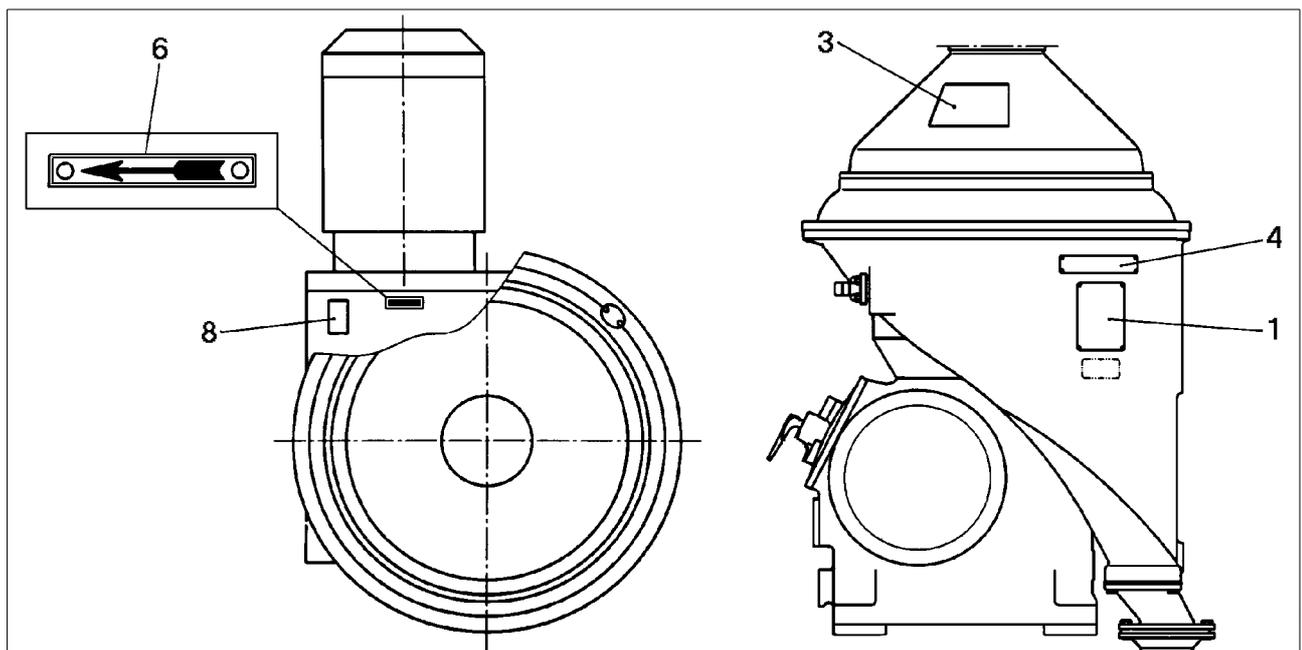
- 1)  $I_{st} / I$  = starting current /rated current at direct on line starting.
- 2) Thermistors tripping temperature if applicable
- 3) The motors can be designed to fulfill requirements of following Classification Societies:
- Lloyds Register of shipping (LRS) (Essential Service)
  - Det Norske Veritas (DnV) (Essential Service)
  - Germanischer Lloyd (GL) (Essential Service)
  - Bureau Veritas (BV) (Essential Service)
  - American Bureau of shipping (ABS) (Essential Service)
  - Registro Italiano Navale (RINA) (Essential Service)
  - USSR Register of Shipping (RSU) (Essential Service)
  - Japanese Classification Society (NKK) (Essential Service)

Required classification society must always be specified when ordering. Factory test certificate to be enclosed at the delivery.

Rated output (kW) valid for temp-rise max. 90 °C.

### 8.6.3 Machine plates and safety labels

Alfa Laval ref. 554651



#### 1. Machine plate

Separator	FOPX 611TFD-24
Manufacturing serial No / Year	XXXX
Product No	881245-02-03
Machine top part	555467-03
Bowl	555446-02
Machine bottom part	540225-36/37 (50/60 Hz)
Max. speed (bowl)	5824 r/min (50 Hz), 5874 r/min (60 Hz)
Direction of rotation (bowl)	←
Speed motor shaft	1500 r/min (50 Hz), 1800 r/min (60 Hz)
El. current frequency	50/60 Hz
Recommended motor power	16 kW (50 Hz), 19 kW (60 Hz)
Max. density of feed	1000 kg/m <sup>3</sup>
Max. density of sediment	1744 kg/m <sup>3</sup>
Max. density of operating liquid	1000 kg/m <sup>3</sup>
Process temperature min./max.	0/100 °C



**3. Safety label**

Text on label:

**DANGER**

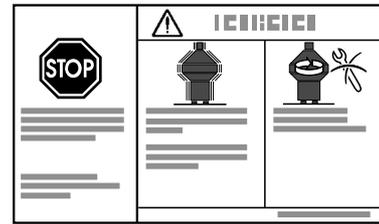
Read the instruction manuals **before** installation, operation and maintenance. Consider inspection intervals.

Failure to strictly follow instructions can lead to fatal injury.

If excessive vibration occurs, **stop** separator and **keep bowl filled** with liquid during rundown.

Out of balance vibration will become worse if bowl is not full.

Separator must **stop rotating** before **any** dismantling work is started.



S0061521

**4. Name plate**



S0063211

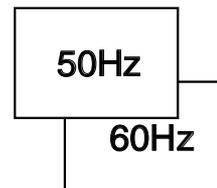
**6. Arrow**

Indicating direction of rotation of horizontal driving device.



S00688

**8. Power supply frequency**



S0063111

### 8.6.4 Vibration sensor (option)

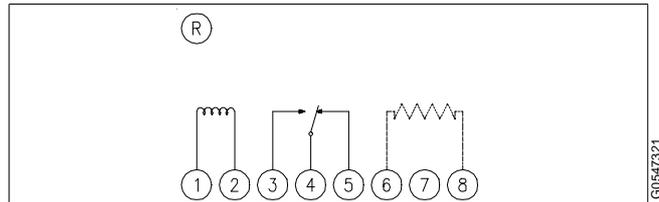
Alfa Laval ref. 536498-80

**Type:** Mechanical velocity

**Switch rating, voltage:** Max. 460 V AC

**Reset coil:** 24 V DC, 48 V DC,  
117 V AC 60 Hz

For other technical information see chapter “8.2.3 Connection list” on page 179 and “8.3 Interface description” on page 181.



Interconnection diagram

- 1-2 Reset coil
- 3 No
- 4 Common
- 5 NC
- 6-8 Heater

R Reset button

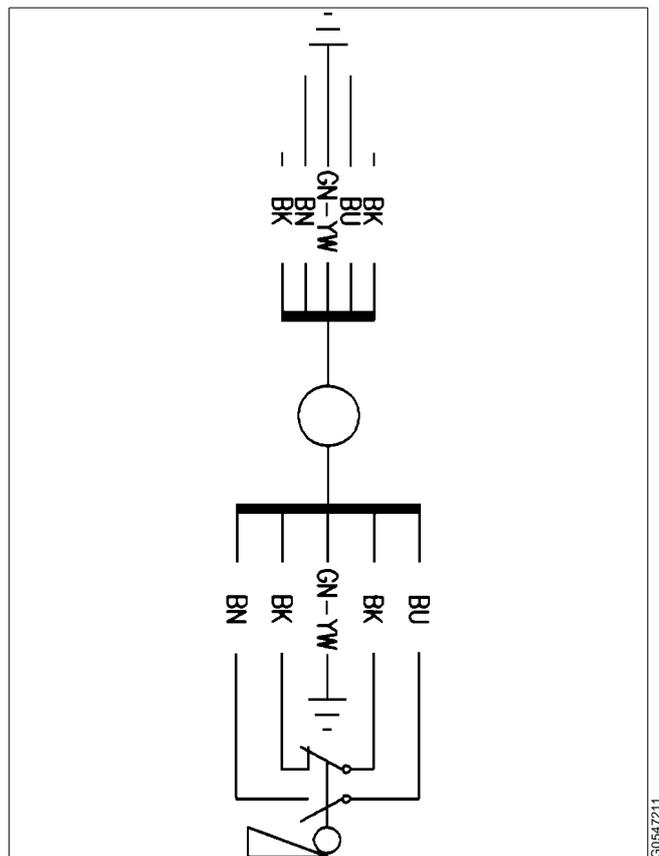
### 8.6.5 Cover interlocking switch (option)

For other technical information see chapter “8.2.3 Connection list” on page 179 and “8.3 Interface description” on page 181.

**Switch rating**

	AC (VA)	DC (W)
12 V	75	7
24 V	200	7
48 V	280	9
127 V	500	13
230 V	550	—

- BK Black
- BN Brown
- BU Blue
- GN Green
- YW Yellow



Interconnection diagram

## 8.7 Storage and installation

### 8.7.1 Introduction

Most of the instructions are specifications, which are compulsory requirements.

These specifications are sometimes completed with non-compulsory recommendations, which could improve the installation quality.

Additional installation information, such as drawings and component installation instructions, can be found previous in this chapter.

### 8.7.2 Storage and transport of goods

#### Storage

##### ***Specification***

Upon arrival to the store, **check all components and keep them:**

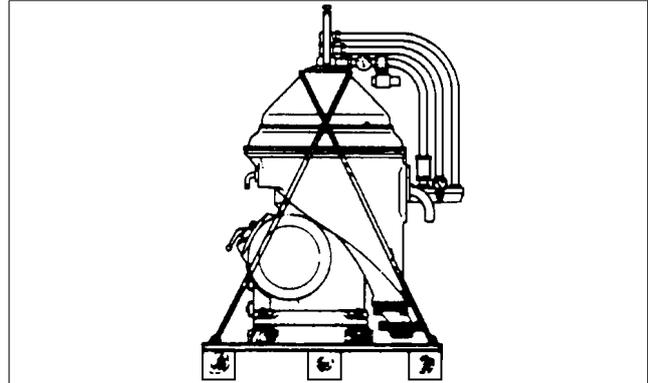
1. Well stored and protected from mechanical damage.
2. Dry and protected from rain and humidity.
3. Organized in the store for ease of access during installation.

A separator can be delivered with different types of protection:

A separator can be delivered with different types of protection:

- Fixed on a pallet.

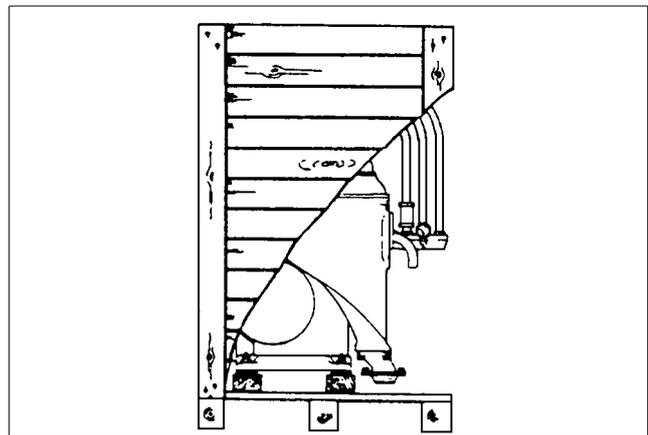
The separator must be stored in a storage room well protected from mechanical damage and also dry and protected from rain and humidity.



*Fixed on a pallet*

- In a wooden box which is not water tight.

The separator must be stored dry and protected from rain and humidity.

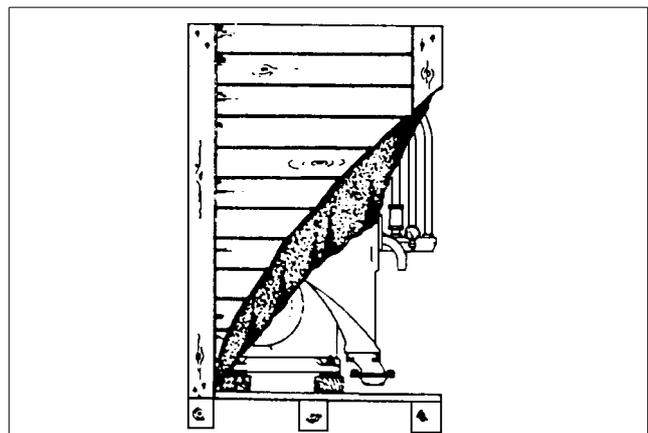


*In a wooden box which is not water tight*

- In a special water-resistant box for outdoor storage.

The separator and its parts have been treated with an anti-corrosion agent. Once the box has been opened, store dry and protected from rain and humidity.

The packaging for outdoor storage is to special order only.

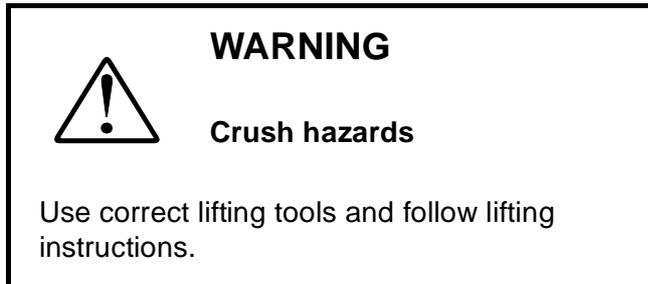


*In a special water-resistant box for outdoor storage*

## Transport

### Specification

- During transport of the separator, the frame hood and bowl **must always be removed from the machine.**
- When lifting a separator it must always be **hung securely.** See chapter “5.5 Lifting instructions” on page 80.



- During erection, all inlets and outlets to separators and accessories must be covered to be protected from dirt and dust.

## 8.7.3 Planning of installation

### Introduction

The space required for one or more separators can be calculated by consulting the drawings in the chapters “8.2.1 Basic size drawing” on page 177, “8.6.1 Foundations” on page 195 and instructions for ancillary equipment, electrical and electronic equipment and cables.

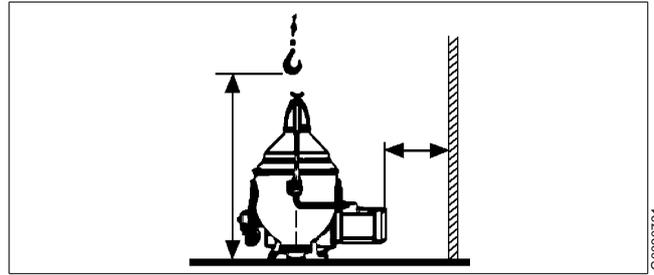


*Check the drawings when planning the installation*

### Important measurements

Important measurements are the minimum lifting height for lifting tackle, shortest distance between driving motor and wall, free passage for dismantling and assembly, maintenance and operation.

Plan your installation with sufficient room for the controls and operation so that instruments are easily visible. Valves and controls must be within convenient reach. Pay attention to space requirements for maintenance work, work benches, dismantled machine parts or for a service trolley.



*Suitable space must be obtained for the maintenance work*

### Space for separator

The separator shall be placed in such a way that suitable space for maintenance and repair is obtained.

#### **Specification**

- See chapter “8.6.1 Foundations” on page 195 for the service space required with the separator installed.

#### **Recommendation**

- The spanner for the large lock ring should have sufficient space to make a complete turn without touching any of the ancillary equipment surrounding the separator.

### Lifting height for transport of bowl

#### **Specification**

- A minimum height is required to lift the bowl, bowl parts and the bowl spindle, see chapter “8.6.1 Foundations” on page 195.

#### **Recommendation**

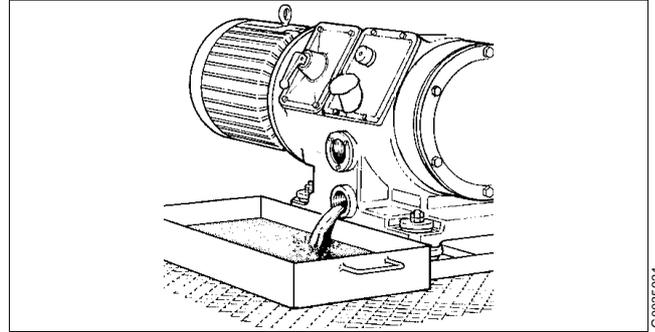
- When two or more separators are installed, the lifting height may have to be increased to enable parts from one separator to be lifted and moved over an adjoining assembled separator.

**Space for oil changing****Specification**

The plug for gearbox oil draining must not be blocked by floor plate arrangement, etc.

**Recommendation**

- It should be possible to place a portable collecting tray under the gearbox drain plug for changing oil.



*Place the separator in such a way that makes the oil change easy*

G00035921

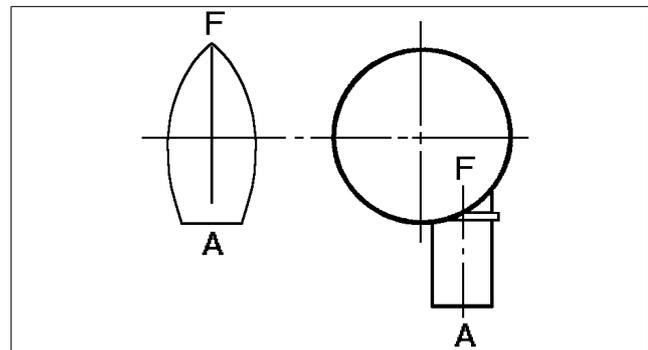
### 8.7.4 Foundation

#### NOTE

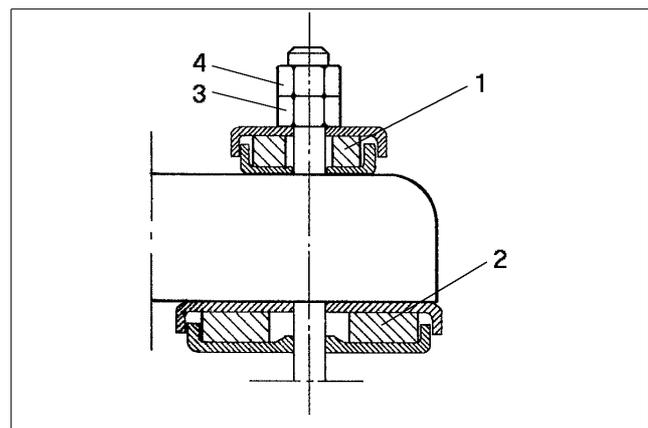
When lifting a separator it must always be **hung securely**. See chapter “5.5 Lifting instructions” on page 80.

#### Specification

- The separator should be installed at floor level, see chapter “8.6.1 Foundations” on page 195.
- When a separator is installed on a ship, the separator should be installed in such a way that the centre line of the electric motor is parallel with the centre line of the ship. The electric motor should preferably be pointing aft.
- The separator must be installed on a strong and rigid foundation to reduce the influence of vibrations from adjacent machinery.
- The foundation should be provided with a cofferdam.
- Fit the separator frame on the foundation as follows:
  - Place the separator frame without cushions in position.
  - Check that the bolts do not press against the edges of the holes, otherwise the elasticity of the mounting of the separator frame will be impeded.
  - Fit height adjusting washers required.
  - Check that the separator frame is horizontal and that all feet rest on the foundation.
  - Lift the separator frame, fit the vibration dampers (1, 2), lower and check that the bolts do not press against the edges of the holes.
  - Tighten nut (3) with **20 Nm**. Hold firmly and secure with the lock nut (4). Repeat for the other frame feet.



*F = Forward*  
*A = Aft*



1. *Vibration damper, upper*  
2. *Vibration damper, lower*  
3. *Nut*  
4. *Lock nut*

---

## Reader's Comment Form

Dear reader,

It is our ambition to produce as useful and instructive manuals as possible. Should you have any comments (positive or negative) regarding this manual, please note them down and send them to us. You can do this by copying this page and sending it by fax, or you could mail it, or hand it over to your local Alfa Laval representative.

Alfa Laval Separation AB, Separator Manuals, dept. SKL, S-147 80 Tumba, Sweden.  
Fax: +46 8 53065029.

Your name:

Company:

Address:

City:

Country:

Product: FOPX 611TFD-24

Book No.:

1270858-02 V3

Date:

	Yes	No
Is it easy to find what you are looking for by using the table of contents?	<input type="checkbox"/>	<input type="checkbox"/>
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Is it easy to understand the instructions in the manual?	<input type="checkbox"/>	<input type="checkbox"/>
Is the terminology sufficiently explained?	<input type="checkbox"/>	<input type="checkbox"/>
Are the illustrations easy to understand?	<input type="checkbox"/>	<input type="checkbox"/>

Your comments:



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