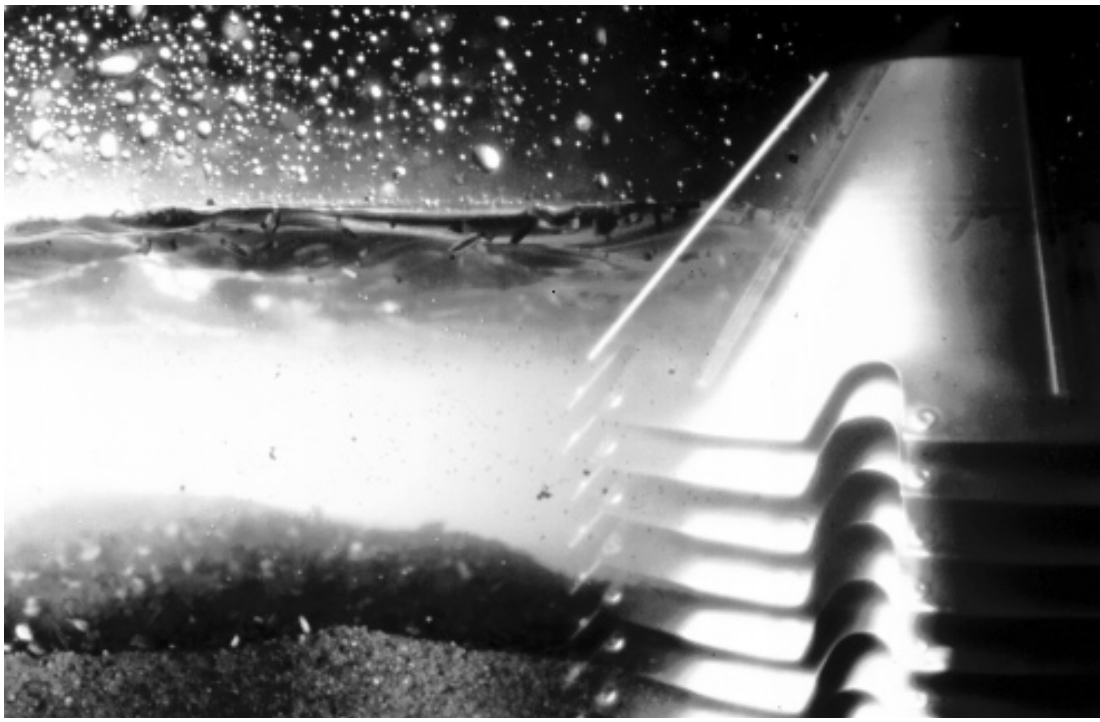
A L F A L A V A L S E P A R A T I O N

FOPX 613TFD-20

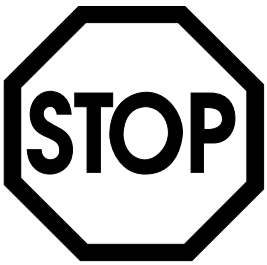


Separator Manual

Product No. 881082-01-06
Book No. 1270229-02 V2

Alfa Laval

Contents



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 613TFD-20.

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 Manual. In this case, study carefully all the instructions in the System Manual.

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

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.

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 Manual first.

Technical Reference

This chapter contains technical data concerning the separator and drawings.

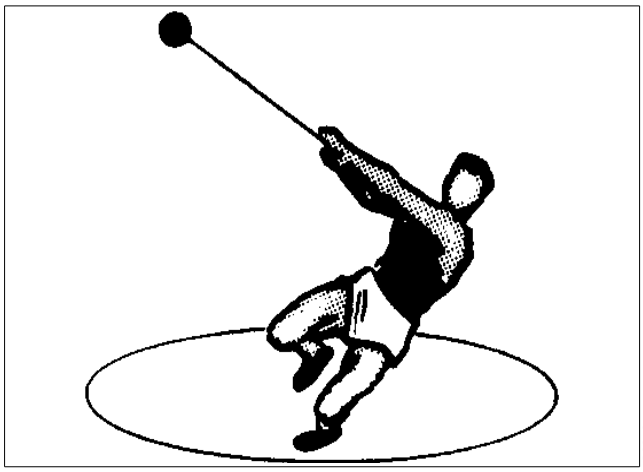
Index

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.

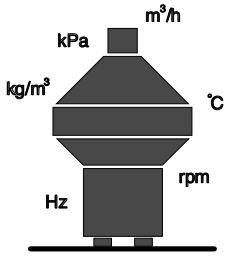
The following basic safety instructions therefore apply:

- **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. ϕ-mark on lock ring must not pass opposite ϕ-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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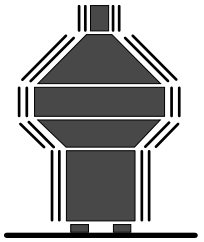

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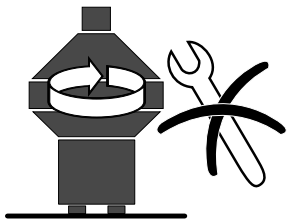
DANGER

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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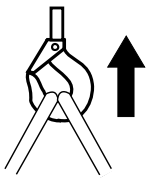
WARNING

Crush hazards

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



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Noise hazards

- Use ear protection in noisy environments.

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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.

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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.

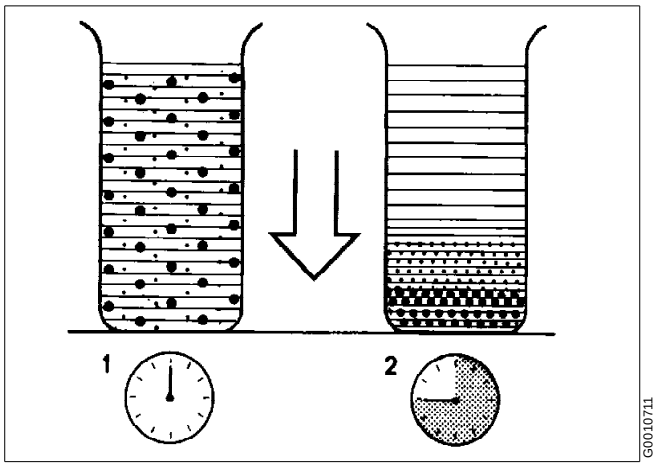
3 Separator Basics

Contents

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.



Sedimentation by gravity

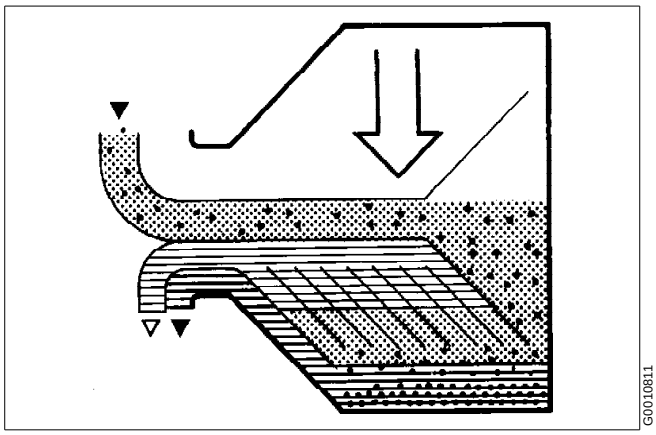
Separation by gravity

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.



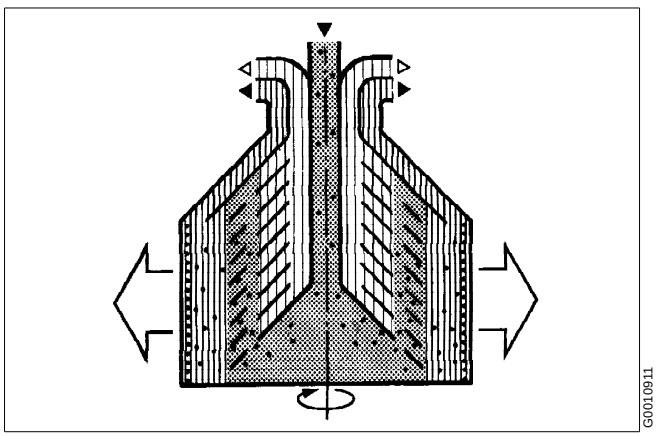
Sedimentation in a settling tank, with outlets making it possible to separate the lighter liquid parts from the heavier

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.



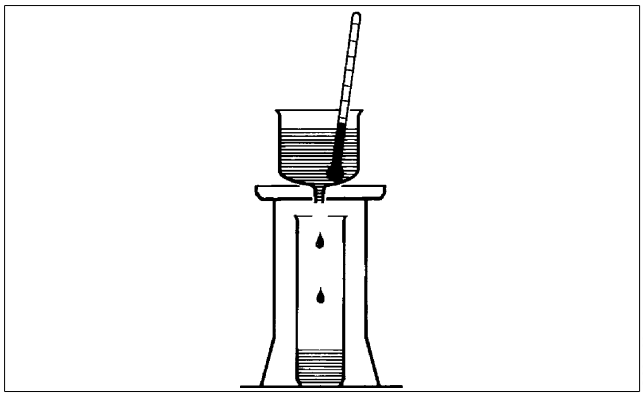
The centrifugal solution

Separating temperatures

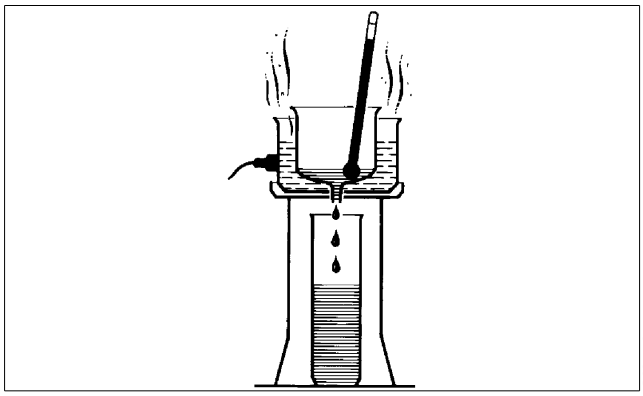
For some types of process liquids (e.g. mineral oils) a high separating temperature will normally increase the separation capacity. The temperature influences oil viscosity and density and should be kept constant throughout the separation.

Viscosity

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



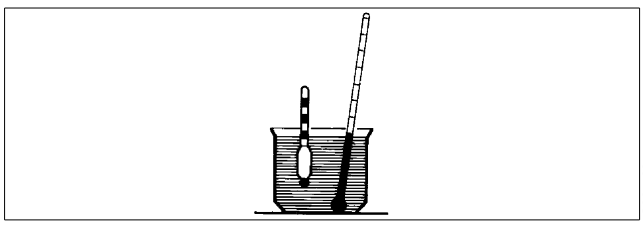
High viscosity (with low temperature)



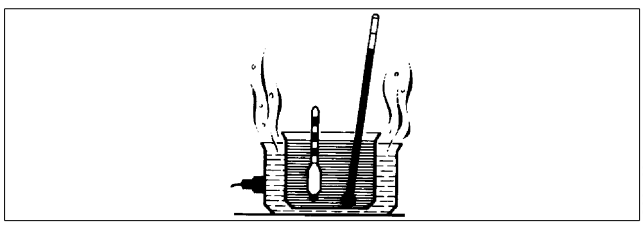
Low viscosity (with high temperature)

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.

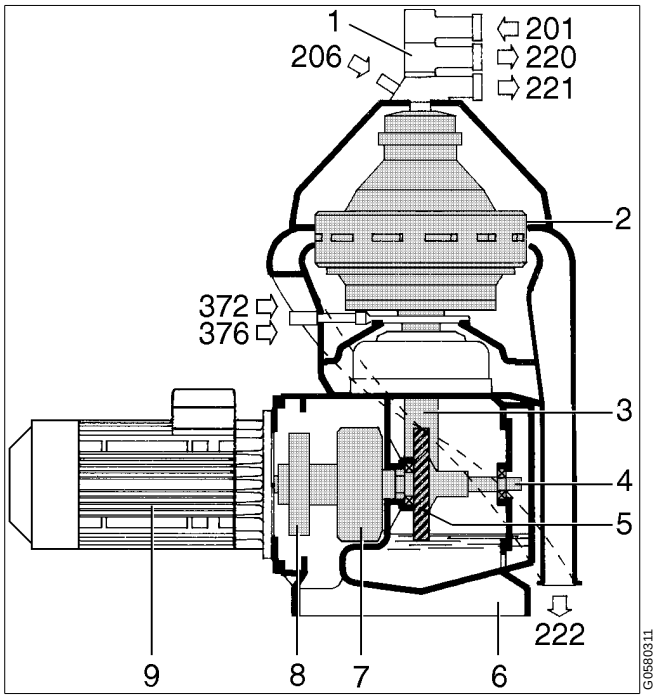
The bottom part of the separator contains the horizontal driving device (4), driving shaft with couplings (7, 8), a worm gear (5) and a vertical spindle (3).

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. Dirty 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

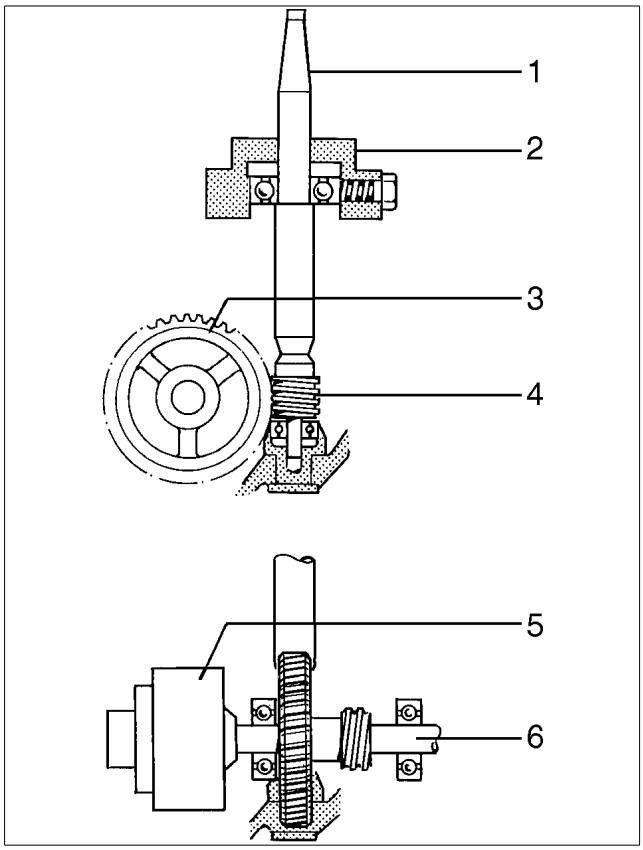
The main parts of the power transmission between motor and bowl are illustrated in the figure.

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 increase the bowl speed several times compared with the motor speed. For correct ratio see chapter “8.1 Technical data” on page 174.

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.

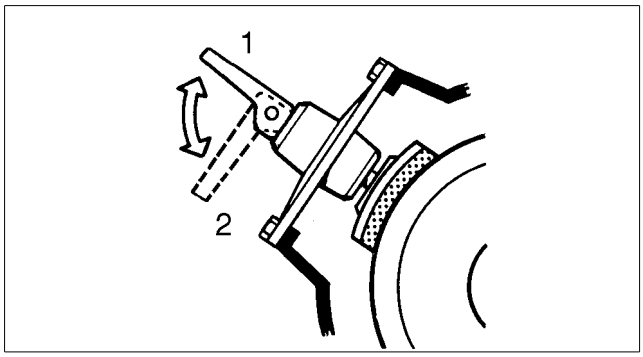


1. *Bowl spindle*
2. *Top bearing and spring casing*
3. *Worm wheel*
4. *Worm*
5. *Friction coupling*
6. *Worm wheel shaft*

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.

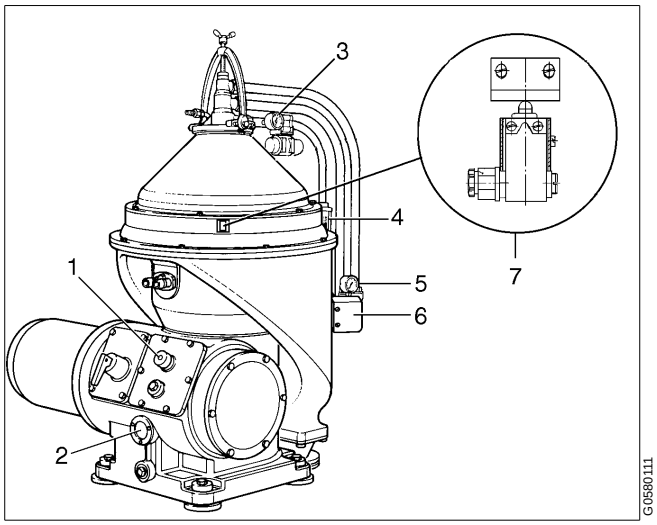


Applying (1) and releasing (2) of brake

3.2.3 Sensors and indicators

Revolution counter (1)

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.



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

Sight glass (2)

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

Indicating pressure gauge (3)

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.

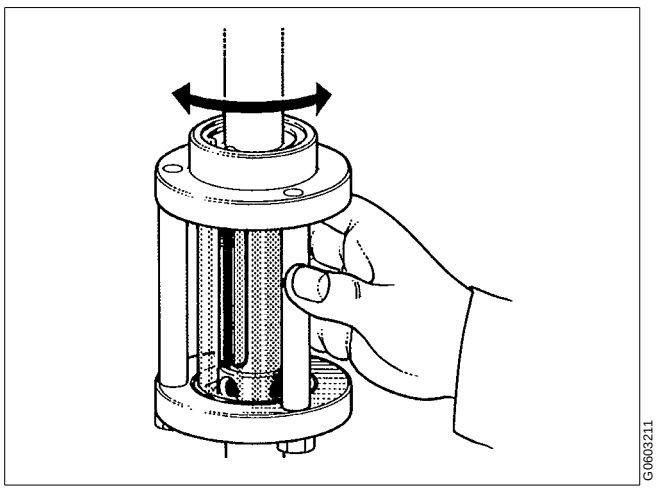
See also chapter "7.2.6 High pressure in water outlet" on page 170**.**

Sight glass wiper (4)

Cleaning of the sight glass for separated water has to be done frequently.

The advantages of the wiper are:

- it is not necessary to stop the separator in order to be able to clean the glass.
- oil contents in the water can be checked at a glance.
- poor performance of the separator can be checked; i.e. no water separated out.



Clean the sight glass by turning it around the scraper

Back pressure gauge (5)

Correct limits for the back pressure in the clean oil outlet can be found in chapter “8.2 Connection list” on page 176.

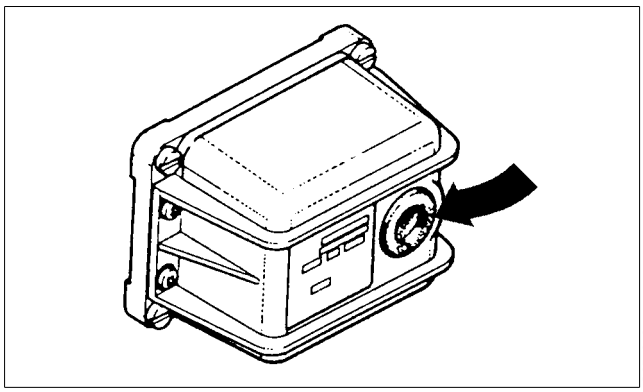
Increasing back pressure in the clean oil outlet can be caused by:

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

Vibration switch (6, option)

The vibration switch, properly adjusted, trips on a relative increase in vibration.

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

Cover interlocking switch (7, option)

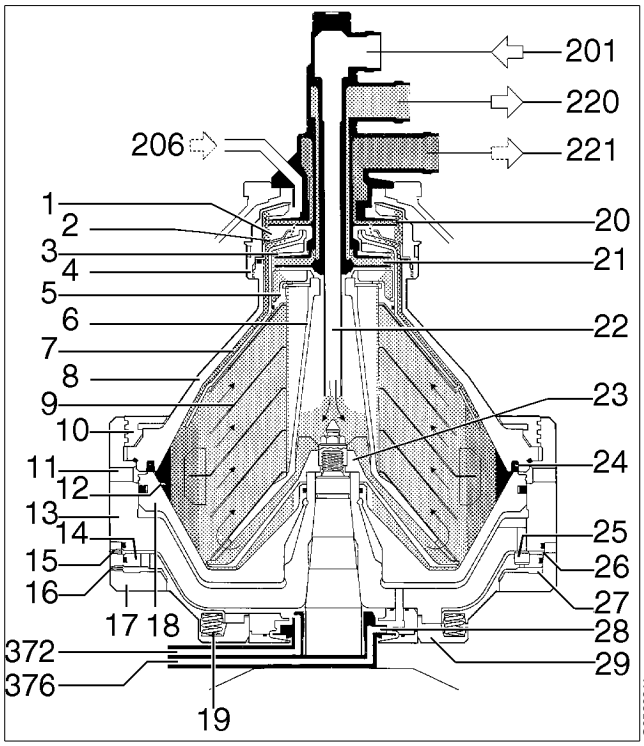
When required, the cover interlocking switch should be connected to the starter equipment so that starting of the motor is prevented when the separator hood is not (completely) closed.

3.2.4 Process main parts

1. Upper paring camber
2. Flow control disc
3. Oil paring chamber
4. Small lock ring (with paring chamber cover)
5. Level ring
6. Distributor
7. Top disc
8. Bowl hood
9. Bowl disc stack
10. Large lock ring
*11. Sludge port **
12. Sludge space
13. Bowl body
*14. Operating slide **
*15. Nozzle **
*16. Nozzle **
*17. Dosing ring **
*18. Sliding bowl bottom **
*19. Spring **
20. Upper paring disc
21. Oil paring disc
22. Inlet pipe
23. Distributing cone
*24. Bowl hood seal ring **
*25. Drain valve plug **
*26. Opening chamber **
*27. Closing chamber **
*28. Control paring disc **
*29. Spring support **

201. Oil inlet
206. Displacement/conditioning water inlet
220. Clean oil outlet
221. Water outlet
*372. Opening water inlet **
*376. Closing and make-up water inlet **

**Parts effecting a sludge discharge*



Separator bowl, feed and discharge assembly, control paring disc and liquid flow.
Non-rotating parts are indicated by black shade.

Inlet and outlet device

The inlet and outlet device consists of the following parts:

- The inlet (201). This comprises the pipe bend and the long inlet pipe (22) which extends into the middle of the bowl.
- The outlets (220, 221). These comprise the discharge cover and the paring discs (20, 21) which pump the separated oil and water out of the bowl. Each paring disc is located in a paring chamber (1, 3) 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 outlet connection housing is fastened to the separator frame hood. Height adjusting rings determine the height position of the paring discs in the paring chambers.

Separator bowl

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

The bowl body (13) and bowl hood (8) are held together by the large lock ring (10). Inside the bowl are the distributing cone (23), the distributor (6) and the disc stack (9). The disc stack is kept compressed by the hood. The sliding bowl bottom (18) forms an internal separate bottom in the bowl.

The bowl top is covered by the paring chamber cover (4). The space between this cover and the top disc (7) is the upper paring chamber with the upper paring disc which pumps the separated water out of the bowl. The oil paring chamber with its paring disc is located inside the upper part of the top disc. From this space the cleaned oil is pumped out of the bowl.

The sludge space (12) 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 (24) in the bowl hood.

Sludge discharge mechanism

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

The sludge discharge mechanism, which controls the sliding bowl bottom, comprises an operating slide (14) and an operating water device. Passive parts are: the dosing ring (17), nozzles (15, 16) and drain valve plugs (25). The operating water device on the underside of the bowl supplies opening (372) and closing/make-up (376) water to the discharge mechanism via the control paring disc (28).

3.2.5 Separating function

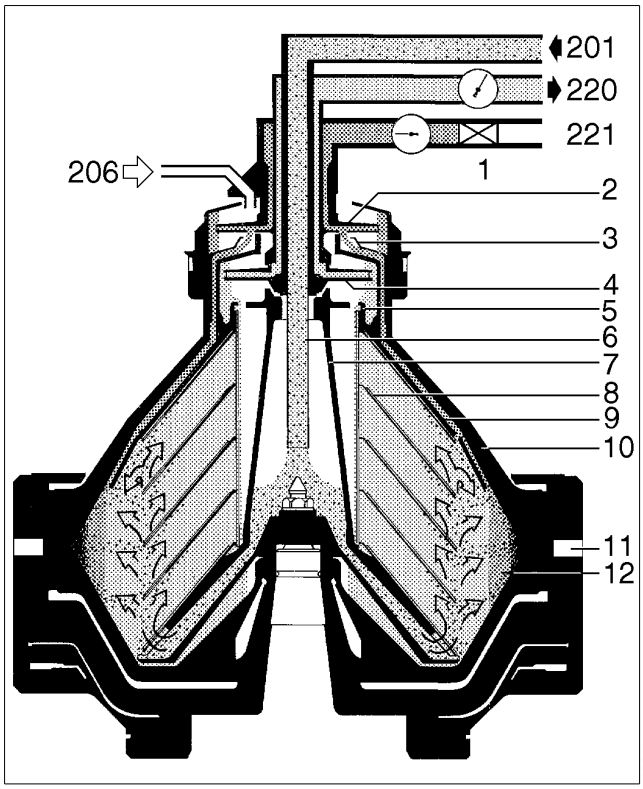
Unseparated oil is fed into the bowl through the inlet pipe (6) and is pumped via the distributor (7) towards the periphery of the bowl.

When the oil reaches slots of the distributor, it will rise through the channels formed by the disc stack (8) 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 (5) and enters the oil paring chamber. 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 (12).

The space between bowl hood (10) 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.

During normal operation, the outlet for the upper paring disc (2) is closed by the water drain valve (1).



Separating principle

1. *Water drain valve*
2. *Upper paring disc*
3. *Flow control disc*
4. *Oil paring disc*
5. *Level ring*
6. *Inlet pipe*
7. *Distributor*
8. *Bowl disc stack*
9. *Top disc*
10. *Bowl hood*
11. *Sludge port*
12. *Sludge space*

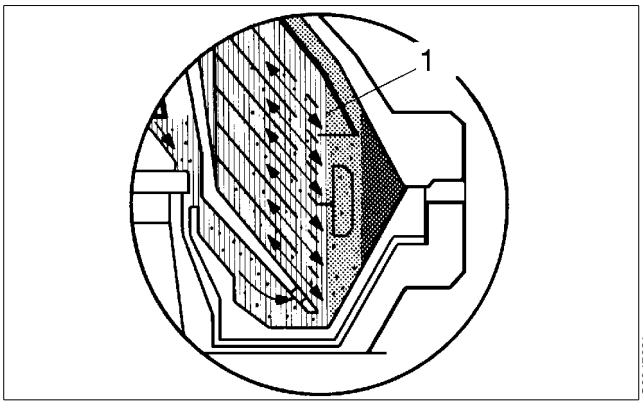
201. Unseparated oil, inlet
206. Displacement/conditioning water inlet
220. Clean oil outlet
221. Water outlet

3.2.6 Sludge discharge cycle

An interface (1) is formed between the oil and water in the bowl. In order to achieve optimum separation of the oil, the interface must be maintained in the correct position, that is outside the disc stack.

When the sludge space is filled up and water approaches the disc stack, some droplets of water start to escape with the cleaned oil. The small increase of the water content in the cleaned oil must be sensed and initiate a short opening of the water drain valve or initiate a 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.



Correct interface position (1) is outside the disc stack

Closed bowl (normal operation)

The sliding bowl bottom (6) is pressed upwards by force of the closing water in the closing water space (8) under the sliding bowl bottom which is greater than the force of the process liquid above the sliding bowl bottom.

The operating slide (2) is pressed upwards by the springs (7) and the valve plugs (10) then cover the drain channels (9).

Bowl opens for discharge

The opening water (372), which is supplied into the space above the operating slide (2), overcomes the force from the springs (7) and the operating slide is pressed downwards. The drain channels (9) open and the closing water drains out through the nozzle (3). This allows the force on the underside of the sliding bowl bottom (6) 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).

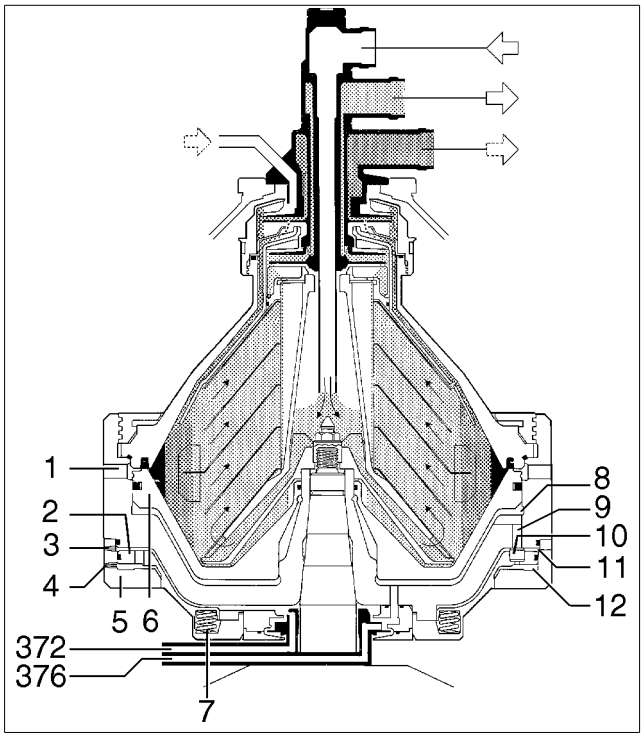
Bowl closes after discharge

After some hundreds of a second the opening chamber (11) above the operating slide (2) has been filled by water leaving the closing water space (8). This water overflows through channels in the operating slide down to the closing chamber (12) between the operating slide and dosing ring (5). When also this chamber has been filled, the hydraulic forces directed up- and downwards on the operating slide are equal and the springs (7) move the operating slide upwards.

The drain channels (9) are closed by the drain valve plugs (10) and the increasing force from the closing water (376) presses the sliding bowl bottom (6) 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.

Closing and opening water are supplied from the high pressure water system.



Separator bowl, feed and discharge assembly, control paring disc and liquid flow

1. Sludge port
*2. Operating slide **
*3. Nozzle **
*4. Nozzle **
*5. Dosing ring **
*6. Sliding bowl bottom **
*7. Spring **
8. Closing water space
9. Drain channel
10. Drain valve plug
*11. Opening chamber **
*12. Closing chamber **

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

* *Parts effecting a sludge discharge*

3.3 Definitions

Back pressure Pressure in the separator outlet.

Clarification Liquid/solids separation with the intention of separating particles, normally solids, from a liquid (oil) having a lower density than the particles.

Clarifier disc An optional disc, which replaces the gravity disc in the separator bowl, in the case of clarifier operation. The disc seals off the heavy phase (water) outlet in the bowl, thus no liquid seal exists.

Counter pressure See Back pressure.

Density Mass per volume unit. Expressed in kg/m^3 at specified temperature, normally at 15 °C.

Gravity disc 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.

Interface Boundary layer between the heavy phase (water) and the light phase (oil) in a separator bowl.

Intermediate Service (IS) Overhaul of separator bowl, inlet/outlet and operating water device. Renewal of seals in bowl inlet/outlet and operating water device.

Major Service (MS) 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.

Purification 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 **lighter** liquid phase (oil), which is the major part of the mixture, shall be purified as far as possible.

Sediment (sludge) Solids separated from a liquid.

Sludge discharge Ejection of sludge from the separator bowl.

Throughput The feed of process liquid to the separator per time unit.
Expressed in m^3/or lit/h.

Viscosity Fluid resistance against movement. Normally expressed in centistoke (cSt = mm^2/sec), at specified temperature.

Water seal 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.

4 Operating Instructions

Contents

4.1 Operating routine

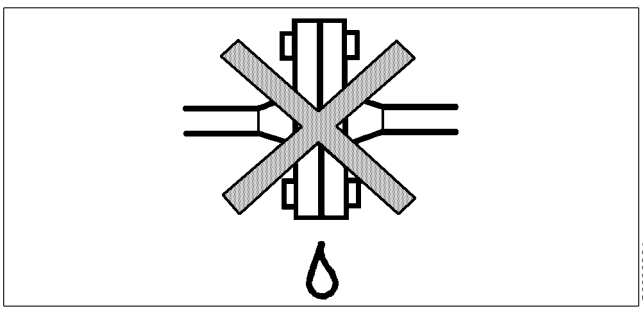
These operating instructions describe routine procedures to follow before and during the start, running and stopping sequences of the separator.

If there is a System Manual, always follow the operating instructions of the System Manual. If there is no System Manual the instructions below are to be followed.

4.1.1 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.



Check for leakages (not admitted)

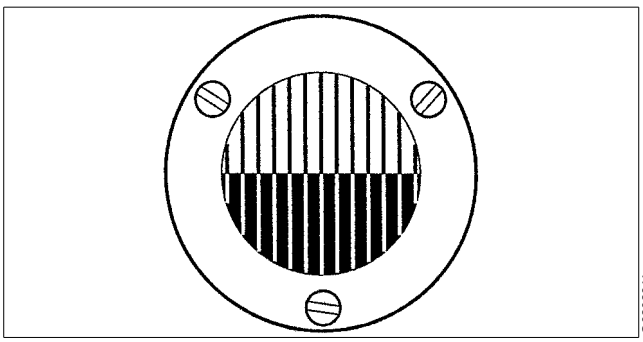
CAUTION

Burn hazards

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

Escaping hot liquid can cause burns.

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



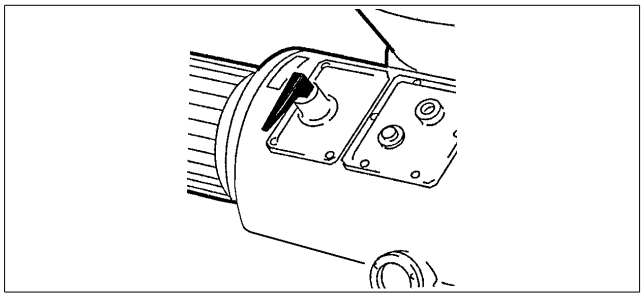
Check the oil level

NOTE

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

Fill if necessary. See chapter “8.5 Lubricants” on page 183**,** for a list of recommended oils.

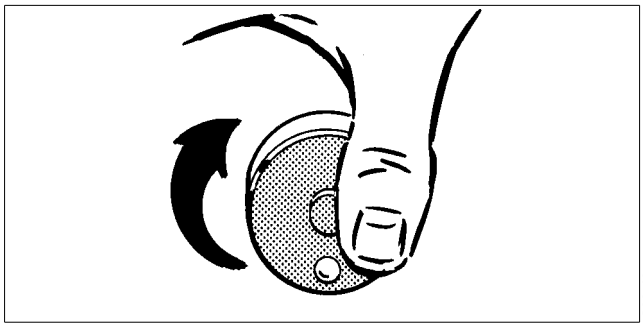
4. Make sure that the brake is released.



Release the brake

4.1.2 Start

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



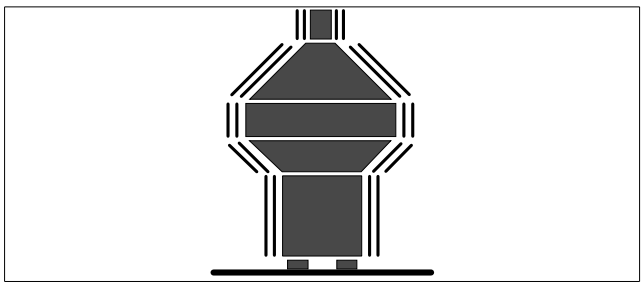
Check for correct direction of rotation

DANGER

Disintegration hazards

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

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 over without danger. Try to learn the vibration characteristics of the critical speed pattern.



Check for vibration

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

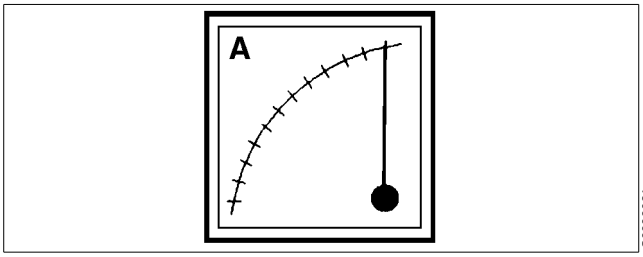
In the trouble-tracing chapter “7.1.1 Separator vibrates” on page 164, a number of causes are described that can create vibration.

4. Check, ifpossible, the current consumption of the motor starter to ensure that the separator has reached full speed.

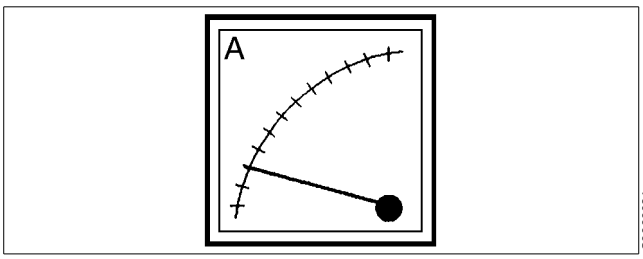
   During start, the current reaches a peak and then drops slowly. When the friction coupling engages, the current slowly increases again before decreasing to a low and stable level, which is the normal current during running.

   The time to reach full speed may not exceed the limit given in chapter “8 Technical Reference” on page 173.

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

4.1.3 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 - 2 bar.
3. Discharge by opening the valve for opening water valve (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 41.

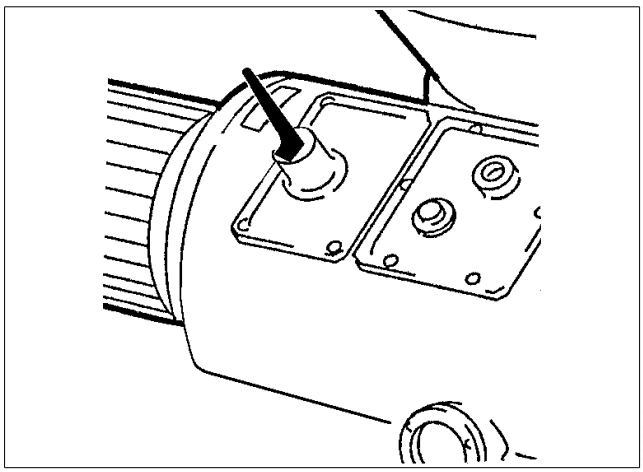
4.1.4 Normal stop

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.



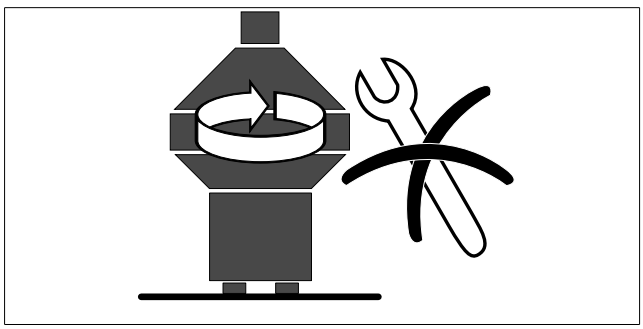
The final action, apply the brake

4.1.5 Safety stop

DANGER

Entrapment hazards

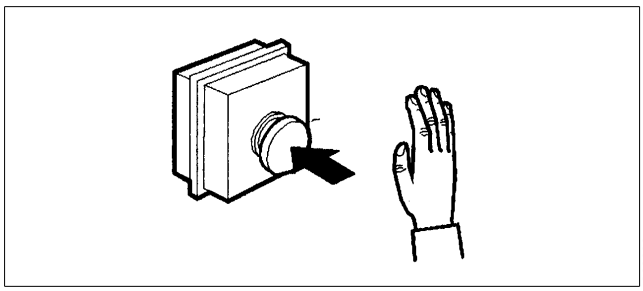
Make sure that rotating parts have come to a **complete standstill** before starting **any** dismantling work. The revolution counter and the motor fan indicate if the separator parts are rotating or not.



The separator must not be dismantled before standstill

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

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



Push the safety stop if excessive vibration

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

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 safety 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.

5 Service Instructions

Contents

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.

DANGER

Disintegration hazards

Separator parts that are either worn beyond their safe limits or incorrectly assembled may cause severe damage or fatal injury.

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)

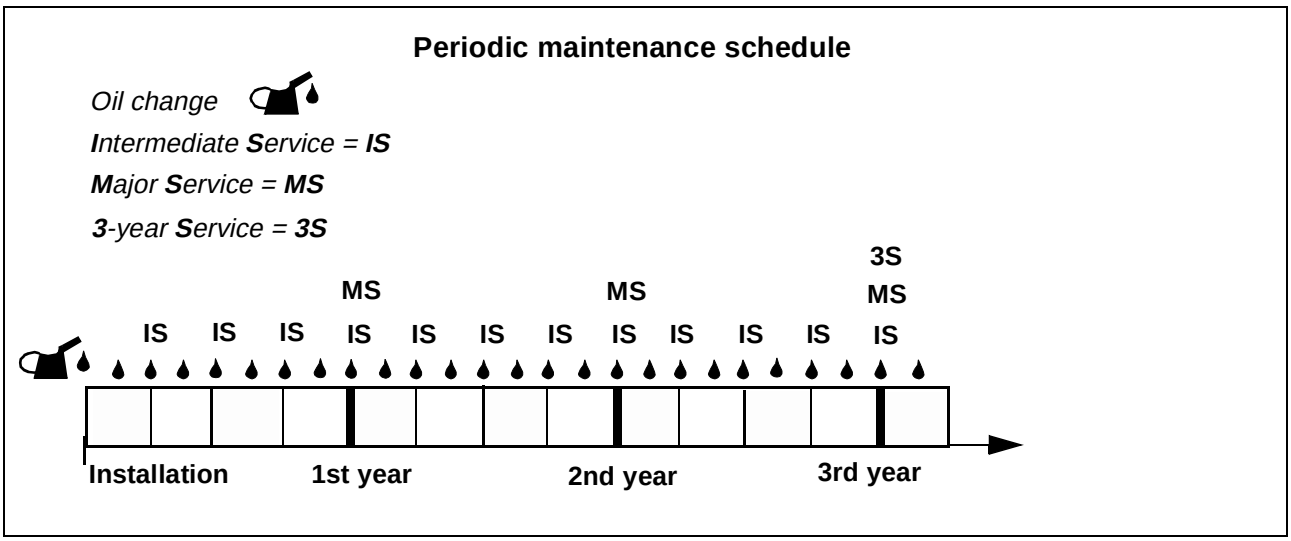
Intermediate Service consists of an overhaul of the separator bowl, inlet/outlet and operating device every 3 months or 2000 operating hours. Seals in bowl and gaskets in inlet/outlet device are renewed.

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 an overhaul of the complete separator. The service should be coordinated with a Major Service. Compared with the Major Service additional spare parts with longer life time have to be renewed.



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 93.

   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 kits while assembling the separator as described in chapter ‘‘6 Dismantling/Assembly” on page 93. The assembly instructions have references to check points which should be carried out before and during the assembly.

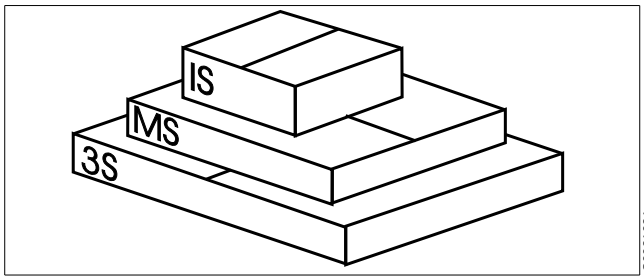
5.1.4 Service kits

Special service kits are available for Intermediate Service (IS), Major Service (MS) and 3-year Service (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 and parts for IS & MS are not included in the 3S kit.

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



Kits are available for Intermediate Service, Major Service and 3-year Service

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 spare 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
Inlet and outlet			
Check for leakage	Connecting housing	–	
Separator bowl			
Check for vibration and noise		87	
Horizontal driving device			
Worm wheel shaft and gear casing			
Check for vibration and noise		87	
Check	Oil level in gear housing	30	
Electrical motor			
Check for heat, vibration and noise		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[a)] hours of operation.

Note! In a new installation, or after replacement of gear, change the oil after 200 operating hours.

Main component and activity	Part	Page	Notes
Horizontal driving device			
Worm wheel shaft and gear housing			
Check	Worm wheel and worm	83	
Renew	Oil[b)] in gear housing	86	

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 183 for further information.

5.2.3 Intermediate Service (IS)

Name of plant: Local identification:

Separator: FOPX 613TFD-20 Manufacture No./Year:

Total running hours: Product No: 881082-01-06

Date: Signature:

Main component and activity	Part	Page	Notes
Inlet and outlet			
Clean and inspect	Threads of inlet pipe	58	
	Connecting housing	–	
Separator bowl			
Clean and check	Upper paring disc	–	
	Flow control disc	–	
	Lock ring	59	
	Bowl hood	47	
	Top disc	–	
	Oil paring disc	58	
	Level ring	58	
	Bowl discs	81	
	Distributor	–	
	Distributing cone	–	
	Sliding bowl bottom	62	
	Bowl body	–	
	Bowl spindle cone and bowl body nave	48	
	Operating mechanism	54, 61, 63	
Check	Corrosion	48	
	Cracks	51	
	Erosion	54	
	Galling of guide surface	57	
	Disc stack pressure	52	
Operating device			
Clean and check	Operating paring disc	–	

Main component and activity	Part	Page	Notes
Horizontal driving device			
Worm wheel shaft and gear housing			
Check	Worm wheel and worm	83	
Renew	Oil in gear housing	86	
Electrical motor			
Lubrication (if nipples are fitted)	See sign on motor	–	
Signs and labels on separator			
Check attachment and legibility	Safety label on hood	198	
	Direction of rotation arrow	198	
	Power supply frequency	198	
Monitoring equipment (option)			
Function check	Vibration switch	63	
	Cover interlocking switch	63	

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

5.2.4 Major Service (MS)

Name of plant: Local identification:

Separator: FOPX 613TFD-20 Manufacture No./Year:

Total running hours: Product No: 881082-01-06

Date: Signature:

Main component and activity	Part	Page	Notes
Inlet and outlet			
Clean and inspect	Threads of inlet pipe	58	
	Connecting housing	–	
Separator bowl			
Clean and check	Upper paring disc	–	
	Flow control disc	–	
	Lock ring	72, 59	
	Bowl hood	47	
	Top disc	–	
	Oil paring disc	58	
	Level ring	58	
	Bowl discs	81	
	Distributor	–	
	Distributing cone	–	
	Sliding bowl bottom	62	
	Bowl body	–	
	Bowl spindle cone and bowl body nave	48	
	Operating mechanism	54, 61, 63	
Check	Corrosion	48	
	Cracks	51	
	Erosion	57	
	Galling of guide surface	57	
	Disc stack pressure	52	
	Height position of oil paring disc	74	

Main component and activity	Part	Page	Notes
Operating device			
Clean and check	Operating paring disc	–	
Check	Height position of operating paring disc	74	
Vertical driving device			
Clean and check	Bowl spindle	–	
	Wear of groove in worm	76	
	Buffer springs and ball bearing housing	66	
	Radial wobble of bowl spindle	64	
Renew	Spindle bearings	134	
Horizontal driving device			
Worm wheel shaft and gear housing			
Check	Worm wheel and worm	83	
	Radial wobble of worm wheel shaft	77	
	Axial play of flexible plate	70	
Renew	Bearings	150	
	Oil in gear housing	86	
Brake			
Clean and check	Spring and brake shoe	65	
Renew	Friction pad	65	
Friction coupling			
Clean and check	Worm wheel coupling	–	
Renew	Friction pads	68	
Electrical motor			
Lubrication (if nipples are fitted)	See sign on motor	–	
Signs and labels on separator			
Check attachment and legibility	Safety label on hood	198	
	Direction of rotation arrow	198	
	Power supply frequency	198	
Monitoring equipment (option)			
Function check	Vibration switch	63	
	Cover interlocking switch	63	

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).

NOTE

Renew all parts included in the Intermediate Service kit (IS), Major Service kit (MS) and 3-year Service kit (3S).

The 3S kit consists among other parts of vibration dampers for renewal of frame feet. How to renew the frame feet is described below.

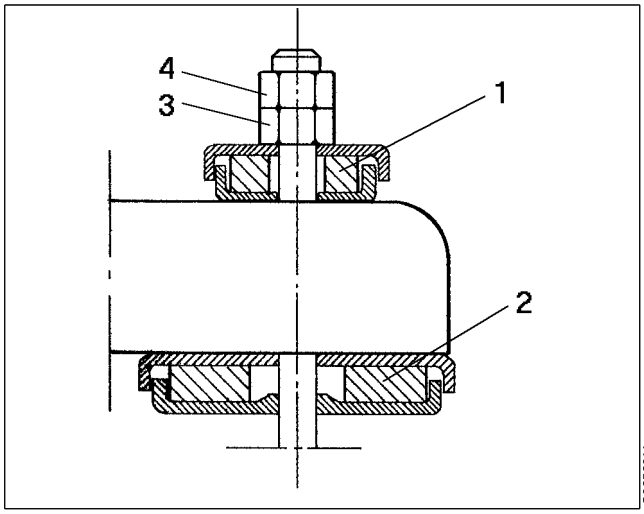
Frame feet, renewal

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 78.

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.



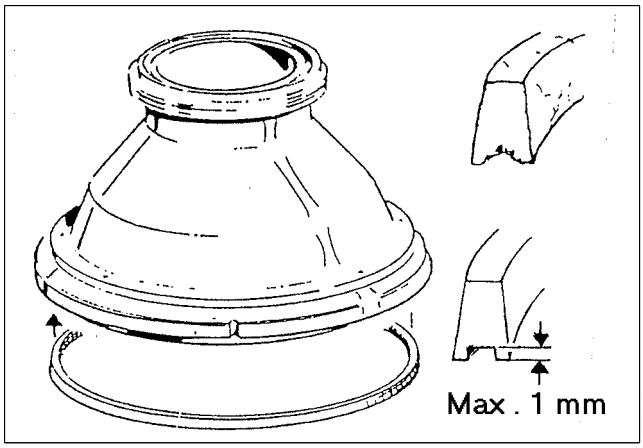
1. Vibration damper, upper
2. Vibration damper, lower
3. Nut
4. Lock nut

5.3 Check points at Intermediate Service (IS)

5.3.1 Bowl hood seal ring

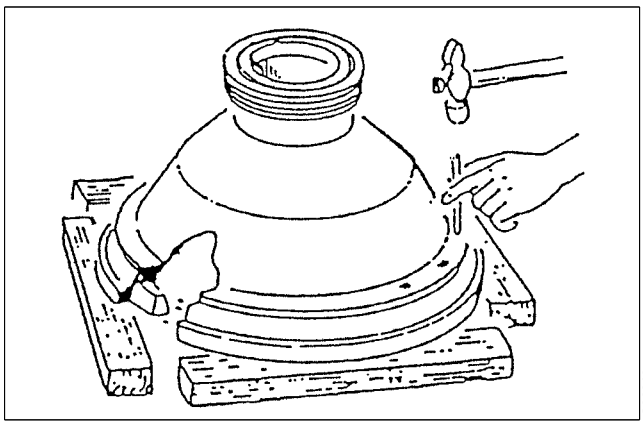
Poor sealing between the bowl hood seal ring and the sealing edge of the sliding bowl bottom will cause a leakage of process liquid from the bowl.

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



Max. permitted indentation of the seal ring is 1 mm

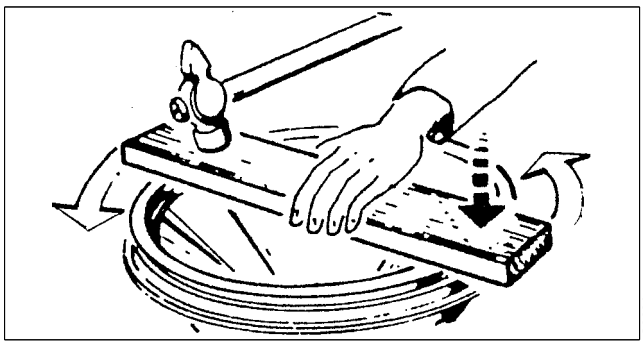
Knock out the old ring by means of a pin inserted in the holes intended for this purpose.



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



Fitting of the seal 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 in 80-90 °C for about 24 hours.

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.

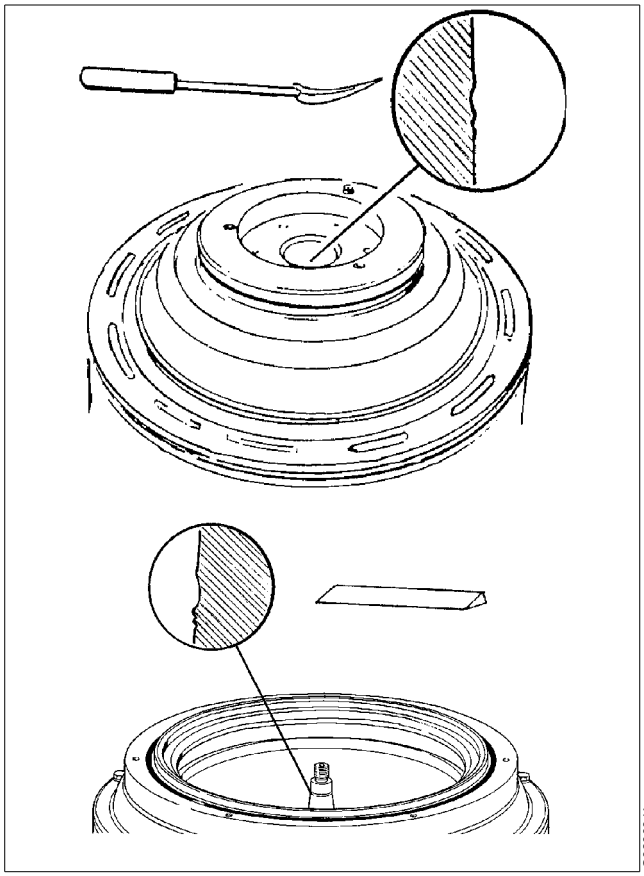
Corrosion may cause the bowl to stick firmly to the spindle cone and cause difficulties during the next dismantling.

- 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

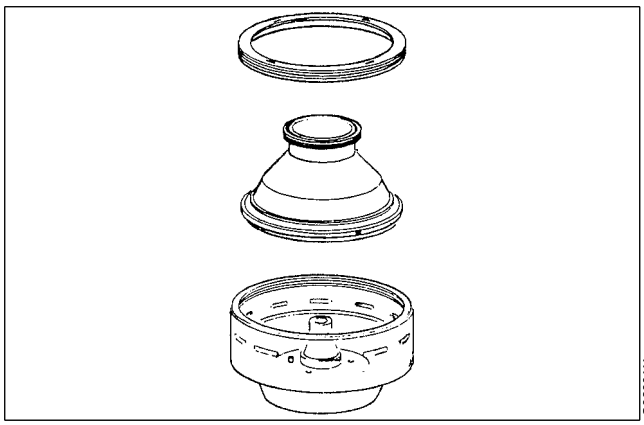
5.3.3 Corrosion

Evidence of corrosion attacks 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

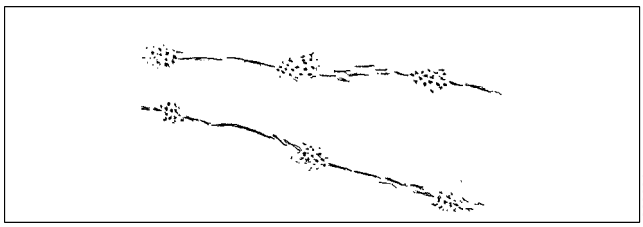
Corrosion (rusting) can occur on unprotected surfaces of non-stainless steel and cast iron. Frame parts can corrode when exposed to an aggressive environment.

Stainless steel

Stainless steel parts corrode when in contact with either chlorides or acidic solutions. Acidic solutions causes a 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:

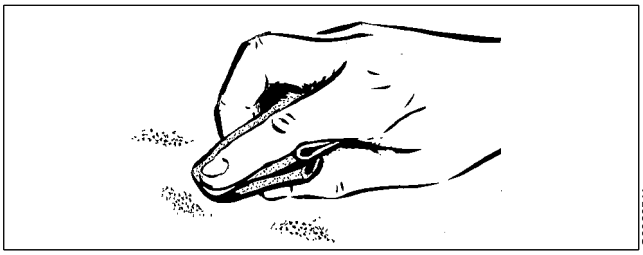
- Exposed to a stationary solution.
- In a crevice.
- Covered by deposits.
- Exposed to a solution that has a low pH value.

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



Example of chloride corrosion in stainless steel

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.

Replace 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.

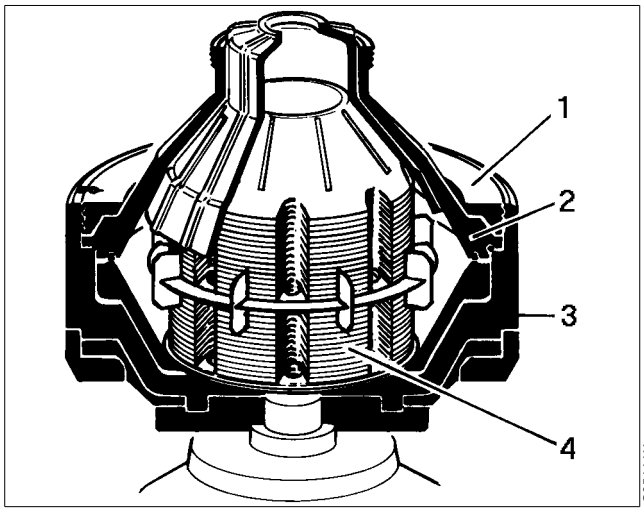
5.3.5 Disc stack pressure

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

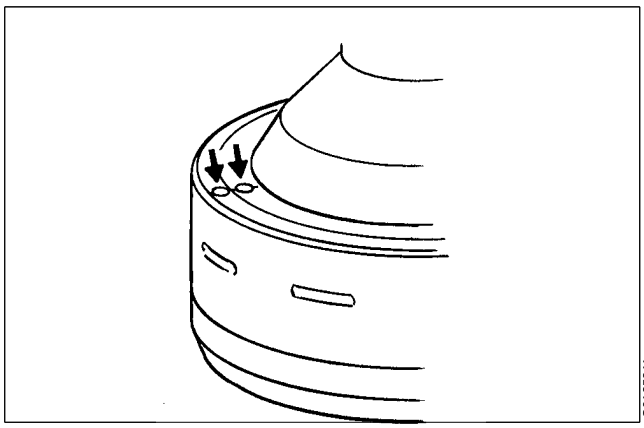
Compress the disc stack by tightening the lock ring, see chapter ‘‘6.3.3 Assembly” on page 107.

Correct pressure is obtained when it is possible to tighten the lock ring so far by hand that the ϕ-mark on the lock ring is positioned 60° - 90° before 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 ϕ-marks are passed and the bowl is fully assembled.

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



ϕ-marks on bowl body and lock ring in line

Complementary check using the compressing tool

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

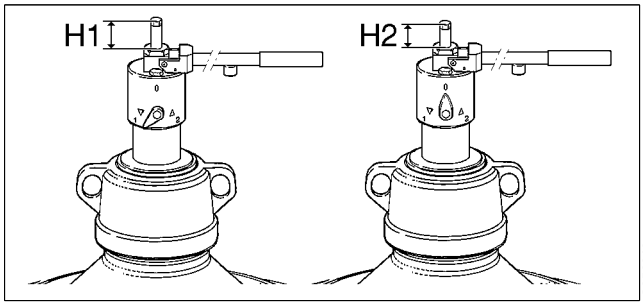
Compress the disc stack by pumping the level arm until the oil pressure is released through the relief valve.

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

Release the pressure in the compressing tool by turning the switch 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 callipers 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

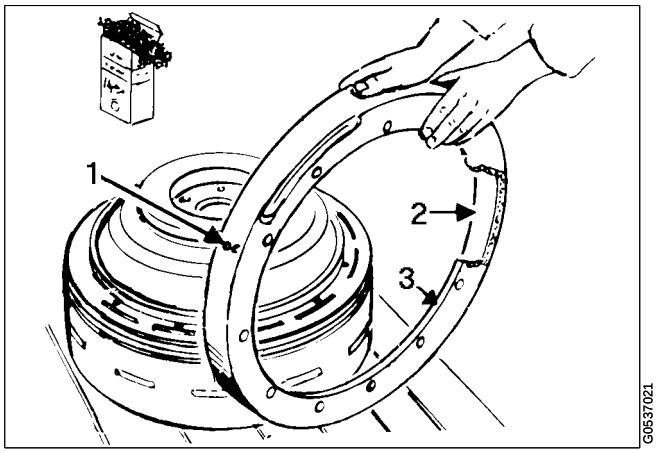
NOTE

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).



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 slide along or strike against a surface. Erosion can become intensified locally by flows of higher velocity.

DANGER

Disintegration hazard

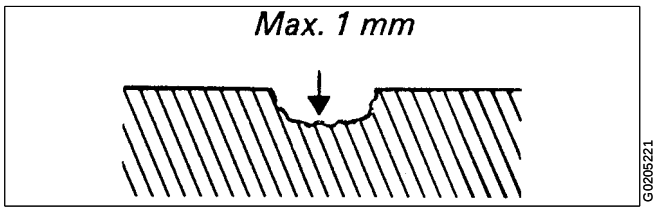
Inspect regularly for erosion damage. Inspect frequently if the process liquid is erosive.

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.

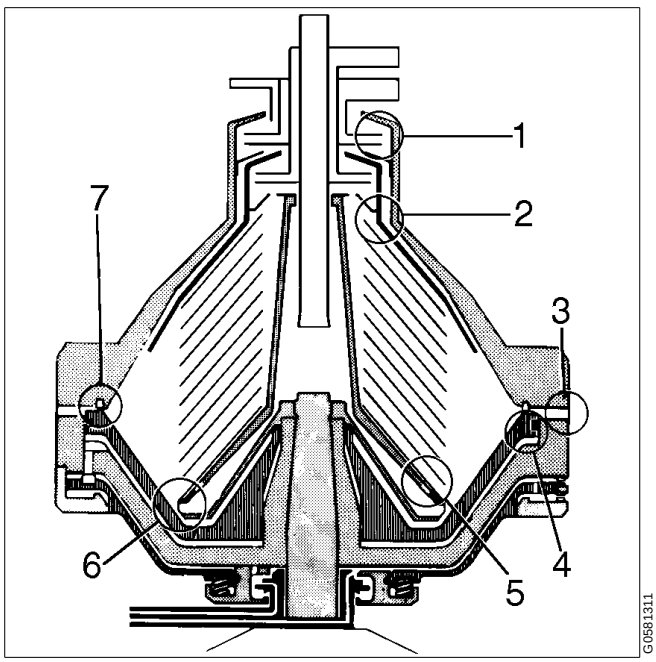
Erosion is characterised by:

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

Surfaces particularly subjected to erosion are:



Max. permitted erosion



Surfaces particularly subjected to erosion

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 bowl body for the seal ring in 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 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.

DANGER

Disintegration hazard

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

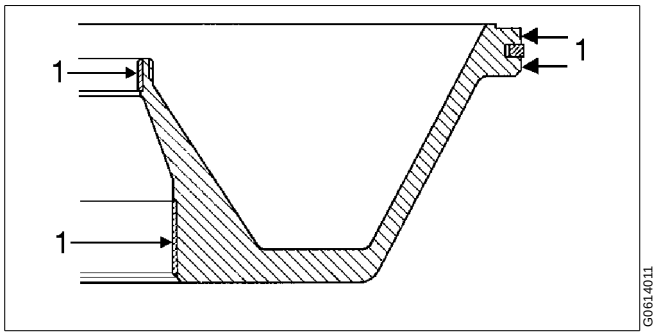
Pay special attention to the pillars between the sludge ports in the bowl wall.

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

5.3.8 Guide surfaces

Check surfaces indicated (1) 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 and 2). Apply Alfa Laval lubricating paste or Molykote 1000 Paste with a well-cleaned brush on surfaces (1 and 2).

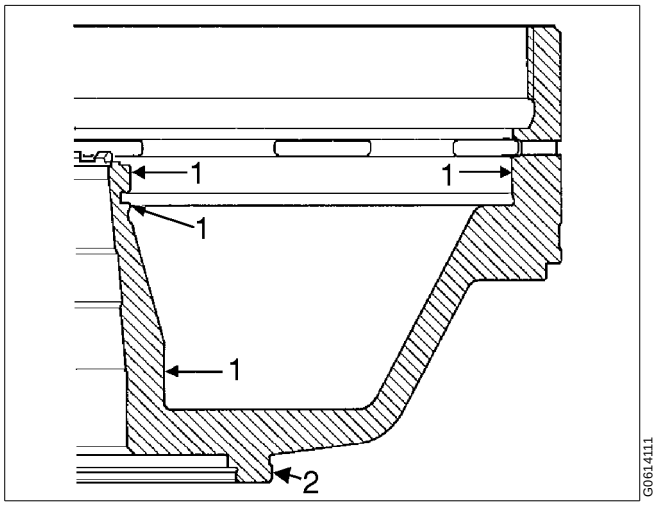


Sliding bowl bottom

NOTE

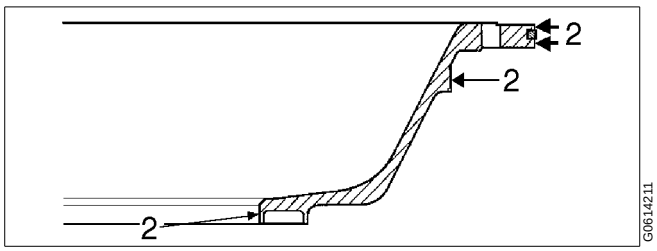
To avoid the risk of galling, the contact surfaces (1) should be primed with a slide lacquer at every Major Service (MS).

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

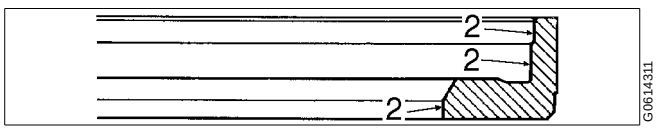


Bowl body

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



Operating slide



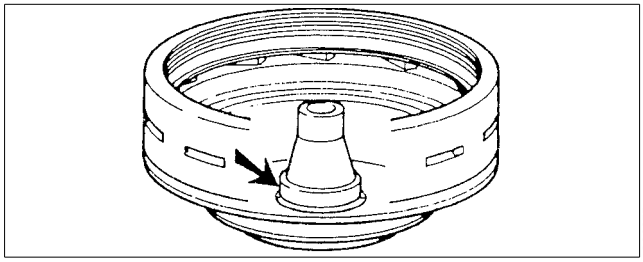
Dosing ring

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.

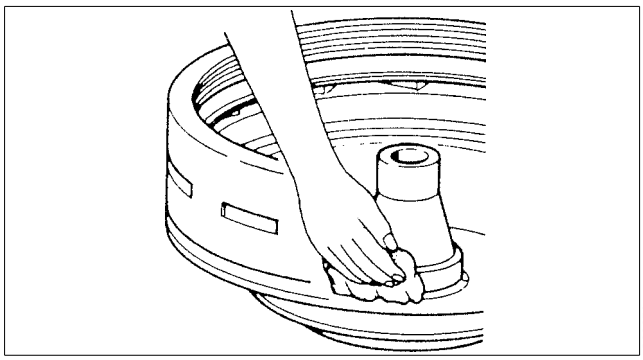


Guide surface in the bowl body

Recommended tools for correction of galling:

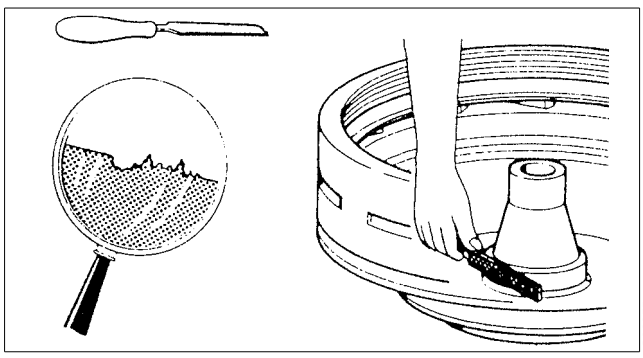
- Emery cloth, 240 grade.
- Hand drilling machine
- Degreasing agent.
- Fibre brush, ∅ 25mm.
- Fibre brush, ∅ 50 mm.
- Very fine single-cut file.

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

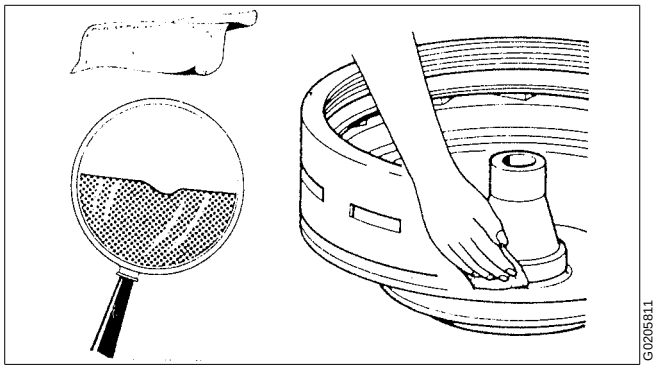


2. If the galling is excessive, first use the fine single-cut file. The file should be used with caution so that the damage is not made worse.

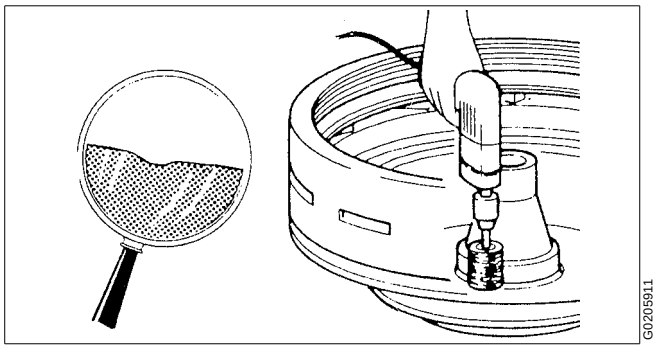
   Remove the high spots on the surface. Do not use rotating files or similar. Remove the high spots only - not the undamaged material.



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 smoothen the whole of the damaged area, even in the deepest parts.

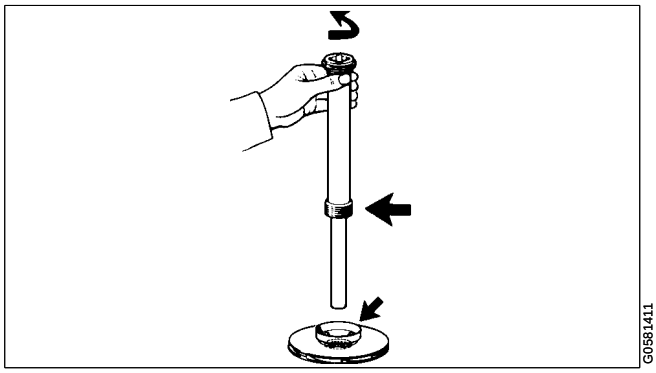


Prime the repaired area with lubricating spray Molykote 321 R. Read the correct procedure under checkpoint “5.4.16 Lock ring; priming” on page 72. Apply Alfa Laval lubricating paste or Molykote 1000 Paste to the surface after priming.

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.

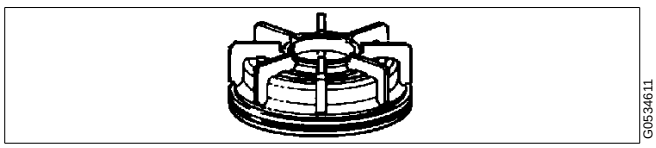
Screw the inlet pipe into the paring disc and check that the inlet pipe turns easily.



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

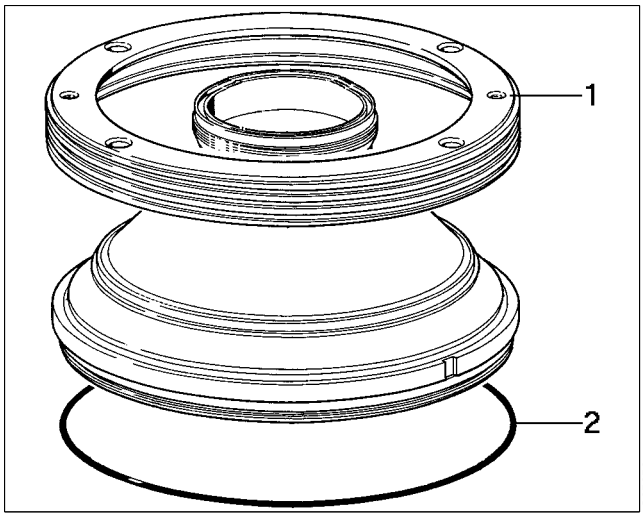
Excessive wear or impact marks on threads, guide and contact surfaces of the lock ring, bowl hood and bowl body may cause hazardous galling.

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 ϕ-mark on lock ring must not pass opposite ϕ-mark by more than the specified distance.



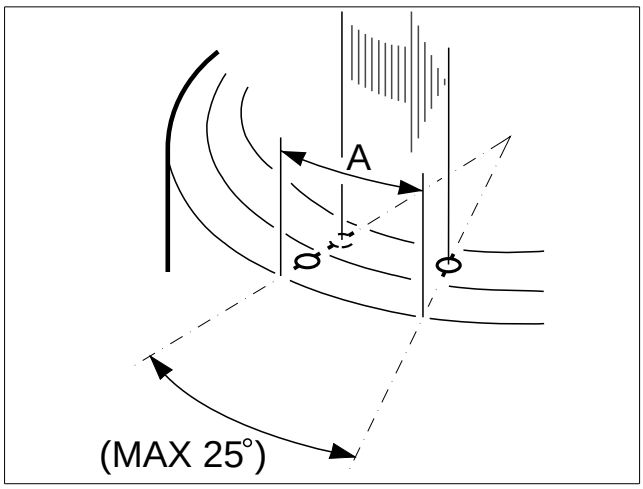
1. *Lock ring*
2. *O-ring for the bowl hood*

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 bowl body at the new position of the alignment mark on the lock ring by punching in a new alignment mark.

If the original ϕ–mark on the lock ring passes the ϕ–mark on the bowl body by more than 25° (which corresponds to **A=120 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 ϕ-mark on the lock ring must not pass the ϕ-mark on the bowl body by more than 25°

Damage

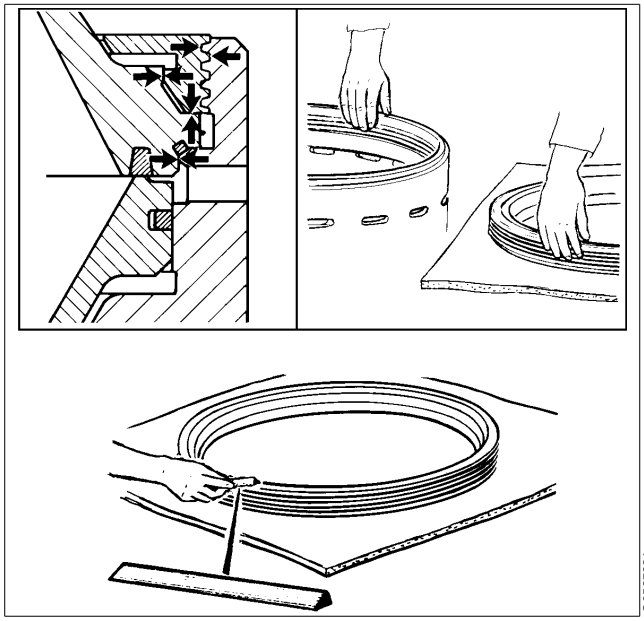
The position of the threads, contact and guide surfaces are indicated by arrows in the illustration.

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

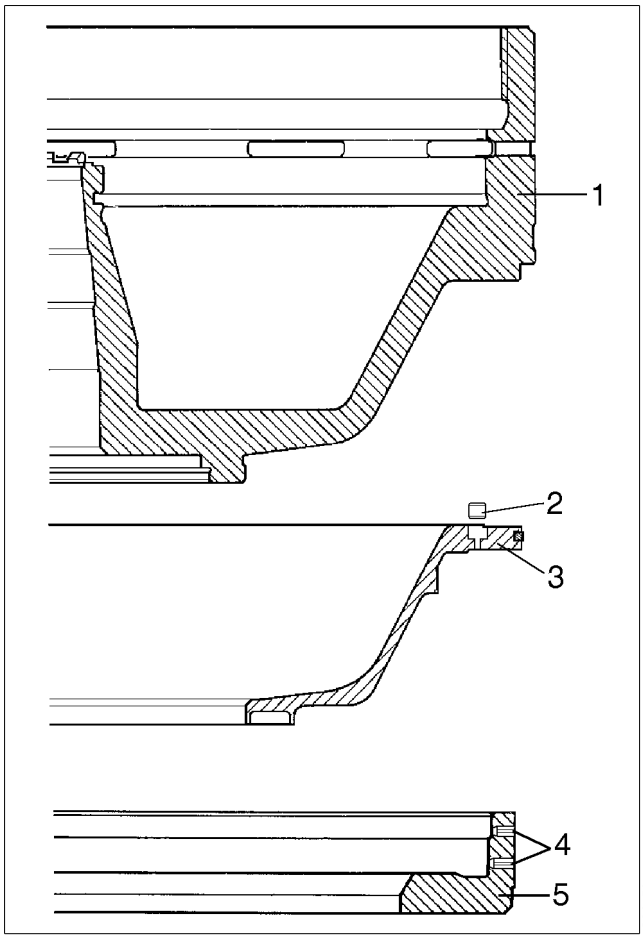
5.3.12 Operating mechanism

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.



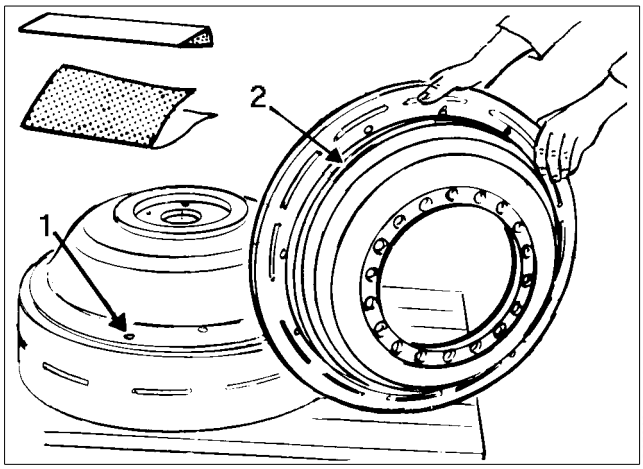
1. *Bowl body*
2. *Valve plug*
3. *Operating slide*
4. *Nozzles*
5. *Dosing ring*

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.

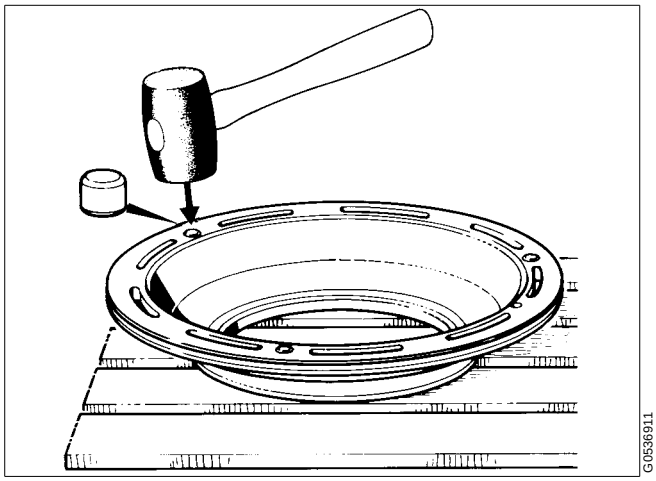
Check the guiding surface (2) in contact with the dosing ring. Remove any marks with a whetstone (grain size 240).



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: **13,4 mm**.



Tap in new valve plugs

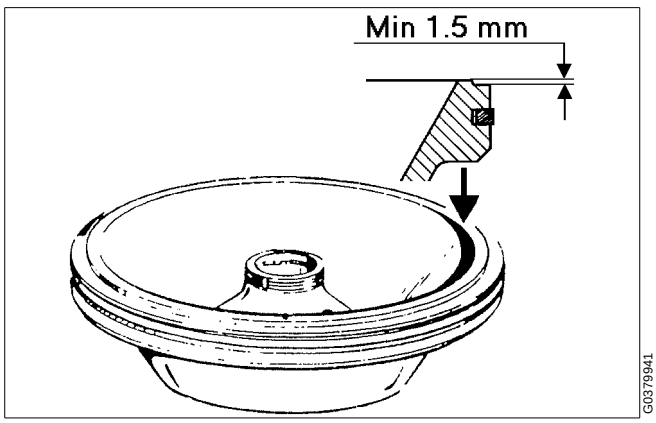
5.3.14 Sliding bowl bottom

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.



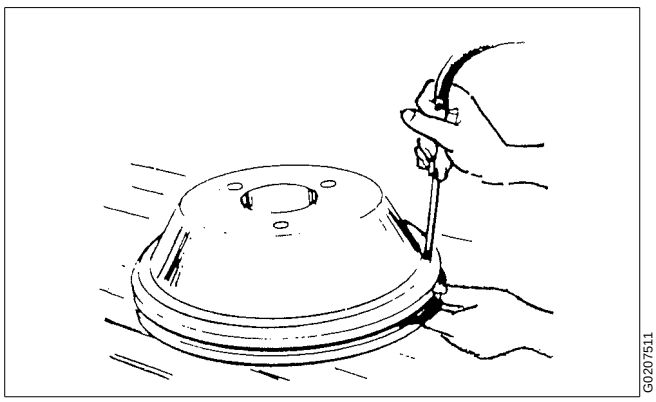
Min. height of the profile on sliding bowl bottom

If the seal ring for the sliding bowl bottom is to be replaced, 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.

WARNING

Risk for eye injury

Wear safety goggles.



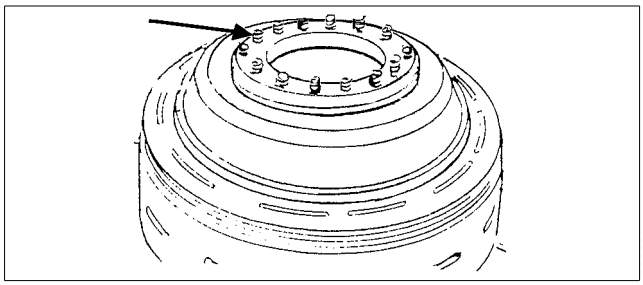
Removal of the O-ring in sliding bowl bottom using compressed air

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.Worm wheel and worm; wear of teeth

Same as described in ‘‘5.7.1 Worm wheel and worm; wear of teeth” on page 83 in this chapter.



Check for defective or broken springs

5.3.16 Cover interlocking switch (option)

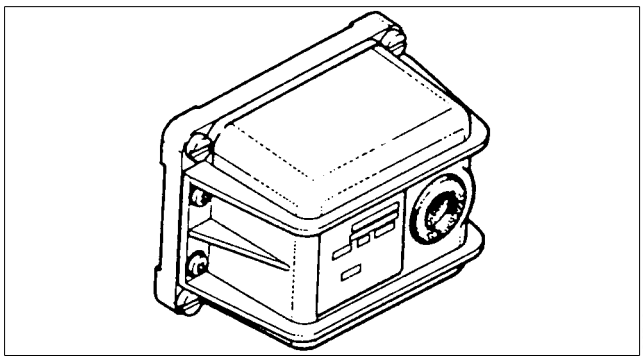
When the button is pushed, check that the connections 13 and 14 inside the switch are short -circuited. A principal diagram of the connections is shown in chapter ‘‘8.6.7 Cover interlocking switch (option)” on page 200.

5.3.17 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 88.



Vibration switch

5.4 Check points at Major Service (MS)

5.4.1 Bowl hood seal ring

Same as described in “5.3.1 Bowl hood seal ring” on page 47.

5.4.2 Bowl spindle cone and bowl body nave

Same as described in ‘‘5.3.2 Bowl spindle cone and bowl body nave” on page 48.

5.4.3 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.

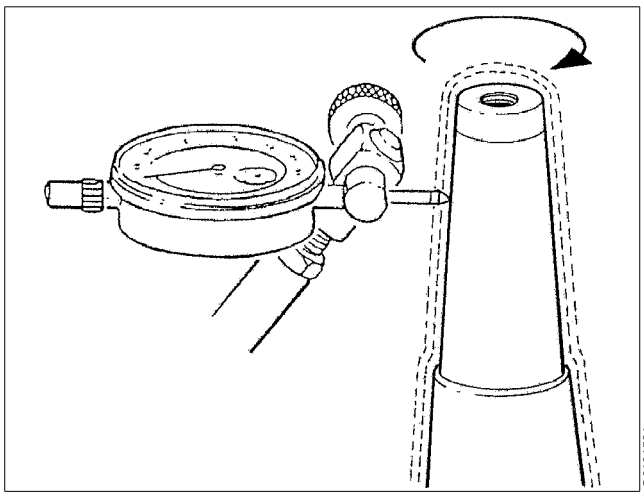
NOTE

Spindle wobble will cause rough bowl run. 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. Maximum permissible radial wobble is **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 replaced.

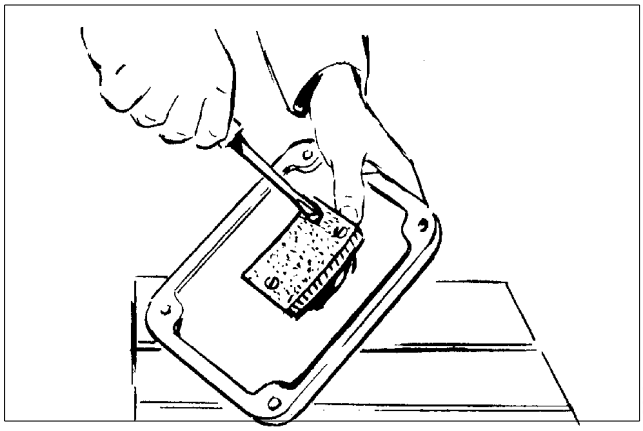
5.4.4 Brake

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 in both ends.

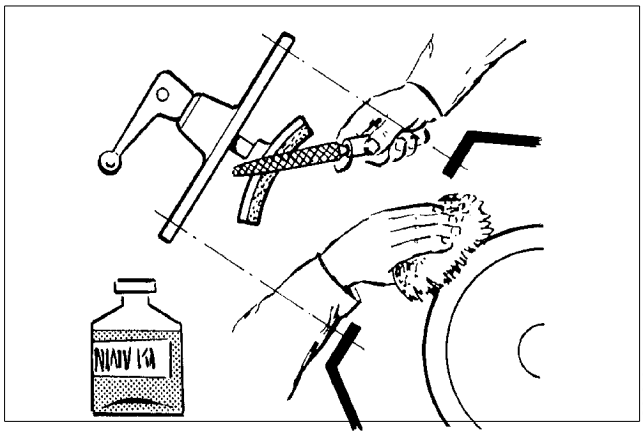


Friction pad is fastened with screws

If 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.

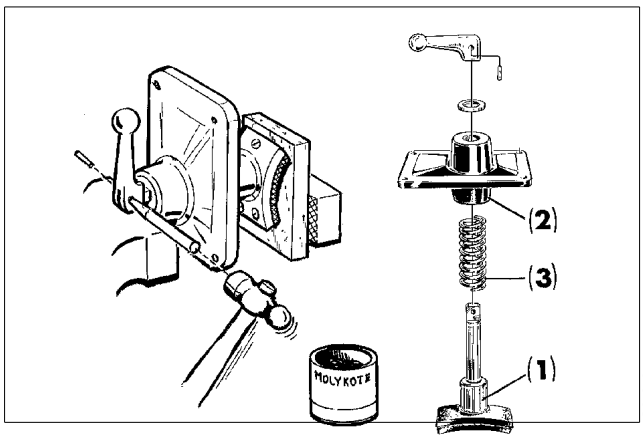


Measurements when the friction pad is oily

Checking of spring and brake shoe:

Formation of rust on brake parts may cause the brake to jam.

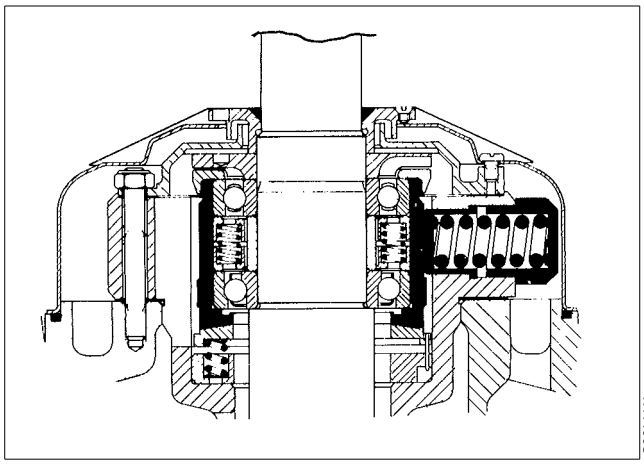
- Remove any rust from the surface (1) of the brake shoe and the corresponding guide surface in the cap (2).
- Rub in Molykote Paste on the surfaces.
- Replace the spring (3) if it has been weak. This is indicated by chattering from the spring when the brake is in released position.
- Oil the spring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



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

5.4.5 Buffer springs and ball bearing housing

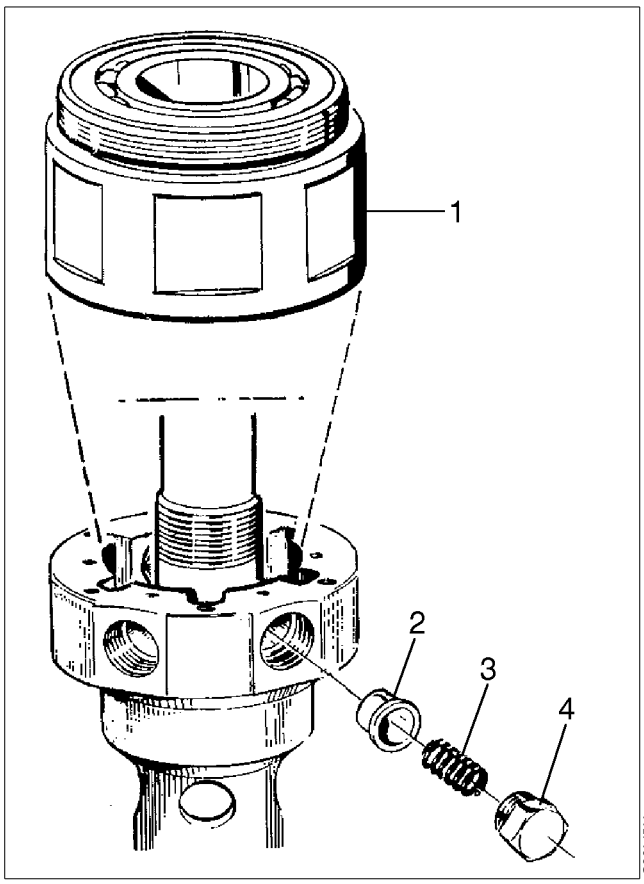
Weakened or broken buffer springs or defective contact surfaces for the buffers on the ball bearing housing may give rise to separator vibration (rough bowl run).



Cut view of ball bearing housing

Top bearing springs

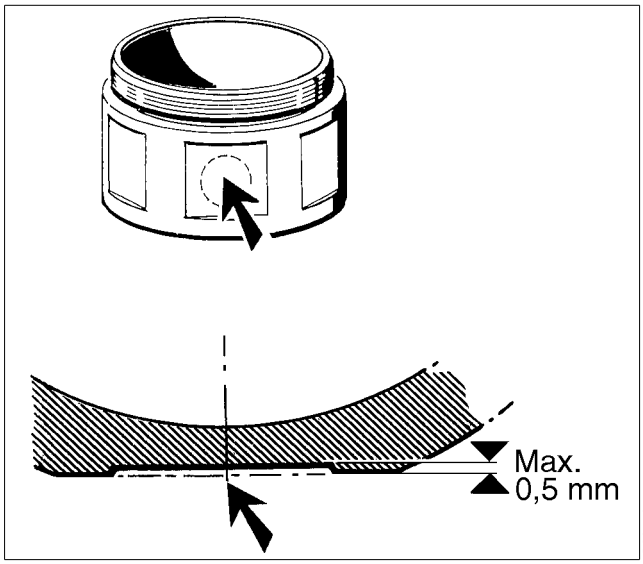
In case of spring fracture, the complete set of springs should be replaced, even if only one spring is broken.



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

5.4.6 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 the bowl lose 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.

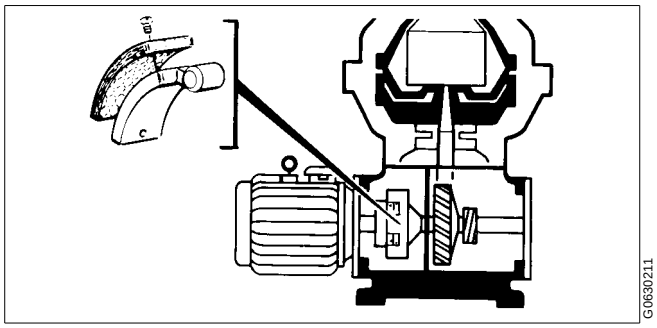
If the pads are worn:

- Remove the screws and renew the pads.

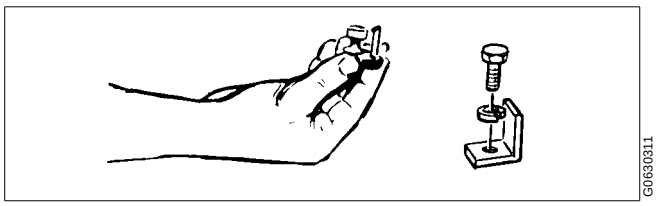
NOTE

The screws are slotted in both ends.

Replace all pads even if only one is worn.



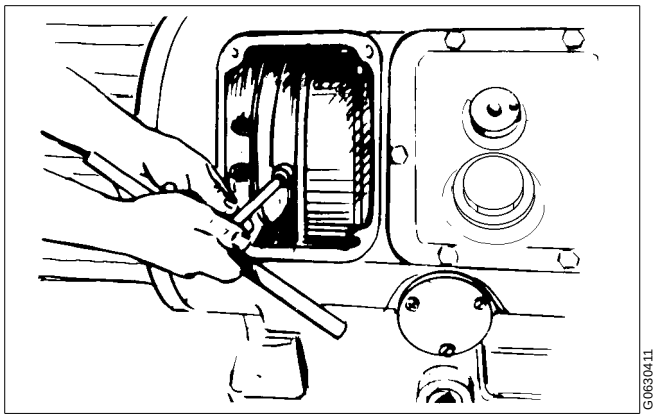
Location of coupling friction blocks



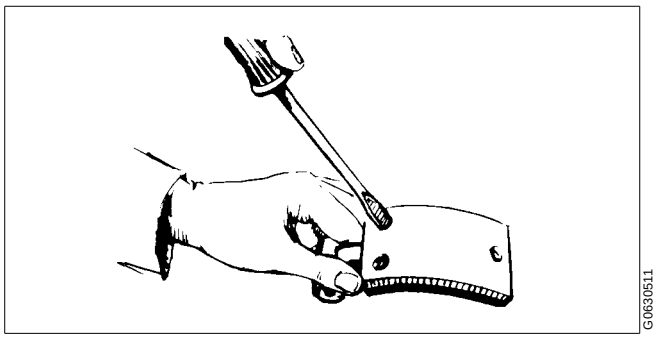
A friction block is fixed with screw, spring washer and holding bracket

How to renew friction pads without dismantled 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.



Unscrew the holding bracket screws to remove the friction blocks



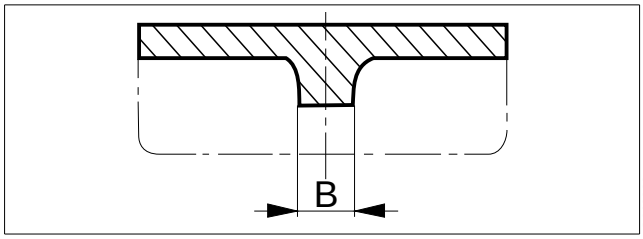
Three screws fix the friction pad to the friction block

Different friction blocks for different power supply frequencies

If mounting new friction blocks, check that the blocks are correct for the power supply frequency. The measure B is different for 50 and 60 Hz separators.

50 Hz: B = 35 mm

60 Hz: B = 4 mm



Measure B is different for 50 and 60 Hz installations

5.4.7 Corrosion

Same as described in “5.3.3 Corrosion” on page 48.

5.4.8 Cracks

Same as described in “5.3.4 Cracks” on page 51.

5.4.9 Disc stack pressure

Same as described in “5.3.5 Disc stack pressure” on page 52.

5.4.10 Dosing ring

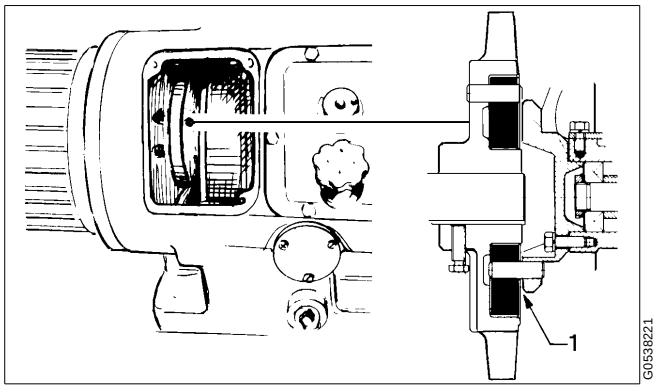
Same as described in “5.3.6 Dosing ring” on page 54**.**

5.4.11 Erosion

Same as described in “5.3.7 Erosion” on page 54.

5.4.12 Flexible plate in coupling

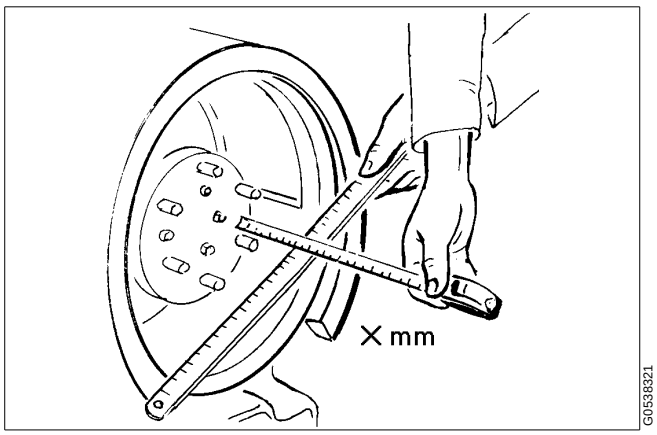
The axial play (1) of the flexible plate should be approximately 2 mm.



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.

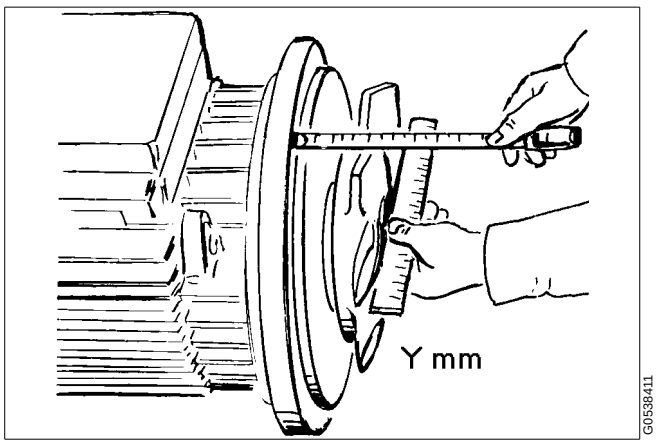


Measure of distance for coupling in separator frame

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

X mm - Y mm = 2 mm.

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



Measure of distance for coupling on motor

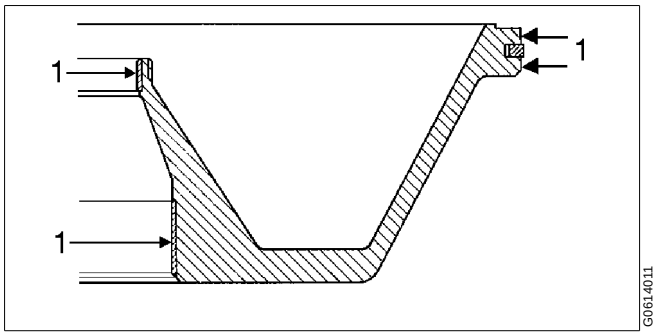
5.4.13 Guide surfaces

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

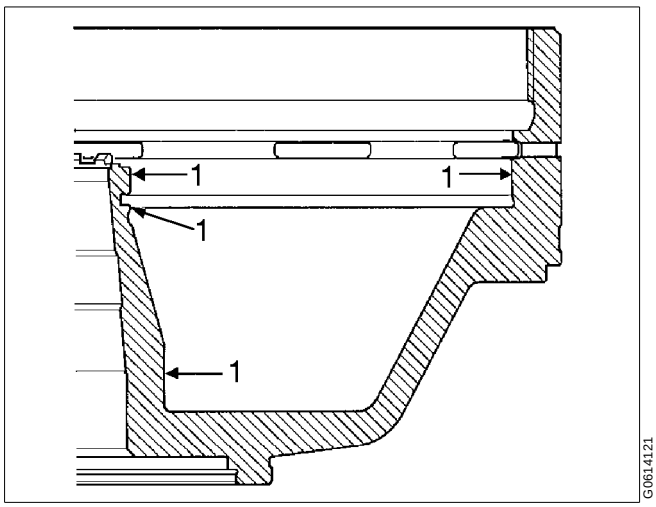
Repair of galling on guiding surfaces, see ‘‘5.3.8 Guide surfaces” on page 56.

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

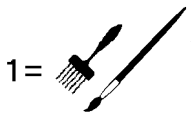
1. Mask the nave hole of the bowl body. Slide lacquer must not enter this hole.
2. Carefully degrease the contact surfaces (1) between the sliding bowl bottom and bowl body. Dry the surfaces well.
3. Apply slide lacquer Molykote D321R with a well cleaned brush. Protect the surfaces which should not be treated.
4. Air-cure the treated surfaces for 20 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 20 minutes.
8. Polish the film to a shiny surface. The film should look like well-polished leather when properly done.
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 excessive paste.
10. Lubricate the O-ring and the seal ring with silicone grease and check that they lie properly in their grooves.



Sliding bowl bottom



Bowl body



At major service

Alfa Laval lubricating paste or Molykote 1000 Paste

Slide lacquer (Molykote D 321R) Paste

5.4.14 Inlet pipe and oil paring disc

Same as described in “5.3.9 Inlet pipe and oil paring disc” on page 58.

5.4.15 Level ring

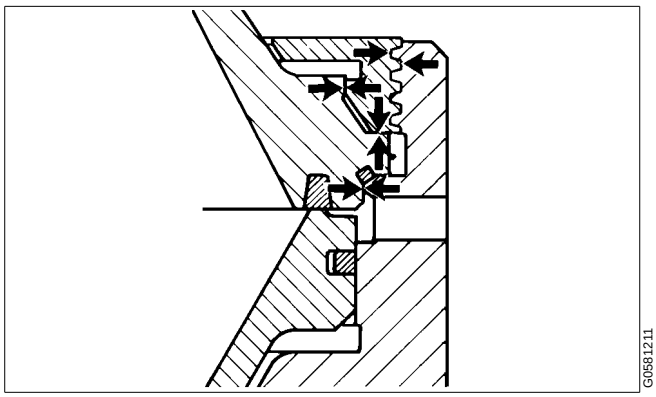
Same as described in section “5.3.10 Level ring” on page 58.

5.4.16 Lock ring; priming

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

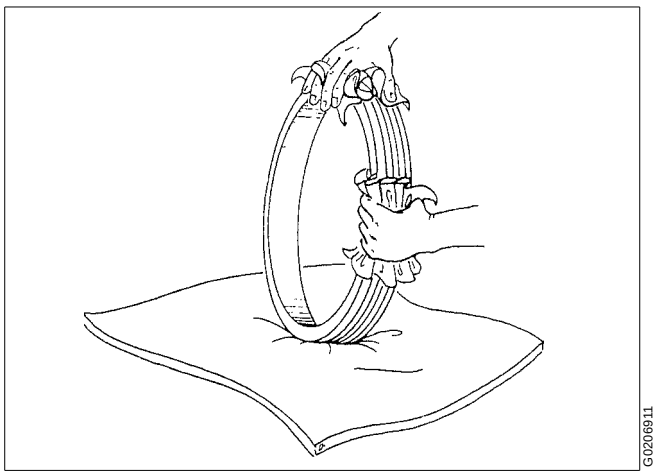
Recommended agents for priming procedure:

- Degreasing agent
- Lubricating spray Molykote 321 R
- Hand drilling machine
- 2 fibre brushes

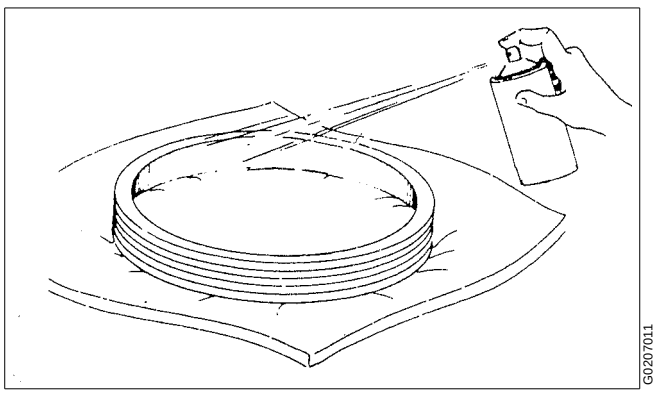


Threads, guide and contact surfaces to be primed

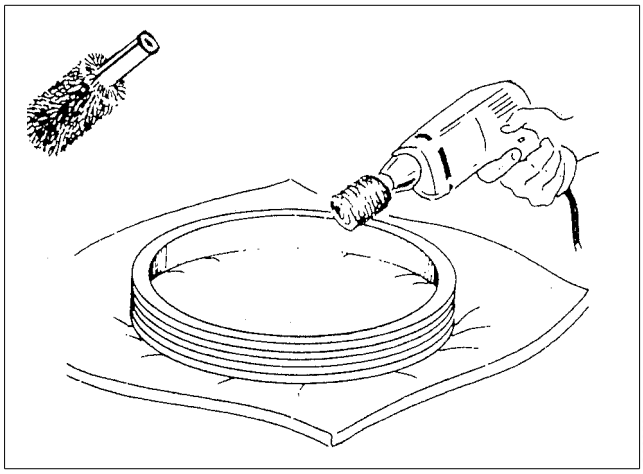
1. Clean the lock ring thoroughly with a degreasing agent and wipe it off.



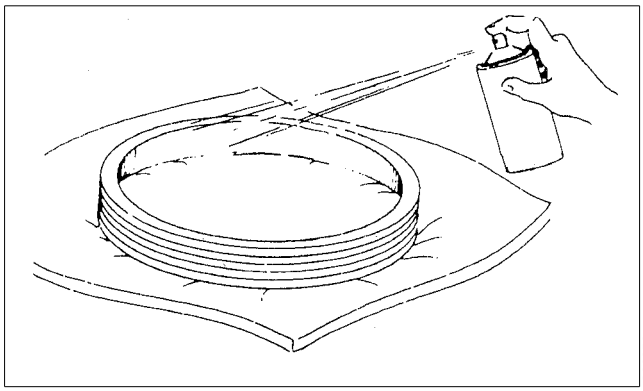
2. Spray the threads, guide and contact surfaces with slide lacquer Molykote 321 R. Let the lacquer air-cure for about 15 minutes.



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

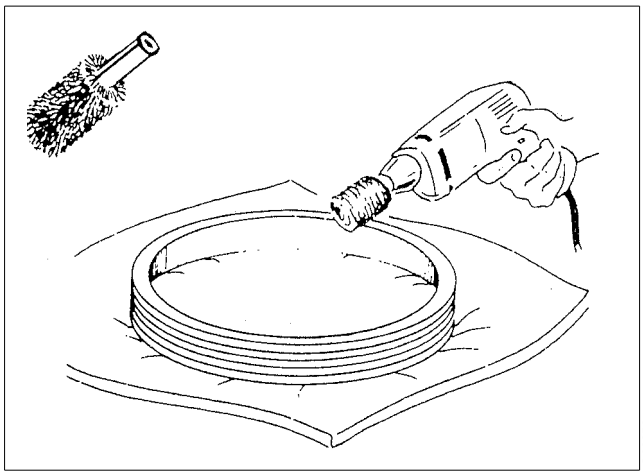


4. Spray the lock ring a second time and let it dry for about 15 minutes.



5. Polish the slide lacquer to a black shiny surface which can 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.



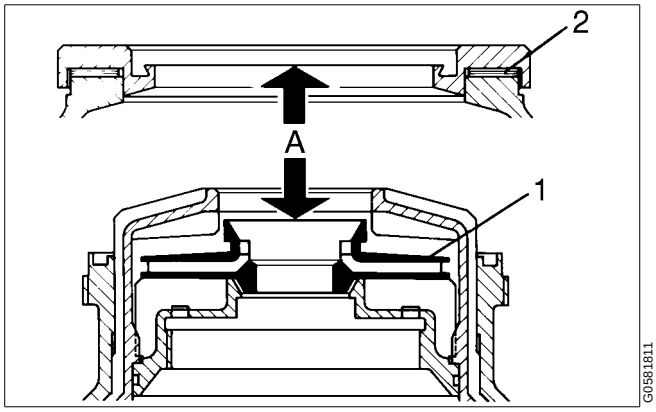
5.4.17 Lock ring; wear and damage

Same as described in section “5.3.11 Lock ring; wear and damage” on page 59.

5.4.18 Oil paring disc; height position

The height position of the oil paring disc (1) should be checked if the bowl spindle has been removed or the bowl has been replaced.

- Assemble the bowl without small lock ring, flow control disc and upper paring disc.
- Tighten the large lock ring until the bowl hood is in close contact with the bowl body.
- Put frame hood in place and tighten it to the frame ring.
- Measure the distance A according to the figure. The distance should be **75 ±0,5 mm**.
- Adjust the distance by adding or removing height adjusting rings (2).



Measurement of distance A

With inlet and outlet parts mounted:

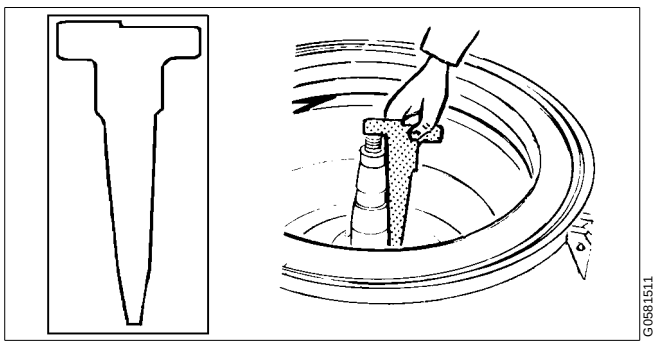
- Revolve the worm wheel shaft by hand. If it turns heavily or if a scraping noise is heard, wrong height adjustment or wrong fitting of the inlet pipe may be the cause.

5.4.19 Operating mechanism

Same as described in section “5.3.12 Operating mechanism” on page 61**.**

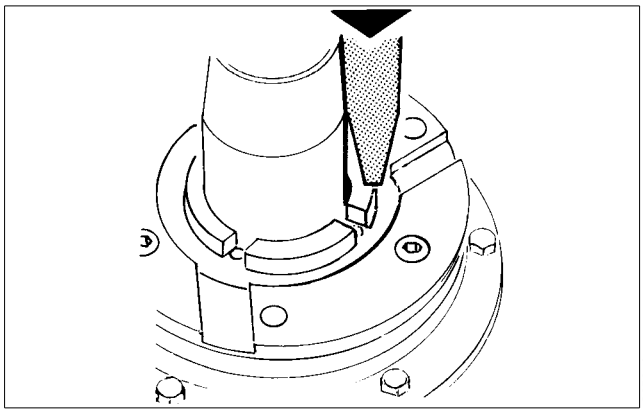
5.4.20 Operating paring disc; height position

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.

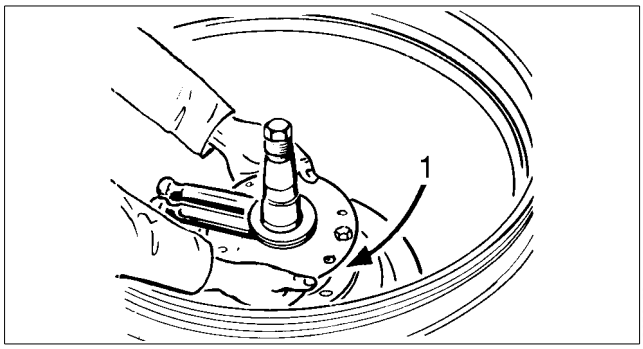


Templet supported on the spindle top

- The operating paring disc device should be assembled and fitted.
- Support the templet on the spindle top with the measurement indication 218,5 facing the spindle.
- There should be a small gap between the lower end of the templet and the upper side of the paring disc, otherwise the paring disc position is too high.
- Turn the templet so that the measurement indication on the other side (219,5) faces the spindle and the templet lower end supports on the paring disc.
- There should be a small gap between the templet tongue and the spindle top, otherwise the paring disc position is too low.
- The height position is adjusted by adding or by removing height adjusting rings (1) under the distributing cover.
- After adjustment rotate the spindle. If a scraping noise is heard, re-adjust.



Templet supported on the operating paring disc



The height position can be adjusted with height adjusting rings (1)

5.4.21 Operating slide

Same as described in section “5.3.13 Operating slide” on page 61.

5.4.22 Sliding bowl bottom

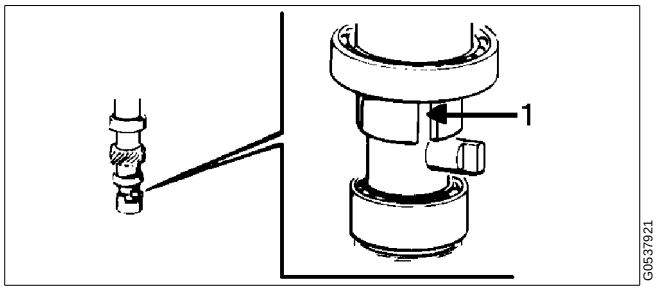
Same as described in section “5.3.14 Sliding bowl bottom” on page 62.

5.4.23 Springs for operating mechanism

Same as described in “5.3.15 Springs for operating mechanism” on page 63.

5.4.24 Worm; wear of groove

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



Measurement of wear in groove (1)

5.4.25 Worm wheel and worm; wear of teeth

Same as described in section “ Renew those springs which differ from other springs in regard to length or are defective in other respects.Worm wheel and worm; wear of teeth” on page 63.

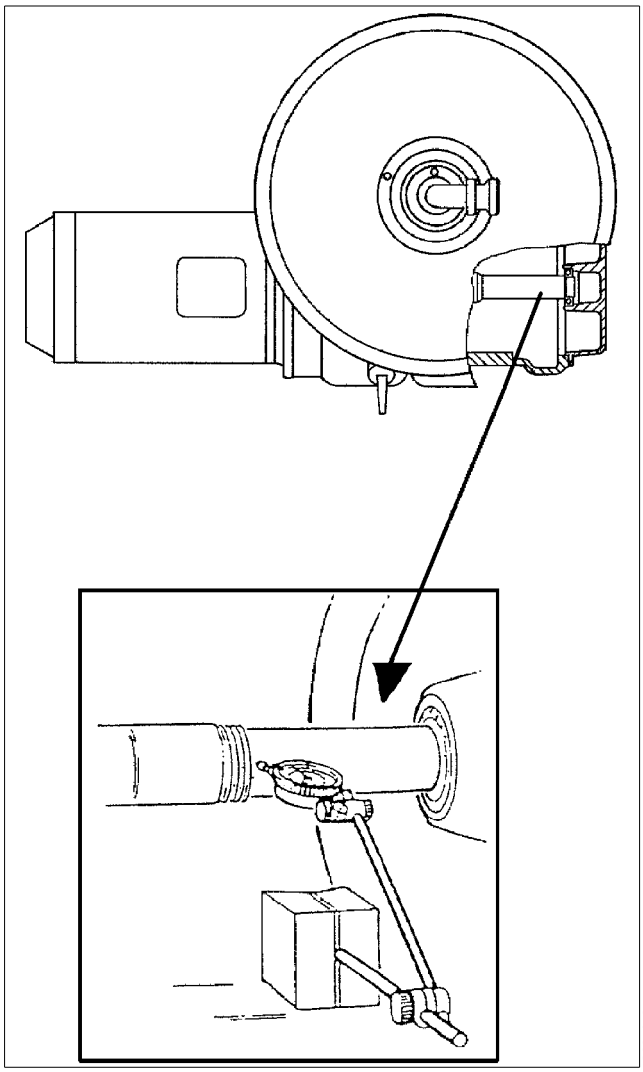
5.4.26 Worm wheel shaft; radial wobble

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.

Maximum permissible radial wobble is **0,10 mm**.

If the wobble is larger, 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 replaced.



Measurement of the radial wobble

5.4.27 Cover interlocking switch (option)

Same as described in “5.3.16 Cover interlocking switch (option)” on page 63.

5.4.28 Vibration switch (option)

Same as described in “5.3.17 Vibration switch (option)” on page 63.

5.5 Lifting instructions

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

Length of each sling must be min. 2 metres (6,5').

NOTE

Machine weight without frame hood and bowl is approx. 950 kg.

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

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

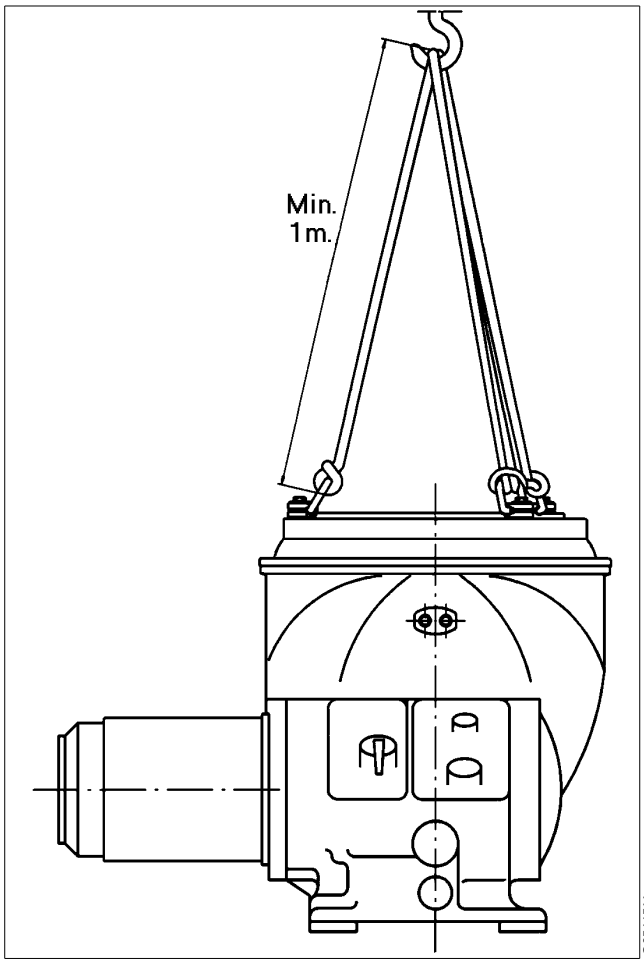
NOTE

Check that the lock ring is properly tightened.

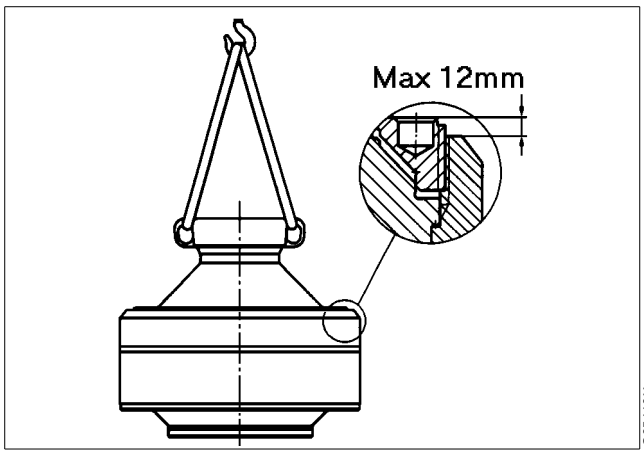
The height of the lock ring above the bowl body must not exceed 12 mm, see illustration.

Weight to lift is approx. 450 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.



Lift the separator with the frame hood and bowl removed



The lock ring must be properly tightened when lifting the bowl

5.6 Cleaning

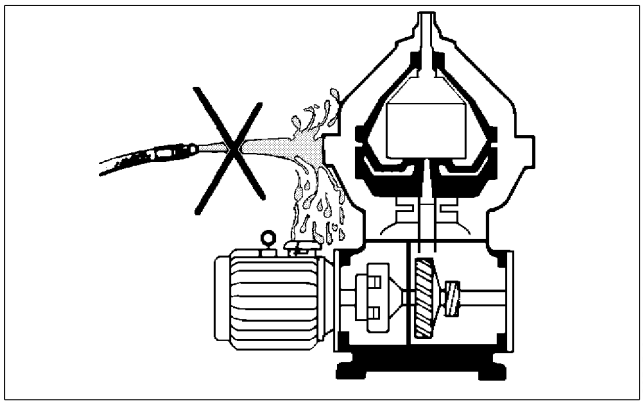
5.6.1 External cleaning

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.

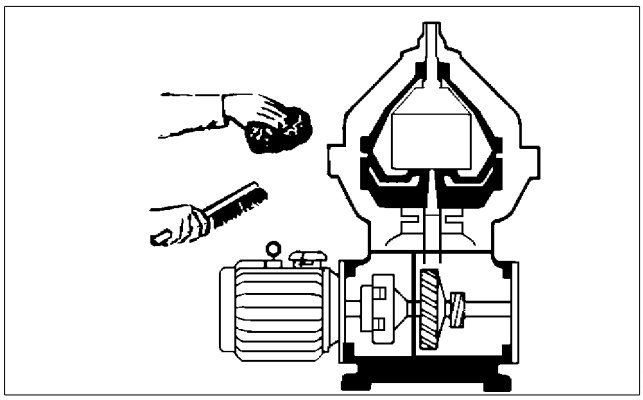
Never wash down a separator with a direct water stream. Totally enclosed motors can be damaged by direct hosing to the same extent as open motors and even more than those, because:

- 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.

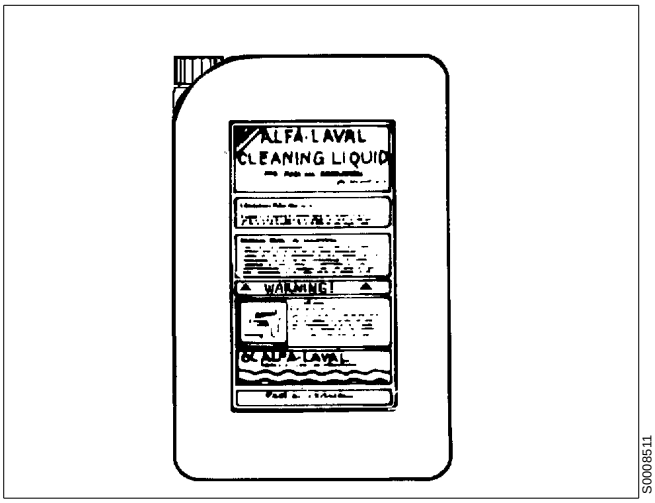
For separator bowl, inlet and outlet

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

- For cleaning of **lube oil** separators the most important function of the cleaning agent is to be a good solvent for the gypsum in the sludge. It should also act as a dispersant and emulsifier for oil. It is recommended to use **Alfa Laval cleaning liquid for lube oil separators** which has the above mentioned qualities. Note that carbon steel parts can be damaged by the cleaning agent if submerged for a long time.
- **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 fuel and lube 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.

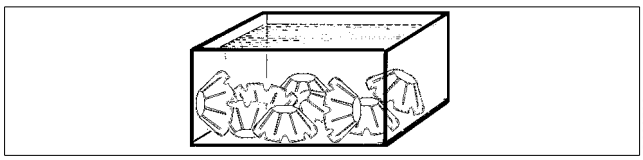
5.6.3 Cleaning of bowl discs

Bowl discs

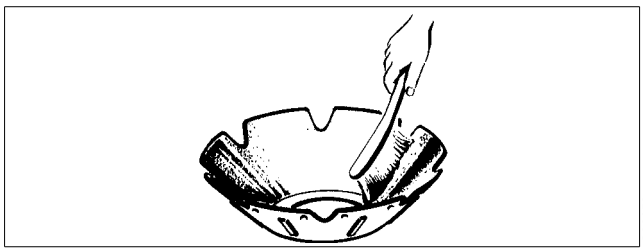
Handle the bowl discs carefully so as to avoid damage to the surfaces during cleaning.

> **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.



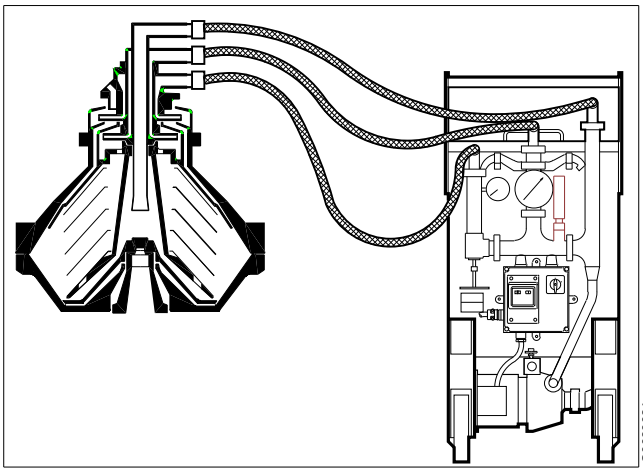
Put the discs one by one into the cleaning agent



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 with the inlet and outlets of lube and fuel oil separators without the need of dismantling.



CIP Unit connected to separator

5.7 When changing oil

5.7.1 Worm wheel and worm; wear of teeth

To check at each oil change

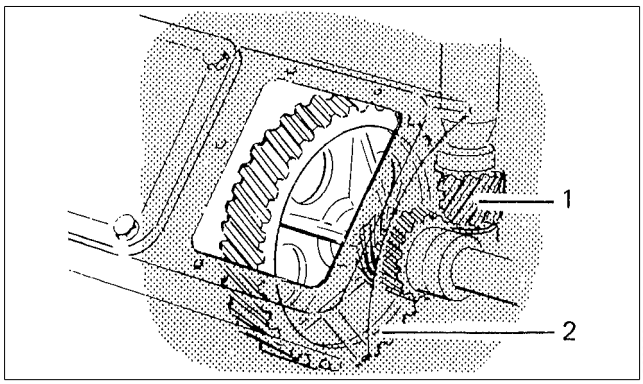
Check the teeth of both the worm wheel and worm for wear.

See the “ Tooth appearance examples” on page 85. 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 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 174 for correct number of teeth.

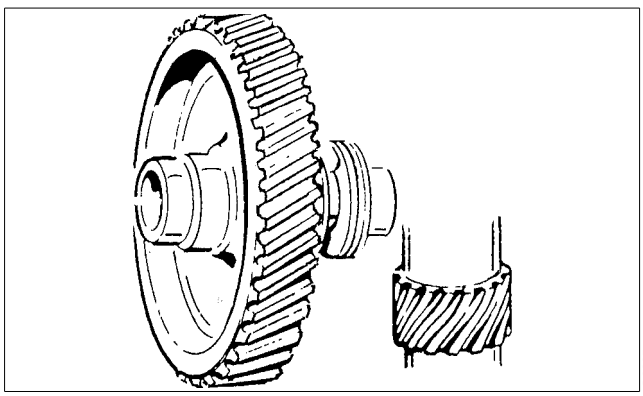


1 Worm
2 Worm wheel

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

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 pits are 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.

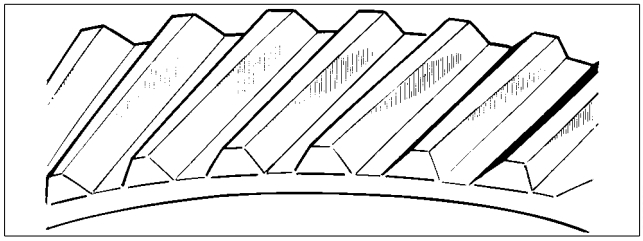
For further information, see chapter “8.5 Lubricants” on page 183.

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.

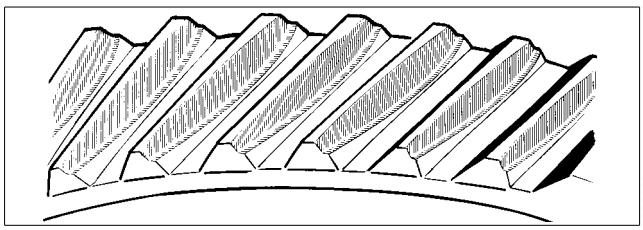


Satisfactory teeth

Worn teeth:

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

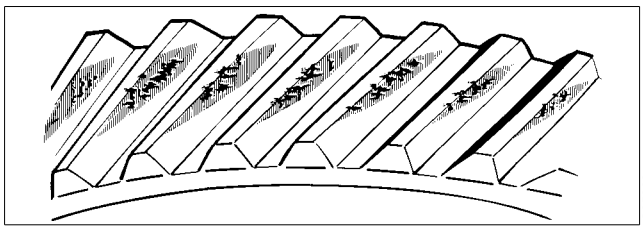
- the wear is uniform over the whole of the flank of a tooth
- and all teeth are worn in the same way.



Worn teeth

Spalling:

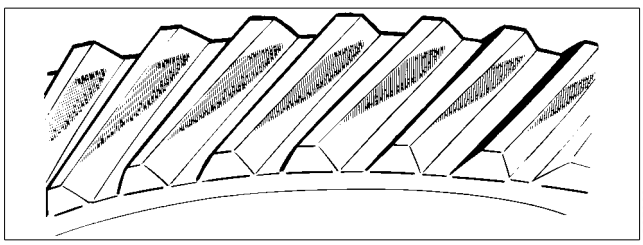
Small bits of the teeth have broken off, so-called spalling. This is generally due to excessive load or improper lubrication. Damage of this type need not necessitate immediate replacement, but careful checking at short intervals is imperative.



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 imperative.

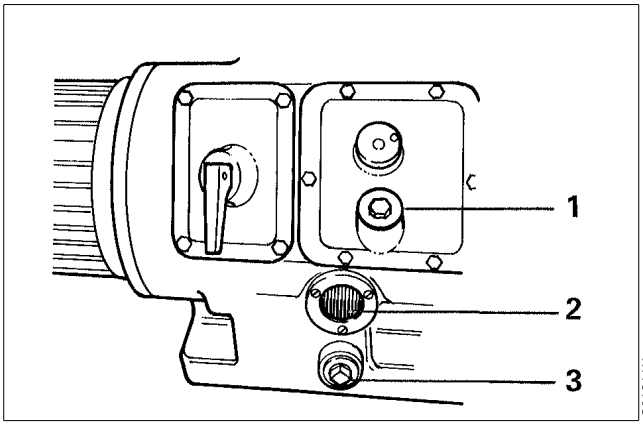


Pitting

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 183 must be well known.



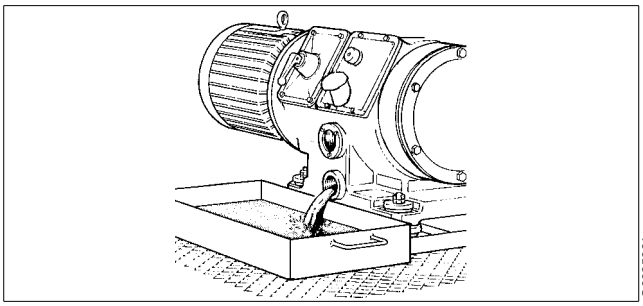
1. Oil filling plug
2. Sight glass
3. Oil drain plug

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 can be hot

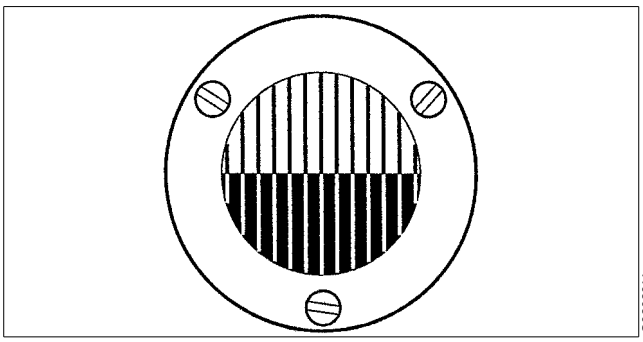
2. Fill new oil in the worm gear housing. The oil level should be exactly in the middle of the sight glass:

   Oil volume: approx. 12 litres.

NOTE

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

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



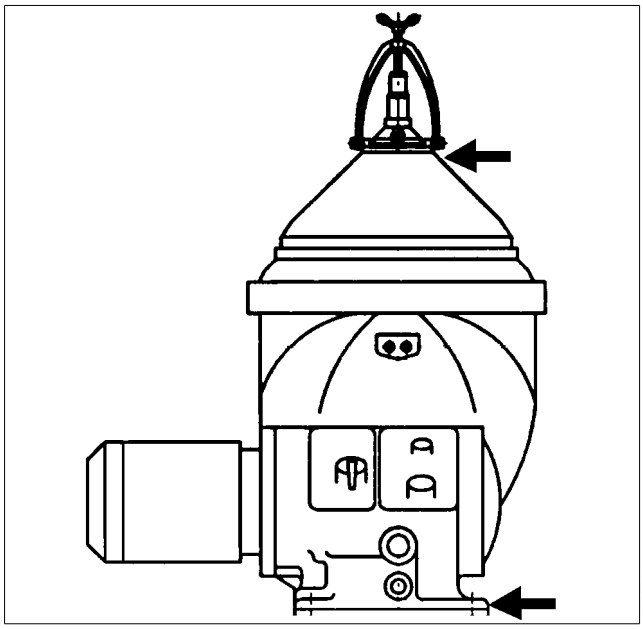
The oil level must not be above the middle of the sight glass

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.



Measuring points for vibration analysis

NOTE

The level of vibration should not exceed **9 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.

5.8.2 Vibration switch (option)

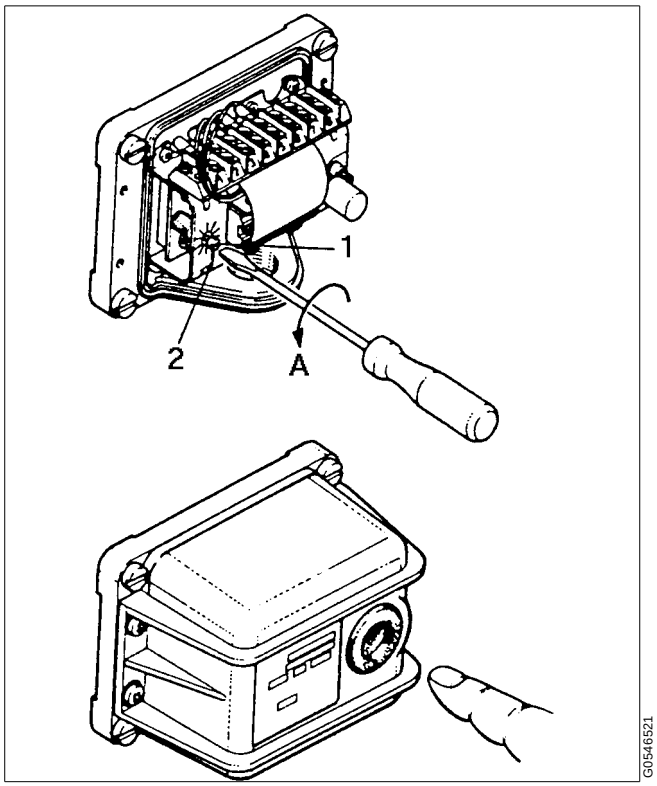
Adjustment of setpoint

The vibration switch is adjusted by a simple procedure with the separator in operation. In making this adjustment, 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

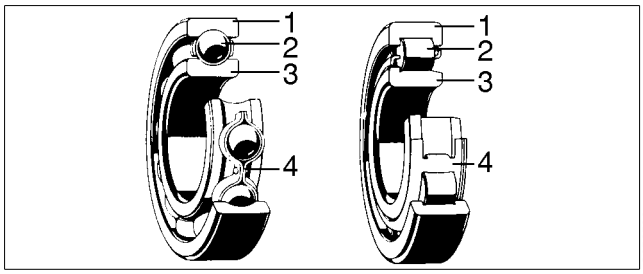
5.9.1 Ball and roller bearings

Special-design bearings for the bowl spindle

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

Only Alfa Laval genuine spare parts should be used.

A bearing that in appearance looks equivalent to the correct may be considerably different in various respects: inside clearances, design and tolerances of the cage and races as well as material and heat treatment.



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

NOTE

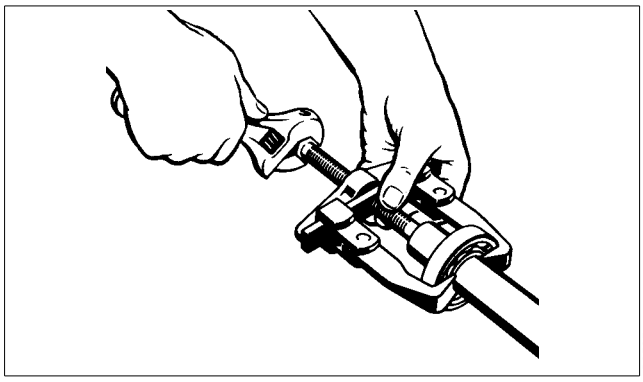
Using an incorrect bearing can cause a serious breakdown with damage to equipment as a result.

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

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 centered during dismantling; otherwise, it is easy to damage the seating.



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

NOTE

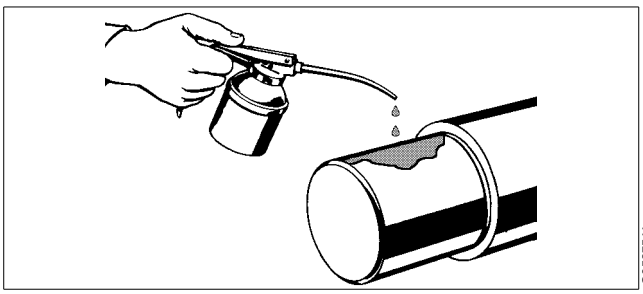
Do not hit with a hammer directly on the bearing.

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 or in some other way.

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 smear the bearing seating on shaft (spindle) or alternatively in housing, with a thin oil.



Clean and smear the bearing seating before assembly

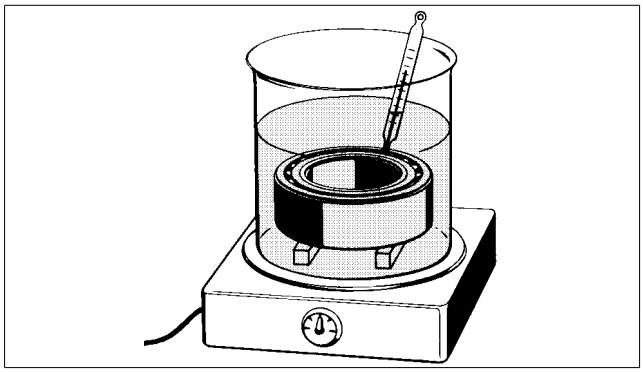
- When assembling ball bearings, the bearings must be heated in oil to max. 125 °C.

NOTE

Heat the bearing in a clean container.

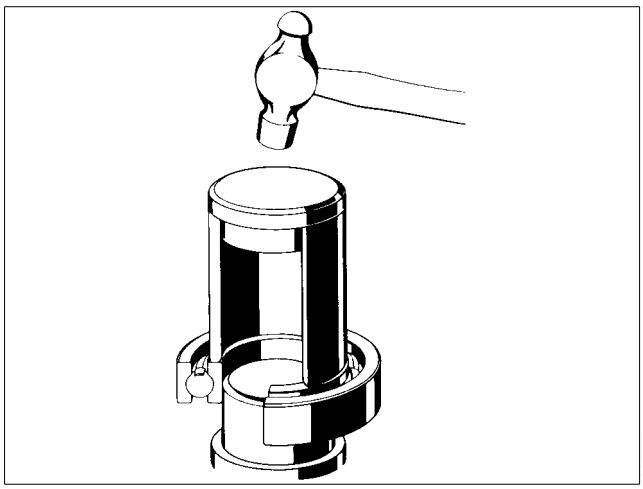
Use only clean oil with a flash point above 250 °C.

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

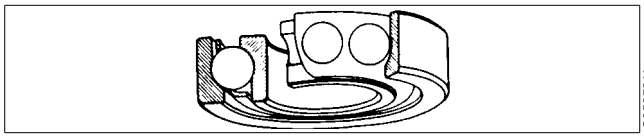
- There are several basic rules for assembling cylindrical bore bearings:
  - Never directly strike a bearing's rings, cage or rolling elements while assembling. A ring may crack or metal fragments break off.
  - Never apply pressure to one ring in order to assemble the other.
  - Use an ordinary hammer. 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 93.

NOTE

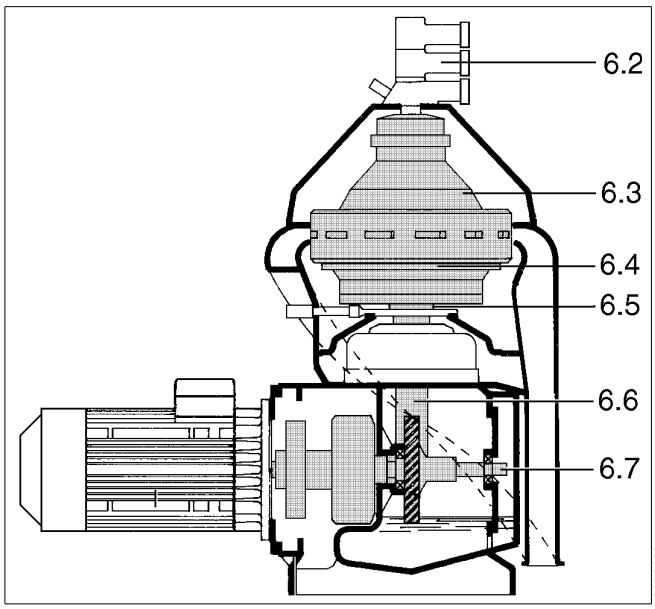
The bowl must not be left on the spindle during standstill for more than one week.

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

Contents



6.1 Introduction

6.1.1 General directions

The separator must be dismantled regularly for cleaning and inspection.

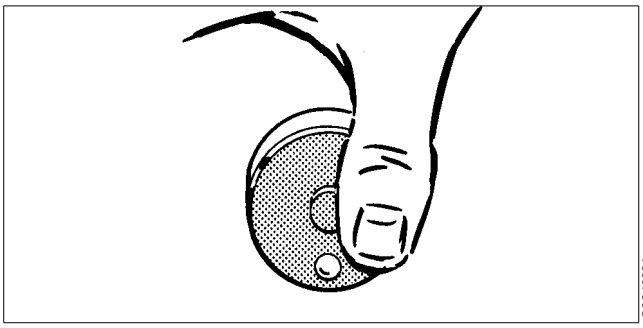
The recommended intervals are stated in chapter “5.1.2 Maintenance intervals” on page 37.

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 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 tree 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**
“5.3.5 Disc stack pressure” on page 52.

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

6.1.3 Tools

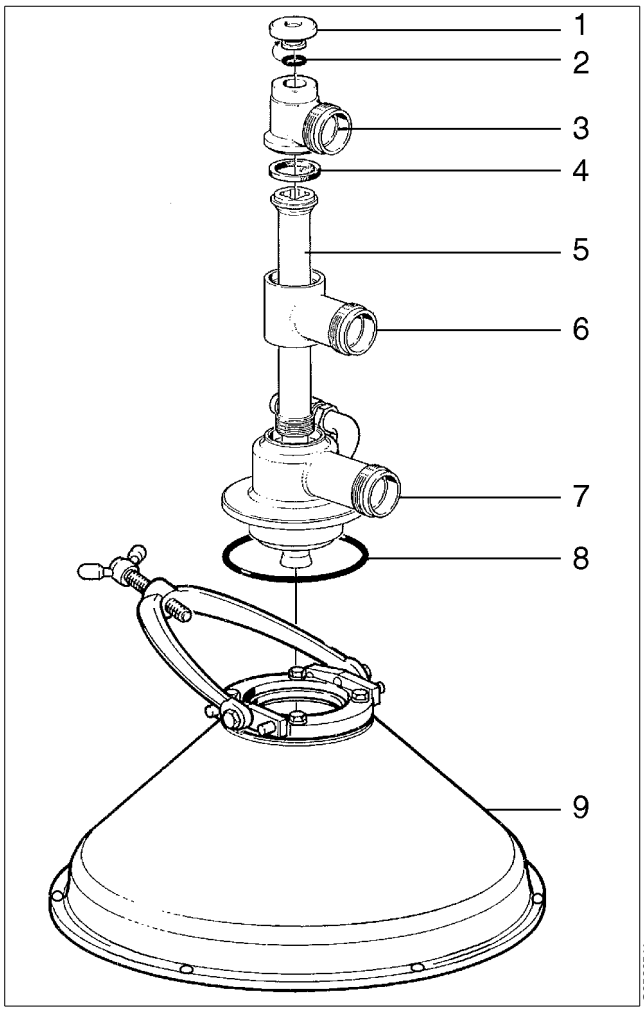
Special tools from the tool kit must be used for dismantling and assembly. The special tools are specified in the Spare Parts Catalogue and are shown as illustrations together with the dismantling/assembly instructions.

NOTE

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

6.2 Inlet/outlet, frame hood (IS)

6.2.1 Exploded view



1. *Plug*
2. *O-ring*
3. *Support*
4. *Square-sectioned ring*
5. *Inlet pipe*
6. *Support*
7. *Connecting housing*
8. *O-ring*
9. *Frame hood*

6.2.2 Dismantling

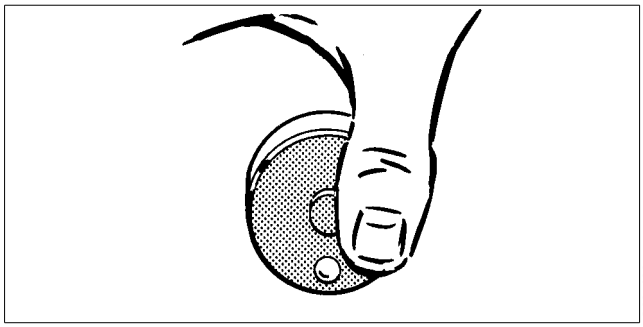
DANGER

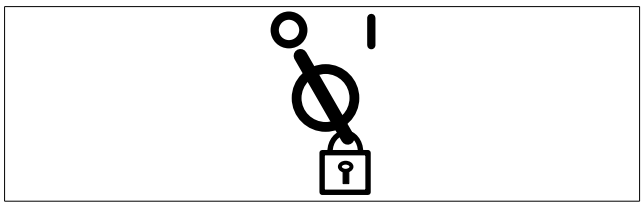
Entrapment hazards

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.

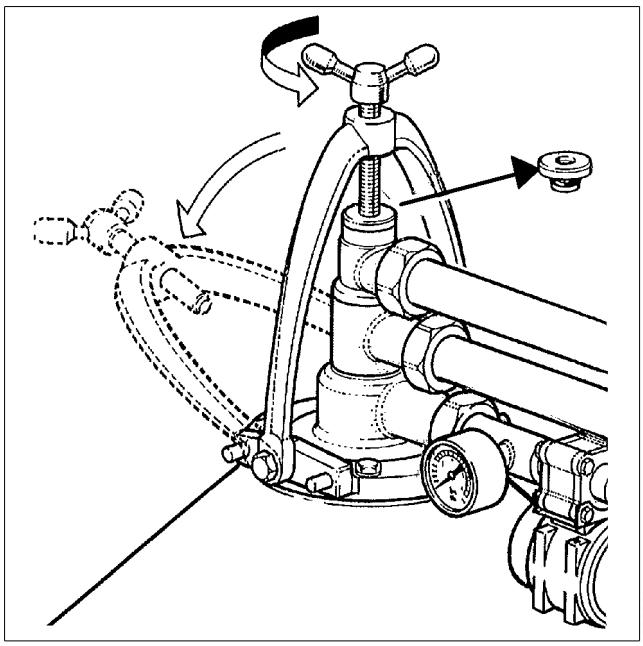




The frame hood and the heavy bowl parts must be lifted by means of a hoist. Position the hoist exactly above the bowl centre. Use an endless sling and a lifting hook with catch.

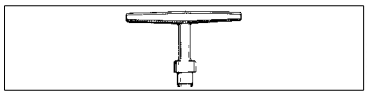
The parts must be handled carefully. Don't place parts directly on the floor, but on a clean rubber mat, fibreboard or a suitable pallet.

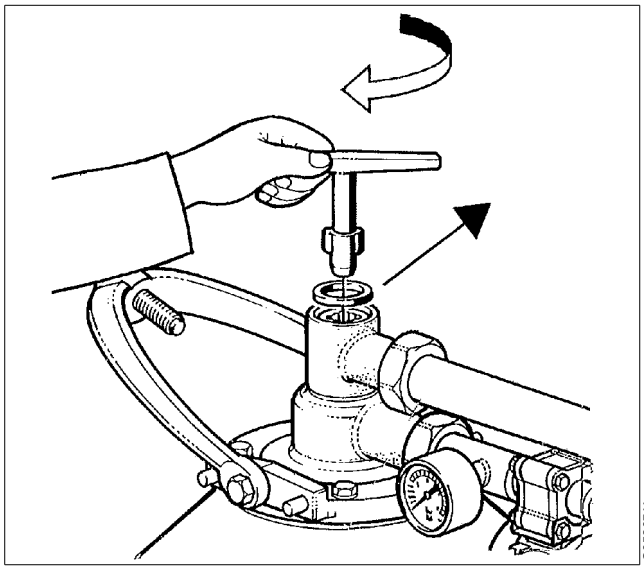
1. Loosen the clamp screw and lower the clamping stirrup. Remove the plug.
2. Undo the coupling nuts of inlet and outlet piping at the pipe support. Swing aside the feed pipe.



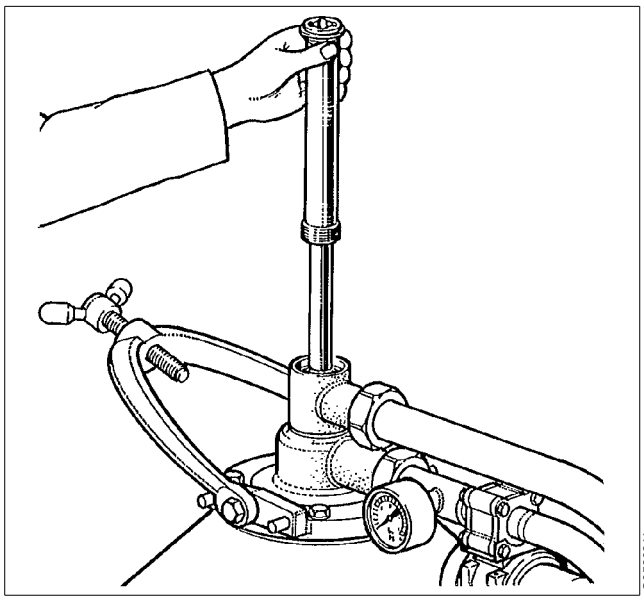
3. Unscrew the inlet pipe using the special pin spanner.

   Left-hand thread!

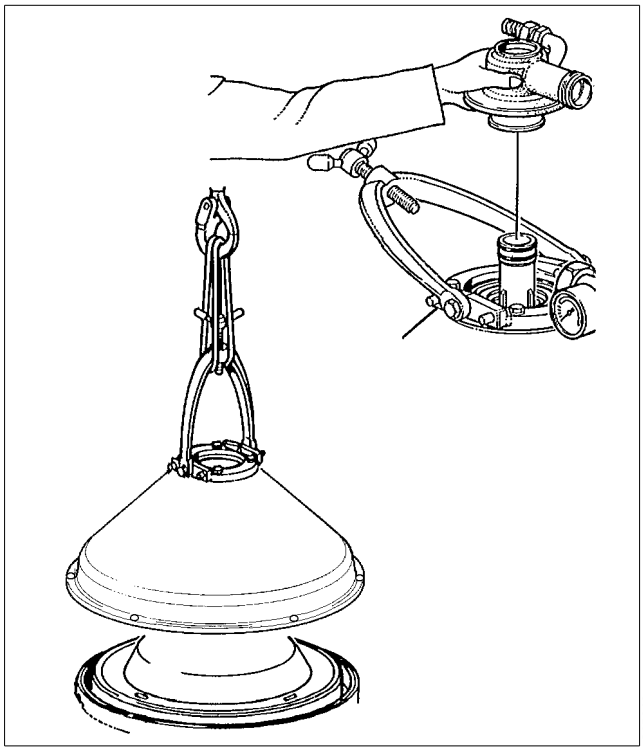




4. Remove the inlet pipe.
5. Swing aside the oil outlet pipe. Loosen the coupling nut of the connection housing.



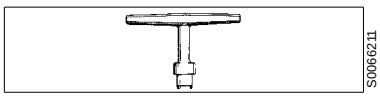
6. Remove the connection housing.
7. Remove the six screws holding the frame hood at lift it off.



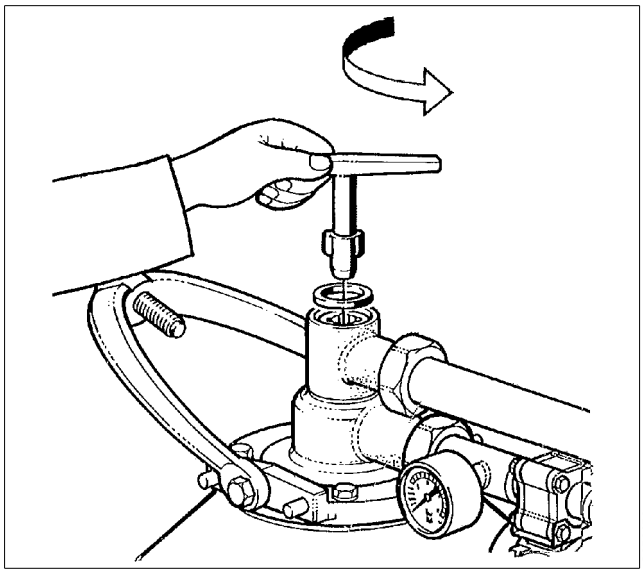
6.2.3 Assembly

1. Put the frame hood in place and tighten it with the six screws.
2. Fit the connection housing. Note its angular position on the upper paring disc.
3. Connect the water outlet pipe and oil outlet pipe. Do not tighten the coupling nuts yet.
4. Fit the inlet pipe.
5. Tighten the inlet pipe properly using the special pin spanner.

   Left-hand thread!



6. Fit the square-sectioned ring upon the inlet pipe.

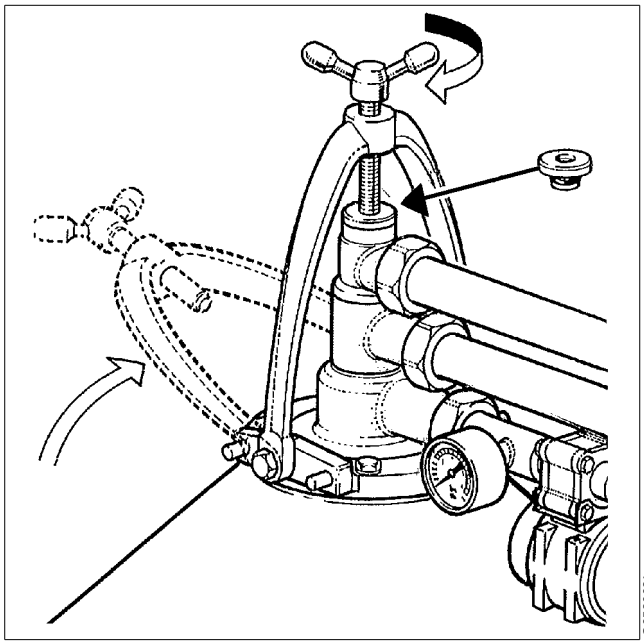


7. Fit the feed pipe and plug and tighten the clamp screw properly.
8. Tighten the coupling nuts of inlet and outlet piping at the pipe support.

DANGER

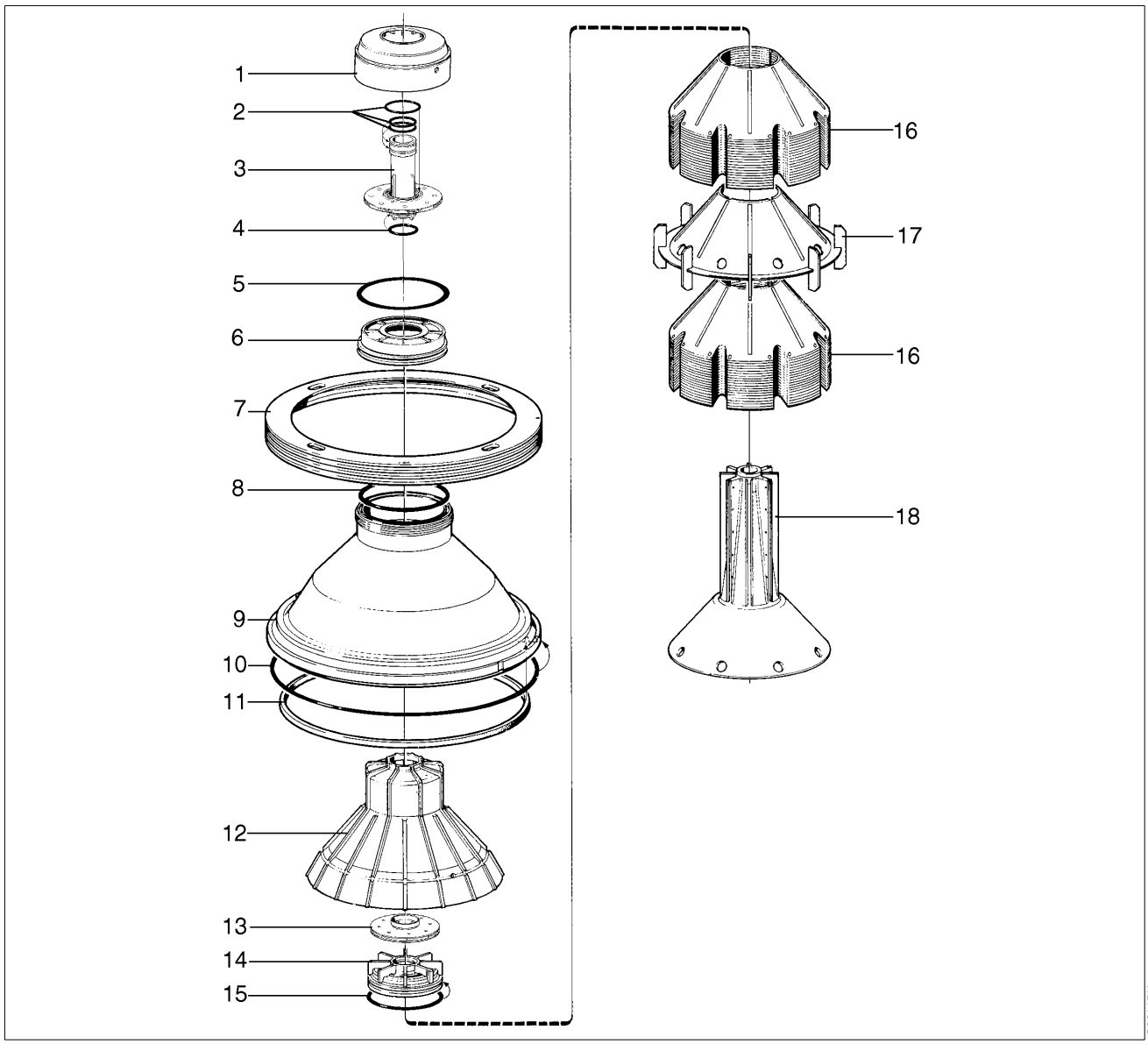
Disintegration hazards

When power cables have been connected, always check direction of rotation. 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

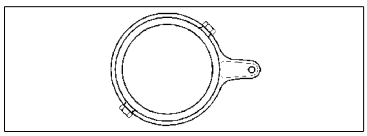


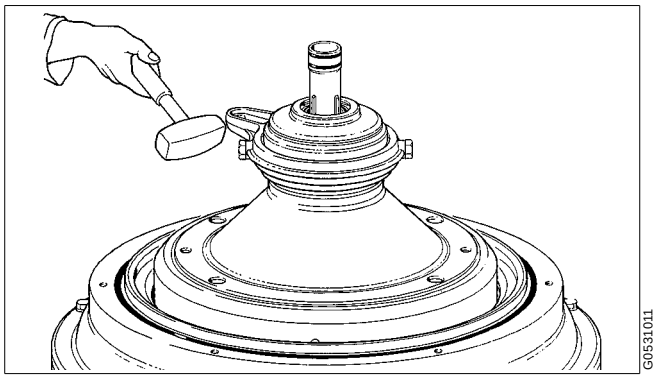
1. *Paring chamber cover (small lock ring)*
2. *O-ring*
3. *Upper paring disc*
4. *O-ring*
5. *O-ring*
6. *Flow control disc*
7. *Lock ring*
8. *O-ring*
9. *Bowl hood*
10. *O-ring*
11. *Seal ring*
12. *Top disc*
13. *Oil paring disc*
14. *Level ring*
15. *O-ring*
16. *Bowl disc*
17. *Wing insert*
18. *Distributor*

6.3.2 Dismantling

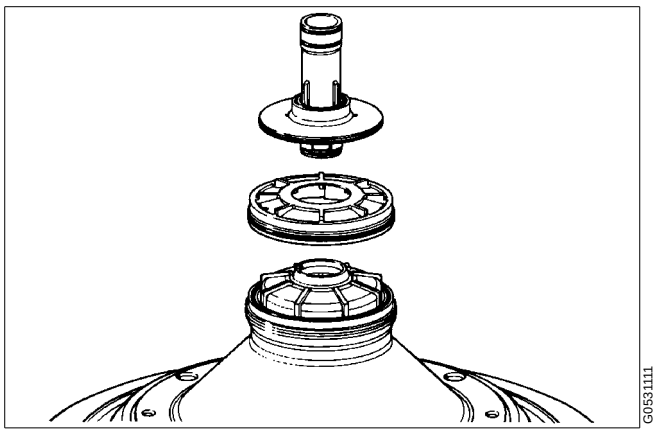
1. Unscrew the paring chamber cover using the spanner.

   Left-hand thread!





2. Remove the upper paring disc and flow control disc.



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

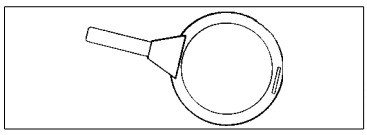
NOTE

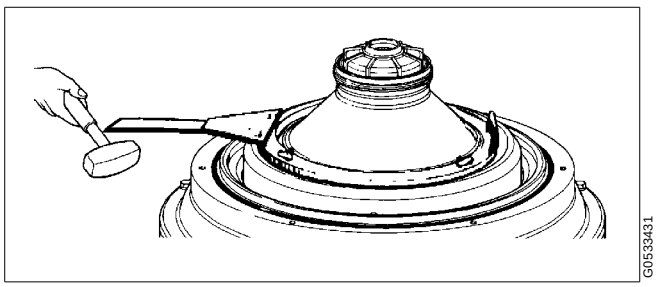
To facilitate unscrewing the large lock ring, reduce shocks to bearings and keep thread wear to a minimum, the disc stack should be compressed using an Alfa Laval compressing tool (optional) as described below.

Unscrewing lock ring without using a compressing tool

a. Unscrew the lock ring using the spanner.

Left-hand thread!

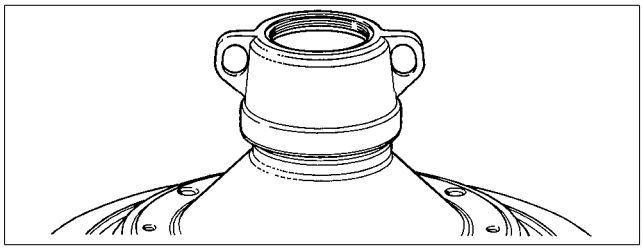




Unscrewing lock ring with a compressing tool

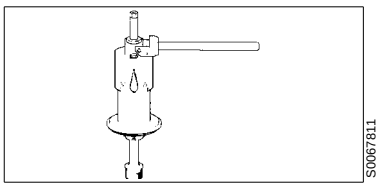
a. Fit the lifting tool on the bowl hood.

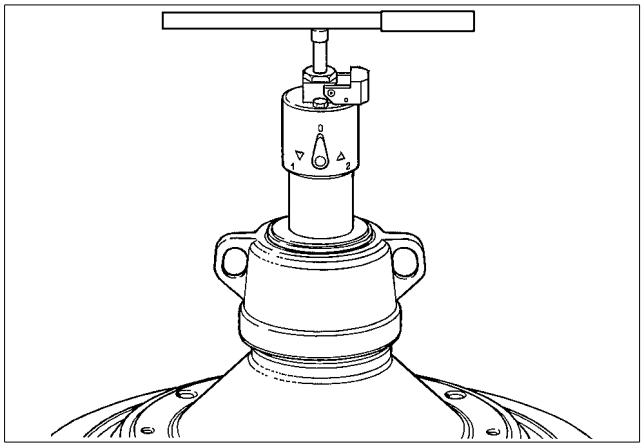

S0067611


G0531221

b. Fit the compressing tool by screwing the pillar of the tool into the threads of the distributor using the lever.

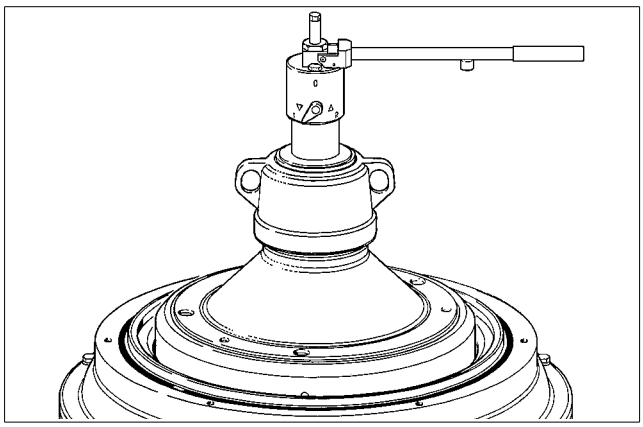
The switch on the compressing tool should be in position 0.


S0067811


G0531311

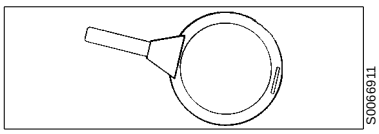
c. Turn the switch to position 1 for compression.

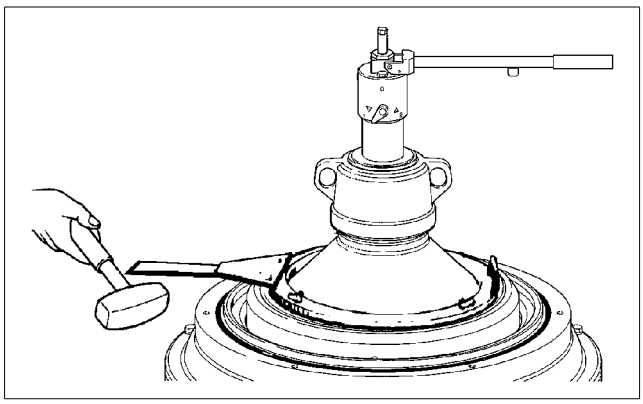
Compress the disc stack by pumping the lever until the oil pressure is released through the relief valve.


G0533621

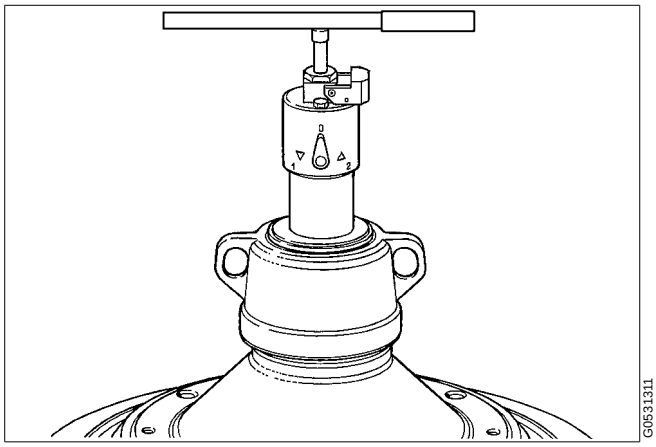
d. Unscrew the large lock ring using the spanner.

Left-hand thread!

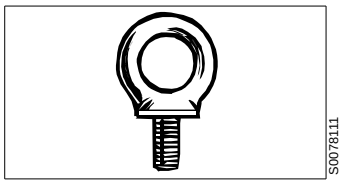

S0066911

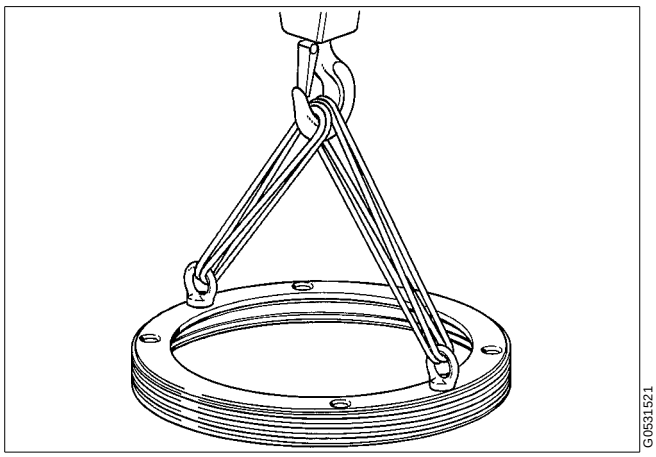

G0531421

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



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





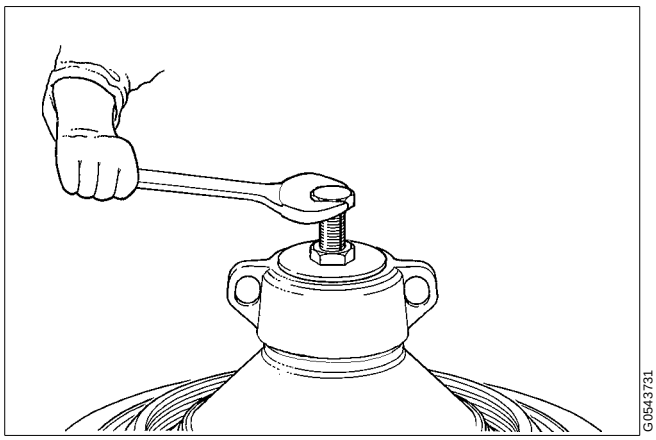
NOTE

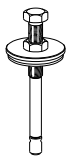
The lock ring must be kept lying horizontally or it may become distorted. Even slightest distortion could make it impossible to refit.

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 spindle plate into the lifting tool. Unscrew the spindle a few turns if the plate is not in contact with the lifting tool.





b. Screw home the spindle with the wrench until the bowl hood loosens from the bowl body.

c. Remove the spindle plate from the lifting tool.

Separating bowl hood with 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 lever.

   The switch on the compressing tool should be in position 0.

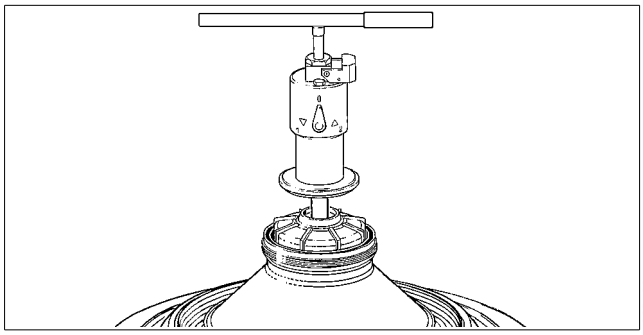
c. Fit the lifting tool on the bowl hood.

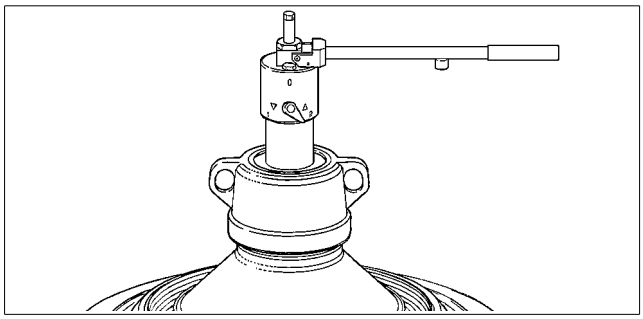
d. Turn the switch to position 2 for expansion.

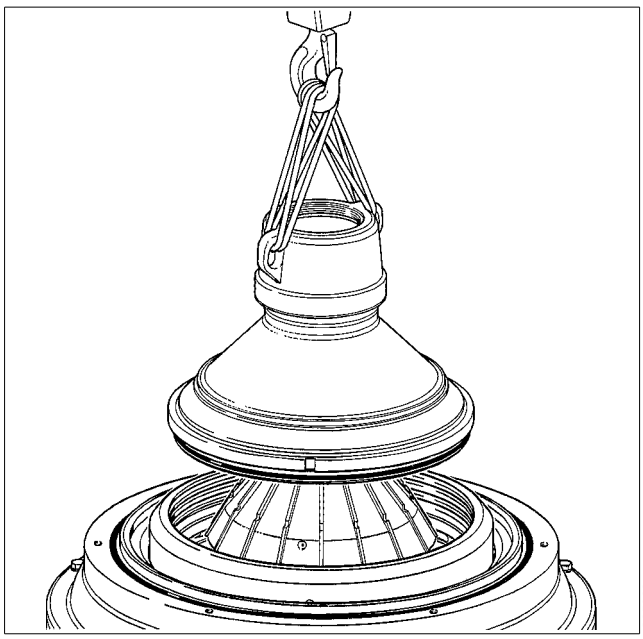
   Separate the bowl hood from the bowl body by pumping the lever.

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

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





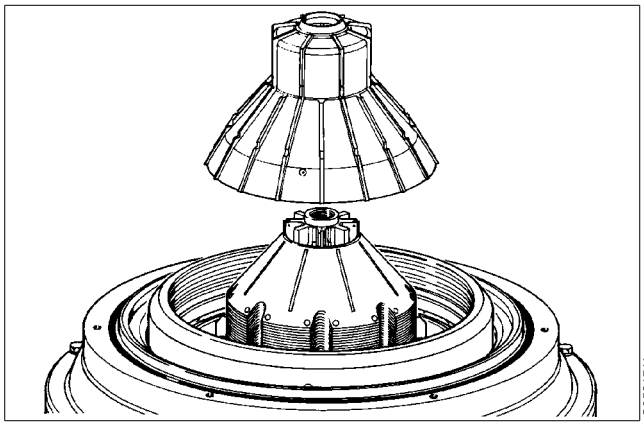


CAUTION

Crush hazards

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

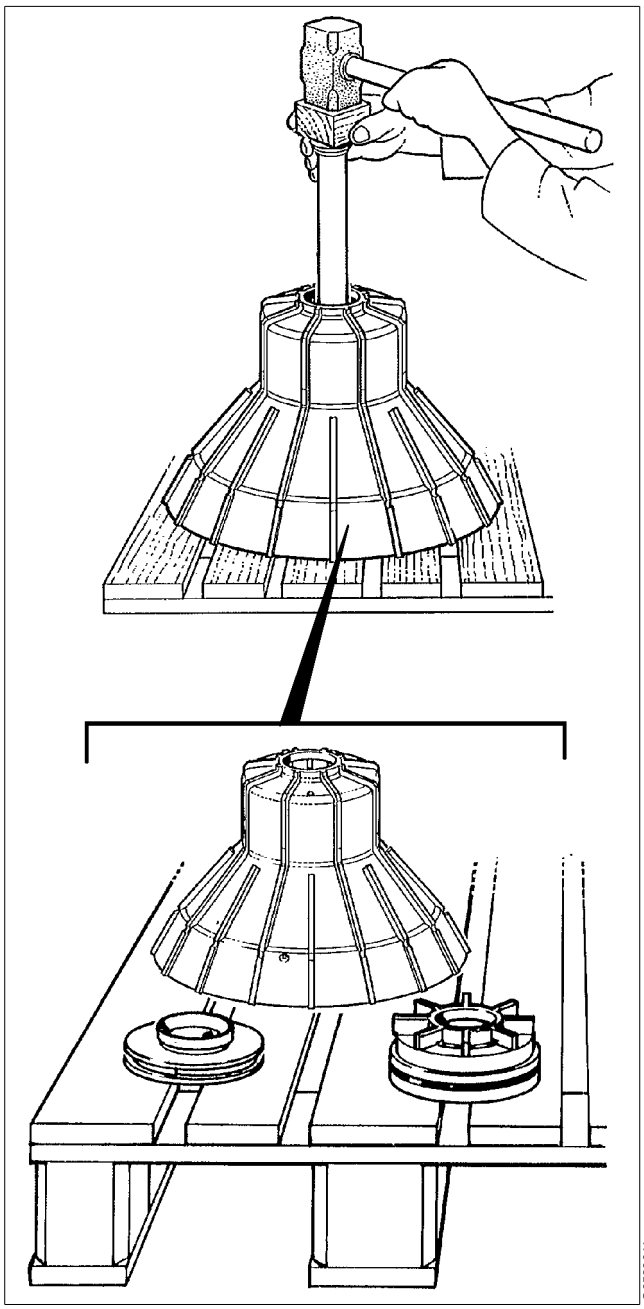
7. Remove the top disc.



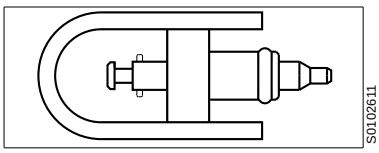
8. Screw the inlet pipe into the paring disc located above the level ring inside the top disc.

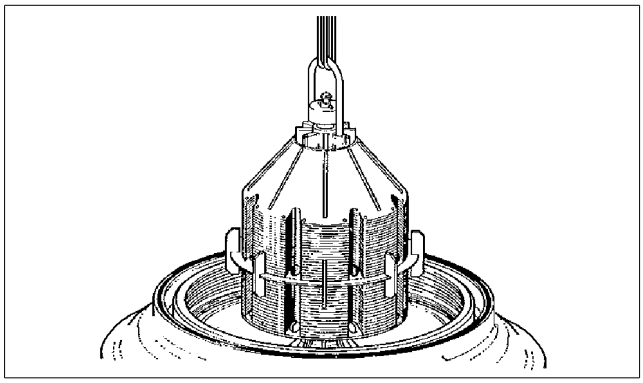
   Left-hand thread!

   Place the top disc onto wooden blocks to act as protection for the top disc edge and for falling level ring. Place a piece of wood between the tin hammer and the inlet pipe and then force out the level ring and the paring disc carefully from the top disc.



9. Fit the lifting tool into the distributor and lift the distributor with disc stack out of the bowl body using hoist.





10. Remove deposits and clean all parts thoroughly in a suitable cleaning agent. See chapter “5.6 Cleaning” on page 79.

6.3.3 Assembly

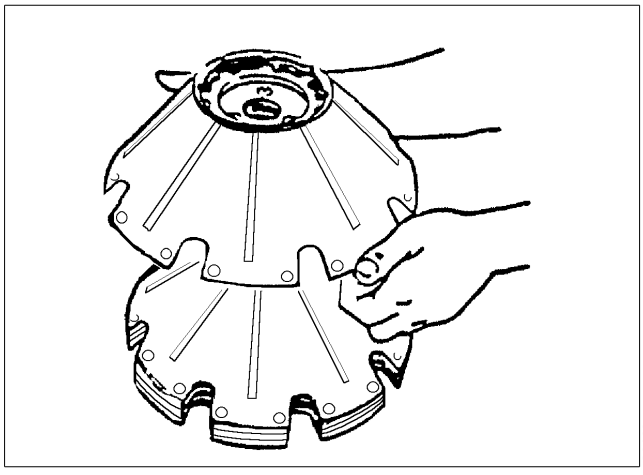
✔ **Check point**
“5.3.3 Corrosion” on page 48,
“5.3.4 Cracks” on page 51,
“5.3.7 Erosion” on page 54,
“5.3.11 Lock ring; wear and damage” on page 59.

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

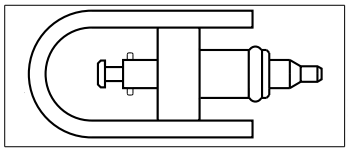
Sharp edges on the separator discs may cause cuts.



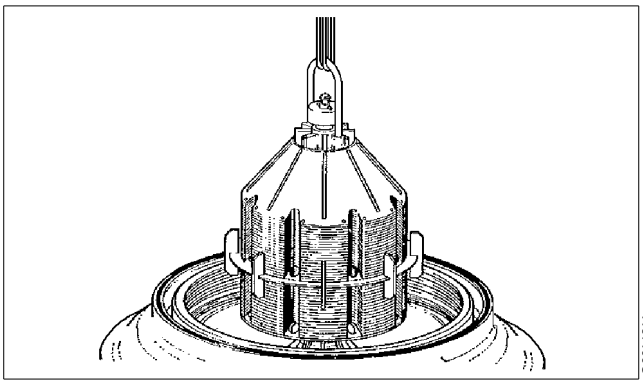
For correct number of discs above and below the wing insert when the machine was new, see the *Spare Parts Catalogue*.

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 hoist.



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

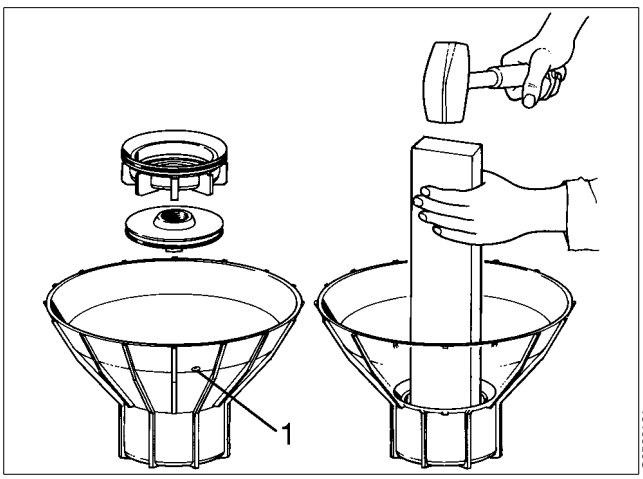


✔ **Check point**
"5.3.10 Level ring" on page 58.

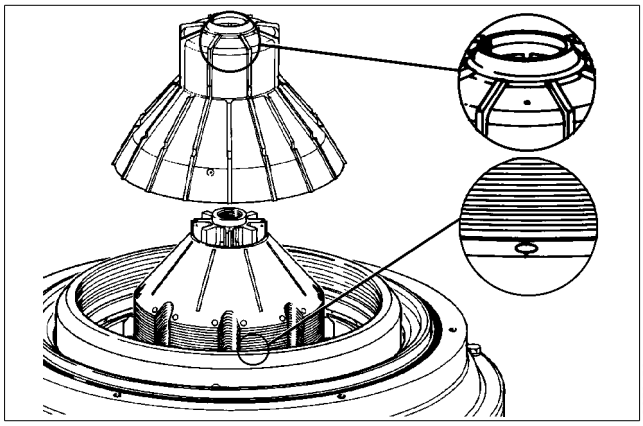
3. Check that the small hole (1) in the top disc is not clogged.

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

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



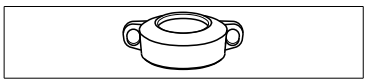
4. Fit the top disc onto the distributor. The drilled assembly mark on the top disc must face the guide lug on the bowl body.



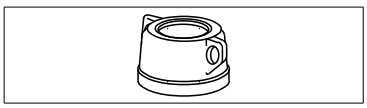
✔ **Check point**
"5.3.1 Bowl hood seal ring" on page 47.

5. Fit the lifting tool to the bowl hood and lift it using 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.

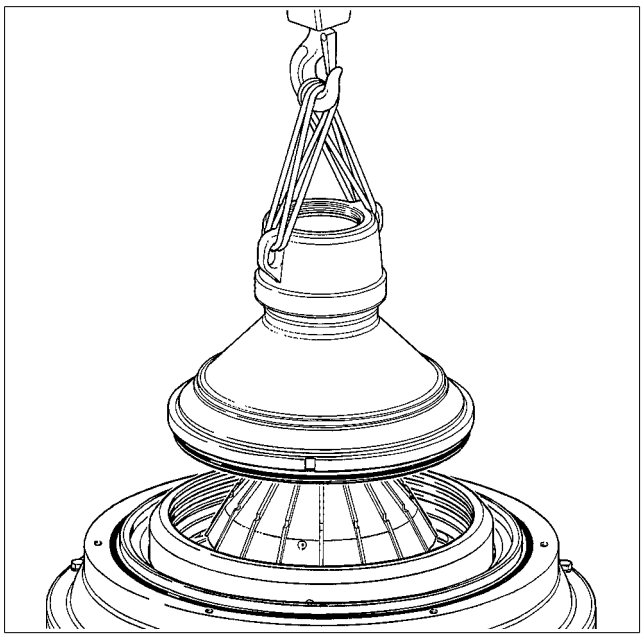


In set of tools **without** *compressing tool.*

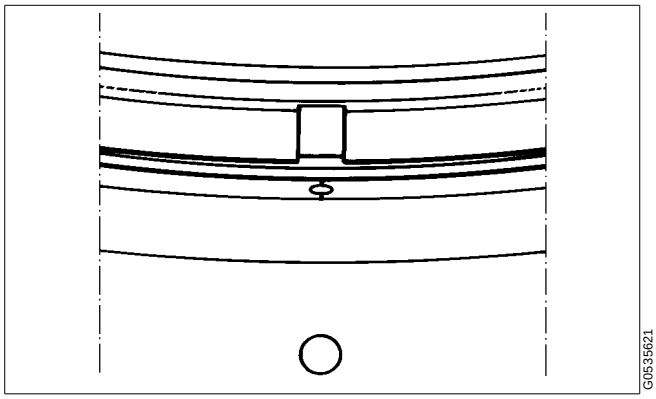


In set of tools **with** *compressing tool.*

For correct position of bowl hood, see next illustration.

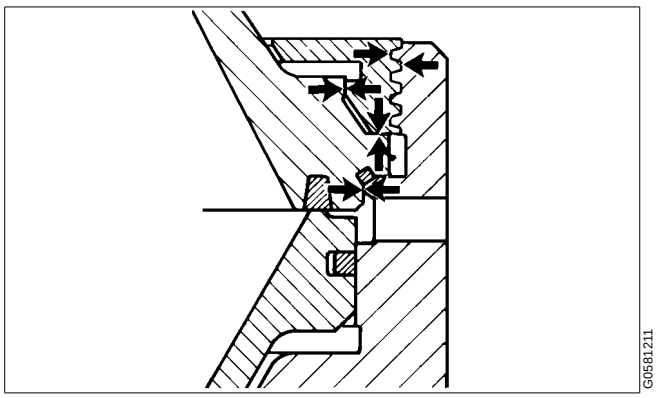


6. Check that the guide recess on the bowl hood enters the guide lug in the bowl body.

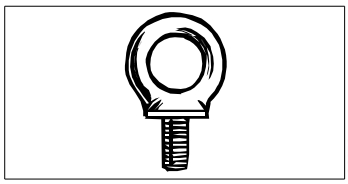


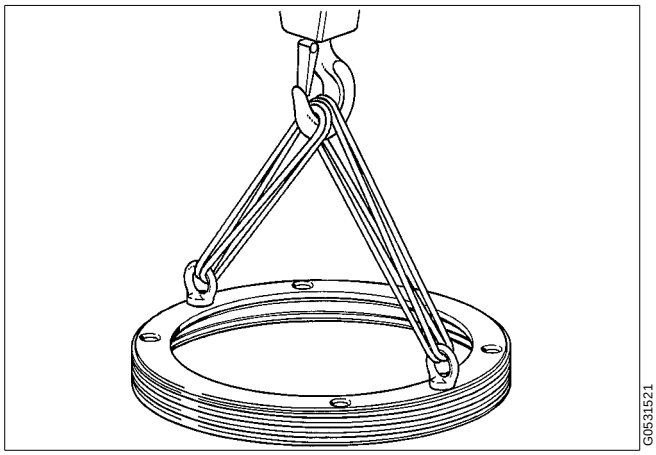
7. Remove the lifting tool.
8. Lubricate the lock ring threads, contact and guide surfaces with lubricating paste.

✔ **Check point**
"5.4.16 Lock ring; priming" on page 72 (only when Major Service).



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





10. Tighten the lock ring.

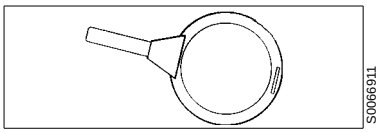
NOTE

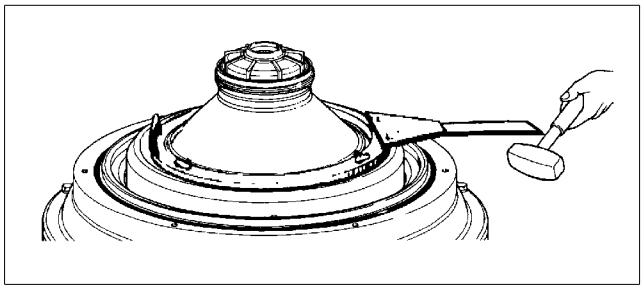
To facilitate tightening of the lock ring, reduce shocks to bearings and keep the thread wear to a minimum, the disc stack should be compressed using an Alfa Laval compressing tool (optional) as described below.

Tightening of lock ring without using a compressing tool

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

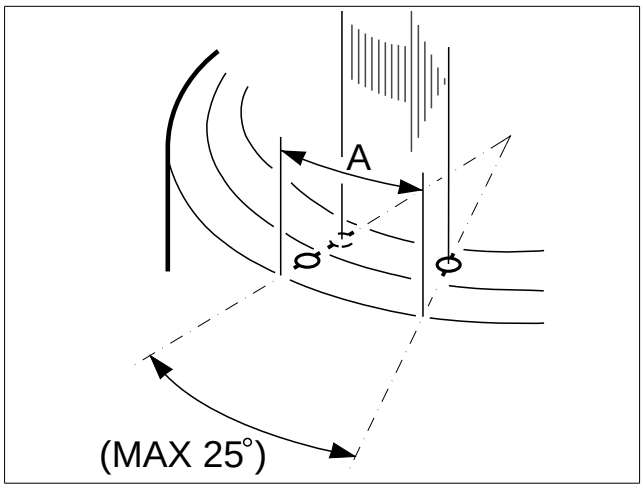
Left-hand thread!





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

✔ **Check point**
"5.3.5 Disc stack pressure" on page 52.

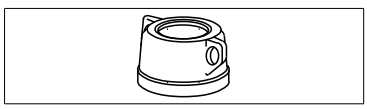


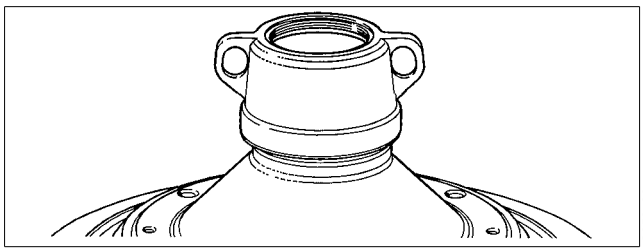
NOTE

The assembly marks must never pass each other more than 25° which corresponds to A=120 mm.

Tightening of lock ring using a compressing tool

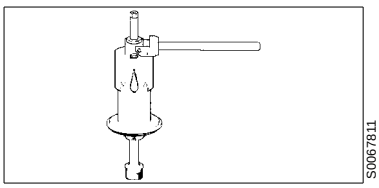
a. Fit the lifting tool onto the bowl hood.

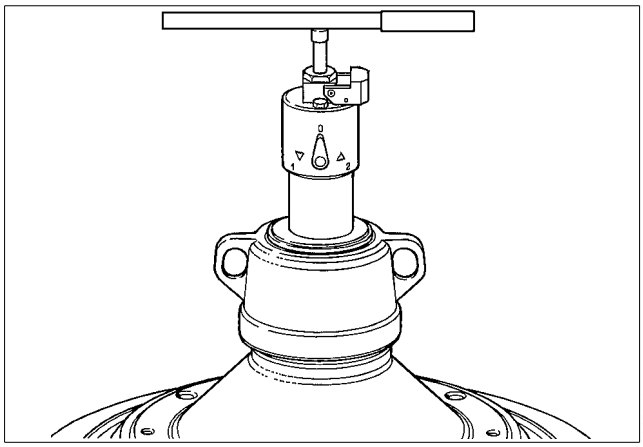




b. Fit the compressing tool by screwing the pole of the tool into the threads of the distributor by the lever arm.

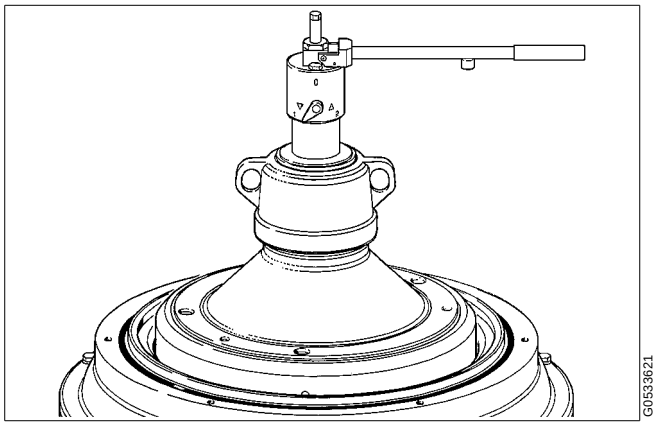
The switch on the compressing tool, should be in position 0.





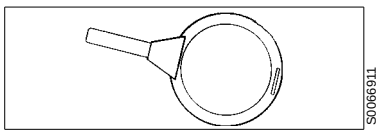
c. Turn the switch to position 1 for compression.

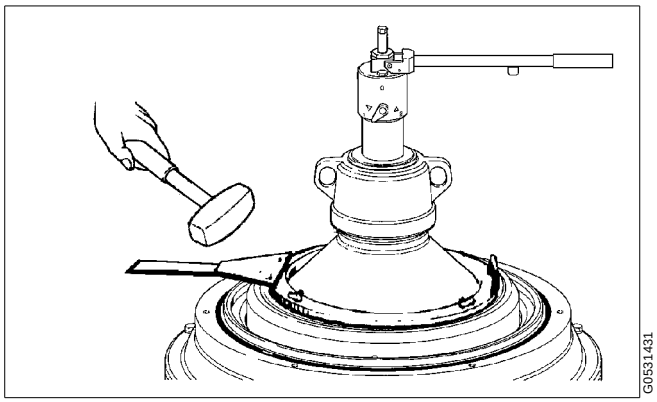
Compress the disc stack by pumping with the lever arm until the oil pressure is released through the relief valve.



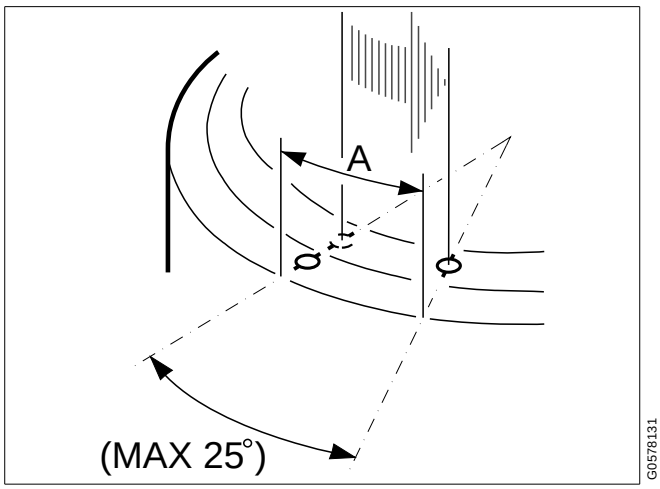
d. Tighten the lock ring using the spanner for lock ring.

Left-hand thread!





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



✔ **Check point**
“5.3.5 Disc stack pressure” on page 52.

NOTE

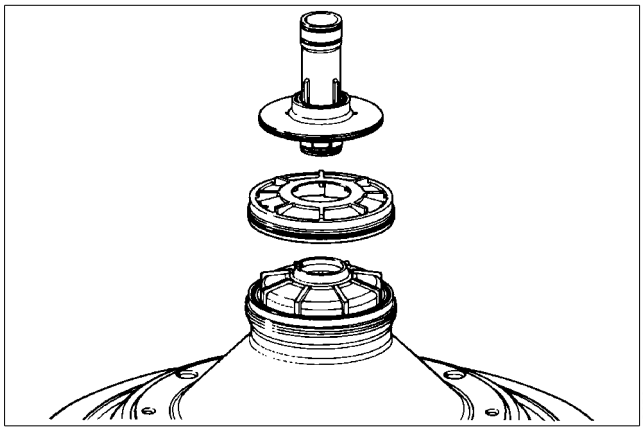
The assembly marks must never pass each other more than 25° which corresponds to A=120 mm.

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

11. Check that the small holes in the flow control disc and upper paring disc are not clogged.

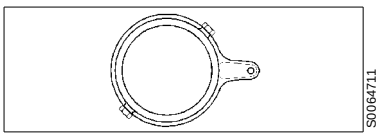
    Fit the flow control disc with O-ring, and the upper paring disc.

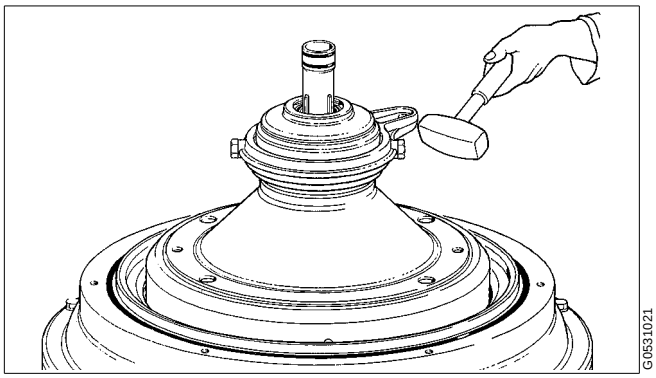
✔ **Check point**
"5.3.9 Inlet pipe and oil paring disc" on page 58.



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

    Left-hand thread!



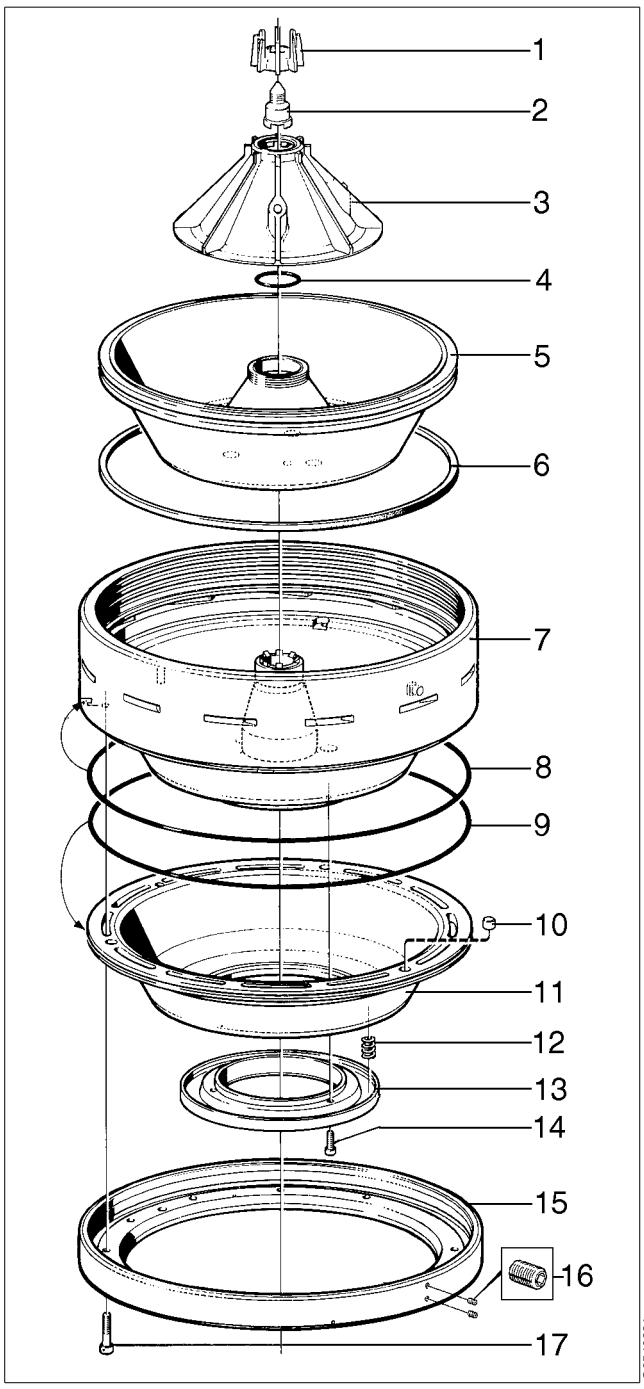


6.4 Bowl body and operating mechanism (IS)

6.4.1 Exploded view

1. *Cap nut*
2. *Lifting stud*
3. *Distributing cone*
4. *O-ring*
5. *Sliding bowl bottom*
6. *Rectangular ring*
7. *Bowl body*
8. *O-ring*
9. *O-ring*
10. *Valve plug*
11. *Operating slide*
12. *Spring*
13. *Spring support*
14. *Screw*
15. *Dosing ring*
16. *Nozzle **
17. *Screw*

** Secured with Loctite 242.*

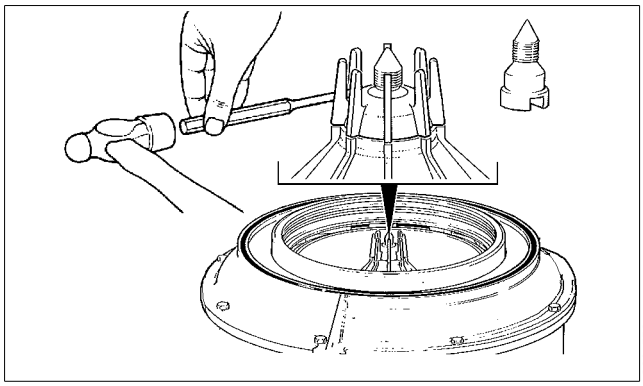


6.4.2 Dismantling

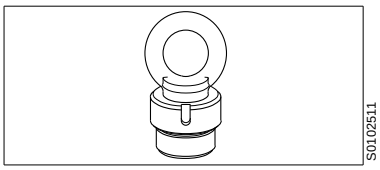
1. Unscrew and remove the cap nut. Hit with light blows on the lower part of the capnut wings with a drift and hammer.

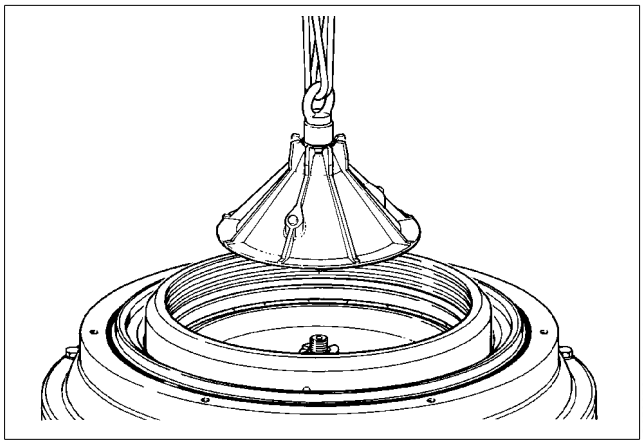
   Left-hand thread!

   Also remove the lifting stud.

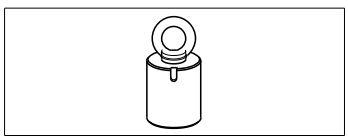


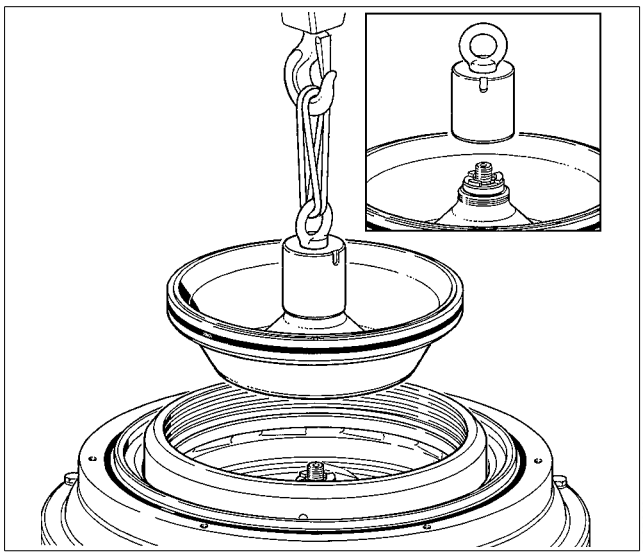
2. Fit the lifting tool into the distributing cone and lift it out.



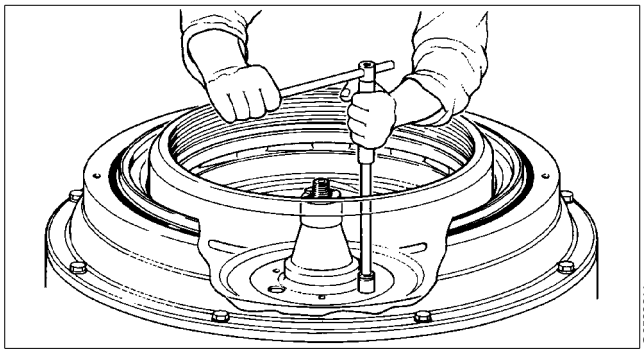


3. Fit the lifting tool onto the sliding bowl bottom and lift it out by hoist.

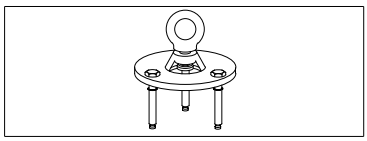




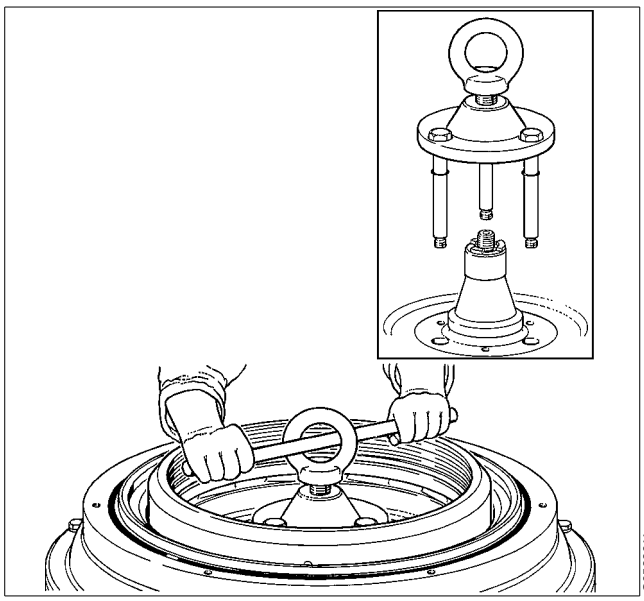
4. Unscrew the three screws in the bottom of the bowl body.



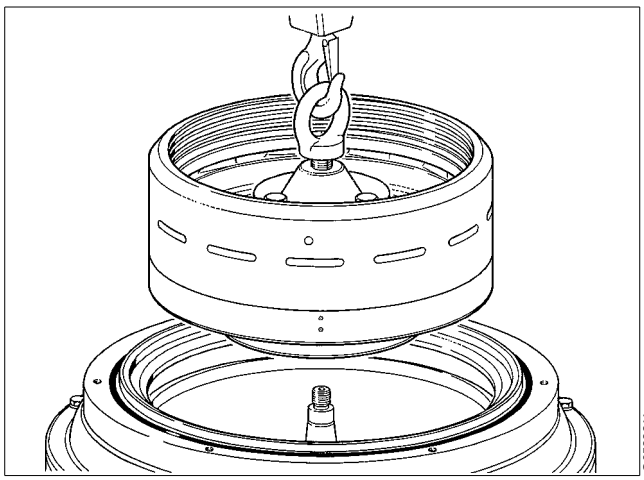
5. Fit the lifting tool into the bowl body bottom with the three screws.



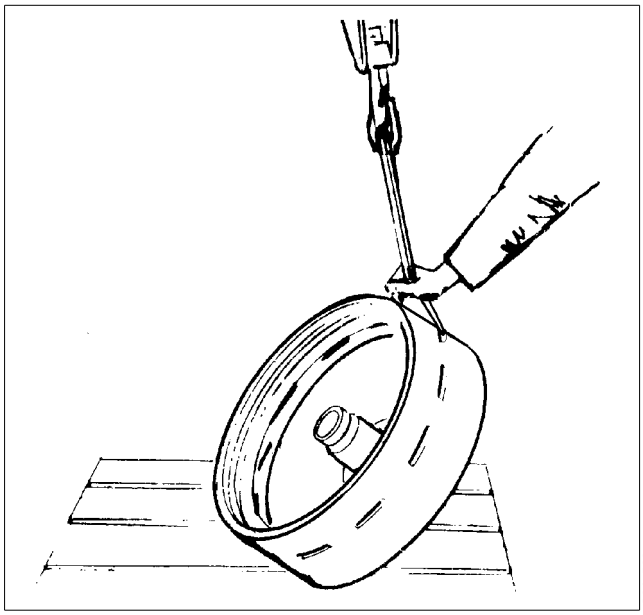
Release the bowl body from the spindle by using the lifting tool as a puller. Turn the handle at top of the lifting tool until the bowl body comes loose from the spindle taper. Turn the handle two more turns in order to avoid damaging the paring disc device.



6. Lift out the bowl body using hoist.

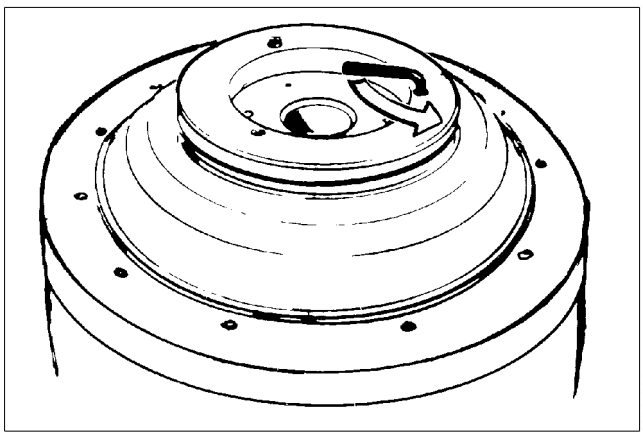


7. Thread a strap through two sludge ports and turn the bowl body upside down using hoist.

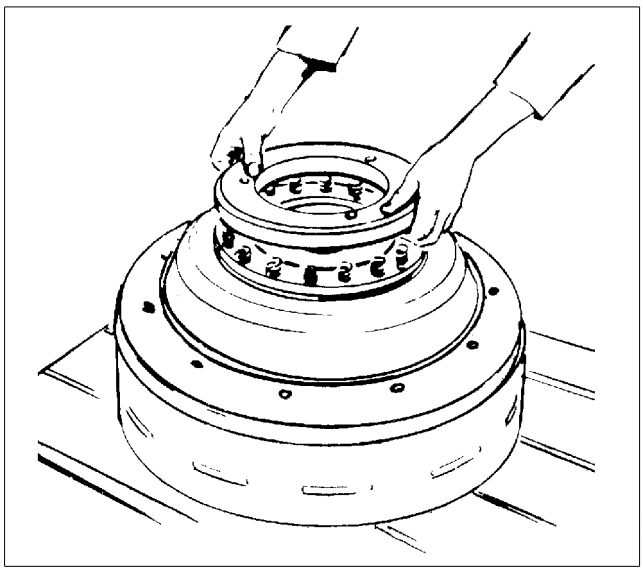


> **WARNING**
>
> **Crush hazards**
>
> Support the bowl body when turning to prevent it from rolling.

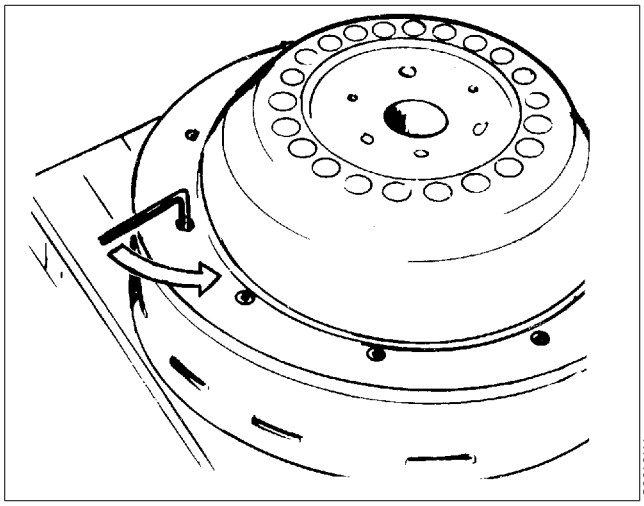
8. Loosen the screws for the spring support successively a little at a time. Remove the screws.



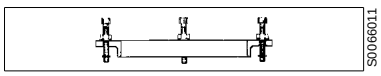
9. Remove the spring support and the springs.



10. Unscrew the screws for the dosing ring.



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

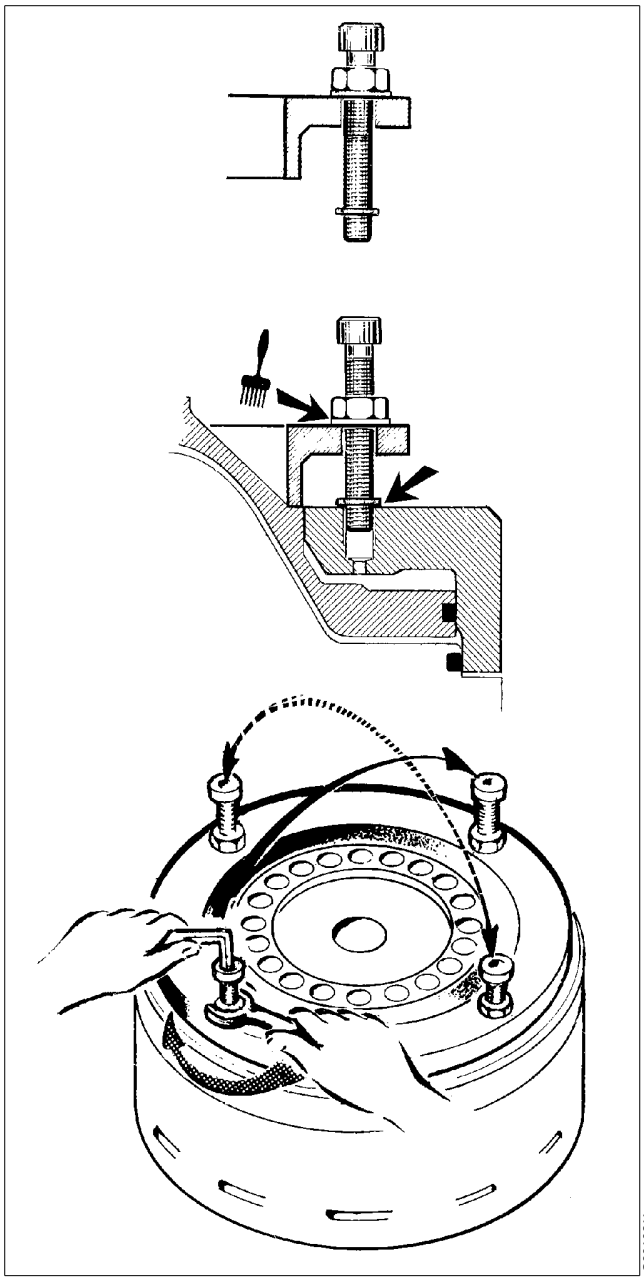


Proceed in the following way:

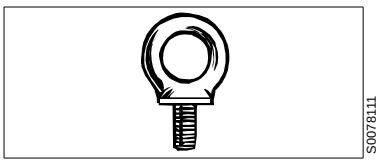
a. Screw the nuts against the heads of the screws.

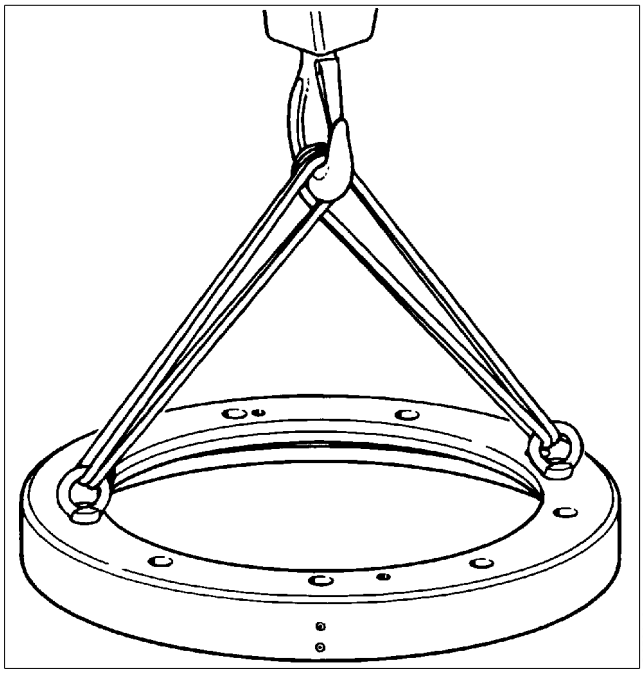
b. Place the puller on the operating slide and screw the screws into the dosing ring.

c. Force off the dosing ring by tightening the nuts crosswise. Remove the puller when the dosing ring is loose.

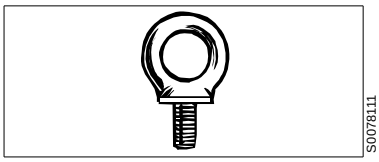


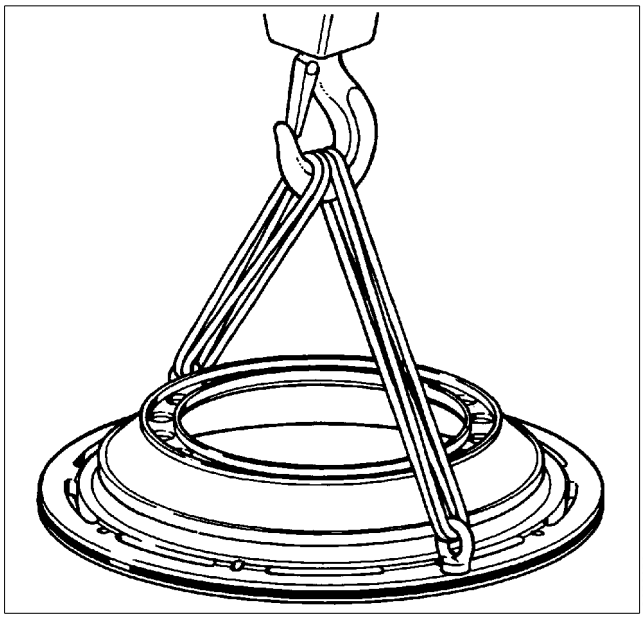
12. Fit two lifting eyes (M10) or two screws from the puller into the dosing ring and lift it off from the bowl body.



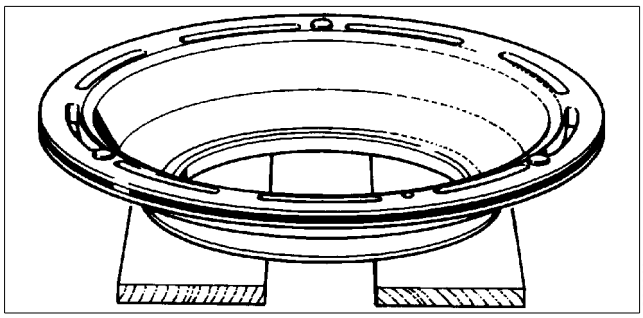


13. Fit two lifting eyes (M10) or two screws from the puller into the operating slide and lift it off from the bowl body.





14. Place the operating slide with the valve plugs facing upwards. Remove any thick deposits in the frame hood and clean all other parts thoroughly in a suitable cleaning agent. See chapter “5.6 Cleaning” on page 79.

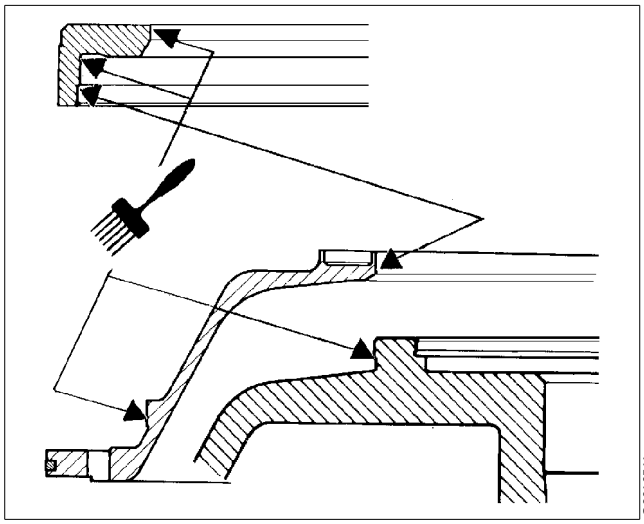


6.4.3 Assembly

✔ **Check point**

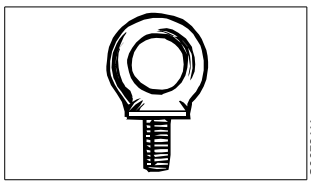
“5.3.3 Corrosion” on page 48,
“5.3.4 Cracks” on page 51,
“5.3.6 Dosing ring” on page 54,
“5.3.7 Erosion” on page 54,
“5.3.8 Guide surfaces” on page 56,
“5.3.12 Operating mechanism” on page 61,
“5.3.13 Operating slide” on page 61,
“5.3.14 Sliding bowl bottom” on page 62,
“5.3.15 Springs for operating mechanism” on page 63.

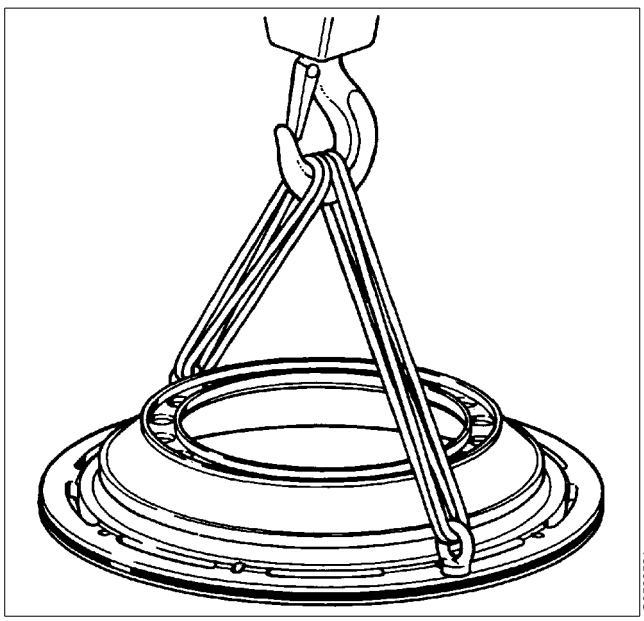
1. Lubricate the guide surfaces of the bowl body, operating slide and dosing ring with lubricating paste. See chapter “8.5 Lubricants” on page 183.



2. Fit the operating slide onto the bowl body.

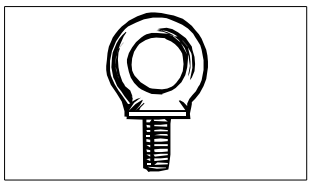
   Check that the guide pin in the bowl body enters the hole in the operating slide.

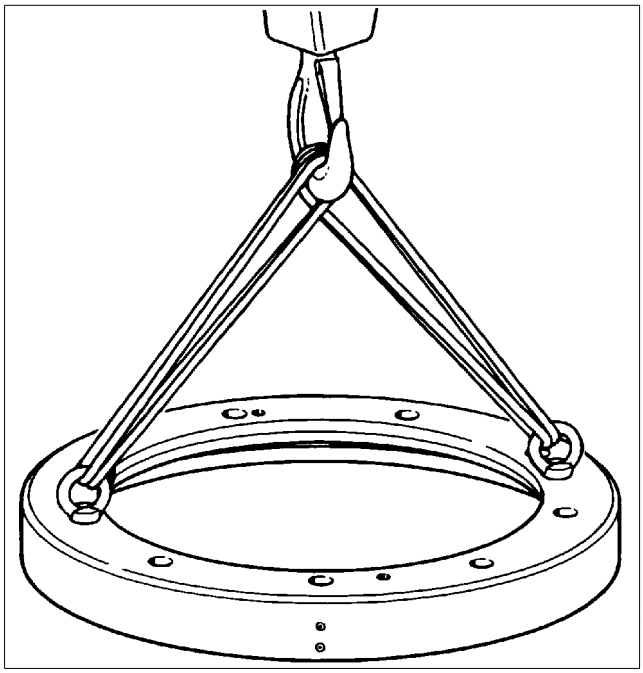




3. Fit the dosing ring.

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





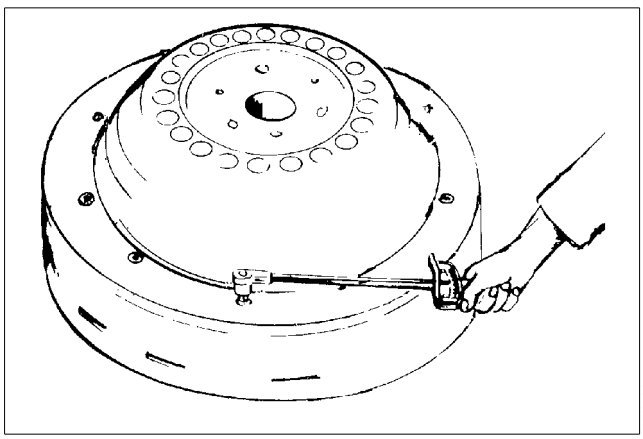
4. Apply only a thin film of lubricating paste on the screws for the dosing ring.

NOTE

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

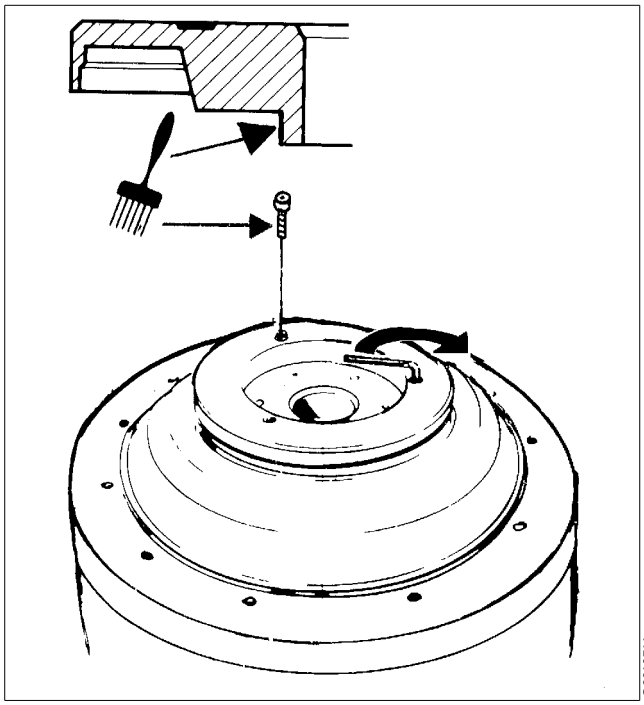
If torque is too low, there is a risk that the bolts will loosen by themselves when the separator is in operation. If torque is too high, the dosing ring as well as the bolts will be deformed. This may lead to sticking of the operating slide which moves inside the dosing ring.



5. Lubricate the guide surfaces of the spring support. See chapter “8.5 Lubricants” on page 183.

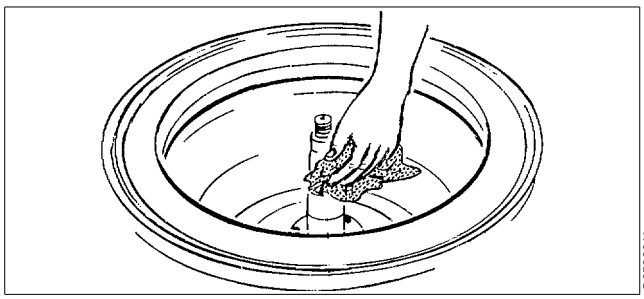
   Fit springs and support

6. Tighten the three screws for the spring support successively by hand a little at a time.



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 48.

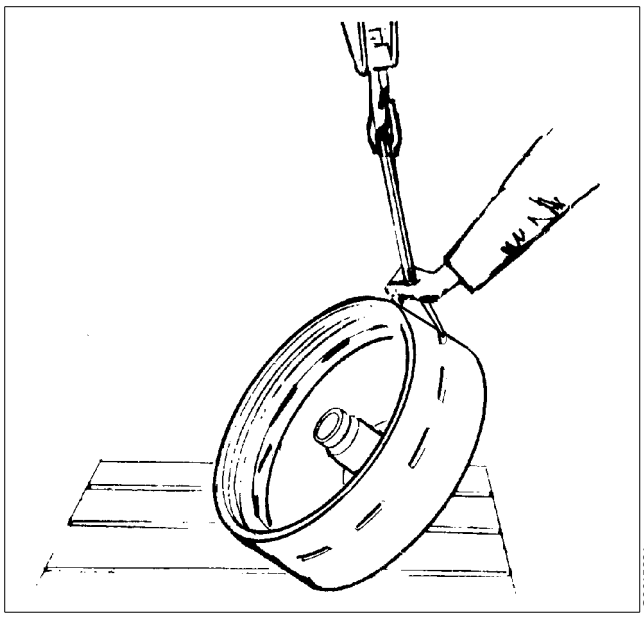


8. Turn the bowl body using a hoist to its upright position with a strap threaded through two sludge ports.

WARNING

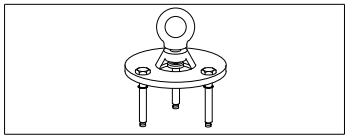
Crush hazards

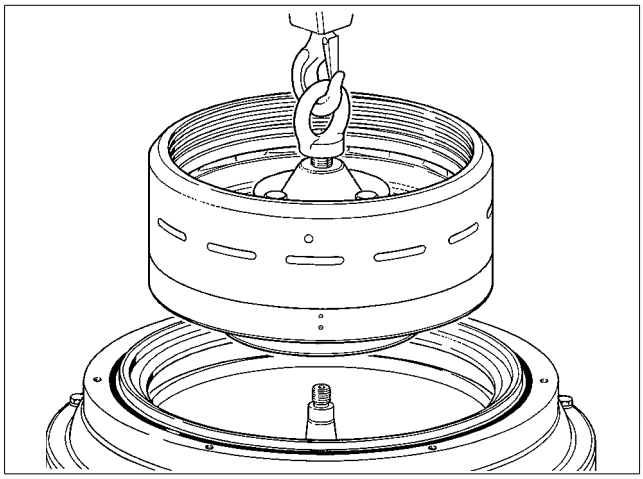
Support bowl body when turning to prevent it from rolling.



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.



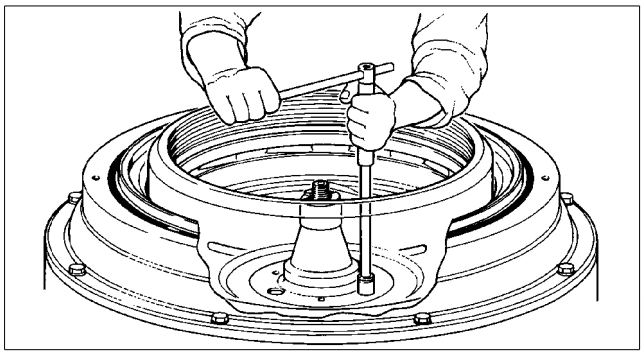


10. Lower the bowl body using hoist until the central screw rests on the spindle top. Then screw up the central screw so that the bowl body sinks down onto the spindle.

    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.

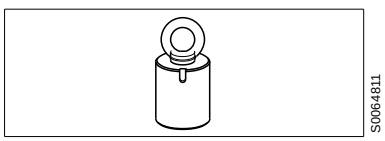
    Tighten the three screws firmly.

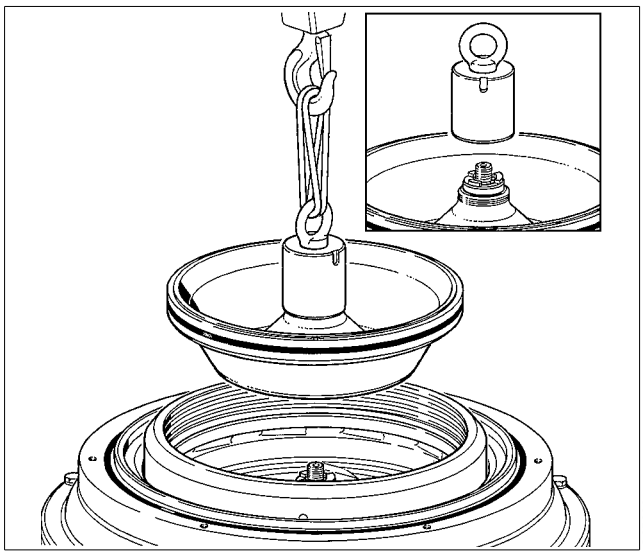


12. Lubricate the guide surfaces of the bowl body and sliding bowl bottom with lubricating paste. See chapter “8.5 Lubricants” on page 183.

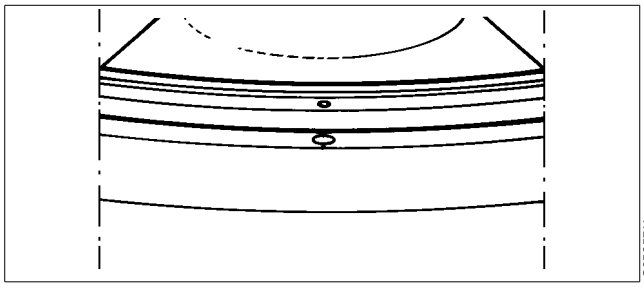
13. Fit the lifting tool to the sliding bowl bottom and lift it into the bowl body using hoist.

    For correct position of the sliding bowl bottom, see next illustration.



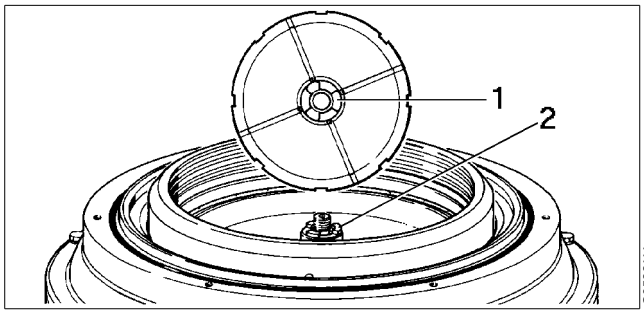


14. Bring the assembly mark on the sliding bowl bottom in line with the guide lug on the bowl body to ensure that the sliding bowl bottom enters into the correct position.



15. Fit the distributing cone onto the bowl body.

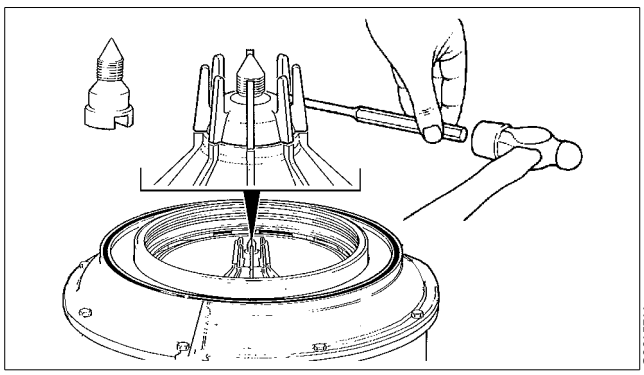
    Check that the guide recesses (1) on the underside of the distributing cone enter the correct guide lugs (2) in the bowl body. The relative sizes of the guides are different.



16. Place the lifting stud onto the spindle top. The groove should fit over the lug on the spindle top.

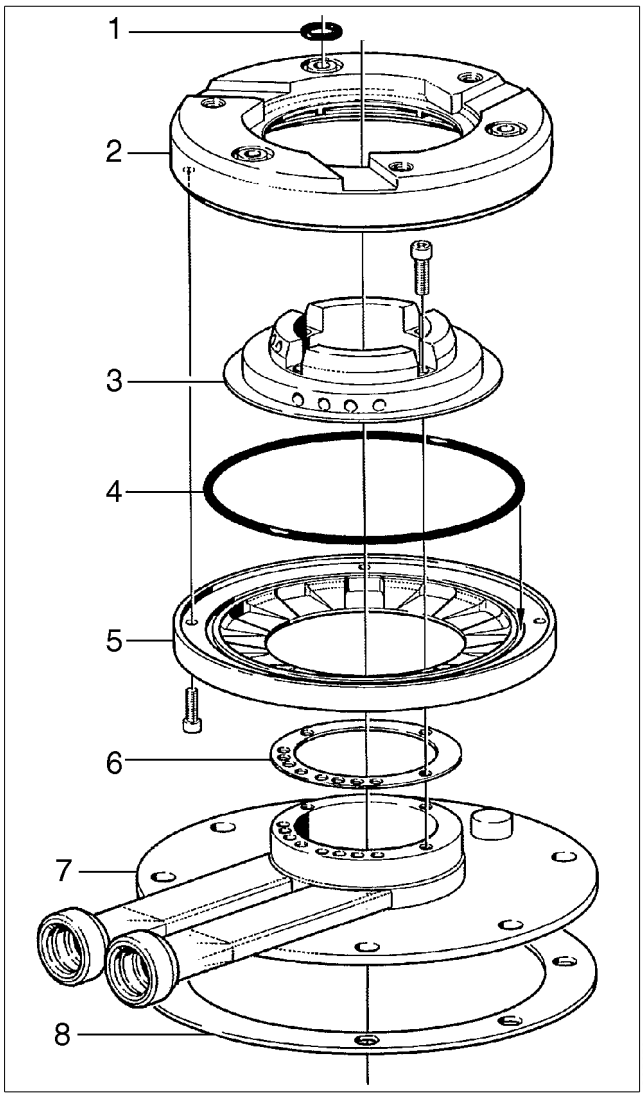
    Screw on the cap nut and tighten firmly. Hit with light blows on the lower part of the capnut wings with a drift and hammer.

    Left-hand thread!



6.5 Operating water device (IS)

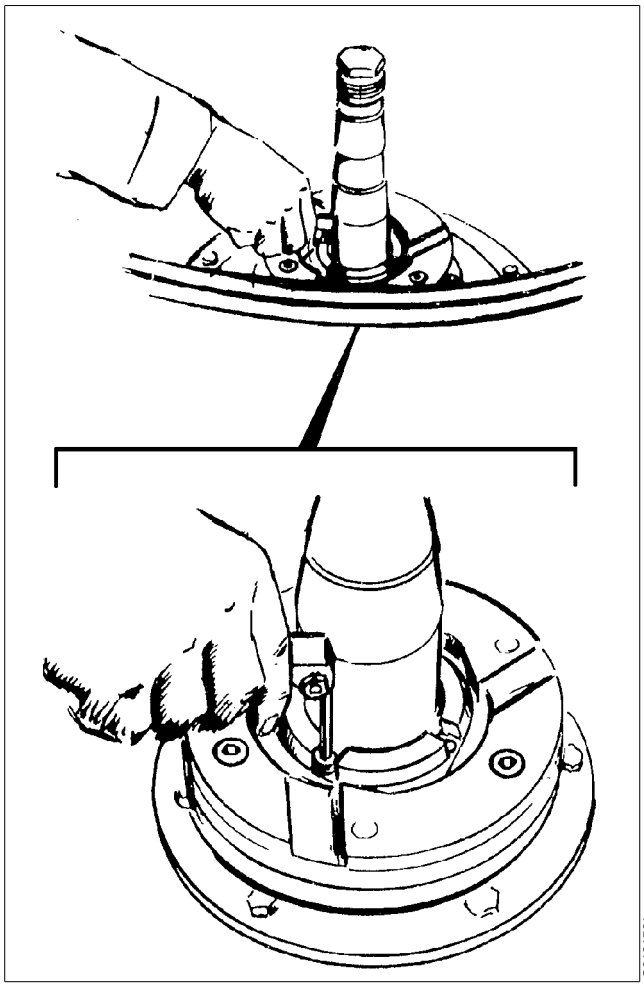
6.5.1 Exploded view



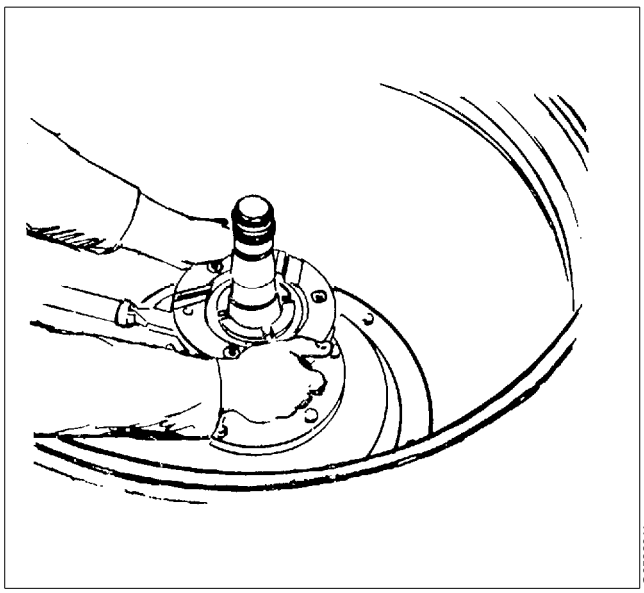
1. *O-ring*
2. *Distributing ring*
3. *Control paring disc*
4. *O-ring*
5. *Cover*
6. *Gasket*
7. *Distributing cover*
8. *Height adjusting ring*

6.5.2 Dismantling

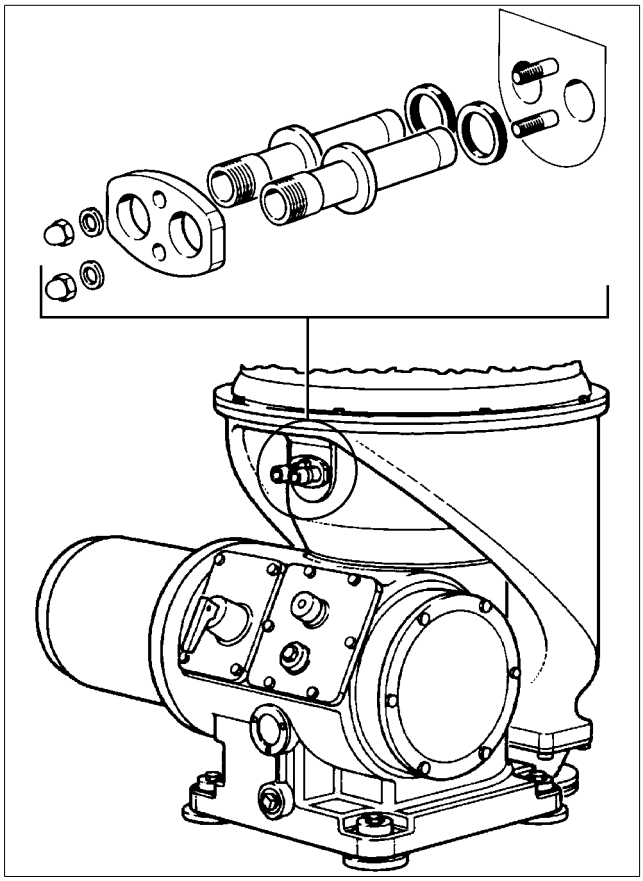
1. Slacken the screws of the paring disc with a hexagon wrench and unscrew with a suitable screw driver.



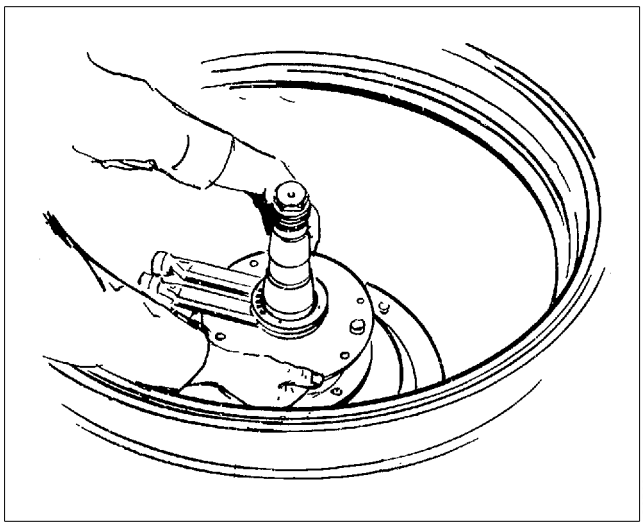
2. Lift out the paring disc device.



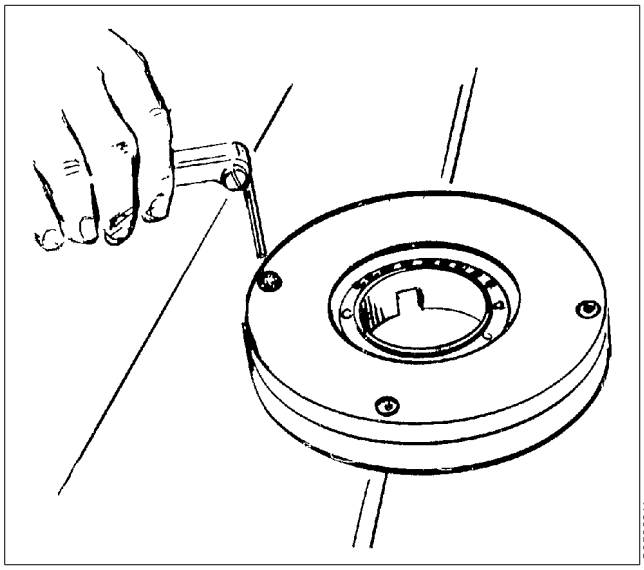
3. Loosen and pull out the operating water inlet pipes.



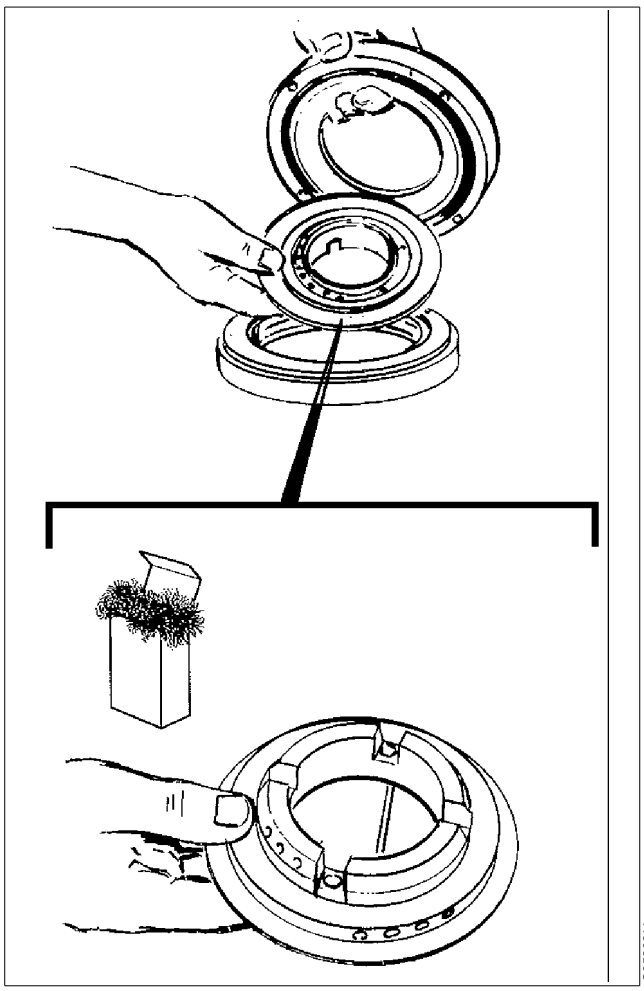
4. Lift out the distributing cover.



5. To dismantle the paring disc device turn it upside down and remove the screws.

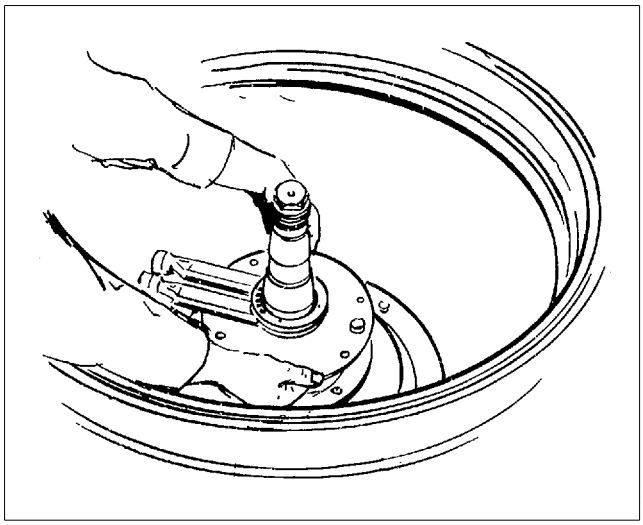


6. Remove deposits and clean all parts thoroughly in a suitable cleaning agent. Pay special attention to the channels. See chapter “5.6 Cleaning” on page 79.
7. Check the parts for damage and corrosion.

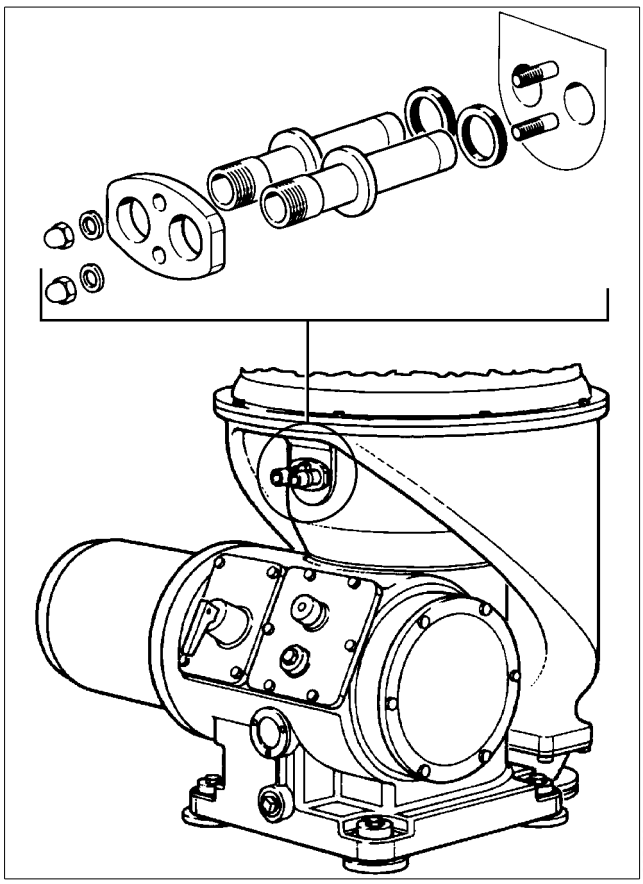


6.5.3 Assembly

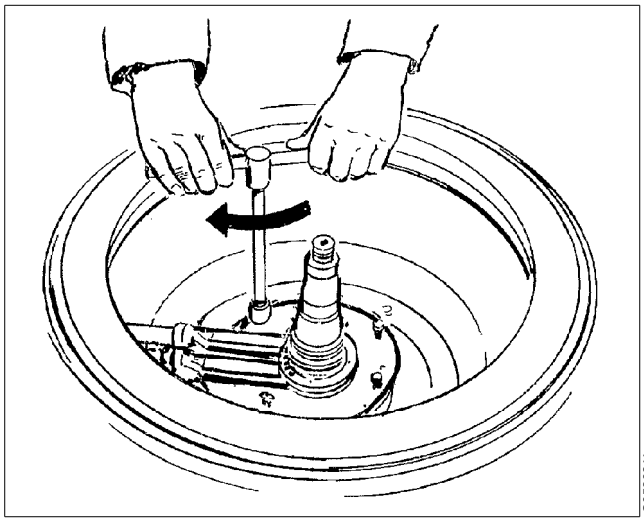
1. Put the distributing cover in place. Do not tighten the screws (this will make it easier to fit the operating water inlet tubes).



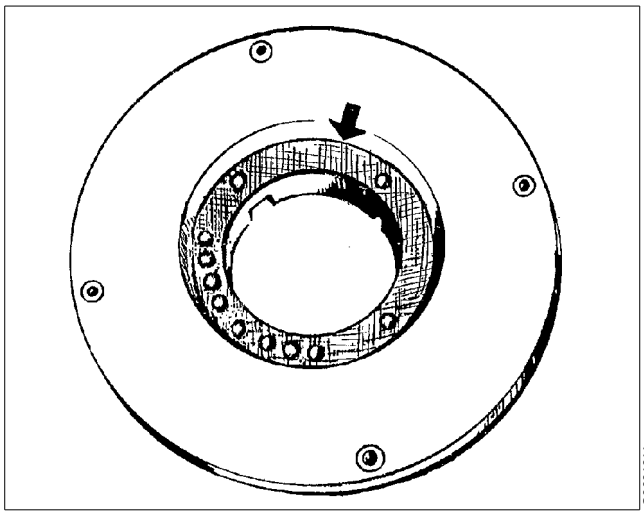
2. Fit the operating water inlet pipes into the distributing cover.



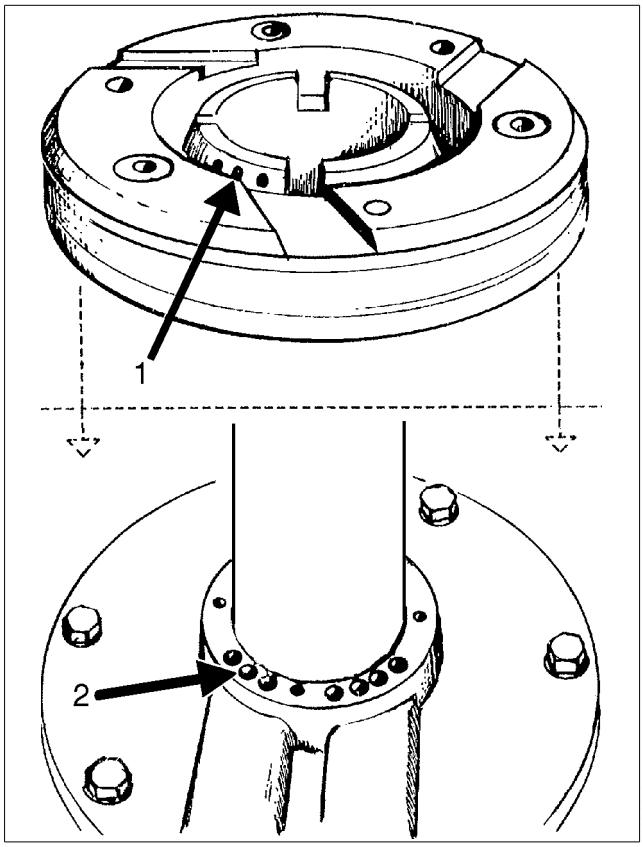
3. Fasten the distributing cover.



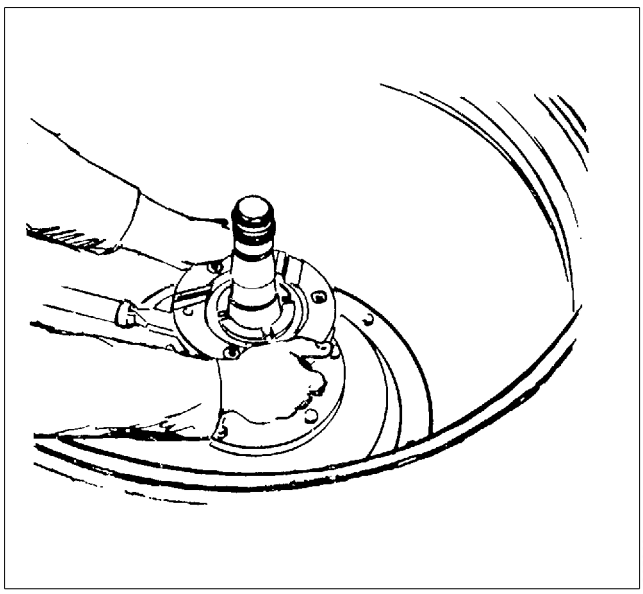
4. Assemble the paring disc device. Do not forget the gasket on its underside.



5. Align the three holes (1) in the paring disc with the three holes (2) in the distributing cover.

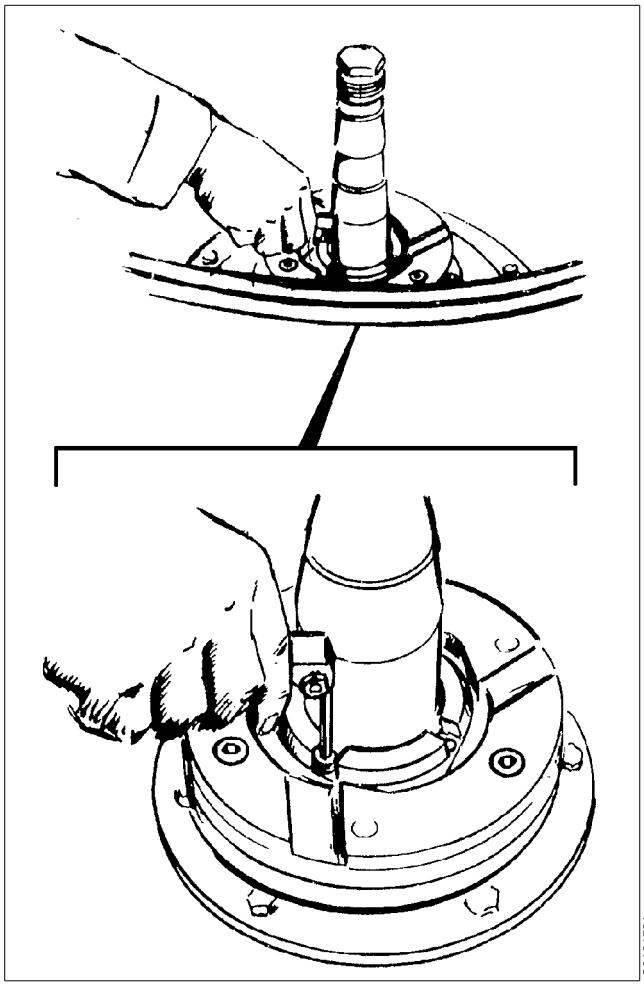


6. Fit the paring disc device in its place.



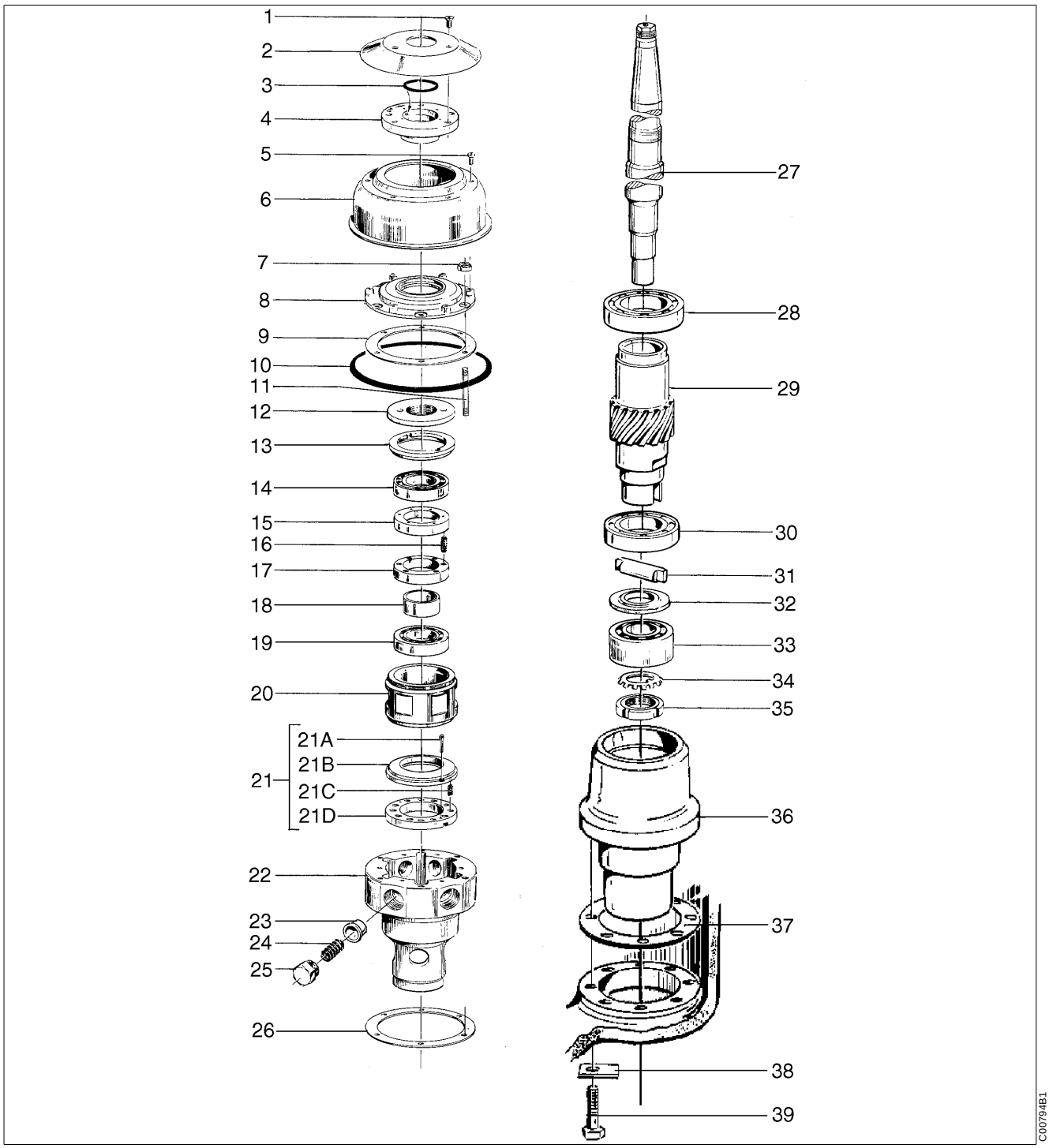
7. Tighten the screws of the paring disc.

✔ **Check point**
“5.4.20 Operating paring disc; height position” on page 74. Only at Major Service (MS).



6.6 Vertical driving device (MS)

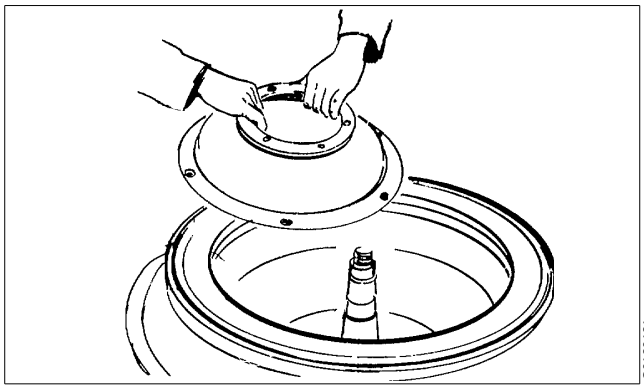
6.6.1 Exploded view



1. Screw
2. Protecting plate
3. O-ring
4. Protecting collar
5. Screw
6. Guard
7. Nut
8. Cover
9. Gasket
10. O-ring
11. Stud bolt
12. Oil fan
13. Lock ring
14. Ball bearing
15. Spring support
16. Spring
17. Spring support
18. Spacing sleeve
19. Ball bearing
20. Ball bearing housing
21. Buffer
    - 21A. Split pin
    - 21B. Wear ring
    - 21C. Spring
    - 21D. Spring support
22. Spring casing
23. Buffer
24. Spring
25. Screw plug
26. Gasket
27. Bowl spindle
28. Ball bearing
29. Worm
30. Ball bearing
31. Conveyor
32. Washer
33. Ball bearing
34. Lock washer
35. Round nut
36. Bottom sleeve
37. Gasket
38. Washer
39. Screw

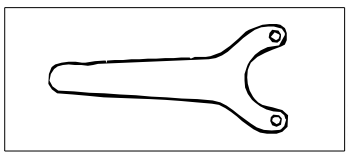
6.6.2 Dismantling

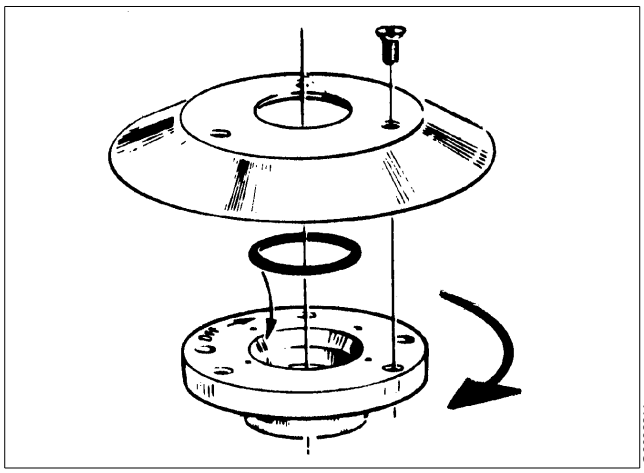
1. Unscrew the six screws and remove the hood and O-ring.



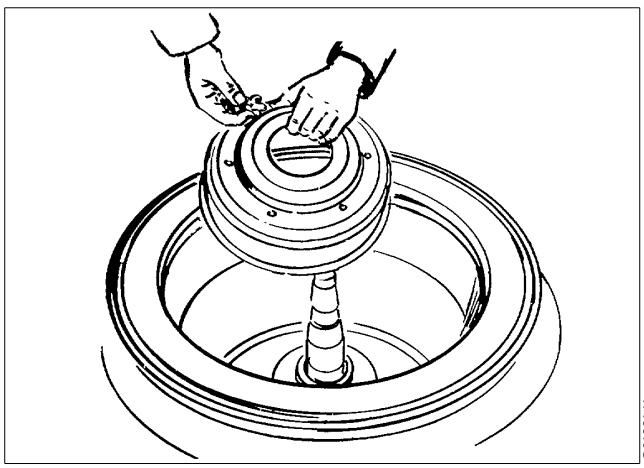
2. Remove the protecting plate and the protecting collar with O-ring.

   Left-hand thread!

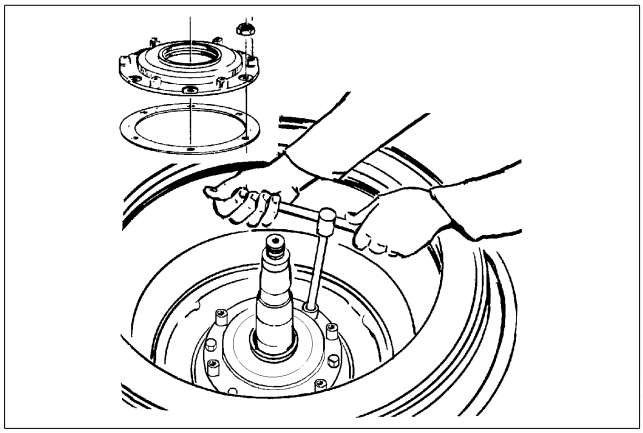




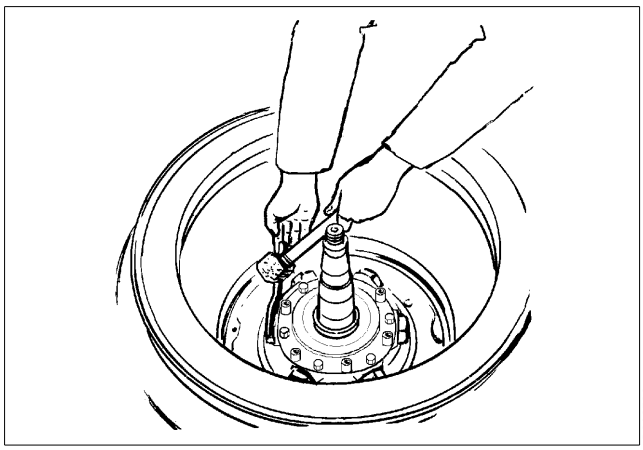
3. Unscrew the six screws and remove the guard and O-ring.



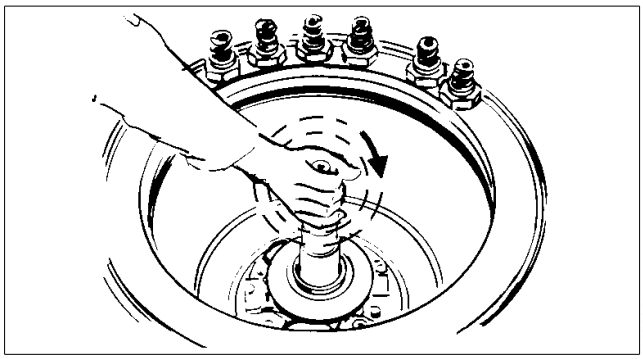
4. Unscrew the six nuts and remove the cover and gasket.



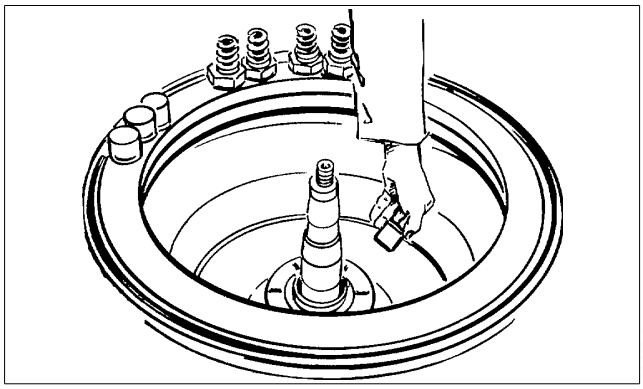
5. Loosen (but do not remove) the six screw plugs for the buffers with a spanner and a hammer.



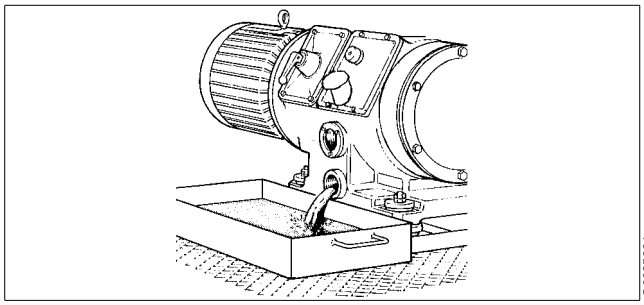
6. Unscrew the six screw plugs and remove the springs. Move the spindle top a few turns in a circle while pressing outwards. This will disengage buffers from the ball bearing housing.



7. Remove the six buffers from the spring casing.



8. Drain the oil from the worm gear housing.

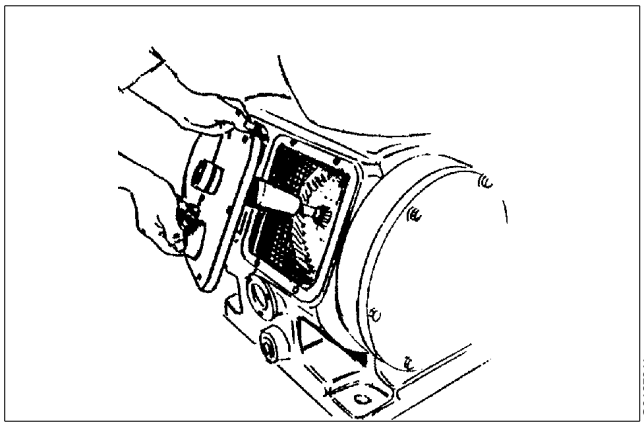


CAUTION

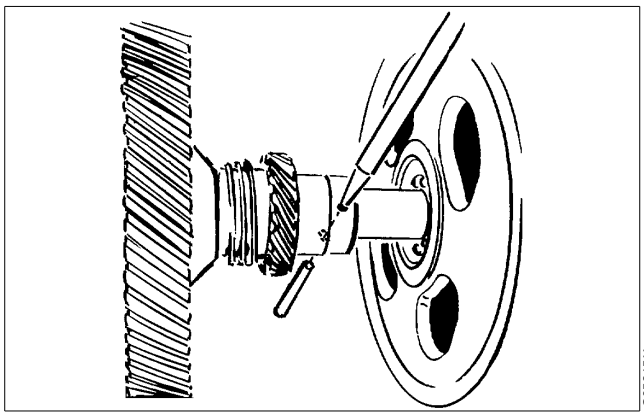
Burn hazards

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

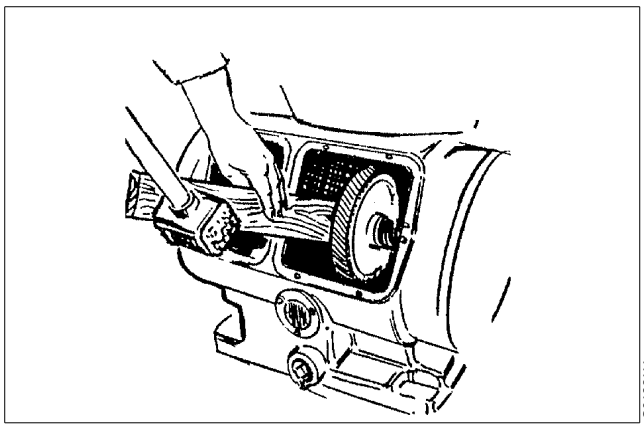
9. Remove the brake cover and the revolution counter cap and their gaskets.



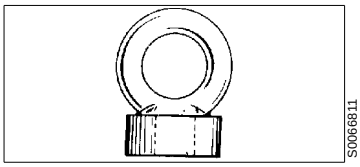
10. Knock out the taper pin from the worm wheel stop ring.

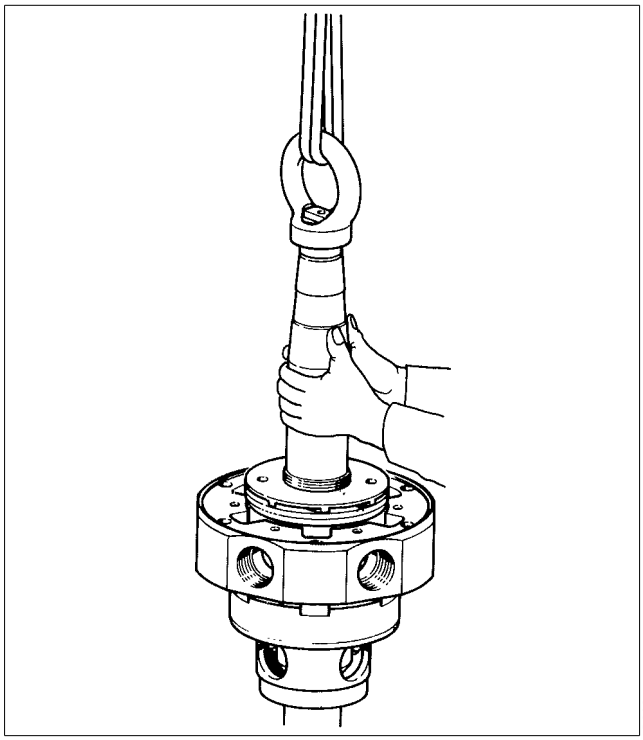


11. Push the worm wheel to one side before removing the spindle. If worm wheel is stuck use a piece of wood to loosen it.

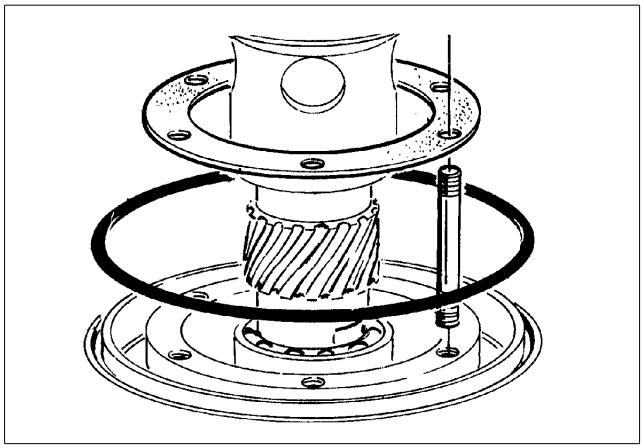


12. Fit the lifting tool onto the spindle and lift it out using the hoist.





13. Remove the gasket and O-ring which are remaining in the separator frame.



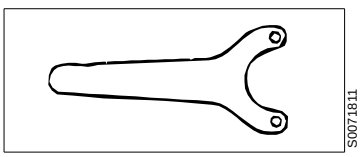
14. Unscrew

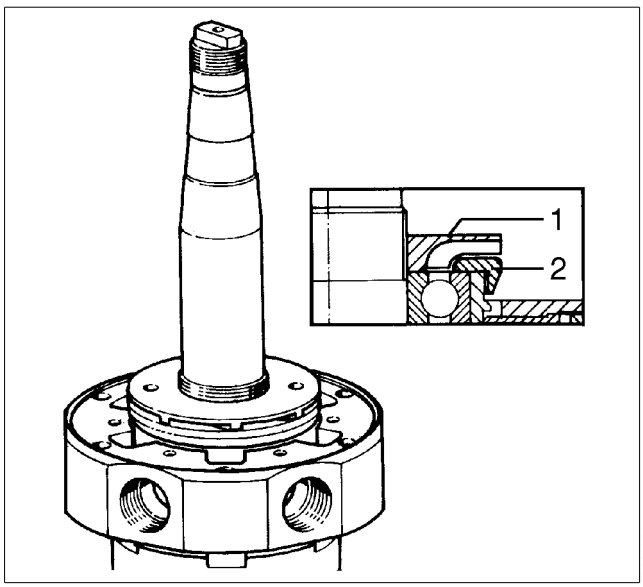
    - the oil fan (1) clockwise

    Left-hand thread!

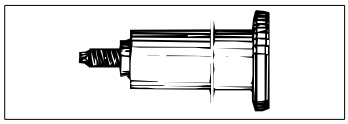
    - the lock ring (2) counter-clockwise

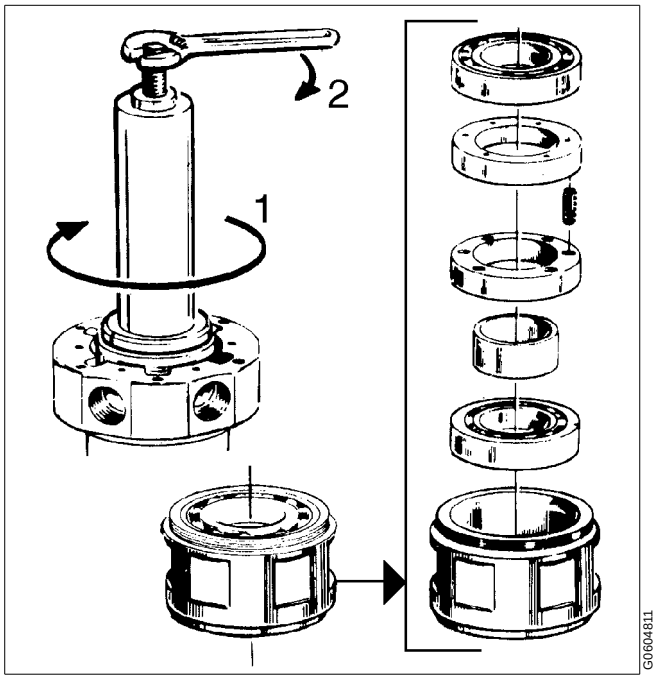
    Right-hand thread!



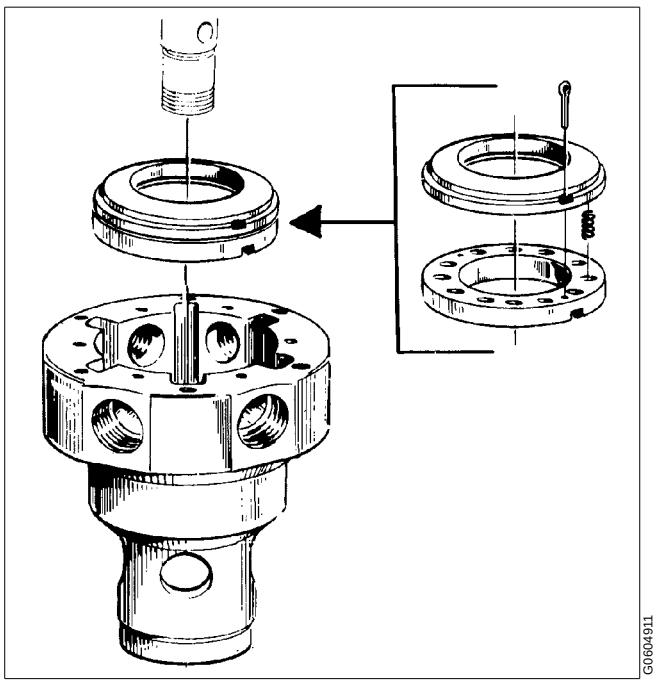


15. Remove the ball bearing housing and bearings by means of the puller.





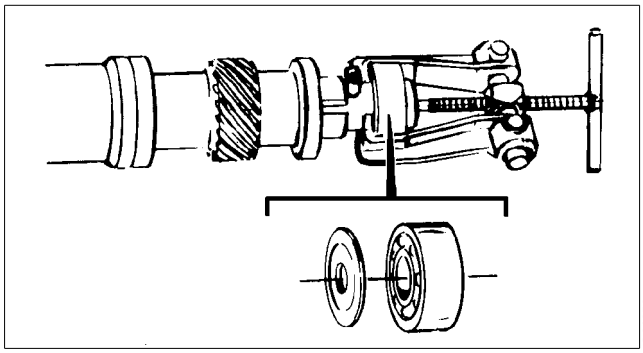
16. Remove the buffer.



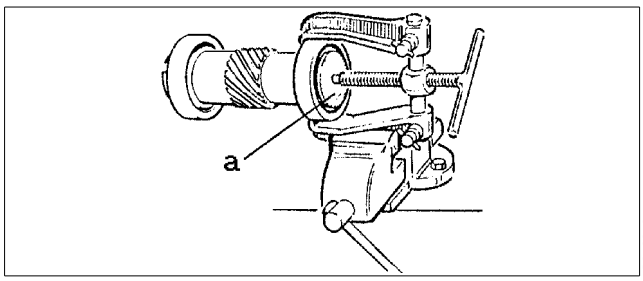
17. To strip the spindle, unscrew the round nut and remove the lock washer.

    Pull off the bearing together with the intermediate washer.

    Remove the driver which fits in the groove in the worm.



18. Remove the ball bearings from the worm by proceeding as illustrated. Use a thrust washer (a) as a support for the jack screw of the puller.



6.6.3 Assembly

When mounting ball bearings on the spindle and the worm as described below, the bearings must be heated in oil to max 125 °C (225 °F).

WARNING

Burn hazards

Use protective gloves when handling the heated bearings.

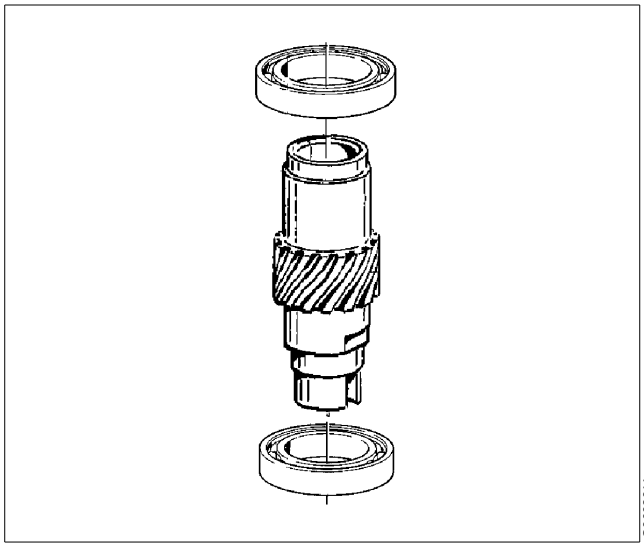
NOTE

If any doubt how to mount roller bearings in a correct way, see the detailed description in chapter “5.9.1 Ball and roller bearings” on page 89.

✔ **Check point**

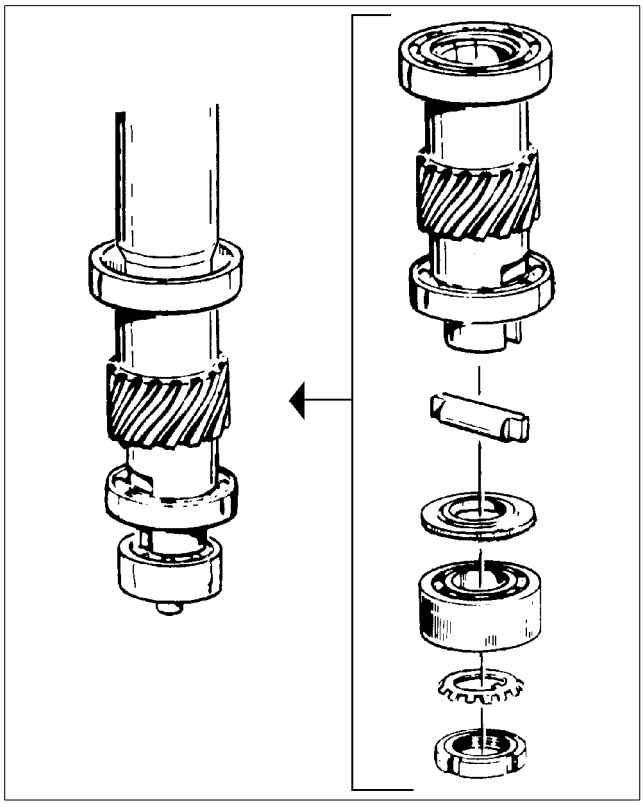
‘‘5.4.24 Worm; wear of groove” on page 76
‘‘5.7.1 Worm wheel and worm; wear of teeth” on page 83.

1. Heat and mount the two bearings for the worm.

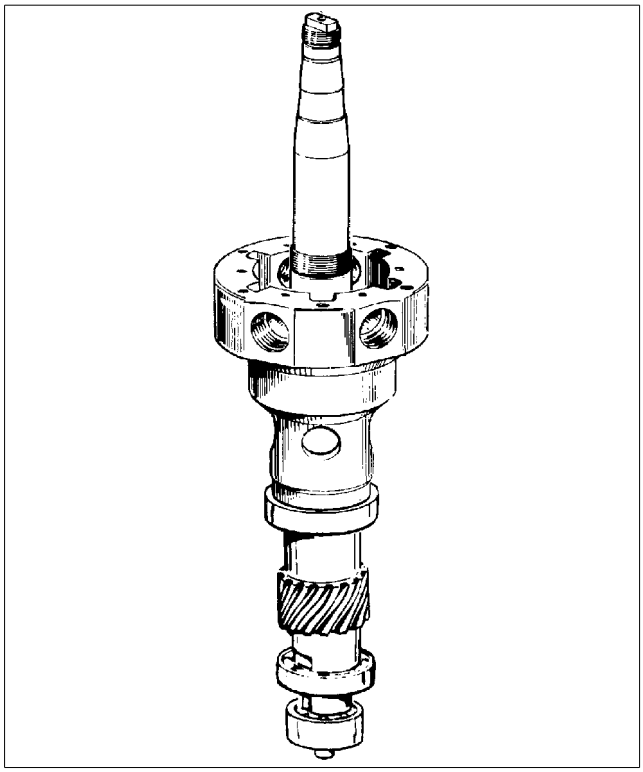


2. Fit the worm onto the spindle.
3. Fit the protecting washer and the heated ball bearing.

   Fix the bearing with the round nut and lock washer.
4. Place the conveyor through the groove in the worm and hole in the bowl spindle.



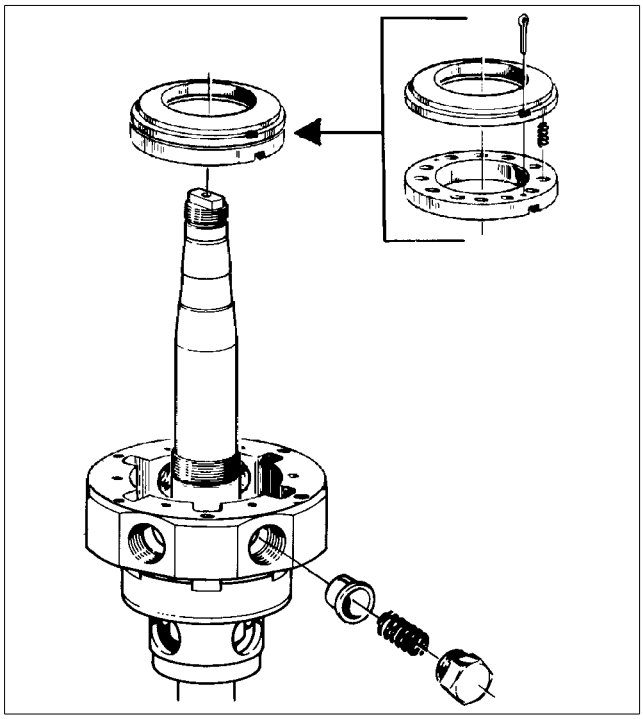
5. Place the spring casing carefully to rest on the upper ballbearing on worm



✔ **Check point**

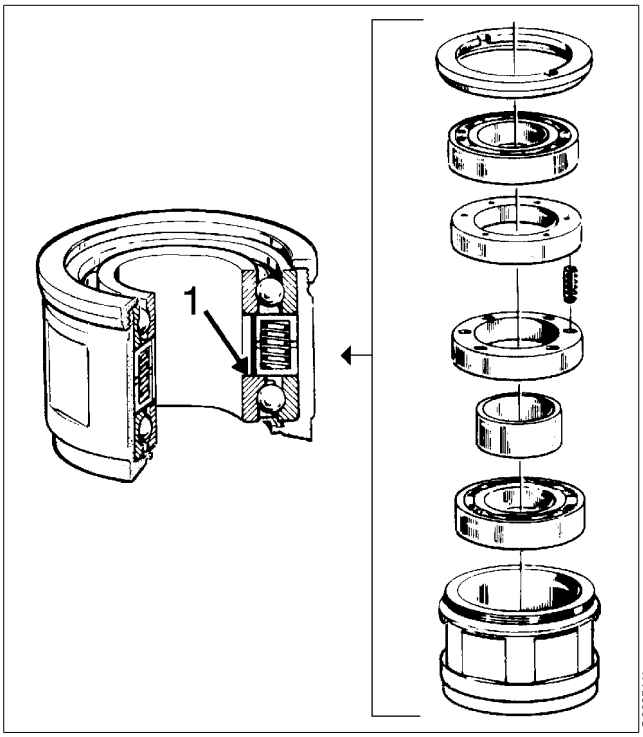
"5.4.5 Buffer springs and ball bearing housing" on page 66.

6. Place the axial buffer in the spring casing .



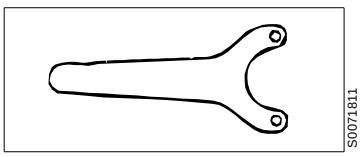
7. Assemble the parts included in the bearing housing as shown in the illustration.

   If the bearings cannot be pushed in by hand, heat the ball bearing housing in oil.

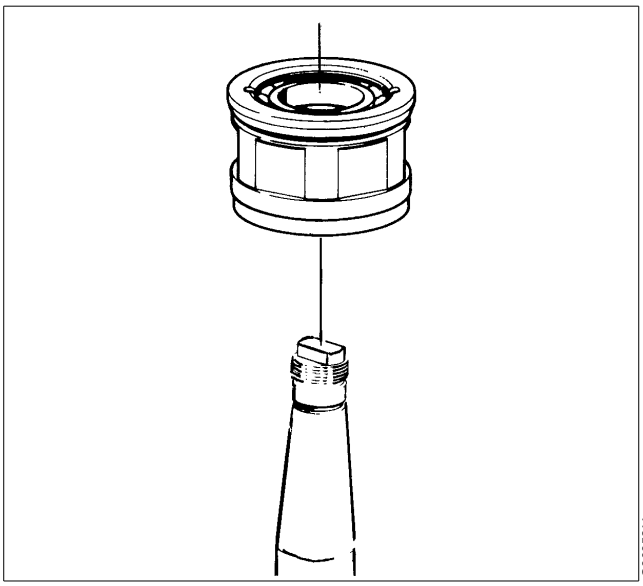


NOTE

The angular contact ball bearing (1) must be fitted with the wide shoulder of the inner ball race facing upwards.

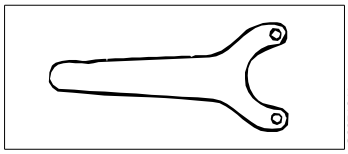


8. Fit the bearing housing onto the bowl spindle. Heat the housing in oil to facilitate the fitting.



9. Screw the oil fan into the spring casing. Tighten the oil fan with the pin spanner.

   Left-hand thread!

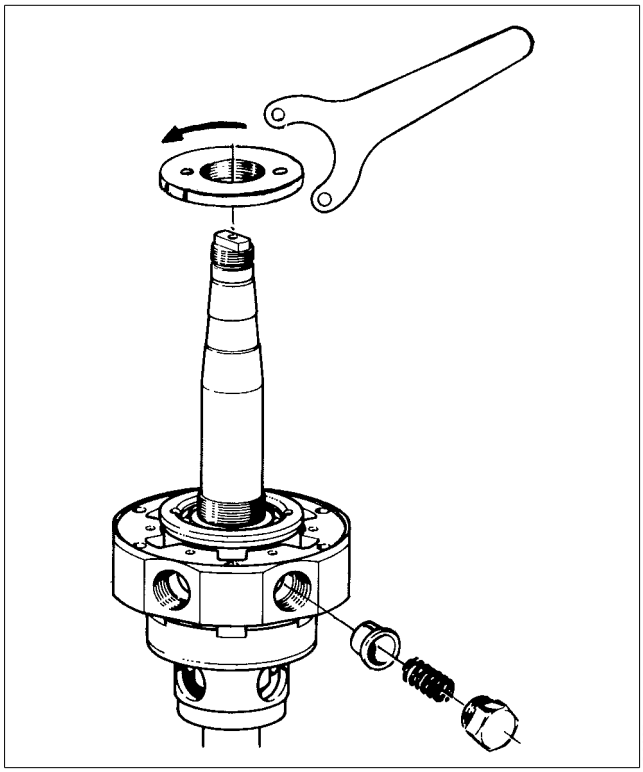


   The oil fan will fix the bearing housing into the spring casing.

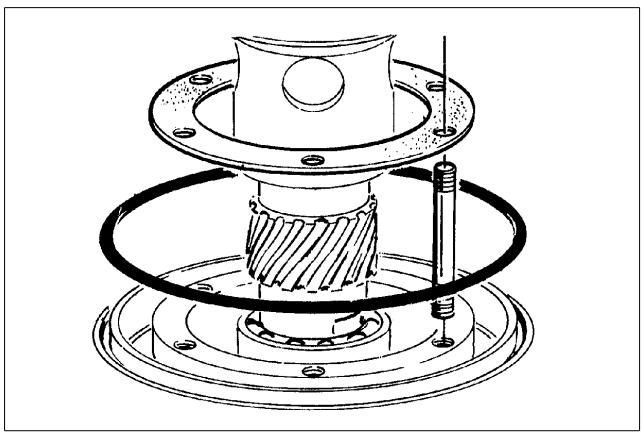
10. Fit the buffers, springs and screw plugs into the bearing housing.

    Make sure the buffers come to rest against the flats of the ball bearing housing.

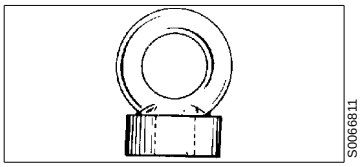
    The final tightening of the plugs is preferably done when the spindle has been placed in the frame.



11. Fit the O-ring and gasket into the separator frame.

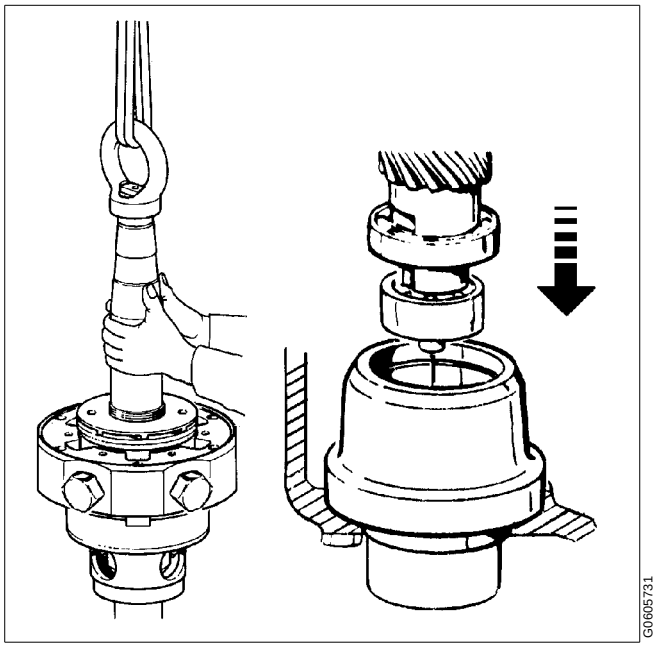


12. Fit the lifting tool to the spindle and lift it by hoist.

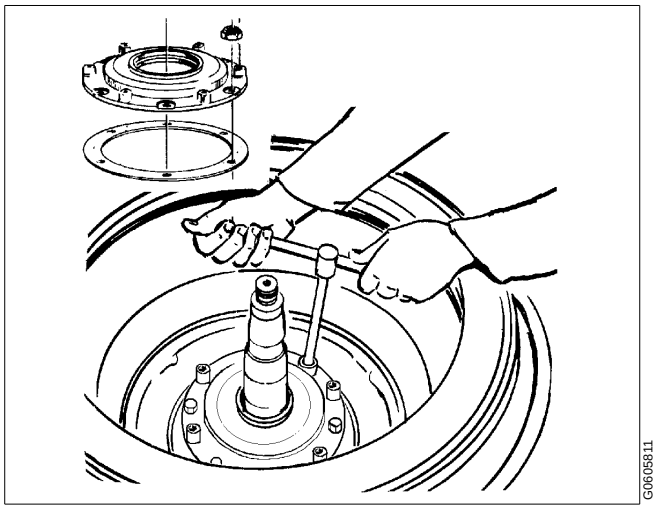


13. Carefully lower the spindle into the frame.

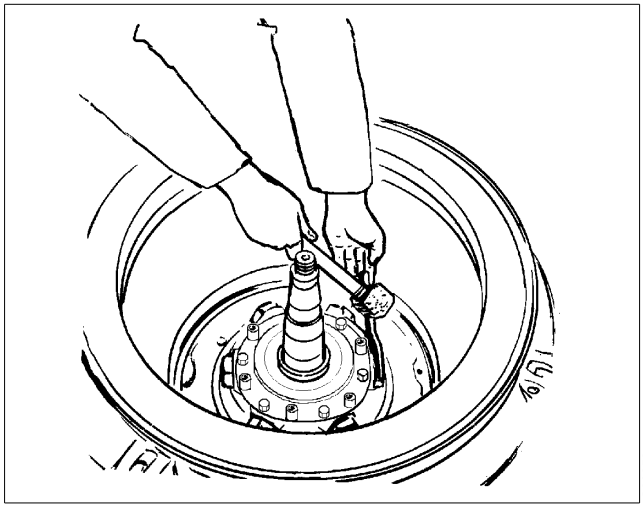
    Guide the bearings into the bottom sleeve. If they do not completely enter their seats, tap the spindle top with a tin hammer.



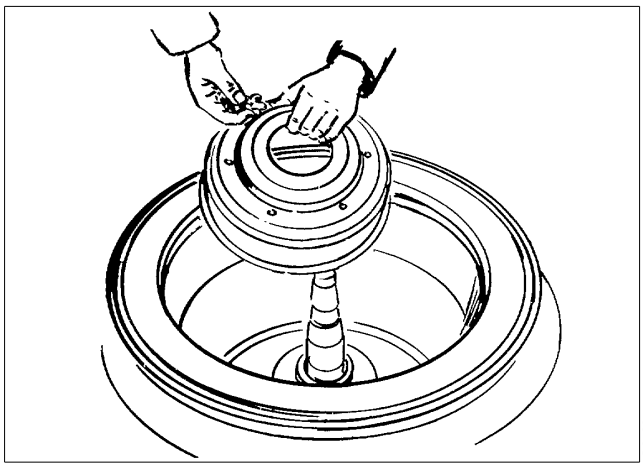
14. Fit the gasket and cover above the spring casing and tighten the nuts.



15. Tighten the screw plugs.

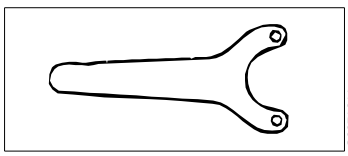


16. Fit the guard and tighten the six screws.

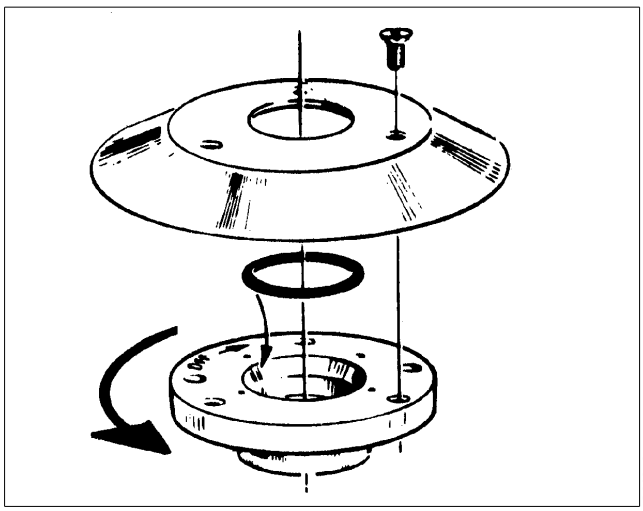


17. Fit the protecting collar.

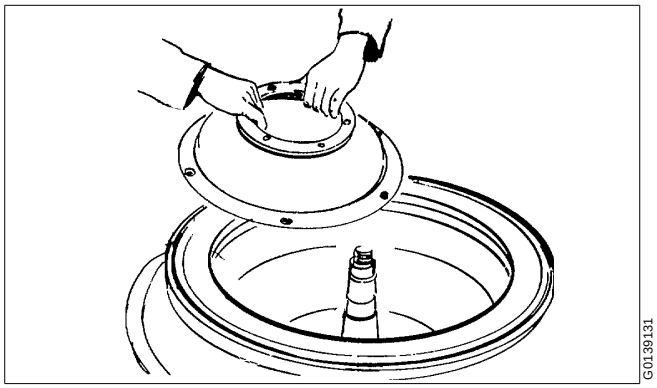
    Left-hand thread!



18. Fit the O-ring and protecting plate. Tighten the three screws for the protecting plate.



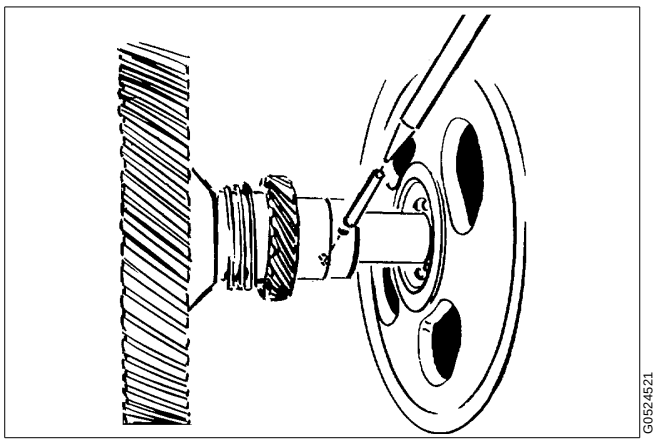
19. Fit the hood with O-ring and tighten the six screws.



20. 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**

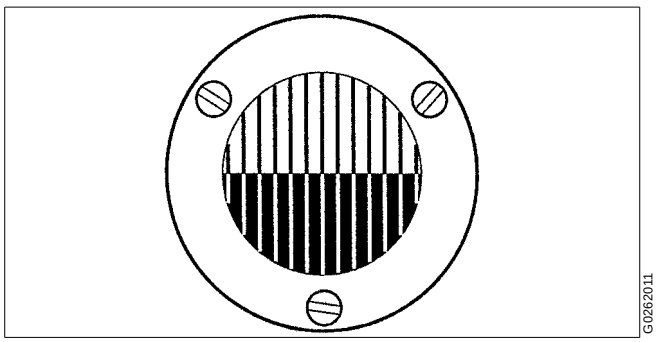
“5.4.26 Worm wheel shaft; radial wobble” on page 77,
“5.4.3 Bowl spindle; radial wobble” on page 64.



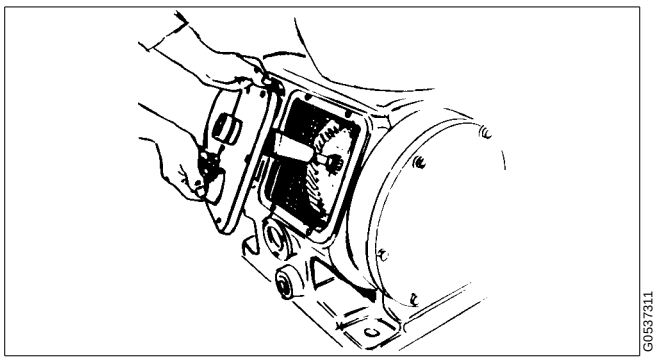
21. Pour oil into worm gear housing. The oil level should be exactly in the middle of the sight glass.

For correct oil volume and recommended oil brands, see chapter “8.5 Lubricants” on page 183.

✔ **Check point**
“5.4.4 Brake” on page 65.

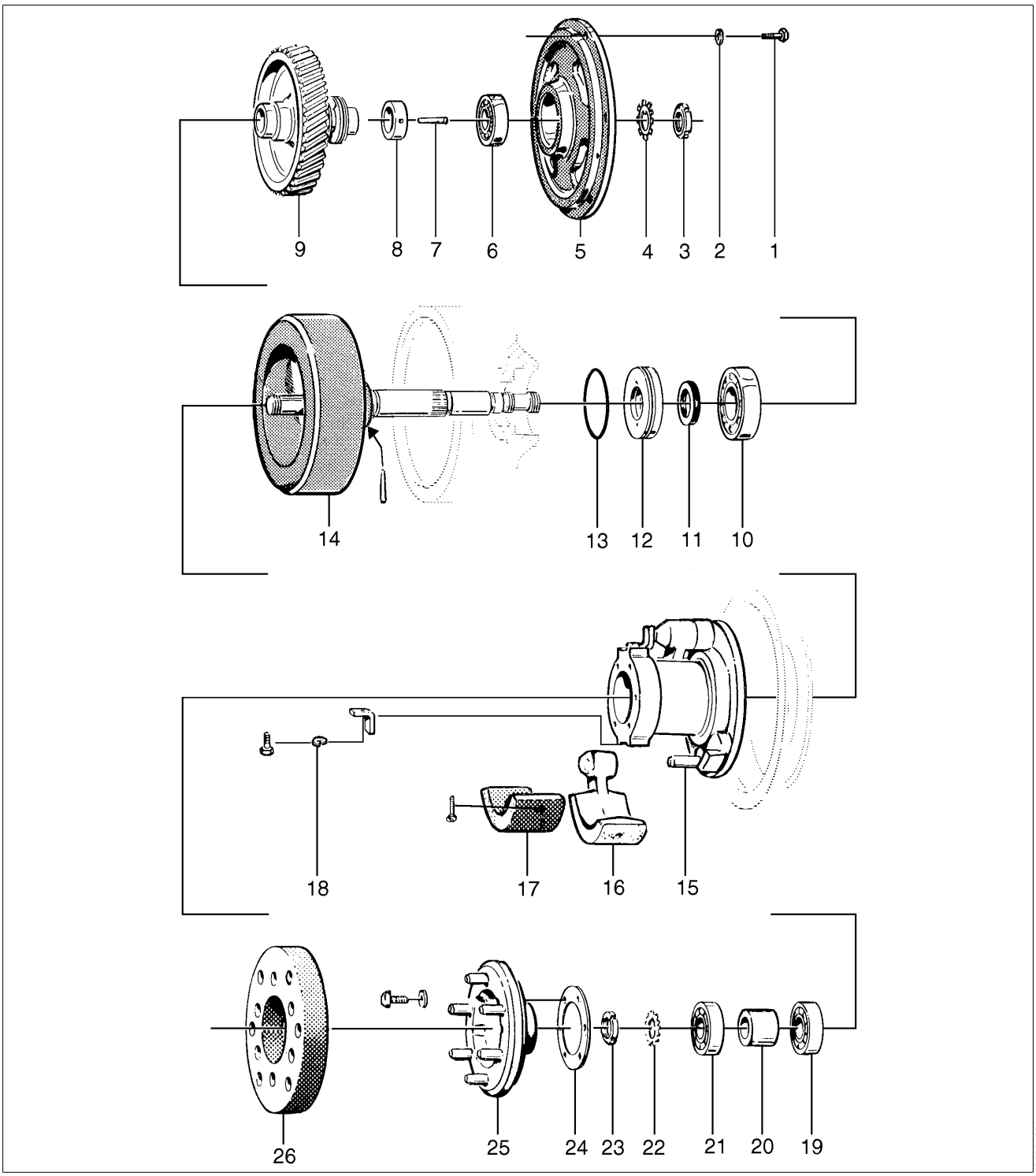


22. Fit the brake cover and revolution counter cap and their gaskets.



6.7 Horizontal driving device (MS)

6.7.1 Exploded view



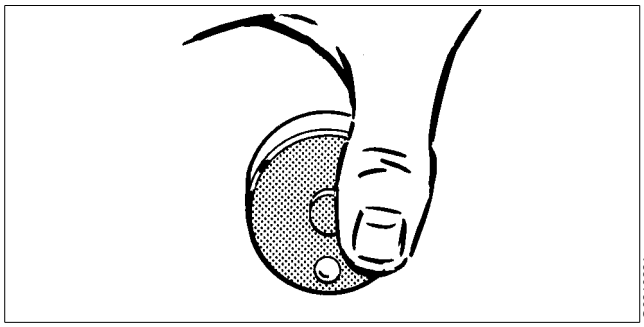
1. Screw
2. Spring washer
3. Round nut
4. Lock washer
5. Bearing shield
6. Ball bearing
7. Taper pin
8. Stop ring
9. Worm wheel
10. Ball bearing
11. Sealing ring
12. Sealing washer
13. O-ring
14. Worm-wheel shaft with coupling drum
15. Nave
16. Friction block
17. Friction pad
18. Holding bracket
19.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

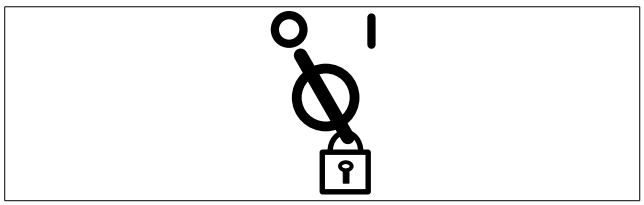
6.7.2 .Dsmantling

DANGER

Entrapment hazards

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





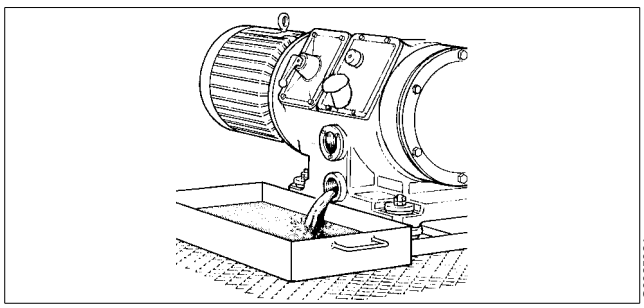
The parts must be handled carefully. Don't place parts directly on the floor, but on a clean rubber mat, fibreboard or a suitable pallet.

1. Drain the oil from the worm gear housing.

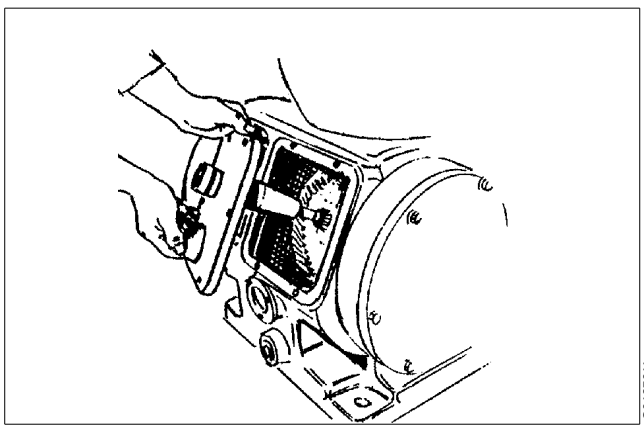
CAUTION

Burn hazards

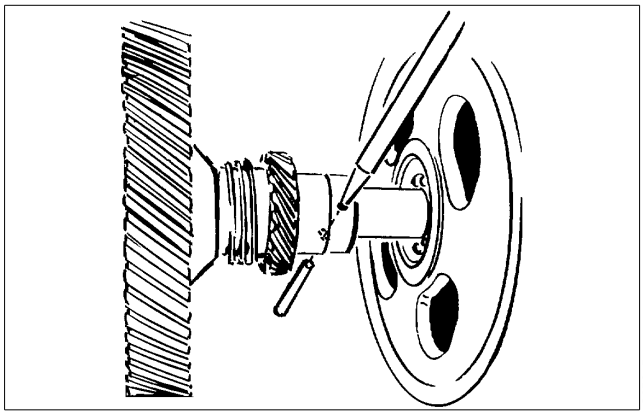
Lubricating oil and various machine surfaces can be hot and cause burns.



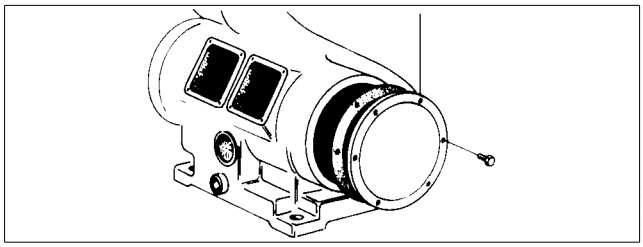
2. Remove the brake cover and revolution counter cap and their gaskets.



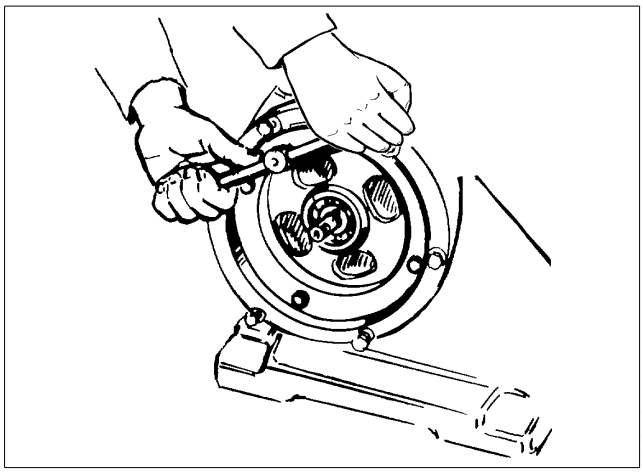
3. Knock out the taper pin from the worm wheel stop ring.



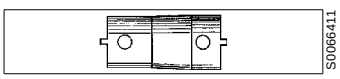
4. Remove the protecting cover with gasket.

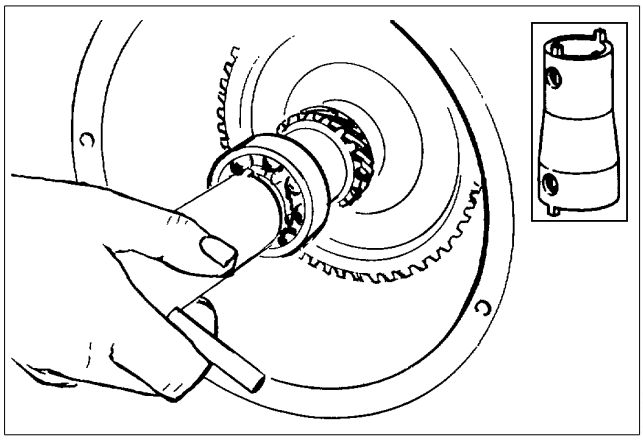


5. Unscrew the four screws for the bearing shield and remove it.

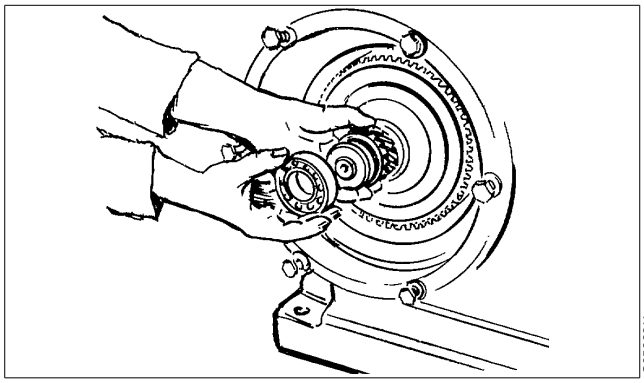


6. Unscrew and remove the round nut and lock washer.

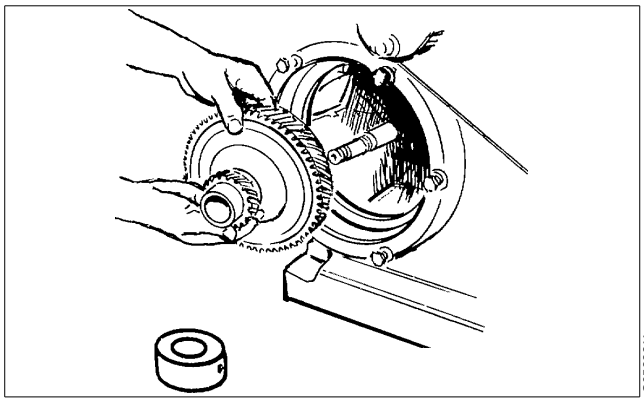




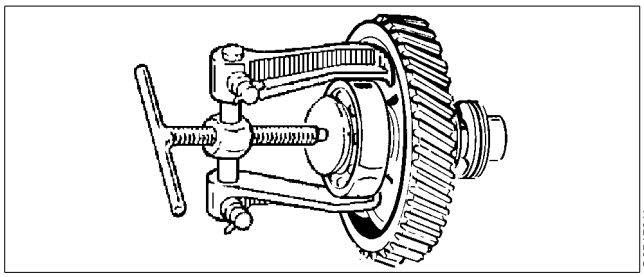
7. Remove the ball bearing.



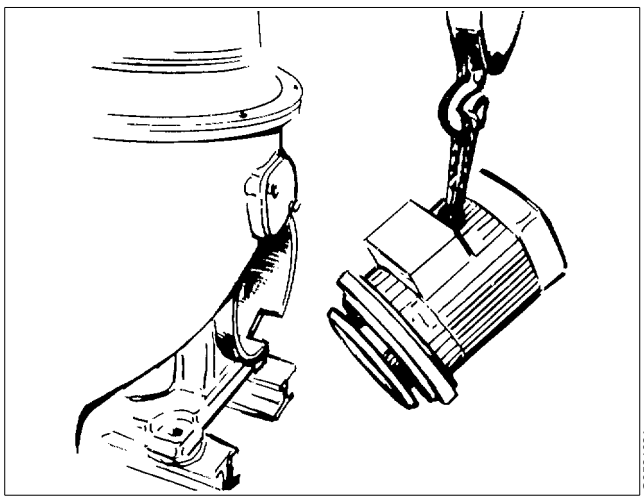
8. Remove the stop ring and worm wheel with ball bearing.



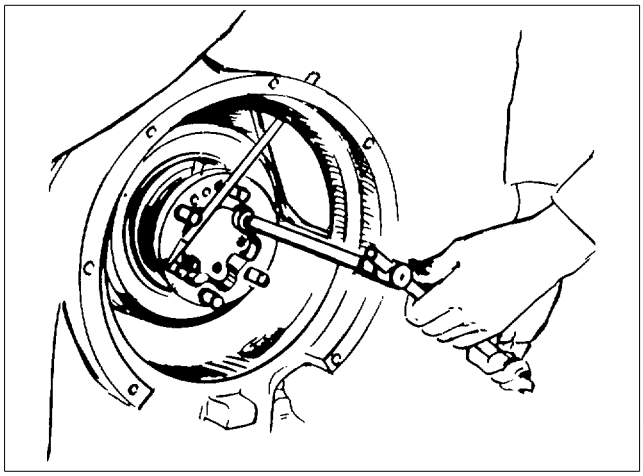
9. Pull off the ball bearing from the worm wheel. Use a washer as a support for the puller.



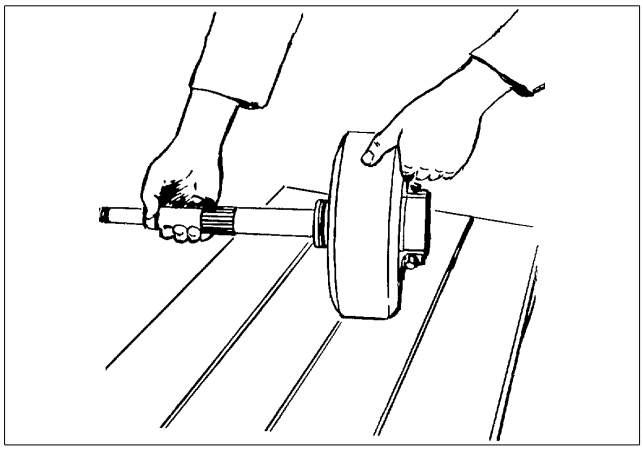
10. Disconnect the motor cables. Note the positions of cables in the terminal box to re-connect correctly (for correct direction of rotation).
11. Remove the electrical motor using hoist.



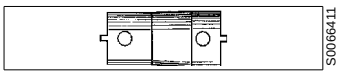
12. Remove the flexible plate and unscrew the six screws for the coupling disc and remove it.

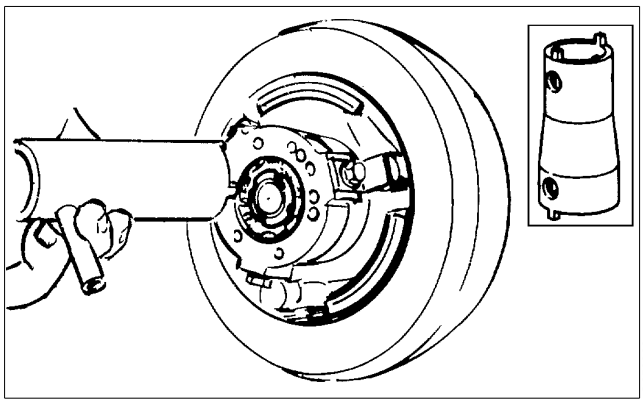


13. Remove the worm wheel shaft with friction clutch pulley.

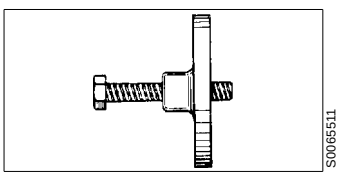


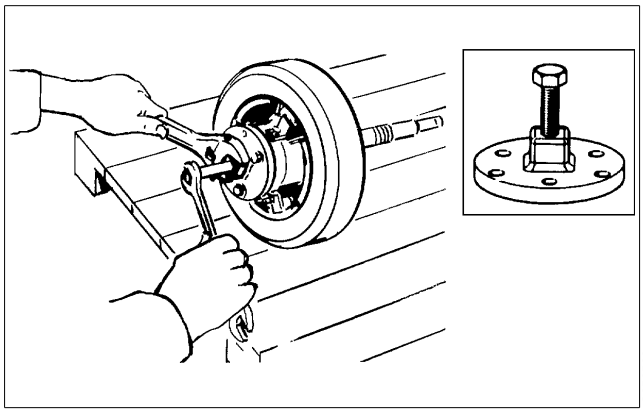
14. To dismantle the nave, unscrew the round nut with the pin spanner and remove the lock washer.



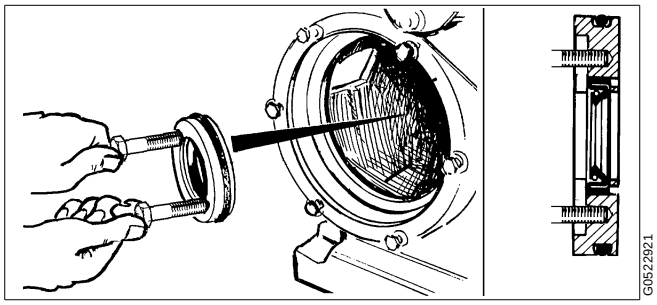


15. Pull off the nave with the puller and remove the friction blocks.



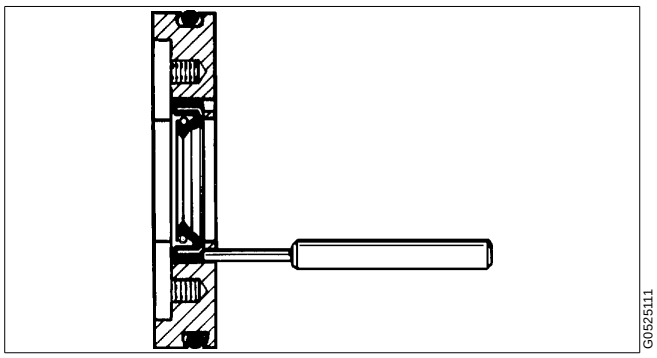


16. Remove the sealing washer using two screws with 1/4”-20 UNC threads.



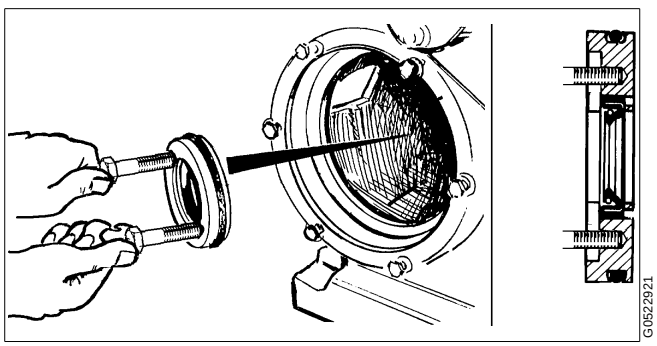
17. Remove the sealing ring from the sealing washer.

18. Remove deposits and clean all parts thoroughly in a suitable cleaning agent. See chapter “5.6 Cleaning” on page 79.



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.



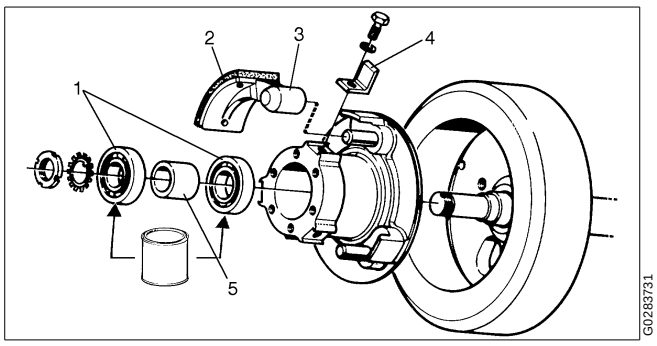
✔ **Check point**
“5.4.6 Coupling friction pads” on page 68.

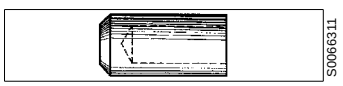
2. Fit the friction blocks (3) with pads (2) on the nave and lock them with holding brackets (4).

   Lubricate the ball bearings.

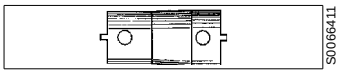
   For recommended lubricants, see chapter “8.5 Lubricants” on page 183.

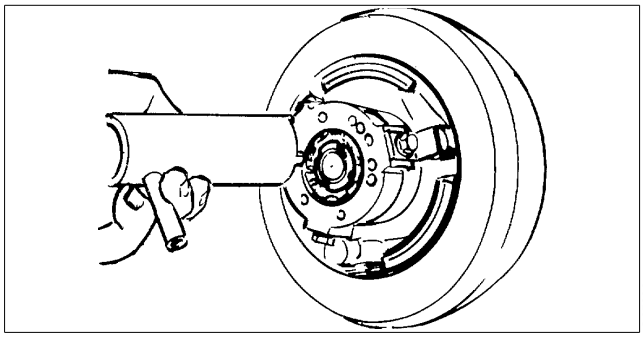
3. Fit the ball bearings (1) and spacing sleeve (5) with the driving on sleeve tool to force the ball bearings into their correct positions.



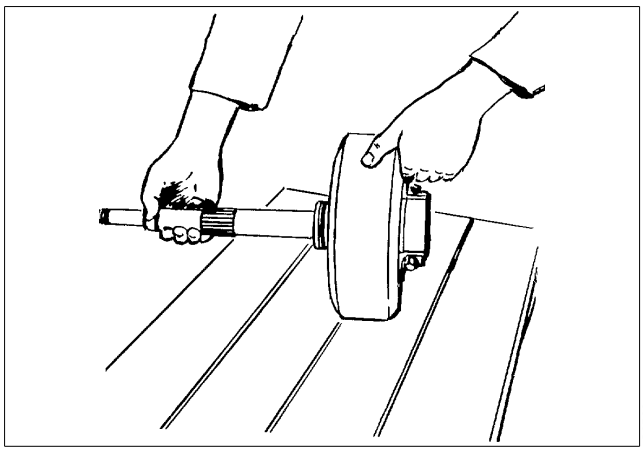


4. Tighten the round nut with the pin spanner and secure it with the lock washer.





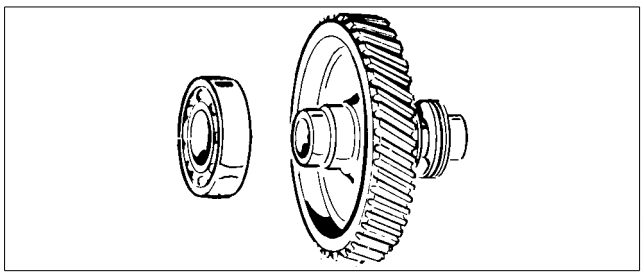
5. Fit the worm wheel shaft.



✔ **Check point**
"5.4.25 Worm wheel and worm; wear of teeth" on page 76.

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 (225 °F).



WARNING

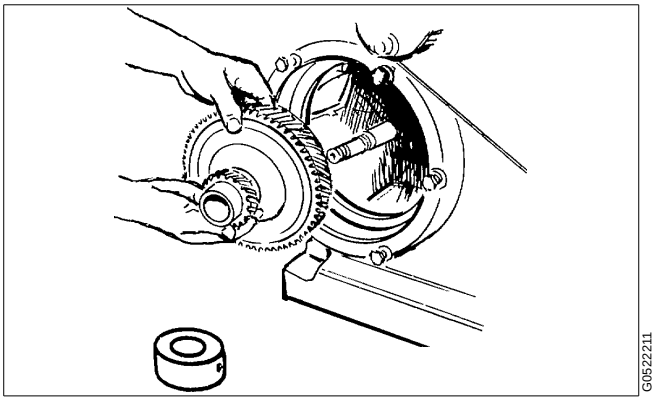
Burn hazards

Use protective gloves when handling the heated bearings.

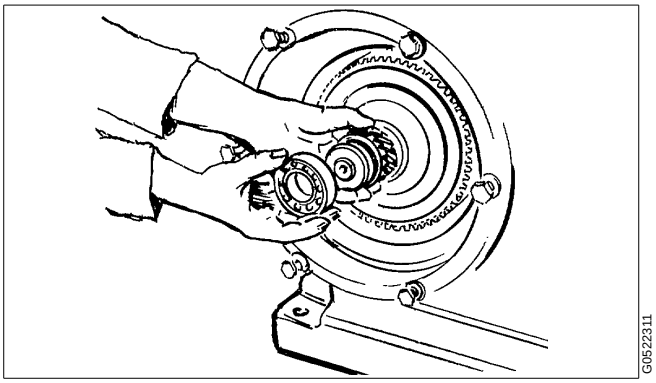
NOTE

If any doubt how to mount roller bearings in a correct way, see the detailed description in chapter “5.9.1 Ball and roller bearings” on page 89.

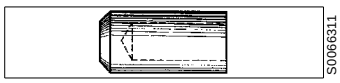
7. Fit the worm wheel with the ball bearing and fit the stop ring.

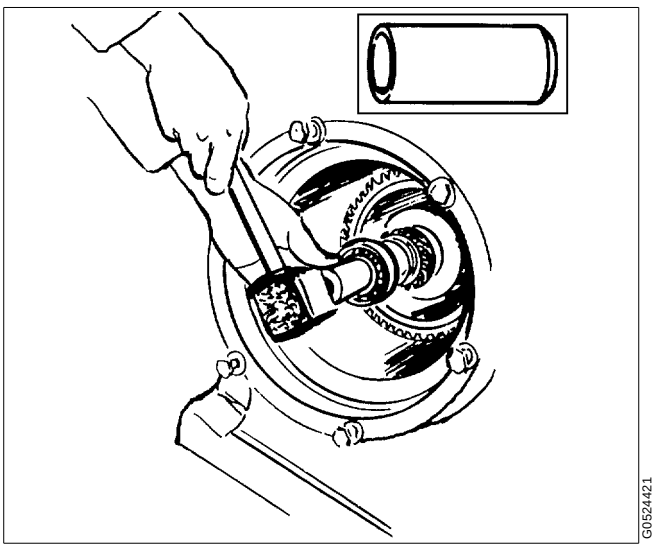


8. Fit the ball bearing.

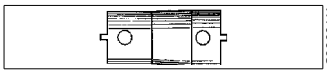


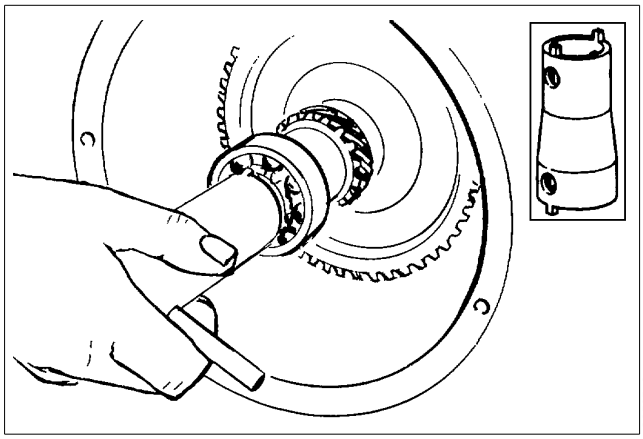
9. Knock the ball bearing into its seat with the driving-on sleeve tool.



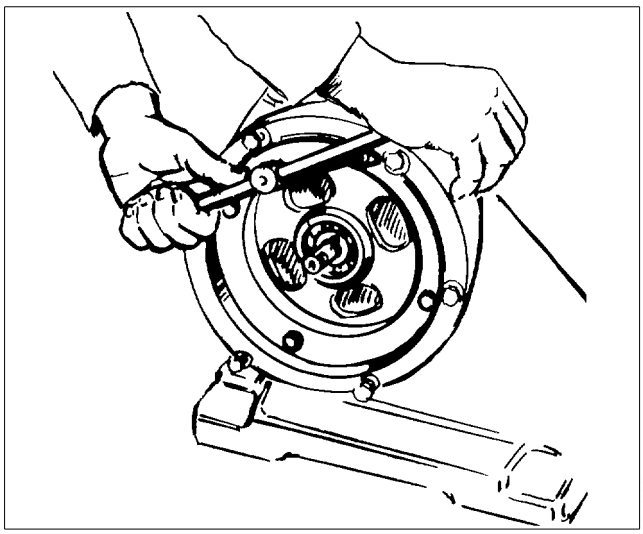


10. Tighten the round nut with the pin spanner and secure it with the lock washer.



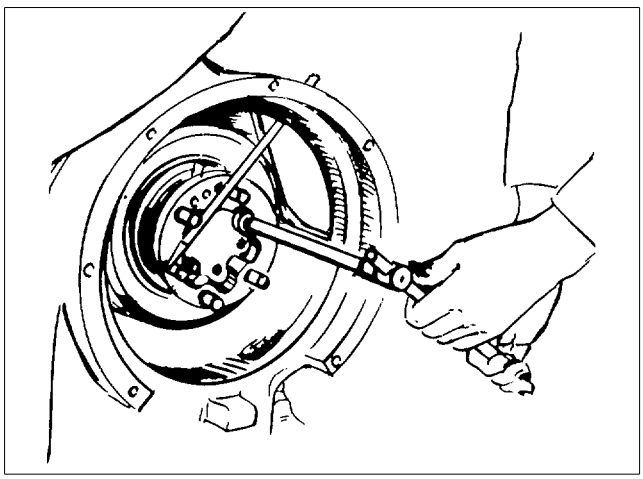


11. Fit the bearing shield and tighten the four screws.

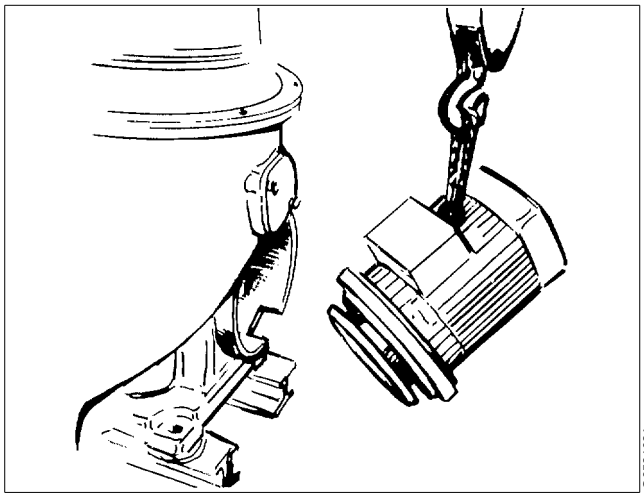


12. Fit the coupling disc with gasket and tighten the six screws. If necessary, use the driving-on sleeve.
13. Fit the flexible plate.

✔ **Check point**
“5.4.12 Flexible plate in coupling” on page 70.



14. Fit the electrical motor.



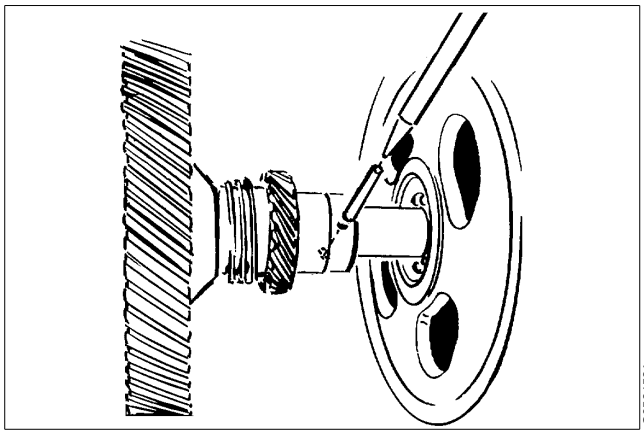
DANGER

Disintegration hazards

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

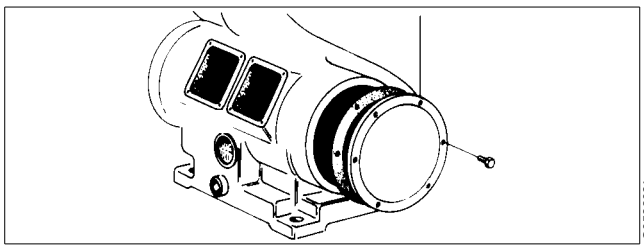
The remaining description in this section implies that the bowl spindle is mounted in the frame. If not, proceed with the assembly instruction for the vertical driving device in chapter “6.6.3 Assembly” on page 141.

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.



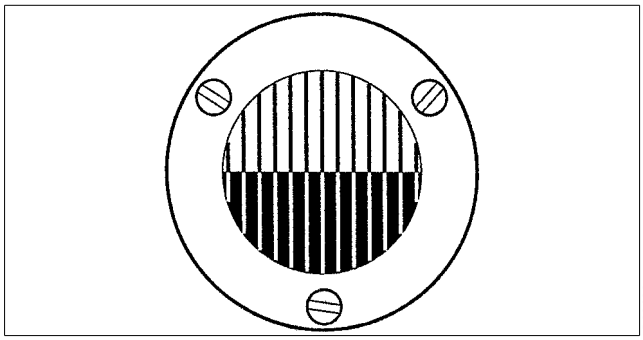
✔ **Check point**
“5.4.26 Worm wheel shaft; radial wobble” on page 77.

16. Fit the protecting cover with gasket.



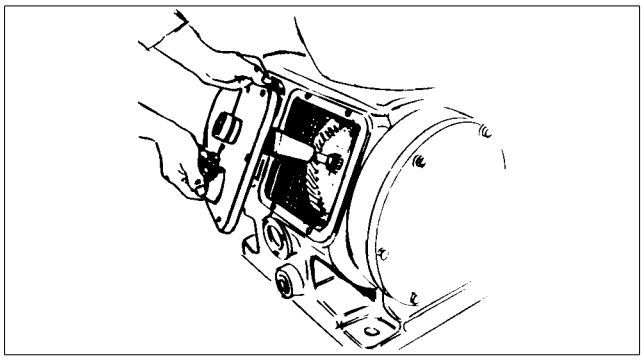
17. Pour oil into worm gear housing. The oil level should be exactly in the middle of the sight glass.

    For correct oil volume and recommended oil brands see chapter “8.5 Lubricants” on page 183.



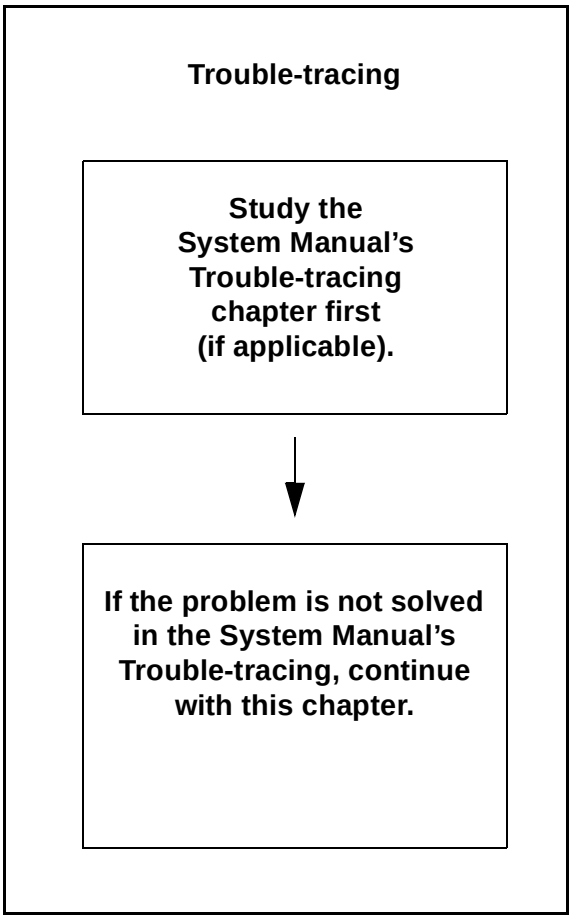
✔ **Check point**
“5.4.4 Brake” on page 65.

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



7 Trouble-tracing

Contents



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 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 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	107
Uneven sludge deposits in the sludge space	Dismantle and clean the separator bowl	102
Height adjustment of the oil paring disc is incorrect	Stop the separator, measure and if necessary adjust the height	74
Bowl spindle bent (max 0,04 mm)	Renew the bowl spindle	64
Bearing is damaged or worn	Renew all bearings	134, 150
Vibration damping rubber cushions are worn out	Renew all rubber cushion	46
Spindle top bearing spring broken	Renew all springs	134

7.1.2 Smell

Cause	Corrective actions	Page
Normal occurrence during start while the friction blocks are slipping	None	–
Brake is applied	Release the brake	–
Oil level in gear housing too low	Check oil level and add oil if necessary	30

7.1.3 Noise

Cause	Corrective actions	Page
Oil level in gear housing too low	Check oil level and add oil if necessary	30
Height adjustment of the oil paring disc is incorrect	Stop the separator, measure and adjust the height	74
Worm wheel and worm are worn	Renew worm wheel and worm	83
Bearing is damaged or worn	Renew all bearings	134, 150
Incorrect play between coupling pulley and elastic plate	Adjust the play	70

7.1.4 Speed too low

Cause	Corrective actions	Page
Brake is applied	Release the brake	–
Coupling friction pads are oily or worn	Clean or renew friction pads	68
Bowl is not closed or leaking	Dismantle the bowl and check	101
Motor failure	Repair the motor	–
Bearing is damaged	Renew all bearings	134, 150
Incorrect gear transmission (60 Hz gear for 50 Hz power supply)	Stop and change the gear transmission to suit the power supply frequency	83, 134, 150

7.1.5 Starting power too high

Cause	Corrective actions	Page
Incorrect friction blocks (50 Hz blocks for 60 Hz power supply)	⚠ **DANGER** Stop immediately and change the friction blocks to suit the power supply frequency	68
Wrong direction of rotation	Change electrical phase connections to the motor	–

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	68
Friction pads are oily or worn	Clean or renew friction pads	68
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	68
Height position of oil paring disc or operating device is incorrect	Stop, check and adjust the height	68, 74
Motor failure	Repair the motor	–
Bearing is damaged or worn	Renew all bearings	134, 150

7.1.8 Retardation time too long

Cause	Corrective actions	Page
Brake friction pad is worn or oily	Renew or clean brake friction pad	65

7.1.9 Water in worm gear housing

Cause	Corrective actions	Page
Bowl casing drain obstructed	Clean worm gear housing and change oil	83
Leakage at top bearing	Renew seal ring and change oil	134, 86
Condensation	Clean worm gear housing and change oil	86

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 Opening water flow, min.18 litres/minute	–
Channels in operating water device are clogged	Clean the operating water device	125
O-rings at the flow control disc defective	Renew the O-rings	101
Paring chamber cover (small lock ring) defective	Renew the paring chamber cover	101
Seal ring in the bowl hood defective	Renew the seal ring	101
Sealing edge of the sliding bowl bottom defective	Smoothen sealing edge of the sliding bowl bottom or renew it	62
Valve plugs are defective	Renew all valve plugs	61
Bowl speed 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	Correct	–
Upper nozzle in the dosing ring is clogged	Clean the nozzle. Carry out an Intermediate Service (IS)	54
Square-sectioned ring in sliding bowl bottom is defective	Renew the square-sectioned ring. Carry out an Intermediate Service (IS)	62
Valve plugs are defective	Renew all plugs. Carry out an Intermediate Service (IS)	61
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 device defective	Renew the seal rings	125
Water flow too low	Check the opening water flow; min. 18 litres/minute	–
Dosing ring too firmly tightened	Check the tightening torque	121
Lower nozzle in the dosing ring is clogged	Clean the nozzle. Carry out an Intermediate Service (IS)	54
Seal ring in the operating slide is defective	Renew the seal ring. Carry out an Intermediate Service (IS)	114

7.2.4 Unsatisfactory sludge discharge

Cause	Corrective actions	Page
Dosing ring too firmly tightened	Check the tightening torque	121
Valve plugs in the operating slide too high	Renew with correct valve plugs	61
Sludge deposits in the operating system	Check and clean the operating system	114, 125

7.2.5 Unsatisfactory separation result

Cause	Corrective actions	Page
Incorrect separation temperature	Adjust	–
Throughput too high	Adjust	–
Disc stack is clogged	Clean disc stack	81
Sludge space in bowl is filled	Clean and reduce the time between sludge discharges	81
Bowl speed too low	Examine the motor and power transmission including the gear ratio	83, 150

7.2.6 High pressure in water outlet

Cause	Corrective actions	Page
Throughput too high	Adjust	–
Valve(s) in oil outlet line closed	Open the valve(s)	–
Separation temperature too low	Adjust	–
Bowl disc stack is clogged	Clean disc stack	81
Bowl is incorrectly assembled	Check assembly	107
Oil paring disc is defective	Renew the oil paring disc	101

7.3 Vibration switch (option)

7.3.1 Vibration switch does not reset

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

7.3.2 Impossible to adjust setpoint setting 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	Replace 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	–

8 Technical Reference

Contents

8.1 Technical data

Alfa Laval ref. 557643

NOTE

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

Product number	881082-01-06	
Separator type	FOPX 613TFD-20	
Application	Continuous clarification of heavy fuel oil.	
	The flash point of the fuel oil to be separated must be min. 60 °C.	
Density of operating water, max.	1 000	kg/m^3
Density of sediment/feed, max.	2 171/1 100	kg/m^3
Hydraulic capacity, max.	24 500	litres/hour

Process capacity (heavy fuel oil), max.	**Viscosity in cSt/50 °C**	**Oil flow litres/hour**
	30	15 200
	40	15 200
	60	11 500
	100	11 000
	180	9 600
	380	7 000
	460	6 400
	600	5 300
	700	4 700

Note 1: Distillate and marine diesel oil (MDO)
A purifier is recommended for cleaning distillate or MDO. However an FOPX separator in the ALCAP separation system for heavy fuel oil can be used for cleaning distillate or MDO. The maximum capacity to be used in such a case is equal to the recommended capacity for cleaning of heavy fuel oil of 30 cSt at 50 °C.

Note 2: Density
Maximum density of oil is 1010 kg/m^3 at 15 °C. Density preferably measured at 50 °C and according to ASTM method D 1298-80, corrected to 15 °C according to ASTM tables 1250-80.

Note 3: Lubricating oil
The ALCAP separation system with FOPX separators must not be used for cleaning of lubricating oil.

Feed temperature, min./max.	0/100	°C	
Ambient temperature, min./max.	5-15/55	°C	The min. temperature is dependent of the used oil type. See “8.5.2 Recommended lubricating oils” on page 185.

Bowl speed, max.	4140/4125	r.p.m., 50/60 Hz
Motor shaft speed, max.	1500/1800	r.p.m., 50/60 Hz
Revolution counter	118-125 / 142-150 r.p.m., 50/60 Hz	
No. of teeth;		
- on worm, 50 Hz	21	
- on worm, 60 Hz	24	
- on worm wheel, 50 Hz	58	
- on worm wheel, 60 Hz	55	
Valve plugs, height	13,4	mm
Lubricating volume	approx. 12	litres
Motor power rating	16/19	kW, 50/60 Hz
Power consumption, max.	18	kW (at starting up)
Power consumption, normal	7/11,2	kW (idling/at max. capacity)
Discharge volume, min./max.	7,6/9,6	litres variable discharge volume
Discharge interval, min./max.	1/240	minutes
Bowl volume	29	litres
Starting time	5-6	minutes
Stopping time with brake	6-7	minutes
Max. running time without flow;		
- empty bowl	180	minutes
- filled bowl	180	minutes
Sound power level	–	Bel(A) ISO 3744, 4,5 m^3/h
Sound pressure level	85	dB(A) ISO 3744, 4,5 m^3/h
Vibration level, separator in use, max.	9	mm/s (RMS)
Weight of separator (without motor)	1 360	kg
Weight of bowl	406	kg

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

8.2 Connection list

Alfa Laval ref. Alfa Laval ref. 557882

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	Fresh water
	- Momentary flow	5,5 litres/minute
220	Outlet for light phase (oil)	
	- Counter pressure	0-270 kPa
221	Outlet for heavy phase (water)	
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)
	- Discharge interval	Min. 1 minute, max. 4 hours
	- Discharge volume	Min. 7,6, max. 9,6 litres
372	Inlet of discharge liquid	See demand in chapter ‘‘8.4 Water quality” on page 182
	- Momentary flow	18 litres/minute
	- Consumption	About 11 litres/discharge
376	Inlet for make-up liquid	See demand in chapter ‘‘8.4 Water quality” on page 182
	- Pressure	Min. 22 kPa, max. 32 kPa
	- Consumption	Max. 10 litres/hour
377	Outlet for operating liquid (discharge and make-up liquid)	
(463)	Drain of frame top part, upper	

Connection No.	Description	Requirements/limits
462	Drain of frame top part, lower	
463	See connection No. 377 (common outlet)	
701	Motor for separator - Deviation from nominal frequency	 ± 5% (momentarily 10% during a period of maximum 5 seconds)
753	Vibration sensor (delivered as option) Mechanical switch - Switch rating, voltage - Reset coil	See “8.3 Interface description” Max. 460 V AC 24 V DC, 48 V DC, 117 VAC 60 Hz
760	Cover interlocking switch (delivered as option) Type: Double, two-way microswitch Switch rating: Voltage Current	See “8.3 Interface description” Max. 500 V Max. 3 A

8.3 Interface description

Alfa Laval ref. 557138, rev. 3

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

Stand still (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- (direct on line) started 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.

Signal Processing

The vibration sensor gives an open contact when the vibration exceeds the preset value.

If too high vibration occurs the separator must be stopped with automatic Safety Stop.

Cover interlocking switch 760 (option)

The cover of the separator can be equipped with an interlocking switch as option.

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.

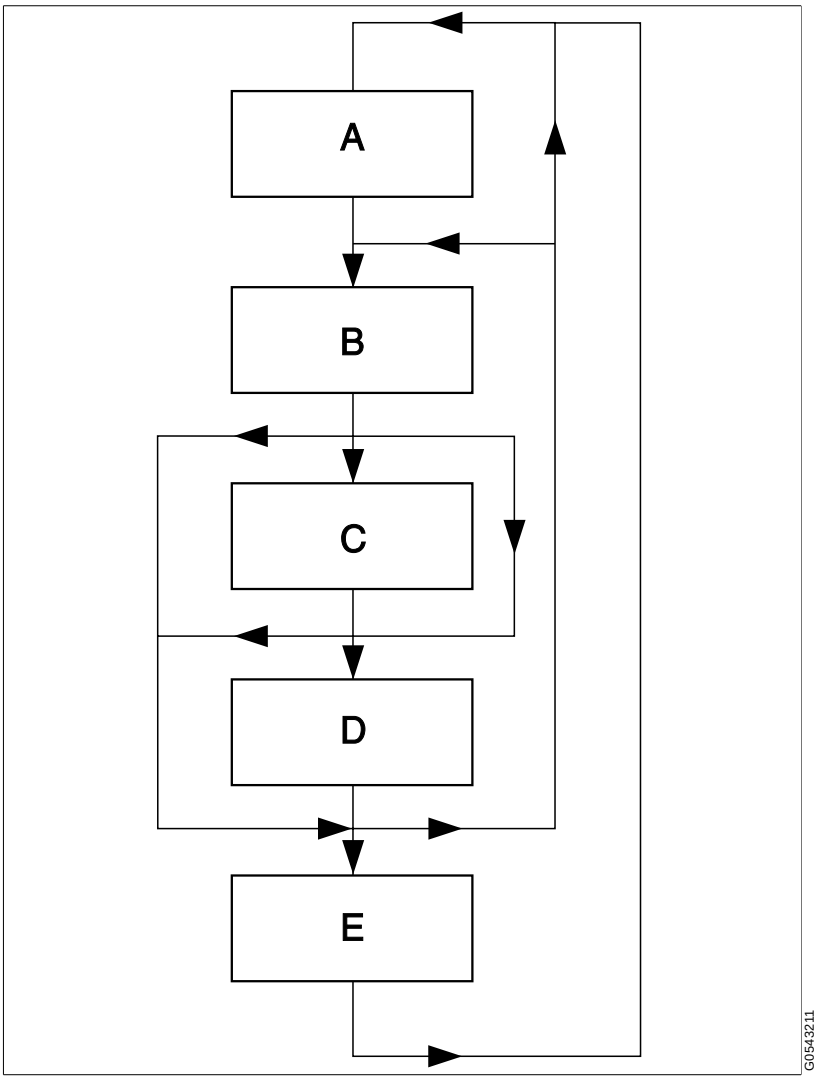
Discharge

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. Alfa Laval ref. 553406

General

Specific requirements regarding the purity of water are necessary.

– Deposits must not be allowed to form inside the separator.

– Erosion and corrosion of the PX mechanism must also be prevented.

The four requirements below are of fundamental importance.

For test methods, contact an Alfa Laval representative.

If these demands cannot be met, the water should be pre-treated in accordance with Alfa Laval's recommendations.

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

Suspended particles

Content of suspend substances: Less than 0,001 percentage of volume.

Turbidity-free water, solids content < 0,001 percentage of volume. Due to the centrifugal force, any suspended particles present in the water will separate out in the operating mechanism, causing the valves to clog and the system to breakdown. A mere 0,001 percentage of volume solids content in the operating water produces 10 ml of precipitate in two days when using as little as 20 lit/h of operating water.

Max. particle size: 50 µm.

Total hardness

Less than 10° dH (180 mg $CaCO_3$/lit).

If the water is hard (i.e. 10° dH or 12,5° E), in time chalk deposits build up around the operating mechanism including the valves. The build-up of deposits accelerates with increased operating temperature and low discharge frequency.

The harder the water is, the more severe these effects become.

Chloride content

Less than 100 ppm NaCl (60 mg Cl/lit).

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

pH value

pH > 6

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

8.5 Lubricants

8.5.1 Lubrication chart, general

Alfa Laval ref. 553210-01

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 185
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 189 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 189
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 ‘‘4.1.1 Ready for start” on page 30.

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. 553216-01

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 186.

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 litres
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

Viscosity grade VG (ISO 3448/3104) 220

Viscosity index VI (ISO 2909) > 130

Manufacturer	Designation
Alfa Laval	542690-80 20 litres 542690-81 4 litres 542690-82 208 litres 542690-83 1 litres
BP	Enersyn 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) > 130

Manufacturer	Designation
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

Manufacturer	Designation	Alfa Laval No.	Application
Gleitmolybdän	Gleitmo 805 K or 805 K varnish 901 Gleitmo Paste G rapid	537086-04	All pressure loaded surfaces
Dow Corning	Molykote paste 1000 spray D321 R varnish D321 R	537086-02 535586-01 535586-02	
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 gr 25 gr	 539474-02 539474-03
Gleitmolybdän	Silicone paste 750	
Wacker	Silicone Paste P (vacuum paste)	

Greases for ball and roller bearings

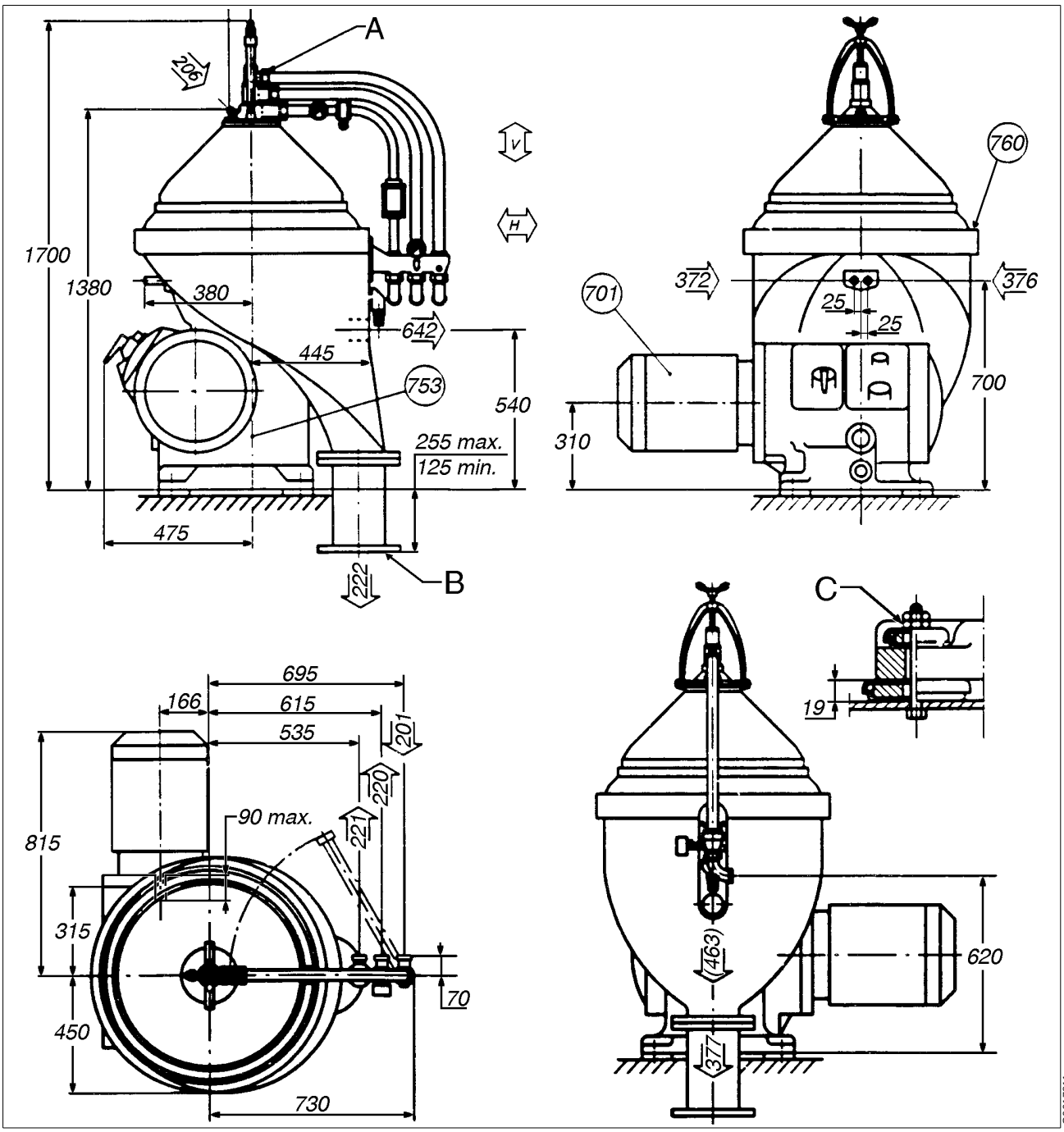
Alfa Laval ref. 554900-01

Manufacturer	Designation	Alfa Laval No.
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 Basic size drawing

Alfa Laval ref. 556860



A. Maximum horizontal displacement at the in/outlet connections during operation ±15 mm.

B. Maximum vertical displacement at the sludge connection during operation ±10 mm.

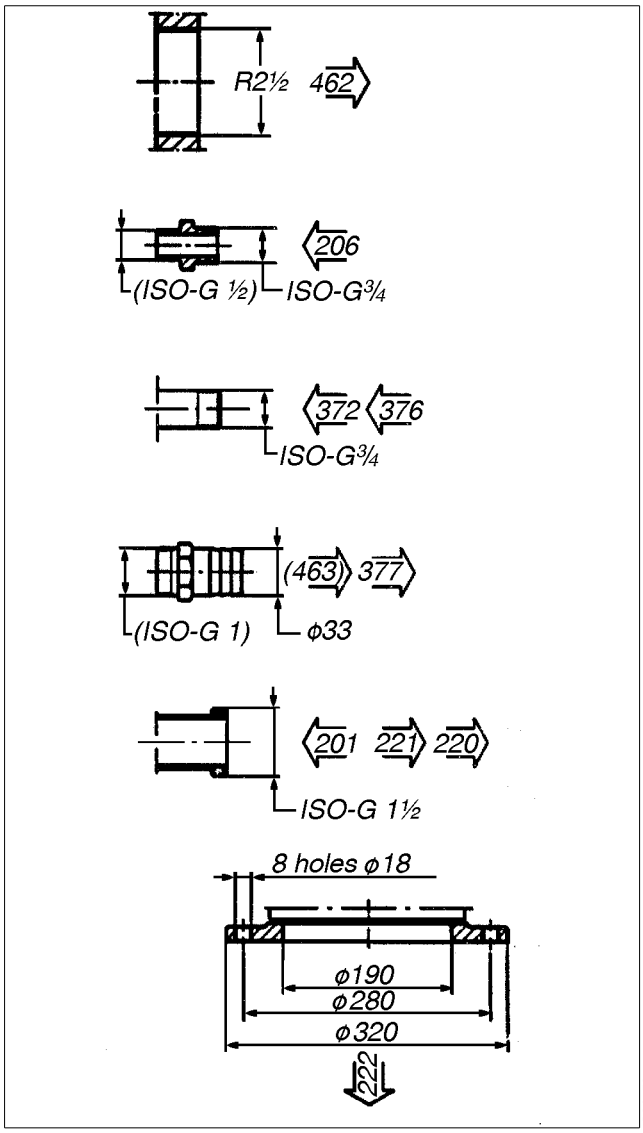
C. Tigthening torque 20 Nm. Locked with lock nut.

8.6.2 Dimensions of connections

Alfa Laval ref. 556860

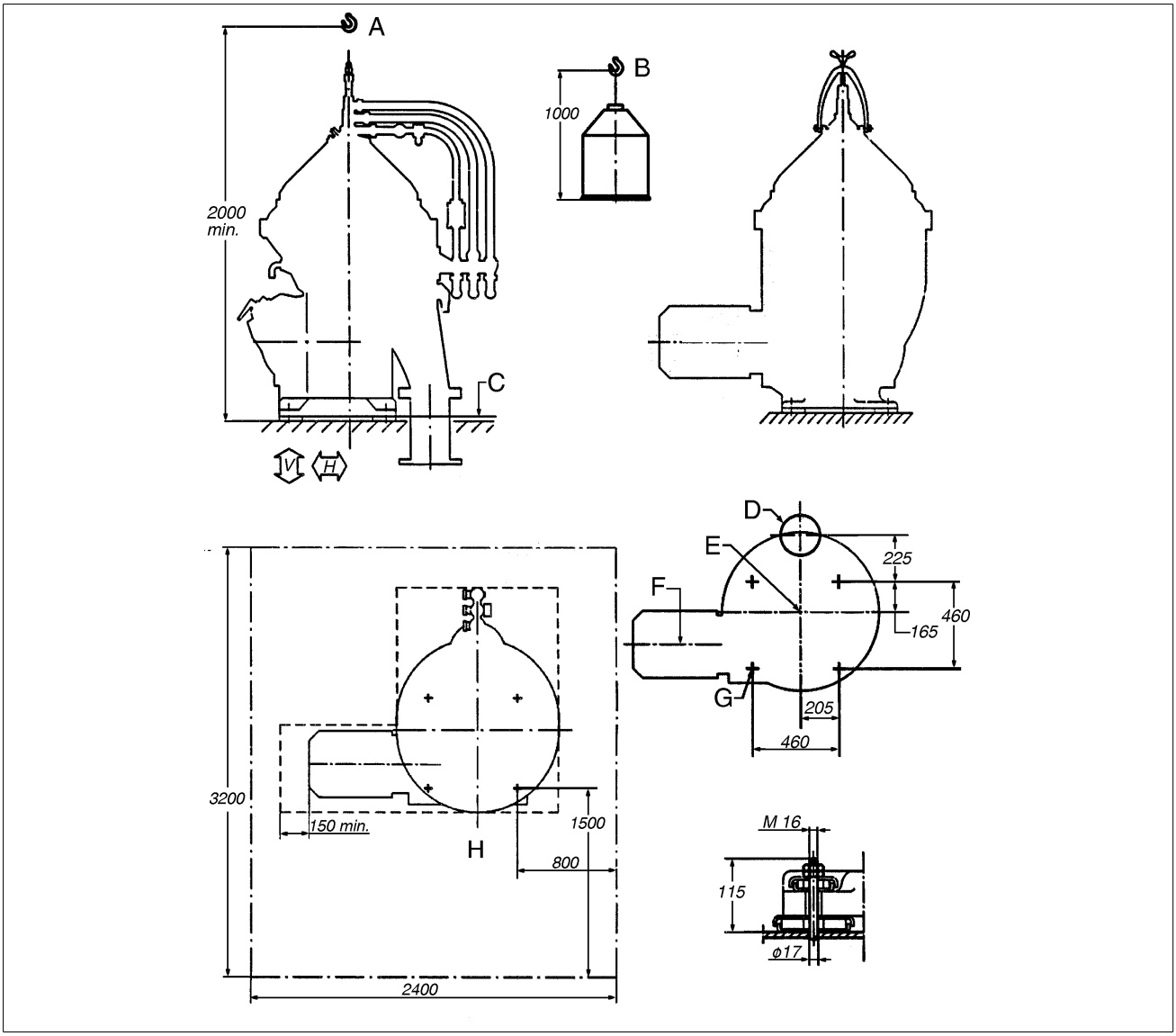
Data for connections, see chapter
“8.2 Connection list” on page 176.

All connections to be installed non-loaded and flexible.



8.6.3 Foundations

Alfa Laval ref. 557660



A. Min. lifting capacity 1000 kg
Recommended speed for lifting:
Low speed 0,5-1,5 m/min.
High speed 2-6 m/min.

B. Max. height of largest component incl. lifting tool

C. Horizontal max. deviation 0,4 °.

D. Hole Ø 220 for sediment outlet

E. Center of separator bowl

F. Center of motor

G. 4 holes Ø 17 for anchorage

H. Service side

Recommended free floor space for unloading when doing service

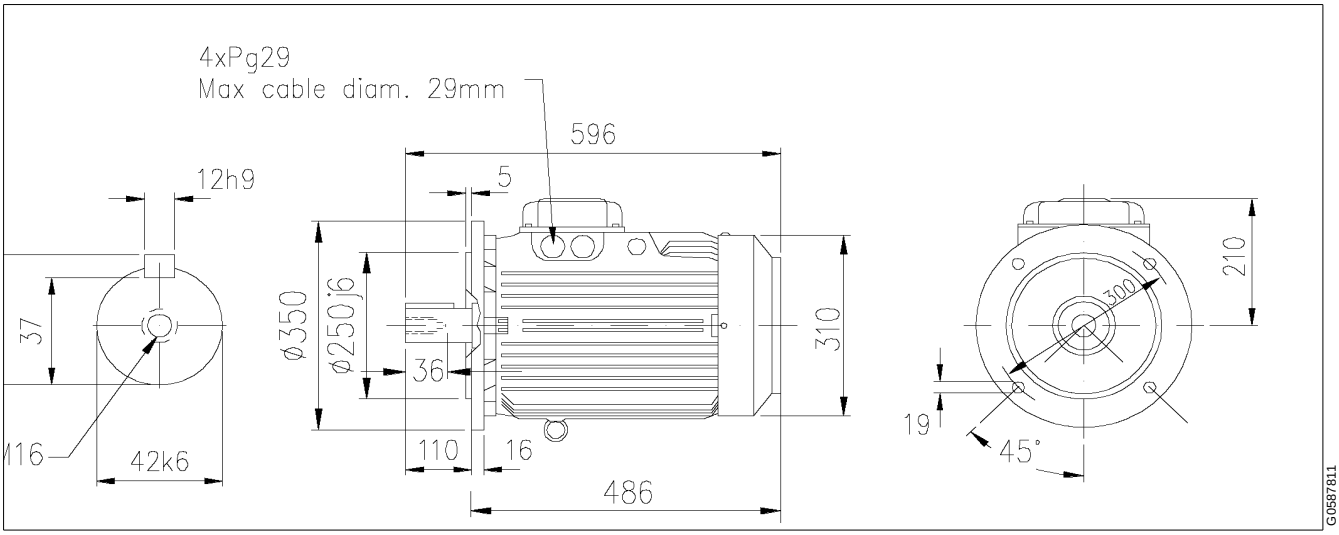
Min. access area for overhead hoist. No fixed installations within this area.

Vertical force not exceeding 41 kN/foot

Horizontal force not exceeding 41 kN/foot

8.6.4 Electric motor

Alfa Laval ref. 552814



Manufacturer	ABB Motors
Manufacturers drawing	MK20-92S
Standards	IEC 34-1, IEC 72
Size	160L
Type	MBT 160L
Weight	87 kg
Poles	4
Insulation class	F
Bearings	DE 6209-Z/C3 – NDE 6209-Z/C3
Method of cooling	IC 41 (IEC 34-6)
Specification	Totally enclosed three-phase motor for marine service [3)]

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 φ	I_{st} / I [1]	Therm [2] ℃	Note
552814-01	6	1445	50	200 D	61	0,86	7,0		
552814-02	6	1445	50	220 D	55	0,86	7,0		
552814-03	6	1445	50	380 D	32	0,86	7,0		
552814-04	6	1445	50	415 D	29	0,86	7,0		
552814-05	6	1445	50	440 D	28	0,86	7,0		
552814-06	6	1445	50	500 D	24	0,86	7,0		
552814-07	9	1750	60	220 D 440 D	66 33	0,86	6,8		D-par D-ser
552814-08	9	1750	60	230 D 460 D	64 32	0,86	6,8		D-par D-ser
552814-09	9	1750	60	575 D	25	0,86	6,8		CSA-plated
552814-10	6 9	1445 1750	50 60	380 D 440 D	32 33	0,86	7,0 6,8		

1) I_{st} /I=starting current /rated current at direct on line starting.

2) Thermistors tripping temperature if applicable

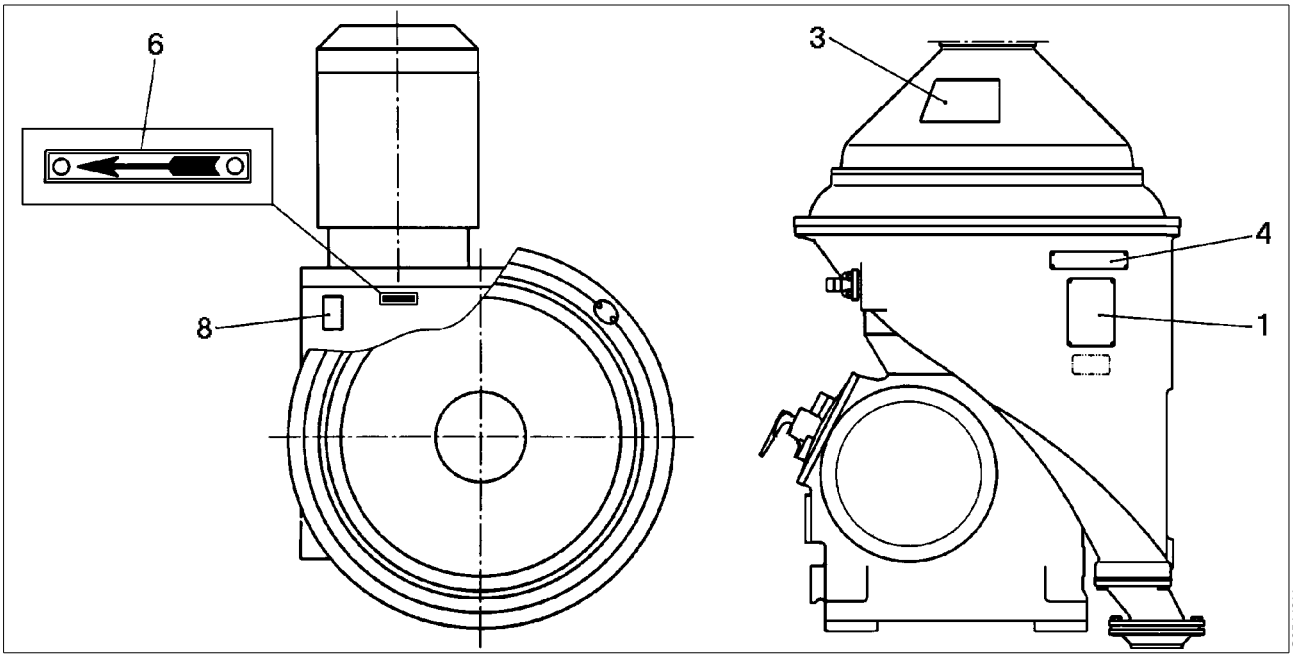
3) The motors can be designed to fulfill requirements of following Classification Societies:

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 ℃.

8.6.5 Machine plates and safety labels

Alfa Laval ref. 554651

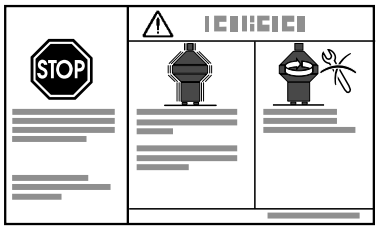


S0061411

1. Machine plate

Separator	FOPX 613TFD-20
Manufacturing serial No / Year	XXXX
Product No	881082-01-06
Machine top part	557702-01
Bowl	545006-04
Machine bottom part	543048-16/17 (50/60 Hz)
Max. speed (bowl)	4140 r.p.m. (50 Hz), 4125 r.p.m. (60 Hz)
Direction of rotation (bowl)	←
Speed motor shaft	1500 r.p.m. (50 Hz), 1800 r.p.m. (60 Hz)
El. current frequency	50/60 Hz
Recommended motor power	16 kW
Max. density of feed	1100 kg/m^3
Max. density of sediment	2171 kg/m^3
Max. density of operating liquid	1000 kg/m^3
Process temperature min./max.	0/100 °C

3. Safety label



S0061521

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.

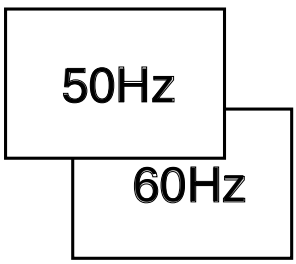
4. Name plate

S0063211

6. Arrow

Indicating direction of rotation of horizontal driving device.

8. Power supply frequency



S0063111

8.6.6 Vibration sensor (option)

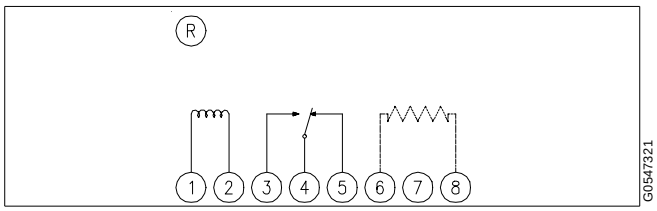
Alfa Laval ref. 557311, rev. 1

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 Connection list” on page 176 and “8.3 Interface description” on page 178.



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

R Reset button

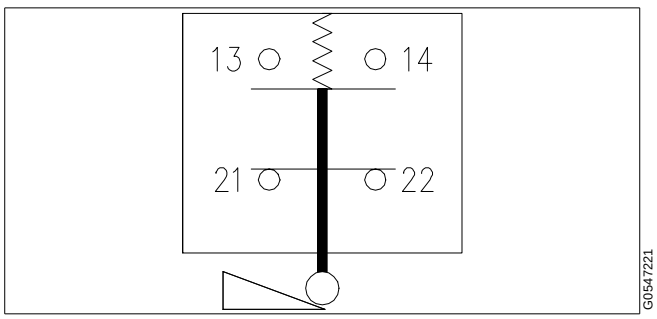
8.6.7 Cover interlocking switch (option)

Alfa Laval ref. 557311, rev. 1

Switch rating, voltage: Max. 500 V

current: Max. 3 A

For other technical information see chapter “8.2 Connection list” on page 176 and “8.3 Interface description” on page 178.



8.7 Storage and installation

8.7.1 Storage and transport of goods

Storage

Specification

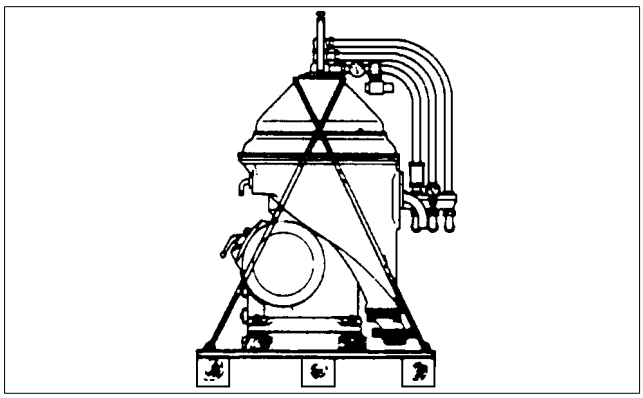
Upon arrival to the store, **check all components and keep them:**

1. Well stored and protected from mechanical damage and theft.
2. Dry and protected from rain and humidity.
3. Organized in the store in such a way that the goods will be easily accessible when installation is about to take place.

A separator can be delivered with different types of protection:

- Fixed on a pallet.

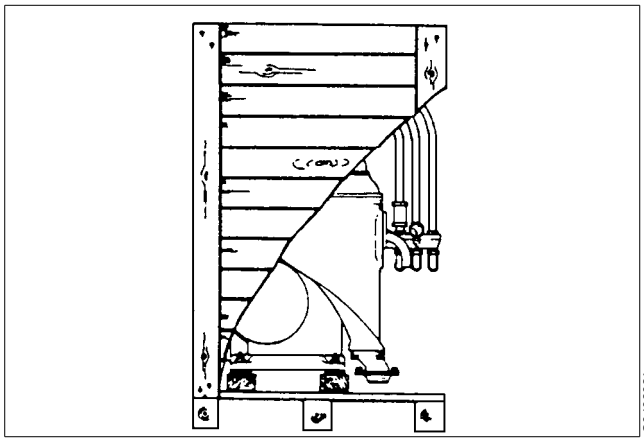
  The separator must be stored in a storage room well protected from mechanical damage and theft and also dry and protected from rain and humidity.



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.

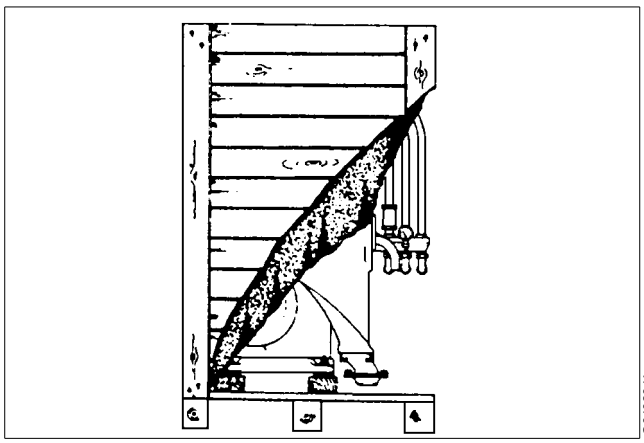


In a wooden box which is not water tight

- 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 only to special order.



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 78

WARNING

Crush hazards

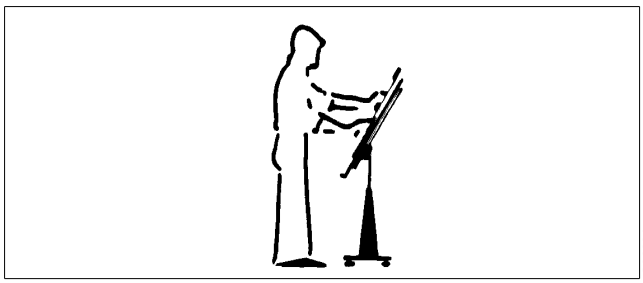
Use correct lifting tools and follow lifting instructions.

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

8.7.2 Planning of installation

Introduction

The space required for one or more separators can be calculated by consulting the drawings in the chapters ‘‘8.6.1 Basic size drawing” on page 192, ‘‘8.6.3 Foundations” on page 194 and instructions for ancillary equipment, electrical and electronic equipment and cables.

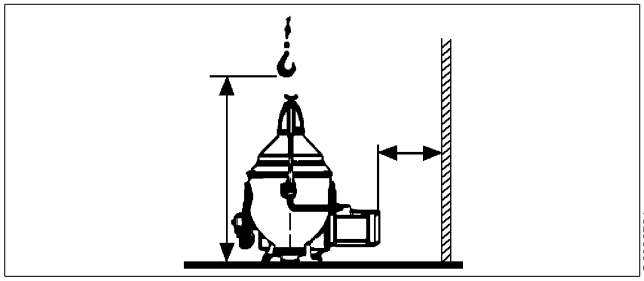


Check the drawings when planning the installation

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 ‘‘8.6.3 Foundations” on page 194 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 ‘‘8.6.3 Foundations” on page 194**.**

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.

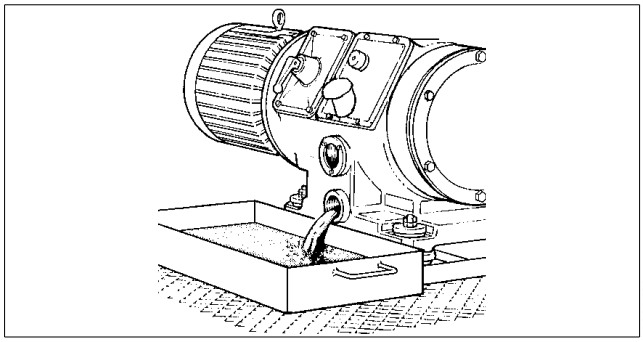
Space for oil changing

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

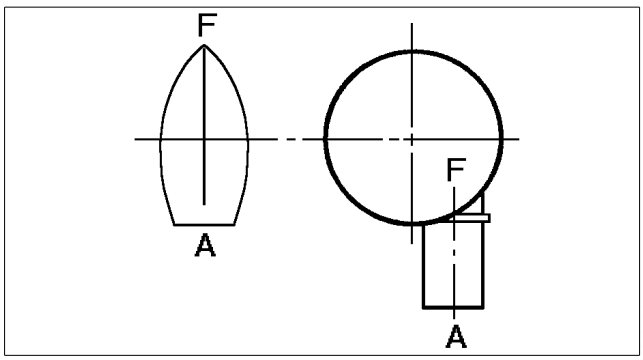
8.7.3 Foundations

NOTE

When lifting a separator it must always be **hung securely**. See chapter “5.5 Lifting instructions” on page 78.

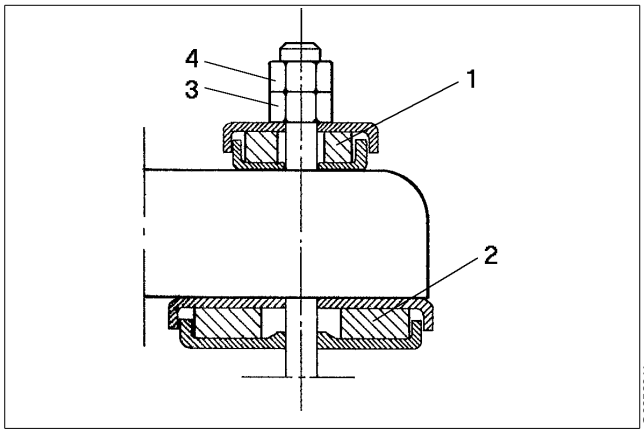
Specification

- The separator should be installed at floor level, see chapter “8.6.3 Foundations” on page 194**.**
- 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.



F = Forward
A = Aft

- 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.



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

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