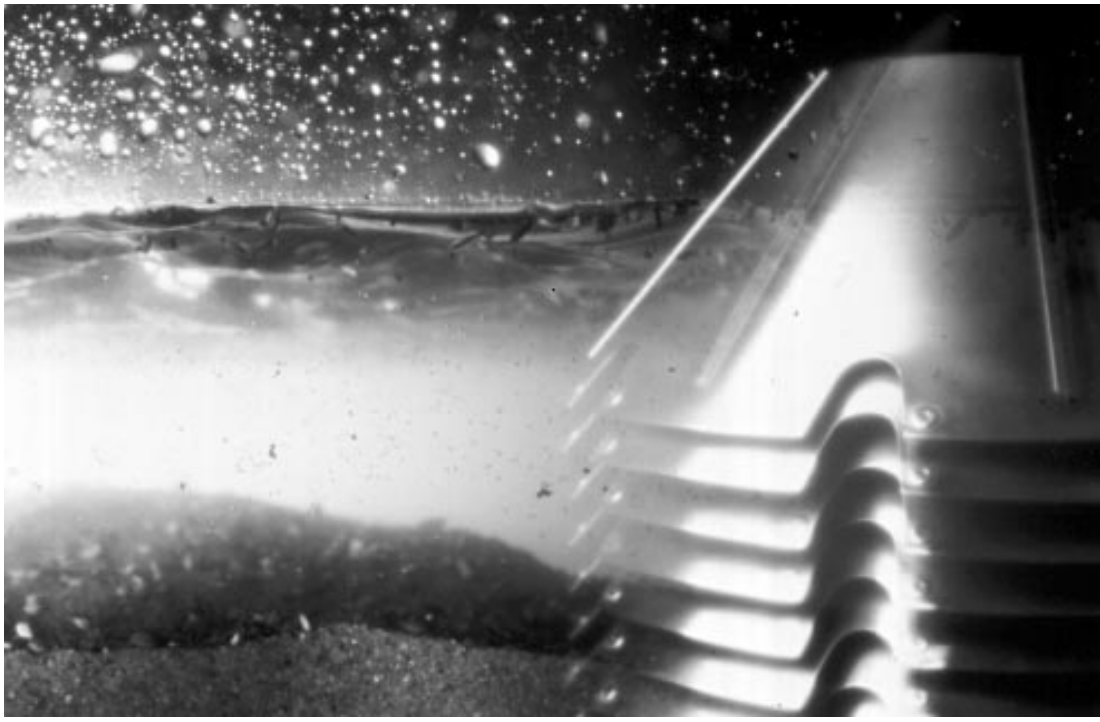
A L F A L A V A L S E P A R A T I O N

FOPX 605TFD-20



Separator Manual

Product No. 881111-01-05/0
Book No. 1270769-02 V3

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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 605TFD-20.

For information concerning the function of the separator, see chapter “3 Separator Basics” on page 15 and chapter “8 Technical Reference” on page 163.

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.

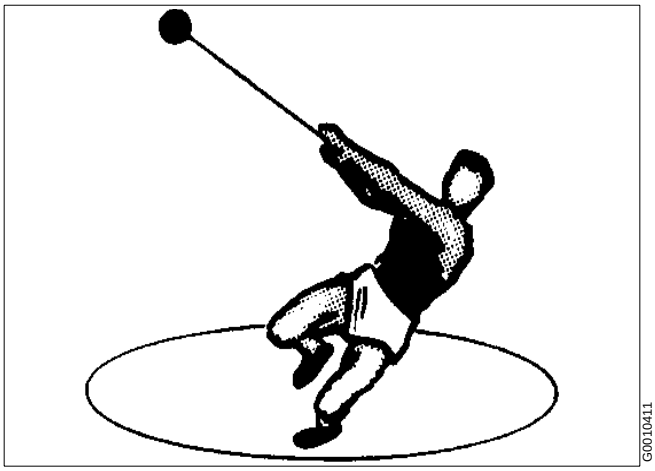
Index

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.

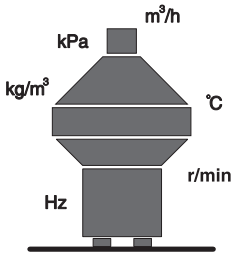
The following basic safety instructions therefore apply:

- **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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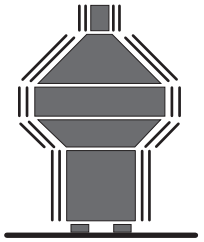

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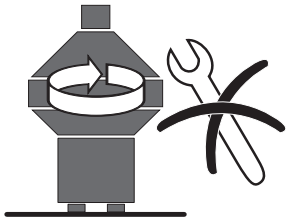
DANGER

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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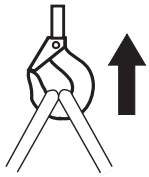
WARNING

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.

S0051611

CAUTION

Burn hazards

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

Cut hazards

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

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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.

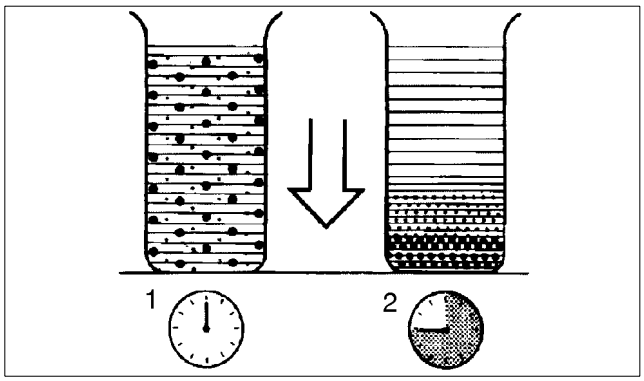
3 Separator Basics

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

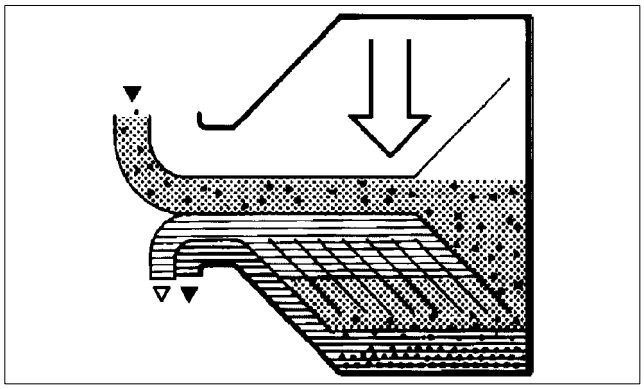
Separation by gravity

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.



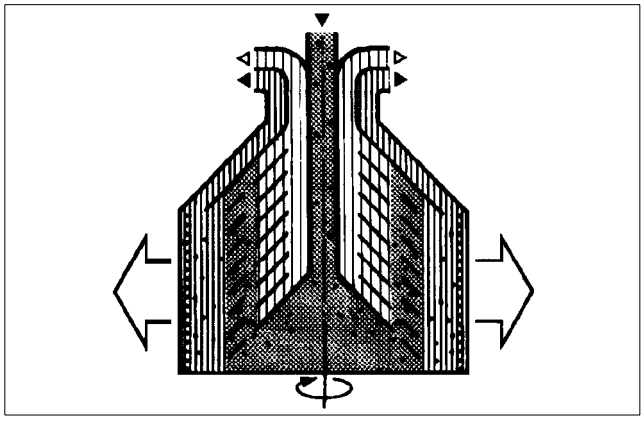
Sedimentation in a settling tank, with outlets making it possible to separate the lighter liquid parts from the heavier

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.



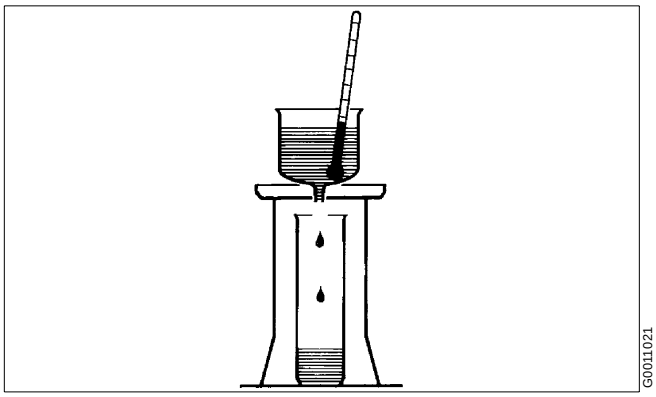
The centrifugal solution

Separating temperatures

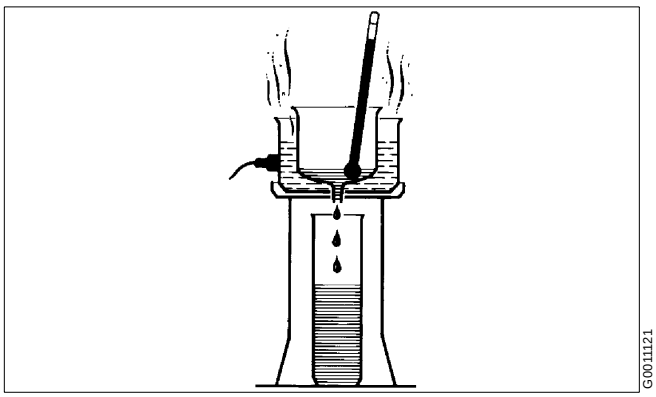
For some types of process liquids (e.g. mineral oils) a high separating temperature will normally increase the separation capacity. The temperature influences oil viscosity and density and should be kept constant throughout the separation.

Viscosity

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



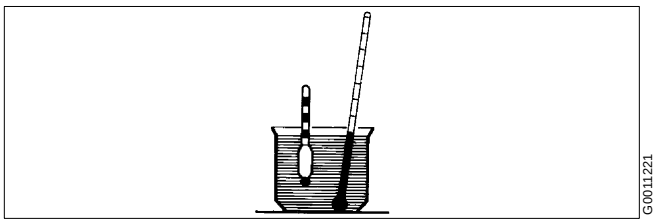
High viscosity (with low temperature)



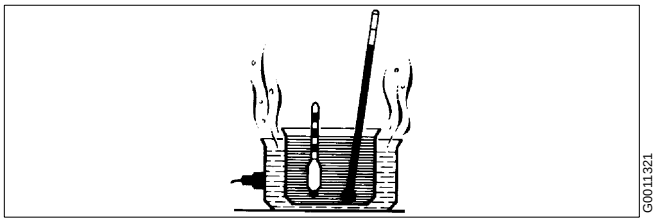
Low viscosity (with high temperature)

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.

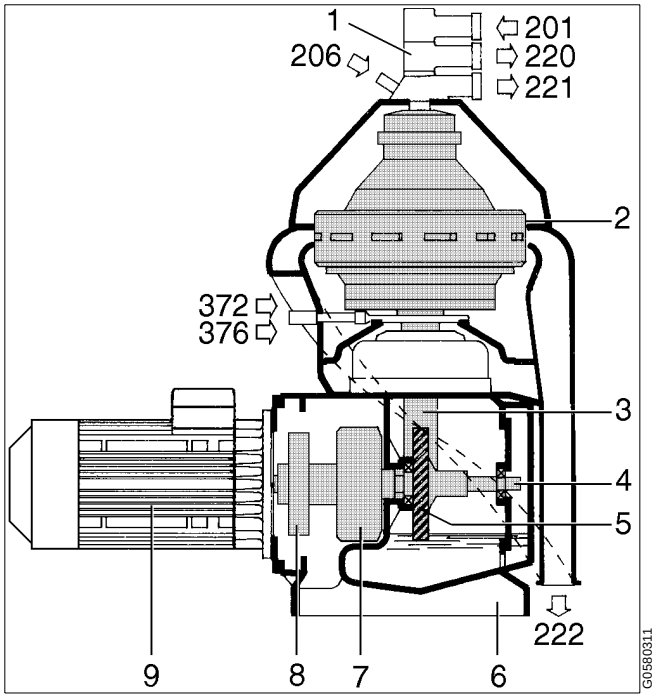
The bottom part of the separator contains the horizontal driving device (4), driving shaft with couplings (7, 8), a worm gear (5) and a vertical spindle (3).

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 163.



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

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

3.2.2 Mechanical power transmission

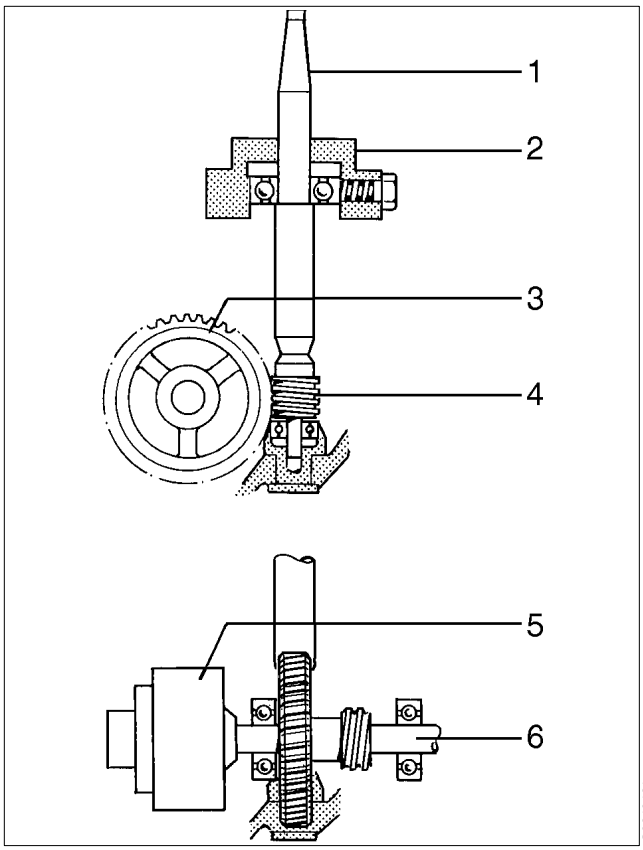
The main parts of the power transmission between motor and bowl are illustrated in the figure.

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

The worm gear has a ratio which increase the bowl speed several times compared with the motor speed. For correct ratio see chapter “8.1 Technical data” on page 165.

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.

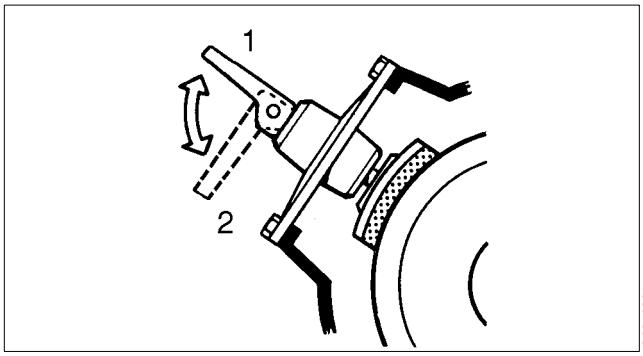


1. *Bowl spindle*
2. *Top bearing and spring casing*
3. *Worm wheel*
4. *Worm*
5. *Friction coupling*
6. *Worm wheel shaft*

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 163. Refer to name plate for speed particulars.

Sight glass (2)

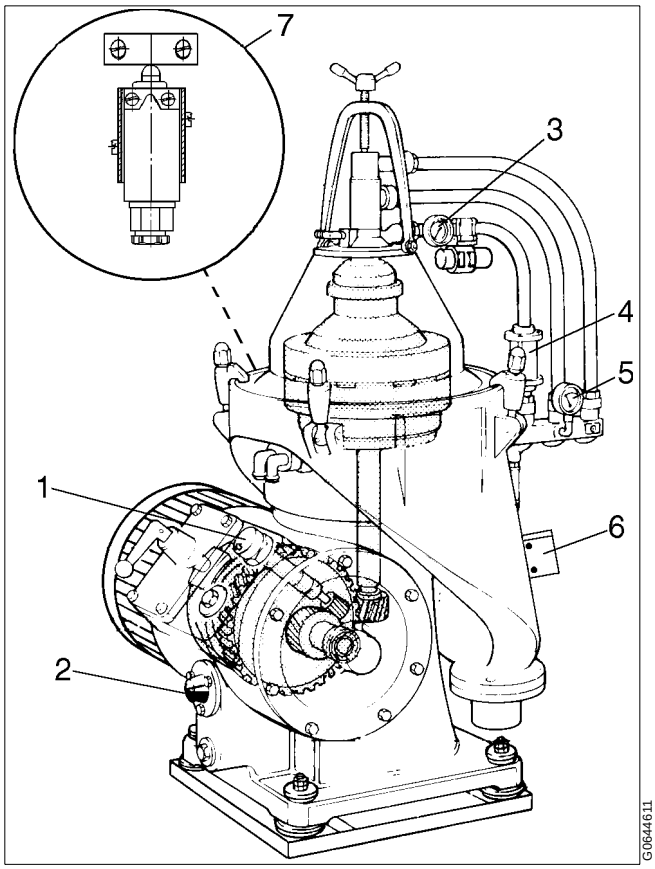
The sight glass shows the oil level in the worm gear housing.

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 161.



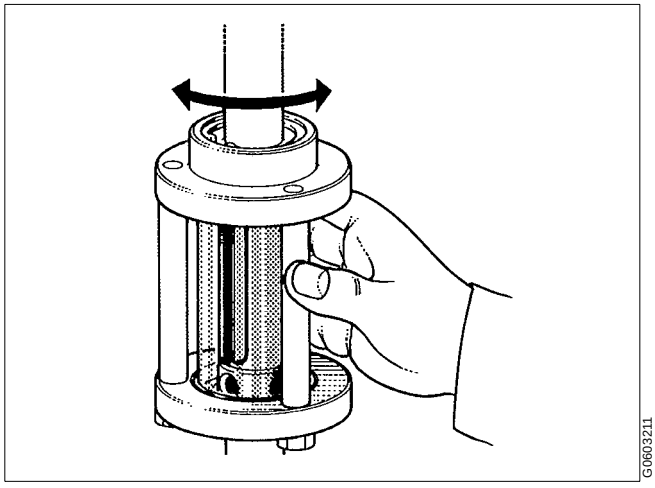
1. *Revolution counter*
2. *Oil sight glass*
3. *Indicating pressure gauge*
4. *Sight glass wiper*
5. *Back pressure gauge*
6. *Vibration switch (option)*
7. *Cover interlocking switch (option)*

Sight glass 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 167.

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.

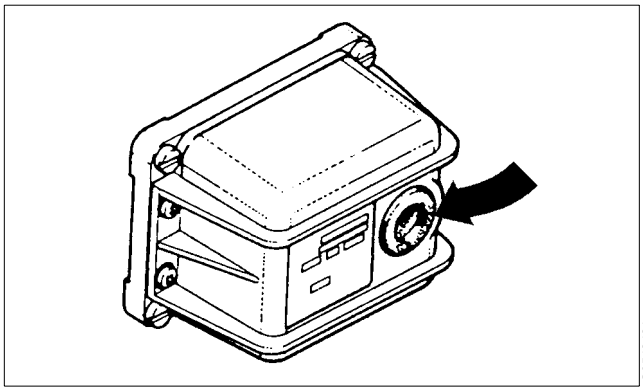
Vibration switch (6, option)

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.

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.

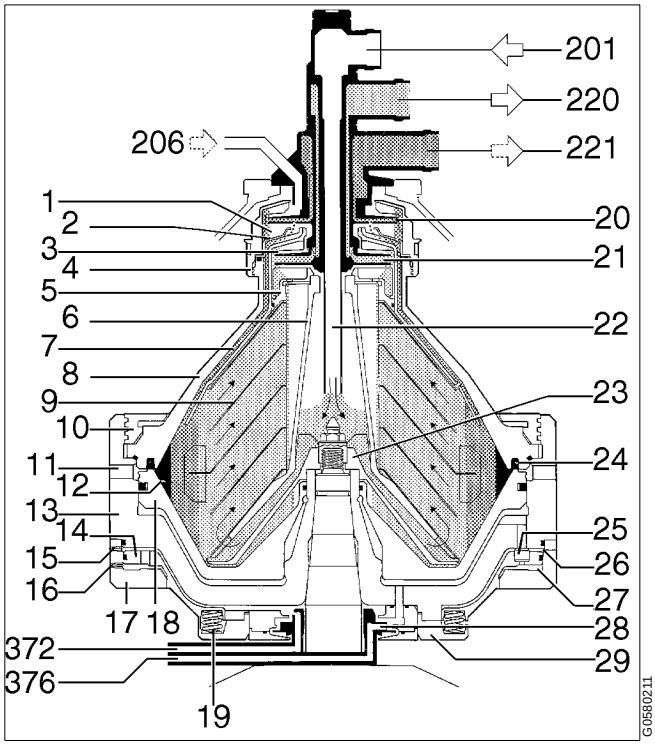


Reset push button on vibration switch

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. Unseparated 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 **



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

* *Parts effecting a sludge discharge*

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

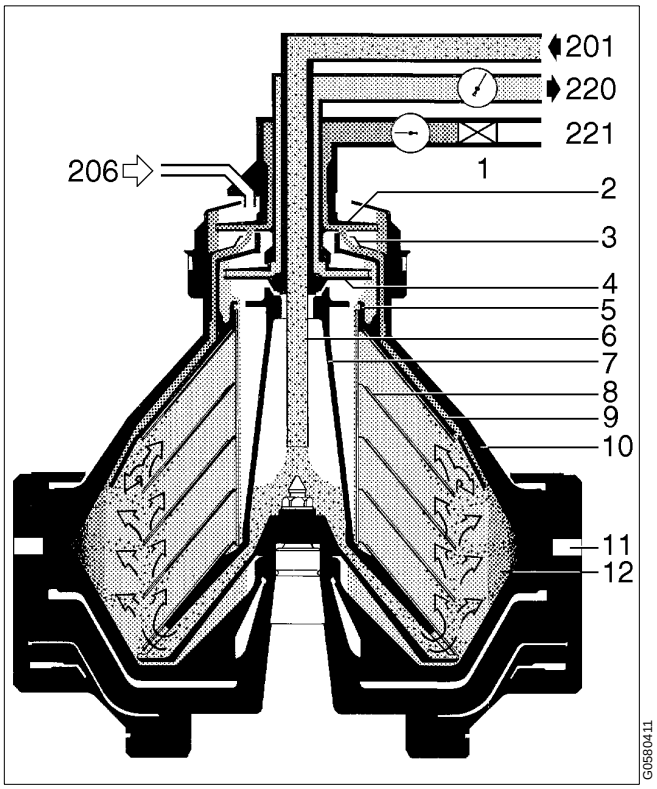
Unseparated oil is fed into the bowl through the inlet pipe (6) and is pumped via the distributor (7) towards the periphery of the bowl.

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*

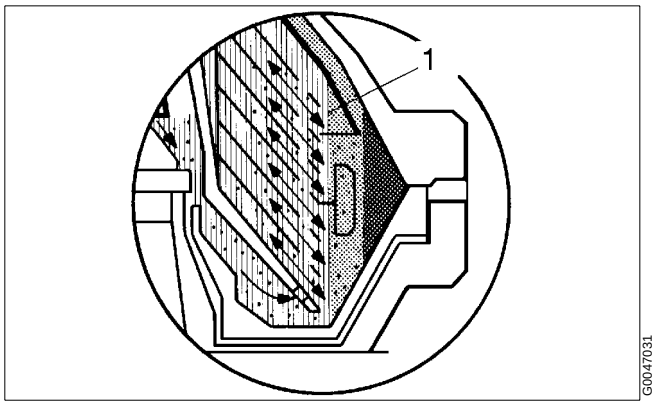
201. Unseparated oil inlet
206. Displacement/conditioning water inlet
220. Clean oil outlet
221. Water outlet

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).

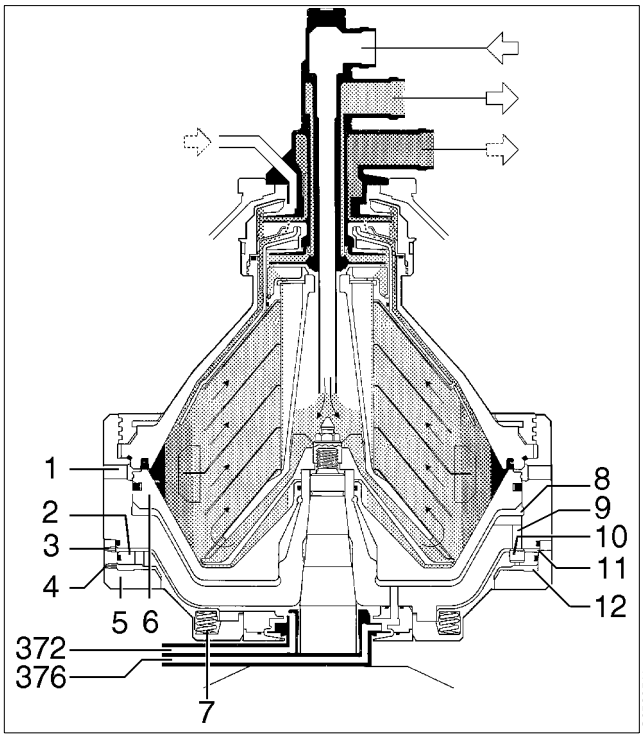
Bowl closes after discharge

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

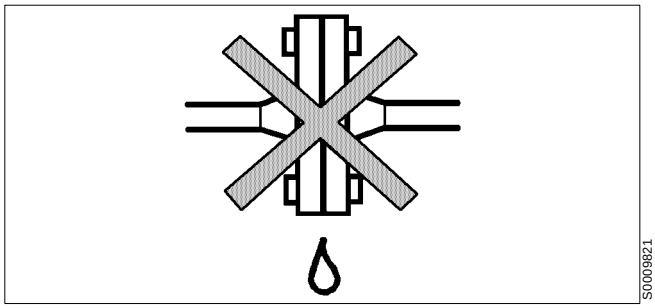
These operating instructions describe routine procedures to follow before and during the start, running and stopping sequences of the separator.

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 hinged bolts for 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)

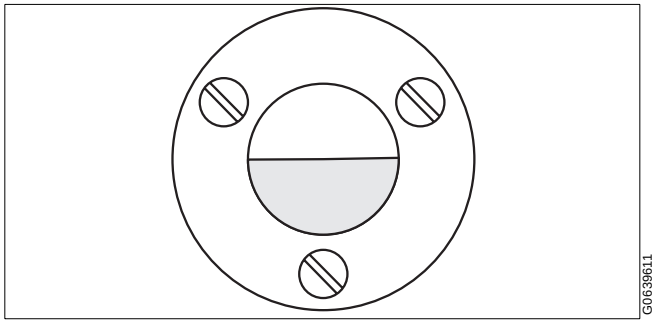
CAUTION

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 slightly above the middle of the sight glass.



Check the oil level

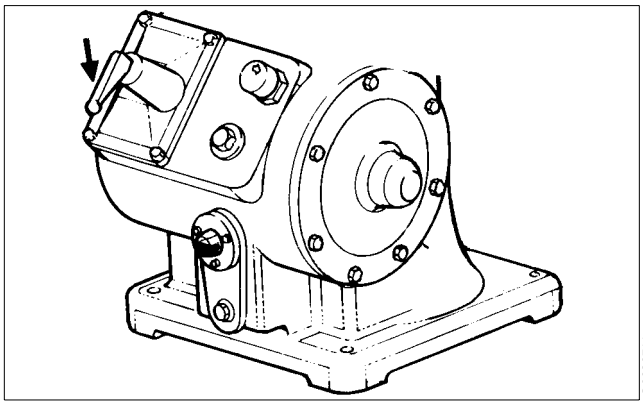
NOTE

During running the oil level should be barely visible in the lower part of the sight glass.

Too much or too little oil can damage the separator bearings.

Fill if necessary. See chapter “8.4 Lubricants” on page 172, for a list of recommended oils.

4. Make sure that the brake is released.



Release the brake

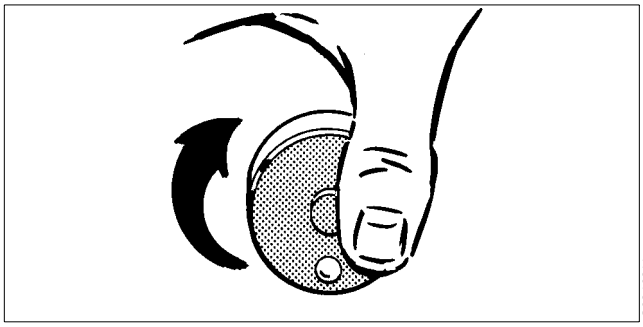
4.1.2 Start

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

DANGER

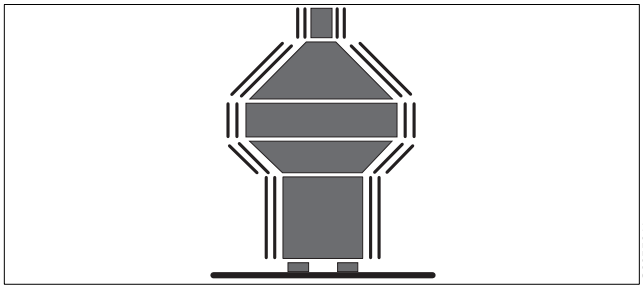
Disintegration hazards

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



Check for correct direction of rotation

3. Check the separator for vibration. Some vibration can occur for short periods during the starting cycle, when the separator passes through its critical speeds. This is normal and passes 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.

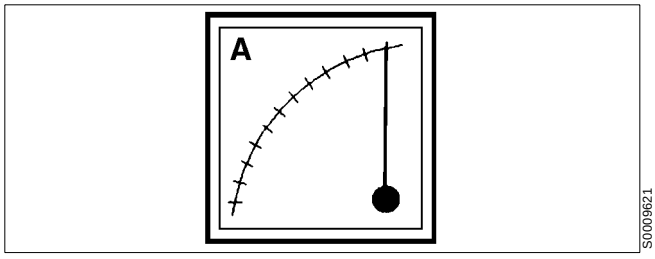
In the trouble-tracing chapter “7.1.1 Separator vibrates” on page 155, a number of causes are described that can create vibration.

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

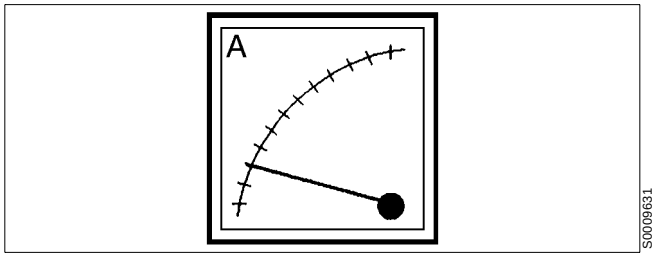
   During start, the current reaches a peak and then drops slowly. When the friction coupling engages, the current slowly increases again before decreasing to a low and stable level, which is the normal current during running.

   The time to reach full speed may not exceed the limit given in chapter “8 Technical Reference” on page 163.

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 163 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 163.

DANGER

Disintegration hazards

Ensure that correct discharge intervals and cleaning procedures are used.

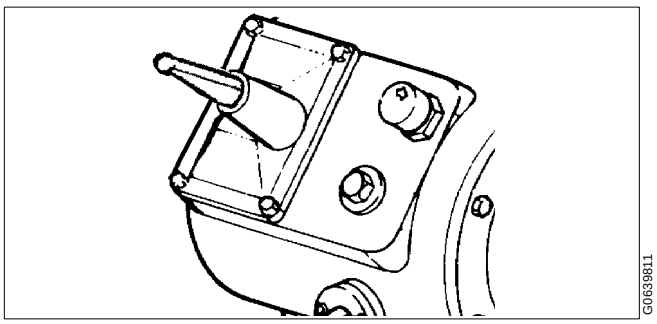
Unbalance due to improper washing out of solids may lead to contact between rotating and non-rotating parts.

4. For daily condition checks, see “5.2.1 Daily checks” on page 45.

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.



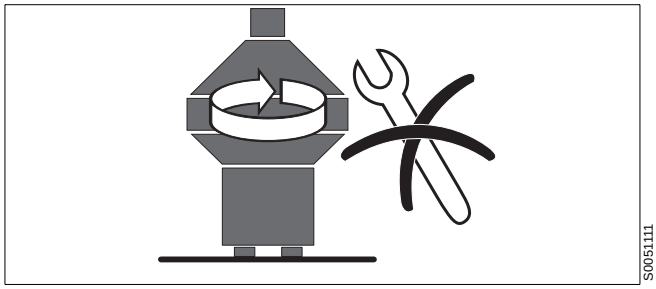
The final action, apply the brake

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.

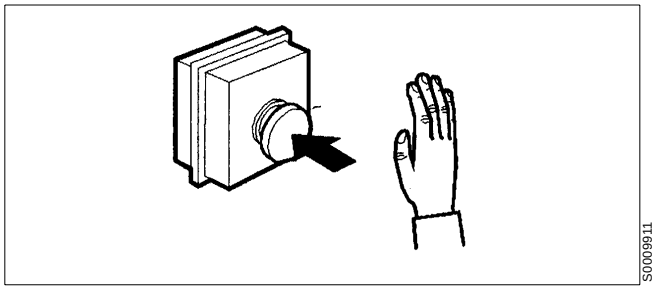


The separator must not be dismantled before standstill

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.

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



Push the safety stop if excessive vibration

DANGER

Disintegration hazards

Do not discharge a vibrating separator.

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

CAUTION

Disintegration hazards

After a 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)

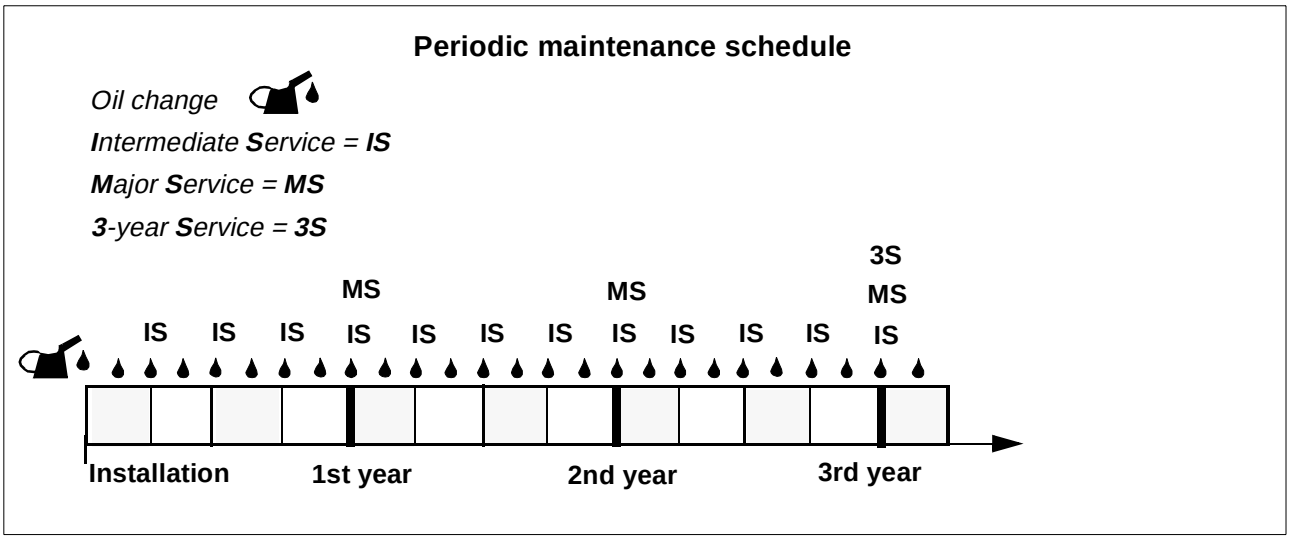
Intermediate Service consists of an overhaul of the separator bowl, inlet/outlet and operating device every 3 months or 2000 operating hours. Seals in bowl and gaskets in inlet/outlet device are renewed.

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 renewing the frame feet. The feet get harder with increased use and age.



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 99.

   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 99. The assembly instructions have references to check points which should be carried out before and during the assembly.

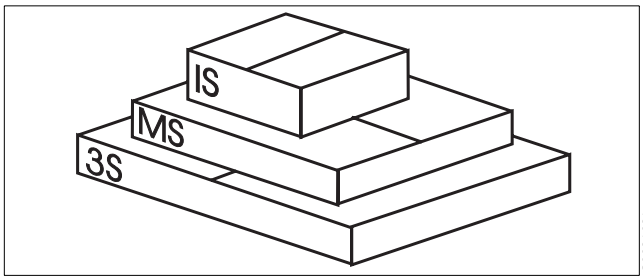
5.1.4 Service kits

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		92	
Horizontal driving device			
Worm wheel shaft and gear casing			
Check for vibration and noise		92	
Check	Oil level in gear housing	33	
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	88	
Renew	Oil[b)] in gear housing	90	

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 "8.4 Lubricants" on page 172 for further information.

5.2.3 Intermediate Service (IS)

Name of plant: Local identification:

Separator: FOPX 605TFD-20 Manufacture No./Year:

Total running hours: Product No: 881111-01-05

Date: Signature:

Main component and activity	Part	Page	Notes
Inlet and outlet			
Clean and inspect	Threads of inlet pipe	61	
	Connecting housing	–	
Renew	Sealing rings in sight glass	65	
Separator bowl			
Clean and check	Upper paring disc	–	
	Flow control disc	–	
	Lock ring	61	
	Bowl hood	51	
	Top disc	–	
	Oil paring disc	61	
	Level ring	61	
	Bowl discs	86	
	Distributor	–	
	Distributing cone	–	
	Sliding bowl bottom	65	
	Bowl body	–	
	Bowl spindle cone and bowl body nave	52	
	Operating mechanism	56, 63, 66	
Check	Corrosion	52	
	Cracks	54	
	Erosion	56	
	Galling of guide surface	59	
	Disc stack pressure	55	
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	88	
Renew	Oil in gear housing	90	
Electrical motor			
Lubrication (if nipples are fitted)	See sign on motor	–	
Signs and labels on separator			
Check attachment and legibility	Safety label on hood	186	
	Direction of rotation arrow	186	
	Power supply frequency	186	
Monitoring equipment (option)			
Function check	Vibration switch	67	
	Cover interlocking switch	66	

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

5.2.4 Major Service (MS)

Name of plant: Local identification:

Separator: FOPX 605TFD-20 Manufacture No./Year:

Total running hours: Product No: 881111-01-05

Date: Signature:

Main component and activity	Part	Page	Notes
Inlet and outlet			
Clean and inspect	Threads of inlet pipe	61	
	Connecting housing	–	
Renew	Sealing rings in sight glass	65	
Separator bowl			
Clean and check	Upper paring disc	–	
	Flow control disc	–	
	Lock ring	76, 61	
	Bowl hood	51	
	Top disc	–	
	Oil paring disc	61	
	Level ring	61	
	Bowl discs	86	
	Distributor	–	
	Distributing cone	–	
	Sliding bowl bottom	65	
	Bowl body	–	
	Bowl spindle cone and bowl body nave	52	
	Operating mechanism	56, 63, 66	
Check	Corrosion	52	
	Cracks	54	
	Erosion	59	
	Galling of guide surface	59	
	Disc stack pressure	55	
	Height position of oil paring disc	78	

Main component and activity	Part	Page	Notes
Operating device			
Clean and check	Operating paring disc	–	
Check	Height position of operating paring disc	78	
Vertical driving device			
Clean and check	Bowl spindle	–	
	Buffer springs and ball bearing housing	70	
	Radial wobble of bowl spindle	68	
Renew	Spindle bearings	130	
Horizontal driving device			
Worm wheel shaft and gear housing			
Check	Worm wheel and worm	88	
	Radial wobble of worm wheel shaft	81	
	Axial play of flexible plate	73	
Renew	Bearings	142	
	Oil in gear housing	90	
Brake			
Clean and check	Spring and brake shoe	69	
Renew	Friction pad	69	
Friction coupling			
Clean and check	Worm wheel coupling	–	
Renew	Friction pads	71	
Electrical motor			
Lubrication (if nipples are fitted)	See sign on motor	–	
Signs and labels on separator			
Check attachment and legibility	Safety label on hood	186	
	Direction of rotation arrow	186	
	Power supply frequency	186	
Monitoring equipment (option)			
Function check	Vibration switch	67	
	Cover interlocking switch	66	

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

5.2.5 3-year Service (3S)

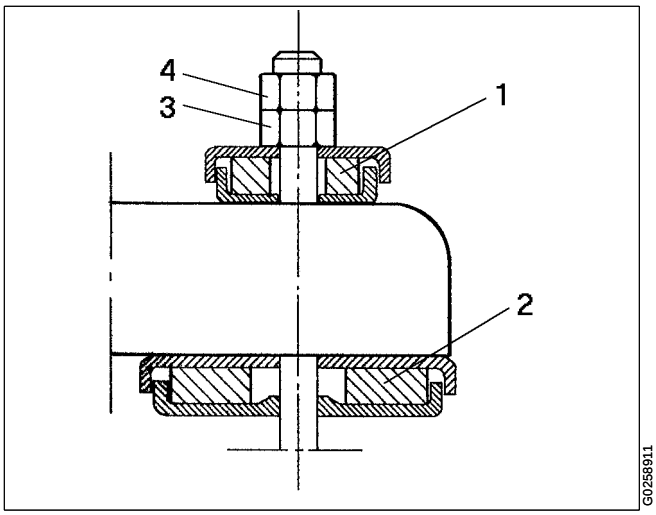
Renew the frame feet as described below. The 3-year service should be carried out in conjunction with a Major Service (MS). The extent of the 3-year service is the same as for a major service plus the parts included in the 3-year Service kit (3S).

Frame feet, renewal

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

> **NOTE**
>
> When lifting a separator it must always **hang securely**. See separate instruction in chapter “5.5 Lifting instructions” on page 82.

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.



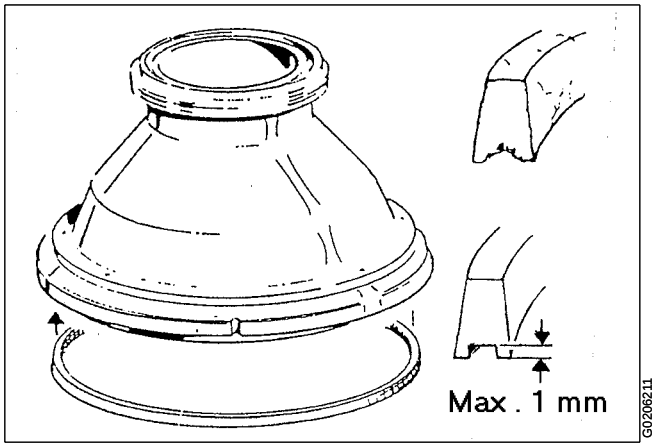
1. *Vibration damper, upper*
2. *Vibration damper, lower*
3. *Nut*
4. *Lock nut*

5.3 Check points at Intermediate Service (IS)

5.3.1 Bowl hood seal ring

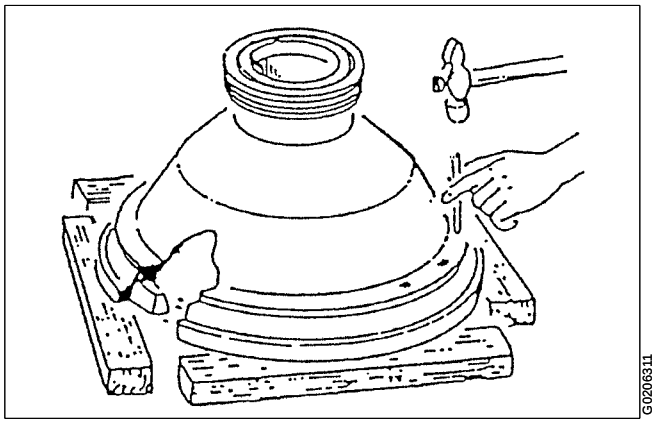
Poor sealing between the bowl hood seal ring and the sealing edge of the sliding bowl bottom will cause a leakage of process liquid from the bowl.

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



Max. permitted indentation of the seal ring is 1 mm

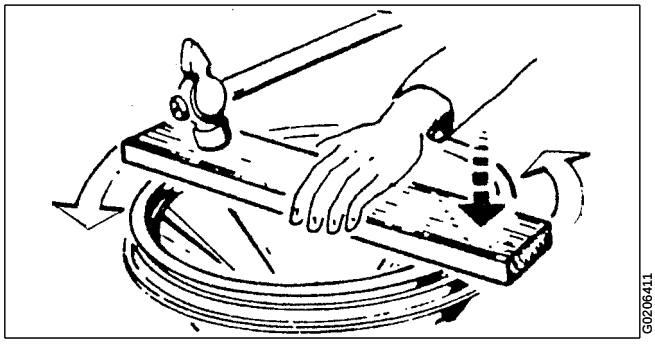
Knock out the old ring by means of a pin inserted in the holes intended for this purpose.



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.

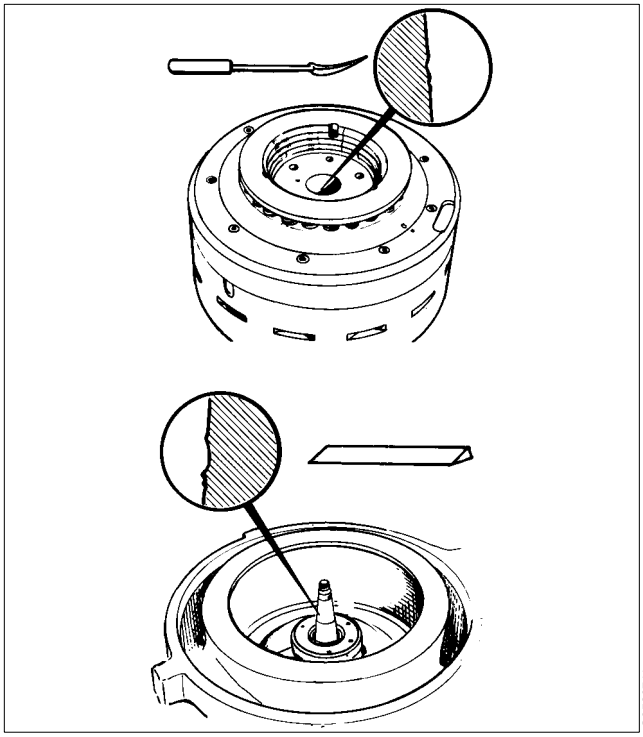
Corrosion may cause the bowl to stick firmly to the spindle cone and cause difficulties during the next dismantling.

- 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

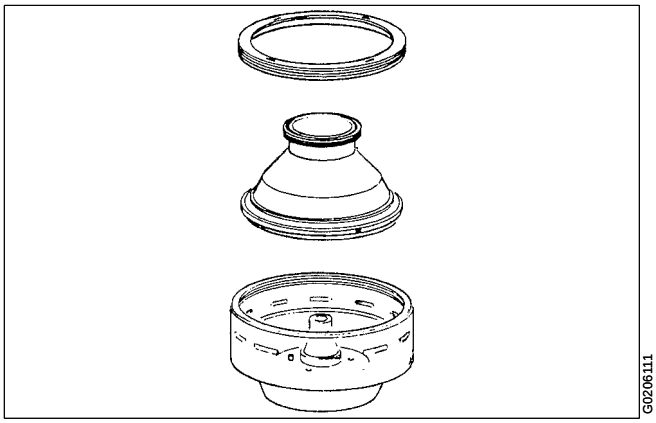
5.3.3 Corrosion

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.

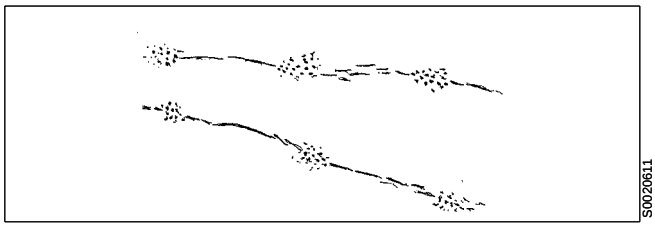
Stainless steel

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:

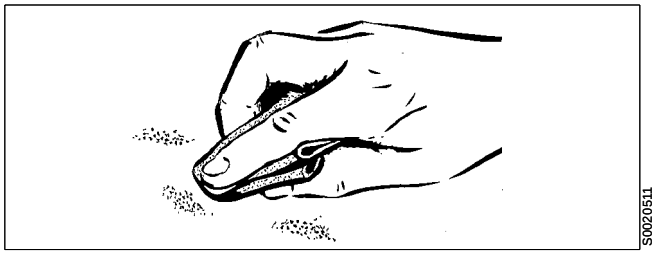
- Exposed to a stationary solution.
- In a crevice.
- Covered by deposits.
- Exposed to a solution that has a low pH value.

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

1. Inspect closely for all types of damage by corrosion and record these observations carefully.



Example of chloride corrosion in stainless steel



Polish corrosion marks to prevent further damage

2. Polish dark-coloured spots and other corrosion marks with a fine grain emery cloth. This may 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.

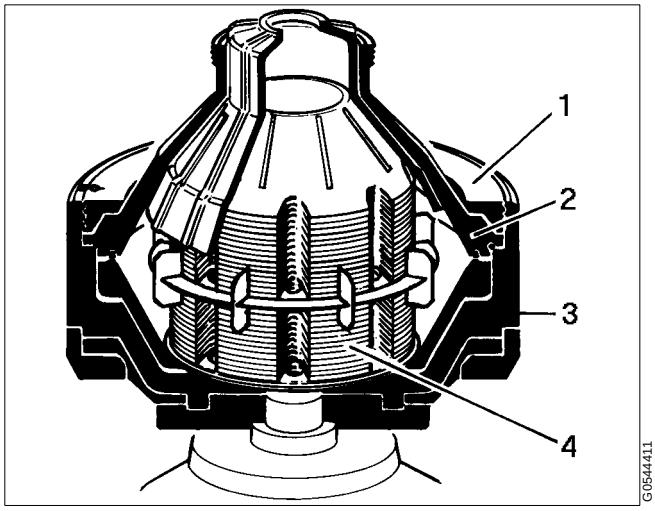
5.3.5 Disc stack pressure

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

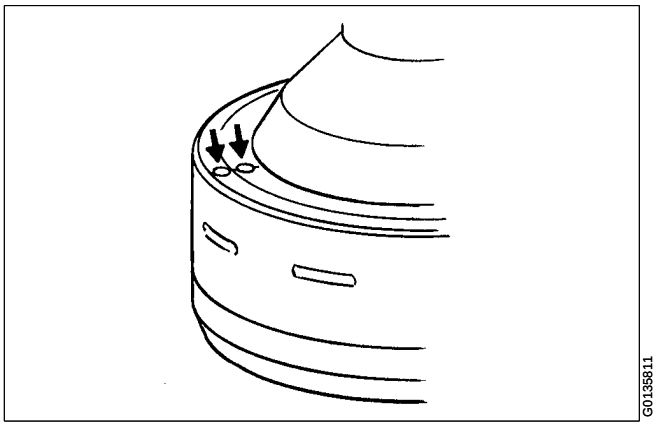
Compress the disc stack by tightening the lock ring, see chapter “6.3.3 Assembly” on page 113.

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.

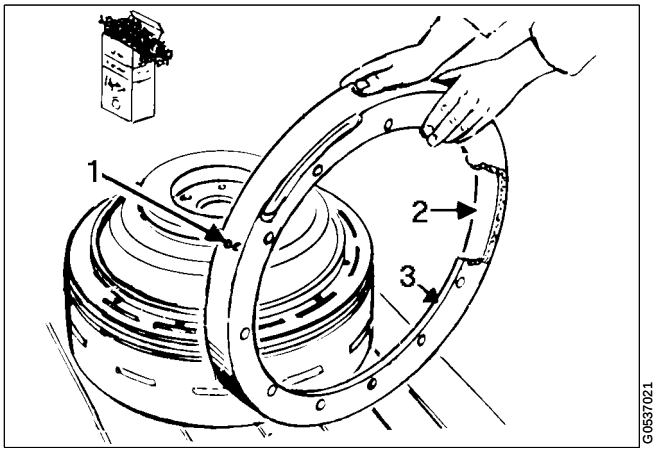


ϕ-marks on bowl body and lock ring in line

5.3.6 Dosing ring

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

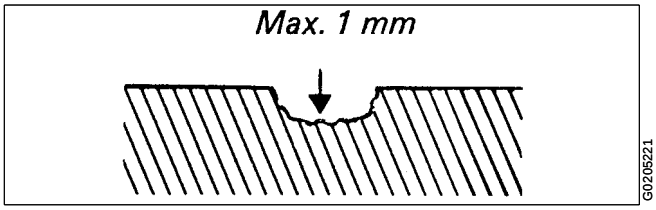
Inspect the surface (3) in contact with the operating slide. Remove any marks with a whetstone or fine emery cloth (grain size 240).



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.



Max. permitted erosion

DANGER

Disintegration hazard

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

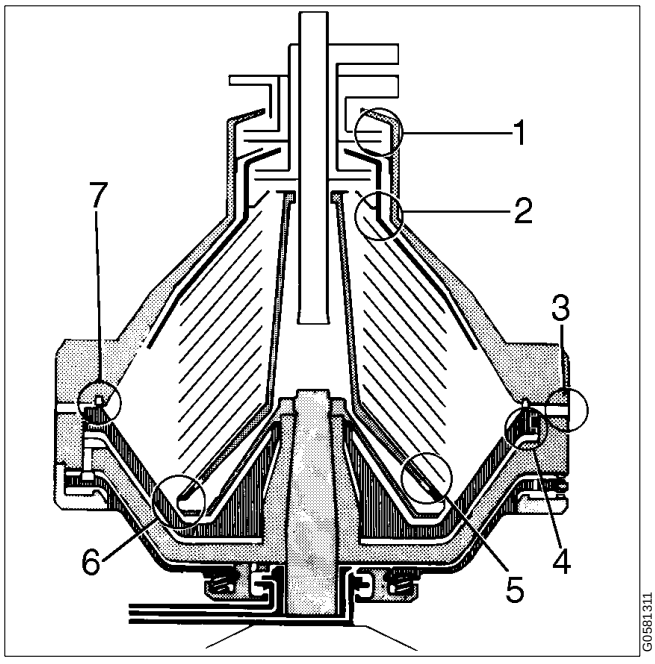
Always contact your Alfa Laval representative if the largest depth of any erosion damage exceeds 1,0 mm. Valuable information as to the nature of the damage can be recorded using photographs, plaster impressions or hammered-in lead.

Erosion is characterised by:

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

Surfaces particularly subjected to erosion are:

1. The upper paring disc.
2. The top disc.
3. The pillars between the sludge ports in the bowl wall.
4. The sealing edge of the 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.



Surfaces particularly subjected to erosion

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.

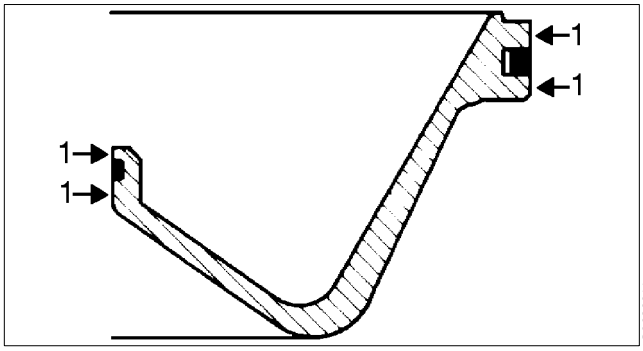
Pay special attention to the pillars between the sludge ports in the bowl wall.

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).

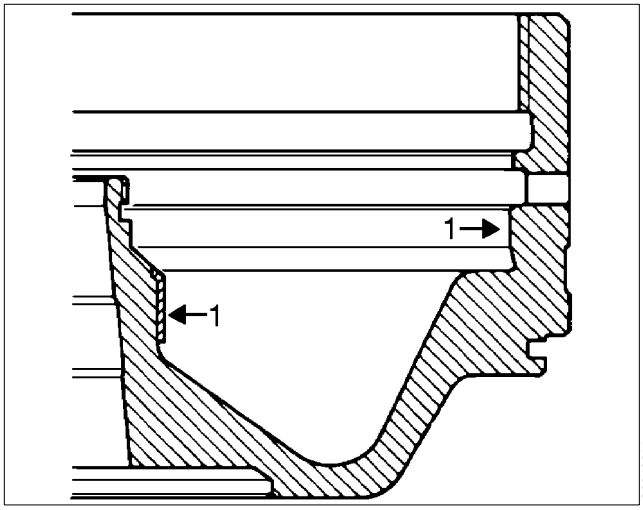


Sliding bowl bottom

NOTE

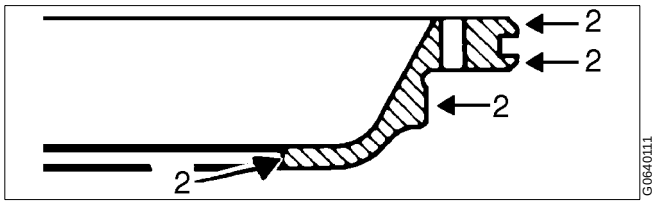
To avoid the risk of galling, the contact surfaces (1) should be primed with a slide lacquer at every Major Service (MS).

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

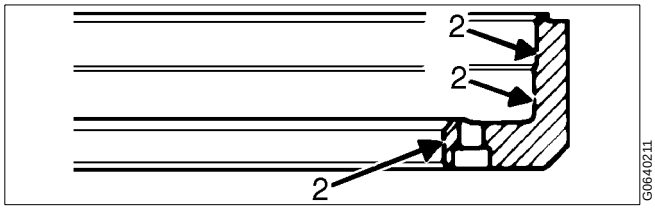


Bowl body

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

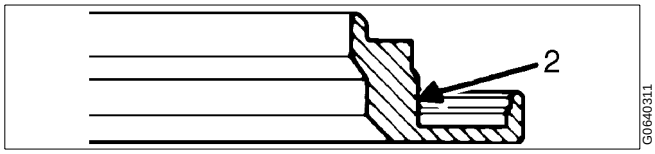


Operating slide



Dosing ring

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

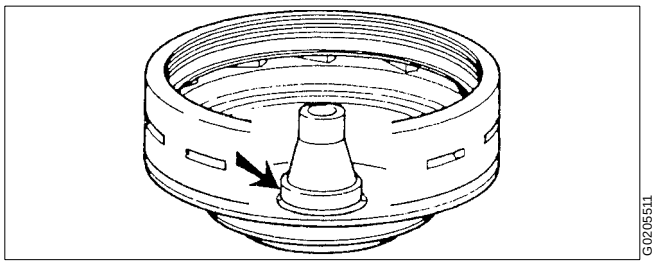


Spring support

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.

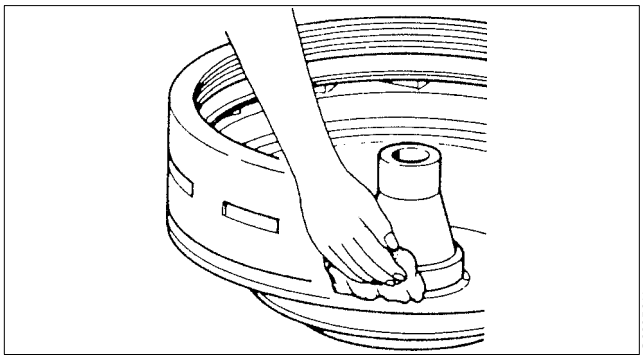


Guide surface in the bowl body

Recommended tools for correction of galling:

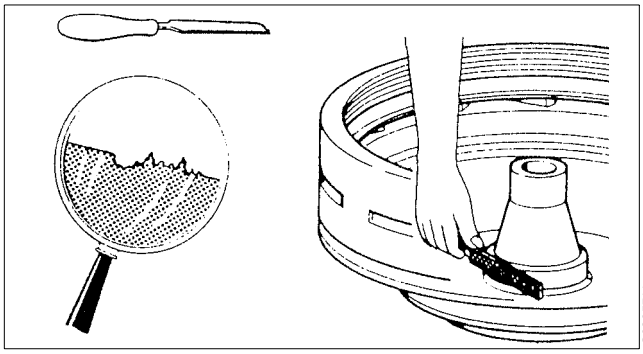
- Emery cloth, 240 grade.
- Hand drilling machine
- Degreasing agent.
- Fibre brush, ∅ 25mm.
- Fibre brush, ∅ 50 mm.
- Very fine single-cut file.

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

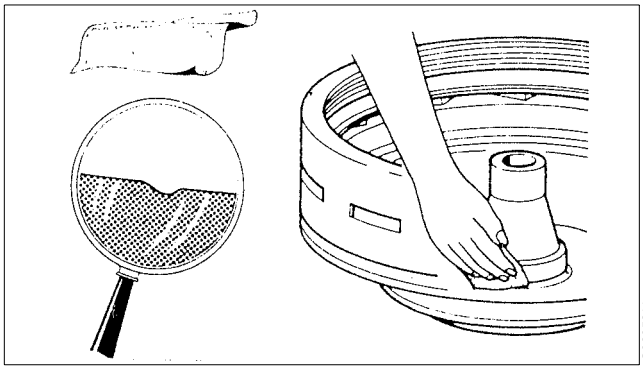


2. If the galling is excessive, first use the fine single-cut file. The file should be used with caution so that the damage is not made worse.

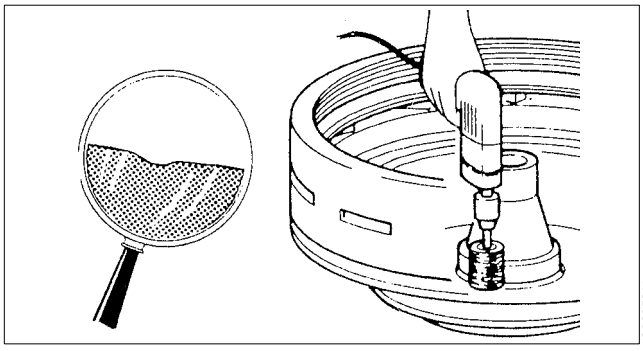
   Remove the high spots on the surface. Do not use rotating files or similar. Remove the high spots only - not the undamaged material.



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.

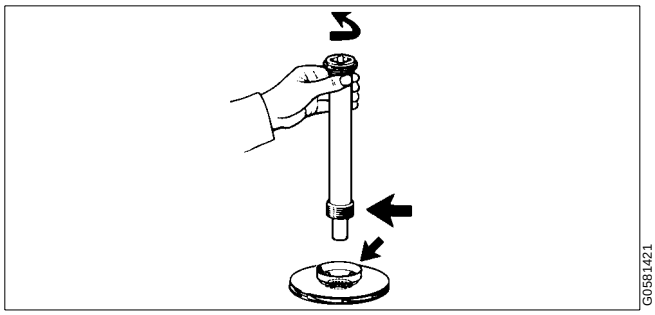


Prime the repaired area with lubricating spray Molykote 321 R. Read the correct procedure under checkpoint “5.4.16 Lock ring; priming” on page 76. Apply Alfa Laval lubricating paste or Molykote 1000 Paste to the surface after priming.

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.

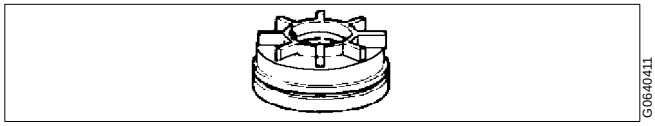
Screw the inlet pipe into the paring disc and check that the inlet pipe turns easily.



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

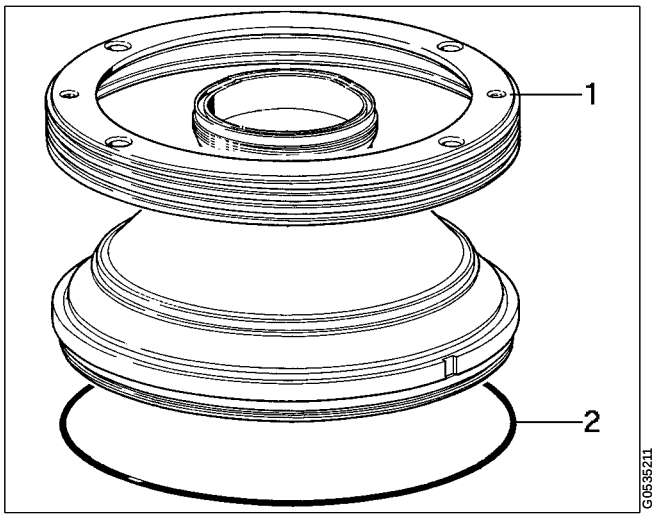
Excessive wear or impact marks on threads, guide and contact surfaces of the lock ring, bowl hood and bowl body may cause hazardous galling.

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.



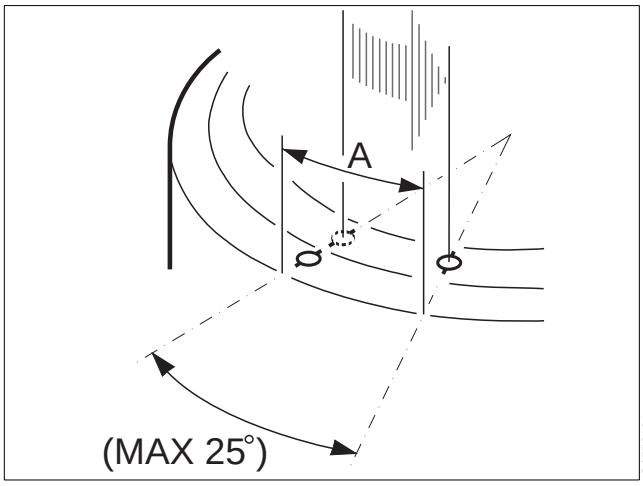
1. *Lock ring*
2. *O-ring for the bowl hood*

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=60 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

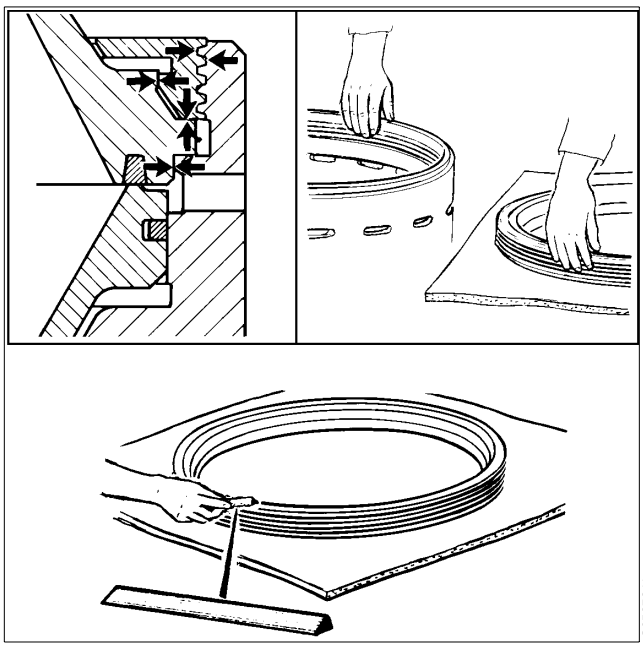
The position of the threads, contact and guide surfaces are indicated by arrows in the illustration.

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

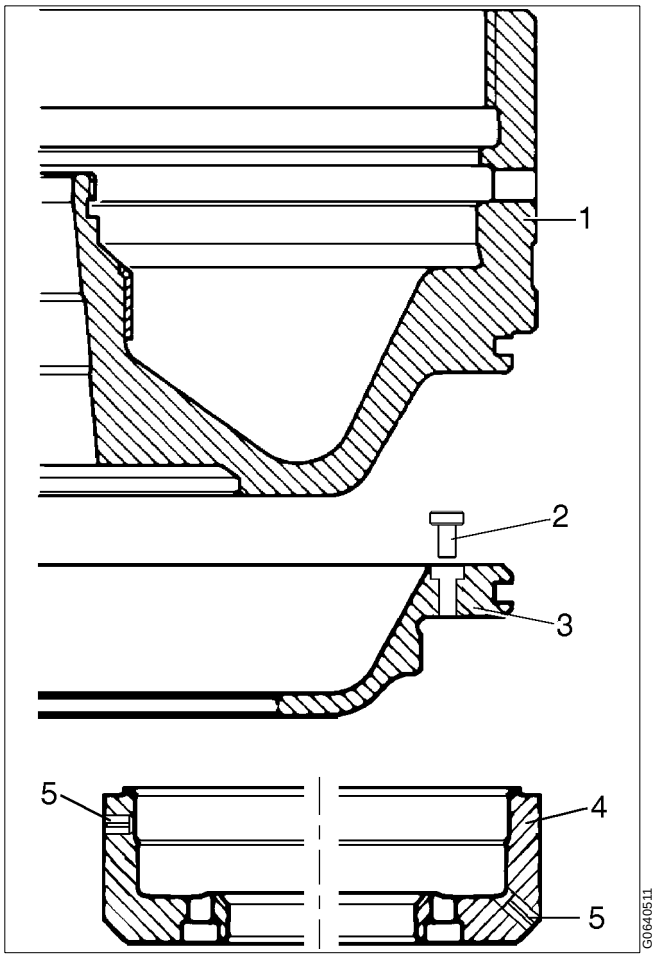
5.3.12 Operating mechanism

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.



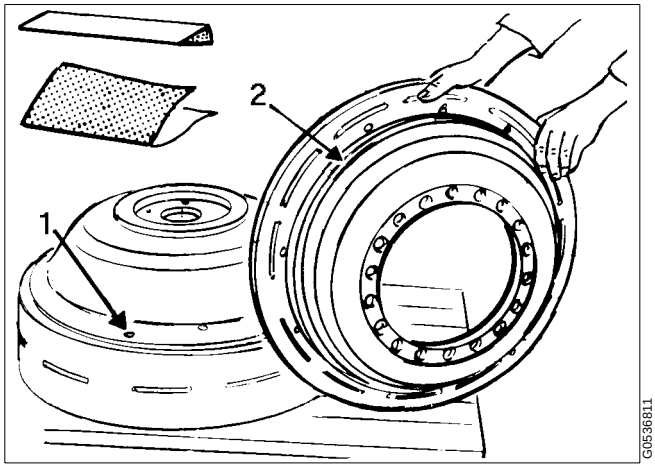
1. *Bowl body*
2. *Valve plug*
3. *Operating slide*
4. *Dosing ring*
5. *Nozzles*

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.

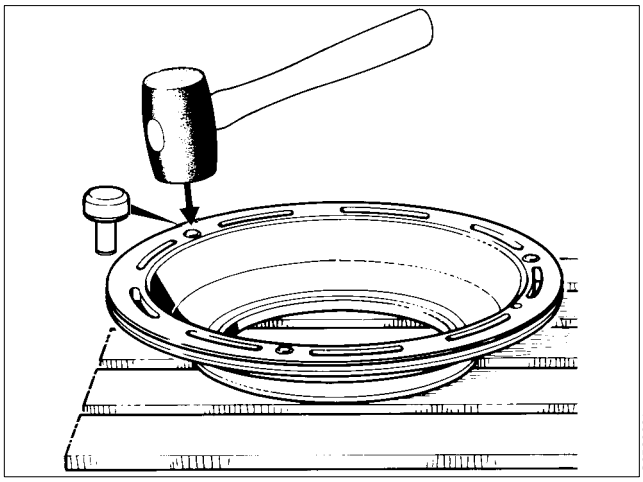
Examine the sealing surfaces (1) of the bowl body in contact with the valve plugs. Remove any marks and lime deposits with a very fine grain emery cloth.

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



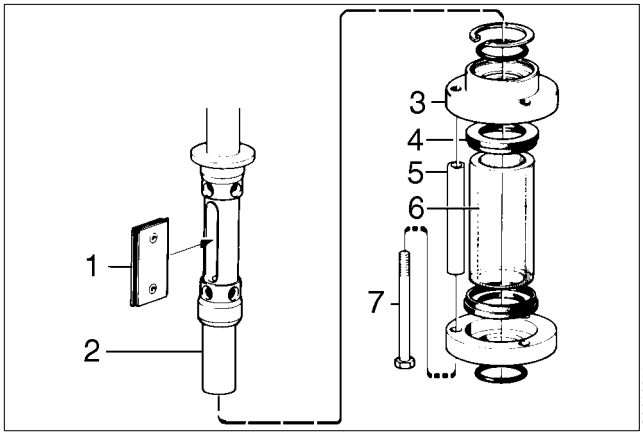
1. *Bowl body sealing surfaces in contact with the valve plugs*
2. *Operating slide guide surface in contact with the dosing ring*

Remove all the valve plugs. Tap in the new plugs.



Tap in new valve plugs

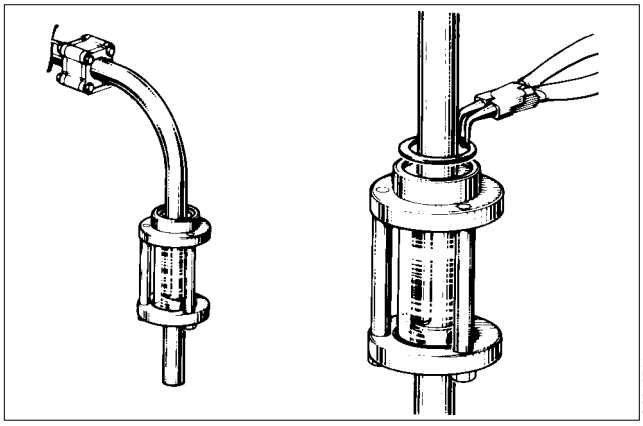
5.3.14 Sight glass



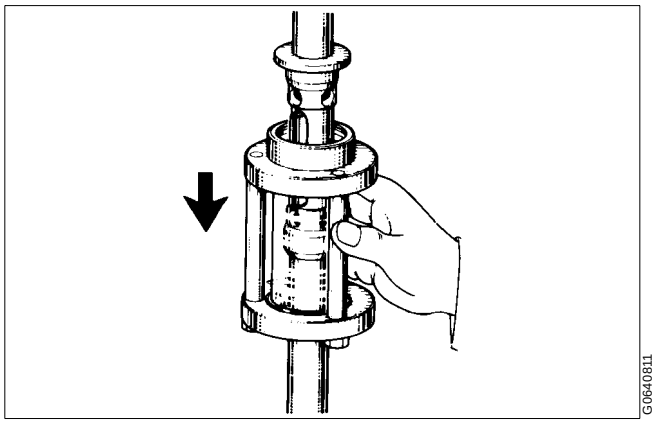
1. *Scraper*
2. *Water outlet pipe with sight glass body*
3. *Flange*
4. *Sealing ring*
5. *Spacing tube*
6. *Glass tube*
7. *Screw*

Renewing of sealing rings

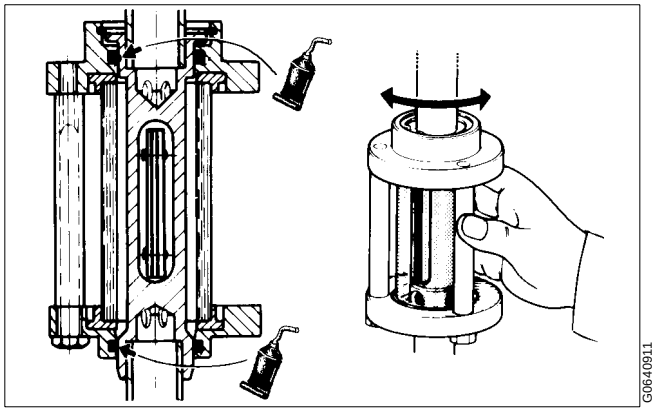
1. Remove the water outlet pipe from the separator.
2. Remove the snap ring.



3. Pull off the sight glass from the pipe. The flange of the sight glass has a smaller internal diameter than that of the glass and it is therefore necessary to use more force when the flange is pulled along the scraper.
4. Dismantle the sight glass assembly. Clean the sight glass body and renew the sealing rings.



5. After assembly, lubricate the sealing rings with silicone grease.
6. Push up the sight glass and lock it with the snap ring. Check that it is possible to turn the sight glass around the scraper.



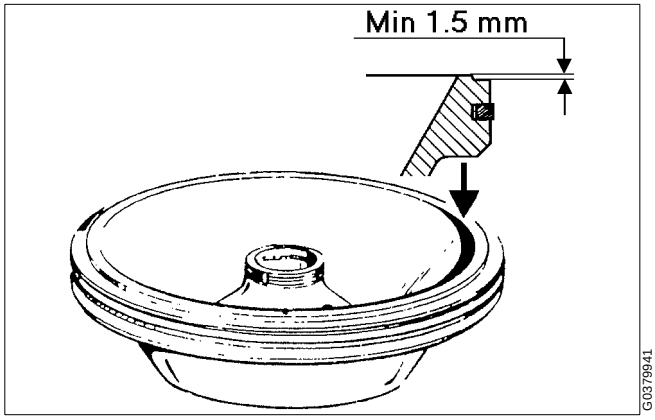
5.3.15 Sliding bowl bottom

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.



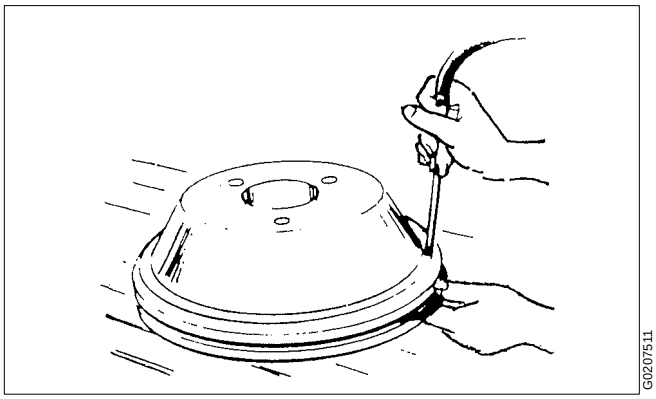
Min. height of the profile on sliding bowl bottom

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.



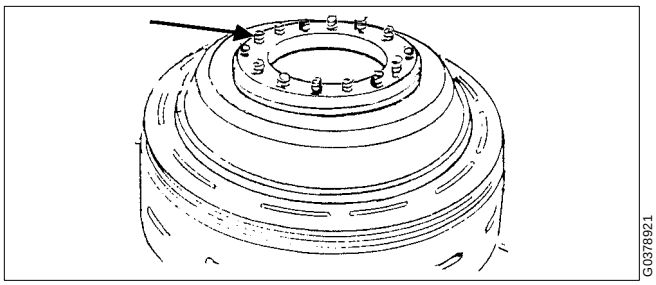
Removal of the O-ring in sliding bowl bottom using compressed air

5.3.16 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 88 in this chapter.



Check for defective or broken springs

5.3.17 Cover interlocking switch (option)

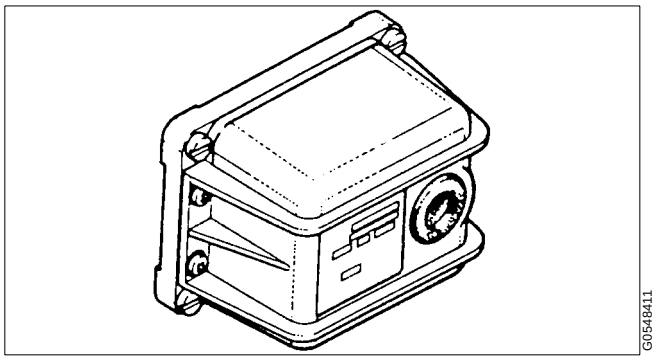
When the button is pushed, check that the connections 13 and 14 inside the switch are short -circuited. A principal diagram of the connections is shown in chapter “8.6.6 Cover interlocking switch (option)” on page 188.

5.3.18 Vibration switch (option)

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

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

How to adjust the setpoint is described in chapter “5.8.2 Vibration switch (option)” on page 93.



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 51.

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 52.

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

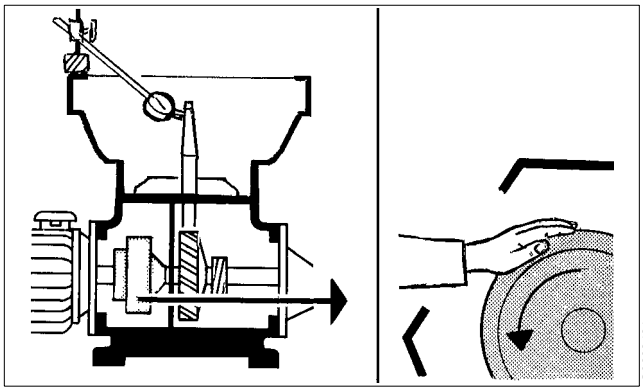
Spindle wobble will cause rough bowl run. This leads to vibration and reduces lifetime of ball bearings.

Check the wobble before mounting the bowl.

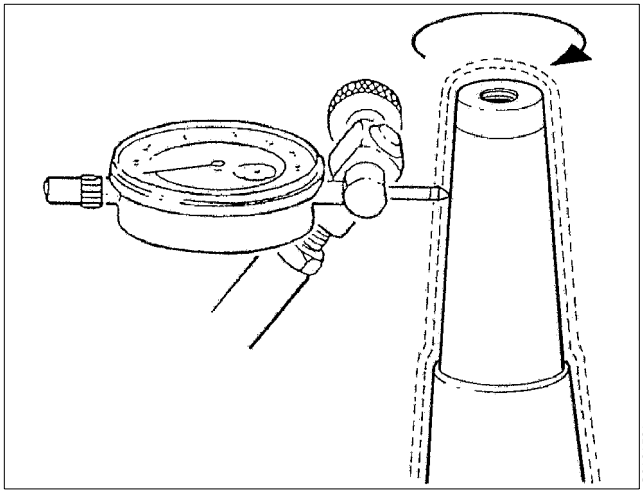
Before measuring, make sure that the buffer plugs are properly tightened.

- 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. Permissible radial wobble is maximum **0,04 mm**.
- If wobble is too large, renew all the ball bearings on the spindle.

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



Revolve the spindle manually



Measurement of radial wobble

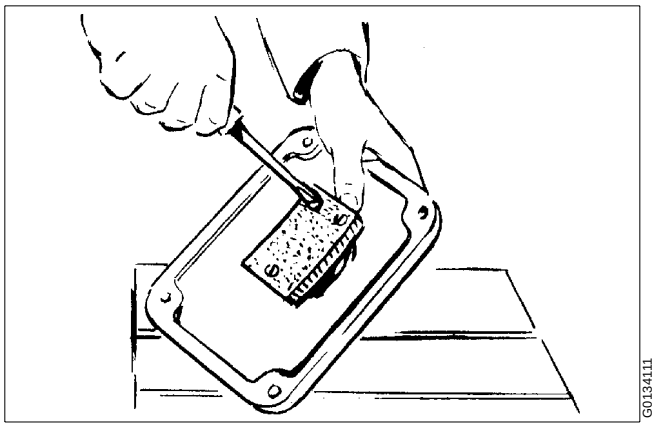
5.4.4 Brake

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.

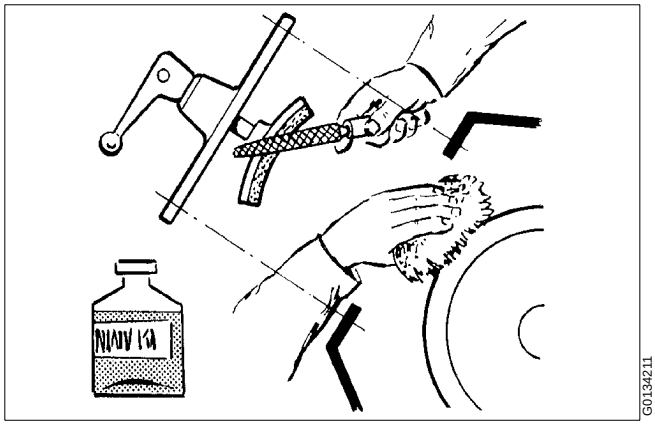


Friction pad is fastened with screws

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.

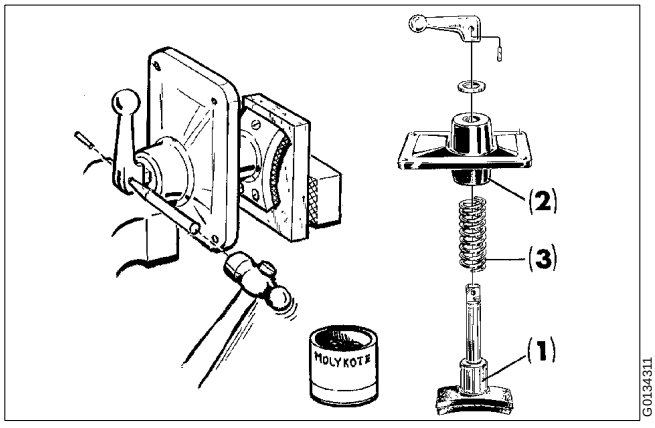
NOTE
Identify the cause of oily friction pad. If oil is leaking from the gear housing, renew the sealing ring between the two parts.



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.



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

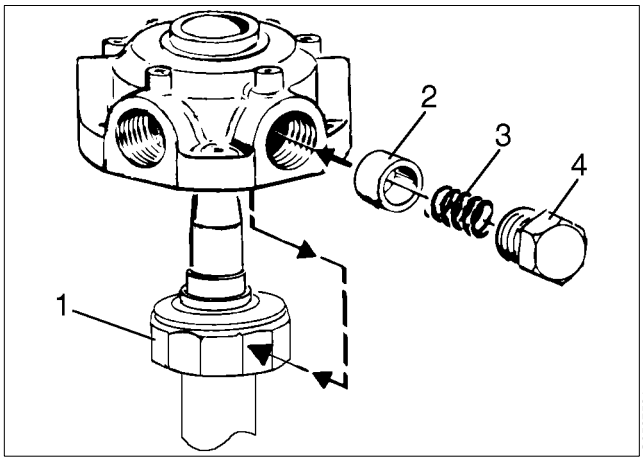
- Remove any rust from the surface (1) of the brake shoe and the corresponding guide surface in the cap (2).
- Rub in Molykote Paste on the surfaces.
- Replace the spring (3) if it has been weak. This is indicated by chattering from the spring when the brake is in released position.
- Oil the spring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

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).

Top bearing springs

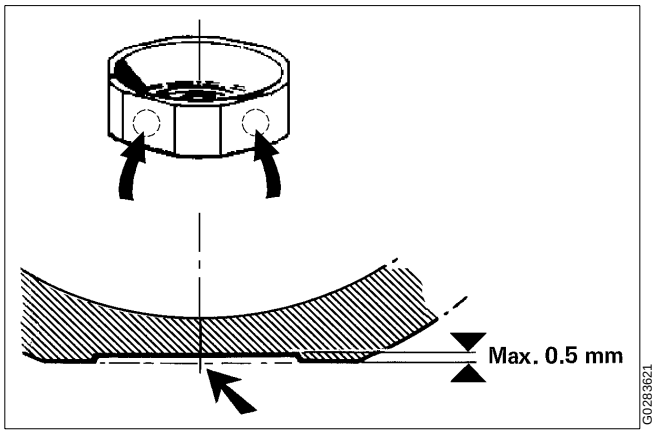
In case of spring fracture, the complete set of springs should be replaced, even if only one spring is broken.



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 4 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:

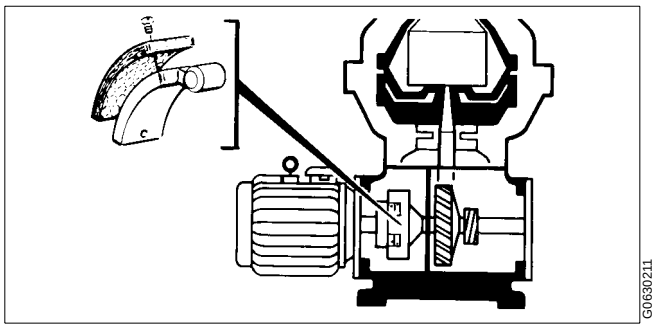
- Clean the pads and the inside of the coupling drum with a suitable degreasing agent. Roughen the friction surfaces of the pads with a coarse file.

If the pads are worn:

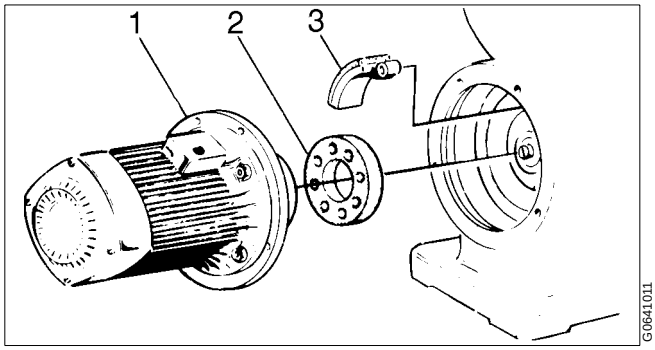
- Remove the screws and renew the pads.

> **NOTE**
>
> The screws are slotted in both ends.
>
> Replace all pads even if only one is worn.

How to renew friction pads:



Location of coupling friction blocks



1. *Electric motor*
2. *Elastic plate*
3. *Friction block*

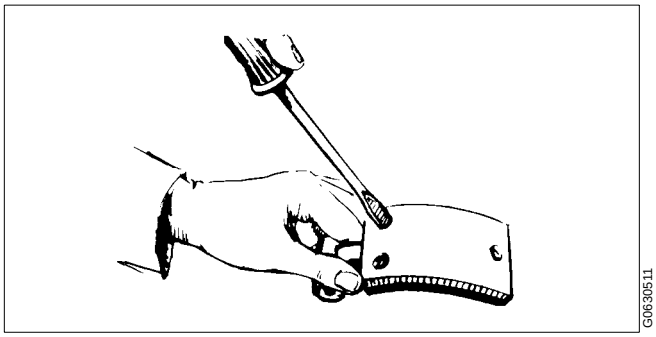
- Remove the
  - electric motor (1)
  - elastic plate (2)
  - friction blocks (3).

  If disconnecting the motor cables, note the positions of cables in the terminal box to reconnect correctly (for correct direction of rotation).
- Remove the screws and renew the pads

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.



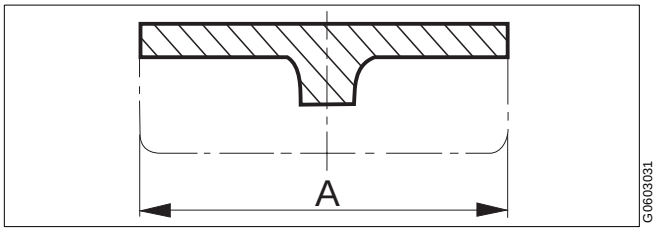
Three screws fix the friction pad to the friction block

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 A is different for 50 and 60 Hz separators.

50 Hz: A = **55 mm**

60 Hz: A = **35 mm**



Measure A is different for 50 and 60 Hz installations

5.4.7 Corrosion

Same as described in “5.3.3 Corrosion” on page 52.

5.4.8 Cracks

Same as described in “5.3.4 Cracks” on page 54.

5.4.9 Disc stack pressure

Same as described in “5.3.5 Disc stack pressure” on page 55.

5.4.10 Dosing ring

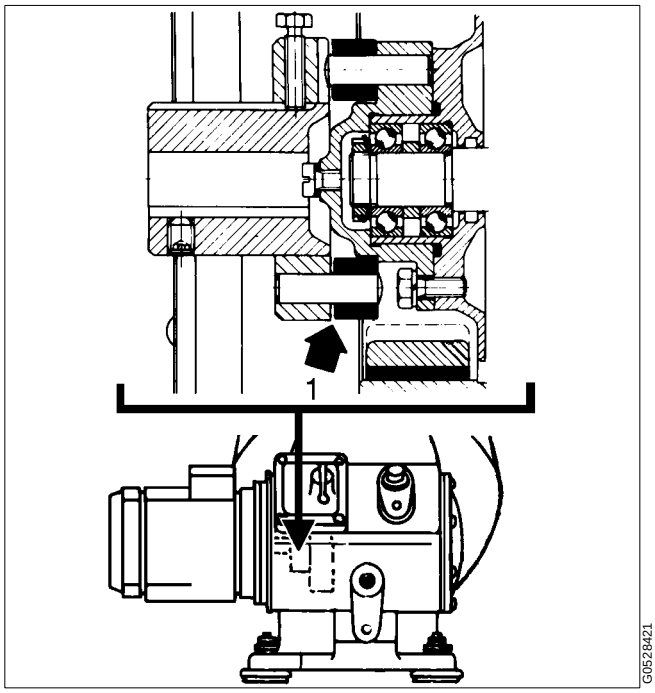
Same as described in “5.3.6 Dosing ring” on page 56.

5.4.11 Erosion

Same as described in “5.3.7 Erosion” on page 56.

5.4.12 Flexible plate in coupling

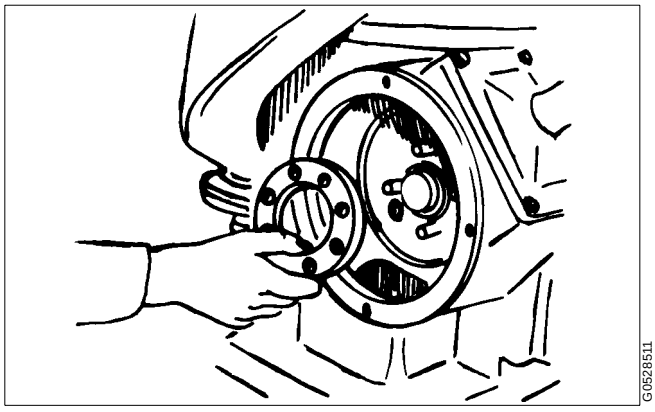
The axial play (1) of the flexible plate should be approximately 2 mm.



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

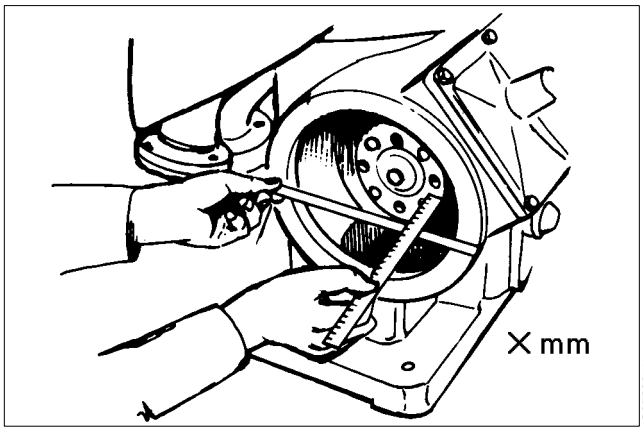
Check the play as follows:

Fit the elastic plate in its place in the coupling disc of the separator. Make sure that good contact is obtained.



The elastic plate must be fitted

Measure the distance from the frame ring (or motor adapter) to the coupling disc of the separator.

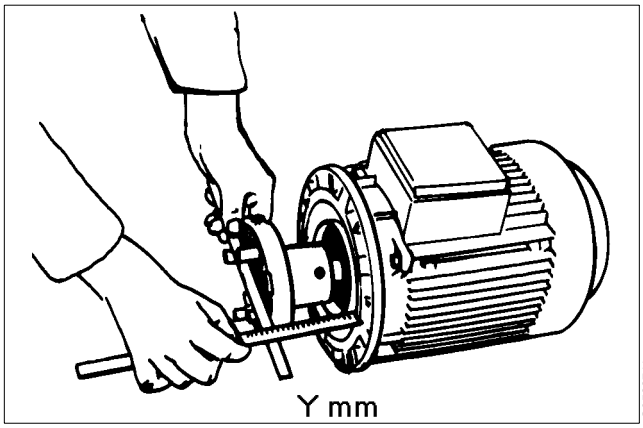


Measure of distance for coupling in separator frame

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.



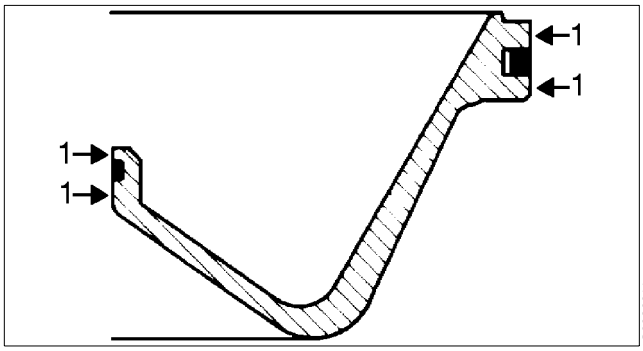
Measure of distance for coupling on motor

5.4.13 Guide surfaces

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

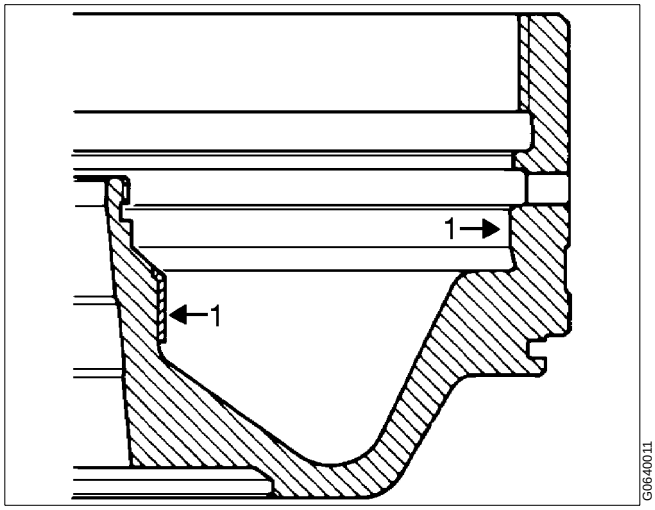
Repair of galling on guiding surfaces, see “5.3.8 Guide surfaces” on page 58.

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

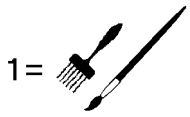


Sliding bowl bottom

1. Mask the nave hole of the bowl body. Slide lacquer must not enter this hole.
2. Carefully degrease the contact surfaces (1) between the sliding bowl bottom and bowl body. Dry the surfaces well.
3. Apply slide lacquer Molykote D321R with a well cleaned brush. Protect the surfaces which should not be treated.
4. Air-cure the treated surfaces for 15 minutes.
5. Use a smooth fibre brush to polish to an even, homogeneous contact film.
6. Apply slide lacquer a second time.
7. Air-cure the lacquer for a further 15 minutes.
8. Polish the film to a shiny surface. The film should look like well-polished leather when properly 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.



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 61.

5.4.15 Level ring

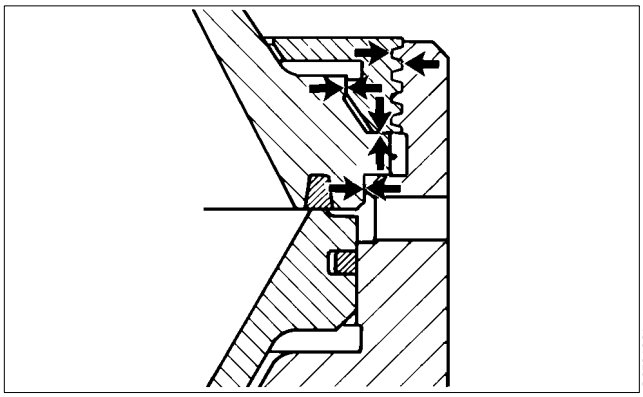
Same as described in section “5.3.10 Level ring” on page 61.

5.4.16 Lock ring; priming

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

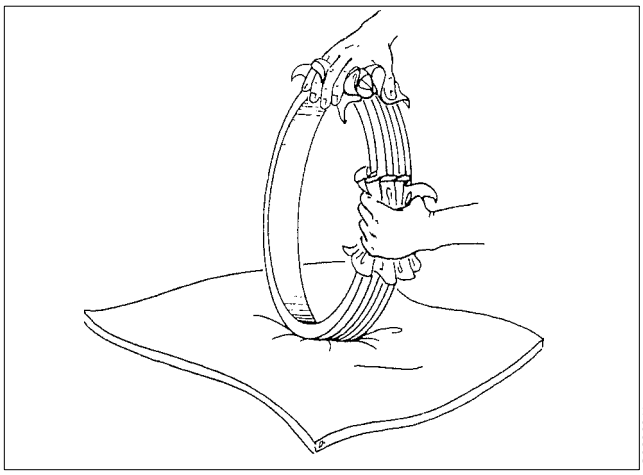
Recommended agents for priming procedure:

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

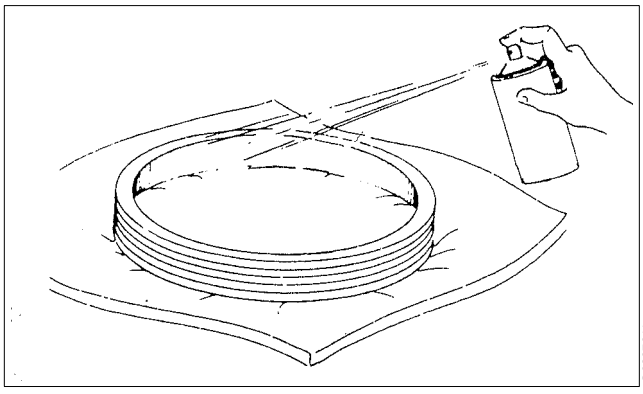


Threads, guide and contact surfaces to be primed

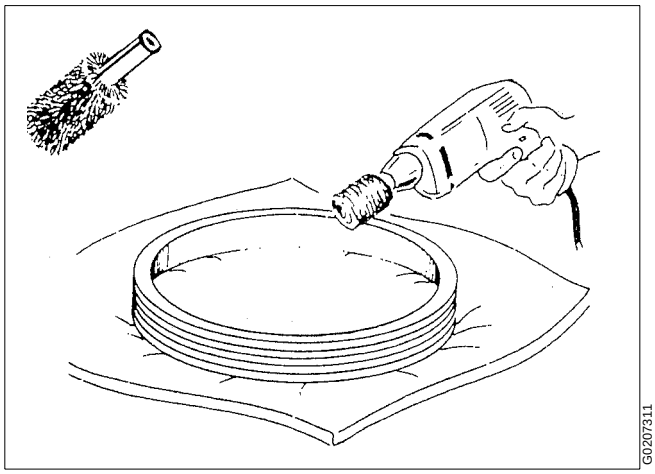
1. Clean the lock ring thoroughly with a degreasing agent and wipe it off.



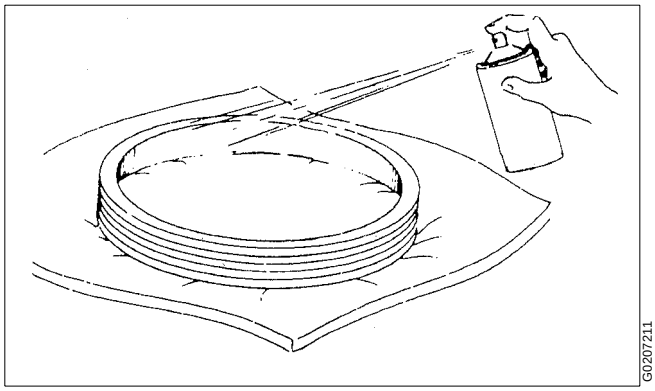
2. Spray the threads, guide and contact surfaces with slide lacquer Molykote 321 R. Let the lacquer air-cure for about 15 minutes.



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.

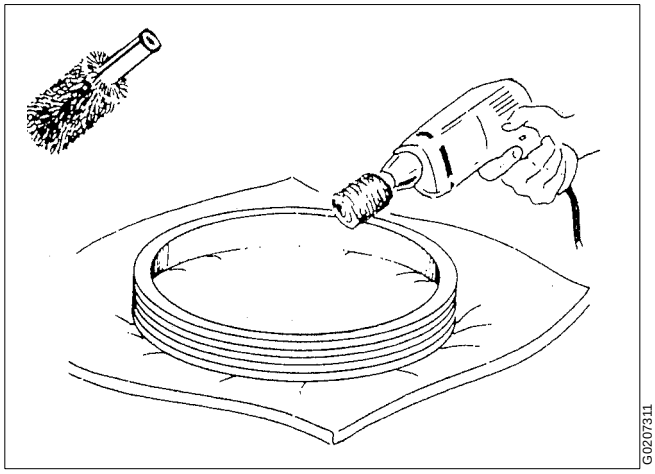


4. Spray the lock ring a second time and let it dry for about 15 minutes.



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 61.

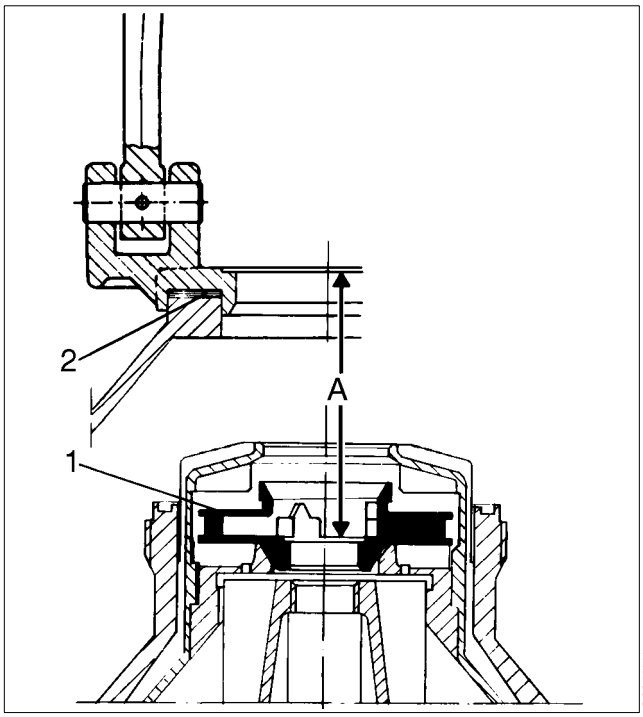
5.4.18 Oil paring disc; height position

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 **95 ±0,5 mm**.
- Adjust the distance by adding or removing height adjusting rings (2).

With inlet and outlet parts mounted:

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



Measurement of distance A

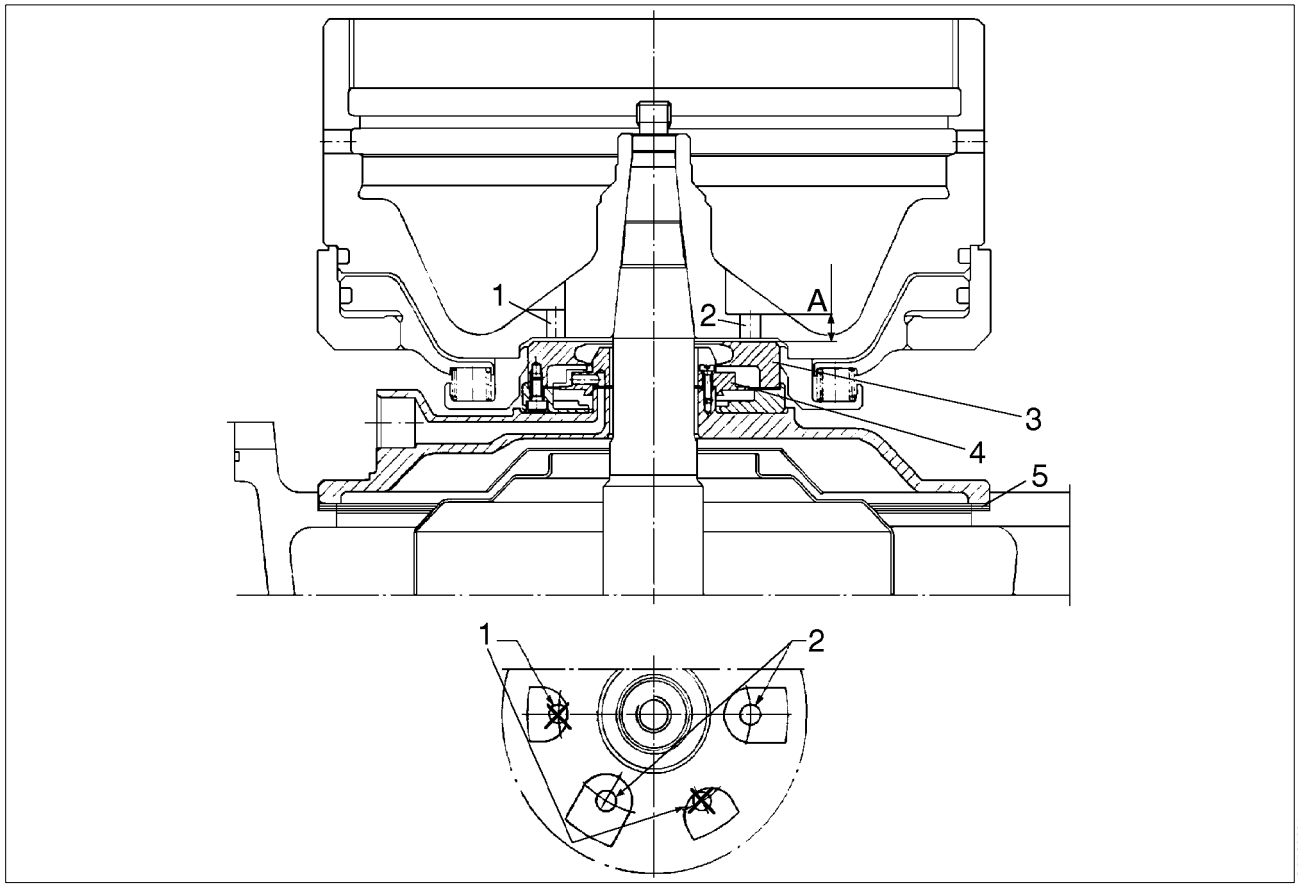
5.4.19 Operating mechanism

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

5.4.20 Operating paring disc; height position

Incorrect height position may cause the control paring disc (4) to scrape against the paring chamber housing.

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



A. Distance to measure

1. *Smaller holes*
2. *Screw holes*
3. *Distributing ring*
4. *Control paring disc*
5. *Height adjusting rings*

- Before starting to measure the height position, the following parts must be mounted in the separator:
  - the operating paring disc device
  - the bowl body with mounted bottom parts.

- Measure, through any of the three screw holes (2), the distance between the surface for the screw head to the upper surface of the distributing ring (3). Use a sliding calliper.

NOTE

Measure through any of these holes (2) only and **not** through the somewhat smaller holes (1) for the closing water.

The height (A) must be **12 ±0,5 mm**.

- Adjust the height by adding or removing height adjusting rings (5) under the distributing cover.
- After adjustment rotate the spindle. If a noise is heard, readjust the height.

5.4.21 Operating slide

Same as described in section “5.3.13 Operating slide” on page 63.

5.4.22 Sliding bowl bottom

Same as described in section “5.3.15 Sliding bowl bottom” on page 65.

5.4.23 Springs for operating mechanism

Same as described in “5.3.16 Springs for operating mechanism” on page 66.

5.4.24 Worm wheel and worm; wear of teeth

Same as described in section “5.7.1 Worm wheel and worm; wear of teeth” on page 88.

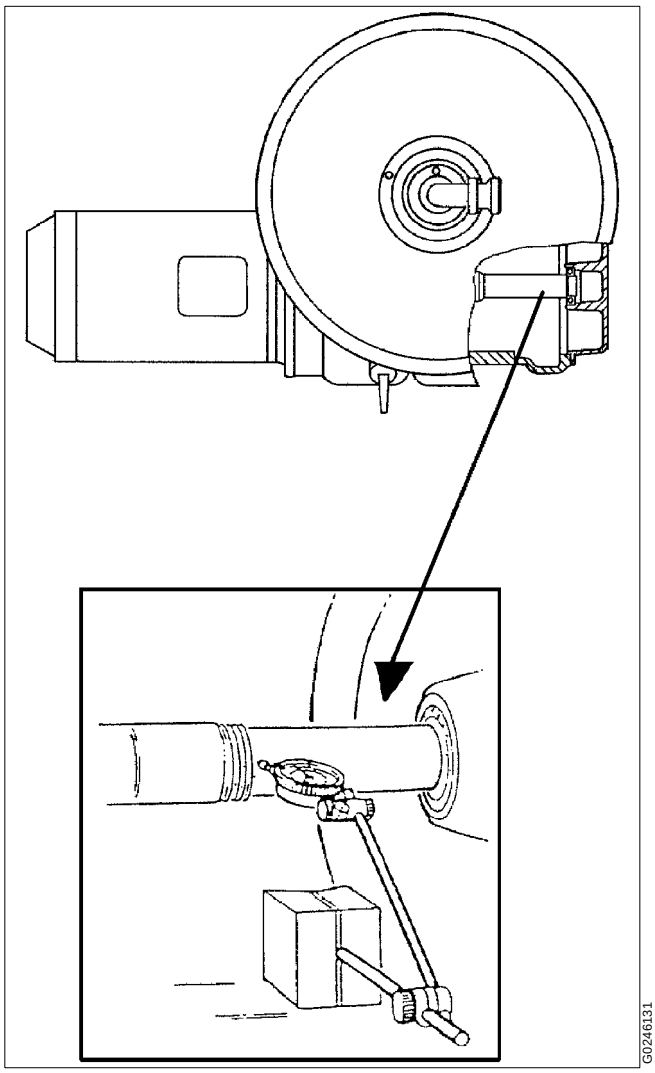
5.4.25 Worm wheel shaft; radial wobble

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

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

Permissible radial wobble is **max. 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

5.4.26 Cover interlocking switch (option)

Same as described in “5.3.17 Cover interlocking switch (option)” on page 66.

5.4.27 Vibration switch (option)

Same as described in “5.3.18 Vibration switch (option)” on page 67.

5.5 Lifting instructions

Attach two endless slings or cables to the separator frame as illustrated.

Length of each sling must be min. 1,5 metres.

NOTE

Machine weight without frame hood and bowl is approx. 500 kg.

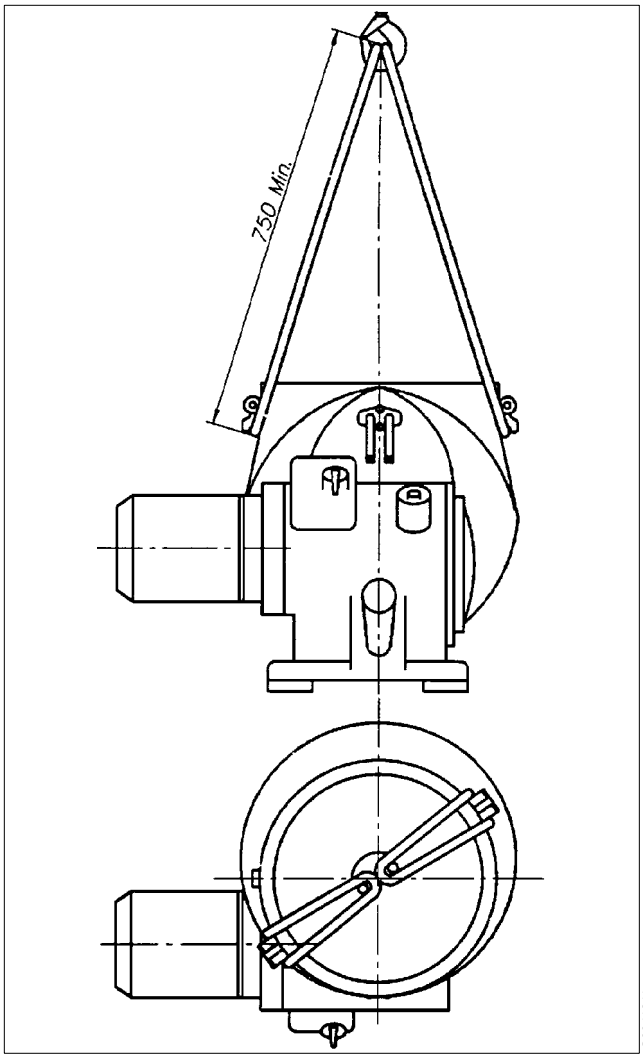
Do not lift the separator unless the frame hood and bowl have been removed.

WARNING

Crush hazards

Lift the separator in no other way than illustrated.

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



Lift the separator with the frame hood and bowl removed

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

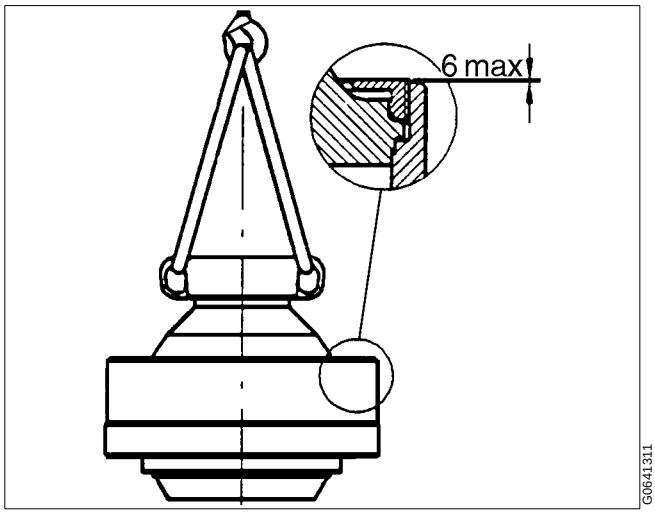
NOTE

Check that the lock ring is properly tightened.

The height of the lock ring above the bowl body must not exceed 6 mm, see illustration.

Weight to lift is approx. 70 kg.

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



The lock ring must be properly tightened when lifting the bowl

5.6 Cleaning

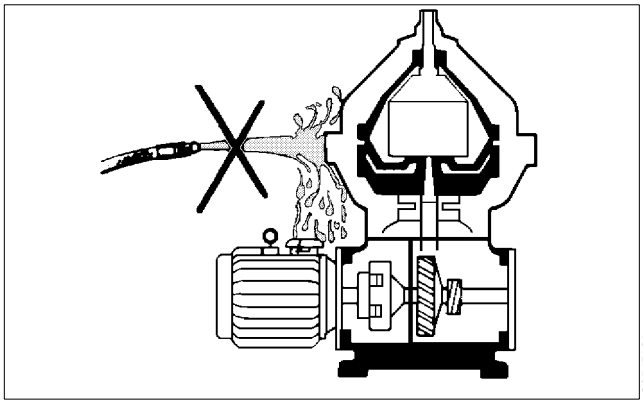
5.6.1 External cleaning

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.

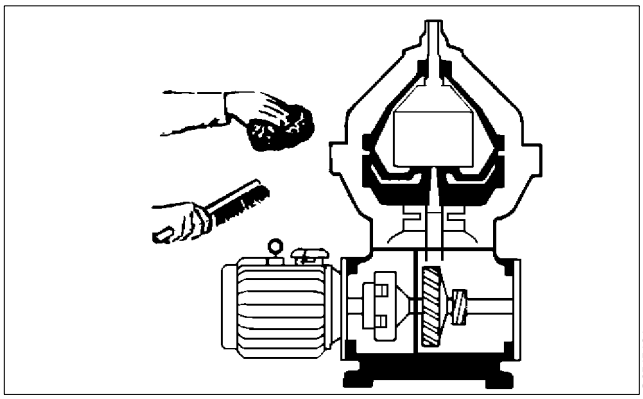
Never wash down a separator with a direct water stream. Totally enclosed motors can be damaged by direct hosing to the same extent as open motors and even more than those, because:

- 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.

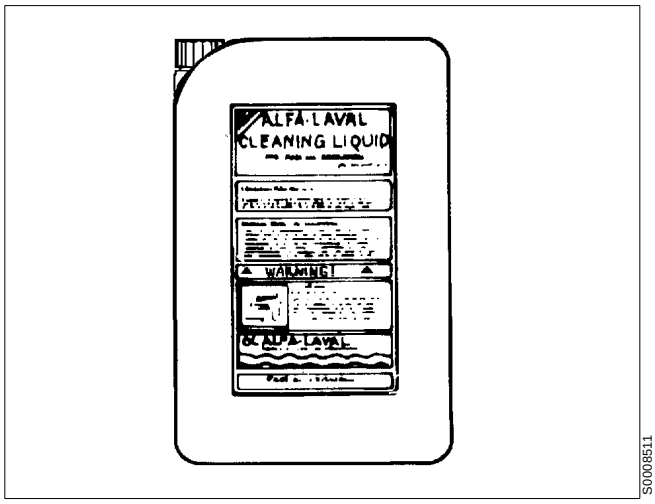
For separator bowl, inlet and outlet

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.

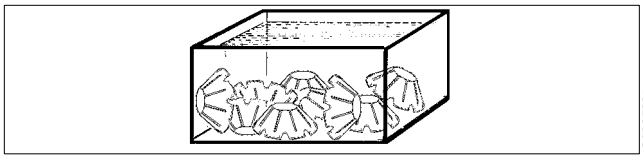
5.6.3 Cleaning of bowl discs

Bowl discs

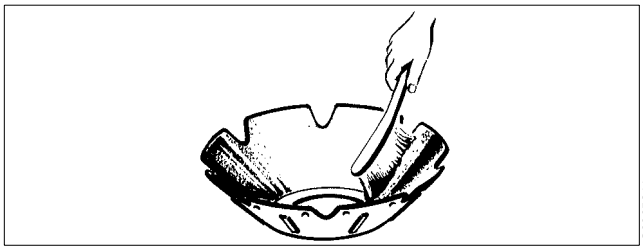
Handle the bowl discs carefully so as to avoid damage to the surfaces during cleaning.

> **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.



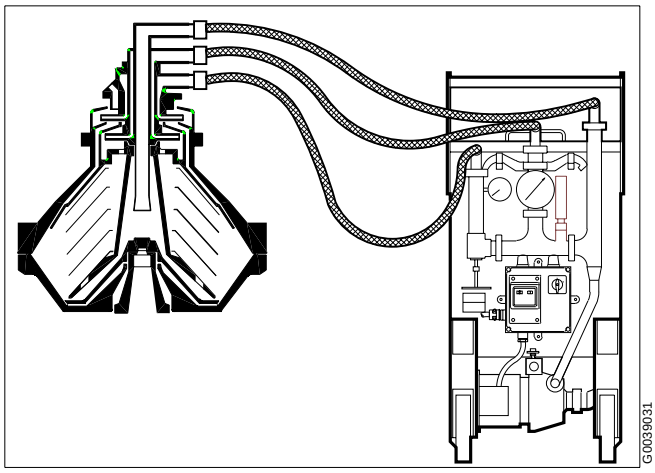
Put the discs one by one into the cleaning agent



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

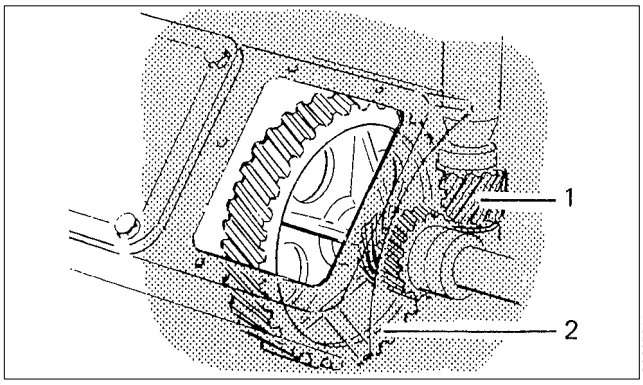
Check the teeth of both the worm wheel and worm for wear.

See the “ Tooth appearance examples” on page 89. 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 165 for correct number of teeth.

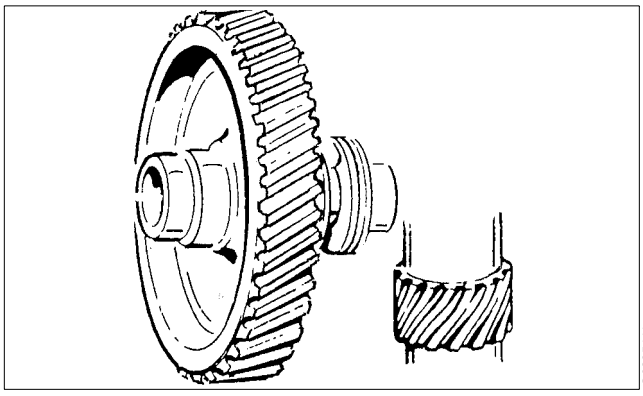


1 Worm
2 Worm wheel

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.

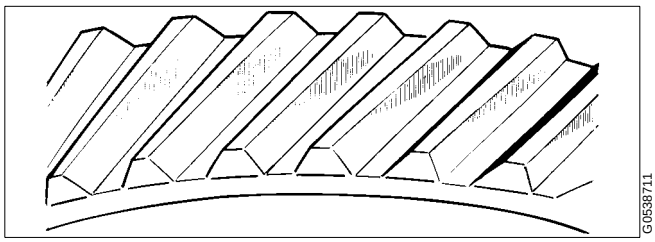
For further information, see chapter “8.4 Lubricants” on page 172.

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.

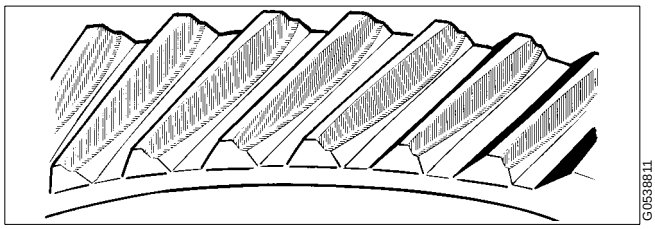


Satisfactory teeth

Worn teeth:

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

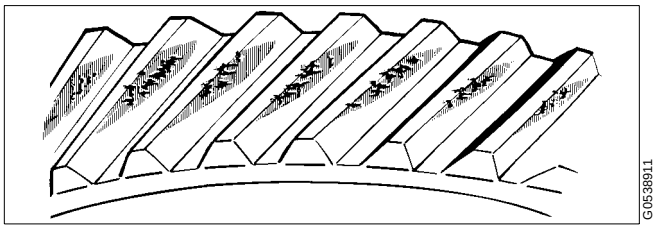
- the wear is uniform over the whole of the flank of a tooth
- and all teeth are worn in the same way.



Worn teeth

Spalling:

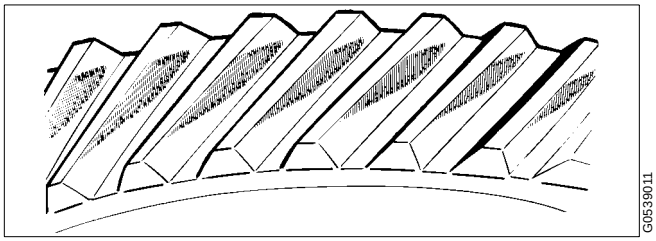
Small bits of the teeth have broken off, so-called spalling. This is generally due to excessive load or improper lubrication. Damage of this type need not necessitate immediate replacement, but careful checking at short intervals is imperative.



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.

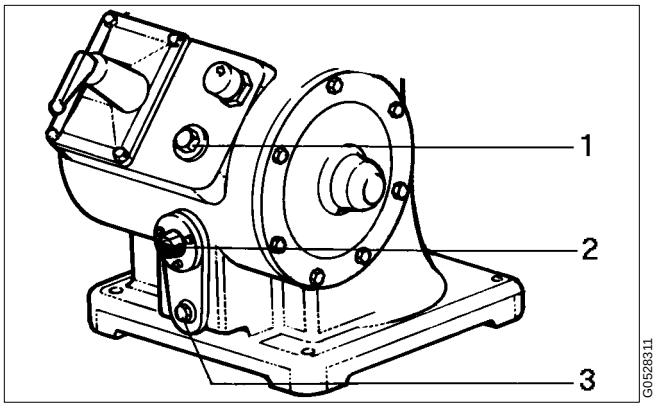


Pitting

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 “8.4 Lubricants” on page 172 must be well known.



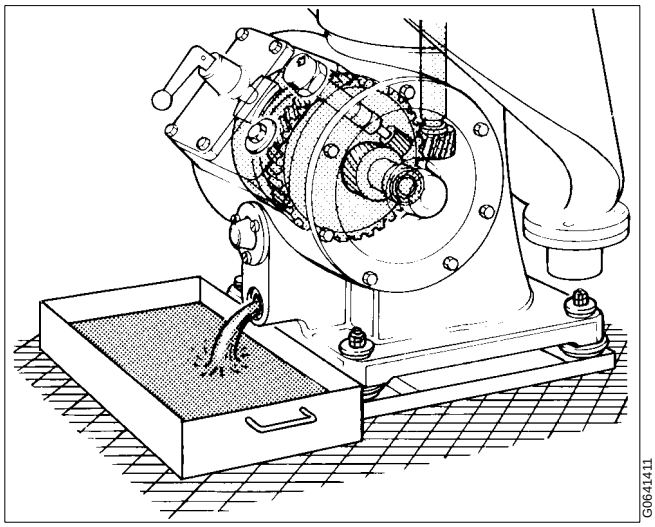
1. *Oil filling plug*
2. *Sight glass*
3. *Oil drain plug*

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

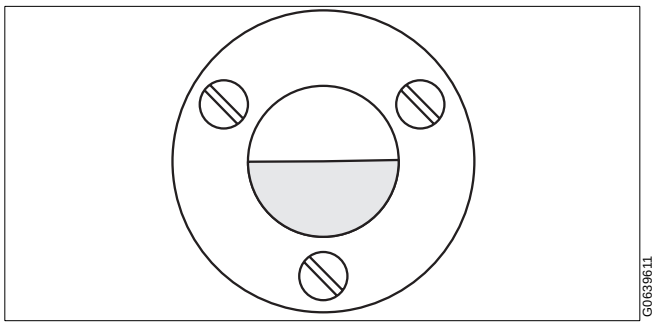
2. Fill new oil in the worm gear housing. The oil level should be slightly above the middle of the sight glass.

   Oil volume: approx. 4,1 litres.

NOTE

During operation the oil level is normally just visible in the lower part of the sight glass.

Too much or too little oil can damage the separator bearings.



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

5.8 Vibration

5.8.1 Vibration analysis

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

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

NOTE

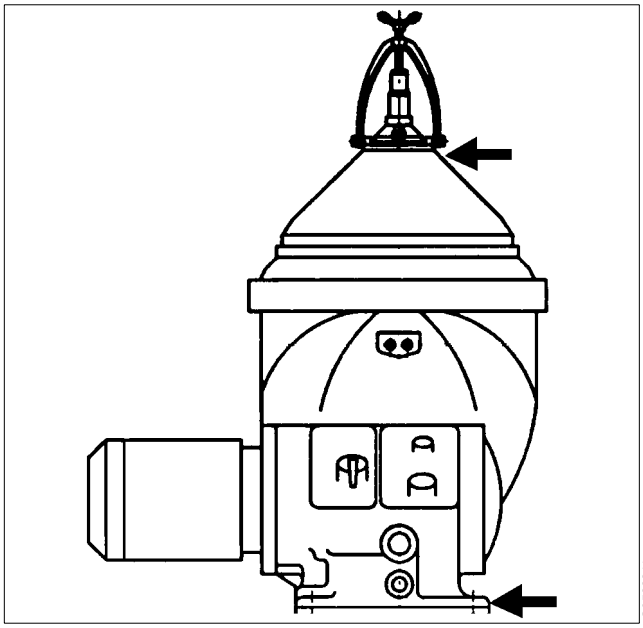
The level of vibration should not exceed **7,1 mm/s** at full speed.

DANGER

Disintegration hazards

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

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



Measuring points for vibration analysis

5.8.2 Vibration switch (option)

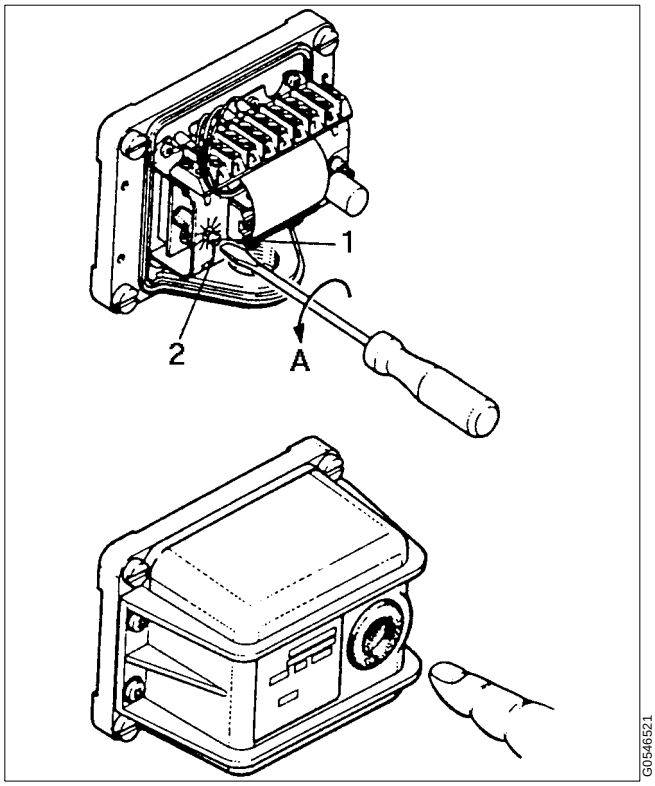
Adjustment of setpoint

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

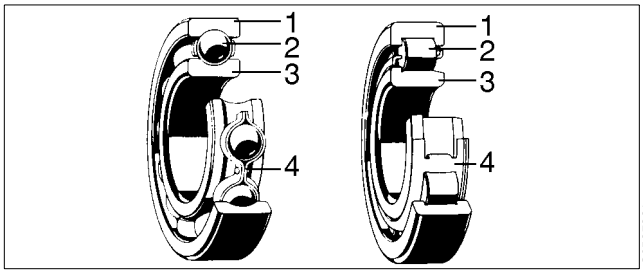
5.9.1 Ball and roller bearings

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

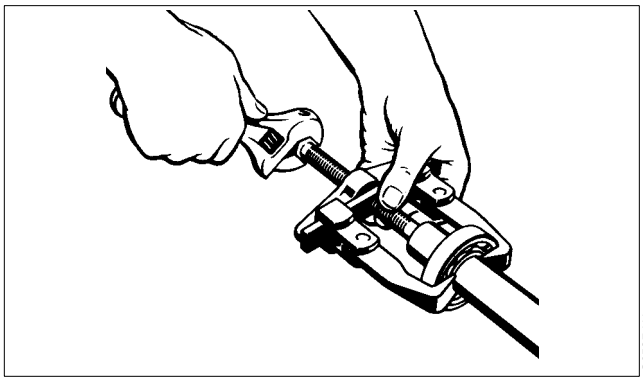
NOTE
Using an incorrect bearing can cause a serious breakdown with damage to equipment as a result.

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

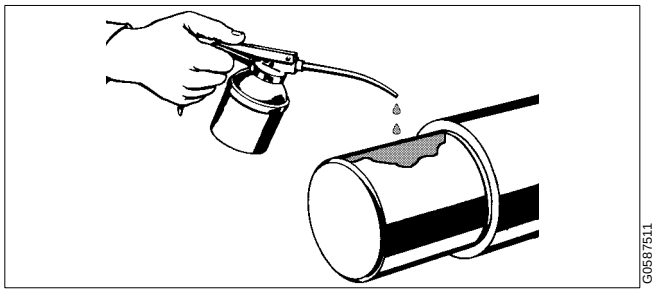
Do not hit with a hammer directly on the bearing.

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

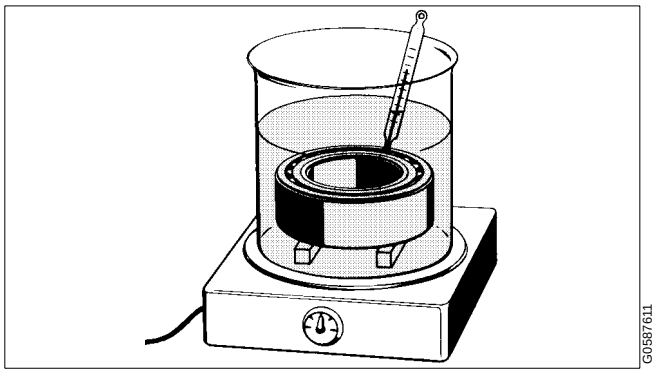
- When assembling ball bearings, the bearings must be heated in oil to max. 125 °C.

NOTE

Heat the bearing in a clean container.

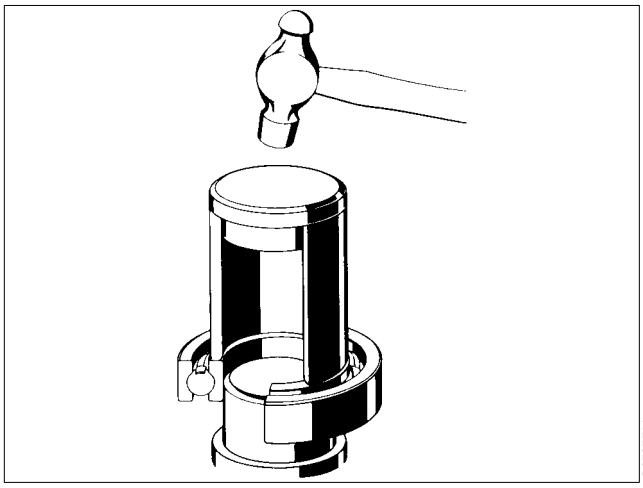
Use only clean oil with a flash point above 250 °C.

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

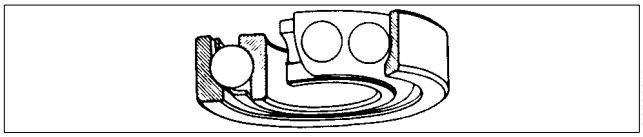
- There are several basic rules for assembling cylindrical bore bearings:
  - Never directly strike a bearing's rings, cage or rolling elements while assembling. A ring may crack or metal fragments break off.
  - Never apply pressure to one ring in order to assemble the other.
  - Use an ordinary hammer. 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 99.

NOTE

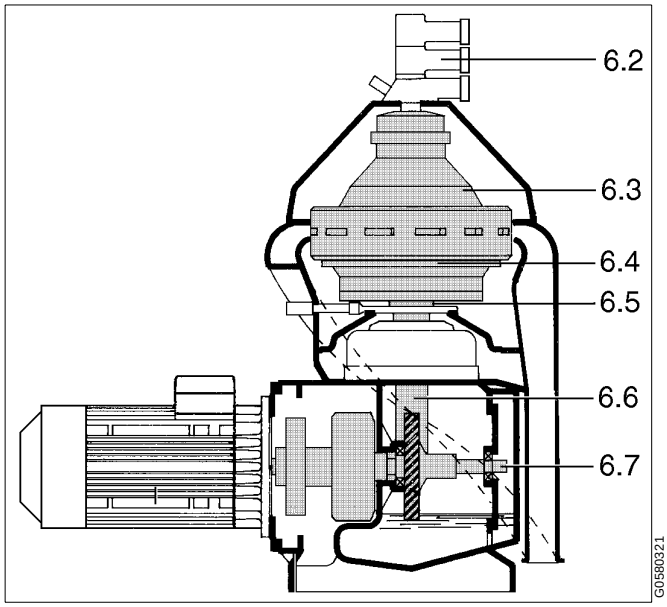
The bowl must not be left on the spindle during standstill for more than one week.

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.

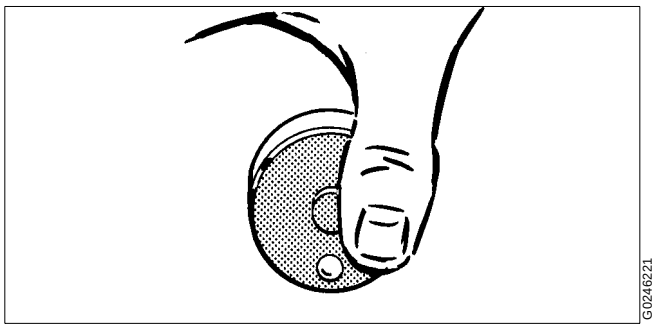
The recommended intervals are stated in chapter “5.1.2 Maintenance intervals” on page 41.

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 55.

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

6.1.3 Tools

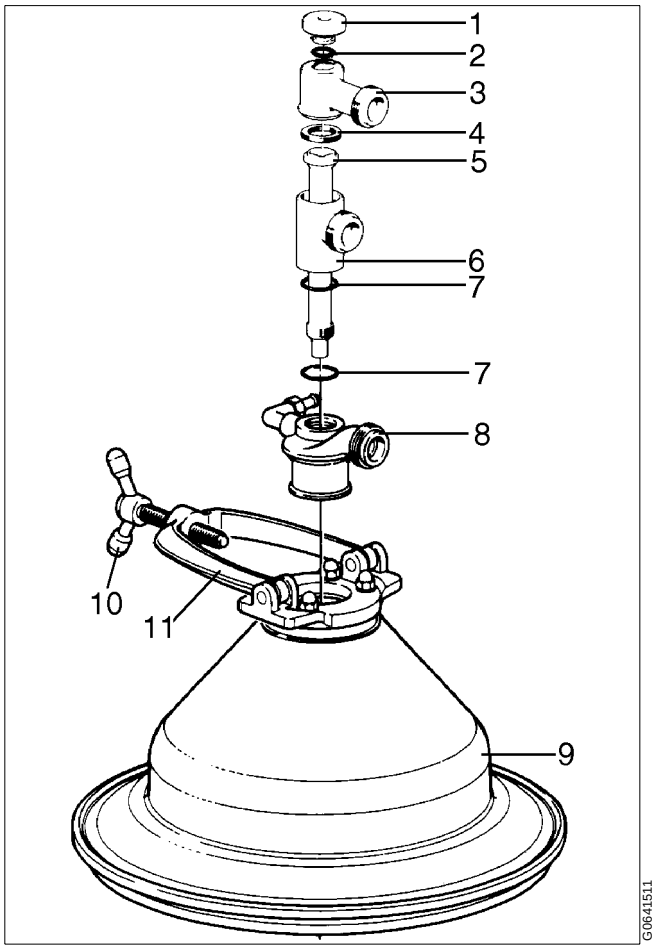
Special tools from the tool kit must be used for dismantling and assembly. The special tools are specified in the Spare Parts Catalogue and are shown as illustrations together with the dismantling/assembly instructions.

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. *O-ring*
8. *Connecting housing*
9. *Frame hood*
10. *Clamp screw*
11. *Clamping stirrup*



6.2.2 Dismantling

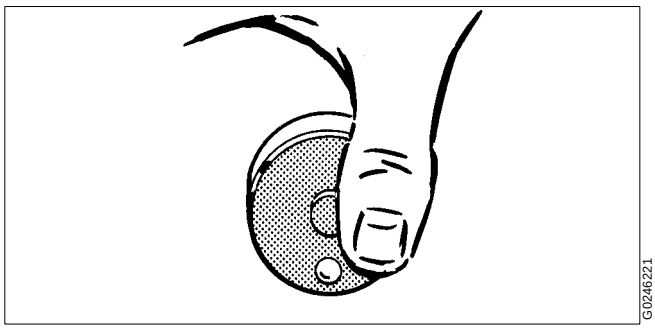
DANGER

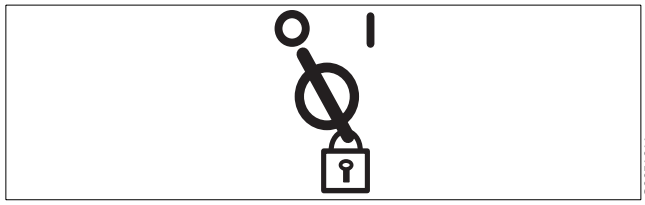
Entrapment hazards

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.

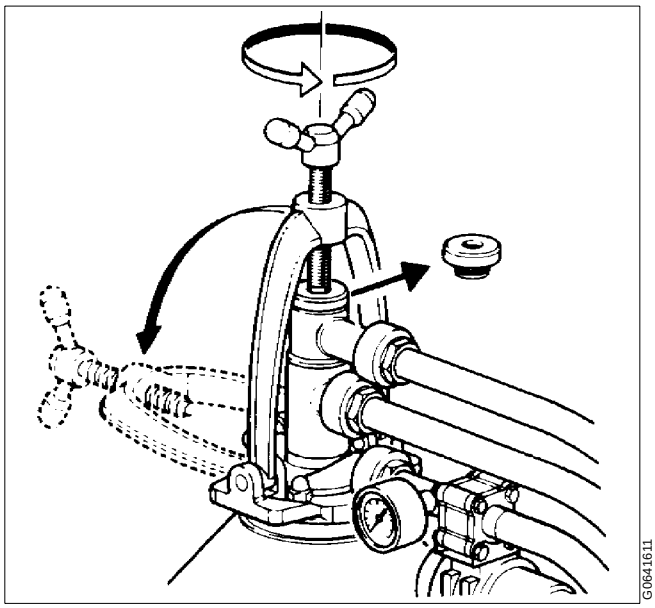
2. To avoid accidental start, switch off and lock power supply before starting **any** dismantling work.





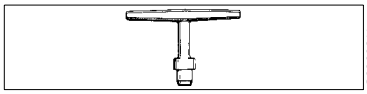
The parts must be handled carefully. Don't place parts directly on the floor, but on a clean rubber mat, fibreboard or a suitable pallet.

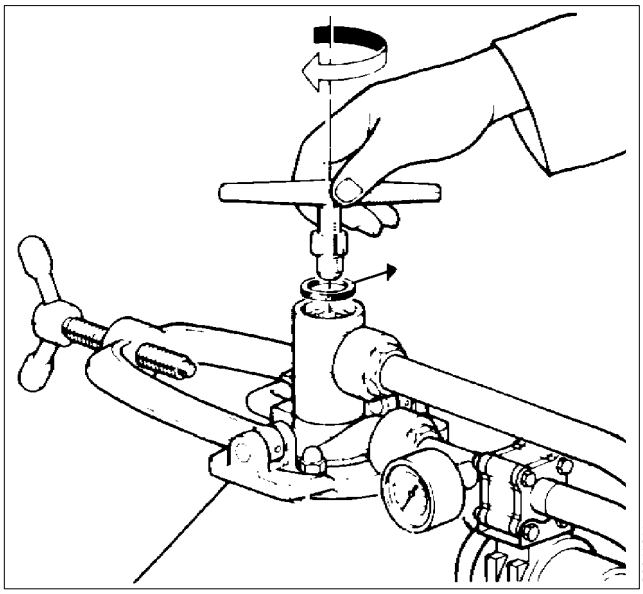
1. Loosen the clamp screw and lower the clamping stirrup. Remove the plug.
2. Undo the coupling nuts of inlet and outlet piping at the pipe support. Swing aside the feed pipe.



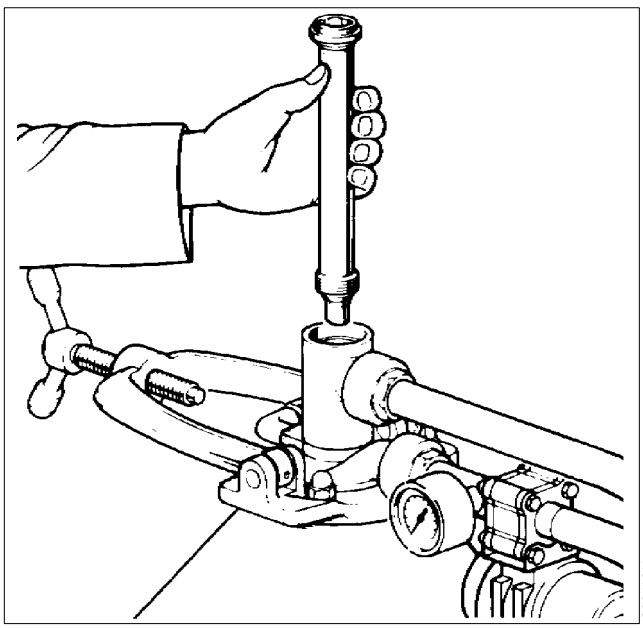
3. Unscrew the inlet pipe using the special pin spanner.

   Left-hand thread!

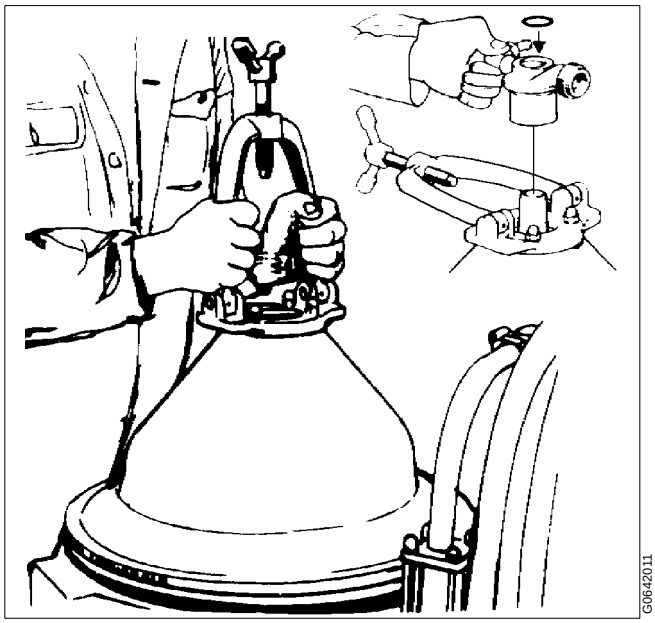




4. Remove the inlet pipe.
5. Swing aside the oil outlet pipe. Loosen the coupling nut of the connection housing.



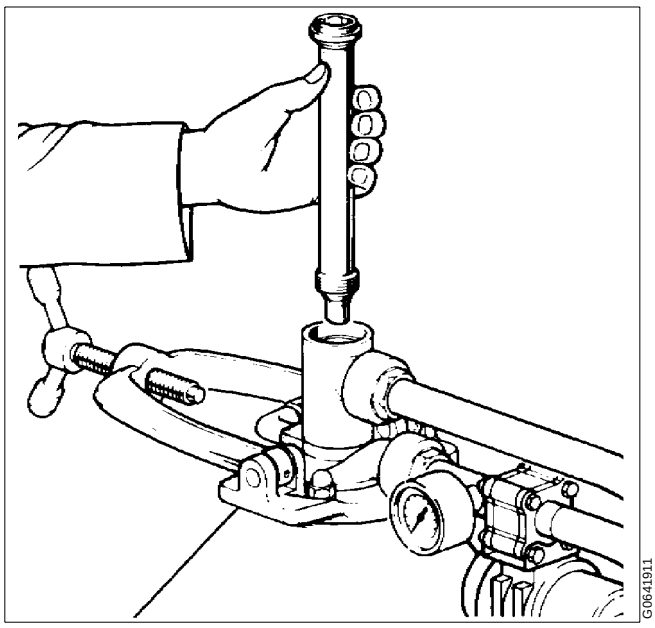
6. Remove the connection housing.
7. Unscrew the four hinged bolts holding the frame hood at lift it off. If necessary, use a hoist.



6.2.3 Assembly

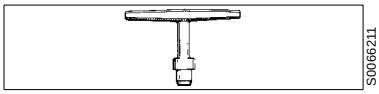
✔ **Check point**
"5.3.14 Sight glass" on page 64.

1. Put the frame hood in place and tighten it with the four hinged bolts.
2. Lubricate the sealing rings for the inlet/outlet device with silicone grease. Renew the sealing rings at each Intermediate Service (IS).
3. Fit the connection housing. Note its angular position on the upper paring disc.
4. Connect the water outlet pipe and oil outlet pipe. Do not tighten the coupling nuts yet.
5. Fit the inlet pipe.

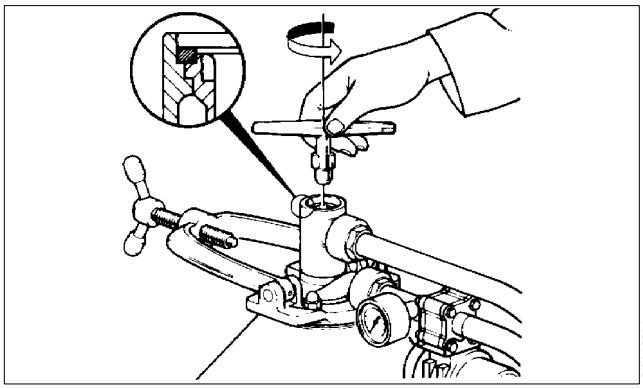


6. Tighten the inlet pipe properly using the special pin spanner.

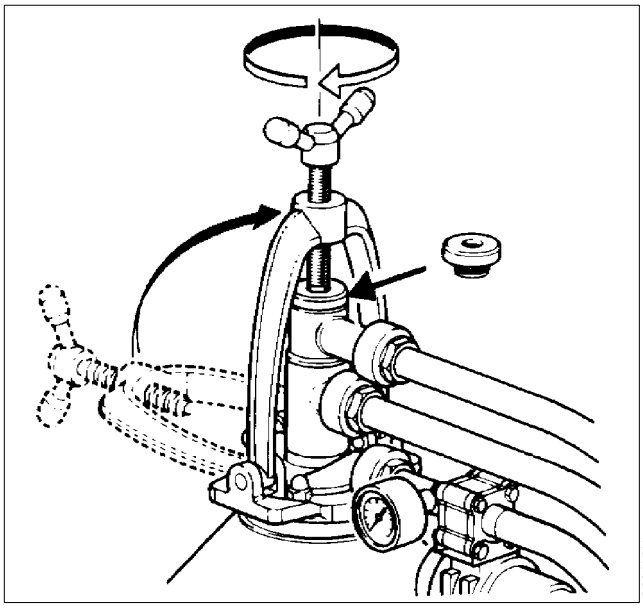
   Left-hand thread!



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



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



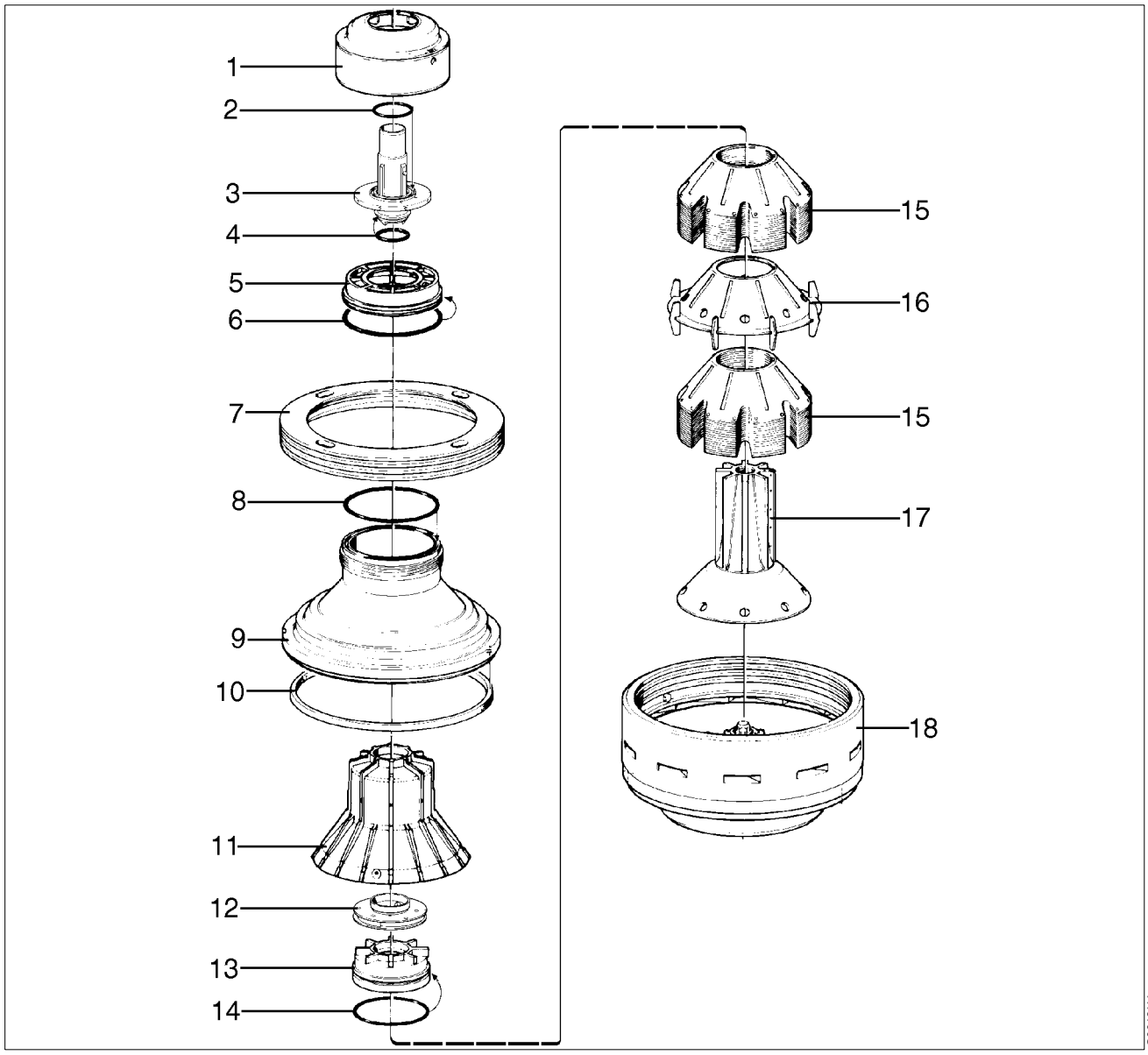
DANGER

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

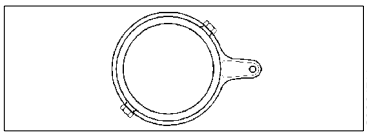


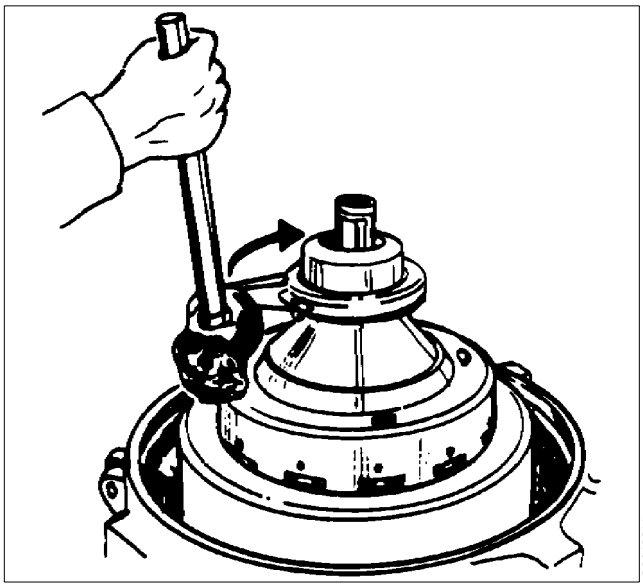
1. *Paring chamber cover (small lock ring)*
2. *O-ring*
3. *Upper paring disc*
4. *O-ring*
5. *Flow control disc*
6. *O-ring*
7. *Lock ring*
8. *O-ring*
9. *Bowl hood*
10. *Seal ring*
11. *Top disc*
12. *Oil paring disc*
13. *Level ring*
14. *O-ring*
15. *Bowl disc*
16. *Wing insert*
17. *Distributor*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

6.3.2 Dismantling

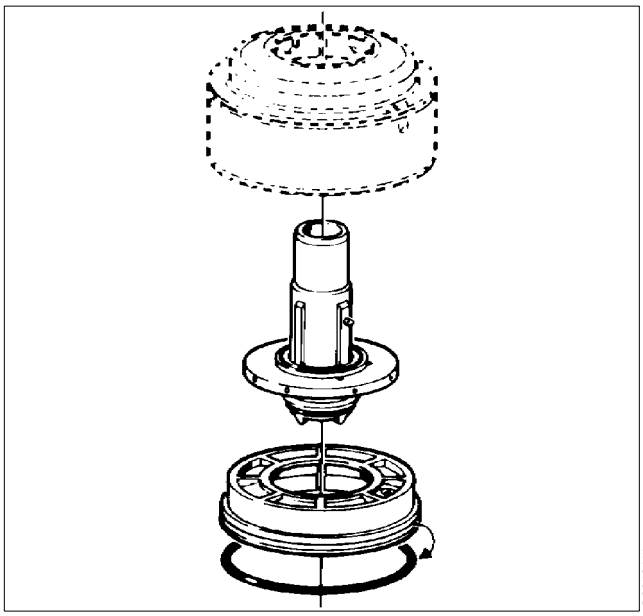
1. Unscrew the paring chamber cover using the spanner.

   Left-hand thread!

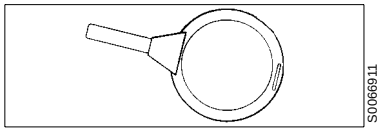


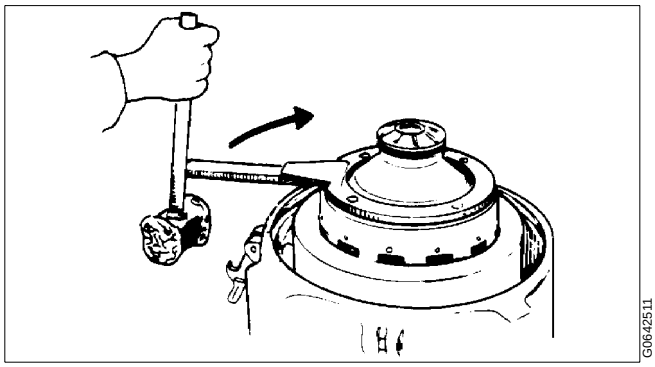


2. Force out the flow control disc and the upper paring disc from the cover.



3. Apply the brake and unscrew the lock ring**.**
   Left-hand thread!

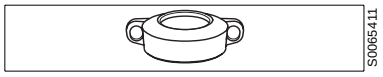


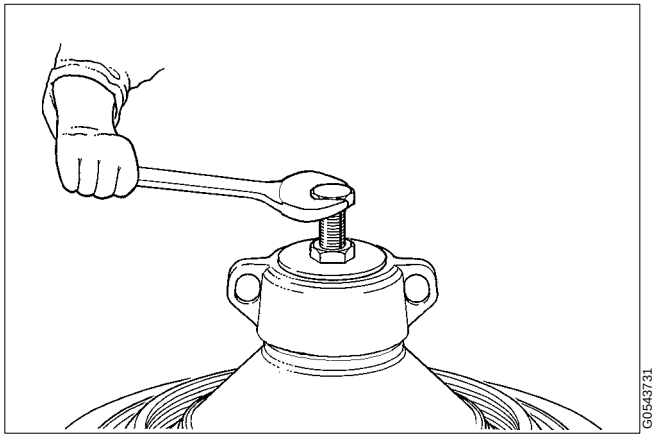


NOTE

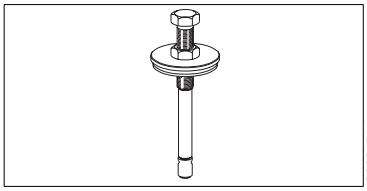
After removing the lock ring it must be kept lying horizontally or it may become distorted. Even slightest distortion could make it impossible to refit.

4. Fit the lifting tool on the bowl hood.

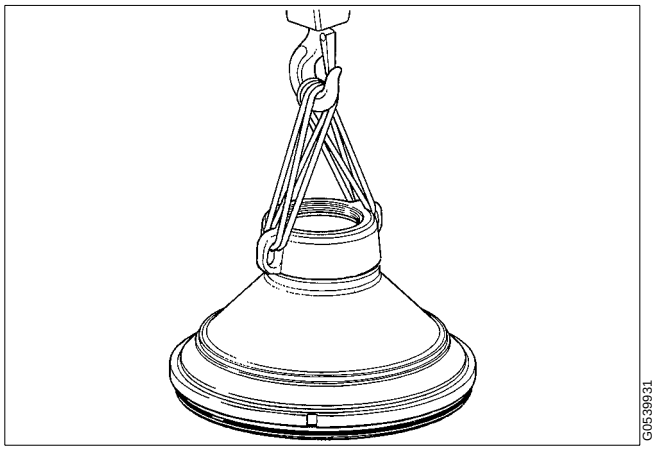




5. Screw the spindle plate into the lifting tool. Unscrew the spindle a few turns if the plate is not in contact with the lifting tool.



6. Screw home the spindle with the wrench until the bowl hood loosens from the bowl body.
7. Remove the spindle plate from the lifting tool.
8. Lift off the bowl hood using hoist. Be careful not to scratch the bowl hood seal ring.



CAUTION

Crush hazards

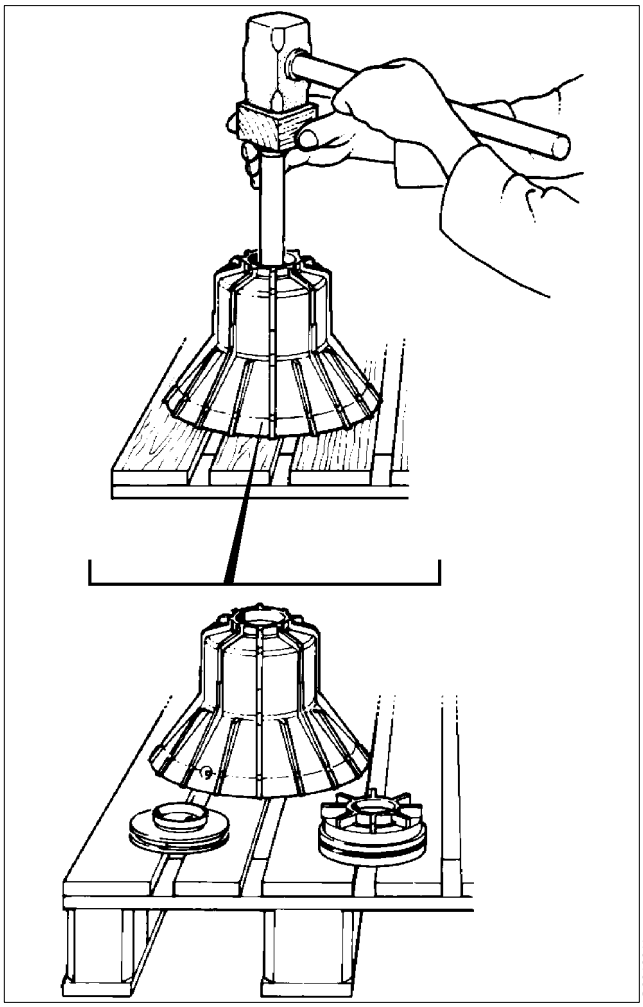
If the top disc is stuck into the bowl hood, remove it now before it accidentally falls out.

9. Remove the top disc.

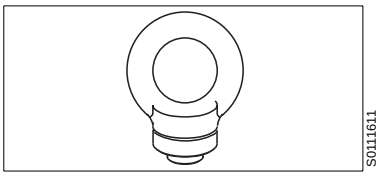
10. Screw the inlet pipe into the paring disc located above the level ring inside the top disc.

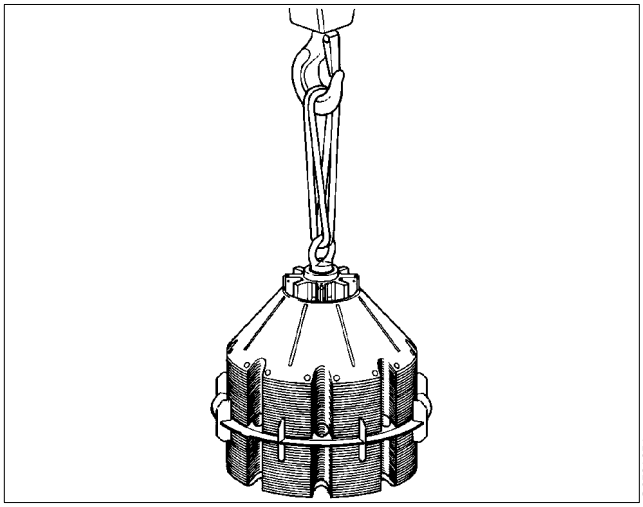
    Left-hand thread!

    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.



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





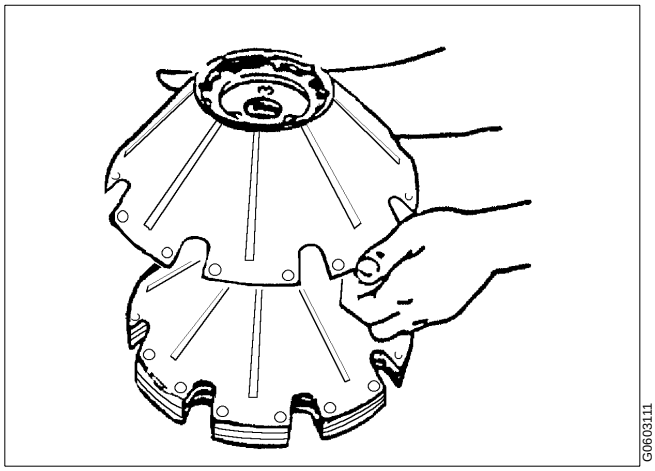
12. Remove deposits and clean all parts thoroughly in a suitable cleaning agent. See chapter “5.6 Cleaning” on page 84.

6.3.3 Assembly

✔ **Check point**

"5.3.3 Corrosion" on page 52,
"5.3.4 Cracks" on page 54,
"5.3.7 Erosion" on page 56,
"5.3.11 Lock ring; wear and damage" on page 61.

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



CAUTION

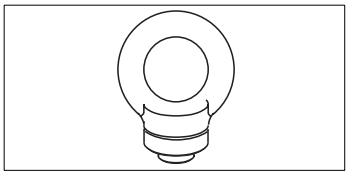
Cut hazard

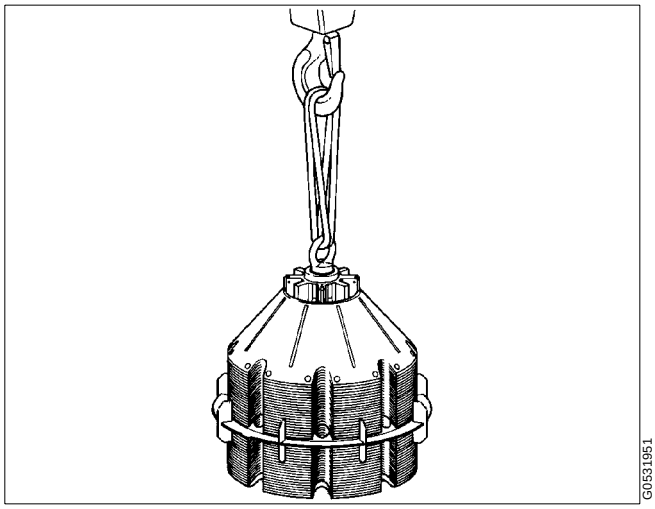
Sharp edges on the separator discs may cause cuts.

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.



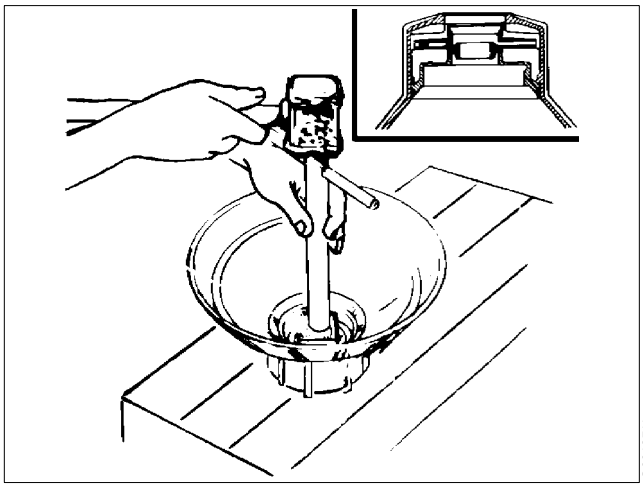


Check that the guide pins in the distributing cone fit into the recesses on the underside of the distributor.

✔ **Check point**
"5.3.10 Level ring" on page 61.

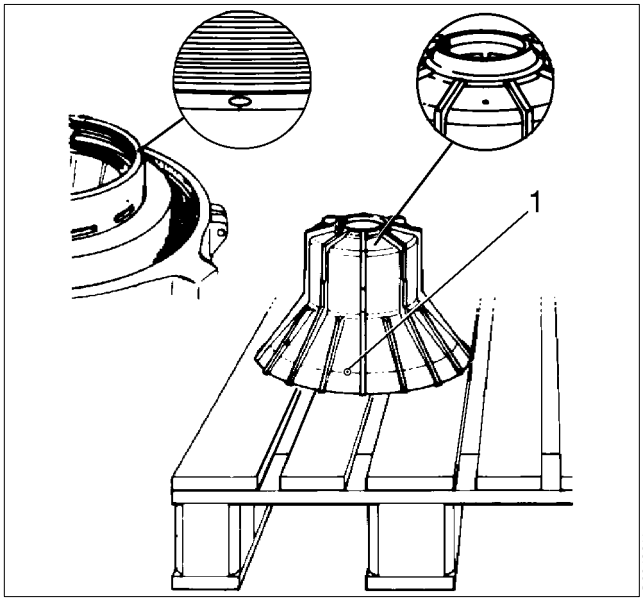
3. Fit the oil paring disc and level ring with O-ring into the top disc.

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



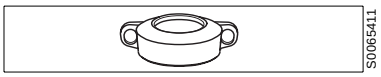
4. Check that the small hole (1) in the top disc is not clogged.

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



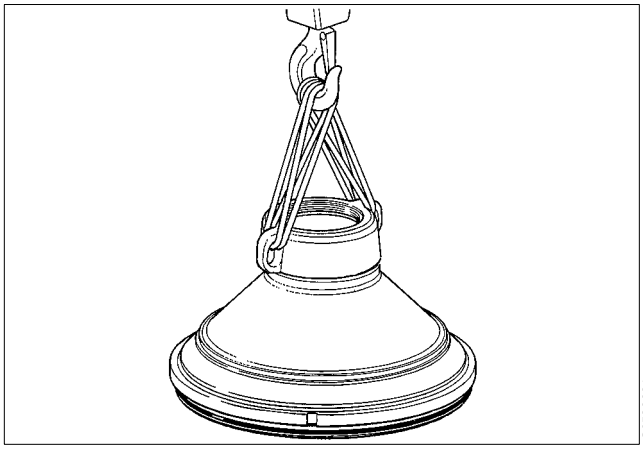
✔ **Check point**
"5.3.1 Bowl hood seal ring" on page 51.

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

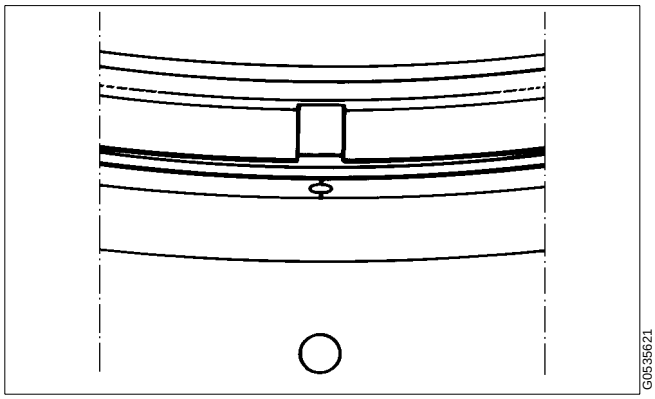


   Lower the bowl hood straight down onto the disc stack, otherwise it may get stuck. Be careful not to scratch the bowl hood seal ring.

   For correct position of bowl hood, see next illustration.

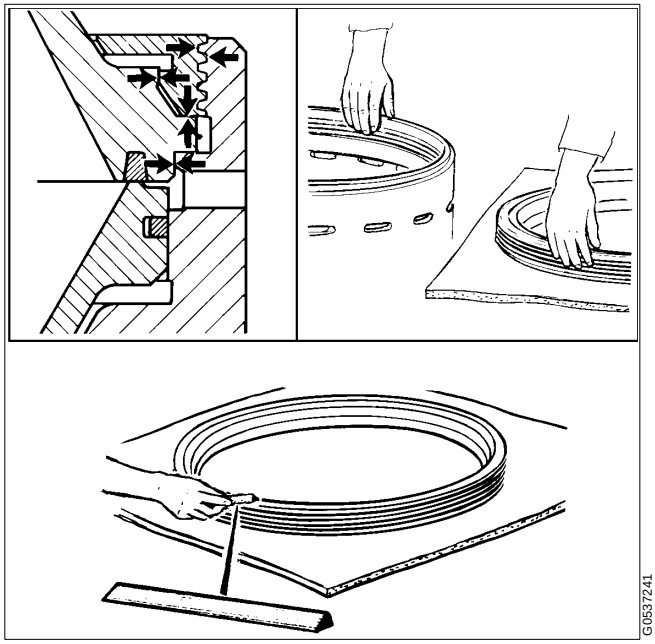


6. Check that the guide recess on the bowl hood enters the guide lug in the bowl body.



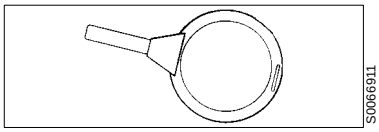
7. Remove the lifting tool.
8. Lubricate the lock ring threads, contact and guide surfaces with lubricating paste.

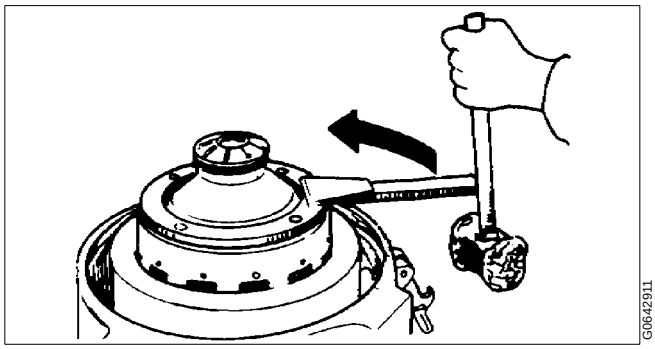
✔ **Check point**
"5.4.16 Lock ring; priming" on page 76 (only when Major Service).



9. Tighten the lock ring.

Left-hand thread!

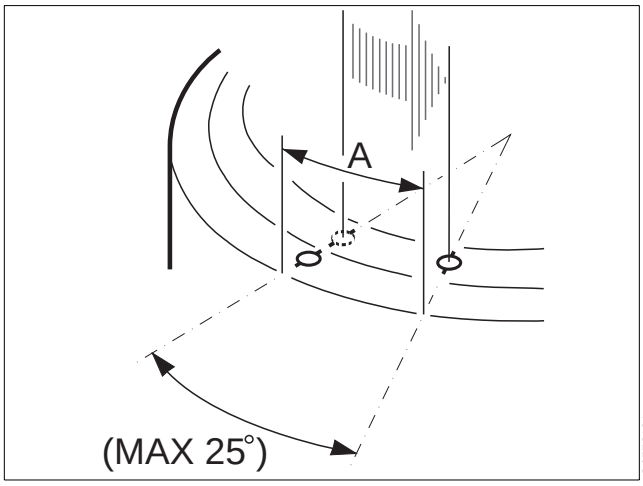




10. Tighten until the assembly marks are at least in line.

✔ **Check point**
"5.3.5 Disc stack pressure" on page 55.

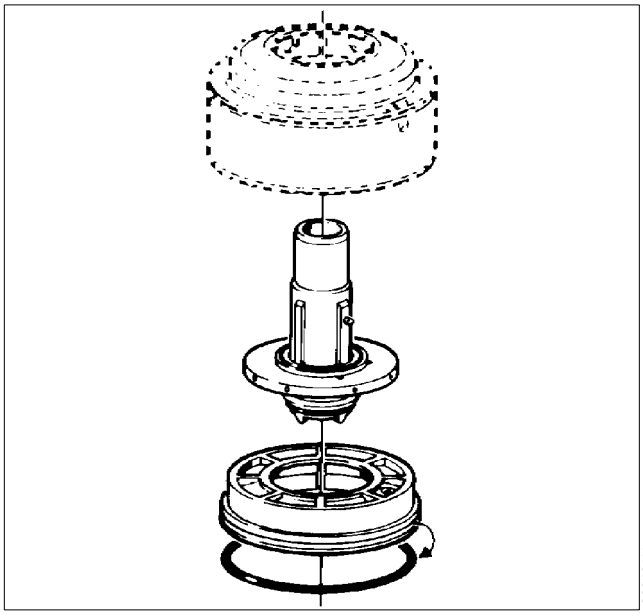
NOTE
The assembly marks must never pass each other more than 25° which corresponds to A=60 mm.



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

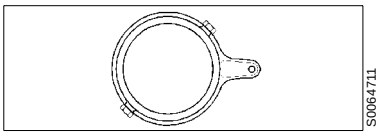
    Fit the upper paring disc and the flow control disc with O-ring into the paring chamber cover.

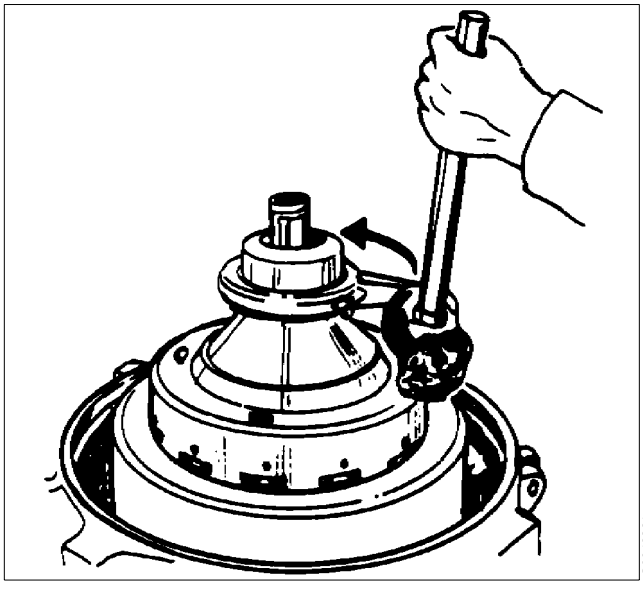
✔ **Check point**
"5.3.9 Inlet pipe and oil paring disc" on page 61.



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

    Left-hand thread!

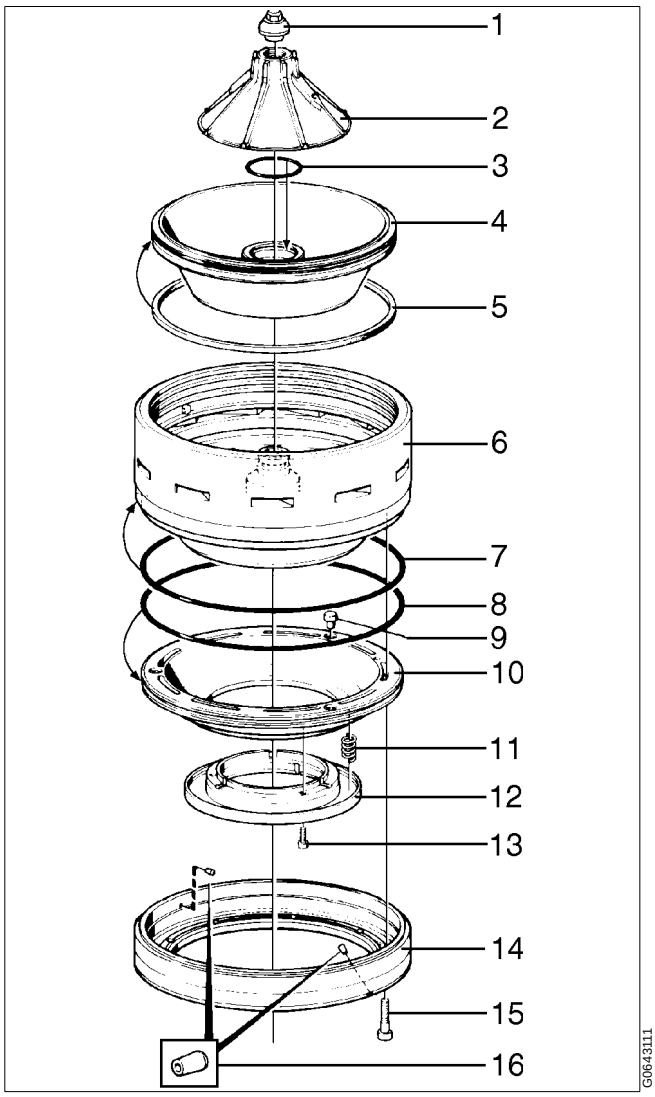




6.4 Bowl body and operating mechanism (IS)

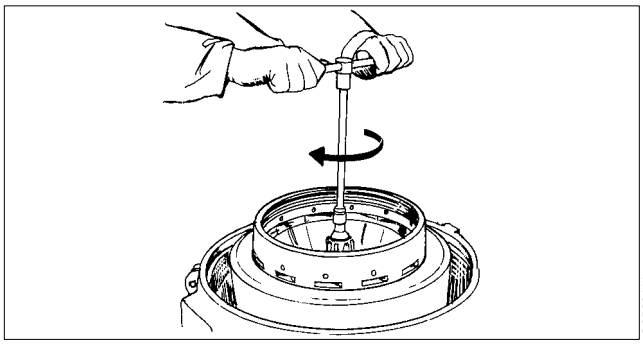
6.4.1 Exploded view

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

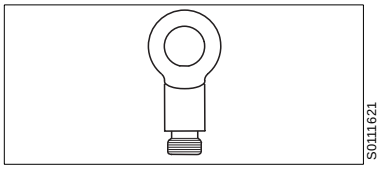


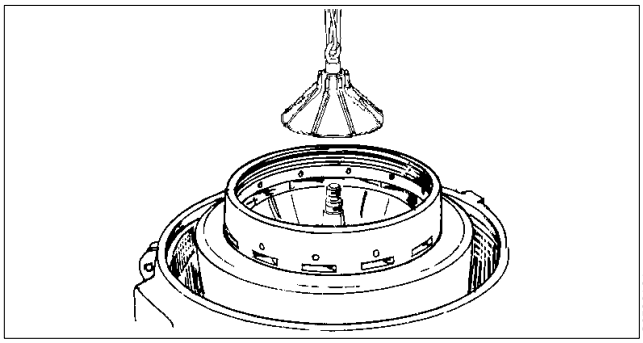
6.4.2 Dismantling

1. Unscrew and remove the cap nut.
   Left-hand thread!

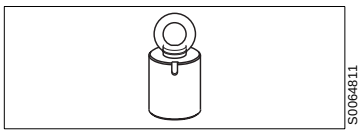


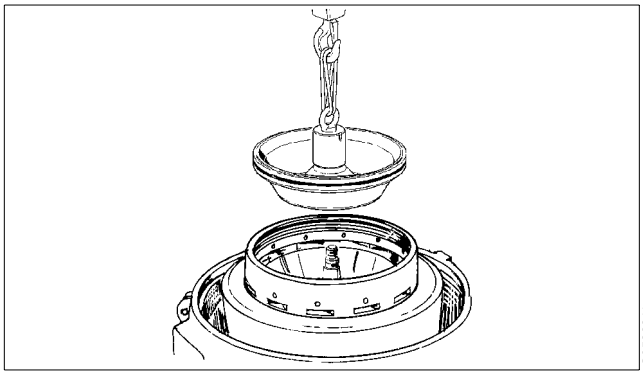
2. Fit the lifting tool into the distributing cone and lift it out.



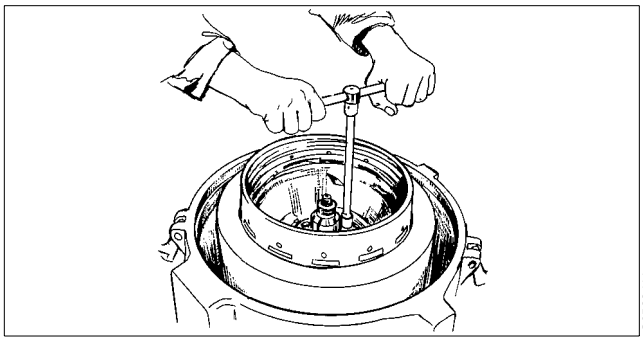


3. Fit the lifting tool onto the sliding bowl bottom and lift it out by hoist.

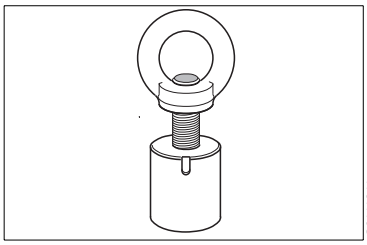




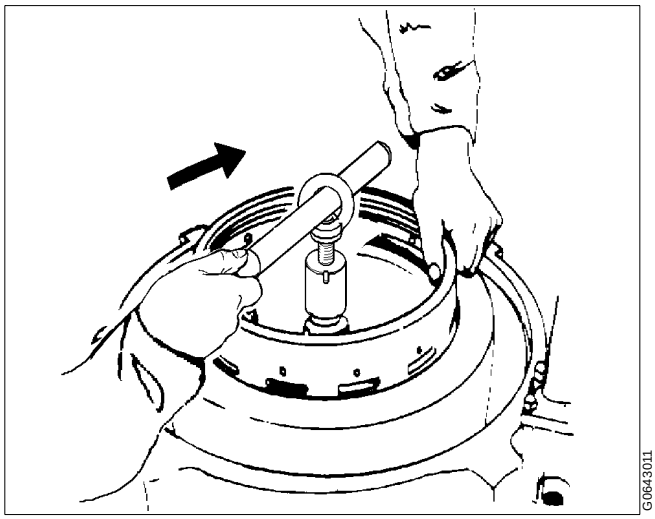
4. Unscrew the three screws in the bottom of the bowl body.



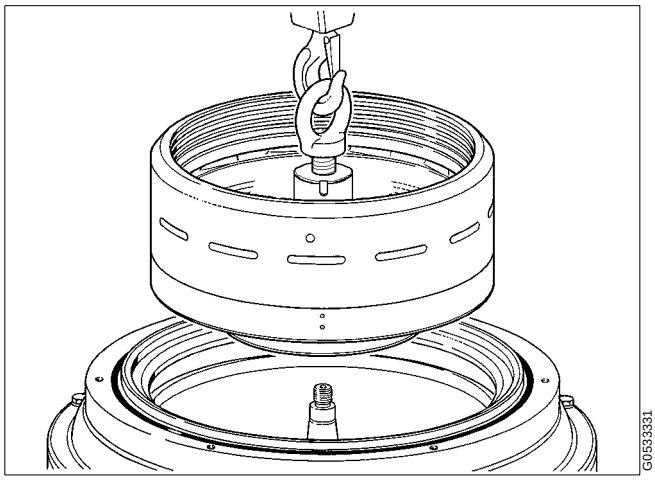
5. Fit the lifting tool onto the bowl body bottom. If necessary, unscrew the central screw.



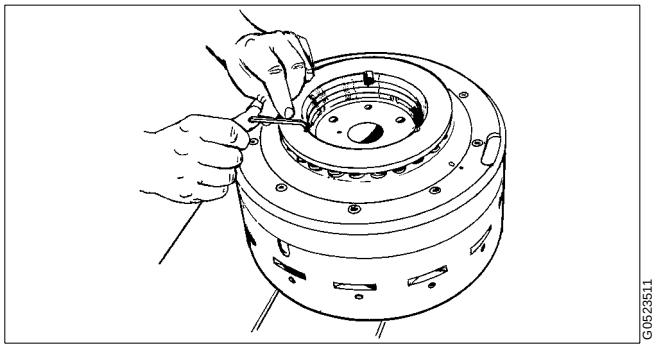
Release the bowl body from the spindle by using the lifting tool as a puller. Turn the eye of the central screw at top of the lifting tool until the bowl body comes loose from the spindle taper. Turn the eye two more turns in order to avoid damaging the paring disc device.



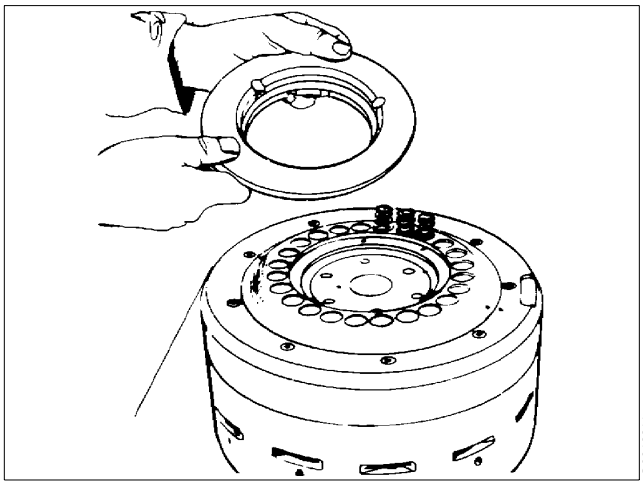
6. Lift out the bowl body using hoist.



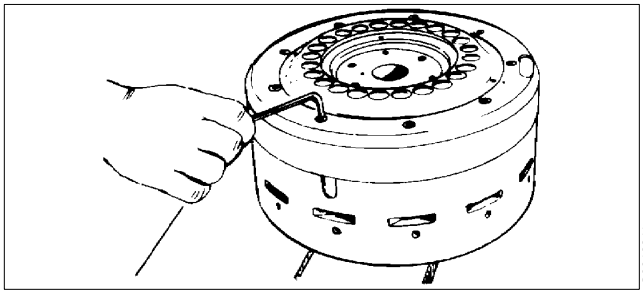
7. Turn the bowl body upside down.
8. Loosen the screws for the spring support successively a little at a time. Remove the screws.



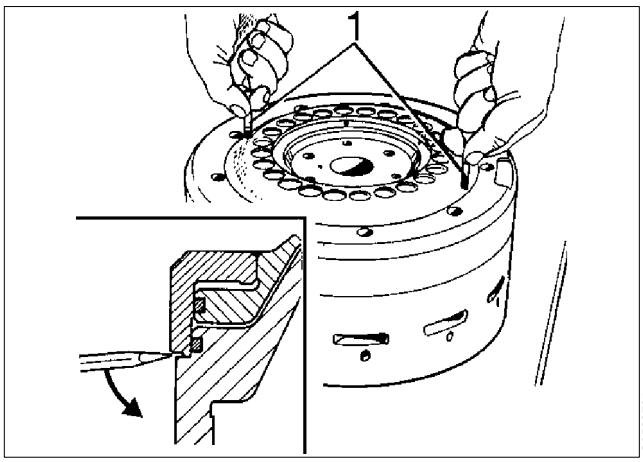
9. Remove the spring support and the springs.



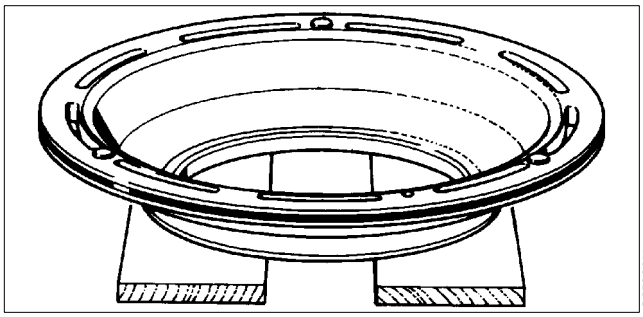
10. Unscrew the screws for the dosing ring.



11. Lift the dosing ring and operating slide with two of the dosing ring screws (1). If necessary, prize loose the dosing ring as shown in the illustration.

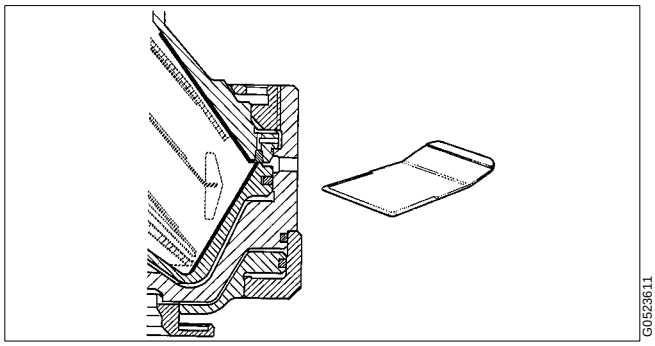


12. Remove the operating slide and place it with the valve plugs facing upwards.



13. 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 84.

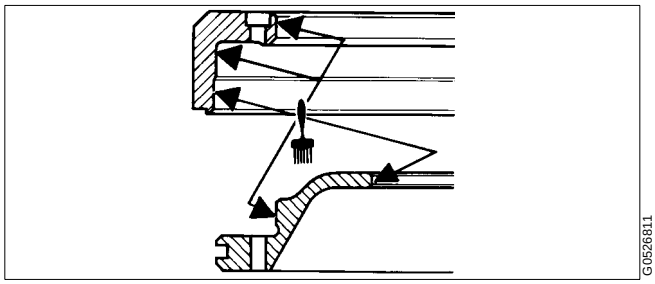
    The surfaces of the sludge space (shown with a thick line in the illustration) must not be damaged. Be cautious when cleaning. Do not use a steel toll but the sludge scraper of brass included in the set of tools.



6.4.3 Assembly

✔ **Check point**
“5.3.3 Corrosion” on page 52,
“5.3.4 Cracks” on page 54,
“5.3.6 Dosing ring” on page 56,
“5.3.7 Erosion” on page 56,
“5.3.8 Guide surfaces” on page 58,
“5.3.12 Operating mechanism” on page 63,
“5.3.13 Operating slide” on page 63,
“5.3.15 Sliding bowl bottom” on page 65,
“5.3.16 Springs for operating mechanism” on page 66.

1. Lubricate the guide surfaces of the bowl body, operating slide and dosing ring with lubricating paste. See chapter “8.4 Lubricants” on page 172.



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.

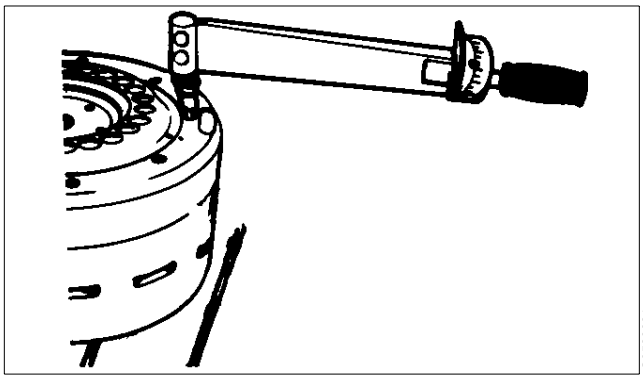
4. Apply only a thin film of lubricating paste on the screws for the dosing ring.

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 **7 Nm**. The screws should first be tightened diametrically, then tightened symmetrically around the bowl.

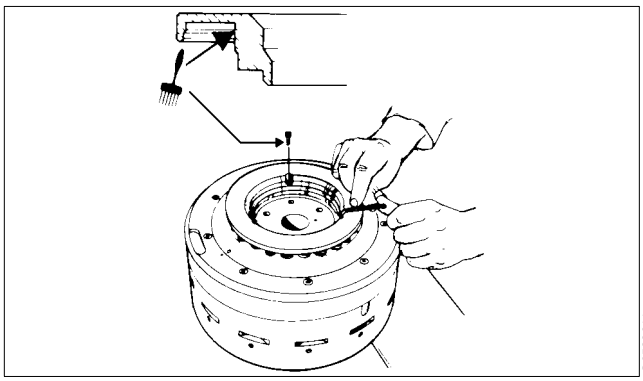
If torque is too low, there is a risk that the bolts will loosen by themselves when the separator is in operation. If torque is too high, the dosing ring as well as the bolts will be deformed. This may lead to sticking of the operating slide which moves inside the dosing ring.



5. Lubricate the screw threads and the guide surfaces of the spring support. See chapter “8.4 Lubricants” on page 172.

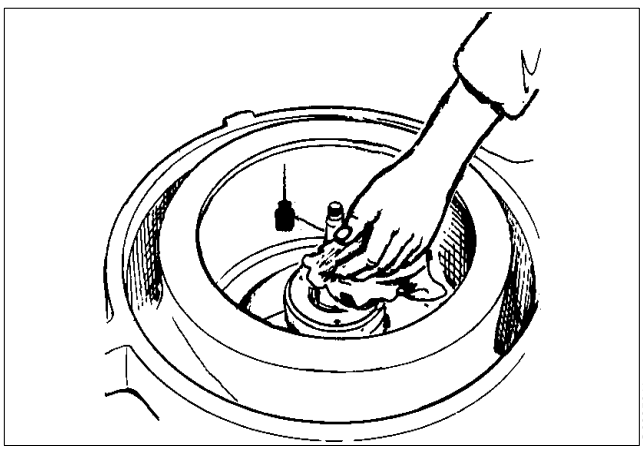
   Fit springs and support.

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



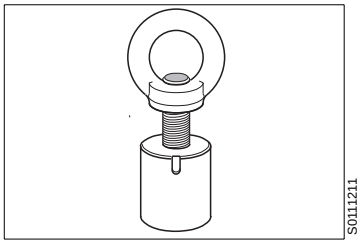
7. Wipe off the spindle top and nave bore in the bowl body. Lubricate the tapered end of the spindle and wipe it off with a clean cloth.

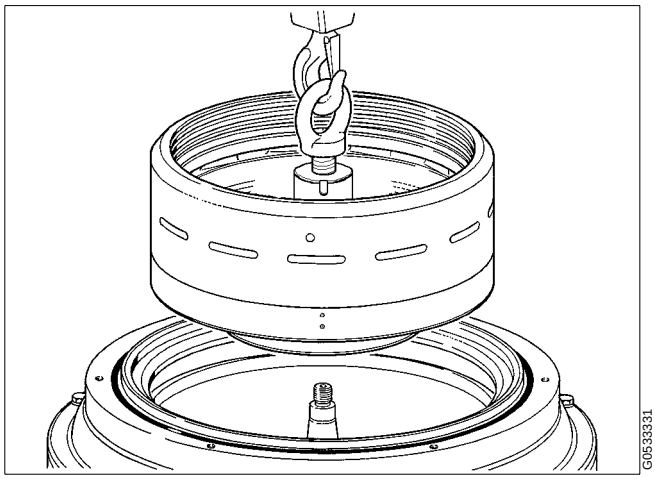
✔ **Check point**
“5.3.2 Bowl spindle cone and bowl body nave” on page 52.



8. Turn the bowl body and fit the lifting tool onto the bowl body bottom.

   Turn the handle at the top of the lifting tool so that the central screw is home.



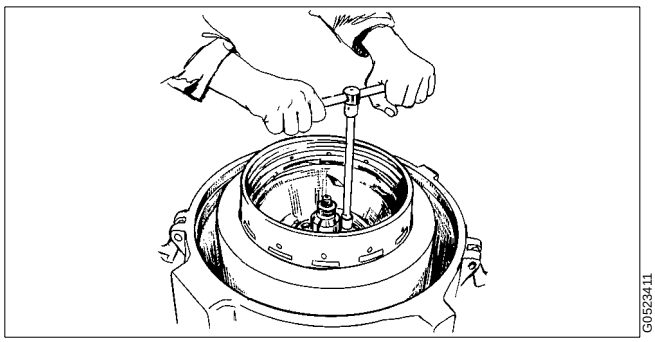


9. Lower the bowl body using hoist until the central screw rests on the spindle top. Then screw up the central screw so that the bowl body sinks down onto the spindle.

   Remove the tool.

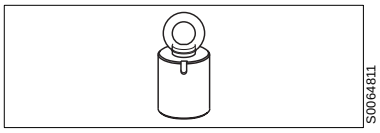
10. Rotate the bowl body and align it so that the three screw holes in the bowl body bottom are exactly above the three holes in the distributing ring.

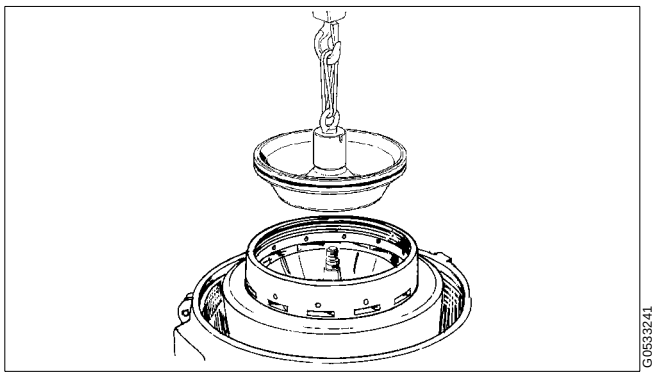
    Tighten the three screws firmly.



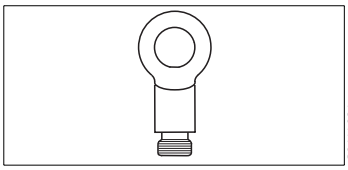
11. Lubricate the guide surfaces of the bowl body and sliding bowl bottom with lubricating paste. See chapter “8.4 Lubricants” on page 172.

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

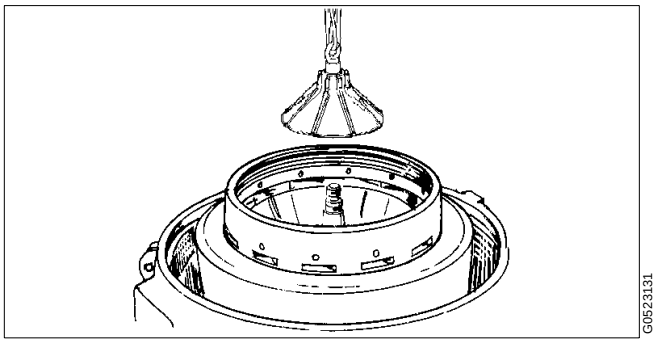




13. Fit the distributing cone onto the sliding bowl bottom.

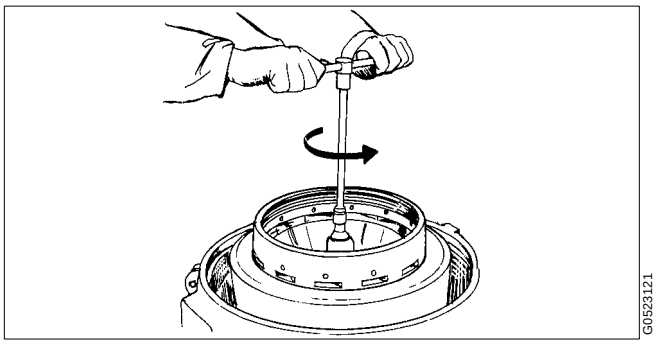


Check that the guide pins on the underside of the distributing cone enter the recesses in the bowl body nave.



14. Screw on the cap nut and tighten firmly.

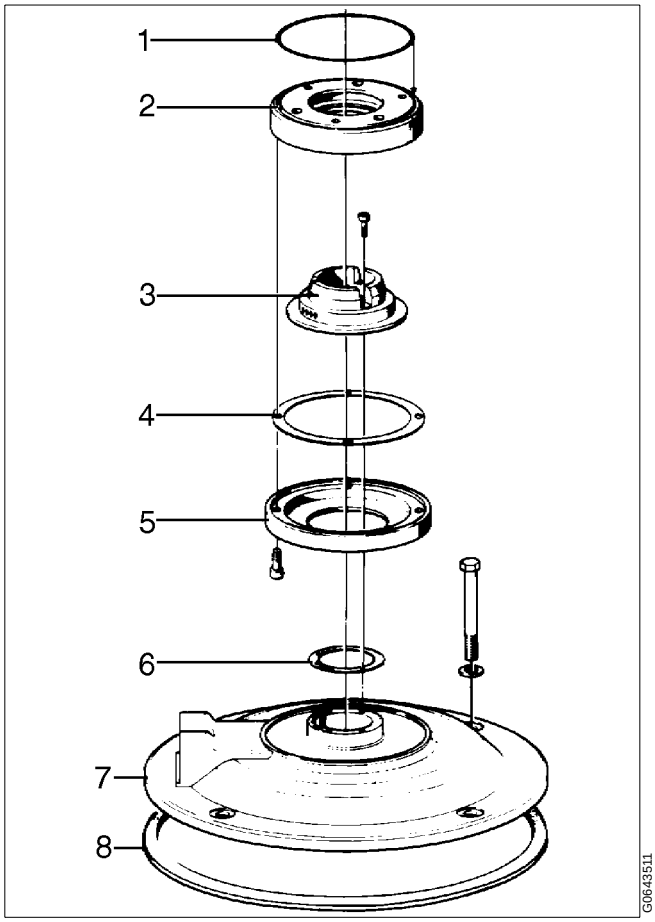
Left-hand thread!



6.5 Operating water device (IS)

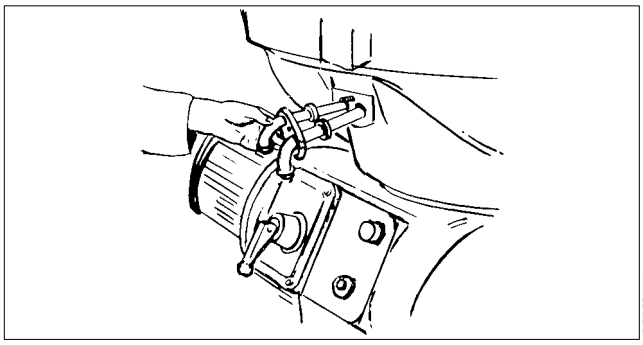
6.5.1 Exploded view

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

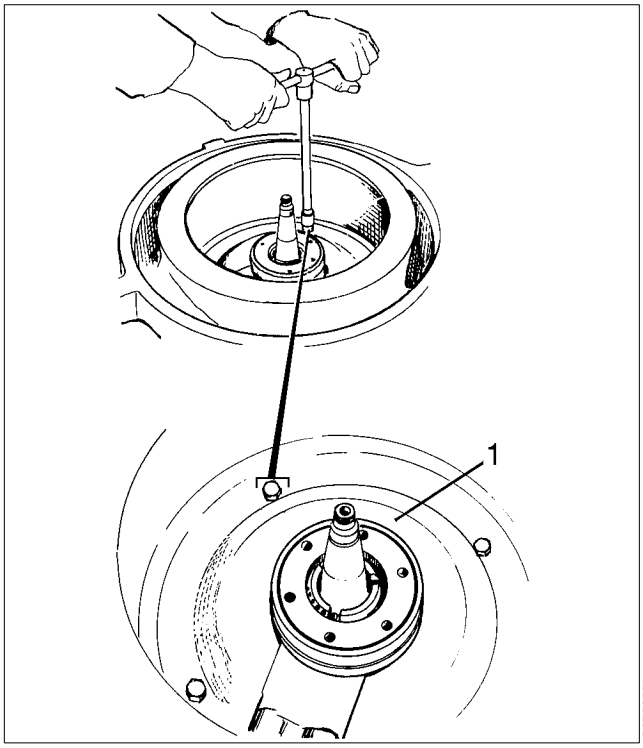


6.5.2 Dismantling

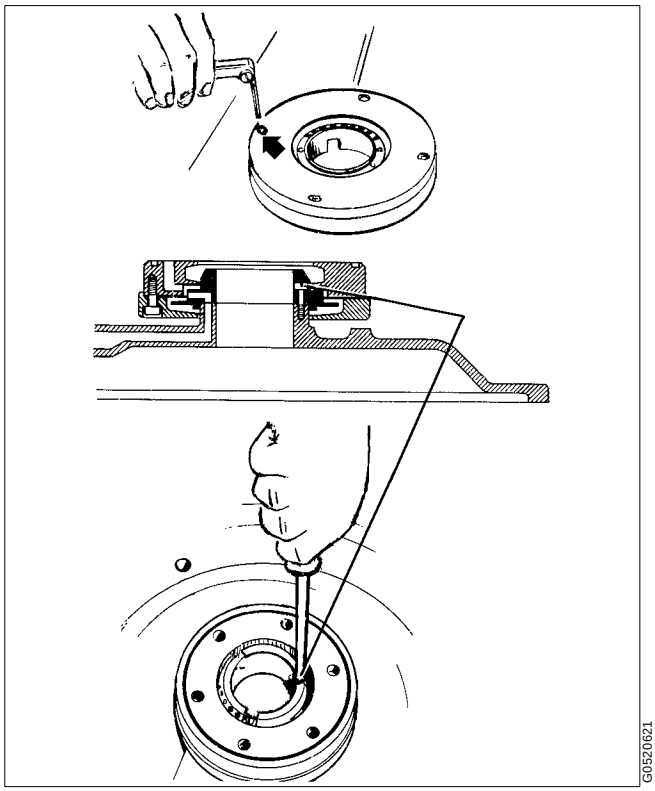
1. Unscrew the two cap nuts holding the clamp washer and then pull out the operating water inlet tubes.



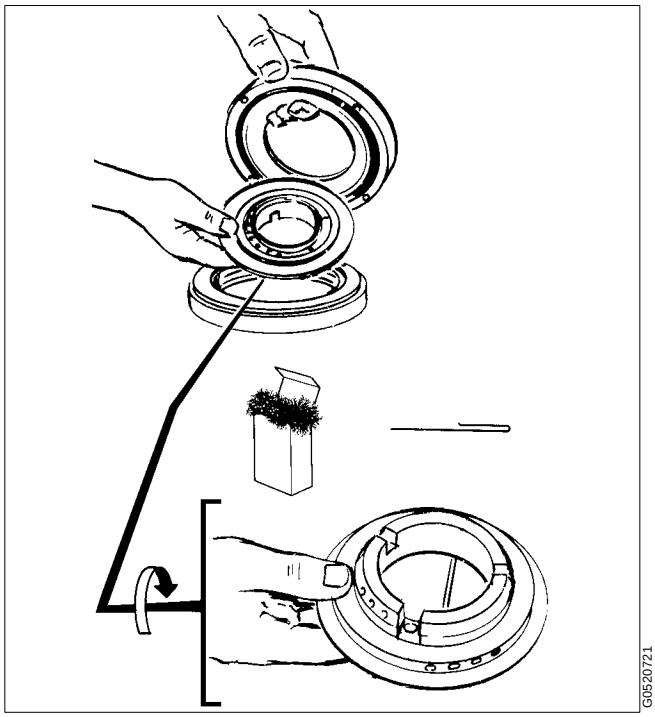
2. Screw out the screws for the distributing cover and remove the cover (1) together with the paring disc device.



3. To take apart the paring disc device, first remove it from the distributing cover by screwing out the screws.
4. Turn the paring disc device upside down and remove the screws on its underside.

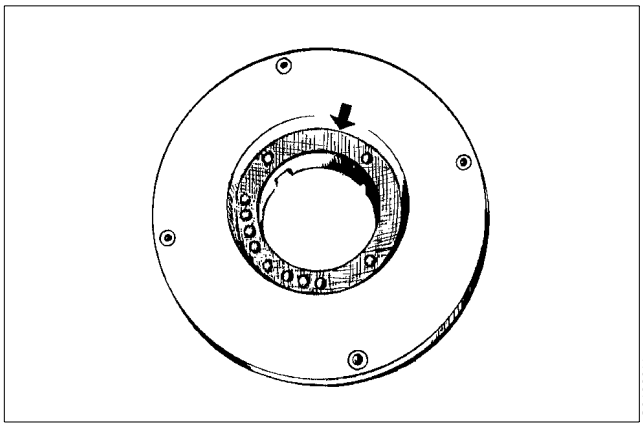


5. Remove deposits and clean all parts thoroughly in a suitable cleaning agent. Pay special attention to the channels. See chapter “5.6 Cleaning” on page 84.
6. Check the parts for damage and corrosion.

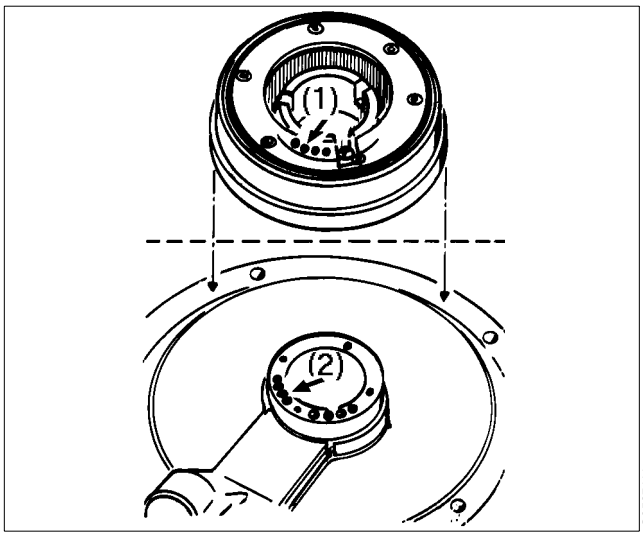


6.5.3 Assembly

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

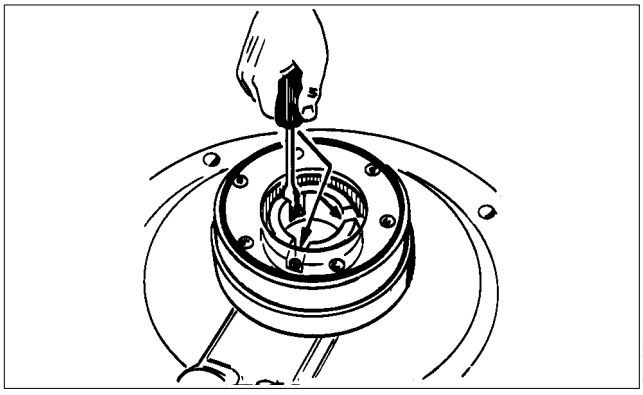


2. Align the four holes in the paring disc (1) with the four holes in the distributing cover (2).

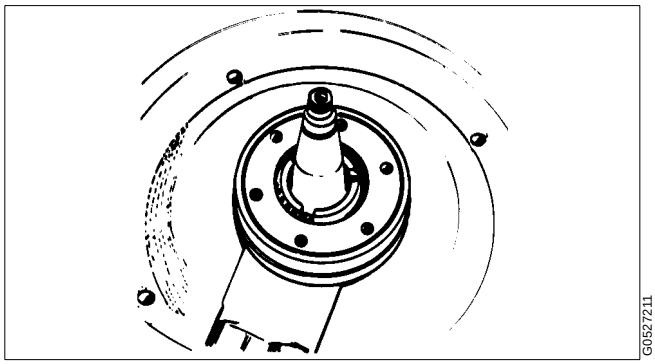


3. Tighten the screws of the control paring disc.

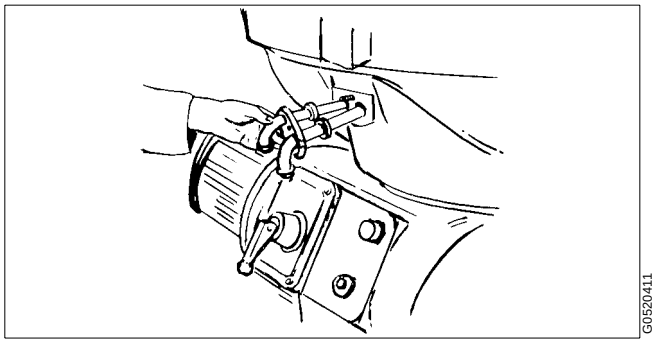
   Note: Do not tighten too hard, as the threads may be damaged.



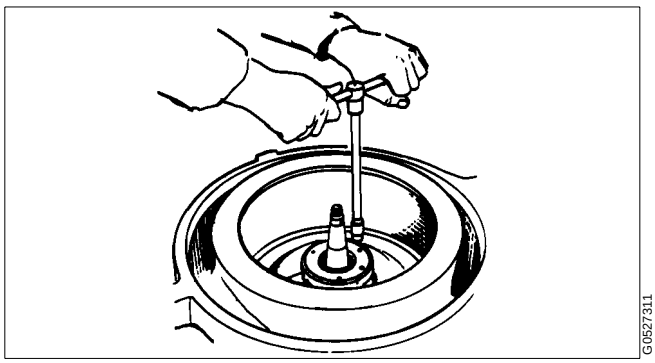
4. Put the distributing cover in place. Do not tighten the screws before the operating water inlet tubes are fitted.



5. Fit the operating water inlet tubes.

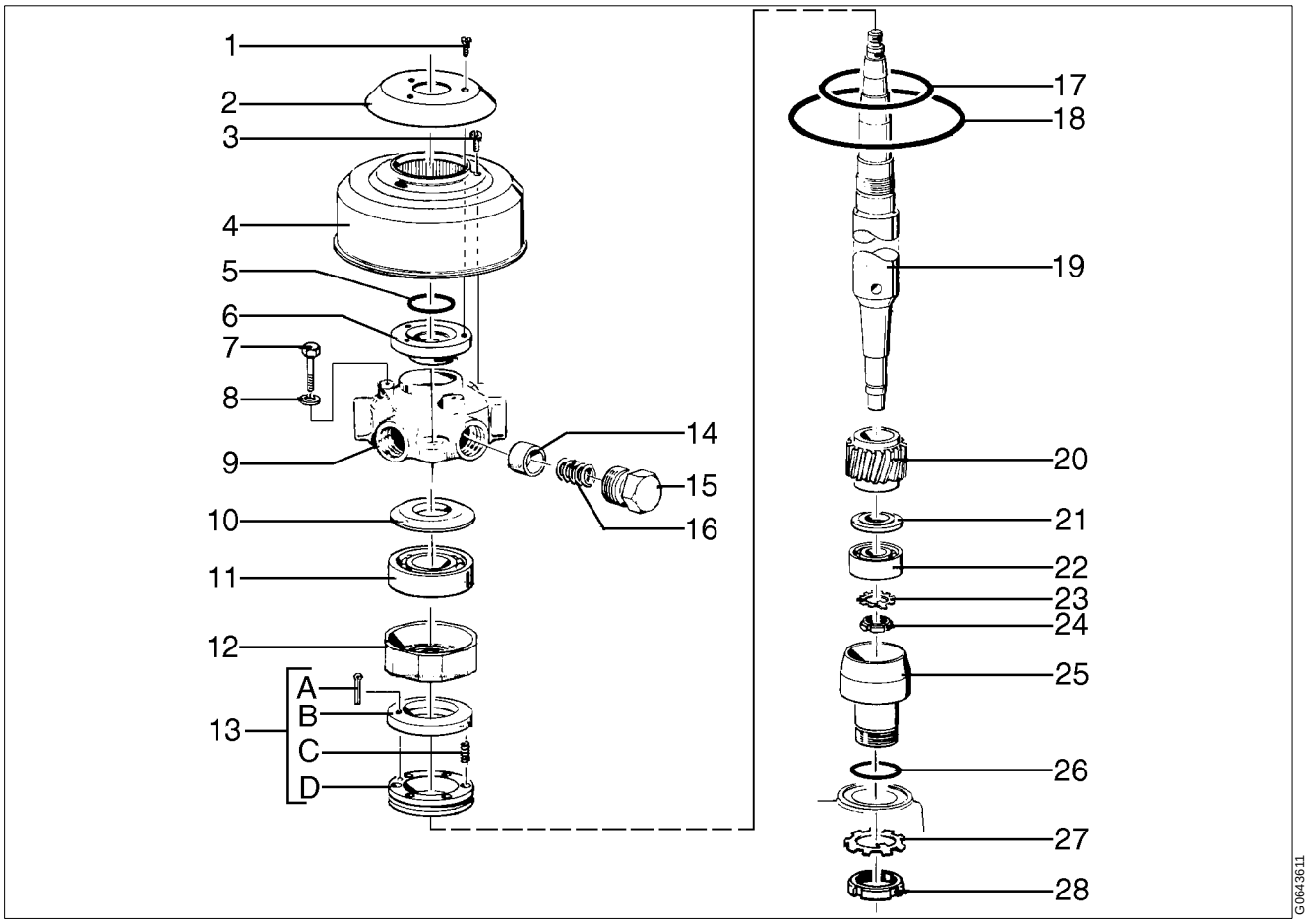


6. Fasten the distributing cover.



6.6 Vertical driving device (MS)

6.6.1 Exploded view



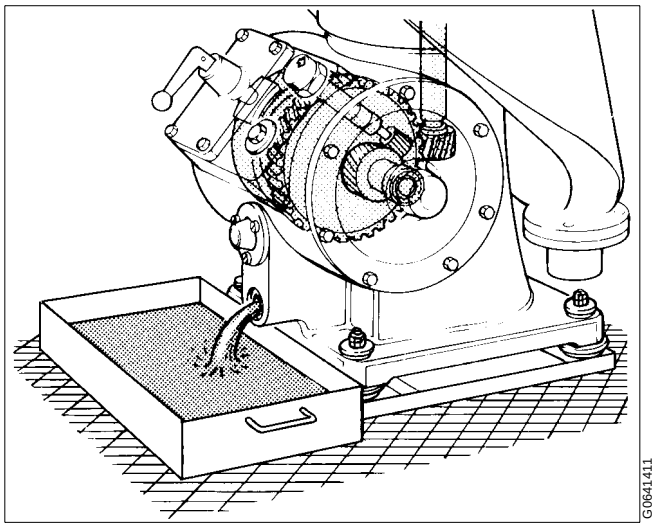
1. Screw
2. Protecting plate
3. Screw
4. Protecting guard
5. O-ring
6. Protecting collar
7. Screw
8. Spring washer
9. Spring casing
10. Deflector
11. Ball bearing
12. Ball bearing housing
13. Axial buffer
    - 13A. Split pin
    - 13B. Wear ring
    - 13C. Spring
    - 13D. Spring support
14. Buffer
15. Screw plug
16. Spring
17. O-ring
18. O-ring
19. Bowl spindle
20. Worm
21. Spacing washer
22. Ball bearing
23. Lock washer
24. Round nut
25. Bushing
26. O-ring
27. Lock washer
28. Round nut

6.6.2 Dismantling

NOTE

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

1. Drain the oil from the worm gear housing.



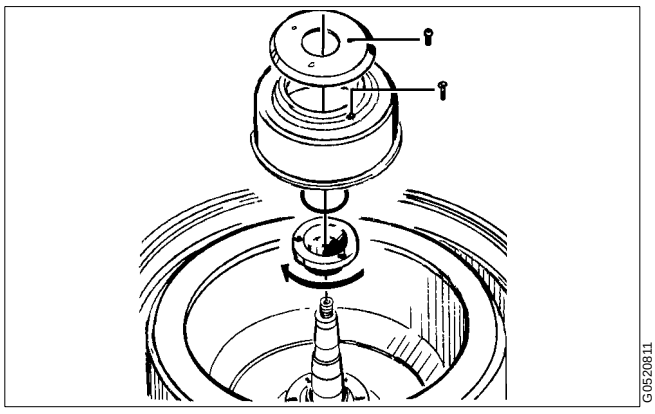
CAUTION

Burn hazards

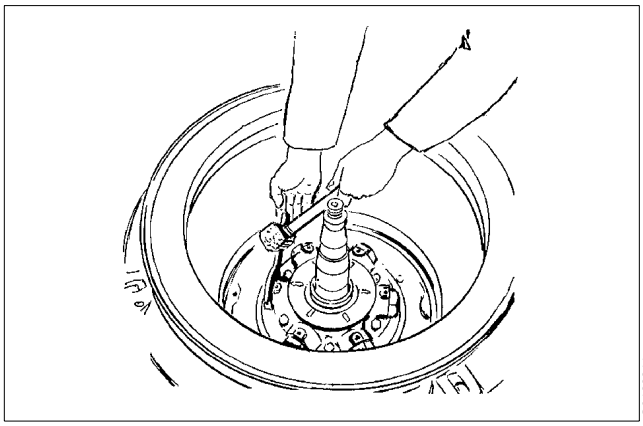
Lubricating oil and various machine surfaces can be hot and cause burns.

2. Unscrew and remove the protecting plate and the protecting guard.
3. Remove the O-ring and unscrew the protecting collar with e.g. a drift.

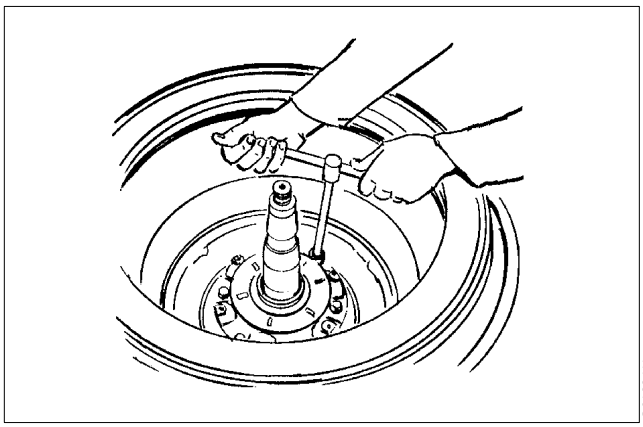
   Left-hand thread!



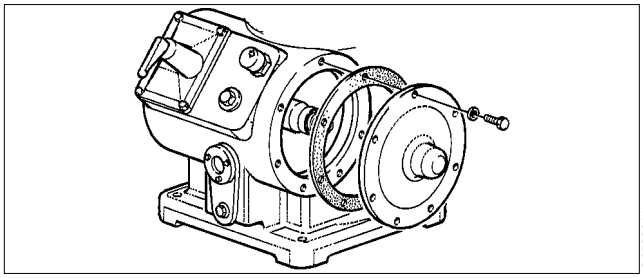
4. Unscrew the screw plugs a little, not completely.



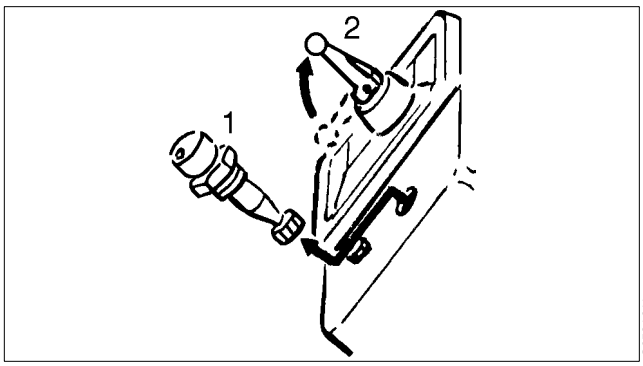
5. Unscrew the screws of the spring casing.



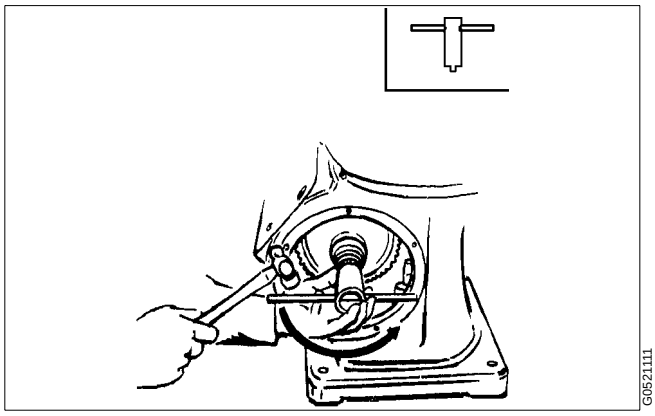
6. Remove the bearing shield and gasket.



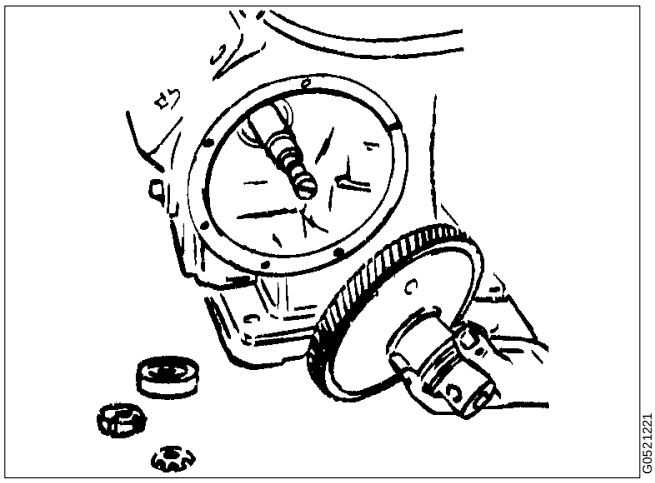
7. Remove the revolution counter (1). Apply the brake (2).



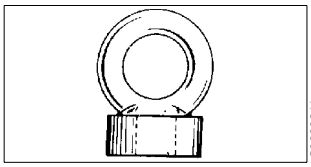
8. Remove the round nut and lock washer at the worm wheel shaft.

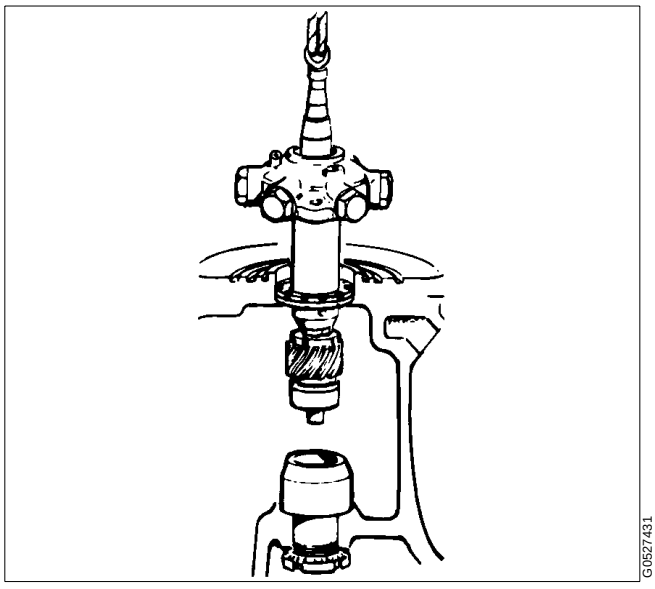


9. Remove the ball bearing and worm wheel fitted on the shaft.



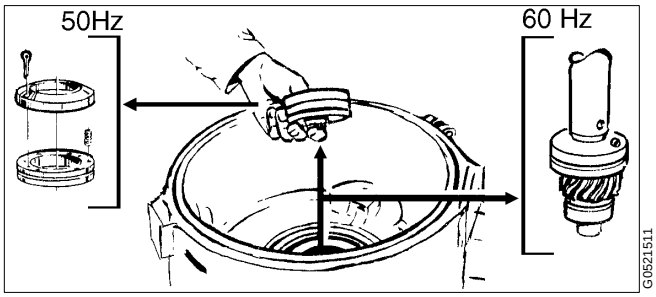
10. Lift out the bowl spindle by using the special lifting tool.



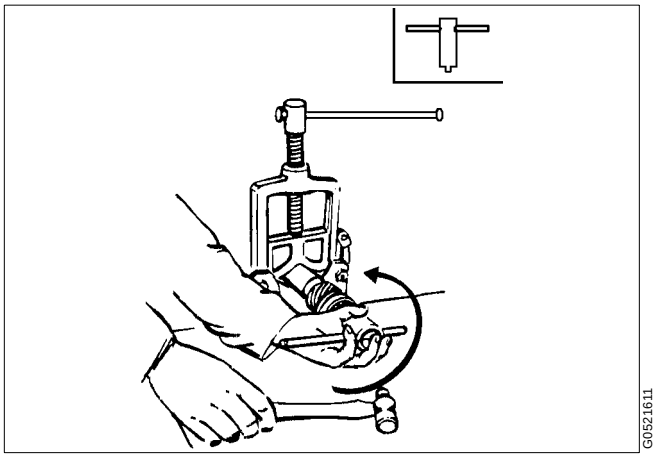


11. If a 50 Hz separator, remove the axial buffer from the frame.

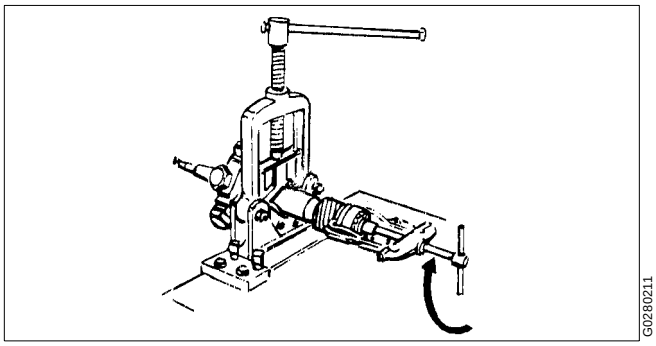
    For 60 Hz separators, the buffer can be removed from the spindle after the worm has been knocked off.



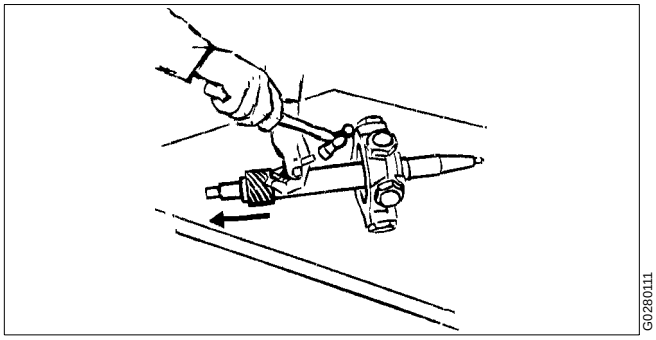
12. Clamp the bowl spindle in a screw vice, protected with copper liners.
13. Remove the round nut and lock washer for the bottom bearing on spindle.



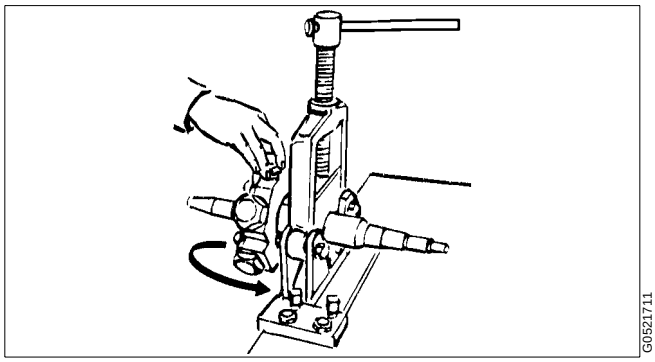
14. Pull off the ball bearing together with the spacing washer.



15. Knock off the worm using a hammer and a **soft** drift.
16. If a 60 Hz separator, remove the axial buffer.

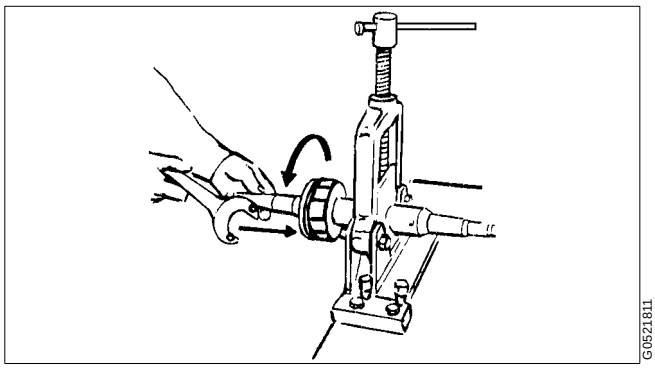


17. Remove the screw plugs, springs and buffers. Then remove the spring casing.

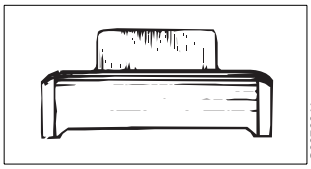


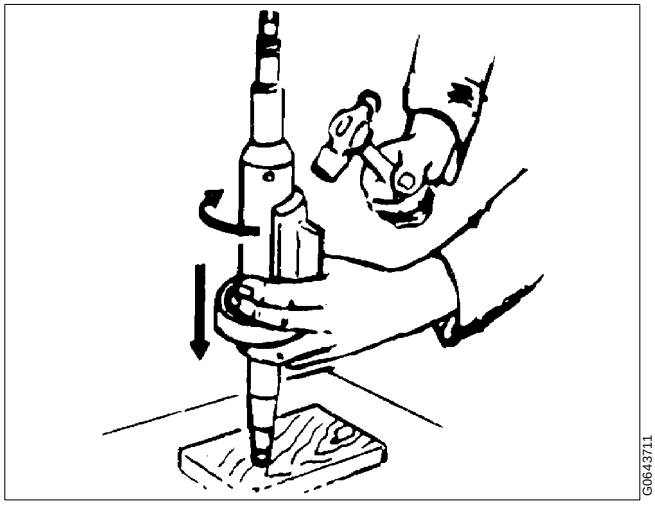
18. Unscrew the deflector and remove the ball bearing housing.

    Left-hand thread!



19. Knock off the ball bearing.





6.6.3 Assembly

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

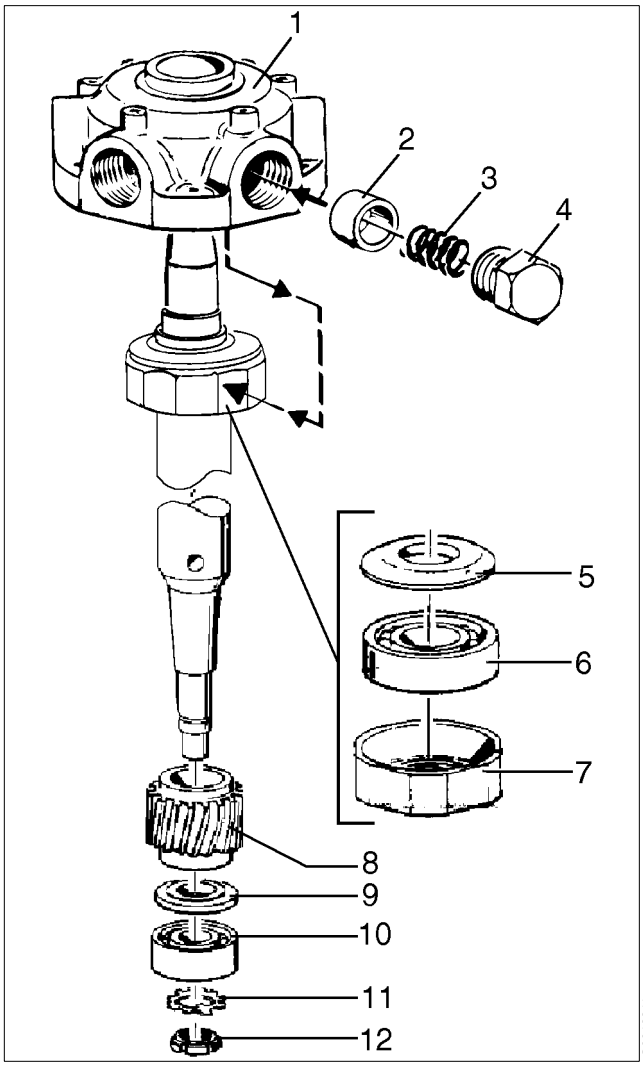
WARNING

Burn hazards

Use protective gloves when handling the heated bearings.

NOTE

If 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 94.



✔ Check point

“5.4.5 Buffer springs and ball bearing housing” on page 70.

1. Mount the upper ball bearing (6) onto the spindle. Make sure it enters its seat.
2. Fit the bearing housing (7) and tighten the deflector (5).

   Left-hand thread!
3. Fit the spring casing (1), buffers (2), springs(3) and plugs (4).

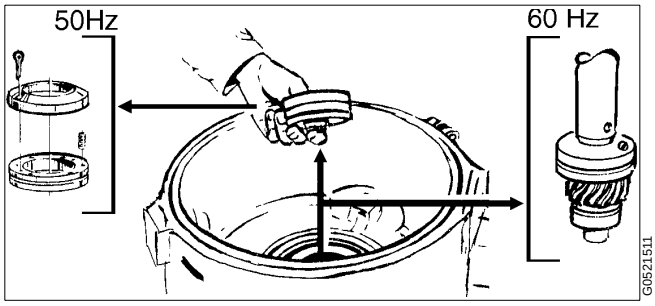
   Make sure the buffers come to rest against the flats of the ball bearing housing.

   The final tightening of the plugs is preferably done when the spindle has been placed in the frame.
4. Fit the worm (8), spacing washer (9) and bottom ball bearing (10).

   Note: For 60 Hz separators, the axial buffer must be mounted on the spindle before the worm and ball bearing are mounted, see next illustration.

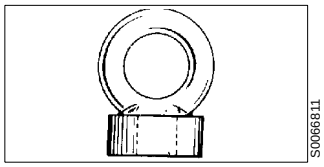
5. Finally fit the lock washer (11) and tighten the round nut (12).

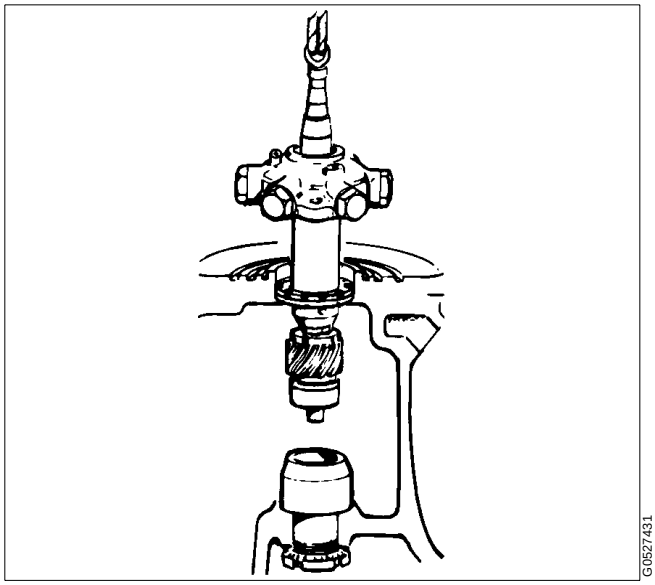
6. For 50 Hz separators, fit the axial buffer in the frame.



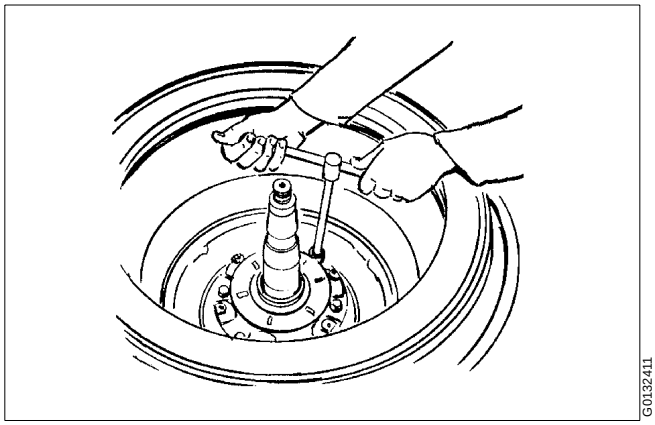
7. Carefully lower the spindle into the frame.

   Guide the bearing into the bottom bushing. If it does not completely enter its seat, tap the spindle top with a tin hammer.

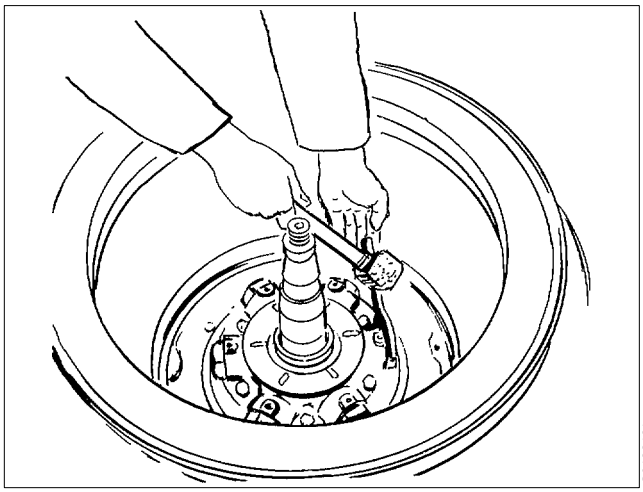




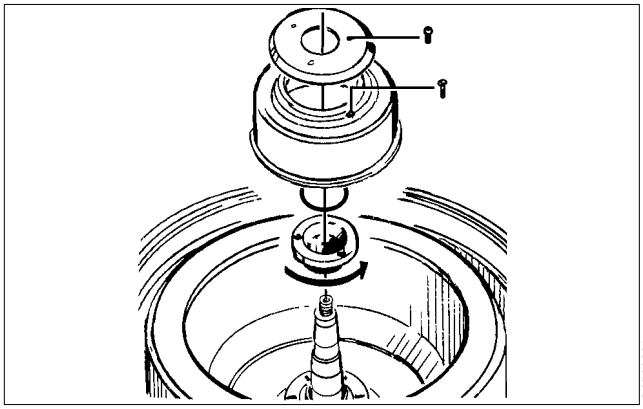
8. Tighten the screws of the spring casing.



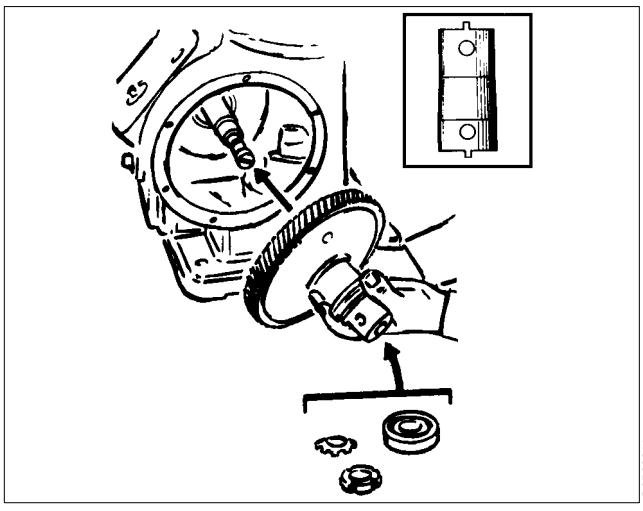
9. Tighten the buffer plugs.



10. Screw the protecting collar onto the spindle.
    Left-hand thread!
    Fit its O-ring, guard and protecting plate.

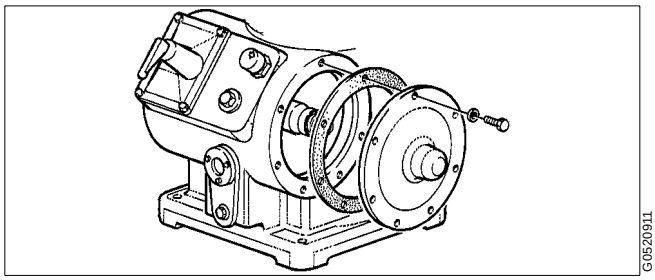


11. Fit the worm wheel with ball bearing onto the shaft. Match the worm wheel with the teeth in the worm of the bowl spindle.
12. Fit the ball bearing and lock washer onto the shaft and tighten the round nut.



✔ **Check point**
“5.4.25 Worm wheel shaft; radial wobble” on page 81,
“5.4.3 Bowl spindle; radial wobble” on page 68.

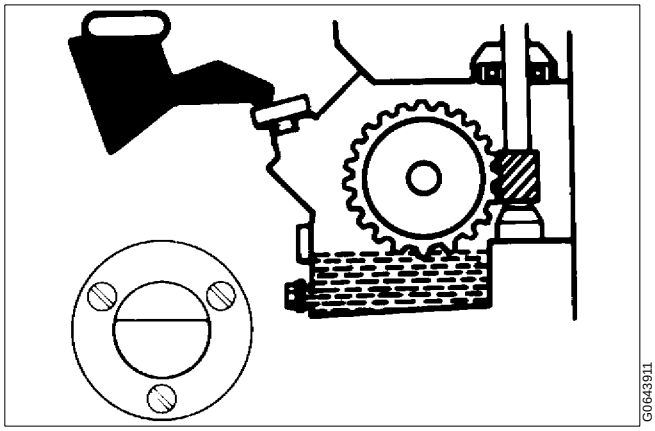
13. Fit the revolution counter.
14. Fit the gasket and bearing shield. The parts can be fitted only in one position because of the asymmetrical positioned screw holes.



15. Pour oil into worm gear housing. The oil level should be slightly above the middle of the sight glass.

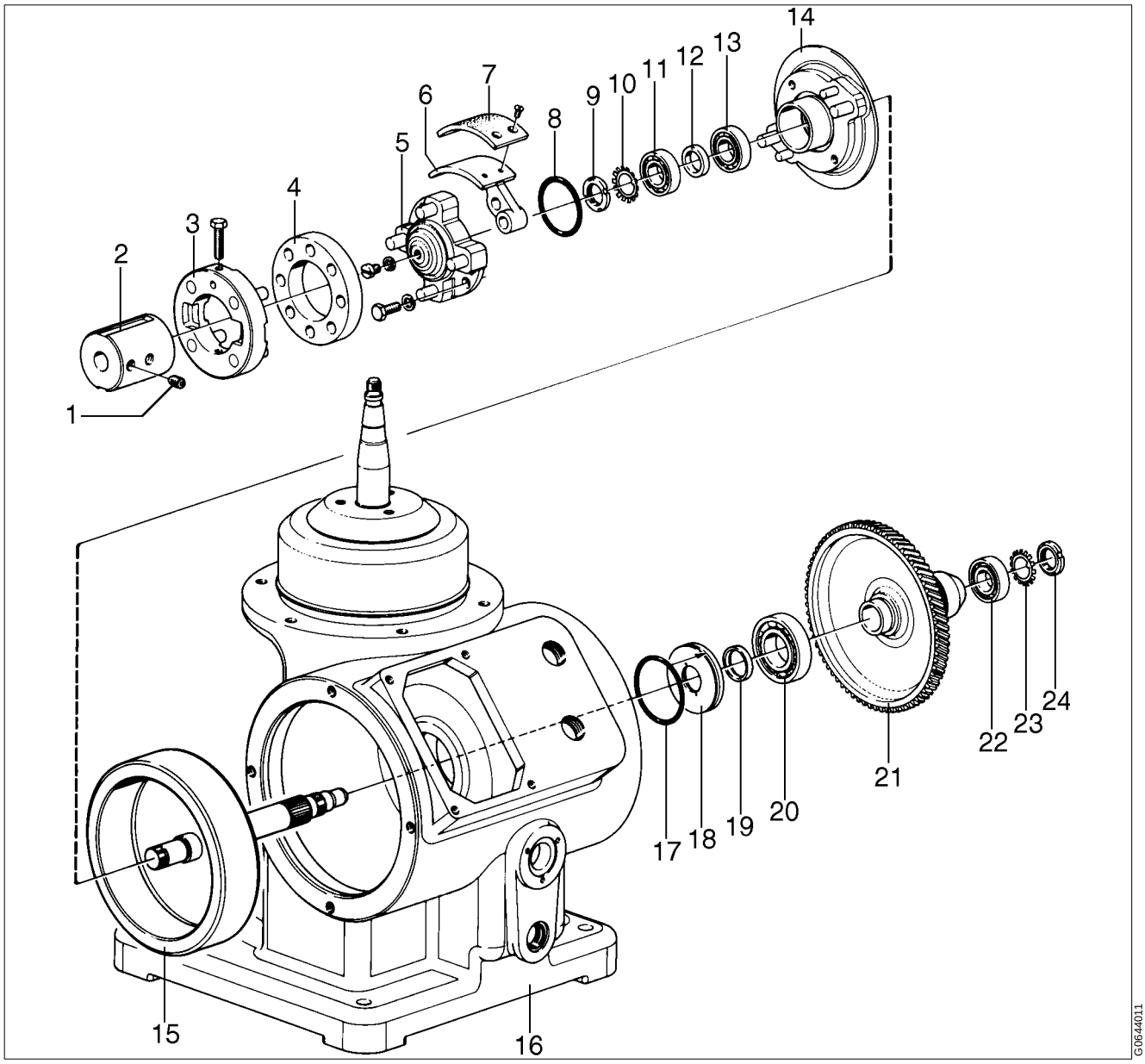
    For correct oil volume and recommended oil brands, see chapter “8.4 Lubricants” on page 172.

✔ **Check point**
“5.4.4 Brake” on page 69.



6.7 Horizontal driving device (MS)

6.7.1 Exploded view



1. Screw
2. Coupling nave
3. Coupling disc
4. Elastic plate
5. Coupling disc
6. Friction block
7. Friction pad
8. O-ring
9. Round nut
10. Lock washer
11. Ball bearing
12. Spacing ring
13. Ball bearing
14. Nave
15. Worm wheel shaft
16. Frame
17. O-ring
18. Sealing washer
19. Seal ring
20. Ball bearing
21. Worm wheel
22. Ball bearing
23. Lock washer
24. Round nut

6.7.2 Dismantling

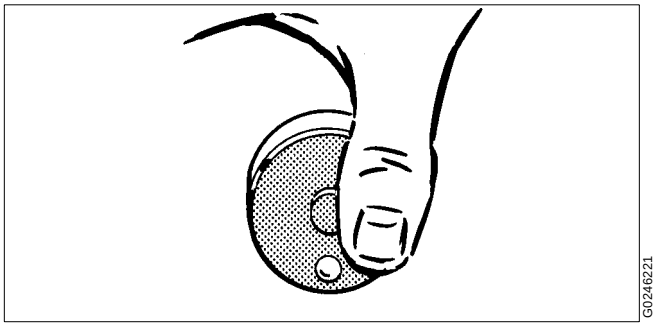
DANGER

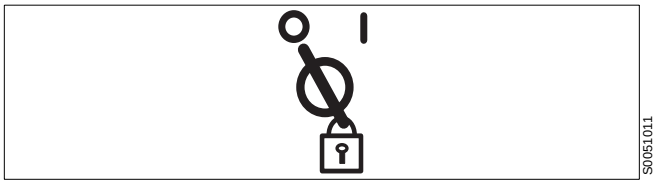
Entrapment hazards

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

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

2. To avoid accidental start, switch off and lock power supply before starting **any** dismantling work.





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

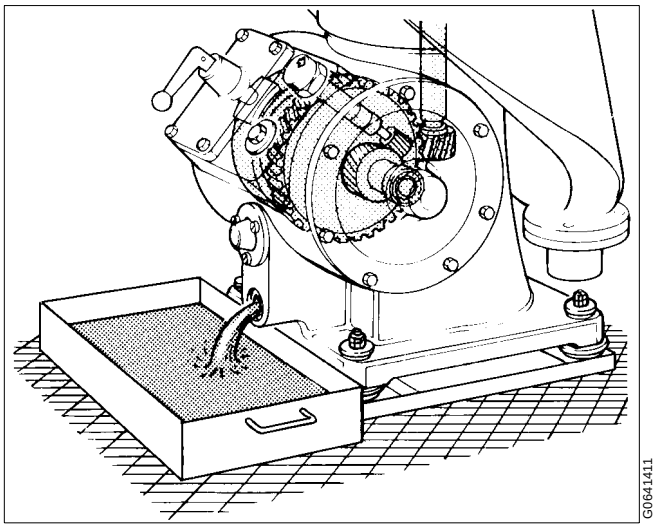
If the bowl spindle has been removed according to earlier description, points 1-5 below are already done. Proceed then with point 6

1. Drain the oil from the worm gear housing.

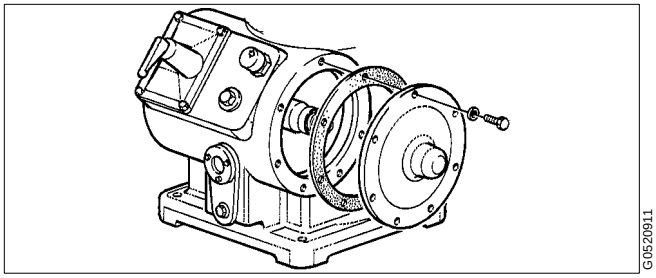
CAUTION

Burn hazards

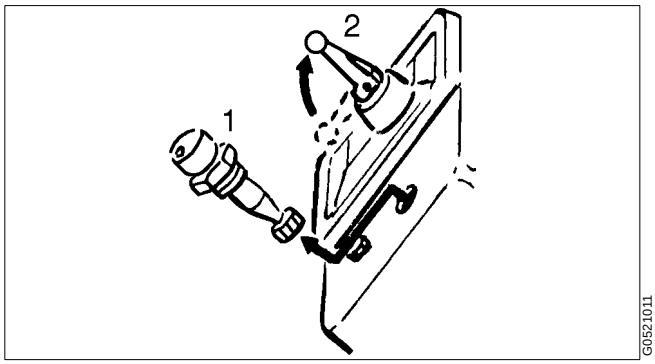
Lubricating oil and various machine surfaces can be hot and cause burns.



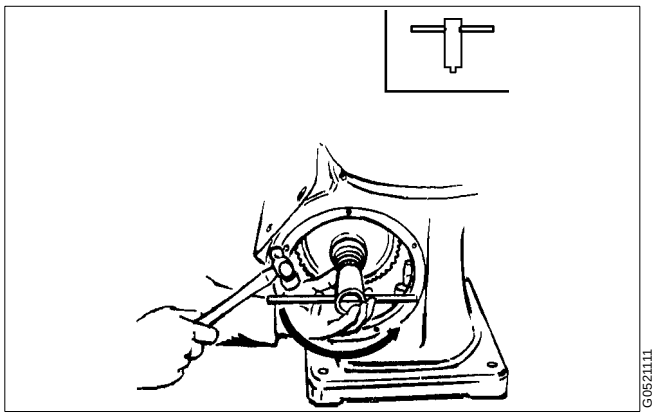
2. Remove the bearing shield and gasket.



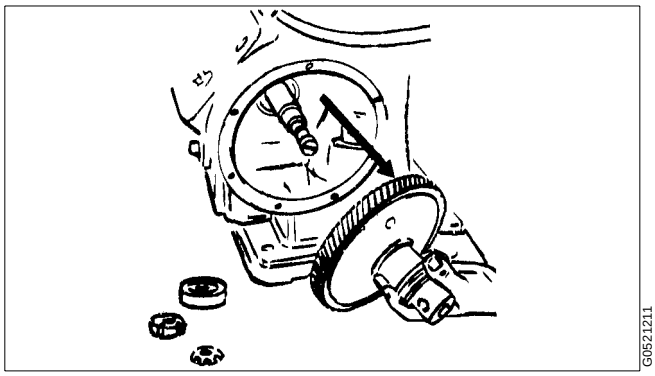
3. Remove the revolution counter (1).
   Apply the brake (2).



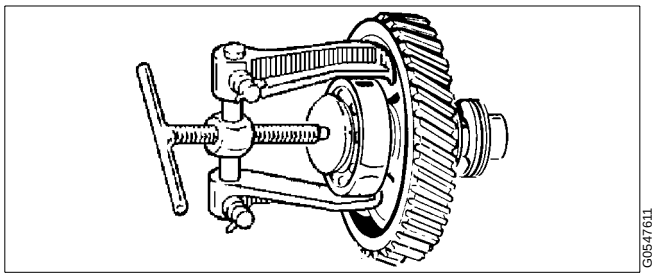
4. Remove the round nut and lock washer at the worm wheel shaft.



5. Remove the ball bearing and worm wheel fitted on the shaft.

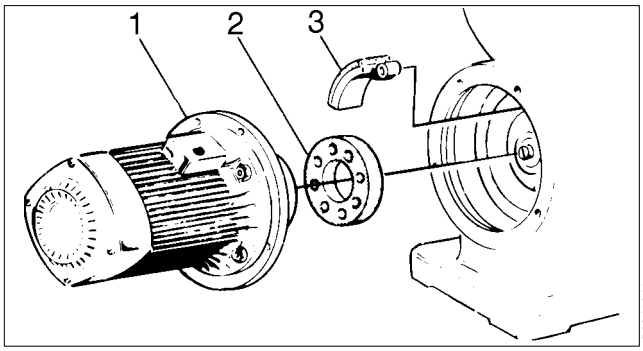


6. Pull off the ball bearing from the worm wheel. Use a washer as a support for the puller.

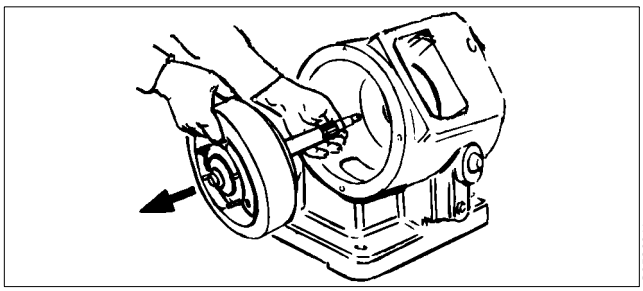


7. Remove:
   – the electric motor (1)
   – the elastic plate (2)
   – the friction blocks (3).

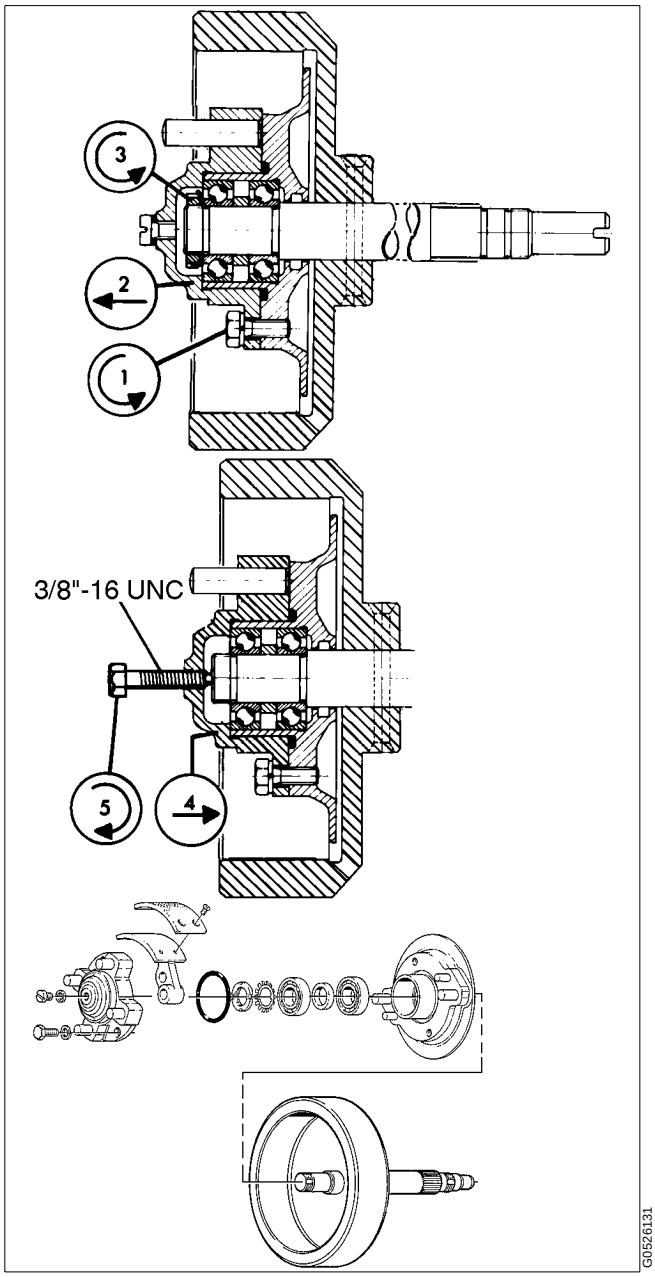
   If disconnecting the motor cables, note the positions of cables in the terminal box to reconnect correctly (for correct direction of rotation).



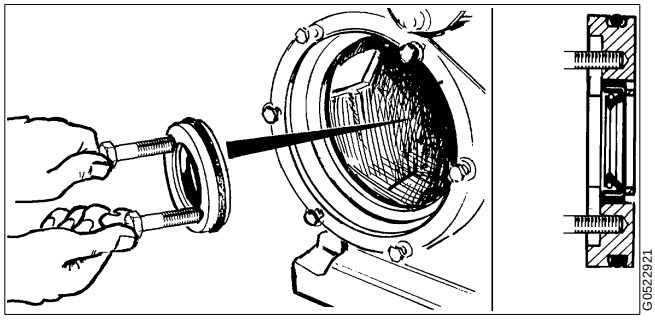
8. Lift out the worm wheel shaft.



9. Dismantle the nave in the following way:
   - remove the screws (1) and then the coupling disc (2)
   - unscrew the round nut (3) and remove the lock washer
   - put the coupling disc in place (4) again and pull off the nave with a 3/8” - 16 UNC screw (5).

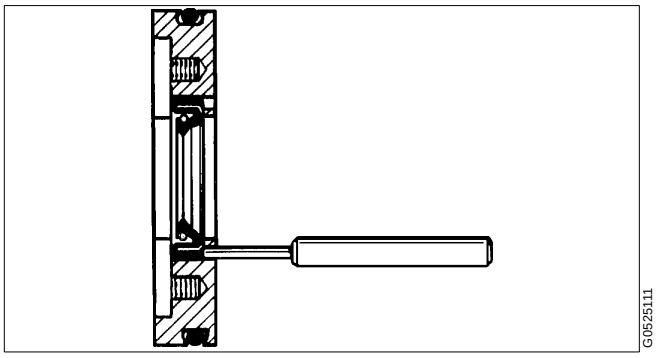


10. Remove the sealing washer using two screws with threads 1/4”-20 UNC screw.



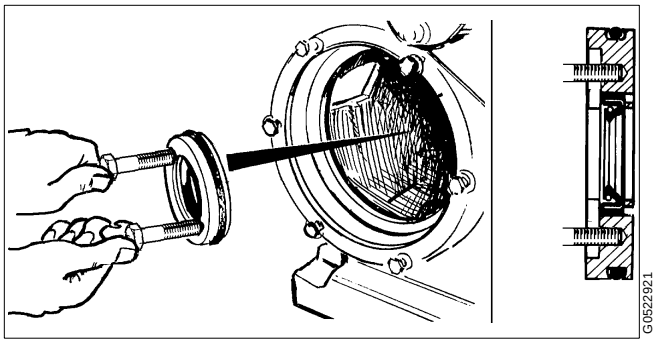
11. Remove the seal ring by using a drift.

12. Remove deposits and clean all parts thoroughly in a suitable cleaning agent. See chapter “5.6 Cleaning” on page 84.



6.7.3 Assembly

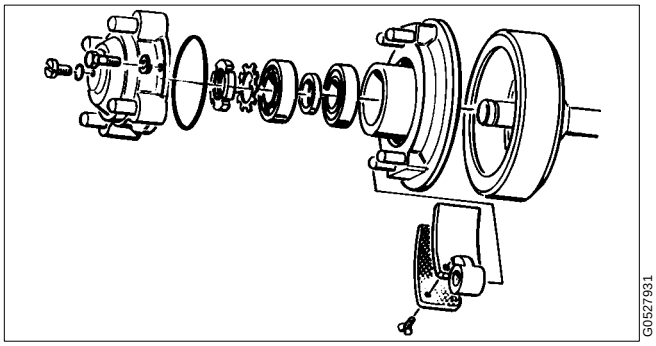
1. Lubricate the O-ring on the sealing washer periphery and the sealing ring with silicone grease. Fit the sealing washer in frame and check that the sealing ring is fitted in the correct direction, as illustrated.

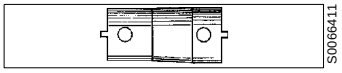


✔ **Check point**
“5.4.6 Coupling friction pads” on page 71.

2. Apply ball bearing grease into the bearings (fill about 1/3 of the free volume in each bearing). Note that no grease must be packed in the nave proper, as superfluous grease might ooze out of the nave and adhere to the friction blocks.

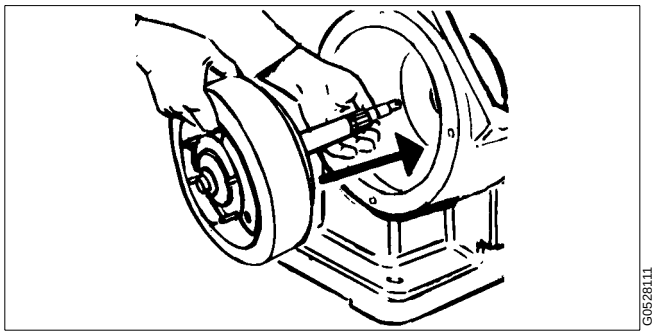
3. Fit the nave, bearings and spacing sleeve, lock washer and the round nut.





4. Fit the O-ring onto the nave and fasten the coupling disc. Put the friction blocks in place inside the coupling drum.

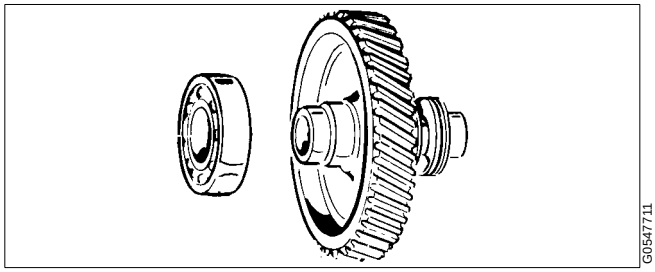
5. Fit the worm wheel shaft.



NOTE

Before fitting the worm wheel, mount the bowl spindle into the separator frame if removed (see separate description).

✔ **Check point**
"5.4.24 Worm wheel and worm; wear of teeth" on page 80.



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.

WARNING

Burn hazards

Use protective gloves when handling the heated bearings.

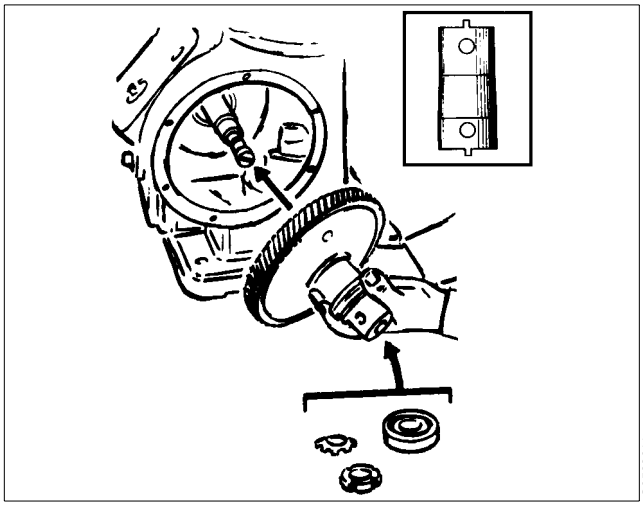
NOTE

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 94.

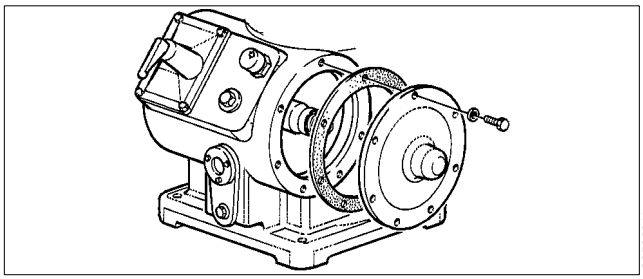
The remaining description in this section implies that the bowl spindle is mounted in the frame. If not, proceed with the assembly instruction for the vertical driving device in chapter “6.6.3 Assembly” on page 138.

7. Fit the worm wheel with the ball bearing onto the shaft. Match the worm wheel with the teeth in the worm of the bowl spindle.
8. Fit the ball bearing and lock washer onto the shaft and tighten the round nut.

✔ **Check point**
“5.4.25 Worm wheel shaft; radial wobble” on page 81,
“5.4.3 Bowl spindle; radial wobble” on page 68.



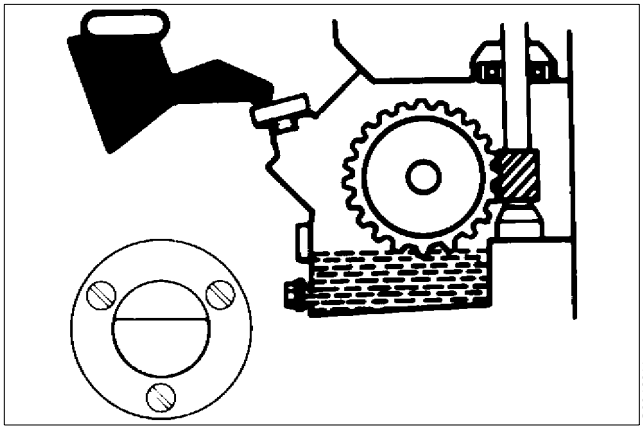
9. Fit the revolution counter.
10. Fit the gasket and bearing shield. The parts can be fitted only in one position because of the asymmetrical positioned screw holes.



11. Pour oil into worm gear housing. The oil level should be slightly above the middle of the sight glass.

    For correct oil volume and recommended oil brands, see chapter “8.4 Lubricants” on page 172.

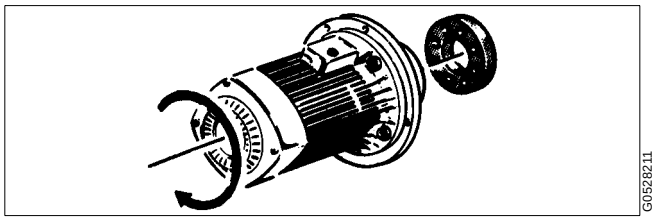
✔ **Check point**
“5.4.4 Brake” on page 69.



12. Fit the elastic plate.

✔ **Check point**
“5.4.12 Flexible plate in coupling” on page 73.

13. Fit the electric motor.



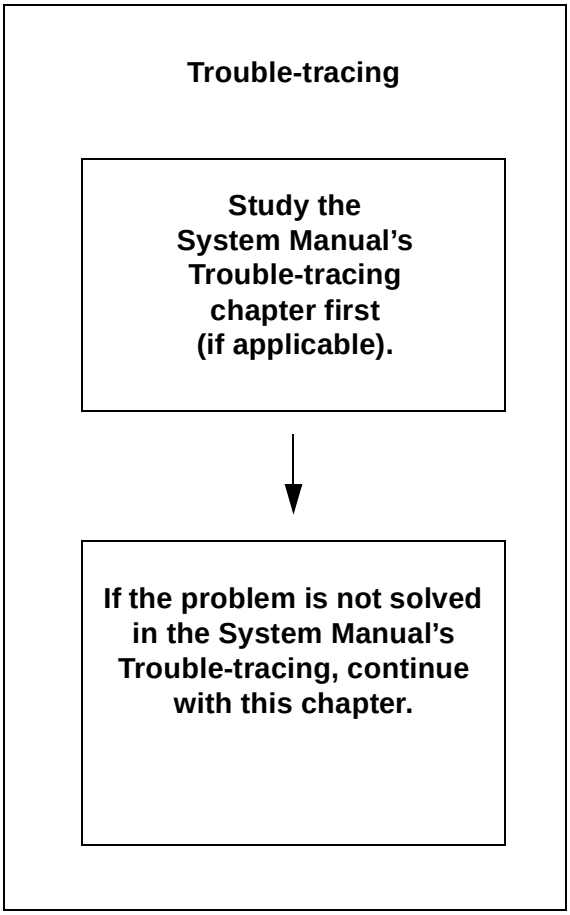
DANGER

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.

7 Trouble-tracing

Contents



7.1 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	113
Uneven sludge deposits in the sludge space	Dismantle and clean the separator bowl	110
Height adjustment of the oil paring disc is incorrect	Stop the separator, measure and if necessary adjust the height	78
Bowl spindle bent (max 0,04 mm)	Renew the bowl spindle	68
Bearing is damaged or worn	Renew all bearings	130, 142
Vibration damping rubber cushions are worn out	Renew all rubber cushion	50
Spindle top bearing spring broken	Renew all springs	130

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	33

7.1.3 Noise

Cause	Corrective actions	Page
Oil level in gear housing too low	Check oil level and add oil if necessary	33
Height adjustment of the oil paring disc is incorrect	Stop the separator, measure and adjust the height	78
Worm wheel and worm are worn	Renew worm wheel and worm	88
Bearing is damaged or worn	Renew all bearings	130, 142
Incorrect play between coupling pulley and elastic plate	Adjust the play	73

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	71
Bowl is not closed or leaking	Dismantle the bowl and check	109
Motor failure	Repair the motor	–
Bearing is damaged	Renew all bearings	130, 142
Incorrect gear transmission (60 Hz gear for 50 Hz power supply)	Stop and change the gear transmission to suit the power supply frequency	88, 130, 142

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	71
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	71
Friction pads are oily or worn	Clean or renew friction pads	71
Motor failure	Repair the motor	–

7.1.7 Starting time too long

Cause	Corrective actions	Page
Brake is applied	Release the brake	–
Friction pads are oily or worn	Renew or clean friction pads	71
Height position of oil paring disc or operating device is incorrect	Stop, check and adjust the height	71, 78
Motor failure	Repair the motor	–
Bearing is damaged or worn	Renew all bearings	130, 142

7.1.8 Retardation time too long

Cause	Corrective actions	Page
Brake friction pad is worn or oily	Renew or clean brake friction pad	69

7.1.9 Water in worm gear housing

Cause	Corrective actions	Page
Bowl casing drain obstructed	Clean worm gear housing and change oil	88
Leakage at top bearing	Renew seal ring and change oil	130, 90
Condensation	Clean worm gear housing and change oil	90

7.2 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	109
Paring chamber cover (small lock ring) defective	Renew the paring chamber cover	109
Seal ring in the bowl hood defective	Renew the seal ring	109
Sealing edge of the sliding bowl bottom defective	Smoothen sealing edge of the sliding bowl bottom or renew it	65
Valve plugs are defective	Renew all valve plugs	63
Bowl speed too low	See section ‘‘7.1.4 Speed too low” on page 156 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)	56
Square-sectioned ring in sliding bowl bottom is defective	Renew the square-sectioned ring. Carry out an Intermediate Service (IS)	65
Valve plugs are defective	Renew all plugs. Carry out an Intermediate Service (IS)	63
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	122
Lower nozzle in the dosing ring is clogged	Clean the nozzle. Carry out an Intermediate Service (IS)	56
Seal ring in the operating slide is defective	Renew the seal ring. Carry out an Intermediate Service (IS)	117

7.2.4 Unsatisfactory sludge discharge

Cause	Corrective actions	Page
Dosing ring too firmly tightened	Check the tightening torque	122
Valve plugs in the operating slide too high	Renew with correct valve plugs	63
Sludge deposits in the operating system	Check and clean the operating system	117, 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	86
Sludge space in bowl is filled	Clean and reduce the time between sludge discharges	86
Bowl speed too low	Examine the motor and power transmission including the gear ratio	88, 142

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	86
Bowl is incorrectly assembled	Check assembly	113
Oil paring disc is defective	Renew the oil paring disc	109

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. 559623, rev. 0

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	881111-01-05	
Separator type	FOPX 605TFD-20	
Application	Cleaning of fuel oil.	
Technical design	Intended for marine- and land applications.	
	Machine top part with deep sludge cover.	
	Sealings available in Nitrile.	
Designed in accordance with standards:	89/392 91/368 93/44	The Council Directive of the European Communities.
	EN 292-2	Safety of machines. Use of the machine in applications subject to hygienic demands requires a well adapted cleaning program.
Restrictions:	Fedd temperature: 0°C to +100°C	
	Ambient temperature: 5°C to +55°C	
	Max. allowed density of operating liquid: 1000 kg/m^3	
	Viscosity max. 700 cSt at 50°C	
	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.	
	Not to be used for liquids with flaspoint below 60 °C	

Alfa Laval ref. 557388, rev. 0

Density of sediment/feed, max.	1 896/1 100	kg/m^3
Hydraulic capacity, max.	4 700	litres/hour
Bowl speed, max.	7 605/7 540	r/minute, 50/60 Hz
Motor shaft speed, max.	1 500/1 800	r/minute, 50/60 Hz
Revolution counter	118-125 / 142-150 r/minute, 50/60 Hz	
No. of teeth;		
- on worm, 50 Hz	14	
- on worm, 60 Hz	16	
- on worm wheel, 50 Hz	71	
- on worm wheel, 60 Hz	67	
Lubricating volume	4,1	litres
Motor power rating	4	kW
Power consumption, max.	5,9	kW (at starting up)
Power consumption, normal	2,2/3,6	kW (idling/at max. capacity)
Discharge volume, min./max.	1/1,3	litres variable discharge volume
Discharge interval, min.	1	minute
Bowl volume	3,1	litres
Starting time	1,5-3,5	minutes,
Stopping time with brake, min./max.	4/6	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	75	dB(A) ISO 3744, 4,5 m^3/h
Vibration level max. separator in use/new separator,	7,1/5,6	mm/s (RMS)
Weight of separator (without motor)	400	kg
Weight of bowl	60	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. 560523 rev. 0

Connection No.	Description	Requirements/limits
201	Inlet for product - Allowed temperature	 Min. 0 °C, max. 100 °C
206	Inlet to liquid seal or displacement liquid, water – Instantaneous flow – Pressure (Min./Max.)	Fresh water 0,9 litres/minute 200/600 kPa
220	Outlet for light phase (oil) – Counter pressure	 0-250 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)
372	Inlet of discharge liquid – Instantaneous flow – Time – Pressure (Min./Max.)	See demand in chapter “8.5 Water quality” on page 181 11 litres/minute 3 seconds/discharge 200/600 kPa
376	Inlet for make-up liquid – Pressure (Min./Max.)	See demand in chapter “8.5 Water quality” on page 181 22/32 kPa
372 + 376 (463)	Discharge and make-up liquid – Consumption Drain of frame top part, upper	 0,8 litres/discharge
462	Drain of frame top part, lower	

Connection No.	Description	Requirements/limits
377	Outlet for operating liquid (discharge and make-up liquid)	
(463)	Drain of frame top part, upper	
462	Drain of frame top part, lower	
701	Motor for separator – Deviation from nominal frequency	 ± 5% (momentarily 10% during a period of maximum 5 seconds)
753	Vibration sensor (delivered as option) – Type – Vibration measurement range – Switch rating, resistive load max. – Reset coil power supply max. 14 W	See "8.3 Interface description" and "8.6.5 Vibration sensor (option)" on page 188 Mechanical switch 0 to 4,5 g from 0 to 300 Hz 5 A12 V DC 2 A24 V DC 1 A48 V DC 0,5 A120 V DC 7 A460 V AC 50/60 Hz 48 V DC
760	Cover interlocking switch (delivered as option) – Type – Switch rating, resistive load max.	See "8.3 Interface description" and "8.6.6 Cover interlocking switch (option)" on page 188 Mechanical switch 3 A 500 V

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.

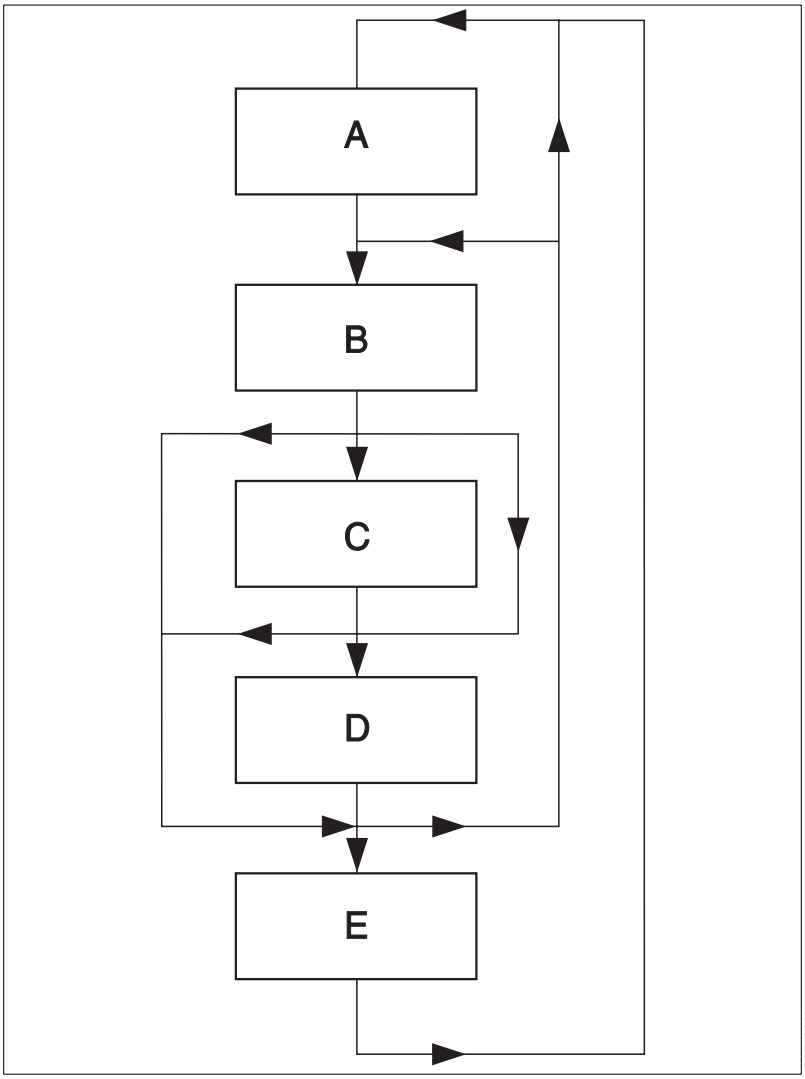
Discharge

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 Lubricants

8.4.1 Lubrication chart, general

Alfa Laval ref. 553216-01, rev. 6

Lubricating points	Type of lubricant
Bowl spindle ball bearings and buffers are lubricated by oil mist	Lubricating oil as specified in “8.4.2 Recommended lubricating oils” on page 174
Bowl spindle taper	Lube oil, only a few drops for rust protection
Metal buffers of bowl spindle	Lube 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 “8.4.4 Recommended lubricants” on page 178
Rubber seal rings	Grease as specified in “8.4.4 Recommended lubricants” on page 178
Friction coupling ball bearings	The bearings are packed with grease and sealed and need no extra lubrication
Electric motor	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.
- **Group E oil:** Characteristics as a group D-oil but suitable at a higher operation power (≤55 kW)
- 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 occurs.
- 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.

CAUTION

Check the oil level before start.
Top up when necessary.
Oil volume = see ‘‘8.1 Technical data” on page 165.

- 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 oilbrands 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.

8.4.2 Recommended lubricating oils

Alfa Laval ref. 553219-03, rev. 1

Type of frame **B 207** with motor ≤ 12 kW.

Three different groups of lubricating oils are approved.

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

The numerical value after the letter states the viscosity grade.

The corresponding commercial oil brands are found in chapter "8.4.3 Recommended oil brands" on page 175.

Ambient temperature °C	Alfa Laval lubricating oil group	Time in operation Oil change interval
between +5 and +45	A/220 B/220	1 500 h
between +2 and +65	D/220	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.

8.4.3 Recommended oil brands

Alfa Laval ref. 553218-01, rev. 2

NOTE

The data in below tables is based on supplier information in regards to lubrication properties. Trade names and designations might vary from country to country, contact your local supplier for more information.

Brands with Alfa Laval article number are approved and recommended for use.

Alfa Laval lubrication oil group A	
Viscosity grade VG (ISO 3448/3104) Viscosity index VI (ISO 2909)	220 >92
Manufacturer	**Designation**
Castrol	Alpha ZN 220
ELF	Polytelis 220
Esso/Exxon	Nuto 220 Tersso 220 Terrestic 220
Mobil	DTE Oil BB
Optimol	Ultra 220
Shell	Morlina 220 Tellus 220
Texaco/Caltex	Regal Oil 220 Paper Machine Oil Premium 220

Alfa Laval lubricating oil group B/220

Alfa Laval ref. 553218-02, rev. 3

NOTE

The data in below tables is based on supplier information in regards to lubrication properties. Trade names and designations might vary from country to country, contact your local supplier for more information.

Brands with Alfa Laval article number are approved and recommended for use.

Alfa Laval lubrication oil group B	
Viscosity grade VG (ISO 3448/3104) Viscosity index VI (ISO 2909)	220 >92
Manufacturer	**Designation**
Bel-Ray	06-220
BP	Energol GR-XP 220
Castrol	Alpha SP 220
Chevron	Ultra Gear 220 Gear Compound EP 220
ELF	Epona Z 220
Esso/Exxon	Spartan EP 220
Fina	Giran 220
Mobil	Mobilgear 630 (Mobilgear SHC 220) ***** Synthetic
Optimol	Optigear BM 220
Q8/Kuwait Petroleum	Goya 220
Shell	Omala 220 (Delima HT 320) ***** Synthetic
Texaco/Caltex	Meropa 220

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

If you can't verify the temperature by measuring, a rough estimate is that 80 °C is when you can touch the surface of lower part of frame for a short time only.

Alfa Laval lubricating oil group D/220

Alfa Laval ref. 553218-03

NOTE

The data in below tables is based on supplier information in regards to lubrication properties. Trade names and designations might vary from country to country, contact your local supplier for more information.

Brands with Alfa Laval article number are approved and recommended for use.

Alfa Laval lubrication oil group D	
Viscosity grade VG (ISO 3448/3104) Viscosity index VI (ISO 2909)	220 >135
Manufacturer	**Designation**
Alfa Laval	542690-80 (20 litres) 542690-81 (4 litres) 542690-82 (208 litres) 542690-83 (1 litre)
BP	Enersyn HTX 220
Castrol	Alphasyn EP 220
ELF	Epona SA 220
Mobil	SHC 630
Shell	Delima HT 220 Paolina 220

8.4.4 Recommended lubricants

Alfa Laval ref. 553217-01

NOTE

The data in below tables is based on supplier information in regards to lubrication properties. Trade names and designations might vary from country to country, contact your local supplier for more information.

Brands with Alfa Laval article number are approved and recommended for use.

Pastes for non-food applications:

Manufacturer	Designation	Alfa Laval No	
Fuchs Lubritech	Gleitmo 805K Gleitmo 705K		
Dow Corning	Molykote 1000 (Paste) Molykote 1000 (Paste) Molykote G-rapid plus (Paste)	537086-02 (1000 g) 537086-03 (100 g) 537086-04 (50 g)	
Rocol	Antiscuffing (ASP) (Paste)		
Klüber	Wolfracoat C (Paste)		

Bonded coatings:

Manufacturer	Designation	Alfa Laval No	
Fuchs Lubritech	Gleitmo 900 (Varnish or spray)		
Dow Corning	Molykote D321R (Spray) Molykote D321R (Varnish)	535586-01 (300 ml) 535586-02 (60 ml)	

Pastes for food applications

Manufacturer	Designation	Comment	Alfa Laval No	
Fuchs Lubritech	Gleitmo 805			
	Geralyn 2	USDA H1	561764-01 (50 g)	
Dow Corning	Molykote TP 42 Molykote D			
	Molykote Foodslip EP-2	USDA H1 (Mineral oil base)	537086-07 (50 g)	
Klüber	Klüberpaste 46 MR 401			
	Klüberpaste UH1 96-402	USDA H1		
Lubrication Engineers	LE 4025	USDA H1		

Silicone grease for rubber rings:

Manufacturer	Designation	Alfa Laval No	
Dow Corning	Molykote 111 (Compound) Molykote 111 (Compound)	539474-02 (100 g) 539474-03 (25 g)	
Fuchs Lubritech	Gleitmo 750		
Klüber	Unisilkon L 250 L		
Wacker	Silicone P (Paste)		

Greases for ball and roller bearings:

> **NOTE**
>
> Always follow the specific recommendation for lubrication as advised by the manufacturer.

Manufacturer	Designation	Alfa Laval No
BP	Energrease MM-EP2 Energrease LS2	
Castrol	APS 2 Grease EPL 2	
Chevron	Dura-Lith Grease EP2	
Elf	Epexa 2	
Esso/Exxon	Beacon EP2 Unirex N2	
Fina	Marson EPL 2A	
Mobil	Mobilith SHC 460 Mobilux EP2	
Gulf	Gulflex MP2	
Q8/Kuwait Petroleum	Rembrandt EP2	
Shell	Alvania EP Grease 2 Albida Grease EP2	
SKF	LGEP2 or LGMT2	
Texaco	Multifak AFB 2	

8.5 Water quality

Alfa Laval ref. 553406 rev.5

Operating water is used in the separator for several different functions: e.g. to operate the discharge mechanism, to lubricate and cool mechanical seals, etc.

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

The following requirements are of fundamental importance

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

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

1.2 Max particle size 50 µm.

2. Total hardness less than 180 mg $CaCO_3$ per litre, which corresponds to 10 °dH or 12,5 °E.

Hard water may with time form deposits in the operating mechanism. The precipitation rate is accelerated with increased operating temperature and low discharge frequency. These effects become more severe the harder the water is.

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

Chloride ions contribute to corrosion on the separator surfaces in contact with the operating water, including the spindle. Corrosion is a process that is accelerated by increased separating temperature, low pH, and high chloride ion concentration.

A chloride concentration above 60 mg/l is not recommended.

4. pH>6

Increased acidity (lower pH) increases the risk for corrosion; this is accelerated by increased temperature and high chloride ion content.

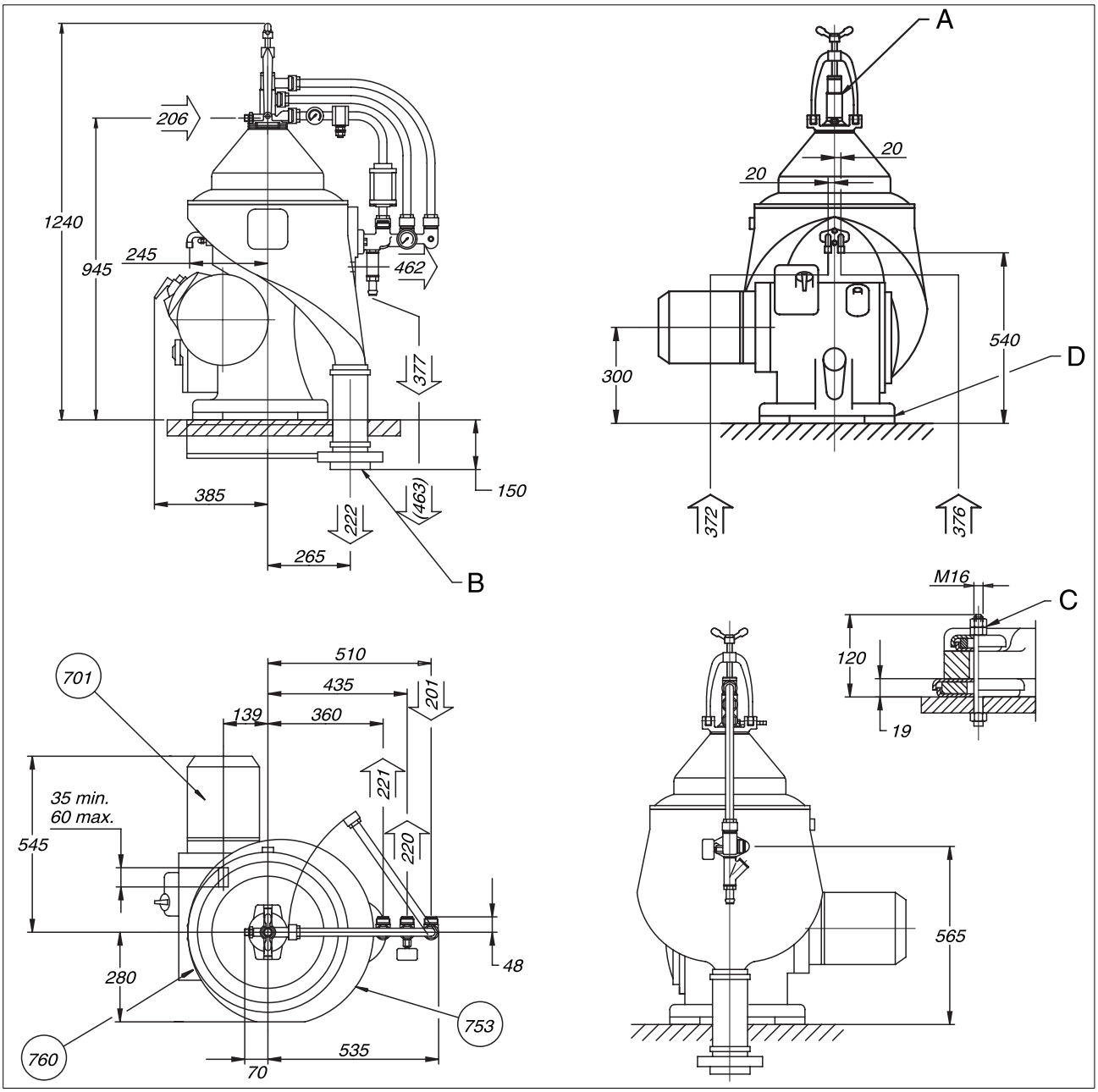
NOTE

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

8.6 Drawings

8.6.1 Basic size drawing

Alfa Laval ref. 557493, rev. 3



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. Secured with counter nut.

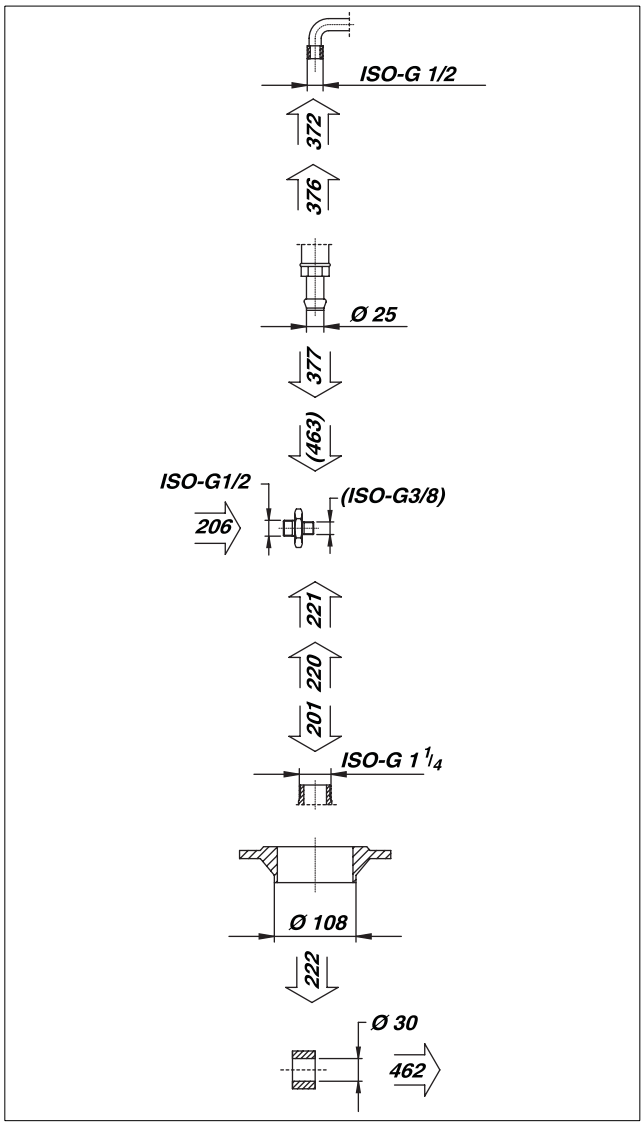
D. Horizontal max. deviation 0,4 °.

8.6.2 Dimensions of connections

Alfa Laval ref. 557493, rev. 3

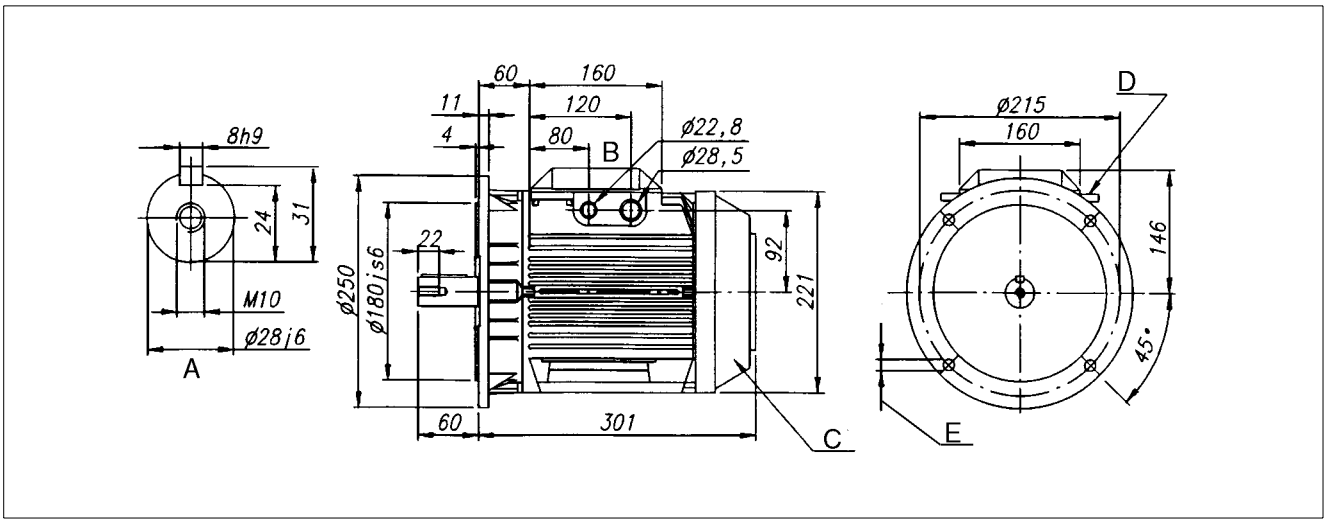
Data for connections, see chapter “8.2 Connection list” on page 167.

All connections to be installed non-loaded and flexible.



8.6.3 Electric motor

Alfa Laval ref. 552810, rev. 3



A. Shaft dimension
B. Knockout openings for cable glands on both sides
C. Metal fan cover
D. Casted lifting lugs on both sides
E. 4 holes Ø 14,5

Manufacturer	ABB Motors
Manufacturers drawing	Cat. BA/Marine motors GB 98-05
Standards	IEC 34-series, 72, 79 and 85
Size	112 M
Type	M2AA 112 M
Weight	27 kg
Poles	4
Insulation class	F
Bearings	DE 6206-2Z/C3 – NDE 6205-2Z/C3
Method of cooling	IC 411 (IEC 34-6)
Specification	Totally enclosed three-phase motor for marine service [1)]

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

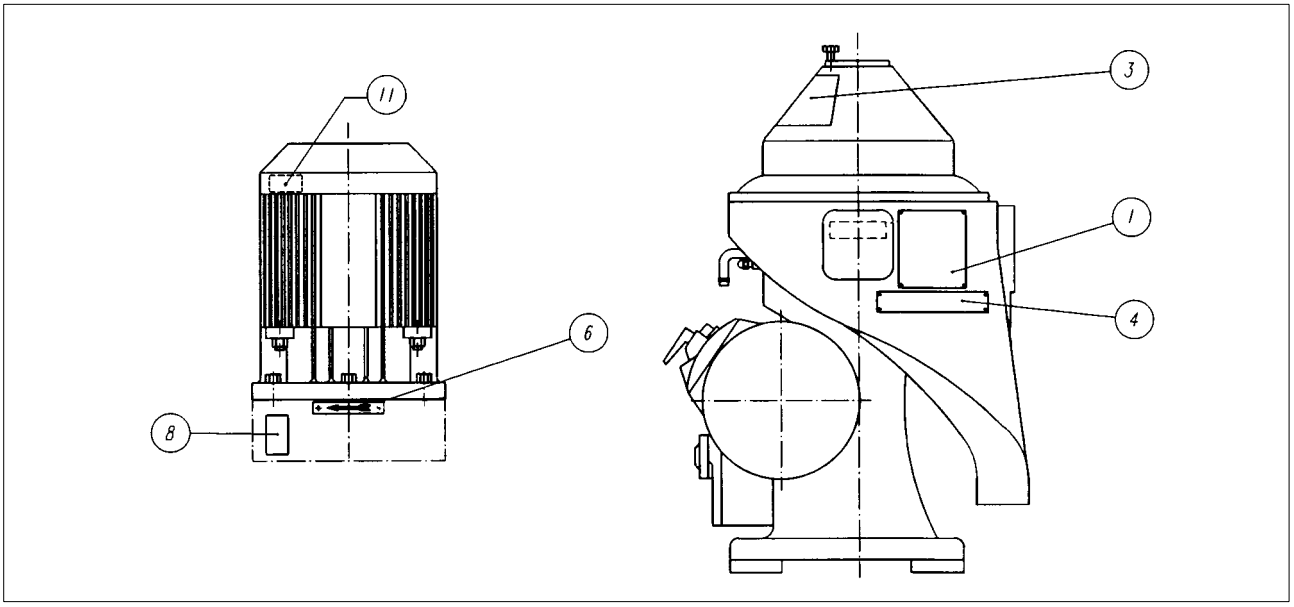
1) The motors can be designed to fulfil requirements of following Classification Societies:

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)
Nippon Kaiyi Kyoaki	(NK)	(Essential Service)
Korean Register of Shipping	(KR)	(Essential Service)
Polski Rejester Statkow	(PRS)	(Essential Service)
China Classification Societies	(CCS)	(Essential Service)
Indian Register of Shipping	(IRS)	(Essential Service)
Martime Register of Shipping	(RMS)	(Essential Service)

Required classification society must always be specified when ordering. Factory test certificate to be enclosed at the delivery.
Rated output (kW) valid for temp-rise max. 90 °C.
The motors can be provided with space heaters for 110V or 220 V 25W as option.
State supply when ordering.
Connection to separate terminal board in the main terminal box acc. to attached connection diagram.

8.6.4 Machine plates and safety labels

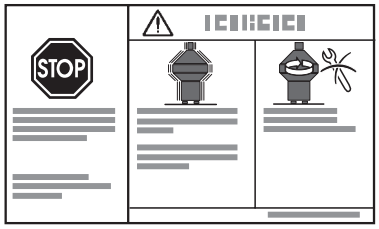
Alfa Laval ref. 557410, rev. 1



1. Machine plate

Separator	FOPX 605TFD-20
Manufacturing serial No / Year	XXXX
Product No	881111-01-05
Machine top part	546226-01
Bowl	546224-04
Machine bottom part	540224-10/11 (50/60 Hz)
Max. speed (bowl)	7605 r/min. (50 Hz), 7540 r/min. (60 Hz)
Direction of rotation (bowl)	←
Speed motor shaft	1500 r/min. (50 Hz), 1800 r/min. (60 Hz)
El. current frequency	50/60 Hz
Recommended motor power	4 kW
Max. density of feed	1100 kg/m^3
Max. density of sediment	1896 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.

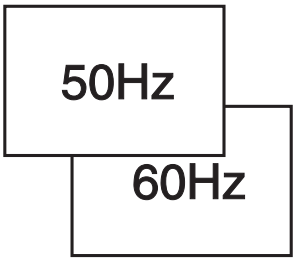
4. Name plate

S0063211

6. Arrow

Indicating direction of rotation of horizontal driving device.

8. Power supply frequency



S0063111

11. Space for additional label as specified in the order.

8.6.5 Vibration sensor (option)

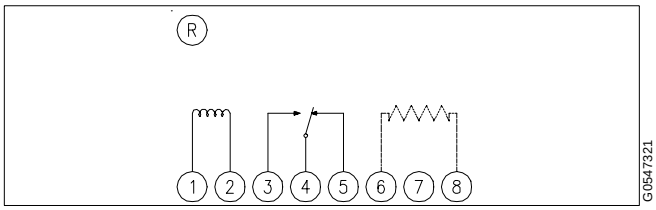
Alfa Laval ref. 557311, rev. 1

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 167 and “8.3 Interface description” on page 169.



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

R Reset button

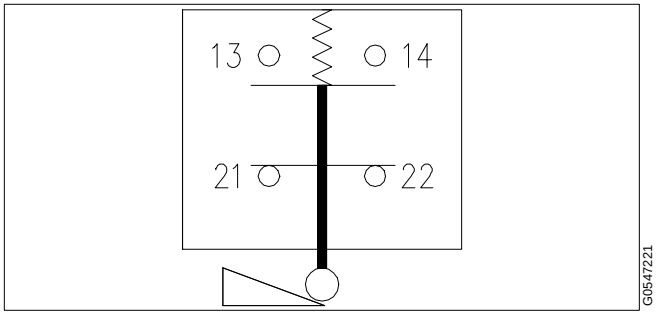
8.6.6 Cover interlocking switch (option)

Alfa Laval ref. 557311, rev. 1

Switch rating, voltage: Max. 500 V

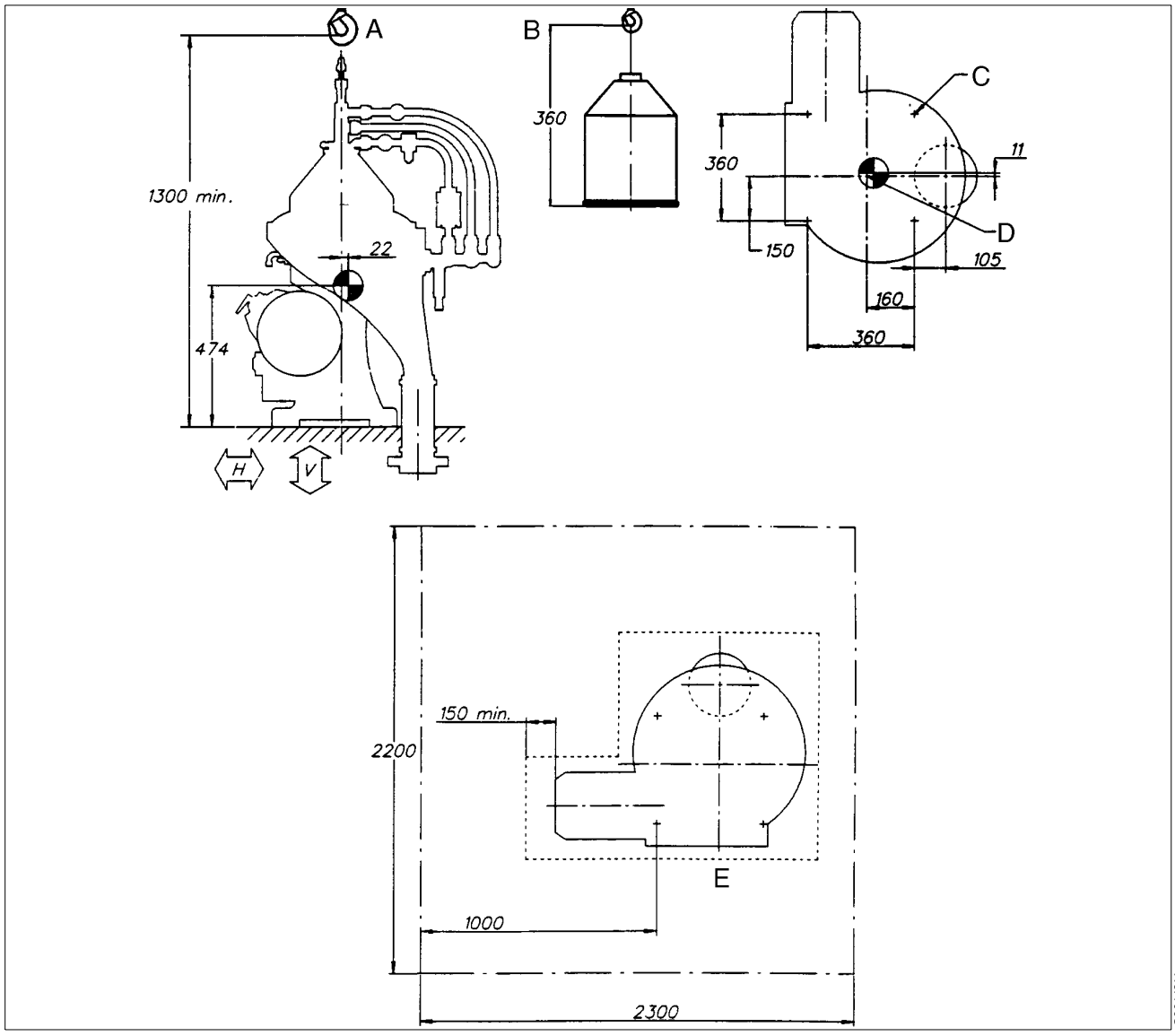
current: Max. 3 A

For other technical information see chapter “8.2 Connection list” on page 167 and “8.3 Interface description” on page 169.



8.6.7 Foundations

Alfa Laval ref. 557508, rev. 0



A. Min. lifting capacity required when doing service: 500 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. 4 holes Ø 18 for anchorage

D. Center of separator bowl

E. Service side

Recommended free floor space for unloading when doing service

No fixed installations within this area.

Center of gravity (without motor)

Vertical force not exceeding 10 kN/foot

Horizontal force not exceeding 10 kN/foot

8.7 Storage and installation

8.7.1 Storage and transport of goods

Storage

Specification

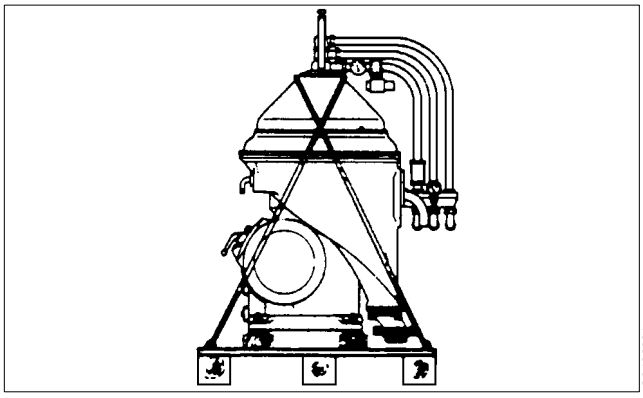
Upon arrival to the store, **check all components and keep them:**

1. Well stored and protected from mechanical damage.
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.

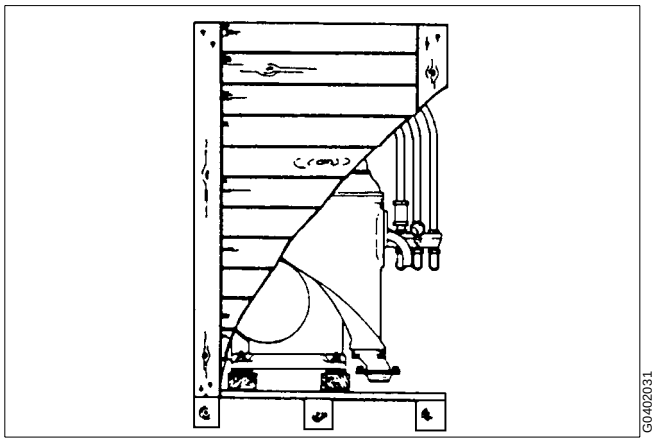
  The separator must be stored in a storage room well protected from mechanical damage and also dry and protected from rain and humidity.



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.

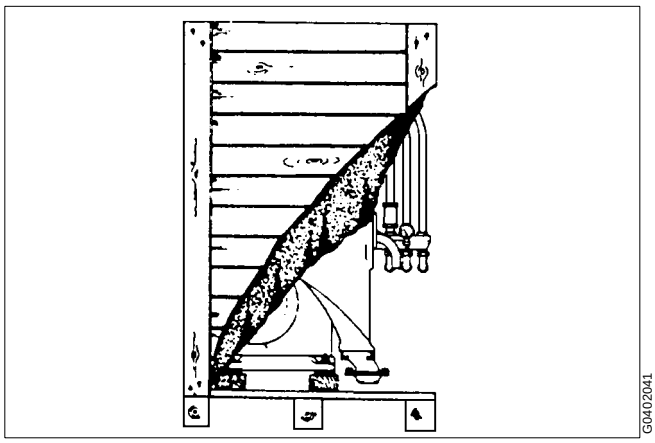


In a wooden box which is not water tight

- 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 82.

WARNING

Crush hazards

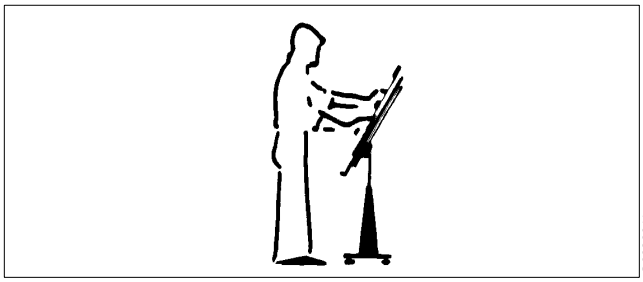
Use correct lifting tools and follow lifting instructions.

- 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 182, “8.6.7 Foundations” on page 189 and instructions for ancillary equipment, electrical and electronic equipment and cables.

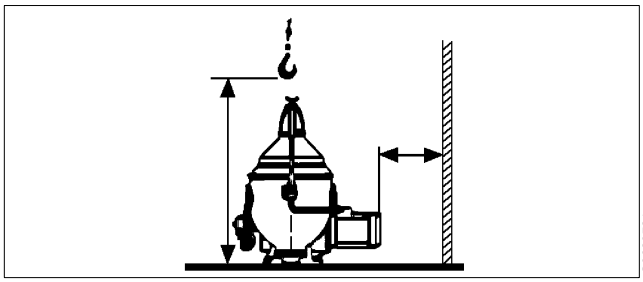


Check the drawings when planning the installation

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 “8.6.7 Foundations” on page 189 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 "8.6.7 Foundations" on page 189.

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.

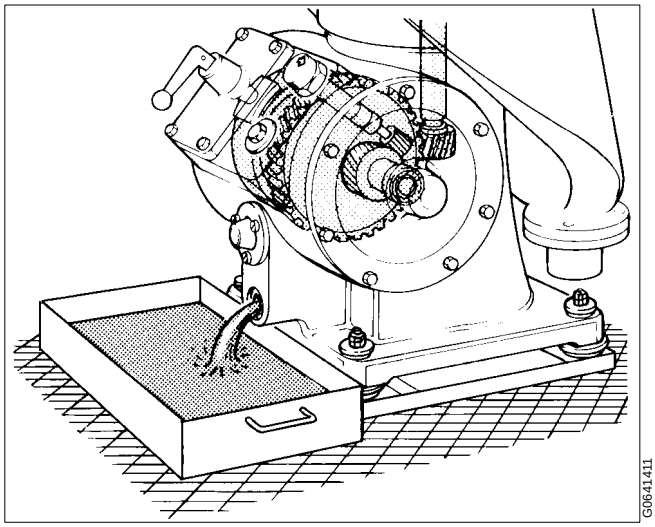
Space for oil changing

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

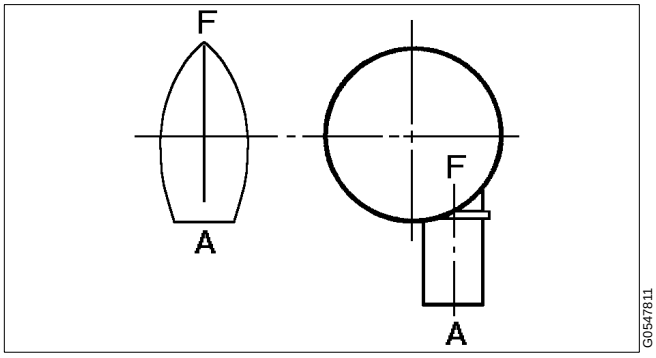
8.7.3 Foundations

NOTE

When lifting a separator it must always be **hung securely**. See chapter "5.5 Lifting instructions" on page 82.

Specification

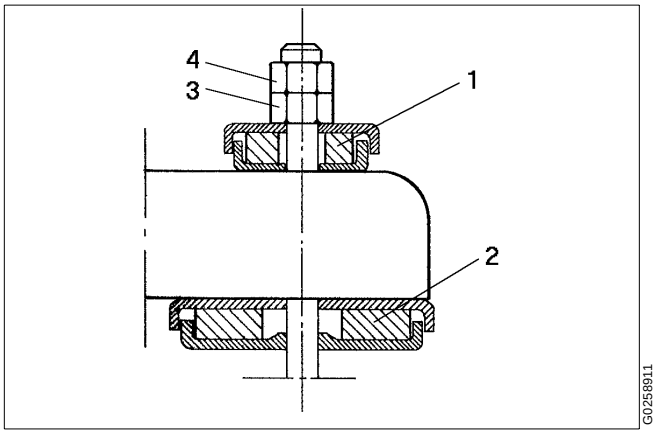
- The separator can either be installed at floor level or on a platform, see chapter “8.6.7 Foundations” on page 189.



F = Forward
A = Aft

- When a separator is installed on a ship, the separator should be installed in such a way that the centre line of the electric motor is parallel with the centre line of the ship. The electric motor should preferably be pointing aft.
- The separator must be installed on a strong and rigid foundation to reduce the influence of vibrations from adjacent machinery.
- The foundation should be provided with a cofferdam.
- Fit the separator frame on the foundation as follows:
  - Place the separator frame without cushions in position.
  - Check that the bolts do not press against the edges of the holes, otherwise the elasticity of the mounting of the separator frame will be impeded.
  - Fit height adjusting washers required.
  - Check that the separator frame is horizontal and that all feet rest on the foundation.
  - Lift the separator frame, fit the vibration dampers (1, 2), lower and check that the bolts do not press against the edges of the holes.

Tighten nut (3) with **20 Nm**. Hold firmly and secure with the lock nut (4). Repeat for the other frame feet.



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

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