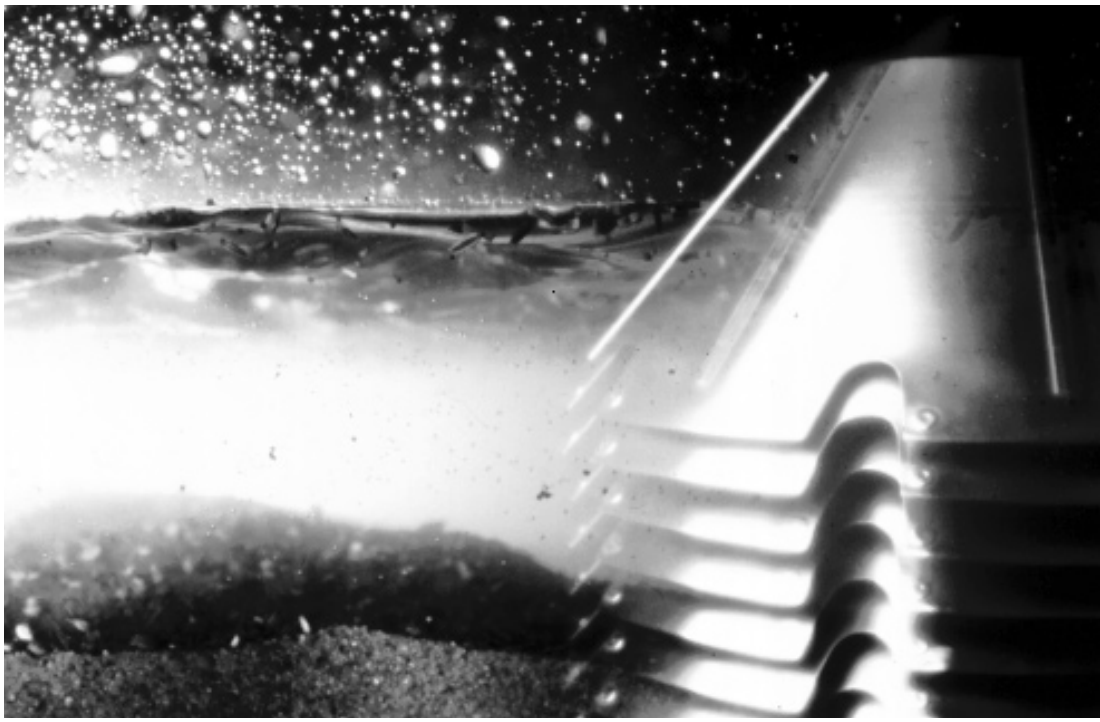
A L F A L A V A L S E P A R A T I O N

MOPX 205TGT-24



Separator Manual

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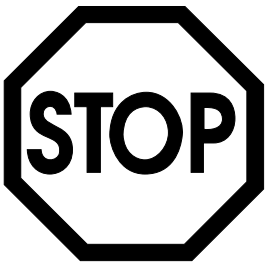
Contents



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 MOPX 205TGT-24.

For information concerning the function of the separator, see chapter “3 Separator Basics” on page 15 and chapter “8 Technical Reference” on page 169.

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

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

This Separator Manual consists of:


S0068011

Separator Manual and Spare Parts Catalogue

Safety Instructions

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

Separator Basics

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

Operating Instructions

This chapter contains operating instructions for the separator only.

Service Instructions

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

Dismantling / Assembly

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

Trouble-tracing

Refer to this chapter if the separator functions abnormally.

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

Technical Reference

This chapter contains technical data concerning the separator and drawings.

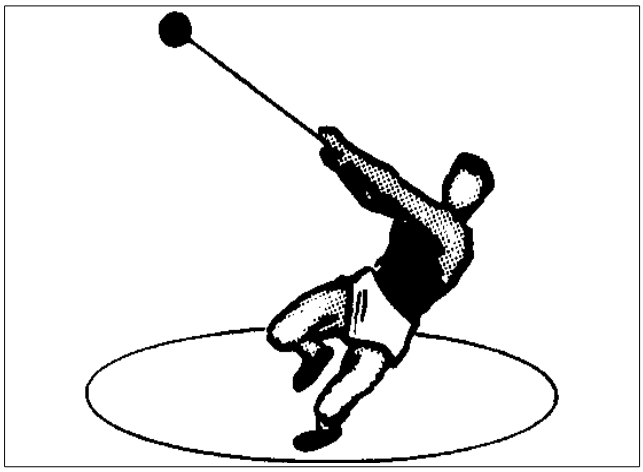
Index

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

2 Safety Instructions

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

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



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

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

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

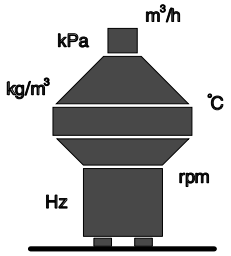
The following basic safety instructions therefore apply:

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

DANGER

Disintegration hazards

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



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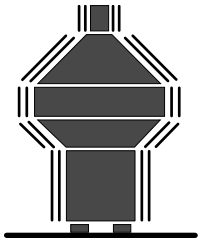

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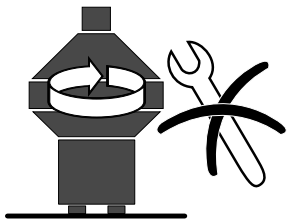
DANGER

Entrapment hazards

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

Electrical hazards

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



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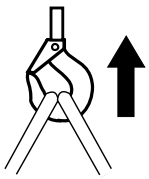
WARNING

Crush hazards

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



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Noise hazards

- Use ear protection in noisy environments.

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CAUTION

Burn hazards

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

Cut hazards

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

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S0054311

Warning signs in the text

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

DANGER

Type of hazard

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

WARNING

Type of hazard

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

CAUTION

Type of hazard

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

NOTE

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

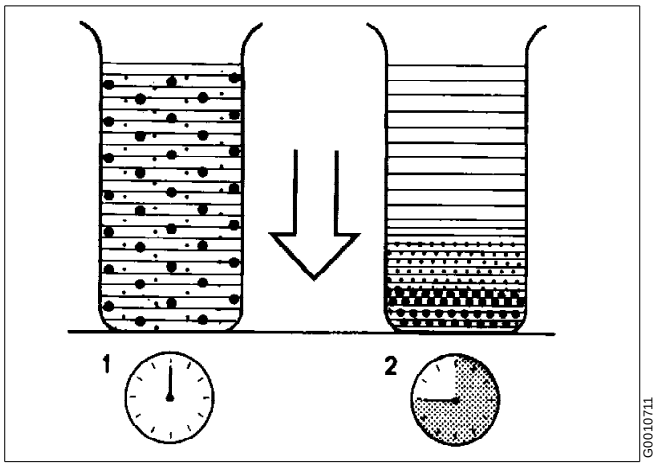
3 Separator Basics

Contents

3.1 Basic principles of separation

The purpose of separation can be:

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



Sedimentation by gravity

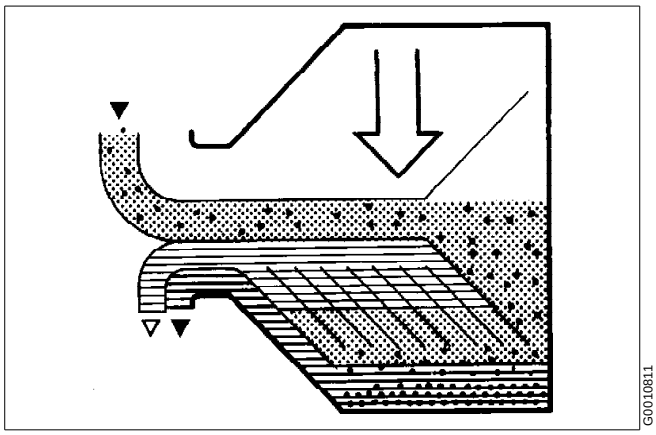
Separation by gravity

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

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

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

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



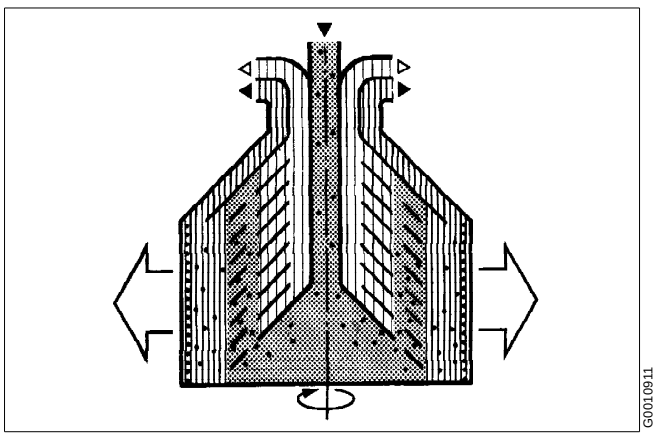
Sedimentation in a settling tank, with outlets making it possible to separate the lighter liquid parts from the heavier

Centrifugal separation

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

Separation and sedimentation is continuous and happens very quickly.

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



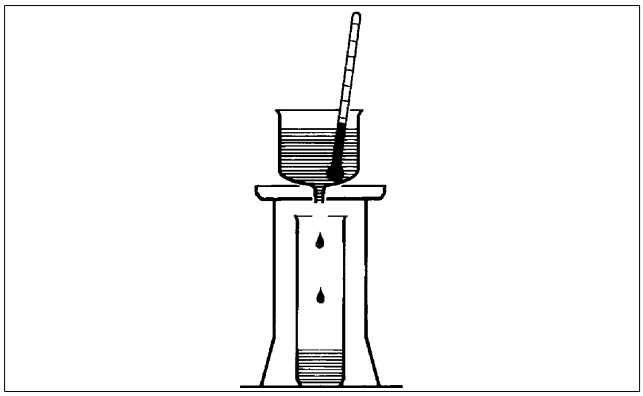
The centrifugal solution

Separating temperatures

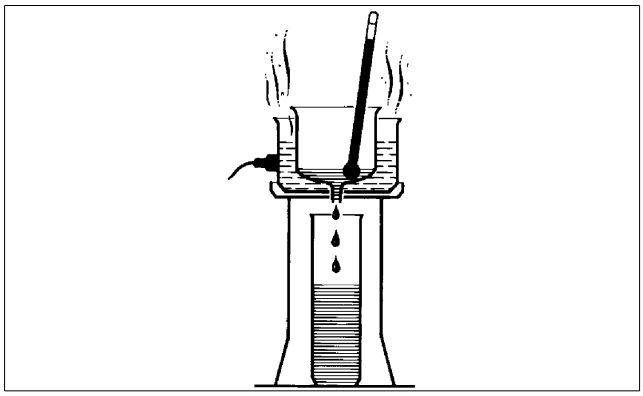
For some types of process liquids (e.g. mineral oils) a high separating temperature will normally increase the separation capacity. The temperature influences oil viscosity and density and should be kept constant throughout the separation.

Viscosity

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



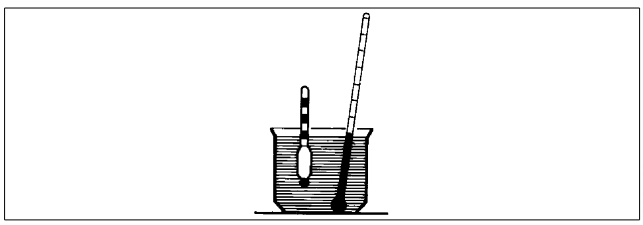
High viscosity (with low temperature)



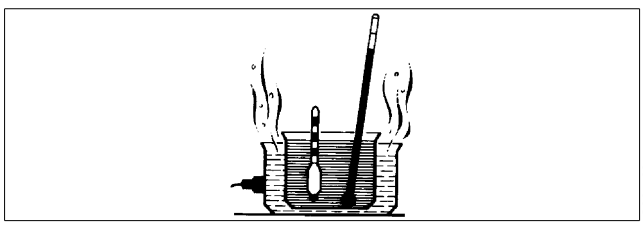
Low viscosity (with high temperature)

Density difference

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



High density (with low temperature)



Low density (with high temperature)

3.2 Design and function

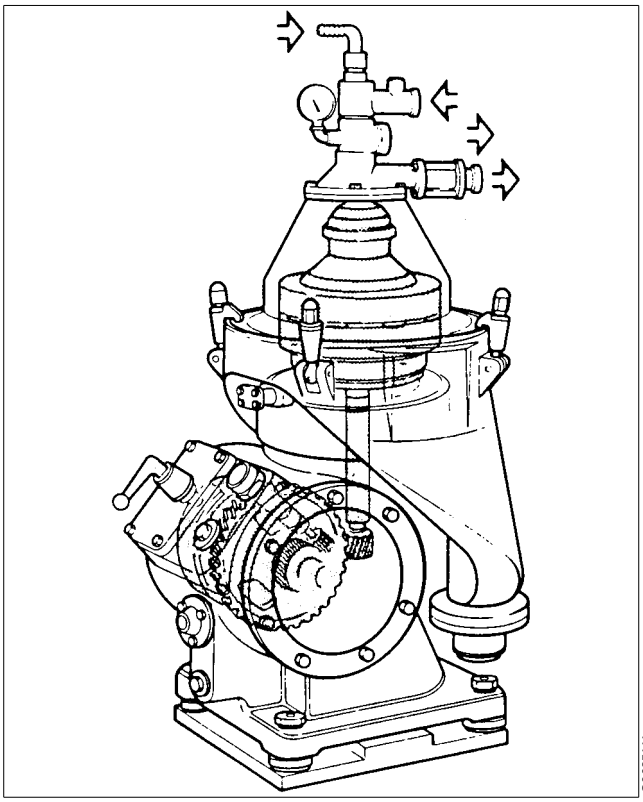
3.2.1 Application

The MOPX 205TGT-24 is a high-speed centrifugal separator intended for marine and land applications. It is specifically designed for cleaning of mineral oils from water and solid particles (sludge). The cleaned oil is discharged continuously, while the sludge is discharged at intervals.

The separator can be operated either as a purifier or as a clarifier. When operated as a purifier the separator discharges the separated water continuously.

When the oil contains only small amounts of water the separator is operated as a clarifier, discharging the water together with the solid particles.

The separator has to be installed together with devices for control of its operation. It can be delivered with a built-on pump for oil inlet feed.



The MOPX 205TGT-24 separator

DANGER

Disintegration hazards

Use the separator only for the purpose and parameters (type of liquid, rotational speed, temperature, density etc.) specified in chapter “8 Technical Reference” on page 169 and in the Purchase Order documents.

Consult your Alfa Laval representative before any changes outside these parameters are made.

3.2.2 Overview

The separator comprises a processing part and a driving part. It is driven by an electric motor (10).

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 (5) are vibration damping.

The bottom part of the separator contains the horizontal driving device (6), driving shaft with couplings (8, 9), a worm gear (7) and a vertical spindle (3).

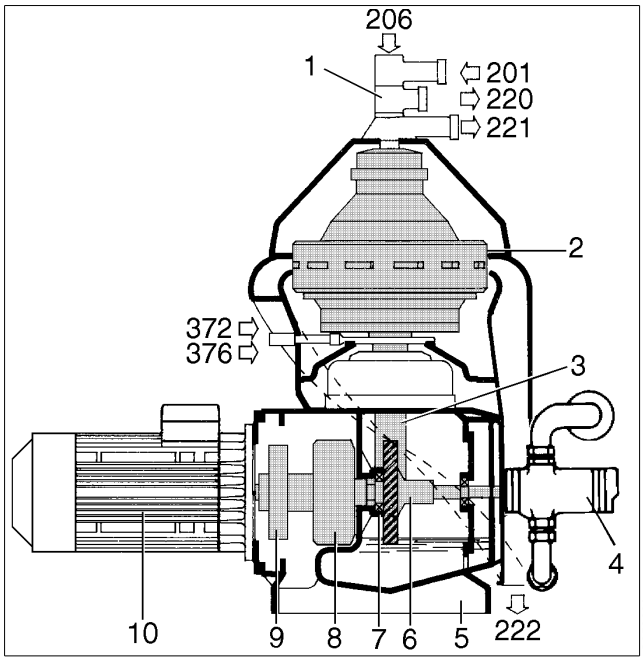
The bottom part also contains an oil bath for the worm gear, a brake and a revolution counter.

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 is of disc type and also contains the hydraulically operated discharge mechanism which empties the bowl of sludge.

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 169, where also permissible pressures and operating conditions are specified.

As option the separator can be equipped with a feed inlet pump (4).



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

201. Unseparated oil inlet
206. Sealing/displacement 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

3.2.3 Mechanical power transmission

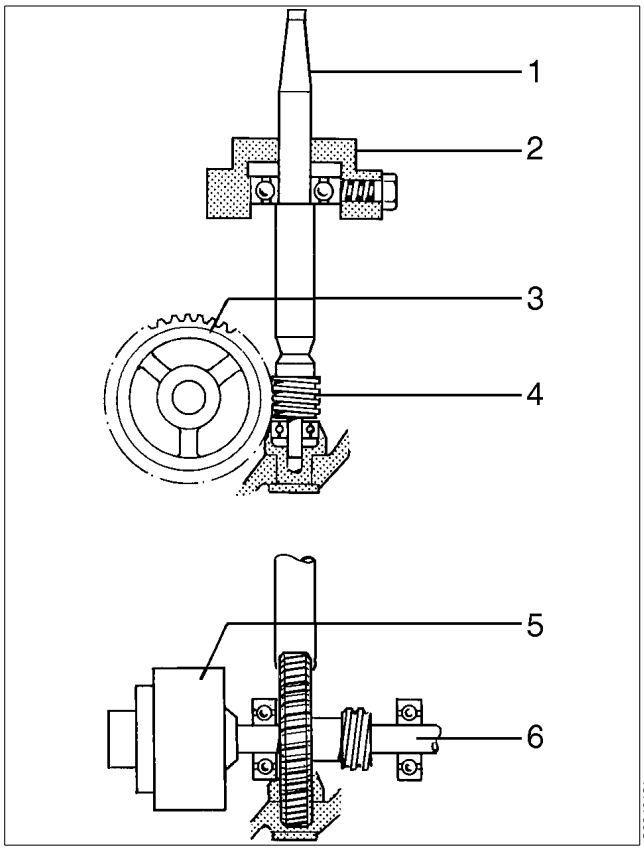
The main parts of the power transmission between motor and bowl are shown in the illustration.

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

The worm gear has a ratio which increases the bowl speed several times compared to the motor speed. For correct ratio see chapter ‘‘8.1 Technical data” on page 170.

To reduce bearing wear and the transmission of bowl vibrations to 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.

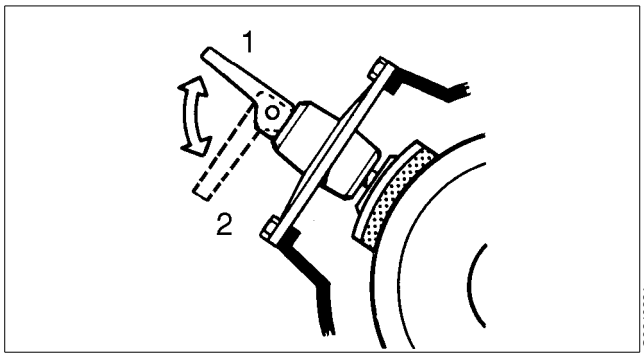


1. *Bowl spindle*
2. *Top bearing and spring casing*
3. *Worm wheel*
4. *Worm*
5. *Friction coupling*
6. *Worm wheel shaft*

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.



1. *Brake ON*
2. *Brake OFF*

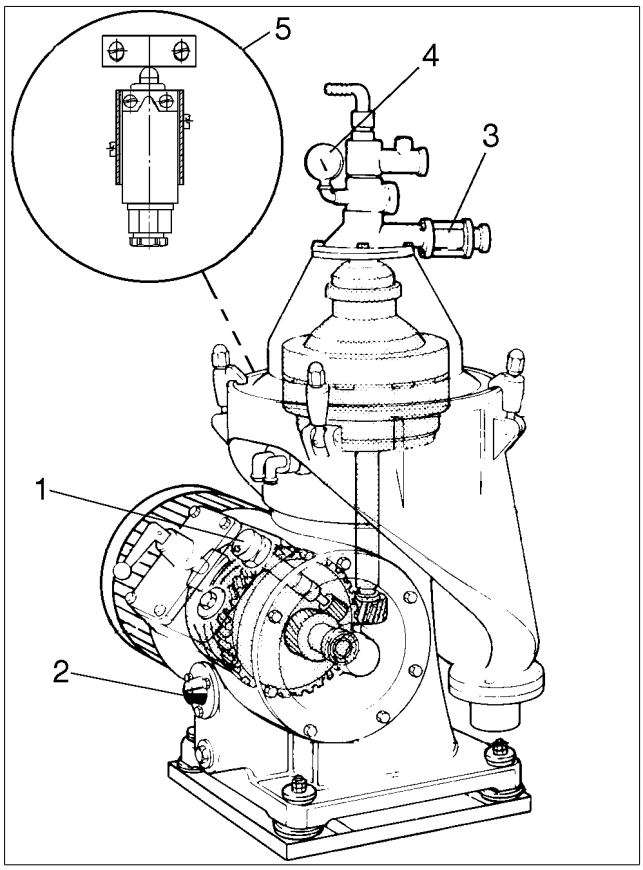
3.2.4 Sensors and indicators

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 169. Refer to name plate for speed particulars.

Sight glass (2) for oil sump

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



1. *Revolution counter*
2. *Oil sight glass*
3. *Sight glass*
4. *Back pressure gauge*
5. *Cover interlocking switch*

Sight glass (3) for separated water outlet

The sight glass shows the flow of the separated water and if any oil is escaping through the water outlet. If so, see“7 Trouble-tracing” on page 157.

Back pressure gauge (4)

Correct limits for the back pressure in the clean oil outlet can be found in chapter ‘‘8.2 Connection list” on page 172.

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

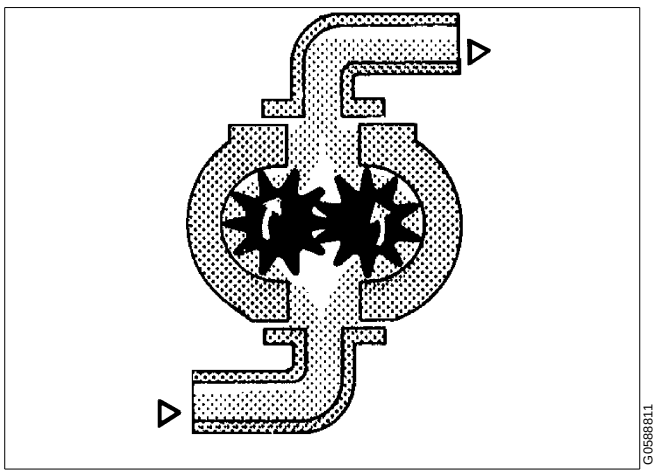
- restriction in the outlet piping, e.g. a buckled or bent pipe,
- increased throughput,
- increased viscosity, decreased separating temperature.

Cover interlocking switch (5)

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

3.2.5 Inlet pump (option)

The separator can be equipped with a built-on pump of gear type. The pump is driven by the horizontal driving shaft. This pump feeds the oil to the feed inlet (201).

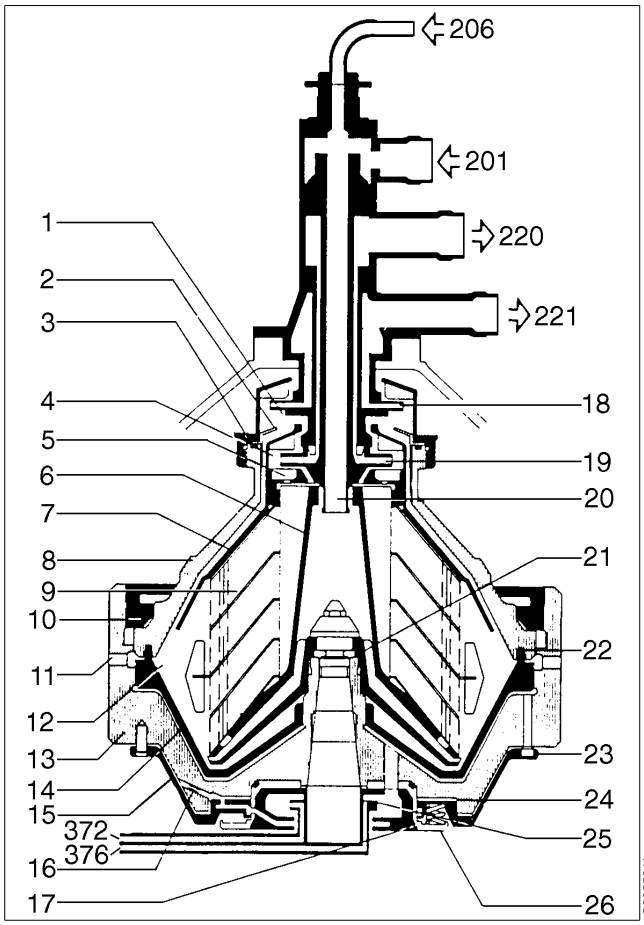


Gear pump

3.2.6 Process main parts

1. *Water paring chamber*
2. *Gravity disc or clarifier disc*
3. *Small lock ring (with paring chamber cover)*
4. *Oil paring chamber*
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. *Sliding bowl bottom**
15. *Operating slide **
16. *Nozzle **
17. *Spring **
18. *Water paring disc*
19. *Oil paring disc*
20. *Inlet pipe*
21. *Distributing cone*
22. *Bowl hood seal ring **
23. *Drain valve plug **
24. *Opening chamber **
25. *Control paring disc **
26. *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 **



Sectional view of separator bowl, feed and discharge assembly and operating mechanism

* *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 feed connection and the long inlet pipe (20) which extends into the middle of the bowl.
- The outlets (220, 221). These comprise the discharge cover and the paring discs (18, 19) which pump the separated oil and water out of the bowl. Each paring disc is located in a paring chamber (1, 4) 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 (21), the distributor (6) and the disc stack (9). The disc stack is kept compressed by the hood. The sliding bowl bottom (14) 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 (22) 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 (15) and an operating paring disc device. Passive parts are: nozzles (16) and drain valve plugs (23). 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 (25).

3.3 Separating function

3.3.1 Purifier bowl

Characteristic parts

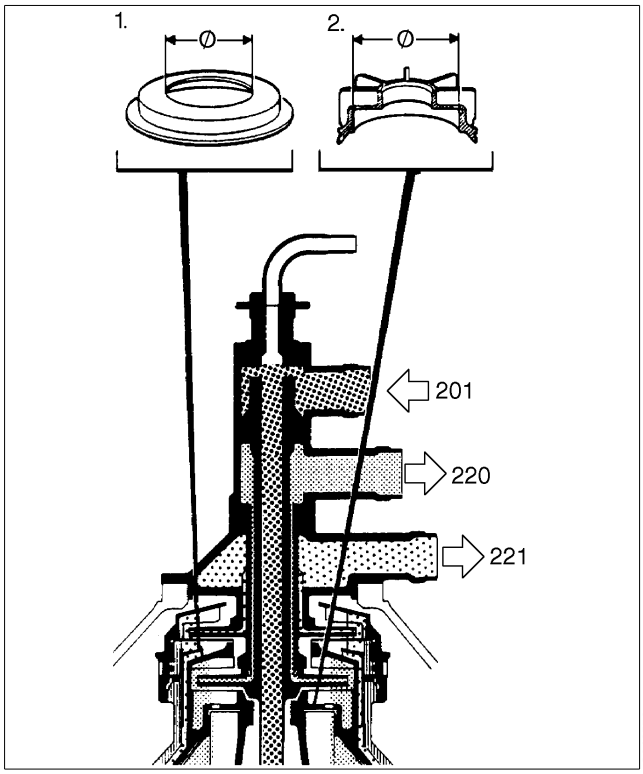
The illustration shows characteristic parts of the purifier bowl:

1. The gravity disc, which should be chosen according to directions in chapter ‘‘4.1.2 Selection of gravity disc” on page 36.

   The gravity disc determines the interface position (see below) in a purifier bowl.

2 The level ring diameter Ø determines the free oil level in the bowl (the interface between oil and air in the centre of the bowl).

A purifier bowl has two liquid outlets, 220 (oil) and 221 (water).



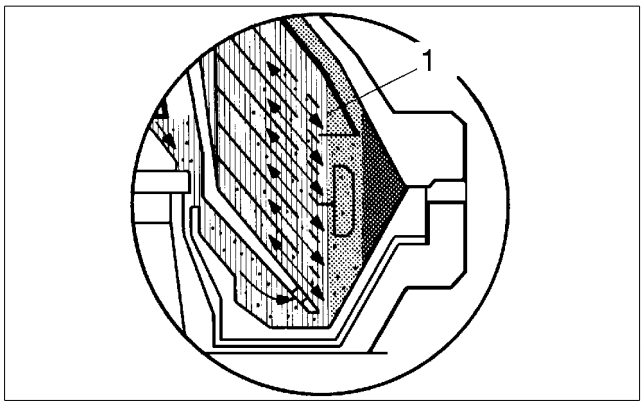
Purifier bowl

Position of interface

An interface (1) must be 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, which is between the disc stack and the outer edge of the top disc.

If the interface moves outside the outer edge of the top disc the water seal will break and oil will be discharged with the water. An interface positioned inside the disc stack will cause bad separation results.

The position of the interface is adjusted by altering the pressure balance of the liquid phases, oil and water, inside the separator. This is done by exchanging the gravity disc. For this purpose a number of gravity discs with various hole diameters is delivered with the separator.

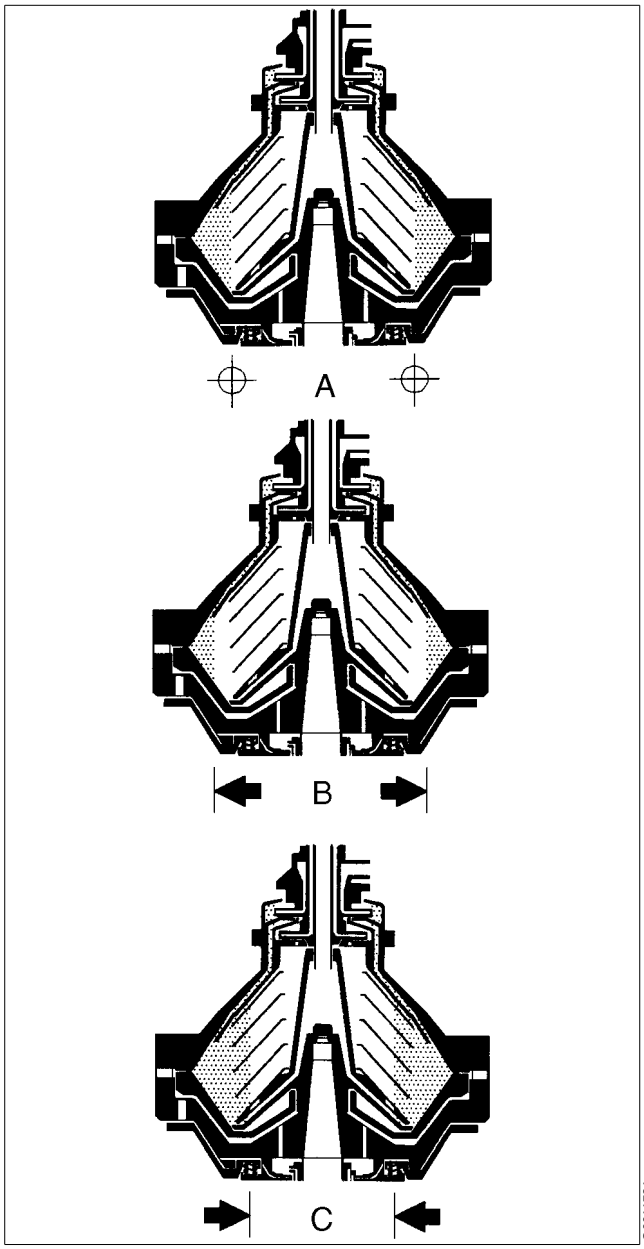


Interface position (1)

A. Correct interface position

B. Wrong interface position - broken water seal

C. Wrong interface position - bad separation

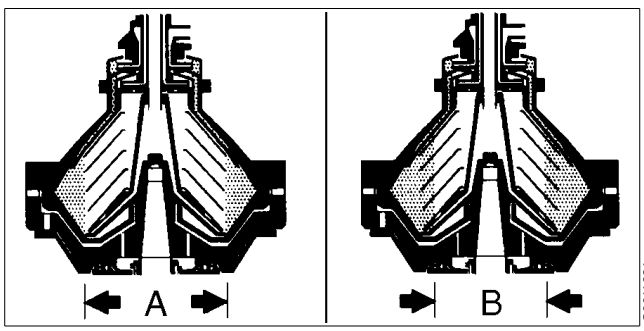


Factors influencing the interface position:

1. Oil viscosity, density and throughput

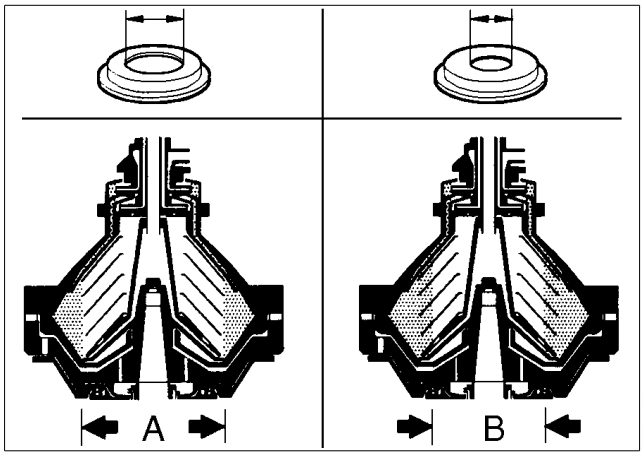
Oil with high density and/or high viscosity, as well as high throughput, will position the oil/water interface closer to the bowl periphery than for oil with low properties.

A. High viscosity/density/throughput
B. Low viscosity/density/throughput



2. Gravity disc

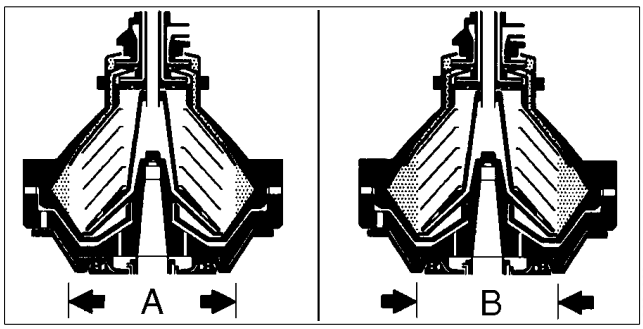
To compensate for the above factors the interface is adjusted to a correct position by altering the outlet for the water, i.e. exchanging the gravity disc. Changing to a gravity disc with a larger hole diameter will move the interface towards the bowl periphery whereas a disc with a smaller hole diameter will move the interface closer to the bowl centre.



A. Gravity disc with large hole diameter
B. Gravity disc with small hole diameter

3. Excessive back pressure

Excessively high back pressure in the oil outlet prevents the oil from being pumped out. The inner oil level will then move towards centre of the bowl and, at the same time, push the oil/water interface outwards towards the bowl periphery. The effect is a wrong interface position, which may cause broken water seal.



A. Excessive back pressure
B. Normal back pressure

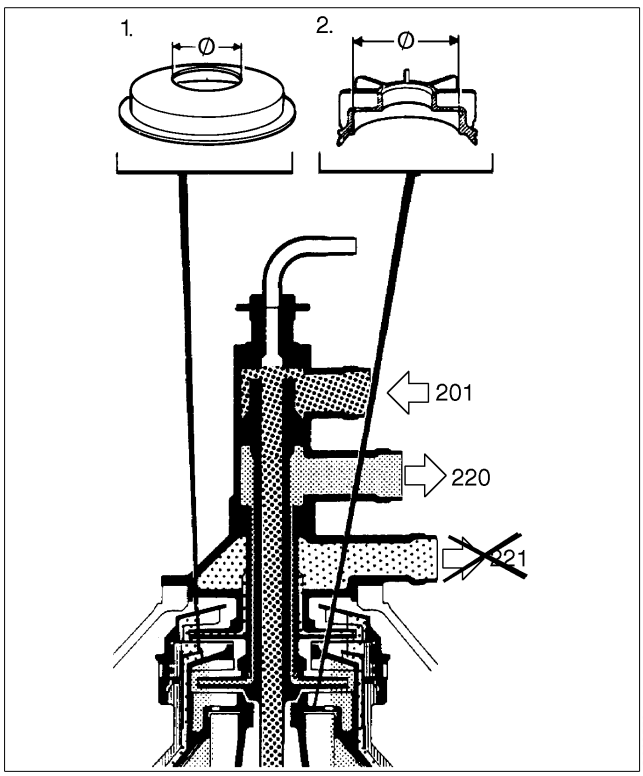
3.3.2 Clarifier bowl

Characteristic parts

The illustration shows characteristic parts of the clarifier bowl:

1. In clarification, the gravity disc is replaced by a so called clarifier disc, i.e. a disc with smallest possible hole diameter (Ø) which seals off the water outlet. No liquid seal is needed when clarifying.
2. The level ring which has a large hole diameter (Ø).

The clarifier bowl has only one liquid outlet, 220 (oil).



Clarifier bowl

3.3.3 Normal separation

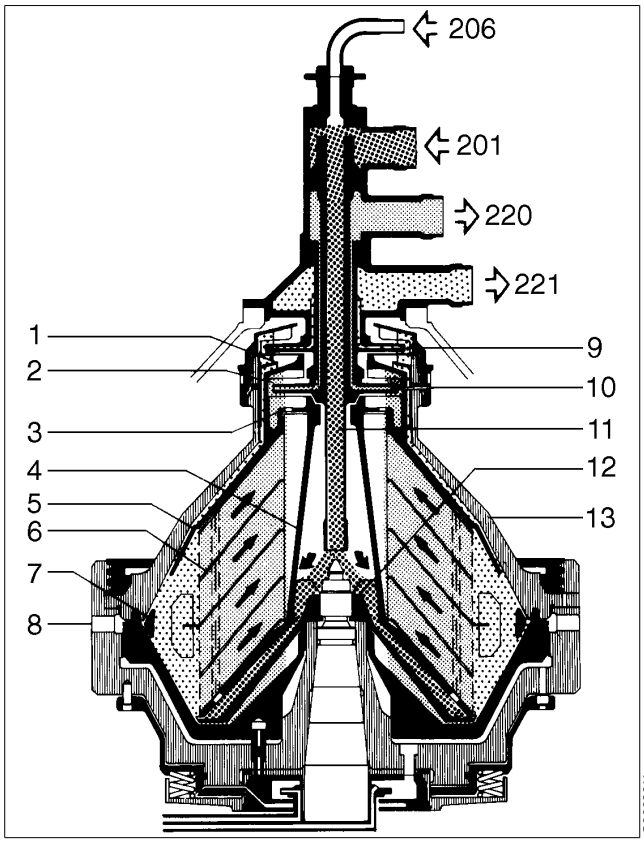
Unseparated oil is fed into the bowl through the inlet pipe (11) and is led via the distributor (4) and distributing cone (12) towards the periphery of the bowl.

When the oil reaches slots of the distributor, it will rise through the channels formed by the disc stack (6) where it is evenly distributed into the disc stack.

The oil is continuously separated from water and particles as it will flow towards the centre of the bowl. When the cleaned oil leaves the disc stack it rises upwards, flows over the level ring (3) and enters the oil paring chamber (2). From here it is pumped by the non-rotating oil paring disc (10) and leaves the bowl through outlet (220).

Separated water, sludge and solid particles, which are heavier than the oil, move towards the periphery of the bowl and collect in the sludge space (7). The bowl content is discharged at pre-selected intervals through the sludge ports (8).

At purification the separated water rises along the outside of the top disc (5) over gravity disc (1) and is then pumped out by the non-rotating upper paring disc (9). The water then leaves the bowl through water outlet (221).



Separating principle

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

201. Unseparated oil inlet
206. Sealing/displacement water inlet
220. Clean oil outlet
221. Water outlet (only at purification)

3.3.4 Sludge discharge cycle

Sludge discharge interval

The MOPX-separator is a total-discharge type separator which completely discharges sludge and water from the bowl.

The appropriate time to be choosen between sludge discharges depends on local conditions because many factors influence accumulation and hardening of sludge between discharges. However, keep the discharge interval within the minimum and maximum time stated in ‘‘8.1 Technical data” on page 170.

Long intervals between sludge discharges can cause accumulation and compaction of sludge. The sludge may then break-up unevenly on discharge and cause the bowl to become unbalanced. If such unbalance is too large, there is risk of serious separator damage and injury to personnel.

Closed bowl (normal operation)

The sliding bowl bottom (2) is pressed upwards by force of the closing water in the closing water space (6) under the sliding bowl bottom which is greater than the force of the process liquid above the sliding bowl bottom.

The operating slide (3) is pressed upwards by the springs (9); the valve plugs (8) cover the drain channels (7).

Bowl opens for discharge

Before starting the sludge discharge cycle the oil feed should be cut off.

At purification, displacement water (206) should be added to the bowl before the discharge to avoid oil losses. The oil/water interface (h1) moves towards the centre of the bowl (h2).

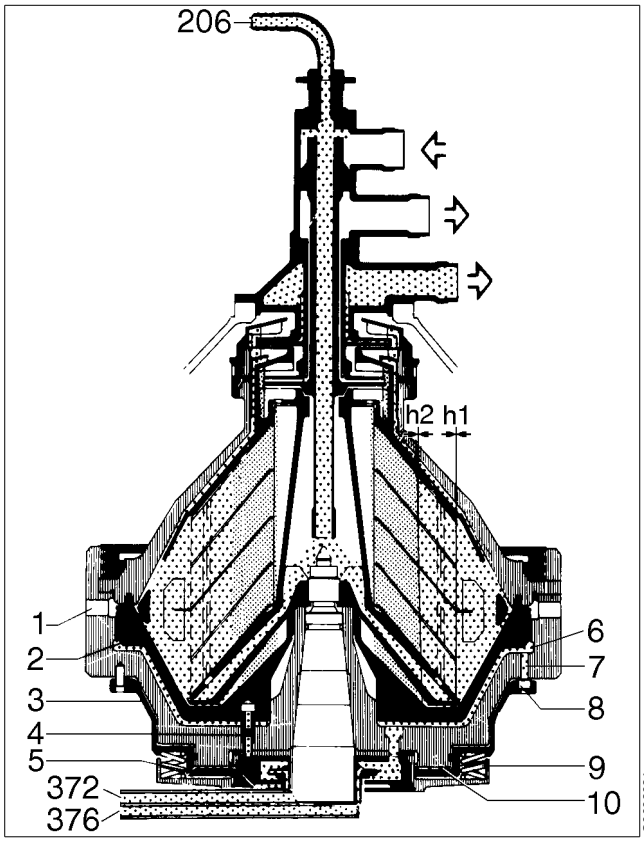
The opening water (372), which is supplied into the space above the operating slide (3), overcomes the force from the springs (9) and the operating slide is pressed downwards. The drain channels (7) open and the closing water is drained. This allows the force on the underside of the sliding bowl bottom (2) to become lower than the force on the upper side. The sliding bowl bottom moves downwards and the bowl opens for a discharge through the sludge ports (1).

Bowl closes after discharge

The opening water supply is closed and the water in the opening chamber is drained through nozzle (5). The springs (9) move the operating slide upwards and the drain channels (7) are closed by the drain valve plugs (8). The closing water (376) is supplied via the nozzle (4) to the closing water space which presses the sliding bowl bottom (2) upwards. The bowl closes and the sludge discharge cycle is complete.

At purification, sealing water (206) must be supplied to the bowl before the oil supply is turned-on.

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



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

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

206. Sealing/displacement water inlet
*372. Opening water inlet **
*376. Closing and make-up water inlet **

** Parts effecting a sludge discharge*

3.4 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 a 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 bowland inlet/outlet. 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.

Phase Light phase: the lighter liquid separated, e.g. oil.
Heavy phase: the heavier liquid separated, e.g. water.

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/hour or litres/hour.

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

Water seal Water in the solids space of the separator bowl which prevents 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 are related only to the separator itself. If the separator is part of a system or module, also follow the instructions for the system.

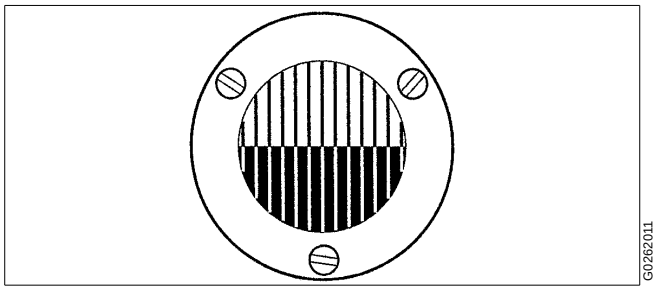
4.1.1 Before first start

Technical demands for connections and logical limitations for the separator are listed in chapter “8 Technical Reference” on page 169:

- Technical data
- Connection list
- Interface description
- Basic size drawing
- Foundation drawing.

Before first start the following shall be checked:

1. Ensure the machine is installed correctly and that feed lines and drains have been flushed clean.
2. Fill oil in the gear housing. (The separator is delivered without oil in the gear housing). Fill up to slightly above the middle of the sight glass. For grade and quality of oil see “8.5.2 Recommended lubricating oils” on page 182.
3. Make sure the direction of rotation of the motor corresponds to the arrow on the motor, see “8.6.9 Machine plates and safety labels” on page 200.



Fill oil in the gear housing

4.1.2 Selection of gravity disc

The separator is delivered with a set of gravity discs with different diameters. The hole diameter of the gravity disc sets the position of the oil/water interface in the separator, see page 27. The separation efficiency can be optimized by selection of the correct diameter for each oil quality.

How to replace a gravity disc is described in “6.3 Bowl hood and disc stack (IS)” on page 105.

Clarification

When the separator is run as a clarifier, select the gravity disc with the smallest hole diameter. See the *Spare Parts Catalogue* for actual diameters delivered.

Purification

The best separation results are obtained by using a gravity disc with as large a hole diameter as possible, which will not cause a broken water seal in the bowl or an emulsification in the water outlet. The heavier or more visous the oil is and the greater the feed rate the smaller the diameter should be.

As a guide the ‘‘8.6.6 Gravity disc nomogram” on page 194, can be used when the density of the oil at a temperature of +15 °C is known. The hole diameter of the first gravity disc to try can be read directly from the nomogram.

The nomogram is based on the properties of fresh water in the oil and is purely theoretical. In practical operation operation, practice the following general rule:

1. Fit a gravity disc one size larger than recommended in the nomogram for the actual conditions.
2. Run the separator
3. Observe if oil flows through the water outlet (seen through the sight glass).
   - If yes, stop the separator and fit the next **smaller** gravity disc.
   - If no, stop the separator and fit the next **larger** gravity disc.
4. Repeat steps 1-3 above until the gravity disc with the **largest** hole diameter has been selected without causing a break of the water seal.

4.1.3 Ready for start

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

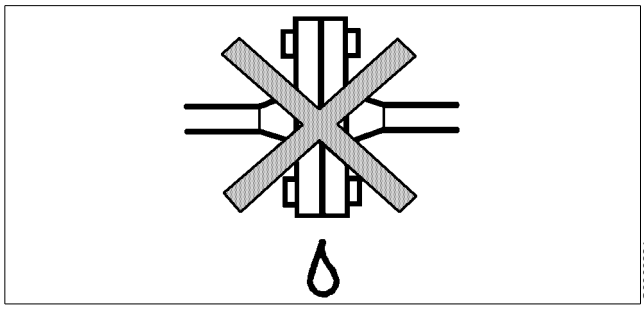
1. Check that the hinged bolts for the frame hood are fully tightened.
2. Check that all inlet and outlet connections have been correctly made and properly tightened.

CAUTION

Burn hazards

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

Escaping hot liquid can cause burns.



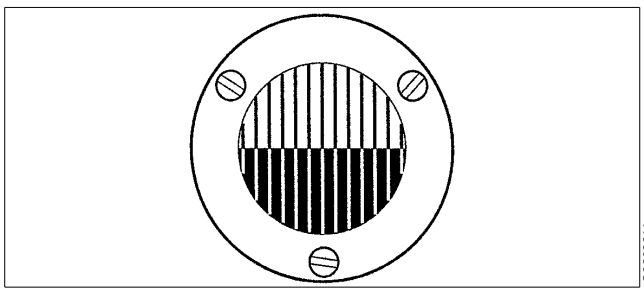
Check for leakages (not admitted)

3. Check that the oil level is slightly above the middle of the sight glass.

NOTE

During operation 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.



Check the oil level

Fill if necessary. See chapter “8.5 Lubricants” on page 180**,** for a list of recommended oils.

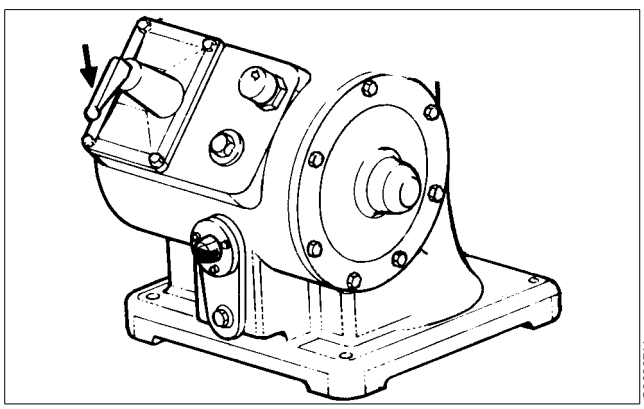
4. Make sure that the brake is released.

DANGER

Disintegration hazards

After change of feed the sludge discharge interval must be adjusted.

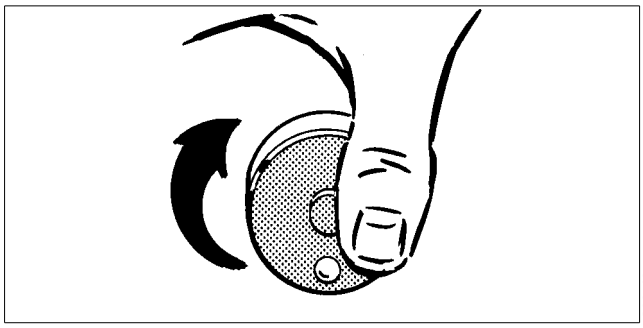
Too long intervals between discharges can result in breakdown.



Release the brake

4.1.4 Start and running-up

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



Check for correct direction of rotation

DANGER

Disintegration hazards

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

3. Be alert for unusual noises and conditions.
4. Note the normal occurrence of critical speed periods. Some vibrations 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.

DANGER

Disintegration hazards

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

The cause of the vibration must be identified and rectified before the separator is restarted.

Excessive vibration may be due to incorrect assembly or insufficient cleaning of the bowl.

In the trouble-tracing chapter “7.1.1 Separator vibrates” on page 158, a number of causes are described that can create vibration.

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

   At full speed the starter ammeter reading has decreased from a high starting value to a low, steady value - the idling value, which is slightly lower than the normal operating value.

   The time to reach full speed should not exceed the limit given in chapter ‘‘8 Technical Reference” on page 169.

6. When the separator runs normally, open the water supply valve(s).

7. For **purification**:

   a. Supply water to form the water-seal. The water should have the same temperature as the process liquid and be supplied quickly.

   b. Close the water feed when water flows out through the water outlet.

   c. Start the oil feed slowly to avoid breaking the water seal. Then fill the bowl as quickly as possible.

8. For **clarification**:

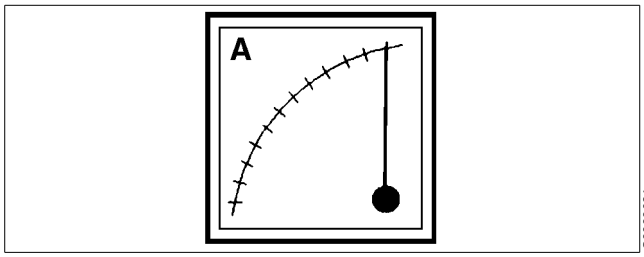
   a. Start the oil feed with full flow. Fill the bowl as quickly as possible.

9. For both **purification** and **clarification** modes:

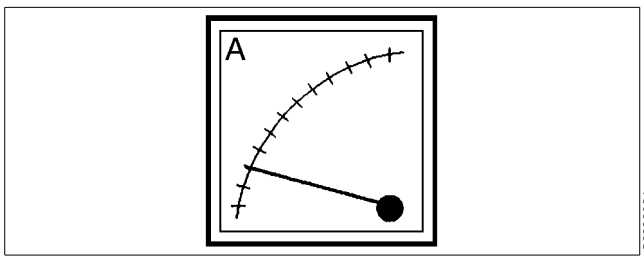
   Check the separator inlet and outlet pressures. See recommended values in your system documentation.

10. Adjust to desired throughput.

11. Discharge by opening the valve for opening water valve (at connection 372) until a discharge is heard. For maximum and minimum time for discharge intervals, see chapter ‘‘8 Technical Reference” on page 169.



Current increases when the coupling engages...



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

4.1.5 Running

1. Check that the feed has the correct flow and temperature. See chapter ‘‘8 Technical Reference” on page 169 for correct values.

.

DANGER

Disintegration hazards

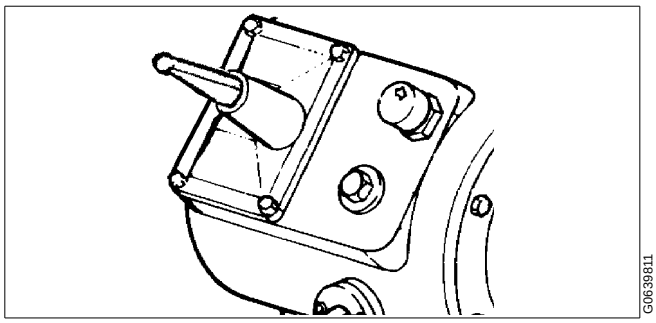
Ensure that correct discharge intervals and cleaning procedures are used.

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

2. For daily condition checks, see ‘‘5.2.1 Daily checks” on page 49.

4.1.6 Normal stop

1. Shut off the feed.
2. Carry out a sludge discharge before stopping the separator. Otherwise the bowl must be cleaned manually before the next start up.
3. After the discharge, supply displacement/ sealing water to fill the bowl. Stop the separator, the bowl filled with liquid.
4. Apply the brake.
5. Wait until the separator has come to a complete standstill (3,5 - 4,5 minutes).

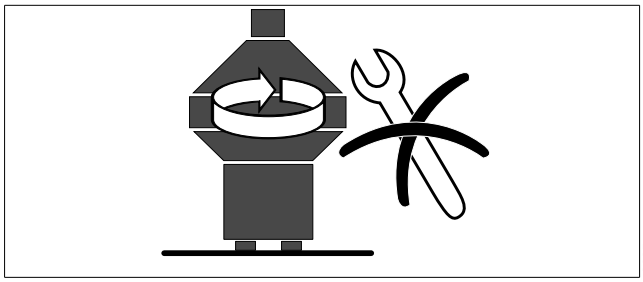


The final action, apply the brake

DANGER

Entrapment hazards

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

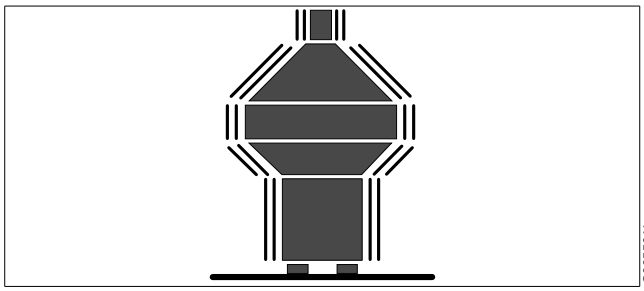


The separator must not be dismantled before standstill

4.1.7 Safety stop

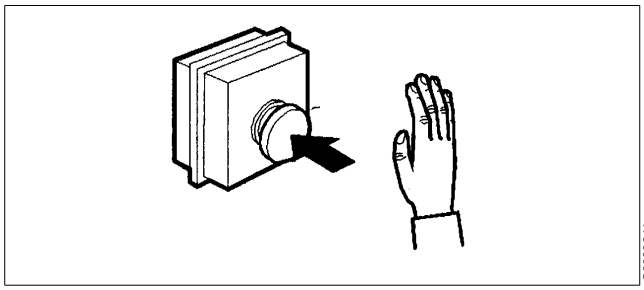
If the separator begins to vibrate excessively during operation, stop it immediately by pushing the **safety stop**. The separator motor is switched off.

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



Hazard!

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



Push the safety stop

DANGER

Disintegration hazards

Do not discharge a vibrating separator.

Out-of-balance vibration can become worse!

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)

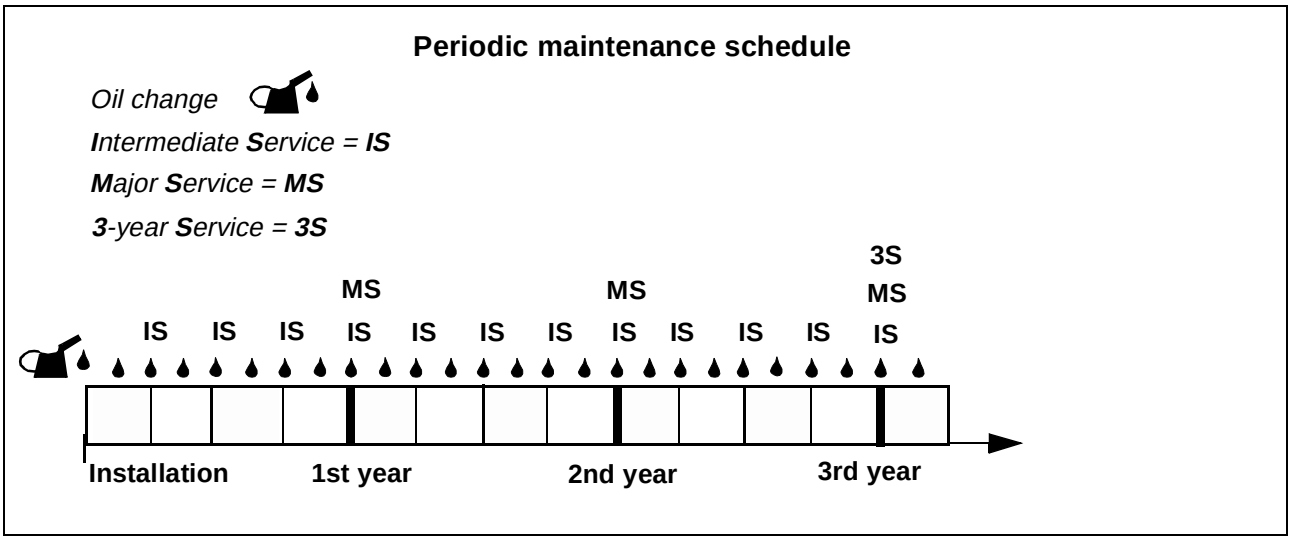
Intermediate Service consists of an overhaul of the separator bowl, inlet/outlet and operating device every 3 months or 2000 operating hours. Seals in bowl and gaskets in inlet/outlet device are renewed.

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 vibration damping rubber cushions 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

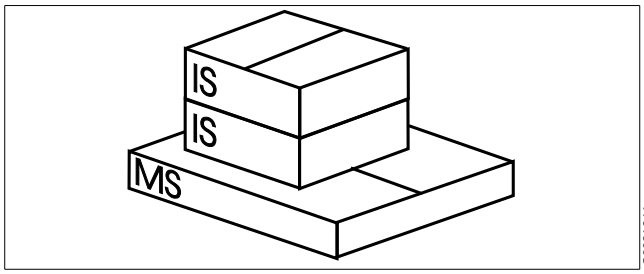
Special service kits are available for Intermediate Service (IS) of top part and Intermediate Service (IS) of bowl as well as for Major Service (MS).

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

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

For separators with built-on pump there i also a service kit for the pump.

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



Kits are available for Intermediate Service of top part and of bowl and for Major 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		93	
Horizontal driving device			
Worm wheel shaft and gear casing			
Check for vibration and noise		93	
Check	Oil level in gear housing	38	
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	89	
Renew	Oil[b)] in gear housing	92	

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

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

b) See chapter ‘‘8.5 Lubricants” on page 180 for further information.

5.2.3 Intermediate Service (IS)

Name of plant: Local identification:

Separator: MOPX 205TGT-24 Manufacture No./Year:

Total running hours: Product No: 881034-01-09

Date: Signature:

Main component and activity	Part	Page	Notes
Inlet and outlet			
Clean and inspect	Threads of inlet pipe	66	
	Connecting housing	–	
Renew	Sealing rings in sight glass	70	
Separator bowl			
Clean and check	Upper paring disc	–	
	Lock ring	67	
	Bowl hood	56	
	Top disc	–	
	Oil paring disc	66	
	Level ring	66	
	Bowl discs	88	
	Distributor	–	
	Distributing cone	–	
	Sliding bowl bottom	70	
	Bowl body	–	
	Bowl spindle cone and bowl body nave	57	
	Operating mechanism	69, 71	
Check	Corrosion	57	
	Cracks	60	
	Erosion	62	
	Galling of guide surface	65	
	Disc stack pressure	61	
Paring disc 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	89	
Renew	Oil in gear housing	92	
Electrical motor			
Lubrication (if nipples are fitted)	See sign on motor	–	
Signs and labels on separator			
Check attachment and legibility	Safety label on hood	200	
	Direction of rotation arrow	200	
	Power supply frequency	200	
Other equipment			
Function check	Cover interlocking switch	71	

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

5.2.4 Major Service (MS)

Name of plant: Local identification:

Separator: MOPX 205TGT-24 Manufacture No./Year:

Total running hours: Product No: 881034-01-09

Date: Signature:

Main component and activity	Part	Page	Notes
Inlet and outlet			
Clean and inspect	Threads of inlet pipe	66	
	Connecting housing	–	
Renew	Sealing rings in sight glass	70	
Separator bowl			
Clean and check	Upper paring disc	–	
	Lock ring	80, 67	
	Bowl hood	56	
	Top disc	–	
	Oil paring disc	66	
	Level ring	66	
	Bowl discs	88	
	Distributor	–	
	Distributing cone	–	
	Sliding bowl bottom	70	
	Bowl body	–	
	Bowl spindle cone and bowl body nave	57	
	Operating mechanism	69, 71	
Check	Corrosion	57	
	Cracks	60	
	Erosion	65	
	Galling of guide surface	65	
	Disc stack pressure	61	
	Height position of oil paring disc	82	

Main component and activity	Part	Page	Notes
Paring disc device			
Clean and check	Operating paring disc	–	
Check	Height position of operating paring disc	82	
Vertical driving device			
Clean and check	Bowl spindle	–	
	Buffer springs and ball bearing housing	74	
	Radial wobble of bowl spindle	72	
Renew	Spindle bearings	126	
Horizontal driving device			
Worm wheel shaft and gear housing			
Check	Worm wheel and worm	89	
	Radial wobble of worm wheel shaft	84	
	Axial play of elastic plate	77	
Renew	Bearings	138	
	Oil in gear housing	92	
Brake			
Clean and check	Spring and brake shoe	73	
Renew	Friction pad	73	
Friction coupling			
Clean and check	Worm wheel coupling	–	
Renew	Friction pads	75	
Electrical motor			
Lubrication (if nipples are fitted)	See sign on motor	–	
Signs and labels on separator			
Check attachment and legibility	Safety label on hood	200	
	Direction of rotation arrow	200	
	Power supply frequency	200	
Monitoring equipment (option)			
Function check	Cover interlocking switch	71	

Main component and activity	Part	Page	Notes
Oil feed pump (if applicable)			
Cleaning and inspection	Bushings, wear gaskets, flexible coupling, relief/safety valve and impeller shaft	148	
Renew	Lipseal rings		

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

5.2.5 3-year Service (3S)

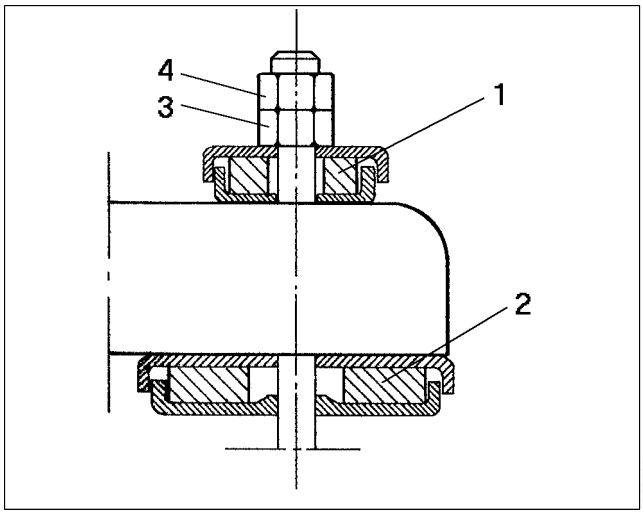
Renew the frame feet as described below. The 3-year service should be carried out in conjunction with a Major Service (MS).

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 85.

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



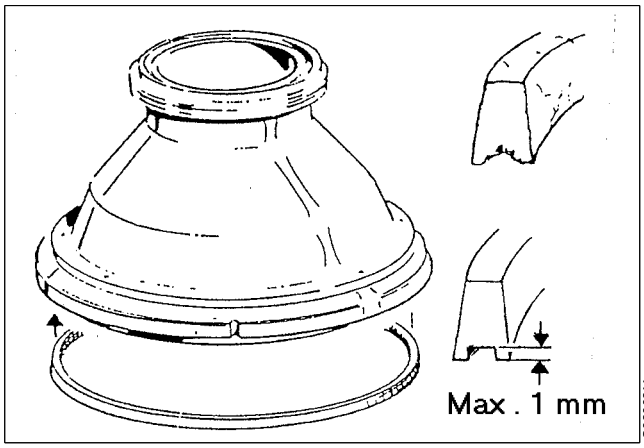
1. Vibration damper, upper
2. Vibration damper, lower
3. Nut
4. Lock nut

5.3 Check points at Intermediate Service (IS)

5.3.1 Bowl hood seal ring

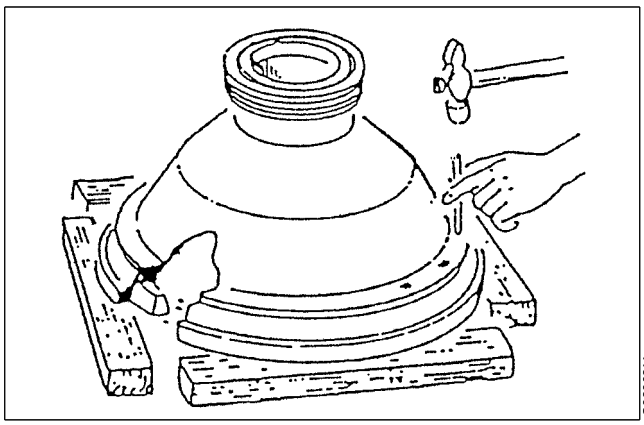
Poor sealing between the bowl hood seal ring and the sealing edge of the sliding bowl bottom will cause a leakage of process liquid from the bowl.

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



Max. permitted indentation of the seal ring is 1 mm

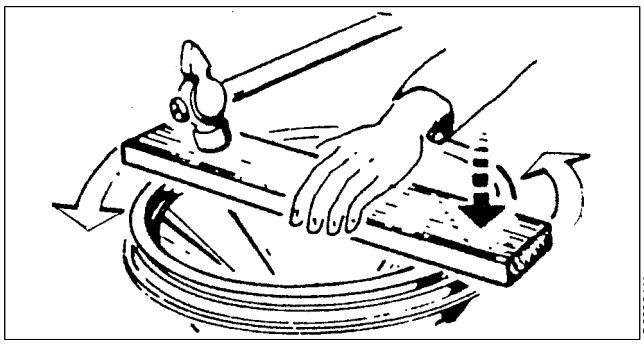
Knock out the old ring by means of a pin inserted in the holes intended for this purpose.



Removal of the seal ring

Fit the new ring as follows:

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



Fitting of the seal ring

NOTE

If the new ring is too narrow, place it in hot water (70-80 °C) for about 5 minutes.
If it is too wide, it will shrink after drying in 80-90 °C for about 24 hours.

5.3.2 Bowl spindle cone and bowl body nave

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

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

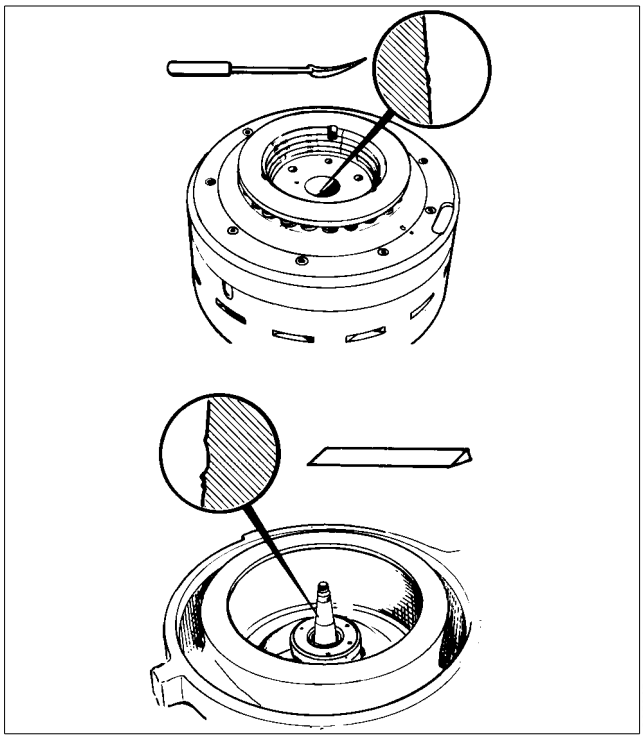
Corrosion may cause the bowl to stick firmly to the spindle cone and cause difficulties during the next dismantling.

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

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

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

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



Remove impact marks from the nave and cone

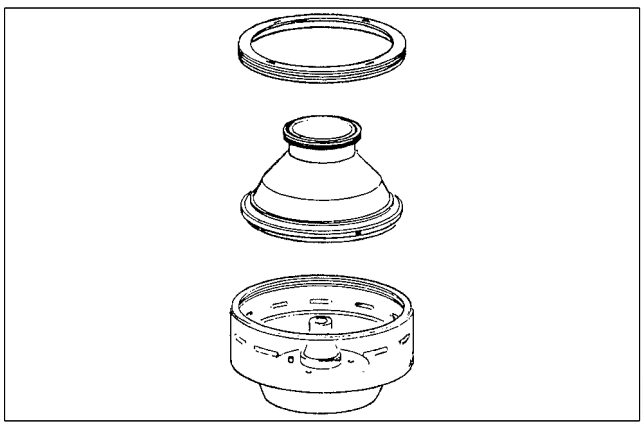
5.3.3 Corrosion

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

DANGER

Disintegration hazard

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



Main bowl parts to check for corrosion

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

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

Non-stainless steel and cast iron parts

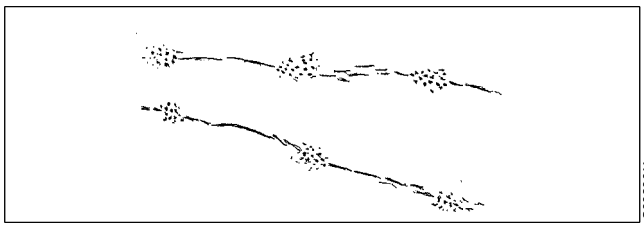
Corrosion (rusting) can occur on unprotected surfaces of non-stainless steel and cast iron. Frame parts can corrode when exposed to an aggressive environment.

Stainless steel

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

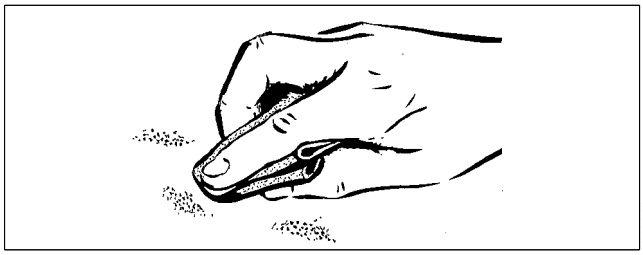
- Exposed to a stationary solution.
- In a crevice.
- Covered by deposits.
- Exposed to a solution that has a low pH value.

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



Example of chloride corrosion in stainless steel

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



Polish corrosion marks to prevent further damage

DANGER

Disintegration hazard

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

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

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

Other metal parts

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

5.3.4 Cracks

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

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

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

DANGER

Disintegration hazard

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

Always replace a part if cracks are present.

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

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

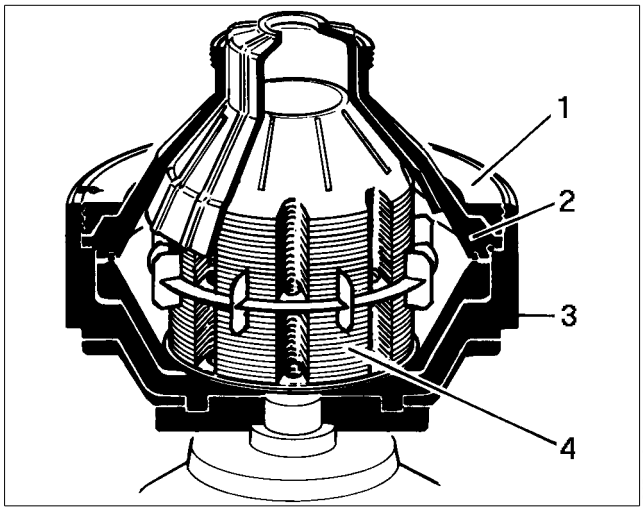
5.3.5 Disc stack pressure

NOTE

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

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

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



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

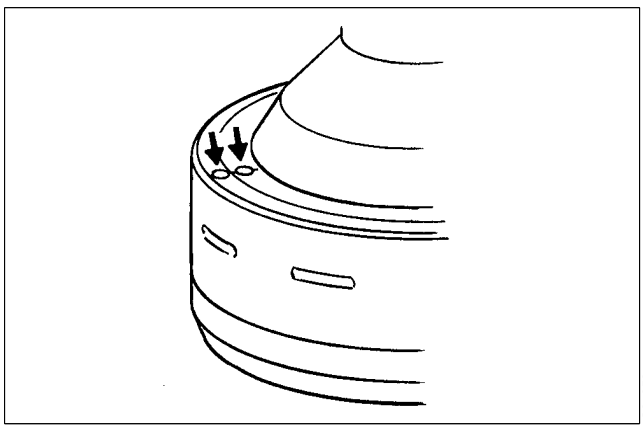
Compress the disc stack by tightening the lock ring, see chapter “6.3.3 Assembly” on page 109.

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.

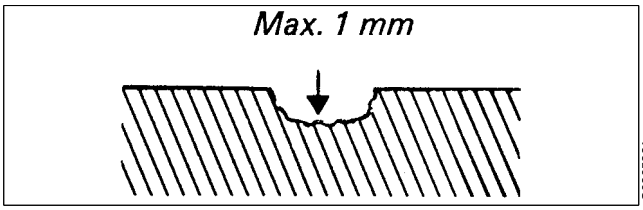
If the ϕ-marks do not reach or pass each other, the reason could be an incorrectly assembled bowl or to many discs in the disc stack. Reassemble and check.



ϕ-marks on bowl body and lock ring in line

5.3.6 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.

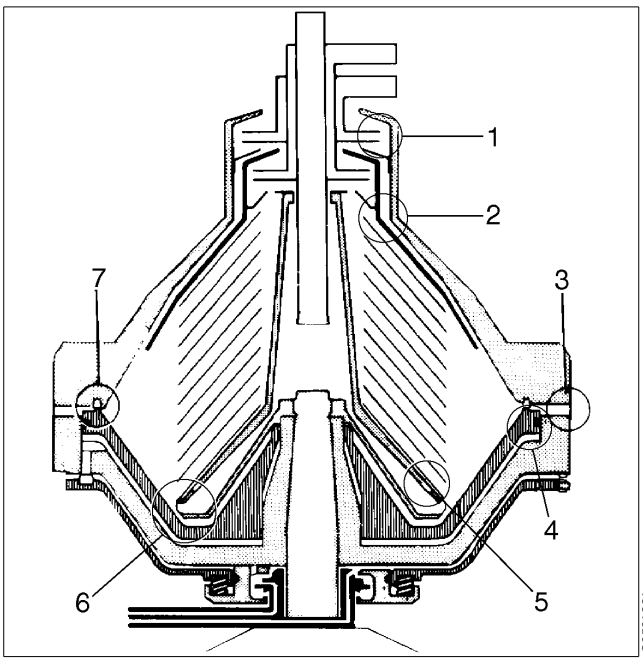
Always contact your Alfa Laval representative if the largest depth of any erosion damage exceeds **1,0 mm**. Valuable information as to the nature of the damage can be recorded using photographs, plaster impressions or hammered-in lead.

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.
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.

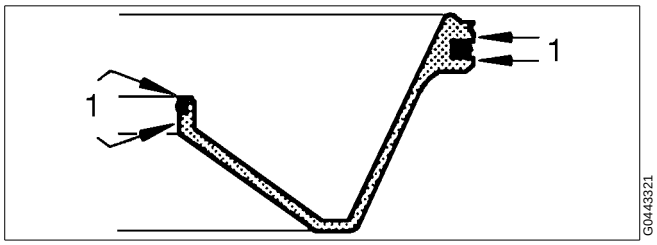
Pay special attention to the pillars between the sludge ports in the bowl wall.

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

5.3.7 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).

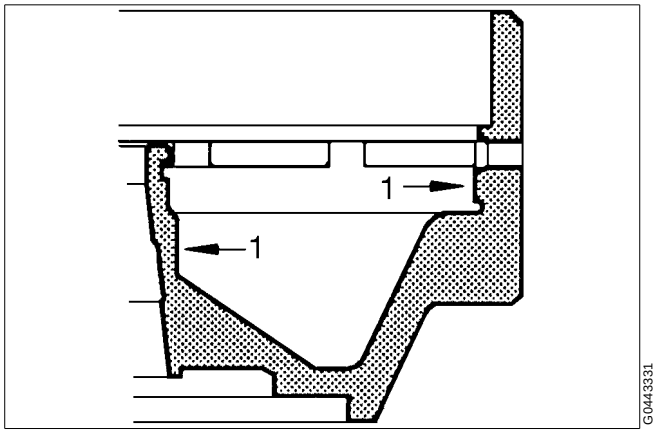


Sliding bowl bottom

NOTE

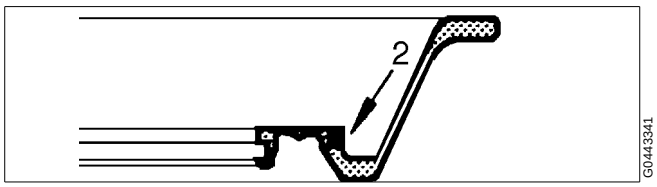
To avoid the risk of galling, the contact surfaces (1) should be primed with a slide lacquer at every Major Service (MS).

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



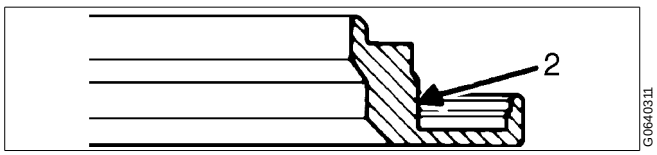
Bowl body

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

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

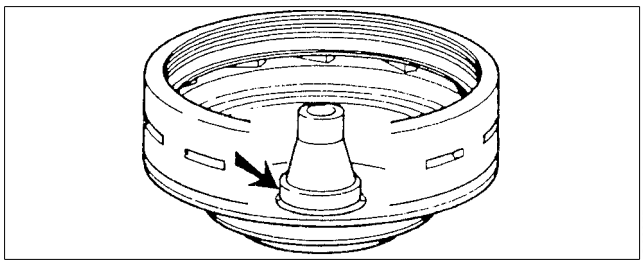


Spring support

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.

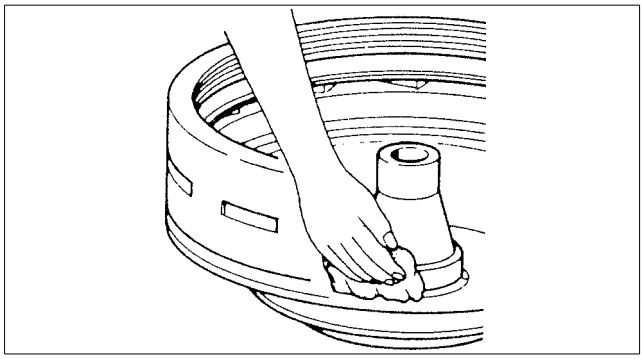


Guide surface in the bowl body

Recommended tools for correction of galling:

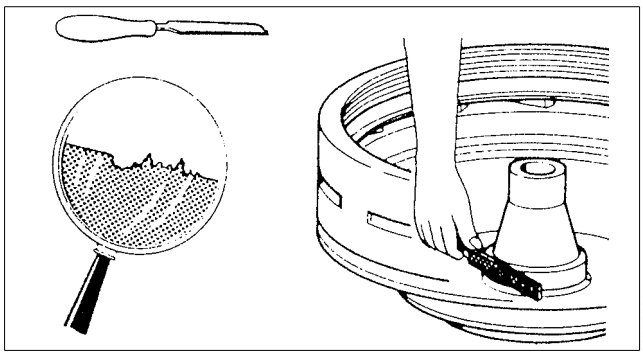
- Emery cloth, 240 grade.
- Hand drilling machine
- Degreasing agent.
- Fibre brush, ∅ 25mm.
- Fibre brush, ∅ 50 mm.
- Very fine single-cut file.

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

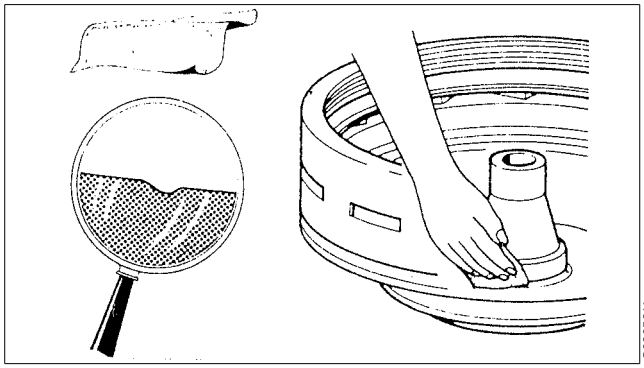


2. If the galling is excessive, first use the fine single-cut file. The file should be used with caution so that the damage is not made worse.

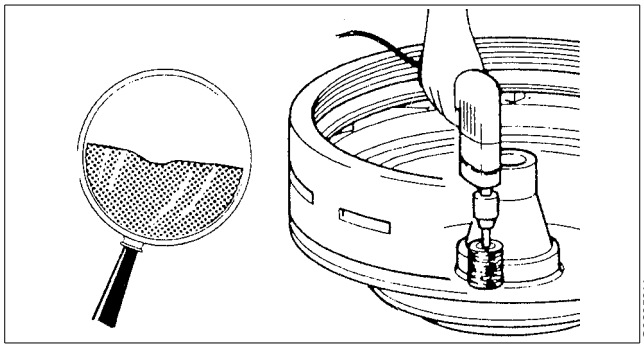
   Remove the high spots on the surface. Do not use rotating files or similar. Remove the high spots only - not the undamaged material.



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.

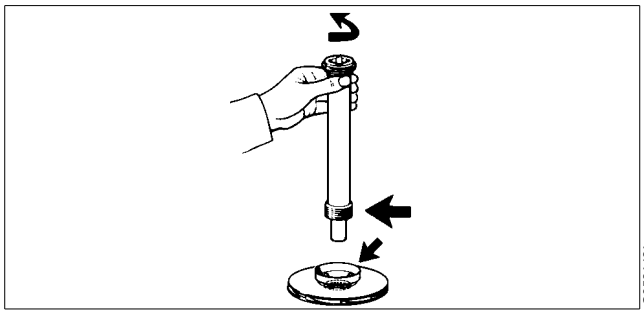


Prime the repaired area with lubricating spray Molykote 321 R. Read the correct procedure under checkpoint “5.4.15 Lock ring; priming” on page 80. Apply Alfa Laval lubricating paste or Molykote 1000 Paste to the surface after priming.

5.3.8 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.

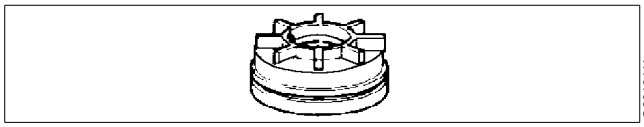
Screw the inlet pipe into the paring disc and check that the inlet pipe turns easily.



Check the threads of the inlet pipe and oil paring disc

5.3.9 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.

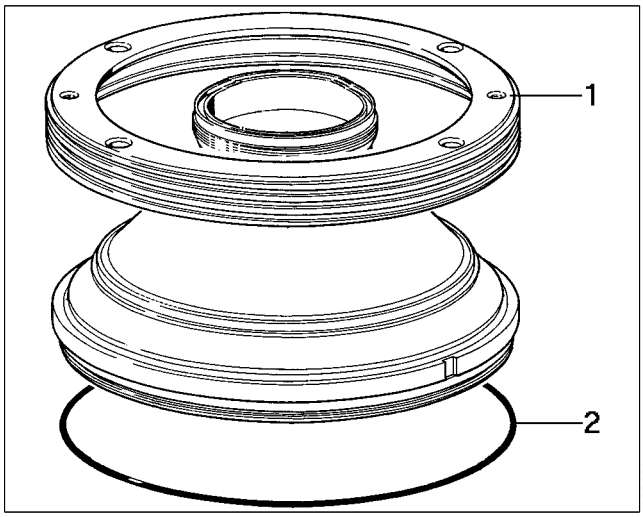


Check the level ring for burrs

5.3.10 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.



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

DANGER

Disintegration hazards

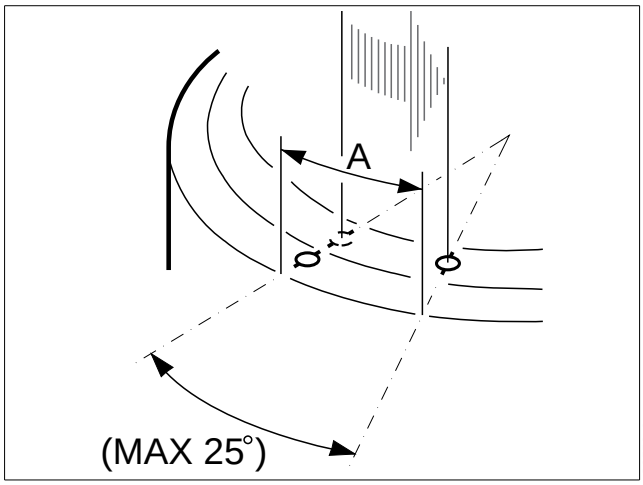
Wear on large lock ring thread must not exceed safety limit. The ϕ-mark on lock ring must not pass opposite ϕ-mark by more than the specified distance.

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 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°, 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 the distance A

Damage

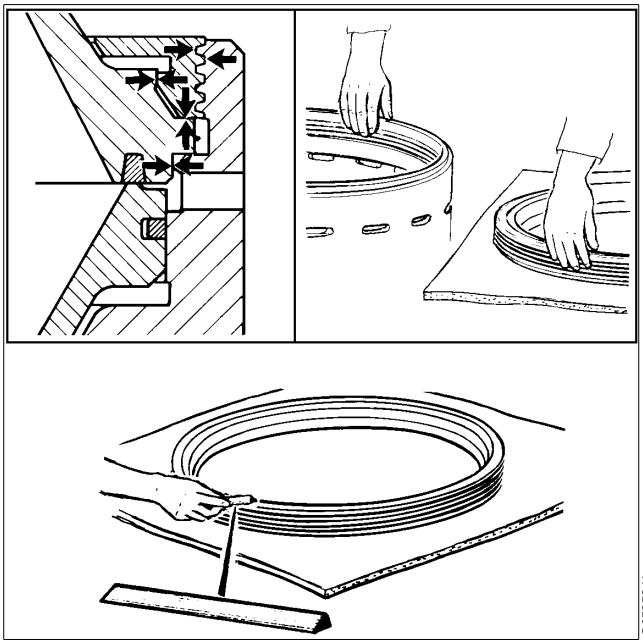
The position of the threads, contact and guide surfaces are indicated by arrows in the illustration.

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

5.3.11 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:

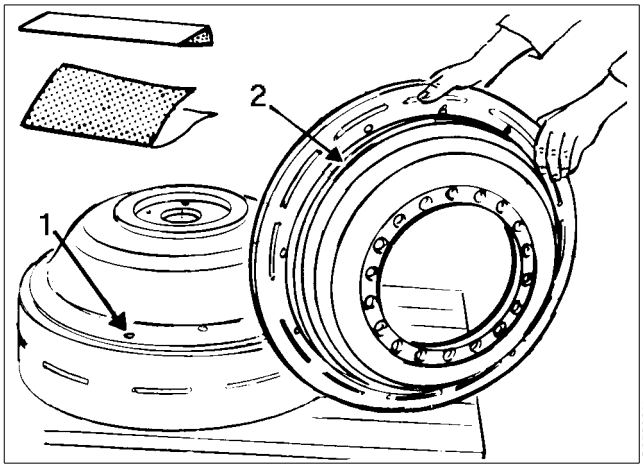
- Hard or unclean operating water. Change water supply or install a water softener or a fine filter.
- Sludge has been sucked down into bowl casing and into the operating system. Check the installation and the venting system of both the sludge tank and bowl casing drain.

5.3.12 Operating slide

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

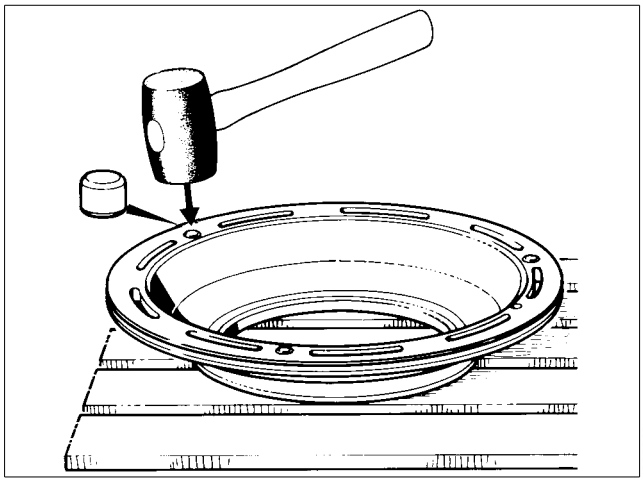
Examine the sealing surfaces (1) of the bowl body in contact with the valve plugs. Remove any marks and lime deposits with a very fine grain emery cloth.

Check the guiding surface (2). 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

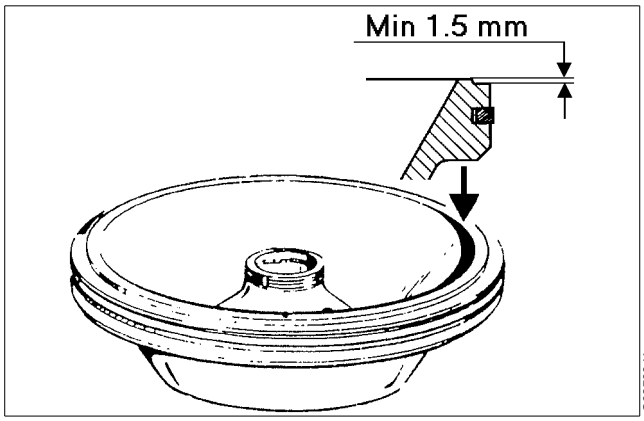
Remove all valve plugs. Tap in the new plugs.



5.3.13 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.

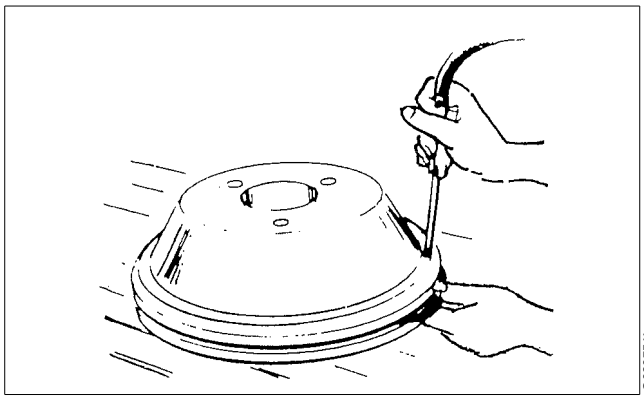


Min. height of the profile on sliding bowl bottom

NOTE

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

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.

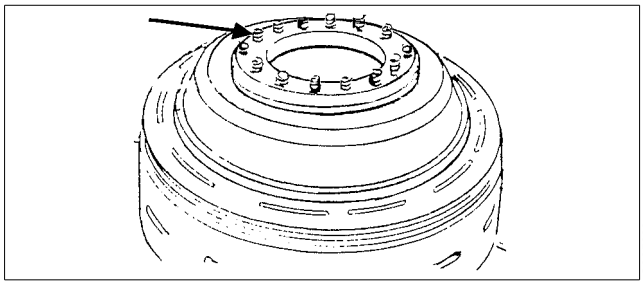


Removal of the O-ring in sliding bowl bottom using compressed air

5.3.14 Springs for operating mechanism

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

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



Check for defective or broken springs

WARNING

Risk for eye injury

Wear safety goggles.

5.3.15 Worm wheel and worm; wear of teeth

Same as described in “5.7.1 Worm wheel and worm; wear of teeth” on page 89 in this chapter.

5.3.16 Cover interlocking switch

When the button is pushed, check that the connections 13 and 14 inside the switch are short-circuited.

Check that the circuit is open when the button is not pushed.

A principal diagram of the connections is shown in chapter “8.6.10 Cover interlocking switch” on page 201.

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 56.

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 57.

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.

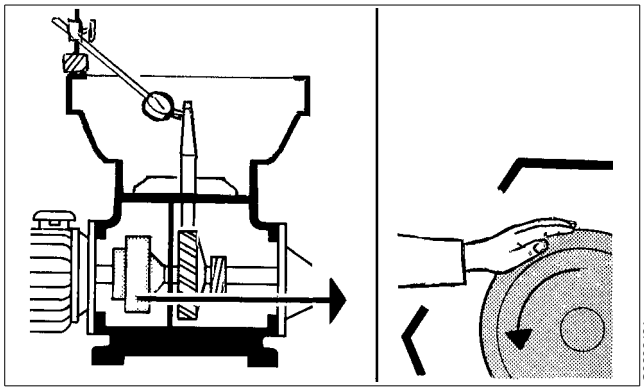
> **NOTE**
>
> Spindle wobble will cause rough bowl run. This leads to vibration and reduces lifetime of ball bearings.

Check the wobble before mounting the bowl.

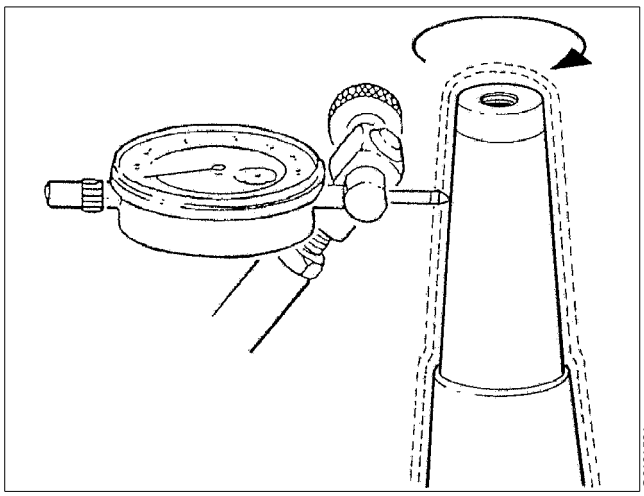
Before measuring, make sure that the buffer plugs are properly tightened.

- 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

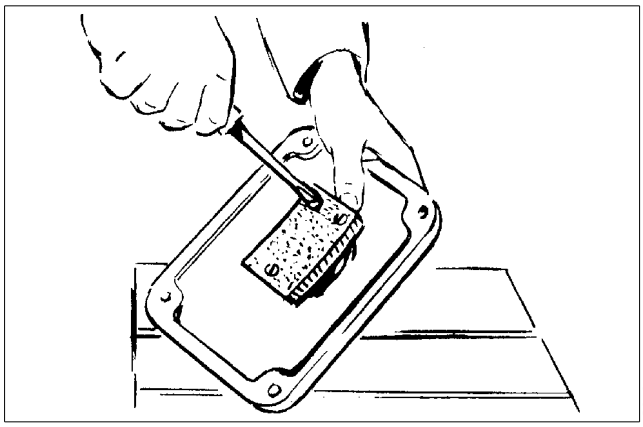
5.4.4 Brake

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.

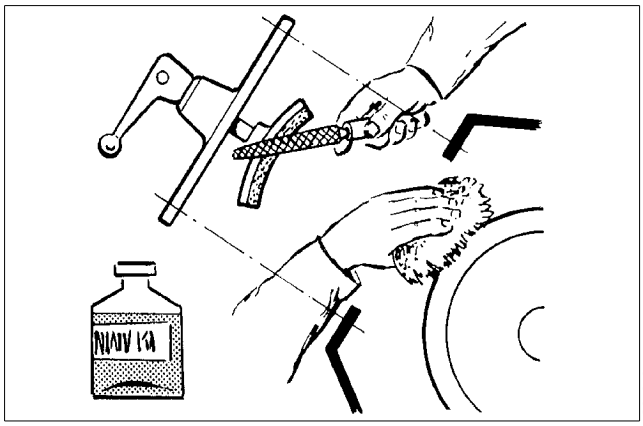


Friction pad is fastened with screws

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.

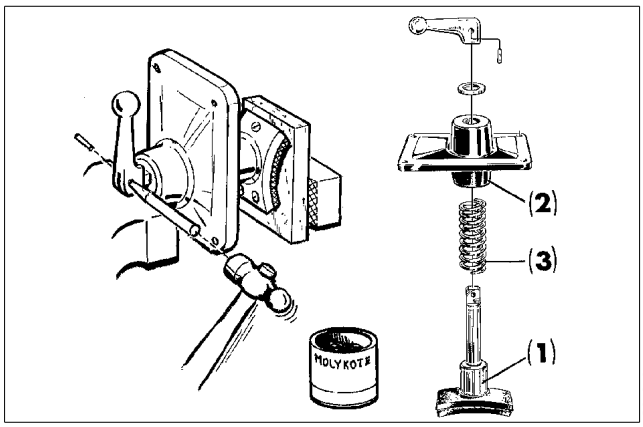


Actions when the friction pad is oily

Checking of spring and brake shoe:

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

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



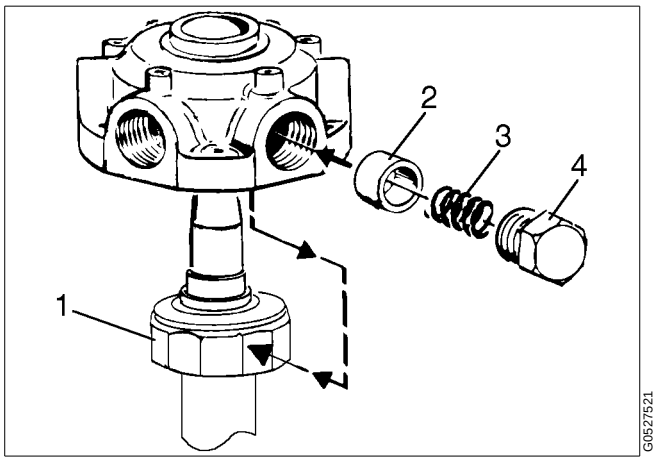
1. *Contact surface on the brake shoe for the spring*
2. *Guide surface in the cap for the brake shoe*
3. *Spring*

5.4.5 Buffer springs and ball bearing housing

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

Top bearing springs

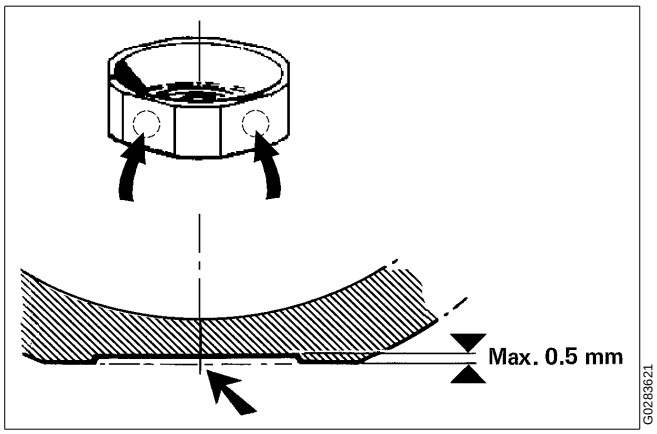
In case of spring fracture, the complete set of springs should be replaced, even if only one spring is broken.



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 3 minutes or the bowl loses speed during operation, the friction pads of the coupling may be worn or oily.

Check the pads. If the pads are oily:

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

If the pads are worn:

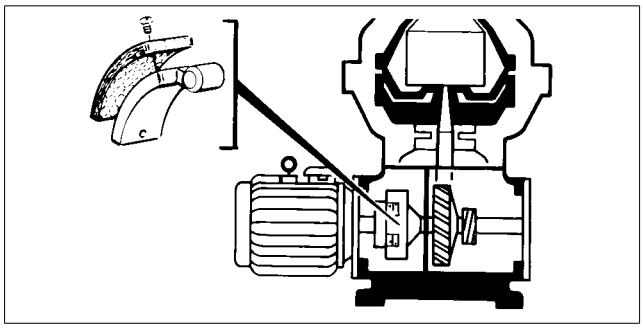
- Remove the screws and replace the pads.

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

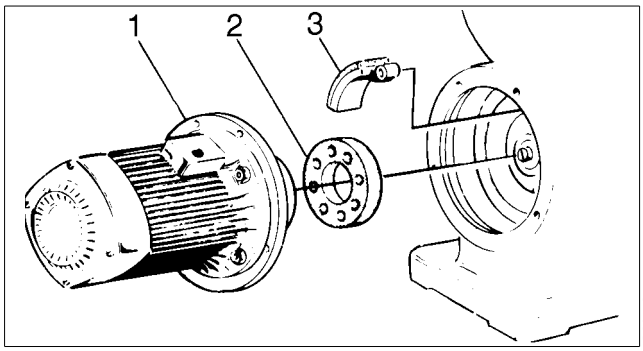
How to replace friction pads:

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

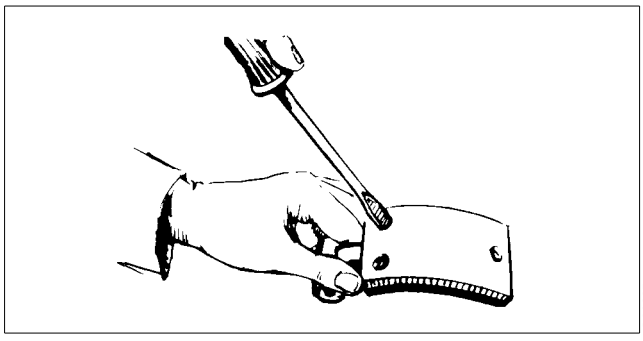
  If disconnecting the motor cables, note the positions of cables in the terminal box to reconnect correctly (for correct direction of rotation).
- Remove the screws and replace the pads.



Location of coupling friction blocks



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



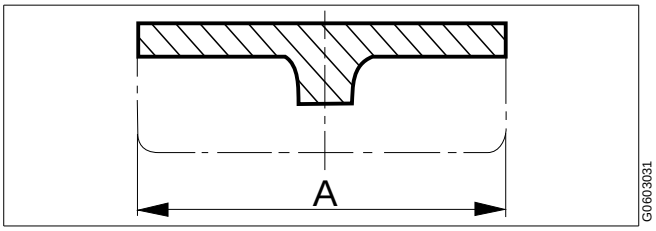
Three screws fix the friction pad to the coupling friction block (50 Hz); two screws in 60 Hz installations

Different friction blocks for different power supply frequencies

When 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**



Profile of friction block
Measure A is different for 50 and 60 Hz installations

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.

5.4.7 Corrosion

Same as described in ‘‘5.3.3 Corrosion” on page 57.

5.4.8 Cracks

Same as described in ‘‘5.3.4 Cracks” on page 60.

5.4.9 Disc stack pressure

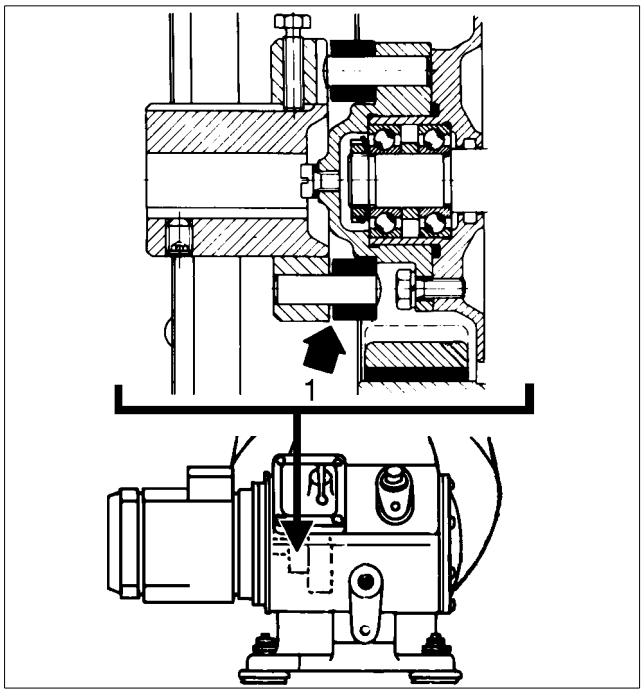
Same as described in ‘‘5.3.5 Disc stack pressure” on page 61.

5.4.10 Erosion

Same as described in “5.3.6 Erosion” on page 62.

5.4.11 Elastic plate in coupling

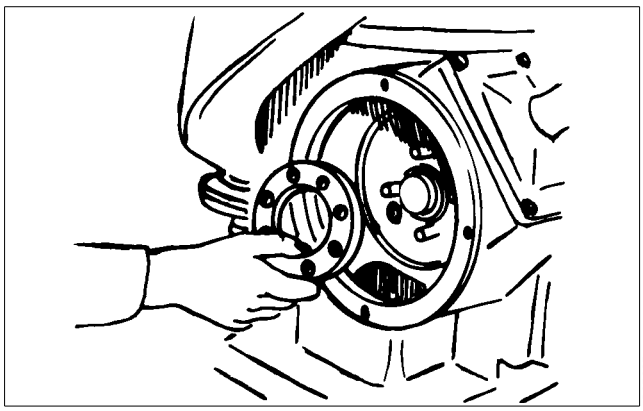
The axial play (1) of the flexible plate should be approximately 2 mm.



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

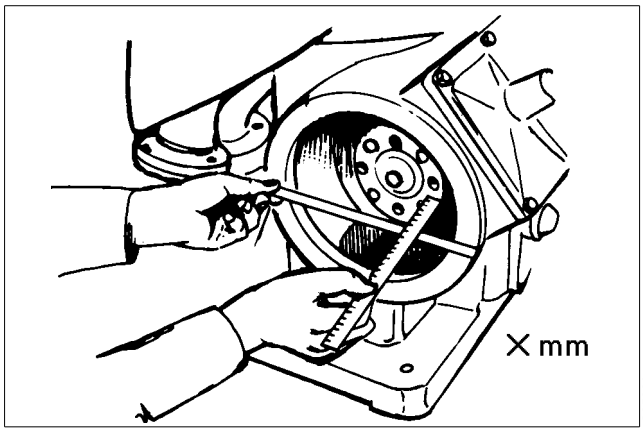
Check the play as follows:

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 elastic plate in the coupling disc.

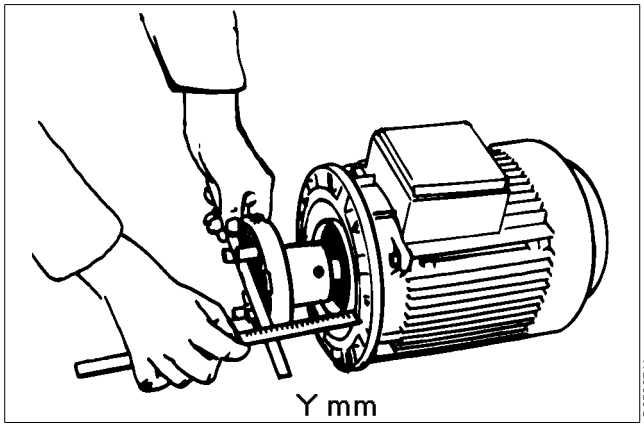


Measure of distance for coupling in separator frame

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

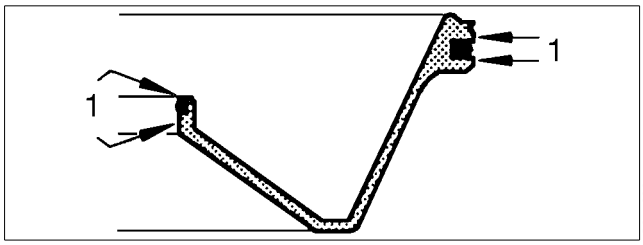
5.4.12 Guide surfaces

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

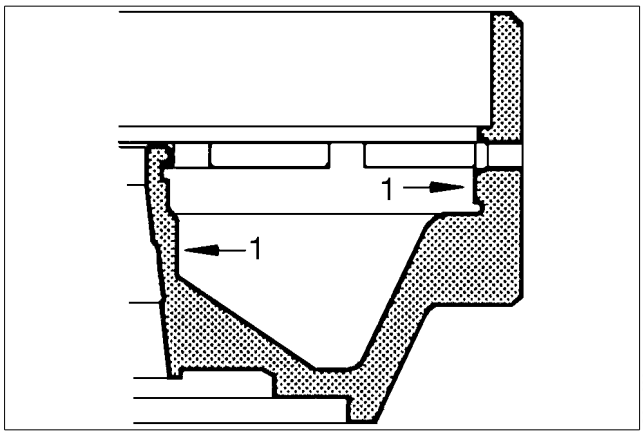
Repair of galling on guiding surfaces, see “5.3.7 Guide surfaces” on page 64.

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

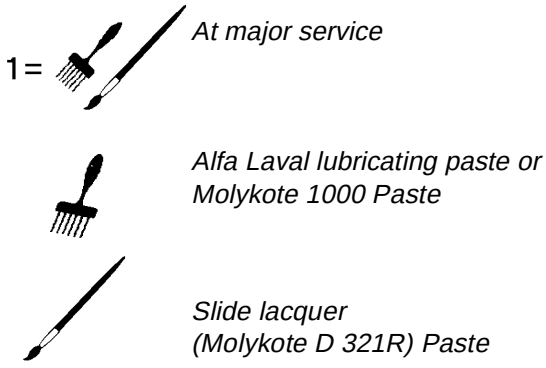
1. Mask the nave hole of the bowl body. Slide lacquer must not enter this hole.
2. Carefully degrease the contact surfaces (1) between the sliding bowl bottom and bowl body. Dry the surfaces well.
3. Apply slide lacquer Molykote D321R with a well cleaned brush. Protect the surfaces which should not be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



Sliding bowl bottom



Bowl body



5.4.13 Inlet pipe and oil paring disc

Same as described in “5.3.8 Inlet pipe and oil paring disc” on page 66.

5.4.14 Level ring

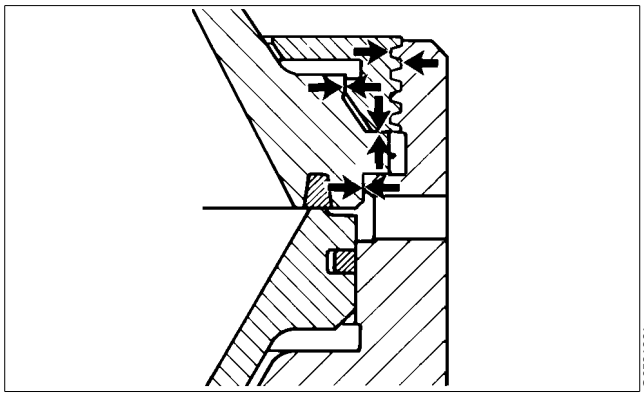
Same as described in section “5.3.9 Level ring” on page 66.

5.4.15 Lock ring; priming

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

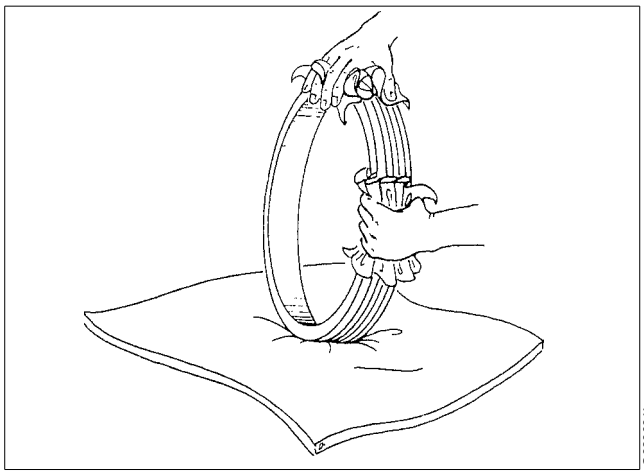
Recommended agents for priming procedure:

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

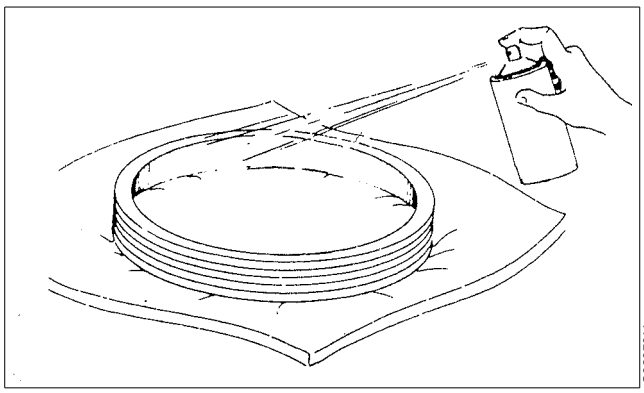


Threads, guide and contact surfaces to be primed

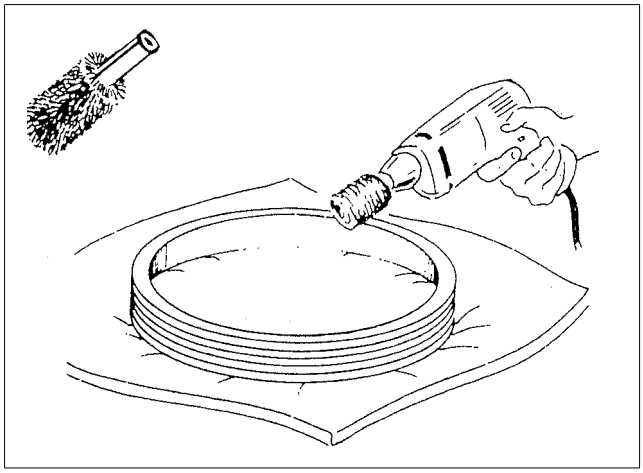
1. Clean the lock ring thoroughly with a degreasing agent and wipe it off.



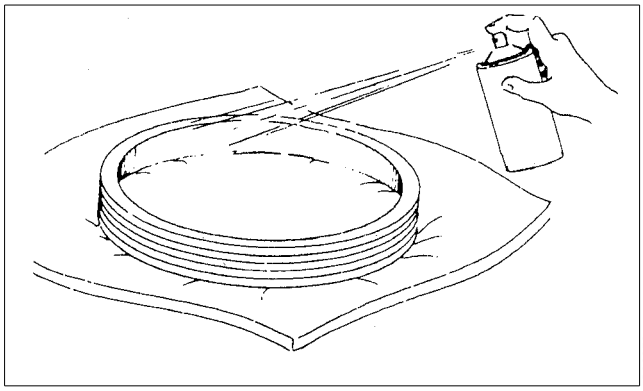
2. Spray the threads, guide and contact surfaces with slide lacquer Molykote 321 R. Let the lacquer air-cure for about 15 minutes.



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.

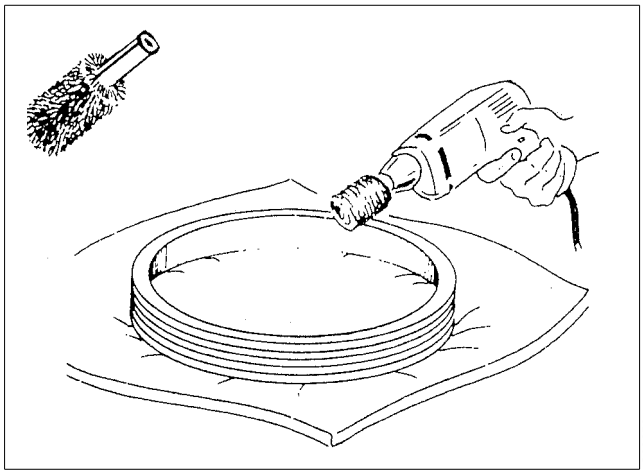


4. Spray the lock ring a second time and let it dry for about 15 minutes.



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.



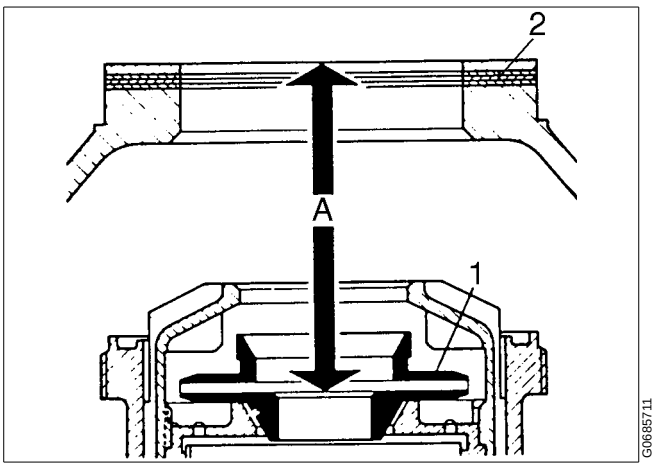
5.4.16 Lock ring; wear and damage

Same as described in section “5.3.10 Lock ring; wear and damage” on page 67.

5.4.17 Oil paring disc; height position

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

- Assemble the bowl but do not fit small lock ring and upper paring disc.
- Tighten the large lock ring until the bowl hood is in close contact with the bowl body.
- Put the frame hood in place and tighten it to the frame ring.
- Measure the distance A according to adjacent illustration. The distance should be **87,5 ±0,5 mm**.
- Adjust the distance by adding or removing height adjusting rings.



1. Oil paring disc
2. Height adjusting rings

When inlet and outlet parts have been mounted:

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

5.4.18 Operating mechanism

Same as described in section “5.3.11 Operating mechanism” on page 69**.**

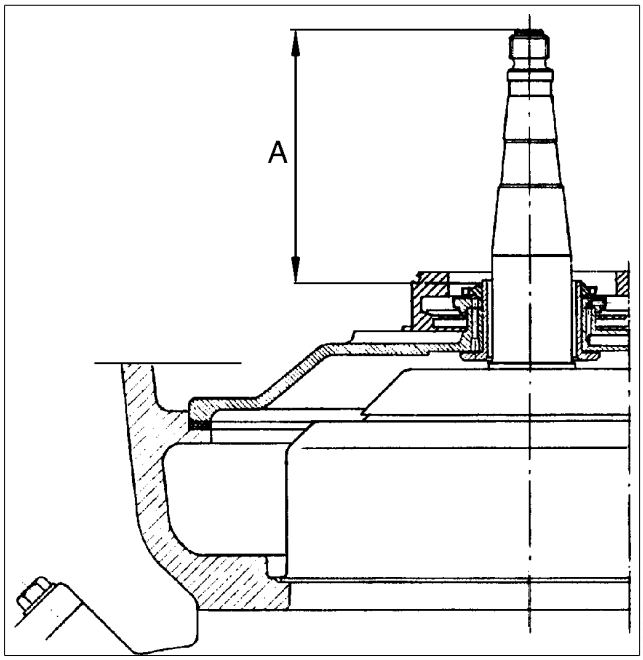
5.4.19 Control paring disc device; height position

Incorrect height position may cause the control paring disc to scrape against the distributing cover.

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

The height A must be **113,5 ±0,5 mm**.

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



A: Distance to measure

5.4.20 Operating slide

Same as described in section “5.3.12 Operating slide” on page 69.

5.4.21 Sliding bowl bottom

Same as described in section “5.3.13 Sliding bowl bottom” on page 70.

5.4.22 Springs for operating mechanism

Same as described in “5.3.14 Springs for operating mechanism” on page 71.

5.4.23 Worm wheel and worm; wear of teeth

Same as described in section “5.7.1 Worm wheel and worm; wear of teeth” on page 89.

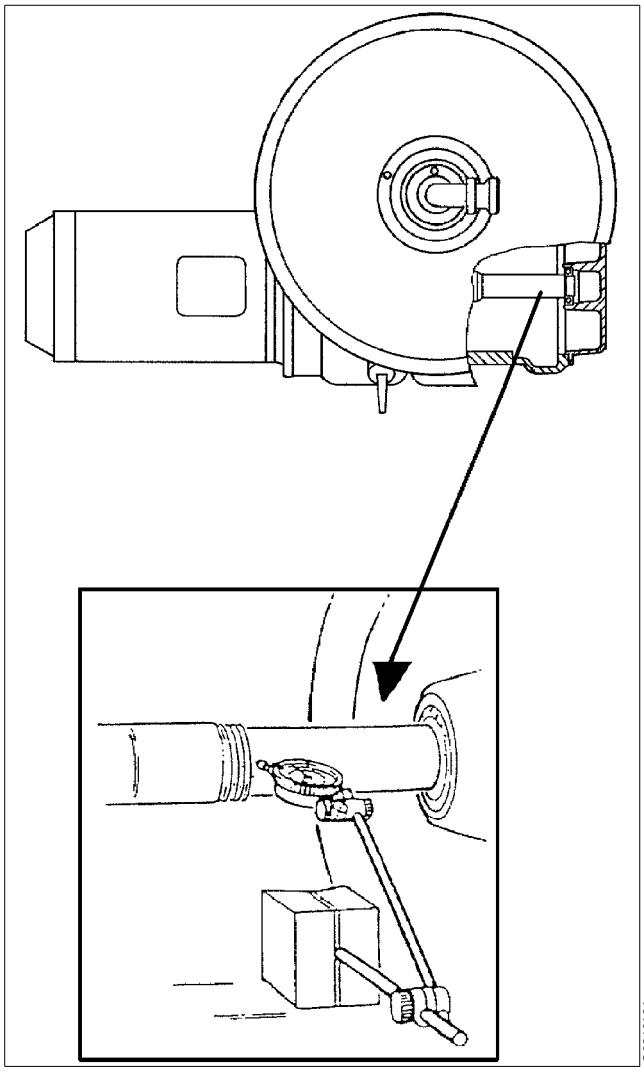
5.4.24 Worm wheel shaft; radial wobble

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

5.4.25 Cover interlocking switch

Same as described in ‘‘5.3.16 Cover interlocking switch” on page 71.

5.5 Lifting instructions

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.

Attach two endless slings or cables to the separator frame as illustrated. Length of each sling must be at least 1,5 metres.

NOTE

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

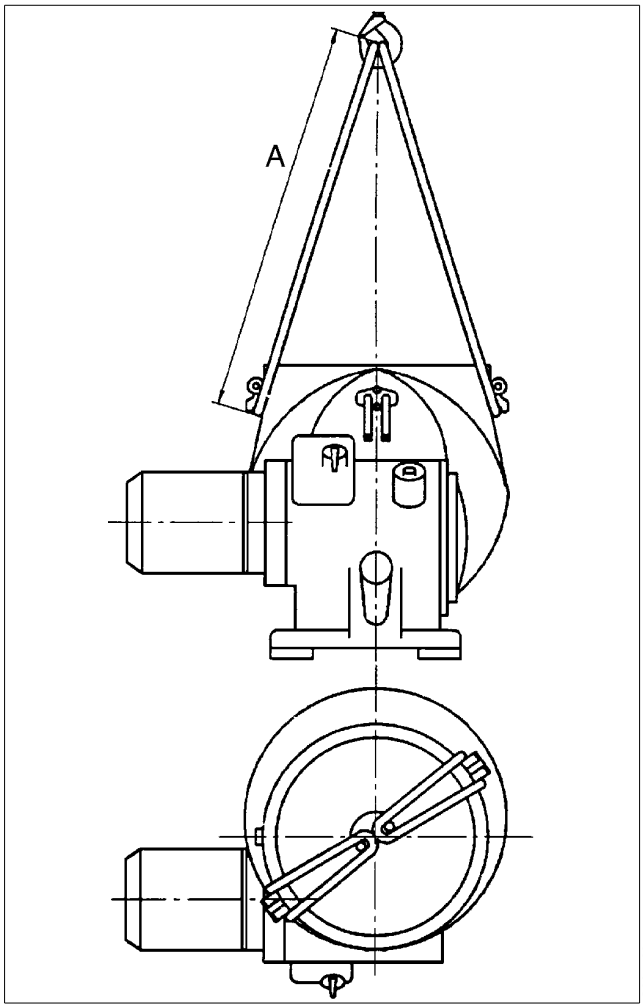
Do not lift the separator unless the frame hood and bowl have been removed.

WARNING

Crush hazards

Lift the separator in no other way than illustrated.

A falling separator can cause accidents resulting in serious injuries and damage.



Lift the separator only after the frame hood and bowl have been removed. A=minimum 750 mm

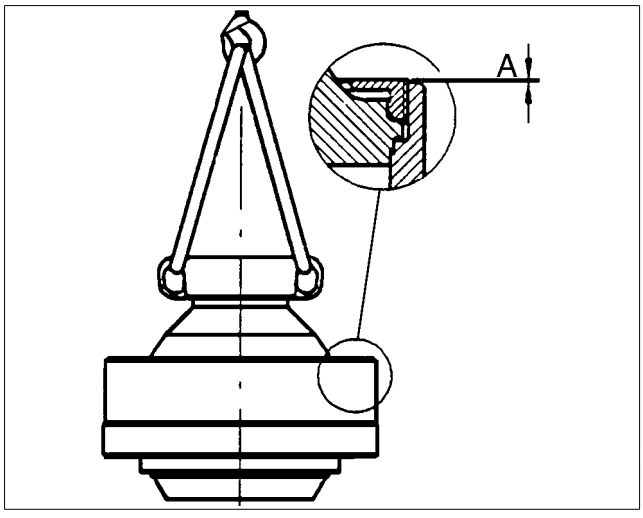
When lifting the bowl, use the special lifting tool fastened on the bowl hood.

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**.



The lock ring must be properly tightened before the bowl is lifted. Distance A: maximum 6 mm

5.6 Cleaning

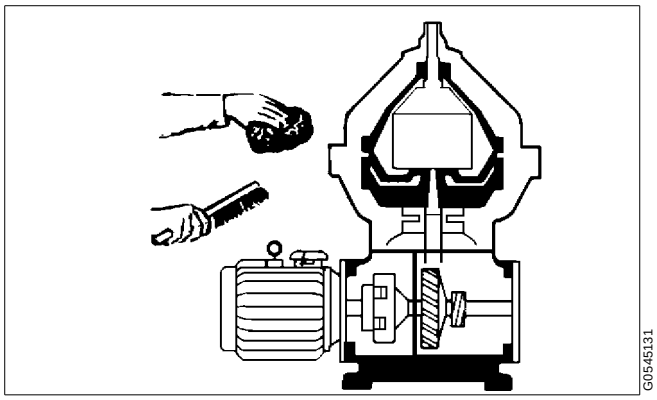
5.6.1 External cleaning

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.

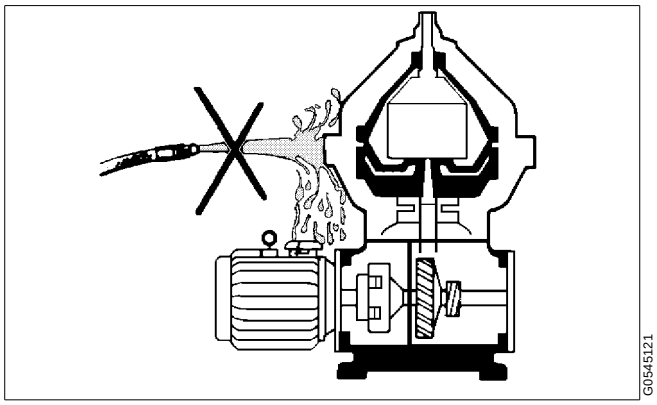
Never wash down a separator with a direct water stream. Totally enclosed motors can be damaged by direct hosing to the same extent as open motors and even more than those, because:

- 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.



Use a brush and sponge or cloth when cleaning



Never wash down a separator with a direct water stream or spray

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.

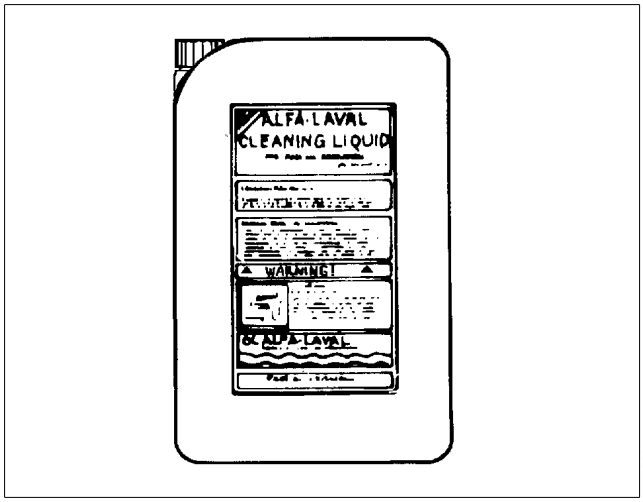
For separator bowl, inlet and outlet

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 oil 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

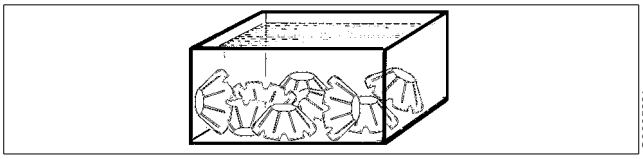
Handle the bowl discs carefully so as to avoid damage to the surfaces during cleaning.

NOTE

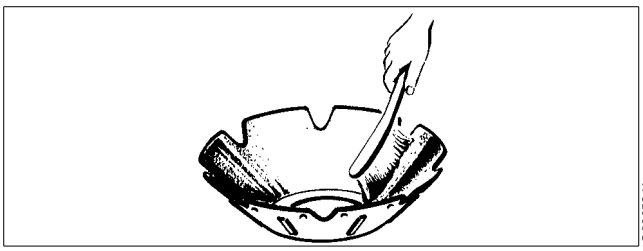
Mechanical cleaning is likely to scratch the disc surfaces causing deposits to form quicker and adhere more firmly.

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 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

CAUTION

Cut hazard

Sharp edges on the separator discs may cause cuts.

5.7 When changing oil

5.7.1 Worm wheel and worm; wear of teeth

To check at each oil change

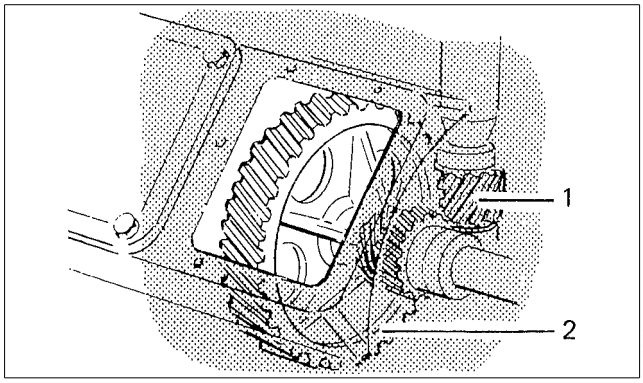
Check the teeth of both the worm wheel and worm for wear.

See the “ Tooth appearance examples” on page 91. Examine the contact surfaces and compare the tooth profiles. The gear may operate satisfactorily even when worn to some degree.

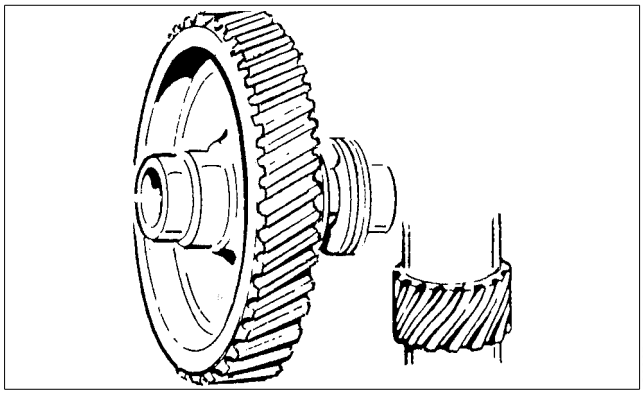
- Replace both worm wheel and worm at the same time, even if only one of them is worn.
- To avoid damaging the teeth when lifting the bowl spindle: push the worm wheel to one side first.

  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 170 for correct number of teeth.



1 Worm
2 Worm wheel



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

DANGER

Disintegration hazards

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

NOTE

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

Important!

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

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

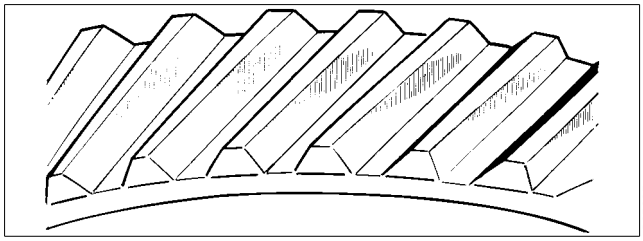
For further information, see chapter “8.5 Lubricants” on page 180.

Tooth appearance examples

Satisfactory teeth:

Uniform wear of contact surfaces. Surfaces are smooth.

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

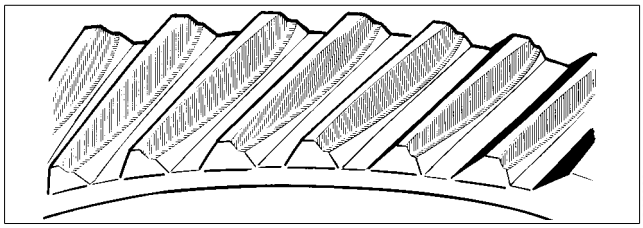


Satisfactory teeth

Worn teeth:

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

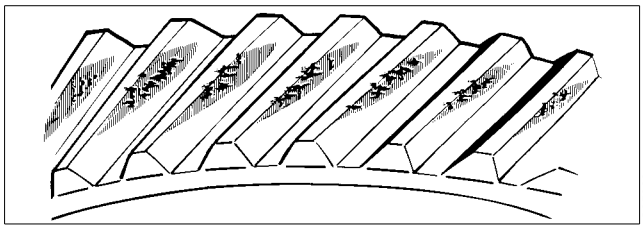
- the wear is uniform over the whole of the flank of a tooth
- and all teeth are worn in the same way.



Worn teeth

Spalling:

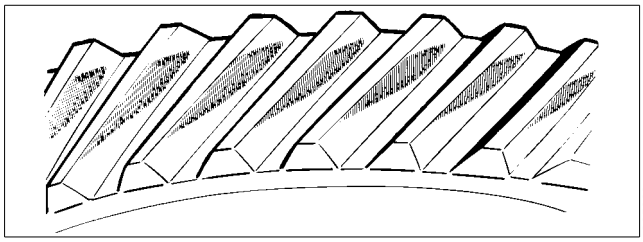
Small bits of the teeth have broken off, so-called spalling. This is generally due to excessive load or improper lubrication. Damage of this type need not necessitate immediate replacement, but careful checking at short intervals is imperative.



Spalling

Pitting:

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

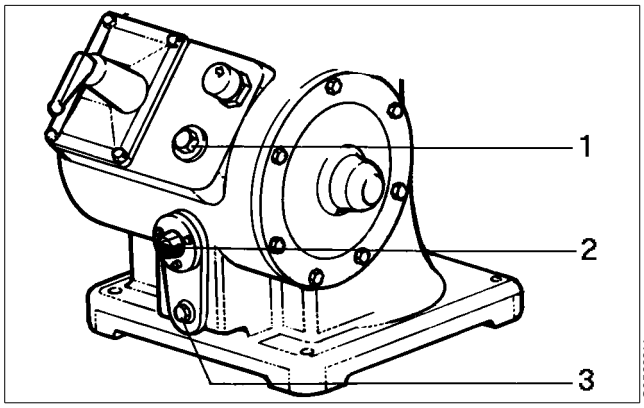


Pitting

5.7.2 Oil change procedure

NOTE

Before adding or renewing lubricating oil in the worm gear housing, the information concerning different oil groups, handling of oils, oil change intervals etc. given in chapter “8.5 Lubricants” on page 180 must be well known.



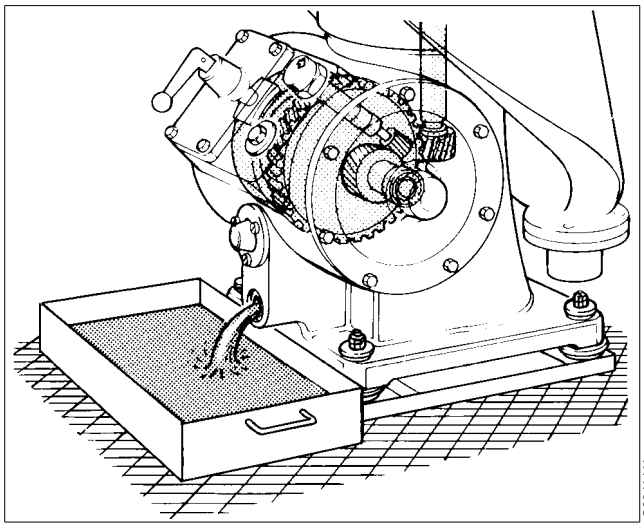
1. *Oil filling plug*
2. *Sight glass*
3. *Oil drain plug*

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

CAUTION

Burn hazards

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



Burn hazards: The drained oil can be hot

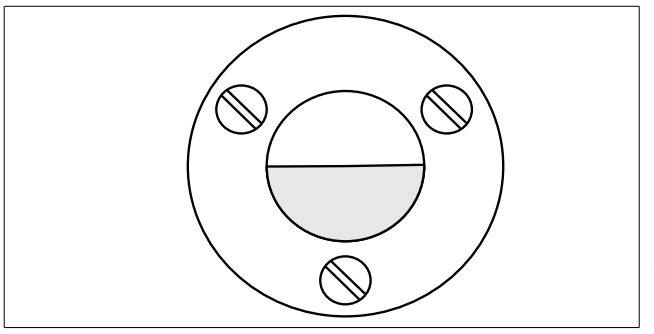
2. Fill new oil in the worm gear housing. The oil level should be slightly above the middle of the sight glass.

   Oil volume: approx. 4,0 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 at standstill must not be below the middle of the sight glass

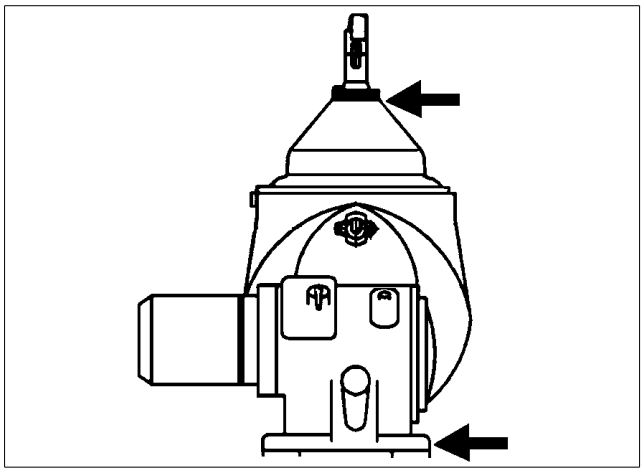
5.8 Vibration

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.

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



Measuring points for vibration analysis

DANGER

Disintegration hazards

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

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

5.9 Common maintenance directions

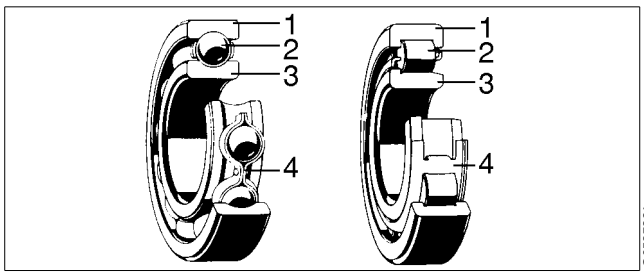
5.9.1 Ball and roller bearings

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

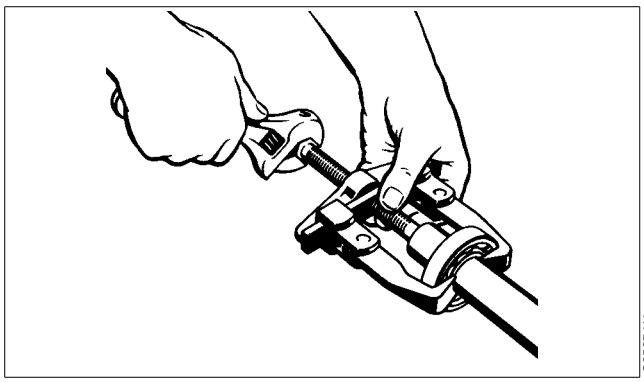
NOTE
Using an incorrect bearing can cause a serious breakdown with damage to equipment as a result.

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

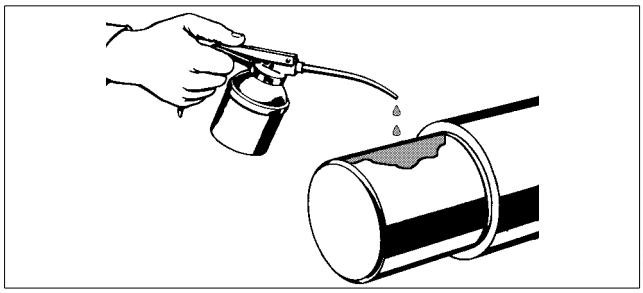
Do not hit with a hammer directly on the bearing.

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

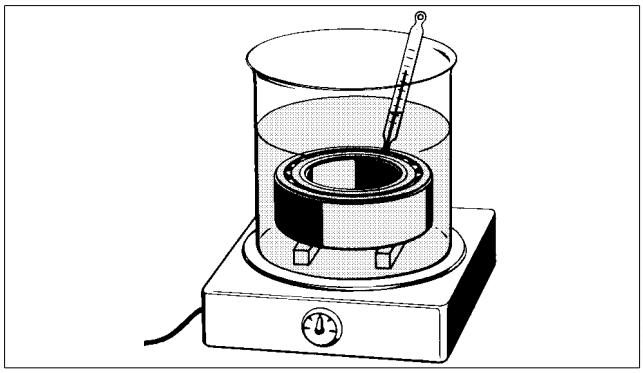
- When assembling ball bearings, the bearings must be heated in oil to max. 125 °C.

NOTE

Heat the bearing in a clean container.

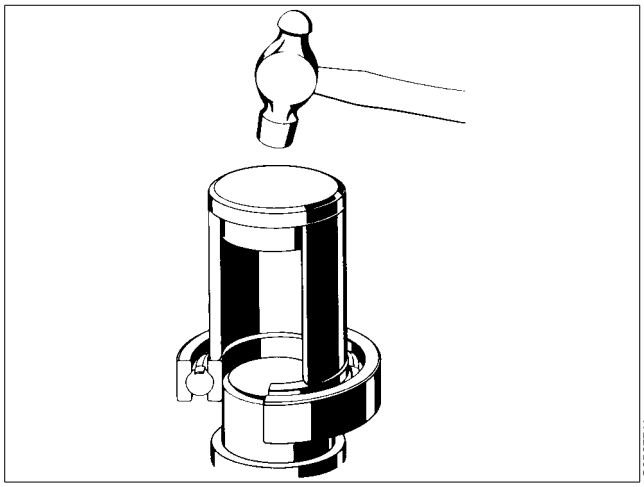
Use only clean oil with a flash point above 250 °C.

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

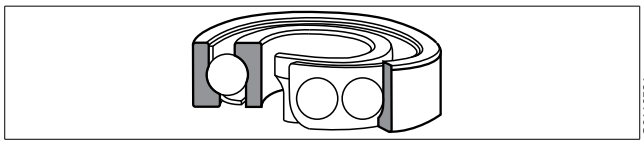
- There are several basic rules for assembling cylindrical bore bearings:
  - Never directly strike a bearing's rings, cage or rolling elements while assembling. A ring may crack or metal fragments break off.
  - Never apply pressure to one ring in order to assemble the other.
  - Use an ordinary hammer.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

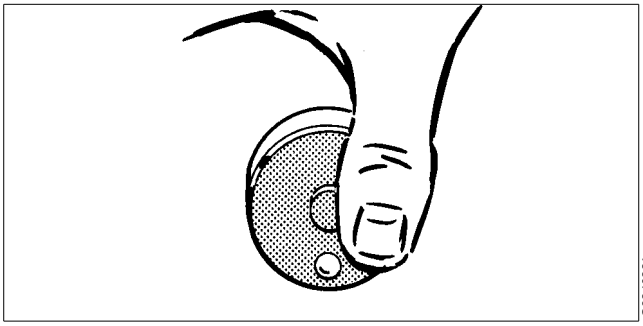
The recommended intervals are stated in chapter “5.1.2 Maintenance intervals” on page 45.

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 61.

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.

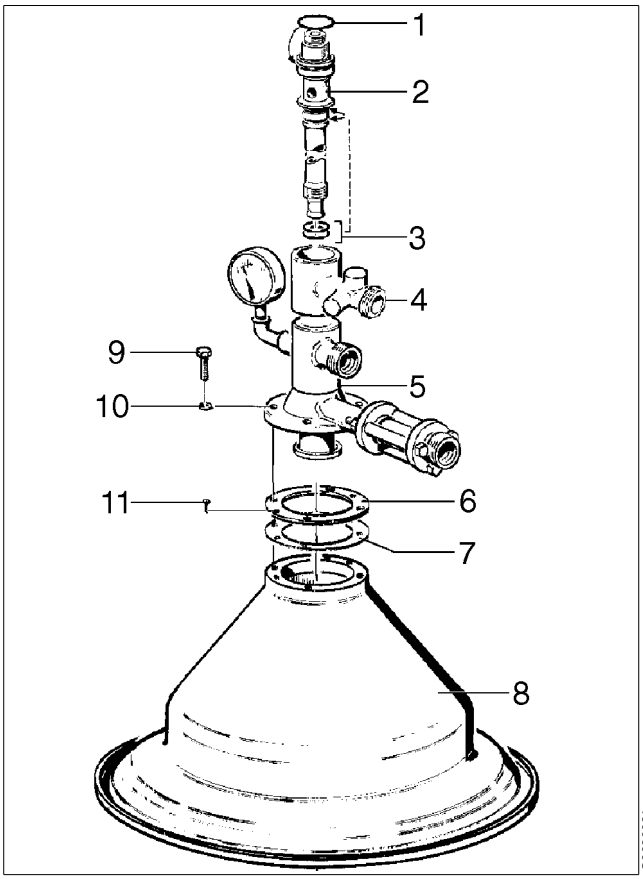
NOTE

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

6.2 Inlet/outlet, frame hood (IS)

6.2.1 Exploded views

1. *O-ring*
2. *Inlet pipe*
3. *O-ring*
4. *Support*
5. *Connecting housing (with sight glass and pressure gauge)*
6. *Protecting washer*
7. *Height adjusting ring*
8. *Frame hood*
9. *Screw*
10. *Washer*
11. *Screw*



6.2.2 Dismantling

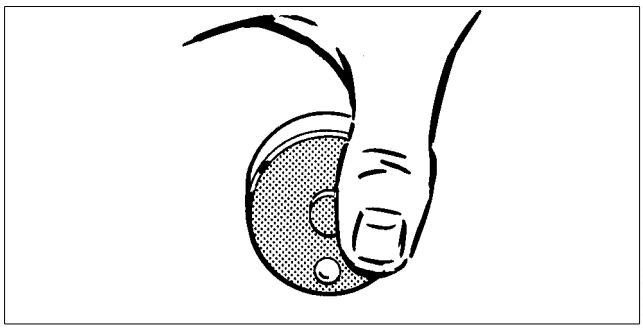
DANGER

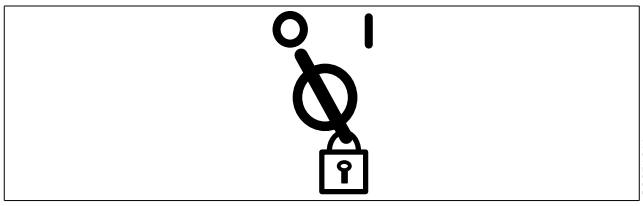
Entrapment hazards

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

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

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

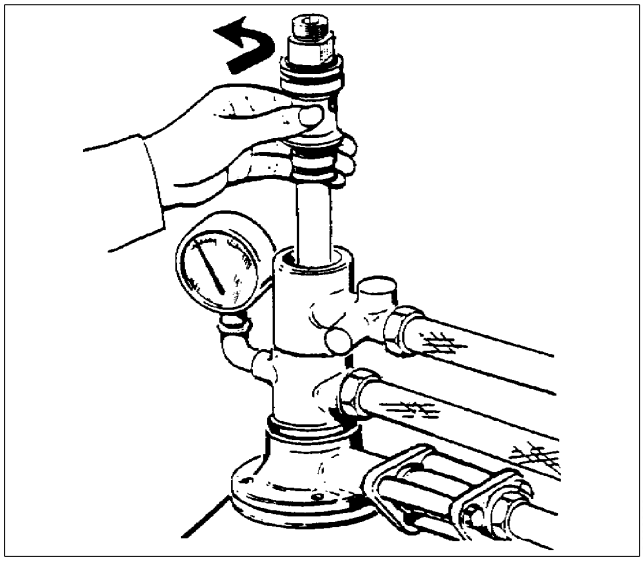




The parts must be handled carefully. Don't place parts directly on the floor, but on a clean rubber mat, fibreboard or a suitable pallet.

1. Disconnect the water supply hose. Unscrew the inlet pipe clockwise and remove it.

   Left-hand thread!



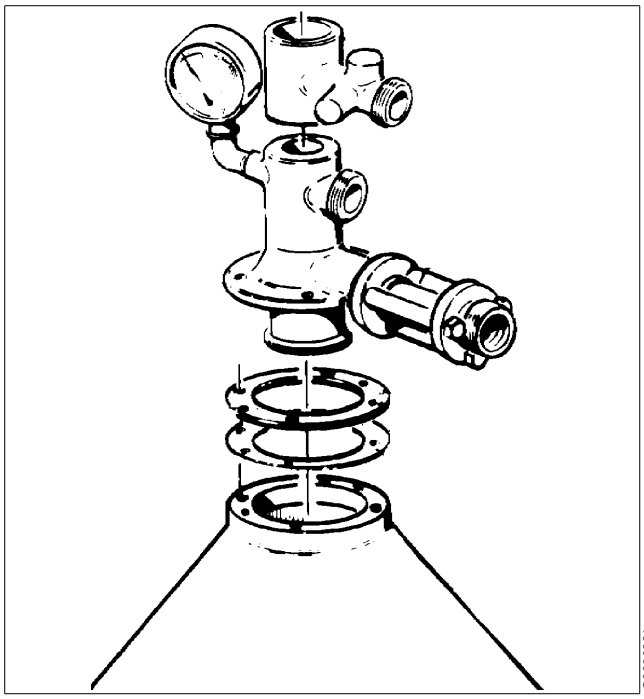
2. Remove the inlet and outlet piping support, connection housing, protecting washer and height adjusting ring.

3. Loosen the hinged bolts and remove the frame hood.

   The bowl parts can remain very hot for a considerable time after the bowl has come to a standstill.

6.2.3 Assembly

1. Put the frame hood in place and clamp it with the 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 and inlet and outlet parts.
4. Connect oil and water inlet and outlet parts.

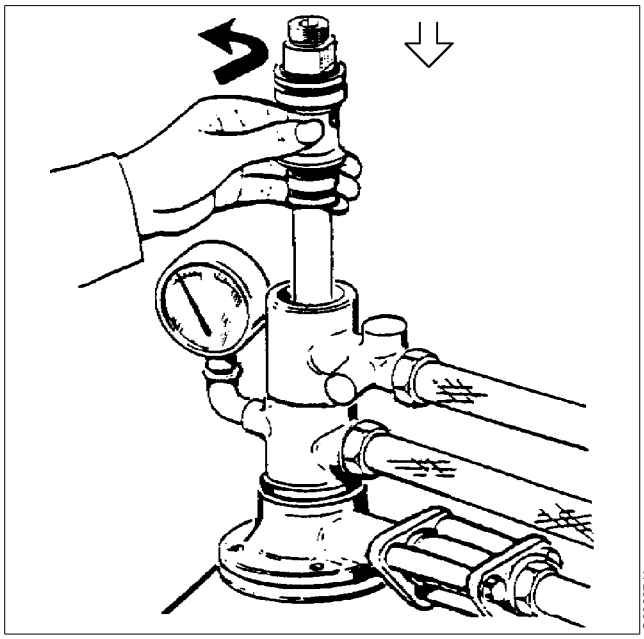


5. Fit the inlet pipe and connect the water hose.

DANGER

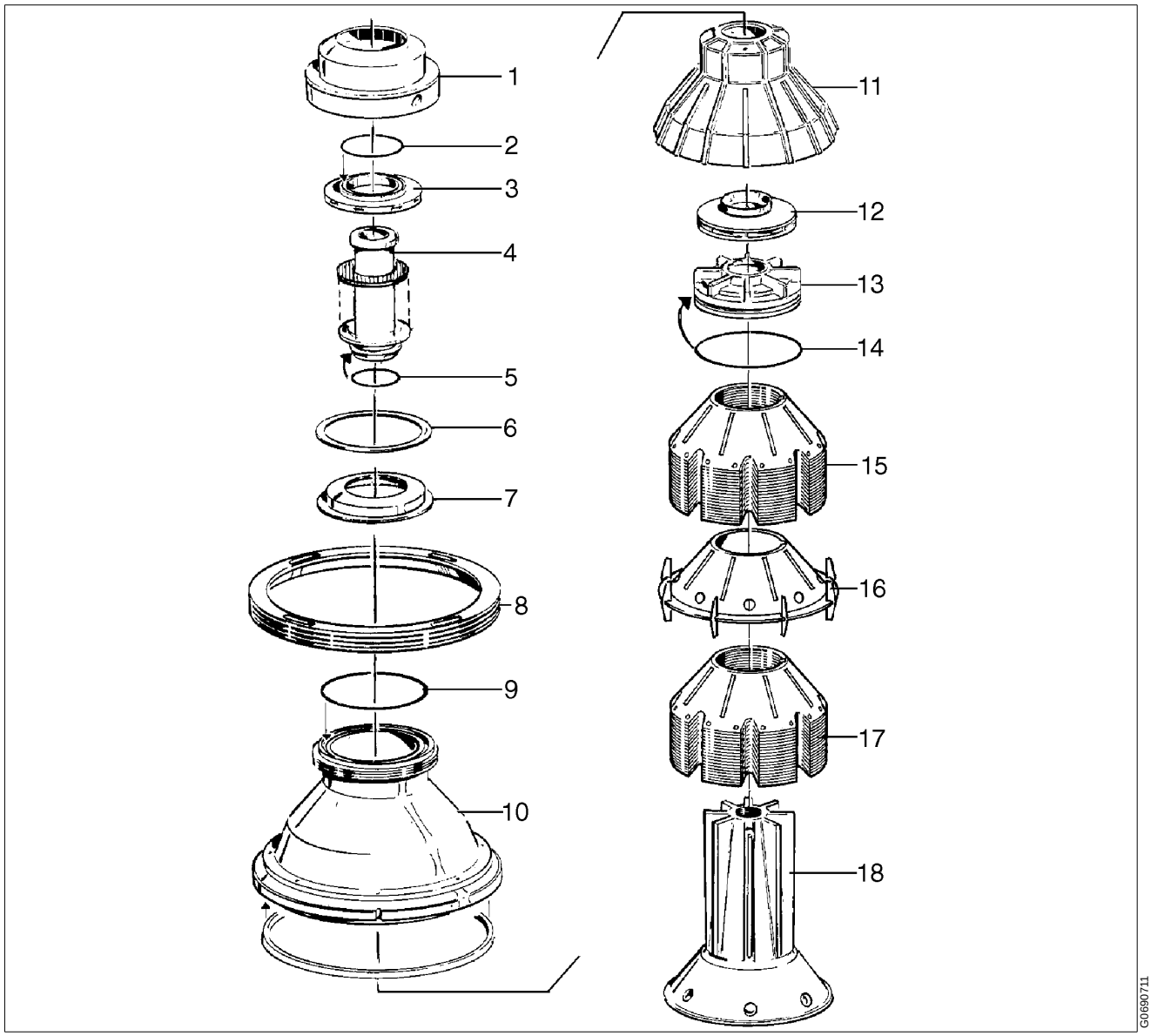
Disintegration hazards

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

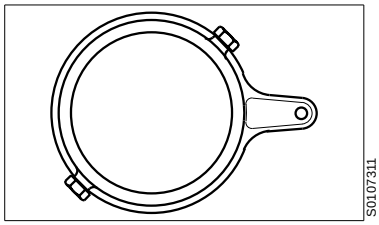


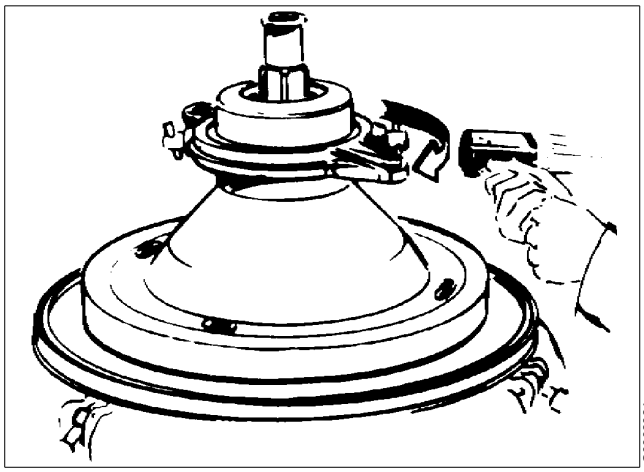
1. *Paring chamber cover (small lock ring)*
2. *O-ring*
3. *Upper paring disc*
4. *Guide sleeve with gasket*
5. *O-ring*
6. *Gasket*
7. *Gravity disc (or clarifier disc)*
8. *Lock ring*
9. *O-ring*
10. *Bowl hood with seal ring*
11. *Top disc*
12. *Oil paring disc*
13. *Level ring*
14. *O-ring*
15. *Bowl discs*
16. *Wing insert*
17. *Bowl discs*
18. *Distributor*

6.3.2 Dismantling

1. Unscrew the small lock ring (paring chamber cover) by using the special spanner.

   Left-hand thread!

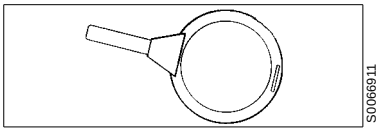


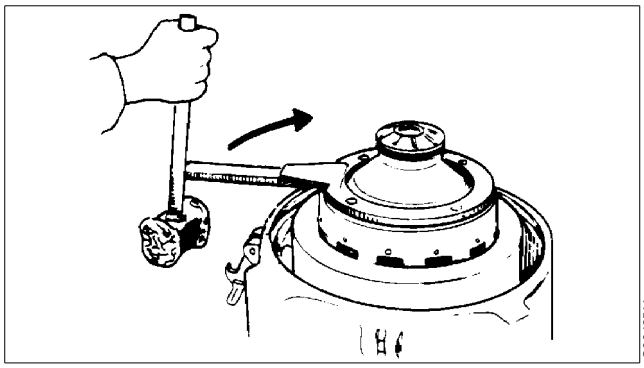


2. Remove the lock ring, paring disc, guide sleeve, gasket and gravity disc.

3. Apply the brake and unscrew the large lock ring**.**

   Left-hand thread!



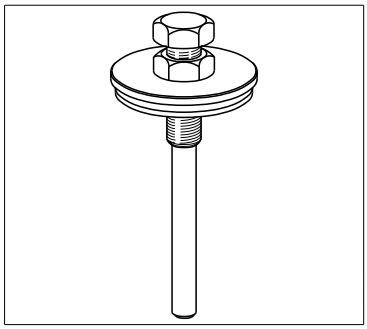


NOTE

After removing the lock ring it must be kept lying horizontally or it may become distorted. Even the 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.

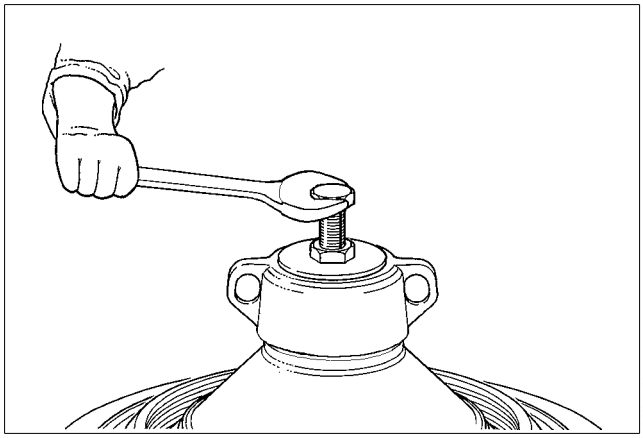


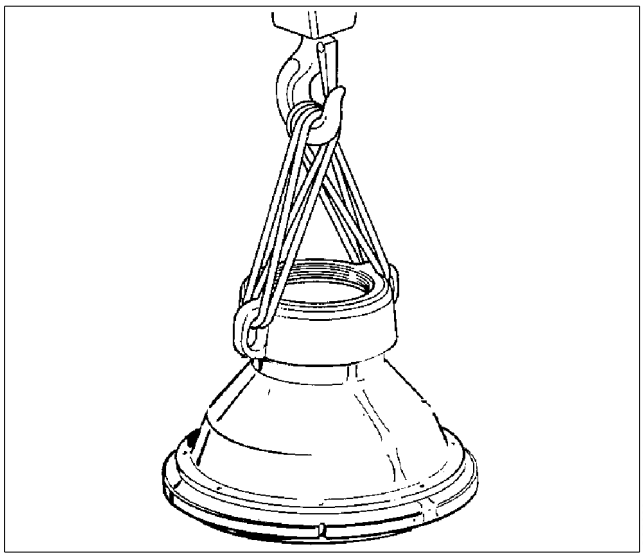
6. Screw home the spindle with a wrench until the bowl hood loosens from the bowl body.
7. Remove the spindle plate from the lifting tool.
8. Lift off the bowl hood using hoist. Be careful not to scratch the bowl hood seal ring

CAUTION

Crush hazards

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



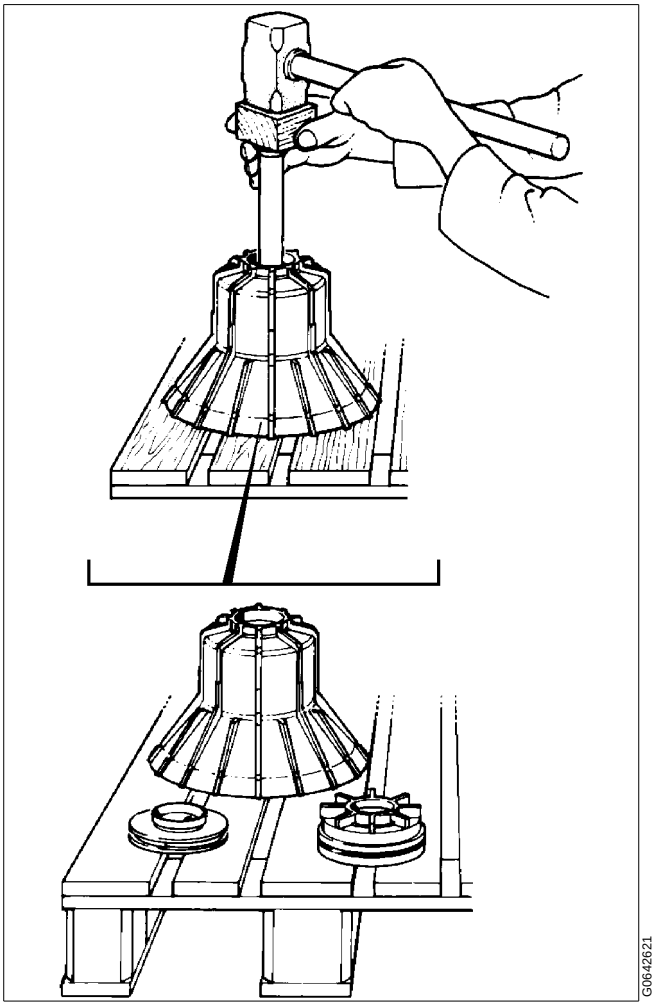


9. Remove the top disc.

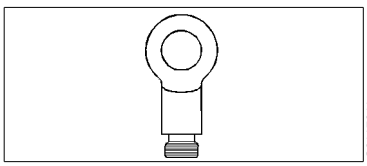
10. Screw the inlet pipe into the oil paring disc located above the level ring inside the top disc.

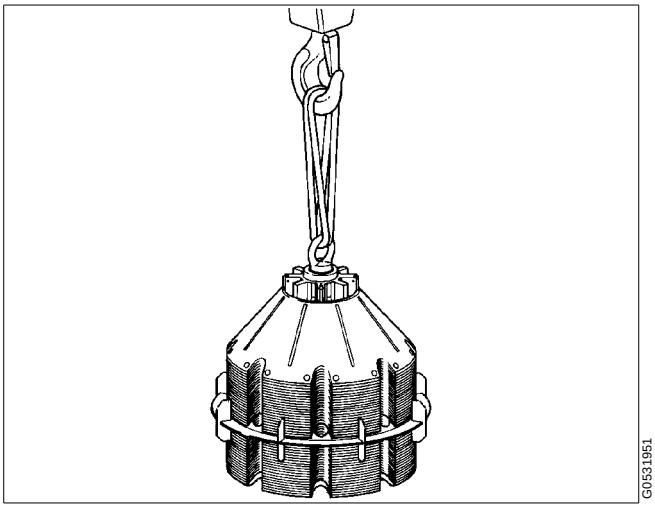
    Left-hand thread!

    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 by hoist.





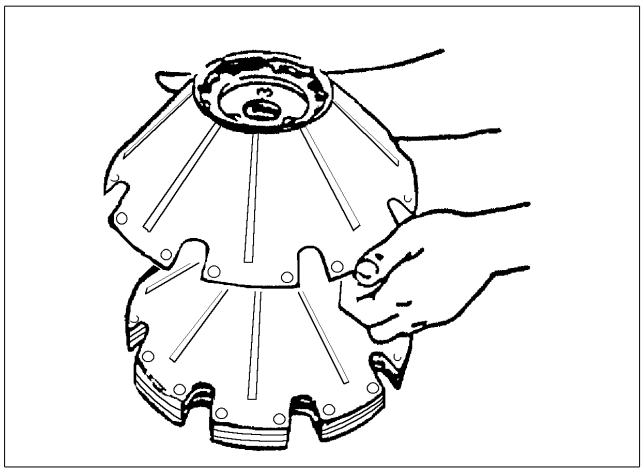
12. Remove deposits and clean all parts thoroughly in a suitable cleaning agent. See chapter “5.6 Cleaning” on page 86.

6.3.3 Assembly

✔ **Check point**

“5.3.3 Corrosion” on page 57,
“5.3.4 Cracks” on page 60,
“5.3.6 Erosion” on page 62,
“5.3.10 Lock ring; wear and damage” on page 67.

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



CAUTION

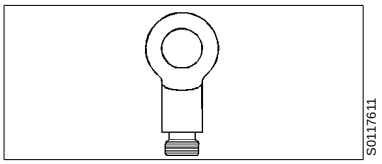
Cut hazard

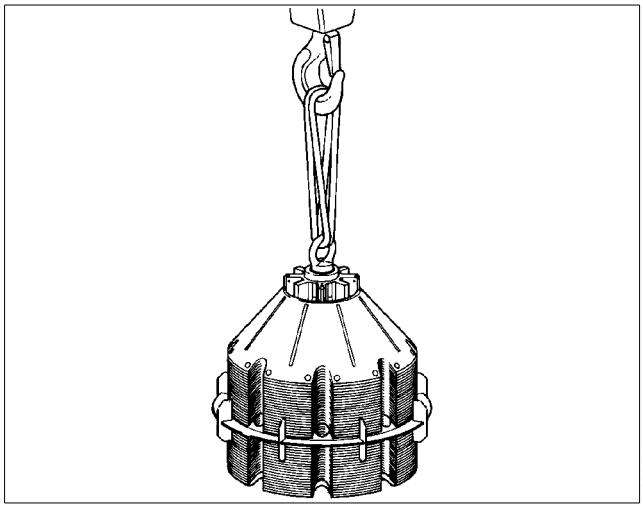
Sharp edges on the separator discs may cause cuts.

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.

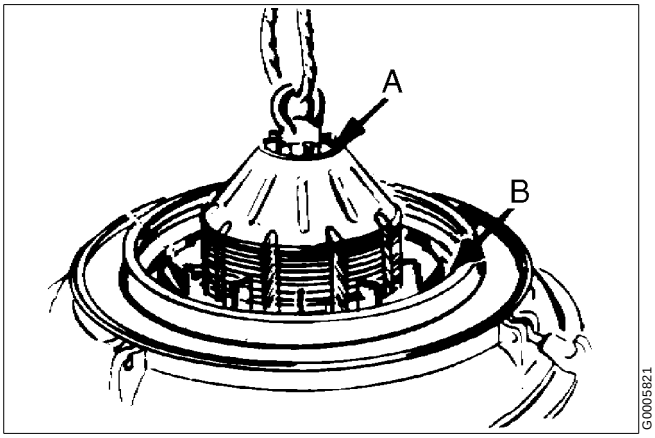
2. Fit the lifting tool to the distributor and lift the distributor with disc stack into the sliding bowl bottom using hoist.





3. Check that the guide pin in the distributing cone (in line with guide lug B) fits into the recess on the underside of the distributor.

   The recess is in line with the disc guide rib (A).

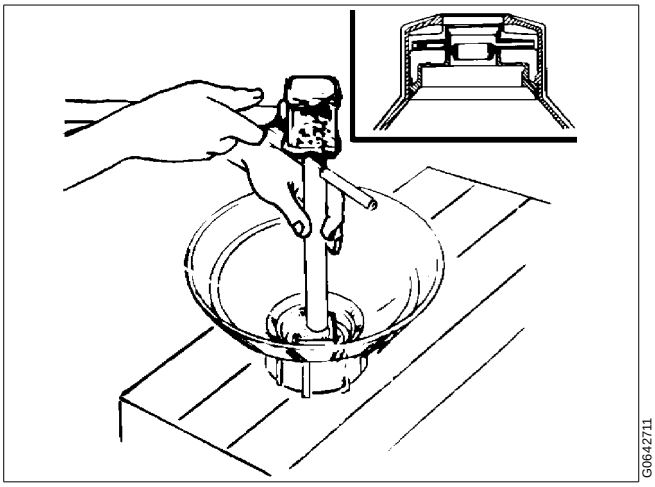


✔ **Check point**

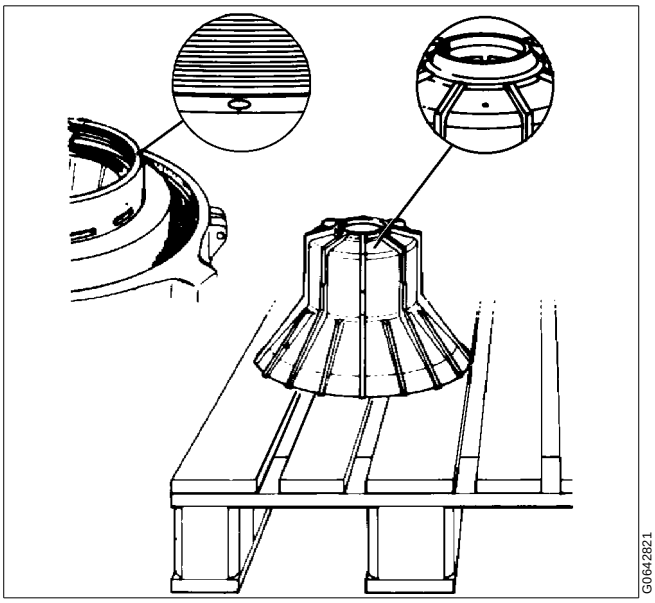
‘‘5.3.9 Level ring” on page 66.
‘‘5.3.8 Inlet pipe and oil paring disc” on page 66.

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

   Make sure that the paring disc is positioned in correct direction (i.e. not upside down).



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



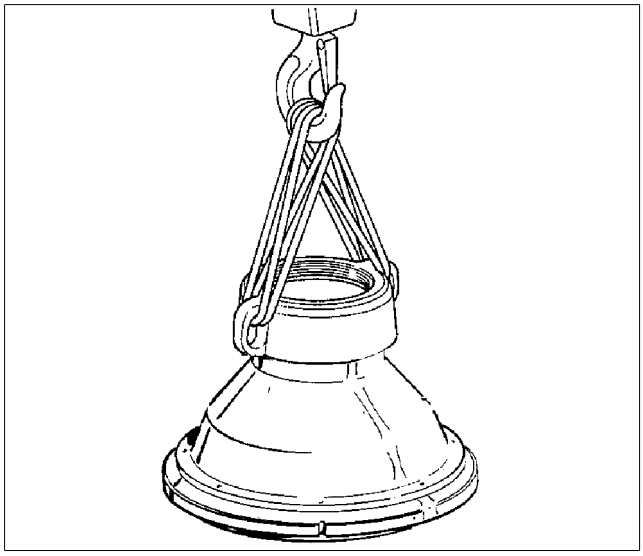
✔ **Check point**

“5.3.1 Bowl hood seal ring” on page 56.

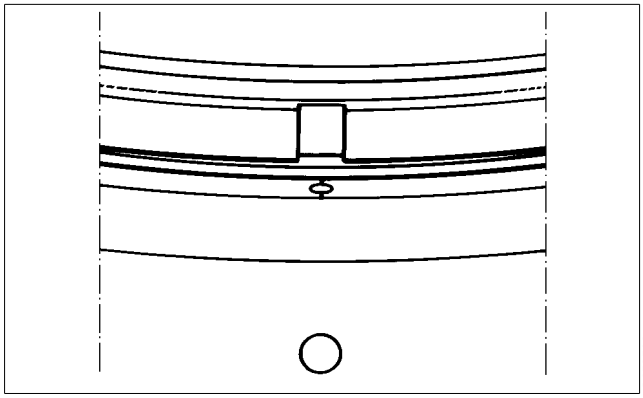
6. Fit the lifting tool to the bowl hood and lift it using hoist. Check that the seal rings of the bowl hood are properly fitted and lubricated.

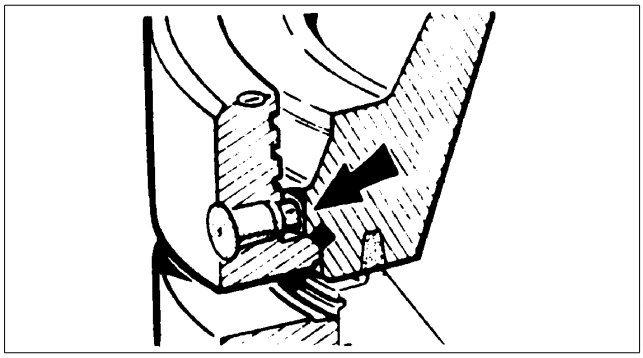
   Lower the bowl hood straight down onto the disc stack, otherwise it may get stuck. Be careful not to scratch the bowl hood seal ring.

   For correct position of bowl hood, see next illustration.



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

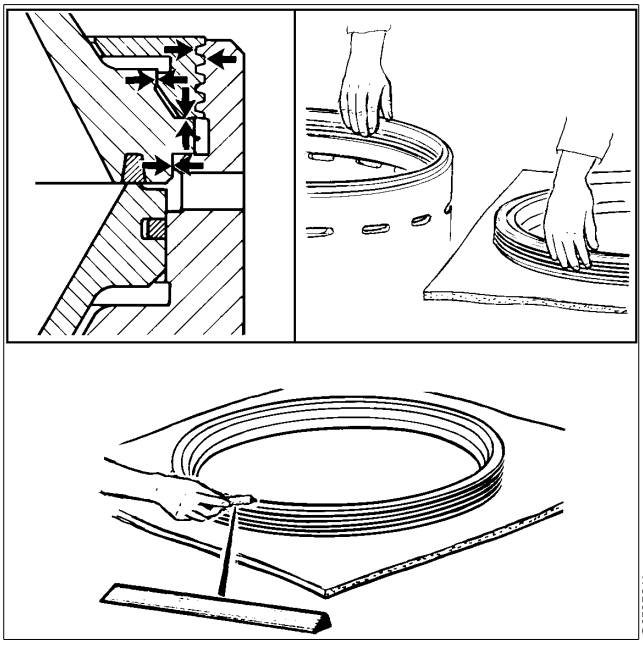




8. Remove the lifting tool.

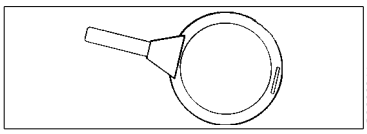
9. Lubricate the lock ring threads, contact and guide surfaces with lubricating paste.

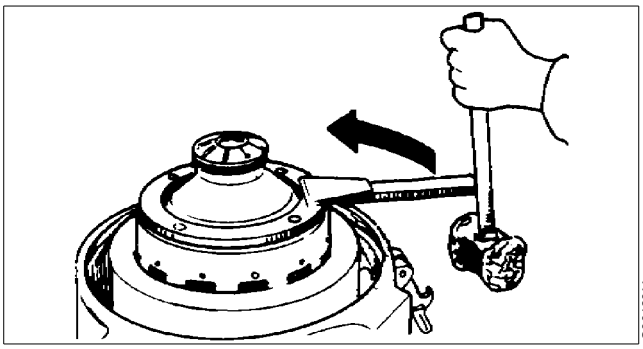
✔ **Check point**
“5.4.15 Lock ring; priming” on page 80 (only at Major Service).



10. Tighten the lock ring.

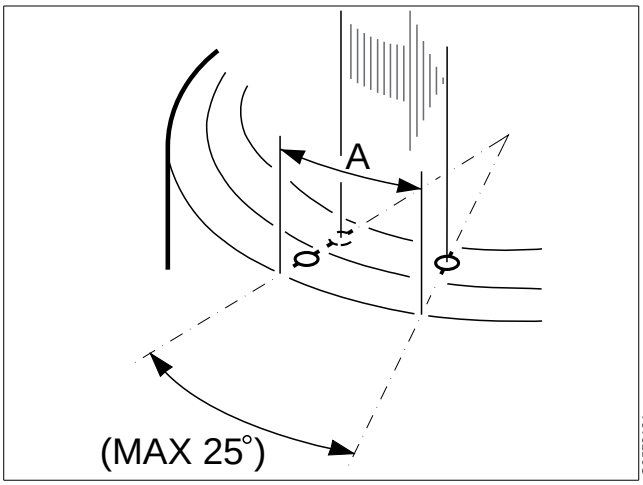
Left-hand thread!





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

✔ **Check point**
“5.3.5 Disc stack pressure” on page 61.



NOTE

The assembly marks must never pass each other by more than 25°.

12. Assemble the upper paring disc and the guide sleeve to the small lock ring (paring chamber cover).

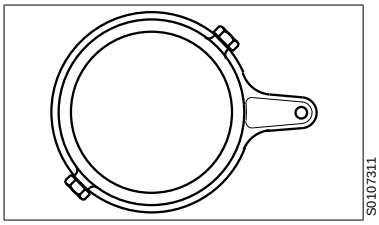
    Then fit the gravity disc and the lock ring assembly to the bowl hood.

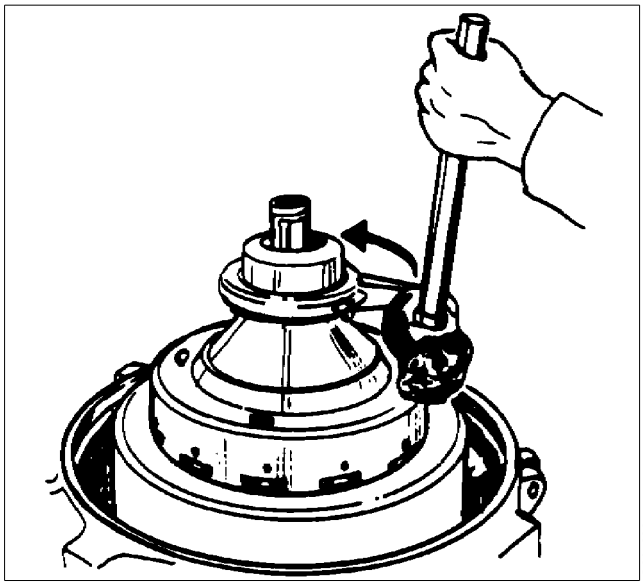
✔ **Check point**

"5.3.8 Inlet pipe and oil paring disc" on page 66.

13. Tighten the paring chamber cover using the spanner.

    Left-hand thread!

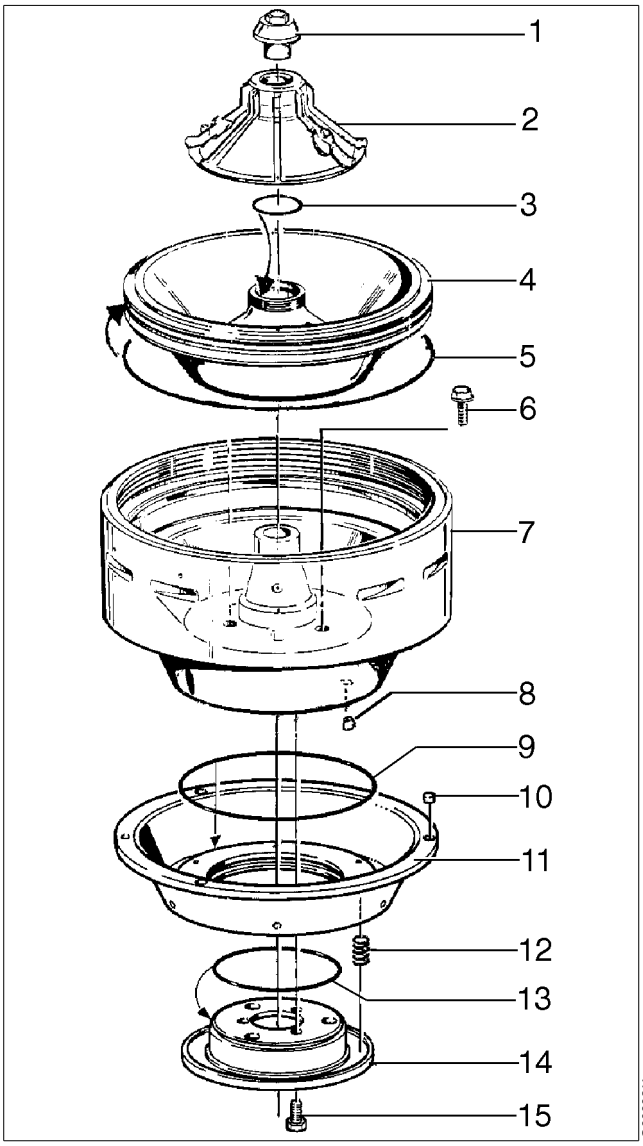




6.4 Bowl body and operating mechanism (IS)

6.4.1 Exploded view

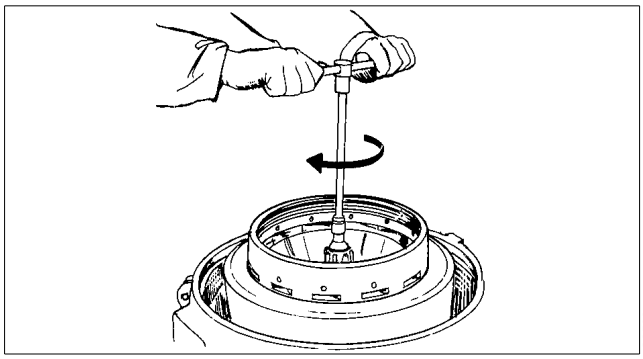
1. *Cap nut*
2. *Distributing cone*
3. *O-ring*
4. *Sliding bowl bottom*
5. *Rectangular ring*
6. *Screw*
7. *Bowl body*
8. *Nozzle*
9. *O-ring*
10. *Valve plug*
11. *Operating slide*
12. *Spring*
13. *O-ring*
14. *Spring support*
15. *Screw*



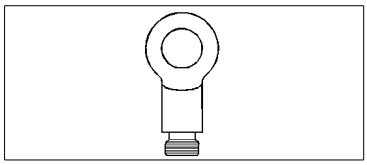
6.4.2 Dismantling

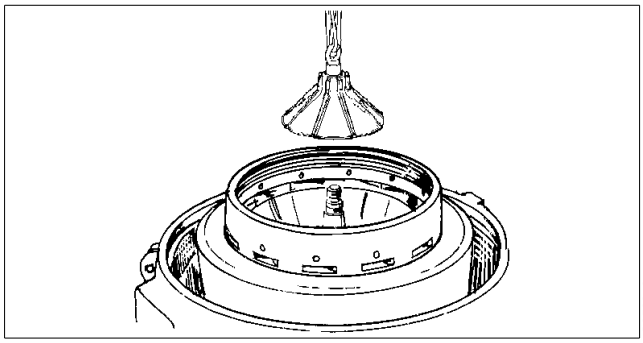
1. Unscrew and remove the cap nut.

   Left-hand thread!

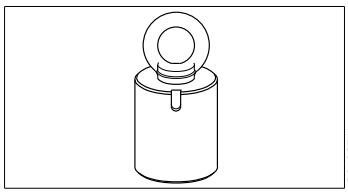


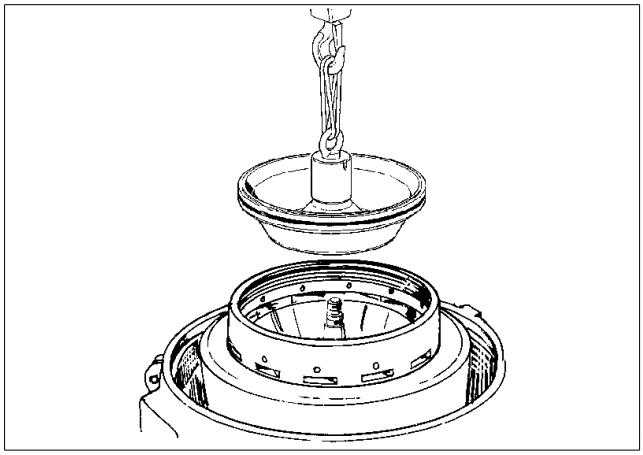
2. Fit the lifting tool into the distributing cone and lift it out.



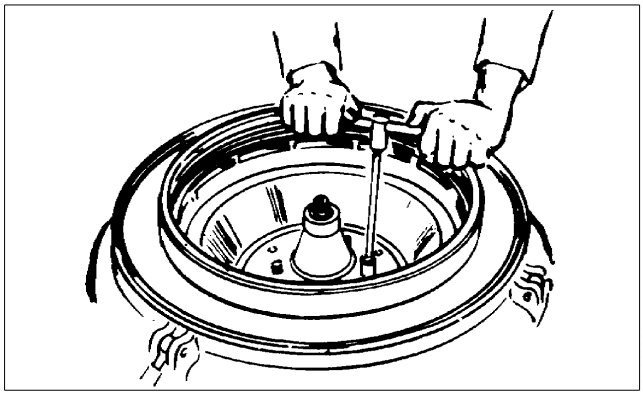


3. Fit the lifting tool onto the sliding bowl bottom and lift it out by hoist.

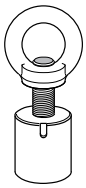




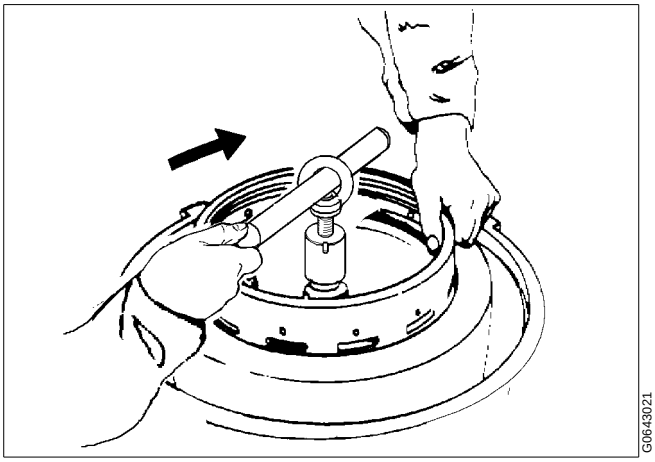
4. Unscrew the three screws in the bottom of the bowl body.



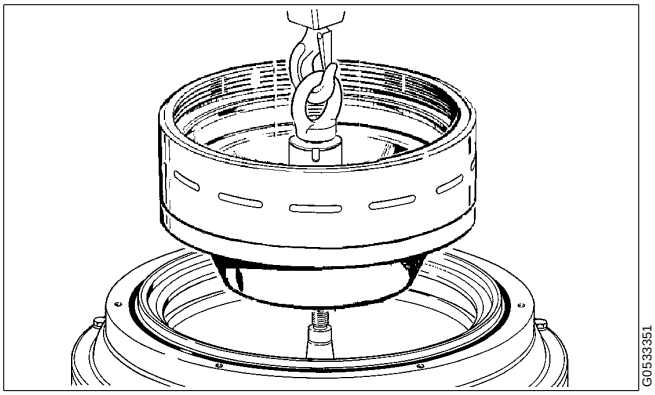
5. Fit the lifting tool onto the bowl body bottom. If necessary, unscrew the central screw.



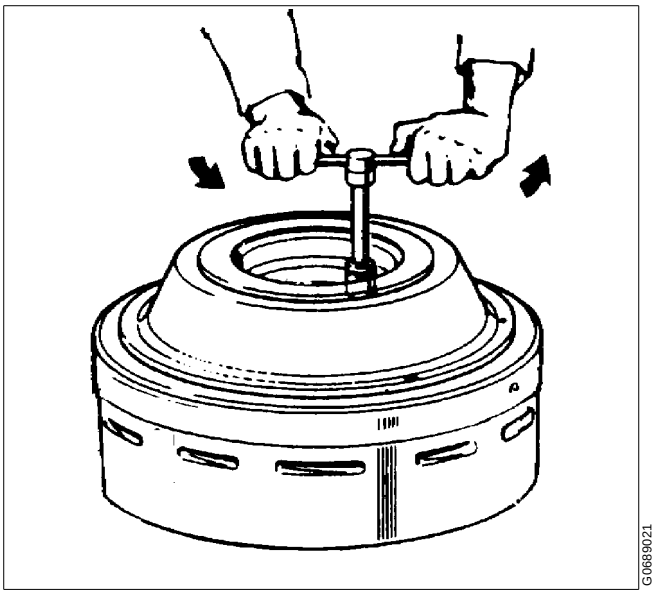
Release the bowl body from the spindle by using the lifting tool as a puller. Turn the eye of the central screw of the lifting tool until the bowl body comes loose from the spindle taper. Turn the eye two more turns in order to avoid damaging the paring disc device.



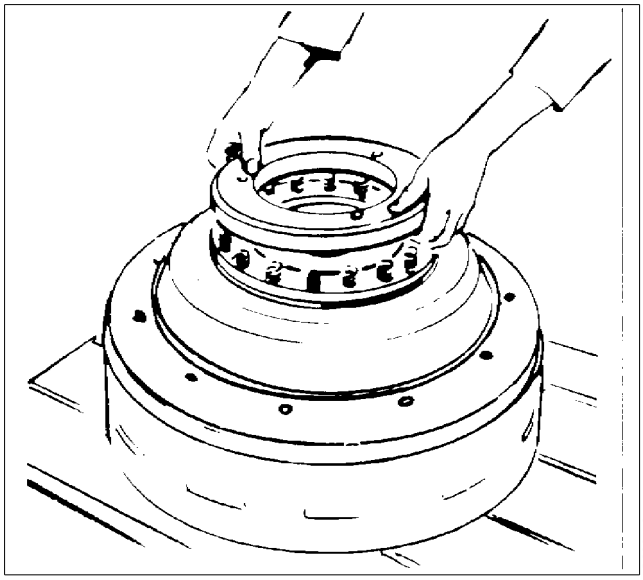
6. Lift out the bowl body using hoist.



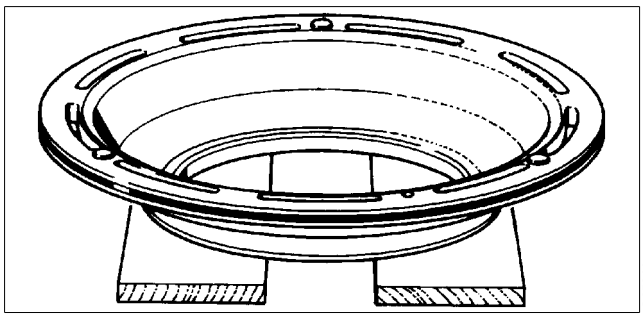
7. Turn the bowl body upside down.
8. Loosen the screws for the spring support successively a little at a time. Remove the screws.



9. Remove the spring support and the springs.

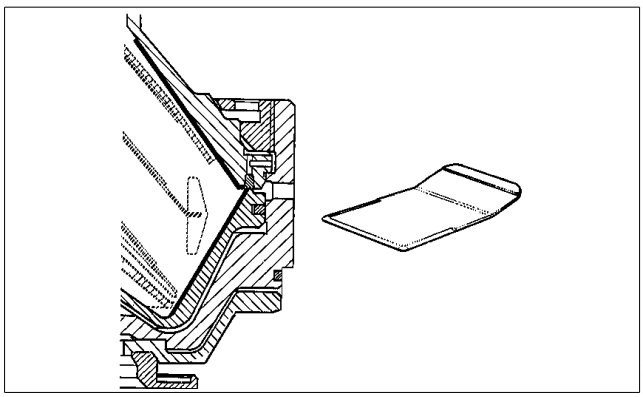


10. Remove the operating slide and place it with the valve plugs facing upwards.



11. 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 86.

    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 tool but the sludge scraper of brass included in the set of tools.



6.4.3 Assembly

✔ **Check point**

“5.3.3 Corrosion” on page 57,
“5.3.4 Cracks” on page 60,
“5.3.6 Erosion” on page 62,
“5.3.7 Guide surfaces” on page 64 (IS),
“5.4.12 Guide surfaces” on page 79 (MS),
“5.3.11 Operating mechanism” on page 69,
“5.3.12 Operating slide” on page 69,
“5.3.13 Sliding bowl bottom” on page 70,
“5.3.14 Springs for operating mechanism” on page 71.

1. Lubricate the guide surfaces of the bowl body and operating slide with lubricating paste. See chapter “8.5 Lubricants” on page 180.
2. Fit the operating slide onto the bowl body.

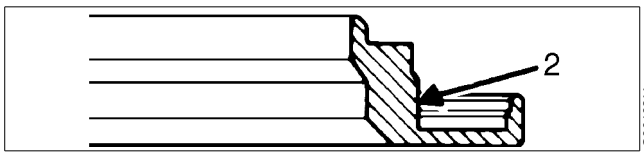
   Check that the guide pin in the bowl body enters the hole in the operating slide.

NOTE

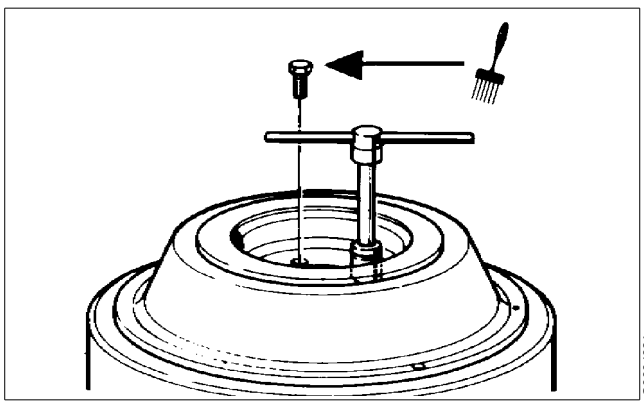
If there is too much lubrication paste applied, the surplus will collect between the operating slide and bowl body with risk for malfunction.

3. Lubricate the screw threads and the guide surfaces of the spring support. See chapter “8.5 Lubricants” on page 180.

   Fit springs and spring support.

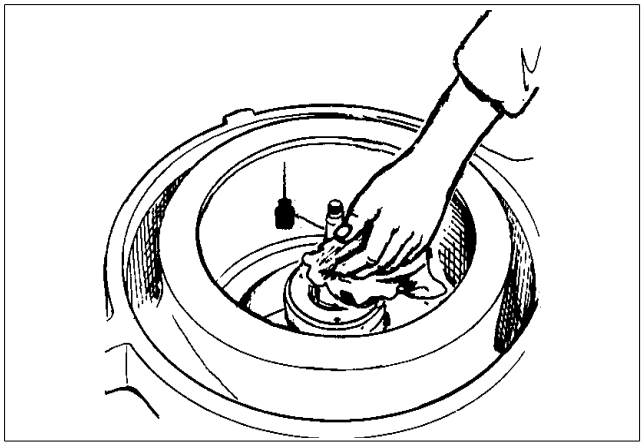


4. Tighten the screws for the spring support successively a little at a time. Finally tighten firmly (by hand).



5. Wipe off the spindle top and nave bore in the bowl body. Apply a drop of oil to the tapered end of the spindle, smear it over the surface and wipe it off with a clean cloth.

✔ **Check point**
"5.3.2 Bowl spindle cone and bowl body nave" on page 57.

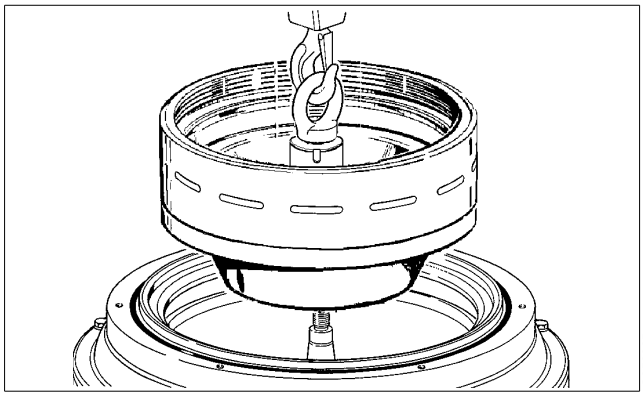

G0285011

6. 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.

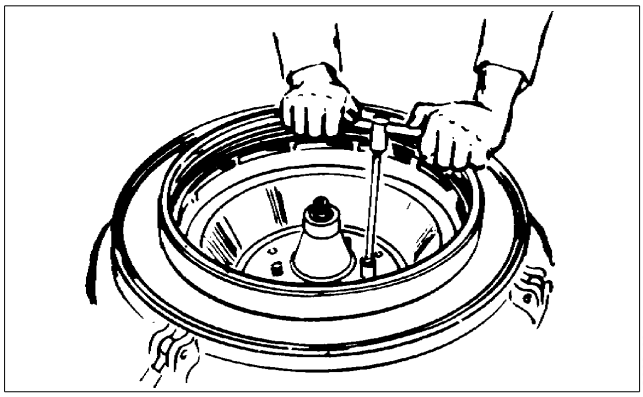
7. Lower the bowl body by hoist until the central screw rests on the spindle top. Then screw up the central screw so that the bowl body sinks down onto the spindle.

   Remove the tool.


G0533351

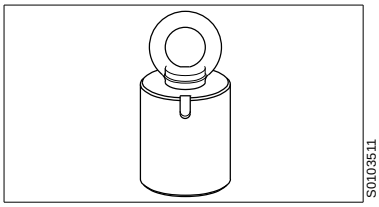
8. Rotate the bowl body and align it so that the screw holes in the bowl body bottom are exactly above the holes in the operating device.

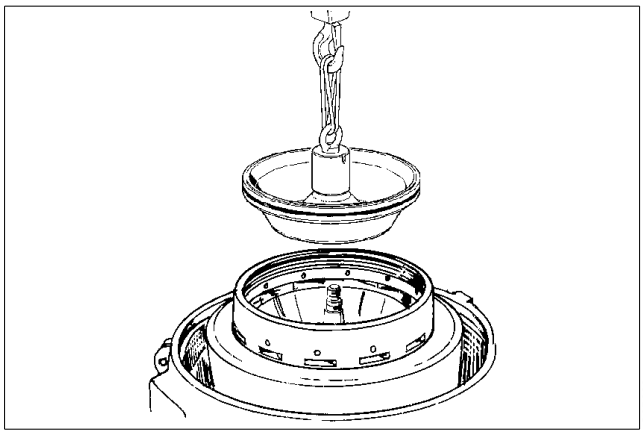
   Tighten the bowl body screws firmly.


G0004021

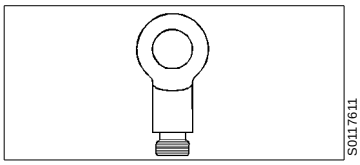
9. Lubricate the guide surfaces of the bowl body and sliding bowl bottom with lubricating paste. See chapter "8.5 Lubricants" on page 180.

10. Fit the lifting tool to the sliding bowl bottom and lift it into the bowl body by hoist.

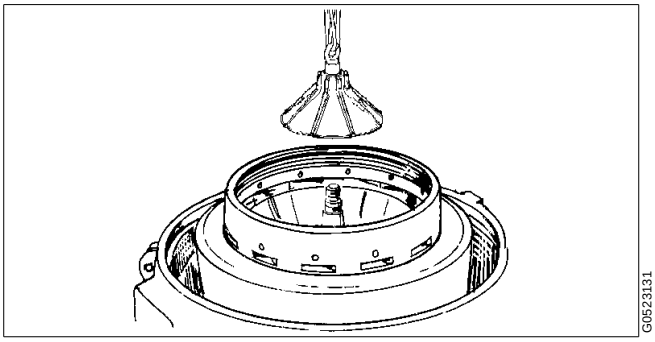

S0103511


G0533241

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

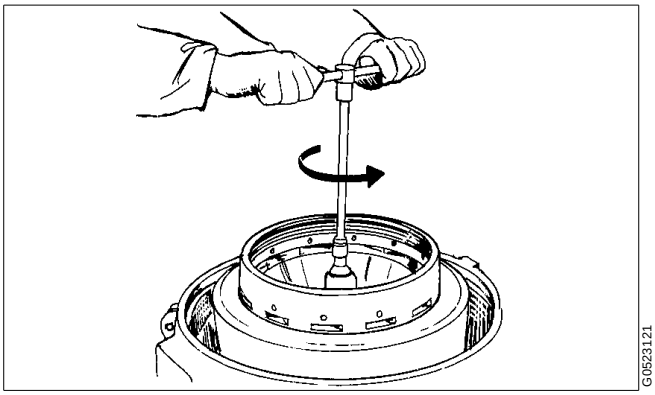


Check that the guide pins on the underside of the distributing cone enter the recesses in the sliding bowl bottom.



12. Screw on the cap nut and tighten firmly.

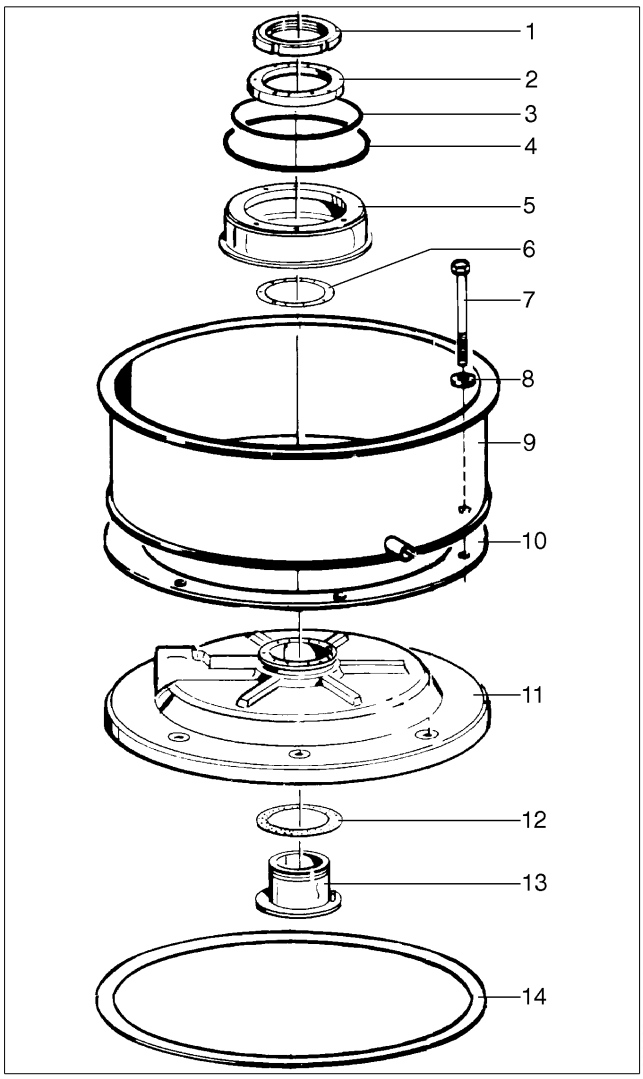
Left-hand thread!



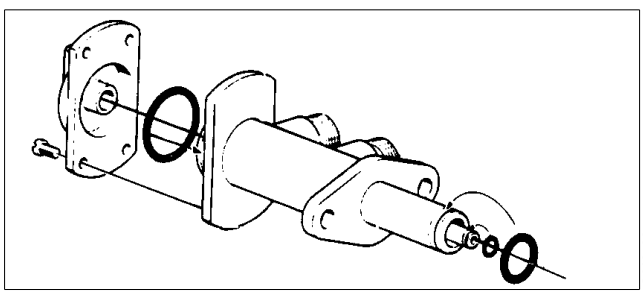
6.5 Paring disc device for operating water (IS)

6.5.1 Exploded view

1. *Ring nut*
2. *Control paring disc*
3. *O-ring*
4. *O-ring*
5. *Distributing ring*
6. *Gasket*
7. *Screw*
8. *Washer*
9. *Screen*
10. *Rectangular ring*
11. *Distributing cover*
12. *Gasket*
13. *Sleeve*
14. *Rectangular ring (height adjusting ring)*

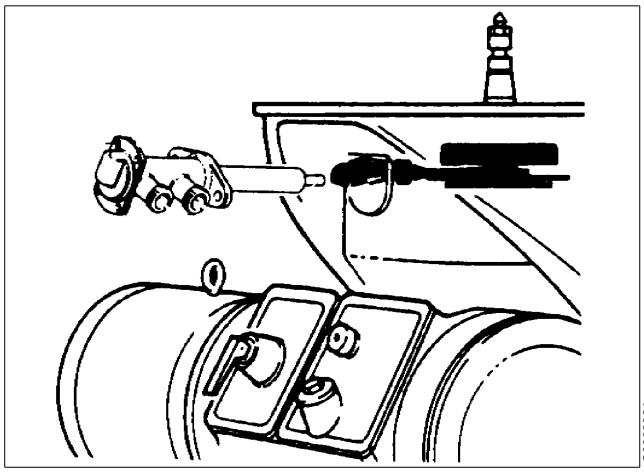


Operating device

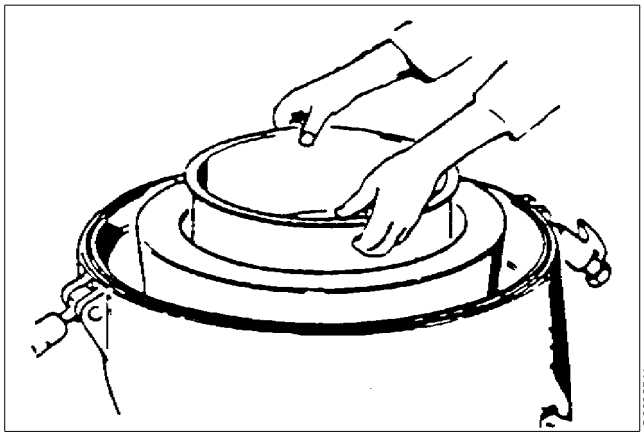


6.5.2 Dismantling

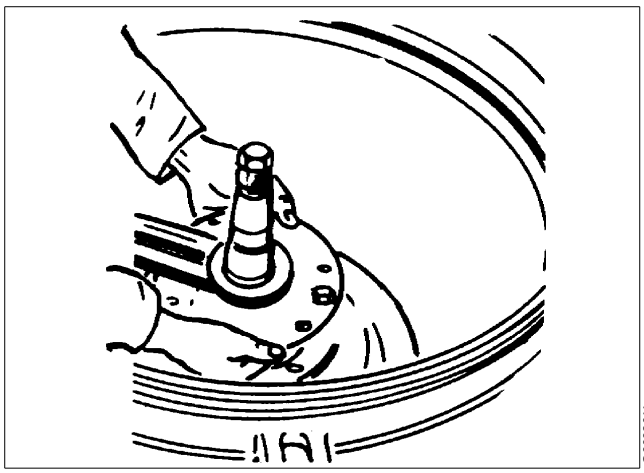
1. Remove the operating device



2. Remove the screen



3. Ease off the ring nut. Remove the distributing cover together with the paring disc device.
4. Dismantle the parts in the sequence appearing from the exploded view.
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 86.
6. Check the parts for damage and corrosion.

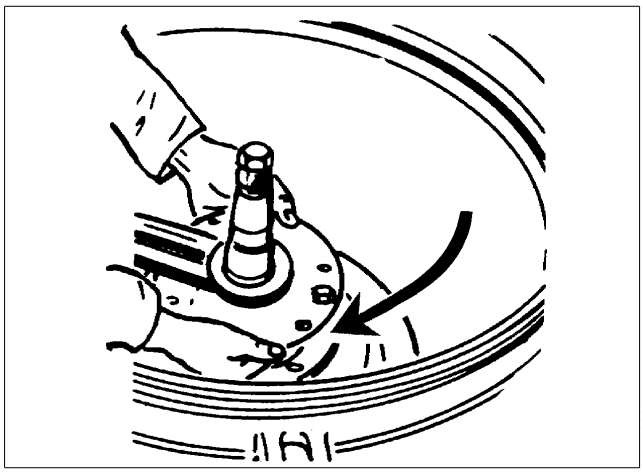


6.5.3 Assembly

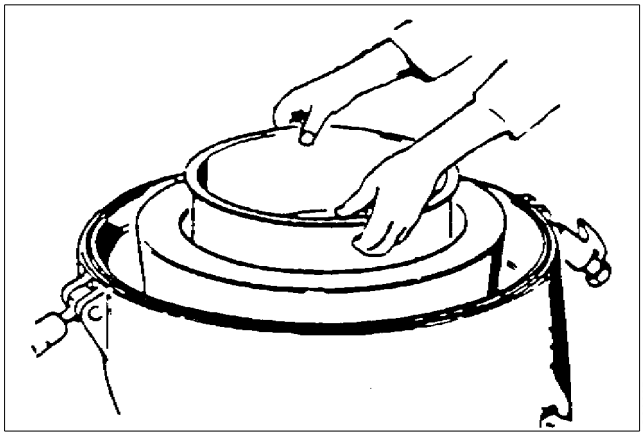
1. Assemble the parts to the distributing cover in the sequence appearing from the exploded view.

   Ensure the parts are placed in positions defined by guides.

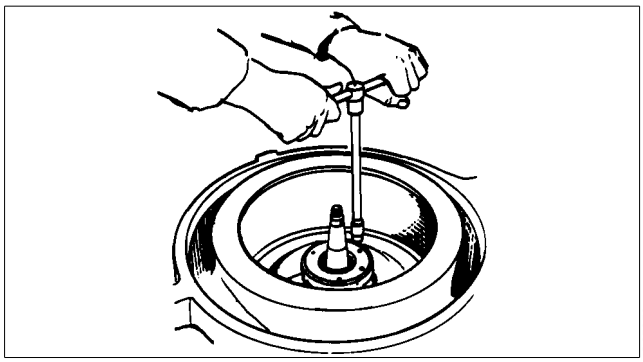
2. Fit the distributing cover with the paring disc assembly and the height adjusting ring (see arrow). Do not tighten the screws until the operating device has been fitted.



3. Fit the screen.

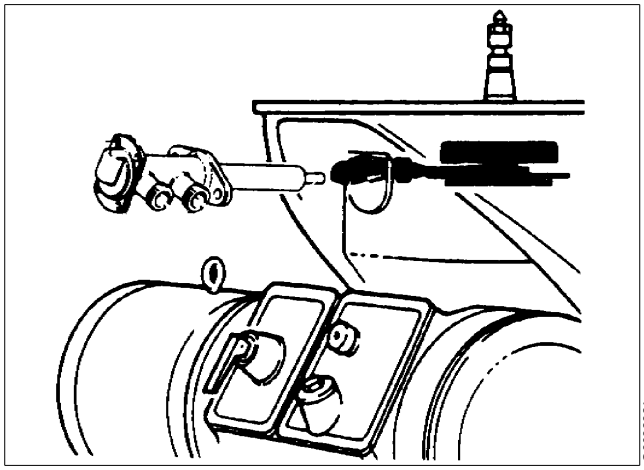


4. Fasten the distributing cover.



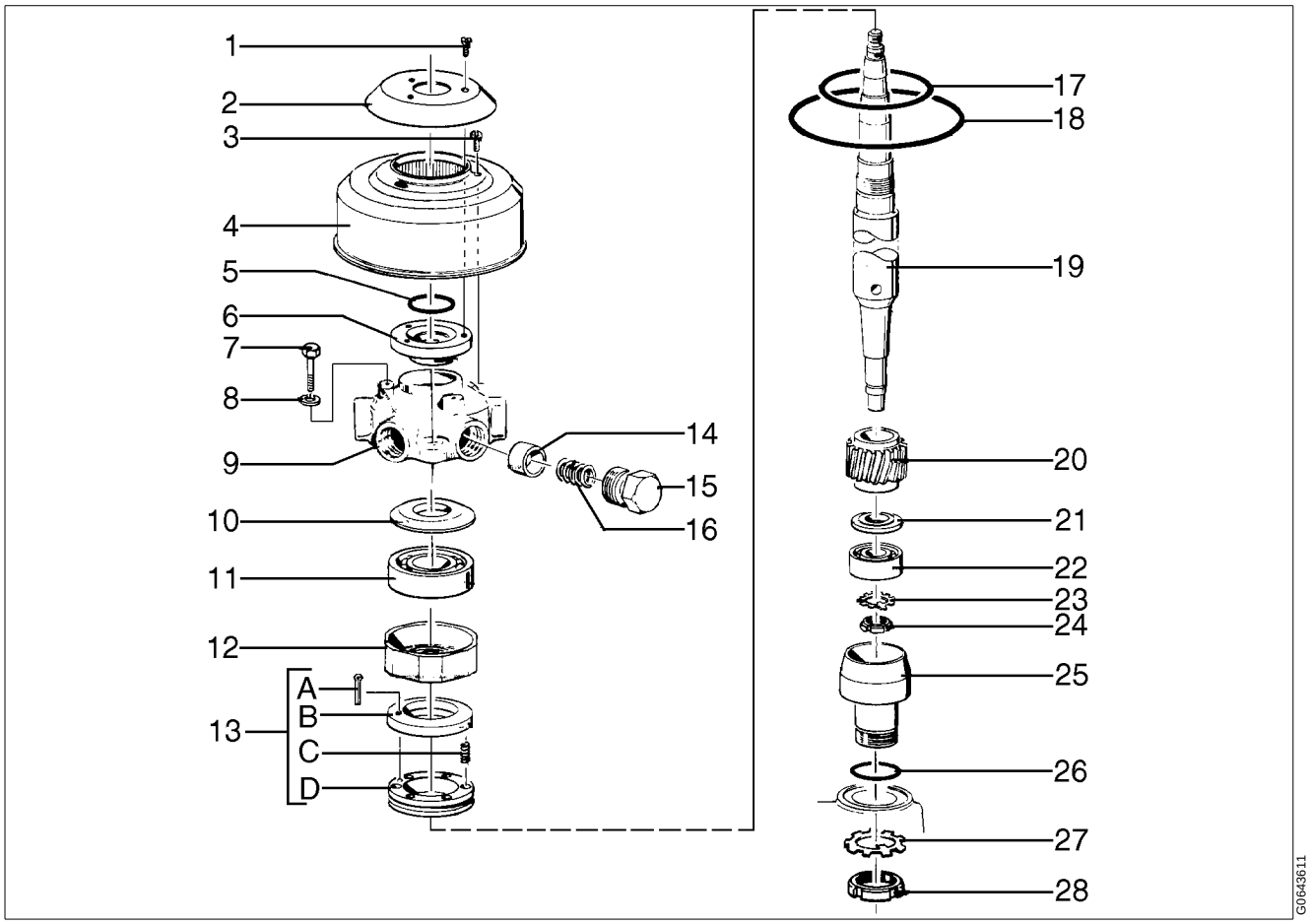
✔ **Check point**
"5.4.19 Control paring disc device; height position" on page 83.

5. Fit the operating device.



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*

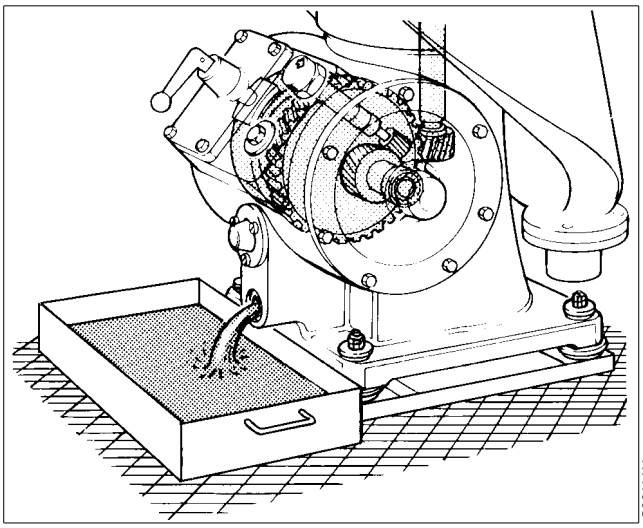
28. *Round nut*

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.



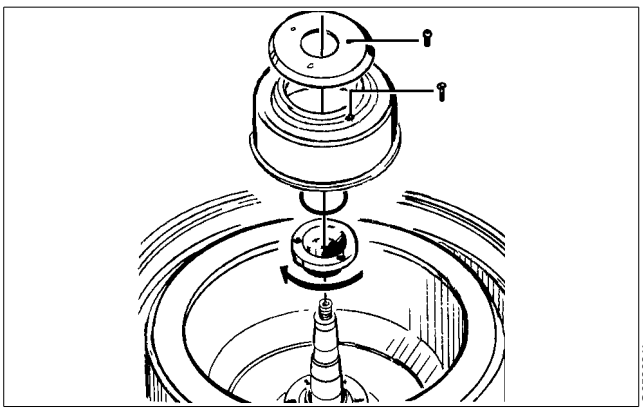
CAUTION

Burn hazards

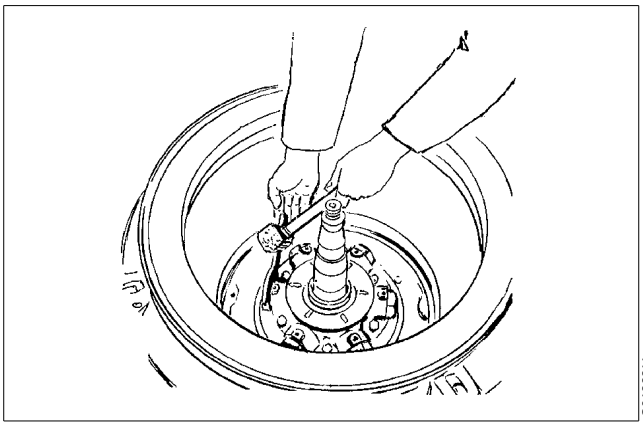
The lubricating oil and various machine surfaces can be hot and cause burns.

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.

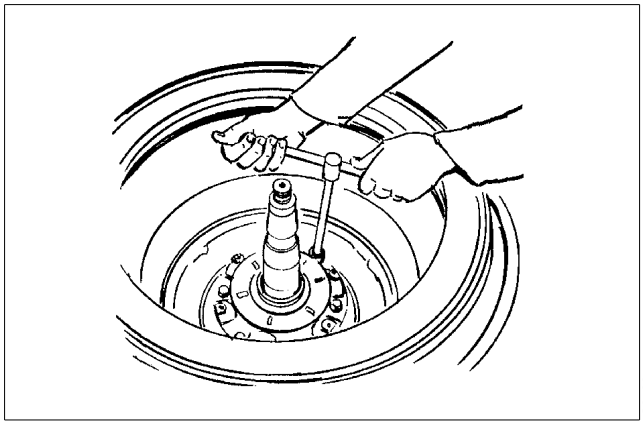
   Left-hand thread!



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



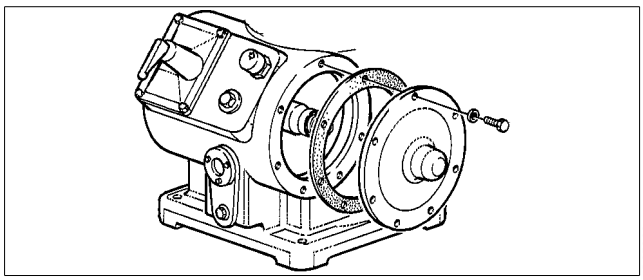
5. Unscrew the screws of the spring casing.



6. Remove the bearing shield/built-on pump:

Separator with no built-on pump

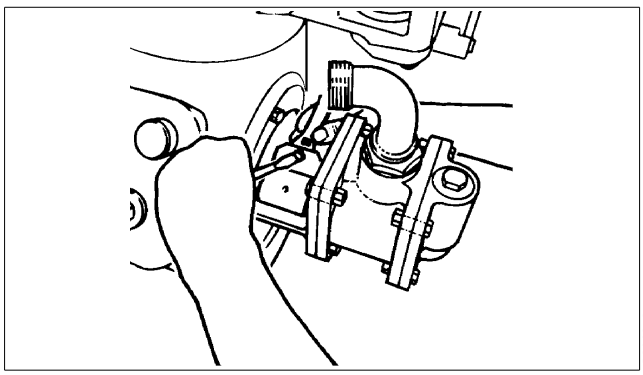
a. Remove the bearing shield and gasket.



Separator with built-on pump

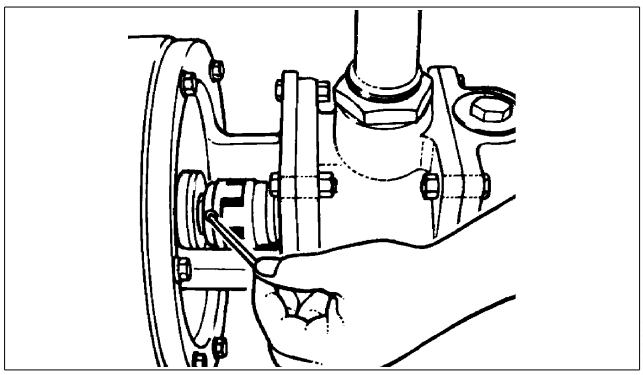
a. Remove the pipe connections from the pump.

b. Remove the sleeve halves over the coupling.

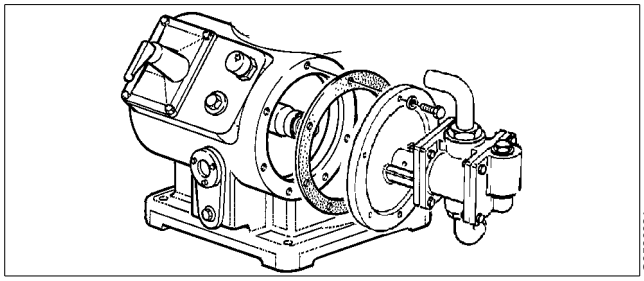


c. Loosen. but do not remove the stop screw positioned in the coupling half nearest the separator frame. Use a hexagon wrench.

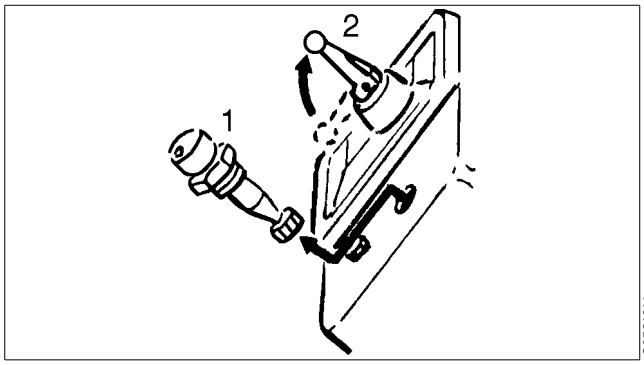
   Turn the coupling drum by hand until the stop screw is in a convenient position.



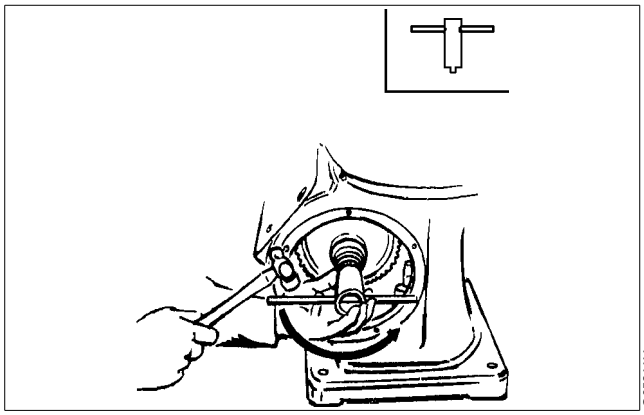
d. Remove the pump assembly and gasket.



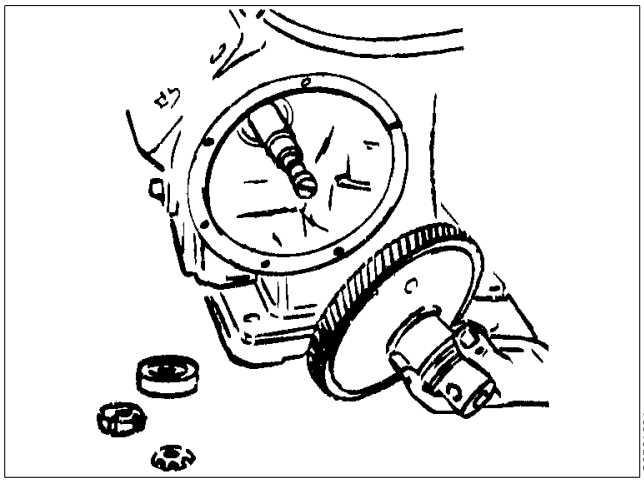
7. Remove the revolution counter (1). Apply the brake (2).



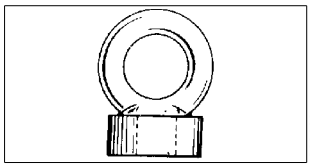
8. Remove the round nut and lock washer at the worm wheel shaft.

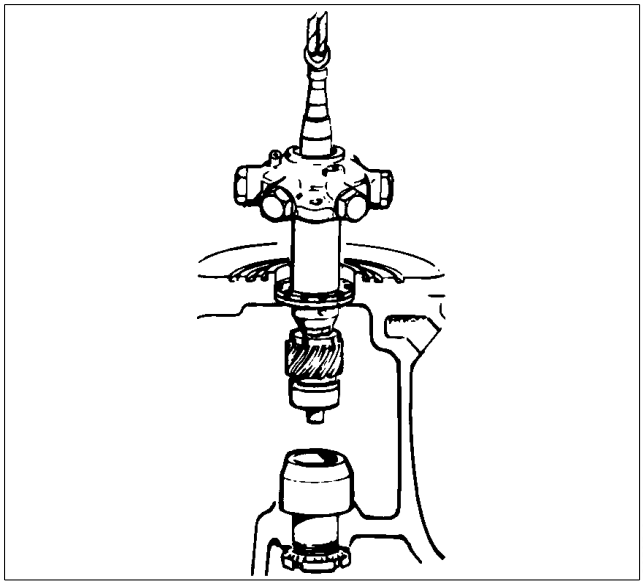


9. Remove the ball bearing and worm wheel fitted on the shaft.



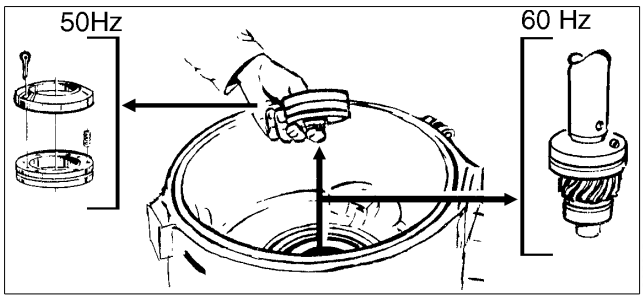
10. Lift out the bowl spindle by using the special lifting tool.



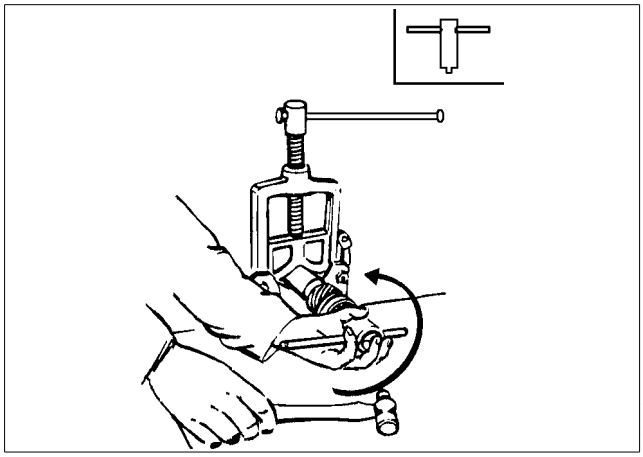


11. **50 Hz** separator: Remove the axial buffer from the frame.

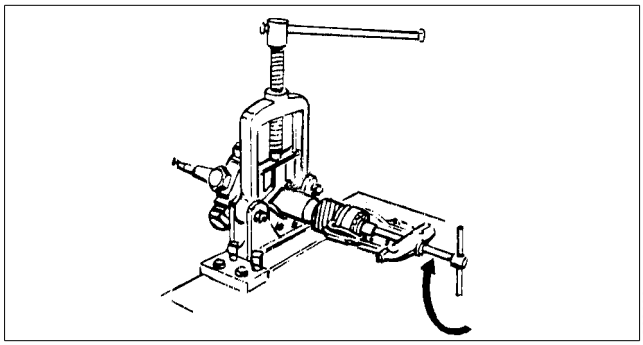
    60 Hz separator: The buffer can be removed from the spindle after the worm has been knocked off, see following text.



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.

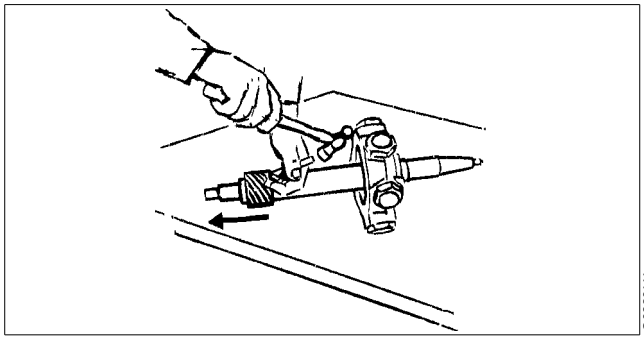


14. Pull off the ball bearing together with the spacing washer.

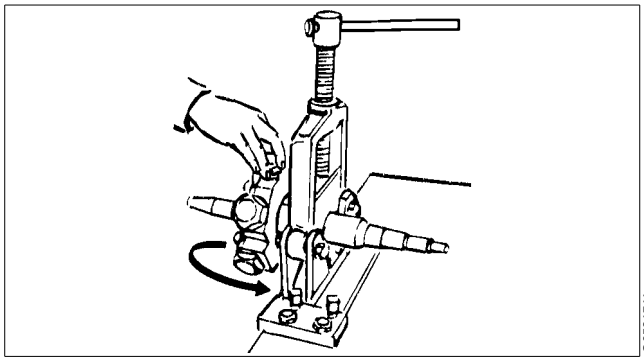


15. Knock off the worm by using a hammer and a **soft** drift.

16. **60 Hz** separator: Remove the axial buffer.

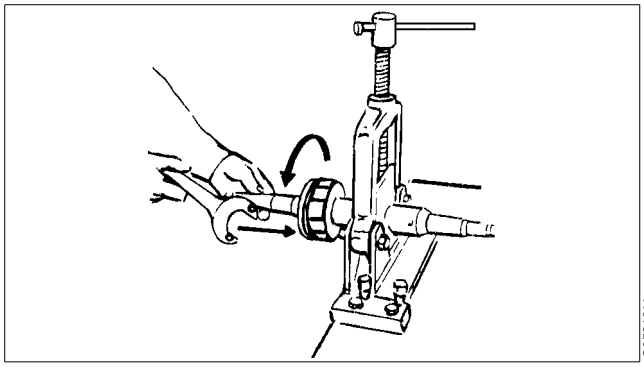


17. Remove the screw plugs, springs and buffers. Then remove the spring casing.

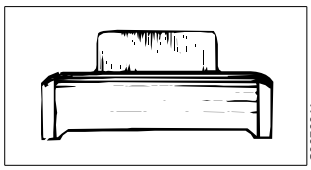


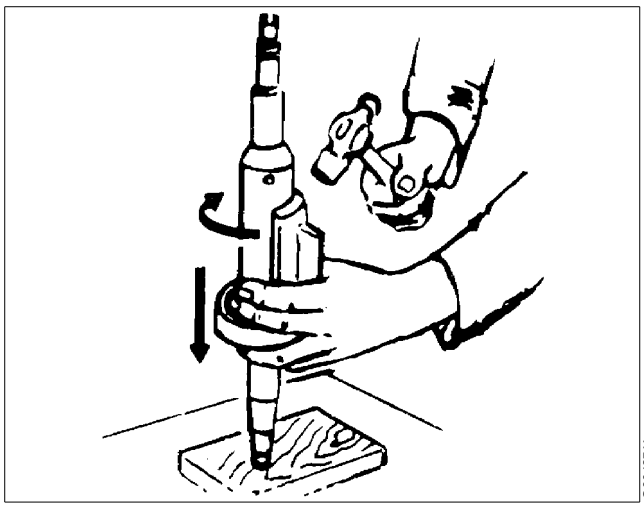
18. Unscrew the deflector and remove the ball bearing housing.

    Left-hand thread!



19. Knock off the ball bearing.





20. Clean all dismantled parts thoroughly in a degreasing agent and check for damage and corrosion.

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 74.

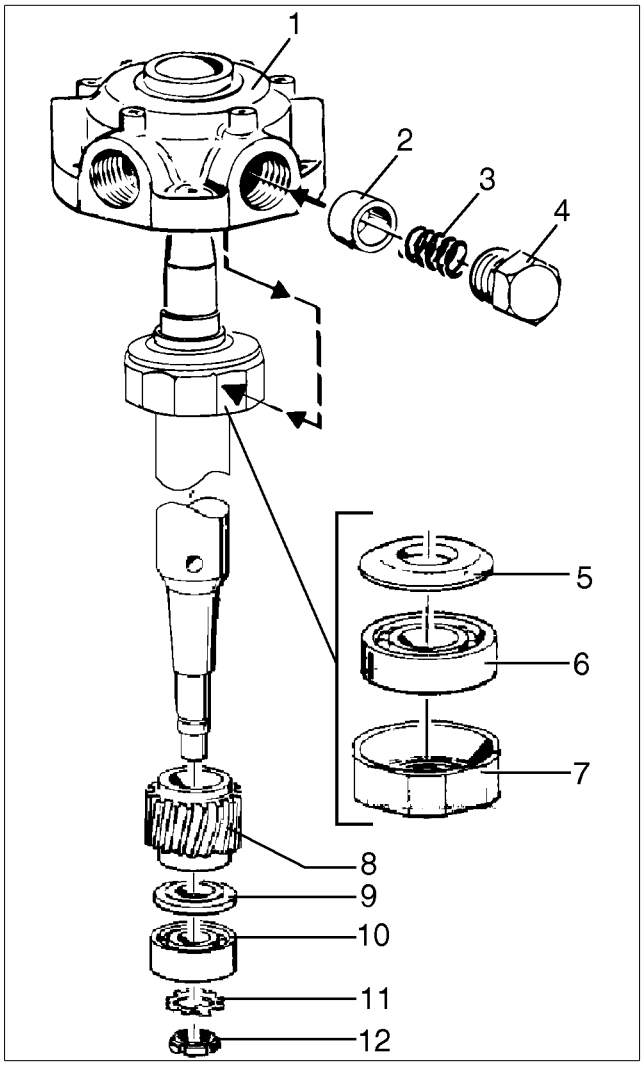
1. Mount the upper ball bearing (6) onto the spindle. Make sure it enters its seat.
2. Fit the bearing housing (7) and tighten the deflector (5).

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

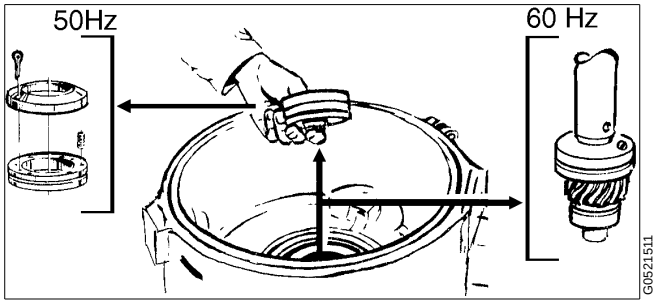
   Make sure the buffers come to rest against the flats of the ball bearing housing.

   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).

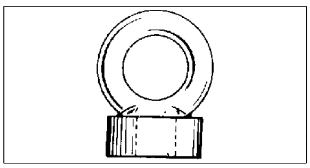


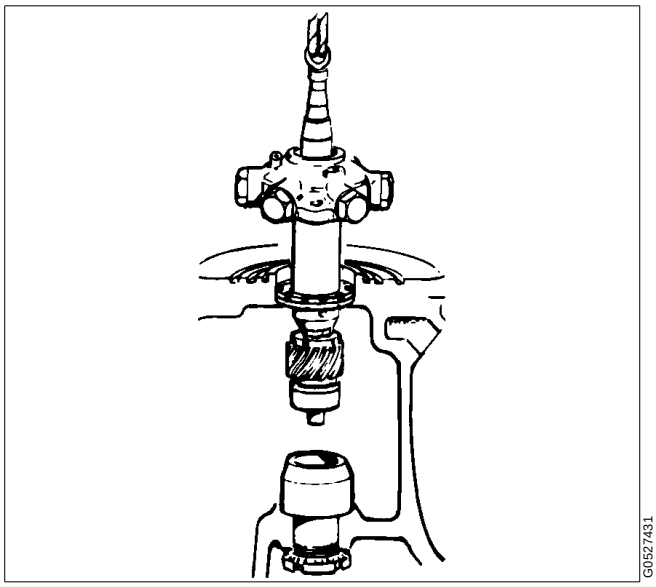
6. For **50 Hz** separators, fit the axial buffer in the frame.



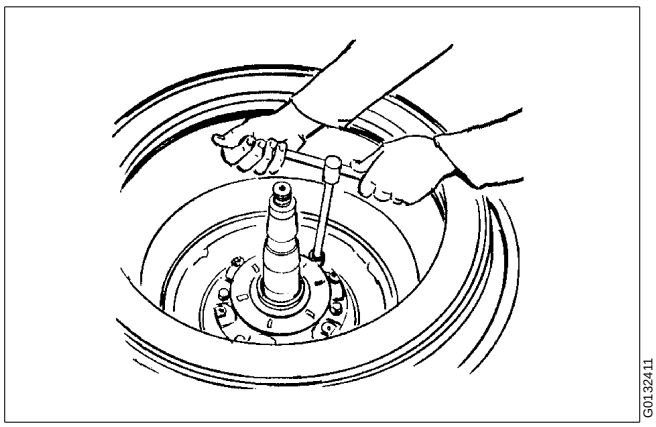
7. Carefully lower the spindle into the frame.

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

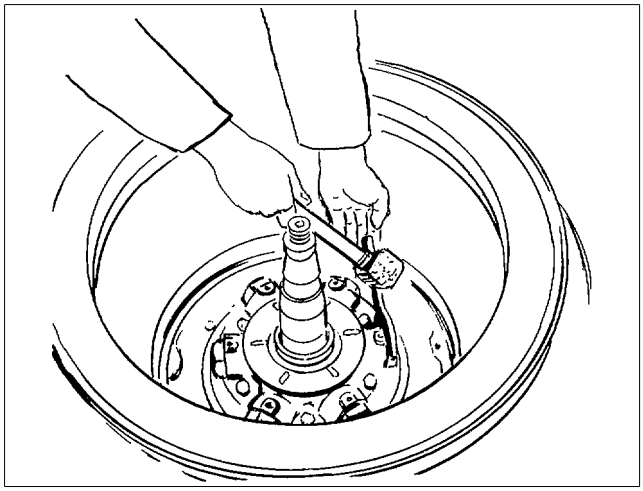




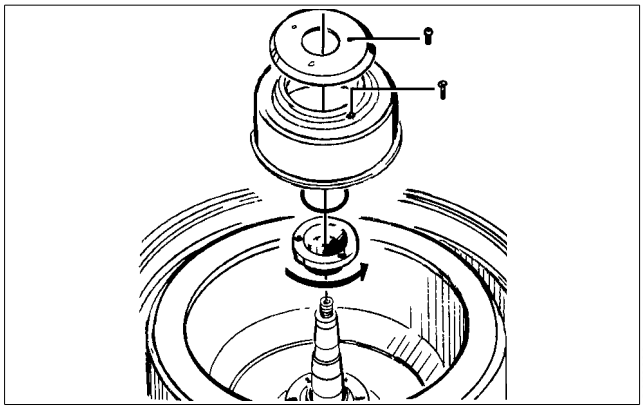
8. Tighten the screws of the spring casing.



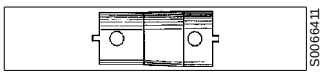
9. Tighten the buffer plugs.

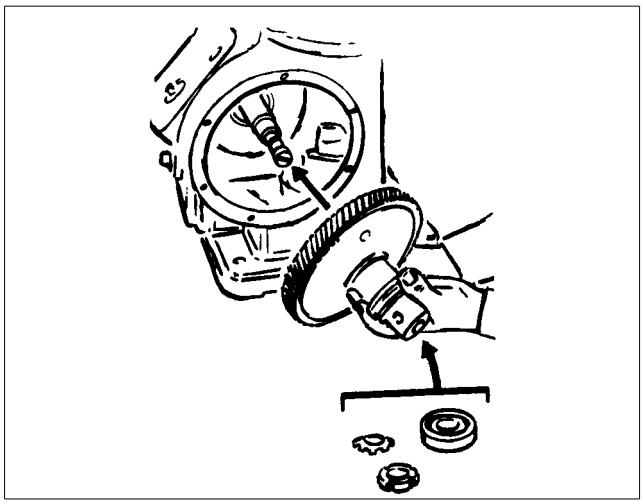


10. Screw the protecting collar onto the spindle.
    Left-hand thread!
    Fit its O-ring, guard and protecting plate.



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



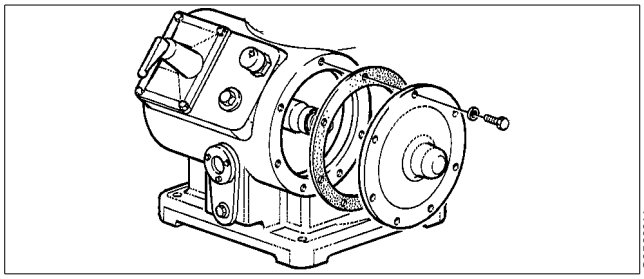


✔ **Check point**
“5.4.24 Worm wheel shaft; radial wobble” on page 84,
“5.4.3 Bowl spindle; radial wobble” on page 72.

13. Fit the revolution counter.
14. Fit the bearing shield/built-on pump:

Separator with no built-on pump

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



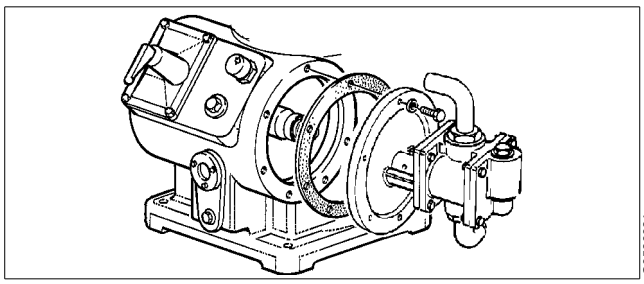
Separator with built-on pump

a. Check that the key for the pump coupling half is fitted in the keyway in the worm wheel shaft.

b. Fit the gasket and pump assembly.

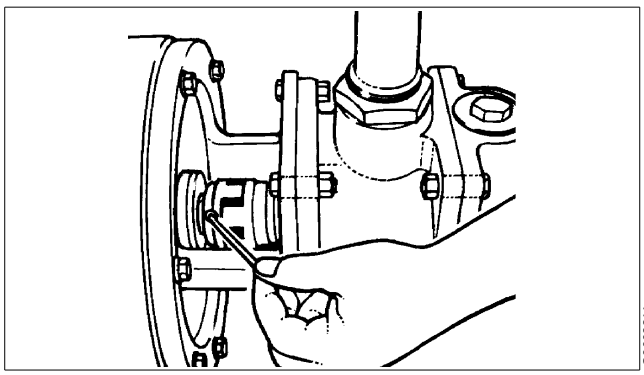
   Be careful that the lipseal ring is not damaged by the shaft end and by the key in shaft.

   Check that the key is facing the keyway in the coupling half.



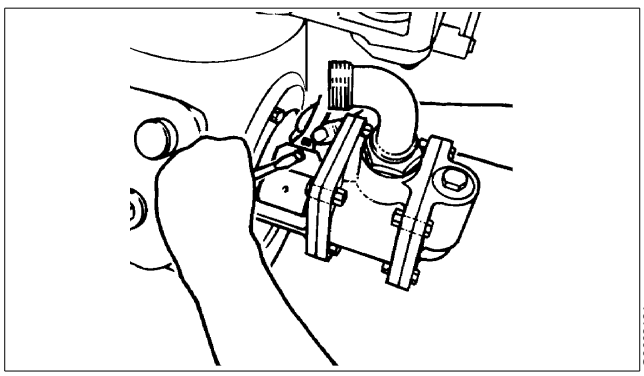
c. Check that the clearance on each side of the coupling flexible element is **2 mm**.

   Tighten the stop screw in the coupling half with a hexagon wrench. Check that the holders for the lipseal rings are located so that the sleeve halves can easily be fitted.



d. Mount the sleeve halves over the coupling.

e. Refit the pump connections.



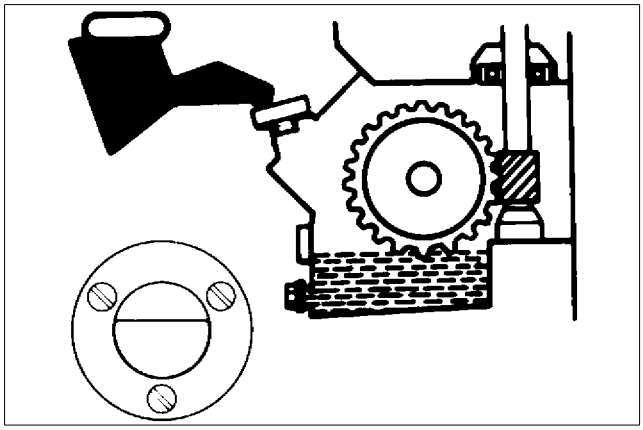
15. Pour oil into worm gear housing. The oil level should be slightly above the middle of the sight glass.

    For correct oil volume, see chapter “8.1 Technical data” on page 170.

    For recommended oil brands, see chapter “8.5.3 Recommended oil brands” on page 183.

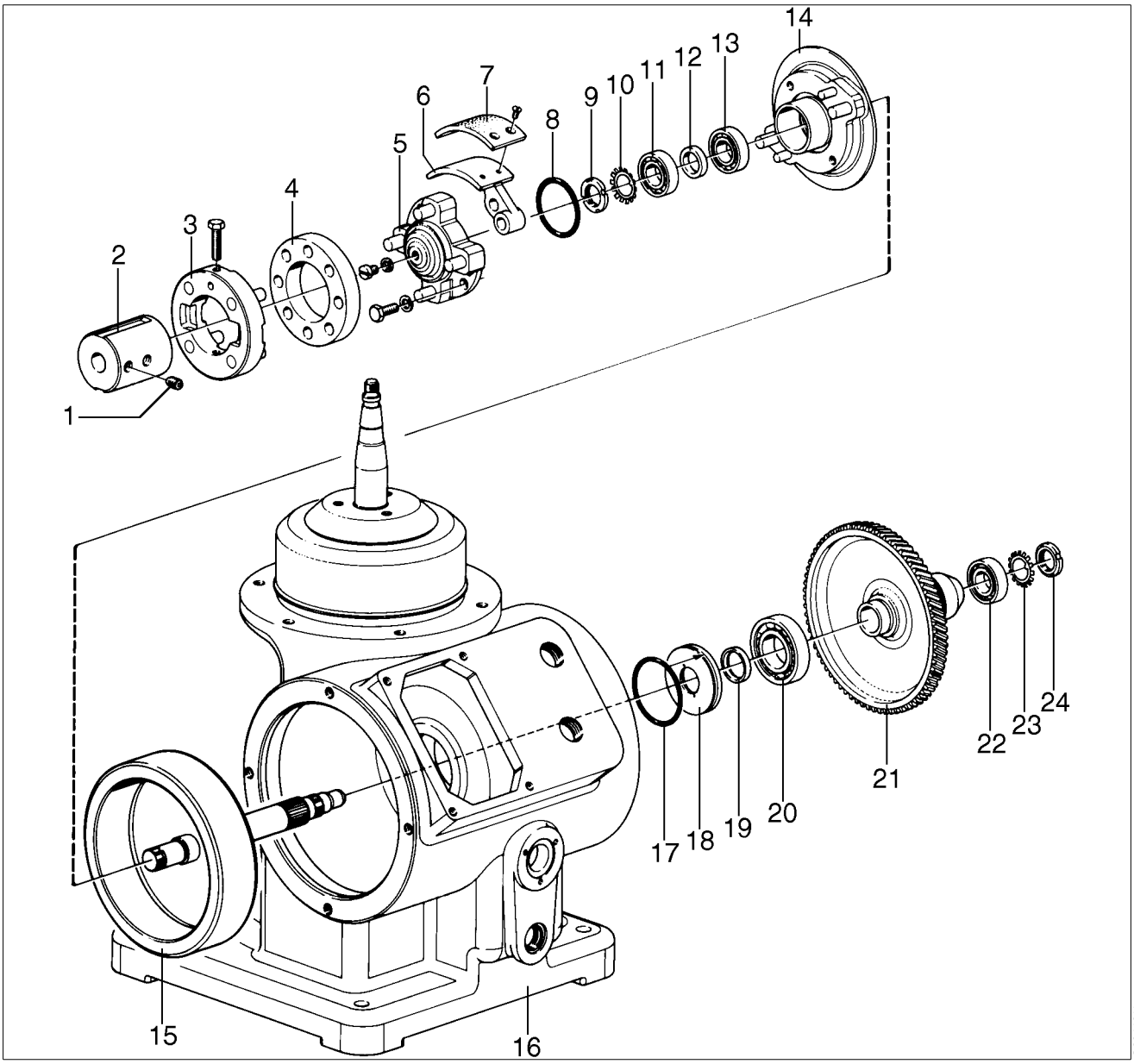
✔ **Check point**

“5.4.4 Brake” on page 73.



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

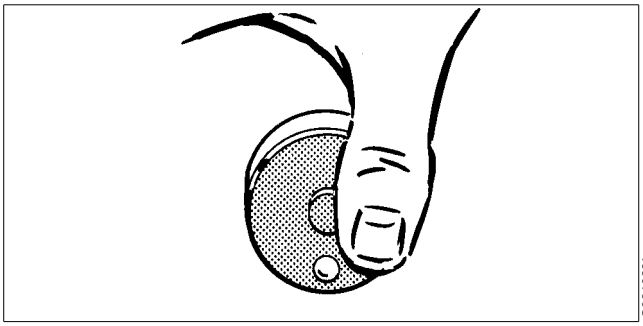
DANGER

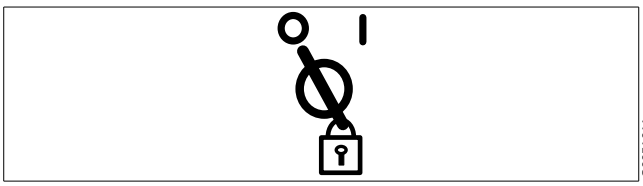
Entrapment hazards

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

   The revolution counter and the motor fan indicate 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.

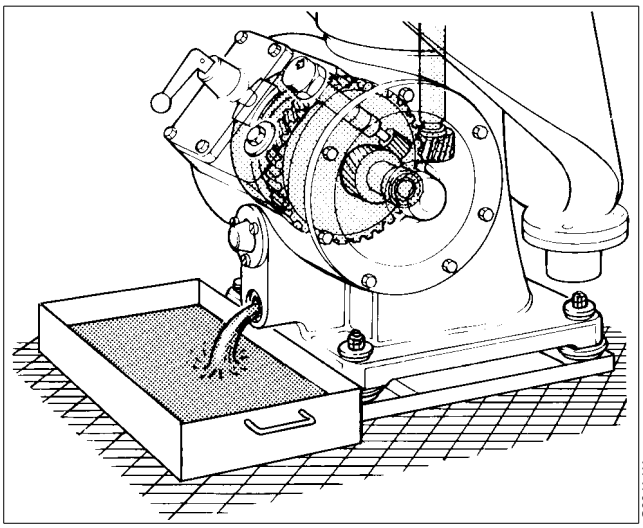
If the bowl spindle has been removed according to earlier description, points 1-5 below are already done. In this case proceed with point 6.

1. Drain the oil from the worm gear housing.

CAUTION

Burn hazards

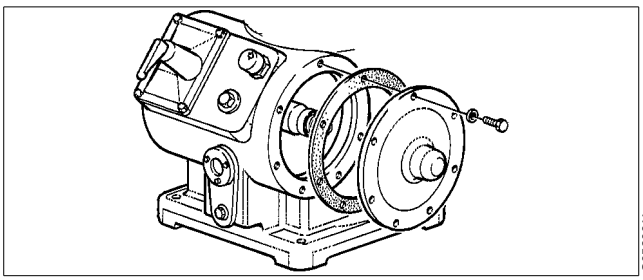
The lubricating oil and various machine surfaces can be hot and cause burns.



2. Remove the bearing shield/built-on pump:

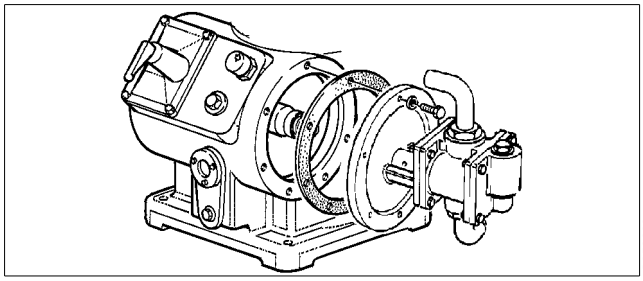
   Separator with no built-on pump

   a. Remove the bearing shield and gasket.

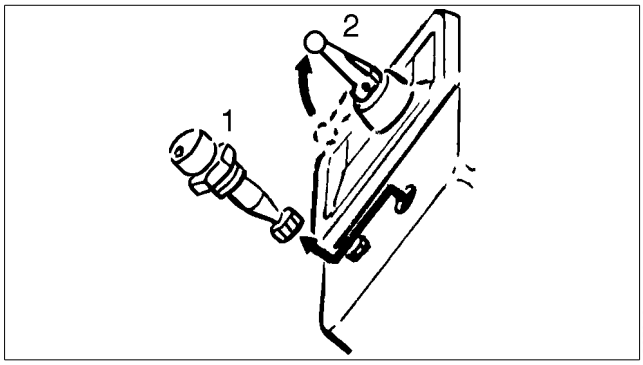


Separator with built-on pump

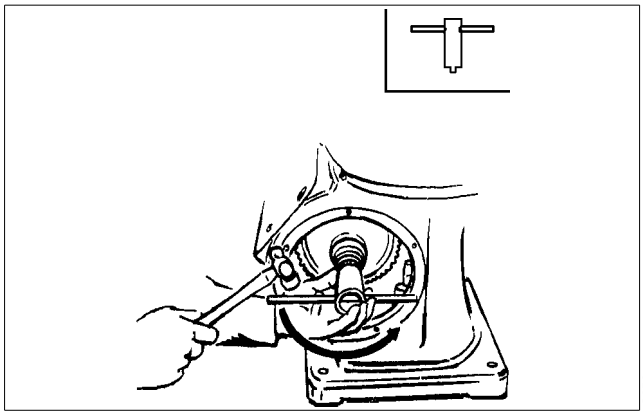
a. Remove the pump assembly. See the dismantling instructions for the vertical driving device on page 129 for a detailed description.



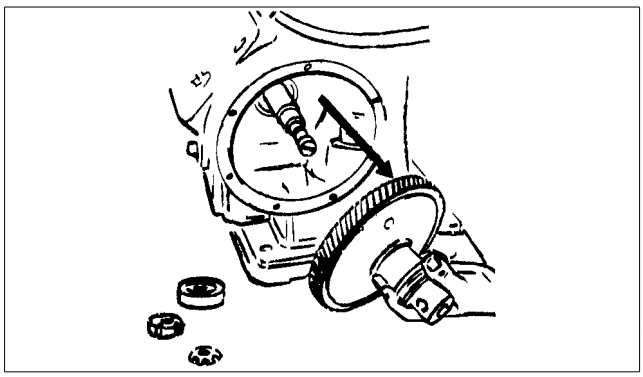
3. Remove the revolution counter (1).
   Apply the brake (2).



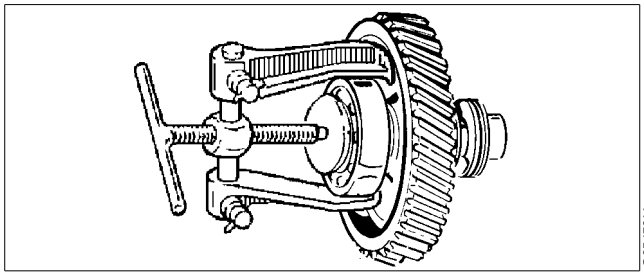
4. Remove the round nut and lock washer at the worm wheel shaft.



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

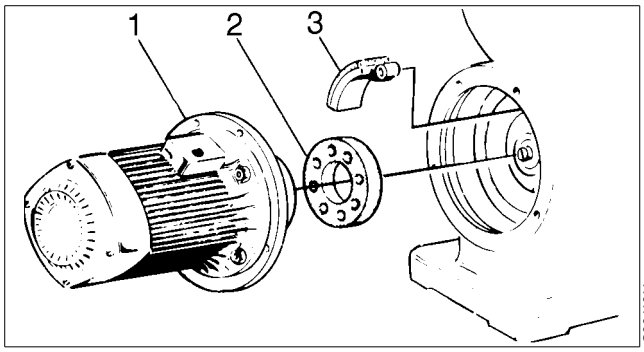


6. Pull off the ball bearing from the worm wheel. Use a washer as a support for the puller.

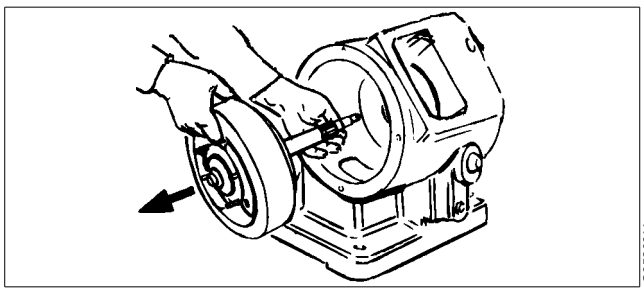


7. Remove:
   - the electric motor (1)
   - the elastic plate (2)
   - the friction blocks (3).

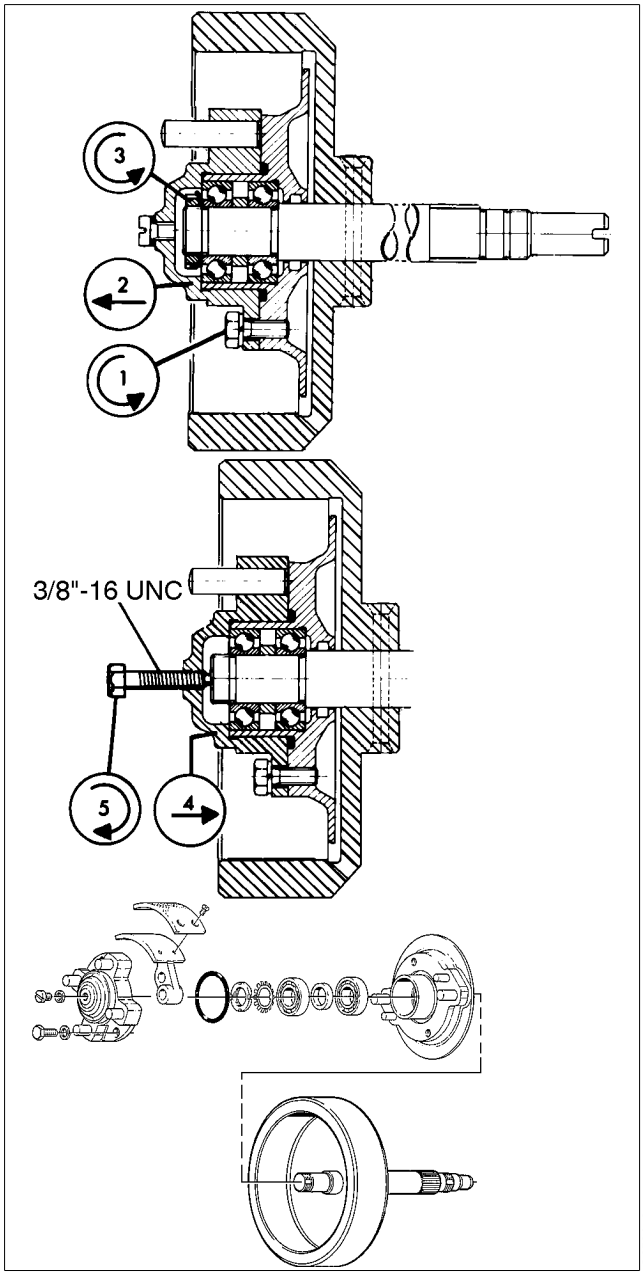
   If disconnecting the motor cables, note the positions of cables in the terminal box to reconnect correctly (for correct direction of rotation).



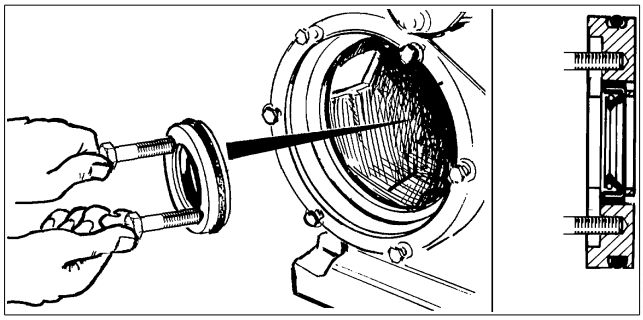
8. Lift out the worm wheel shaft.



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).

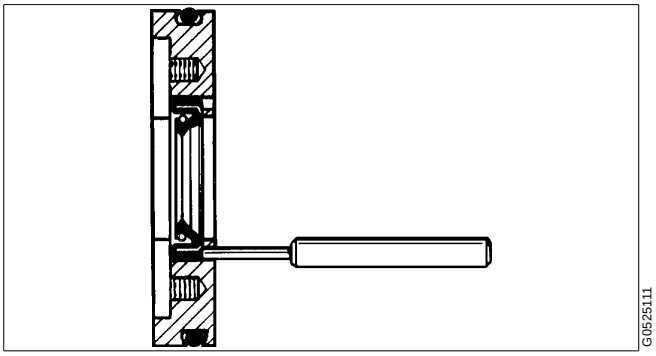


10. Remove the sealing washer using two screws with threads 1/4” - 20 UNC.



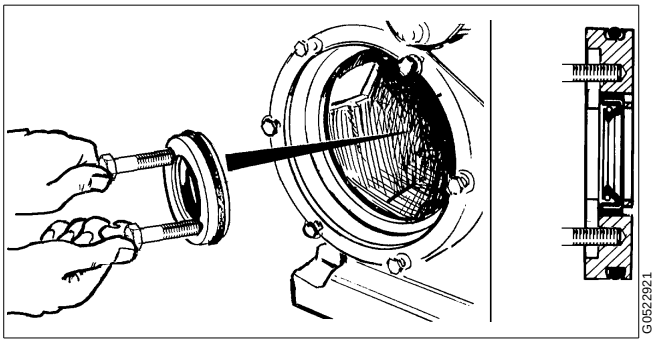
11. Remove the seal ring by using a drift.

12. Remove deposits and clean all parts thoroughly in a suitable cleaning agent. See chapter ‘‘5.6 Cleaning” on page 86.



6.7.3 Assembly

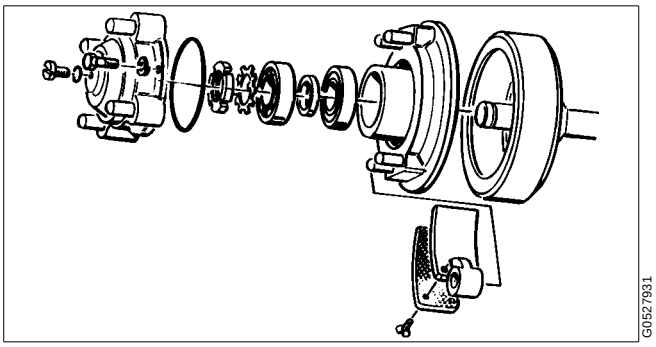
1. Lubricate the O-ring on the sealing washer periphery and the sealing ring with silicone grease. Fit the sealing washer in the frame and check that the seal ring is fitted in the correct direction, as illustrated.

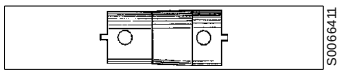


✔ **Check point**
‘‘5.4.6 Coupling friction pads” on page 75.

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.

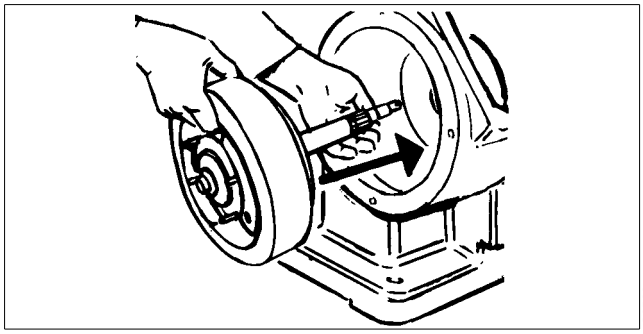
3. Fit the nave, bearings and spacing ring, lock washer and the round nut.





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

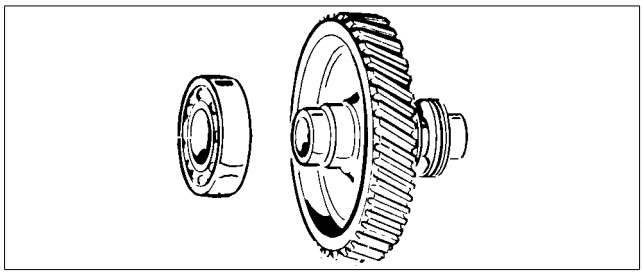
5. Fit the worm wheel shaft.



NOTE

Before fitting the worm wheel, mount the bowl spindle into the separator frame if removed.

✔ **Check point**
"5.4.23 Worm wheel and worm; wear of teeth" on page 83.



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.

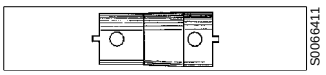
NOTE

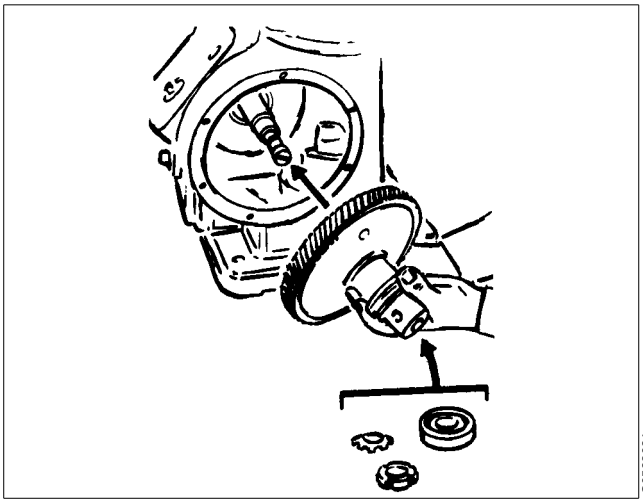
If any doubt how to mount roller bearings in a correct way, see the detailed description in chapter "5.9.1 Ball and roller bearings" on page 94.

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 133.

7. Fit the worm wheel with ball bearing onto the shaft. Match the worm wheel with the teeth on the worm of the bowl spindle.

8. Fit the ball bearing and lock washer onto the shaft and tighten the round nut.





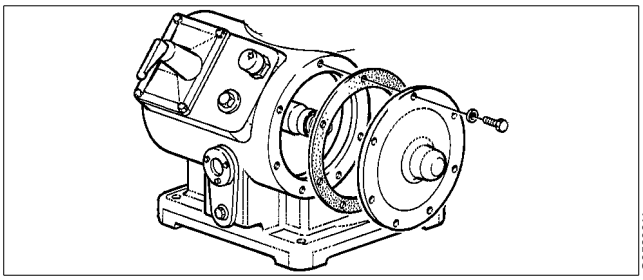
✔ **Check point**
‘‘5.4.24 Worm wheel shaft; radial wobble” on page 84,
‘‘5.4.3 Bowl spindle; radial wobble” on page 72.

9. Fit the revolution counter.

10. Fit the bearing shield/built-on pump:

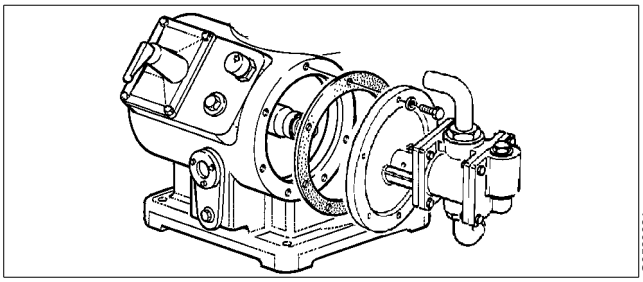
Separator with no built-on pump

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



Separator with built-on pump

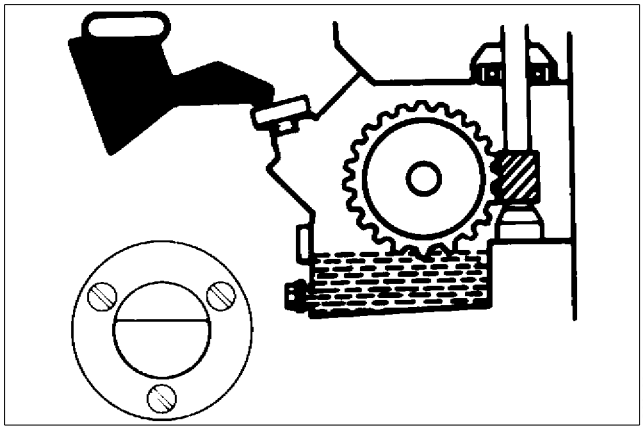
a. Fit the gasket and pump assembly. See the assembly instructions on page 136 for a detailed description.



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

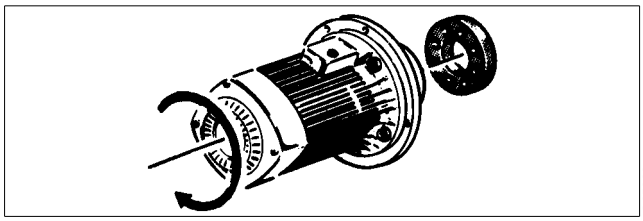
    For correct oil volume, see chapter “8.1 Technical data” on page 170.

    For recommended oil brands, see chapter “8.5.3 Recommended oil brands” on page 183.



✔ **Check point**
“5.4.4 Brake” on page 73.

12. Fit the elastic plate.



✔ **Check point**
“5.4.11 Elastic plate in coupling” on page 77.

13. Fit the electric motor.

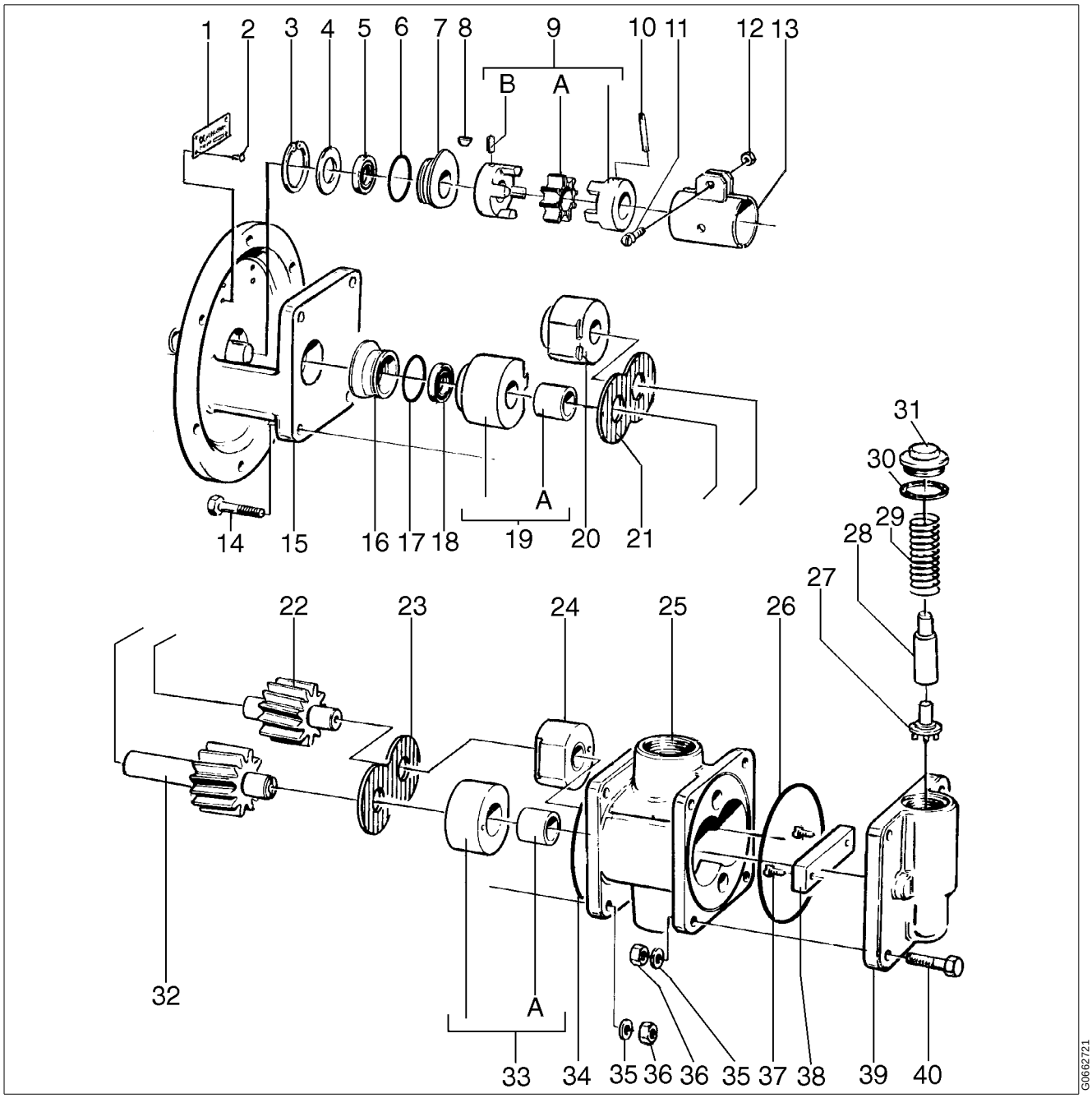
DANGER

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.

6.8 Built-on oil feed pump

6.8.1 Exploded view

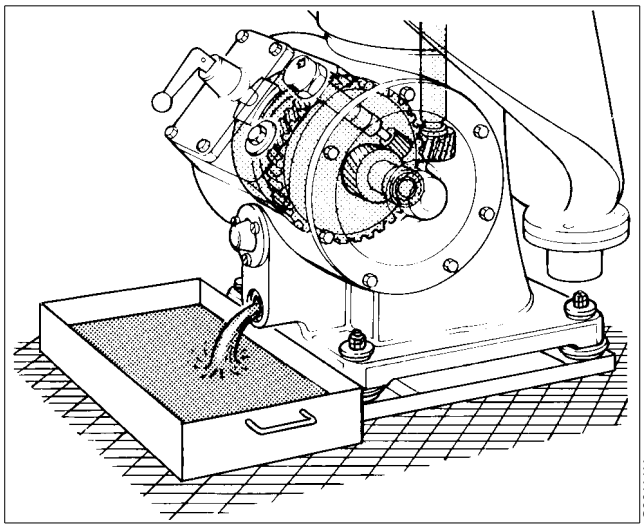


1. *Plate*
2. *Drive screw*
3. *Snap ring*
4. *Washer*
5. *Seal ring*
6. *O-ring*
7. *Sleeve*
8. *Key*
9. *Flexible coupling*
   - *9A. Tooth rim (flexible element)*
   - *9B. Stop screw*
10. *Tubular spring pin*
11. *Screw*
12. *Nut*
13. *Sleeve half*
14. *Screw*
15. *Bearing shield*
16. *Sleeve*
17. *O-ring*
18. *Seal ring*
19. *Bearing*
    - *19A. Bushing*
20. *Bearing*
21. *Wear gasket*
22. *Impeller*
23. *Wear gasket*
24. *Bearing*
25. *Pump housing*
26. *O-ring*
27. *Valve cone*
28. *Guide pole*
29. *Spring*
30. *Gasket*
31. *Cover*
32. *Impeller*
33. *Bearing*
    - *33A. Bushing*
34. *O-ring*
35. *Washer*
36. *Nut*
37. *Screw*
38. *Spacer*
39. *Shield*
40. *Screw*

6.8.2 Dismantling

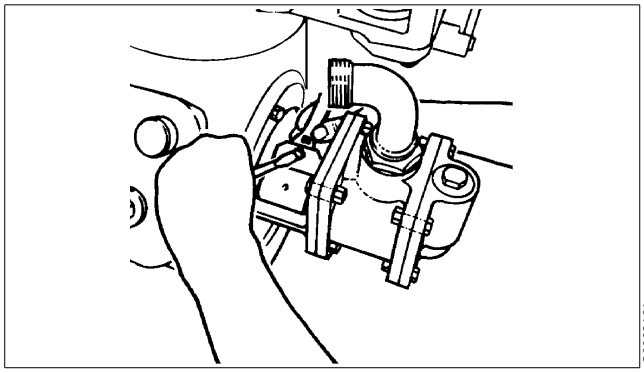
The oil feed pump should be dismantled for inspection of parts with respect to wear and cavitation damage.

1. Drain the oil from the worm gear housing.



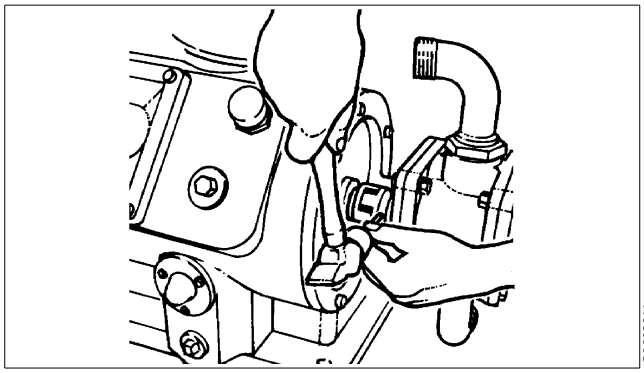
> **CAUTION**
>
> **Burn hazards**
>
> Lubricating oil and various machine surfaces can be hot and cause burns.

2. Remove the pipe connections from the pump.
3. Remove the sleeve halves over the coupling.

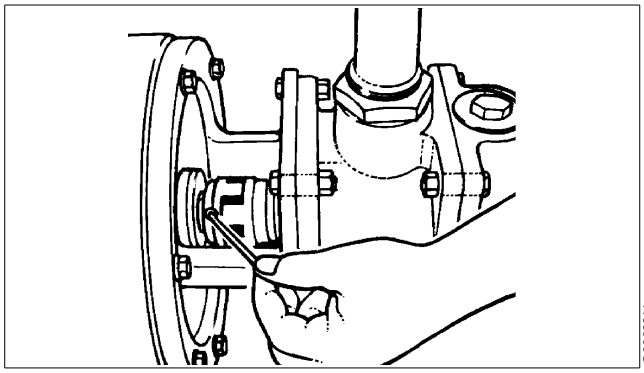


4. Drive out the tubular spring pin, positioned in the coupling half nearest the pump.

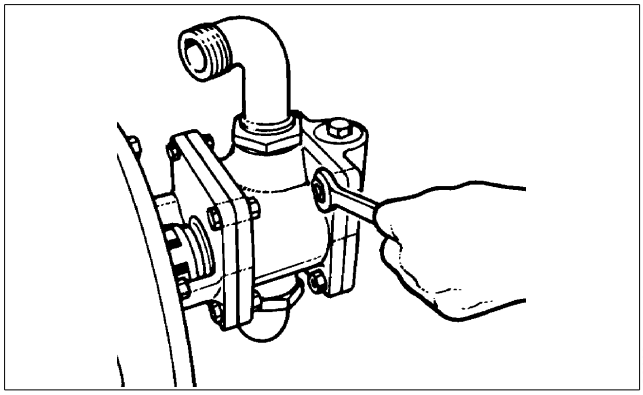
   Turn the coupling drum by hand until the pin is in a convenient position.



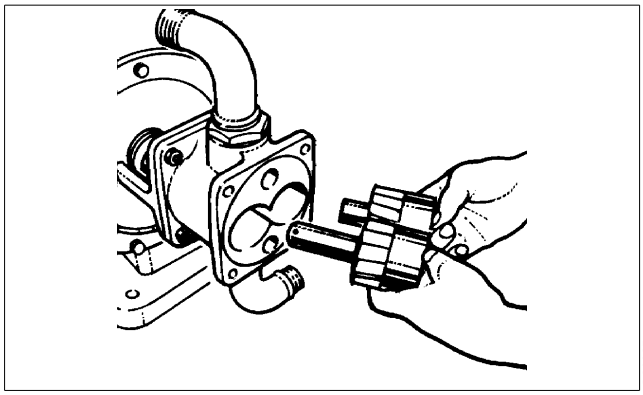
5. Loosen, but do not remove the stop screw positioned in the other coupling half with a hexagon wrench.



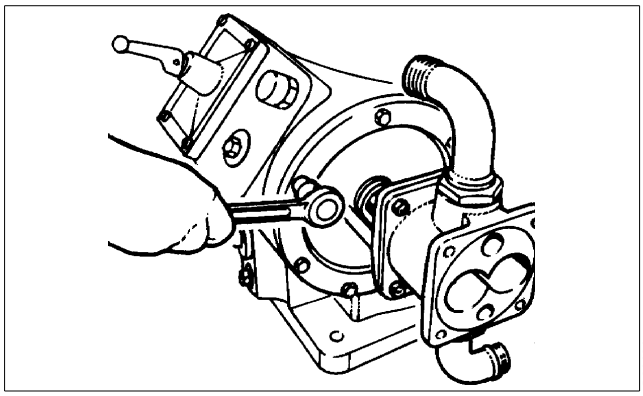
6. Undo the four screws holding the pump shield and remove the shield.



7. Insert two screws (3/8”-16 UNC) into the centre hole of the impeller shafts. Use the screws as a handle to withdraw the impellers.



8. Loosen the screws for the bearing shield, but do not remove them.
9. Remove the coupling by pulling the complete pump outwards a short distance until the coupling can be loosened from the worm wheel shaft. Take care not to damage the lipseal ring.



6.8.3 Cleaning and inspection

1. Remove deposits and clean all parts thoroughly in a suitable cleaning agent. See chapter “5.6 Cleaning” on page 86.
2. Examine following parts:

Bushings (2)

Renew the bushings if they are scratched or if there is a play between any impeller shaft and a bushing.

Impeller shafts (5)

Check the impeller shafts for grooves. Polish or renew if necessary.

Wear gaskets (3)

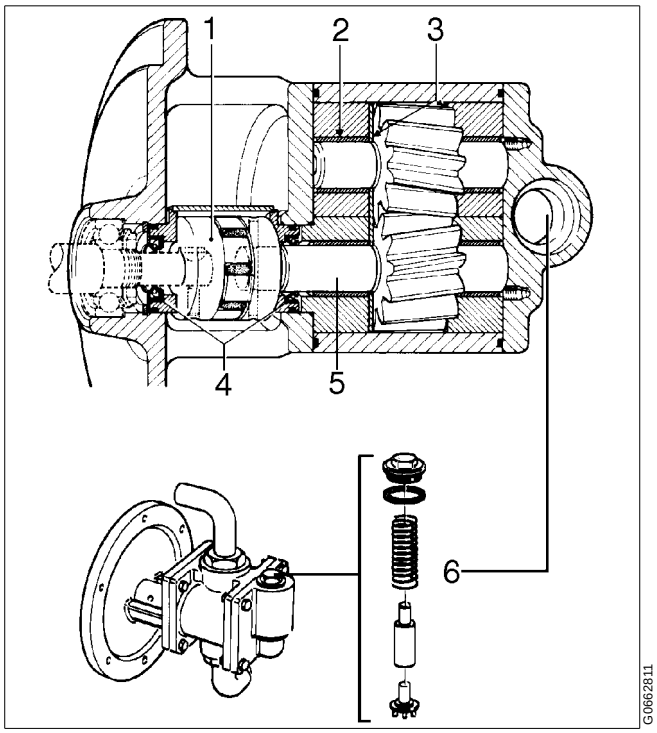
Renew the wear gaskets if any surface is rough, cracked or dented by the impellers.

Relief/safety valve (6)

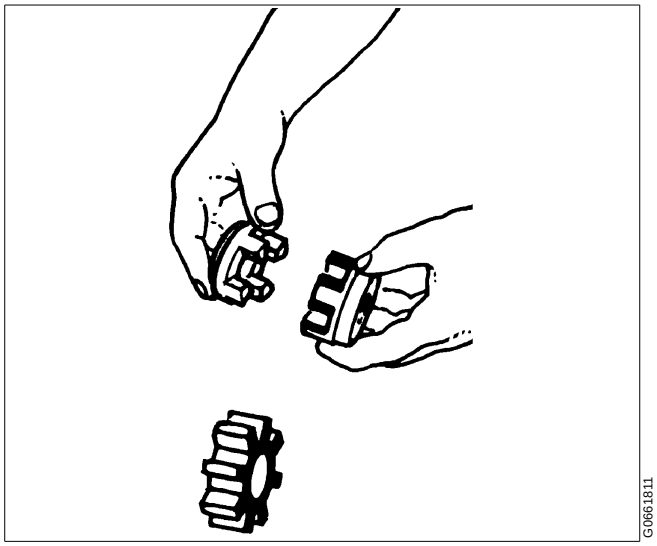
Examine the sealing surfaces on the valve cone and valve seat in the shield. Grind or renew if necessary.

Flexible coupling (1)

Dismantle and examine the coupling parts. If necessary, renew the flexible element or the complete coupling.



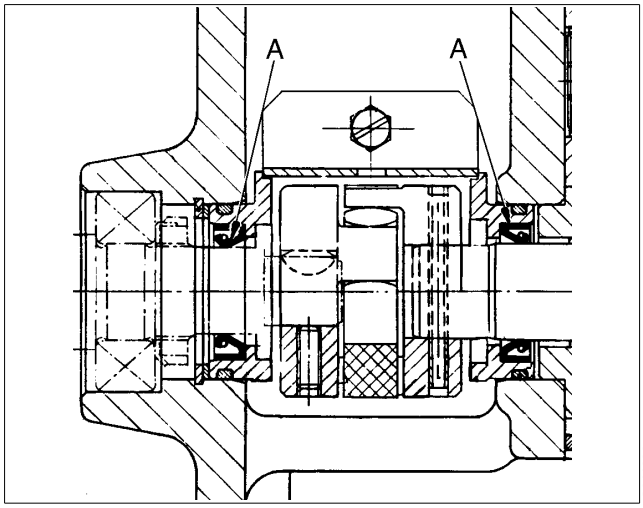
1. *Flexible coupling*
2. *Bushing*
3. *Wear gasket*
4. *Lipseal ring*
5. *Impeller shaft*
6. *Relief/safety valve*



Lipseal rings (4)

Renew the lipseal rings at MS-service.

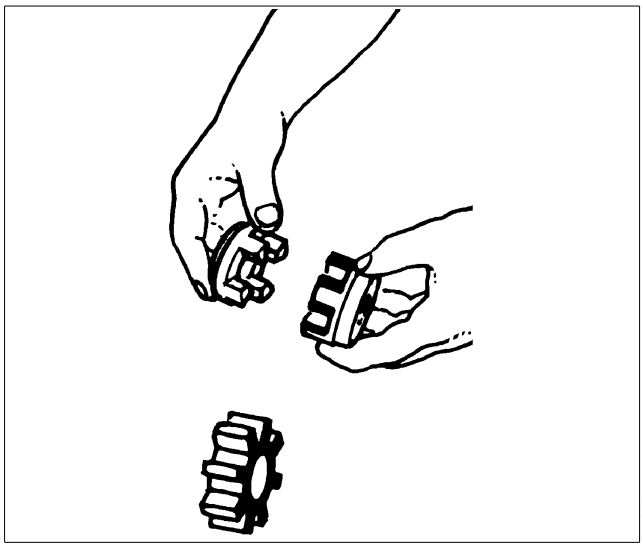
Note: Turn the rings the right way round, see pos. A in the illustration.



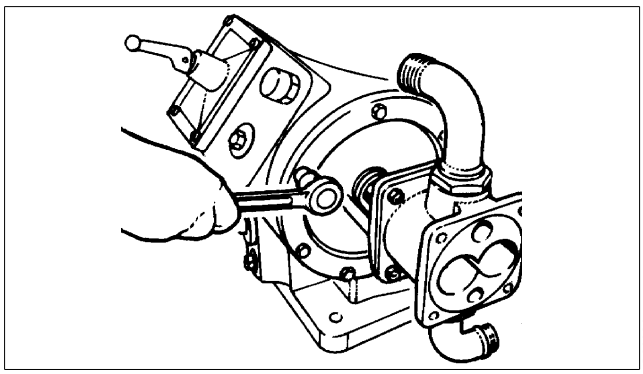
6.8.4 Assembly

1. Check that the lipseal rings are correctly mounted, see above.
2. Assemble the coupling.

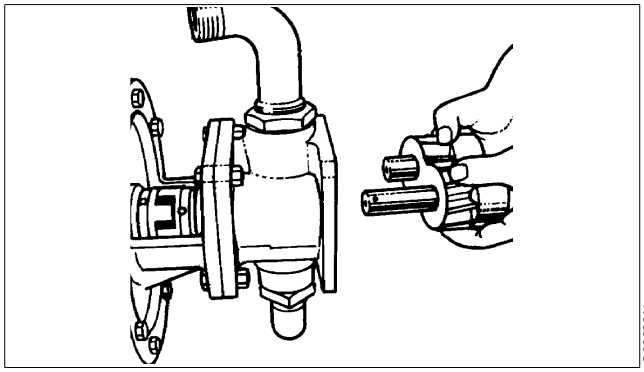
   The parts must not be pushed together too hard. The flexible element is provided with projections to ensure that the correct clearance is maintained in the coupling, and these must not be deformed.
3. Fit the coupling in position on the worm wheel shaft with the keyway facing the key.



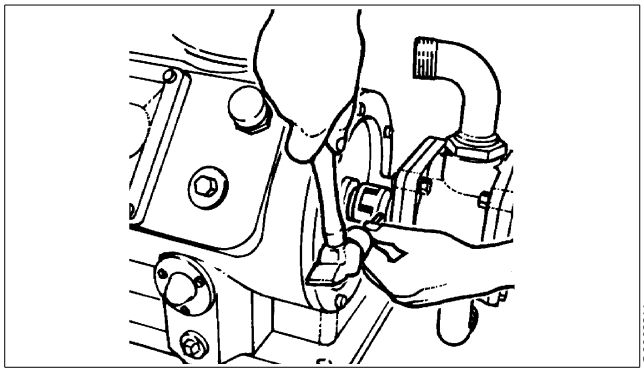
4. Tighten the bearing shield screws.



5. Refit the impellers. Check that the hole for the tubular pin is exactly opposite the corresponding hole in the coupling.



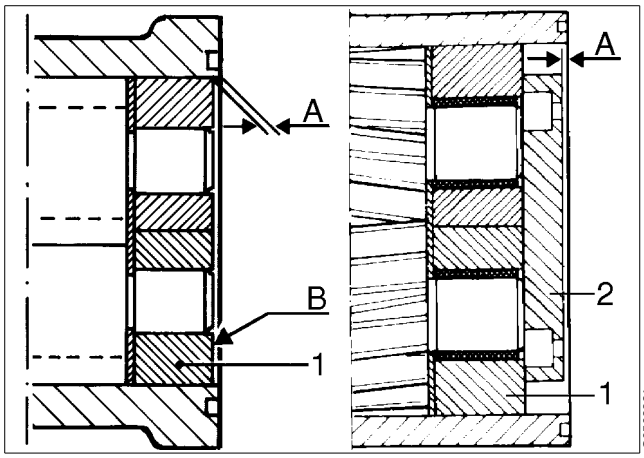
6. Drive in the tubular spring pin.



7. Check the axial play with a liner (B).

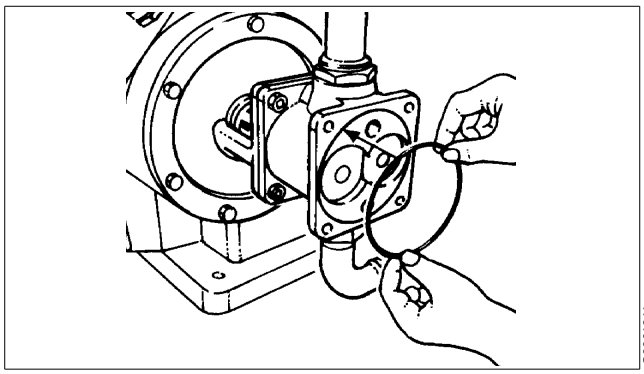
   The total axial play (A) must be **0,1 - 0,3 mm**. If the play is too large even though the wear gaskets have been renewed, it can be compensated by adding a brass leaf liner.

   If the play is too small, grind off the bearing (1).

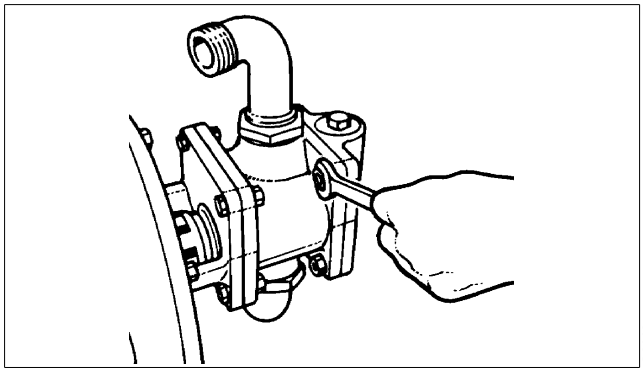


A. Axial play
B. Where to insert the liner
1. Bearing
2. Spacer

8. Fit the O-ring on the pump housing.

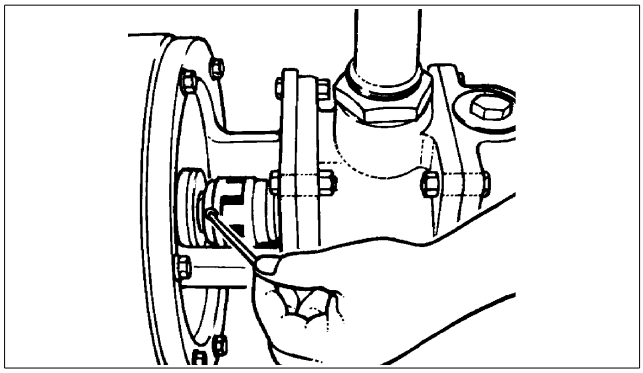


9. Fit the pump shield. (Four screws, four washers and four nuts.)

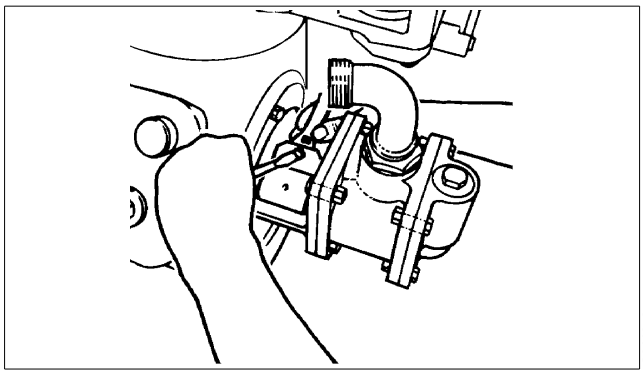


10. Check that the clearance on each side of the coupling flexible element is **2 mm**.

    Tighten the stop screw in the coupling half nearest the separator frame with a hexagon wrench. Check that the holders for the lipseal rings are located so that the sleeve halves can easily be fitted.



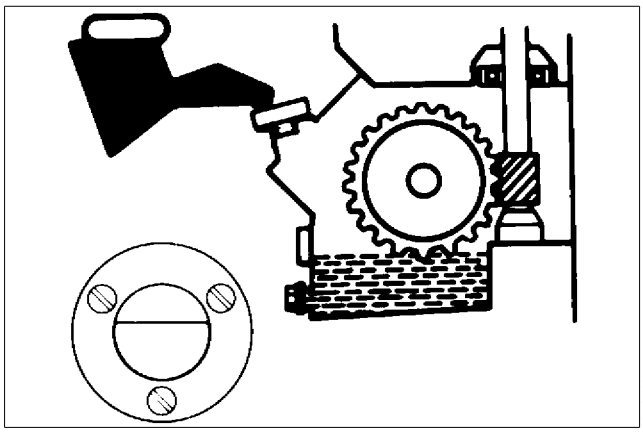
11. Mount the sleeve halves over the coupling.
12. Refit the pipe connections.



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

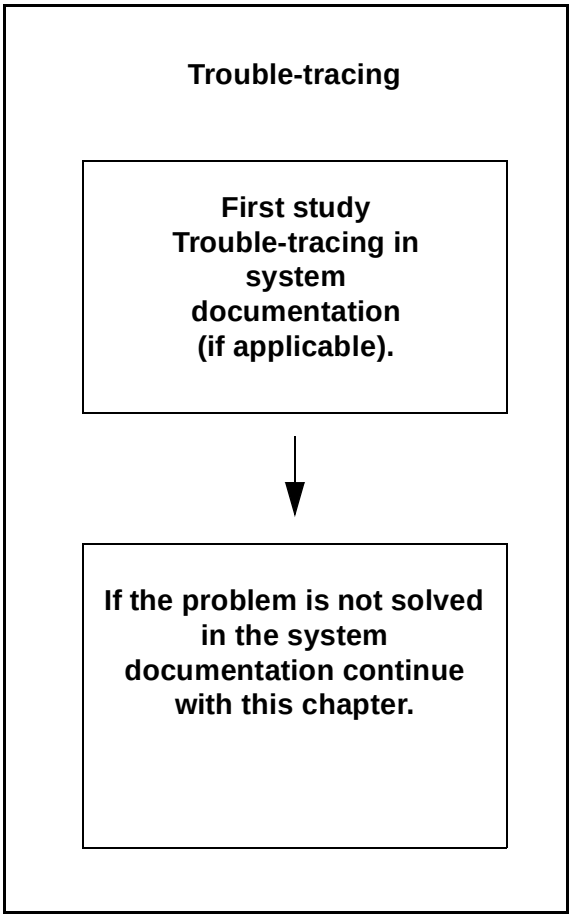
    For correct oil volume, see chapter “8.1 Technical data” on page 170.

    For recommended oil brands, see chapter “8.5.3 Recommended oil brands” on page 183.



7 Trouble-tracing

Contents



7.1 Mechanical function

7.1.1 Separator vibrates

NOTE

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

DANGER

Disintegration hazards

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 is 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	109
Uneven sludge deposits in the sludge space	Dismantle and clean the separator bowl	106
Height adjustment of the oil paring disc is incorrect	Measure and adjust the height	82
Wrong height adjustment of operating device/bowl spindle	Measure and adjust the height	83
Bowl spindle bent (max 0,04 mm)	Renew the bowl spindle	72
Bearing is overheated, damaged or worn	Renew all bearings	126, 138
Vibration dampers in frame feet are worn out	Renew all rubber cushion	55
Spindle top bearing spring broken	Renew all springs	126

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	38
Bearing is overheated	Renew all bearings	126, 138

7.1.3 Noise

Cause	Corrective actions	Page
Oil level in gear housing too low	Check oil level and add oil if necessary	38
Height adjustment of the oil paring disc is incorrect	Measure and adjust the height	82
Wrong height adjustment of operating device/bowl spindle	Measure and adjust the height	83
Worm wheel and worm are worn	Renew worm wheel and worm	89
Bearing is overheated, damaged or worn	Renew all bearings	126, 138
Incorrect play between coupling pulley and elastic plate	Adjust the play	77

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	75
Bowl is not closed or leaking	Dismantle the bowl and check	105
Motor failure	Repair the motor	–
Bearing is overheated, damaged or worn	Renew all bearings	126, 138
Incorrect gear transmission (60 Hz gear for 50 Hz power supply)	Change the gear transmission to suit the power supply frequency	89, 126, 138

7.1.5 Speed too high

Cause	Corrective actions	Page
Incorrect gear transmission (50 Hz gear running on 60 Hz power supply)	After immediate stop, install correct transmission. **DANGER**  In the event of overspeed, examine the bowl for possible deformation. The separator must not be started before the effects of the fault have been corrected. Contact your Alfa Laval representative.	89, 126, 138
Frequency of power supply (50/60 Hz)	Check	–

7.1.6 Starting power too low

Cause	Corrective actions	Page
Incorrect gear transmission (60 Hz gear for 50 Hz power supply)	Change the gear transmission to suit the power supply frequency	89, 126, 138
Incorrect friction blocks (60 Hz coupling for 50 Hz power supply)	Stop immediately and change the friction blocks to suit the power supply frequency	75
Friction pads are oily or worn	Clean or renew friction pads	75
Motor failure	Repair the motor	–

7.1.7 Starting power too high

Cause	Corrective actions	Page
Incorrect gear transmission (50 Hz gear running on 60 Hz power supply)	**DANGER**  After immediate stop, install correct transmission	89, 126, 138
Incorrect friction blocks (50 Hz coupling for 60 Hz power supply)	**DANGER**  After immediate stop change the friction blocks to suit the power supply frequency	75
Brake is applied	Release the brake	–
Wrong height adjustment of operating device/bowl spindle	Measure and adjust the height	83
Worm wheel and worm are worn	Replace	89, 126, 138
Motor failure	Repair the motor	–
Bearing is damaged or worn	Renew all bearings	126, 138
Wrong direction of rotation	Change electrical phase connections to the motor	–

7.1.8 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	75
Height position of oil paring disc or operating device is incorrect	Check and adjust the height	75, 83
Motor failure	Repair the motor	–
Bearing is damaged or worn	Renew all bearings	126, 138

7.1.9 Retardation time too long

Cause	Corrective actions	Page
Brake friction pad is worn or oily	Renew or clean brake friction pad	73

7.1.10 Water in worm gear housing

Cause	Corrective actions	Page
Bowl casing drain obstructed	Clean worm gear housing and change oil	89
Leakage at top bearing	Renew seal ring and change oil	126, 92
Condensation	Clean worm gear housing and change oil	92

7.2 Separation faults, purifier and clarifier

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

Cause	Corrective actions	Page
Sludge discharge in progress	None (normal)	–
Strainer in operating water line is clogged or pressure is too low	Clean the strainer and check pressure/flow: Discharge liquid (opening): 200-600 kPa Make-up liquid (closing): 140-240 kPa	
Channels in operating device are clogged	Clean the operating device	121
Seal rings in operating device are defective	Renew the seal rings	121
Sludge deposits on operating slide	Clean	...
Seal ring at gravity disc or small lock ring (paring chamber cover) defective	Replace	105
Paring chamber cover (small lock ring) defective	Renew the paring chamber cover	105
Seal ring in the bowl hood defective or sealing surface of sliding bowl bottom is damaged	Renew the seal ring. Polish the surface on sliding bowl bottom or replace	105
Seal ring of the sliding bowl bottom defective	Smoothen sealing edge of the sliding bowl bottom or renew it	70
Valve plugs are defective	Renew all valve plugs	69
Displacement water volume too large	Check water supply and filling time	
Bowl speed too low	See 7.1.4	159

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	
Nozzle in operating slide clogged	Clean the nozzle. Carry out an Intermediate Service (IS)	
Sludge deposits on operating slide	Clean	
Square-sectioned ring in sliding bowl bottom is defective	Renew the square-sectioned ring. Carry out an Intermediate Service (IS)	70
Valve plugs are defective	Renew all plugs. Carry out an Intermediate Service (IS)	69
Supply valve for opening water is leaking	Rectify	–

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	–
Water pressure too low Water flow too low	Check the opening water pressure Check the opening water flow	172
Seal rings in operating device defective	Renew the seal rings	121
Seal ring in the operating slide is defective	Renew the seal ring. Carry out an Intermediate Service (IS)	114

7.2.4 Unsatisfactory sludge discharge

Cause	Corrective actions	Page
Water pressure too low Water flow too low	Check the opening water pressure Check the opening water flow	172
Valve plugs in operating slide too high	Fit correct valve plugs	69
Sludge deposits in the operating system	Check and clean the operating system	114, 121

7.3 Separation faults, purifier

7.3.1 Unsatisfactory separation result

Cause	Corrective actions	Page
Gravity disc hole is too small	Use a gravity disc with a larger hole	194
Incorrect separation temperature	Adjust	–
Throughput too high	Adjust	–
Disc stack is clogged	Clean disc stack	88
Sludge space in bowl is filled	Clean the bowl and reduce the time between sludge discharges	88
Bowl speed too low	See 7.1.4	159

7.3.2 Outgoing water contains oil

Cause	Corrective actions	Page
Gravity disc hole is too large	Use a gravity disc with a smaller hole	194
Seal ring on top of the heavy phase paring disc defective	Fit a new seal ring	–
Seal ring at gravity disc or small lock ring (paring chamber cover) defective	Fit a new seal ring	–
Disc stack is clogged	Clean disc stack	88

7.3.3 Oil discharges through water outlet = Broken water seal

Cause	Corrective actions	Page
Gravity disc hole is too large	Use a gravity disc with a smaller hole	194
Incorrect separation temperature	Adjust	–
Throughput too high	Adjust	
Valves in clean oil outlet line closed	Check	
Sealing water volume too small	Check sealing water supply	
Seal ring at gravity disc or small lock ring (paring chamber cover) defective	Fit a new seal ring	–
Seal ring in the bowl hood defective or sealing surface of sliding bowl bottom is damaged	Renew the seal ring. Polish the surface on sliding bowl bottom or replace	105
Seal ring of the sliding bowl bottom defective	Smoothen sealing edge of the sliding bowl bottom or renew it	70
Disc stack is clogged	Clean disc stack	88
Bowl speed too low	See 7.1.4	159
Bowl incorrectly assembled	Check and rectify	105

7.4 Separation faults, clarifier

7.4.1 Unsatisfactory separation result

Cause	Corrective actions	Page
Feed oil contains water	b. Reduce time between discharges c. Assemble and operate the separator as a purifier	–
Incorrect separation temperature	Adjust	–
Throughput too high	Adjust	–
Disc stack is clogged	Clean the disc stack	88
Sludge space in bowl is filled	Clean and reduce the time between sludge discharges	88
Bowl speed too low	See 7.1.4	159

7.4.2 Oil discharges through water outlet

Cause	Corrective actions	Page
Valves in outlet line closed		194
Seal rings on top of the heavy phase paring disc defective	Fit a new seal ring	–
Disc stack is clogged	Clean the disc stack	88
Bowl incorrectly assembled	Check and rectify	105

8 Technical Reference

Contents

8.1 Technical data

Alfa Laval ref. 557602, 557614

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	881034-01-09	
Separator type	MOPX 205TGT-24	
Application	Intended for both land and marine applications. - Continuous purification of fuel oil or lubrication oil from solid particles and water - Continuous clarification of fuel oil or lubrication oil from solid particles and water The flash point of the oil to be separated must be above 60 °C.	
Density of operating liquid, max.	1 000	kg/m^3
Density of sediment, max.	2 362	kg/m^3
Density of feed, max.	1 100	kg/m^3
Hydraulic capacity	4 900	litres/hour
Feed temperature, min./max.	0 - 100	°C
Ambient temperature, min./max.	5 - 55	°C
Bowl speed, max.	7 607	r/min. at 50 Hz
	7 537	r/min. at 60 Hz
Motor shaft speed, max.	1 500	r/min. at 50 Hz
	1 800	r/min. at 60 Hz
Revolution counter	118-125	r/min. at 50 Hz
	142-150	r/min. at 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 oil volume	approx. 4,0	litres

Motor power rating	4	kW
Power consumption, max.	6,5	kW (at starting up)
Power consumption, idling	2,2	kW
Power consumption, at max. capacity	2,4	kW
Discharge volume	3,1	litres fixed discharge volume
Discharge interval, min.	1	minute
Discharge interval, max.	240	minutes
Bowl volume	3,1	litres
Starting time	2 - 2,5	minutes
Stopping time with brake	3,5 - 4,5	minutes
Max. running time without flow		
- empty bowl	180	minutes
- filled bowl	180	minutes
Sound pressure level	73	dB(A) ISO 3744
Vibration level, separator in use, max.	7,1	mm/s (RMS)
Weight of separator (without motor)	430	kg
Weight of bowl	56	kg

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

8.2 Connection list

8.2.1 Separator without pump

Alfa Laval ref. 557950 rev.2

Connection No.	Description	Requirements/limits
201	Inlet for product	
	– Allowed temperature	Min. 0 °C, max. 100 °C
206	Inlet for liquid seal or displacement liquid	Fresh water
	– Instantaneous flow	5,5 litre/minute
	– Pressure	Min. 200 kPa, Max.600 kPa
220	Outlet for light phase (oil)	
	– Pressure	Max. 250 kPa
221	Outlet for heavy phase (water)	
222	Outlet for solid phase	To be installed in such a way that the frame top part cannot fill with sludge. (Guidance of sludge pump or open outlet).
372	Inlet for discharge liquid	See “8.4 Water quality” on page 179
	– Instantaneous flow	11 litres/minute
	– Time	3 seconds/discharge
	– Pressure	Min. 200 kPa, Max.600 kPa
376	Inlet for make-up liquid	
	– Pressure	Min. 140 kPa, Max. 240 kPa
	– - Quality requirements	See “8.4 Water quality” on page 179
372 + 376	Discharge and make-up liquid	
	– Consumption	6 litres/discharge
377	Outlet for operating liquid (water)	
462	Drain of frame top part, lower	

Connection No.	Description	Requirements/limits
463	Drain of frame top part, upper	
701	Motor for separator – Deviation from nominal frequency	 ± 5% (momentarily 10% during a period of maximum 5 seconds)
760	Cover interlocking switch – Type – Switch rating, resistive load	See “8.3 Interface description’’ and “8.6.10 Cover interlocking switch” on page 201. Mechanical switch Max. 3 A, 500 V

8.2.2 Separator with built-on pump

Alfa Laval ref. 557951

Connection No.	Description	Requirements/limits
201.1	Inlet for process liquid, to pump	
201.2	Outlet for process liquid, from pump	
201.3	Inlet for process liquid, to separator – Allowed temperature	 Min. 0 °C, max. 100 °C
206	Inlet for liquid seal and displacement liquid – Instantaneous flow – Pressure	Fresh water 5,5 litre/minute Min. 200 kPa, Max.600 kPa
220	Outlet for light phase (oil) - Pressure	 Max. 250 kPa
221	Outlet for heavy phase (water)	
222	Outlet for solid phase	To be installed in such a way that the frame top part cannot fill with sludge. (Guidance of sludge pump or open outlet).

Connection No.	Description	Requirements/limits
372	Inlet for discharge liquid – Instantaneous flow – Time – Pressure	See ‘‘8.4 Water quality” on page 179 11 litres/minute 3 seconds/discharge Min. 200 kPa, Max.600 kPa
376	Inlet for make-up liquid - Pressure - Quality requirements	 Min. 140 kPa, Max. 240 kPa See ‘‘8.4 Water quality” on page 179
377	Outlet for operating liquid (water)	
462	Drain of frame top part, lower	
463	Drain of frame top part, upper	
701	Motor for separator - Deviation from nominal frequency	 ± 5% (momentarily 10% during a period of maximum 5 seconds)
760	Cover interlocking switch – Type – Switch rating, resistive load	See ‘‘8.3 Interface description’’ and ‘‘8.6.10 Cover interlocking switch” on page 201. Mechanical switch Max. 3 A, 500 V

8.3 Interface description

Alfa Laval ref. 557697rev. 2

8.3.1 General

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

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

8.3.2 Definitions

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.

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.

Discharge signal processing

At indication of the absence of a discharge, the operator or the starter control 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.

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

Cover interlocking switch 760

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

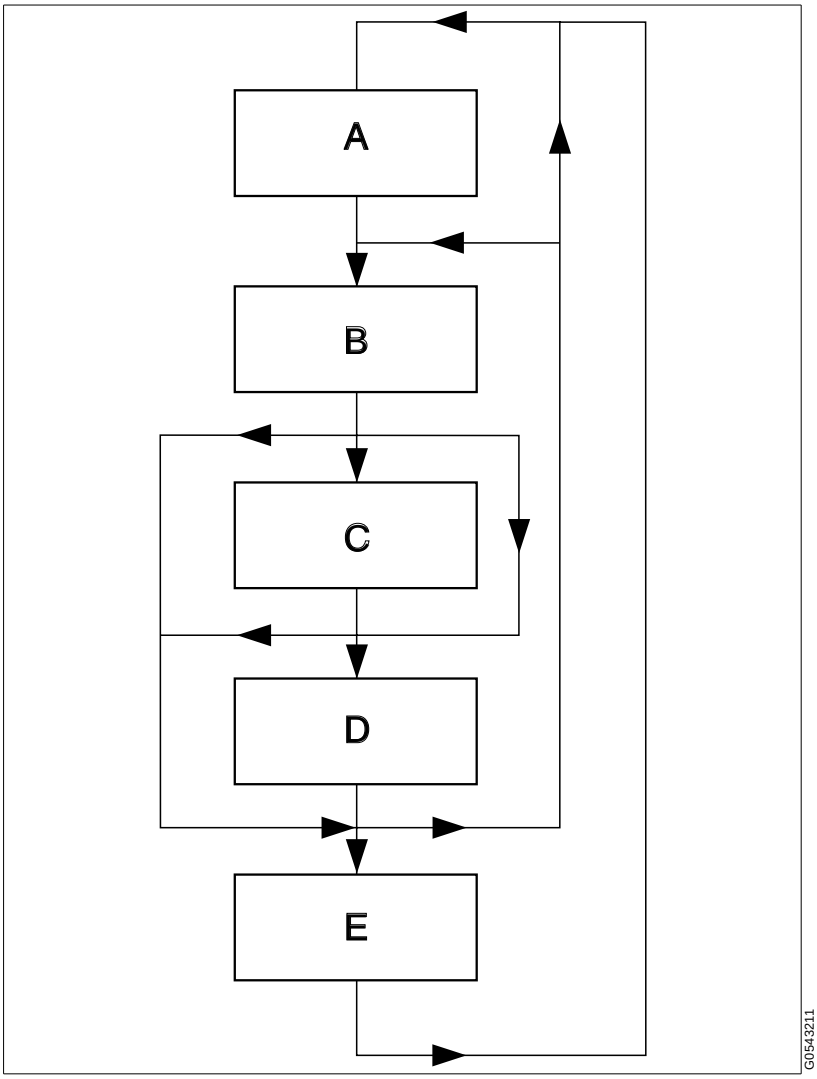
When the cover is closed the interlocking circuit in the control system is closed and the separator could be started.

Signal Processing

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

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

8.3.4 Function graph and running limitations



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

8.4 Water quality

Alfa Laval ref. 553406

General

Specific requirements regarding the purity of water are necessary.

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

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

The four requirements below are of fundamental importance.

For test methods, contact an Alfa Laval representative.

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

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

Suspended particles

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

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

Max. particle size: 50 μm.

Total hardness

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

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

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

Chloride content

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

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

pH value

pH >6

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

8.5 Lubricants

8.5.1 Lubrication chart, general

Alfa Laval ref. 553216-01

Lubricating points	Lubricants
Bowl spindle ball bearings and buffers are lubricated by oil mist	Lubricating oil as specified in “8.5.2 Recommended lubricating oils” on page 182
Bowl spindle taper	Lubricating oil (only a few drops for rust protection)
Buffers of bowl spindle	Lubricating oil
Bowl: Sliding contact surfaces and pressure loaded surfaces such as lock rings, threads of lock rings, bowl hood, and cap nut	Pastes as specified in “8.5.4 Recommended lubricants” on page 186 If not specified otherwise, follow the supplier’s recommendation about method of application
Rubber seal rings	Grease as specified in “8.5.4 Recommended lubricants” on page 186
Friction coupling ball bearings	The bearings are packed with grease and sealed and need no extra lubrication
Electric motor (if nipples are fitted)	Follow manufacturer’s instructions.

Alfa Laval Lubricating Oil Groups:

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

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

Always use clean vessels when handling lubricating oil.

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

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

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

NOTE

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

NOTE

Check the oil level before start. Top up when necessary. Oil volume see ‘‘8.1 Technical data” on page 170.

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

Applying, handling and storing of lubricants

Always be sure to follow lubricant manufacturer’s instructions.

8.5.2 Recommended lubricating oils

Alfa Laval ref. 553219-03

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

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 listed in chapter ‘‘8.5.3 Recommended oil brands” on page 183.

Ambient temperature °C	Alfa Laval lubricating oil group	Time in operation Oil change interval
between +5 and +45	A/220, B/220	1 000 - 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.

8.5.3 Recommended oil brands

Alfa Laval lubricating oil group A/220

Alfa Laval ref. 553218-01

Viscosity grade VG (ISO 3448/3104) 220

Viscosity index VI (ISO 2909) > 92

Manufacturer	Designation
Castrol	Alpha ZN 220
Esso Standard Oil/ Svenska Statoil/Exxon	Teresso 220 Terrestic 220
Lubmarine/Beijer (ELF Brand designation according to ELF)	Polytelis 220
Mobil	DTE Oil BB
Nynäs	TD EX 220
Optimol Ölwerke	Ultra 220
Q8/Kuwait (Gulf)	Harmony AW 220
Shell	Tellus C 220 Tellus 220
Texaco/	Regal R&O 220 Paper Machine HD 220

Alfa Laval lubricating oil group B/220

Alfa Laval ref. 553218-02

Viscosity grade VG (ISO 3448/3104) 220

Viscosity index VI (ISO 2909) > 92

Manufacturer	Designation
Bel Ray	100/06-220
BP	Energol GR-XP 220
Castrol	Alpha SP 220
Chevron	Ultragear 220 (NL Gear Compound 220)
DIN 51517, part 3	CLP 220
Esso Standard Oil/ Svenska Statoil/Exxon	Spartan EP 220
Fina/Petrofina	Giran 220
ISO/DIS 6743/6	L-CKC-220
Lubmarine/Beijer (ELF Brand designation according to ELF)	Epona Z 220
Mobil	Mobilgear 630 (Mobilgear SHC 220)
Nynäs	(GL 220)
Optimol Ölwerke	Optigear BM 220 (5150)
Q8/Kuwait (Gulf)	Goya 220
Shell	(Lorina 220) Omala 220 Delima HT 220
Texaco	Meropa 220
Soviet (GHOST-) Standard	IGP-152 according to TU 38.101413-90

( ) = available in a few countries

Alfa Laval lubricating oil group D/220

Alfa Laval ref. 553218-03

Viscosity grade VG (ISO 3448/3104) 220

Viscosity index VI (ISO 2909) > 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	Alpha Synt T 220
Lubmarine/Beijer (ELF Brand designation according to ELF)	Epona SA 220
Mobil	SHC 630
Shell	Delima HT 220 Paolina 220

8.5.4 Recommended lubricants

Pastes and bonded coatings for non-food applications

Alfa Laval ref. 553217-01

Manufacturer	Designation	Alfa Laval No.	Application
Gleitmolybdän	Gleitmo 805 K or 805 K varnish 901 Gleitmo Paste G rapid	 537086-04	All pressure loaded surfaces
Dow Corning	Molykote paste1000 spray D321 R varnish D321 R	537086-02 535586-01 535586-02	
Rocol	Antiscuffing paste (ASP)		
Klueber	Wolfracoat C paste		
Russian Standard	VNII NP 232 Gost 14068-90		

Silicone grease

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

Greases for ball and roller bearings

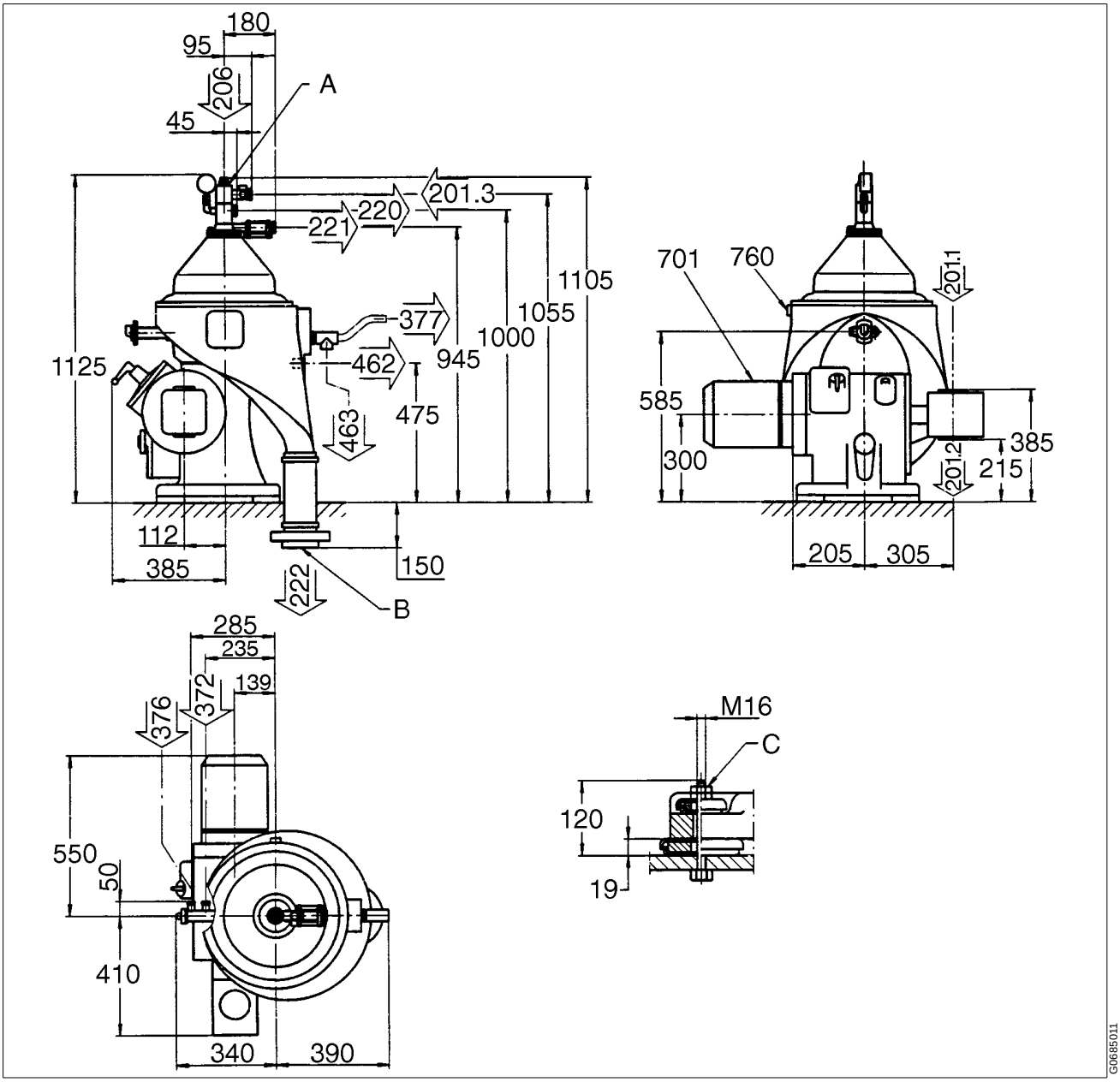
Alfa Laval ref. 553217-01

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

8.6 Drawings

8.6.1 Basic size drawing, separator with built-on pump

Alfa Laval ref. 557889



A. Maximum horizontal displacement at the in/outlet connections during operation: ±20 mm

B. Maximum vertical displacement at the solid phase connection during operation: ±10 mm.

C. Tigthening torque 20 Nm. Secured with lock nut

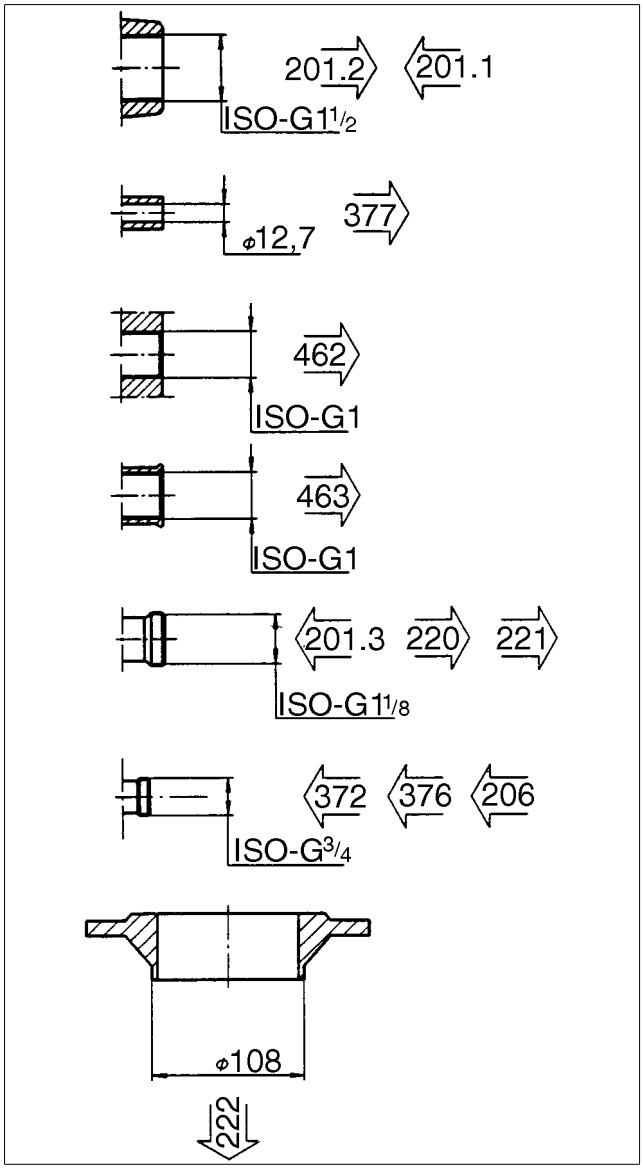
8.6.2 Dimensions of connections, separator with built-on pump

Alfa Laval ref. 557889

Data for connections, see chapter “8.2 Connection list” on page 172.

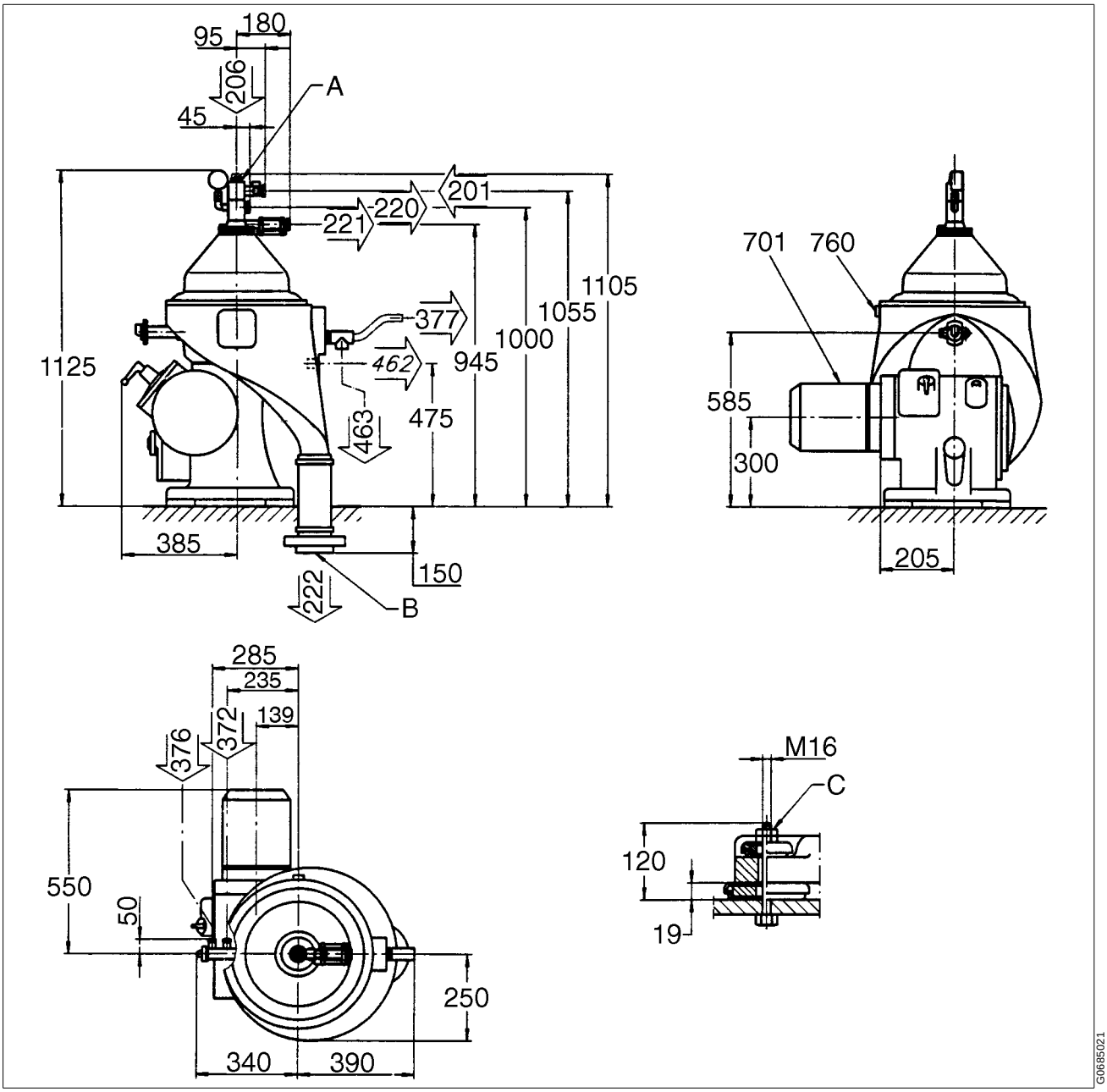
All connections to be installed non-loaded and flexible.

Connections 201.3 and 220 are turnable.



8.6.3 Basic size drawing, separator without pump

Alfa Laval ref. 557600



A. Maximum horizontal displacement at the in/outlet connections during operation: ±20 mm

B. Maximum vertical displacement at the solid phase connection during operation: ±10 mm

C. Tigthening torque 20 Nm. Secured with lock nut

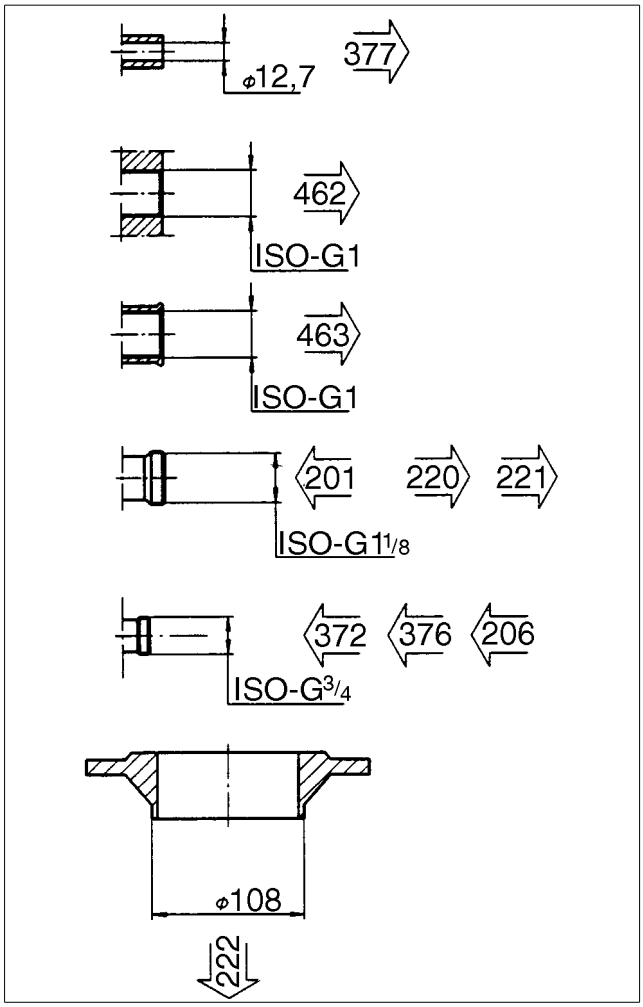
8.6.4 Dimensions of connections, separator without pump

Alfa Laval ref. 557600

Data for connections, see chapter “8.2 Connection list” on page 172.

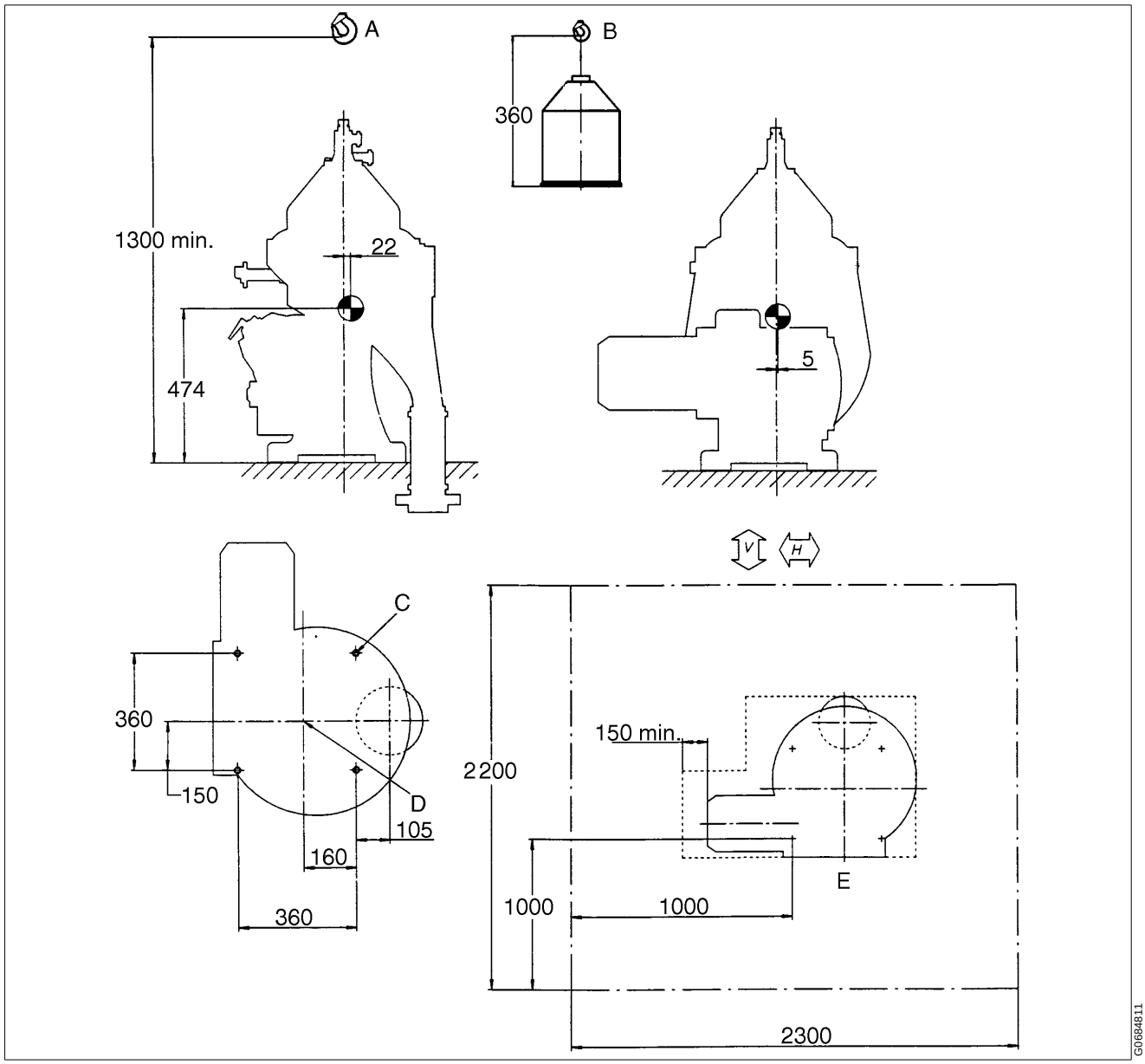
All connections to be installed non-loaded and flexible.

Connections 201 and 220 are turnable.



8.6.5 Foundations

Alfa Laval ref. 557856



A. Min. lifting capacity required when doing service: 100 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

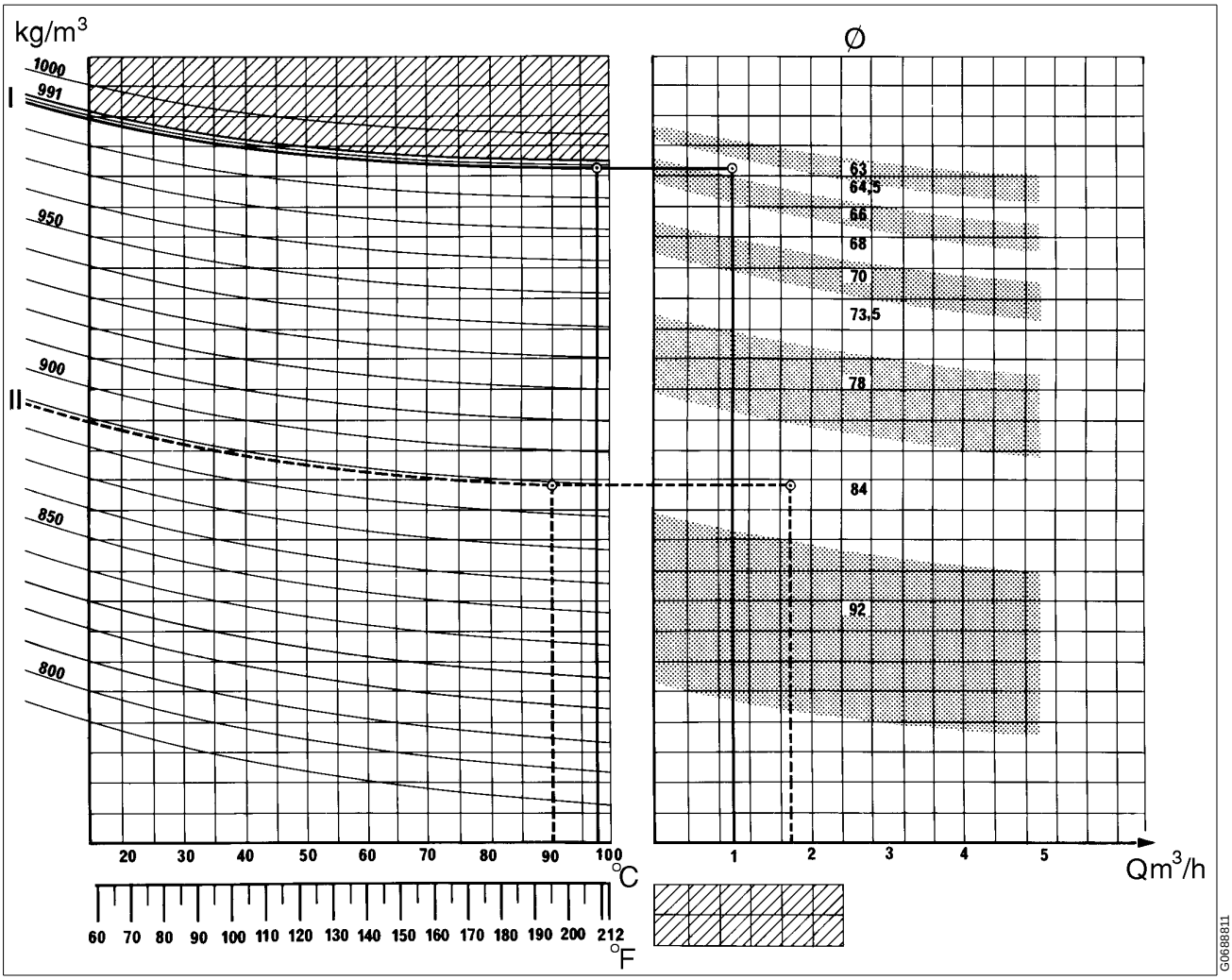
No fixed installations within this area.

Center of gravity (without motor)

Vertical force not exceeding 10 kN/foot

Horizontal force not exceeding 10 kN/foot

8.6.6 Gravity disc nomogram



ρ = Oil density, kg/m³ at 15 °C

Oil temperature in °C or °F

Gravity disc hole diameter, ϕ mm

Q = Throughput, m³/h

The nomogram is based on the properties of fresh water. The presence of salt water in the oil may demand a gravity disc with a larger hole than indicated in the nomograms.

Example I in nomogram

Reference in graph: _____

Oil density	988 kg/m^3 at 15 °C (60 °F)
Separation temperature	98°C (208 °F)
Throughput	1,0 m^3/h

From the graphs (heavy line), the correct gravity disc has a hole diameter of 64,5 mm.

Example II in nomogram

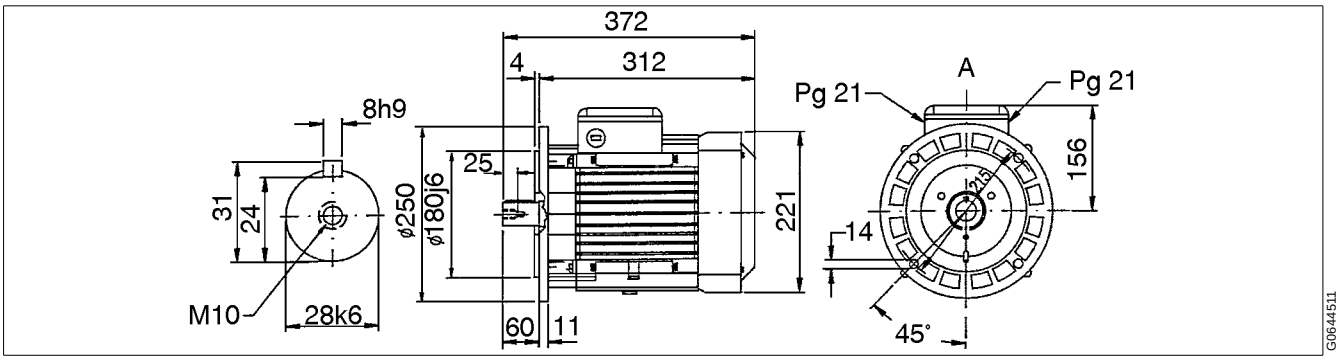
Reference in graph: _ _ _ _ _ _

Oil density	888 kg/m^3 at 15 °C (60 °F)
Separation temperature	90 °C (194 °F)
Throughput	1,8 m^3/h

From the graphs (broken line), the correct gravity disc has a hole diameter of 84 mm.

8.6.7 Electric motor

Alfa Laval ref. 552810



A. Max. cable diameter is 21 mm

Manufacturer	ABB Motors
Manufacturers drawing	MK20-92S
Standards	IEC 34-1, IEC 72
Size	112 M
Type	MBT 112M
Weight	31 kg
Poles	4
Insulation class	F
Bearings	DE 6206-Z/C3 – NDE 6205-Z/C3
Method of cooling	IC 41 (IEC 34-6)
Specification	Totally enclosed three-phase motor for marine service [3)]

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

Article No	Output kW	Speed RPM	Freq Hz	Voltage V	Current A	Pow.fac cos φ	I_{st} / I [1]	Therm [2] ℃	Note
552810-01	4	1425	50	200 D	17	0,83	5,6		
552810-02	4	1425	50	220 D	16	0,83	5,6		
552810-03	4	1425	50	380 D	9	0,83	5,6		
552810-04	4	1425	50	415 D	8,2	0,83	5,6		
552810-05	4	1425	50	440 D	7,8	0,83	5,6		
552810-06	4	1425	50	500 D	6,8	0,83	5,6		
552810-07	4,6	1725	60	220 D 440 D	18 9	0,83	5,6		D-par D-ser
552810-08	4,6	1725	60	230 D 460 D	18 8,6	0,83	5,6		D-par D-ser
552810-09	4,6	1725	60	575 D	6,9	0,83	5,6		CSA-plated
552810-10	4 4,6	1425 1725	50 60	380 D 440 D	9 9	0,83	5,6 5,6		

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

2) Thermistors tripping temperature if applicable

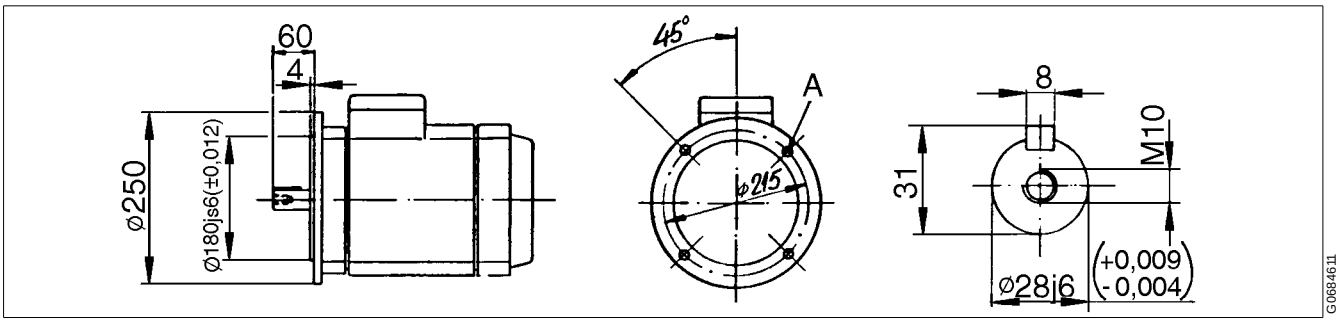
3) The motors can be designed to fulfill requirements of following Classification Societies:

Lloyds Register of shipping	(LRS)	(Essential Service)
Det Norske Veritas	(DnV)	(Essential Service)
Germanischer Lloyd	(GL)	(Essential Service)
Bureau Veritas	(BV)	(Essential Service)
American Bureau of shipping	(ABS)	(Essential Service)
Registro Italiano Navale	(RINA)	(Essential Service)
USSR Register of Shipping	(RSU)	(Essential Service)
Japanese Classification Society	(NKK)	(Essential Service)

Required classification society must always be specified when ordering. Factory test certificate to be enclosed at the delivery.
Rated output (kW) valid for temp-rise max. 90 ℃.

8.6.8 Electric motor

Alfa Laval ref. 540196



A: 4 holes, diam. 14 mm

Only for applications on shore.

Standards	IEC 34-1, IEC 72
Size	112 M/F215 acc. to IEC72
Poles	4
Method of cooling	R
Specification	Totally enclosed three-phase induction motor, fan cooled

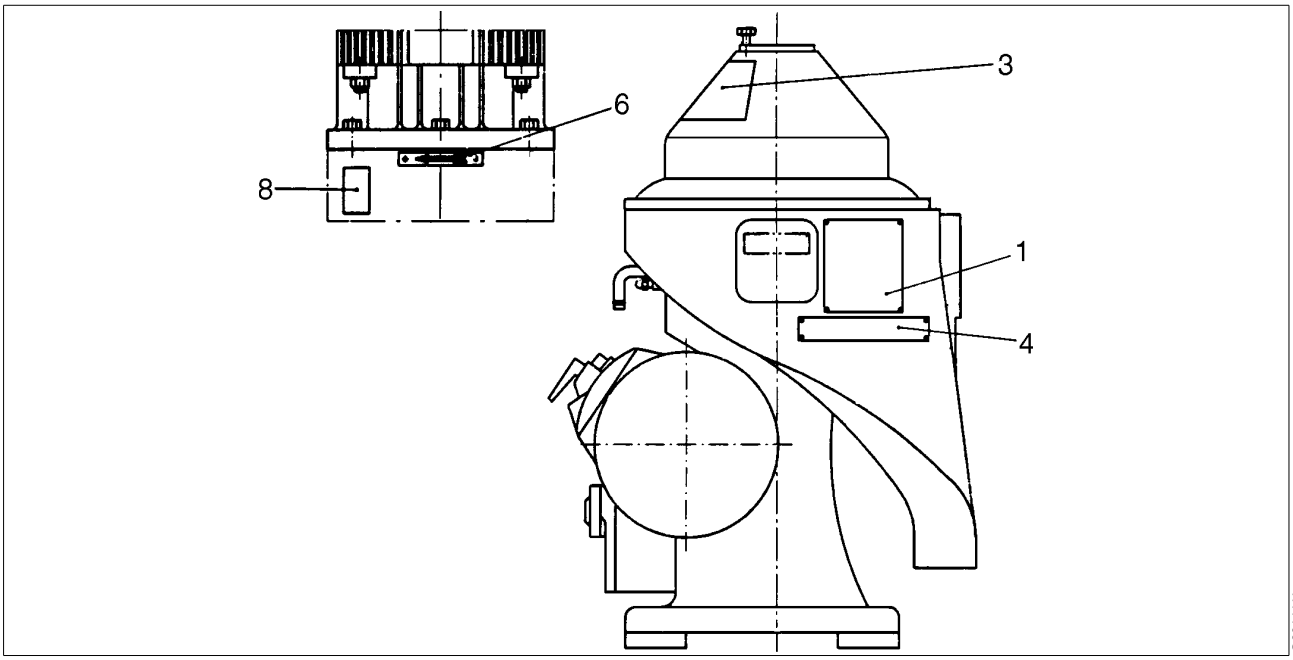
Type of mounting		Degree of protection
	IM 1001	IP 44
	IM 3001	
	IM 3011	
	IM 3031	

Article No	Power kW	Freq Hz	Voltage V	Note
540196-10	4	60	220 VD	
540196-11	4	60	380 VD	
540196-12	4	60	440 VD	
540196-13[1)]	4	60	575 VD	
540196-18	4	50	200 VD	
540196-19	4	50	220 VD	
540196-20	4	50	380 VD	
540196-21	4	50	415 VD	
540196-22	4	50	500 VD	
540196-23	4	50	660 VD	
540196-24	4	60	200 VD	

1) According to the rules of CSA

8.6.9 Machine plates and safety labels

Alfa Laval ref. 557410, 557602, 557614



1. Machine plate

Separator	MOPX 205TGT-24
Manufacturing serial No. / Year	XXXX
Product No.	881034-01-09
Machine top part	540216-87
Bowl	540148-83
Machine bottom part (without pump) Machine bottom part (with pump)	540224-10/11 (50/60 Hz) 540224-03/04 (50/60 Hz)
Max. speed (bowl)	7607 r/min. (50 Hz), 7537 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	2362 kg/m^3
Max. density of operating liquid	1000 kg/m^3
Process temperature min./max.	0/100 °C

3. Safety label

Text on label:

DANGER

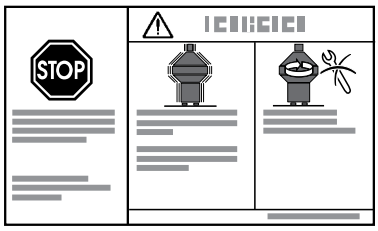
Read the instruction manuals **before** installation, operation and maintenance. Consider inspection intervals.

Failure to strictly follow instructions can lead to fatal injury.

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

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

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



S0061521

4. Name plate

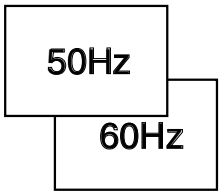
Alfa Laval

S0063211

6. Arrow

Indicating direction of rotation of horizontal driving device.

8. Power supply frequency



S0063111

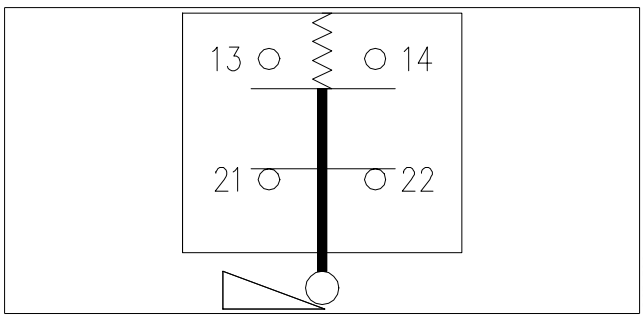
8.6.10 Cover interlocking switch

Alfa Laval ref. 557950, 557951, 557237

Switch rating, voltage: Max. 500 V

current: Max. 3 A

For other technical information see chapter “8.3 Interface description” on page 175.



G0547221

8.7 Storage and installation

8.7.1 Storage and transport of goods

Storage

Specification

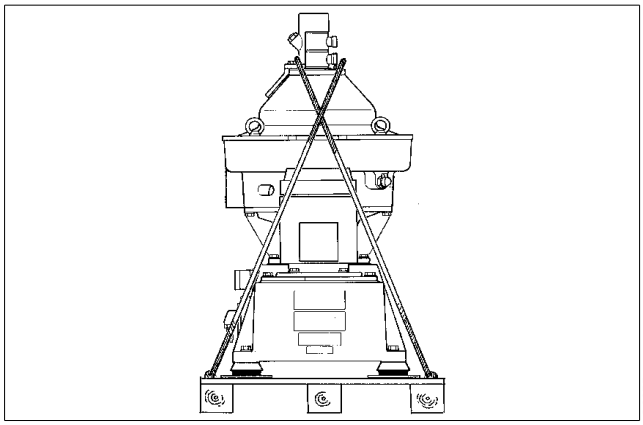
Upon arrival to the store, **check all components and keep them:**

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

A separator can be delivered with different types of protection:

- Fixed on a pallet.

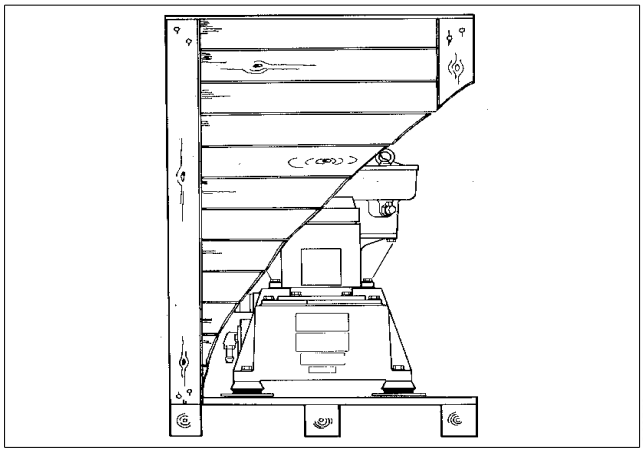
  The separator must be stored in a dry storage room, protected from rain and humidity. It must be well protected from mechanical damage and theft.



Fixed on a pallet

- In a wooden box which is not water tight.

  The separator must be stored in a dry storage room, protected from rain and humidity.

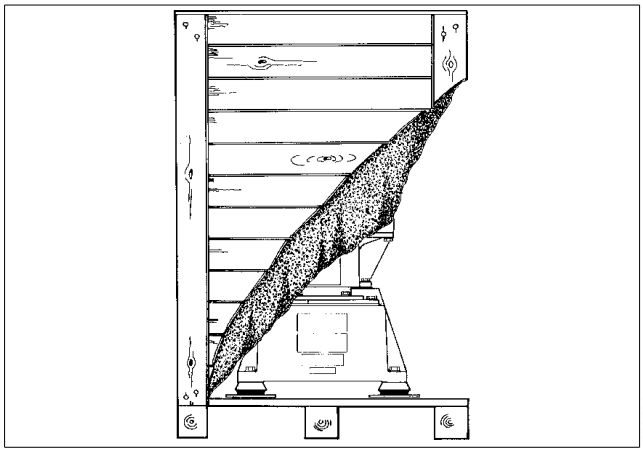


In a wooden box which is not water tight

- 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 details in chapter “5.5 Lifting instructions” on page 85.

WARNING

Crush hazards

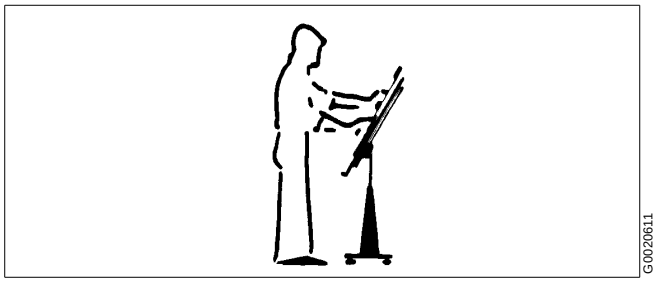
Use correct lifting tools and follow lifting instructions.

- 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, separator with built-on pump” on page 188, “8.6.5 Foundations” on page 193 and instructions for ancillary equipment, electrical and electronic equipment and cables.

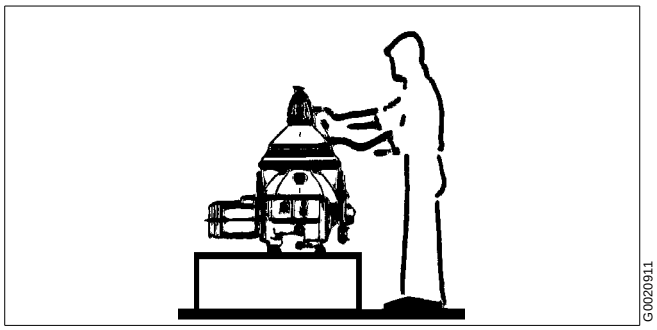


Check the drawings when planning the installation

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.

Small size separators are easier to operate and maintain if mounted on an elevated foundation.



Small size separators are easier to operate and maintain if mounted on an elevated foundation

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.

Space for separator

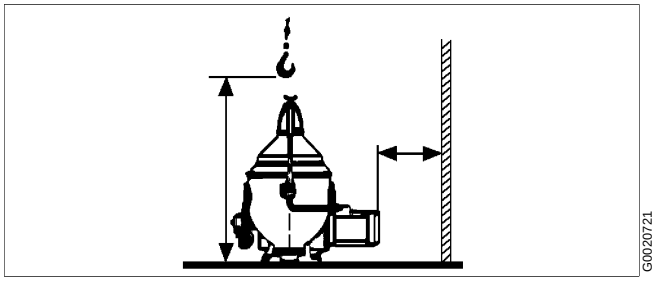
The separator shall be placed in such a way that suitable space for maintenance and repair is obtained.

Specification

- See chapter ‘‘8.6.5 Foundations” on page 193 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.



Suitable space must be obtained for the maintenance work

Lifting height for transport of bowl

Specification

- A minimum height is required to lift the bowl, bowl parts and the bowl spindle, see chapter ‘‘8.6.5 Foundations” on page 193**.**

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.

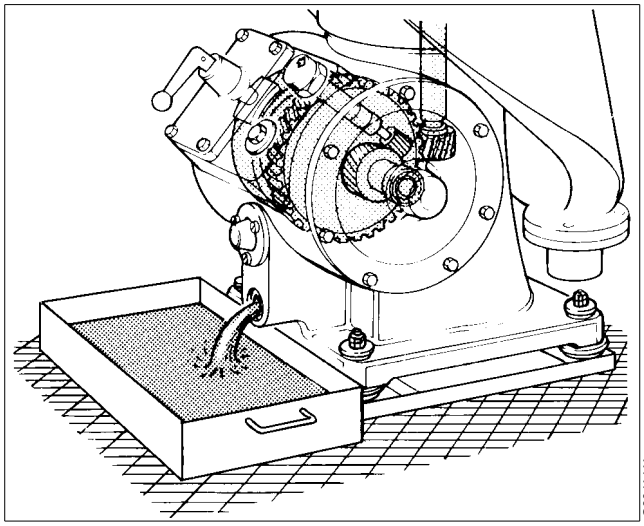
Space for oil changing

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

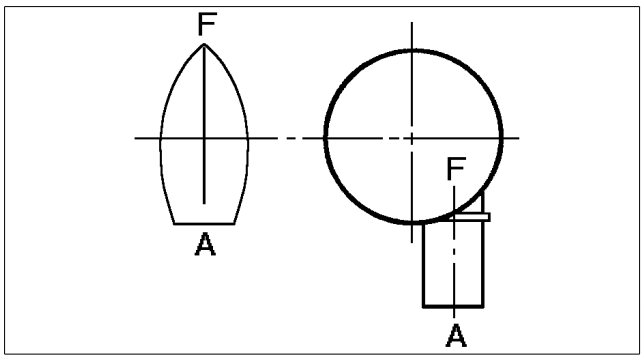
8.7.3 Foundations

NOTE

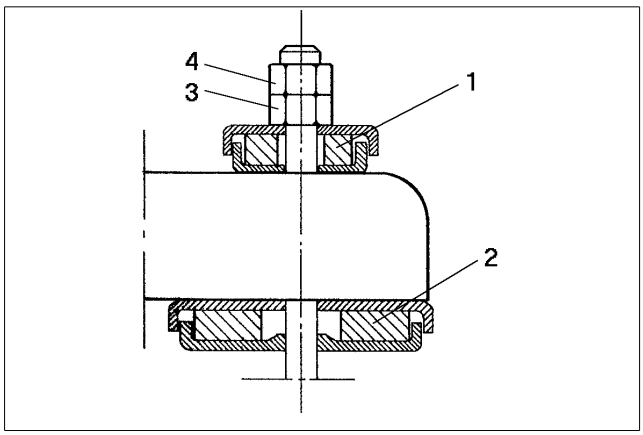
When lifting a separator it must always be **hung securely**. See chapter “5.5 Lifting instructions” on page 85.

Specification

- The separator can either be installed at floor level or on a platform, see chapter ‘‘8.6.5 Foundations” on page 193**.**
- When a separator is installed on a ship, the separator should be installed in such a way that the centre line of the electric motor is parallel with the centre line of the ship. The electric motor should preferably be pointing aft.
- The separator must be installed on a strong and rigid foundation to reduce the influence of vibrations from adjacent machinery.
- The foundation should be provided with a cofferdam.
- Fit the separator frame on the foundation as follows:
  - Place the separator frame without cushions in position.
  - Check that the bolts do not press against the edges of the holes, otherwise the elasticity of the mounting of the separator frame will be impeded.
  - Fit height adjusting washers required.
  - Check that the separator frame is horizontal and that all feet rest on the foundation.
  - Lift the separator frame, fit the vibration dampers (1, 2), lower and check that the bolts do not press against the edges of the holes.
  - Tighten nut (3) with **20 Nm**. Hold firmly and secure with the lock nut (4). Repeat for the other frame feet.



F = Forward
A = Aft



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

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