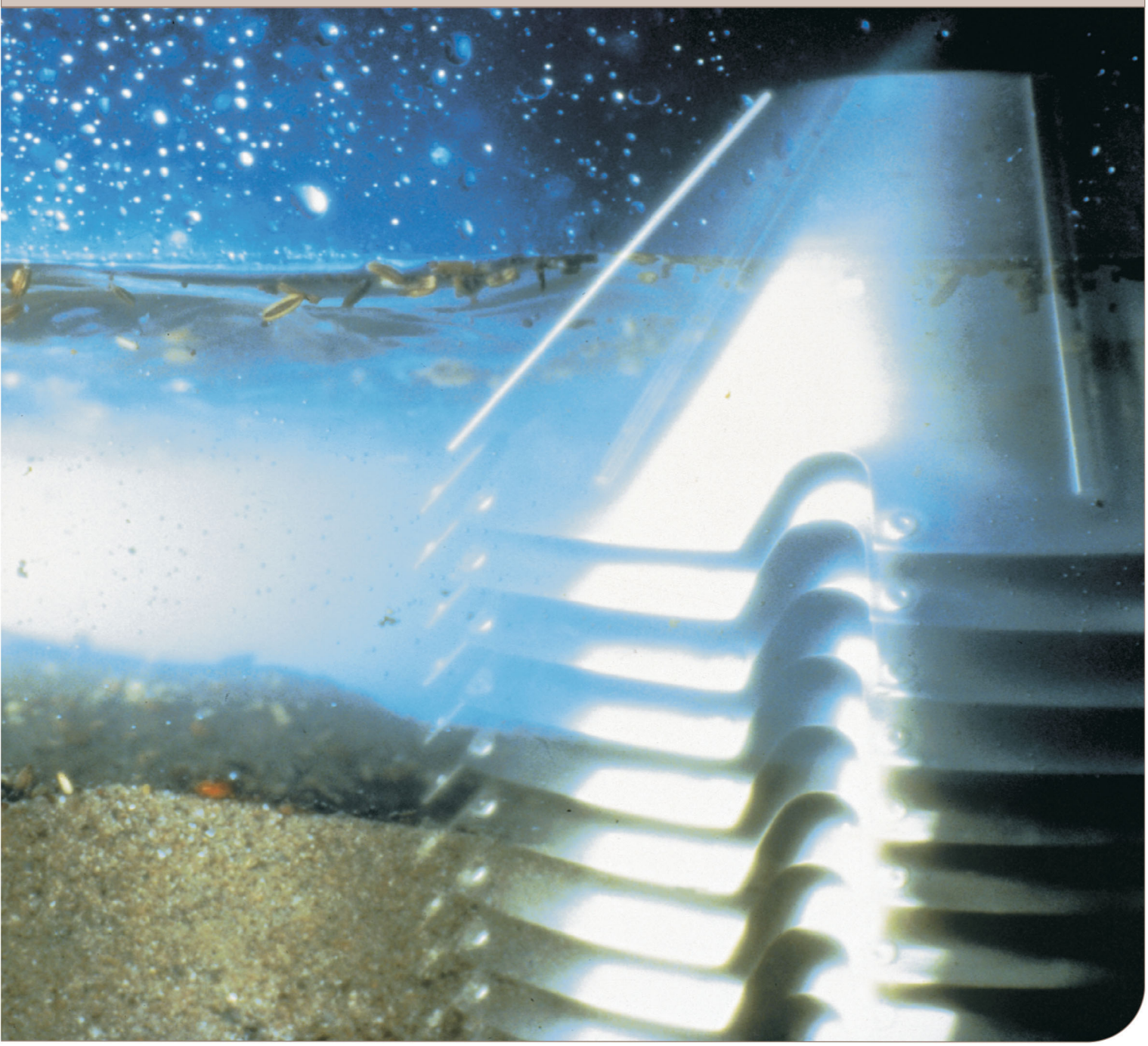
Separator Manual
High Speed Separator
MOPX 308



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Contents

Read and understand 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 308.

For information concerning the function of the separator, see chapter “3 Separator Basics” on page 17 and chapter “8 Technical Reference” on page 175.

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.

S0068011

Separator Manual and Spare Parts Catalogue

This Separator Manual consists of:

Safety Instructions

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

Separator Basics

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

Operating Instructions

This chapter contains operating instructions for the separator only.

Service Instructions

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

Dismantling / Assembly

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

Trouble-tracing

Refer to this chapter if the separator functions abnormally.

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

Technical Reference

This chapter contains technical data concerning the separator and drawings.

Index

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

2 Safety Instructions

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

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

G0010421

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.

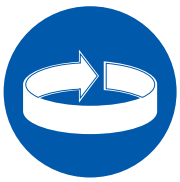
The following basic safety instructions therefore apply:

- **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.**

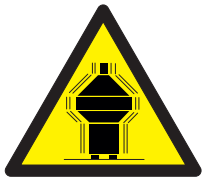
S0151211

Disintegration hazards

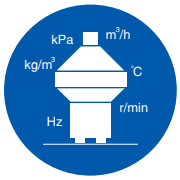
- When power cables are connected, always check direction of motor rotation. If incorrect, vital rotating parts could unscrew.


S01512F1

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

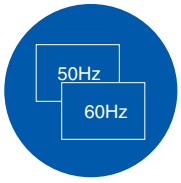

S01512N1

- Use the separator only for the purpose and parameter range specified by Alfa Laval.



S01512P1

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



S01512L1

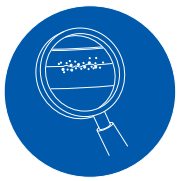
- Welding or heating of parts that rotate can seriously affect material strength.


S0151241

- 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.

S01512G1

- Inspect regularly for **corrosion** and **erosion** damage. Inspect frequently if process liquid is corrosive or erosive.


S01512H1

Entrapment hazards

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

  If there is no braking function the run down time can exceed two hours.

S01512O1

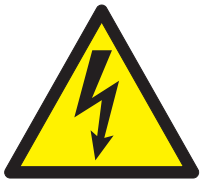
- To avoid accidental start, switch off and lock power supply before starting **any** dismantling work.

  Assemble the machine **completely** before start. **All** covers and guards must be in place.

S0151261

Electrical hazard

- Follow local regulations for electrical installation and earthing (grounding).
- To avoid accidental start, switch off and lock power supply before starting **any** dismantling work.



S0151271

Crush hazards

- Use correct lifting tools and follow lifting instructions.

S01512M1

Do **not** work under a hanging load.

S01512Y1

Noise hazards

- Use ear protection in noisy environments.

S0151291

Burn hazards

- Lubrication oil, machine parts and various machine surfaces can be hot and cause burns. Wear protective gloves.

S01512A1

Skin irritation hazards

- When using chemical cleaning agents, make sure you follow the general rules and suppliers recommendation regarding ventilation, personnel protection etc.
- Use of lubricants in various situations.

S01512D1

Cut hazards

- Sharp edges, especially on bowl discs and threads can cause cuts. Wear protective gloves.

S01512B1

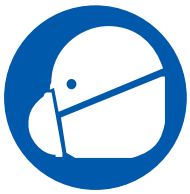
Flying objects

- Risk for accidental release of snap rings and springs when dismantling and assembly. Wear safety goggles.

S01512C1

Health hazard

- Risk for unhealthy dust when handling friction blocks/pads. Use a dust mask to make sure not to inhale any dust.



S01512V1

2.1 Warning signs in 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

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Type of hazard

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Type of hazard

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTE

NOTE indicates a potentially hazardous situation which, if not avoided, may result in property damage.

2.2 Environmental issues

Unpacking

Packing material consists of wood, plastics, cardboard boxes and in some cases metal straps.

Wood and cardboard boxes can be reused, recycled or used for energy recovery.

Plastics should be recycled or burnt at a licensed waste incineration plant.

Metal straps should be sent for material recycling.

Maintenance

During maintenance oil and wear parts in the machine are replaced.

Oil must be taken care of in agreement with local regulations.

Rubber and plastics should be burnt at a licensed waste incineration plant. If not available they should be disposed to a suitable licensed land fill site.

Bearings and other metal parts should be sent to a licensed handler for material recycling.

Seal rings and friction linings should be disposed to a licensed land fill site. Check your local regulations.

Worn out or defected electronic parts should be sent to a licensed handler for material recycling.

2.3 Requirements of personnel

Only **skilled** or **instructed** persons are allowed to operate the machine, e.g. operating and maintenance staff.

- **Skilled person**: A person with technical knowledge or sufficient experience to enable him or her to perceive risks and to avoid hazards which electricity/mechanics can create.
- **Instructed person**: A person adequately advised or supervised by a skilled person to enable him or her to perceive risks and to avoid hazards which electricity/mechanics can create.

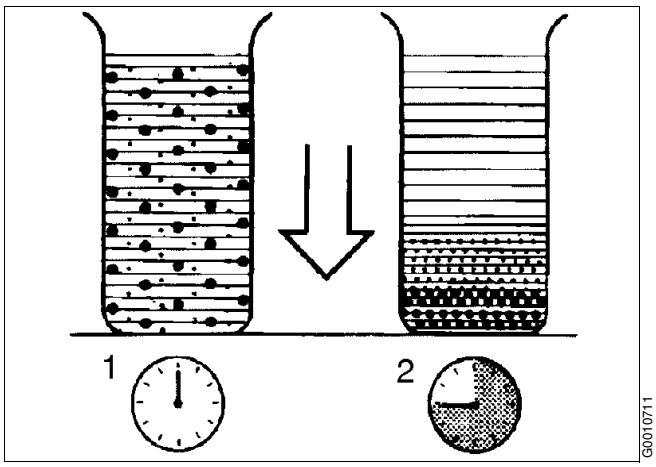
In some cases special skilled personnel may need to be hired, like electricians and others. In some of these cases the personnel has to be certified according to local regulations with experience of similar types of work.

3 Separator Basics

3.1 Basic principles of separation

The purpose of separation can be:

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



Sedimentation by gravity

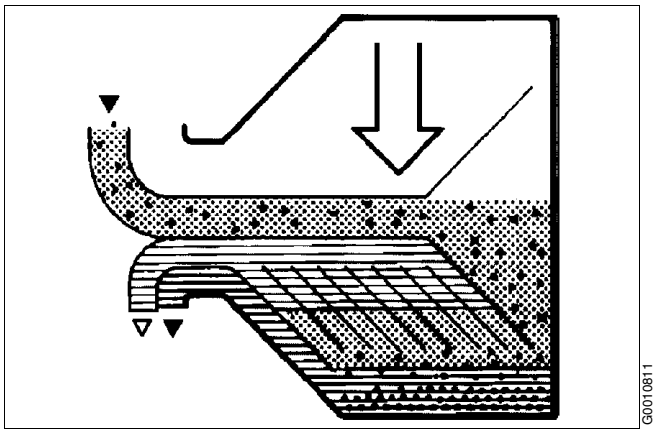
Separation by gravity

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

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

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

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



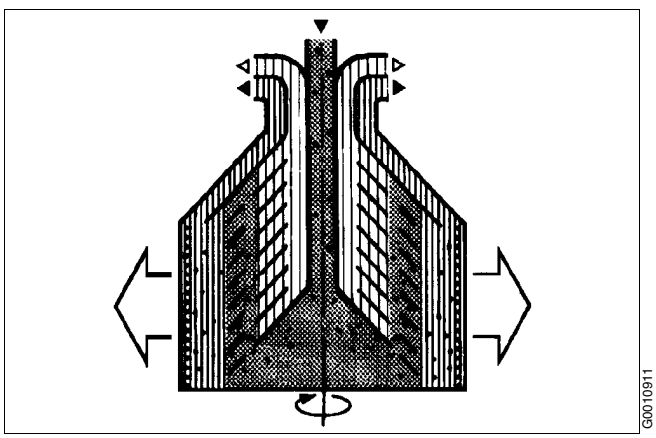
Sedimentation in a settling tank, with outlets making it possible to separate the lighter liquid parts from the heavier

Centrifugal separation

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

Separation and sedimentation is continuous and happens very quickly.

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



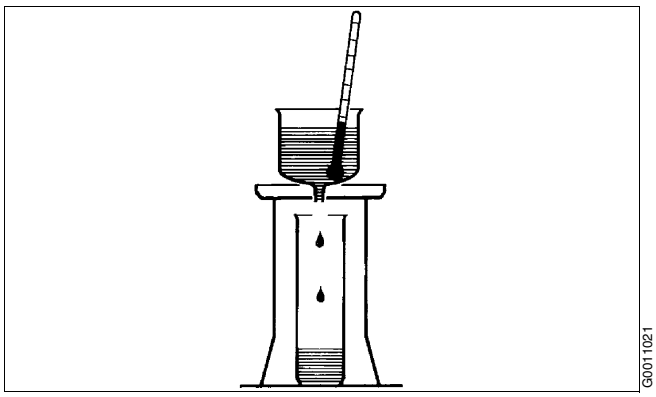
The centrifugal solution

Separating temperatures

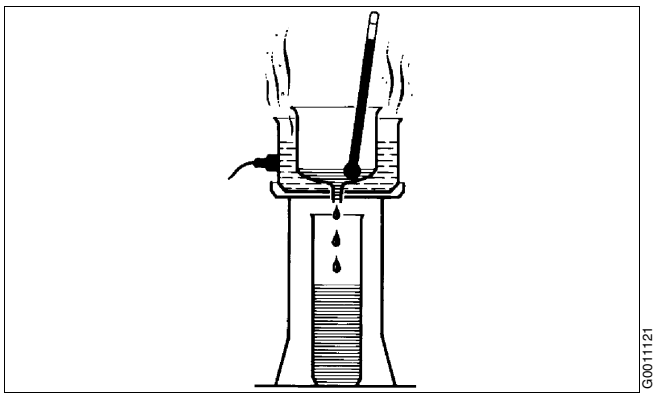
For some types of process liquids (e.g. mineral oils) a high separating temperature will normally increase the separation capacity. The temperature influences oil viscosity and density and should be kept constant throughout the separation.

Viscosity

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



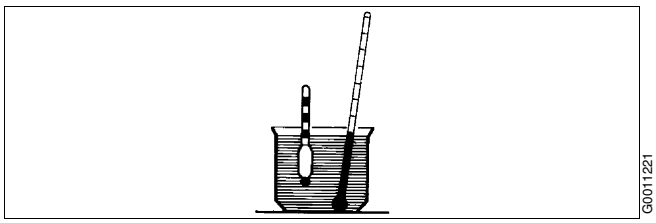
High viscosity (with low temperature)



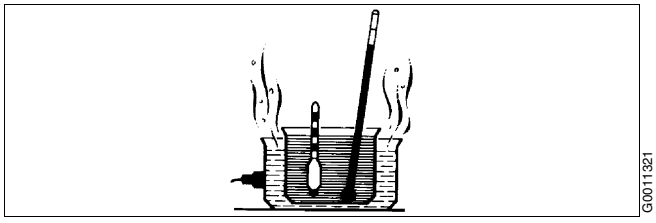
Low viscosity (with high temperature)

Density difference

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



High density (with low temperature)



Low density (with high temperature)

3.2 Design and function

3.2.1 Overview

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

Mechanically, the separator machine frame is composed of a bottom part, a top part and a frame hood. The motor is flanged to the frame as shown in the illustration. The frame feet (5) are vibration damping.

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

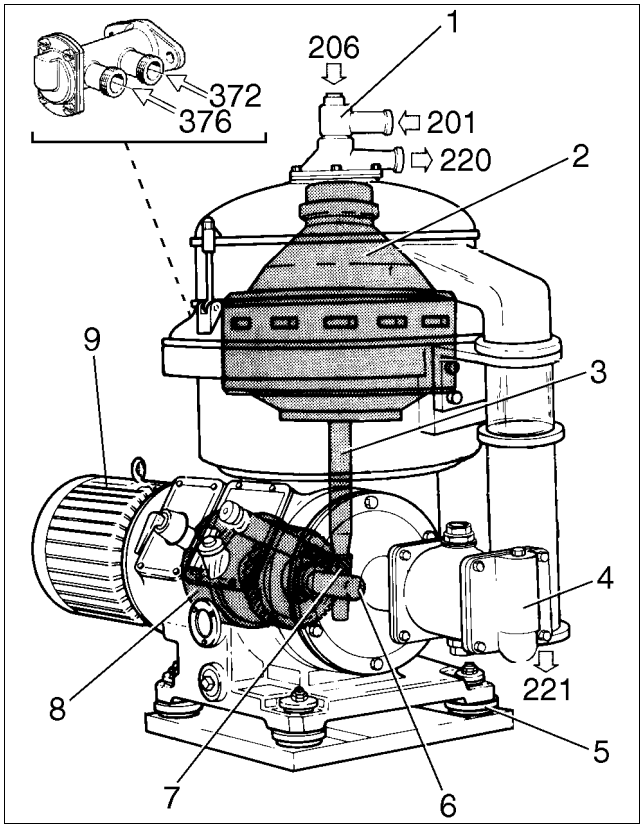
The bottom part also contains an oil bath for the worm gear, a brake and a revolution counter.

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 also contains the discharge mechanism which empties the sludge from the bowl.

The main inlets and outlets are shown with connection numbers in the illustration. These numbers correspond with the numbers used in the connection list and the basic size drawing which can be found in chapter “8 Technical Reference” on page 175.

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 and elastic couplings*
9. *Electric motor*

201. Unseparated oil inlet
206. Sealing/displacement water inlet
220. Clean oil outlet
221. Water outlet
372. Bowl opening water inlet
376. Bowl closing and make-up water inlet

3.2.2 Mechanical power transmission

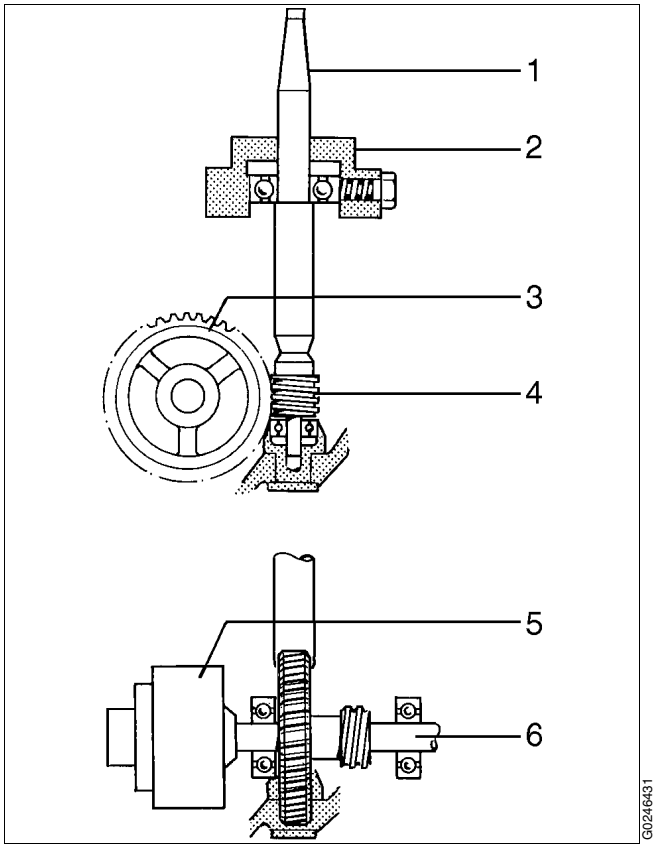
The main parts of the power transmission between motor and bowl are illustrated in the figure.

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

The worm gear has a ratio which increase the bowl speed several times compared with the motor speed. For correct ratio see chapter “8.2 Technical data” on page 179.

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

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

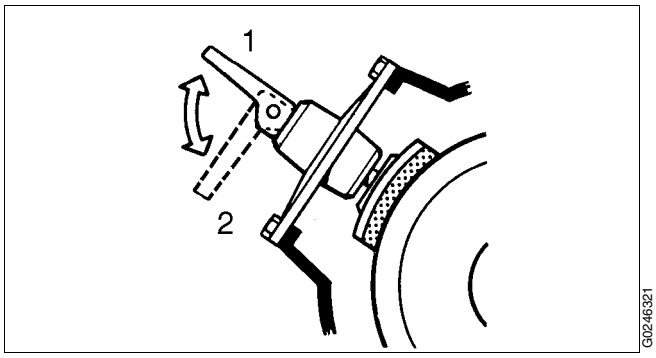


1. *Bowl spindle*
2. *Top bearing and spring casing*
3. *Worm wheel*
4. *Worm*
5. *Friction coupling*
6. *Worm wheel shaft*

3.2.3 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.

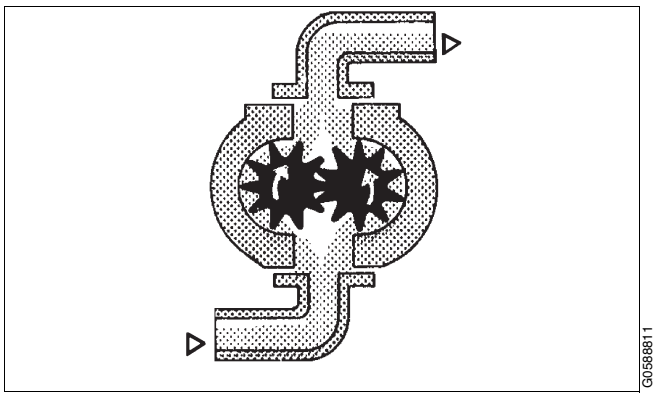
The brake friction pad acts on the outside of the coupling pulley.



Applying (1) and releasing (2) of brake

3.2.4 Feed inlet pump (option)

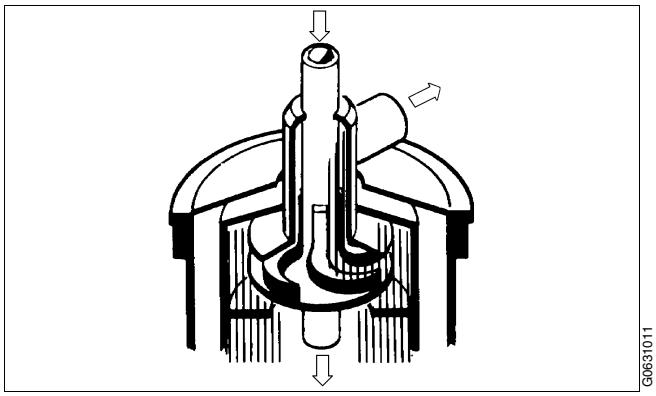
The separator can be equipped with a built-on feed inlet pump of gear type. The pump will be attached to and driven by the horizontal worm wheel shaft.



Feed inlet pump of gear type (option)

3.2.5 Paring disc pump

The paring disc serves as a stationary discharge pump mounted in a chamber in the rotating bowl neck. The paring disc dips radial into the rotating liquid which then is pared out.



Paring disc pump

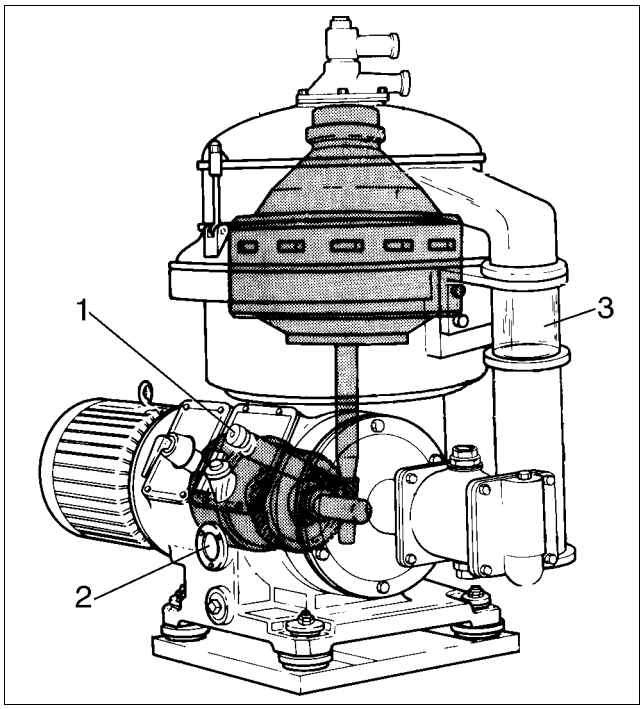
3.2.6 Sensors and indicators

Back pressure gauge

Correct limit for the back pressure in the clean oil outlet can be found in chapter “4.1.5 Running” on page 45 or preferably in the System Manual, if any.

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

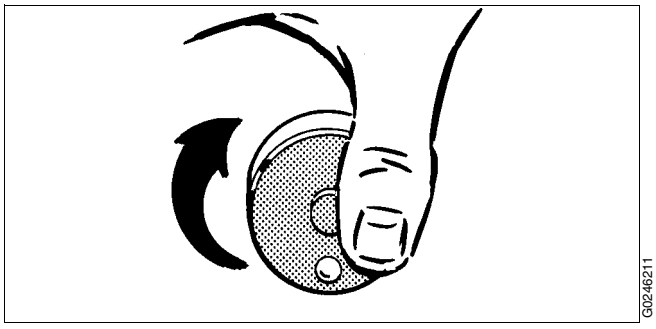
- restriction in the outlet piping, e.g. a buckled or bent pipe,
- increased throughput,
- increased viscosity, decreased separating temperature.



1. *Revolution counter*
2. *Oil sight glass*
3. *Sight glass for separated water outlet*

Revolution counter

A revolution counter, which should turn clockwise during operation, 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 175. Refer to name plate for speed particulars.



The revolution counter should turn clockwise

Oil sight glass

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

Sight glass for separated water outlet

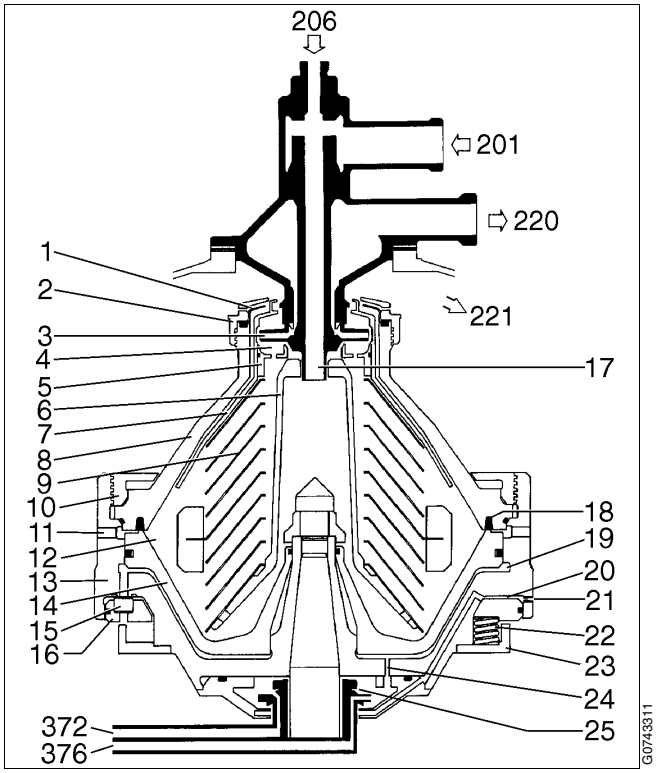
The sight glass shows the flow of the separated water and if any oil is escaping through the water outlet. If so, see chapter “7 Trouble-tracing” on page 163.

3.2.7 Process main parts

1. Gravity/clarifier disc
2. Small lock ring
3. Oil paring disc
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. Drain valve plug **
*16. Operating slide **
17. Inlet pipe
*18. Bowl hood seal ring **
*19. Closing water chamber **
*20. Opening water chamber **
*21. Nozzle * for opening water*
*22. Spring **
*23. Spring holder **
*24. Hole for closing water **
*25. Control paring disc **

201. Unseparated oil inlet
206. Sealing/displacement water inlet
220. Clean oil outlet
221. Water outlet
*372. Opening water inlet **
*376. Closing and make-up water inlet **

* *Parts effecting a sludge discharge*



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

Inlet and outlet device

The inlet and outlet device consists of the following parts:

- The inlet (201). This comprises the pipe bend and the inlet pipe (17) which extends into the bowl.
- The outlets (220, 221). These comprise the collecting cover and the oil paring disc (3) which continuously pumps the separated oil out of the bowl. The paring disc is located in a paring chamber (4) in the top of the bowl.

  The separated water flows over the edge of the small lock ring (2) out to the inside of the collecting cover.

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 rectangular ring seal the connections between the parts.

The oil outlet connecting housing is fastened to the separator frame hood. Height adjusting rings determine the height position of the oil paring disc in the paring chamber.

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 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.

On top of the bowl hood (8) sits the small lock ring (2) which holds the gravity disc (1) in place. Separated water is coming out from the bowl via the small lock ring. 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 (18) in the bowl hood.

Sludge discharge mechanism

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

The sludge discharge mechanism, which controls the sliding bowl bottom, comprises an operating slide (16) and an operating water device. Passive parts are the nozzle (21), hole (24) and drain valve plugs (15). 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

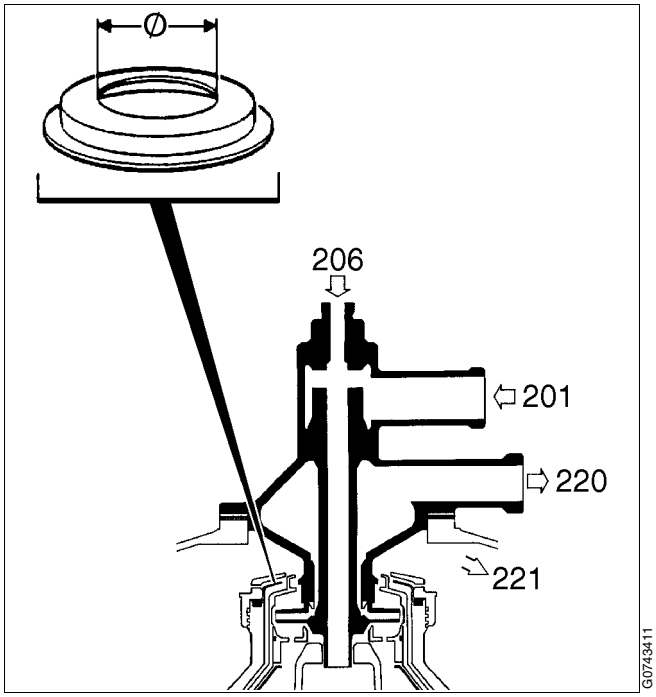
3.3.1 Purifier bowl

Characteristic parts

The illustration shows the characteristic part of the purifier bowl, the gravity disc. The disc should be chosen according to directions in chapter “4.1.2 Selection of gravity disc” on page 39.

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

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

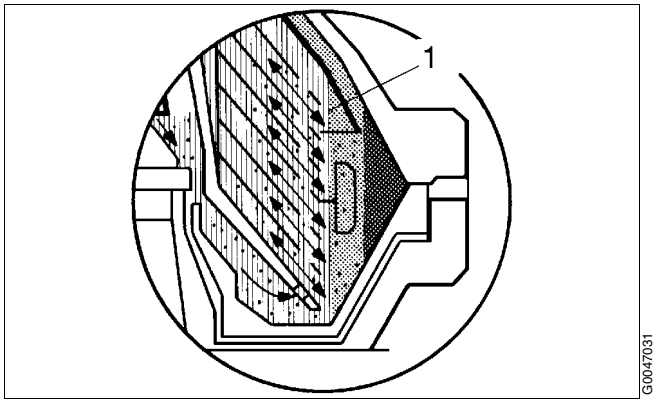


Purifier bowl

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. That is done by exchanging the gravity disc. For this purpose a number of gravity discs with various hole diameters are delivered with the separator.

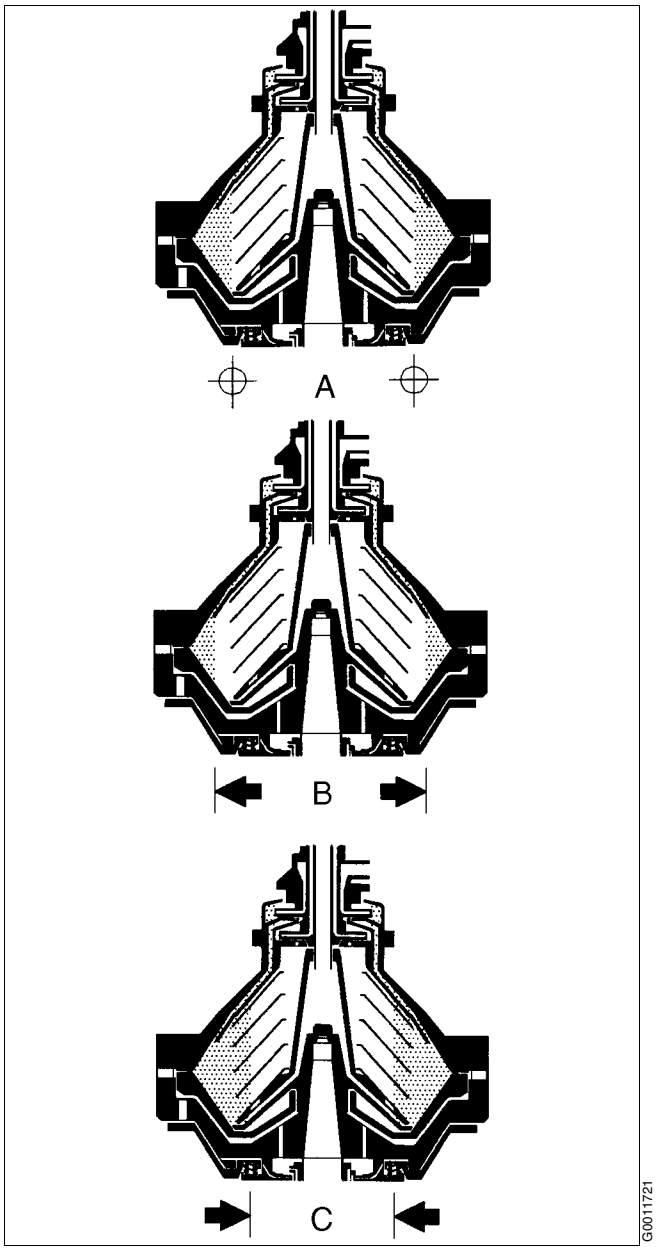


Interface position (1)

A. Correct interface position

B. Wrong interface position - broken water seal

C. Wrong interface position - bad separation

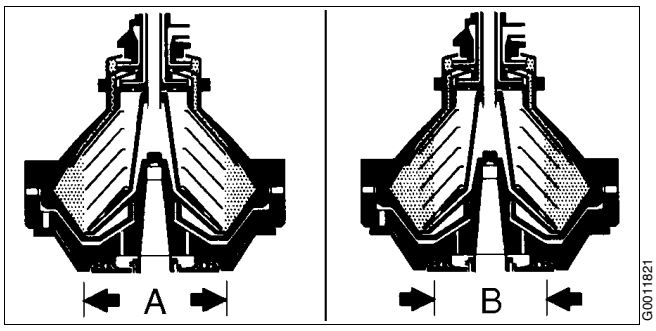


Factors influencing the interface position

1. Oil viscosity, density and throughput

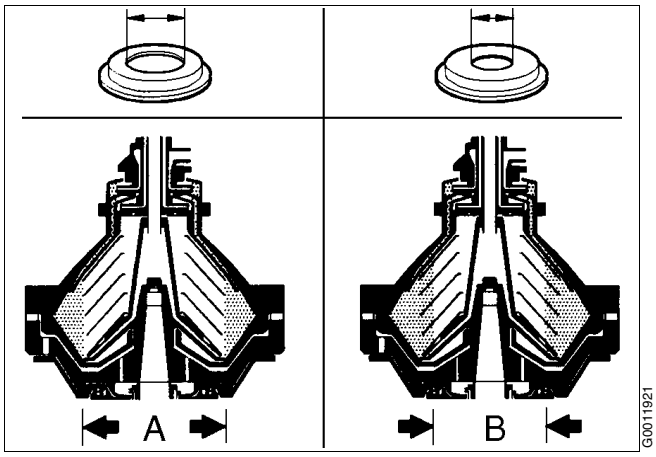
Oil with high density and/or high viscosity, as well as high throughput, will position the oil/water interface closer to the bowl periphery than for oil with low properties.

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



2. Gravity disc

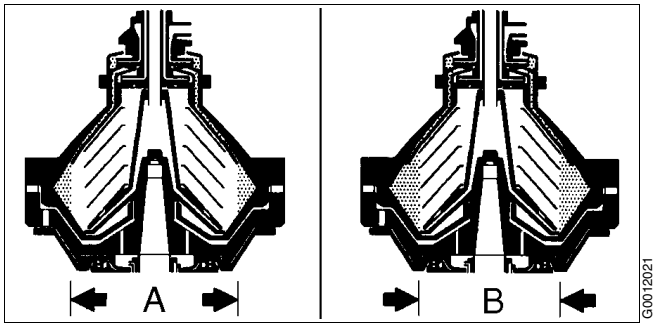
To compensate for the above factors the interface is adjusted to a correct position by altering the outlet for the water, i.e. exchanging the gravity disc. Changing to a gravity disc with larger hole diameter will move the interface towards the bowl periphery whereas a disc with smaller hole diameter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



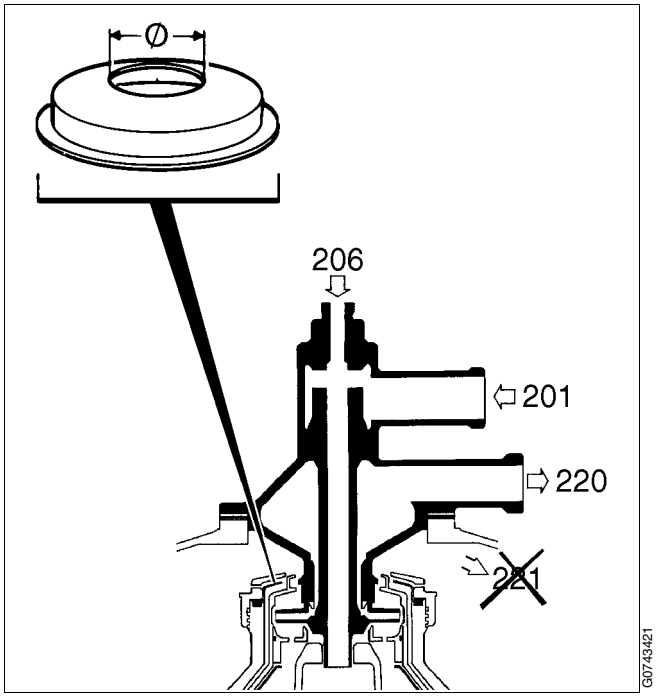
A. Excessive back pressure
B. Normal back pressure

3.3.2 Clarifier bowl

Characteristic parts

The illustration shows the characteristic part of the clarifier bowl. 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.

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



Clarifier bowl

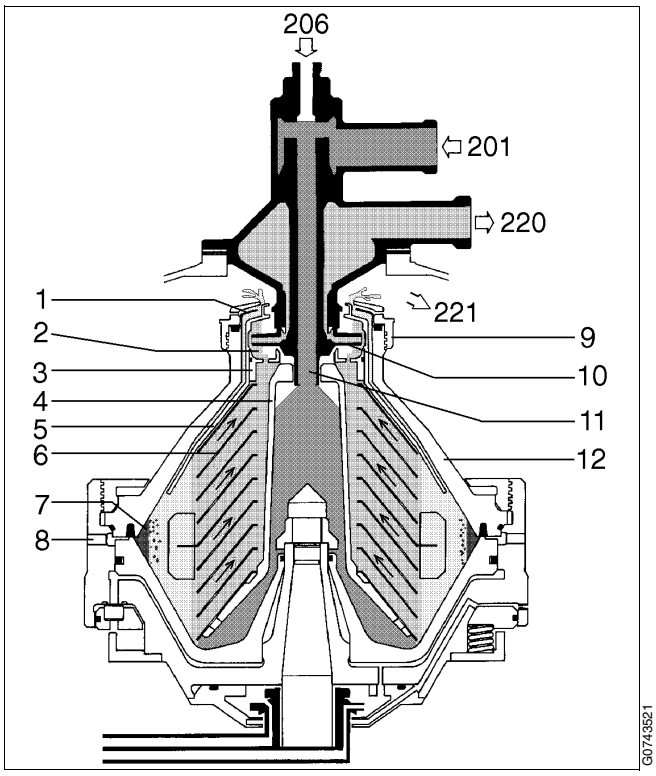
3.3.3 Normal separation

Unseparated oil is fed into the bowl through the inlet pipe (11) and is pumped via the distributor (4) 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.

The oil is continuously cleaned as it travels 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, are forced towards the periphery of the bowl and collected in the sludge space (7). The bowl content is discharged at 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 then flows over the edge of the small lock ring (9) out to the inside of the collecting cover.



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. *Small lock ring*
10. *Oil paring disc*
11. *Inlet pipe*
12. *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 min. and max. time stated in “8.2 Technical data” on page 179.

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 chamber (6) under the sliding bowl bottom which is greater than the force of the process liquid above the sliding bowl bottom.

The operating slide (5) is pressed upwards by the springs (9) and the valve plugs (4) then cover the drain channels (3).

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).

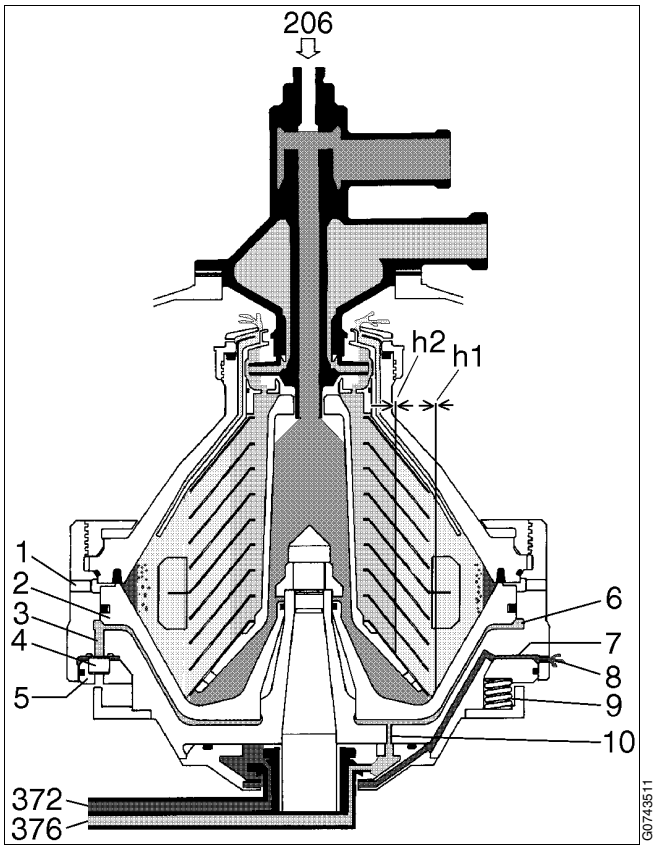
The opening water (372), which is supplied into the space above the operating slide (5), overcomes the force from the springs (9) and the operating slide is pressed downwards. The drain channels (3) open and the closing water is drained. This allows the force on the underside of the sliding bowl bottom (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 water chamber (7) is drained through nozzle (8). The springs (9) move the operating slide upwards and the drain channels (3) are closed by the drain valve plugs (4). The closing water (376) is supplied via the hole (10) in the bowl body to the closing water chamber (6) which presses the sliding bowl bottom (2) upwards. The bowl closes and the sludge discharge cycle is complete.

At purification, add sealing water (206) to the bowl before supplying oil to the separator.

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. Drain channel
4. Drain valve plug
*5. Operating slide **
6. Closing water chamber
*7. Opening water chamber **
*8. Nozzle * for opening water*
9. Spring
*10. Hole * for closing water*

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 bowl, inlet/outlet and operating water device. Renewal of seals in bowl inlet/outlet and operating water device.

Major Service (MS) Overhaul of the complete separator, including bottom part (and activities included in an Intermediate Service, if any). Renewal of seals and bearings in bottom part.

Purification Liquid/liquid/solids separation with the intention of separating two intermixed and mutually insoluble liquid phases of different densities. Solids having a higher density than the liquids can be removed at the same time. The **lighter** liquid phase (oil), which is the major part of the mixture, shall be purified as far as possible.

Sediment (sludge) Solids separated from a liquid.

Sludge discharge Ejection of sludge from the separator bowl.

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

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

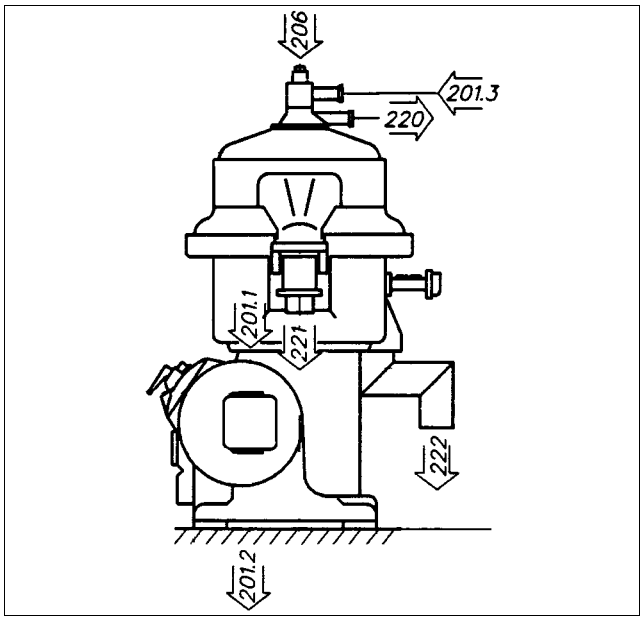
Water seal Water in the solids space of the separator bowl to prevent the light phase (oil) from leaving the bowl through the heavy phase (water) outlet, in purifier mode.

4 Operating Instructions

Contents

4.1 Operating routine

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



Explanations of the separator connections are given in “8.4 Connection list” on page 184.

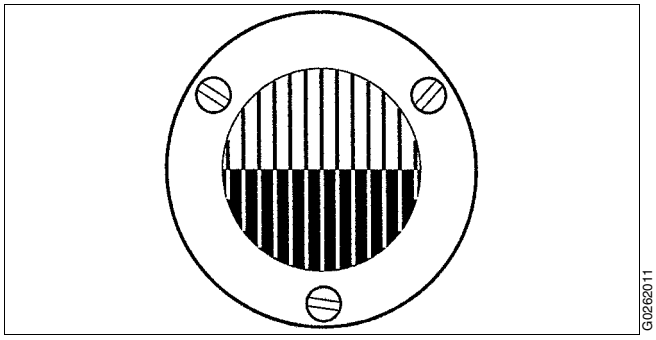
4.1.1 Before first start

Technical demands for connections and logical limitations for the separator is described in chapter “8 Technical Reference” on page 175 in the documents:

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

Before first start the following check points shall be carried out:

- Ensure the machine is installed correctly and that feed-lines and drains have been flushed clean.
- Fill oil in the gear housing. Fill up to the middle of the sight glass. Use the correct grade of oil. The separator is delivered without oil in the worm gear housing. For grade and quality, see “8.7 Lubricants” on page 192.
- Make sure the direction of rotation of the motor corresponds to the sign on the motor, see “8.11 Machine plates and safety labels” on page 205.

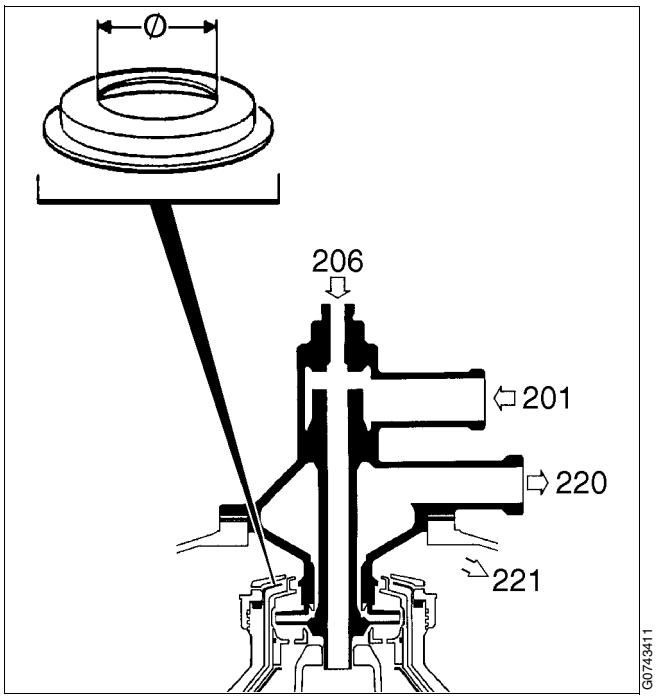


Fill oil in the gear housing

4.1.2 Selection of gravity disc

The separator is delivered with a set of gravity discs.

How to replace a gravity disc is described in “6.3 Bowl hood and disc stack (IS)” on page 112.



Fit correct gravity disc

Clarification

When running the separator as a clarifier, select the gravity disc with the smallest hole diameter, the so-called clarifier disc. See the *Spare Parts Catalogue* for correct hole diameter.

Purification

A number of gravity discs are delivered for operating the separator as a purifier. The diameter of a gravity disc sets the position of the oil-water interface in the separator. The separation efficiency can be optimized by selection of the correct diameter for each process.

When selecting a gravity disc the general rule is to use the disc having the largest possible hole without causing a break of the water seal.

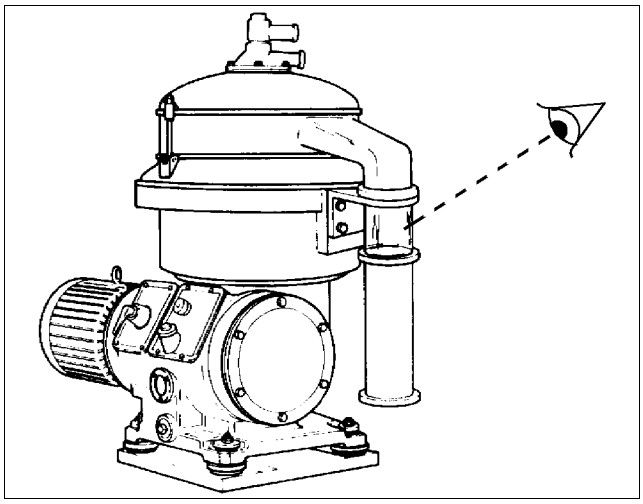
The heavier or more viscous the light phase (oil) and the larger the liquid feed the smaller the diameter should be.

When the heavy phase (water) is wanted more free from the light one (oil), the interface should be placed nearer the bowl centre, however not inside the outer edge of the discs (too small gravity disc), as this would prevent the liquid flow.

For a more detailed description of the interface position, see “3.3.1 Purifier bowl” on page 29.

As an aid, use the nomogram on next page to find the correct gravity disc. It can be used when the density of the oil at a temperature of 15 °C is known. However, note that the nomogram is purely theoretical. In practical operation, practice the following general rule:

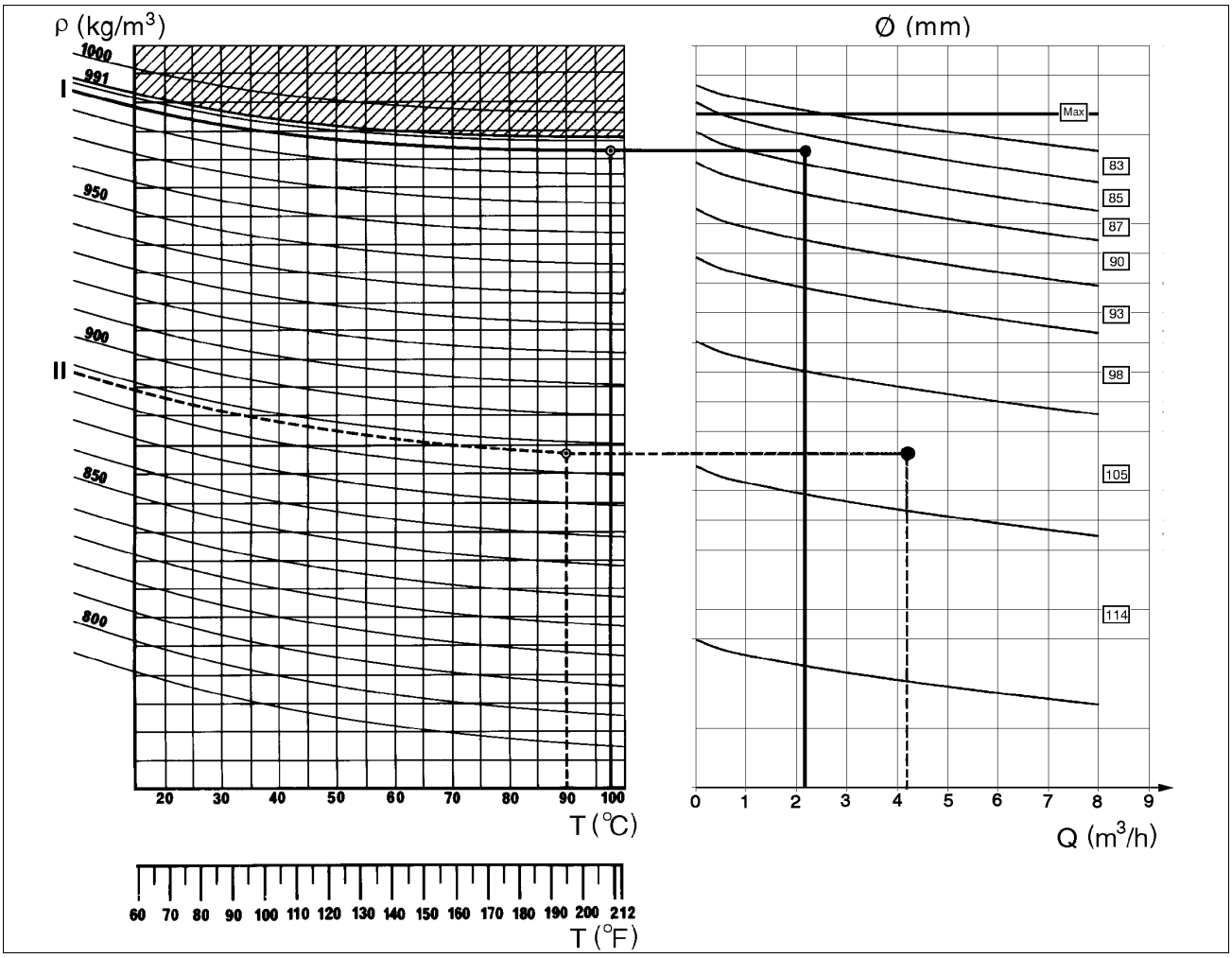
1. Fit a gravity disc one size larger than the recommended in the nomogram.
2. Run the separator.
3. Observe if oil flows through the water outlet. The observation can be done through the sight glass.
   - If **Yes**, stop the separator and fit the next **smaller** gravity disc.
   - If **No**, stop the separator and fit the next **larger** gravity disc.
4. Repeat steps 1-3 above until having the gravity disc with the **largest** hole diameter without causing a break of the water seal



Check if oil flows through the water outlet

How to use the nomogram

Alfa Laval ref. 567638, rev. 0



Nomogram for MOPX 308

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

ρ = Density of oil in kg/m^3 at 15 °C

Q = Throughput in m^3/h

T = Separating temperature in °C or °F

Ø = Gravity disc hole diameter in mm

Example I in nomogram

Reference in graph:	_____
Oil density:	988 kg/m^3 at 15 °C
Separating temperature:	98 °C
Throughput:	2,2 m^3/h

The nomogram indicates that a gravity disc with a hole diameter of 85 mm should be tried.

Example II in nomogram

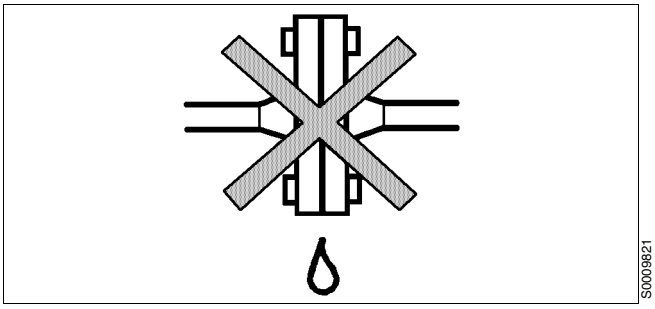
Reference in graph:	_ _ _ _ _ _ _ _ _ _
Oil density:	888 kg/m^3 at 15 °C
Separating temperature:	90 °C
Throughput:	4,2 m^3/h

The nomogram indicates that a gravity disc with a hole diameter of 105 mm should be tried.

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 collecting and top covers are fully tightened.
2. Check that all inlet and outlet connections have been correctly made and properly tightened.



Check for leakages (not admitted)

CAUTION

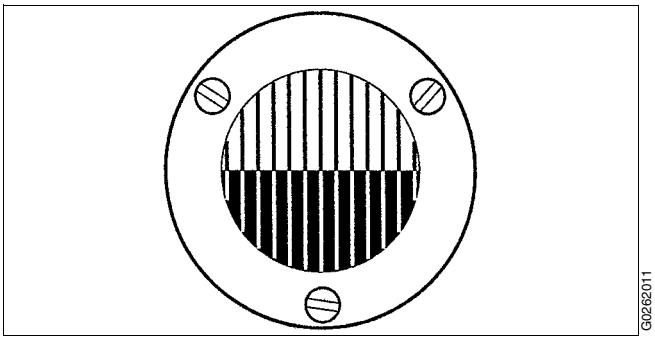
Burn hazards

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

Escaping hot liquid can cause burns.

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

   Fill if necessary. See chapter "8.7 Lubricants" on page 192 for a list of recommended oils.



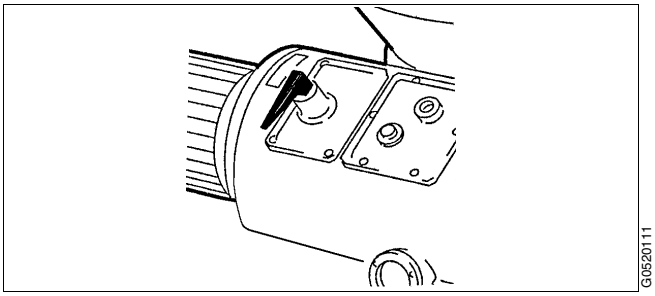
Check the oil level

NOTE

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

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

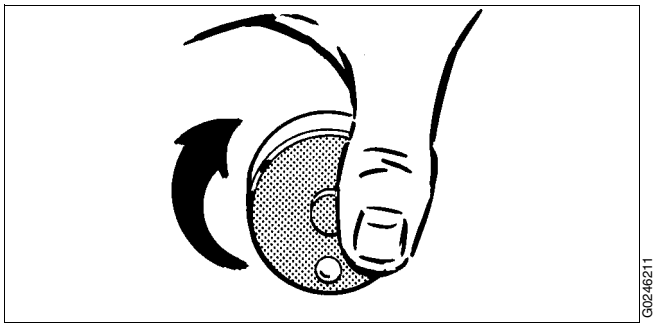
4. Make sure that the brake is released.



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.



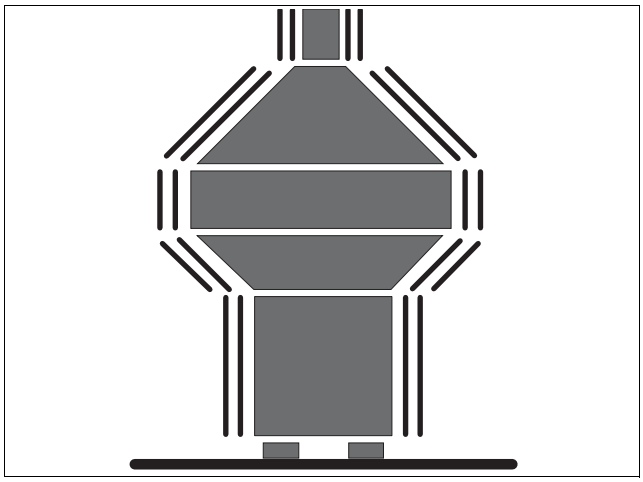
Check for correct direction of rotation

WARNING

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.



Check for vibration

WARNING

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 164, 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”.

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**:

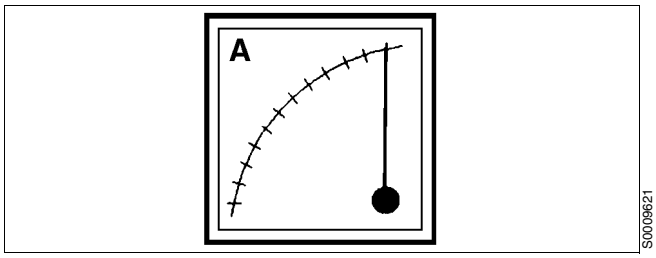
   a. Start the oil feed with full flow. Fill the bowl as quickly as possible.

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

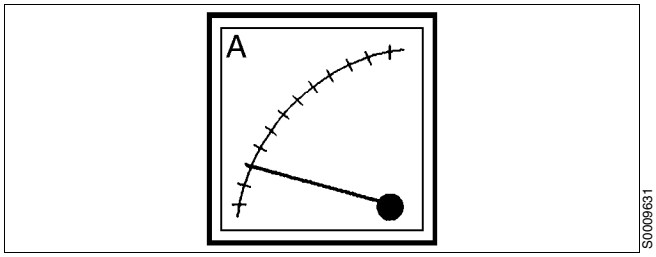
   Check the separator inlet and outlet pressures. See recommended values in your system documentation.

10. Adjust to desired throughput.

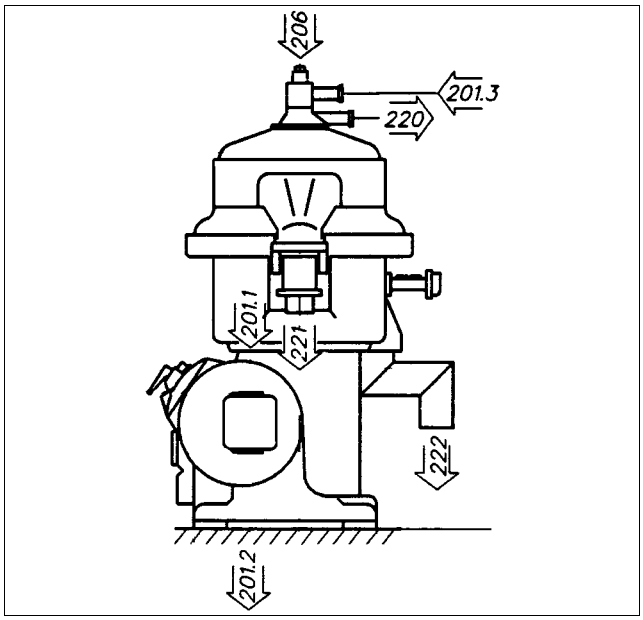
11. Discharge by opening the valve for discharge liquid (at connection 372) until a discharge is heard. For maximum and minimum time for discharge intervals, see chapter “8 Technical Reference” on page 175.



Current increases when the coupling engages...



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



In- and outlets of the separator

4.1.5 Running

1. Check that the feed has the correct flow and temperature. See chapter “8 Technical Reference” on page 175 for correct values.

.

WARNING

Disintegration hazards

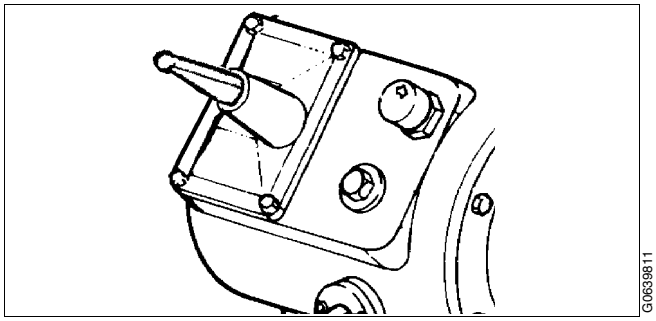
Ensure that correct discharge intervals and cleaning procedures are used.

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 53.

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.



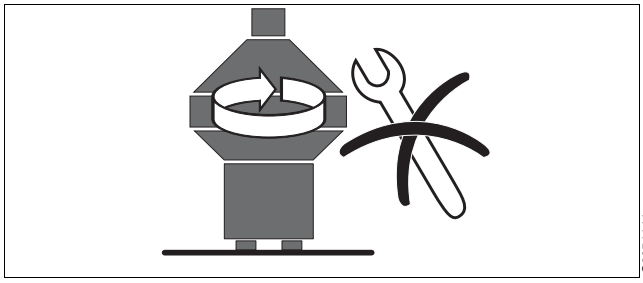
The final action, apply the brake

5. Wait until the separator has come to a complete standstill (3,5 - 4,5 minutes).

WARNING

Entrapment hazards

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

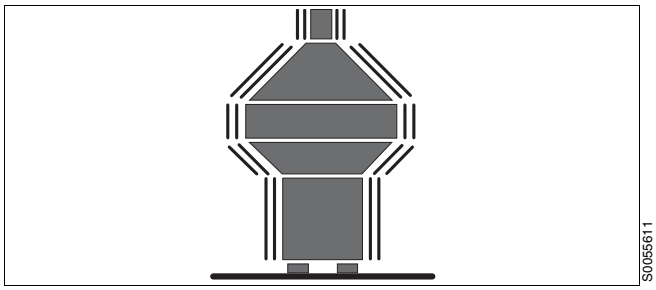


The separator must not be dismantled before standstill

4.1.7 Emergency stop

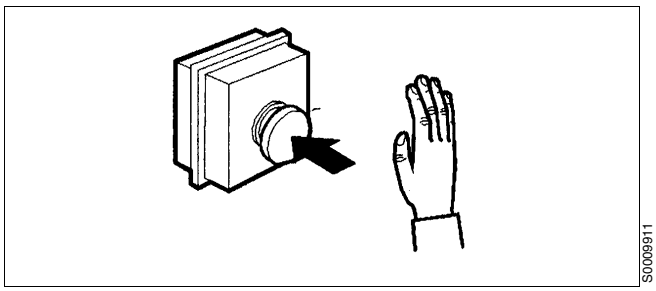
If the separator begins to vibrate excessively during operation, stop it immediately by pushing the **emergency stop**. The separator motor is switched off.

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



Hazard!

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



Push the emergency stop if vibration is excessive

WARNING

Disintegration hazards

Do not discharge a vibrating separator.

Out-of-balance vibration can become worse!

CAUTION

Disintegration hazards

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

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

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.

WARNING

Disintegration hazards

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

5.1.2 Maintenance intervals

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

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

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

Oil change

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

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

Intermediate Service (IS)

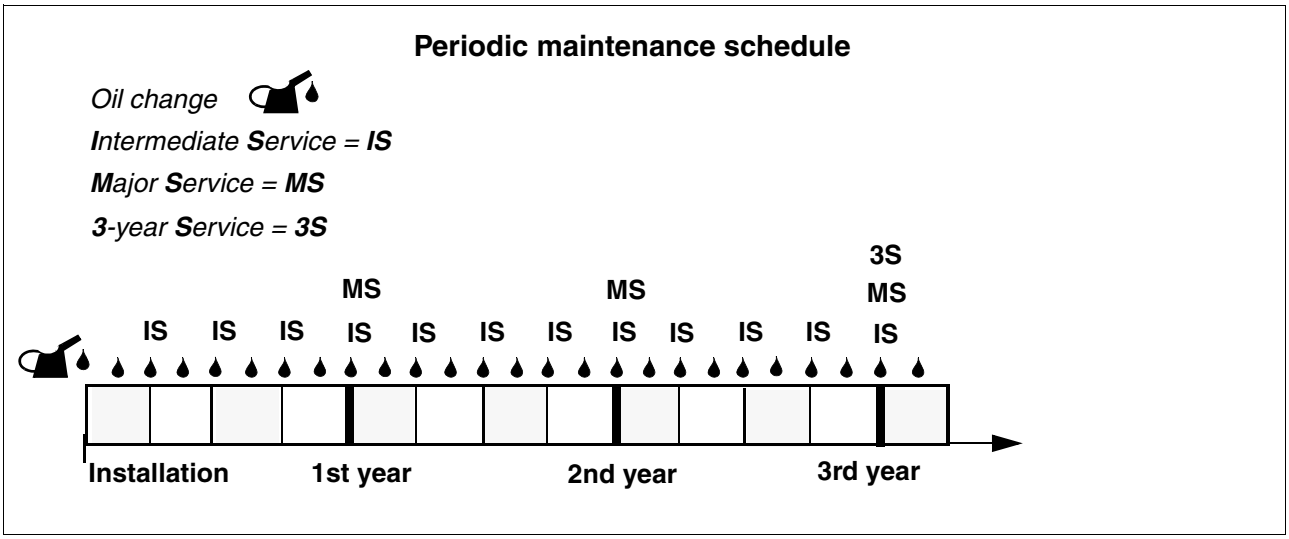
Intermediate Service consists of an overhaul of the separator bowl, inlet/outlet and operating device every **3 months** or **2000 operating hours**. Seals in bowl and gaskets in inlet/outlet device are renewed.

Major Service (MS)

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

3-year Service (3S)

3-year Service consists of an overhaul of the complete separator. The service should be coordinated with a Major Service. Compared with the Major Service additional spare parts with longer lifetime have to be renewed.



5.1.3 Maintenance procedure

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

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

1. Dismantle the parts as mentioned in the maintenance log and described in chapter “6 Dismantling/Assembly” on page 105.

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

5.1.4 Service kits

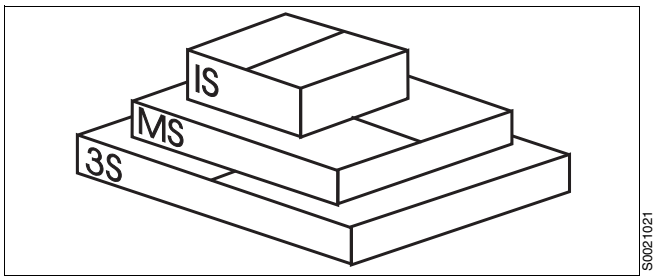
Special service kits are available for Intermediate Service (IS), Major Service (MS) and 3-year Service (3S).

The built-on feed pump (option) has its own service kit for Major Service.

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

Note that the parts for IS are **not** included in the MS kit and parts for IS & MS are not included in the 3S kit.

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



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

NOTE

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

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

WARNING

Disintegration hazards

Use of imitation parts may cause severe damage.

5.2 Maintenance Logs

5.2.1 Daily checks

The following steps should be carried out daily.

Main component and activity	Part	Page	Notes
Inlet and outlet			
Check for leakage	Connecting housing	–	
Separator bowl			
Check for vibration and noise		100	
Horizontal driving device			
Worm wheel shaft and gear casing			
Check for vibration and noise		100	
Check	Oil level in gear housing	42	
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** and clean the gear housing.

Main component and activity	Part	Page	Notes
Horizontal driving device			
Worm wheel shaft and gear housing			
Check	Worm wheel and worm	96	
Renew	Oilb) in gear housing	99	

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 "8.7 Lubricants" on page 192 for further information.

5.2.3 Intermediate Service (IS)

Name of plant:		Local identification:	
Separator:	MOPX 308	Manufacture No./Year:	
Total running hours:		Product No:	881033-16-02/1
Date:		Signature:	

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

Main component and activity	Part	Page	Notes
Inlet and outlet			
Clean and inspect	Threads of inlet pipe	70	
	Connecting housing	–	
Separator bowl			
Clean and check	Gravity/clarifier disc	–	
	Lock ring	71	
	Bowl hood	60	
	Top disc	–	
	Oil paring disc	70	
	Level ring	70	
	Bowl discs	95	
	Distributor	–	
	Sliding bowl bottom	74	
	Bowl body	–	
	Bowl spindle cone and bowl body nave	61	
	Operating mechanism	73, 75	
Check	Corrosion	61	
	Cracks	64	
	Erosion	66	
	Galling of guide surface	69	
	Disc stack pressure	65	
Renew	O-rings and sealings	–	

Main component and activity	Part	Page	Notes
Operating device			
Clean and check	Operating paring disc	–	
Renew	O-rings	–	
Horizontal driving device			
Worm wheel shaft and gear housing			
Check	Worm wheel and worm	96	
Renew	Oil in gear housing	99	
Electrical motor			
Lubrication (if nipples are fitted)	See sign on motor	–	
Signs and labels on separator			
Check attachment and legibility	Safety label on hood	205	
	Direction of rotation arrow	205	
	Power supply frequency	205	

5.2.4 Major Service (MS)

Name of plant:		Local identification:	
Separator:	MOPX 308	Manufacture No./Year:	
Total running hours:		Product No:	881033-16-02/1
Date:		Signature:	

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

Main component and activity	Part	Page	Notes
Inlet and outlet			
Clean and inspect	Threads of inlet pipe	70	
	Connecting housing	–	
Separator bowl			
Clean and check	Gravity/clarifier disc	–	
	Lock ring	86, 71	
	Bowl hood	60	
	Top disc	–	
	Oil paring disc	70	
	Level ring	70	
	Bowl discs	95	
	Distributor	–	
	Sliding bowl bottom	74	
	Bowl body	–	
	Bowl spindle cone and bowl body nave	61	
	Operating mechanism	73, 75	
Check	Corrosion	61	
	Cracks	64	
	Erosion	69	
	Galling of guide surface	69	
	Disc stack pressure	65	
	Oil paring disc height position	87	
Renew	O-rings and sealings	–	

Main component and activity	Part	Page	Notes
Operating device			
Clean and check	Operating paring disc	–	
Check	Height position of operating paring disc	87	
Renew	O-rings	–	
Vertical driving device			
Clean and check	Bowl spindle	–	
	Buffer springs and ball bearing housing	80	
	Radial wobble of bowl spindle	77	
Renew	Spindle bearings and O-rings	130	
Horizontal driving device			
Worm wheel shaft and gear housing			
Check	Worm wheel and worm	96	
	Radial wobble of worm wheel shaft	90	
	Axial play of flexible plate	84	
Renew	Bearings, O-rings and sealings	140	
	Oil in gear housing	99	
Brake			
Clean and check	Spring and brake shoe	79	
Renew	Friction pad	78	
Friction coupling			
Clean and check	Worm wheel coupling	–	
Renew	Friction pads	81	
Electrical motor			
Lubrication (if nipples are fitted)	See sign on motor	–	
Signs and labels on separator			
Check attachment and legibility	Safety label on hood	205	
	Direction of rotation arrow	205	
	Power supply frequency	205	

Main component and activity	Part	Page	Notes
Feed pump (option)			
Clean and check	Bushings, wear gaskets, flexible coupling, relief/safety valve and impeller shaft	154	
Renew	Lipseal rings	154	

5.2.5 3-year Service (3S)

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

NOTE

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

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

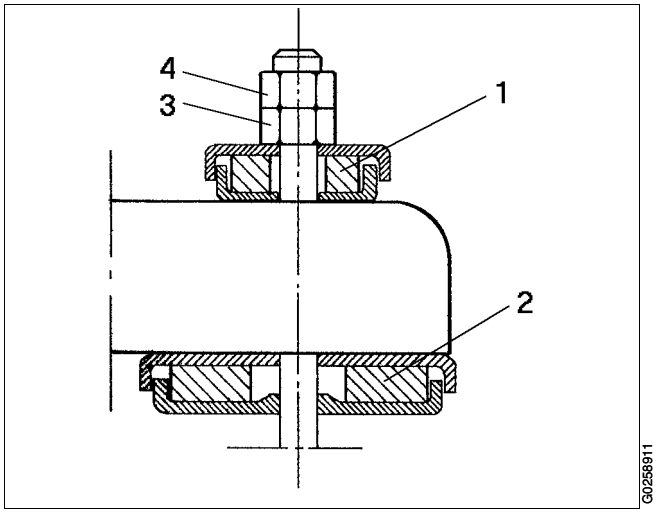
Frame feet, renewal

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

NOTE

When lifting a separator it must always **hang securely**. See separate instruction in chapter "5.5 Lifting instructions" on page 91.

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 **16 Nm**.
7. Hold the nut (3) firmly and secure with the lock nut (4).
8. Connect the previously disconnected pipes, hoses and cables.



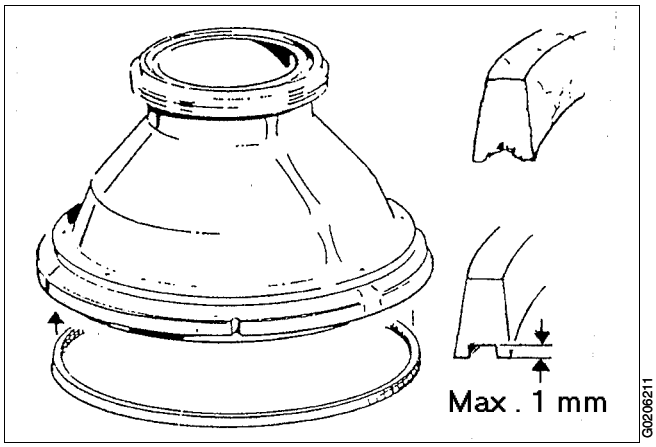
1. Vibration damper, upper
2. Vibration damper, lower
3. Nut
4. Lock nut

5.3 Check points at Intermediate Service (IS)

5.3.1 Bowl hood seal ring

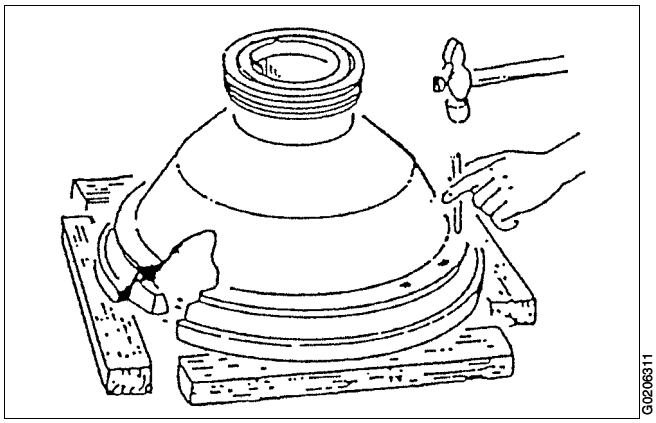
Poor sealing between the bowl hood seal ring and the sealing edge of the sliding bowl bottom will cause a leakage of process liquid from the bowl.

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



Max. permitted indentation of the seal ring is 1 mm

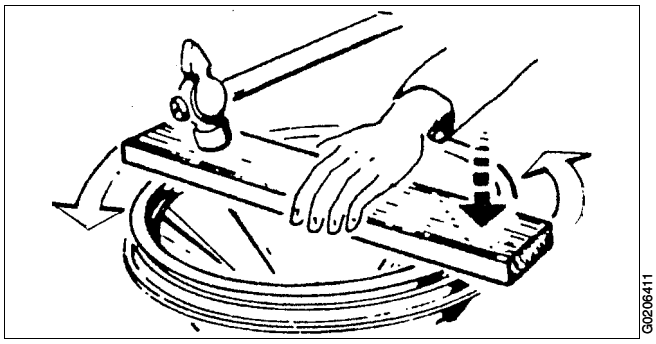
Knock out the old ring by means of a pin inserted in the holes intended for this purpose.



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.

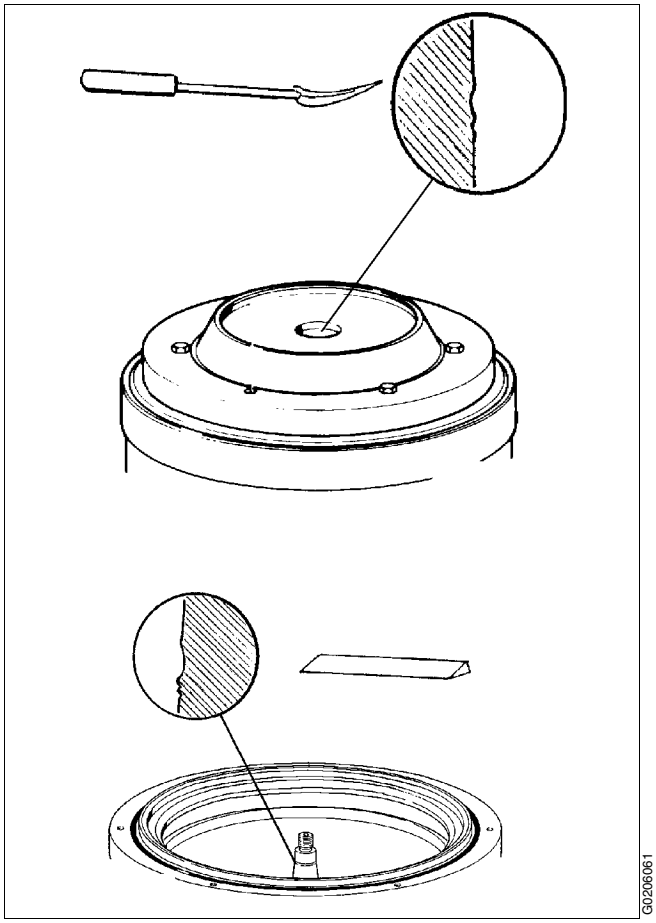
Corrosion may cause the bowl to stick firmly to the spindle cone and cause difficulties during the next dismantling.

- 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

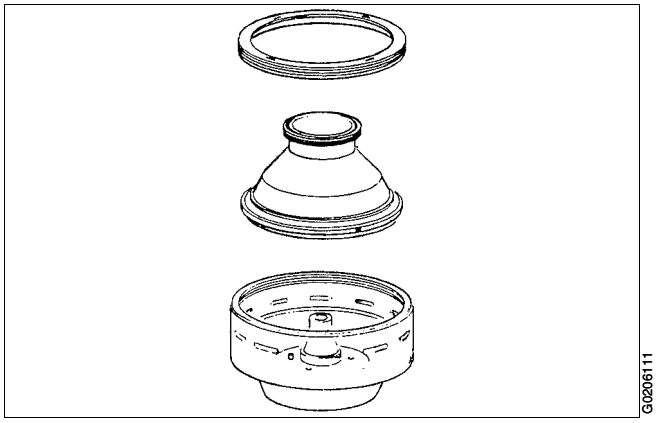
5.3.3 Corrosion

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.

WARNING

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

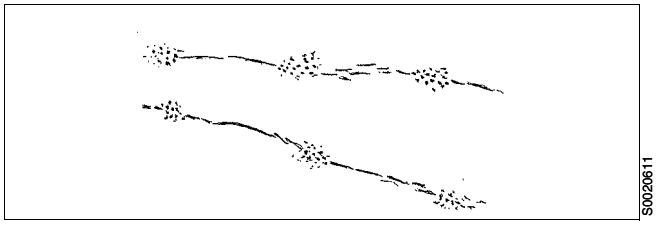
Corrosion (rusting) can occur on unprotected surfaces of non-stainless steel and cast iron. Frame parts can corrode when exposed to an aggressive environment.

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:

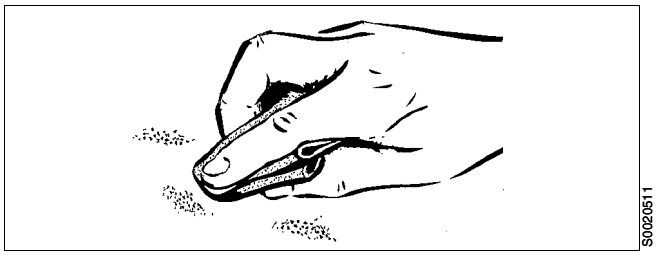
- Exposed to a stationary solution.
- In a crevice.
- Covered by deposits.
- Exposed to a solution that has a low pH value.

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

WARNING

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.

WARNING

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.

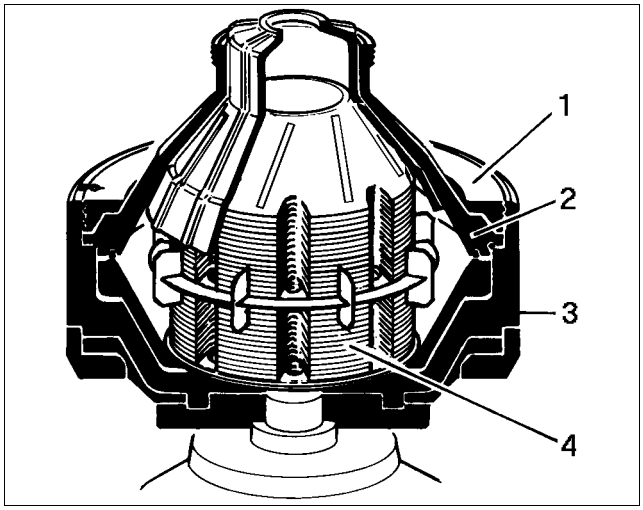
5.3.5 Disc stack pressure

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

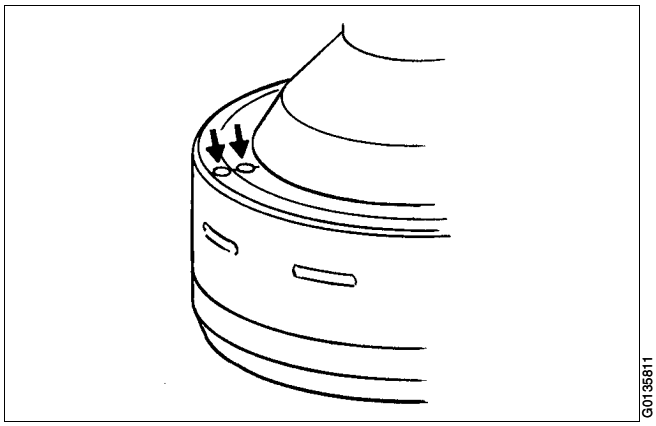
Compress the disc stack by tightening the lock ring, see chapter “6.3.3 Assembly” on page 116.

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° ahead of the mark on the bowl body.

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

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

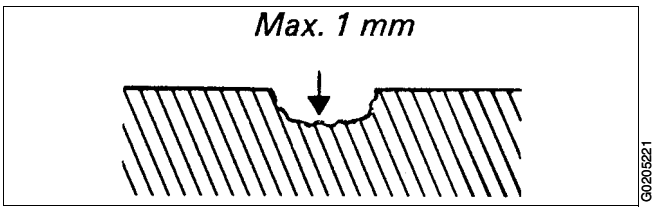
If the ϕ-marks do not reach or pass each other, the reason could be an incorrectly assembled bowl or too many discs in the disc stack. Reassemble and check.



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

WARNING

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.

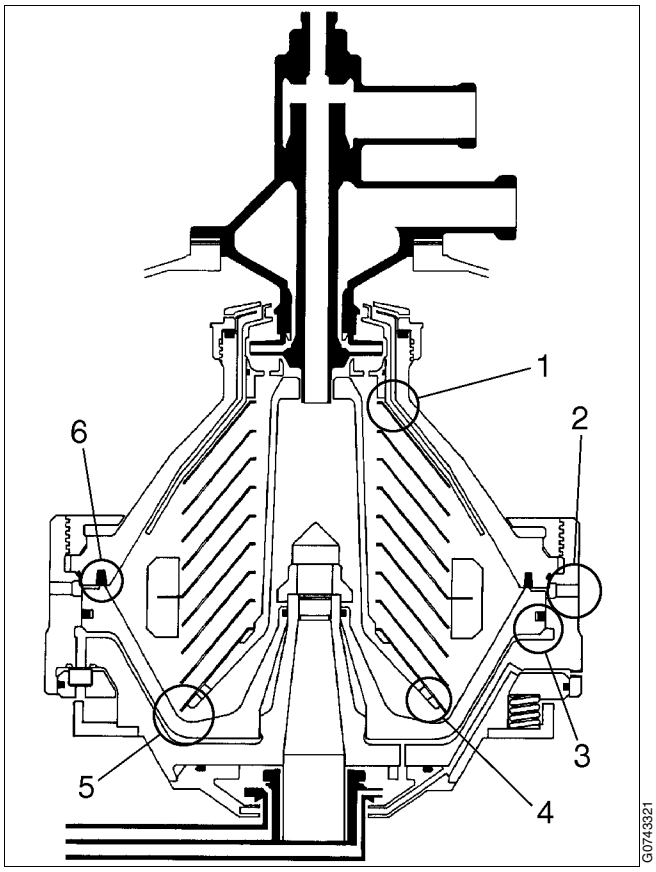
Erosion is characterised by:

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

Surfaces particularly subjected to erosion are:

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



Surfaces particularly subjected to erosion

WARNING

Disintegration hazard

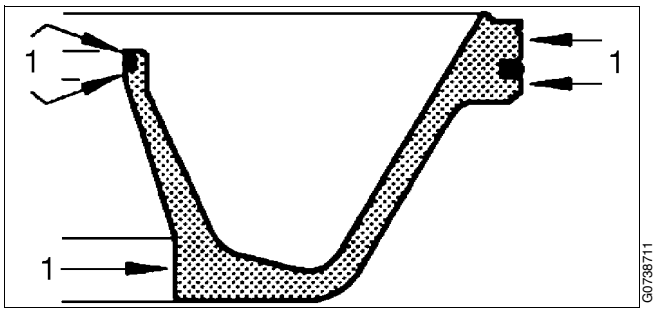
Erosion damage can weaken parts by reducing the thickness of the metal.

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).

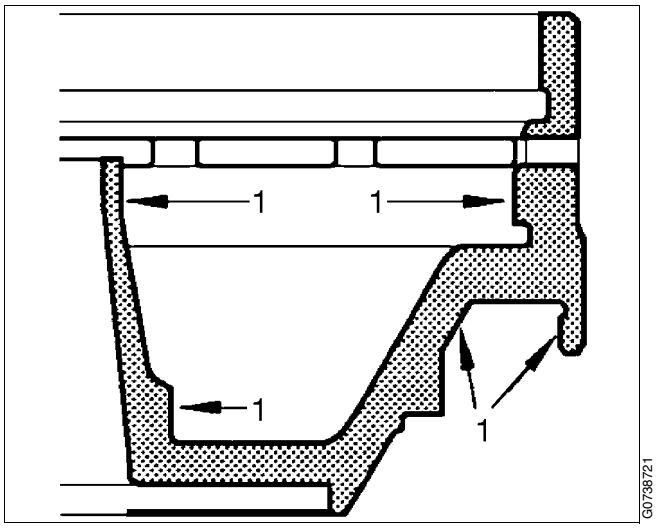


Sliding bowl bottom

NOTE

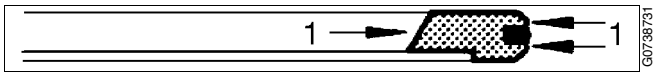
To avoid the risk of galling, the contact surfaces (1) should be primed with a slide lacquer at every Major Service (MS), see "5.4.17 Guide surfaces" on page 85.

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.



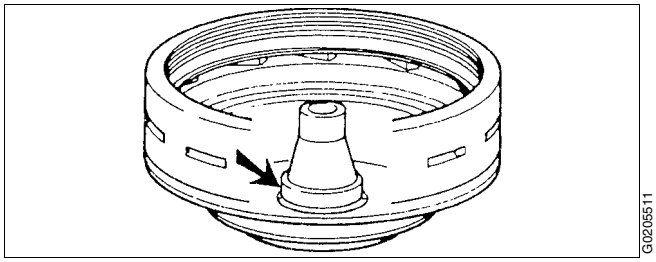
Operating slide

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

Repair of galling on guide surfaces

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

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

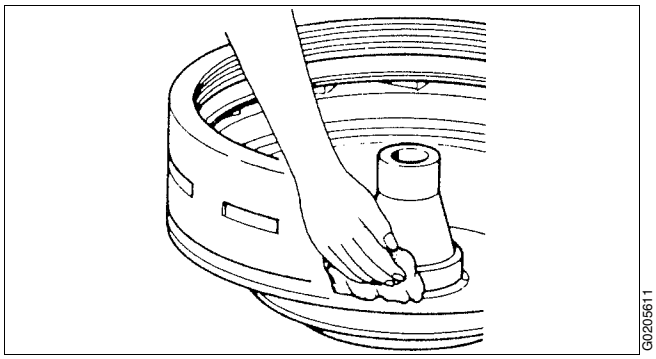


Guide surface in the bowl body

Recommended tools for correction of galling:

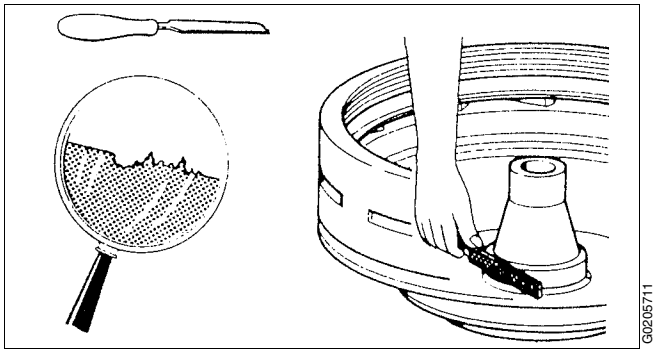
- Emery cloth, 240 grade.
- Hand drilling machine
- Degreasing agent.
- Fibre brush, ∅ 25mm.
- Fibre brush, ∅ 50 mm.
- Very fine single-cut file.

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

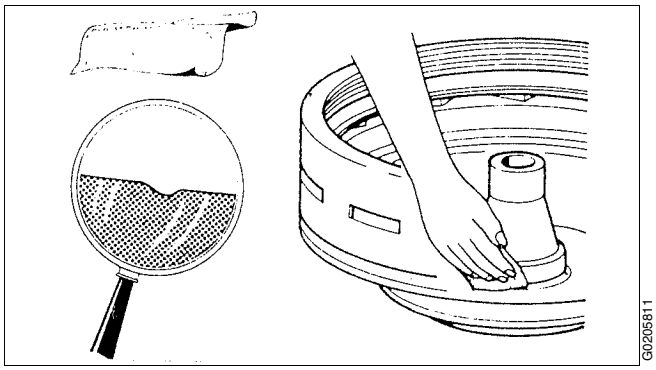


2. If the galling is excessive, first use the fine single-cut file. The file should be used with caution so that the damage is not made worse.

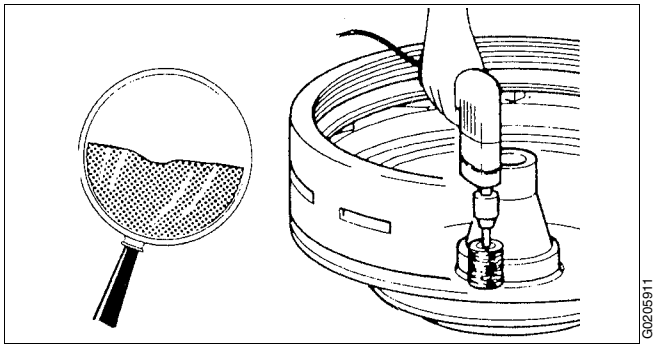
   Remove the high spots on the surface. Do not use rotating files or similar. Remove the high spots only - not the undamaged material.



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



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

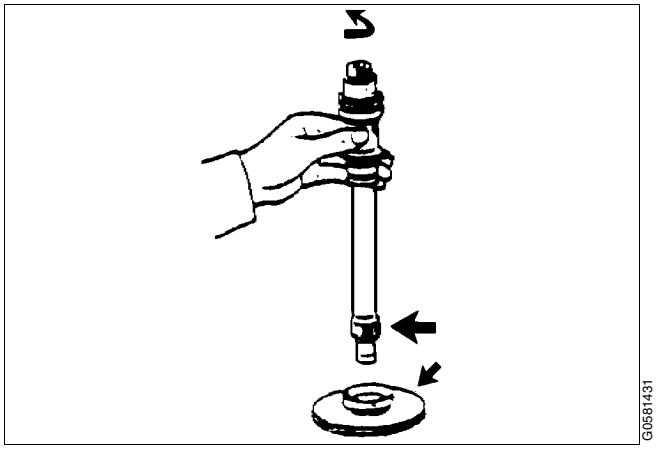


Prime the repaired area with lubricating spray Molykote 321 R. Read the correct procedure under checkpoint. Apply Alfa Laval lubricating paste or Molykote 1000 Paste to the surface after priming.

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.

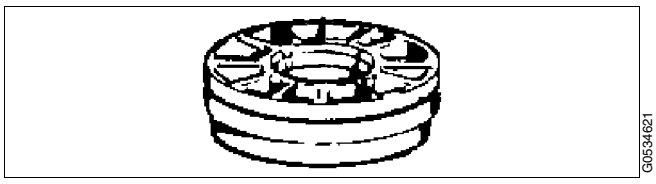
Screw the inlet pipe into the paring disc and check that the inlet pipe turns easily.



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.

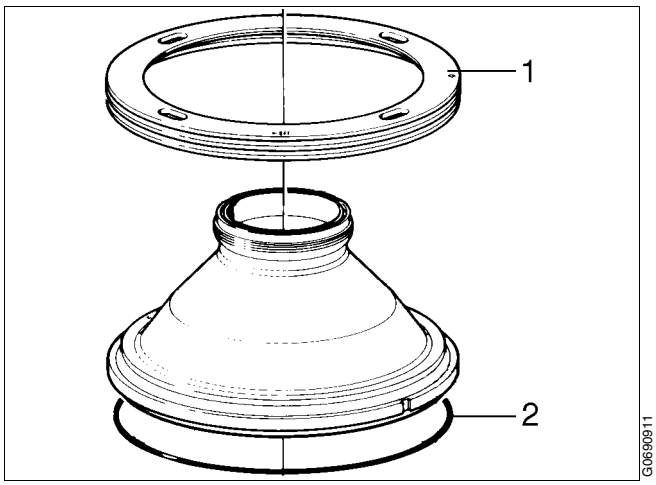


Check the level ring for burrs

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

WARNING

Disintegration hazards

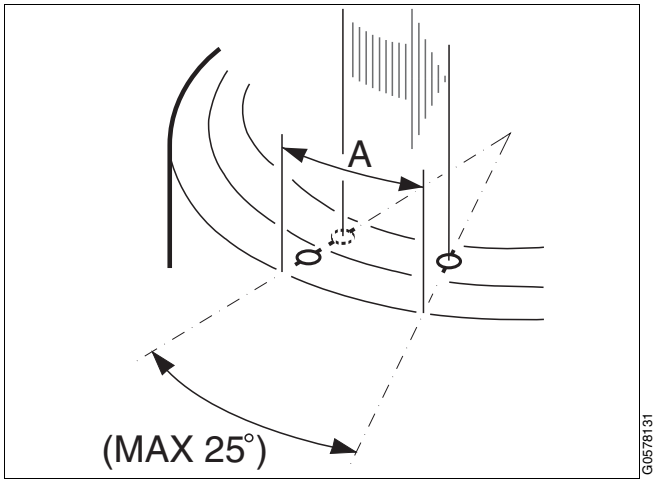
Wear on large lock ring thread must not exceed safety limit. The ϕ-mark on lock ring must not pass opposite ϕ-mark by more than the specified distance.

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 in a new alignment mark.

If the original ϕ–mark on the lock ring passes the ϕ–mark on the bowl body by more than 25° (which corresponds to **A=80 mm for MOPX 308**), an Alfa Laval representative must be contacted immediately.

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



The ϕ-mark on the lock ring must not pass the ϕ-mark on the bowl body by more than 25°

Damage

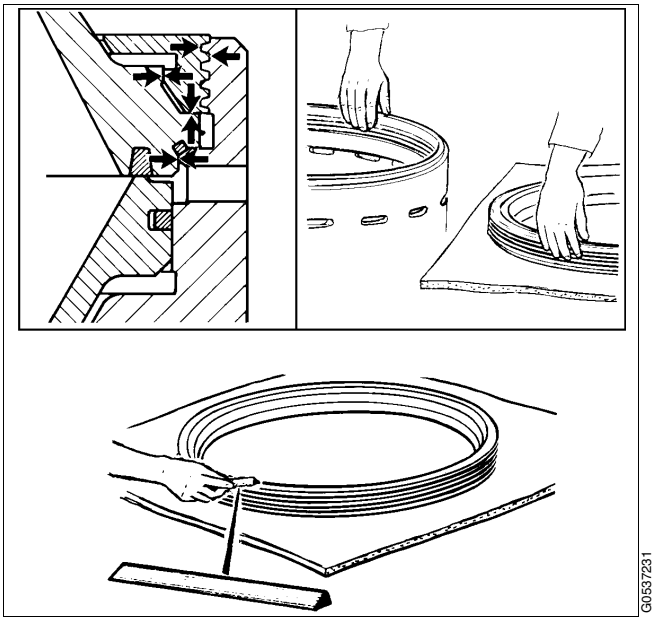
The position of the threads, contact and guide surfaces are indicated by arrows in the illustration.

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

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

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

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



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

5.3.11 Operating mechanism

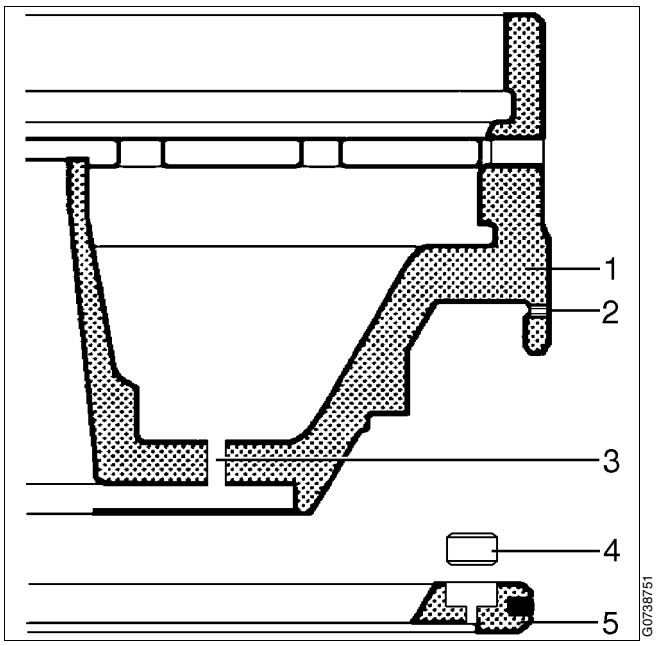
Dirt and lime deposits in the operating mechanism may cause poor discharge function or no function at all.

Clean and polish surfaces with steel wool if necessary.

Clean the nozzle (2) with a soft iron wire.

Reasons for dirt or deposits:

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

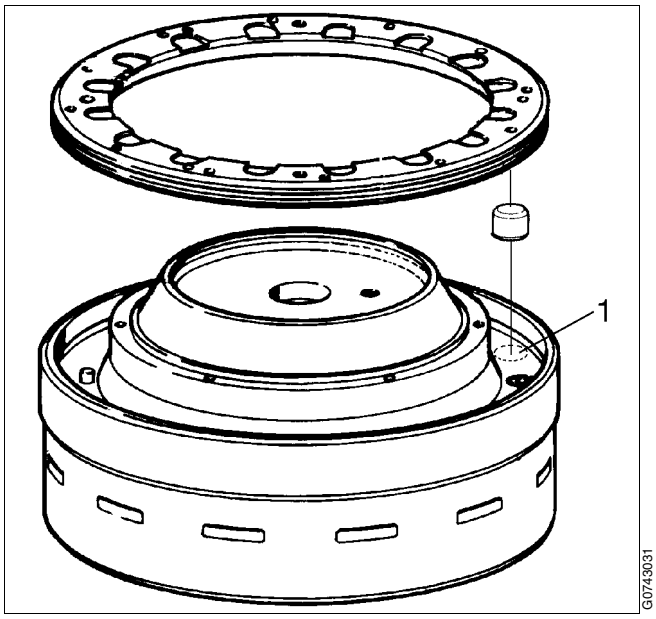


1. *Bowl body*
2. *Nozzle*
3. *Hole, Ø = 5 mm*
4. *Valve plug*
5. *Operating slide*

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.

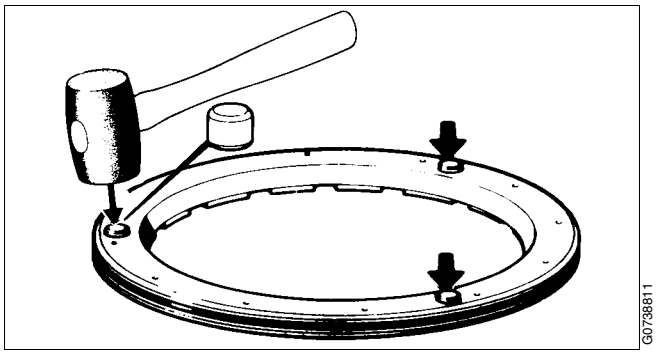
Examine the sealing surfaces (1) of the bowl body in contact with the valve plugs. Remove any marks and lime deposits with a very fine grain emery cloth.



1. *Bowl body sealing surfaces in contact with the valve plugs*

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

Correct height of plugs: **14,0 mm**.



Tap in new valve plugs

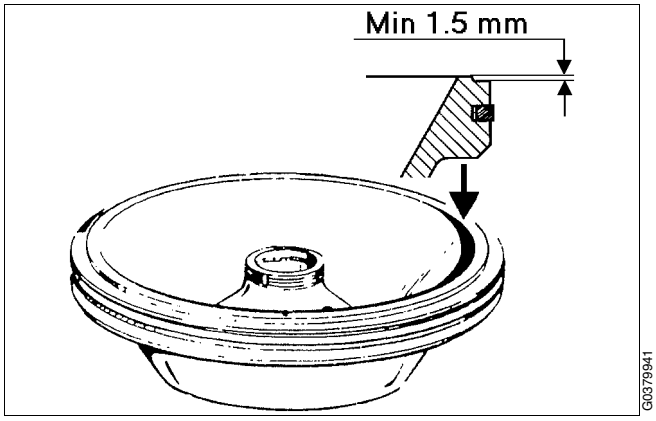
5.3.13 Sliding bowl bottom

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. Permissible **reduction** of the original profile height (2,0 mm) is **max. 0,5 mm**.

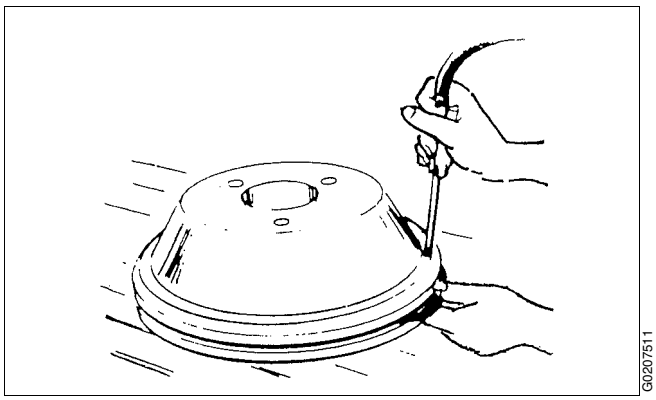
NOTE

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



Min. height of the profile on sliding bowl bottom

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



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

WARNING

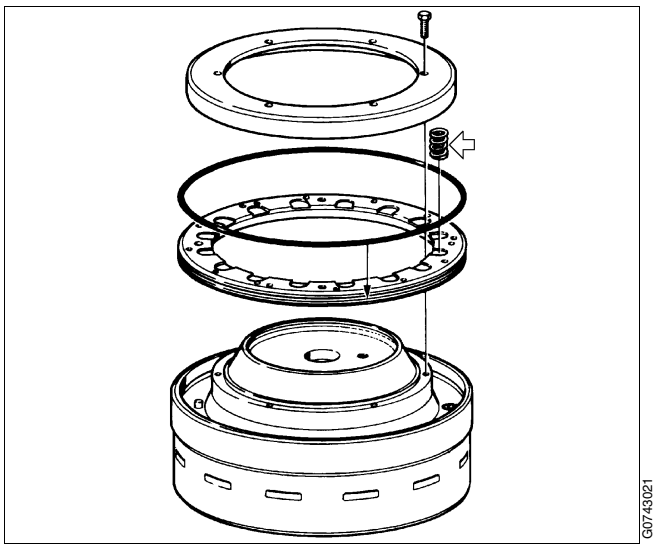
Risk for eye injury

Wear safety goggles.

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

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 96 in this chapter.

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 60.

5.4.2 Bowl spindle cone and bowl body nave

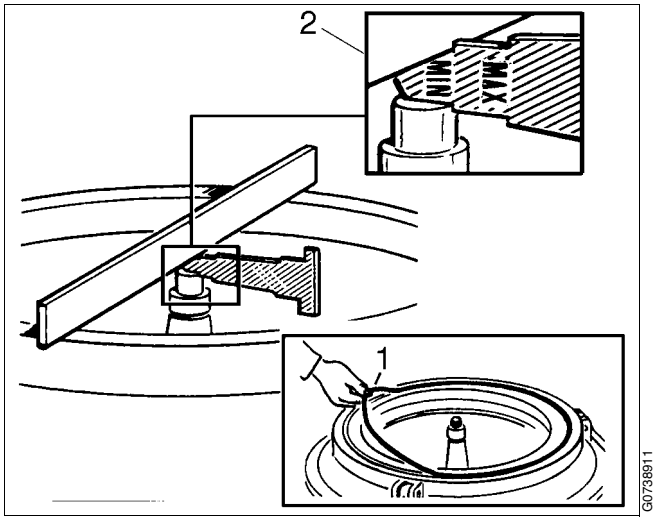
Same as described in “5.3.2 Bowl spindle cone and bowl body nave” on page 61.

5.4.3 Bowl spindle; height position

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

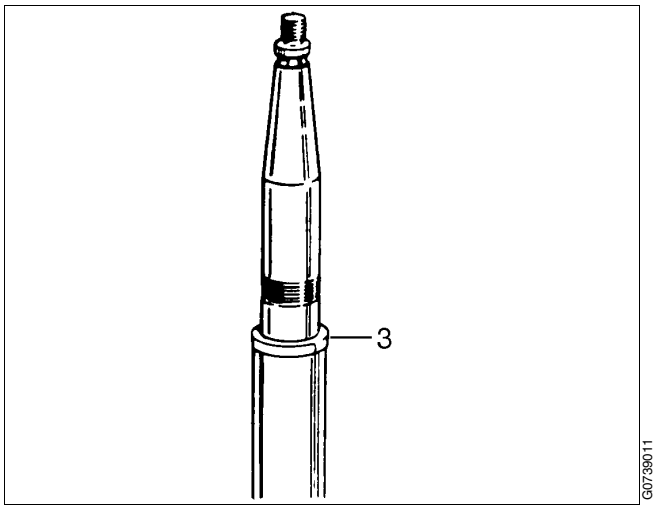
NOTE
Before starting adjustment, tap the spindle top a few times with a tin hammer to ensure that the bottom bearing of the spindle is properly seated in the bottom bearing housing.

- Remove the seal ring (1) from the frame ring.
- Place a steel ruler across the frame ring. Push the narrow tongue of the templet (2), marked MIN (16,5 mm), between the ruler and the spindle top. There should now be a small gap between the templet and the ruler, however not so large that the wide templet tongue marked MAX (18,5 mm) can be inserted.



Measurement of the bowl spindle height

- The height position is adjusted by adding or removing height adjusting rings (3), see the illustration.



Position of the height adjusting ring (one or more) on the bowl spindle

5.4.4 Bowl spindle; radial wobble

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

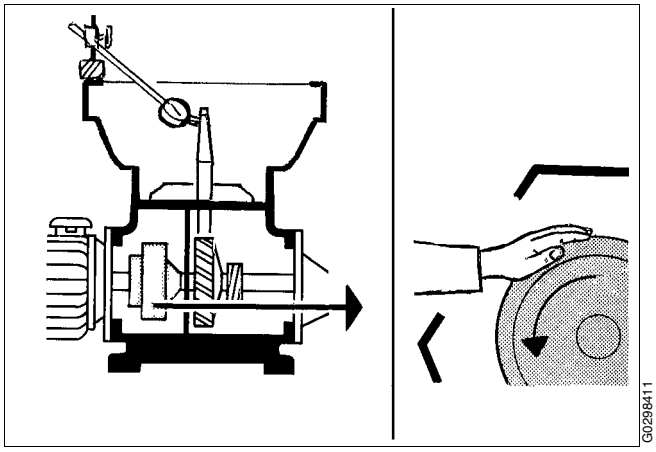
> **NOTE**
>
> Spindle wobble will cause rough bowl run. This leads to vibration and reduces lifetime of ball bearings.

Check the wobble before mounting the bowl.

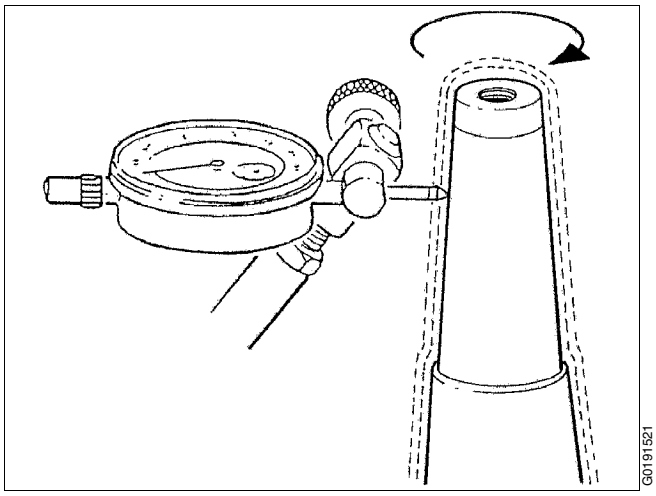
Before measuring, make sure that the buffer plugs are properly tightened.

- 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.



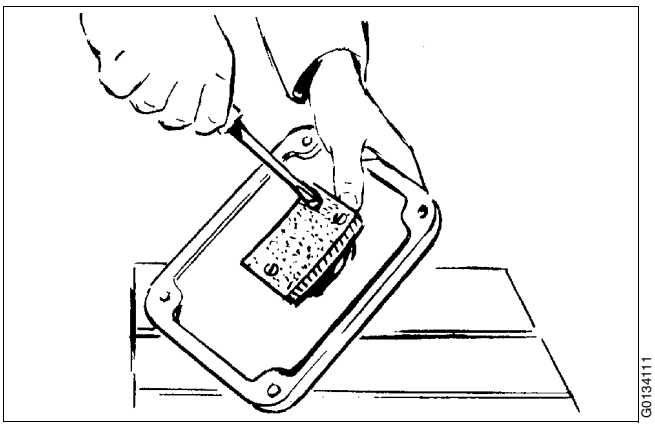
Revolve the spindle by turning the coupling drum by hand



Measurement of the radial wobble

5.4.5 Brake

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



Friction pad is fastened with screws

CAUTION

Inhalation hazard

When handling friction blocks/pads use a dust mask to make sure not to inhalate any dust.

Do not use compressed air for removal of any dust. Remove dust by vacuum or wet cloth.

See Safety instructions for enviromental issues regarding correct disposal of used friction blocks/pads.

If the friction pad is worn:

- Remove the screws and exchange the friction pad.

NOTE

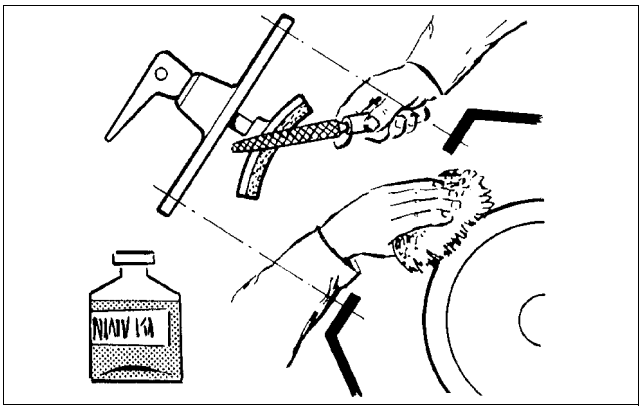
The screws are slotted in both ends.

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.

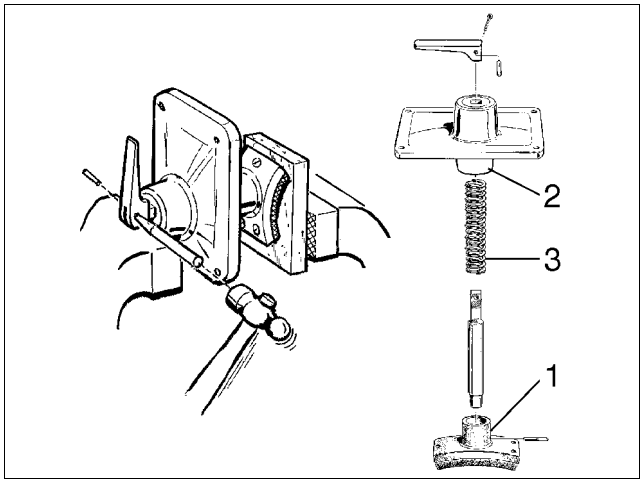


Actions to be taken when the brake friction pad is oily

Checking of spring and brake shoe:

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

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



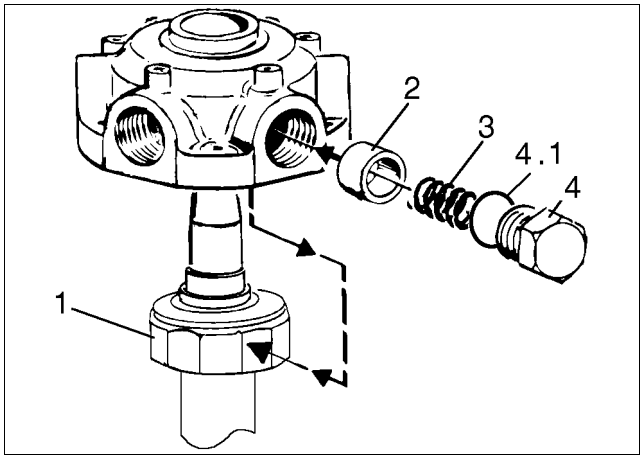
1. Contact surface on the brake shoe for the spring
2. Guide surface in the cap for the brake shoe
3. Spring

5.4.6 Buffer springs and ball bearing housing

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

Top bearing springs

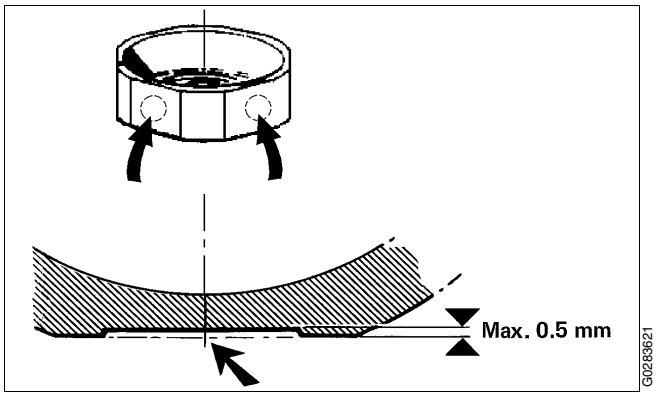
In case of spring fracture, the complete set of springs should be replaced, even if only one spring is broken.



1. Ball bearing housing
2. Radial buffer
3. Buffer spring
4. Screw plug
4.1 O-ring

Ball bearing housing

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



Max. permitted indentations made by radial buffers

5.4.7 Coupling friction pads

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

CAUTION

Inhalation hazard

When handling friction blocks/pads use a dust mask to make sure not to inhalate any dust.

Do not use compressed air for removal of any dust. Remove dust by vacuum or wet cloth.

See Safety instructions for enviromental issues regarding correct disposal of used friction blocks/pads.

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

Check the pads. If the pads are oily:

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

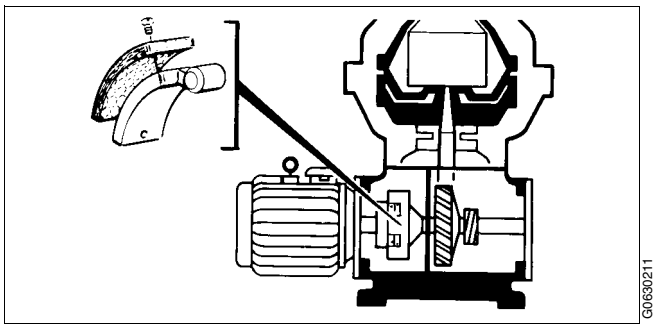
If the pads are worn:

- Remove the screws and renew the pads.

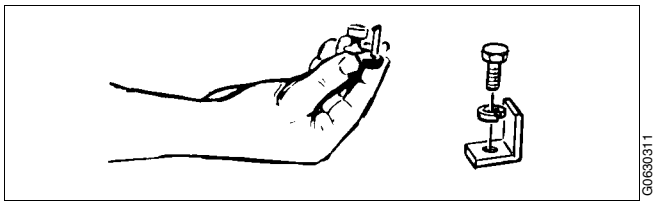
NOTE

The screws are slotted in both ends.

Replace all pads even if only one is worn.



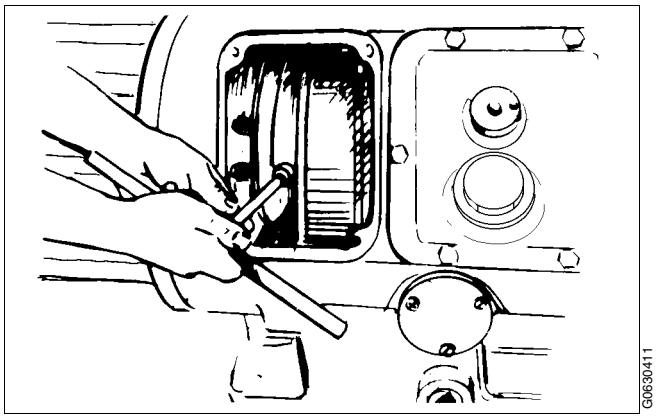
Location of coupling friction blocks



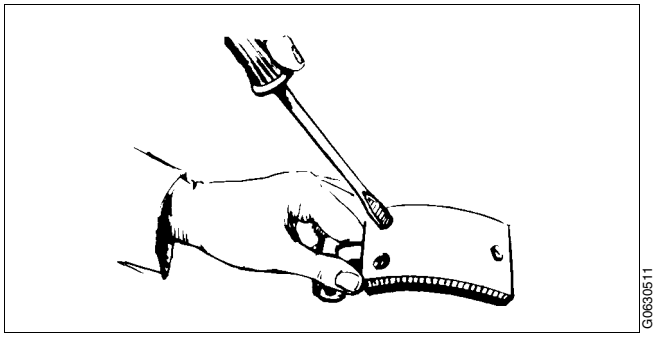
A friction block is fixed with screw, spring washer and holding bracket

How to renew friction pads without dismantled horizontal driving device.

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



Unscrew the holding bracket screws to remove the friction blocks



The screws fix the friction pad to the friction block

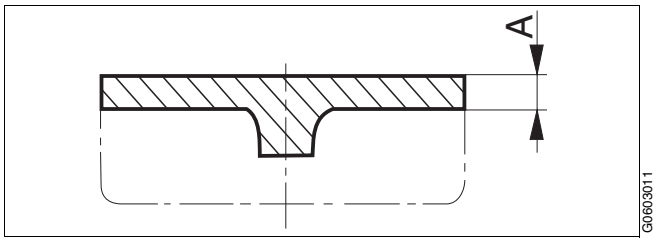
Different friction blocks for different power supply frequencies

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

50 Hz: A = **15 mm**

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

The thickness does not include the friction pad.



Measure A is different for 50 and 60 Hz installations

5.4.8 Corrosion

Same as described in “5.3.3 Corrosion” on page 61.

5.4.9 Cracks

Same as described in “5.3.4 Cracks” on page 64.

5.4.10 Disc stack pressure

Same as described in “5.3.5 Disc stack pressure” on page 65.

5.4.11 Erosion

Same as described in “5.3.6 Erosion” on page 66.

5.4.12 Level ring

Same as described in section “5.3.9 Level ring” on page 70.

5.4.13 Inlet pipe and oil paring disc

Same as described in “5.3.8 Inlet pipe and oil paring disc” on page 70.

5.4.14 Lock ring; wear and damage

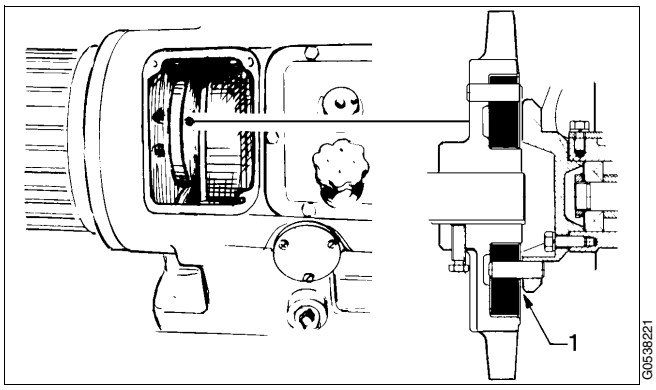
Same as described in section “5.3.10 Lock ring; wear and damage” on page 71.

5.4.15 Operating mechanism

Same as described in section “5.3.11 Operating mechanism” on page 73.

5.4.16 Flexible plate in coupling

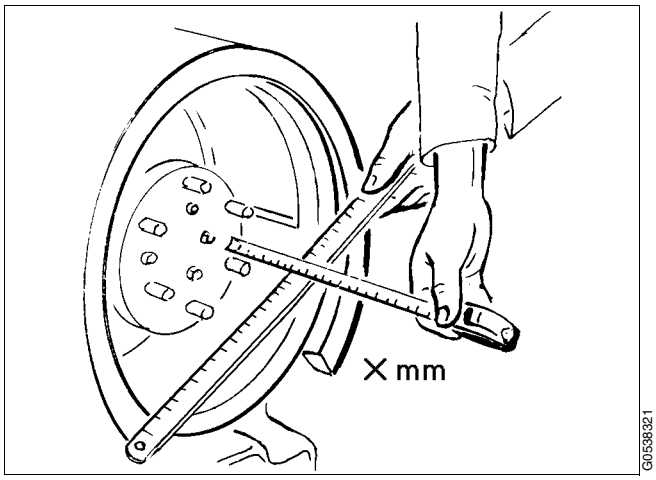
The axial play (1) of the flexible plate should be approximately 2 mm.



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

Check the play as follows:

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

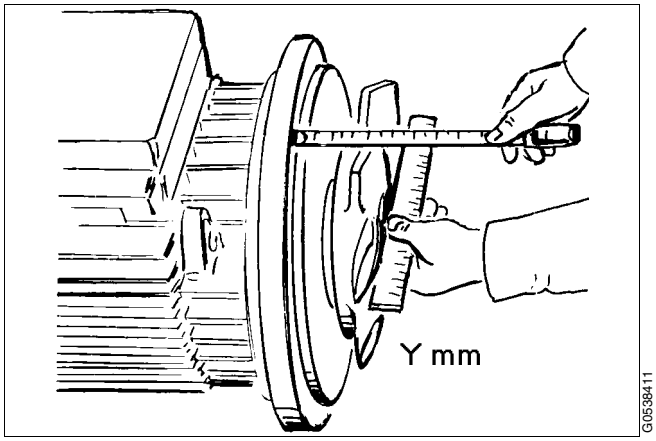


Measurement of distance for coupling in separator frame

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.



Measurement of distance for coupling on motor

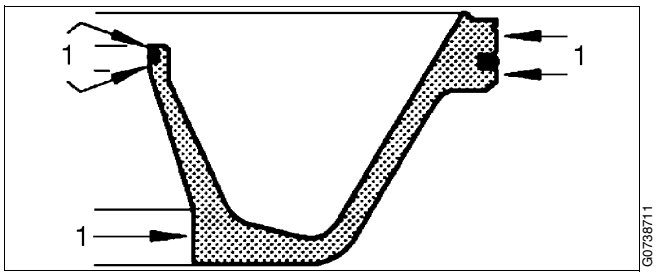
5.4.17 Guide surfaces

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

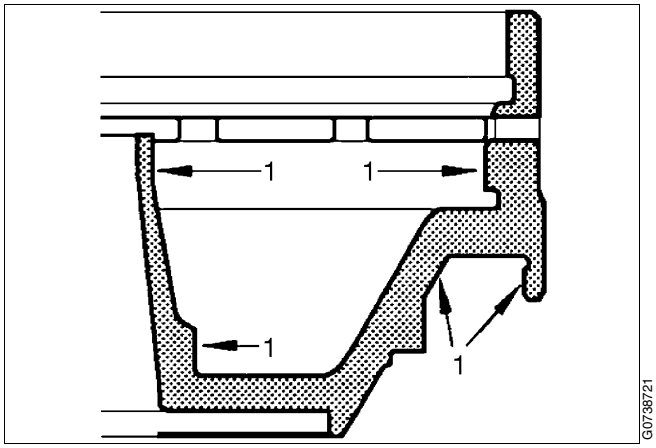
Repair of galling on guiding surfaces, see “5.3.7 Guide surfaces” on page 68.

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

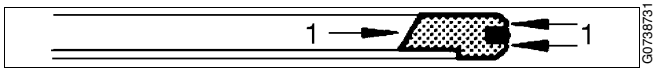
1. Mask the nave hole of the bowl body. Slide lacquer must not enter this hole.
2. Carefully degrease the contact surfaces (1) between the sliding bowl bottom and bowl body. Dry the surfaces well.
3. Apply slide lacquer Molykote D321R with a well cleaned brush. Protect the surfaces which should not be 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



Operating slide

At major service

Alfa Laval lubricating paste or Molykote 1000 Paste

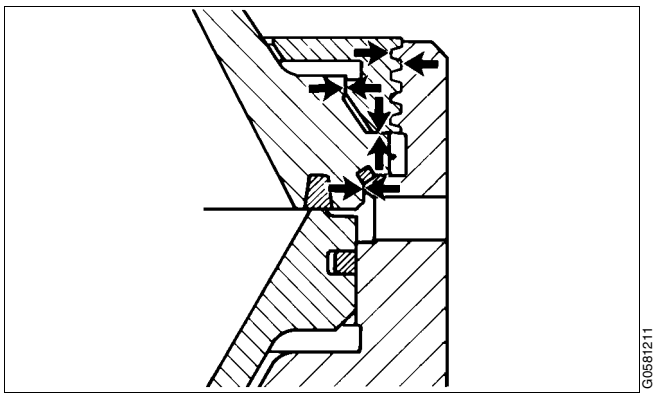
Slide lacquer (Molykote D 321R) Paste

5.4.18 Lock ring; priming

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

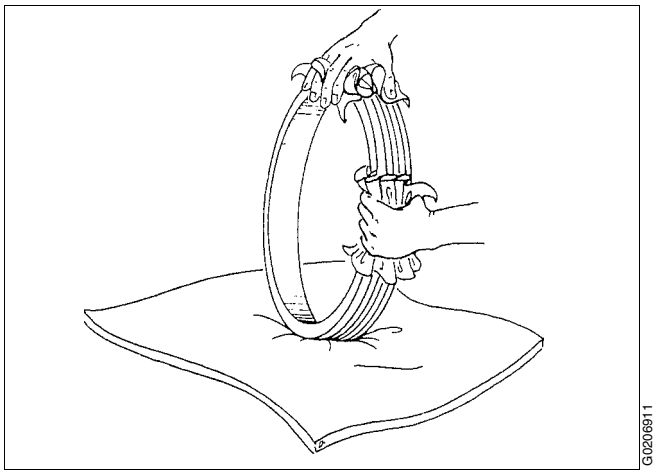
Recommended agents for priming procedure:

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

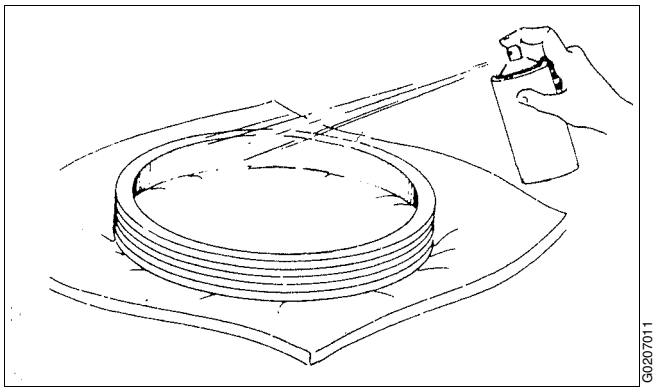


Threads, guide and contact surfaces to be primed

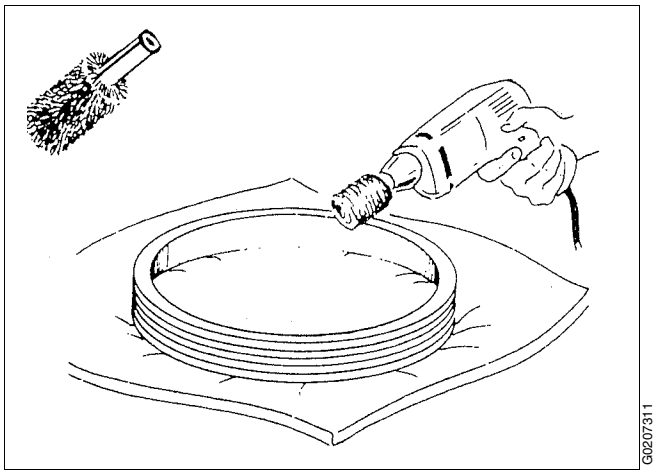
1. Clean the lock ring thoroughly with a degreasing agent and wipe it off.



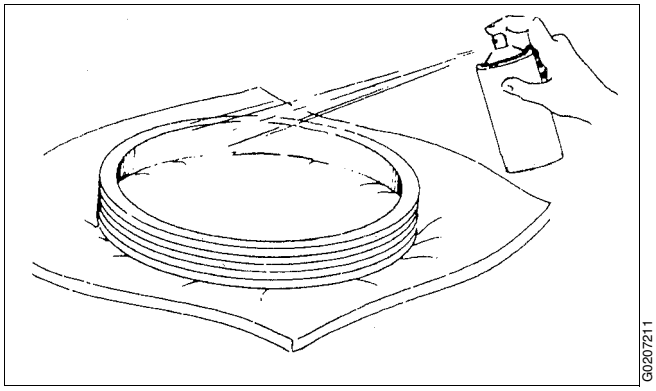
2. Spray the threads, guide and contact surfaces with slide lacquer Molykote 321 R. Let the lacquer air-cure for about 15 minutes.



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.

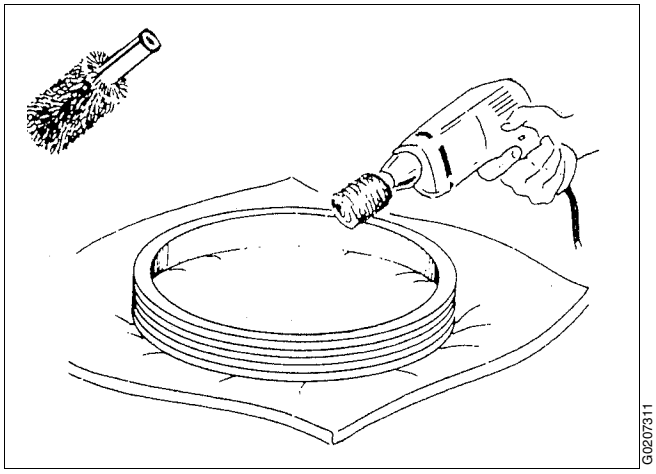


4. Spray the lock ring a second time and let it dry for about 15 minutes.



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.



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5.4.19 Oil paring disc; height position

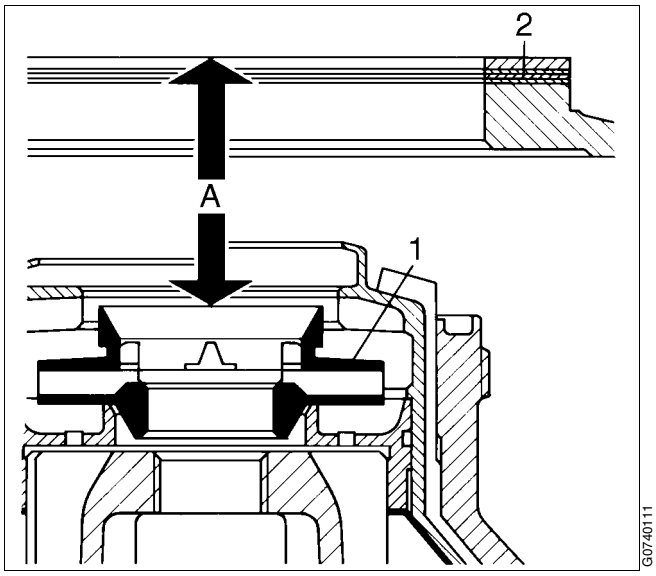
Alfa Laval ref. 540074, rev. 1

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

- Assemble the bowl without the gravity disc and small lock ring.
- Tighten the large lock ring until the bowl hood is in close contact with the bowl body.
- Put the collecting covers in place and clamp them to the frame ring with the hinged bolts.
- Measure the distance A according to the figure. The distance should be **66,5 ±0,5 mm**.
- Adjust the distance by adding or removing height adjusting rings (2).

With inlet and outlet parts mounted:

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



Measurement of distance A

5.4.20 Operating paring disc; height position

Alfa Laval ref. 420747, rev.1

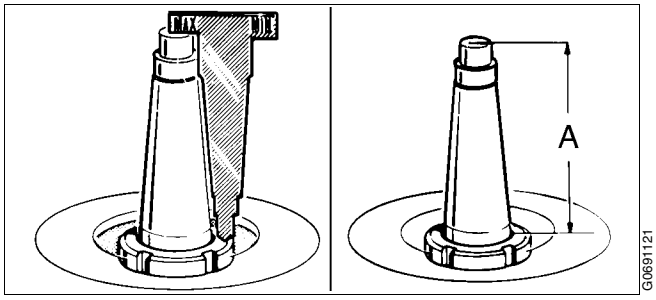
If the bowl spindle has been removed or the bowl has been replaced, the height position of the operating device relative to the bowl spindle top must be checked.

Correct measure (A) is **149 ±0,5 mm**.

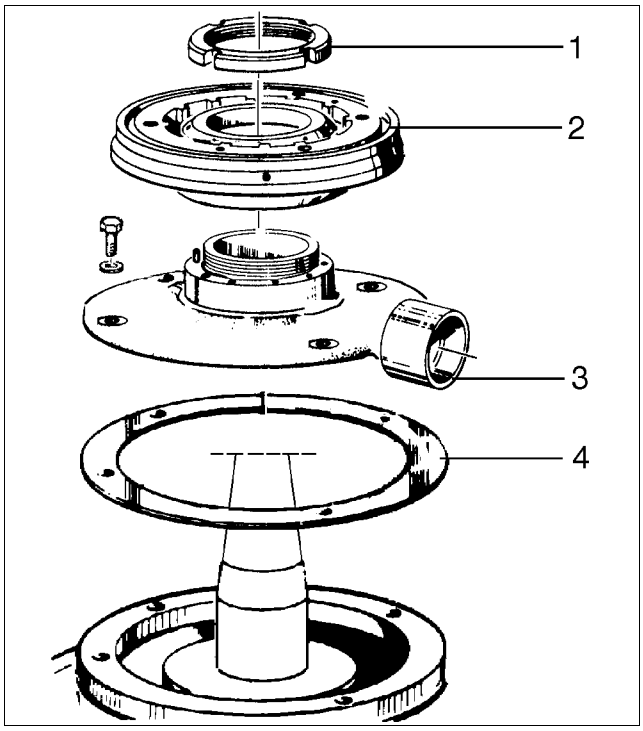
- The operating water device should be assembled and fitted.
- Support the templet on the spindle top with the measurement indication MIN facing the spindle.

  There should be a small gap between the lower end of the templet and the top face of the ring nut (1), otherwise the paring disc position is too high.
- Turn the templet so that the measurement indication MAX on the other side faces the spindle and the templet lower end supports on the paring disc.

  There should be a small gap between the templet tongue and the spindle top, otherwise the paring disc position is too low.
- The height position is adjusted by adding or by removing height adjusting rings (4) under the distributing cover (3).
- After adjustment rotate the spindle. If a scraping noise is heard, re-adjust.



Measurement of distance A



1. *Ring nut*
2. *Paring disc assembly*
3. *Distributing cover*
4. *Height adjusting ring(s)*

5.4.21 Operating slide

Same as described in section “5.3.12 Operating slide” on page 73.

5.4.22 Sliding bowl bottom

Same as described in section “5.3.13 Sliding bowl bottom” on page 74.

5.4.23 Springs for operating mechanism

Same as described in “5.3.14 Springs for operating mechanism” on page 75.

5.4.24 Worm wheel and worm; wear of teeth

Same as described in section “5.7.1 Worm wheel and worm; wear of teeth” on page 96.

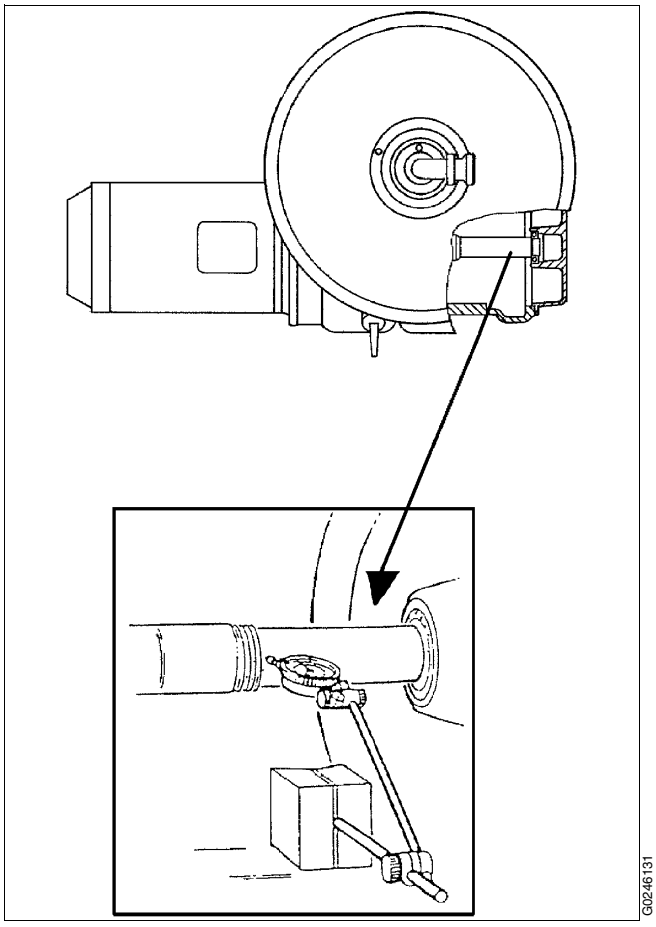
5.4.25 Worm wheel shaft; radial wobble

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

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

Permissible radial wobble is **maximum 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.



Measuring radial wobble of worm wheel shaft

5.5 Lifting instructions

Alfa Laval ref. 557049, rev.0

5.5.1 Separator

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

The circumference of each endless sling must be **min. 1,5 metres**.

NOTE

Machine weight without frame hood and bowl is approx. **700 kg**.

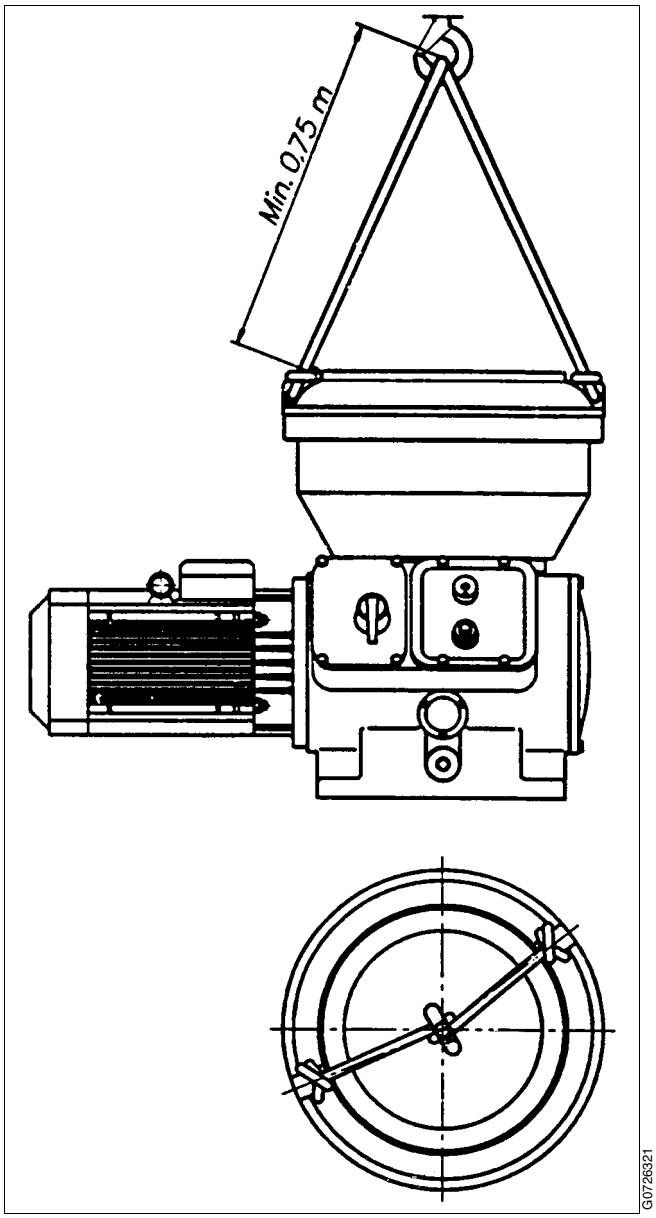
Do not lift the separator unless the frame hood and bowl have been removed.

WARNING

Crush hazards

Lift the separator in no other way than illustrated.

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



Lift the separator with the frame hood and bowl removed

5.5.2 Bowl

This instruction describes how to lift a complete bowl, which is normally done only during a transport of the separator.

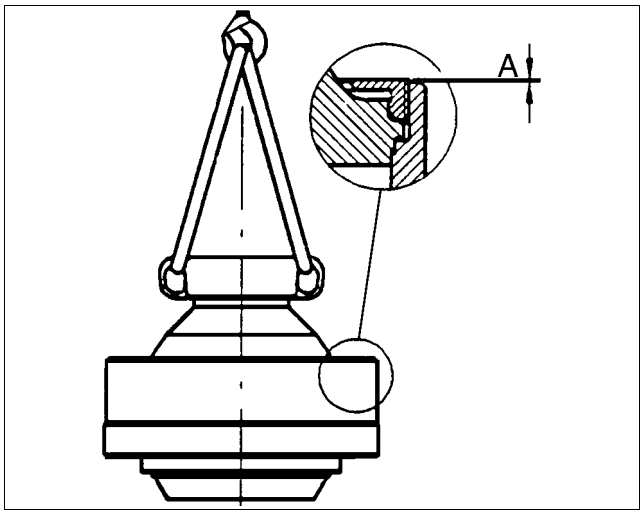
When lifting the bowl, use the special lifting tool fastened on the bowl hood.

NOTE

Check that the lock ring is properly tightened. The height of the lock ring above the bowl body must not exceed **6 mm**.

Weight to lift is approx. **130 kg**.

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



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

5.5.3 Other parts

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

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

NOTE

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

5.6 Cleaning

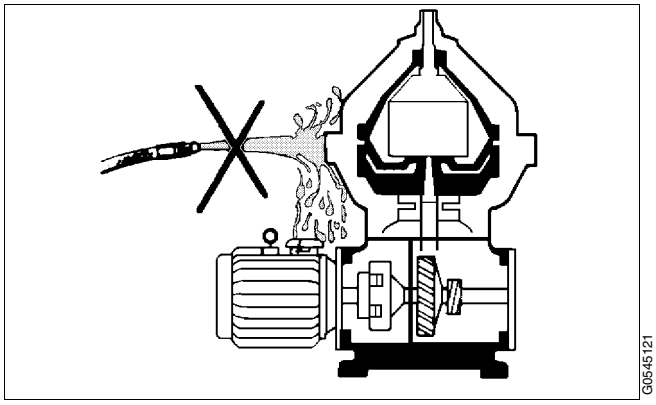
5.6.1 External cleaning

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

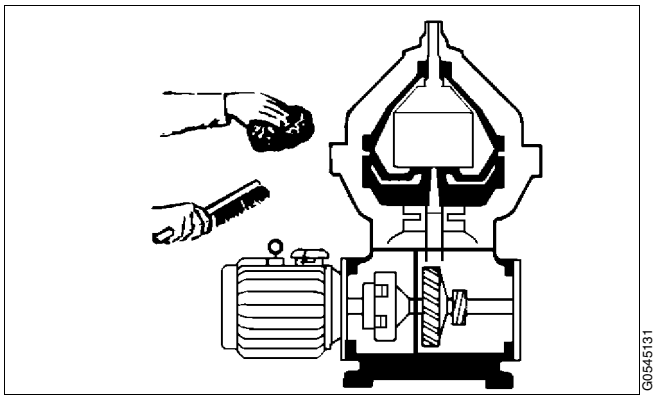
Never wash down a separator with a direct water stream. Totally enclosed motors can be damaged by direct hosing to the same extent as open motors and even more than those, because:

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

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



Never wash down a separator with a direct water stream. Never play a water jet on the motor



Use a sponge or cloth and a brush when cleaning

5.6.2 Cleaning agents

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

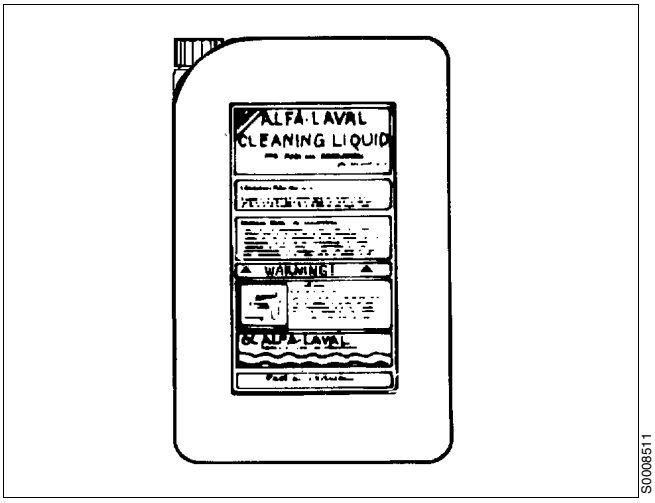
For separator bowl, inlet and outlet

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

- For cleaning of **lube oil** separators the most important function of the cleaning agent is to be a good solvent for the gypsum in the sludge. It should also act as a dispersant and emulsifier for oil. It is recommended to use **Alfa Laval cleaning liquid for lube oil separators** which has the above mentioned qualities. Note that carbon steel parts can be damaged by the cleaning agent if submerged for a long time.
- **Fuel oil** sludge mainly consists of complex organic substances such as asphaltenes. The most important property of a cleaning liquid for the removal of fuel oil sludge is the ability to dissolve these asphaltenes.

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

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



Alfa Laval cleaning liquid for fuel and lube oil separators

CAUTION

Skin irritation hazard

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

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

For operating mechanism

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

For parts of the driving devices

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

Oiling (protect surfaces against corrosion)

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

5.6.3 Cleaning of bowl discs

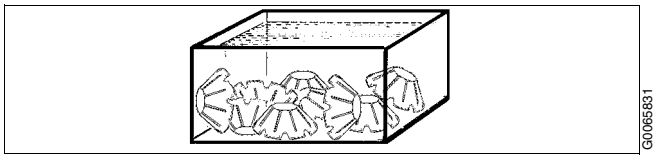
Handle the bowl discs carefully so as to avoid damage to the surfaces during cleaning.

NOTE

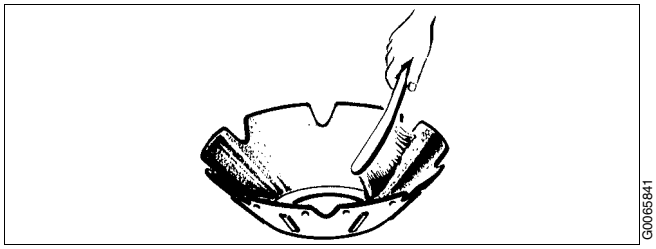
Mechanical cleaning is likely to scratch the disc surfaces causing deposits to form quicker and adhere more firmly.

A gentle chemical cleaning is therefore preferable to mechanical cleaning.

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



Put the discs one by one into the cleaning agent



Clean the discs with a soft brush

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

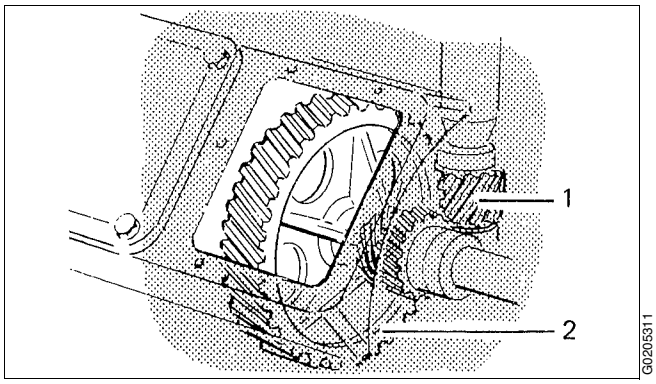
To check at each oil change

Check the teeth of both the worm wheel and worm for wear. Examine the contact surfaces and compare the tooth profiles with the “ Tooth appearance examples” on page 98. The gear may operate satisfactorily even when worn to some degree.

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

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

When replacing the gear, always make sure that the new worm wheel and worm have the same number of teeth as the old ones. See chapter “8.2 Technical data” on page 179 for correct number of teeth.

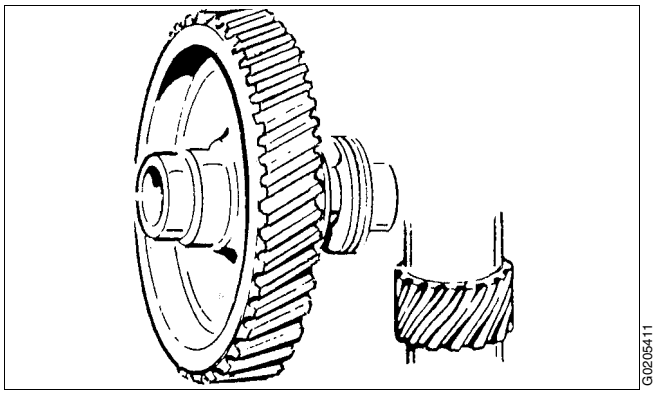


1. Worm
2. Worm wheel

WARNING

Disintegration hazards

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



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

NOTE

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

Important!

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

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

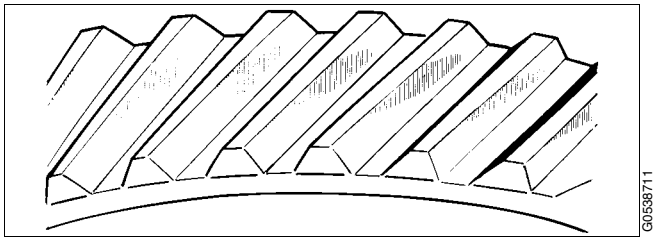
For further information, see chapter “8.7 Lubricants” on page 192.

Tooth appearance examples

Satisfactory teeth:

Uniform wear of contact surfaces. Surfaces are smooth.

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

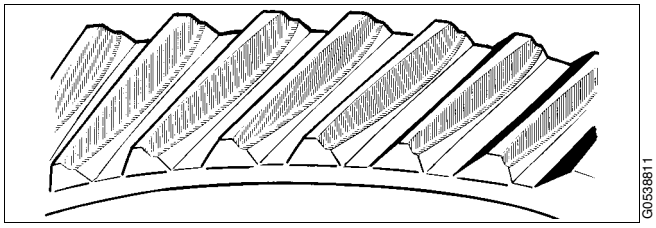


Satisfactory teeth

Worn teeth:

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

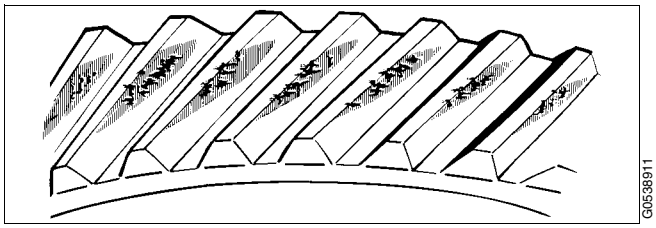
- the wear is uniform over the whole of the flank of a tooth
- and all teeth are worn in the same way.



Worn teeth

Spalling:

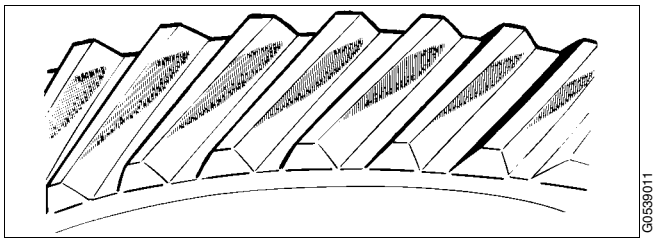
Small bits of the teeth have broken off, so-called spalling. This is generally caused by excessive load or improper lubrication. Damage of this type need not necessitate immediate replacement, but careful checking at short intervals is of imperative importance.



Spalling

Pitting:

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

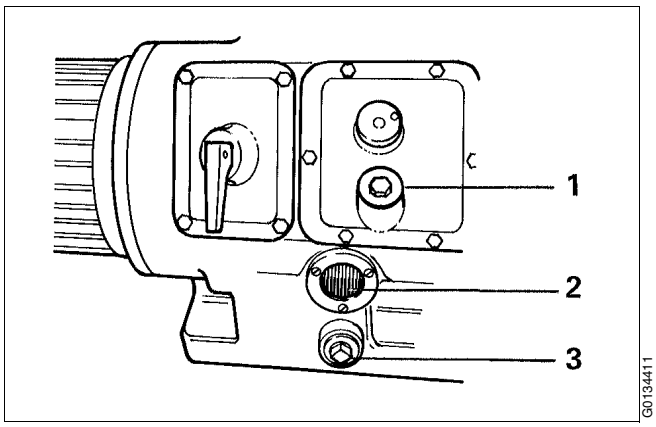


Pitting

5.7.2 Oil change procedure

NOTE

Before adding or renewing lubricating oil in the worm gear housing, the information concerning different oil groups, handling of oils, oil change intervals etc. given in chapter “8.7 Lubricants” on page 192 must be well known.



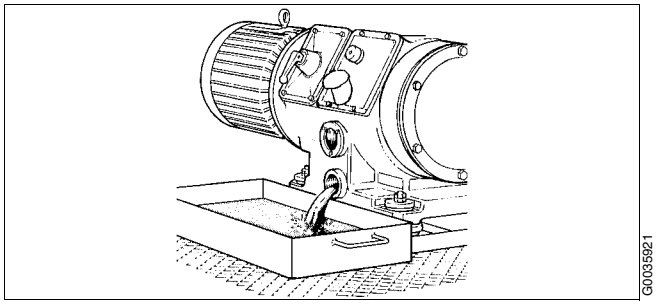
1. *Oil filling plug*
2. *Sight glass*
3. *Oil drain plug*

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

CAUTION

Burn hazards

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

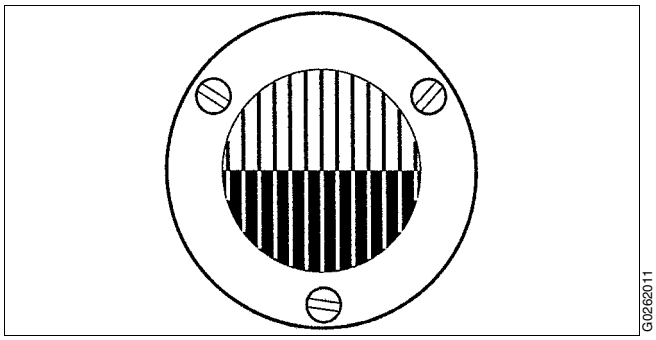


Burn hazards: The drained oil can be hot

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

   Oil volume: approx. **7,5 litres**.

   Suitable oil brands can be found in “8.7.2 Recommended lubricating oils” on page 193.



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

NOTE

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

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

5.8 Vibration

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

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

NOTE

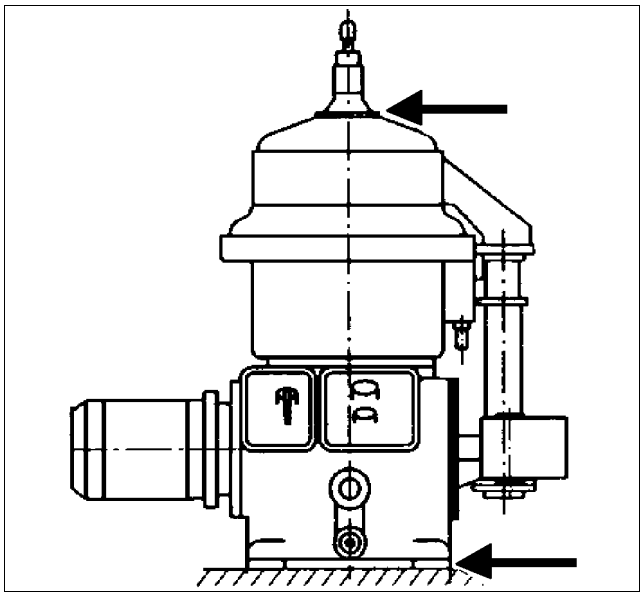
The level of vibration should not exceed **9,0 mm/s** at full speed.

WARNING

Disintegration hazards

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

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



Measuring points for vibration analysis

5.9 Common maintenance directions

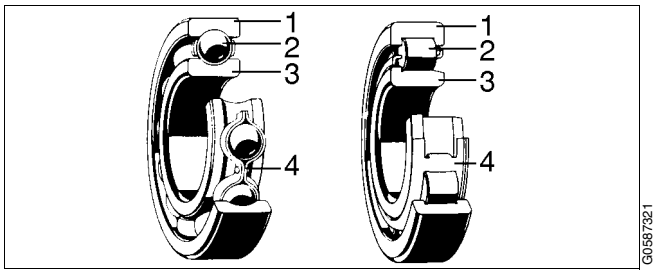
5.9.1 Ball and roller bearings

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

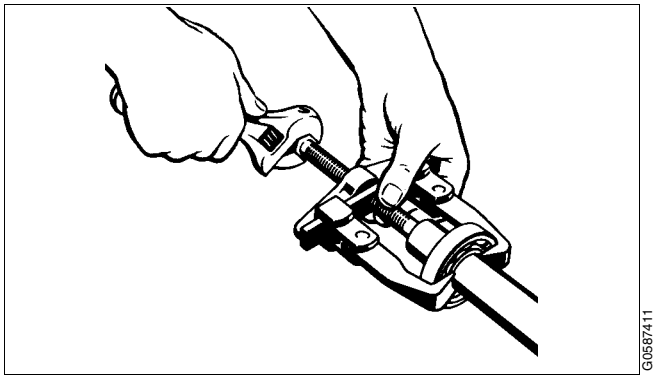
Using an incorrect bearing can cause a serious breakdown with damage to equipment as a result.

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

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

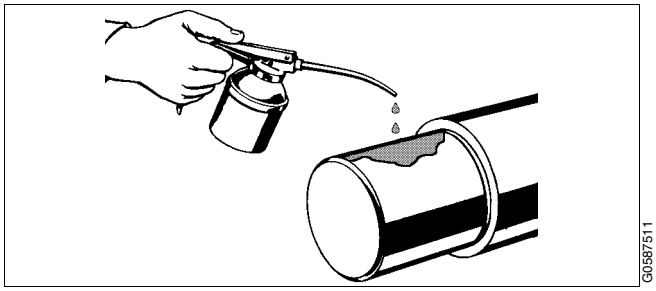
Do not hit with a hammer directly on the bearing.

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.

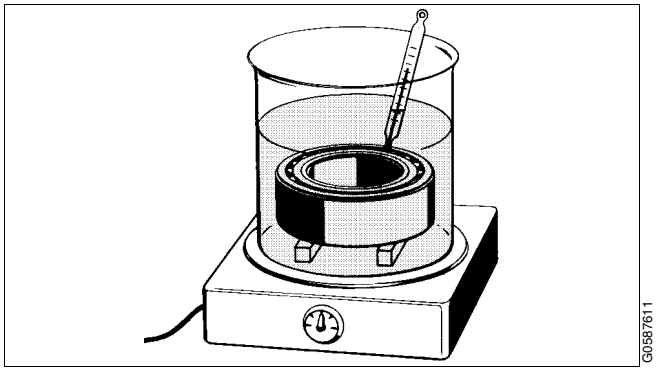
Assembly

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



Clean and lightly oil the bearing seating before assembly

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



The bearing must not be in direct contact with the container

NOTE

Heat the bearing in a clean container.

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

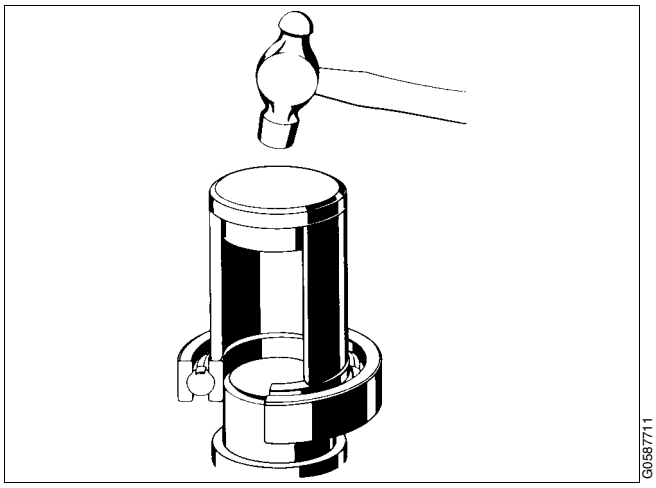
The bearing must be well covered by the oil and not be in direct contact with the sides or the bottom of the container. Place the bearing on some kind of support or suspended in the oil bath.

WARNING

Burn hazards

Use protective gloves when handling the heated bearings.

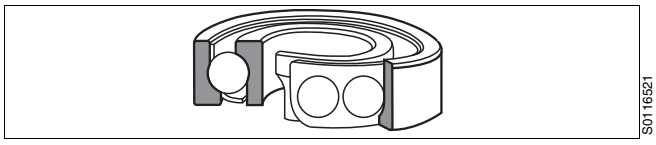
- There are several basic rules for assembling cylindrical bore bearings:
  - Never directly strike a bearing's rings, cage or rolling elements while assembling. A ring may crack or metal fragments break off.
  - Never apply pressure to one ring in order to assemble the other.
  - Use an ordinary hammer.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



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

Angular contact ball bearings

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



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

5.9.2 Before shutdowns

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

- Remove the bowl, according to instructions in chapter “6 Dismantling/Assembly” on page 105.

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.

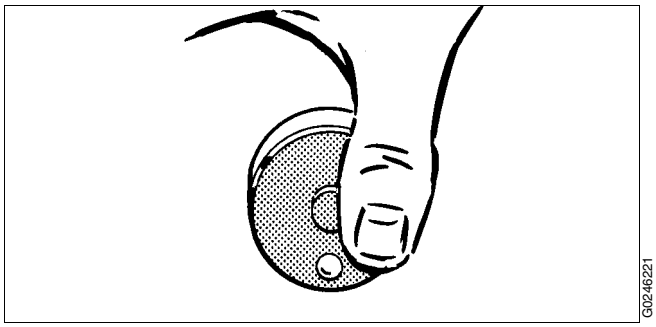
The recommended intervals are stated in chapter “5.1.2 Maintenance intervals” on page 49.

WARNING

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 three digits.

6.1.2 References to check points

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

✔ **Check point**
"5.3.5 Disc stack pressure" on page 65.

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

6.1.3 Tools

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

NOTE

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

6.1.4 Tightening of screws

When tightening screws, use the torques stated in the table below unless otherwise stated. The figures apply to lubricated screws tightened with a torque wrench.

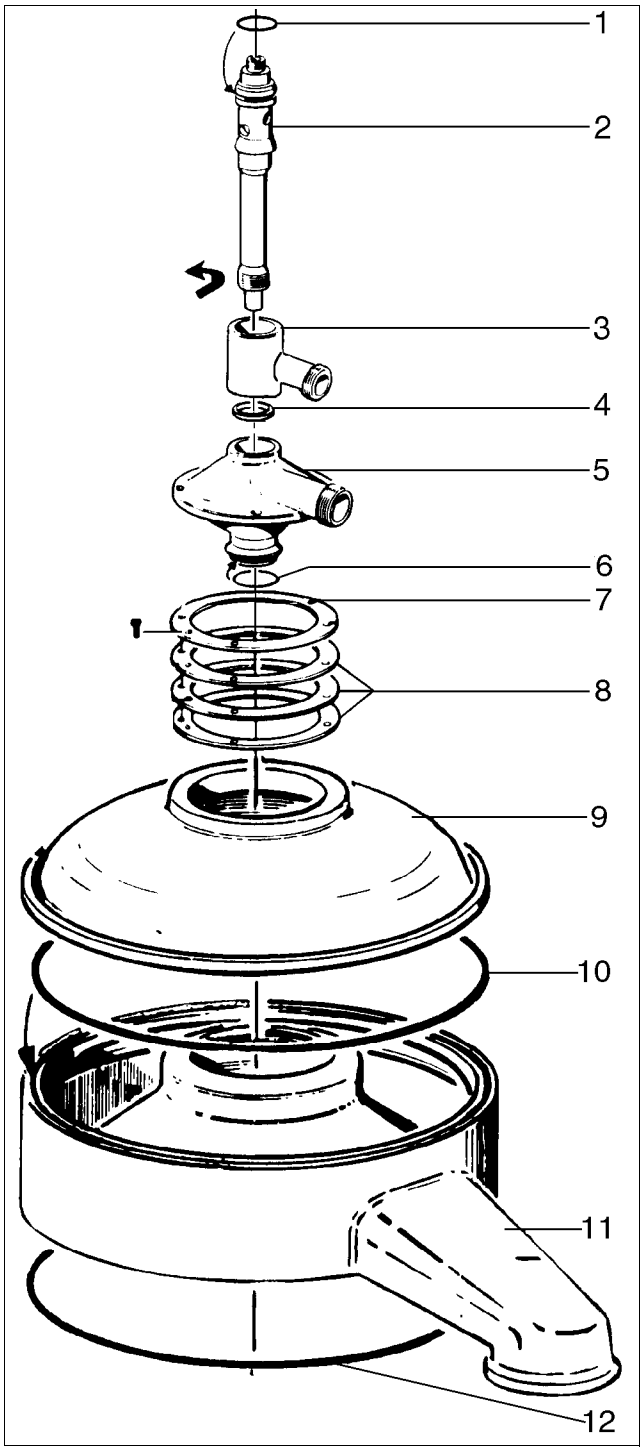
METRIC THREAD		
Thread	Torque in Nm	
	Stainless steel	Carbon steel
M6	7	8
M8	17	20
M10	33	39
M12	57	68
M16	140	155
M20	275	325
M24	470	570

6.2 Inlet/outlet and covers (IS)

6.2.1 Exploded view

1. *O-ring*
2. *Inlet pipe*
3. *Support*
4. *Rectangular ring*
5. *Connecting housing*
6. *O-ring*
7. *Protecting washer*
8. *Height adjusting ring(s)*
9. *Top cover*
10. *O-ring*
11. *Collecting cover*
12. *O-ring*

Left-hand thread



6.2.2 Dismantling

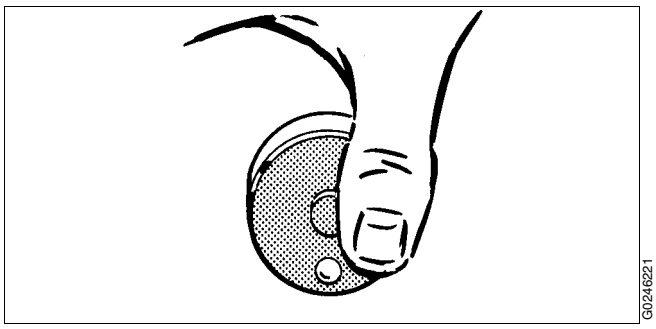
WARNING

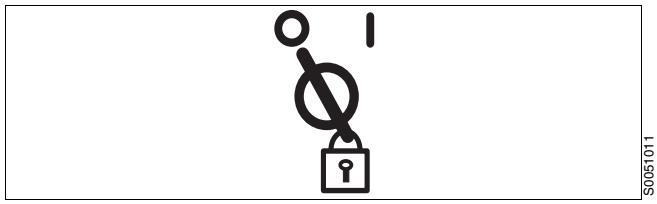
Entrapment hazards

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.



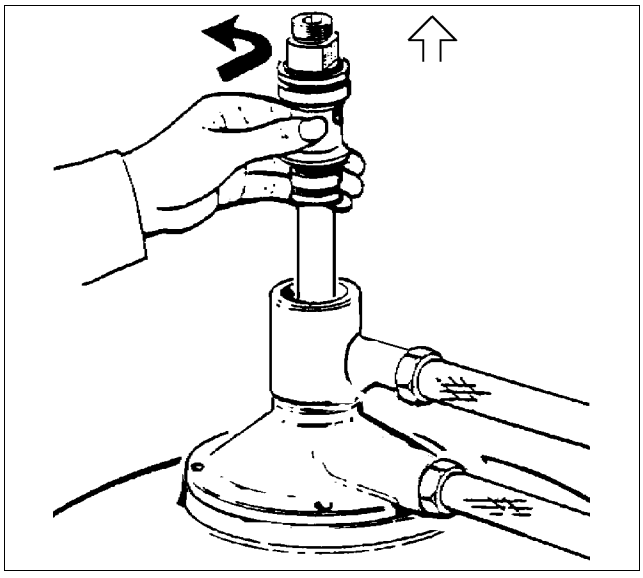


The frame hood and the heavy bowl parts must be lifted by means of a hoist. Position the hoist exactly above the bowl centre. Use an endless sling and a lifting hook with catch.

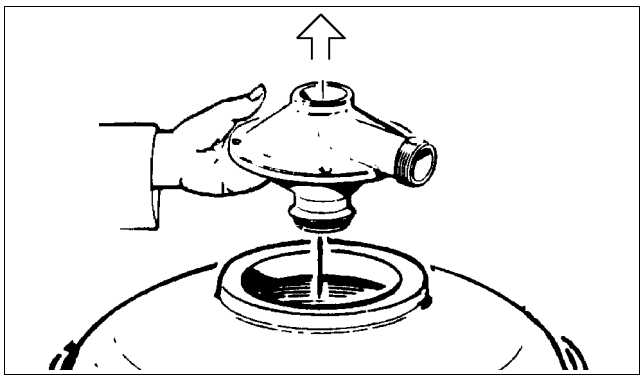
The parts must be handled carefully. Don't place parts directly on the floor, but on a clean rubber mat, fibreboard or a suitable pallet.

1. Disconnect and remove the hose for liquid seal/displacement water.
2. Unscrew the inlet pipe and lift out carefully.

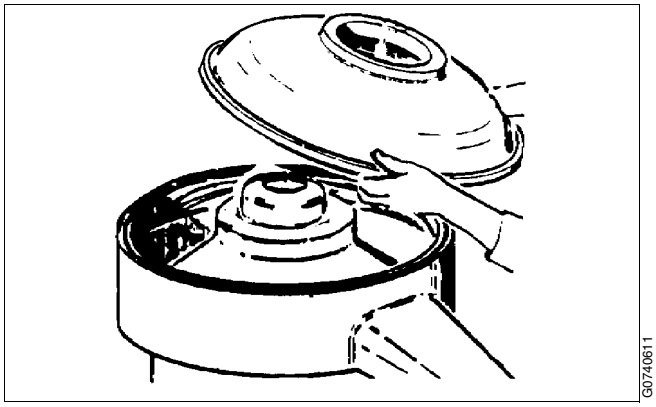
   Left-hand thread!



3. Remove the inlet piping support and the connecting housing. Take care of the rectangular ring.

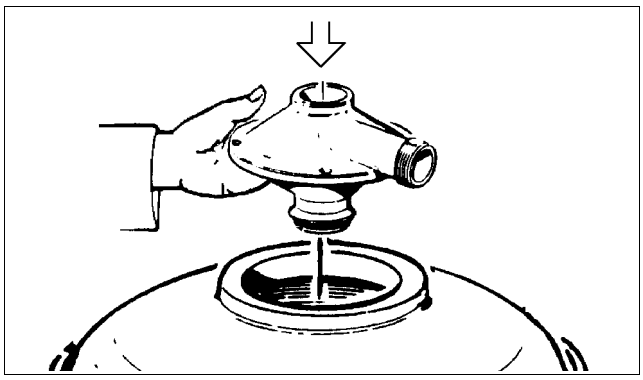


4. Unscrew the four hinged bolts holding the top cover. Lift off the top and collecting covers.



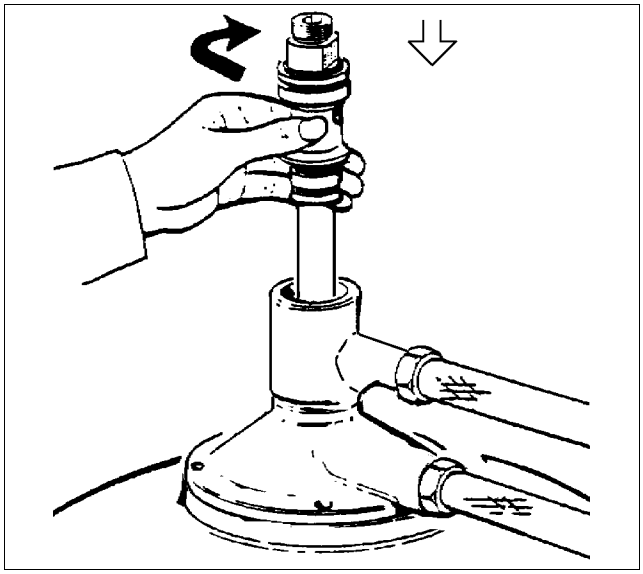
6.2.3 Assembly

1. Clean the sight glass for the water outlet.
2. Check that the O-rings for the collecting and top covers are fitted and that they are lubricated with silicone grease.
3. Put the two covers in place and tighten them with the four hinged bolts.
4. Fit the connecting housing and the inlet piping support. The rectangular ring situated in between should be lubricated.



5. Lubricate the O-rings of the inlet pipe.
   Fit the inlet pipe and tighten it firmly.
   Left-hand thread!

6. Connect the displacement/liquid seal water hose.



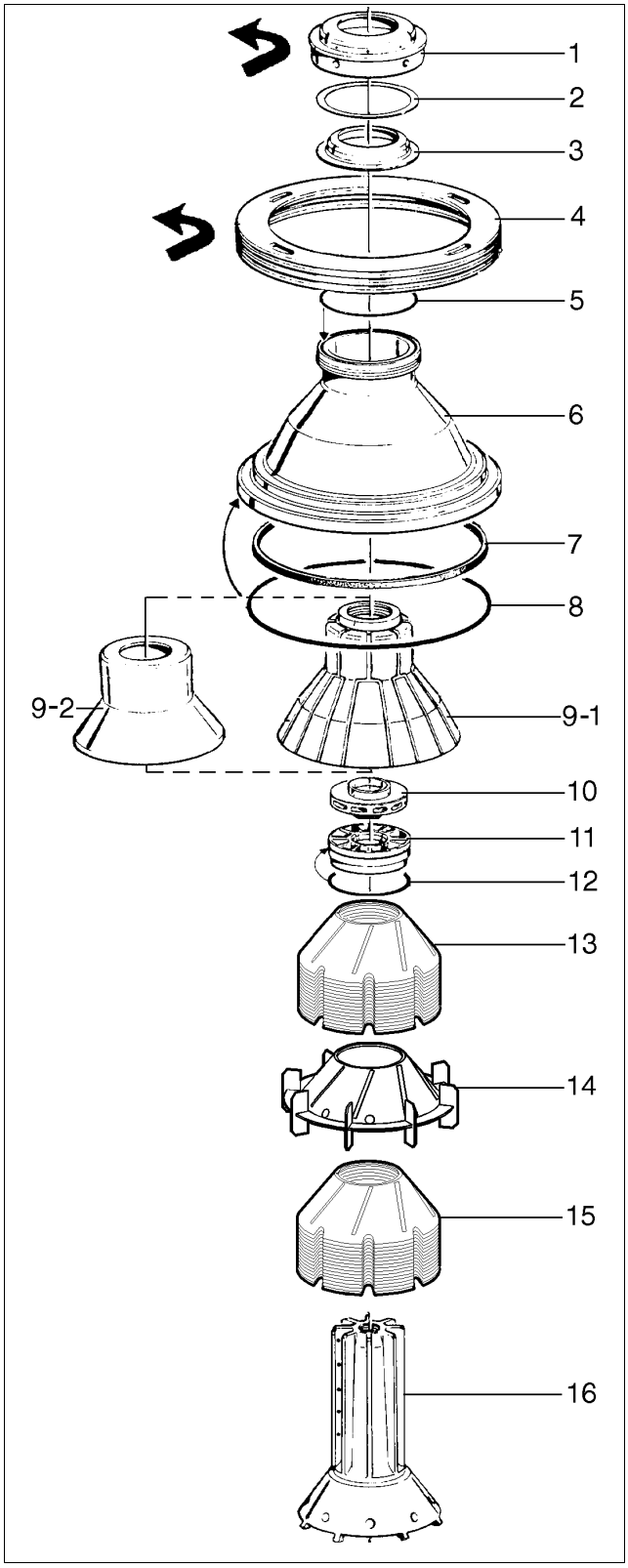
WARNING

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. *Small lock ring*
2. *Gasket*
3. *Gravity/clarifier disc*
4. *Large lock ring*
5. *O-ring*
6. *Bowl hood*
7. *Seal ring*
8. *O-ring*

9-1. *Top disc for purification*

9-2. *Top disc for clarification*

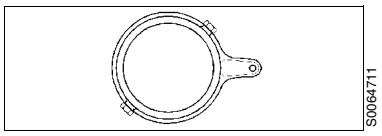
10. *Oil paring disc*
11. *Level ring*
12. *O-ring*
13. *Bowl discs*
14. *Wing insert*
15. *Bowl discs*
16. *Distributor*

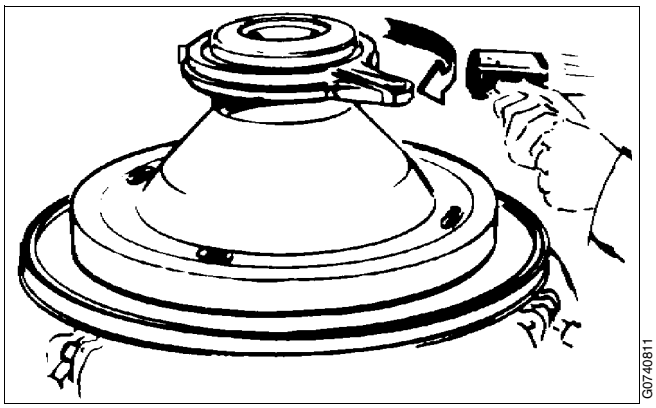
Left-hand thread

6.3.2 Dismantling

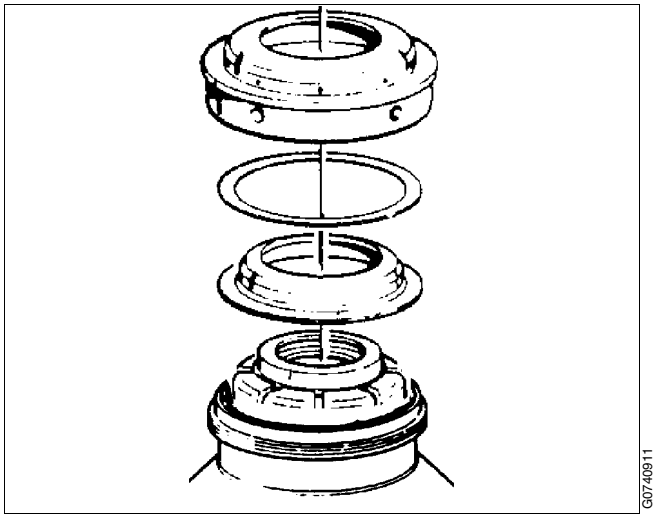
1. Unscrew the small lock ring using the special spanner.

   Left-hand thread!



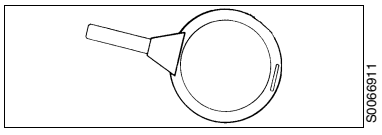


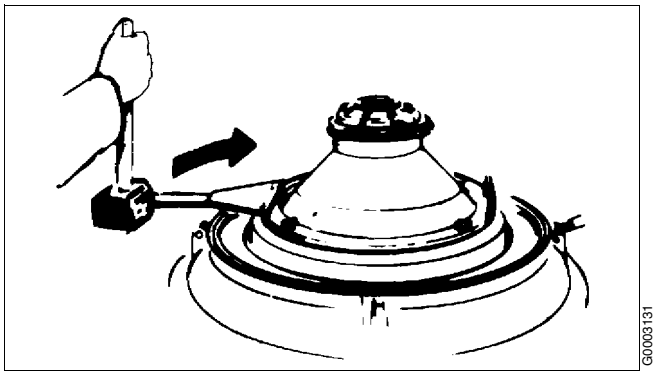
2. Remove the small lock ring, gasket and gravity/clarifier disc.



3. Apply the brake and unscrew the lock ring using the special spanner.

   Left-hand thread!



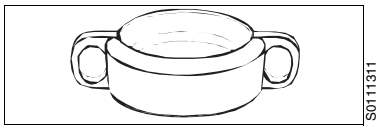


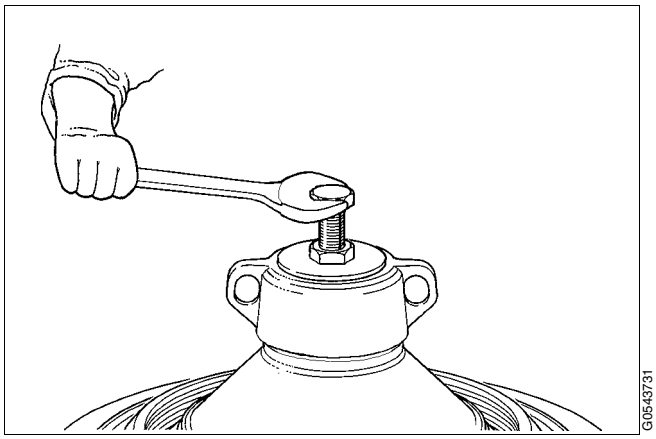
4. Remove the lock ring.

NOTE

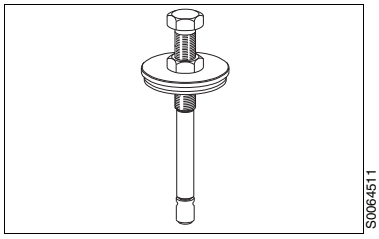
The lock ring must be kept lying horizontally or it may become distorted. Even slightest distortion could make it impossible to refit.

5. Fit the lifting tool on the bowl hood.

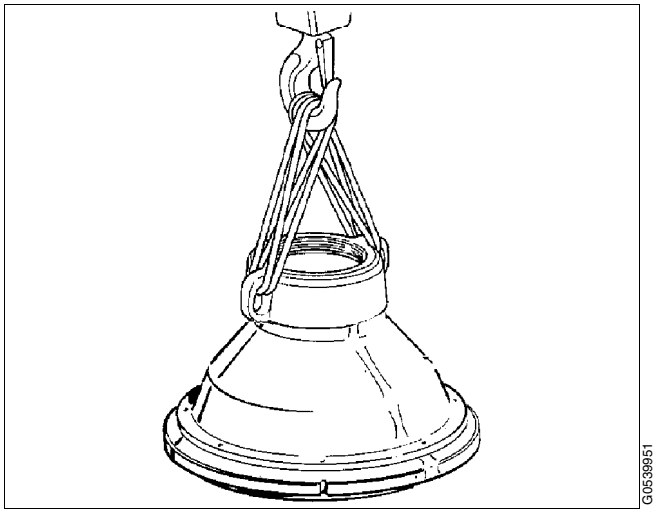




6. Screw the spindle plate into the lifting tool. Unscrew the spindle a few turns if the plate is not in contact with the lifting tool.



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



CAUTION

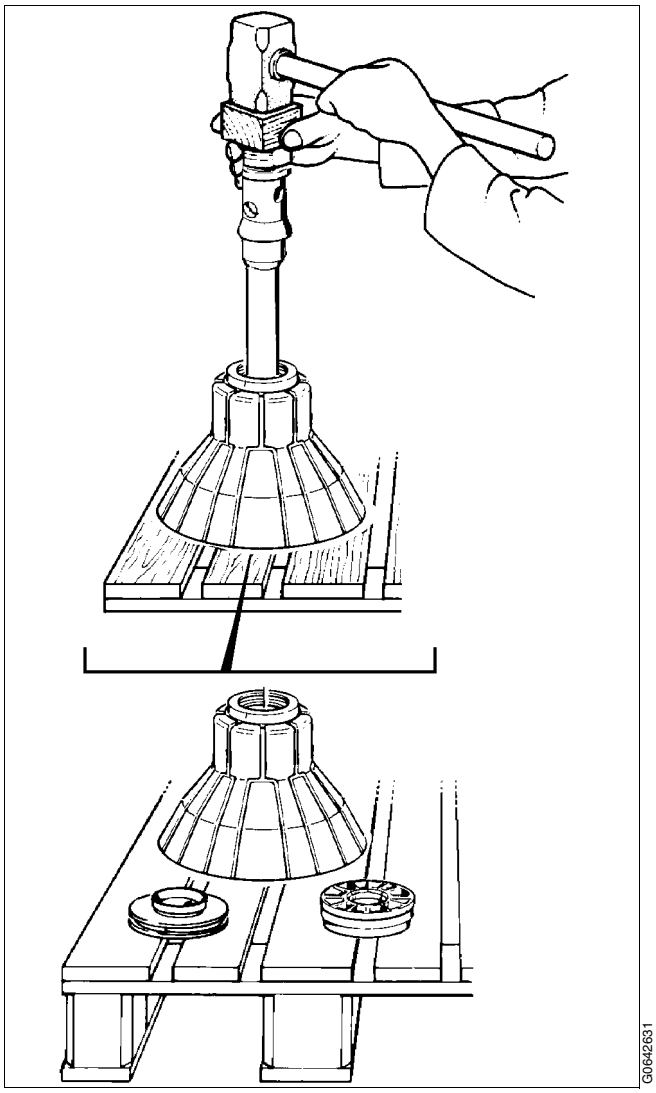
Crush hazards

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

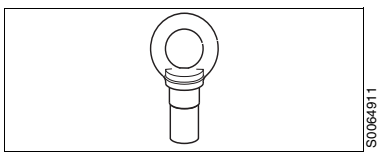
10. Remove the top disc.
11. Screw the inlet pipe into the oil paring disc located above the level ring inside the top disc.

    Left-hand thread!

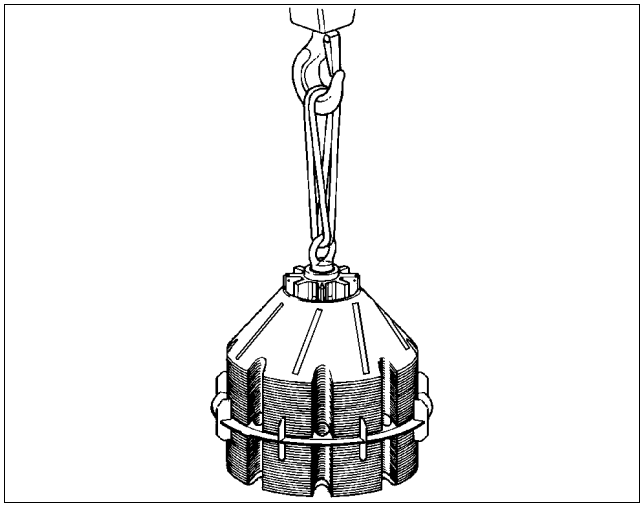
    Place the top disc onto wooden blocks to act as protection for the top disc edge and for falling level ring. Place a piece of wood between the tin hammer and the inlet pipe and then force out the level ring and the paring disc carefully from the top disc.



12. Fit the lifting tool into the distributor and lift the distributor with disc stack out of the bowl body by a hoist.



13. Remove deposits and clean all parts thoroughly in a suitable cleaning agent. See chapter “5.6 Cleaning” on page 93.

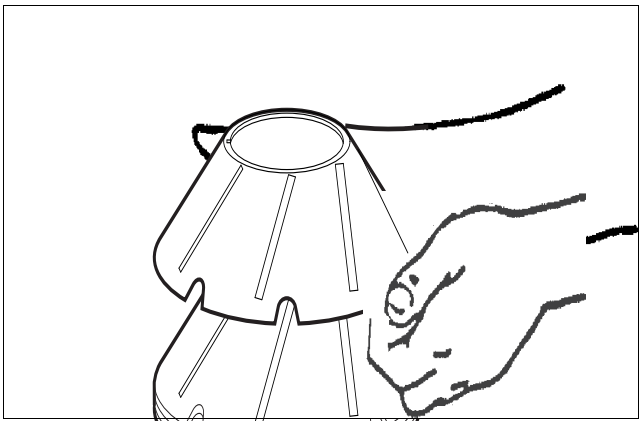


6.3.3 Assembly

✔ **Check point**

"5.3.3 Corrosion" on page 61,
"5.3.4 Cracks" on page 64,
"5.3.6 Erosion" on page 66,
"5.3.10 Lock ring; wear and damage" on page 71.

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



CAUTION

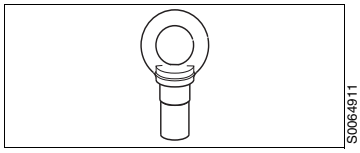
Cut hazard

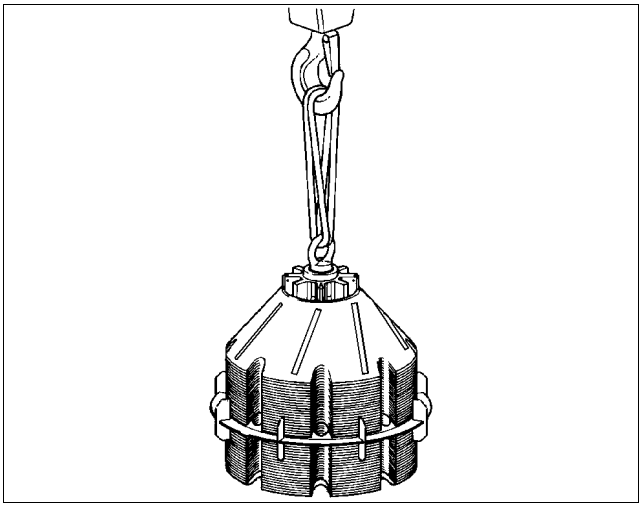
Sharp edges on the separator discs may cause cuts.

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

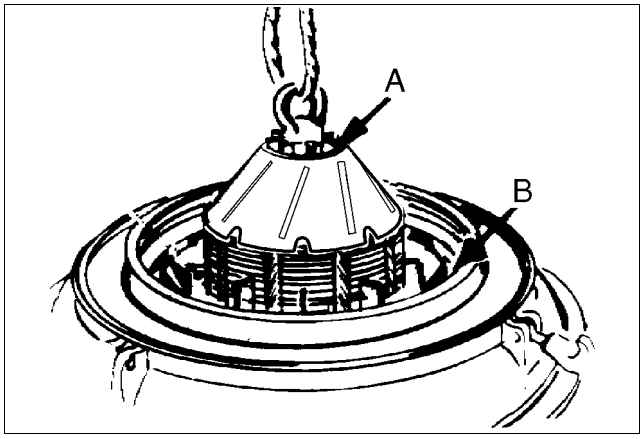
The number of bowl discs above the wing insert may be increased to adjust the disc stack pressure.

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





3. Check that the guide pins on underside of the distributor, which is in line with the drilled mark on the guide rib (A), enter the recesses in the sliding bowl bottom, which is in line with the guide lug on the bowl body (B).



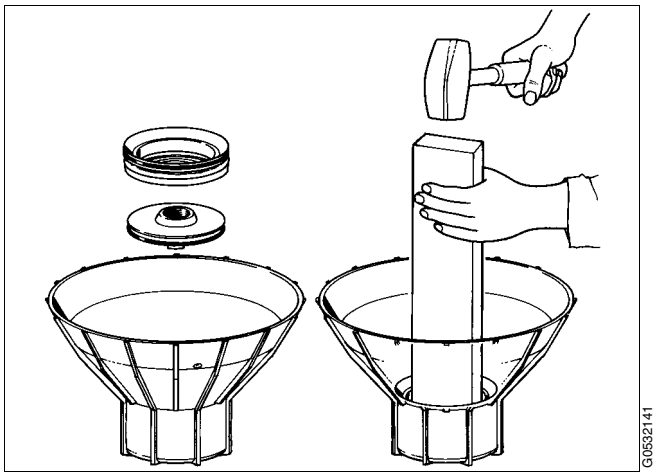
✔ **Check point**

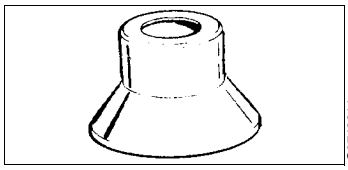
"5.3.8 Inlet pipe and oil paring disc" on page 70, "5.3.9 Level ring" on page 70.

4. Fit the oil paring disc and level ring with the O-ring into the top disc. Before assembly, lubricate the O-ring with silicone grease.

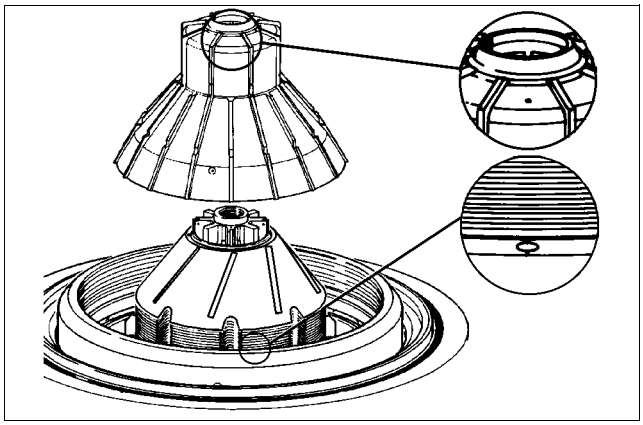
   Make sure that the paring disc is positioned in the right direction.

   If the separator is to be assembled for clarifier mode and the smallest gravity disc is to be used, the top disc must be replaced with the small top disc, see the illustration below.





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.

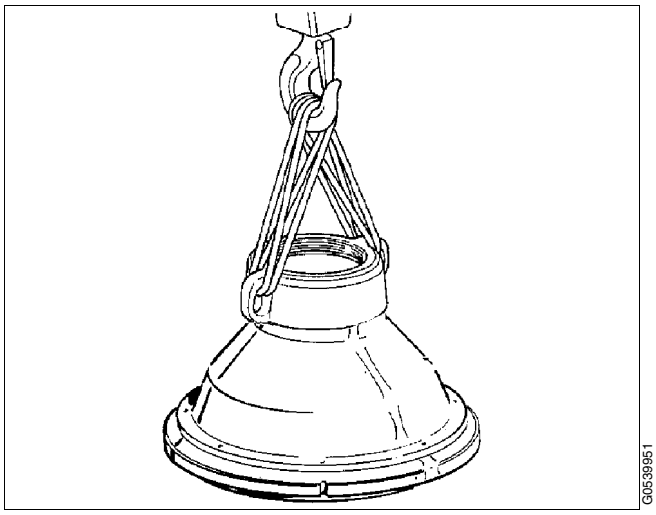


✔ **Check point**
"5.3.1 Bowl hood seal ring" on page 60.

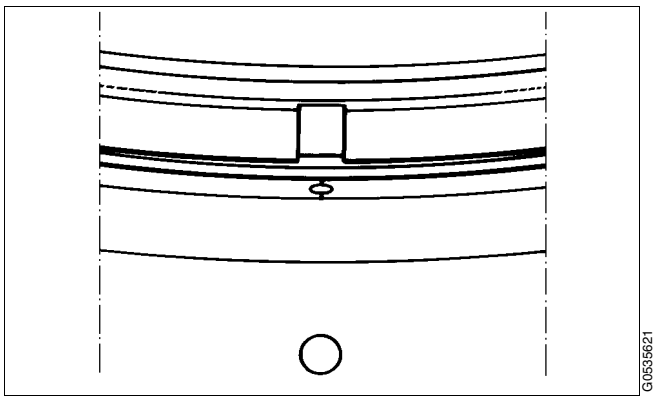
6. Fit the lifting tool to the bowl hood and lift it using a hoist. Check that the O-ring and the seal ring of the bowl hood are properly fitted and lubricated.

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

   For correct position of bowl hood, see next illustration.

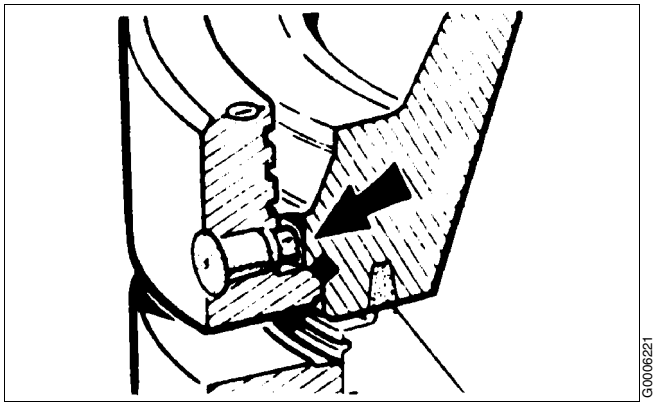


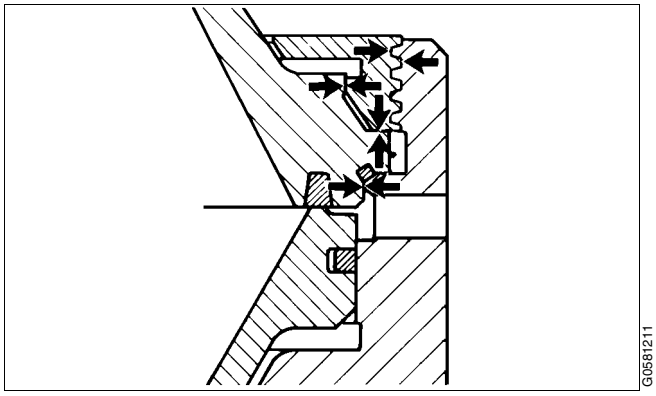
7. Check that the guide recess on the bowl hood enters the guide lug in the bowl body.



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

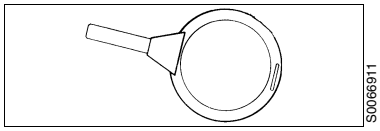
✔ **Check point**
"5.4.18 Lock ring; priming" on page 86 (only when Major Service).

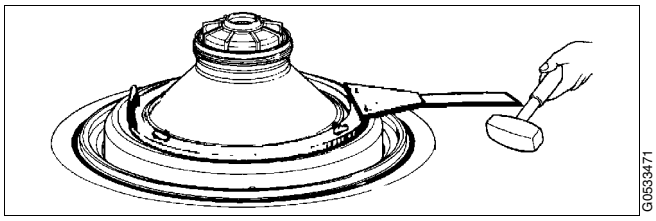




10. Tighten the lock ring.

Left-hand thread!





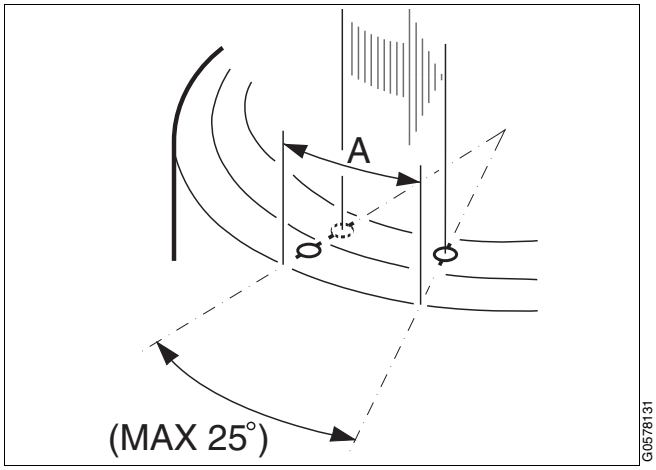
11. Tighten until the assembly marks are at least in line.

✔ **Check point**

"5.3.5 Disc stack pressure" on page 65.

NOTE

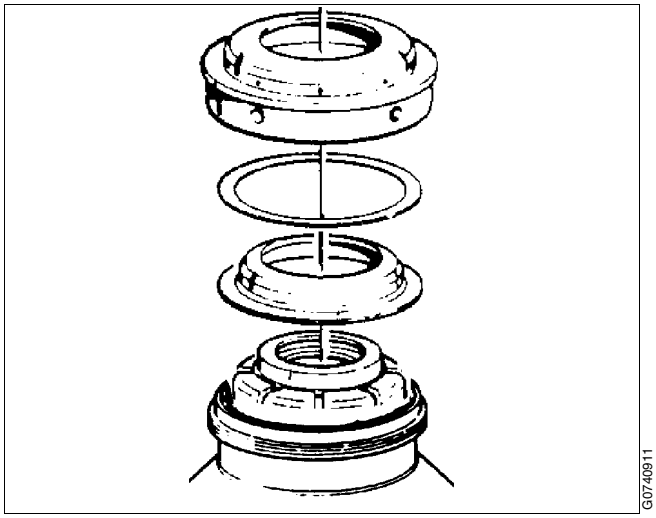
The assembly marks must never pass each other more than 25° which corresponds to **A=80 mm**.



12. Fit the gravity/clarifier disc, gasket and small lock ring.

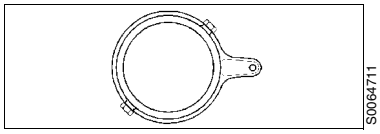
✔ **Check point**

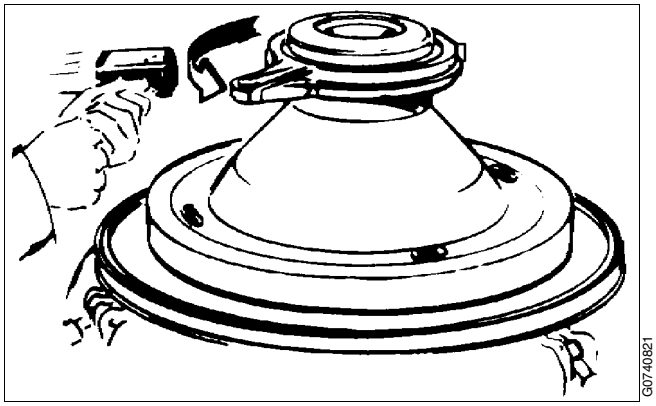
"5.3.8 Inlet pipe and oil paring disc" on page 70.



13. Tighten the small lock ring.

Left-hand thread!

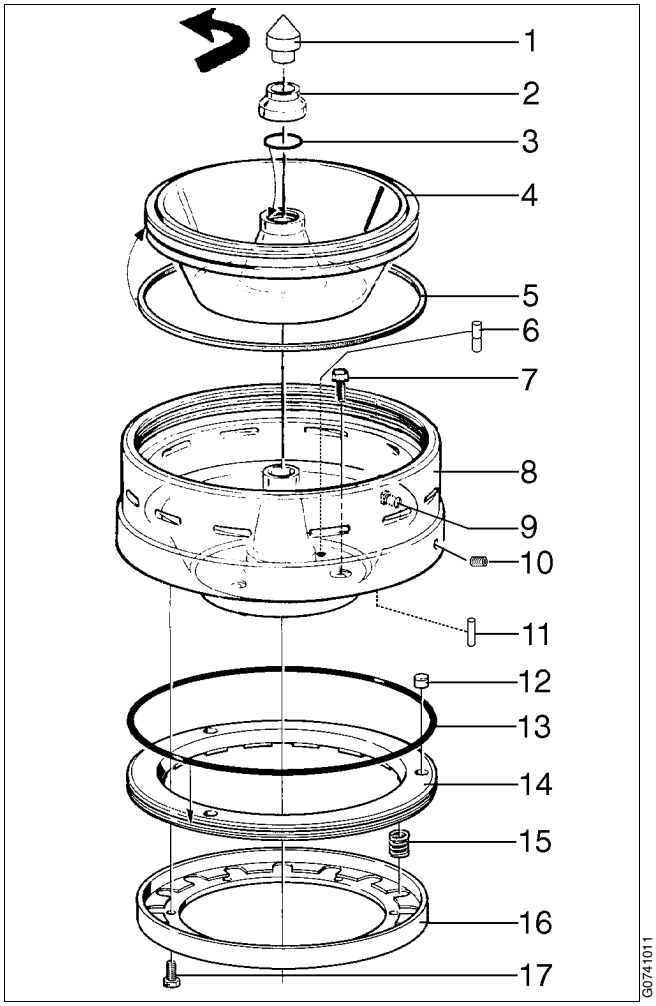




6.4 Bowl body and operating mechanism (IS)

6.4.1 Exploded view

1. *Cap nut*
2. *Nave cap*
3. *O-ring*
4. *Sliding bowl bottom*
5. *Rectangular ring*
6. *Guide pin*
7. *Screw*
8. *Bowl body*
9. *Guide lug*
10. *Nozzle*
11. *Guide pin*
12. *Valve plug*
13. *O-ring*
14. *Operating slide*
15. *Spring*
16. *Spring holder*
17. *Screw*



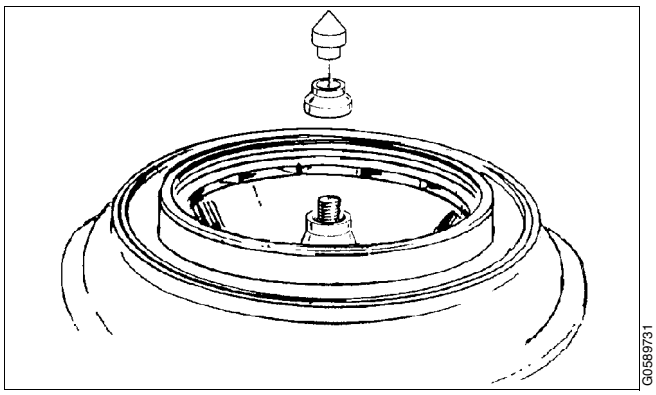
Left-hand thread

6.4.2 Dismantling

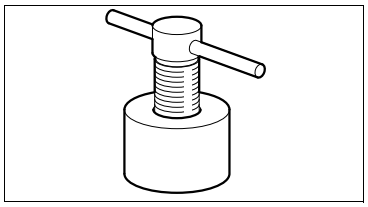
1. Unscrew and remove the cap nut by using e.g. a bar. The hole diameter in the cap nut is 12 mm.

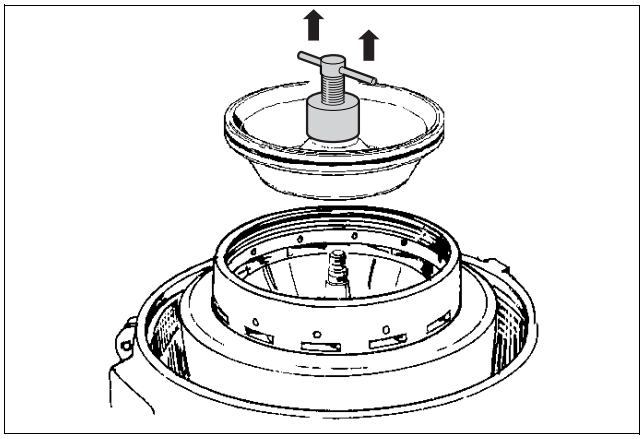
   Left-hand thread!

2. Remove the nave cap.



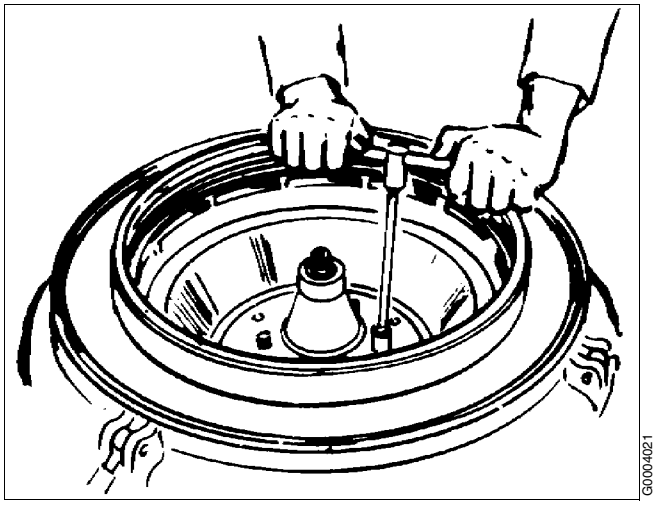
3. Fit the lifting tool onto the sliding bowl bottom and turn the handle until the sliding bowl bottom comes loose from the bowl body.



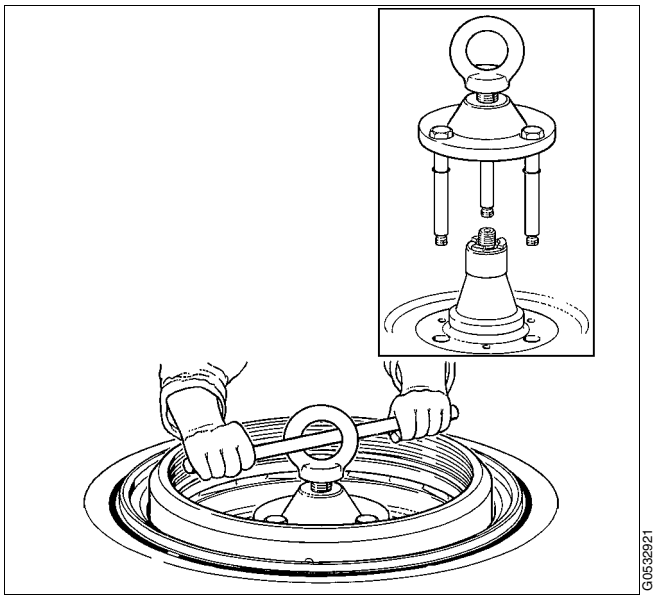


   Lift out the sliding bowl bottom.

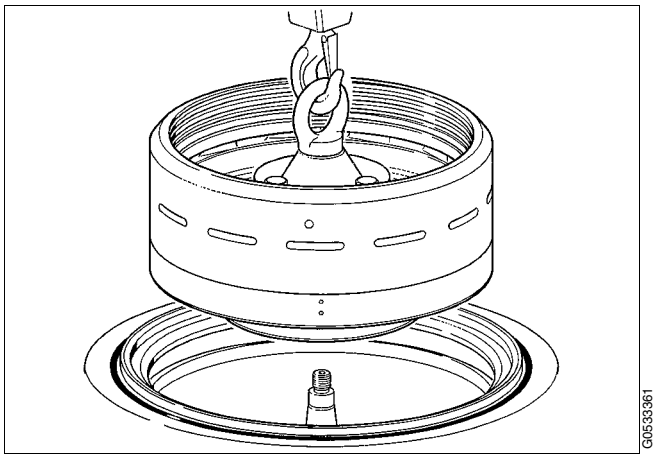
4. Unscrew the three screws in the bottom of the bowl body.



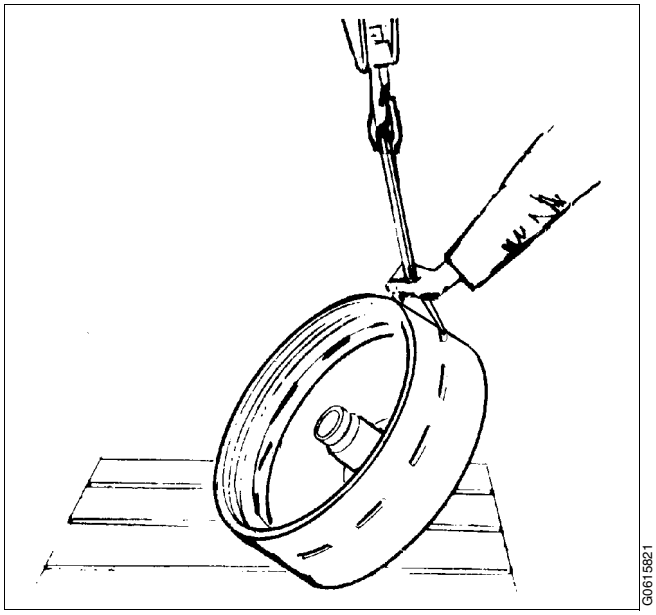
5. Fit the lifting tool for the bowl body bottom with the three screws.
6. Release the bowl body from the spindle by using the lifting tool as a puller. Turn the handle at top of the lifting tool until the bowl body comes loose from the spindle taper. Turn the handle two more turns in order to avoid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



7. Lift out the bowl body using a hoist.



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

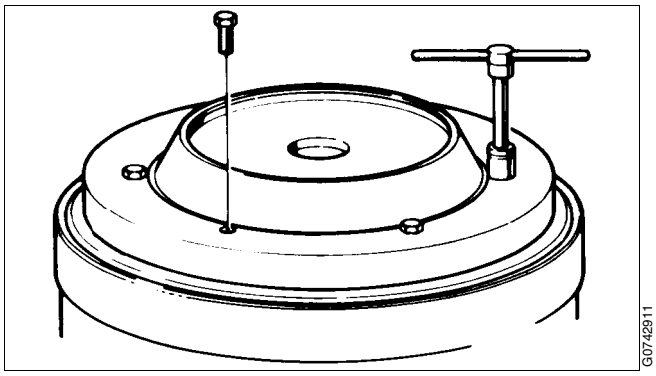


WARNING

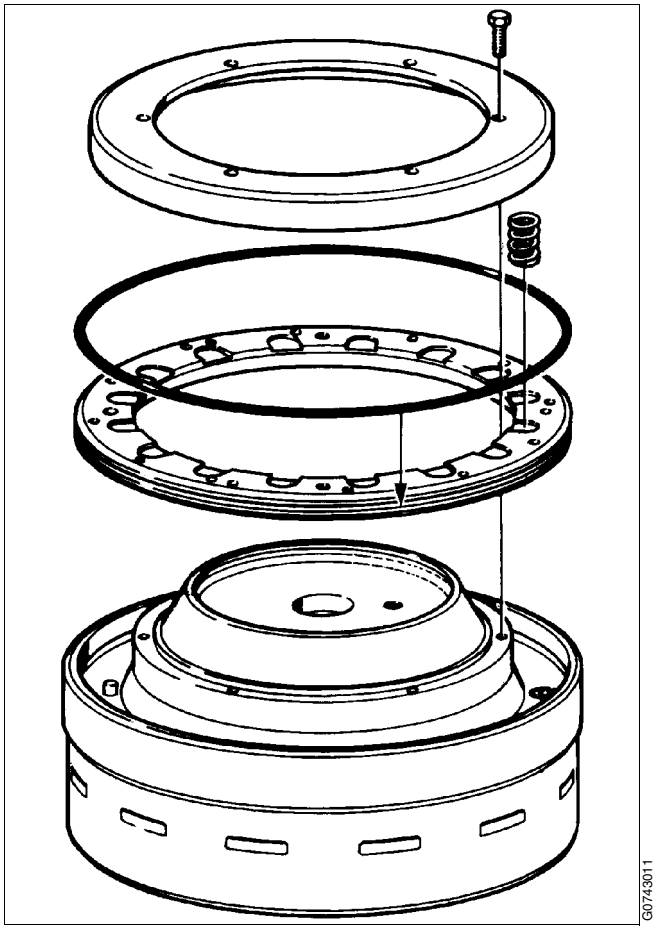
Crush hazards

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

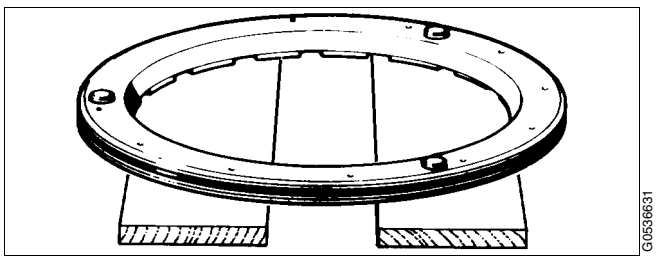
9. Loosen the screws for the spring holder successively a little at a time. Remove the screws.



10. Remove the spring holder, springs and operating slide.



11. Place the operating slide with the valve plugs facing upwards.
12. 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 90.



6.4.3 Assembly

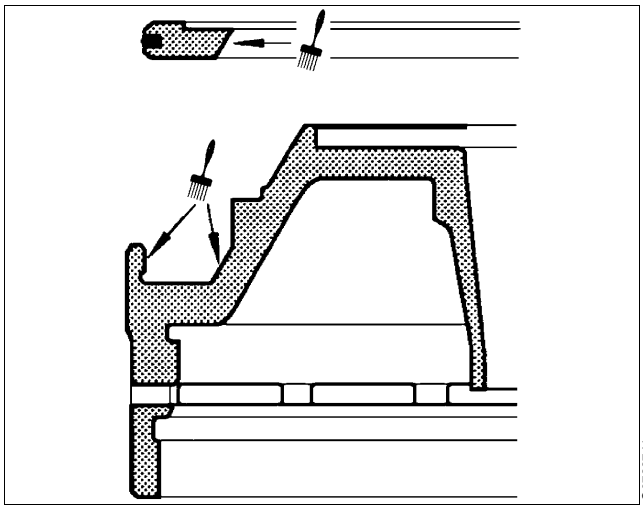
✔ **Check point**

“5.3.3 Corrosion” on page 61,
“5.3.4 Cracks” on page 64,
“5.3.6 Erosion” on page 66,
“5.3.7 Guide surfaces” on page 68,
“5.3.11 Operating mechanism” on page 73,
“5.3.12 Operating slide” on page 73,
“5.3.13 Sliding bowl bottom” on page 74,
“5.3.14 Springs for operating mechanism” on page 75.

1. Check that the nozzle fitted in the lower part of the bowl body is well cleaned (is preferably cleaned by a soft iron wire).
2. Lubricate the guide surfaces and O-rings on the bowl body and operating slide with lubricating paste. See chapter “8.7 Lubricants” on page 192.

NOTE

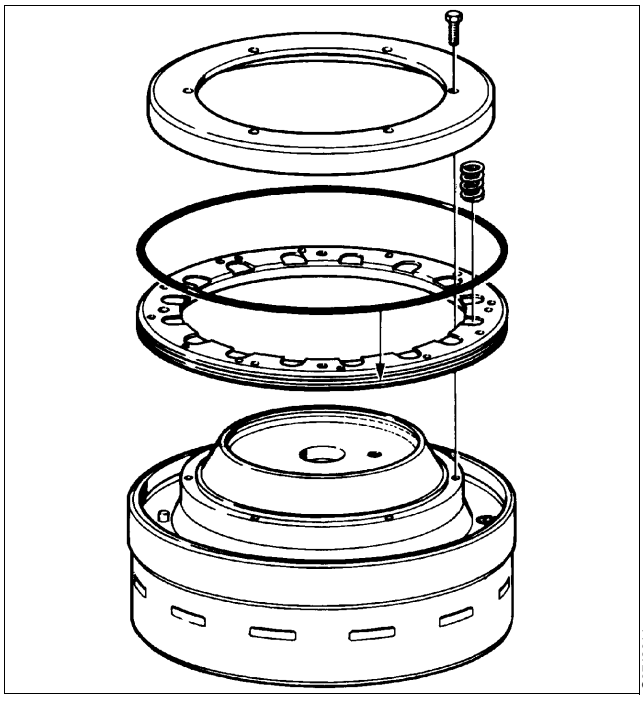
If there is too much lubrication paste applied, the surplus will collect between the operating slide and bowl body with risk for malfunction.



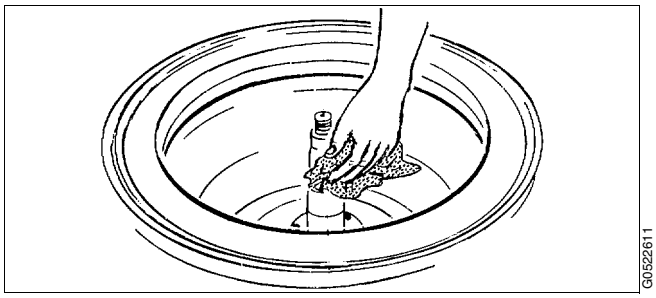
3. Lubricate the O-ring fitted on the operating slide. Fit the slide onto the bowl body.

   Check that the guide pin in the bowl body enters the hole in the operating slide.
4. Lubricate the guide surfaces on the spring holder. See chapter “8.7 Lubricants” on page 192.

   Fit the springs and support.
5. Lubricate and then tighten the six screws for the spring holder successively a little at a time. Finally tighten firmly (by hand).



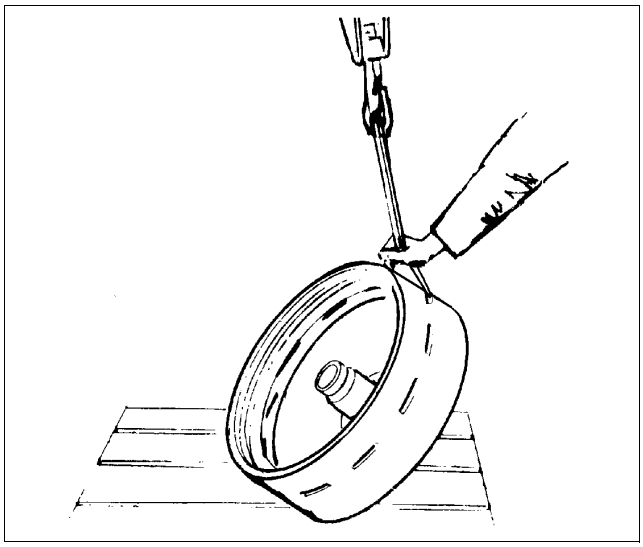
6. Wipe off the spindle top and nave bore in the bowl body. Lubricate the tapered end of the spindle and wipe it off with a clean cloth.



✔ **Check point**

"5.3.2 Bowl spindle cone and bowl body nave" on page 61

7. Wipe off the spindle top and nave bore in the bowl body. For rust protection, lubricate the tapered end of the spindle with a few drops of oil (**no** other lubricant shall be used). Spread it over the surface carefully. Wipe off surplus oil with a clean cloth.

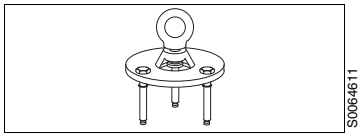


NOTE

Too much oil on the surface between the spindle and bowl body, or if other lubricant is used, will reduce the friction between the two parts. This may result in a relative rotation between the parts, which can lead to seizure, scoring and possible welding.
Support bowl body when turning to prevent it from rolling.

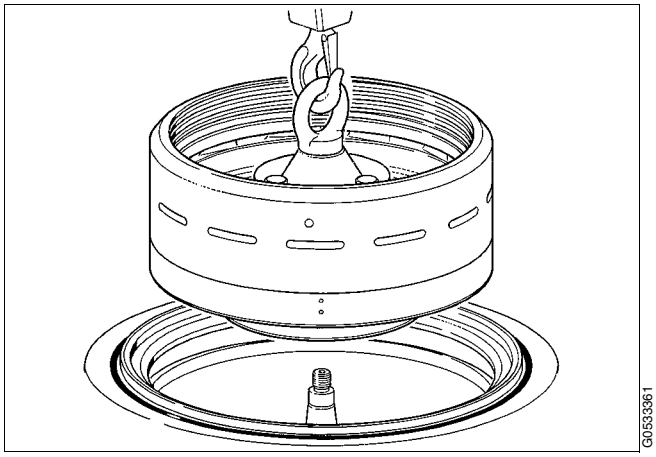
8. Fit the lifting tool into the bowl body bottom with the three screws.

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



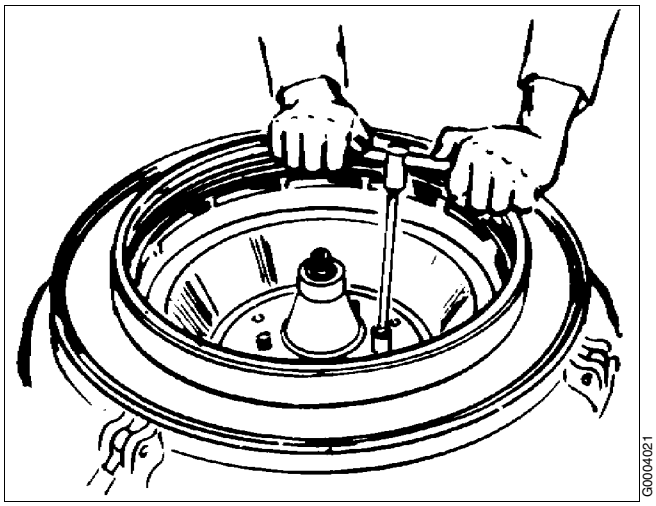
9. Lower the bowl body using a hoist until the central screw rests on the spindle top. Then screw up the central screw so that the bowl body sinks down onto the spindle.

   Remove the tool.



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

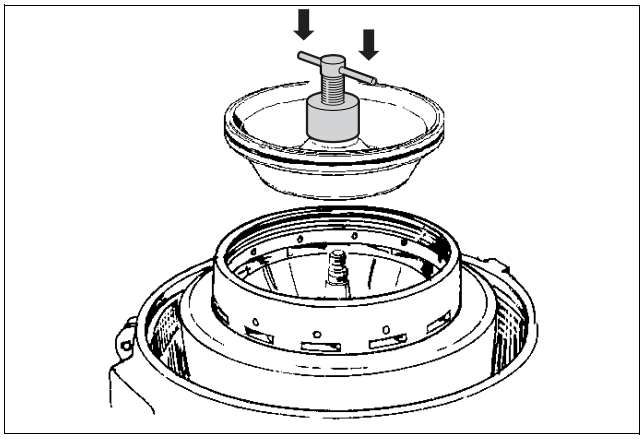
    Tighten the three screws firmly.

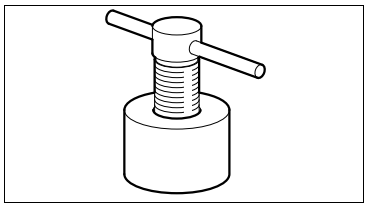


11. Lubricate the guide surfaces of the bowl body and sliding bowl bottom with lubricating paste. See chapter “8.7 Lubricants” on page 192.

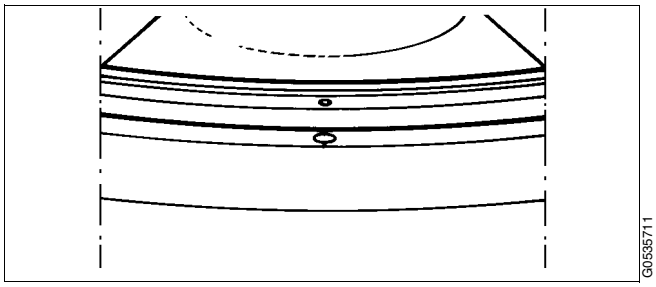
12. Fit the lifting tool to the sliding bowl bottom and lift it into the bowl body.

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



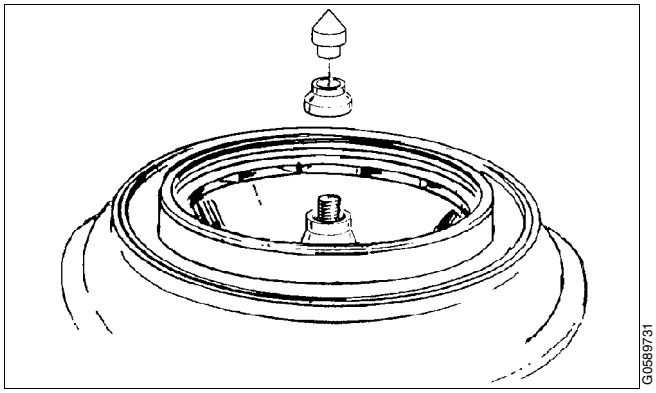


13. Bring the assembly mark on the sliding bowl bottom in line with the guide lug on the bowl body to ensure that the sliding bowl bottom enters into the correct position.



14. Fit the nave cap and tighten the cap nut firmly by using e.g. a bar.

    Left-hand thread!

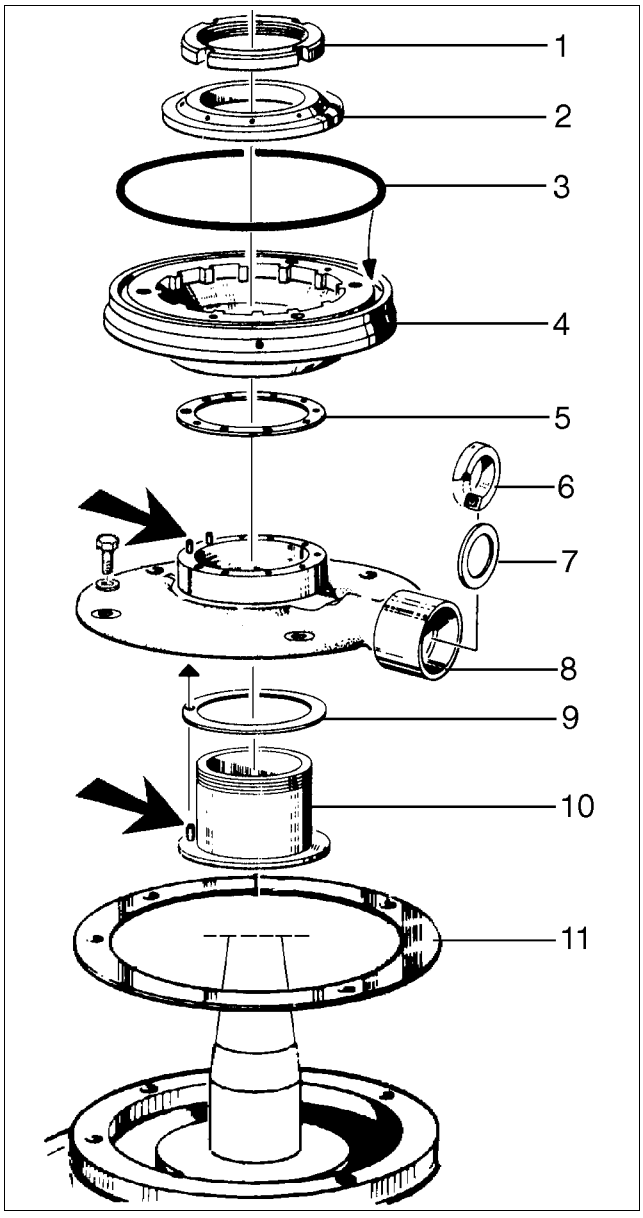


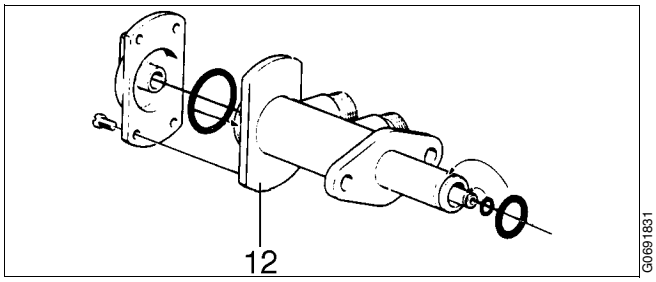
6.5 Operating water device (IS)

6.5.1 Exploded view

1. *Ring nut*
2. *Control paring disc*
3. *O-ring*
4. *Distributing ring*
5. *Gasket*
6. *Seal ring*
7. *Guide ring*
8. *Distributing cover*
9. *Gasket*
10. *Sleeve*
11. *Height adjusting ring*
12. *Operating device*

Guide



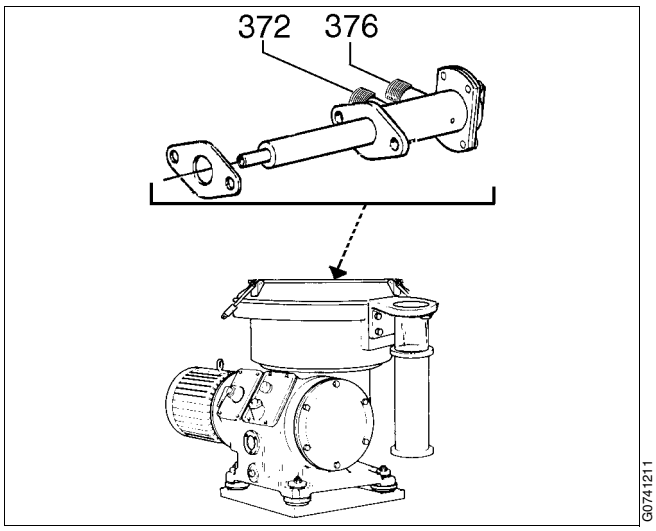


6.5.2 Dismantling

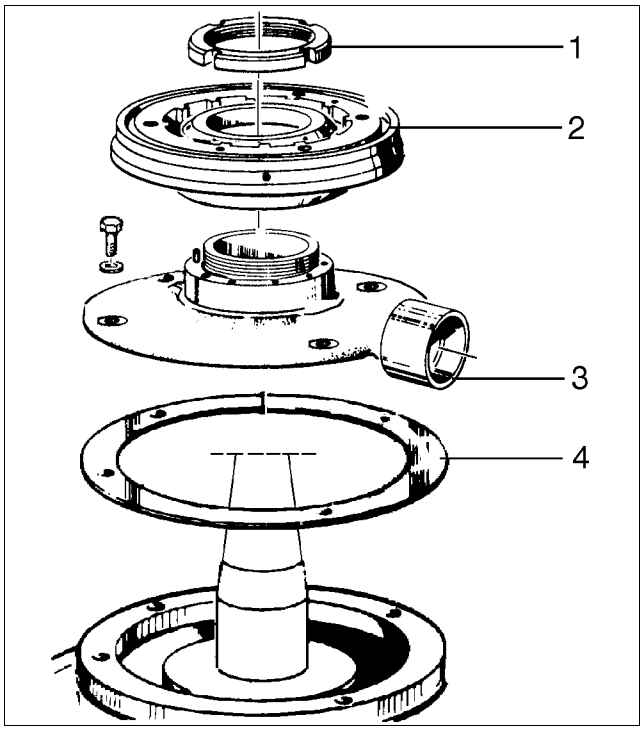
1. Disconnect the water hoses to the operating water inlet device.

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

2. Loosen and pull out the device from the distributing cover.



3. Ease off the ring nut (1).
4. Unscrew the screws fixing the distributing cover (3) and lift it out together with the paring disc assembly (2).
5. Dismantle the parts in the sequence appearing from the illustration on previous page.
6. Remove deposits and clean all parts thoroughly in a suitable cleaning agent. Pay special attention to the channels. See chapter “5.6 Cleaning” on page 93.
7. Check the parts for damage and corrosion.



1. *Ring nut*
2. *Paring disc assembly*
3. *Distributing cover*
4. *Height adjusting ring(s)*

6.5.3 Assembly

1. Assemble the parts in the sequence appearing from the illustration on page 127. See also following text.

   Ensure the parts are placed in the positions defined by the guides.

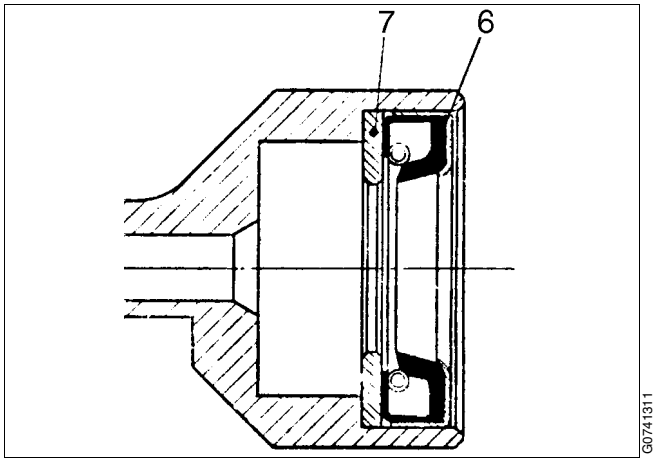
2. Fit the height adjusting ring(s) (4) and distributing cover (3) including the sleeve.

3. Fasten the distributing cover with the six screws.

4. Fit the paring disc assembly (2) and tighten the ring nut (1).

✔ **Check point**
"5.4.20 Operating paring disc; height position" on page 89. Only at Major Service (MS).

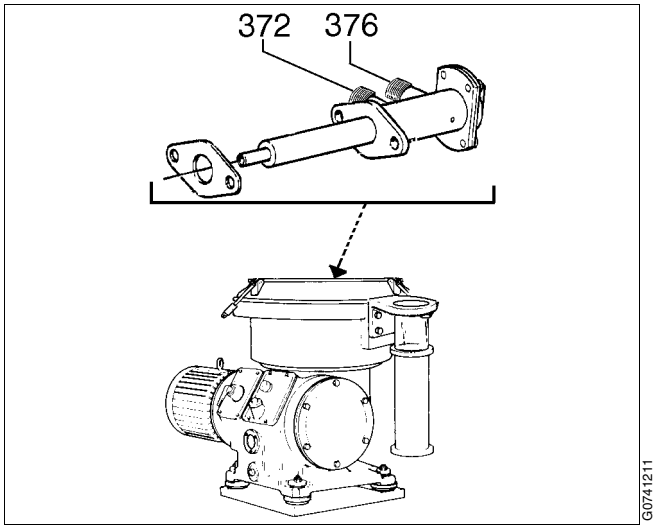
5. When fitting a new seal ring (6) in the distributing cover, be sure that the ring is fitted in the right direction, see the illustration.



6. Seal ring
7. Guide ring

6. Fit the operating water inlet device into the distributing cover.

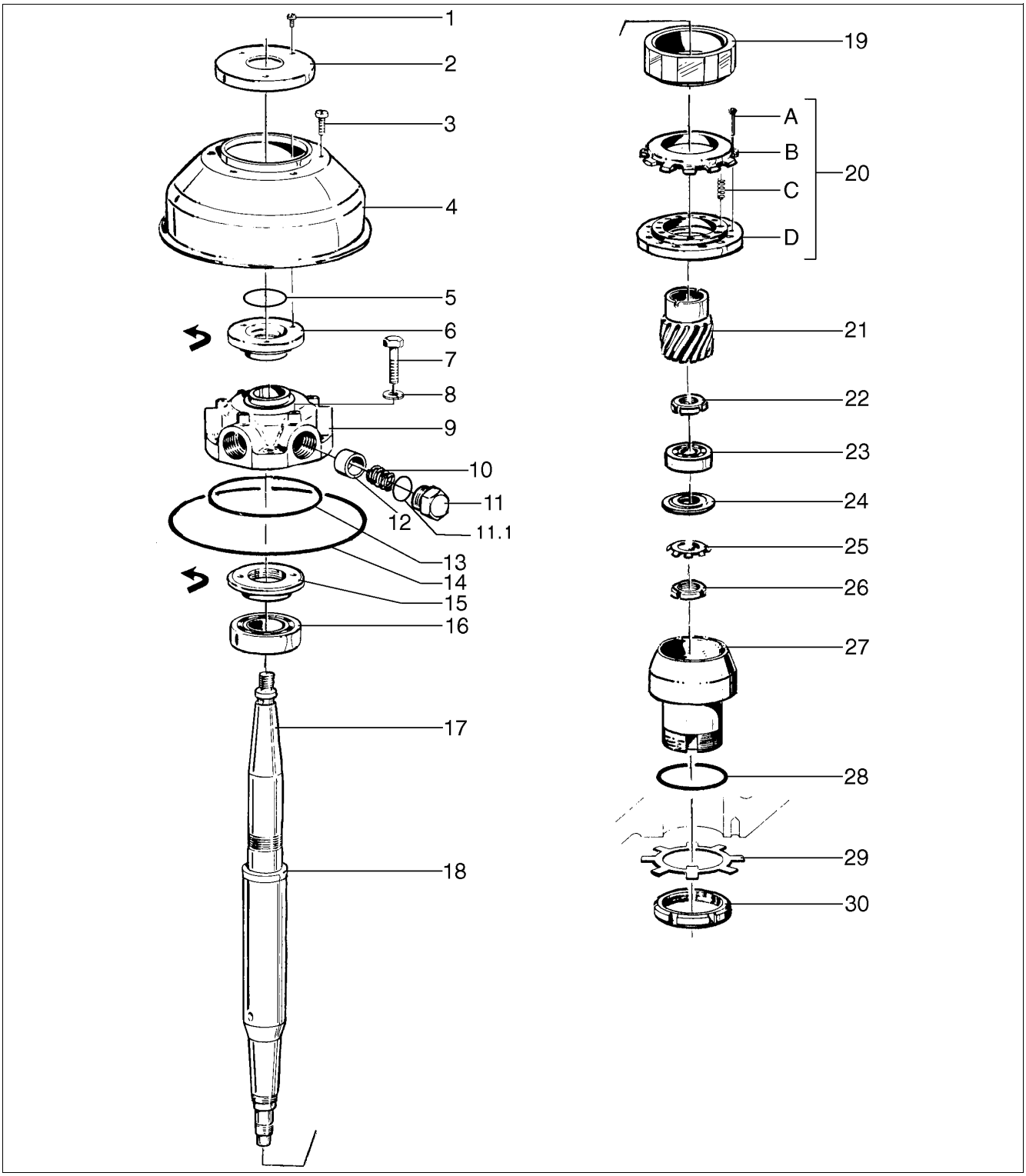
7. Connect the water hoses to the device.



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

6.6 Vertical driving device (MS)

6.6.1 Exploded view



1. *Screw*
2. *Protecting plate*
3. *Screw*
4. *Guard*
5. *O-ring*
6. *Protecting collar*
7. *Screw*
8. *Spring washer*
9. *Spring casing*
10. *Spring*
11. *Screw plug*

11.1 *O-ring*

12. *Buffer*
13. *O-ring*
14. *O-ring*
15. *Deflector*
16. *Ball bearing*
17. *Bowl spindle*
18. *Height adjusting ring*
19. *Ball bearing housing*
20. *Buffer*
    - *20A. Slit pin*
    - *20B. Wear ring*
    - *20C. Spring*
    - *20D. Holder*
21. *Worm*
22. *Round nut*
23. *Ball bearing*
24. *Washer*
25. *Lock washer*
26. *Round nut*
27. *Bushing*
28. *O-ring*
29. *Lock washer*
30. *Round nut*

 *Left-hand thread*

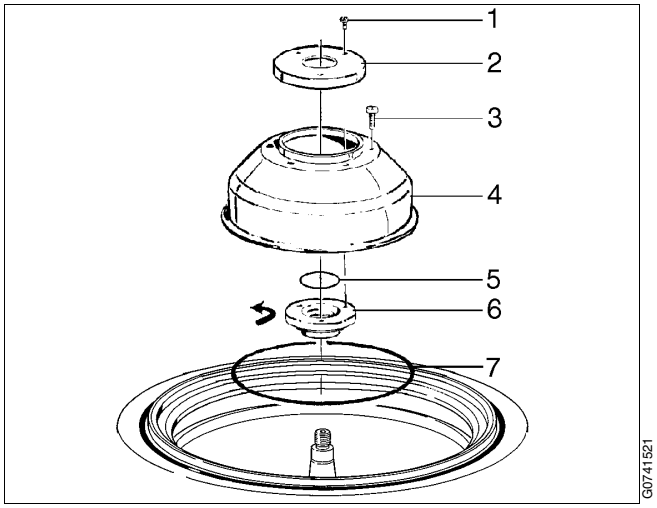
6.6.2 Dismantling

NOTE

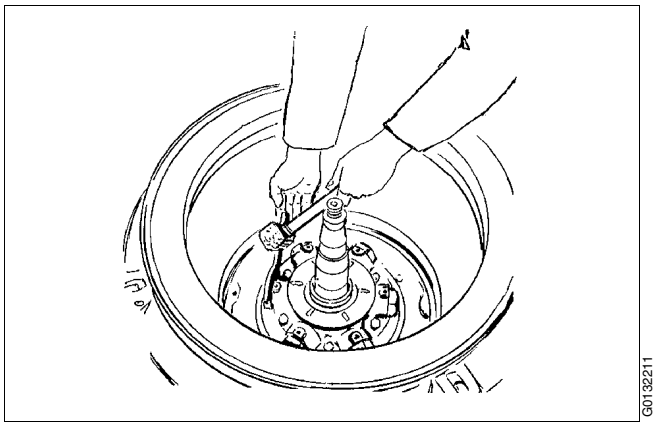
Clean the space in the bowl casing thoroughly before starting to dismantle the bowl spindle to prevent contaminations falling down into the oil gear housing.

1. Unscrew the three screws (1) and remove the protecting plate (2).
2. Unscrew the six screws (3) and remove the guard (4) and O-ring (7).
3. Remove the O-ring (5) and unscrew the protecting collar (6).

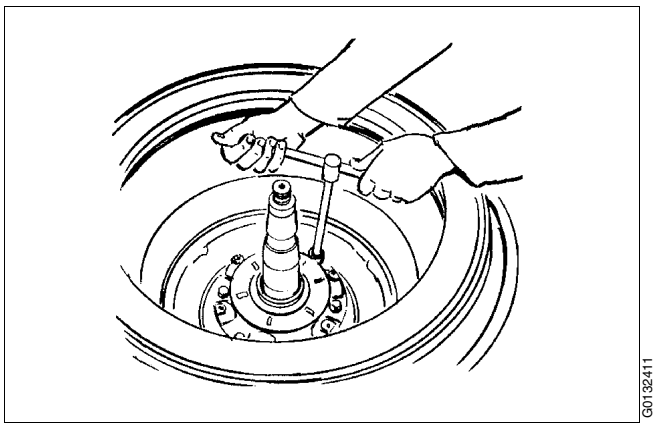
   Left-hand thread!



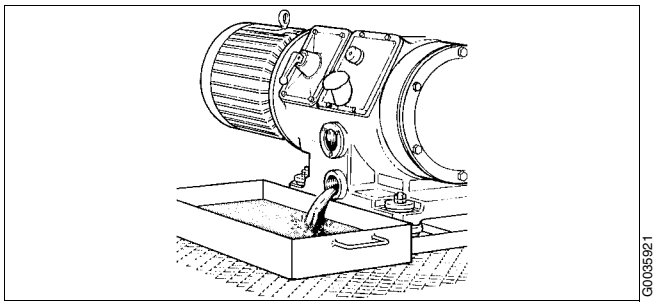
4. Loosen (but do not remove) the six screw plugs for the buffers with a spanner and a hammer.



5. Unscrew the six screws holding the spring casing.



6. Drain the oil from the worm gear housing.

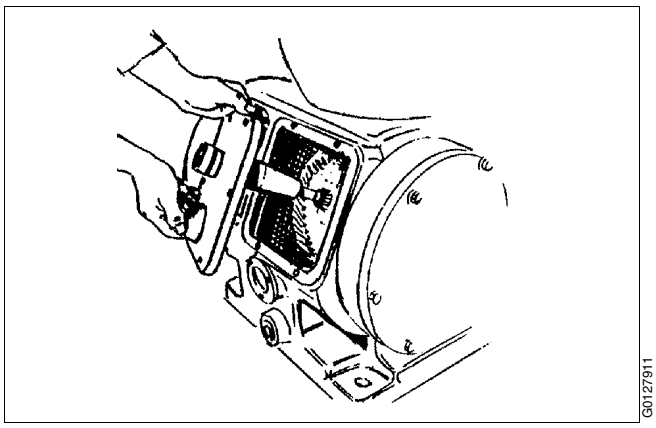


CAUTION

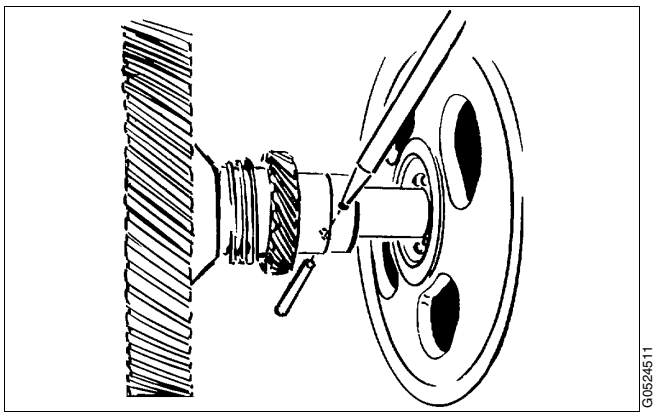
Burn hazards

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

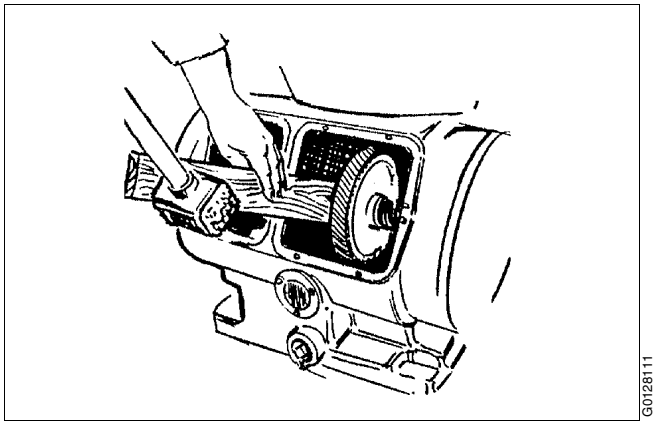
7. Remove the brake cover and the revolution counter cap and their gaskets.



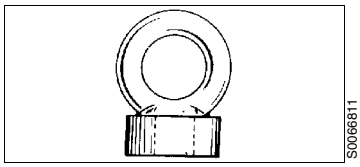
8. Knock out the taper pin from the worm wheel stop ring.

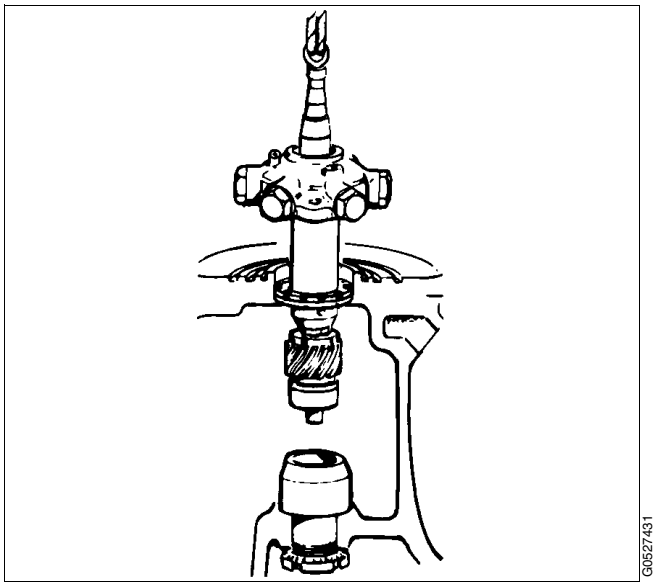


9. Push the worm wheel to one side before removing the spindle. If worm wheel is stuck use a piece of wood to loosen it.

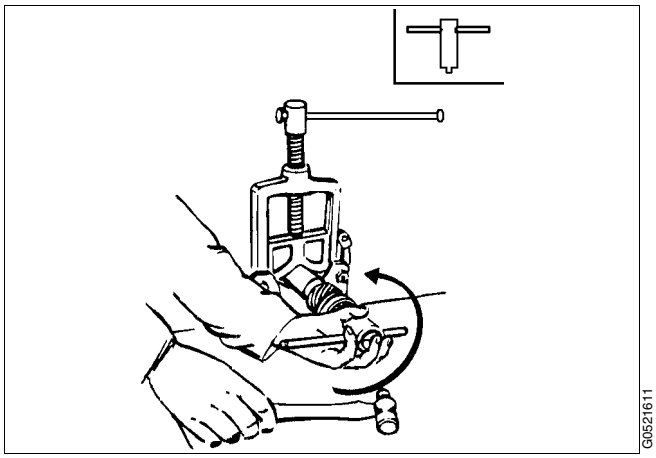


10. Fit the lifting tool onto the spindle and lift it out using a hoist.

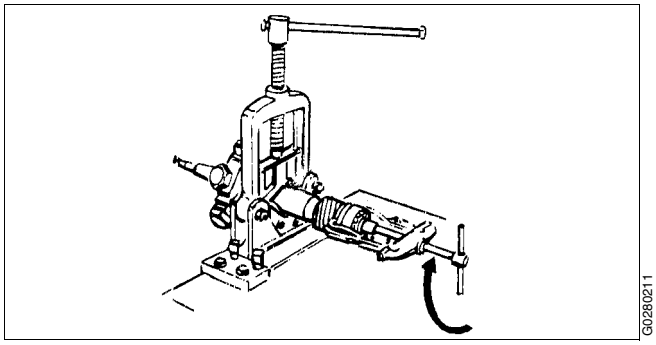




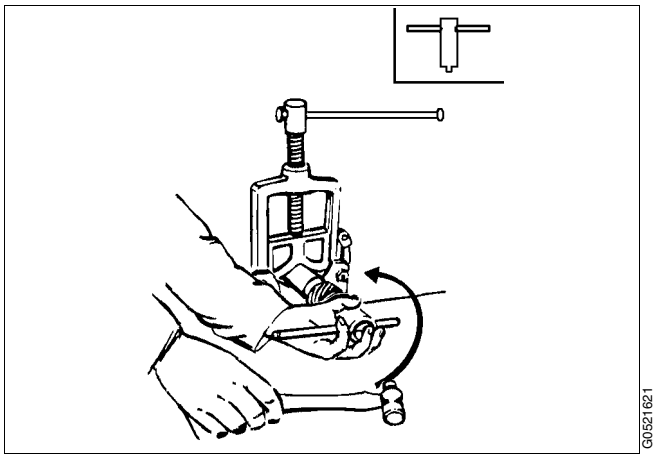
11. Clamp the bowl spindle in a screw vice, protected with copper liners.
12. Remove the round nut and lock washer for the bottom bearing on the spindle.



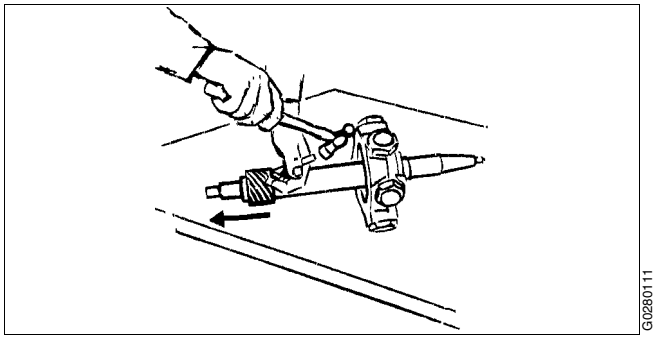
13. Pull off the ball bearing together with the spacing washer.



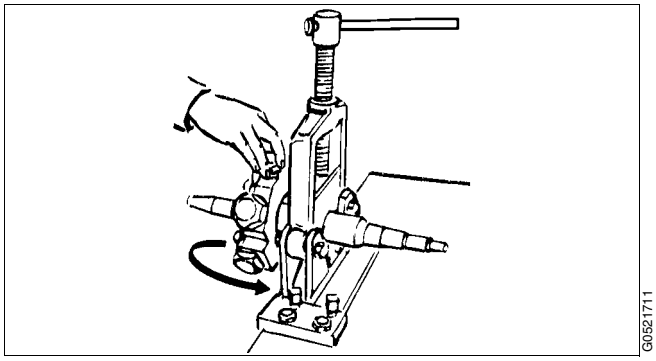
14. Remove the round nut for the worm on the spindle.



15. Knock off the worm by using a hammer and a **soft** drift.
16. Remove the axial buffer.

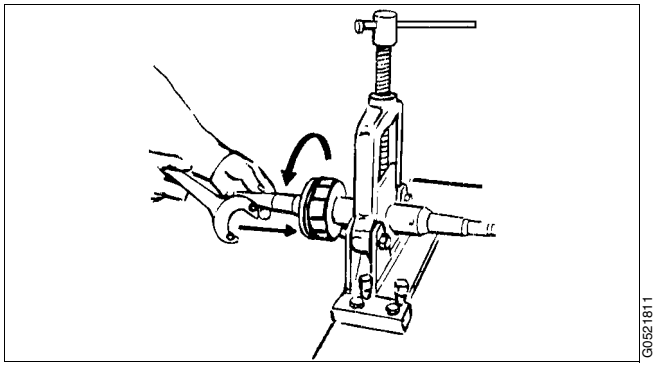


17. Remove the screw plugs, O-rings, springs and buffers. Then remove the spring casing.

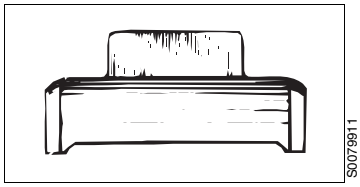


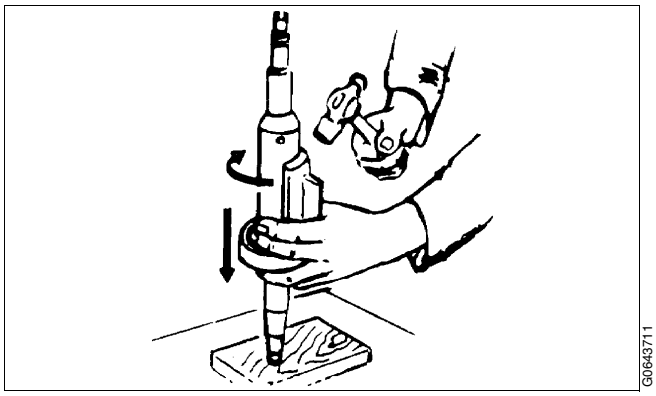
18. Unscrew the deflector and remove the ball bearing housing.

    Left-hand thread!



19. Knock off the ball bearing.





20. Remove deposits and clean all parts thoroughly in a suitable cleaning agent. See chapter “5.6 Cleaning” on page 93.

6.6.3 Assembly

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

WARNING

Burn hazards

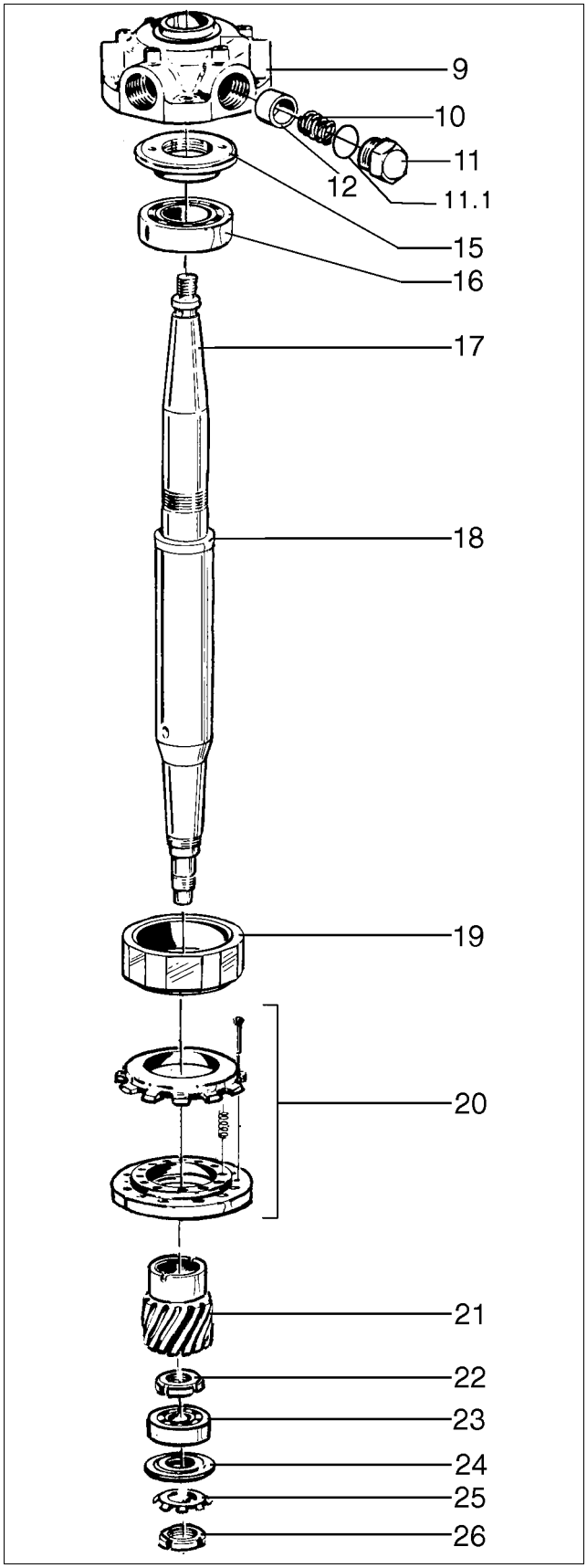
Use protective gloves when handling the heated bearings.

NOTE

If 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 101.

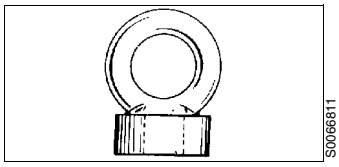
✔ **Check point**
“5.4.6 Buffer springs and ball bearing housing” on page 80.

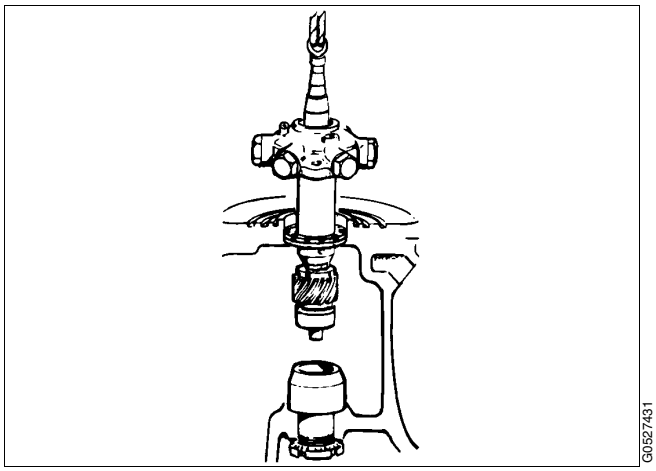
1. Check that the height adjusting ring (18) is fitted. The spindle height can be adjusted by exchanging or adding an adjusting ring.
2. Mount the upper ball bearing (16) onto the spindle. Make sure it enters its seat.
3. Fit the ball bearing housing (19) and tighten the deflector (15).
   Left-hand thread!
4. Fit the spring casing (9), buffers (12), springs (10), O-rings (11.1) and plugs (11).
   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.
5. Fit the axial buffer (20) and worm (21). Tighten the round nut (22).
6. Fit the bottom ball bearing (23) and spacing washer (24).



7. Finally fit the lock washer (25) and tighten the round nut (26).

8. Fit the lifting tool to the spindle and lift it using a hoist.



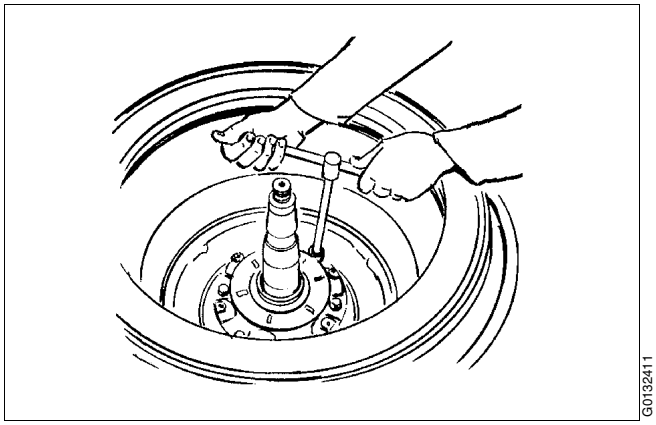


9. Carefully lower the spindle into the frame and guide the spindle into the right position in the bottom bearing housing so the ball bearing enters its seat. If the ball bearing do not completely enters its seat, tap the spindle top gently with a tin hammer.

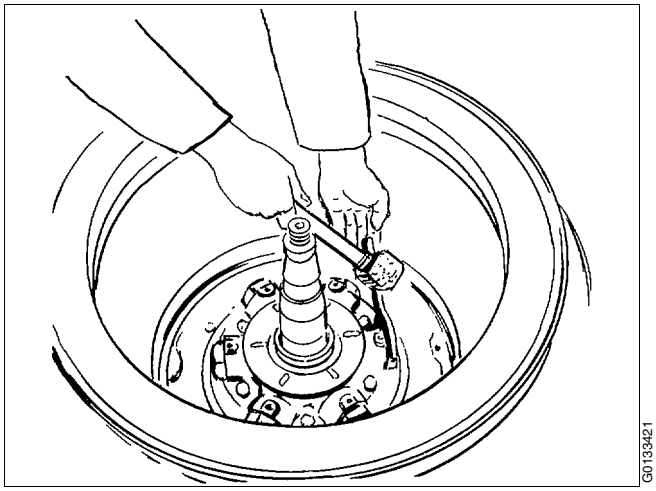
10. Tighten the six screws for the spring casing.

✔ **Check point**

“5.4.3 Bowl spindle; height position” on page 76.



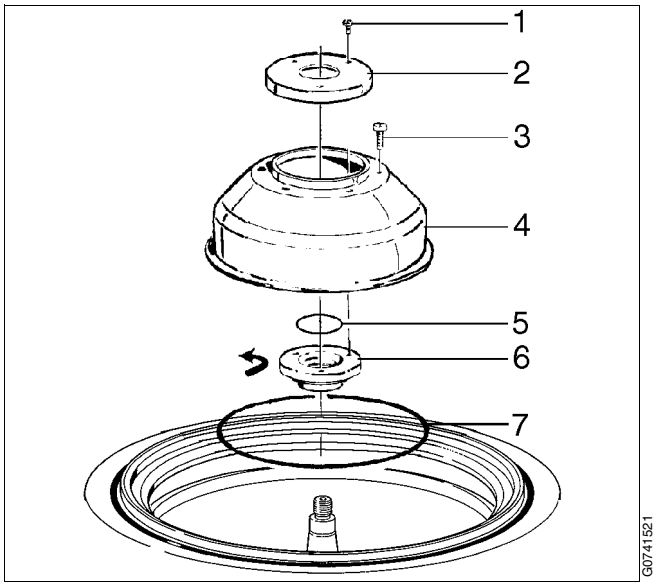
11. Tighten the buffer plugs.



12. Tighten the protecting collar (6).

    Left-hand thread!

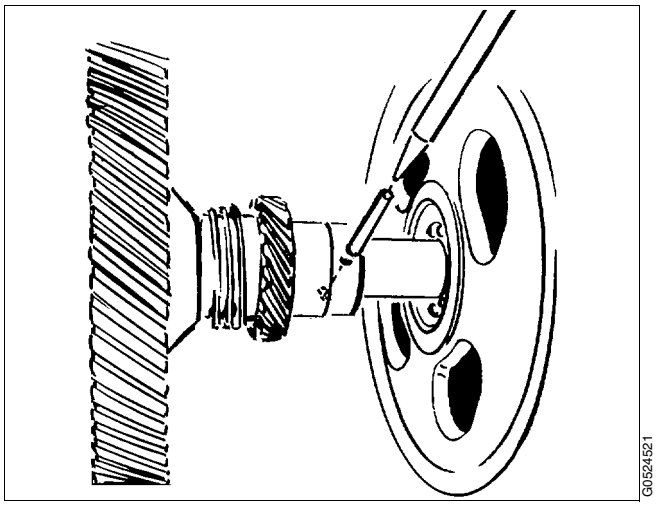
13. Fit the O-rings (5 & 7) and fasten the guard (4) with the six screws (3).
14. Fit the protecting plate (2) and tighten the three screws (1).



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

✔ **Check points**

"5.4.25 Worm wheel shaft; radial wobble" on page 90,
"5.4.4 Bowl spindle; radial wobble" on page 77.



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

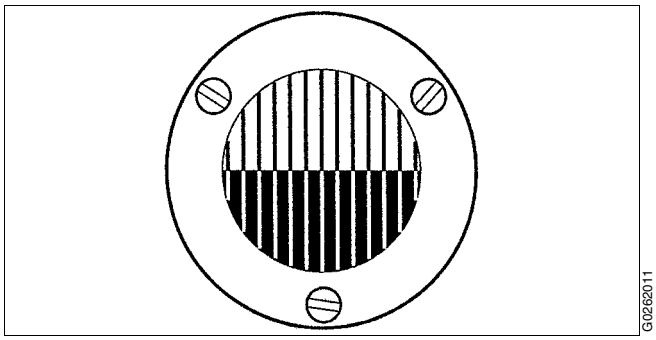
    Oil volume: Approx. **7,5 litres**

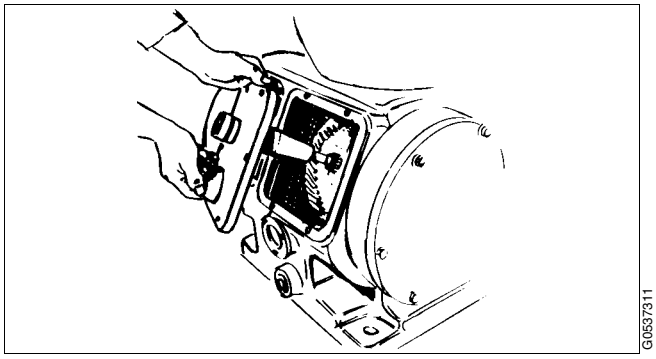
    For recommended oil brands, see chapter "8.7 Lubricants" on page 192.

✔ **Check point**

"5.4.5 Brake" on page 78.

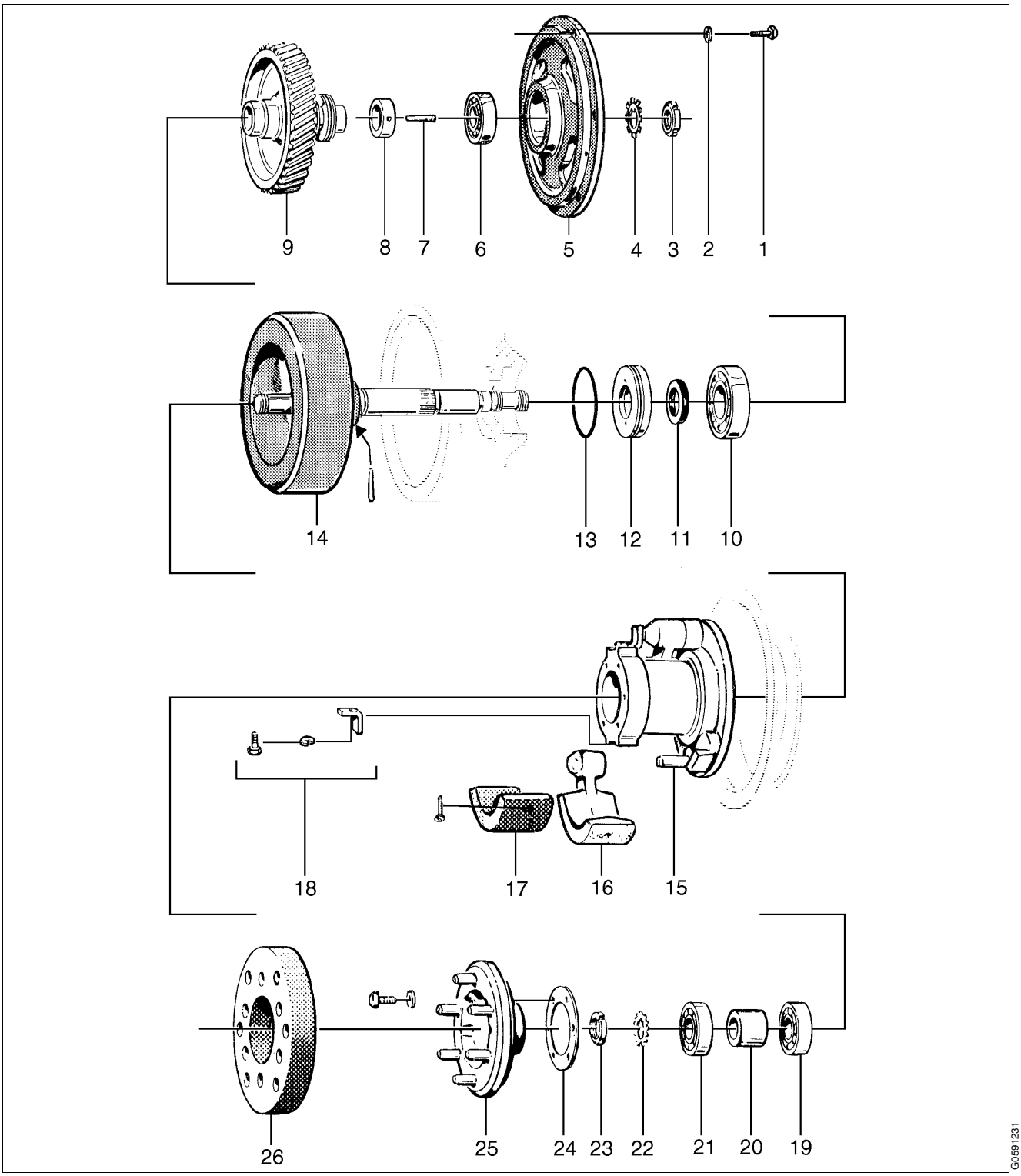
17. Fit the brake cover and the revolution counter cap and their gaskets.





6.7 Horizontal driving device (MS)

6.7.1 Exploded view



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

6.7.2 Dismantling

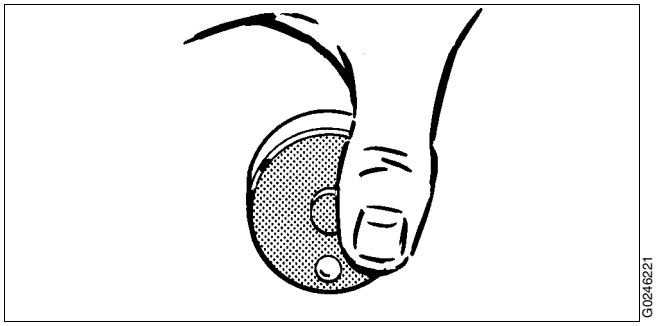
WARNING

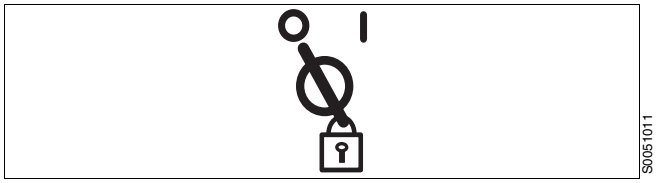
Entrapment hazards

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

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

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





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

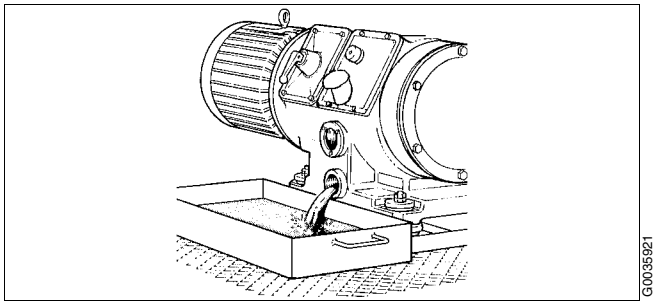
If the bowl spindle has been removed according to earlier description, points 1-3 below are already done. Proceed then with point 4.

1. Drain the oil from the worm gear housing.

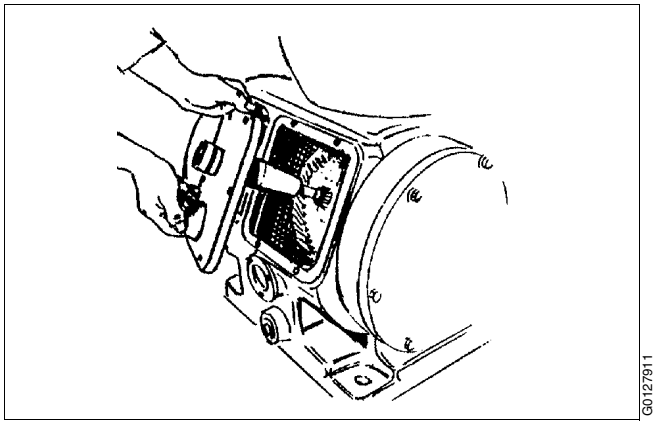
CAUTION

Burn hazards

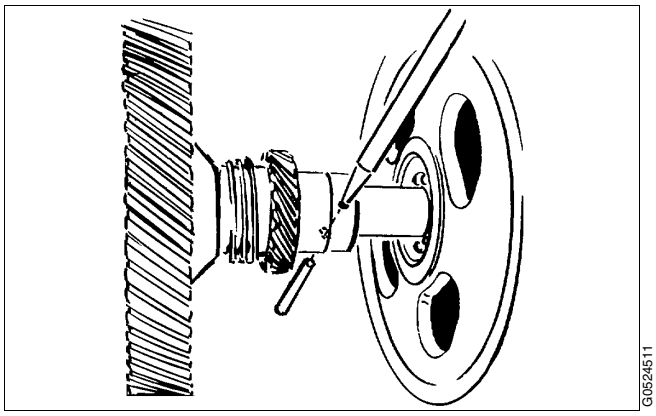
Lubricating oil in worm gear and various machine surfaces can be hot and cause burns.



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



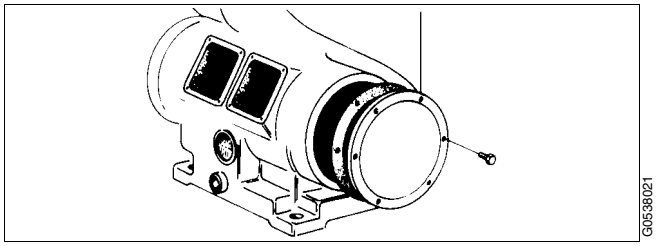
3. Knock out the taper pin from the worm wheel stop ring.



4. Remove the bearing shield/built-on pump.

Separator with no built-on pump

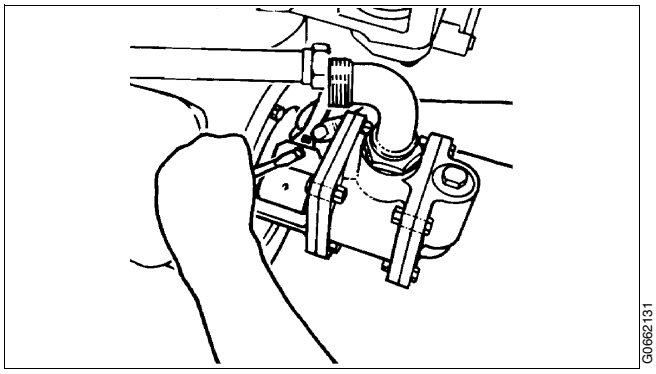
a. Remove the bearing shield and gasket.



Separator with built-on pump

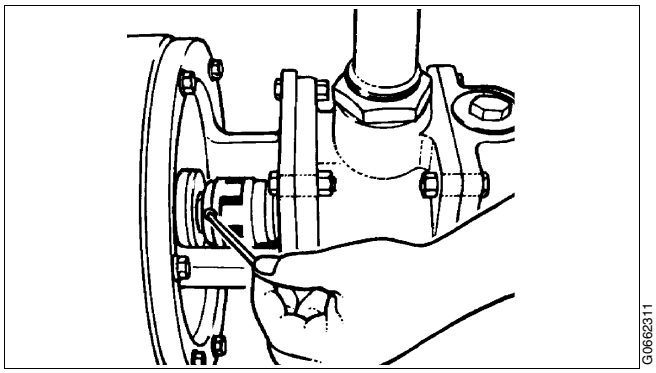
a. Remove the pipe connections from the pump.

b. Remove the sleeve halves over the coupling.

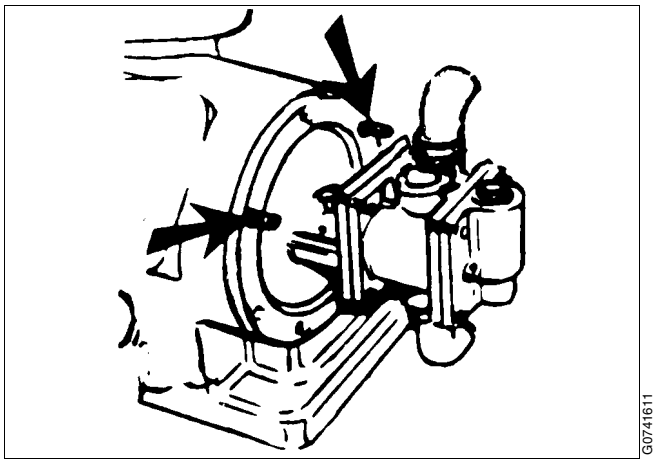


c. Slacken (do not remove) the stop screw positioned in the coupling half nearest the separator frame. Use a hexagon wrench.

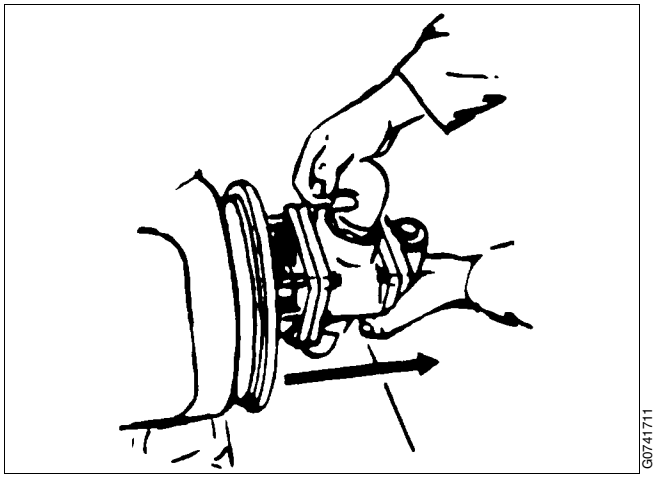
   Turn the coupling drum by hand until the stop screw is in a convenient position.



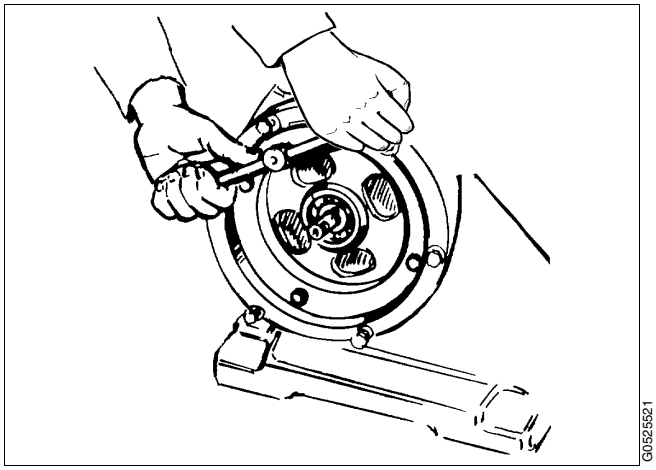
d. Remove two screws of the pump bearing shield and replace them by studs ½" W.



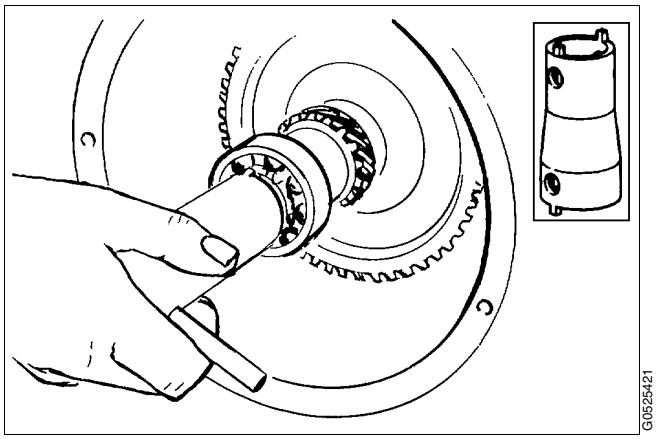
e. Pull out the pump using the studs as guides. This procedure will reduce the risk of damaging the lipseal ring in the bearing shield.



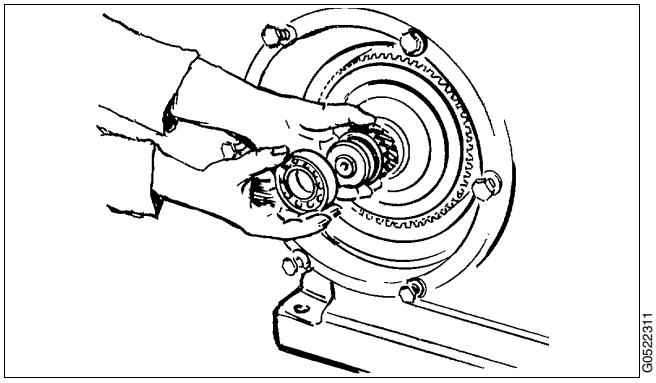
5. Unscrew the four screws for the bearing shield and remove it.



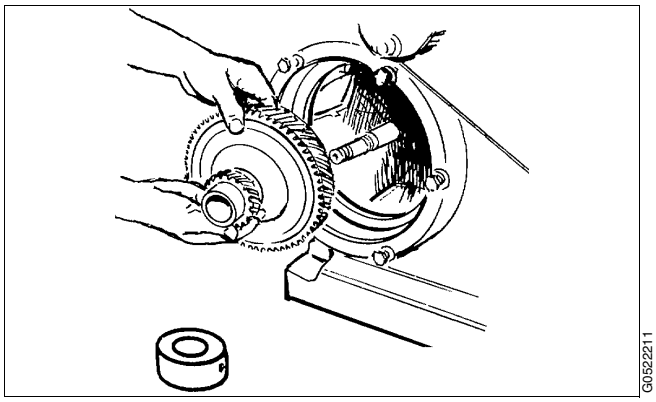
6. Unscrew and remove the round nut and lock washer.



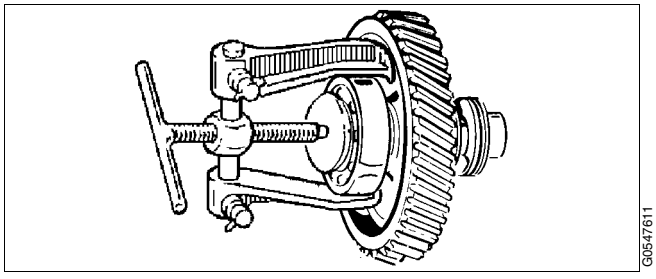
7. Remove the ball bearing.



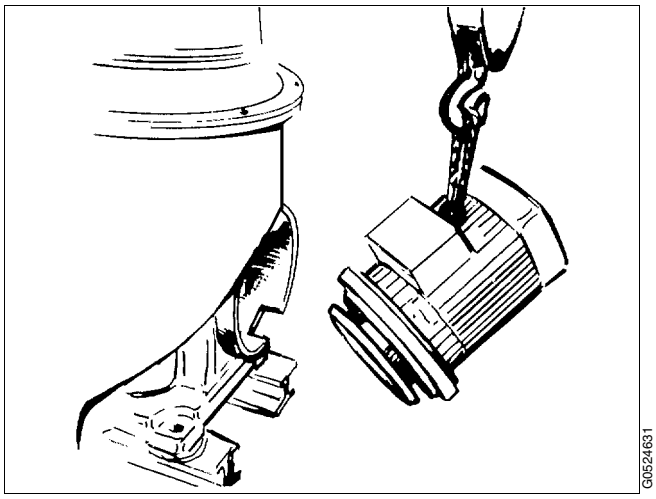
8. Remove the stop ring and worm wheel with ball bearing.



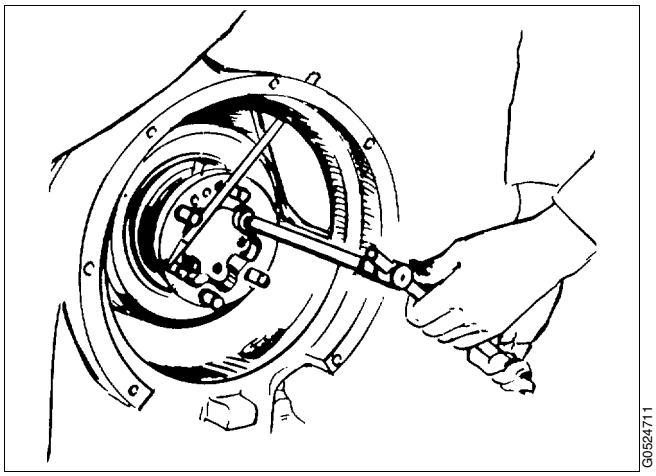
9. Pull off the ball bearing from the worm wheel. Use a washer as a support for the puller.



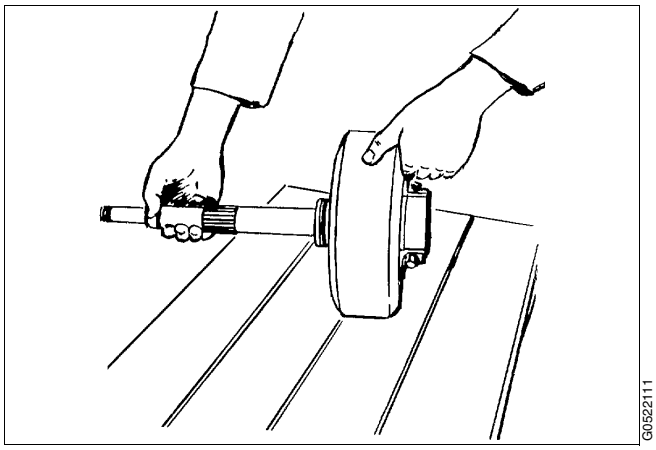
10. Disconnect the motor cables. Note the positions of cables in the terminal box to re-connect correctly (for correct direction of rotation).
11. Remove the electric motor by using a hoist.



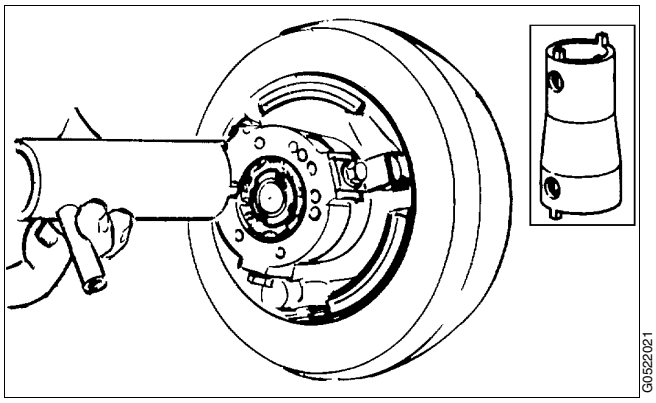
12. Remove the flexible plate and unscrew the six screws for the coupling disc and remove it.



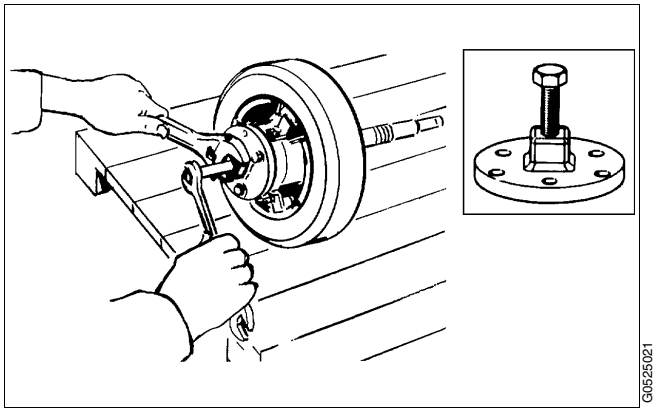
13. Remove the worm wheel shaft with friction clutch pulley.



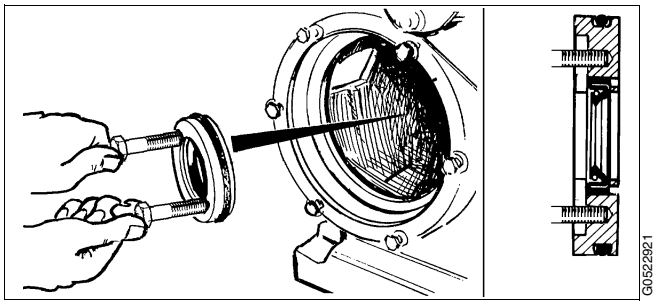
14. To dismantle the nave, unscrew the round nut with the pin spanner and remove the lock washer.



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

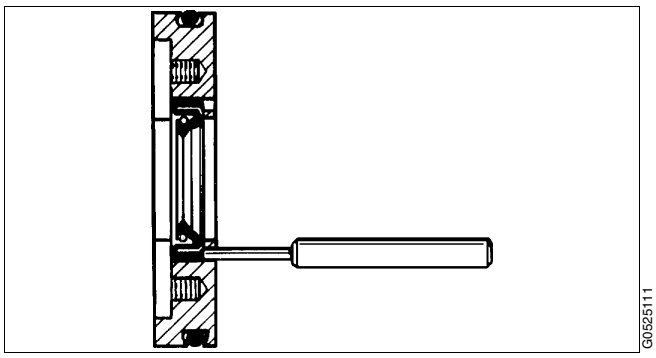


16. Remove the sealing washer using two screws with 1/4”-20 UNC threads.



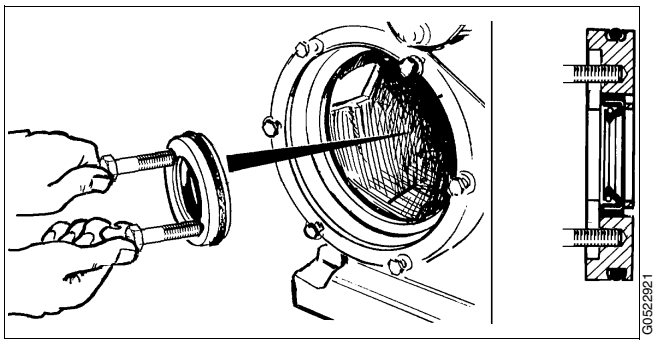
17. Remove the sealing ring from the sealing washer.

18. Remove deposits and clean all parts thoroughly in a suitable cleaning agent. See chapter “5.6 Cleaning” on page 93.



6.7.3 Assembly

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

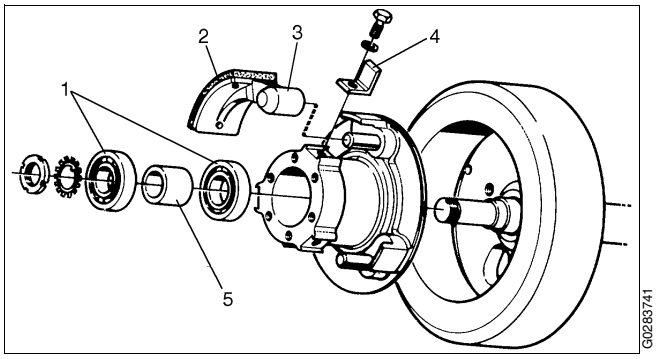


✔ **Check point**
“5.4.7 Coupling friction pads” on page 81.

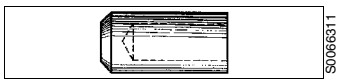
2. Fit the friction blocks (3) with pads (2) on the nave and lock them with holding brackets (4).

   Slip the nave and the ball bearing (1) with the largest inner diameter onto the shaft. Knock the ball bearing into its seat with the driving-on sleeve and fill the space between the ball bearings to one third with ball bearing grease - take care not to leave grease on pads.

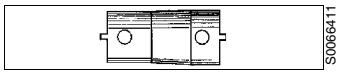
   For recommended lubricants, see chapter “8.7 Lubricants” on page 192.

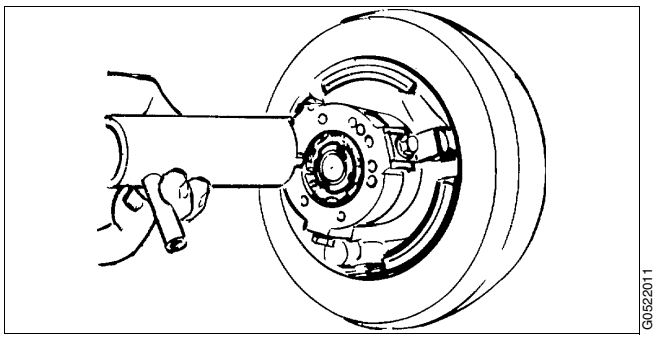


3. Fit the ball bearings (1) and spacing sleeve (5) with the driving on sleeve tool to force the ball bearings into their correct positions.

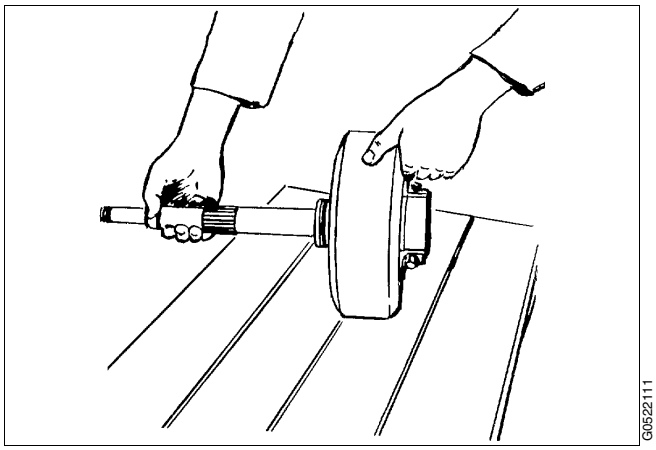


4. Tighten the round nut with the pin spanner and secure it with the lock washer.





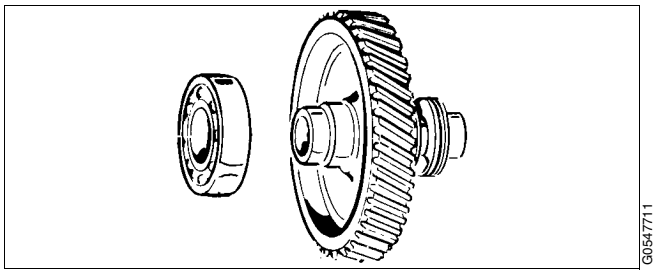
5. Fit the worm wheel shaft.



✔ **Check point**
"5.7.1 Worm wheel and worm; wear of teeth" on page 96.

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

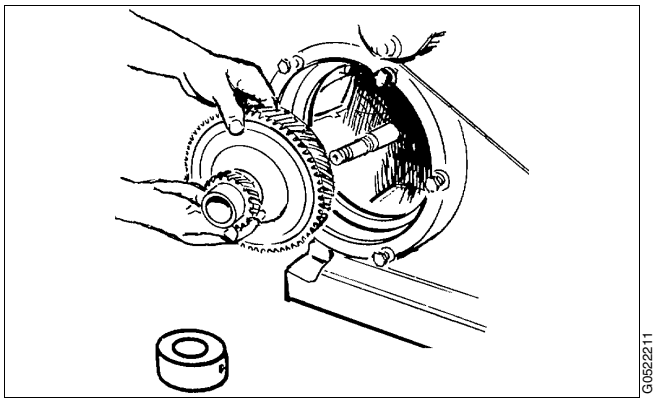
Burn hazards

Use protective gloves when handling the heated bearings.

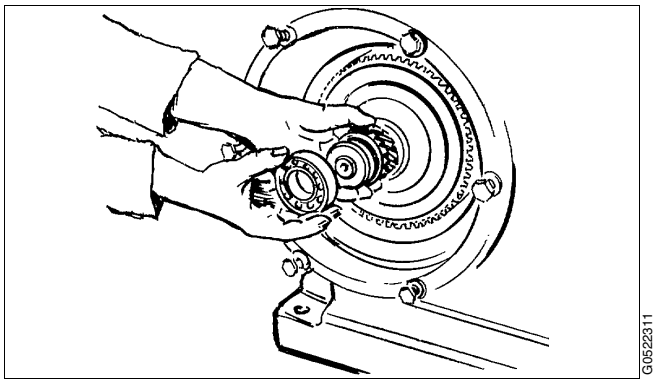
NOTE

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 101.

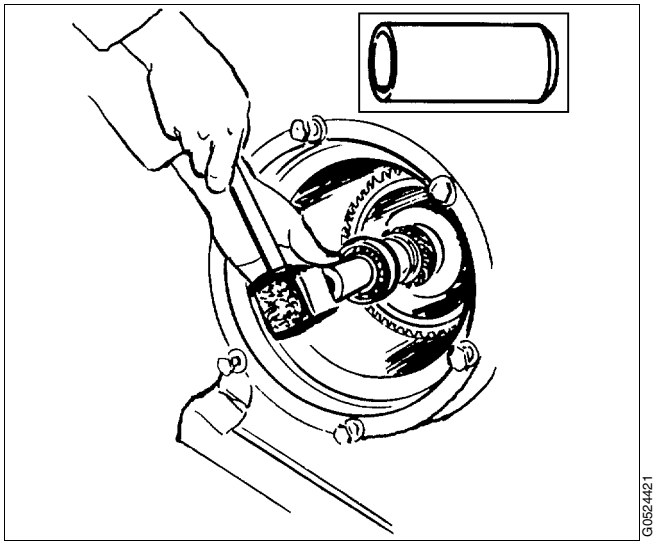
7. Fit the worm wheel with the ball bearing and fit the stop ring.



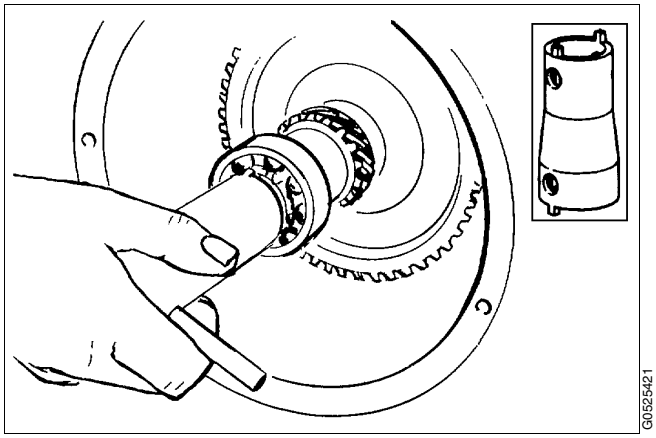
8. Fit the ball bearing.



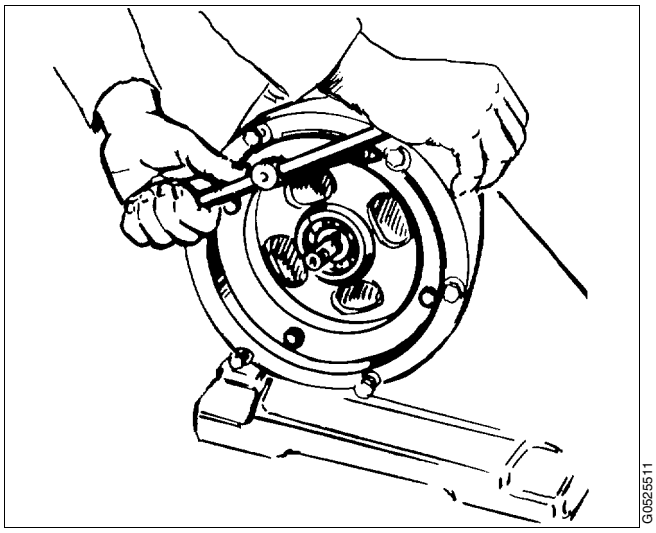
9. Knock the ball bearing into its seat with the driving-on sleeve tool.



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

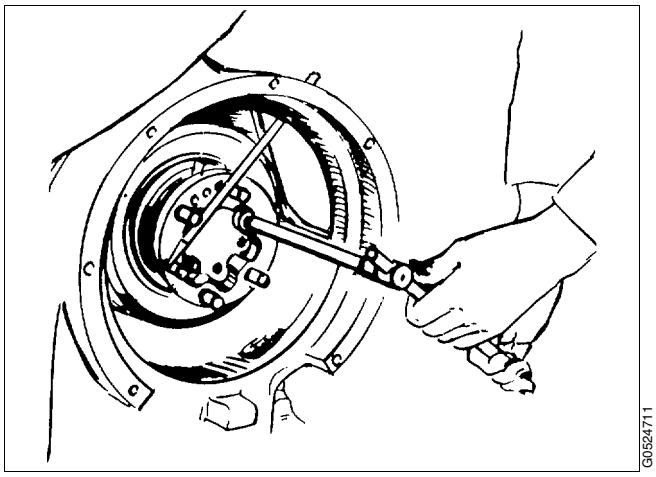


11. Fit the bearing shield and tighten the four screws.



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

✔ **Check point**
"5.4.16 Flexible plate in coupling" on page 84.



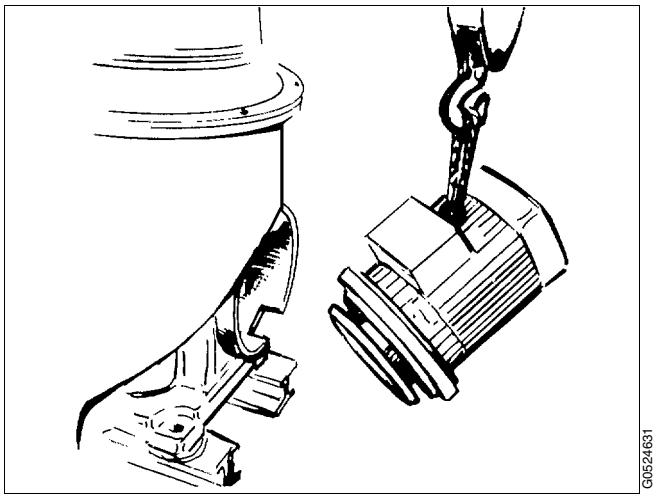
14. Fit the electric motor.

WARNING

Disintegration hazards

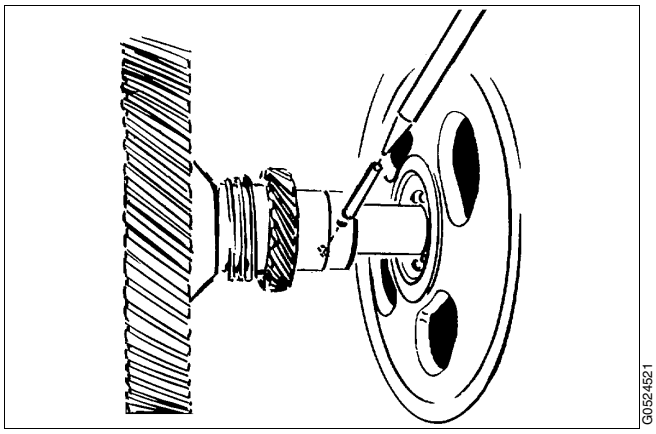
When power cables have been connected, always check direction of rotation.

If incorrect direction, vital rotating parts could unscrew causing disintegration of the machine.



The remaining description in this section implies that the bowl spindle is mounted in the frame. If not, proceed with the assembly instruction for the vertical driving device in chapter "6.6.3 Assembly" on page 137.

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



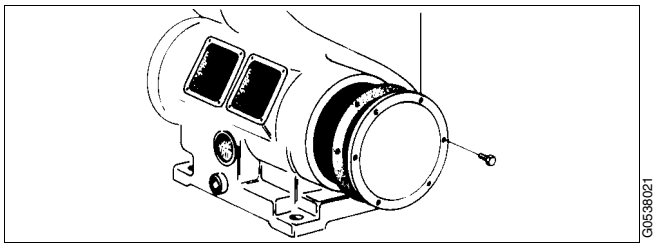
✔ **Check point**

"5.4.25 Worm wheel shaft; radial wobble" on page 90.

16. 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

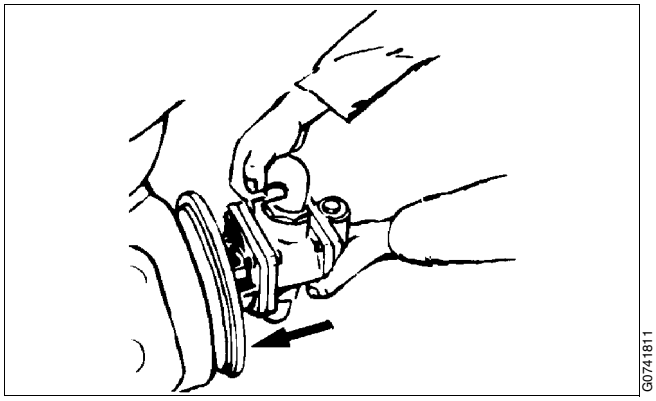
a. Check that the key for the pump coupling half is fitted in the keyway in the worm wheel shaft.

b. Lubricate the lipseal ring in the bearing shield with silicone grease.

c. Fit the gasket and pump assembly. Use the two studs previously fitted in the frame flange as guides.

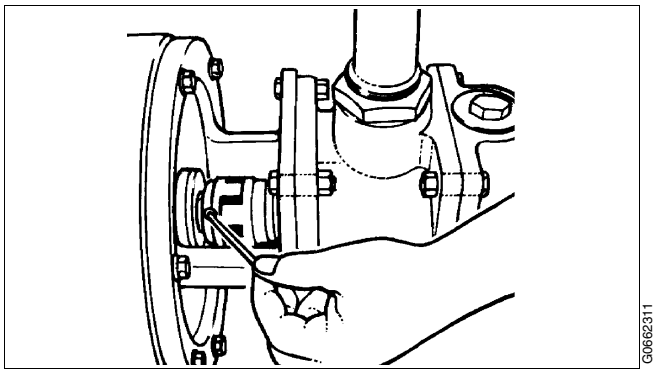
   Be careful that the lipseal ring is not damaged by the shaft end and by the key in shaft.

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



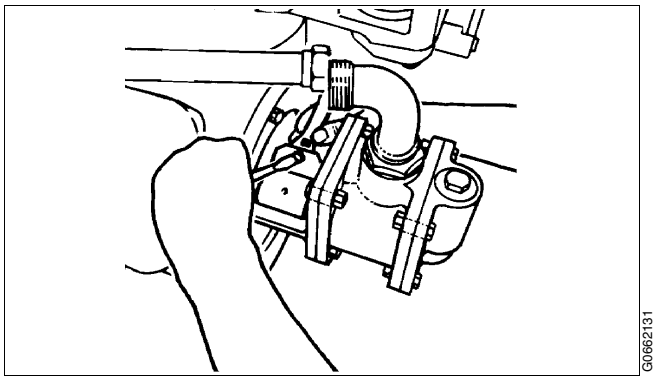
d. Check that the clearance on each side of the coupling flexible element is **2 mm**.

   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.



e. Mount the sleeve halves over the coupling.

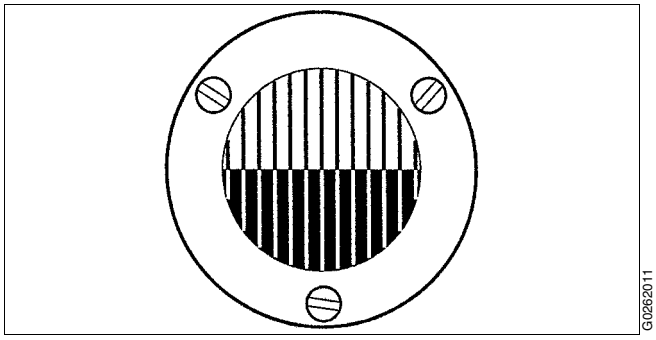
f. Refit the pump connections.



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

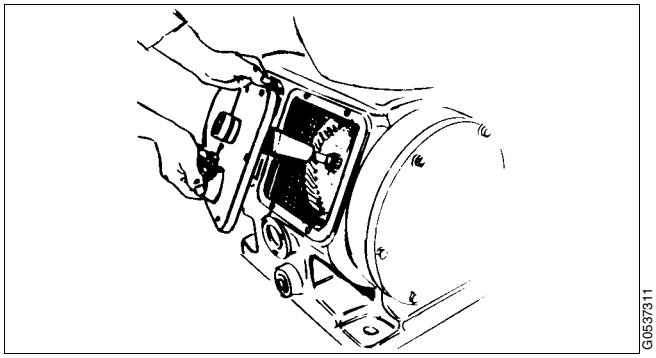
    Oil volume: Approx. **7,5 litres**.

    For recommended oil brands, see chapter “8.7 Lubricants” on page 192.



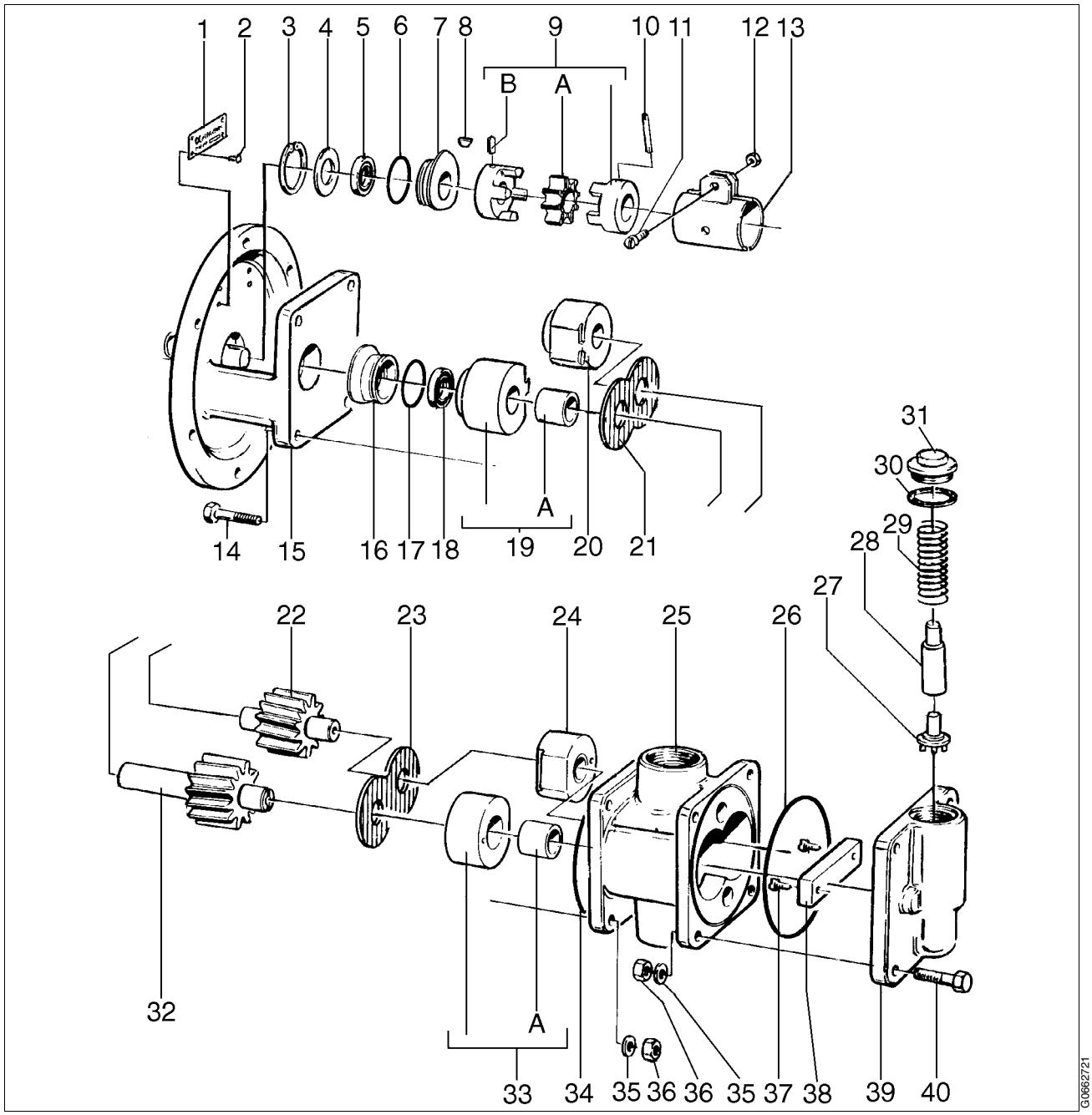
✔ **Check point**
“5.4.5 Brake” on page 78.

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



6.8 Built-on oil feed pump (MS), option

6.8.1 Exploded view

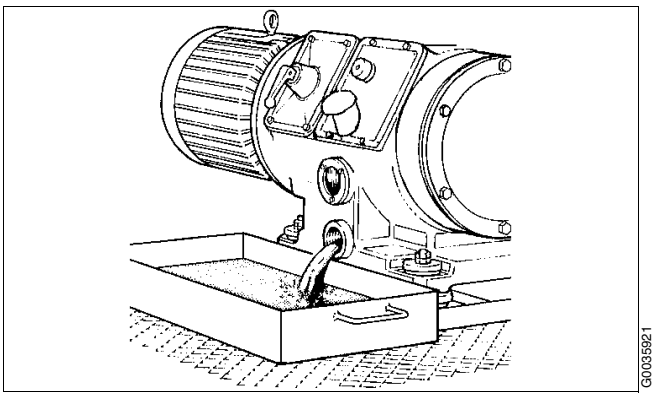


1. Plate
2. Drive screw
3. Snap ring
4. Washer
5. Lipseal ring
6. O-ring
7. Sleeve
8. Key
9. Flexible coupling
   9A. Tooth rim (flexible element)
   9B. Stop screw
10. Tubular spring pin
11. Screw
12. Nut
13. Sleeve half
14. Screw
15. Bearing shield
16. Sleeve
17. O-ring
18. Lipseal ring
19. Bearing
    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

* Not included in all pumps

6.8.2 Dismantling

1. Drain the oil from the worm gear housing.

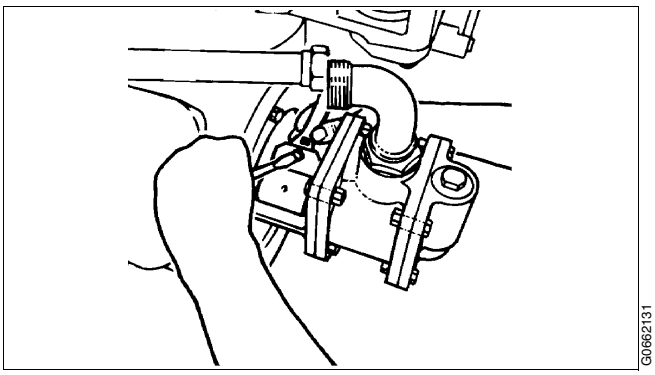


CAUTION

Burn hazards

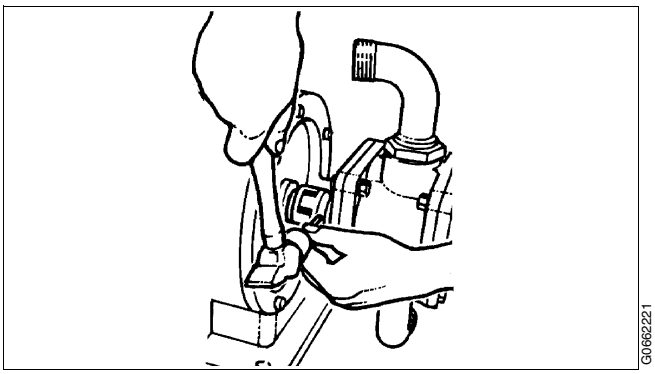
Lubricating oil and various machine surfaces can be hot and cause burns.

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

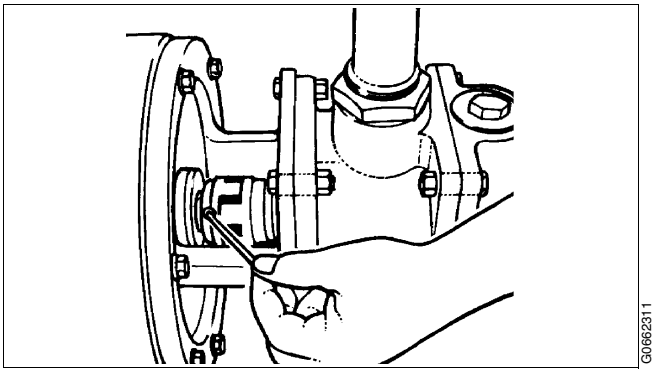


4. Drive out the tubular spring pin, positioned in the coupling half nearest the pump.

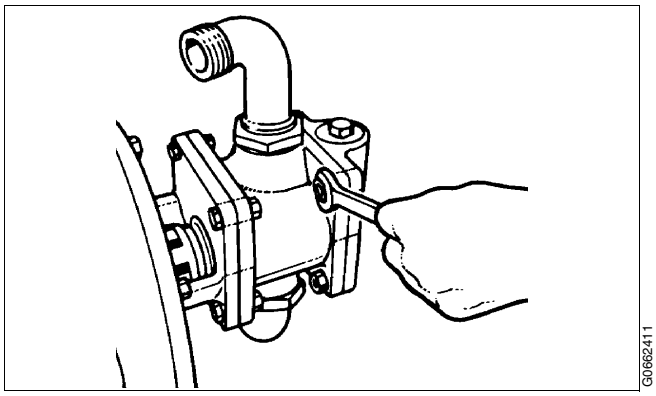
   Turn the coupling drum by hand until the pin is in a convenient position.



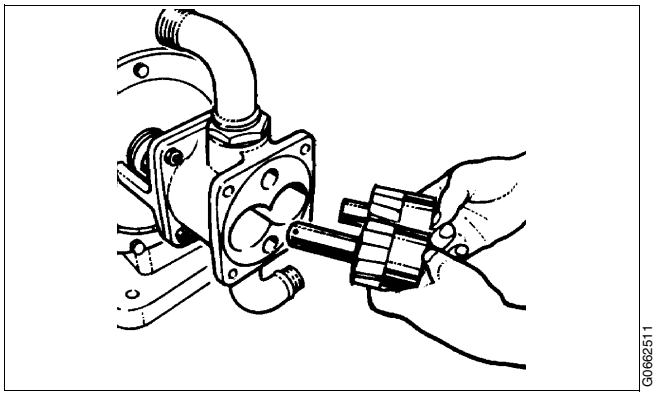
5. Slacken (do not remove) the stop screw positioned in the other coupling half with a hexagon wrench.



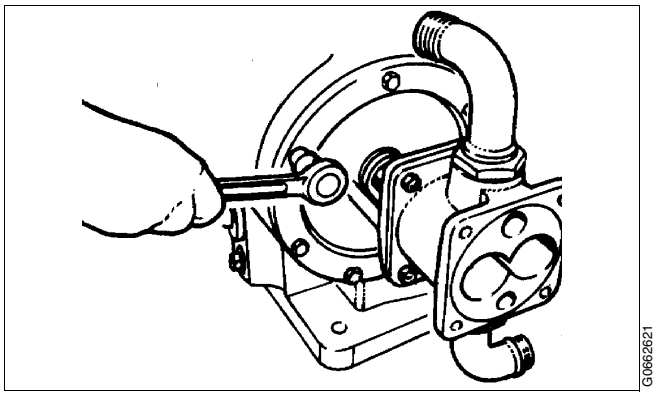
6. Undo the four screws holding the pump shield and remove the shield.



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. Slacken 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 “5.6.2 Cleaning agents” on page 93.
2. Examine following parts:

Bushings (2)

Renew the bushings if they are scratched or 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)

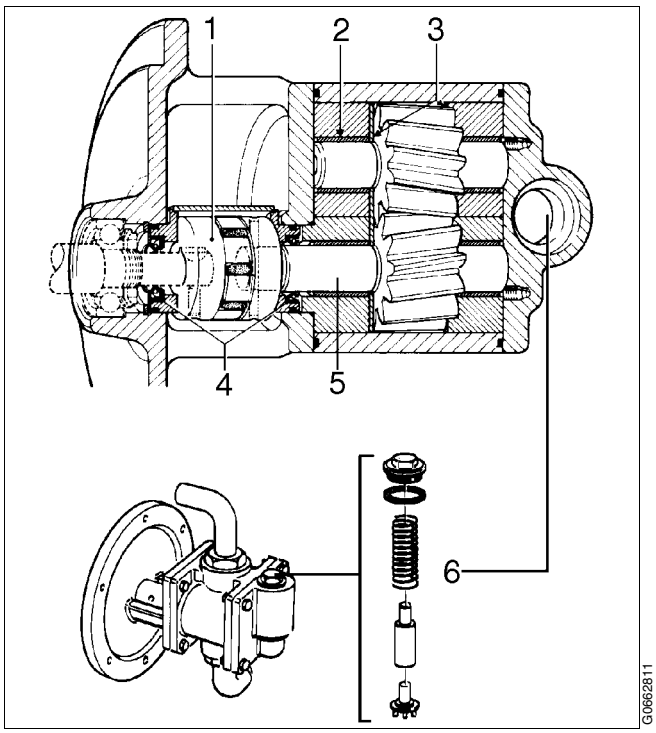
Renew the wear gaskets if any surface is rough, cracked or dented by the impellers.

Relief/safety valve (6)

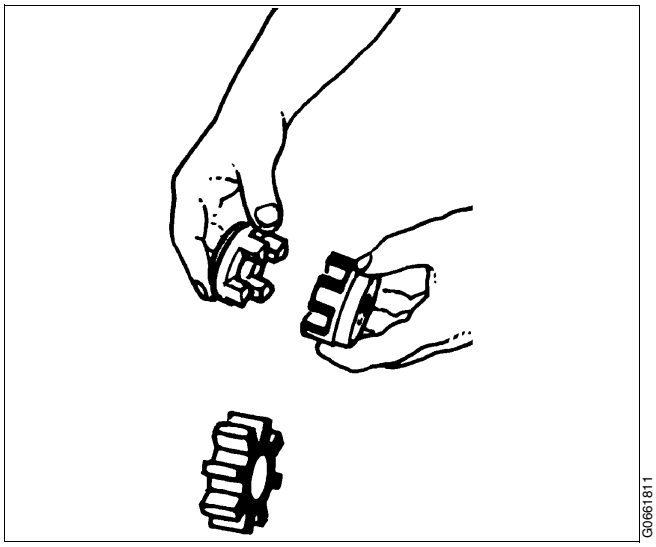
Examine the sealing surfaces on the valve cone and valve seat in the shield. Grind or renew if necessary.

Flexible coupling (1)

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



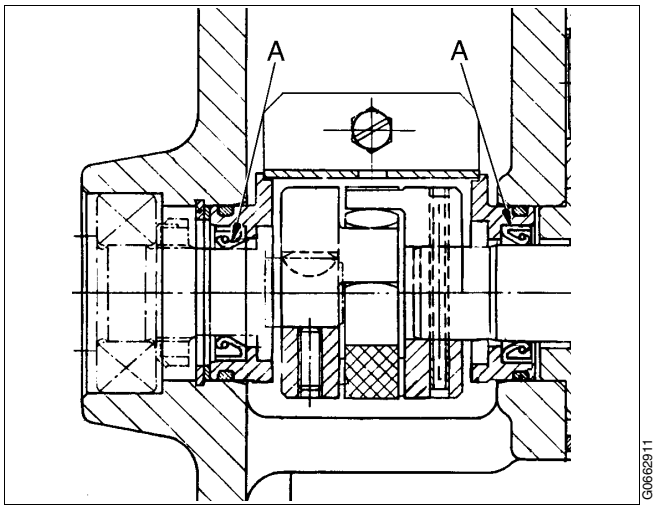
1. *Flexible coupling*
2. *Bushing*
3. *Wear gasket*
4. *Lipseal ring*
5. *Impeller shaft*
6. *Relief/safety valve*



Lipseal rings (4)

Renew the lipseal rings at MS-service.

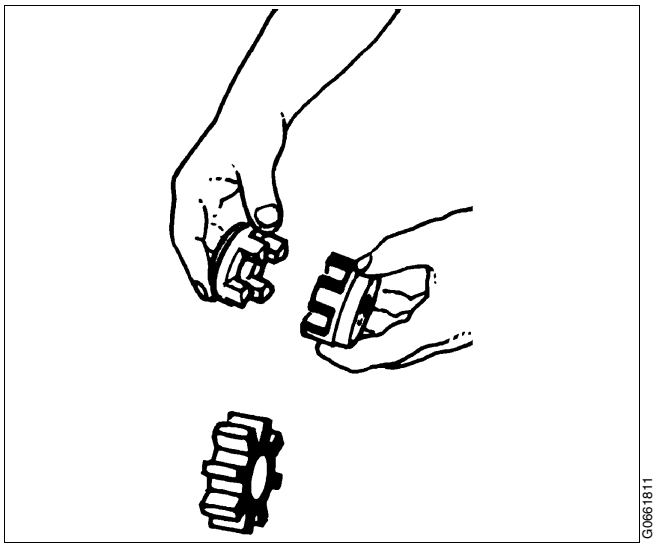
Note: Turn the rings the right way round, see pos. A in the illustration.



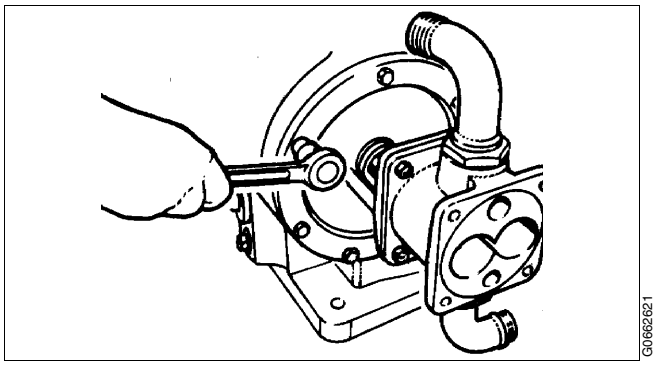
6.8.4 Assembly

1. Check that the lipseal rings are correctly mounted, see description in the “Cleaning and inspection”-section above.
2. Assemble the coupling.

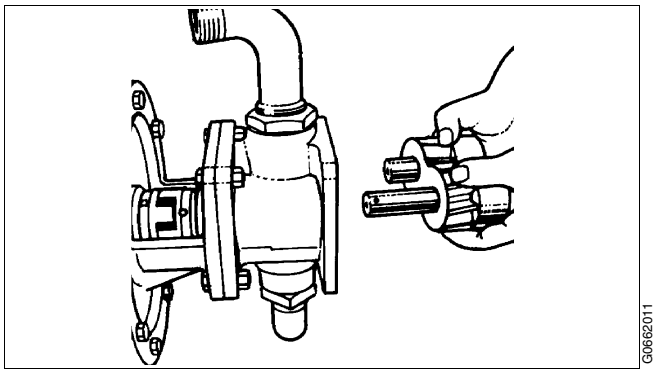
   The parts must not be pushed together too hard. The flexible element is provided with projections to ensure that the correct clearance is maintained in the coupling, and these must not be deformed.
3. Fit the coupling in position on the worm wheel shaft with the keyway facing the key.



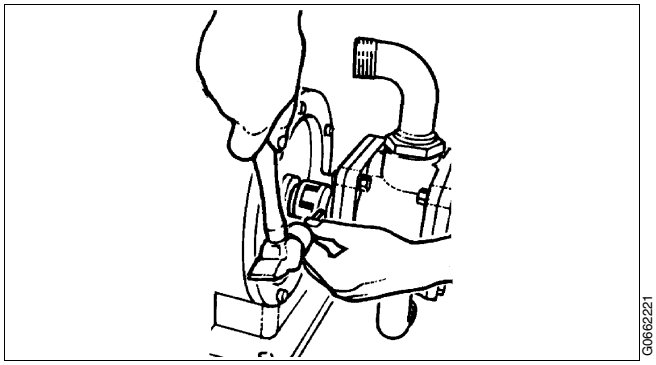
4. Tighten the bearing shield screws.



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



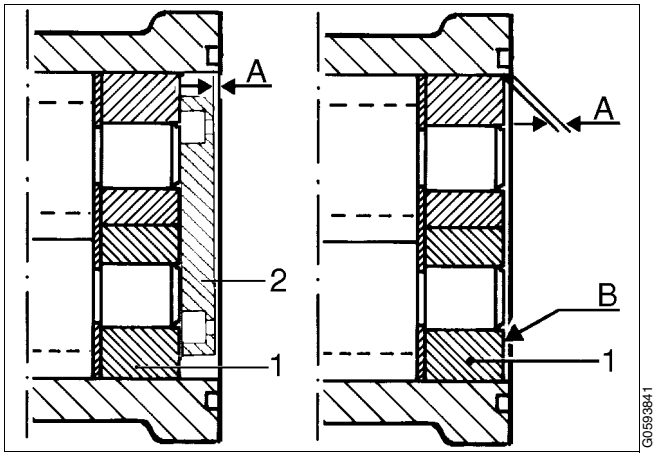
6. Drive in the tubular spring pin.



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

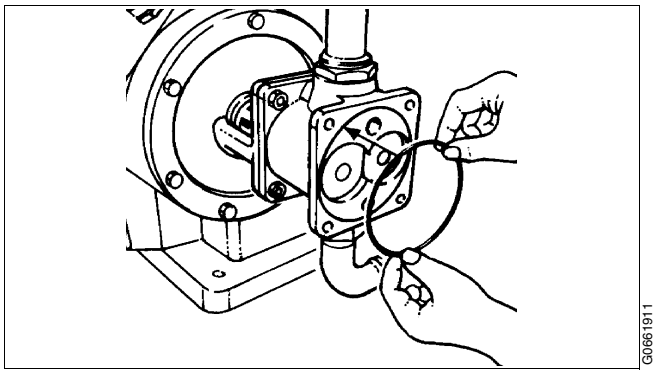
   The total axial play (A) must be **0,1 - 0,3 mm**. If the play is too large even though the wear gaskets have been renewed, it can be compensated by adding a brass leaf liner.

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

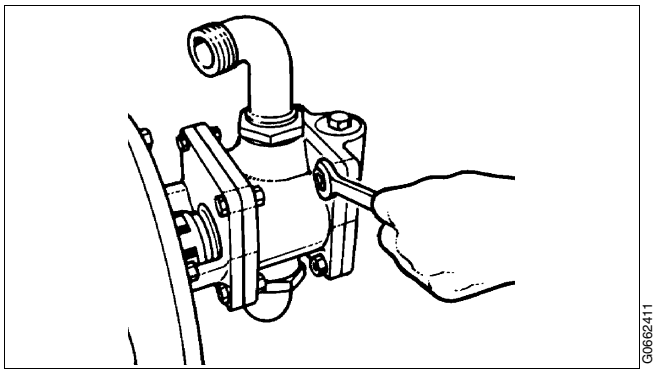


A. Axial play = 0,1 - 0,3 mm
B. Where to insert the liner
1. Bearing
2. Spacer (not included in all pumps)

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

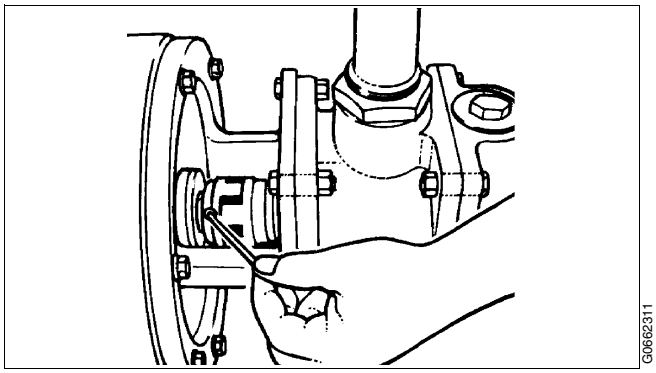


9. Fit the pump shield. (Four screws, four washers and four nuts.)

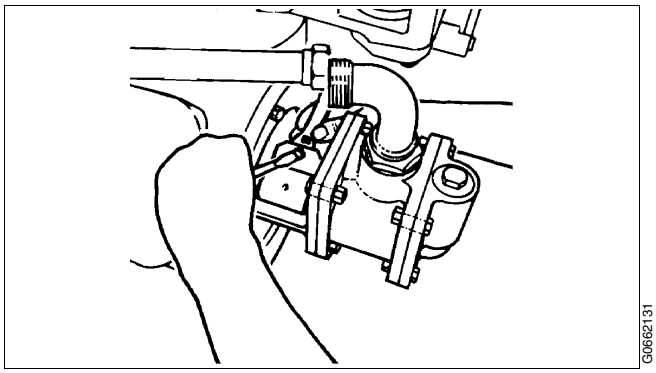


10. Check that the clearance on each side of the coupling flexible element is **2 mm**.

    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.



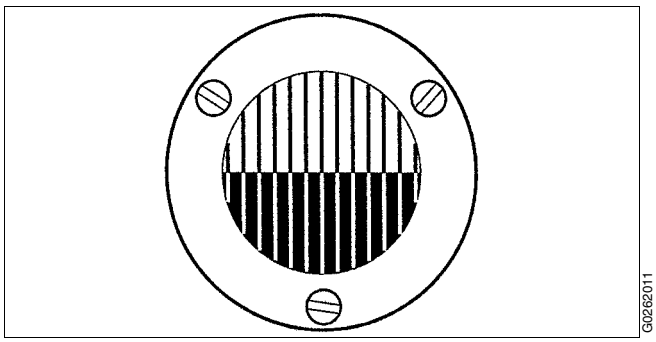
11. Mount the sleeve halves over the coupling.
12. Refit the pipe connections.



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

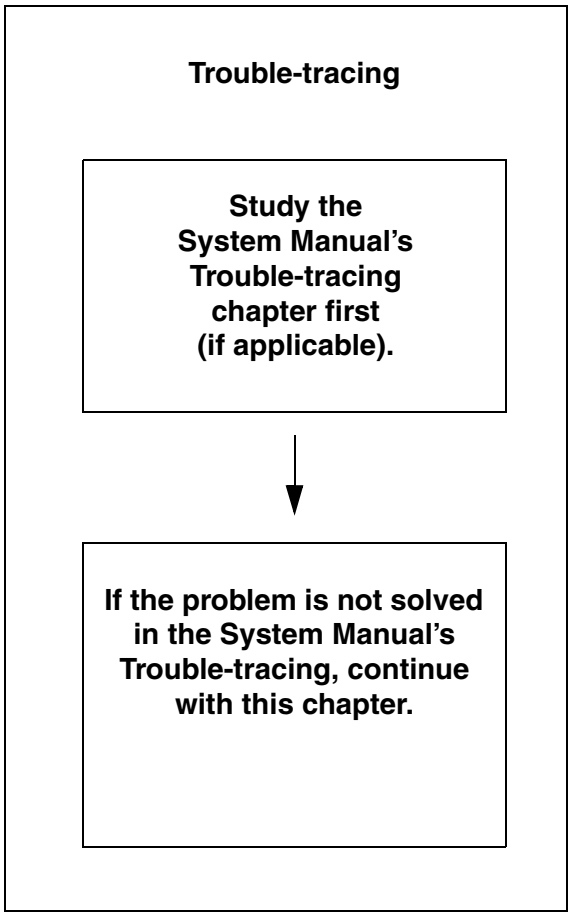
    Oil volume: Approx. **7,5 litres**.

    For recommended oil brands, see chapter “8.7 Lubricants” on page 192.



7 Trouble-tracing

Contents



7.1 Mechanical functions

7.1.1 Separator vibrates

NOTE

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

WARNING

Disintegration hazards

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

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

Cause	Corrective actions	Page
Bowl out of balance due to: - poor cleaning - incorrect assembly - incorrect disc stack compression - bowl assembled with parts from other separators	Dismantle the separator and check the assembly and cleaning. Check the number of bowl discs, compare with the number in *Spare Parts Catalogue*. If necessary, rebalance the bowl.	116
Uneven sludge deposits in the sludge space	Dismantle and clean the separator bowl	113
Height adjustment of the oil paring disc is incorrect	Stop the separator, measure and if necessary adjust the height	87
Bowl spindle bents (max 0,04 mm)	Renew the bowl spindle	77
Bearing is damaged or worn	Renew all bearings	130, 140
Vibration damping rubber cushions are worn out	Renew all rubber cushions	59
Spindle top bearing spring is broken	Renew all springs	130

7.1.2 Smell

Cause	Corrective actions	Page
Normal occurrence during start while the friction blocks are slipping	None	–
Brake is applied	Release the brake	–
Oil level in gear housing is too low	Check oil level and add oil if necessary	42

7.1.3 Noise

Cause	Corrective actions	Page
Oil level in gear housing is too low	Check oil level and add oil if necessary	42
Height adjustment of the oil paring disc is incorrect	Stop the separator, measure and adjust the height	87
Worm wheel and worm are worn	Renew worm wheel and worm	96
Bearing is damaged or worn	Renew all bearings	130, 140
Incorrect play between coupling pulley and elastic plate	Adjust the play	84

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	81
Bowl is leaking or not closed	Dismantle the bowl and check	112
Motor failure	Repair the motor	–
Bearing is damaged	Renew all bearings	130, 140
Incorrect gear transmission (60 Hz gear for 50 Hz power supply)	Stop and change the gear transmission to suit the power supply frequency	96, 130, 140
Incorrect coupling friction blocks (60 Hz blocks for 50 Hz power supply)	Change the friction blocks to suit the power supply frequency	81

7.1.5 Starting power too high

Cause	Corrective actions	Page
Incorrect friction blocks (50 Hz blocks for 60 Hz power supply)	⚠ **WARNING** Stop immediately and change the friction blocks to suit the power supply frequency	81
Wrong direction of rotation	Change electrical phase connections to the motor	–
Brake is applied	Release the brake	–

7.1.6 Starting power too low

Cause	Corrective actions	Page
Incorrect friction blocks (60 Hz blocks for 50 Hz power supply)	Stop immediately and change the friction blocks to suit the power supply frequency	81
Coupling friction pads are oily or worn	Clean or renew friction pads	81
Motor failure	Repair the motor	–

7.1.7 Starting time too long

Cause	Corrective actions	Page
Brake is applied	Release the brake	–
Coupling friction pads are oily or worn	Renew or clean friction pads	81
Height position of oil paring disc or operating device is incorrect	Stop, check and adjust the height	81, 89
Motor failure	Repair the motor	–
Bearing is damaged or worn	Renew all bearings	130, 140

7.1.8 Retardation time too long

Cause	Corrective actions	Page
Brake friction pad is worn or oily	Renew or clean friction pad	78

7.1.9 Water in worm gear housing

Cause	Corrective actions	Page
Bowl casing drain is obstructed	Clean the casing and the drains properly. The drains have connection Nos. 462 and 463 on the *Basic size drawing*. Solve the reason for obstruction. Clean worm gear housing and change oil.	96 182
Leakage at the top bearing	Renew seal ring and change oil	130, 99
Condensation	Clean worm gear housing and change oil	99

7.2 Separating functions, purification and clarification

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

Cause	Corrective actions	Page
Sludge discharge or water draining in progress	None (normal)	–
The operating water line is obstructed or the water pressure/flow is too low, which give rise to leakage through the sludge ports	Clean the strainer and check pressure/flow: Opening water pressure, 200-600 kPa Closing water flow, 2,8 litres/minute	–
Channels in operating water device are clogged	Clean the operating water device	127
Gasket at the gravity/clarifier disc is defective	Renew the gasket	112
Paring chamber cover (small lock ring) is defective	Renew the paring chamber cover	112
Seal ring in the bowl hood is defective	Renew the seal ring	112
Sealing edge of the sliding bowl bottom is defective	Smoothen sealing edge of the sliding bowl bottom or renew it	74
Valve plugs are defective	Renew all valve plugs	73
Bowl speed is too low	See section “7.1.4 Speed too low” on page 165 in this chapter	–

7.2.2 Bowl opens accidentally during operation

Cause	Corrective actions	Page
Strainer in the operating water supply is clogged	Clean the strainer	–
No water in the operating water system	Check the operating water system and make sure the valve(s) are open	–
Water connections to the separator are incorrectly fitted	Correct	–
Nozzle in the operating slide is clogged	Clean the nozzle. Carry out an Intermediate Service (IS)	121
Square-sectioned ring in sliding bowl bottom is defective	Renew the square-sectioned ring. Carry out an Intermediate Service (IS)	74
Valve plugs are defective	Renew all plugs. Carry out an Intermediate Service (IS)	73
Supply valve for opening water is leaking	Rectify the leak	–

7.2.3 Bowl fails to open for sludge discharge

Cause	Corrective actions	Page
Strainer in the operating water supply is clogged	Clean the strainer	–
Supply valve for opening water is closed	Open	–
Seal rings in operating water device are defective	Renew the seal rings	127
Opening water flow is too low	Check the opening water flow; min. 11 litres/minute	–
Seal ring in the operating slide is defective	Renew the seal ring. Carry out an Intermediate Service (IS)	120

7.2.4 Unsatisfactory sludge discharge

Cause	Corrective actions	Page
Valve plugs in the operating slide are too high	Renew with correct valve plugs	73
Sludge deposits in the operating system	Check and clean the operating system	120, 127

7.2.5 High pressure in oil outlet

Cause	Corrective actions	Page
Throughput too high	Adjust	–
Valve(s) in the oil outlet line is closed	Open the valve(s) and adjust the oil outlet pressure to 1,5 bar	–

7.3 Separating functions, purification only

7.3.1 Unsatisfactory separation result

Cause	Corrective actions	Page
Gravity disc hole is too small	Use a disc with larger hole	39
Incorrect separation temperature	Adjust	–
Throughput is too high	Adjust	–
Disc stack is clogged	Clean disc stack	95
Sludge space in bowl is filled	Clean and reduce the time between sludge discharges	95
Bowl speed is too low	See “7.1.4 Speed too low” on page 165	–

7.3.2 Outgoing water contains oil

Cause	Corrective actions	Page
Gravity disc hole is too large	Use a disc with smaller hole	39
The closing water line is obstructed or the water pressure/flow is too low, which give rise to leakage through the sludge ports and the water seal moves outwards	Check water pressure/flow: Operating water pressure, 200-600 kPa Closing water flow, 2,8 litres/minute	–
No or insufficient sealing/displacement water supply (206)	Rectify the water supply	–
Gasket/O-ring at the gravity disc is defective	Renew the gasket/O-ring	112
Disc stack is clogged	Clean disc stack	95

7.3.3 Oil discharges through water outlet (broken water seal)

Cause	Corrective actions	Page
Gravity disc hole is too large	Use a disc with smaller hole	39
Incorrect separation temperature	Adjust	–
Throughput is too high	Adjust	–
The closing water line is obstructed or the water pressure/flow is too low, which give rise to leakage through the sludge ports and the water seal moves outwards	Check water pressure/flow: Closing water pressure, 20-30 kPa Closing water flow, min. 11 litres/minute	–
No or insufficient sealing/displacement water supply (206)	Rectify the water supply	–
Valve(s) in oil outlet line is closed	Open the valve(s)	–
Sealing water volume is too small	Check the water supply flow (min. 7 litres/ minute)	–
Gasket/O-ring at the gravity disc is defective	Renew the gasket/O-ring	112
Disc stack is clogged	Clean the disc stack	112
Bowl hood seal ring is defective or the sealing surface of sliding bowl bottom is damaged	Renew the seal ring. Polish the surface on sliding bowl bottom or renew it	112
Rectangular seal ring in sliding bowl bottom is defective	Renew the seal ring	120
Bowl speed is too low	Check that the brake is released. Examine the motor and power transmission including the gear ratio	96, 140
Bowl is incorrectly assembled	Check the assembly	112

7.4 Separating functions, clarification only

7.4.1 Unsatisfactory separation result

Cause	Corrective actions	Page
Incorrect separation temperature	Adjust	–
Throughput is too high	Adjust	–
Feed oil contains water	1. Check preceeding purifier when operating in series 2. Reduce the time between discharges 3. Operate the separator as purifier	 – – 39
Bowl disc stack is clogged	Clean the disc stack	108
Sludge space in bowl is filled	Clean and reduce the time between discharges	112
Bowl speed is too low	Check that the brake is released. Examine the motor and power transmission including the gear ratio	112

7.4.2 Oil discharges through water outlet

Cause	Corrective actions	Page
Valve(s) in oil outlet line is closed	Open the valve(s)	–
Bowl disc stack is clogged	Clean the disc stack	112
Bowl is incorrectly assembled	Check the assembly	112

8 Technical Reference

Contents

8.1 Product description

Alfa Laval ref. 567627, rev. 2

Product number:	881033-16-02/1
Separator type:	MOPX 308
Application:	Mineral oil
Technical Design:	Purifier / Clarifier with total discharge Intended for land and marine applications. Intended for Japanese and Korean market. (JIS) Nitrile sealings. Colour of finish painting of painted parts according to order. Quality of painting according to specifications on drawings.
Restrictions:	Feed temperature: 0 °C to +100 °C
	Ambient temperature: +5 °C to +55 °C
	Discharge volume: 7,5 litres
	Discharge intervals: min.1 minute, max. 4 hours
	Maximum allowed density of operating liquid: 1000 kg/m^3
	Not to be used for liquids with flash point below 60 °C
	The separator should be install in such a way, that the centre line of the electrical motor is parallel with the centre line of the ship.
	Risk for corrosion and erosion have to be investigated in each case by the application centre.
	Further restrictions and instructions are found in other chapters in this manual.

8.1.1 Declaration

Alfa Laval ref. 591985, rev. 5

Supplier:

Supplier adress:

Separator type:

Product specification:

Configuration number:

Serial number:

Declaration of Incorporation of Partly Completed Machinery

The machinery complies with the relevant, essential health and safety requirements of:

Designation	**Description**
2006/42/EC	Machinery Directive

To meet the requirements the following standards have been applied:

Designation	**Description**
EN 60204-1	Electrical equipment of machines, part 1: General requirements
EN ISO 12100	Safety of machinery - General principles for design - Risk assessment and risk reduction
ISO 3744	Acoustics - Determination of sound power levels of noise sources using sound pressure

Declaration of Conformity

The machinery complies with the following Directives:

Designation	Description
2004/108/EC	Electromagnetic Compatibility

To meet the requirements the following standards have been applied:

Designation	**Description**
EN 60204-1	Safety of machinery - Electrical equipment of machines. Part 1: General requirements
EN 61000-6-2	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
EN 61000-6-4	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industria1l environments
EN ISO 12100	Safety of machinery - General principles for design - Risk assessment and risk reduction

The technical construction file for the machinery is compiled and retained by the authorized person Tomas Zetterling within the Product Centre for High Speed Separators, Alfa Laval Tumba AB, SE-14780 Tumba Sweden. By reasoned request all relevant technical documentation will be sent by post to national authorities.

This machinery is to be incorporated into other equipment and must not be put into service until it has been completed with starting/stopping equipment, control equipment, auxiliary equipment. e.g. valves, according to the instructions in the technical documentation, and after the completed machinery has been declared in conformity with the directives mentioned above, in order to fulfil the EU-requirements.

Location: .....

Date: .....

Signature: .....

Name: .....

Title: .....

8.2 Technical data

Alfa Laval ref. 557348, rev. 4

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.

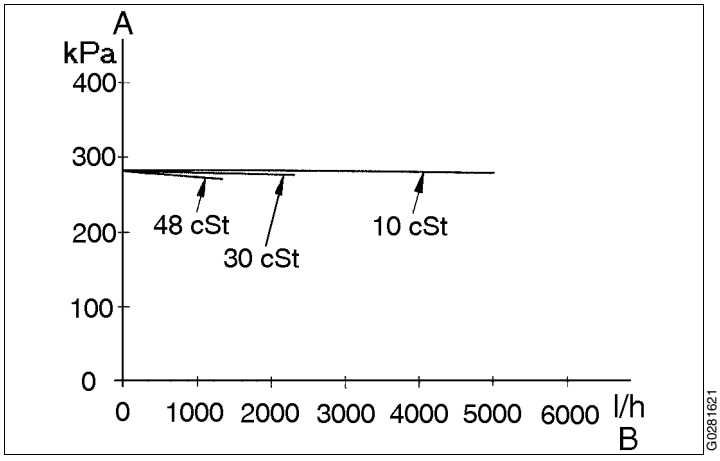
Weight of separator (without motor)	785	kg
Motor power:	7,5	kW
Power consumption, normal	5/6,4	kW (idling/at max. capacity)
Power consumption, max. (start-up)	10,3	kW (at starting up)
Starting time min./max.	2,5/4,5	minutes
Stopping time min./max.	2/3	minutes
Max. running time without flow;		
- empty bowl	180	minutes
- filled bowl	180	minutes
Sound pressure level	79	dB(A)
Vibrations, separator in use.	9,0	mm/s (RMS)
Lubricating oil volume	8	litres
Motor speed, synchronous	1500/1800	r/min., 50/60 Hz
Gear ratio	59:14 64:18	50 Hz 60 Hz
Bowl speed, synchronous	6321/6400	r/min., 50/60 Hz
Revolution counter speed synchronous	125/150	r/min., 50/60 Hz
Bowl inner diameter max.	317	mm
Discharge volume, fixed	7,5	litres
Discharge interval, min./max	1/240	minutes
Max. density of operating liquid:	1000	kg/m^3
Min./Max. feed temperature:	0 / 100	°C
Bowl body material	Al 111 2377-02	
Bowl liquid volume	7,5	litres
Sludge volume, efficient/total	1,3/3,9	litres
Density of sediment/feed, max.	1 989/1 100	kg/m^3
Density ratio min./max.	0,8/0,977	
Weight of bowl	135	kg
Jp reduced to motor shaft, 50/60 Hz:	41.2 / 29.33	kgm^2

Oil inlet pump, built-on (option)

	Capacity	
	50 Hz	*60 Hz*
Pump No.	(lit/h)	(lit/h)
538721-87	2 420	2 900
538721-84	3 630	4 350
538721-85	4 350	5 220
538721-83	5 760	6 920
538721-81	8 540	10 250
Suction lift:	Max. 40 kPa	
Delivery head:	Max. 150 kPa	

Oil outlet paring disc

Delivery head: 100-250 kPa, depending of flow and viscosity

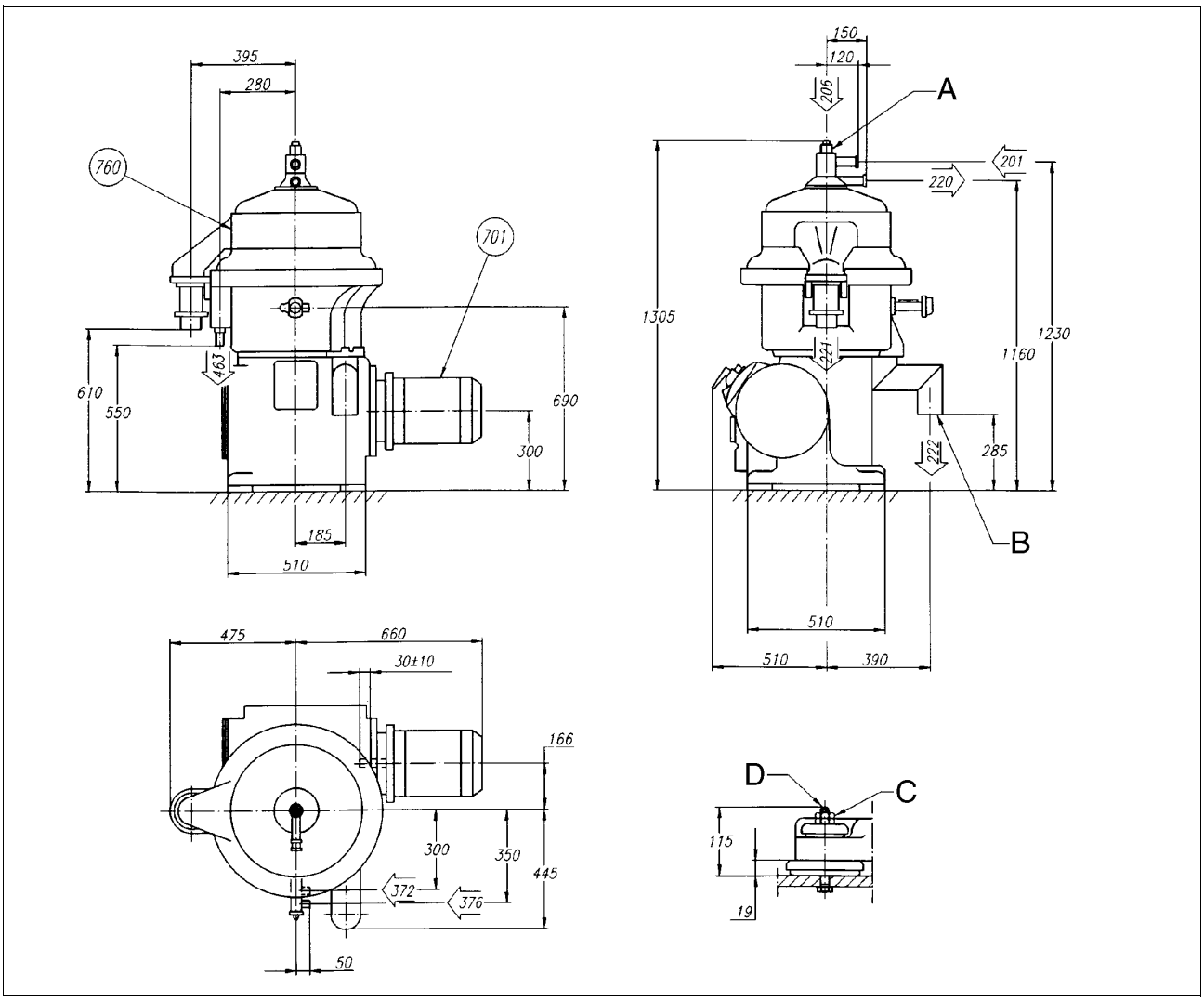


A. Back pressure in kPa
B. Flow in m^3/h

8.3 Basic size drawing

8.3.1 Separator excl. connections

Alfa Laval ref. 565339, rev.0



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

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

C. Tightening torque 16 Nm.

D. Screw M16, locked with lock nut.

For description of the connection numbers, see “8.4 Connection list” on page 184 *and* “8.5 Interface description” on page 186.

Dimensions of connections, separator without pump

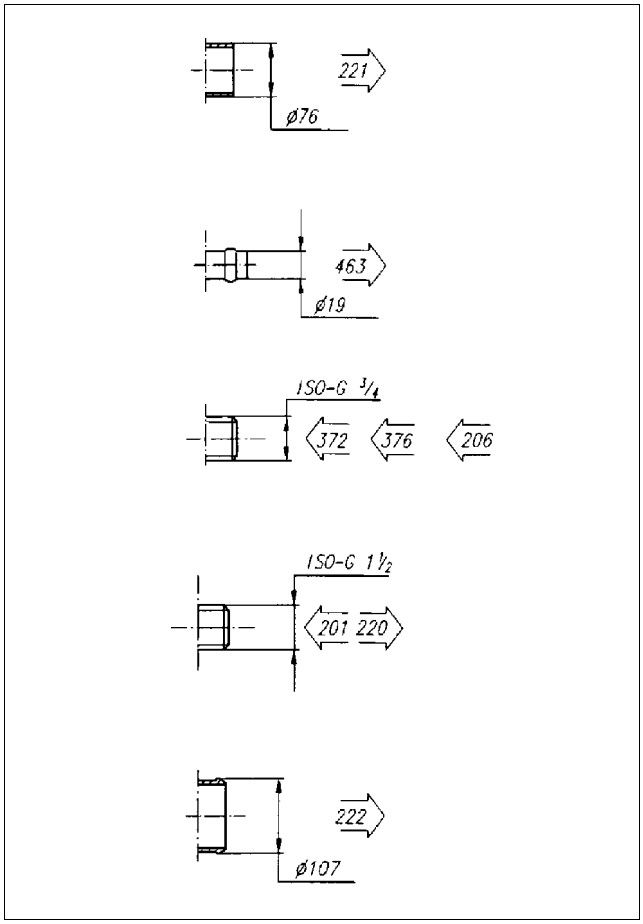
Alfa Laval ref. 565339, rev. 0

Data for connections, see chapter “8.4 Connection list” on page 184.

Connection 201 is turnable 360°.

Connection 220 is turnable 360° in 90° steps.

All dimensions are nominal. Reservation for individual deviations due to tolerances.
All connections to be installed non-loaded and flexible.



8.4 Connection list

Alfa Laval ref. 567625, rev. 1

Connection No.	Description	Requirements/limits
201	Inlet for process liquid – Pressure	 Max. 150 kPa
206	Inlet for liquid seal and displacement liquid – Flow, set value – Quality requirements	 8,8-13,2 litres/minute See “8.6 Quality requirements for operating water” on page 191
220	Outlet for light phase (oil) – Back pressure	 0 - 250 kPa
221	Outlet for heavy phase (water)	
222	Outlet for solid phase – Interface	 The outlet after the separator should be installed in such a way that you can not fill the frame top part with sludge. (Guidance of sludge pump or open outlet)
372	Inlet of discharge liquid – Flow, set value – Time (to trigger discharge) – Pressure – Quality requirements	 8,8-13,2 litres/minute 3 seconds 200-600 kPa See “8.6 Quality requirements for operating water” on page 191

Connection No.	Description	Requirements/limits
376	Inlet for make-up liquid	
	– Flow, set value	2,24-3,36 litres/minute
	– Pressure	200-600 kPa
	– Quality requirements	See “8.6 Quality requirements for operating water” on page 191
463	Drain of frame top part, upper	
	– Interface	Free outlet, without water trap
701	Motor for separator	
	– Allowed frequency variation	± 5% (Momentarily during maximum 5 seconds: ±10%)
760	Cover interlocking switch (option)	See “8.5 Interface description” on page 186.
	– Type	Mechanical switch
	– Switch rating, resistive load max.	3 A, 500 V

8.5 Interface description

Alfa Laval ref. 567632 rev. 0

8.5.1 Scope

This document gives information, requirements and recommendations about operational procedures and signal processing for safe and reliable operation of the separator. It is intended to be used for designing auxiliary equipment and control system for the separator.

8.5.2 References

This Interface Description is one complementary document to the separator. Other such documents that contain necessary information and are referred to here are:

- *Interconnection diagram*
- *Connection List*
- *Technical Data*
- *Operating water interface*

Standards referred to are:

- EN 418 Safety of machinery - Emergency stop equipment, functional aspects - Principles of design
- EN 1037 Safety of machinery - Prevention of unexpected start-up

8.5.3 Definitions

For the purpose of this document, the following definitions apply:

- **Synchronous speed:** The speed the machine will attain when it is driven by a three phase squirrel-cage induction motor and there is no slip in the motor and the drive system.
- **Full speed:** The synchronous speed minus normal slip.

8.5.4 Goal

Information and instructions given in this document aim at preventing situations such as the following:

Situation	Effect
Unbalanced caused by uneven sediment accumulation in the bowl.	Too high stress on bowl and bearing system which might cause harm.
Too high bowl speed.	Too high stress on bowl which might cause harm.
Access to moving parts.	Can cause injury to person who accidentally touches these parts.
Insufficient cleaning of separator	Unsatisfactory product quality.
Bowl leakage.	Product losses.

Control and supervision can be more or less comprehensive depending on the type of used control equipment. When a simple control unit is used it would be impossible or too expensive to include many of the functions specified here while these functions could be included at nearly no extra cost when a more advanced control unit is used. For this reasons functions that are indispensable or needed for safety reasons to protect the machine and/or personnel are denoted with *shall* while other functions are denoted with *should.*

8.5.5 Description of separator modes

For control purposes, the operation of the separator should be divided into different modes. The normally used modes are described below but other modes might exist.

It is assumed that:

- The separator is correctly assembled.
- All connections are made according to Connection List, Interconnection Diagram and Interface Description.
- The separator control system is activated.

If above conditions are not fulfilled the separator is unready for operation.

STAND STILL means:

- The power to the separator motor is off.
- The bowl is not rotating.

STARTING means:

- The power to the separator motor is on.
- The bowl is rotating and accelerating.

RUNNING means:

- The power to the separator motor is on.
- The bowl is rotating at full speed.

- *RUNNING* is a collective denomination for a number of sub modes which e.g. can be:
  - *STAND BY:* Separator is in a waiting mode and not producing.
  - *PRODUCTION:* Separator is fed with product and producing.
  - *CLEANING:* Separator is fed with cleaning liquids with the intention to clean the separator.

STOPPING means:

- The power to the separator motor is either off or used for braking.
- The bowl is rotating and decelerating.

- *STOPPING* is a collective denomination for a number of sub modes which e.g. can be:
  - *NORMAL STOP:* A manually or automatically initiated stop.
  - *SAFETY STOP:* An automatically initiated stop at to high vibrations.
  - *EMERGENCY STOP:* A manually initiated stop at emergency situations. This stop will be in effect until it is manually reset.

8.5.6 Handling of connection interfaces

Electrical connections

Separator motor 701

The separator is equipped with a 3-phase squirrel-cage induction motor

There shall be an emergency stop circuit designed according to EN 418 and a power isolation device according to EN 1037.

There shall be a start button close to the separator that shall be used for first start after assembly of the separator.

There should be a counter to count number of running hours.

There should be a current transformer to give an analogue signal to the control unit about the motor current.

Cover interlocking switch 760

The separator is equipped with an interlocking switch to detect if the cover is mounted.

Signal processing at *STAND STILL:*

- The circuit is closed when the cover of the separator is mounted.
- The interlocking switch should be connected in such a way that starting of the motor is prevented when the separator cover is not mounted.

Signal processing in *STARTING* and *RUNNING*:

- If the circuit is broken the separator should be stopped automatically by *NORMAL STOP*. This is to minimise the risk of having access to moving parts.

Fluid connections

Complementary information is given in the document Connection List.

Inlet 201

Processing in *STAND STILL:*

- Shall be closed.

Processing in *STARTING:*

- Should be closed. Bowl will be open and empty or closed and filled depending on if start is done from *STAND STILL* or *STOPPING.*

Processing in *RUNNING*:

- Could be closed or open.
- Shall be open at discharges.

Processing in *CLEANING*:

- A sequence of cleaning liquids should be fed to the separator. The flow rate should be as high as possible and preferably not less than the production flow rate.

Processing in *NORMAL STOP* or *EMERGENCY STOP*:

- Could be closed or open but the bowl should be filled unless the stop is initiated in *STARTING.*

Processing in *SAFETY STOP:*

- Could be closed or open but the bowl shall be filled unless the stop is initiated in *STARTING.*

220 and 222 Outlets

Processing in *STAND STILL:*

- Could be closed or open.

Processing in other modes:

- Shall be open.

8.6 Quality requirements for operating water

Alfa Laval ref. 553406, rev. 10

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

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

NOTE

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

The following conditions must be fulfilled

1. Turbidity free water, solids content <0,001% by volume.
   Deposits must not be allowed to form in certain areas in the separator
2. Max. particle size 50 μm
3. Total hardness less than 180 mg $CaCO_3$ per litre, which corresponds to 10°dH or 12.5°E Hard water may with time form deposits in the operating mechanism. The precipitation rate is accelerated with increased operating temperature and low discharge frequency. These effects become more severe as the hardness of the water increase.
4. Chloride content max 100 ppm NaCl (equivalent to 60 mg Cl/l)
   A chloride concentration above 60 mg/l is not recommended.

   Chloride ions contribute to corrosion on the separator surface in contact with the operating water, including the spindle. Corrosion is a process that is accelerated by increased separating temperature, low pH, and high chloride ion concentration.
5. pH>6
   Increased acidity (lower pH) increases the risk for corrosion; this is accelerated by increased temperature and high chloride ion content.

8.7 Lubricants

8.7.1 Lubrication chart, general

Alfa Laval ref. 553216-02, rev. 2

Lubricating points	Type of Lubricant	Interval
The oil bath. Bowl spindle bearings are lubricated by oil mist from the oil bath.	Lubricating oil as specified in “8.7.2 Recommended lubricating oils” on page 193.	1. Continuous operation: 2000h 2. Seasonal operation: Before every operating period 3. Short period's operation: 12 months even if total number of operating hours is less than stated above.
Bowl spindle taper.	Lubricating oil (only a few drops for rust protection).	At assembly.
Bowl: Sliding contact surfaces, thread of lock nut and cap nut.	Pastes as specified in “8.7.4 Recommended lubricants” on page 197. If not specified otherwise, follow the supplier’s recommendation about method of application.	At assembly.
Rubber seal rings.	Grease as specified in “8.7.4 Recommended lubricants” on page 197.	At assembly.
Friction clutch bearings	Fill the space between the bearings to one third with ball bearing grease.	At assembly.
Electric motor	Follow manufacturer’s instructions.	Follow manufacturer's instructions.
Threads	Lubricating oil, if not otherwise stated.	At assembly.

CAUTION

Check the oil level before start.

Top up when necessary.

Do not overfill.

8.7.2 Recommended lubricating oils

Alfa Laval ref. 553219-01, rev. 1

Selection of lubricating oil

Select lubricating oil type with regards to ambient temperature.

Ambient temperature (°C)	Oil type	Oil change interval (operating hours)
Between +5 - +45	Paraffinic mineral lubricating oil, category (ISO-L-) CKC 220 (See Recommended oil brands)	1 500
±0 - +55	Synthetic lubricating oil, category PAO (ISO-L-) CKE 220 (See Recommended oil brands)	2000

NOTE

The use of other lubricants than the recommended is done on the exclusive responsibility of the user or oil supplier.

Oil change interval

Oil change interval is dependent on operating hours

Operating conditions	Oil change interval
In a new installation. After change of gear transmission.	200hours
Continuous operation.	See Selection of lubricating oil
When the separator is operated for short periods.	12 months
Seasonal operation	Before every operating period

Other information

Check and prelubricate spindle bearings on separators which have been out of service for 6 months or longer.

8.7.3 Recommended oil brands

Alfa Laval ref. 553218-01, rev. 5

Paraffinic mineral lubricating oil, category (ISO-L-) CKC 220

Trade names and designations might vary from country to country, Please contact your local supplier for more information.

Recommended oil brands

Viscosity grade (ISO 3448/3104) VG 220 /
Viscosity index (ISO 2909) VI >90

Part No	Quantity	Designation	Manufacturer
		Bartran 220	BP
		Energol SHF-HV	BP
		Alpha ZN 220 Ultra 220	Castrol
		Clarity machine oil Meropa 220 Paper machine oil	Chevron
		Mobil DTE oil BB	ExxonMobil
		Wagner 220	Q8/Kuwait Petroleum
		Morlina S2 B 220	Shell
		LubeWay XA 220	Statoil
		Cirkan ZS 220	Total

Standard requirements

Standard	Designation
ISO 11158, (ISO 6743/4)	ISO-L-HM or HV 220
ISO 12925-1, (ISO 6743/6)	ISO-L-CKC or CKT 220
DIN 51517 part 3	DIN 51517 - CLP 220
DIN 51524 part 2 or 3 (German standard)	DIN 51524 - HLP or HVLP 220

The oil must be endorsed for worm gear with bronze worm wheel.

Alfa Laval ref. 553218-03, rev. 7

Synthetic lubricating oil, category PAO (ISO-L-) CKE 220

Trade names and designations might vary from country to country, Please contact your local supplier for more information.

Recommended oil brands - General demands

Viscosity grade (ISO 3448/3104) VG 220

Part No	Quantity	Designation	Manufacturer
		Enersyn HTX 220	BP
		Enersyn EP-XF 220	BP
		Alphasyn EP 220	Castrol
		Alphasyn HG 220	Castrol
		Optigear Synthetic A 220	Castrol
		Pinnacle EP 220	Chevron
		Pinnacle Marine Gear 220	Chevron
		Tegra Synthetic Gear Lubricant220 (H2)	Chevron
		Mobil SHC 630	ExxonMobil
		Schumann 220	Q8/Kuwait Petroleum
		Morlina S4 B 220	Shell
		Mereta 220	Statoil
		Carter SH 220	Total
		Elf Epona SA 220	Total

Recommended oil brands–Special hygienic demands

Viscosity grade (ISO3448/3104) VG 220 Conform to U.S. Food and Drug Administration (FDA) requirements of lubricants with incidental food contact, Title CFR 21 178.3570, 178.3620 and/or those generally regarded as safe (US21CFR182). The hygienic oil on the list is in the online “NSF White Book™ Listing” at the time of the revision of this document. For more information about the NSF registration and up to date H1 registration, see www.nsf.org(http://www.nsf.org/business/nonfood_compounds/)

Part No	Quantity	Designation	Manufacturer
		Cassida Fluids GL 220	Fuchs

Standard requirements

Standard	Designation
ISO 12925-1, (ISO 6743/6)	ISO-L-CKC/CKD/CKE/CKT 220
DIN 51517 part 3	DIN 51517 - CLP 220

The oil must have a synthetic base oil of polyalphaolefin type (PAO) instead of mineral base oil.

The oil must be endorsed for worm gear with bronze worm wheel.

8.7.4 Recommended lubricants

Alfa Laval ref. 553217-01, rev. 14

Lubricant recommendation for hygienic and non-hygienic applications

Lubricants with an Alfa Laval part number are approved and recommended for use.

The data in the tables below is based on supplier information.

Trade names and designations might vary from country to country. Please contact your local supplier for more information.

Paste for assembly of metallic parts, non-hygienic applications:

Part No	Quantity	Designation	Manufacturer	Remark
537086-02	1000 g	Molykote 1000 Paste	Dow Corning	-
537086-03 537086-06	100 g 50 g	Molykote G-n plus Paste	Dow Corning	-
537086-04	50 g	Molykote G-rapid plus Paste	Dow Corning	-
-	-	Gleitmo 705	Fuchs Lubritech	-
-	-	Wolfracoat C Paste	Klüber	-
-	-	Dry Moly Paste	Rocol	-
-	-	MTLM	Rocol	-

Bonded coating for assembly of metallic parts, non-hygienic applications:

Part No	Quantity	Designation	Manufacturer	Remark
535586-01	375 g	Molykote D321R Spray	Dow Corning	-
-	-	Gleitmo 900	Fuchs Lubritech	Varnish or spray

Paste for assembly of metallic parts, hygienic applications (NSF registered H1 is preferred):

Part No	Quantity	Designation	Manufacturer	Remark
-	-	Molykote D Paste	Dow Corning	-
537086-07	50 g	Molykote P-1900	Dow Corning	NSF Registered H1 (7 Jan 2004)
-	-	Molykote TP 42	Dow Corning	-
561764-01	50 g	Geralyn 2	Fuchs Lubritech	NSF Registered H1 (3 sep 2004)
-	-	Geralyn F.L.A	Fuchs Lubritech	NSF Registered H1 (2 Apr 2007) German §5 Absatz 1 LMBG approved
554336-01	55 g	Gleitmo 1809	Fuchs Lubritech	-
-	-	Gleitmo 805	Fuchs Lubritech	DVGW (KTW) approval for drinking water (TZW prüfzeugnis)
-	-	Klüberpaste 46 MR 401	Klüber	White; contains no lead, cadmium, nickel, sulphur nor halogens.
-	-	Klüberpaste UH1 84-201	Klüber	NSF Registered H1 (26 Aug 2005)
-	-	Klüberpaste UH1 96-402	Klüber	NSF Registered H1 (25 Feb 2004)
-	-	252	OKS	NSF Registered H1 (23 July 2004)
-	-	Foodlube Multi Paste	Rocol	NSF Registered H1 (13 Apr 2001)

Silicone grease/oil for rubber rings, hygienic and non-hygienic applications

Part No	Quantity	Designation	Manufacturer	Remark
-	-	No-Tox Food Grade Silicone grease	Bel-Ray	NSF Registered H1 (16 December 2011)
-	-	Dow Corning 360 Medical Fluid	Dow Corning	Tested according to and complies with all National Formulary (NF) requirements for Dimethicone and European Pharmacopeia (EP) requirements for Dimeticone or Silicone Oil Used as a Lubricant, depending on viscosity.
569415-01	50 g	Molykote G 5032	Dow Corning	NSF Registered H1 (3 June 2005)
-	-	Geralyn SG MD 2	Fuchs Lubritech	NSF Registered H1 (30 March 2007)
-	-	Chemplex 750	Fuchs Lubritech	DVGW approved according to the German KTW-recommendations for drinking water.
-	-	Paraliq GTE 703	Klüber	NSF Registered H1 (25 Feb 2004). Approved according to WRAS.
-	-	Unisilkon L 250 L	Klüber	Complies with German Environmental Agency on hygiene requirements for tap water. Certified by DVGW-KTW, WRAS, AS4020, ACS.
-	-	ALCO 220	MMCC	NSF Registered H1 (25 March 2002)
-	-	Foodlube Hi-Temp	Rocol	NSF Registered H1 (18 April 2001)

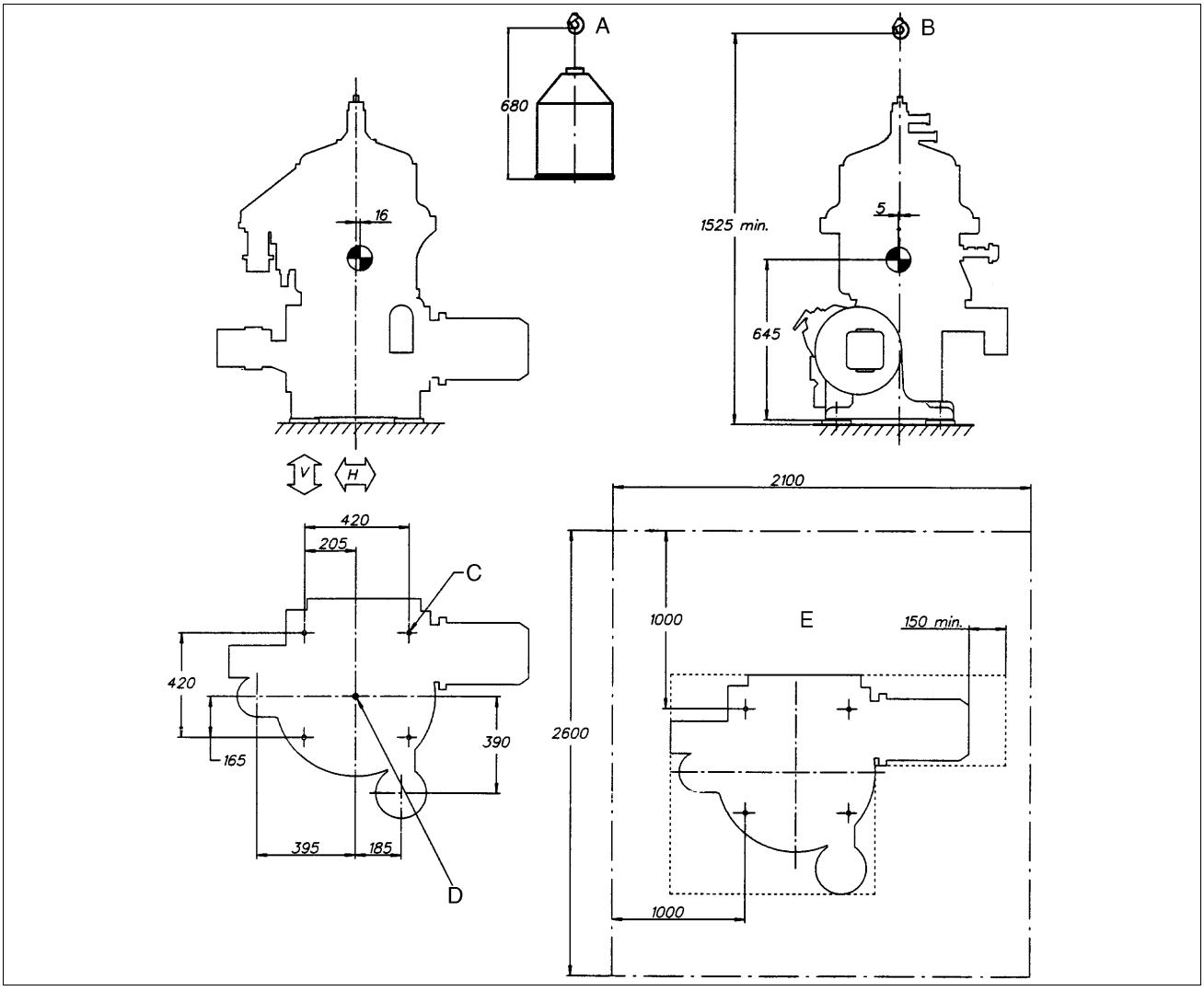
Always follow the lubrication recommendations of the bearing manufacturer.

Grease for ball and roller bearings in electric motors

Part No	Quantity	Designation	Manufacturer	Remark
-	-	Energrease LS2	BP	-
-	-	Energrease LS-EP2	BP	-
-	-	Energrease MP-MG2	BP	-
-	-	APS 2	Castrol	-
-	-	Spheerol EPL 2	Castrol	-
-	-	Multifak EP2	Chevron	-
-	-	Multifak AFB 2	Chevron	-
-	-	Molykote G-0101	Dow Corning	-
-	-	Molykote Multilub	Dow Corning	-
-	-	Unirex N2	ExxonMobil	-
-	-	Mobilith SHC 460	ExxonMobil	-
-	-	Mobilux EP2	ExxonMobil	-
-	-	Lagermeister EP2	Fuchs Lubritech	-
-	-	Rembrandt EP2	Q8/Kuwait Petroleum	-
-	-	Alvania EP 2	Shell	-
-	-	LGEP 2	SKF	-
-	-	LGMT 2	SKF	-
-	-	LGFP 2	SKF	NSF Registered H1 (17 Aug 2007)
-	-	Multis EP2	Total	-

8.8 Foundation drawing

Alfa Laval ref. 554446, rev. 0



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

B. Min. lifting capacity when doing service: 1000 kg

C. 4 holes Ø 17 for anchorage

D. Centre of separator bowl

E. Service side

Recommended free floor space for unloading when doing service

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

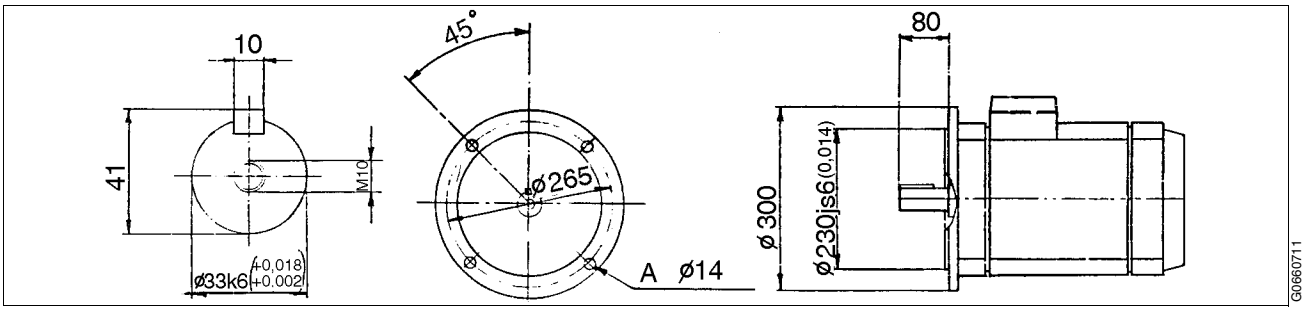
Centre of gravity (complete machine)

Vertical force not exceeding 7 kN/foot

Horizontal force not exceeding 10 kN/foot

8.9 Electric motor for land application

Alfa Laval ref. 540467, rev. 2



A. Four holes, diameter 14 mm

Manufacturer	Not fixed
Standards	IEC 72
Size	132M
Poles	4
Degree of protection	IP44
Method of cooling	R
Specification	Totally enclosed fan-cooled three-phase induction motor

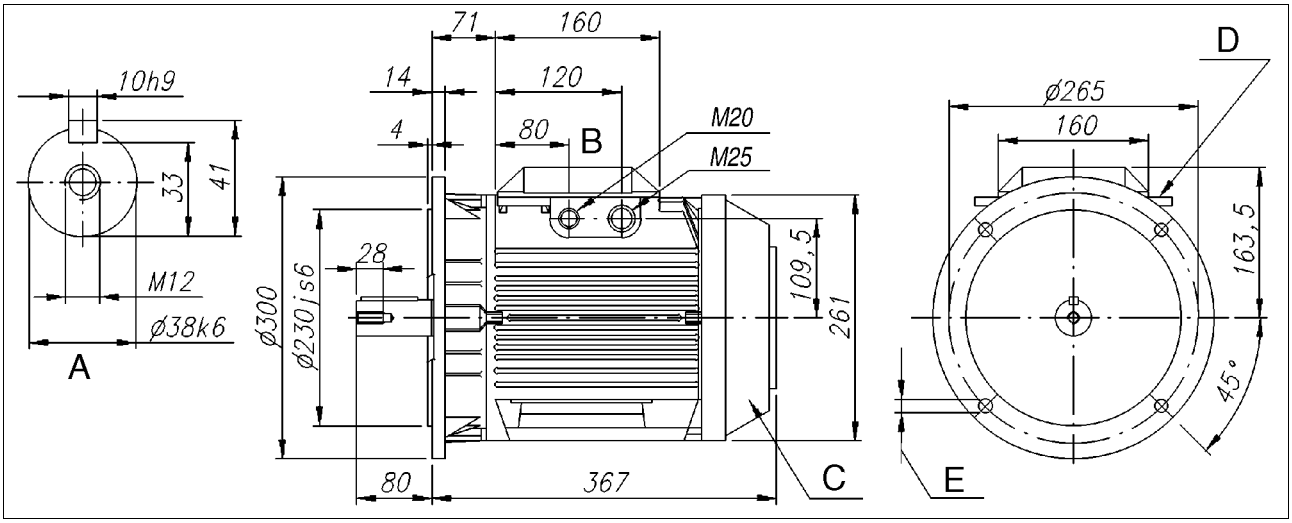
Article No.	Output kW	Freq Hz	Voltage V
540467-10	7,5	60	220D/380Y
540467-11	7,5	60	380D
540467-12	7,5	60	440D
540467-13[1)]	7,5	60	575D
540467-14	7,5	60	460D
540467-16	7,5	50	400D

Article No.	Output kW	Freq Hz	Voltage V
540467-17	7,5	50	200D
540467-18	7,5	50	220D/380Y
540467-19	7,5	50	380D
540467-20	7,5	50	415D
540467-21	7,5	50	500D
540467-22	7,5	50	660D
540467-23	7,5	60	200D

1) In accordance with the rules of CSA.

8.10 Electric motor for marine application

Alfa Laval ref. 552812, rev. 4



A. Shaft dimension
B. Knock out openings for cable glands on both sides
C. Metal fan cover
D. Casted lifting lugs on both sides
E. 4 holes, diameter =14,5 mm

Manufacturer	ABB Motors
Manufacturers drawing	CAT. BA/Marine motors GB 08-2001
Standards	IEC 34-series, 72, 79 and 85
Size	132 M
Type	M3AA 132 M
Weight	48 kg
Poles	4
Insulation class	F
Bearings	D-end 6208-2Z/C3 N-end 6206-2Z/C3
Method of cooling	IC 411 (IEC 34-6)
Specification	Totally enclosed three-phase motor for marine service [1)]
Note	The motor bearings are permanently lubricated

Type of mounting IEC 34-7		Degree of protection IEC 34-5
	IM 3001	IP 55
	IM 3011	IP 55
	IM 3031	IP 55

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

Lloyds Register of shipping	(LRS)	(Essential Service)
Det Norske Veritas	(DnV)	(Essential Service)
Germanischer Lloyd	(GL)	(Essential Service)
Bureau Veritas	(BV)	(Essential Service)
American Bureau of shipping	(ABS)	(Essential Service)
Registro Italiano Navale	(RINA)	(Essential Service)
Nippon Kaiyi Kyokai	(NK)	(Essential Service)
Korean Register of Shipping	(KR)	(Essential Service)
Polski Rejester Statkow	(PRS)	(Essential Service)
China Classification Societies	(CCS)	(Essential Service)
Indian Register of shipping	(IRS)	(Essential Service)
Maritime Register of shipping	(RMS)	(Essential Service)

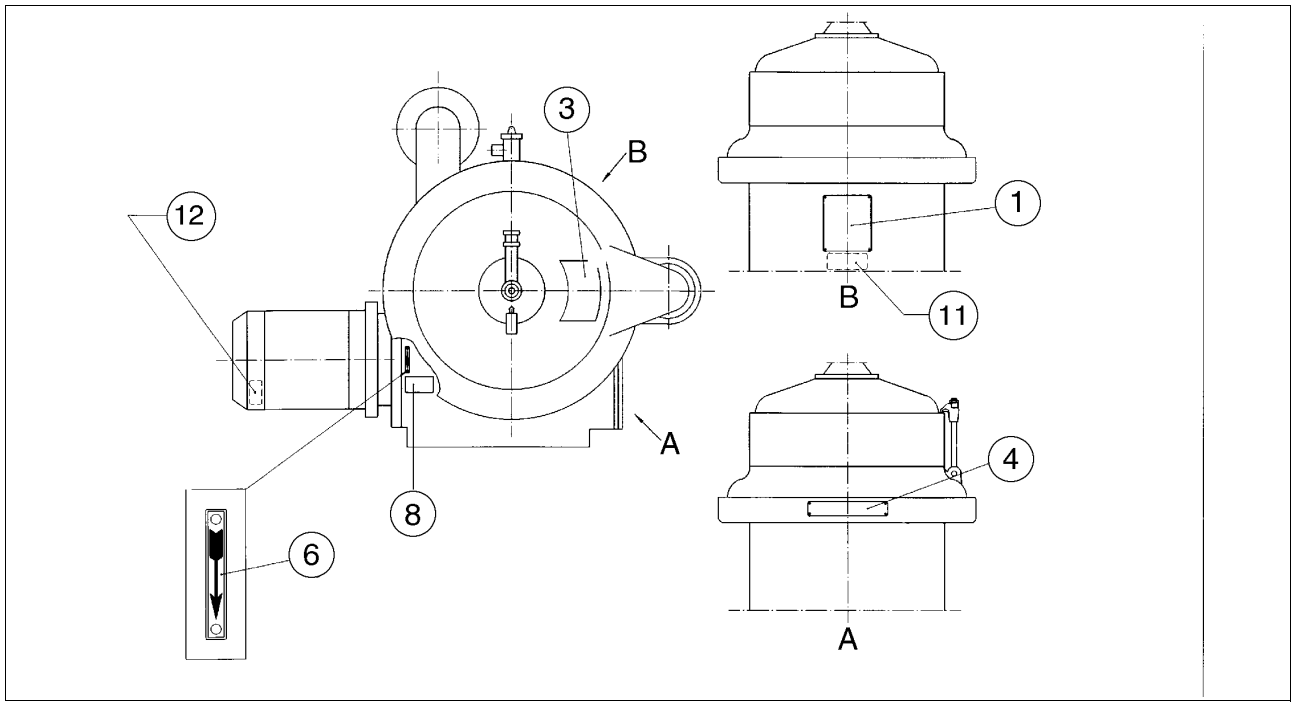
Required classification society must always be specified when ordering. Factory test certificate to be enclosed at the delivery.

Rated output (kW) valid for temp-rise max. 90 °C. The motors can be provided with space heaters for 110 V or 220 V, 25 W as option.

State supply voltage when ordering. Connection to separate terminal board in the main terminal box acc. to attached connection diagram.

8.11 Machine plates and safety labels

Alfa Laval ref. 557323, rev. 1



A and B are different views

1. Machine plate

Separator
Manufacturing serial No./ Year
Product No.
Machine top part
Bowl
Machine bottom part
Max. speed (bowl)
Direction of rotation (bowl)
Speed motor shaft
El. current frequency
Recommended motor power
Max. density of feed
Max. density of sediment
Max. density of operating liquid
Process temperature min./max.

3. Safety label

S00690N1

Text on label:

WARNING

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

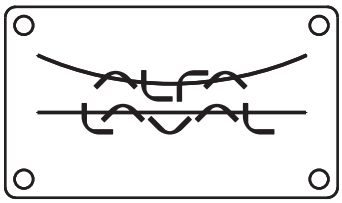
Failure to strictly follow instructions can lead to fatal injury.

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

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

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

4. Name plate

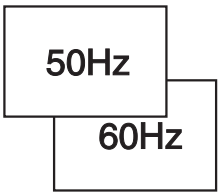


S0063211

6. Arrow

Indicating direction of rotation of horizontal driving device.

8. Power supply frequency



S0063111

11. Representative label

Space for label indicating representative.

12. Additional label

Space for additional label as specified in the order.

8.12 Storage and installation

8.12.1 Introduction

Most of the installation instructions are *Specifications*, which are compulsory requirements. These specifications are sometimes completed with non-compulsory *Recommendations*, which could improve the installation quality.

Additional installation information, such as drawings, connection lists and interface description, can be found previous in this chapter.

8.12.2 Storage and transport of goods

Storage

Specification

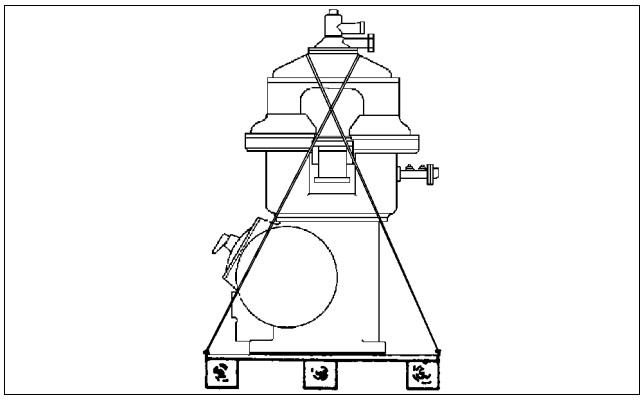
Upon arrival to the store, **check all components and keep them:**

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

A separator can be delivered with different types of protection:

- Fixed on a pallet.

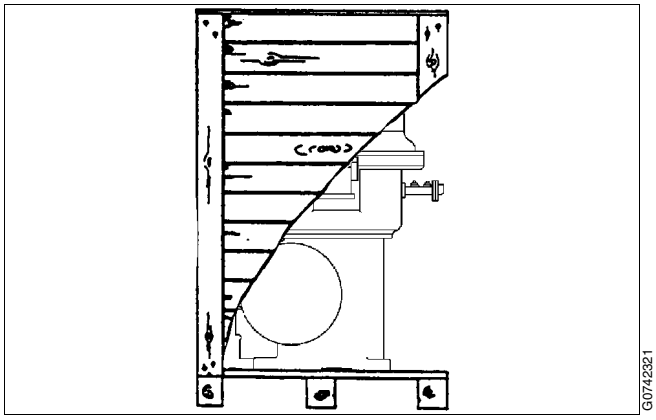
  The separator must be stored in a storage room well protected from mechanical damage and also dry and protected from rain and humidity.



Fixed on a pallet

- In a wooden box which is not water tight.

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

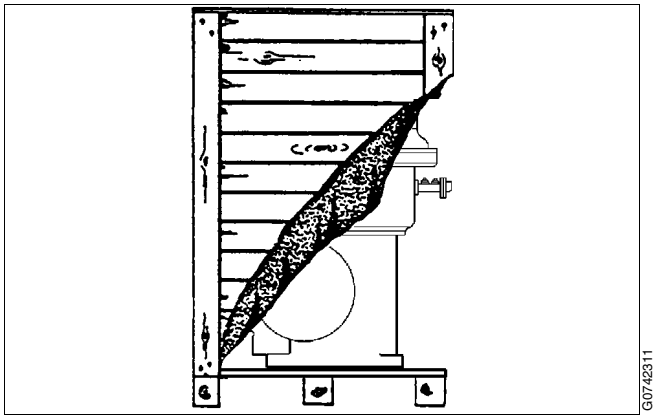


In a wooden box which is not water tight

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

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

  The packaging for outdoor storage is only to special order.



In a special water-resistant box for outdoor storage

Transport

Specification

- During transport of the separator, the frame hood and bowl **must always be removed from the machine.**
- When lifting a separator it must always be **hung securely**. See chapter “5.5 Lifting instructions” on page 91.

WARNING

Crush hazards

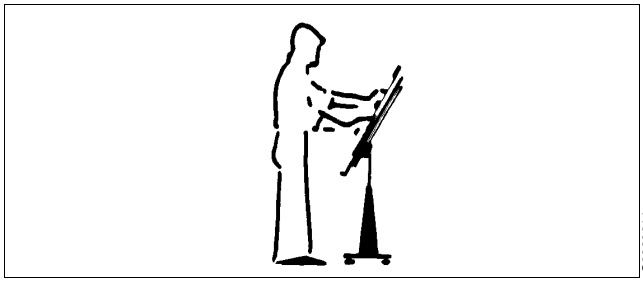
Use correct lifting tools and follow lifting instructions.

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

8.12.3 Planning of installation

Introduction

The space required for one or more separators can be calculated by consulting the drawings in the chapters ““8.3 Basic size drawing” on page 182” on page 182, “8.5 Interface description” on page 186, “8.8 Foundation drawing” on page 201 and instructions for ancillary equipment, electrical and electronic equipment and cables.

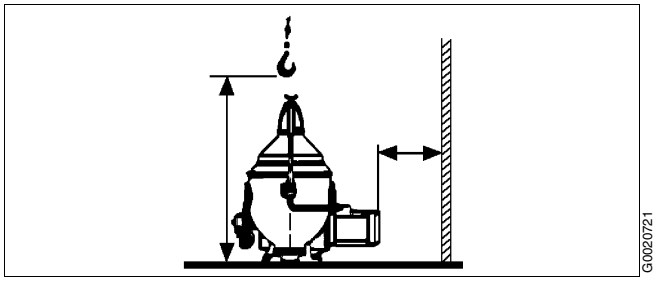


Check the drawings when planning the installation

Important measurements

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

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



Suitable space must be obtained for the maintenance work

Space for separator

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

Specification

- See chapter “8.8 Foundation drawing” on page 201 for the service space required with the separator installed.

Recommendation

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

Lifting height for transport of bowl

Specification

- A minimum height is required to lift the bowl, bowl parts and the bowl spindle, see chapter “8.8 Foundation drawing” on page 201.

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.

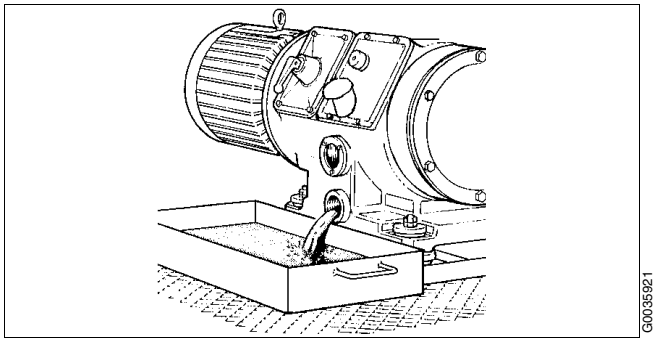
Space for oil changing

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

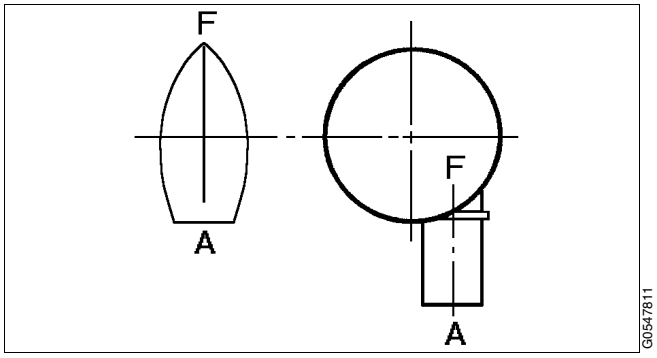
8.12.4 Foundations

NOTE

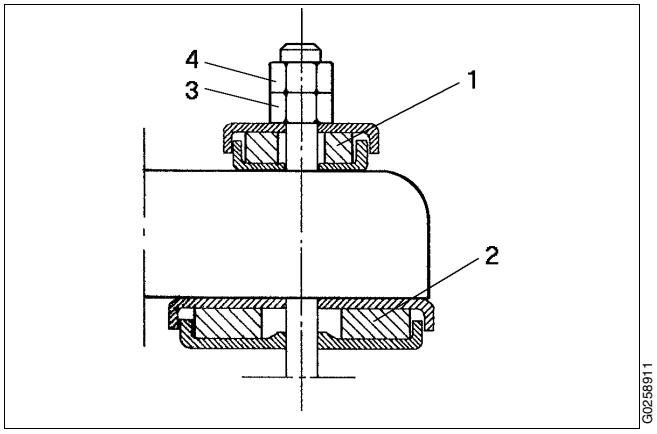
When lifting a separator it must always be **hung securely**. See chapter "5.5 Lifting instructions" on page 91.

Specification

- The separator should be installed at floor level, see chapter "8.8 Foundation drawing" on page 201.
- 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 **16 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