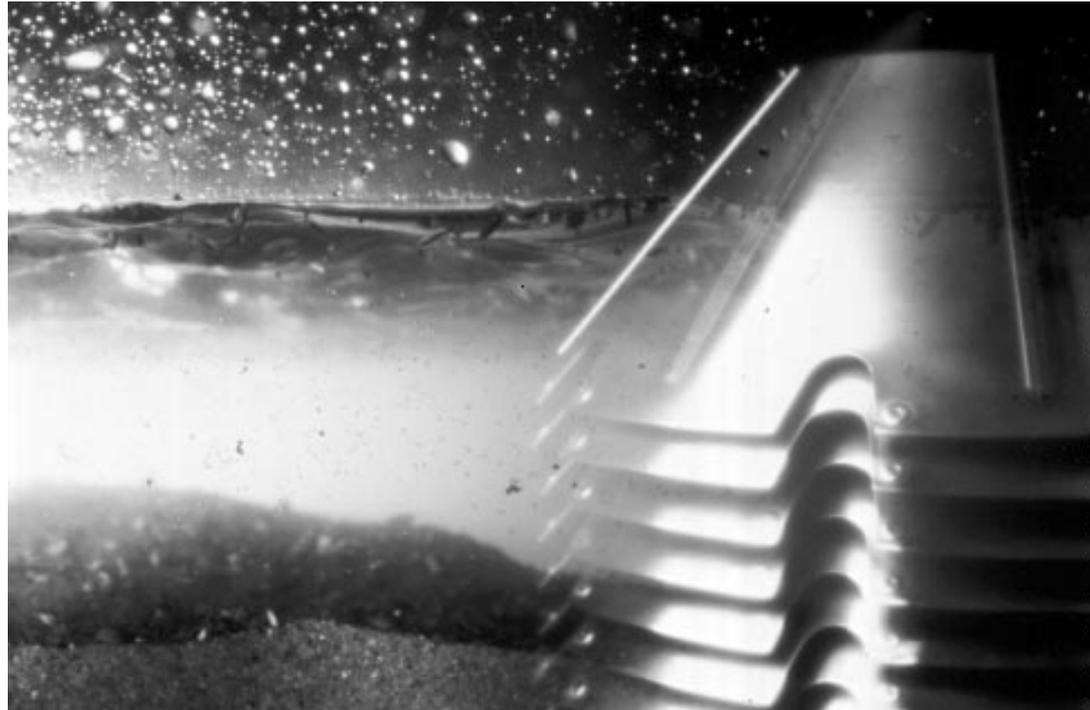


A L F A L A V A L

FOPX 614TFD-20



Separator Manual

Product No.
Book No.

881082-02-03/1
1270864-02 Rev. 4

Alfa Laval

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Printed in Sweden, 01-08

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Contents

1	Read this first	7
2	Safety Instructions	9
3	Separator Basics	15
	3.1 Basic principles of separation	16
	3.2 Design and function	18
	3.3 Definitions	28
4	Operating Instructions	29
	4.1 Operating routine	30
5	Service Instructions	35
	5.1 Periodic maintenance	37
	5.2 Maintenance Logs	41
	5.3 Check points at Intermediate Service (IS)	47
	5.4 Check points at Major Service (MS)	64
	5.5 Lifting instructions	78
	5.6 Cleaning	79
	5.7 When changing oil	83
	5.8 Vibration	87
	5.9 Common maintenance directions	89
6	Dismantling/Assembly	93
	6.1 Introduction	94
	6.2 Inlet/outlet, frame hood (IS)	96
	6.3 Bowl hood and disc stack (IS)	101
	6.4 Bowl body and operating mechanism (IS)	115
	6.5 Operating water device (IS)	126
	6.6 Vertical driving device (MS)	134
	6.7 Horizontal driving device (MS)	150

7	Trouble-tracing	163
7.1	FOPX mechanical functions	164
7.2	Separating functions	168
7.3	Vibration switch (option)	171
8	Technical Reference	173
8.1	Technical data	174
8.2	Basic size drawing	176
8.3	Connection list	178
8.4	Interface description	180
8.5	Water quality	184
8.6	Lubricants	185
8.7	Drawings	193
8.8	Storage and installation	199
	Index	209



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

Not following the instructions can result in serious accidents.

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



1 *Read this first*

This manual is designed for operators and service engineers working with the Alfa Laval separator FOPX 614TFD-20.

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

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

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

This Separator Manual consists of:

Safety Instructions

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

Separator Basics

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

Operating Instructions

This chapter contains operating instructions for the separator only.



Separator Manual and Spare Parts Catalogue

S0068011

Service Instructions

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

Dismantling / Assembly

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

Trouble-tracing

Refer to this chapter if the separator functions abnormally.

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

Technical Reference

This chapter contains technical data concerning the separator and drawings.

Index

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

2 Safety Instructions



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

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

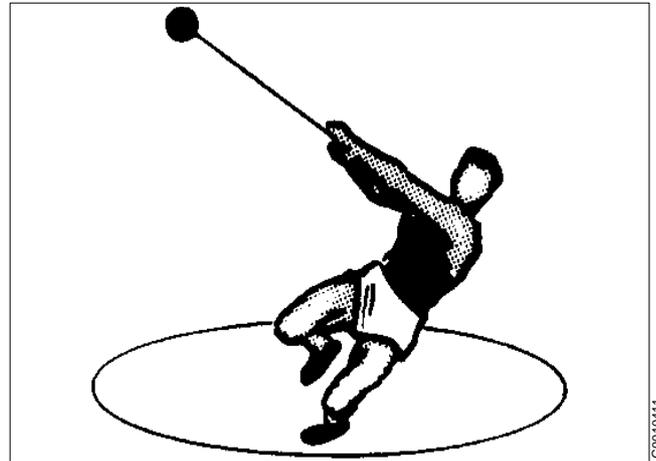
Manufacturing tolerances are extremely fine. Rotating parts are carefully balanced to reduce undesired vibrations that can cause a breakdown. Material properties have been considered carefully during design to withstand stress and fatigue.

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

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

The following basic safety instructions therefore apply:

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

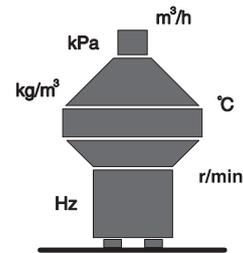




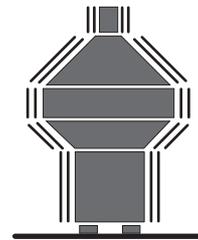
DANGER

Disintegration hazards

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



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S0055611



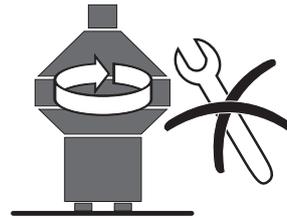
DANGER

Entrapment hazards

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

Electrical hazards

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



S0051111



S0051011



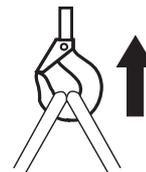
WARNING

Crush hazards

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

Noise hazards

- Use ear protection in noisy environments.



S0051711



S0051611



CAUTION

Burn hazards

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

Cut hazards

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



S0055411



S0054311



Warning signs in the text

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



DANGER

Type of hazard

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



WARNING

Type of hazard

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



CAUTION

Type of hazard

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

NOTE

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



3 *Separator Basics*

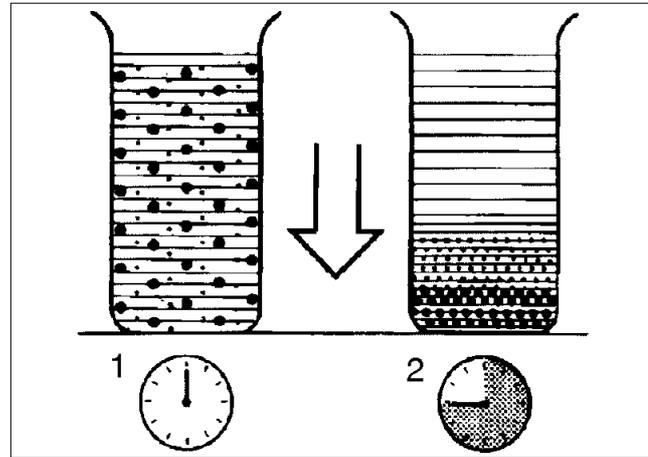
Contents

3.1 Basic principles of separation	16
3.2 Design and function	18
3.2.1 Overview	18
3.2.2 Mechanical power transmission	19
3.2.3 Sensors and indicators	20
3.2.4 Process main parts	22
3.2.5 Separating function	25
3.2.6 Sludge discharge cycle	26
3.3 Definitions	28

3.1 Basic principles of separation

The purpose of separation can be:

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



Sedimentation by gravity

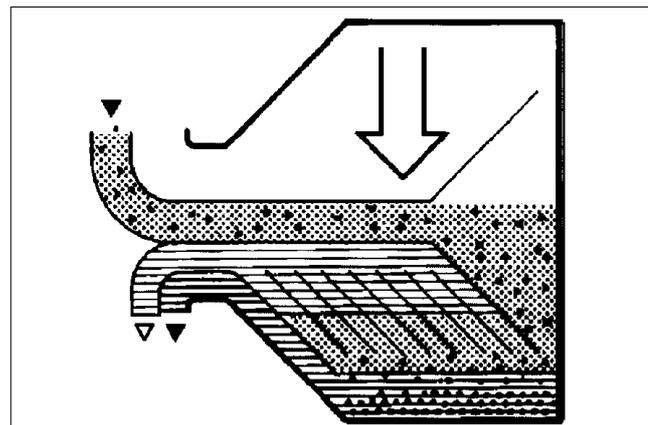
Separation by gravity

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

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

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

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



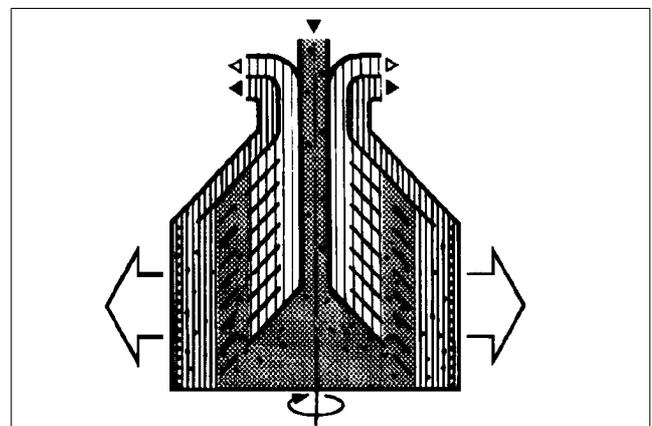
Sedimentation in a settling tank, with outlets making it possible to separate the lighter liquid parts from the heavier

Centrifugal separation

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

Separation and sedimentation is continuous and happens very quickly.

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



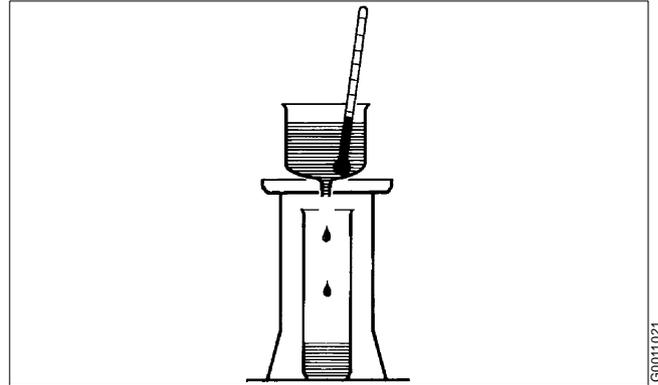
The centrifugal solution

Separating temperatures

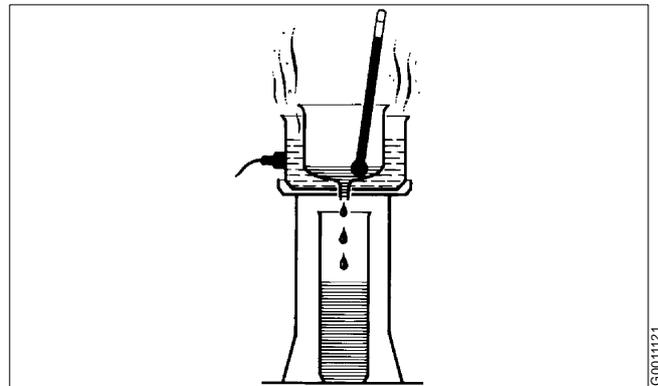
For some types of process liquids (e.g. mineral oils) a high separating temperature will normally increase the separation capacity. The temperature influences oil viscosity and density and should be kept constant throughout the separation.

Viscosity

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



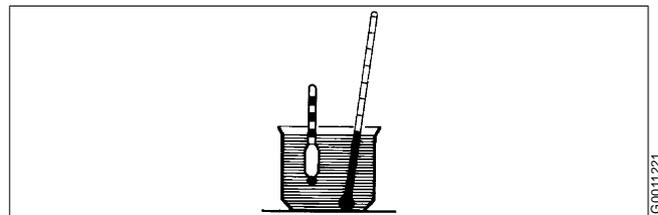
High viscosity (with low temperature)



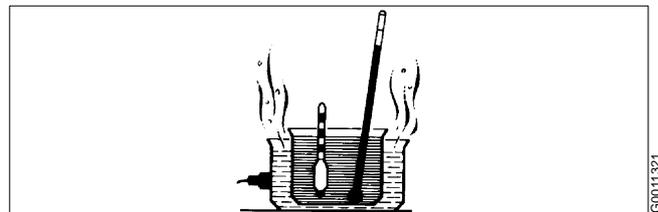
Low viscosity (with high temperature)

Density difference

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



High density (with low temperature)



Low density (with high temperature)

3.2 Design and function

3.2.1 Overview

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

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

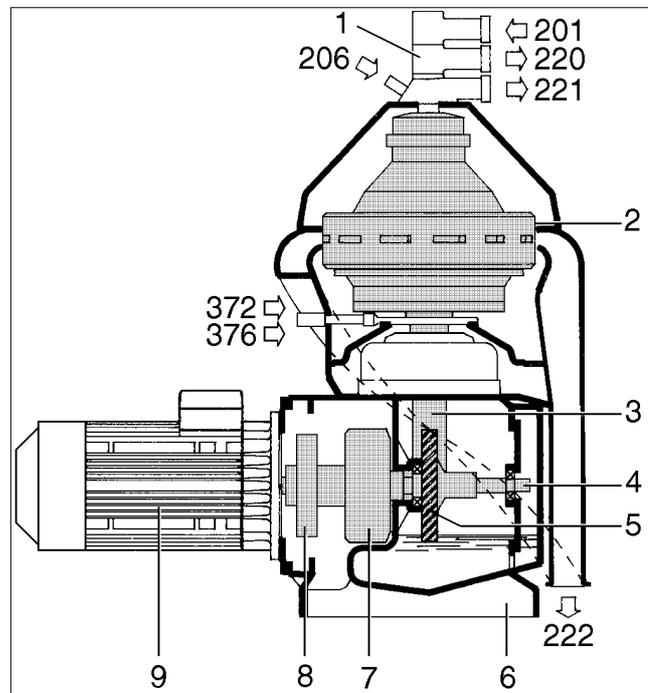
The bottom part of the separator contains the horizontal driving device (4), driving shaft with couplings (7, 8), a worm gear (5) and a vertical spindle (3).

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

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

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

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



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

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

3.2.2 Mechanical power transmission

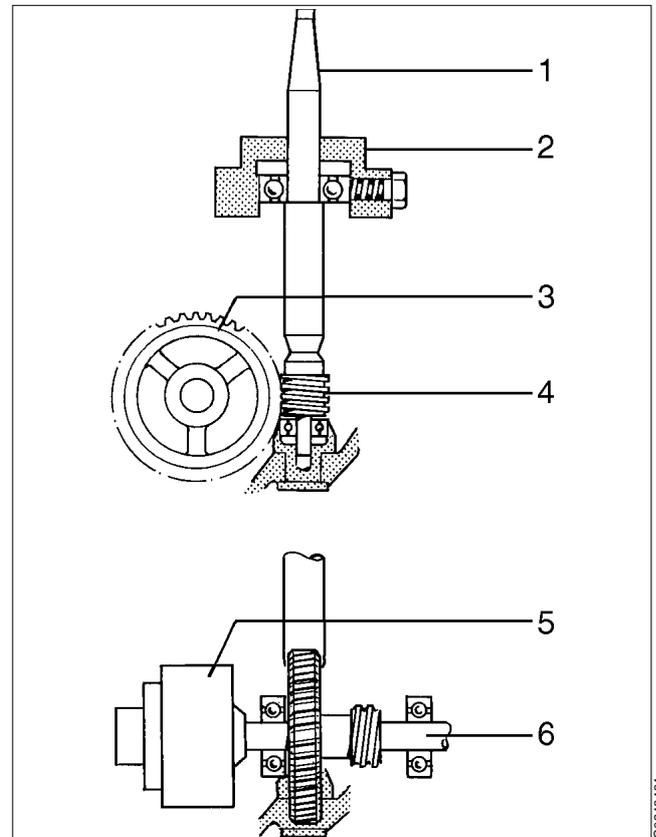
The main parts of the power transmission between motor and bowl are illustrated in the figure.

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

The worm gear has a ratio which increases the bowl speed several times compared with the motor speed. For correct ratio see chapter "8.1 Technical data" on page 174.

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

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

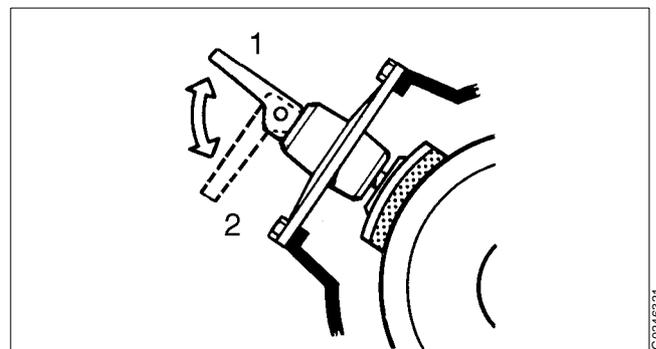


1. Bowl spindle
2. Top bearing and spring casing
3. Worm wheel
4. Worm
5. Friction coupling
6. Worm wheel shaft

Brake

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

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



Applying (1) and releasing (2) of brake

3.2.3 Sensors and indicators

Revolution counter (1)

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

Sight glass (2)

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

Indicating pressure gauge (3)

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

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

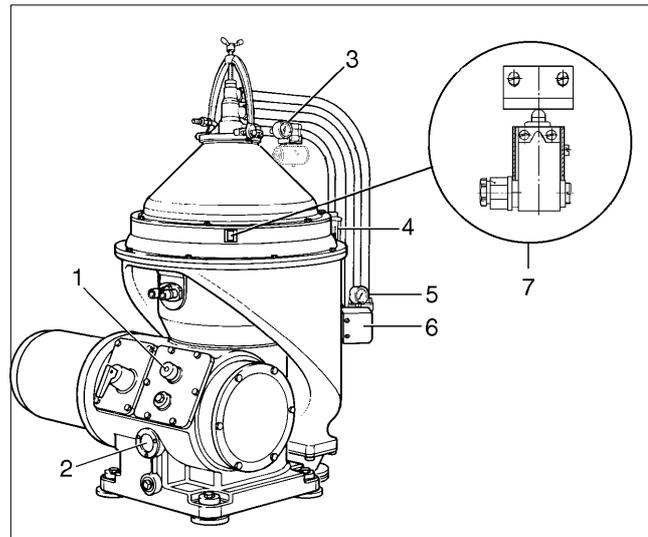
See also chapter "7.2.6 High pressure in oil outlet" on page 170.

Sight glass wiper (4)

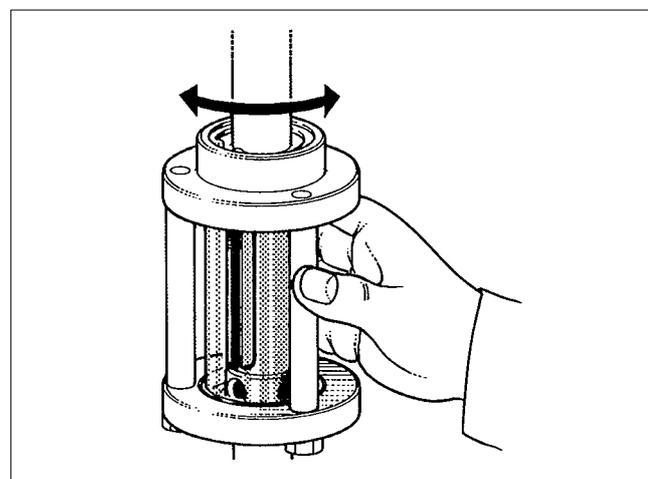
Cleaning of the sight glass for separated water has to be done frequently.

The advantages of the wiper are:

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



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



Clean the sight glass by turning it around the scraper

Back pressure gauge (5)

Correct limits for the back pressure in the clean oil outlet can be found in chapter “8.3 Connection list” on page 178.

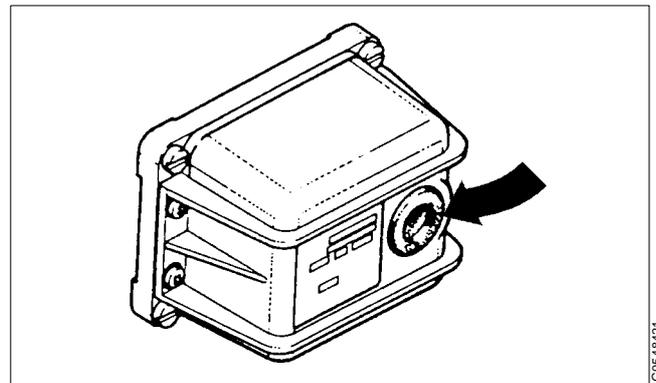
Increasing back pressure in the clean oil outlet can be caused by:

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

Vibration switch (6, option)

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

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



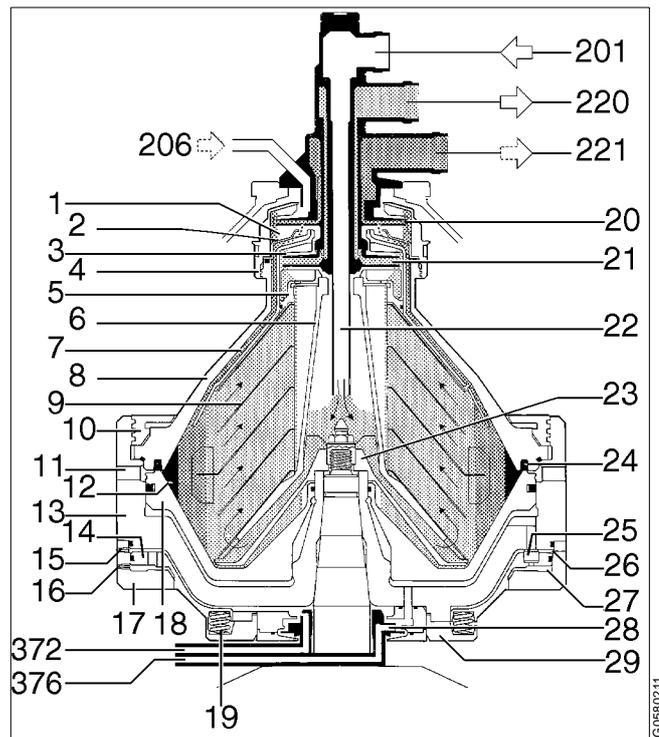
Reset push button on vibration switch

Cover interlocking switch (7, option)

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

3.2.4 Process main parts

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



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

Non-rotating parts are indicated by black shading.

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

*Parts effecting a sludge discharge

Inlet and outlet device

The inlet and outlet device consists of the following parts:

- The inlet (201). This comprises the pipe bend and the long inlet pipe (22) which extends into the middle of the bowl.
- The outlets (220, 221). These comprise the discharge cover and the paring discs (20, 21) which pump the separated oil and water out of the bowl. Each paring disc is located in a paring chamber (1, 3) in the top of the bowl.

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

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

Separator bowl

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

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

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

The sludge space (12) is the space between the sliding bowl bottom and the bowl hood in the bowl periphery. It is kept closed by the sliding bowl bottom which seals against a seal ring (24) in the bowl hood.

Sludge discharge mechanism

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

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

3.2.5 Separating function

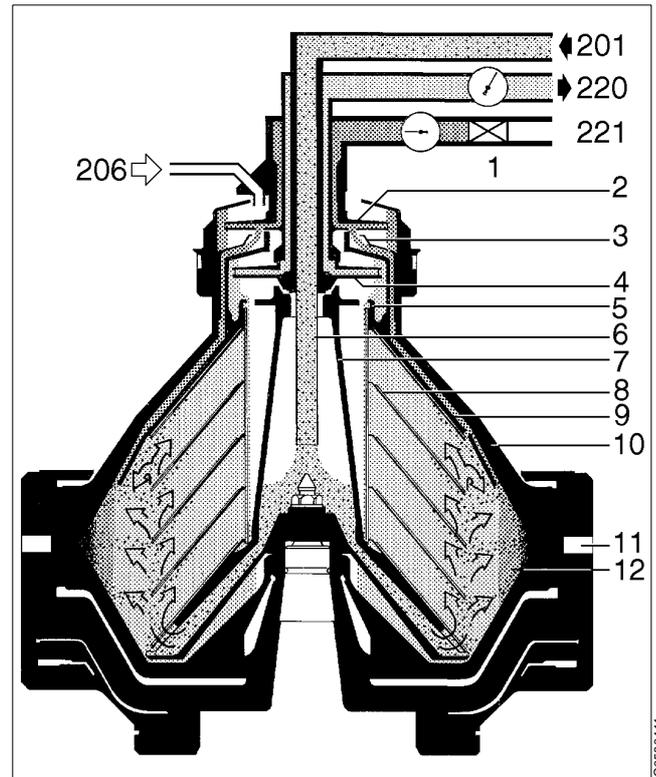
Unseparated oil is fed into the bowl through the inlet pipe (6) and is pumped via the distributor (7) towards the periphery of the bowl.

When the oil reaches slots in the base of the distributor, it will rise through the channels formed by the disc stack (8) where it is evenly distributed.

The oil is continuously cleaned as it travels towards the center of the bowl. When the cleaned oil leaves the disc stack it rises upwards, flows over the level ring (5) and enters the oil paring chamber. From the latter it is pumped by the oil paring disc (4) and leaves the bowl through outlet (220). Separated water, sludge and solid particles, which are heavier than the oil, are forced towards the periphery of the bowl and collected in the sludge space (12).

The space between bowl hood (10) and top disc (9) and also the upper paring chamber are filled with oil, which is distributed over the entire circumference via the groove in the top disc.

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



Separating principle

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

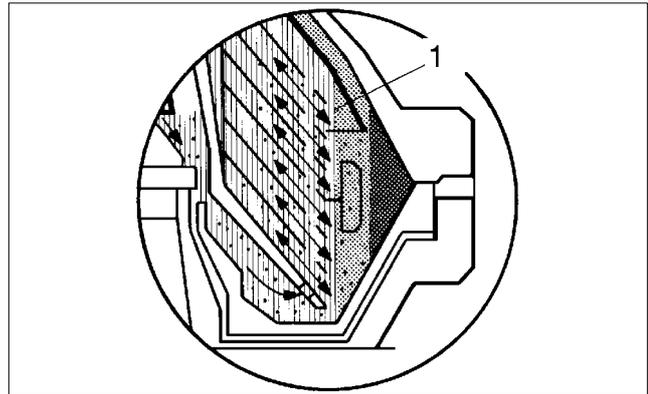
201. Unseparated oil, inlet
206. Displacement/conditioning water inlet
220. Clean oil outlet
221. Water outlet

3.2.6 Sludge discharge cycle

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

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

The separator discharges a fixed volume of sludge and water. The discharge volume is approximately 70% of the space outside the disc stack, the so-called sludge space. The contents of the discharge can contain some emulsified oil.



Correct interface position (1) is outside the disc stack

G0027031

Closed bowl (normal operation)

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

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

Bowl opens for discharge

The opening water (372), which is supplied into the space above the operating slide (2), overcomes the force from the springs (7) and the operating slide is pressed downwards. The drain channels (9) open and the closing water drains out through the nozzle (3). This allows the force on the underside of the sliding bowl bottom (6) to become lower than the force on the upper side. The sliding bowl bottom moves downwards and the bowl opens for a discharge through the sludge ports (1).

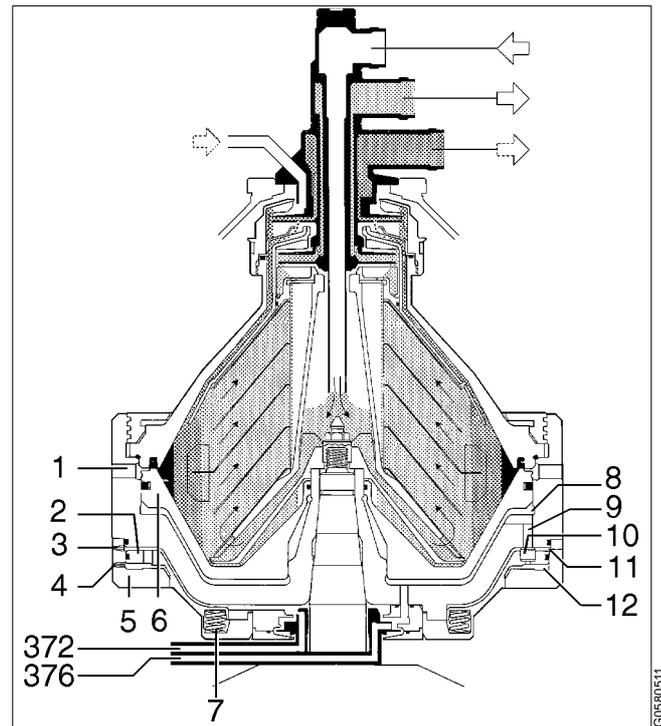
Bowl closes after discharge

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

The drain channels (9) are closed by the drain valve plugs (10) and the increasing force from the closing water (376) presses the sliding bowl bottom (6) upwards. The bowl closes and the sludge discharge cycle is complete.

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

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



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

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

372. Opening water inlet *

376. Closing and make-up water inlet *

* Parts effecting a sludge discharge

3.3 Definitions

Back pressure	Pressure in the separator outlet.
Clarification	Liquid/solids separation with the intention of separating particles, normally solids, from a liquid (oil) having a lower density than the particles.
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 lit/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	30
4.1.1	Ready for start	30
4.1.2	Start	31
4.1.3	Running	32
4.1.4	Normal stop	33
4.1.5	Safety stop	34

4.1 Operating routine

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

If there is a system documentation, always follow the operating instructions of the system documentation. If there is no such documentation the instructions below are to be followed.

4.1.1 Ready for start

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

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

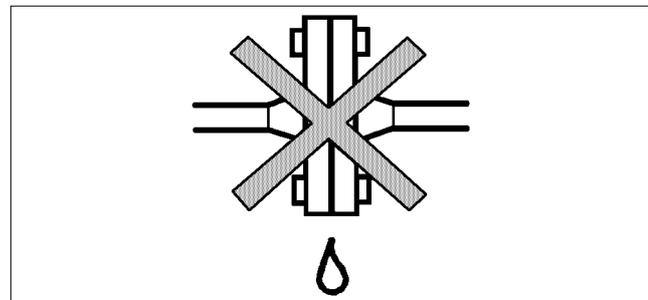


CAUTION

Burn hazards

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

Escaping hot liquid can cause burns.



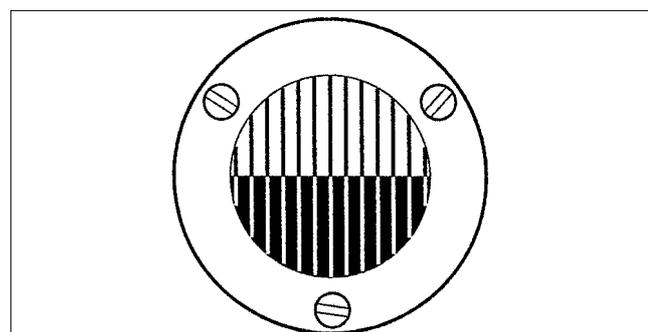
Check for leakages (not admitted)

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

NOTE

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

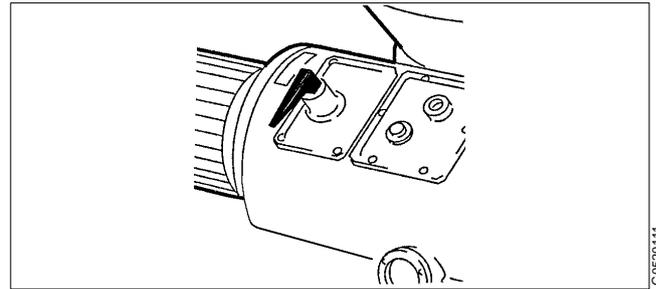
Too much or too little oil can damage the separator bearings.



Check the oil level

Fill if necessary. See chapter “8.6 Lubricants” on page 185, for a list of recommended oils.

4. Make sure that the brake is released.



Release the brake

4.1.2 Start

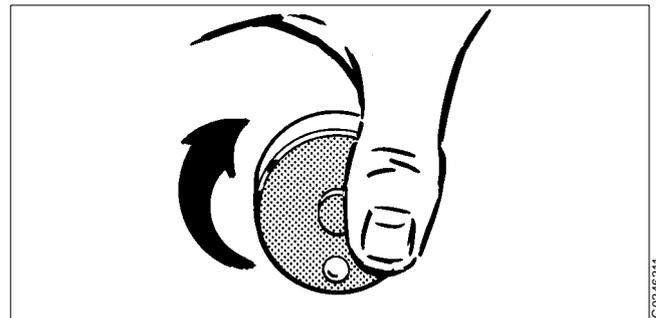
1. Start the separator.
2. Check the direction of rotation of the bowl. The revolution counter should turn clockwise.



DANGER

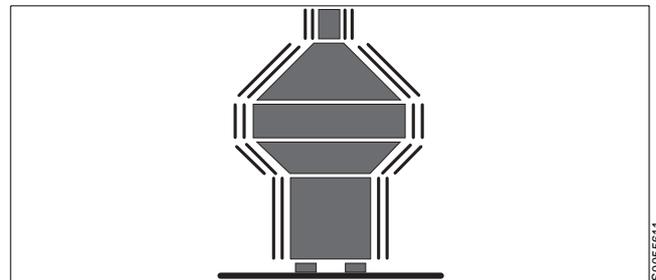
Disintegration hazards

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



Check for correct direction of rotation

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



Check for vibration



DANGER

Disintegration hazards

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

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

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

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

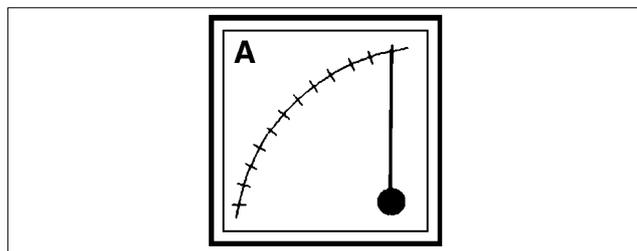
At full speed the starter ammeter reading has decreased from a high starting value to a low steady value.

The time to reach full speed may not exceed the limit given in chapter “8.1 Technical data” on page 174.

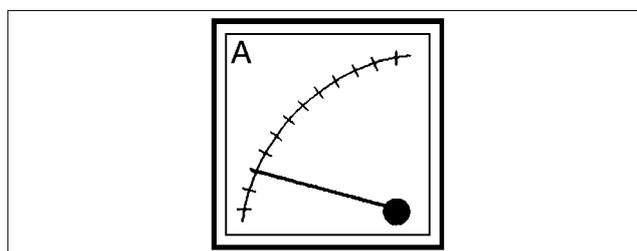
5. When running normally, open the closing water valve (connection 376) for approximately 5 seconds to close the bowl.

4.1.3 Running

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



Current increases when the coupling engages...



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



DANGER

Disintegration hazards

Ensure that correct discharge intervals and cleaning procedures are used.

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

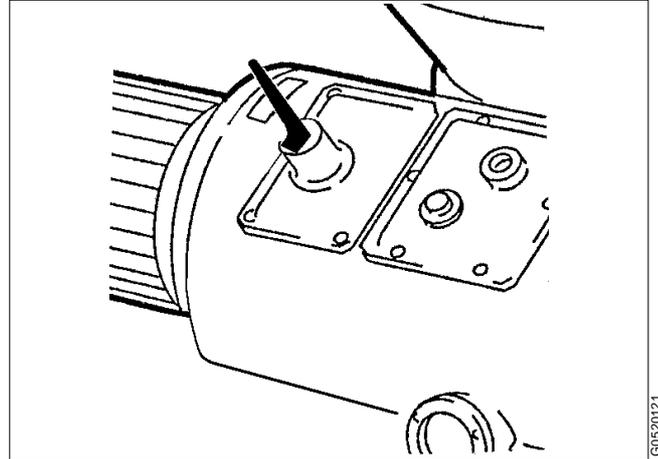
4. For daily condition checks, see “5.2.1 Daily checks” on page 41.

4.1.4 Normal stop

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

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

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



The final action, apply the brake

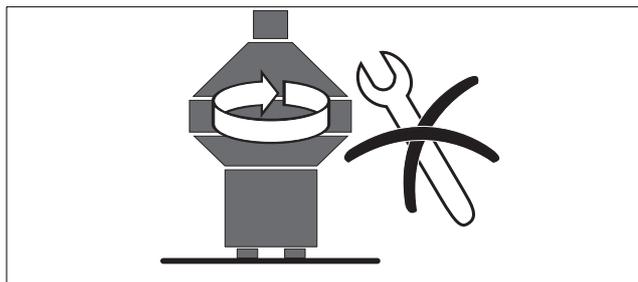
4.1.5 Safety stop



DANGER

Entrapment hazards

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

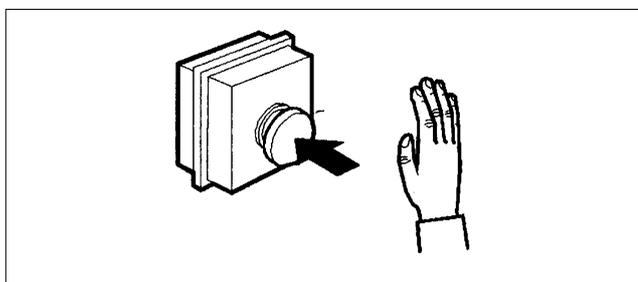


The separator must not be dismantled before standstill

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

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

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



Push the safety stop if vibration is excessive



DANGER

Disintegration hazards

Do not discharge a vibrating separator.

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



DANGER

Disintegration hazards

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

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

5 Service Instructions

Contents

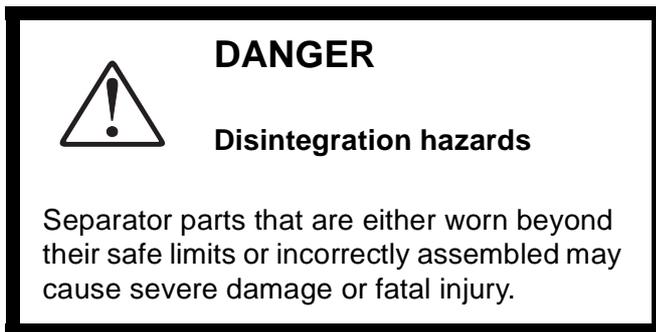
5.1 Periodic maintenance	37	5.4 Check points at Major Service (MS)	64
5.1.1 Introduction	37	5.4.1 Bowl hood seal ring	64
5.1.2 Maintenance intervals	37	5.4.2 Bowl spindle cone and bowl body nave	64
5.1.3 Maintenance procedure	39	5.4.3 Bowl spindle; radial wobble	64
5.1.4 Service kits	40	5.4.4 Brake	65
5.2 Maintenance Logs	41	5.4.5 Buffer springs and ball bearing housing	66
5.2.1 Daily checks	41	5.4.6 Coupling friction pads	68
5.2.2 Oil change	41	5.4.7 Corrosion	69
5.2.3 Intermediate Service (IS)	42	5.4.8 Cracks	69
5.2.4 Major Service (MS)	44	5.4.9 Disc stack pressure	69
5.2.5 3-year Service (3S)	46	5.4.10 Dosing ring	69
5.3 Check points at Intermediate Service (IS)	47	5.4.11 Erosion	69
5.3.1 Bowl hood seal ring	47	5.4.12 Flexible plate in coupling	70
5.3.2 Bowl spindle cone and bowl body nave	48	5.4.13 Guide surfaces	71
5.3.3 Corrosion	48	5.4.14 Inlet pipe and oil paring disc	71
5.3.4 Cracks	51	5.4.15 Level ring	72
5.3.5 Disc stack pressure	52	5.4.16 Lock ring; priming	72
5.3.6 Dosing ring	54	5.4.17 Lock ring; wear and damage	74
5.3.7 Erosion	54	5.4.18 Oil paring disc; height position	74
5.3.8 Guide surfaces	56	5.4.19 Operating mechanism	74
5.3.9 Inlet pipe and oil paring disc	58	5.4.20 Operating paring disc; height position	75
5.3.10 Level ring	58	5.4.21 Operating slide	75
5.3.11 Lock ring; wear and damage	59	5.4.22 Sliding bowl bottom	75
5.3.12 Operating mechanism	61	5.4.23 Springs for operating mechanism	76
5.3.13 Operating slide	61	5.4.24 Worm; wear of groove	76
5.3.14 Sliding bowl bottom	62	5.4.25 Worm wheel and worm; wear of teeth	76
5.3.15 Springs for operating mechanism	63	5.4.26 Worm wheel shaft; radial wobble	77
5.3.16 Worm wheel and worm; wear of teeth	63	5.4.27 Cover interlocking switch (option)	77
5.3.17 Cover interlocking switch (option)	63	5.4.28 Vibration switch (option)	77
5.3.18 Vibration switch (option)	63		

5.5 Lifting instructions	78
5.6 Cleaning	79
5.6.1 External cleaning	79
5.6.2 Cleaning agents	80
5.6.3 Cleaning of bowl discs	81
5.6.4 CIP-system	82
5.7 When changing oil	83
5.7.1 Worm wheel and worm; wear of teeth	83
5.7.2 Oil change procedure	86
5.8 Vibration	87
5.8.1 Vibration analysis	87
5.8.2 Vibration switch (option)	88
5.9 Common maintenance directions	89
5.9.1 Ball and roller bearings	89
5.9.2 Before shutdowns	92

5.1 Periodic maintenance

5.1.1 Introduction

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



5.1.2 Maintenance intervals

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

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

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

Oil change

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

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

Intermediate Service (IS)

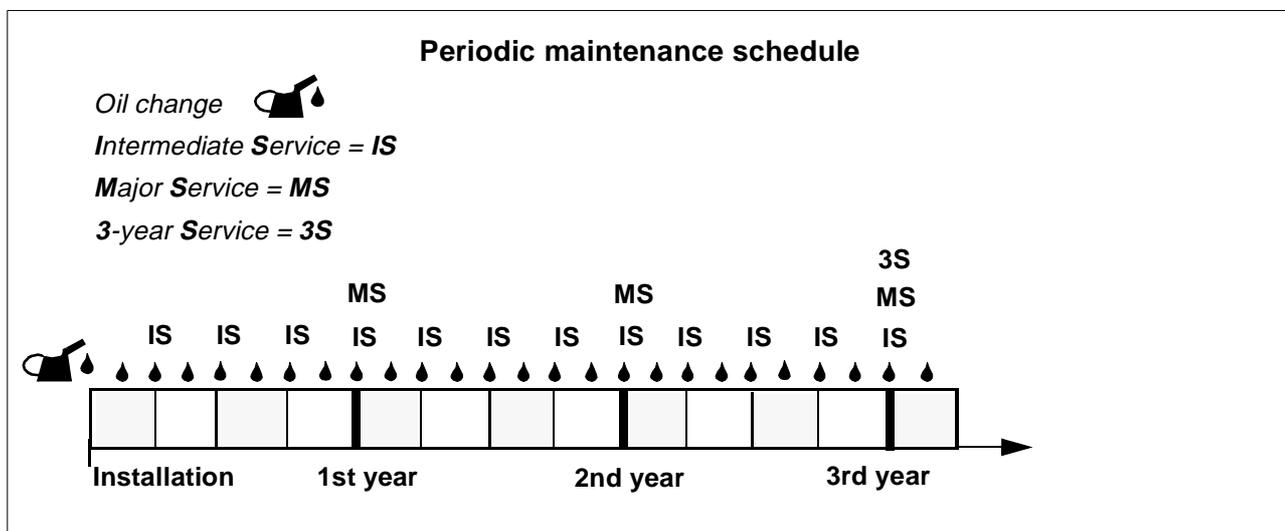
Intermediate Service consists of an overhaul of the separator bowl, inlet/outlet and operating device every **3 months** or **2000 operating hours**. Seals in bowl and gaskets in inlet/outlet device are renewed.

Major Service (MS)

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

3-year Service (3S)

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



5.1.3 Maintenance procedure

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

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

1. Dismantle the parts as mentioned in the maintenance log and described in chapter “6 Dismantling/Assembly” on page 93.
Place the separator parts on clean, soft surfaces such as pallets.
2. Inspect and clean the dismantled separator parts according to the maintenance log.
3. Fit all the parts delivered in the service kits while assembling the separator as described in chapter “6 Dismantling/Assembly” on page 93. The assembly instructions have references to check points which should be carried out before and during the assembly.

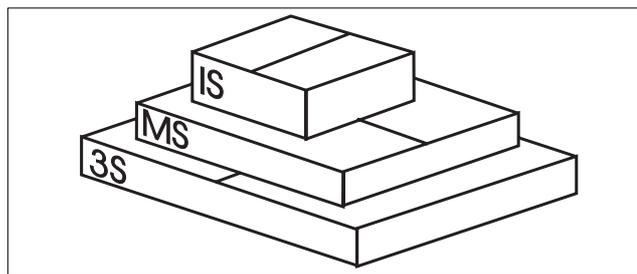
5.1.4 Service kits

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

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

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

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



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

NOTE

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

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



DANGER

Disintegration hazards

Use of imitation parts may cause severe damage.

5.2 Maintenance Logs

5.2.1 Daily checks

The following steps should be carried out daily.

Main component and activity	Part	Page	Notes
Inlet and outlet Check for leakage	Connecting housing	–	
Separator bowl Check for vibration and noise		87	
Horizontal driving device Worm wheel shaft and gear casing Check for vibration and noise Check Electrical motor Check for heat, vibration and noise	Oil level in gear housing	87 30 1)	

1) See manufacturer's instruction

5.2.2 Oil change

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

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

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

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

- a) When using a group D oil, time of operation between oil changes can be extended from the normal **1000-1500 hours to 2000 hours**.
- b) See chapter "8.6 Lubricants" on page 185 for further information.

5.2.3 Intermediate Service (IS)

Name of plant: _____ Local identification: _____
 Separator: FOPX 614TFD-20 Manufacture No./Year: _____
 Total running hours: _____ Product No: 881082-02-03
 Date: _____ Signature: _____

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

Main component and activity	Part	Page	Notes
Horizontal driving device			
Worm wheel shaft and gear housing			
Check	Worm wheel and worm	83	
Renew	Oil in gear housing	86	
Electrical motor			
Lubrication (if nipples are fitted)	See sign on motor	–	
Signs and labels on separator			
Check attachment and legibility	Safety label on hood	196	
	Direction of rotation arrow	196	
	Power supply frequency	196	
Monitoring equipment (option)			
Function check	Vibration switch	63	
	Cover interlocking switch	63	

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

5.2.4 Major Service (MS)

Name of plant: _____ Local identification: _____
 Separator: FOPX 614TFD-20 Manufacture No./Year: _____
 Total running hours: _____ Product No: 881082-02-03
 Date: _____ Signature: _____

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

Main component and activity	Part	Page	Notes
Operating device			
Clean and check	Operating paring disc	–	
Check	Height position of operating paring disc	74	
Vertical driving device			
Clean and check	Bowl spindle	–	
	Wear of groove in worm	76	
	Buffer springs and ball bearing housing	66	
	Radial wobble of bowl spindle	64	
Renew	Spindle bearings	134	
Horizontal driving device			
Worm wheel shaft and gear housing			
Check	Worm wheel and worm	83	
	Radial wobble of worm wheel shaft	77	
	Axial play of flexible plate	70	
Renew	Bearings	150	
	Oil in gear housing	86	
Brake			
Clean and check	Spring and brake shoe	65	
Renew	Friction pad	65	
Friction coupling			
Clean and check	Worm wheel coupling	–	
Renew	Friction pads	68	
Electrical motor			
Lubrication (if nipples are fitted)	See sign on motor	–	
Signs and labels on separator			
Check attachment and legibility	Safety label on hood	196	
	Direction of rotation arrow	196	
	Power supply frequency	196	
Monitoring equipment (option)			
Function check	Vibration switch	63	
	Cover interlocking switch	63	

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

5.2.5 3-year Service (3S)

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

NOTE

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

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

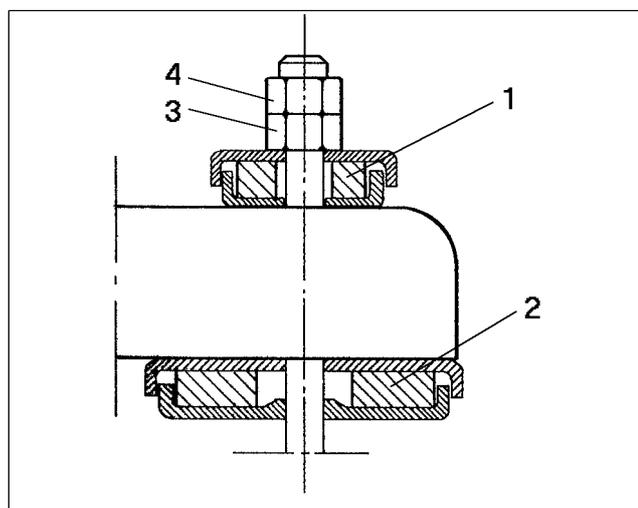
Frame feet, renewal

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

NOTE

When lifting a separator it must always **hang securely**. See separate instruction in chapter "5.5 Lifting instructions" on page 78.

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



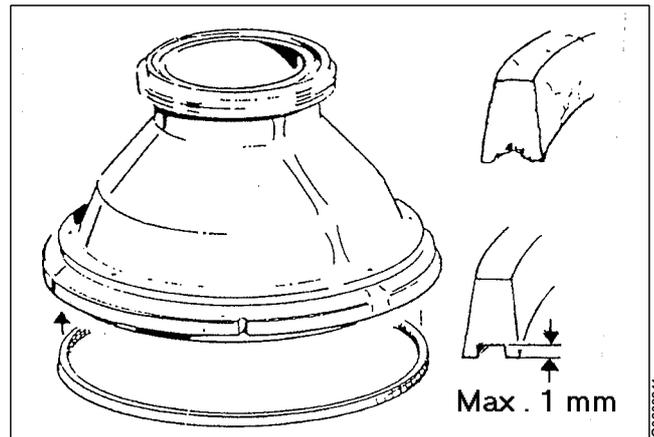
1. Vibration damper, upper
2. Vibration damper, lower
3. Nut
4. Lock nut

5.3 Check points at Intermediate Service (IS)

5.3.1 Bowl hood seal ring

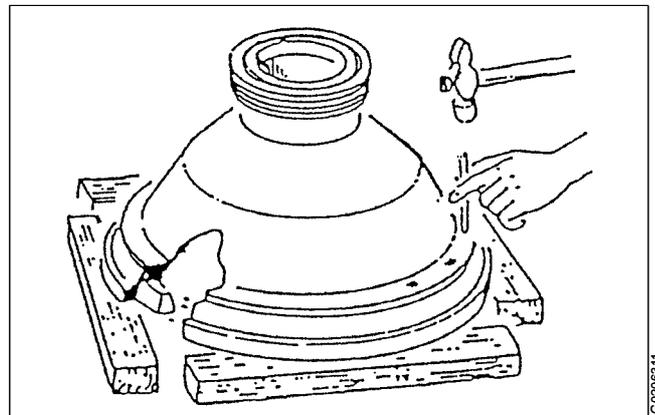
Poor sealing between the bowl hood seal ring and the sealing edge of the sliding bowl bottom will cause a leakage of process liquid from the bowl.

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



Max. permitted indentation of the seal ring is 1 mm

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



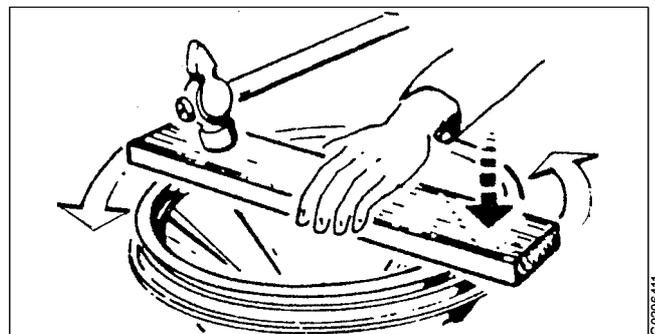
Removal of the seal ring

Fit the new ring as follows:

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

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.



Fitting of the seal ring

5.3.2 Bowl spindle cone and bowl body nave

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

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

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

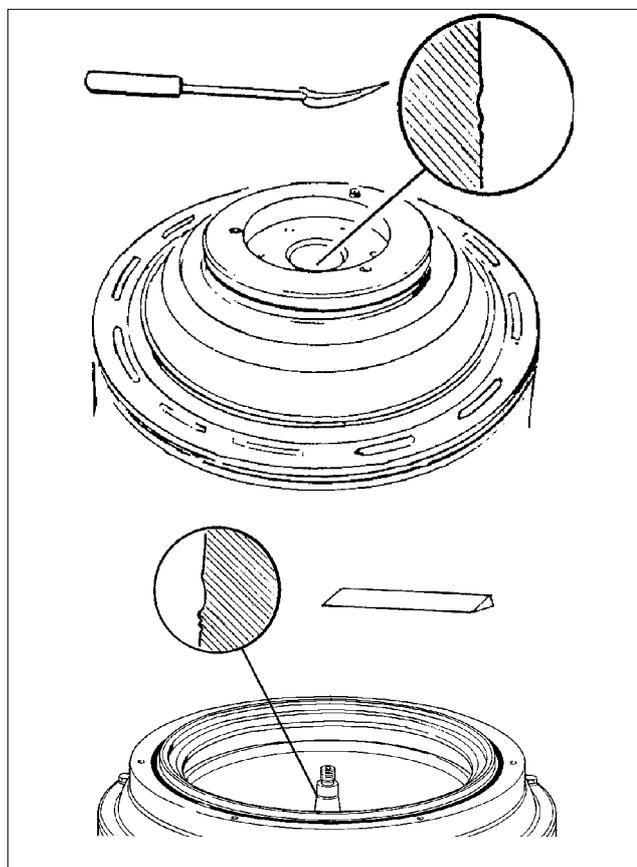
- Remove any impact marks with a scraper and/or whetstone.

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

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

NOTE

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



Remove impact marks from the nave and cone

5.3.3 Corrosion

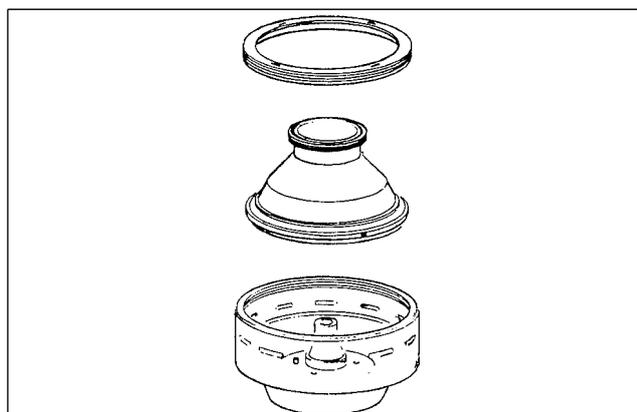
Evidence of corrosion attacks should be looked for and rectified each time the separator is dismantled. Main bowl parts such as the bowl body, bowl hood and lock ring must be inspected with particular care for corrosion damage.



DANGER

Disintegration hazard

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



Main bowl parts to check for corrosion

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

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

Non-stainless steel and cast iron parts

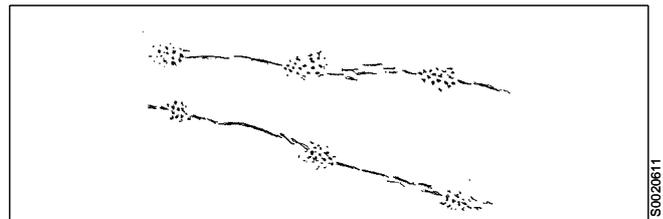
Corrosion (rusting) can occur on unprotected surfaces of non-stainless steel and cast iron. Frame parts can corrode when exposed to an aggressive environment.

Stainless steel

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

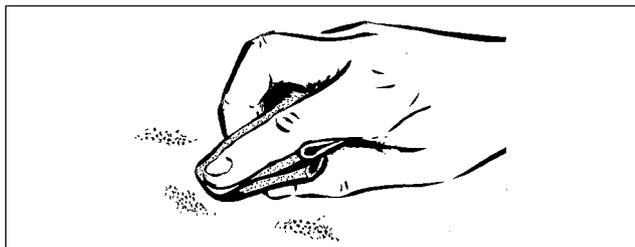
- Exposed to a stationary solution.
- In a crevice.
- Covered by deposits.
- Exposed to a solution that has a low pH value.

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



Example of chloride corrosion in stainless steel

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



SC020511

Polish corrosion marks to prevent further damage



DANGER

Disintegration hazard

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

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

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

Other metal parts

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

5.3.4 Cracks

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

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

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



DANGER

Disintegration hazard

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

Always replace a part if cracks are present.

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

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

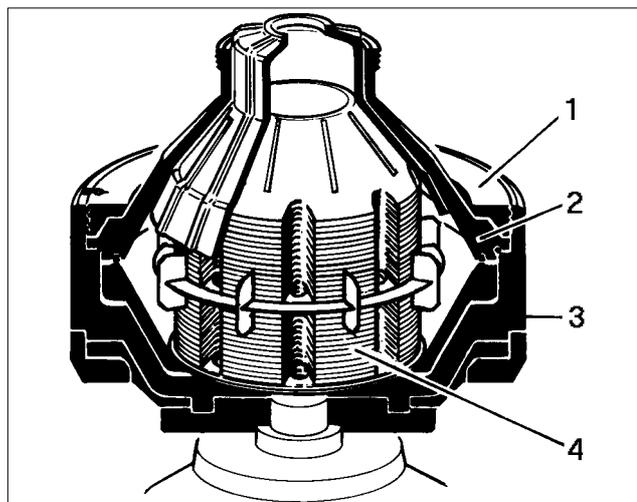
5.3.5 Disc stack pressure

NOTE

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

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

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



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

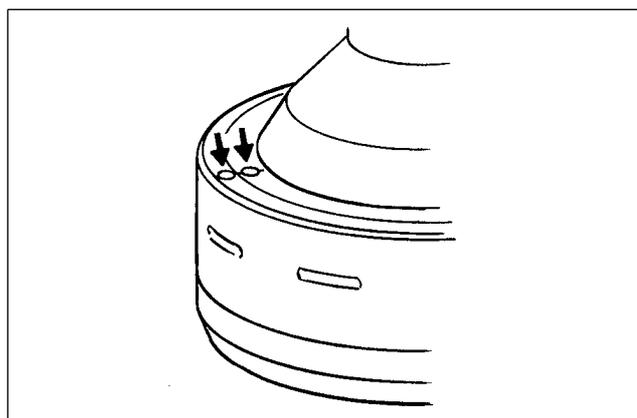
Compress the disc stack by tightening the lock ring, see chapter "6.3.3 Assembly" on page 109.

Correct pressure is obtained when it is possible to tighten the lock ring so far by hand that the ϕ -mark on the lock ring is positioned 60° - 90° 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

Complementary check using the compressing tool

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

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

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

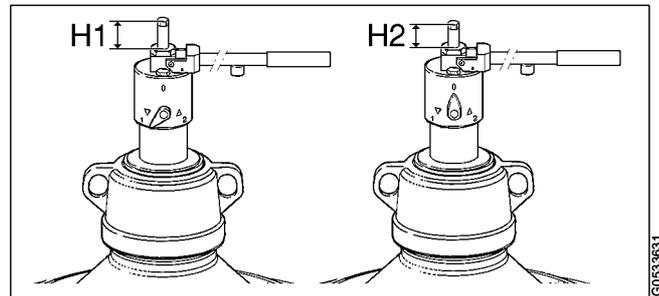
Release the pressure in the compressing tool by turning the switch to position 0. The piston rod will now move downwards slightly when the disc set is released inside the bowl.

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

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

NOTE

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



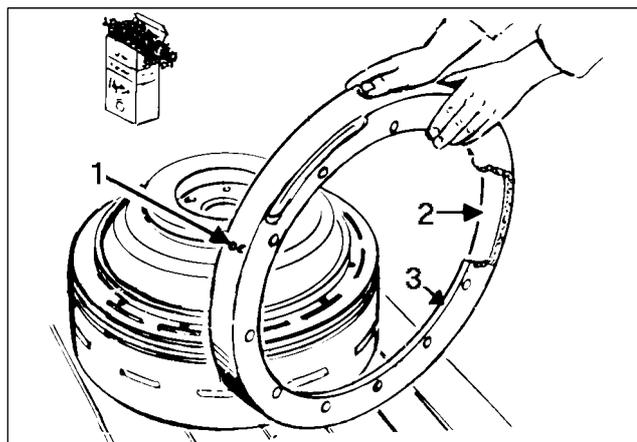
Measure of disc stack pressure with use of a compressing tool

G0633631

5.3.6 Dosing ring

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

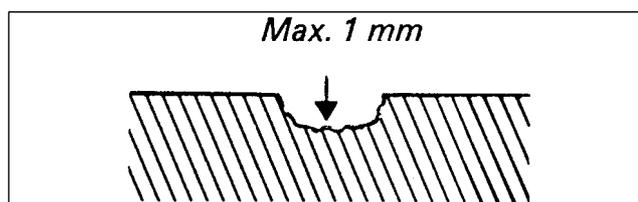
Inspect the surface (3) in contact with the operating slide. Remove any marks with a whetstone or fine emery cloth (grain size 240).



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

5.3.7 Erosion

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



Max. permitted erosion



DANGER

Disintegration hazard

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

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

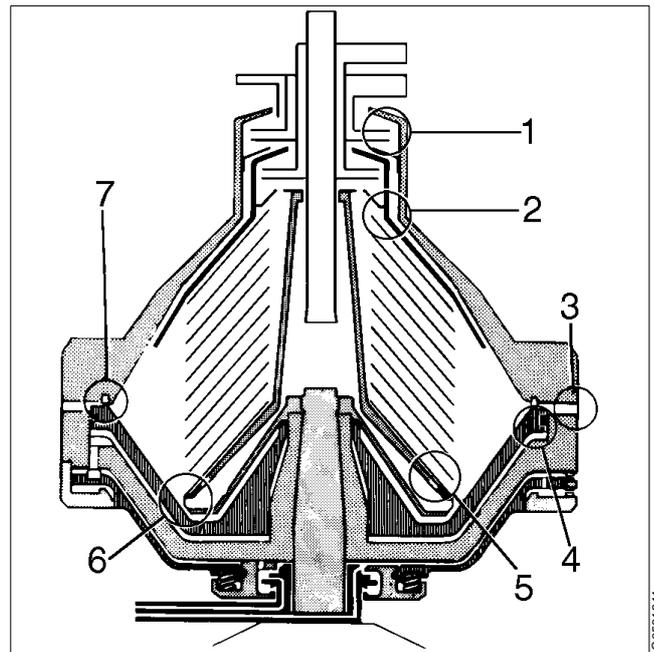
Erosion is characterised by:

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

Surfaces particularly subjected to erosion are:

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

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



Surfaces particularly subjected to erosion



DANGER

Disintegration hazard

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

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

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

5.3.8 Guide surfaces

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

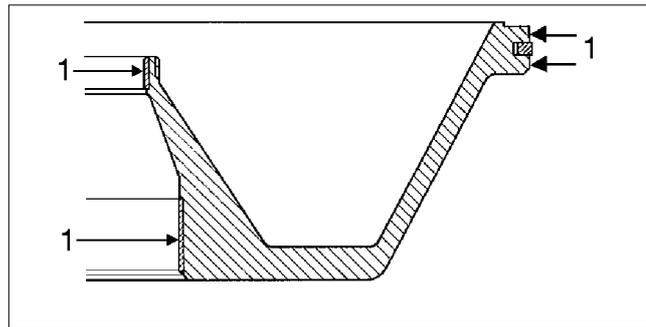
Repair of galling on guide surfaces; see following pages. Before fitting the sliding bowl bottom, clean (**do not** degrease) the contact surfaces (1 and 2). Apply Alfa Laval lubricating paste or Molykote 1000 Paste with a well-cleaned brush on surfaces (1 and 2).

NOTE

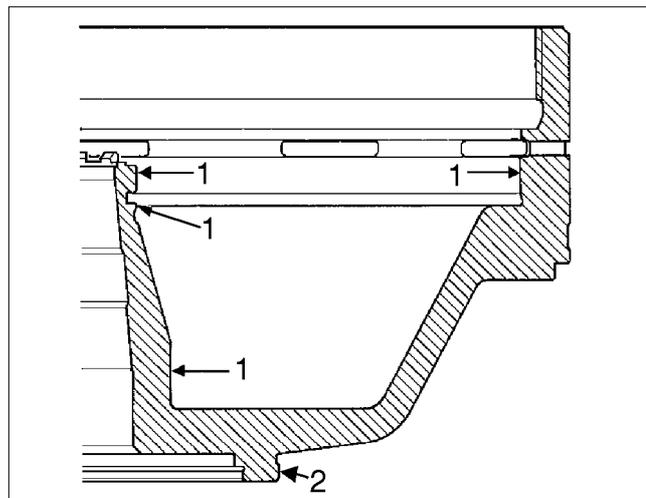
To avoid the risk of galling, the contact surfaces (1) should be primed with a slide lacquer at every Major Service (MS).

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

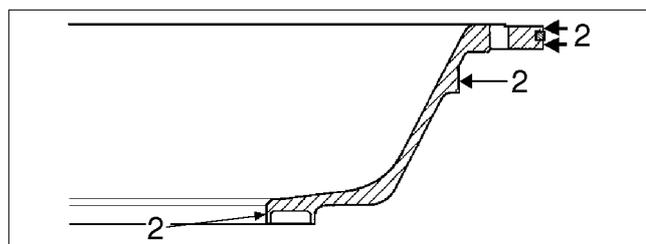
Lubricate the O-ring and the seal ring with silicone grease making sure they are not damaged and lie properly in their grooves.



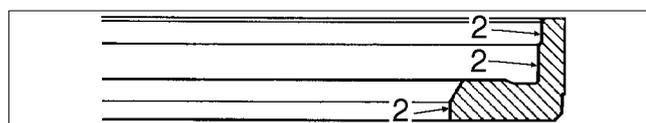
Sliding bowl bottom



Bowl body



Operating slide



Dosing ring

1, 2 =

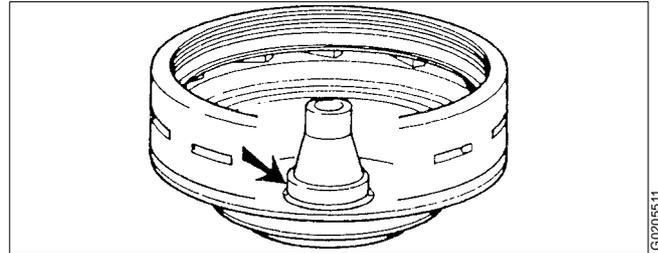


Alfa Laval lubricating paste or Molykote 1000 Paste.

Repair of galling on guide surfaces

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

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

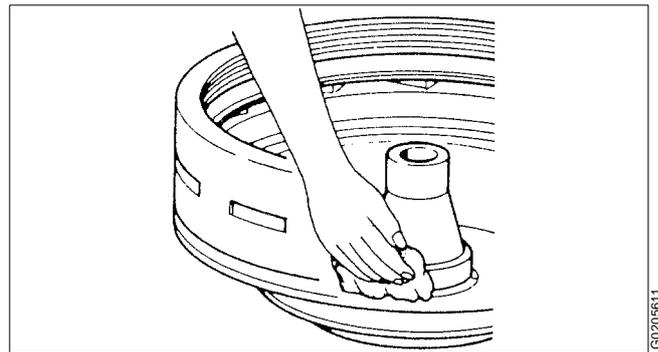


Guide surface in the bowl body

Recommended tools for correction of galling:

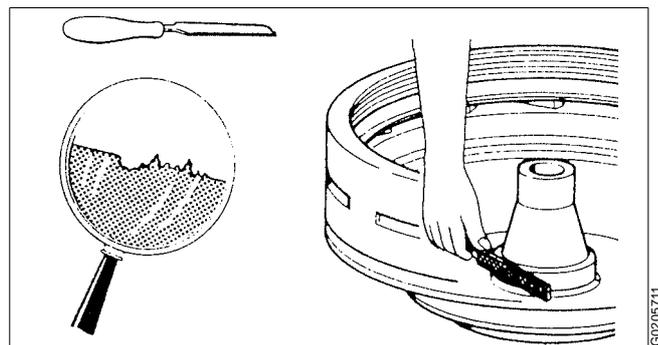
- Emery cloth, 240 grade.
- Hand drilling machine
- Degreasing agent.
- Fibre brush, \varnothing 25mm.
- Fibre brush, \varnothing 50 mm.
- Very fine single-cut file.

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

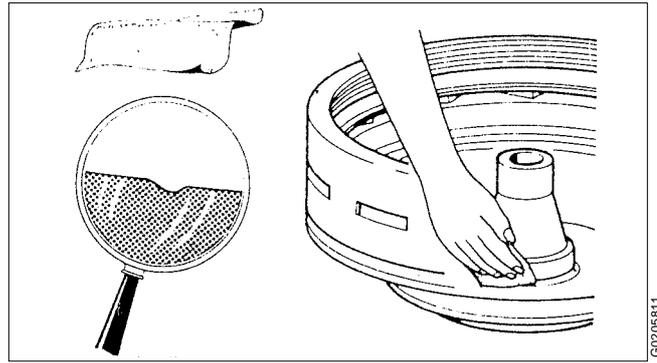


2. If the galling is excessive, first use the fine single-cut file. The file should be used with caution so that the damage is not made worse.

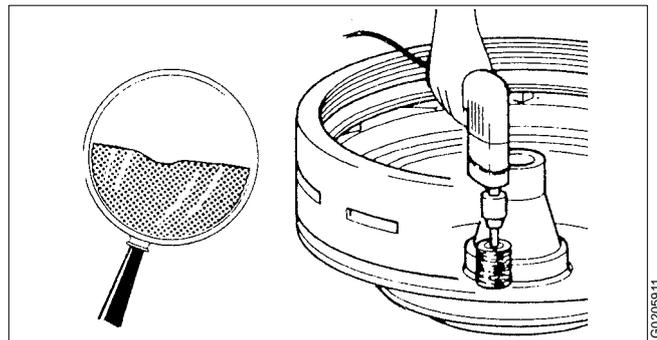
Remove the high spots on the surface. Do not use rotating files or similar. Remove the high spots only - not the undamaged material.



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



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

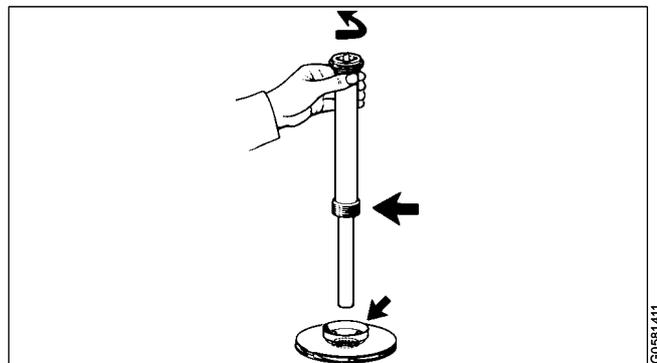


Prime the repaired area with lubricating spray Molykote 321 R. Read the correct procedure under checkpoint "5.4.16 Lock ring; priming" on page 72. Apply Alfa Laval lubricating paste or Molykote 1000 Paste to the surface after priming.

5.3.9 Inlet pipe and oil paring disc

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

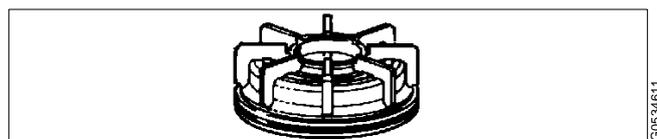
Screw the inlet pipe into the paring disc and check that the inlet pipe turns easily.



Check the threads of the inlet pipe and oil paring disc

5.3.10 Level ring

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



Check the level ring for burrs

5.3.11 Lock ring; wear and damage

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

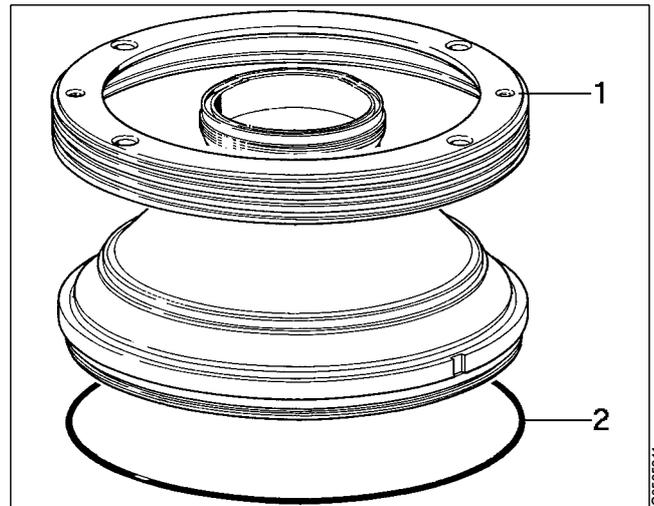
Check the thread condition by tightening the lock ring (1) after removing the disc stack and bowl hood O-ring (2) from the bowl.



DANGER

Disintegration hazards

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



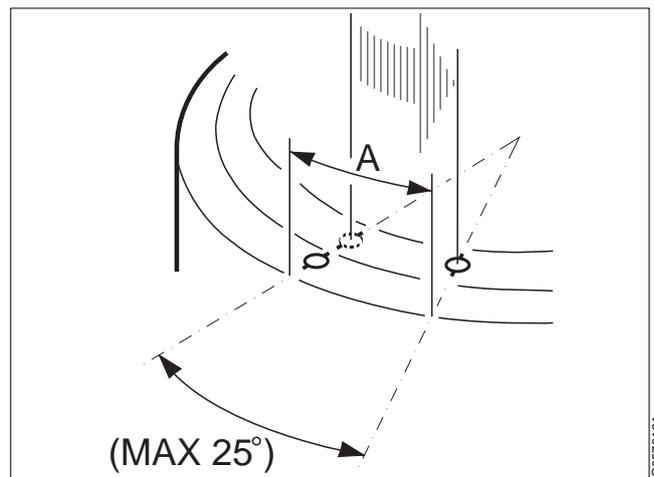
1. Lock ring
2. O-ring for the bowl hood

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

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

If the original ϕ -mark on the lock ring passes the ϕ -mark on the bowl body by more than 25° (which corresponds to **A=120 mm for FOPX 614TFD-20**), an Alfa Laval representative must be contacted immediately.

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



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

Damage

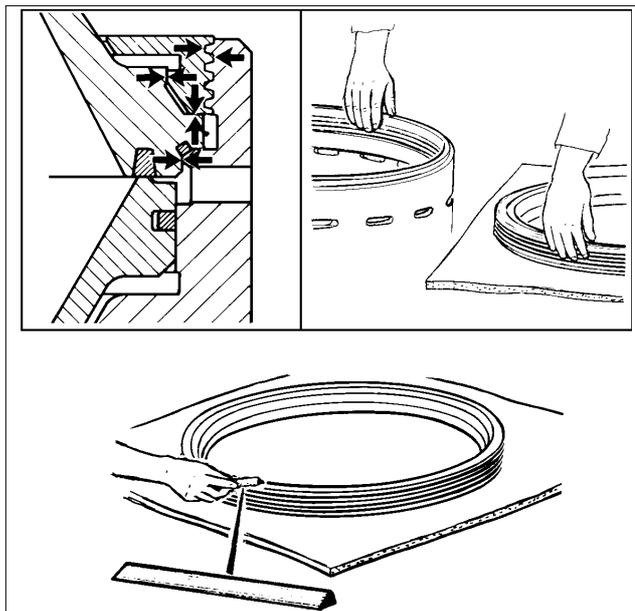
The position of the threads, contact and guide surfaces are indicated by arrows in the illustration.

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

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

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

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



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

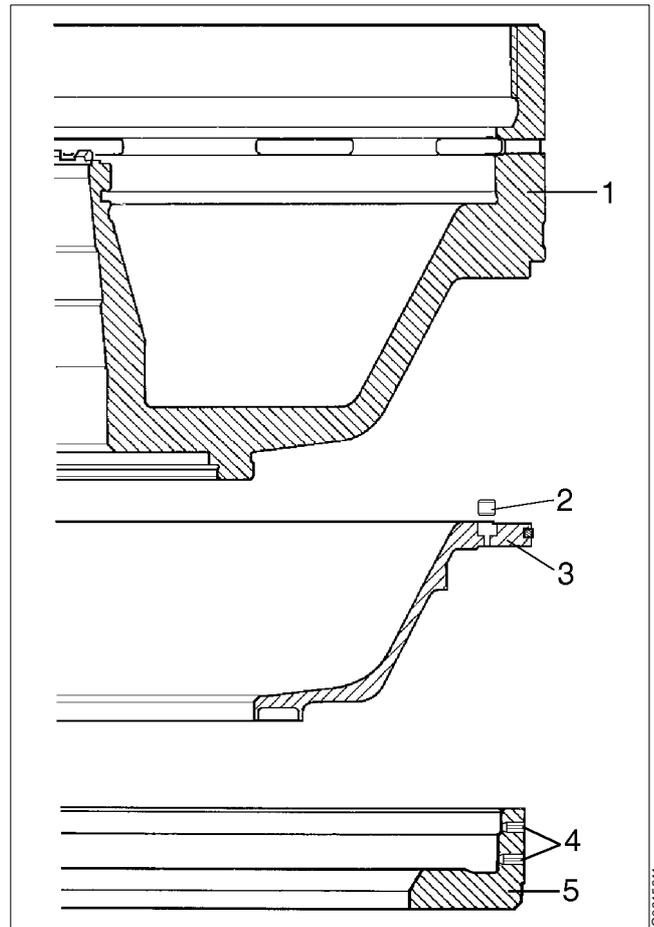
5.3.12 Operating mechanism

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

Clean and polish surfaces with steel wool if necessary.

Reasons for dirt or deposits:

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



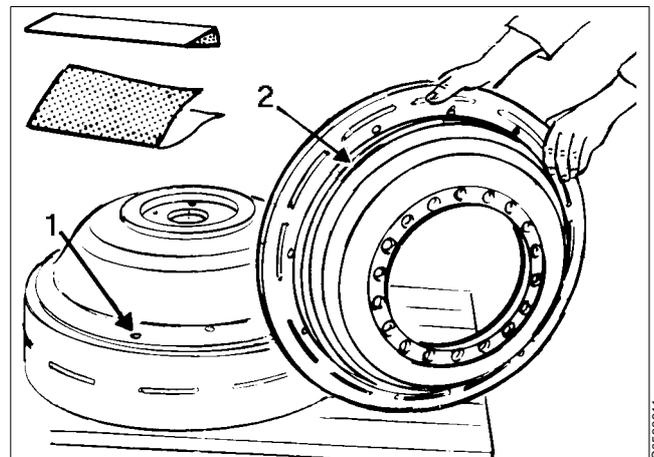
1. Bowl body
2. Valve plug
3. Operating slide
4. Nozzles
5. Dosing ring

5.3.13 Operating slide

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

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

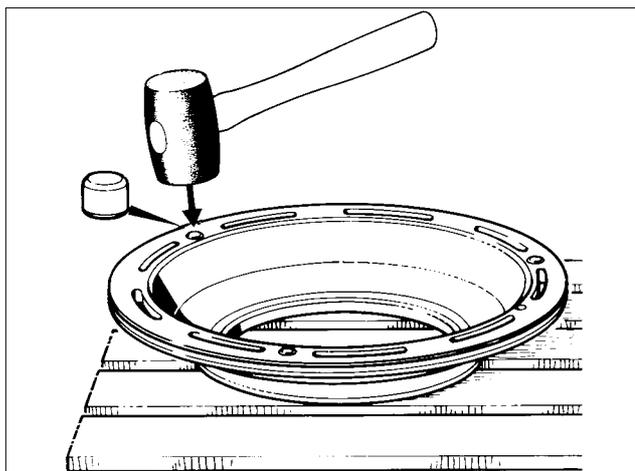
Check the guiding surface (2) in contact with the dosing ring. Remove any marks with a whetstone (grain size 240).



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

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

Correct height of plugs: **13,4 mm**.

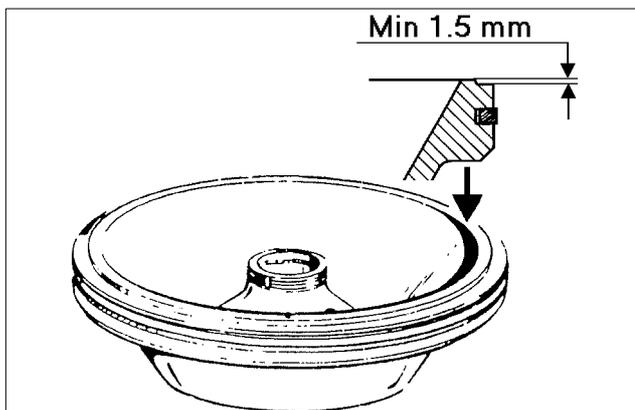


Tap in new valve plugs

5.3.14 Sliding bowl bottom

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

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

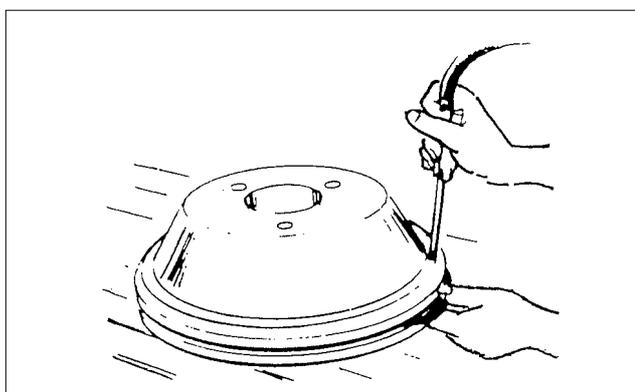


Min. height of the profile on sliding bowl bottom

NOTE

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

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



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



WARNING

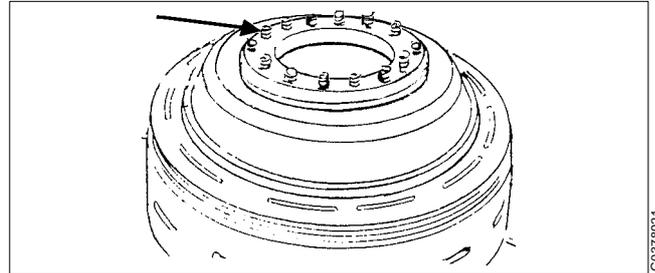
Risk for eye injury

Wear safety goggles.

5.3.15 Springs for operating mechanism

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

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



Check for defective or broken springs

5.3.16 Worm wheel and worm; wear of teeth

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

5.3.17 Cover interlocking switch (option)

When the button is pushed, check that the connections 13 and 14 inside the switch are short-circuited. A principal diagram of the connections is shown in chapter “8.7.5 Cover interlocking switch (option)” on page 198.

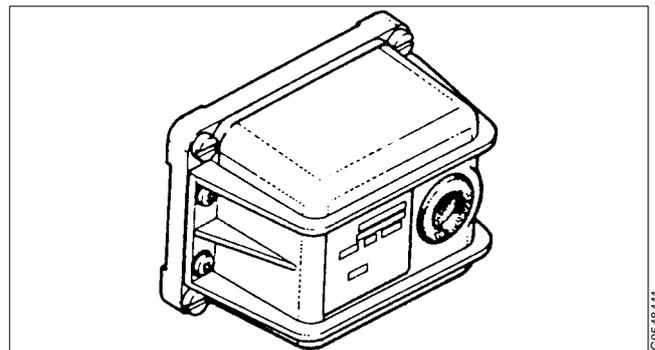
5.3.18 Vibration switch (option)

NOTE

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

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

How to adjust the setpoint is described in chapter “5.8.2 Vibration switch (option)” on page 88.



Vibration switch

5.4 Check points at Major Service (MS)

5.4.1 Bowl hood seal ring

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

5.4.2 Bowl spindle cone and bowl body nave

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

5.4.3 Bowl spindle; radial wobble

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

NOTE

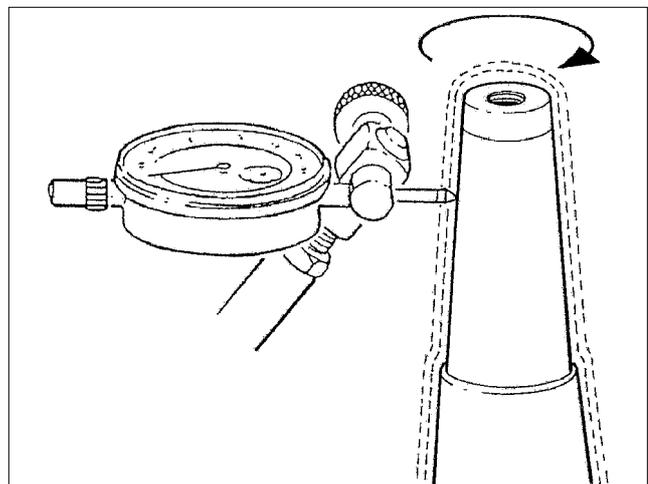
Spindle wobble will cause rough bowl run. This leads to vibration and reduces lifetime of ball bearings.

Check the wobble before mounting the bowl.

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

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

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



Measuring the radial wobble

5.4.4 Brake

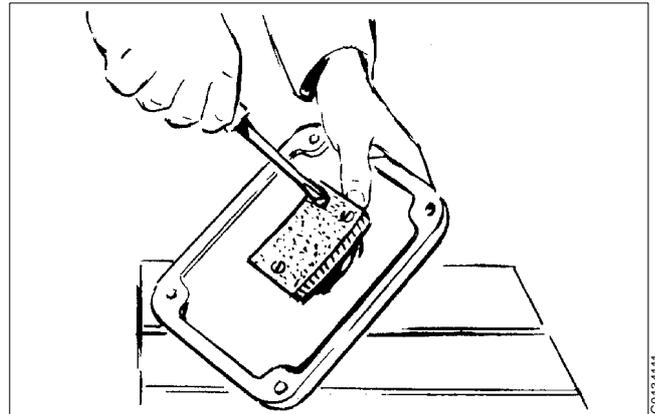
A worn or oily friction pad will lengthen the braking period.

If the friction pad is worn:

- Remove the screws and exchange the friction pad.

NOTE

The screws are slotted in both ends.



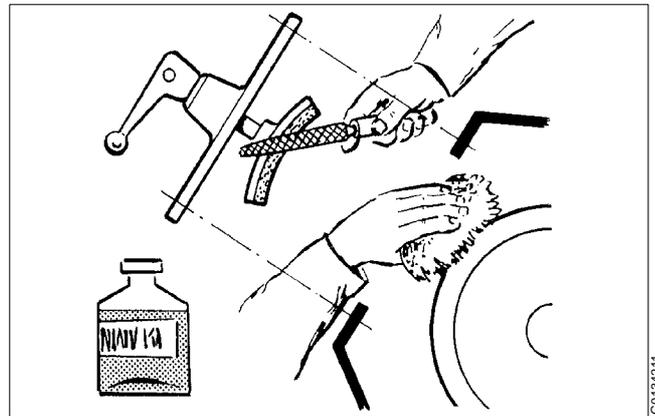
Friction pad is fastened with screws

If the friction pad is oily:

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

NOTE

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

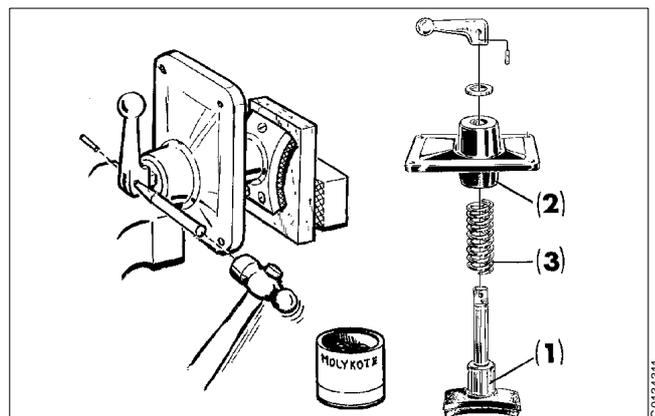


Actions when the friction pad is oily

Checking of spring and brake shoe:

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

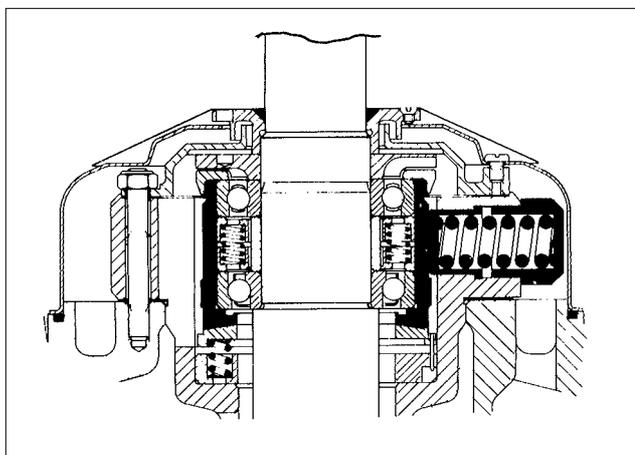
- Remove any rust from the surface (1) of the brake shoe and the corresponding guide surface in the cap (2).
- Rub in Molykote Paste on the surfaces.
- Replace the spring (3) if it has been weak. This is indicated by chattering from the spring when the brake is in released position.
- Oil the spring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



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

5.4.5 Buffer springs and ball bearing housing

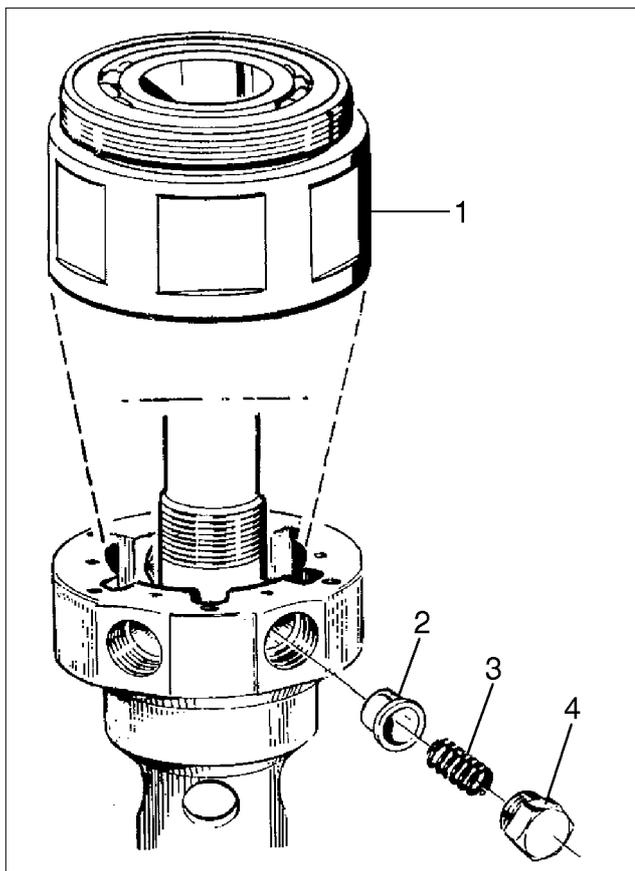
Weakened or broken buffer springs or defective contact surfaces for the buffers on the ball bearing housing may give rise to separator vibration (rough bowl run).



Cut view of ball bearing housing

Top bearing springs

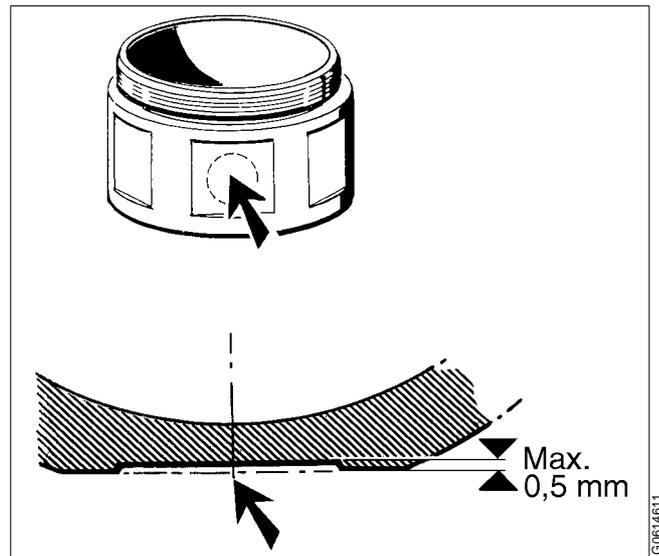
In case of spring fracture, the complete set of springs should be replaced, even if only one spring is broken.



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

Ball bearing housing

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



Max. permitted indentations made by radial buffers

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5.4.6 Coupling friction pads

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

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

Check the pads. If the pads are oily:

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

If the pads are worn:

- Remove the screws and renew the pads.

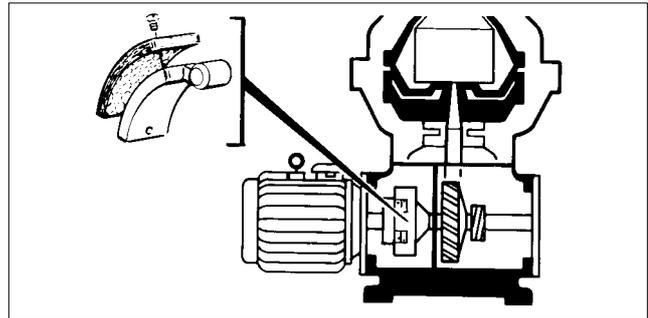
NOTE

The screws are slotted in both ends.

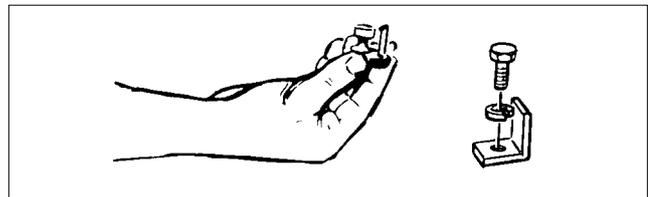
Replace all pads even if only one is worn.

How to renew friction pads without dismantled horizontal driving device.

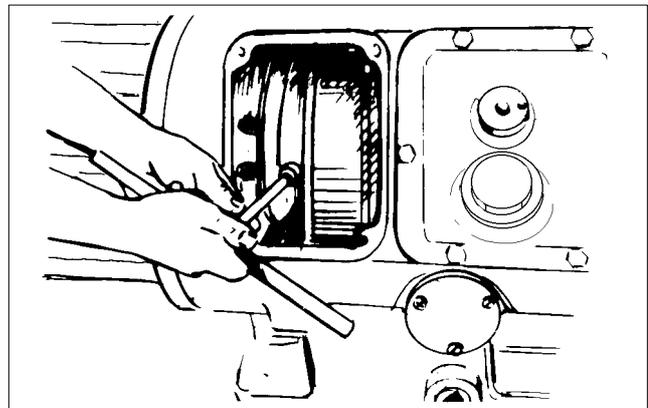
- Remove the brake cap.
- Undo the screws of the holding brackets.
- Remove the holding brackets and friction blocks.
- Remove the screws and renew the pads.



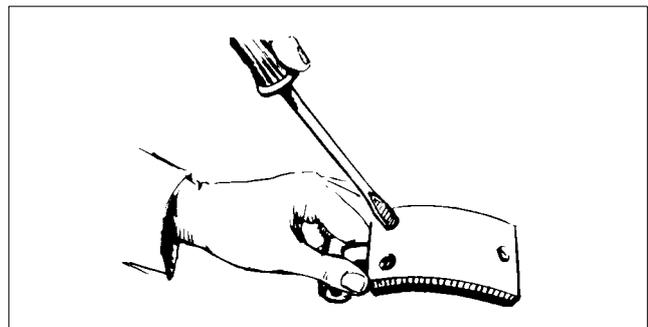
Location of coupling friction blocks



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



Unscrew the holding bracket screws to remove the friction blocks



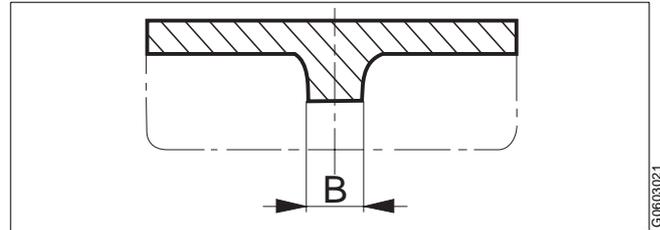
The screws fix the friction pad to the friction block

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 B is different for 50 and 60 Hz separators.

50 Hz: B = 35 mm

60 Hz: B = 4 mm



Measure B is different for 50 and 60 Hz installations

5.4.7 Corrosion

Same as described in "5.3.3 Corrosion" on page 48.

5.4.8 Cracks

Same as described in "5.3.4 Cracks" on page 51.

5.4.9 Disc stack pressure

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

5.4.10 Dosing ring

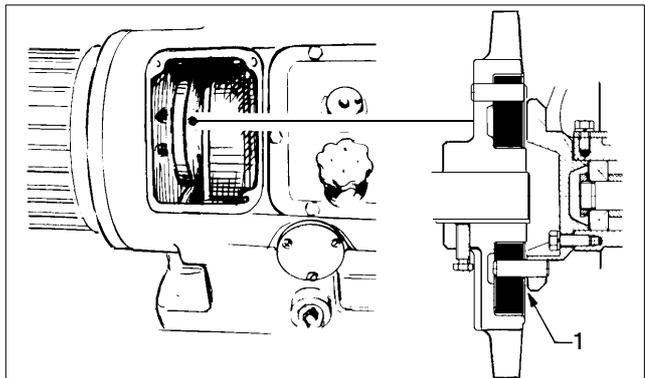
Same as described in "5.3.6 Dosing ring" on page 54.

5.4.11 Erosion

Same as described in "5.3.7 Erosion" on page 54.

5.4.12 Flexible plate in coupling

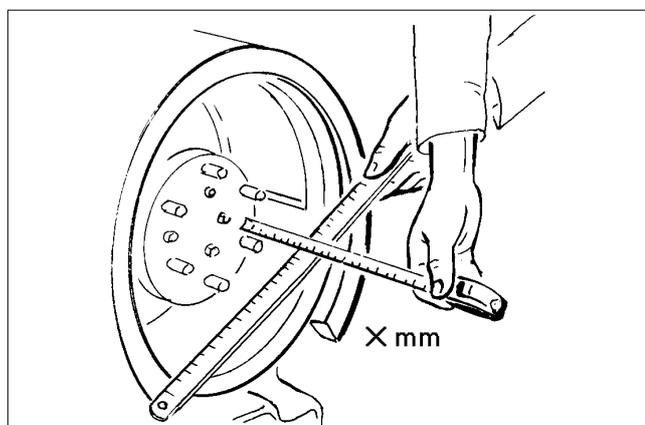
The axial play (1) of the flexible plate should be approximately 2 mm.



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

Check the play as follows:

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

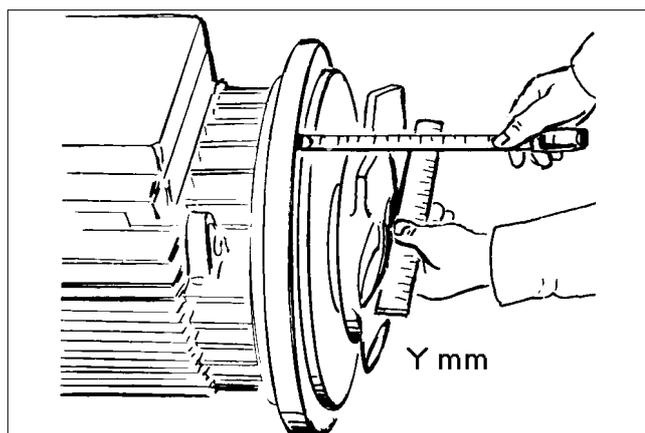


Measure of distance for coupling in separator frame

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

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

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



Measure of distance for coupling on motor

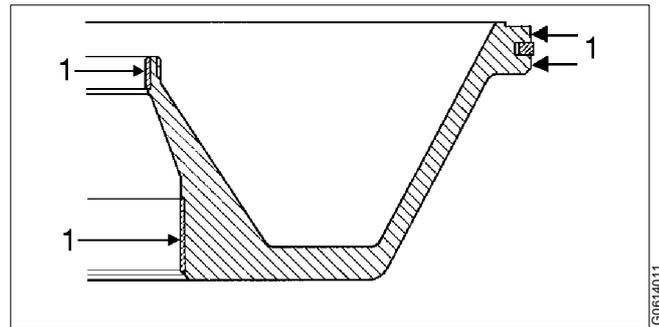
5.4.13 Guide surfaces

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

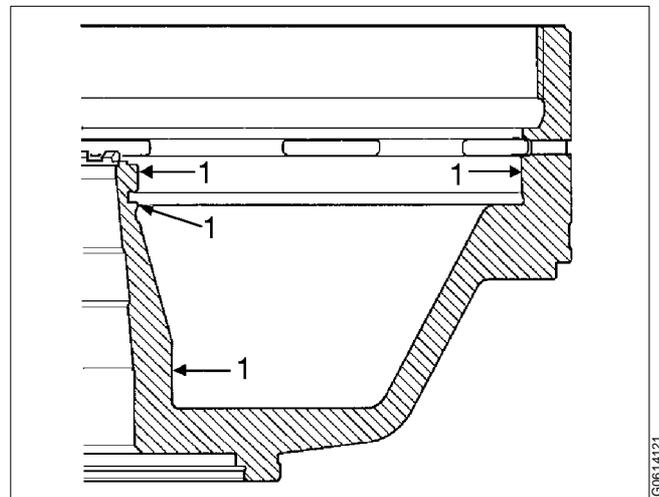
Repair of galling on guiding surfaces, see “5.3.8 Guide surfaces” on page 56.

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

1. Mask the nave hole of the bowl body. Slide lacquer must not enter this hole.
2. Carefully degrease the contact surfaces (1) between the sliding bowl bottom and bowl body. Dry the surfaces well.
3. Apply slide lacquer Molykote D321R with a well cleaned brush. Protect the surfaces which should not be treated.
4. Air-cure the treated surfaces for 20 minutes.
5. Use a smooth fibre brush to polish to an even, homogeneous contact film.
6. Apply slide lacquer a second time.
7. Air-cure the lacquer for a further 20 minutes.
8. Polish the film to a shiny surface. The film should look like well-polished leather when properly done.
9. Finish the treatment by lubricating the contact surfaces (A) with Alfa Laval lubricating paste or Molykote 1000 Paste. Use a well-cleaned brush. Rub it into the surface, do not leave any excessive paste.
10. Lubricate the O-ring and the seal ring with silicone grease and check that they lie properly in their grooves.



Sliding bowl bottom



Bowl body



At major service



Alfa Laval lubricating paste or
Molykote 1000 Paste



Slide lacquer
(Molykote D 321R) Paste

5.4.14 Inlet pipe and oil paring disc

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

5.4.15 Level ring

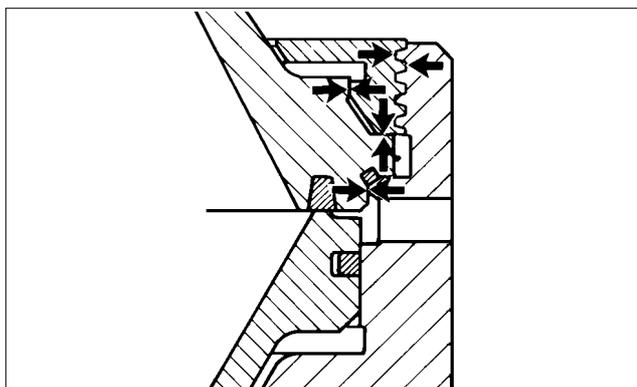
Same as described in section "5.3.10 Level ring" on page 58.

5.4.16 Lock ring; priming

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

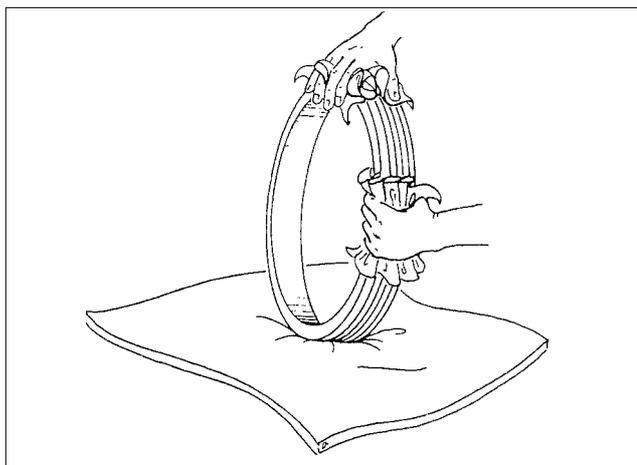
Recommended agents for priming procedure:

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

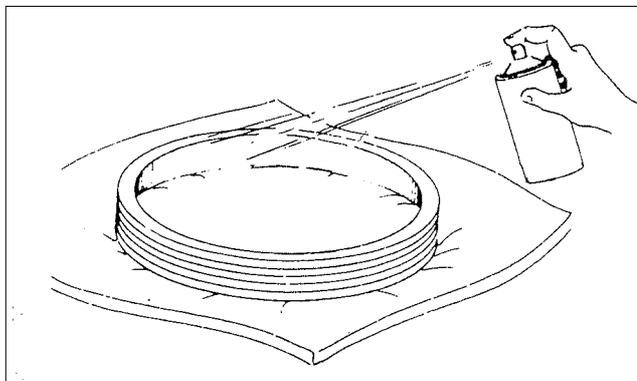


Threads, guide and contact surfaces to be primed

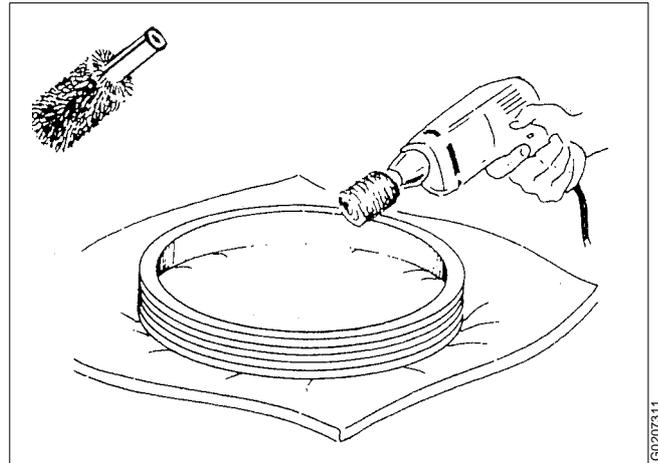
1. Clean the lock ring thoroughly with a degreasing agent and wipe it off.



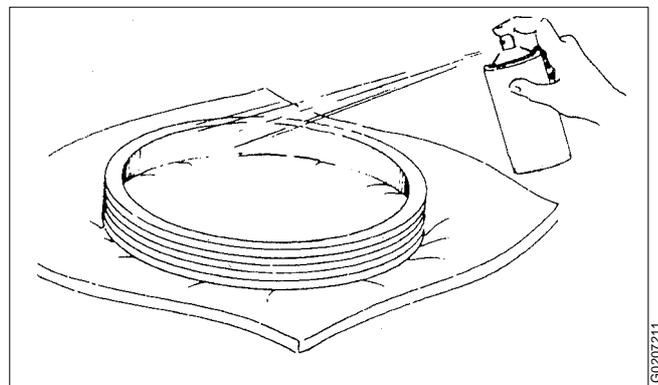
2. Spray the threads, guide and contact surfaces with slide lacquer Molykote 321 R. Let the lacquer air-cure for about 15 minutes.



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

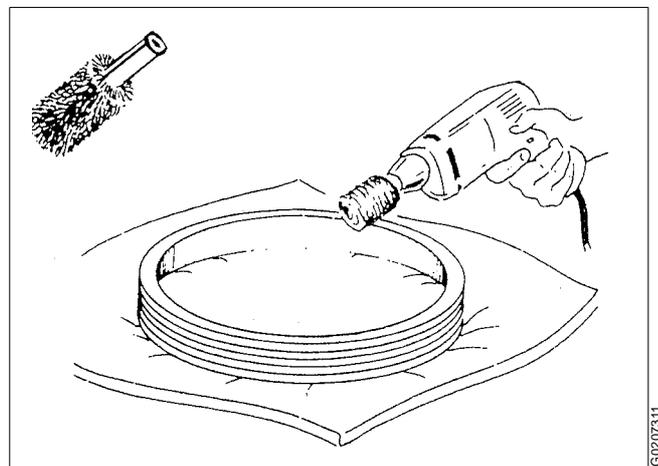


4. Spray the lock ring a second time and let it dry for about 15 minutes.



5. Polish the slide lacquer to a black shiny surface which can now last about a year.

Proceed in the same way with the threads of the bowl body and with the guide surfaces of the bowl hood and bowl body.



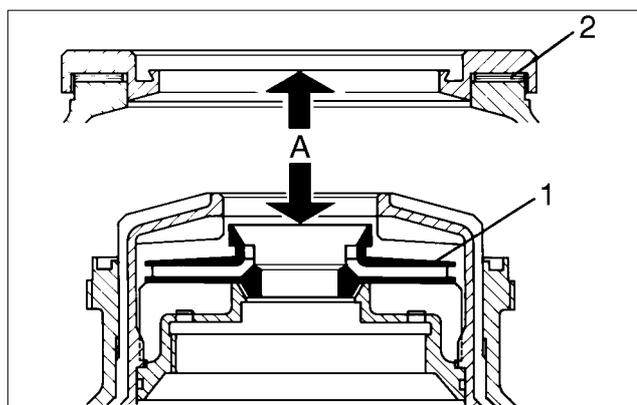
5.4.17 Lock ring; wear and damage

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

5.4.18 Oil paring disc; height position

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

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



Measurement of distance A

With inlet and outlet parts mounted:

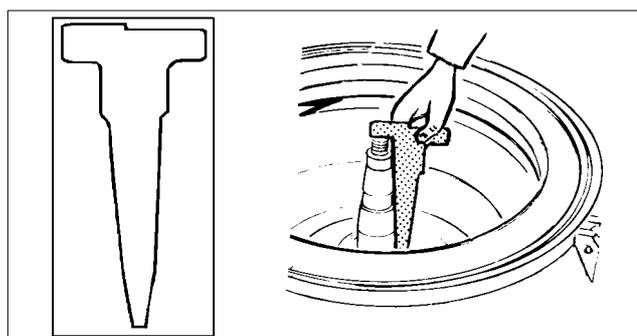
- Revolve the worm wheel shaft by hand. If it turns heavily or if a scraping noise is heard, wrong height adjustment or wrong fitting of the inlet pipe may be the cause.

5.4.19 Operating mechanism

Same as described in section "5.3.12 Operating mechanism" on page 61.

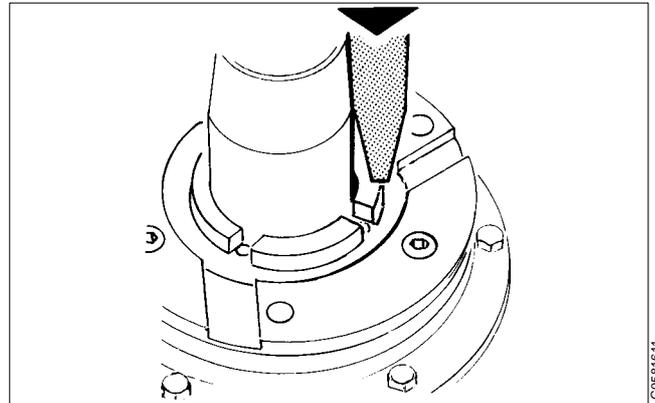
5.4.20 Operating paring disc; height position

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

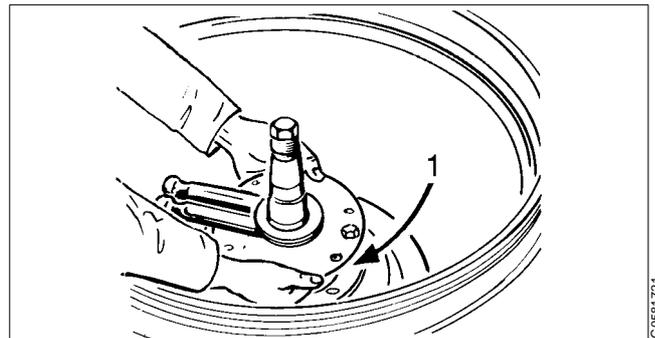


Templet supported on the spindle top

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



Templet supported on the operating paring disc



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

5.4.21 Operating slide

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

5.4.22 Sliding bowl bottom

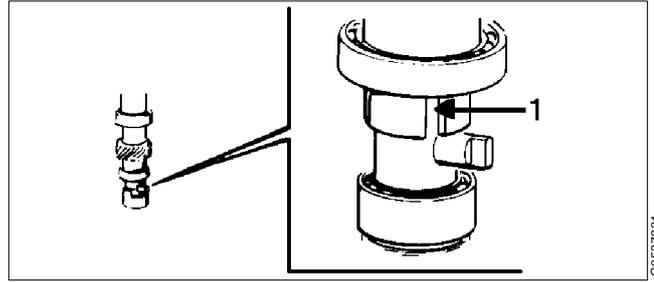
Same as described in section “5.3.14 Sliding bowl bottom” on page 62.

5.4.23 Springs for operating mechanism

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

5.4.24 Worm; wear of groove

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



Measurement of wear in groove (1)

5.4.25 Worm wheel and worm; wear of teeth

Same as described in section "5.7.1 Worm wheel and worm; wear of teeth" on page 83.

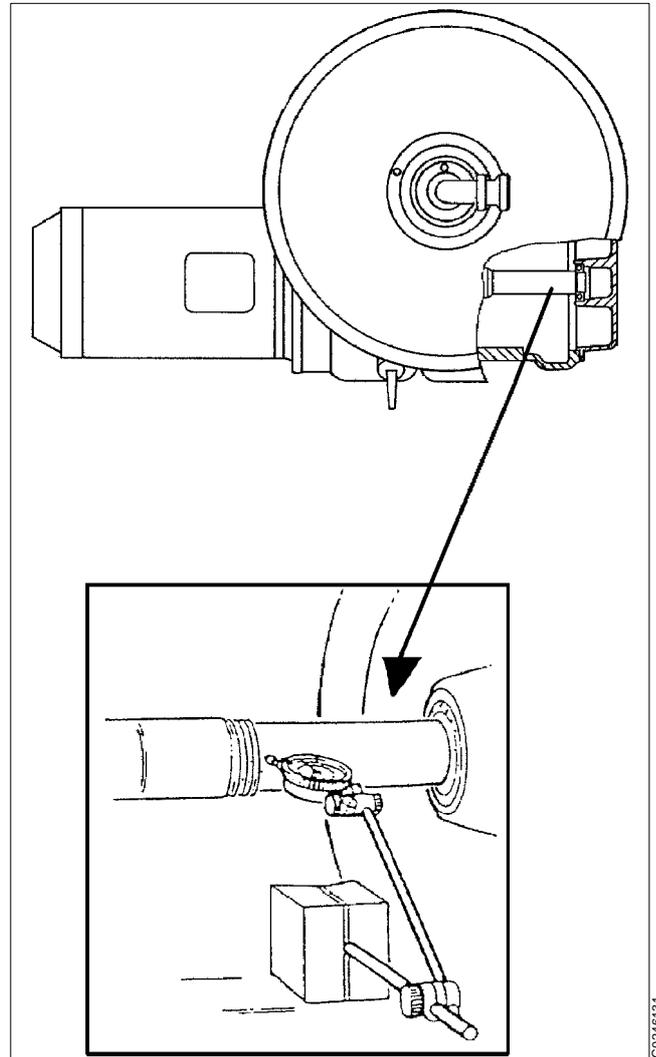
5.4.26 Worm wheel shaft; radial wobble

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

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

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

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



Measurement of the radial wobble

5.4.27 Cover interlocking switch (option)

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

5.4.28 Vibration switch (option)

Same as described in “5.3.18 Vibration switch (option)” on page 63.

5.5 Lifting instructions

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

Length of each sling must be min. 2 metres.

NOTE

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

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



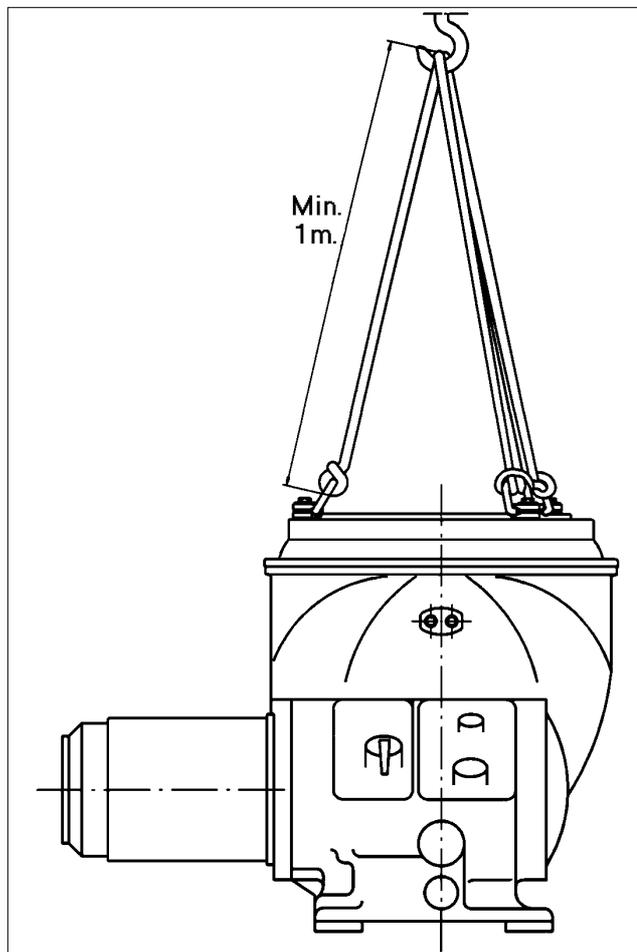
WARNING

Crush hazards

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

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

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



Lift the separator with the frame hood and bowl removed

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

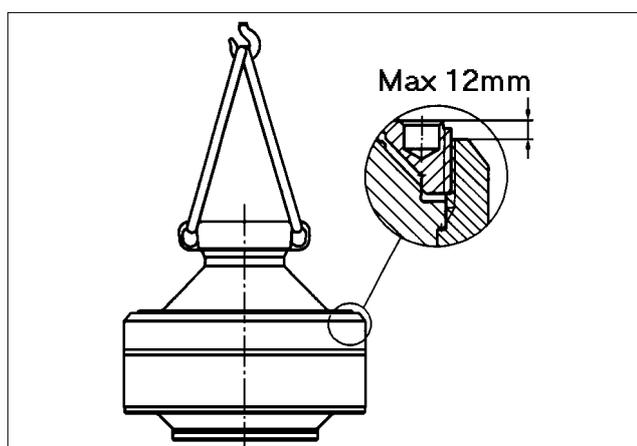
NOTE

Check that the lock ring is properly tightened.

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

Weight to lift is approx. 450 kg.

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



The lock ring must be properly tightened when lifting the bowl

5.6 Cleaning

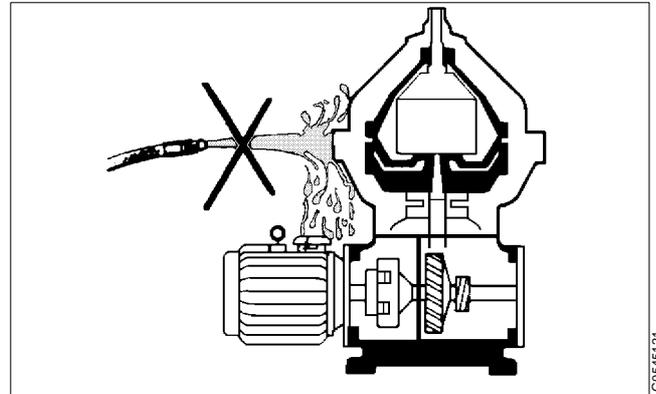
5.6.1 External cleaning

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

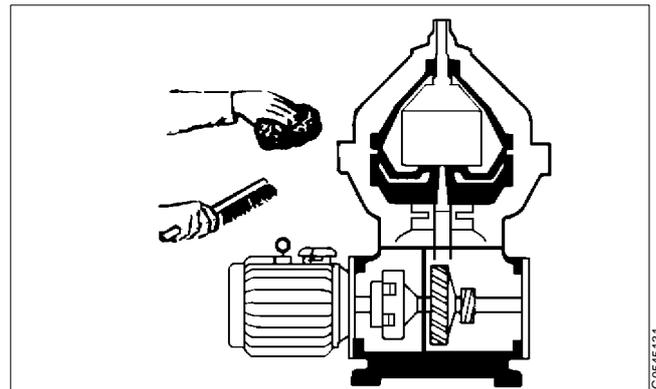
Never wash down a separator with a direct water stream. Totally enclosed motors can be damaged by direct hosing to the same extent as open motors and even more than those, because:

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

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



Never wash down a separator with a direct water stream. 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.

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

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

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



Alfa Laval cleaning liquid for fuel oil separators

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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

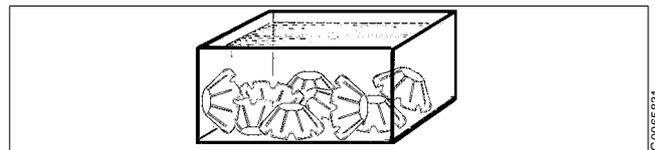
Handle the bowl discs carefully so as to avoid damage to the surfaces during cleaning.

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



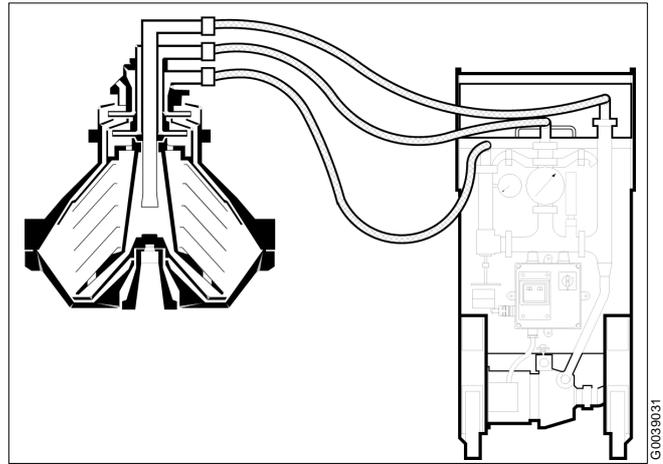
Clean the discs with a soft brush

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5.6.4 CIP-system

Alfa Laval has developed a CIP (Cleaning-In-Place) system specifically designed for cleaning the bowl and with the inlet and outlets of lube and fuel oil separators without the need of dismantling.



CIP Unit connected to separator

5.7 When changing oil

5.7.1 Worm wheel and worm; wear of teeth

To check at each oil change

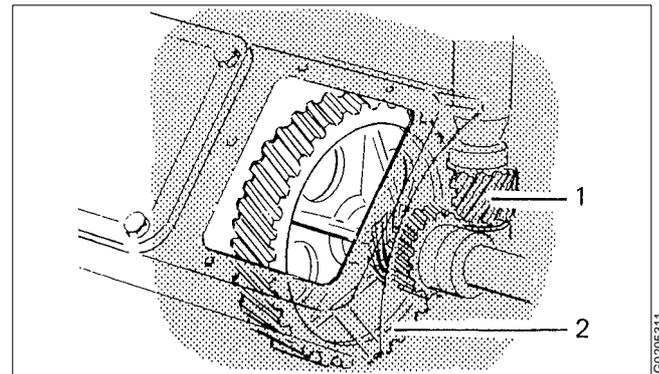
Check the teeth of both the worm wheel and worm for wear.

See the “Tooth appearance examples” on page 85. Examine the contact surfaces and compare the tooth profiles. The gear may operate satisfactorily even when worn to some degree.

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

Position the spindle in place before fitting the worm wheel.

When replacing the gear, always make sure that the new worm wheel and worm have the same number of teeth as the old ones. See chapter “8.1 Technical data” on page 174 for correct number of teeth.



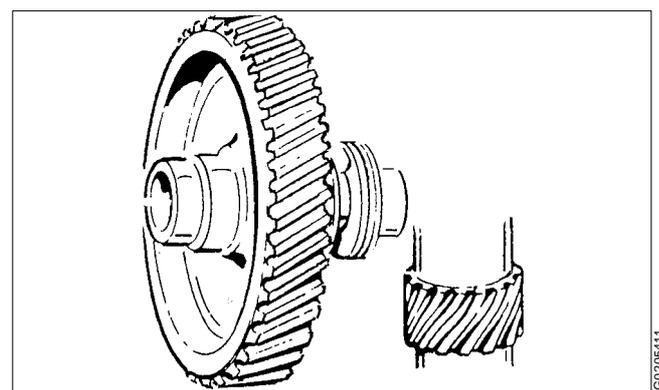
1 Worm
2 Worm wheel



DANGER

Disintegration hazards

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



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

NOTE

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

Important!

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

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

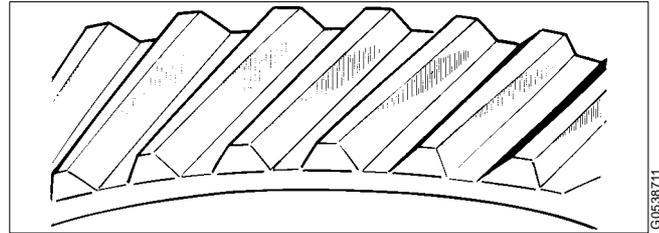
For further information, see chapter "8.6 Lubricants" on page 185.

Tooth appearance examples

Satisfactory teeth:

Uniform wear of contact surfaces. Surfaces are smooth.

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

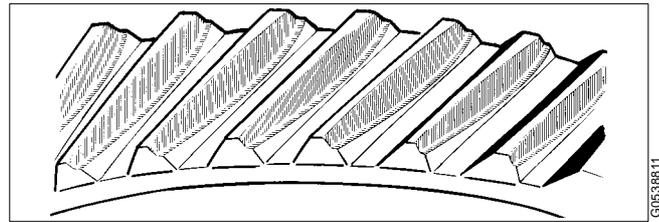


Satisfactory teeth

Worn teeth:

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

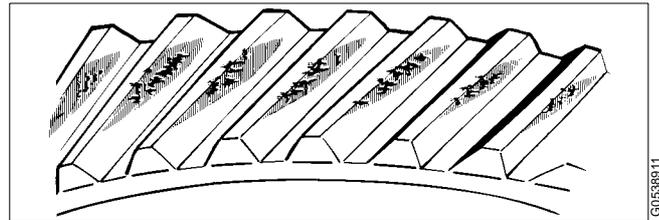
- the wear is uniform over the whole of the flank of a tooth
- and all teeth are worn in the same way.



Worn teeth

Spalling:

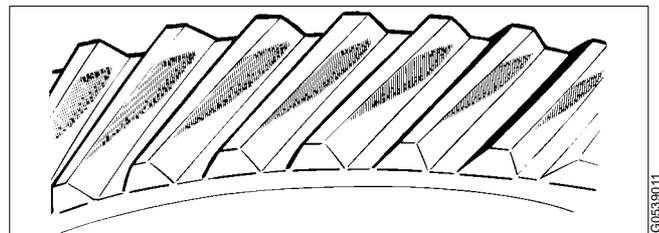
Small bits of the teeth have broken off, so-called spalling. This is generally due to excessive load or improper lubrication. Damage of this type need not necessitate immediate replacement, but careful checking at short intervals is imperative.



Spalling

Pitting:

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

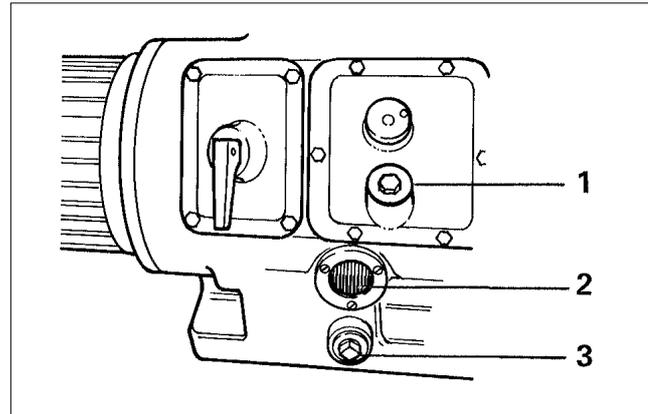


Pitting

5.7.2 Oil change procedure

NOTE

Before adding or renewing lubricating oil in the worm gear housing, the information concerning different oil groups, handling of oils, oil change intervals etc. given in chapter "8.6 Lubricants" on page 185 must be well known.



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

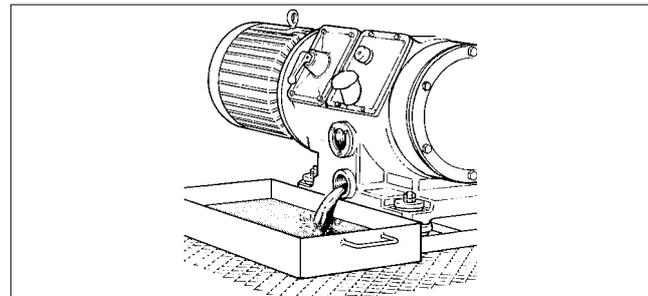
1. Place a collecting tray under the drain hole, remove the drain plug and drain off the oil.



CAUTION

Burn hazards

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



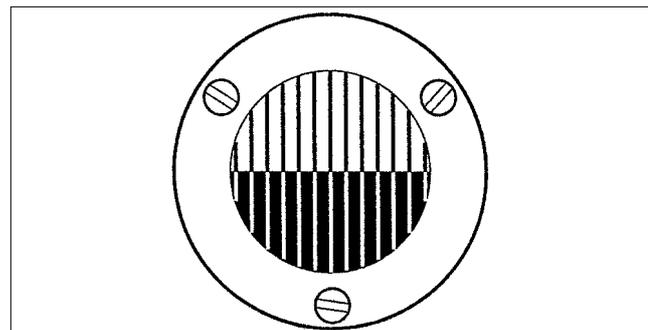
Burn hazards: The drained oil can be hot

2. Fill new oil in the worm gear housing. The oil level should be exactly in the middle of the sight glass:
Oil volume: approx. 12 litres.

NOTE

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

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



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

5.8 Vibration

5.8.1 Vibration analysis

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

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

NOTE

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

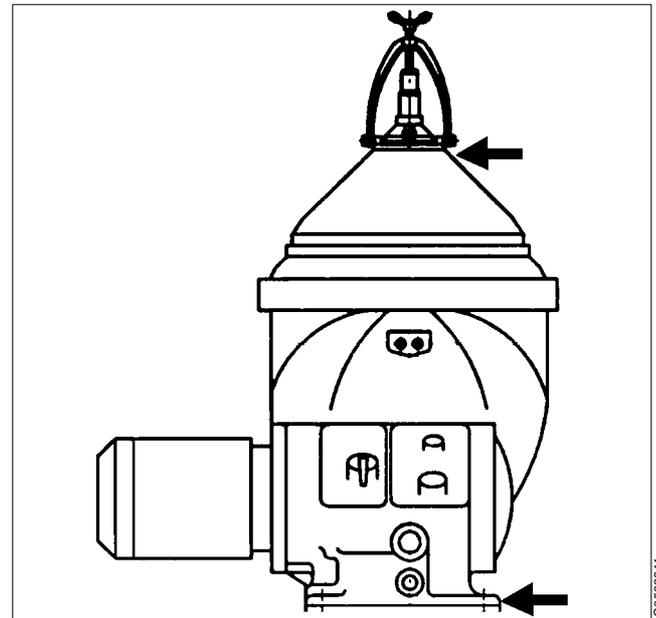


DANGER

Disintegration hazards

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

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



Measuring points for vibration analysis

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5.8.2 Vibration switch (option)

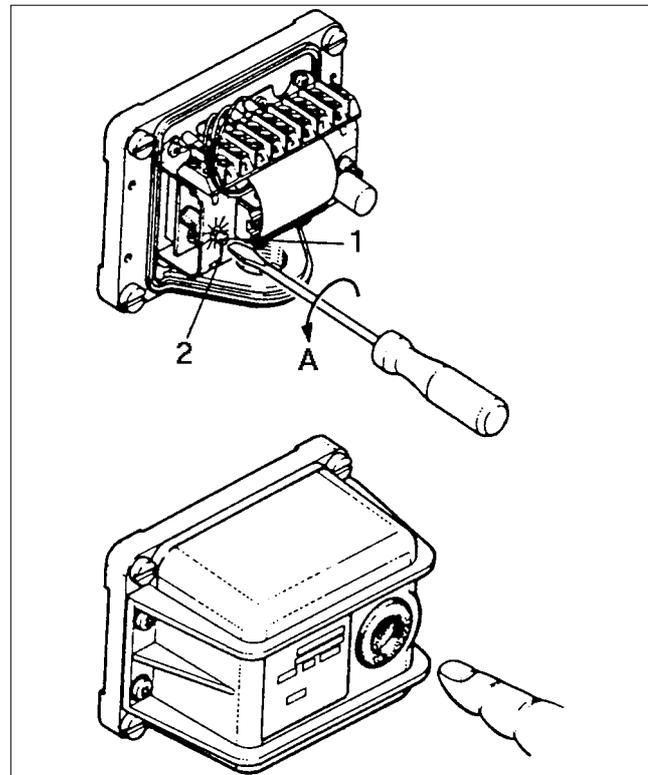
Adjustment of setpoint

The vibration switch is adjusted by a simple procedure with the separator in operation. In making this adjustment, the cover must be removed to gain access to the setpoint adjusting screw (1).

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

NOTE

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



Setpoint adjustment

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

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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.

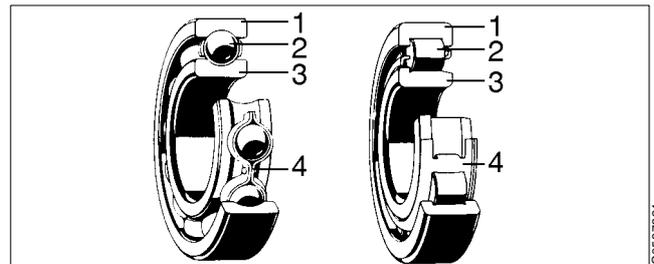
Only Alfa Laval genuine spare parts should be used.

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.

NOTE

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

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



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

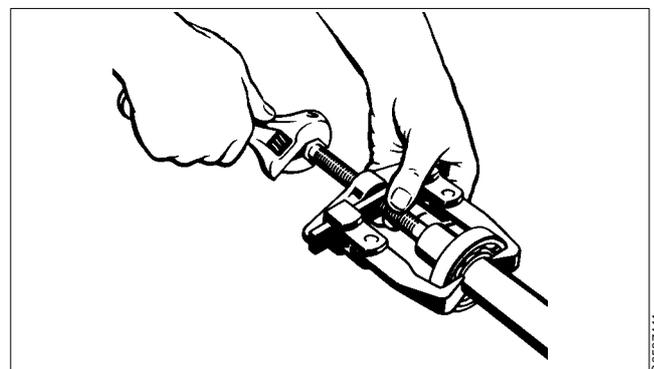
Dismantling

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

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

NOTE

Do not hit with a hammer directly on the bearing.



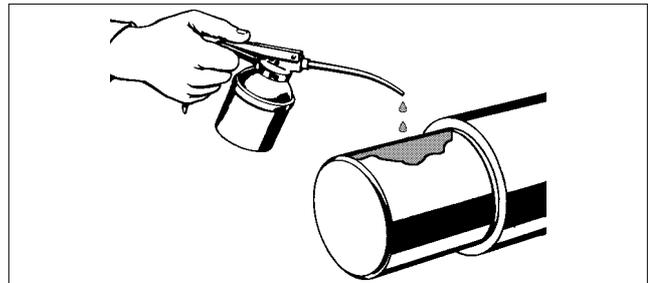
For bearings where no driving-off sleeve is included in the tool kit, use a puller when removing bearings

Cleaning and inspection

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

Assembly

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



Clean and oil the bearing seating before assembly

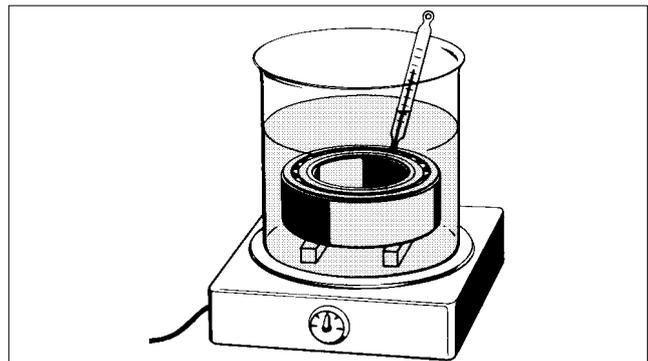
- When assembling ball bearings, the bearings must be heated in oil to max. 125 °C.

NOTE

Heat the bearing in a clean container.

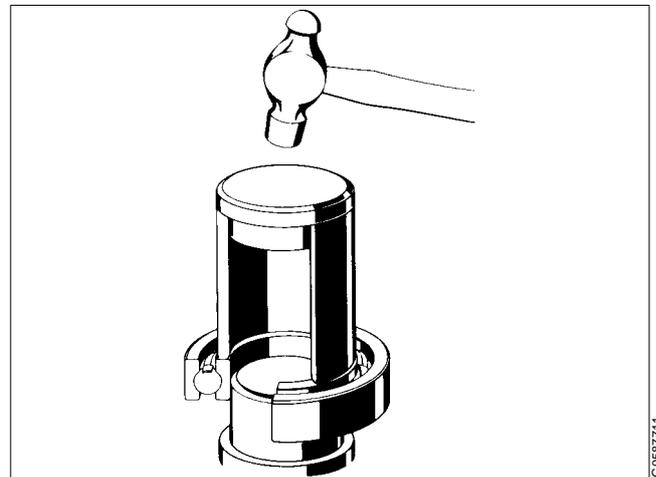
Use only clean oil with a flash point above 250 °C.

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



The bearing must not be in direct contact with the container

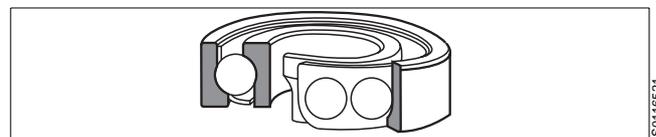
- There are several basic rules for assembling cylindrical bore bearings:
 - Never directly strike a bearing's rings, cage or rolling elements while assembling. A ring may crack or metal fragments break off.
 - Never apply pressure to one ring in order to assemble the other.
 - Use an ordinary hammer.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



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

Angular contact ball bearings

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



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

5.9.2 Before shutdowns

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

- Remove the bowl, according to instructions in chapter “6 Dismantling/Assembly” on page 93.

NOTE

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

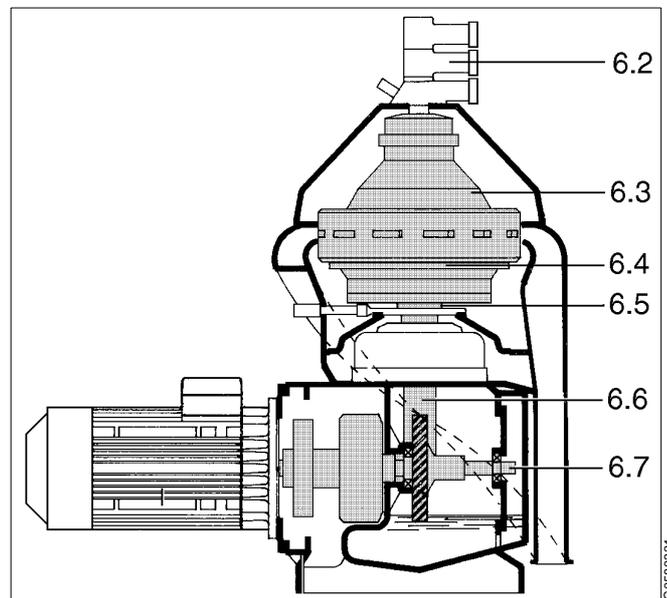
Vibration in foundations can be transmitted to the bowl and produce one-sided loading of the bearings. The resultant indentations in the ball bearing races can cause premature bearing failure.

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

6 Dismantling/Assembly

Contents

6.1 Introduction	94	6.7 Horizontal driving device (MS)	150
6.1.1 General directions	94	6.7.1 Exploded view	150
6.1.2 References to check points	95	6.7.2 Dismantling	152
6.1.3 Tools	95	6.7.3 Assembly	156
6.2 Inlet/outlet, frame hood (IS)	96		
6.2.1 Exploded view	96		
6.2.2 Dismantling	97		
6.2.3 Assembly	99		
6.3 Bowl hood and disc stack (IS)	101		
6.3.1 Exploded view	101		
6.3.2 Dismantling	102		
6.3.3 Assembly	109		
6.4 Bowl body and operating mechanism (IS)	115		
6.4.1 Exploded view	115		
6.4.2 Dismantling	116		
6.4.3 Assembly	121		
6.5 Operating water device (IS)	126		
6.5.1 Exploded view	126		
6.5.2 Dismantling	127		
6.5.3 Assembly	130		
6.6 Vertical driving device (MS)	134		
6.6.1 Exploded view	134		
6.6.2 Dismantling	137		
6.6.3 Assembly	142		



6.1 Introduction

6.1.1 General directions

The separator must be dismantled regularly for cleaning and inspection.

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

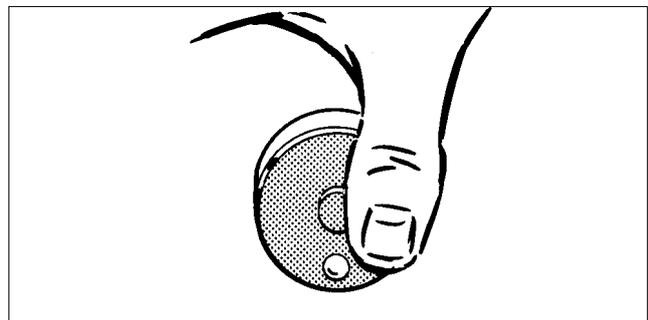


DANGER

Entrapment hazard

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

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



The revolution counter indicates if the separator still is rotating

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

These parts must be handled carefully.

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

NOTE

Never interchange bowl parts

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

6.1.2 References to check points

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

✓ Check point

“5.3.5 Disc stack pressure” on page 52.

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

6.1.3 Tools

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

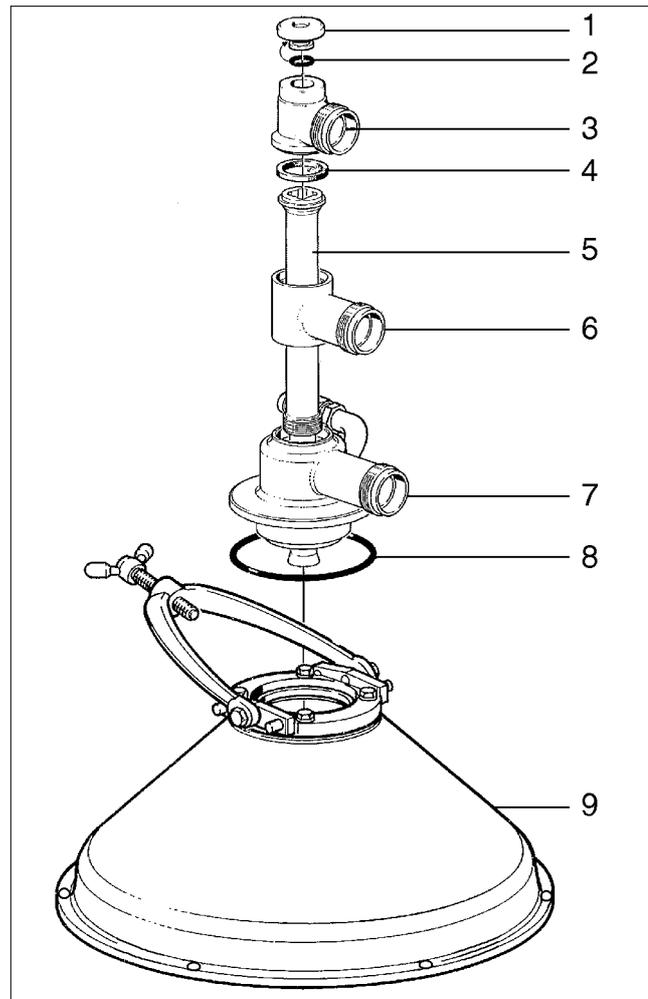
NOTE

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

6.2 Inlet/outlet, frame hood (IS)

6.2.1 Exploded view

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



6.2.2 Dismantling



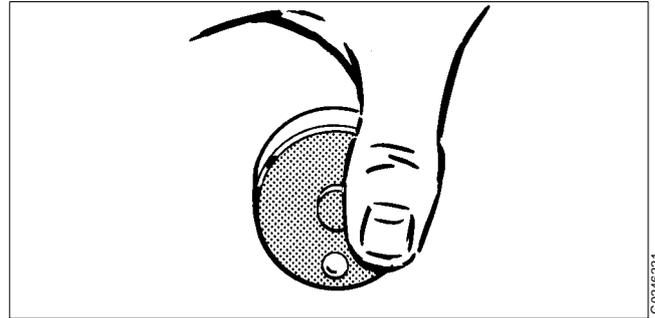
DANGER

Entrapment hazards

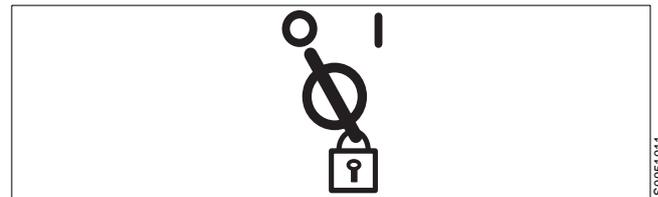
1. Make sure that rotating parts have come to a **complete standstill** before starting **any** dismantling work.

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

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



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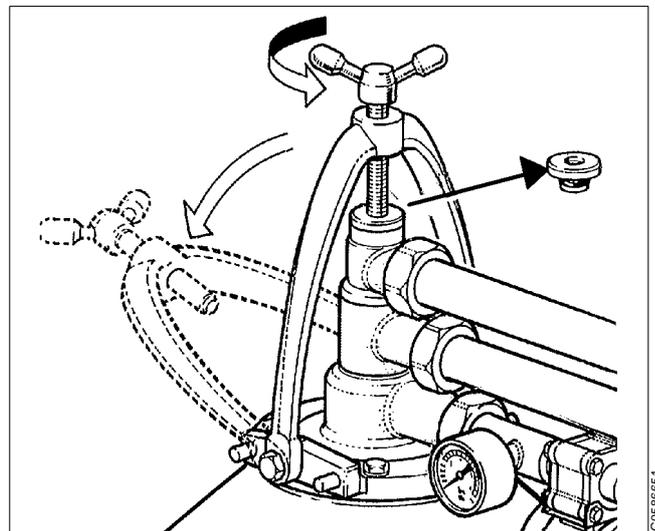


S0051011

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

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

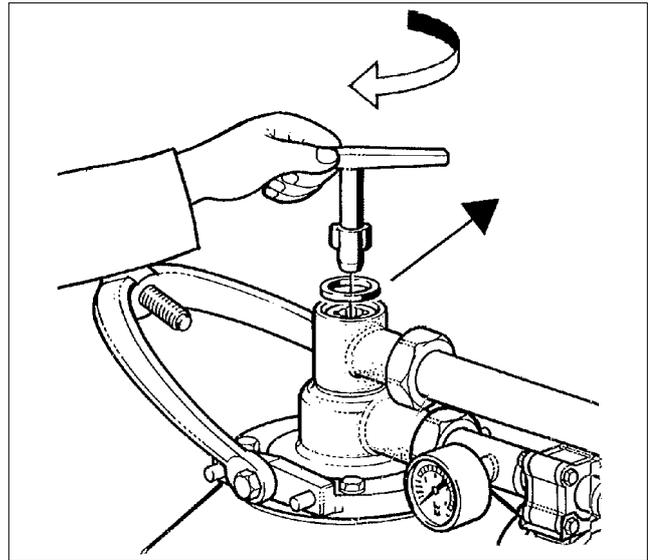
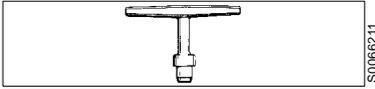
1. Loosen the clamp screw and lower the clamping stirrup. Remove the plug.
2. Undo the coupling nuts of inlet and outlet piping at the pipe support. Swing aside the feed pipe.



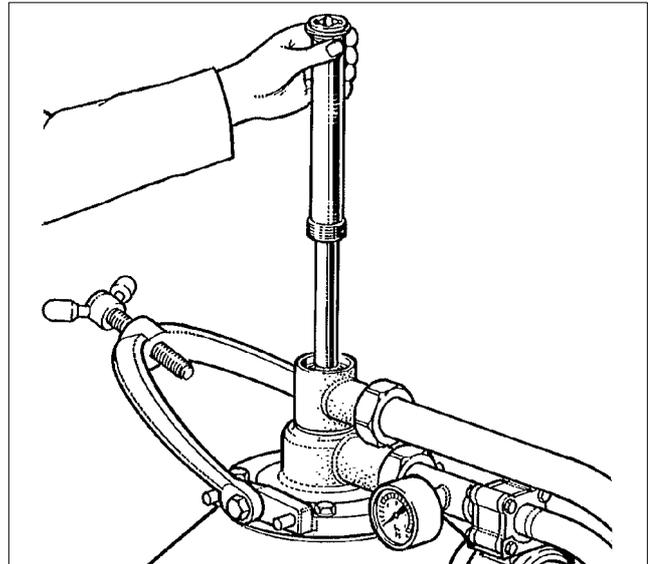
G0586651

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

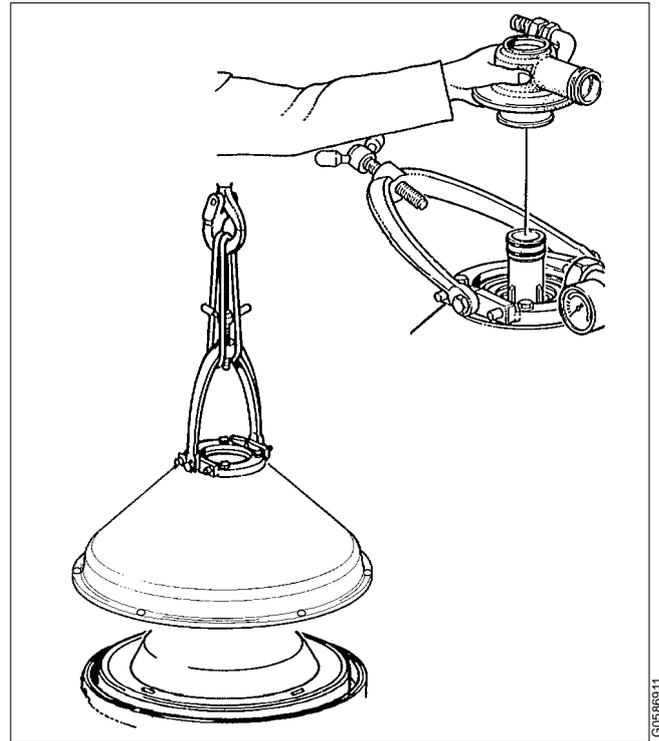
Left-hand thread!



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



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



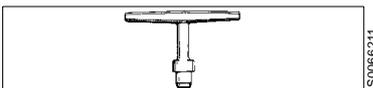
6.2.3 Assembly

✓ Check point

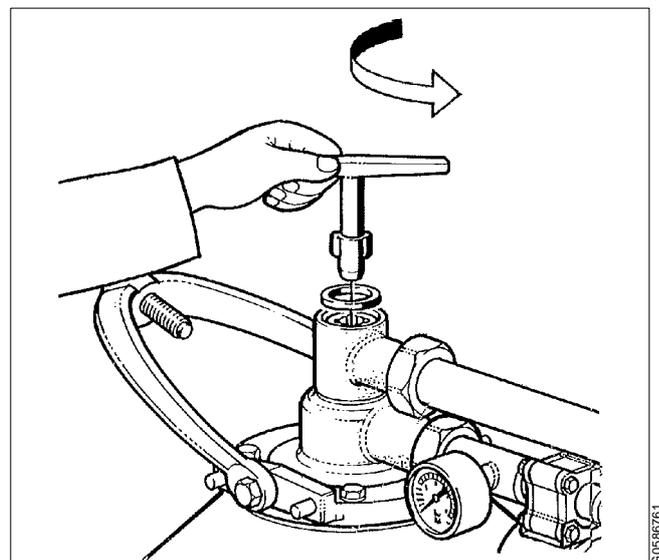
“5.7.2 Oil change procedure” on page 86

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

Left-hand thread!



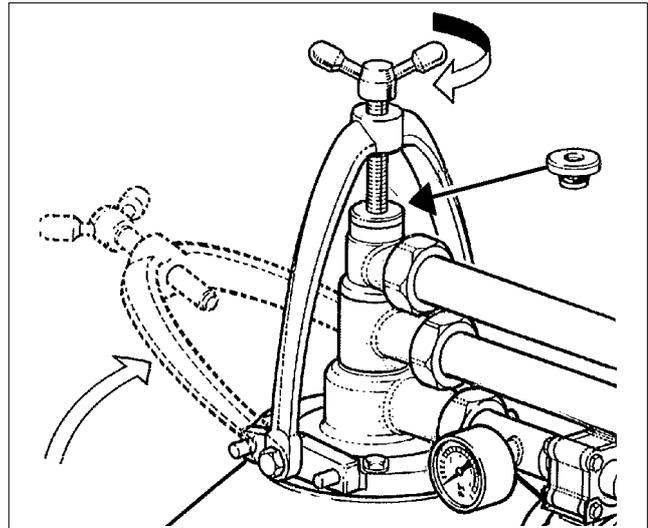
6. Fit the square-sectioned ring on the inlet pipe.



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

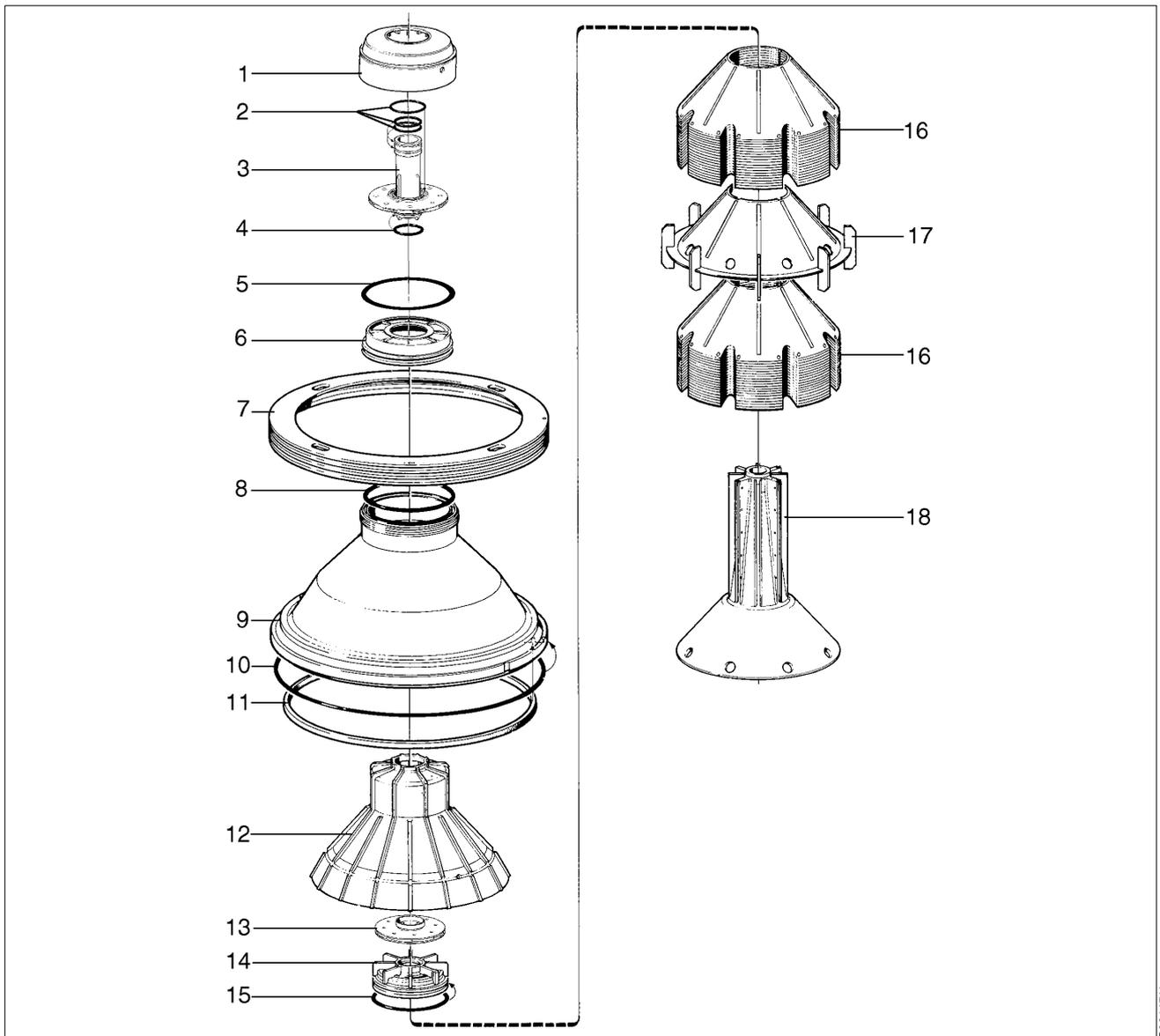
**DANGER****Disintegration hazards**

When power cables have been connected, always check direction of rotation see "4.1.1 Ready for start" on page 30. If incorrect, vital rotating parts could unscrew causing disintegration of the machine.



6.3 Bowl hood and disc stack (IS)

6.3.1 Exploded view



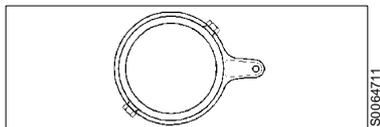
1. Paring chamber cover (small lock ring)
2. O-ring
3. Upper paring disc
4. O-ring
5. O-ring
6. Flow control disc
7. Lock ring
8. O-ring
9. Bowl hood

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

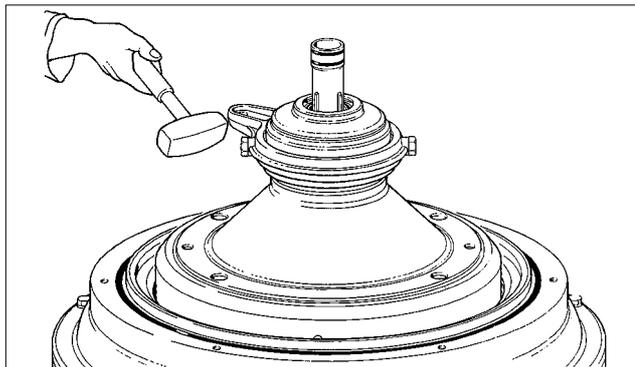
6.3.2 Dismantling

1. Unscrew the paring chamber cover using the spanner.

Left-hand thread!

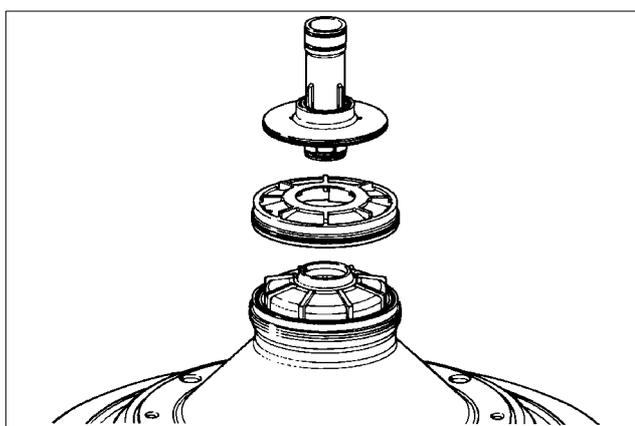


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2. Remove the upper paring disc and flow control disc.



G0531111

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

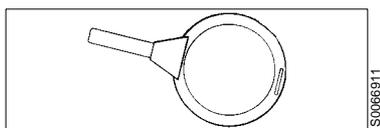
NOTE

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

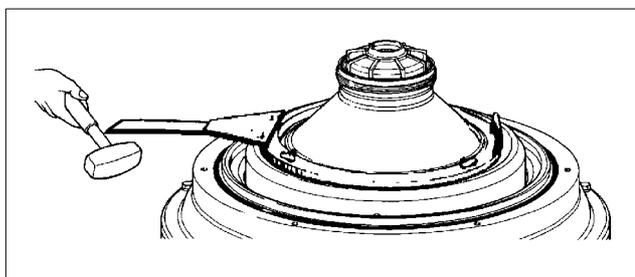
Unscrewing lock ring without using a compressing tool

- a. Unscrew the lock ring using the spanner.

Left-hand thread!



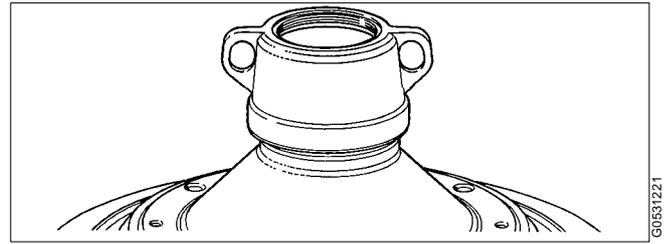
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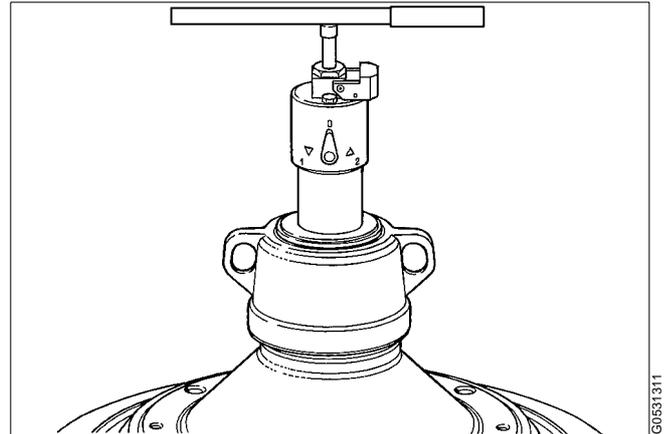
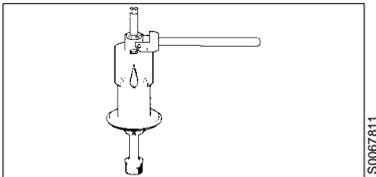
Unscrewing lock ring by using a compressing tool

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



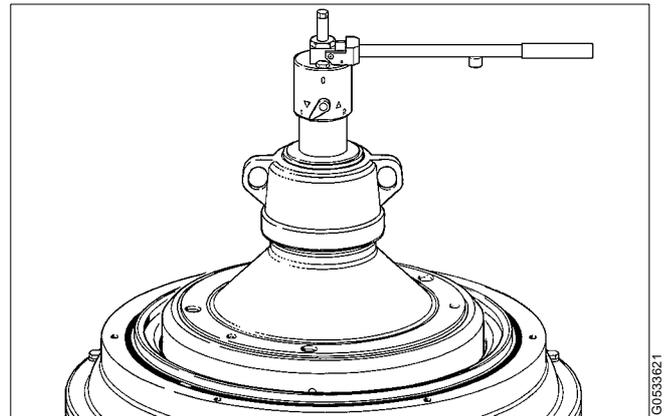
- b. Fit the compressing tool by screwing the pillar of the tool into the threads of the distributor using the horizontal handle.

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



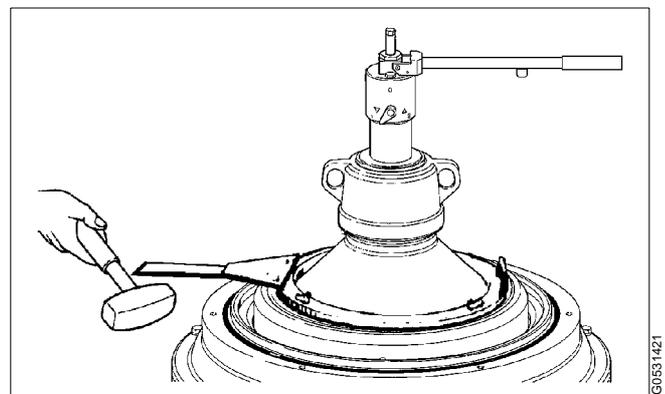
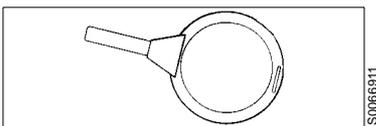
- c. Turn the control lever to position 1 for compression.

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

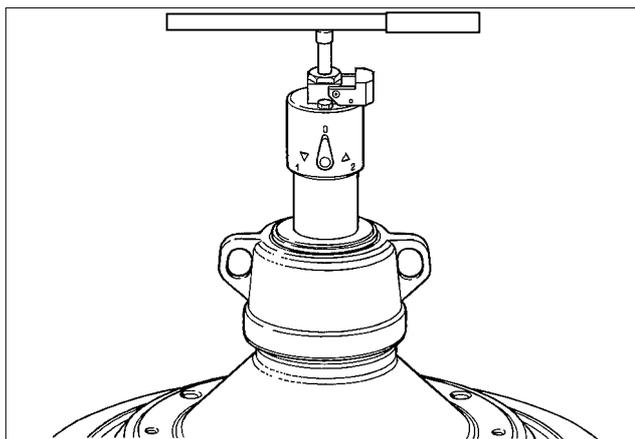


- d. Unscrew the large lock ring using the spanner.

Left-hand thread!



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

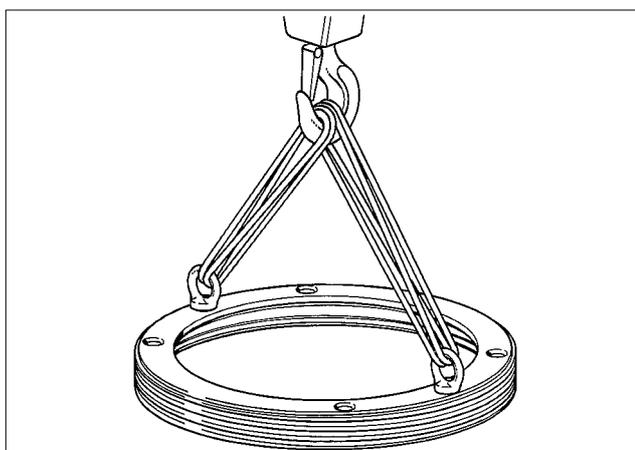


G0531311

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



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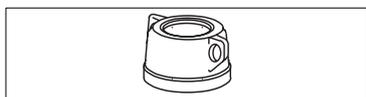
NOTE

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

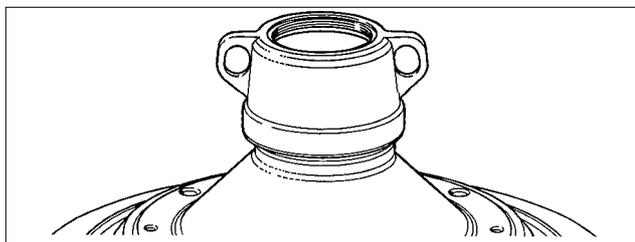
- 5. Separate the bowl hood from the bowl body as described below before lifting off the bowl hood.

Separating bowl hood without using a compressing tool

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

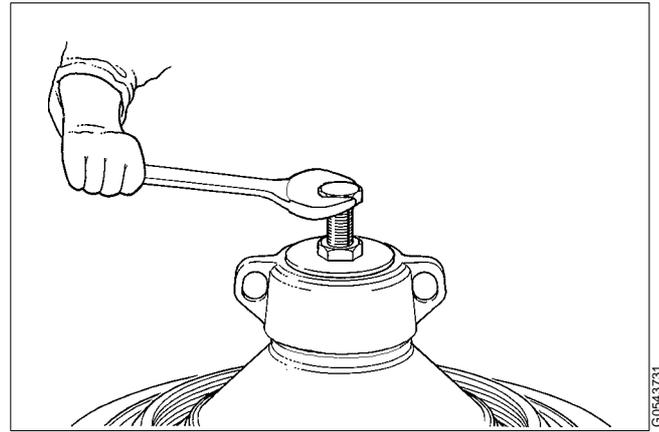
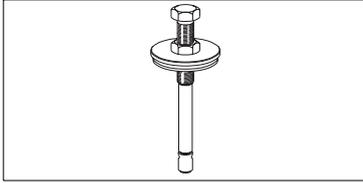


S0067611



G0531221

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



- c. Screw home the spindle with the wrench until the bowl hood loosens from the bowl body.
- d. Remove the spindle plate from the lifting tool.

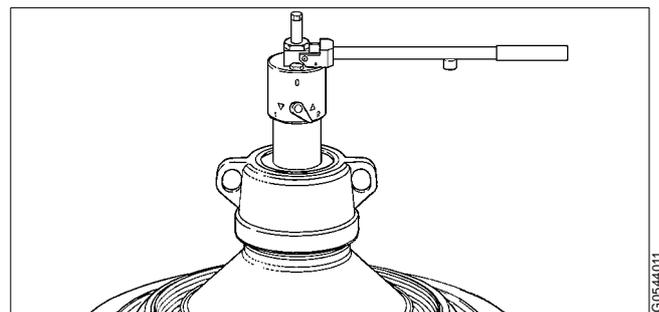
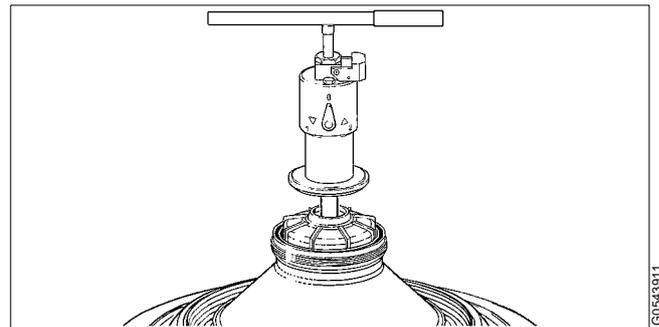
Separating bowl hood by means of a compressing tool

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

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

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

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

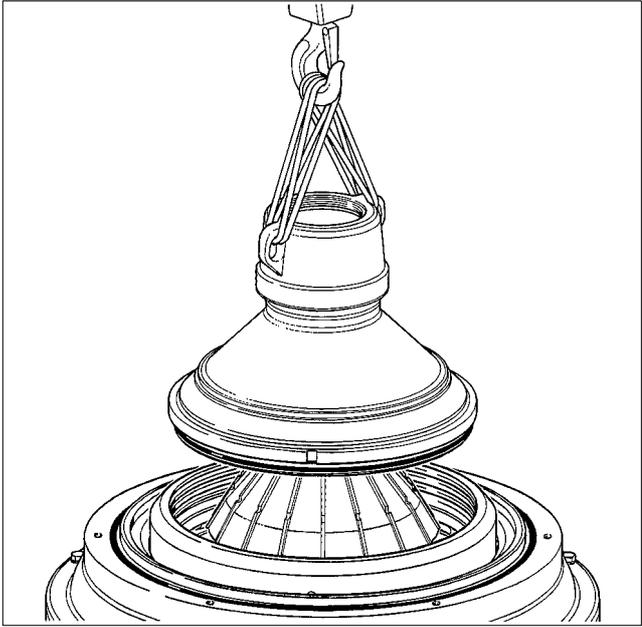


- e. Remove the lifting tool and the compressing tool. Then refit the lifting tool.

- 6. Lift off the bowl hood by means of a hoist. Be careful not to scratch the bowl hood seal ring.

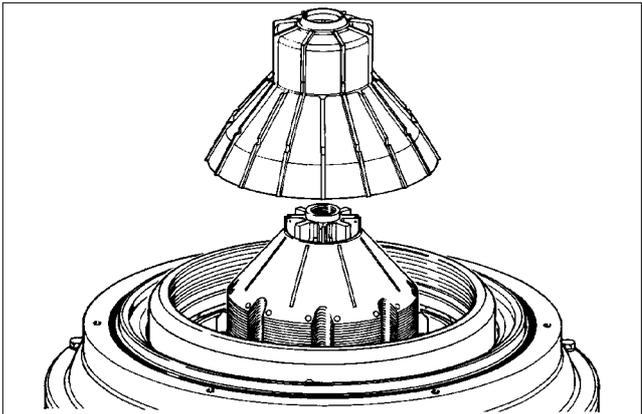
 **CAUTION**
Crush hazards

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



G0539971

- 7. Remove the top disc.

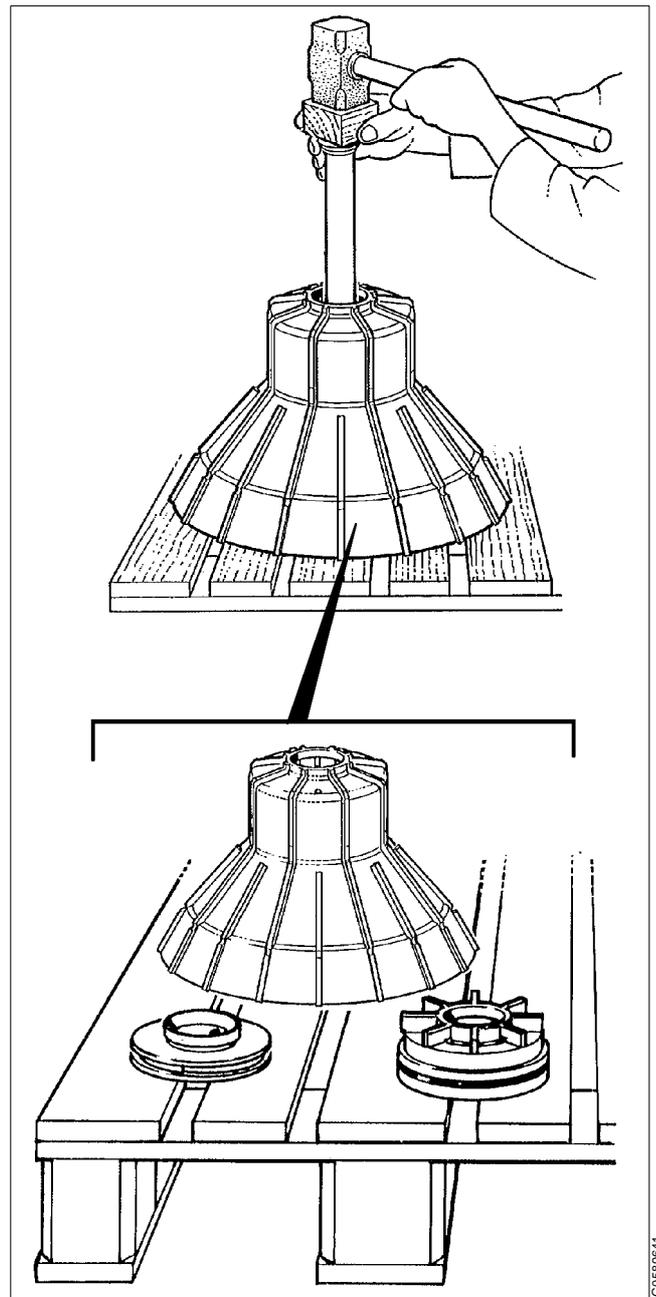


G0531791

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

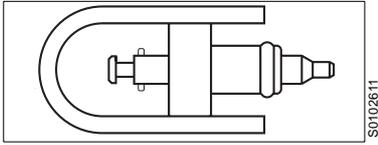
Left-hand thread!

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

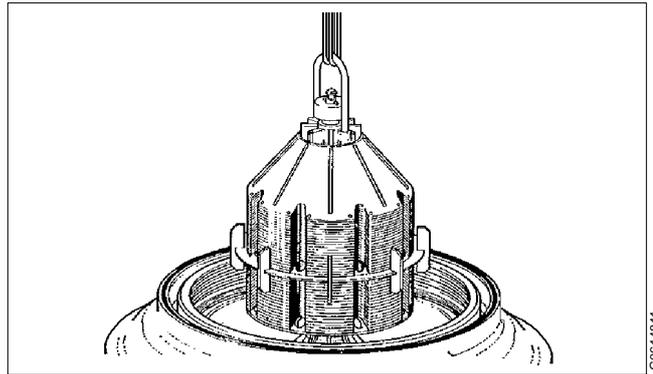


G0589641

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



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

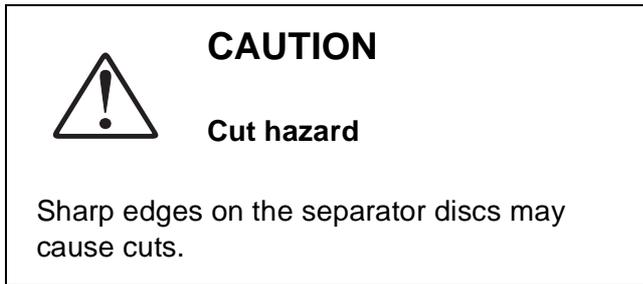


6.3.3 Assembly

✓ Check point

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

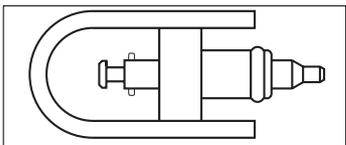
1. Assemble the discs one by one on the distributor. The distributor has one guide rib for the correct positioning of the discs.



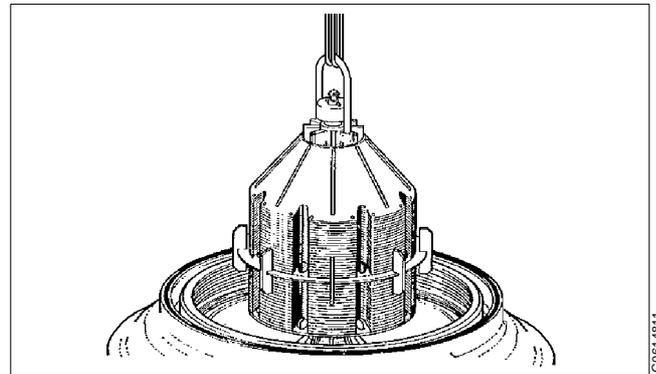
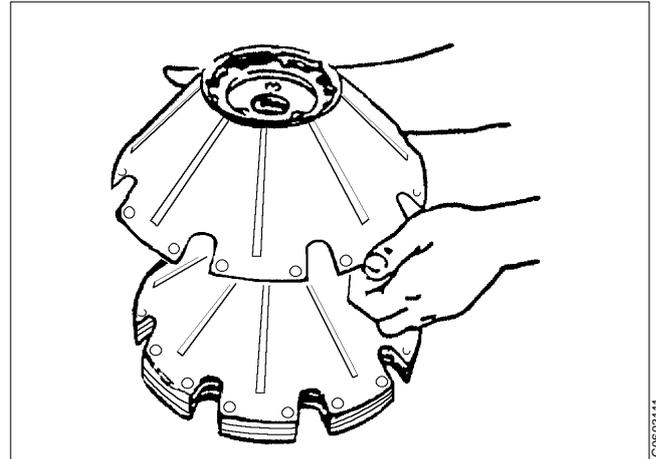
For correct number of discs above and below the wing insert when the machine was new, see the *Spare Parts Catalogue*.

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 means of a hoist.



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

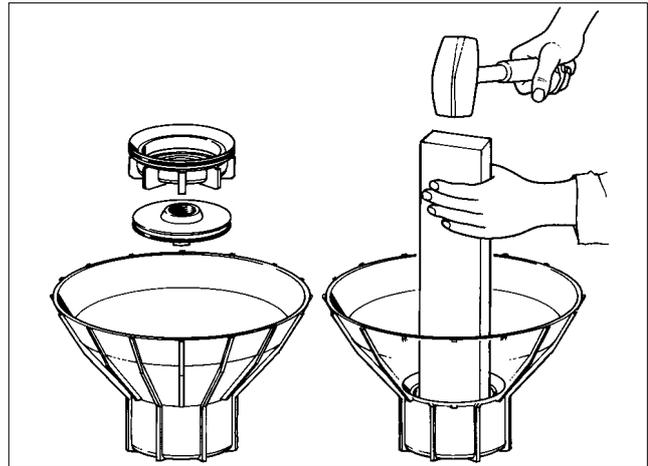


✓ **Check point**

“5.3.10 Level ring” on page 58.

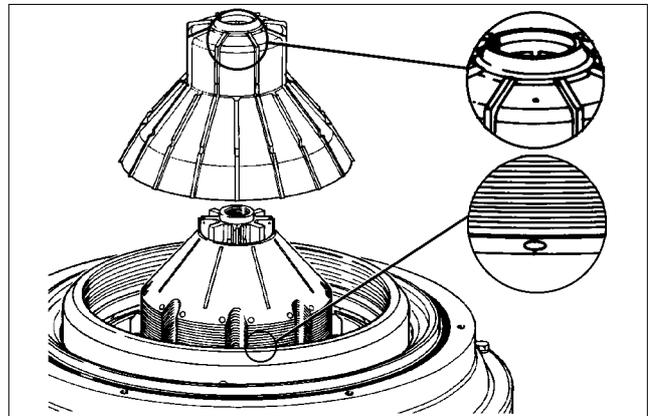
3. Fit the oil paring disc and level ring with the O-ring into the top disc.

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



G0532151

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



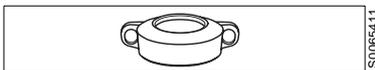
G06317A1

✓ **Check point**

“5.3.1 Bowl hood seal ring” on page 47.

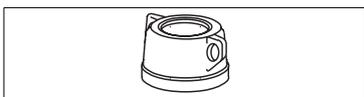
5. Fit the lifting tool to the bowl hood and lift it using a hoist. Check that the O-ring and the seal ring of the bowl hood are properly fitted and lubricated.

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.



S0065411

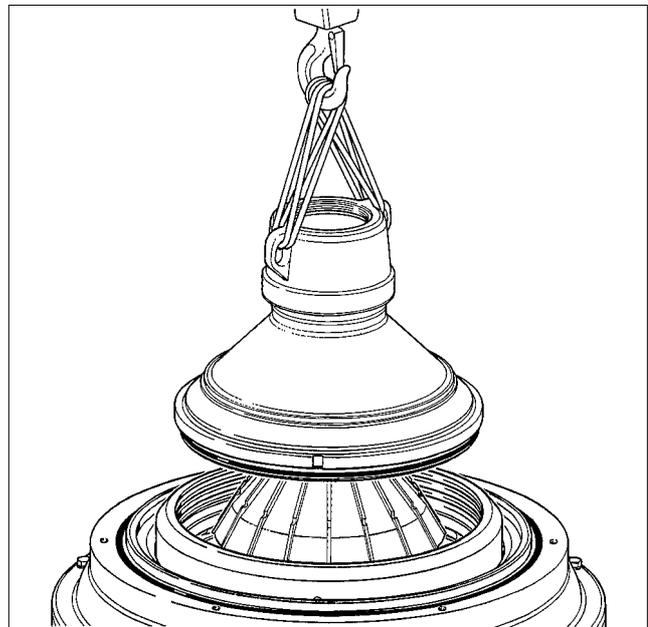
*In set of tools **without** compressing tool.*



S0067611

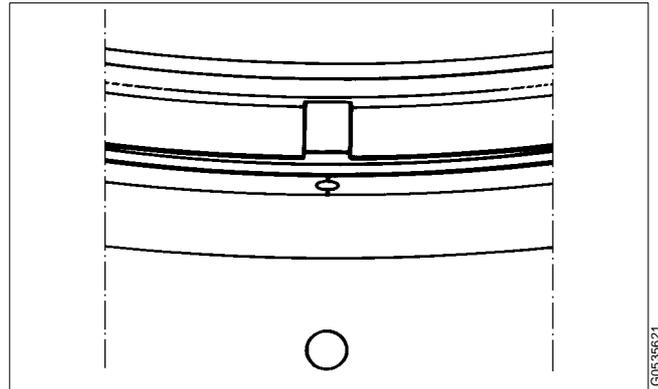
*In set of tools **with** compressing tool.*

For correct position of bowl hood, see next illustration.



G0539971

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

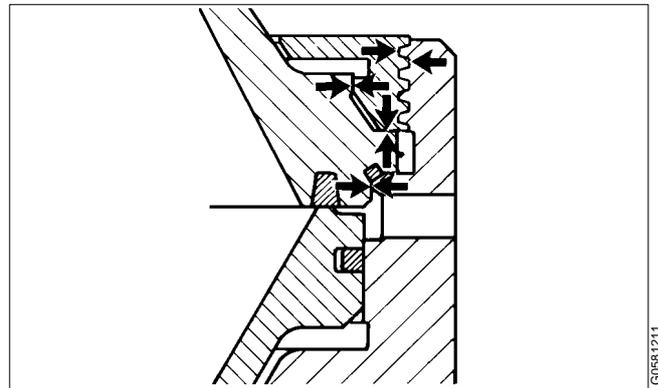


G0536621

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

✓ **Check point**

“5.4.16 Lock ring; priming” on page 72 (only when Major Service).

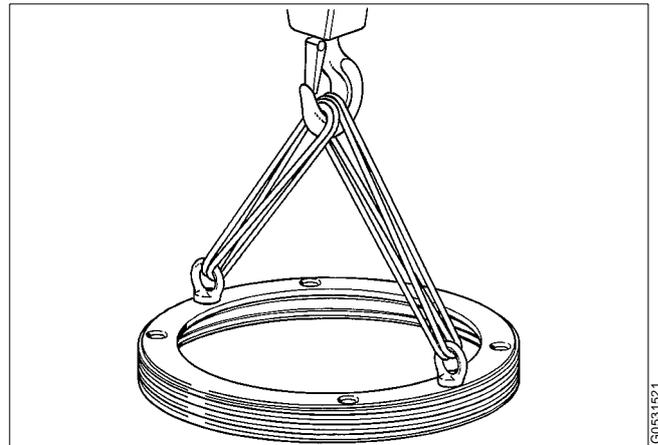


G0581211

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



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G0531521

10. Tighten the lock ring.

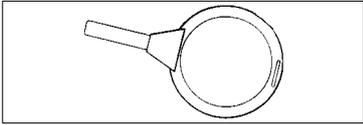
NOTE

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

Tightening of lock ring without using a compressing tool

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

Left-hand thread!



S0066911

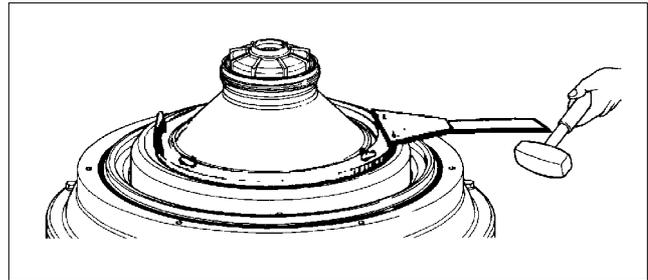
- b. Tighten until the assembly marks are at least in line.

✓ **Check point**

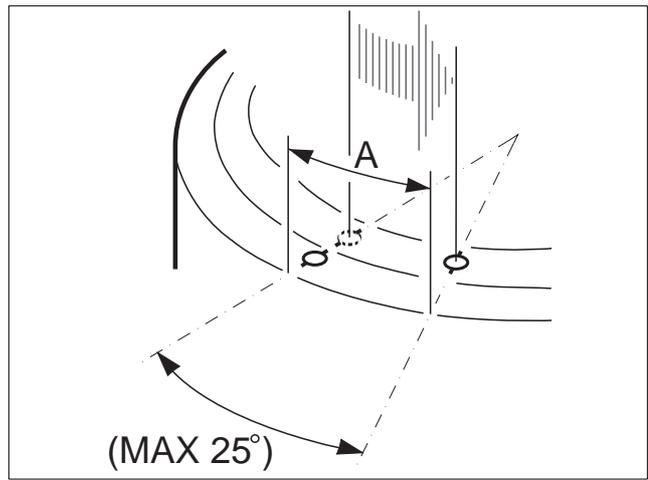
“5.3.5 Disc stack pressure” on page 52.

NOTE

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



G0533441



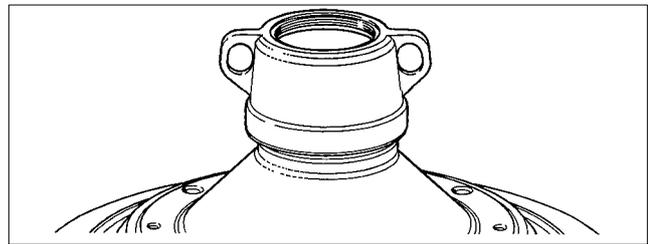
G0578131

Tightening of lock ring by means of a compressing tool

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



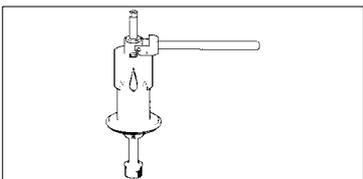
S0067611



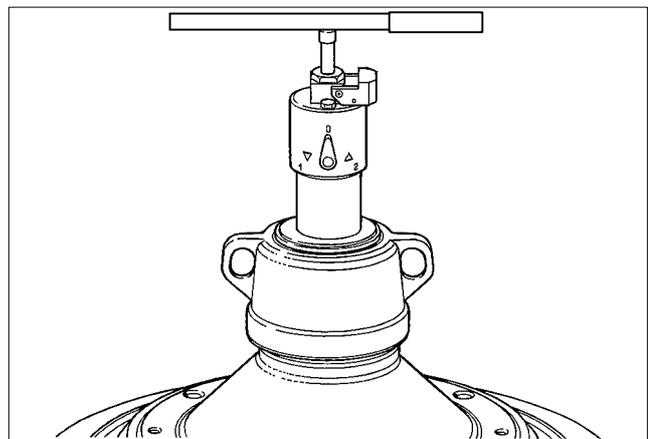
G0531221

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

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



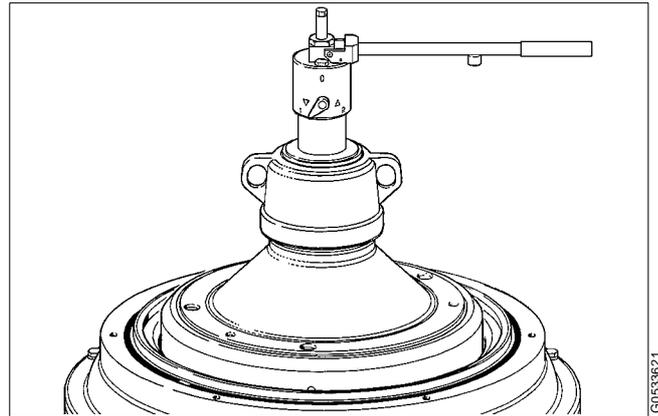
S0067811



G0531311

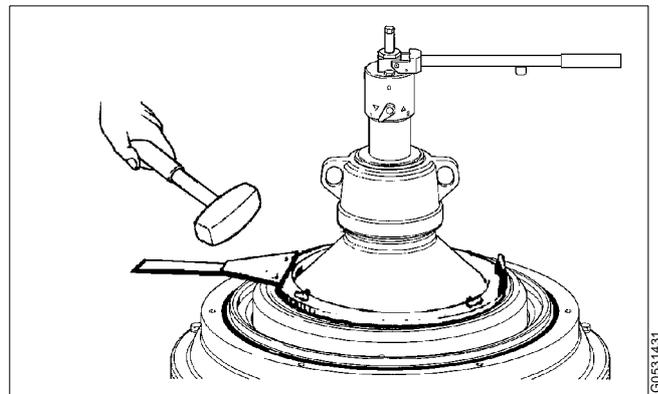
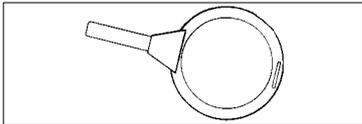
- c. Turn the control lever to position 1 for compression.

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



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

Left-hand thread!



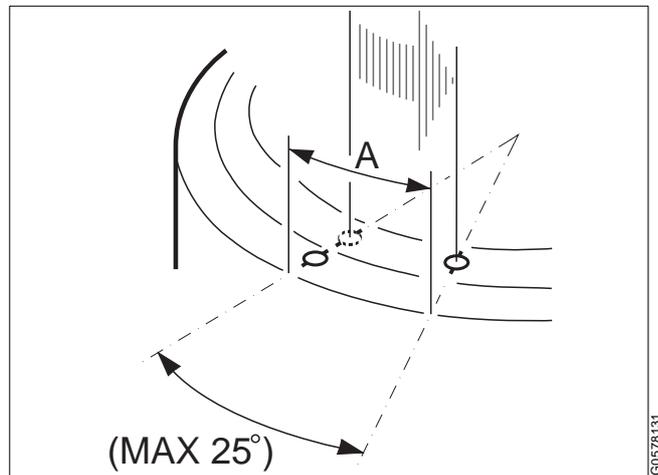
- e. Tighten until the assembly marks are at least in line.

✓ **Check point**

“5.3.5 Disc stack pressure” on page 52.

NOTE

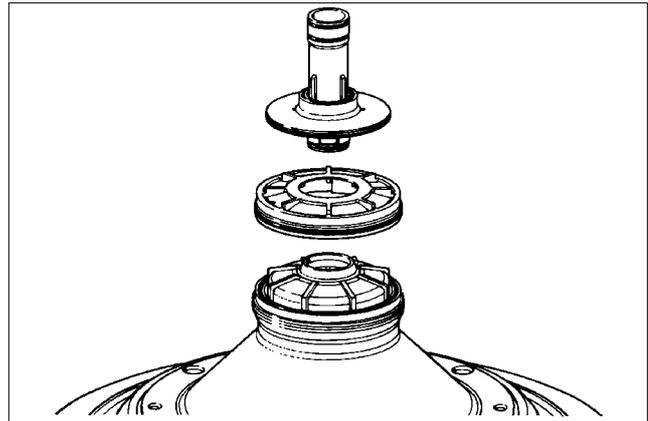
The assembly marks must never pass each other more than 25° which corresponds to A=120 mm.



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

11. Check that the small holes in the flow control disc and upper paring disc are not clogged.
Fit the flow control disc with O-ring, and the upper paring disc.

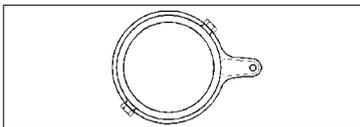
✓ **Check point**
“5.3.9 Inlet pipe and oil paring disc” on page 58.



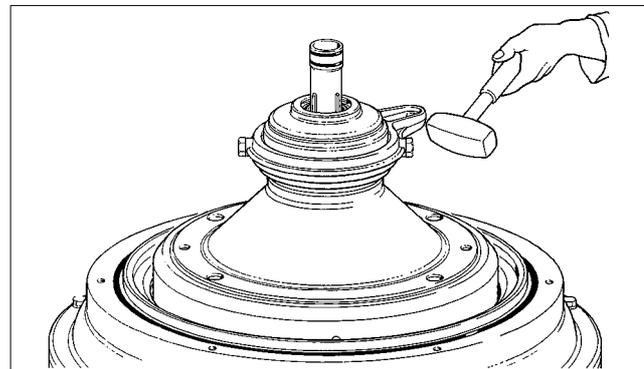
G0531111

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

Left-hand thread!



S0064711



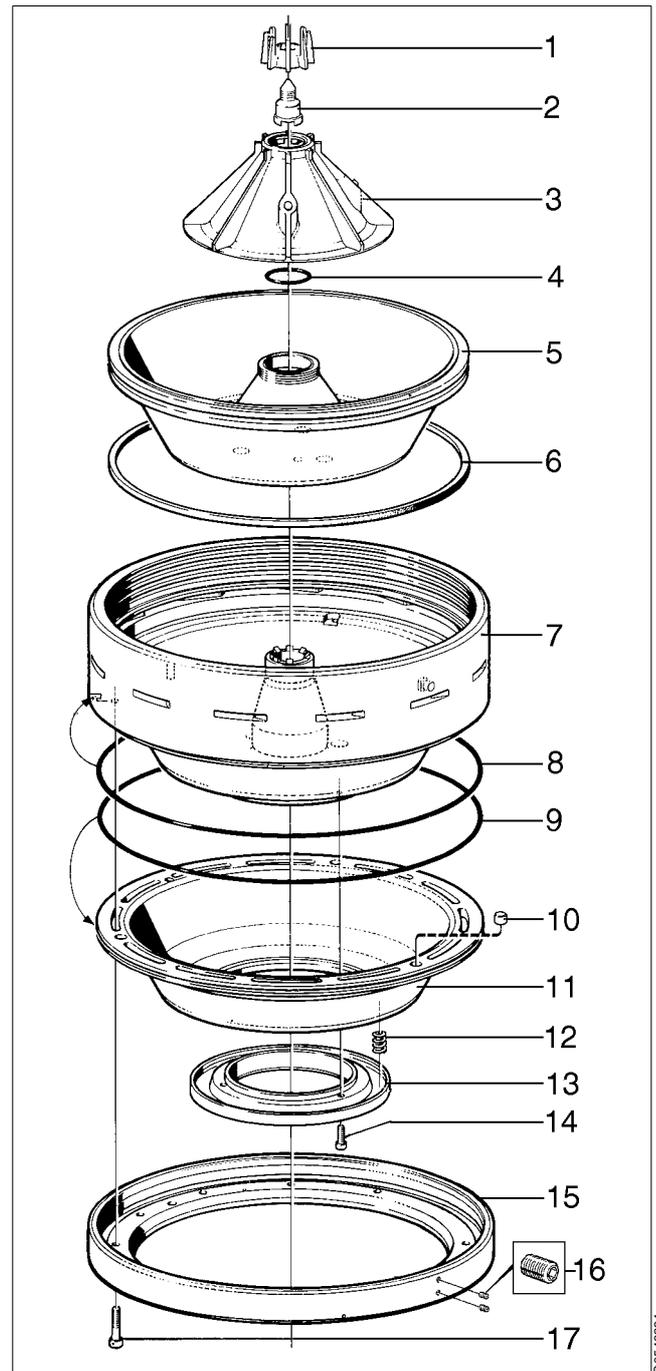
G0531021

6.4 Bowl body and operating mechanism (IS)

6.4.1 Exploded view

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

* Secured with Loctite 242.



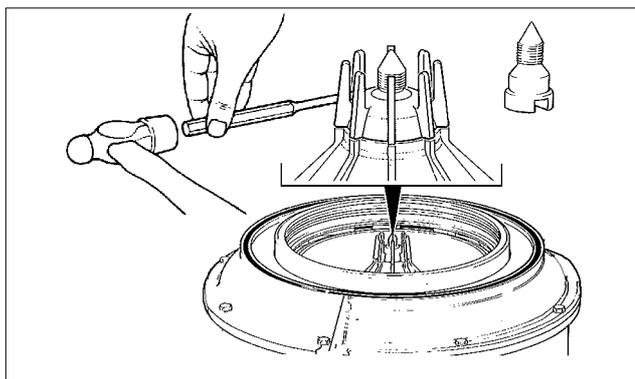
G0646231

6.4.2 Dismantling

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

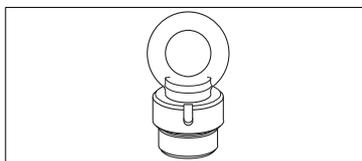
Left-hand thread!

Also remove the lifting stud.

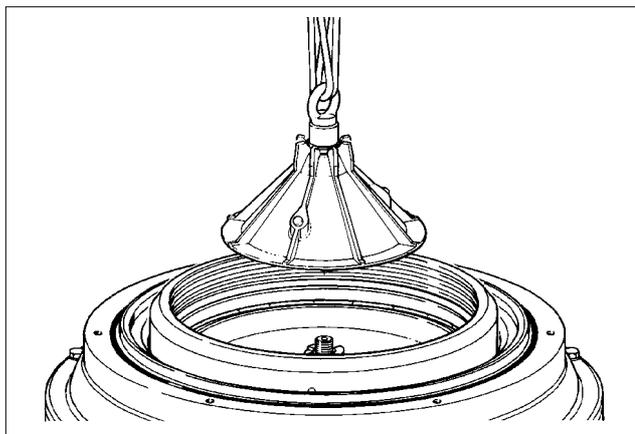


G0615721

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

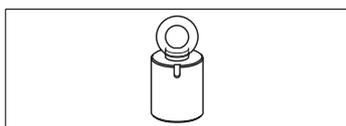


S0102511

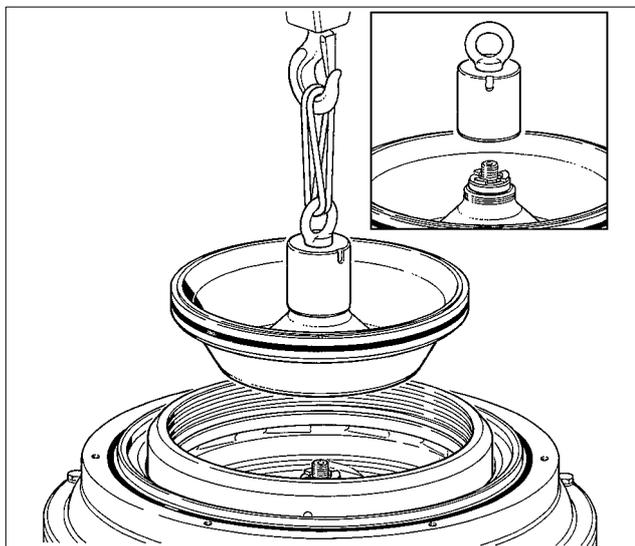


G0532721

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

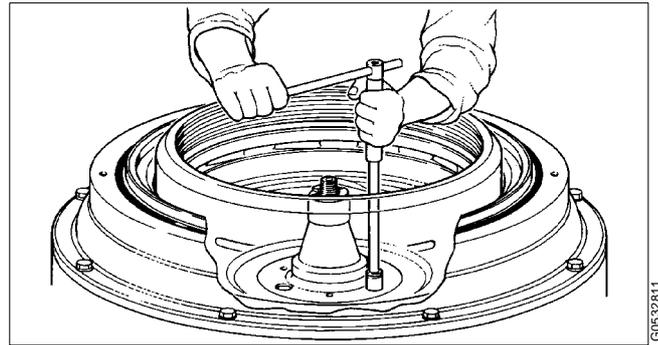


S0064811



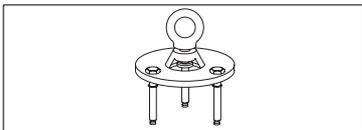
G0533211

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



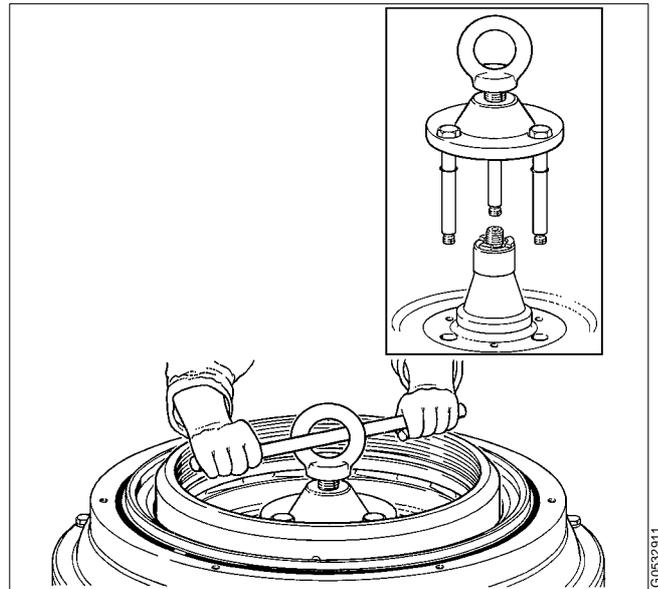
G0532811

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



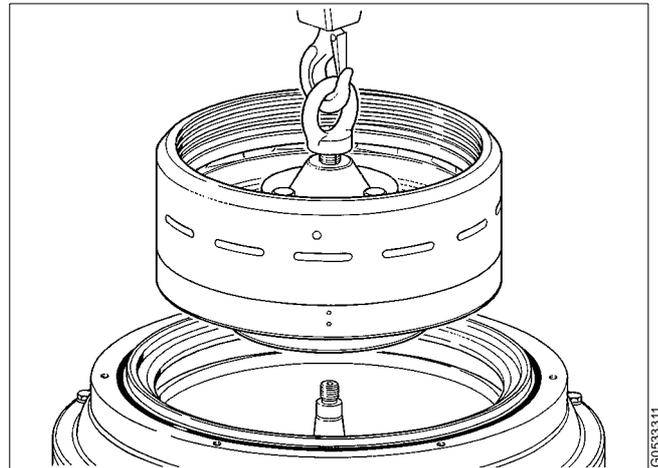
S0064611

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



G0532811

6. Lift out the bowl body by a hoist.



G0533311

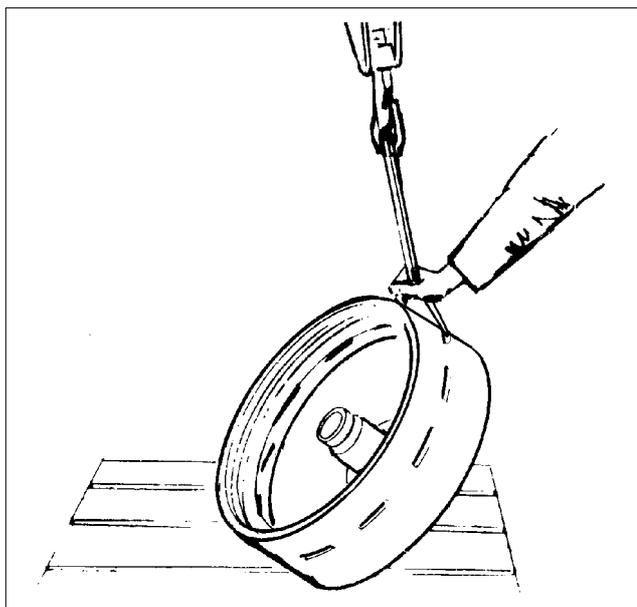
- 7. Thread a strap through two sludge ports and turn the bowl body upside down using a hoist.



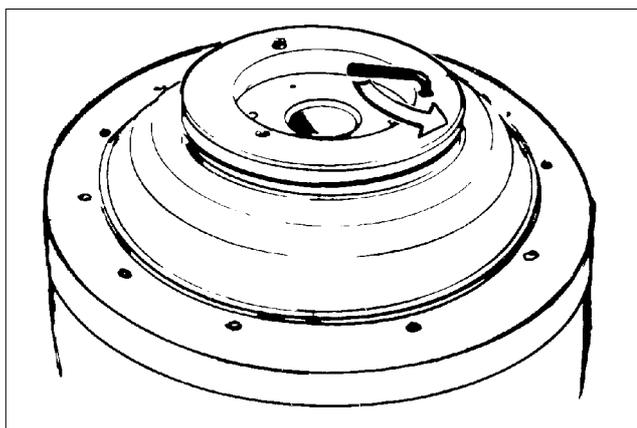
WARNING

Crush hazards

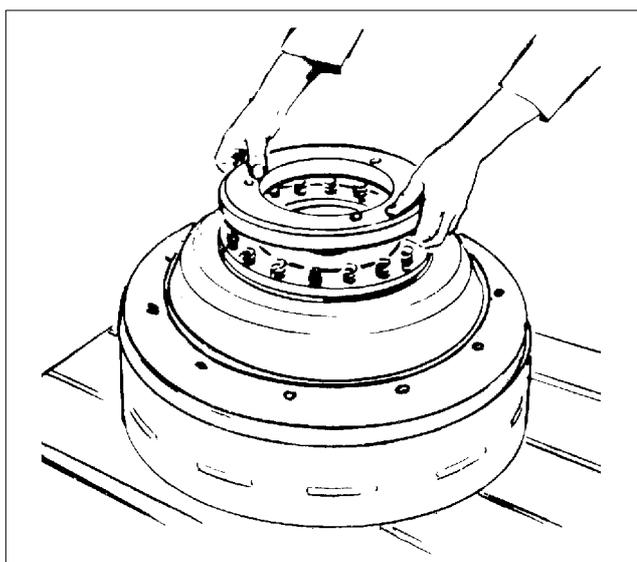
Support the bowl body when turning to prevent it from rolling.



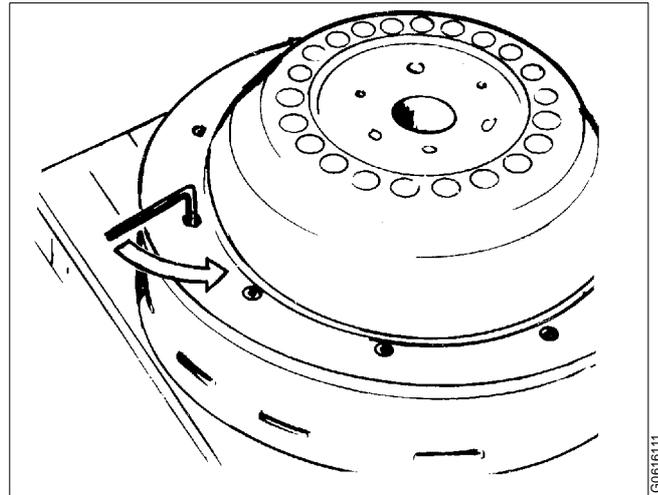
- 8. Loosen the screws for the spring support successively a little at a time. Remove the screws.



- 9. Remove the spring support and the springs.

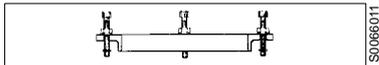


10. Unscrew the screws for the dosing ring.



G0616111

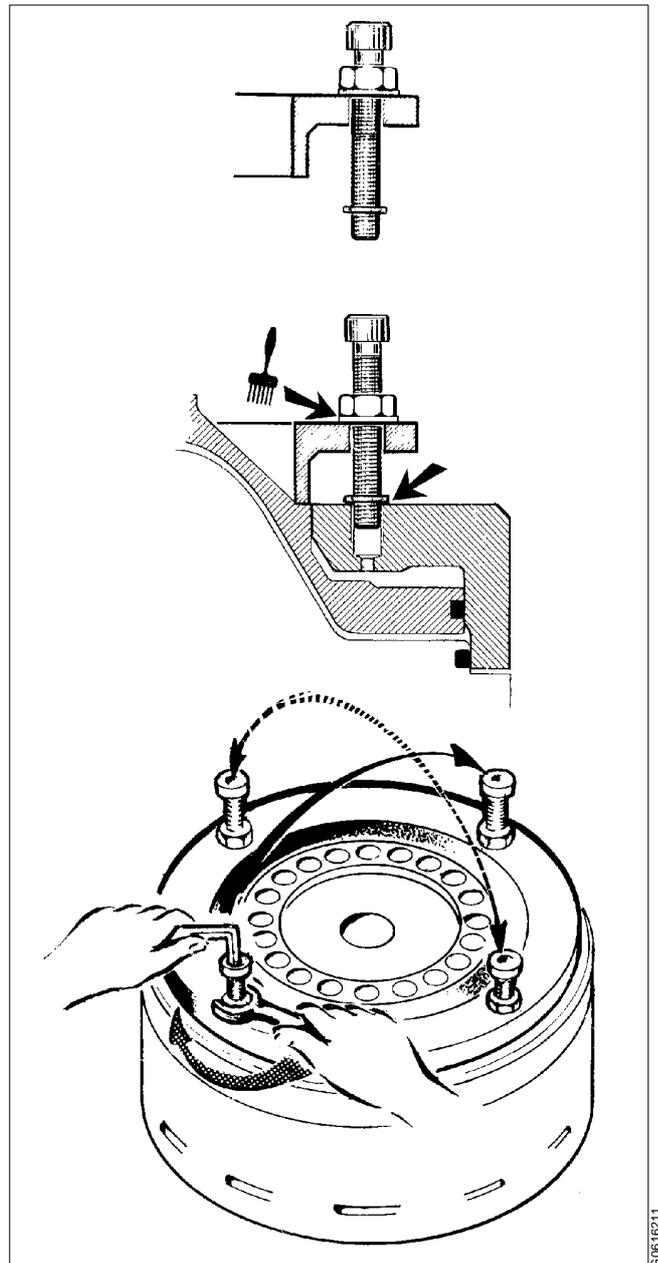
11. Dismantle the dosing ring from the bowl body with the special puller.



S0066011

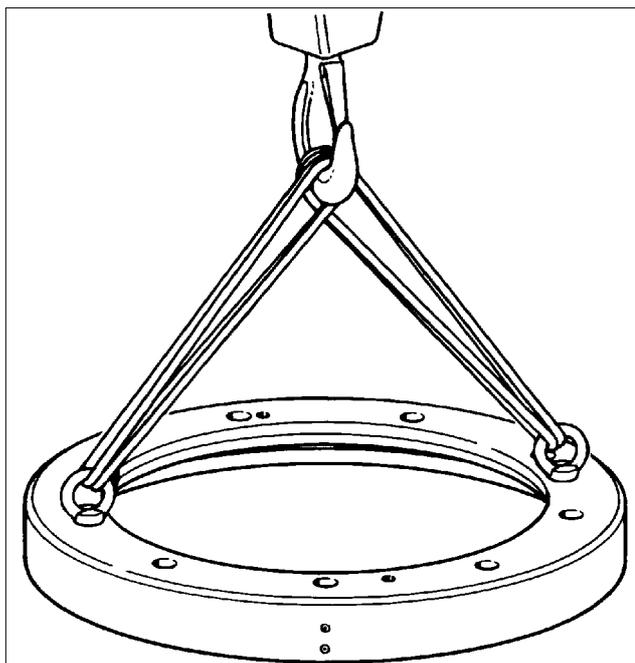
Proceed in the following way:

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

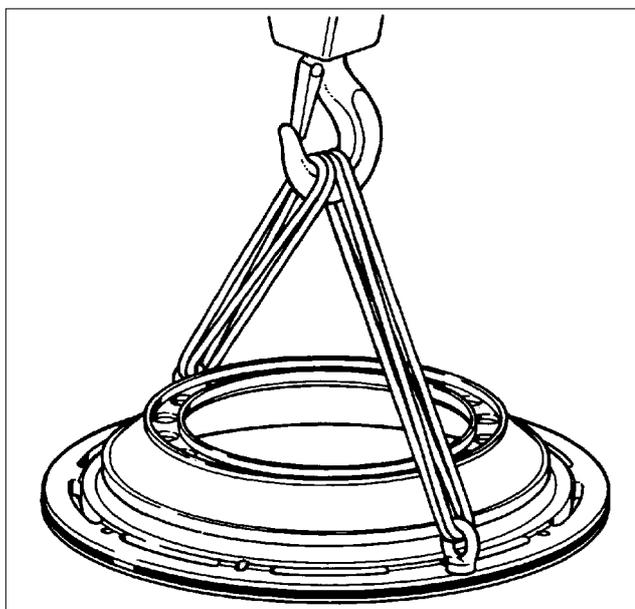
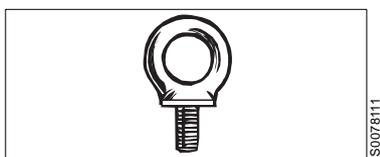


G0616211

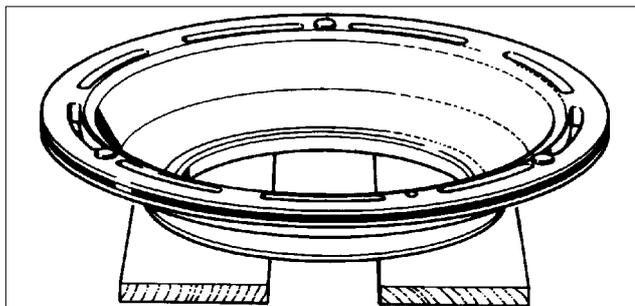
12. Fit two lifting eyes (M10) or two screws from the puller into the dosing ring and lift it off from the bowl body.



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



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

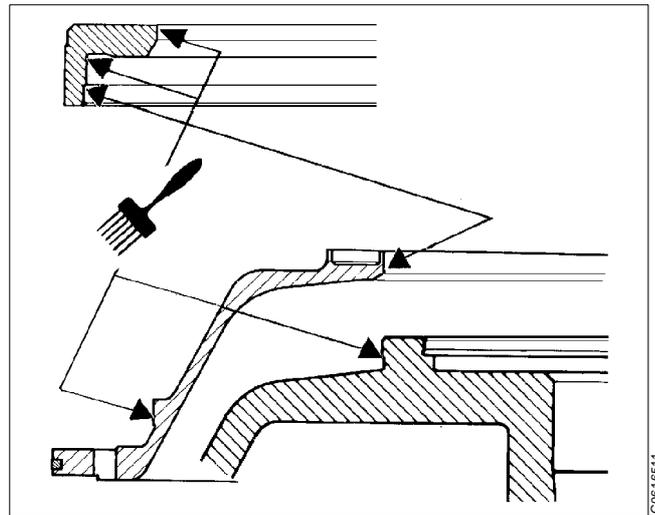


6.4.3 Assembly

✓ Check point

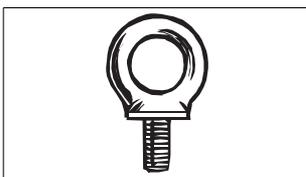
“5.3.3 Corrosion” on page 48,
 “5.3.4 Cracks” on page 51,
 “5.3.6 Dosing ring” on page 54,
 “5.3.7 Erosion” on page 54,
 “5.3.8 Guide surfaces” on page 56,
 “5.3.12 Operating mechanism” on page 61,
 “5.3.13 Operating slide” on page 61,
 “5.3.14 Sliding bowl bottom” on page 62,
 “5.3.15 Springs for operating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

1. Lubricate the guide surfaces of the bowl body, operating slide and dosing ring with lubricating paste. See chapter “8.6 Lubricants” on page 185.

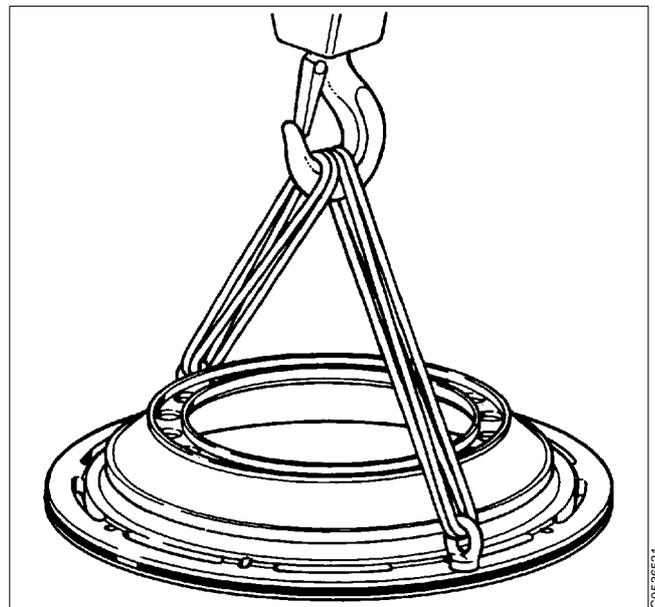


G0616511

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



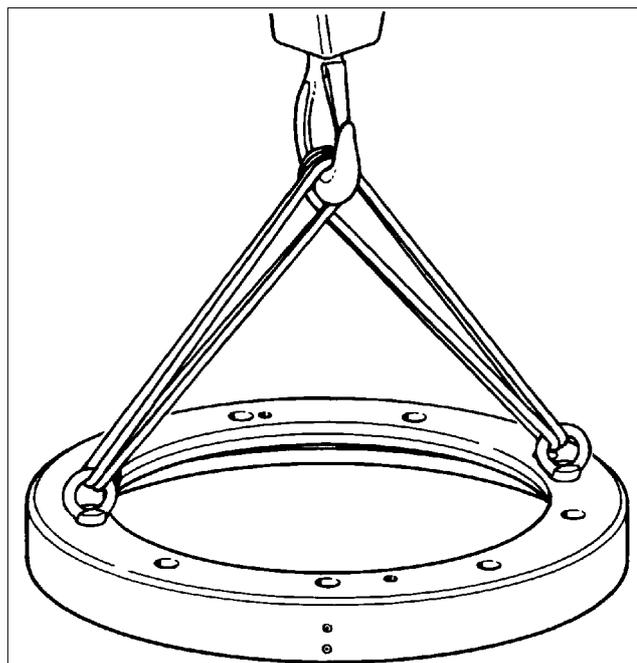
S0078111



G0536521

3. Fit the dosing ring.

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



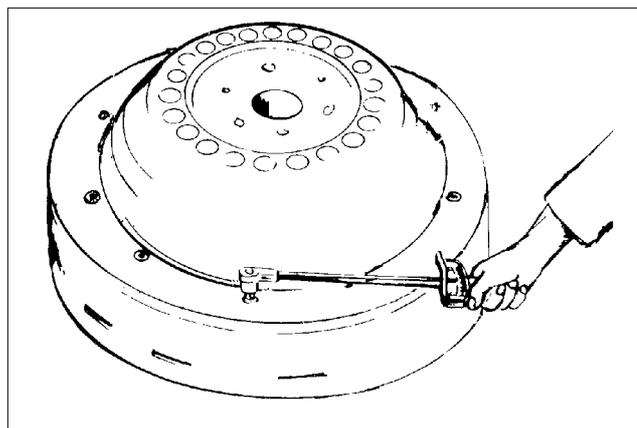
4. Apply only a thin film of lubricating paste on the screws for the dosing ring.

NOTE

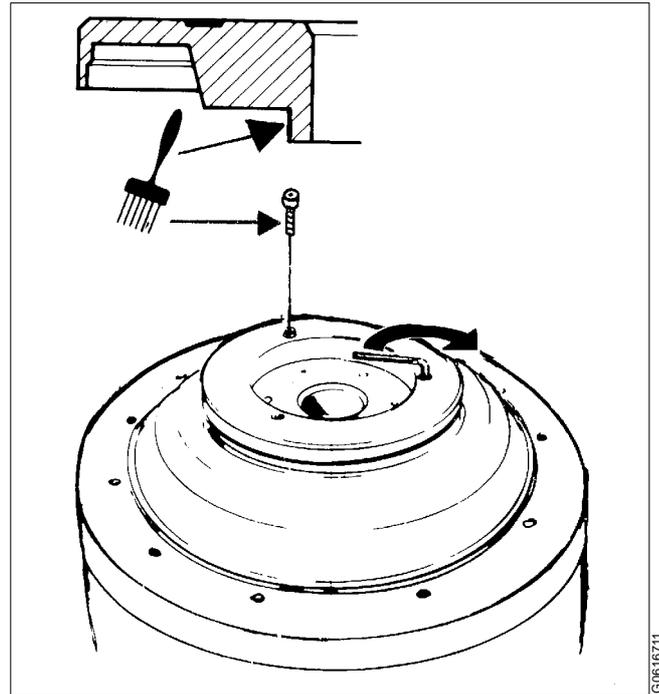
If there is too much lubrication paste applied, the surplus will collect between the operating slide and bowl body with risk for malfunction.

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

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



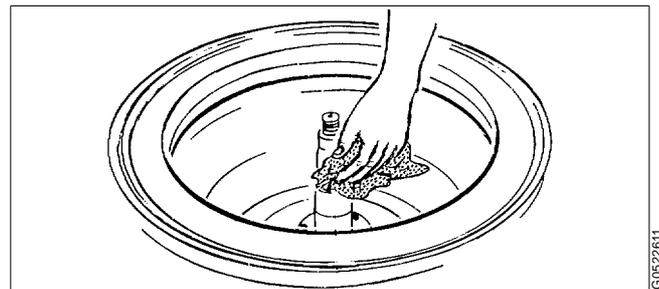
5. Lubricate the guide surfaces of the spring support. See chapter "8.6 Lubricants" on page 185.
Fit springs and support.
6. Tighten the three screws for the spring support successively by hand a little at a time.



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

✓ **Check point**

"5.3.2 Bowl spindle cone and bowl body nave" on page 48.



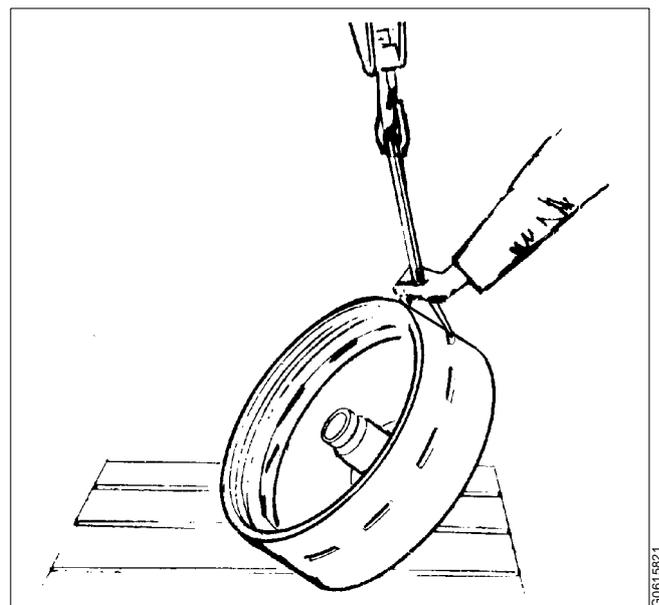
8. Turn the bowl body using a hoist to its up-right position with a strap threaded through two sludge ports.



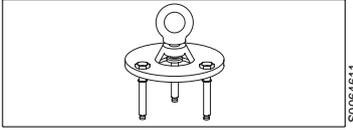
WARNING

Crush hazards

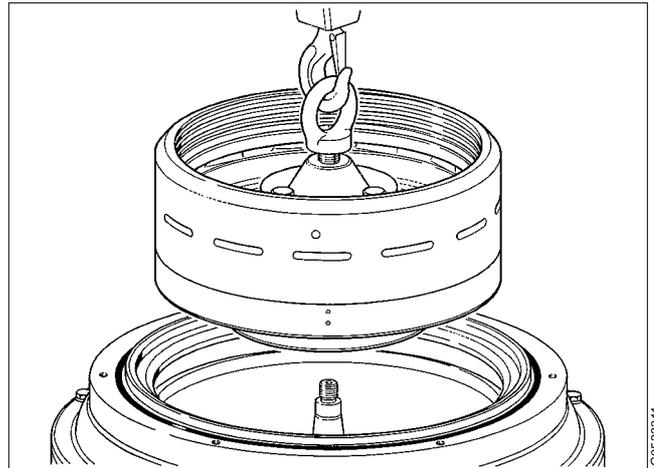
Support bowl body when turning to prevent it from rolling.



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

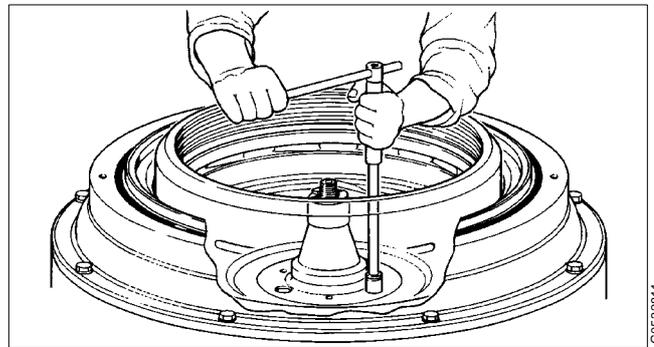


10. Lower the bowl body using a hoist until the central screw rests on the spindle top. Then screw up the central screw so that the bowl body sinks down onto the spindle.



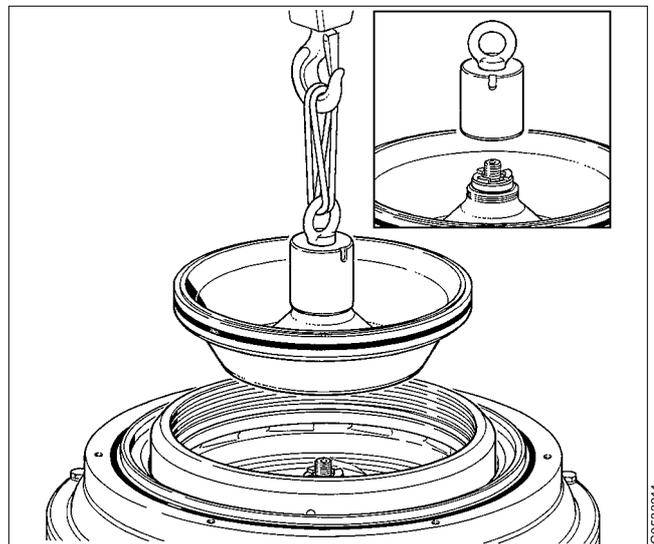
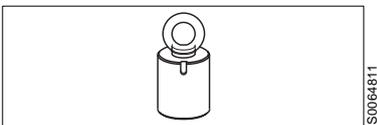
Remove the tool.

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

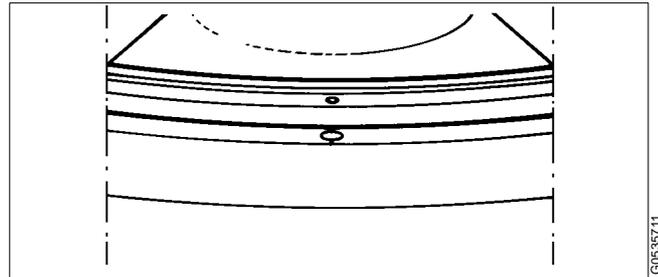


12. Lubricate the guide surfaces of the bowl body and sliding bowl bottom with lubricating paste. See chapter "8.6 Lubricants" on page 185.

13. Fit the lifting tool to the sliding bowl bottom and lift it into the bowl body using a hoist.
For correct position of the sliding bowl bottom, see next illustration.



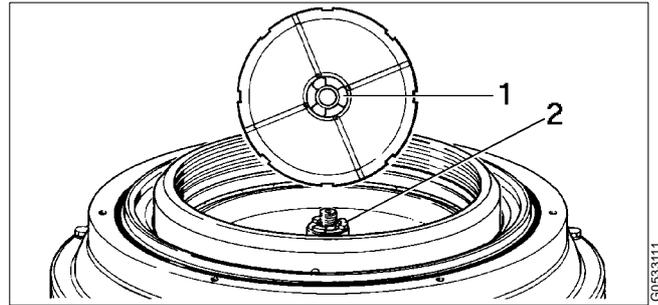
14. Bring the assembly mark on the sliding bowl bottom in line with the guide lug on the bowl body to ensure that the sliding bowl bottom enters into the correct position.



G0535711

15. Fit the distributing cone onto the bowl body.

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

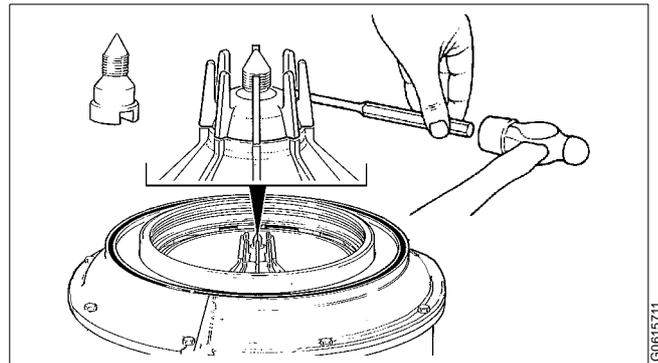


G0533111

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

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

Left-hand thread!

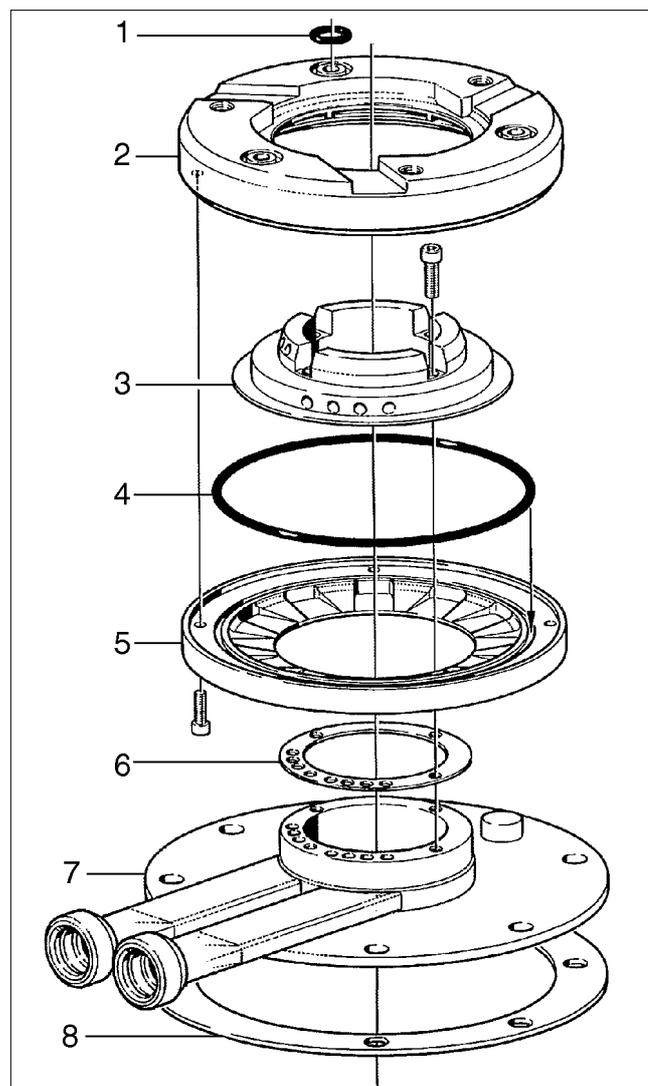


G0615711

6.5 Operating water device (IS)

6.5.1 Exploded view

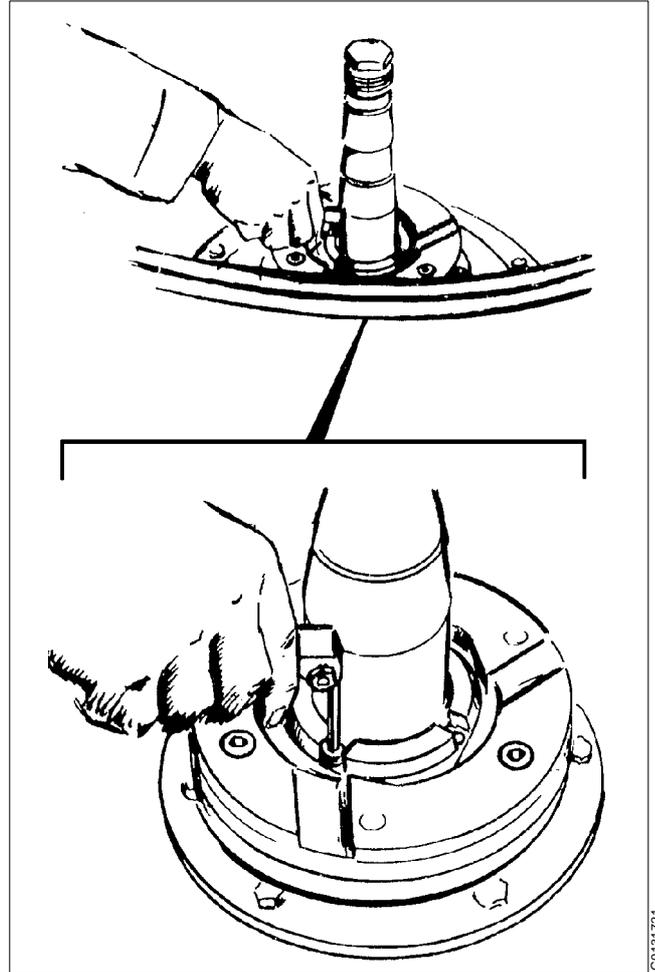
- 1. O-ring
- 2. Distributing ring
- 3. Operating paring disc
- 4. O-ring
- 5. Cover
- 6. Gasket
- 7. Distributing cover
- 8. Height adjusting ring



G0587911

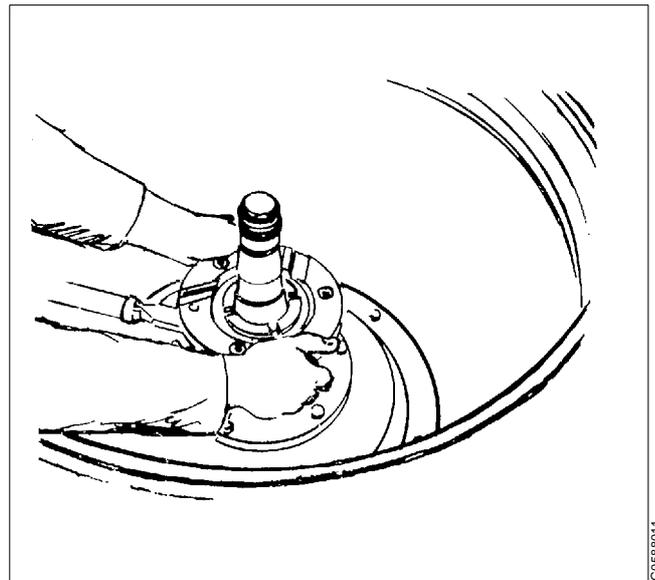
6.5.2 Dismantling

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



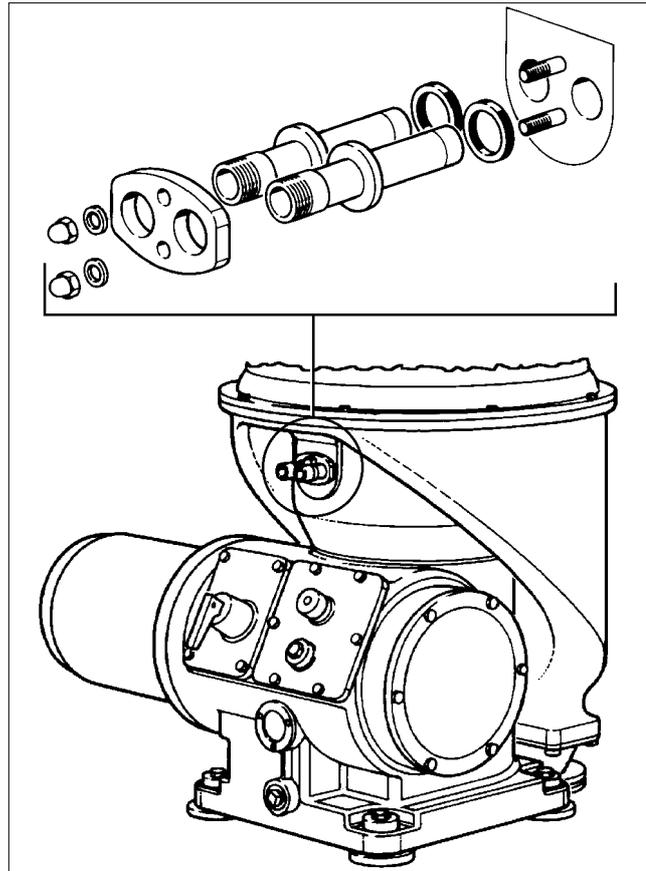
G0131721

2. Lift out the paring disc device.



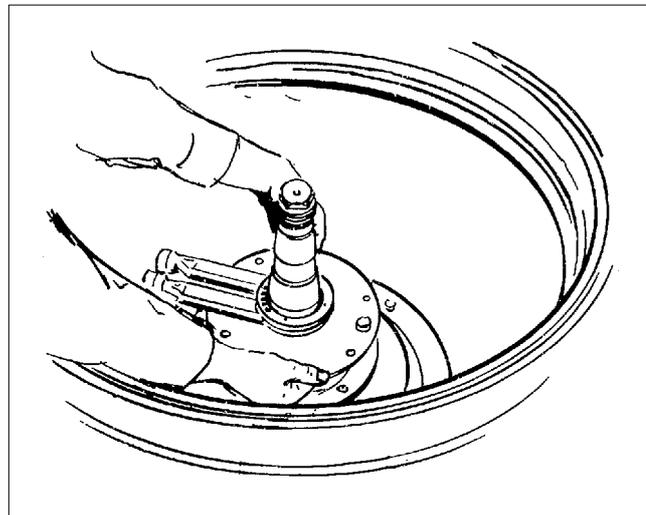
G0689011

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



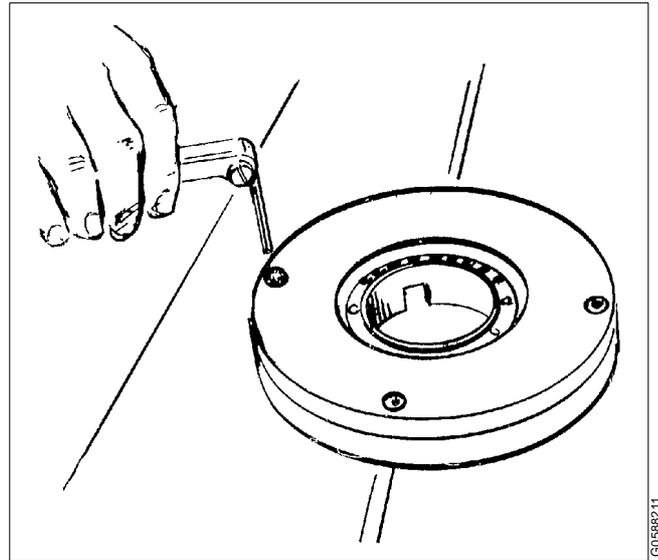
G0548311

- 4. Loosen the screws and lift out the distributing cover.

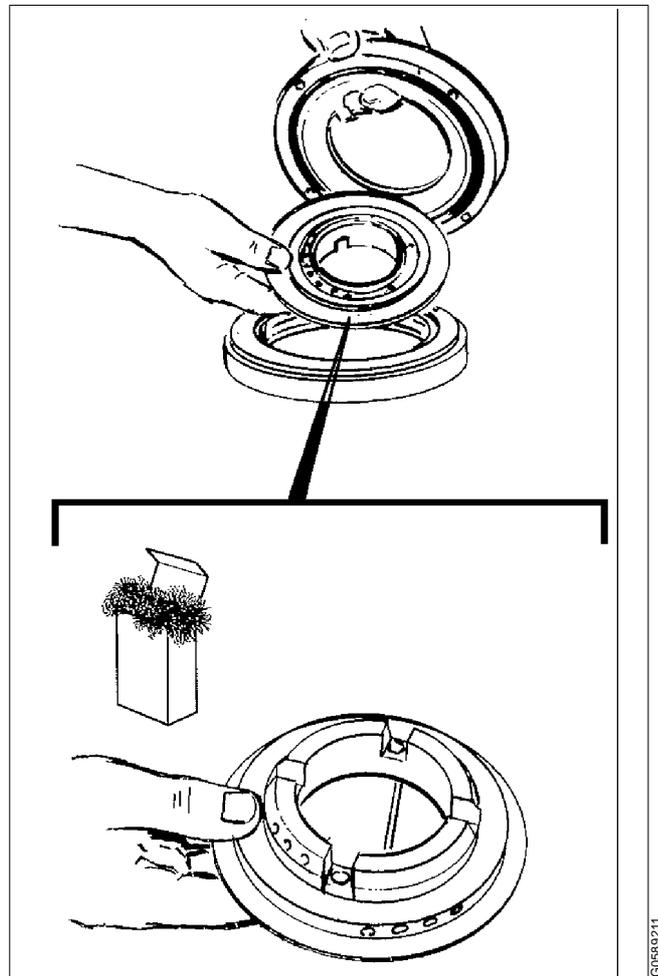


G0568111

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

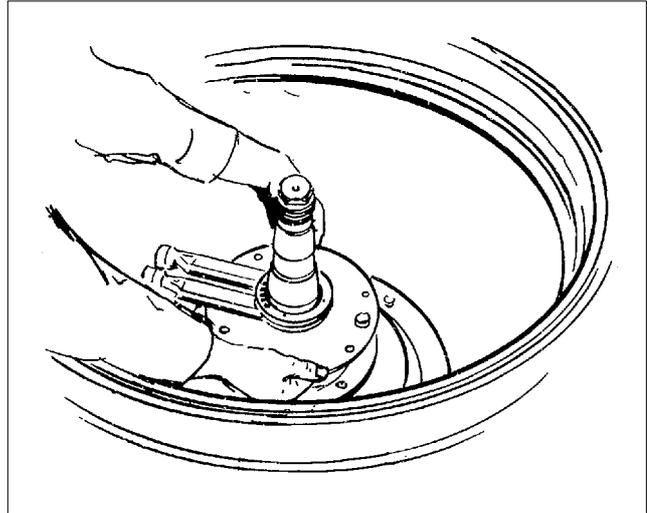


6. Remove deposits and clean all parts thoroughly in a suitable cleaning agent. Pay special attention to the channels. See chapter "5.6 Cleaning" on page 79.
7. Check the parts for damage and corrosion.



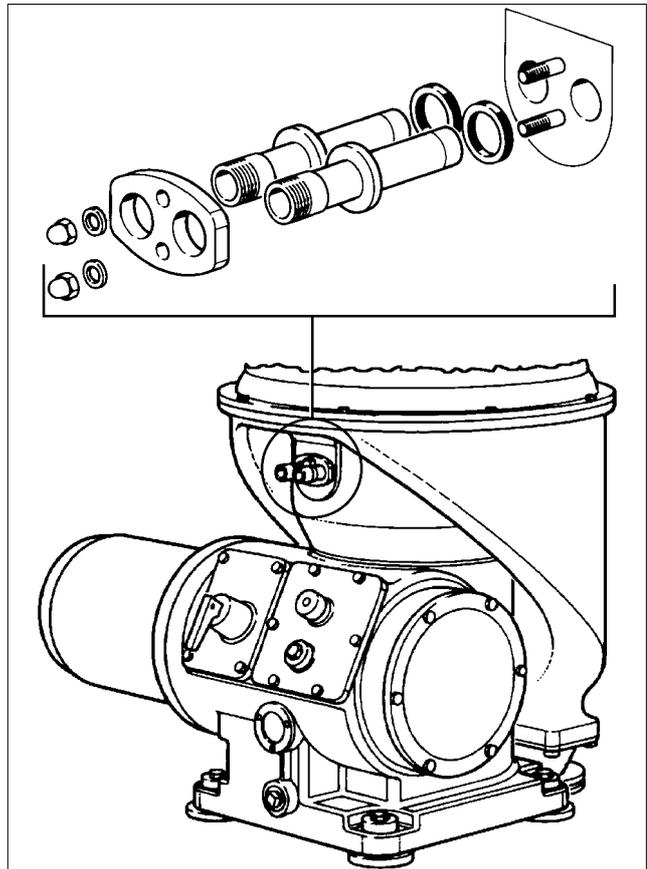
6.5.3 Assembly

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



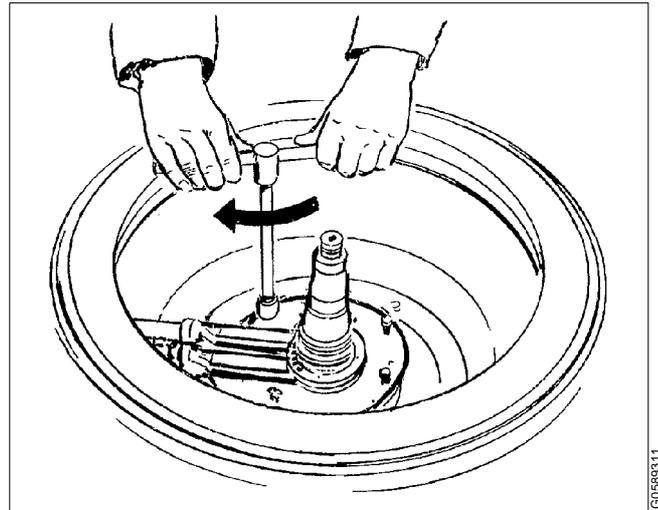
G0588111

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



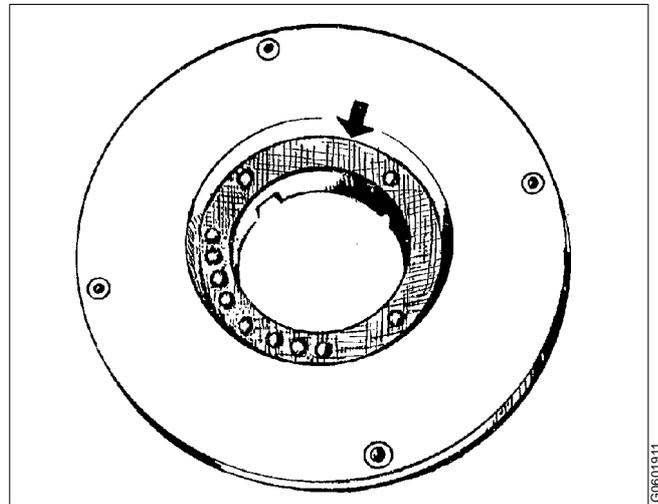
G0548311

3. Fasten the distributing cover.



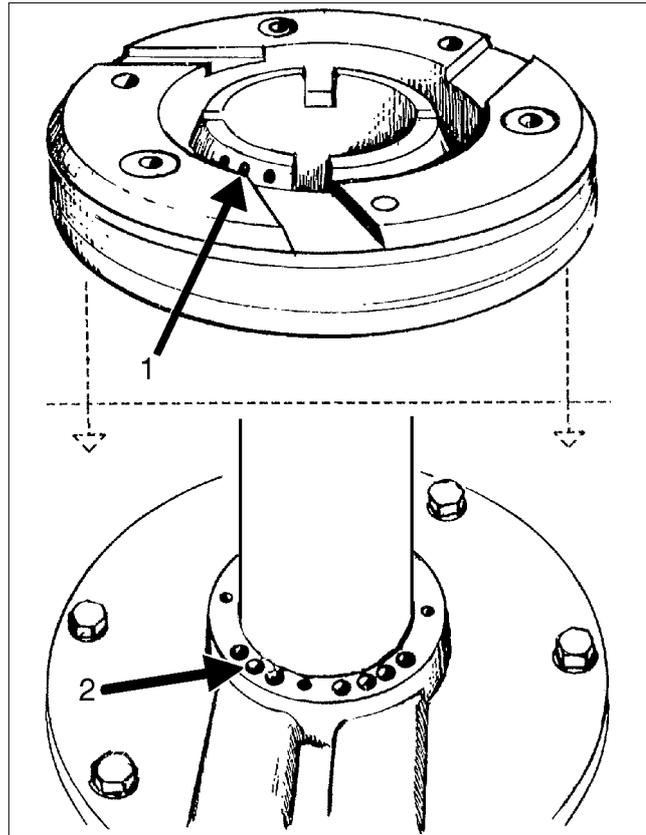
G0589311

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



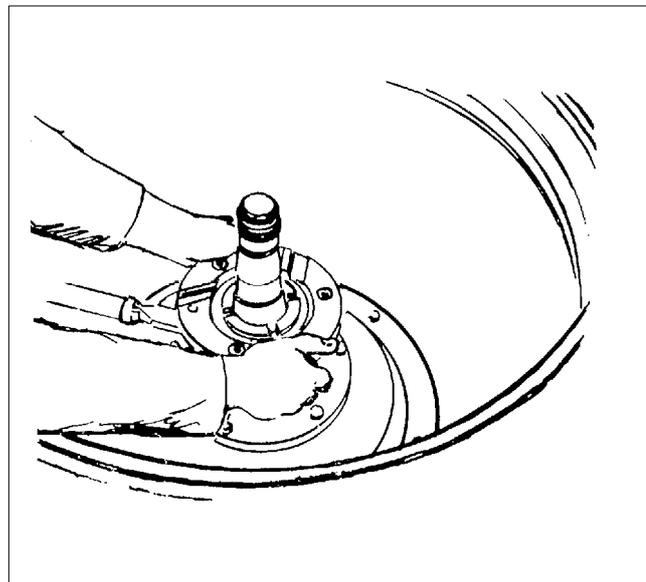
G0601911

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



G0569421

6. Fit the paring disc device in its place.

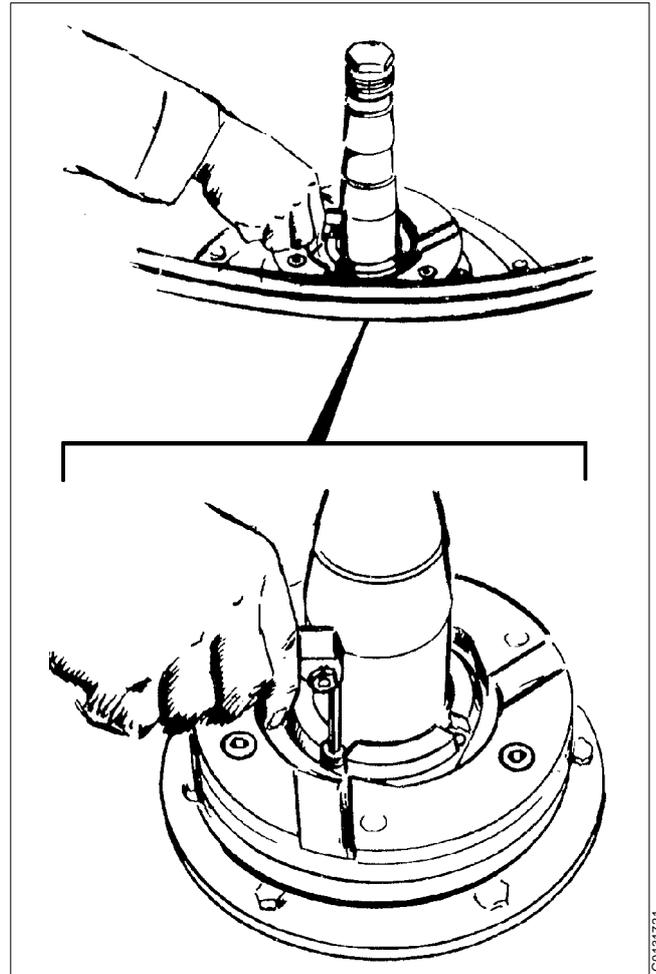


G0568011

7. Tighten the screws of the paring disc.

✓ **Check point**

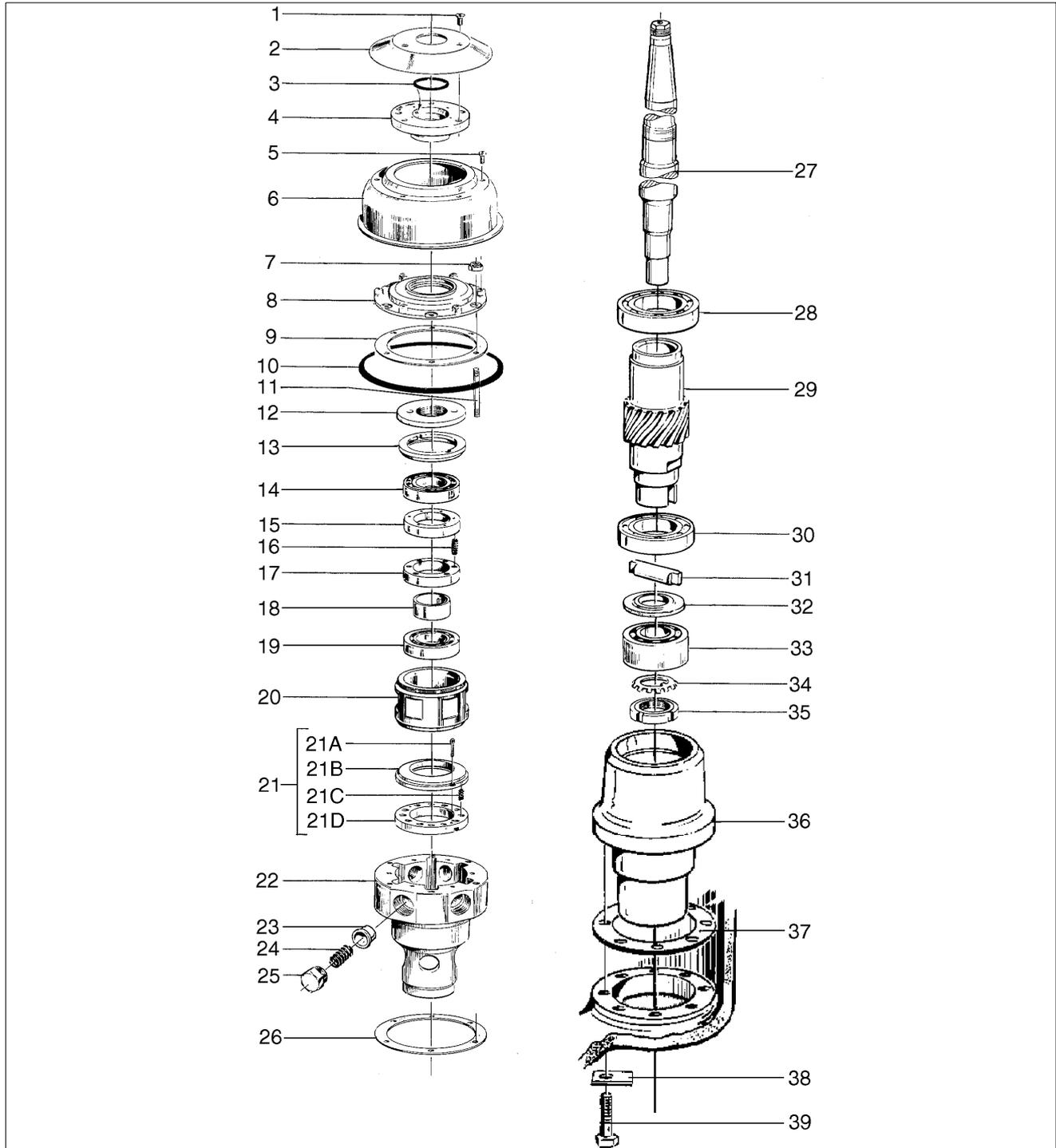
“5.4.20 Operating paring disc; height position”
on page 74. Only at Major Service (MS).



G0131721

6.6 Vertical driving device (MS)

6.6.1 Exploded view



C00794/E1

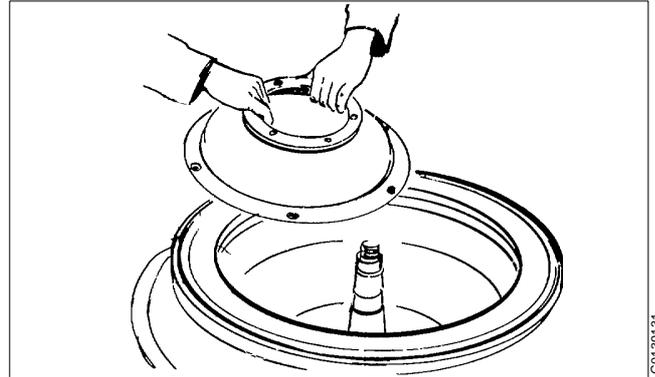
- | | | | |
|-----|-----------------------------|-----|----------------------|
| 1. | <i>Screw</i> | 22. | <i>Spring casing</i> |
| 2. | <i>Protecting plate</i> | 23. | <i>Buffer</i> |
| 3. | <i>O-ring</i> | 24. | <i>Spring</i> |
| 4. | <i>Protecting collar</i> | 25. | <i>Screw plug</i> |
| 5. | <i>Screw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

6.6.2 Dismantling

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

NOTE

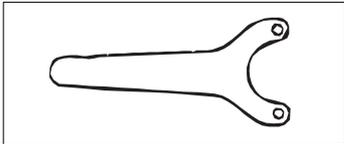
Clean the space in the bowl casing thoroughly before starting to dismantle the bowl spindle to prevent contaminations falling down into the oil gear housing.



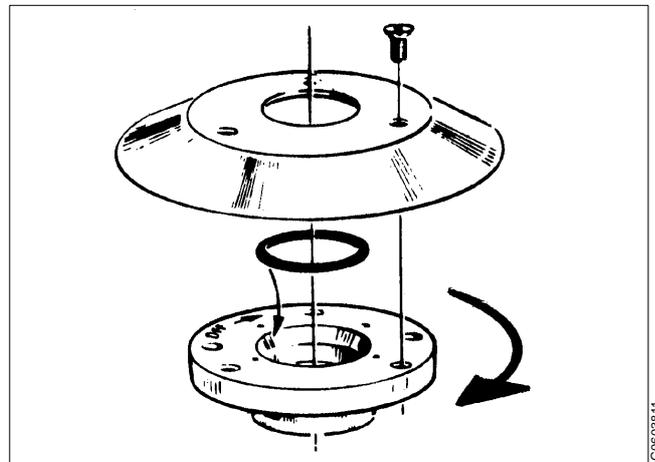
G0139131

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

Left-hand thread!

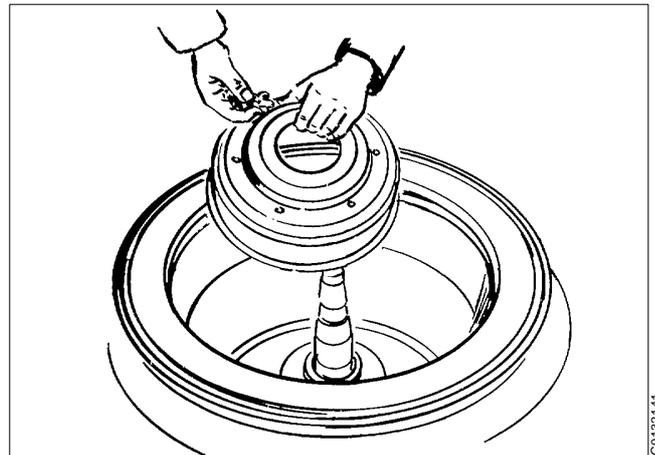


S0071811



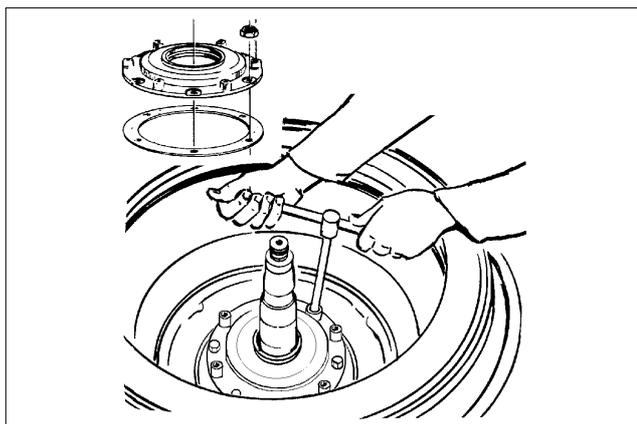
G0603811

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

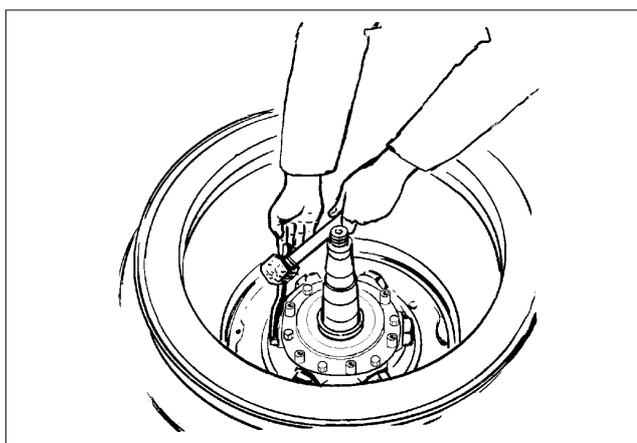


G0132141

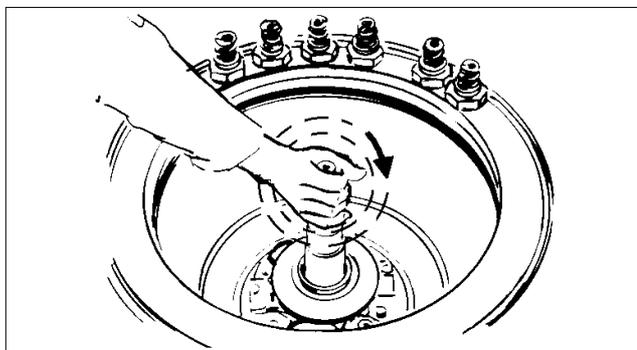
4. Unscrew the six nuts and remove the cover and gasket.



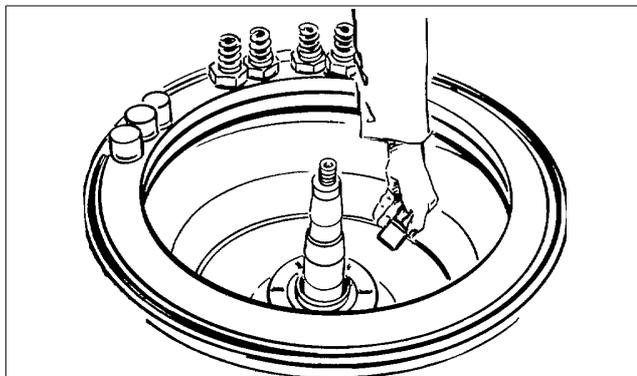
5. Loosen (but do not remove) the six screw plugs for the buffers with a spanner and a hammer.



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



7. Remove the six buffers from the spring casing.



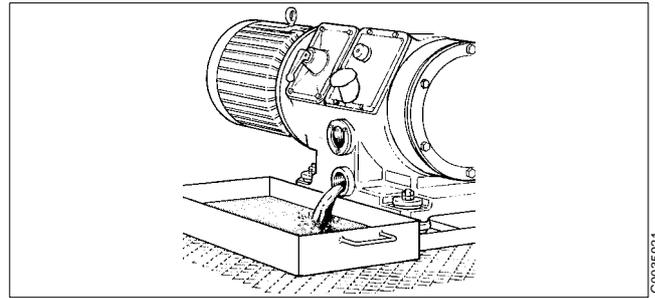
8. Drain the oil from the worm gear housing.



CAUTION

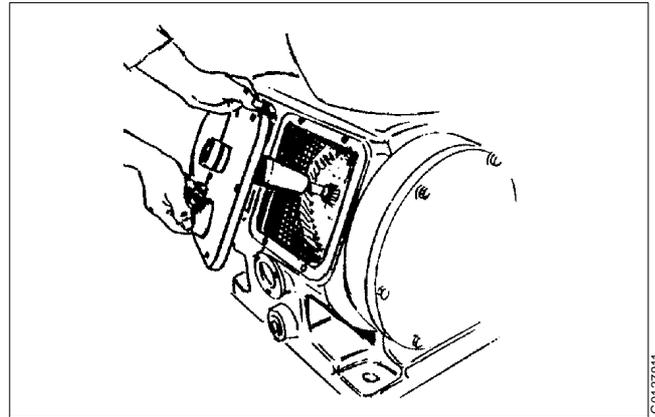
Burn hazards

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



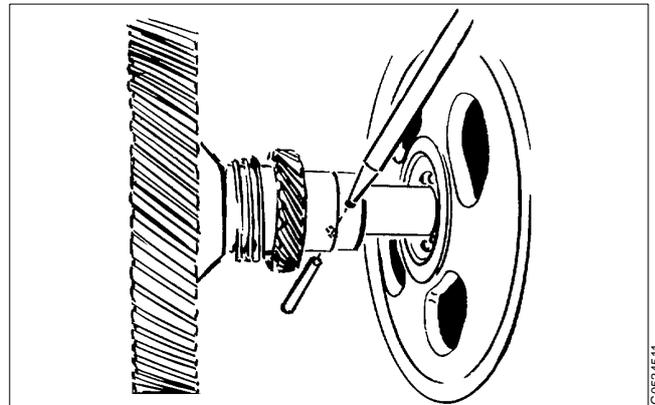
G0035921

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



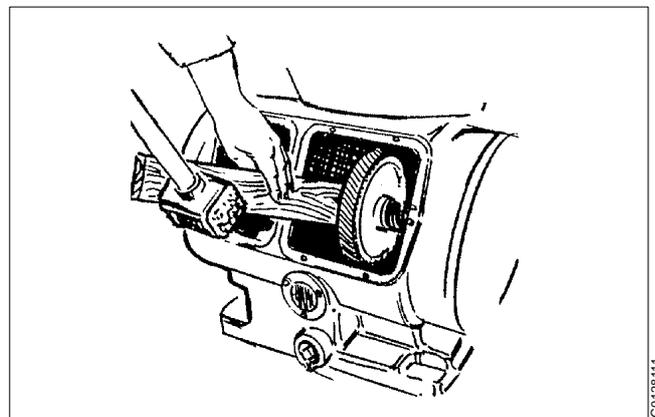
G0127911

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



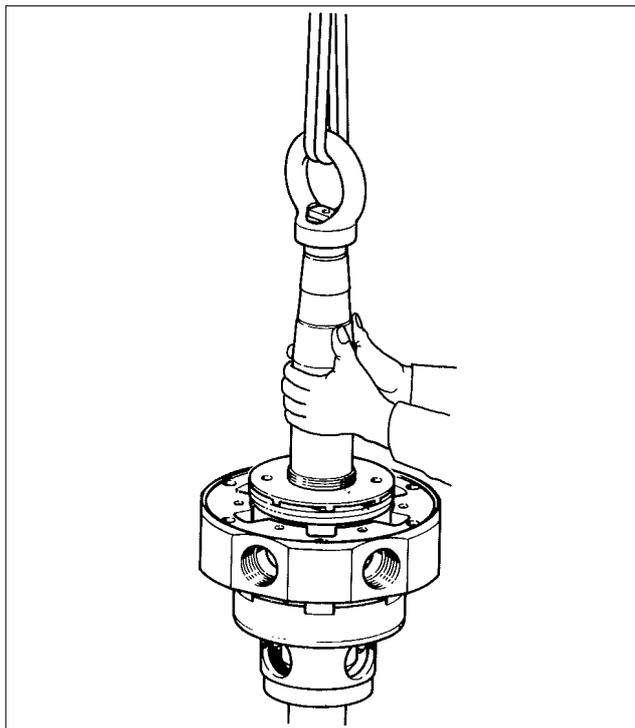
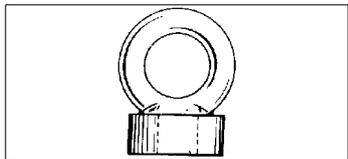
G0524511

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

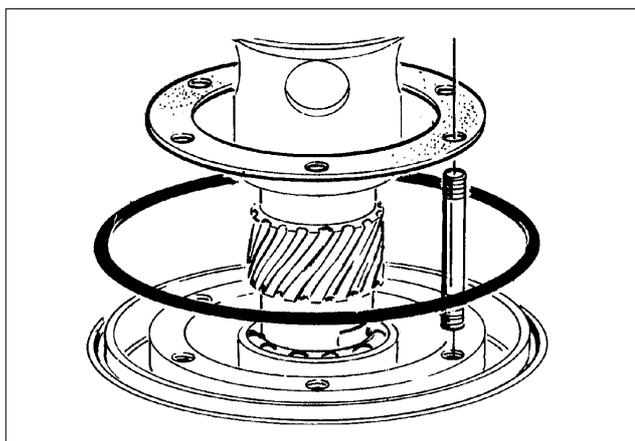


G0128111

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



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



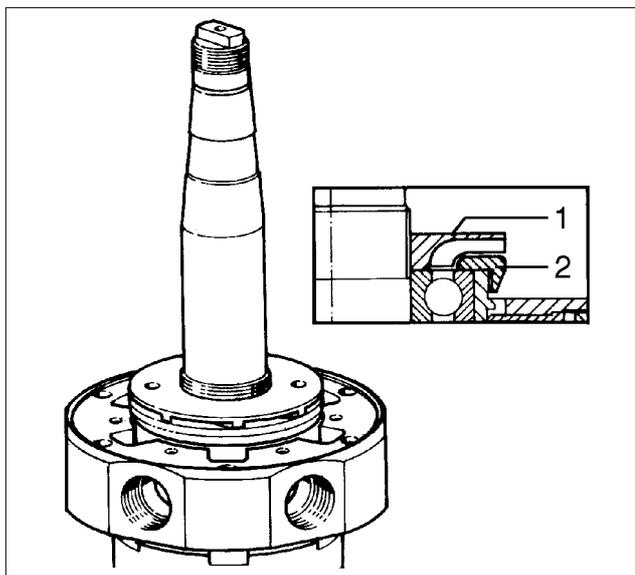
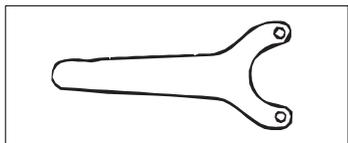
14. Unscrew

- the oil fan (1) clockwise

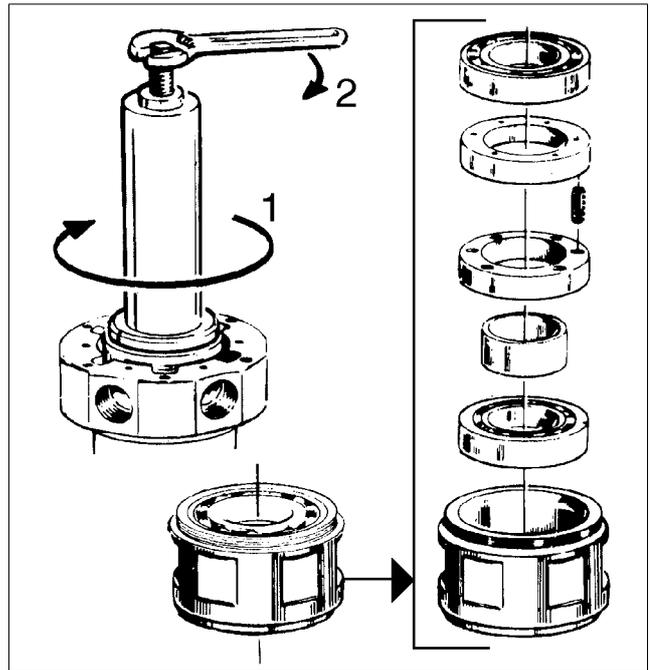
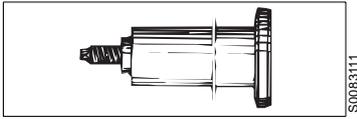
Left-hand thread!

- the lock ring (2) counter-clockwise

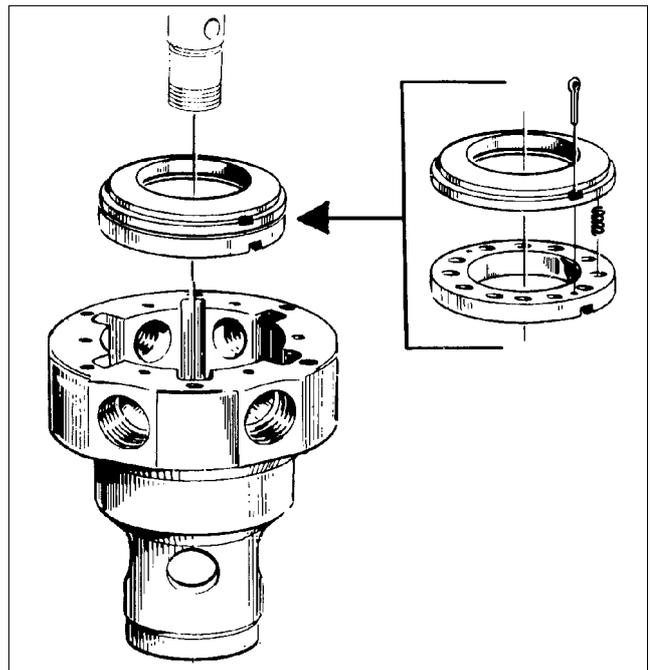
Right-hand thread!



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



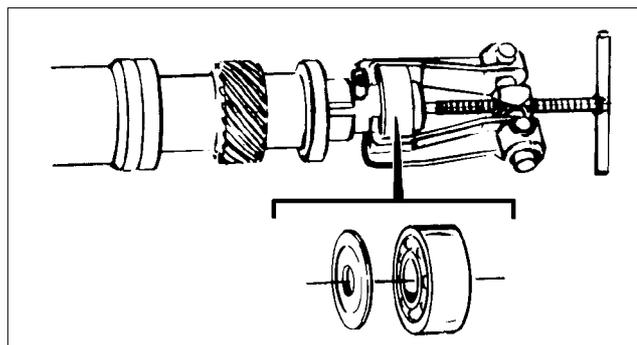
- 16. Remove the buffer.



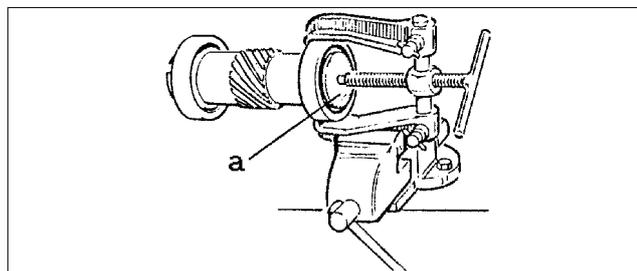
17. To strip the spindle, unscrew the round nut and remove the lock washer.

Pull off the bearing together with the intermediate washer.

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



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



6.6.3 Assembly

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



WARNING

Burn hazards

Use protective gloves when handling the heated bearings.

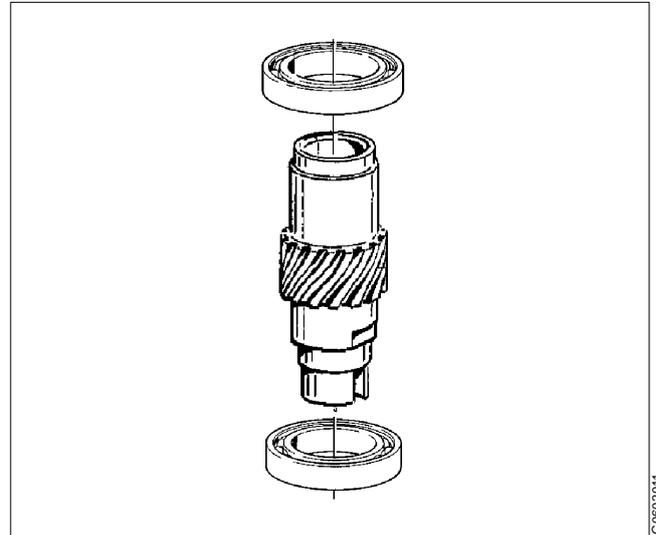
NOTE

If in doubt how to mount roller bearings correctly, see the detailed description in chapter "5.9.1 Ball and roller bearings" on page 89.

✓ **Check point**

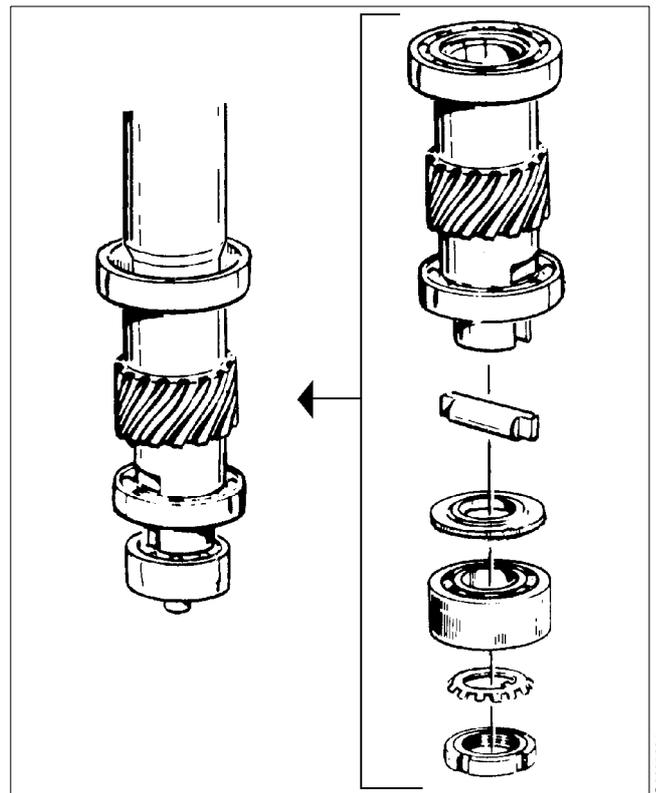
“5.4.24 Worm; wear of groove” on page 76
 “5.7.1 Worm wheel and worm; wear of teeth”
 on page 83.

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



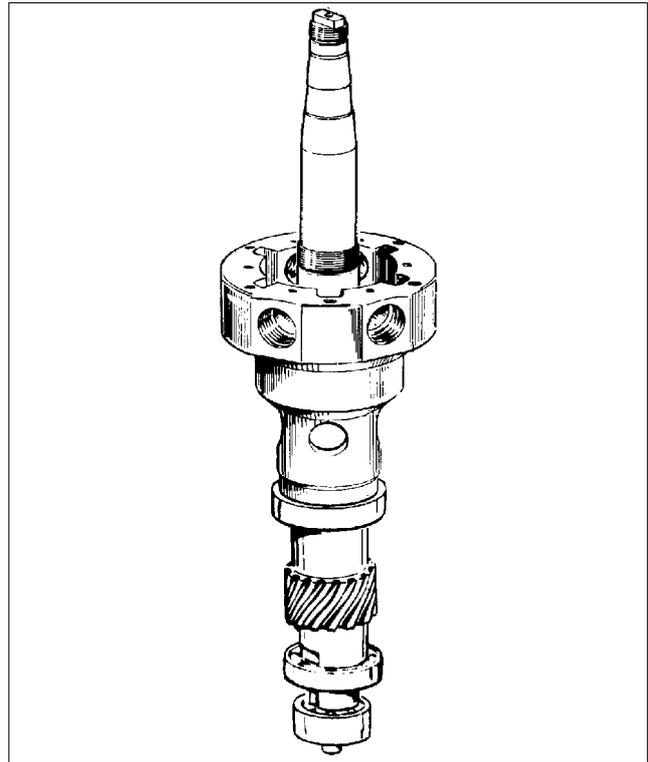
G 06602011

2. Fit the worm onto the spindle.
3. Fit the protecting washer and the heated ball bearing.
 Fix the bearing with the round nut and lock washer.
4. Place the conveyor through the groove in the worm and hole in the bowl spindle.



G 06605621

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

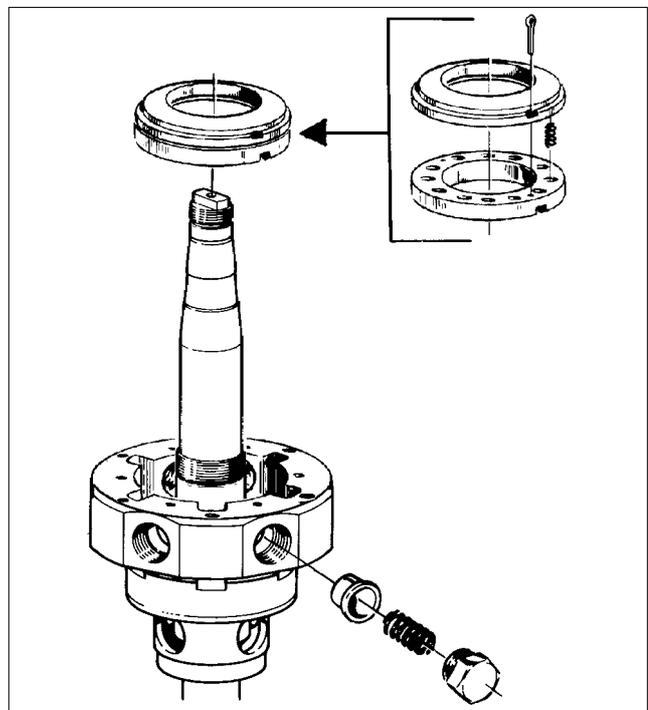


G0905411

✓ **Check point**

“5.4.5 Buffer springs and ball bearing housing” on page 66.

6. Place the axial buffer in the spring casing .

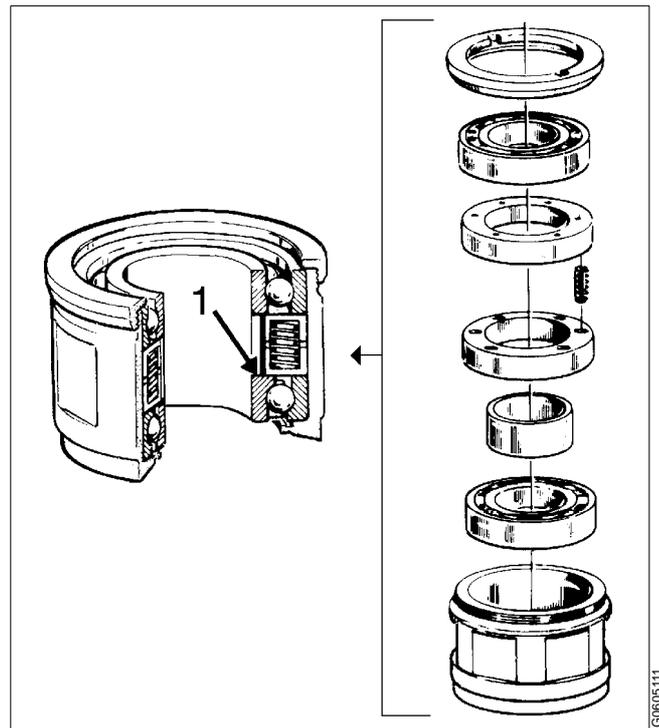
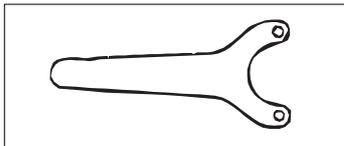


G0605421

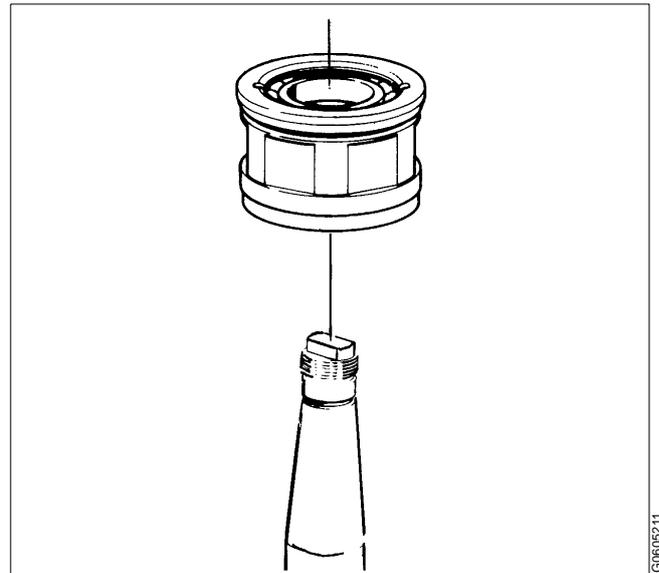
7. Assemble the parts included in the bearing housing as shown in the illustration.
If the bearings cannot be pushed in by hand, heat the ball bearing housing in oil.

NOTE

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

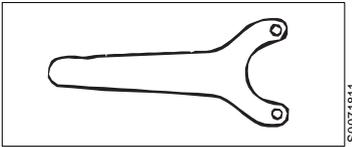


8. Fit the bearing housing onto the bowl spindle.
Heat the housing in oil to facilitate the fitting.



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

Left-hand thread!

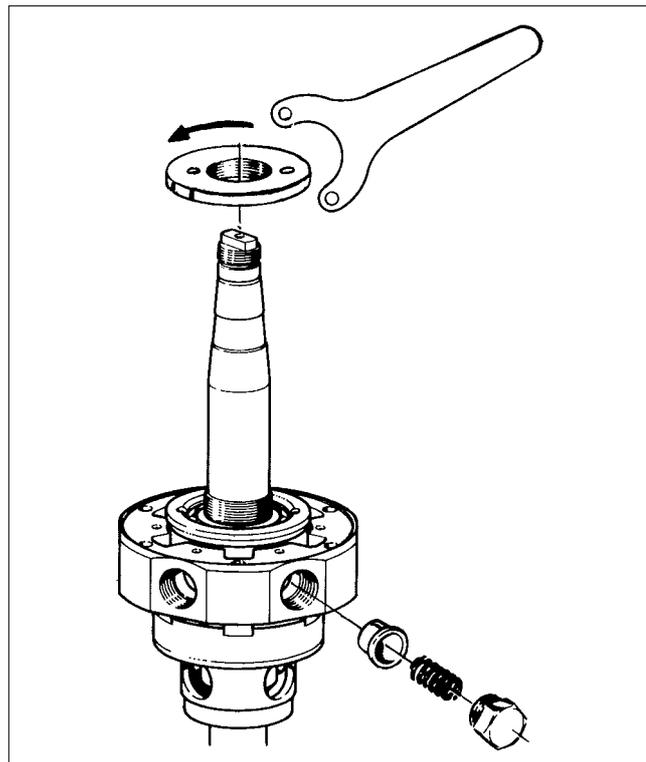


The oil fan will fix the bearing housing into the spring casing.

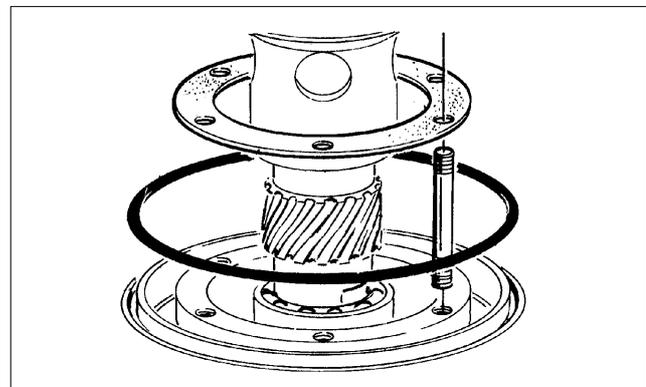
10. Fit the buffers, springs and screw plugs into the bearing housing.

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

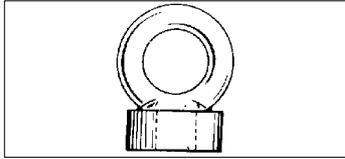
The final tightening of the plugs, in criss-cross fashion to prevent displacing of the spindle, is preferably done when the spindle has been placed in the frame.



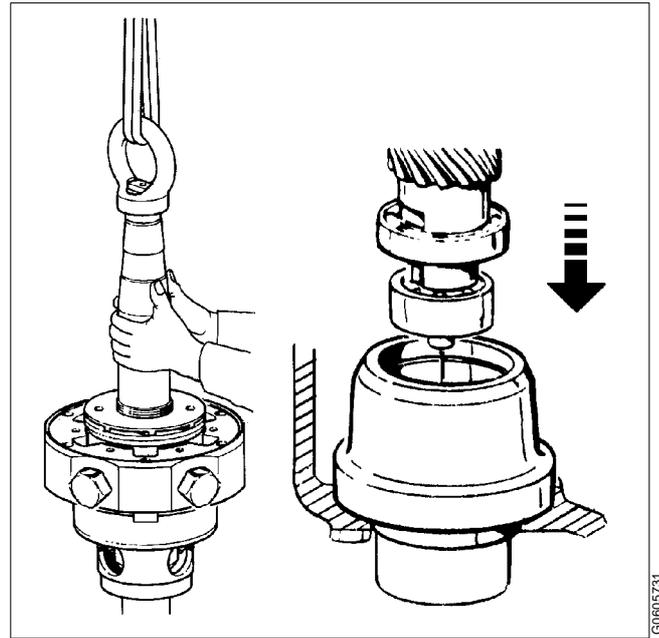
11. Fit the O-ring and gasket into the separator frame.



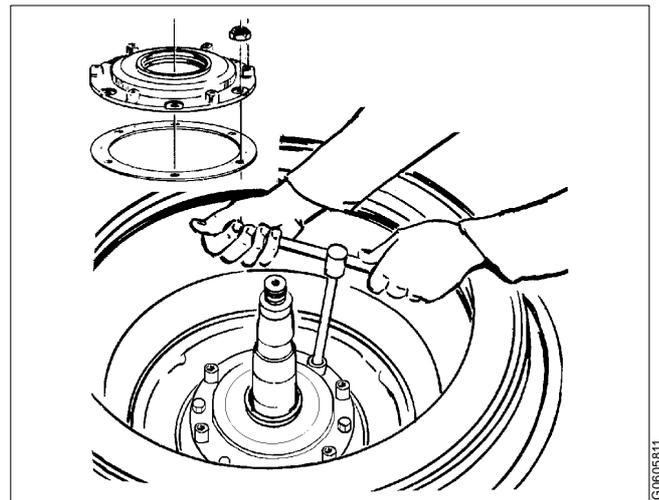
12. Fit the lifting tool to the spindle and lift it by a hoist.



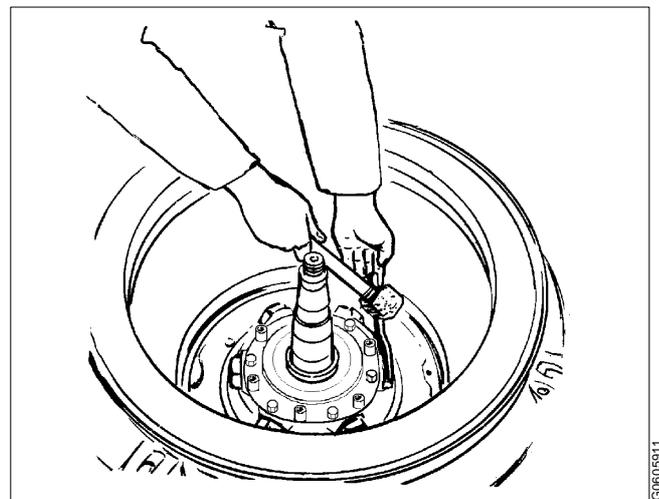
13. Carefully lower the spindle into the frame.
Guide the bearings into the bottom sleeve. If they not completely enter their seats, tap the spindle top with a soft hammer.



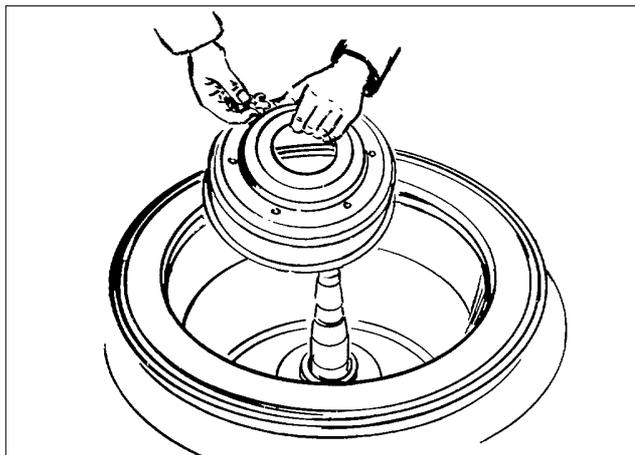
14. Fit the gasket and cover above the spring casing and tighten the nuts.



15. Tighten the screw plugs.



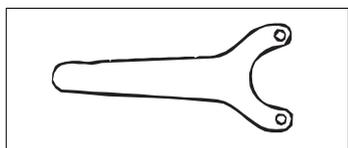
16. Fit the guard and tighten the six screws.



G0132141

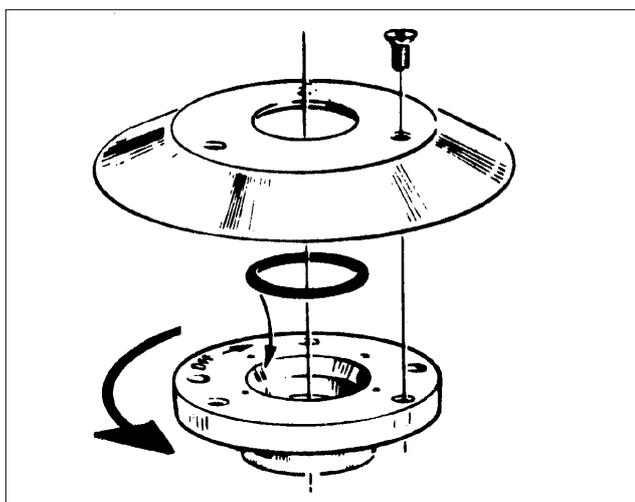
17. Fit the protecting collar.

Left-hand thread!



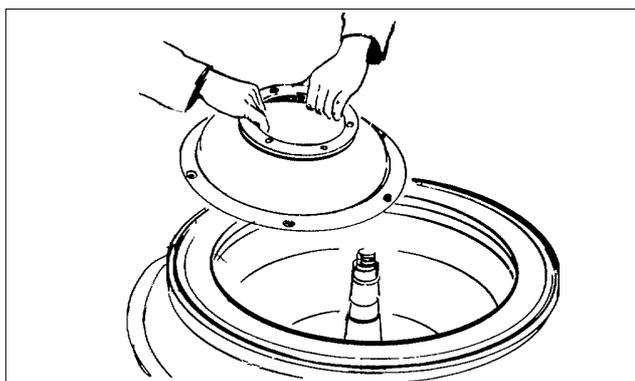
S0071811

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



G0604311

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

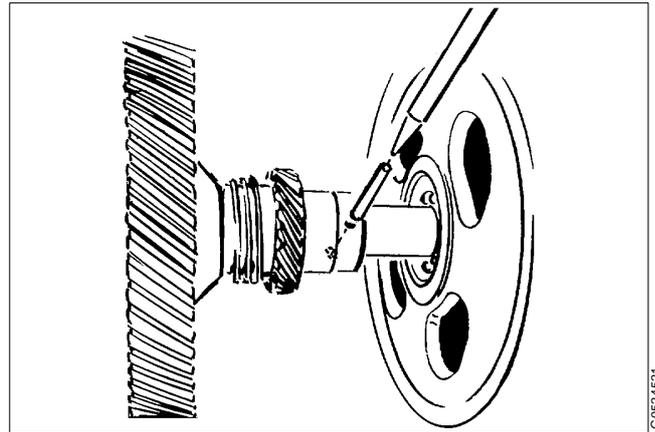


G0139131

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

✓ **Check point**

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



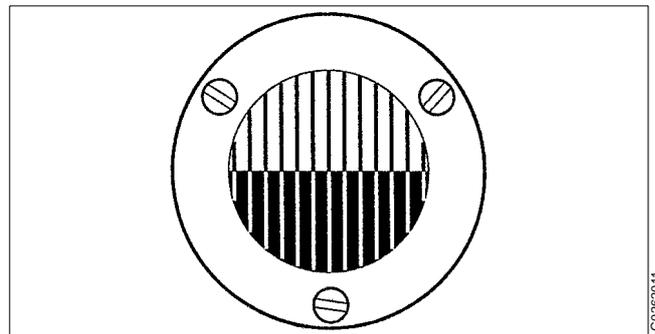
G0524521

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

For correct oil volume and recommended oil brands, see chapter “8.6 Lubricants” on page 185.

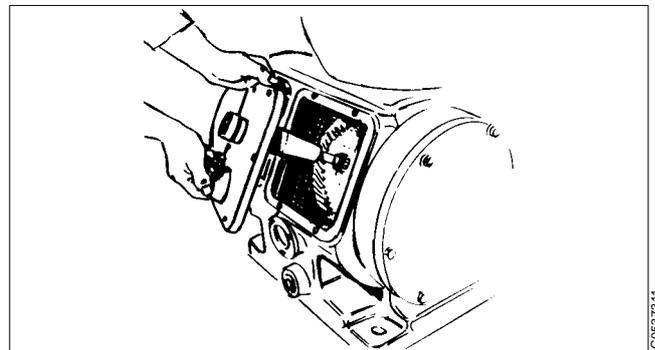
✓ **Check point**

“5.4.4 Brake” on page 65.



G0262011

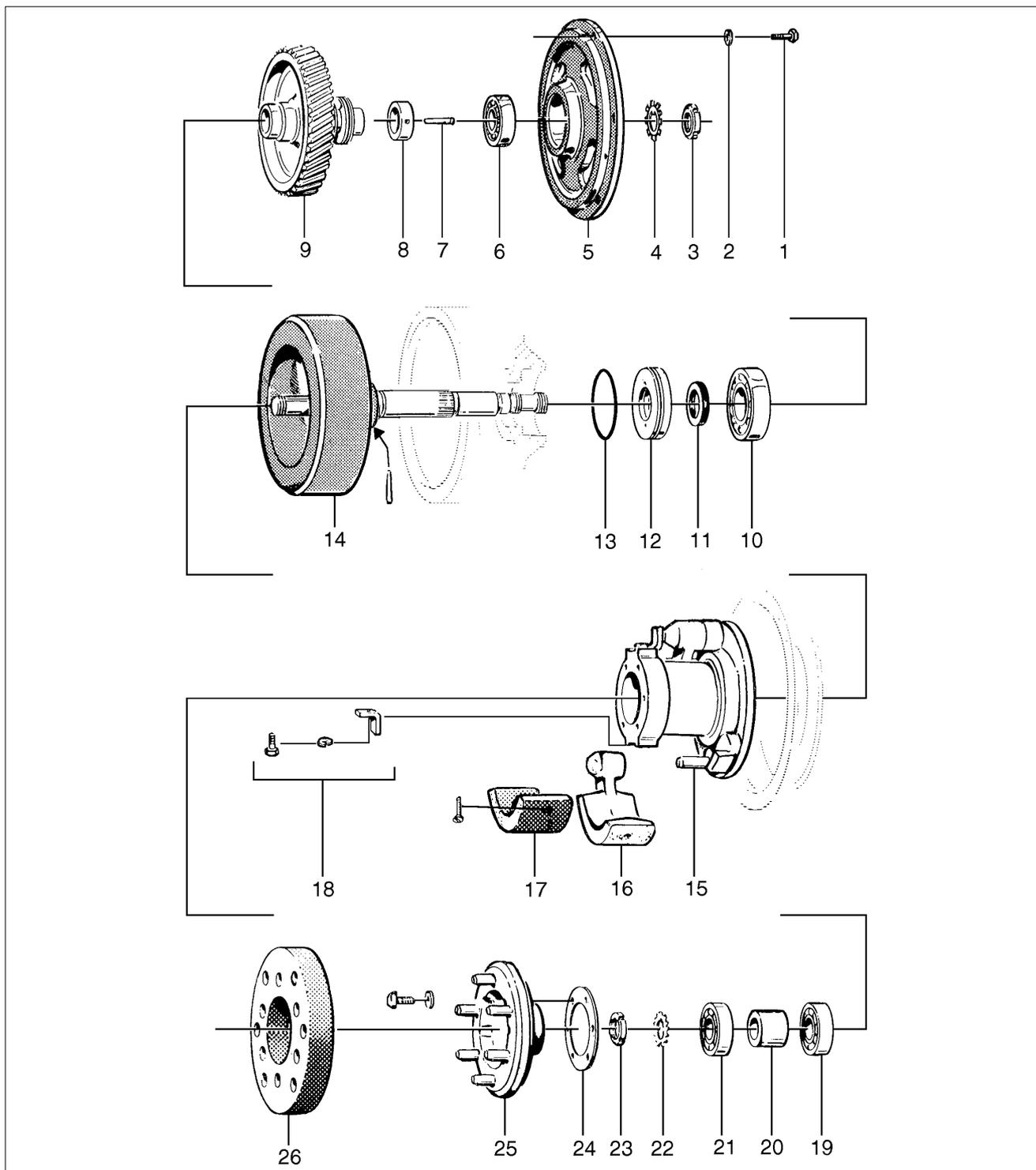
22. Fit the brake cover and revolution counter cap and their gaskets.



G0537311

6.7 Horizontal driving device (MS)

6.7.1 Exploded view



G0597231

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

6.7.2 Dismantling



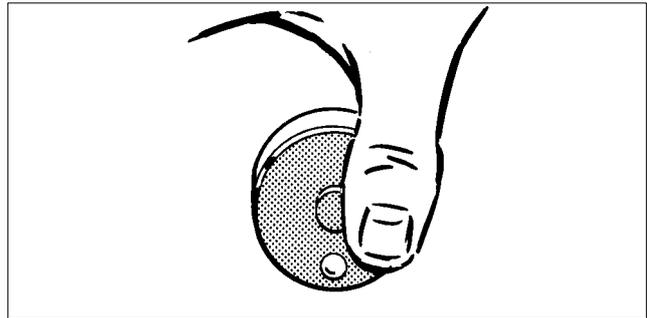
DANGER

Entrapment hazards

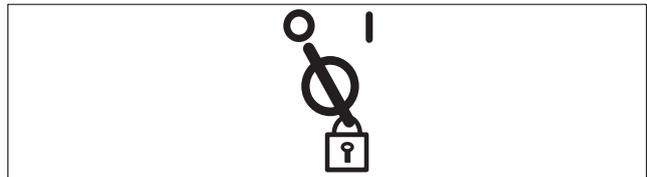
1. Make sure that rotating parts have come to a **complete standstill** before starting **any** dismantling work.

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

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



G0246221



S0051011

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

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

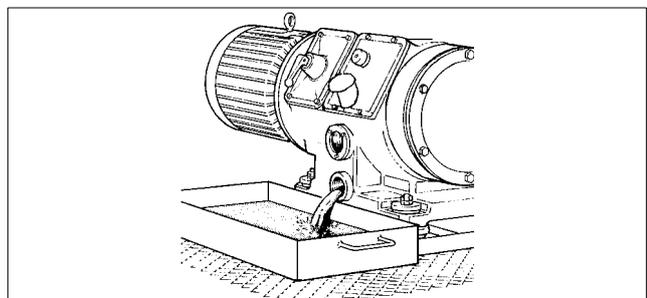
1. Drain the oil from the worm gear housing.



CAUTION

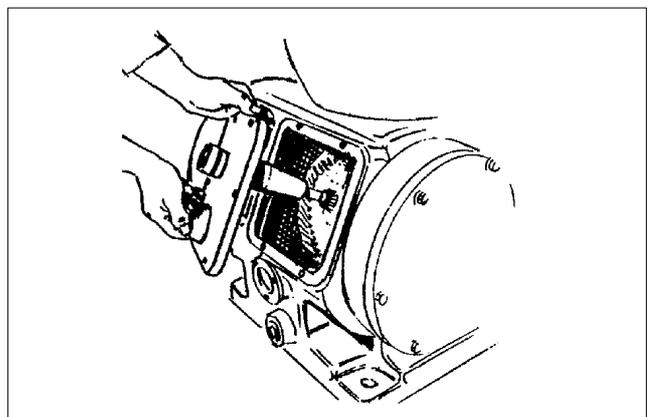
Burn hazards

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



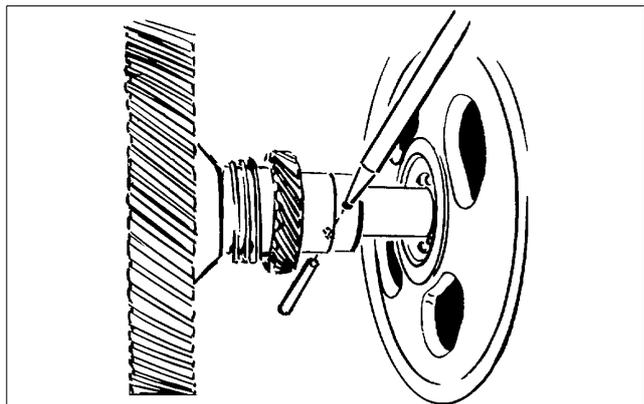
G0036921

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



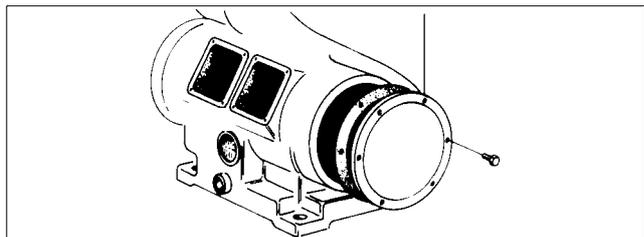
G0127911

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



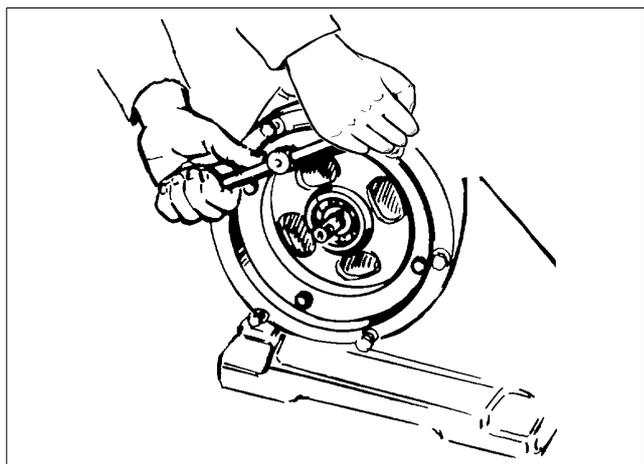
G0524511

4. Remove the protecting cover with gasket.



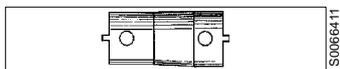
G0538021

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

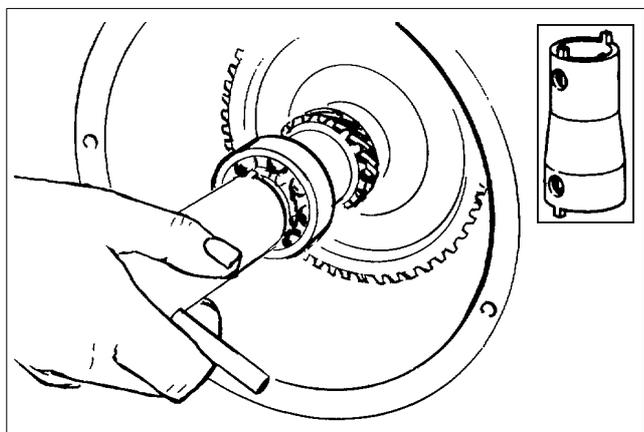


G0525521

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

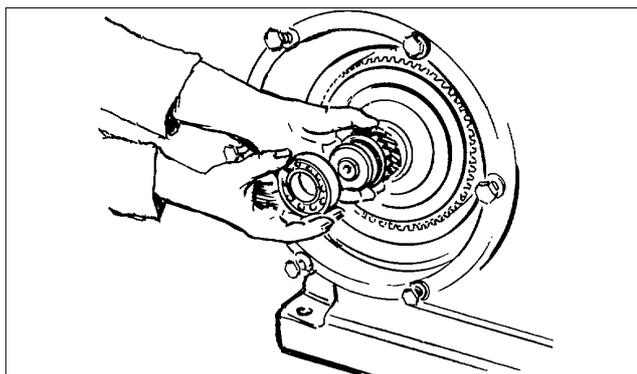


S0086411

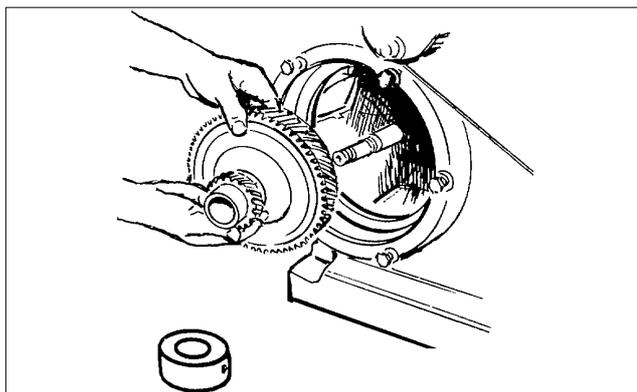


G0525421

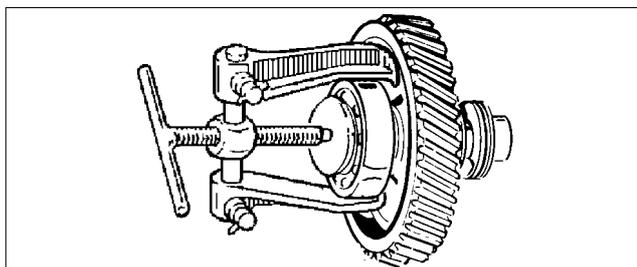
7. Remove the ball bearing.



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

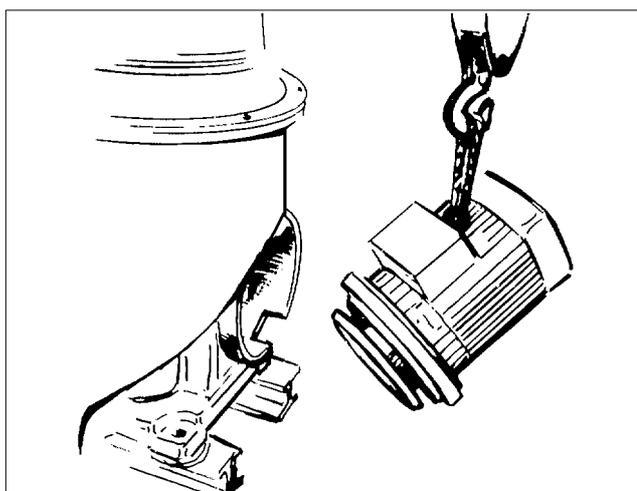


9. Pull off the ball bearing from the worm wheel. Use a washer as a support for the puller.

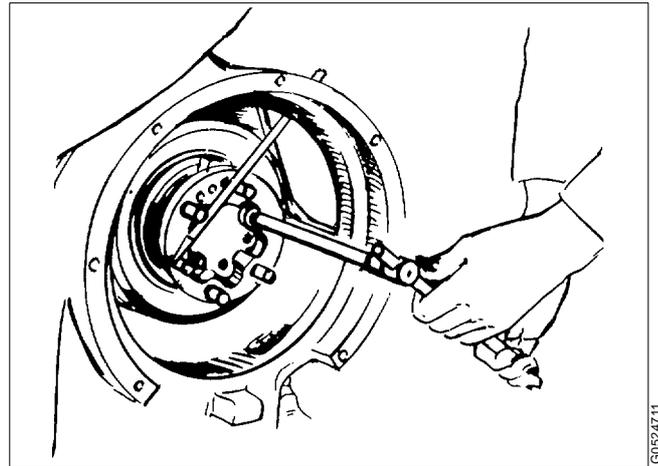


10. Disconnect the motor cables. Note the positions of cables in the terminal box to re-connect correctly (for correct direction of rotation).

11. Remove the electrical motor using a hoist.

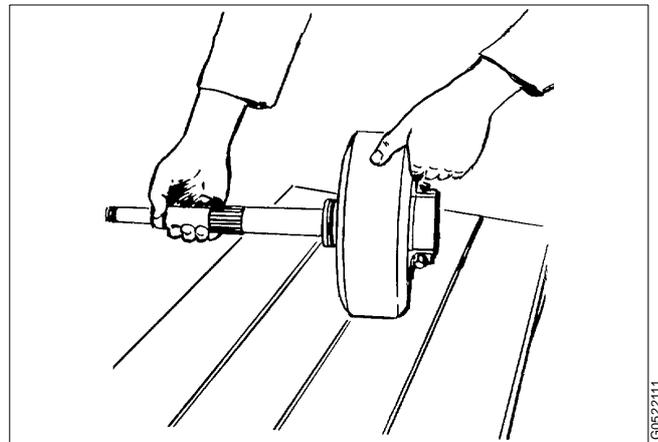


12. Remove the flexible plate and unscrew the six screws for the coupling disc and remove it.



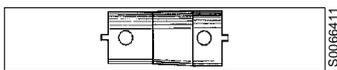
G0524711

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

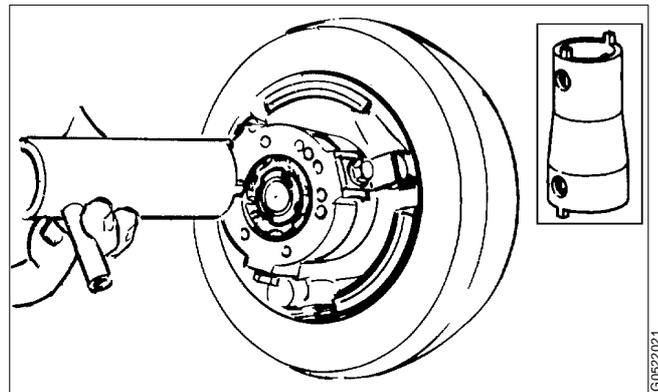


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14. To dismantle the nave, unscrew the round nut with the pin spanner and remove the lock washer.

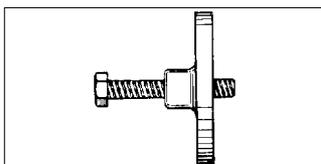


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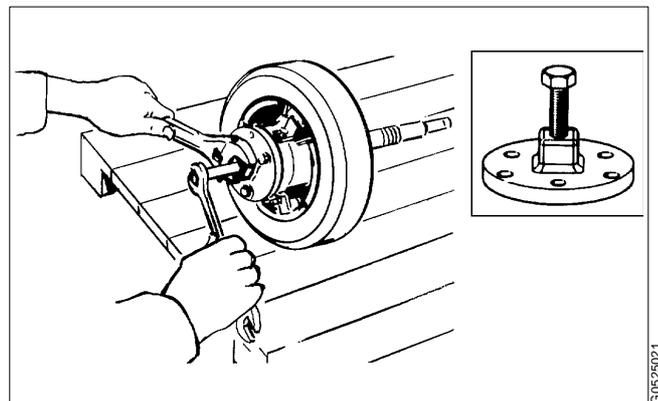


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15. Pull off the nave with the puller and remove the friction blocks.

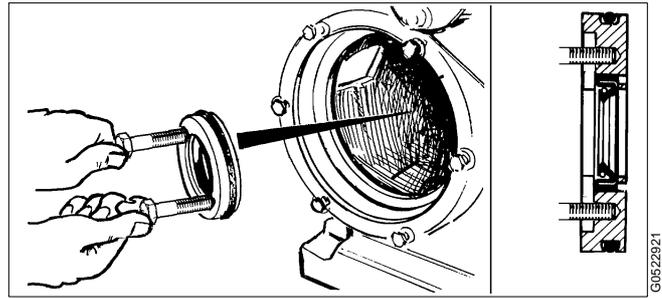


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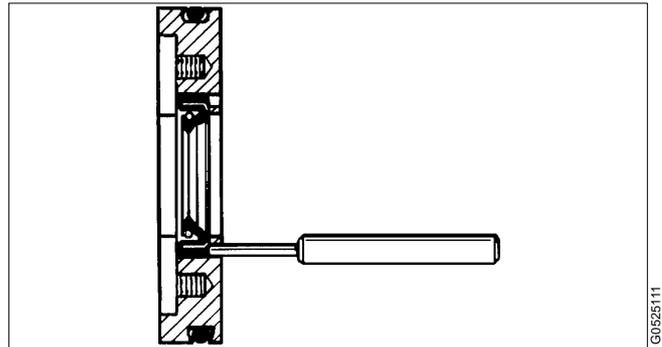
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16. Remove the sealing washer using two screws with 1/4"-20 UNC threads.



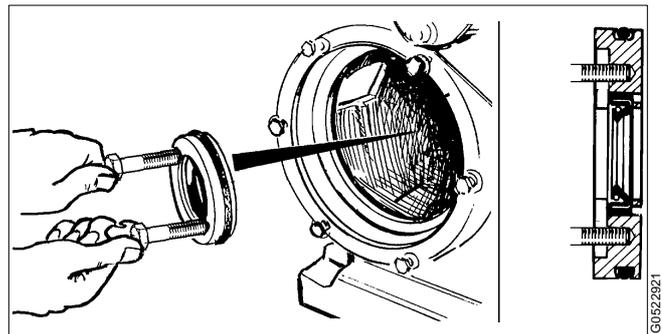
17. Remove the sealing ring from the sealing washer.

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



6.7.3 Assembly

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



✓ Check point

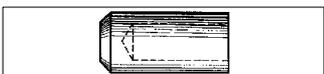
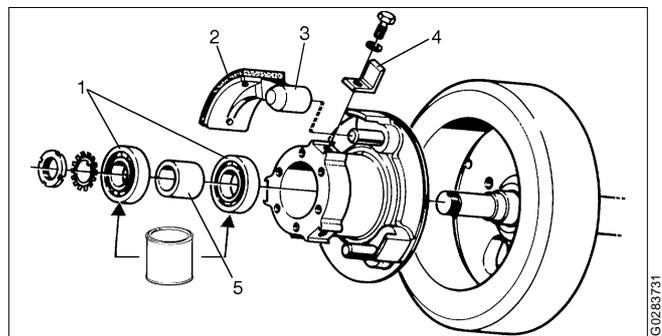
"5.4.6 Coupling friction pads" on page 68.

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

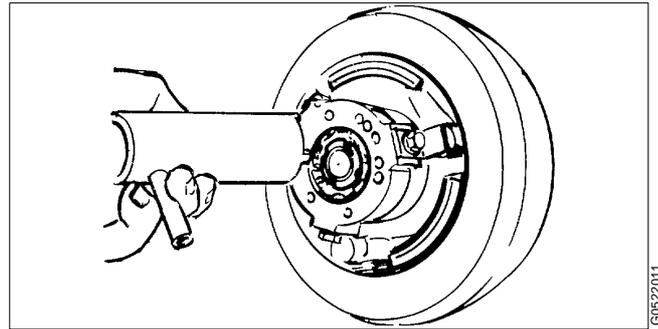
Lubricate the ball bearings.

For recommended lubricants, see chapter "8.6 Lubricants" on page 185.

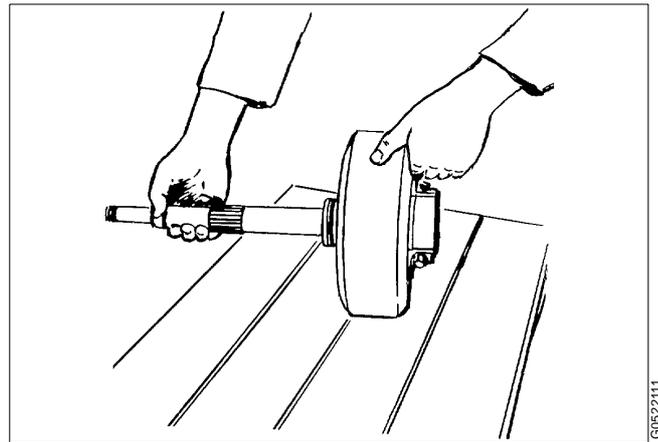
3. Fit the ball bearings (1) and spacing sleeve (5) with the driving on sleeve tool to force the ball bearings into their correct positions.



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



5. Fit the worm wheel shaft.

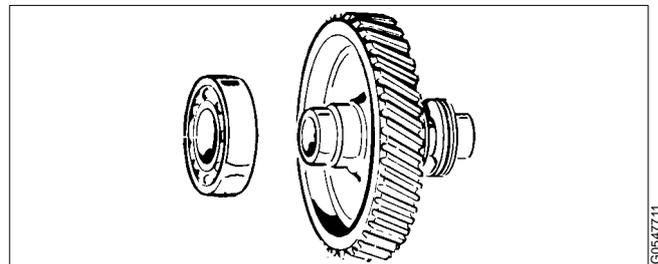


✓ **Check point**

“5.7.1 Worm wheel and worm; wear of teeth”
on page 83.

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

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



WARNING

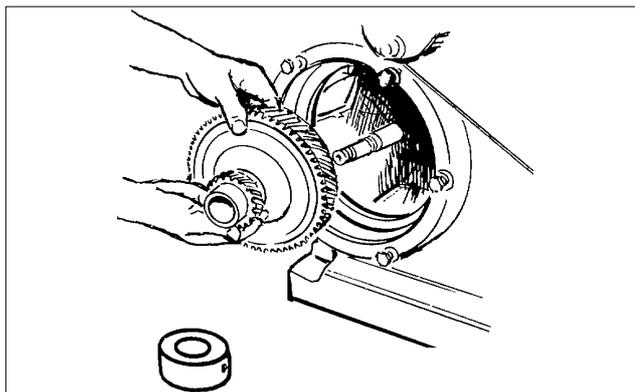
Burn hazards

Use protective gloves when handling the heated bearings.

NOTE

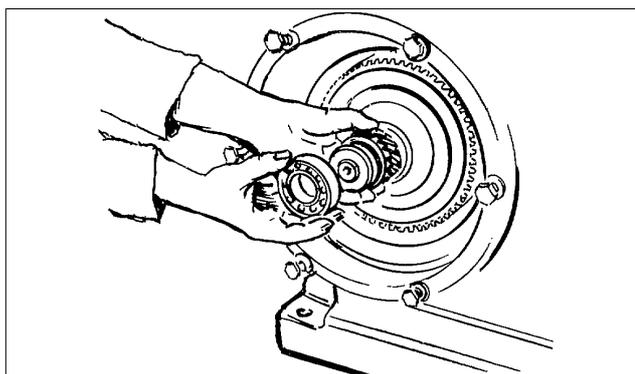
If any doubt how to mount roller bearings in a correct way, see the detailed description in chapter "5.9.1 Ball and roller bearings" on page 89.

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



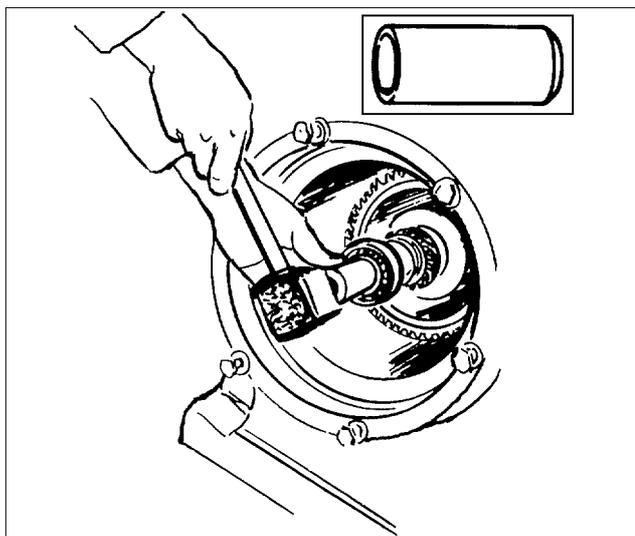
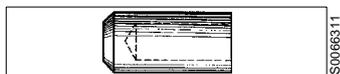
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- 8. Fit the ball bearing.



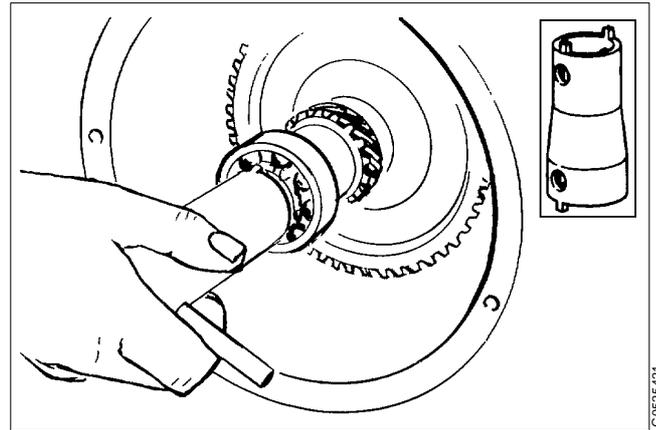
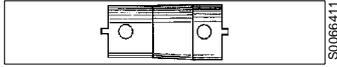
G0522311

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

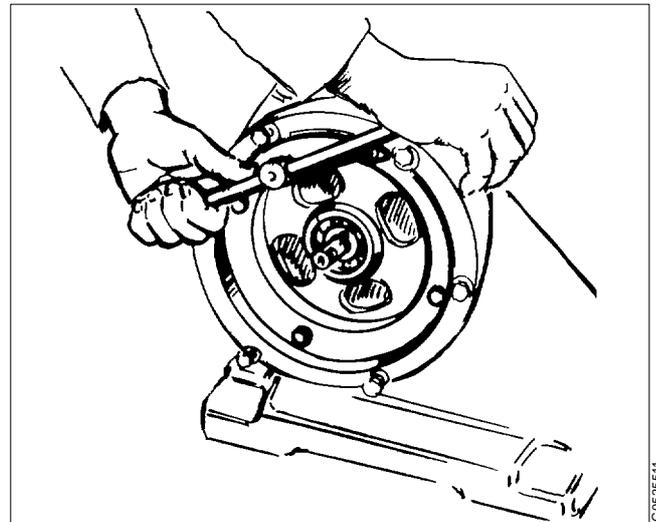


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10. Tighten the round nut with the pin spanner and secure it with the lock washer.



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

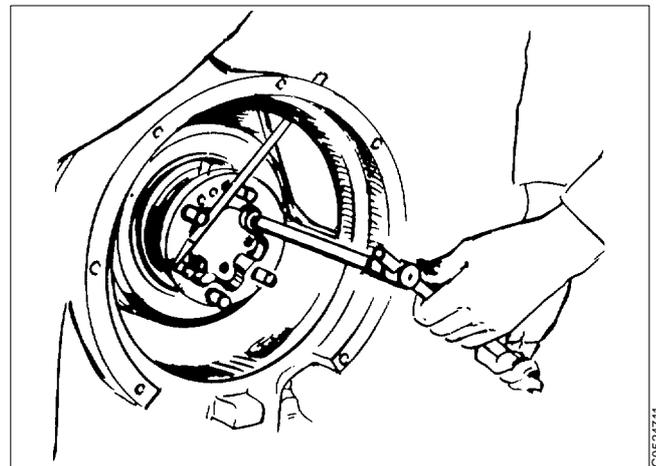


12. Fit the coupling disc with gasket and tighten the six screws. If necessary, use the driving-on sleeve.

13. Fit the flexible plate.

✓ **Check point**

“5.4.12 Flexible plate in coupling” on page 70.



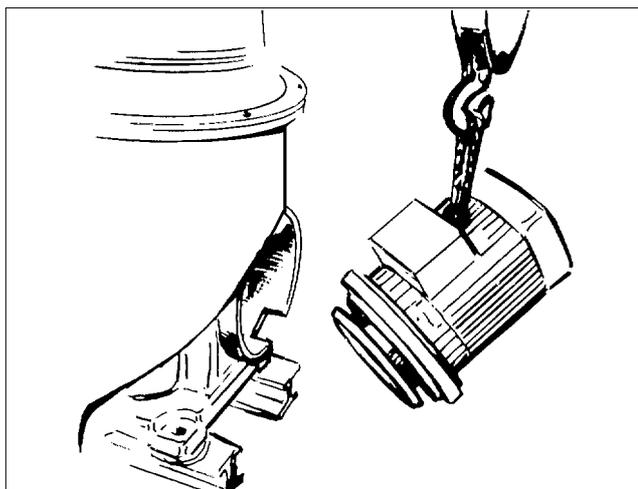
14. Fit the electrical motor.



DANGER

Disintegration hazards

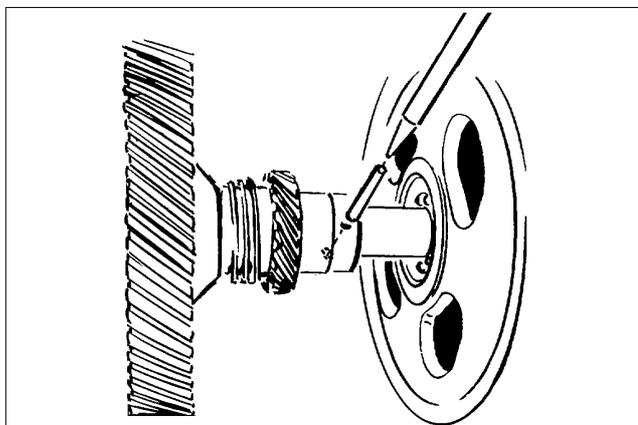
When power cables have been connected and the separator is completely assembled see “4.1.1 Ready for start” on page 30, always check direction of rotation. If incorrect, vital rotating parts could unscrew causing disintegration of the machine.



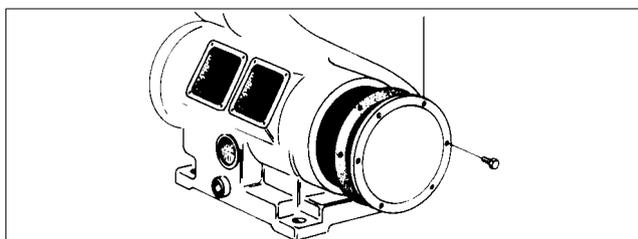
The remaining description in this section implies that the bowl spindle is mounted in the frame. If not, proceed with the assembly instruction for the vertical driving device in chapter “6.6.3 Assembly” on page 142.

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

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



16. Fit the protecting cover with gasket.



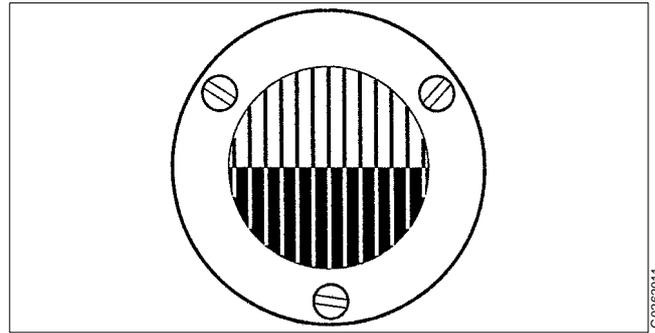
17. Pour oil into worm gear housing. The oil level should be exactly in the middle of the sight glass.

For correct oil volume and recommended oil brands see chapter "8.6 Lubricants" on page 185.

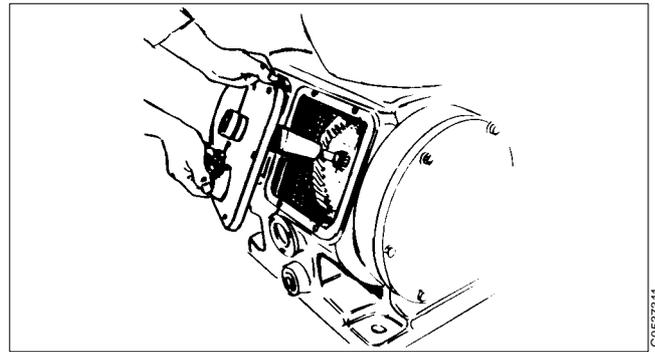
✓ **Check point**

"5.4.4 Brake" on page 65.

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



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7 *Trouble-tracing*

Contents

7.1 FOPX mechanical functions	164
7.1.1 Separator vibrates	164
7.1.2 Smell	165
7.1.3 Noise	165
7.1.4 Speed too low	165
7.1.5 Starting power too high	166
7.1.6 Starting power too low	166
7.1.7 Starting time too long	166
7.1.8 Retardation time too long	167
7.1.9 Water in worm gear housing	167
7.2 Separating functions	168
7.2.1 Liquid flows through the bowl casing drain and/or sludge outlet	168
7.2.2 Bowl opens accidentally during operation	169
7.2.3 Bowl fails to open for sludge discharge	169
7.2.4 Unsatisfactory sludge discharge	170
7.2.5 Unsatisfactory separation	170
7.2.6 High pressure in oil outlet	170
7.3 Vibration switch (option)	171
7.3.1 Vibration switch does not reset	171
7.3.2 Impossible to adjust setpoint to obtain tripping	171
7.3.3 Vibration switch does not reset	171
7.3 Vibration switch (option)	171
7.3.1 Vibration switch does not reset	171
7.3.2 Impossible to adjust setpoint to obtain tripping	171
7.3.3 Vibration switch does not reset	171

7.1 FOPX mechanical functions

7.1.1 Separator vibrates

NOTE

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



DANGER

Disintegration hazards

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	109
Uneven sludge deposits in the sludge space	Dismantle and clean the separator bowl	102
Height adjustment of the oil paring disc is incorrect	Stop the separator, measure and, if necessary, adjust the height	74
Bowl spindle bent (max 0,04 mm)	Renew the bowl spindle	64
Bearing is damaged or worn	Renew all bearings	134, 150
Vibration damping rubber cushions are worn out	Renew all rubber cushions	46
Spindle top bearing spring broken	Renew all springs	134

7.1.2 Smell

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

7.1.3 Noise

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

7.1.4 Speed too low

Cause	Corrective actions	Page
Brake is applied	Release the brake	–
Coupling friction pads are oily or worn	Clean or renew friction pads	68
Bowl is not closed or leaking	Dismantle the bowl and check	97
Motor failure	Repair/renew the motor	–
Bearing is damaged	Renew all bearings	134, 150
Incorrect gear transmission (60 Hz gear for 50 Hz power supply)	Stop and change the gear transmission to suit the power supply frequency	83, 134, 150
Incorrect coupling friction blocks (60 Hz blocks for 50 Hz power supply)	Change the friction blocks to suit the power supply frequency	68

7.1.5 Starting power too high

Cause	Corrective actions	Page
Incorrect friction blocks (50 Hz blocks for 60 Hz power supply)	 DANGER Stop immediately and change the friction blocks to suit the power supply frequency	68
Wrong direction of rotation	Change electrical phase connections to the motor	–
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	68
Coupling friction pads are oily or worn	Clean or renew friction pads	68
Motor failure	Repair the motor	–

7.1.7 Starting time too long

Cause	Corrective actions	Page
Brake is applied	Release the brake	–
Coupling friction pads are oily or worn	Renew or clean friction pads	68
Height position of oil paring disc or operating device is incorrect	Stop, check and adjust the height	68, 74
Motor failure	Repair the motor	–
Bearing is damaged or worn	Renew all bearings	134, 150

7.1.8 Retardation time too long

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

7.1.9 Water in worm gear housing

Cause	Corrective actions	Page
Bowl casing drain obstructed	Clean the casing and the drains properly. The drains have connection Nos. 462 and 463 on the <i>Basic size drawing</i> . Solve the reason for obstruction. Clean worm gear housing and change oil.	83
Leakage at top bearing	Renew seal ring and change oil	134, 86
Condensation	Clean worm gear housing and change oil	86

7.2 Separating functions

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

Cause	Corrective actions	Page
Sludge discharge or water draining in progress	None (normal)	–
Strainer in operating water line is clogged or water pressure/flow is too low	Clean the strainer and check water pressure/flow: Closing water pressure, 20-30 kPa Closing water flow	–
Channels in operating water device are clogged	Clean the operating water device	126
O-rings at the flow control disc defective	Renew the O-rings	101
Paring chamber cover (small lock ring) defective	Renew the paring chamber cover	101
Seal ring in the bowl hood defective	Renew the seal ring	101
Sealing edge of the sliding bowl bottom defective	Smoothen sealing edge of the sliding bowl bottom or renew it	62
Valve plugs are defective	Renew all valve plugs	61
Bowl speed too low	See section “7.1.4 Speed too low” on page 165 in this chapter	–

7.2.2 Bowl opens accidentally during operation

Cause	Corrective actions	Page
Strainer in the operating water supply is clogged	Clean the strainer	–
No water in the operating water system	Check the operating water system and make sure the valve(s) are open	–
Water connections to the separator are incorrectly fitted	Rectify	–
Upper nozzle in the dosing ring is clogged	Clean the nozzle. Carry out an Intermediate Service (IS)	54
Square-sectioned ring in sliding bowl bottom is defective	Renew the square-sectioned ring. Carry out an Intermediate Service (IS)	62
Valve plugs are defective	Renew all plugs. Carry out an Intermediate Service (IS)	61
Supply valve for opening water is leaking	Rectify the leak	–

7.2.3 Bowl fails to open for sludge discharge

Cause	Corrective actions	Page
Strainer in the operating water supply is clogged	Clean the strainer	–
Seal rings in operating device defective	Renew the seal rings	126
Opening water flow too low	Check the opening water flow; min. 18 litres/minute	–
Dosing ring too firmly tightened	Check the tightening torque	122
Lower nozzle in the dosing ring is clogged	Clean the nozzle. Carry out an Intermediate Service (IS)	54
Seal ring in the operating slide is defective	Renew the seal ring. Carry out an Intermediate Service (IS)	115

7.2.4 Unsatisfactory sludge discharge

Cause	Corrective actions	Page
Dosing ring too firmly tightened	Check the tightening torque	122
Valve plugs in the operating slide too high	Renew with correct valve plugs	61
Sludge deposits in the operating system	Check and clean the operating system	115, 126

7.2.5 Unsatisfactory separation

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

7.2.6 High pressure in oil outlet

Cause	Corrective actions	Page
Throughput too high	Adjust	
Valve(s) in oil outlet line closed	Open the valve(s)	–

7.3 Vibration switch (option)

7.3.1 Vibration switch does not reset

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

7.3.2 Impossible to adjust setpoint to obtain tripping

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

7.3.3 Vibration switch does not reset

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

8 *Technical Reference*

Contents

8.1	Technical data	174
8.2	Basic size drawing	176
8.2.1	Dimensions of connections	177
8.3	Connection list	178
8.4	Interface description	180
8.4.1	General	180
8.4.2	Definitions	180
8.4.3	Component description and signal processing	181
8.4.4	Function graph and running limitations	183
8.5	Water quality	184
8.6	Lubricants	185
8.6.1	Lubrication chart, general	185
8.6.2	Recommended lubricating oils	187
8.6.3	Recommended oil brands	188
8.6.4	Recommended lubricants	191
8.7	Drawings	193
8.7.1	Foundations	193
8.7.2	Electric motor	194
8.7.3	Machine plates and safety labels	196
8.7.4	Vibration sensor (option)	198
8.7.5	Cover interlocking switch (option)	198
8.8	Storage and installation	199
8.8.1	Storage and transport of goods	199
8.8.2	Planning of installation	201
8.8.3	Foundations	204

8.1 Technical data

Alfa Laval ref. 557643, rev. 1

NOTE

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

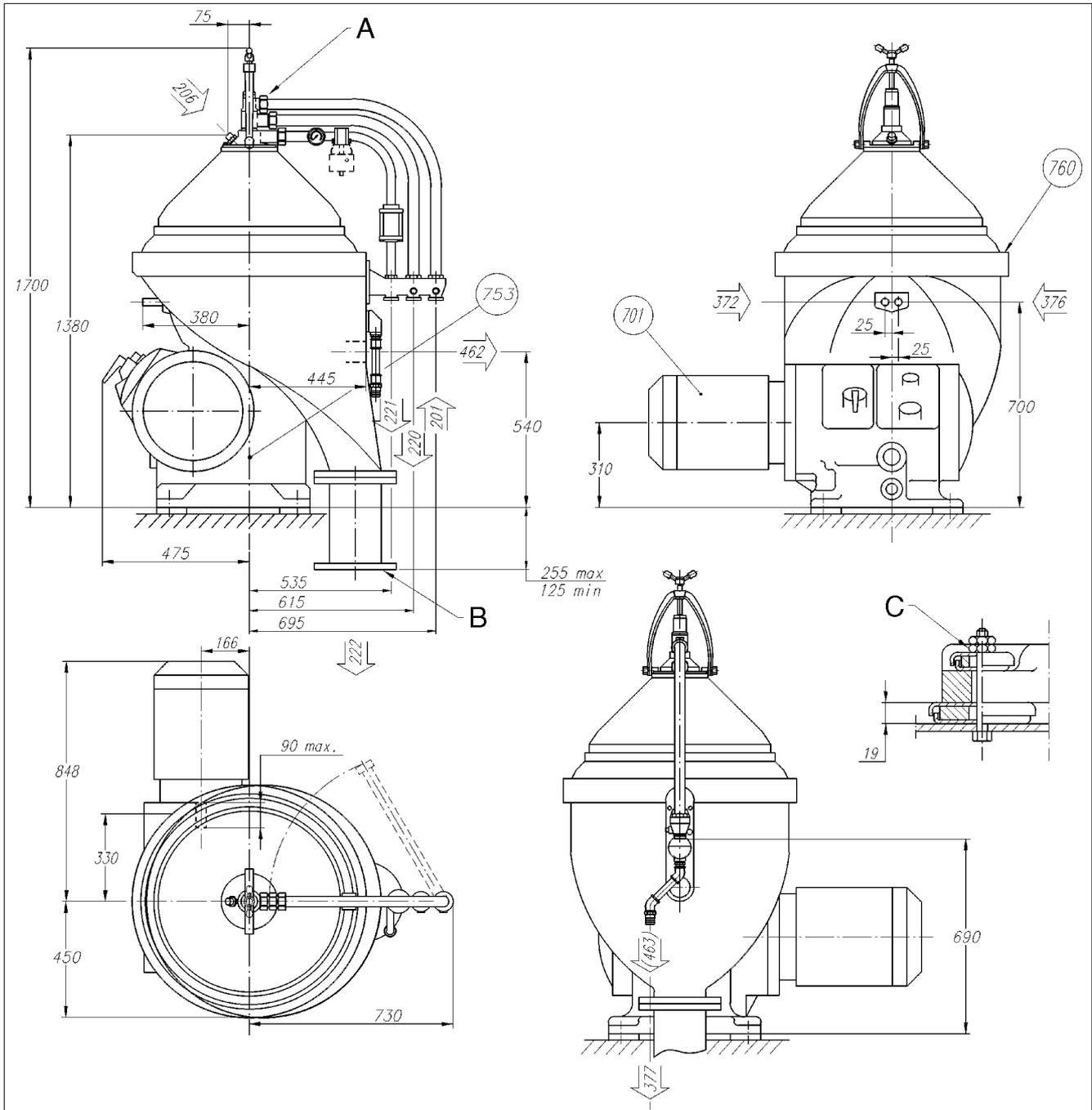
Product number	881082-02-03	
Separator type	FOPX 614TFD-20	
Application	Continuous clarification of heavy fuel oil. Intended for both land and marine applications. Cast iron frame.	
	The flash point of the fuel oil to be separated must be min. 60 °C.	
Density of operating water, max.	1 000	kg/m ³
Density of sediment/feed, max.	2 171/1 100	kg/m ³
Hydraulic capacity, max.	24 500	litres/hour
Feed temperature, min./max.	0/100	°C
Ambient temperature, min./max.	5-15/55	°C The min. temperature is dependent of the used oil type. See "8.6.2 Recommended lubricating oils" on page 187.
Bowl speed, max.	4140/4125	r.p.m., 50/60 Hz
Motor shaft speed, max.	1500/1800	r.p.m., 50/60 Hz
No. of teeth;		
- on worm, 50 Hz	21	
- on worm, 60 Hz	24	
- on worm wheel, 50 Hz	58	
- on worm wheel, 60 Hz	55	
Lubricating volume	approx. 12	litres
Motor power rating	16	kW
Power consumption, max.	18	kW (at starting up)
Power consumption, normal	7/11,2	kW (idling/at max. capacity)
Discharge volume, min./max.	7,6/9,6	litres variable discharge volume
Discharge interval, min.	1	minute

Bowl volume	29	litres
Starting time	5-6	minutes
Stopping time with brake	6-7	minutes
Max. running time without flow;		
- empty bowl	180	minutes
- filled bowl	180	minutes
Sound power level	–	Bel(A)
Sound pressure level	85	dB(A)
Vibration level, separator in use, max.	9	mm/s (RMS)
Weight of separator (without motor)	1 360	kg
Weight of bowl	406	kg

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

8.2 Basic size drawing

Alfa Laval ref. 558570, rev. 2



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

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

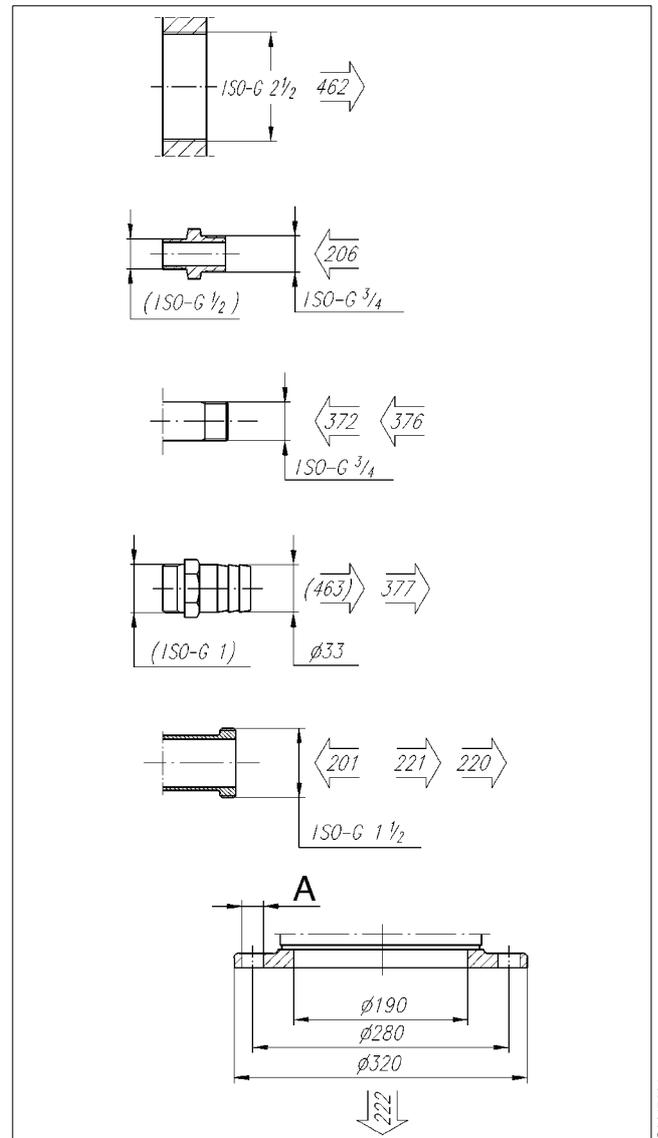
C. Tightening torque 20 Nm. Locked with lock nut.

8.2.1 Dimensions of connections

Alfa Laval ref. 558570, rev. 2

Data for connections, see chapter "8.3 Connection list" on page 178.

All connections to be installed non-loaded and flexible.



A. 8 holes, $\phi 23$ mm

G0617991

8.3 Connection list

Alfa Laval ref. 557882, rev. 4

Connection No.	Description	Requirements/limits
201	Inlet for product – Allowed temperature	Min. 0 °C, max. 100 °C
206	Inlet to liquid seal or displacement liquid, water – Instantaneous flow – Pressure (Min./Max.)	Fresh water 5,5 litre/minute 200/600 kPa
220	Outlet for light phase (oil) – Counter pressure	0 - 200 kPa
221	Outlet for heavy phase (water)	
222	Outlet for solid phase	The outlet after the separator should be installed in such a way that you can not fill the frame top part with sludge. (Guidance of sludge pump or open outlet)
372	Inlet of discharge liquid – Instantaneous flow – Time – Pressure (Min./Max.)	See demand in chapter “8.5 Water quality” on page 184 18 litres/minute 3 seconds/discharge 200/600 kPa
376	Inlet for make-up liquid – Instantaneous flow – Time – Pressure (Min./Max.)	See demand in chapter “8.5 Water quality” on page 184 18 litres/minute Intermittent 200/600 kPa
372 + 376	Discharge and make-up liquid – Consumption	1,7 litres/discharge

Connection No.	Description	Requirements/limits
377	Outlet for operating liquid (discharge and make-up liquid)	
462	Drain of frame top part, lower	
(463)	Drain of frame top part, upper	
701	Motor for separator <ul style="list-style-type: none"> - Deviation from nominal frequency 	± 5% (momentarily 10% during a period of maximum 5 seconds)
753	Unbalance sensor (delivered as option) <ul style="list-style-type: none"> - Type - Vibration measurement range - Switch rating, resistive load max. - Reset coil power supply max. 14 W 	See "8.4 Interface description" Mechanical switch 0 to 4,5 g from 0 to 300 Hz 5 A 12 V DC 2 A 24 V DC 1 A 48 V DC 0,5 A 120 V DC 7 A 460 V AC 50/60 Hz 48 V DC
760	Cover interlocking switch (delivered as option) <ul style="list-style-type: none"> - Type - Switch rating, resistive load max. 	See "8.4 Interface description" Mechanical switch 3 A 500 V

8.4 Interface description

Alfa Laval ref. 557138, rev. 3

8.4.1 General

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

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

8.4.2 Definitions

Stand still (Ready for start) means:

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

Start means:

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

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

Normal stop means:

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

Safety stop means:

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

Comply to following conditions:

- The bowl must be kept filled.
- Sludge ejection must not be made.
- The machine must not be restarted before the reason for the safety stop has been investigated and action has been taken.
- In case of emergency condition in the plant, the machine must be stopped in a way that is described in EN 418.

8.4.3 Component description and signal processing

Separator motor 701

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

Vibration sensor 753 (option)

The vibration sensor is an acceleration sensitive instrument with a mechanical switch.

Signal Processing

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

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

Cover interlocking switch 760 (option)

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

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

Signal Processing

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

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

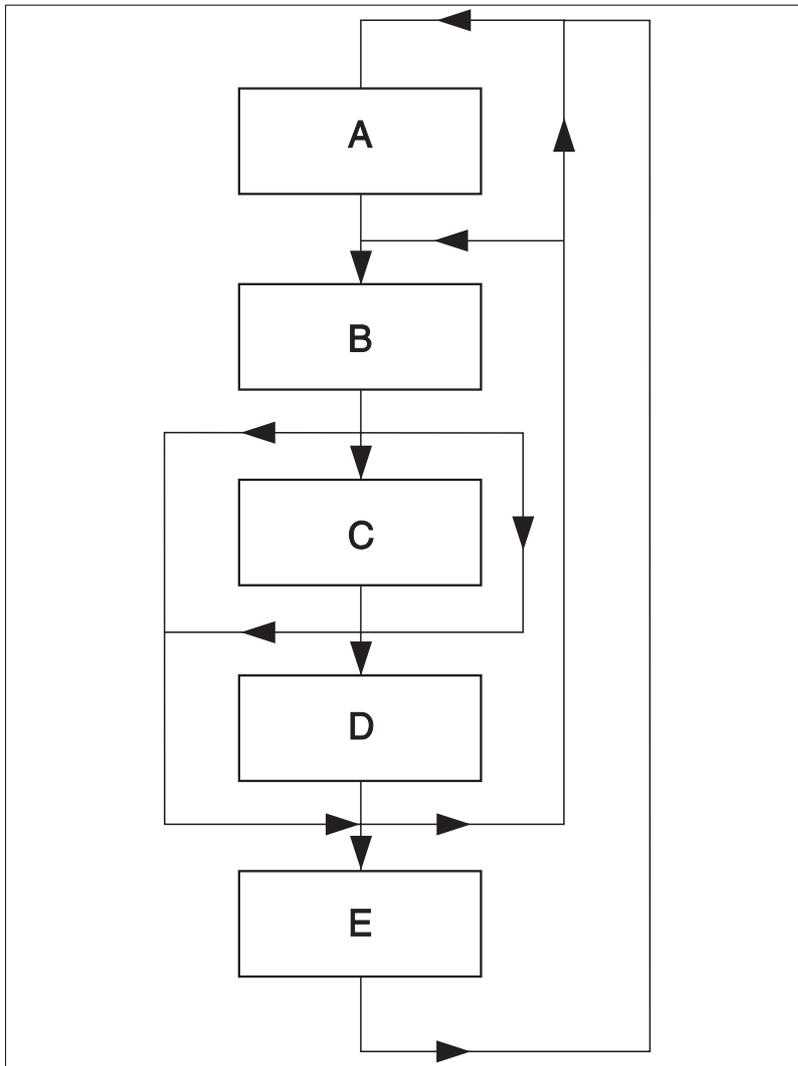
Discharge

Signal processing

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

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

8.4.4 Function graph and running limitations



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

8.5 Water quality

Alfa Laval ref. 553406, rev. 5

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

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

The following requirements are of fundamental importance

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

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

1.2 Max particle size 50 µm.

2. Total hardness less than 180 mg CaCO₃ per litre, which corresponds to 10 °dH or 12,5 °E.

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

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

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

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

4. pH>6

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

NOTE

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

8.6 Lubricants

8.6.1 Lubrication chart, general

Alfa Laval ref. 553216-01, rev. 6

Lubricating points	Type of lubricant
Bowl spindle ball bearings and buffers are lubricated by oil mist	Lubricating oil as specified in "8.6.2 Recommended lubricating oils" on page 187
Bowl spindle taper	Lube oil, only a few drops for rust protection
Metal buffers of bowl spindle	Lube oil
Bowl: Sliding contact surfaces and pressure loaded surfaces such as lock rings, threads of lock rings, bowl hood and cap nut	Pastes as specified in "8.6.4 Recommended lubricants" on page 191
Rubber seal rings	Grease as specified in "8.6.4 Recommended lubricants" on page 191
Friction coupling ball bearings	The bearings are packed with grease and sealed and need no extra lubrication
Electric motor	Follow manufacturer's instructions

Alfa Laval Lubricating Oil Groups:

- **Group A oil:** a high quality gear oil on paraffin base with stable AW (anti wear) additives.
- **Group B oil:** a high quality gear oil on paraffin base with stable EP (extreme pressure) additives.
- **Group D oil:** a synthetic base oil with additives stable at high operating temperatures.
- **Group E oil:** Characteristics as a group D oil but suitable at a higher operation power (max. 55 kW).

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

Always use clean vessels when handling lubricating oil.

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

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

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

NOTE

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

NOTE

Check the oil level before start. Top up when necessary. For correct oil volume see chapter *Technical data* in the *Installation Manual*.

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

Applying, handling and storing of lubricants

Always be sure to follow lubricants manufacturer's instructions.

8.6.2 Recommended lubricating oils

Alfa Laval ref. 553219-15, rev. 0

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

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

The numerical value after the letter states the viscosity grade.

The corresponding commercial oil brands are found in chapter "8.6.3 Recommended oil brands" on page 188.

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

Note:

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

8.6.3 Recommended oil brands

NOTE

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

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

Alfa Laval lubricating oil group A/320

Alfa Laval ref. 553218-11, rev. 2

Viscosity grade VG (ISO 3448/3104)	320
Viscosity index VI (ISO 2909)	>95
Manufacturer	Designation
Alfa Laval	546099-80 (20 litres) 546099-81 (4 litres) 546099-82 (208 litres) 546099-83 (1 litre)
BP	Bartran 320
Castrol	Alpha ZN 320
ELF	Polytelis 320
Engen	Genecirc TQ320
Esso/Exxon	Nuto 320 Teresso 320 Terrestic 320
Mobil	DTE oil AA
Shell	Morlina 320 Tellus 320
Texaco/Caltex	Regal Oil 320 Paper Machine Oil Premium 320

Alfa Laval lubricating oil group D/220

Alfa Laval ref. 553218-08, rev. 3

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

Viscosity grade VG (ISO 3448/3104)	220
Manufacturer	Designation
Alfa Laval	542690-80 (20 litres) 542690-81 (4 litres) 542690-82 (208 litres)
BP	Enersyn HTX 220
Castrol	Alphasyn EP 220 Alphasyn HG 220
Chevron	Tegra 220
ELF	Epona SA 220
Esso/Exxon	Terresstic SHP 220 Terresso SHP 220
Mobil	SHC 630
Q8/Kuwait Petroleum	Schumann 220
Shell	Paolina 220 Omala RL 220
Statoil	Mereta 220
Texaco/Caltex/FAMM	Pinnacle Marine Gear 220

The list of recommended oil brands is not complete. Other oil brands may be used as long as they have equivalently quality as the brands recommended. The oil must have the same viscosity class and ought to follow the ISO standard 12925-1, category ISO-L-CKE (ISO 6743-6) or DIN 51517, part 3 CLP, but shall have a synthetic base oil of polyalphaolefin type (PAO) instead of mineral base oil.

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

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

Alfa Laval lubricating oil group D/320

Alfa Laval ref. 553218-06, rev. 3

Synthetic lubricating oil, category PAO (ISO-L-) CKE 320

Viscosity grade VG (ISO 3448/3104)	320
Manufacturer	Designation
Alfa Laval	542690-84 (20 litres) 542690-85 (4 litres) 542690-86 (208 litres)
BP	Enersyn HTX 320
Castrol	Alphasyn EP 320 Alphasyn HG 320
Chevron	Tegra 320
ELF	Epona SA 320
Esso/Exxon	Terresstic SHP 320 Terresso SHP 320
Mobil	SHC 630
Optimol	Optigear Synthetic A 320
Q8/Kuwait Petroleum	Schumann 320
Shell	Delima HT 320 Paolina 320 Omala RL 320
Statoil	Mereta 220

The list of recommended oil brands is not complete. Other oil brands may be used as long as they have equivalently quality as the brands recommended. The oil must have the same viscosity class and ought to follow the ISO standard 12925-1, category ISO-L-CKE (ISO 6743-6) or DIN 51517, part 3 CLP, but shall have a synthetic base oil of polyalphaolefin type (PAO) instead of mineral base oil.

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

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

8.6.4 Recommended lubricants

Alfa Laval ref. 553217-01, rev. 7

NOTE

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

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

Pastes for food applications:

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

Pastes for non-food applications:

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

Bonded coatings:

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

Silicone grease for rubber rings:

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

Greases for ball and roller bearings:**NOTE**

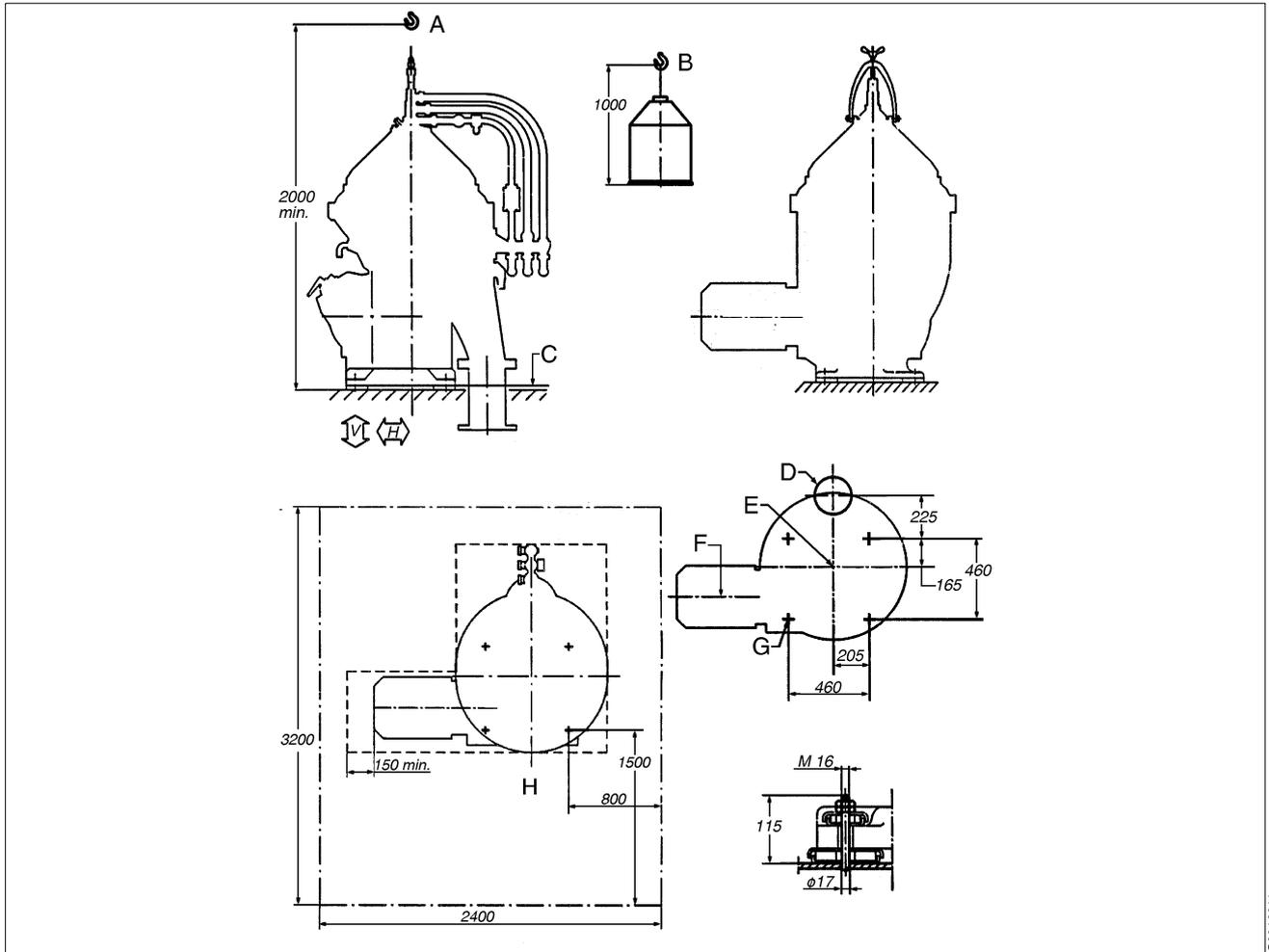
Always follow the specific recommendation for lubrication as advised by the manufacturer.

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

8.7 Drawings

8.7.1 Foundations

Alfa Laval ref. 557660, rev. 0

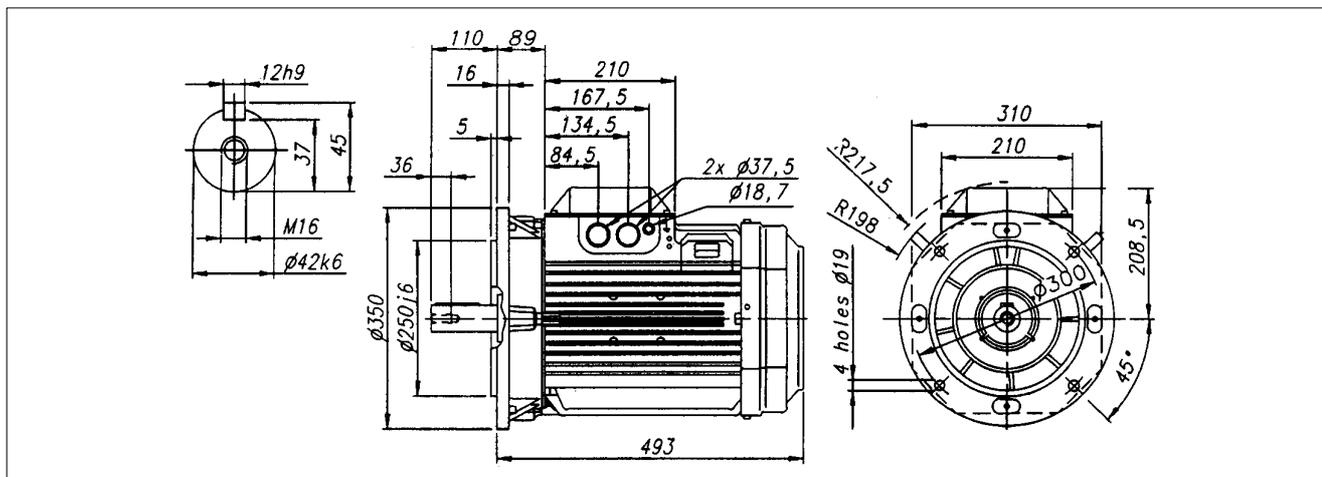


- A. Min. lifting capacity 1000 kg
Recommended speed for lifting:
Low speed 0,5-1,5 m/min.
High speed 2-6 m/min.
 - B. Max. height of largest component incl. lifting tool
 - C. Horizontal max. deviation 0,4 °.
 - D. Hole Ø 220 for sediment outlet
 - E. Center of separator bowl
 - F. Center of motor
 - G. 4 holes Ø 17 for anchorage
 - H. Service side
- Recommended free floor space for unloading when doing service
 - Min. access area for overhead hoist. No fixed installations within this area.
 - Vertical force not exceeding 41 kN/foot
 - Horizontal force not exceeding 41 kN/foot

G0618011

8.7.2 Electric motor

Alfa Laval ref. 552814, rev. 2



G0868311

Manufacturer	ABB Motors
Manufacturers drawing	3GZV 100 007-4
Standards	IIEC 34-series, 72, 79, 85
Size	160L
Type	M2AA 160L-4
Weight	63 kg
Poles	4
Insulation class	F
Bearings	D/N-end 6209-2Z/C3 Note: The bearing have permanent lubrication.
Method of cooling	IC 41 (IEC 34-6)
Specification	Totally enclosed three-phase motor for marine service ³⁾

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

Article No	Output kW	Speed RPM	Freq Hz	Voltage V	Current A	Pow.fac cos ϕ	I_{st} / I ¹⁾	Therm ²⁾ °C	Note
552814-01	15,5	1450	50	200 D	58	0,85	6,5		
552814-02	15,5	1450	50	220 D	52	0,85	6,5		
552814-03	15,5	1450	50	380 D	30,5	0,85	6,5		
552814-04	15,5	1450	50	415 D	28	0,85	6,5		
552814-05	15,5	1450	50	440 D	26,5	0,85	6,5		
552814-06	15,5	1450	50	500 D	23	0,85	6,5		
552814-07	18	1750	60	220 D 440 D	61 30,5	0,85	6,5		D-par D-ser
552814-08	18	1750	60	230 D 460 D	58,5 29	0,85	6,5		D-par D-ser
552814-09	17	1752	60	575 D	23	0,84	6,7		CSA- plated
552814-10	15,5 18	1450 1750	50 60	380 D 440 D	30,5 30,5	0,85	6,5 6,5		
552814-11	15,5	1450	50	690 Y 400 D	16,8 29	0,85	6,5		
552814-12	18	1750	60	460 D	29	0,85	6,5		
552814-13	18	1750	60	480 D	28	0,85	6,5		
552814-14	15	1452	50	660 Y 380 D	17 29,5	0,85	6,7		Stamp. 15 kW
552814-15	15	1758	60	440 D	26,5	0,83	7,5		Stamp. 15 kW
552814-16	18	1750	60	440 D	30,5	0,85	6,5		
552814-17	18	1750	60	690 Y	19,4	0,85	6,5		
552814-18	18	1750	60	380 D	35,5	0,85	6,5		
552814-19	15,5	1450	50	660 Y	17,6	0,85	6,5		

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

2) Thermistors tripping temperature if applicable

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

Lloyds Register of shipping	(LRS)	Nippon Kaiyi Kyoaki	(NK)
Det Norske Veritas	(DnV)	Korean Register of shipping	(KR)
Germanischer Lloyd	(GL)	Polski Rejester Statkow	(PRS)
Bureau Veritas	(BV)	China Classification societies	(ZC)
American Bureau of shipping	(ABS)	Register of Shipping	(RS)
Registro Italiano Navale	(RINA)		

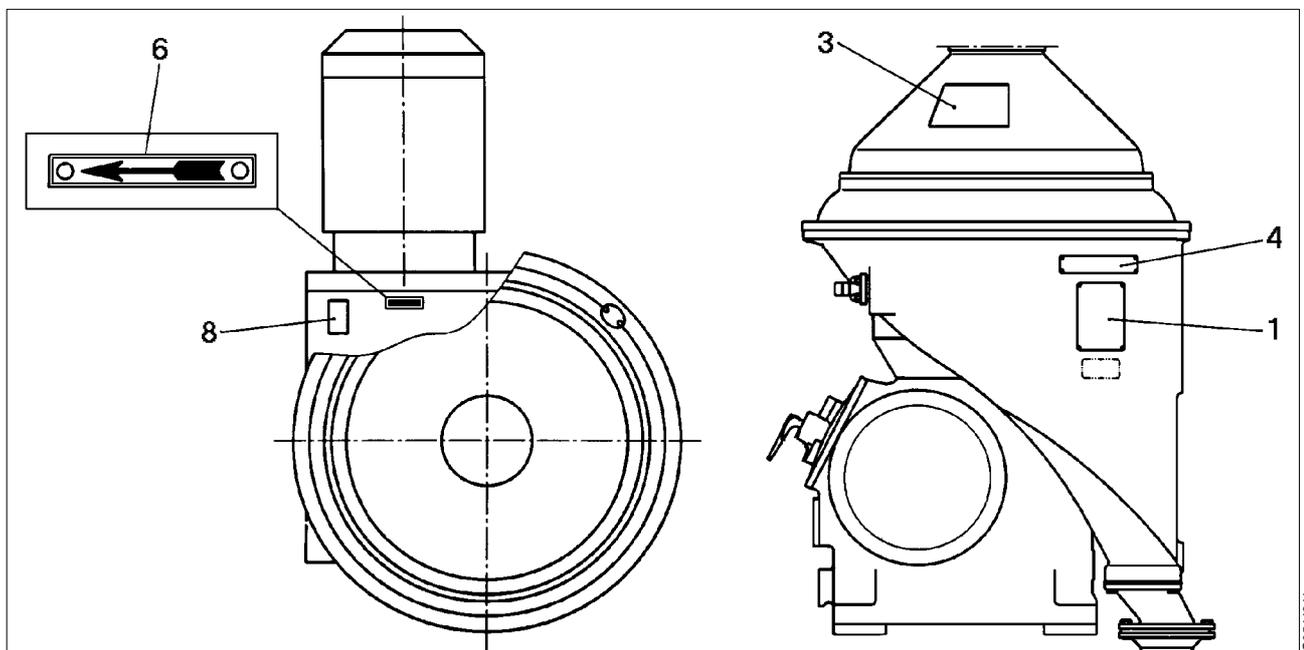
Required classification society must always be specified when ordering. Factory test certificate to be enclosed at the delivery.

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

4) The motors can be delivered with space heaters for 110V or 220V 25W as option. State supply voltage when ordering. Connection to separate terminal board in the main box acc. to attached connection diagram.

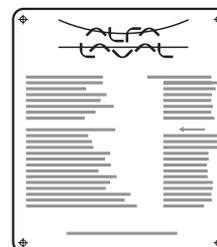
8.7.3 Machine plates and safety labels

Alfa Laval ref. 554651, rev. 2



1. Machine plate

Separator	FOPX 614TFD-20
Manufacturing serial No./ Year	XXXX
Product No.	881082-02-03
Machine top part	561138-02
Bowl	561204-01
Machine bottom part	543048-16/17 (50/60 Hz)
Max. speed (bowl)	4140 r.p.m. (50 Hz), 4125 r.p.m. (60 Hz)
Direction of rotation (bowl)	←
Speed motor shaft	1500 r.p.m. (50 Hz), 1800 r.p.m. (60 Hz)
El. current frequency	50/60 Hz
Recommended motor power	16 kW
Max. density of feed	1100 kg/m ³
Max. density of sediment	2171 kg/m ³
Max. density of operating liquid	1000 kg/m ³
Process temperature min./max.	0/100 °C



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S0061411

3. Safety label

Text on label:

DANGER

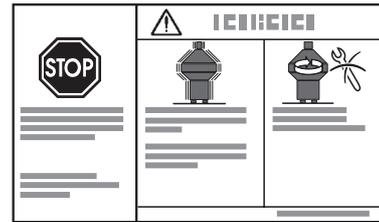
Read the instruction manuals **before** installation, operation and maintenance. Consider inspection intervals.

Failure to strictly follow instructions can lead to fatal injury.

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

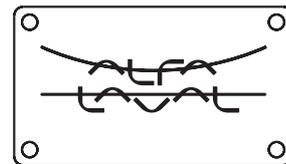
Out of balance vibration will become worse if bowl is not full.

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



S0061521

4. Name plate

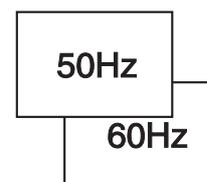


S0063211

6. Arrow

Indicating direction of rotation of horizontal driving device.

8. Power supply frequency



S0063111

8.8 Storage and installation

8.8.1 Storage and transport of goods

Storage

Specification

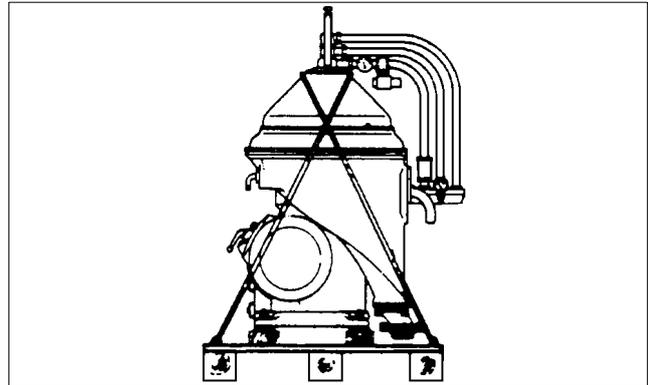
Upon arrival to the store, **check all components and keep them:**

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

A separator can be delivered with different types of protection:

- Fixed on a pallet.

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

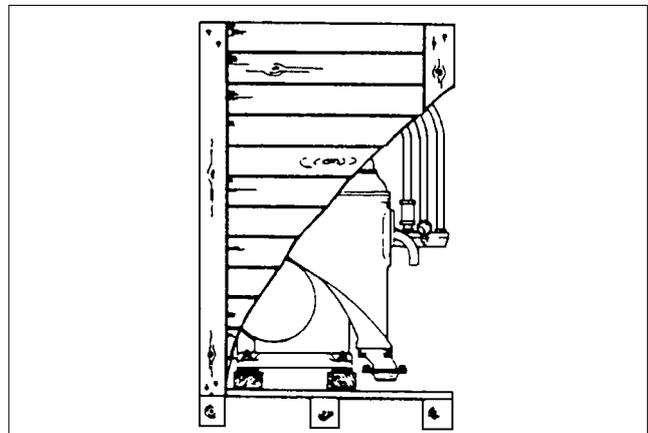


G0402051

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.



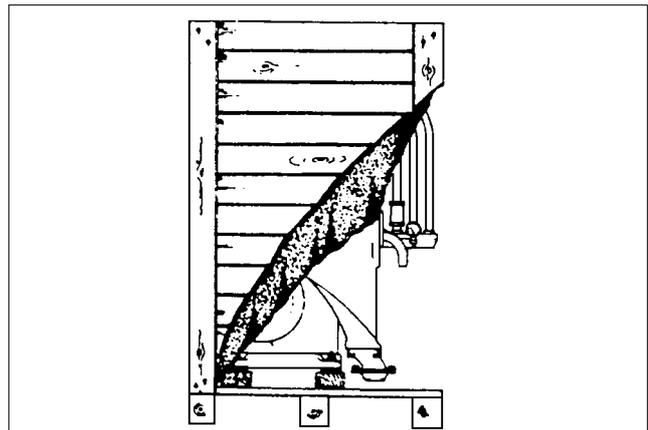
G0402061

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.



G0402071

In a special water-resistant box for outdoor storage

Transport

Specification

- During transport of the separator, the frame hood and bowl **must always be removed from the machine.**
- When lifting a separator it must always be **hung securely.** See chapter “5.5 Lifting instructions” on page 78.

	WARNING
	Crush hazards
Use correct lifting tools and follow lifting instructions.	

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

8.8.2 Planning of installation

Introduction

The space required for one or more separators can be calculated by consulting the drawings in the chapters “8.2 Basic size drawing” on page 176, “8.7.1 Foundations” on page 193 and instructions for ancillary equipment, electrical and electronic equipment and cables.

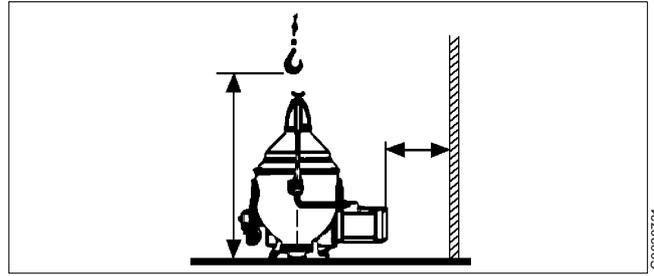


Check the drawings when planning the installation

Important measurements

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

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 “8.7.1 Foundations” on page 193 for the service space required with the separator installed.

Recommendation

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

Lifting height for transport of bowl

Specification

- A minimum height is required to lift the bowl, bowl parts and the bowl spindle, see chapter “8.7.1 Foundations” on page 193.

Recommendation

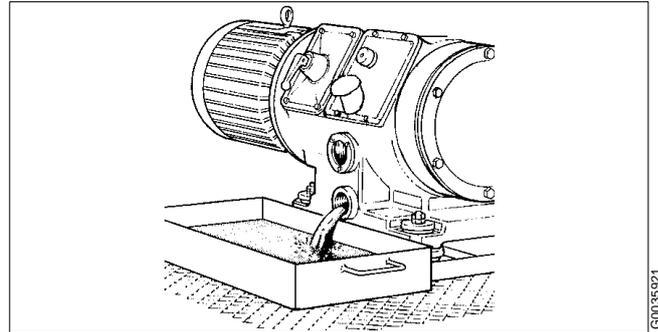
- When two or more separators are installed, the lifting height may have to be increased to enable parts from one separator to be lifted and moved over an adjoining assembled separator.

Space for oil changing**Specification**

The plug for gearbox oil draining must not be blocked by floor plate arrangement, etc.

Recommendation

- It should be possible to place a portable collecting tray under the gearbox drain plug for changing oil.



Place the separator in such a way that makes the oil change easy

G0035921

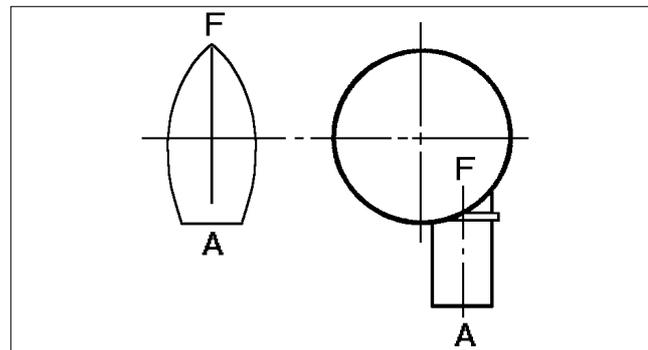
8.8.3 Foundations

NOTE

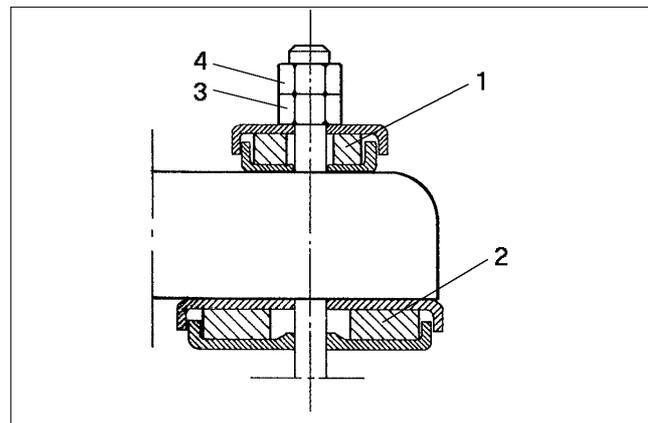
When lifting a separator it must always be **hung securely**. See chapter “5.5 Lifting instructions” on page 78.

Specification

- The separator should be installed at floor level, see chapter “8.7.1 Foundations” on page 193.
- When a separator is installed on a ship, the separator should be installed in such a way that the centre line of the electric motor is parallel with the centre line of the ship. The electric motor should preferably be pointing aft.
- The separator must be installed on a strong and rigid foundation to reduce the influence of vibrations from adjacent machinery.
- The foundation should be provided with a cofferdam.
- Fit the separator frame on the foundation as follows:
 - Place the separator frame without cushions in position.
 - Check that the bolts do not press against the edges of the holes, otherwise the elasticity of the mounting of the separator frame will be impeded.
 - Fit height adjusting washers required.
 - Check that the separator frame is horizontal and that all feet rest on the foundation.
 - Lift the separator frame, fit the vibration dampers (1, 2), lower and check that the bolts do not press against the edges of the holes.
 - Tighten nut (3) with **20 Nm**. Hold firmly and secure with the lock nut (4). Repeat for the other frame feet.



F = Forward
A = Aft



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

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Date:

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Index

A

Assembly

Bowl body and operating mechanism	121
Bowl hood and disc stack	109
General directions	94
Horizontal driving device	156
Inlet/outlet, frame hood	99
Operating water device	130
Tools (special)	95
Vertical driving device	142

B

Bearings

Maintenance directions	89
Replacement on bowl spindle	134
Replacement on horizontal driving device	150

Bowl

Assembly	109, 121
Dismantling	102, 116

Bowl discs

Cleaning	81
Disc stack pressure	52

Bowl spindle

Assembly	142
----------	-----

Brake

Design and function	18
Renewing of friction pad	65

C

Centrifugal separation

	16
--	----

Check points

Ball and roller bearings	89
Before shutdowns	92
Bowl hood seal ring	47
Bowl spindle - radial wobble	64
Bowl spindle cone and bowl body nave	64
Brake	65
Buffer springs and ball bearing housing	66
Cleaning agents	80
Cleaning of bowl discs	81
Corrosion	48
Coupling friction pads	68
Cover interlocking switch	63
Cracks	51

Disc stack pressure	69
Dosing ring	54
Erosion	54
External cleaning	79
Flexible plate in coupling	70
Guide surfaces	56, 71
Inlet pipe and oil paring disc	58
Level ring	58
Lifting instructions	78
Lock ring - priming	72
Lock ring - wear and damage	74
Oil change procedure	86
Oil paring disc - height position	74
Operating mechanism	61
Operating paring disc - height position	74
Operating slide	61
Repair of galling	57
Sliding bowl bottom	62
Springs for operating mechanism	63
Vibration analysis	87
Vibration switch - adjustment of set point	88
Vibration switch - function check	63
Worm - wear of groove	76
Worm wheel and worm - wear of teeth	83
Worm wheel shaft - radial wobble	77
Clarifier	
Definition	28
Description	25
Cleaning	
CIP-system	82
Cleaning agents	80
Cleaning of bowl discs	81
External cleaning	79
Connection list	178
Connections	
Description	180
Dimensions	177
Corrosion	48
Coupling	
Function	19
Renewing of friction pads	68
Cover interlocking switch (option)	
Design and function	20
Drawing	198
Cracks	51

D		H	
Daily checks	41	Horizontal driving device	
Density of feed	174	Assembly	156
Disc	52	Dismantling	152
Disc stack pressure	52		
Dismantling		I	
Bowl body and operating mechanism	116	Installation	201
Bowl hood and disc stack	102	Interface	
General directions	94	Definition	28
Horizontal driving device	152	Description	26
Inlet/outlet, frame hood	97	Interface description	180
Operating water device	127	Intermediate service	37, 42
Tools	95		
Vertical driving device	137	L	
Drawings		Lifting instructions	78
Basic size drawing	176	Lock ring	
Cover interlocking switch (option)	198	Priming	72
Dimensions of connections	177	Wear and damage	59
Electric motor	194	Lubricants	
Foundations	193	Lubrication chart, general, oil groups	185
Machine plates and safety labels	196	Oil change interval	187
Vibration sensor (option)	198	Oil change procedure	86
		Oil level	86
E		Recommended greases	192
Electric motor		Recommended lubricating oils	187
Drawings. See Motor	194	Recommended oil brands	188
Emergency stop. See Safety stop		Recommended pastes and bonded coatings	191
Erosion	54	Volume of lubricating oil	175
Exploded views			
Bowl body and operating mechanism	115	M	
Bowl hood and disc stack	101	Machine plates and safety labels	196
Horizontal driving device	150	Main parts	18
Inlet/outlet, frame hood	96	Maintenance intervals	38
Operating water device	126	Maintenance logs	
Vertical driving device	134	3-year Service (3S)	46
		Daily checks	41
F		Intermediate Service (IS)	42
Foundations		Major Service (MS)	44
Drawing	193	Oil change	41
Installation	204	Maintenance, general information	
Frame feet		Ball and roller bearings	89
Installation	204	Before shutdowns	92
Replacement	46	Cleaning	79
Friction coupling		Lifting instructions	78
Function	19	Maintenance intervals	37
		Maintenance procedure	39
G		Oil change procedure	86
Gear		Service kits	40
Number of teeth	174	Vibration analysis	87
Wear of teeth	83	Major service	37, 44
Guide surfaces		Materials	174
Intermediate Service	56		
Major Service	71		
Repair of galling	57		

Metal surfaces				
Cleaning and cleaning agents		79, 80		
Corrosion		48		
Cracks		51		
Erosion		54		
Motor				
Cleaning		79		
Coupling		70		
Drawing		194		
Power consumption		174		
N				
Noise		174		
O				
Oil. See Lubrication				
Operation		30		
P				
Power consumption		174		
Power transmission		19		
Process capacity		174		
Purification				
Definition		28		
R				
Ready for start		30		
Revolution counter				
Design and function		20		
Number of revolutions		174		
S				
Safety Instructions		9		
Separation				
Basic principles		16		
Process main parts		22		
Separating function trouble tracing		168		
Separation temperatures		17		
Separator				
Brake		19		
Connection list		178		
Foundations		193		
Installation planning		201		
Interface description		180		
Lifting instructions		78		
Main parts		22		
Mechanical power transmission		19		
Normal stop		33		
Overview		18		
Ready for start		30		
Running		32		
Safety stop		34		
Sensors and indicators		20		
Separating function		25		
Sludge discharge cycle		26		
Start		31		
Storage and transportation		199		
Technical data		174		
Service instructions. See Check points				
Service kits		40		
Shutdown		92		
Start		31		
Stopping procedure		33		
Storage		199		
T				
Technical data		174		
Throughput				
Capacity		174		
Definition		28		
Transport		199		
Trouble tracing - mechanical functions				
Noise		165		
Retardation time too long		167		
Separator vibrates		164		
Smell		165		
Speed too low		165		
Starting power too high		166		
Starting power too low		166		
Starting time too long		166		
Water in worm gear housing		167		
Trouble tracing - separating functions				
Bowl fails to open		169		
Bowl opens accidentally		169		
Unsatisfactory separation result		170		
Trouble tracing - vibration switch				
Impossible to adjust setpoint to obtain tripping		171		
Vibration switch does not reset		171		
V				
Vertical driving device				
Assembly		142		
Vibration				
During start		31		
Safety stop		34		
Trouble tracing		164		
Vibration analysis		87		
Vibration switch (option)				
Adjustment of setpoint		88		
Description and signal processing		181		
Drawing		198		
Function check		63		
Trouble tracing		171		

W

Warning signs	13
Water	
Water quality specifications	184
Weight	174
Worm gear	
Function and description	19
Number of teeth	174
Wear of teeth	83