WESTFALIA SEPARATOR

SENIOR

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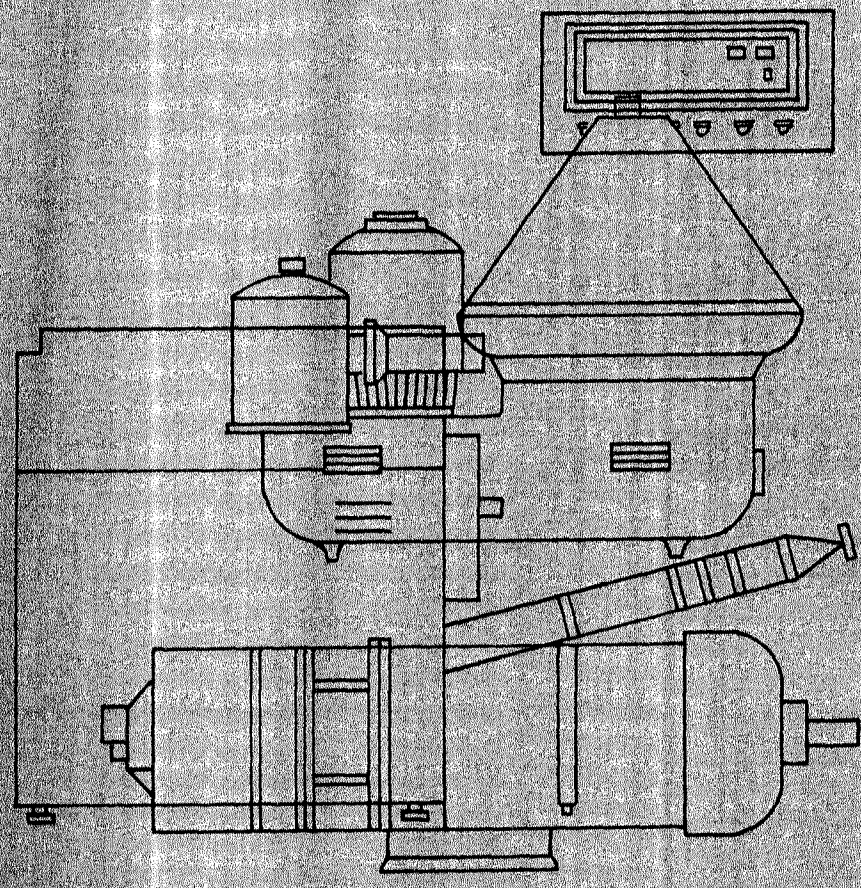
Instruction Manual and Parts List

No. 2168-9001-040

Separator
with self-cleaning bowl

Model OSA 7-02-066



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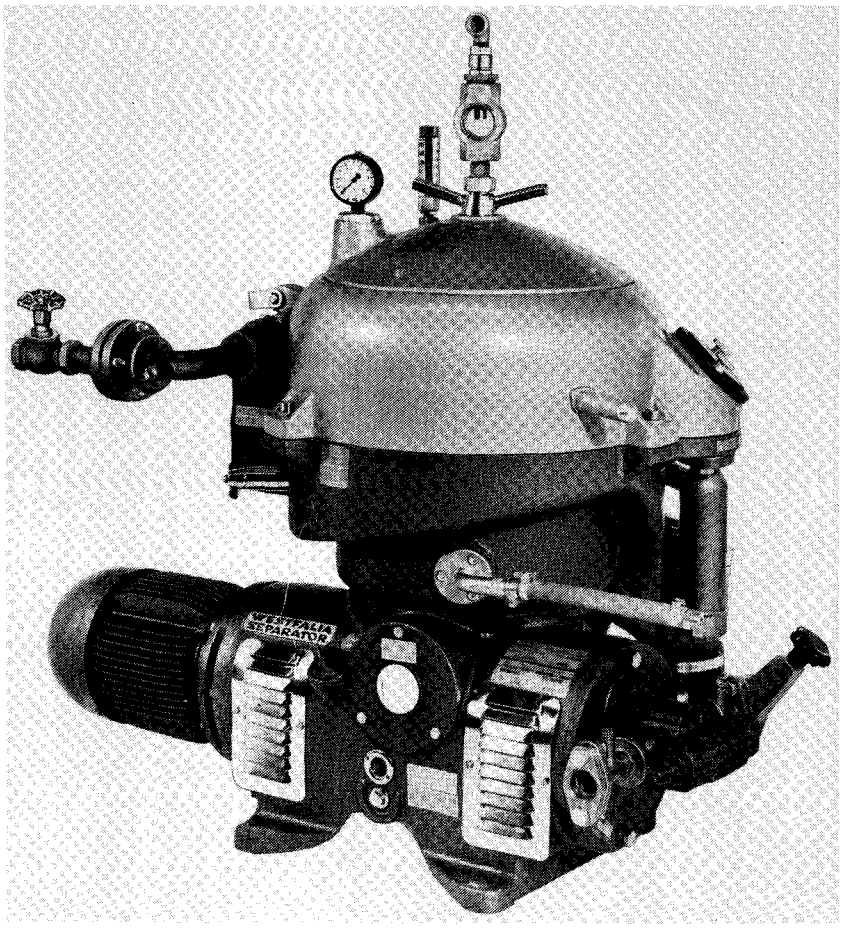

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Diagram of the Separator Plant

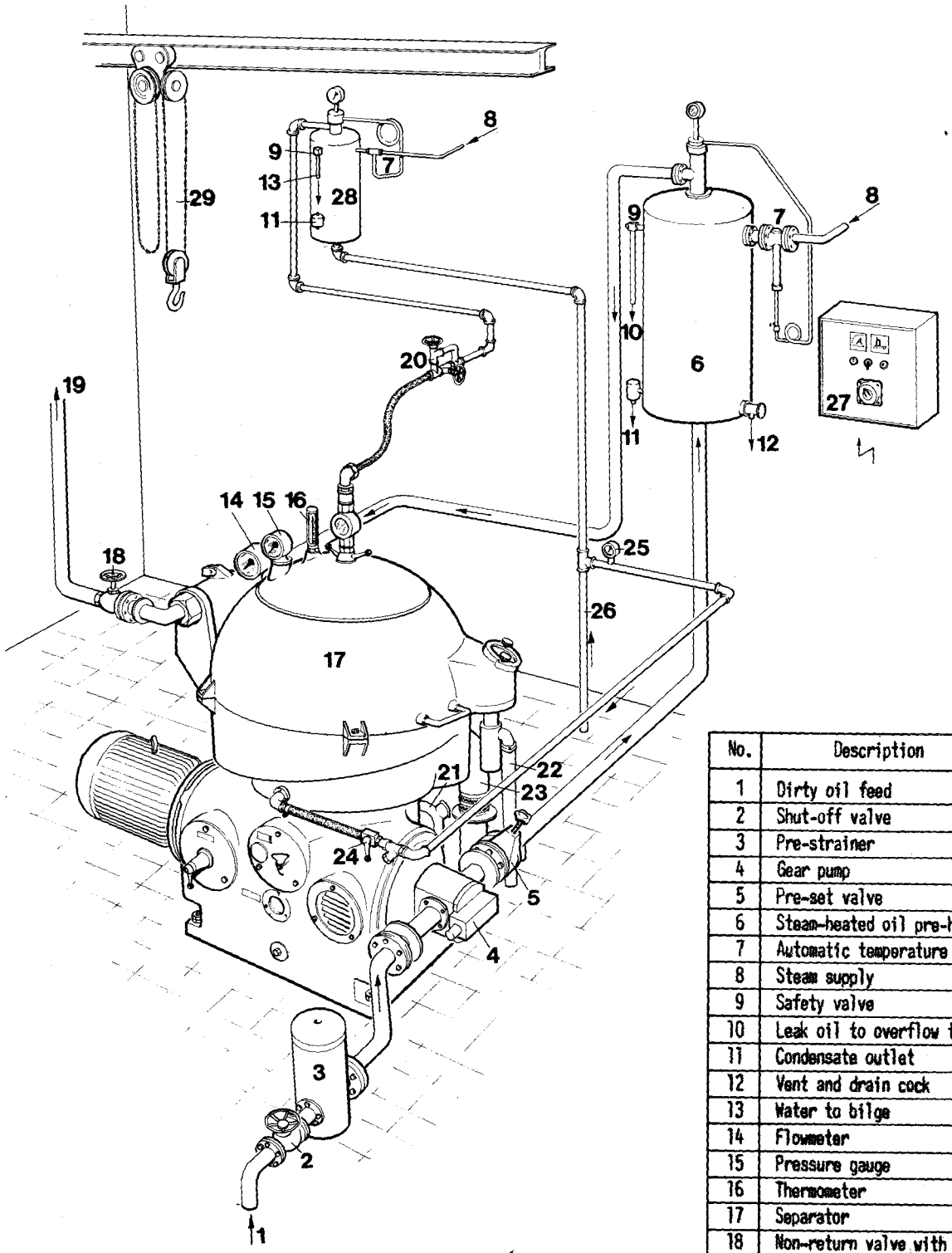


Fig. 0/1

No.	Description
1	Dirty oil feed
2	Shut-off valve
3	Pre-strainer
4	Gear pump
5	Pre-set valve
6	Steam-heated oil pre-heater
7	Automatic temperature control
8	Steam supply
9	Safety valve
10	Leak oil to overflow tank
11	Condensate outlet
12	Vent and drain cock
13	Water to bilge
14	Flowmeter
15	Pressure gauge
16	Thermometer
17	Separator
18	Non-return valve with shut-off device
19	Clean oil discharge
20	Make-up water connection
21	Operating-water discharge
22	Water discharge
23	Sludge discharge
24	Shut-off valve for operating water
25	Pressure gauge for operating water
26	Cold water feed
27	Motor control
28	Steam-heated water pre-heater
29	Hoist

Sectional View of the Separator

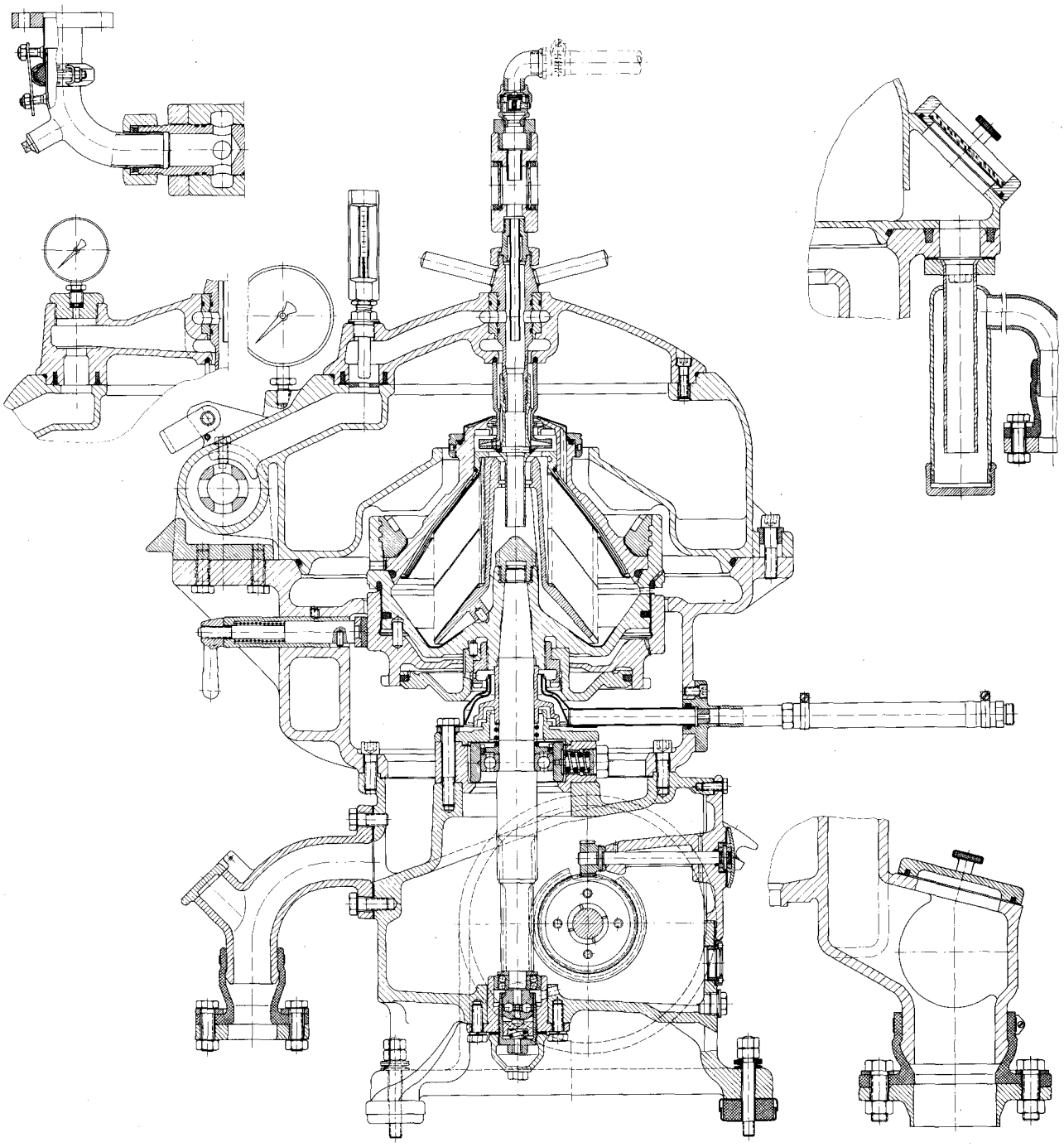


Fig. 0/2

Fig. 0/3: Component parts of the bowl

Fig. 0/4: Cross section of the bowl

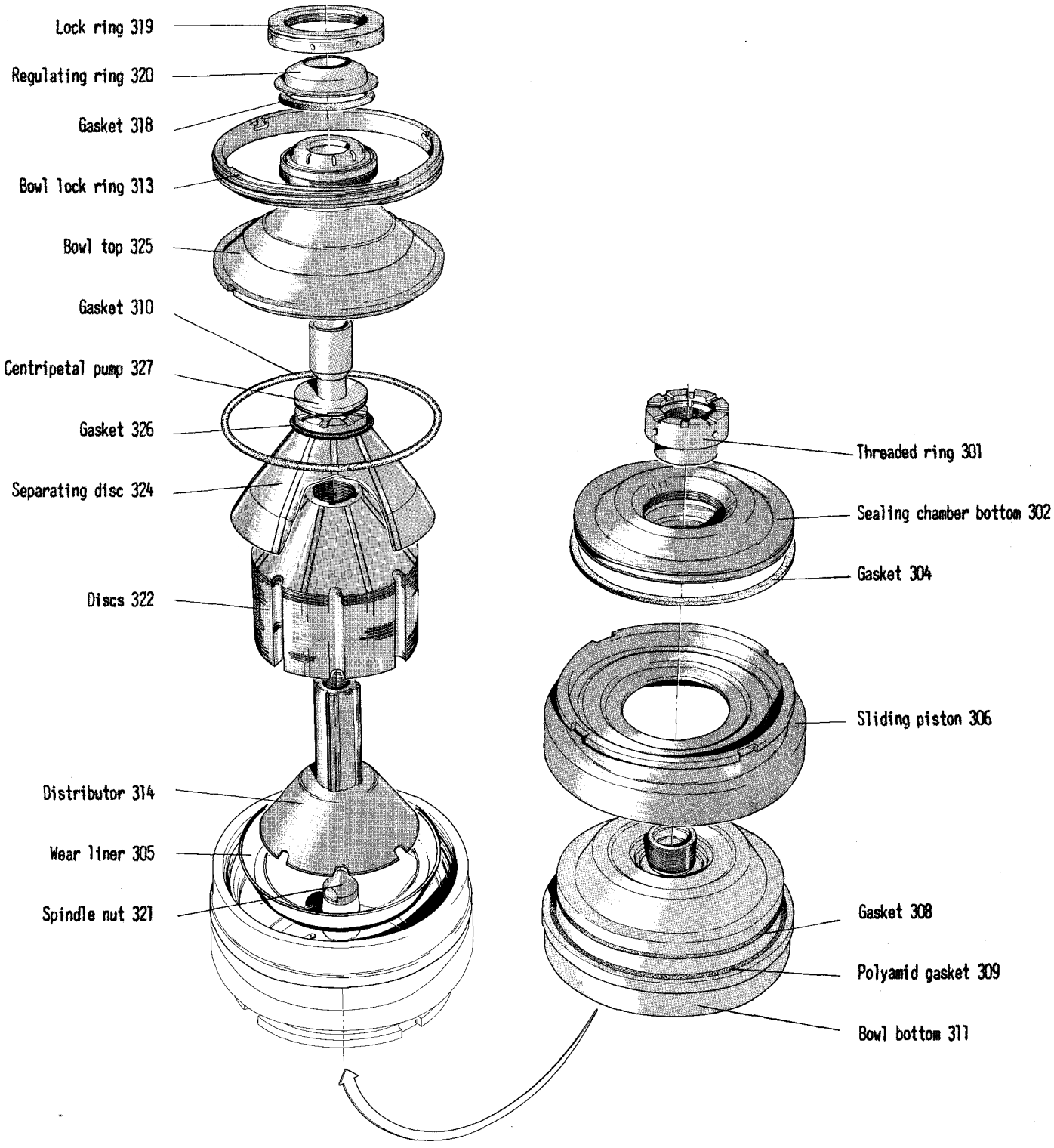


Fig. 0/3

Exploded view of the bowl

Sectional View of the Bowl

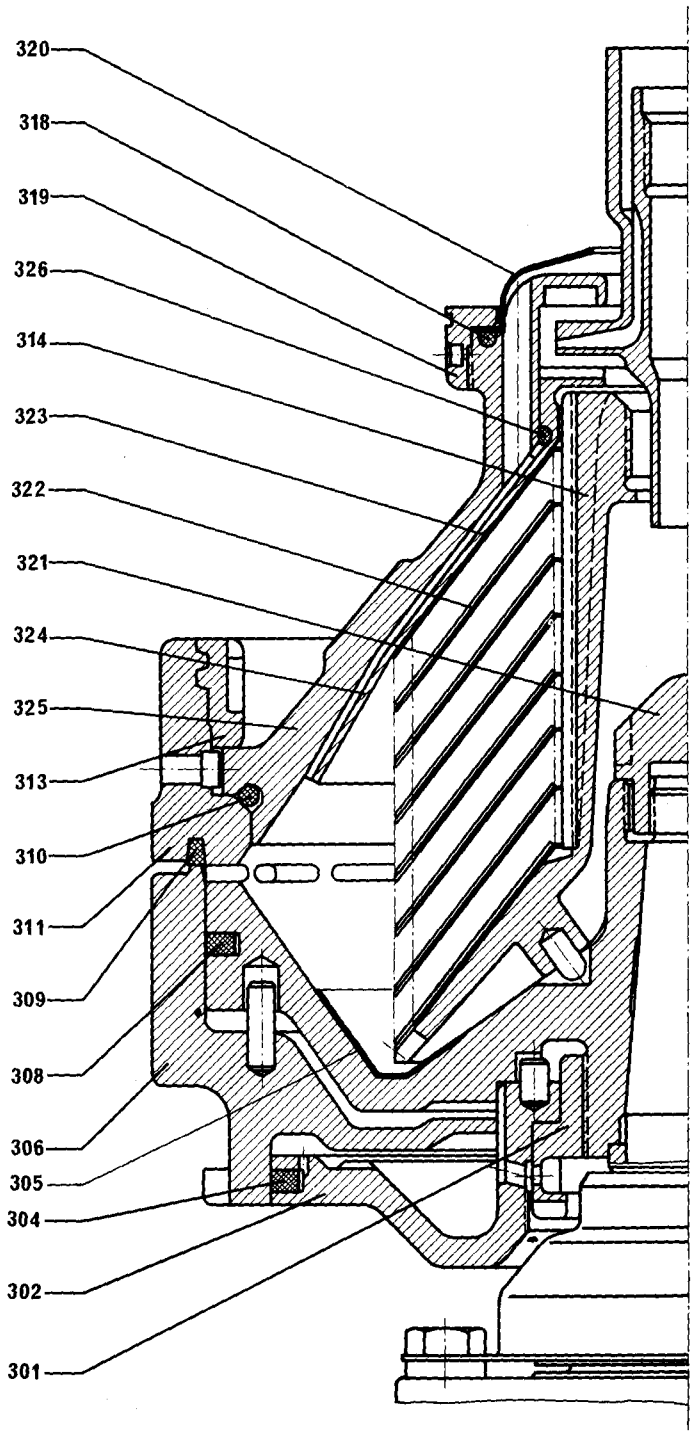


Fig. 0/4

301 Threaded ring
302 Sealing chamber bottom
304 Gasket
305 Wear liner
306 Sliding piston
308 Gasket
309 Polyamid gasket
310 Gasket
311 Bowl bottom
313 Bowl lock ring
314 Distributor
318 Gasket
319 Lock ring
320 Set of regulating rings
321 Spindle nut
322 Disc
323 Compensating disc
324 Separating disc
325 Bowl top
326 Gasket

Part I

1. Specification

The machine described in this instruction manual is a high speed centrifuge with self-cleaning bowl briefly called "Separator".

1.1. Application

The separator can be used either for the separation of oil-water mixtures (purification) or for the clarification of water-free oils.

Purification = separation of liquid mixtures made up of two liquids, with simultaneous removal of solids contained in the liquid.

Clarification = removal of solids from a liquid.

The most important part of the separator is the bowl which can be easily converted for clarification or purification as required.

Centrifugal separation is, however, only possible if the components of the feed liquid can be mechanically separated, if they are of different density, and if they are not emulsified.

1.2. Component parts of the separator and the separator plant

The main components of the separator and of the separator plant are:

Frame and hood
Gear parts
Bowl
Gear pump
Pre-strainer
Motor
Oil pre-heater
Water pre-heater

The separator comprises: Frame, hood, gear parts, bowl, centripetal pump as well as attached motor and attached pump.

The complete separator plant consists of the separator, pre-strainer, oil pre-heater, water pre-heater, switches, pipe lines, accessories, and special tools for operation and repair.

1.3 Technical data

Bowl

Sludge holding capacity	1.5 dm^3
Bowl speed: for densities of the heavy liquid up to 1.0 kg/dm^3 and of the separated solids up to 1.4 kg/dm^3	8,520 rpm
for densities of the heavy liquid higher than 1.0 kg/dm^3 and of the separated solids higher than 1.4 kg/dm^3	check with the factory
Starting time	2 - 5 minutes

Motor

Motor rating for separator without gear pump	3 kW
Motor rating for separator with gear pump	3.7 kW
Motor speed at 50 cycles	1,455 rpm
Motor speed at 60 cycles	1,745 rpm
Type of construction	B5

Pump

Gear pump, flanged	Type R 31/10 F1-So-C	Type R31/20 F1-So-C	Type R41/40 F1-So-C
Output when conveying oil of a viscosity of 40-80 cSt in working condition			
at a motor speed of 1455 rpm	840 1/h	1650 1/h	3400 1/h
at a motor speed of 1745 rpm	1000 1/h	2000 1/h	4000 1/h
Suction head	0.4 bar	0.4 bar	0.4 bar
Delivery head	1-3 bar	1-3 bar	1-3 bar

Centripetal pump

Output	3400 1/h
Delivery head	1 - 2 bar

Weights:

Separator without motor and pump	300 kg
Bowl	55 kg
Three-phase AC motor	63 kg
DC motor	110 kg
Gear pump R 31/10 F1-So-C	11 kg
Gear pump R 31/20 F1-So-C	12 kg
Gear pump R 41/40 F1-So-C	31 kg
Pre-strainer (depending on pump size)	8 or 10 kg

Capacity

The effective capacity of the separator depends on the viscosity, temperature, density, degree of contamination, water content and required purity level of the oil.

The standard capacity values for fuel and lubricating oils are stated in the attached table. These values apply unless the Diesel motor manufacturer specifies other capacities.

1.4. Operating principles

1.4.1. General

The bowl determines the field of application of the separator. Before giving a detailed description of the bowl, the operating principles of the separator are explained.

Liquid-liquid and liquid-solid mixtures can be separated in settling tanks (by gravity) or in centrifugal separators (by centrifugal force), provided that the components of the feed liquid have different densities. Since centrifugal force developed by centrifuges is many thousand times the force of gravity, separation by centrifuging is accomplished many thousand times faster than by natural settling and takes place in seconds.

1.4.2. The principle of clarification

Clarification means the removal of solids from a liquid.

If a liquid-solid mixture is poured into a stationary vessel, the solid particles, being heavier, will slowly sink to the bottom under the action of gravity (fig. 1/1).

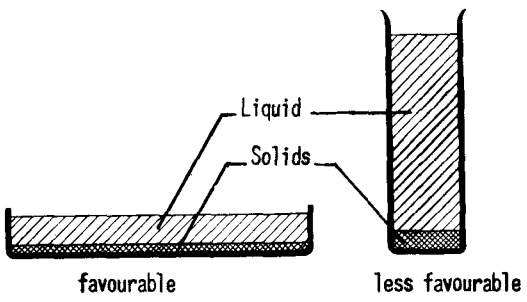


Fig. 1/1
Vessels with different settling area.

The larger the settling area and the shallower the vessel, the shorter will be the settling time required to achieve a certain degree of clarification for a specified volume of liquid. The greater the difference between the densities of the liquid and the solids, the more effective will be the clarification.

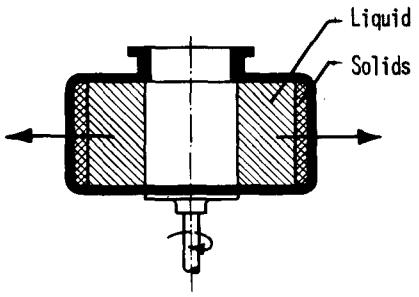


Fig. 1/2
Rotating vessel

In a rotating vessel, the solid particles, subjected to centrifugal force, will deposit much faster than in a stationary vessel (fig. 1/2).

1.4.3. The principle of purification

Purification means the separation of liquid mixtures made up of two liquids, with simultaneous removal of solids contained in the liquids.

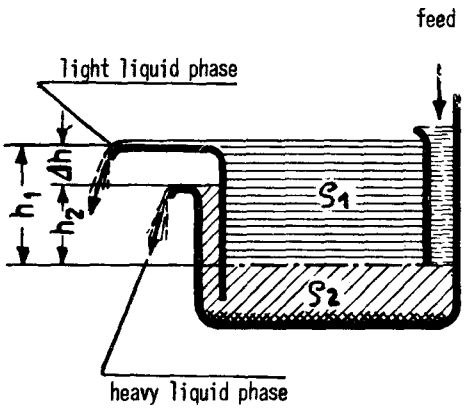


Fig. 1/3

Settling tank for continuous separation of a liquid-liquid mixture

Fig. 1/3 shows a settling tank with one feed inlet and two outlets, which can be used for continuous separation of a liquid-liquid mixture with simultaneous removal of solids. The difference in height h between the two overflows must be adjusted in accordance with the difference in density of the two liquid phases so as to achieve equal hydrostatic pressure, thus

$$\rho_1 \cdot h_1 = \rho_2 \cdot h_2$$

Before separating, for instance, an oil-water mixture containing a preponderance of oil, the vessel must first be filled with water (heavy phase) so as to form a water seal (see fig. 1/3).

The throughput of a settling tank of this kind is dependent on the retention time required for complete separation of the components of the feed liquid.

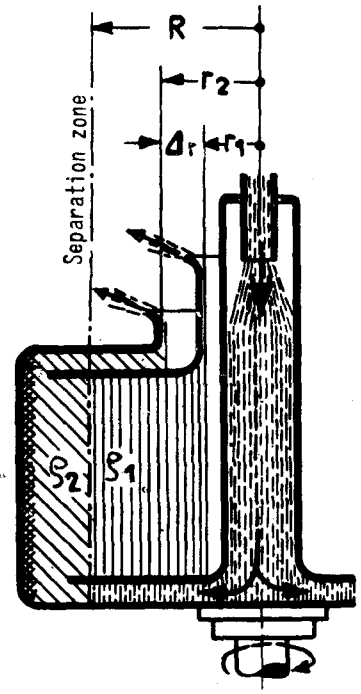


Fig. 1/4

Rotating vessel for continuous separation of a liquid-liquid mixture

In Fig. 1/4 the settling vessel is shown rotating about an axis. This is a separator bowl in its simplest form where separation takes place in the same way as in a stationary vessel. However, the centrifugal field in a rotating bowl is much more effective than the gravitational field of a stationary settling vessel since the liquid pressure increases with the square of the distance from the axis of rotation.

For the balance of the hydrostatic pressure in the rotating bowl the following formula applies:

$$\rho_1(R^2 - r_1^2) = \rho_2 (R^2 - r_2^2).$$

1.4.4. Operating principle of the purifier bowl

The principle of purification is described under 1.4.3. Separation, for example, of an oil water mixture is not accomplished as shown in fig. 1/4, but takes place in a disc set consisting of a large number of conical discs arranged one above the other. The individual discs are provided with spacers to obtain precisely calculated narrow spaces between the discs, which divide the liquid bowl contents into a great number of very thin layers. This means that the radial settling path of the components is very small.

The solids collect on the upper walls of the spaces between the discs and slide down into the sludge holding space of the bowl since the angle of the cone of the discs corresponds to the angle of the slope of the solids in the centrifugal field. If the disc surfaces are smooth, the sludge will slide down without sticking and discs will clean themselves to a great extent.

The oil and water components are separated in the separation chamber of the bowl. Bowls used for separating oil-water mixtures are provided with a regulating ring. By means of this regulating ring the diameter of the water outlet can be adapted to the difference in densities of the oil and water. For further details refer to sect. 2.4.3.

1.4.5. Operating principle of the clarifier bowl

To remove impurities from water-free oils, the disc type bowl described under 1.4.4 can be converted for clarification. The water outlet is to be blocked by inserting the regulating ring with the smallest inner diameter, to prevent oil discharge from the water outlet.

1.4.6. Operating principles of the hydraulically controlled sliding piston of the self-cleaning bowl

The operating liquid (generally water) rotating with the bowl develops high centrifugal pressure which is used to operate the sliding piston for opening and sealing the bowl.

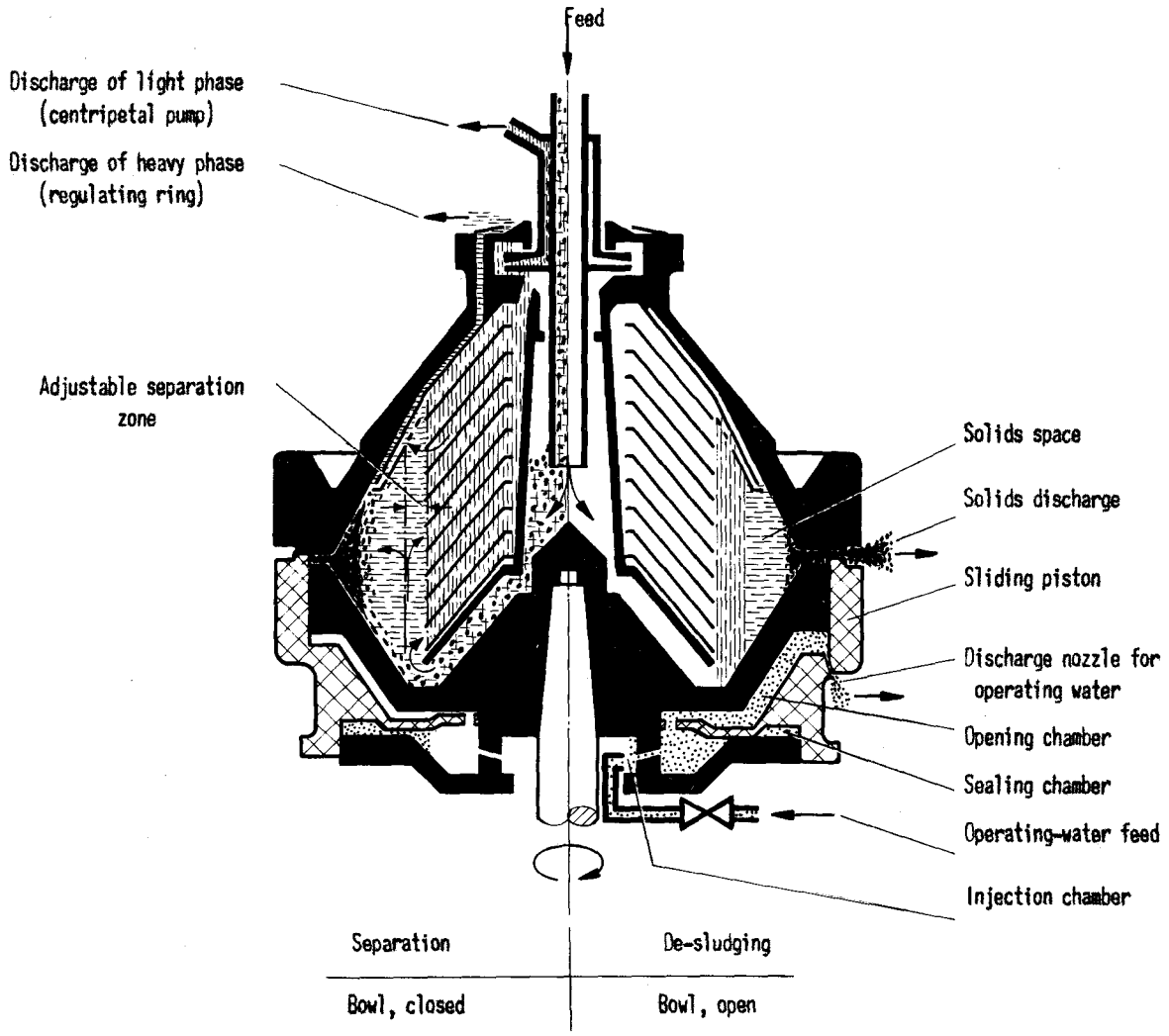


Fig. 1/5

Diagram of the self-cleaning bowl

As shown in fig. 1/5, the sliding piston is arranged around the bowl bottom. It rotates at the same angular velocity as the other bowl parts but can be moved axially.

Sealing of the bowl: Upon starting the separator, the operating-liquid valve is briefly opened several times. The operating liquid flows into the injection chamber from where it is directed, through inlet nozzles, to the sealing chamber beneath the piston.

The liquid pressure developed in the sealing chamber raises the sliding piston and presses it against the gasket of the bowl bottom, thus sealing the bowl. Separation can now begin.

Opening of the bowl (de-sludging):

When the sludge space of the bowl is filled with solids, the operating-liquid valve is opened. The operating liquid flows via the injection chamber into the sealing chamber. When the sealing chamber is filled, the operating liquid passes on into the opening chamber.
A small portion of operating liquid escapes through the discharge nozzle the diameter of which has been so selected that the amount of discharging liquid is smaller than that of the incoming liquid. The effective area of the piston is greater in the opening chamber than in the sealing chamber, and so the force tending to open the bowl due to the area and the pressure of the operating liquid is greater than the force tending to keep the bowl closed. The piston therefore moves downwards and opens the discharge ports in the bowl bottom.

Re-sealing of the bowl:

Upon de-sludging the operating-liquid supply is shut off. The liquid contained in the opening chamber is ejected through the discharge nozzle. As the liquid level recedes, the opening pressure acting on the upper side of the sliding piston quickly decreases. As soon as it has dropped below the sealing pressure acting on the underside of the piston, the latter is forced upwards thus re-sealing the centrifugation room.

By briefly opening and closing the operating-liquid valve (see 2.3.2.1 No. 3) several times, the sealing chamber, extended by the upwards movement of the sliding piston, is re-filled. The separating process can now be resumed.

The bowl emptying process takes place in a matter of seconds. It can be controlled manually or by means of an automatically operating timing unit. For a bowl de-sludging 2 litres of operating liquid are required. During centrifugation operating liquid need not be supplied.

1.4.7. Operating principle of the centripetal pump

The centripetal pump discharges the clarified oil under pressure. It operates on the reverse principle as a centrifugal pump. In the latter case the impeller, which has inclined vanes, rotates in a stationary casing. The liquid being pumped flows out from within the pump through the impeller vane channels. The reverse is the case with the centripetal pump. It is fixed to the hood of the separator, and its disc, which is provided with channels, is immersed in the liquid rotating with the bowl (see fig. 1/7).

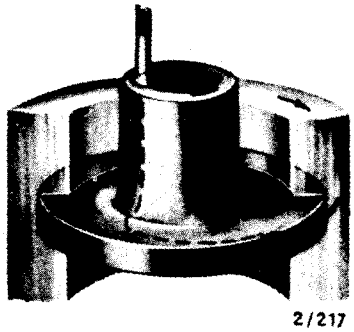


Fig. 1/7
Centripetal pump for liquid discharge under pressure.

The oil is peeled off by the centripetal pump and flows into its spiral channels from outside, its kinetic energy being converted into pressure energy.

When the back-pressure is low, the depth of immersion of the centripetal pump in the oil is small. It can, however, be increased by throttling the valve in the discharge line. In this way, a good liquid seal is obtained and the liquid does not come into contact with the air and remains free of foam. In addition, high backpressure is obtained, so that delivery heads of up to 20 m water column can be achieved.

1.4.8. Operating principle of the gear

The separator is driven by a standard motor, type of construction B5, via a centrifugal clutch acting on the worm wheel shaft. Power transmission from the worm wheel shaft to the bowl spindle is effected by means of a worm wheel drive, in which the worm wheel on the worm wheel shaft is the driving member and the worm on the bowl spindle the driven member. The attached gear pump is also driven by the worm wheel shaft via a safety coupling.

1.4.9. Operating principle of the centrifugal clutch

The centrifugal clutch gradually brings the bowl to its rated speed, eliminating premature wear on gear parts and on motor. The acceleration time can be regulated by the number of clutch shoes inserted. For further details refer to sect. 3.4.4.

1.4.10. Operating cycle of the separator plant (fig. 0/1)

The separator plant is shown in fig. 0/1. The gear pump sucks the oil from the dirty oil tank via shut-off valve and pre-strainer and pumps it to the separator via the pre-set valve and oil heater.

The cleaned oil is passed to the clean oil tank by means of the built-in centripetal pump.

The make-up water used in the purification of oil-water mixtures is heated to separating temperature in a water pre-heater and is fed to the separator in the right proportion through a make-up water regulating device.

Erosion

General advice about erosion

on self-cleaning separators

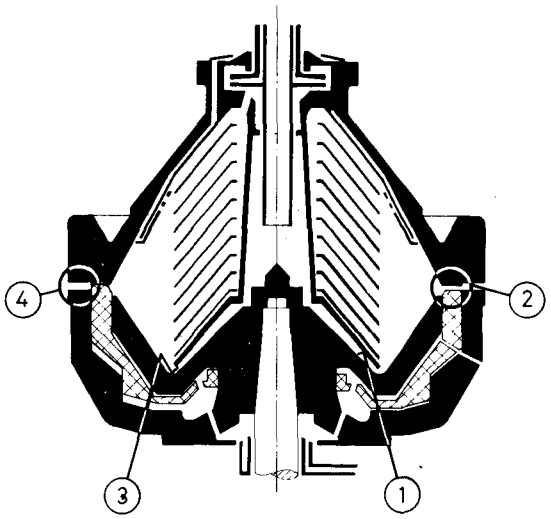


Fig. 1

Erosion may occur when solids contained in the process liquid slide along a surface or strike a surface while passing through the bowl.

Erosion is characterized in the former case by grinding marks and in the latter case by dents or pits with a granular and bright surface.

Erosion is intensified in some areas by high flow rates.

Surfaces subjected to erosion are, for example (Fig. 1):

1. the underside of the distributor, especially in front of the guide ribs and in the area of the rising holes;
2. the sealing edge of the piston and the main gasket in the bowl top;
3. the wear liner in the centrifugation chamber bottom;
4. the land between the solids discharge ports in the bowl bottom.

Carefully observe any signs of erosion. Defects may deepen rapidly and weaken the bowl parts by reduction of the material cross sections. Pay special attention to the land between the solids discharge ports.

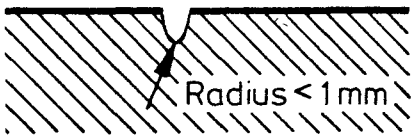


Fig. 2

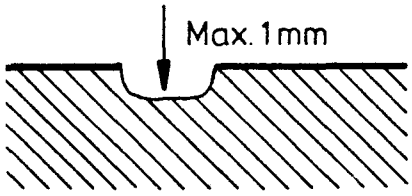


Fig. 3

Consult the Westfalia representative if

1. the bottom radius of the erosion mark is less than 1 mm at the narrowest point, or coarse scratches are present (Fig. 2);
2. the deepest erosion mark exceeds 1 mm (Fig. 3).

The nature of the defects can be determined by photographs, plaster impressions or hammered-in lead.

If excessive erosion occurs on the bowl parts, consider the possibility of eliminating the abrasive solids by suitable pre-treatment of the process liquid (e.g. by settling in a tank) before centrifugation to reduce the wear on the bowl parts. Should this treatment be insufficient, the bowl surfaces subjected to erosion can be protected by hard-facing or by wear liners.

Part II

2. Operating Safety, Attendance, Operation and Cleaning of the Separator

2.1. Operating safety of the separator

2.1.1. Hints regarding operating safety

The WESTFALIA Separator is a high-speed centrifuge which works reliably, provided that it is operated and looked after in accordance with our Operating Instructions.

The bowl speed has been rated so as to ensure the operating safety of the separator. It depends on the densities of the centrifugally separated solids and of the heavy liquid. If the densities exceed those shown on the name-plate of the separator, check with the factory or with authorized representatives for detailed information, since in the majority of such cases the bowl speed will have to be reduced by changing the gear parts.

The amount of solids in the feed liquid must be kept as constant as possible.

When assembling the bowl, strictly adhere to the instructions of this working manual, to avoid undue unbalance which may result in heavy damage.

Corrosive liquids and liquids containing abrasive solids, particularly when being processed at high temperatures, may attack the bowl material after quite a short period of operation, resulting in impaired safety. To obviate the danger arising from impaired safety, keep a regular check on all bowl components. Special attention must be given to the threads of the bowl bottom and of the bowl lock ring as well as to the area between the sludge ejection ports in the bowl bottom.

We, therefore, recommend in your own interest to have your separator inspected by WESTFALIA service engineers at regular intervals. Such inspections will keep your separator working reliably and prevent undesirable shut-downs.

2.1.2. Important hints regarding accident prevention

1) Do NOT loosen any part of the separator or of the feed and discharge connections before the bowl has stopped completely.

   Note that the bowl will not be at rest before revolution indicator disc (fig. 3/3) has ceased rotating.

2) The bowl speed as seen on the name-plate of the separator is rated for densities of the heavy liquid phase and of the separated solids up to the maximum values also stated on the name-plate. In case of higher densities check with the factory. Be sure to refer to sect. 3.1.3.

3) Check the bowl height for possible re-adjustment before the initial start-up of the separator, after re-assembling the vertical gear parts, and after exchanging the bowl or the centripetal pump. See sect. 3.4.3.

4) Be sure to strictly follow the instructions of the lubrication and maintenance schedule (see 3.2.1).

5) If the bowl comes up to rated speed as per name-plate of separator in less than 2 minutes and the motor pulls too high a starting current, reduce number of clutch shoes to 3 or 2. Refer to sect. 3.4.4.

6) Never use blow-torch on bowl or expose bowl to heat of open flame.

7) When using a water pre-heater, be sure to provide the pre-heater or the hot-water line between pre-heater and shut-off device with a safety valve. This safety valve has to be cleaned from time to time, at least twice a year.

8) When separating inflammable liquids, e.g. mineral oils of dangerous-materials classes I, II or III, be sure to refer to page 2/3.

9) The Operating Directions supplied with the separator should be kept near the separator within reach of sight.

Specifications

for the use of WESTFALIA separators of the OTA and OSA series, intended for the separation of mineral oils (inflammable liquids) classified under group A (VbF) of the dangerous-materials classes I, II or III.

The manufacturing programme of the Westfalia Separator AG. includes mineral oil separators of the self-cleaning and non-self-cleaning version, - available with frame and hood of different designs, depending on the classification of the inflammable liquids to be processed.

Standard type separators, version "-066"

e.g. self-cleaning type OSA 7-02-066
non-self-cleaning type OTA 14-00-066

Separators of the -066 version have an enclosed housing. For more than 65 years they have been used for the treatment of mineral oils of the dangerous-materials class A III at separating temperatures of up to 100°C. They are normally equipped with electric motors of IP 44 enclosure. Plants comprising such separators are to be provided with electrical equipment of IP 54 or IP 55 enclosure.

The rooms where the separators are installed should have their own aeration and de-aeration system.

Standard values for the change of air:

in small closed rooms of up to 100 m^3: 30...50 times per hour

in halls: 15...20 times per hour

in niches of engine rooms: 50...70 times per hour

Separators with flame-proof sections of the frame (for brakes and clutch) - version -566

e.g. self-cleaning type OSA 7-02-566
non-self-cleaning type OTA 14-00-566

Separators of the version -566 have an enclosed housing. Brakes and clutch are arranged in flame-proof sections of the frame. The frame has been tested by the Federal German Physical and Technical Institute (PTB), Braunschweig, in accordance with the requirements of German specifications VDE 0171, type of enclosure (Ex) d2 "flame-proof". Not subjected to this test is the separator OTA 2-00-566 which has neither a centrifugal clutch nor a brake. All separators of the -566 version are equipped by WESTFALIA SEPARATOR AG. with electric motors of flame-proof enclosure (Ex) d3n, ignition category G4.

Each separator frame has been tested at a static pressure of 10 bar. Westfalia separators of the version -566 are suitable for operation in plants endangered by inflammable materials of the dangerous-materials classes 1 and 2.

Temperatures measured by WESTFALIA SEPARATOR AG. on the outside of the separator housings while the machines were in operation, were found to be below the limit temperature of 160°C admissible for ignition category G3.

Separators of the version -566 are provided with a fitting for nitrogen blanketing of the interior space of the machine. This fitting has to be connected by the customer to the nitrogen supply line. The nitrogen blanketing pressure may range between 100 and 3000 Pa.
Separators of the -566 version are required if inflammable liquids of the dangerous-materials classes A I and A II are to be treated.

The type of enclosure of the electrical equipment necessary to operate the plant, such as motor control, timing unit, electric heater, heater control, and solenoid valves has to be selected so as to meet the requirements for explosion-hazarded areas, otherwise it has to be installed outside the explosion-hazarded area.

WESTFALIA SEPARATOR Mineral Oil Separators	**Operating Instructions for self-cleaning WESTFALIA Mineral Oil Separators Type OSA**	No. 2178-9101-010

Separator with separating bowl

Separator with clarifying bowl

These operating instructions are no substitute for the instruction manual. They contain only the most important points which must be observed without fail if the separator is to work reliably and efficiently.

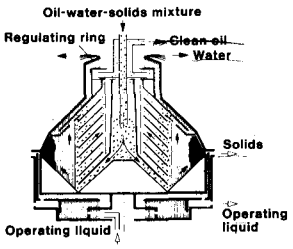
1. Points to note when installing and before starting the separator for the first time
Fill the gear chamber up to the top third of the sight glass with the oil specified in the instruction manual. Connect up the motor, install the bowl and check the bowl height (see instruction manual). Make sure that the bowl (when viewed from above) and the revolution indicator disc rotate in clockwise direction. Pour oil into the intake of the gear pump.

2. Points to note each time before starting

2.1. Lubrication. Check the oil filling of the separator. With the bowl stationary, the oil level must not be below the middle of the sight glass. Use only the grade of oil specified in the instruction manual. Before assembling the bowl, apply a thin coating of grease containing molybdenum disulfide to the sliding surfaces of hydraulic system parts and the lock ring.

2.2. Assembly of bowl. See instruction manual. No component must be omitted or replaced by the same component of another bowl. Lock rings have left-hand thread. All "0" marks must be radially in line.

2.3. Setting for separation:



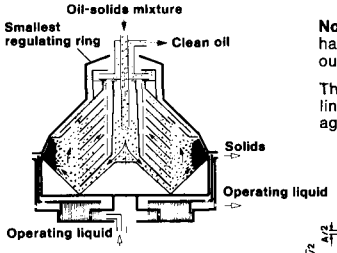
Separation of two liquids with simultaneous removal of solids.

Note. The right regulating ring must be selected. See instruction manual.

Effect of regulating ring being too wide: discharging clean oil is free of water, discharging water contains oil.

Effect of regulating ring being too close: discharging clean oil contains water, discharging water is free of oil.

2.3. Setting for clarification:



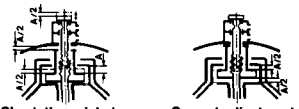
Removal of solids from a liquid.

Note. The smallest regulating ring has to be fitted to block the water outlet.

The shut-off valves in the hot water line must be closed and secured against unintended opening.

2.4. Release brake. Check if the bowl can be turned by hand. Close the hood and fasten it with screws.

2.5. Prior to fastening the centripetal pump by means of the handle connection piece, move centripetal pump axially up and down in the hood and measure the axial play; this must be A/2 (see Fig.). Dimension "A" is the total play in the centripetal pump chamber. The value is stated in the instruction manual, but can also be measured prior to closing the hood. If the dimension is incorrect, consult the instruction manual.



Check the axial play — Correct adjustment

3. Starting the separator with separating bowl

3.1. Position of shut-off devices prior to starting:

in feed lines for dirty oil and water	:	closed
in discharge line for clean oil (centripetal pump)	:	closed

3. Starting the separator with clarifying bowl

3.1. Position of shut-off devices prior to starting:

in feed line for dirty oil	:	closed
in discharge line for clean oil (centripetal pump)	:	closed

Important. If feed line for filling, displacing and make-up water is provided, close shut-off valves and make sure that water cannot enter bowl through misoperation.

3.2. Switch on the motor, and wait 5 to 12 minutes until the bowl has reached its rated speed (check revolution indicator disc).

3.3. Open and close the bowl hydraulically by operating the operating-water shut-off valve as follows:

open for 10 sec. / close for 20 sec. } de-sludging and closing of the bowl

open for < 1 sec. — close for 10 sec. / open for < 1 sec. — close for 10 sec. / open for < 1 sec. — close } further filling of the closing chamber to prevent the bowl from opening prematurely

3.4. Fill oil pre-heater with dirty oil, switch on heater and bring the oil up to separating temperature.

3.5. Heat up the separating bowl by feeding hot water
Before admitting oil, supply hot fresh water to the bowl. As soon as the bowl has adequately heated, set the needle valve in the hot water line to the amount of make-up water required for the type of oil to be processed (see instruction manual). Observe the sludge discharge via the sight glass. If the bowl does not close properly, liquid will flow out via the sludge discharge, and in this case re-opening and closing of the bowl must be carried out.

3.5. Heat up the clarifying bowl by feeding hot oil
Open shut-off device in clean oil discharge line completely. Slightly open the shut-off valve in the dirty oil feed. Observe the sludge discharge via the sight glass. If the bowl does not close properly, liquid will flow out via the sludge discharge, and in this case re-opening and closing of the bowl must be carried out.

3.6. After the bowl has warmed up and the amount of make-up water has been adjusted, slowly open the shut-off devices in the clean oil discharge and dirty oil feed. Setting of the pre-set valve to the throughput capacity is necessary only for first start-up. Set back-pressure in clean oil discharge line as explained in the instruction manual.

3.6. After the bowl has warmed up, open the shut-off valve in the dirty oil feed completely. Setting of the pre-set valve to the throughput capacity is necessary only for first start-up. Set back-pressure in clean oil discharge line as explained in the instruction manual.

4. De-sludging the bowl
The frequency of de-sludging depends on the dirt content of the feed product.

4.1. Switch off the oil pre-heater on units without circulating facility.
Shut off the oil feed and oil discharge.

4.1. Switch off the oil pre-heater on units without circulating facility.
Shut off the oil feed.

4.2. To de-sludge the bowl, operate the operating-water valve as indicated under 3.3. The operating water should have a pressure of 1.5 to 3 bar and should be cold and as clean as possible. The strainer in front of the shut-off valve must be cleaned from time to time.

4.3. If flush de-sludging is provided, feed the bowl with hot water until water discharges from the water outlet. Then de-sludge bowl as indicated under 3.3.

4.3. Not applicable

4.4. After the final de-sludging, feed the bowl with hot water until water discharges from the water outlet. Then check setting of the make-up water regulating valve.

4.4. Not applicable

4.5. Switch on the oil pre-heater again on units without circulating facility.
Slowly open shut-off devices in clean oil discharge and dirty oil feed. Check discharges.

4.5. Switch on the oil pre-heater again on units without circulating facility.
Open dirty oil feed. Check discharges.

5. Shutting down the separator
Switch off the oil and water pre-heaters; continue feeding oil and water for some minutes. Shut off the oil feed and oil discharge and close the needle valve in the hot water line. Carry out de-sludging with subsequent flush de-sludging (see under 3.3 and 4.3). Switch off the motor and apply the brake.
Do not detach any part before the bowl has come to a stop.

5. Shutting down the separator
Switch off the oil pre-heater; continue feeding oil for some minutes. Shut off the oil feed. De-sludge as indicated under 3.3. Switch off the motor and apply the brake. After the bowl has come to a stop, close the shut-off device in the clean oil discharge.
Do not detach any part before the bowl has come to a stop.

6. General. Observe the schedule for lubrication and maintenance. Read the instruction manual carefully.

WESTFALIA SEPARATOR Mineral Oil Separators	**Operating Instructions for self-cleaning WESTFALIA Mineral Oil Separators Type OSA with Automatic Timing Unit VB**	No. 2178-9101-010

Separator with separating bowl

Separator with clarifying bowl

These operating instructions are no substitute for the instruction manual. They contain only the most important points which must be observed without fail if the separator is to work reliably and efficiently.

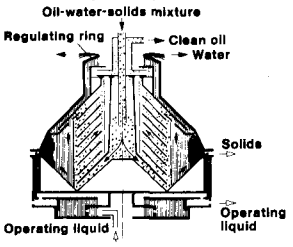
1. Points to note when installing and before starting the separator for the first time
Fill the gear chamber up to the top third of the sight glass with the oil specified in the instruction manual. Connect up the motor, install the bowl and check the bowl height (see instruction manual). Make sure that the bowl (when viewed from above) and the revolution indicator disc rotate in clockwise direction. Pour oil into the intake of the gear pump.

2. Points to note each time before starting

2.1. Lubrication. Check the oil filling of the separator. With the bowl stationary, the oil level must not be below the middle of the sight glass. Use only the grade of oil specified in the instruction manual. Before assembling the bowl, apply a thin coating of grease containing molybdenum disulfide to the sliding surfaces of hydraulic system parts and the lock ring.

2.2. Assembly of bowl. See instruction manual. No component must be omitted or replaced by the same component of another bowl. Lock rings have left-hand thread. All "0" marks must be radially in line.

2.3. Setting for separation:



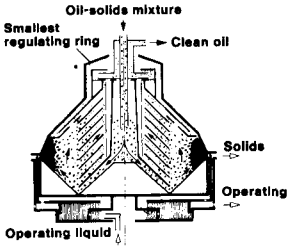
Separation of two liquids with simultaneous removal of solids.

Note. The right regulating ring must be selected. See instruction manual.

Effect of regulating ring being too wide: discharging clean oil is free of water, discharging water contains oil.

Effect of regulating ring being too close: discharging clean oil contains water, discharging water is free of oil.

2.3. Setting for clarification:



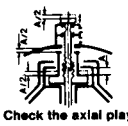
Removal of solids from a liquid.

Note. The smallest regulating ring has to be fitted to block the water outlet.

The shut-off valves in the hot water line must be closed and secured against unintended opening.

2.4. Release brake. Check if the bowl can be turned by hand. Close the hood and fasten it with screws.

2.5. Prior to fastening the centripetal pump by means of the handle connection piece, move centripetal pump axially up and down in the hood and measure the axial play; this must be A/2 (see Fig.). Dimension "A" is the total play in the centripetal pump chamber. The value is stated in the instruction manual, but can also be measured prior to closing the hood.
If the dimension is incorrect, consult the instruction manual.



Check the axial play

Correct adjustment

3. Starting the separator with separating bowl

3.1. Position of shut-off devices prior to starting:

in feed lines for dirty oil and water	:	closed
in discharge line for clean oil (centripetal pump)	:	closed
in compressed-air line	:	open

3. Starting the separator with clarifying bowl

3.1. Position of shut-off devices prior to starting:

in feed line for dirty oil	:	closed
in discharge line for clean oil (centripetal pump)	:	closed
in compressed-air line	:	open

Important. If feed line for filling, displacing and make-up water is provided, close shut-off valves and make sure that water cannot enter bowl through misoperation.

3.2. Switch on the motor, and wait 5 to 12 minutes until the bowl has reached its rated speed (check revolution indicator disc).

3.3. Open and close the bowl hydraulically by operating the operating-water shut-off valve as follows:

open for 10 sec. / close for 20 sec. } de-sludging and closing of the bowl

open for < 1 sec. — close for 10 sec. / open for < 1 sec. — close for 10 sec. / open for < 1 sec. — close } further filling of the closing chamber to prevent the bowl from opening prematurely

3.4. Open shut-off valve in suction line of oil feed pump. Switch on the oil pre-heater and bring the dirty oil up to separating temperature. While the oil is warmed up, it circulates via pump, pre-heater and three-way diaphragm valve.

3.5. Heat up the separating bowl by feeding hot water
Before admitting oil, supply hot fresh water to the bowl. As soon as the bowl has adequately heated, set the needle valve in the hot water line to the amount of make-up water required for the type of oil to be processed (see instruction manual). Observe the sludge discharge via the sight glass. If the bowl does not close properly, liquid will flow out via the sludge discharge, and in this case re-opening and closing of the bowl must be carried out.

3.6. Open and close the bowl hydraulically (see 3.3) to eject the water filling.
Open the shut-off valve in the clean oil discharge.

4. Starting the automatic timing unit for separators with separating bowl

4.1. First start-up. Check the following settings or carry out, as applicable: filling and displacing water, operating water, dirty oil throughput, clean oil discharge pressure, pressure switch in clean oil discharge, flow detector in water discharge, min./max. temperature guard (if fitted), impulse relay, delay time for monitoring devices, separating time between de-sludging phases. For further details see instruction manual.

4.2. Starting the automatic timing unit
Close the main switch and "Separator" selector switch on the control cabinet. The "Separator ready for operation" pilot lamp lights up.
Operate the "Displacing" selector switch if the feed product is to be displaced from the bowl prior to de-sludging.
Operate the "Flushing" selector switch if the de-sludging programme is to be followed by flush de-sludging.
Operate the "Separating I" push button. A de-sludging programme precedes separating. During this time the "De-sludging programme" pilot lamp lights up. Opening of the control valves is indicated by pilot lamps. However only the valves of the separator which is ready for operation are opened.

4.3. Malfunctions. Oil discharge from the water outlet, leakage of the bowl, gear damage, failure of dirty oil pump or blockage of strainer are signalled by the red pilot lamp "Oil and water discharge". If a min./max. temperature guard is fitted, excessively high or excessively low temperature of the dirty oil is signalled by the "Oil temperature" pilot lamp. In the event of a malfunction, the separating action is interrupted after a delay and at the same time an alarm is given. The alarm can be stopped by operating the "Alarm off" push button. If a malfunction cannot be overcome by repeated operation of the "Separating I" push button, the cause of the trouble should be traced. When located, the automatic system should be shut down (5) and the fault rectified in accordance with the instructions given in the section entitled "Trouble shooting" of the instruction manual for the separator.

5. Shutting down the automatic system
Switch off the oil and water pre-heaters; continue feeding oil and water for a few minutes. Close the manually operated shut-off valve in the dirty oil feed and the needle valve in the hot water feed. Set the selector switch on the control cabinet to flushing and by operating the "Separating I" push button initiate de-sludging with subsequent flush de-sludging. Immediately after flush de-sludging, switch off the "Separator" selector switch to prevent automatic filling of the bowl with water. Switch off the motor and apply the brake. After the bowl has come to a stop, close the shut-off valves in the clean oil discharge, hot water feed, operating-water feed and compressed-air line. **Do not detach any part before the bowl has come to a stop.** Switch off the main switch.

3.5. Heat up the clarifying bowl by feeding hot oil
Open shut-off device in clean oil discharge line completely. Slightly open the three-way diaphragm valve in the dirty oil feed by hand. As soon as the bowl is adequately heated up, close the three-way valve. Observe the sludge discharge via the sight glass. If the bowl does not close properly, liquid will flow out via the sludge discharge, and in this case re-opening and closing of the bowl must be carried out.

3.6. Not applicable

4. Starting the automatic timing unit for separators with clarifying bowl

4.1. First start-up. Check the following settings or carry out, as applicable: operating water, dirty oil throughput, clean oil discharge pressure, pressure switch in clean oil discharge, min./max. temperature guard (if fitted), impulse relay, delay time for monitoring devices, separating time between de-sludging phases. For further details see instruction manual.

4.2. Starting the automatic timing unit
Close the main switch and "Separator" selector switch on the control cabinet. The "Separator ready for operation" pilot lamp lights up.
Make sure that the "Displacing" and "Flushing" selector switches are at "0".
Operate the "Separating I" push button. A de-sludging programme precedes clarification. During this time the "De-sludging programme" pilot lamp lights up.
Opening of the control valves is indicated by pilot lamps. However only the valves of the separator which is ready for operation are opened.

4.3. Malfunctions. Bowl leakage, gear damage, failure of the dirty oil pump or blockage of strainer are signalled by the red pilot lamp "Oil and water discharge". If a min./max. temperature guard is fitted, excessively high or excessively low temperature of the dirty oil is signalled by the "Oil temperature" pilot lamp. In the event of a malfunction, clarification is interrupted after a delay and at the same time an alarm is given. The alarm can be stopped by operating the "Alarm off" push button. If the malfunction cannot be overcome by repeated operation of the "Separating I" push button, the cause of the trouble should be traced. When located, the automatic system should be shut down (5) and the fault rectified in accordance with the instructions given in the section entitled "Trouble shooting" of the instruction manual for the separator.

5. Shutting down the automatic system
Switch off the oil pre-heater; continue feeding oil for some minutes. Close the manually operated shut-off valve in the dirty oil feed. Operate the "Separating I" push button to initiate de-sludging. After de-sludging, switch off the motor and apply the brake. After the bowl has come to a stop, close the shut-off valves in the clean oil discharge, operating-water feed and compressed-air line. **Do not detach any part before the bowl has come to a stop.** Switch off the main switch.

6. Changing over the separator system from automatic control to manual operation
Set the "Separator" selector switch on the control cabinet to "0" and operate the three-way diaphragm valve and the shut-off valves in the valve bypass lines by hand.

7. General. Observe time schedule for lubrication and maintenance. Read instruction manual carefully.

2.2. Technical Information

2.2.1. Recommended separating temperatures and make-up water percentages

Optimum purification is obtained when the viscosity of the oil to be treated is as low as possible.
Economical operation will be achieved by separating at the following temperatures:

Type of oil	Separating temperature	*Make-up water (fresh water)
Gas oil	room temp.	1-3 drops/sec. max.
Diesel oils, medium	up to 40°C	
Diesel oils, heavy	up to 70°C	
Heavy fuel oils (bunker oil C) of the following viscosity		
500 s.R.I./100°F	80 - 90°C	
1500 s.R.I./100°F	90 - 95°C	
3500 s.R.I./100°F	95 -100°C	
Steam turbine lube oils	70 - 80°C	
Oils sensitive to water, e.g. oils with additives (HD oils)	75 - 90°C	
Diesel engine lube oils, except for oils sensitive to water	75 - 90°C	2 - 5 %

* for separation with purifier bowl only (see 2.2.2.3)

When treating emulsified oils, the separating temperature will have to be increased. The temperature of the incoming product is indicated on the thermometer fitted in the upper section of the separator hood.

For controlling the oil pre-heater, a thermostat should be installed.

2.2.2. Hints for operating the purifier

2.2.2.1. The water seal

Make sure that the water seal,which prevents oil escaping through the water outlet, is maintained during separation. Since the water required for the water seal gradually evaporates due to the high separating temperature of the hot oil or becomes less due to damaged gaskets, it is necessary to replenish it constantly or to replace it at intervals of 1 - 2 hours. Feed hot fresh water (see 2.2.2.3.). The supply of hot water (see 2.2.1.) is controlled by needle valve 151a of the water feed line.

2.2.2.2. Temperature of make-up water

The temperature of the make-up water should normally be at least as high as the temperature of the oil, and preferably about 5°C higher. If fresh water is added drop by drop, it will be very difficult and considering the low percentage of the water added, not even necessary, to keep this temperature exactly.

2.2.2.3. Make-up water percentages for different types of oils

When treating fuel oils or steam turbine lube oils, hot fresh water is, in general, added drop by drop, to maintain the water seal in the bowl. If salt is present in the oil, the hot fresh water will become saturated and carry it off.

For Diesel engine lube oils, (except for oils sensitive to water) the quantity of constantly added hot fresh water amounts to 2-5% of the throughput. By adding this amount of hot fresh water, the water seal is maintained. Besides that, the water addition favours the discharge of light impurities.

The impurities in the Diesel engine lube oil consist of light carbon and soot sludge as well as of aging products. In addition to these impurities, a mixture of sulphurous residues, decomposition products, and condensate gets into the lubricating oil, especially when trunk-type piston engines are used. This mixture (acidulous water) resulting from the fuel oil combustion, can lead to serious damage to bearings, pistons and cylinders. The separator removes the acidulous water and the impurities from the lubricating oil.

With regard to Diesel engine lube oils with additives and sensitive to water, e.g. HD oils, it should be noted that, considering the risk of emulsification etc., make-up water may only be added after checking with the oil company.
Dropwise addition of fresh water is generally sufficient to maintain the water seal.
If the oil company does not permit the addition of water, then the purifier bowl is to be converted into a clarifier bowl by installing the regulating ring with the smallest inner diameter.

2.2.3. Hints for operating the clarifier

The clarifier bowl may only be fed with water-free oils. Never feed water to clarifier bowl, neither before nor during operation.

2.2.4. De-sludging the bowl

2.2.4.1. When to de-sludge the bowl

The bowl has to be de-sludged at intervals which depend on the solids content and nature of the feed liquid. The separating period between de-sludgings can be determined by running a test.

Before starting the test, make sure that the sludge space of the bowl (fig. 1/5) is free of solids.

Set the separator to the desired throughput capacity. Feed the separator with oil during a fixed period of time (e.g. one or two hours) without de-sludging.

Stop the separator: 2.3.4.1, No. 1-2, 6-8 or 2.3.4.2.,No. 1 and 5.
Remove bowl top and separating disc: see fig. 2/32 - 2/42.

From the amount of solids having collected in the sludge space of the bowl during a certain period of time you can judge how often de-sludging has to take place. To avoid impaired separating efficiency be sure not to extend the processing period until the sludge space is entirely filled up.

Before processing oil with a different solids content, the test should be repeated after cleaning of the bowl.

Particularly long processing periods are only feasible if the solids content of the feed liquid is low and if the centrifugally removed solids will slide from the conical wall of the centrifugation room even after having remained in the bowl for a long period.

Long separating periods will lead to a decrease in operating liquid in the sealing chamber (e.g. due to evaporation). Therefore, the operating liquid has to be replenished repeatedly between de-sludging procedures. It is recommended that, for this purpose, a solenoid valve be used instead of the manually operated shut-off valve, since the solenoid valve will open automatically for a few seconds at pre-set intervals.

2.2.4.2. Displacement

When separating, the loss of feed liquid unavoidable during de-sludging, can be reduced to a minimum by displacing the feed liquid with water before sludge ejection takes place. This is of special importance when processing valuable feed liquid.

2.2.4.3. Flush de-sludging

It may happen that part of the sediment sticks to the wall of the sludge space due to particular properties or as a result of having been retained too long in the bowl. To overcome this trouble, the time of separation should be reduced, or "complete de-sludging" should be followed by a "flush de-sludging". Flush de-sludging is accomplished by filling the purifier bowl with water and the clarifier bowl with oil and then emptying the bowl by way of de-sludging. See sect. 2.3.3.1, No. 4 or 2.3.3.2., No. 2.

2.2.4.4. Programme control

The most dependable way to control displacement of feed liquid as well as de-sludgings and flush de-sludgings is to use an automatic timer. The timer also monitors the clean oil and water discharge and indicates troubles that may occur.

2.3. Attendance

2.3.1. Measures to be taken before starting the separator

2.3.1.1. Before initial start-up

1) Fill gear chamber with oil until oil level is up to the upper third of sight glass (see 3.2.2).

2) Give some oil into oil suction pipe of gear pump to prevent the pump from seizing.

3) Check height of bowl and of centripetal pump: see 3.4.3.

4) See 2.3.1.2, No. 1 - 5.

2.3.1.2. Before each start-up

1) Release brake by turning handle in clockwise direction.

2) Check if bowl can be turned by hand.

3) Close hood and fasten with Allen screws.

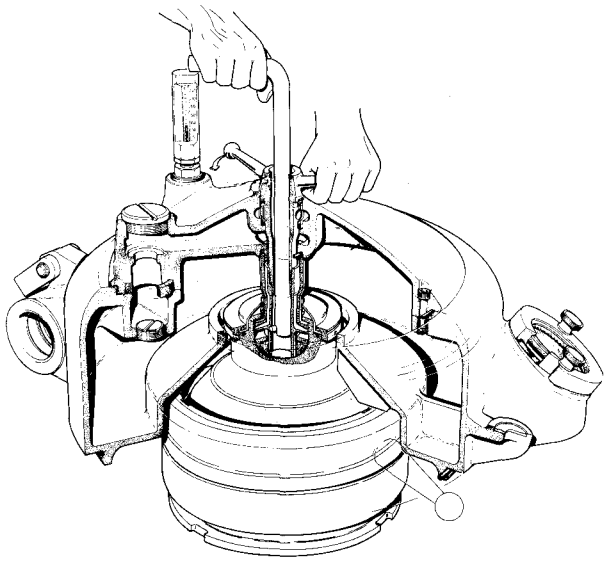


Fig. 2/1

Tightening the centripetal pump

4) Apply a thin film of molybdenum disulfide paste to guide surfaces and threads of handle connection piece. Fasten centripetal pump by means of handle connection piece (left-hand thread). While doing so, block centripetal pump by means of wrench 404 (see fig. 2/1).

5) Connect water feed line.

6) Make sure oil level in gear chamber is up to upper third of sight glass.

2.3.2. Starting the separator

2.3.2.1. Starting the separator with purifier bowl

1) See sect. 2.3.1.
2) Start the motor. Wait 2 - 5 minutes until the bowl has come up to its rated speed as seen on the name-plate of the separator. Check revolution indicator disc.

3) Close the bowl hydraulically by actuating the shut-off valve for operating water as follows:

   open for 10 seconds
   close for 20 seconds

   < open for 1 second
   close for 10 seconds
   < open for 1 second
   close for 10 seconds
   < open for 1 second
   then close again

   } This additional filling of the sealing chamber is to avoid premature opening of the bowl.

4) Check if valve 109 in clean oil discharge is closed.

5) Check bowl for leakage:
   Fill bowl with warm water by opening shut-off valve 151c. The bowl is filled up when water discharges from water outlet (to be seen through sight glass on water outlet). Close shut-off valve.

   Water discharging through the sludge outlet while the bowl is being filled indicates that the bowl leaks. In this case, open operating-water valve for about 10 seconds to accomplish opening and closing of the bowl. This should be repeated until the bowl is properly closed. Then fill up the sealing chamber as described under para. 3.

6) Before feeding oil, heat up the bowl by feeding hot fresh water (see 2.2.2.2.). This is especially important when processing oil which tends to emulsify.

7) As soon as the bowl is sufficiently heated, throttle hot water supply by actuating needle valve 151a and adjust it to the amount of make-up water required for the type of oil to be processed (see 2.2.2.3).

   The seal formed by the hot fresh water will prevent the oil from escaping through the water outlet (see 2.2.2.1).

8) Open shut-off valve in suction pipe of feed pump or in feed line to separator in order to feed dirty oil to oil pre-heater. Then close shut-off valve again.

9) Switch on oil pre-heater and bring the oil up to separating temperature (see 2.2.1).

10) Open valve in clean oil discharge.

11) Slowly open valve in oil supply line to separator.

12) When starting the separator for the first time, adjust the pre-set valve in the dirty oil feed line to the proper hourly capacity. By turning the handle to the right, smaller capacities, by turning to the left, greater capacities will be obtained. Numbered marks on threaded spindle facilitate re-setting.

    As long as the same material is processed the pre-set valve need not be re-set. The hourly capacity will then remain constant during the whole separation process. For processing a different type of feed liquid, the pre-set valve has to be re-set.

The throughput capacity of the separator depends on the viscosity, temperature, density, degree of impurity, water content as well as on the desired degree of purity of the oil.
For detailed information refer to attached capacity chart.

13) Adjust counter pressure in clean oil line to 1,5 bar. If necessary, the counter pressure may be increased to 2 bar.

14) Check water, oil and sludge outlets for proper functioning of the bowl.

2.3.2.2 Starting the separator with clarifier bowl

1) See 2.3.1 .

2) Start the motor: see 2.3.2.1 No. 2 .

3) Close the bowl hydraulically: see 2.3.2.1 No. 3 .

4) Feed dirty oil to oil pre-heater and heat oil to separating temperature: see 2.3.3.1 No. 8-9 .

5) Open shut-off valve in clean oil discharge.

6) Heat up the bowl by feeding hot oil: Open shut-off valve in oil supply line slightly only.
Never feed clarifier bowl with water.

7) Check bowl for leakage:
If oil discharges from the sludge outlet (watch outlet while bowl is being filled), the bowl proves to be leaky. In this case stop the oil supply and open shut-off-valve for operating water for about 10 seconds in order to accomplish opening and closing of the bowl. This should be repeated until the bowl is properly sealed. Then fill the sealing chamber as described under sect. 2.3.2.1 No. 3 .

If oil discharges from the water outlet, the bowl is not equipped with the smallest I.D. regulating ring, or the gasket under the regulating ring is worn and needs replacement.

8) As soon as the bowl is heated up, open shut-off valve in oil supply line all the way.

9) When starting the separator for the first time, adjust pre-set valve to hourly capacity: see 2.3.2.1 No. 12.

10) Adjust counter pressure in clean oil line to 1,5 bar. If necessary, the counter pressure may be increased to 2 bar.

11) Check sludge and oil outlets for proper functioning of the bowl.

2.3.3. De-sludging the bowl

2.3.3.1. De-sludging the purifier bowl

The separating period between the de-sludgings has to be determined by experiment (see 2.2.4.1). To avoid impaired separating efficiency, the separating time should, however, not be extended until the sludge space is entirely filled up.

1) In plants without circulation system: Switch off oil pre-heater.

2) Close shut-off devices in oil supply line and oil discharge line.

3) De-sludge the bowl by actuating shut-off device for operating water as follows:

open for 10 seconds close for 20 seconds	De-sludging
open for 1 second close for 10 seconds open for 1 second close for 10 seconds open for 1 second then close again	This additional filling of the sealing chamber is to prevent premature opening of the bowl.

4) If a flush de-sludging becomes necessary in order to remove solids which have remained in the bowl, open shut-off valve 151c in water supply line and fill bowl with hot water until water flows out of the water outlet. Then close shut-off valve 151c and de-sludge again by opening shut-off device for operating water for about 10 seconds. Re-fill sealing chamber with operating water (see No.3).

5) To obtain a water seal, feed hot water to bowl until water starts to flow out of the water outlet (to be seen through sight glass on water outlet). Check make-up water supply.

6) In plants without circulation system re-start oil pre-heater.

7) Fill oil pre-heater with dirty oil and heat up oil to separating temperature: see 2.3.2.1, No. 8-9.

8) Slowly open shut-off devices in oil discharge line and oil supply line.

9) Observe water and sludge outlets.

2.3.3.2. De-sludging the clarifier bowl

The clarifying period between the de-sludgings has to be determined by experiment (see 2.2.4.1). To avoid impaired clarifying efficiency the clarifying time should, however, not be extended until the sludge space is entirely filled up.

1) See 2.3.3.1, No. 1-3.

2) If a flush de-sludging becomes necessary in order to remove solids which have remained in the bowl, fill bowl with oil and de-sludge by opening shut-off device for operating water for about 10 seconds. Re-fill sealing chamber (see 2.3.3.1 No. 3).

3) See 2.3.3.1, No. 6-8.

4) Observe sludge outlet.

2.3.4. Stopping the separator

2.3.4.1. Stopping the separator with purifier bowl

1) Switch off oil pre-heater. Continue feeding oil for a few minutes since the pre-heater continues to heat.

2) Stop dirty oil supply: Close shut-off device in suction line of feed pump or in feed line.

3) Close shut-off device in clean oil discharge.

4) De-sludge the bowl: see 2.3.3.1, No. 3.

5) Flush bowl with fresh water and de-sludge in order to remove residual solids from the bowl. To do this proceed as follows: Fill bowl with water and de-sludge by opening shut-off device for operating water for about 10 seconds. After flush de-sludging check to be sure that shut-off device for operating water is closed.

6) Stop hot water supply by closing needle valve 151a.

7) Switch off water pre-heater.

8) Switch off motor.

9) Apply brake by turning handle in counter-clockwise direction. Wait until bowl has come to a complete stop.

   Do NOT loosen any part of the separator or of the feed and discharge connections before the bowl has come to a complete stop.

   Note that the bowl will not be at rest before revolution indicator disc (fig. 3/3) has ceased rotating.

2.3.4.2. Stopping the separator with clarifier bowl

1) See 2.3.4.1 No. 1-2.

2) De-sludge the bowl: see 2.3.3.1, No. 3.

3) Flush bowl with oil and de-sludge to make sure that no solids are left in the bowl:
   Fill bowl with oil and de-sludge by opening shut-off device for operating water for about 10 seconds.

4) Close shut-off device in clean oil discharge.

5) See sect. 2.3.4.1, No. 8-9.

2.4. The Bowl

2.4.1. General

The bowl can be used for purification or for clarification. The purifier bowl is easily converted into a clarifier bowl and vice versa.

The purifier bowl is used for the separation of water from oil, with simultaneous removal of solids. The bowl is to be adjusted to the difference in densities of oil and water by inserting the properly sized regulating ring which is to be selected from the set of rings 320 (see 2.4.3).

The clarifier bowl is used to remove solids from water-free oils. To prevent the oil from escaping through the water outlet, the bowl is to be equipped with the regulating ring of the smallest inner diameter. The valve in the hot water supply line must be closed and secured against unintended opening.

2.4.2. Assembling the purifier bowl
(unfold page 0/8)

Before assembling the bowl check if contact surfaces of all bowl parts are clean.
During assembly make sure that the "0" marks of the bowl parts are aligned.

If the plant has several separators, be careful not to interchange parts of different bowls since each bowl has been balanced with its component parts. The main parts of the bowl are marked with the last three digits of the Serial-Number of the separator.

2.4.2.1. Assembling the lower bowl parts

The lower bowl parts are to be assembled in reverse order of actual service position. See fig. 0/3 on page 0/8.

1) For installation of Polyamid gasket 309 refer to sect. 2.4.6.2.
2) Thoroughly clean groove in bowl bottom for gasket 308 and apply a thin layer of grease.
   In case the gasket is new and a bit too small stretch it out equally all the way around until the outer diameter of the gasket is almost equal to the outer diameter of the groove.
   Insert gasket 308 in groove of bowl bottom. Then put a screwdriver under the gasket and run it around the bowl bottom two or three times (see fig. 2/2). (This equalizes the gasket fitting all the way around and makes for best sealing during operation).
   Then tap the gasket back in with a rubber hammer (see fig. 2/3).

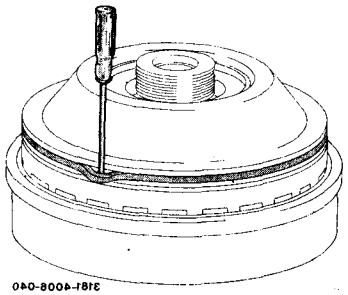


Fig. 2/2

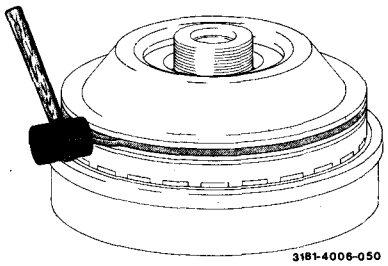


Fig. 2/3

If the gasket has not been removed or replaced (e.g. when cleaning the bowl) lift it out in one place with a small flat screwdriver to allow water which has collected behind the gasket to flow out. Then tap gasket back into its groove with a rubber hammer. Re-installation of the sliding piston (see No. 3) will now be as easy as if a new gasket were used.
The same procedure should be followed when installing gasket 304 into sealing-chamber bottom.

3) Apply a thin film of a mixture of molybdenum disulfide paste and high quality lubricating grease (ratio 1:4) to guide surfaces of sliding piston 306 (see No. 4 in lubrication chart on page 3/7).
Before installing the sliding piston, heat its outer surface with hot water or steam for about 5 minutes. Never use any other sources of heat, e. g. blow torch or welding torch.
Then place the sliding piston onto bowl bottom, by hand.
The "0" marks of both parts must be in line with each other.
The sliding piston is properly mounted when its sealing edge rests on gasket 309.

4) Insert gasket 304 in groove of sealing-chamber bottom 302. To do this, proceed in the same manner as when installing gasket 308 into bowl bottom (see No. 2 on page 2/14).

5) Apply a thin film of the before-mentioned mixture to guide surfaces of sealing-chamber bottom. With the aid of jack 423 place sealing-chamber bottom into sliding piston (fig. 2/4). By turning jackscrew "A" counter-clockwise lower sealing-chamber bottom slowly until its arresting pin catches into hole of bowl bottom. The "0" marks of sealing-chamber bottom and sliding piston must be aligned.

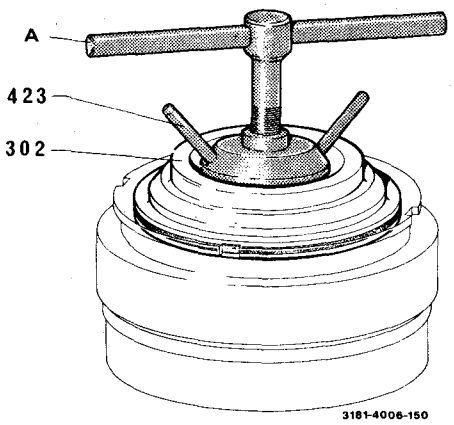


Fig. 2/4
Installation of sealing-chamber bottom

6) Apply a thin film of the grease mixture mentioned above to threaded areas, guide and contact surfaces of bowl bottom , threaded ring 301 and of sliding piston.
Then screw threaded ring onto bowl bottom (right-hand thread) and tighten it firmly with wrench 412 (see fig. 2/5) until "0" marks on sealing-chamber bottom and threaded ring are in line with each other.

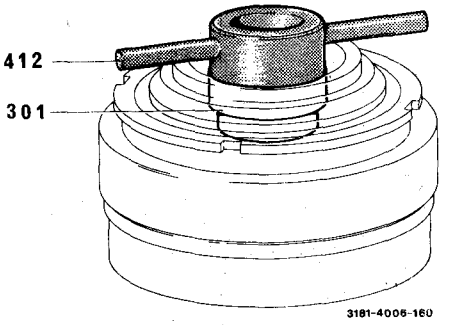


Fig. 2/5
Installation of threaded ring

2.4.2.2. Assembling the upper bowl parts

1) Oil the upper part of the spindle (thread, cone and cylindrical guide surface for spindle cap). It must be possible to move the spindle cap easily up and down on the spindle.
Then clean and wipe dry the conical part of the spindle with a smooth rag. Carefully clean the inside of the bowl hub as well to assure proper fitting.

2) With the aid of jack 411 place bowl bottom 311 together with sliding piston, sealing-chamber bottom and threaded ring onto spindle (see fig.2/6)

3) Screw on spindle nut 321 tightly (left-hand thread). See fig. 2/6.

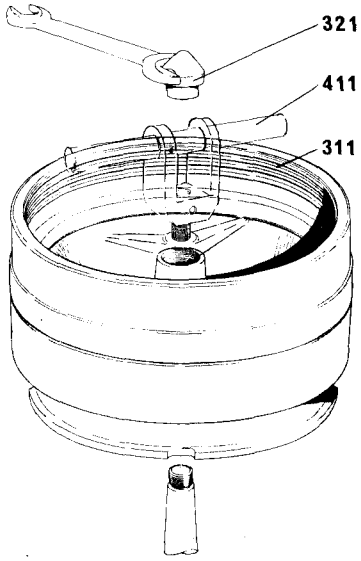


Fig. 2/6
Installation of bowl bottom

4) Install wear liner 305 into bowl bottom (see fig. 2/7).

5) Stack discsonto neck of distributor 314 as follows:

   a) discs 322 in numerical order, beginning with No. 1,

   b) compensating disc 323 (without slots, without spacers). This disc is only used if a disc with an overall thickness less than that of the normal disc 322 (with spacers) is required to obtain the necessary pressure in the disc set (see sect. 3.3.1.4.,No. 1c). The compensating disc is furnished as spare disc unless it is already contained in the bowl. When being used, it must always be placed on top of the disc set directly below separating disc 324.

6) With the aid of jack 411 place distributor together with the disc stack into the bowl bottom (see fig. 2/7). Make sure arresting pin of distributor snaps into groove of bowl bottom. The "0" marks of both parts must be in line with each other.

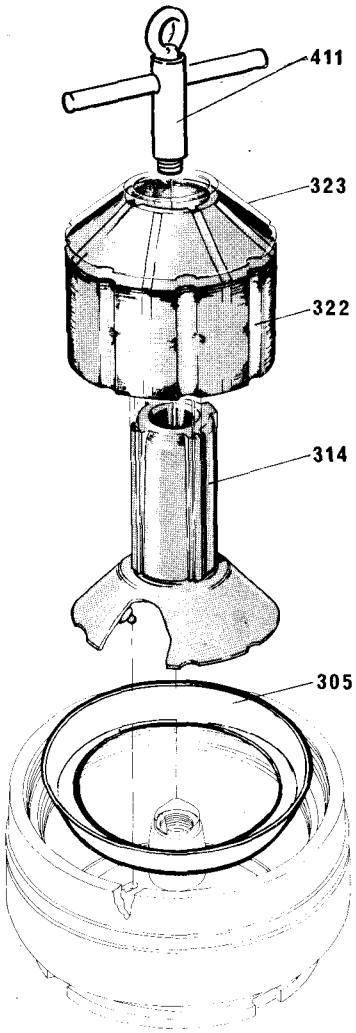


Fig. 2/7
Installation of distributor and disc stack.

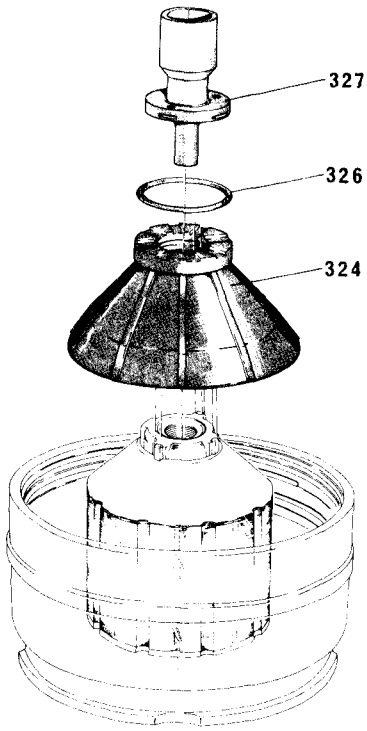


Fig. 2/8

7) Place separating disc 324 so onto distributor neck that the ribs of the distributor fit into the grooves of the separating disc. The "0" marks of separating disc and bowl bottom must be in line with each other.

8) Insert gasket 326 into groove of separating disc.

9) Install centripetal pump 327.

NOTE: Apply a thin film of molybdenum disulfide paste to thread in centripetal pump tube.

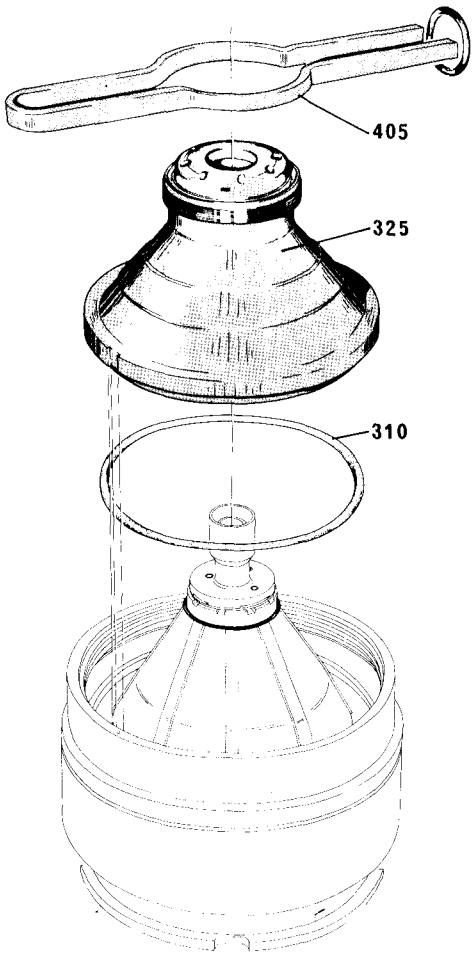


Fig. 2/9

10) Insert gasket 310 into groove of bowl top 325.

11) Apply a thin film of a mixture of molybdenum disulfide paste and high quality lubricating grease (ratio 1:4) to guide surfacesof bowl top and bowl bottom (see No. 4 in lubricating chart on page 3/7).

12) With the aid of lifting tongs 405 place bowl top so into bowl bottom that the "0" marks of both parts are in line with each other and the arresting pin of bowl bottom snaps into the groove of bowl top.

13) Thoroughly clean and wipe dry threads and guide surfaces of bowl bottom and lock ring 313 as well as contact surfaces of bowl top and lock ring. Then apply a thin film of a mixture of molybdenum disulfide paste and high quality lubricating grease (ratio 1:4) to prevent galling of threads (see No. 4 in lubrication chart on page 3/7).

Screw lock ring into bowl bottom, by hand (left-hand thread).

Check pressure in disc stack.

Then tighten lock ring by means of annular wrench 413. Rap with a mallet against handle of wrench until "0" marks on ring and on bowl bottom are in line with each other.

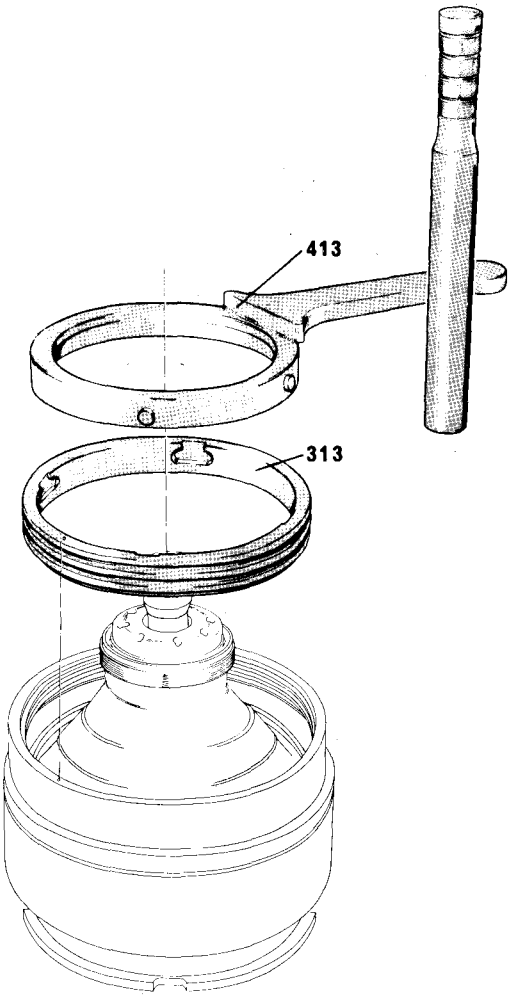


Fig. 2/10

14) Insert gasket 318 in groove of bowl top.

15) Install regulating ring to be selected from set 320 (see 2.4.3).

16) Use hook wrench 422 to tightly screw on small lock ring (left-hand thread).

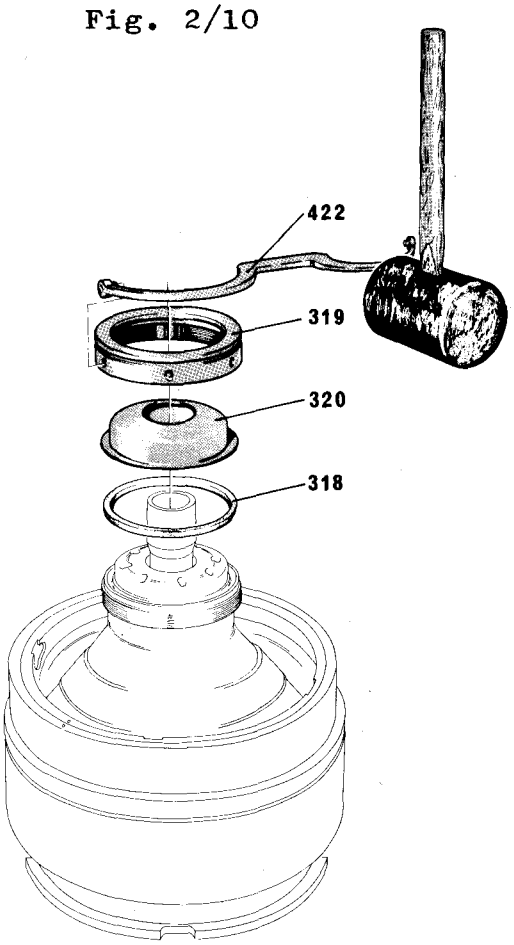


Fig. 2/11

2.4.3. The Regulating Ring

2.4.3.1. Purpose of the regulating ring

Oils containing water can only be de-hydrated in a perfect manner if the bowl is accurately adjusted to the difference in densities of oil and water. The regulating ring with the proper inner diameter, i.e. with the diameter that corresponds to the difference in densities of the oil-water mixture to be treated, should therefore be inserted in the bowl. This ring can be chosen from the set of regulating rings (with different inner diameters) furnished with the separator. The inner diameter of the ring to be chosen can be determined by calculation (see sect. 2.4.3.2) or by experiment (see sect. 2.4.3.3). The general rule is:

Small diameter regulating ring when treating heavy oil,
Large diameter regulating ring when treating light oil.

2.4.3.2. Determining size of regulating ring by calculation (diagram) (Page 2/21)

For a given separating temperature, the inner diameter of the regulating ring and, if desired, the density of the oil can be determined from the diagram, provided that the density of the oil at a temperature ranging between 15° and 90°C is known.

Example:

Given:	Density of oil at 20°C	$\rho_{oil\ 20°C}$	= 0.873 kp/dm^3
	Separating temperature	t	= 70°C
To be determined:	Inner diameter of regulating ring	d	= ?
	Density of oil at 70°C	$\rho_{oil\ 70°C}$	= ?
Determined:	Inner diameter of regulating ring according to diagram, page 2/21	d	= 79 mm
	Density of oil at 70°C according to diagram, page 2/21	$\rho_{oil\ 70°C}$	= 0.838 kp/dm^3

If no regulating ring of the determined inner diameter is available, check by experiment (see sect. 2.4.3.3) whether the regulating rings available are suitable for perfect de-hydration. If that is not the case, machine a smaller diameter regulating ring to the required dimension.
In general, the regulating rings furnished with the machine are adequate.

2.4.3.3. Determining size of regulating ring by experiment

To avoid emulsification begin the test by inserting a large diameter regulating ring and then change over to the next smaller one.
If the inner diameter of the regulating ring is too large the water discharging from the water outlet will contain oil; if the diameter of the ring is too small, the oil will tend to emulsify, or the oil discharging from the clean oil outlet will contain water.

The milky or dirty appearance of the water is quite normal; it results from the oil washing process.
During operation a separation zone between the light and heavy liquid will form in the bowl. The middle of this zone, referred to as separation line, should be close to the large diameter of the discs (see fig. 2/29).

The separation line between water and oil can mostly be distinguished on the underside of the separating disc.

Properly chosen regulating ring

The regulating ring has been chosen properly, when the separation line between water and oil is close to the large diameter of the discs.

The position of the separation line is to be seen on the underside of the separating disc (fig. 2/29).

Result:

The discharging clean oil is free of water.
The discharging water is free of oil.

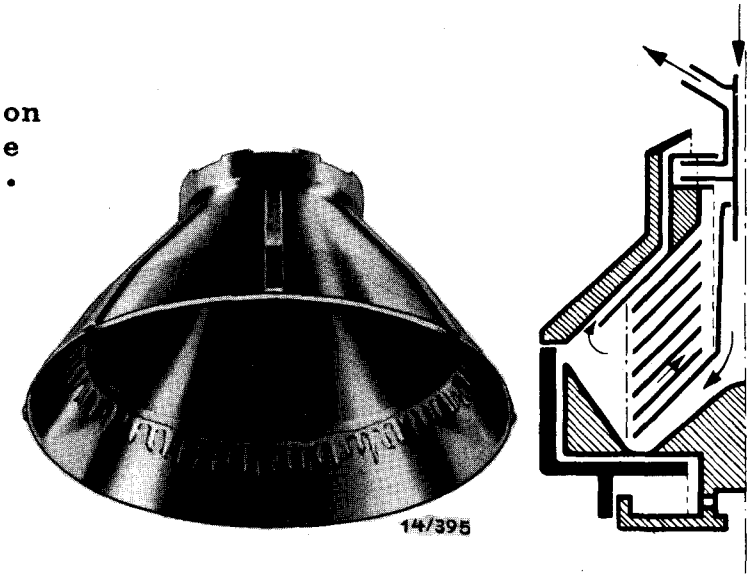


Fig. 2/29

Position of separation line when inner diameter of regulating ring is correct

Inner diameter of ring too large

The inner diameter of the regulating ring proves to be too large, if the separation line between water and oil is found to be outside of the disc stack and too close to the large diameter of the separating disc (fig. 2/30).

Result:

The discharging clean oil is free of water.
The discharging water contains oil or the oil breaks the water seal.

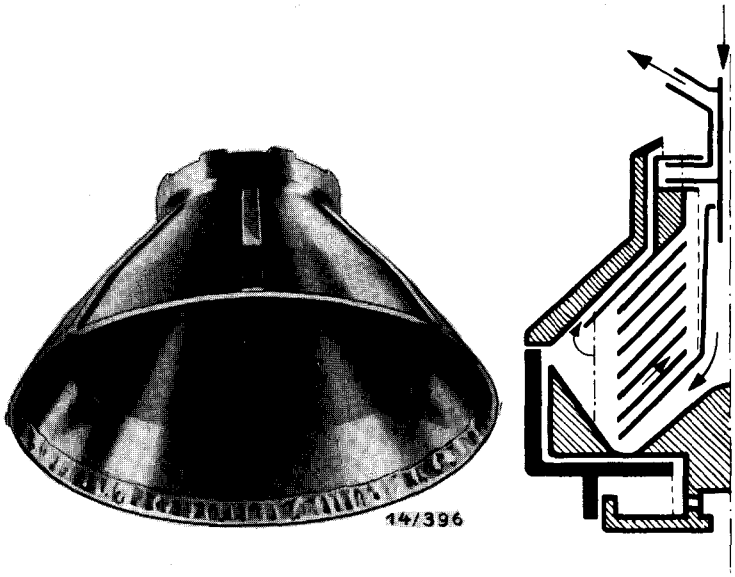


Fig. 2/30

Position of separation line when inner diameter of regulating ring is too large

Inner diameter of ring too small

The inner diameter of the regulating ring proves to be too small, when the separation line between the liquid components, instead of being near the large diameter of the discs, is found to be nearer to the small diameter of the discs.

Result:

The discharging clean oil contains water.
The discharging water is free of oil.

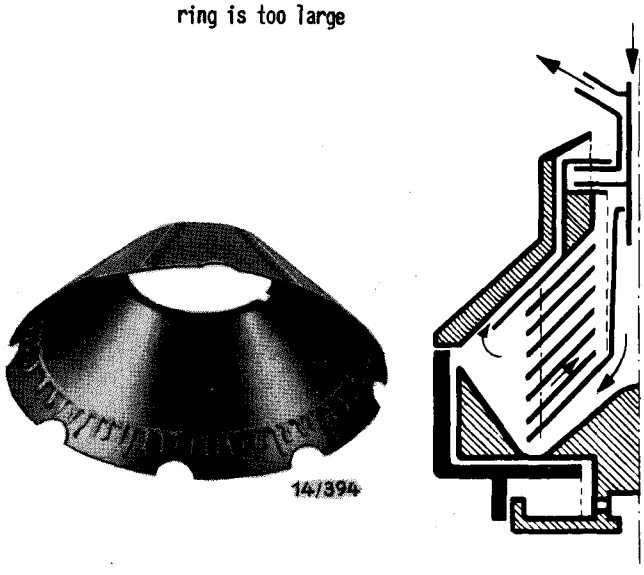
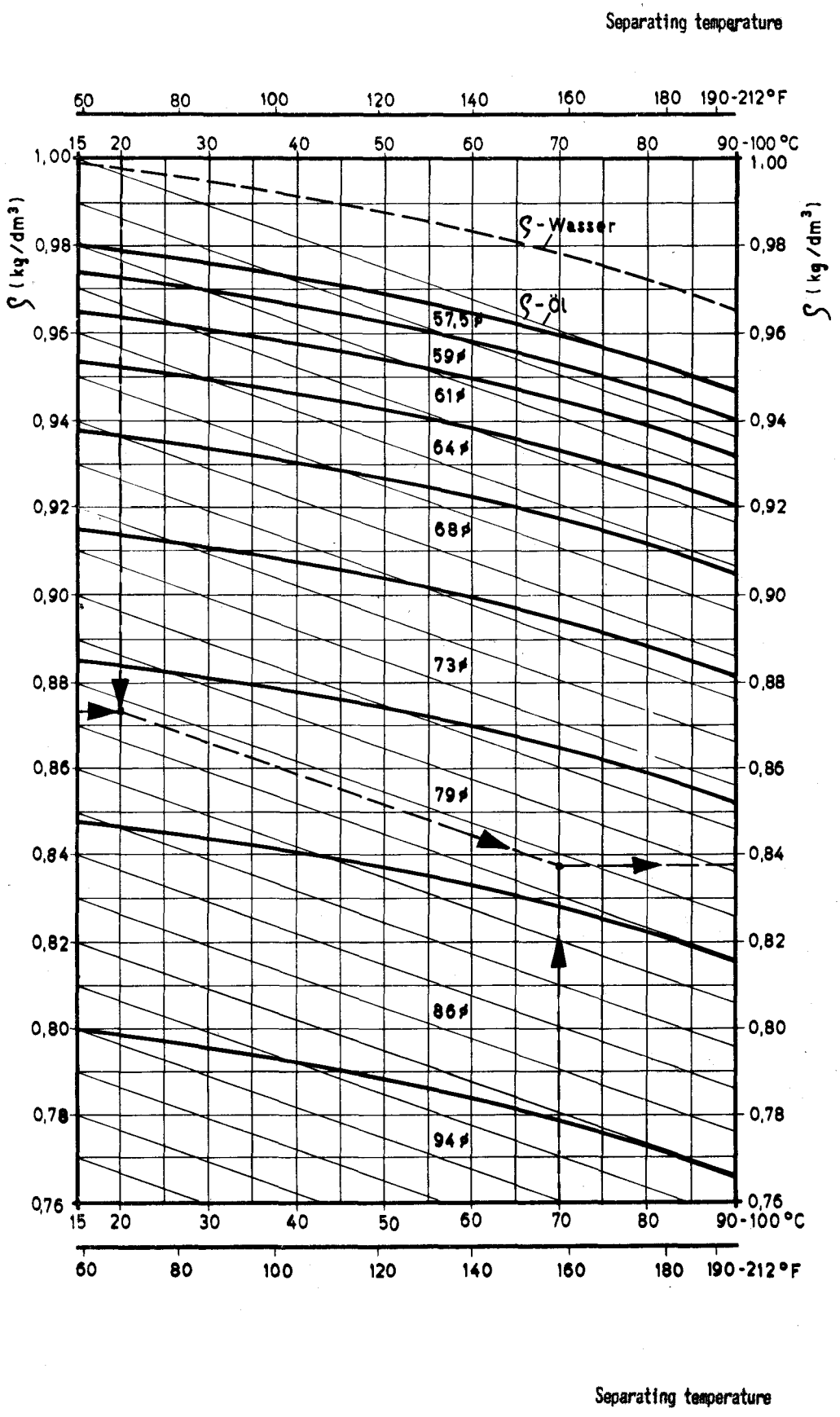


Fig. 2/31

Position of separation line when inner diameter of regulating ring is too small

Diagram for determining correct size of regulating ring



Example: To be determined: Diameter of regulating ring and ρ oil 70°C

Given: ρ Oil 20°C = 0.873 kg/dm³, Separating temperature 70°C

Determined: Diameter of regulating ring = 79 mm, ρ oil 70°C = 0.838 kg/dm³

2.4.4. Assembling the clarifier bowl

The clarifier bowl has to be assembled in the same manner as the purifier bowl (see 2.4.2)except that it has to be equipped with the smallest diameter regulating ring (45 mm ø).

2.4.5. Dismantling the bowl

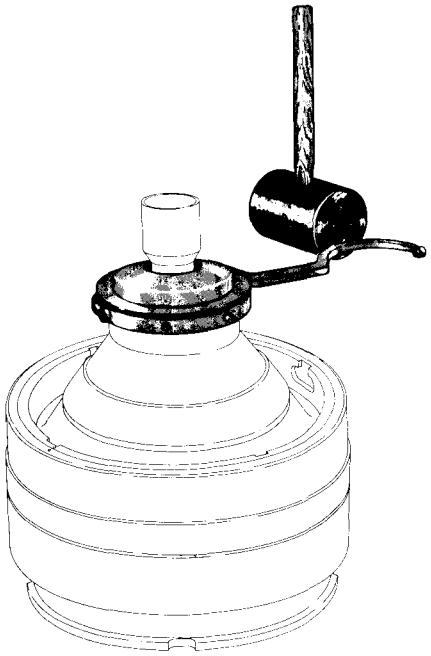


Fig. 2/32

1) Use hook wrench to unscrew small lock ring (left-hand thread).
Then remove regulating ring and gasket.

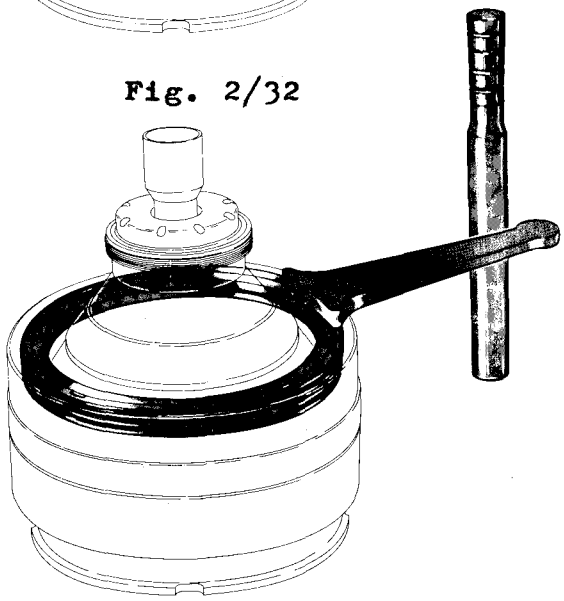


Fig. 2/33

2) Unscrew lock ring by rapping with mallet against handle of annular wrench. Then remove lock ring, by hand (left-hand thread).
In case the bowl lock ring jams in bowl bottom (e.g. after too long a time of operation) warm up the bowl bottom in the area of the bowl lock ring with hot water or steam.
Do NOT use any other sources of heat.

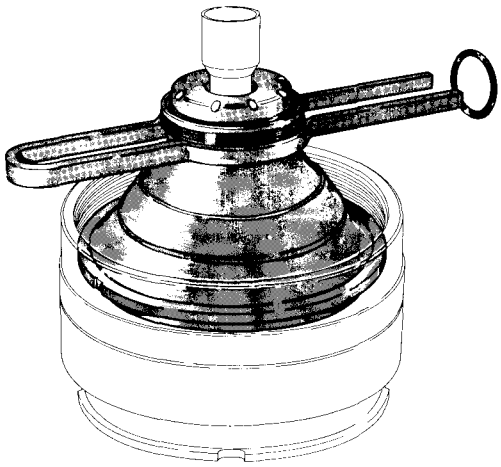


Fig. 2/34

3) Remove bowl top with the aid of lifting tongs.

4) Remove centripetal pump, then remove separating disc and gasket.

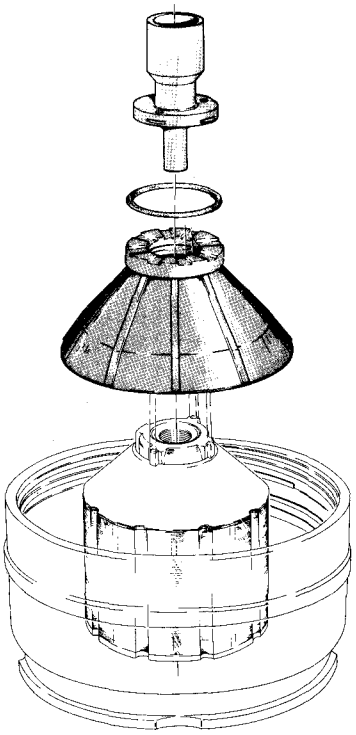


Fig. 2/35

5) With the aid of jack remove distributor and disc stack.

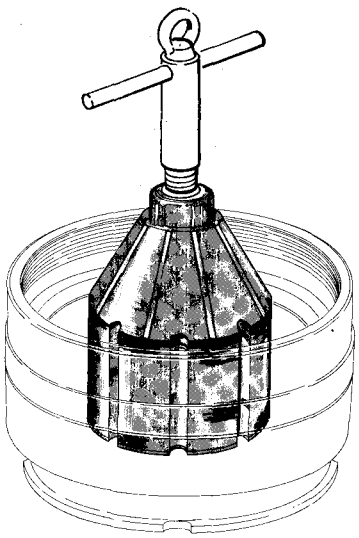


Fig. 2/36

6) Unscrew spindle nut (<u>left-hand thread</u>). By means of jack force bowl bottom off the spindle cone and remove it.

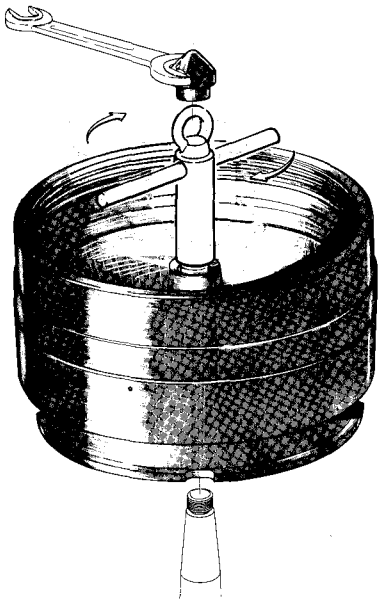


Fig. 2/37

7) In general, the lower bowl parts (bowl bottom, sliding piston, sealing-chamber bottom and threaded ring) need only be dismantled when gaskets 304, 308 and 309 have to be replaced. Removal of sliding piston is facilitated by giving some oil into annular gap between bowl bottom and sliding piston, for better sliding of gasket 308. Let oil soak in for about 15 minutes, then place lower bowl assembly upside down on a stand and dismantle as follows:

8) Use wrench 412 to unscrew threaded ring (right-hand thread). Rap with mallet against handle of wrench (see fig. 2/38).

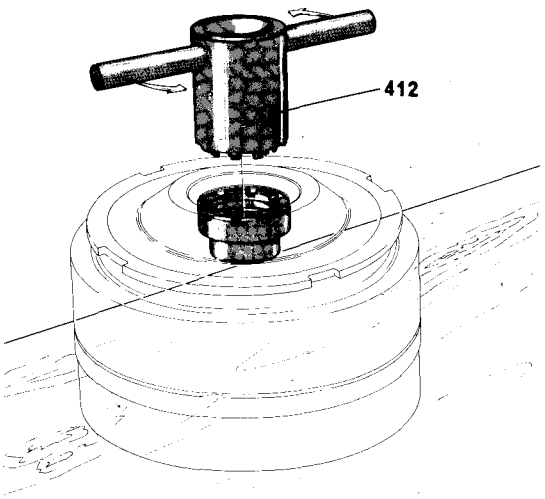


Fig. 2/38
Unscrewing the threaded ring

9) Place ring 403 onto sliding piston and turn it (bayonet catch).See fig. 2/39.

With the aid of jack 423 withdraw sealing-chamber bottom together with sliding piston from bowl bottom.

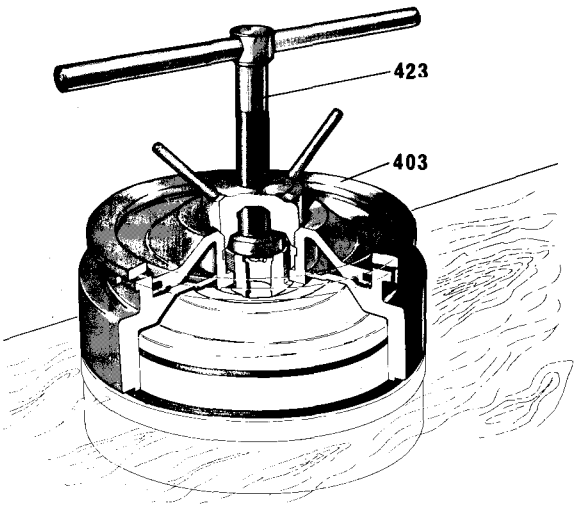


Fig. 2/39
Withdrawing sealing-chamber bottom and sliding piston from bowl bottom.

10) Remove ring 403.

Loosen sliding piston from sealing-chamber bottom by striking with a rubber hammer on sliding piston (see fig. 2/40). Tap evenly with the rubber hammer on the sliding piston to prevent tilting of the sealing-chamber bottom. Never tap on one side of sliding piston only. Let sliding piston drop on a wooden surface to avoid damage to the sealing edge.

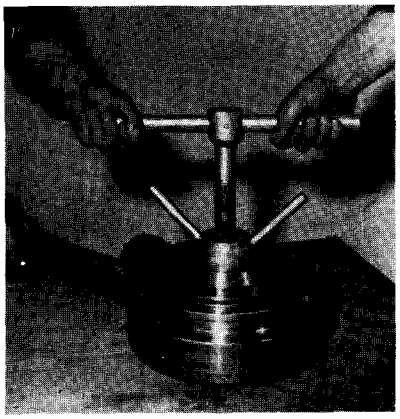


Fig. 2/40
Separating sealing-chamber bottom from sliding piston.

2.4.6. Polyamid gasket in bowl bottom

2.4.6.1. Removal of Polyamid gasket

1) For about 10 minutes heat up gasket with a 70 - 100°C hot water or steam jet.

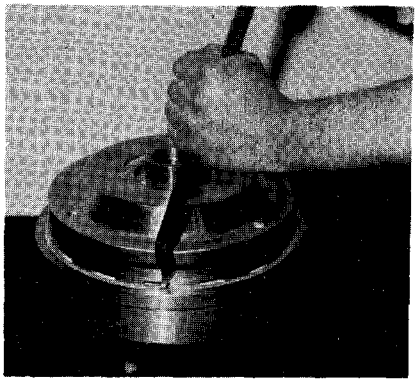


Fig. 2/41

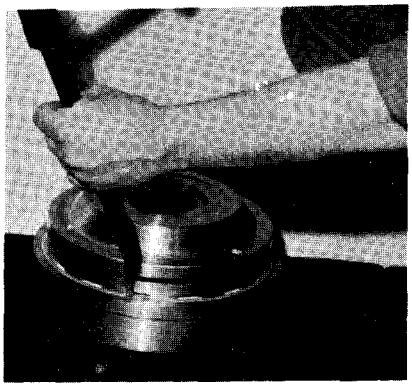


Fig. 2/42

2) Use chisel 424 to cut a small triangular piece out of the gasket.

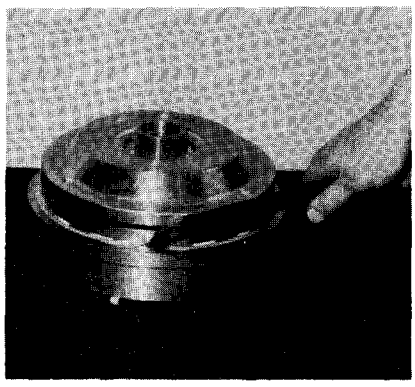


Fig. 2/43

Fig. 2/44

3) With the aid of the chisel press the gasket out of its groove.

2.4.6.2. Installation of Polyamid gasket

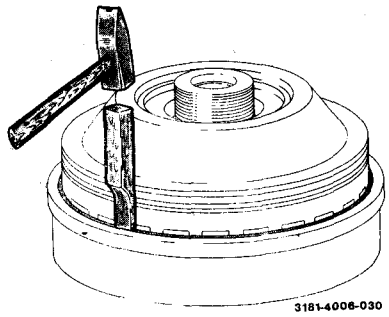


Fig. 2/45

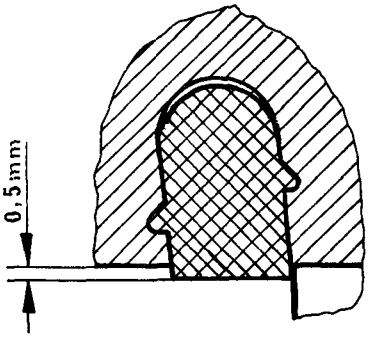


Fig. 2/46

1) Thoroughly clean gasket groove in bowl bottom and wipe dry.

2) To heat up Polyamid gasket keep it for about 5 minutes in 80°C hot water. Wipe gasket dry and insert it into groove.

Due to heating, the gasket may have become too large. Therefore, let it cool down until it fits into groove of bowl bottom. Then place a piece of hard wood on the gasket and hammer it evenly into its groove (see fig. 2/45).

If, on the other hand, the gasket can be pressed in without using a hammer, it has not expanded enough. In that case put gasket into hot water and let it expand for about an hour. Then install it as shown in fig. 2/45. The inserted gasket may protrude from the groove by 0.5 mm (see fig. 2/46).

To be sure that the gasket fits tightly in its groove, proceed as follows:
After having assembled the bowl, start the separator without feeding water or oil so that no liquid can seep into the groove. When the bowl has reached its operating speed, close and open it hydraulically ten to twenty times. By the movement of the sliding piston the gasket will be pressed evenly into the anchor grooves.

2.5. Cleaning

2.5.1. Cleaning the bowl

In general, self-cleaning bowls need not be dismantled for cleaning at the end of a run, unless the nature of the product to be processed makes bowl dismantling necessary or the separator is to be shut down for an extended period.

IMPORTANT: From time to time, however, the bowl should be dismantled (see 2.4.5) for inspection and cleaning. This should be done after 1,500 working hours at the latest, but never wait longer than 6 months.

Never use metal scrapers and metal brushes for cleaning the discs and bowl parts.

Remove gaskets from the bowl parts and clean grooves and gaskets to prevent grooves from corroding. Replace damaged gaskets. Swollen gaskets should be left to dry at a warm place so that they can regain their original dimensions and can be re-used.

The gaskets in bowl bottom and sealing-chamber bottom whose edges have been frayed through abrasion, can be re-used after grinding off the edges with an emery wheel. When grinding, be careful not to damage the sealing surfaces.

Special care should be taken in cleaning the small orifices in threaded ring and sliding piston for feed and discharge of operating water (see fig. 1/5) to ensure trouble-free performance of the de-sludging process.

Be sure to remove dirt which has accumulated in the distributor neck, using brush 417. Dirt accumulation in the distributor neck will hinder the feed, which may result in overflow.

After having cleaned and wiped dry guide surfaces and threads of bowl parts grease them lightly with a mixture of molybdenum disulfide paste and high quality lubricating grease (ratio 1: 4). See lubrication chart on page 3/7.
Re-assemble bowl immediately after cleaning (see 2.4.2 or 2.4.4.).

2.5.2. Cleaning the upper section of the frame

The inside of the upper section of the frame must be cleaned from time to time. For this purpose, disassemble the bowl (see 2.4.5). While cleaning make sure that no wash liquid seeps into the gear chamber since it would render the gear lubricating oil unserviceable.

2.5.3. Cleaning the strainer and the operating-water feed system

Strainer 67 and the small orifices in operating-water feed system 170 should be cleaned every 3 to 6 months.

2.5.4. Cleaning the gear chamber

When making oil change, clean gear chamber thoroughly with kerosene and be sure to remove all metal particles from walls and corners. Do NOT use fluffy cleaning rags or cotton waste.

2.5.5. Cleaning the pre-strainer at the suction side of the pump

The pre-strainer at the suction side of the dirty-oil feed pump should be cleaned from time to time, depending on the solids content of the feed material.
To do this proceed as follows:
Loosen handles 345, undo hinge screws 344, remove cover 350 and take out screen insert 348 for cleaning.

2.5.6. Cleaning before a long-term shut-down of the separator

Even if the plant comprises a stand-by separator, the separator in operation should be run for as long a period of time as possible to avoid the cleaning and maintenance work that will become necessary prior to a long-term shut-down of the separator. Insufficient or improper upkeep may lead to corrosion on the bowl parts soon after shutting down of the separator.

Before shutting down the separator for a longer period of time clean the separator thoroughly (see sect. 2.5.1 and 2.5.2). The clean bowl parts and all unvarnished machine parts should be wiped dry and greased to avoid corrosion.

On separators aboard ships, the bowl should be locked,after cleaning and re-installation, by applying the brake and turning in the bowl lock screws in order to avoid damage to bearings which might be caused by ship's vibrations during shut-down of the separator.

When shutting down separators in land installations for a longer period of time, it is recommended that the clean bowl be kept in a dry place.

Drain the lubricating oil and fill corrosion-preventing oil, e.g. SHELL Ensis Oil 30, into gear chamber. Oil level must be up to middle of sight glass. Let separator run without bowl for approx. 10 minutes to make sure that all gear parts are sprinkled with corrosion-preventing oil. Then drain the oil. Special measures for the removal of the coating of corrosion-preventing oil need not be taken.

Check water shut-off devices for leakage. If necessary, remove connecting piping between faulty shut-off device and separator to avoid damage which may be caused by drip water.

Before re-starting the separator, fill in lubricating oil as specified on page 3/6. Oil level must be slightly above middle of sight glass. Let separator run without bowl for about 10 minutes.

Part III
========

3. Installation, Maintenance, Assembly and Disassembly of Gear Parts

3.1. Installation

3.1.1. Installing the separator

When installing the separator make sure that there is sufficient room for hinging up the hood and for installing and removing the motor and the pump.

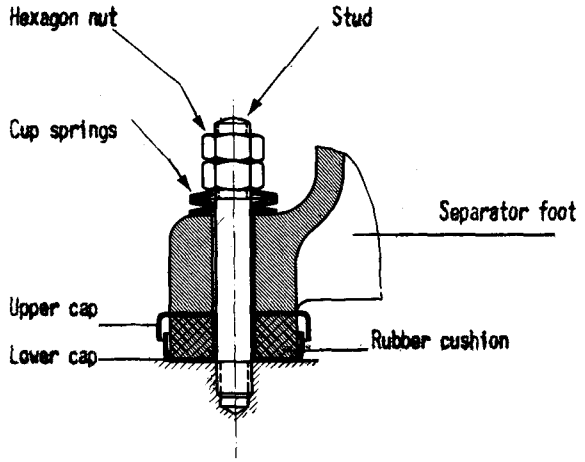


Fig. 3/1
Fastening the separator aboard ships

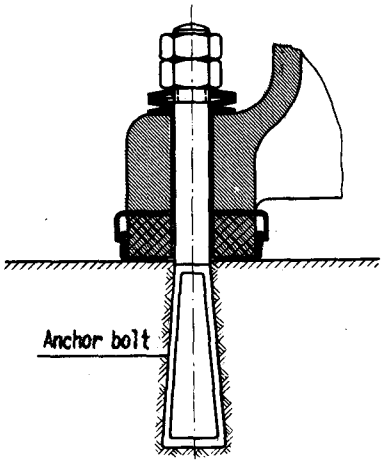


Fig. 3/2
Fastening the separator in land installations

Separators aboard ships are fastened with studs (fig. 3/1), and separators in land installation with anchor bolts (fig. 3/2).

To avoid damage to bearings make sure that the foundation has no contact with foundations of other units (e.g. auxiliary Diesel engine, or pumps).

Connect feed and discharge lines as shown in fig. 0/1. The sludge and water discharge lines should have sufficient fall and no sharp curves. Choose pipe lines with sufficiently large diameters. The pump suction line has to have the same inner diameter as the pump inlet.

Do NOT install a shut-off valve in the line which will be connected to the operating-water outlet. The line should have a 40 mm I.D. It should have sufficient fall and must not be too long to allow the operating-water to flow off freely, since otherwise the water will rise and enter the upper section of the frame, resulting in slowing down of the bowl. It can also seep through the neck bearing into the gear chamber and damage the bearings and the other gear parts.

It is recommended that beside shut-off valve 15 (fig. 3/5) a second shut-off device be installed in the operating-water line to prevent infiltration of water as a result of unintended opening of shut-off valve 15 during shut-down of the separator.

The hot water is supplied through the make-up water line.

When using a water pre-heater, a safety valve has to be installed in the pre-heater or in the hot-water line between pre-heater and shut-off valve. This safety valve is to be checked from time to time, at least twice a year.

When using an oil pre-heater, the heater or the oil line between pre-heater and shut-off valve has to be equipped with a safety valve. Do NOT install a shut-off valve between pre-heater and separator when the oil pre-heater is heated electrically.

3.1.2. Motor connection

3.1.2.1. Connecting the three-phase AC motor

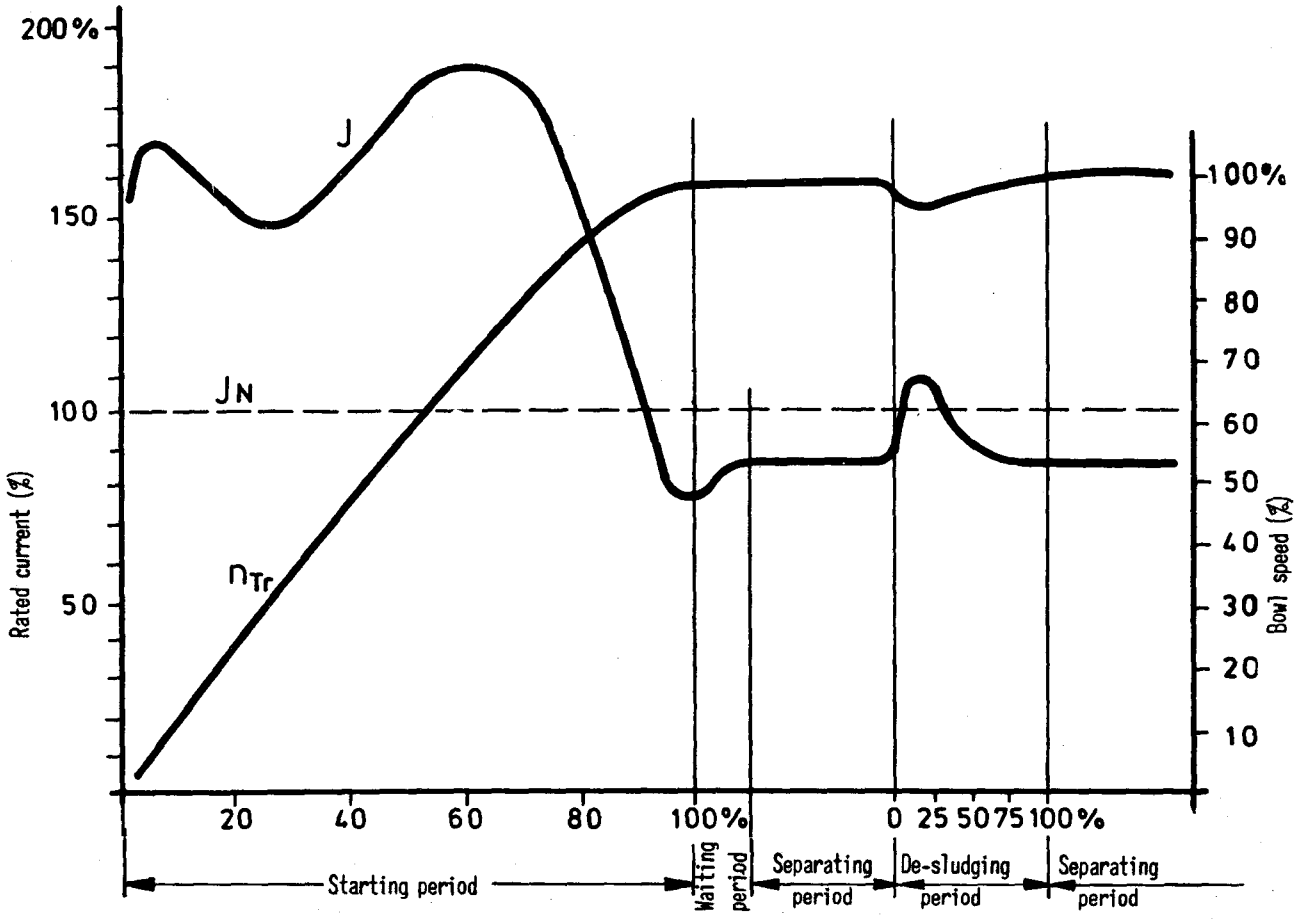


Diagram showing current and speed characteristic curves

Bowl speed	Moment of inertia	Starting period	De-sludging period	Motor				
				Capacity		Type of construction	Speed	
				Separator without pump	Separator with pump		at 50 Hz	at 60 Hz
rpm	GD^2 kp m^2	min	sec	kW	kW		rpm	rpm
8500	2,67	2.....5	30	3	3.7	B5	1455	1745

The separator is powered by a three-phase AC motor of type B5, type of enclosure IP 44, via a centrifugal clutch. The motor can be started across the line.

The rated power figures include sufficient reserve to cover the increased starting load. After the starting period, the power demand drops, so that overloading of the motor during operation is eliminated.

The starting time depends on the moment of inertia of the bowl as well as on the number and condition of the clutch shoes. The starting current can reach 1.8 times the value of the rated current (see diagram on page 3/2). This is to be considered when dimensioning switches, lead-in wires and fuses.

The motor has to be protected against undue temperature rise either by thermal releases or by means of a device which ensures full motor protection.

Protection of the motor by means of thermal releases has to be ensured as follows: during operation, by a release adjusted to the rated current and during start-up by means of a release adjusted to 1.4 times the value of the rated current. The release adjusted to the rated current must be bridged during the starting time.

Full motor protection can only be ensured when PTC resistor type temperature feelers are incorporated in the winding of the motor. The temperature feelers are to be connected to a commercial tripping device. External voltage higher than 2.5 volts must not be applied to the terminals of the temperature feelers. When testing for continuity do NOT use a test lamp, but only an ohmmeter.

If apart from the motor control, the plant comprises other control systems, e.g. timing unit, heater control, alarm device, these systems have to be interlocked with the motor control. Circuit diagrams will be furnished on demand.

3.1.2.2. Connecting the DC motor

When selecting DC motors take into account that after the start, the power demand often drops to about two thirds of the rated figure resulting in increase of the speed. For this reason, the speed/loading characteristics have to be taken into consideration.

Shunt wound motors (or compound wound motors) may only be used in connection with the separator.

NOTE: At 2/3 of the full load the speed of the DC motor must not exceed 1500 rpm.
A 1430 rpm motor is therefore recommended.

3.1.2.3. Checking the direction of rotation of the bowl

NOTE: The motor must never be started before the gear chamber is filled with oil. Oil level must be up to the upper third of sight glass (see 3.2.2).

The bowl must rotate in clockwise direction when looked at from above. The direction of rotation is correct when revolution indicator disc (fig. 3/3) rotates clockwise; it can be reversed by interchanging two lead-in wires.

3.1.3. Speed and starting time of the bowl

The bowl speed has been rated so as to ensure the operating safety of the separator. It depends on the densities of the sedimented solids and of the heavy liquid.

For densities of the heavy liquid up to 1.0 kg/dm^3 and of the separated solids up to 1.4 kg/dm^3, the bowl speed is 8520 rpm.

If the densities exceed those specified above, the gear must be changed to reduce the bowl speed. In this case be sure to check with the factory. Gears for 1455 and 1745 rpm motors are available.

Before the initial start of the separator and after changing the gear parts, check the number of revolutions of the spindle (rpm of bowl) with a hand tachometer before installing the bowl (see fig. 3/3).

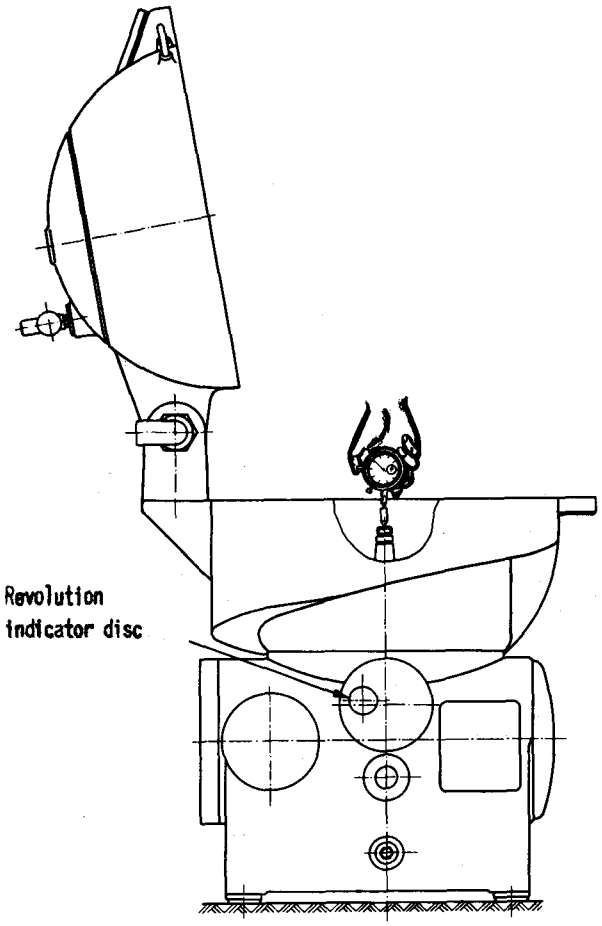


Fig. 3/3

Checking the spindle speed with a hand tachometer

The rotating revolution indicator disc shows that the bowl is rotating and in which direction (see 3.1.2.3). It also allows checking the revolutions of the bowl.

The bowl has reached its full speed, when after start-up of the bowl, the revolution indicator disc makes the following revolutions:

65 rpm at a motor speed of 1455 rpm,
78 rpm at a motor speed of 1745 rpm.

Speed variations up to 5% are permissible.

The starting time of the bowl is 2 - 5 minutes.

Make sure that the bowl comes up to its rated speed (as per name-plate of separator) within the starting time and that this speed is maintained during operation (see 3.3.1.1 - 3.3.1.3)

3.2. Maintenance

3.2.1. Lubrication and maintenance schedule

	Lubricant	after operating hours 250	750	1500	3000	6000	MAINTENANCE	Every week	3 months	6 months	year	2 years
Lubrication Chart							First oil change after starting.					
	O						Check oil level.					
	O						Oil change and thorough cleaning of the gear chamber.					
	O						Lubrication of hand-operated parts, such as lock screws.					
	MF						Grease sliding surfaces of essential parts of self-cleaning bowls.		as needed			
	F						Pack motor bearing with grease.					
Servicing Program	Cleaning						Clean filter in suction side of dirty-oil pump.					
			as needed				Clean operating-water filters of de-sludgers.		as needed			
							Clean gear chamber (oil change).					
							Remove bottom bearing and clean all parts thoroughly.					
							Remove bowl and clean interior of upper frame part.					
			as needed				Disassemble self-cleaning bowls and clean all bores, nozzles, and chambers of the hydraulic system.		as needed			
	Inspection						Remove and inspect gaskets of bowl, and clean the grooves. Check for corrosion. Check if disc set is compressed sufficiently.					
							Check starting time; check thickness of clutch linings.					
							Check thickness of brake linings.					
							Inspect neck bearing springs and spring pistons.					
							Inspect spindle bearings.					
							Check gearing of worm drive through inspection hole (after removing the revolution indicator housing).					
							Check spindle speed (bowl speed): with 3phase AC					
							Check spindle speed (bowl speed): with DC					
	Replacement						Clutch shoes.					
							Ball bearings on spindle.					
							Ball bearings on worm wheel shaft.					

Explanation of signs

O = Lubricating oil

MF = Lubricating grease containing MoS_2

F = Roller and ball bearing grease

3.2.2. Lubrication

All bearings and gear parts are splash lubricated from a central oil bath.

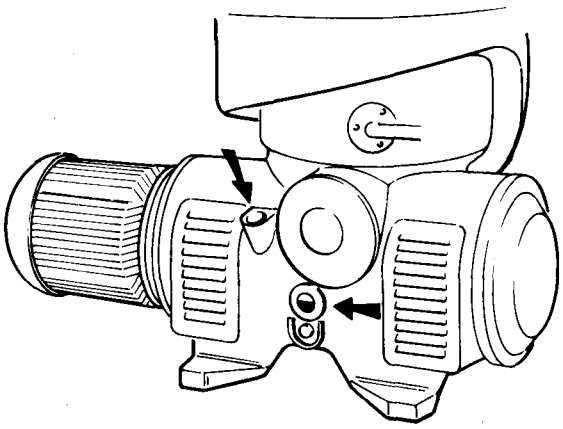


Fig. 3/4

OIL LEVEL

Before the initial start-up of the separator fill gear chamber with oil through the filling hole until oil level is slightly above middle of sight glass. About 1.2 litres of oil are required for a filling.
During operation oil level must never be allowed to sink below middle of sight glass; refill oil whenever necessary.

OIL CHECK

Check oil level once a week.
From time to time check if oil contains water. To do this, loosen oil drain screw and allow a small amount of oil to drain.

An immediate oil change becomes necessary when the oil shows a milky colouring (emulsification).

OIL CHANGE

Make first oil change after about 250 operating hours; then change oil every 750 operating hours. However be sure not to wait longer than six months to change the oil.

Each time when carrying out oil change, thoroughly clean gear chamber and flush with thin-bodied oil, prior to filling in new oil.
Remove all metal particles from inner walls and corners of the gear chamber. Do NOT use fluffy cleaning rags or cotton waste. The sight glass should also be cleaned, as a layer of oil will probably have deposited on the inner side of the glass and this is easily mistaken for the oil level.

LUBRICATING OIL

As lubricating oil use only high grade solvent refined mineral oils designated, according to DIN 51502,

C 100 (SAE 30)
of the viscosity 100 ± 10 mm^2/s (cSt) /40 °C.

This lubricating oil shall meet the requirements specified for lubricating oils C according to DIN 51517.

NOTE: Bear in mind that the viscosity group SAE 30 covers a larger viscosity range than that stated above. However, the oils used for the lubrication of the separator may only have the viscosity specified above.

EP oils (oils with high pressure additives) may only be used if they have no corrosive effect on copper base alloy (see table of lubricating oils).
The gear oil designated "Separator lubricating oil C100" which has been extensively investigated by us meets the above requirements and should preferably be used. For the order number refer to page 4/18.

For re-greasing the motor ball bearings refer to the instructions of the motor manufacturer.

WESTFALIA SEPARATOR

Schmieröl - Tabelle für
WESTFALIA Mineralöl - Separatoren
in Land- und Schiffsbetrieben

TABLE OF LUB. OILS
FOR WESTFALIA MINERAL OIL SEPARATORS
IN LAND- AND SHIPBOARD INSTALLATIONS

Separator Typ neu NEW	Separator Typ alt OLD	Ölfüllung QUANTITY l	Schmieröl LUB. OIL: Symbol mit Kennzahl nach DIN 51502*	Klasse/class SAE	Viskosität Viscosity Kin. Visk. bei/at 40 °C 104 °F mm²/s [cSt]	Viskosität Viscosity Kin. Visk. bei/at 50 °C 122 °F mm²/s [cSt]
	MOC 211 ON 311	0,5	C 100	30	90 bis/to 110	62 bis/to 74
OTB 2	MOC 515 ON 616 OTA 2	0,75				
	MOC 1015	0,9				
ON 1046 OTA 7 OTA 14 OSA 7	OG 2016 ON 1016 ON 1516 ON 2016 SAOON 1516	1,2				
	MOC 2015	1,3				
	MOC 4015 MOC 8015 OG 4016 OG 8016	2,5	C 220	40	198 bis/to 242	106** bis/to 122
ON 3046 OTA 18 OTA 30	ON 4016 ON 8016	4				
	OG 10016	2,8		50		
	SAOG 2016 SAOG 2516 SAOG 4016 SAOG 4516	2,5				
SAOG 3046 SAOG 5046	SAOG 3016 SAOG 5016	4				
OSA 20				50		
OSA 35	SAOON 7016	7				

von einigen Firmen vorgeschlagene Schmierölsorten — RECOMMENDED OILS FROM VARIOUS FIRMS

Firm	Oil	Viscosity
AGIP	AGIP BLASIA 100	100 mm²/s bei 40°C
AGIP	AGIP RADULA 100	100 mm²/s bei 40°C
AGIP	AGIP DIESEL GAMMA 30	100 mm²/s bei 40°C
AGIP	AGIP OSO 220	220 mm²/s bei 40°C
antar marine	ATLANTA MARINE 30	115 mm²/s bei 40°C
antar marine	TURBINE T 100	95 mm²/s bei 40°C
antar marine	REDUCTELF SP 100	100 mm²/s bei 40°C
antar marine	EPONA Z 220	210 mm²/s bei 40°C
antar marine	DISOLA M 40	175 mm²/s bei 40°C
ARAL	Aral Vitam GF 100	100 mm²/s bei 40°C
ARAL	Aral Motanol HK 100	100 mm²/s bei 40°C
ARAL	Aral Degol BG 220	220 mm²/s bei 40°C
ARAL	Aral Degol TU 220	220 mm²/s bei 40°C
ARAL	Aral Motanol HP 220	220 mm²/s bei 40°C
BP	BP Energol HLP 100	100 mm²/s bei 40°C
BP	BP Energol GR-XP 100	100 mm²/s bei 40°C
BP	BP Energol IC-MB 30	70 mm²/s bei 50°C
BP	BP Energol IC-MB 40	92 mm²/s bei 50°C
BP	BP Energol GR-XP 220	220 mm²/s bei 40°C
Castrol	CASTROL HYSPIN AWS 100	100 mm²/s bei 40°C
Castrol	CASTROL ALPHA ZN 100	100 mm²/s bei 40°C
Castrol	CASTROL MARINE HEAVY	99 mm²/s bei 40°C
Castrol	CASTROL ALPHA ZN 220	220 mm²/s bei 40°C
Chevron	OC Turbine Oil 100	77 mm²/s bei 40°C
Chevron	Marine Oil R & O	70 mm²/s bei 50°C
Chevron	OC Turbine Oil 220	219 mm²/s bei 40°C
Chevron	Circulating Oil 220	200 mm²/s bei 40°C
Chevron	Delo 3000 Marine Oil SAE 50	220 mm²/s bei 40°C
Esso	ESSO TRO-MAR 30	110 mm²/s bei 40°C
Esso	ESSO NUTO H 100	100 mm²/s bei 40°C
Esso	ESSO SPARTAN EP 100	100 mm²/s bei 40°C
Esso	ESSO SPARTAN EP 220	220 mm²/s bei 40°C
FINA	FINA HYDRAN 100	100 mm²/s bei 40°C
FINA	FINA SOLNA 100	100 mm²/s bei 40°C
FINA	FINA GIRAN 220	220 mm²/s bei 40°C
FINA	FINA SOLNA 220	220 mm²/s bei 40°C
Gulf	Gulf Harmony 100	95 mm²/s bei 40°C
Gulf	Gulf Veritas 30	110 mm²/s bei 40°C
Gulf	Gulf EP Lubricant 220	219 mm²/s bei 40°C
INA	INA HIDRAOL HD 70	95 mm²/s bei 40°C
INA	INA CIRKOL 225	220 mm²/s bei 40°C
INA	INA HIDRAOL HD 225	220 mm²/s bei 40°C
Mobil	Mobil D.T.E. Oil Heavy	81 mm²/s bei 40°C
Mobil	Mobil Mobilgard 312	68 mm²/s bei 50°C
Mobil	Mobil Mobilgear 630	206 mm²/s bei 40°C
Mobil	Mobil Mobilgard 412	86 mm²/s bei 50°C
SHELL	Shell Gadinia Oil 30	64 mm²/s bei 50°C
SHELL	Shell Vitrea Oil 100	100 mm²/s bei 40°C
SHELL	Shell Omala Oil 220	220 mm²/s bei 40°C
SHELL	Shell Tellus Oil C 220	220 mm²/s bei 40°C
TEXACO	Regal Oil R & O 100	93 mm²/s bei 40°C
TEXACO	Doro AR SAE 30	119 mm²/s bei 40°C
TEXACO	Ursa Oil Extra Duty SAE 30	97 mm²/s bei 40°C
TEXACO	Taro XD SAE 40	166 mm²/s bei 40°C
TEXACO	Meropa 220	199 mm²/s bei 40°C
Valvoline	VALVOLINE WA-7	95 mm²/s bei 40°C
Valvoline	VALVOLINE WA-15	215 mm²/s bei 40°C
Valvoline	RITZOL IRF	200 mm²/s bei 40°C
Wisura	Wisura Hydroma 100	110 mm²/s bei 40°C
Wisura	Wisura Ventura 62/SAE 30	113 mm²/s bei 40°C
Wisura	Wisura Kineta 100	100 mm²/s bei 40°C
Wisura	Wisura Kineta 220	220 mm²/s bei 40°C

* Symbol: SHOULD READ: »SYMBOL WITH IDENTIFICATION NUMBER«

** In Schiffsbetrieben sind Öle der Klasse SAE 40 ab 85 mm²/S zulässig / IN SHIPPBOARD INSTALLATIONS MORE THAN 85 MM²/S IN CLASS SAE 40

3558/282

WESTFALIA SEPARATOR

Anmerkungen zur Schmieröl – Tabelle für WESTFALIA Mineralöl – Separatoren

Für einen einwandfreien Betrieb der Separatoren ist die richtige Auswahl eines geeigneten Schmieröles von größter Wichtigkeit, da ein gutes, den sehr hohen Anforderungen entsprechendes Öl den Verschleiß auf ein Mindestmaß herabsetzt und somit die Lebensdauer und Betriebssicherheit des Separators erhöht.

Zur Schmierung unserer Mineralöl - Separatoren empfehlen wir, die von uns getesteten Marken - Mineralöle, die in der Schmieröl - Tabelle zusammengestellt sind, zu verwenden.
Falls andere Schmieröle gewünscht werden, sind nur hochausraffinierte Solventraffinate zu wählen.

Für die einzelnen Separatorentypen und Ölsorten schreiben wir die in der Schmieröl - Tabelle aufgeführten Viskositätsbereiche vor.

Die genannten Separatorentypen haben Tauchschmierung. Der Antrieb erfolgt über Schneckengetriebe, bei denen die Zahnbelastung relativ hoch ist. Die Separator - Betriebstemperatur liegt in der Regel über 80 °C.

Deshalb ist grundsätzlich zu beachten, daß keine dünnflüssigeren Schmieröle verwendet werden sollen als in der Schmieröl - Tabelle angegeben. Zu dünnflüssige Öle führen durch die geringere Tragfähigkeit des Schmierfilmes zu einer Mischreibung und höherem Verschleiß. Dagegen ist eine geringfügige Überschreitung des vorgeschriebenen Viskositätsbereiches zulässig.

Man beachte, daß die Viskositätsklassen SAE 30, 40 und 50 (SAE = Society of Automotive Engineers) sich über größere Viskositätsbereiche erstrecken. Es dürfen aber die in der Tabelle angegebenen unteren Grenzen der für die einzelnen Separatorentypen eingeengten Viskositätsbereiche keinesfalls unterschritten werden.

EP-Öle (EP = Extreme Pressure), also Öle mit Hochdruckzusätzen, dürfen nur dann verwendet werden, wenn sie auch bei Eindringen von Wasser ins Ölbad keine korrodierende Wirkung haben. Versuchserfahrungen mit verschiedenen Marken-EP-Ölen ergaben, daß die beabsichtigte Wirkung ausgeprägter Grenzflächenaktivität und -aggressivität der EP - Zusätze auf Zahnräder aus Bronze sehr unterschiedlich ist. Deshalb dürfen EP - Öle nur eingesetzt werden, wenn sie Bronze nicht angreifen.

Comments on Table of Lubricating Oils for WESTFALIA Mineral Oil Separators

Faultless functioning of separators very much depends on the proper type of lubricating oil used, since a high grade oil, selected to meet all requirements of service, will minimize the wear, thus extending the service life and increasing the operating safety.

For the lubrication of WESTFALIA mineral oil separators, the standard types of mineral oil as specified on the attached table should be used. They have been tested in service and proved to meet all requirements.
If such types of oil are not available, be sure to select only high grade solvent refined products.

For the viscosity ranges of the different types of oil to be used for WESTFALIA separators, refer to the attached table.

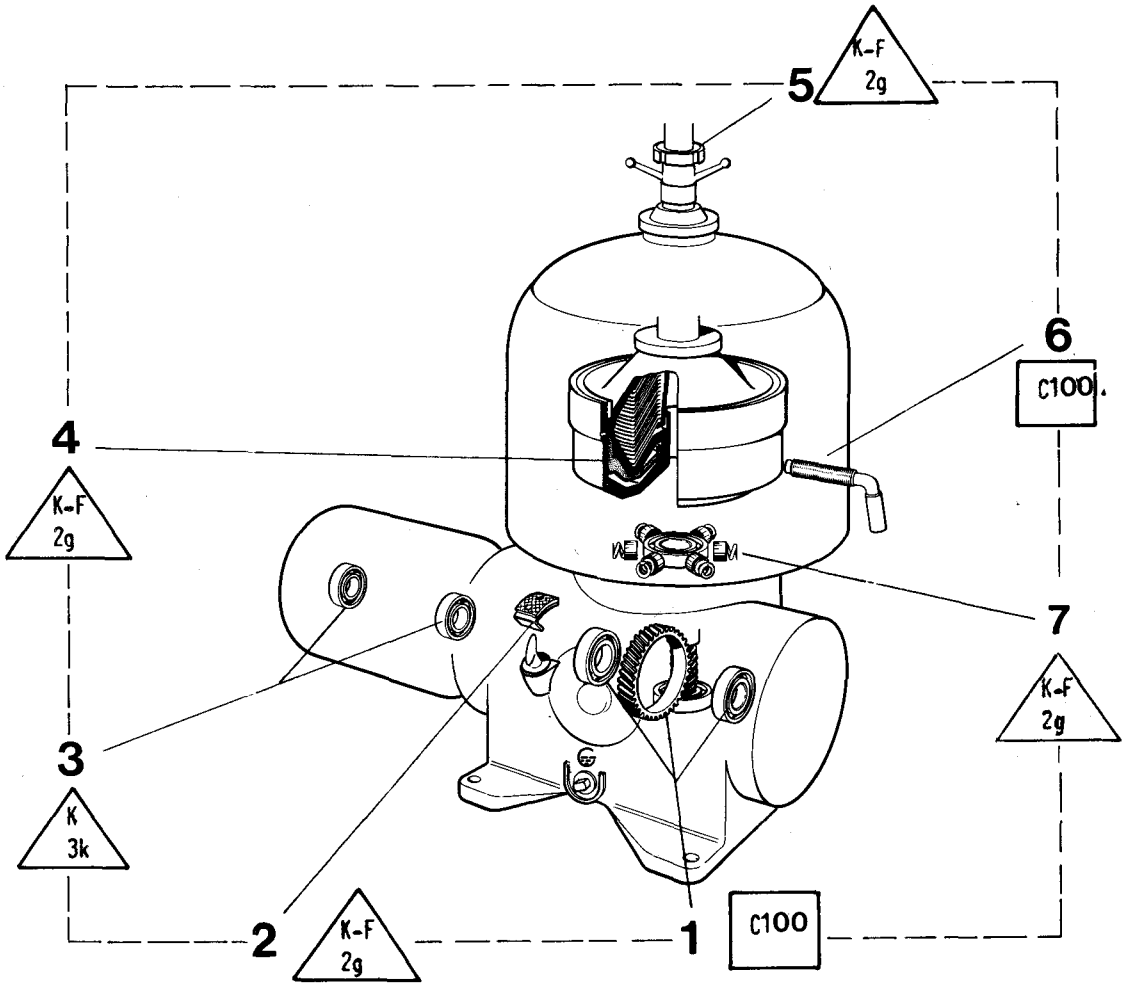
The separator types listed on the table are splash lubricated. Power is transmitted to a worm gear with a relatively high tooth load. The operating temperature of the separator generally exceeds 80 °C.

Therefore, be sure not to use lubricating oils with viscosities lower than those specified on the attached table. As a matter of fact, because of the possibility of the oil film breaking down, oils of too low a viscosity will give insufficient lubrication, resulting in increased wear. Oils with a slightly higher viscosity than specified may, however, be used.

Bear in mind that the viscosity groups SAE 30, 40 and 50 cover larger viscosity ranges and be sure to select lubricating oils with viscosities not lower than the minimum values of the viscosity ranges restricted for the different separator types.

EP oils, i.e. oils with high pressure additives, may only be used if they have no corrosive effect even in the event of water seeping into the oil sump. Since tests carried through with various types of standard EP oils have shown that there are great differences in the intended effect of marked interfacial activity and aggressiveness of EP additives on bronze toothed wheels, EP oils may only be used if they do not attack bronze.

3.2.3. Lubrication chart



No. in Fig.	Lubricant: Designation according to DIN	Lubricant: Label	Frequency of lubrication: 1) per year	Frequency of lubrication: after operating hours	Amount of lubricant	Type of lubrication	Lubrication points
1	Gear oil C100 according to DIN 51517	C100 blue	2 x	750 h	1200 cm^3		Gear chamber
2		2) K-F 2g violet		when required	3) 0.1 cm^3		Clutch shoes
3	Ball bearing grease 120 according to DIN 51825	K 3k violet		20,000 h (if re-greasing is possible)	60 cm^3		Motor bearings
4		2) K-F 2g violet	3 x	when required	150 cm^3		Threads and sliding surfaces of bowl
5		2) K-F 2g violet		when required	10 cm^3		Threads of fittings
6	Gear oil C100 according to DIN 51517	C100 blue	2 x	when required	10 cm^3		Manually operated parts such as lock screws, etc.
7		2) K-F 2g violet		when required	20 cm^3		Neck bearing springs and spring pistons

Check oil level regularly through sight glass.

This lubricating chart has been prepared in accordance with specifications of DIN 8659.

1) For 8 hours' operation per day.

2) K-F 2g Mixture of ball bearing grease and molybdenum disulfide paste (ratio 4:1).

3) See sect. 3.4.4.3, No. 5.

3.3. Trouble Shooting

3.3.1. General

Troubles	Causes	Remedies
3.3.1.1. The bowl does not come up to rated speed or takes too long to do so.	1) Brake is on.	Release brake by turning handle in clockwise direction.
	2) Motor is incorrectly connected.	See wiring diagram.
	3) Friction surfaces of clutch shoes are oily.	Wipe friction surfaces dry. Do NOT use benzine, nor trichlorethylene, nor any other solvent.
	4) Linings of clutch shoes are worn.	Renew clutch shoes (see 3.4.4.2 and 3.4.4.3).
	5) Insufficient number of clutch shoes.	Add one or two clutch shoes. See sect. 3.4.4.3.
	6) Bowl is too high or too low and thus rubs against centripetal pump.	Adjust to proper height (see 3.4.3).
	7) Liquid or sludge has accumulated in upper section of frame, resulting in slowing-down of the bowl.	Check operating-water outlet: liquid must run out freely (see 3.1.1). Clean interior of upper section of frame (see 2.5.2).
	8) Clamp plates are not tight enough; worm wheel slips on worm wheel shaft.	Tighten long hex head screws on worm wheel, crosswise, evenly and firmly (see 3.4.10, No.3).
3.3.1.2. The bowl speed drops during operation.	1) Friction surfaces of clutch shoes are oily.	Wipe friction surfaces dry. Do NOT use benzine, nor trichlorethylene, nor any other solvent.
	2) Motor speed drops during operation.	Check line voltage and inspect motor.
3.3.1.3. The bowl comes up to rated speed too fast (in less than 2 minutes). Motor pulls too high a starting current.	Too many clutch shoes are used. Note that driving effect of new clutch shoes will improve after several starts.	Reduce number of clutch shoes to three or two. Make sure they are equally distributed (see 3.4.4.3).

Troubles	Causes	Remedies
3.3.1.4. Uneven run of the separator.	1) Bowl is out of balance due to the following possible causes (see 1a-1d):	Stop separator. Apply brake. Close dirty-oil supply and clean oil discharge. Do NOT de-sludge the bowl since otherwise the vibrations occurring during slowing-down of the bowl will increase. If the bowl leaks, open make-up water supply line all the way. See No. 1a-1d.
	1a) The separated solids have deposited unevenly in the bowl.	See No. 1. Clean the bowl (see sect. 2.5.1).
	1b) Bowl is incorrectly assembled or parts of different bowls (if plant has several separators) have been interchanged.	See No. 1. Assemble bowl properly (see 2.4.2 or 2.4.4).
	1c) Pressure in disc stack has slackened.	See No. 1. Make sure bowl lock ring is screwed on tightly (see 2.4.2.2 No. 13). Check disc count. If necessary, add spare disc or compensating disc (see 2.4.2.2 No.5).
	1d) Bowl parts are damaged.	See No. 1. Send bowl to factory or authorized factory repair shop. Do NOT attempt to make your own repairs. Never weld or solder. Bowl is made of heat-treated steels.
	2) Neck bearing springs are weak or broken.	Replace all six neck bearing springs.
	3) Pressure spring in bottom bearing is broken. Bowl is found to be about 1.5 mm too low in the frame.	Renew pressure spring (see 3.4.2.2). Re-adjust bowl height (see 3.4.3).
	4) Ball bearings are worn.	Install new bearings. NOTE: As spindle bearings use only bearings as stated in the List of Parts.

Troubles	Causes	Remedies
3.3.1.4. Uneven run of the separator (cont'd.).	5) Gear parts are in bad condition as a result of 1. normal wear, 2. premature wear caused by: a) lack of oil b) oil of too low a viscosity, } in general, recognizable by blue tempering colour of gear parts c) metal abrasives present in the lubricating oil due to the following possible causes: - viscosity of oil too low, - oil has not been changed in time, - gear chamber has not been cleaned, d) replacement of one gear part only instead of both parts, e) infiltration of water because operating-water pressure is too high or because shut-off device was open for a longer period during shut-down of the separator.	Thoroughly clean gear chamber (see 2.5.4). Replace worm wheel assembly and at the same time worm spindle (never replace only one part). Be sure to refer to sect. 3.4.10 Change the oil (see 3.2.2). If necessary, change oil more often. Regarding infiltration of water, the following should be kept in mind: The operating-water pressure must range between 2 and 3 bar. Make sure that shut-off device is always closed during shut-down of the separator. If necessary, provide a second shut-off device.
3.3.1.5. Dirty-oil pump does not suck in.	Dirty-oil pump is defective.	Check sealing rings and gaskets on pump shaft. Check spill valve; if necessary, re-adjust valve.
	Suction lines are clogged or leaking.	Clean or seal suction lines. Check foot valve.
	Pre-strainer is clogged or leaking.	Clean pre-strainer (see 2.5.5). Renew gasket in cover.

3.3.2. Bowl performance
(unfold page 3/14)

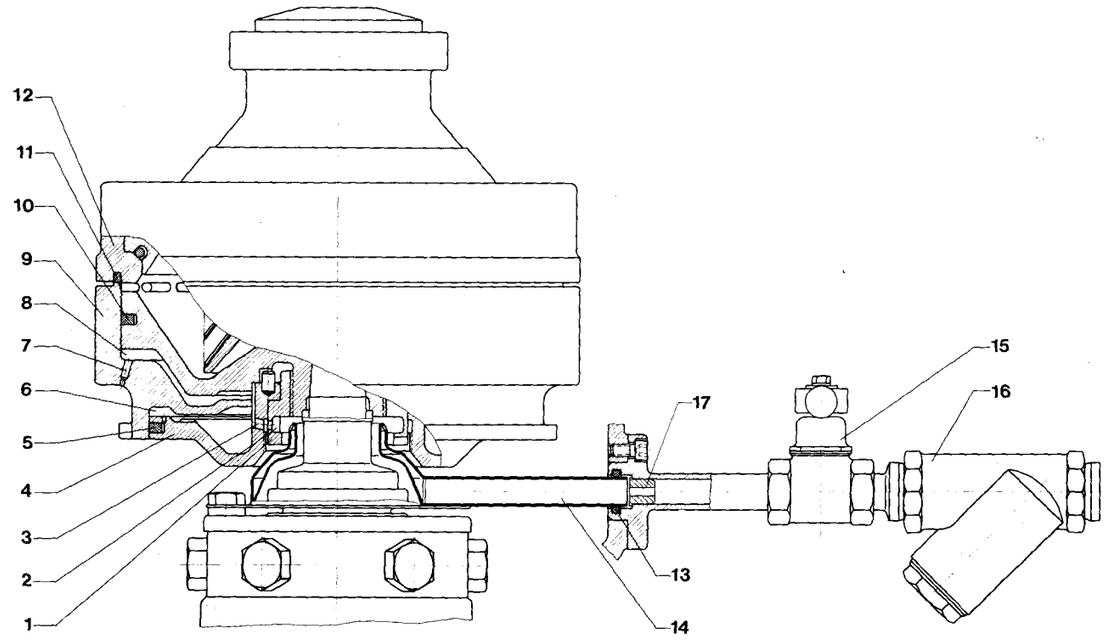
Troubles	Causes	Remedies
3.3.2.1. The bowl fails to close.	1) Feed ducts 3 in threaded ring and sealing-chamber bottom leading from injection chamber to sealing chamber are clogged or injection chamber is dirty.	Clean feed ducts 3 and injection chamber.
	2) Discharge nozzle 7 in sliding piston, through which water leaves the opening chamber, is clogged.	Remove sliding piston. Clean discharge nozzle. Be sure not to enlarge the diameter (1.2 Ø) of the discharge nozzle while cleaning.
	3) A rim of dirt has formed in the opening chamber 8 which prevents the sliding piston from reaching its end position.	Dismantle the bowl. Clean opening chamber. If necessary, replace gasket 10. Check if operating water contains impurities.
	4) Gasket 5 in sealing-chamber bottom is damaged, or its edges have been frayed through the up- and down- movement of the sliding piston.	Replace damaged gasket. If however, only the edges of the gasket are frayed and it is not damaged otherwise, it can be re-used after grinding off the edges with an emery wheel.
3.3.2.2. The bowl does not close properly.	1) Gasket 5 in sealing-chamber bottom or gasket 10 in bowl bottom does not contact the sliding piston all around.	If gasket fits too tightly, stretch it. Before inserting gasket, lightly grease groove in sealing-chamber bottom or bowl bottom (see 2.4.2.1, No. 2).
	2) Gasket 11 in bowl bottom is damaged.	Replace damaged gasket.
	3) Gasket 5 in sealing-chamber bottom or gasket 10 in bowl bottom is uneven in height.	Insert gasket which is true to measure. The gasket must not differ in height by more than 0.25 mm.
	4) Sealing edge of sliding piston 9 is damaged.	Face sealing edge of piston lightly or send piston to factory for repair.
	5) Shut-off device 15 for operating water does not close properly.	Install a new shut-off device.
	6) The bowl is placed too high, thus too small an amount of operating water gets into the injection chamber.	Adjust bowl to proper height (see 3.4.3).

Troubles	Causes	Remedies
3.3.2.3. The bowl does not open at all or not completely.	1) The amount of operating water available per unit of time is too small.	Check water pressure. If necessary, increase pressure. Required operating-water pressure: 2 - 3 bar.
	2) Strainer in operating-water line is clogged.	Clean the strainer.
	3) Gasket in operating-water line is damaged. Part of operating water seeps away.	Replace gasket in operating-water line.
	4) Passage section of operating-water line has become too narrow due to dirt accumulation or damage. Too small an amount of operating-water is injected.	Clean or replace operating-water line.
	5) Dry dirt or rubber particles have become lodged between sealing-chamber bottom and sliding piston or between sliding piston and bowl bottom.	Clean bowl parts. Round off edges of gaskets. Replace damaged gaskets. Apply a thin film of molybdenum disulfide paste to guide surfaces (see 3.2.3).
	6) The sealing chamber is soiled.	Dismantle the bowl (see 2.4.5) and clean the sealing chamber.
	7) Polyamid gasket fits loosely in groove of bowl bottom. Liquid which has infiltrated in the groove, behind the gasket, presses the latter out of the groove while the piston is moving downwards, so that there is no gap for sludge ejection.	Install new Polyamid gasket (see 2.4.6).
3.3.2.4. Incomplete de-sludging of the bowl. Part of the sludge remains in the bowl.	1) The bowl has closed too soon. Solid particles which could not be ejected have gradually accumulated in the bowl and hardened through the long time of centrifugation.	Clean the bowl. Leave operating-water valve open for about 10 seconds. If necessary, carry out flush de-sludgings after de-sludging (see 2.3.3).
	2) Discharge hole in sliding piston through which the water leaves the opening chamber, has been enlarged (due to cleaning or erosion). The sliding pstion moves down too slowly; part of the sludge remains in the bowl.	Reduce diameter of discharge hole to 1.2 mm. This is done by drilling up the hole to 4 mm, then closing it by driving in a pin and re-drilling to proper diameter; or reduce diameter of hole by beating.

Troubles	Causes	Remedies
3.3.2.4. Incomplete de-sludgingof the bowl. Part of the sludge remains in the bowl (cont'd.).	3) Pressure in disc stack has slackened or pressure is too low because of an insufficient number of discs. As a result, discs have deformed.	Add spare disc or compensating disc (see 2.4.2., No. 5). Re-shape deformed discs. If necessary, replace them.
3.3.2.5. Gasket in bowl bottom show premature wear.	1) Bowl has closed too soon. Solids have been pressed into the gasket by the rising piston.	Leave shut-off device for operating water open for about 10 sec.
	2) The feed liquid contains abrasive solids.	Pre-strain feed liquid.
3.3.2.6. The bowl opens after a long separating time.	The amount of operating-water in the sealing chamber has lessened during a long separating period (due to evaporation, etc.).	Replace manually-operated shut-off valve for operating water by a solenoid valve which is opened briefly at pre-set intervals by an electronic timing relay.
3.3.2.7. The bowl does not close or open properly after a long-term shut-down of the separator.	The bowl has not been cleaned thoroughly before the long-term shut-down of the separator. Scale has formed between sealing-chamber bottom and sliding piston or between sliding piston and bowl bottom.	Before removing sealing-chamber bottom and sliding piston, dissolve the scale by means of citric acid. Then dismantle the bowl and clean it thoroughly (see 2.5.1).
3.3.2.8. Overflow of the bowl, recognized by dirty oil discharging from the clean-oil outlet.	Impurities of high density (e.g. rust from tanks and pipe lines) have accumulated in the distributor neck. Feed to bowl is hindered, resulting in overflow.	Clean distributor neck (see 2.5.1).

Bowl and operating-water feed assembly

shown with regard to possible operating troubles



1 Threaded ring
2 Injection chamber
3 Feed ducts
4 Sealing-chamber bottom
5 Gasket in sealing-chamber bottom
6 Sealing chamber
7 Discharge nozzle
8 Opening chamber
9 Sliding piston
10 Gasket in bowl bottom
11 Polyamid gasket in bowl bottom
12 Bowl bottom
13 Gasket in operating-water line
14 Operating-water feed
15 Shut-off device
16 Strainer
17 Nozzle 4,5 mm Ø

Fig. 3/5

The operating water should be cold and clean and should meet the following requirements:

hardness	6 - 10° dH
chlorine ions	≤ 100 mg/l
pH value	6.5 - 7.5

Operating-water line: NW 20

Operating-water pressure: 2 - 3 bar

Amount of operating-water: 2 litres/10 sec. at a pressure of 2 bar

The amount of operating water can be adapted to the operating-water pressure by enlarging or reducing the inner diameter of nozzle 17.

Page 3/14, Fig. 3/5

3.4. The gear parts

3.4.1. Removing the vertical gear parts

1) After having dismantled the upper bowl parts (see 2.4.5) force bowl bottom off the spindle cone with the aid of jack 411. Then lift bowl bottom out of the frame (see fig. 2/37).

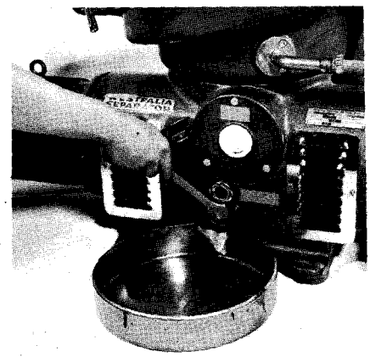


Fig. 3/6

2) Loosen oil drain screw and let oil drain into oil pan.

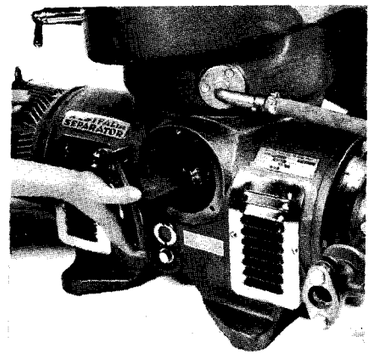


Fig. 3/7

3) Remove revolution indicator housing.

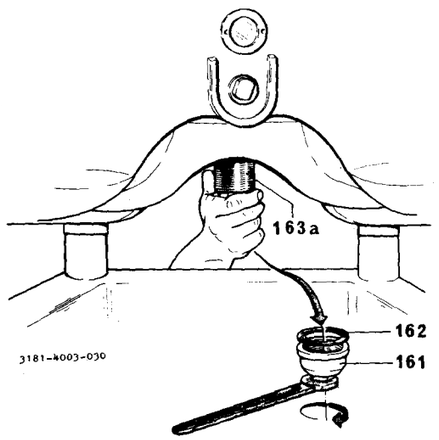


Fig. 3/8

4) Unscrew bottom bearing cap 161 and remove gasket 162.

5) Unscrew bottom bearing threaded piece 163a and remove it together with the other parts of the bottom bearing.

6) In case bottom bearing housing 166 (fig. 4/4) must be replaced, undo hex head screws 164 and remove lock washers 165. Then take two hex head screws and screw them into two opposite tapholes of the bottom bearing housing in order to force the latter out of the lower section of the frame.

7) Undo hex head screws 169s and remove operating-water feeding device 170, spindle cap 168h, neck bearing protection cap 169m and spindle spring 168g (see fig. 3/9).

8) Screw spindle nut 321 onto worm spindle, by hand. Then pull out worm spindle together with neck bearing bridge.
IMPORTANT: Be sure not to damage gaskets 169k and 169a while removing. If necessary, install new gaskets.

9) To remove neck bearing bridge, hold spindle in inverted position, upper end down, and tap spindle lightly against a wooden surface (see fig. 3/10). Neck bearing bridge will then slide off.

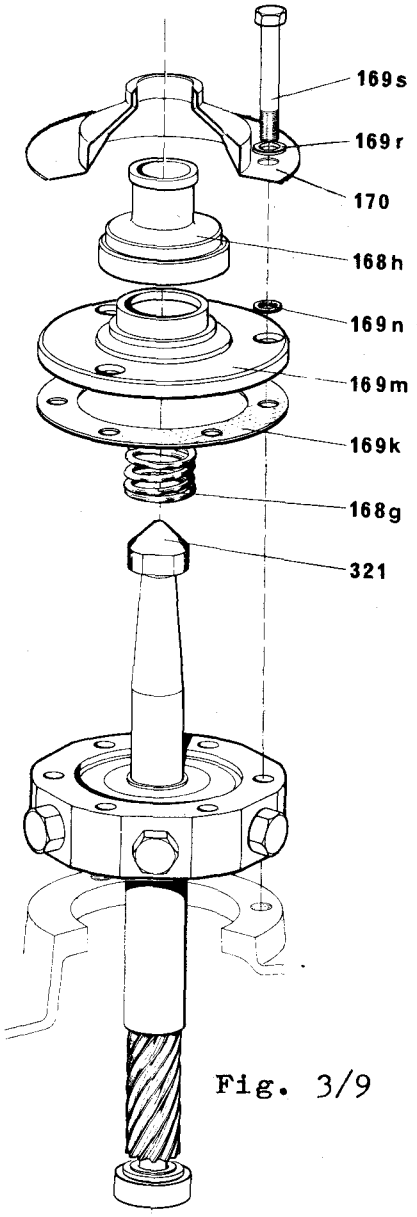


Fig. 3/9

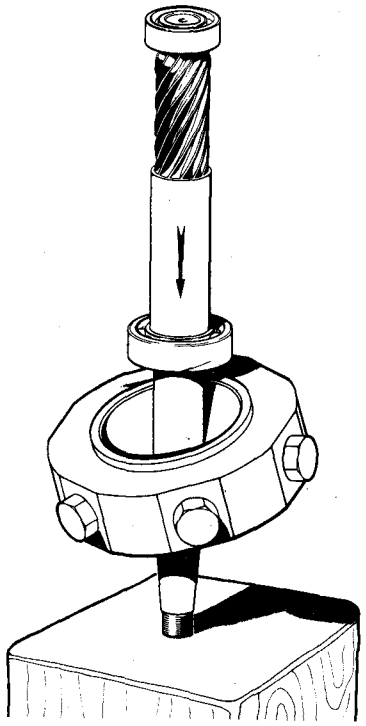


Fig. 3/10

3.4.2. Re-assembly of the vertical gear parts (fig. 4/4)

For re-assembly proceed in reverse order of removal (see 3.4.1) and according to the instructions given in sect. 3.4.2.1 - 3.4.2.2.

3.4.2.1. Important hints for re-assembly

1) Before re-assembly, thoroughly clean gear chamber (see 2.5.4).

2) Check condition of ball bearings before re-fitting.
NOTE: Use only high speed precision ball bearings (see Parts List).

3) Before fitting ball bearings and ball bearing protection rings 168b and 168f onto the worm spindle heat them up in 80°C hot oil.

4) It must be possible to install the worm spindle, with ball bearings attached, without having to rap on the upper spindle end, and to move the built-in spindle axially by hand. The outer ring of the pendulum ball bearing 168a must fit snug in the bottom bearing housing. If this is not the case, smooth the inside of the bottom bearing housing with a very fine emery paper.

5) When installing a new worm spindle, the entire worm wheel assembly with clamp plates, 216, must be replaced at the same time, since this assembly, also worn down to some extent, would cause premature wear to the new worm spindle.

6) When installing the neck bearing bridge assembly, 169b-g, make sure that the gaskets 169a and 169k are in good condition.

7) Before installing neck bearing protection cap check if cams of distance ring 169h are flush with the upper surface of neck bearing pressure ring 169g or slightly below it (not more than 2 mm). If this is not the case, proceed according to the instructions given in sect. 3.4.3, last but one para.

8) IMPORTANT: After re-installation of the vertical gear parts, check bowl height for possible re-adjustment (see 3.4.3).

3.4.2.2. Assembly of the bottom bearing

1) Thoroughly clean all parts of the bottom bearing assembly 163a-h (fig. 3/11).
2) Fit pressure spring 163b into bottom bearing pressure piece 163c.
3) Fit bottom bearing pressure piece together with pressure spring into bottom bearing threaded piece 163a.
4) Install bottom bearing running parts into bottom bearing threaded piece:

   Bottom bearing pressure disc 163d,
   Ball cage 163f,
   Bottom bearing running disc 163g.
5) Insert snap ring 163h into bottom bearing threaded piece.

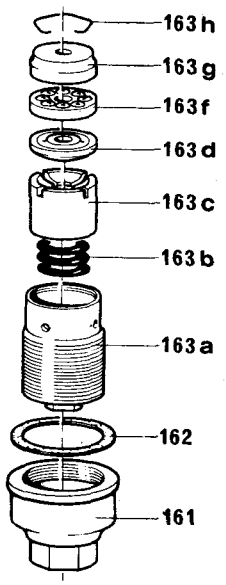


Fig. 3/11

3.4.3. Re-adjustment of bowl height

IMPORTANT: For reasons of operating safety, the bowl height should be adjusted with great care.

The bowl height is adjusted at the factory before the separator is shipped. It must be checked for re-adjustment before the initial start of the separator, after re-assembling the vertical gear parts, after exchanging the bowl or the centripetal pump or when the centripetal pump shows any grinding marks.

Correct bowl height adjustment can only be made when the bowl is properly closed, i.e. when the "0" marks on bowl lock ring and on bowl bottom are in line with each other.

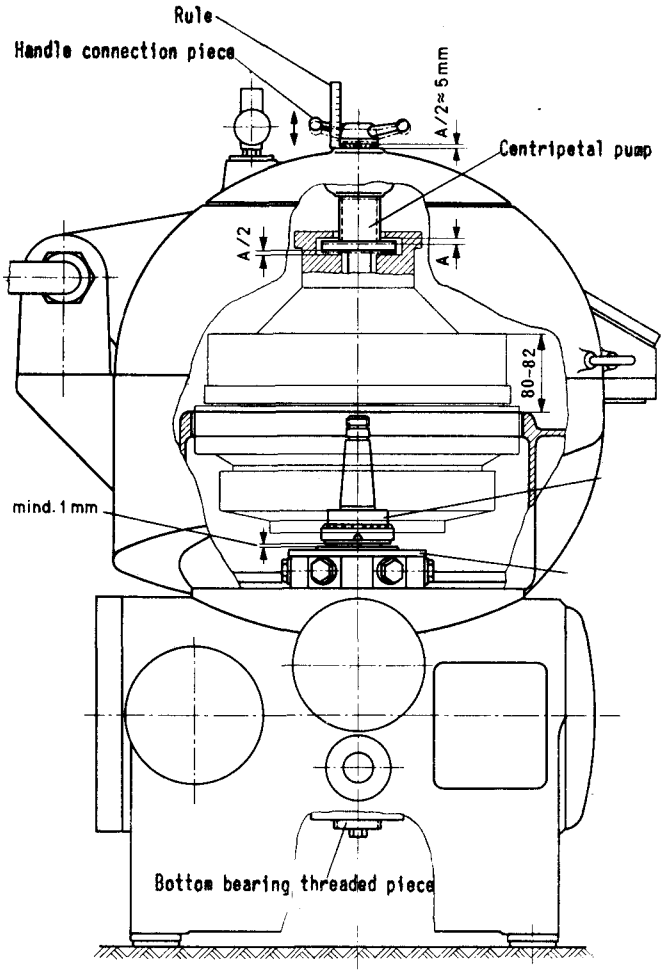


Fig. 3/21: Adjusting the bowl height

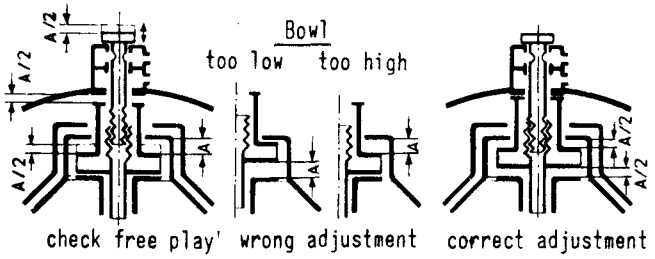


Fig. 3/22: Checking the play above and below the centripetal pump

After unscrewing bottom bearing cap adjust bowl height by turning bottom bearing threaded piece 163a until there is a distance of 80 - 82 mm between upper edge of inner frame wall and upper edge of bowl bottom (see fig. 3/21).
A full turn of the bottom bearing threaded piece to the Right or to the Left raises or lowers the bowl by 1.5 mm.

After bowl height adjustment, move centripetal pump 327 axially in the pump chamber and in doing so, measure the total play "A" which is about 8 mm.
Then close the hood and fasten by means of Allen screws 118. Apply a thin film of molybdenum disulfide paste to thread of handle connection piece 137. Fasten centripetal pump by means of handle connection piece (left-hand thread). While fastening block centripetal pump with wrench 404 (see fig. 2/1).
Then loosen the centripetal pump until it rests on the ribs of the separating disc and the shoulder of the handle connection piece is flush with the upper edge of hood.
Now lift handle connection piece until centripetal pump touches the gasket in the cover of hood.
Measure axial play A/2. The clearance above and below the centripetal pump in the pump chamber is correct when the measure A/2 is 3 - 4 mm (see fig. 3/21 and 3/22).

Each time the bowl has been lowered or raised, check if the cams of distance ring 169h are flush with the upper surface of neck bearing pressure ring 169g or slightly below it (not more than 2 mm). In order to be able to check this, remove bowl, operating-water feeding device, spindle cap and neck bearing protection cap. This check is not necessary when it has been made after re-assembling the vertical gear parts (see sect. 3.4.2.1, No. 7) and the bowl had not to be raised by more than 1 mm.

If the cams of the distance ring exceed the upper surface of the neck bearing pressure ring, file them to proper dimension.
If the cams lie below the upper surface of neck bearing pressure ring by more than 2 mm, increase height of cams by welding or check with the factory for a new distance ring with properly sized cams.

After checking the clearance between distance ring and neck bearing pressure ring, re-install the above-mentioned parts. Replace bottom bearing cap including gasket and close tightly. While tightening, make sure bottom bearing threaded piece will not turn.

3.4.4. The centrifugal clutch

3.4.4.1. General

The centrifugal clutch gradually brings the bowl up to its rated speed, eliminating premature wear on gear parts and motor. The acceleration time can be controlled by the number of clutch shoes used.

When fewer clutch shoes are used, the friction moment will be lower, the starting time longer, and the wear on gear parts and motor less. Only 2 or 3 or 4 clutch shoes may be inserted in the clutch driver (see 3.4.4.3). The number of clutch shoes to be used depends on the motor power to be transmitted.
Note that the driving effect of new clutch shoes will improve after several starts.

Smoking of the clutch during the first few starts is normal and will disappear after a short time of operation.

If the bowl comes up to rated speed as per name-plate of separator in less than 2 minutes, the motor will pull too high a starting current. This condition can easily be overcome by reducing the number of clutch shoes to 3 or 2. Make sure the clutch shoes are equally distributed (see fig. 3/25).

Check condition of clutch shoes from time to time (see lubrication and maintenance schedule on page 3/5). Be sure to replace clutch shoes before the linings are worn down to the rivet heads, to avoid damage to the contact surface of ring of clutch drum. Such damage would result in premature wear of the clutch shoe linings. To avoid unbalance, all the clutch shoes have to be replaced as soon as one of the linings is worn. Never replace only one clutch shoe.

3.4.4.2. Removing the clutch shoes

1) Remove ventilation grid.
2) Use a socket wrench to undo screw 207 (see fig. 3/24).
3) Push clutch cover 206 towards motor side.
4) Remove clutch shoes 208 by pulling out in direction of motor.

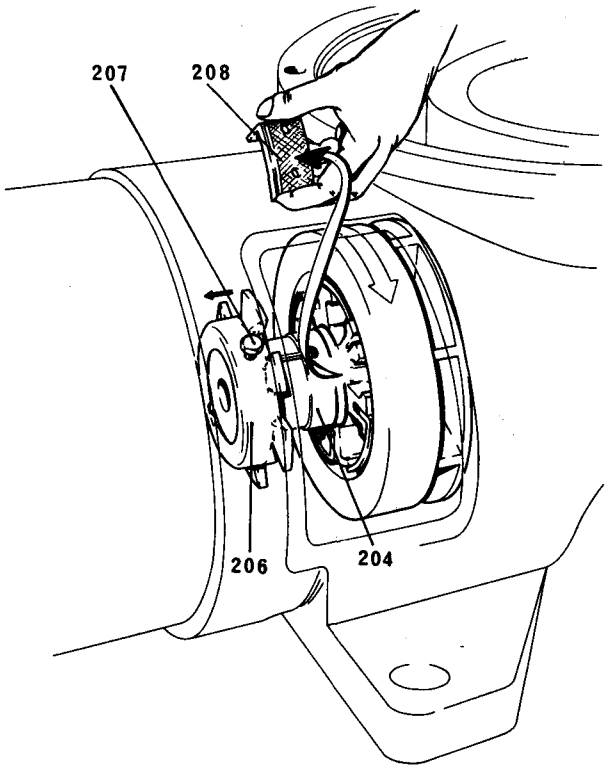


Fig. 3/24

3.4.4.3. Installation of clutch shoes

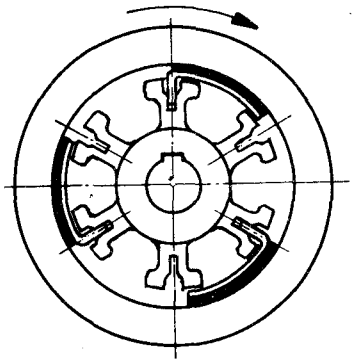


Fig. 3/25
Clutch driver with clutch shoes (seen from motor side)

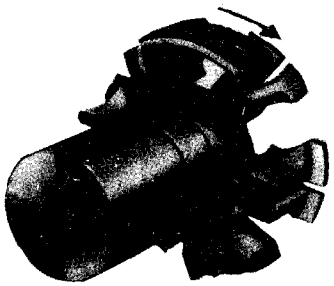


Fig. 3/26
Clutch driver with one clutch shoe

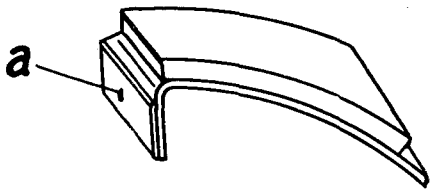


Fig. 3/27
Clutch shoe

1) Put clutch shoes 208 (either 2, 3 or 4 shoes) - equally distributed - into slits of clutch driver 204 in such a manner that they will be pushed by the driver and NOT pulled (see figs. 3/25, 3/26, 3/28). Make sure that the clutch shoes have a slack fit in the slits of the clutch driver.

2) Push clutch cover 206 forward until it rests on the centering rim of the clutch driver and NOT before it.

3) Tighten hex head screw 207 in clutch cover, using a socket wrench.

4) Fasten ventilation grid to frame.

5) In case the clutch emits disturbing noises during the acceleration period, apply a very thin film of molybdenum disulfide paste to the lips "a" of the clutch shoes (fig. 3/27). If too much paste is applied, there is the chance that small particles of the paste might be centrifugally thrown on the friction surfaces, leading to clutch slippage.

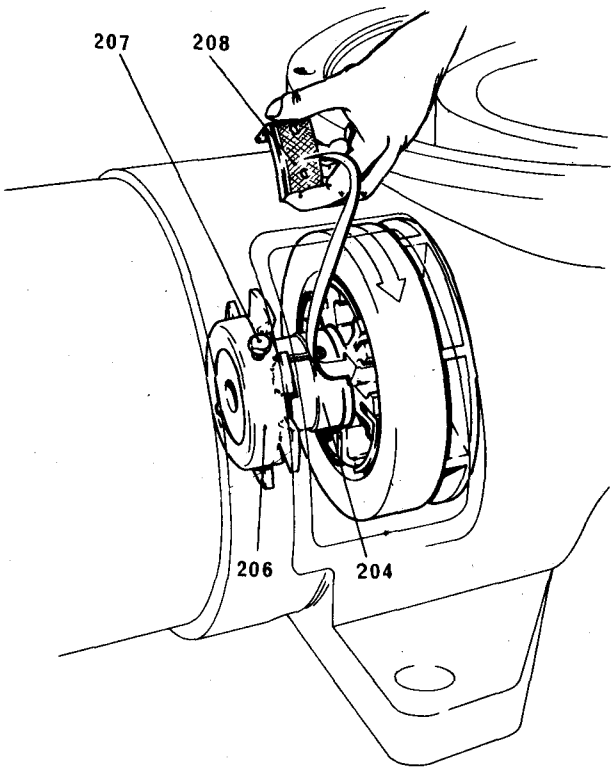


Fig. 3/28

3.4.5. Removing the motor

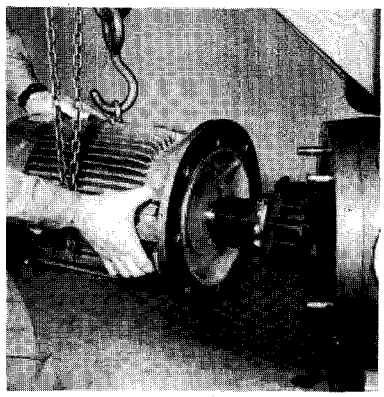


Fig. 3/29

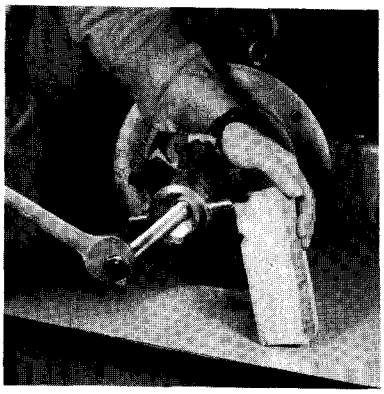


Fig. 3/30

1) Remove lead-in wires from motor terminals.
2) Remove clutch shoes (see 3.4.4.2).
3) Remove hexagon nuts from flange and remove lock washers.
4) Remove motor together with clutch driver 204 (fig. 3/29).
5) Use a wrench to loosen hex head screw 205 on clutch driver.
6) By means of puller 406 withdraw clutch driver from motor shaft end (fig. 3/30).

3.4.6. How to fit the motor

For fitting the motor proceed in reverse order of removal and according to the instructions given in sect. 3.4.6.1.

3.4.6.1. Mounting the clutch driver

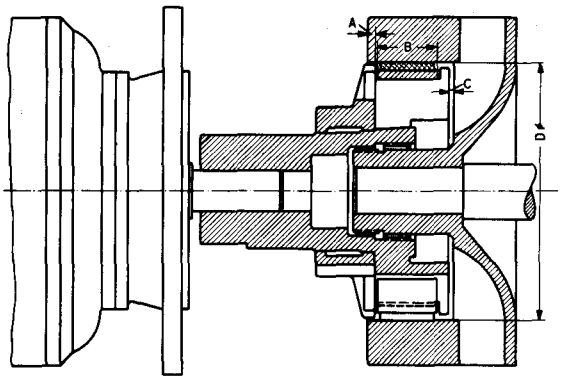


Fig. 3/31
Position of clutch driver in ring of clutch drum

Dimensions in mm					
Fig. 3/1				Fig. 3/2	
A	B	C	D	E	d
3.5	33	4 ±0.5	140	M10	7

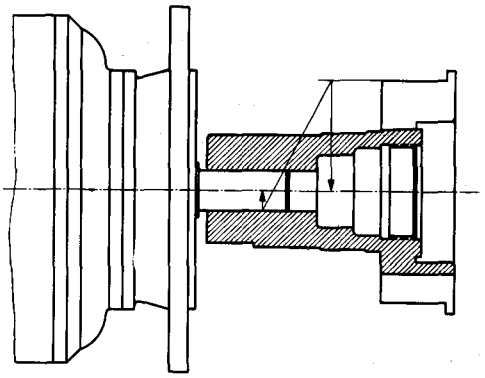


Fig. 3/33
Tolerance between axis of clutch driver and axis of motor shaft

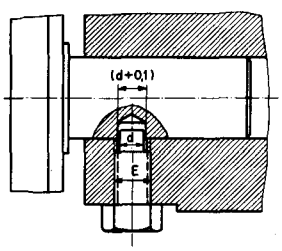


Fig. 3/32
Fastening the clutch driver on the motor shaft

The motor power is transmitted to the worm wheel shaft of the separator via a centrifugal clutch. For proper functioning of the centrifugal clutch, fit the clutch driver onto the motor shaft end as shown in figs. 3/31 and 3/32. Make sure to fit it in such a manner that after mounting the motor the clutch shoes rest completely on the inner surface of the ring of the clutch drum (fig. 3/31).

For fitting the clutch shoes, refer to sect. 3.4.4.3.

Fasten clutch driver on motor shaft by means of hex head screw (fig. 3/32). Head of screw must rest on spot-faced surface of clutch driver.

After having fastened the clutch driver, check tolerance between axis of clutch driver and axis of motor shaft. The tolerance must not exceed 0.05 mm (fig. 3/33).

For connecting the motor proceed according to the instructions given in sect. 3.1.2. Then check the direction of rotation, speed, and starting time of the bowl (see 3.1.2.3 and 3.1.3).

3.4.7. Removing the gear pump and the pump clutch

1) Remove ventilation grid from separator, on pump side.

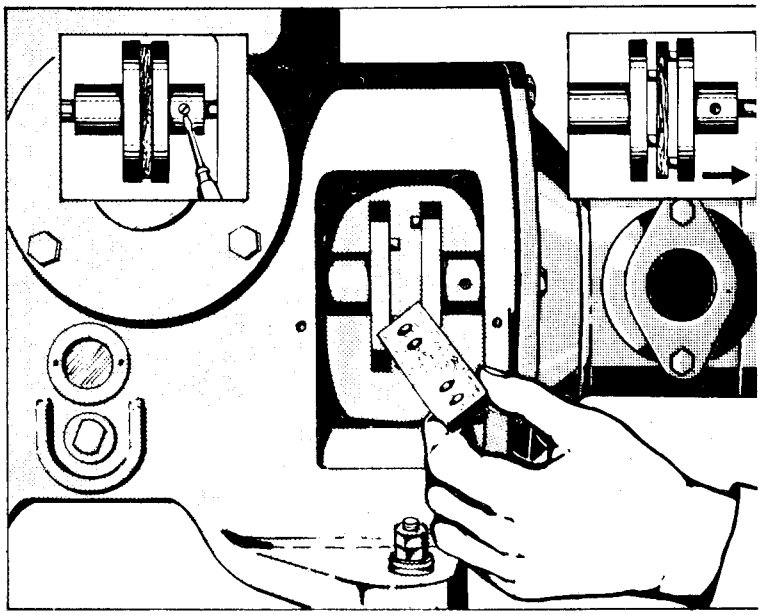


Fig. 3/34

2) Loosen threaded pin 355 and push clutch pulley 354 on pump shaft end towards pump side (fig. 3/34).
3) Remove flexible coupling 353.
4) Undo hex head screws of expansion joints. Remove expansion joints and pre-set valve 379.
5) Undo fastening screws and remove pump and clutch pulley.
6) Remove clutch pulleys from pump shaft end and worm wheel shaft end.

3.4.8. Removing the centrifugal clutch

1) Remove the motor (see 3.4.5, No. 1 - 4).

2) Undo Allen screws and remove flange.

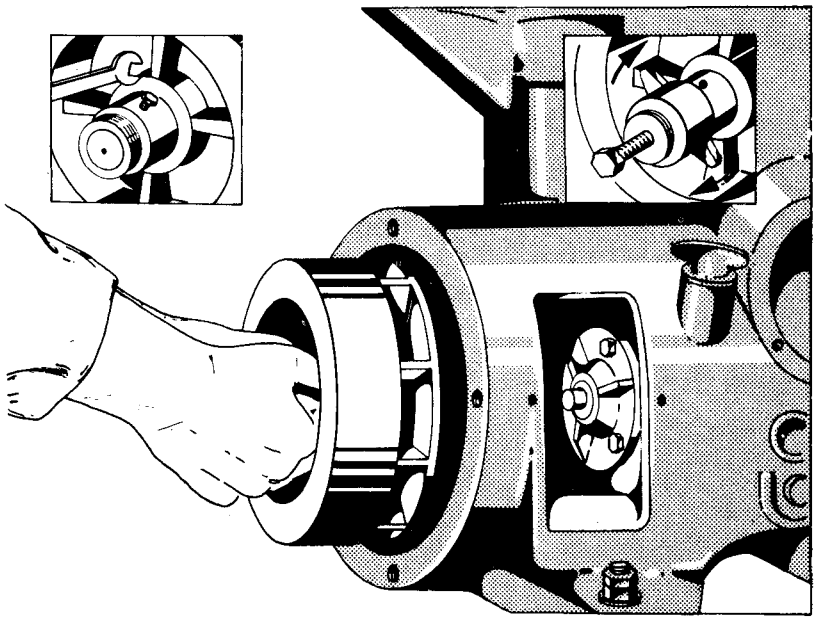


Fig. 3/35

3) Loosen hex head screw 209 in hub of clutch drum 202.

4) Use puller 406 to withdraw clutch drum from worm wheel shaft end, on motor side. Then remove clutch drum, by hand.

3.4.9. Removing the worm wheel and worm wheel shaft

1) Remove the motor (see 3.4.5).

2) Remove gear pump and pump clutch (see 3.4.7).

3) Loosen oil drain screw and let oil drain into oil pan.

4) Remove revolution indicator assembly.

5) Loosen long hex head screws in worm wheel. While doing so, block clutch drum to prevent worm wheel shaft from turning.

6) Loosen clamp plates until worm wheel can be moved on worm wheel shaft.

7) Remove clutch drum (see sect. 3.4.8).

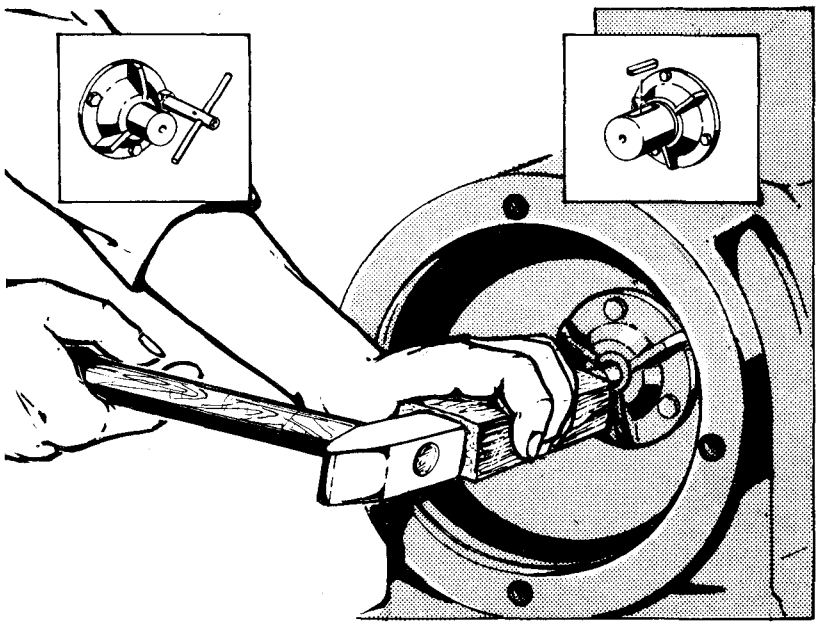


Fig. 3/36

Undo hex head screws on bearing cover situated on pump side.

Remove key from shaft end, on motor side.

Place a hard wood block on worm wheel shaft end and rap it lightly with a hammer to drive out shaft towards pump side or protection cap side. When shaft has completely loosened from ball bearing, on motor side, remove it by hand. While doing so hold worm wheel to prevent damage to gear teeth.
Then take worm wheel assembly with clamp plates out of the gear chamber.

3.4.10. Re-assembly of the horizontal gear parts (see fig. 4/5).

For re-assembly proceed in reverse order of removal (see sect. 3.4.9) and according to the following instructions:

1) The worm wheel with clamp plates 216 has been balanced in the factory as complete assembly. To avoid unbalance, clamp plates 217 and 222 must, therefore, not be rotated on wheel body 220, and parts 217 -220 and 222 must not be replaced individually.

2) When mounting the worm wheel assembly with clamp plates, push worm wheel towards pump side until it rests before shoulder of worm wheel shaft 225. This will assure correct positioning of the toothed rim with reference to the worm spindle.

3) The worm wheel must be firmly tightened to the worm wheel shaft accomplished by tightening screws 223 in both clamp plates. Tighten the screws crosswise, by single turns, to make sure clamp plates are drawn together evenly.

4) IMPORTANT: When toothed rim 219 is worn and needs replacement, the entire worm wheel assembly with clamp plates, 216, must be replaced. It is recommended that worm spindle 168c (fig. 4/4) be replaced at the same time, since this part, also worn down to some extent, would cause premature wear to the new toothed rim.

5) After having mounted the new gear parts, install the bowl and adjust it to proper height (see 3.4.3).

6) Fill gear chamber with oil as specified in sect. 3.2.2. until oil level is up to the upper third of sight glass.

7) IMPORTANT: To prevent the gear pump from rotating while the gear parts are being run in, check to be sure that flexible coupling 353 has not been inserted in the pump clutch.

8) Check spindle speed with a hand tachometer (see 3.1.3) and check direction of rotation of the bowl (see 3.1.2.3.).

9) To run in new gear parts, let the separator run - without bowl - for about an hour.
During this time switch the motor on and off several times.

10) After running in new gear parts install the bowl and insert flexible coupling into pump clutch.

3.4.11. Final check-up

3.4.11.1. before starting the separator

Before starting the reconditioned separator the following has to be checked:

	Section
1) Bowl height	3.4.3.
2) Oil level in gear chamber	3.2.2.
3) Direction of rotation of bowl	3.1.2.3.
4) Speed of bowl	3.1.3.
5) Starting time of bowl	3.1.3.
6) Smooth run of separator	3.3.1.4.
7) Tightness of suction line of dirty-oil pump	
8) On purifier bowl: correct size of regulating ring	2.4.3.
On clarifier bowl: regulating ring of smallest inner diameter	2.4.4.

3.4.11.2. during start-up of the separator

During start-up of the reconditioned separator the following has to be checked:

	Section
1) Temperature of feed liquid	2.2.1.
2) Temperature of make-up water	2.2.2.2.
3) Adjustment of pre-set valve	2.3.2.1.
4) discharging water, sludge and oil, to see if bowl functions properly	

Part IV

L I S T O F P A R T S

IMPORTANT

When ordering parts, please state the following:

1) Model 2) Serial - No.	of the separator: Both designations are shown on the name-plate of the separator. The Serial-No. also appears on the frame rim.
3) Description 4) Part - No.	of the part to be replaced: For details refer to List of Parts. The Part-No. is also shown on all major parts.
5) Bowl Serial-No.	(only required when ordering bowl parts) The Bowl Serial-No. appears, in large figures, on the bowl lock ring and on bowl bottom.
6) Model 7) Serial-No.	of the gear pump: (only required when ordering parts for gear pump and pump connection). Both designations are shown on the name-plate of the gear pump.

Part-Nos. ending with letter L (e.g. 2170-3468-L) designate parts which are available in different designs for the separator concerned.
To ensure correct delivery of these parts, Model and Serial-No. of the Separator MUST be stated.

Lower section of frame

No.in Fig.	Part - No.	Qty.		Part Description
-	2162-3495-000	1		Revolution indicator assembly (1-6)
1	0026-1049-030	2		Cylindrical pin 3h8x24 DIN 7
2	3117-3497-010	1		Revolution indicator disc
3	2162-3488-010	1		Shaft
4	0007-2502-750	1		Gasket 12/3
5	2162-3493-000	1		Housing
6	2162-3487-000	1		Worm wheel
7	0019-9117-400	1		Screw plug M22x1.5 DIN 7604
8	0004-1798-550	1		Gasket DIN 7603 - C22x27
9	0001-0006-640	1		Sight glass
10	0004-5034-760	1		Gasket 35/44x1.5
11	0019-7677-150	4		Stud M12x80 DIN 939 (for shipboard installation)
11	0019-4864-000	4		Anchor bolt FM12x200 DIN 529 (for land installation)
12	0026-2024-030	4		Cap 56
13	0021-3014-750	4		Rubber cushion
14	0026-2025-030	4		Cap 58
15	0006-4329-010	12		Cup spring
16	0013-0280-150	8		Hexagon nut M12 DIN 934
17	0019-6971-150	4		Hex head screw M12x35 DIN 933
18	3033-1066-000	1	*	Cover
19	3033-1001-090	1		Lower section of frame
-	2168-1045-000	1		Inspection nipple assembly (20a-g)
20a	2168-1047-000	1		Inspection nipple
20b	0026-1556-150	1		Cylindrical pin 4x25 DIN 1473
20c	2178-1160-000	1		Cover
20d	0018-3817-300	1		Hose clamp 50-70
20f	0001-0182-030	1		Flange 40
20g	2178-1124-020	1		Flange
20h	0019-6972-150	2		Hex head screw M12x40 DIN 933
20k	0001-0146-000	1		Flange
20m	0013-0280-150	2		Hexagon nut M12 DIN 934
21	0019-6970-150	2		Hex head screw M12x30 DIN 933
22	0004-5453-740	1		Gasket 44/70x112x2
-	2162-1021-L	1		Flange assembly (23-28)
23	3033-1028-L	1	**	Flange
24		4		Lock washer } for fastening the motor
25	depending on motor	4		Hexagon nut } for fastening the motor
26		4		Stud } for fastening the motor
27	0019-6166-150	4		Allen screw M12x35 DIN 912
28	0026-1328-190	4		Lock washer A12 DIN 127
29	0019-1741-800	1		Oil fill screw
30	3033-1085-000	2		Ventilation grid
31	0019-2248-030	4		Cheese head screw AM 6x12 DIN 84
32	0004-5228-700	1		Gasket 126/158x1
33	0019-6903-150	3		Hex head screw M8x20 DIN 933

* Not used on separators with attached pump.

** When ordering this part, please state also diameter of motor centering rim.

Lower Section of Frame

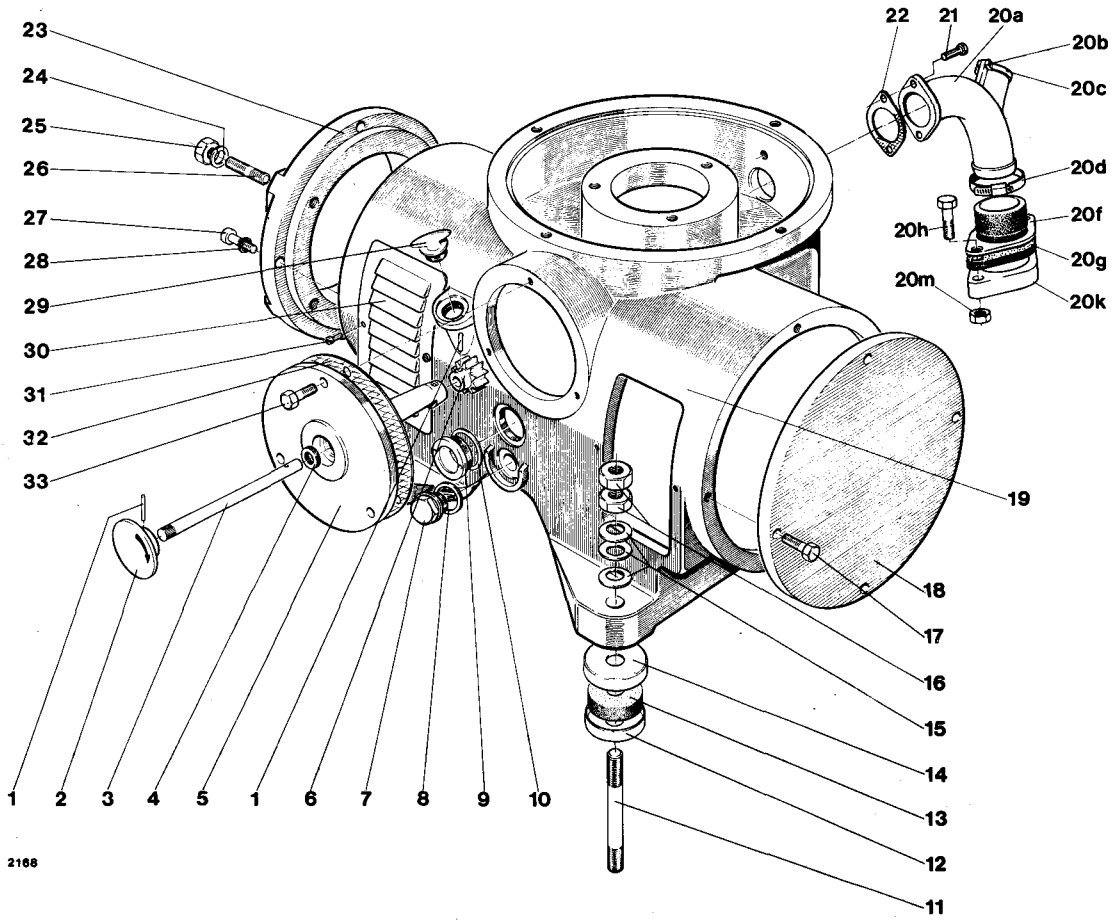


Fig. 4/1

Upper section of frame

No.in Fig.	Part - No.	Qty.		Part Description
51	2171-1002-040	1		Upper section of frame
52	0019-6972-150	2		Hex head screw M12x40 DIN 933
53	2171-1126-000	1		Support
54	0019-5195-150	2		Hex head screw AM 10x25 DIN 561
55	0019-3973-060	1		Threaded pin M8x10 DIN 438
-	2168-1043-000	1		Brake assembly (56-60)
56	0021-3515-690	1		Handle
57	0021-3542-640	1		Brake housing
58	0006-4195-160	1		Cylindrical pressure spring
59	2168-1031-000	1		Brake bolt, complete
60	0021-4094-860	1	*	Brake lining
-	0026-1262-550	2	*	Countersunk rivet 4x12 DIN 661
61	0019-6166-150	4		Allen screw M12x35 DIN 912
62	0007-2388-750	1		Gasket 54/68x15
63	0004-5453-740	1		Gasket 44/70x112x2
64	2168-2775-020	1		Siphon
64a	0018-1201-260	1	*	Cap 2" - T2 DIN 2950
64b	0018-3666-300	1	*	Hose clamp 35-57
64c	0001-0162-030	1	*	Oval flange 1"
64d	2168-1124-000	1	*	Flange
65	0019-6971-150	2		Hex head screw M12x35 DIN 933
67	0018-2523-600	1		Strainer R 3/4"
67.1	0018-2523-300	1	*	Strainer insert
68	0018-0934-260	1		Double nipple 3/4"x1/2" - N8 DIN 2950
69	0018-1712-630	1		Shut-off device 1/2"
-	2168-8769-000	1		Hose, complete (70-74)
70	0018-1796-600	1		Hose connection R 1/2" / 12
71	0018-3816-300	2		Hose clamp 8-22
72	0018-2786-758	1		Hose 13x200
74	0018-3064-600	1		Hose connection R 1/2" / 10
75	0004-5274-740	1		Gasket 12/19x3
76	2171-2184-000	1		Bend
77	0019-6120-150	3		Allen screw M8x16 DIN 912
78	0018-4060-600	1		Nozzle 4.5 (glued in with Loctite)
79	0007-2391-750	1		Gasket 18/4.5
80	0019-4547-090	2		Knurled screw M8x30 DIN 464
81	2178-8851-000	1		Inspection cover
82	0007-1845-750	1		Gasket 106/7
-	2168-1121-000	1		Flange assembly (83-88)
83	0019-7038-150	4		Hex head screw M16x45 DIN 933
84	0018-3819-300	1		Hose clamp
85	0026-0209-040	1		Washer
86	2178-1124-000	1		Flange
87	0001-0771-000	1		Flange
88	0013-0282-150	4		Hexagon nut M16 DIN 934
89	0019-6972-150	2		Hex head screw M12x40 DIN 933
90	0001-0140-000	1		Flange 3/4"
91	0013-0280-150	2		Hexagon nut M12 DIN 934

* This part is contained in the previous "complete" part, but it can also be ordered separately.

Upper Section of Frame

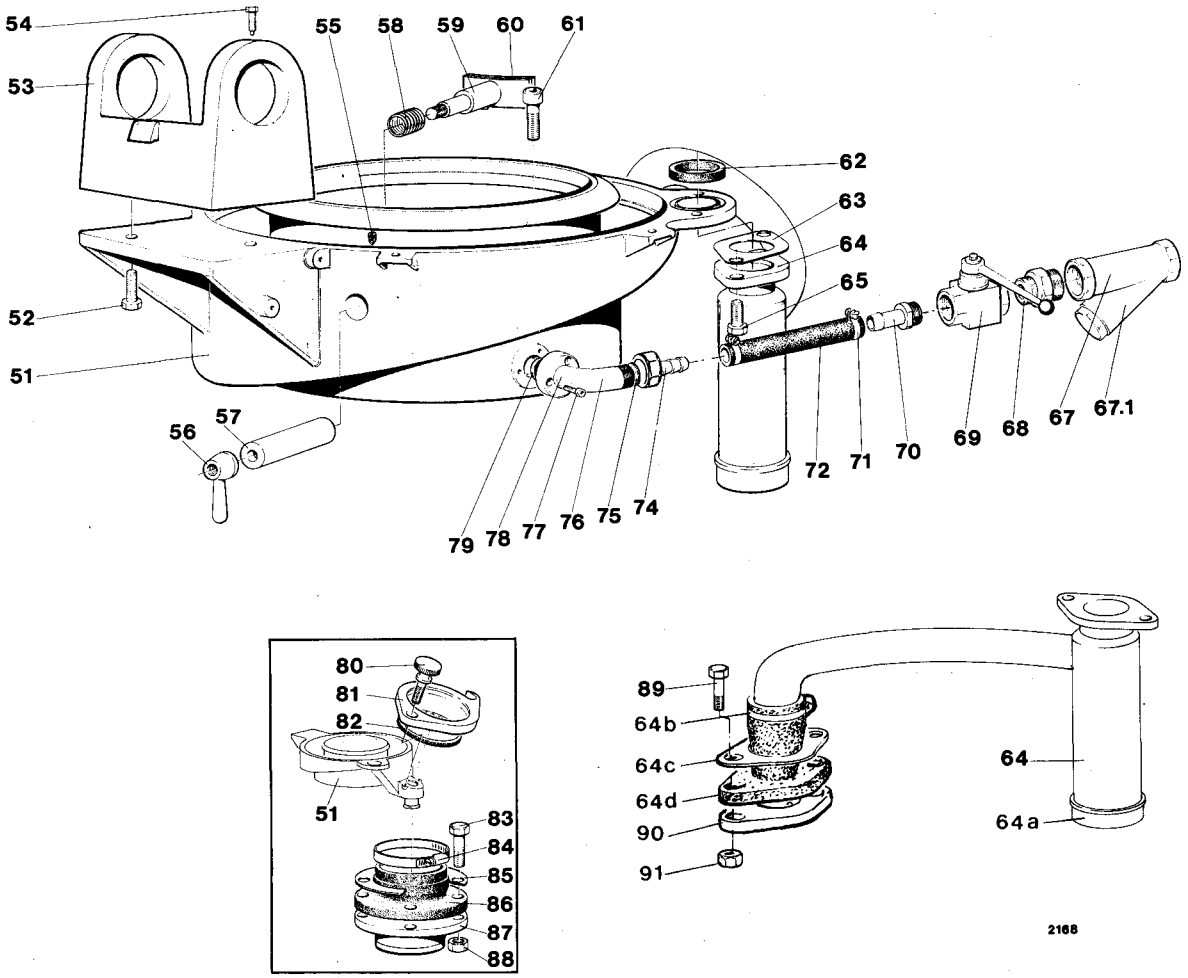


Fig. 4/2

Hood

No.in Fig.	Part - No.	Qty.		Part Description
-	2168-2805-050	1		Junction assembly (104a-110)
-	2168-2832-000	1		Expansion joint (104a-k)
104a	2168-2831-060	1		Expansion joint with coupling nut
104b	2178-1108-000	1		Plate
104c	0013-0291-150	2		Hexagon nut M8 DIN 985
104d	0018-0990-260	1		Plug 1/2" T9 DIN 2950
104f	0018-4842-010	1		Gasket holder 25
104g	0018-4842-750	1		Gasket 25
104h	0018-4842-020	1		Clamp 25
104k	2168-2831-050	1		Expansion joint
105	0013-0279-150	8		Hexagon nut M10 DIN 934
106	0004-2186-740	2		Gasket 20 ND 40 DIN 2690
108	0019-6512-150	8		Hex head screw M10x40 DIN 931
109	0018-1392-500	1		Straight-way valve 25
110	0001-0770-000	1		Flange 25/30 DIN 2631
-	2168-2805-060	1		Junction assembly
105	0013-0279-150	4		Hexagon nut M10 DIN 934
106	0004-2186-740	1		Gasket 20 ND 40 DIN 2690
108	0019-6512-150	4		Hex head screw M10x40 DIN 931
110	0001-0770-000	1		Flange 25/30 DIN 2631
111	2168-2832-000	1		Expansion joint (Part-Nos. of components see 104a-k)
115	0007-2277-750	2		Gasket 32/42x5
116	2171-1222-000	1		Hinge sleeve
117	0007-2925-750	5		Gasket 36.2/3
118	0019-6169-400	3		Allen screw M12x50 DIN 912
-	2168-8800-010	1		Hood assembly (119-146)
119	0007-2620-750	1		Gasket 376/4
-	2168-8815-010	1		Lower section of hood (120-128)
120	2168-8801-010	1		Lower section of hood with inserted bushes
121	0003-0690-000	3		Bush A 13.5x16 DIN 172
122	2163-8850-010	1		Inspection cover
123	0007-2114-750	1	*	Gasket 106/114x6
124	0019-4548-090	2		Knurled screw M8x40 DIN 464
125	0026-1075-030	1		Cylindrical pin 5h8x24 DIN 7
-	0026-2101-000	1		Holding ring assembly (126-128)
126	0026-5856-170	2		Securing ring
127	0026-2091-020	1		Bow
128	0026-0721-090	1		Bolt
129	0026-1826-300	1		Centering disc
130	0007-2571-750	1		Gasket 297/4
131	0007-2517-850	1		Gasket 36/44x4
132	0019-6125-150	4		Allen screw M8x30 DIN 912
133	0007-2181-750	2		Gasket 38/46x15
134	2171-8839-000	1		Threaded piece
135	2171-8805-000	1		Upper section of hood with distance sleeve
135a	2171-2239-000	1	*	Distance sleeve
135b	0007-1904-750	1		Gasket 40.2/3
136	0007-1936-750	2		Gasket 29.2/3
137	2171-2191-010	1		Handle connection piece
-	2168-8816-000	1		Make-up water supply line, compl.(138-146)
138	2168-8448-000	1		Pipe
139	0013-1006-260	1		Coupling nut R 1" P1 DIN 2950
140	2168-8840-000	1		Sight glass housing
141	0004-1915-740	2		Gasket 38/45.5x2
142	0001-0040-820	2		Sight glass
143	0019-1621-030	2		Threaded ring
144	0018-2015-000	1		Breather 3/8"
145	0018-0021-260	1		Angle 1/2" A4 DIN 2950
146	0018-0871-260	1		Reducing nipple 1"x1/2" - N4 DIN 2950
-	2168-8769-010	1		Hose, complete (147-150)
147	0018-1796-600	2		Hose connection R 1/2" / 12
148	0018-3816-300	2		Hose clamp 22
149	0018-0867-260	1		Reducing nipple 3/4"x1/2" - N4 DIN 2950
150	0018-2786-758	1		Hose 13
151	2168-8215-000	1		Make-up water connection
151a	0018-1676-600	1	*	Needle valve 1/2"
151b	0018-0207-260	2	*	T-Piece 3/4"x1/2"x3/4" -B1 DIN 2950
151c	0018-1409-650	1	*	Shut-off valve 3/4"
152	0001-0576-600	1		Flowmeter 2500 1/h
153	0007-2099-850	1		Gasket 5/11x4
154	0001-0304-600	1		Pressure gauge M63 - 10 bar
156	0001-0326-280	1		Thermometer (0 - 120 °C)
157	0004-5030-590	1		Gasket 21/32x2

* This part is contained in the previous "complete" part, but it can be ordered separately.

H o o d

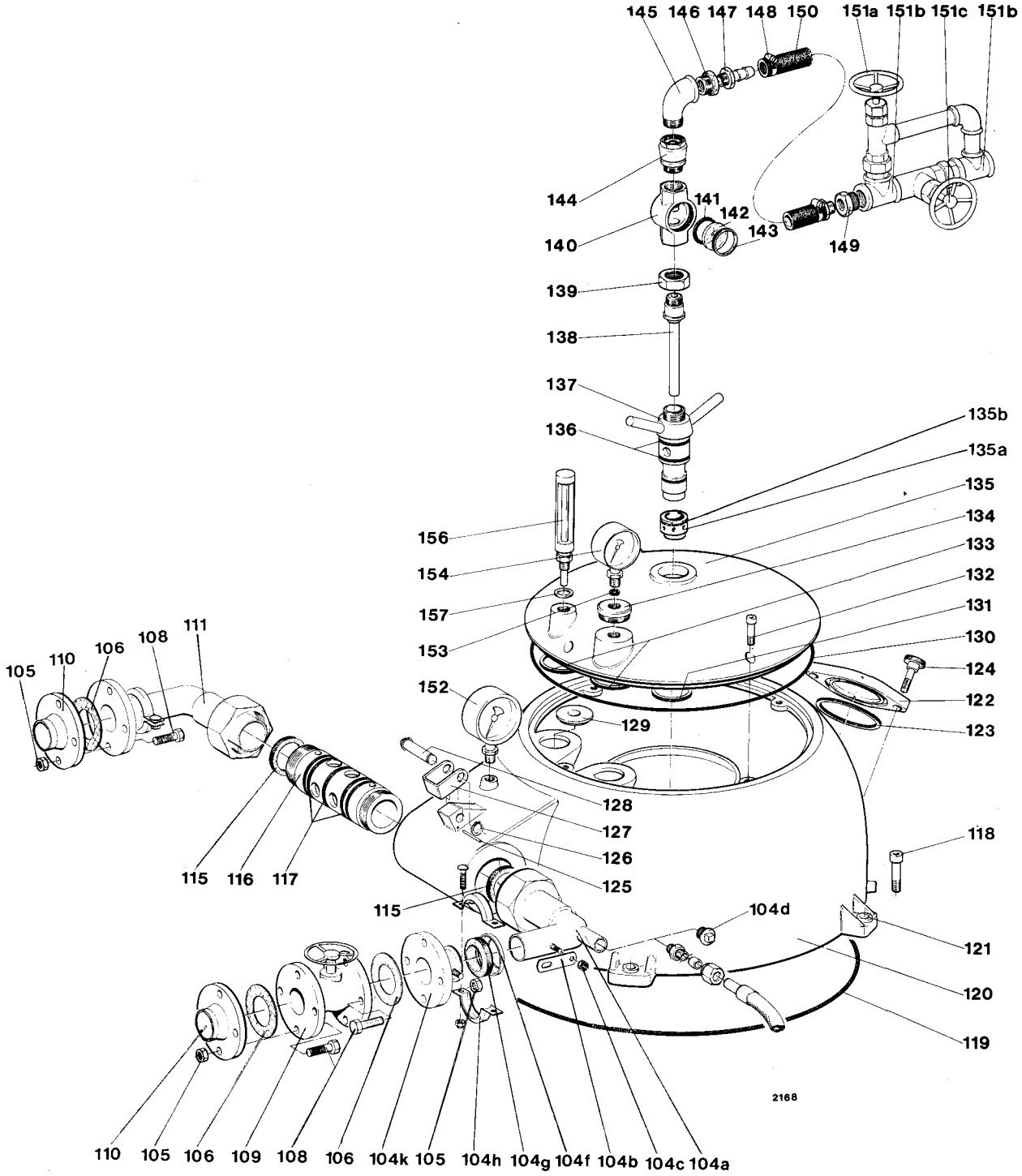

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Fig. 4/3

Vertical Gear Parts

No. in Fig.	Part - No.	Qty.		Part Description
161	0010-3003-200	1		Bottom bearing cap
162	0004-1891-740	1		Gasket 38/57x2
-	0010-3000-000	1		Bottom bearing assembly (163a-h)
163a	0010-3002-000	1		Bottom bearing threaded piece
163b	0006-4209-160	1		Cylindrical pressure spring
163c	0010-3001-200	1		Bottom bearing pressure piece
-	0010-3010-000	1		Set of bottom bearing running parts (163d-g)
163d	-	1	*	Bottom bearing pressure disc
163f	-	1	*	Ball cage
163g	-	1	*	Bottom bearing running disc
163h	0026-1473-170	1		Snap ring
164	0019-6935-150	4		Hex head screw M 10x25 DIN 933 - 8.8
165	0026-1337-190	4		Lock washer A 10 DIN 127
166	3033-1112-010	1		Bottom bearing housing
167	0004-5254-770	1		Gasket 61/102x0.3
-	2162-3429-L	1	***	Worm spindle assembly (168a-h)
168a	0011-1303-030	1		Pendulum ball bearing 1303 M/P 62 DIN 630
168b	0008-1708-000	1		Ball bearing protection ring
168c	see page 4/12	1	***	Worm spindle
168d	0011-6207-010	1		Grooved ball bearing 6207 / P62 DIN 625
168f	0008-3508-000	1		Ball bearing protection ring
168g	0006-4226-160	1		Spindle spring
168h	0008-3501-580	1		Spindle cap
-	0008-3500-230	1		Neck bearing bridge assembly (169a-s)
169a	0004-5002-770	1		Gasket 110/162x0.3
-	0008-3510-220	1		Neck bearing bridge, complete (169b-g)
169b	0008-3506-000	1		Neck bearing bridge
169c	0026-1286-110	6		Spring piston
169d	0006-4375-060	1		Set of neck bearing springs
169f	0019-1420-030	6		Threaded plug
169g	0008-3507-090	1		Pressure ring
169h	0008-3509-020	1		Distance ring
169k	0004-5002-770	1		Gasket 110/162x0.3
169m	0008-3502-070	1		Neck bearing protection cap
169n	0007-2502-750	3		Gasket 12/3
169r	0026-1371-030	3		Washer 13 DIN 125
169s	0019-6541-150	3		Hex head screw M 12x75 DIN 931 - 8.8
170	2171-1219-010	1		Operating-water feeding device

* This part is not available as separate item, but only assembled with parts 163d-g.

*** The number of this part depends on the motor speed as well as on the bowl speed stated on the name-plate of the separator (see page 4/12). In case of reduced bowl speed be sure to refer to sect. 3.1.3.
IMPORTANT: When replacing this part, be sure to replace also worm wheel 216.

Vertical Gear Parts

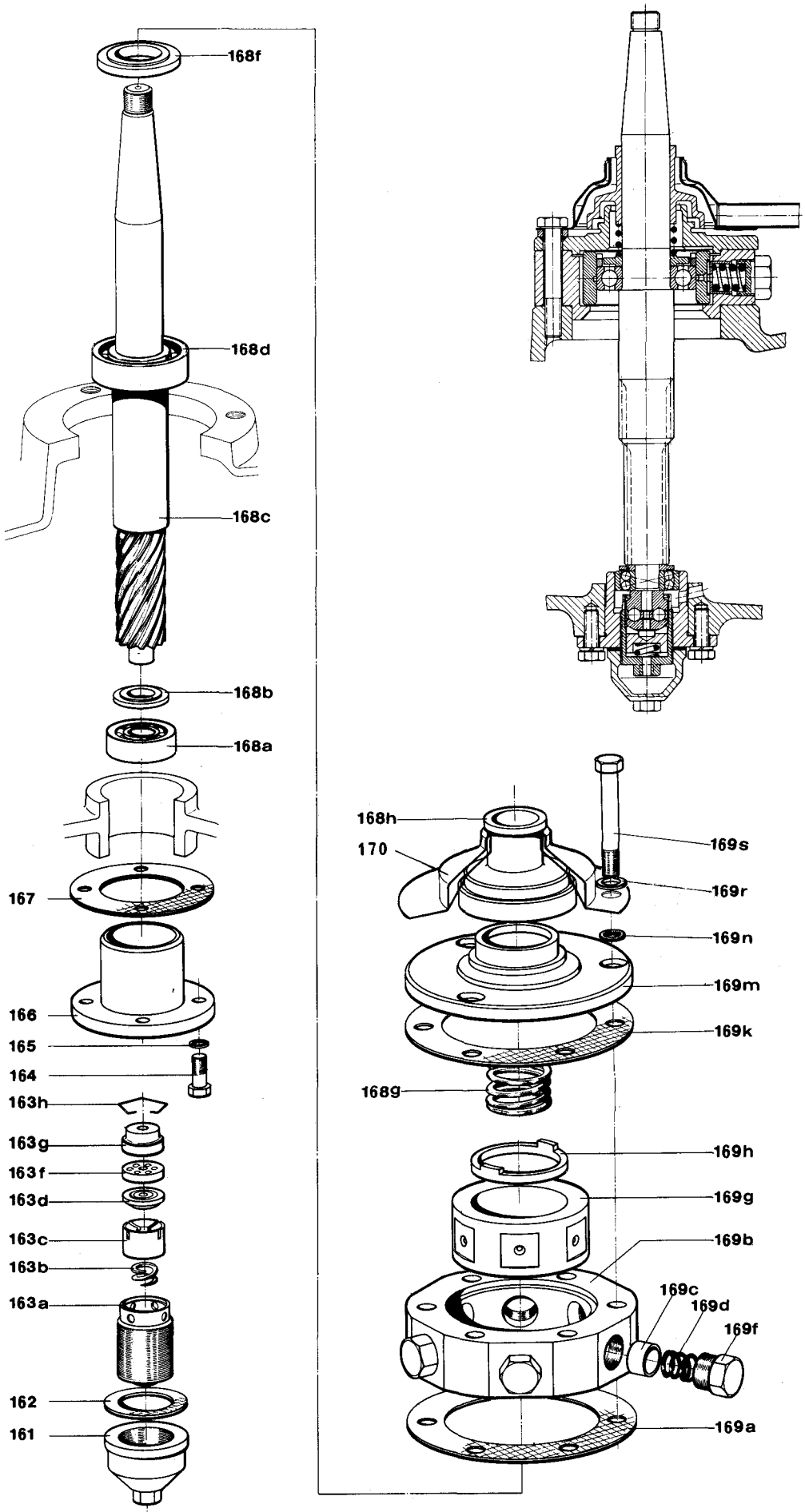

Fig. 4/4

Horizontal Gear Parts

No. in Fig.	Part - No.	Qty.		Part Description
-	3033-3385-020	1		Centrifugal clutch assembly (201-209)
201	0019-6941-150	4		Hex head screw M 10x50 DIN 933 - 8.8
202	3033-3365-000	1		Clutch drum
203	3033-3366-000	1		Ring
204	3033-3468-L	1	*	Clutch driver
205	0019-5194-150	1		Hex head screw AM 10x20 DIN 561 - 8.8
206	3033-3479-000	1		Clutch cover
207	0019-5195-150	1		Hex head screw AM 10x25 DIN 561 - 8.8
208	3033-3397-000		+)	Clutch shoe
209	0019-5194-150	1		Hex head screw AM 10x20 DIN 561 - 8.8
211	0004-1945-830	2		Felt ring 30 DIN 5419
212	0019-0717-150	3		Hex head screw M 8x22 DIN 933 - 8.8
213	3033-3376-000	1		Bearing cover
214	0004-5353-700	1		Gasket 62/100x1
215	0011-6206-000	1		Grooved ball bearing 6206 DIN 625
216	see page 4/12	1	***	Worm wheel assembly (217-223)
217		1	**	Clamp plate
218	Not available individually	1	**	Pressure ring
219		1	**	Toothed rim
220		1	**	Wheel body
221	0019-6502-150	4		Hex head screw M 8x80 DIN 931 - 8.8
222	Not available individually	1	**	Clamp plate with toothing
223	0019-6502-150	4		Hex head screw M 8x80 DIN 931 - 8.8
224	0026-1743-160	1		Key A 8x7x40 DIN 6885
225	3033-3400-010	1		Worm wheel shaft
226	0011-6206-000	1		Grooved ball bearing 6206 DIN 625
227	0013-3011-060	1		Nut M 35x1.5
228	0004-5353-700	1		Gasket 62/100x1
229	3033-3375-000	1		Bearing cover
230	0019-0717-150	3		Hex head screw M 8x22 DIN 933 - 8.8
231	0004-1943-830	2		Felt ring 28 DIN 5419

+) The number of clutch shoes (2 or 3 or 4) depends on the driving force required for the separator as well as on the motor speed.

* When ordering this part, please state also diameter of motor shaft end and width of key.

** This part is not available as separate item, but only assembled with the parts 217-223.

*** The number of this part depends on the motor speed as well as on the bowl speed as stated on the name-plate of the separator (see page 4/12). In case of reduced bowl speed be sure to refer to sect. 3.1.3.
IMPORTANT: When replacing this part, replace worm spindle 168c at the same time.

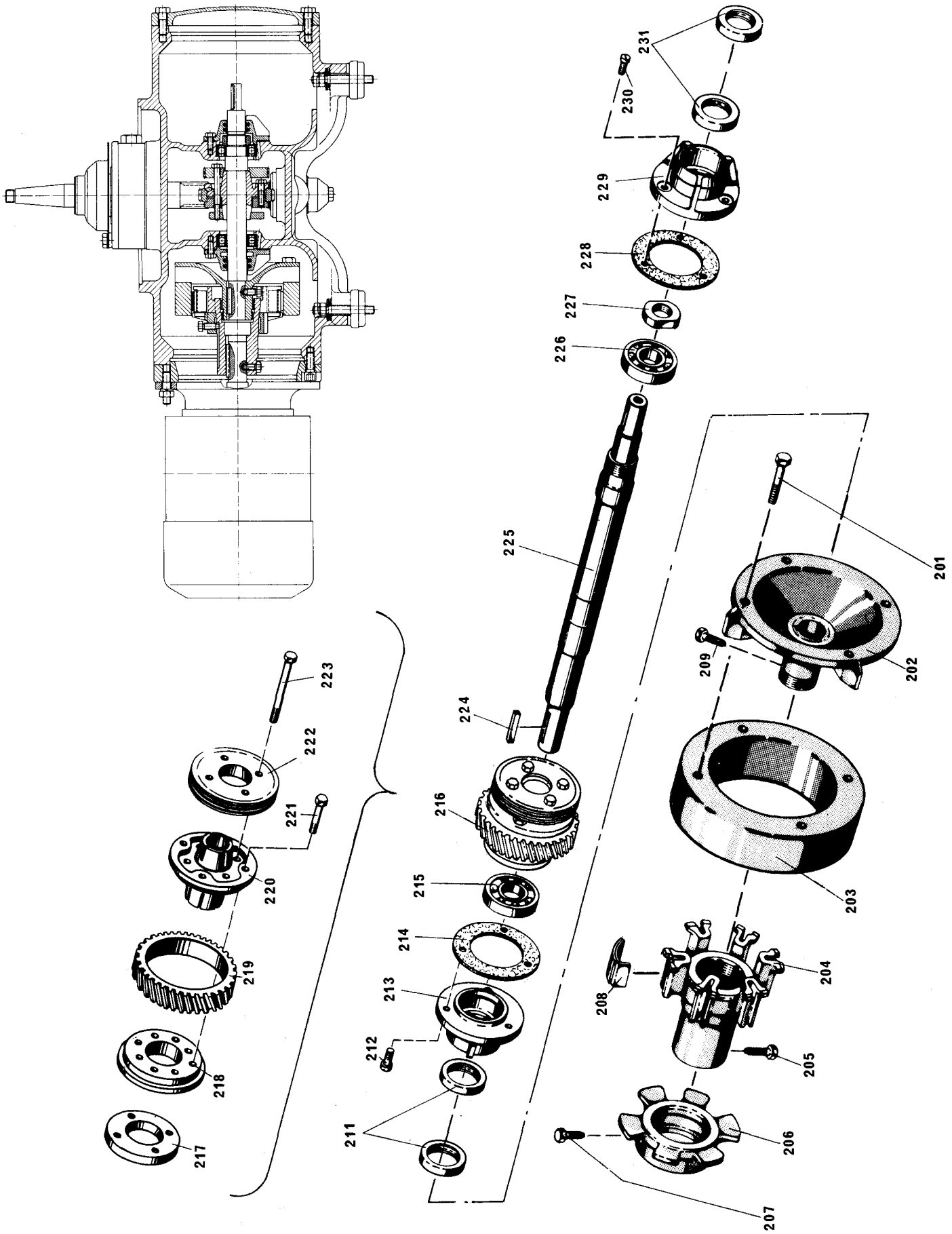
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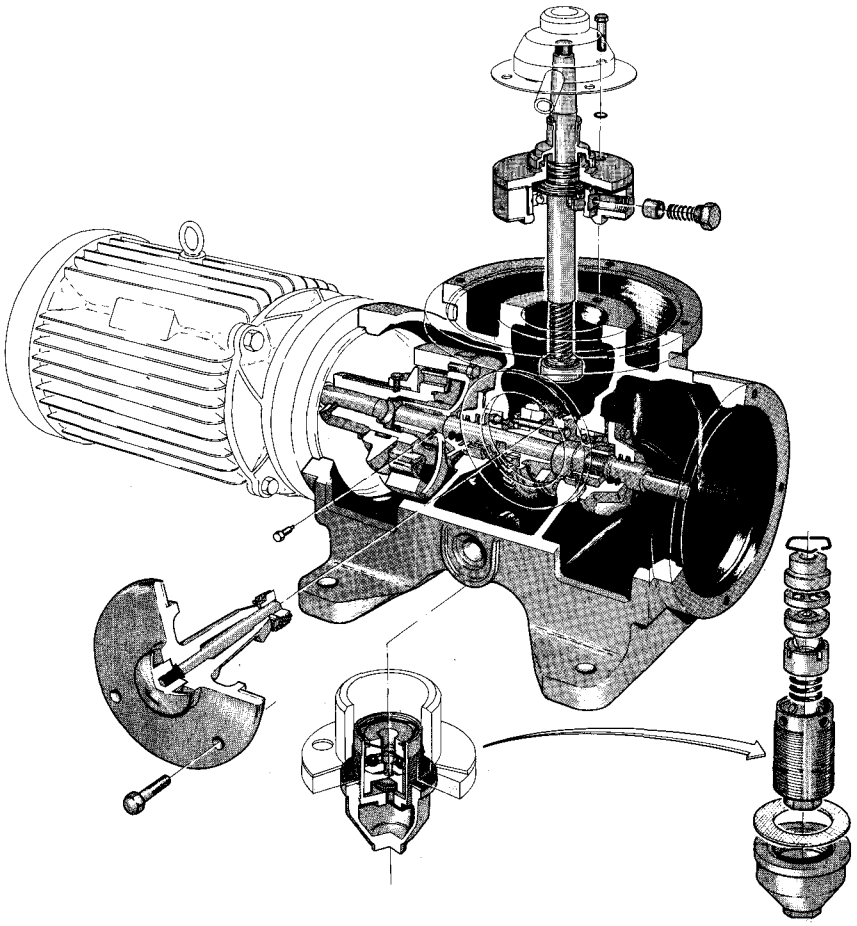
Fig. 4/5



Available Gear Parts

No. in Fig.	Fig.	Part Description	Motor speed n = 1455 rpm (50 Hz) Part - No. Bowl speed = 8520 rpm	Motor speed n = 1745 rpm (60 Hz) Part - No. Bowl speed = 8510 rpm
-	4/4	*** Worm spindle assy.	2162-3429-000	2162-3429-010
168c	4/4	*** Worm spindle	3033-3420-010	3033-3420-000
217-223	4/5	*** Worm wheel assy.	2162-3449-000	2162-3449-010
219	4/5	*** Toothed rim	3033-3443-019	3033-3443-009

*** The number of this part depends on the motor speed as well as on the bowl speed as stated on the name-plate of the separator.
In case of reduced bowl speed be sure to refer to sect. 3.1.3.
IMPORTANT: Worm spindle 168c and worm wheel assembly 217 - 223 should always be replaced at the same time (see 3.4.2.1, No. 5 and 3.4.10, No.4).

B o w l

No. in Fig.	Part - No.	Qty.		Part Description
-	2168-6600-000	1		Bowl, complete (301-326)
301	2171-6627-000	1		Threaded ring
302	2171-6425-000	1	*	Sealing chamber bottom, complete
303	0026-1106-400	1	+)	Cylindrical pin 8h8x12 DIN 7
304	0007-2421-750	1		Gasket 209/225x6
305	3205-6490-000	1		Wear liner
306	2171-6500-060	1	*	Sliding piston, complete
307	0026-1106-400	3	+)	Cylindrical pin 8h8x24 DIN 7
308	0007-2420-750	1		Gasket 242/258x6
309	0007-2855-840	1		Gasket 264x8.2
310	0007-2084-750	1		Gasket 235/7
311	3205-6604-020	1	*	Bowl bottom, complete
312	3181-6647-000	1	+)	Arresting pin
313	3205-6631-000	1	*	Bowl lock ring
314	2171-6620-000	1	*	Distributor, complete
315	0026-1610-300	1	+)	Cylindrical pin 8h8x14
316	0019-0347-400	9	+)	Countersunk screw M 4.5x8
317	0020-7406-300	3	+)	Guide rib
318	0007-2583-750	1		Gasket 100/5
319	0821-6631-030	1		Lock ring
320	2171-6691-000	1		Set of regulating rings
321	0013-3109-400	1		Spindle nut
-	2171-6660-000	1		Set of discs (322-323)
322	2171-6663-000	61		Disc
323	2171-6666-000	1		Compensating disc
324	2168-6650-000	1		Separating disc
325	2168-6611-010	1	*	Bowl top
326	0007-2057-750	1		Gasket 71/4.5
327	2171-2213-000	1		Centripetal pump

* This part can only be replaced by a WESTFALIA factory engineer or by a special repair shop authorized by WESTFALIA, because of special re-fitting to machine and possible re-balancing of bowl.

+) This part is included in the preceding "complete" part, but it is also available as separate item.

B o w l

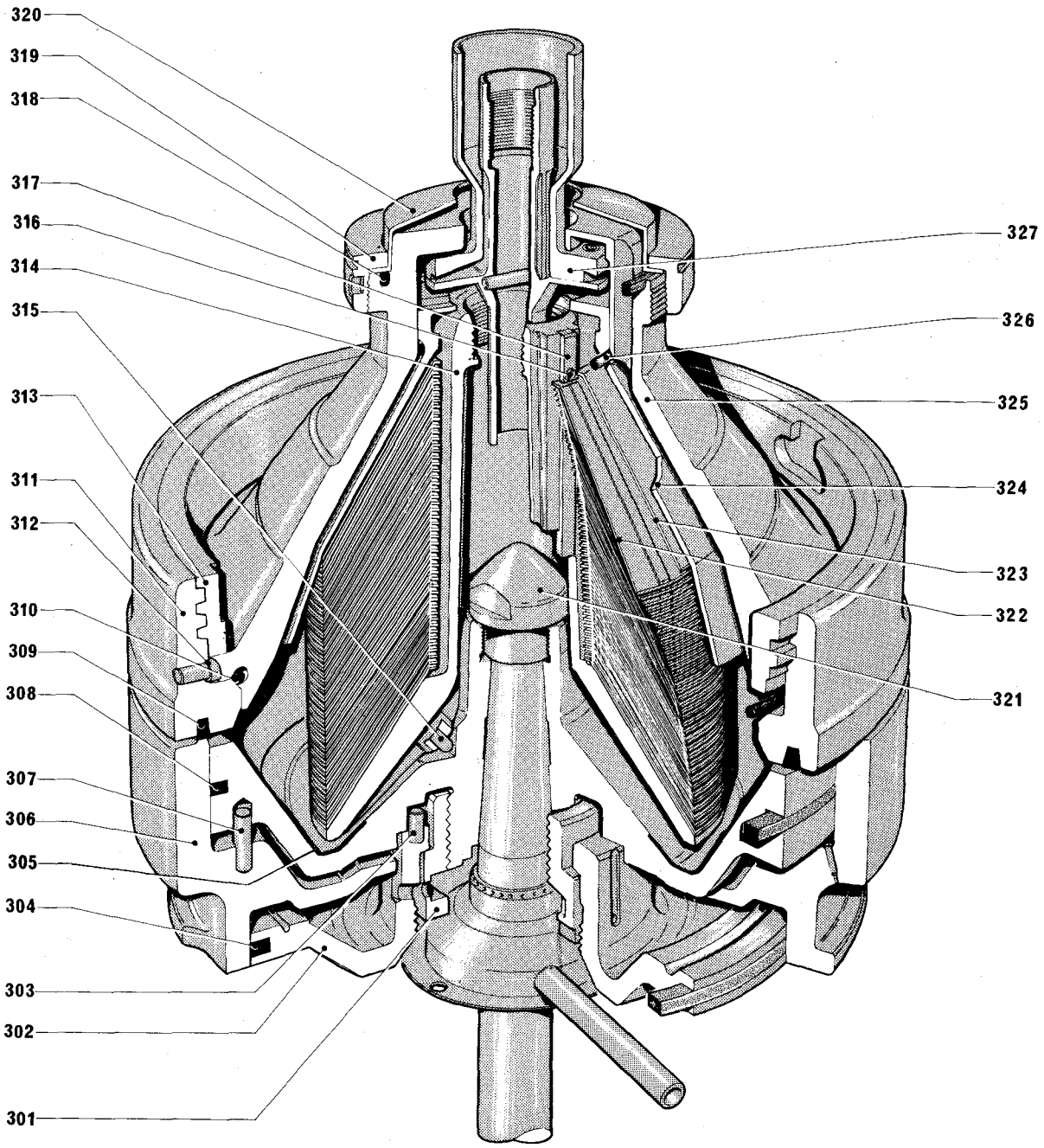

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Fig. 4/6

The pre-strainer protects the dirty-oil gear pump from coarse impurities
(On special order only)

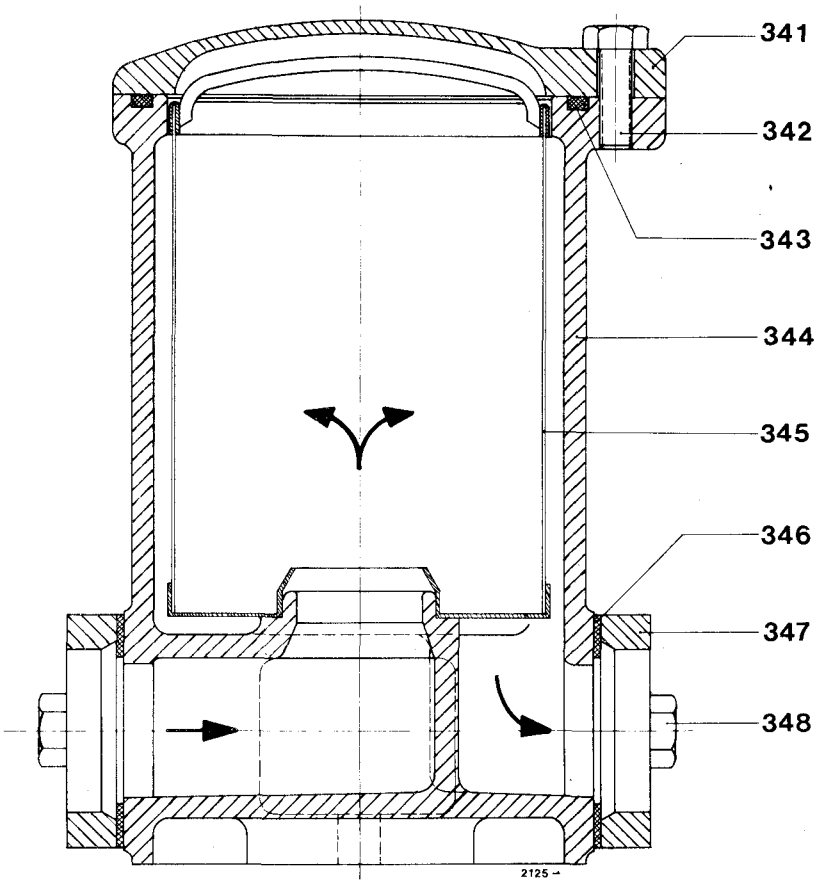

Fig. 4/7

No. in Fig.	Part - No. up to 2000 l/h NW 25	3000-4500 l/h NW 40	5000-7200 l/h NW 50	abore 10.000 l/h NW 65	Qty	Part Deseription
-	8821-2110-100	8822-2110-040	8823-2110-150	8823-2110-160	1	Pre-strainer (341-348)
341	8821-2115-010	8821-2115-010	8823-2115-030	8823-2115-030	1	Cover
342	0019-6937-150	0019-6937-150	0019-6937-150	0019-6937-150	3	Hex head screw M 10x30 DIN 933 - 8.8
343	0007-2170-750	0007-2170-750	-	-	1	Gasket 130/5
343	-	-	0007-2029-750	0007-2029-750	1	Gasket 189,3/5,7
344	8821-2114-000	8821-2114-000	8823-2114-040	8823-2114-040	1	Housing
345	8821-2119-000	8821-2119-000	8823-2119-070	8823-2119-070	1	Strainer insert
346	0004-5454-740	0004-5454-740	-	-	2	Gasket 44/70x112x2
346	-	-	0004-5460-740	0004-5460-740	2	Gasket 65/100x140x2
347	0001-0163-000	-	-	-	2	Flange 1"
347	-	0001-0146-000	-	-	2	Flange 1 1/2"
347	-	-	0001-0147-000	-	2	Flange 2"
347	-	-	-	0001-0490-000	2	Flange 2 1/2"
348	0019-6970-150	0019-6970-150	0019-6970-150	0019-6970-150	4	Hex head screw M 12x30 DIN 933 - 8.8

Single Gear Pump and Pump Connection for OSA 7-02-

No.in Fig.	Part - No.: R31/10 Fl-So-C Nominal capacity: 840 l/h	R31/20 Fl-So-C Nominal capacity: 1,650 l/h	R41/40 Fl-So-C Nominal capacity: 3,400 l/h	Qty.		Part Description
-	2168-1159-070	2168-1159-080	2168-1159-090	1		Pump connection, complete (351-369)
351	0026-1744-160	0026-1744-160	0026-1744-160	1		Key A 6x6x35
-	2161-3320-010	2161-3320-000	0822-3425-000	1		Pump coupling, complete (352-355)
352	2161-3322-010	0822-3325-000	0822-3325-000	1		Coupling pulley (separator side)
353	0021-4791-710	0021-4793-710	0021-4793-710	1		Flexible coupling
354	2160-3322-000	2161-3322-000	0822-3322-020	1		Coupling pulley (pump side)
355	0019-9063-150	-	-	1		Threaded pin M 8x10 DIN 916
355	-	0019-3982-060	-	1		Threaded pin M 10x12 DIN 438
355	-	-	0019-0421-000	1		Threaded pin 3/8"x14 DIN 437
-	2178-2805-170	2178-2805-170	2178-2805-130	1		Junction assembly (356-360.8)
356	0019-6972-150	0019-6972-150	-	2		Hex head screw M 12x40 DIN 933
356	-	-	0019-6973-150	2		Hex head screw M 12x45 DIN 933
357	0001-0135-000	0001-0135-000	-	1		Flange 1"
357	-	-	0001-0153-000	1		Flange 1 1/2"
358	0004-5447-740	0004-5447-740	-	1		Gasket 28/52x96x2
358	-	-	0004-5456-740	1		Gasket 50/74x120x2
359	0013-0280-150	0013-0280-150	0013-0280-150	2		Hexagon nut M12 DIN 934
-	2178-2832-020	2178-2832-020	2178-2832-040	1		Expansion joint, complete (360.1-360.8)
360.1	2178-2831-020	2178-2831-020	2178-2831-060	1		Expansion joint
360.2	2178-2831-030	2178-2831-030	2178-2831-070	1		Expansion joint
360.3	0018-4841-750	0018-4841-750	-	1		Gasket 20
360.3	-	-	0018-4844-750	1		Gasket 40
360.4	0018-4841-010	0018-4841-010	-	1		Gasket retainer 20
360.4	-	-	0018-4844-010	1		Gasket retainer 40
360.5	0018-4841-020	0018-4841-020	-	1		Clamp 20
360.5	-	-	0018-4844-020	1		Clamp 40
360.6	2178-1108-000	2178-1108-000	2178-1108-000	1		Plate
360.7	0013-0291-150	0013-0291-150	0013-0291-150	2		Hexagon nut M8 DIN 985
360.8	0018-0988-260	0018-0988-260	0018-0988-260	1		Plug 1/4" T9 DIN 2950
362	0019-6108-150	0019-6108-150	-	8		Allen screw M 6x20 DIN 912
362	-	-	0019-6971-150	8		Hex head screw M 12x35 DIN 933
363	0004-5472-740	0004-5472-740	-	1		Gasket 20/40x40x2
363.1	0004-5471-740	0004-5471-740	-	1		Gasket 15/35x35x2
363	-	-	0004-5475-740	2		Gasket 94x82
-	2178-2805-160	2178-2805-160	2178-2805-150	1		Expansion joint, assembly (364-369)
364	2178-2832-010	2178-2832-010	2178-2832-040	1		Expansion joint, complete
-	2178-2831-020	2178-2831-020	2178-2831-060	1		Expansion joint
-	2178-2831-010	2178-2831-010	2178-2831-070	1		Expansion joint
-	0018-4841-750	0018-4841-750	-	1		Gasket 20
-	-	-	0018-4844-750	1		Gasket 40
-	0018-4841-010	0018-4841-010	-	1		Gasket retainer 20
-	-	-	0018-4844-010	1		Gasket retainer 40
-	0018-4841-020	0018-4841-020	-	1		Clamp 20
-	-	-	0018-4844-020	1		Clamp 40
-	2178-1108-000	2178-1108-000	2178-1108-000	1		Plate
-	0013-0291-150	0013-0291-150	0013-0291-150	2		Hexagon nut M8 DIN 985
-	0018-0988-260	0018-0988-260	0018-0988-260	1		Plug 1/4" T9 DIN 2950
365	0019-6540-150	0019-6540-150	-	2		Hex head screw M 12x70 DIN 931
365	-	-	0019-6542-150	2		Hex head screw M 12x80 DIN 931
366	0004-5447-740	0004-5447-740	-	1		Gasket 28/52x96x2
366	-	-	0004-5456-740	1		Gasket 50/74x120x2
367	0001-0140-000	0001-0140-000	-	1		Flange 3/4"
367	-	-	0001-0153-000	1		Flange 1 1/2"
368	0013-0280-150	0013-0280-150	0013-0280-150	1		Hexagon nut M12 DIN 934
369	0018-1684-000	0018-1684-000	0018-1686-000	1		Pre-set valve, complete
-	8056-9110-070	-	-	1		Single gear pump assembly R31/10 Fl-So-C (371-399)
-	-	8056-9110-050	-	1		Single gear pump assembly R31/20 Fl-So-C (371-399)
-	-	-	8059-9100-120	1		Single gear pump assembly R41/40 Fl-So-C (371-399)
371	-		-	1	*	Securing ring
371		-		1	*	Securing ring 43x1,75 DIN 472
372	0004-5574-830	0004-5574-830	-	1		Sealing ring
372	-	-	0004-5539-830	1		Sealing ring 25x43x10 - Viton
373						
374	8056-9121-000	8056-9121-000	8059-9121-000	1		Set of bearing bushes (two drive bushes, three bearing bushes)
375						
-	8056-9415-030	8056-9415-020	8059-9415-050	1		Set of gear parts (376-378)
376				1		Key
377				1		Gear shaft
378				1		Drive shaft
379						
380						
381	8056-9125-000	8056-9125-000	8059-9125-000	1		Set of gaskets (379-383)
382						
383						

* Instead of part-number state number in figure (see first column).

No.in Fig.	Part - No.: R31/10 Fl-So-C Nominal capacity: 840 l/h	R31/20 Fl-So-C Nominal capacity: 1,650 l/h	R41/40 Fl-So-C Nominal capacity: 3,400 l/h	Qty.	Part Description
384				1	* Flange
385				4	* Bush
386				8	* Allen screw M 5x25 DIN 912
387				1	* Pump housing
388				1	* Cap
389				1	* Pressure-adjusting screw
390				1	* Screw plug
391				1	* Cup spring
392				1	* Pressure spring
393				1	* Valve housing
394				4	* Allen screw M 12x120 DIN 912
395				1	* Piston
396				1	* Cylindrical pin
397				1	* Valve insert
398				1	* Cover
398.1				1	* Threaded pin M 8x10 DIN 914
399				1	* Cylindrical pin M 8x20 DIN 914

* Instead of part-number state number in figure (see first column).

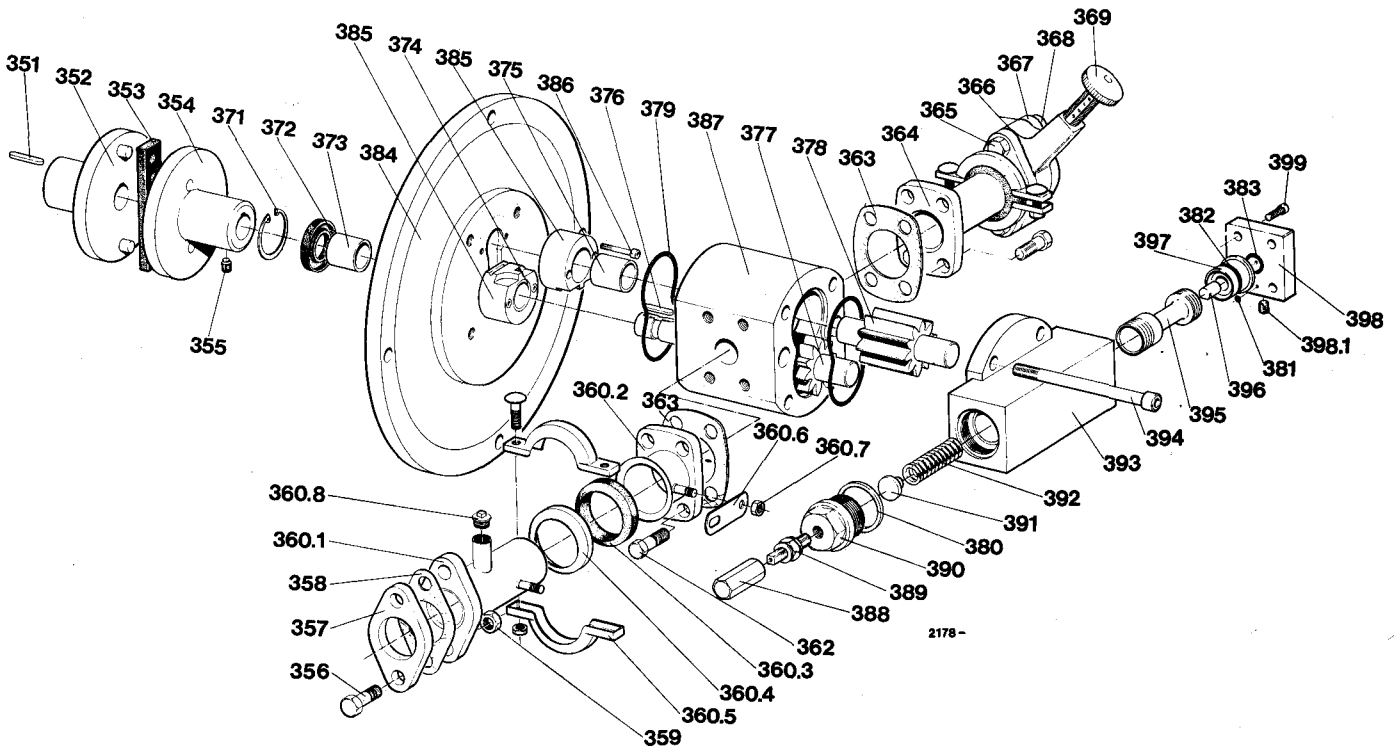

Fig. 4/8

Tools and Accessories

All the parts mentioned in the packing list furnished with the separator should be found in the packing case.

No. in Fig.	Part - No.	Qty.	Part Description
401	0003-4585-000	1	Wrench (for oil sight glass)
402	0003-3778-320	1	Allen wrench 10 DIN 911
403	2171-9942-000	1	Ring (for sliding piston)
404	0003-3340-000	1	Wrench (for centripetal pump)
405	0003-3403-170	1	Lifting tongs (for bowl top)
406	3033-9910-000	1	Puller (for clutch)
409	0003-4211-320	1	Double-ended wrench 27x32 DIN 3110
410	0003-4222-320	1	Double-ended wrench 36x41 DIN 3110
411	2168-9930-000	1	Jack (for bowl bottom)
412	2171-9855-000	1	Wrench (for threaded ring in bowl bottom)
413	0003-0354-000	1	Annular wrench (for bowl lock ring)
414	0003-0200-000	1	Mallet
415	0003-0211-950	1	Scraper 70
416	0003-0210-950	1	Scraper 25
417	0003-4695-960	1	Brush 70x100x500
418	0003-4540-960	1	Cylindrical brush 10x40x160
419	0003-4690-960	1	Brush 35x125x285
422	0003-3685-000	1	Hook wrench 94/132
423	2171-9800-000	1	Jack (for sealing-chamber bottom)
424	0003-0216-000	1	Chisel 4x330
425	0003-0277-800	1	Oil cup (2.7 litres)
426	0015-0103-000	1	Tube of Molykote paste DX white, 50 grams
-	0015-0003-080	1	2.5-litre can of separator lubricating oil C 100

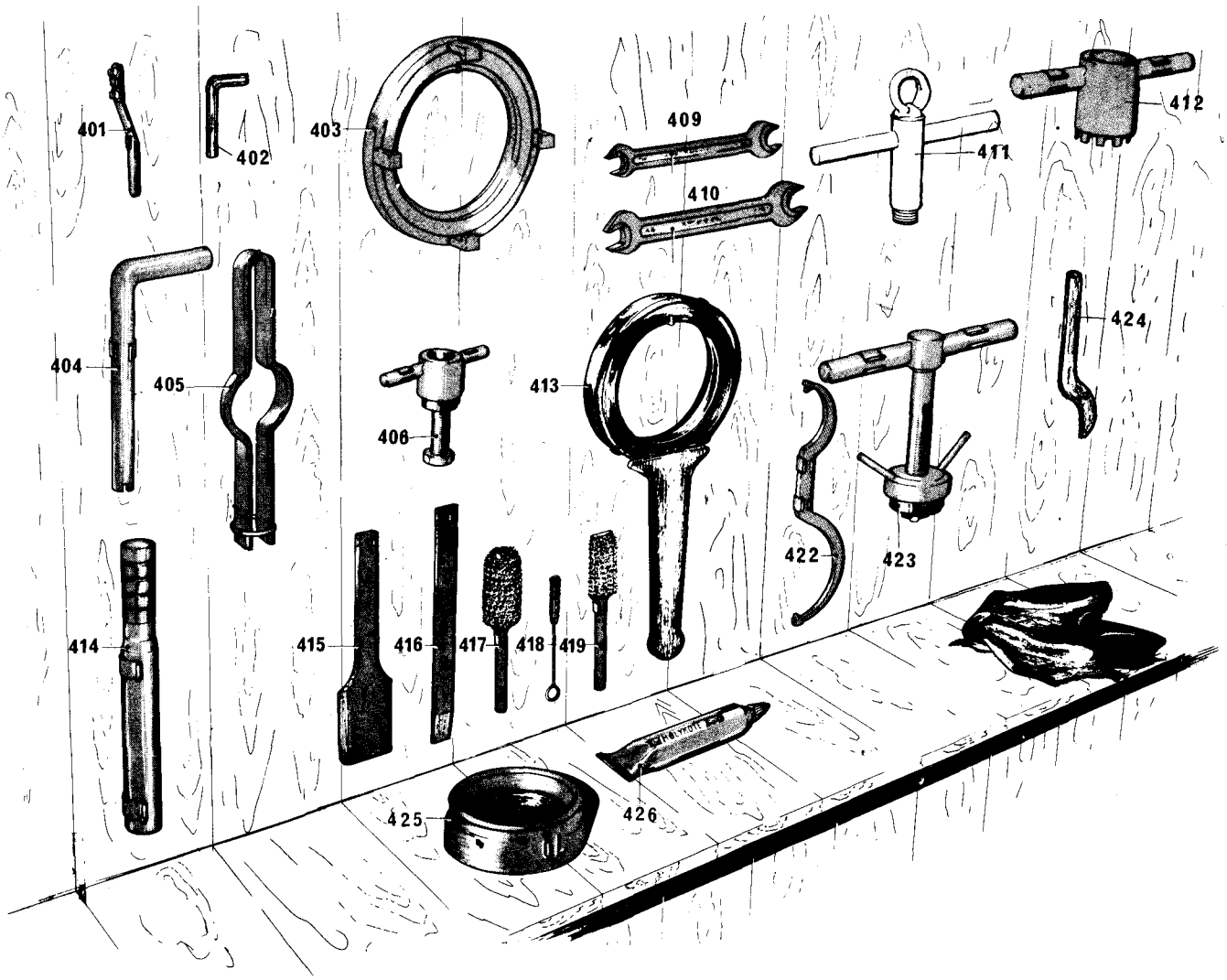
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Fig. 4/9

Trommel-Feststoffräume, Motordaten, Zahnradpumpen, Nennweiten und Gewichte
Bowl Sludge Spaces, Motor Data, Gear Pumps, Nominal Pipe Width and Weights

Separator Typ / Model	Trommel / Bowl	Feststoffraum der Trommel / Sludge Space of Bowl	erforderlicher Antriebsmotor / Driving Motor: Bauart: B 5, Drehzahl (min⁻¹): 1455 oder 1745 / Type: B 5, Speed (rpm): 1455 or 1745 — Leistung / Motor Power			Zur Verfügung stehende Zahnradpumpen / Gear Pumps Available: klein / small; groß / large — Förderleistung ⑥ bei Motor-Drehzahl (min⁻¹) / Pump Capacities at rpm of motor				Nennweiten / Nominal Pipe Width		Netto-Gewichte / Net-Weights									
			Separator ohne Pumpe / Separator without Pump	Separator mit kl. Pumpe / Separator with Small Pump	Separator mit gr. Pumpe / Separator with Large Pump	klein / small: 1455 50 Hz 50 cycles	klein / small: 1745 60 Hz 60 cycles	groß / large: 1455 50 Hz 50 cycles	groß / large: 1745 60 Hz 60 cycles	Vorsieb / Pre-Strainer: klein / small; groß / large	Dreiwege-Ventil / Three-way Valve: klein / small; groß / large	Separator ohne Pumpe, ohne Motor / Separator without Pump and Motor	Reservetrommel / Stand-by Bowl	Einzelpumpe / Single Pump: klein / small	Doppelpumpe / Double Pump: klein / small	Einzelpumpe / Single Pump: groß / large	Doppelpumpe / Double Pump: groß / large	Vorsieb / Pre-Strainer: klein / small; groß / large	Dreiwege-Ventil / Three-Way Valve: klein / small; groß / large	Trommelheber / Bowl Lifter	Motor für Separator m. gr. Pumpe / Motor for Separator with Large Pump — Drehstrom / Threephase Current 3 ~
		l	kW	kW	kW	l/h	l/h	l/h	l/h	NW	NW	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg
OTB 2-00-066	nicht selbstentleerend / Manual Cleaning Type	0,8	0,55	0,75	0,75	420	500	900	1080	25	25	82	16	10	16	11	17	8	10	–	12
OTA 7-00-066		1,5	1,5	1,8	2,2	1500	1800	3000	3600	25 40	25	180	31	20	32	28	43	8 10	10	–	22
OTA 14-00-066		3,2	2,2	3	3,3	3000	3600	5000	6000	40 50	25 40	300	80	28	43	33	50	10 26	10 18	18	42
OTA 18-00-066		5,5	4,5	5,5	6	5000	6000	10000	12000	50 65	40 50	500	125	33	50	46	76	26	18 21	45	66
OTB 35-02-066 Ausf./design 35		7,4	11	11	15	3300	4000	10000	12500	40 65	40 50	690	148	14	–	20	–	10 26	18 21	–	92
			15	15	18,5	5200	6300	13000	16000	50 80	50 65			15		20		26 51	21 30		110
OTB 35-02-066 Ausf./design 40		7,4	11	11	15	4000	5000	10000	12500	50 65	40 50	700	155	15	–	20	–	26 26	18 21	–	92
			15	15	18,5	6600	8000	16500	20000	65 80	50 65			18		34		26 51	21 30		110
OSA 7-02-066 Ausf./design 5	selbstentleerend / Self-Cleaning Type	1,5	3	3,7	3,7	520	630	1300	1600	25 25	25	295	52	7	–	8	–	8	10	–	42
						820	1000	2000	2500	25 25				7		12					
OSA 7-02-066 Ausf./design 7		1,5	3	3,7	3,7	650	800	1650	2000	25 25	25	300	55	7	–	8	–	8 8	10	–	42
						1000	1250	2600	–	25 40				8		12		10			
OSA 20-02-066 Ausf./design 14		4,2	8,5	8,5	8,5	1300	1600	4000	5000	25 50	25 40	920	158	11	–	14	–	8 26	10 18	–	92
						2000	2500	6600	8000	40 65	25 50			14		18		10 26	10 21		
OSA 20-02-066 Ausf./design 20		4,2	8,5	8,5	8,5	1650	2000	5200	6300	25 50	25 40	925	163	11	–	15	–	8 26	10 18	–	92
						2600	3150	8000	–	40 65	25 50			14		18		10 26	10 21		
OSA 35-02-066 Ausf./design 30		11	13,5	15	15	2600	3150	8000	10000	40 65	25 50	1080	320	14	–	18	–	10 26	10 18	–	92
					18,5	6600	8000	13000	16000	65 80	50 65			18		20		26 51	21 30		110
OSA 35-02-066 Ausf./design 35		11	13,5	15	15	3300	4000	10000	12500	40 65	25 50	1090	330	14	–	20	–	10 26	10 18	–	92
					18,5	8000	10000	16500	20000	65 80	50 65			18		34		26 51	21 30		110
OSA 35-02-066 Ausf./design 40		11	13,5	15	15	4000	5000	13000	16000	50 80	40 65	1100	340	15	–	20	–	26 51	18 30	–	92
					18,5	10000	12500	20500	–	65 80	50 65			20		34		26 51	21 30		110

⑥ Die Pumpenleistungen beziehen sich auf die Förderung von Öl mit der Viskosität 40 – 80 cSt im Betriebszustand. Leistungstoleranz ± 5%.
Bei abweichenden Viskositäten gelten die Förderstromtoleranzen nach VDMA 24284, Gruppe II.

⑥ The pump capacities refer to oils with viscosities of 40 – 80 cSt in working condition. Capacity tolerances: ± 5%.
For viscosities differing from the a/m values refer to the flow tolerances specified according to VDMA 24284, group II.

Optimalleistungen von Mineralöl-Separatoren in Großkraftanlagen
Optimum Capacities of Mineral Oil Separators in High-Power Plants

WESTFALIA SEPARATOR

Abteilung BT 1205
Mineralöltechnik

Engineering Dept. BT 1205
Mineral Oil Technique

	Dieselöl ⑤ Diesel Oil		Schweröl Heavy Fuel Oil								Schmieröl ③ Lubricating Oil			Turbinenöl Turbine Oil
	MDO	MDO	IF 30	IF 80	IF 180	IF 380	IF 420	IF 460	IF 500	IF 600	unlegiert Premium Oil	mild legiert mild alkaline	legiert (HD) Detergent Oil	
	7,5 cSt/ 40°C	12 cSt/ 40°C	30 cSt/ 50°C	80 cSt/ 50°C	180 cSt/ 50°C	380 cSt/ 50°C	420 cSt/ 50°C	460 cSt/ 50°C	500 cSt/ 50°C	600 cSt/ 50°C	100–120 cSt/ 40°C			65 cSt/ 40°C
	45 sRI/ 100°F	65 sRI/ 100°F	200 sRI/ 100°F	610 sRI/ 100°F	1500 sRI/ 100°F	3500 sRI/ 100°F	4000 sRI/ 100°F	4500 sRI/ 100°F	5000 sRI/ 100°F	5900 sRI/ 100°F	450–600 sRI/ 100°F			300 sRI/ 100°F
Separierungstemperatur ① Separating Temperature	20°C 68°F	35–50°C 95–122°F	65°C 149°F	80°C 176°F	90°C 194°F	95°C 203°F	98°C 208°F	98°C 208°F	98°C 208°F	98°C 208°F	80°C 176°F			75°C 168°F

Separator Typ Modell	Trommel Bowl	Nennleistung Rated Capacity ②	Einstufen-Separierung ④ Single-Stage Separation												
		l/h	l/h	l/h	l/h	l/h	l/h	l/h	l/h	l/h	l/h	l/h	l/h	l/h	l/h
OTB 2-00-066	nicht selbstentleerend Manual Cleaning Type	1320	1100	860	860	660	–	–	–	–	–	–	770	400	270	940
OTA 7-00-066		3400	2900	2200	2200	1800	1400	1100	950	850	750	680	2000	1000	700	2400
OTA 14-00-066		6600	5600	4300	4300	3600	2700	2050	1800	1650	1450	1300	3900	2000	1400	4600
OTA 18-00-066		8400	7100	5500	5500	4500	3500	2600	2300	2100	1800	1600	5000	2500	1700	6000
OTB 35-02-066 Ausführung/design 35		17200	14600	11200	11200	9400	7000	5400	4700	4300	3800	3400	10200	5200	3700	12000
OTB 35-02-066 Ausführung/design 40		21000	17800	13700	13700	11500	8500	6600	5750	5250	4650	4150	12500	6350	4500	14600
OSA 7-02-066 Ausführung/design 5	selbstentleerend Self-Cleaning Type	2700	2300	1800	1800	1500	1100	850	750	670	590	540	1600	800	580	1900
OSA 7-02-066 Ausführung/design 7		3700	3100	2400	2400	2000	1500	1150	1000	920	810	740	2200	1100	780	2600
OSA 20-02-066 Ausführung/design 14		7400	6300	4800	4800	4000	3000	2300	2000	1800	1600	1500	4400	2200	1550	5200
OSA 20-02-066 Ausführung/design 20		10000	8500	6600	6600	5600	4200	3200	2800	2500	2200	2000	6000	3000	2200	7000
OSA 35-02-066 Ausf./design 30		15000	13000	10000	10000	8300	6300	4700	4200	3700	3300	3000	9000	4500	3100	10500
OSA 35-02-066 Ausführung/design 35		19000	16000	12300	12300	10500	7900	6000	5300	4700	4200	3800	11400	5700	4200	13300
OSA 35-02-066 Ausführung/design 40		23000	20000	15000	15000	12600	9600	7300	6400	5700	5000	4600	13800	6900	5000	16100

Bei ϱ Öl 15° C > 0,991 bis 1,05 ist das Zusatzwasser mit $MgSO_4$-Zusatz zu beschweren.
Bei ϱ Öl 15° C > 1,05 sind die Separatoren mit innenliegenden Steigekanälen auszurüsten.
Die Leistungen reduzieren sich dann auf etwa 70% der in der Tabelle angegebenen Leistungen.

When the specific gravity of the oil at 15° C is in the range of 0.991 to 1.05, the make-up-water has to be weighted by addition of $MgSO_4$.
When the specific gravity of the oil at 15° C exceeds 1.05, disc sets with inner rising channels have to be used. In such a case, the capacities will drop to about 70% of those stated in the table above.

① Bei einer anderen Separierungstemperatur ändert sich die in der Tabelle angegebene Optimalleistung entsprechend der Separierungsviskosität etwa nach der Beziehung:

$$L_2 \approx L_1 \cdot \frac{\upsilon_1}{\upsilon_2} \text{ [l/h]}$$

L = Separatorenleistung [l/h]
υ = kinematische Viskosität des Öles [cSt]
(die geänderten Werte erhalten Index 2)

① At a different separating temperature the optimum capacities indicated in the table above will vary with the viscosity and can be calculated by the following formula:

$$L_2 \approx L_1 \cdot \frac{\upsilon_1}{\upsilon_2} \text{ [l/h]}$$

L = capacity of separator [l/h]
υ = kinematic viscosity of the oil [cSt]
(the modified data bear subscript 2)

② Nennleistung = max. effektive Leistung bei unlegiertem Öl und einer Separierungsviskosität <12 cSt, sofern das Öl nicht zur Emulsionsbildung neigt.

② Rated capacity = maximum effective capacity when treating oil without additives and with a viscosity at separating temperature lower than 12 cSt provided that the oil does not tend to emulsify.

③ Die angegebenen Leistungen gelten für die kontinuierliche Reinigung im Nebenstrom. Bei periodischer Reinigung sind die Werte um ca. ⅓ zu reduzieren.

③ The capacities stated apply to continuous cleaning of the product in the by-pass. Batch operation yields capacities which have to be reduced by about one third.

④ Die für HFO angegebenen Durchsatzleistungen gelten für die einstufige Separierung. Bei der zweistufigen Separierung, d.h. Serienschaltung von Trenn-Separator und nachgeschaltetem Klär-Separator gleichen Typs können die angegebenen Leistungen um etwa ⅓ erhöht werden. Falls im bestimmten Anwendungsfall Vorschriften – z.B. des Dieselmotorherstellers – bestehen, sind diese zu erfüllen.

④ The capacities stated for HFO operation apply to single-stage separation. With two-stage separation, i.e. when a purifier and a clarifier operate in series, the capacities stated can be increased by about one third. Regulations, e.g. of the diesel engine manufacturer, for a specific application have however to be fulfilled.

⑤ Bei stark schäumendem Dieselöl sollte die Leistung um 20% reduziert werden!

⑤ With heavily foaming Diesel oils the capacity should be reduced by 20%!

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