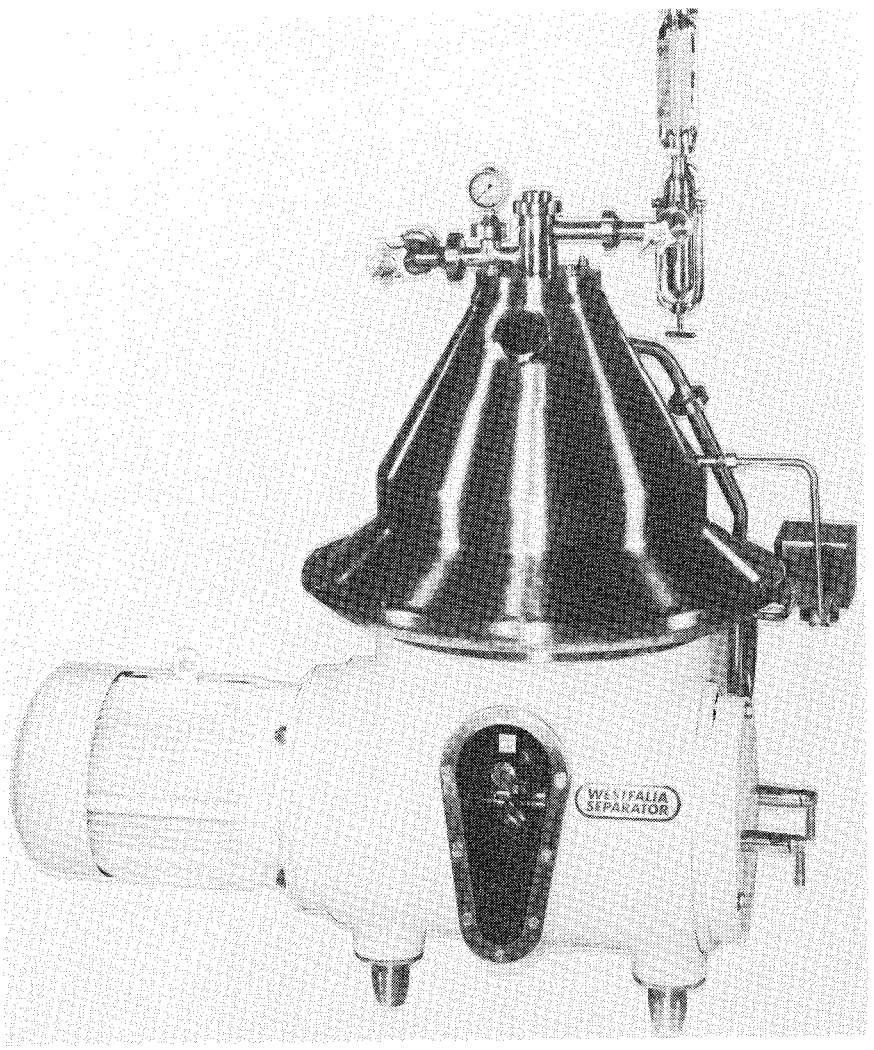
WESTFALIA SEPARATOR

Skimming Separator
with self-cleaning bowl

Model MSD 50-01-076



CONTENTS

		Page
Safety hints		0/2
Sectional view of the separator		0/15
Dimensioned drawing		0/16

Operating Instructions

1 Installation

1.1	Transport	1/1
1.2	Installation	1/2
1.2.1	Foundation and frame	1/2

2 Lubrication

2.1	Lubrication of bearings and gear parts	2/1
2.1.1	Lubricating oil	2/1
2.1.2	Oil filling, oil level	2/1
2.1.3	Oil check	2/1
2.1.4	Oil change	2/2
2.2	Lubrication of threads and contact surfaces on bowl parts	2/2
2.3	Lubrication of the motor bearings	2/2

3 Motor connection

3.1	Three-phase AC motor, 7.5 kW	3/1
3.2	Direction of rotation of the bowl	3/1
3.3	Speed and starting time of the bowl	3/1

4 Bowl, feed and discharge connections

4.1	Assembling the bowl	4/3
4.2	Assembling the feed and discharge connections	4/8
4.3	Removing the feed and discharge connections	4/10
4.4	Dismantling the bowl	4/12

5 Technical information

5.1	Application	5/1
5.2	Operating principles of the bowl	5/1
5.3	Operating principles of the bowl hydraulic system	5/2
5.3.1	Closing the bowl	5/2
5.3.2	Opening the bowl (de-sludging)	5/2
5.4	Timing unit	5/3
5.5	Operating water connection	5/3
5.5.1	Arrangement of the solenoid valves, manual control of the separator	5/4
5.5.2	Solenoid valves	5/5
5.5.2.1	Operating principles	5/5
5.5.2.2	Maintenance	5/6
5.5.2.3	Locating electric troubles	5/6
5.5.2.4	Technical data	5/6

		Page
6	**Operation**	
6.1	Before start-up	6/1
6.2	Starting the separator	6/2
6.3	The separator in operation	6/3
6.4	De-sludging of the bowl:	
6.4.1	General	6/4
6.4.2	Partial de-sludging	6/4
6.4.3	Program sequence	6/5
6.4.4	Total de-sludging	6/6
6.4.5	Manually initiated bowl de-sludgings	6/6
6.5	Stopping the separator	6/7
7	**Cleaning**	
7.1	Cleaning-in-place	7/1
7.2	Cleaning the bowl	7/1
7.3	Cleaning the upper section of the frame	7/2
7.4	Cleaning the operating-water feeding system	7/2
7.5	Cleaning the gear chamber	7/2
7.6	Cleaning prior to a long-term shut-down of the separator	7/2
8	**The gear**	
8.1	Dismantling the vertical gear parts	8/1
8.2	Assembling the vertical gear parts	8/2
8.2.1	Assembling the bottom bearing	8/2
8.2.2	Assembling the neck bearing bridge	8/3
8.3	Bowl height:	
8.3.1	Checking the bowl height	8/4
8.3.2	Re-adjusting the bowl height	8/5
8.4	The centrifugal clutch:	
8.4.1	General	8/6
8.4.2	Removing the clutch shoes	8/6
8.4.3	Installing the clutch shoes	8/7
8.4.4	Removing the clutch drum	8/8
8.4.5	Installing the clutch drum	8/9
8.5	Removal of the horizontal gear parts:	
8.5.1	Removing the motor	8/9
8.5.2	Removing the worm wheel shaft and worm wheel	8/10
8.5.3	Removing the ball bearing on the motor side	8/11
8.5.4	Removing the ball bearing on the brake side	8/11
8.6	Installing the horizontal gear parts	8/12
10	**Trouble shooting**	
10.1	General	10/1
10.2	Bowl performance	10/4
11	**Lubrication and maintenance schedule**	11/1

List of Parts

	Page
Important hints for ordering parts	12/1
Frame	13/1
Brake	13/3
Intermediate flange	13/4
Foot	13/5
Foundation frame	13/6
Vertical gear parts	14/1
Bottom bearing	14/3
Worm spindle	14/4
Tachometer drive and tachometer	14/5
Neck bearing bridge	14/6
Horizontal gear parts	15/1
Worm wheel	15/3
Centrifugal clutch	15/4
Eupex coupling	15/4
Operating-water connection	17/1
Solenoid valve	17/2
Hood	17/3
Feed and discharge connections	18/1
Valve (cream discharge)	18/2
Valve (skim milk discharge)	18/3
Flowmeter (cream discharge)	18/4
Double centripetal pump	18/6
Flowmeter (feed)	18/7
Standardizing device	18/9
Clarifying device	18/10
Flowmeter (standardizing device)	18/11
Bowl	19/1
Tools	20/1
Accessories	20/3
Sterilizing tank	21/1
Flow constrictor	22/1
Important hints - Flow constrictor	22/2
Installation plan of the flow constrictor	22/3

Basic operating principles

Separators are used for the separation of liquid mixtures or for the separation of solids out of liquids or liquid mixtures.

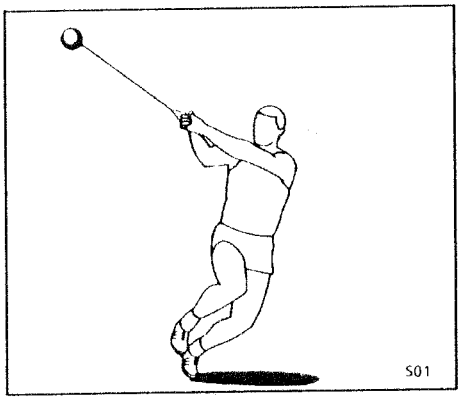


Fig. 1

High centrifugal forces are produced in the rotating bowl.

Under the influence of the centrifugal forces, separation of the liquid mixture and/or ejection of the solids particles takes place most rapidly.

The specifically heavier components are displaced to the bowl periphery, whereas the specifically lighter components are displaced towards the centre of the bowl.

The high centrifugal force is produced by very high bowl speeds. On the one hand, high bowl speeds signify high efficiency, while on the other hand, they signify high material stressing of the separator.

Bowl speed and product

The bowl speed is an important parameter when rating the separator. It depends on the chemical and physical properties of the product such as

- temperature (if higher than 100°C or lower than 0°C),
- density of the fluid and solid components
- aggressiveness of the product as regards corrosion and erosion (has influence on the selection of the bowl material)

The bowl speed is determined on the basis of these parameters allowing for an adequate safety margin.

If one of these parameters should change during operation, it is imperative to contact Westfalia Separator AG.

Operations on the separator

The separator works reliably, provided that it is operated and looked after in accordance with our operating Instructions.

Special attention must be given to:

- assembly
- starting
- shutting-down
- maintenance and servicing

Assembly

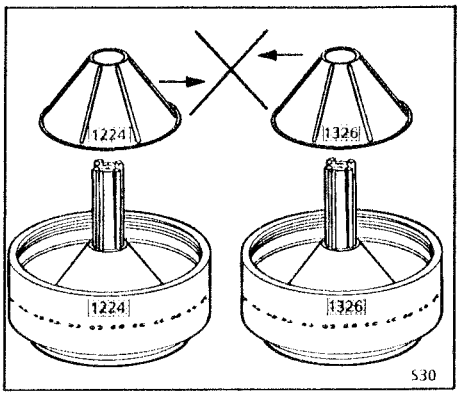


Fig. 2

If the plant has several centrifuges, be careful not to interchange parts of different bowls since each bowl has been balanced individually.

The bowl parts are marked with the serial-number of the machine or with the last three digits of the serial-number.

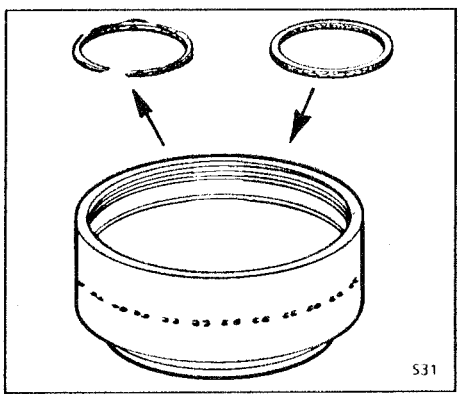


Fig. 3

Damaged parts must be replaced immediately by practically new ones.

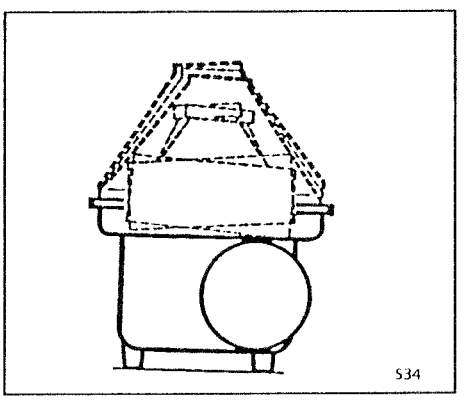


Fig. 4

After installing spare bowl parts, the bowl must be re-balanced.

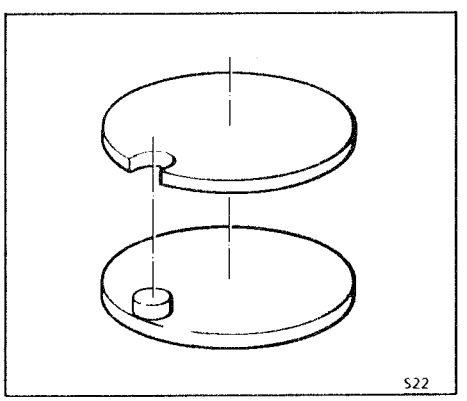


Fig. 5

The bowl parts are arranged in fixed positions relative to one another.

Locking devices and alignment marks must be in perfect condition.

The bowl must not be operated if these locking devices and alignment marks are not in perfect condition.

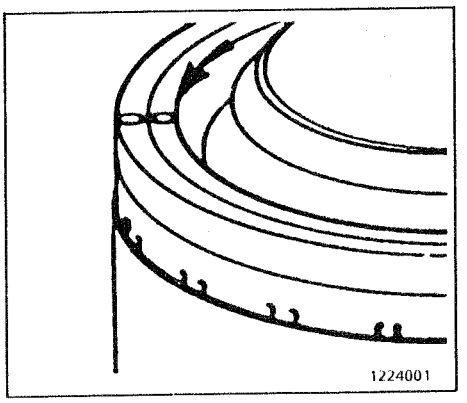


Fig. 6

When assembling the bowl, be sure to strictly adhere to the instructions given in chapter 4, in order to avoid undue unbalance.

Before starting the bowl, be sure to fit all parts.

Tighten the bowl lock ring securely: the O marks on the bowl bottom or bowl top and on the lock ring must be in line with each other.

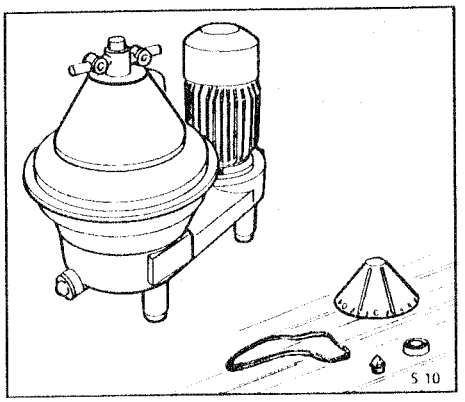


Fig. 7

Check if the machine is completely assembled and properly installed.

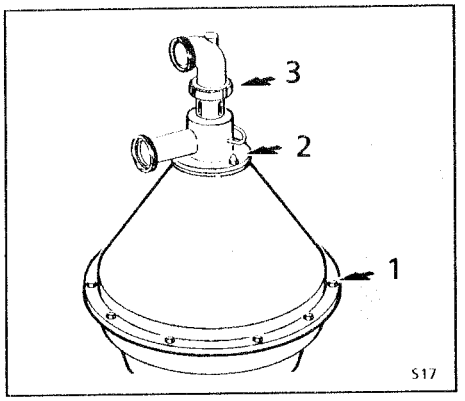


Fig. 8

Carefully fasten hood 1, feed and discharge housing 2 and centripetal pump 3.

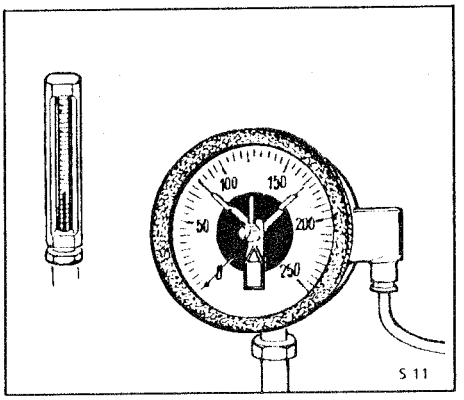


Fig. 9

Check whether the supervisory equipment is operational and the correct limit values are adjusted.

When hoods, concentrate collectors and vessels are pressurized, e.g. by
- inert gas,
- cooling,
- steam sterilization etc.

the pressures stated on the name-plate must not be exceeded.

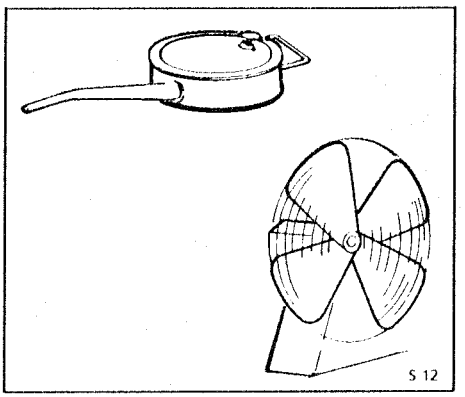


Fig. 10

Check that the lubrication and cooling systems are serviceable.

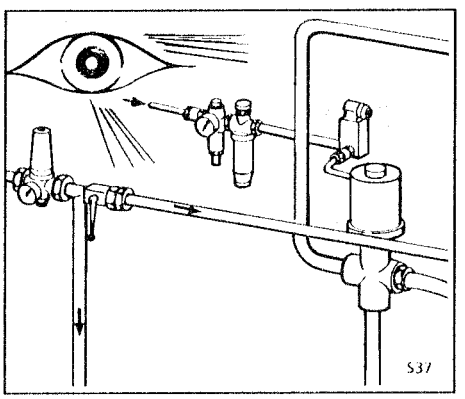


Fig. 11

Check that the product lines are set to operation.

Electrical appliances

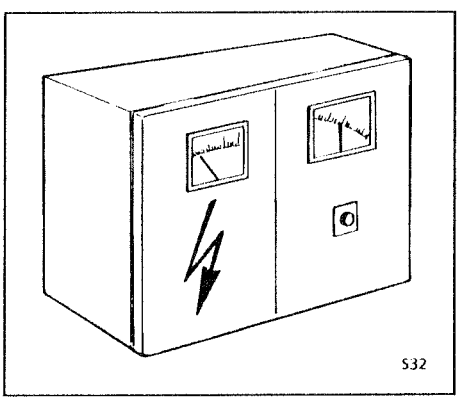


Fig. 12

The governing accident prevention regulations apply for the electrical appliances and installations.

Before start-up

Before initial starting special attention must be given to the following:

- Frequency and voltage of power supply must comply with the machine specifications.
- The bowl must rotate in clockwise direction (see arrow on frame and hood).
- The bowl speed must correspond with the value stated on the name-plate of the machine.

Starting

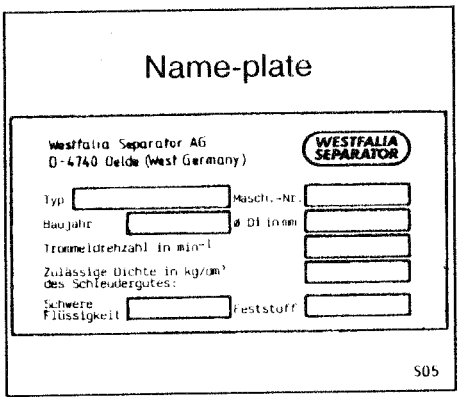


Fig. 13

- Refer to chapter 6.
- Feed only product which conforms to the specifications on the name-plate of the machine.
- Check that the correct operating speed is reached and maintained.

Fig. 14

- Do not feed product which is subjected to explosion protection regulations.
- The separator must not be used in areas where explosion protection is required.

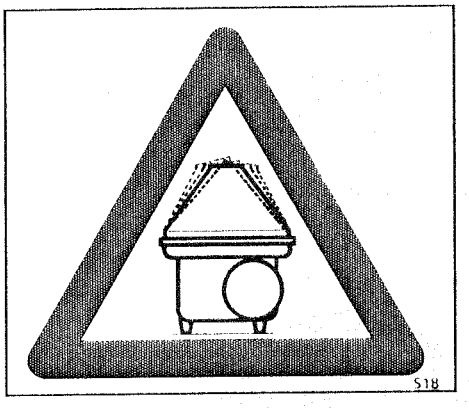


Fig. 15

- Stop the separator immediately if unusual noises or vibrations occur.

The adjacent figure is attached to the separator (adhesive foil). It must be kept in good condition. If it is damaged, it must be replaced immediately. Part-No.: 0024-5868-000

- The bowl is not allowed to run without liquid supply for more than 15 minutes, as otherwise it would result in overheating of the bowl material.

Shut-down

Refer to chapter 6.

Maintenance and repair

Unfavourable operating conditions can increase the risk of impaired operating safety in relatively short time. The factors listed below are unfavourable because they either attack the separator material directly or impair the lubrication/cooling system:

- aggressive product (chemical or physical)
- high product temperature
- product with grease decaying properties
- environment: temperature, dust and vapours

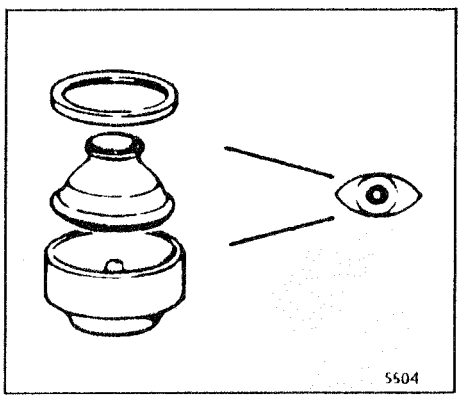


Fig. 16

Particularly stressed parts such as bowl lock ring, bowl bottom, bowl top and other bowl parts with a large diameter must be checked on a regular basis to ensure safe and efficient operation.

Timely maintenance and replacement of worn or damaged machine parts is essential for safe operation of the machine.

Maintenance and repair work may only be carried out by the customer to the extent as described in this instruction manual.

Maintenance and repair work not described in this manual may only be carried out by the manufacturer or by repair shops authorized by the manufacturer.

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

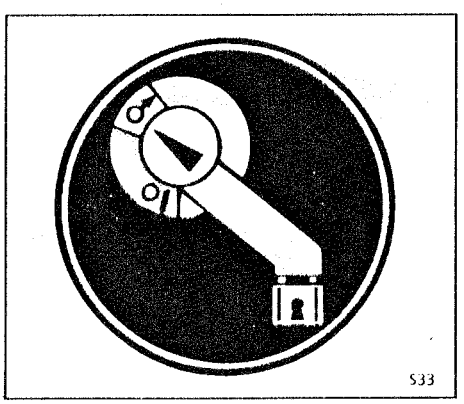


Fig. 17

Before maintenance and servicing:

- switch off all electrical appliances via the main switch,
- secure installation against unintended re-starting with locking devices.

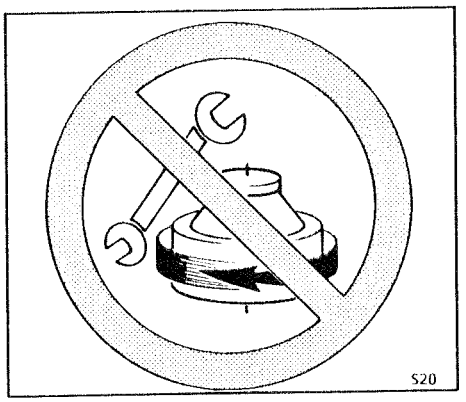


Fig. 18

Do not loosen any part before the bowl has come to a standstill.

The adjacent figure (adhesive foil) is attached to the separator and must always be in perfect condition. If it is damaged it must be replaced immediately. Part-No.: 0024-5868-000

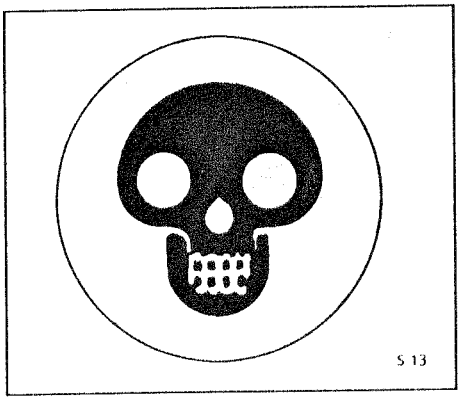


Fig. 19

When processing products which can cause injuries, observe the pertinent safety regulations.

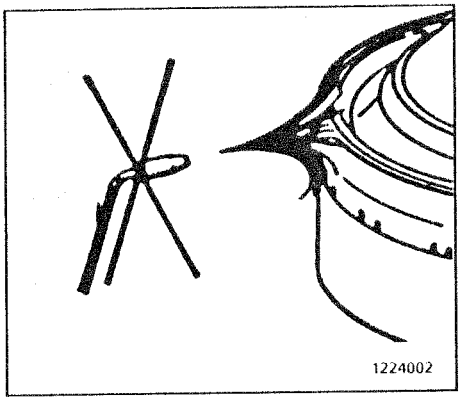


Fig. 20

Do not heat bowl parts with the naked flame.

Bowl parts must never be welded. This also applies for hood and solids collector parts of steam-sterilizable separators.

Even during cleaning the bowl parts the temperature must not exceed 100 °C.

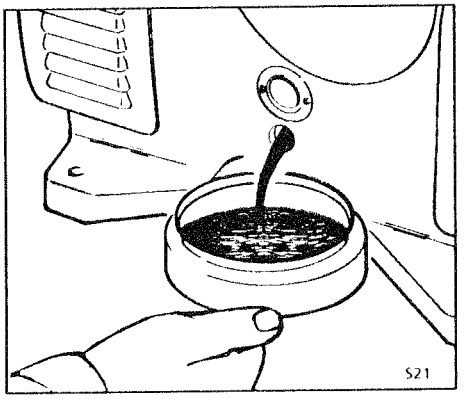


Fig. 21

Collect dripping oil to prevent danger of slipping or product infection.

When handling waste oils note:

- They can be injurious to health, depending on their chemical composition.
- Waste oil must be disposed of in accordance with local regulations.

Corrosion

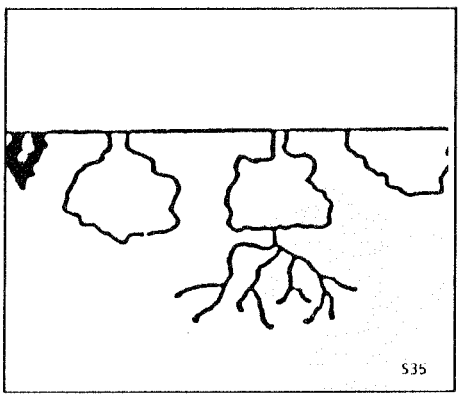
Corrosion can also affect bowl parts made of stainless steel. This corrosion can be flat-spread or pit- or crack-shaped and merits special attention.

Corrosion on stainless steel bowl material should be examined thoroughly and documented.

Flat-spread corrosion can usually be measured (reduction of wall thickness)

Pit- or crack-shaped corrosion cannot be measured without the risk of damage. At the initial stage pit-shaped corrosion is generally caused by chlorine ions.

Depending on the stressing of the part, pit-shaped corrosion can result in crack-shaped corrosion.



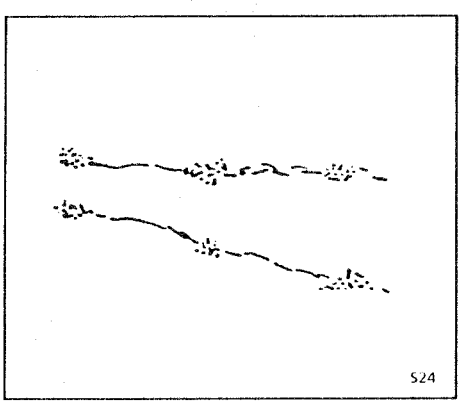
Possible formation of pit-shaped corrosion

Fig. 22

Such pittings can only be investigated by a materials expert.

In case of crack-shaped corrosion attack with or without superposed flat-spread and pit-shaped corrosion on main bowl components, the machine must be shut down immediately.

Contact your nearest Westfalia Separator representative for a thorough examination.



Pittings

Pittings which are close together or form a linear pattern can signify crack formation beneath the surface.

Such pittings should be investigated by a materials expert.

Fig. 23

Erosion

Erosion is caused by solid particles in the process liquid.

These solid particles grind marks into the surfaces with which they come into contact.

The following factors favour the occurence of erosion:

- hard solids particles
- high throughput capacities

The first signs of erosion should be carefully observed and documented. Erosion can deepen rapidly, thereby weakening the bowl material.

Contact your nearest Westfalia Separator representative for a thorough examination. Information on the nature of the damage can be provided by photos, plaster casts or lead molds.

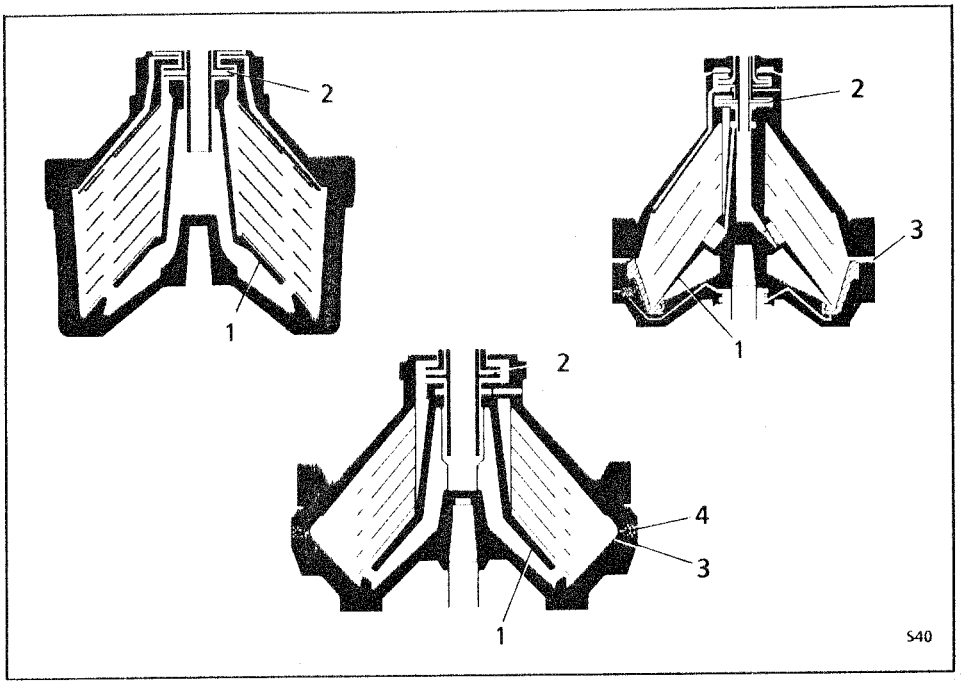


Fig. 24

The surfaces most susceptible to erosion are:

1) the bottom of the distributor, the rising channels and the ribs.

2) the centripetal pump (Cavitation)

3) all surfaces in the area of the solids discharge ports

4) the nozzles

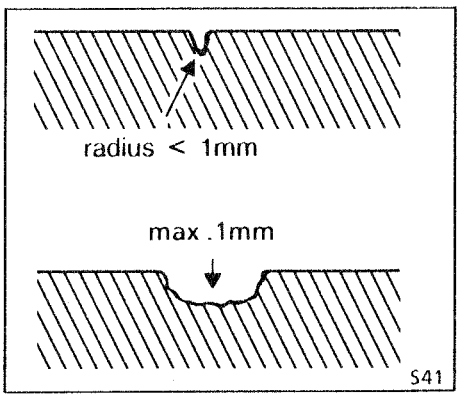
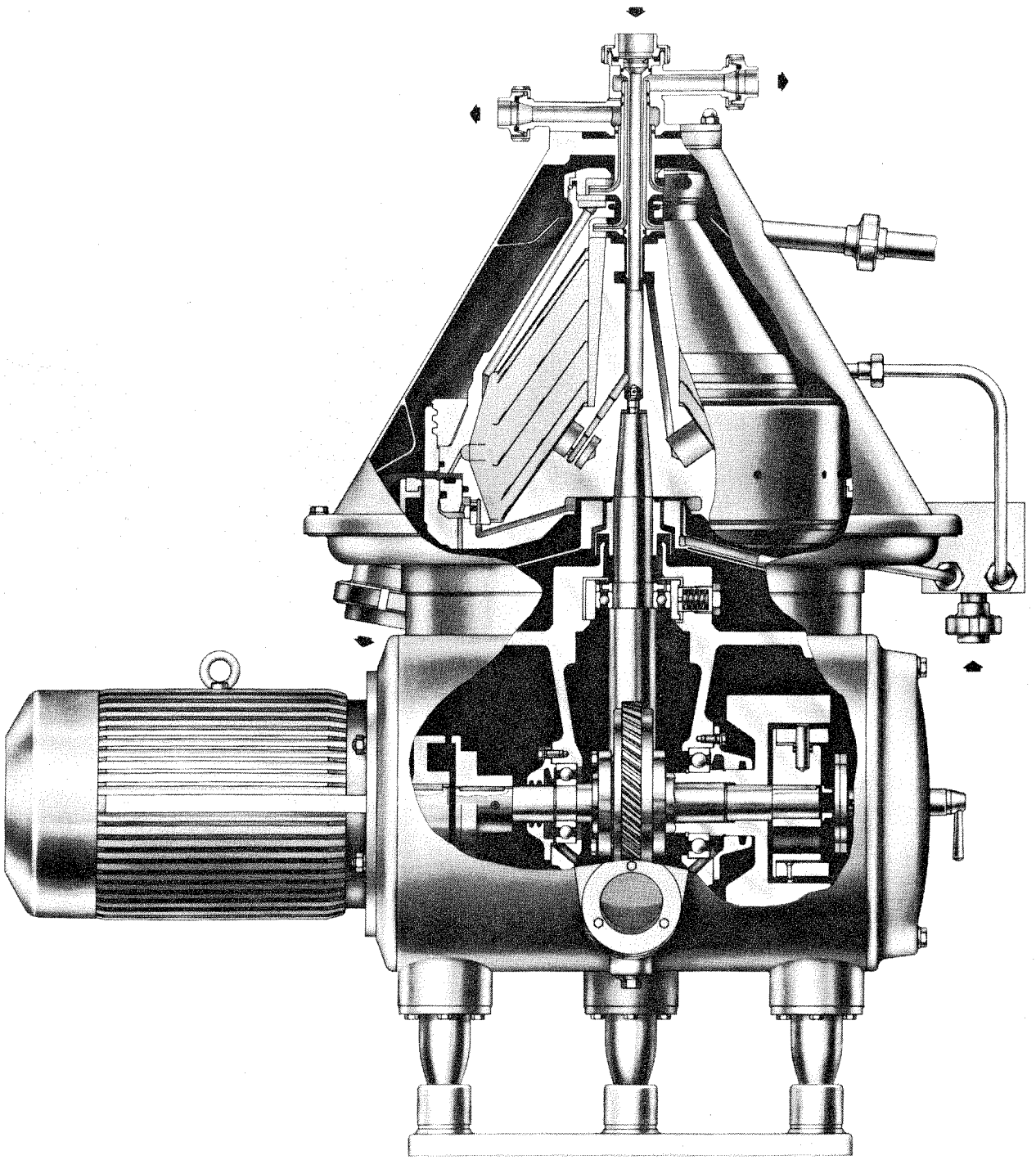


Fig. 25

Signs of erosion which you should immediately report to your nearest Westfalia Separator representative:

- The bottom of the erosion mark has a radius smaller than 1 mm (large notch effect).
- The depth of erosion mark exceeds 1 mm at the deepest point.



Dimensioned drawing

Subject to modification.

1 Installation

1.1 Transport

Suspend the separator as shown in fig. 1/1. Never attach rope to eye bolt on motor. To prevent rope from slipping, wind it around the crane hook.
When lowering the separator, make sure it touches down gently.

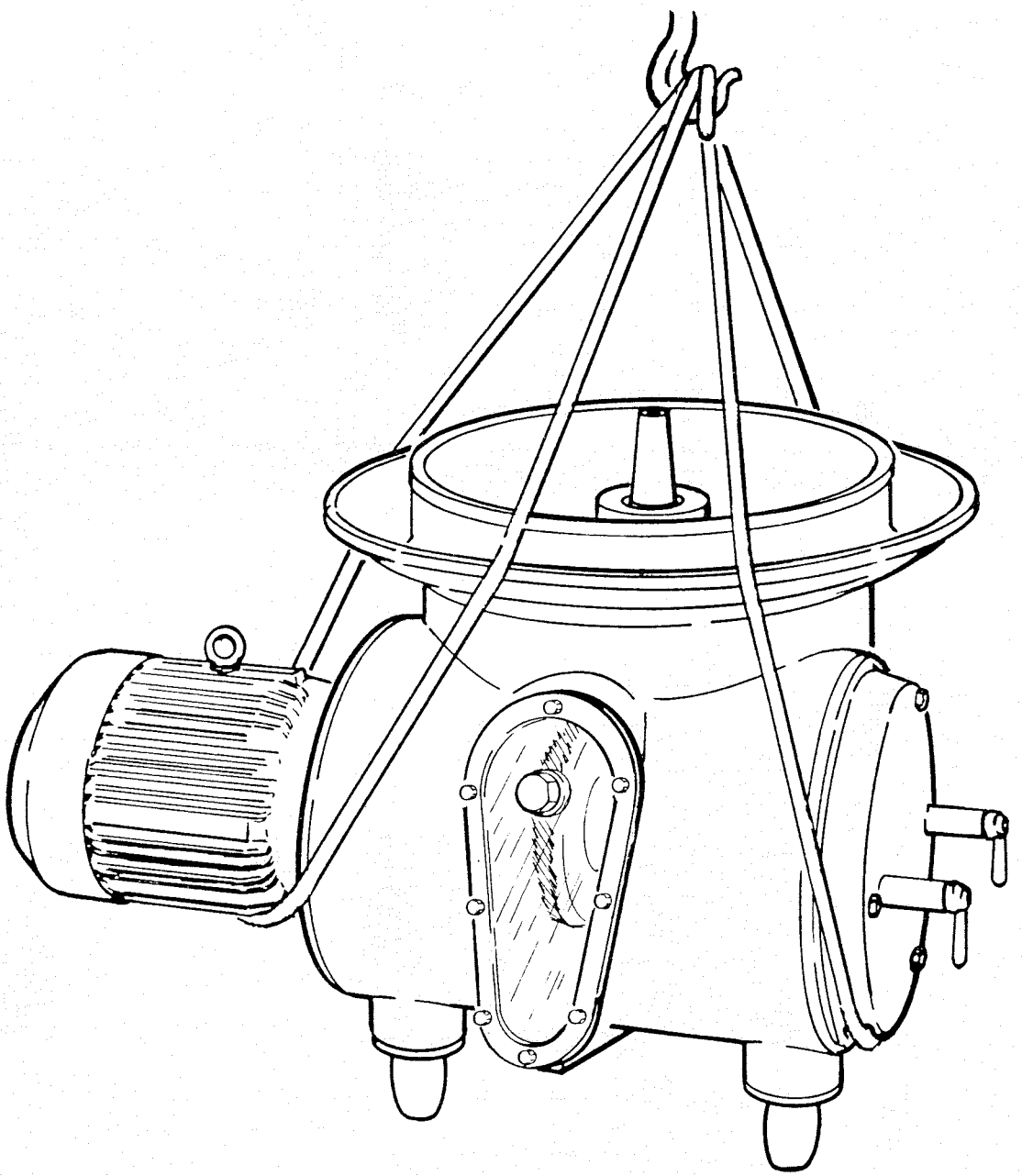


Fig. 1/1

Weight: 730 kg

1.2 Installation

When installing the separator, make sure that sufficient room is available to mount and remove the motor (see dimensioned drawing).

When installing several separators side by side be sure to keep a center-to-center distance of 1.5 m.

Do **not** install a shut-off valve in the frame drain and do **not** connect this frame drain to a piping system. The operating water must be able to discharge freely into a sewer or sludge tank, e. g. via a funnel. Otherwise it will rise into the upper section of the frame, resulting in slowing down of the bowl. It can also seep down through the neck bearing into the gear chamber and damage the gear.

For mounting and removing the bowl a 250 kg hoist or a swivel hoist is required. On request a swivel hoist can be supplied.

1.2.1 Foundation and frame

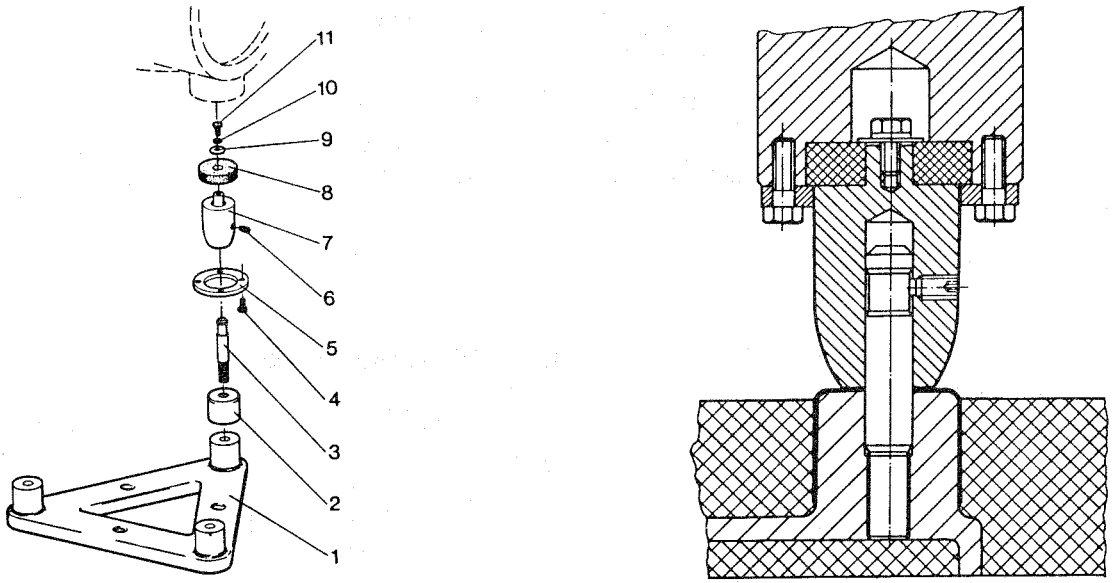


Fig. 1/2

- Screw bolts 3 into the three raised blocks of the foundation frame; make sure they are screwed in **all the way.**
- Embed the foundation frame in such a manner that the raised blocks protrude about 5 mm from the floor.
- Make sure the raised blocks of the foundation frame are **absolutely level.**
- Attach the caps 2. For fastening the foundation frame use commercially available heavy-duty plugs and hex head screws (M 16).
- By means of screws 11 bolt rubber cushions 8, lock washers 10, washers 9 and feet 7 together.
- By means of screws 4 and flanges 5 fasten the feet to the separator frame.
- Lift the separator onto the foundation frame, placing the feet onto the bolts.
- Insert threaded pins 6 and tighten them with a wrench.

2.1 Lubrication of bearings and gear parts

All the bearings of the separator are splash lubricated from a central oil bath.

2.1.1 Lubricating oil

As lubricating oil use only a gear oil designated

CLP 220 - according to DIN 51502

CC 220 - according to ISO 3498

The lubricating oil must meet the following requirements:

- Viscosity: 220 $\pm$ 22 mm^2/s (cSt) at 40 ^oC
- Additives
  - Additives giving increased protection against corrosion and increased resistance to aging, - with properties preventing corrosion on steel according to DIN 51355/B, degree of corrosion 0. Corrosive effect on copper according to DIN 51759/100 A3, degree of corrosion 1.
  - Additives for decreasing wear and increasing the load-carrying capacity. The FZG gear rig test according to DIN 51354 as well as the FZG gear rig test according to A/16.6/90, load grade > 12 must have been passed.
- Demulsifying behaviour according to DIN 51599: < 60 minutes

The gear oil designated "Separator lubricating oil CLP 220" which we have subjected to extensive tests meets the above requirements and should be used. For the order number refer to parts list on page 20/3.

Note: Do **not** use motor car oils or motor oils.

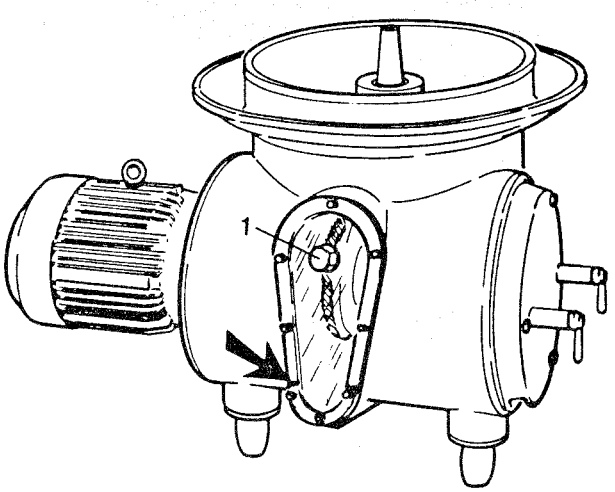


Fig. 2/1

2.1.2 Oil filling, oil level

Before initial start-up of the separator fill the gear chamber with oil. Unscrew oil fill screw 1 from gear sight glass. Then fill in oil using funnel 4 (fig. 20/2). About 3.5 litres of oil are required for one filling.

Minimum oil level: red oil level mark

Maximum oil level: 10 mm above the red oil level mark

During operation the oil level must never be allowed to sink below the red oil level mark; refill oil when necessary.

2.1.3 Oil check

Check oil level once a week. Check from time to time if oil contains water. To do this, loosen oil drain screw and allow a small amount of oil to drain out. If the oil shows a milky colouring (emulsification) an immediate oil change is necessary.

2.1.4 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 6 months to change the oil.

Each time when changing the oil, thoroughly clean gear chamber and flush it with thin-bodied oil before 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.

Clean sight glass.

2.2 Lubrication of threads and contact surfaces on bowl parts

Before assembling the bowl apply a thin film of one of the lubricants specified below to threads and contact surfaces of bowl bottom, bowl top, lock rings, etc.

For separators operating in the food processing industry we recommend you to use the following lubricants:

- Klüber Grease KSB 8 (may be used in excess).

For separators operating in the chemical industry we suggest using molybdenum disulfide pastes, e. g.

- Molykote G
- Molykote G Rapid.

In addition to the above lubricants, other pastes or greases with the same properties may be used.

2.3 Lubrication of the motor bearings

For lubrication of the motor bearings, refer to the instructions of the motor manufacturer (see motor plate).

3.1 Three-phase AC motor, 7.5 kW

The separator is driven by a flange type motor via a centrifugal clutch. The motor should be connected to a motor control which is designed for star-delta switching. Switching over from star to delta connection takes place after approx. 4 seconds.

Motor protection is ensured by PTC resistor type temperature feelers incorporated in the winding of the motor. These temperature feelers have to be connected to an appropriate 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.

The measuring circuit line (between tripping device and motor) has to be laid separate from other lines.

Dimensioning of switches, wiring and fuses must **not** be based on the rated current, but on the **starting current** which reaches approx. 1.8 - 2 times the value of the rated current.

3.2 Direction of rotation of the bowl

IMPORTANT: The bowl must rotate in clockwise direction when looked at from above.

Direction of rotation of the bowl is shown on the hood.
If it turns in anti-clockwise direction (incorrect), two lead-in wires have to be interchanged.

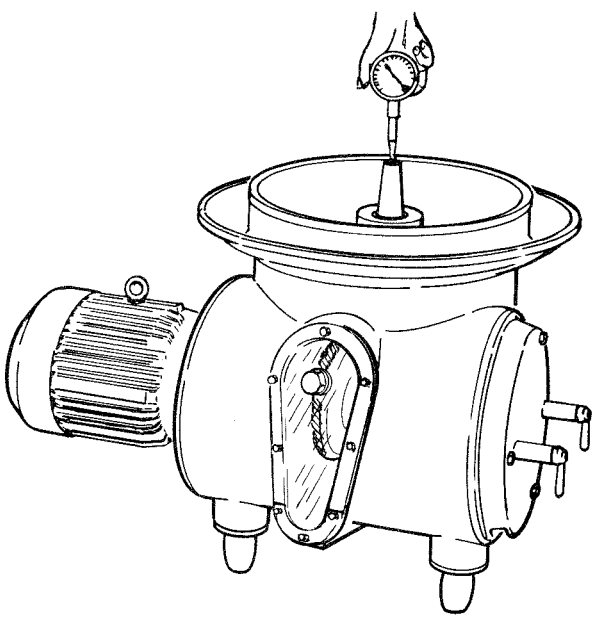


Fig. 3/1

3.3 Speed and starting time of the bowl

The bowl **speed** is 6 200 rpm. It is indicated by a tachometer.

Speed variations up to 3 % are permissible.

For replacing the tachometer, remove the cap and unscrew the tachometer by hand.

Before initial starting and after exchanging the gear parts, check the number of revolutions of the spindle with a hand tachometer before installing the bowl (fig. 3/1).

The spindle speed can be 5 % above the rated bowl speed.

Starting of the bowl takes about 4 - 5 minutes.

Make sure that the bowl reaches its rated speed (as per name-plate of separator) within the starting time and that this speed is maintained during operation.

Important Hints

The forces resulting from the high speed rotation of the bowl are likely to endanger the operating safety of the separator if the bowl has been improperly assembled or cleaned. When assembling the bowl, strictly adhere to the instructions given in this manual.
In addition, the following should be considered:

- Prior to assembling the bowl parts, carefully clean all contact surfaces and grease them according to the instructions given under 2.2. Also, lubricate threaded areas of bowl bottom and bowl lock ring as specified under 2.2.

- When installing the bowl parts, make sure that the "O" marks of the bowl parts are in line. "O" mark alignment will ensure that the parts are properly positioned and locked in place by arresting pins and guide ribs.

- To avoid damage to guide surfaces and arresting pins when installing or removing the bowl parts, make sure the hoist is in the correct position. The hoist is to be operated at the low lifting speed. Never use force when installing or removing the bowl parts.

- Before inserting gaskets, check them for wear. Make sure that gasket grooves and gaskets are clean and that gaskets are in perfect condition. Be careful not to twist the gaskets while inserting them and check to be sure that they fit properly in their grooves.

- 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 parts of a bowl are marked with the serial-number of the separator or with the last three digits of the serial-number.

- Place bowl parts on a rubber mat or wooden pallet, never on the stone floor.

- Handle bowl parts carefully.

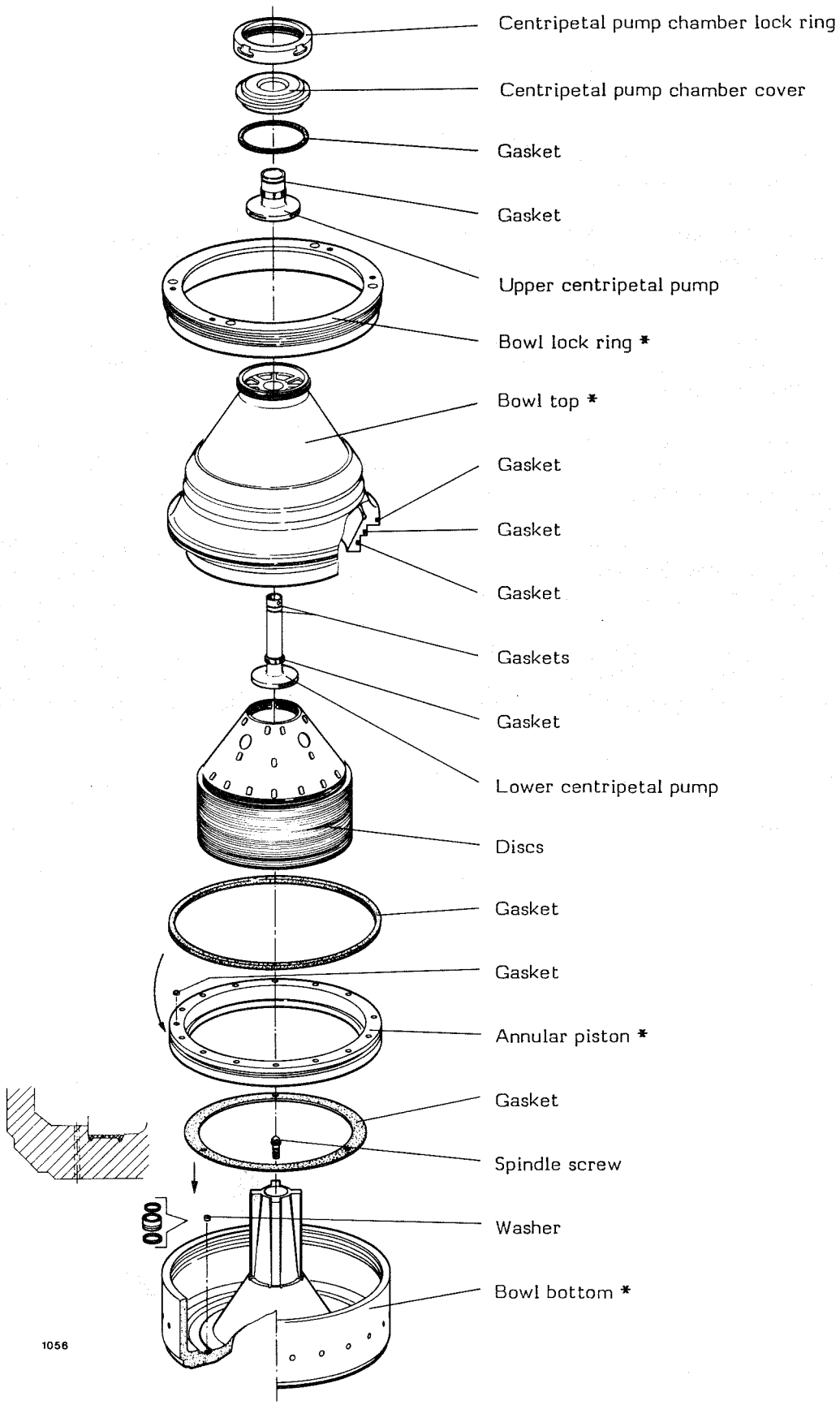
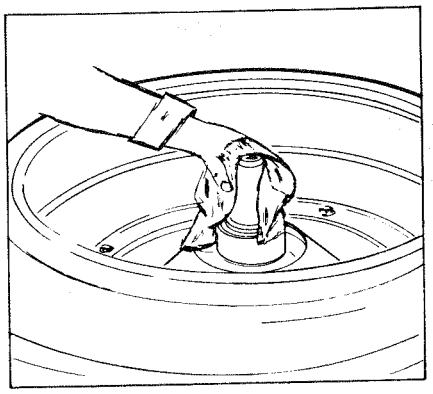


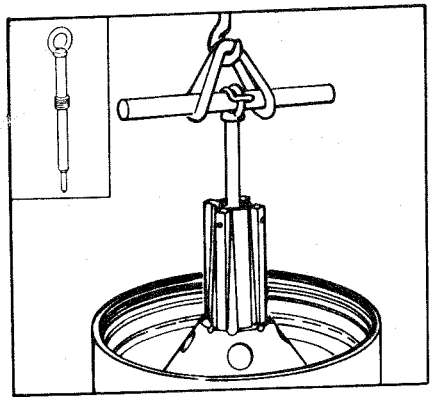
Fig. 4/2

* **Note:** After replacing this part, the complete bowl must be re-balanced.



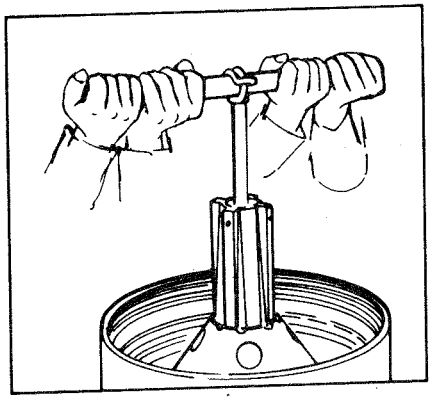
4.1 Assembling the bowl (for tools refer to page 20/2)

Oil the upper part of the worm spindle (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 spindle with a smooth rag. Also clean the inside of the bowl hub to ensure proper fitting.**

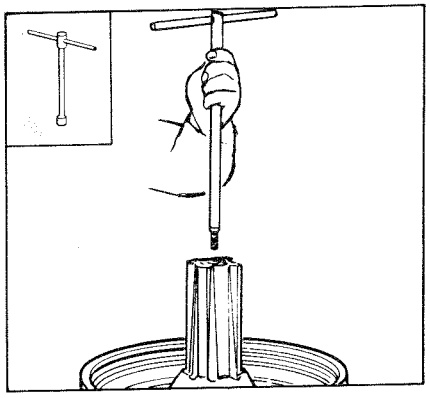


Screw jack into bowl bottom.

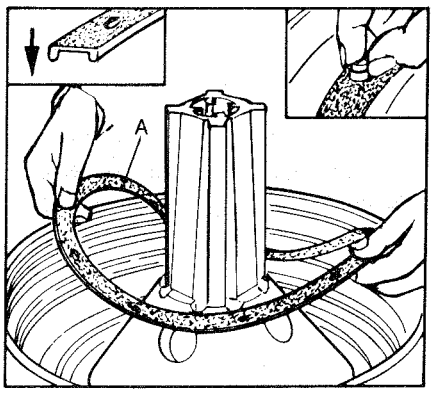
Place bowl bottom onto the spindle, using a lifting device and hoist.



If no hoist is available, place on bowl bottom by hand.



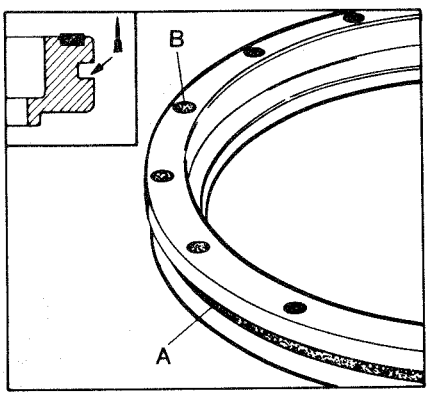
Screw spindle screw **tightly** into worm spindle, using a wrench **(left-hand thread).**



Thoroughly clean gasket groove in bowl bottom and let it dry.

Insert gasket A into groove of bowl bottom.
Watch for correct mounting position!
Insert the gasket with both beads into the grooves of bowl bottom.

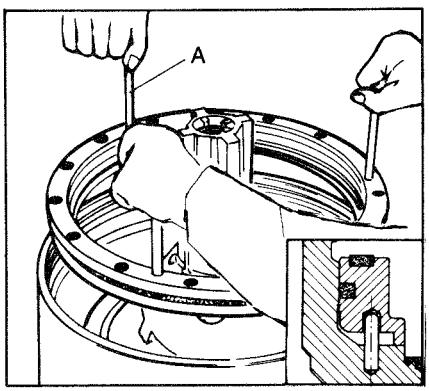
Insert metal supports (disks) into gasket and operating-water holes.



Thoroughly clean gasket groove in annular piston and apply a **thin** film of grease.

Insert gasket A into groove of annular piston.

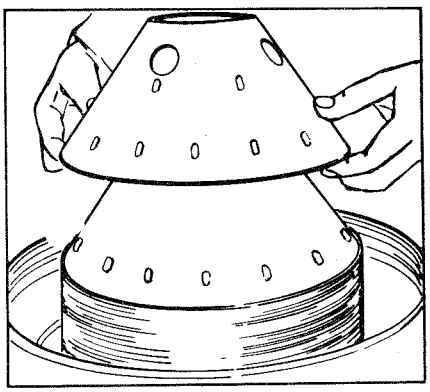
Insert the 15 gaskets B into the annular piston by lightly rapping with a plastic hammer.
Replace the gaskets during each bowl inspection to avoid erosion on the sealing surface of the bowl top.
Be sure to replace all the gaskets.



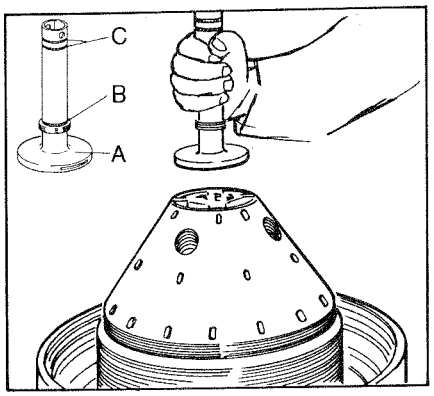
Screw 3 cylindrical screws A (M 10x90) into the tapholes of the annular piston.

Place annular piston into bowl bottom.
The "O" marks on annular piston and bowl bottom must be in line with each other. Watch for engaged position.

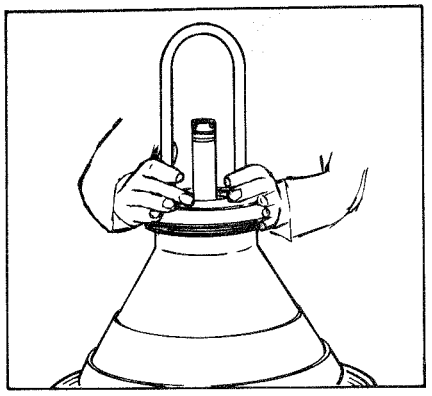
Unscrew cylindrical screws.



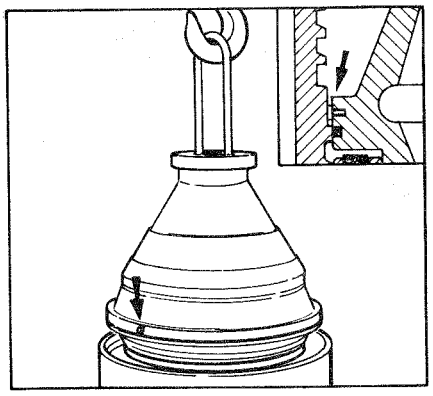
Stack the discs onto the neck of bowl bottom in numerical order, beginning with no. 1.



Install lower centripetal pump A with inserted gaskets B and C.

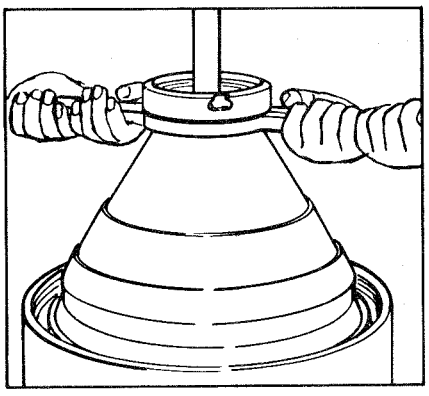


Attach lifting device to bowl top.

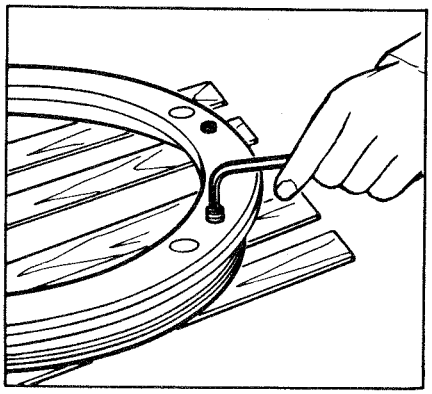


Clean and grease guide and conical surfaces on bowl bottom and bowl top (see 2.2).
Insert the gaskets into the grooves of bowl top.

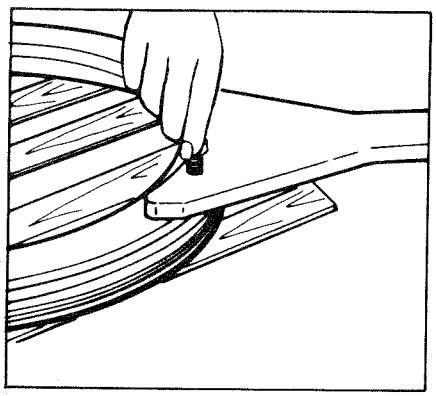
Place bowl top into bowl bottom by means of the lifting device. Make sure that the arresting cam of bowl bottom catches into the groove of bowl top. The "O" marks of both parts must be in line with each other.



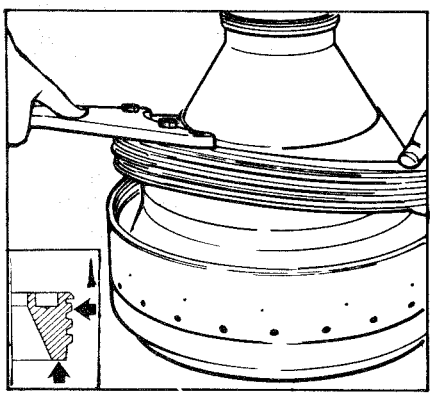
If no hoist is available, use lifting tongs.
Screw on centripetal pump chamber lock ring **(left-hand thread).**
Place on bowl top by hand.



Unscrew two hexagon socket set screws (M 12x16) from the bowl lock ring.

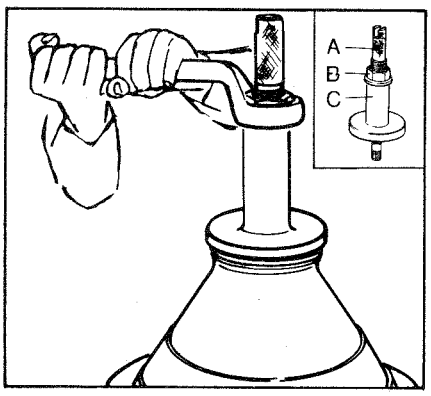


Screw wrench and bowl lock ring together: the fastening screws of wrench must be tightened **firmly.**



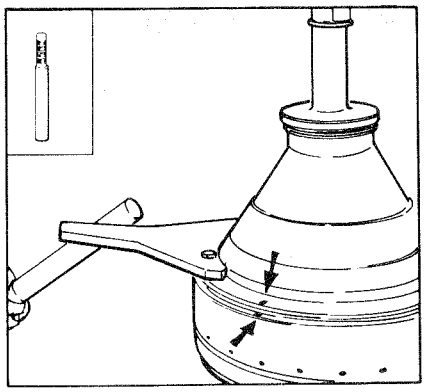
Thoroughly clean and grease threads on bowl bottom and bowl lock ring as well as the guide and sliding surfaces.

Place bowl lock ring together with the wrench onto bowl bottom and tighten manually **(left-hand thread)** until the "O" marks on bowl lock ring and bowl bottom are 3 - 5 cm apart.



To facilitate tightening of the bowl lock ring, compress the disc stack by means of the mechanical compressing device:

Place pressure piece C onto bowl top.
Screw threaded bolt A into neck of bowl bottom as far as it will go.
Tighten hexagon nut B by means of a ring spanner.
Compress disc stack by lightly tapping with the mallet against the handle of the ring spanner.

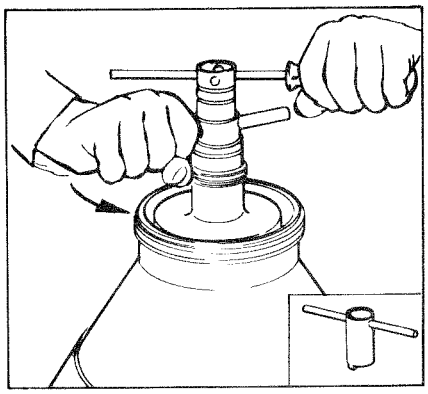


Tighten the bowl lock ring by rapping with the mallet against the wrench handle until the "O" marks on bowl bottom and bowl lock ring are in line with each other.

Unscrew the wrench.

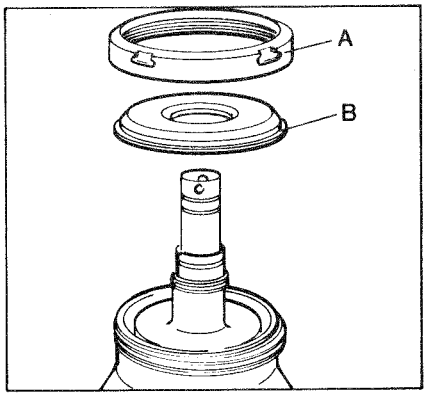
Replace hexagon socket set screws into bowl lock ring.

Remove mechanical compressing device.



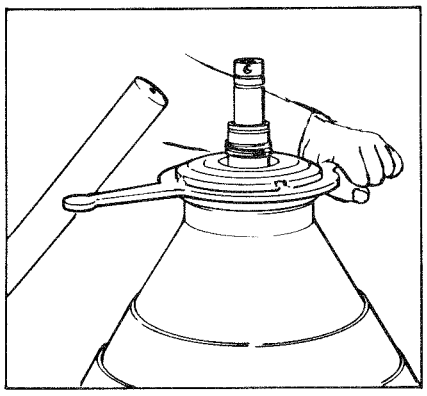
Screw upper centripetal pump (with inserted gaskets) onto the lower centripetal pump by hand **(left-hand thread)** and turn it with the socket wrench until it hits stop. Then turn the centripetal pump slightly back from the stop to prevent seizing of the thread. Block the lower centripetal pump by putting a screwdriver through the holes in the centripetal pump tube.

IMPORTANT: Do not use force. Do not rap against the wrench handle.



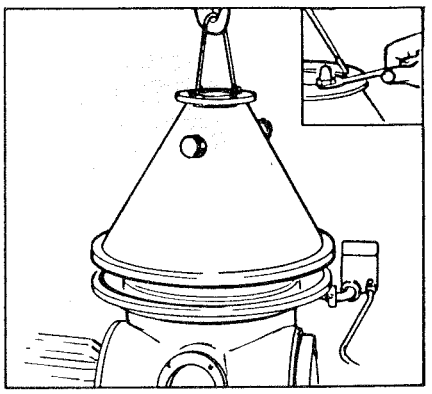
Place on centripetal pump chamber cover B (with inserted gasket). Pay attention to "O" mark alignment of centripetal pump chamber cover and bowl top.

Screw on centripetal pump chamber lock ring A, by hand **(left-hand thread).**



Tighten centripetal pump chamber lock ring by lightly tapping against handle of annular wrench **(left-hand thread).**

Check if bowl can be turned by hand.



4.2 Assembling the feed and discharge connections

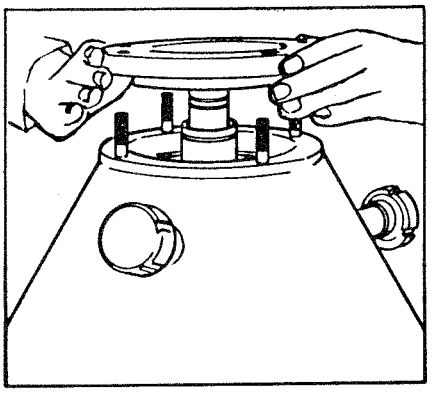
Fasten lifting device to hood by means of 4 cap nuts.

By means of the hoist install the hood, considering the position of the pipe connections.
Watch for engaged position.

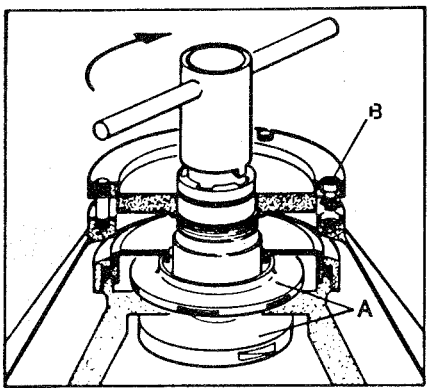
Bolt hood and solids collector together.

Connect hood flush line with operating-water connection.

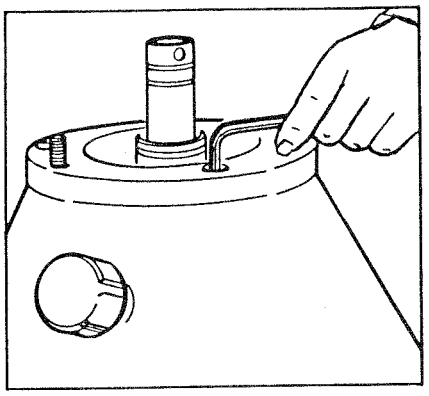
Remove lifting device from hood.



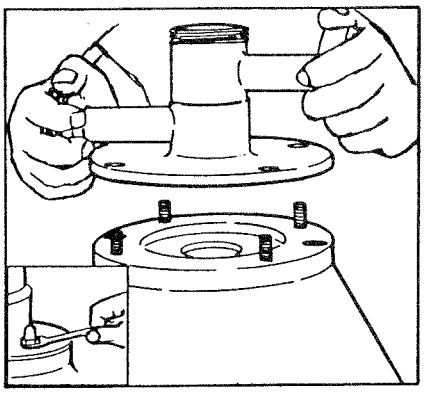
Place the ring onto hood in such a manner, that the two Allen screws B are above the corresponding tapholes of the hood. Do **not** tighten the screws!



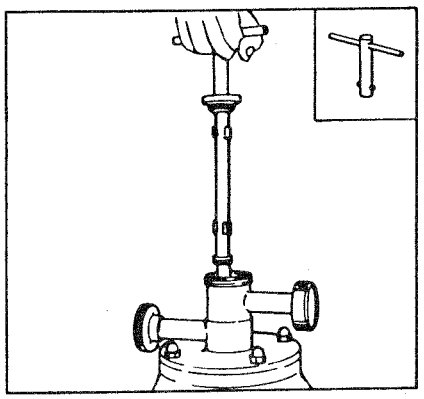
By means of the socket wrench screw centripetal pump A **clockwise** into the ring until it hits stop.



Screw the two Allen screws of the ring into the hood.



Install feed and discharge housing and fasten it with cap nuts.

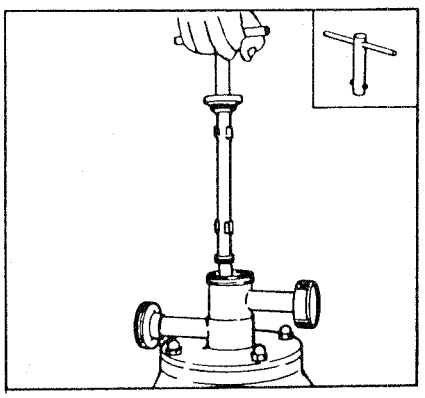


With the aid of the wrench insert feed tube with gaskets into the feed and discharge housing as far as it will go.

Connect feed and discharge lines.

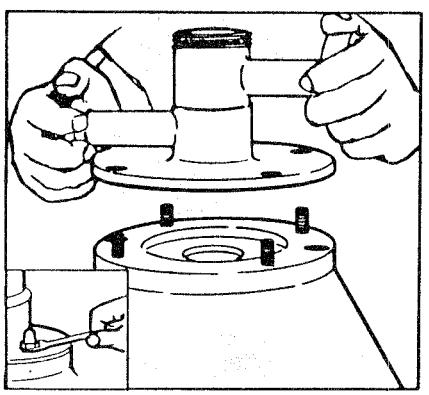
4.3 Removing the feed and discharge connections

NOTE: **To avoid accidents do not loosen any part before the bowl is at rest.**
Only when the gear sight glass is clear and the worm wheel has stopped rotating is the bowl at a standstill.

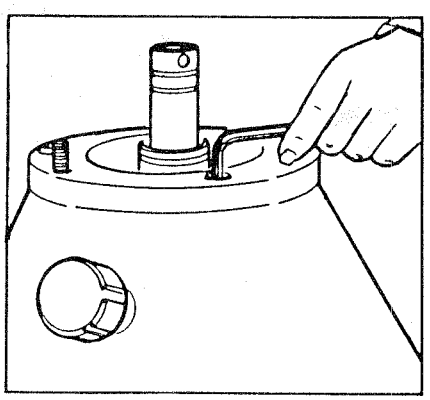


Remove feed and discharge lines.

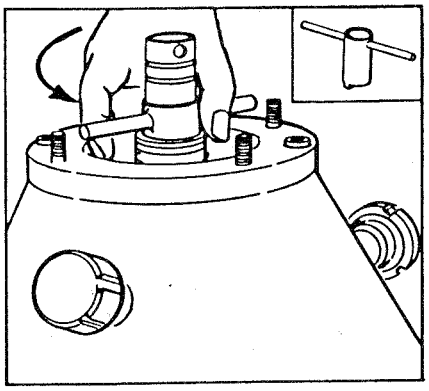
Pull feed tube out of the feed and discharge housing, using the socket wrench.



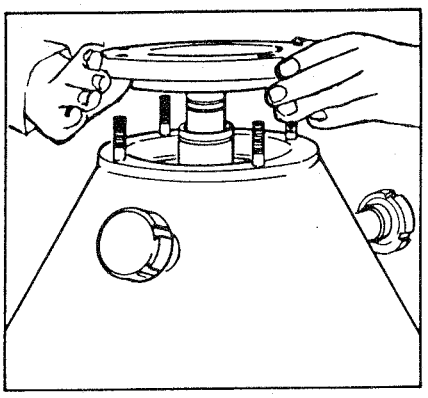
Loosen cap nuts of feed and discharge housing and remove housing.



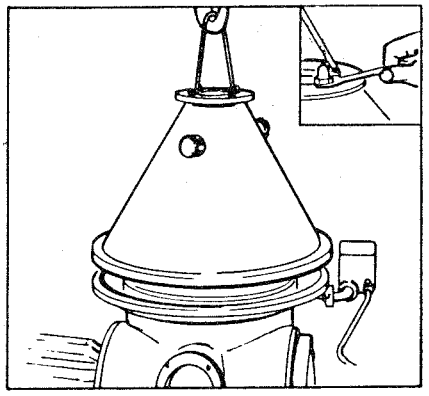
Loosen two Allen screws of the ring.



Screw centripetal pump out of the ring by turning the wrench **anti-clockwise.**



Remove the ring.



Fasten lifting device to hood by means of four cap nuts.

Disconnect hood flush-water line from operating-water connection.

Separate hood from solids collector.

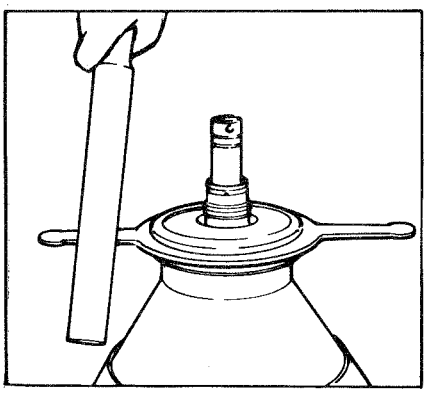
Use hoist to remove hood.

4.4 Dismantling the bowl

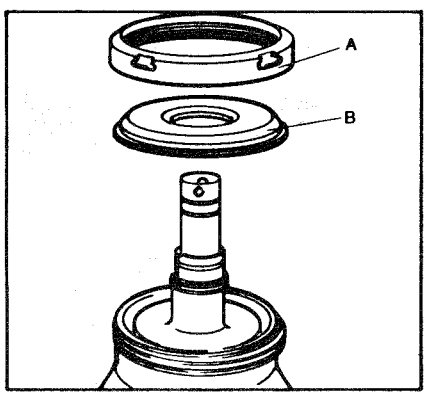
Before opening the bowl, release the brakes by turning the two handles of the brake housing in clockwise direction.

Handle bowl parts with care.

Replace worn gaskets immediately.

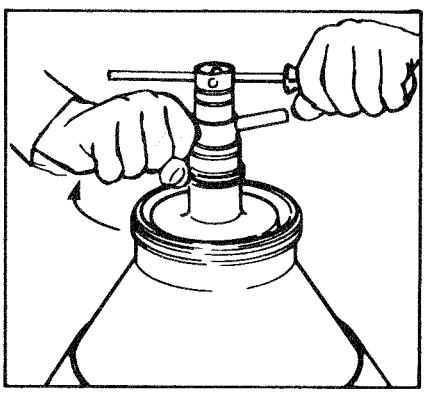


Loosen centripetal pump chamber lock ring by lightly tapping with the mallet against the handle of the annular wrench **(left-hand thread).**



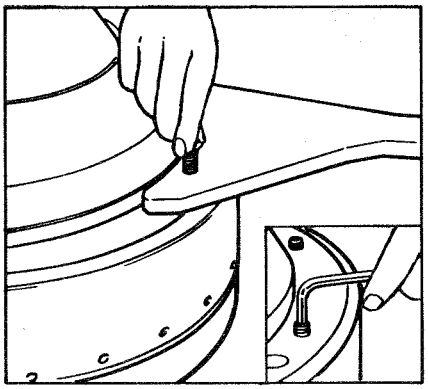
Unscrew centripetal pump chamber lock ring A by hand and remove it.

Remove centripetal pump chamber cover B.



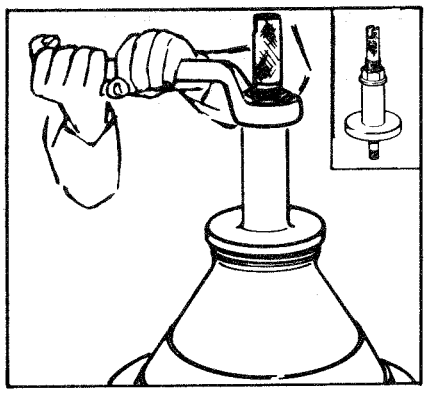
Use socket wrench to loosen upper centripetal pump on lower centripetal pump **(left-hand thread).** Then unscrew it by hand and remove it.

Block lower centripetal pump by placing a screwdriver through the holes in the upper area of the centripetal pump tube.



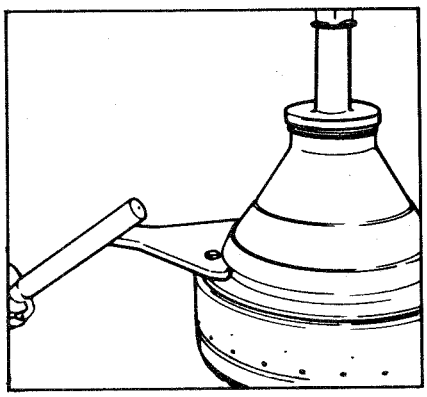
Unscrew two hexagon socket set screws from the bowl lock ring and fasten wrench to bowl lock ring by means of screws.

Tighten the fastening screws of the wrench **firmly.**

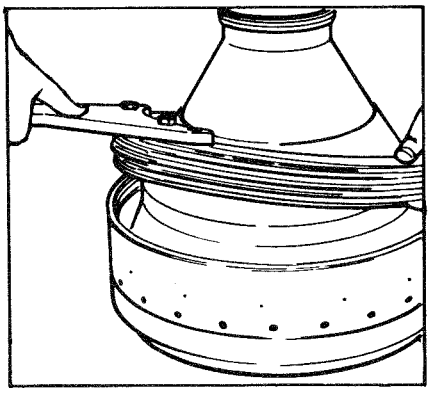


To facilitate loosening of the bowl lock ring attach mechanical compressing device (see sect. 4.1, page 4/6, last para.).

Compress disc stack by turning hexagon nut with ring spanner.

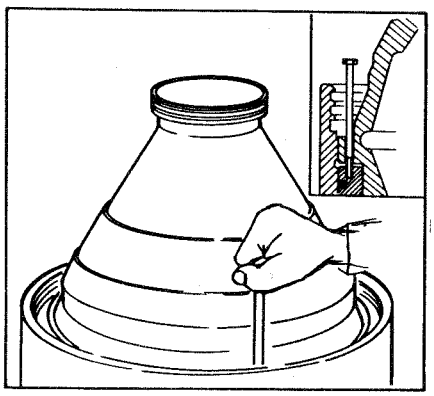


Loosen bowl lock ring **(left-hand thread)** by tapping with a mallet against the wrench handle.



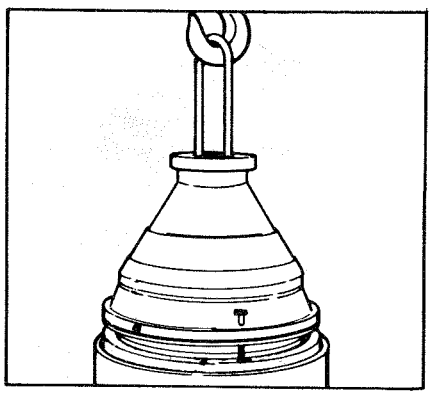
Remove bowl lock ring by hand, using the wrench.

Remove the compressing device.



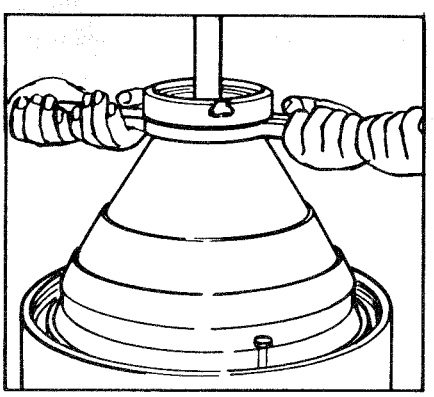
Put three cylindrical screws through the through holes in bowl top and screw bowl top and annular piston together.

Bowl top and annular piston are lifted out together.



Screw lifting device onto bowl top **(left-hand thread).**

Use hoist to lift out bowl top and annular piston.

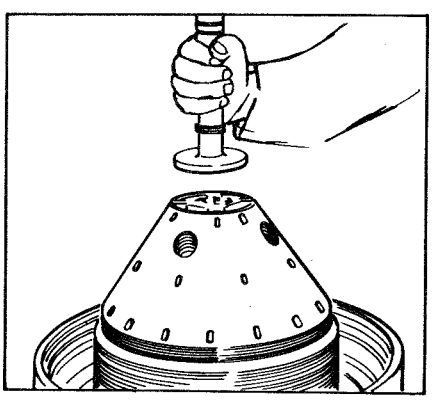


If no hoist is available, proceed as follows:

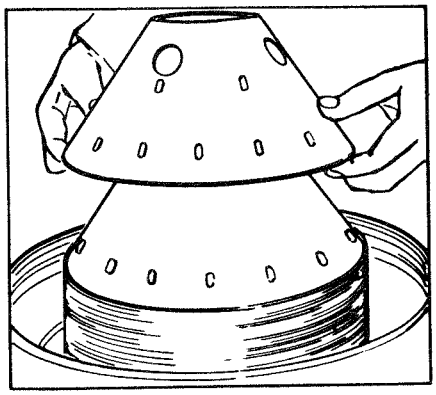
Attach lifting tongs for bowl top.

Screw on centripetal pump chamber lock ring **(left-hand thread).**

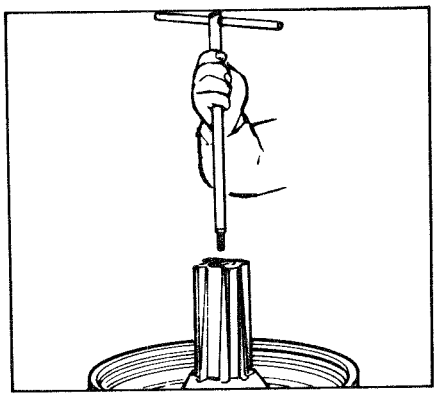
Lift out bowl top and annular piston, by hand.
Two people are necessary for this job.



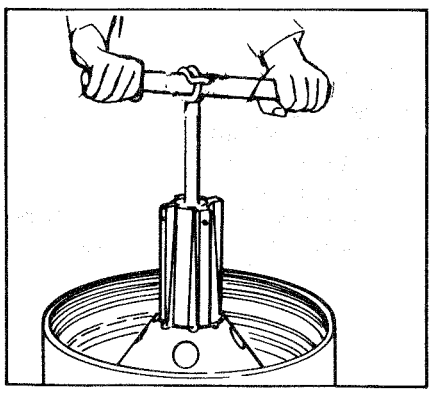
Remove lower centripetal pump.



Remove discs from neck of bowl bottom.

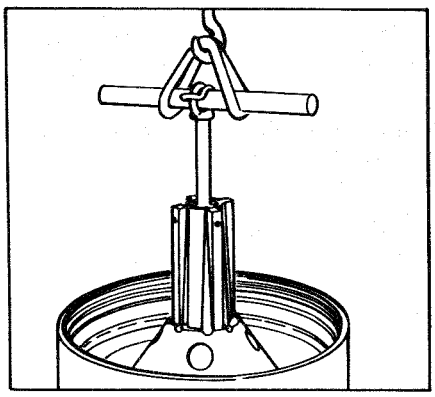


Loosen spindle screw with the wrench and unscrew it **(left-hand thread).**



Screw jack into neck of bowl bottom.

Force bowl bottom off the spindle cone by means of the jack.



Use hoist to lift bowl bottom out of the frame.

If no hoist is available, lift out bowl bottom by hand, using the jack.

5.1 Application

The separator is employed for:

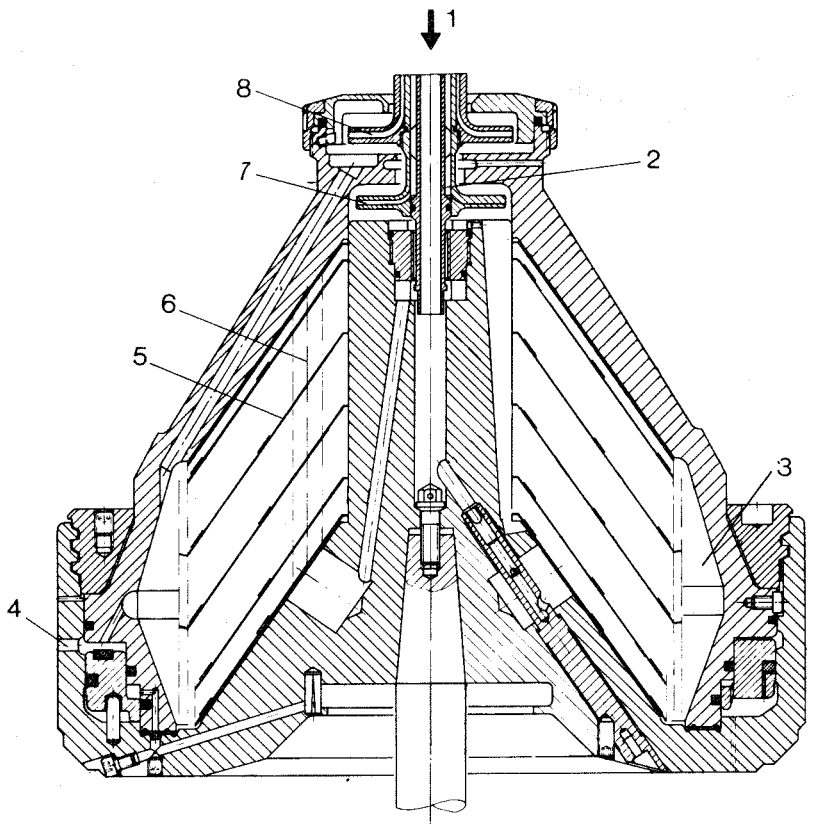
Milk separation

Milk clarification

Milk standardisation

Whey separation

5.2 Operating principles of the bowl



1 Feed
2 Inlet tube
3 Sediment holding space
4 Ejection ports
5 Disc stack
6 Rising channels
7 Centripetal pump for cream
8 Centripetal pump for skim milk

Fig. 5/1

The product enters the bowl through the "Soft-Stream-Inlet" system. This arrangement ensures gentle and turbulence-free product feed into the rising channels 6 of the disc stack 5.

In disc stack 5, the product is separated into skimmed phase and cream. Both phases are discharged foam-free and under pressure by means of centripetal pumps 7 and 8.

The separated solids accumulate in sediment holding space 3 and are ejected at periodic intervals through ejection ports 4. The de-sludging cycles are initiated by a timing unit.

5.3 Operating principles of the bowl hydraulic system

The operating liquid fed into the rotating bowl produces a high centrifugal pressure. This pressure is used to actuate the annular piston which seals and opens the ejection ports during separation.

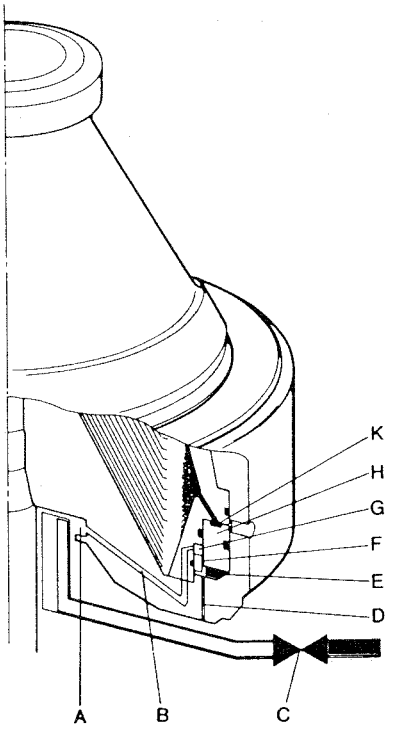


Fig. 5/2a

5.3.1 Closing the bowl

When the bowl has reached its rated speed, the solenoid valve C for operating water is opened briefly several times. The operating water flows into the injection chamber A in the bowl bottom and from there through the feed channel B into the opening chamber G. From the opening chamber the water flows through the overflow holes F into the closing chamber E which is provided with overflow holes D to limit the closing pressure. The overflow holes are arranged in such a way that when the bowl is rotating the outer section of the closing chamber is always filled with liquid. Owing to the speed of rotation, pressure builds up in the closing chamber and produces a force in axial direction which presses the annular piston with its gaskets K against the bowl top thus sealing the ejection ports.

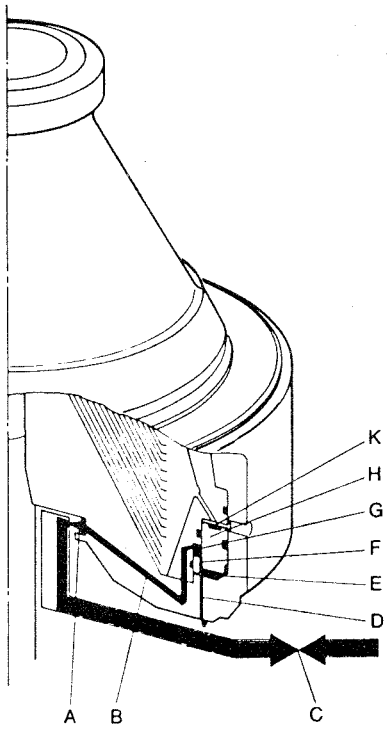


Fig. 5/2b

5.3.2 Opening the bowl (de-sludging)

To de-sludge or partially de-sludge the sediment holding space the solenoid valve C for operating water is opened and operating water is fed into the opening chamber G. From there a small portion flows through the overflow holes F into the closing chamber E. The diameter of the overflow holes F is selected to ensure that the pressure produced in the opening chamber exceeds the pressure in the closing chamber. Thus, the annular piston is forced downwards, opening the holes in the bowl top. The solids are then ejected through the solids ejection ports in the bowl bottom.

Once the de-sludging has taken place, the operating water feed is again shut off. The operating water in the opening chamber flows off through the overflow holes F, whereas the closing chamber E remains filled up to the overflow holes D. As soon as the opening pressure falls below the closing pressure, the annular piston moves upwards, thereby sealing the centrifugation chamber.

5.4 Timing unit

Partial sediment ejections during milk processing are initiated automatically by the timing unit TA 2-M in accordance with a pre-set program. By pressing the button "De-sludging", the program in progress can be interrupted and a partial ejection initiated immediately.

After this "forced" de-sludging has taken place, the control program switches automatically back to separation.

Total de-sludgings of the bowl during cleaning-in-place are initiated either manually or automatically by a separate CIP unit.

For further details, refer to the instruction manual "Timing unit".

5.5 Operating water connection

Operating water connection: DN 25 mm (1")

Operating water pressure: 2.0 bar

Operating water capacity: 2 000 l/h

Operating water specifications:

Hardness: $\leq 15^{o}$ English hardness at separating temperatures of up to 55 ^{o}C
$\leq 7.5^{o}$ English hardness at separating temperatures above 55 ^{o}C

Chlorine ions: $\leq$ 100 mg/l

pH value: 6.5 to 7.5

A water-pressure reducer is supplied with the operating water connection for fitting in the water feed line (fig. 5/4). The function of the former is to throttle the line pressure to approx. 2 bar and keep it constant.

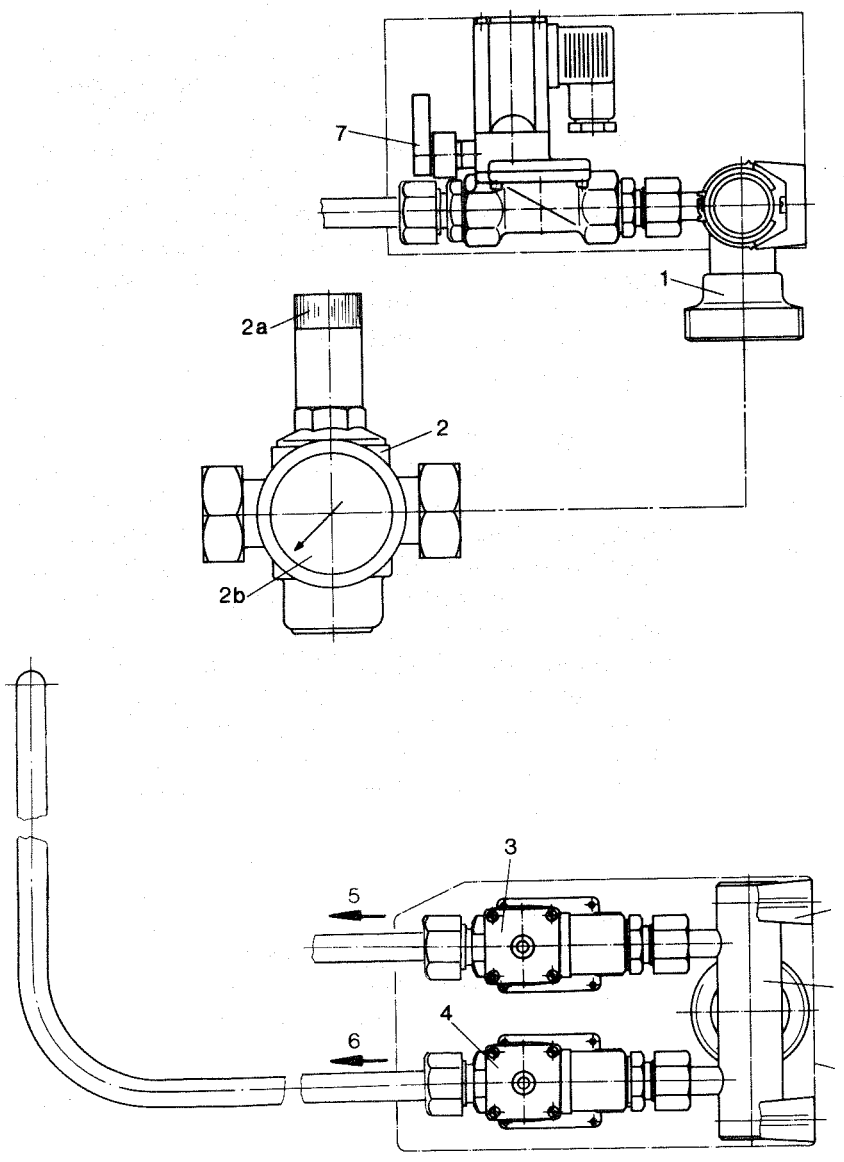
The water-pressure reducer is to be adjusted as follows:

1. Open solenoid valve 4.
2. Adjust pressure using adjusting screw 2a until the pressure gauge 2b on pressure reducer 2 indicates **2 bar.**
3. Close solenoid valve.

5.5.1 Arrangement of the solenoid valves, manual control of the separator

The solenoid valves built into the operating-water connection are equipped with levers (marked red) for manual operation.

If the timing unit fails or the solenoid coil of the solenoid valve for operating water is defective, the bowl can be emptied by manually operating the solenoid valve.



1 Water feed
2 Pressure reducer
2a Adjusting screw
2b Pressure gauge
3 Solenoid valve for operating water
4 Solenoid valve for hood flush water
5 Operating water to separator
6 Hood flush water to separator
7 Manual control of solenoid valve

Fig. 5/4

5.5.2 Solenoid valves

The solenoid valves (fig. 5/4) incorporated in the operating-water system are 2/2-way straight-flow diaphragm valves with internal piloting. They are equipped with a manual operator (override) for testing purposes and manual control for the separator.

The solenoid coil is entirely embedded in Epoxy resin which ensures protection against moisture, good dissipation of heat, and perfect electrical insulation. The valves are fully tropicalized.

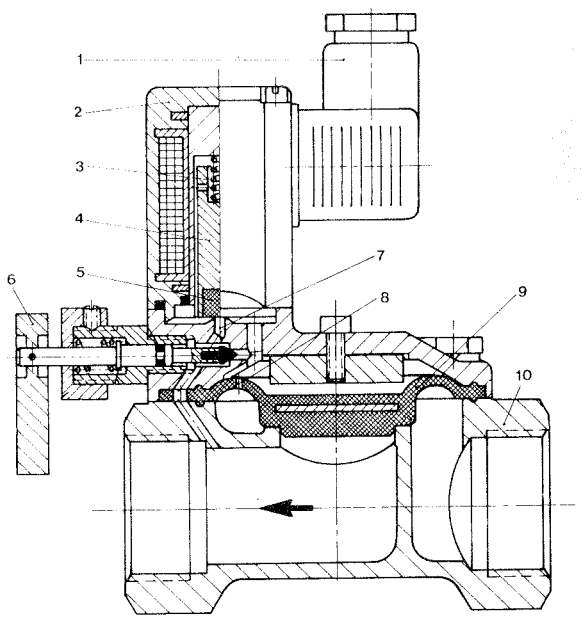


Fig. 5/5

1 Coupler socket
2 Solenoid head
3 Cylindrical pressure spring
4 Solenoid core
5 Plug (pilot valve)
6 Manual operator (override)
7 Outlet hole
8 Inlet hole
9 Diaphragm
10 Valve housing

5.5.2.1 Operating principles

When the valve is closed (de-energized), the upper side and the underside of the diaphragm are exposed to the water line pressure, because water can flow from the valve inlet side through a small hole in the diaphragm into the chamber above the diaphragm. As the area exposed to the water line pressure on the upper side of the diaphragm is larger than the area exposed to the same pressure on the underside, the diaphram is kept pressed against the valve seating.

Upon energization of the solenoid coil, the plug which is integrally vulcanized in the solenoid core is lifted from the seating of the pilot valve thus opening a duct between the space above the diaphragm and the discharge side of the diaphragm valve. As this duct is larger in diameter than the small hole on the inlet side, the water can flow faster out of the space above the diaphragm than it flows into it. Thus the water pressure above the diaphragm drops so that the diaphragm is lifted by the pressure acting on its underside; the valve is opened.

If the energizing current is disconnected, the spring will drive the solenoid core downwards and the pilot valve will close. Consequently, the water pressure above the diaphragm builds up again so that the diaphragm is pressed against the valve seating; the valve is closed.

5.5.2.2 Maintenance

The solenoid valves do not require special maintenance. However, care should be taken that the coupler socket is always screwed tightly to the solenoid head to ensure perfect sealing action of the gasket.

5.5.2.3 Locating electric troubles

If it has been found that the control cabinet functions properly and that voltage is present at the valve terminals of the terminal strip while the corresponding time function element is operating, the trouble will have to be ascribed either to a defective solenoid coil, or to open circuit between terminal strip and valve, or to poor connection.

In the event of a defective solenoid coil, the solenoid head can be removed from the valve. To do this, remove first the coupler socket (loosen screw and pull out the socket), then loosen the fillister head screws.
Note: Before doing so, shut off the main valve for operating water.

Since the solenoid coil is entirely embedded in the solenoid head, the complete solenoid head (No. 0018-3710-820, see page 17/2) has to be replaced.

5.5.2.4 Technical data

Solenoid valve		Type	40 S / 3051
Part - Number			0018-5652-640
Pipe connection		R	3/8in
Voltage		V	24 DC
Power consumption:	pull-in	W	5
	operation	W	5
Duty cycle		%	100
Frequency of operations		/h	1,000
Type of enclosure		IP	65
Pressure range		bar	0.5 - 6
Temperature:	medium	°C	+90
	ambient	°C	+35
Cable entry		Pg	9

This chapter gives general instructions for operating the separator. However, operation of the respective machine depends on the timing unit used and the arrangement of the valves.

The individual process may necessitate changes in the operating procedure.

Refer also to the instruction manual of the respective timing unit.

6.1 Before start-up

- check that
  - brakes are released by turning handles clockwise.
  - oil level is above the red oil level mark.

    Minimum oil level: red oil level mark

    Maximum oil level: 10 mm above the red oil level mark
  - hex head screws for fastening the hood and cap nuts for fastening the feed and discharge housing are tightened securely,
  - hand shut-off valves are opened in the supply lines for:
    - operating water
    - cooling water
    - compressed air
  - cream valve is open.
  - timers on the timing unit are set according to the instructions in the "Timing unit" manual.

6.2 Starting

- Start the motor; press push button "separator I".

  If severe vibrations occur during the start-up phase, shut down the separator immediately and check whether the bowl has been correctly assembled and thoroughly cleaned.

- Acceleration of the separator to operating speed in approx. 4 - 5 min.

- Switch on main switch of timing unit (position I).

  The timing relay "separation" and impulse relay "hood flushing water" are activated immediately.

- Initiate 4 to 5 partial de-sludgings by pressing push button "de-sludging".
  Closing chamber fills up with operating water. Thus the annular piston is forced against the bowl top, resulting in closing of the ejection ports.

- Switch on the feed pump and start the water circulation as is usually practised in dairies.

- Switch over from water to product.

- Adjust operating discharge pressure and cream volume as follows:

  - Throttle skim milk discharge with hand valve or constant-pressure valve and simultaneously adjust cream valve to desired flow rate.

  - First throttle hand valve or constant-pressure valve in skim milk discharge until slight overflow occurs.
    To check the overflow, open inspection cover of hood.
    The pressure indicated by the pressure gauge at the moment of overflow is to be considered as maximum pressure.

  - Now open manual valve or constant-pressure valve in skim milk discharge to such an extent that a discharge pressure of 0.3 - 0.5 bar lower than the maximum pressure results.

6.3 The separator in operation

The backpressure of the downstream equipment must not exceed the pressure of 4.5 bar in the skim milk discharge and the pressure of 3.5 bar in the cream discharge.

Separating temperature of milk: 50 - 55 °C

To fully utilize the discharge pressure of the cream pump, e. g. when the separator is used for milk clarification where cream and skim milk are re-combined after separation, adjust the skim milk valve to the highest possible discharge pressure.

When clarifying milk, it may happen that cream with a high butterfat content is discharged from the overflow pipe of the hood although the cream valve is open and maximum pressure is prevailing in the skim milk line. This indicates that the back-pressure of the equipment downstream of the separator has to be reduced or a booster pump has to be installed.

It should be noted that cream with a very high butterfat content will cause the measuring rod in the cream flowmeter to rise due to the high viscosity of the cream, thus indicating a flow rate that is higher than the actual cream flow.

If there is overflow despite a low skim milk discharge pressure, check the gaskets in the centripetal pump chamber cover and on the pump shafts for damage.

In some cases, especially when using heaters with a low back-pressure, it is advisable to fit a throttle into the cream line upstream or downstream of the heater and to set it to about 1.5 bar in order to ensure foamfree operation of the separator.

Possible causes of inefficient separation

- Unfavourable pre-treatment of the milk (pumps, agitator, very high temperature, cold storage of raw milk over a long period).
- Variations in temperature, bowl speed, throughput capacity, or skim milk pressure.
- Re-mixing of cream and skim milk after separation, e. g. caused by leaking cocks in pipe lines connected for drink milk production.
- Homogenized return milk or sweet cream buttermilk added to the raw milk.

Analysis of milk samples:

Skim milk samples should always be taken at the screwed union of the skim milk discharge.

If the trouble cannot be found with the separator or with upstream equipment of the separator, check condition of chemicals used to analyse the skim milk. For this purpose, fill water instead of skim milk into butyrometers.

6.4 De-sludging of the bowl

6.4.1 General

Solids ejection from the bowl must be carried out at periodic intervals in relation to the product and the process. The solids chamber of the bowl should not be filled to capacity. As soon as the separating or clarifying efficiency decreases, a partial de-sludging must be carried out.

Total de-sludgings are performed when stopping the separator and during chemical cleaning.

6.4.2 Partial de-sludging

Partial de-sludging of the bowl during milk processing means partial emptying of the sediment space of the bowl. **The milk supply to the bowl is not interrupted during partial sediment ejection.**

Amount of solids to be ejected

when separating milk: approx. 3.5 l

when separating whey: approx. 5.0 l

The amount of solids to be ejected is determined by the opening time of the operating-water valve (opening time = de-sludging time).

The opening time of the operating-water valve is set by means of timing relay "de-sludging".

The duration of operating-water feed (partial de-sludging time) depends on the amount of solids to be ejected and on the operating-water pressure. The **operating-water pressure must remain constant,** so that always equal amounts of solids will be ejected. The exact time for partial de-sludging must be found out by running tests with water and by assessing the ejected amount of solids while the machine is operating.

For determining the ejected amount of solids, feed the bowl with water and measure the amount of liquid discharging from the solids outlet by means of a measuring bowl.

Check the ejected amount of solids during separation and re-adjust the opening time of operating-water valve, if necessary.

To ensure the exact measurement of the discharge **without** flush water, unscrew the flush-water line from the hood and switch it to one side.

The partial de-sludging operations required during separation are carried out automatically according to a preset program by timing unit.

Sterilizing vessel

During partial de-sludging approx. 18 l liquid (2.5 l dirt and 15.5 l flush water) flow into the sterilizing vessel. It can hold the liquid from 5 partial de-sludgings.
After adding 1 kg alkaline cleaning agent the liquid in the sterilizing vessel is heated with steam to 95 ^{0}C and kept at this temperature for 10 minutes. Then the liquid can be discharged.

6.4.3 Program sequence

- The separating time (time period between de-sludgings) is controlled by the timing relay "Separation".

  Separating time

  when separating **milk:** approx. 30 min

  when separating **whey:** approx. 10 min

- After switching on the main switch on timing unit the timing relay "Separation" and relay for hood flush-water impulse (impulse 1 sec., pause 60 secs.) start operating.

- When the pre-set separating time has elapsed, hood flushing is initiated via timing relay "pre-flushing".

  The timing relay "pre-flushing" controls the duration of hood flush-water supply before partial ejection.

  Adjustment time: approx. 30 secs.

- The solenoid valve "hood flush-water" is opened and the hood is flushed.

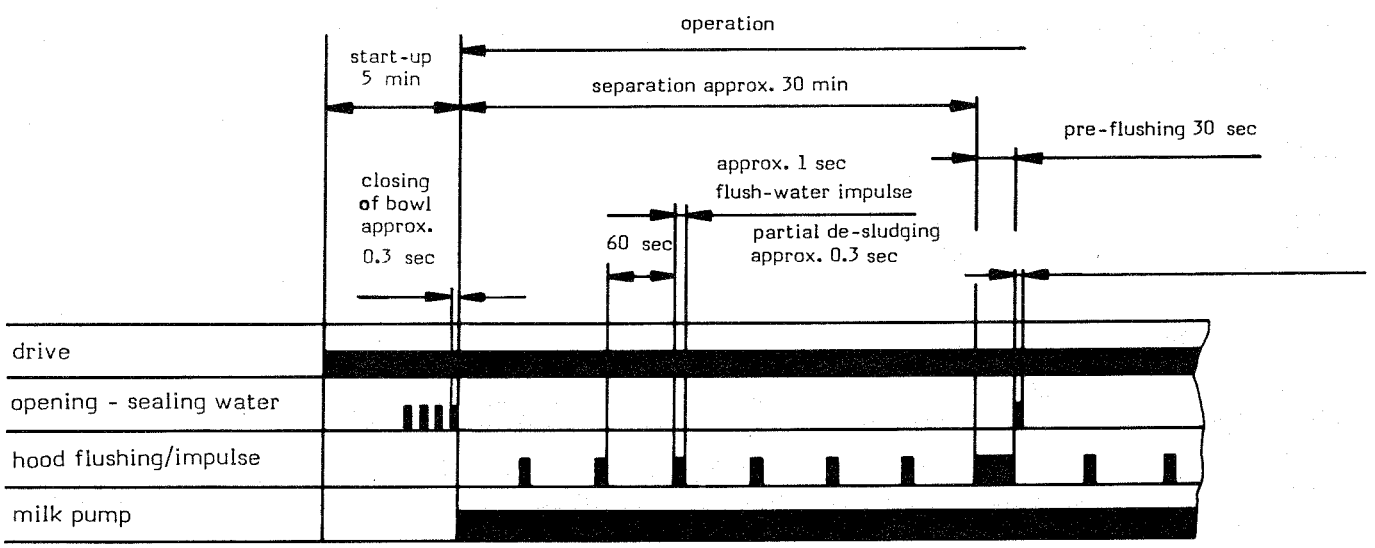
- After the pre-flushing time has elapsed, the timer "de-sludging" causes the solenoid valve "operating water" to open and ejection is initiated.

  Opening time of solenoid valve: approx. 0.3 sec. (see sect. 6.4.2)

- After completion of partial de-sludging the timing program automatically switches back to separation.

- The program sequence is interrupted when the main switch is turned off. All timing relays and the impulse relay revert to their initial position.

  The function diagram below shows the program sequence.



6.4.4 Total de-sludging

During total de-sludging the whole bowl contents is ejected.

During chemical cleaning or after stopping the separator, total de-sludgings can only be performed by pressing a push button on the timing unit.

Performance:

Switch off feed pump!

Set timing relay "de-sludging" to 2 sec.

Adjusting the running time in the opposite direction to the direction of the elapsed time (increased time) becomes only effective after the running time in progress has elapsed.

Press push button "de-sludging".

Re-start feed pump approx. 1 min after total de-sludging (speed recovery).

After refilling of the bowl, a further total de-sludging can be introduced by pressing the push button "de-sludging" again.

After completion of the total de-sludgings, set timing relay "de-sludging" to the calculated and determined partial de-sludging time (approx. 0.3 sec).

With this bowl design total de-sludgings are not always necessary during chemical cleaning. Partial de-sludgings are adequate. The intervals are to be found out by running tests on site.

For adjustment, working principle and operation of the timing unit refer to chapter 5 of the instruction manual for the timing unit.

6.4.5 Manually initiated bowl de-sludgings

In an emergency, e. g. when the timing unit fails, the bowl can be de-sludged by opening and closing the solenoid valve manually. During de-sludging the bowl speed drops slightly. Only when the bowl has reached its operating speed again may the de-sludging cycle be repeated.

6.5 Stopping the separator

1) **Flushing the system with water** (not necessary, if chemical cleaning has been carried out after milk processing):

   a) Switch off feed pump to stop milk supply.

   b) Displace residual milk from the bowl by using water.

   c) Thoroughly flush the system with water.

   d) Carry out total de-sludging.

   e) Perform 1 - 2 flush de-sludgings to ensure that no solids remain in the bowl. After each de-sludging flush the hood by throttling the valve in skim milk discharge.

2) Switch off motor.

3) Apply brakes by turning the two handles in anti-clockwise direction.
   IMPORTANT! Do not loosen any part before the bowl has stopped completely!
   Only when the gear sight glass is clear and the worm wheel has stopped rotating is the bowl at a standstill.

7.1 Cleaning-in-place

The separator is generally included in the CIP cycle of the pasteurizers. For cleaning the separator, the detergents used for the pasteurizers are adequate. The latest cleaning agent to be circulated must always be acid.

After milk processing, the residual milk is displaced with water and the whole equipment thoroughly flushed with water. Then two total de-sludgings must be carried out.

The system must be flushed with water and the subsequent flush de-sludgings have to be performed even if the system cannot be cleaned-in-place for some reason after milk processing.

The CIP-program should comprise the following program steps:

1) flushing with caustic solution,
2) flushing with water,
3) flushing with acid solution,
4) flushing with water.

IMPORTANT: Each of the program steps 1 - 4 should end with a total de-sludging.

During each program step the valve incorporated in the skim milk line must be throttled several times. This will cause flooding of the centripetal pump chamber of the separator, resulting in thorough flushing of hood and sediment collector.

IMPORTANT: Bear in mind that stainless steel bowl parts will be attacked by chlorine. Therefore, make sure that detergents are free from chlorine.

7.2 Cleaning the bowl

Normally it is not necessary to dismantle and clean the self-cleaning bowl upon completion of the separation process, provided that cleaning-in-place has been adequately performed while the bowl was still moving. How often the bowl needs to be cleaned by hand depends on the nature of the product and can only be found out by experience.

The bowl must be dismantled once a month for a check-up and manual cleaning.

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

Remove gaskets from the bowl parts and clean grooves and gaskets to prevent corrosion. Replace damaged or swollen gaskets.

Carefully clean the small holes for the supply and discharge of operating liquid in bowl bottom, bowl top and annular piston.

Clean and wipe dry guide surfaces and threads of bowl parts and grease them (see 2.2). Spindle cone and inside of bowl hub should be oiled and then **wiped clean and dry with a smooth rag.**

Re-assemble bowl immediately after cleaning.

7.3 Cleaning the upper section of the frame

From time to time, the inside of the upper section of the frame has to be cleaned in the area below the bowl. After removing the bowl place splash cover over the spindle to prevent wash liquid from seeping into the drive and rendering the lubricating oil unserviceable.

Never aim a water jet directly at the separator for the purpose of cleaning. Clean it by hand with a sponge or cloth.

7.4 Cleaning the operating-water feeding system

The small holes in the operating-water feeding device should be cleaned every 3 - 6 months.

7.5 Cleaning the gear chamber

When changing oil, clean gear chamber thoroughly with kerosene. Be sure to remove all metal particles from walls and corners. Do **not** use fluffy cleaning rags or cotton waste.

7.6 Cleaning prior to a long-term shut-down of the separator

Prior to a long-term shut-down, clean the separator thoroughly (see 7.2 and 7.3). The clean bowl parts and all unvarnished machine parts should be wiped dry and greased to avoid corrosion. The clean grease-coated bowl should be kept in a dry place.

To prevent gaskets from getting brittle, keep them in a cool and dry room, protected from dust and light.

Drain the lubricating oil and fill the gear chamber up to oil level mark with corrosion-preventing oil, e. g. SHELL Ensis Oil 30.

Let separator run without bowl for approx. 10 minutes to make sure that all gear parts are coated with the corrosion-preventing oil.

Then drain the oil.

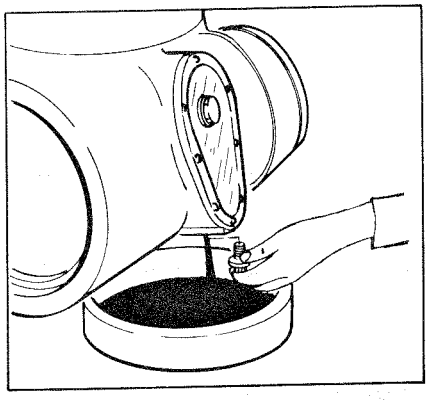
Oil upper end of spindle by hand and protect it with splash cover.

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.

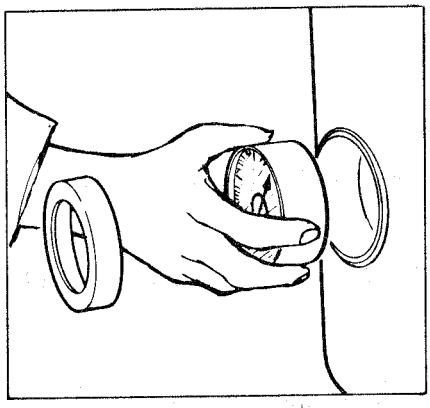
Stop operating-water supply at the branch point of the water mains to prevent inrush of water into the separator, caused by unintended opening of the shut-off valve.

Before re-starting the separator, fill the gear chamber with the lubricating oil specified on page 2/1 until the oil level is slightly above the oil level mark. Then let the separator run **without bowl** for 10 minutes.

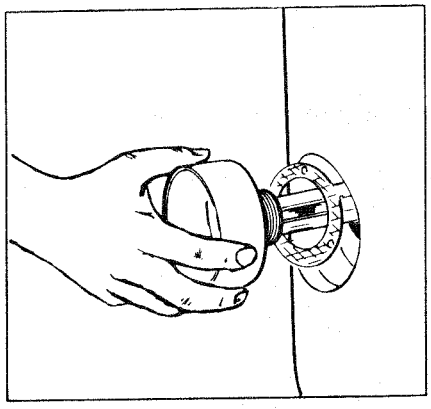
8.1 Dismantling the vertical gear parts



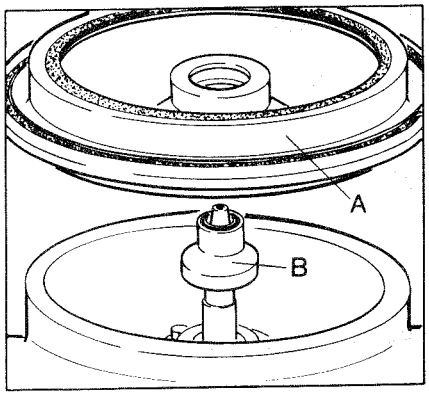
Remove oil drain screw.
Drain off oil.



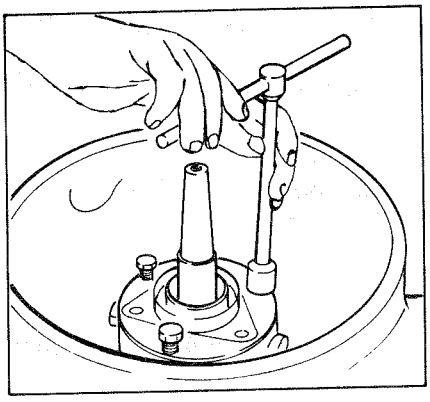
Remove cap.
Unscrew tachometer by hand.



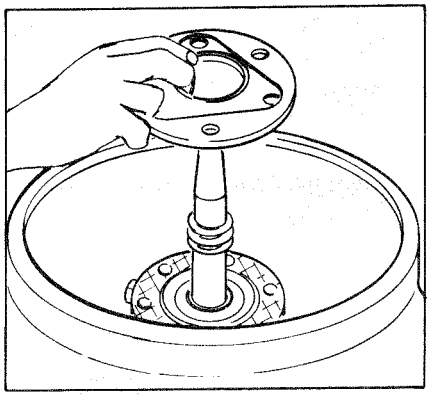
Remove screws.
Withdraw tachometer drive.
Remove gasket.



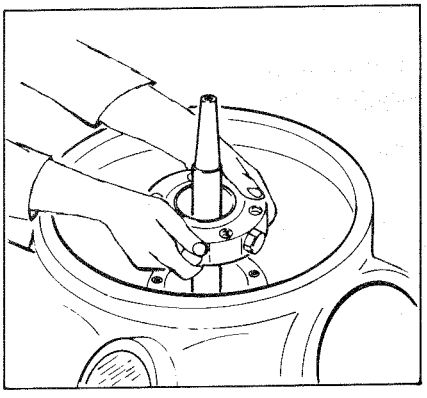
Detach sediment collector A. Remove spindle cap B.



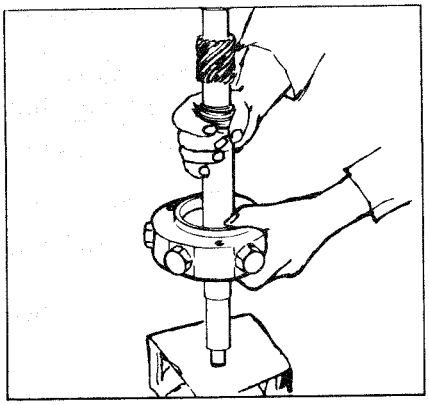
Remove screws.



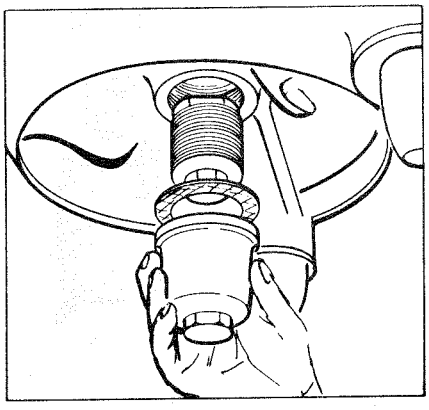
Remove neck bearing protec-cap and spindle spring.



Pull out worm spindle together with neck bearing bridge. Make sure not to damage gaskets during removal. If necessary, replace gaskets.



Invert the worm spindle. Remove the neck bearing bridge by tapping the end of the spindle against a wooden block.



After removing bottom bearing cap and gasket, unscrew bottom bearing threaded piece and remove it together with the bottom bearing.

8.2 Assembling the vertical gear parts

In order to assemble the vertical gear parts, proceed in the reverse order to that described in section 8.1.

Important tips for assembly

- The gear chamber must be thoroughly cleaned every time before the vertical gear parts are re-installed (7.5).
- For safety reasons, the ball bearing of the worm spindle must be replaced every 5,000 operating hours.
- Check the ball bearings on the worm spindle before re-installation.
  N.B. Use only the precision ball bearings which are indicated in the spare parts list.
- Before the ball bearings and the ball bearing protection rings are placed over the spindle, they must be warmed in an oil bath to a temperature of approx. 80 ^{0}C.
- The assembled spindle must slide into position without having to be hit with a mallet. It must be possible to move the spindle assembly axially by hand. Should this not be possible, any burrs in the bottom bearing housing must be removed with fine emery cloth.
- When installing a new worm, the entire worm wheel assembly with clamp plates (fig. 15/2) must be replaced.
- **IMPORTANT:** Whenever the vertical gear parts have been installed, the height of the bowl must be checked and re-adjusted if necessary (see 8.3).

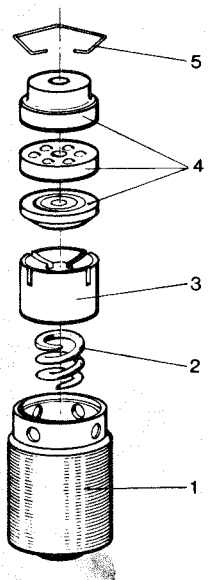


Fig. 8/2

8.2.1 Assembling the bottom bearing

Clean all parts of the complete bottom bearing thoroughly.

Place pressure spring 2 into bottom bearing pressure piece 3 and fit both into bottom bearing threaded piece 1.

Place bottom bearing running parts 4 into the bottom bearing threaded piece:

bottom bearing pressure disc,

ball cage,

bottom bearing running disc.

Place snap ring 5 into bottom bearing threaded piece.

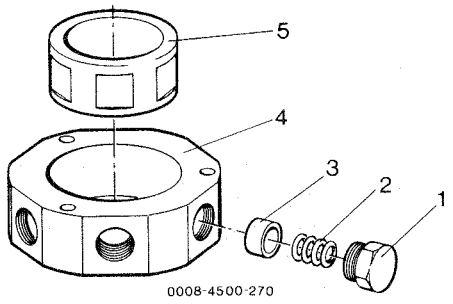


Fig. 8/3

8.2.2 Assembling the neck bearing bridge

The upper ball bearing on the spindle is contained in pressure ring 5. The latter is held in place by six radially arranged equally distributed springs 2.

- Place pressure ring into neck bearing bridge 4 so that the six recesses on the pressure ring are aligned directly with the six holes in the neck bearing bridge.

- Thoroughly grease spring pistons 3. Place neck bearing springs 2 into spring pistons and insert both into threaded plugs 1.

- Screw threaded plugs together with inserted springs and pistons into the six tapholes in the neck bearing bridge.

8.3 Bowl height

8.3.1 Checking the bowl height

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

Prerequisite to correct bowl height adjustment is that

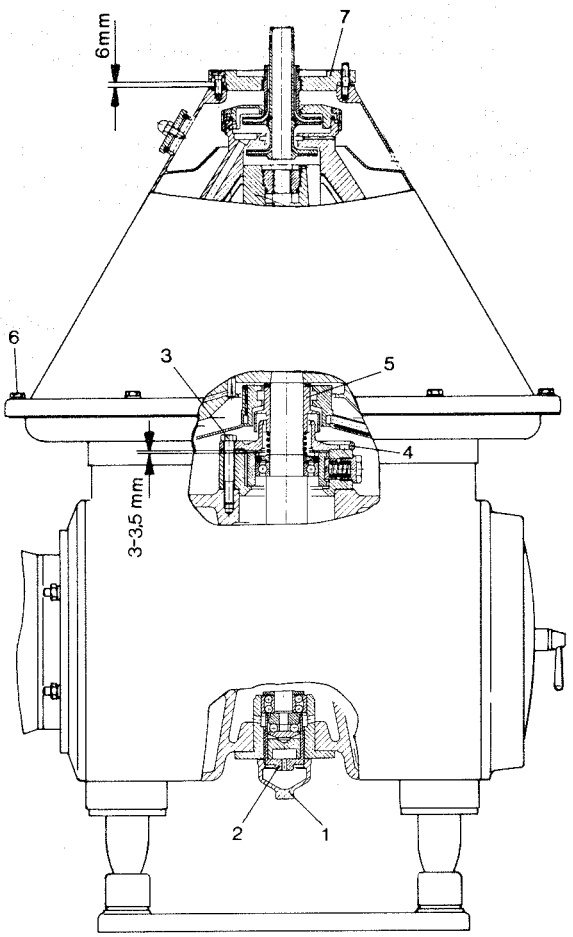


Fig. 8/4

- the bowl is properly closed (the "O" marks on bowl lock ring and on bowl bottom must be in line with each other),
- the hood is properly seated on the frame rim, locked in place, and hex head screws 6 are tightened **securely,**
- upper centripetal pump is screwed onto lower centripetal pump as far as it will go and that centripetal pump assembly is screwed all the way into ring 7.

The bowl height is correct when the ring 7 with the screwed-in centripetal pumps can be raised by about 6 mm. Otherwise the bowl height has to be re-adjusted (see 8.3.2).

8.3.2 Re-adjusting the bowl height

For re-adjustment of the bowl height proceed as follows:

Unscrew bottom bearing cap 1. Adjust bowl height by turning bottom bearing threaded piece 2 (fig. 8/4). One complete revolution of the bottom bearing threaded piece to the Right or to the Left raises or lowers the bowl by 2 mm.

If the clearance shown in Fig. 8/4 is **greater than 6 mm,** the bowl is too high. Lower the bowl by turning the bottom bearing threaded piece in **counter-clockwise** direction.

If the clearance shown in Fig. 8/4 is **less than 6 mm,** the bowl is too low. Raise the bowl by turning the bottom bearing threaded piece in **clockwise direction.**

If the bowl has to be raised by more than 1 mm, then remove bowl and sediment collector (see 4.4).
Take off spindle cap 5, undo screws 3 and remove neck bearing protection cap 4. Then turn bottom bearing threaded piece clockwise until bowl is adjusted to proper height.

Each time the bowl has been lowered or raised, check if there is a clearance of 3 to 3.5 mm between cams of distance ring 2 and neck bearing bridge 1. In order to be able to check this clearance, remove bowl, sediment collector, spindle cap and neck bearing protection cap, unless these parts have already been removed before raising the bowl by more than 1 mm. This check is not required if it has been made after re-assembling the vertical gear parts and the bowl had not to be raised by more than 1 mm.

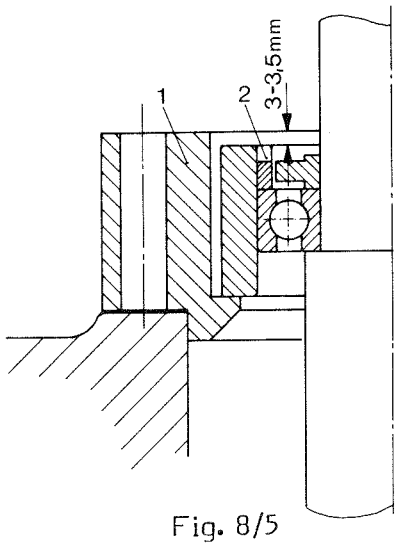


Fig. 8/5

If the clearance between the cams of the distance ring and the neck bearing bridge is smaller than 3 mm, the cams have to be filed to proper dimension. If the distance is greater than 3.5 mm, increase height of cams by welding or check with the factory for a new distance ring with properly sized cams.

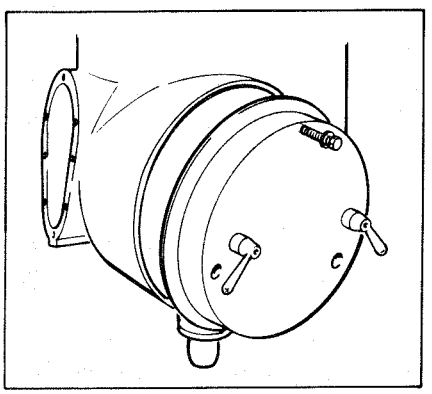
After checking the clearance between distance ring and neck bearing bridge, re-install the dismantled parts.
Replace bottom bearing cap 1 (fig. 8/4) including gasket and screw on tightly.

8.4 The centrifugal clutch

8.4.1 General

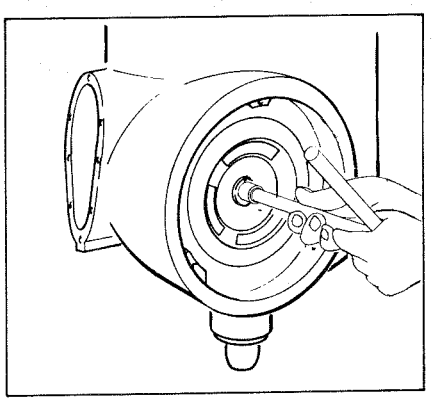
The centrifugal clutch gradually accelerates the bowl to the desired speed. It reduces strain on the motor and gear to a minimum. The power from the motor is transferred to the clutch drum via three clutch shoes, which are fitted in the slits of the clutch driver, and subsequently to the gear parts (see page 15/4).

The condition of the clutch shoes must be checked every four weeks. The linings must be renewed before they wear down to the rivets, so that the latter do not damage the clutch drum. If the clutch drum is damaged then it would cause premature wear to the clutch linings. To ensure smooth running, the linings of all clutch shoes must be changed at the same time. Never replace the lining on just one clutch shoe. It is recommendable to replace the complete clutch shoes.



8.4.2 Removing the clutch shoes

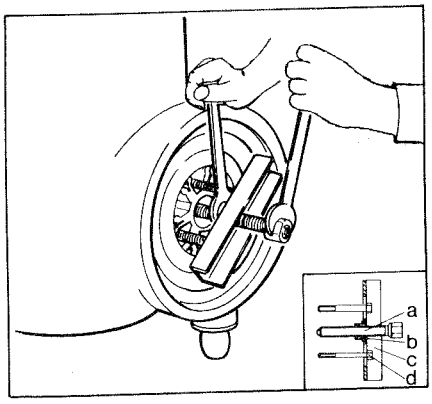
Undo three hex head screws (M 12x100).
Remove washers and cover.



While unscrewing nut, hold worm wheel shaft.

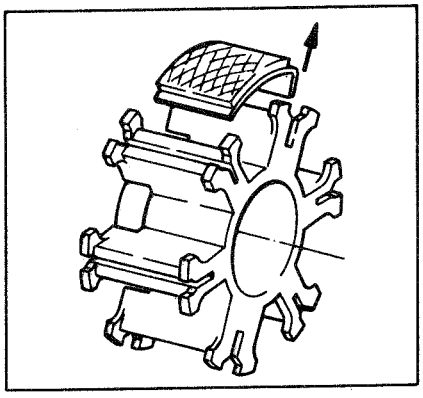
Tools:

Socket wrench 15
Socket SW 30



Use pulling device to remove the clutch driver from the worm wheel shaft:

- Fasten device to clutch driver by means of screws **d** (M 12x110). Ensure that nut **b** is on the clutch side. (Refer to drawing opposite.)
- Screw in threaded spindle **a** by hand. Ensure that the point of the spindle presses into the centering hole on the worm wheel shaft.
- Remove the clutch driver together with the clutch shoes by turning the threaded spindle in clockwise direction and by holding the nut (SW 27) at the same time.



Remove the clutch shoes from the slits of the clutch driver.

8.4.3 Installation of the clutch shoes

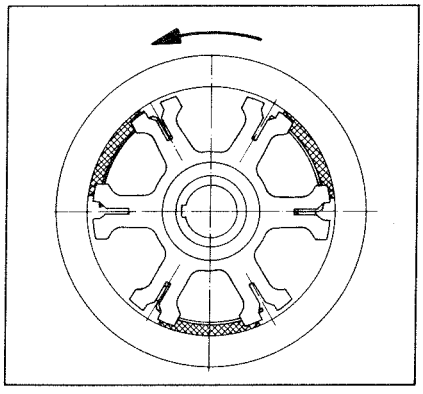


Fig. 8/7a

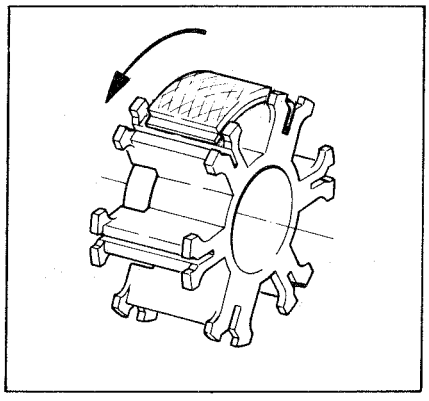


Fig. 8/7b

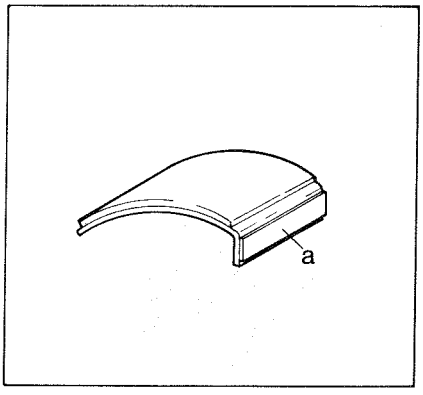


Fig. 8/7c

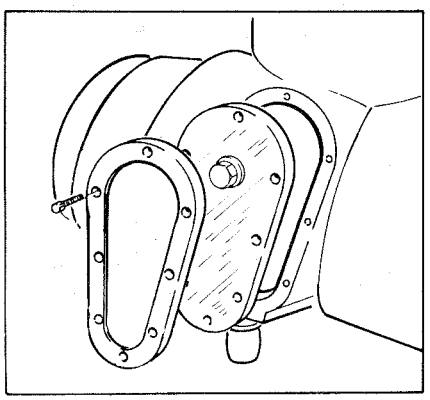
For installing the clutch shoes proceed in the reverse order of removal (8.4.2) and bear in mind the following:

- Insert the clutch shoes into the slits of the clutch driver in such a manner that they will be **pushed** by the driver and **not pulled** (see figs. 8/7a, 8/7b).
  Make sure that the clutch shoes are loosely seated in the slits of the clutch driver.

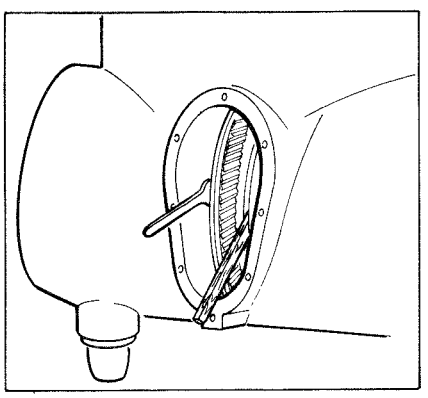
- In case the centrifugal clutch emits disturbing noises during the acceleration period, apply a very thin film of grease to the lips "a" (fig. 8/7c) of the clutch shoes. If too much grease is applied, there is the chance that some might be thrown by centrifugal force on the friction surfaces, leading to clutch slippage.

8.4.4 Removing the clutch drum

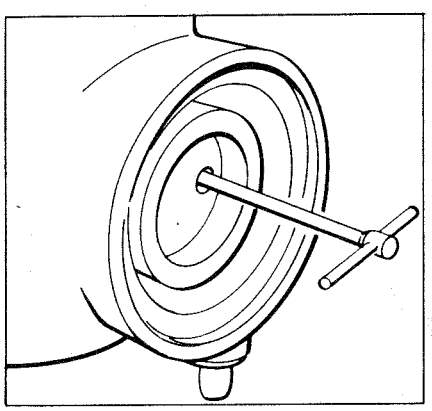
1) Remove the clutch shoes (see 8.4.2).



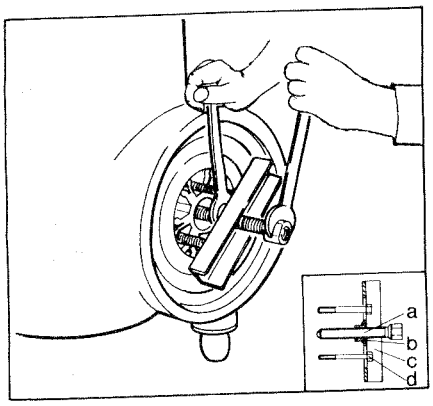
2) Remove gear sight glass together with the frame.



3) Undo 3 hex head screws (M 10x75) in worm wheel and loosen clamp plates.

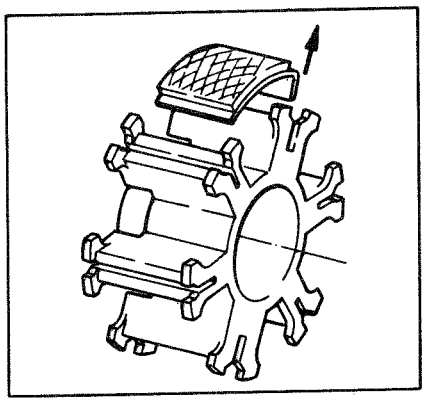


4) Use wrench to remove the screws of the bearing cover through the holes in the clutch drum.



Use pulling device to remove the clutch driver from the worm wheel shaft:

- Fasten device to clutch driver by means of screws **d** (M 12x110). Ensure that nut **b** is on the clutch side. (Refer to drawing opposite.)
- Screw in threaded spindle **a** by hand. Ensure that the point of the spindle presses into the centering hole on the worm wheel shaft.
- Remove the clutch driver together with the clutch shoes by turning the threaded spindle in clockwise direction and by holding the nut (SW 27) at the same time.



Remove the clutch shoes from the slits of the clutch driver.

8.4.3 Installation of the clutch shoes

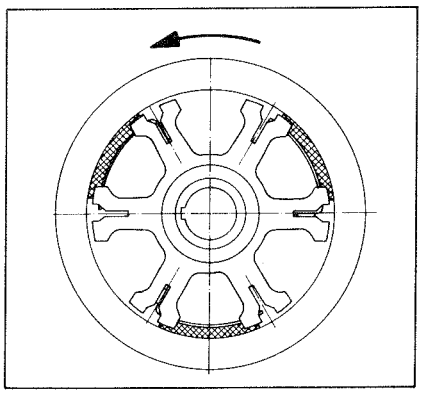


Fig. 8/7a

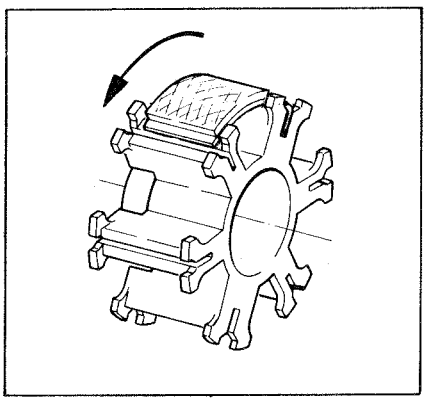


Fig. 8/7b

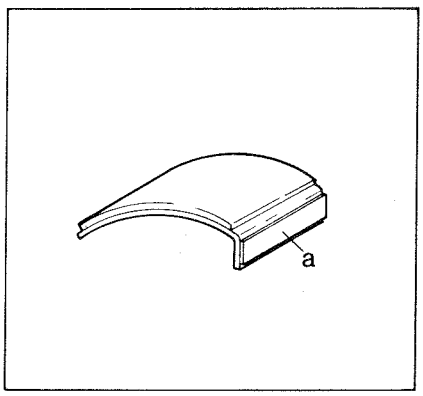


Fig. 8/7c

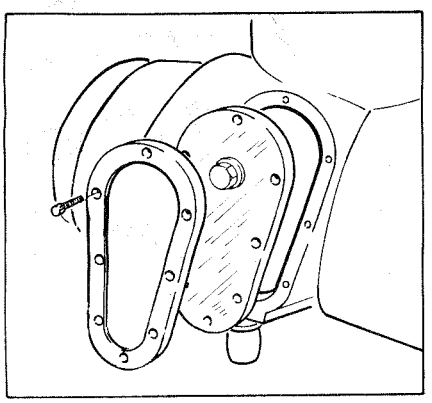
For installing the clutch shoes proceed in the reverse order of removal (8.4.2) and bear in mind the following:

- Insert the clutch shoes into the slits of the clutch driver in such a manner that they will be **pushed** by the driver and **not pulled** (see figs. 8/7a, 8/7b).
  Make sure that the clutch shoes are loosely seated in the slits of the clutch driver.

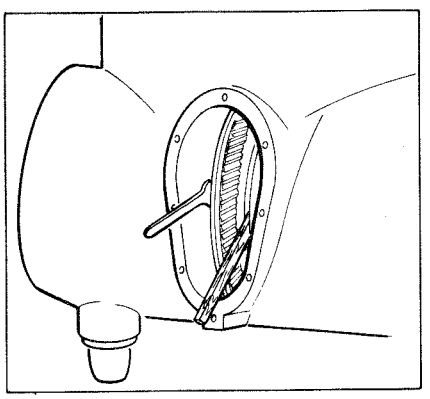
- In case the centrifugal clutch emits disturbing noises during the acceleration period, apply a very thin film of grease to the lips "a" (fig. 8/7c) of the clutch shoes. If too much grease is applied, there is the chance that some might be thrown by centrifugal force on the friction surfaces, leading to clutch slippage.

8.4.4 Removing the clutch drum

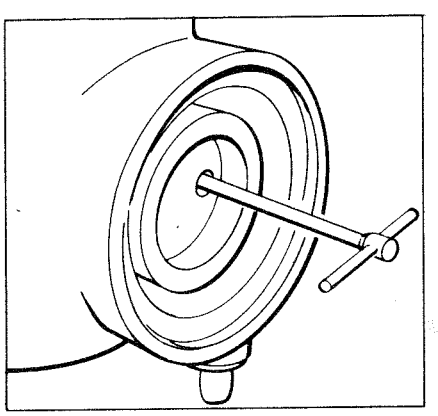
1) Remove the clutch shoes (see 8.4.2).



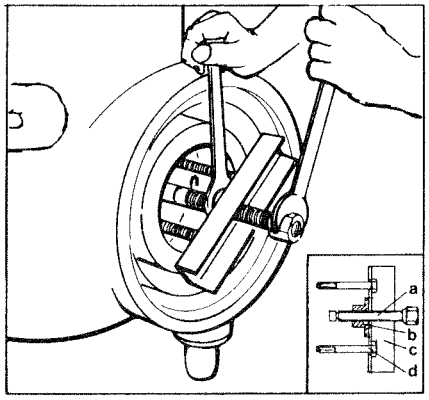
2) Remove gear sight glass together with the frame.



3) Undo 3 hex head screws (M 10x75) in worm wheel and loosen clamp plates.



4) Use wrench to remove the screws of the bearing cover through the holes in the clutch drum.

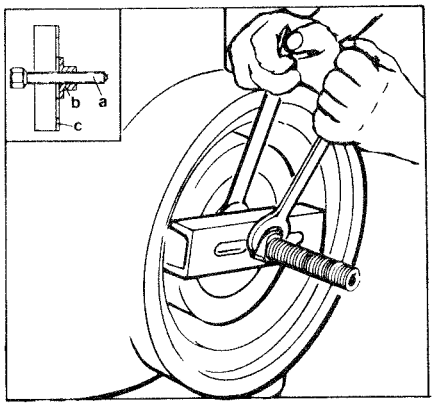


5) Use pulling device to remove the clutch drum from the worm wheel shaft.

   a) Fasten device to clutch drum by means of screws **d** (M 12x140). Ensure that nut **b** is on the clutch side. (Refer to drawing opposite.)

   b) Screw in threaded spindle **a** by hand. Ensure that the point of the spindle presses into the centering hole of the worm wheel shaft.

   c) Remove the clutch drum by turning the threaded spindle in clockwise direction and by holding the nut (SW 27) at the same time.



8.4.5 Installing the clutch drum

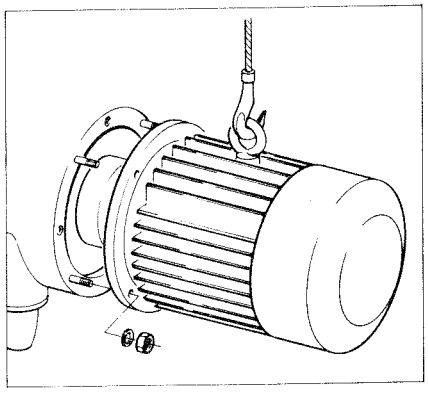
- Use device to install the clutch drum:

  a) Assemble clutch drum, bearing cover and ball bearing and place carefully onto the worm wheel shaft.

  b) Attach device as shown in opposite drawing (nut **b** on the outside). Screw threaded spindle **a** onto worm wheel shaft.

  c) Hold threaded spindle (SW 27) and tighten nut **b** until the bearing which sits on the clutch drum is pressed into the bearing seat.

- Proceed in opposite manner as detailed for removal: See 8.4.4, items 2 - 4. Before the screws for the bearing cover are screwed down, ensure that the oil return hole in bearing cover is pointing downwards.



8.5 Removal of the horizontal gear parts

8.5.1 Removing the motor

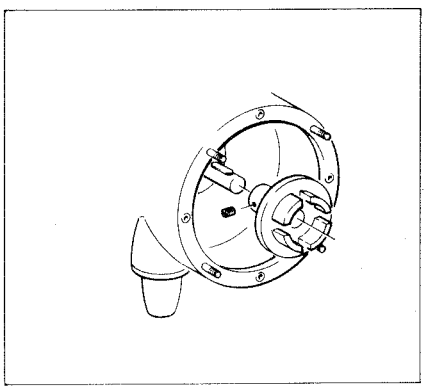
- Disconnect motor.
- Hang load hook into eye bolt of motor and tighten carrying rope.
- Unscrew nuts and remove lock washers.
- By means of hoist lift off the motor.

8.5.2 Removing the worm wheel shaft and worm wheel

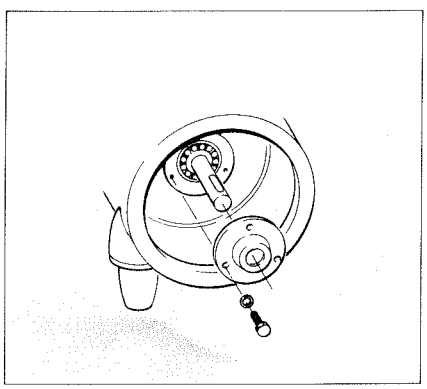
Remove the motor (see 8.5.1).

Remove the clutch shoes (see 8.4.2).

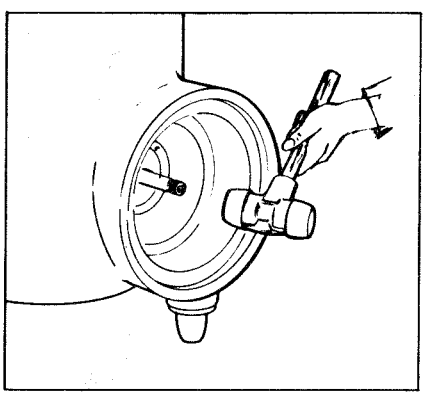
Remove the clutch drum (8.4.4).



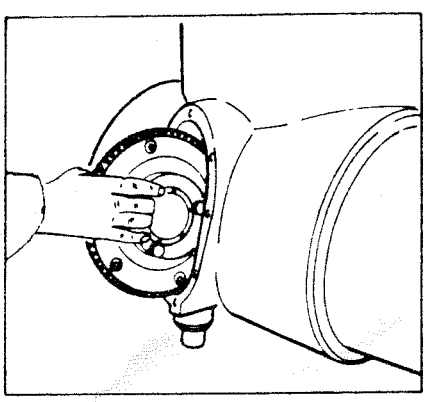
Loosen threaded pin.
Pull off clutch hub, using device.



Unscrew screws holding the bearing cover.



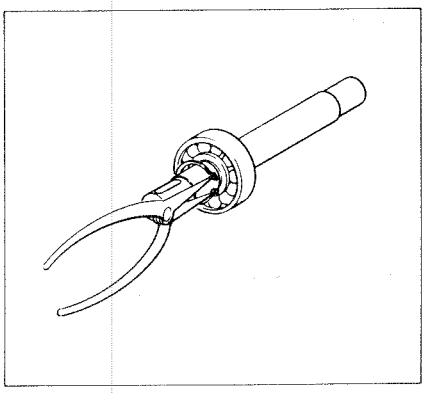
Drive out worm wheel shaft towards motor side by rapping with a rubber hammer on the shaft end. Then pull out the shaft by hand, holding the worm wheel.



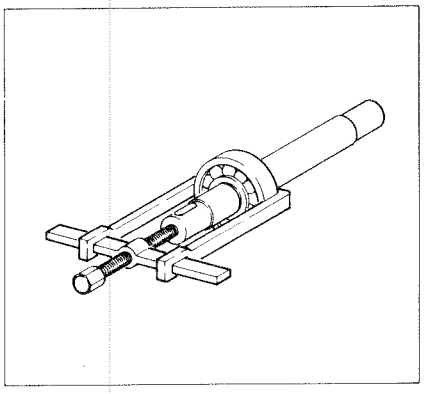
Remove the worm wheel from the gear chamber.

8.5.3 Removing the ball bearing on the motor side

Remove the worm wheel shaft (see 8.5.2).



Use pliers to remove securing ring from worm wheel shaft.

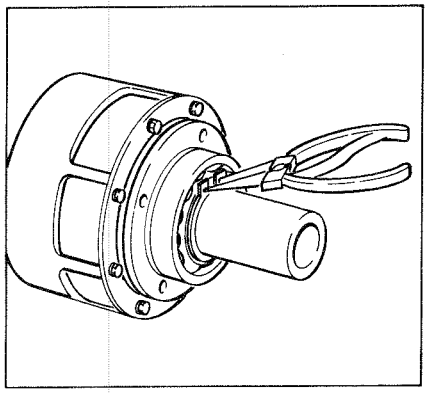


Remove ball bearing from worm wheel shaft.

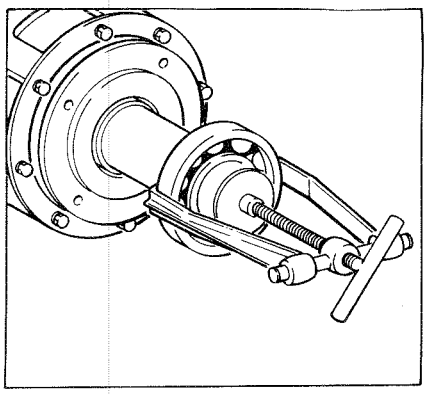
8.5.4 Removing the ball bearing on the brake side

Remove the clutch shoes (8.4.2)

Remove the clutch drum (8.4.4).



Use pliers to remove securing ring from clutch drum.



Pull ball bearing from hub of clutch drum.

8.6 Installing the horizontal gear parts

Proceed in the opposite direction required for removing the horizontal gear parts (see 8.5). Bear in mind the following:

- For reasons of safety the bearing on the worm wheel shaft must be replaced every 5 000 operating hours.
- The complete worm wheel assembly, together with its clamp plates (fig. 15/2), has been balanced in our factory. In order to ensure smooth running, single parts should not be replaced individually. (This, however, does not apply to the clamp plates 5 and 6 and hex head screws 7).
- When installing the worm wheel with clamp plates ensure that the middle of toothing meshes with the middle of worm spindle.
- The worm wheel must be clamped securely to the hub of the clutch drum. This is done by **tightening** the screws in the two clamp plates crosswise. In order to facilitate this process, it is advisable to place the bowl bottom onto the spindle.
- N.B. When the toothed rim is being replaced, **the complete worm wheel assembly, together with the clamp plates,** must be replaced at the same time. The worm should also be replaced.
- Once the new gear parts have been installed, the bowl can be lowered into place and set to the correct height (see sect. 8.3).
- Fill the gear chamber with the oil specified in sect. 2 until the oil level is slightly above the oil level mark.
- Check spindle speed (see 3.3) and direction of bowl rotation (see 3.2).
- In order to run in the new gear parts (worm wheel and worm), run the separator for about one hour **without the bowl.** During this running-in process, turn the motor on and off several times.

10.1 General

Troubles	Causes	Remedies
The bowl does not come up to rated speed or takes too long to do so.	Brakes are on.	Release brakes by turning handles clockwise.
	Motor is incorrectly connected.	See wiring diagram.
	Oil on surfaces of clutch shoes.	Wipe dry the surface of the clutch shoes. Do **not** use benzene, trichlorethylene or other solvents.
	Clutch shoe linings are worn.	Replace clutch shoes (8.4.2 and 8.4.3).
	Bowl is too high or too low and, therefore, rubs against centripetal pump.	Adjust to proper bowl height (see 8.3).
	Clamp plates are not tight enough; worm wheel slips on shaft.	Tighten long hex head screws on worm wheel evenly and **firmly.** Tighten with a torque of 45 Nm.
	Product feed valve is open.	Close product feed valve.
The bowl speed drops during operation.	Oil on surface of clutch shoes.	Wipe dry the surface of the clutch shoes. Do **not** use benzene, trichlorethylene or other solvents.
	Motor speed drops during operation.	Inspect motor and line voltage.
	The gaskets in annular piston do not seal.	Replace all gaskets.

Troubles	Causes	Remedies
Uneven run of the separator.	Incomplete solids ejection. The remaining solids have deposited unevenly in the bowl.	Perform several partial de-sludgings (6.4.2). If this does not improve conditions, close the bowl and fill it with water to attenuate the increased vibrations occurring during slowing-down of the bowl. Stop the separator and apply brakes. If bowl is leaking, leave feed open. Clean bowl thoroughly.
	Bowl is not properly assembled or, if plant has several separators, parts of different bowls may have been interchanged.	Assemble bowl properly (see 4.1).
	Tension of disc stack has slackened.	Make sure bowl lock ring is screwed on tightly (see 4.1). Check disc count. If necessary, add spare disc or compensating disc.
	Bowl is damaged and, therefore, out of balance.	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.
	Neck bearing springs are weak or broken.	Replace all 6 neck bearing springs.
	Pressure spring in bottom bearing is broken, bowl is approx. 2 mm too low in the frame.	Put in new spring (see 8.2.1). Set bowl to correct height (see 8.3).
	Ball bearings are worn.	Replace worn bearings. **N.B.** Use only precision ball bearings (see spare parts list).

Troubles	Causes	Remedies
Uneven run of the separator (cont'd.)	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, recognized by blue tempering colour of gear parts) c) metal abrasives present in the lubricating oil due to the following possible causes: viscosity of oil is 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.	Clean gear chamber thoroughly (see 7.5). Replace damaged gear parts (see 8.2 and 8.6). Change oil (see chapt. 2). If necessary, change oil more often.

10.2 Bowl performance (Fig. 10)

Troubles	Causes	Remedies
The bowl does not close at all.	Water pressure in supply line to operating-water connection is too low.	Check water line pressure. With open valves the pressure must be at least 2 bar.
	Water discharge holes in the top of the operating-water feed are partially blocked by scale.	Clean discharge holes.
	Operating-water feed leaks.	Check line, screw couplings and gaskets.
	Operating-water feed is clogged.	Clean operating-water feed.
	Solenoid valve 3 (fig. 5/4) does not function properly, because the diaphragm has become brittle and, therefore, fails to seal properly.	Replace diaphragm. Ensure that the hole on outer rim of diaphragm is aligned with the hole of valve housing.
	The 15 gaskets C in annular piston do not seal.	Replace all 15 gaskets.
	Gasket D in annular piston or gaskets B in bowl top are damaged or their edges have been frayed through the up- and down movement of the piston.	Replace damaged gaskets. If only the edges of the gasket are frayed and the gasket is not damaged otherwise, it can be re-used after grinding it off with an emery wheel.
The bowl does not close and open properly.	Gasket D in annular piston or gaskets B in bowl top do not seal effectively at all points.	If necessary, stretch gasket. Before inserting gaskets, lightly grease grooves in annular piston or in bowl top to ensure that gasket can slide outwards.
	Gasket H in bowl bottom is damaged.	Replace gasket.
	Holes G in bowl top (feed of operating water to opening chamber) are clogged.	Remove bowl top (4.4). Clean holes.
	Holes K in annular piston (feed of operating water to closing chamber) are clogged.	Remove annular piston (4.4). Clean holes.

Fig. 10

	Lubricant	Operating hours 250	750	1500	2500	3000	5000	10000	MAINTENANCE	Every week	3 months	6 months	1 year	2 years
Lubrication Chart		●							First oil change after initial start-up (see 2.1) and thorough cleaning of gear chamber.					
	O								Check oil level.	●				
	O		●						Oil change and thorough cleaning of gear chamber.			●		
	O			●					Lubrication of hand-operated parts such as brake bolt, valves, etc.			●		
	MF	whenever disassembling							Grease bowl lock ring and guide and sliding surfaces of bowl parts.	whenever disassembling				
	F								Grease motor ball bearings according to manufacturer's instructions.					
Servicing Program	Cleaning		when necessary						Clean strainer in operating-water line.		when necessary			
				●					Clean gear chamber (oil change).			●		
						when necessary			Clean discharge holes in operating-water feeding system.			●		
					●				Remove bowl and clean interior of frame and sediment collector.			●		
		product dependent							Dismantle the bowl and clean thoroughly bores and chambers of the hydraulic system.		product dependent			
	Inspection			●					Check bowl gaskets.		●			
				●					Check starting time and rated speed.			●		
				●					Check neck bearing springs and spring pistons. Check brake linings.			●		
						●			After removing the gear sight glass, check gearing of worm wheel gear.				●	
		product dependent							Check spaces between solids ejection holes.	product dependent				
									Bowl inspection. Check threads of lock rings for erosion and corrosion.				●	
	Replacement						●		Replace ball bearings on spindle.					
							●		Replace ball bearings on worm wheel shaft.					
							●		Replace neck bearing springs.					
									Replace gaskets in annular piston.				●	

Abbreviations:

O = Lubricating oil

MF = Molykote D
Molykote DX
Klüber grease

F = Ball and roller bearing grease

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 rim of the sediment collector.
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. The encircled parts (e. g. ②) within an assembly are complete parts. The corresponding parts are shown in a separate drawing referred to in column "Part-No.".
5) Bowl Serial-No.	(only required when ordering bowl parts): The Bowl Serial-No. appears, in large figures, on bowl lock ring and on bowl bottom.

Part-Numbers ending with letter "L" (e. g. 3158-1021-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.**

No. in Fig.	Part - No.	Qty.	Part Description
-	1056-1100-060	1	Frame, complete (1 - 42)
1	1056-1001-010	1	Lower section of frame
2	0004-5252-770	1	Gasket 85/135x0.3
3	3036-1112-010	1	Bottom bearing housing
4	0026-1328-190	4	Lock washer DIN 127 - A 12
5	0019-6970-400	4	Hex head screw DIN 933 - M 12x30
6	0004-5292-740	1	Gasket 24/36x2
7	0019-1712-400	1	Lock screw M 24x1.5
8	1056-1277-000	2	Gasket
9	1056-8852-000	1	Sight glass
10	1056-1447-000	1	Frame
11	0026-1345-300	8	Washer DIN 125 - 8.4
12	0019-6906-300	8	Hex head screw DIN 933 - M 8x25
13	0007-2501-750	1	Gasket 23/3
14	0019-1419-300	1	Threaded plug M 26x1.5x13
23	1056-1066-000	1	Cover
24	0026-1371-400	3	Washer DIN 125 - 13
25	0019-6984-400	3	Hex head screw DIN 933 - M 12x100
(26)	1073-1043-000	2	Brake, complete
	see page 13/3		
27	0019-3973-060	2	Threaded pin DIN 438 - M 8x10
(28)	2308-1021-070	1	Intermediate flange, complete
	see page 13/4		
29	1056-1018-010	1	Sediment collector
30	0019-6144-400	8	Allen screw DIN 912 - M 10x25
31	0004-2361-758	1	Packing cord 6x6 (2.20 m)
32	0026-1348-400	8	Washer DIN 125 - 10.5
33	0019-6933-400	8	Hex head screw DIN 933 - M 10x20
34	0007-1731-840	1	Gasket 480x517x16
35	0019-6106-400	8	Allen screw DIN 912 - M 6x16
36	0007-2212-750	1	Gasket DIN 11851 - G 65
37	1056-1177-000	1	Bend
38	0013-2846-300	1	Grooved coupling nut DIN 11851 - F 65
(39)	1033-1015-000	3	Foot, complete
	see page 13/5		
40	0001-0515-300	3	Flange 60
41	0019-6906-300	9	Hex head screw DIN 933 - M 8x25
(42)	1033-1020-020	1	Foundation frame, complete
	see page 13/6		

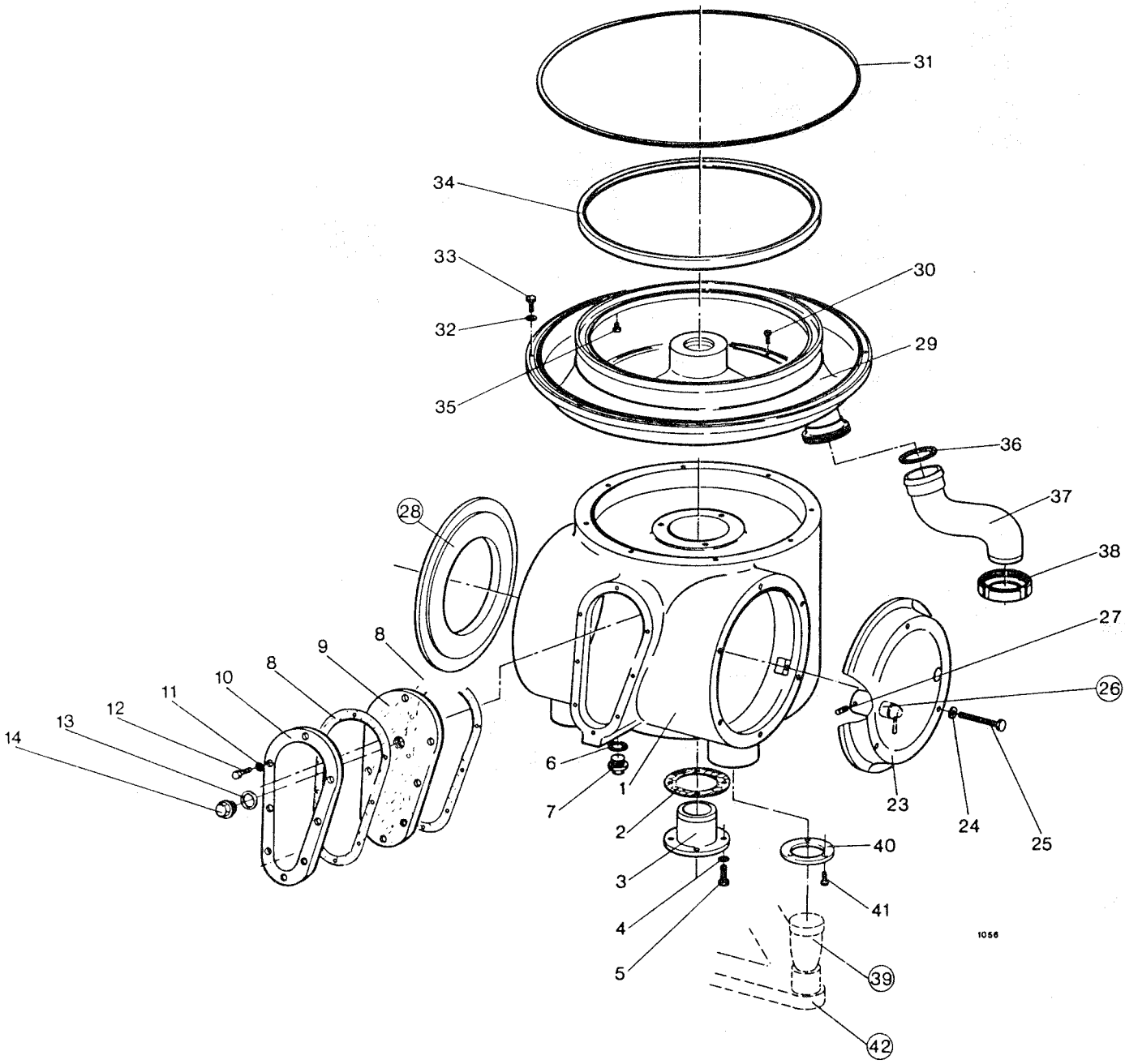

31
34
33
30
32
29
35
36
37
28
38
27
8
9
8
10
26
11
12
13
14
6
1
7
2
23
24
25
40
3
41
4
5
1056
39
42

Fig. 13/1

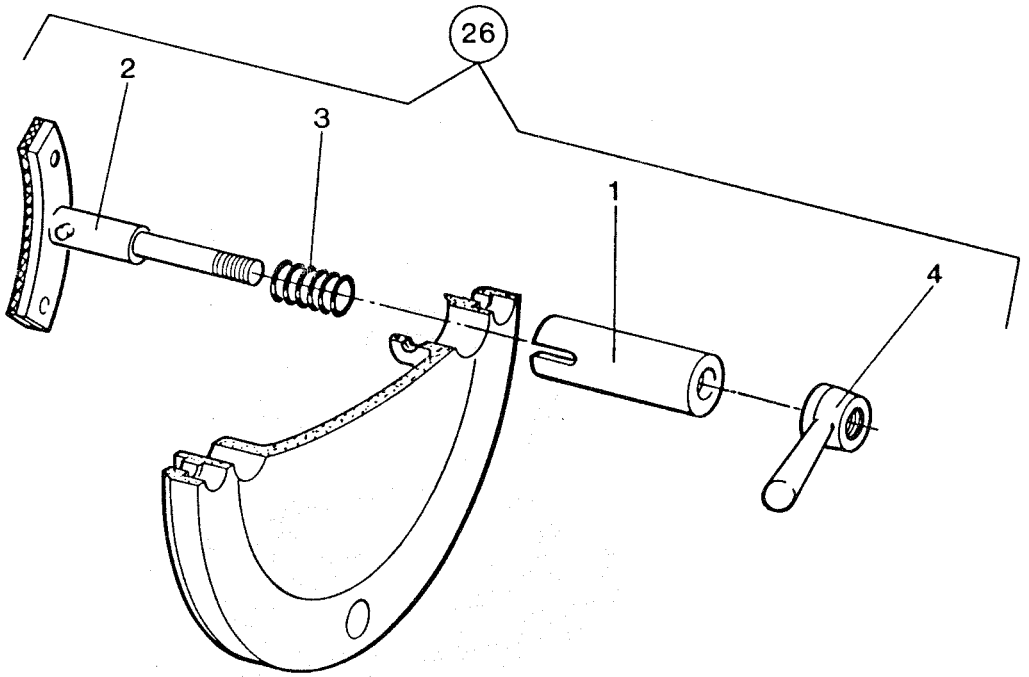


Fig. 13/2

No. in Fig.	Part - No.	Qty.	Part Description
(26)	1073-1043-000	2	Brake, complete (1 - 4)
1	0021-3544-640	1	Brake housing 30/22x114
2	1073-1031-020	1	Brake bolt
3	0006-4338-160	1	Cylindrical pressure spring 21x3.5x70 - 13.5 Wdg.
4	0021-3515-690	1	Handle M 12

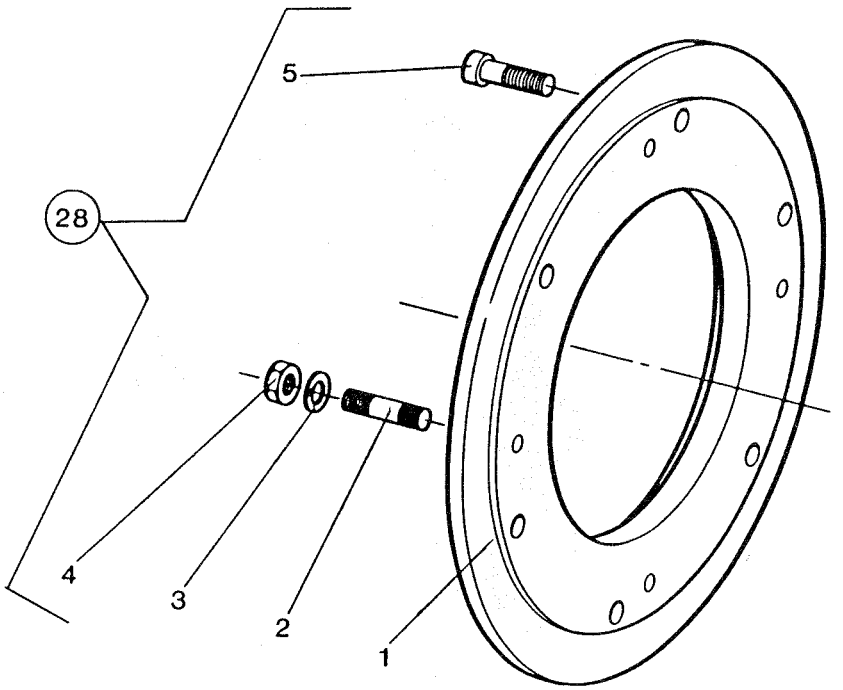


Fig. 13/3

No. in Fig.	Part - No.	Qty.	Part Description
(28)	2308-1021-070	1	Intermediate flange, complete (1 - 5)
1	2308-1028-070	1	Intermediate flange
2	0019-7668-090	4	Stud DIN 939 - M 12x35
3	0026-1328-190	4	Lock washer DIN 127 - A 12
4	0013-0280-400	4	Hexagon nut DIN 934 - M 12
5	0019-6168-150	6	Allen screw DIN 912 - M 12x45

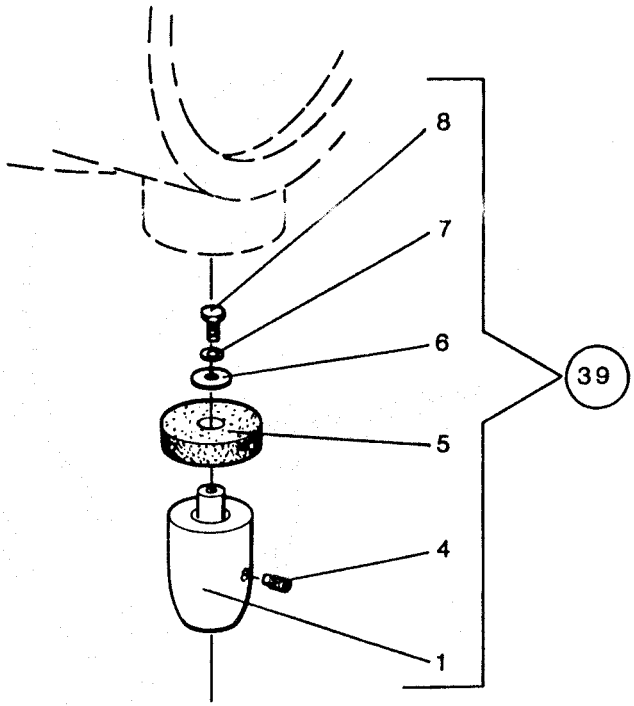


Fig. 13/4

No. in Fig.	Part - No.	Qty.	Part Description
39	1033-1015-000	3	Foot, complete (1, 4 - 8)
1	1033-1011-000	1	Foot with lining
4	0019-6376-400	1	Threaded pin DIN 915 - AM 10x20
5	0021-3017-750	1	Rubber cushion 18/70x20
6	0026-1336-030	1	Washer 8.2x30x2
7	0026-1325-190	1	Lock washer DIN 127 - A 8
8	0019-6901-400	3	Hex head screw DIN 933 - M 8x16

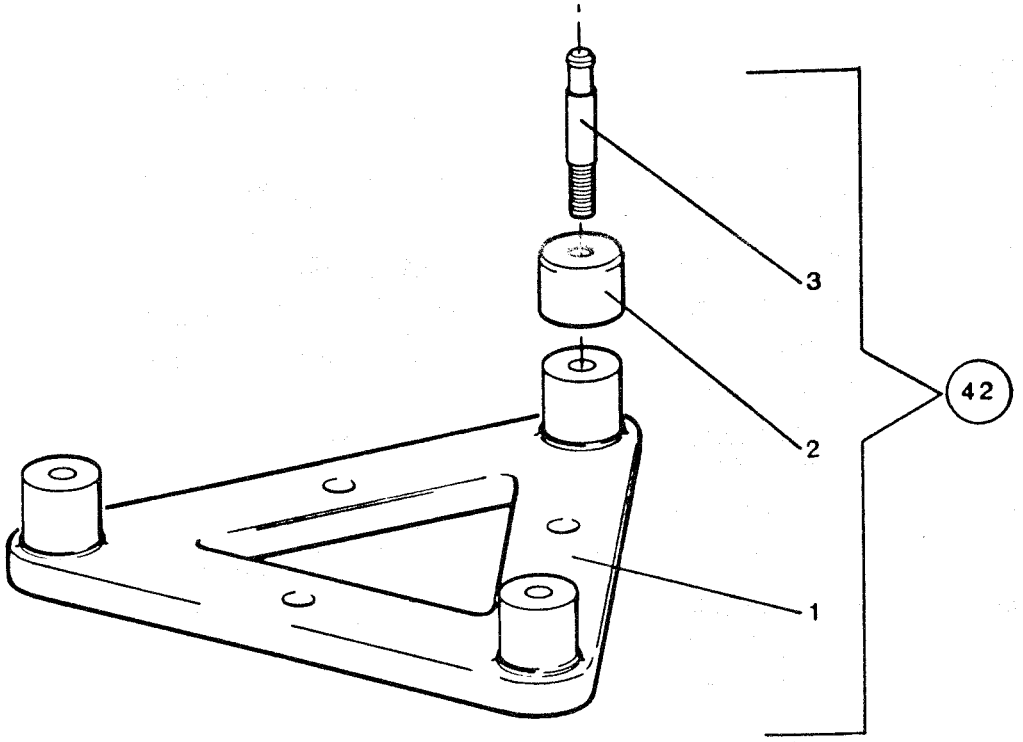


Fig. 13/5

No. in Fig.	Part - No.	Qty.	Part Description
(42)	1033-1020-020	1	Foundation frame, complete (1 - 3)
1	1033-1003-020	1	Foundation frame
2	0026-2032-300	3	Cap 60x46
3	1033-1033-010	3	Bolt

No. in Fig.	Part - No.	Qty.	Part Description
(1)	0010-4200-000 see page 14/3	1	Bottom bearing, complete
2	0004-5048-740	1	Gasket 55/70x2
3	0010-4203-200	1	Bottom bearing cap 42
(4)	1056-3429-000 see page 14/4	1	Worm spindle, complete
(25)	1033-3490-000 see page 14/5	1	Tachometer drive, complete
26	0004-5212-700	1	Gasket 58/82x1
27	0019-2250-030	3	Cheese head screw DIN 84 - M 6x18
(28)	8473-3000-050 see page 14/5	1	Tachometer, complete
29	1033-3494-030	1	Cap
(30)	0008-4500-270 see page 14/6	1	Neck bearing bridge assembly with covering

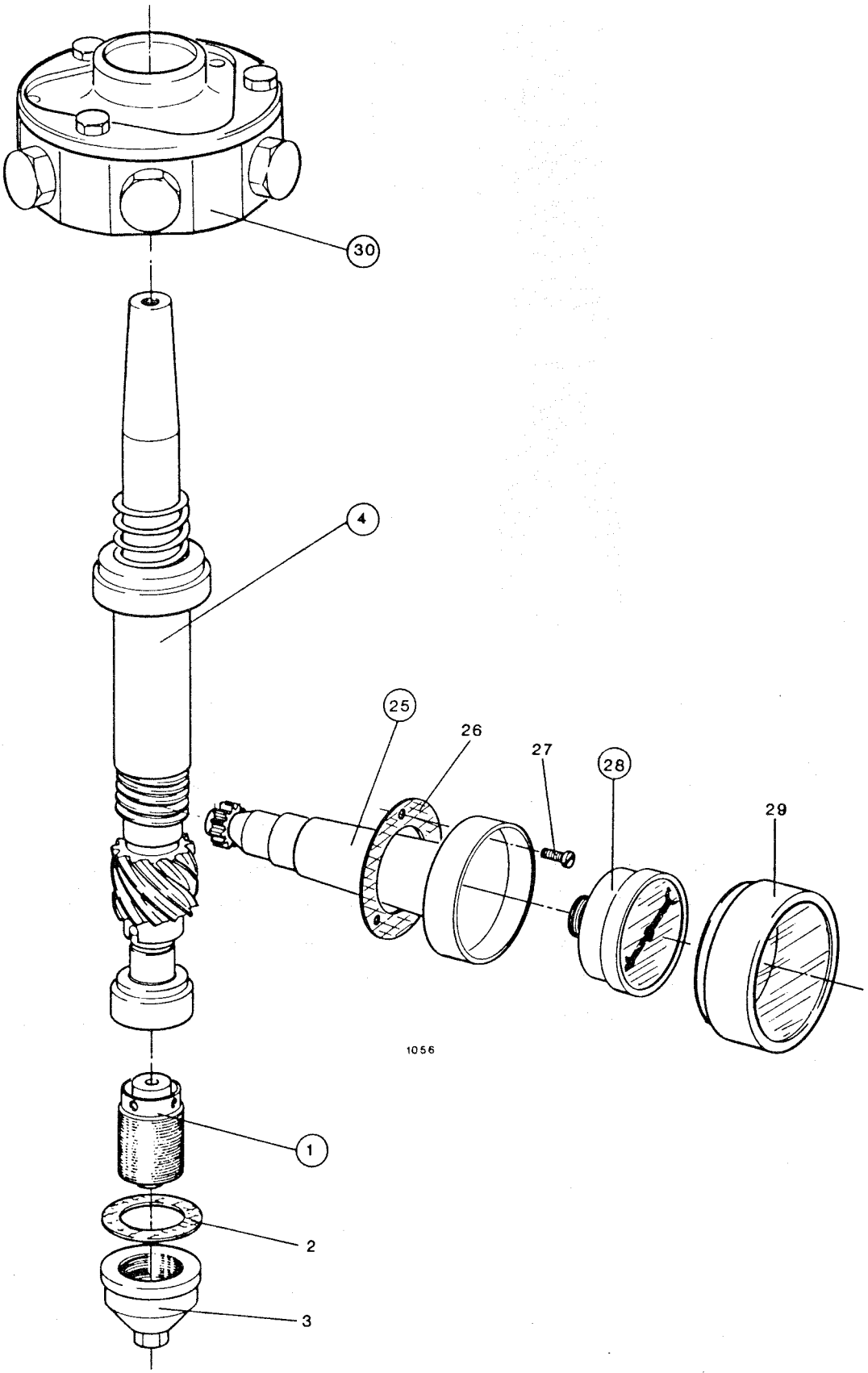


Fig. 14/1

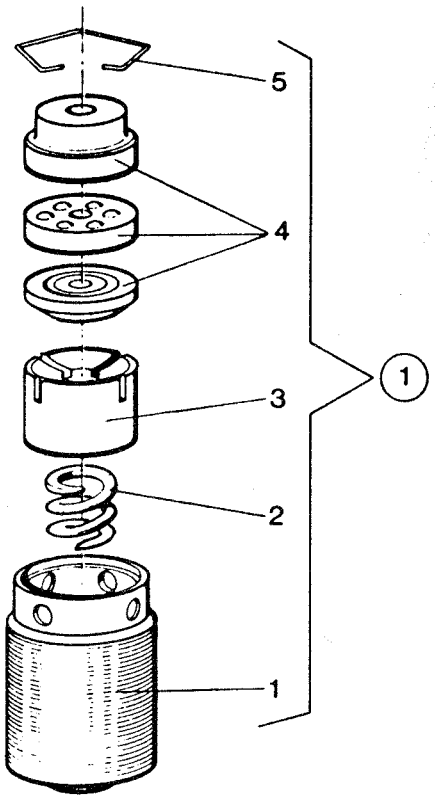


Fig. 14/2

No. in Fig.	Part - No.	Qty.	Part Description
①	0010-4200-000	1	Bottom bearing, complete (1 - 5)
1	0010-4202-000	1	Bottom bearing threaded piece
2	0006-4250-160	1	Cylindrical pressure spring
3	0010-4201-200	1	Bottom bearing pressure piece
4	0010-4210-000	1	Bottom bearing running parts, complete
5	0026-1482-170	1	Snap ring

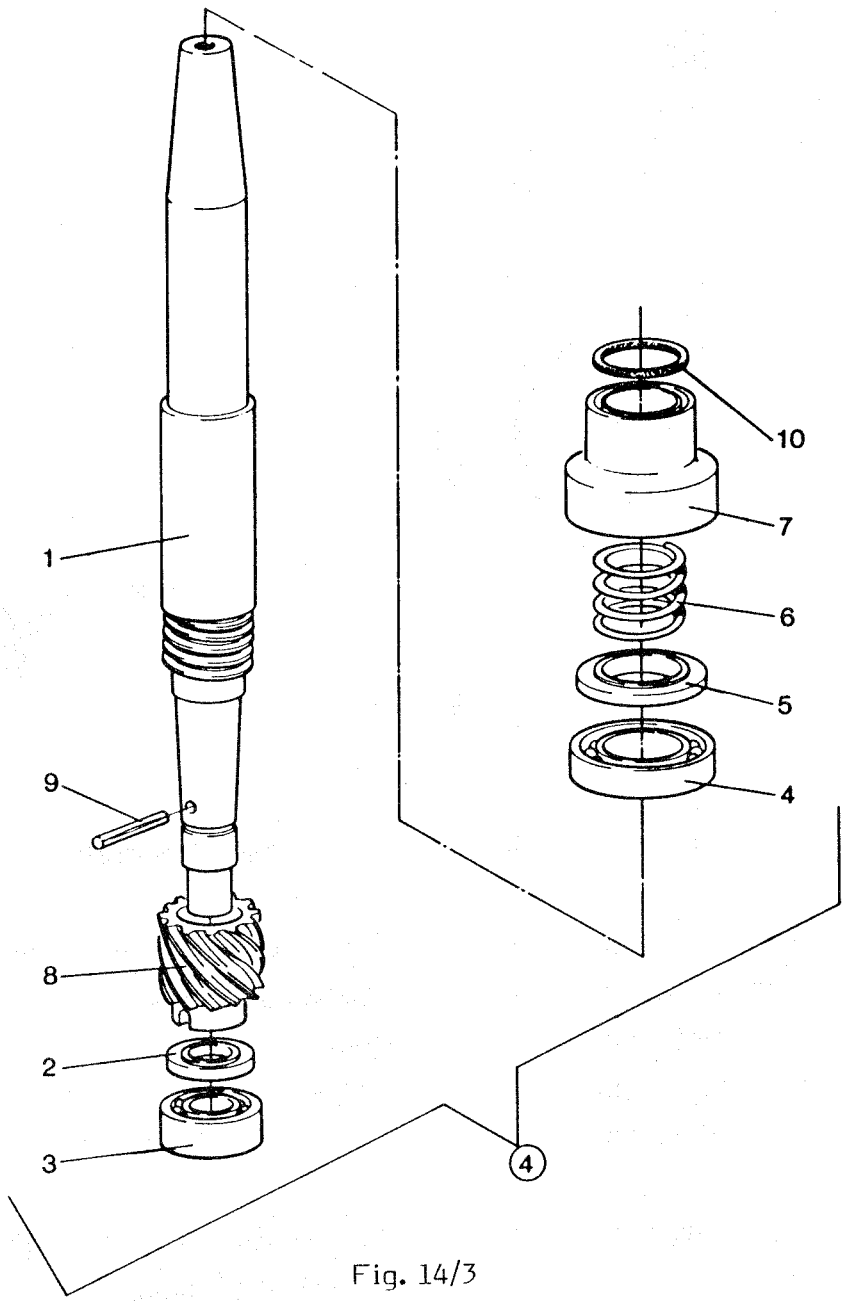


Fig. 14/3

No. in Fig.	Part - No. 50 Hz	Part - No. 60 Hz	Qty.	Part Description
④	1056-3429-000	1056-3429-020	1	Worm spindle, complete (1 - 10)
1	1056-3410-000	1056-3410-000	1	Spindle
2	0008-2508-000	0008-2508-000	1	Ball bearing protection ring
3	0011-2305-120	0011-2305-120	1	Pendulum ball bearing DIN 630 - 2305 MP 6
4	0011-6209-110	0011-6209-110	1	Grooved ball bearing DIN 625 - 6209 - P 6
5	0008-4508-000	0008-4508-000	1	Ball bearing protection ring 45
6	0006-4231-160	0006-4231-160	1	Cylindrical pressure spring
7	0008-4501-680	0008-4501-680	1	Spindle cap
8	1056-3423-000	1056-3423-020	1	Worm
9	0026-1578-120	0026-1578-120	1	Cylindrical notched pin DIN 1473-6x45
10	0007-2320-750	0007-2320-750	1	Gasket 45/55x5

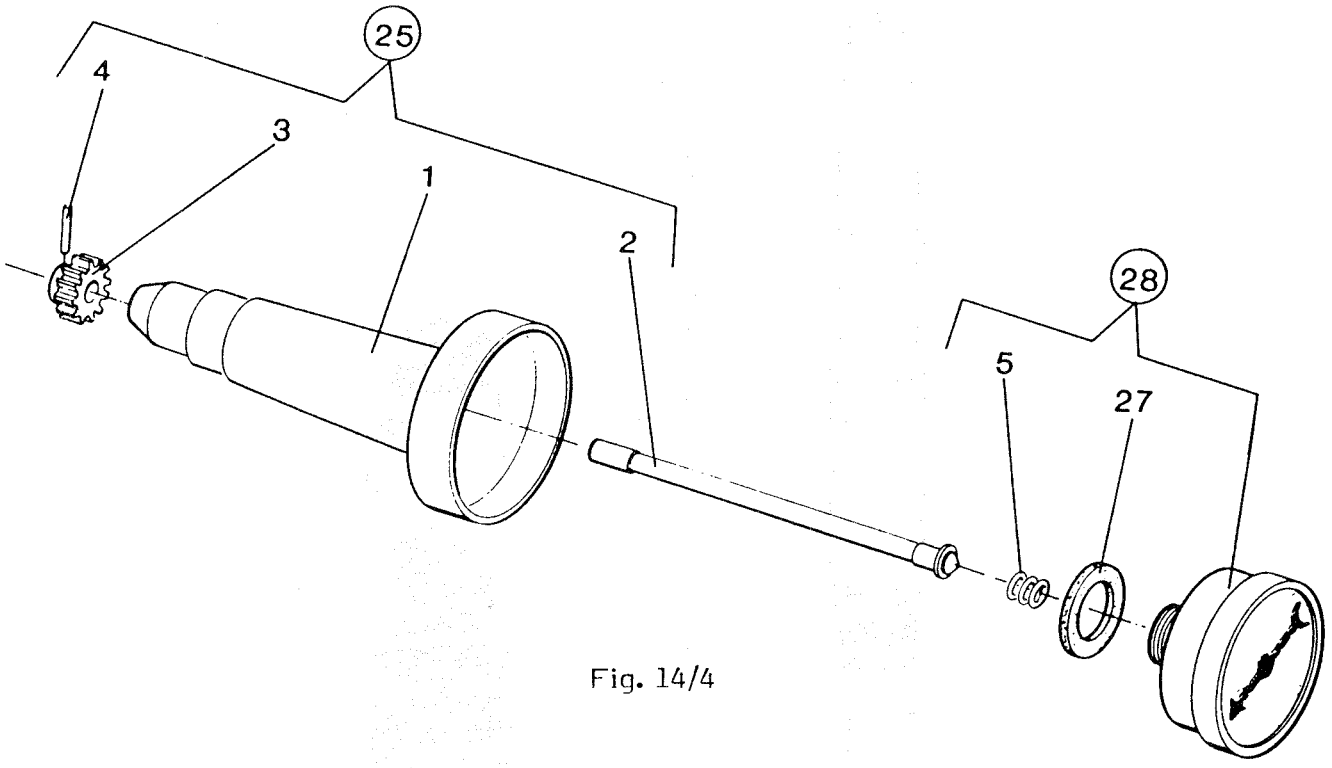


Fig. 14/4

No. in Fig.	Part - No.	Qty.		Part Description
(25)	1033-3490-000	1		Tachometer drive assembly (1 - 4)
1	1033-3493-000	1		Tachometer housing
2	1033-3485-000	1		Shaft, complete
3	1033-3483-010	1		Pinion
4	0026-1561-150	1		Cylindrical notched pin DIN 1473 - 2.5x16
(28)	8473-3000-050	1		Tachometer, complete 3 000 - 9 000 rpm
5	0006-4013-160	1	*	Cylindrical pressure spring 9.5/1x1.5 - 6.5 Wdg.
27	0004-1974-830	1	*	Felt ring 29/40x10

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

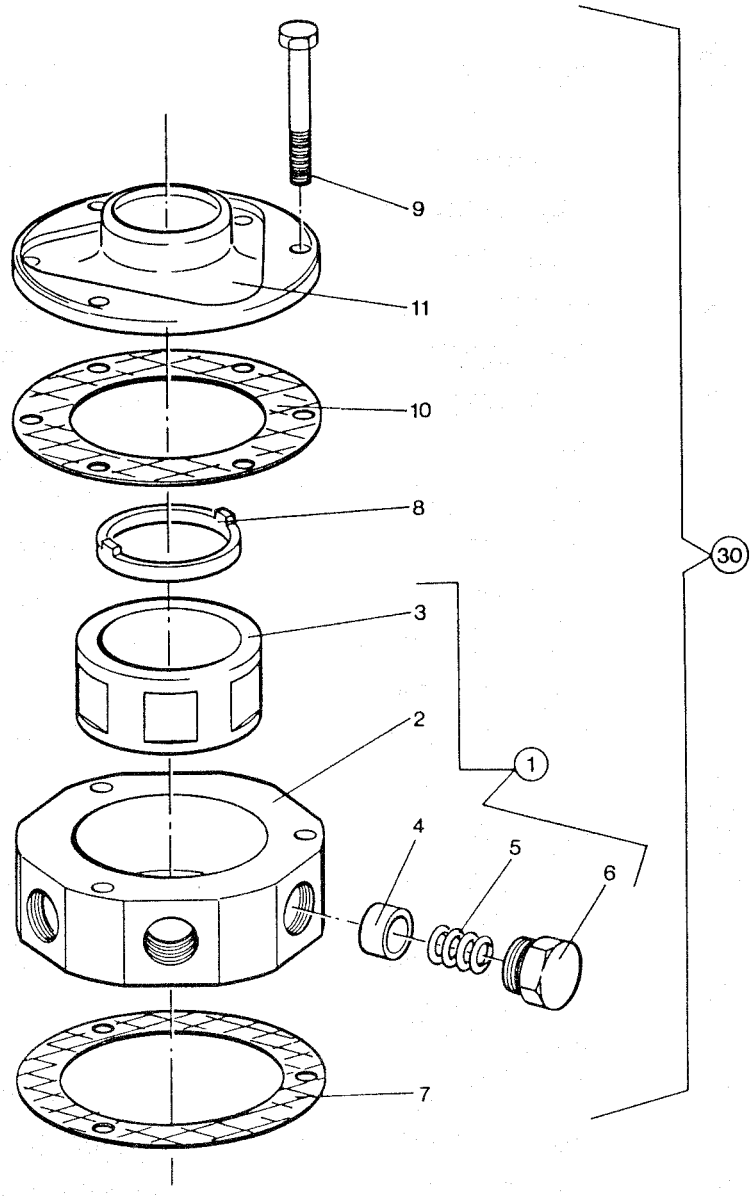


Fig. 14/5

No. in Fig.	Part - No.	Qty.	Part Description
(30)	0008-4500-270	1	Neck bearing bridge assembly with covering (1 - 11)
1	0008-4510-200	1	Neck bearing bridge, complete (2 - 6)
2	0008-4506-000	1	Neck bearing bridge
3	0008-4507-170	1	Neck bearing pressure ring
4	0026-1289-110	6	Spring piston
5	0006-4306-060	1	Set of neck bearing springs
6	0019-1423-030	6	Threaded plug
7	0004-5017-770	1	Gasket 129/182x0.3
8	0008-4509-010	1	Distance ring
9	0019-6543-150	3	Hex head screw DIN 931 - M 12x85
10	0004-5016-770	1	Gasket 115/182x0.3
11	0008-4502-230	1	Neck bearing protection cap

No. in Fig.	Part - No.	Qty.	Part Description
(5)	see page 15/3	1	Worm wheel
6	2308-3400-010	1	Worm wheel shaft
7	0026-1741-160	2	Key DIN 6885 - A 8x5x50
8	0011-6214-110	1	Grooved ball bearing DIN 625 - 6214 P 6
9	0011-6308-000	1	Grooved ball bearing DIN 625 - 6308
10	2308-3375-020	1	Bearing cover
11	0004-5434-770	1	Gasket 125.5/170x0.25
12	0004-1963-830	1	Felt ring 75 DIN 5419
13	0026-1325-190	4	Lock washer DIN 127 - A 8
14	0019-6903-150	4	Hex head screw DIN 933 - M 8x20
15	2308-3375-000	1	Bearing cover
16	0004-1838-700	1	Gasket 91/129x1
17	0004-1953-830	2	Felt ring 40 DIN 5419
18	0026-1325-190	3	Lock washer DIN 127 - A 8
19	0019-6903-150	3	Hex head screw DIN 933 - M 8x20
(20)	1056-3385-000 see page 15/4	1	Centrifugal clutch assembly
21	0026-5869-170	1	Securing ring DIN 471 - 40x1.75
(22)	2308-3390-030 see page 15/4	1	Eupex coupling, complete
23	0019-5053-090	2	Threaded pin DIN 553 - M 8x16
24	0013-0043-090	1	Hexagon nut M 22x1.5
26	0004-5212-700	1	Gasket 58/82x1
27	0019-2250-030	3	Cheese head screw DIN 84 - M 6x18
28	see item 1.6, page 15/4	1	Securing ring DIN 471 - 70x2.5

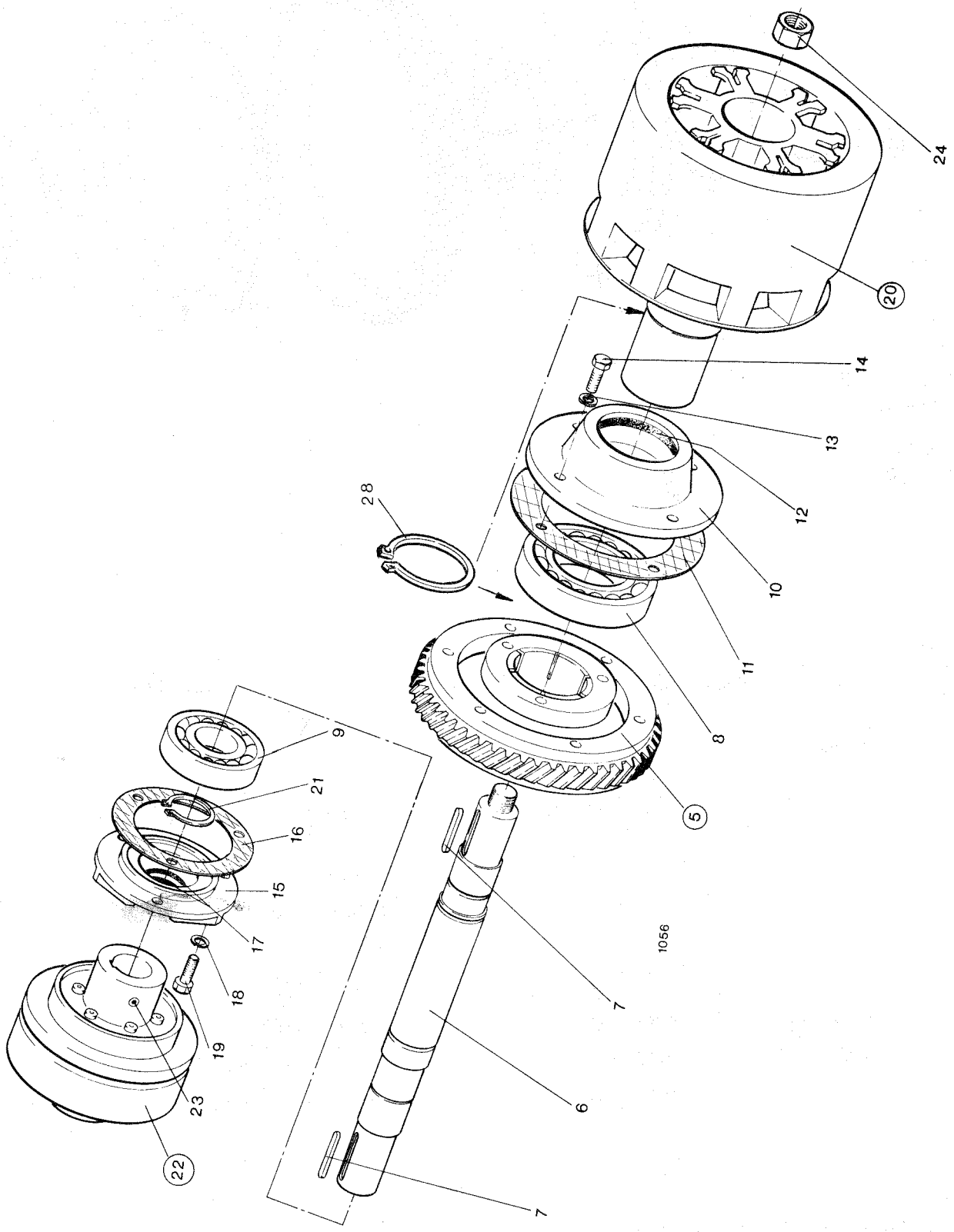


Fig. 15/1

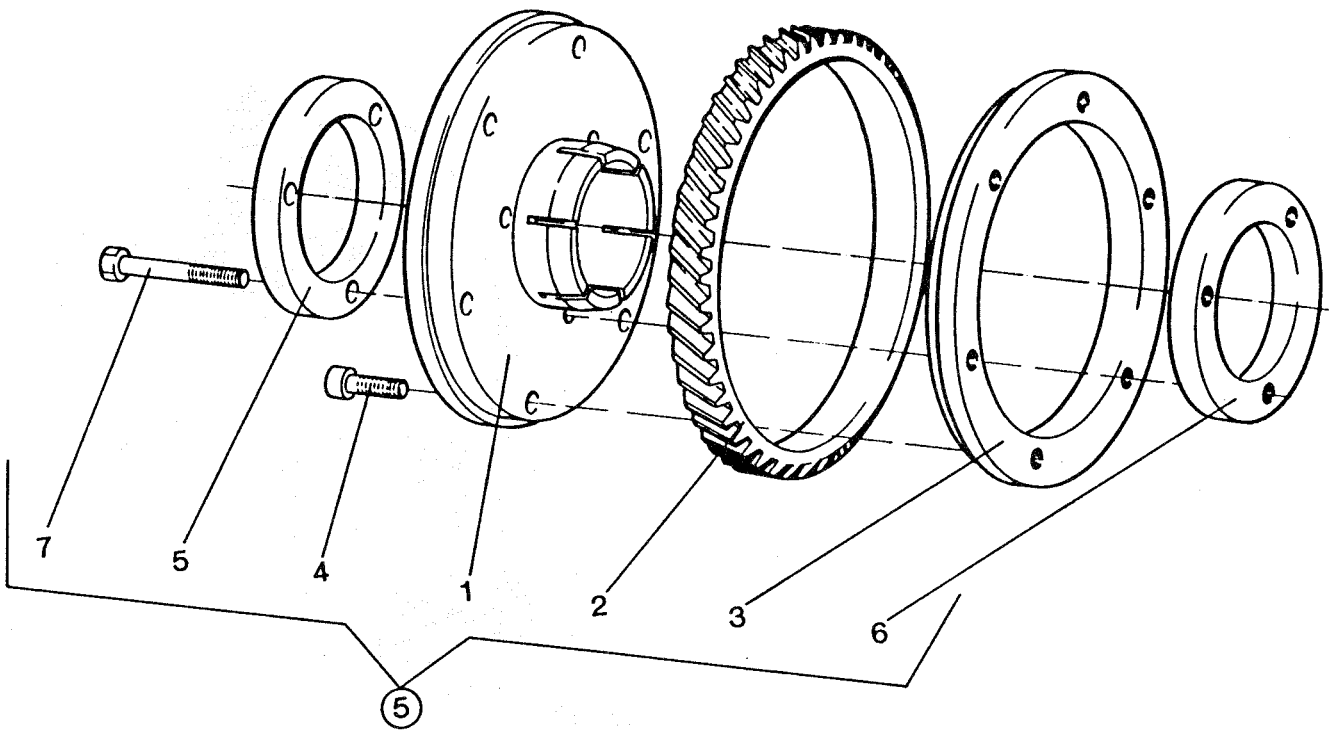


Fig. 15/2

No. in Fig.	Part - No. 50 Hz	Part - No. 60 Hz	Qty.		Part Description
(5)	1056-3449-010	1056-3449-020	1		Worm wheel assembly with clamp plates (1 - 7)
1	-	-	1		Wheel body
2	-	-	1		Toothed rim
3	-	-	1		Pressure ring
4	-	-	6		Allen screw DIN 912 - M 10x30
5	0931-3446-000	0931-3446-000	1	*	Clamp plate
6	1084-3447-000	1084-3447-000	1	*	Clamp plate with thread
7	0019-6519-150	0019-6519-150	3	*	Hex head screw DIN 931 - M 10x75

* This part is included in the worm wheel assembly with clamp plates, but it is also available as separate item.

When the worm wheel is worn and needs replacement, the worm 8 should be replaced at the same time (fig. 14/4).