Operating and maintenance instructions

Voith-Schneider Propeller

Table of Contents

I. Principal Data:

Name of vessel: . . . . . .
Type of vessel: . . Double-ended ferry . . . . . .
Number of propellers installed per vessel: . . two . . .
Factory number(s): . 1759, 1760, 1761, 1762 . . .
Direction of propeller rotation: . . clockwise . . . . .
Position of propeller(s) in the vessel: bow and stern
Weight of one propeller: . . . . 58,500 kg . . . . .
Blade orbit diameter (mm): . . . 3,600 . . . . . .
Blade length (mm): . . . . . 2,250 . . . . . .
Number of blades per propeller: . . . . five . . . . .
Speed of propeller pinion shaft (rpm): . . 180 . . .
Speed of propeller rotor (rpm): . . . . . 61 . . .
Type of drive: . . . . . diesel engine
Supplier of driving unit: . . . . . Ruston-Diesels - 3625 a
Output of driving unit (HP): . . . . . 3,200 . - 2386 KW a
Type of coupling on propeller pinion shaft: bow-toothed coupling

With elevated oil level (pipeline (906) between lower propeller casing (450) and elevated oil tank (903), minimum clearance to be: . . . . . 80 . . . . . mm

Remarks: . . . . . .
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Voith Codeword: . . . . VSP Borden . . . . . .

Servo Motor (Complete) 1300 Lbs

II. Operating Data:

1400 gl. old Book

Oil filling per propeller — about 5500 ? litres

Oil level

measuring point at oil dip stick

(918) see fig. 6 — about . . . . mm

Oil pressures

Control oil	p_1	=	16.0 kg/cm^2 – 288 P.S.I.
Lubricating oil	p_2	=	min. 0.5 kg/cm^2 – 7 P.S.I.
			max. 2.0 kg/cm^2 – 29 P.S.I.

Both oil pressures can be selected by adjustment of overflow valves p_1 and p_2, fig. 6.

Oil temperature:

maximum	60°C	140°F
minimum	5°C (upon starting)	41°F

Oil characteristics:

High-grade mineral oil of high pressure and age resistance, specially refined product, with or without additives, non-solidifying at low temperatures, non-greased, non-foaming and non-emulsifying.

Viscosity	8 - 10° Engler at 50°C
Pour point	below -10°C
Viscosity index	above 60

Filling oil into propeller type G
with elevated oil level

1.) After installation (IV page 6) and prior to setting the vessel afloat, fill each propeller with oil.

2.) The oil must be free of contaminations and should be filtered before or during filling (oil grades see page 3).

3.) For filling in the operating oil, remove indicator plate (415).

After removal of pitch indicator (314), pour in the oil filling for rotor casing (101) and the interior of the propeller through filling opening and control rod. The procedure can be facilitated by using a suitable pipe and funnel put on top of the filling-in opening in the control rod. Filling can be continued until the oil starts spilling over at the filling-in opening, as the air in the rotor casing and in the interior of the propeller compartment can escape via the elevated oil tank. Then tightly close off the filling-in opening by pitch indicator (314).

Propeller casing (450) is filled through the opening left after removal of indicator plate (415). The oil will then flow to the oil tanks in the propeller feet through the bores provided for this purpose.

The oil level in propeller casing (450) should at least reach up to a level at which upper thrust ring (724) is immersed in oil. With inclined propeller, this requirement is of utmost importance.

The erector should mark the required oil level at oil dipstick (916).

Mount elevated oil tank (903) in a visible place at least 500 mm above the CWL. For topping up the oil filling of elevated oil tank (903), use hand-operated pump (901).

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Oil circuit and oil supply for propeller type "G"
Figs.1, 6, 7, 16 and 17

Arrangement of the pumps fig.6

Gear pump (900), flanged onto the pinion bearing, supplies the propeller with pressure oil; this pump is direct driven off pinion shaft (702) through bevel gear set (956, 957). In the event of failure of pump (900) (pressure drop), this pump should be shut down at the earliest moment possible (screw off pump or remove pinion (956)) and change over to motor-driven spare pump (907).

After prolonged standstill of the propeller or when the oil is cold, switch on motor-driven pump (907) before putting the propeller into operation. This is necessary to supply the bearings in the propeller with the oil film required for the startup and to raise the oil temperature sufficiently.

CAUTION:

Do n o t forget to shut down motor-driven pump (907) before putting the propeller into operation. On no account may the two pumps operate at the same time.

Both pumps (900 and 907) are so connected to delivery line (915) via non-return valves (914) that the oil flows to the two valve groups (902).

Valve group fig.16

Control-oil pressure valve (941), lubricating-oil pressure valve (943) and safety valve (944) as well as 2 plate-type filters (lamellar filters) (942) for the cleaning of the oil are grouped in one housing (902) to form a complete unit. A spring-loaded piston in the valve housing maintains a constant control-oil pressure of 16 kp/cm^2 in delivery line (915) and in the branch lines to the servomotors. Any surplus oil, delivered by the pump and not required for the control, flows into the filter compartment through control-pressure piston (941, fig.16) and from there to lubricating-oil pressure valve (943) through plate-type filter (942, fig.16). An additional spring-loaded piston (944) (safety valve, set at about 5 kp/cm^2) prevents excessive pressure in the valve housing, if the oil is cold and thus viscous or if the plate-type filters (942) are choked. From lubricating-oil pressure valve (943), set at about 2.5 kp/cm^2, lubricating-oil line (904) branches off which leads to the various lubricating points such as pinion bearings, thrust bearings, etc.

The oil pressure can be read off on the pressure gauge in line (904).

The remaining oil flows into overflow line (905) behind valve group (902) and from there into the rotor casing via flexible hose (925) and through control rod (510).

In this line (905), 2 additional overflow valves (928) are fitted, which go into operation when the oil is cold or when the oil

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flow is excessive; these valves direct part of the oil into propeller casing (450). The pressure at which the valves are set is 1 kp/cm^2 (maximum 1.5 kp/cm^2) and can be read off on the pressure gauge in line (905).

Oil cooling in rotor casing

In the rotor casing the oil is cooled and forced by static pressure into elevated oil tank (903) through line (906). The cooling-oil temperature can be read off on thermometer (919) in line(906). Non-return valve (912) prevents the oil from flowing back into the rotor casing when the propeller is standing still. From the elevated oil tank, the cooled oil flows back into the propeller casing through return line (906).

Lubrication of rotor seal (main seal)

Main seal (736) is supplied with lubricating and cooling oil through lubricating-oil pressure line (904), at the end of which filter (920) is fitted. At the inlet of this filter a throttling plate (938) is attached which supplies oil to sight-feed oilers (922) at no pressure. The sight-feed oilers are so adjusted that they pass a maximum of about 5 to 10 drops of oil per minute into piping (911).

Lubrication of the bottom sealing ring of the rotor seal

The oil fed into line (911) evenly distributes over the bottom sealing lip and, if sight-feed oilers (922) are adjusted to pass an excessive flow, can spill over at overflow cock (923) via vent line (930). (Normally, overflow cock (923) should be open and check cock (924) closed.) If,with the propeller at standstill, neither oil nor water discharges, the bottom rotor seal is in order and sight-feed oiler (922) is adjusted correctly.(Some drops of oil or water are of no consequence.)

However, if a larger amount of oil is discharged, the operation and adjustment of the sight-feed oiler must be checked.

If,with check cock (924) closed, water discharges at overflow cock (923), the bottom sealing lip is no longer effective. In this case, the throttling screw at sight-feed oiler (922) should be closed; furthermore, check cock (924) and overflow cock (923)must remain closed. The propeller can continue in operation, as the centre sealing ring also provides watertightness.

Lubrication of the centre sealing ring of the rotor seal

Oil supply and adjustment of sight-feed oilers (922) are similar as in the case of the bottom sealing ring. The oil can discharge through leakage-oil channel (415). A weekly check should be made. If there is a major oil leakage when the propeller is at standstill,while at the same time the oil level in propeller casing (450) drops,this indicates a leaking upper sealing ring (736). The oil can be collected and restored to the propeller casing. However,if water discharges through leakage-oil channel (415), this indicates that the bottom and centre sealing rings are

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defective. These seals must be checked and renewed, if necessary.

Elevated oil tank

Elevated oil tank (903) subjects the oil in the rotor casing, when the propeller is stationary, to a certain overpressure in respect of the waterline, so that no water can enter the rotor casing through the blade shaft seals. In the case of prolonged standstill of the propeller, the filling of elevated oil tank (903) must be topped through filling line (909), using hand-operated pump (901), as some leakage oil may flow back into the propeller.

Operation of relief valves (934)
on servomotors (500 and 600) (fig.7)

When the blades of the Voith-Schneider Propeller hit foreign matter, e.g. ice floes, shocks and moments are set up which are transmitted to the servomotors via blade actuating gear and control rod.

Relief valves (934) on the speed and steering servomotors (500) and (600) are fitted to protect the mechanical components of the propeller from excessive strains.

Arrangement

The two piston sides of a servomotor are interconnected through two pipes (935) in which the relief valves (934) are fitted, as shown in fig.7. Depending upon the direction of the overload, one or the other relief valve becomes effective and allows oil to flow to the opposite piston side. The resulting pressure balance allows the propeller blade to give way in the direction of the load.

Setting

The relief valves must be so set that the overflow pressure is about 12 kp/cm^2. If necessary, the erector may use different settings.

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III. Betrieb und Wartung
Operation and maintenance
Service et entretien

	prior to startup	daily	weekly	monthly	after 100 operating hours	after 500 operating hours	after 1000 operating hours	when ship is docked
1.) Prior to starting and stopping, move speed lever and steering wheel to "neutral".	●							
2.) Prior to starting, switch on pump (907). This is of primary importance when the oil is cold (see page 4a). CAUTION: Stop again pump (907) before starting propeller.	●							
3.) Check regularly lubricating-oil and control-oil pressures on pressure gauges (see fig.6), (see page 3)		●						
4.) Operate plate-type filter (lamellar filter) (942) in valve group (902) once every day. During the first operating hours, the filter should be checked frequently. If excessive dirt has collected in the filter, (it can be operated with difficulty only) remove the filter from the housing and clean filter. Turn the removed filter several times and wash filter. Drain oil sump in the casing or suck off and clean the oil. When fouling of filter decreases noticeably, it will suffice to clean the filter once every month (see page 4a).		●						
5.) Check the temperatures on the thermometers. If the temperature rises above 60°C, investigate the cause(fig.6).	●	●						
6.) Check the number of drops delivered by the two sight-feed oilers (922). They should supply a maximum of 5-10 drops of oil per minute (see page 4b).		●						
7.) Check main seal (rotor seal) (fig.6). Check at cock (924) and at leakage-oil channel (415) whether oil or water escapes (see page 4b).			●					
8.) Check oil level in elevated oil tank. Should, after prolonged standstill, the oil level drop, top up oil filling by means of hand-operated pump (see page 4b).		●						
9.) Check prescribed oil level in casing foot (918). Renew oil filling only if absolutely necessary and only on the occasion of a routine propeller overhaul. If the oil is heavily fouled or contains an excessive amount of water, the oil must be renewed at an earlier date. When in doubt, have the oil checked for usability by the field service of the oil supplier.		●						
10.) See that control linkage can move freely. Lubricate linkage occasionally.				●				
11.) Check propeller setting frequently during running by comparing the positions of the speed control lever and the steering wheel with the respective positions of the pointer (314, fig.2) on indicator plate (413, fig.2). If speed control lever and steering wheel are in "neutral", the pointer must be approximately in the middle of the indicator plate.				●				
12.) 1st check of gearing 2nd " " " 3rd " " "					●	●	●	
13.) Check and retighten, if necessary, the screw connections: driving sleeve (704)- rotor casing (101)(nut 706) as well as on blade bearing cap (213).								●
14.) Check zinc protection plate (104). If necessary, exchange plate and renew protective coat.								●
15.) Check blade (201) for damage. If necessary, remove and straighten blade in conformity with the instructions.								●

Installation and removal of propeller from underneath

IV.) Installation and removal of the complete propeller with elevated oil tank

A propeller with elevated oil tank can be installed and removed only, if the ship is ashore or docked. The propeller is lowered into the well of the ship's hull from above. For lifting the propeller, only the eyebolts provided for this purpose may be used. N e v e r lift the propeller by the servomotors or pinion shaft (fig.18). Between propeller and well flange, a seal, about 2 mm thick, is interposed. This seal may be of any conventional sealing material that is suitable for use in water. However, highly resilient material such as rubber, etc. may n o t be used. The bottom of the installed rotor casing should preferably be flush with the skin plating. Furthermore, the clearance between well and rotor casing (101) should be as uniform as possible over the entire periphery.

The assembly procedure is as follows:-

1.) Check well for concentricity, height and planeness of the flange.

2.) Insert propeller and bolt it to the well flange in such a way that the pinion shaft is in perfect alignment with the drive shafting.

(For the manufacture of the well flange, the recommendations given on our instruction sheet dealing with the design of the propeller well should be considered.)

3.) Couple pinion shaft to shafting.

4.) Connect steering and speed controls.

5.) Install elevated oil tank (903) and all pipes (906 - 909) between the elevated oil tank and the propeller. The elevated oil tank must with its lower edge be at least 500 mm above the CWL.

Disassembly is in the reverse order.

V.) Dismantling and reassembly

Except when removing the servomotors (according to b), the control rod (according to c), the oil-pressure shaft seal (according to e), the bevel gear ring (according to f), the pumps (according to o), prior to any disassembly, the oil must be drained from the propeller casing until the oil level comes to lie below lower thrust ring (723).

Prior to dismantling the rotor casing from underneath, the oil in the rotor casing should be drained through the bottom valve (fig.12) in the bottom of the rotor casing. Or the oil may be sucked off by means of a suction pipe (see jig W 5, fig.8) through control rod (510).

When reassembling the propeller, make sure that all matching parts bear the same numbers. Bolts and nuts secured by split pins, locking plates or lock washers must be properly locked again after being reassembled. When reassembling the propeller, use new round cord seals of oil-resistant or an equivalent material. The maximum permissible tolerance of the cord diameter is + 0.3 mm.

The instructions given in the following paragraphs (a to o) for the removal of the various propeller parts also apply to reassembly, although in the reverse order.

a) Removal of casing cover (412)

1.) Uncouple control units for speed and steering controls.

2.) Remove oval covers.

3.) Remove the two connecting pins (515 and (615) (fig.5)

4.) Remove casing cover (412) from above together with the stroke-limiting rod gear of the servomotors.

b) Removal of the speed control servomotor (500) and steering servomotor (600)

1.) Drain oil from servomotor cylinders (501 and 601). For this purpose, remove the two screw plugs at the bottom of the servomotor cylinder.

2.) Remove pipe connections at the servomotors. Remove the two oval covers on cover (412) and further the two connecting pins (515 and 615). Remove cover (412).

3.) Remove control pin (509, 609) on forked strap by removing connecting pin (516, 616). After removal of screw plug (511, 611) the control pin (509,609) can be withdrawn outwards.

4.) Remove from above the pins between the push rods (505, 605) and inner pistons (503, 603), using eyebolts. Prior to this, the lever attached to the bolts must have been loosened and withdrawn.

5.) Loosen the nuts on the fixation flange of the servomotor cylinder (501, 601) and remove the complete servomotor.

6.) Dismantle the servomotors into the component parts, after loosening the two nuts of the stud bolts which attach the cylinder cover (502, 602) to the cylinder (501, 601) and after loosening the castle nut (512, 612) in front of the inner piston.

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c) Removal and installation of control rod (310) (fig.2)

Removal:

1.) Remove casing cover (412) (Dismantling instructions a).

2.) Remove pitch indicator (314) and screw in eyebolt.

3.) Remove retaining flange (319) and pins (519 and 619). Withdraw push rods (505 and 605) from above from push-rod sleeve (318).

4.) Remove retaining sleeve (332). The oil in the elevated oil tank will now flow into the propeller casing.

5.) Remove from above control rod (310) along with central spherical bushing half (312), retaining sleeve (332) and push rods (505 and 605).

Installation: Reassembly is in the reverse order. Prior to reassembly, insert jig (W 3, fig.8) through control rod (310) and centring disk (324) to ensure proper centring. Tighten screws of lower spherical bushing until the spherical bushing makes good contact on the bottom sphere of the control rod. After retaining sleeve (332) has been screwed home, the oil escaped from the elevated oil tank can be pumped back to this tank by means of hand-operated pump (901).

d) Removal of pinion shaft bearing
figs.2; 6

1.) Prior to removal of the pinion shaft bearing, disconnect the flange connection of the coupling at the input shaft and remove the adjoining shaft section.

2.) Suck off the oil in propeller casing (450) until the oil level comes to lie below the pinion shaft opening.

3.) Drain remaining oil from pump casing (750) through screw plug (752) and through suction pipe (910).

4.) Remove suction pipe (910), delivery pipe (915) and lubricating oil pipes (904).

5.) Loosen flange connection at bearing cover (739) and attach suspension device (see W 5, fig.9).

For suspension, use marked bore to ensure that the pinion shaft bearing is in the centre of gravity.

6.) Removal of the complete pinion shaft bearing with pump (900), using puller screws.

To prevent damage to the teeth or the bearing bushings, exercise care when withdrawing the pinion shaft bearing.

7.) Remove pump according to (o).

8.) Removal of the remaining components in the following sequence:-
sealing flange (741)
lock nut (743)
bevel gear wheel (957)
spacer ring (959)
pump casing (750)
lock nut (744)
outer pressure ring (745)

Remove bearing cover (739) along with bearing bushing (746) from pinion shaft (702). If necessary, remove inner bearing bushing (761).

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e) Removal of oil-pressure shaft seal (331) (fig.2)

The oil-pressure shaft seal can be removed with the vessel afloat.

Removal: After removal of casing cover (412)(according to instructions a), of the servomotors (according to instructions b), of the control rod (according to instructions c) and of the pinion shaft bearing (according to instructions d), the control-rod bearing support (327) can be removed after connecting screws (329) and the pipes have been removed.

Flange (333) with oil-pressure shaft seal (331) and balking ring (330) can now be removed jointly from above.

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f) Removal of bevel gear ring (701) (fig.2)

The bevel gear ring can be removed with the vessel afloat.

After removal of the parts listed in instructions a) to d), bevel gear ring (701) can be removed as follows:-

1.) Loosen connecting screws (722).

2.) Remove from above bevel gear ring (701), using puller screws and eyebolts.

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g) Removal of rotor seal (736) (fig.2)

1.) With this model, the rotor seal can be removed only when the ship is docked. For the installation and removal of the seals, the complete rotor casing (101) with driving sleeve (704) must be fixed inside the propeller well. First, in order to support the weight of the rotor casing, a minimum of five withdrawal ledges with screws must be attached to the propeller well (see fig.10).

For lateral centring, steel wedges are provided at several points between rotor casing and well.

2.) For reasons of safety, suspend the rotor casing additionally by the ribs provided for this purpose and slightly stretch the ropes (according to i.3) or arrange for props to support the rotor casing.

3.) After removal of the parts listed in the instructions a),b), c), d), f), upper thrust ring (724) can be removed.

4.) Loosen nuts (708) and remove thrust plate (720).

5.) Remove bearing ring (732) and outer bearing ring (731). CAUTION: Outer bearing ring (731) is loose in bearing ring (732) and may fall out!

6.) Remove by suction the oil between bearing flange (726) and driving sleeve (704).

7.) Removal of bearing flange (726) along with rotor seal (736).

Prior to disassembly, remove lubricating-oil pipes (911) and vent pipe (930) from the propeller casing. Remove pressing ring (737). Loosen screws (727). Suspend bearing flange (726) and remove it, exercising extreme care. To protect the seals of (736), fill annular clearance between gland ring (710) and inner bearing ring (731), using guiding tape, (see fig.10).

Reassembly is in the reverse order.

Make sure that nuts (708) are tightened to such an extent that necked-down bolts (707) are preloaded as specified.

Preloading of the necked-down bolts (fig.13)

L_o = 667 mm.

L_1 = 667.6 mm

L = 0.6 - 0.8 mm

h) Removal of roller bearing (731) (fig.2)

Proceed as described under g) 1.) - 5.) for the removal of the rotor seal.

After removal of thrust plate (720), remove from above the outer race of roller bearing (731) along with roller-bearing cage and bearing ring (732). The bearing inner race of roller bearing should be removed by using a pulling-off device.

i) Removal of the complete rotor casing (101) with the ship docked (figs.2 and 6)

1.) Drain oil from rotor casing through bottom valve (fig.12) fitted in the bottom of the rotor casing or suck off oil through control rod (510), using suction pipe (see jig W3, fig.6).

2.) Remove the 3 inspection covers (408, 409 and 410) on the bottom of the rotor casing.

3.) Suspend the rotor casing from the ribs provided for this purpose and tighten the ropes. The suspended ropes should be passed through the 3 inspection openings.

4.) Loosen nuts (706) of the stud bolts connecting rotor casing (101) and driving sleeve (704). Lower and deposit casing gently on wooden beams.

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k) Removal of a blade (201) (figs. 5; 6)

The blades (201) cannot be removed with the ship afloat.

If a blade (201) with plain bearings (223, 224, 225 and 226) and blade shaft seals (209) is to be removed from the still assembled propeller or from the propeller still installed in the vessel, screw off inspection cover (409) and crank the propeller until the respective blade bearing cap (213) comes to lie under the inspection opening. Prior to opening blade bearing cap (213), drain the oil from the rotor casing and the oil from the pressure compartment through the bottom valve (shown in fig. 12).

1.) Lift off blade bearing cap (213) with upper bearing bushing (224) after removal of the fixation screws.

2.) Suspend blade (201) in the centre of gravity by means of suspension device (W 6, fig. 9) and lift the blade.

3.) Loosen clamping screw (203) in actuating lever (202) and open up the slot in the actuating lever by means of a puller screw.

4.) Remove axle holder (220) fastened to actuating lever (202) by 2 screws. Remove from above pin (308), using an eyebolt.

5.) Remove from underneath the suspended blade (201) with junk excluder (215), gland ring (208), upper and lower blade bearing rings (226 and 225).

1) Removal of blade shaft seal (fig.3)

After completing disassembly as described under k), proceed as follows:-

1.) Remove blade actuating lever (202).

2.) Remove connecting screws (221) of packing ring (211) in rotor casing (101).

3.) Remove from underneath packing ring (211) and sealing ring (227) along with inner blade shaft seal (209).

For pressing off packing ring (211), insert two long eyebolts into the through-bores in the rotor casing and screw them into the threaded holes in the packing ring. Withdraw packing ring from underneath by gentle pressing and tapping on the eyebolts.

4.) Remove blade shaft seals (209) from packing ring (211) only if damaged.

5.) Press in new blade shaft seals (209) into packing ring (211), using device W4, fig.8.

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m) Replacement of plain bearings (223, 224, 225, 226), gland ring (208) and junk excluder (215) from the removed blade (201) (fig.3)

1.) For the removal of the bearing rings put the blade on the shaft with the blade leaf on top and separate the bearing rings from the shaft by applying heat. (When heating the shaft, proceed with special care and apply heat evenly to avoid damage to the bearing rings which may become unusable. Local overheating by contact with the flame of a cutting torch should be avoided.) Remove bearing bushings (223 and 224) from blade bearing cap (213) and bearing support (219) only if the running surface is damaged. For the removal use a pulling-off device.

2.) Should the surface of gland ring (208) show grooving, the grooved surface can be reconditioned, provided that the outer diameter is not reduced by more than 0.5 mm by such reconditioning. Extensive grooving requires the replacement of the gland ring.

3.) For the removal of gland ring (208), put blade (201) on the shaft with the blade leaf on top.

4.) When removing junk excluder (215), gland ring (208) is also removed. To achieve this, place one flat iron bar edgewise on either side of the blade leaf and apply even and simultaneous hammer blows to remove the junk excluder and the gland ring from the blade shaft.

The junk excluder, the gland ring and the bearing rings should be heated in an oil bath to about 100°C before being shrunk-on on the blade shaft. The gland ring is fitted after sealing ring (216) and pressed against the junk excluder until having cooled off. Make sure that any scoring (grooving) on the blade shaft or on the inner surface of the gland ring is rectified prior to reassembly of these parts.

Prior to installing the complete blade (201), first slip assembled packing ring over the blade shaft, and then insert the blade into the bearing and actuating lever (202). To ensure correct alignment of the tapped holes in the packing ring, insert two long eyebolts through these holes instead of screws (221).

For the further installation proceed as described under l) 1 - 2) and k) 1 - 5).

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n) Removal of blade actuating gear (fig.2)

After completion of the removal of the rotor casing (101), proceed as follows:-

1.) Loosen screws (726), separate and lift off upper bearing plate (712) together with stop ring (715).

2.) Remove axle holder (220 and 354) and withdraw pins (306) at either end of the connecting rod. Slip connecting rods into the blade pocket as far as possible.

3.) Loosen screws on bottom bearing plate (721), separate and lift off the remaining assembly of blade actuating gear:- +/
lower bearing plate (721)
main coupling (343),
2 inner couplings (344),
2 outer couplings (345),
rocking arm (346),
pin (348)
coupling sleeve (351)
and flange (352).

4.) Remove connecting rods (307) from rotor casing.

5.) Disassemble blade actuating gear after loosening screws (349) and withdraw pins (346) from the couplings and loosen flange (352).

+/(use eyebolt)

o) Removal of 'Allweiler' screw pumps (900 and 907) (fig.2)

Removal of pump (900) flanged onto pinion bearing

1.) Drain oil from suction pipe (910) and pump casing (750) through drain plug (752).

2.) Detach suction and delivery pipes from pump.

3.) Undo screw connections on pump flange and pump, and remove pump.

4.) Remove pinion lock and withdraw pinion (956).

Reassembly is in the reverse order. When adjusting the backlash of the gear, a suitable spacer disk (958) must be chosen.

Removal of motor-driven pump (907) (spare pump)

1.) Disconnect power supply leads on pump.

2.) Detach delivery pipe on pump.

3.) Loosen flange connection between pump and propeller casing foot.

4.) Remove pump together with electric motor.

p) Speed measurement

The propeller (input) speed should be measured by means of a tachometer, without any coupling. Thus, the propeller speed can be measured on any rotating shaft with due consideration of the gear ratio.

Gear ratios:

i_1	flange gear	=	-
i_2	bevel gear	=	2.95
i_{total}		=	2.95

VI.) Spare parts:

. . . . blades (201)
for anticlockwise rotation
with junk excluder (215) and gland ring (208)
fitted in position

. .1. . blades (201) for clockwise rotation

. . . . lower bearing bush (223)

. . . . upper bearing bush (224)

. . . . lower spherical bush (311) for control rod

. . . . spherical bush (518) for push rod

. .1. . set(s) of sealing rings (209) for the blades

. .1. . sealing ring (736) for main seal

. .1. . oil pressure shaft seal (331)

. .2. . set(s) round rubber gaskets

. .2. . set(s) locking plates

1 sealing ring (742) for pinion shaft . . . . . .

2 gland rings (208) for blade . . . . . .

1 connecting hose (921) . . . . . .

1 hose line . . . . . .

. . . . . .

. . . . . .

Spare parts should be replaced when expended.
When re-ordering, please state propeller number and direction of rotation.

Recommendations regarding the repair
Disassembly and reassembly of the propeller

General

Repair work on the Voith-Schneider Propellers mainly concerns the replacement of worn or damaged components. The table underneath gives instructions for the location of faults. The symptoms characteristic of the faults are listed in the left-hand column headed "Irregularities observed". In the centre column headed "Cause" the probable cause of the trouble is indicated, while the right-hand column headed "Remedy" gives recommendations for remedial action.

If trouble develops which is not included in the table, all parts of the propeller must be carefully checked in order to determine the cause of the trouble.

Sections IV and V give recommendations for the dismantling and reassembly of the propeller. The sequence of these instructions is such as to permit complete dismantling in connection with major overhauls. However, if only some parts of the Voith-Schneider Propeller must be replaced, dismantling should be made only to the extent required for the renewal of faulty parts.

Irregularities observed	Cause	Remedy
1. Low oil level	a) In the interior of the propeller, air bubbles had been left which could not escape before the first startup.	a) Fill in oil through opening in inspection cover (405, fig.6) until oil reaches up to mark.
	b) Breakage of oil line.	b) Locate breakage and repair pipe by welding or replace piping.
	c) Leaky blade shaft seals.	c) Renew blade shaft seals (see par.1) page 18).
	d) Seal of blade bearing cap (213) leaky or leaky connection: driving sleeve (704) - rotor casing (101).	d) Check whether hex.nuts are loose. Retighten loose nuts. Should leakage persist, renew sealing rings.
	e) Damaged rotor casing (101) as a result of overstressing by grounding.	e) Locate leakages. Minor damage can be repaired by welding. In the case of major damage, the rotor casing must be replaced.
	f) Leaky rotor seal (736).	f) Removal according to par.g) page 14, and installation of a new seal.
2. Traces of oil in the water outboard.	As described under 1.c) to f)	As described under 1.c) to f).
3. Oil in leakage channel (415)	a) Upper sealing ring of (736) leaking.	a) Replace upper sealing ring following instructions g) page 14.
NOTE: A small amount of oil in this channel is of no significance. Unless the oil is contaminated, it can be restored to the propeller casing.	b) Oil flow from sight-feed oiler (922) to central sealing ring of (736) excessive.	b) Readjust sight-feed oiler.

Irregularities observed	Cause	Remedy
4. Oil discharge at overflow cock (923).	Excessive flow from sight-feed oiler (922) to lower sealing ring of (736).	Readjust sight-feed oiler.
5. Discharge of water at overflow cock (923) NOTE: A small amount of water is of no consequence.	Leaky lower sealing ring.	Keep closed overflow cock (923), check cock (924) and sight-feed oiler (922). Propeller can continue in operation.
6. Water in propeller (condensate water on indicator plate (413)).	As described under 1.e) to f).	Proceed in the same way as described under 1.e) to f).
7. Pressure drop in control-oil circuit (line 915).	a) Because of low oil level, pump delivery inadequate. Pay attention to 1.a) to f).	a) Restore "normal" oil level. Pay attention to 1.a) to f).
	b) Failure of pump (900).	b) Remove pump. Close off opening or remove pinion (956); switch on motor-driven pump (907).
	c) Broken spring in control-pressure valve (941).	c) Replace spring.
8. Pressure drop in lubricating-oil circuit NOTE: Pressure drop at high oil temperatures is of no significance, provided that the pressure does not fall below 1 kp/cm².	a) Breakage of an oil pipe.	a) Locate breakage; repair pipe by welding or replace piping.
	b) Spring in low-pressure valve (943) broken	b) Remove broken spring and fit a replacement spring.

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Irregularities observed	Cause	Remedy
9. Control rod (310) vibrating.	a) Bushings in blade-actuating gear worn.	a) Replace bushings.
	b) Air in control-oil circuit because of low oil level.	b) Restore "normal" oil level. Pay attention to 1.a) to f).
	c) Blade bearings seized.	c) Renew bearing bushings (223 and 224) as well as bearing rings (225 and 226). See instructions m), page 19
	d) Lower spherical bushing seized.	d) Removal according to instructions c), page 10.
10. Rough operation of propeller or operation accompanied by irregular shocks.	a) Gearing damaged.	a) Provisional: Smoothen gear flanks and correct backlash. Final: Replace gearing.
	b) Blade actuating gear damaged.	b) Locate cause of trouble and renew damaged part.
	c) Deformed control rod (310) as a result of overstressing. Blade actuating gear butting.	c) Remove and replace control rod.
11. Jolting vibrations on propeller and ship.	a) Deformed or broken propeller blade (201).	a) Remove blade. Minor deformation of the blades can be rectified by cold bending. In the event of major deformations or broken blades, the blades must be replaced. (See k), page 17)
	b) Trapped foreign matter, e.g. towropes or buoys.	b) Clear blade. Repair damaged blade as recommended under a).

Irregularities observed	Cause	Remedy
12. Propeller cannot be controlled.	a) Control stand or control linkage damaged.	a) Locate cause of trouble. Repair or renew damaged parts.
	b) Control shafts (525, 625) cannot be turned.	b) Remove control shafts. Clean and grease bores and shafts. Refit control shafts.
	c) Control pin (509, 609) seized.	c) Remove control pin (see par.b, page 9). Remedy cause of trouble, e.g. burr or foreign matter and refit control pin.
	d) No control oil available. For causes see 1.a) to f) and 8.a) and b).	d) As described under 1.a) to f) and 8.a) and b).
13. Pitting due to corrosion on rotor casing	Zinc protection plate (104) used up.	Fit new zinc protection plates on rotor casing. Apply protective coat to rotor casing.

./.

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VII.) List of illustrations

VIII. List of numbered parts

101	rotor casing
102	
103	
104	zinc protection plate
201	blade
202	blade actuating lever
203	clamping screw for 202
204	
205	
206	
207	
208	gland ring on blade
209	blade shaft seal
210	balking ring
211	packing ring
212	Ring in 211
213	blade bearing cap
214	
215	junk excluder
216	round rubber cord seal
217	'O' Rings For 212
218	
219	bearing support
220	axle holder
221	screw in packing ring
222	" " lower bearing bushing
223	lower bearing bushing
224	upper bearing bushing
225	lower bearing ring
226	upper bearing ring
227	round rubber cord seal
228	
229	
230	'O' Rings for Blade Cover!

302	
303	
304	
305	
306	
307	connecting rod
308	pin for actuating lever and coupling
309	
310	control rod
311	lower spherical bushing
312	central spherical bushing
313	upper spherical bushing
314	pitch indicater
315	intermediate bushing
316	ring for intermediate bushing
317	screw for intermediate-bushing ring
318	push-rod sleeve
319	retaining flange
320	lower knuckle pin
321	central knuckle pin
322	hex.screw for upper spherical bushing
323	sealing ring
324	centring disk
325	
326	
327	control-rod bearing support
328	
329	screw for control-rod bearing support
330	balking ring (oil pressure shaft seal)
331	oil pressure shaft seal
332	retaining sleeve
333	flange for oil-pressure shaft seal
334	
335	
336	

343	main coupling
344	inner coupling
345	outer coupling
346	rocking arm
347	
348	pin
349	screw for pin
350	
351	coupling sleeve
352	flange
353	bushing for coupling
354	axle holder
355	
356	
357	
358	

400	
401	
403	
404	
405	inspection cover
406	
407	
408	large inspection cover
409	large inspection cover
410	small inspection cover
411	
412	casing cover
413	indicator plate
414	
415	leakage-oil channel

450	casing

500	speed servomotor
501	cylinder
502	cylinder cover
503	inner piston
504	outer piston
505	push rod
506	inner spring plate
507	outer spring plate
508	cylindrical compression spring
509	control pin
510	servo valve
511	screw plug
512	castle nut
513	bushing
514	cover
515	connection pin
516	connection pin
517	
518	spherical bushing in push rod
519	pin
520	lever
521	control-oil line
522	connecting line
523	connecting line
524	leakage-oil line
525	control shaft

600	steering servomotor
601	cylinder
602	cylinder cover
603	inner piston
604	outer piston
605	push rod
606	inner spring plate
607	outer spring plate
608	cylindrical compression spring
609	control pin
610	servo valve
611	screw plug
612	castle nut
613	bushing
614	cover
615	connecting pin
616	connecting pin
617	push-rod bushing
618	spherical bushing in push rod
619	pin
620	lever
621	control-oil line
622	connecting line
623	connecting line
624	leakage-oil line
625	control shaft

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701 bevel gear ring
702 bevel pinion with shaft
703 spacer ring for bevel gear ring
704 driving sleeve
705 screw plug for driving sleeve
706 hex.nut for driving sleeve
707 necked-down bolt
708 hex.nut for necked-down bolt
709 locking ring
710 gland ring
711 round rubber cord seal underneath the gland ring
(Voith: Am(2) [illegible] (1) Size 10 m/m Both Ships.)
712 upper bearing plate
713
714 screw plug
715 stop ring
716 fitted pin
717
718 upper gland ring (for oil-pressure shaft seal)
719
720 thrust plate
721 lower bearing plate
722 hex.screw for bevel gear ring
723 lower thrust ring
724 upper thrust ring
725 hex.screw for upper thrust ring
726 bearing flange
727 hex.nut for bearing flange
728 hex.socket cap screw for upper bearing plate
729 round rubber cord seal for bearing flange
730 round rubber cord seal for bearing flange
731 cylindrical roller bearing
732 bearing ring
733
734 protecting ring
735 intermediate ring
736 sealing ring (main seal)
737 pressing ring

738	spacer ring
739	outer flange bearing
740	spacer ring
741	sealing flange
742	sealing ring (pinion shaft)
743	lock nut
744	
745	outer pressure ring
746	outer bearing bushing
747	thrust ring
748	cover for flange bearing
749	
750	pump casing
751	cover for pump casing
752	oil drain plug
753	
754	
755	
756	vent
757	
758	
759	
760	
761	inner bearing bushing
762	
763	
764	
765	
766	
767	
768	
769	
770	

900	screw pump
901	hand-operated pump
902	valve group and plate-type filter (lamellar filter)
903	elevated oil tank
904	lubricating-oil line
905	overflow line to rotor casing
906	line from elevated oil tank
907	motor-driven pump (spare pump)
908	return line to elevated oil tank
909	filling line for elevated oil tank
910	suction pipe
911	line collecting drip oil
912	non-return valve
913	
914	non-return valve
915	delivery line
916	
917	
918	oil dipstick
919	connection for thermometer
920	filter
921	nose
922	sight-feed oiler
923	overflow cock
924	drain cock (check cock)
925	nose
926	articulated member
927	
928	overflow valve
929	connection for pressure gauge
930	vent line
934	relief valve on servomotors
935	piping to relief valves
936	sleeve cock
937	venting valve
938	throttle, 1 mm dia
939	throttle, 2 mm dia

940
941 piston for control-oil pressure valve
942 plate-type filter (lamellar filter)
943 piston for lubricating-oil pressure valve
944 safety valve
945 connection for control unit
946
947
948
949
950 stuffing box housing
951 flexible coupling
952 suction pipe
953 radial seal
954 deep-groove ball bearing
955 driving spindle
956 bevel pinion for pump drive
957 bevel gear for pump drive
958 spacer disk
959 spacer ring

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IX.) List of tools and jigs

W_1 Jig for adjustment of servomotor pistons

W_2

W_3 Suction pipe and jig for installation of lower spherical bushing

W_4 Jig for installation of blade shaft seals

W_5 Suspension jig for pinion shaft bearing

W_6 Jig for suspension of blades

W_7 Jig for installation of main bearing and of rotor seal

W_8 Jig for centring of driving sleeve in respect of propeller casing

Approximate weights of size 36 G
Voith-Schneider Propeller

1.)	Total weight <u>without</u> oil filling	58,500 kg
	Total weight <u>with</u> oil filling	64,000 kg
2.)	<u>Weights of the various subassemblies:</u>	
	Rotor casing	8,500 kg
	Rotor casing with blade actuating gear	16,450 kg
	Rotor casing with blade actuating gear and blades	24,200 kg
	Casing	10,500 kg
	Casing with inner parts, servomotors and pinion bearings, but without rotor casing	34,300 kg
	Servomotor (unit weight)	1,060 kg
	Pinion bearing (with pump and bearing cover)	2,950 kg

3.) Approximate unit weights

Part No.		
101	rotor casing	8,500 kg
201	blade (complete)	1,554 kg
202	actuating lever	130 kg
213	blade bearing cap with bronze bushing	300 kg
219	bearing support with bronze bushing	150 kg
307	connecting rod	60 kg
310	control rod complete	1,085 kg
312	central spherical bushing	165 kg
327	control-rod bearing support	3,300 kg
343	main coupling	210 kg
344	inner coupling	190 kg
345	outer coupling	190 kg
346	rocking arm	150 kg
351	coupling sleeve	85 kg
450	casing	10,500 kg
500	speed servomotor	1,060 kg
600	steering servomotor	1,060 kg
701	bevel gear ring	1,955 kg
702	bevel pinion with shaft	1,800 kg
704	driving sleeve	3,600 kg
712	upper bearing plate	800 kg
720	thrust plate	3,100 kg
721	lower bearing plate	400 kg
724	upper thrust ring	1,150 kg
726	bearing flange	500 kg
731	cylindrical roller bearing	350 kg
739	bearing cover	650 kg
750	pump casing	250 kg
900	pump	270 kg
902	valve group and plate-type filter	100 kg

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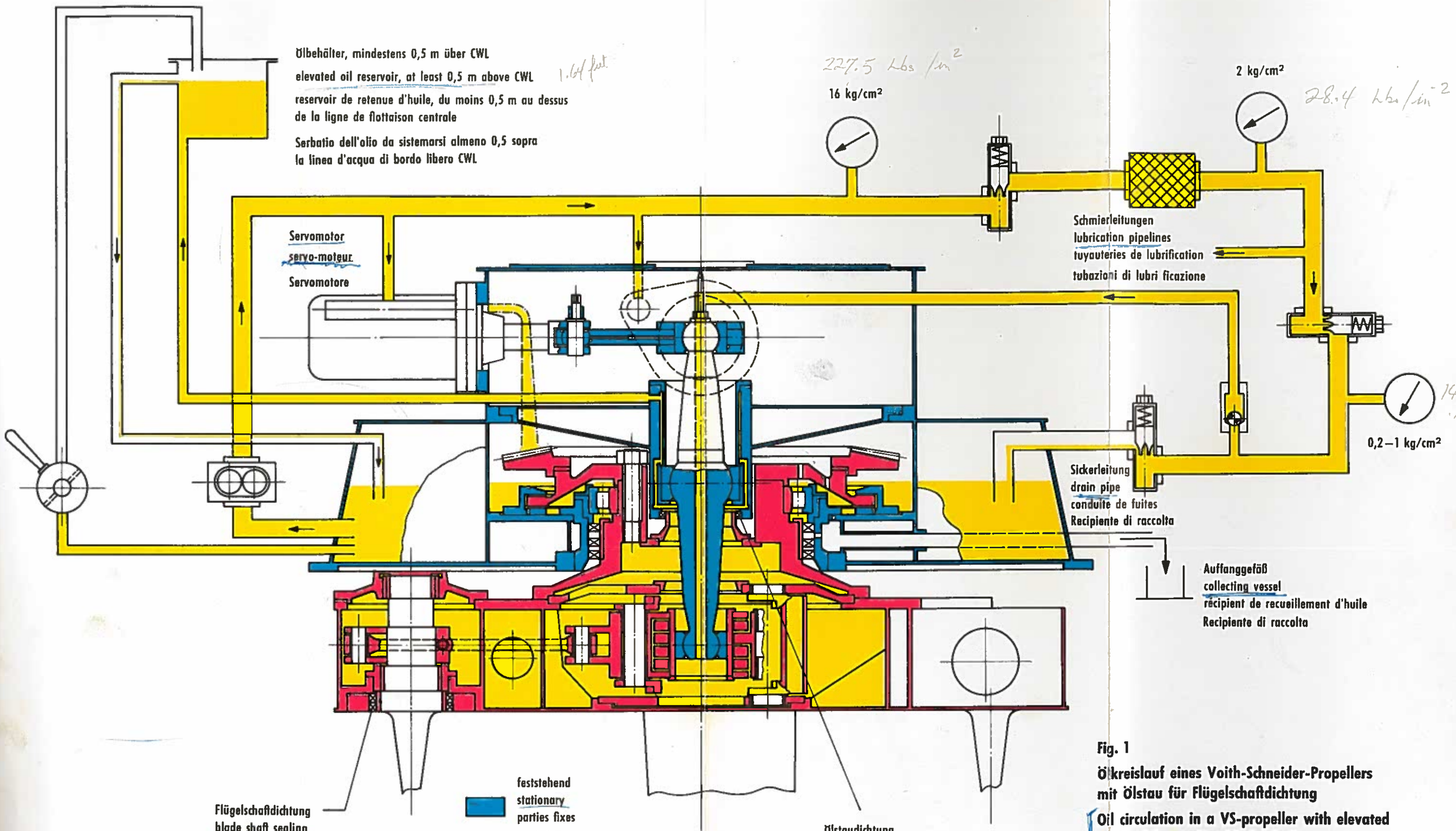


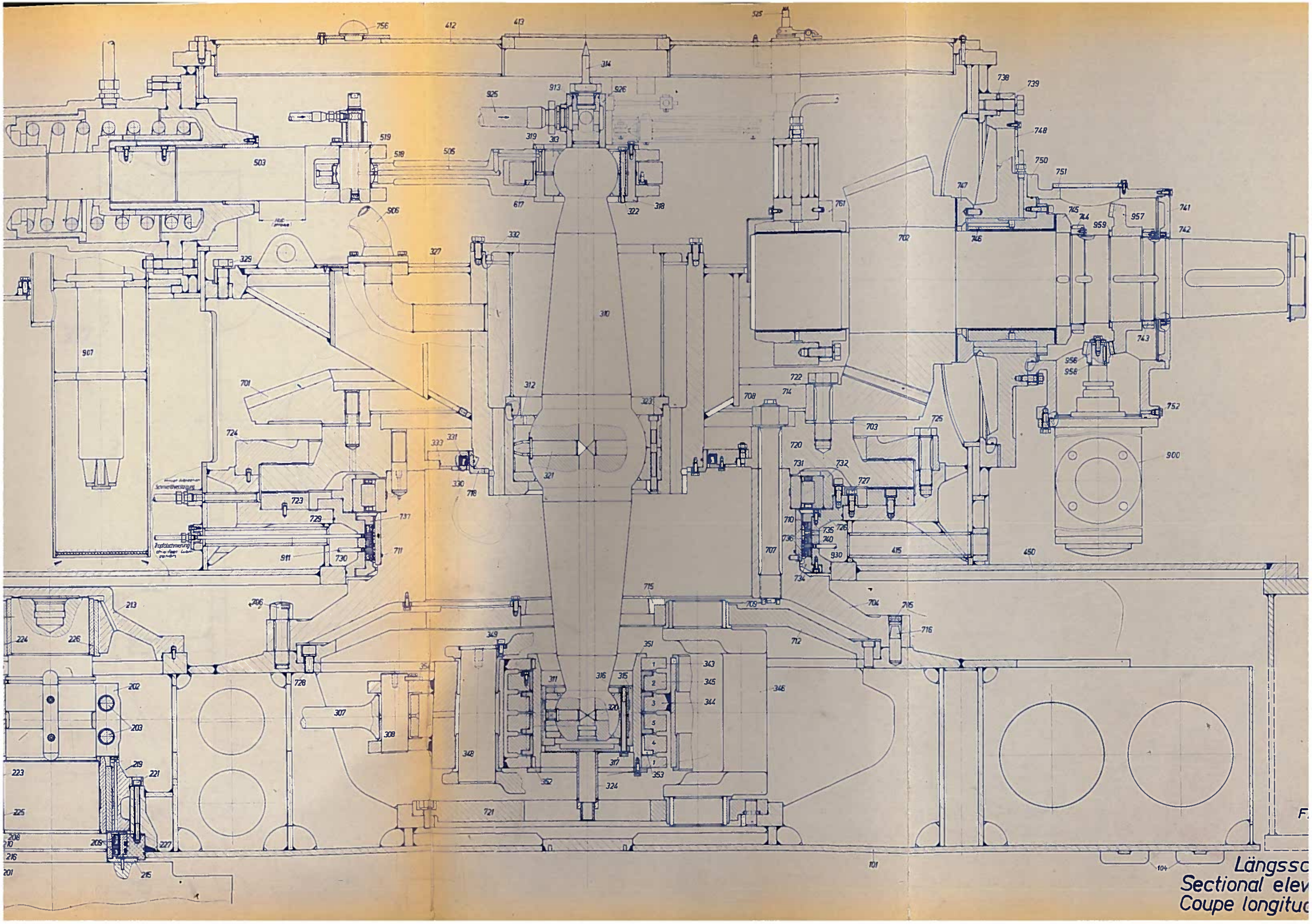
Fig. 1

Ölkreislauf eines Voith-Schneider-Propellers mit Ölstau für Flügelschaftdichtung

Oil circulation in a VS-propeller with elevated oil level for sealing blade shafts

Circulation d'huile d'un propulseur Voith-Schneider avec système de retenue d'huile pour l'étanchement des ailes

Circuito dell'olio di un propulsore Voith-Schneider con sistema di ritegno d'olio per la guarnizione del gabo della pala


Längssc
Sectional elev
Coupe longitud

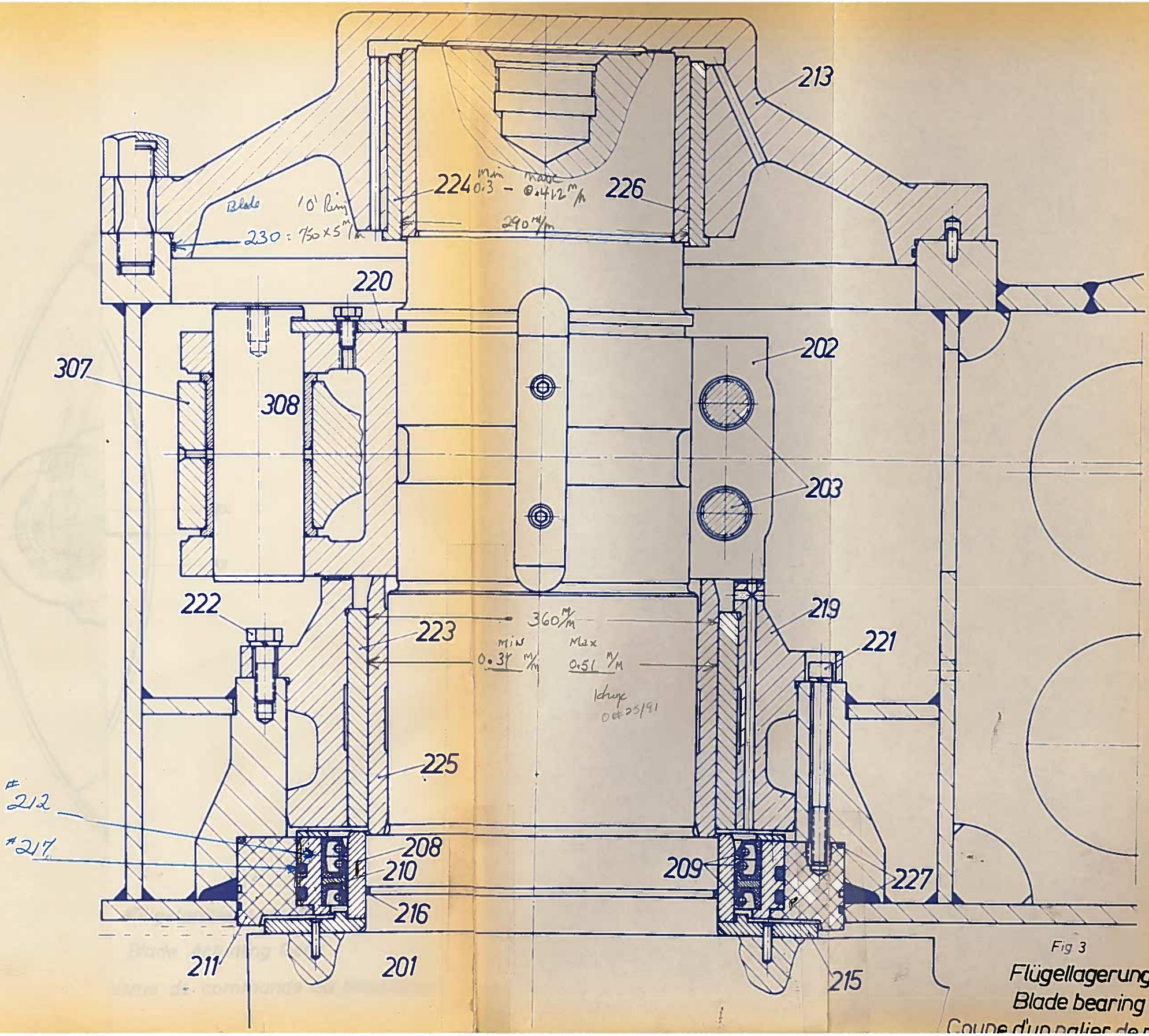


Fig 3

Flügellagerung

Blade bearing

Coupe d'un palier de pale

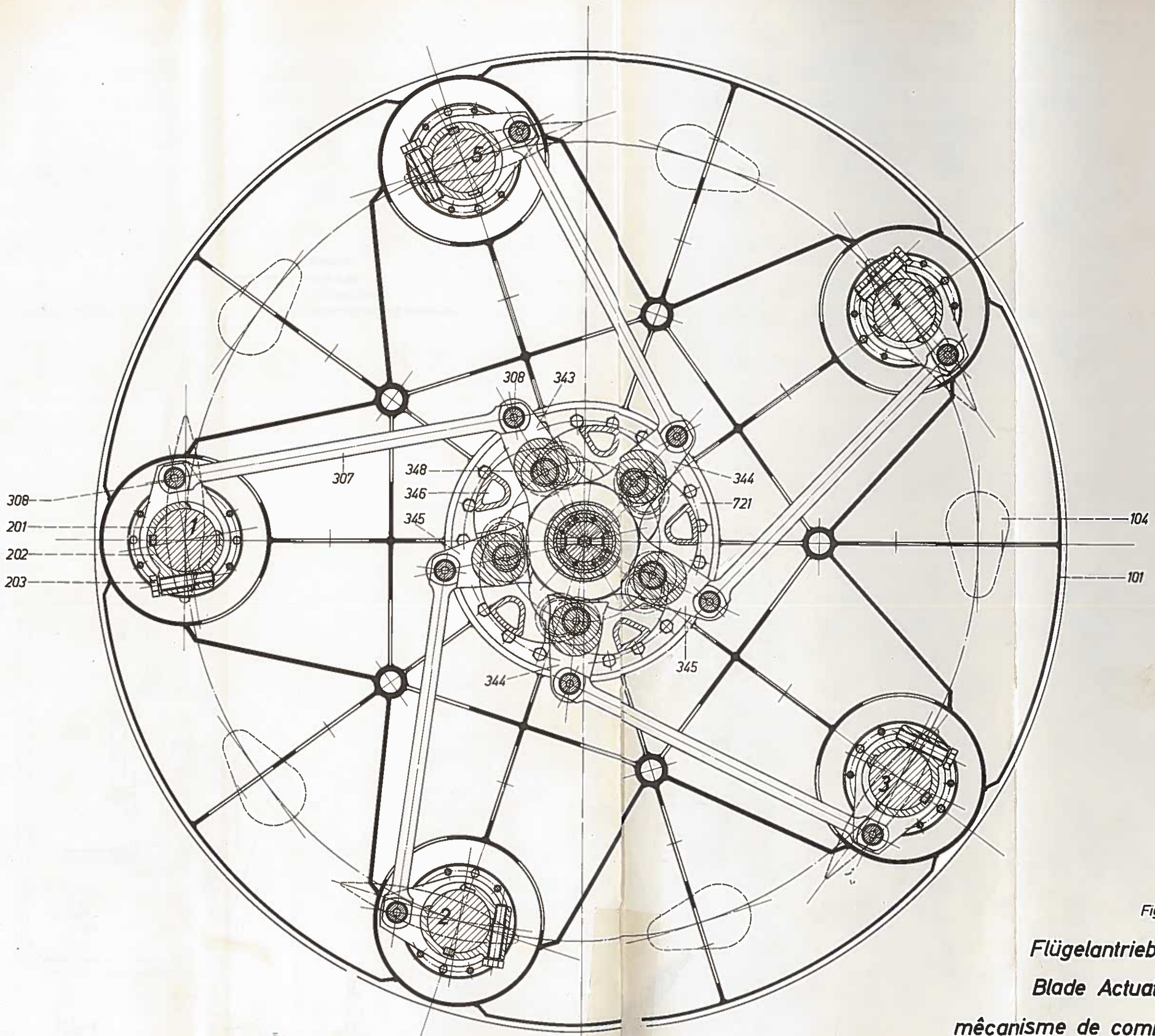


Fig. 4

Flügelantriebsgestänge

Blade Actuating Gear

mêcanisme de commande du propulseur

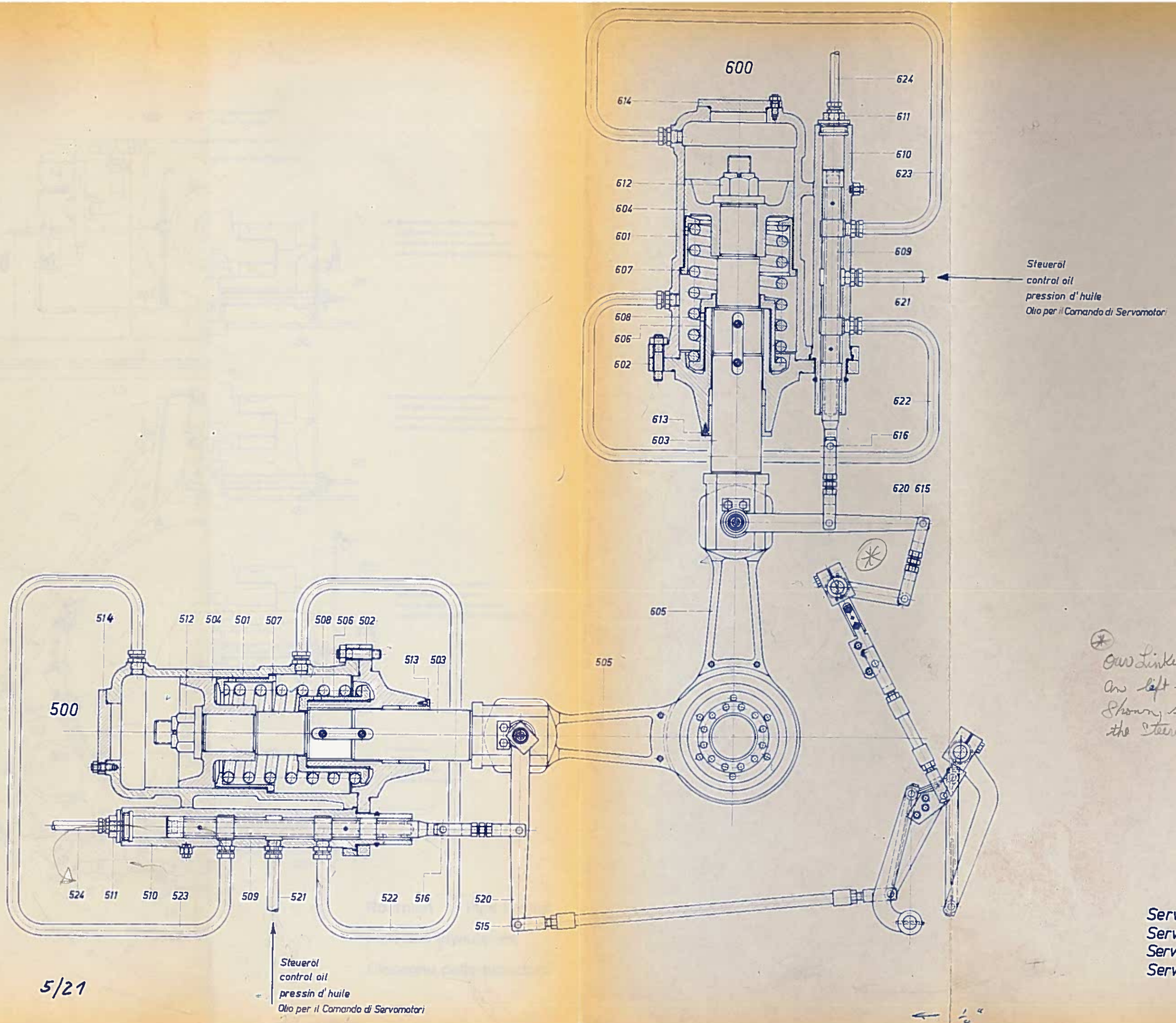


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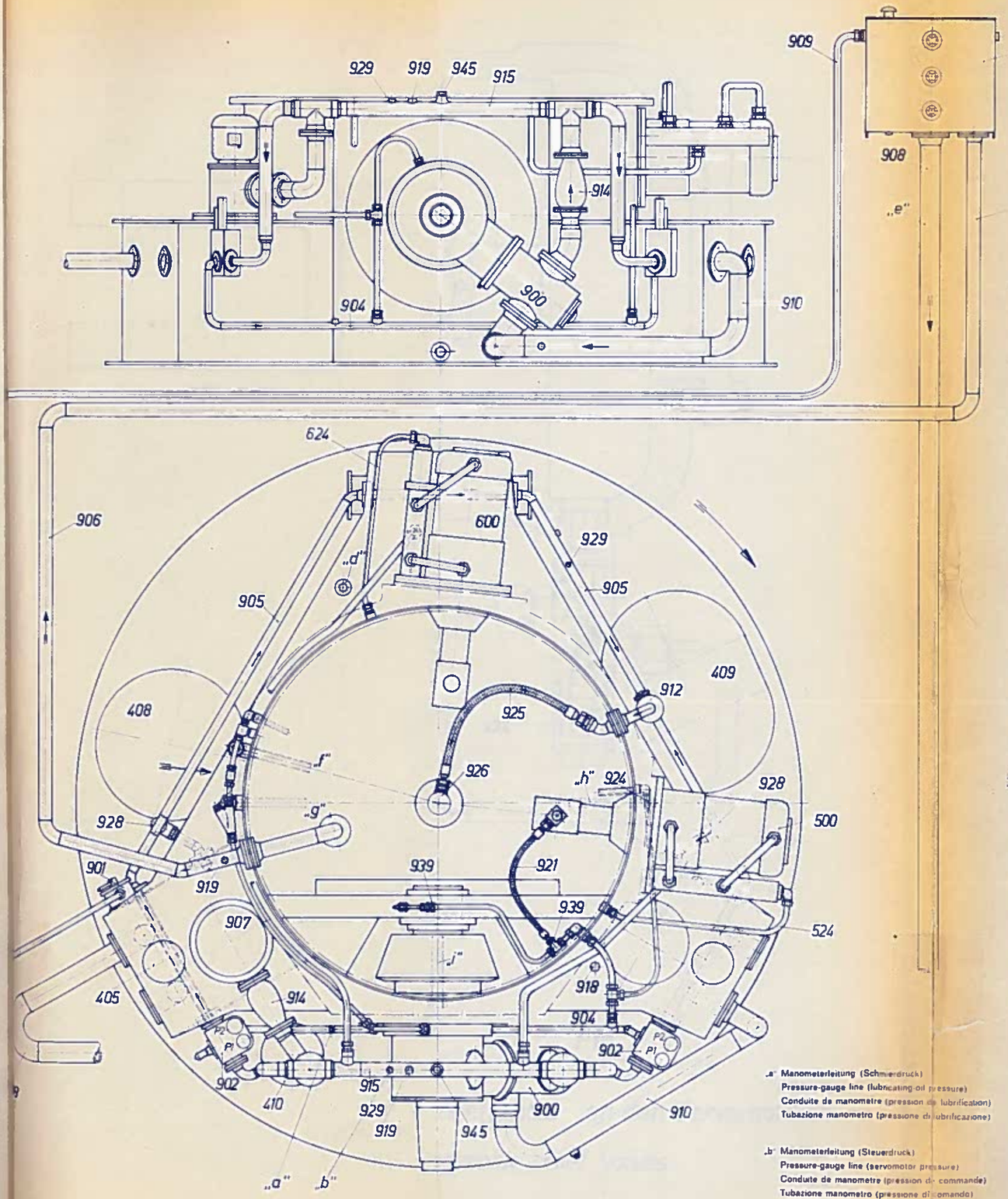
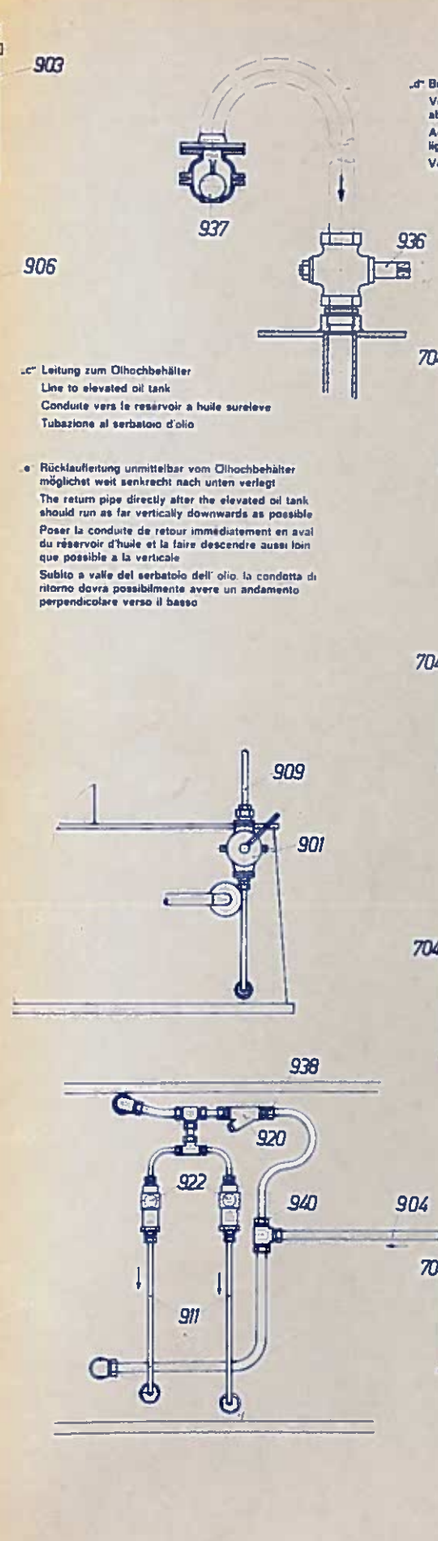
Fig. 5

Servomotoren
Servomotors
Servo-moteurs
Servomotori



„a" Manometerleitung (Schmierdruck)
Pressure-gauge line (lubricating-oil pressure)
Conduite de manometre (pression de lubrification)
Tubazione manometro (pressione di lubrificazione)

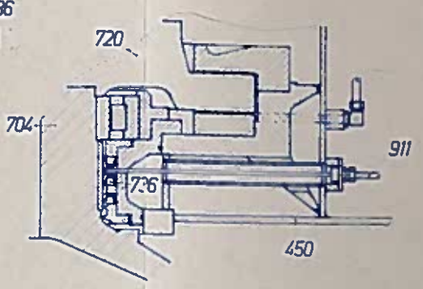
„b" Manometerleitung (Steuerdruck)
Pressure-gauge line (servomotor pressure)
Conduite de manometre (pression de commande)
Tubazione manometro (pressione di comando)



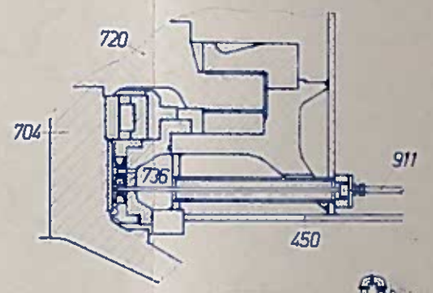
„c" Leitung zum Ölhochbehälter
Line to elevated oil tank
Conduite vers le reservoir a huile surelevé
Tubazione al serbatoio d'olio

„e" Rücklaufleitung unmittelbar vom Ölhochbehälter möglichst weit senkrecht nach unten verlegt
The return pipe directly after the elevated oil tank should run as far vertically downwards as possible
Poser la conduite de retour immédiatement en aval du réservoir d'huile et la faire descendre aussi loin que possible à la verticale
Subito a valle del serbatoio dell' olio la condotta di ritorno dovra possibilmente avere un andamento perpendicolare verso il basso

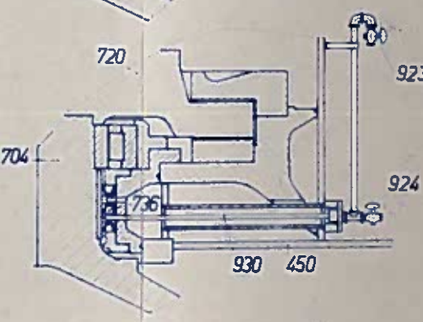
„d" Brunnenbelüftung über die Wasserlinie geführt
Vent pipe of propeller well to be extended above water line
Aération du carlingage prolongée au-delà de la ligne de flottaison
Ventilazione del pozzo sopra la linea di galleggiamento



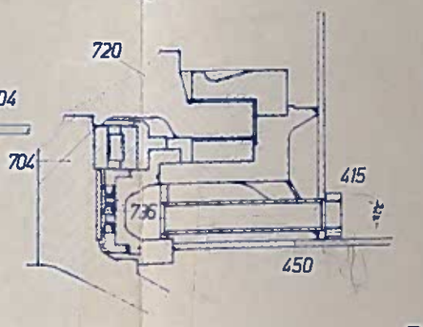
„f" Schmierung zur mittleren Hauptdichtung
Lubrication for central main seal
Lubrification pour joint principal median
Lubrificazione per la guarnizione principale centrale



„g" Schmierung zur unteren Hauptdichtung
Lubrication for lower main seal
Lubrification pour joint principal inferieur
Lubrificazione per la guarnizione principale interiore



„h" Kontrollstelle für Hauptdichtung
Inspection point for main seal
Point de contrôle pour joint principal
punto di controllo per guarnizione principale



„J" Sickerkanal
Leakage canal
canal de furtes
canale di drennaggio

Fig. 8

Rohrplan Pipe Layout
Plan des tuyauteries
Diasegno delle tubazioni

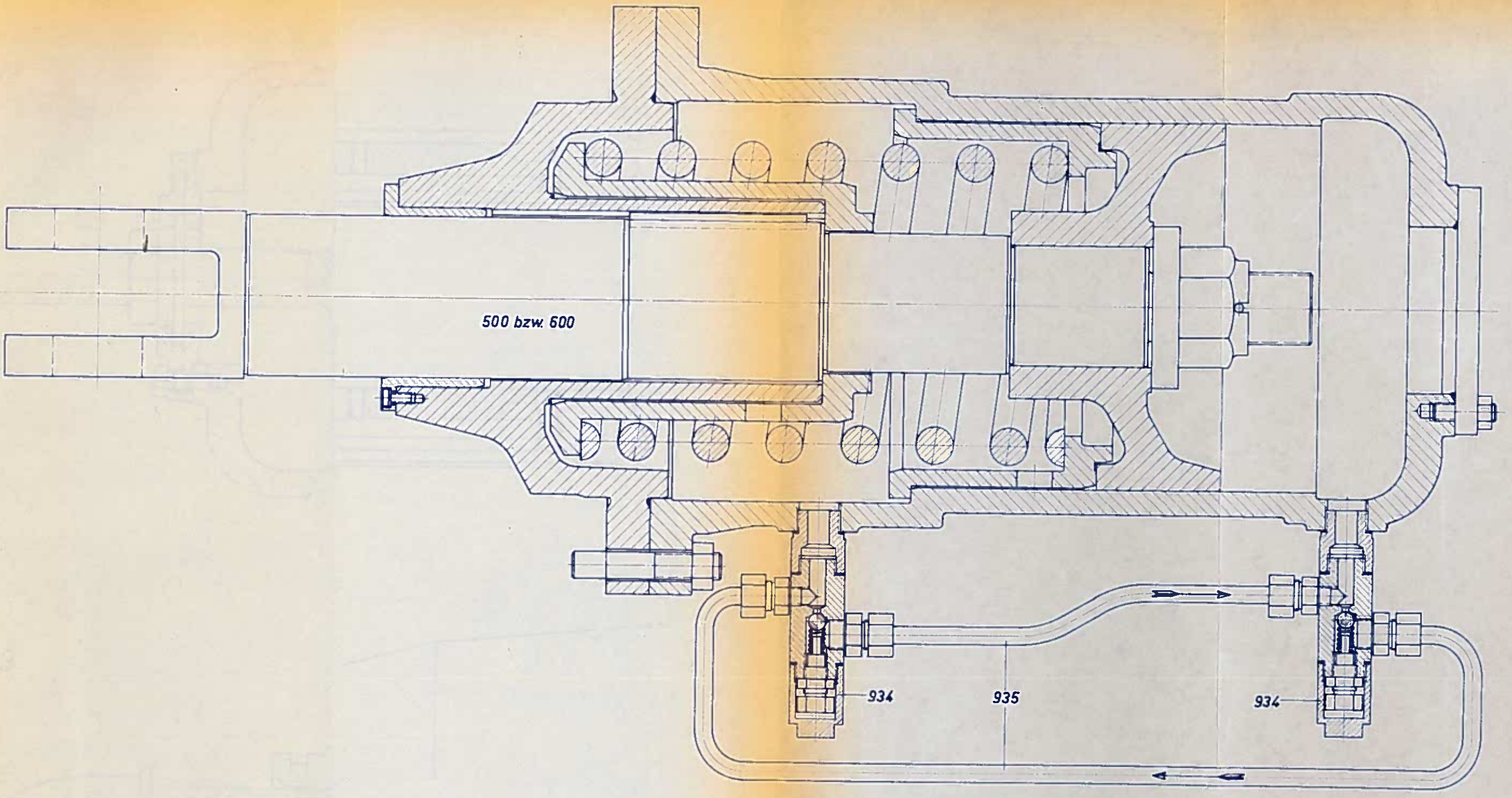


Fig. 7

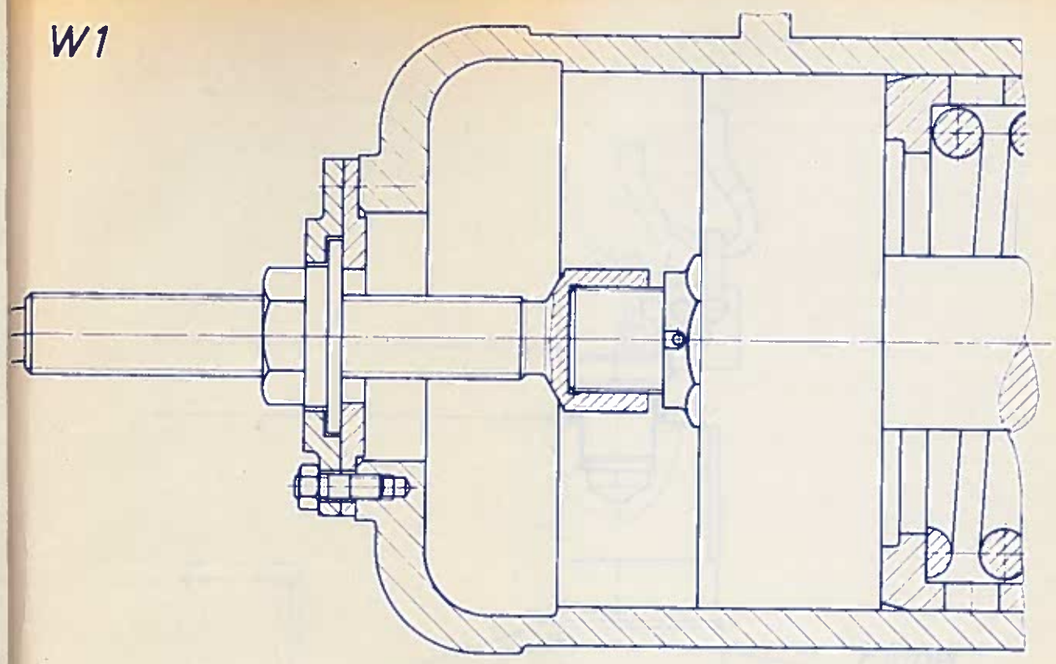
Überlastventile an den Servomotoren

servomotor relief valves

soupapes de securite aux servo-moteurs

valvole di sicurezza sui servomotori

W1



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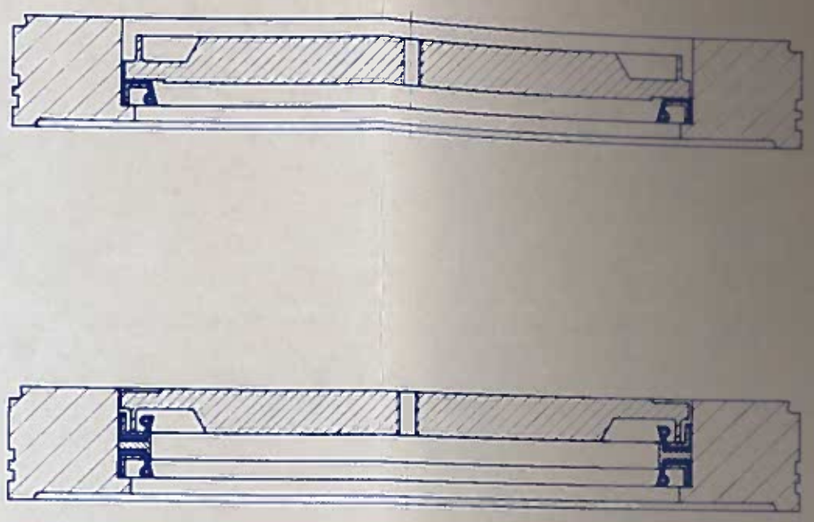
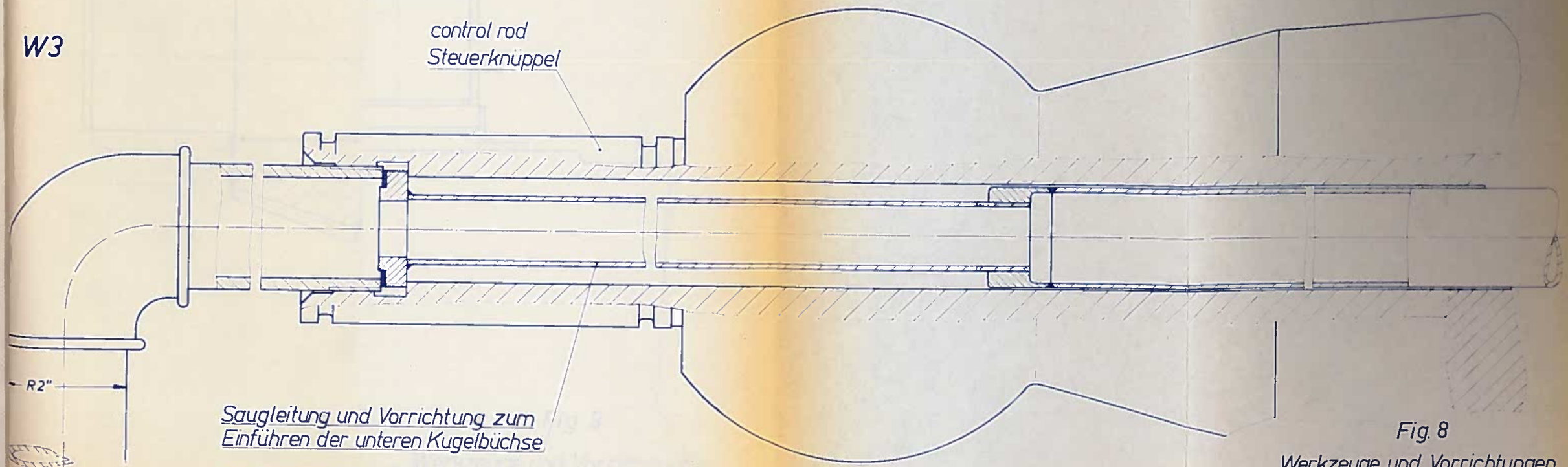


W3



Saugleitung und Vorrichtung zum Einführen der unteren Kugelbüchse

suction pipe line and jig for guiding lower spherical bush

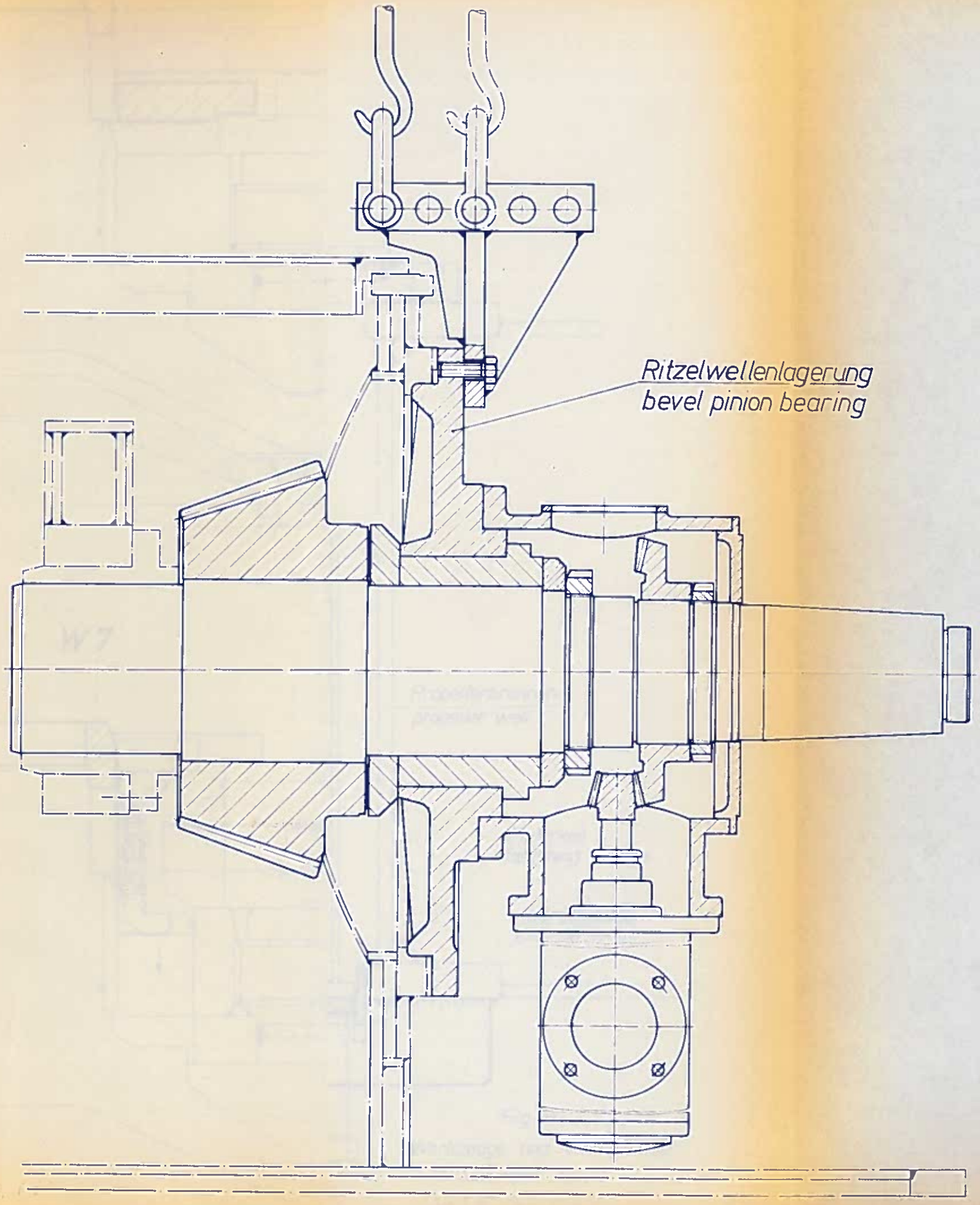
Fig. 8

Werkzeuge und Vorrichtungen

Tools and Jigs

Outils et instruments

W5



W6

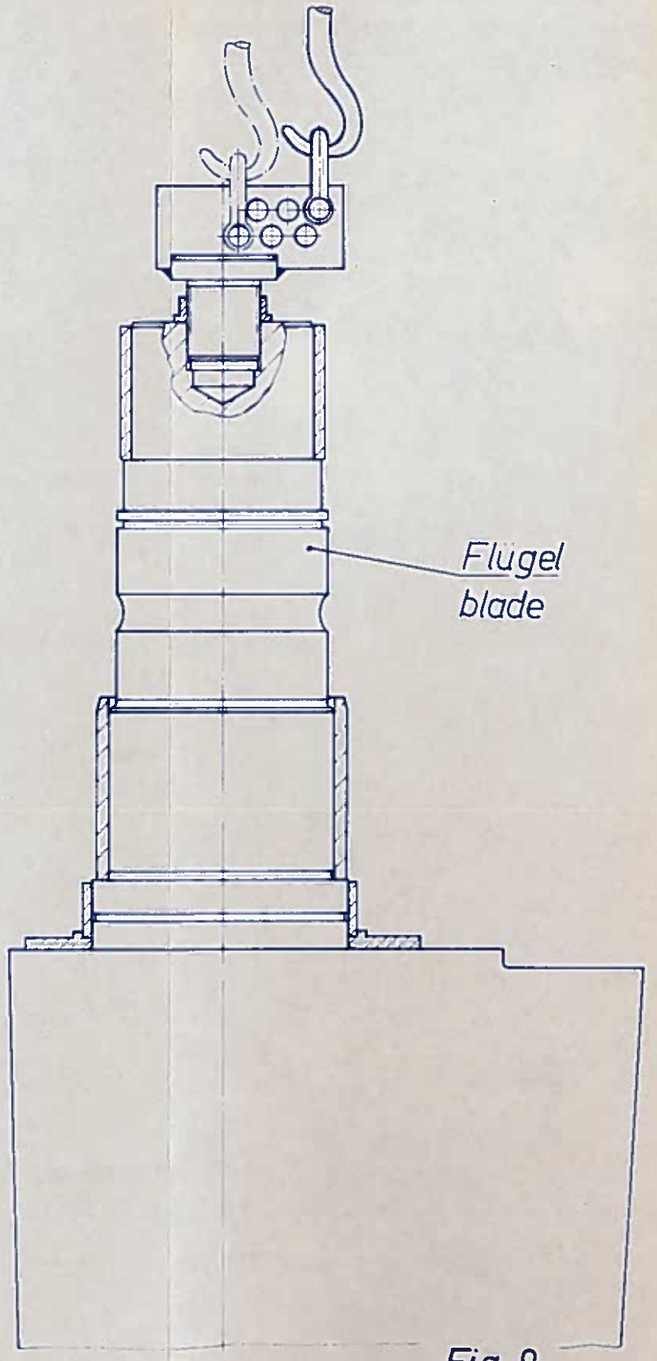


Fig. 9

Werkzeuge und Vorrichtungen
Tools and Jigs
Outils et instruments

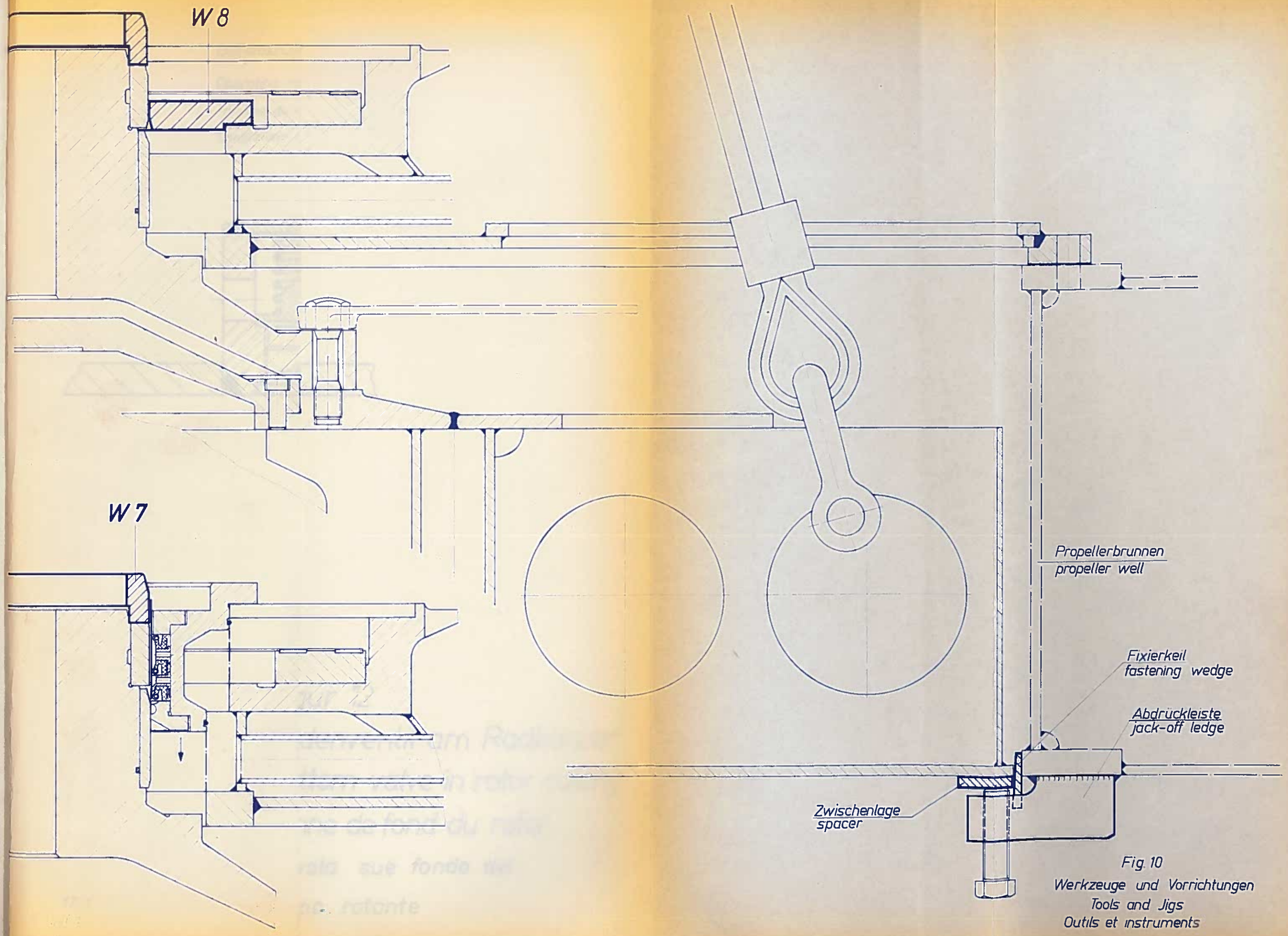


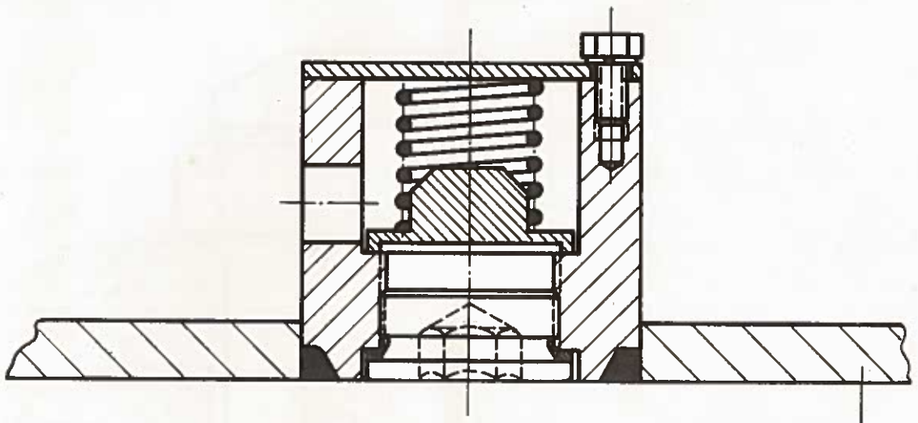
Fig. 10
Werkzeuge und Vorrichtungen
Tools and Jigs
Outils et instruments

Betriebszustand

Operating condition

Régime de marche

Condizione di esercizio



Radboden

Bottom of rotor casing

Fond de rotor

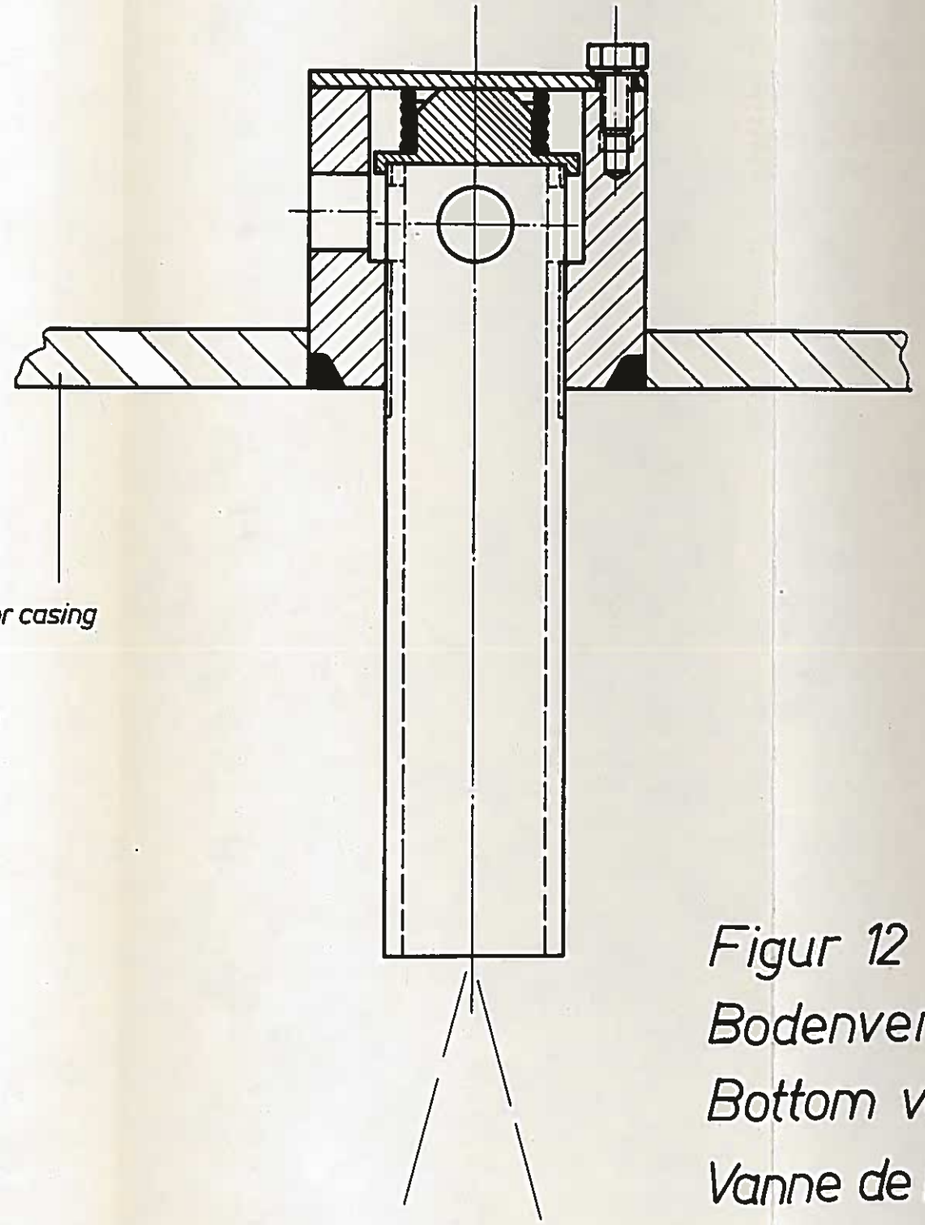
Base rotante

Entleerung

Oil drainage

Vidange

Scarico olio



Figur 12

Bodenventil am Radkörper

Bottom valve in rotor casing

Vanne de fond du rotor

Valvola sue fondo del corpo rotante

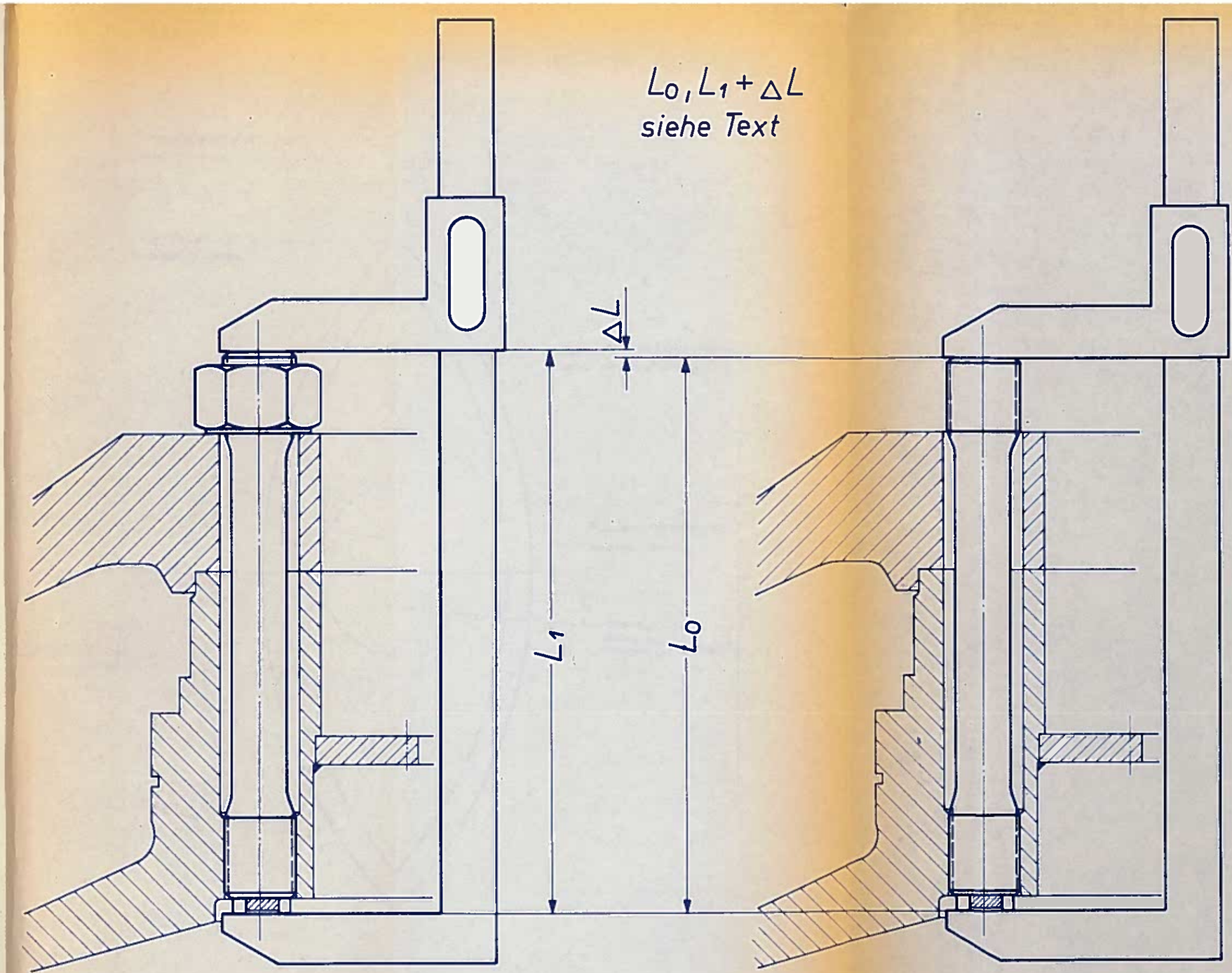


Fig. 13

Vorspannen der Dehnschrauben

Pre-stessing of nected-down bolts

Préserrage des boulons décolletés à portée de centrage

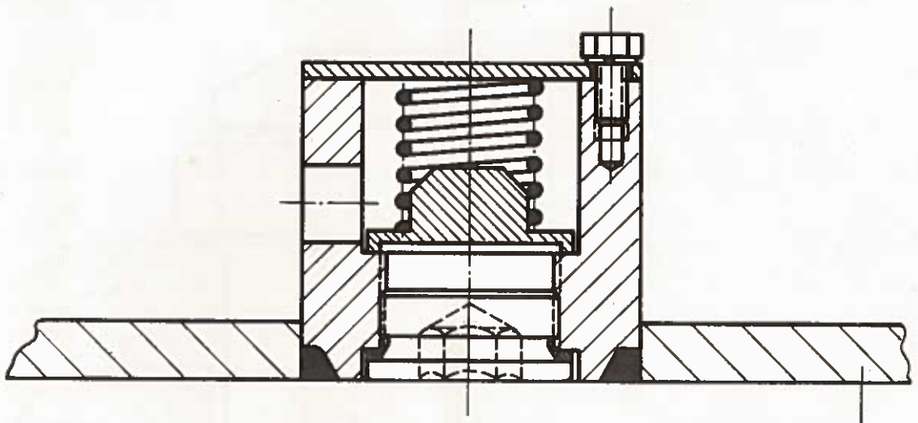
Vedere il relativo capoverso

Betriebszustand

Operating condition

Régime de marche

Condizione di esercizio



Radboden

Bottom of rotor casing

Fond de rotor

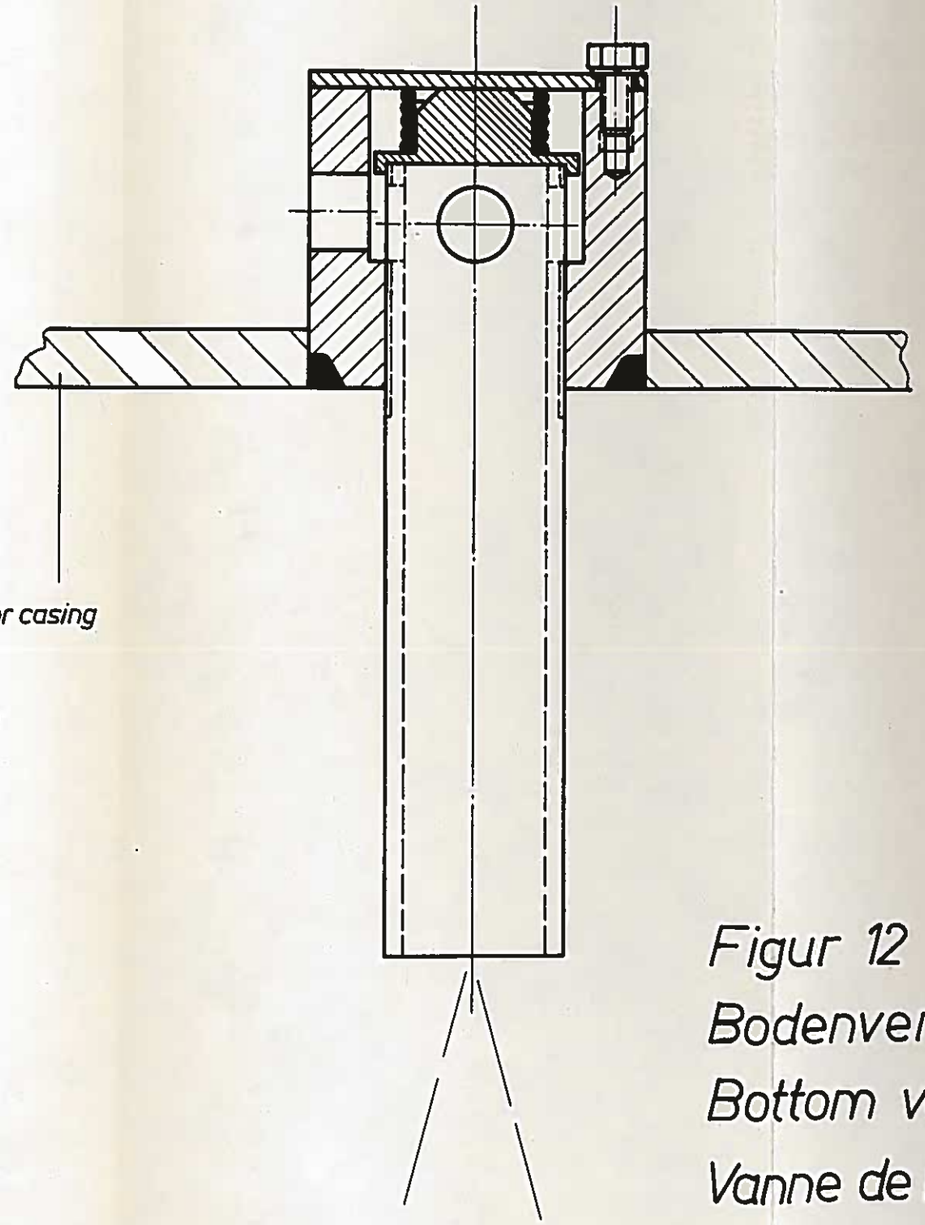
Base rotante

Entleerung

Oil drainage

Vidange

Scarico olio



Figur 12

Bodenventil am Radkörper

Bottom valve in rotor casing

Vanne de fond du rotor

Valvola sue fondo del corpo rotante

Mitte FS
centreline of speed servomotor

Propeller-Nr. 1759 und 1761

Verstelleinheit bei Montage an Bord montiert
control unit installed aboard during erection

Mitte RS
centreline of steering servomotor

Mitte Ritzelwelle
pinion-shaft centreline

Ruder Verstellung
steering control

Hebel für Hand-Not-Steuerung
Lever for hand emergency control

Fahrtverstellung
speed control

Hebel für Hand-Not-Steuerung
Lever for hand emergency control

Deckel auf dem Propeller-Gehäuse
cover on propeller casing

Schnitt C-C
section C-C
coupe C-C
sezione C-C

Schnitt A-A
section A-A
coupe A-A
sezione A-A

Schnitt D-D
section D-D
coupe D-D
sezione D-D

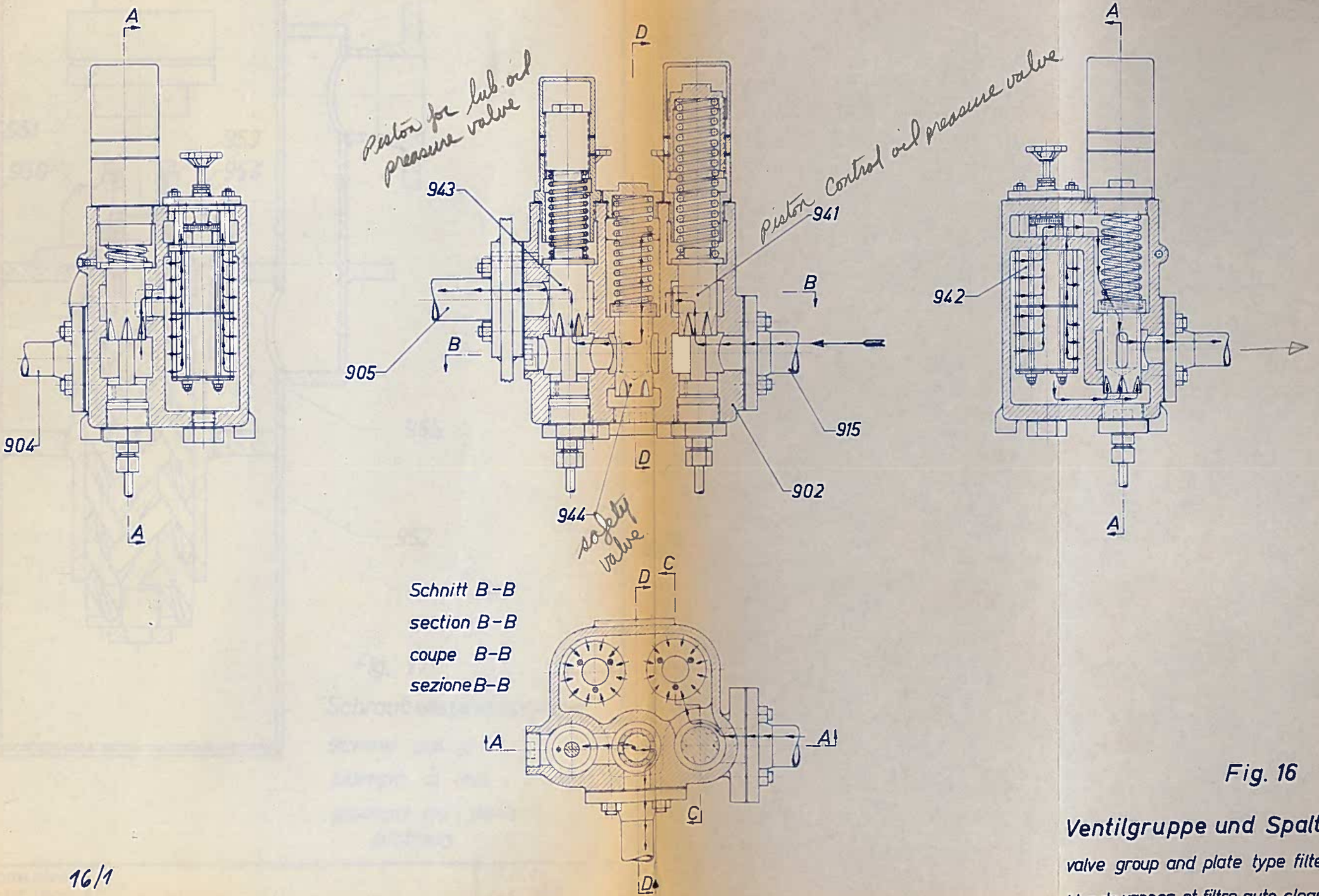


Fig. 16

Ventilgruppe und Spaltfilter

valve group and plate type filter

bloc de vannes et filtre auto-clean

gruppo valvole e filtri a spacchi

Hebel für Hand- Not - Steuerung
Lever for hand emergency control

Deckel auf dem Propeller - Gehäuse
cover on propeller cosing

Fahrtverstellung
speed control

Hebel für Hand- Not- Steuerung
Lever for hand emergency control

Mitte Ritzelwelle
pinion-shaft centreline

Mitte FS
centreline of steering
gear

Propeller-Nr 1759 und 1761

Versteilerkraft bei Montage
an Bord „montiert"
control „in" „installed
aboard during erection

Mitte RS
centreline of steering
gear

Hebel für Hand- Not- Steuerung
Lever for hand emergency control

Mitte R
pinion-s

Hebel für Hand
Lever for hand

Deckel auf dem Propeller-Gehäuse
cover on propeller casing

Fahrt-Verstellung
speed control

Hebel für Hand-Not-Steuerung
Lever for hand emergency control

Mitte Ritzelwelle
pinion-shaft centreline

control unit installed
aboard during erection
Verstelleinheit bei Montage
an Bord montiert

Propeller Nr. 1760
1762

Mitte F.S.
centreline of speed
servomotor

Fig 15

Hand-Not-Steuerung

hand emergency control

Schnitt C-C
section C-C
coupe C-C
sezione C-C

Schnitt A-A
section A-A
coupe A-A
sezione A-A

Schnitt D-D
section D-D
coupe D-D
sezione D-D

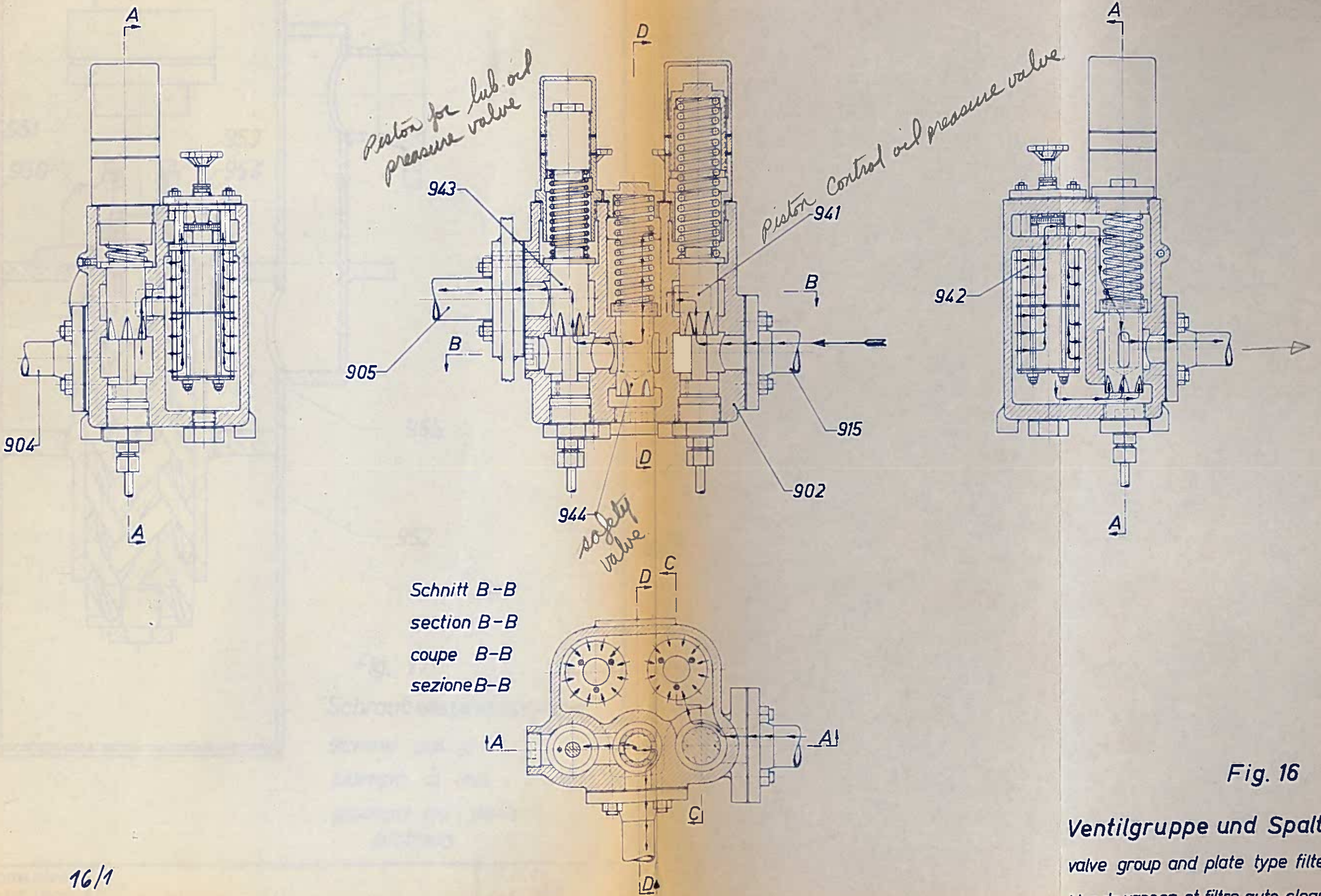


Fig. 16

Ventilgruppe und Spaltfilter

valve group and plate type filter

bloc de vannes et filtre auto-clean

gruppo valvole e filtri a spacchi

VOITH

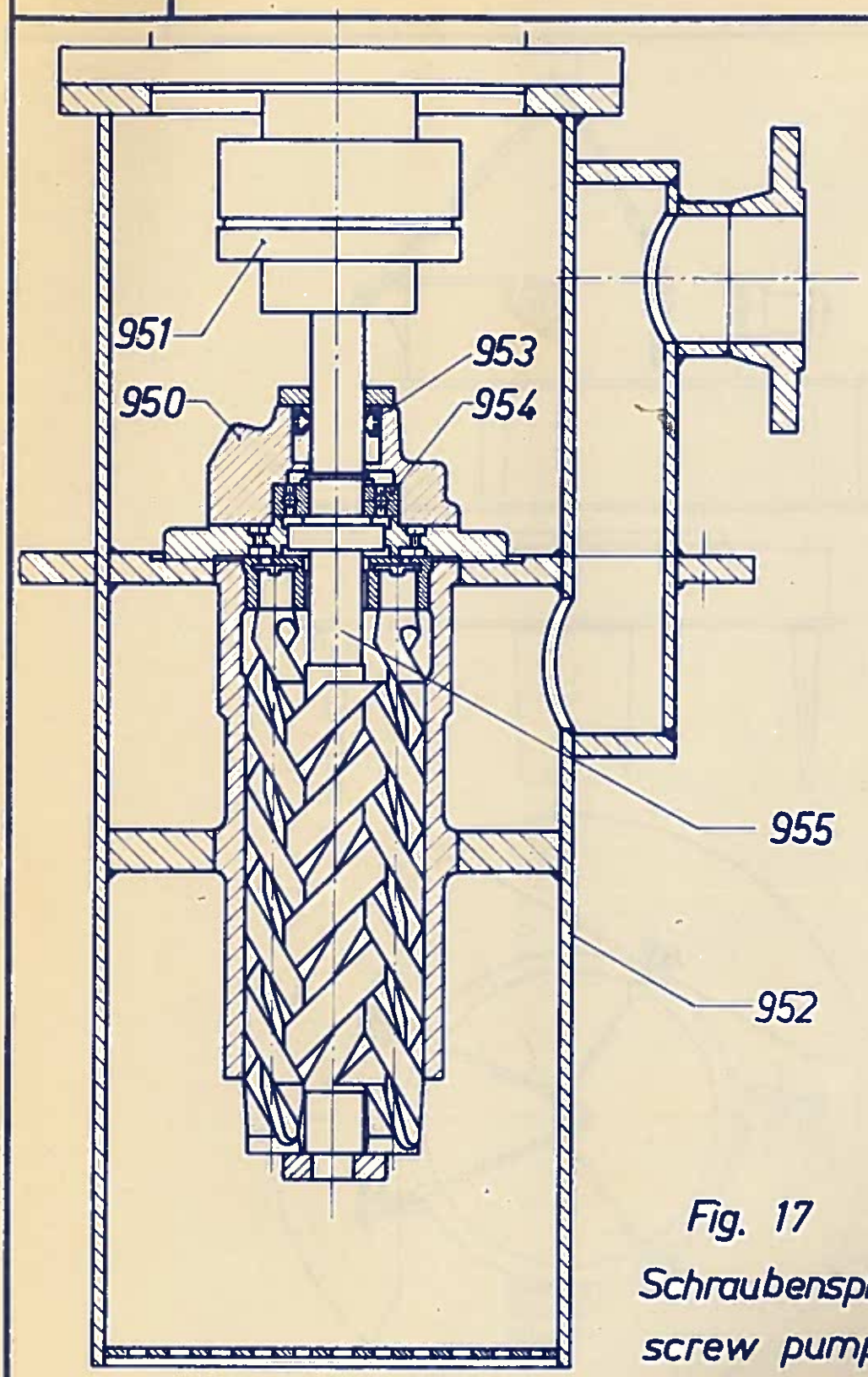


Fig. 17

Schraubenspindelpumpe

screw pump

pompe à vis

pompa ad asta filettata

Wöhrle & Co., Rastatt 48

VOITH

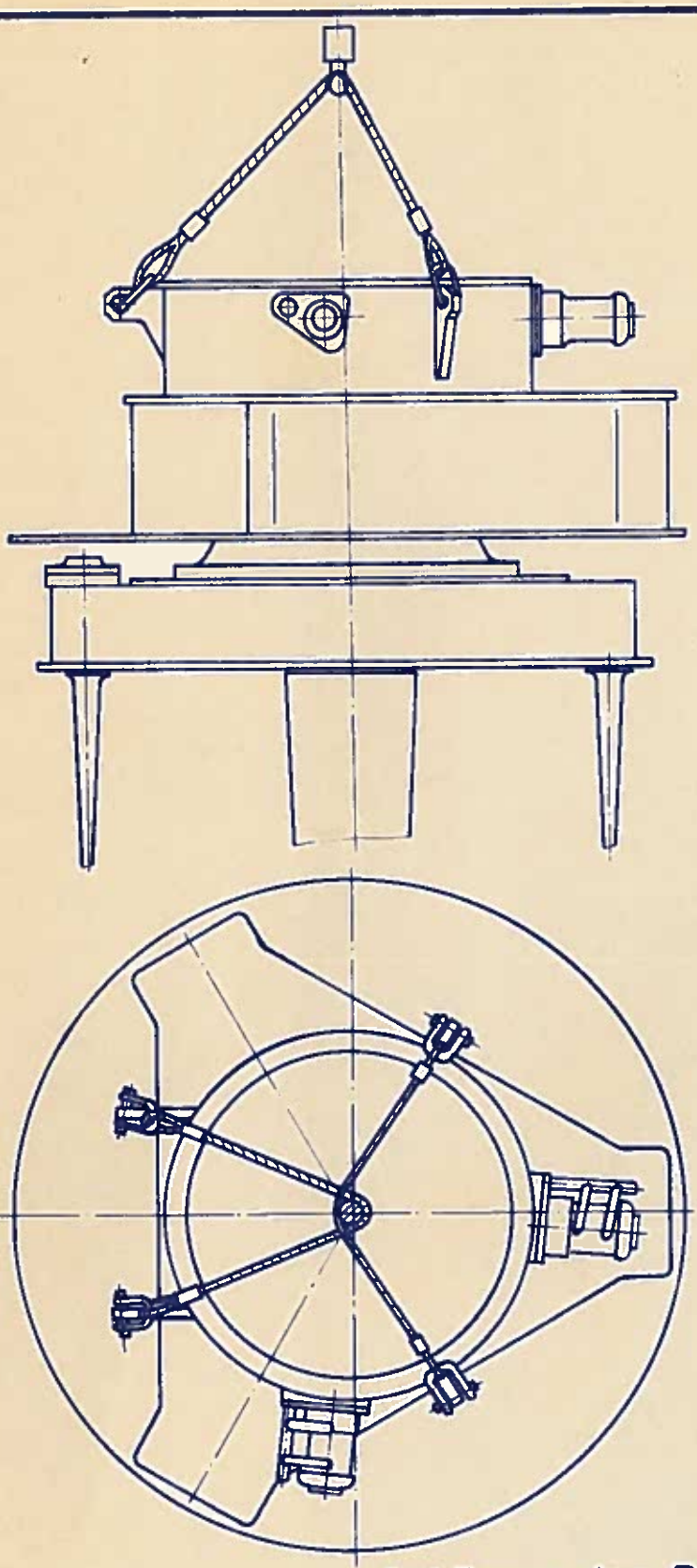


Fig.18
Anhängen des Propellers
suspension of propeller
suspendre le propulseur

Wöhrle & Co., Rastatt