SCHOTTEL - RUDDER PROPELLER

"SRP"

OPERATING INSTRUCTIONS

1. DESCRIPTION

1.1 GENERAL

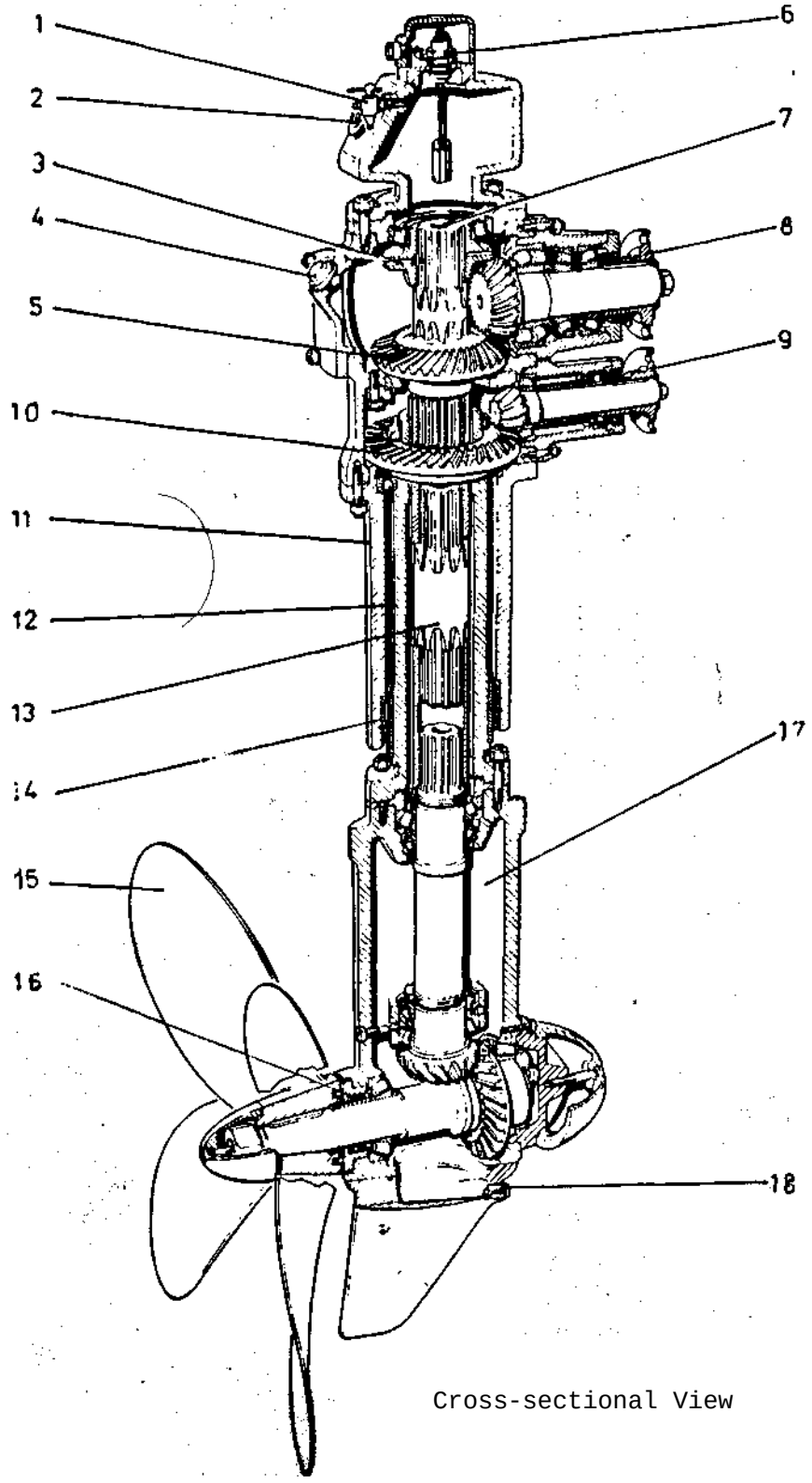
The SCHOTTEL rudder propeller, hereafter called SRP, is a Z-drive unit. The lower gearing with the propeller has been designed to be able to infinitely turn to port or starboard, so that the full propeller thrust can be directed to any desired direction, thus obtaining the optimum combination of propulsion and steering.
The power is transmitted through two pairs of spiral bevel gears made from high quality material.
The steering is transmitted through such a pair of bevel gears.
All bevel gears have been hardened and lapped in pairs
The lower gearing with associated screws and gaskets is made of corrosion resistant material.

1.2 DESIGN

Legend for Fig. 1

1) Vent cock
2) Plug screw and oil level sight glass at the side
3) Oil slinger, only for SRP's up to SRP 100
4) Plug screw
5) Bevel gear set for the drive in the upper gearing
6) Float switch for lack of oil warning
7) Plug in the vertical drive shaft
8) Flange for input drive shaft
9) Flange for steering drive shaft
10) Bevel gear set for steering
11) Carrying pipe
12) Steering pipe
13) Power transmission shaft
14) Seal between carrying pipe and steering pipe
15) Propeller
16) Sealing of the propeller shaft
17) Lower gearing
18) Magnetic plug

Figure 1



Cross-sectional View

To avoid air from entering the propeller, a cover plate (Figures 4/2 or 6/2) can be provided. In addition, a nozzle can be provided for increasing the thrust.

1.3 LUBRICATION

The SRP features oil bath lubrication, i.e. it is filled with oil. An oil tank, either directly mounted on the SRP or separately mounted, is used as expansion and compensating tank. The oil in the SRP is circulated during operation and cooled in the lower section. The circulation is accomplished by an oil slinger (Figure 1/3) for sizes up to SRP 100, and by a worm gear (Figure 7) for sizes SRP 150-300. This oil worm gear is located on the power transmission shaft and forces the oil down. A sight-glass (Figure 1/2) on the oil tank and an electric warning switch (Figure 1/6) are provided for checking the oil level; the warning switch closes a contact as soon as the specified oil quantity is fallen below. The attached steering worm gear (Figure 2) are sealed from the upper gearing and are equipped with a separate oil fill hole.

1.4 COMPENSATING FIN

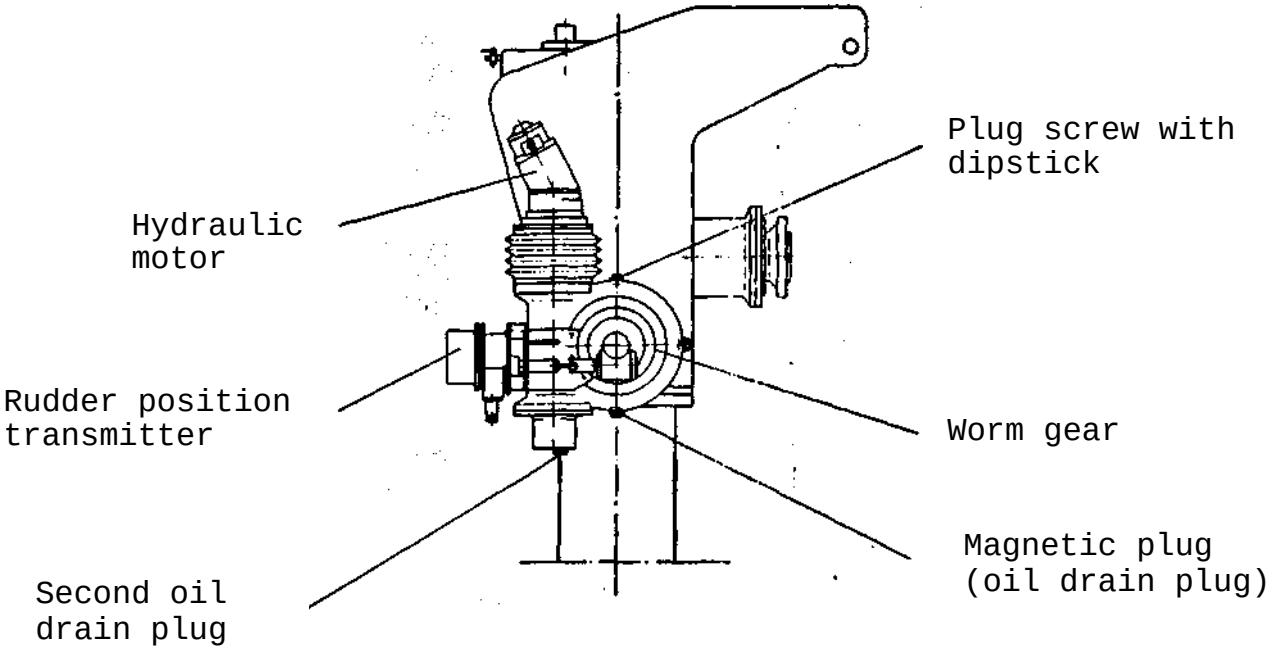
The torque of the vertical power transmission shaft (Figure 1/13) is transmitted through the bevel gear pair of the lower gearing of the SRP to its housing. The torque must be fully absorbed by the steering gear, unless it is compensated.
For this reason, the manually controlled SRP's (steering systems S 100, S 200 and S 300) are equipped with compensating fins (Figures 4/4, 5/1 or 6/4).

1.5 STEERING WORM GEARS (See Figure 2)

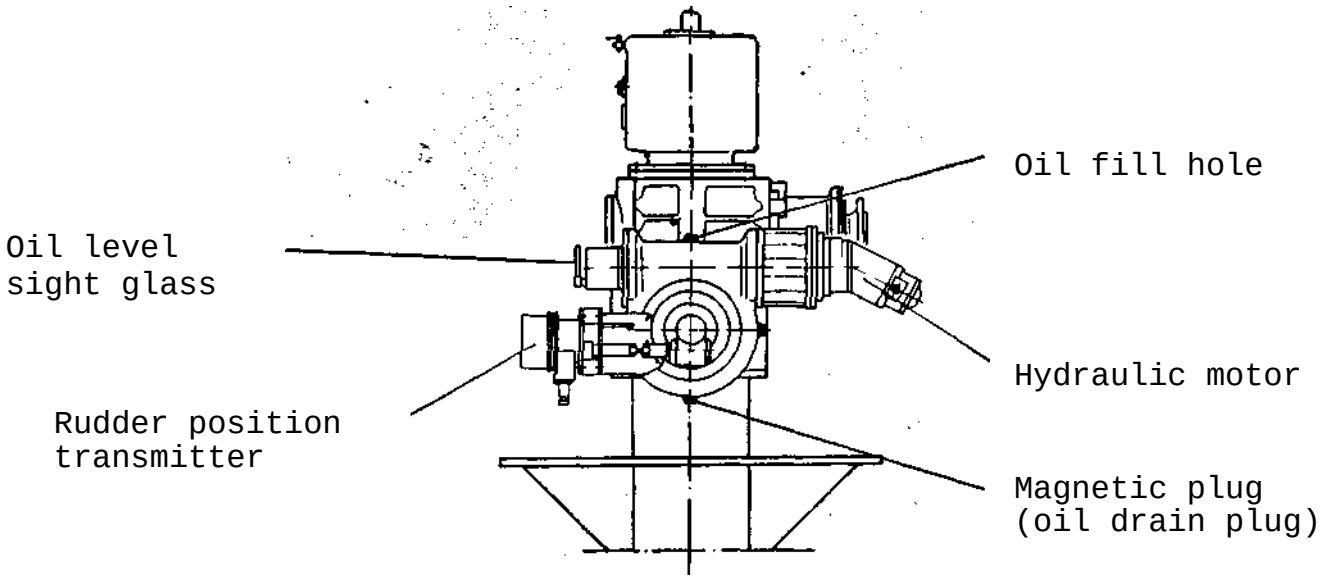
One, or, in case of higher outputs, two (DST) worm gears can be mounted at the side of the upper gearing. The steering drive is accomplished by a hydraulic motor attached to each worm gear.

Figure 2 Steering Worm Gear

Design for Navigator



Design for Well Installation



2 OPERATION

2.1 MEASURES TO BE TAKEN WHEN OPERATING A NEW OR REPAIRED SRP

The inside of the SRP is preserved after the test stand run. The corrosion preventative lasts for about 6 months when stored in dry ambient air (no sea-water atmosphere). Fill in oil before operating the system.

2.1.1 Filling-in Oil

To fill in oil, remove plug (Figures 1/2 and 1/4), fill in oil through hole (Figure 1/4) until it overflows, reinstall the plug, then carry on filling through hole (Figure 1/2).
The oil level must be continuously checked during the first operating hours after having started a new or repaired SRP or after an oil change, because replenishing may become necessary due to possibly existing air traps. The required oil quantities are specified in the table on page 7, these data, however, are only reference values, since the oil quantities may deviate up to 10l, depending on the configuration.
The oil for the steering worm gear (Figure 2) is filled in through the bore of the top plug screw; the oil quantity is approximately 8 litres for each worm gear. For the oil level check, either a sight glass or a dip stick (depending on the arrangement) is provided.

2.2 REGULAR CHECKS PRIOR TO START-Up

- The vent cock (Figure 1/1) of the oil tank must be open (does not apply to separate oil tank with air filter).
- On the separate oil tank, the shut-off valve below the oil tank must be open.
- Check the SRP oil level, tand also the oil level of the possibly attached steering worm gears.

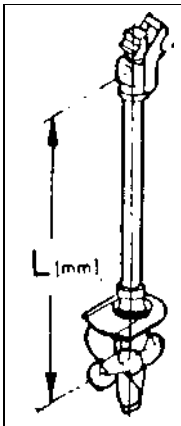


Table of Oil Quantities

Type SRP

L [mm]	15/30	50	75	100	150	225	300
800	7,5	11,5					
900	8	12	15				
10OO	8,5	13	16	21,5			
1100	9	14	17	22,5			
1200	9,5	15	18	23,5			
1300	10	16	19	24,5			
1400	10,5	16,5	20	25,5	45		
1500	11	17,5	21	26,5	46,5		
1600	11,5	18,5	22	27,5	48		
1700	12	19	23	28	50	90	
1800	12,5	20	24	29	51,3	93	106
1900	13	20,5	25	30	53	96	109
2000	13,5	21,5	26	31	54,5	99	113
2100	14	22,5	27	39	56	102	116
2200	14,5	23	28	33	58	106	119
2300		24	29	34	59,5	109	122
2400		25	30	34,5	61	112	126
2500		26	31	35,5	63	115	129
2600		27	32	36,5	64,5	113	132
2700		27,5	33	37	66	121	135
2800		28,5	34	38	67,5	125	138
2900		29	35	39	69,5	128	141
3000		30	36	40	71	131	145
3100			37	41	72,5	134	148
3200			38	42	74	137	151
3300			39	43	76	140	154
3400			40	44	77,5	144	158
3500				45	79	147	161
3600				46	81	150	164
3700				47	82,5	164	179
3800				47,5	88	168	183
3900				48,5	90	171	186
4000				49	91,5	175	190
4200					95	182	197
4400					99	189	205
4600					102	197	212
4800					106	204	219
5000					109	211	227
5200						219	234
5400						226	241
5600							249

2.3 CHECKS DURING OPERATION

- Check the condition of the SRP gear-box lubricating oil; if the oil has a milky colour, water has entered the lower section: Have it repaired.
- Check the oil level of the SRP.
- In case of manual steering, the force to be applied by hand to the steering wheel shall be approximately the same in both directions. If this is not the case, correct the fin setting at the lower section, to do this, see section 3.5.

2.4 SWINGING OUT THE SRP

- Disconnect the drive shaft from the engine mounted clutch and from the SRP; the shaft must not be disconnected only from the SRP under any circumstances (danger of accidents).
  Note:
  Close the vent cock on the attached oil tank (Figure 1/1) (see section 3.8).

3 MAINTENANCE

3.1 MAINTENANCE

After 50 Operating Hours on a New SRP

Check the mounting screws of the lower section (Figure 7/2) and the cover plate or nozzle (Figure 4/1 or 6/1) for security of attachment, retighten, if required; for the torque loads, see the table on page 13.

After 250 Operating Hours on a New SRP

Change the oil of the SRP gear-box (without possibly attached steering worm gears) in accordance with section 3.2.

After every 250 Operating Hours, at least every three months

Clean the air filter of the separate oil tank in accordance with section 3.7.

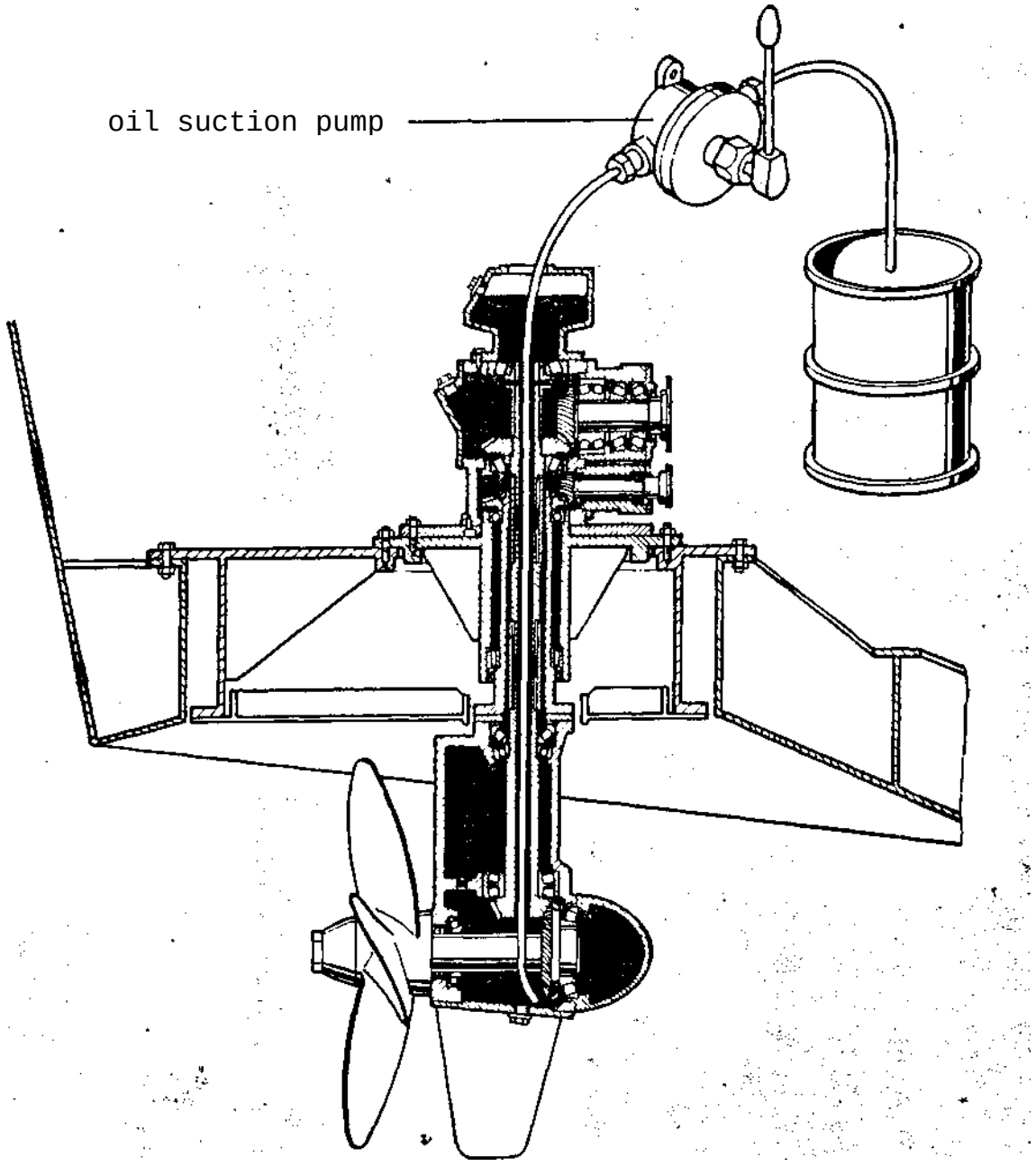
After every 2500 Operating Hours, at least annually

Change the oil of the SRP gear-box (without possibly attached steering worm gears) in accordance with section 3.2.

After every 5 years

Change the oil of the attached steering worm gears in accordance With section 3.3.

Figure 3



SRP Well Installation

3.2 SRP GEAR-BOX OIL CHANGE

The oil can be drained by unscrewing the magnetic plug (Figure 1/16) or pumped out from the top; observe the relevant laws for keeping waters clean.

Note:

When the magnetic plug has been removed, check it for sticking particles. Fine abrasion is normal for running-in new or repaired systems, small fragments, however, indicate gear teeth or bearing damages, which will also be noticed by noisy running, In such a case, the drive must be checked and repaired, if required.

Clean and reinstall the magnetic plug, checking the seal for proper condition.

If the oil has to be pumped out (see Figure 3) e.g. for well installations, remove the oil warning switch (Figure 1/6). Then pull out the plug (Figure 1/7) on SRP's up to SRP 100 by means of an M 10 threaded rod.

Pass the hose (18 mm outside diameter maximum) of the suction pump through the bore of the vertical shaft down to the bottom of the lower gearing and pump out the oil. Then reinstall the plug again, refit the oil warning switch, and fill in the oil as described in section 2.1.1.

3.3 ATTACHED STEERING GEARING OIL CHANGE (See Figure 2)

The oil change is described for one gearing, it also applies to the DST arrangement.

Remove the top plug and bottom magnetic plug for draining the oil; observe the note in section 3.2. Reinstall the magnetic plug, checking the seal for proper condition. On the vertically arranged worm gear, the oil must also be drained from the second oil drain plug (see Figure 2).

For filling in the oil, see section 2.1.1.

Figure 4

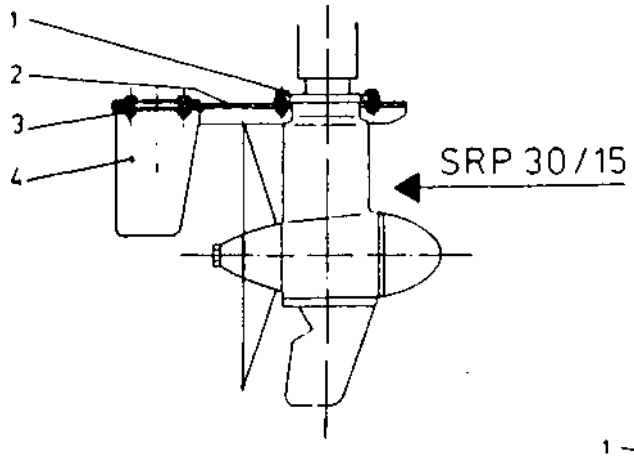


Figure 5

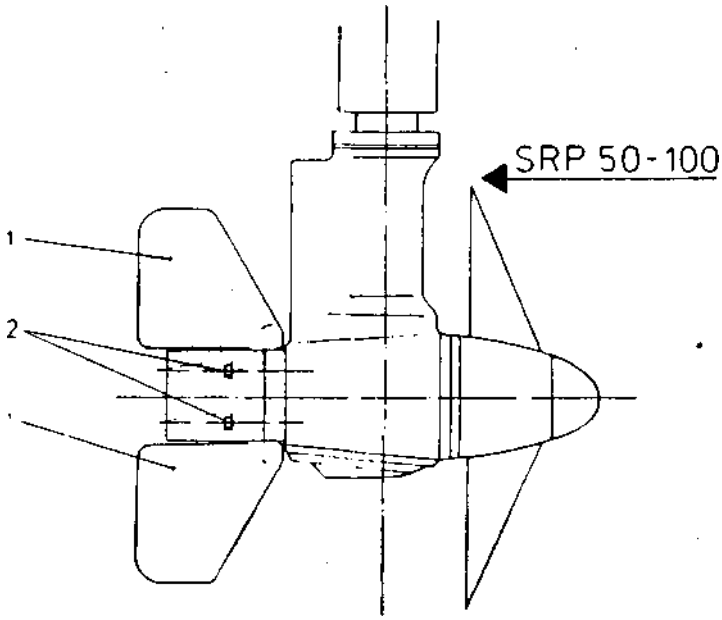
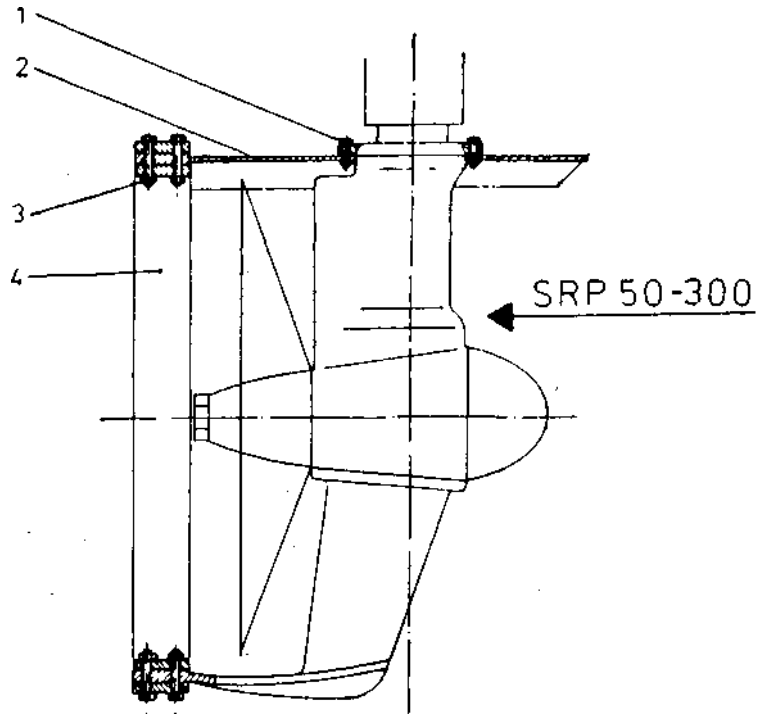


Figure 6



3.4 CHECKS ON THE LOWER GEARING

If the ship is hauled up or the SRP swung out or removed, the following checks should be carried out:

- Check all gaskets on and above the lower gearing (Figures 1/14 and 1/16) for oil leaks, have repaired, if required.
- Check propeller for damage. Since there is the risk that the teeth of the gears may break if there is severe damage to the propeller, the gears must be checked.
- The space between propeller hub and lower gearing must be free from foreign matter. If present, dismount the propeller remove foreign matter, and check the seals.
- Check the mounting screws of the lower gearing and cover plate or nozzle for security of attachment, retighten, if required. For torque loads, see page 13.

3.5 MEASURES TO BE TAKEN FOR TAKING AN SRP OUT-OF-OPERATION FOR UP TO 6 MONTHS

If an SRP is taken out-of-operation or removed due to damages, it must be filled with fresh oil during the storage, in order to prevent corrosion damages. To do this, close the vent cock on the oil tank.

Prior to transporting the SRP, drain the oil.

CAUTION:

The relevant laws on environmental protection must be absolutely complied with.

SETTING THE COMPENSATING FIN

See Figures 4, 5 and 6

The fin (Figures 4/4, 5/1 or 6/4) is supplied in normal position. If the lower section is found to steer easier to one side, loosen clamping screws (Figures 4/3, 5/2 or 6/3) and adjust the fin in such a way that the rear edge is adjusted 1 to 2 mm in the same direction in which the lower section runs out.

Retighten the clamping screws.

Continue the compensating process until the SRP is balanced.

Torque Loads for the Mounting Screws of

A: Lower Gearing
B: Copper plate or nozzle

SRP Type		Thread size	Wrench Size mm	Torque	
				Nm	mkp
30/15	A	M 10	17	37	3,8
	B	M 12	19	65	6,6
30/31	A B	M 12	19	65	6,6
50/50 50/51	A B	M 12	19	65	6,6
76/75 76/76	A	M 14	22	114	11,6
	B	M 16	24	177	18,1
100/l00 100/103	A	M 14	22	114	11,6
	B	M 16	24	177	18,1
150/152	A	M 16	24	177	18,1
	B	M 20	30	346	35,3
225/226	A B	M 24	36	599	61,1
300/300	A B	M 24	36	599	61,1

3.7 AIR FILTER CLEANING (on separate oil tank)

- Remove any dirt from around the filter.
- Unscrew the air filter.
- Wash in clean petrol.
- Blow out with compressed air from the inside.
- Wet filter texture with a few drops of gear lubricating oil.
- Screw in air filter by hand only.

3.8 RUDDER POSITION INDICATOR ADJUSTMENT

The rudder position indicator must be adjusted in such a way that the straight-ahead position of the lower section corresponds to the indication. Since the lower section of the SRP is not visible when installed in the well, a feeler pin (Figure 7/1) is provided at the upper gearing, which, when pushed in by hand, is engaged with a groove at the straight-ahead position. After the rudder position indicator has been adjusted, pull out the feeler pin (Figure 7/1) again.

4 INSTALLATION

4.1 SCHOTTEL NAVIGATOR INSTALLATION

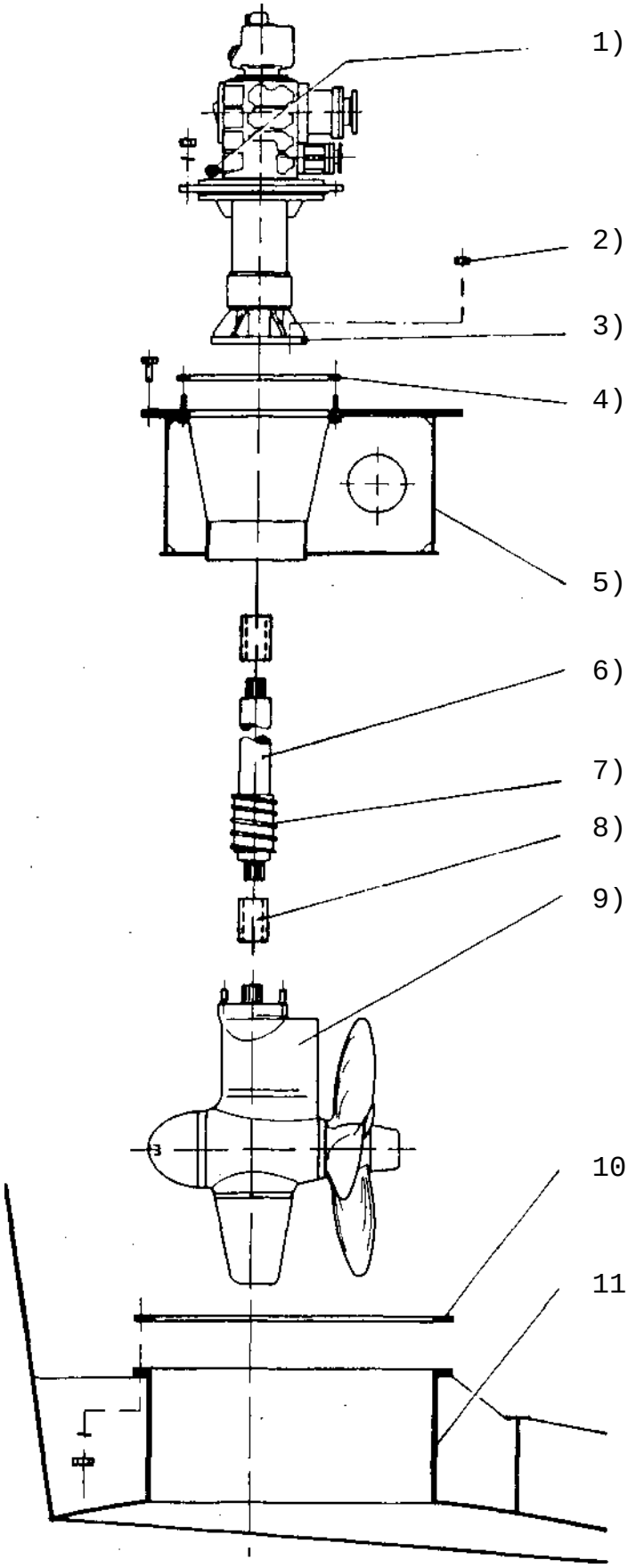
If special instructions have to be observed for this installation, refer to the applicable operating instructions of the navigator.

4.2 INSTALLATION OF THE SRP IN THE WELL

See Figure 7

- Remove the lower section (9) after having unscrewed the hexagon nuts (2).
- Install the SRP in the well foundation (5) with rubber gasket (4).
- Attach the lower section (9) again, checking sealing faces and sealing ring for cleanliness.
  Caution;
  On the SRP's 150 ... 300, install the power transmission shaft (6) in such a way that the worm (7) is located at the bottom.

Figure 7 Installation of the SRP in the Well



- Install the SRP with well foundation (5) completely with rubber gasket (10) in well (11).
- Connect the electric oil warning system to the flow switch (Figure 1/6) by means of a 2 x 1.5 mm2 cable.

4.3 PROPELLER INSTALLATION

The installation of a flanged-on propeller in the form of a pulling configuration does not cause any problems, so that it is not described herein in more detail. The torque load for the mounting screws (M 16) is 177 Nm (18.1 mkp).

When installing a propeller on a tapered shaft (see Figures 8 and 9), pay attention to the following points:

- Remove the fitting key (Figure 8/5 or 9/1) and check that it can be pushed through the slot of the hub bore, remachine the slot, if required.
- Install the fitting key again, paying attention to secure seating by the clamping sleeve.
- When installing a new propeller (spare propeller), apply dye check paint onto the taper of the propeller shaft, provisionally fit the propeller and check the wear pattern; the supporting surface must be at least 70$, remachine the propeller hub, if required.
- The labyrinth space between propeller hub and gear-box must be free from foreign matter.
- The seating faces of the propeller shaft and hub bore must be cleaned; the hub seat must be fitted in a hand dry condition.
- After the propeller has been fitted (Figure 8/1 or 9/7) screw on the propeller nut (Figures 8/3 or 9/5) and tighten the nut by means of a wrench hammer (normally, the wrench hammer forms part of the scope of delivery of the SCHOTTEL rudder propeller). When the arrangement is according to Figure 8, pay attention to the tab washer (Figure 8/2).
  Caution:
  When tightening the propeller nut by means of the wrench hammer, the propulsion system must be disengaged, in order to prevent gear teeth and bearings from being damaged.

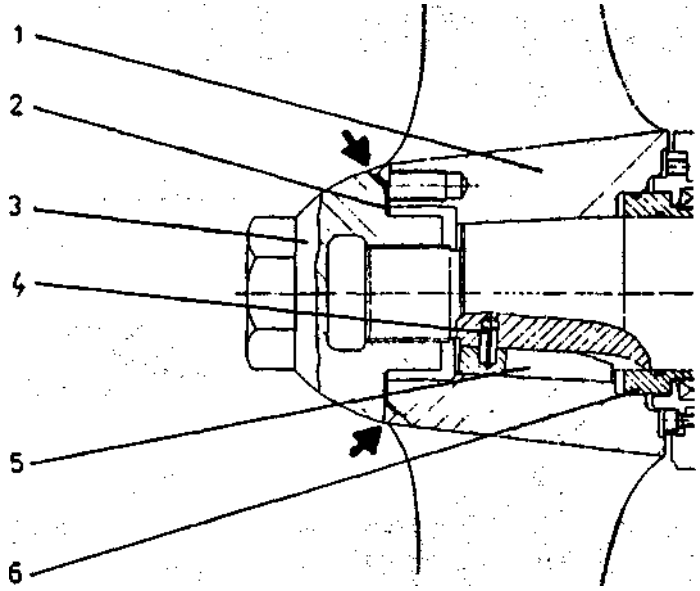


Figure 8

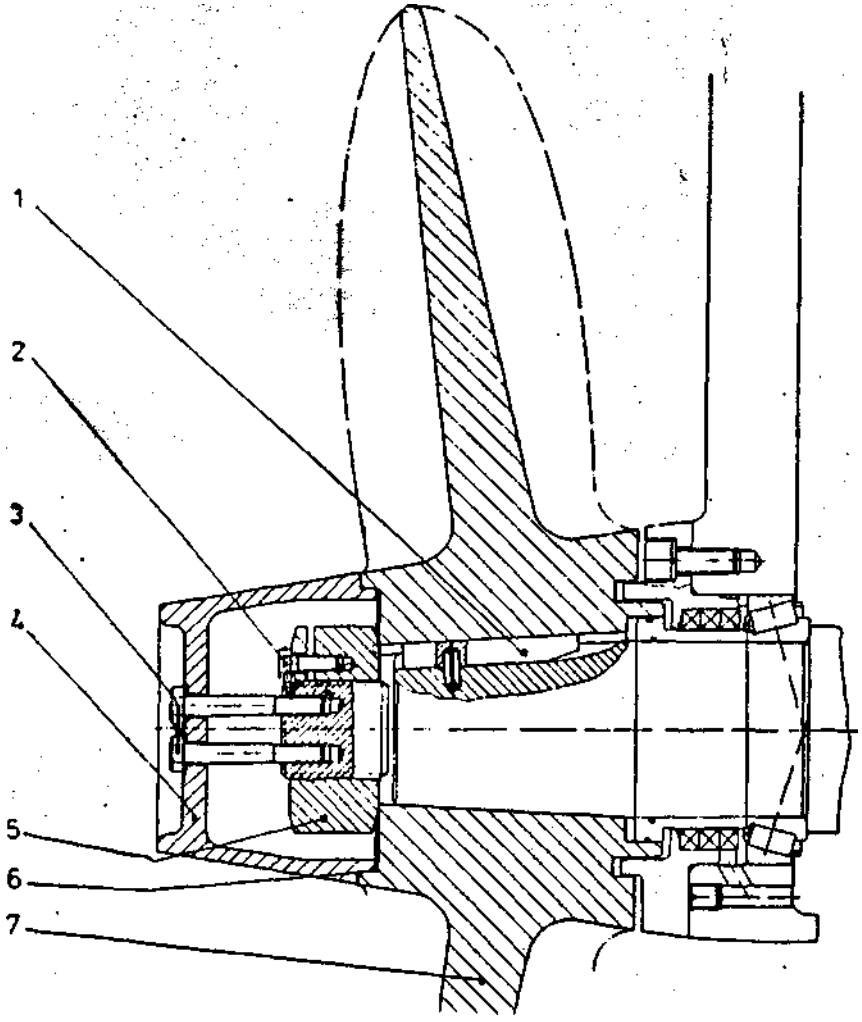


figure 9

- Lock the propeller nut according to Figure 8 by forcing the tab washer (Figure 8/2) into the slots of the propeller hub and lock the propeller nut.
- Lock the propeller nut according to Figure 9 by tightening the clamping screws (Figure 9/2) , for the specified torque loads of the clamping screws (Figure 9/2), see the following table, the values apply to slightly oiled screws.

Thread size	Wrench size	Torque load	
		Mm	mkp
M 8	13	27,5	2,8
M 10	17	52	5,3
M 12	19	88,3	9

- Lock the screws (Figure 9/2) by means of locking wire (1.5 mm diameter).
- Fit the propeller cap (Figure 9/4), checking the sealing ring (Figure 9/6) for proper condition, replace, if required.
- Screw in the screws (Figure 9/3), checking the USIT rings under the bolt heads for proper condition. Tighten the screws (Figure 9/3) only to such an extent that the bottom of the propeller cap (Figure 9/4) does not bend.
  Note:
  The mounting screws (Figure 9/3) must be secured against loosening; the locking method differs in accordance with the configuration. This may be accomplished by means of locking wire, tab washers or by using Loctite No. 241.

RECOMMENDED LUBRICANTS		
Brand	Lubricating oil for SRP drive	Lubricating oil for Worm Gearing
ARAL	Degol BG 68 (ISO) Degol TU 68 (ISO)	Degol BG 46O
BP	Energol GR-XP 68 (ISO) Energol IC-D 20 Energol HLP 68 (ISO)	Energol GR-XP 460 (ISO)
Chevron	Non-Leaded Gear Compound 68	Non-Leaded Gear Compound 46C
Esso	Spartan EP 68	Spartan EP 46O
FINA	Giran 68 ISO Pontonic N 80 Dilano 20 W/20	Giran 460 ISO
Mobil	Mobilgear 626 Mobilube GX 8O	Mobilgear 634
Shell	Omala Oel 68 (ISO) Gadinia 20 W/2O Melina 1O W/30	Omala Oel 460 (ISO)
TEXACO	Meropa 68 Multigear Lubricant EP 80 Rando Oil HD CZ -68	Meropa 460 Multigear Lubricant EP 460
The load stage for the oils of the SRP drive must be above 12 of the FZG-Test A 8.3/90 according to DIN 51354.		