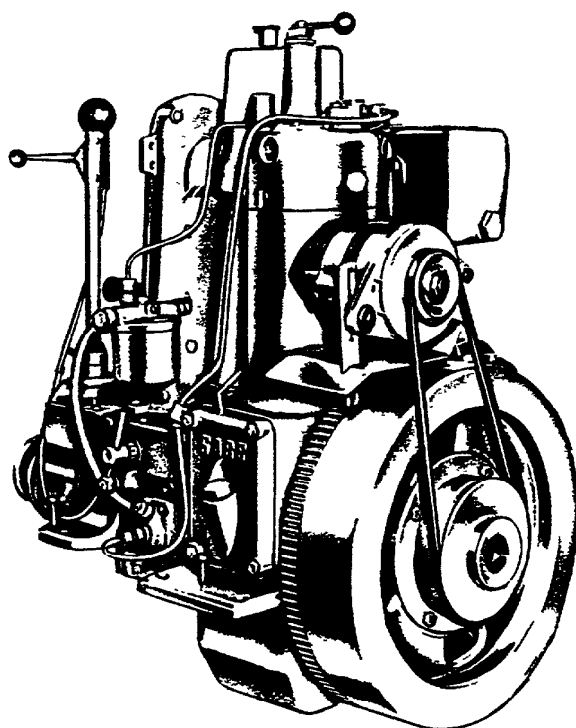


SABB DIESEL

Type GG

Instruction Book



Spare parts catalogue

SABB MOTOR A.S

TELEPHONE 53 47 55 34 35 10 - FAX 53 47 55 34 48 80

TELEX 42559 SABB-N

P.O. BOX 40 - N-5031 BERGEN - NORWAY

INTRODUCTION:

The diesel engine (compression ignition engine) is the simplest and most reliable of prime movers, with the lowest fuel consumption. To ensure satisfactory functioning of the engine however, there are certain requirements as regards care and maintenance which should be considered, but these are easily managed by anyone interested in boats and engines.

The manufacturers' engine guarantee is effective on the condition that the engine is installed, operated and serviced in accordance with the directions of this manual. Therefore our clients are recommended to study the main points of the manual before the engine is put into operation, it will pay off. The contents are based on many years' experience in operation, service and maintenance of SABB diesel engines. The first part of the manual deals with installation and regular engine service and operation. The second part contains parts lists and repair guide. Finally, a chapter on faults location..

July 1994

SABB MOTOR A·S

Instruction Book

AND PARTS LIST FOR SABB MARINE DIESEL ENGINE

Type . GG

Engine with reverse gear and solid propeller

SABB MOTOR A.S

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TELEX 42559 SABB-N

P.O.BOX 40 - N-5031 BERGEN - NORWAY

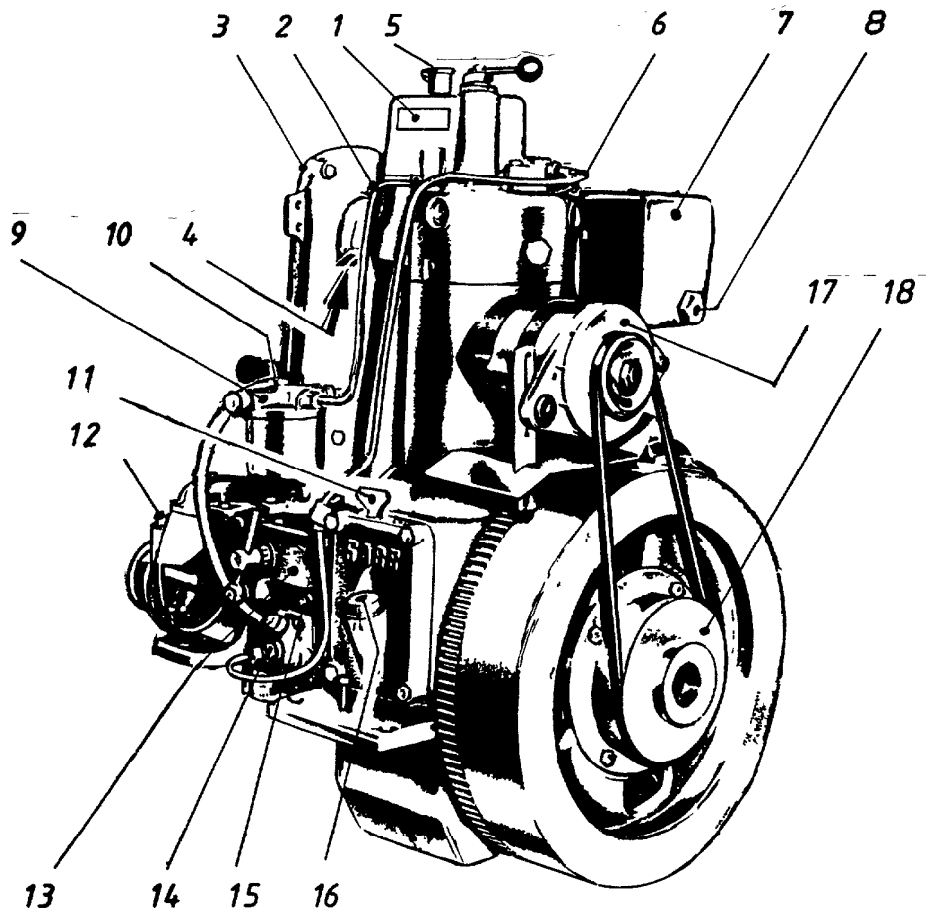
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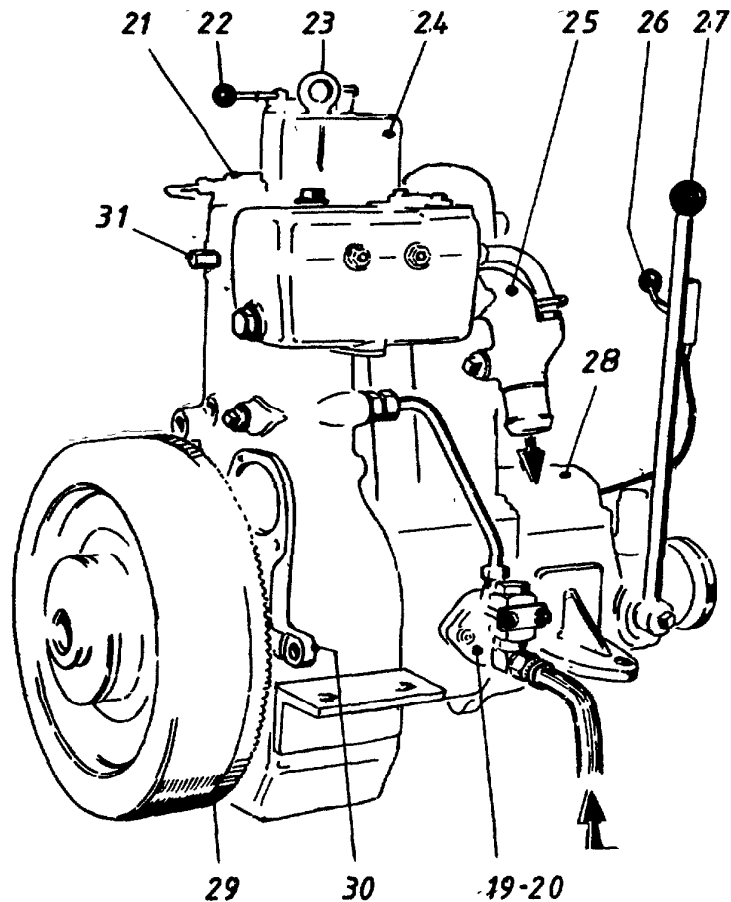
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Type GG



- | | |
|--------------------------|-------------------------------|
| 1. Engine number plate | 10. Bleeder screw, fuel |
| 2. Leak-off pipe | 11. Dipstick, engine |
| 3. Starting bracket | 12. Dipstick, gearbox |
| 4. Air inlet | 13. Governor cover |
| 5. Valve lubrication cup | 14. Injection pump |
| 6. Injection pipe | 15. Idling adjusting screw |
| 7. Silencer | 16. Lub oil filler plug |
| 8. Zinc anode | 17. Alternator, optional |
| 9. Fuel filter | 18. Flywheel pulley, optional |

Type GG



- | | |
|--|--|
| 19. Water pump with
two drain cocks | 28. Gearbox |
| 20. Water valve housing | 29. Starter ring |
| 21. Nozzle holder compl | 30. Bracket for
Starter and bilge pump,
optional |
| 22. Decompressor handle | 31. Starting Cartridge plug |
| 23. Lifting nut | |
| 24. Cylinder head cover | |
| 25. Exhaust bend, waterinj. | |
| 26. Governor control handle | |
| 27. Gearbox operating lever | |

LUBRICATING AND SERVICING CHART

Every 5 hours (Daily):

1. Fill valve lubrication cup page 19
2. Give stuffing box greaser one turn ..z.. page 14
3. Dipstick, Check oil level page 12

Every 25 hours (Weekly):

1. Rear oil seal, 5 shots, gearbox page

Every 50 hours:

1. Change engine oil, 2 litre page 13
2. Grease or oil Governor control handle .. page 5
3. Grease starting shaft page

Every 300 hours (yearly):

1. Grease rocker arm bearings in
connection with valve adjustment page 35
2. Change lub. oil in gearbox 1/2 litre ... page 14
3. Inspect water pump diaphragm, page 39
4. Change fuel oil filter page 15
5. Check all pipes connection page

Every 600 hours (every 2nd year):

1. Remove crankcase cover for cleaning
interior, magnet pos 9, gr. 20 cyl. block
(in connection with lub. oil change) page 13

SPECIFICATION

Model G, one-cylinder, 4-stroke diesel engine. Swirl type combustion chamber. Roller bearing as big end- and main bearings. Removable cylinder liner (wet type). Centrifugal governor. Splash lubrication. Bosch fuel injection equipment. Vibration dampers. Reverse gear and solid propeller.

Cylinder bore.....90 mm 3,54 in.
Stroke.....120 mm 4,72 in.
Cylinder displacement.....760 cm² 46,37 cu.in.
Compression ratio.....1:20
Comression pressure.....30 kp/cm² 426,7 psi

Continuous rating at 1500 rpm.....8 HP
Continuous rating at 1800 rpm.....10 HP
Brake mean effective pressure:6,3-6,55 kp/cm²....89,6-93,4 psi
Fuel consumption (10 hp).....2,5 litres/h 4,5 pints/h
Reduction gear ratio.....2:1

Propeller torque, cont rating.....7,65-7,95 kpm 55-57 ft.lbs.
Direction of rotation.....Left
Weight of engine without prop.equipm.....GG 200 kilos, 441 lbs
Max.permmissible installation angle.....15 degrees

Valve clearance, intake and exhaust, cold.....0,3 mm, .012"
Piston top clearance incl.gasket.....1,5-2 mm .059-.079 in.
Injection pressure (opening).....100 kp/cm² 1422 psi
Injection starts.....14 degrees before TDC

Exhaust valve opens.....60 degrees before BDC
Exhaust valve closes.....10 degrees after TDC
Inlet valve opens.....12 degrees before TDC
Inlet valve closes.....45 degrees after BDC

Lub. oil Capacities:

Engine sump.....2 litres, 3,5 pints
Reverse gear GG.....0,5 litres, .88 pint
Lub.oil viscosity (above freezing point).....SAE 15W/40
Lub.oil viscosity (below freezing point).....SAE 10W
Capacity of cooling water system.....4 litres, .88 Imp.gall.

Torque Load of Nuts and Bolts:

Cylinder head nuts.....14 kpm, 100 ft.-lbs.
Big end bearing bolts (Verbus-Tensilock)..18 kpm, 130 ft.-lbs.
Gear housing bolts (Page , fig 26).....8,5 kpm, 60 ft.-lbs.

INSTALLING THE ENGINE (See Installation and Dimensional Drawing)

Installation is a one time job and it will be worth your while to use some time and care to get the engine installed solidly and correctly.

Foundation

The engine should be installed so that it will be easy to work with when overhauling or servicing. The maximum permissible installation angle is not to exceed 15° .

In wooden boats the foundations should be made of two alongships beams of 4"×4" resting on 3 or better 4 cross beams exactly shaped to fit the hull of the boat. The cross beams should not be less than 2 1/2" thick. The use of pine is recommended for these parts because of its good vibration and noise dampening properties. It is important that the foundation is bolted well to the keel and hull using metal or stainless steel throughbolts. The engine is then bolted down by 4 throughbolts (5/8") which should be heated at the lower ends before being rivetted over, and two 1/2" wood screws for the clutch housing lugs.

NOTE: The housing foundation lugs are not machined on the base. It might be necessary to shim the rear lugs to make the rest flush with the crankcase foundation lugs.

In steel boats the engine foundation is made of section steel welded to the hull. In order to insulate the engine from the bed, reducing the hull resonance, one can use blocks of oak or mahogany of about 1/2" thickness or 1/8" (3 mm) hard synthetic rubber.

Glass fibre hulls (GRP)

As a rule glass fibre boats are built complete from the boat building yards with ready made foundations. In some cases it will be necessary to reinforce the foundations with several additional layers of glass fibre. It is very important to obtain a good jointing between the foundation and the hull in order to get maximum rigidity and dispersing of the load on the largest possible area of the hull. The engine can be bolted direct to the foundation using studs, space should be provided for, so that nuts can be fastened to the lower ends of the studs. 5/8" wood studs can also be used, these should be glued into the woodwork.

The engine can also be fastened to either flat steel or L shaped steel (galvanized) which must be solidly bolted to the moulded foundation. Glass fibre is a hard and strong material for hulls and foundations, but it has very poor vibration- and noise dampening properties. One must therefore take a lot of care in noise insulation.

PROPELLER

The propeller should be fitted as low as possible. Before fitting the propeller, see that it is straight and undamaged.

The engine and the propeller shaft must line up exactly to avoid bend in bearings and trouble with reverse gear.

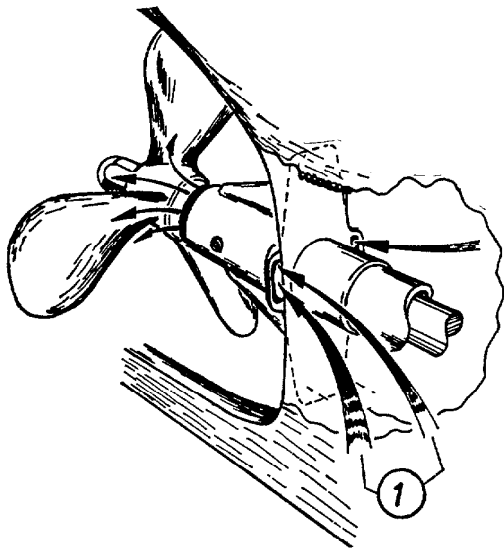
Check the alignment with a feeler blade between the two flange coupling halves.

Above and below the stern bearing the stern post should be sharpened to allow proper flow of water to the propeller (and water lub. stern bearing).

The distance between stern and propeller wing should not be less than 1 inch. If there is insufficient room for the propeller a loose stern batten has to be fitted, thereby enabling the propeller to be moved further back.

The greaser tube to propeller is inserted together with the stern bearing (not for water lub. stern bearing).

Drill 1/2" hole 10 degrees upwards through the stern post, or drill parallel with the stern tube if more convenient.



Water Lubricated Stern Bearing

This is available for shaft to solid propellers only. The stern bearing comprises a rubber lining which is lubricated by the water streaming through it (Pos. 1) No greasing is required for the stern bearing.

Before fitting the propeller shaft check that it is completely straight, and not damaged during transport.

If free length of propeller shaft (between int. stuffing box and shaft coupling) exceeds 1,5 metre (60 in.) a support bearing should be fitted.

PIPING

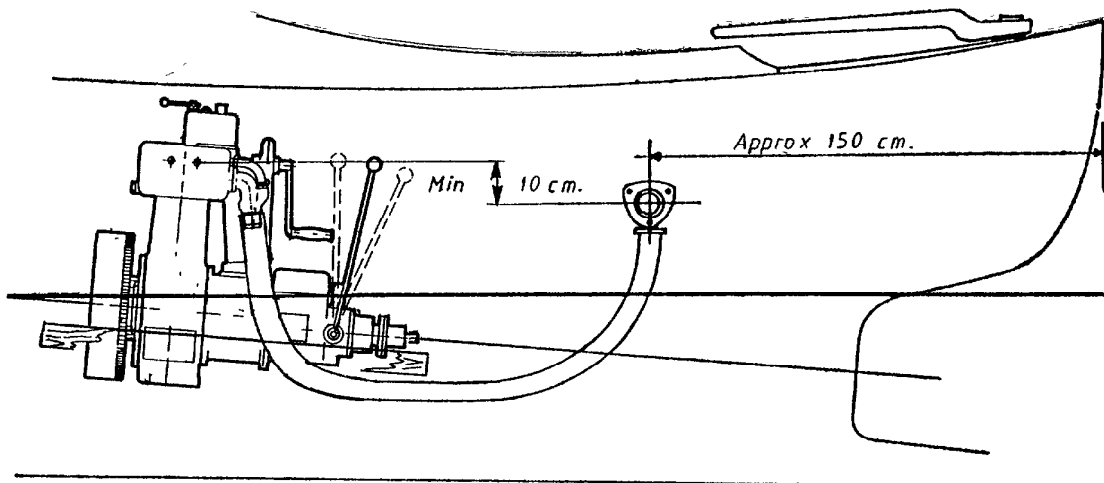
The sea cock and strainer should be fitted through the bottom of the boat near the cooling water pump. Easy access to the cock and water filter (if any) is important. The internal filter is recommended if the boat is to be operated in sandy or muddy waters. The filter is fitted directly to the sea cock.

The fuel oil tank should be installed as high as possible, bottom of tank at least 4 inches (10 cm) above fuel filter. See that the fuel tank pipe gets even fall from tank, without ups and downs, to avoid air straps.

The fuel tank has two bleeding nipples. Avoid smell of fuel oil under deck by fitting two 1/4" PVC hoses, "swan-necked" overboard to avoid any water entering.

Fuel lift pump can be fitted, for lower installation of tank.

Wet exhaust



Wet exhaust is used to reduce exhaust noise and to keep temperature of silencer and exhaust pipe low. Rubber exhaust pipe is recommended. The pipe is a special rubber hose, easy to fit and long lasting. It is absolutely necessary that the hose is water cooled except on idling and up to 1/4 of normal output.

Heavy steel pipe can be used, stainless steel is excellent. Copper pipe is not recommended. The silencer must be in opening at rear end/down position (exhaust bend) and the pipe outlet through the hull must be as low as possible. It is important, in order to prevent water from returning to the silencer when the engine is being stopped, that the hose is laid with a deep bow from engine, forming an angle water reservoir. (See above).

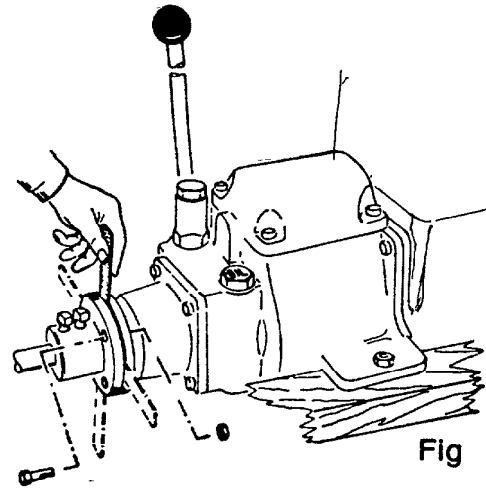
The rubber exhaust pipe, when correctly fitted, will swallow all the cooling water from the engine at all speed.

CHECKING THE ALIGNMENT

The alignment of engine and propeller shaft should be checked after the boat has been in the water a sufficient length of time to permit the hull to set. The alignment is controlled with a feeler gauge between the coupling flanges (see fig -), in 4 positions up, down and laterally.

If required loosen engine fixing bolts and fit shims under frames until flanges are exactly parallel.

Check again after engine is fixed.



Use feeler gauge 0,1 mm

SUPPLIES

A. LUBRICATING OIL

Check sump oil level regularly with dipstick which has two marks. Top mark indicates full sump, i. e. 2 litres (3,5 pints). Never permit level to sink below lower mark.

To ensure successful operation over a long time, it is not enough to see that the engine gets sufficient lubricating oil, it is equally important to use oil with the right qualities.

Use lubricating oil of good brand, "Service CA or CC".

LUB.OIL QUALITY	VISCOSITY AT AMBIENT TEMPERATURES		SUMP CAPACITY	
	Below 0° C (32° F)	Above 0° C (32° F)	Oil Change	Incl. Oil Filter
Service CC	SAE 10W	15W / 40	2 litres (3,5 pints)	/

The following makes and grades may be used (as may other makes of corresponding quality):

BP ENERGOL DS3/NOROL MARINE TMA 300	GULFLUBE MOTOR OIL
CASTROL DEUSOL RX SUPER	MOBIL OIL SPECIAL
CHEVRON SUPREME MOTOR OIL	OCEAN DIESOLINE
ELF PERFORMANCE	SHELL MELINA OIL / RIMULA X
ESSOLUBE XD3 +	TEXACO HAVOLINE MOTOR OIL
FINA SOLNA S3	

Use the same oil for gearbox (15W / 40).

IMPORTANT:

If the engine has been wholly or partially immersed in water, all oil in the crankcase and gearbox must be changed immediately. Run engine for 1/2 hour and change oil once more in engine and gearbox.

EVERY 50 OPERATING HOURS: Sump Oil Change.

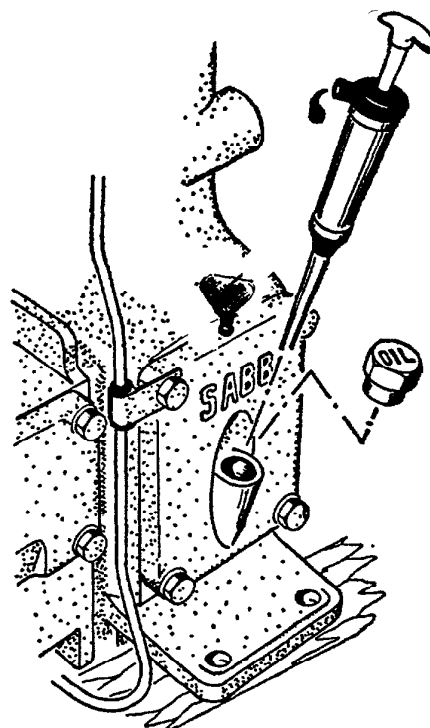
Change the sump oil after the first 25 hours of operation and clean the magnet in the crankcase. (Page 14.)

Later oil changes every 50 hours of operation. (Unless the engine has a tachometer with hourmeter, it is easier to record fuel oil consumption than operating hours, i. e. 50 hours equal to 125 litres (27,5 Imp.gall) fuel consumption).

1. Stop engine.
2. Unscrew «OIL» plug in crankcase cover.
3. Insert hand pump into sump and pump out. Use a tin or bottle under pump outlet.
4. Pour 2 litres new oil into sump through plug hole. Fit «OIL» plug.

IMPORTANT:

If the engine has been immersed in water, the oil in crankcase and reverse gear box should be changed without delay.



Every 600 operating hours (for pleasure craft: Every 2nd year)

the crankcase interior should be cleaned.

Fill $\frac{3}{4}$ litre (1,3 pint) of *fuel oil* into the sump before draining the lub.oil. Let the engine run for about 5 min. at 1000 r.p.m., then drain the oil as described. Stop the engine and remove the crankcase cover. Wash engine interior with clean fuel oil, removing soot deposits and sediment.

It is recommended after some years of operation to remove governor cover and wash interior with fuel oil. Use sump pump to drain. Dry with cloth or paper waste. Remove the magnet placed in front of the crankcase bottom. Clean and replace.

EVERY 300 OPERATING HOURS: (At least once yearly)

Reverse Gearbox Oil Change (Model GG)

The gearbox contains 1/2 litre lub. oil.
Change oil after the first 25 hours

To drain remove the dipstick plug at rear end of gearbox righthand side. Insert hand pump into sump through the dipstick plug hole, and pump out. Use a tin or bottle under pump outlet.

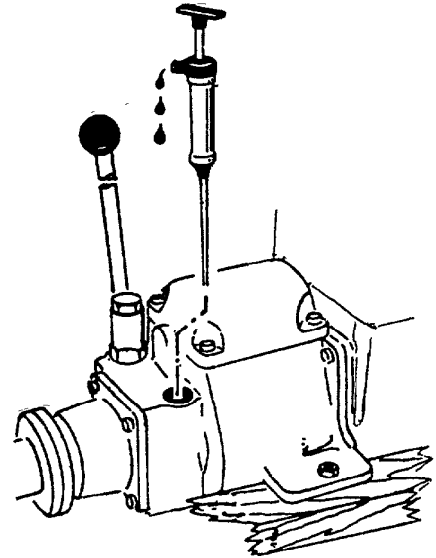
If lub. oil gets thick and dirty, remove the gearbox cover, wash out gearbox with fuel oil and dry well before new oil is filled up.

Do not pour extra oil into gearbox as the gearbox is ventilated to the air intake and excessive oil may be sucked into cylinder head causing carbon deposit on the valves.

Excessive oil will also influence the clutch operation.

Check lub. oil level regularly, every 25 hours.

Note that the dipstick reading depends upon the installation angle.



GREASING

The engine, and remote control equipment if fitted, have greasing points that require regular attention by grease gun or grease cup.

The following types of universal grease can be used for all greasing points (engine and propeller):

Norol Universalfett EP2
Castrol Spherol AP2
Chevron Dura-Lith Grease No 2
Esso MP Grease Beacon EP2
ELF Epexa 2

Fina Marson EPL
Gulfpride SF
Mobilux 2 or Mobilplex 47
Shell Alvania Grease EP2
Texaco Multifak EP2

B. FUEL OIL

For fuel oil always use gas oil (destillate fuel). Dirty fuel oil should never be used, the cleaner the fuel, the better the performance of the engine.

Drain water and sediment from fuel tank regularly.

Use strainer in the funnel when filling tank. Make sure that the fuel tank never runs dry. In case the engine stops because of an empty fuel tank, the whole fuel system must be bled again.

When leaving the boat, it is not necessary to close the fuel tank cock, because leakage is impossible provided the suction pipe connections are properly tightened. If you forget to open the fuel tank cock before starting, the engine will run for a few minutes and then stop. To start again, it is necessary to bleed the whole fuel system.

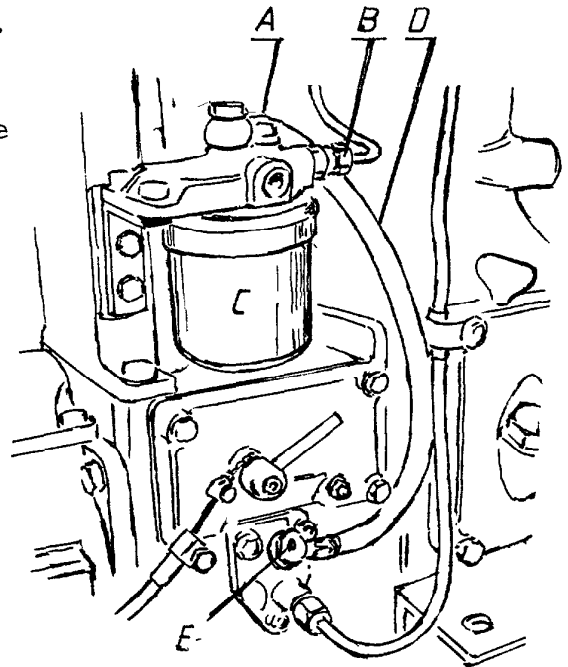
Water coming in with fuel will accumulate in the fuel filter bowl. Foreign particles will settle in the filter element.

CHANGING FUEL FILTER

(Every 300 running hours, or annually.)

The filter is of the Spin-on type (fig.) Unscrew the filter with a adj. spanner. Apply an oil film on the gasket before reinstalling the new filter. Screw the filter in by hand, until it seats. Tighten by hand one half turn only, and bleed the system, see below

- A) Bleeder screw
- B) Leak-off pipe nut
- C) Fuel filter, Spin-on
- D) Suction hose
- E) Banjo nipple on fuel pump



BLEEDING FUEL SYSTEM

(As required):

1. Fuel filter and tank tube are bleed by loosening the fuel leak-off pipe nut on filter (B) and the bleeder screw (A) on filter top. Keep open until fuel flows freely without bubbles. First tighten the nut and then the bleeder screw securely.
2. To bleed the fuel suction hose (D) between filter (top) and injection pump, loosen the banjo nipple (E) screw on fuel pump 3 turns (ss fig.). Shake the hose and keep screw open until the fuel flows freely.

Cont. from page

Bleeding the Fuel System

Note: The pressure valve on the injection pump should not be unscrewed for bleeding of the pump.

Tighten the banjo nipple screw. The suction hose end should point upwards from the banjo nipple to avoid air lock.

3. To bleed the injection pipe crank the engine with governor handle in full speed position, until noticeable "jerks" in the injection pipe tell that the fuel has arrived to the injector and that the injector functions.

C. COOLING WATER

The cooling water pump is of diaphragm type (Page.)
For sea water cooling the water discharge temperature should be between 40° and 55° C (degrees Celcius), and it is controlled by adjusting the sea cock at full speed.

IMPORTANT:

Make it a rule - before starting in cold weather - to ease carefully the starting handle to ascertain that there is no undue resistance to turning, caused by ice in water pump.

Close sea cock and drain water from engine and water pump before storage and after each time of operation in freezing temperature.

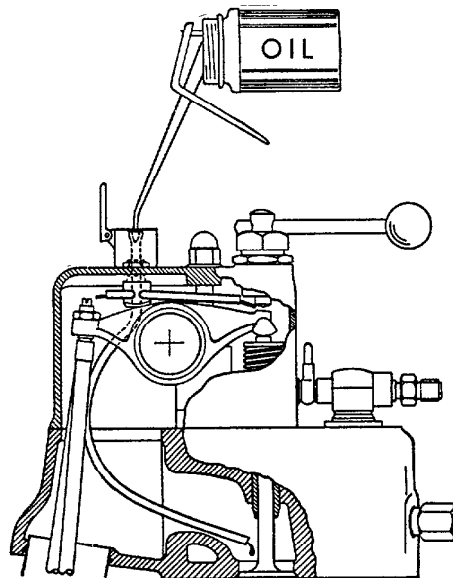
There are two drain plugs in the water pump. To avoid air lock, keep 1/2" BSP plug on top of cylinder head open. Remember: Screw the plug home and close drain plugs in water pump before next starting.

D. AIR

The air is drawn into the cylinder through the starting bracket which serves as intake silencer. The crankcase and the gearbox housing are ventilated to the starting bracket through gearbox housing so that smoke and oil vapour are sucked back into the engine.

The engine case should be fairly tight above the flooring. Then most of the intake air will be cold and humid coming from the room under the flooring.

Valves, see page



See also page 19

STARTING RULES

Easy starting depends on 3 factors:

1. Correct injection with proper atomization of fuel.
2. Proper compression and sufficient flywheel speed when decompressor is turned.
3. Thin lubricating oil in order to get good speed on engine when cranking.

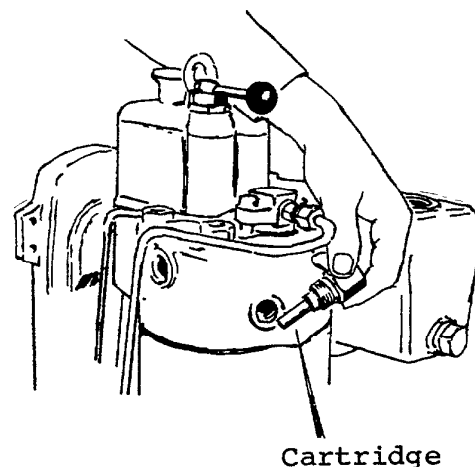
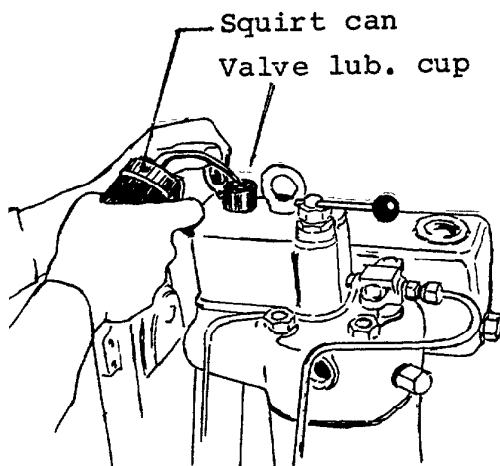
When the decompressor valve on top of cylinder head cover is in its lower position, i.e. handle pointing ahead or astern, the inlet valve is kept open and the engine can be turned easily (page 23).

To ensure proper injection the fuel must be clean and the nozzle in good working order. Check by holding right hand on injection pipe when cranking. A noticeable "jerk" in the pipe for each turn of the crank tells that the nozzle functions. (See page 15, Bleeding)

When the engine has been out of operation for some time the oil has evaporated from the cylinder liner, making it dry, and the piston rings can not seal properly.

This is remedied by squirting a small quantity of lubricating oil into the start oil tube in the valve lub. cup (Page 4, no.5 and below). Inject 6 shots (6 cm³) with squirt can through the tube or through the starting Cartridge hole (Page 5 , no.31). Use of starting Cartridge is recommended in cold weather to facilitate starting.

The Cartridge (6 mm) is self-igniting when dry. Insert white end of Cartridge into the plug and fit plug again. In very cold weather, use both starting Cartridge and lubricating oil.



CHECK BEFORE STARTING FIRST TIME:

1. Fuel tank filled up and fuel tank cock open.
2. Fuel system "bled" and all pipe connections securely tightened.
3. Lubricating oil in engine and reverse gearbox.
4. Sea cock open (open circuit). The two drain cocks closed.

HAND START:

1. Propeller disengaged.
2. Governor handle in full speed position.
3. Open decompressor. Handle forward or astern.
4. In cold weather. Inject 6 shots lub. oil into lub. oil start tube, or use starting cigarette.
5. Operate crank with left hand and decompressor handle with right. Stand on right side of the engine, not behind it. Crank rapidly and close decompressor by turning handle 1/4 turn while cranking. Engine starts.
6. Control engine speed with governor handle.
7. Check cooling water circulation.

RUNNING-IN PERIOD

Run engine with moderate load when new; full speed only for short periods. Increase load gradually during the first 25 hours.

After the first 25 hours:

- | | |
|---|----|
| 1. Change lubricating oil in engine sump.....page | 13 |
| 2. Model GG: Change lub.oil in reverse gearbox.....page | 14 |
| 3. Check engine alignment.....page | 11 |
| 4. Check all pipes connection. | |

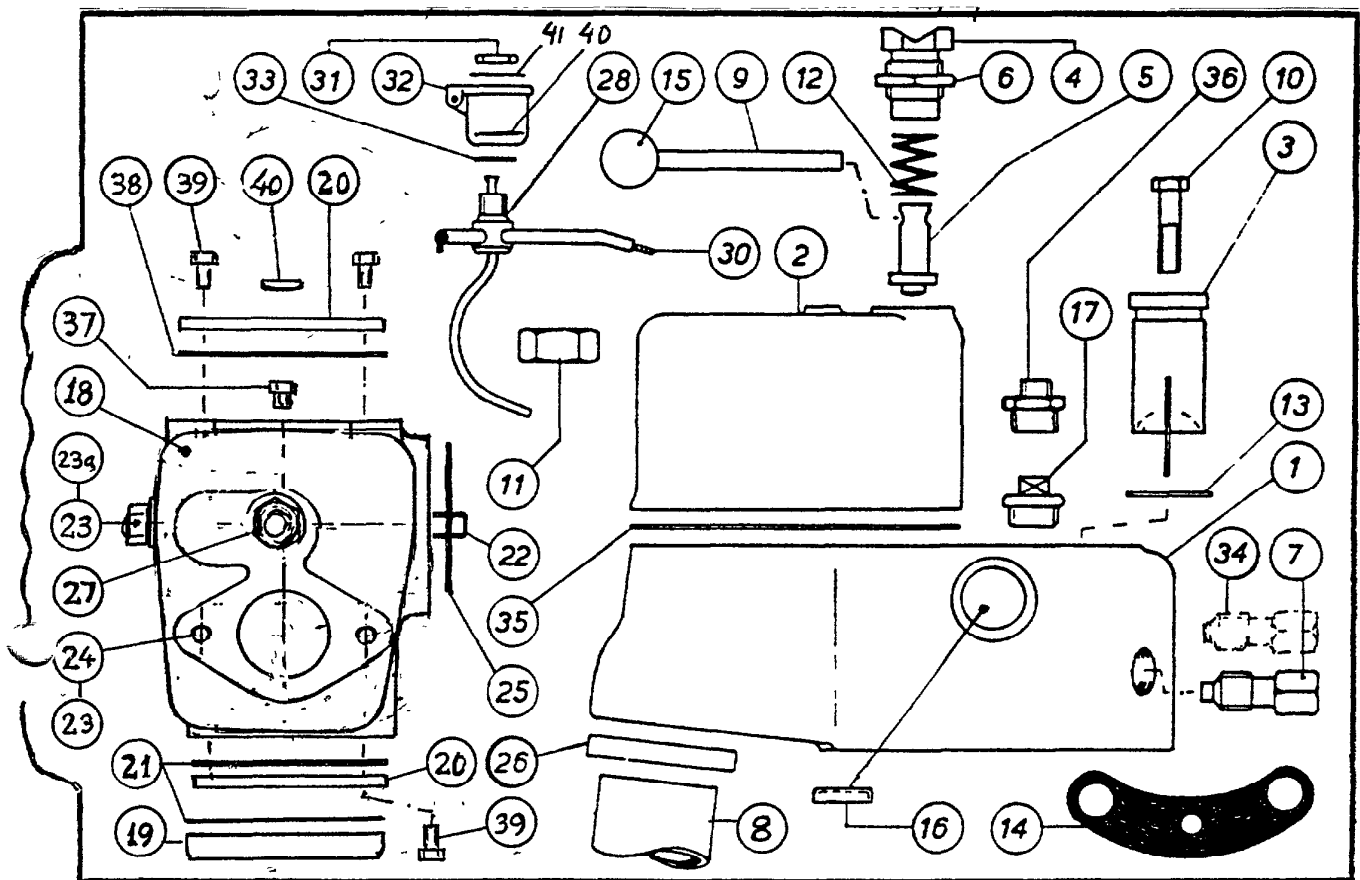
After the first 50-100 hours:

- | | |
|---|----|
| 1. Adjust valve tappet clearance.....page | 35 |
| 2. For later servicing, see.....page | 6 |

OPERATION:

Let the engine idle at 400-600 rpm

1. Engage propeller by pressing lever completely forward or backward, as far as it goes. See that the lever does not hit any obstruction, and is free to move.
2. Control engine speed with governor handle.
Never race a cold engine. Always permit engine to warm up gradually with moderate load and speed. Never stop the engine suddenly from full speed, but let it idle for some minutes to dissipate heat gradually.
3. Check cooling water.



Group G 10-20. CYLINDER HEAD AND SILENCER

No	Part name	Part no	No	Part name	Part no
1	Cylinder head w/valves.	000126	20	Blank flange.....	000221
2	Cylinder head cover....	000104	21	Exhaust flange gasket..	814035
3	Swirl chamber insert w/glow wire.....	000075	22	Silencer stud M10x135..	437080
4	Decrompressor sleeve...	000106	23	Nut M10.....	441052
5	Decrompressor bolt.....	000107	24	Exhaust flange bolt....	437083
6	Decrompressor nut.....	541002	25	Exhaustflange/waterglass	814036
7	Torch paper holder.....	000115	26	Intake tube seal upper.	824020
	Torch paper(1 box à 100)	935002	27	Hose nipple.....	518020
8	Air intake tube.....	001149	28	Wick tube/start oil pipe	000099
9	Decrompressor handle...	452008	30	Wick.....	834001
10	Bolt M8x35.....	432017	31	Wick tube nut.....	541006
11	Nut M16.....	441053	32	Oil cup.....	941001
12	Decrompressor spring...	711008	33	Oil cup gasket.....	825026
13	Swirl chamber gasket...	831008	34	Glow plug nipple.....	002513
14	Water gasket.....	811014	35	Cylinder head cover gask	813026
15	Handle knob.....	971007			
16	Core plug (1").....	743007			
17	Plug (1/2").....	516039			
18	Silencer.....	000216			
19	Exhaust pipe flange....	000246			

Group G 10-20. CYLINDER HEAD AND SILENCER

If the water gaskets (14) are leaky, this is due to overheating or rubber becoming old and hard, or insufficient gasket pressure. The gaskets should be renewed. Do not attempt to put excessive force on cylinder head bolts as the rubber compression is determined by the cylinder liner flange. (Gr 20, pos 2), liner flange and cylinder head gasket. The water gaskets should be compressed 0,3-0,8 mm (.12-.31"). Use only original gaskets (3 mm). The piston top clearance (clearance between piston and cylinder head) should be 1,5-2 mm (.059-.079") including cylinder head gasket (Gr 20, pos 13). The clearance is adjusted by means of the 0,5 mm (.02") liner flange rings (Gr 20, pos 14) underneath cylinder liner flange.

Torque load: Page 7.

The aluminium cylinder head cover (2) contains the decompressor, wick tubes with start oil tube. To remove tilt cover forward and lift so that the start oil tube is not bent. The wick tubes lubricate valve springs and adjusting screws. If the engine is steeply installed, the rear wick tube ends should be squeezed some or plugged to allow for more oil at the fore wick ends. When fitting cover see that the start oil tube enters the air inlet in cylinder head and that it does not touch the valve springs.

IMPORTANT:

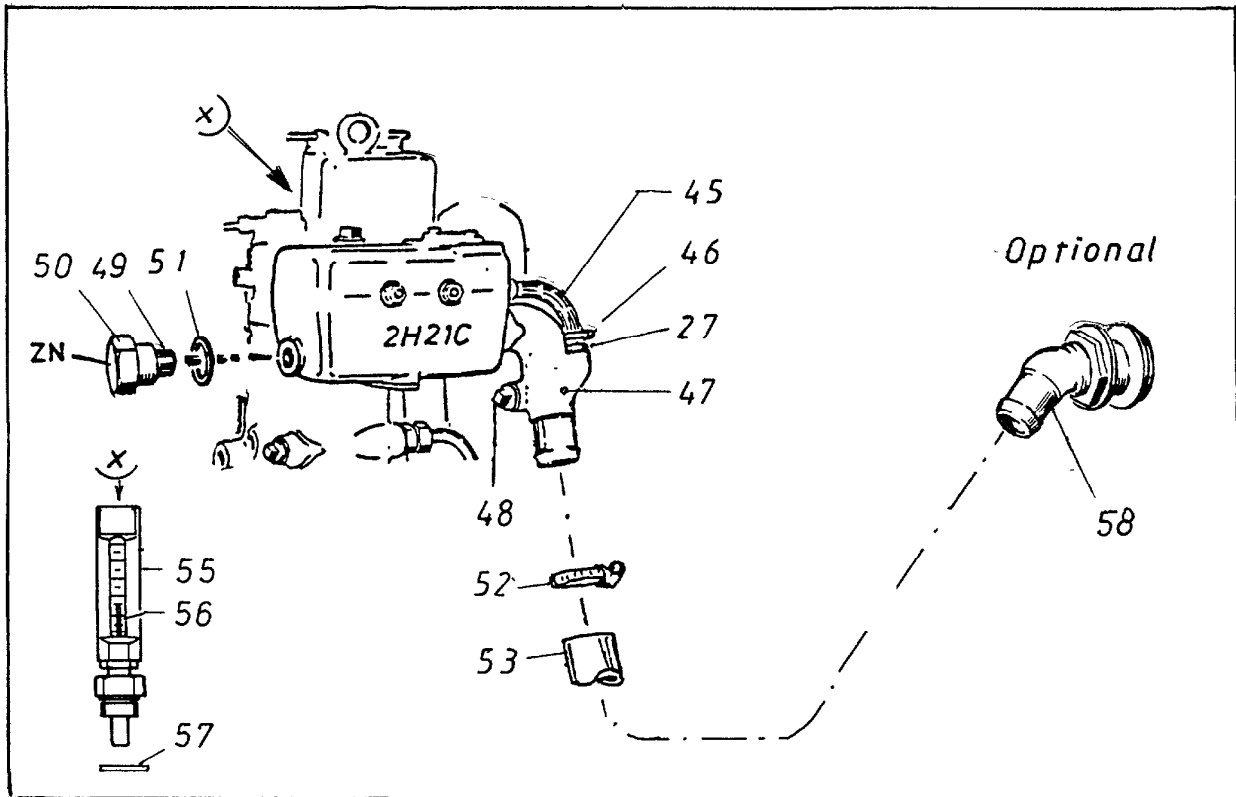
The decompressor has to be correctly adjusted. Adjust by means of the sleeve (4). If sleeve is too high the inlet valve is not enough open and the engine is hard to turn. If sleeve is adjusted too low the rocker arm might touch the decompressor bolt with decompressor on "closed" position, causing loss of compression and valve damage. To adjust loosen nut (6) place piston in top position with both valves closed. The handle (9) should be in its groove. Adjust decompressor sleeve (4) until the decompressor bolt is lifted slightly (0,5mm) each time piston passes top dead centre, turning the flywheel slowly left and right by hand. Then adjust the decompressor holder so that the groove points forward and the bolt is still affected by the piston in its top position. This is correct position of the decompressor and the nut is tightened.

Air and fuel are mixed in the swirl chamber which is machined in the cylinder head. The top half of the swirl chamber is formed by the insert (3) kept in place by the two injector fixing bolts (10). The insert should be removed only when gasket (13) under the flange is leaky. It is internally threaded and is removed by means of a 5/8" W threaded bolt and a clamp.

Check the flange copper ring and anneal if necessary.

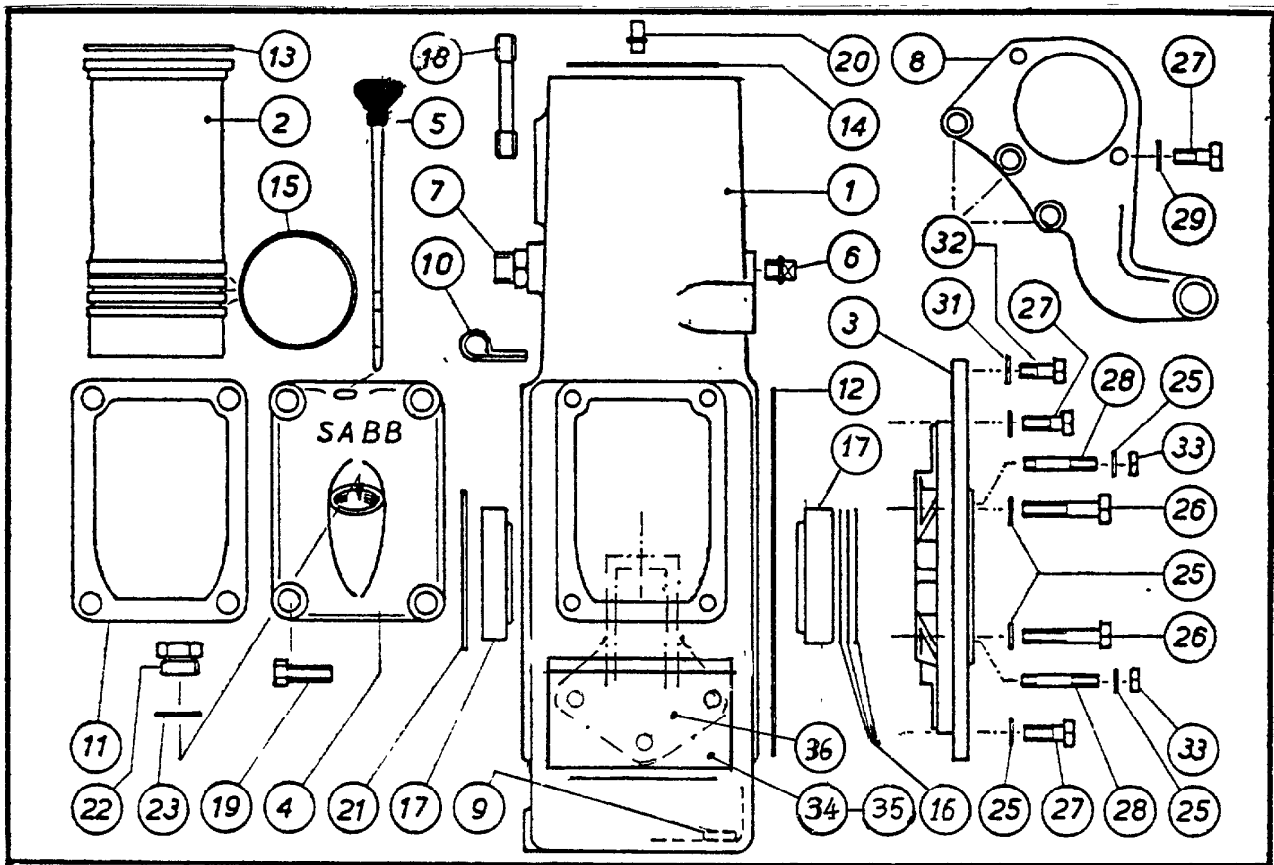
The function of the glow wire (3) is to improve the combustion and give easier starting. When inserting see that the glow wire is placed at silencer side, and the glow wire end should be approx. 2mm off centre towards silencer side, and about 2,5mm rear of centre.

The core plug (16) in cylinder head should be checked regularly. Replace if sign of leakage. To fit new, clean hole carefully. Place a piece of wood over the plug and hammer into place.



Group G 10-20. CYLINDER HEAD AND SILENCER

No	Part name	Part no	No	Part name	Part no
36	Reducing nipple.....	511013	48	Plug 3/8" BSP.....	516040
37	Nipple.....	511060	49	Zinc anode.....	516005
38	Blank flange-watergasket	814007	50	Zinc anode compl.....	516006
39	Plug M10X20.....	432011	51	Coppergasket.....	831033
40	Rubber washer.....	826041	52	Hose clip 55-70 stainl..	921043
41	Washer.....	721082	53	Rubberhose exh 1 3/4"Ø63	841056
45	Hose.....	841026	Optional:		
46	Hose clip.....	921003	55	Thermometer, cool. water	953016
27	Hose nipple.....	518020	56	Thermometer glass	953017
47	Exh bend,waterinj,	001859	57	Copper washer, 21 mm ...	831020
47	Exh bend,waterinj,stainl	011143			
			58	Exh skin fitting w/nut.,.	975060



Group G 20. CYLINDER BLOCK

No	Part name	Part no	No	Part name	Part no
1	Engine block w/pins....	002102	20	Water temp nozzle.....	631017
2	Cylinder liner.....	000400	21	Bearing thrust ring....	734030
3	Bearing flange.....	001122	22	Oil filler plug.....	516030
4	Crankcase cover.....	001699	23	Fibre gasket.....	725010
5	Dipstick.....	001124	25	Lock washer B 10.....	725010
6	Plug (3/8").....	516040	26	Bolt M10 x 65 (4 pcs)..	432020
7	Nipple water.....	511050	27	Bolt M10 x 25 (6 pcs)..	432009
8	Start-bilgep/bracket...	001145	28	Stud M10 x 46 (2 pcs).	432078
9	Magnet.....	942001	29	Washer (3/8").....	721057
10	Injection pipe clamp...	744021	31	Lock washer (3/8")....	722031
11	Crankcase cover gasket.	813034	32	Bolt M10 x 20.....	432011
12	Bearing flange gasket..	813037	33	Nut M10.....	441052
13	Cylinder head gasket...	831009	34	Bracket H23AL.....	001970
14	Liner flange ring.....	831015	35	Bolt M12 x 30.....	432072
15	Cyl liner rubber (3 pcs)	821028	36	Bracket.....	003360
16	Main bearing shim.....	741033		Vibration damper.....	925002
	.....	741034			
17	Tapered roller bearing.	912017			
18	Cylinder head stud.....	437105			
19	Bolt.....	432013			

Group G 20. CYLINDER BLOCK

The cylinder liner (2) is fitted into cylinder block (1). Under the liner top flange is a copper ring (14) and on top of flange is the cylinder head gasket (13). The cylinder liner has in its lower part grooves to take three rubber rings (15) sealing cooling water jacket crankcase.

The piston should be replaced if scratched or if top groove is worn to 3,3 mm (.130"). Original ring groove 3,07 mm (.113"). Replace rings if ring gap exceeds 2 mm (.0,79") when fitted in liner. Original 0,2 mm.

Piston ring set S1-G32b: (page 30) 003378

Top compression ring is chromium plated. No.2 is plain and no.3 is a combined compression/scrapper ring with "nose". No.4 is oil control ring. (In case of excessive lub.oil consumption no.3 ring should be replaced by a "super ring", part no G32be).

NOTE: That piston ring marking is facing upwards.

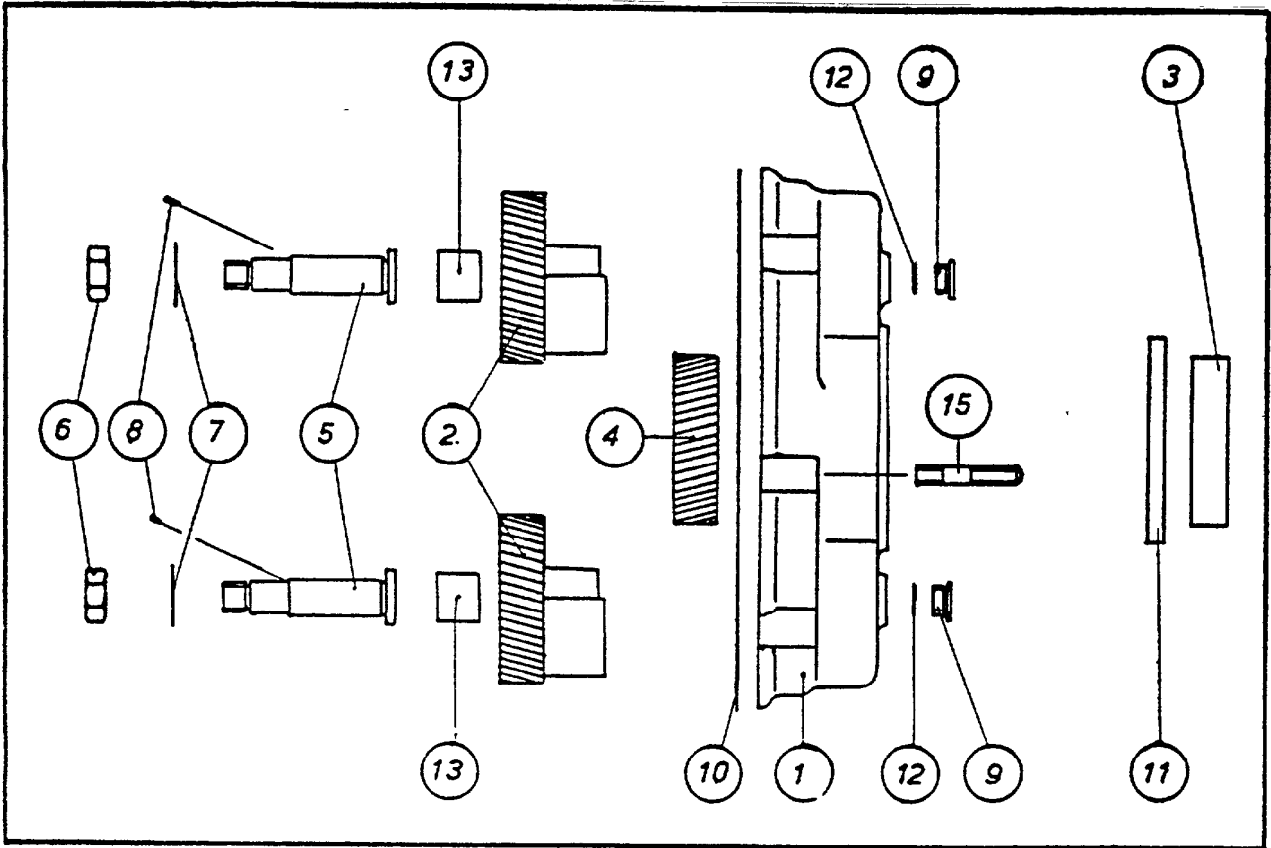
The life of the cylinder liners depends mainly on the following factors: Correct quality of lubricating oil and regular changes. Correct cooling water temperature. The liner should be renewed when worn 0,25 mm (.01"), i.e. it measures 90,25 mm dia. New liner measures 90,00 mm, new piston 89,90 mm which means that the cylinder/piston clearance is 0,10 mm (.004").

Heat piston carefully 80-100C (176-212F) to remove and fit the gudgeon pin. The small end bush (Gr 30-25) is press fitted in the connecting rod. Correct bush pin clearance 0,03 mm (.0012"), max allowed 0,10 mm (.004").

Use traverse when extracting cylinder liner. A simple extracting tool can be made for this purpose: See page 62

Before inserting new liner, clean all contact surfaces. Test by inserting liner without O-rings. Correct fit allows liner to be pressed in and out by hand. Put on new O-rings and apply some clean engine oil to the O-rings. Only original 3 mm circular section rings (O-rings) must be used. Rings of different dimensions will either compress the liner or give leaky joint. Drive home the liner by hammering on a wooden block on top of liner.

Note: Inner dia. of liner when fitted must not measure less than 90,00 mm



Group G 23. VIBRATION DAMPER

No	Part name	Part no
1	Vibration damper housing	002112
2	Vibration damper wheel.	001572
3	Flywheel brass ring....	626005
4	Flywheel gear ring.....	001447
5	Vibration damper shaft.	001127
6	Nut.....	441014
7	Washer.....	725002
8	Lock pin.....	454023

No	Part name	Part no
9	Inspection plug.....	516031
10	Housing gasket.....	813039
11	Oil seal	824003
12	O-ring.....	821037
13	Needle bearing.....	913002
15	Stud.....	437078

Group G 23. VIBRATION DAMPER

The vibration damper housing (1) is fastened to the bearing flange (Gr 20, pos 3) in front of the engine. The housing mounted horizontally contains the vibration damper wheels (2), the lead counter weights rotating in the opposite direction of engine and driven from the flywheel gear ring (4) which is shrunk on the flywheel boss.

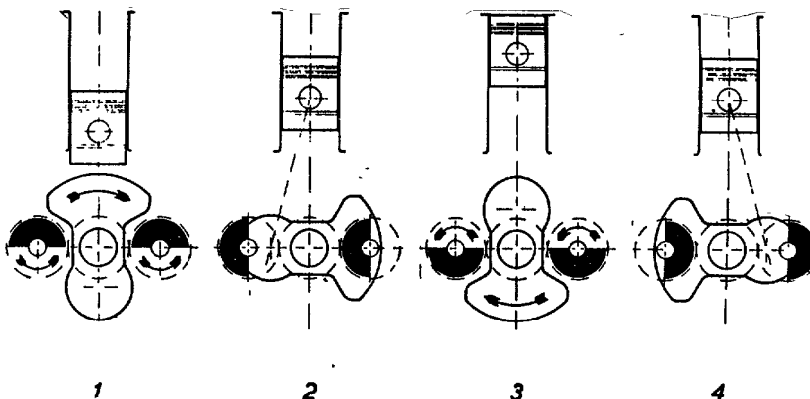
In order to achieve correct effect from the vibration damper it is essential that the damper wheels are correctly timed, i.e. when piston is in its upper position (T.D.C.) the damper counterweights should be in lower position. If the flywheel and vibration damper housing have been removed, timing should be carried out as follows:

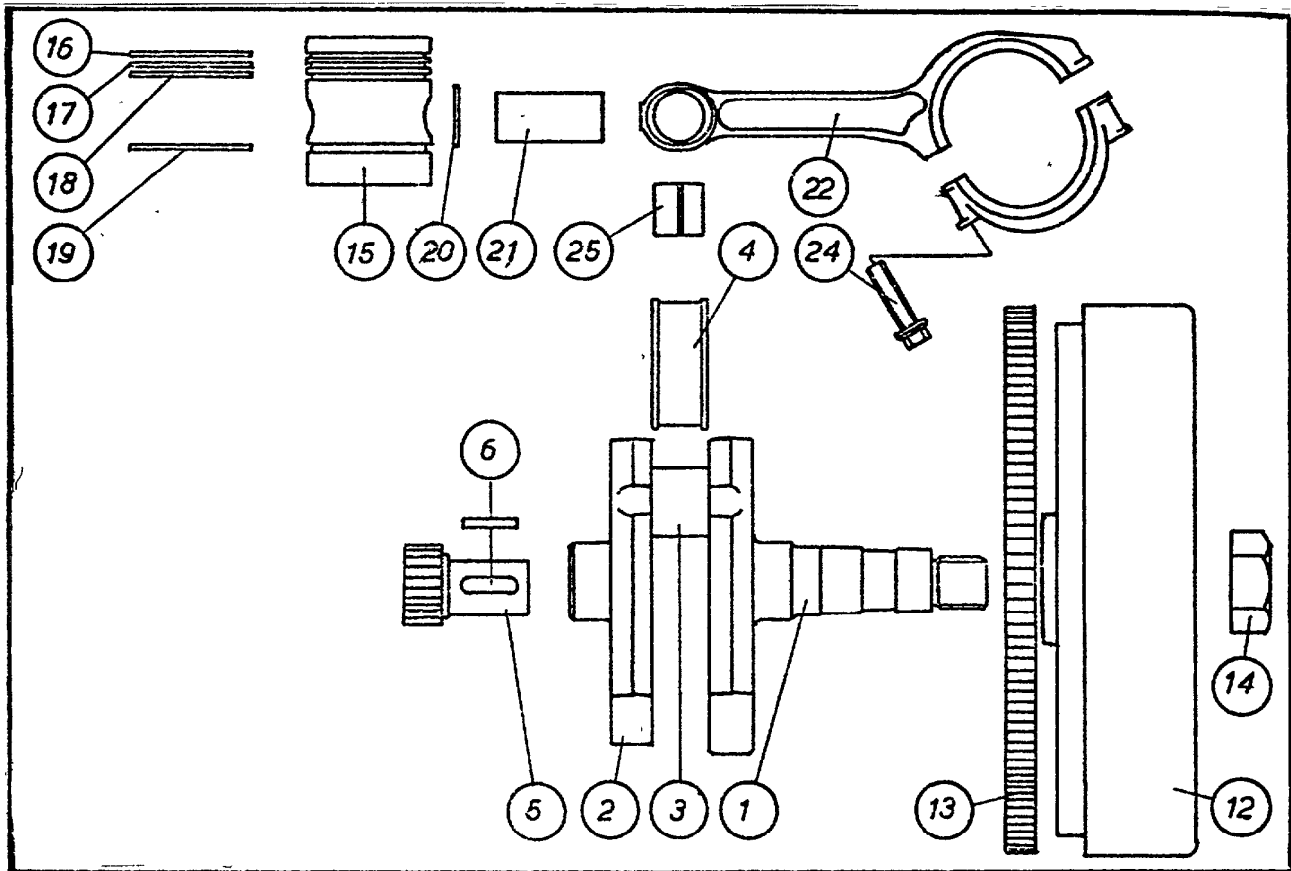
Fasten the housing in correct position on its guide ring. Remove the two inspection plugs (9) with the 3/16" socket wrench. Place piston in exactly top position (T.D.C.). This position is easily found by watching the decompressor bolt (Gr 10-20, pos 5) which is lifted slightly each time the piston hits the inlet valve, when crankshaft is turned slowly left and right by hand. Place flywheel carefully on the crankshaft taper and note that two holes in flywheel correspond with inspection holes in housing. The edge of the damper weights can be observed through inspection holes. With both damper edges horizontally the flywheel is pushed backwards until the gears engage. Check position once more. Press the flywheel on and give a few gentle strokes with a hammer to make it bite on the taper. See page 30 for fitting the flywheel nut. Squirt some lubricating oil through the plug holes and fit the plugs with O-rings.

Replacing Front Oil Seal

The vibration damper is lubricated from the sump. If leakage occurs around the flywheel boss the oil seal (11) should be replaced. See that the oil seal lips is undamaged. To fit the oil seal in the housing, apply some lub.oil to the ring surface and place a plane wooden chock on the oil seal and hammer it in. If the chromium plated brass ring (3) is worn, this should be pressed further in or it should be replaced by a new ring.

Special tools are required. It is recommended to contact SABB Service Shop or the factory. Replacement flywheels with new rings are available.





Group G 30-1. CRANKSHAFT

No	Part name	Part no	No	Part name	Part no	
1	Crankshaft front part..	001128	24	Connecting rod bolt....	432053	
2	Crankshaft rear part...		25	Small end bush.....	622012	
3	Crankpin 49mm.....				Piston ring set.....	003378
4	Roller bearing 912020					
5	Crankshaft pinion 001132					
6	Cranksh drive key 451003					
12	Flywheel compl.,.....	001146				
13	Starter ring.....	001409				
14	Flywheel nut.....	441055				
15	Piston.....	000721				
16	Compression ring (chrom)	000722				
17	Compression ring.....	000723				
18	Compr/scraper ring.....	000725				
19	Oil control ring.....	000724				
20	Circlip.....	734034				
21	Gudgeon pin.....	001450				
22	Connecting rod.....	001136				

Group G 30-1. CRANKSHAFT

The connecting rod (22) big end is divided at an angle so that the piston with connecting rod can be removed through the liner. The connecting rod bolts (Verbus Tensilock) are self-locking. However, the locking effect is reduced by repeated unscrewing. torque load 18 kpm (130 ft.lbs).

The crankshaft (1) consists of two parts in which the crankpin (3) is press fitted. To replace the complete big end roller bearing or the rollers the crankshaft will have to be parted in a hydraulic press. Place the shaft on solid base, taper pointing down. Press out the crankpin enough to make rear part and bearing loose. Then apply some oil to the pin and press it back until it protrudes 71,5 mm from the web. To fit, place crank shaft with the pin pointing up. Heat the big end bearing in oil to 150C (302F) and drop it on the pin. Then heat rear shaft web to approx 300C (572F) and fit it. Permit the shaft to cool before adjusting the webs. Place it in a lathe between center supports. Check that the front center is undamaged. When correctly adjusted the shaft will run completely straight. To easen the control remove the two main roller bearings. Use a 1/2" brass drift.

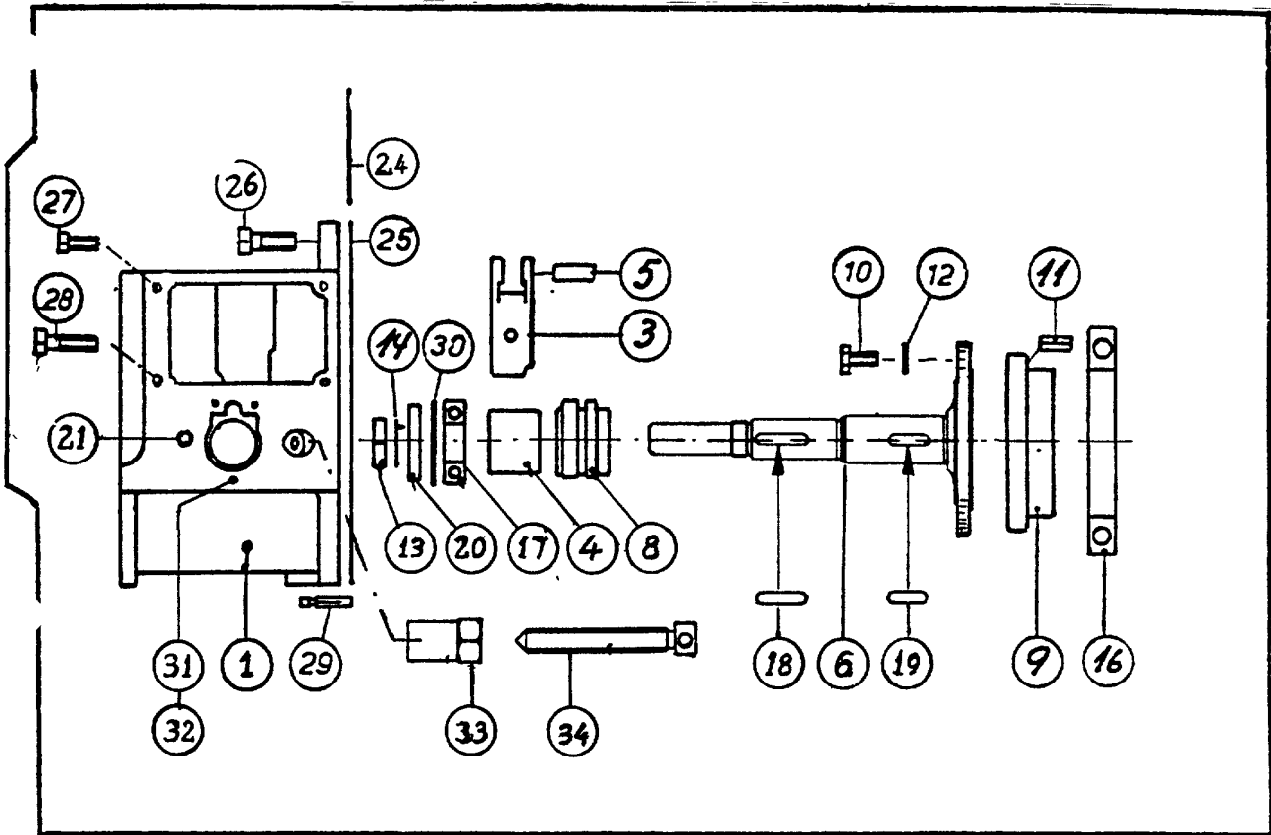
Adjusting of axial movement

The crankshaft runs in tapered roller bearings (Gr 20, fig 17), "Timken" bearings. Any wear of the rollers or race will allow axial movement of the crankshaft. If the movement exceeds 0,3 mm (.012") the end play should be adjusted by means of shims (Gr 20, fig 16) under front bearing race. The end play should be 0,05-0,10 mm (.002"-.004"). If too small clearance the shaft and the flywheel will tend to be warmer than normal.

Standard shims measure 0,2 and 0,05 mm (.0079" and .002"). To adjust the bearing clearance the flywheel must be removed by two 5/8" W threaded bolts and a clamp. Do not attempt to withdraw the flywheel by wedges or by hammering. When fitting the flywheel use a strong spanner (25cm), preferably ring spanner on the flywheel nut and tighten with a heavy hammer (5 kilos).

See page for timing of the vibration damper.

The bearing flange (Gr -20, pos 3) is removed with two 3/8" W bolts in the free holes of the bearing flange plane. The roller race is hammered out with 1/4" brass drift.



Group G 30-2. GEAR HOUSING

No	Part name	Part no	No	Part name	Part no
1	Gear housing.....	003643	26	Bolt M12 x 30.....	432021
3	Eccentric ring.....	001106	27	Bolt M8 x 35.....	432017
4	Eccentric pulley.....	001109	28	Bolt M8 x 50.....	432022
5	Pump cross head bolt...	454009	29	Dowel.....	454007
6	Camshaft.....	000421	30	Shim.....	741037
8	Cam.....	001110	31	Stud.....	437088
9	Internal gear wheel....	000408	32	Nut.....	441066
10	Flange screw.....	432019	33	Adjusting screw nut....	001714
11	Elastic pin.....	456020	34	Adjusting screw	001713
12	Lock washer.....	722027			
13	Camshaft nut.....	541009			
14	Lock washer.....	725013			
16	Gear wheel ball bearing	911028			
17	Ball bearing.....	911026			
18	Crankshaft drive key...	451003			
19	Crankshaft drive key...	451004			
20	Oil seal with dust lip.	824011			
21	Plug 3/8 BSP	516045			
24	Governor cover gasket..	813052			
25	Gear housing gasket ...	813051			

Group G 30-2. GEAR HOUSING

The gear housing (1) is fitted between cylinder block and gearbox housing. It contains important small parts: Reduction gear, injection pump, governor, cams and valve lifters, water pump eccentric etc. All parts are lubricated by oil mist from crankcase. Oil is thrown into the reduction gear through a hole in cylinder block and returns to sump through a lower hole.

The camshaft (6) runs in ball bearings (16-17). The camshaft parts are kept in position by the ahead clutch cone (Gr 84, pos 27) and the nut (13). The axial position is fixed by shims (30) behind the small ball bearing. The internal gear wheel (9) is fastened by flange screws and elastic pins to camshaft flange. The internal gear wheel meshes the crankshaft pinion (Gr 30-1, pos 5) giving 2:1 reduction.

The tooth clearance between pinion and internal gear wheel is determined by the two dowels (29) fixing position of the entire gear housing. If gear housing, cylinder block or one of the gears have been replaced, readjustment of tooth clearance will be necessary:

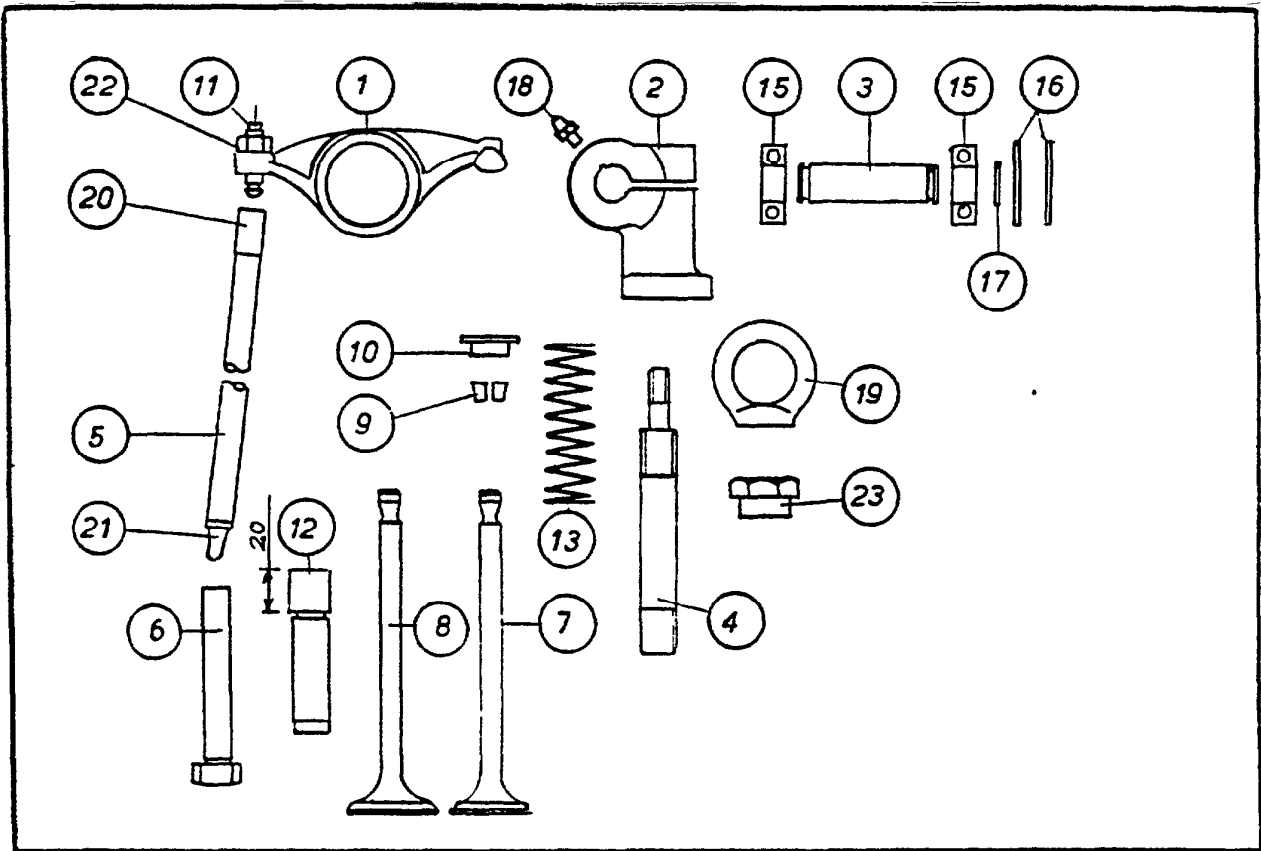
Adjusting of gear wheel clearance

Fit gear housing loosely and tighten retaining bolts (26) just enough to allow the internal gear wheel to rest against the crankshaft pinion.

Note: Correct timing, page . When turning flywheel carefully by hand, the gear housing will move some up and down due to the permissible untrue run of the gears. Use a magnet foot type dial indicator to determine highest position of housing, and from this position the housing is lifted 0,05-0,10 mm (.002-.004") which becomes the minimum tooth clearance.

Tighten retaining bolts, torque load 8,5 kpm (60 ft.lbs.). Make sure that the gears have clearance in all positions by feeling the play of the camshaft (or ahead clutch cone) (Gr 84- , pos 27), turning flywheel little by little two turns.

It is possible to adjust roughly the clearance without dial indicator by feeling the camshaft play in all positions for two turns of the flywheel, reducing the clearance gradually by lowering the gear housing.



Group G 34. VALVE GEAR

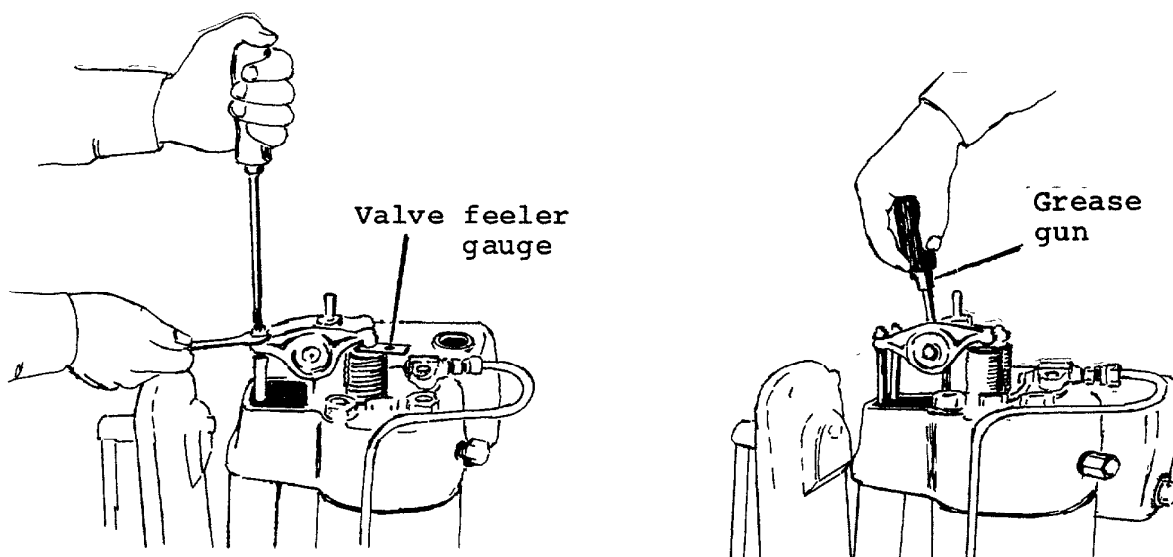
No	Part name	Part no	No	Part name	Part no
1	Rocker arm.....	000089	20	Push rod top.....	001490
2	Rocker arm bracket.....	001621	21	Push rod foot.....	001491
3	Rocker arm bolt.....	000092	22	Nut.....	441054
4	Bracket bolt.....	001546	23	Rocker arm bracket nut.	441053
5	Push rod.....	001147			
6	Valve lifter.....	001118			
7	Valve inlet.....	003785			
8	Valve exhaust.....				
9	Valve spring cone.....	000082			
10	Valve spring collar....	000083			
11	Rocker arm adjust screw	000851			
12	Valve guide.....	000078			
13	Valve spring.....	711013			
15	Rocker arm ball bearing	911030			
16	Circlip big.....	734034			
17	Circlip small.....	734039			
18	Grease nipple.....	517004			
19	Eye nut.....	443015			

Group G 34. VALVE GEAR

Overhead inlet and exhaust valves (7 and 8) are controlled by the cams (Gr 30-2, pos 8) in the gear housing through the valve lifters (6) push rods (5) and rocker arms (1).

The exhaust valve on port side is served by the rear and the inlet valve by the front valve lifter. The valve lifters can be seen at the bottom of the air intake tube (Gr 10-20, pos 8).

The valves move in replaceable guides (12) of fine grained cast iron pressed into the cylinder heads. Inlet and exhaust valves are identical and marked G34K. Each cylindrical valve spring (13) is locked by the valve spring cone (10) and the two-piece collar (9). The springs are identical.

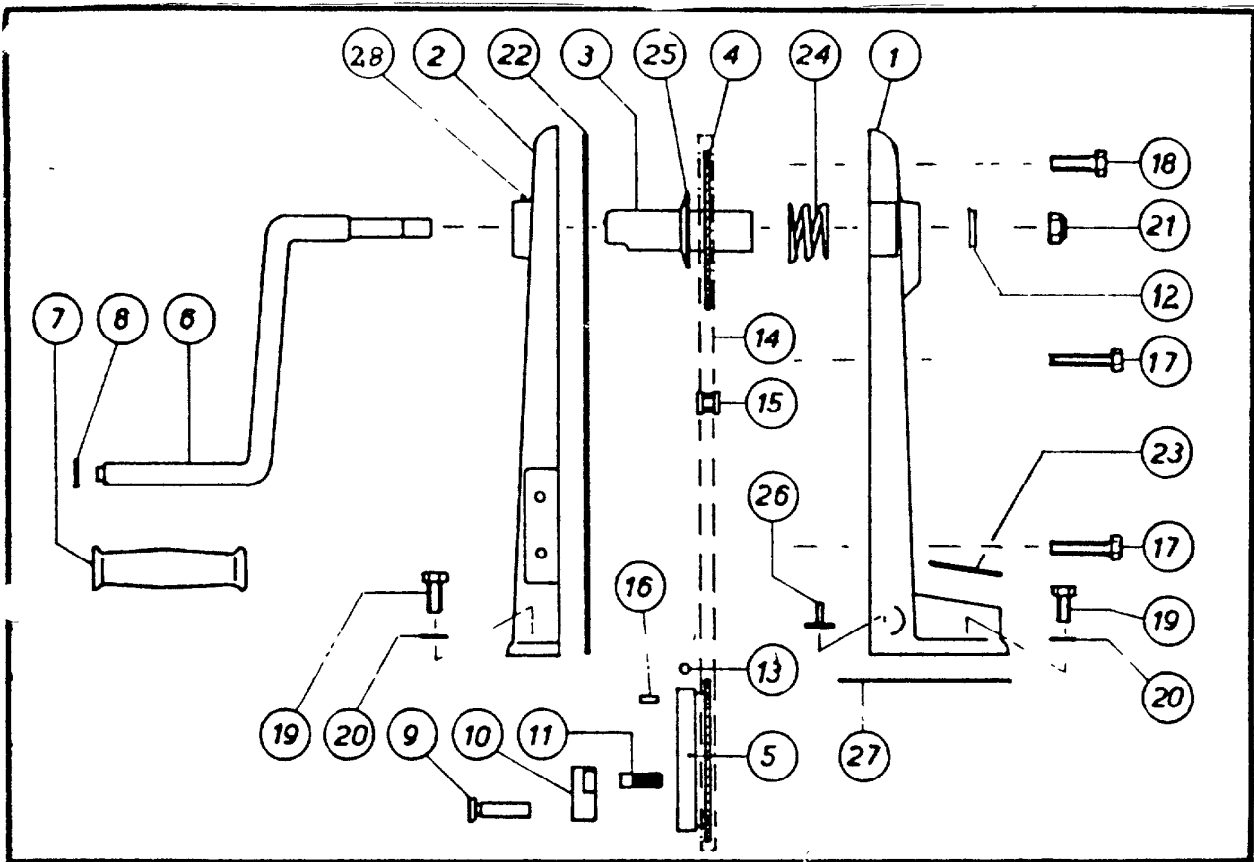


Valve adjustment

All valve parts are easily accessible for control by removing the cylinder head cover. The valve clearance should be checked after the first 50 hours of operation and later every 300 hours or when noisy tappet operation is noticed. The clearance is measured between valve stem and its rocker arm with valve in closed position. Correct valve tappet clearance for inlet and exhaust valves (engine, cold) is 0,3 mm (.012"). A special valve feeler gauge is supplied in tool box. See that the push rods are straight and undamaged.

If the engine is difficult to start, the valves should be checked for proper seating. To check inlet valve, remove the cylinder head cover, turn engine by hand and listen if air leaks out through inlet port in cylinder head. To check the exhaust valve, undo the silencer or listen at the exhaust pipe outlet if air blows by. In case of leaky valves, remove the cylinder head and undo valve parts. Clean valve stems and seats. If necessary regrind or lap the valve seats, using fine grinding compound. Valve seat angle 45 degrees.

If the valve seats in cylinder head after long use become burnt and worn due to repeated grinding, the cylinder head should be machined for inserting of replaceable valve seats. Counterbores in cylinder heads for driveshrink fit of seats should be made in a lathe to ensure concentricity with valve guides.



Group G 35. HAND STARTING GEAR

No	Part name	Part no	No	Part name	Part no
1	Starting bracket front.	001150	20	Washer.....	722031
2	Starting bracket rear..		21	Nut M10 Nylock.....	441071
3	Starting shaft	001152	22	Starter bracket rubber.	822004
4	Upper sprocket		23	Air tube O-ring.....	821033
5	Lower sprocket.....	001115	24	Starting shaft spring..	711016
6	Starting crank.....	001151	25	Rubber washer.....	826006
7	Hand grip.....	001496	26	Dice valve.....	000318
8	Washer.....	721042	27	Starting bracket gasket	813061
9	Starting pawl bolt.....	000727	28	Grease nipple.....	517004
10	Starting pawl.....	001116			
11	Starting pawl pin.....	455009			
12	Washer.....	726022			
13	Steel ball.....	915004			
14	Starting chain.....	003645			
15	Starting chain lock....	931016			
16	Grooved pin.....	456020			
17	Bolt M8 x 35.....	432017			
18	Bolt M8 x 30.....	432033			
19	Bolt M10 x 20.....	432011			

Group G 35. HAND STARTING GEAR

The upper sprocket (4) is connected to the lower (5) with the starting chain (14). Lower sprocket which is located on a boss in the gear housing, has a pawl (10) which is operated by its own weight. When fitting the chain see that the pawl is in its bottom dead centre when the starting crank is in the same position, otherwise the pawl will hammer on its catcher (ahead clutch cone, Gr 84- , pos 27), and the starting crank might "kick" if the engine turns opposite when stopping. The lower sprocket runs on 34 balls (13) of 1/4" dia. To remove the sprocket, extract the grooved pin (16) and undo the ball plug (12). Now the balls can be poured out through the plug hole and the sprocket is loose.

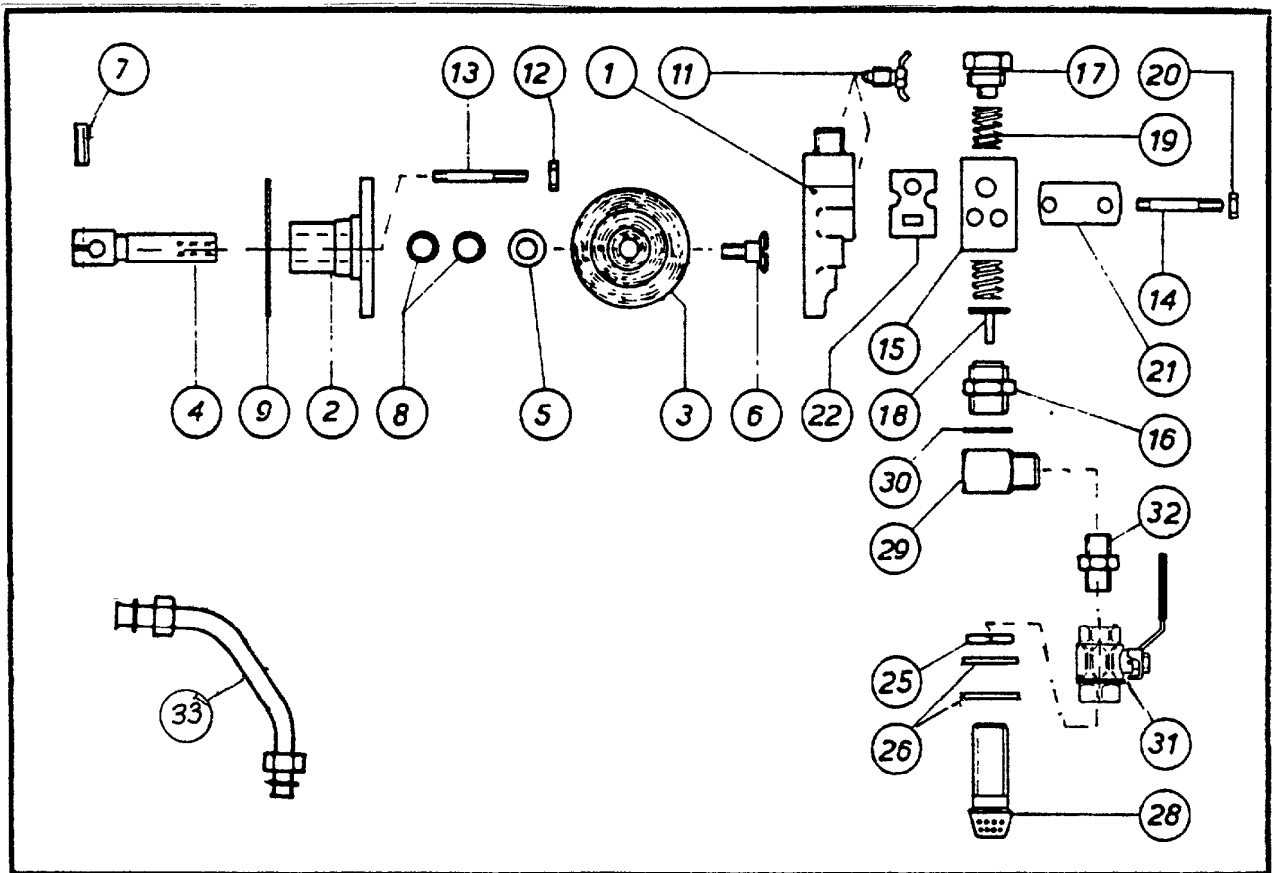
If the pawl gets stuck in thick oil it should be washed with fuel oil through the clutch housing lid opening.

The engine air intake is situated at the upper front part of the starting bracket from where it passes through the air intake tube (Gr 10-20, pos 8) to the cylinder head.

Crankcase ventilator

The crankcase is ventilated through the small breather disc valve (26) located inside the front starting bracket foot. Oil-vapour sucked back to engine. Normally the valve makes vacuum in the crankcase.

Check valve by removing rear half of starting bracket (2). Rinse valve with fuel oil. To fit rear bracket it is recommended to loosen the retaining bolts for the front part and tilt this forward.



Group G 42-1. WATER PUMP AND WATER VALVES

No	Part name	Part no	No	Part name	Part no
1	Water pump housing.....	002127	20	Nut M8.....	441066
2	Water pump flange.....	000373	21	Water valve clamp.....	000232
3	Diaphragm.....	851005	22	Water valve gasket.....	814015
4	Water pump rod.....	003847	25	Strainer nut.....	541014
5	Diaphragm washer.....	726008	26	Strainer washer intern.	721054
6	Diaphragm screw.....	000381	28	Sea cock strainer.....	000738
7	Rifled pin.....	454009		Sea water inlet.....	001459
8	O-ring.....	821037	29	Elbow.....	000321
9	Pump flange gasket.....	813066	30	Elbow joint washer.....	831020
10	Drain cock.....	000312	31	Hand wheel cock 1/2"...	946021
12	Nut M10.....	441052	32	Nipple 1/2".....	511050
13	Stud M10 x 46.....	437078	33	Pressure pipe	
14	Stud M8 x 47.....	437079		(1/2" X 250)	611043
15	Water valve housing....	001415			
	with elbow.....	003533			
16	Water valve seat.....	000319			
17	Plug.....	000317			
18	Dice valve.....	000318			
19	Spring (2 pcs).....	711026			

Group G 42-1. WATER PUMP WITH VALVES AND COCK

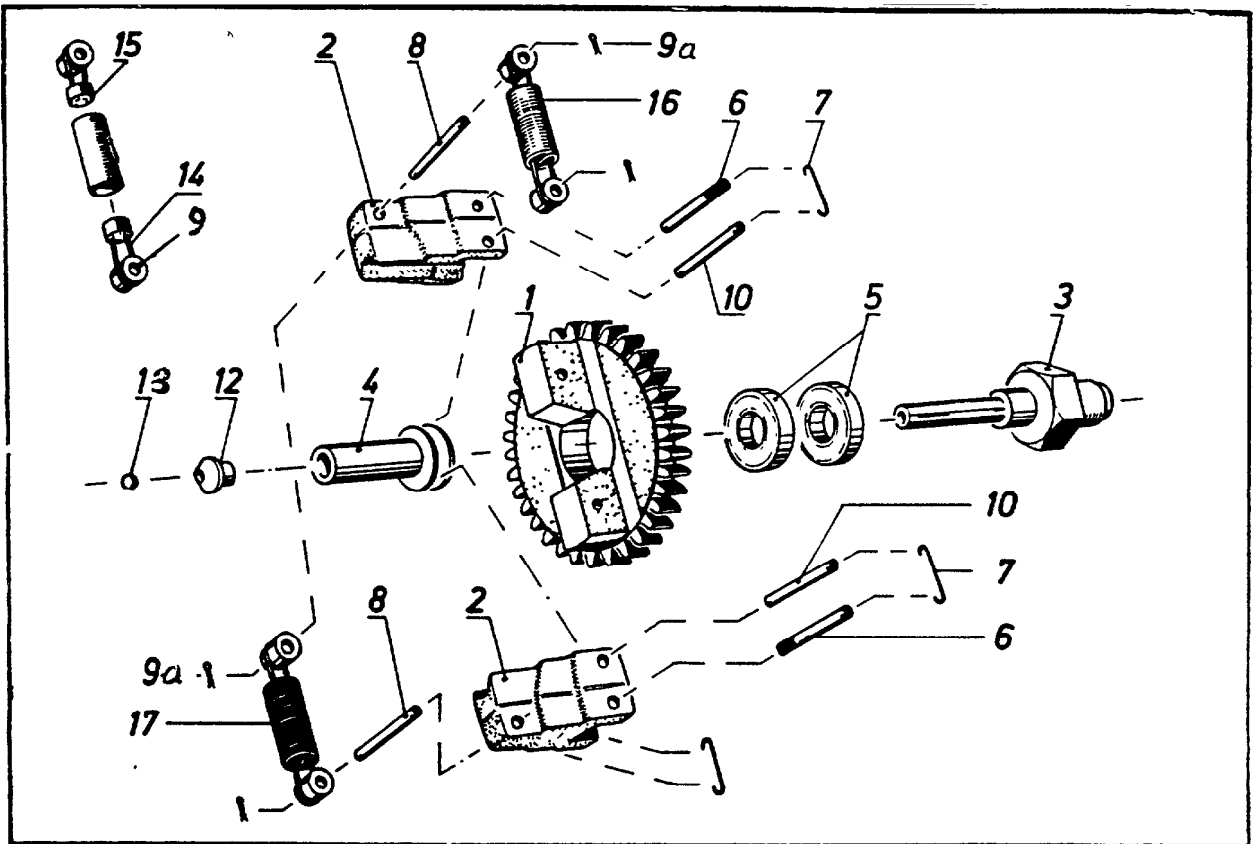
The cooling water pump is of the diaphragm type and is located on port side of gear housing. The rod (4) which is operated by the eccentric ring (Gr 30-2, pos 3) is connected to the diaphragm (3) with the screw (6) and the washer (5). The rod slides in flange (2) which fits oiltight against the gear housing gasket (9). Annular grooves in the flange takes the two rubber O-rings (8) which seals the rod. The diaphragm rim is clamped between the flange and the pump housing (1), its central part is moved in and out (about 4mm) by the rod, thus producing the pump effect in the pump housing and valve housing.

Replacing Water Pump Diaphragm

Inspect diaphragm at least once a year. Close sea cock and drain water from engine. Undo pipe connections to water pump and loosen the pump housing. The diaphragm screw (6) is unscrewed with a solid screw driver or coin. Fit new diaphragm with marked side facing in. The brass washer (5) is fitted with curved side against diaphragm.

Water valves

The water valves housing is a square metal casing containing the suction and pressure valves (18) with springs (19). If the cooling water pump is not working, the valves are usually clogged in the housing (15). First try to prime the pump by unscrewing plug (17) and pouring some water into the valve housing. If pump still fails to work, the valve housing must be removed for cleaning of the valves. For access to the suction valve, remove the suction valve seat (16). Constant clogging of valves may be remedied by fitting a mudbox between sea cock and pump.



Group G 43-1. CENTRIFUGAL GOVERNOR

No	Part name	Part no	No	Part name	Part no
1	Governor gear wheel....	000374	12	Governor sleeve pin ...	000176
2	Governor weight.....	000144	13	Spring eye washer.....	915002
3	Governor spindle.....	000175	14	Spring eye.....	712020
4	Governor sleeve.....	004042	15	Spring eye holder.....	000308
5	Ball bearing.....	911035	16	Governor spring no 1...	712017
6	Governor weight pin....	000364	17	Governor spring no 2...	712019
7	Lock wire.....				
8	Spring pin.....	000338		Compl governor.....	000135
9	Split pin.....	712021			
9a	Split pin.....	731015			
10	Sleeve pin.....	000358			

Group G 43-1. CENTRIFUGAL GOVERNOR

(See cut-away view of governor, page 61)

The function of the centrifugal governor is to maintain the predetermined engine speed on idling and on load conditions. Should the engine speed change, the governor will automatically act on fuel pump, reducing or increasing fuel supply to enable engine to keep the predetermined speed.

The governor is placed in the gear housing on the spindle (3). The gear wheel (1) runs in two ball bearings (5) at engine speed, driven by the camshaft flange gear wheel and carries the two governor weights (2) which are kept together by two springs (16 and 17). When the engine speeds up, the centrifugal force of the weights (2) overcomes the tension of the springs and the weights come apart. This movement of the weights causes the sleeve (4) to press on the governor arm (Gr 43-2, pos 3) and through the arm link (Gr 43-2, pos 6) the movement acts on the fuel pump rack.

If after long time of use the governor spring stretch, this will influence the governor function. The springs should be shortened or replaced by new ones. Spring measure, measured between spring eyes internally, unloaded, should be:

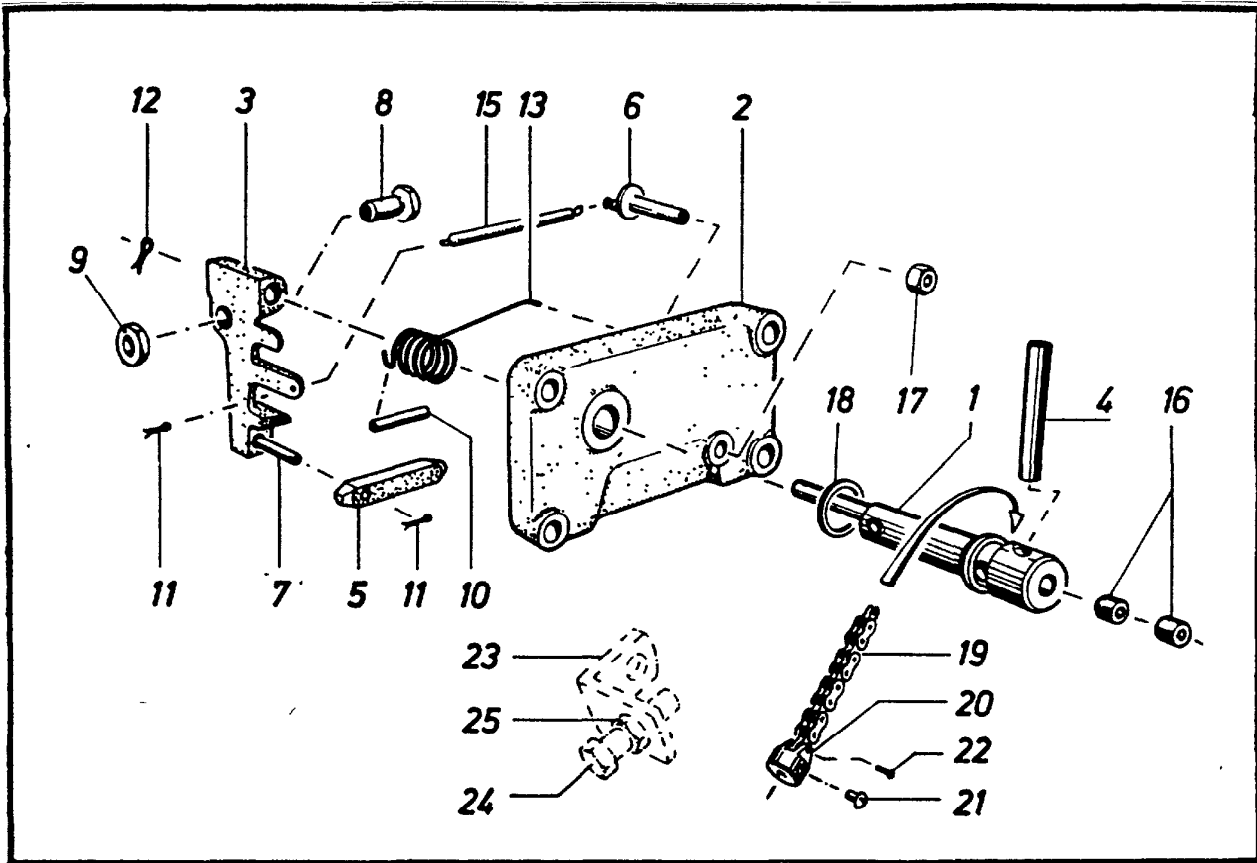
Spring 743 m: 47 +/- 0,5 mm

Spring 743 q: 50 +/- 0,5 mm

The complete governor is unscrewed by means of the 22 mm spanner supplied. The governor spindle has rights hand threads.

Before leaving the factory the engine is thoroughly tested and is set to develop 10 HP at 1800 by means of adjusting screw (6). To avoid overloading and subsequent troubles the adjusting screw is sealed. Our guarantee is void if the seal is broken without our written consent.

See also Gr 43-2.



Group G 43-2. GOVERNOR PARTS

No	Part name	Part no
1	Governor shaft.....	001451
2	Governor cover.....	000485
3	Governor cover compl...	000465
3	Governor arm.....	000486
4	Handle.....	452009
5	Arm link.....	000497
6	Idling adjusting screw.	000501
7	Governor arm bolt.....	000513
8	Adjustong screw.....	000531
9	Lock nut.....	541006
10	Grooved pin.....	454008
11	Split pin.....	731015
12	Split pin.....	731005
13	Governor shaft spring..	713002
15	Idling spring.....	712022
16	Socket set screw.....	434017
17	Nut M6.....	441078
18	Rubber washer,gov shaft	826001
19	Chain.....	931025

No	Part name	Part no
20	Chain fork and chain...	001409
21	Set screw M5 x 10.....	431007
22	Lock pin.....	
23	Handle stopper GS.....	000729
24	Handle stop screw.....	432017
25	Nut M8.....	441066

Group G 43-2. GOVERNOR PARTS

(See cut-away view of governor, page
The governor shaft (1) passes the side cover (2) of the gear housing and is kept in position by the pin (10) and the spring (13).

Speed control is possible by pushing the handle (4) forward to slow down, and aft to increase speed. The governor arm (3) is fastened to the eccentric spindle end of the shaft. When the shaft is turned by hand, the arm will move about a point determined by the adjusting screw (8), and the ball (Gr 43-1, pos 12) located in the governor sleeve plug, thus controlling the fuel supply.

Adjusting Idling Speed

Lowest idling speed should be about 350 rpm and is constant for about 5-10 degrees movement of speed control handle.

Within this constant rpm range, the "idling range", the speed is controlled by idling spring (15) only. Tension of idling spring is adjusted by idling spring adjusting screw (6).

Tighter spring gives higher idling speed.

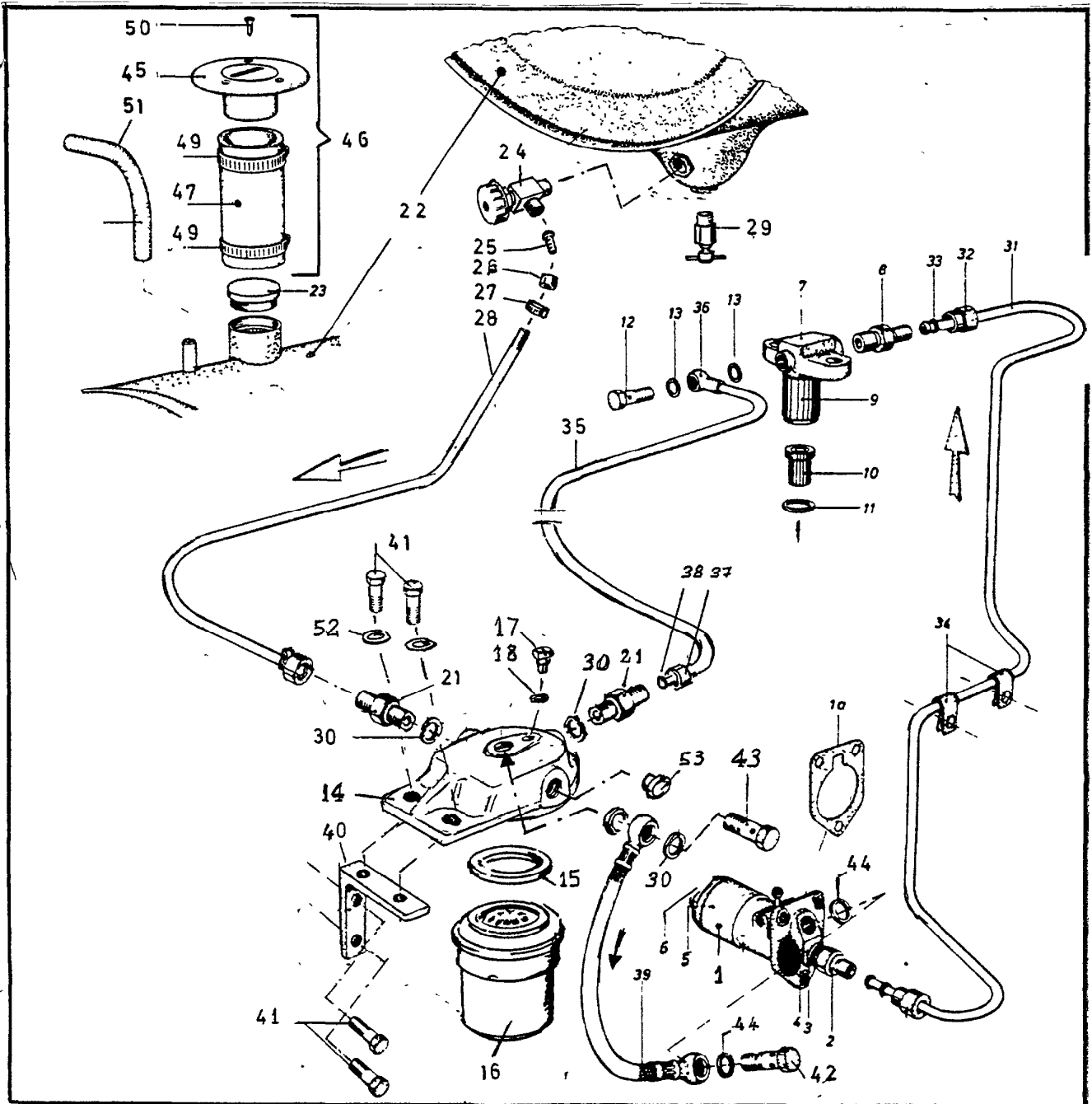
If after long time use the idling spring stretches, it should be shortened or replaced by a new one. Spring measure, measured between spring eyes, is 53-55 mm.

The extent of the idling range (i.e. extent of handle movement within which lowest idling speed remains constant) is adjusted by means of adjusting screw (8) in governor arm. The more forward the setting of adjusting screw, the greater the extent of idling range. However, if screw is adjusted too much forward, this will reduce engine output.

It is important for proper governor function that fuel pump rack and all moving parts of governor such as weights, springs, links etc. can work freely.

Any resistance due to sticking of governor parts or fuel pump rack will cause irregularities in speed control, engine will tend to run uneven, to "stutter". In this case governor cover should be taken off and all governor parts rinsed with clean fuel oil, removing any thick oil and dirt from governor and fuel pump rack. Cleaning and inspection of governor should preferably be carried out in connection with ordinary oil-change.

NB! Make sure that the arm link (5) engages the ball at the fuel pump when fitting the cover.
The cover must be off before removing the fuel injection pump.



Group G 44. FUEL INJECTION EQUIPMENT

No	Part name	Part no	No	Part name	Part no
1	Injection pump.....	001111	5	Injection pump element.	001440
1a	Injection pump shim....	741046	6	Cam roller complete....	001209
	.....	741047	7	Injection holder compl.	000093
	.....	741048	8	Inj nipple with filter.	001891
2	Pressure valve holder..	001441	9	Nozzle nut.....	
3	O-ring.....	821020	10	Injector nozzle.....	001196
4	Pressure valve.....	002092			

Group G 44. FUEL INJECTION EQUIPMENT

No	Part name	Part no	No	Part name	Part no
11	Nozzle joint washer....	831026	31	Injection pipe.....	613007
	Nozzle holder spring...	719007	32	Injection pipe nut.....	443010
	Pressure valve spring..	719003	33	Injection pipe collar..	449002
12	Banjo nipple plug.....	521008	34	Inj pipe clamp & rubber	744021
13	Copper washer.....	831025	35	Leak-off pipe, injector-	
14	Fuel filter housing comp	942039		filter, complete starbor	613012
15	Filter house gasket....		36	Banjo nipple.....	521007
16	Fuel filter elem spin-on	942040	37	Pipe nut.....	512010
17	Bleeder screw,fuel filt		38	Solder sleeve.....	514003
18	Bleeder screw joint....		39	Hose filter inj pump stb	845022
21	Fuel filter nipple.....	511036	40	Filter holder.....	001143
22	Fuel tank stainless stl	003850	41	Head screw M8 x 25.....	432009
23	Fuel tank cap.....	003753	42	Banjonipple plug M12x1,5	521015
24	Fuel tank cock.....	946001	43	Banjonipple plug M14x1,5	521011
25	Hose nipple.....	518018	44	Copper washer 12mm.....	831018
26	Pipe nut.....	512007	45	Filler cap.....	003514
27	Hose clamp.....	921001	46	Filler cap compl.....	003515
28	PVC-armed tankhose w/nipples		47	Hose 1 1/2"x300mm.....	841044
	1/4" x 2500.....	003851	49	Hose clamp Ø50-65.....	921043
	1/4" x 5000.....	003852	50	Screw.....	
29	Fuel drain cock compl..	946006	51	Air hose.....	842022
30	Copper washer.....	831035	52	Washer brass.....	721042
			53	Plug M14 x 1,5.....	515058

Group G 44. FUEL INJECTION EQUIPMENT

(see page 8)

The fuel injection pump (1), the injector with nozzle (7 and 10) and the fuel filter (14) are of Bosch make and not covered by the engine guarantee.

The fuel injection pump (1) is fed with fuel oil through flexible pipe from the fuel oil filter. The pump is very robust and reliable as long as fuel oil is clean, but made with such accuracy that any repairs must be carried out by a trained man.

Never undo pressure valve(4) when loosening suction pipe or pressure pipe. Before loosening the injection pump the governor cover must be removed.

Under the flange of the injection pump there are some fuel pump shims (1a) by means of which injection can be timed. The more shims, the later the injection. Fuel injection is normally timed to commence 8 degrees before T.D.C. and end about 7 degrees after T.D.C. Each shim of 0,1 mm under pump flange will shift injection timing about 1 degree crank angle. The factory stock shims approx 0,2-0,3-0,5 mm.

Injector holder

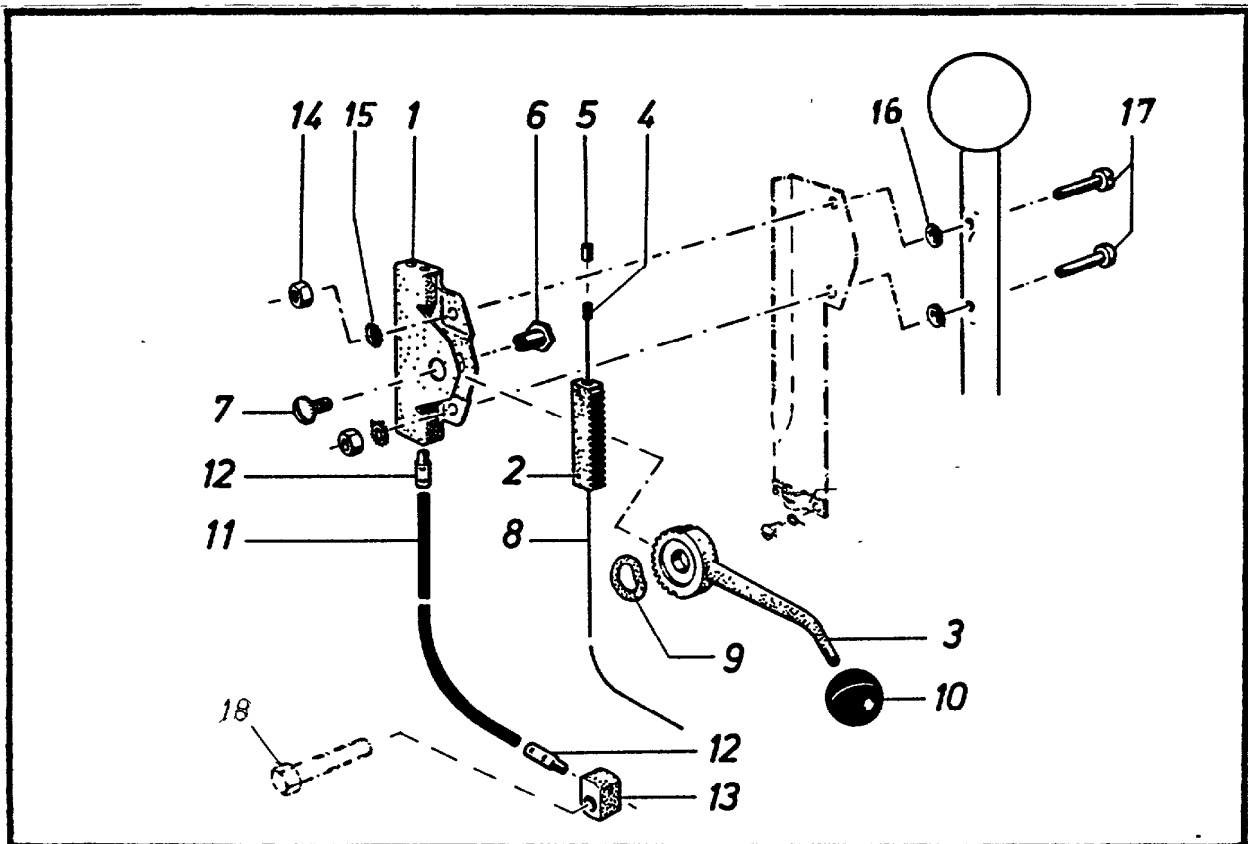
The importance of clean fuel is emphasized, because practically all injector service trouble are due to loose particles, grit or any other foreign matter which stick in nozzle. This will cause bad pulverisation, distorted spray etc., and nozzle should be cleaned. Dirty nozzle is noticeable on the metallic sound of injection; the engine will knock or smoke and is liable to have starting troubles. Cleaning or changing of nozzle can be carried out by everyone, provided proper cleanliness and caution are observed.

Disconnect fuel pipe from nozzle holder, remove holder from cylinder head, place it upside-down on its studs and reconnect fuel pipe. With speed control open (full speed) crank engine and watch fuel spray. Correct injection gives a slender spray of fine and evenly distributed particles without drops and dribble. With nozzle holder in upside-down position the nozzle may be carefully unscrewed.

Behind the spring in the holder is a small distance washer which determines spring tension and injection pressure. The needle in the nozzle should move freely. Do not touch the needle with your fingers, but hold it in the small tap end to avoid acid from fingers. Rinse all parts in clean fuel oil. Do not use hard tools, remove dirt with a wooden stick and wipe with clean rag.

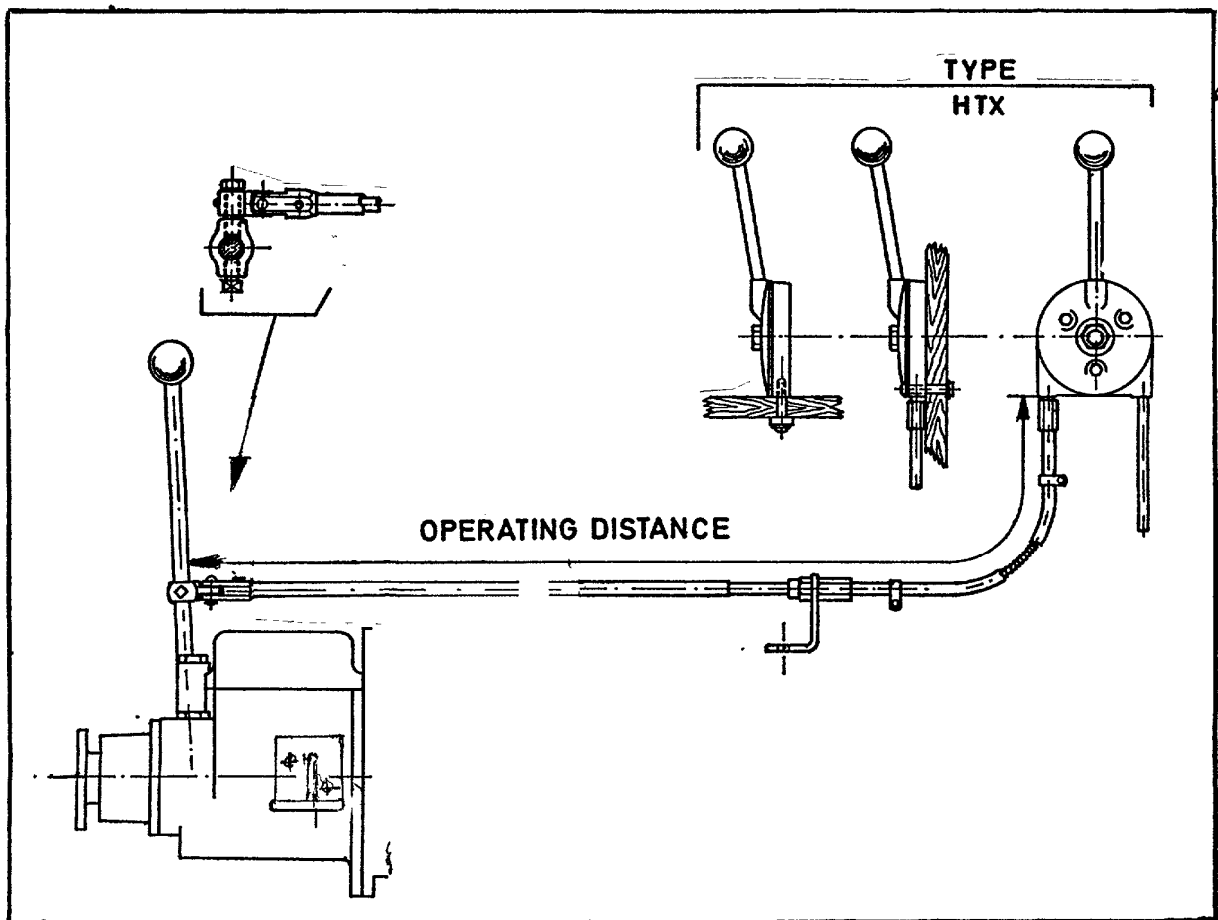
IMPORTANT:

When reassembling nozzle the pointed end of the piece between needle and spring must point towards the spring.



Group G 72-1. GOVERNOR CONTROL

No	Part name	Part no	No	Part name	Part no
1	Governor control handle	001486	11	Bowden cable.....	001485
1	Govern contr handle w/wire, bowden cable and block.	001144	12	Bowden cable sleeve....	571006
2	Rack	003897	13	Block.....	571005
3	Handle.....	011380	14	Nut M5.....	441010
4	Handle knob.....	001487	15	Washer 3/16".....	722033
5	Wire lock M5 x 6.....	434001	16	Bush 3mm.....	514010
6	Handle bolt	011379	17	Screw M5 x 30.....	431010
7	Screw	438026	18	Headscrew M8 x 50.....	432022
8	Wire	772001			
9	Washer.....	725029			
10	Roller.....	971007			



Group G72-2. REMOTE PROPELLER CONTROL - HTX

This equipment is used for remote control of reverse gear.

The operator can be fitted horizontally or vertically. Determine position of Operator, considering the operating distance (measured along cable run from Operator to engine control).

Check that handle movement of the Operator corresponds to forward/reverse positions of engine control, if not interchange cable inlet and outlet at the Operator. Lay the blue conduit the easiest run under flooring from Operator to angular support. Remember that few bends with large bend radii give easiest operation. Fix conduit with clips spaced approx. 40 inches apart.

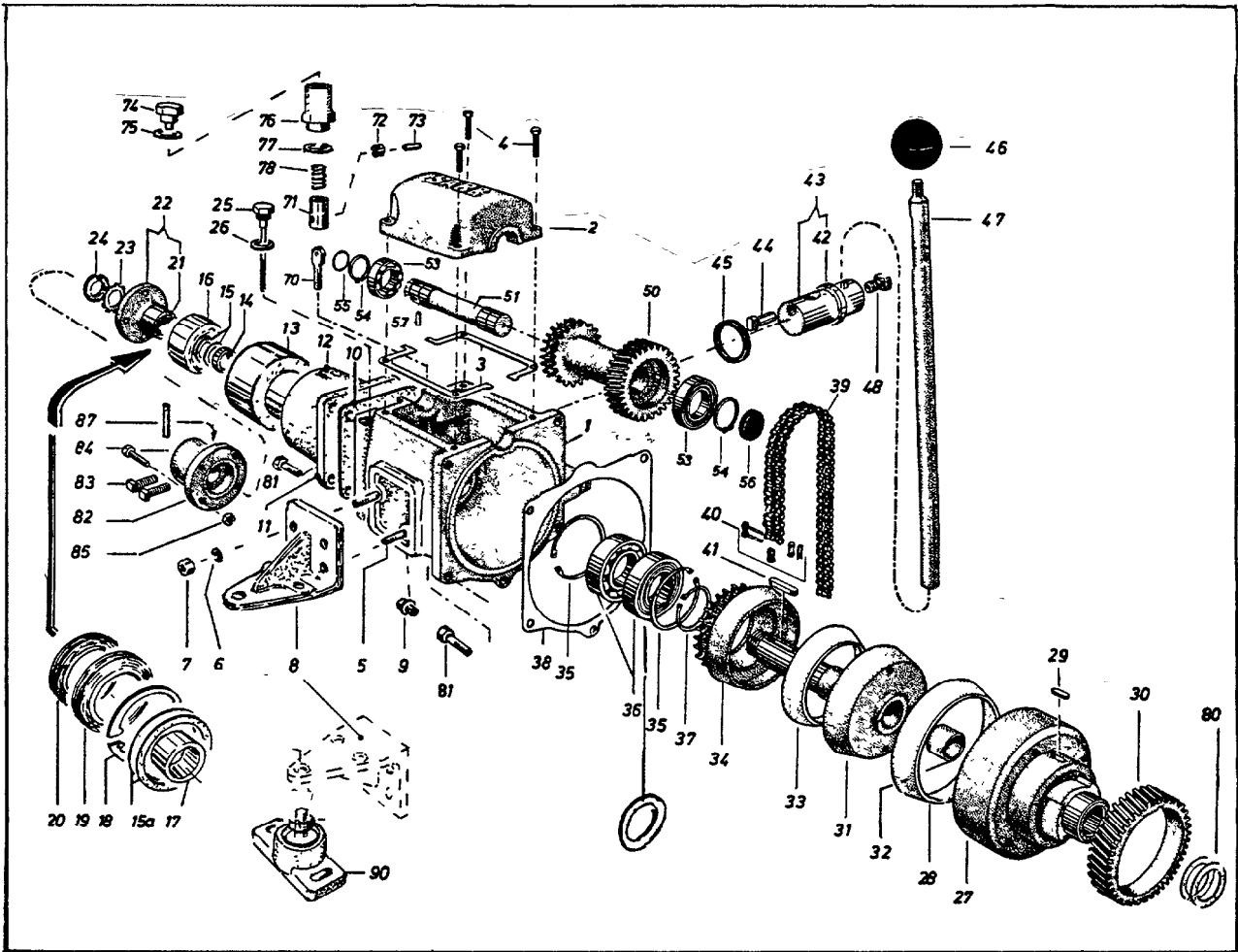
Undo block (G71tb) and screw it on the control lever. Insert steel cable in conduit and cover entirely with grease (i.e. Esso Beacon 300 EP) while inserting. Attach telescope fork to block (G71tb) and secure with split pin.

Group G72-2. REMOTE PROPELLER CONTROL

Engines with reverse gearbox for solid propeller have special connector link (see group G 72—2) to which the block (G71tb) is fitted. Unscrew lever lock screw and take off lever from its shaft. Put on connector link and fix in position wanted.

The pitch control lever should be adjusted 90 degrees to the engine axis when in neutral position. In this neutral position the telescope tube and angular support bracket must be as straight as possible. This is very important in order to avoid undue bend in the flexible joint of the telescope. If necessary, twist or bend the support bracket to reduce deflection at the joint. Fit support firmly and use lock washer under nut. Check that engine control lever, telescope support etc. are securely fastened.

The operator type HTX (visible mounting) has a central nut in the cover, by means of which the internal friction is controlled. Loosen the nut to see that the cable runs freely in the conduit and tighten it to the required brake effect is obtained.



Group GG 84. REVERSE GEARBOX (Modell H-1971)

No	Part name	Part no	No	Part name	Part no
	Reverse gearbox compl.. except:90,91,92,95,96,97	000046		Operating sleeve w/bearing Pos:13,15a,16,18.....	003530
1.	Gearbox.....	000047	13.	Operating sleeve.....	000026
2.	Gearbox cover.....		14.	Spacer.....	632021
3.	Gear housing cover gask		15.	Shims PS 35x45x0,1.....	741006
4.	Head screw M8 x 25.....			Shims PS 35x45x0,3.....	741007
5.	Stud.....	437108	15a.	Shims PS 56x72x0,1.....	741011
6.	Lock washer.....	722005		Shims PS 56x72x0,2.....	741014
7.	Nut.....	441068	16.	Angular contact bearing	911045
8.	Rear mount bracket.....	002057	17.	Spacer.....	632020
9.	Plug.....	516019	18.	Circlip.....	734050
10.	Rear support flange gask	813093	19.	Oil seal.....	824017
11.	Rear support flange w/oil seals Pos:11,12,19,20..	003864	20.	Oil seal w/dust lip....	824025
11.	Rear support flange....	000025	21.	Sleeve.....	626023
12.	Grease nipple.....	517004	22.	Front coupl flange w/sleeve Pos:21,22.....	000032

Group GG 84. REVERSE GEARBOX (Modell H-1971)

No	Part name	Part no	No	Part name	Part no
23.	Lock washer.....	725021		Washer 25Ø x 1.....	826032
24.	Ring nut.....	442008	57.	Dowel 6Ø x 20.....	454006
25.	Dipstick.....		70.	Lock bolt.....	000029
26.	Copper washer.....	831033	71.	Lock sleeve	000036
27.	Ahead clutch cone w/lining and driv gear Pos:27,28,29,30	003669	72.	Lock sleeve roller.....	000037
27.	Ahead clutch cone.....	000008	73.	Lock sleeve pin.....	455011
28.	Ahead clutch lining....	000007	74.	Plug 3/4".....	516050
29.	Key 8 x 4 x 20.....	451005	75.	Copper washer.....	831033
30.	Driving gear.....	000009	76.	Lock sleeve retainer...	000032
32.	Bush.....	622017	77.	Fibre joint.....	825030
33.	Gear shaft w/astern clutch cone lin Pos:31,32,33..	000014	78.	Spring.....	711066
33.	Astern clutch cone lin. Lower chain wheel w/ball bearings Pos:34,35,36..	000013 003670	80.	Shim 40 x 30 x 0,5..... Shim 40 x 30 x 0,3..... Shim 40 x 30 x 0,1.....	741054 741055 741056
34.	Lower chain wheel.....	000019	81.	Headscrew M10 x 25.....	432128
35.	Circlip.....	734048	82.	Coupling flange split type w/screws Ø28.....	005116
36.	Ball bearing.....	911038	83.	Bolt M12 x 10 acid proof	432187
37.	Circlip.....	734047	84.	Bolt M10 x 30 acid proof	432186
38.	Gear housing gasket....	813081	85.	Nut M10 acid proof.....	441087
39.	Chain, 19 links 483mm..	931021	87.	Lock pin Ø8 x 55 acidprf	456026
40.	Chain lock.....	931023	90.	Flex eng mount (extra).	925002
41.	Key.....	451003			
42.	Operating shaft sleeve.	632023			
43.	Operating shaft w/sleeve Pos:42,43.....	003865			
44.	Operating shaft dowel..	000030			
45.	Oil seal.....	824011			
46.	Knob.....	971003			
47.	Gear operating lever...	000043			
48.	Set screw.....	434007			
	Intermediate gear, shaft and ball bearing Pos:50,51,53,54,55.....	003866			
50.	Intermediate gear.....	000021			
51.	Intermediate shaft.....	000023			
53.	Ball bearing.....	911033			
54.	Circlip.....	734049			
55.	O-ring.....	821056			
56.	Rubberwasher 25Ø x 3... Rubber 25Ø x 2.....	826031 826030			

Group GG 84. REVERSE GEAR (Model H-1971)

The reverse gear works on the principle with self-adjusting cone clutches for ahead and astern drive. When moving the operating lever (47) the entire propeller shaft and gear shaft (31) with its double conical clutch linings are pulled in and out thus engaging the ahead and the astern clutch cones respectively. The clutches are kept in position by the propeller thrust and the lock spring (78).

Note that the operating lever must be free to move, and not hitting against engine case or flooring.

Perfect alignment of the engine and propeller shaft is essential, otherwise the clutches might slip.

If the bilge water is high in the boat, avoid repeated manipulating of clutches until water is pumped out. This is in order to avoid water being sucked into the gearbox at the rear, which would possibly hurt the angular contact ball bearing (16). Damaged bearings is noticed by lever movement becoming longer, and the bearing should be replaced. Double oil seals in rear end of reverse gear.

Dismantling of Reverse Gear:

Replacement of rear oil seals (19-20) can be carried out by dismantling the flange couplings (22, 82). Push propeller shaft back. Unlock the nut (24) and unscrew nut and remove lock washer. With operator lever in rearmost position, place two 1" chocks something similar between flange coupling and rear support flange (11), and press operating lever carefully forward to loosen the coupling.

Further dismantling:

For further dismantling drain lub.oil. Unscrew plug (78) and remove the spring, sleeve (71) and lock bolt. The latter has a 3 mm hole and can be pulled up with a 2 mm dia wire bent at an angle. Operating shaft (47) and operating shaft dowel (73) pulled out.

Undo the engine foundation bolts so that the engine can be tilted forwards enough for the complete gearbox to be removed. Take off gearbox cover (2), open chain lock, remove chain and the complete intermediate gear (50). Unscrew the five gearbox fixing bolts and pull off the gearbox.

Take off the key (41) from the gear shaft and press out the shaft from rear. To assemble: Reverse the dismantling procedure.

Set with "O-rings and oil seals" for engine: Code 0-14

Adjustment of Gear-Operating Lever Movement

If, after long time of use, the ahead clutch lining (28) becomes worn, this will increase forward movement of the operator lever. The movement can be adjusted by fitting shims in front of the ahead clutch cone (27) against ball bearing (Gr 30-2, pos 17) on the camshaft. Correspondingly, the astern movement of lever is reduced by removing shims (15 or 15A) from fore end of bearing (43) in the coupling sleeve (42).

CHECK OF FRONT COUPLING FLANGE MOVEMENT FOR NEW ENGINE TYPE GG AND 2JHR

Check:

- 1) Engage Gearbox Oper. Lever to Astern Pos. B (Measure A - B are Approx. 100 mm), Fig. 1.
- 2) In this pos. use the slide gauge, fig. 2 against Front coupl. Flange in Astern pos. Measure - Approx. 29,8 mm
- 3) Then, engage Gearbox Oper. Lever to Ahead Pos. B (Measure A - B are Approx. 100 mm)
- 4) In this pos. use the Slide gauge, fig. 2 against Front coupl. Flange in Ahead pos. Measure - Approx. 26,0 mm
 Front coupl. Flange Movement 3,8 mm
 See below.

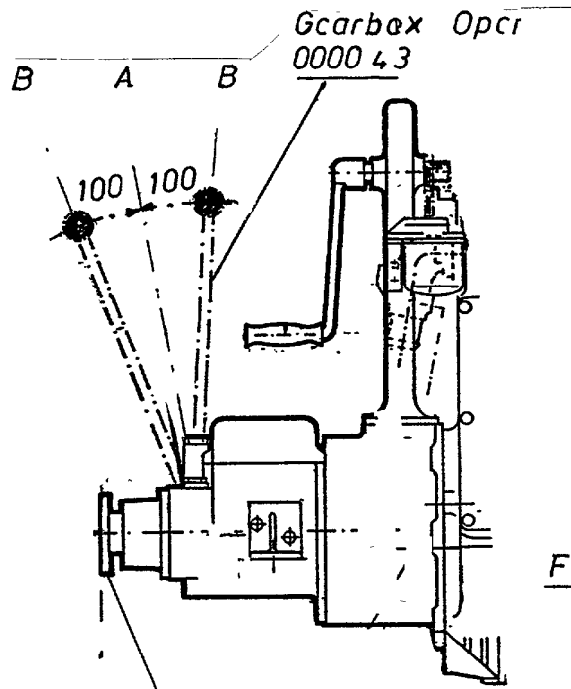


Fig. 1

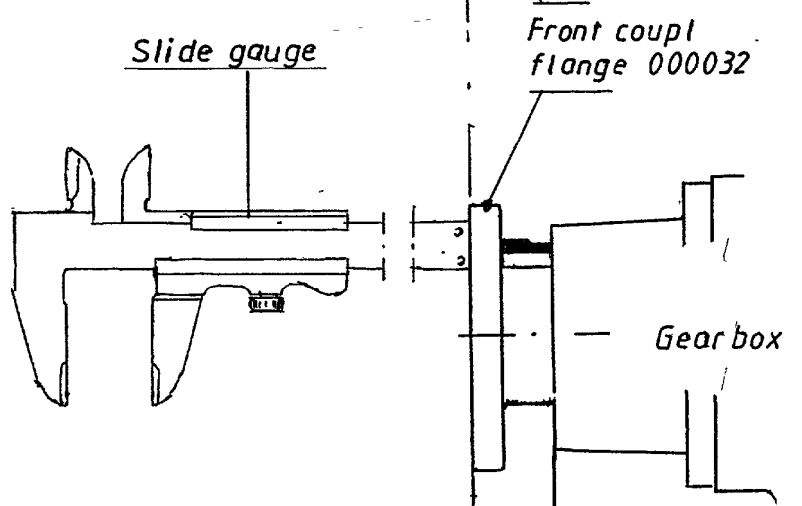
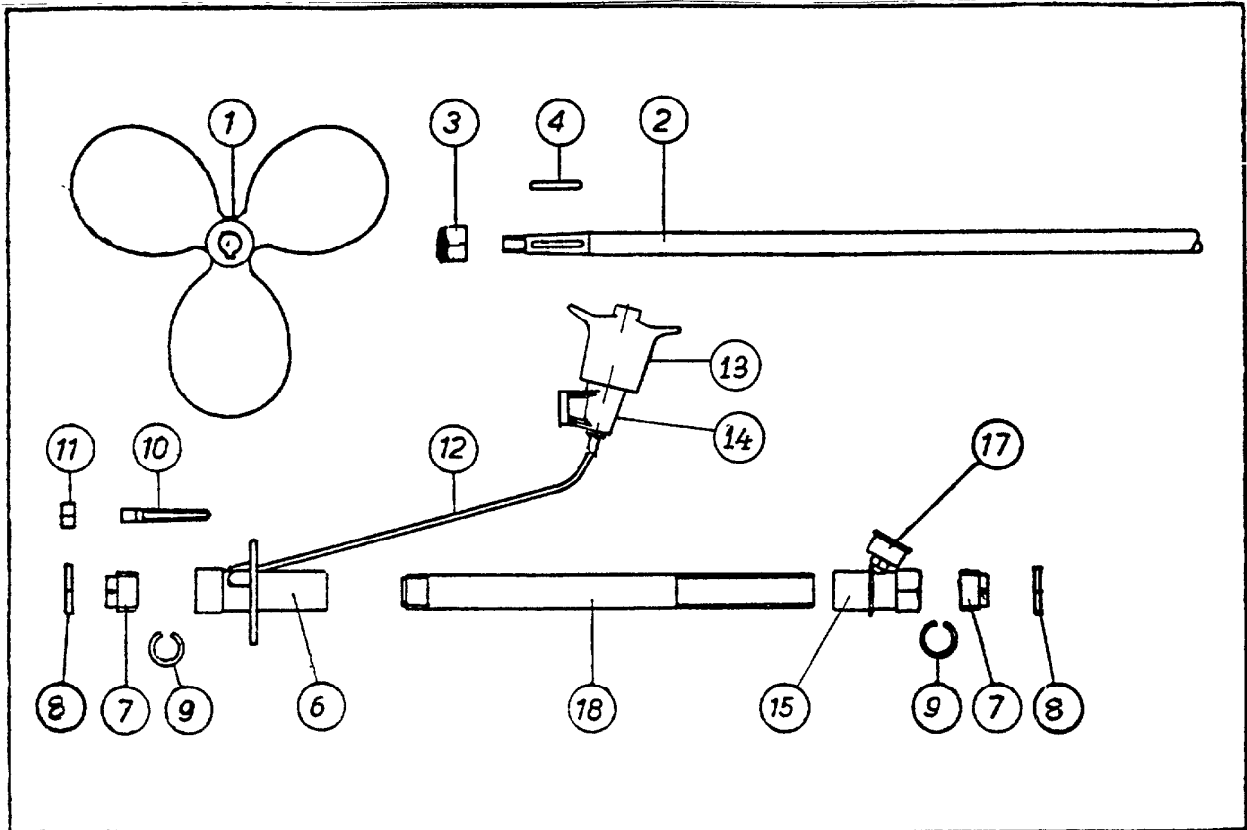


Fig. 2

<u>Gear Operating Lever:</u>			
In Astern Pos.:	→	B	29,8 mm Approx.
In Ahead Pos.:	→	B	26,0 mm — " —
<u>Front coupl. flange movement</u>			<u>3,8 mm Approx.</u>



Group 92. SOLID PROPELLER

No	Part name	Part no	No	Part name	Part no
1	3-blade propeller.....	001540	11	Nut 1/2".....	441028
2	Propeller shaft stainl.	001782	12	Greaser tube.....	612010
2a	Prop shaft w/nut & key.	003707	13	Greaser.....	001406
3	Shaft nut M16 x 1,5....	441104	14	Greaser bracket.....	
4	Key 6 x 6 x 40.....	451014	15	Stuffing box compl.....	003726
6	Stern bearing compl....	003725	17	Stuffing box greaser...	517020
7	Gland.....	001432	18	Stern tube Ø33 x 450...	001522
8	Gland nut.....	541019			
9	Stuff box gasket.....	827014			
10	Stern wood screw.....	001076			

Group G 92. SOLID PROPELLER

Engine with reverse gear has a solid three blade bronze propeller. The propeller sits on a metric cone 1:10, held in place by a key (4) and a shaft nut (3). Acid proof, lock nut.

The stern bearing is provided with a stuffing box, which should be serviced of regular intervals. The stuffing box also provides a bearing for the shaft, but if the free shaft length from stuffing box to engine exceeds 1,5 m the shaft should be supported by a babbit lined bearing which we supply on request.

Greasing: The greaser (13-14) lubricates the stern bearing. Give greaser 1/2-1 turn daily. Stuffing box, greases from stuffing box greaser(17).

WATER LUB. STERN BEARING (VSL)

See next page. 56

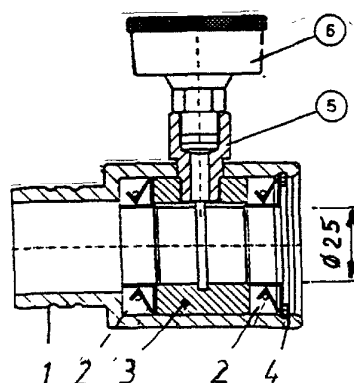
No greasing is required for the stern bearing.

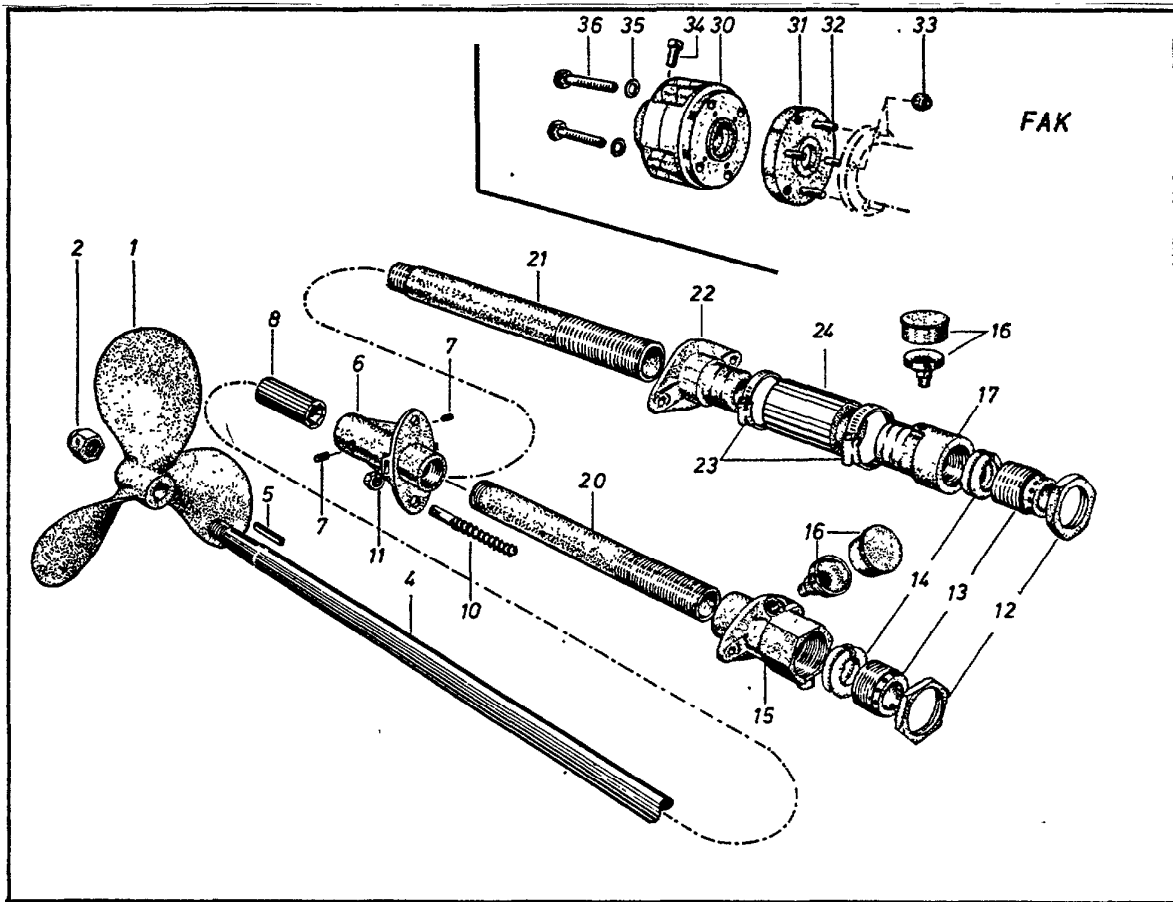
FLEXIBLE STUFF.BOX (New type)

No	Part name	Part no
1.	Flex. stuffing box	011485
2.	Oil seal	824055
3.	Bush	011486
4.	Cipclip	734009
5.	Reducing nipple	511144
6.	Stuffing box greaser ..	517020
	Flex. stuffing box	
	(as shown)	011489

Note:

Forstern tube flange, hose clamp and stuffing box hose - see next page, pos. 22, 23 and 24,





Group G 92. SOLID PROPELLER, WATER LUB. STERN BEARING (VSL), FLEXIBLE STUFF.BOX (GUP), FLEXIBLE SHAFTS COUPLING (FAK)

No	Part name	Part no	No	Part name	Part no
1	3-blade propeller.....	001540	20	Stern tube.....	001522
2	Shaft nut M16 x 1,5....	441104	21	Stern tube for flexible stuffing box.....	003882
4	Prop shaft stainl.....	001782	22	Stern tube flange.....	000704
5	Key.....	451014	23	Hose clamp 44-55.....	921039
6	Water lubr stern bearin	002934	24	Stuffing box hose.....	841045
7	Set screw M8 x 10.....	434028	30	Flexible shaft coupling	981011
8	Cutless rubber bearing.	992010	31	Nut M10.....	441087
10	Stern wood screw.....	001076	32	Lock washer 10,2.....	722003
11	Nut 1/2" W.....	441028		Flex stuff box w/tubes.	003728
12	Lock nut.....	541019			
13	Gland.....	001432			
14	Stuffing box gasket....	827014			
15	Stuffing box.....	000635			
	Stuffing box compl.....	003726			
16	Stuffing box greaser...	517020			
17	Flexible stuffing box..	000703			
	Flexible stuff box compl	003727			

IRREGULAR ENGINE OPERATION

Faults Location Chart

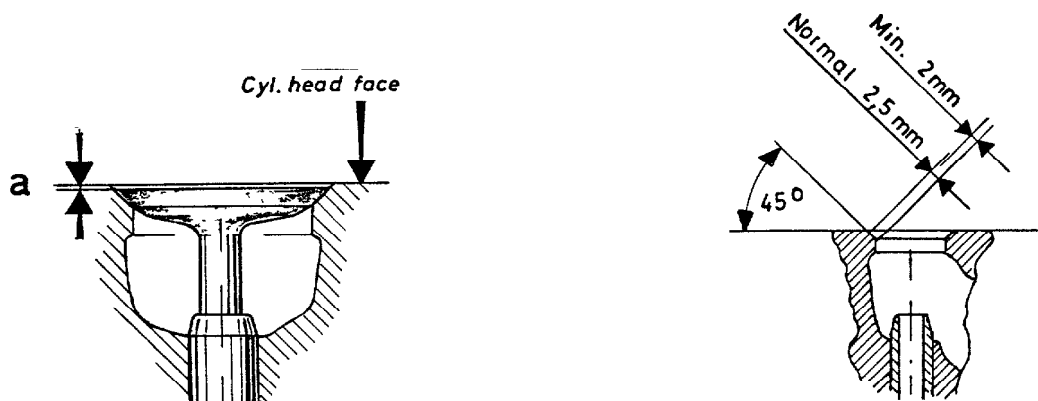
1. THE ENGINE WILL NOT START
 - a. Fuel control not wide open (in full speed position).
 - b. Too low cranking speed.
 - c. Humid or defective starting cigarette, or dry cylinder
Squirt some lub oil into cylinder through lub oil starting tube 4-6 shots with the squirt can. Page 19.
 - d. Water in fuel oil.
 - e. Injection not good. Page . Check nozzle, page 46.
2. LACK OF COMPRESSION
 - a. Check valve tappet clearance, page 35.
 - b. Valve sticking. To loosen, squirt mixture of lub oil and fuel through springs to lubricate valve stem. Check valve movement by hand.
 - c. Valve leaking. Listen for leakage while turning engine by hand. If blow-by, remove cylinder head to clean and lap valve seats. Page 35.
 - d. Check adjustment of decompressor. Page 23.
 - e. Check cylinder and piston ring wear. Page 27.
3. THE ENGINE IS HARD TO CRANK
 - a. Too heavy lub oil. Page 12.
 - b. Bent propeller shaft. Check flange coupling. Page 11.
4. LACK OF POWER
 - a. Fuel oil filter clogged. Change element. Page 15.
 - b. Air in fuel system. Page 15.
 - c. Dirty injector nozzle. Page 46
 - d.
 - e. Incorrect valve tappet clearance. Page 35.
 - f. Exhaust pipe clogged.
Rubber exhaust pipe collapsed due to overheating.
 - g. Lack of compression. See above.
5. ENGINE STOPS
 - a. Lack of fuel. Fuel tank cock closed. Fuel filter clogged.
 - b. Air or water in the fuel system. Page 15.
 - c. Injection pipe leaking.
 - d. Rope in propeller.
 - e. Lack of lubricating oil.
 - f. Seized piston due to overheating or lack of lub oil.
Let the engine cool down before turning to check compression. Start again and slowly load the engine.
6. SMOKY EXHAUST
 - a. Injector nozzle choked. Page 46.
 - b. Worn piston rings and poor compression.
 - c.
 - d. Valves leaking. Page 35.
 - e. Air intake clogged.
 - f. Unsuitable fuel or lubricating oil. Page 15 and 12 .

7. UNEVEN RUNNING (GOVERNOR "STUTTERING")
 - a. Fuel pump rack or governor parts sticking. Remove the governor cover and clean internal parts. Page 43.
8. ENGINE STOPS WHEN IDLING
 - a. Leaky valves. Page 5g, 2c
 - b. Injector nozzle clogged. Page 46
 - c. Remote governor control wire too slack at engine side.
 - d. Idling spring too weak. Page 43
 - e. Fuel filter clogged. Page .
 - f. Fuel tank pipe long and narrow or tank located too low.
9. EXCESSIVE LUBRICATING OIL CONSUMPTION
 - a. Test first the breather valve in starting bracket foot. Page 36,
 - b. Defect oil seal. Check vibration damper oil seal Page 29
 - c. Defect oil control ring on piston. Replace. In difficult cases a "super oil control ring" could be fitted. Contact the factory or the Service Shop.
 - d. If oil level sinks in crankcase and rises in clutch housing, the reason could be blow-by in cylinder. Check cylinder and piston rings. Page 27 .
A leaky oil seal in the gear housing (Gr 30-2, pos 20).
10. ENGINE KNOCKING
 - a. Injector nozzle clogged or leak-off pipe not open. Page 46
 - b. Engine cold. Check water temperature.
 - c. Mechanical defects. Check valves, big-end bearings and crankpins.
11. ENGINE HOT OR WATER PUMP NOT IN ORDER
 - a. Water inlet or water valves clogged. Clean.
 - b. Defective water pump diaphragm. Replace.
 - c. Engine compartment too hot.
 - d.
- 12.
13. REVERSE GEAR CLUTCH SLIPPING
 - a. Gear operating lever not free to move, stops against engine case, flooring etc.
 - b. Propeller shaft bent. Check alignment of engine. Page 11.
 - c. Too much lub oil in reverse gear. Page 14.
 - d. Shaft coupling set screws not properly tightened.

WINTER STORAGE

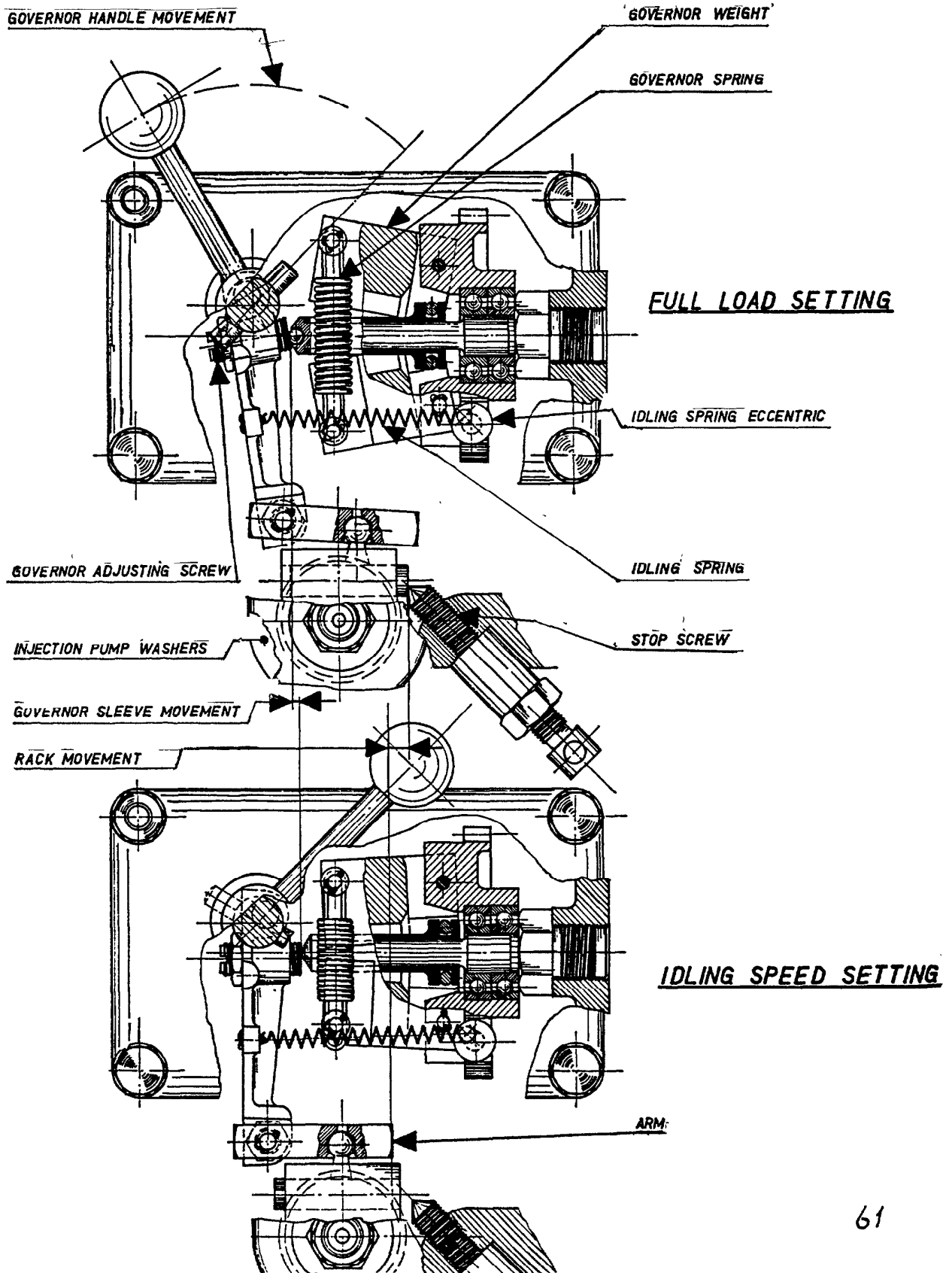
When the boat is put ashore for the winter the engine should be protected against rust and frost:
Change the lub.oil in sump and reverse gear. Grease all nipples. Let the engine blow the water from wet exhaust pipe. Drain cooling system, water pump and pipes. Flush through system with freshwater if possible, and drain completely. Lubricate rocker arms and valve springs with squirt can. Unscrew starting cigarette plug and inject 10 shots lub.oil (10 cm³) through plug hole. Crank the engine to lubricate cylinder. Wash or clean the engine exterior and restore paint wounds. Cover engine and keep it dry. Drain water and sediment from fuel tank and top up with fuel oil.

VALVE DEPTH CLEARANCE UNDER CYLINDER HEAD FACE:

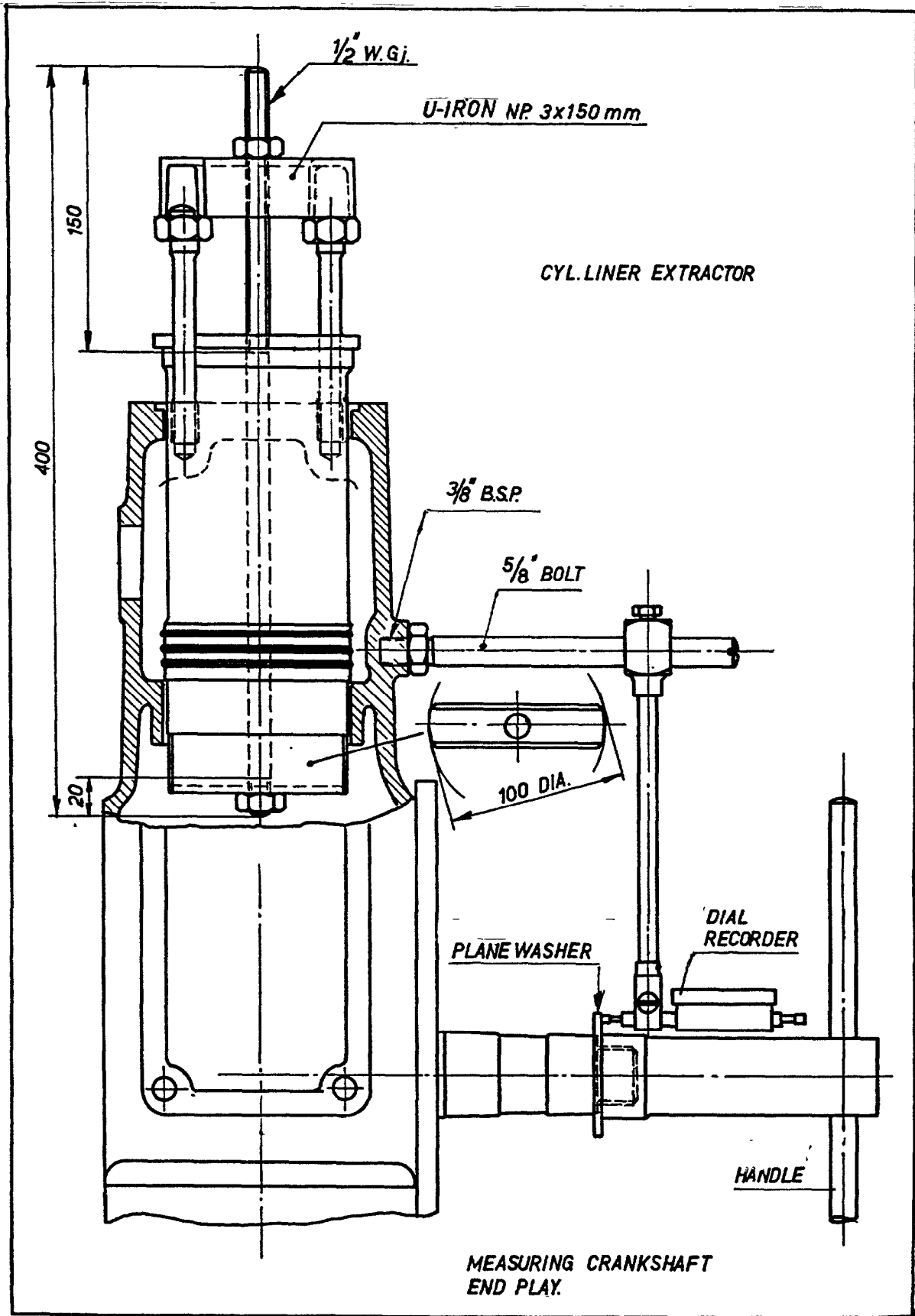


Measure (a) in millimetres Min: 0,2 mm
Max. valve recess (a) after grinding: 2,0 mm

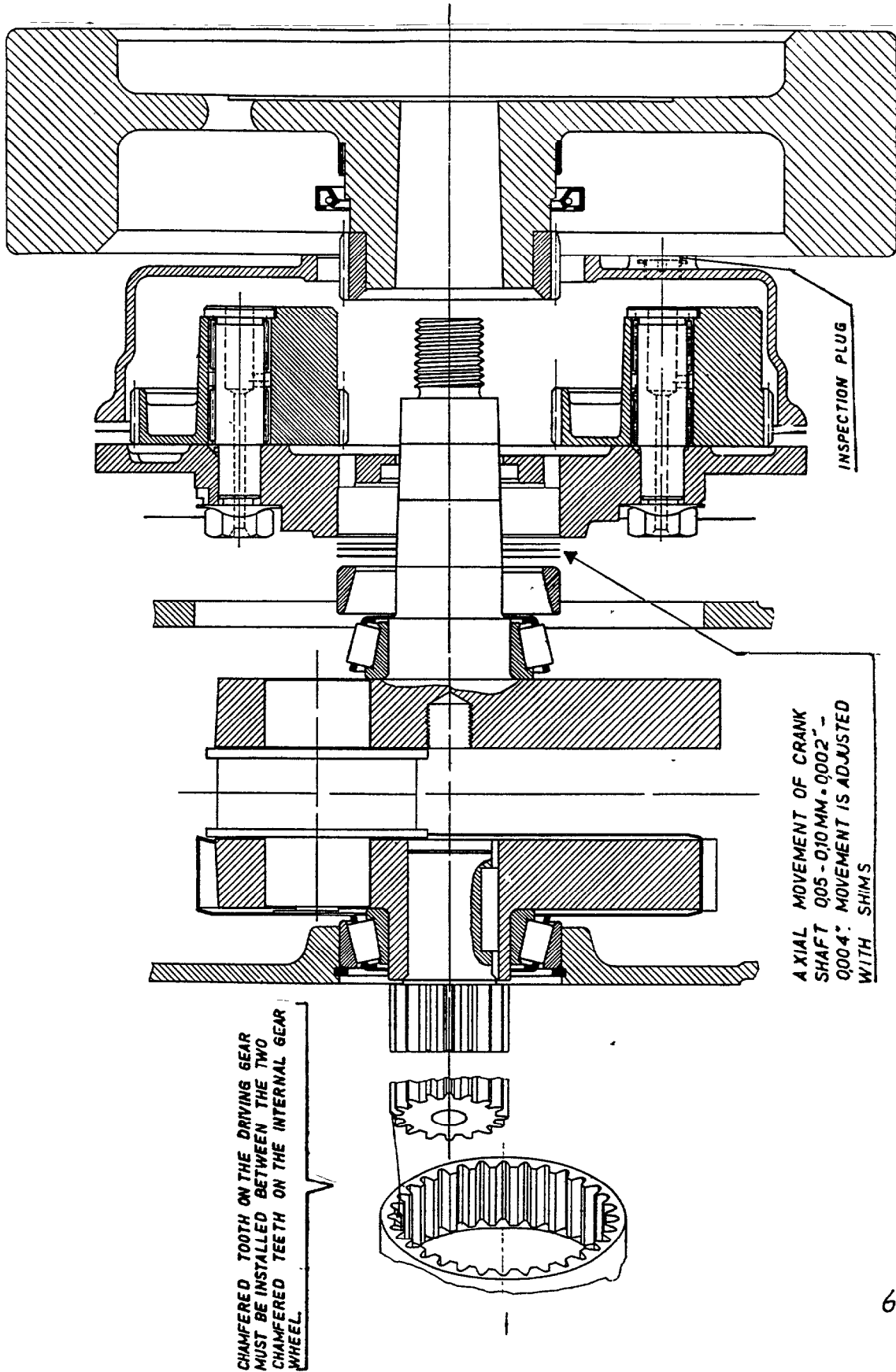
CUT AWAY VIEW OF GOVERNOR



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