

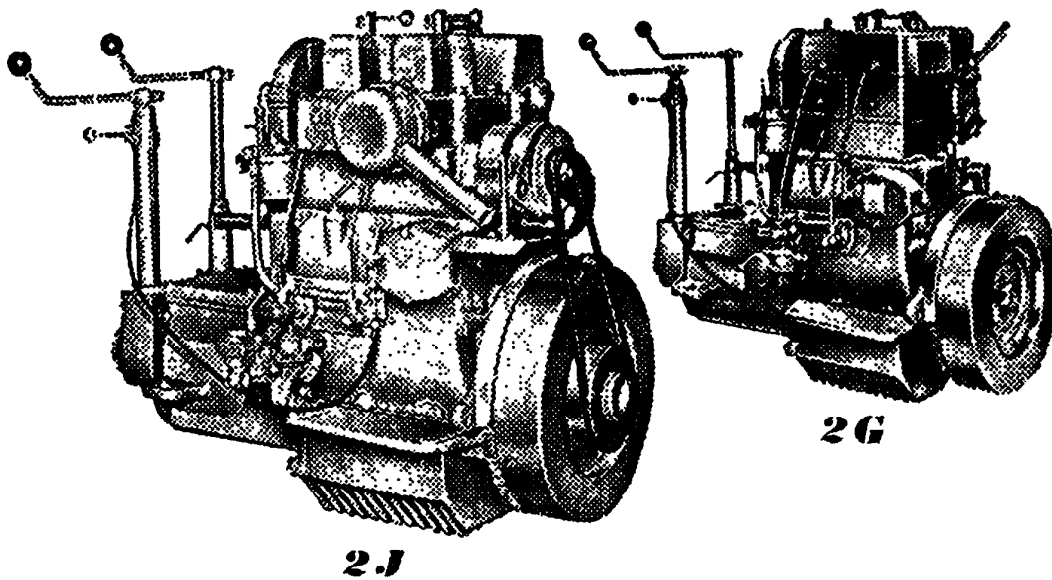
Form.: 977.041

# **SABB DIESEL**

**Type 2G og 2J**

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## **Instruction Book**



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**SABB MOTOR A.S**

Telephone: 05 34 35 10 - Telegram: "Sabbmotor" - Telex: 42559 Sabb n  
BOX 40 - 5031 BERGEN - NORWAY

# INTRODUCTION

**Before taking into service your new SABB DIESEL, we advice you to read through the main points in this manual. Most important are:**

**BEFORE STARTING — STARTING — RUNNING-IN**

**The manufacturer's engine guarantee is effective on the condition that the engine has been correctly installed and is operated and serviced according to the directions in this manual.**

**We constantly strive to improve and enlargen our service department which is at our customer's disposition. For any queries, need of service or spare parts contact your nearest SABB DIESEL representative or the factory in Bergen.**

**With all correnspondence quote the type of engine and the serial number.**

***SABB MOTOR A.S***

**ENGINE SERIAL NO. ....**

**Dimensions and specifications subject to alteration without notice.**

# INSTRUCTION BOOK

## type 2G and 2J marine dieselmotor

Form.: 977.041

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- TYPE 2G—2J:** Reduction 2:1, clutch and 2-blade controllable pitch propeller with 4½ turns control.
- TYPE 2GZ—2JZ:** Same, but with ¼ turn propeller control.
- TYPE 2GRG—2JRG:** Reduction 2:1, reverse gearbox and 3-blade (left hand) solid propeller.
- TYPE 2GGR—2JGR:** Reverse gearbox (heavy duty) and special 2:1 reduction gear and 3-blade solid propeller.
- TYPE 2GHR—2JHR:** Reduction 2:1, reverse gearbox "Hurth" HBW-20 or HBW-250 and 3-blade (right hand) solid prop.
- TYPE 2JBWV:** Borg Warner V-drive, reduction 3,14:1 and 3-blade (right hand) solid propeller.
- TYPE 2GRS—2JRS:** Stationary engine with reduction 2:1 without clutch.
- 

**SABB MOTOR A·S**

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BOX 2728 — 5010 BERGEN — NORWAY

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## DESIGN AND CONSTRUCTION

Types 2G and 2J are largely identical. The main differences are the cubic capacity and the combustion system.

**Type 2G:** Indirect injection. Swirl type combustion chamber located in cylinder heads. Pistons With 3 compression rings above the pin, one oil control ring below pin. Identic inlet and exhaust valves. Air inlet manifold integral with rocker cover. Self-closing decompressor for lifeboat engine only.

**Type 2J:** Direct injection, combustion chamber in pistons and toroidal induction ports in cylinder heads with special inlet valves. All piston rings above gudgeon pin. Separate air inlet muffler.

### General Description:

Replaceable cylinder liners, wet type.

Crankcase with "tunnel-bore" for crankshaft. Oil sump. Crankshaft taps hardened and ground. Lead bronze lined bearings. Fully floating gudgeon pins. Connecting rods with oblique parting can be pulled up through cylinders.

Replaceable valve guides. Rocker bearings are ball bearings.

Force feed lubricating oil system with full-flow filter.

Bosch injection equipment. Fuel lift pump with hand pumping device.

Centrifugal governor. Raised hand start. Front hand start optional.

Fresh water cooling system with external keel cooler. Sea water cooling (direct system) available.

Header tank integral with exhaust silencer.

### SPECIFICATION:

#### Two-cylinder, Water Cooled, Four-stroke Diesel Engines

	Type 2G	Type 2J
Cylinder bore, mm .....	90, 3,54 in.	100, 3,93 in.
Stroke, mm .....	120, 4,72 in.	120, 4,72 in.
Cubic capacity .....	1520 kp/cm <sup>3</sup> , 92,6 cu.in.	1880 cm <sup>3</sup> , 114,7 cu.in.
Compression ratio .....	20:1	16,5:1
Compression pressure, cranking speed	30 kp/cm <sup>2</sup> , 426,7 p.s.i.	27 kp/cm <sup>2</sup> , 384 p.s.i.
Continuous rating at 1800 rpm .....	22 hp (DIN B) (16,2 kW/30 r/s)	
Continuous rating at 1900 rpm .....		30 hp (DIN B) (22 kW/32 r/s)
Brake mean effective press. ....	6,3 kp/cm <sup>2</sup> , 89,6 p.s.i.	7,5 kp/cm <sup>2</sup> , 106,6 p.s.i.

#### FUEL SYSTEM:

Fuel injection pump .....		Bosch
Injection pump element .....	7 mm	8 mm
Injection .....	Indirect	Direct
Injection press. (opening press.) ....	100 kp/cm <sup>2</sup> /1422 p.s.i.	180 kp/cm <sup>2</sup> /2520 p.s.i.
Nozzles, Bosch .....	1-hole	4-hole
Injection starts, before TDC .....	15 degrees	24 degrees

#### Fuel consumption:

200 g/hph (at 22 hp) .....	5,5 liters/h	
180 g/hph (at 30 hp) .....		6,5 liters/h
Fuel oil type .....		Gas oil

If the engine has to work in areas with extremely low ambient temperatures, use fuel oil with good clog characteristic Clog point (CFPP) max. — 25° C.

Fuel tank, capacity (extra equipm.) .	75 or 100 liters/132—176 pints
Fuel lift pump, max. suction head .	1 meter
Cam lift (exh./inlet and fuel) .....	7 mm

**LUBRICATING SYSTEM:**

Lub.oil consumption 1,5—2 g/hph .	0,035—0,5 l/h
Lub.oil pressure .....	2,5 kp/cm <sup>2</sup>
Lub.oil (minimum, idle) .....	0,5 kp/cm <sup>2</sup>

**Lubricating oil capacities (Lubricating oil grade, see page 21):** 5

Crankcase (incl. 0,5 liter in filter) .....	6,4 liters/11,5 pints
Clutch housing, 2G/2GZ — 2J/2JZ .....	1,5 liters/ 2,6 pints
Reverse gearbox 2GRG — 2JRG "Sabb" .....	0,5 liters/ .9 pints
Reverse gearbox 2GGR — 2JRG "Heavy Duty" .....	1,0 liters/ 1,7 pints
Reverse gearbox 2GHR — 2JHR "Hurth" HBW-250 .....	*) 0,75 liters/ 1,2 pints
Reverse gearbox 2JBWV "Borg Warner" V-drive .....	*) 4,3 liters/ 7,5 pints

\*) Automatic Transmission Fluid (AFT), type A.

**COOLING SYSTEM:**

Fresh water (closed) cooling system with keel cooler .....	7 liters/12,3 pints
Keel cooler, over all length .....	3074 mm
Thermostat opens .....	55° C
Thermostat fully open .....	75° C
Water pump rod stroke .....	6 mm
Zinc anode in cylinder block .....	Type 2G: 1 pc.
Impeller (if Imp. pump is fitted) 3/8" 1026B	947.010
Temperature and oil pressure alarm system, 12 or 24V (if fitted)	Type 2J: 2 pc.
Will give signal when:	
Water temperature exceeds .....	94° C
Oil pressure below .....	0,5 kp/cm <sup>2</sup>

**ELECTRICAL SYSTEM:**

	<b>Standard engine:</b>	<b>Lifeboat engine:</b>
Voltage .....	12V	24V
Electric starter, Bosch .....	12V - 1,9 kW	24V - 4 kW
Alternator, P. Rhone/S.E.V. ....	12V - 40/50A	24V - 25A, 2-pole
From mid. 1983 (approx.):		
Alternator: Motorola .....	12V - 65/75A, 2-pole	24V - 35/45A, 2-pole
Glow plugs, Bosch (only 2G) .....	11V	
Block heater (mains) .....		500 or 400W - 220V
Sump heater (mains), extras .....		110W - 220V
V-belt alternator 9,5×1125 .....	932.046	932.046
Extra flywheel pulley for higher dynamo speed (243 mm SPZ) ....	G33.010	

**ENGINE AND GEARBOXES:**

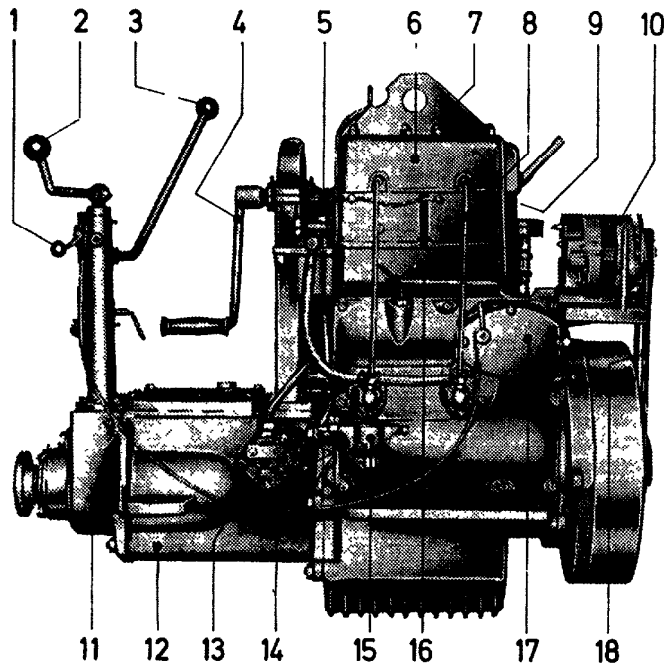
	<b>Rotation:</b>	<b>Ratio:</b>
Engine 2G/2J - 2GRG/2JRG ....	Left	2:1
Gearbox "Sabb" .....	Left	(1:1)
Gearbox "Hurth" HBW-20		
(From mid. 1983: HBW-250) ...	Right	2:1 or 2,75:1
Gearbox "Borg Warner" V-drive .	Right	3,14:1
<b>Controllable pitch propeller:</b>		
Crank operated pitch control 2G/2J .....		4¼ turn
Lever operated pitch control 2GZ/2JZ .....		¼ turn (90° degrees)

Propeller torque at 1800 rpm (engine rotation) . . . .	18 kpm/130 ft.lbs.	23 kpm/166 ft.lbs.
<b>Solid propeller:</b>		
Type 2GRG/2JRG, left . . . . .	20"×15" LH "Sabb"	20"×16" LH
Type 2GHR/2JHR, right . . . . .	20"×15" RH "Hurth"	20"×16" RH
Type 2JBWV, right (V-drive) . . . .		22"×14" RH
Propeller 2G/2J, 2-blade controllable pitch, diam. . . . .	590 mm/23.22 in.	620 mm/24.40 in.
Propeller shaft, diam., stand. . . . .	32 mm	32 or 35 mm
Shaft coupling, split type . . . . .		Standard
Flexible shaft coupling "Hurth" . . . .		Standard
<b>Piston top clearance</b>		
(Cyl. liner top face above piston) . . .	1—1,5 mm	0,3—1,1 mm
Cylinder liner protrusion above cylinder block . . . . .	2,2 <sup>±</sup> 0,15	Max. 0,11 - Min. 0,05 mm
Max. installation angle, under power .		15 degrees
Max. Heel, starboard and port . . . . .		22 degrees
Valve seat in cyl.head and valve . . . .		45 degrees
Max. valve recess (after grinding) . .		2 mm
Valve stem clearance, exhaust and air, cold . . . . .		0,3 mm/.012'
<b>Weight of engine, less stern gear:</b>		
2G/2GZ, 2J/2JZ . . . . .	390 kg/860 lbs.	400 kg/882 lbs.
2GRG/2JRG . . . . .	365 kg/724 lbs.	375 kg/836 lbs.
2GHR/2JHR . . . . .	360 kg/719 lbs.	370 kg/815 lbs.
<b>Bolts and nuts torque (cold engine):</b>		
	<b>Type 2G</b>	<b>Type 2J</b>
Cylinder head nuts 2G/Bolts 2J . .	14 kpm., 101 ft.lbs.	16 kpm., 115 ft.lbs.
Rock. arm brack. nuts 2G/Studs 2J:	5 kpm., 36 ft.lbs.	8 kpm., 58 ft.lbs.
Injector holder clamp bolt . . . . .	3 kpm., 22 ft.lbs.	
Cylinder block bolt . . . . .	13 kpm., 94 ft.lbs.	
Big end bearing, Tensilock M14. Use only new bolts . .	17 kpm., 123 ft.lbs.	
Bearing flange wedge (2G23mb) . . . . .	8,5 kpm., 60 ft.lbs.	
Propeller boss bolt . . . . .	7,5 kpm., 54 ft.lbs.	
Camshaft nut . . . . .	17 kpm., 123 ft.lbs.	
Nut for alternator pulley . . . . .	5 kpm., 36 ft.lbs.	
Governor nut M14 . . . . .	10 kpm., 72 ft.lbs.	
Gear housing bolts . . . . .	8,5 kpm., 60 ft.lbs.	
Central bearing flange . . . . .	17 kpm., 123 ft.lbs.	
Counterweight bolt M16 . . . . .	30 kpm., $\begin{smallmatrix} +5 \\ -0 \end{smallmatrix}$ 217 $\begin{smallmatrix} +5 \\ -0 \end{smallmatrix}$	
<b>Remaining bolts and nuts:</b>		
M8 (or 5/16 UNC) . . . . .	2—2,4 kpm., 14—17 ft.lbs.	
M10 (or 3/8 UNC) . . . . .	4—4,2 kpm., 29—30 ft.lbs.	
M12 (or 1/2 UNC) . . . . .	6—6,2 kpm., 43—44 ft.lbs.	

Cont. page 8.

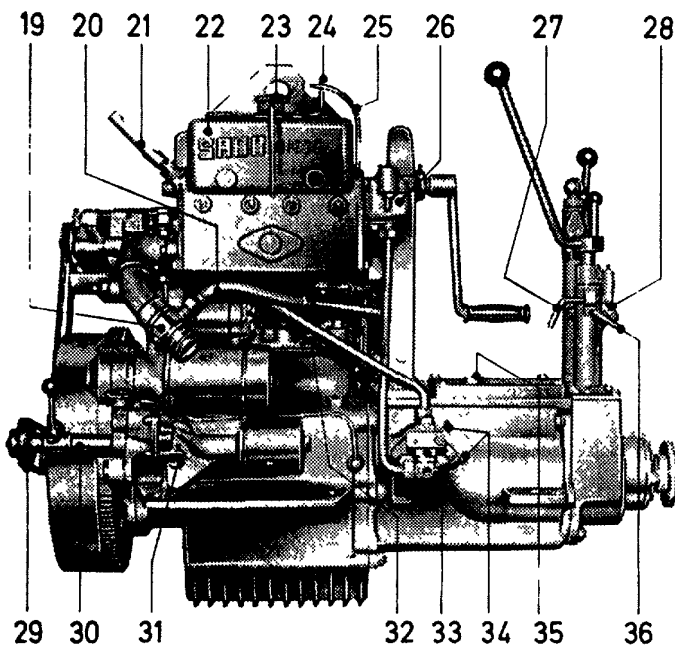
CHECK POINTS		Daily	Weekly	At least annually			As required	
		Every 5 running hrs	Every 25 running hrs	Every 150 running hrs	Every 300 running hrs	Every 600 running hrs		
<b>A. Lubricating oil (page 20—25)</b>								
1	Check engine oil level	●						1
2	Check gearbox oil level		●					2
3	Check heavy duty gearbox oil level		●					3
4	Check reduction gear oil level						●	4
5	Check clutch housing oil level			●				5
6	Change engine oil			●				6
7	Change oil filter				●			7
8	Change clutch oil				●			8
9	Change reverse gearbox oil				●			9
10	Change heavy duty gearbox oil				●			10
11	Change reduction gear oil				●			11
<b>B. Greasing (page 25—30)</b>								
12	Grease propeller	●						12
13	Grease stern bearing (lifeboats)		●					13
14	Grease inboard stuffing box	●						14
15	Grease flexible stuffing box	●						15
16	Grease pitch control		●					16
17	Grease starting bracket seal						●	17
18	Lubricate front end hand start bearing						●	18
19	Grease gear handle bearing		●					19
20	Grease gearbox seal		●					20
<b>Auxiliary equipment</b>								
21	Grease starter pinion						●	21
22	Grease governor control handle						●	22
23	Grease remote control						●	23
24	Grease rudder controls						●	24
25	Grease gearwheel bilge pump						●	25
<b>C. Fuel Oil (page 31—35)</b>								
26	Change fuel filter element				●			26
27	Bleed fuel system						●	27
28	Clean injector nozzles (Type 2G)						●	28
	Clean injector nozzles (Type 2J)				●			
29	Clean lift pump strainer				●			29
30	Check or renew lift pump diaphragm						●	30
<b>D. Cooling water (page 35—42)</b>								
31	Drain cooling water						●	31
32	Check cooling water level		●					32
33	Check water valve						●	33
34	Check water pump diaphragm				●			34
35	Renew water pump diaphragm						●	35
36	Check thermostat and thermostat strainer					●		36
	Check block heater (lifeboat engine)				Annually			
37	Clean water jacket						●	
37a	Check zink anode, sea water cooled engine				●			





**Fig 1 — 2GZ Starboard**

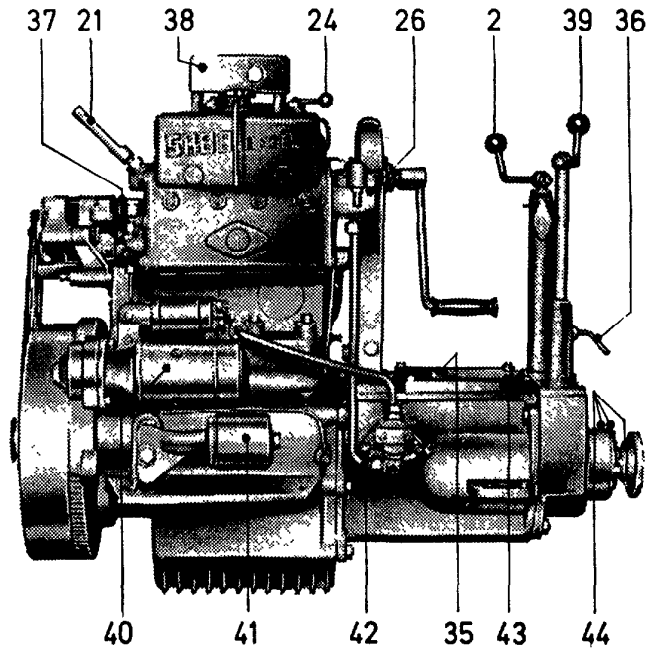
1. Governor control handle
2. Clutch handle
3. Pitch control handle
4. Starting handle
5. Leak-off pipe
6. Cylinder head cover
7. Engine lifter plate
8. Injection pipe
9. Air intake
10. Alternator
11. Reversing housing
12. Clutch housing
13. Water valve housing — exhaust cooling
14. Drain cocks, water pump
15. Fuel lift pump
16. Dipstick, sump
17. Governor cover
18. V-belt, alternator
19. Exhaust hose nipple
20. Exh. cooling pipe and hose
21. Water thermometre
22. Water tank (silencer)
23. Pressure cap
24. Decompressor handle
25. Decompressor arm (from -77 only for Lifeboat engine)
26. Thermostat cover
27. Pitch control screw
28. Neutral pos. pin
29. V-belt, bilge pump
30. Bilge pump
31. Drain cock
32. Drain cock, cylinder block (only type 2G before 1979)
33. Water valve housing — engine cooling
34. Drain cocks
35. Dipstick, clutch sump
36. Locking screw, propeller pitch



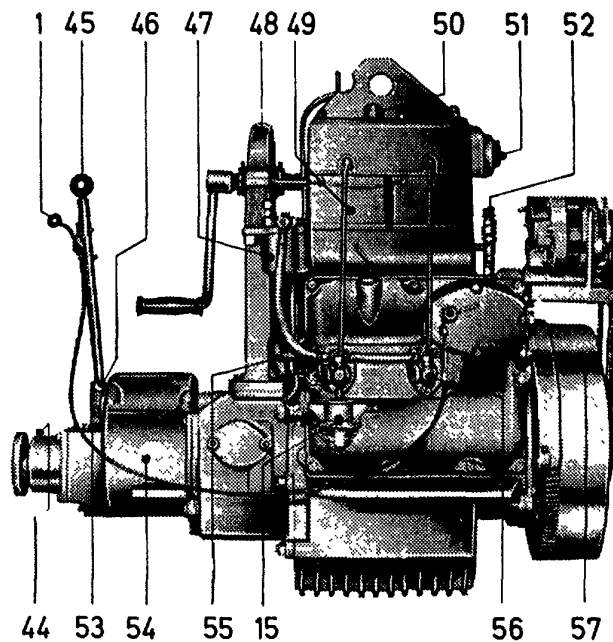
**Fig 2 — 2GZ Port**

**SABB DIESEL TYPE 2J PORT SIDE - TYPE 2GRG STARBOARD SIDE**

- 37. Lub. oil pressure gauge (if fitted)
- 38. Engine lifter iron
- 39. Pitch control crank
- 40. Selfstarter
- 41. Lub. oil filter
- 42. By-pass pipe
- 43. Clutch cover
- 44. Grease nipples
- 45. Gearbox operating lever
- 46. Lock sleeve retainer
- 47. Fuel filter
- 48. Starting bracket
- 49. Starting cartridge holder (only type 2G)
- 50. Crankcase ventilators
- 51. Air intake
- 52. Lub. oil pipe connection (engines before medio 1977)
- 53. Dipstick, reverse gearbox
- 54. Reverse gearbox (Lifeboat engine)
- 55. Tachometer connection, mechanical  
Electrical, see page 17
- 56. Injection pump
- 57. Adjusting screw, engine output
- 58. Gearbox "Hurth"
- 59. Dipstick
- 60. Control lever
- 61. Bracket for control cable

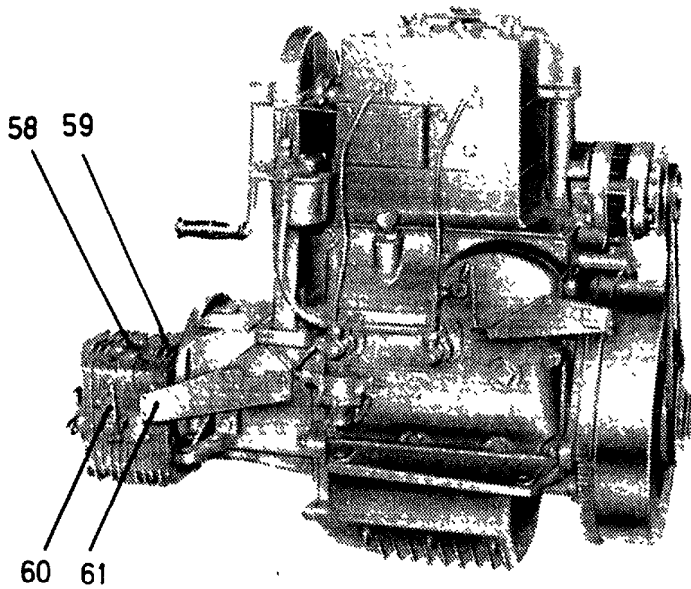


**Fig 3 — 2J Port**



**Fig 4 — 2GRG Starboard**

**SABB DIESEL** TYPE 2GHR (2JHR), STARBOARD SIDE



**Fig 5 —  
2GHR Starboard**

**NB.!**  
Reverse gearbox  
"Hurth" HBW-250

*Cont. from page 5.*

**Propeller shaft-coupling, split type (from med. 1982):**

Tightening torque for M12 bolts .....	9,1 ± 0,5 kpm., 65 ft.lbs.
Tightening torque for M10 bolts .....	5,2 ± 0,5 kpm., 36 ft.lbs.

**BEARING MEASURES**  
(millimetres)

	<i>Original</i>		<i>Std. reconditioned taps and undersize bearings</i>	
	Min.	Max.	Min.	Max.
Front main, big end and central bearing .. . . .	70,06	70,09	69,81	69,84
Rear main bearing .. . . .	80,06	80,09	79,81	79,84
Front main, big end and central taps .. . . .	69,98	70,00	69,73	69,75
Rear crankshaft tap .. . . .	79,98	80,00	79,73	79,75
Correct bearing play, radially Max. allowed .. . . .	0,06	0,11 0,15	0,06	0,11 0,15
Crankshaft end float in main bearings .. . . .	0,2	0,3	0,2	0,3
Big end bearing float .. . . .	0,5	0,6	0,5	0,6
Correct gudgeon pin play in bush .. . . .	0,02	0,04 0,10		

Standard bearings are marked STD. Undersize bearings are marked ÷ 0,25.  
Reconditioned crankshaft are kept in stock.

## ELICTRICAL EQUIPMENT

### Alternator 12V—35A (500W), 12V—40/50A (700W), 12V—65/75A (1050W)

The alternator produces 3-phase alternating current. The alternating outputs of each phase rectified by means of 6 silicon diodes (3 positive and 3 negstive diodes). During starting, the field current is fed to the rotor from the battery via the regulator.

*The alternator must therefore only be runned if the battery is connected. If a battery isolating switch is fitted the engine must not be started until battery has been switched on.*

Use of an alternator ensures continuous charging of the battery even if the engine is idling for long periods.

All alternators have an integral electronic regulator.

*Follow the connection diagram precisely. Incorrect connection will probable damage alternator or voltage regulator and repair will be expensive.*

**NOTE! Do not fit V-belt before the system is wired and battery connected.**

*In addition to the above:*

1. Check carefully that all connections are made as shown in diagram.
2. The alternator must never be run unless both battery terminals and the regulator are connected. Remove the alternator drive belt before disconnecting the battery.
3. If the battery is to be charged from an external source, first disconnect both battery terminals.
4. When welding on board (steel hulls), disconnect the battery negative terminal beforehand.

### Starter

It is very important that the starter should not be exposed to sea water. The engine must not be started if the level of water in the bilge reaches to the flywheel. Pump out sufficiently to avoid splashing the starter.

To prevent rust the bendix pinion and shaft must be greased regularly.

### Starter switch.

Push in switch key and turn clockwise to start.

### Glow starter switch - Glow plug.

Hold glow starter switch in glow position for 20—40 seconds to heat, and then turn clockwise to start. The plug is disconnected when the key switch is released.

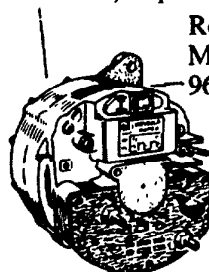
### Battery

Check the battery regularly. Top up with distilled water to keep the electrolyte level  $\frac{1}{2}$  cm—1 cm above the plates. After topping up in cold weather, run the engine for a while to ensure circulation of the electrolyte. Keep the battery terminals and cable clamps clean. Remove any oxidation and coat lightly with vaseline. Make sure the cables are tightly clamped onto the terminals.

**The electrical equipment is not covered by the engine guarantee.**

#### From mid. 1983:

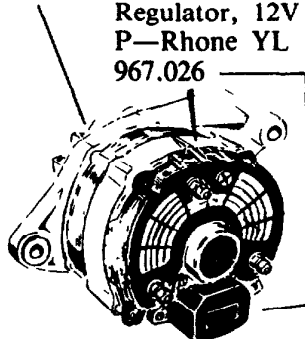
Alternator 12V—65/75A  
Motorola 9AR2712P.  
984.075, 2-pole



Regulator, 12V  
Motorola 9RC7045  
967.037

#### From Jan. 1982:

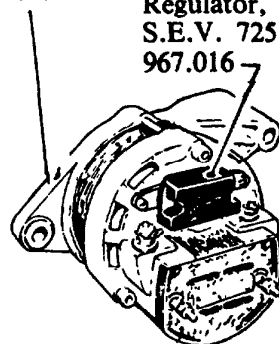
Alternator 12V—40/50A  
Paris—Rhone 100-606  
964.051



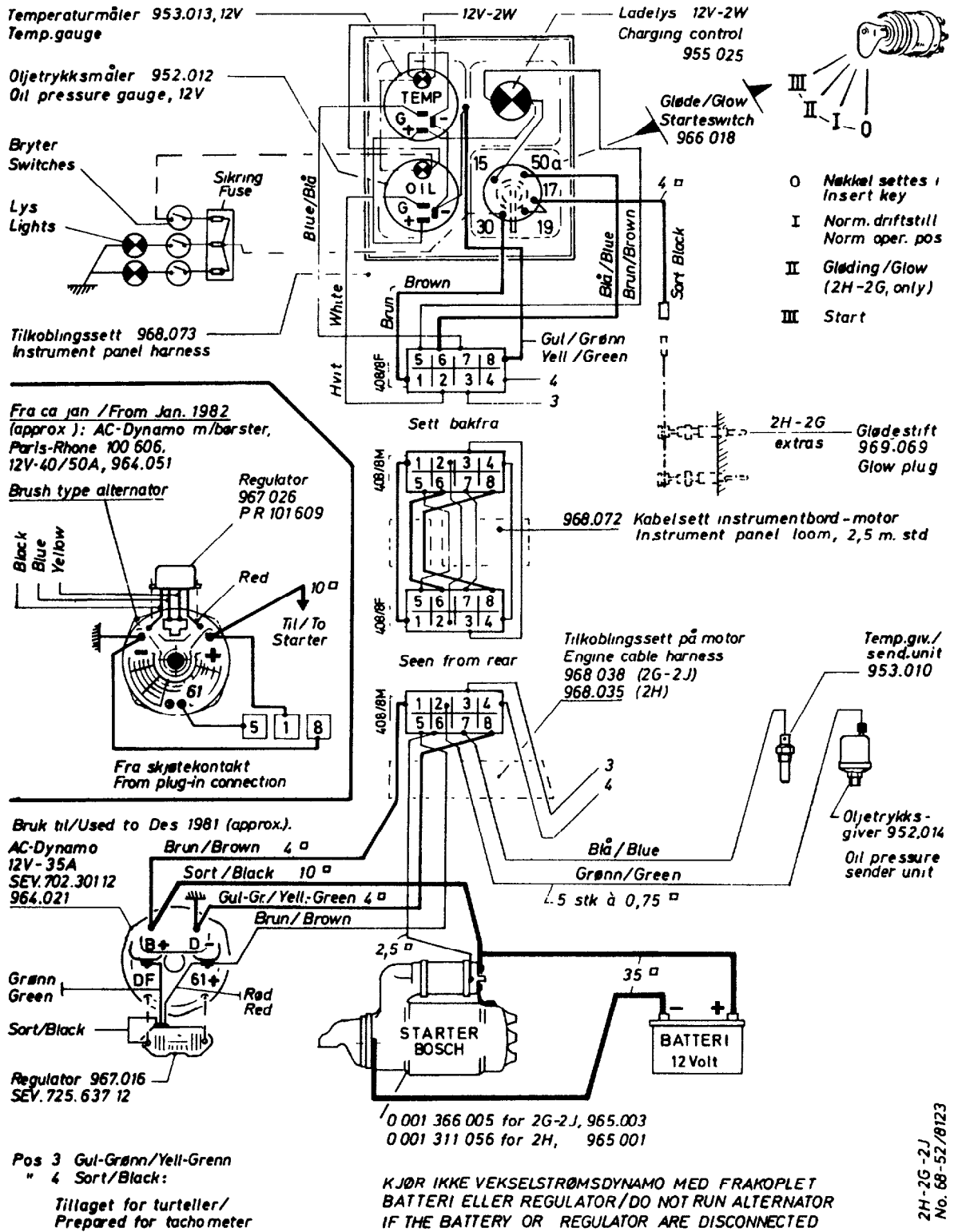
Regulator, 12V  
P—Rhone YL 135  
967.026

#### Used to Des. 1981:

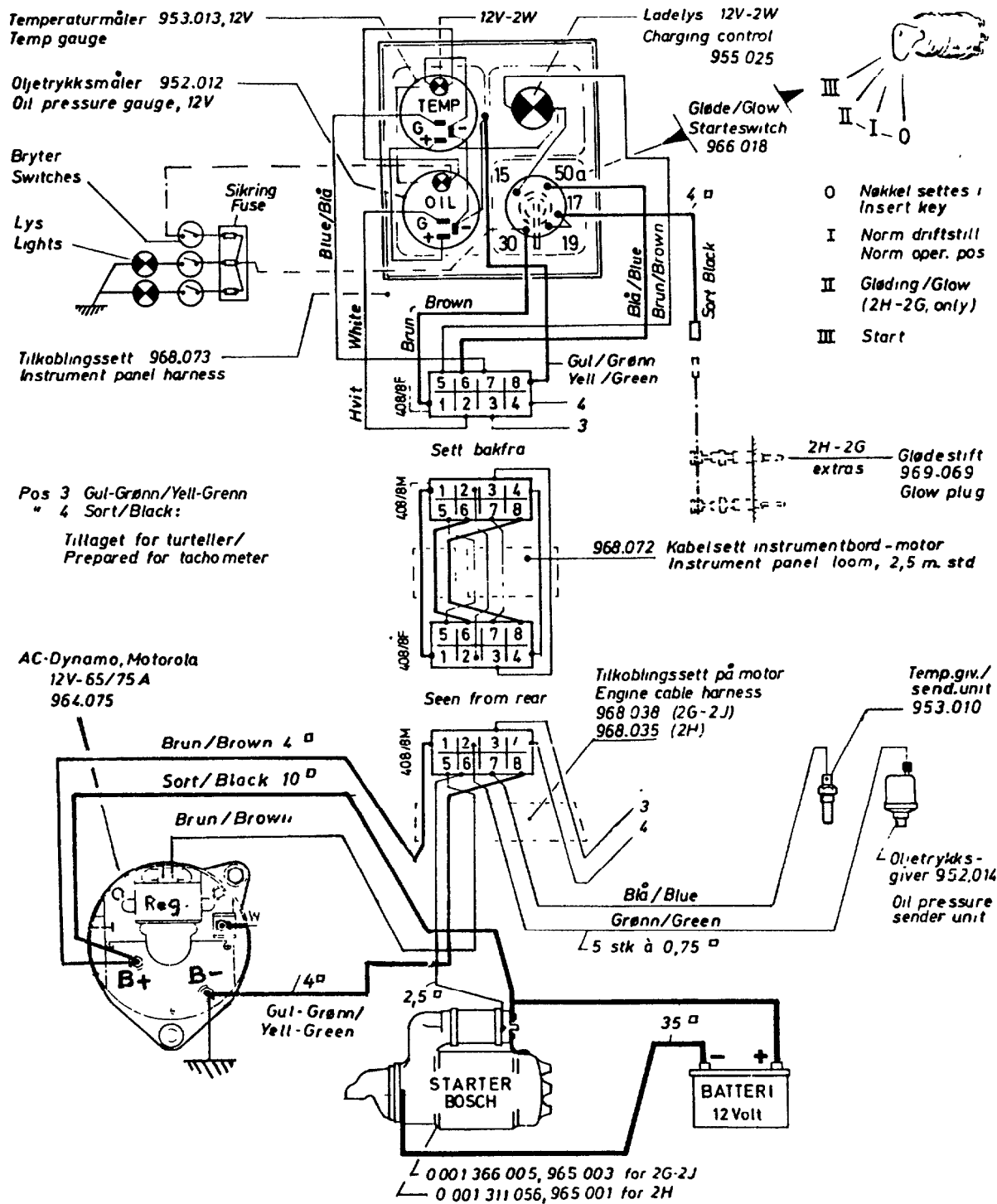
Alternator 12V—35A  
S.E.V. 702 301 12  
964.021



Regulator, 12V  
S.E.V. 725 637 12  
967.016



**Wiring diagram 68—52 for Starter 12V, alternator 12V—35A (S.E.V.) and 12V—40/50A (Paris—Rhone), charge control, glow starter switch. VDO electrical instruments. Instrument panel 951.040, 12V standard from Nov. 1980. For large instrument panel — see page 71.**



KJØR IKKE VEKSELSTRØMSDYNAMO MED FRAKOPLET  
BATTERI ELLER REGULATOR/DO NOT RUN ALTERNATOR  
IF THE BATTERY OR REGULATOR ARE DISCONNECTED

Wiring diagram 961.030 for Starter 12V, alternator 12V—65/75A (Motorola), charge control, glow starter switch, VDO electrical instruments. (From mid. 1983 approx.).  
Instrument panel 951.040, 12V.  
For large instrument panel — see page 71.

## RULES FOR STARTING

### Before starting, check:

1. Fuel tank filled up, fuel tank cock open.
2. Fuel system bled, all connections tight (see page 32),
3. Correct lubricating oil in engine and clutch or reverse gearbox (see page 21).
4. *Fresh water cooled engine:*  
Drain cocks on pump and extra pump closed. Filled with fresh water or fresh water/antifreeze mixture.  
See page 38, Winter use.
5. *Sea water cooled engine:*  
Sea cock open and pump drain cocks closed.  
NB.! *Type 2G has additional drain cock on cylinder block, pre. 1979.*
6. Sea cock for extra pump open.
7. *Electrical equipment:*  
Correctly connected in accordance with interconnection diagram.  
Exercise particular care with alternating current installations.
8. *With "Hurth" gearbox or "Borg Warner" V-drive:*  
Be sure Stop Control is pushed down (see page 15).

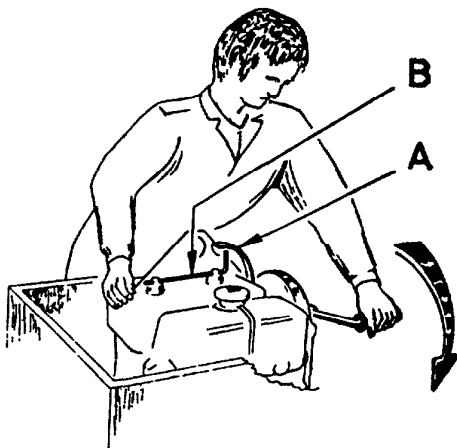


Fig 6

### HAND STARTING:

1. Ensure that alternator is connected to battery.
2. Propeller disengaged (gearbox or clutch in neutral).
3. Set governor control handle (fig 10) to full speed position (down).  
Insert starting handle.

### Type 2G:

*Self-closing decompressor, if fitted:*  
Move decompressor arm (A) to starboard so that it engages with the threads on the starting spindle.  
Open decompressor valves using decompressor handle (B) which should then be vertical.

### Type 2J:

Open both decompressor valves (page 43, fig 62) using both handles which should then rest in its groove.

- Stand to *starboard* of the engine and crank with *the left hand*. Keep the right hand on the decompressor handle. Crank rapidly to build up a good flywheel speed.

2G: The compressor valves close automatically, if fitted.

2J: Close the decompressor valves one at a time by turning 90 degrees.

- For cold weather starting, see Starting with Cartridge or Lub Oil.
- Once the engine has started and is running evenly, return the governor control handle to a position giving a suitable engine speed. Remove the starting handle.
- Check oil pressure and cooling water circulation.

### ELECTRICAL STARTING:

If the battery is well charged, it is not normally necessary to use the decompressor.

In cold weather, or if the battery charge is low, the start load can be reduced by using the decompression valves.

- Propeller disengaged (gearbox or clutch in neutral).
- Set governor control handle to full speed position, ie handle pointing downwards (fig 10).

For engines with "Hurth" gearbox or "Borg Warner" V-drive, see fig. 11.

- 0 OFF: Insert key (or pull out) fig 7).  
I ON: Normal operating position.  
II GLOW: *Type 2G only:*  
Hold for 20—40 seconds to heat glow plugs.
- III START: Push in switch key and turn clockwise. When engine starts, release key which returns to Position I.
- Set governor control handle to give a suitable engine speed.
- Check oil pressure, cooling water circulation and battery charging.

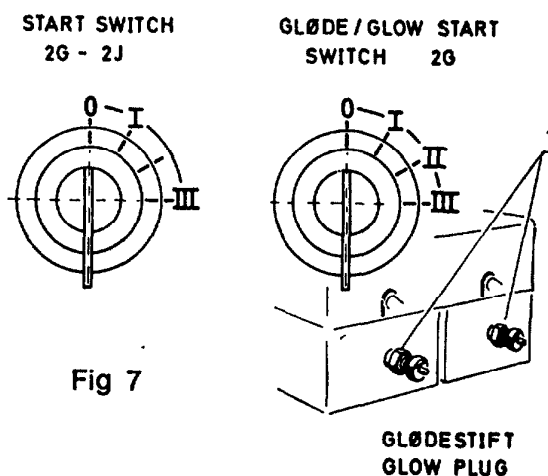


Fig 7



## Starting using Cartridge (or Lub Oil):

In cold weather, or if the engine has not been used for some time, use starting cartridges (7 mm).

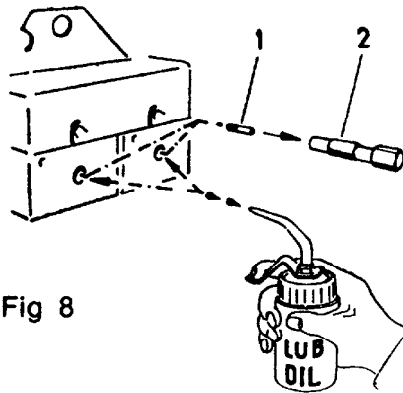


Fig 8

### Type 2G:

1. Unscrew both cartridge holders (2).
2. Insert cartridges (1) into holders (2), white end first. Replace holders and screw firmly home. The cartridges are self-igniting provided that they are dry.
3. As an alternative to, or in addition to, cartridges, a recommended procedure is to spray 6 full shots of LUB OIL into the upper cylinders to facilitate starting.

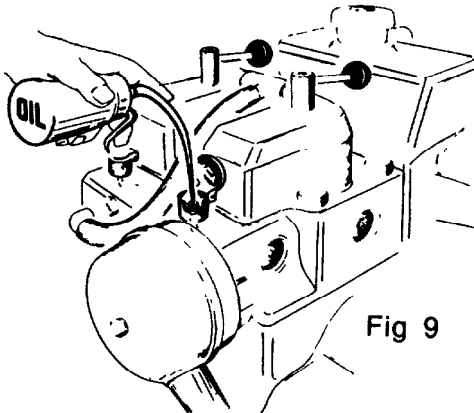


Fig 9

### Type 2J: Lub. oil only, not cartridges.

1. Open oil cup cover(s).
2. Inject 2—4 shots of thin Lub.oil directly into each cylinder via start oil pipes:

### Starting fluid:

In particularly difficult cases it may be advantageous to use an aerosol starting fluid. NB.! Be careful if hand starting.

## OPERATION

- 1 Let engine idle at 400/600 rpm.
2. ENGAGING CLUTCH:

### *With pitch control:*

Move clutch handle forward to full extent of its travel. It moves over an indent to hold it in the engaged position.

Use pitch control handle to select desired propeller pitch (2G—2J).

**IMPORTANT:** Do not manoeuvre the boat using the clutch. All manoeuvring must be carried out using propeller pitch control. With either pitch control or reverse gear, engine speed should be reduced to approx. 1.000 rpm. for manoeuvring.

Ensure that gear or clutch handle does not foul on the engine casing or other obstruction.

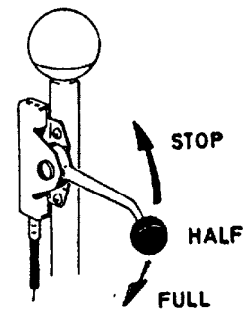


Fig 10

## Operation cont.:

*With "Sabb" reverse gear:* Engage using light pressure on the gear control handle, fig. 10.

*With "Hurth" reverse gear or B.W. V-drive:*

Single lever control of gearbox and speed:

Press button to control engine speed only (starting). The button is released when lever passes neutral. Permit engine to slow down before engaging gearbox forward or reverse, fig 11.

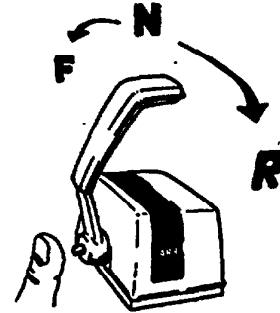


Fig 11

3. Set governor control handle to give required engine speed. Do not use full power until the engine has started to warm up. The fuel supply should be gradually increased to the full speed position.

## CHECK INSTRUMENTS:

*Cooling water temperature:*

Fresh water cooling: 55—75° C.

Sea water cooling: 40—60° C.

Oil pressure . . 1,5—2,5 kg/cm<sup>2</sup>.

Charging indicator lamp: Off.

Engine speed. See page 15—16.

The hourmeter is an electrical watch which starts when the alternor begins to charge (Charging lamp off).

## STOPPING

1. Reduce engine speed.
2. Gearbox or clutch in neutral.
3. Allow engine to idle for a few minutes to dissipate heat.
4. Stop engine. Governor control handle up.

**NB.!** *With "Hurth" gearbox or "Borg Warner" V-drive:*

Pull out Stop Control (fig 13) until engine stops and push down.

5. Turn switch key to position 0. Remove key and replace protective cover.

12a. Panel  
951.040, 12V.  
stand. from 1981.

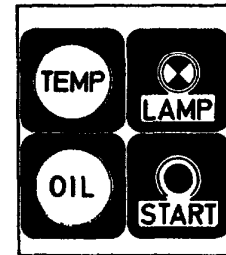


Fig 12a

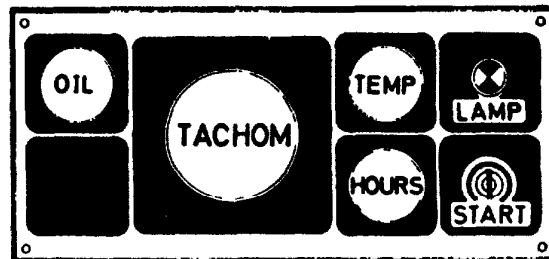


Fig 12

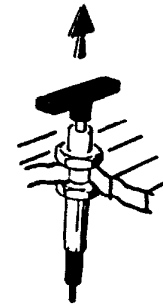


Fig 13

## ADJUSTMENT OF LEVER TYPE PITCH CONTROL (2GZ—2JZ)

This pitch control bracket has a neutral position adjusting screw to define the neutral propeller pitch position for manoeuvring. This is set during the initial trial run as follows:

*Cont.*

Cont. from page 15.

1. Neutral position screw (3) fully home with slot aligned fore and aft and with neutral position pin in place.
2. Slacken set screws (5) in max pitch stop arm (1).
3. Select neutral pitch position with pitch control handle.
4. Re-tighten set screws.

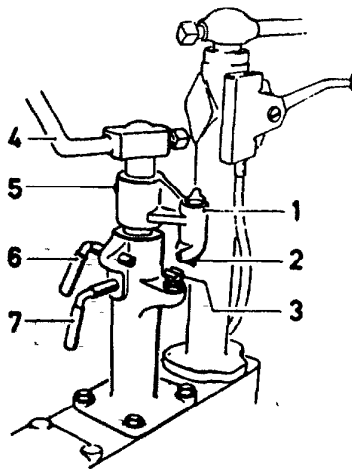


Fig 14

The hand screw (6) facilitates setting the normal full speed position of the propeller blades. The screw is adjusted so that the propeller pitch matches the optimum engine speed with regard to vibration and the speed of the boat. The engine speed will depend on the hull form of the boat and its size. It will normally lie in the range 1600—1800 rpm. Maximum values are 1800 for the 2G engine and 1900 for the 2J. If the boat is used for fishing, it is generally preferable to use max. pitch when towing lines and a slightly reduced pitch when at full speed.

## RUNNING IN A NEW ENGINE

A new engine should not be subjected to any unnecessary stress or loading. Run the engine carefully to begin with, using full speed only for short periods. Increase the engine loading gradually during the initial 25 hours running.

*Remember that treating the engine sensibly during the running-in period will lengthen the life of the engine appreciably.*

### After the first 25 hours running:

1. Change engine oil ..... page 23
2. 2GRG/2JRG: Change reverse gearbox oil ..... page 24
- 2GGR/2JGR: Change Heavy Duty reverse gearbox oil ..... page 25
- 2GHR/2JHR: Change reverse gearbox oil "Hurth" (ATF) ..... page 24
- 2JBWV: Change reverse gearbox oil "B. Warner" (ATF) ... page 72
3. Check engine alignment ..... page 17
4. Check all pipe connections.
5. Check V-belt tension ..... page 42
6. Check coupling flange set screws tightness ..... page 17

### After the first 50—100 hours running:

1. Adjust valve clearances 2G and 2J ..... page 44
2. Adjust clutch ..... page 48
3. For subsequent routine maintenance, follow "CARE AND MAINTENANCE" chart ..... page 18—19

## 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 15), 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.

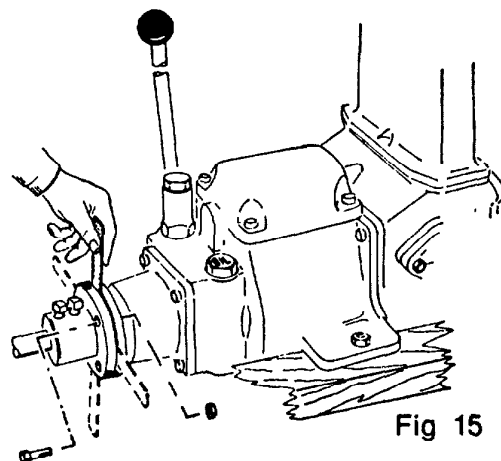


Fig 15

Use feeler gauge 0,1 mm

## INSTRUMENT CONNECTIONS — Tachometer (Electrical Impuls Type)

1. Screw tachometer sender unit (A), fig 16, into the flywheel shield of main bearing housing (fig 16a) against the flywheel starter ring.

Then **two turns up**, see mark. X.

Tighten counter nut.

If the distance between sender unit and starter ring is **too small**, tachometer will show too high r.p.m. If distance is **too big**, the tachometer will show zero r.p.m.

### Thermometer (Electrical):

Temperature sender unit (B) is fitted into front or rear cover of water tank/silencer.

2. **For wiring:**

See wiring diagram, page 10 and 11.

### Oil Pressure Gauge (Electrical):

The sender unit (C) or pipe connection (for mechanical type gauge) is fitted on port side of crankcase.

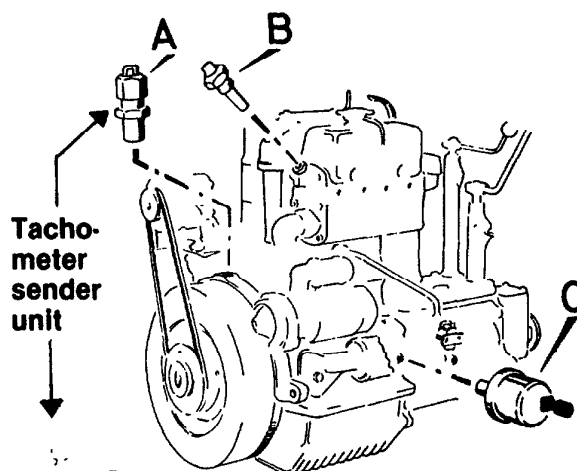


fig 16

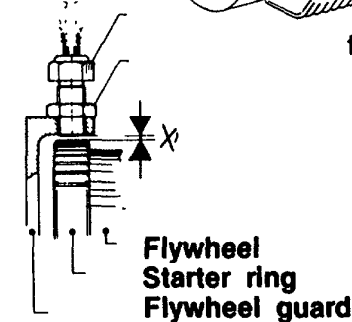


Fig 16a

## CARE AND MAINTENANCE

To achieve good results in use, it is important to give the engine the attention recommended (see chart on pages 18—19).

The following section includes general guidance, descriptive notes and sketches to assist in routine maintenance.

If the specified maintenance is carried out correctly and at the recommended intervals, engine deterioration will be minimised and optimum performance will be ensured.

In case where the maintenance procedures differ for the two engine types, this is especially mentioned in the text.

CHECK POINTS		At least annually			2 yearly	
		Every 100 running hrs	Every 300 running hrs	Every 600 running hrs	Every 1200 running hrs	As required
<b>E. Adjustments (page 42—49)</b>						
38	Adjust V-belt	●				38
39	Adjust decompressor valves				●	39
40	Adjust inlet and exhaust valve clearances			●		40
41	Cleaning of cylinder head cover damper plates (Type 2G)		●			41
42	Adjust full speed setting				●	42
43	Adjust idle				●	43
44	Adjust clutch				●	44
45	Adjust heavy duty reserve gear				●	45
<b>F. Checks (page 50—58)</b>						
46	Check oil pressure relief valve				●	46
47	Check oil pressure relief valve (older engines)				●	47
48	Check valve lubrication			●		48
49	Check injection pumps				●	49
50	Check inlet and exhaust valves				●	50
51	Check cylinder head gaskets — leakage				●	51
52	Removal of cylinder head				●	52
53	Check injection timing				●	53
54	Check or clean governor				●	54
55	Renew governor bearings				●	55
56	Tightening cylinder head bolts				●	56
57	Cleaning of sump and strainer				●	57
58	Removal of propeller				●	58
<b>G. Repairs (page 59—66)</b>						
59	Withdrawal of pistons—piston ring renewal				●	59
60	Withdrawal of cylinder liners				●	60
61	Removal of camshaft				●	61
62	Check swirl chamber and glow wire — Type 2G				●	62
63	Renew oil seals (pitch control engines)				●	63
64	Renew oil seals (reverse gear engines)				●	64
65	Gear handle travel				●	65
66	Renewal of shaft driving block				●	66
<b>Engine fault and fault finding guide (page 69).</b>						

## S U P P L I E S

### A. LUBRICATING OIL SYSTEM

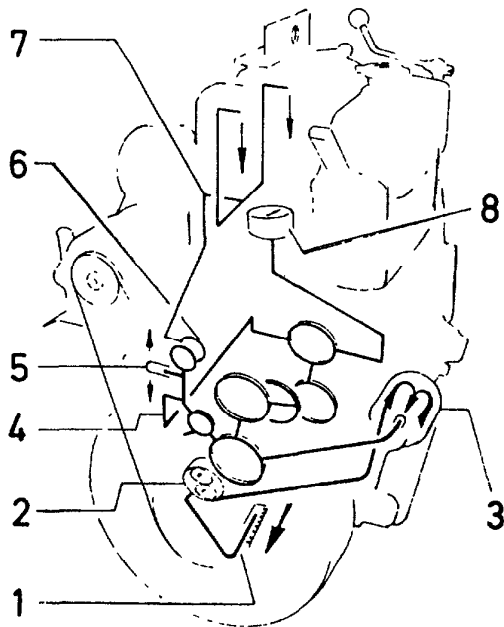


Fig 17

The lubricating oil system is pressurised, the oil being pumped from the sump oil filter (1) via the oil pump (2) (gear pump fitted in the forward crankcase bearing flange) through internal bores to the externally mounted full flow filter (3).

The filter has an integral safety valve which allows the filter to be by-passed and the oil flow maintained even if the filter becomes blocked.

The oil then passes via further bores in the crankcase bearing flange to the forward main bearing and, through bores in the crankshaft, to the forward big end bearing and the central main bearing.

Bores from the forward main bearing lead oil via the idler gear shaft to the starboard side of the crankcase (see also page 50) where there are three oil outlets.

The lower outlet (4) takes oil via an internal pipe to the after main bearing and the after big end bearing. The oil is then taken to the port side and, via an external pipe, to the oil pressure gauge (8) (if fitted).

The oil pressure relief valve (5) ensures an even oil pressure and is connected to the centre outlet.

From the bored out camshaft the oil is taken via the bearing (6) to a channel on the outer bearing surface. The upper outlet also feeds a pulsating oil supply via the internal pipe (7) to the rocker arms. Fig. 17 shows Type 2J. In the Type 2G engine the pipe (7) is led out through the after cylinder head.

### LUBRICATING OIL

The engine oil should be checked daily before starting. The dipstick is located in the governor cover and has two level marks. The upper mark indicates the oil level when the sump is full (6 litres). The level should never be allowed to fall below the lower mark.

To ensure effective lubrication and long lasting engine cleanliness, it is important to use an approved oil to the correct specification.

## 2JHR

### API-SERVICE CD (Previous nomenclature: Service DS—Series III):

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 CD	SAE 10W	15W / 40	6 litres (10,5 pints)	6,5 litres (11,4 pints)

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

BP Energol DS3/Norol Marine TMA 300	Gulfpride Series 3
Castrol Deusol RX Super	Mobil Delvac 1300
Chevron Delo 300 Motor Oil	Ocean Diesoline 3
ELF Disola GM 3C	Shell Super Marine Oil/Rimula X
Essolube XD-3	Texaco Ursa Super LA
Fina Solna S3	

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

For "Hurth" gearbox and "Borg Warner" V-drive, hydraulic oil (AFT), type A. Synthetic lubricating oil for engine — API-SERVICE CD — is recommended for lifeboat engines, for the sake of preparedness.

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

#### 1. CHECKING ENGINE OIL LEVEL (Daily):

1. Remove and wipe dipstick (1).
2. Insert dipstick fully and withdraw to read oil level. Repeat if necessary.
3. The oil level must never be allowed to fall below the lower mark on the dipstick. If necessary top up to upper mark.
4. Replace dipstick and screw home.

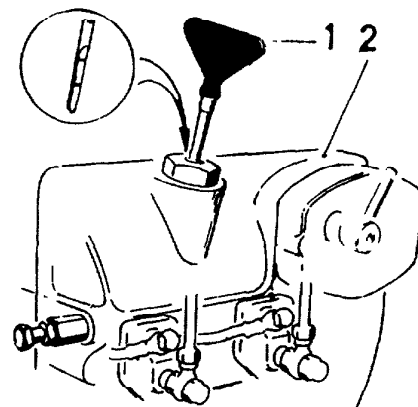


Fig 18

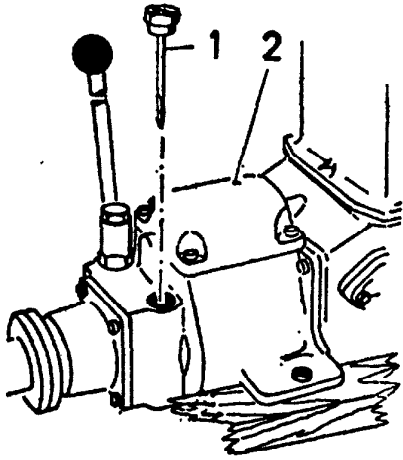


Fig 19

**2. CHECKING GEARBOX OIL LEVEL**  
 (also for Gearbox HBW-20/HBW-250)  
 (For Borg Warner V-drive, see page 72)  
 (Weekly):

1. Unscrew dipstick ("OIL" cap) (1) and wipe clean.
  2. Insert dipstick fully (to start of thread) and withdraw to read oil level.
  3. Top up if necessary. Replace "OIL" cap and screw home.
- Note that dipstick reading is dependent on engine mounting angle.

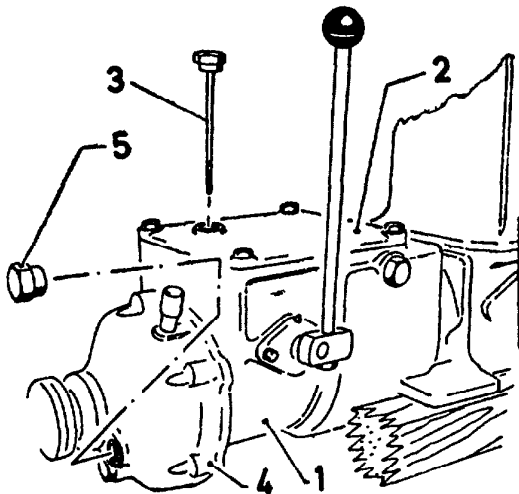


Fig 20

**3. CHECKING GEARBOX OIL LEVEL (Weekly):**

**Heavy Duty Reverse Gear**

1. Unscrew dipstick ("OIL" cap) (3) and wipe clean.
2. Insert dipstick fully (to start of thread) and withdraw to read oil level.
3. Top up if necessary. Replace "OIL" cap and screw home.

**4. CHECKING REDUCTION GEAR OIL LEVEL**  
 (Weekly or as required):

1. Unscrew level plug (5) in after face of reduction gear housing (4).
2. Top up if necessary through filler tube (fig 26, item 3) until oil runs out of level plug aperture.
3. Replace level plug (5) and cap (3).



## 5. CHECKING CLUTCH HOUSING OIL LEVEL (At least annually):

The dipstick is located in the clutch housing cover (1).

1. Unscrew dipstick ("OIL" cap) (2) and wipe clean.
2. Insert dipstick fully (to start of thread) and withdraw to read oil level.
3. Top up if necessary. Replace "OIL" cap and screw home.

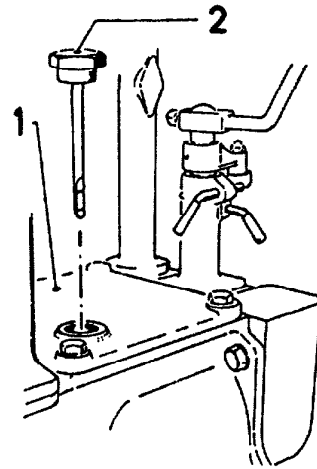


Fig 21

## 6. CHANGING ENGINE OIL (At least annually):

The engine sump contains 6 litres of oil. The oil should be changed while it is still warm.

1. Clean round "OIL" cap (1) and unscrew it.
2. Insert flexible tube of oil removal syringe into engine sump. Pump oil out and into an empty can.
3. Use a funnel to fill sump with 6 litres of clean engine oil of the correct grade. See page 21.
4. Screw "OIL" cap back and replace dipstick.
5. Start engine and check oil level.

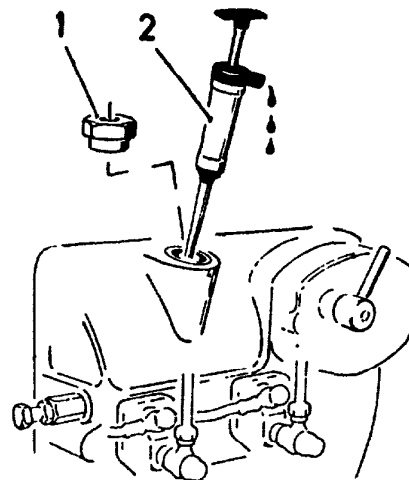


Fig 22

## 7. CHANGING OIL FILTER (At least annually):

The engine oil filter is located externally on the left side of the crankcase. The filter element should be renewed when the engine oil is changed.

1. Loosen filter (1) using an adjustable spanner. Remove and discard filter element and rubber gasket.
2. Before fitting the new filter (MANN W 920, GROSLAND 529, or other makes of corresponding types), clean face of filter retaining bracket (3) with a clean rag.
3. Apply a film of oil to the new gasket (2) before refitting.

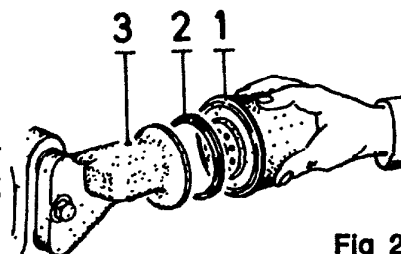


Fig 23

Replace filter and screw home by hand until the slack is taken up. Tighten by hand one further half turn. Do not use tools when tightening.

4. After refilling with oil (6.5 litres including filter), start engine and check filter seal for leakage.

### 8. CHANGING CLUTCH OIL (SAE 15W/40) (Annually):

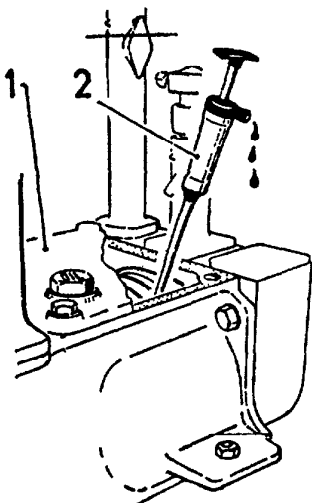


Fig 24

The clutch housing contains 1.5 litres of oil.

All clutch and pitch control components operate in an oil separate from crankcase.

1. Unscrew clutch housing cover (1). Insert oil bath syring (2) into clutch housing sump and pump out oil into an empty can.
2. If the oil is thick or dirty, the clutch housing should be flushed out with fuel oil and thoroughly dried before filling with clean oil.
3. Fill with 1.5 litres of clean lub. oil (SAE 15W/40) via the cover opening. If the clutch slips, see page 48. Replace the cover, making sure it is the right way round, and screw home the dipstick.

### 9. CHANGING REVERSE GEARBOX OIL, SABB AND HURTH (HBW-250) (At least annually):

The SABB reverse gearbox contains 0.5 litres of oil (SAE 15W/40).

The HURTH reverse gearbox contains 0.75 litres of Automatic Transmission Fluid (ATF), type A.

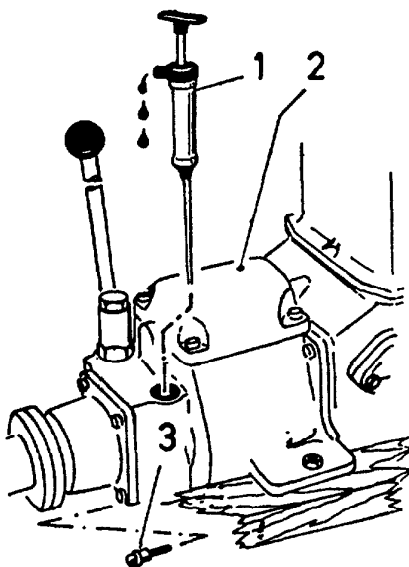


Fig 25

1. Unscrew dipstick. Insert oil removal syringe through dipstick opening and pump out into an empty can.
2. The oil can also be drained by unscrewing the plug (3) (not for HBW) in the after end of the reverse gearbox. Replace the plug and screw home.
3. If the oil is thick or dirty, remove the gearbox housing cover, flush housing (SABB) with fuel oil, dry and refill with 0.5 litres of clean oil (SAE 15W/40) via the cover opening or the dipstick opening. For HURTH gearbox fill 0.75 litres clean hydraulic oil (ATF), type A, through the dipstick opening.
4. Replace dipstick and screw home. For HBW: Check that air hole in dipstick is open.

## 10. CHANGING HEAVY DUTY GEARBOX OIL (At least annually):

The heavy duty reverse gearbox contains 1 litre of oil (SAE 15W/40).

1. Remove gearbox cover (2).  
Insert oil removal syringe (1) and pump out oil into an empty can.
2. If the oil is thick or dirty, the housing should be flushed with fuel oil and thoroughly dried before filling with clean oil.
3. Fill with 1 litre clean lubricating oil (SAE 15W/40) via the cover opening.  
If the reverse gear needs adjustment, see page 49.  
Replace cover and make sure dipstick is screwed home.

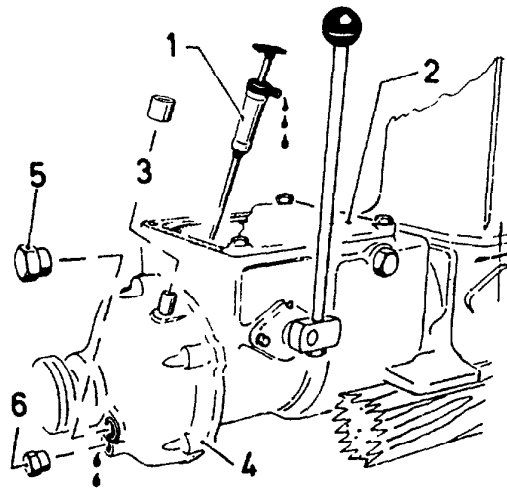


Fig 26

## 11. CHANGING REDUCTION GEARBOX OIL (when changing reverse gearbox oil):

The reduction gear contains 0.25 litres of oil (SAE 15W/40).

1. Remove cap (3).
2. Unscrew oil drain plug (6) in after end and drain out oil.  
Flush if necessary. Screw plug back into place.
3. Unscrew level plug (5) (upper plug).
4. Fill with clean oil (SAE 15W/40) via filler tube (3) until oil runs out of level plug opening. Approximately 0.25 litres.
5. Screw home plug (5) and replace cap (3).

**For changing hydraulic oil in Borg Warner V-drive, see page 72.**

## B. 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

## 12. GREASING PROPELLER (Daily):

Propeller and stern bearing are lubricated by screwing in one turn on the grease cup (1) after every 5 hours running or once daily.

*Note:*

When operating in sandy waters it is important that the controllable pitch propeller should be greased regularly and liberally.

### IMPORTANT:

If the controllable pitch propeller controls are noticeably heavier when the boat has been out of use for some time, the reason may be that the propeller water has been washed out by contaminated sea water or strong currents etc. In such cases the propeller should be greased with special stern grease.

There are many good quality stern greases but they should only be used for propellers and stern bearings.

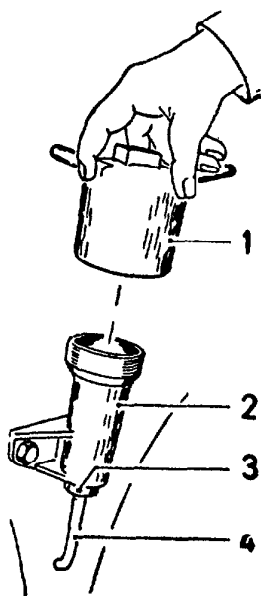


Fig 27

## 13. GREASING STERN BEARING WITH EXTERNAL GREASE NIPPLE

(For lifeboats, weekly):

Use grease gun to give 5 shots to the grease nipple (1) weekly or after lifeboat drill.

The stern bearing gland (2) has a tallow packing. The gland should be tightened just sufficiently to prevent leakage. Excessive tightening will cause wear on the propeller shaft.

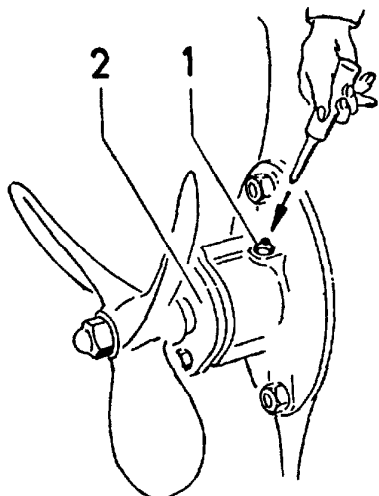


Fig 28

## 14. GREASING INBOARD STUFFING BOX (Daily):

One turn of the grease cup (5) every 5 hours running or once daily.

The stuffing box has a gland (6) with a tallow packing. The gland should be tightened just sufficiently to prevent leakage. Excessive tightening will cause overheating and wear on the propeller shaft. The tallow packing must be changed when the gland has been fully tightened or if the gland leaks.

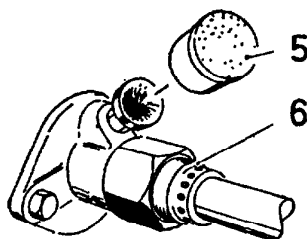


Fig 29

**15. GREASING FLEXIBLE STUFFING BOX (Daily):**

One turn of the grease cup (7) every 5 hours running or once daily.

The stuffing box has a gland with 1/4" tallow packing.

1. Tighten the gland (8) just sufficiently to prevent leakage. Excessive tightening of the screws (9) will cause overheating and wear on the propeller shaft.
2. The tallow packing must be changed when the gland is fully tightened or if the gland leaks.

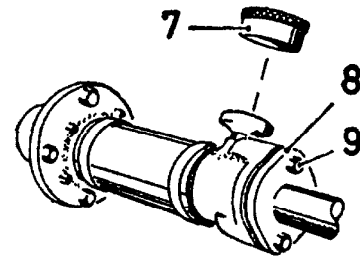


Fig 30

**16. GREASING PITCH CONTROL (Weekly):**

Engines with facilities for rapid reverse pitch control (2GZ—2JZ) have eight greasing points, other engines with pitch control have seven points and engines with reverse gears have three points for grease gun application.

1. Clutch pillar: 2—3 shots with grease gun every 50—100 running hours.
2. Pitch control pillar: 2—3 shots every 50—100 running hours.
3. Neutral position pin . . . . . 3 shots
4. Sliding bolts . . . . . 5 shots
5. Sealing rings . . . . . 5 shots
6. Pitch control bearing . . . . . 5 shots

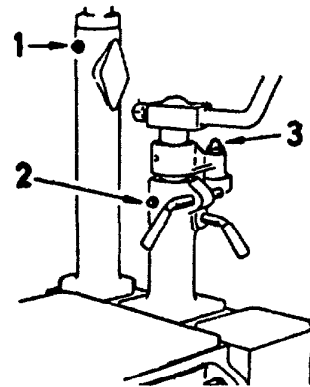


Fig 31

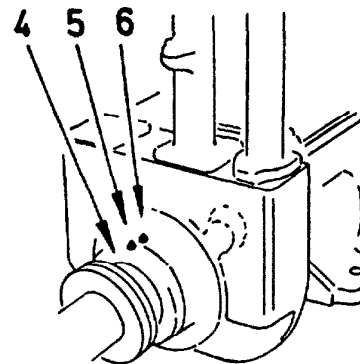


Fig 32

**17. GREASING STARTING BRACKET**

**Engines pre-1975 (as required):**

The sealing rings in the starting bracket should be lubricated with 3—5 shots with grease gun as required.

When hand starting, lubricate weekly.

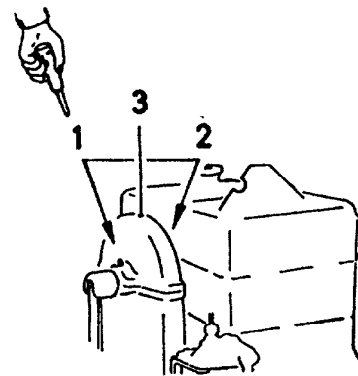


Fig 33

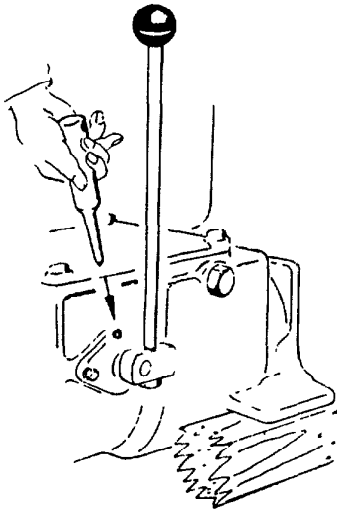


Fig 34

**18. LUBRICATING FRONT END HAND START BEARINGS (As required):**

Apply a few drops of oil to the hand start bearings and chain to facilitate cranking.

**19. GREASING GEAR HANDLE BEARING (Weekly):**

**Heavy Duty reverse gear.**

The gear handle bearings (starboard side) should be given 3—5 shots weekly.

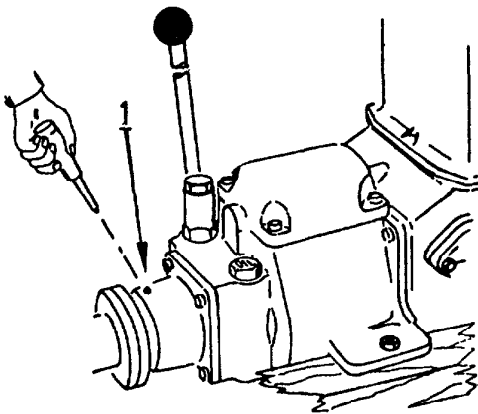


Fig 35

**20. GREASING GEARBOX SEAL (Weekly):**

The sealing rings (1) in the rear face should be given 5 shots weekly, or until surplus grease escapes round the wear ring.

**IMPORTANT:**

If there is so much water in the boat that it covers the sealing rings, the boat should be pumped out before operating the gearbox.

**GREASING AUXILIARY EQUIPMENT**

**21. Greasing the Starter Pinion (As required):**

The starter must not be subjected to water spray off the starter ring. (See page 9.)

Apply a little oil (1) from time to time to the Bendix pinion (2) and shaft as shown in fig 36.

If the Bendix pinion becomes rusted, the starter (3) should be removed and the starter pinion greased.

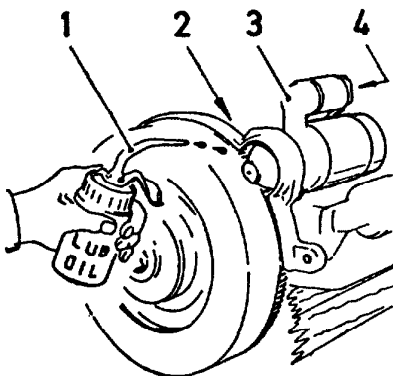


Fig 36

1. Disconnect electrical leads and unscrew starter from engine.
2. Insert screwdriver behind pinion. Lever starter pinion out while turning it clockwise.
3. Apply grease (or lubricating oil) to shaft and starter pinion. Turn pinion to and from until it moves freely in its track.
4. Replace the starter. Reconnect battery and electrical leads. Ensure that the starter connections are free from corrosion and that the screws are tight.

**22. Greasing Governor Control Handle  
(As required):**

Apply a little oil (or grease) periodically to the rack drive as shown in fig 37.

**Special Grease for SABB Remote Control and Rudder Controls:**

Cables for propeller pitch, clutch or reverse gear control, rudder control cables and cable guides should be coated with grease during assembly.

*Esso Unirex Lo temp EP.*

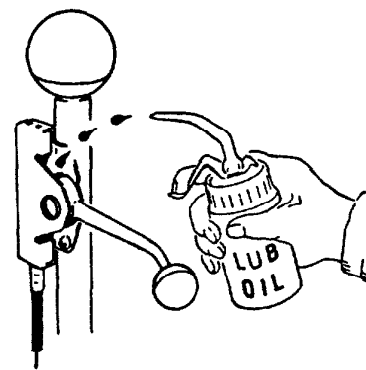


Fig 37

**23. Greasing of Remote Controls  
(As required):**

The drive block (2) on the end of the telescope tube is free to move on its securing bolt and this nipple (1) should be greased as required.

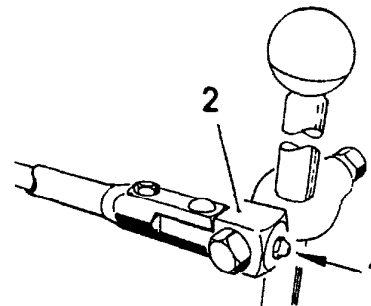


Fig 38

**24. Greasing of Rudder Controls  
(As required):**

SABB rudder controls incorporate 2 grease nipples. One is on the underside of the Operator Unit and one (2) is on the universal joint. Both points should be greased as required.

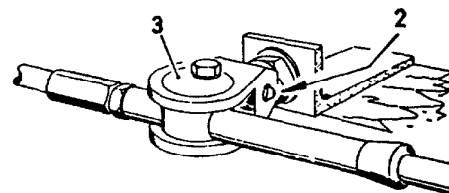


Fig 39

## Gearwheel Bilge Pump

The pump is driven by V-belt from the outer track of the flywheel drive pulley. The V-belt is tightened by slackening screws (1) and turning the whole pump. Re-tighten screws securely.

Engaging and disengaging (handle 5) must only be performed at low engine speeds to avoid wear in the drive or damage to the drive key.

Ensure that pump is engaged or disengaged fully.

The drive key (2) can be replaced by unscrewing set screw (3) with a 5 mm socket spanner. A new drive key can be made from 1/4"×1/4"×34 mm mild steel.

If the pump is not working properly or if it needs excessive priming, this may be an indication of internal wear causing leakage between suction and pressure sides of the pump. In this case the end clearances of the gearwheels must be reduced by filing the pump housing flange until flush with the gearwheels.

Use a thin gasket (0.15—0.20 mm).

(V-belt: LT 28 or Z-27 (9320169)).

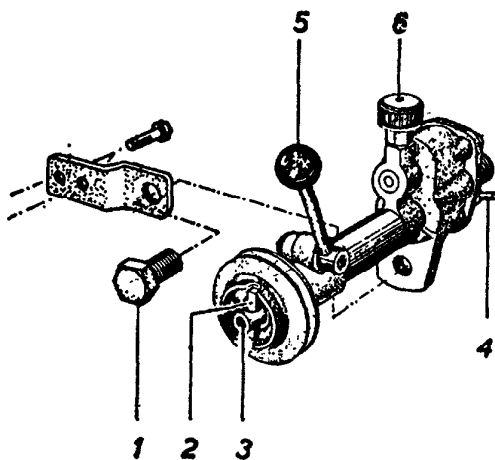


Fig 40

### 25. Greasing (As required):

Lubricate regularly using the grease cup (6) with the handle (5) in rear position. The coupling sleeve and coupling bolt also need greasing occasionally.

The bearings are sealed and do not need lubricating.

Use the drain cock (4) to drain off the water in cold weather.

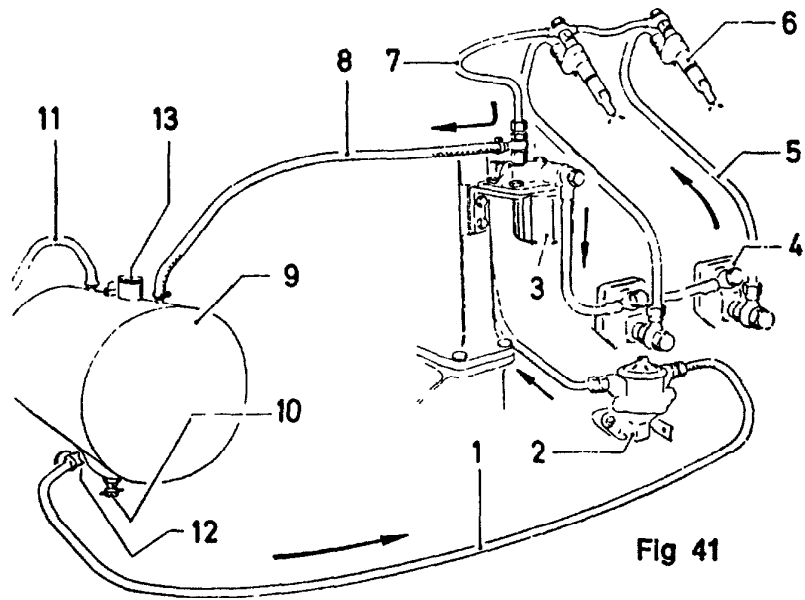
Keep the strainer clean.



## C. FUEL SYSTEM

The fuel system, Type 2J, is shown in fig 41.

It consists of lift pump (2) with hand feed arrangements, fuel filter (3), injection pumps (4), injector nozzles (6) with the associated pipes and hoses and fuel tank. The purpose of the lift pump is to feed fuel to the filter and injection pump with a slight over-



pressure. The injection pumps feed the fuel under high pressure, at the right moment and in the right quantities, to the injector nozzles where the fuel oil is atomised.

Leak-off oil (7) is taken back direct to the tank via the return hose. The leak-off oil, in the case of the 2G engine, is taken to the filter. Some engines, mainly in self-righting covered lifeboats, have an automatic bleeder valve mounted on top of fuel filter taking surplus fuel and leak-off back to the tank. The tank is vented via hose (11).

The injection equipment (Bosch) is robust and reliable provided that the fuel is clean and free from water contamination but it is high precision equipment that will not stand improper use.

Any maintenance, apart from that described in these instructions, must be carried out by properly trained personnel.

### FUEL OIL

Use only gas oil (auto diesel).

The oil must be absolutely clean and should contain as little water as possible. This is a good insurance against fuel pump or injector nozzle problems.

Drain off water (cock 10) and sediment from the tank at regular intervals, at least once every time the tank is filled. Use a straining cloth, cotton cloth or nylon stocking over the funnel when filling.

Make sure the tank is never run dry. If this does happen, the fuel system must be bled. The cock (12) must not be closed. If the engine is started with the cock closed, it will stop after a few minutes running and the system will need to be bled.

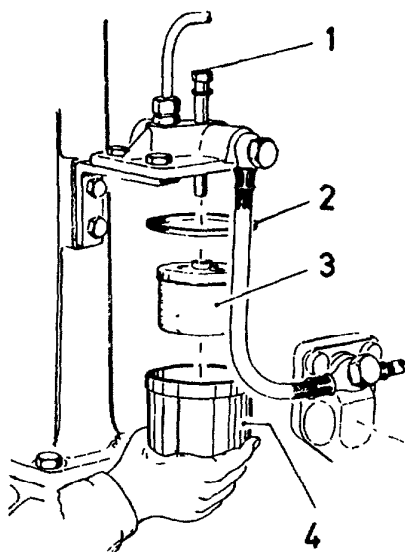


Fig 42

## 26. CHANGING FUEL FILTER ELEMENT (At least annually):

1. Close fuel tank cock.
2. Unscrew central bolt (1) and lower filter bowl (4) and element (3). Remove and dispose of the used element (3). Clean filter bowl and fit new element.  
(BOSCH FJ/SJ 2751 — 1 457 431 324.)
3. Ensure that the rubber seal (2) is properly seated in the filter bowl and refit central bolt (1).
4. Open fuel cock and bleed fuel system. See Section 27 below for instructions for bleeding. Tighten central bolt.

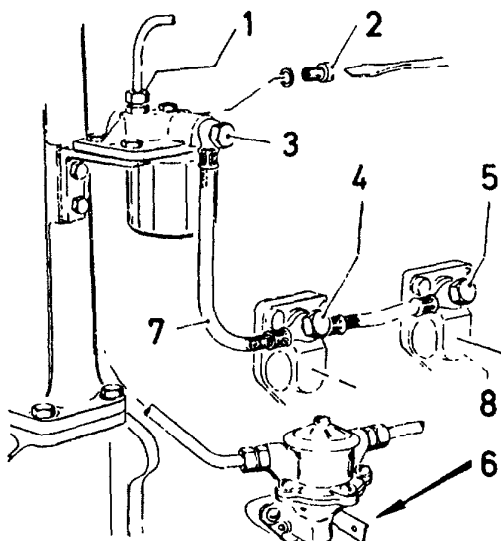


Fig 43

## 27. BLEEDING FUEL SYSTEM (As required):

1. Dip tank to check level and ensure that fuel cock is open.
  2. Ensure that air is not drawn into the system via any loose connections.
  3. Bleed the filter by loosening bleed screw (2) and banjo plug (3) in fuel filter housing.  
(For Type 2G, nut (1) on the leak-off pipe must also be loosened.)  
Pump using hand feed (6) on lift pump until oil runs out from the filter free of bubbles.  
Retighten filter connections again.
  4. Bleed fuel hose (7) to injection pumps by loosening banjo plugs (4 and 5) 3 turns and pumping with hand feed until oil flow is free from bubbles. Retighten banjo plugs in the order 5—4.
- NB: Do not loosen the injection pump pressure valves (8).
5. Open decompression valve and set governor control handle to full speed position. Crank engine (or turn using starter) until noticeable "knocking" can be felt in the injector pipes coincident with each injection. The knocking indicates that the system is free of air and that the injectors are functioning.

## 28. CLEANING INJECTOR NOZZLES

Impurities in the fuel, or fuel containing water, can lead to poor atomisation in the nozzles, spray distortion or post-injection leakage. The engine may knock, make black smoke in the exhaust and be difficult to start. The nozzles must be cleaned or renewed.

### Type 2G (for 2J see page 34):

1. Remove cylinder head cover. Disconnect injector pipes (1) from injectors. The rocker arm bracket nuts (2) are removed and the rocker arms lifted off.
2. Disconnect leak-off oil pipes (banjo plug 4), and set the washers aside.
3. Remove injector body bolts (14) and withdraw injector bodies for further dismantling.

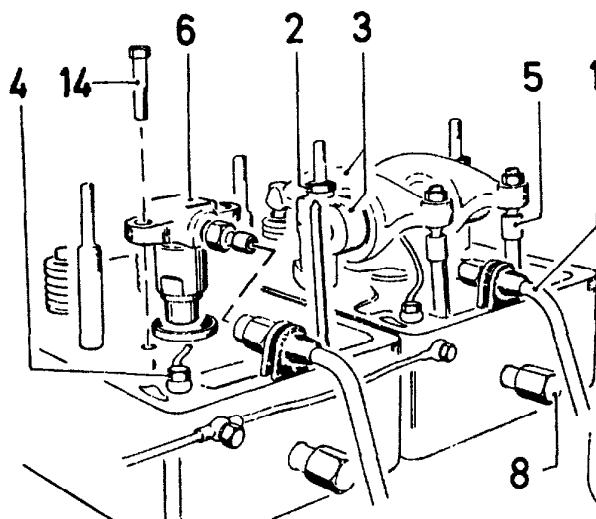


Fig 44

Place injector body upside down in a vice, or it may be placed upside down on the cylinder head and secured by means of its bolts (14).

4. The nozzle sleeve (7) is unscrewed and the nozzle (12) removed. The needle (11) should move freely in the nozzle. Never touch the needle itself but hold it by the cylindrical spigot.

Wash all components in clean fuel oil. Any particles adhering to the nozzle or to the needle should be removed using a small piece of wood or a matchstick.

5. Re-assemble the injector body as shown in fig 45. Make sure that item (9) is fitted with its shorter spigot towards the spring.

Remember to replace the nozzle washers (13) before positioning and securing injector body.

Torque setting approx 3 kpm.

6. Fit leak-off pipes and see that the connections are tight, otherwise the engine can fill with fuel.

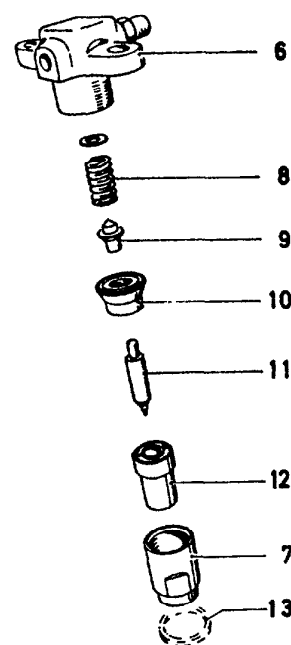


Fig 45

- The injector pipe connections should be screwed up lightly. Turn the engine over with the governor control handle set to the full speed position (starting cartridges (8) out) until oil sprays out. Tighten connections fully and replace cylinder head cover.

Ensure that the injector pipes lie centrally in the recesses in the cylinder head cover, otherwise the rubber seals will not fit properly.

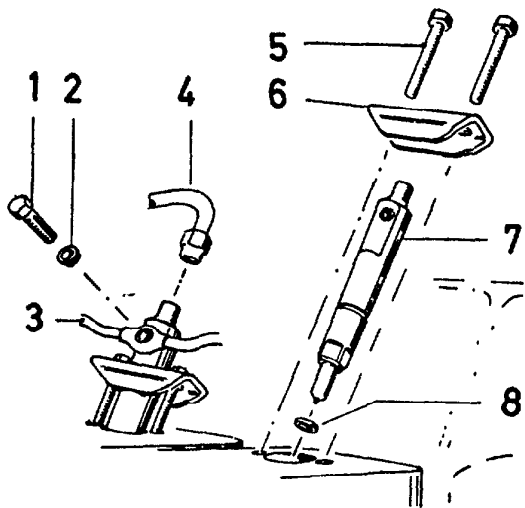


Fig 46

### Cleaning (or replacing) Injector Nozzles from Engine Serial No. 2J76-31 (Every 300 running hours):

It is convenient to have one set spare nozzles in the boat. The nozzles should be serviced by Bosch or C.A.V. every 300 running hours. If only lightly sooted the spray holes can be rinsed by means of 0.25 mm needle.

- Disconnect leak-off pipe (3) and injection pipes (4) from injectors.
- Remove clamp bolts (5) and clamp, withdraw injector (7) for further checking. If stuck, apply some rust dissolving liquid to injector stem, and allow to function before loosening injector using adjustable spanner on flats (not pipe wrench!). Take care of nozzle washer (8).

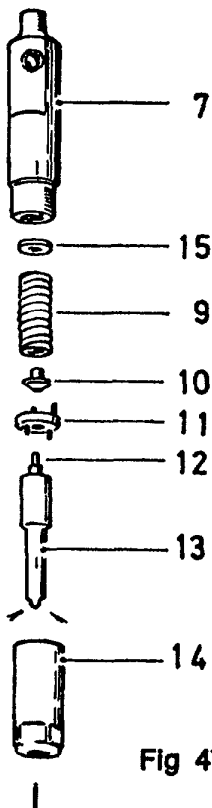


Fig 47

- Rotate the after injection pipe and attach injector. Crank engine and check if all 4 nozzle holes are spraying properly.
- For further dismantling, fit injector upside down in a vice. Unscrew nozzle sleeve (14) and remove nozzle. Take care of washer (11) and spring tap (10). The needle (12) must move freely in the nozzle. Never touch the needle itself, but hold it by the cylindrical spigot.
- Wash all components in clean fuel oil. Any particles adhering to the nozzle or needle are best removed with a small piece of wood or a matchstick. The holes should be cleaned with a 0.25 rinsing needle.
- Assembling.* Fit washer (15), spring (9) and tap (10) with narrow end into spring. Fit washer (11) with the longer spigots against the holder (7). Put the nozzle into place and screw home sleeve (14).
- Apply some graphite or antiseize compound (COPO-SLIP) to the injector holder externally to prevent this part from sticking in cylinder head. Remember nozzle washer (8). See that leak-off plug hole faces rocker cover. Torque setting of bolts (5) 3 kpm. (22 ft.lbs.).
- The injection pipe connections should be screwed up lightly. Turn engine over with governor control handle in full speed position (decompressed) until fuel sprays out. Tighten the injector pipe connections and fit leak-off pipe with tapered washer (2) correct way.

## 29. CLEANING LIFT PUMP STRAINER

(When changing oil filter):

The lift pump (AC 795067) is located on the right hand side of the crankcase cover, below the after fuel pump. It feeds oil to the filter.

1. Close fuel tank cock.
2. Undo the pipe connections to the lift pump. Remove the screws (7) and withdraw the pump.
3. Undo central bolt (1). Remove cover, extract strainer (2) and clean off any impurities.
4. Replace strainer, gasket and cover. Tighten central bolt securely.
5. Replace pump. Refit pipe connections and bleed the system.

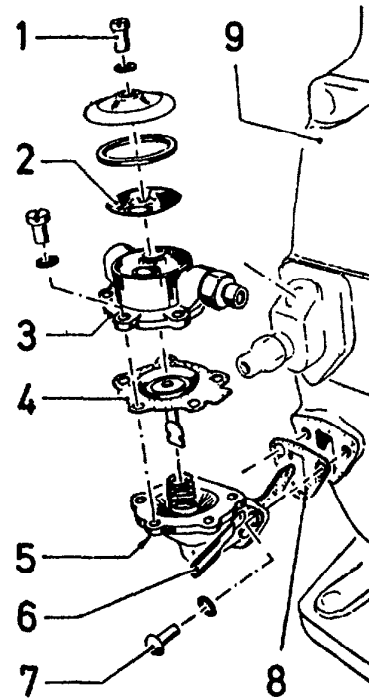


Fig 48

## 30. CHECKING OR RENEWAL OF LIFT PUMP DIAPHRAGM (As required):

1. Carry out steps 1 to 3 above then:
2. Remove upper part of pump body (3), inspect the two valves and check that the diaphragm is in good condition. If the diaphragm needs renewing, hold the lift pump arm and press the diaphragm down while at the same time turning it a quarter of a turn to free it for removal.  
Ensure that the spring underneath the diaphragm is properly in place before fitting a new diaphragm.
3. Check that the air vent (5) on the underside of the lift pump body is open. (This prevents fuel being pumped into the engine if the diaphragm is damaged.)
4. Refit pump. See steps 4 and 5 above.

## D. COOLING WATER

The cooling water pump is a diaphragm pump consisting of a rubber diaphragm sandwiched between the pump housing and the flange beneath. Fresh water cooled engines are normally equipped with two similar pumps. The standard pump on the port side circulates the engine coolant and the extra pump on the starboard side cools the rubber exhaust pipe.

*Cont.*

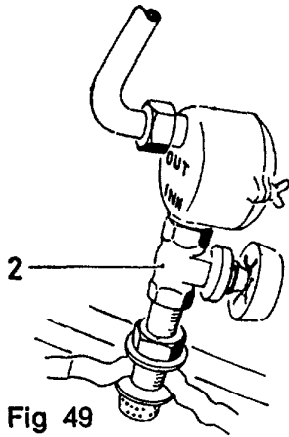


Fig 49

In fresh water cooled engines the thermostat ensures that the cooling water temperature is held in the correct range between 55° and 75° C.

In sea water cooled engines the cooling water flow is regulated by means of the sea cock (2) to give a suitable water temperature when the engine is at full load. This temperature should lie in the range 40°—60° C.

At reduced speeds the temperature will fall somewhat. This is not harmful to the engine and there is no need to regulate the opening of the sea cock to match engine loading.

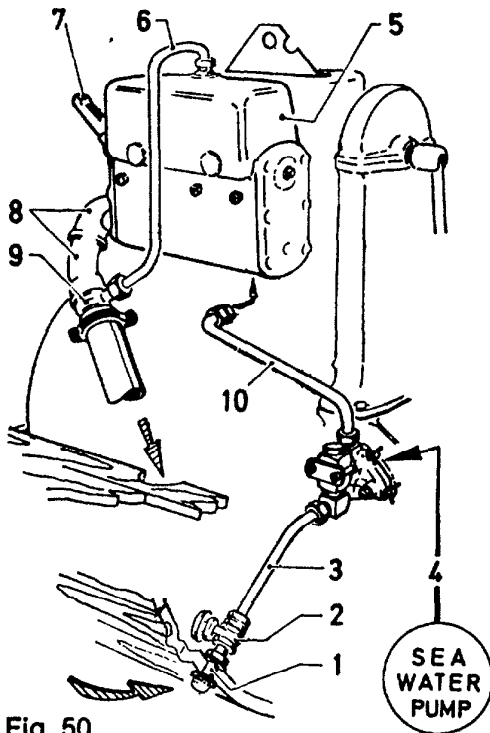


Fig 50

### SEA WATER COOLING (Open Syst.)

The sea water is sucked from the water intake strainer (1) through the sea cock (2) and the suction pipe (3) to the water circulating pump (4), from which the water is pumped through the cylinder block and cylinder head and into the header tank (5).

Usually the water is discharged through the exhaust hose as shown.

If dry exhaust is used the water is discharged directly from the header tank via separate pipe. A two-way cock can be inserted in the water nipple for the purpose of dividing the discharge water flow overboard and through exhaust pipe.

### 31. DRAINING OFF THE COOLING WATER.

**Important—in case of frost.**

*Sea water or fresh water cooled engines without anti-freeze:*

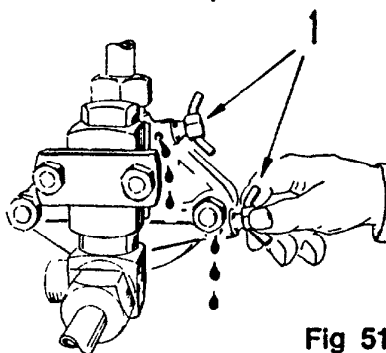


Fig 51

In cold weather—when there is a risk of frost—the sea cock should be closed and cooling water must be drained off using the drain cocks (1) on the water pump(s) and on cylinder block (2G only).

Undo the discharge pipe to avoid air lock.

*Engine with separate inboard heat exchanger:*

Drain off sea water from the heat exchanger by means of plugs in covers (see page 38).

The impeller pump is drained by loosening the pump coverplate.

**FRESH WATER COOLING WITH KEEL COOLER (Closed System):**

The header tank (1) is integral with the exhaust silencer. The thermostat (3) is fitted in cover (4).

The keel cooler (8) which is fitted under the bottom of the boat, close to the keel, should not be painted as paint insulates and reduces cooling efficiency.

Before starting first time, fill up water and antifreeze. Permit coolant to disperse and top up until the tank is full.

Check that there are no leaks in the system. Separate inboard type heat exchanger, see page 38.

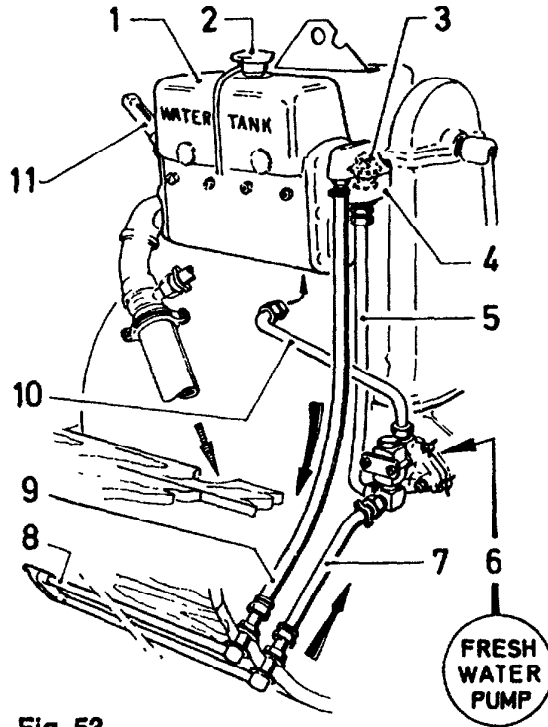


Fig 53

From January 1979 the exhaust outlet is fitted at rear edge of the silencer (thermostat in front).

Fig 53 and 54 shown thermostat cover fitted at rear and exhaust outlet in front of silencer.

**OPERATION**

Until the cooling water has warmed up the flow is from the header tank through thermostat cover (thermostat closed) and via by-pass pipe back to the water pump.

When the engine has warmed the cooling water up to 55° C, the thermostat begins to open and diverts part of the water through thermostat housing to the external cooler (or internal heat exchanger) where it is cooled before once more entering the water pump.

When in operation, the thermostat will automatically distribute the cooling water between external cooler and by-pass pipe, thus maintaining the cooling water temperature between 55° and 75° C.

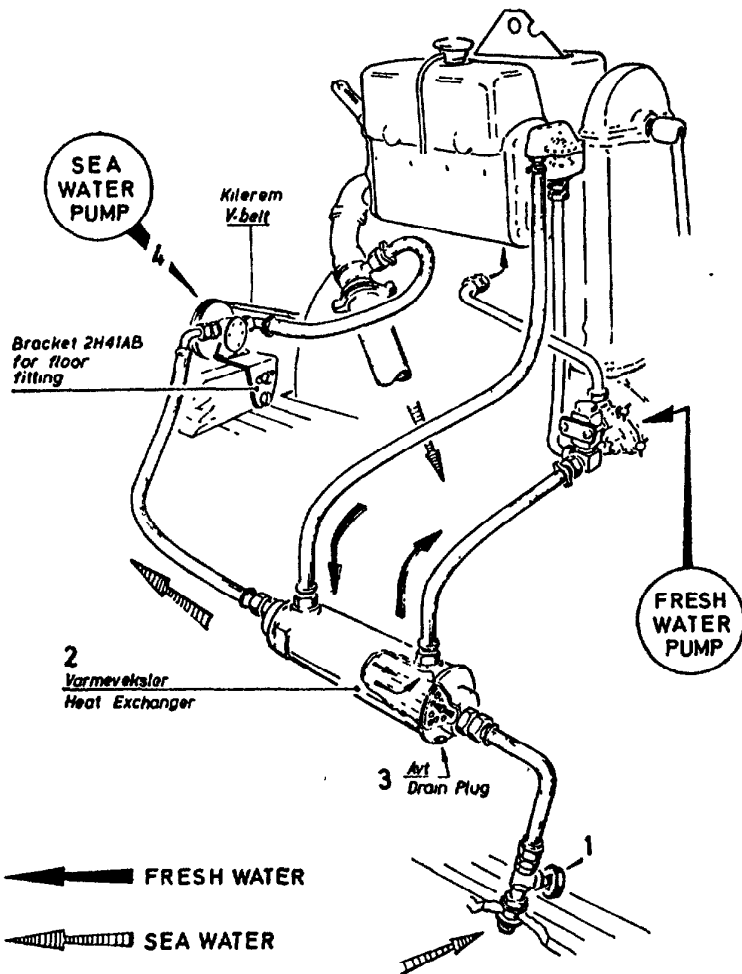
In case of incorrect operation (water temperature too high/low), check:

- 1. Water pump diaphragm . . . . . page 40
- 2. Water valves . . . . . page 39
- 3. Thermostat . . . . . page 41
- 4. Water level in tank . . . . . page 39

5. Keel cooler . . . . . page 37
6. Heat exchanger . . . . . page 38
7. Excessive friction in cylinder . . . . . page 60
8. Cylinder heads. A cracked cylinder head causes compression to leak into cooling jackets. Symptom will be heavy bubbling in water tank. Most easily confirmed by letting engine down and then idle.

**Winter Use**

For use in winter the system should be filled with an approved make of glycol anti-freeze. With standard piping the system holds approximately 7 litres. The addition of 1 litre anti-freeze (6 litres water) affords protection down to  $-5^{\circ}\text{C}$  while 2 litres of anti-freeze will protect down to  $-13^{\circ}\text{C}$ . Flush the whole system with water before filling with anti-freeze solution. After filling, run the engine for 3 minutes to ensure thorough mixing. When using glycol anti-freeze it is not necessary to drain the system before or after winter use (or laying up) provided that the coolant remains clean and free of rust flakes. If this is not the case the system must be flushed through.



**Fresh Water Cooling with Heat Exchanger**

The impeller pump (4) pumps sea water through the heat exchanger (2) where the engine fresh water is cooled. The sea water may be discharged overboard via the exhaust hose (wet exhaust).

**NOTE:**

When there is a risk of frost the sea water must be drained from heat exchanger and impeller pump. The pum may be drained by slacking the pump housing cover slightly. The heat exchanger may be drained by slacking off the drain plug (3). Close the gate valve (1).



**NB.! FITTING V-BELT:**

Combined V-belt pulley for alternator and bilge pump has internal threads to take drive axle G33.002 (25 mm dia.) for fitting V-belt pulley (4" dia.) "S" groove.

**NB.!** Type 2G—2GZ—2GRG can use EP—Extra-pump fitted on star-board side instead of impeller pump. 2GGR and all 2J variants must use impeller pump.

**32. CHECKING COOLING WATER LEVEL (Weekly):**

When the engine is in daily use in warm weather, it may be necessary to check the level daily.

Open the pressure cap carefully to avoid possibility of scalding.

Check the level and top up if necessary so that the level is at the base of the filler throat.

If the cooling system contains antifreeze, it must be topped up with either a similar strength antifreeze mixture or with anti-freeze alone. See page 38.

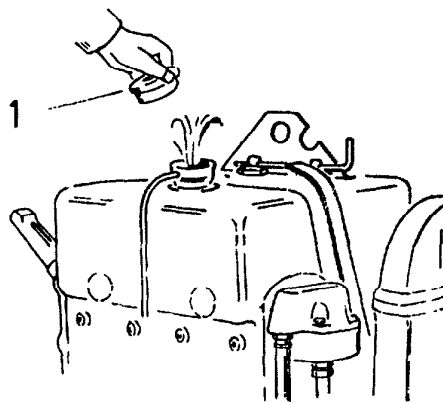


Fig 55

**33. CHECKING WATER VALVE (As required):**

The water valve housing (4) is attached to the cooling water pump. Poor coolant circulation may be due to dirt under the valves (3).

Fresh water cooled systems seldom experience trouble in this respect since the cooling system is kept clean.

Sea water cooled system are more at risk since grains of sand may be able to pass through the sea water strainer.

First try to prime the pump by removing the plug (1) and pouring water into the valve housing. If this does not help, the valve must be dismantled and cleaned.

*Count.*

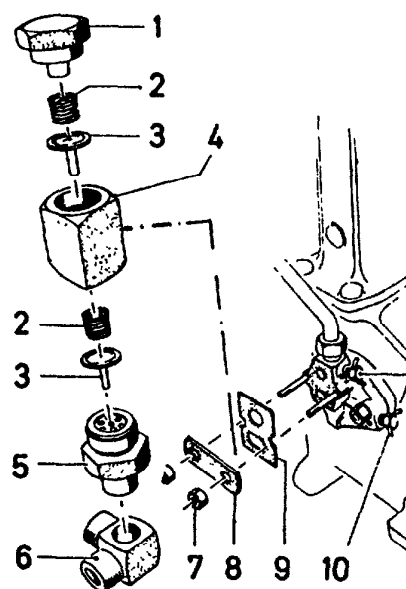


Fig 56

1. Close the sea cock (if fitted). Open the drain cocks (10).
2. Disconnect suction and bypass pipes from elbow (6). Remove valve housing (4).
3. Place housing in a vice (or attach it to the pump). Remove plug (1), elbow (6) and valve seat (5). Check for dirt under the valves. Renew valves and springs if necessary.
4. If there is wear, grooving etc., on the valve set (5), this can be faired off by light and careful filing while rotating the seat at the same time.
5. Before refitting the valve housing, check that the gasket (9) is in good condition.
6. Reconnect pipes/hoses. Close drain cocks and open sea cock or top up system with clean fresh water. See Fresh Water Cooling.

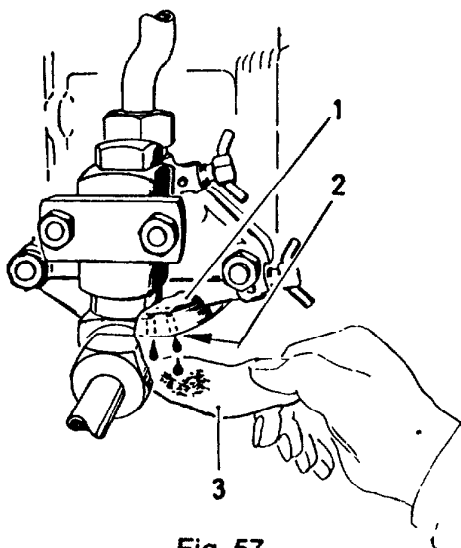


Fig 57

### 34. CHECKING WATER PUMP DIAPHRAGM (At least annually):

1. If the cooling water level falls abnormally, or if the pump gives irregular circulation (sea water cooled engine), the cause may be a defective pump diaphragm.
2. This can be easily checked by slipping a piece of paper (3) underneath the pump housing and flange while the engine is running.
3. The pump flange (1) has drain holes (2) underneath and, if the diaphragm is defective, water will drain out and wet the paper.

### 35. RENEWING WATER PUMP DIAPHRAGM (As required): (Also applies to Extra Pump.)

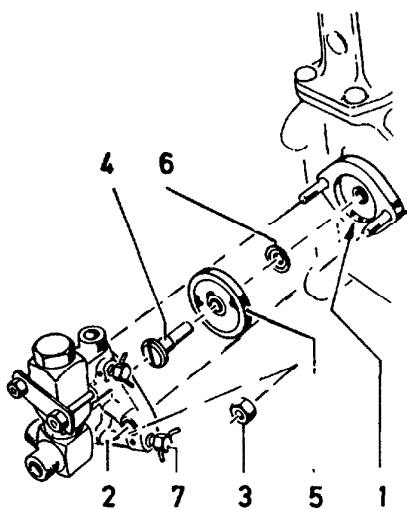


Fig 58

1. Close sea cock. Open drain cocks (7) and undo pipe connections. In the case of fresh water cooled engines, drain off the antifreeze into an empty can.
2. Unscrew the nuts (3) and withdraw pump housing (2) and valve housing together.
3. Undo the diaphragm screw (4) using a good screwdriver, remove diaphragm washer (6) and replace defective diaphragm (5) with a new one.

NB.! There are two types of diaphragms (thin and thick):

For types 2G/2J and 2GRG/2JRG use thin Diaphragm (842ff) 851.005.

For types 2GGR/2JGR and 2GHR/2JHR use thick (842fd) 851.004.

4. The new diaphragm is fitted with its marked side facing inwards. The membrane washer is fitted on the inner side of the diaphragm with its convex side against the diaphragm.—Tighten screw securely.
5. Refit pump and pipe connections. Close, drain cocks and open sea cock valve. In the case of fresh water cooled engines, fill cooling system adding antifreeze as required.

**36. CHECKING THERMOSTAT, CLEANING THERMOSTAT STRAINER (At least annually):**

1. Remove pressure cap (1) and open drain valves on water pump.
2. Drain off antifreeze into an empty can.
3. Remove thermostat housing (2) and take out thermostat (3). Place it in water at a temperature above 60° C. The thermostat should now open and should close again when placed in colder water.
4. Remove thermostat cover (5) and clean strainer (6).

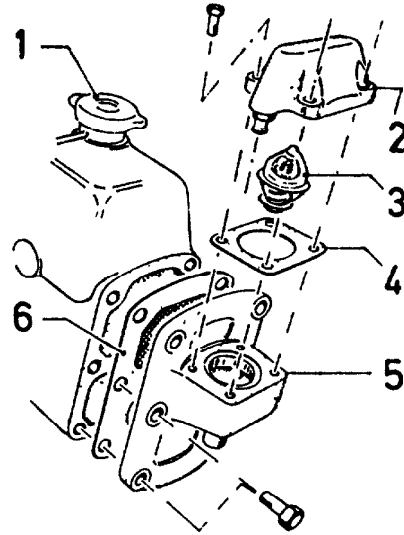


Fig 59

Thermostat and strainer can be washed in *white spirit* if necessary. If the thermostat does not work, the installation can be run without a thermostat provided that the by-pass pipe is blanked off.

5. Refit thermostat (Part No. 945.001). Ensure that correct amount of antifreeze is added during topping up. Remember to close drain cocks.

**37. CHECKING BLOCK HEATER (Lifeboat engine) (Annually):**

The heater (B) is located behind the starter (A). If the heater is being used continuously, the heater element is exposed to burning and should be checked yearly.

Drain the coolant through the drain cock on water pump. Unscrew the heater, using a wrench.

If the element is badly burnt, it should be replaced.

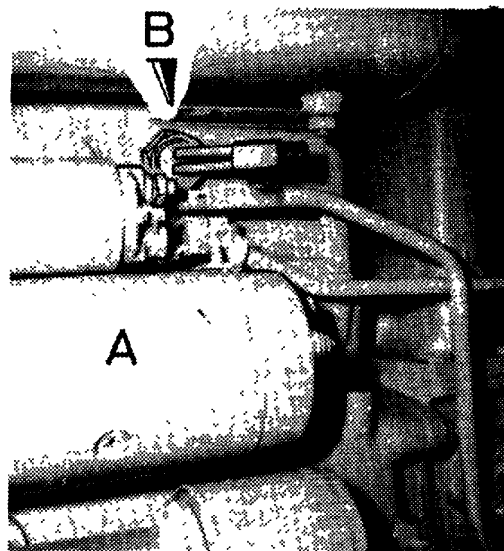


Fig 59a

### 37a. CLEANING WATER JACKETS (As required):

Sea water cooled engines and, to a lesser extent, fresh water cooled engines will eventually build up a deposit of rust and chalk (salt) in the water jackets of cylinder head and cylinder block. This applies particularly if the sea water has a sand or chalk content. The deposit reduces the cooling capacity and thus increases the risk of cylinder head cracking.

The water jackets should be cleaned as required:

1. Drain the system. Dismantle cylinder head and clean out water jackets with a suitable implement. Remove all loose rust.
2. Unscrew the water nipple in the cylinder block and clean out the channels working from the top. Ensure that the water temperature openings are not blocked, especially those on the port side (see Fig 75, pos. 2).
3. Remove as much loose rust as possible via the water nipple opening. If possible blow through with compressed air, working from above, or flush through with fresh water
4. Unscrew zinc anode (if fitted) from port side of cyl. block:

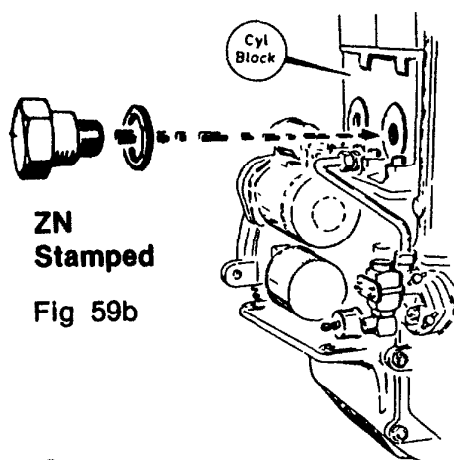


Fig 59b

If a deposit has formed on the anode, this should be scraped off.

If more than half the anode has been corroded away, it should be renewed.

Spare Part No 516.006.

When reassembling, use only undamaged, or preferably new, gaskets.

See also page 54 for details of cylinder head assembly.

## E. ADJUSTMENTS

### 38. ADJUSTING V-BELT

The important function of the V-belt is to drive the alternator and maintain the battery charge.

Therefore check the V-belt regularly (initially after the first 25 hours running), and particularly if charging is not satisfactory.

1. Slightly loosen securing bolts (1 and 5) and loosen tensioning bolt (3).
2. Tension the belt (6) by moving the alternator upwards. Tighten the bolt (3).
3. Check the tension.

When the tension is correct, it should be possible to deflect the belt about 3 mm using thumb at a point midway flywheel and drive pulley. (V-belt: 932.046, Rofan 4610.)

4. Tighten bolts (1 and 5), check that tensioning bolt (3) is tight.

**Note!** For higher dynamo speed: Extra flywheel pulley fits outside standard pulley clamped with 4 screws. Longer V-belt.

Service instruction No. 169.

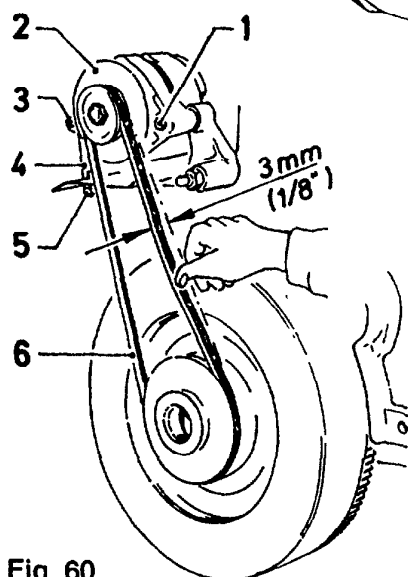


Fig 60

## DECOMPRESSOR VALVE

The decompression arrangement is situated in the cylinder head cover(s) and is used when hand starting.

### Type 2G (fig 61):

With handle (3) in the vertical position, the compressor bolts are depressed, holding the inlet valves open. When the handle is turned to point to port the engine has full compression.

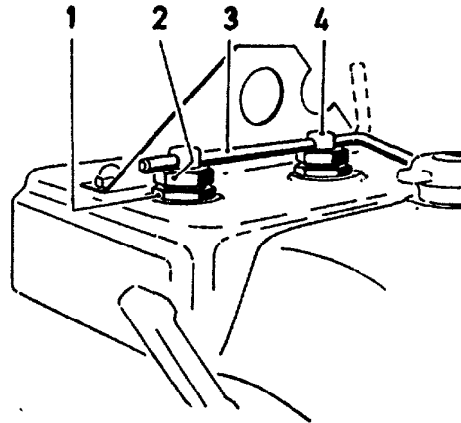


Fig 61

### Type 2J (fig 62):

With the handles (4) lying in the sleeve grooves (2), the compressor bolts (3) are depressed, holding the valves open. When the handles are turned to lie across the grooves, the engine has full compression.

**Important:** The decompressor bolts must be correctly positioned. This is best done with the engine running by screwing the sleeves (2) up or down.

If the sleeve is raised too far, the valve will not be held open sufficiently and the engine will be difficult to crank. If it is too low, the bolt (3) will remain in contact with the rocker arm, thus preventing the engine from achieving full compression. This can be felt by touching the compressor bolts with the engine running.

## 39. ADJUSTING DECOMPRESSOR VALVES (As required):

Type 2G: Fig 61, Type 2J: Fig 62.

1. Allow engine to idle.
2. Loosen the locknuts (1) and screw sleeve (2) down until the bolt just comes into contact with the rocker arm.
3. Then screw sleeve *up* 1/3 turn (2 flats on the hexagon) and tighten the lock nut. Repeat for cylinder No 2. Ensure that the setting is as nearly as possible the same for both cylinders.

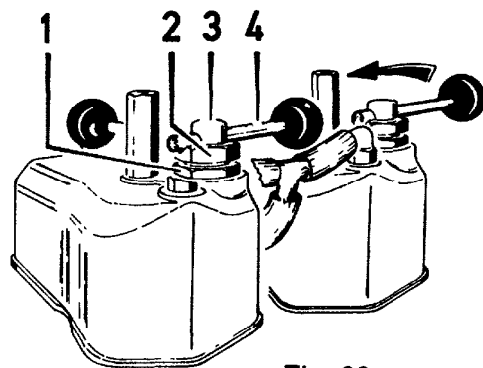


Fig 62

## 40. ADJUSTING INLET AND EXHAUST VALVE CLEARANCES (0.3 mm when engine is cold):

Adjust initially after 50—100 running hours and subsequently every 600 running hours, or in case of starting difficulties.

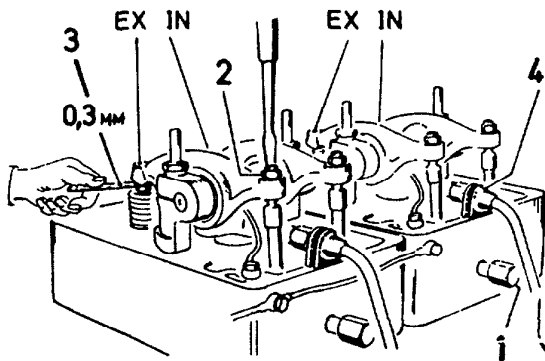


Fig 63. 2G—Viewed from rear.

1. *Type 2G*, fig 63. Unscrew both starting cartridges (1).  
*Type 2J*, fig 64. Disconnect leak-off pipe, injector pipe and injector clamps. Withdraw injectors slightly and let them lie forwards in their sockets.
2. Loosen lock nuts on decompressor sleeves in cylinder head cover(s), screw nut up towards decompressor sleeves. Make a mark on each sleeve parallel to the compressor handles and screw down the sleeves.

3. Turn the flywheel in its normal direction until the piston (nearest the flywheel) lifts the decompressor bolt to its highest point. Make a coincidence mark on flywheel and guard, adding the letter F (forward cylinder). Make a further half turn. Find the top point and make another coincidence mark on flywheel, this time adding the letter A (after cylinder). Screw decompressor sleeve(s) up again. Secure exactly on the mark parallel to the handle(s). Remove cylinder head cover(s).
4. Turn flywheel until piston in cylinder No 1 (nearest flywheel) is again at TDC and both valves for this cylinder are closed (pushrods free to move).

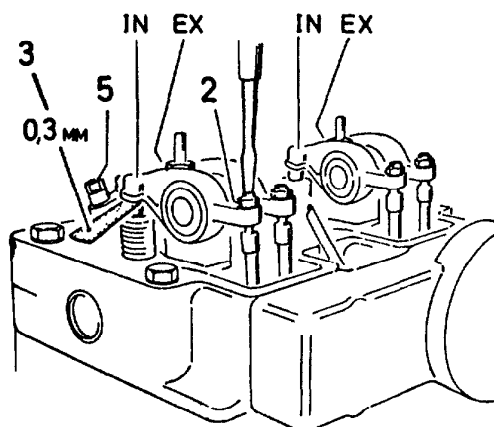


Fig 64. 2J—Viewed from rear.

Start with inlet valve "IN". In *Type 2G*, nearest the flywheel; in *Type 2J*, valve No 2 from the flywheel.

5. Insert valve clearance feeler gauge (3) (0.3 mm) between rocker arm and valve stem. Loosen locknuts (2) and set adjusting screw so that the feeler can be moved with only slight resistance. Retighten locknut (2) and re-check clearance. Transfer feeler gauge to exhaust valve "EX" and set the same clearance as for the inlet valve.

6. Repeat for cylinder No 2: Turn flywheel one half turn in normal direction. See coincidence mark "A". Proceed as in 5 above.
7. When replacing cylinder head cover (2G), ensure that cork gasket is correctly seated and that the rubber seals (4) are properly positioned. When replacing injectors (2J), ensure that the guide pins engage in the guide holes in the cylinder heads (Engines before 2J.76.31).

#### 41. CLEANING OF CYLINDER HEAD COVER DAMPER PLATES — TYPE 2G (When adjusting valves or checking injectors):

Air is drawn in through an opening in the forward face of the cylinder head cover and passes through the inlet chamber (port side), which contains damper plates, before being drawn into the engine.

Inspect the damper plates (only for engines with cylinder head cover as shown in Fig 65), and remove for cleaning if necessary.

1. Remove securing wire and screws (4). Withdraw the perforated steel plates (5 and 2) and the foam plastic sheets (1 and 3).
2. Dry cylinder head cover (6) internally. Check that the air aperture (arrowed) in the wall between inlet chamber and cylinder head cover chamber is unobstructed.

(This serves to extract oil vapour from the crankcase.)

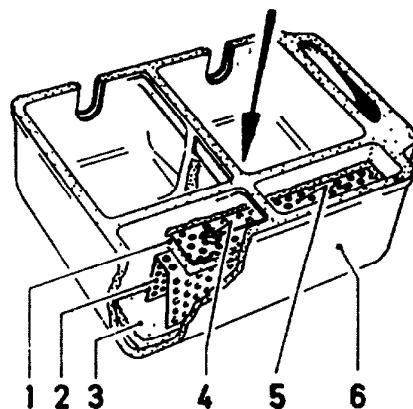


Fig 65

3. Wash damping material in fuel oil or white spirit.
4. Dry and refit foam plastic sheet (3), or replace with new sheet. Replace plates (2 and 5), with foam sheet (1) between them, close up against the inlet aperture in the cylinder head cover. Remember to wire lock the screws (4).

## 42. ADJUSTING FULL SPEED SETTING (As required):

The adjusting screw (9) in the forward end of the crankcase cover acts as a stop for the governor arm link (3—5) and thus controls the engines maximum output.

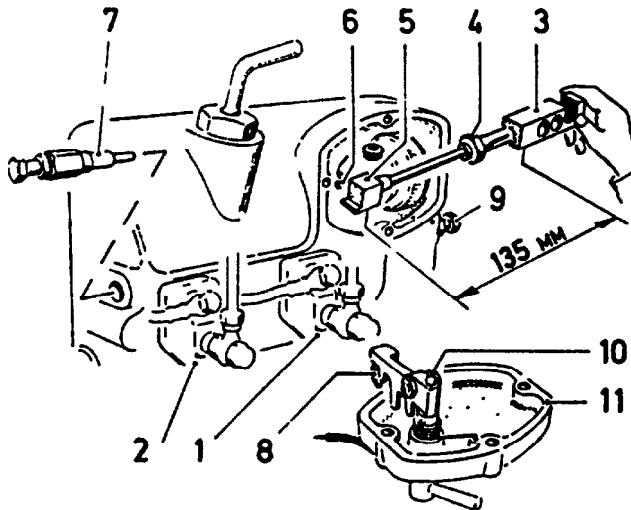


Fig 66

To prevent overloading, this adjusting screw is lead sealed and the guarantee becomes void if this seal is broken without permission.

1. Run the engine at full load.
2. Adjust engine output by screwing adjusting screw (9) in or out. The further out the screw is set, the more fuel is fed to the engine.
3. Ensure that the engine runs so that it gives out as little smoke as possible. Tighten locking nut.

## Adjusting governor arm link pin to equalise fuel feed from pumps:

The theoretically correct distance between the two links acting on the injection pump racks is 135 mm (c-c) but this can vary from pump to pump. Adjustment may be necessary if, for example, one of the pumps is changed.

For stop control (not shown in fig 67) see page 58.

### Check before adjustment:

1. Run engine at maximum setting.
2. Unscrew nut on injector pipe connection to pump No 1 (forward pump) approximately one turn. Check engine revs to find out which cylinder is being fed with most fuel. Tighten the connection and let engine output increase to maximum again.

Unscrew nut on injector pipe connection to pump No 2 (after pump) approximately one turn. Check engine revs. Re-tighten connection.

3. Stop engine. Disconnect remote control at crankcase cover (with Hurth gearbox: Undo control- and stop control cables, pages 58). Carefully remove governor cover (11). Unscrew idling spring sleeve (7) in the after end of the crankcase.



4. With the right hand, reach into the cover opening and lift out the governor arm links (3—5).

NOTE: *The governor pin (6) is loose. Remove it so that it cannot fall into the sump.*

Mount the arm link (3) in a vice or hold it by means of a pin through the holes of the link. Slacken the lock nut (4) and adjust length as necessary.

*If cylinder No 1 is receiving more fuel, the link pin needs shortening.  
If cylinder No 2 is receiving more fuel, the link pin needs lengthening.*

Adjust the length by 0.2—0.3 mm steps and test for pump feed equality each time. This can be done with engine at full power as described above, or by cranking the engine and letting both pumps fill their respective injector pipes. (Disconnect pipe from injector and turn to starboard to avoid getting oil into the engine.) During cranking, both pumps should be set to the full speed setting, that is with governor arm link (3) up against the adjusting screw (9).

#### **Re-assembly:**

5. Insert arm link pin through cover opening and ensure that arm link (5—3) engages properly with the ball fittings on the two pumps. Ensure that the arm roller (8) slides properly in the groove on the forward arm link (3) when the governor cover (11) is refitted. This can be clearly felt when the governor control handle is moved to its forward position.
6. Refit idling spring sleeve.

### **43. ADJUSTMENT OF IDLING**

Idling speed is adjusted externally by means of the adjusting screw (3) in the idling spring sleeve (1) located in the after end of the crankcase cover.

1. Adjust idling by loosening lock nut (2) and screwing adjusting screw in or out. If the adjusting screw (3) is screwed in, the idling spring tension is increased and the idling speed increases.
2. Minimum idling speed should lie in the range 380—400 rpm and it should be constant for 5—10 degrees of movement of the governor control handle.
3. Adjustment of the extent of the idling region (not normally needed), see fig 68.

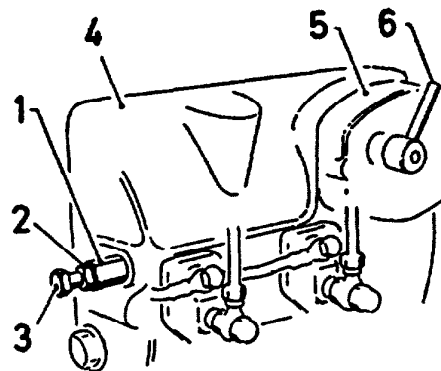


Fig 67

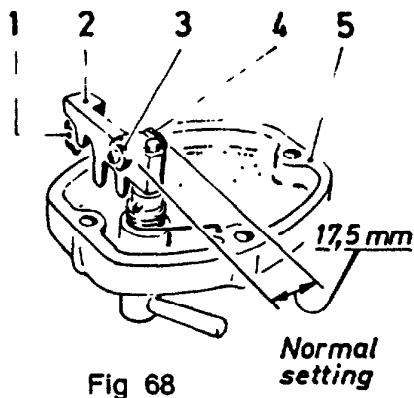


Fig 68

Normal setting

Loosen and remove governor cover (5). Slack off nut (3). Normal setting 17.5 mm.

The further forward (towards the governor) the adjusting screw (4) on the governor arm (2) is set, the greater the extent of the idling range, but the maximum speed will also be reduced correspondingly.

Re-assembly of cover: See page 47, para 5 (adjustment of full speed setting, fig 66).

#### 44. ADJUSTMENT OF CLUTCH

(As required):

The clutch may be adjusted when necessary (eg if slipping occurs), preferably in conjunction with a clutch oil change.

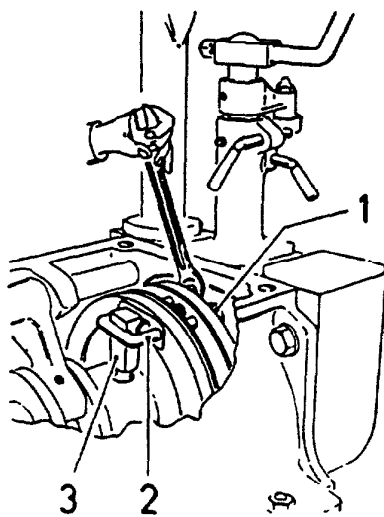


Fig 69

1. Remove clutch housing cover.
2. First check that the clutch handle is pushed forward. The clutch arms (3) must pass the indent of the clutch is to remain in position.
3. The engagement pressure can be regulated by means of the nuts (1) on the six clamps (2). After tightening all nuts by one sixth of a turn, check engagement pressure by operating clutch handle.

If the clutch is then too tight, it may be sufficient to slack back one sixth of a turn on one nut on each clamp, ie nuts spaced 60° apart. Engines delivered before 2G.77.435 and 2J.77.1 have three clamps (2) spaced 120° apart.

On the next occasion of clutch adjustment, tighten the other six (or three) nuts correspondingly. This will ensure an even adjustment. The nuts are locked by means of springs positioned against the flats.

#### 45. ADJUSTMENT OF REVERSE GEAR (As required): (Heavy Duty type.)

The reverse gear works on the principle using a gear housing and brake ring. The brake ring acts on the gear housing (going astern) and the cone clutch for going ahead is built into the rear of the gear housing.

##### Astern adjustment:

1. Remove gear housing cover. Check tension using gear handle (7).
2. Gear handle in neutral. Loosen lock nut (2) and screw nut (3) inwards. Re-tighten lock nut. Re-check tension. (Handle in astern position.)
3. The braking must be just sufficient to hold the gear housing stationary when the engine is going full astern.

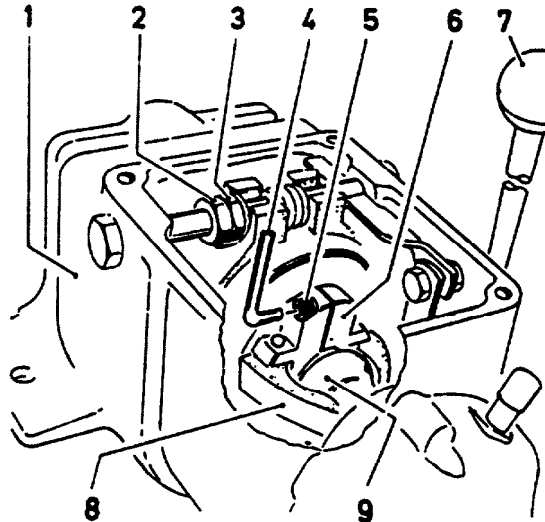


Fig 70

##### Ahead adjustment:

1. Gear handle in neutral. Loosen socket screw (5) using hexagon key (4) (5/16").
2. Tighten clutch by rotating clutch finger carrier (6) inwards (to star-board).
3. Check clutch action. Re-tighten socket screw securely when tension is correct.

The cone clutch is operated by the two clutch fingers (8) being forced out by the clutch sleeve (9) and pressing against the clutch cone pressure ring.

Never let the engine run if clutch or brake ring slip. Excessive clutch pressure should also be avoided.

4. Refit gear housing cover. Check oil level.

## F. CHECKS

### 46. CHECKING OIL PRESSURE RELIEF VALVE (As required):

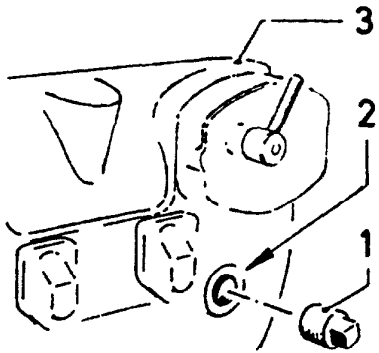


Fig 71

#### Engine loses oil pressure.

During normal full power running, oil pressure should be approximately 2.5 kg/cm<sup>2</sup>.

The oil pressure relief valve is located inside the crankcase cover (3) and is made accessible for checking by removal of plug (1).

1. Dip engine oil and check engine externally for oil leakage.
2. Unscrew engine oil pressure gauge (fig 72, item 8) or the oil pressure gauge pipe (to the instrument panel).

(NB.! Engines delivered after (approx.) June 1977 have an electrical oil pressure sender unit fitted. See fig 16.)

*If oil is not pumped out of this connection when the engine is cranked, there is a fault (or dirt) in the pressure relief valve.*

3. Using a 22 mm box spanner through the plug aperture (2), unscrew the relief valve (fig 72, item 9). Dismantle the spring sleeve (1/4" socket spanner) and wash components in fuel oil or kerosine. If the valve seat shows any sign of damage, the valve should be renewed

#### Re-assembly:

4. Refit valve using box spanner through plug aperture. Ensure that the valve body threads engage properly. Screw in securely and refit plug. Check engine for correct running.

### 47. CHECKING OIL PRESSURE RELIEF VALVE (Older engines):

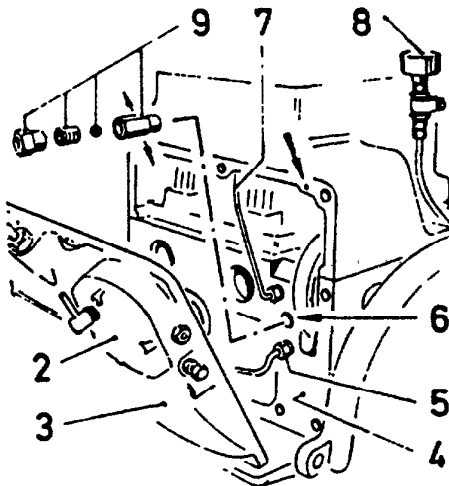


Fig 72

Engines not incorporating a plug for easier access (fig 71, item 2), the crankcase cover (3) must be removed to enable the oil pressure relief valve to be checked.

1. Carry out steps 1 and 2 above.
2. Close fuel cock, disconnect pipes from lift pump, filter and injector pumps. Loosen and lift off crankcase cover (3) without dismantling.

*Cont.*

3. The oil pressure relief valve (9) can then be seen in the centre hole (6). Unscrew the valve, dismantle and clean components in fuel oil or kerosine. If the valve seat shows any sign of damage, the valve should be renewed (S1-2G54gb).

**Re-assembly:**

4. Refit oil pressure relief valve and crankcase cover. Make sure that the guide pins in the upper edge of the cover engage in the corresponding holes in the crankcase (arrowed).
5. Refit the pipe connections. Bleed fuel system and check engine for correct running.

**48. CHECKING VALVE LUBRICATION (As required):  
(When adjusting valve clearances.)**

A pulsed oil supply is fed via the oil pressure outlet (3) from the camshaft to the cylinder head cover. This sprays from small holes in the top of the pipes (1) and lubricates the valve gear. In Type 2G engines the spray pipe is located in the after cylinder head cover as shown in fig 44.

1. The engine must be still warm after running. Cylinder head covers off.
2. Crank engine. Check that oil sprays from pipes.
3. If necessary, clean out holes (0.9 mm) with wire or a needle. If sprays fail to operate after cleaning, crankcase cover (4) must be removed (fig 73, item 4) and the valve lubricating pipe (3) disconnected.
4. Crank engine. If oil is pumped from this connection, the pipe is still blocked. If oil is not pumped out, there is a blockage in the internal bore. Attempt to clear using compressed air. If this is not successful, the camshaft must be removed for cleaning of lubrication holes and channels.

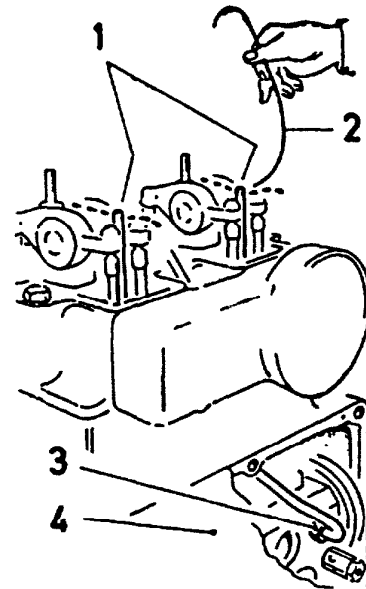


Fig 73

## 49. CHECKING INJECTION PUMPS (As required):

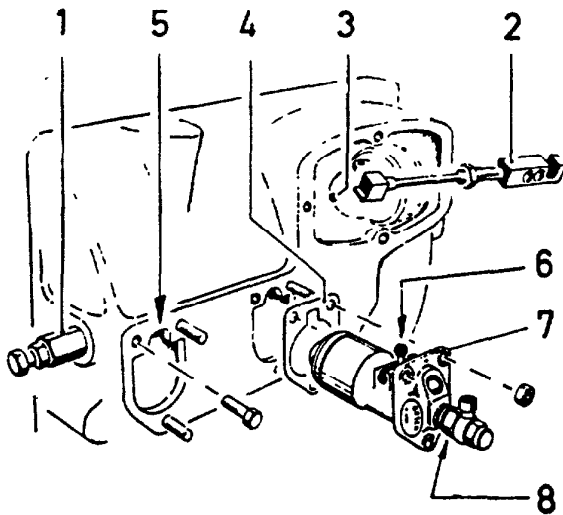


Fig 74

The injection pumps are robust and reliable provided that the fuel oil is clean and free of water, but they are high precision products that require proper handling.

The pumps can be removed for checking but the delivery valves (inside valve housings [8]) must only be removed by trained personnel who should also undertake any repairs to the pumps themselves.

Before the pumps can be removed, the governor cover (fig 66, item 11) must be taken off and the governor arm link pin (2) withdrawn.

### Checking pumps for "sticking":

When the handle on the governor cover is moved to the forward position it should be possible to feel a little "click". If this "click" is not felt when the handle is moved backwards and forwards, "sticking" of one or both pumps is indicated.

#### Dismantling (fig 74):

1. Remove fuel pipes and suction hose from both pumps. Remove remote controls and governor cover. Unscrew idling spring sleeve (1).
2. Inserting right hand through cover opening, set the ball joint control levers (6) in the central position using the governor arm links (2). Lift and remove links.  
NB: The governor pin (3) is loose. Remove it to prevent it falling into the crankcase.
3. Using a box spanner or articulated socket spanner to loosen the nuts, carefully remove for inspection. The ball joint control levers should pass through the cut-outs (5).

#### Re-assembly:

4. Ensure that the pump spacer shims (4) are in place. Set ball joint control levers (6) in central position and refit pump. Tighten nuts.
5. Proceed as in steps 5 and 6, page 47 (adjustment of full speed setting), and reconnect pipes. Bleed fuel system, page 32.

## 50. CHECKING OF INLET AND EXHAUST VALVES (As required):

If engine is difficult to start, the possibility of leakage past one of the valves should be examined. This check involves removing the cylinder head cover (inlet damper in the case of Type 2J) and turning the engine over while listening for the sound of air escaping past either of the inlet valves.

If the valves are leaking, the cylinder head must be removed and the valves and seats ground and lapped. Fine grinding past should be used. The valve seat angle in the cylinder head is  $45^{\circ}$ .

## 51. CHECKING CYLINDER HEAD OR CYLINDER GASKETS (As required):

If the cylinder head gaskets show signs of leakage, the cylinder heads must be removed and the gaskets renewed.

**Type 2J** engines are fitted with cylinder head gaskets that cover the whole of the cylinder head interface, the gasket itself incorporating holes for the cooling water jackets.

**Type 2G** engines are fitted with separate cylinder head gaskets (0,45 mm copper) and water jackets gaskets (3 mm acid-resistant rubber) on each side. Together these cover the whole area to be sealed.

## 52. REMOVAL OF CYLINDER HEAD (In connection with sections 50 or 51):

1. Remove pressure cap and empty anti-freeze mixture into an empty can. Unscrew starting cartridges (2G) (inlet manifold in the case of Type 2J engines).
2. Disconnect pipes from silencer and unscrew.
3. Remove cylinder head cover(s), injector pipes, rocker arm brackets (not Type 2J) and oil leak-off pipe to filter. Undo cylinder head nuts and lift off cylinder head.
4. If necessary, lap valves and valve seats with fine grinding paste.
5. Remove old gaskets and clean mating surfaces thoroughly. Clean out water temperature nozzles (2).

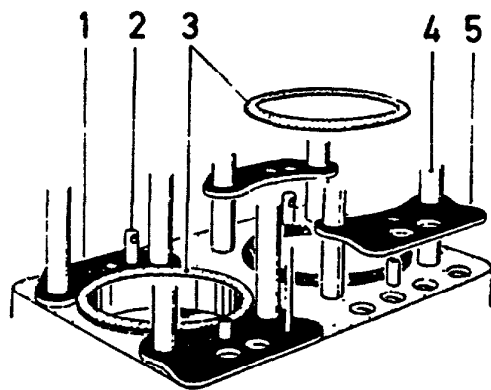


Fig 75

### Re-assembly:

6. **Type 2J:** Position new cylinder head gaskets on cylinder block and ensure correct fitting round cylinder liners.  
**Type 2G:** Place new cylinder head gasket rings (3) on liners with lip facing downwards. Then fit new water channel gaskets (1 and 5) down over cylinder head studs (4).
7. Refit cylinder heads and position cylinder head nuts, hand tight only. Fit silencer and secure before tightening down cylinder heads. Tighten nuts evenly and in a "cross-wise" sequence with a torque setting of 14 kpm for Type 2G, or 16 kpm for Type 2J.

## 53. CHECKING INJECTION TIMING

(See SPECIFICATIONS, technical data page 3):

Severe engine knocking not due either to mechanical noise or dirty nozzles with subsequent poor fuel atomisation, may be due to injection being too far advanced.

By varying the number of shims (fig 74, item 4) behind the injection pumps it is possible to advance or retard the injection timing.

The more shims that are used, the more injection is retarded. Every 0.1 mm shim thickness will decrease injection advance by approximately 1° crank

## CENTRIFUGAL GOVERNOR

(Forward end of crankcase, under governor cover):

The centrifugal governor serves to ensure that the engine maintains the set speed regardless of whether the engine is idling or on load. If the speed tends to fall, the governor will automatically compensate by increasing engine fuel supply so that engine speed remains at the value set. Similarly the fuel supply will be automatically reduced if the engine speed tends to increase.

711.044				
711.045		Regulatorfjer 1800 konstant	Heinz. 1439B	Diagram 03618
711.046		Regulatorfjer 1800 konstant	Heinz. 1210R	Diagram 03618
711.047		Regulatorfjer 1500 konstant	Heinz. FD1242	Diagram 03303
711.048		Regulatorfjer 1500 konstant	Heinz. FD1483	Diagram 03303
711.049		Regulatorfjer 2000 båt, ytre	Heinz. FD14100	Diagram 05581
711.050		Regulatorfjer 2000 båt, indre	Heinz. FD12111	Diagram 05581



#### 54. CHECKING OR CLEANING GOVERNOR (As required):

If governor operation is not satisfactory, check that all governor components can move freely. Stiffness or sticking can cause the engine to hunt. The governor can be inspected through the governor cover opening.

1. Carefully remove governor cover.
2. The governor pin (2) is loose and must be removed.
3. Undo nut (8) on forward end of crankcase cover (7) and withdraw governor via the cover opening.
4. Clean governor (2—5) and cover components in fuel oil. Remove thick oil and dirt.

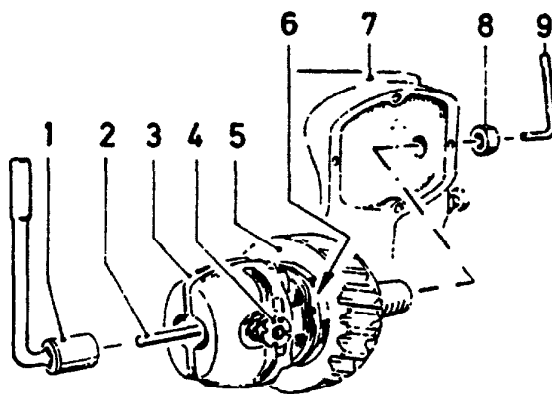


Fig 76

As the same time, using a hand inserted through the cover opening, check that the pump operating levers move freely and smoothly.

5. Apply lubricating oil to governor components. Refit governor through aperture and pass shaft spigot through hole in front casing. Fit washer and tighten nut (8) securely using key (9) (3/16" or 5 mm) to prevent shaft rotating meanwhile. (Torque setting 6—6.5 kpm.)
6. Refit governor pin (2) (45 mm) and replace cover. Ensure that the arm roller slides properly in the groove on the forward governor arm link. See page 47, step 5.

#### 55. RENEWING GOVERNOR BEARINGS (As required):

To renew the bearings, governor (3) and gearwheel (5) must be separated. First carry out steps 1, 2 and 3 above.

7. Mount governor in vice using shaft spigot hexagon. Straighten locking collar (arrowed). Using a 14 mm socket spanner inserted between governor weights (3), unscrew governor anti-clockwise (left hand thread).
8. Support gear wheel (5) and knock out bearing using two steel pins (1/8" diam) through holes in gearwheel (arrowed).
9. After pressing on new bearing, secure by centrepunching gear wheel rim. Refit governor and secure by bending down locking collar. Complete re-assembly with steps 4, 5 and 6 above.

## 56. TIGHTENING CYLINDER HEAD BOLTS

If cylinder head has been removed, the cylinder head bolts should be tightened after about 10 hours further running. First run engine until it reaches normal temperature then stop.

1. Undo and lift off cylinder head cover(s).
2. **Type 2G:** Rocker arm bracket nuts (fig 44, item 2, page 33) are removed and brackets (3) with rocker arm lifted off.  
**Type 2J:** Leak-off pipe, injector pipes and injector clamps are removed. Injectors are lifted slightly and tipped forwards but need not be fully extracted.
3. Tighten cylinder head bolts evenly and in cross-wise order, using torque wrench set at 14 kpm for Type 2G and 16 kpm for Type 2J. Tighten silencer bolts.
4. **Type 2G:** Refit rocker arms and adjust valve clearances. Replace cylinder head cover. Ensure that injector pipes lie centrally in the cover opening so that the rubber seals can seat correctly.  
**Type 2J:** Straighten injectors and ensure that guide pins are correctly located in cylinder head guide holes before clamping in place (Engines before 2J.76.31.).
5. Test run.

## 57. CLEANING OF SUMP AND STRAINER (Every two or three years):

The strainer is not removed for cleaning but can be rinsed through when cleaning out sump with fuel oil. The strainer need only be cleaned if oil pressure is low on starting (when the oil is thickest) and oil level is correct.

1. Close fuel cock, disconnect pipes from lift pump, filter and injection pumps. Remove crankcase cover without further dismantling (fig 72, page 50).
2. Clean crankcase internally with fuel oil. Suck out oil with syringe through crankcase opening.
3. Flush towards holes in sump oil strainer (visible through forward crankcase opening). Repeat several times. Dry crankcase carefully using paper wipes or lint free rags.
4. Fill with clean oil and replace cover. Ensure that guide pin in cover engages in holes in crankcase before securing.
5. Re-connect pipes. Bleed fuel system. Test run engine and check oil pressure.

## 58. VARIABLE PITCH PROPELLER

The propeller blade pitch is altered by means of the drive block (4), the whole shaft being moved in and out. The drive block thus both transmits the engine power and controls the pitch of the propeller blades.

The thrust bearing is located in the forward end of the propeller boss and consists of three nylon rings, two (2 and 3) to take the ahead thrust and one, the centre one (not shown), to take the astern thrust.

### Pitch Control Stiff:

A. If the pitch control is stiff to operate, it may be due to lack of grease in the propeller boss, poor alignment between engine and propeller shaft or to stiffness of the drive block within the propeller boss.

B. Check shaft alignment by inserting a feeler gauge between coupling flange and engine drive flange and then try with the two flanges disconnected.

If pitch control then works freely and the shaft alignment is correct, the boat must be slipped for examination of the propeller.

C. In the case of new engines, stiffness in propeller control may be due to incorrect assembly of the propeller components. Therefore check that the marks on the drive block, the propeller boss and one blade all point the same way.

D. If the stiffness continues after a period of use, it may be due to the propeller having struck some obstruction or having become fouled by rope etc.

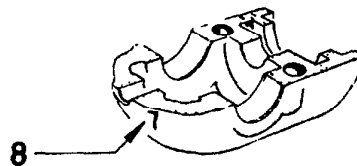
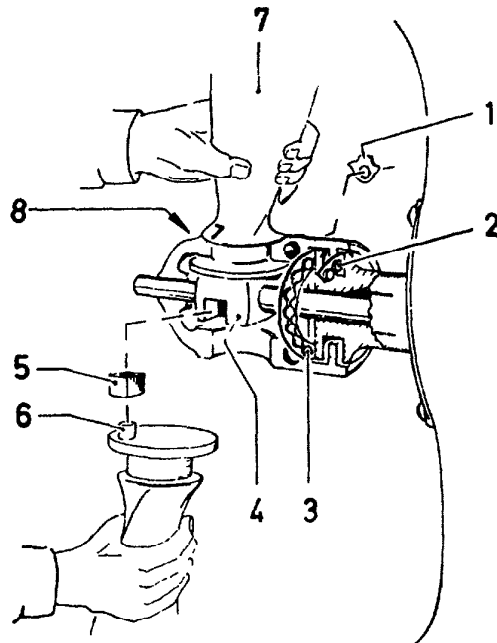


Fig 77

### Dismantling Propeller:

1. Clutch in neutral.
2. Straighten tabs on locking washers and undo boss screws using 22 mm socket spanner.
3. Remove boss and propeller blades. Check whether drive block (4) is cracked. If not, stiffness can possibly be cured by careful filing of the drive block faces.

If the drive block is cracked or loose on its threads, it must be renewed.

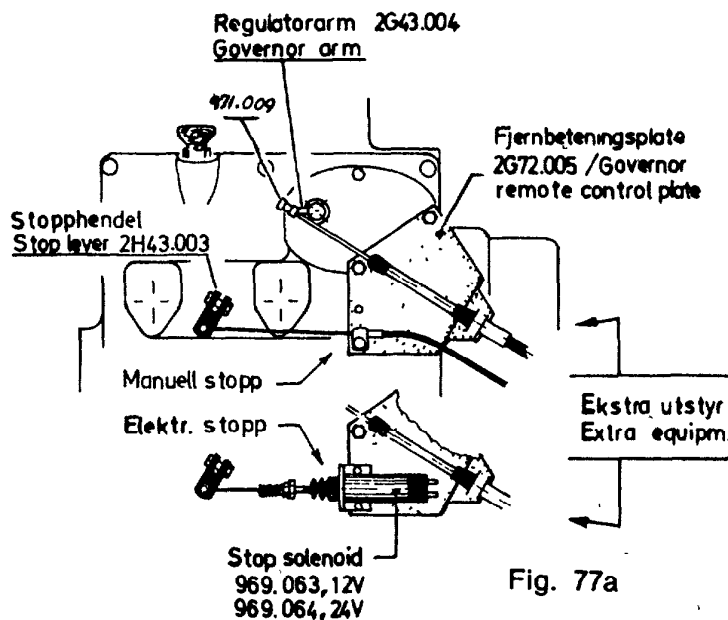
4. If the propeller blades are damaged, they must be repaired so that they are again identical. Any blade differences will cause vibration leading quickly to wear on the shaft.

### Re-assembly:

1. Fit blade tap blocks (5) to blade taps (6).
2. The marked blade (7) is positioned with its tap block (5) engaged in the recess on the marked side of the drive block (4). One half of the propeller boss (8) is then fitted in position from the port side in such a way that all the marks point in the same direction.
3. The other blade is then fitted with its tap block (5) engaged in the remaining recess in the drive block.
4. Fit the thrust rings, ensuring that the raised beaded side of each ring runs in contact with the corresponding bearing surface.  
Fill propeller boss with grease.
5. Fit the remaining half of the propeller boss and screw home. Secure with locking washers. Boss screw torque setting: 7.5 kpm.

**Renewal of Drive Block, see page 66.**

### REMOTE CONTROL ADAPTOR KIT (Governor and stop):



For engines with "HVP-15" and "Hurth" gearbox or engines with Borg Warner V-drive.

See also page 15.

Stop control mechanism (lever 2H43.003) is fitted on crankcase cover for all engine types 2G and 2J made after 2G.80.247 and 2J.80.242.

## G. REPAIRS

### 59. WITHDRAWAL OF PISTONS (As required):

Aluminium alloy pistons with 3 compression rings and one scraper ring. The top ring is chromed, No 2 ring is unchromed and No 3 is a combined compression and scraper ring with "nose". No 4 is a scraper ring.

In Type 2G engines the scraper ring is located below the gudgeon pin. In Type 2J engines all rings are above the gudgeon pin.

When withdrawing pistons, see Dismantling of Cylinder Head, page 53. For dismantling of crankcase cover, see page 50. Then proceed as below:

1. Disconnect internal oil pipes, page 50.
2. Undo connecting rod bolts (2) using 19 mm box spanner. Remove big end bearing cap (1) and big end half-bearings (not shown). Withdraw piston and connecting rod (3).
3. Repeat for other cylinder and make sure that big end half-bearings are not mixed up.
4. Pistons should be renewed if they show signs of cracking or if the upper ring groove is worn:  
For Type 2G, to 3.3 mm  
(originally 3.07 mm),  
For Type 2J, to 2.8 mm  
(originally 2.56 mm).

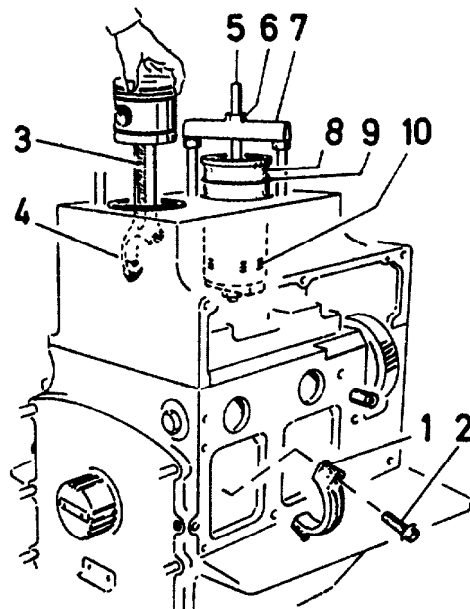


Fig 78

### Renewing Piston Rings (As required):

5. Remove rings from piston and try in cylinder lining to check for wear.
6. Renew rings if gap, with ring in cylinder liner, exceeds 2 mm, (originally 0.2 mm).  
For Type 2G: Piston ring set S1—G32b (Yellow).  
For Type 2J: Piston ring set 2J32.005 (Red).

### Running-in of new Piston/Piston Rings:

1/4 hour idling, 750 rpm. approx. — 1/2 hour with 25 % load and 1000 rpm. Gradually increase load during first 10 hours.

### Renewal of Gudgeon Pin or Small End Bush (As required):

1. Remove gudgeon pin circlips from piston. Heat carefully to 80—100° C, press out gudgeon pin and remove connecting rod.
2. Check clearance between gudgeon pin and small end bush. If clearance exceeds 0.10 mm (original 0.03 mm), press out bush and renew.

3. Press in new bush with oil hole upwards.  
Heat piston to 80—100° C. Fit gudgeon pin and connecting rod.  
Ensure that axial clearance is adequate. Refit circlips.
4. Ensure that combustion chamber on 2J pistons faces towards exhaust port.

## **60. WITHDRAWAL OF CYLINDER LINERS (As required):**

The life of the cylinder liners depends on how the engine is run, whether the operating temperature is correct and whether the lubricating oil is clean and of the correct grade. It is therefore not possible to lay down a definite life for the cylinder liners.

The liners must be regarded as worn when the bore measures 90.25 mm (2G) or 100.25 mm (2J), ie when the wear reaches 0.25 mm. Withdraw liners using extractor (fig 78).

1. For Type 2G: Extractor MVS—2. For Type 2J: MSV—2A.
2. The extractor (7) is laid diagonally across the cylinder head bolts with the cylinder head nuts as a support (directly on the bolts in the case of Type 2J).
3. The extractor screw (5) is passed through the central hole with shorter threaded end down. Bottom clamp is then positioned underneath liner and nut is threaded on.
4. Withdraw liner upwards by tightening top nut (6).

### **Fitting Cylinder Liners:**

Before fitting new liners, clean all surfaces. Also inspect water jackets  
Internal measurements of new liners are 90.00 mm/100.00 mm.

1. First confirm that liner (without O-rings) can be slid easily up and down in the block using hand pressure only.
2. Fit new O-rings (10) into the grooves machined in the outer surfaces of the liners. These provide the cooling water seal. Only the correct O-rings should be used, for Type 2G — SOR-68, 94.5×3<sup>ø</sup> and for Type 2J — SOR-70, 104.5×3<sup>ø</sup>. Apply a little lubricating oil. If the rings are not correct either the liner may be distorted or water leakage into the crankcase may occur.
3. Place new copper gaskets (9) in the cylinder block recesses or anneal and replace the old ones. Use the same number (Copper 0.45 mm) as before. For cylinder head clearances, see page 4.

- Fit liner (8) into cylinder bore. Ensure that it enters absolutely straight. Using a strong piece of wood on top of the liner, tap carefully home.

NB: Once in place in the cylinder block, the liner internal diameter must not be less than 90.00 mm for 2G and not less than 100.00 mm for 2J.

### Refitting of Pistons and Connecting Rods (fig 78):

New pistons have external diameter 89.90 mm for Type 2G and 99.90 mm for Type 2J. Piston clearance is thus 0.1 mm for new engines.

Both big end half-bearings (not shown) are held in place by raised retainer (4).

- Apply lubricating oil to piston rings, gudgeon pins and bearings before assembly. Feed pistons down into liners until they are approximately 20 mm from the top.
- Ensure that big end bearings and crankshaft bearing surfaces are clean. Apply lubricating oil. Place half-bearings round crankshaft with ends without retaining hole upwards and to starboard.
- Feed connecting rod up to the bearing and rotate half-bearings until raised retainer (4) engages in bearing retainer hole. Fit big end bearing cap and secure with bolts (2). Torque setting 17 kpm. Use only new bolts, otherwise their holding capacity may be weakened.
- Connecting rod and bearing should now be worked lightly to and fro, testing freedom of movement in four positions, up, down and sideways. If any resistance to motion is noticeable, the fault may lie in assembly or bearing clearance. This must be rectified to avoid overheating in use.

### 61. CAMSHAFT

Operation and control of inlet and exhaust valves, injection pumps and lift pump are performed by cam section 5 and 8, each with two cam lobes (Type 2G). The rear, wider cam lobe controls the exhaust valve lifters and the injection pumps as well as the fuel lift pump. The front cam lobe controls the inlet valves.

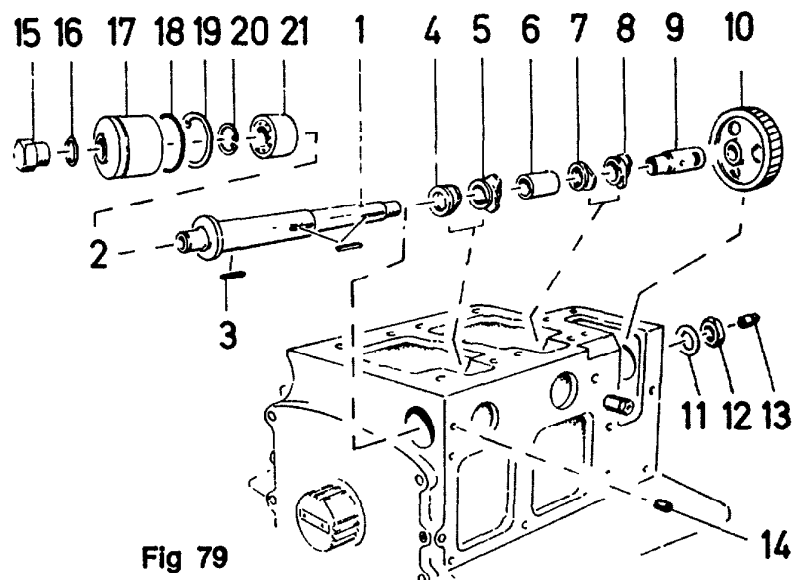


Fig 79

In Type 2J engines, cam sections 5 and 8 control only inlet and exhaust valves, the rear narrower lobe actuating the inlet valve. The injection pumps are operated by separate fuel cam sections (4 and 7) each with one lobe, the rear lobe (4) also operating the fuel lift pump.

The camshaft drive is taken from the crankshaft timing gear wheel (24) via idler wheel (23) to camshaft gear wheel (10).

When replacing a camshaft (1) it is necessary to dismantle crankcase cover, flywheel (use extractor MVS-3), flywheel guard, idler wheel and starting bracket.

For Type 2J engines the cylinder block should also be removed.

#### Dismantling of Camshaft:

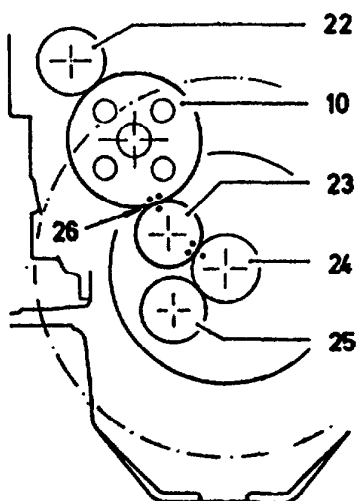


Fig 80

1. For Type 2G engines, remove push rods and support valve lifters in block with rubber bands to prevent them slipping down.
2. Remove idler wheel (23) by extracting circlip. Remove camshaft gear wheel nut (12) and washer (11).
3. Undo locking screw (14) with socket screw key (3/16" or 5 mm). Tap shaft carefully to the rear and remove camshaft gear wheel, cam gear sleeve and cam sections one at a time.
4. If necessary, dismantle rear bearing housing (15 to 21) for renewal of ball bearing (21).

#### Re-assembly of Camshaft

1. Put cam distance sleeve (6) into camshaft bore from the rear.
2. Camshaft (1), complete with rear bearing housing (2) and three keys (3), is inserted from the rear.
3. **Type 2G:** Rear cam (5), with wider lobe to the rear, is slide onto camshaft through rear inspection cover. The camshaft is fed forward through sleeve (6) and forward cam is slid on via forward inspection cover.

**Type 2J:** Rear fuel cam (4), with lobe forward, and cam section (5) with narrow lobe to the rear are slid onto shaft and key from above (as shown). The camshaft is fed forward through sleeve (6) and the forward cam sections (7 and 8) are fitted. Ensure that keys engage.



4. The cam gear sleeve (9) is fitted from the front, with transverse groove to the front, and the camshaft gear wheel (10) is fitted onto the shaft which is then moved forwards until the hole for the set screw (14) corresponds to the hole in the rear bearing housing. Tighten set screw with 3/16" socket set key.  
Use only 5 mm key for engines after 2G.75.431/2J.75.201.
5. Fit washer (11), nut (12) and tighten using torque setting of 17 kpm. Lock the nut. Finally fit idler wheel (23) ensuring that the timing marks (26) on the front faces of the three gear wheels are correctly positioned.

## 62. CHECKING SWIRL CHAMBER AND GLOW WIRE, TYPE 2G

(As required):

Use extractor MVS-1 (4—5—6).

The combustion chamber is located in the cylinder head. The upper part of the swirl chamber is machined out of the eccentric insert (1) which is pressed into the cylinder head and retained by the injector bolts.

The insert is fitted with a glow wire (3) which serves to facilitate starting and delay the onset of smoke in the exhaust. It is important that this is located correctly.

The insert has internal 5/8" Whit. threads and can only be withdrawn by using the extractor (4 and 5), the nut (6) being screwed down to pull out the insert. Never attempt to lever it out.

The insert is fitted with its thickest part (6.5 mm) to starboard, ie with the glow wire to the front corner. The end of the glow wire should be 2.5 mm to port and approximately 2 mm forward with respect to the centre of the chamber.

Before fitting the insert, the gasket (2) must be either renewed or annealed. Using a piece of wood on top of the insert, tap carefully into place.

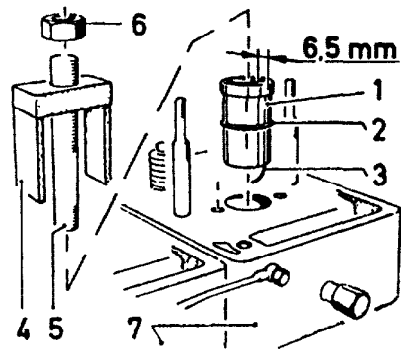


Fig 81

## 63. RENEWING OIL SEALS (Engines with pitch control) As required):

The seals must be renewed in the case of oil leakage or if water is leaking in.

1. Undo coupling flange bolts. If possible, withdraw propeller shaft to the rear (dismantle propeller, or remove engine mounting bolts and tip engine forwards).
2. Straighten locking tabs and knock ring nut (9) loose. Remove wash. (8).

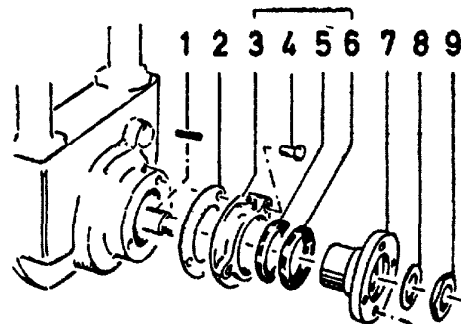


Fig 82

3. Place two wood blocks approximately 1" thick between coupling flange (7) and seal flange (3). Press coupling flange off by pressing pitch control handle forwards. If this is not successful, an extractor must be used.
4. Undo the bolts (4) and remove seal flange (3 to 6). Press out, or otherwise extract, oil seals (5 and 6) and clean the surfaces.
5. Fit new oil seals, both with open side inwards. The outer seal has a dust lip facing outwards. Lay a flat piece of wood against the seals and tap them in one at a time. Ensure that the grease nipple hole opening between the seals is not obstructed. Grease lightly.
6. Place key (1) in position. Screw up seal flange (3) and feed the coupling flange (7) carefully in over the intermediate shaft. Place locking washer over shaft, knock the nut tight and secure with locking washer. Fill with new lubricating oil.

### REVERSE GEARBOX "SABB" 2GRG/2JRG (Model H-1971):

The reverse gear works on the principle of self-adjusting cone clutches for ahead and astern drive. When the operating handle is moved, the whole propeller shaft assembly including gear shaft (fig 83, item 4) and coupling flange (7) is moved forwards for ahead drive and to the rear for astern drive. Propeller thrust holds the clutches engaged. To avoid any clutch slip when engaging drive, the handle should be operated using light pressure. As soon as the propeller begins to drive, the clutch will be held on. The handle must not foul against engine casing or other structure.

Because of the method by which the clutch operates, it is very important that alignment between engine and propeller shaft is accurate. Misalignment may cause the clutches to slip.

If there should be an appreciable amount of water in the boat so that the level could cause penetration of the seals in the rear end of the gear housing, any manoeuvring involving the gears should be avoided until the boat has been pumped out. This will prevent possible damage to the ball bearings behind the oil seals.

### REVERSE GEARBOX "HURTH" HBW-20 (From 1983 HBW-250):

The HBW-marine gearbox has servo-automatically controlled helical gear transmissions. The clutches are of the multiple disc type, permitting the use of one-lever engine/gearbox control. Slow down engine speed before operating the clutch. Only in emergency operate clutch at high speed.

**Lever movement:**

Movement NF-NR must not be less than 35 + 35 mm when measured for the outer holes, and 30 + 30 mm for the inner holes. See sketch.

The control cable must move easily.

**Lever positioning:**

Neutral position should be at right angle (90 degrees) to the control cable. Adjust the lever by loosening the clamp bolt and turn to correct position. Tighten well. Check regularly.

**NOTE:** Minimum distance between actuating lever and the cover 0,5 mm. Adjustment and opening of the cover only by specialist.

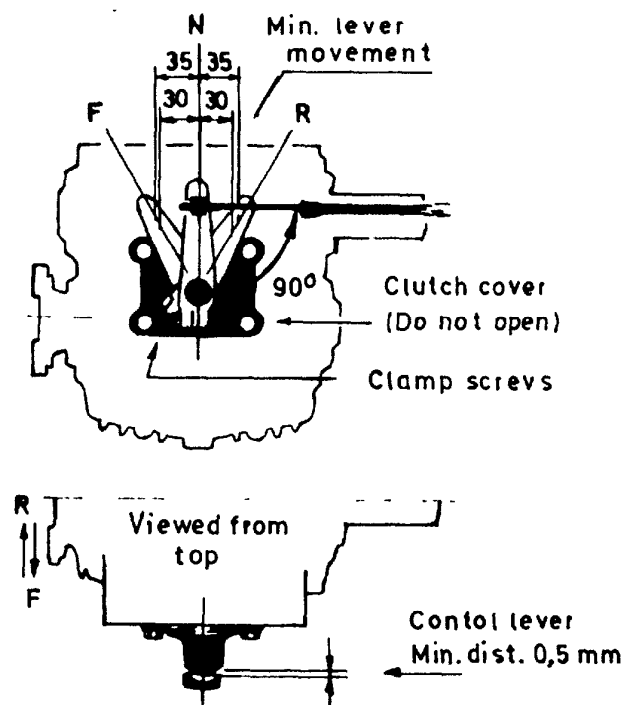


Fig 82a

## 64. RENEWAL OF OIL SEALS (Reverse Gear Engines) (As required):

1. Remove dipstick and pump out lubricating oil.
2. Remove coupling flange bolts and ease propeller shaft and after coupling flange approximately 9 cm to the rear. It usually pays to undo the engine mounting bolts so that the engine can be tilted forward.
3. Straighten locking tabs and knock ring nut (9) loose. Remove locking washer (8).
4. Set gear handle position fully to the rear. Position two wooden blocks, about 1" thick, between coupling flange (7) and gearbox flange (3). Press off coupling flange by pushing gear handle carefully forwards. If this is not effective, an extractor must be used. Take care of the key (10).
5. Lever oil seals (5 and 6) out of gearbox flange (3) and clean sealing surfaces.
6. Insert new oil seals, both with open sides facing inwards. The outer seal has a dust lip facing outwards. Place a flat piece of wood over the seals and tap them in, one at a time. Apply a little grease. Ensure that the grease nipple hole between the seals is not obstructed.
7. Position the key and ease the coupling flange (7) carefully onto the gear shaft (4). Fit the locking washer, knock the nut tight and lock with locking tabs. Fill with fresh oil. Refit propeller shaft.

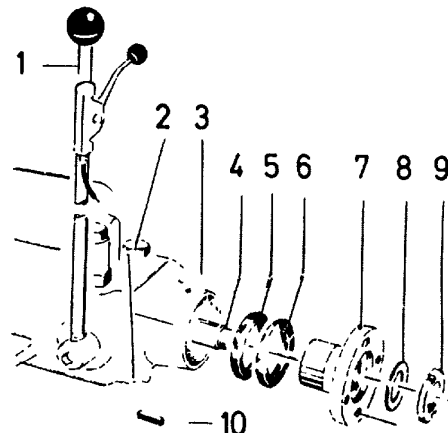
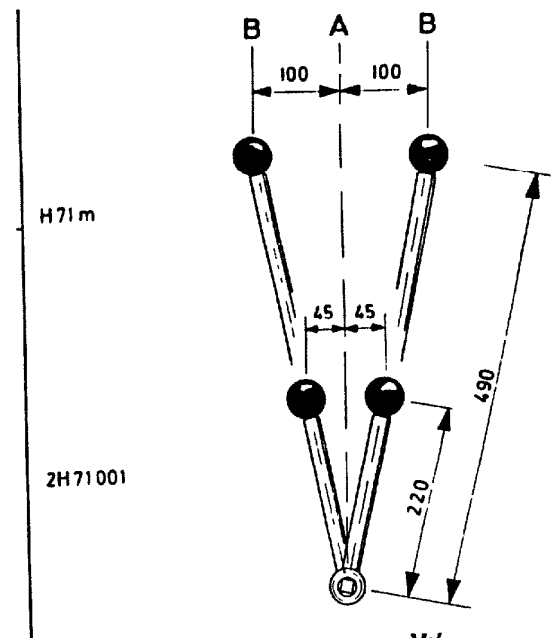


Fig 83

## 65. GEAR HANDLE TRAVEL

If the ahead clutch cone lining becomes worn after a long time in use, the handle will need to be pushed further forward to engage the clutch. This travel can be adjusted using shims between the clutch cone forward face and the ballrace on the shaft spigot in the gear housing (2).

Similarly, if the astern clutch cone lining becomes worn, the gear handle backward travel can be reduced by removing shims from the forward end of the ballrace in the operating sleeve (3).



See serv. instr. No 90.B

### Check:

1. The correct gear handle travel from Neutral (A) to Ahead (B) or Astern is approximately 100 mm.
2. This is a major repair and should be carried out by a SABB workshop or other approved agency. Detailed instructions will be supplied on request.

## 66. RENEWAL OF SHAFT DRIVING BLOCK

The propeller shaft is manufactured from stainless steel and has parallel threads. A replacement block may be tinned and sweated in position but securing with Loctite is preferable. The wear tube should be removed at the same time, cleaned and resecured using Loctite or sweating.

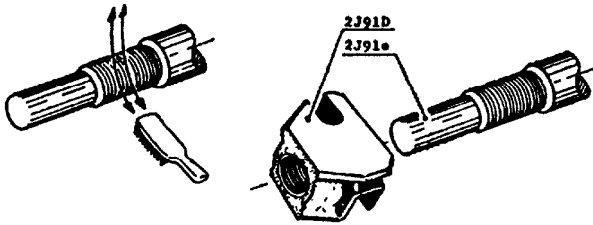


Fig 85

1. Clean shaft threads thoroughly and remove all grease. Use Loctite Activator T or trichlorethylene. The residue of any previous Loctite is most easily removed by heating the threaded length *carefully* using a gas flame (maximum 200° C). Clean out threads with a wire brush.

Remove any loose material.

2. Use LOCTITE 307 as locking compound and LOCQUIC ACTIVATOR T as activator.  
Apply LOCQUIC ACTIVATOR T to threads in driving block and on propeller shaft, and to wear tube and shaft. Wait for the volatile component to evaporate and then apply LOCTITE 307 evenly and thinly. This is most easily done using a small clean brush.  
Fit the wear tube over the end of the shaft and immediately screw on driving block so that wear tube is pressed into position. Tighten hard, for example using a large spanner.
3. The driving block must be fitted to propeller boss and blades by careful filing of the driving block surfaces and one block face should be marked to ensure that it is fitted the right way round.  
Check that propeller blade tap blocks move freely in the driving block grooves.
4. Setting time for Loctite varies from 1 to 4 hours depending on temperature. Setting can be accelerated by warming the ready assembled parts to 100° C for 10 minutes, for example by using boiling water.  
If the propeller shaft is to be fitted immediately and the boat refloated, it is best to wait at least 4 hours before using the engine to ensure satisfactory setting.

## H. WINTER LAYING UP

Before laying the boat up for the winter, protect the engine as follows:

Change oil in engine and clutch or reverse gear. For engines with Hurth gearbox or Borg Warner V-drive: Fill up the gearbox with hydraulic oil. Grease all nipples.

Close gate valve and allow engine to idle for half a minute to expel any water from the exhaust hose.

Drain water from engine, silencer, water pump and piping.

For sea water cooled engines, flush cooling system through with fresh water.

For fresh water cooled engines engines with closed systems, there is no need to drain if antifreeze has been added. See "Fresh Water Cooling". If the system is drained, any external cooler must be blown through dry it.

For fresh water cooled engines with closed systems, there is no need to drain if antifreeze has been added. See "Fresh Water Cooling". If the system is drayned, any external cooler must be blown through dry it.

If a heat exchanger is fitted, the gate valve must be closed and sea water drained from the heat exchanger. Open impeller pump cover, remove impeller and replace cover.

Unscrew starting cartridge plugs (Type 2G) and spray 10 shots (about 10 cc) of lubricating oil into each cylinder. For 2J spray lub.oil via start oil pipes. Turn the engine over a few times. Repeat once or twice during the course of the winter.

Clean engine externally and touch up with engine paint.

Keep engine covered.

Drain off any condensed water in the fuel tank and top up with fuel.

The battery should be recharged two or three times during the course of the winter.

Disconnect the coupling flanges and separate slightly. This will ensure that the shaft will not be damaged of the hull should distort during the lay-up.

## PREPARATION AFTER LAY-UP

When preparing the engine after a winter lay-up, it pays to spend as much time on the work as necessary. When the boat has been refloated, the engine alignment should be checked.

If the engine is supported on rubber mounts, the adjusting nuts (D) above and below the support frames should be checked. Also check the bolts (E).

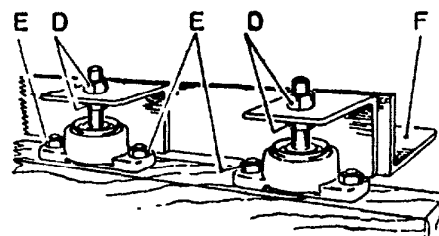


Fig 86

### **Fresh water cooled engines (without antifreeze):**

Suction and return hoses must be connected to the engine and to the external cooler. Fill system with clean fresh water.

Fresh water cooled engines filled with antifreeze, see Winter Use, page 38.

### **Sea water cooled engines:**

Close drain cocks. Make sure that gate valve is open and that the exhaust hose is connected to the silencer.

Fit a fully charged battery and connect it as shown in the wiring diagram.

NB: Never start the engine before alternator and regulator have been connected to the battery. Adjust V-belt tension.

Check that there is fuel in the tank. Drain off sediment.

Check that there is oil in the engine and clutch or gearbox.

Grease all nipples and propeller boss.

### **RECOMMENDED ON BOARD SPARES**

For long journeys or holidays, we recommend that a standard maintenance spare parts kit should be held on board.

These kits contain a selection of those gaskets, hoses and spare parts that experience has shown to be most useful.

For Type 2G—2GZ:	Maintenance Spare Parts Kit V—13
For Type 2GRG—2GHR:	Maintenance Spare Parts Kit V—13A
For Type 2J—2JZ:	Maintenance Spare Parts Kit V—14
For Type 2JRG—2JHR:	Maintenance Spare Parts Kit V—14A

Also available:

Maintenance Set of Gaskets P-4 (2G) and P-12 (2J) (incl. in V-kits)

Repair Set of Gaskets P-5 (2G) and P-6 (2GRG)

Repair Set of Gaskets P-13 (2J) and P-14 (2JRG)

O-Rings and Oil seals O-16 (2G) and O-17 (2J).

Lift pump maintenance set	AC 7950298	.. . . .	(944ka)	944.004
			(incl. in V-kits)	
Lift pump repair set	AC 7950293	.. . . .	(944kb)	944.005

# IRREGULAR ENGINE OPERATION

## Fault Location

### 1. ENGINE FAILS TO START

- a. Governor handle not in full speed position.
- b. Cranking speed too low.
- c. Damp or faulty starting cartridge (Type 2G only) or dry cylinder walls.  
Lubricate with 6 shots from oil can through starting cartridge plug holes or start oil pipes (Type 2J).
- d. Injection pumps not working.
- e. Faulty injection (page 54).

### 2. LACK OF COMPRESSION

- a. Check correct valve clearances (0.3 mm) (page 44).
- b. Check that valves are not sticking by pressing them down by hand. If necessary squirt fuel oil through valve springs and onto valve spindles while pressing them down.
- c. Partially burnt starting cartridges may have formed residue on valve seat (2G). Listen for air escaping past valve when engine is turned by hand (page 53).
- d. Check decompression valve setting (page 43).
- e. Check piston rings (page 59).

### 3. ENGINE HARD TO CRANK

- a. Engine oil too thick.
- b. Misalignment in propeller shaft. Check at coupling flange (page 17).

### 4. LACK OF POWER

- a. Fuel oil filter blocked. Renew filter element (page 32).
- b. Air in fuel system (page 32).
- c. Dirt in injectors 2G—page 33, 2J—page 34).
- d. Clutch slipping (page 48).
- e. Incorrect valve clearance (page 43).
- f. Blocked exhaust. Kink in rubber exhaust hose.
- g. Lack of compression (see above).

### 5. ENGINE STOPS

- b. Lack of fuel. Fuel cock closed.
- a. Air or water in fuel system (page 32).
- c. Rope round propeller.
- d. Piston seized in cylinder. Allow engine to cool. Turn over by hand to test compression. Re-start and load up slowly. At the end of the run, test compression again and, if necessary, remove piston. If scoring has occurred, hone piston and bore using a fine oilstone.

## **6. SMOKY EXHAUST**

- a. Dirt in injectors (2G—page 33, 2J—page 34).
- b. Worn piston rings and poor compression (page 59).
- c. Engine overloaded, propeller pitch too great.
- d. Leakage past valve. Clean and lap (pages 43 and 53).
- e. Air inlet blocked (2G—page 45).
- f. Poor fuel or lubricating oil.

## **7. UNEVEN RUNNING, HUNTING**

- a. Governor parts sticking (page 55).

## **8. ENGINE WILL NOT IDLE**

- b. Valve leakage (pages 43 and 53).
- a. Dirt in injectors (2G—page 33 2J—page 34).
- c. Governor idling spring too slack (page 47).
- d. Blocked fuel filter element (page 32).

## **9. EXCESSIVE LUBRICATING OIL CONSUMPTION**

- a. Oil leakage past defective seals.
- b. Cylinder liners and piston rings worn. Check wear and renew rings if necessary (page 59).

## **10. LOW OIL PRESSURE**

- a. Lubricating oil too thin (page 21).
- b. Too little oil. Pump sucking air.
- c. Sump oil strainer blocked (page 56).
- d. Oil pressure gauge or sender unit defective.
- e. Dirt in oil pressure relief valve (page 50).
- f. Lubricating oil pipe leakage.

## **11. ENGINE KNOCKING**

- a. Dirt in injectors. Leak-off pipe blocked.
- b. Cold running. Check cooling water temperature (page 37).
- c. Injection too far advanced or poor atomisation.
- d. Mechanical failure. Check valves, big end bearings and gudgeon pins.

## **12. WATER PUMP NOT FUNCTIONING**

- a. Check water pump diaphragm (page 40).
- b. Check water valve (page 39).

## **13. COOLING WATER BOILS**

- a. Fresh water cooling—page 37. Cooling water—page 36.



#### 14. KNOCKING SOUND FROM CLUTCH OR PROPELLER

- Lack of grease on sliding bolts. Lubrication sketch on page 27.
- Sliding bolts loose. Avoid running at low engine speed where this causing knocking. Renew sliding bolts.
- Propeller boss loose.
- If sternpost is too thick, this can give rise to knocking at the clutch when at full Fair off sternpost to give smooth water flow to propeller.

#### 15. PITCH CONTROL HARD TO OPERATE

- Grease propeller and sliding bolts. Lubrication sketch on page 27.
- Bent propeller shaft. Check at flange coupling (page 17).
- Propeller damaged.
- Poor greasing of propeller (page 26).

#### 16. ENGINE NOT RUNNING EVENLY ON BOTH CYLINDERS

- Check injectors. Cross them over if necessary.
- Check compression on both cylinders.
- Adjust governor arm link (page 47).

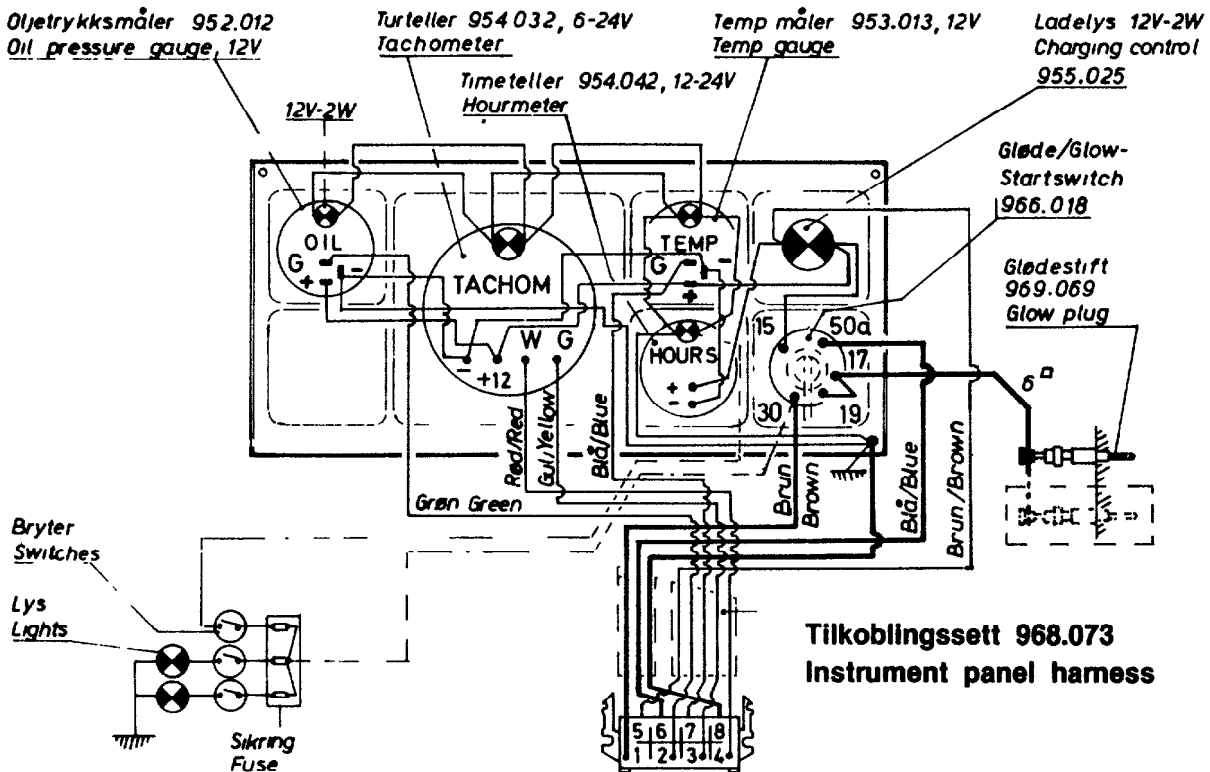
#### 17. LUB. OIL LEAKAGE INTO WATER JACKET

- Overpressure in crankcase forces oil up around cylinder liners (O-rings) and into water jacket.

Cont. from page 10 and 11:

### LARGE INSTRUMENT PANEL 951.024, 12V

(with tachometer, 'hourmeter, glowplugs — extra equipment):



Cont. from pages 22 and 25.

## GEARBOX. TYPE BORG WARNER V-DRIVE

The "Borg Warner" V-drive, gearbox contains 4.3 liter of Automatic Transmission Fluid (ATF), type A (not included cooler and hoses).

The Velvet Drive hydraulic circuit includes the transmission, oil cooler (1), oil hose (2) to cooler and hose (3), return from cooler.

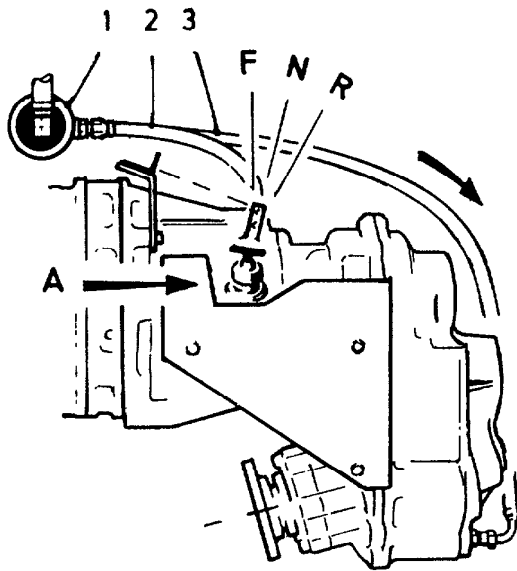


Fig 87

### 2A. CHECKING GEARBOX OIL LEVEL (Daily):

1. Unscrew dipstick (A) and wipe clean.
2. Insert dipstick fully and withdraw to read oil level.
3. Top up if necessary. Replace dipstick and screw home.

Note that dipstick reading is dependent on engine mounting angle.

### 11A. CHANGING GEARBOX OIL (Hydraulic oil (ATF), type A) (First time after 25 running hours, later every 400—500 hours or annually):

1. Unscrew dipstick (A) and wipe clean. Insert oil removal syringe through dipstick opening and pump out into an empty can.
2. Unscrew the return hose (3) at the lower end of gearbox and drain. Replace the hose and screw home.
3. Fill with clean hydraulic oil (ATF), type A.  
Note that dipstick reading is dependent on engine mounting angle. Run engine at idle a few minutes to fill up the cooler and hoses.
4. Stop engine. Withdraw dipstick and read oil level. Top up if necessary.

NOTE: The latest gearboxes have dipstick fitted into rear housing part. Item 2 is then unnecessary to do.