INSTRUCTION MANUAL

SM – 75 / 90

Solé, S.A.

INTRODUCTION

Whe thank you having selected our SM-75 and SM-90 Diesel engine four your use.

BEFORE SETTING THE ENGINE RUNNING, it is important to read the operation and maintenance instructions contained in this booklet closely to follow them strictly.

If you have any doubt or query on your engine or in case of breakdown, please contact the nearest dealer where you will receive due attention.

ATTENTION

So that spare parts deliveries may be exact and immediate, it is extremely important to give the details listed below in your order:

a) Type of engine (given on the nameplate).
b) Engine number (given on the top of the block, fuel injection pump).
c) Number and description of the required part.

OBSERVATIONS: The descriptions and illustrations given in this instruction booklet are not binding. Therefore, whilst maintaining the main features of the engine decribed and illustrated here, SOLE, S. A., reserves all rights to make modifications in parts, details and acessories as may be required for any technical or commercial reasons.

TABLE OF CONTENTS

1 - PRECAUTIONARY MEASURES WHEN USING THE ENGINE

- Always use SOLE DIESEL and keep an eye on oil pressure when the engine is functioning.
- Use clean fuel, free of dirt and impurities.
- Do not let air or water enter the fuel circuit.
- If the starter engine pinion does not couple with the crown wheel when you start the engine, turn the key again when the engine has come to a complete rest.
- Pay attention to the colour of exhaust gases.
- Clean and change the oil and fuel filters regularly.
- Follow the instructions given when doing an oil-change.
- Check that water coolant is circulating properly through the engine.

SAFETY PRECAUTIONS
¡ BEWARE DANGER !

- Fuel is inflammable. DO NOT SMOKE while refuelling or when in the engine-room. There should be NO BARE FLAME ABOARD while refuelling.
- Exhaust gases are toxic. Ensure exhaust fitting is properly installed.
- Keep the engine-room well ventilated.
- Stop the engine when refuelling with diesel.
- Abide by the manufacturer's battery instructions. The acid in the battery is caustic and toxic. Battery gases can ignite. Keep well away from sparks and bare flame.
- When dismantling or assembling, never stand under the engine while it is suspend in the hoist. Ensure the hoist is in good working order.
- Keep a properly functioning fire extinguisher at hand.
- Do not use starter spray. Danger of explosion.
- Important warning for sailboats: If you are attempting to use the engine to leave the shore in heavy seas and the boat is leaning, the engine should not be at a lean of over 30 degrees for more than a few seconds. Otherwise the engine may fail and the craft will run aground.

¡ ACCIDENT PREVENTION !

- Do not touch moving parts while the engine is on.
- Never remove the refrigerator cap while the engine is hot. It could cause severe burns.
- To avoid burns, do not touch the engine unless wearing suitable gloves.
- Keep the area around the engine free of grease and oil to avoid accidents caused by slipping.
- Switch the engine off when doing maintenance jobs.
- Wear protective goggles when doing air-compression jobs.
- Do not keep engine fluids, such as coolants, etc., in containers that could be confused with drinks.
- Avoid contact with fuel and lubricants. Use protective gloves. Used oil has been shown to cause skin-cancers in laboratory animal testing.
- When checking fuel-injection nozzles never place your hand under the fuel-jet.
- Keep loose clothing and long hair away from moving engine parts.
- The engine should only be handled by one person at a time.
- Ensure tools are in good working order. Worn tools can slip and cause accidents.

¡ ENGINE AND CRAFT PRECAUTIONS !

- Do not overexert the engine. Abide by instructions for proper use.
- In the event of malfunctioning: ascertain the cause as soon as possible. otherwise you the risk of causing further engine damage.
- Do not undertake engine repairs or maintenance unless you are experienced in doing so.
- Do not replace parts with any other than original spares.
- If you have undertake emergency repairs at sea, take all proper safety precautions.
- Maximun lean for the engine-mounting is 20 degrees.
- The engine should not be running at a lean of over 30 degrees for more than a few seconds.
- Do not use salt-water or corrosive fluid as a coolant.
- The cooling system should always be topped up. If there is not enough coolant, the engine may overheat.

- Always shut off the sea-water inlet tap before undertaking work on sea-water cooling systems. Failure to do so has been known to sink the craft.
- If the craft is to be out of use for some time, shut off the sea-water inlet tap. Crafts have sink due to faulty cooling pipes.
- When carrying out welding work, abide by the "Instructions for welding work" supplied. Battery clips should be removed while undertaking wealding work on the boat.
- When working on the electrical system, remove the ground clip from the battery.
- Reconnect as the last step of the operating to avoid short-circuiting.
- Never turn the starter key while the engine is still running, as this will damage the regulator.
- Ensure the gear lever is in neutral before starting the engine.
- Do not set the contact key to the "start" position while the engine is running, as this will damage the starter pinion.
- When connecting battery leads do not mix up the battery poles.
- Never change gear while the engine is running at over 750 rpm.
- Never run the engine while dry, i.e, without coolant or lubricant.
- Only use recognised fuel suppliers. Impurities in the fuel can cause serious damage.
- Ensure the control lights are working properly.
- Never shut off negine suddenly when hot. Leave ticking over on idle for five minutes to avoid subsequent boiling over.
- The sea-water pump should never be allowed to run while dry, ortherwise you may damage the rotor wheel. Always open the sea-water inlet tap before starting the engine.
- After starting, check to see taht water-coolant is coming out of the exhaust pipe. If not, shut off the engine immediately and find out why.
- Never put cold coolant into a hot engine, as this may rupture the engine block.
- When topping up with engine oil never overstep the maximum mark on the oil-gauge as this could damage the engine.
- Do not leave the engine running on idle for more than 10 minutes, as this may carbonize the cylinder and piston

- Never change gear/rpm suddenly from forward to reverse gears. Remember that with the sahft engaged, it will only go into gear if the lever has meshed properly. It must be moved gently into forward or reverse, otherwise you may damage the gears.

¡ ENVIRONMENTAL PRECAUTIONS !

- Warning: Dispose of used oil tat authorised sites. Used oil must not be allowed to seep into the soil or drainage systems otherwise there is a danger of poisoning drinking water.
- Used filter ad well as anti-corrosive and anti-freeze substances are toxic waste and should be disposed of at authorised sites. Cylinder head gaskets contain asbestos and are also toxic waste materials.
- Abide by local waste disposal standards for treating used coolant.
- When refuelling never tip fuel into the water. Keep oil-absorbing substances at hand at all times. Wipe up splashes immediately afterwards with an absorbent cloth. Keep the cloth in a safe place. Oil-stained clothing should be changed immediately.
- Do not leave the engine on idle for longer than necessary, as it harmful to the environment.
- If you have to scrap your engine, remove all oil before taking it to the scrapyard. Inform staff at the scrapyard that the head gasket is toxic waste.

SAFETY AT SEA

Before setting off, go trhoungh the following check-list:

- Is there enough fuel in the petrol tank?
- Is the petrol tank cap screwed back on tightly?
- Is there enough oil and coolant in the engine?
- Ara the batteries charged?
- Check for leaking fuel. If you see any, find the leak and repair it.
- Is the sea-water inlet tap open?

Is there enough life-saving equipment aboard for each of the passengers? Check the following:

- Have all passengers been instructed on the use of life-saving equipment?
- Are theare suitable extinguishers aboard in good working order?
- Ensure that all passengers know what to do ina fire emergency and where the extinguishers are located.
- Explain to passengers all that is neccessary to ensure their safety. When mishaps occur there is never time to explain safety measures.
- Do you have enough navigation maps aboard?
- Have you listened to the weather report?

2-SPECIFICATION

	SM-75	SM-90
Type:	Diesel, vertical, 4-stroke, water cooled	
Cylinder number:	4 in line	
Cylinder diameter:	88,9 mm. (3,50 in)	95 mm. (3,74 in)
Stroke:	101,6 mm. (4,00 in)	105 mm. (4,13 in)
Total cylinder capacity:	2.522 cc. (153,91 in)	2.977 cc. (181,60 in)
Compression ratio:	21:1	
Power/rpm DIN 6270-A:	60 HP. (44 KW) 3.400	74 HP. (53 KW) 3.400
Power/rpm DIN 6270-B:	72 HP. (53 KW) 3.600	88 HP. (64,8 KW) 3.600
Idling minimum rpm:	750 - 800	
Gear box:	Mechanical - hidraulic optional	
Ignition sequence:	1 - 3 - 4 - 2	
No-load weight with gear box:	293 Kgs.	295 Kgs.
Maximum assembly angle:	15° continuous - 18° intermittent	
Oil capacity: Engine:	6,25 liter	
Gear box:	0,8 liter	
Oil type:	See pag. 58	
Cooling:	Tap water with thermostatic control and heat exchanger. Cooled exhaust manifold.	
Cooling water capacity:	13 liters	
Injection pump:	Indirect: Model: Diesel Kiki Type: Bosch "VE"	
Injector:	Gas butterfly type	
Injector pressure:	135 - 140	
Electrical system:	Seee diagrams pags. 40, 41 and 42	
Starting engine:	12 V. - 2,7 KW.	
Alternator:	12 V. - 60 A.	
	Glow plug shearthed type	
	60A. general fuse	
Battery capacity	12 V. - 60 Ah x 2	
Dimensions: Length:	1.012 mm.	
Width:	665 mm.	
Height:	692 mm.	

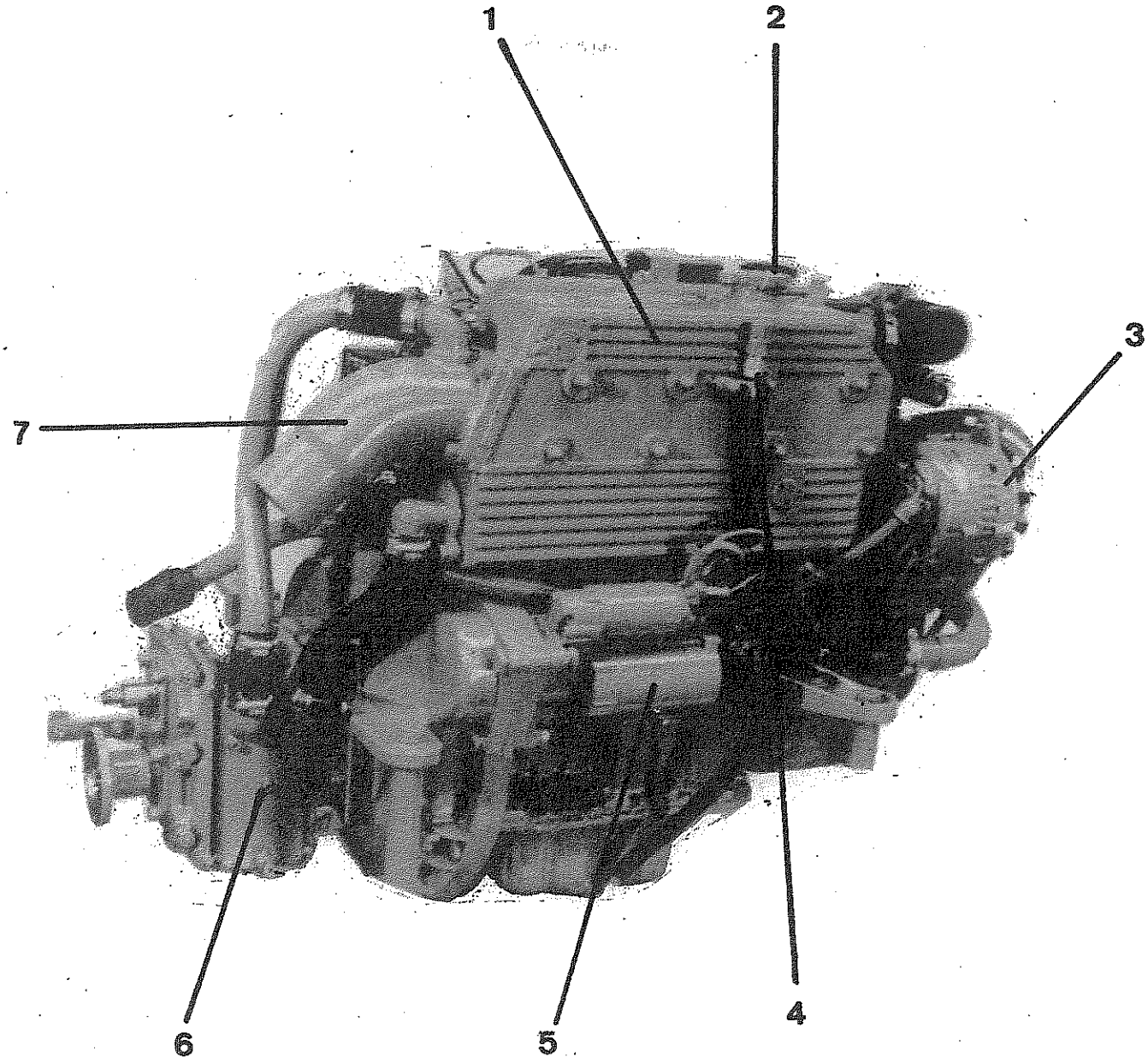


Figure 1

1 Exhaust manifold water cooler
2 Tap water filling plug
3 Alternator
4 Site where oil ejection pump is placed
5 Starting engine
6 Gear box
7 Wet exhaust elbow

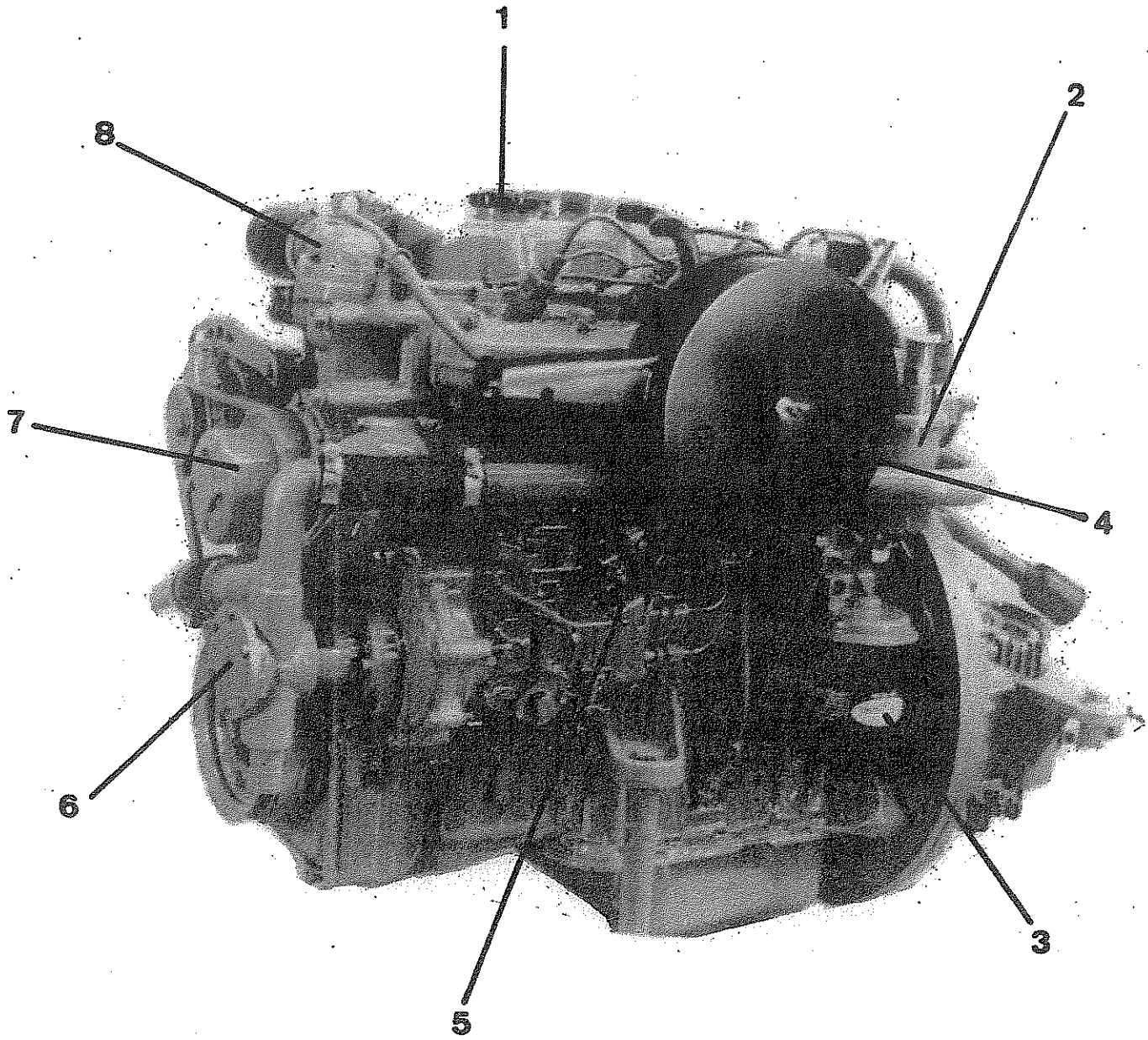


Figure 2

1 Oil filling plug
2 Gas-oil filter
3 Oil filter
4 Air filter
5 Injecting pump
6 Seawater pump
7 Tap water pump
8 Thermostat

3 - USE

3.1 - BEFORE COMMISSIONING

Your new engine requiros 50 operating hours for the running-in of all its movable elements and the performance of a high yield. Carefully perform this running-in, bearing in mind the following points:

PRECAUTION

- Daily checking performances must be made without failure.
- Engine is to be operated at idle speed and heated up minimum 5 minutes after its starting.
- Avoid a speeded-up acceleration.
- Carefully comply with the inspection and maintenance instructions shown in this manual.

3.2 - PRE- ARRANGEMENTS BEFORE COMMISSIONING

1) Engine and inverter oil filling.

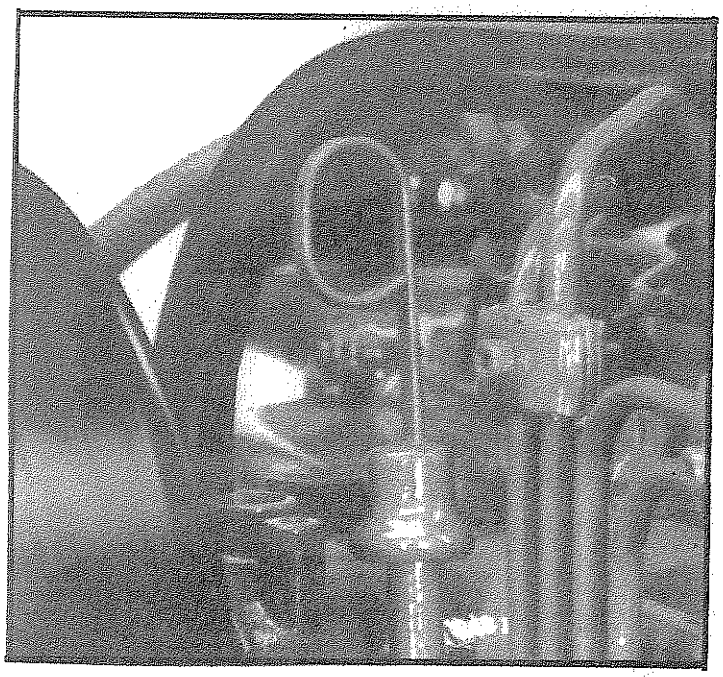


Figure 3

Fill inverter up to the level shown in the rod, through the rod hole (Figure 5). Use the same oil type as in the engine.

Fill engine with oil as shown in page 58 up to the upper limit of the rod mark (Fig. 3). Through the filling plug (Fig. 4).

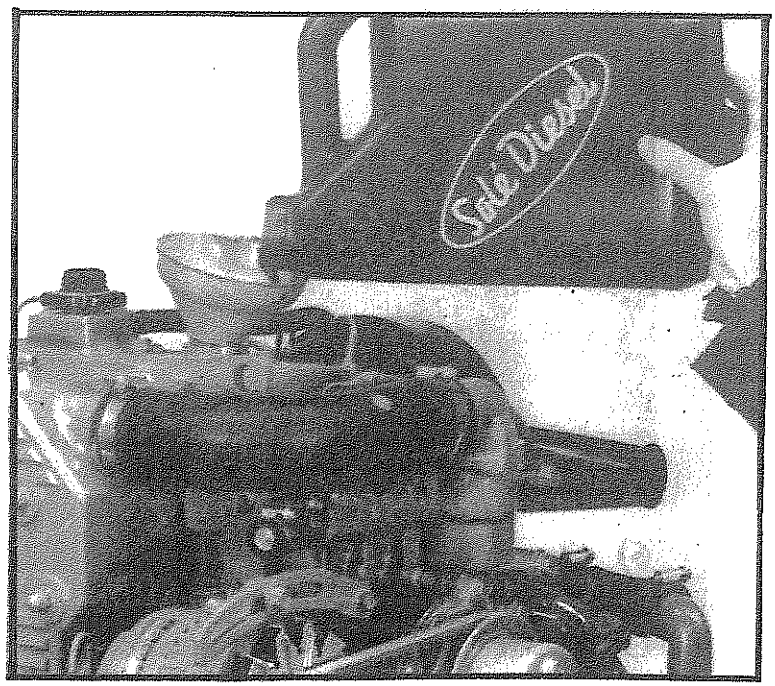


Figure 4

2) Fuel tank filling

Fill fuel tank with clean and filtered gas-oil. Check tank is fully cleaned without iron or polyester particles.

Open the fuel delivery cock.

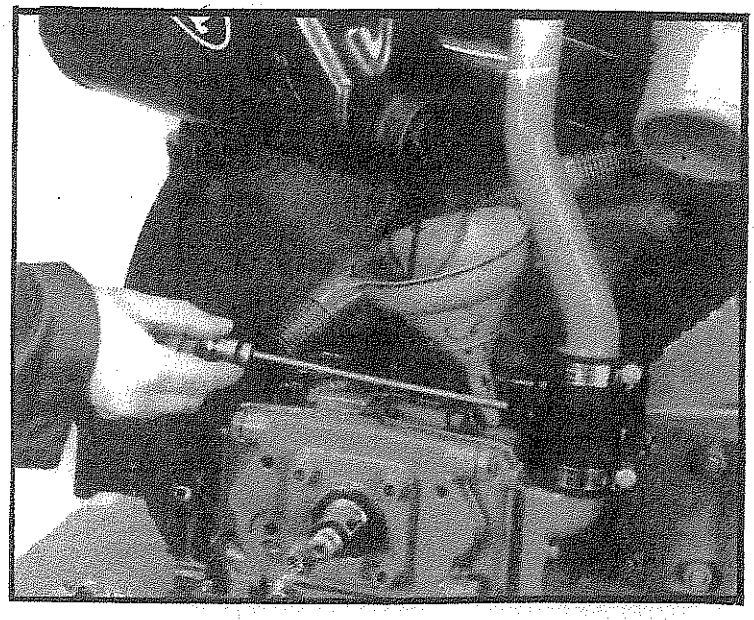
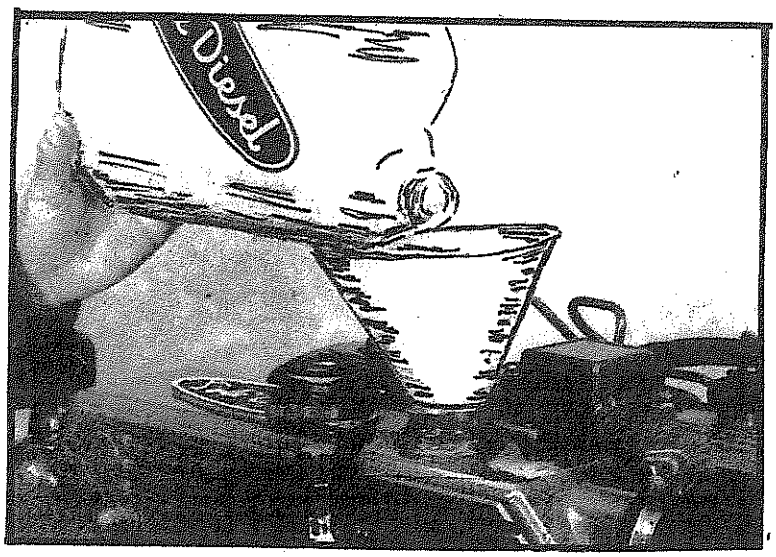


Figure 5

3) Water circuit filling

Fill circuit with clean water by previously pouring a 1 % homologated anticorrosive product (10 cm^3/l.) up to the filling hole. Antifreeze should be added in winter (Fig. 6).



4) Open seawater entry cock

5) Fuel circuit dranaige

Purge the fuel filter. (For more details, refer to "Fuel cicrcuit drainage", chapter 4.2).

Figure 6

6) Connection of the battery disconnector

Connect the battery connector.

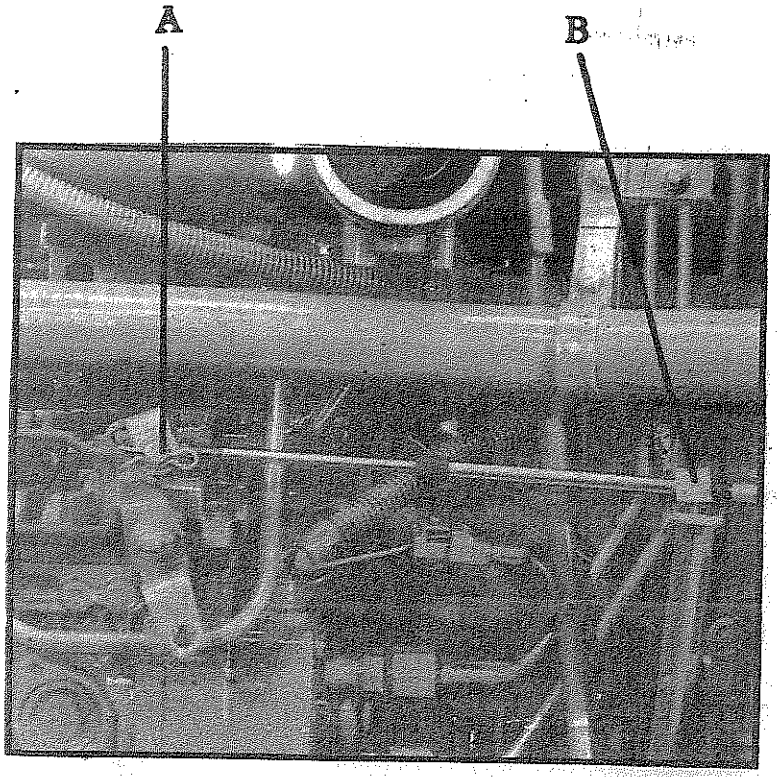


Figure 7

7) Remote control connection

a) Engine

Connect control cable to the ball-joint fitted to the lever (A) and position the cable with the clamp (B). Adjust in a way that gas is not delivered until the inverter gear is engaged (Fig. 7).

b) Gear box

Connect control cable to the lever by means of the ball-joint provided for this purpose and position cable with the clamp.

When fitted, adjust control in a way that it has the same forward running that rearward and gas is not delivered until the gear is perfectly engaged (Fig. 8).

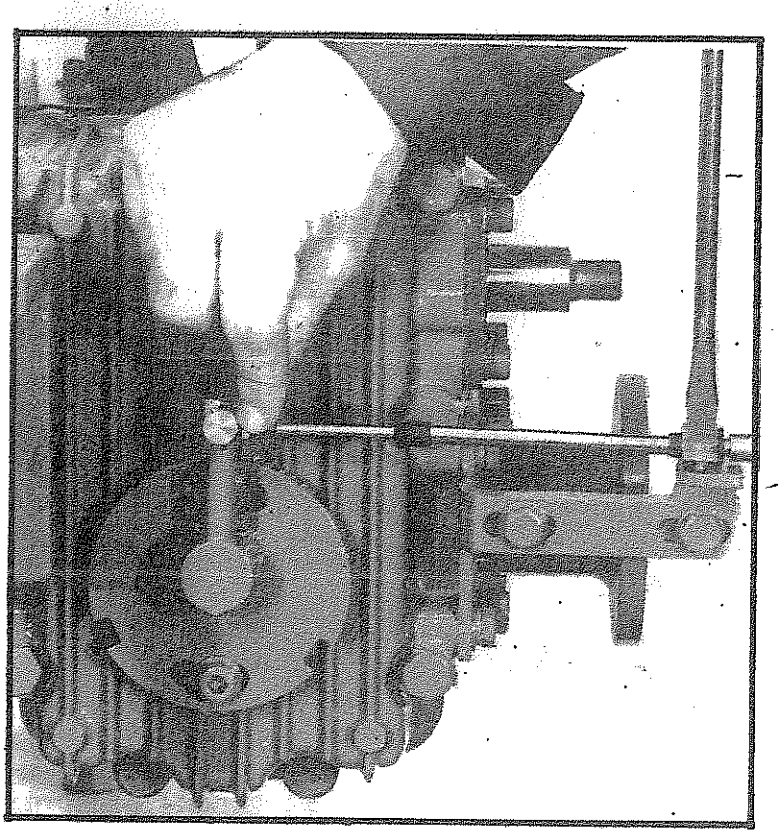


Figure 8

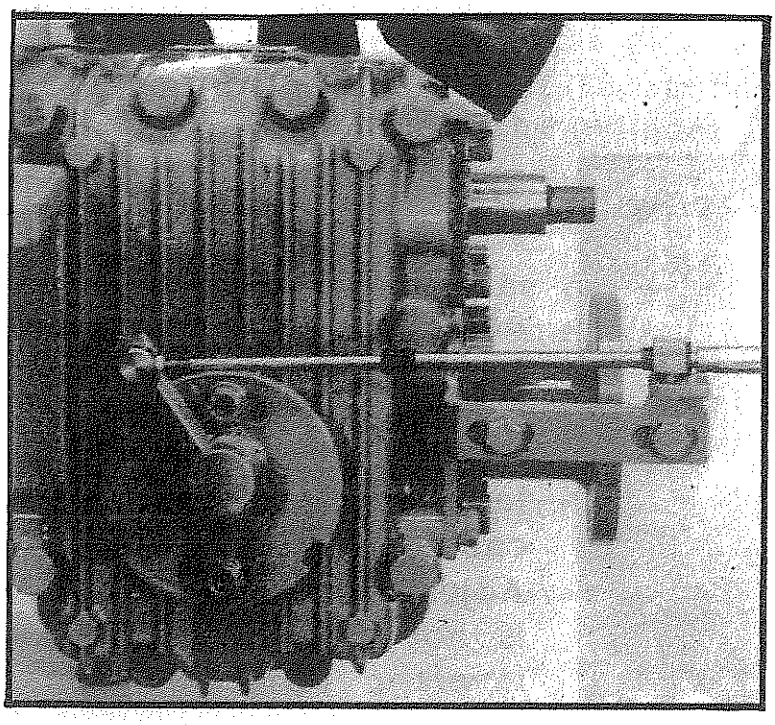


Figure 9

To check fitting is correct, proceed as follows:

Place the inverter lever and remote control lever in the position of forward running.

Adjustment is made by way of the elongated holes of the control and the elongated holes of the cable attachment support (Fig. 9).

8) Other checkings.

a) Carefully check the engine positioning points.
b) Check all screws are correctly tightened.
c) Check all water, oil and gas-oil pipe nipples, verifying if all them are well connected and correctly tightened.
d) Check exhaust and transmission systems.

3.3 - COMMISSIONING

1) Place control lever at the neutral point.

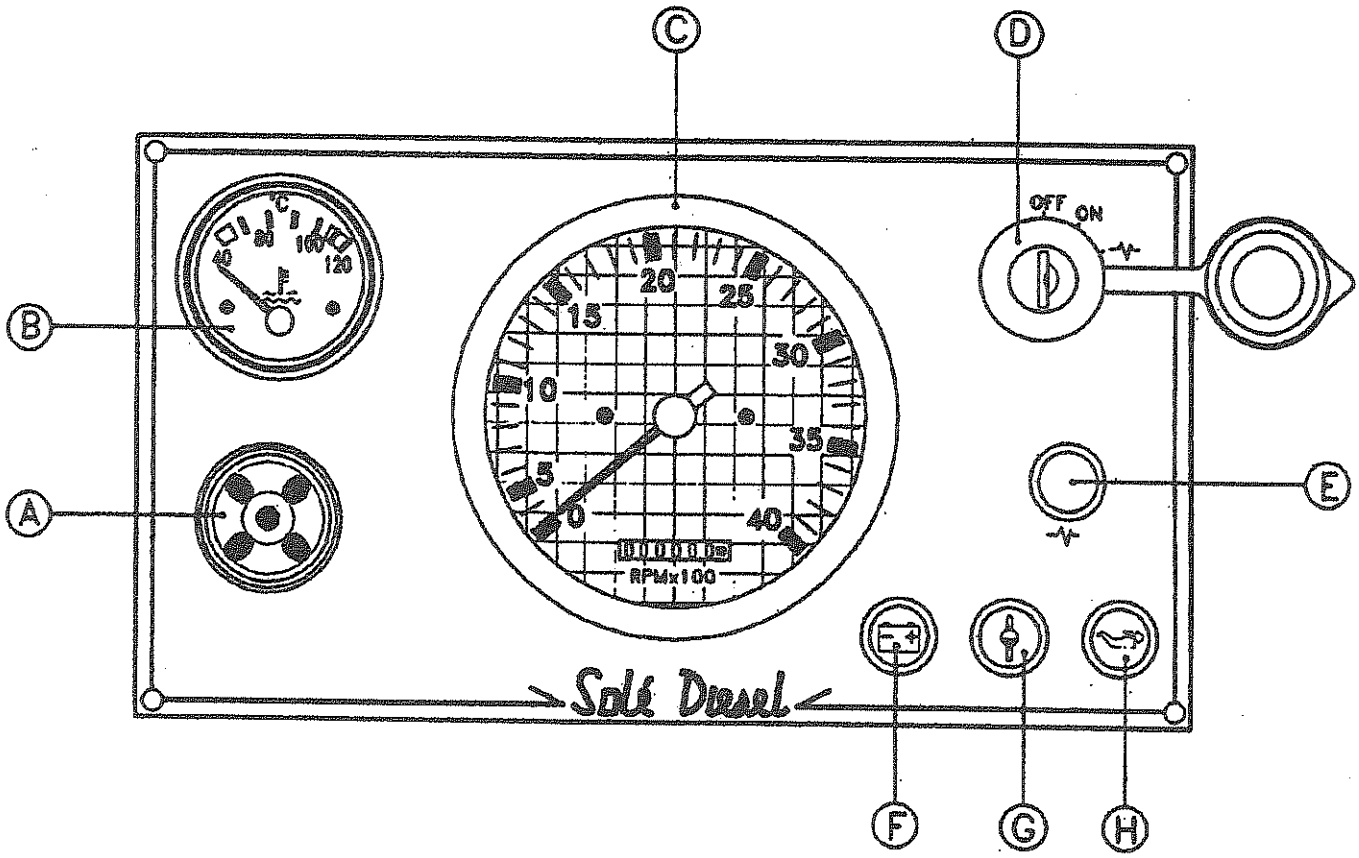
2) Rotate the starting key (D) to position "ON". Check oil pressure (H), battery charge (F) lamps are lighted and the alarm (A) is heard (Fig. 10).

3) Pre-heating of incandescent spark plugs.

   Rotate starting key to position ~ (pre-heating), until the green pilot light is illuminated (E) (Fig. 10).

   The appropriate warm-up time is the time the green pilot ligth is illuminated. The engine is fitted with a timing relay to regulate the warm-up time. If the pilot light does not become illuminated, it should be checked by a SOLE Service Station.

Figure 10



4) Starting

Place the remote control lever to neutral point and deliver gas up to the half position, rotate the starting key to the "START" position until the engine starts running. If the engine does not start running, even with the starting key in the "START" position for 10 seconds, draw your hand out from the key for 30 seconds and then try again to start the engine, if necessary heating again the spark plugs. Never allow the starting engine to operate more then 30 seconds.

Once the engine has fired, release the ignition key to allow it to return automatically to the "ON" position and leave it there while the engine is runing.

After the starting operation, check oil pressure and battery charge lamps are switched off.

5) Heating

Heat the engine for approx. 5 minutes, allowing it to run with no-load at half feed.

CAUTION

The engine during the running must not undergo a starting key rotation at the "START" position since if done the starting motor will be damaged.

If engine is heated, the pre-heating operations should not be done. In this case, directly rotate the starting. Key to the "START" position until the engine is running.

Once the engine has fired, release the ignition key and this will return automatically the "ON" position.

3.4 - STARTING PRECAUTIONS AND OPERATING PRECAUTIONS

1) Usual starting

a) Check inverter and engine oil level and add oil if required.
b) Fill gas-oil to the tank.
c) Check cooling water level and add water if required.
d) Start the engine according to the instructions in the previous pages.

2) Starting in cold weather

When the atmospheric temperature is under zero, the five circumstances set out bellow are happening. In these cases, the engine should be started as shown.

a) The lubricating oil turned viscous.
   - Pour hot water into the cooler.
   - Check oil used is the recommended one. Check also oil has not ben apolled.

b) Voltage running by the battery terminals is reduced.
   - Protect battery against cold, covering it with a suitable material.
   - Check battery is fully charged.

c) The injection air temperature is low and engine is not easily started.
   - Allow incandescent spark plugs to heat as required.

d) The fluid becomes more viscous.
   - Accumulation of impurities in the tank causing insufficient combustion. If necessary, replace it whit one more appropiate for low temperatures.

e) Increase of the charge during start-up.
   - Check the oil viscosity, also check the electric system charge.

3) Precautions during the running

- Check cooling water is flowing.
- Check water or oil leakages are not caused.
- Check oil pressure lamp is switched off.
- Check exhaust smoke is as follows:
  - while the engine is cold: white smoke.
  - when engine is being heated: almost no smoke.
  - when engine is somehow overcharged: some black smoke.

CAUTION

All gears shall always be engaged with engine at idle speed.

WARNING

So as to avoid a quick spoiling of the engine, the system overload should be prevented. This overload migth be caused by an unsuitable propeller, by an incorrect installation (restricted exhaust pipe, incorrect aligning of the main components) etc. It is essential then to check at full power (at full running) the engine rpm which must be lower than 3600 rpm.

3.5 - STOPPAGE

1) The engine revolutions shall gradually be reduced until idle speed is reached and place clutch at neutral point.

2) Turn the ignition key (D), Fig. 10 to the "OFF" position.

   Battery will be discharged if left at the "ON" position.

   To avoid it to happen, draw the key out after the engine is stopped.

   If engine is not to run for a longer period, it is advisable to shut fuel and water cocks and also to disconnect the battery.

CAUTION

The stoppage does not operate if the key is not connected to "ON" position. Never stop engine immediately after running at full power or when the cooling water temperature is high.

Allow the engine to rotate a minimum number of revolutions fort a short period.

4 - MAINTENANCE

4.1 - LUBRICATING SYSTEM

1) Oil with the correct viscosity

Oil with the suitable viscosity to the ambient temperature should be used according to the table of page 58 (Service data). A multigrade oil is recommended for all seasons.

2) Oil pressure

An oil pressure suitable or not during engine operation is shown by the oil pressure alarm lamp and also by the alarm horn.

- During current operation:

  Oil pressure is usual if the lamp is switched off.

- At the starting time:

  Lamp shall be lighted and horn sounding.

Lamp is lighted during the usual operation in case the oil pressure lowers under 0,2-0,4 kg/cm^2 and in such a case refer to SOLE technical assistance service.

3) Oil change

a) Engine

Engine oil should be changed after the first 50 operating hours and afterwards every 100 hours.

Oil shall be changed with a hot engine so as to be sure the oil is fully drained.

This is done by removing the stopper and mounting the drain pump located on the oil filter side of the engine (Fig. 11).

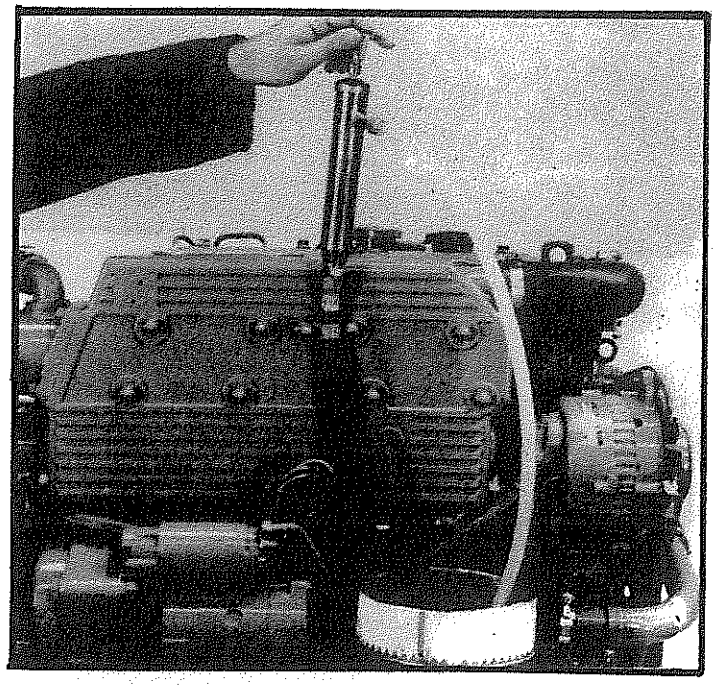


Figure 11

When drained, fill with fresh oil, with the quantity shown 6,25 l., through the plug located at the rocking cap no. 1 of figure 2.

The engine should then bo operated at the idle speed for some minutes until the control lamp of the dash-board is switched off.

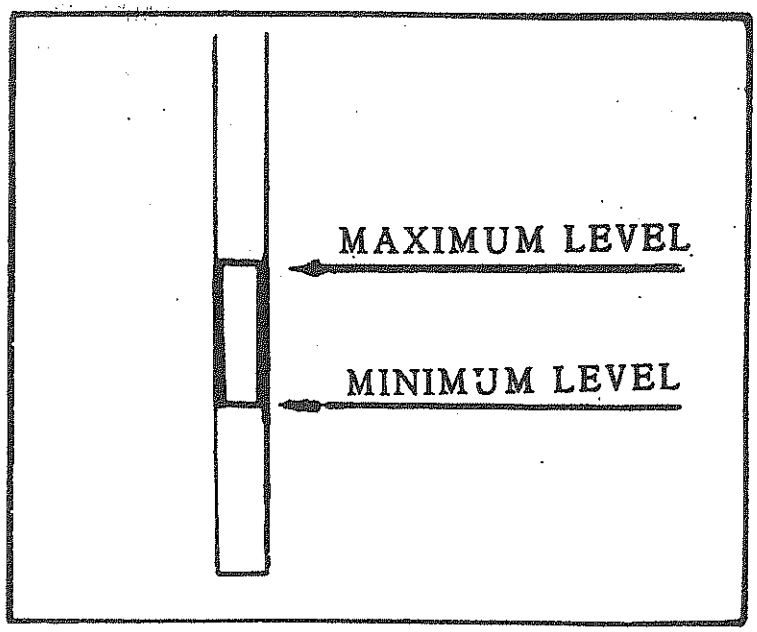


Figure 12

While carrying out this operation, avoid setting the engine running.

Stop the engine. Check filter and engine sealing. Then check oil level, removing the rod, cleaning it with a rag and placing it again by tightening. Then remove the rod again to check oil level and if then the upper mark is not reached, carefully add more oil up to the upper mark of the rod (Fig. 12).

NOTE:

Be careful that any rod marks refer to the engine at a horizontal position.

Therefore, check the engine inclination when the level is verified.

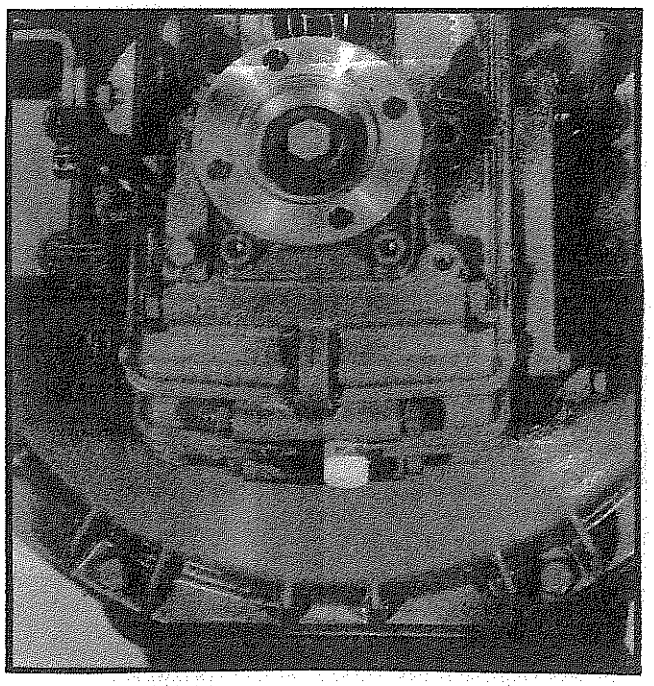


Figure 13

b) Gear box

The gear box is self-lubricated with independence from the engine.

To perform an oil change, drain the used oil by removing the plug located at the lower rear side (Fig. 13).

When drained, tighten the plug and fill with fresh oil through the hole of the level rod (Fig. 5).

Change the oil after the firts 50 hours and thereafter every 200 hours, or once a year if you don't do the number of hours indicated.

4) Oil filter

The oil filter is located under the air filter no. 3 of figure 2.

Change the oil filter after the firts 50 operating hours and afterwards every 100 hours.

The oil filter being a cartridge type of easy handling shall not be cleaned.

To remove the filter, use a tool ref. H-180.24.051 and a wrenck of 26 mm (Fig. 14) (only for spare ones).

USE IT ONLY FOR REMOVAL.

When fitting a fresh oil filter, smear a small quantity of oil into the annular seal and firmly tighten it with the hand.

When this operation i finished, start the engine and check oil is not leaking.

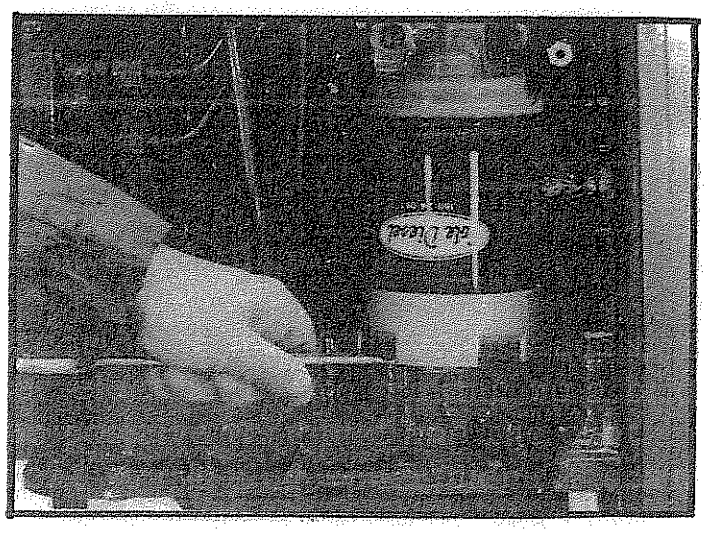


Figure 14

4.2 - COMBUSTION SYSTEM

1) Gas oil

Always use filtered and cleaned gas-oil. Never use kerosene nor heavy oils.

Fuel filling must be made with anticipation. In clod weather, much water steam is caused when there is too much air within the fuel tank. Therefore the tank must be kept full as much as possible.

When filling the tank see that impurities and water are avoided by always using clean plastic containers and have the fuel filtered.

Additionally be careful the tank has not any water nor dust.

Check all tank filling plugs located at the boat deck are sealed.

2) Fuel system drainage

When performing the firts engine running and if the engine has been operated with an empty tank, air might be caused in the combustion system and this air shall be drained.

Proceed as follows:

a) Slacken off screw (1) situated on the filter holder cover (Fig. 15).

b) Completely slacken off the priming pump (2) (Fig. 15).

c) Repeatedly press and release the pump (2) until air bubble free fuel spurts out of the filter screw (1).

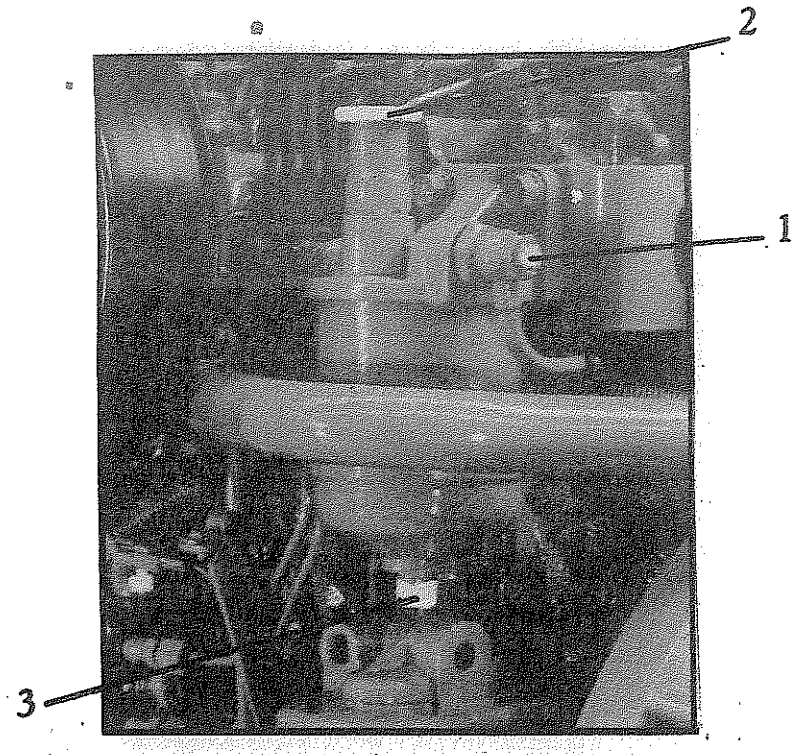


Figure 15

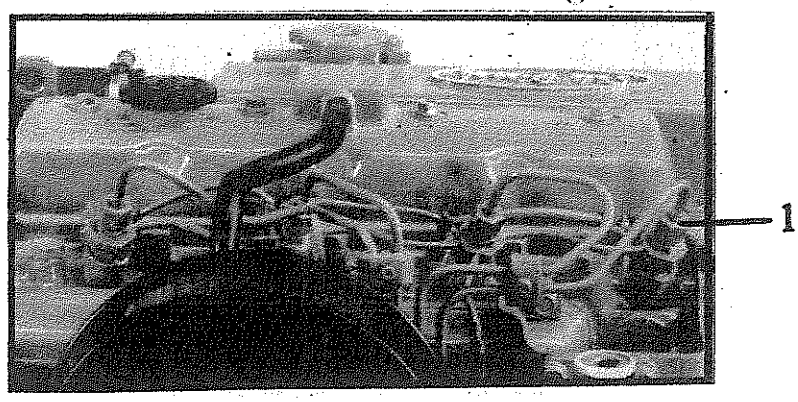


Figure 16

Then tighten the filter screw (1) (Fig. 15).

d) Continue operating the filter pump (2) (Fig. 15) 6 or 7 times.

e) Slacken off the four injection tubes (1) in Figure 16, turn the ignition key to the "START" position and operate the engine until air bubble free fuel spurts out of the four injection tubes. Then, tighten up the four injection tubes (Fig. 16).

f) Check fuel cock located at the tank delivery is open.

CAUTION

Be careful not to allow the starting motor to run for more than 30 seconds continuously at a time.

Once these operations have been terminated, set the engine running following the instructions given in Section 3.3 (start up). Page 17.

3) To drain fuel filter

The regular gas-oil used contains water from condensation. This water may resiously damage the injection pump and injection nozzles.

To prevent this, the fuel filter is fitted with a decanter cup in which the water accumulates. Drain this cup every 100 hours as follows:

- Slacken off the screw (3) in Figure 15 at the bottom of the filter a few turns while placing a small container underneath it, to prevent the water falling on the oil filter and retighten when water-free fuel flows out.

  Then check for air and if there is any, purge again as per Section 2) page 26.

4) Change of the fuel filter

The fuel filter is cladded and cannot be cleaned, it must be replaced every 200 hours and at least once a year.

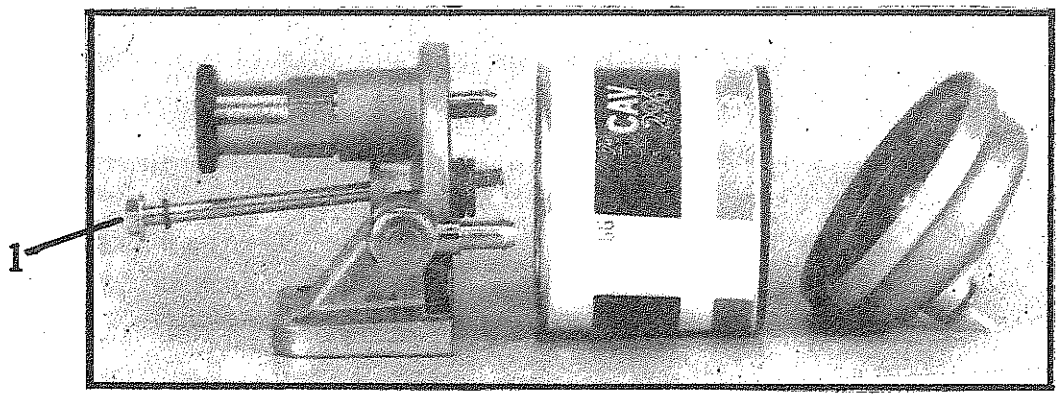


Figure 17

To perform the filter change:

a) Shut off the cock located at the tank delivery.

b) Slacken off screw (1) in Figure 17 located at the top off the filter and replace the filter element and at the same time replace the rubber seals.

c) Carry out the operations listed in Section 2) Fuel system purge, on page 26.

5) Fuel injection pump

The fuel injection pump is one of the most relevant components of a Diesel engine and therefore its handling requires the best care. In addition, the injection pump has carefully been adjusted at factory and should never be adjusted carelesly. Said adjustment, whenever is required, shall be made by a SOLE licensed service shop, since a precision pump monitor and skill knowledge are required.

The requirements for the handling of a fuel injection pump are the following:

- Always use fuel which is without impurities.
- Fuel filter shall be changed at the scheduled time.

6) Injectors

Injectors shall be detached after a prolonged winter or when failure symptoms are perceived.

CAUTION

Injector change and its tare must be performed by SOLE DIESEL or a licensed shop.

7) Idle speed adjustment

The screw nut placed in behind of the gas lever shall be loosened and tighten or loosen the nut, if the idle speed revolutions are wanted to be increased or decreased (Fig. 18). The nut should then be tightened.

This operation of correctly adjusting the idle speed must be performed when the engine has reached the operating usual temperature.

The idle speed rate is from 750 to 800 rpm.

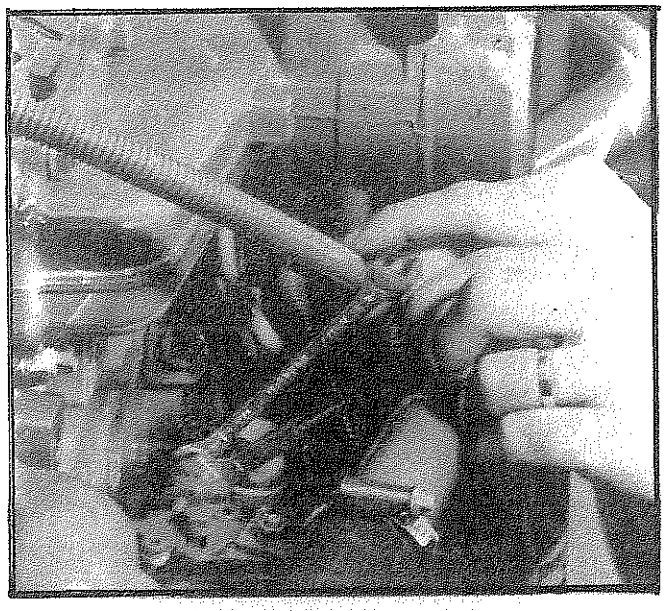


Figure 18

CAUTION

Never tamper with the sealed bolts.

4.3 - COOLING SYSTEM

The engine is cooled with tap water which in turn will be cooled with seawater.

1) Tap water circuit

As cooling water use clean water with minimum impurities such as tap water (Never use rain water). Dusty or hard water use is causing engine fouling with subsequent cooling rate reduction.

Before water is poured into the cooling circuit, add to it 1 % (10 cm^3/l) of a homologated anticorrosive product to avoid oxidation and corrosion of the cooling system and a cooling reduction due to corrosion.

If the danger of low temperatures is envisaged, i.e. temperatures under 0°C, an antifreeze product should be added to the cooling water. Otherwise expansion of frozen water can cause cracks and damages in the block and cooling body.

The antifreezing rate depends on the expected temperatures.

The antifreezing agent manufacturer, in the package labels is giving the instructions to be followed at each case.

However, in the following box, suitable rates are set out in accordance with temperatures:

Antifreezing stength, %	13	23	30	35	45	50	60
Freezing °C temperature (°F)	-5 (23)	-10 (14)	-15 (5)	-20 (-4)	-30 (-22)	-40 (-40)	-50 (-58)

Recommended antifreeze solution can be used during a six month current operation without draining. When the six montss are elapsed, antifreeze shall be drained, made a good cleaning and again prepare an antifreeze solution (never fill up any shortage).

Before antifreeze is again poured check cooling circuit is cleaned.

NOTE

It is advisable the antifreezing agent strength is selected based on a temperature which is approx. 5° C under the actual atmospheric temperature.

Cooling circuit capacity:
13 Liters

a) **Tap water pump**

The tap water pump is located at the engine center forward side, alternator side (no. 7- Fig. 2) and is driven by the same trapezial belt (V-belt) than the alternator. Is said belt is thinly tensioned, the engine can then reheated.

Therefore, the belt tension shall regularly be checked and adjusted if required (Fig. 19).

b) Thermostat

The thermostat is a key component of the engine life, therefore, it is not advisable nor convenient to remove it, since in hot weather it does not absolutely affect the water passage to the interchanger or heat exchanger, on the contrary if it goes to another weather with very low temperatures, the time to take the service temperature is delayed so early wear can be caused.

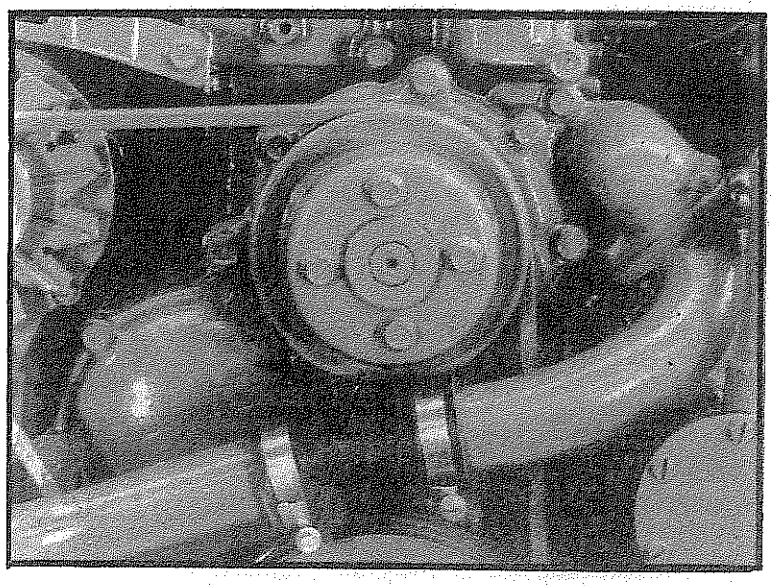


Figure 19

A cooling water temperature with engine load can come from a defective thermostat. In this case, its monitoring is required and the thermostat replaced if advisable.

Before such a checking is made, be sure the V-belt tension is the correct one.

The thermostat is located at the cylinder head lateral side, injecting pump side (no. 8- Figure 2). The thermostat is 76,5°.

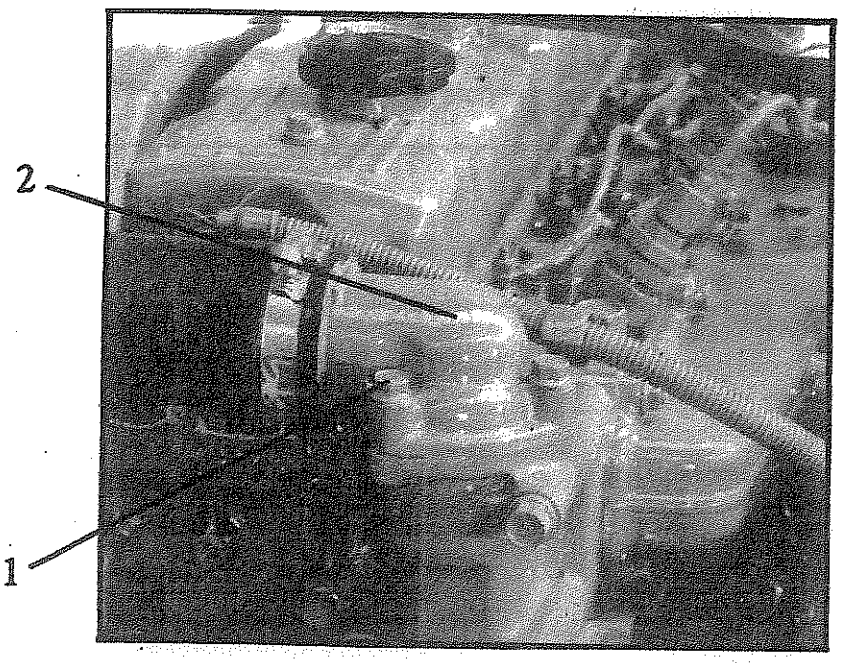


Figure 20

To check, proceed as follows:

DISASSEMBLY

1) Stop the engine and wait until it is cooled.
2) Drain cooling circuit water.
3) Loose a clamp, disconnect the bushing coming from the heat exchanger.
4) Disassemble the three positioning screws (1) in the upper body base and remove the upper body (2) of Fig. 20.

5) Draw the thermostat out from its housing and check its condition and if dusty, go to clean it.

ASSEMBLY

6) Place the thermostat component at its housing.
7) If the seal is damaged on disassembly, replace the seal and fit the upper cap with the three positioning screws (1) of Fig. 20.
8) Connect the exchanger bushing and tighten the clamp.
9) Refill with water the heat exchanger.
10) Start the engine and check its sealing.

c) Heater.

It can be supplied on request.

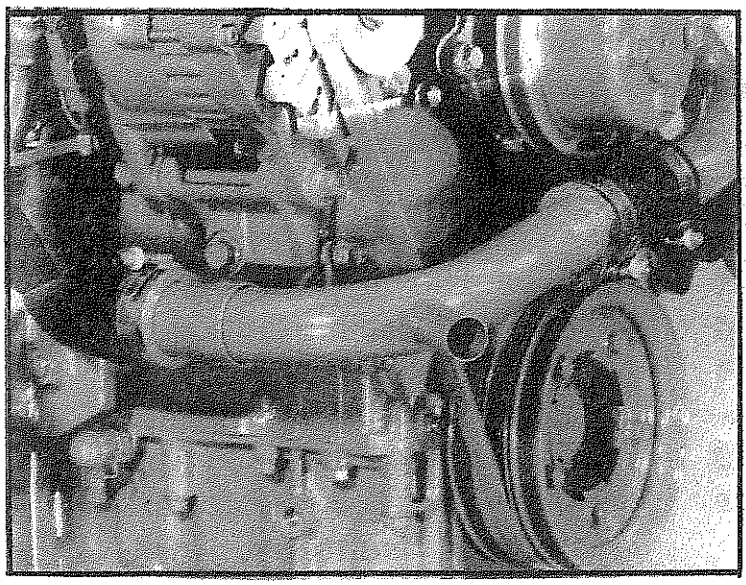


Figure 21

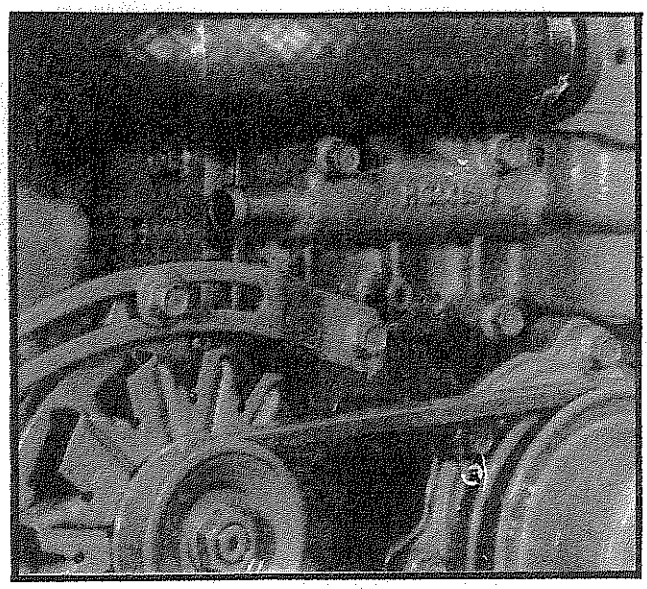
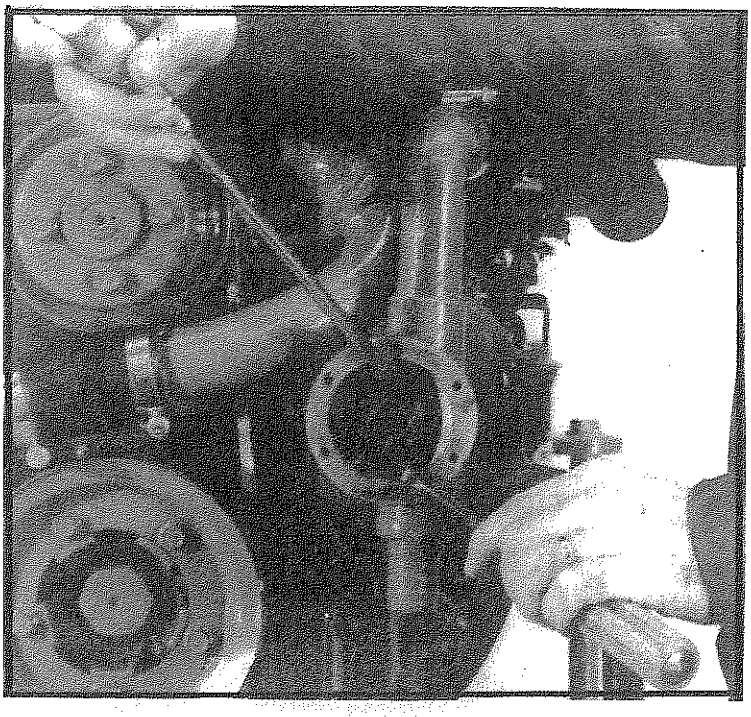


Figure 22

2) Seawater circuit

a) Water pump.

The seawater flowing pump is located at the engine front side (no. 6 of Fig. 2). The driving impeller is neoprene and cannot rotated without load. In case it is operating without water it can also be broken. It is significant then, to have always a spare impeller.



To make its replacement, shut off water acces cock, remove the pump cover and with two screwdrivers lever up by removing the shaft impeller. Clean the housing and replace a fresh one. Fit the cover by placing a fresh seal (Fig. 23). Open the bottom cock.

Figure 23

CAUTION

If the impeller is broken, when its replacement is made, be sure the water pipes are drawn out of the rubber residues which could have been torn.

b) Water filter

It is essential to fit between the engine and the bottom cock a filter to avoid that any impurities existing in the sea water might clog the cooling conduits.

Filter shall be cleaned every 100 hours by loosening the wing nut and removing the filtering component. Clean the filter and fit it again taking care the cover is well seated down (Fig. 24).

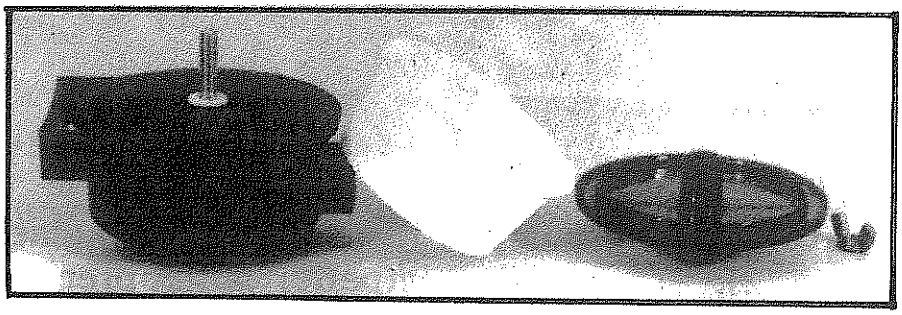


Figure 24

Then the engine is started to check if water is leaking from the cover.

3) Drainages

The engine is provided with two drain cocks, for the fresh water, one in the exchanger (Fig. 25) and one at the cylinder block (Fig. 26).

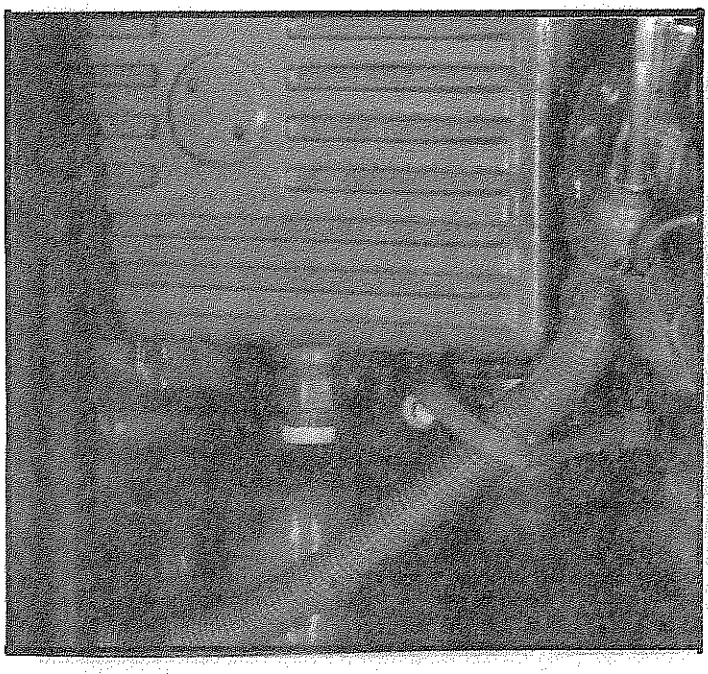


Figure 25

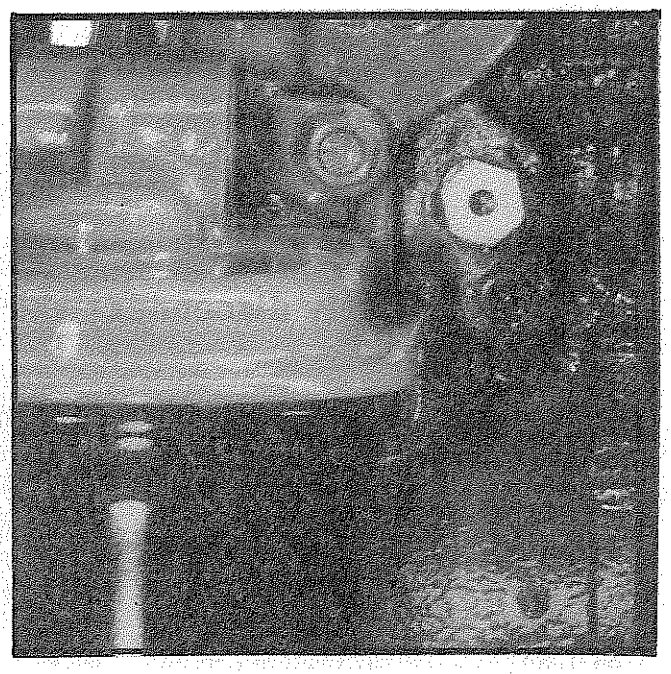


Figure 26

When in cold climates, if the engine is not to be used for a long period, it is advisable to drain the water circuit.

To do this, shut off the bottom cock and drain off all the circuit water by opening the two drain cocks fitted (Figs. 25 and 26).

CAUTION

Water shall be drained with the engine stopped and wait until the water is cold. When draining hot water, be careful not to be scalded.

4.4 - ELECTRICAL SYSTEM

The engine has a 12V system and its electrical circuit is as shown in the following diagrams (Fig 28 and 29).

When fitting electrical components, connect them correctly, referring to the diagram and concurrently checking any damaged cable coating and if earthing is correct.

> **CAUTION**
>
> **Before any handling of the electrical system is performed, firstly disconnect the battery negative cable.**

1) Incandescent spark plugs

In the detection of a defective incandescent spark plug (s) yake a length of electrical wire making up a bridge between the starting motor positive terminal and the contact (screwed rod) or the incandescent spark plug upper side. If sparks are jumped our incandescent spark plug is in a good condition and if otherwise it should be replaced.

2) Alternator

The alternator is a 12V. 60A. and carries a built-in electrical governor. A delivery is also provided for the counter-revolutions intake.

Regularly check the electrical connections, its relevant positioning and the good terminal contact.

a) Alternator belt tension

Check V-belt tension and if required adjust it.

An excessive tension may cause a quick wear of the belt and alternator bearings. Otherwise, if the belt is excessively loose or has oil, an insufficient load due to the belt skidding can be caused.

Never adjust the belt tension with engine running.

A suitable belt tension is provided when the belt is curved from 7 to 10 mm. when depressed with the fore of the thumb finger (some 10 kgs) at the center point of the higher distance between the two pulleys.

To tension the alternator belt the two alternator positioning screws, one located at the alternator lower side (1) and the other at the upper side (2) i.e the tensioner, shall be loosened, the belt shall be tensioned levering up with the alternator until the suitable tension is achieved (Fig. 27).

Then tighten again the two alternator prior positioning screws.

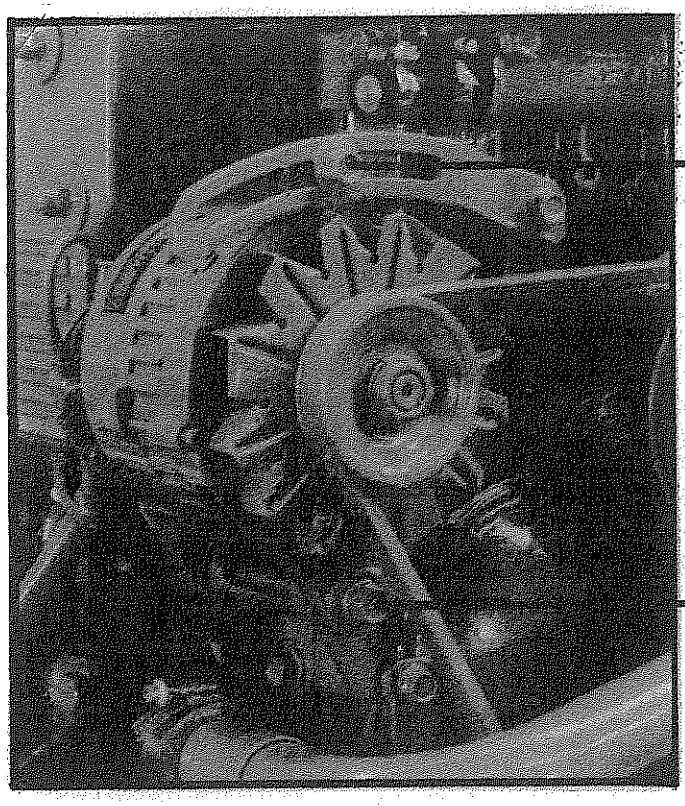


Figure 27

b) Change of belt.

Loosen the two screws (1) and (2) of Fig. 27.

Fully detension old belt so that ist removal can be made easier.

When belt is unfitted, check the condition of the pulley recesses, they shall be dry and clean. Its cleanliness is performed with soap water (never use petrol, gas-oil or similar products).

Fit the belt taking care the belt insertion is made with the hand but without damaging it and if required pace it with a tool at least without any cutting edges since otherwise the belt could be damaged and its life shortened.

The belt shall be tensioned such as is previously explained.

CAUTION

During the engine performance, the alternator shall be continuously connected to the battery. If that condition is not complied with, the voltage governor diodes would immediately be destroyed. Before proceeding to the battery charge with an outside charger, both terminals (positive and negative) shall be disconnected.

3) Battery

Batteries require a very careful handling and frequent checkings.

Proceed as shown below:

a) Always keep batteries dry and cleaned.

b) Regularly check terminal cleaniness. If dust is settled, terminals should be loosened, cleaned and smeared with a neutral grease layer.

c) Do not allow the batteries go into contact with oil or fuel.

d) Metal objects must not be placed over the battery (keys, etc.) (To avoid short-circuits).

e) Batteries or containers containing acids should carefully be handled so as to avoid the acid contact with the skin or clothes. The acid can cause burns and injuries to people and destroy the clothes.

f) Monthly check the acid level and supplement it with distilled water if required. Level should not exceed the battery inside mark.

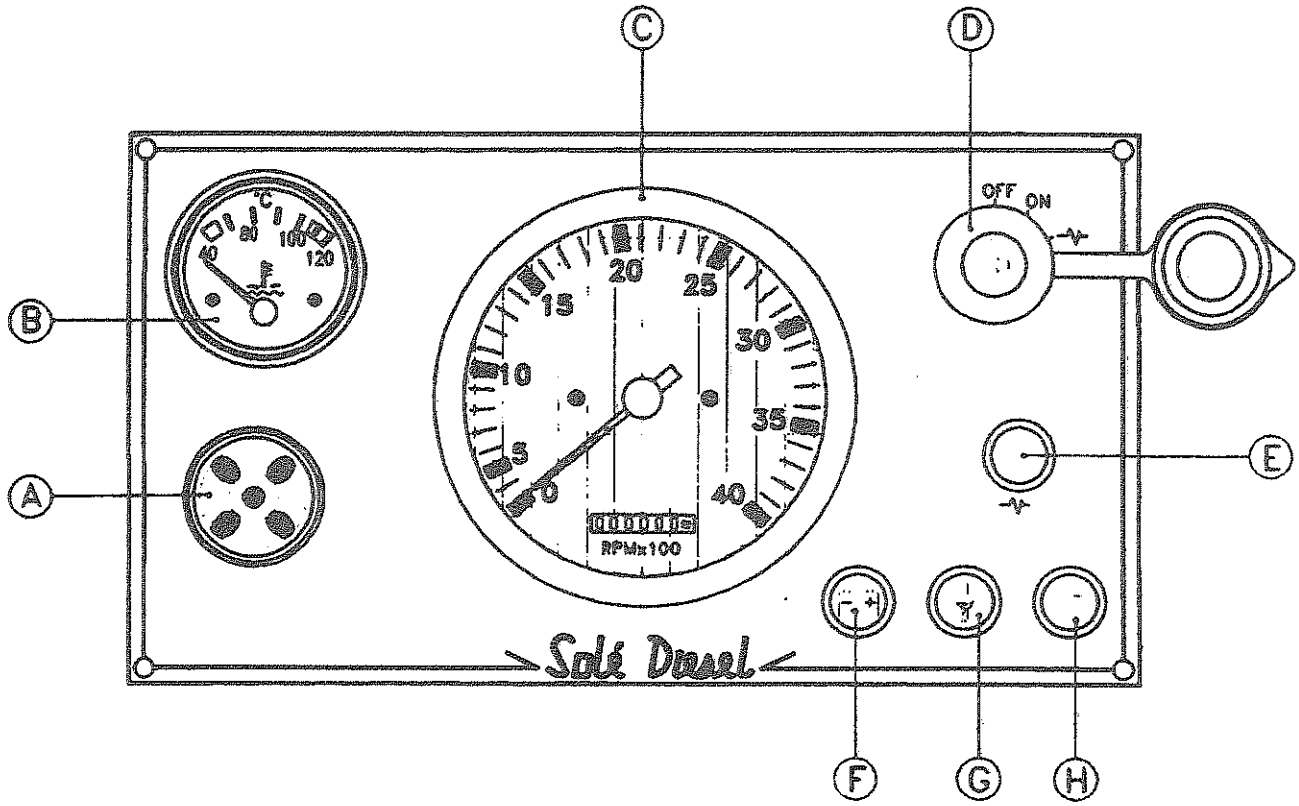
g) Never use open flames to light battery components: there is explosion danger.

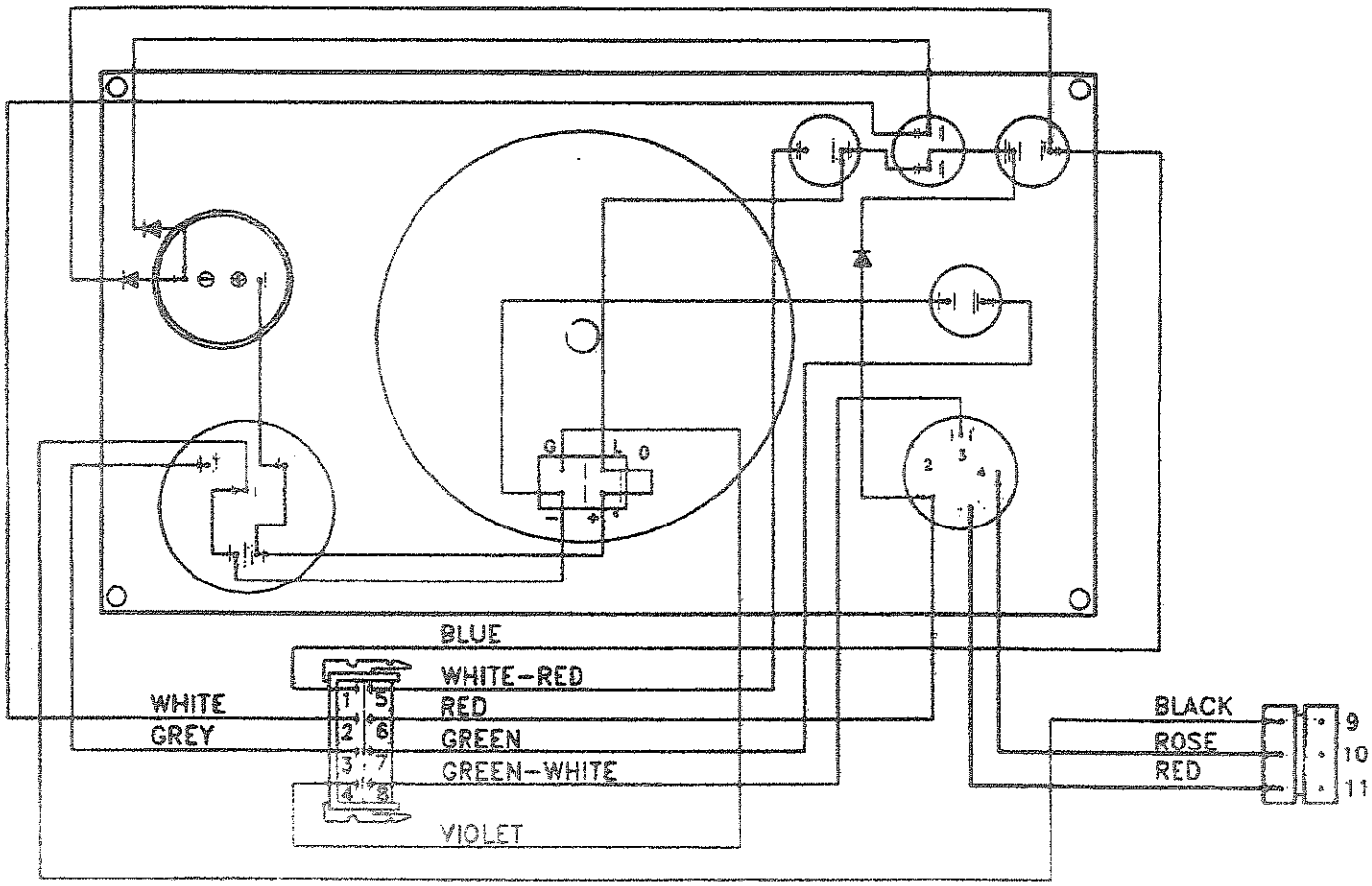
h) In winter, batteries should be detached and placed following the manufacturer's instructions.

4) Fuse

The electrical system carries as protection a 60A. fuse placed at the side of the starting motor in the cable going from the latter to the switchboard (see diagram page 42).

In case the switchboard does not received power supply check if the switchboard is or not fused and replace.


C
D
B
A
E
F
G
H
OFF
ON
RPMx100
Solé Diesel


BLUE
WHITE-RED
WHITE
RED
GREY
GREEN
GREEN-WHITE
VIOLET
BLACK
ROSE
RED
9
10
11

POINT	DESCRIPTION
A	ALARM
B	THERMOMETER
C	TACHOMETER
D	KEY
E	PREHEATING PILOT
F	BATTERY CHARGE LAMP
G	WATER TEMP LAMP
H	OIL PRESS LAMP

N°	FUNTION	COLOR
1	OIL PRESS ALARM	BLUE
2	WATER TEMP LAMP	WHITE
3	WATER TEMP	GREY
4	TACHOMETER	VIOLET
5	BATTERY CHARGE LAMP	WHITE-RED
6	STOP	RED
7	PREHEATING PILOT	GREEN
8	PREHEATING GLOW PLUGS	GREEN-WHITE
9	NEGATIVE	BLACK
10	STARTER	ROSE
11	CURREN TAP	RED

Figure 28

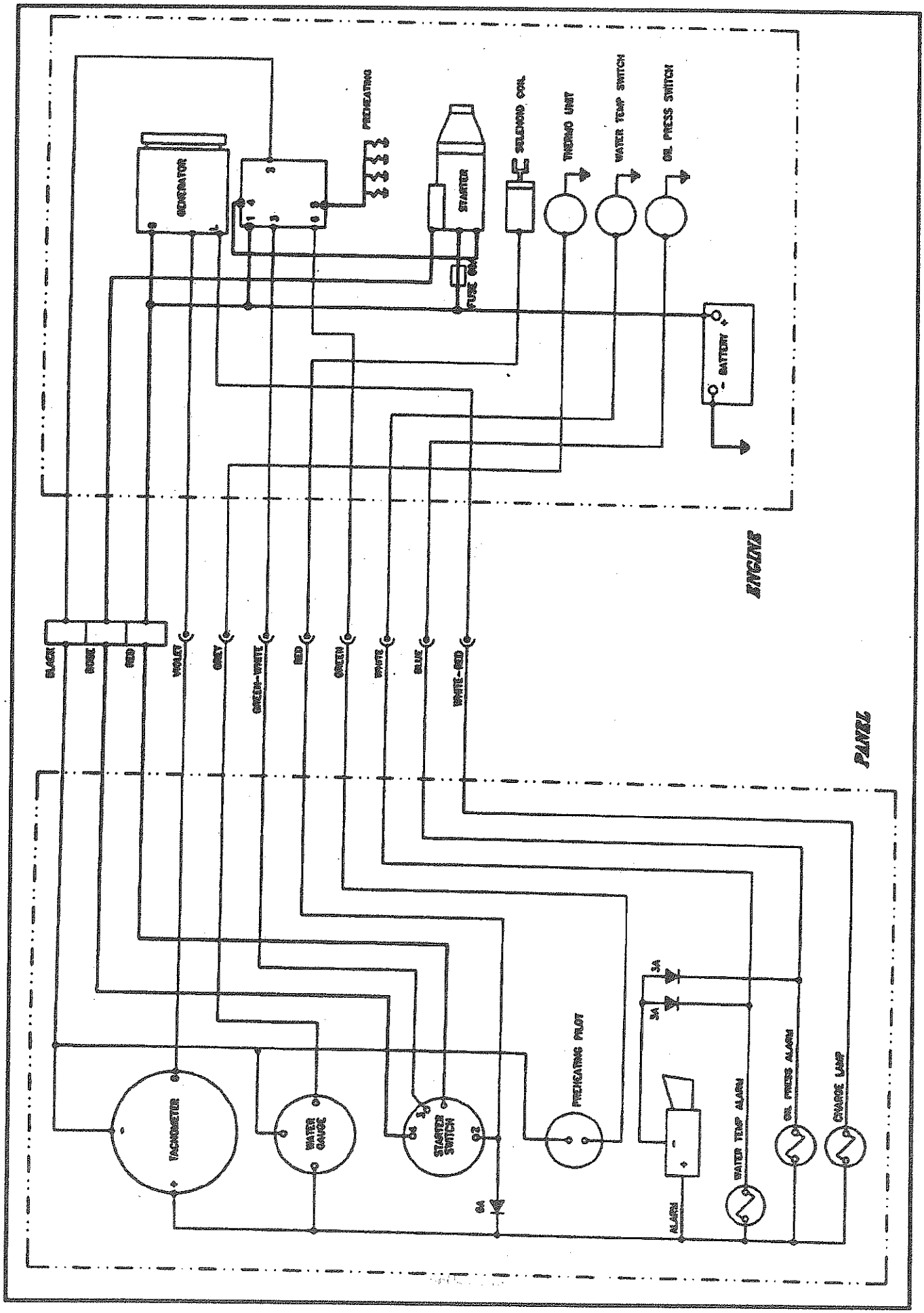

ENGINE
PANEL
GENERATOR
PREHEATING
STARTER
SOLENOID COIL
THERMO UNIT
WATER TEMP SWITCH
OIL PRESS SWITCH
FUSE 30A
BATTERY
+
-
BLACK
BROWN
RED
VIOLET
GREY
GREEN-WHITE
RED
GREEN
WHITE
BLUE
WHITE-RED
TACHOMETER
WATER GAUGE
STARTER SWITCH
PREHEATING PILOT
3A
3A
ALARM
WATER TEMP ALARM
OIL PRESS ALARM
CHARGE LAMP

Figure 29

4.5 - INTAKE SYSTEM

The engine is provided with an injection air filter with a filtering component (no. 4- Fig. 2).

Change the air element every 400 hours.

To change, slacken off the central filter clamp, remove the old element and fit a new one, and tighten up the centre clamp (Fig. 30).

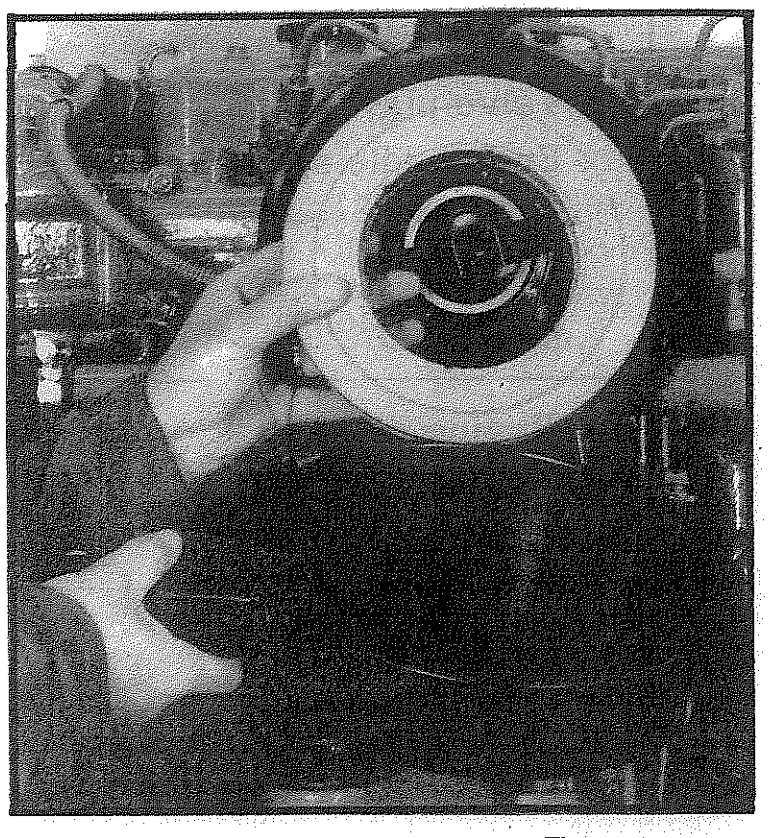


Figure 30

4.6 - GEAR BOX

The mechanically SMI-R gear box is made with high mechanical and seawater resistance grey cast iron alloy.

a) Operation

With engine at idle speed, smoothly push forwardly the inverter lever (foward gear) and rearwardly (rear gear) according to the sense wanted.

○ Inspection, adjustment or filling　□ Cleaning　● Change　△ Drainage

	Inspection concept \ Intervals	Daily	First 50 Hours	Every 100 Hours	Every 200 Hours	Every 400 Hours	Every 800 Hours	For longer time
Engine body	Screw tightening, fixing		○	○		○		
	Valve play		○			○		
	Engine idle speed		○	○				
	Exhaust gases, noise and vibrations	○						
	Compression pressure						○	
Lubricating system	Engine oil	○	●	●				
	Gear box oil	○	●		●			
	Oil filter		●	●				
Combustion system	Fuel	○						△
	Fuel tank					□		□
	Fuel filter (engine)				●			
	Injection pump						○	
	Injector				○			
	Fuel filter (decanter)			△	●			
	Air filter (element)					●		
Cooling system	Cooling water	○	●				●	△
	Water filter	○		□				
	Bottom cock	○						
	Water pump impeller					○		
Electrical system	Every instrument	○						
	Incandescent spark plug					○		
	Alternator and starting motor					○	○	
	Alternator belt and tension	○	○				●	
	Battery water level				○			

5 - REGULAR INSPECTIONS

5.1 - DAYLI CHECKING BEFORE USE OF THE ENGINE

1) Cheek engine and reverse gear box oil level. Filling. Filling is no required if level is near to the rod upper line.

2) Check fuel level and open fuel delivery cock.

3) Open the water acces cock.

4) Check indicators.
After commissioning check oil pressure, water temperature and battery charge. The three lamps must be switched off and the horn must not be sounded.

5) Check cooling water is flowing and if some failure is detected in the exhaust gases, noise and vibrations.

6) Check cooling water level.

7) Check alternator belt integrity and tens'oi..

5.2 - MAINTENANCE AFTER THE FIRST 50 OPERATING HOURS

1) Change oil engine and gear box.
Proceed as shown in the page 22 (4-1 Lubricating system -3).

2) Change oil filter. Proceed as shown in the page 25 (4.1 Lubricating system -4).

3) Adjust valve play.

Perform this operation when the engine is cold in the following way:

a) Whit the rocking cover removed, locsen the rocking nut and while the adjustment screw is rotated, adjust the valve play with a gauge.

b) With the cylinder no. 1 piston (forward) at the neutral point and in the upper side of the compression stroke, the injection and exhaust valves of the cylinder no. 1 shall be adjusted.

Proceed similarly as with the other cylinders.

c) The position of the cylinder no. 1 upper neutral point can be confirmed by alignment of the DC mark on the flywheel with the needle on the engine plate.

d) After the adjustment, the rocking nut should be well tightened while the adjusting screw is locked so that it does not rotate.

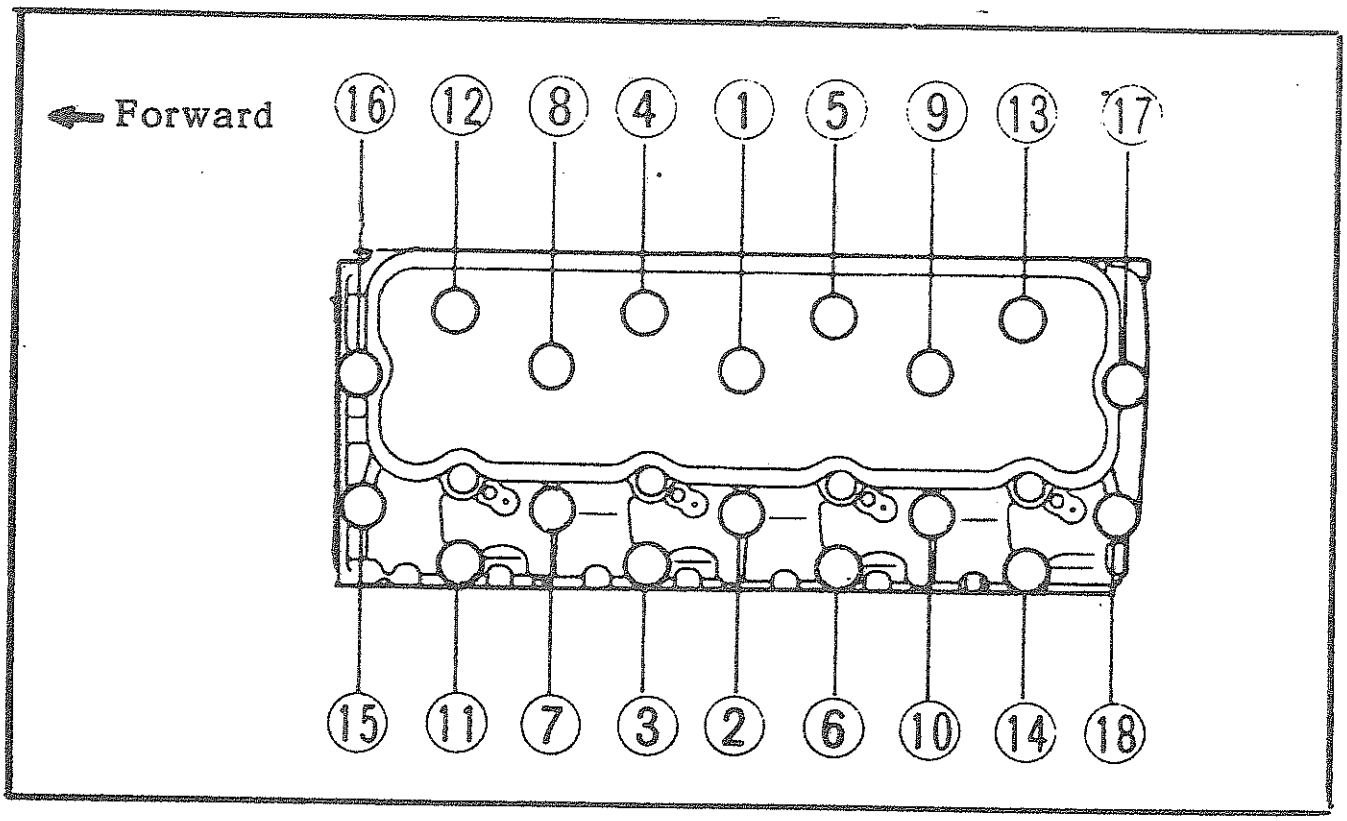


Figure 31

NOTE:

The adjustment of the valve play must be made after the cylinder head screws are again tightened (tightening sequence as per Fig. 31).

Valve play (injection-exhaust 0,30 mm (0,012 in).

Cylinder head screws tightening torsion/torque:

116 - 123 N-m (11,8 - 12,5 m-Kg., 85-90 ft-lb.).

4) Control and eventual adjustment of the alternator belt. Proceed as show int the page 36 (4.4 Electrical system - 2a).

5) Overhaul of the propeller shaft and positioning screw tightening torque.

6) Adjustment of the engine idle speed. Proceed as shown in the page 29 (4.2 Combustions system - 7).

7) Change the cooling water.

5.3 - MAINTENANCE EVERY 100 OPERATING HOURS

1) Change oil engine.
Proceed as shown in the page 22 (4.1 Lubricating system -3).

2) Oil filter change. See page 25 (4.1 - Lubricating system -4).

3) Fuel decanting filter drainege.
Loosen the wing nut located at the lower side of the glass vessel and let go all the acrued water. Shut again off the wing nut and check it does not drip.

4) Water filter cleaning. See page 34 (4.3 Cooling system - 2b).

5) Engine idle speed adjustment. See page 29 (4.2 Combustion system - 7).

6) Again tighten the positioning screws and nuts of the injection and exhaust manifold, alternator, engine positioning and propeller shaft.

5.4 - MAINTENANCE EVERY 200 OPERATING HOURS

1) Change oil gear box.
Proceed as show in the page 24 (4.1 Lubricating system -3b).

2) Replace the fuel filter element.
Replace the filter component, placing also fresh seals.
Check there is not any gas-oil leakage.

3) Injector checking.
Set up the injector pressure to 140 +/- 10-0 kg/cm^2 and remove all the undesirable injection conditions incluging "post-dripping" (This operation shall be made by a SOLE service).

4) Check battery water level.
Check this level, and DISTILLED WATER should be added if required.

5) Replace the element of the decanter fuel filter (if fitted).

5.5 - MAINTENANCE EVERY 400 OPERATING HOURS

1) Check the tightening torque of the engine positioning, propeller shaft screw and gas-oil piping nipples.

2) Valve play shall be adjusted. See page 45.

3) Check incandescent spark plugs.
Check incandescent spark plugs in case they migth fused or if there is two connections.

4) Change air filter. See page 43 (4.5 Intake system).

5) Check condition of seawater pump impeller and its eventual replacement. See page 33 (4.3 Cooling system - 2a).

6) Clean the fuel tank.

7) Check the alternator and starter.

5.6 - MAINTENANCE EVERY 800 OPERATING HOURS

1) Change cooling circuit water.
Drain off any water by opening the drain cocks of the fresh water circuit (Fig. 25 and Fig. 26) Page 35.

When the water is already drained, shut off the cock and fill with fresh and clean water up to the hole of the tank plug (Fig. 6) Page 14.

2) Check alternator and starting motor.

Check brush wear and switch surface roughness. Replace if the service limitation has ben reached.

Check tension and voltage with a circuit motor.

3) Check the starting motor pinion and the flywheel toothed crown.

With a file rectify the belleved area which could have been damaged and replace pinion ot toothed crown if fully damaged.

4) Replace the alternator belt. See page 37(4.4 Electrical system - 2b).

5) Check the compression pressure of each cylinder.

Check each cylinder with the glow plug removed using a compression pressure gawge. If measurement of any cylinder is below 30 Kg/cm^2 (427 psi) at 200 r.p.m., the cylinder must be repaired. Difference in pressure between cylinders must be within 3,0 Kg/cm^2 (43 psi).

6) Inspect injection pump.

Adjust the injection quality if excessive engine vibration is observed during slow running. Use the services of an authorized Solé Diesel workshop, since these are equipped with the pump checker for adjustament.

5.7 - INSTRUCTIONS FOR WINTER LAY-UP

When the engine is not to be used for a long period of time, certain operations must be carried out yo keep it in perfect operating condition. Follow these lay-up instructions carefully.

1 - Carefully clean the external surface of the engine with diesel oil or alcohol.

2 - Drain the fluid from the cooling system. If the engine is conected to a boiler, also drain the boiler system.

3 - Fill the cooling system with clean water to which a rust inhibitor additive has been added in a proportion of 1 %. If very low temperatures are expected, also add antifreeze to the water.

4 - With the engine at operating temperature, drain the oil from the crankcase. Then refill with rust inhibitor oil. The oil level rod should indicate the maximum level.

5 - In the case of low-capacity tanks, drain completely and clean; refill with a mixture of diesel oil and rust inhibitor oil. For diesel oil in large-capacity tanks, it is enough to add 10 % rust inhibitor oil.

6 - Bleed the fuel supply system.

7 - Run the engine at half speed until service temperature is reached (thast is, when the thermostat opens). Then stop the engine.

8 - Remove the cylinder head cover and spray the rocker arms with a protective mixture composed of diesel oil and 10 % rust inhibitor oil. Then put the valve cover on again.

9 - Spray rust inhibitor oil on the intake system.

10 - Turn the engine with the starting motor for a few seconds, without starting it up. In this way the exhaust gases are completely expelled and the cylinder liners are protected with a coating of oil.

11 - Remove the battery and store it away, following the manufacturer's instructions.

5.8 - INSTRUCTIONS FOR STARTING UP THE ENGINE AFTER WINTER LAY-UP

When starting up the engine again after winter lay-up, certain operations must be performed in addition to those described in the instructions in Section 3 (Use).

Follow these steps:

1 - Fill the fuel tank with clean diesel oil.
Carry out the process for checking the fuel filter. If the filter is clogged, replace the filter cartridge.

2 - Drain the rust inhibitor oil contained in the crankcase and refill according to the instructions on page 22 (4.1 Lubrication system - 3).

3 - Inspect the internal water system anf fill according to instructions.

4 - Reconnect the battery and apply a layer of neutral vaseline to the battery terminals.

5 - Remove the nozzle supports and clean them. If possible, verify the setting of the nozzles at a workshop. Turn the engine without nozzles, using the starting motor, to eliminate the rust inhibitor oil used in the winter. Then install the clean nozzles.

6 - Carry out the operations described on page 26 (Bleeding the fuel system - 2) and connect the cooling and exhaust systems.

CAUTION: During this process, remember to remove the plugs installed in the engine for winter lay-up.

7 - Verify whether there are any leaks in the fuel and water systems.

8 - Start up the engine and try it out at different speeds, making sure that the water flows correctly. Check again to see if the connectors leak.

NOTE:

The diesel oil - rust inhibitor oil mixture placed in the tank for winter lay-up can be used to operate the engine.

6 - TROUBLE SHOOTING

It is essential that all faults or defects be detected and corrected as soon as possible. Carry out all inspections and follow the instructions given below. If a fault calls for operations that go beyond your capabilities, have it repaired at an authorized Solé Diesel service.

1 - Engine does not start

a) Engine does not turn

- Instrument panel lights off in "ON" position.	
Battery defective or discharged	Replace or charge battery an check tightness of terminals
Start switch defective	Change or repair switch
Cables rusty or loose	Correct connections and contacts
Fuse burned out	Replace
Instrument panel ligts on ir "ON" position (they always go off in "Start" position).	
Engine seized	Repair. (Call Solé Diesel Service).
Starting motor faulty	Inspect and repair

b) Engine turns very slowly

Battery partly discharged	Charge battery
Engine oil of unsuitable viscosity (especially at very low temperatures)	See the oil specified in the service chart. Change for correct oil.

c) Engine turns but does not start

Fuel tank empty or almost empty	Verify and fill. Bleed the Circuit (See page 26).
Fuel outlet cock closed	Open
Fuel filter clogged	Inspect filter and replace cartridge (page 28).
Air in fuels lines or in injection pump	Check for fuel leaks in lines and connectors. Tighten the clamp on the lines. Bleed the fuel circuit (See page 26).
Incorrect setting of injection pump	Inspect and correct. (Call an authorized Solé Diesel service)
Insufficient preheating of glow plugs	Preheat sufficiently
Preheating glow plugs burned out	Inspect and replace with new glow plugs
Incorrect adjustment of valve play	Inspect and adjust. (Call an authorized Solé Diesel service)
Timing out of adjustment	Correct it. (Call an authorized Solé Diesel service)

2. Engine stops when running

Fuel tank empty	Fill and bleed fuel circuit (see page 26).
Fuel filter clogged	Inspect filter and replace cartridge (see page 28).
Air in fuel lines or in injections pump	Check for fuel leaks in the lines and connectors. Tighten the clamps of the lines. Bleed the fuel circuit (see page 26).

3. Engine lacks power or misfires

Fuel filter clogged	Inspect filter and replace cartridge (see page 28).
Air in fuel lines or in injection pump	Check for fuel leaks in the lines and connectors. Tighten the clamps of the lines. Bleed the fuel circuit (see page 26).
Insufficient air for combustion	Inspect air filter and clean it. Increase air intake to engine compartment.
Valves out of adjustment	Check play and adjust. (Call an authorized Solé Diesel service)
Water in fuel circuit	Replace filter cartridge and drain water from tank, filling with clean diesel oil

4. Engine does not reach rated rpm at full power

Engine overloaded	Check that propeller is not overdimensioned. Change propeller
Exhaust backfires	Check for obstructions in the exhaust system
Vent hole of fuel tank clogged	Inspect the vent tube of the tank. Remove the obstruction.
Insufficient air for combustion	Inspect air filter and clean it. Increase the air intake to the engine compartment

5. Engine discharges a large quantity of blue smoke

Oil level too high	Verify oil level and drain excess

Excessive valve play	Inspect play and adjust. (Call an authorized Solé Diesel service)
Insufficient compression	Check compressions. Loss of compression may be caused by a broken or worn ring or by excessive play of valve guides.

6. Engine discharges black smoke

Engine overloaded	Check that propeller is not overdimensioned. Change propeller.
Nozzle do not spray correctly (dirty or incorretly set)	Have the nozzles inspected at an authorized Solé Diesel service. Set them at the specified pressure.
Injection pump out of adjustment (Excessive flow)	Have the injection pump inspected at an authorized Solé Diesel or Condiesel (CAV) service.
Fuel filter clogged	Inspect filter and replace cartridge (see page 28).

7. Engine heats up

Shortage of water in fresh water circuit	Check level and top off, if necessary
Fresh water pump does not operate correctly	Verify condition and tension of belt. Tighten it or replace it (see page 37). Inspect the condition of the water pump. Repair it or replace it.
Bottom cock to water filter clogged	Inspect and clean (see page 34).

Cooling system clogged	Check that the water cooler tubes are clean. Clean them.
Thermostat faulty	Verify thermostat operation. If necessari, replace it.
Insufficient air flow in engine compartment	Increase air intake to engine compartment
Thermocontact or temperature transmitter faulty	Inspect and replace, if necessary
Salt water pump faulty	Inspect operation and check impeller condition. Replace, if broken (See page 33).
Engine oil level too high	Verify oil level and drain excess

8. Low oil pressure

Engine oil level too low	Verify level and fill to top mark on rod
Oil viscosity too low	Check oil viscosity and replace with oil of correct viscosity
Oil leak through connections, lines or discharge valve	Check for losses and correct
Oil pressure contact defective	Inspect and replace

9. Battery charge defective

Alternator belt tension incorrect or belt broken	Inspect and tighten or replace (see page 37).

Alternator regulator faulty	Have it inspected at an authorized Solé Diesel or Bosch service
Battery defective	Change

10. Gear do not mesh correctly

Remote shitft out of adjustment	Adjust
Reversing gear control out of adjustment	Adjust
Clutch cone worn	Change

7 - SERVICE DATA

7.1 - SERVICE SPECIFICATIONS

a)	Valve play	0,30 mm (0,012 in) cold engine both in the injection as exhaust valves)
b)	Compression pressure:	30 Kg/cm^2 at 200 r.p.m.
c)	Injection time (Before PMS in the compression stroke)	17°
d)	Injector pressure	135-140

7.2 - OIL

Use a Diesel engine oil of known brand. API's service classification will be as follows:

Heavy-duty service . . . . . Class CD
(or continuous rate higher than 3000 rpm)

OIL VISCOSITY

Select oil viscosity most suitable for the atmospheric temperatures on which the engine should be operated. It is recommended to use SAE 10W-30 oil in all the seasons due to the minimum change in its viscosity with the temperature changes.

Atmospheric Temperature	Viscosity
20° C (68° F) or above	SAE 30 or SAE 10W-30
5° C (41° F) to 20° C (68° F)	SAE 20 or SAE 10W-30
5° C (41° F) or below	SAE 10W-30

8 - TIGHTENING TORQUE

		Kg.m	(ft-lb)
Cylinder head bolts		11,8 - 12,5	(85 - 90)
Rocker nut		1,2 - 1,7	(10,4 - 14,8)
Crankshaft pulley bolt		35 - 40	(253 - 289)
Main bearing cap bolts		11 - 11,7	(80 - 85)
Connecting rod cap nuts		8,2 - 9,0	(59 - 65)
Flywheel bolts		18 - 20	(130 - 145)
Oil pan drain plug		3 - 4,2	(22 - 30)
Oil filter		1,1 - 1,3	(8 - 9,4)
Injection pump nuts		2,2 - 3,1	(16 - 22)
Nozzles		6,0 - 7,0	(43 - 51)
Injection tubes nuts		2,0 - 2,5	(14 - 18)
Starter motor		6,5 - 9,1	(47 - 66)
Glow plugs		1,5 - 2,0	(10,8 - 14,5)
Alternator tension bolt		1,9 - 2,6	(14 - 19)
Alternator holding bolt		3,8 - 5,3	(27 - 38)
Reversing gear lay-shaft setscrew		12	(87,6)
Water cooler element locknut		2	(14,6)
Reversing gear body setscrew		4	(29,2)
General tightening torque of screws and nut:	M.6	0,8	(5,8)
	M. 8	1,7	(12,4)
	M. 10	3,5	(25,6)
	M. 12	6,4	(46,7)
	M. 14	9,5	(69,4)

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