SM 615 / 616

INSTRUCTION MANUAL

FOREWORD

Thank you for choosing the SOLE DIESEL SM-615 or SM-616.

BEFORES STARTING THE ENGINE it is very important that you carefully read and follow these operating and maintenance instructions.

If you have any doubts or questions about your engine, or in the event of any fault, please contact your nearest Solé Diesel dealer, who will help you in every way he can.

IMPORTANT

It is very important to state the data listed below when ordering replacement parts to ensure quick and correct supply:

a) Type of engine (stated on the nameplate).
b) Engine serial number (stamped on top of the block on the injection pump side).
c) Number and name of the required part.

NOTE: The descriptions and illustrations in this Manual are not binding. Aside from the main features of the engine described and illustrated here, SOLE, S. A. reserves the right to make any changes in engine parts, details or accessories that it deems appropriate for technical or commercial reasons.

CONTENTS

1 - PRECAUTIONS WHEN USING THE ENGINE

- Always use suitable oil and watch the oil pressure during operation.
- Use clean fuel that is free of impurities and water.
- Do not let water or air enter the fuel system.
- If the starting motor gear does not mesh with the crown gear when starting, let the engine stop completely and then turn the key gain.
- Always observe the color of the exhaust gas.
- Periodically clean or change the fuel and oil filters.
- Change oil according to instructions given here.
- Verify that the cooling water flows correctly through the engine.

Safety Precautions

- Do not touch the moving parts of the engine while it is operating.
- Do not touch hot weack points such as the exhaust pipe, and do not place combustible materials on them.
- Inspect and adjust the parts of the engines only when it is not operating.
- Inspect levels and add oil, cooling water and fuel to the engine only when it is not operating.
- Always use tools of correct size and carry out all servicing operations cautiously.

2 - SPECIFICATIONS

	SM-615	SM-616
Engine Type:	Diesel, 4-stroke, water-cooled	
No. of cylinders:	Straigth-4	
Cylinder bore:	87 mm	90.9 mm
Stroke:	83.5 mm	92.4 mm
Overall displacement:	1988 cc	2399 cc
Compressions ratio:	21:1	
Power/RPM DIN 6270-A:	48.5 HP (35.5 KW) / 3,600	61 HP (45 KW) / 3,600
Power/RPM DIN 6270 B:	56 HP (41 KW) / 4,200	72 HP (53 KW) / 4,400
Minimum RPM in idle:	700-800	
Reducer reversing gear:	Mechanical, type SMI red. 2:1 - 2.5:1 or 3:1	
Dry weight whit reversing gear:	265 Kg	
Maximum assembly angle:	15°	
Oil capacity: Engine:	5 liters	
Oil capacity: Reversing gear:	0.8 liters	
Oil type:	See list of approved oils on page 49	
Cooling:	By fresh water, with thermostatic control, by means of heat exchanger. Cooled exhaust manifold.	
Cooling circuit capacity:	12 liters	
Injection pump:	TDZ or BOSCH	
Injection system:	Indirect	
Electrical system:	See wiring diagrams on pages 34, 35 and 36	
Starting motor:	BOSCH 12 V	
Alternator:	BOSCH 12 V. 55 A.	
	Glow plug	
	50 A main fuse	
Battery capacity:	Minimum 110 Ah - 12 V.	
Dimensions: Length:	997 mm	
Width:	565 mm	
Height:	774 mm	

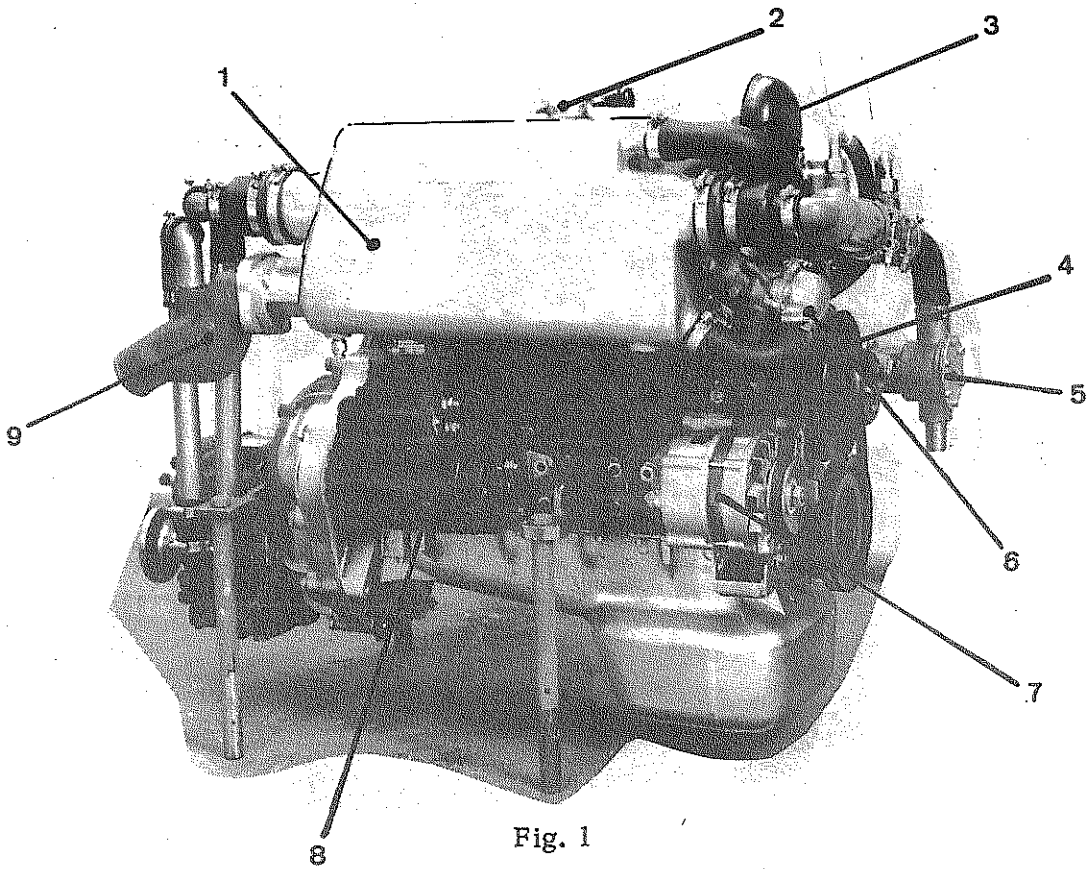


Fig. 1

1 Exhaust manifold water cooler
2 Fresh water filler cap
3 Air filter
4 Fresh water pump
5 Salt water pump
6 Thermostat
7 Alternator
8 Starting motor
9 Wet exhaust elbow

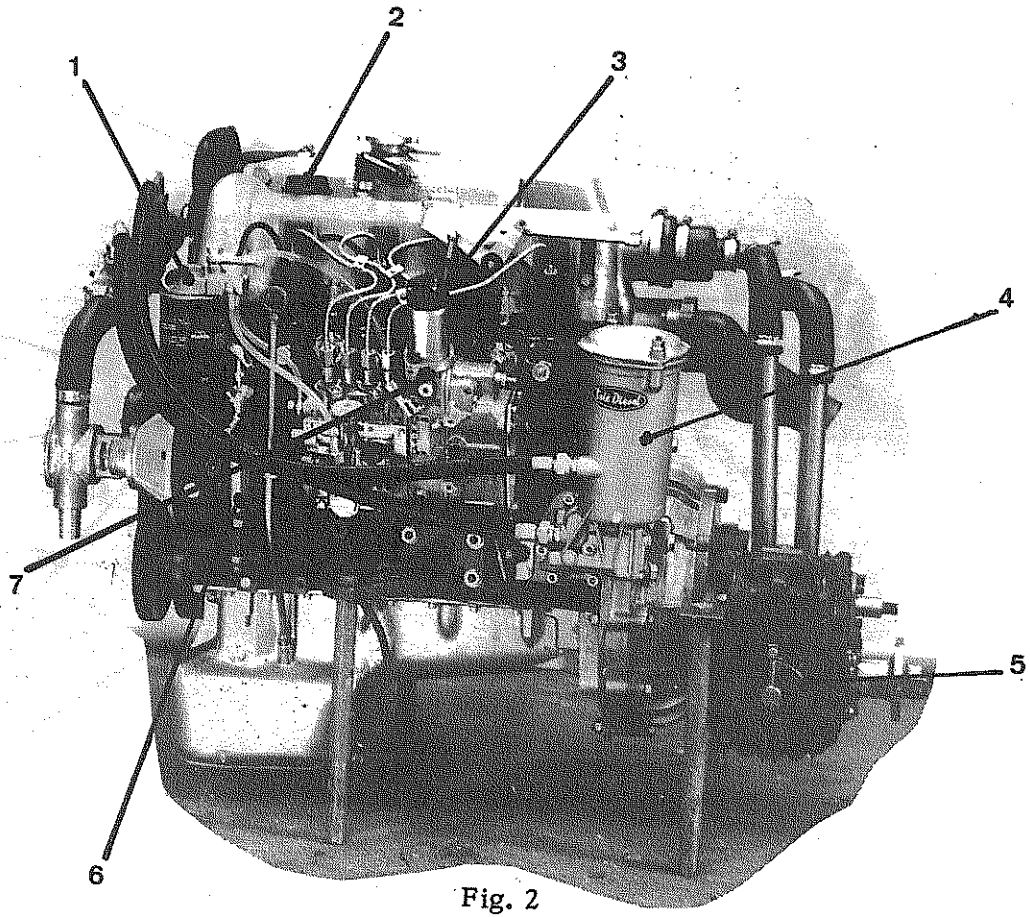


Fig. 2

1 Diesel oil filter
2 Oil filler cap
3 Stop relay
4 Oil filter
5 Reversing gear
6 Oil extraction pump
7 Injection pump

3 - OPERATION

3.1 - BEFORE STARTING THE ENGINE

Your new engine requires 20 HOURS of operation to run in all its moving parts and achieve high performance.
Run in the engine carefully, keeping these points in mind:

CAUTION

- Idle the engine to warm it up for at least 5 minutes.
- Avoid brusque accelerations.

3.2 - PREPARATION BEFORE STARTING

1) Filling the engine and reversing gear with oil.

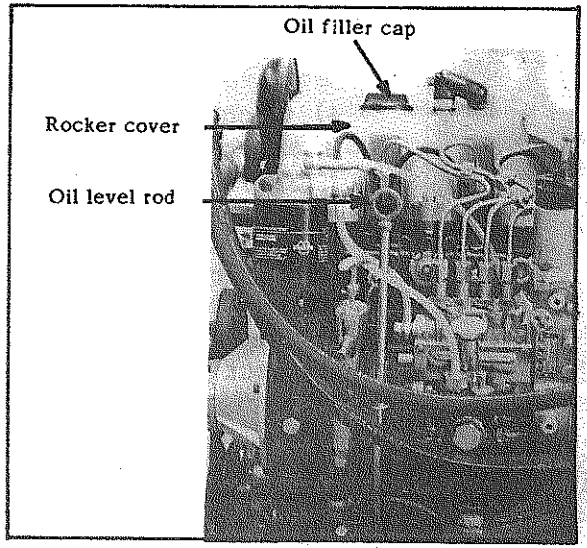


Fig. 3

Fill the engine with the oil listed on page 49, up to the top mark on the level rod (Fig. 3). Fill the reversing gear, througn its oil hole, up to the mark on the rod (Fig. 4). Use the same type of oil as in the engine.

2) Filling the fuel tank

Fill the fuel tank with clean, filtered diesel oil. Verify that the tank is completely clean and free of iron or polyester particles.

Open the fuel outlet cock.

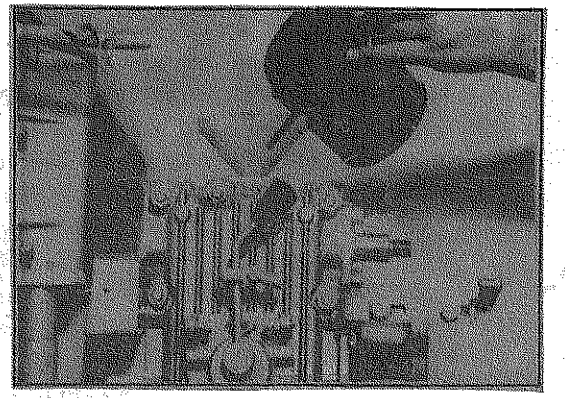
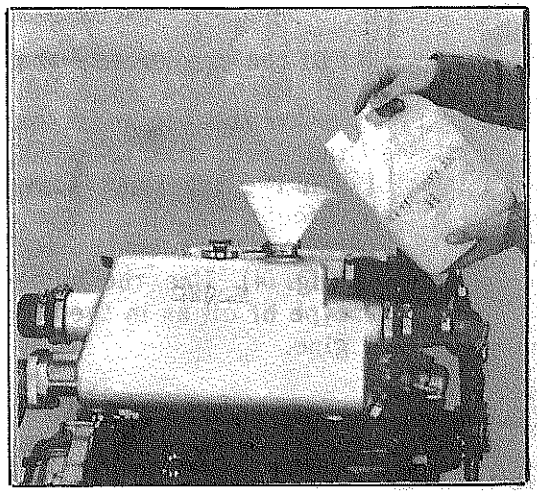


Fig. 4

3) Filling the water circuit

Fill the circuit with clean water up to the filler hole. In the winter, add antifreeze. (Fig. 5).

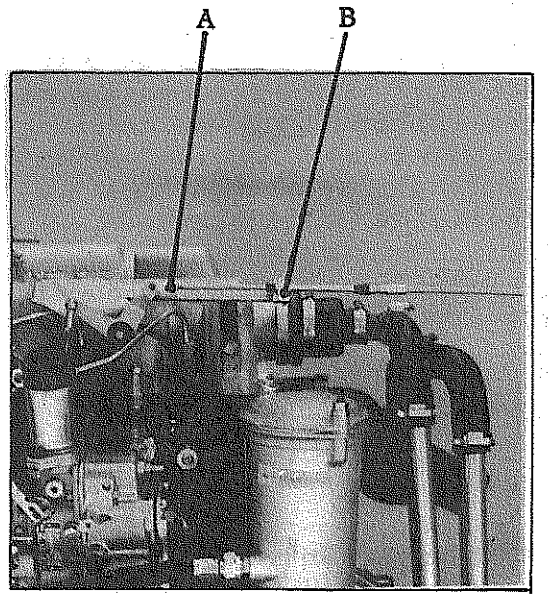


4) Open the salt water intake cock.

5) Connecting the battery disconnector.

Connect the battery disconnector.

Fig. 5



6) Connecting the remote control.

a) Engine.

Connect the control cable to the knuckle mounted on the lever (A) and secure the cable with the clamp (B). Adjust so that fuel does not begin to be supplied until the reversing gear has gone into operation.

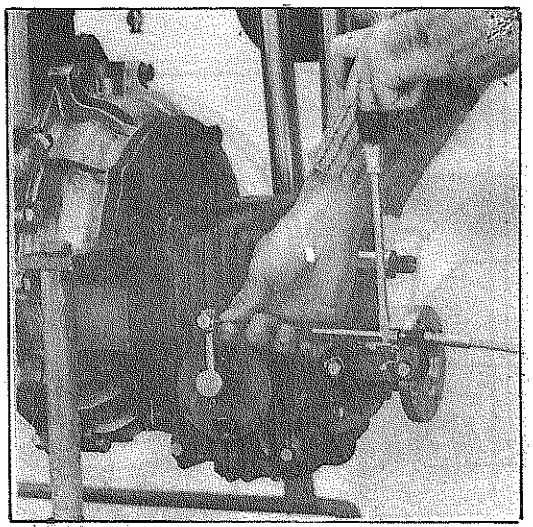
Fig. 6

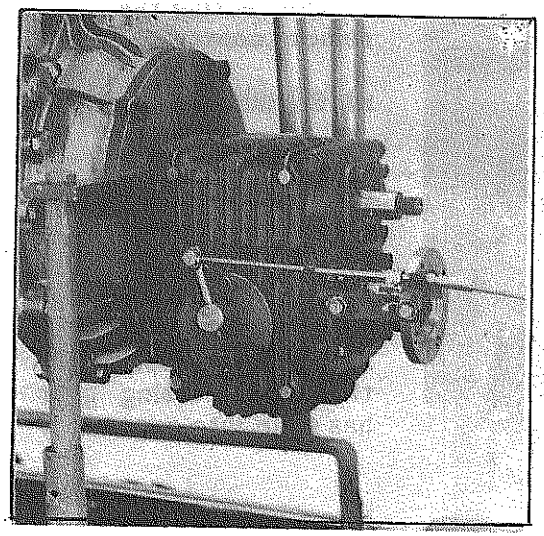
b) Reversing gear

Connect the control cable to the lever by means of the knuckle intended for this purpose and secure the cable with the clamp.

Once assembled, adjust the control so that it has the same travel in front and behind and does not start to supply fuel until it has gone into operation correctly (Fig. 7).

Fig. 7





To verify correct assembly, set the reversing gear lever and the remote shift lever in forward drive position.

Adjustment is made by means of the holes in the reversing gear lever and the slides of the cable attachment support (Fig. 8).

Fig. 8

7) Other checks

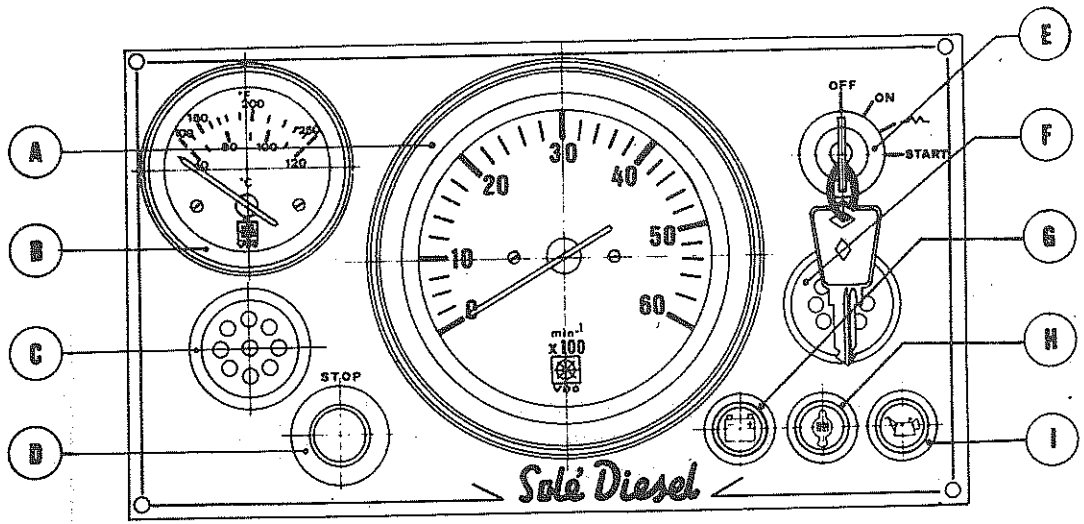
a) Be especially carefull to verify the engine attachment points.
b) Verify that all screws are correctly tightened.
c) Verify the connectors of the water, oil and diesel oil lines, checking that they are correctly connected and tightened.
d) Verify the exhaust and transmission systems.

3.3 - STARTING THE ENGINE

1) Put the shift lever into neutral.
2) Set the ignition key (E) in "ON" position. Check that the oil pressure light (I) and battery charge light (G) go on and that the alarm (C) sounds (Fig. 9).
3) **Preheating**

   Turn the ignition key to position ⌇ (preheat), until the preheat light (F) (Fig. 9) starts to glow red.

Fig. 9



IMPORTANT

Never preheat the engine for over 45 seconds.

4) Starting

Set the remote shift lever into neutral and, while accelerating halfway, turn the ignition key to "START" position until the engine starts up. If the engine does not start, even when the key is in "START" position for 15 seconds, release it for 30 seconds and then try to start up the engine once more, preheating the glow plugs again if necessary. The starting motor should not be operated for over 30 seconds at a time.

Once the engine has started, turn the ignition key to "ON" position.

Likewise, when the engine has started, check that the oil pressure and battery charge lights go off.

5) Warming up the engine

Warm up the engine for about 5 minutes, letting it operate idle at half acceleration.

IMPORTANT

While the engine is operating, do not turn the key to "START" position since this would harm the starting motor.

When the engine is warm, it is not necessary to perform the preheating operations. In such case, turn the key directly to "START" position until the engine starts up. Once it has started, return the key to "ON" position.

3.4 - PRECAUTIONS WHEN STARTING AND DURING OPERATION

1 - Starting in cold weather

When the atmospheric temperature drops below 0º C, three things happen as listed below. In such cases, the engine should be started according to the instructions given here.

a) **The lubricant oil becomes thick.**

- **Pour hot water into the cooler.**
- **Verify that the oil is of the correct type. Also check that it has not become deteriorated.**

b) **The voltage flowing through the battery terminals drops.**

- **Protect the battery against the cold by covering it whit suitable material.**
- **Verify that the battery is fully charged.**

c) The intake air temperature is low and it is hard for the engine to start.

- Let the glow plugs warm up sufficiently.

2 - Verifications after starting

- Verify that the cooling water flows correctly.
- Verify that there are no water or oil leaks.
- Verify that the oil pressure lamp has gone off.
- Verify that the exhaust smoke is as follows:

- When the engine is cold: white smoke.
- When the engine is warm: almost no smoke.
- When the engine is somewhat overloaded: a certain amount of black smoke.

IMPORTANT

Always let the engine idle when shifting speeds.

CAUTION

To prevent the engine from quickly becoming damaged, avoid overloading the system. Overloads can be caused by an unsuitable propeller, an incorrect installation (choked exhaust pipe, misalignment of main parts), etc. For this reason, the engine rpm must be checked at full power (top speed) to verify that it is under 4,000 rpm.

3.5 - STOPPING THE ENGINE

1) Gradually reduce the engine rpm to the minimum. To stop the engine, press the "STOP" button on the panel until it stops completely. Once this has been done, turn the key to "OFF" position.

IMPORTANT

Do not stop the engine immediately after running
it at full power or when the temperature
of the cooling water is high.
Let it idle for a short time.

4 - MAINTENANCE

4.1 - LUBRICATION SYSTEM

1 - Correct oil viscosity

Use oil of the correct viscosity for the ambient temperature concerned, as listed in the table on page 49 (Servicing Data).

The use of a multigrade oil for all seasons is recommended.

2 - Oil pressure

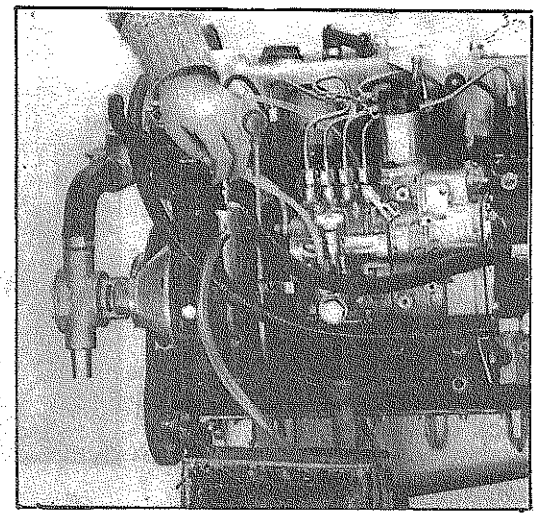
Correct and incorrect oil pressure during engine operation is indicated by the oil pressure alarm lamp and the alarm horn.

- During normal operation: Oil pressure is normal when the lamp is off.
- When starting: The lamp should be on and the horn should sound.

The lamp goes on during normal operation when the oil pressure drops below 0.2-0.4 kg/cm^2, in which case an authorized SOLE DIESEL Service should be notified.

3 - Oil change

Fig. 10



a) Engine

Change the engine oil after the firts 20 hours of operation and then every 150 hours afterwards.

The oil should be changed while the engine is warm so that it will be fully drained. This operation is performed with the extraction pump located beneath the diesel oil filter and injection pump (Fig. 10).

Once the oil has been fully drained, fill with the required quantity (5 lt) of clean oil through the filler located on rocker cover no. 2 of Fig. 2.

Next turn the engine with the starter until the control lamp on the instrument panel goes off. When performing this process, prevent the engine from starting up by pressing the stop button.

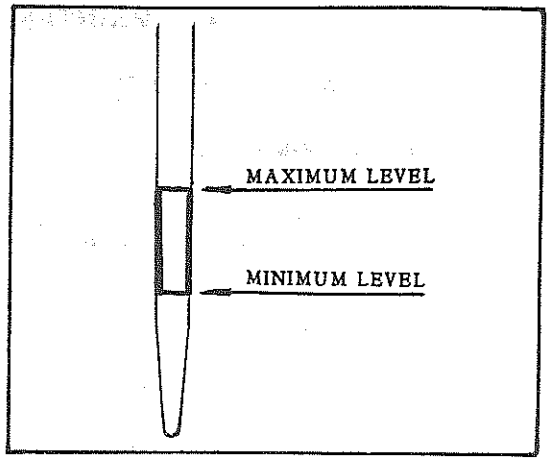


Fig. 11

After that, let the engine idle for a short time and verify the leak-tightness of the engine and filter. Stop the engine. After about 5 minutes, verify the oil level and carefully fill up to the top mark on the rod (Fig. 11).

NOTE

Remember that the marks on the rod are for oil level with the engine in horizontal position. For this reason, always take engine inclination into consideration when verifying oil level.

b) Reversing gear

The reversing gear has ist own lubrication system, which is separate from the engine's system.

To change oil, drain the old oil by removing the plug located on the bottom rear part of the reversing gear (Fig. 12).

Once empty, put the plug back on and tighten, then fill with clean oil through the oil level rod hole (Fig. 4).

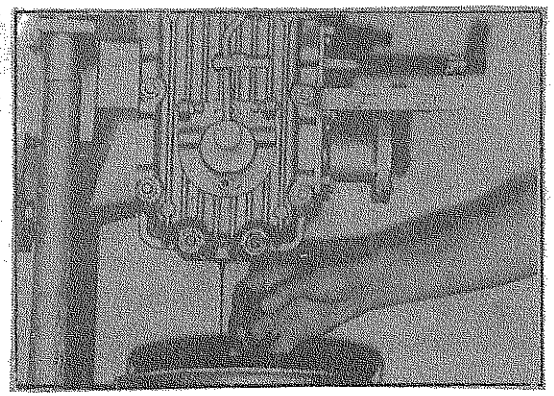


Fig. 12

Change oil after the first 20-25 hours and then every 200 hours afterwards.

NOTE

Change the engine and reversing gear oil at least once each year, even if the operating time is less than stated for oil changes.

4 - Oil filter

The oil filter is located behind the injection pump (Fig. 13).

Replace the dual element after the first 20 hours of operation and then every 150 hours afterwards.

To do this, follow these instructions as illustrated in Fig. 14:

a) Remove the nuts (12) that secure the cover of the filter.

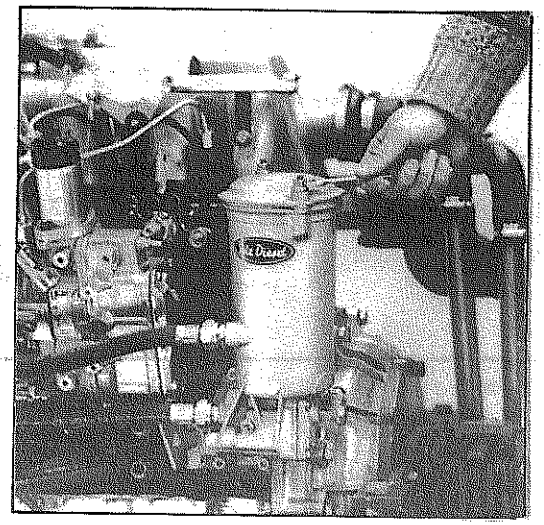


Fig. 13

b) Remove the filter cover (13) and the return line (3). (Note: Upon removing this line, the oil contained in the filter may drop to the crankcase).

c) Remove the dual filter element (1) and (2).

d) Place the new element in the filter body.

e) Verify the condition of the o ring of the cover (14). Change if necessary.

f) Set the cover in place again, tightening the nuts with a torque of 2-2.5 kg.-m.

g) Once oil has been poured into the crankase, turn the engine with the starter for a few moments, until the pressure indicator on the panel goes off. Prevent the engine from starting by pressing the stop button.

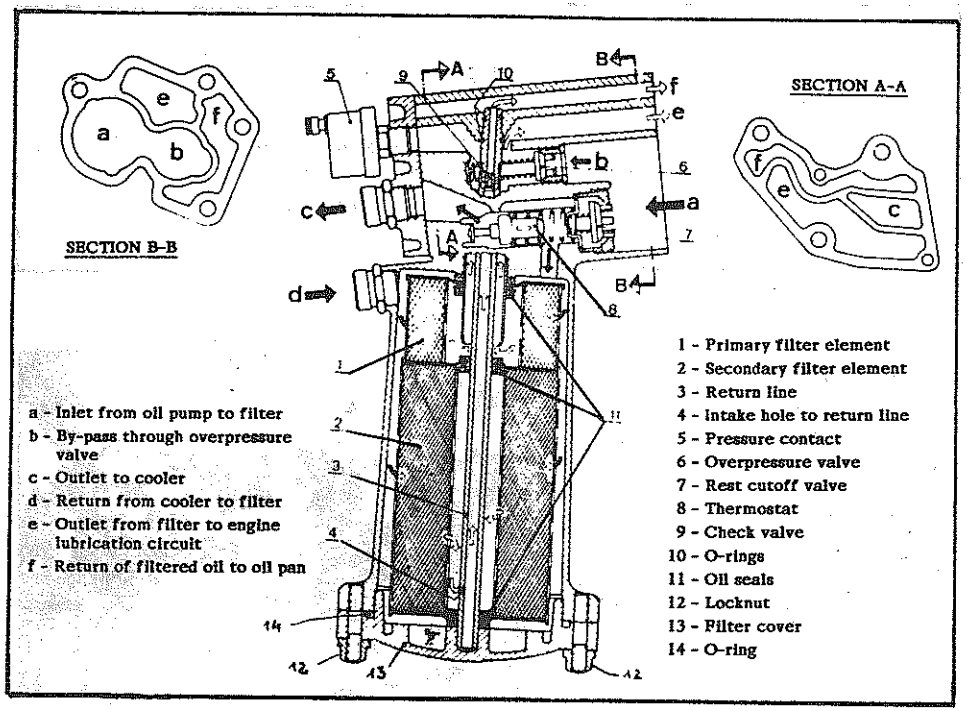


Fig. 14

4.2 - FUEL SYSTEM

1 - Diesel oil

Always use clean diesel oil. Never use kerosene or heavy oils.

Always refill with fuel before the level drops too low. A large quantity of water vapor is produced in cold weather when there is a great deal of air inside the fuel tank. For this reason, always keep the fuel tank as full as possible.

When filling the tank, take measures to prevent the entry of impurities and water by always using clean plastic containers and filtering the fuel.

Always see that the tank is free of water and dirt as well.

Verify that the fuel tank filler caps located on the deck of the boat are leaktight.

4.2 - FUEL SYSTEM

2 - Bleeding the fuel system (Fig. 15)

When starting up the engine for the firts time or if the engine has run out of fuel while operating, air enters the fuels system and must be bled. To do so, follow these instructions:

a) Loosen the manual supply pump (1), turning the knurled cover.

b) Verify that the fuel cock located at the outlet of the tank is open.

c) Actuate the manual supply pump several times, until a certain resistance is noted, then pump a few more times and block it by screwing on the knurled cover.

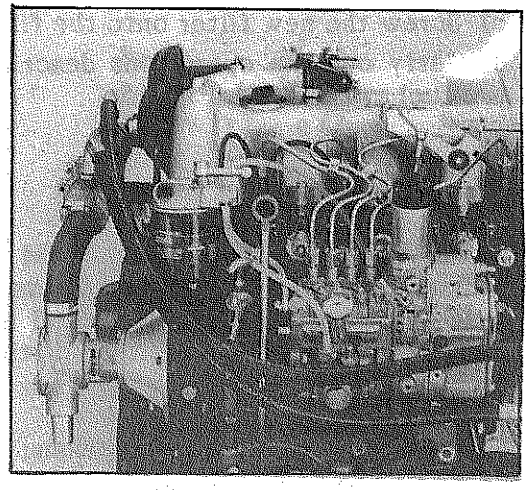


Fig. 15

d) Loosen the air bleed screw (2) one or two turns. This screw is located on top of the filter.

e) Loosen the manual supply pump again and actuate it until a continuous stream of fuel without air bubbles comes out.

f) Tigthen the bleed screw to close it.

g) Actuate the manual supply pump again, until the injection pump opens, which produces a grating noise.

h) Close the manual supply pump again, unscrewing the knurled cover.

3. Changing the fuel filter

The fuel filter is sealed and cannot be cleaned. It must be replaced every 600 hours or at least once each year.

Follow these instructions to change the filter:

a) Close the cock located at the outlet of the tank.

b) Unscrew the filter from the main head with a chain wrench.

c) Screw the new filter onto the filter head by hand.

d) Carry out the operations described in the section on "Bleeding the fuel system" (2), Fig. 15.

4. Verifying the fuel filter

The fuel filter must be changed according to the maintenance schedule. If the filter element becomes dirty sooner than foreseen, reducing the passage of diesel oil and causing a drop in engine power, determine the extent of dirtiness by performing a fuel flow test.

To do so, follow these instructions:

a) Loosen the bleed screw (2), Fig. 15.

b) Loosen the manual supply pump (1), Fig. 15, turning the knurled cover.

c) Turn the manual supply pump several times.

d) Verify that fuel comes out through the bleed screw in a continuous, plentiful stream. If it does not, that is, if the stream of fuel is not constant or not plentiful, the filter is clogged and the filter element must be changed.

5. Nozzles

The nozzles should be removed after a long winter lay-up or when they show signs of faulty operation.

Changing the nozzles

The nozzles must be changed every 4,000 hours or when they operate incorrectly.

a) Disconnect the injection lines, being careful not to bend them out of shape.

b) Disconnect the flexible return lines from the nozzles.

c) Remove the nozzles with a 27 mm socket wrench.

d) Remove the gaskets from the antechamber.

e) Previously clean the nozzles and the nozzle holder witch diesel oil.

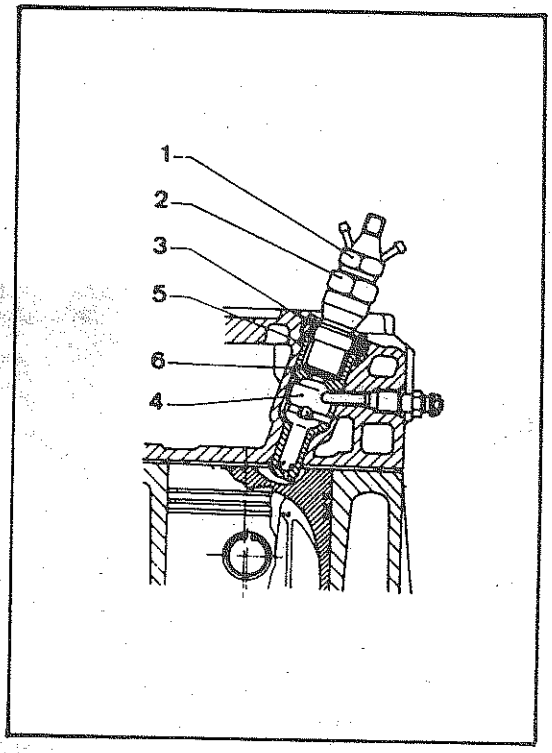


Fig. 16

IMPORTANT

Nozzles should be changed and set by
an authorized Solé Diesel Service
or by a specialized workshop.

Reinstall the nozzles in this way:

a) Give the engine a few turns with the starting motor in order to expell any remains of fuel from the combustion chamber.

b) Install new no. 5 O-rings (Fig. 16).

c) Install the nozzles in the antechambers by means of 27 mm socket wrench, applying a torque of 7-8 Kpm (70-80 Nm).

d) Install the flexible leak fuel return lines on the nozzles.

e) Install the injection lines. Tighten the connector nuts with a torque of 2.5 Kpm (15 Nm).

f) Lastly, start up the engine and verify the leaktightness of the injection and supply lines.

6. - Adjusting engine idle

To correctly adjust the idle, the engine should already have reached its normal operating temperature.

To adjust rpm, turn screw "A" on the injection pump. Idling speed is 750-800 rpm (Fig. 17).

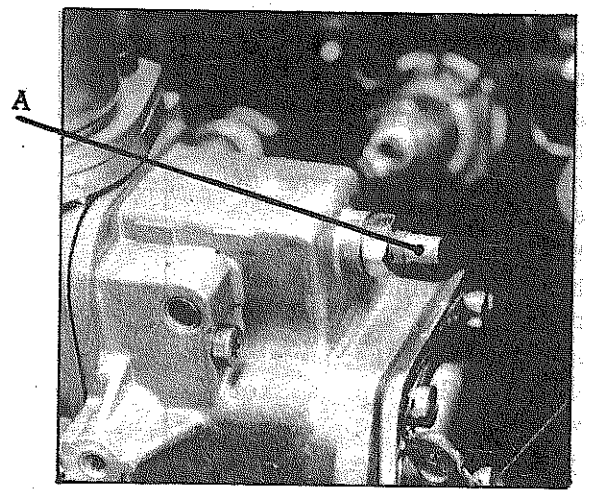


Fig. 17

4.3 - COOLING SYSTEM

The engine is cooled by fresh water, which is in turn cooled by sea water.

1 - Fresh water circuit

For cooling water, use clean water with a minimum of impurities (such as tap or rain water). The use of hard or dirty water leads to the formation of scaling inside the engine, with the resulting decrease in cooling power.

If there is any risk of low temperatures, that is, below 0° C, antifreeze must be added to the cooling water. The proportion of antifreeze to be added depends on the expected temperatures.

On the antifreeze container, the manufacturer gives instructions to be followed in each case. The following table, however, also states suitable proportions for the temperatures listed.

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

Always clean the cooling circuit before adding antifreeze.

NOTE

It is advisable that antifreeze concentration be chosen for a temperature about 5° C lower than the real atmospheric temperature.

Cooling circuit capacity: 12 liters.

a) Fresh water pump

The fresh water pump is located in the middle of the front of the engine on the alternator side (no. 4 - Fig. 1). It is driven by the same V belt as the alternator. The engine may heat up if the belt is too loose, so its tension should be periodically verified and adjusted as required (Fig. 18).

b) Thermostat

The thermostat is a key part in the life of the engine so it is not advisable to remove it. In very hot climates it has no effect at all on the flow of water to the exchanger, but if the engine is operated in a very cold climate, it would take longer to reach its operating temperature, which could leal to premature wear.

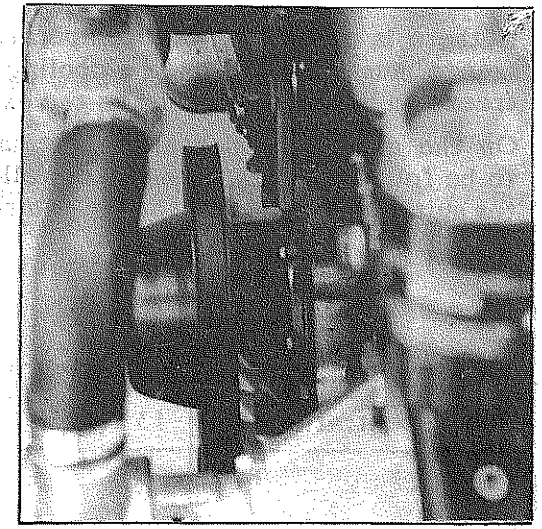


Fig. 18

Excessive temperature of the cooling water when the engine is running under load may be due to a defective thermostat. In such case, the thermostat must be inspected and replaced, if necessary.

Before carrying out such an inspection, verify that the V belt has the correct tension.

The thermostat is located at the outlet of the cylinder head (no. 6, Fig. 1).

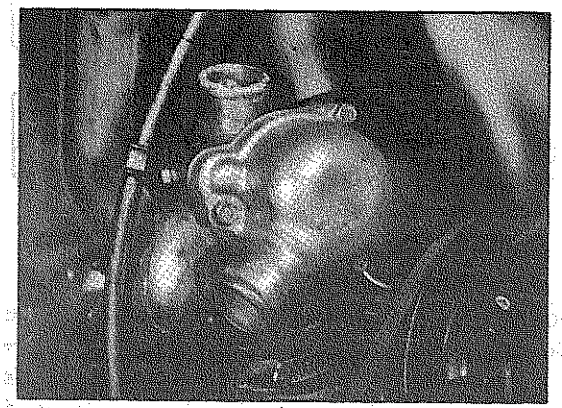


Fig. 19

Inspect the thermostat according to these instructions:

DISASSEMBLY

1) Stop the engine and let it cool off.

2) Drain the water from the cooling circuit.

3) Disconnect the hoses leading from the exchanger.

4) Remove the three setscrews (1) from the base of the upper body and remove the upper body (2) shown in Fig. 19.

5) Remove the thermostat (3) from its housing and verify it as follows (Fig. 20):

Submerge the thermostat in a container filled with water, then heat the water and check the temperature by means of a thermometer.

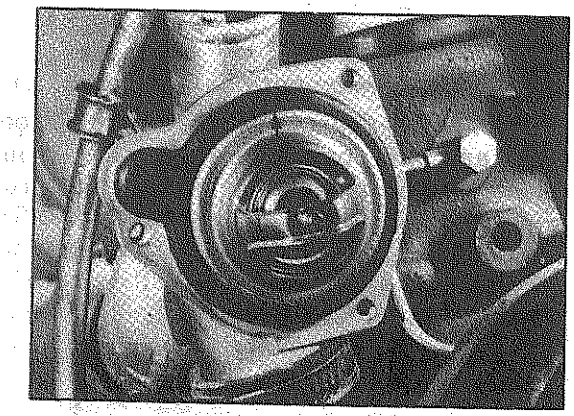


Fig. 20

When the temperature of 72° C is reached, the thermostat valve should begin to open.

Continue heating the water and check the travel of the thermostat valve. Check whether it is completely open at the temperature of 85° C. The overall travel of the valve should be 10 mm.

If these values are not as stated, replace the thermostat.

ASSEMBLY

NOTE: An arrow is marked on the body of the thermostat element to indicate that the element should be upwards in that zone.

6) Install the thermostat element as stated.
7) Install the cover of the thermostat.
8) Install the thermostat.
9) Connect the hoses.
10) Fill the exchanger with water.
11) Start up the engine and verify leaktightness.

c) Heater

A heater may be optionally supplied on demand.
The heater connections are located on the fresh water pump (Fig. 21) and the connector (Fig. 22). To install, the cover of the fresh water pump must be removed and a rubber elbow, Ref. 132.11.034, and two 20 x 32 clamps, Ref. 540.81.020, must be assembled. A connector, Ref. 152.11.050, a copper washer of Ø 30 x Ø 38 x 2, Ref. 560.00.151, a rubber elbow, Ref. 132.11.034, and two clamps of 20 x 32, Ref. 540.81.020, must be assembled on the block.

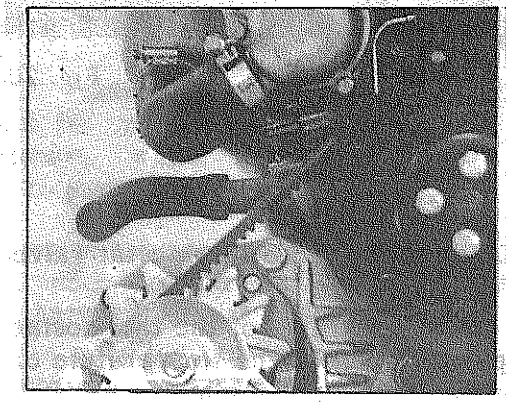


Fig. 21

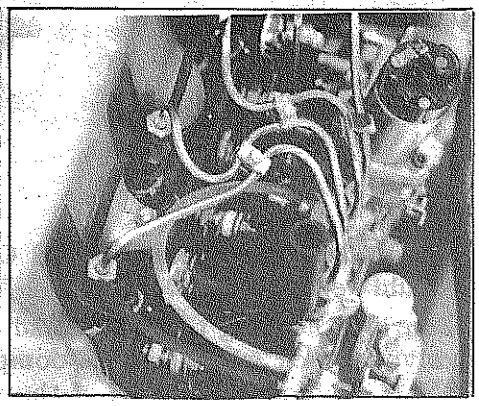


Fig. 22

2 - Salt water circuit

a) Water pump

The salt water flow pump is located on the front of the engine (no. 5, Fig. 1). The discharge impellor is made of neoprene and cannot revolve when dry. If it is operated without water, it may break. For this reason, you should always have a spare impeller on hand.

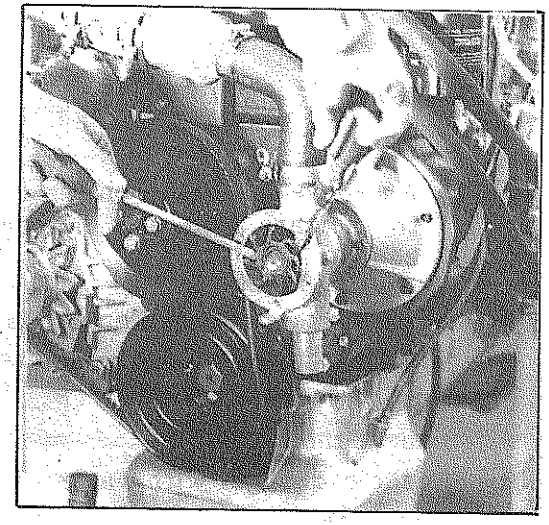


Fig. 23

To change the impeller, close the water intake cock, remove the pump cover and, with two screwdrivers, pry the impeller off the shaft. Clean the housing and install a new impeller. Then put the cover on again, installing a new gasket (Fig. 23).
Open the bottom cock.

b) Water filter

It is important to have a filter between the engine and the bottom cock to prevent the impurities contained in sea water from clogging the cooling lines.
Clean the filter every 50 hours by loosening the wing nut and removing the filter element. Clean the filter element and reinstall it, making sure that the cover seats well on the O-ring (Fig. 24).

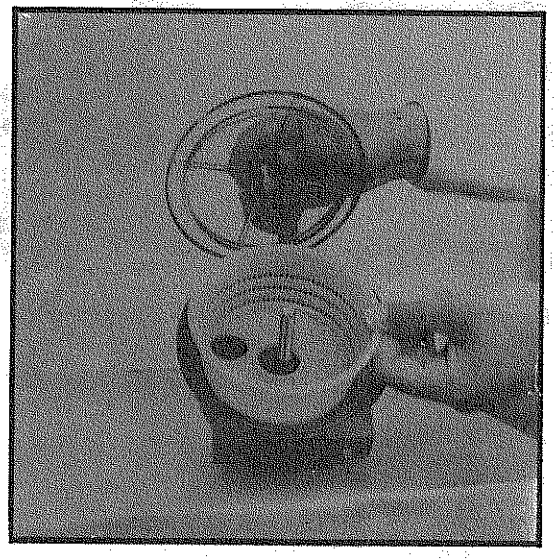


Fig. 24

The start up the engine to verify the leaktightness of the cover.

IMPORTANT

If the impeller breaks and must be changed, be careful to remove any bits of rubber that may have been detached, from the water lines.

3 - Plugs

The engine has two fresh water plugs which are located, respectively, on the engine block and beneath the heat exchanger (Figs. 25 and 26).

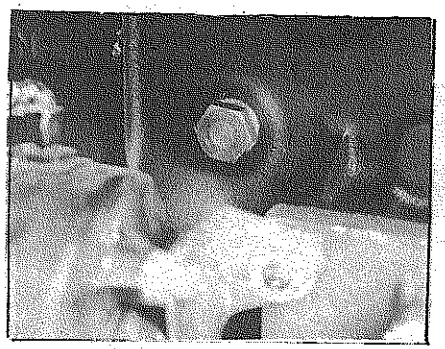


Fig. 25

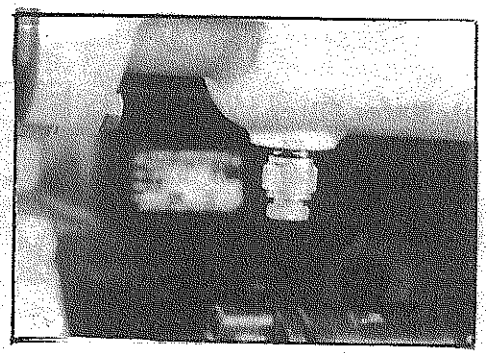


Fig. 26

4.4 - ELECTRICAL SYSTEM

The engine has a 12 V system and its electric circuit is shown, in the diagrams of Figs. 28 and 29.

When installing electrical components, connect it according to the diagram and verify that the cable sheathing is not damaged and that the grounding is correct.

> IMPORTANT
>
> Before handling the electrical system,
> disconnect the negative cable
> from the battery.

1 - Glow plugs

To verify the correct operation of glow plugs, use a piece of copper wire to make a bridge between the positive terminal of the starting motor and the contact (threaded rod) on top of the glow plug. If sparks jump, the glow plug is in good condition.

2 - Alternator

The alternator is a 12 V 55 A unit and has a built-in electrical regulator. It also has an outlet for the tachometer connection (Connection W).

Periodically check the electrical connections, their good attachment and good contact with the terminals.

Also verify the tensions of the V belt and adjust it, if necessary. Excessive tension may lead to rapid wear of the belt and of the alternator bearings. On the other hand, if it is too loose or oily, the charge may be insufficient because the belt slips.

Never try to adjust the tension of the belt while the engine is running.

To verify belt tension, press with your finger in the longest run between two pulleys. Tension is correct when, under a pressure of approximately 6 kp (60 N) exerted with your thumb, the belt gives about 10 mm (Fig. 27). The belt should be tightened before it gives more than 15 mm.

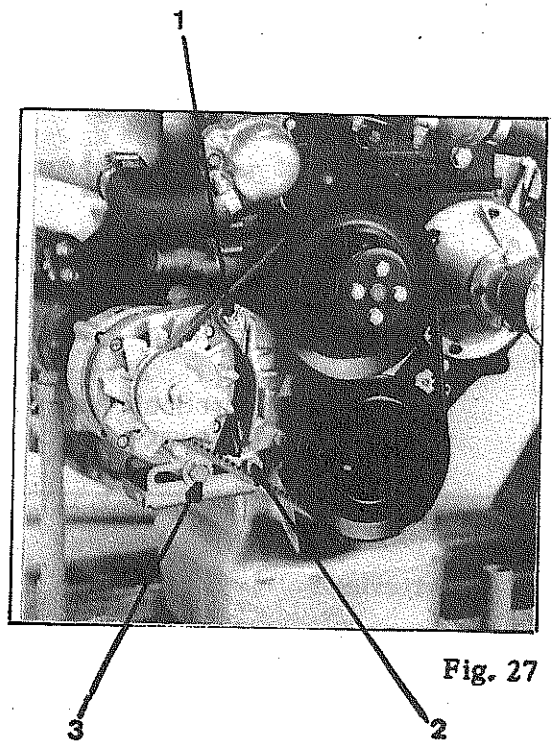


Fig. 27

1 Alternator setscrew
2 Tensor system setscrew
3 Tensor screw

Tightening the V belt

Loosen the setscrews (1) and (2) of the alternator and tensor system on the support. Loosen the locknut (3). Turn the tensor screw (3) at the same time as you exert a pressure of approximately 6 kp (60 N) on the belt with your thumb, and

when the belt gives about 10 mm, tighten screws (1) and (2) and the locknut of the tensor screw (3).

Changing the V belt

Loosen screws (1) and (2) and the locknut of the tensor screw (3).

Completely slacken the old belt so that it will be easy to remove.

Once the belt has been removed, verify the condition of the pulley grooves, which should be clean and dry. Clean them with soapy water (do not use gasoline, diesel oil or similar producte).

Install the new belt, setting it in place without using any tools, if possible, and much less with sharp-edged instruments that could damage the belt and shorten its service life.

Lastly, tighten the V belt as previously explained.

IMPORTANT

While the engine is running, the alternator should be continuously connected to the battery. If it is not, the diodes of the voltage regulator will be immediately destroyed.

Before charging the battery with an external charger, both terminals (positive and negative) must be disconnected.

3 - Batteries

The batteries require very careful maintenance and frequent checks.

Follow these instructions:

a) Always keep the batteries dry and clean.

b) Periodically check that the terminals are clean. If there is any dirt on the terminals, loosen and clean them, then apply a coat of neutral grease.

c) Never let the batteries come into contact with oil or fuel.

d) Never place metal objects on the battery (keys, etc.), to avoid short-circuits.

e) Handle the batteries and acid containers with care to prevent the acid from coming into contact with skin or clothing. Acid can cause burns to people and destroy clothing.

f) Each month verify the acid level and top it off, if necessary, with distilled water. It should never reach a level over 15 mm above the top edge of the plates.

g) Never use bare flames to light up the parts of the battery in order to avoid the risk of explosion.

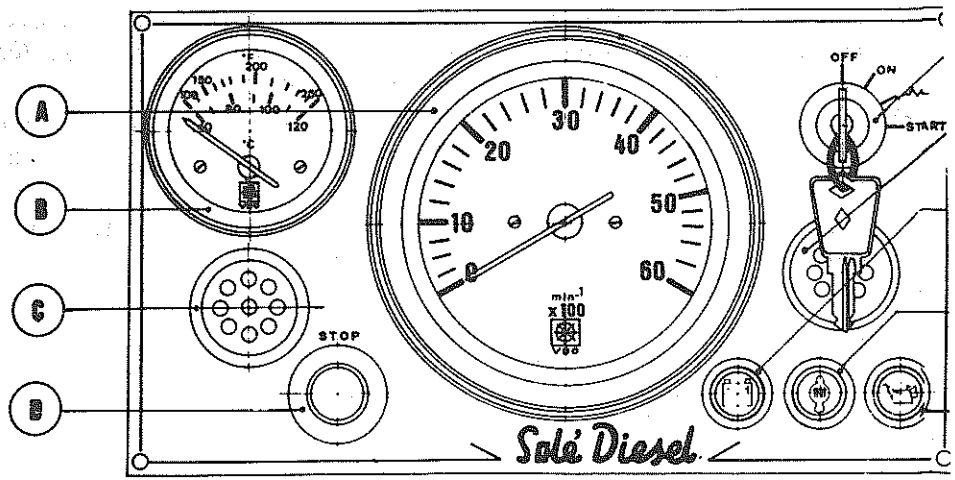
h) During winter lay-up, remove the batteries and store them according to the manufacturer's instructions.

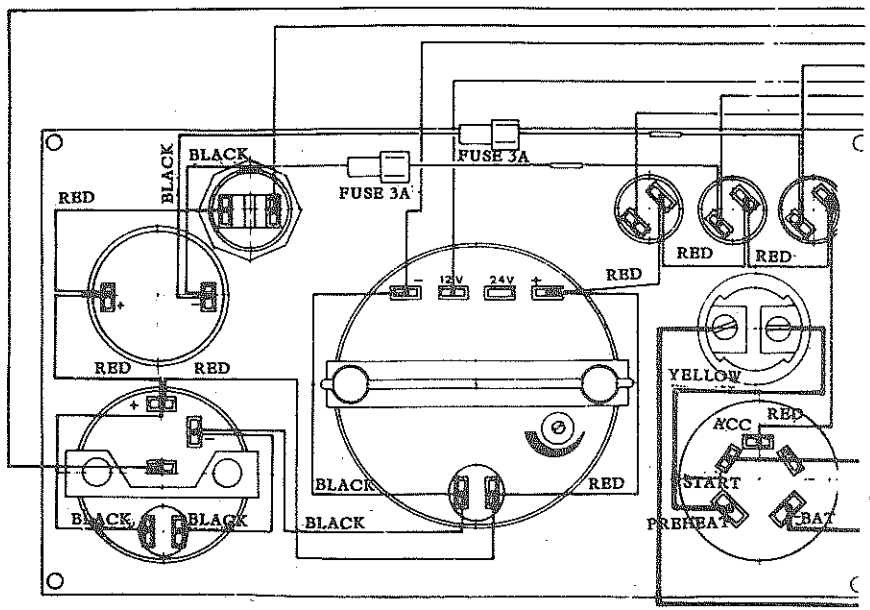
4 - Fuse

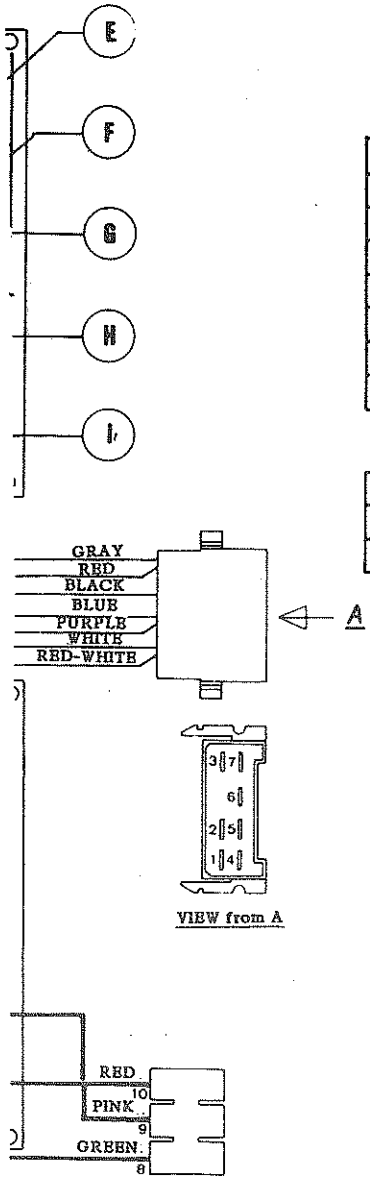
For protection, the electrical system has a 50 A fuse located beside the starting motor on the cable that leads from it to the panel (see the diagram on page 36).

If current does not reach the panel, check the fuse to see if it has burned out and, if so, replace it with a new one.

Fig. 28





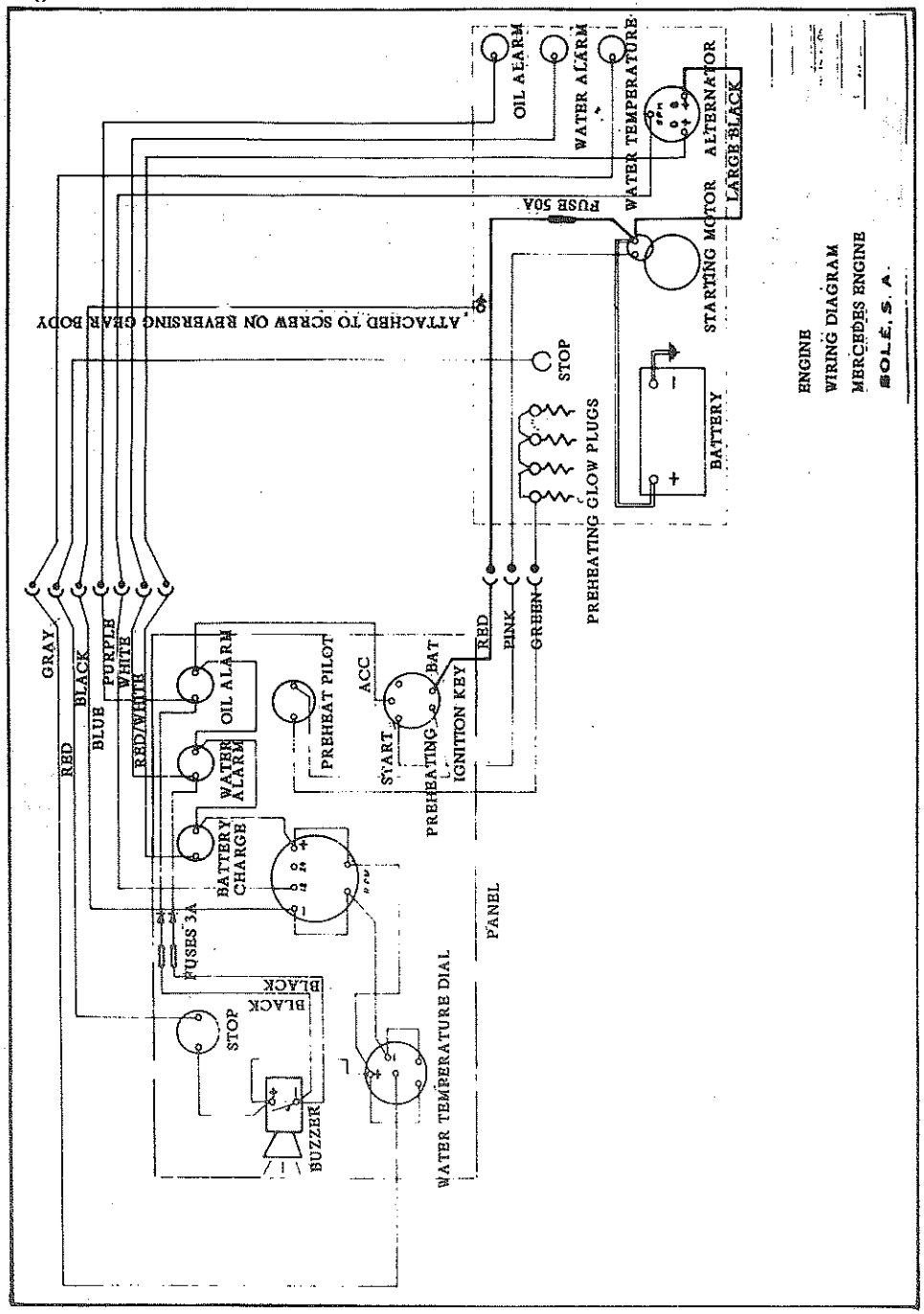


Nº	CABLE FUNCTION	COLOR
1	Water alarm	White
2	Oil alarm	Blue
3	Water temperature dial	Gray
4	Charge control	Red-white
5	Tachometer	Purple
6	Negative	Black
7	Motor stop	Red
8	Preheating glow plugs	Green
9	Starting	Pink
10	Current input +	Red

ITEM	NAME
I	OIL LIGHT
H	WATER TEMPERATURE LIGHT
G	BATTERY CHARGE LIGHT
F	PREHEATING PILOT
E	IGNITION KEY
D	STOP BUTTON
C	BUZZER
B	WATER TEMPERATURE
A	TACHOMETER

ELECTRICAL PANEL
MERCEDES ENGINE

Fig. 29



5 - PERIODIC INSPECTIONS

5.1 - DAILY CHECK BEFORE STARTING THE ENGINE

1 - Check the oil level in the engine and reversing gear. Top off, if necessary. It is not necessary to add oil if the level is near the top mark on the rod.

2 - Verify fuel level and open fuel outlet cock.

3 - Open the water inlet cock.

4 - Check indicators.
After starting the engine, verife oil pressure, water temperature and battery charge. All three lamps should be off and the horn should not sound.

5 - Verify the correct flow of the cooling water and check for any irregularities in the exhaust gas, noise or vibration.

6 - Check the cooling water level.

7 - Verify the good condition and tension of the alternator belt.

5.2 - MAINTENANCE AFTER THE FIRST 20 H. OF OPERATION

1 - Engine and reversing gear oil change. Follow the instrustions on page 17 (4-1 Lubrication System - 3).

2 - Change oil filter. Follow the instructions on page 19 (4.1 Lubrication system - 4).

3 - Verification and, if necessary, adjustment of the alternator belt. Follow the instructions on page 31 (4.4 Electrical System - 2).

4 - Inspect the tightness of the engine attachment screws and of the propeller shaft.

5.3 - MAINTENANCE EVERY 150 HOURS OF OPERATION

1 - Engine and reversing gear oil change. See page 17 (4.1 Lubrication system -3).

2 - Change of oil filter. See page 19 (4.1 Lubrication system - 4).

3 - Change of fuel filter. See page 22 (4.2 Fuel System - 3).

4 - Cleaning of water filter. See page 29 (4.3 Cooling system - 2b).

5 - Verification and, if necessary, adjustment of alternator belt. See page 31 (4.4 Electrical system - 2).

6 - Retighten bolts and nuts of intake and exhaust manifold, alternator, engine attachment and propeller shaft.

5.4 - MAINTENANCE EVERY 300 HOURS OF OPERATION

1 - Change of fuel filter. Follow the instructions on page 22 (4.2 Fuel system - 3).

2 - Check the water level of the battery.

3 - Verification and, if necessary, adjustment of engine idle. See page 24 (4.2 Fuel system - 6).

5.5 - MAINTENANCE EVERY 600 HOURS OF OPERATION

1 - Verification of tappet play and adjustment, if necessary. (This operation should be performed by an authorized Solé Diesel service).

2 - Verification of water pump impeller and replacement, if necessary. See page 28 (4.3 Cooling system - 2a).

3 - Verification of tightness of engine attachment screws, propeller shaft and diesel oil line connectors.

5.6 - MAINTENANCE EVERY 900 HOURS OF OPERATION

1 - Cleaning and washing of nozzles.
Verify the pressure of the nozzles. See page 49. (This operation should be performed by an authorized Solé Diesel service).

5.7 - MAINTENANCE EVERY 1,800 HOURS OF OPERATION

1 - Verification of condition and operation of preheating glow plugs.

2 - Replacement of the toothed timing belt.
This operation should be performed by an authorized Solé Diesel service.

3 - Replacement of the alternator belt. Follow the instructions on page 31 (4.4 Electrical System - 2).

5.8 - 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 to 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 connected 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.

5.9 - 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 17 (4.1 Lubrication system - 3).

3 - Inspect the internal water system and 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 21 (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.

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

	Inspection item \ Interval	Daily	After 1st 20 hours	Every 150 hours	Every 300 hours	Every 600 hours	Every 900 hours	Every 1,800 hours
Engine body	Tightening of att. screws		○			○		
	Tappet play					○		
	Engine idle				○			
	Timing belt							●
Lubrication system	Engine oil	○	●	●				
	Reversing gear oil	○	●	●				
	Oil filter		●	●				
Fuel system	Fuel	○						△ □
	Fuel tank				●			
	Fuel filter (sediment cup)			△ □				
	Water filter (if any)						□	
	Nozzle							
Cooling system	Cooling water	○						
	Water filter	○		□				
	Bottom cock	○						
	Water pump impeller					○		
Electrical system	Each instrument	○						
	Glow plug							○
	Starting motor, alternator and regulator						○	
	Alternator belt		○	○				●
	Battery water level				○			

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 in "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 21)
Fuel outlet cock closed	Open
Fuel filter clogged	Inspect filter and replace cartridge (page 22)
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 21)
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 21)
Fuel filter clogged	Inspect filter and replace cartridge (see page 22)
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 21)

3. Engine lacks power or misfires

Fuel filter clogged	Inspect filter and replace cartridge (see page 22)
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 21)
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 authorised 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 22).

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 31). Inspect the condition of the water pump. Repair it or replace it.
Bottom cock to water filter clogged	Inspect and clean (see page 29)

Cooling system clogged	Verify that the oil and water cooling lines 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 28)
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 31)

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 - SERVICING DATA

7.1 - Servicing Specifications

		With engine at 20° C	With engine at 60° + 15° C
Valve clearance (Cold or warm):	intake:	0.10 mm	0.15 mm
	exhaust:	0.30 mm	0.35 mm
Compression:		22/24 kg/cm^2 (bar)	Normal
		15 kg/cm^2 (bar)	Minimum
Minimum oil pressure with engine warm at 3,000 rpm		4-6 kg/cm^2 (bar)	
Firing order (Cylinder 1 on water pump side)		1-3-4-2	
Injector pressure kg/cm^2 (bar)	New nozzles		
		BOSCH	115 + 8
		T D Z	115 + 5
	Used nozzles, min.		100

7.2 - ENGINE (Multigrade oils)

AGIP SINT - 2.000 AGIP F 1 Super motor oil 20W/50	AGIP
CEPSA multigrade 20W/40 - 10W/30 CEPSA multigrade Diesel 10W/30 - 20W/40 CEPSA super multigrade 15W/50 - 20W/40	CEPSA
BRTOIL super multigrade HD 20W/40 - 20W/50	UNION EXP. RIOTINTO
GULFRIDE multy G 20W/50	GULF
Super VISCO STATIC 20W/50	B. P.
MOTOR OIL super 20W/50	VEEDOL
DIESELGRADO 20W/50 TODOGRADO	ENPETROL C. S.
FINA SUPERGRADO 20W/50	FINA
ESSO EXTRA motor oil 20W/50 ESSOLUBE XD - 3 15W/40	ESSO

8 - Tightening Torques

Thread		Tightening torque Nm	Kgm
Reversing gear lay-shaft setscrew		120	12
Water cooler element locknut		20	2
Reversing gear output clamp setscrew		120	12
Reversing gear body setscrew		40	4
General tightening torque of screws	M. 6	7,8	0,8
	M. 8	27	2,7
	M. 10	35	3,5
	M. 12	64	6,4
	M. 14	95	9,5

Tightening torques

Name		Kpm	Nm
Cylinder head setscrews		(1	
Cylinder head cover locknuts		1,5	15
Antechamber threaded lock rings		15 - 18	150 - 180
Oil pan setscrews	M 6	1,0	10
	M 8	2,5	25
Cylinder block intermediate flange setscrews		5	50
Flywheel setscrews	Preliminary torques	3 - 4	30 - 40
	Goniometric torque	90° - 100°	
Damper setscrews		27 - 30	270 - 300
Connecting rod setscrews	Preliminary torque	4 - 5	40 - 50
	Goniometric torque	90° - 100°	
Engine mounting bearings setscrews		9 ± 0,9	90 ± 9
Camshaft setscrews		2,5	25
Camshaft control gear setscrews		8	80
Rocker supports setscrews (2)		3,8	38
Chain tightener sealing nut		9	90

Tightening torques

Name	Kpm	Nm
Connections of discharge valves in injection pump (3)	3 - 3,5	30 - 35
Injection line connector nuts	2,5	25
Injection advance controller setscrew	4	40
Nozzles on nozzle holders, and nozzle holders on cylinder head	7 - 8	70 - 80
Exhaust manifold locknuts	4	40
Preheating glow plugs	5	50
Alternator support on cylinder block	4,5	45
Alternator on support	3,75	37,5
Alternator pulley	2,5	25
Oil pump setscrews	2,5	25
Oil overpressure valve on oil pump	4	40
Oil filter setscrews to cylinder block	3	30
Oil filter tank setscrew to body	4 - 4,5	40 - 45
Oil filter cover setscrews	2 - 2,5	20 - 25
Water pump discharge setscrews to cylinder block	3	30
Thersmostat setscrews to cylinder block	2,5	25
Thermostat cover setscrews	0,8	8
Engine supports on cylinder block	6,5	65

Explanatory notes on tightening torques

1) Before mounting the cylinder head screws, oil the threads, seating faces and washers.
Apply torques to the screws with engine cold, in the order shown in the diagram (Fig. 30).

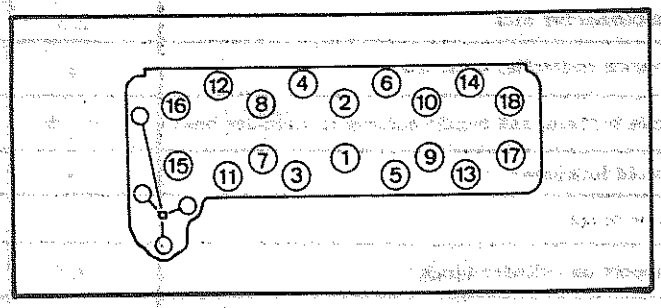


Fig. 30

Tightening the cylinder head screws

Tightening torque with dynamometric wrench		Goniometric torque		
1st torque	2nd torque	Waiting time in minutes	3rd torque	4th torque
4 kpm 40 Nm	7 kpm 70 Nm	10	90°	90°

Screws (a) of M 8 should be tightened with hand wrench.

NOTE: When loosening the setscrews of the cylinder head, follow the order opposite that given in the diagram above.

2) When tightening the setscrews of the rocker supports, the rockers should not be under load from the camshaft.

3) To ensure correct seating of the O-rings of the discharge valve connectors, tighten the connectors with a torque of 3 kpm (30 Nm) and then release them: next, retighten with 3 kpm (30 Mn) and release: lastly, tighten with a torque of 3 + 0.5 kpm (30 + 5 Nm).

NOTE: Before screwing on the connectors, apply tallow to the threads.

The dynamometric wrenches should be chosen in each case so that the specified tightening torque will be 70-75 % of its application margin; for a torque of 4 kpm (40 Nm), for example, use a dynamometric wrench with application margin of 0-6 kpm (60 Nm).

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