

MARNA diesel

TYPE M2 - 16-24 HP

MAINTENANCE MANUAL AND ILLUSTRATED SPARE PARTS LIST

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Fuel, lubricating oil and adjustment data for
MARNA DIESEL ENGINE, TYPE M2

Fuel oil: Gas Oil.

Lubricating oils: FOR MARNA diesel engines use lub. oils according to the API specifications.

Service DG - recommended.

Service DM or DS - preferably.

Summer: SAE 20

Winter: SAE 10

For engines equipped with reduction gear, use the following gear oils in the gearbox:

Mobilube GX 80190
Shell Dentax 90
Esso Gear Oil SAE 90
BP Energol Gear Oil SAE 90
Caltex Thuban 90

For greasing the propeller shaft and the reversing gear we recommend the following grease:

Mobilgrease No. 2
Esso CaZar K2.

If this becomes too thick in the winter, use grease No. 1. The usual consistence grease or cup grease must not be used.

ADJUSTMENT DATA:

Valve clearance: 0,4 mm
Opening pressure of the fuel injector: To be set at 2260 lbs/sq. in. 160 kg/cm² and must not fall below 2055 lbs/sq. in. (145 kg/cm²).
Clearance above piston top: 1,2 - 1,5 mm. Must not be less than 1 mm.

NOTE:

When removing the flywheel, use the pull bar (supplied with each engine).
The crankshaft must never be hammered on in order to loosen the flywheel.

DESCRIPTION OF MARNA 2 CYLINDER DIESEL ENGINE, TYPE M2.

Type: 4 stroke, vertical, water-cooled.
 Bore: 105 mm.
 Stroke: 125 mm
 Piston displacement: 1080 cc.
 Compression ratio: 16,5 : 1

<u>Ratings:</u>	1050	1200	1500	1600 RPM
Type M1 (1 cyl.)	8	9	11,5	12 HP
Type M2 (2 cyl.)	16	18	23	24 HP
Type M3 (3 cyl.)	24	27	34,5	36 HP

Fuel system: Direct injection.
 Fuel pump: Bosch Type PFR1A80/110/8
 Fuel injector: Bosch Type KBL103S15
 Fuel nozzle: Bosch Type DLLA 150S39, 4 holes.
 Fuel filter: C.A.V. Type F2
 Fuel filter cartridge: C.A.V. No. 7111/44.

Opening pressure for the fuel injector: 2260 lbs/sq. in. (160 kg/cm²)

The fuel pump starts to deliver: 25° before TDC.

Lubricating system: The lubricating oil is pressure fed to all moving parts in the engine and the clutch by a gear pump. A full-flow filter is part of the system. Normal oil pressure: 20-35 lbs/sq. in (1,5 - 2,5 kg/cm²). Max. 42 (3) and min. 15 lbs/sq. in. (1 kg/cm²).

Lubricating oil filter: Fram FHM850 for M2 and M3.

Filter cartridge: CH 850-P1 for M2 and M3.

Oil in the sump up to the highest mark on the dipstick: M2: 19 pints (11 l)

Cooling: Fresh water system with thermostat, expansion tank and keel cooler.

Thermostat: Mekano Type T 26.

Pipes for keel cooler: M2: 4,0 yds - 5/8" copper tube.

Starting: Starting handle with chain drive to camshaft and automatic decompression release.

Governing: Centrifugal governor set for marine engine at 1600 rpm max. and 450 rpm idling. For stationary engines the governor is supplied with special springs for 1500, 1200, 1100 and 1000 rpm, with a speed variation of 3-4% from full load to no load.

<u>Engine rotation:</u>	Clock-wise seen from flywheel end.
<u>Propeller rotation with reduction gear:</u>	Anticlock-wise seen from flywheel end.
<u>Weight:</u>	The engine equipped with clutch, starting handle and flywheel: Type M2: 1030 lbs (490 kg) Engine equipped with clutch, starting handle, flywheel and reduction gear: Type M2: 1145 lbs (520 kg) Stationary engine with starting handle and flywheel: Type M2: 1010 lbs. (460 kg).

MARNA DIESEL TYPE M2 MARINE ENGINE is normally supplied with the following equipment:

Equipment D:	Fixed propeller, marine gear and starting handle.
Equipment G:	Variable pitch propeller, clutch and starting handle.
Equipment DR:	Fixed propeller, marine gear, starting handle and reduction gear.
Equipment GR:	Variable pitch propeller, clutch, starting handle and reduction gear.

The engines are also supplied as stationary engines with starting handle, power take-off in front or rear for direct drive with elastic coupling or pulley for V-belt drive. The rear power take-off may be supplied with a clutch.

<u>Electrical equipment:</u>	Electric starter may be supplied with M1 and M2 as extra equipment:
Starter:	1, 8 HP, 12 volts, Bosch Type EJD 1, 8/12/L79
Dynamo:	75 W, 12 volts, Bosch Type REE 75/12/1300 R1
Battery:	Minimum 90 Ah. Maximum 140 Ah.
Alternative dynamo:	130 W, 12 volts, Bosch Type REE 130/12/825R209
Electric starter is supplied with M3 as standard equipment:	
Starter:	1, 8 HP, 12 volts, Bosch Type EJD 1, 8/12/L79
Dynamo:	130 W, 12 volts, Bosch Type RKC 130/12/825R209
Battery (extra):	140 Ah.
A bigger dynamo may be supplied for special purposes.	

Bilge pumps:

Gear pump, delivering 22 gal. /min. with clutch;

Gear pump, delivering 6 1/2 gal. /min. with friction wheel drive, which may be disconnected.

INSTALLATION OF MARINE ENGINE:

Correct installation is the primary condition to be satisfied in order to ensure troublefree running of a marine engine. An incorrect or bad installation of the engine may cause overheating, excessive wear, loss of power, vibration etc.

THE WOODEN FOUNDATION must be of first class material, preferably oak. The foundation consists of two beams 7" x 6" placed edge up. If these beams are well fastened to the boat, excessive vibrations of the engine when running, will be avoided. You will profit by attaching great importance to the foundation of the engine. For engines having reduction gear, the beams may normally be placed so that they also pass underneath the supports of the reduction gear. Before the engine is bolted to the foundation see that the engine centerline is exactly parallel and meets with the propeller shaft centerline. The best way to check this is to place the coupling on the propeller shaft into the coupling on the engine. Then turn the propeller shaft by hand. If the shaft is in line with the engine, there shall not be any visible opening between the couplings. When this is done, the engine may be bolted to its foundation. Finally check the centerline again.

Standard lengths:

Propeller shaft: 2,5 m

Shaft tube: 0,65 m.

CHECKING THE FOUNDATION:

After some time loosen the couplings again and check if the centerline still is correct, as it often happens that the foundation beams have a tendency to warp when they have absorbed water.

Check that the flywheel is properly fastened to the crankshaft.

PROPELLER CLEARANCE:

It is important that the propeller should turn with reasonable clearance behind the boat, and the minimum clearances relative to the propeller diameter, given in the sketch, should not be made any smaller, as this may disturb the efficiency of the propeller and cause propeller vibrations in the boat.

ADJUSTMENT OF PROPELLER

For engines with clutch, red. gear and reversing mechanism in one unit.

The reversing mechanism has a built in maximum turn for forward and reverse of blades.

When the propeller shaft is coupled to the gear shaft, the drawbar for wing adjustment is screwed into the gear shaft drawbar, and the couplings are joined in a position giving a correct pitch for the propeller blades, both forward and rearward.

Note that the turn of the propeller blades by means of the drawbar should not be limited in the propeller head, but by the stop mechanism in the gear box.

REMOTE CONTROL OF CLUTCH HANDLE

Check that the handle movement for the clutch is limited by screws placed beside the handle, if remote control equipment is used.

REMOTE CONTROL OF REVERSING MECHANISM

For this purpose universal joints can be used, but maximum 45° is recommended.

THE EXHAUST PIPE should be 1 1/2" inside diameter for M1 and M2 and 2" inside diameter for M3, and it should be as straight as possible with large radius bends. Each engine is supplied with a silencer. If the exhaust pipe is placed under deck with the outlet aft, it may be necessary to insulate the pipe. This may be done by winding asbestos cord around the pipe or by putting an extra pipe outside the exhaust pipe and placing the silencer as far aft as possible. The cooling water from the engine may then be circulated in the outer pipe and cool the exhaust pipe. With a fresh water cooling system the water from the expansion tank should run along the exhaust pipe before it enters the cooler. The exhaust pipe should always have a bend downwards right after the engine in order to collect the condense water and prevent it from entering the engine. On the bottom of the bend, a drain cock may be placed.

COOLING SYSTEM:

The keel cooler of the standard fresh water cooling system should be mounted underneath the boat as close to the keel as possible for the best protection. - Do not paint the copper tubes of the keel cooler.

INSTALLATION OF STATIONARY ENGINE

The supports of the engine are turned down for mounting on an iron frame or a concrete foundation. The cooling of the engine may be arranged by a cooling tank (approx. 130 gal. (600 l) for 1 cyl., approx. 260 gal. (1200 l) for 2 cyl. and approx. 390 gal. (1800 l) for 3 cyl., or by a radiator with fan. The fuel oil tank must be placed with a head of at least 1/2 yd (0,5 m) from the outlet of the tank to the inlet of the fuel filter. The silencer should be placed not more than 2 yds from the engine. Exhaust pipe lengths shorter than 3 yds measured from the silencer, should have 1 1/2" inside diameter for M1 and M2. Exhaust pipes 3-8 yds require 2" inside diameter. For M3 use 2" inside dia. pipe for lengths shorter than 3 yds, and 3-8 yds pipe lengths require 3" inside diameter.

STARTING THE ENGINE

Before each start it is wise to sound the oil level, the fuel tank and the cooling water. Check that the fuel control lever is turned to the right. Push down the decompression lever and turn the engine 5-10 times in order to prime the fuel and the lubricating oil. Screw the governor handle towards full speed and push the cold start button. Engage the decompression handle on to the threads and turn the engine as fast as possible. Continue to turn when the automatic decompression release disengages, until the engine has had a few firing strokes and is able to increase its speed. The threads for the automatic decompression release will give 6 revolutions on the starting handle. For 2 cyl. also the first cylinder (and the first and second cylinder for M3) must stay decompressed until the second cylinder has fired. When the engine is running, check that the cold start button has been released, that the oil pressure is increasing and that the cooling water pump is working.

THE FUEL TANK should be placed as high up as possible. The outlet of the tank must be at least 8" (20 cm) above the engine fuel filter inlet (corresponds to 1 ft 8" (50 cm) above the engine foundation) in order to attain the necessary pressure for the fuel pump. The fuel pipe from the tank to the fuel filter must be placed in such a way that no air may be trapped in the pipe and restrict the flow of fuel. The fuel tank must be fastened properly, so that it does not come loose in heavy sea. If other fuel tanks than the standard copper tank are used, they must not be made of galvanized material.

AIDS FOR STARTING IN COLD WEATHER.

Starting fluid:

Keep the spray bottle vertical and point it to the hole in the air filter. Keep it as close as possible when the fluid is squirted into the filter for 1-2 seconds, then start the engine immediately. If possible it is advantageously to start the engine simultaneously with squirting the fluid into the filter.

When aids are used for starting, also use the cold start button as for normal starting. The effect of the cold start button is that it breaks off the normal max. limit on the fuel injector, so that an extra quantity of fuel is injected during starting, thereby making the engine start easier. The most effective starting aid is the fluid, and we recommend having this in reserve for very cold weather. The fluid in the bottle is highly inflammable.

ELECTRIC STARTING

It is not necessary to decompress the engine if it is equipped with electric starter, but otherwise follow the instructions given above.

STOPPING THE ENGINE

The engine is stopped by turning the fuel control lever to the left until the engine has stopped. The engine must not be stopped by pushing down the decompression lever, as this will damage the valve. Preferably run the engine at medium speed and with a small load for a little time before it is stopped.

RUNNING THE ENGINE FOR THE FIRST TIME

Marine engine

When the installation is completed and the engine is to be run for the first time, do observe the following:

Make sure that the fuel system is not leaking anywhere and that it is bled, that the cooling water system is not leaking and that the water pump is working. During running, check that the temperature is reasonable. The thermometer on top of the thermostat should indicate about 65-80°C when the engine has reached working temperature.

Before the engine is started, check that the flywheel is properly fastened to the crankshaft. If the flywheel is loose, it will cause a knocking in the engine, and this knocking is difficult to locate.

All engines are filled with lubricating oil in the sump when sent from the factory. Nevertheless check the lubricating oil in the engine. Make sure the oil level is between the two marks on the dip-stick. Refilling oil is done through the plug on top of the casing for the starting handle. If the engine is equipped with reduction gear, check the oil level in the gear. The plug for refilling oil is on top of the gear box. In the beginning it is very important that the reversing gear bearing and the stern tube bearings are kept well greased. Do a turn on the grease cups before each trip, and always keep a container of non-acid grease in the boat.

If the engine is equipped with clutch and variable pitch propeller, full pitch is usually too much for the engine. Adjust the pitch so the engine is running at 1000-1150rpm for engines without reduction gear, and 1350-1600rpm for engines with reduction gear. The exactly right full speed revolution depends on several factors.

If vibration occurs at a certain rpm, even though the foundation is well made, the engine must be made to run at a higher or lower speed in order to reduce this vibration. If the boat is heavy and slow relative to the engine rating, it may happen that the boat's speed does not increase even though the engine speed is raised by reducing the propeller pitch. If, for example, an 8 HP engine without reduction gear is run at 1000 rpm, the boat's speed may increase only a trifle by running the engine at 1150rpm, despite that the engine power now has a marked increase.

It is necessary to understand the fuel pump limit and the working of the governor before the engine is taken into use.

The limit on the fuel pump is set at the factory, so that the pump on full load for all rpm cannot deliver more fuel than the correct quantity corresponding to the ratings given in the HP-diagram.

The governor is set so that the governor handle screwed back all the way will give the engine an idling speed of approx. 400rpm, and the governor handle screwed all the way down will give the engine max. rpm, i. e. 1500rpm. If the engine is to run at full load at a revolution less than 1500rpm, it is not necessary to turn the governor handle all the way down, but set it where the engine appears not to increase its revolutions any more (the fuel pump is at its limit). If the propeller pitch is reduced, the governor handle must again be adjusted to give full power. If the engine is disconnected, the governor will limit the idling rpm, the limit depending on the position of the governor handle. Max. revolutions with the engine disconnected is 1700rpm. This is when the governor handle is turned all the way down.

The first 50 operating hours, do not run the engine at more than 3/4 full load.

NORMAL RUNNING:

Marine engine:

After 50 hours of operation the engine will usually be sufficiently run in, and may run with full load all day. It is important that the fuel tank is not emptied completely during running, as this may cause air to enter the fuel system. As it takes some time to remove the air by bleeding the fuel system, it may cause an inconvenient stop. When running in shallow water or near drifting wood etc., be careful with the propeller. The propeller

blades may easily break or bend if they hit anything. If it is necessary to use the engine, keep the hand ready on the clutch so that the propeller may be quickly disconnected.

When approaching a quay, slow down the engine to idling speed about 70-80 yards from the quay. At a suitable distance (approx. 30 yards, depending on wind, stream flow and the type of boat) disconnect the engine and fully reverse the propeller pitch. Some yards from the quay (5-10) connect the engine, and the boat will quickly reduce its forward speed.

When the boat is to run for some time at slow speed, it is advantageous not to run the engine at minimum revolutions, but increase the revolutions slightly, and instead let the propeller have less pitch. The fuel consumption will be about the same. If the engine is to be used mainly at low rpm, it is advantageous to use lubricating oil SAE 20 in the winter, even if this will cause a somewhat heavier start.

RUNNING IN COLD WEATHER.

Marine engine:

Running the engine at temperatures below freezing is done as usual under normal circumstances. There is only one thing to remember: Fill anti-freeze in the cooling system. If the engine runs without anti-freeze the water in the cooling system will expand when it freezes, and hence crack the cylinder block and cylinder cover. If there is no anti-freeze available, drain all water from the engine. When the cylinder jacket and the water tank is emptied of water, start the engine and run it idling for a short time with the drain cocks open, in order to pump out most of the water in the keel cooler. If the engine has an open salt water cooling system, always drain the water from the engine when it is stopped and while the water is still hot. The inlet valve at the bottom of the boat must be closed.

Engines having closed fresh water cooling system should preferably be cleaned every autumn before the anti-freeze is added. Some grease from the water pump will enter the cooling system. This is harmless as long as it isn't too much, as excessive grease deposit may destroy the cooling effect of the keel cooler and even completely stop the water circulation. However, this may happen if the waterpump is greased too much or if the cooling system has not been cleaned for some years. The most harmless cleansing fluid is White Spirit which is poured into the system after the water is drained. The engine is run for a while at high speed without loading. The White Spirit is then drained and the system flushed with water. Radiator purifiers from the oil firms, or soda solution, may also be used. The system will have to be thoroughly flushed afterwards if soda solution has been used, as this solution will react with the anti-freeze and make froth. The soda solution must not be spilled on the ropes in the boat. After flushing, fill anti-freeze and clean water mixed to the desired freezing protection.

We recommend the following anti-freeze fluids:

Mobil Permazone (Mobil Oil), Atlas Perma Guard (Esso), Glyco Shell (Shell) and BP Anti-Freeze (BP).

These anti-freeze fluids are based on ethylene-glycol and are anti-corrosive. They do not evaporate, so that clean water may be refilled and the freezing protection still kept unchanged.

Should a leak occur, anti-freeze must of course be refilled. The anti-freeze maintains its corrosive protection for 6-12 months, and one fill is enough for a whole winter. The mixing table for the anti-freeze is printed on the can. The cooling system for M1 holds approx. 1,65 gal. (7,5 l), M2 approx. 2,2 gal. (10 l), and M3 approx. 2,8 gal. (13 l) 50 % anti-freeze is usual, and will give a safe protection. But in most places a weaker mixture will do.

CARE AND MAINTENANCE OF THE ENGINE.

It will pay to check the running of the engine and keep it in good condition. Check regularly on the fuel, the cooling water, the lubricating oil, cooling water temperature and the water pump. Lubricating oil must be changed according to instructions. Use only the oils recommended by us. Oils of inferior quality, i.e. cheaper oils, must never be used. Several cheap HD oils are sold, and if these oils are used in an engine with pressure fed circulating oil, they will cause pitching of the piston rings and valves and wear down the engine in a short time. Keep the engine clean. If it starts to rust, scrape the rust off and paint the spot. After some time, check that the engine has not come loose on the foundation and see that the flywheel is properly fastened. Only a trained mechanic should repair or overhaul the engine. Either go to a recognised workshop or send the engine to the factory. The MARNA agents will quickly supply any needed spare parts for the engine. Use only original spare parts.

When the engine is used daily, the control and maintenance should follow the routine listed below:

Daily:	Check the fuel oil level. Check the lubricating oil level. Check the cooling water level. Check that the water pump is working. Check the oil pressure Make a turn on the grease cups on the reversing gear and the propeller shaft bearings.
Every 100 hours:	(Fuel consumption 26 gal. (120 l) for 1 cyl., 53 gal. (240 l) for 2 cyl., and 79 gal. (360 l) for 3 cyl.) Make a few turns on the water pump grease cup. Drain sludge and water from the fuel tank. Check that the cigaretteholder does not stick.
Every 200 hours:	(Fuel consumption 53 gal. (240 l) for 1 cyl., 106 gal. (480 l) for 2 cyl., and 160 gal. (720 l) for 3 cyl.) Change the lubricating oil in the sump. Check the valve clearance.
Every 400 hours:	(Fuel consumption 110 gal. (500 l) for 1 cyl., 220 gal. (1000 l) for 2 cyl., and 330 gal. (1500 l) for 3 cyl.) Change the cartridge in the lubricating oil filter. Adjust the valve clearance.

Check the opening pressure of the fuel injectors and the spraying.

Every 1000 hours:

(Fuel consumption 265 gal. (1200 l) for 1 cyl.
530 gal. (2400 l) for 2 cyl. and 790 gal.
(3600 l) for 3 cyl.

Check the cooling water thermostat.

Check the cartridge in the fuel filter. (Renew if necessary).

If the compression of the engine is not satisfactory, find the cause and have it corrected.

If the lubrication oil consumption becomes too high, replace the piston rings and measure the wear in the cylinder liner.

The fuel consumptions given above corresponds to operating hours with normal use of the boat. At special operating conditions observe the following: If the engine is run at low rpm for long periods (low fuel consumption), change the lubricating oil after 200 hours even if the fuel consumed is less than listed above. If the engine is run with a steady loading, there is no need to change the oil more often than every 200 hours. Note that heavy loading of the engine requires a more frequent check on the lubricating oil filter and the fuel filter, and a high rpm requires more frequent adjustment of valves, fuel injectors, the chain for the starting handle etc.

CHECKING THE LUBRICATING OIL LEVEL:

The control is done before the engine is started. Unscrew the dip-stick, wipe it clean and insert it again without screwing it down. If the oil is below the lower mark, fill oil to the top mark. If the engine is to be run continuously for some time, try to fill a suitable quantity of oil once a day, so that the engine has to be stopped only when oil change is due. There is some variation in the oil consumption, but try for a start with 1 pint (0,5 l) for M1, 2 pints (1 l) for M2 and 3 pints (1,5 l) for M3 every 24 hours.

CHECKING THE COOLING WATER LEVEL:

The water level in the expansion tank should be kept approx. 2 1/2" (6 cm) below the filling plug. Do not let it sink too low in the tank. If the correct anti-freeze is used in the winter, the anti-freeze itself does not evaporate, only the water, so only clean water is needed for refilling. If a leakage should occur in the system, anti-freeze must of course be refilled too.

CHANGING OIL IN THE SUMP

The oil is pumped out of the sump with the hand pump. This must be done immediately after the engine has been running so that the sludge dissolved in the oil does not sink to the bottom of the sump. The hand pump is inserted through the hole for the dip-stick. The new oil is filled on top of the casing for the starting handle.

CONTROL AND ADJUSTMENT OF THE VALVE CLEARANCE

The valve clearance is measured while the engine is cold. The clearance should be 0,4 mm. A feeler gauge is inserted between the valve and the rocker arm and the engine is cranked a few times. The 0,4 mm thick feeler gauge should barely be loose when the valve is closed. If the clearance has to be adjusted, slacken the locknut on the rocker arm adjusting screw and turn the screw until the correct clearance is obtained, then retighten the nut and check the clearance.

REPLACING THE OIL FILTER CARTRIDGE

The cover on the oil filter is removed by unscrewing the centre bolt on top. The cartridge may then be lifted out, and the filter container is wiped clean. A loose spring underneath the cover keeps the cartridge in place. The filter cartridge cannot be cleaned, it must be replaced when it is no longer effective.

CHECKING THE INJECTORS OPENING PRESSURE AND SPRAYING

The injection pressure is set at 2260 lbs/sq.in (160 kg/cm²), but it will decrease after some time because the spring is weakened. The pressure must not fall below 2055 lbs/sq.in (145 kg/cm²), and the injector must therefore be checked and adjusted with an injector testing apparatus at a diesel engine workshop.

If the engine is not running properly, and the cause may be due to the injector the injector may be tested on the engine. Unscrew the injector and connect it to the fuel pipe again. Crank the engine, and it will be seen if all four holes give a perfect spray. If the holes are closed, clean them with the nozzle cleaning needle, which is supplied with the engine. Note that it is dangerous to point the fuel spray towards a person.

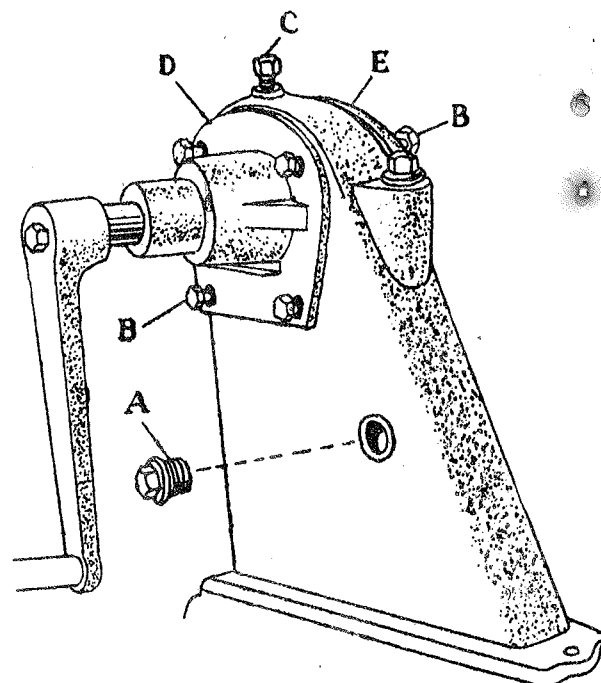
CHECKING THE COOLING WATER THERMOSTAT

The cover on the thermostat housing is unscrewed and the thermostat is lifted out. The thermostat is in working order if it is in closed position when it is cold. However, if it is open when it is cold, it must be replaced because it is leaking in the bellows.

CHECKING THE FUEL FILTER CARTRIDGE

Disconnect the pipe from the filter to the fuel pump. If the fuel flows too slowly through the filter, the cartridge must be replaced. The duration of effectiveness of the cartridge depends very much on the quality of the fuel in the tank. The cartridge cannot be washed and used anew. Note: Never remove the cartridge and run the engine

without, as the fuel pump will be worn out in a short time if it has to work with unfiltered fuel. To replace the cartridge, unscrew the centre bolt on the cover. The filter housing with the cartridge may then be lowered and the cartridge removed. Between the outlet and the inlet ends of the cartridge there are rubber rings at bottom and top to seal the filter. When the housing with the new cartridge is put back, make sure the rubber gasket lays properly and undamaged in its groove in the cover.



ADJUSTING THE CHAIN FOR THE STARTING HANDLE

Before using the engine, unscrew plug A at the rear of the starting handle casing. It is then easy to feel the tightness of the chain by pushing it to the left with a finger. The correct tightness is when the chain may be pushed about 5 mm to the left. When a control shows that the chain is too slack, it must be tightened. Unscrew the bolts (B) rear and front of the casing (4 bolts holding each cover), then tighten the chain by turning the adjusting screw (C) on top of the casing until the chain has got the right tightness. Then replace the bolts first in the rear cover and then the front cover. Finally check that the chain has the right tightness.

FUEL TANK

Remember to let out the water that has separated from the fuel. Use the drain cock underneath the fuel tank. Otherwise the water will enter the fuel filter and damage this by causing freezing in cold weather.

HOUSE FOR CLUTCH, RED. GEAR AND REV. MECHANISM M1. 2319

Lubrication:

The gear wheel housing contains gear oil, which also lubricates the reversing mechanism. Check the oil level by means of the dipstick and change the oil every 1000 hours. If the engine is not used much, never use the same oil in the red. gear more than half a year. When the engine is new, change the oil in the red. gear after 50 operating hours. The oil change should be done right after the engine has been running. The used oil is sucked up by the hand through the hole for the dipstick. Unscrew the filling plug on top of the rear of the gear and fill oil to the top mark on the dipstick approx. 1,8 l.

If the engine has been running for some time with the propeller shaft outlet under water, drain the oil from the box and check that water has not entered. This way it is checked that the sealing rings are not damaged and leaking.

If the engine's gear box has been under water it is possible that water has entered the gear through the breathing hole in the filling plug. The oil must then be changed.

At the rear of the gear housing is placed a grease cup. Use this grease cup regularly but never much at a time. The grease from this cup lubricates the sealing rings. Without grease these rings can be damaged.

ADJUSTMENT OF CLUTCH

If the clutch heats, jumps out of engagement or does not pull, the clutch must be adjusted. Disengage the clutch, and take off clutch cover. Loosen the two locknuts (item 14 draw Ms 2319) and tighten the adjusting screws (item 13) till the clutch requires a distinct pressure to engage. (About one turn will in most cases do). Both screws must be tightened equally. Tighten the lock nuts after the adjustment.

PROPELLER

Grease cups for stern tube and bearings should be operated daily in order to secure sufficient lubrication.

The propeller head is filled with grease, and this should be changed approx. twice a year when in regular use.

ADJUSTMENT OF THE DECOMPRESSORS.

The steps required for the adjustment of the decompressors are as follows:

The engine is turned to upper dead point of the compression stroke for the cylinder needing adjustment. For the rear cylinder with the automatic decompressor, the spring sleeve (item 48 on cylinder head) is screwed down to a position where it allows the decompression Pin (item 50) a free movement of 2-3 mm. Put the decompression handle (item 59) in position on the foremost thread of the threaded bolt for decompression (item 26 on starting handle). Screw down the screw (item 57) first to take out the backlash of 2-3 mm of the decompression pin, and then $3/4$ of a turn which gives about 1 mm of decompression of the valve. Fasten the nut (item 58) to secure the screw (item 57).

For the other cylinders, having decompressors consisting of spring housing, item 72 and decompression pin, item 73, the decompression pin is put in its lower position. Screw the spring housing so far down that it touches the rocker arm (item 21) and then $3/4$ of a turn which gives about 1 mm of decompression of the valve. Fasten the backnut, item 49.

We will call your attention to an alteration in the engine's oil sump capacity. When the oil is changed, new oil must be filled to the highest mark on the dipstick. The oil content in the sump is then about 6, 5 liters on the M1 engine, 11 liters on the M2 engine and 15 liters on the M3 engine. These capacities must be considered to be approximately, and the oil level must always be kept within the two marks on the dipstick.

Oil changes:

For M1: Change oil for every 200 hours (or after a fuel consumption of 53 gal.)

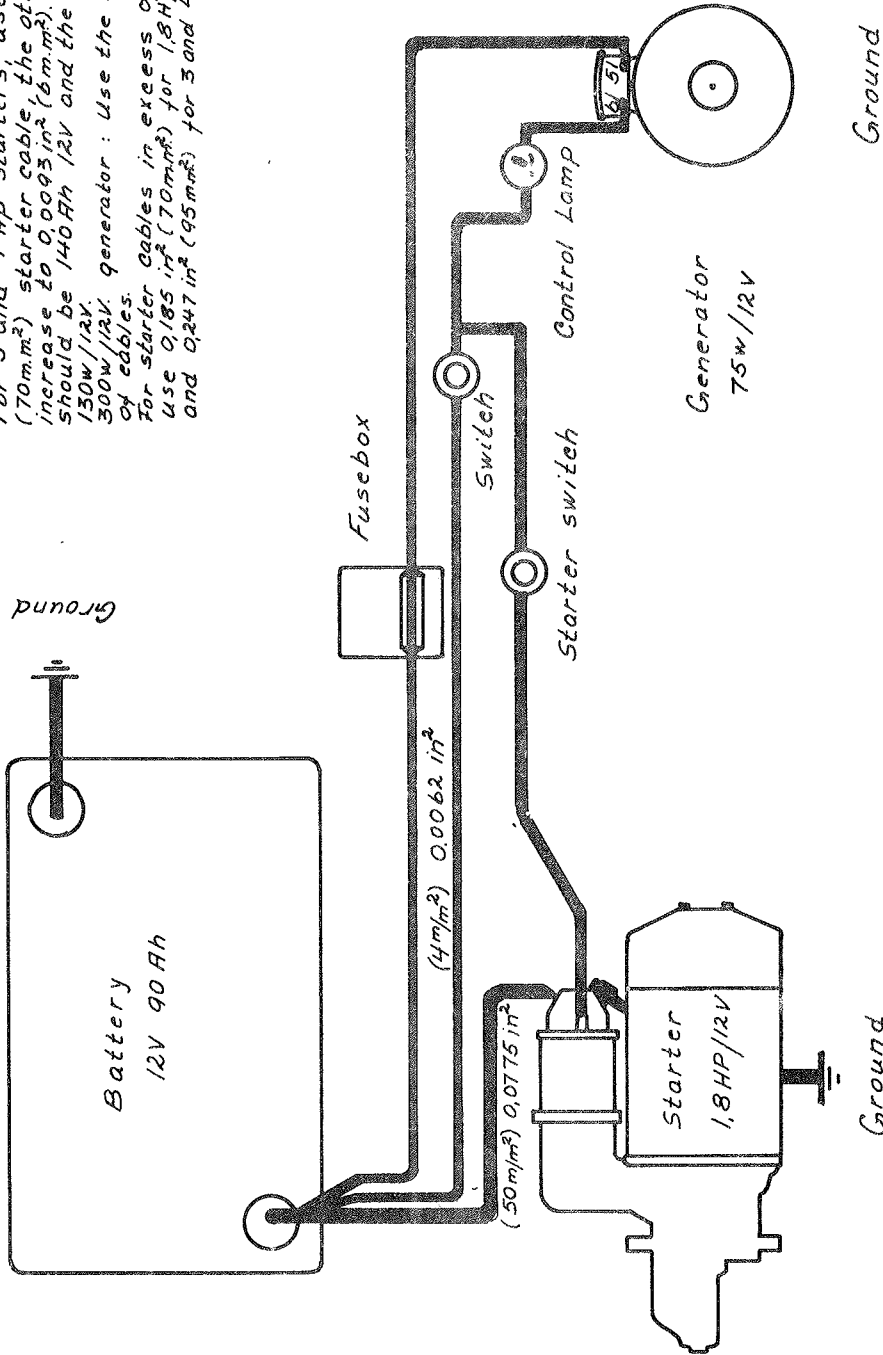
For M2: For every 200 hours (or after a fuel consumption of 106 gal.)

For M3: For every 200 hours (or after a fuel consumption of 160 gal.)

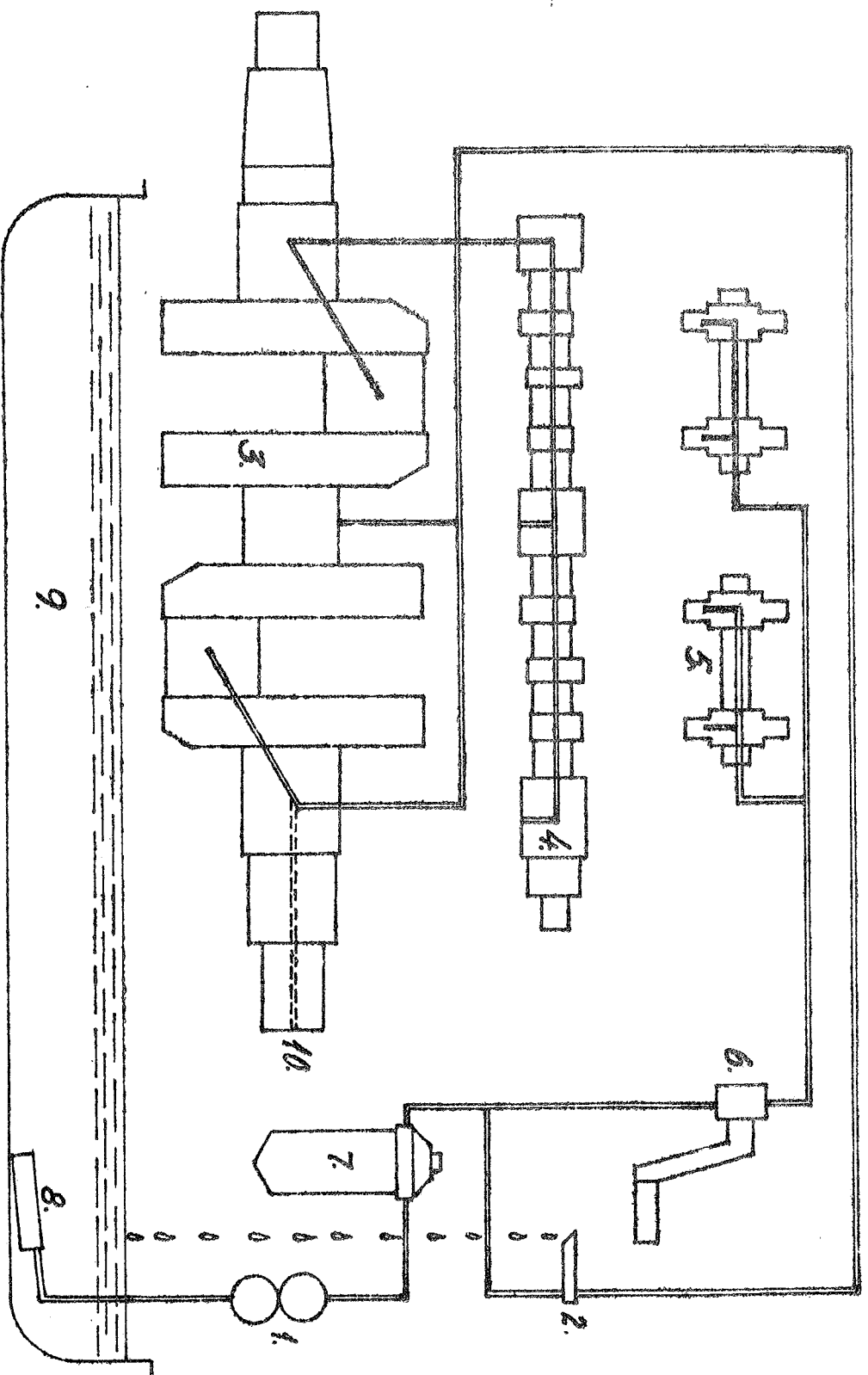
This routine is valid for M1 from engine no. 16936, for M2 from engine no. 17000 and for M3 from engine no. 16910.

Diagrammatic sketch of electric circuit

For 3 and 4 Hp starters, use 0,185 in² (70mm²) starter cable, the other cables increase to 0,0093 in² (6mm²). The battery should be 140 Ah 12V and the generator 150W/12V.
 300W/12V. generator : Use the same sizes of cables.
 For starter cables in excess of 2 yards, use 0,185 in² (70mm²) for 1,8 HP starters and 0,247 in² (95mm²) for 3 and 4 Hp. starters.

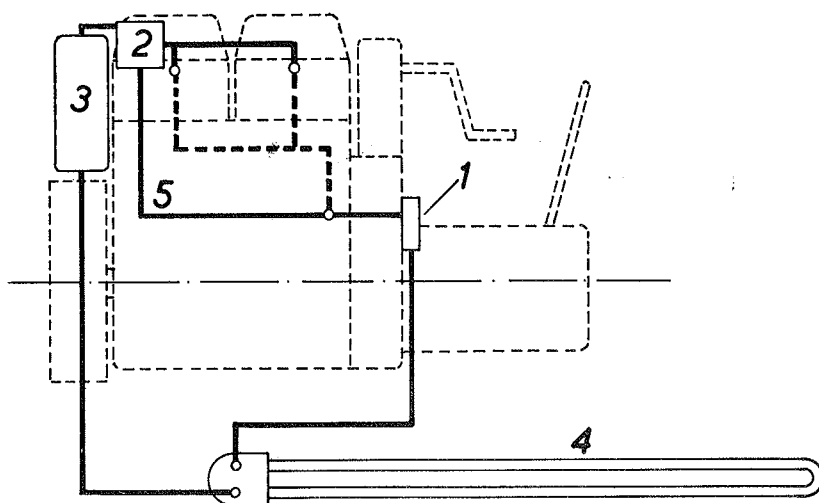


Tegn.		Målest.	Hovedtoleranse ±	Vekt	Matr.
23/6-65		K. Røksvold	Asim.		Modell
Konfir.			M-type M2-M3-M4		Gruppe nr. 55
Mandals Motorfabrik Mandal (Norway)			Løblingsskjema		
			Mt. 2513		



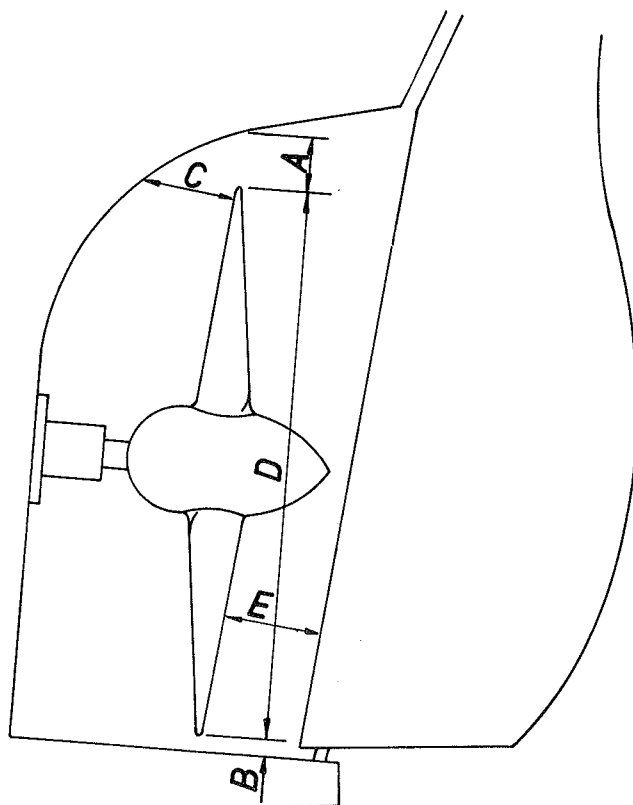
SMÖREOLJESYSTEM (Lubricating oil system)

- 1 Oljepumpe (Oil Pump)
- 2 Overflomsventil (Overflow Valve)
- 3 Veivaksel (Crankshaft)
- 4 Kamaksel (Camshaft)
- 5 Vippearmer (Rocker Arms)
- 6 Sveivlager (Starting Handle Bearing)
- 7 Oljefilter (Oil Filter)
- 8 Oljesil (Oil Strainer)
- 9 Oljesump (Oil Sump)
- 10 Olje til gear (Oil to Gearbox)



KJÖLESYSTEM (COOLING SYSTEM)

- | | |
|------------------------------------|-------------------------------------------|
| 1 VANNPUMPE (COOLING WATER PUMP) | 4 UTENBORDS KJÖLERÖR (KEEL COOLING PIPES) |
| 2 TERMOSTAT (THERMOSTAT) | 5 OMLÖPSRÖR (BY-PASS WATER PIPE) |
| 3 EKSPANSJONSTANK (EXPANSION TANK) | |



MINIMUMSKLARINGER I PROPELLBRÖNN.

(MIN. CLEARANCES FOR PROPELLER)

D-PROPELL DIAMETER (PROPELLER DIA.)

A- 10% av D

B- 3% av D

C- 15% av D

E- 8% av D

ORDERING SPARE PARTS

|||||

In order to avoid unnecessary misunderstandings, delays and annoyances for both you and us, we ask you kindly to follow this procedure when ordering spare parts:

Find the page where the required part is drawn. You will see that all parts are tagged with a number. This number is also found in the list of parts on the opposite page. (POS). Then it is simply to use the given DESCRIPTION and PART NO. At the same time state the group where the needed parts are drawn and listed, and the number of parts wanted.

Also please remember - and this is important:

ALWAYS STATE THE ENGINE NUMBER WHEN ORDERING SPARE PARTS.

|||||