Workshop Manual

Marine carburetor engines

AQ105A, AQ115A, AQ130A, AQ130B, AQ130C
AQ165A, AQ170A, AQ170B, AQ170C

Contents

Safety Precautions

Introduction

This Workshop Manual contains technical data, descriptions and repair instructions for Volvo Penta products or product versions contained in the contents list. Ensure that the correct workshop literature is being used.

Read the safety information and the Workshop Manual "General Information" and "Repair Instructions" carefully before starting work.

Important

In this book and on the engine you will find the following special warning symbols.

WARNING! If these instructions are not followed there is a danger of personal injury, extensive damage to the product or serious mechanical malfunction.

IMPORTANT! Used to draw your attention to something that can cause damage, product malfunction or damage to property.

NOTE! Used to draw your attention to important information that will facilitate work or operations.

Below is a summary of the risks and safety precautions you should always observe or carry out when operating or servicing the engine.

Immobilize the engine by turning off the power supply to the engine at the main switch (switches) and lock it (them) in the OFF position before starting work. Set up a warning notice at the engine control point or helm.

Generally, all servicing should be carried out with the engine switched off. Some work (carrying out certain adjustments for example) requires the engine to be running. Approaching a running engine is dangerous. Loose clothing or long hair can fasten in rotating parts and cause serious personal injury.
If working in proximity to a running engine, careless movements or a dropped tool can result in personal injury. Avoid burns. Take precautions to avoid hot surfaces (exhausts, turbochargers, charge air pipes and starter elements etc.) and liquids in supply lines and hoses when the engine is running or has been turned off immediately prior to starting work on it. Reinstall all protective parts removed during service operations before starting the engine.

Check that the warning or information decals on the product are always clearly visible. Replace decals that have been damaged or painted over.

Never use start spray or similar to start the engine. The starter element may cause an explosion in the inlet manifold. Danger of personal injury.

Avoid opening the filler cap for engine coolant system (freshwater cooled engines) when the engine is still hot. Steam or hot coolant can spray out. Open the coolant filler cap carefully and slowly to release pressure before removing the cap completely. Take great care if a cock, plug or engine coolant line must be removed from a hot engine. It is difficult to anticipate in which direction steam or hot coolant can spray out.

Hot oil can cause burns. Avoid skin contact with hot oil. Ensure that the lubrication system is not under pressure before commencing work on it. Never start or operate the engine with the oil filler cap removed, otherwise oil could be ejected.

Stop the engine and close the sea cock before carrying out operations on the engine cooling system.

Only start the engine in a well-ventilated area. If operating the engine in an enclosed space, ensure that exhaust gases and crankcase ventilation emissions are ventilated out of the working area.

Always use protective goggles where there is a danger of pieces of metal, sparks from grinding, acid or other chemicals being thrown into your eyes. Your eyes are very sensitive, injury can lead to loss of sight!

Avoid skin contact with oil. Long-term or repeated contact with oil can remove the natural oils from your skin. The result can be irritation, dry skin, eczema and other skin problems. Used oil is more dangerous to health than new oil. Use protective gloves and avoid using oil-soaked clothes and rags. Wash regularly, especially before meals. Use the correct barrier cream to prevent dry skin and to make cleaning your skin easier.

⚠ Most chemicals used in products (engine and transmission oils, glycol, petrol and diesel oil) and workshop chemicals (solvents and paints) are hazardous to health Read the instructions on the product packaging carefully! Always follow safety instructions (using breathing apparatus, protective goggles and gloves for example). Ensure that other personnel are not unwittingly exposed to hazardous substances (by breathing them in for example). Ensure that ventilation is good. Handle used and excess chemicals according to instructions.

⚠ All fuels and many chemicals are inflammable. Ensure that a naked flame or sparks cannot ignite fuel or chemicals. Combined with air in certain ratios, petrol, some solvents and hydrogen from batteries are easily inflammable and explosive. Smoking is prohibited! Ensure that ventilation is good and that the necessary safety precautions have been taken before carrying out welding or grinding work. Always have a fire extinguisher to hand in the workplace.

⚠ Store oil and fuel-soaked rags and fuel and oil filters safely. In certain conditions oil-soaked rags can spontaneously ignite. Used fuel and oil filters are environmentally dangerous waste and must be deposited at an approved site for destruction together with used lubricating oil, contaminated fuel, paint remnants, solvent, degreasing agents and waste from washing parts.

⚠ Never allow a naked flame or electric sparks near the batteries. Never smoke in proximity to the batteries. The batteries give off hydrogen gas during charging which when mixed with air can form an explosive gas - oxyhydrogen. This gas is easily ignited and highly volatile. Incorrect connection of the battery can cause a spark which is sufficient to cause an explosion with resulting damage. Do not disturb battery connections when starting the engine (spark risk) and do not lean over batteries.

⚠ Never mix up the positive and negative battery terminals when installing. Incorrect installation can result in serious damage to electrical equipment. Refer to wiring diagrams.

⚠ Always use protective goggles when charging and handling batteries. The battery electrolyte contains extremely corrosive sulfuric acid. If this comes into contact with the skin, wash immediately with soap and plenty of water. If battery acid comes into contact with the eyes, immediately flush with copious amounts of water and obtain medical assistance.

⚠ Turn off the engine and turn off power at main switch(es) before carrying out work on the electrical system.

⚠ Clutch adjustments must be carried out with the engine turned off.

⚠ Use the lifting eyes mounted on the engine/reverse gear when lifting the drive unit.
Always check that lifting equipment is in good condition and has sufficient load capacity to lift the engine (engine weight including reverse gear and any extra equipment installed).
To ensure safe handling and to avoid damaging engine components on top of the engine, use a lifting beam to raise the engine. All chains and cables should run parallel to each other and as perpendicular as possible in relation to the top of the engine.
If extra equipment is installed on the engine altering its center of gravity, a special lifting device is required to achieve the correct balance for safe handling.
Never carry out work on an engine suspended on a hoist.

⚠ Never remove heavy components alone, even where secure lifting equipment such as secured blocks are being used. Even where lifting equipment is being used it is best to carry out the work with two people; one to operate the lifting equipment and the other to ensure that components are not trapped and damaged when being lifted.
When working on-board ensure that there is sufficient space to remove components without danger of injury or damage.

⚠ Components in the electrical system, ignition system (gasoline engines) and fuel system on Volvo Penta products are designed and constructed to minimize the risk of fire and explosion. The engine must not be run in areas where there are explosive materials.

⚠ Always use fuels recommended by Volvo Penta. Refer to the Instruction Book. The use of lower quality fuels can damage the engine. On a diesel engine poor quality fuel can cause the control rod to seize and the engine to overrev with the resulting risk of damage to the engine and personal injury. Poor fuel quality can also lead to higher maintenance costs.

General information

About the workshop manual

This workshop manual contains technical specification, descriptions and instructions for repairing the standard versions of the following engines AQ105A, AQ115A, AQ130A,B,C, AQ165A, AQ170A,B,C. The workshop manual displays the operations carried out on any of the engines above. As a result the illustrations and pictures in the manual that show certain parts on the engines, do not in some cases apply to all the engines listed above. However the repair and service operations described are the same in all essential details. Where they are not the same this is stated in the manual and where the difference is considerable the operations are described separately. Engine designations and numbers are given on the number plate (See Workshop manual Group 21 Engine page 15). The engine designation and number should be given in all correspondence about the engine.

This Workshop Manual has been developed primarily for Volvo Penta service workshops and qualified personnel. Persons using this book are assumed to have a grounding in marine drive systems and be able to carry out related mechanical and electrical work.

Volvo Penta is continuously developing their products. We therefore reserve the right to make changes. All the information contained in this book is based on product data available at the time of going to print. Any essential changes or modifications introduced into production or updated or revised service methods introduced after the date of publication will be provided in the form of Service Bulletins.

Replacement parts

Replacement parts for electrical and fuel systems are subject to statutory requirements (US Coast Guard Safety Regulations for example). Volvo Penta Genuine parts meet these requirements. Any type of damage which results from the use of non-original Volvo Penta replacement parts for the product will not be covered under any warranty provided by Volvo Penta.

The working methods described in the Service Manual apply to work carried out in a workshop. The engine has been removed from the boat and is installed in an engine fixture. Unless otherwise stated reconditioning work which can be carried out with the engine in place follows the same working method.

Warning symbols occurring in the Workshop Manual (for their meaning see *Safety information*)

WARNING!

IMPORTANT!

NOTE!

are not in any way comprehensive since it is impossible to predict every circumstance under which service work or repairs may be carried out. For this reason we can only highlight the risks that can arise when work is carried out incorrectly in a well-equipped workshop using working methods and tools developed by us.

All procedures for which there are Volvo Penta special tools in this Workshop Manual are carried out using these. Special tools are developed to rationalize working methods and make procedures as safe as possible. It is therefore the responsibility of any person using tools or working methods other than the ones recommended by us to ensure that there is no danger of injury, damage or malfunction resulting from these.

In some cases there may be special safety precautions and instructions for the use of tools and chemicals contained in this Workshop Manual. These special instructions should always be followed if there are no separate instructions in the Workshop Manual.

Certain elementary precautions and common sense can prevent most risks arising. A clean workplace and engine eliminates much of the danger of injury and malfunction.

It is of the greatest importance that no dirt or foreign particles get into the fuel system, lubrication system, intake system, turbocharger, bearings and seals when they are being worked on. The result can be malfunction or a shorter operational life.

Our joint responsibility

Each engine consists of many connected systems and components. If a component deviates from its technical specification the environmental impact of an otherwise good engine may be increased significantly. It is therefore vital that wear tolerances are maintained, that systems that can be adjusted are adjusted properly and that Volvo Penta Genuine Parts as used. The engine Maintenance Schedule must be followed.

Some systems, such as the components in the fuel system, require special expertise and special testing equipment for service and maintenance. Some components are sealed at the factory for environmental reasons. No work should be carried out on sealed components except by authorized personnel.

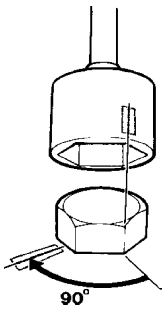
Bear in mind that most chemicals used on boats are harmful to the environment if used incorrectly. Volvo Penta recommends the use of biodegradable degreasing agents for cleaning engine components, unless otherwise stated in a workshop manual. Take special care when working on-board, that oil and waste is taken for destruction and is not accidentally pumped into the environment with bilge water.

Tightening torques

Tightening torques for vital joints that must be tightened with a torque wrench are listed in workshop manual “Technical Data”: “Tightening Torques” and are contained in work descriptions in this Manual. All torques apply for cleaned threads, screw heads and mating surfaces. Torques apply for lightly oiled or dry threads. If lubricants, locking fluid or sealing compound are required for a screwed joint this information will be contained in the work description and in “Tightening Torques” Where no tightening torque is stated for a joint use the general tightening torques according to the tables below. The tightening torques stated are a guide and the joint does not have to be tightened using a torque wrench.

Dimension	Tightening Torques	
	Nm	lbt.ft
M5	5	3,6
M6	10	7,3
M8	20	14,7
M10	40	29,5
M12	70	51,6
M14	115	84,8

Tightening torques-protractor (angle) tightening



Tightening using both a torque setting and a protractor angle requires that first the recommended torque is applied using a torque wrench and then the recommended angle is added according to the protractor scale. Example: a 90° protractor tightening means that the joint is tightened a further 1/4 turn in one operation after the stated tightening torque has been applied.

Locknuts

Do not re-use lock nuts that have been removed during dismantling as they have reduced service life when re-used - use new nuts when assembling or reinstalling. For lock nuts with a plastic insert such as Nylock® the tightening torque stated in the table is reduced if the Nylock® nut has the same head height as a standard hexagonal nut without plastic insert. Reduce the tightening torque by 25% for bolt size 8 mm or larger. Where Nylock® nuts are higher, or of the same height as a standard hexagonal nut, the tightening torques given in the table apply.

Tolerance classes

Screws and nuts are divided into different strength classes, the class is indicated by the number on the bolt head. A high number indicates stronger material, for example a bolt marked 10-9 indicates a higher tolerance than one marked 8-8. It is therefore important that bolts removed during the disassembly of a bolted joint must be reinstalled in their original position when assembling the joint. If a bolt must be replaced check in the replacement parts catalogue to make sure the correct bolt is used.

Sealants

A number of sealants and locking liquids are used on the engines. The agents have varying properties and are used for different types of jointing strengths, operating temperature ranges, resistance to oil and other chemicals and for the different materials and gap sizes in the engines.

To ensure service work is correctly carried out it is important that the correct sealant and locking fluid type is used on the joint where the agents are required.

In this Volvo Penta Service Manual the user will find that each section where these agents are applied in production states which type was used on the engine.

During service operations use the same agent or an alternative from a different manufacturer.

Make sure that mating surfaces are dry and free from oil, grease, paint and anti-corrosion agent before applying sealant or locking fluid.

Always follow the manufacturer's instructions for use regarding; temperature range, curing time and any other instructions for the product.

Tow different basic types of agent are used on the engine and these are:

RTV agent (Room temperature vulcanizing). Use for gaskets, sealing gasket joints or coating gaskets. RTV agent is clearly visible when a component has been dismantled; old RTV must be removed before the joint is resealed.

The following RTV agents are mentioned in the Service Manual: Loctite® 574, Volvo Penta 840879-1, Permatex®
No. 3, Volvo Penta P/N 1161099-5, Permatex® No. 77. Old sealant can be removed using methylated spirits in all cases.

Anaerobic agents. These agents cure in an absence of air. They are used when two solid parts, for example cast components, are installed face-to-face without a gasket. They are also commonly used to secure plugs, threads in stud bolts, cocks, oil pressure switches and so on. The cured material is glass-like and it is therefore colored to make it visible. Cured anaerobic agents are extremely resistant to solvents and the old agent cannot be removed. When reinstalling the part is carefully degreased and then new sealant is applied.

The following anaerobic agents are mentioned in the Service Manual: Loctite® 572 (white), Loctite® 241 (blue).

NOTE! Loctite® is the registered trademark of Loctite Corporation, Permatex® is the registered trademark of the Permatex Corporation.

Type designations

Aquamatic 4-cyl. and 6-cyl. marine carburetor engines are designed in accordance with the same principles and are specially constructed for marine use. The 4-cyl. engine has a capacity of 1.986 litres (121 cu.in.) and the capacity for the 6-cyl. engine is 2.979 litres (182 cu.in.). Basically the engines are Volvo engines with type designation B 20 B for the 4-cyl. engine and B 30 A for the 6-cyl. engine.

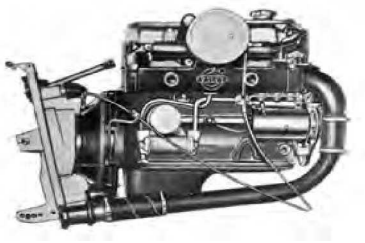


Fig. 1

AQ 105A

Max. output h.p.	105
Compression ratio	9.5:1
Carburetor, number	1 horizontal

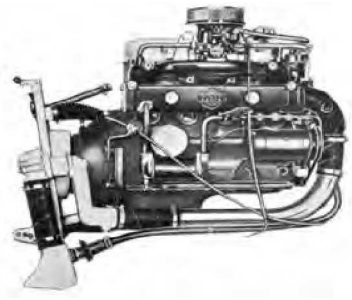


Fig. 2

AQ 115A

Max. output h.p.	115
Compression ratio	9.5:1
Carburetor, number	1 down-draft

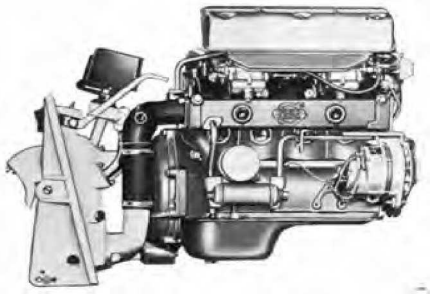


Fig. 3

AQ 130A

Max. output h.p.	130
Compression ratio	9.5:1
Carburetors, number	2 horizontal

AQ130B

Max. output h.p.	115
Compression ratio	8.4:1
Carburetors, number	2 horizontal

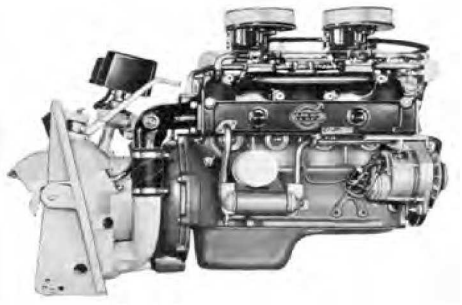


Fig. 4

AQ 130C

Max. output h.p.	130
Compression ratio	9.5:1
Carburetors, number	2 down-draft

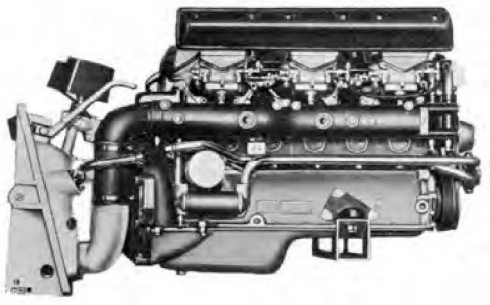


Fig. 5

AQ 165A

Max. output h.p.	165
Compression ratio	9.2:1
Carburetors, number	3 horizontal

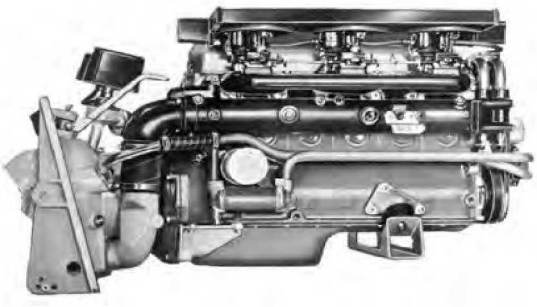


Fig. 6

AQ 170A,B,C

Max. output h.p.	170
Compression ratio	9.5:1
Carburetors, number	3 down-draft

General description

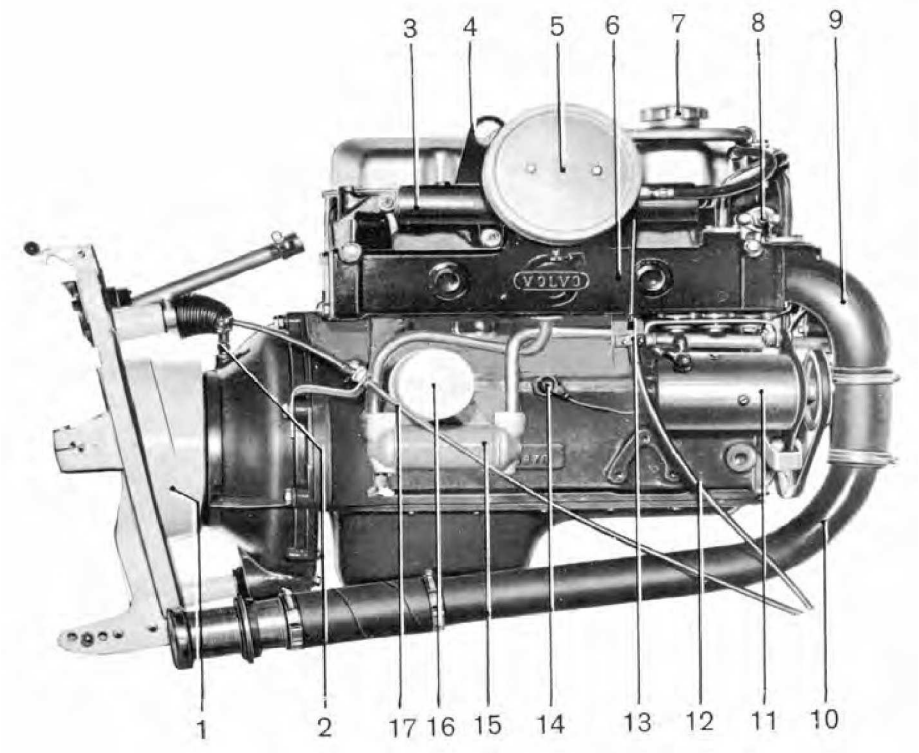


Fig. 1. AQ105A Starboard side

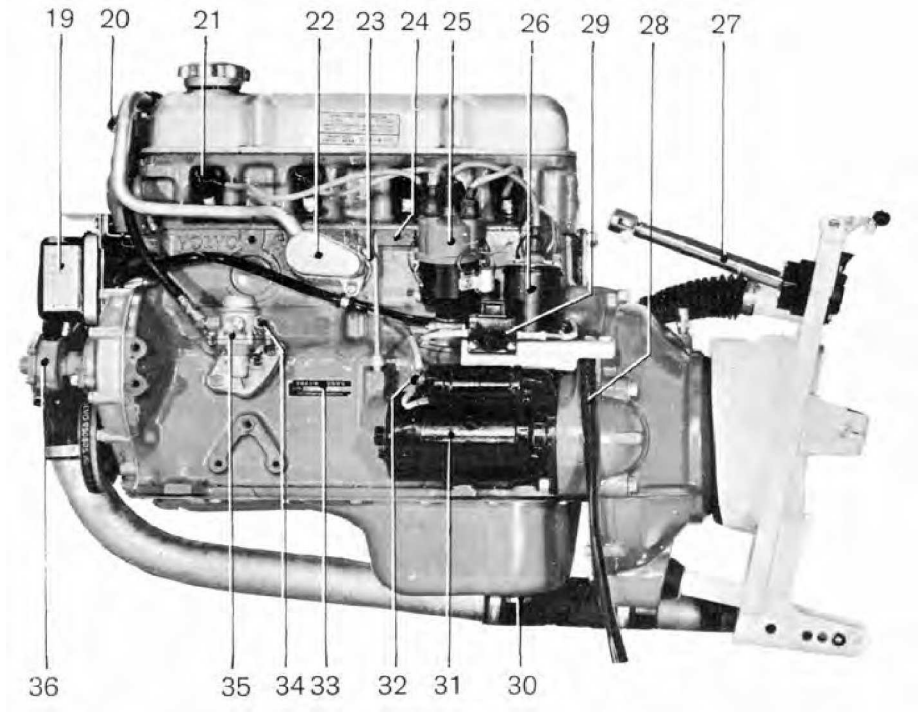


Fig. 2. AQ105A Port side

1. Mounting collar
2. Ventilation nipple
3. Intake manifold
4. Lifting eyelet
5. Flame arrester
6. Water-cooled exhaust manifold
7. Oil filler cap
8. Temperature gauge sender
9. Exhaust elbow
10. Exhaust line
11. D.C. generator
12. Revolution counter cable
13. Cable locking device
14. Oil pressure sender
15. Oil cooler
16. Oil filter
17. Control cable
18. Combined exhaust outlet with cooling water intake
19. Charging regulator
20. Thermostat housing
21. Spark plug
22. Crankcase breather
23. Oil dipstick
24. Serial number
25. Distributor
26. Ignition coil
27. Steering arm
28. Cable harness
29. Fuse
30. Oil drain plug
31. Starter motor
32. Plus pole connection
33. Type designation plate
34. Fuel inlet
35. Fuel pump with hand primer
36. Sea-water pump

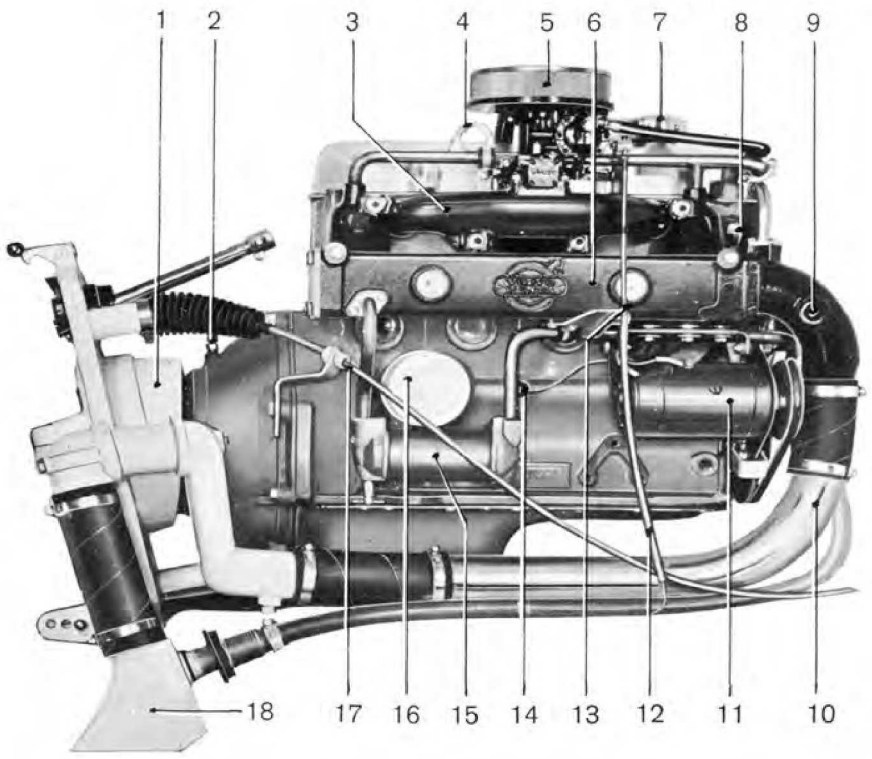


Fig. 3. AQ115A Starboard side
(Reference Nos. see page 8)

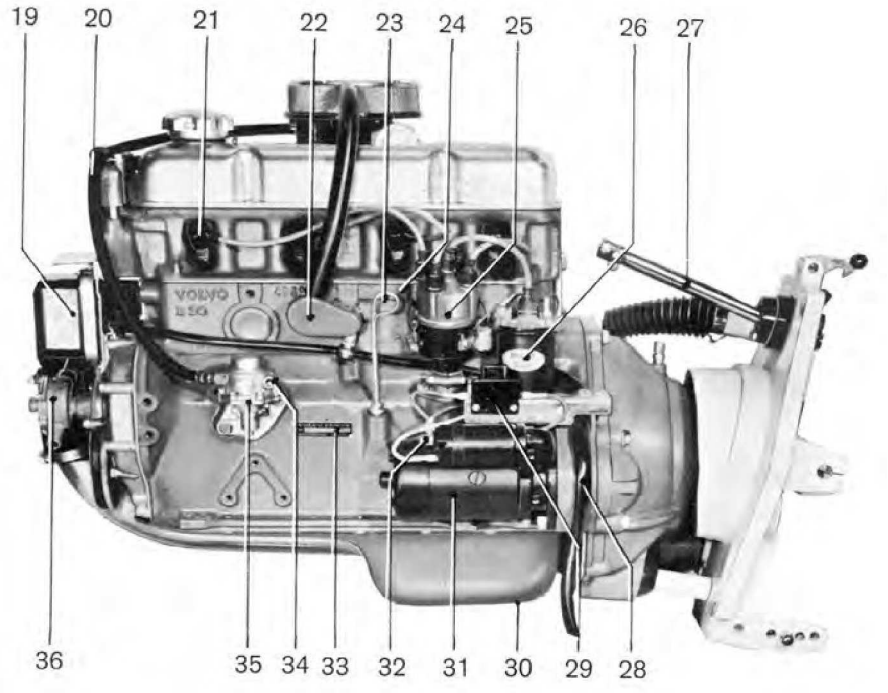


Fig. 4. AQ115A Port side
(Reference Nos. see page 8)

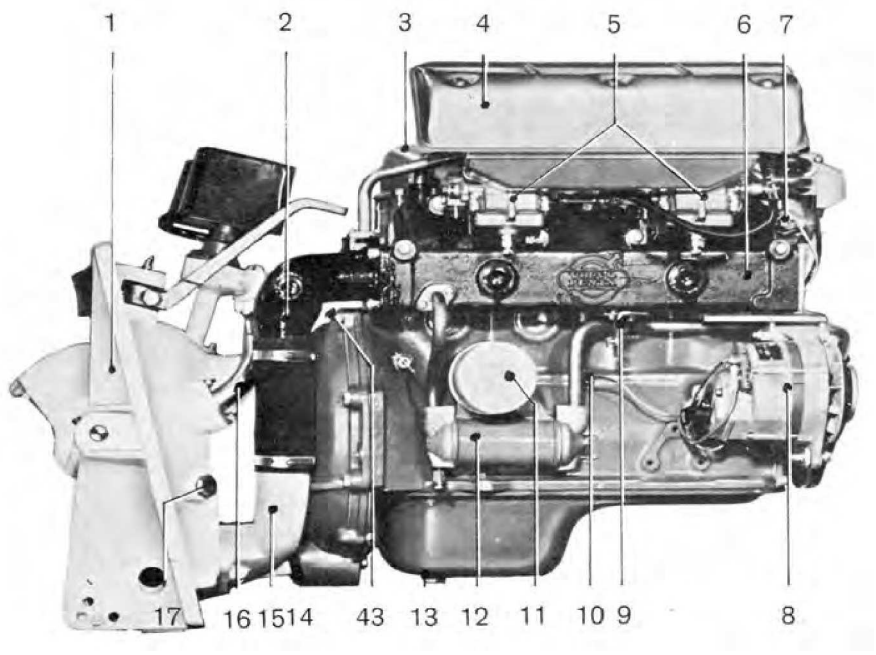


Fig. 5. AQ130A Starboard side

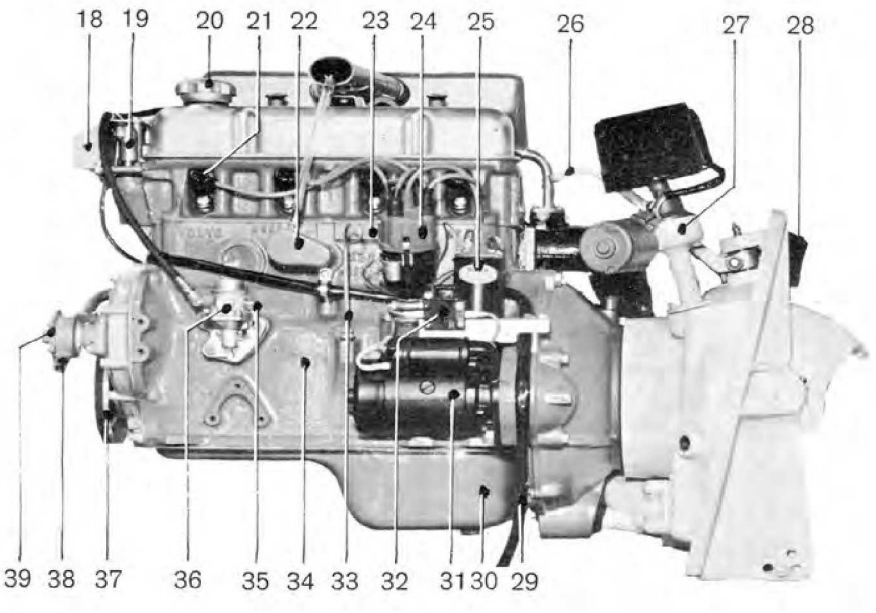


Fig. 6. AQ130A Port side

1. Mounting collar
2. Exhaust elbow
3. Rocker arm cover
4. Air silencer and flame arresters
5. Carburetors
6. Water-cooled exhaust manifold
7. Temperature gauge sender
8. Alternator
9. Cable locking device
10. Oil pressure sender
11. Oil filter
12. Oil cooler
13. Oil drain plug
14. Rubber mounting block
15. Exhaust line
16. Cooling water intake
17. Plug for control cable
18. Charging regulator
19. Water distribution housing
20. Oil filler cap
21. Spark plug
22. Crankcase breather
23. Serial number
24. Distributor
25. Ignition coil
26. Steering arm
27. Electro-mechanical lift
28. Rubber block
29. Cable harness
30. Oil sump
31. Starter motor
32. Fuse
33. Oil dipstick
34. Type designation plate
35. Fuel inlet
36. Fuel pump
37. Crankshaft pulley
38. Cooling water inlet
39. Sea-water pump
40. Vacuum line
41. Circulation pump
42. Vibration damper
43. Lubricator
44. Front support member

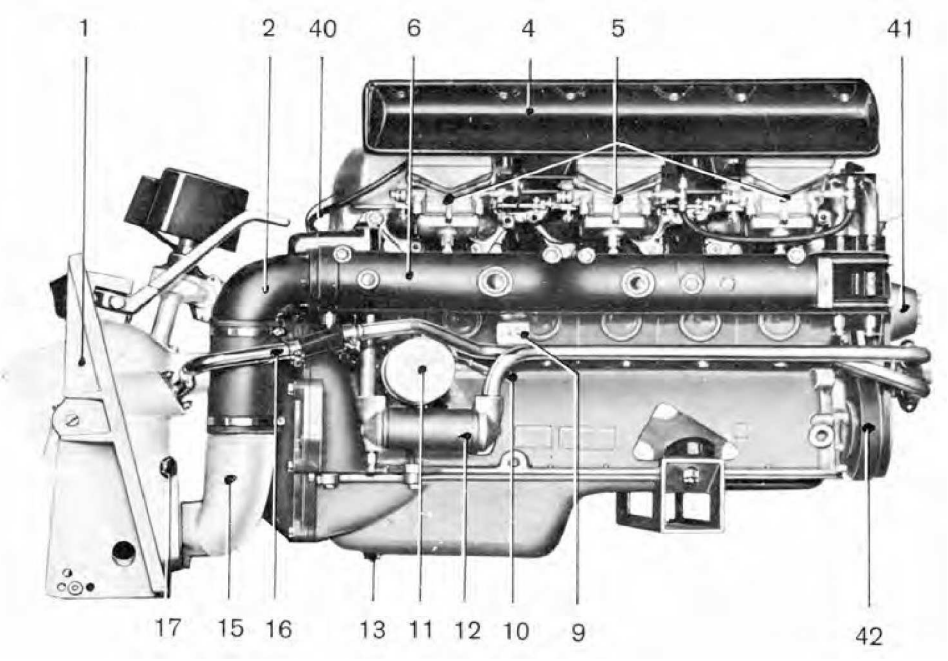


Fig. 7. AQ165A Starboard side
(Reference Nos. see page 10)

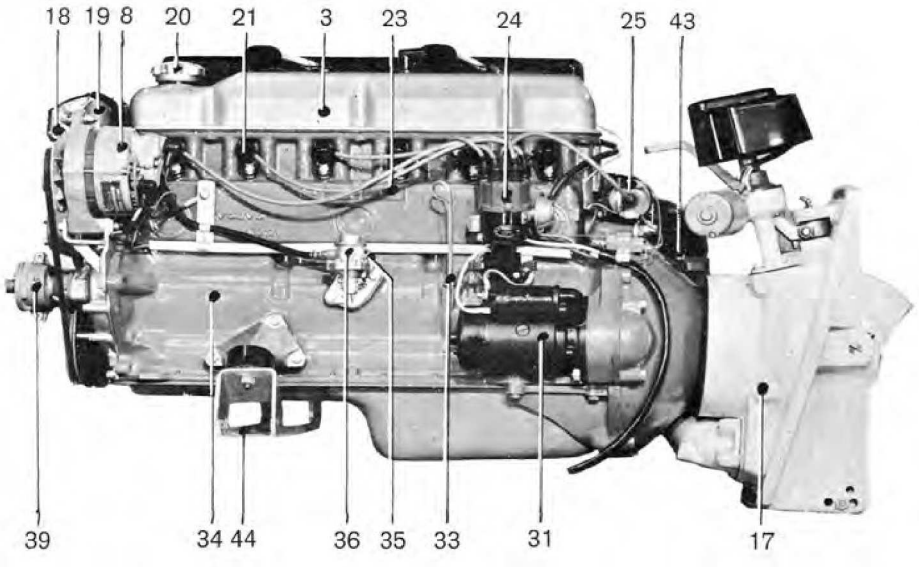


Fig. 8. AQ165A Port side
(Reference Nos. see page 10)

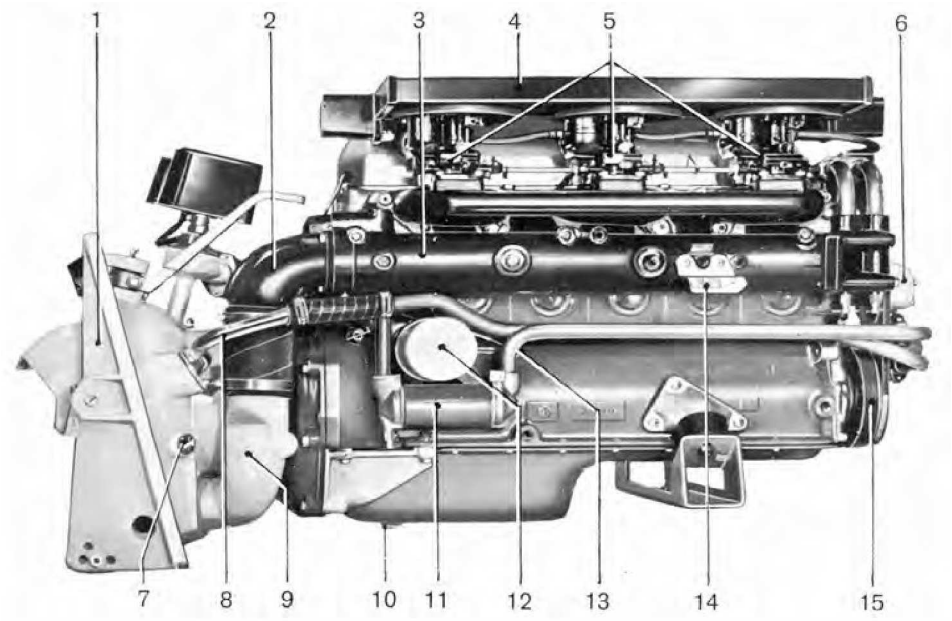


Fig. 9. AQ170A,B,C Starboard side

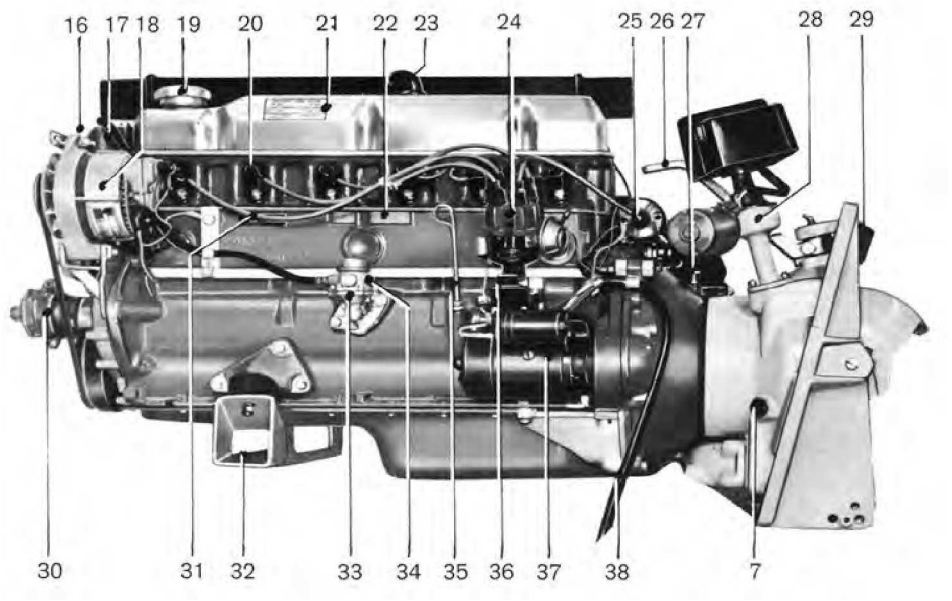


Fig. 10. AQ170A,B,C Port side

1. Mounting collar
2. Exhaust elbow
3. Water-cooled exhaust manifold
4. Air silencer and flame arresters
5. Down-draft carburetors
6. Circulation pump
7. Plug for control cable
8. Cooling water intake
9. Exhaust line
10. Oil drain plug
11. Oil cooler
12. Oil filter
13. Oil pressure sender
14. Cable locking device
15. Vibration damper
16. Charging regulator
17. Water distribution housing
18. Alternator
19. Oil filler cap
20. Spark plug
21. Rocker arm cover
22. Serial number
23. Crankcase breather
24. Distributor
25. Ignition coil
26. Steering arm
27. Lubricator
28. Electro-mechanical lift
29. Rubber support block
30. Sea-water pump
31. Type designation plate
32. Front support member
33. Fuel pump
34. Fuel inlet
35. Oil dipstick
36. Fuse
37. Starter motor
38. Cable harness

ENGINE BODY

The cylinder block is made of special cast iron and is cast in a single unit. The cylinder bores, which are surrounded by cooling jackets, are machined directly in the block.

The cylinder head has separate inlet and exhaust ports, one for each valve. The combustion chambers are machined throughout for precisely equal compression and combustion in all the cylinders.

The valve system is specially designed for severe operation. Valves and valve collets are so constructed that at speeds above approx. 3000 r.p.m. the valves rotate slowly and this increases the lifetime and reduces risk of damage from burning. The valve seats are of special cast iron and replaceable. The sealing surfaces of the exhaust valves have a hard-metal lining of stellite. The intake valve is made of special steel with hardened contact surfaces.

The statically and dynamically balanced crankshaft is journalled in 5 bearings for the 4-cyl. engine and 7 bearings for the 6-cyl. unit. The specially large bearing surfaces are all surface-hardened and the replaceable bearing shells have bearing metal of indium-plated lead-bronze.

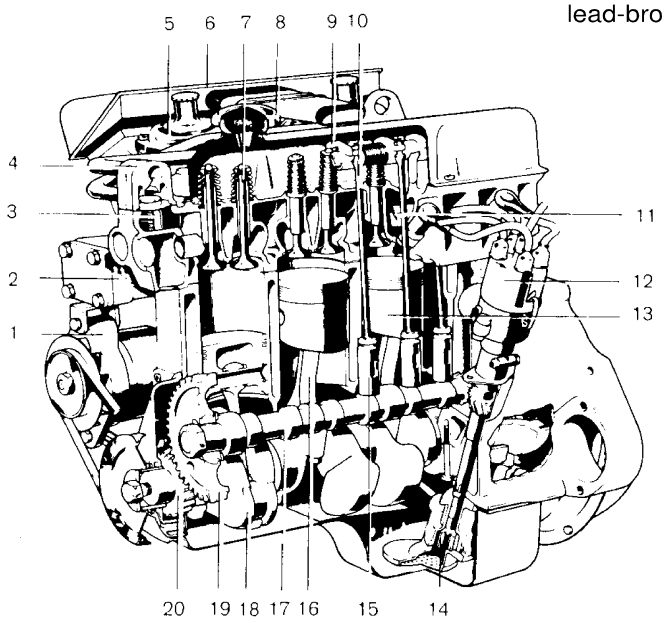


Fig. 1. X-ray view of 4-cyl. engine, type AQ130

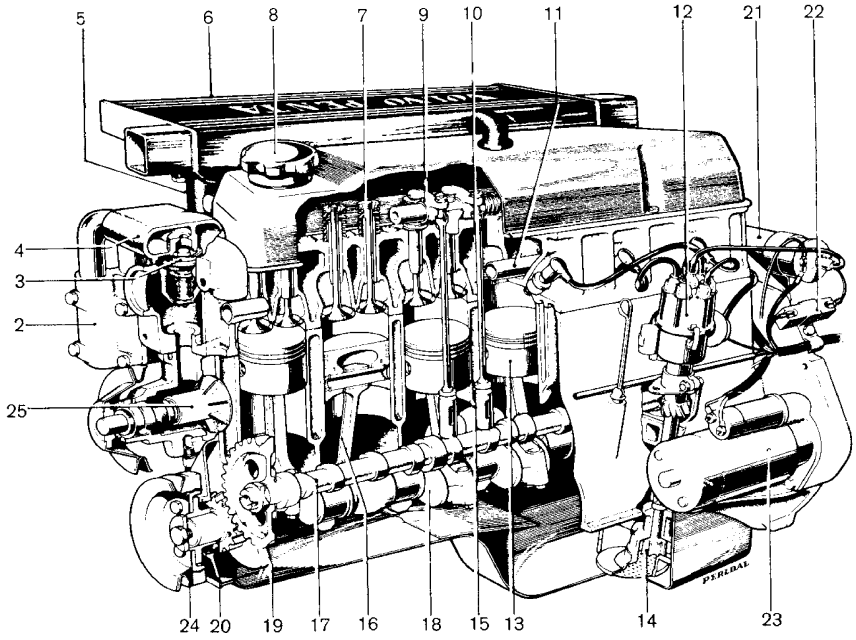


Fig. 2. X-ray view of 6-cyl. engine, type AQ170

1. Alternator
2. Water-cooled exhaust manifold
3. Thermostat
4. Water distribution housing
5. Carburetor
6. Flame arrester with intake silencer
7. Valve
8. Oil filler cap
9. Rocker arm
10. Push rod
11. Water distribution pipe
12. Distributor
13. Piston
14. Oil pump
15. Valve lifter
16. Connecting rod
17. Camshaft
18. Crankshaft
19. Camshaft gear
20. Crankshaft gear
21. Ignition coil
22. Pre-engaging resistance
23. Starter motor
24. Vibration damper
25. Circulation pump

A. LIFTING OUT AND DISASSEMBLING THE ENGINE

With extensive reconditioning work on the engine, it must be lifted out of the boat.

If the boat is afloat, disconnect the engine at the flywheel casing and then pull the engine forwards about 75 mm (3") so that the drive shaft releases from the flywheel vibration damper. If the boat has been taken up on land and the outboard drive has been removed, slacken the clamp ring on the mounting collar, after which the engine can be lifted out.

Lifting out the engine with the boat afloat

1. Disconnect the battery leads from the battery.
2. Disconnect the speed cable from the carburetor lever.
3. Disconnect the hose clamp for the exhaust hose on the engine exhaust manifold. N. B. Not the clamp on the exhaust elbow (250-drive) of the mounting collar or intermediate pipe (100-drive). Twist the hose one way and then the other so that it releases from the exhaust manifold. Check to make sure that water penetration cannot take place.
4. Disconnect the cooling water hose from the seawater pump and attach the opening of the hose so high up that water cannot get in by this way.
5. Disconnect the flexible fuel hose from the other fuel line.
6. Pull the connection box on the cable harness apart from the electric system.
7. If the engine is provided with front engine mounting, the mounting brackets should be released from the engine block after blocks have first been placed under the engine or the engine has been suspended from a crane.
8. Unscrew the bolts securing the engine to the flywheel casing. Also release the cover plate on the front edge of the flywheel casing under the engine and, if the unit is a 6-cyl. engine, also the reinforcement at the front edge of the flywheel casing. Pull the engine forwards about 75 mm (3") so that the drive shaft releases from the flywheel vibration damper.
9. Lift out the engine and place it in stand SVO 2520 with fixture SVO 2521 (4-cyl. engine) or SVO 2820 (6-cyl. engine).
10. Drain off the cooling water and oil, also clean the outside of the engine.

Lifting out the engine with the boat on land

1. Disconnect the cooling water hose and all the rubber bellows from the outboard drive. Remove the casing over the gear mechanism and disconnect the gear cable cube from the lever. Screw off the cube. Remove the lock plate for the gear cable on the front end of the intermediate housing.
2. Unscrew the bolts for the drive suspension pins, and for the 250-drive the bolt for the guide cover. Knock out the pins and lift off the drive.
3. Place block under the engine or suspend it from a crane. Undo the six screws on the clamp ring and remove the ring.
4. Proceed with lifting out the engine by following all the points given under the previous heading "...with the boat afloat", except point 8.

Disassembling the engine

1. Remove the generator, starter motor, ignition coil and distributor.
2. Remove the flywheel casing, vibration damper, flywheel and rear sealing flange.
3. Remove the rocker arm casing, rocker arms, cylinder block and valve lifters (tool SVO 2424). Screw off the oil filter and oil cooler.
4. Remove the timing gear cover and timing gears (tools, see "Replacing the timing gears"). Remove the camshaft.
5. Scrape off the carbon edge on the cylinder liners. Remove the oil sump, oil pump and connecting rods with pistons. Replace the caps properly on their respective connecting rods.
6. Turn the engine with the bottom upwards and remove the crankshaft. Place the caps properly in their respective positions.

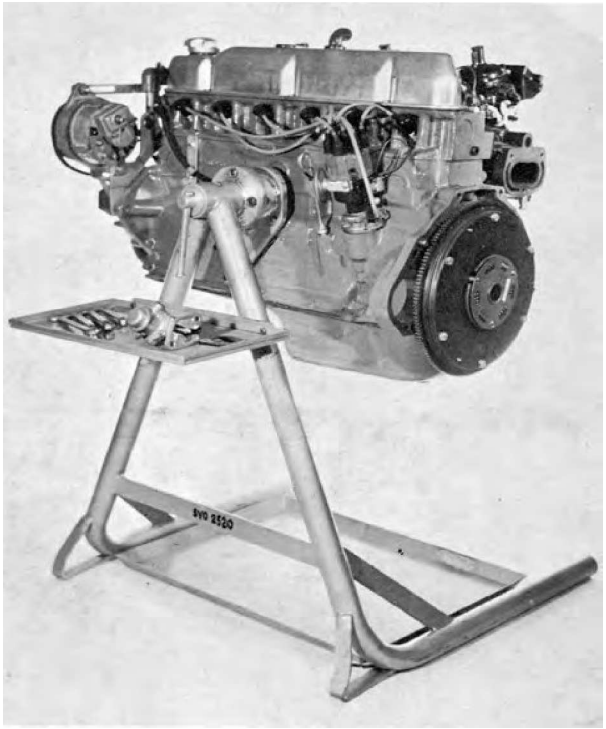


Fig. A1. Engine fixed in stand SVO 2520

B. RECONDITIONING THE CYLINDER HEAD

In most cases the cylinder head can be removed from the engine with the engine still in the boat.

1. Disconnect the battery leads from the battery and drain the water from the engine through the cocks provided for this purpose. Check to make sure that water does not penetrate into the boat.
2. Remove the controls, fuel lines from the carburetors, elec. connections, regulator and generator brace (on certain engines).
3. Disconnect the hose clamp for the exhaust hose on the engine exhaust manifold. N. B. Not the clamp on the exhaust elbow of the mounting collar. Twist the hose forwards and backwards so that it releases from the exhaust manifold.
4. Remove the rocker arm casing, the rocker arm bridge and push rods.
5. Remove the bolts for the cylinder tread and lift off the head.

Disassembling

1. Remove the valve springs by first pressing them together with valve spring pliers, then taking off the valve collets and easing the grip on the pliers. Place the valves in order in a stand. Remove the valve guides, see under ”Replacing the valve guides”.
2. Measure (with a dial indicator) the clearance between the spindle and guide. With a new valve, the clearance may not exceed 0.15 mm (0.006"). Also check that the valves are not too worn. See under ”Valve system” and ”Wear tolerances” in the ”Specifications”.

Cleaning

With rotating brushes, clean the valves, piston crowns, combustion chambers and channels from carbon and combustion deposits.

Replacing the valve seats

1. Remove the old valve seat by grinding two diametrically placed fracture indications (see Fig. B1). Make sure when doing this that the cylinder head is not damaged.

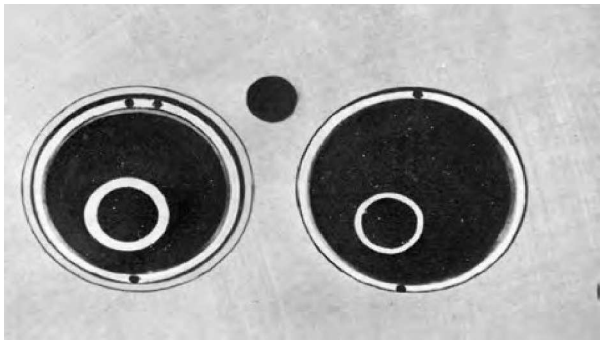


Fig. B1. Replacing the valve seat

2. Split the seat with a sharp chisel and remove the seat.
3. Clean the seat location in the head carefully and check the head all round for cracks.
4. Cool down the new seat in carbon dioxide snow to minus 60-70° C (minus 76-94° F) and heat up the cylinder to 200° C (392° F). Slide the seat down into its location and check to make sure that it has fallen down properly.

   N. B. Do not use a drift. Do not top down the seat.
5. Machine the seats to the correct angle and width. See the ”Specifications” for measurements.

   Check the seat angle by means of a valve seat gauge after the contact surface has been lightly coated with marking blue.

NOTE! The pressed in valve seats have been withdrawn from late version engines. See “Specification” for engine numbers affected.

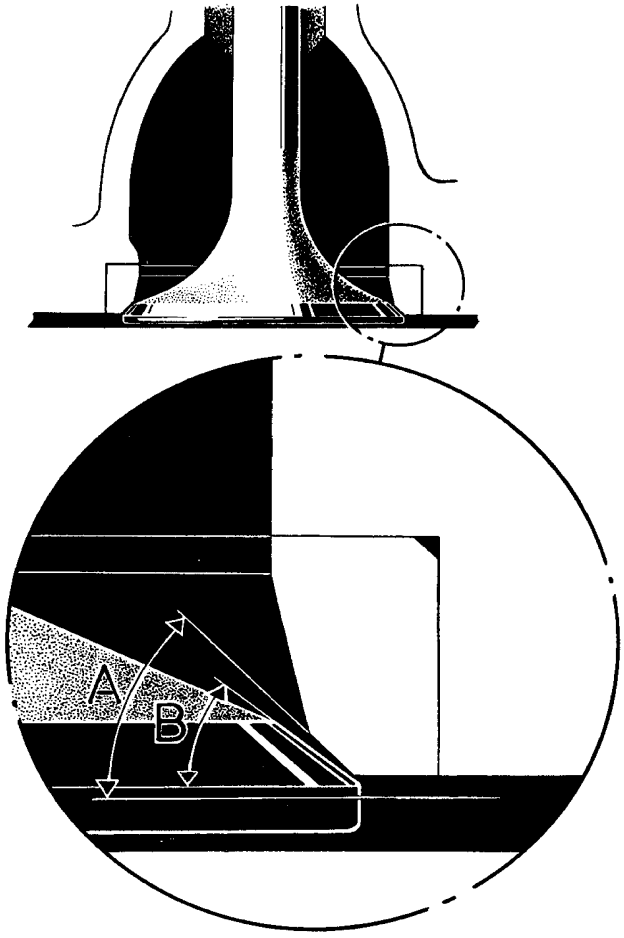


Fig. B2. Valve location in the seat
A. Inlet = 45° outlet = 45°
B. Inlet = 45.5° outlet = 44.5°

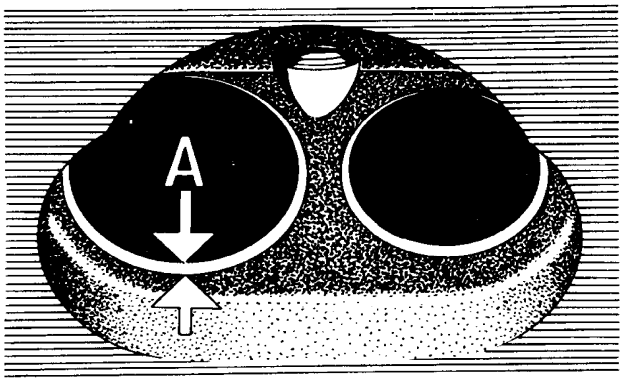


Fig. B3. Valve seat width
A = 2 mm (0.080")

Grinding the valves and valve seats

1. Grind the valves in a machine after they have been cleaned. Fit new valves if the old ones are excessively worn,
2. Grind the valve seats. Use an electrically driven grinder or a hand milling cutter. A pilot spindle must be carefully fitted before work is started and any worn guides must be replaced with new ones.

   The seat should be ground until a good sealing surface is obtained. The angle is 45° and the width of the sealing surface is approx. 2 mm (0.080"), see "A", Fig. B3. If the sealing surface is too wide after grinding, it can be reduced by using a 70° grinding stone from the inside and a 20° grinding stone from the outside.
3. Smear the valve sealing surfaces with a thin layer of fine grinding paste and lap in the valves against their respective seats.

   Then clean the grinding paste well from the valves and seats and check the sealing.

Replacing the valve guides

1. Press out old guides with SVO 2828, see Fig. B4.
2. Press in the new guides, using drift SVO 2819, which gives the correct pressing-in depth. See Fig. B4.
3. Check that the guides are free from burr and that the valves move easily in them.

Assembling

1. Check that the parts are in good condition and are clean. Test the springs to ensure that they maintain the values given in the "Specifications".
2. Place the valves in position. Fit the spring, washer and collet.

   NOTE! BB170B, AQ170B before engine no. 3890 are also equipped with valve stem seal on the exhaust valves. These should not be reinstalled.

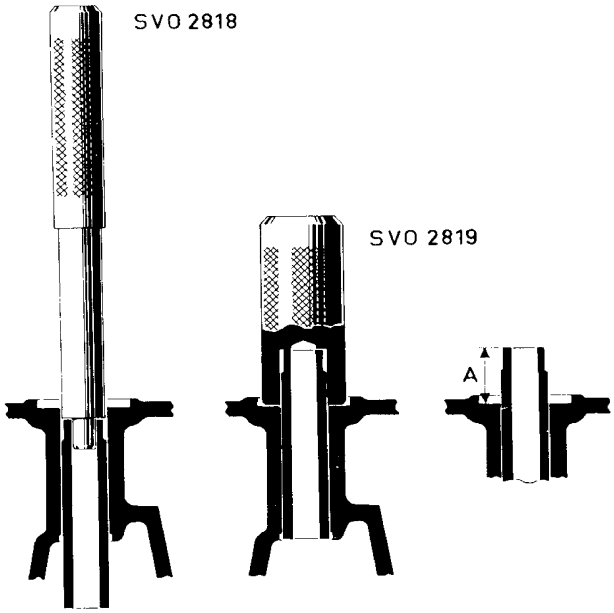


Fig. B4. Replacing the valve guides
A = 17.5 mm (0.689")

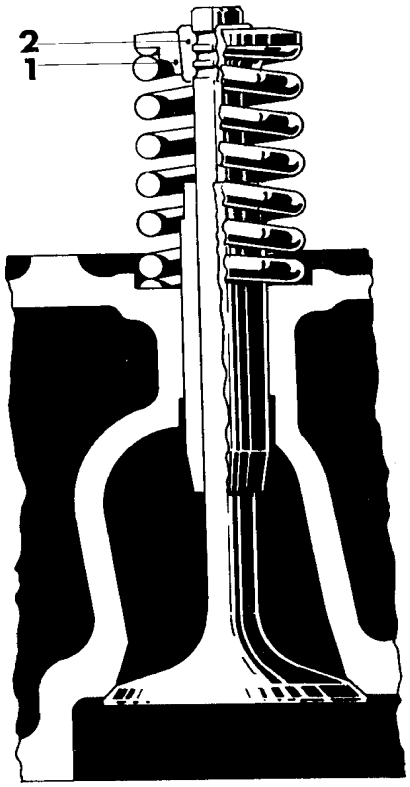


Fig. B5. Valve collet and valve guide seal
1. Spring 2. Valve collet

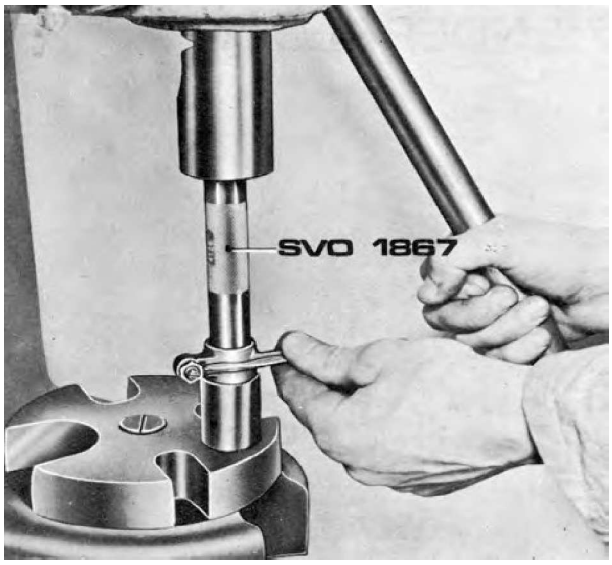


Fig. B6. Replacing bush in rocker arm

Replacing the rocker arm bush and grinding the rocker arm

1. If wear amounts to 0.1 mm (0.004"), replace the rocker arm bush. Use tool SVO 1867 for pressing the bush both out and in. Then ream the bush with a suitable reamer until an accurate fit on the shaft is obtained. The hole in the bush should coincide with the hole in the rocker arm.
2. If necessary, grind the pressure pad of the rocker arm in a special machine.

Fitting the cylinder head

Screw down the guide pins SVO 2435 into the block, one in the front, right and one in the rear, left bolt hole, see Fig. B7. Fit on a new cylinder head gasket and new sealing rings for the water pump (6-cyl. engine) and fit the cylinder head (equally complete as on removal). Screw out the guide pins and fit the bolts also in these holes. Concerning tightening sequence, see Fig. B8. The tightening torque is 8.5-9.5 kpm (61-68 lb.ft.). Re-fit the other parts. Final-tighten the cylinder head after running the engine hot (8.5-9.0 kpm = 61-64 lb.ft.).

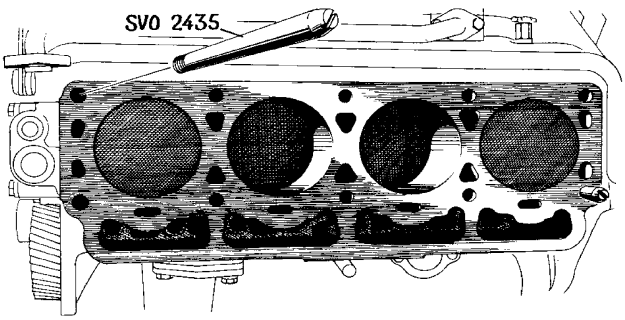
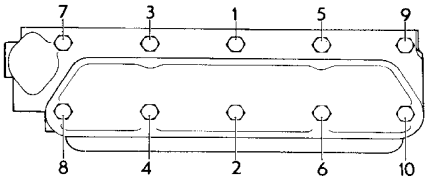
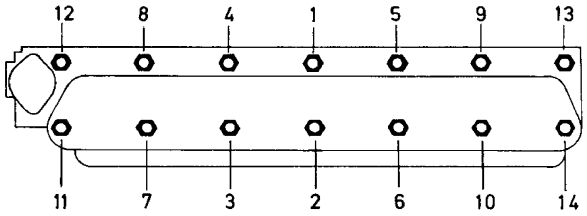


Fig. B7. Guide pins for fitting cylinder head



4-cyl. engine



6-cyl. engine

Fig. B8. Tightening sequence for cylinder head bolts
To be tightened in two stages

1st stage: 2.5-3.0 kpm (18-22 lb.ft.) 2nd stage: 9.0 kpm (64 lb.ft.)

To avoid removing the rocker arm shaft when post tightening the cylinder head screws, special tool SVO 2898 can be used, illustration B 9.

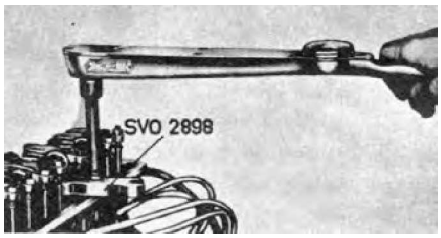


Fig. B 0. SVO 2898 Wrench 11/16" for post-tightening the cylinder head screws

Adjusting the valve clearance

The valve clearance can be adjusted satisfactorily with the engine stationary, irrespective of whether the engine is cold or hot. The clearance is the same for both the inlet and exhaust valves. When adjusting, use two feeler gauges, one "Go" 0.50 mm (0.020") thick and the other "No-Go" 0.55 mm (0.022") thick. The clearance is adjusted so that the thinnest gauge can be inserted easily while the thicker one must not enter.

4-CYL. ENGINE: When the piston in No. 1 cylinder is at top dead centre (the compression stroke), valves Nos. 1, 2, 3 and 5 (counted from the front) are adjusted, and with the piston in the No. 4 cylinder at top dead centre, valves Nos. 4, 6, 7 and 8.

6-CYL. ENGINE: When the piston in No. 1 cylinder is at top dead centre (the compression stroke), valves Nos. 1, 2, 3, 6, 7 and 10 (counted from the front) are adjusted, and with the piston in the No. 6 cylinder at top dead centre, valves Nos. 4, 5, 8, 9, 11 and 12.

C. RECONDITIONING THE CYLINDER BLOCK

Measuring the cylinder bores

The cylinder bores are measured with a special dial indicator. Measuring should be carried out just below the top edge of the bore only in the transverse direction of the engine.

A letter is stamped on each cylinder bore indicating the classification of the bore and piston.

PISTONS, PISTON RINGS AND PISTON PINS

Measuring the pistons

Pistons marked 71/4 on the crown are measured with a micrometer at right angles to the piston pin hole 2.5 mm (0.098") from the lower edge. Pistons marked 71/9 are measured 12 mm (0.48") from the lower edge.

Fit of pistons in cylinders

The fit of the pistons in their respective cylinders is tested without the piston rings being fitted. The clearance at right angles to the piston pin hole is measured with a feeler gauge 12 mm (0.48") wide and 0.03 mm (0.0012") thick, also 0.05 mm (0.002") for AQ170 from engine No 520, attached to a spring balance. The force applied should be 1 kg (2.2 lb.). This gives the average value for the piston clearance. When the force indicated is applied, the piston clearance obtained is equal to the thickness of the feeler gauge used. Therefore, feeler gauges 0.02 mm (0.0008") or 0.04 mm (0.0016") thick, also 0.04 mm (0.0016") or 0.06 mm (0.0024") thick for AQ170 from engine No. 520, can be used. The test is carried out at several different depths. See Fig. C1. Standard bore cylinders have a letter stamped on which shows the dimensions, and the pistons concerned should be marked with the same letter. See Fig. C2.

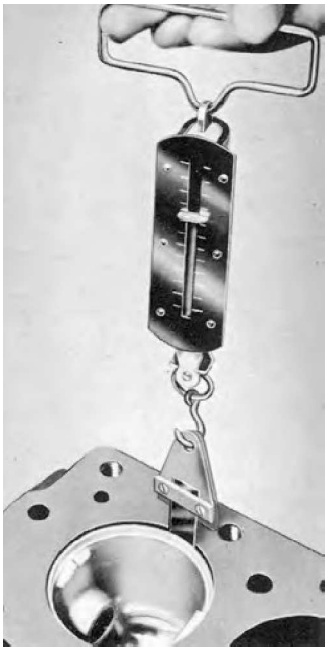


Fig. C 1. Measuring the piston clearance

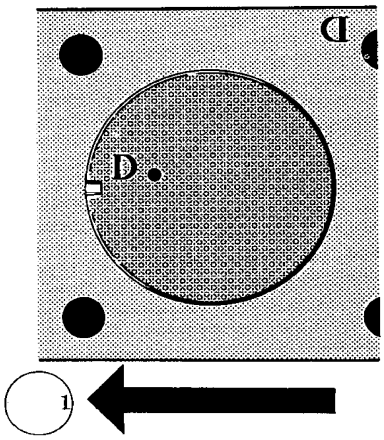


Fig. C2. Marking of piston and cylinder block

PISTON RING FIT

In a new or re-bored cylinder

1. Push down the piston rings one after another in the cylinder bore. Use an inverted piston to ensure that the rings come into the correct position.
2. Measure the ring gap with a feeler gauge. The gap should be 0.40–0.55 mm (0.016–0.022"). See Fig C3. If necessary, the gap can be increased with the help of a special file.
3. Check the piston rings in their respective grooves by rolling them in the groove. Also measure the clearance at a few points. See the "Specifications" for measurements.

In a worn cylinder bore

When checking the fit in a worn cylinder bore, the rings must be checked at the bottom dead centre position where the diameter of the bore is the smallest.

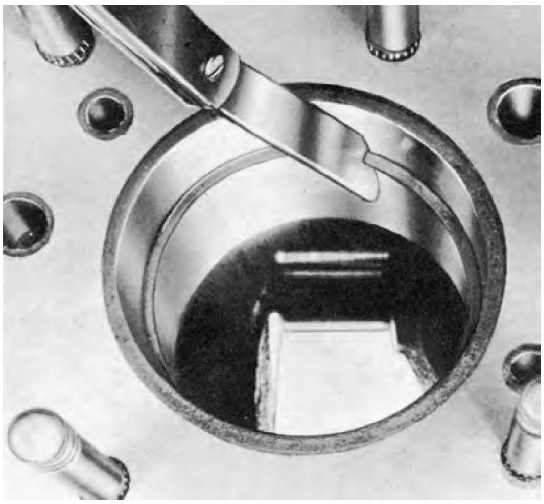


Fig. C3. Measuring the piston ring gap

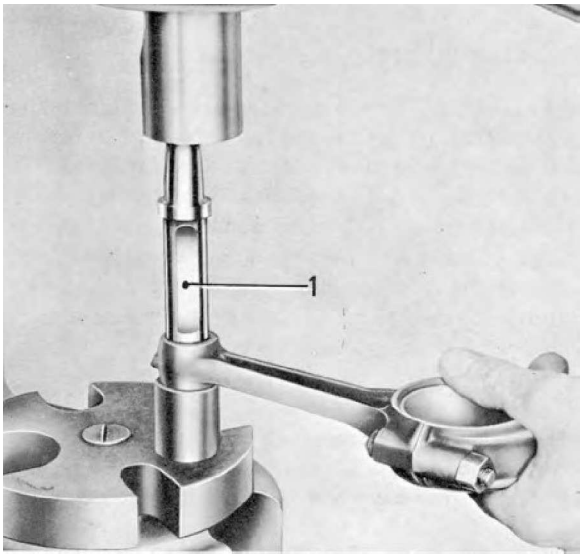


Fig. C4. Replacing connecting rod bush
1. Drift SVO 1867 alt. SVO 5017

Gudgeon pins

There are two sizes of gudgeon pin, the early version were 22 mm, the late version 24 mm. See “Specification” for engine numbers.

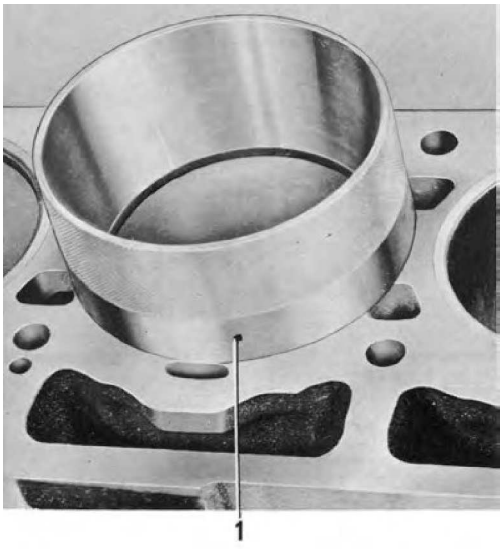


Fig. C5. Fitting the piston
1 Fitting ring SVO 2823

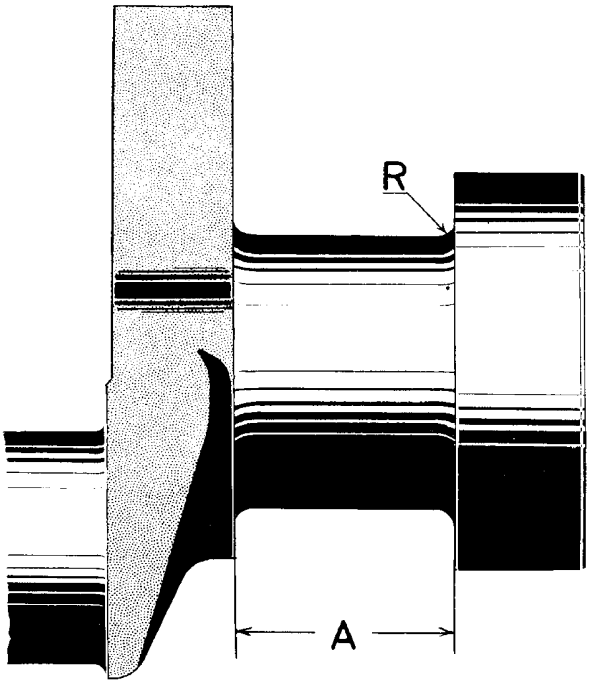


Fig. C6. Bearing journal

CONNECTING RODS

Replacing the bushes

If the old bush in a connecting rod is too worn, press it out by using drift SVO 1867 alt. SVO 5017, and press in a new one with the same tool, see Fig. C4. Make sure that the lubricating holes index with the holes in the connecting rod. Then ream the bush to the correct fit. The piston pin should then slide through the hole under light thumb pressure but without any noticeable looseness.

Straightening

Before being fitted, the connecting rod should be checked for straightness, twist and any S-distortion. If necessary, straighten or replace the connecting rod. Nuts and bolts should be replaced with new ones when reconditioning is being done.

Assembling and fitting the piston and connecting rod

When assembling, make sure that the piston is turned correctly so that the slot on the piston crown points forwards as shown in Fig. C2. If the piston is turned the wrong way, this will cause a loud noise. The number marking on the connecting rod should be turned to face away from the camshaft side. The piston pin is then fitted, the circlip placed in position and the piston rings fitted with the help of piston ring grips. The compression rings are marked ”TOP” and the upper ring on each piston is chromed. Place the bearing shells in position. Turn the rings so that the gaps do not come under one another. Then lubricate the piston and bearing surfaces. Use fitting ring SVO 2823, see Fig. C5, when installing the piston in the cylinder bore. Tighten the connecting rod bolts with a torque wrench. – See ”Specifications” for the correct tightening torque.

CRANKSHAFT

After cleaning the crankshaft, measure its journals with a micrometer. Measure at several points round the circumference and along the longitudinal axis of each journal. Out-of-roundness on the main bearing journals should not exceed 0.05 mm (0.002"), and 0.07 mm (0.003") on the big-end bearing journals. Taper should not exceed 0.05 mm (0.002") on any of the journals.

If the values obtained are close to or are greater than the wear limit mentioned above, grind the crankshaft to undersize. Suitable undersize bearing shells are available. The measurements concerned are to be found in the "Specifications". Check that the crankshaft is straight to within 0.05 mm (0.002") by using a dial gauge. The crankshaft is thereby put on two V-blocks and a dial gauge placed against the centre bearing journal after which the crankshaft is rotated. If necessary, straighten the crankshaft in a press.

GRINDING THE CRANKSHAFT

Before grinding the crankshaft, check to make sure it is straight, this being done as previously. Grinding is carried out in a special machine whereby the main bearing journals and the big-end bearing journals are ground to identical measurements. These measurements which are given in the "Specifications" must be carefully followed in order to ensure correct clearance with ready-machined bearing shells.

On no account may the bearing shells be shaved or the bearing caps filed.

The fillets at the ends of the journals should have a radius of 2.0–2.5 mm (0.080–0.100") for all the journals, see Fig. C6. The width measurement (A) for the pilot bearing depends on the size of the journal and should be ground in order to obtain the correct measurement. See the "Specifications".

After completing the grinding, carefully remove all burr from the oilway openings and lapp all the journals with a fine grinding paste to the finest possible surface finish. Then wash the crankshaft. Clean all the oilways with particular thoroughness to remove any metal chippings and grinding residue.

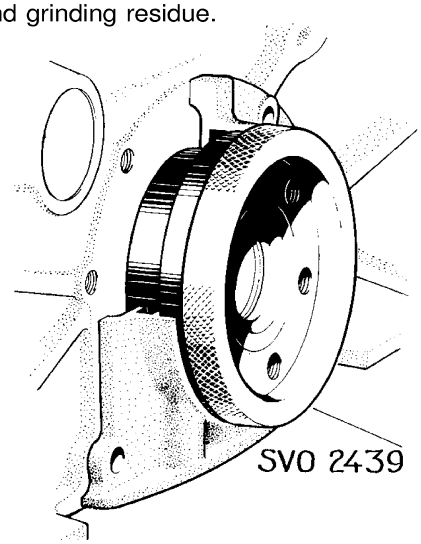


Fig. C7. Centering the rear sealing flange (4-cyl. engine)

MAIN AND BIG-END BEARINGS

In addition to standard sizes, bearing shells are available in undersizes of 0.010" and 0.020". The rear main bearing shells are provided with flanges and have a larger width relative to their size. See the "Specifications". If the crankshaft has been ground to the correct measurement, the right bearing clearance is automatically obtained when the bearing shell concerned is fitted. The bearing shells must not be shaved and the caps must never be filed in order to obtain a closer bearing fit. The bolts should be tightened with a torque wrench. See the "Specifications" for correct tightening torque.

REAR SEALING FLANGE (4-CYL. ENGINE)

1. Screw out the two bolts for the oil sump in the sealing flange. Slacken a bit the two bolts at the side so that the pressure of the oil sump on the sealing flange will not be so great. Remove the sealing flange and felt seal.
2. Make sure that the seal is not damaged and that the flange is clean. Also ensure that the drainage hole does not become blocked with fitting the wrong seal for the oil sump. The felt ring should not be fitted in the flange.
3. Fit on the sealing flange but do not tighten the bolts.
4. Centre the flange with centering sleeve SVO 2439, see Fig. C7. Rotate the sleeve while tightening the bolts and adjust the location if the flange jams firmly. Check to make sure that the flange lies flush against the underside of the block.
5. Fit a new felt ring and install the washer and circlip. Press the circlip into position with the centering sleeve. Check that the circlip is secured in its groove.

REAR SEALING FLANGE (6-CYL. ENGINE)

1. Unscrew the two bolts for the oil sump in the sealing flange. Slacken a bit the two bolts at the side so that the pressure of the oil sump on the sealing flange will not be so great. Remove the sealing flange.

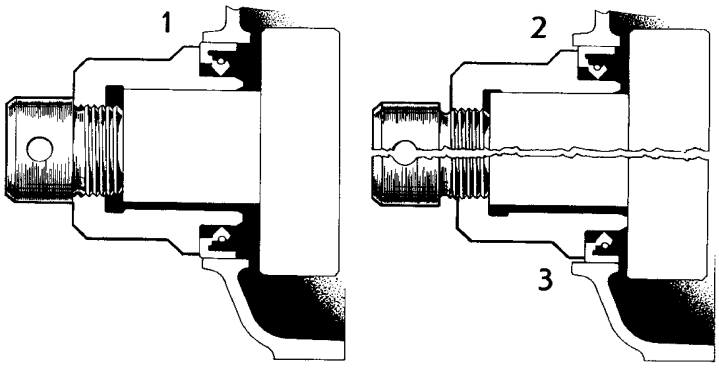


Fig. C8. Centre spindle position on SVO 2816 (6-cyl. engine)

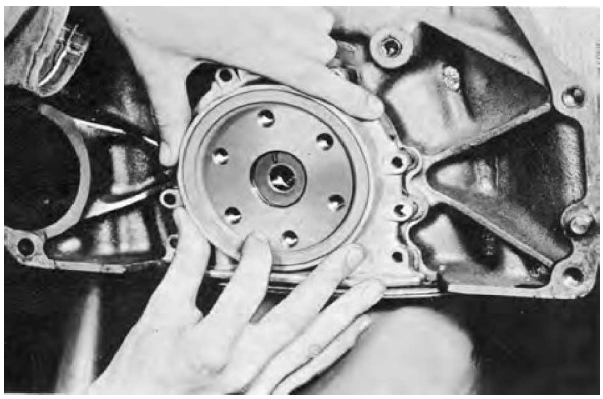


Fig. C9. Fitting the rear sealing flange (6-cyl. engine)

2. Press out the old seal with the help of the drift for tool SVO 2817. Use a suitable cushion for the sealing flange to prevent it from being damaged. Inspect the wear surface of the crankshaft.
3. Press in the sealing ring with tool SVO 2817. The sealing ring can be fitted in three positions with SVO 2817, compare with Fig. C8. With a crankshaft that is new or which has an approved wear surface, fit the seal in its outer position (centre bolt screwed in fully). With the wear mark on the crankshaft, fit the crankshaft with the centre bolt screwed out a couple of turns or completely.
4. Fit the sealing flange, its sealing surface cleaned well, and a new gasket. (Oil first the sealing ring.) The sealing flange should be mounted on the crankshaft carefully, see Fig. C9. Use your finger to fit on the sealing lip.

Pilot bearing for clutch shaft

The pilot bearing circlip and protecting washer are removed, and the pilot bearing is pulled out with tool SVO 4090 and checked after having been washed in white spirit. If the bearing is worn, it should be replaced with a new one. Before fitting, pack the bearing with heat-resistant ball bearing grease. Fit the bearing with drift SVO 1426, and then fit the protecting washer and circlip.

TIMING GEARS

Replacing the sealing ring in timing gear cover (4-cyl. engine)

1. Remove the drive belt. Unscrew the bolt in the crankshaft. Take off the belt pulley.
2. Take out the circlip for the washer retaining the felt ring. Remove the washer and felt ring. Check that the cover is correctly fitted by inserting a 0.10 mm (0.004") feeler gauge in the gap between the cover and the crankshaft hub and moving it all round. If the feeler gauge jams at any point, the cover should be centered, see under "Replacing the timing gear cover".
3. Fit a new felt ring. Re-fit the washer in position and fit the circlip. Check that the circlip locates properly.
4. Fit the remaining parts and tension the drive belt.

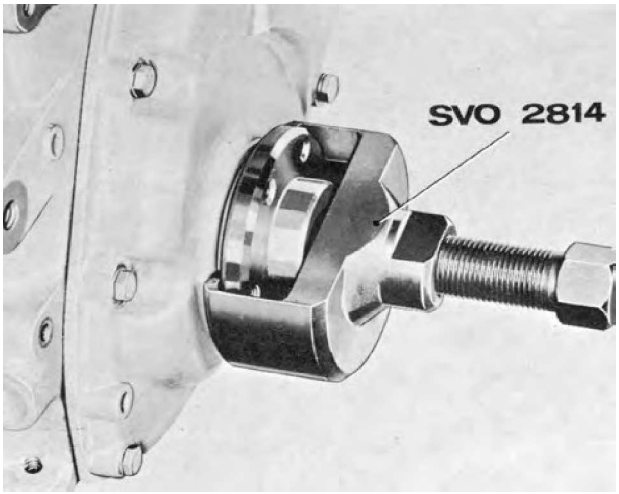


Fig. C10. Removing the polygon hub (6-cyl. engine)

Replacing the sealing ring in timing gear cover (6-cyl. engine)

1. Remove the drive belt. Unscrew the bolts for the pulley and flywheel damper and remove the pulley and damper. Take care not to damage the flywheel damper.
2. Remove the centre bolt and take off the polygon hub with puller SVO 2814, see Fig. C10. (First try to see whether the hub can be removed by hand.)
3. Break out the sealing ring.

   N. B. First inspect the wear surface of the polygon hub. The sealing ring can be fitted in three positions with SVO 2816. With a new polygon hub, the centre bolt of the tool should be screwed fully in, see Fig. C8. In this position, the seal will be fitted in its outer position (position 1). With a wear mark on the polygon hub, fit the seal in position 2 (1 1/4 turns of centre bolt screwed out). With two wear marks, fit the seal in position 3 (centre bolt fully screwed out). With three wear marks, the polygon hub should be replaced by a new one. Lubricate the sealing lip on the new seal and fit it with drift SVO 2816.
4. Fit the polygon hub with tool SVO 2815, see Fig. C11. Before fitting, grease the sliding surfaces of the polygon hub. Note the marking, that is, the pop marks on the crankshaft end and polygon hub. Fit the centre bolt and tighten it to a torque, 7-8 kgm (50-57 lb.ft.).
5. Fit the flywheel damper and pulley. Since the bolt holes are not located symmetrically, fitting can be done only in one position.
6. Fit the other parts and tension the drivebelt so that the pulley starts to slip at the torque indicated in the "Specifications" under "Tightening Torques". Fit the torque wrench on the generator pulley attaching nut and turn it in the same rotational direction as the engine.

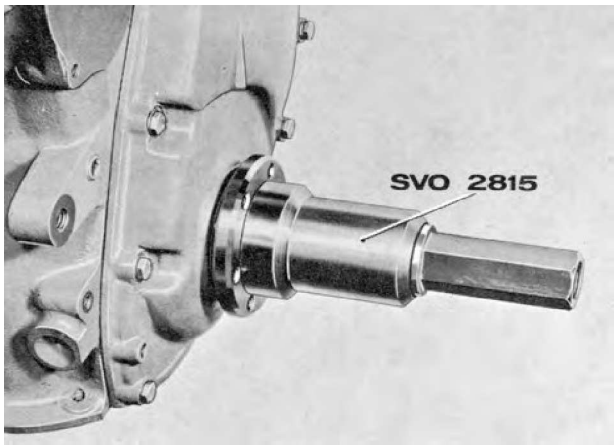


Fig. C11. Fitting the polygon hub (6-cyl. engine)

Replacing the timing gear cover (4-cyl. engine)

1. Remove the sea-water pump and the crankshaft pulley bolt, also take off the pulley.
2. Remove the timing gear cover. Unscrew a couple of bolts extra for the oil sump and take care not to damage the gasket. Take out the circlip, washer and felt ring in the cover.
3. Make sure that the gaskets are in good condition and that the drain hole is open and clean inside the timing gear cover which is to be fitted.
4. Place the cover in position and fit the bolts but without tightening them.
5. Centre the cover with the centering sleeve SVO 2438. Turn the sleeve while tightening and adjust the position of the cover so that the sleeve does not jam. After final-tightening of the cover, check that the sleeve can be easily turned without locking.
6. Fit a new felt ring, washer and circlip. Push them in to their final position with sleeve SVO 2438.
   Check to make sure that the circlip has engaged in its groove.
7. Fit the other parts and tension the drive belt so that the pulley starts to slip at the torque indicated in the "Specifications" under the heading "Tightening torques". The torque wrench is fitted on the attaching nut of the generator pulley and is turned in the same rotational direction as the engine.

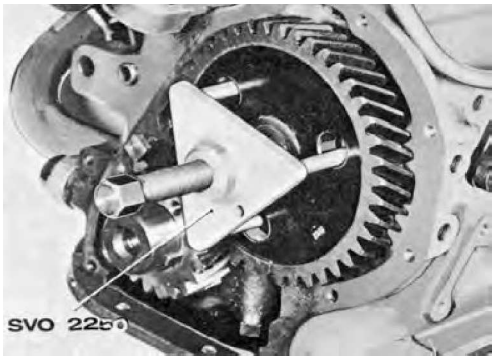


Fig. C12. Removing the camshaft drive (4-cyl. engine)

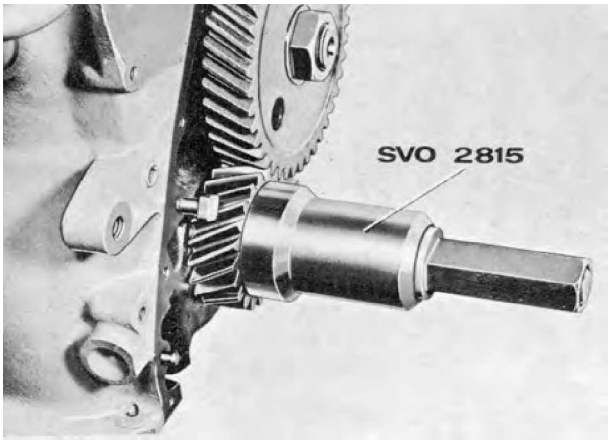


Fig. C13. Fitting the crankshaft gear (6-cyl. engine)

Replacing the timing gear cover (6-cyl. engine)

When replacing the timing gear cover see under "Replacing the sealing ring in the timing gear cover (6-cyl. engine)". Remove the timing gear cover. Move over the sea-water pump and fit the new timing gear cover. The timing gear cover is guided up into position by means of a guide pin.

Replacing the timing gears (4-cyl. engine)

1. Carry out points 1–2 under the heading "Replacing the timing gear cover (4-cyl. engine)".
2. Remove the hub on the crankshaft with puller SVO 2440.
   Before fitting the tool, its forge nut must be unscrewed so that the taper is not tensioned. The centre bolt should also be unscrewed.
   Then fit the tool, screw in the large nut so that the hub is securely held. Pull off the hub by screwing in the centre bolt.
3. Remove the camshaft nut and pull off the gear with puller SVO 2250, see Fig. C12.

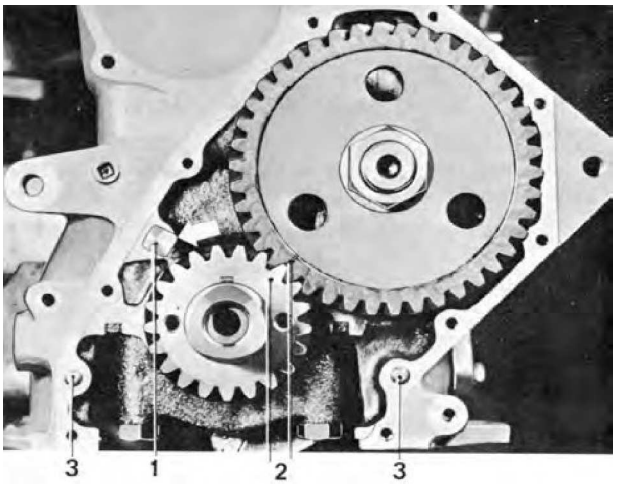


Fig. C14. Marking on timing gears (6-cyl. engine)
1 Oil nozzle 2 Markings 3 Guide pins
The arrow shows the direction of rotation

4. Pull off the crankshaft drive with puller SVO 2405, see Fig. C15. Unscrew the oil nozzle, blow it clean and then refit it according to Fig. C14, so that the oil jet is aimed at the meshing of the timing gears.
5. Fit the crankshaft drive with tool SVO 2407, and the camshaft gear with tool SVO 2408, see Fig. C16. Fit the hub on the crankshaft. The hub can be drawn into position by the bolt for the crankshaft pulley. Do not push the camshaft towards the rear so that the sealing washer on the rear end loosens. Check that the gears have the correct position relative to each other, as shown in Fig. C14. Tool SVO 2407 has wrench flats intended for turning the crankshaft. The measurements for the tooth flank clearance and axial play of the camshaft, which is determined by the spacer ring behind the camshaft gear, are to be found in the "Specifications". Centre and fit the timing gear cover and the rest of the parts according to points 4-8 under "Replacing the timing gear cover (4-cyl. engine)".

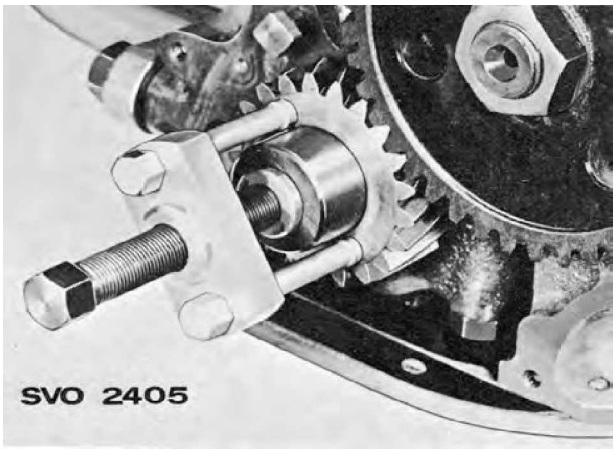


Fig. C15. Removing the crankshaft drive (4-cyl. engine)

Replacing the timing gears (6-cyl. engine)

1. See points 1 and 2 under "Replacing the sealing ring in timing gear cover (6-cyl. engine)".
2. Remove the timing gear cover. Slacken a couple of bolts extra for the oil sump and observe proper care that the sump gasket is not damaged.
3. Remove the camshaft nut and pull off the camshaft gear with puller SVO 2250, see Fig. C12.
4. Pull off the camshaft gear with puller SVO 2822. Screw out the oil nozzle, blow it clean and refit it according to Fig. C14. The timing gears are lubricated from the oil nozzle.
5. Fit the crankshaft drive with tool SVO 2815, see Fig. C13.

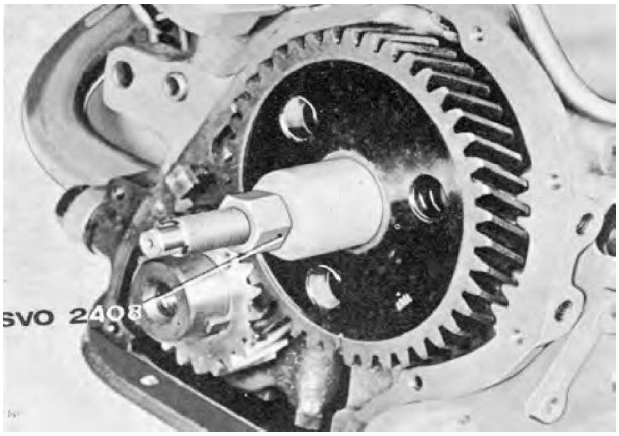


Fig. C16. Fitting the camshaft gear(4-cyl. engine)

6. Fit the camshaft gear with tool SVO 2408, see Fig. C16. When the timing gear drive markings coincide with each other, then the piston for No. 6 cylinder is at top dead centre, firing position. Do not press the camshaft backwards so the sealing washer at the rear end loosens. Fit the nut and tighten it to a torque of 13–15 kgm (94–108 lb.ft.).

   The measurements for the tooth flank clearance and the camshaft axial play, which is determined by the spacer ring behind the camshaft gear, are to be found in the "Specifications".
7. Fit the timing gear cover with gasket. The timing gear cover is guided up by means of a guide pin. See points 4, 5 and 6 under "Replacing the sealing ring in the timing gear cover (6-cyl. engine)".

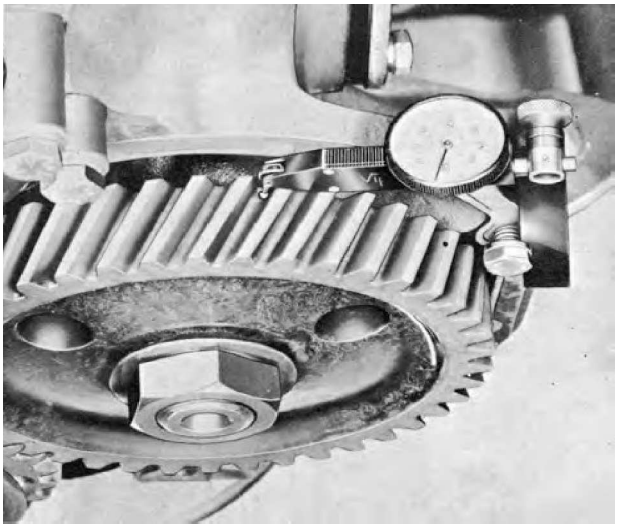


Fig. C17. Measuring the tooth flank clearance

D. LUBRICATING SYSTEM

DESCRIPTION

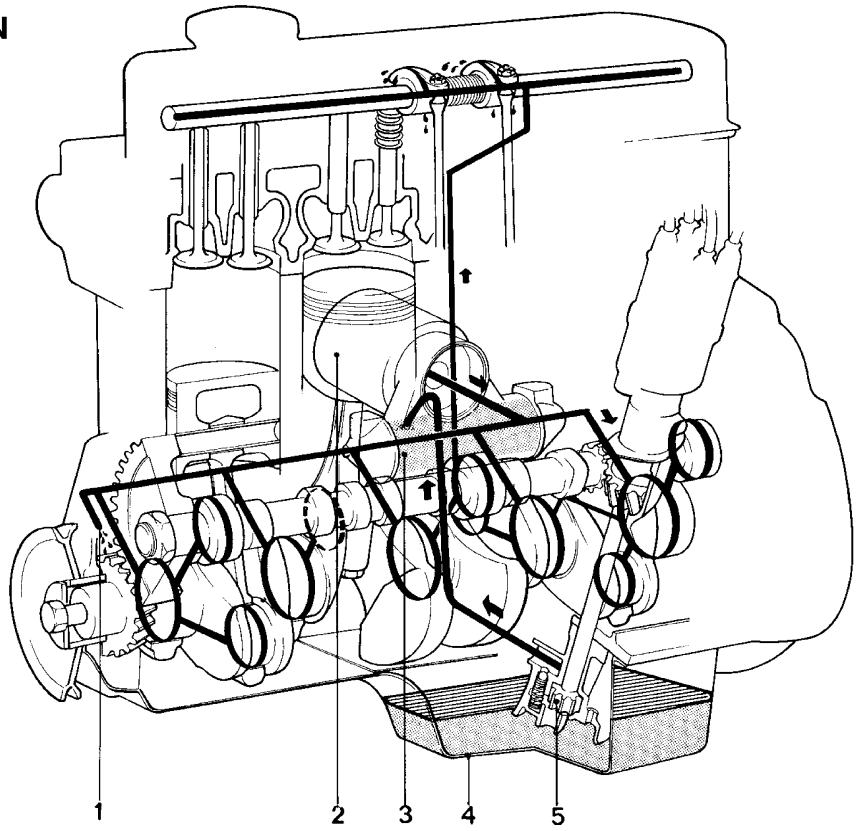


Fig. D1. Lubricating system
1. Nozzle
2. Oil filter
3. Oil cooler
4. Oil sump
5. Oil pump

The engine is lubricated by oil under pressure, which is provided by a gear pump driven from the camshaft and fitted under the crankshaft in the sump. The pump has a relief valve which consists of a spring-loaded ball.

All the oil passes through an ail cooler as well as a full-flow type filter before being forced out to the various lubricating points.

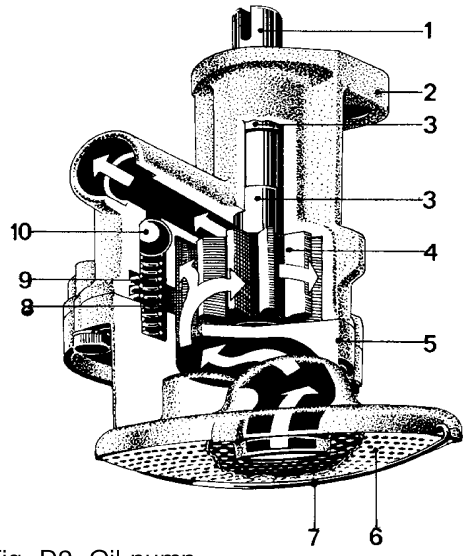


Fig. D2. Oil pump
1. Drive shaft
2. Pump body
3. Bushes
4. Driving gear
5. Cover
6. Strainer
7. Retainer clip
8. Driven gear
9. Relief valve spring
10. Valve ball

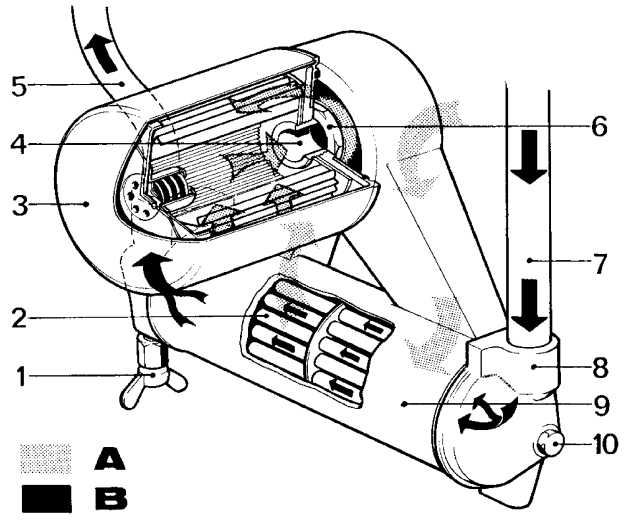


Fig. D3. Combined oil filter and oil cooler
A=Lubricating oil
B=Cooling water
1. Drain cock
2. Cooling tubes
3. Oil filter
4. Nipple
5. Water outlet
6. Nut
7. Water inlet
8. End cover
9. Oil cooler
10. Centre bolt

REPAIR INSTRUCTIONS

Replacing the oil filter

Fig. D4. Oil filter ready for fitting
1. Gasket (oiled) 2. Filter

Together with the element and relief valve, the oil filter (Fig. D4) is screwed as a complete unit on to a nipple fitted in the cylinder block.

The filter should be replaced after every 100 hours of operation, when the old filter is discarded. With an engine that is new or reconditioned, the filter should be changed for the first time after 20 hours running.

1. Remove the old filter with the help of chain tongs according to Fig. D5.
2. Smear oil on the rubber gasket (1, Fig. D4), also make sure that the contact surface for the oil filter is free from dirt. By smearing it with oil, the gasket slides into better contact with the sealing surface. Screw on the filter by hand until it just touches the cylinder block.
3. Tighten the oil filter further a half turn by hand. The chain tongs must not be used for fitting. Start the engine and check that the oil pressure lamp goes out and that the joint between the filter and block is tight. Fill up with oil if necessary.

Fig. D5. Removing the oil filter

Oil pump and relief valve

After the pump has been disassembled and then cleaned, check that all the parts are in good condition. Test the relief valve spring (2, Fig. D6), and for the test values concerned see the ”Specifications”.

Check that the tooth flank clearance is 0.15–0.35 mm (0.006–0.014"), see Fig. D7.

Check the end float with a feeler gauge and a new cover or the old one if it is not noticeably worn. The end float should be 0.02–0.10 mm (0.0008–0.0040"), see Fig. D8. If the bushes or shaft are worn, replace them with new ones. Note that the driving shaft with gear is replaced as a single unit.

The new bushes should be reamed after pressing with a reamer provided with a pilot guide.

The sealing rings at the ends of the delivery pipe are made of special rubber and are manufactured to very close tolerances. Use only genuine Volvo Penta spare parts. The delivery pipe must be clamped in its correct position first in the oil pump and then the oil pump and pipe together clamped against the block. The connecting flange of the pump should lie flush against the block before being tightened. Before fitting the rubber rings on the pipe, coat them with soapy water as this enables the pipe to take up its position more easily. Tap lightly on the pipe with a soft mallet if necessary.

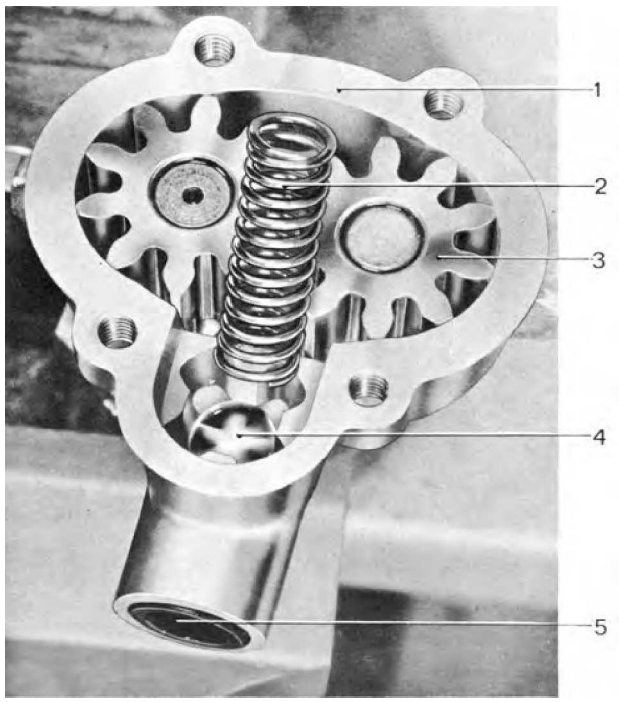


Fig. D6. Oil pump

1. Pump body
2. Spring for relief valve
3. Gear
4. Valve ball
5. Hole for oil pipe

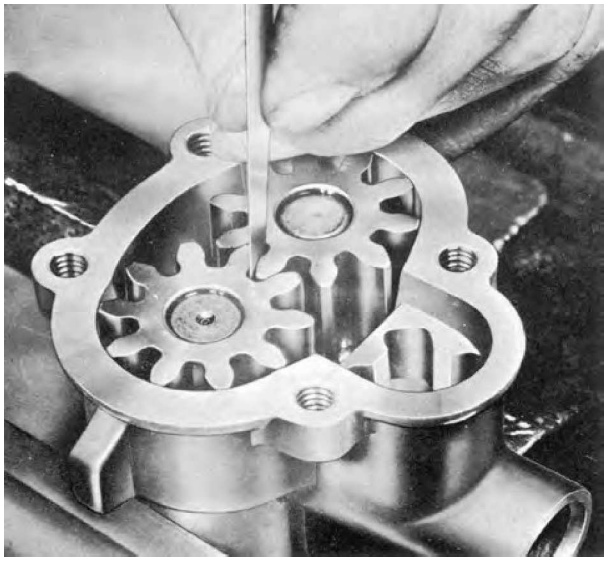


Fig. D7. Measuring tooth flank clearance

Oilways

To avoid damage to bearings, bearing journals and to other components, all the oilways must be cleaned very thoroughly.

Fig. D8. Measuring the axial clearance

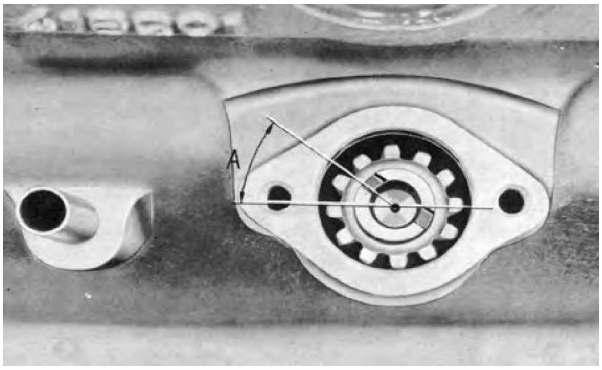


Fig. D9. Distributor drive position
A = approx. 35°

Fitting the oil pump

When No. 1 cylinder is at top dead centre and for firing, fit the drive for the oil pump and distributor. The small part at the groove is turned obliquely upwards-backwards and the groove set at an angle of 35° to the longitudinal axis of the engine (see A, Fig. D9). Ensure that the shaft goes down into its groove in the pump shaft.

N. B. When the timing gear marks are opposite each other, then the piston for No. 4 cylinder (No. 6 cylinder for 6-cyl. engine) is in the top dead centre position, firing position.

Oil cooler

The oil cooler is combined with an oil filter (see Fig. D3) and should be checked for blockage and leakage. Remove the filter and screw apart the oil cooler. The parts must be thoroughly cleaned, especially the tubes. If there is any reason to test the oil cooler under pressure, this should be done with kerosene (paraffin). The water side should be tested under a pressure of 1 kg/cm^2 (14 p.s.i.) and the oil side with 10 kg/cm^2 (142 p.s.i.). After the pressure-testing, the cooler should be emptied of fluid. Use new O-rings when assembling and fitting. See the ”Specifications” for the tightening torques. Fit a new filter, see under the heading, ”Replacing the oil filter”.

Fitting the oil sump

Fit the oil sump together with a new gasket. Tighten securely the drain plug.

E. ASSEMBLING AND INSTALLING THE ENGINE

When assembling and fitting the complete units, cylinder head and cylinder block, you are referred to the respective sections on reconditioning, which contain full instructions for both reconditioning and assembling as well as subsequent checks and adjustments.

Before the engine is lifted into position in the boat, the exhaust hose with hose clamps should be fitted on the outgoing exhaust pipe. Check that the exhaust hose is completely free from damage. With the slightest sign of damage, it should be replaced with a new hose.

Installing the engine with the boat afloat

1. Lift the engine from its lifting eyelet (6-cyl. engine, 2 eyelets) and lower it into the boat. If the engine has previously been released from the flywheel cover, the engine should be lowered to a close level so that the crankshaft center coincides with the drive shaft center in the flywheel cover.
2. Move the engine in towards the flywheel cover at the same time as the splined shaft in the flywheel cover fits in the vibration damper.
3. Fit the exhaust hose over the exhaust pipe and turn the engine crankshaft pulley so that the splined joint engages.
4. Assemble the engine and flywheel cover together with the bolts and fit the starter motor at the same time.
5. Connect the engine to the front engine mounting, if such is fitted.
6. Adjust the position of the exhaust hose and connect up the cooling water pipe and tighten all hose clamps.
7. Connect together the cable harnesses of the electrical system and connect up other electrical cables to the engine. Check to make sure that the battery is fully charged and connect up the battery leads.

   N. B. Do not mix up the leads. A negative pole stud should be connected to the earth cable on the engine. Lubricate the cable shoes with pole grease after the final tightening.
8. Connect up the control cable and the fuel line to the engine. Use thread tape or sealing on the fuel line connections.
9. Pump the fuel up to the carburetor with the help of the hand primer and carefully check that it is absolutely certain there is no leakage in lines, connections and cocks.
10. Check that the new oil filter has been fitted and fill the engine with oil. Use only Multigrade oil grade Service MS and viscosity SAE 10 W/30 or 20 W/40.
11. Test-run the engine after all the control measures have been carried out, for which see under the heading ”Test running”.

Installing the engine with the boat on land

Lower the engine to the correct level in the boat and move the flywheel cover neck into the mounting collar and fit at the same time the exhaust hose between the engine exhaust manifold and outgoing exhaust pipe.

N.B. If the engine does not have a front rubber mounting block, the support rubber block should be fitted in the collar before the engine is lowered. Line up the engine and tighten it to the mounting collar by means of the clamping ring. Tighten the bolts to the correct torque with the torque wrench. Tighten in diagonal sequence. For tightening torque, see the ”Specifications”.

Fit the outboard drive unit. (See the separate workshop manual for the respective outboard drive units.)

Carry out points 6 to 11 under the heading ”Installing the engine with the boat afloat.

F. FUEL SYSTEM

DESCRIPTION

CARBURETORS

The following engines are fitted with the Zenith-Stromberg horizontal type carburetor:

AQ105 (one 150 CD), AQ130 A and B (two 175 CDSE) and AQ165A (three 175 CDSE).

The Solex down-draft carburetor, type 44 PAI, is fitted in the following engines:

AQ115A (one carburetor), AQ130C (two carburetors) and AQ170A,B,C (three carburetors).

The down-draft carburetor has fixed jets such as the main jet, idling jet, acceleration jet and emulsion jet.

The carburetor is fitted with an acceleration pump, which is also used as an aid in starting during cold weather. The carburetor does not have any other cold start device.

The floatchamber, which is incorporated in the carburetor body has internal ventilation, which eliminates any external flooding of fuel.

REPAIR INSTRUCTIONS

CARBURETOR, ZENITH STROMBERG

Removing

1. Clean the carburetor, remove the intake silencer (AQ130, AQ165) and remove the flame arrester and drip pan.
2. Disconnect the fuel line and speed cable from the carburetor.
3. Unscrew the nuts securing the carburetor and lift off the carburetor. Cover the holes in the intake manifold to prevent foreign particles entering the engine.

DISASSEMBLING

1. Mark up the position of the floatchamber cover on the carburetor body. Screw out the plug with the damper piston. Unscrew the four screws and lift off the cover and the spring.
2. Lift out the air valve with metering needle and diaphragm. See Fig. F6.
3. Pull off the lock clamp for the idle trimming screw. Then remove the floatchamber. On the Stromberg 150 CD the float can be removed after its suspension spindle has been pulled out sideways, and on the Stromberg 175 CDSE the spindle with float is pressed straight down out of its spring holder.
4. Screw out the jet holder (8) together with idle trimming screw (10), jet (7), spring (6), guide (4) and washers (3 and 5). See Fig. F1.
5. Screw out the float valve with washer
6. Remove the cold start device (175 CDSE).

The horizontal type carburetors have only one nozzle, which is adjustable. A tapered metering needle is fixed in the air valve and its vertical location is determined by the vacuum at the moment existing in the valve.

The carburetors are fitted with a cold start device. The Stromberg 150 CD carburetor has a specially designed choke spindle which, when the choke lever is engaged, turns. When turning, the spindle lifts the air valve and this increases the flow of fuel.

The Stromberg 175 CD carburetor has a special cold start device which, when engaged, provides an extra supply of fuel through the calibrated holes. See Fig. F 7.

FUEL PUMP

The fuel pump is of the diaphragm type and is driven by a cam on the camshaft. When the rocker arm in the pump is pressed upwards by the cam, the diaphragm is pulled downwards and fuel is drawn up to the pump. When the rocker arm returns, the diaphragm is pressed upwards by a spring and fuel is fed to the floatchamber. When the level in the floatchamber reaches a sufficient height, the float valve closes.

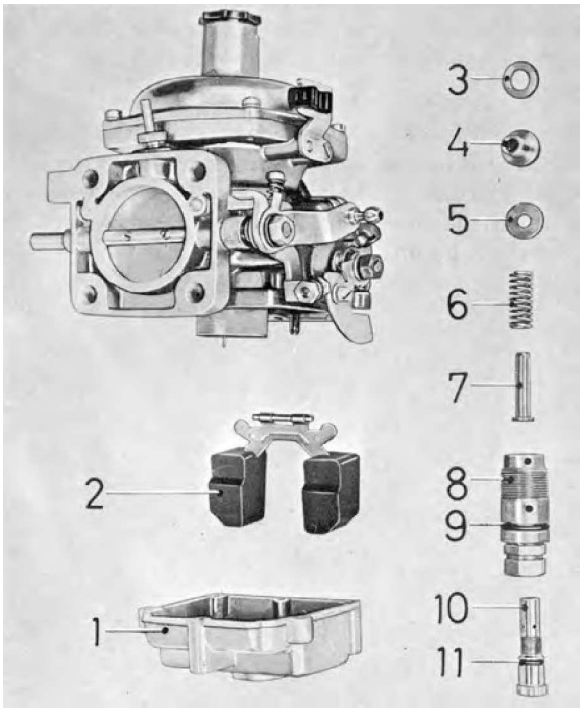


Fig. F1. Floatchamber dismantled

1. Float chamber
2. Float
3. Washer
4. Guide
5. Washer
6. Spring
7. Jet
8. Jet holder
9. O-ring
10. Idle trimming screw
11. O-ring

Cleaning
Except for the diaphragm, clean all the carburetor parts in white spirit. The diaphragm should be cleaned in paraffin or similar. Blow the carburetor parts clean with compressed air.

INSPECTING
Check to make sure that the diaphragm is in good condition and otherwise not deformed. When fitting a new diaphragm, see under the heading "Assembling the carburetor".

Check to make sure that the metering needle is straight and otherwise not damaged. The metering needle is installed according to the instructions given under "Assembling the carburetor".

Check to make sure that the cold start device (175 CDSE) is not damaged, that the sealing surfaces are clean and that none of the calibrated holes is blocked. Check that all sealing surfaces on the carburetor are otherwise not damaged and that the seat for the diaphragm and the O-ring is without fault.

ASSEMBLING
1. When fitting a new diaphragm, place the nib on the inner diameter of the diaphragm in the corresponding recess in the sealing surface on the air valve. Fit the clamp washer for the diaphragm. Check when putting together that the diaphragm is not displaced from its location.
2. When a new metering needle is to be fitted, a needle with the same letter designation should be fitted. The metering needle should be fitted so that the transition between the tapered needle and the cylindrical part is level with the bottom side of the air valve.
3. Fit the air valve with the diaphragm in the carburetor body. N. B. The nib on the outer diameter of the diaphragm should fit into the corresponding recess in the sealing surface in the carburetor body. When the air valve reaches the bottom position, the metering needle will project out under the floatchamber face.

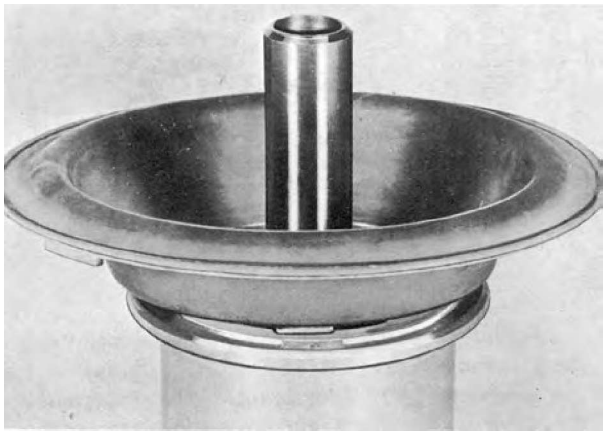


Fig. F2. Diaphragm in air valve

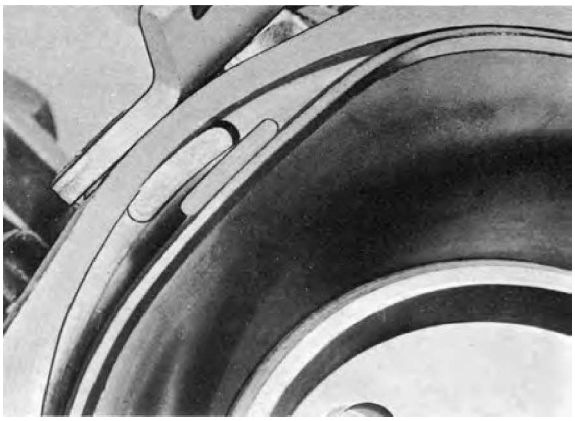


Fig. F3. Diaphragm location in carburetor body

To protect the needle, the valve should be lifted slightly when fitting the cover. Fit the spring and air valve cover according to the line-up marks made when removing. Tighten the cover with the screws in diagonal sequence.

4. Fit a new O-ring on the throat of the idle trimming screw and screw the idle trimming screw all the way in the jet holder. Fit the spring on the jet and install the washer, O-ring, guide and light-metal washer in the order just mentioned. Place the complete jet in the jet holder and screw the holder securely in the carburetor body. Lift up the air valve to its top position while tightening. Then let the air valve fall back. If it does not bottom of its own volition, see under "Centering the jet".
5. Fit the float valve with washer.
6. Fit the float.
7. Check the float level, see under the heading "Checking the float level".
8. Fit a new gasket between the carburetor body and floatchamber. Fit the floatchamber on the jet holder sufficiently far that it just makes contact with the O-ring. Then tighten the screw diagonally to ensure even tightening as far as possible. Fit the lock clamp on the idle trimming screw.

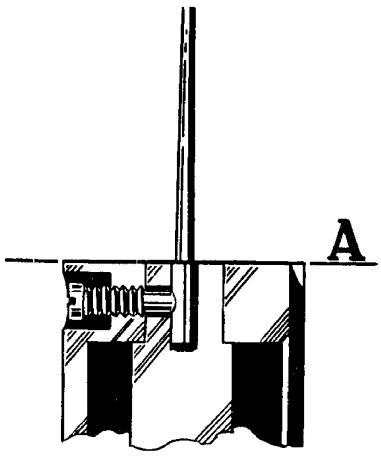


Fig. F4. Location of metering needle in air valve

9. Fit the cold start device (175 CDSE). If the disc with the calibrated holes has been removed, it should be turned when fitting so that the holes are nearest the lever cam disc.

CHECKING THE FLOAT LEVEL

The float level should be checked with the carburetor removed from the engine.

1. Remove the floatchamber. Be careful when removing that the gasket and O-ring are not damaged.
2. Invert the carburetor and check that the float closes the float valve and that the float valve does not jam.

   Check the measurements "A" and "B", see Fig. F5. The measurements are measured between the carburetor body face and the highest or lowest point on the float. Do not press on the float when measuring. Measurements "A" and "B" are given in the "Specifications".
3. If the measurement is not correct, adjusting can be done by bending the tab which lies against the float valve.
4. Check that the gasket and O-ring are not damaged. With the slightest indication of damage, they should be replaced. Fit the floatchamber.

CENTERING THE JET

1. Lift the air valve to its top position. Adjust the idle trimming screw so that the opening of the jet is level with the bridge in the carburetor venturi.
2. Slacken the jet holder about one turn. Release the air valve. If it does not strike the bridge with a light sound, then the jet is incorrectly centred in relation to the metering needle. Lift up and release the air valve several times until its movement is easy all the way and it strikes the bridge with a metallic click.

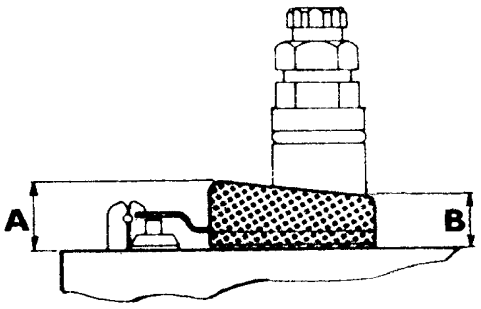


Fig. F 5. Checking the float level

3. Begin by slowly drawing out the jet holder while lifting and releasing the air valve at the same time in order not to disturb the centering. Tighten the jet holder fully. Check to make sure there is no jamming anywhere.

FITTING THE CARBURETOR

Remove the protection from the holes in the intake manifold. Clean round the area of the carburetor which fits against the intake and fit a new washer between it and the intake manifold. When more than one carburetor is involved, the intermediate shaft between the throttle spindles of the carburetors should be fitted at the same time.

SETTING THE CARBURETORS

When setting and synchronizing the carburetors, the intake silencer and flame arrester should be removed.

1. Adjust the vertical location of the jet so that its opening is in exact contact with the bottom side of the air valve. If it is not possible to see when the jet comes in contact with the air valve, it is possible to feel with a thin wooden pin when the jet starts lifting the air valve.

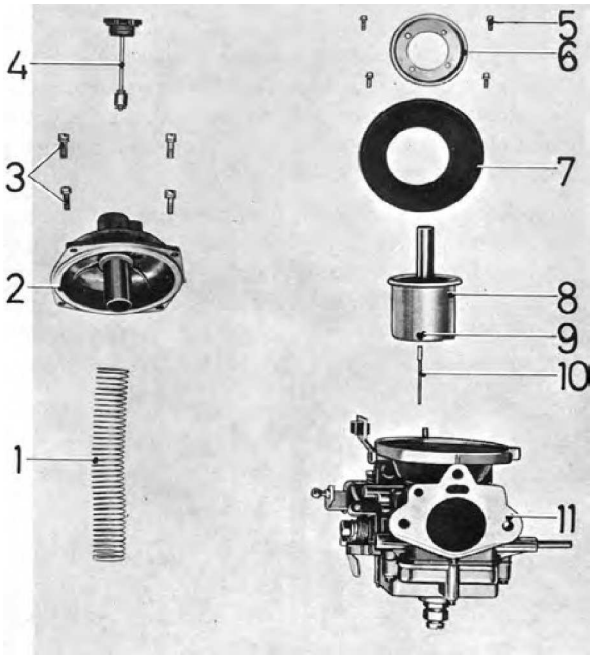


Fig. F6. Upper section dismantled

1. Spring
2. Suction chamber
3. Screw
4. Hydraulic damper
5. Screw
6. Washer
7. Diaphragm
8. Air valve
9. Lock screw, metering needle
10. Metering needle
11. Intermediate section

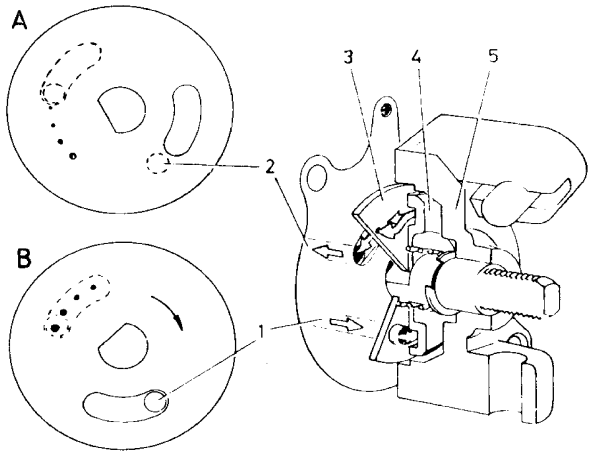


Fig. F7. Cold start device

A = Disengaged
1. From floatchamber
2. To venturi

B = Engaged
3. Choke lever
4. Channel disc
5. Housing

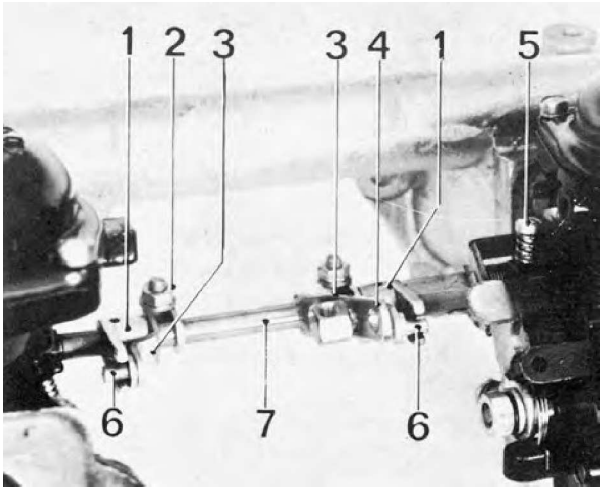


Fig. F8. Carburetor 175 CDSE

1. Throttle lever
2. Clamp nut for lever
3. Lever
4. Carburetor lever
5. Throttle stop screw
6. Pin
7. Intermediate shaft

2. Check the centering of the jet. See under the heading "Centering the jet".
3. Screw out (down) the idle trimming screw on the carburetor exactly 2 1/2 turns for the AQ105 unit, 1 1/4 turns for the AQ130 and 3 turns for the AQ165 units.
4. Check to make sure that the oil level is about 6 mm (0.24") below the edge of the centre spindle in the carburetor damper cylinder. If necessary, fill with the same oil that is used for the engine.

Synchronizing the carburetors

When synchronizing the carburetors, the speed cable should be disconnected from the carburetor lever (4, Fig. F8).

1. Screw back all fast-idle stop screws so that there is a clearance between the screws and the cams on the cold start levers. Then adjust the throttle stop screws (5, Fig. F8) so that they just touch the boss on the throttle lever, but without altering the position of the lever.
2. Screw down the throttle stop screw exactly 2 1/2 turns for the AQ105 and AQ130 units, and 1 3/4 turns for the AQ165 unit.
3. Adjust the fast-idle stop screw on the AQ130 unit so that there is a clearance of 1 mm (0.04") between the screw and the cam of the cold start lever. On the AQ165 unit, the clearance for the front and intermediate carburetors is adjusted to 1 mm (0.04") and for the rear carburetor to 0.5 mm (0.02").
4. Adjust the levers of the intermediate shaft as follows:

   AQ130: Adjust the levers (3, Fig. F8) in such a position that the bottom edges of the pins (6) actuate the throttle levers (1) for both the carburetors simultaneously, and lock them in this position.

   AQ165: Adjust the levers (3, Fig. F8) between the middle and rear carburetors so that the bottom edges of the pins (6) actuate both the carburetors simultaneously, and lock them. Then connect up the cold start lever to the middle carburetor. Lock the levers (3) between the middle and rear carburetor so that there is a total clearance of 0.5 mm (0.02") between the bottom edge on the pins (6) of the levers and the recess in the throttle levers. Thereafter check when connecting up the cold start lever for the middle carburetor that the front carburetor is not influenced.
5. Check that the intermediate shaft (7) has an axial clearance of approx. 1 mm (0.04").
6. Connect the cube of the control cable to the control lever (4) so that the pins (6) on the levers (3) for the intermediate shaft (rear intermediate shaft, AQ165) are in the middle of the gap for the levers (1) of the throttle shaft. N. B. This space must be found in order to be able to connect up the cold start levers.
7. Run the engine warm and fine-adjust the idling speed to that indicated in the "Specifications". Adjust equally far the throttle stop screws. Where the engine runs unevenly, the idle trimming screws are adjusted maximum 1/2 turn in either direction.

CARBURETOR, SOLEX 44 PAI

Removing

1. Clean the carburetor, remove the intake silencer (AQ170), the flame arrester cover and the flame arrester.
2. Disconnect the fuel line and the speed cable from the carburetor.
3. Unscrew the nuts securing the carburetor and lift off the carburetor. Cover the holes in the intake manifold to prevent foreign particles from entering the engine.

Disassembling the carburetor

1. Undo the four screws (one on the bottom side) for the upper carburetor body section and lift off the section.
2. Screw out the float valve with washer.
3. Press loose the link rod for the acceleration pump from the throttle lever.
4. Remove the throttle housing from the carburetor body.
5. Remove the acceleration pump.
6. Remove the float by releasing the screw on the outside of the floatchamber. The screw acts as a shaft for the float.
7. Remove all the jets (emulsion - acceleration-main and idling), also the check valve for the floatchamber.
8. The air taper can be removed after its lock screw on the outside of the carburetor body has been released.

Cleaning

See the appropriate instructions for Zenith Stromberg carburetor.

Inspecting

Check to make sure that the diaphragm for the acceleration pump is not damaged. Also check that the calibrated holes in the jets are open. N. B. Never try to clean the holes with a steel wire or similar. Check the float valve. Check that all the sealing surfaces are clean. Use compressed air for blowing clean the jets and other channels in the carburetor body. If necessary, check the weight of the float to ensure that it weighs 7.3 9 (0.25 oz.).

Assembling the carburetor

1. Fit the air taper with designation ”Solex 44-31” inverted. Make sure that the taper rests against the stop nib in the carburetor body.
2. Fit all the jets. If necessary, use new seals.
3. Fit the float in the floatchamber.
4. Fit the diaphragm of the acceleration pump so that its guide pin faces the cover. The spring should be placed between the diaphragm and the carburetor body. Fit the cover with the lever turned downwards.
5. Check that the throttle disc in the throttle housing exactly takes up a vertical position when throttle lever is turned to full throttle position. If otherwise, adjust with the stop screw on the throttle lever. Fit the throttle housing. If necessary, use a new gasket.
6. Fit the float valve with washer (1 mm = 0.04" thick).
7. Fit the upper carburetor body section. If necessary, use a new gasket.
8. Press firmly the link rod for the acceleration pump.

Fitting the carburetor

1. Take off the protective cover over the hole for the intake manifold and clean the contact surface.
   Check that the contact face of the carburetor against the intake manifold is level. If necessary, file it level. Use a new gasket between the carburetor and intake manifold. Tighten the carburetor.
2. Fit the fuel line (if necessary also new copper washers) and the speed cable.
3. Fit the flame arrester and the intake silencer, where such is fitted.

Checking the float level

Where it is suspected that the float level is faulty, replace the float. At the same time, check that the float valve closes and does not jam.

Setting and synchronizing the carburetors, AQ130C, AQ170A,B,C

When setting and synchronizing the carburetors, the intake silencer (AQ170A) and the speed cable should be removed.

1. AQ130C: Release the clamp nut for one of the levers (2) Fig. F10.
   AQ170 A: Release the clamp nut for one of the levers (2) on the front and rear intermediate shaft.
2. Screw back (up) all the throttle stop screws (3) so far that they just touch (but do not press on) the boss on the carburetor body. Then screw in all the throttle stop screws (3) exactly one turn.
3. AQ130C: Adjust and lock the lever (2) in such a position that both the throttle levers (4) are actuated simultaneously.
   AQ170: Adjust and lock the lever (2) on the front intermediate shaft in such a position that both the throttle levers (4) are actuated simultaneously.

4. AQ130C: Adjust the position of the cube on the control cable so that the pins (7) for the levers (2) come in the middle of the gap on the throttle levers (4) when the cube is connected to the control lever. Connect up the cube and lock it.
   AQ170A: Connect up the cube to the control lever for the front intermediate shaft according to AQ130C. Thereafter the levers (2) between the rear and intermediate carburetors should be adjusted so that there is a small space between the levers and pins (see 5, 7).
5. Screw in the air screw (6) fully and then screw it back 1 1/4 turns.
6. AQ170: Fit the intake silencer.
7. Start the engine and run it warm to normal operating temperature.
8. Check that the engine idling speed agrees with the value given in the "Specifications". If necessary, adjust the throttle stop screw (3) exactly the same amount for each carburetor.

Setting the idling, AQ115

1. Check when the control lever is in neutral position that the spring-loaded cube has a spring tension of about 2 mm (0.08") (see A, Fig. F9). When adjusting, slacken the locknut under the spring sleeve and screw the sleeve on the thread of the control cable until the correct measurement is obtained.
2. Run the engine warm and check that the idling speed agrees with the value given in the "Specifications". If necessary, adjust the throttle stop screw (1, Fig. F9). If the engine runs unevenly, adjust the air screw until smooth running is obtained. The basic setting for the air screw is about 2 turns of the screw out from its screwed in position.

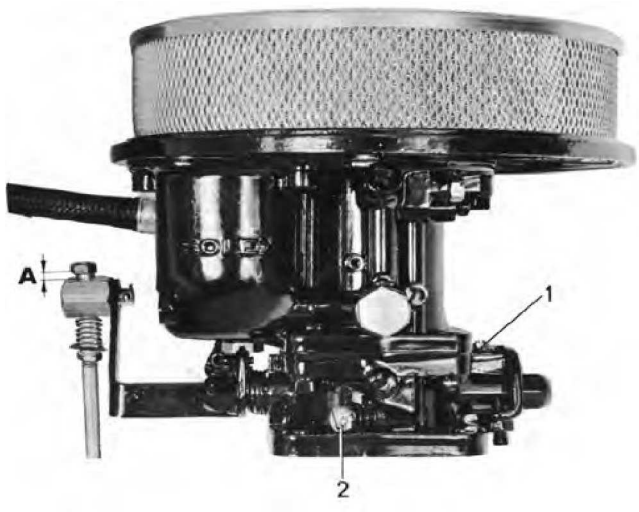


Fig. F9. Single carburetor Solex (AQ115A)

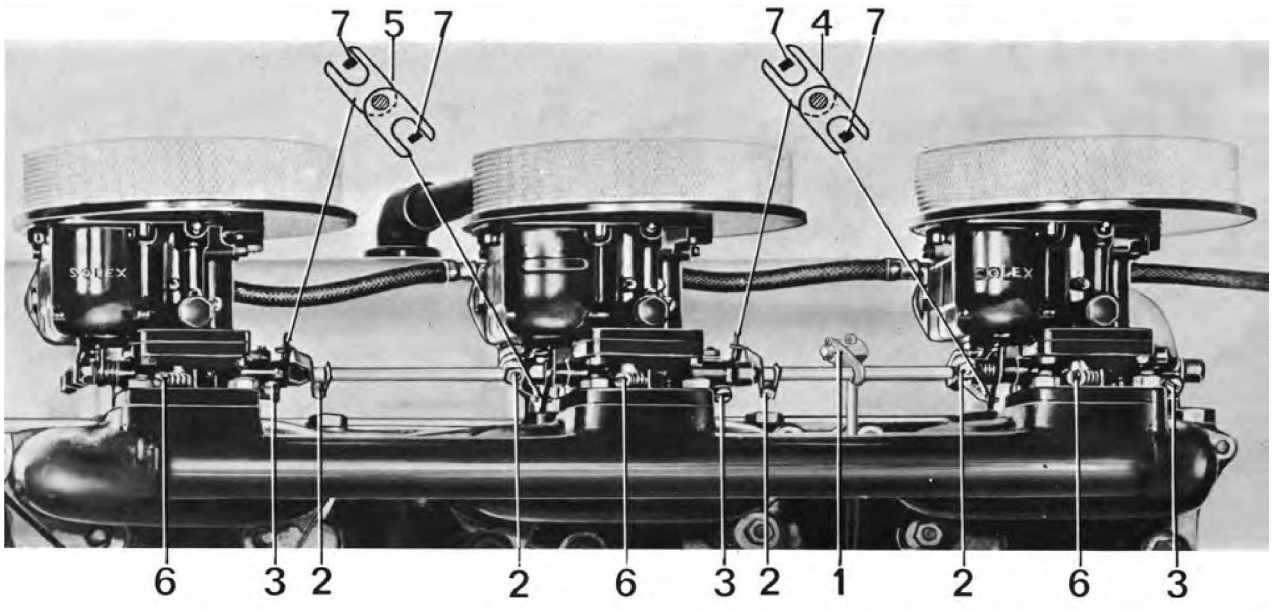


Fig. F10. 3 synchronized Solex carburetors (AQ170A,B,C)

FUEL PUMP

Dismantling

1. Mark up the upper and lower sections. Screw loose the upper section from the lower section.
2. Screw off the lever shaft (2, Fig. F11). Pull out the lever (4) and the spring (3).
3. Remove the diaphragm (13) with spring (14), guide (15) and rubber seal (16). The spring can be removed after the rubber seal has been prised over the nylon washer.
4. Slacken the screw underneath the upper section, remove the stop arm and spring (12). The outlet valve cannot be removed.

   Check the parts for wear.

Assembling

1. Fit the spring and stop arm. Tighten the screw but just sufficiently so that the spring fits well against the pump body.
2. Fit the spring (14) and guide (15). Prise on the rubber seal (16) with the flange facing in towards the guide.
3. Fit the diaphragm unit in the lower section of the pump. Press downwards so that the rubber packing comes in the proper position.
4. Press down the diaphragm, move in the lever (4) and make sure that the lever takes up the proper position in relation to the diaphragm rod. Fit the lever shaft (2), the spring holder and spring (3).
5. Fit the upper section according to the line-up markings and tighten it securely.
6. Fit the strainer and cover.

Test the pump. Make sure when fitting that the lever takes up the proper position above its cam.

For fuel pressure, see the ”Specifications”.

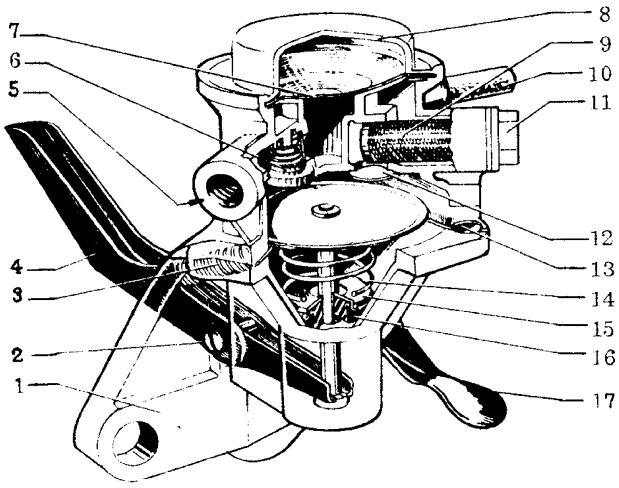


Fig. F11. Fuel pump

1. Lower pump body
2. Lever shaft
3. Return spring
4. Lever
5. Outlet
6. Outlet valve
7. Diaphragm
8. Cap
9. Strainer
10. Inlet
11. Plug
12. Inlet valve (spring)
13. Diaphragm
14. Diaphragm spring
15. Guide
16. Rubber seal
17. Manual pump

G. COOLING SYSTEM

DESCRIPTION

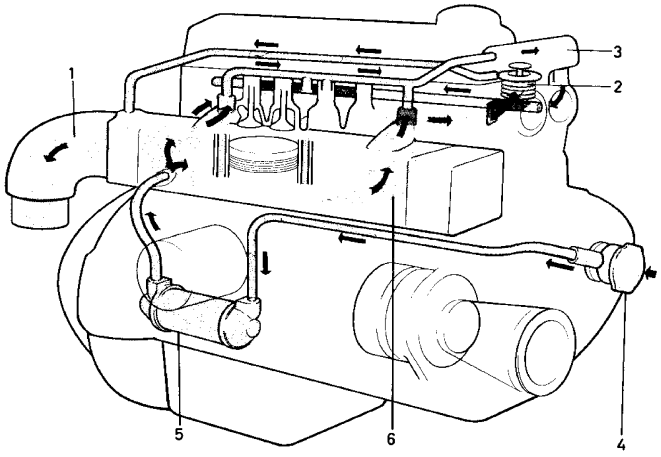


Fig. G1. 4-cyl. engine

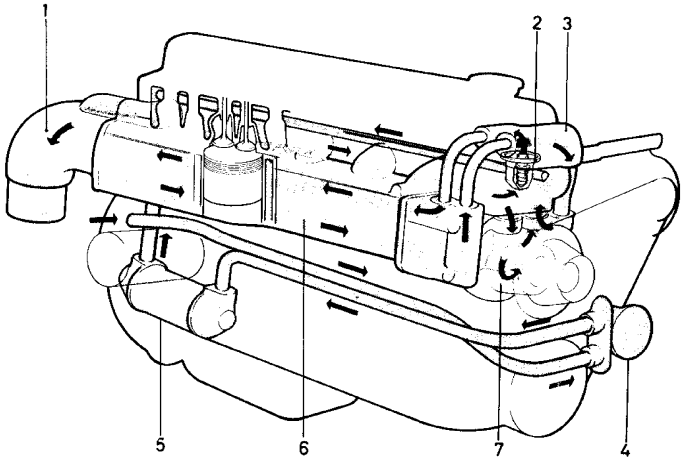


Fig. G2. 6-cyl. engine

Cooling water circulation

1. Cooling water outlet in exhaust elbow
2. Thermostat (open)
3. Distribution housing
4. Sea-water pump
5. Oil cooler
6. Water-cooled exhaust pipe
7. Circulation pump

The engine is sea-water cooled and fitted with a thermostat which controls the temperature of the engine. Cooling water circulation is taken care of by means of a sea-water pump fitted on the timing gear cover. This pump is driven from the camshaft gear through a rubber flange. The pump impeller is made of neoprene rubber and works against the cam.

The 6-cyl. engine is also fitted with a circulation pump. The exhaust manifold cooling jacket is divided up into two ducts. One half of the manifold is in direct contact with the cooling channels in the engine block and thus helps to warm up the engine rapidly before the thermostat has opened.

The sea-water pump sucks in cooling water through the water intakes (250 outboard drive) and through the separately fitted water intake (100 outboard drive). The water is then forced through the oil cooler and the exhaust manifold cooling jacket to the distribution housing. From the distribution housing the cooling water can follow two paths. While the engine is cold and the thermostat closed, the through-flow of cooling water is prevented so all the cooling water is forced out to the exhaust elbow via the distribution housing where it is mixed with the engine exhaust gases. The cooling water in the engine cooling channels is thus heated up rapidly. This opens the thermostat and forces the cooling water to pass through the engine cooling channels before leaving the engine at the exhaust elbow. The cooling water circulation is thus controlled by the the

REPAIR INSTRUCTIONS

Circulation pump 6-cyl. engine

Disassembling and checking

1. Screw loose the pump from the engine block.
2. Remove the pulley hub with puller SVO 2462 and pull out the lock wire.
3. Place the pump in a press. Press out the shaft, the bearing and the impeller with drift SVO 884347. See Fig. G3.
4. Inspect the impeller and bearing. If the bearing is worn or feels loose or if it jams, discard the shaft and bearing (bearing, shaft and deflector cannot be taken apart). If the bearing can be used again, it must not be heated or washed in fluid as this destroys the bearing lubricant. The sealing ring and impeller wear ring should always be replaced. When the shaft is to be separated from the impeller, push down the sealing ring and move the press washer SVO 2429 in under the impeller. Then press out the shaft with drift SVO 2266.

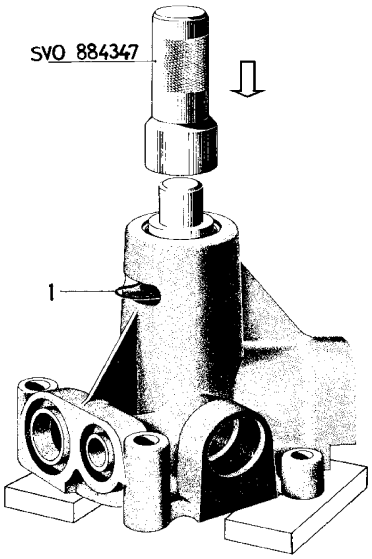


Fig. G3. Removing the shaft and impeller
1. Lock wire

Assembling the circulation pump

Before assembling, check to make sure that the parts are not damaged.

1. With SVO 2463 press down the shaft with bearing into the housing. Press down so far that the lock wire can be inserted in its groove. Fit the lock wire.
2. Fit the sealing ring with drift SVO 2430. Smear the contact surface of the carbon washer against the impeller wear ring with molybdenum disulphide mixed with mineral oil SAE 30. The molybdenum disulphide must be completely dry before fitting.
3. Make sure that the wear ring for the impeller is fitted properly and press on the impeller with SVO 2266 so far that the impeller lies evenly with or down to 0.4 mm (0.016") below the face of the pump body. The lower end of the shaft should be against a counterhold. See Fig. G4.
4. Turn the pump. Place a counterhold under the shaft end in the impeller hole and press on the hub with drift SVO 2266. Use for example puller SVO 2462 with centre bolt screw in as a counterhold so that it supports against the shaft. Carefully press so far that the measurement between the pulley face and that of the pump body will be 120 ± 0.2 mm (4.7 ± 0.008").
5. Check that the pump can be rotated by hand without too great resistance and that it does not catch.

Fitting the circulation pump

When fitting, make sure that the sealing rings on the top of the pump are not damaged and that they take up their proper position. Force in the water pipe carefully when attaching. Also press the pump upwards to the cylinder head extension while bolting in order to ensure fully satisfactory sealing between the pump and the cylinder head.

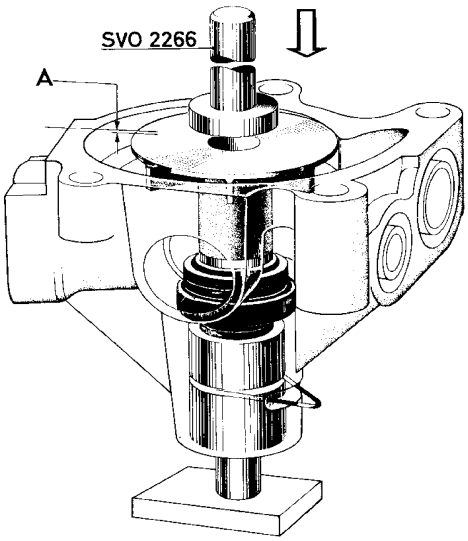


Fig. G4. Fitting the impeller

A = 0 to 0.4 mm (0.016")

Sea-water pump

1. Remove the cover from the sea-water pump. Look out for water which might come in. If the pump sealing rings are damaged or the flange broken (this can be checked by turning the pump gear), the pump should be removed from the engine and the damaged ports replaced. Use a new O-ring between the pump and the timing gear cover when the pump is fitted. N. B. The pump should be turned so that the drain hole comes downwards.
2. If the pump gear is damaged, it should be removed as follows:

   With the help of two screwdrivers bend the pump gear half-way out of the body. N. B. Place protection under the screwdrivers in order not to damage the body.

   4-cyl. engine: Unscrew the bolt securing the pump gear. Pull the pump gear from the shaft, clean the pump body, fit a new pump gear and tighten it with the bolt.

   6-cyl. engine: Pull the pump gear from the shaft.

   N.B. The pump gear is held in position by means of the key component. Take care that the key does not drop off. Clean round the pump body and fit a new pump gear.
3. Press the pump gear and shaft into the body and turn the pump gear until the shaft engages with the flange. Fit the cover with a new packing.

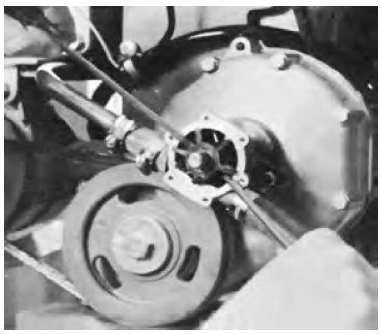


Fig. G 5. Removing the pump gear

Thermostat

The thermostat can be removed after the water distribution housing on the front end of the cylinder head has been taken off. Test the thermostat with heated water. The thermostat should open and close according to the values given in the ”Specifications”. A faulty thermostat should be scrapped. Use a new seal when fitting.

Oil cooler

The end cover of the oil cooler can be removed for any cleaning of the water ducts. Look out for possible water penetration (with the boat in the water). See also under ”Lubricating system”.

H. ELECTRICAL SYSTEM

DESCRIPTION

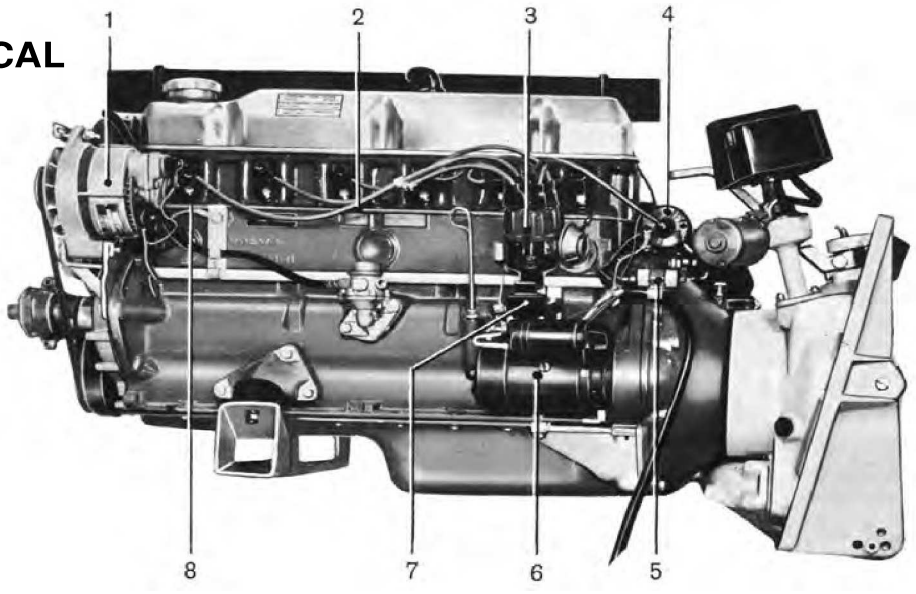


Fig. H1. Electrical system (6-cyl. engine)

1. Alternator
2. Ignition cables
3. Distributor
4. Ignition coil
5. Advance engaging resistor (6-cyl. engine)
6. Starter motor
7. Fuse
8. Spark plug (No. 1 cyl.)

The electrical system is of the battery ignition type with a voltage of 12V and especially designed and constructed for marine use. It consists of the following main parts: Ignition coil (with advance engaging resistor on 6-cyl. engine), distributor, ignition cables and ignition system. Service current is provided by an alternator for all engines except AQ105 and AQ115, which have a current and voltage controlled D.C. generator. The starter motor is a 4-pole series motor fitted with a sliding drive, which is actuated by a solenoid. To avoid damage to the electrical system through overloading, there is an easily accessible main fuse round which is wound spare fuse wire.

Warning

Never break the current circuit between the alternator and battery when the engine is running. This would immediately ruin the charging regulator diodes.

The main switch must not be switched off until the engine has stopped. See further under the heading "ALTERNATOR".

REPAIR INSTRUCTIONS

Starter motor

REPLACING THE CARBON BRUSHES

To replace the carbon brushes remove and disassemble the starter motor. Solder loose the brushes from their respective attachments in the brush holders and field winding. New brushes should be soldered on rapidly and with sufficient heat. Soldering tin may not run in to the brush cables since this will hinder the movement of the carbon brushes in the brush holders and can reduce the brush spring pressure. Carbon brushes shorter than 14 mm (9/16") should be replaced by new ones.

REMOVING AND DISASSEMBLING

1. Disconnect the battery leads from the battery.
2. Disconnect the cables from the starter motor.
3. Remove the bolts holding the starter motor to the flywheel casing and take off the starter motor.
4. Remove the small cover over the front shaft end.
5. Lift off the lock washer and adjusting washers.
6. Remove the two bolts holding the commutator bearing shield and take off the shield.
7. Lift the carbon brushes out of their holders.
8. Remove the brush bridge from the rotor shaft.

   N. B. The washers are according to Fig. H2. When the bridge is removed, the negative brushes also follow, but the positive brushes will remain in the field winding.

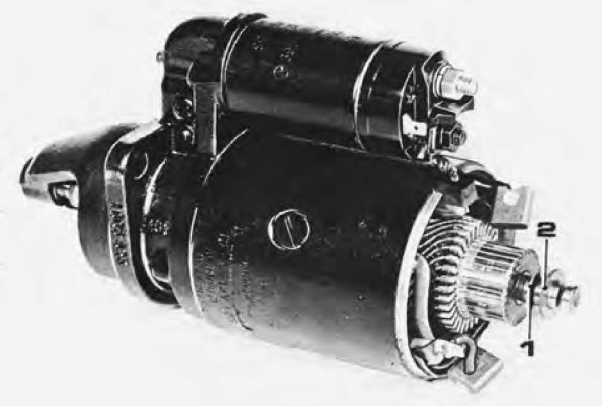


Fig. H2. Starter motor with brush bridge removed

1. Steel washer 2. Fibre washer

ASSEMBLING AND FITTING

1. Fit the washers on the rotor shaft according to Fig. G2.
2. Place the brush bridge in position. Fit the carbon brushes.
3. Fit the commutator bearing shield. Screw the starter motor together with the two through going bolts.
4. Place the adjusting washers and the lock washer on the shaft end. Check the axial clearance of the rotor. If necessary, adjust the number of washers until the clearance agrees with the values in the "Specifications".
5. Screw on the small cover over the shaft end.
6. Lift the starter motor into position and bolt it on securely.
7. Connect up the electrical cables.
8. Fit the cable terminals on the battery.

FOR A MORE COMPREHENSIVE OVERHAUL AND REPAIRS YOU ARE REFERRED TO AN AUTHORIZED SERVICE WORKSHOP

ALTERNATOR

In order for the alternator and its regulator to function satisfactorily, it is of the greatest importance that the following instructions are observed:

1. Never break the service circuit between the alternator and battery when the engine is running. This would cause short-circuiting immediately in the charging regulator, which would be ruined.
   Never switch off the main switch until the engine has stopped.
2. Do not mix up the terminal poles on the battery. One pole has a plus mark stamped on it and the other a negative mark. The negative pole should always be earthed to the engine frame.
   Use only the Volvo Penta double-diode kit for charging two batteries with a generator.
   With a twin installation, both the batteries must not be moved when any of the engines is running.
3. If an extra battery is used for starting, the following should be done:
   Allow the ordinary battery to be connected up. Connect up the extra battery to the ordinary battery, plus to plus and negative to negative. When the engine has started, remove the extra battery but under no circumstances must the circuit be broken to the ordinary battery.
4. Do not use a rapid charger unit when the generator is connected to the battery.
5. Always disconnect both battery cables before carrying out any work on the generator equipment.
6. If any welding is to be carried out on the engine or installation components, the cable for the charging regulator should be disconnected at the generator and should be insulated.
7. Check the belt tension and the cable connections regularly.

For description and servicing of the alternator, see Publ. No. 1814B.

REPLACING THE CARBON BRUSHES IN THE D.C. GENERATOR

For replacement of the carbon brushes, see the description given under "Starter motor". For more comprehensive overhaul and repairs, you are referred to an authorized service workshop.

DISTRIBUTOR

Replacing the contact breaker

The contact breaker can be replaced in the boat but should be done with the distributor removed by an authorized service workshop.

1 Remove the distributor rotor arm.
2. Remove the electrical lead at the primary connection.
3. Remove the screw for the contact breaker and lift up the old contacts.
4. Lubricate the distributor with some drops of engine oil on the drive shaft lubricating felt (1, Fig. H3) under the rotor. Also fill the lubricator (3) under the distributor with some drops of oil.
5. Fit the new contact breaker.
6. Connect the electrical lead at the primary connection.
7. Check that the contact breaker is located correctly both vertically and horizontally.
   Adjustment should be made with a suitable tool (for example, Bosch EFAW 57 A), but only the fixed contact may be bent. Wash the breaker contacts with trichlorethylene or chemically pure gasoline (petrol).
8. Adjust the contact gap. Turn the engine so that full breaking is obtained and check the contact gap (A), see the "Specifications". The gap is adjusted by turning the fixed contact (2) after the lock screw for the fixed plate has been slackened.

Disassembling

1. Take off the distributor cap and the vacuum hose (AQ165). Mark up the location of the distributor in the retainer. Slacken the retainer screw and lift up the distributor.
2. Pull off the distributor arm.

   Take off the circlip for the pull rod from the vacuum regulator (vacuum regulator only on AQ165). Remove the vacuum regulator (6, Fig. H4).
3. Disconnect the springs for the centrifugal governor and mark up how the breaker cam is located in relation to the distributor shaft. Secure the breaker cam in a vice with soft jaws. Carefully tap out the distributor housing with a plastic mallet until the circlip, 22, releases.
4. Remove the resilient ring, 13, and mark up how the driving collar, 14, is located in relation to the distributor shaft.

   Tap out the pin, 12, lift off the driving collar and pull up the distributor shaft.

   Check to make sure that no washers have been lost.
5. Remove the lock springs for the centrifugal weights and lift up the weights.

Inspecting the distributor plate

1. The surface of the contact breaker points should be flat and smooth. The colour of the contacts should be grey. Oxidized or burnt contacts must be replaced. After a long period of use, the contact lip can be worn and the spring fatigued, so that the contacts should be replaced if the distributor for any reason is disassembled.
2. The contact plate must not be loose, worn or have burr on.

Distributor shaft

1. The clearance between the distributor shaft and the breaker camshaft must not exceed 0.1 mm (0.004").
2. The cams on the breaker camshaft must not be scored or worn down so that the dwell angle is altered.
3. The holes in the centrifugal weights must not be oval or deformed in any other way.
4. The centrifugal weight springs must not be deformed or damaged.

Distributor housing

1. The clearance between the distributor housing and the shaft should not exceed 0.2 mm (0.008"). If the clearance is excessive, replace the bushes, and if this is insufficient, also the shaft.

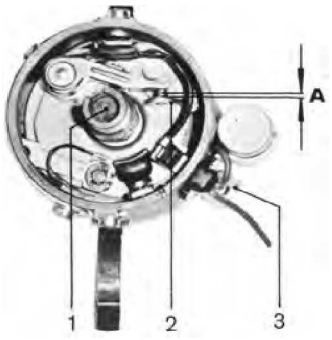


Fig. H 3. Distributor

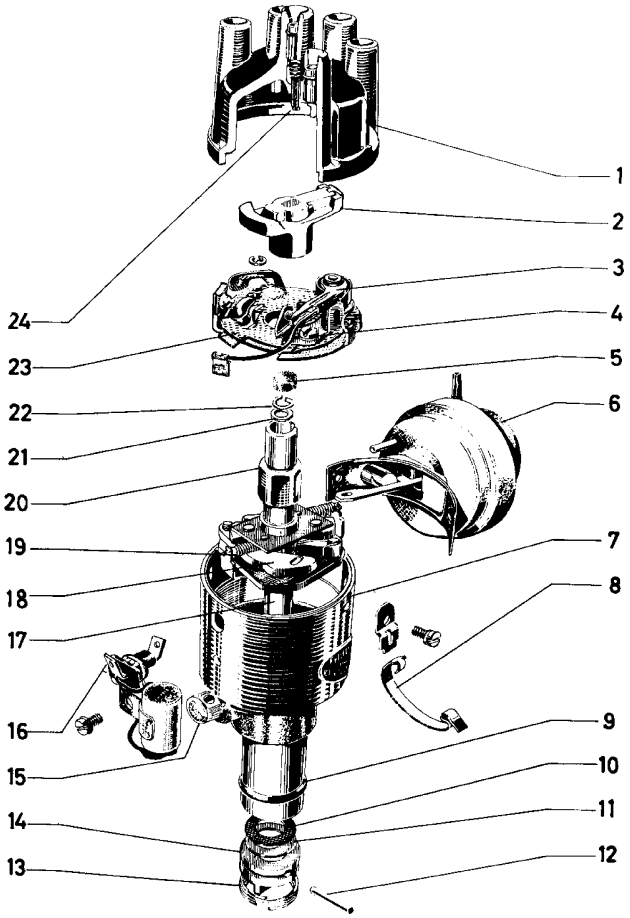


Fig. H4. Distributor

1. Distributor cap
2. Distributor arm
3. Contacts
4. Lock screw for breaker contacts
5. Lubricating felt
6. Vacuum regulator (AQ165)
7. Distributor housing
8. Cap clasp
9. Rubber seal
10. Fibre washer
11. Steel washer
12. Lock pin
13. Resilient ring
14. Driving collar
15. Lubricator
16. Primary connection
17. Distributor shaft
18. Centrifugal governor weight
19. Centrifugal governor spring
20. Breaker cam
21. Washer
22. Circlip
23. Breaker plate
24. Rod brush (carbon)

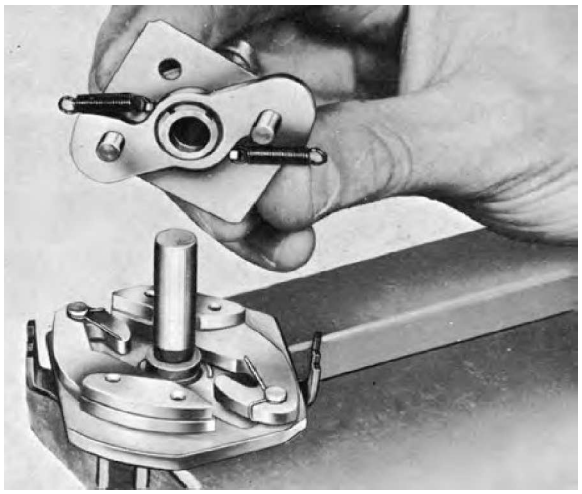


Fig. H5. Fitting the breaker cam

ASSEMBLING

1. Lubricate the movable parts of the distributor.
2. Fit the centrifugal weights and also the lock-springs on to the weights. Fit the breaker cam on the distributor shaft, Fig. H5. Hook the springs for the centrifugal governor. Install the washer and circlip for the breaker camshaft. The circlip can be fitted into position by means of a suitable sleeve. Fit the lubricating felt.
3. Install the distributor shaft in the distributor housing and fit the driving collar on the distributor shaft. Make sure that the fibre washers come up against the distributor housing. Put the pin in the collar and check the axial clearance on the distributor shaft. The clearance should be 0.1-0.25 mm (0.004-0.010"). Any adjustment can be done by altering the number of adjusting washers on the distributor shaft. Fit the resilient ring on to the driving collar.
4. Install the breaker plate. Fit the lock clamps for the cap. Fit the primary connection and connect the cable from the breaker contacts.
5. Fit the vacuum regulator and connect the pull rod for the breaker plate (AQ165).
6. Check that the breaker contacts are mounted correctly both horizontally and vertically. Adjustment should be made with a suitable tool (for example, Bosch EFAW 57 A), but only the fixed contact may be bent. Wash the breaker contacts with trichlorethylene or chemically pure gasoline (petrol).

   Run the distributor in a test bench and check the values according to the ”Specifications”.

Testing the distributor in test bench

1. Run the distributor in its ordinary direction of rotation (anti-clockwise) and adjust the contact breaker dwell angle according to the ”Specifications”.

   To adjust slacken the screw for the breaker contacts a little and then insert a screwdriver in the recess. Turn with the screwdriver until the dwell angle is the correct one.

   Then tighten securely the screw for the breaker contacts.

Fitting

1. Place the distributor in position.
2. Press down the distributor while turning the distributor arm at the same time. When the distributor goes down about 5 mm (3/16") and it is not possible to turn the distributor arm more, the driving collar of the distributor is then in the slot on the distributor drive.
3. Turn the distributor housing so that it has the same position it had before being removed. (See also under ”Basic setting, Specifications”.)
4. Connect up the primary cable. Fit on the distributor cap.
5. Start the engine and adjust the ignition.

Ignition setting

The ignition should always be set while the engine is running and with the help of a Stroboscope.

1. Clean the pulley or flywheel damper, whichever the case may be, in order to be to see the graduation marks, see Fig. H6.
2. Remove the hoses from the vacuum regulator (AQ165). (The hose to the intake manifold should be shut off, for example, by bending it or by plugging it with a suitable plug, so that unwanted air does not enter the engine.)
3. Connect up the Stroboscope to the spark plug for No. 1 cylinder and the battery.

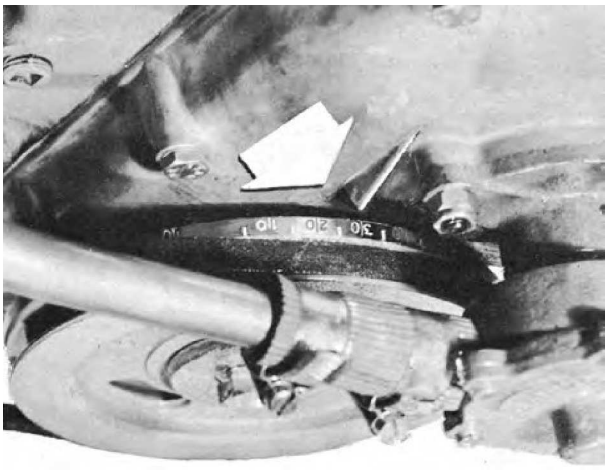


Fig. H6. Graduation for firing position (4-cyl. engine)

4. Start the engine and run it at the r.p.m. given in the "Specifications". Sight the Stroboscope on the graduation marking on the flywheel damper. Slacken the distributor and turn it until the firing position is the same as that given in the "Specifications". Securely tighten the distributor and make sure that the firing position and speed have not altered. Remove the Stroboscope and refit the hoses on the vacuum regulator (AQ165).

Ignition leads and spark plugs

The ignition leads have been specially made for marine use. Leads with embedded resistance should not be used. When replacing a spark plug, see the "Specifications".

Wiring diagram: Engine

Ignition coil and advance engaging resistor (AQ165, AQ170)

The ignition coil and advance engaging resistor are fitted on the engine body, see Fig. G1. The function of the advance engaging resistor is to protect the ignition coil from damage by heating, if the ignition coil is cut in and the engine is not running. In order to raise the ignition voltage at the moment starting takes place, the advance engaging resistor is by-passed when the starter motor is engaged. The ignition coil is actuated directly by the battery voltage via a contact on the starter motor, see wiring diagram. The advance engaging resistor has a resistance of 0.9 ohm.

Fusing

To avoid damage to the electrical system through overloading, there is an easily accessible main fuse, see Fig. H1, with reserve fuse wire wound round it.

Cable markings

Mark	Colour	sq. mm	AWG
A	Ivory	6	9
B	Black	1.5	15
B'	Black	0.6	19
B^+	Black	35	1
C	Red	6	9
C^+	Red	35	1
C^{++}	Red	4	11
C''	Red	0.6	19
D	Green	1.5	15
D^+	Green	0.6	19
E	Grey	1.5	15
F	Yellow	1.5	15
G	Brown	1.5	15
H	Blue	1.5	15
H'	Blue	4	11

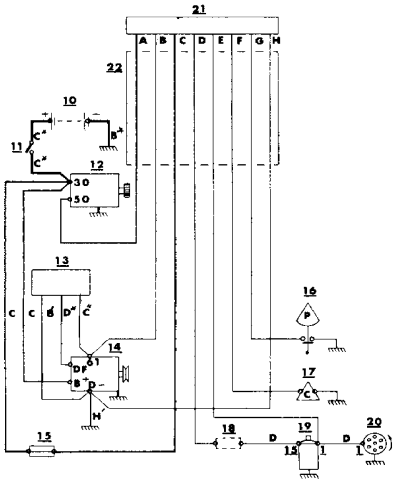


Fig. H7. 4-cyl. and 6-cyl. engines with alternator

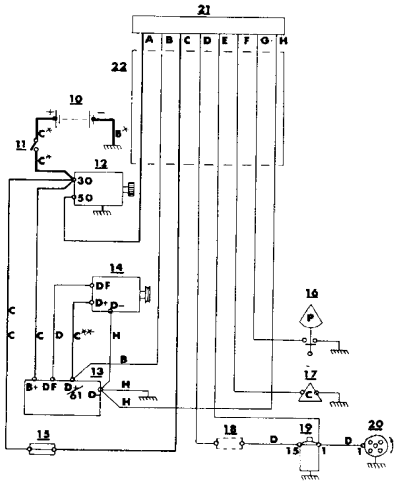


Fig. H8. 4-cyl. engine with D. C. generator

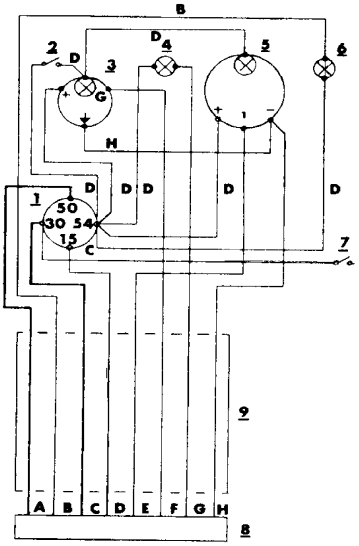


Fig. H9. Instrument panel (all engines)

Legend for Fig. H7, H8 and H9

1. Key switch with starter contact
2. Instrument lighting switch
3. Temperature gauge
4. Warning lamp for "low oil pressure"
5. Revolution counter
6. Charging control lamp
7. Extra switch
8. Connection terminal
9. Cable harness
10. Battery
11. Master switch

Legend for Fig. H7, H8 and H9

12. Starter motor
13. Charging regulator
14. Alternator (or D.C. generator)
15. Fuse
16. Oil pressure sender
17. Temperature sender
18. Advance engaging resistor
19. Ignition coil
20. Distributor
21. Connector
22. Cable harness

I. TEST RUNNING

When the engine has been newly reconditioned, a certain amount of care should always be observed during the first 20 hours of operation. Do not load the engine fully for more than short periods. Always follow the instructions given in the instruction book under the heading ”Running the unit”.

Control measures

1. Check the oil level in the engine and outboard drive. Use only Multigrade oil in the engine with grade Service MS and viscosity SAE 10 W/30 or 20 W/40. Concerning the oil grade for the outboard drive, see the respective instruction book.
2. Lubricate all lubricating points in accordance with the instruction book.
3. Start the engine but do not let the speed exceed about 1500 r.p.m. Immediately after starting, check that the warning lamps for charging and oil pressure are not lighted. If oil pressure is not obtained within 30 seconds, the engine should be immediately stopped for attention.
4. Check the water circulation in the engine by feeling the exhaust elbow and the sea-water pump which should not be abnormally hot.
5. Run the engine warm at rapid idle for about 15 minutes with the gear of the drive engaged. Check to make sure that the instruments are functioning properly.
6. Examine and attend to the engine with regard to any leakage of water, oil, air, fuel or exhaust gases.
7. Check-tighten all hose clamps and bolts and nuts for the oil sump, timing gear casing, exhaust manifold and intake manifold.
8. Check-tighten the cylinder head bolts with a torque wrench. (See ”Fitting the cylinder head”, page 17.)
9. Adjust the valve clearance. (See page 17.)
10. Check, and if necessary adjust, the function of the speed and operating controls also the engine idling speed, carburetor setting and the tension of the drive belts.
11. Check the ignition setting with the help of a stroboscope. (See page 40 and ”Specifications”)
12. After an operating time of 20 hours, the oil filter and lubricating oil should be changed. Also carry out all control points given under ”Free service inspection ” in the guarantee certificate.

Special tools

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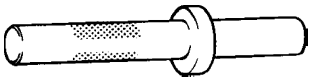

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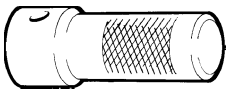

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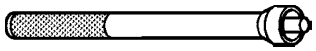

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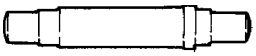

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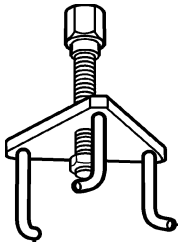

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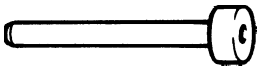

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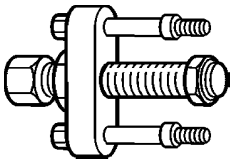

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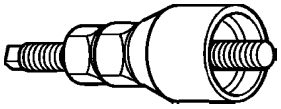

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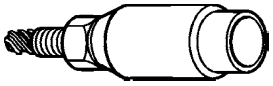

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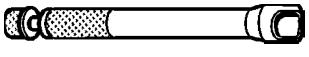

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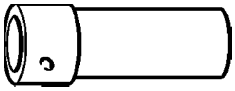

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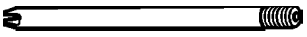

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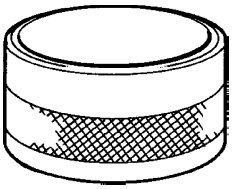

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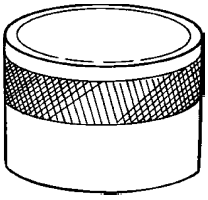

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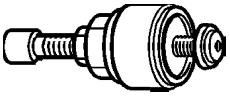

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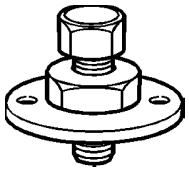

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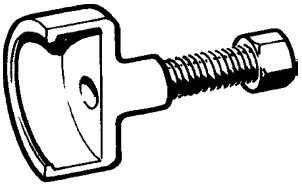

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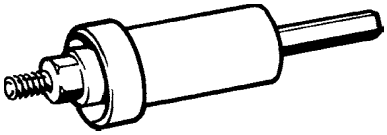

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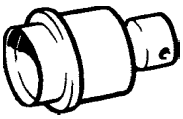

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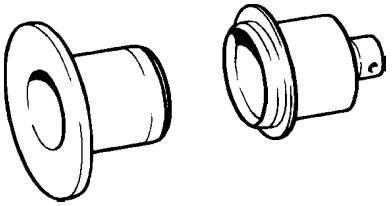

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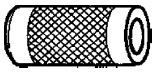

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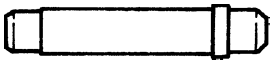

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Location list, see next page.

Location list for special tools, see previous page.

NOTE! In the workshop manual the tool is given a four digit SVO no, for example SVO 1426. When ordering the tool the complete number is provided by adding 999, for example 9991426.

Pos.	SVO No.	Description	Engine No. of cyl.
1	884306	Drift for fitting valve seat	4
2	884347	Drift for fitting and removing bearings, water pump	6
3	9991426	Drift for fitting pilot bearing in flywheel	4 and 6
4	9991867	Drift for removing and fitting bush in rocker arm and connecting rod	4 and 6
5	9992250	Puller for camshaft drive	4 and 6
6	9992266	Drift for removing and fitting hub and impeller, water pump	6
7	9992405	Puller for crankshaft gear	4
8	9992407	Press tool for fitting crankshaft gear	4
9	9992408	Press tool for fitting camshaft gear	4 and 6
10	9992424	Grip tool for removing and fitting valve lifters	4 and 6
11	9992429	Press washer for removing impeller, water pump	6
12	9992430	Drift for fitting seal, water pump	6
13	9992435	Dowels (2) for fitting cylinder head	4 and 6
14	9992438	Centering sleeve for timing gear cover and fitting felt ring circlip	4
15	9992439	Centering sleeve for rear sealing flange and fitting felt ring circlip	4
16	9992440	Puller for crankshaft hub	4
19	9992462	Puller for hub, water pump	6
17	9992520	Stand excluding fixture	4 and 6
18	9992521	Fixture for 2520	4
20	9992814	Puller for polygon hub	6
21	9992815	Press tool for fitting crankshaft drive and polygon hub	6
22	9992816	Drift for fitting crankshaft seal on engine front end	6
23	9992817	Drift for fitting crankshaft seal on engine rear end	6
24	9992818	Drift for removing valve guide	4
27	9992819	Drift for fitting valve guide	4
25	9992820	Fixture for 2520	6
26	9992822	Puller for crankshaft drive	6
28	9992823	Ring for fitting standard piston	4
29	9994090	Puller for crankshaft pilot bearing	4 and 6
30	9995017	Drift for removing and fitting bush in rocker arm and connecting rod	4 and 6

Specifications

Aquamatic, engine version	AQ105A	AQ115A	AQ130A	AQ130B	AQ130C	AQ165A	AQ170A AQ170B,C
Max. output, h p. (SAE)	105	115	130	115	130	165	170
Max. engine speed r.p.m.	5100 [1]	5100 [1]	5100 [1]	5100 [1]	5100 [1]	5000	5000
Compression ratio	9, 5:1	9, 5:1	9, 5:1	8, 4:1	9, 5:1	9, 2:1	9, 5:1
Compr. pressure (at starter motor speed 200 r.p.m.) kg/cm² (lb./sq.in)	11–13 (155–185)	12–14 (170–200)	12–14 (170–200)	10–12 (145–170)	12–14 (170–200)	10–12 (145–170)	12–14 (170–200)
Number of cylinders	4	4	4	4	4	6	6
Bore, mm (in.)	88.90 (3.50)	88.90 (3.50)	88.90 (3.50)	88.90 (3.50)	88.90 (3.50)	88.90 (3.50)	88.90 (3.50)
Stroke, mm (in.)	80.0 (3.15)	80.0 (3.15)	80.0 (3.15)	80.0 (3.15)	80.0 (3.15)	80.0 (3.15)	80.0 (3.15)
Capacity, liters (cu.in.)	1.986 (121)	1.986 (121)	1.986 (121)	1.986 (121)	1.986 (121)	2.979 (182)	2.979 (182)
Weight, incl. elec. equipment, carburetor, approx. kg (lb.)	180 (396)	180 (396)	180 (396)	180 (396)	180 (396)	220 (485)	220 (485)
Idling speed, r.p.m.	900–1000	900–1000	900–1000	900–1000	900–1000	800–900	900–1000
Cylinder block							
Material	Special alloy cast iron						
Bore, nominal, standard mm (in.)	88.90–88.92 mm (3.50–3.508") [2]						
Bore, 0.030" oversize mm (in.)	89.66–89.68 mm (3.529– 3.530") [2]						
Bore, standard D-marked	88.91–88.92 mm (3.5004–3.5008") [4]						
Bore, oversize 0.37 mm (0.015")	89.295 mm (3.5155") [4]						
Bore, oversize 0.75 mm (0.030")	89.675 mm (3.5305") [4]						
Pistons							
Material	Light-alloy						
Permissible weight deviation between pistons in the same engine, g (oz.)	10 (0.35)						
Height, overall, mm (in.)	71.0 (2.79)						
Weight standard, g (oz.)	495–505 (19.48–19.88)						
	502–512 (19.74–20.14) [3]						
Height, piston pin centre – piston crown, mm (in.)	46 (1.81)						
Piston clearance	0.02–0.04 (0.0008–0.0016)						
(Piston diameter should be measured 7 mm (0.28") from the lower edge.)	0.04–0.06 (0.0016–0.0024) [2]						
	0.01–0.03 (0.0004–0.0012) [4]						
Piston rings							
Piston ring gap, mm (in.)	0.40–0.55 (0.0158–0.0217)						
Piston ring oversize	0.030"						
Compression rings							
Marked "TOP". Top ring chromed.							
Number on each piston	2						
Height, mm (in.)	1.98 (0.078)						
Piston ring clearance in groove, mm (in.)	0.045–0.072 (0.0018–0.0028)						
Oil scraper rings							
Number on each piston	1						
Height, mm (in.)	4.74 (0.186)						
Piston ring clearance i groove, mm (in.)	0.045–0.072 (0.0018–0.0028)						
Piston pins							
Floating fit. Circlips at both ends in piston							
Fit:							
In connecting rod	Close running fit						
In piston	Push fit						
Diameter, standard, mm (in.)	22.00 (0.866)						
	24.00 (0.945) [4]						
0.05 mm (0.002") oversize, mm (in.)	22.05 (0.868)						
	24.05 (0.947) [4]						

[1] In light boats with a speed exceeding 30 knots (35 miles) the maximum speed of the 4-cyl. engine may reach 5500 r.p.m.

[2] AQ115 to no 86908
AQ130 to no 87512
AQ170 to no 87712

[3] AQ105A-130A from no 5929, AQ165A-130A from no 1379
AQ130C, AQ170A,B,C, BB115B, BB170B, MB20B

[4] AQ115A from no xxxx/86909
AQ130C from no xxxx/87513
AQ170B from no xxxx/87713
AQ170C
BB1158 from no 97175
BB170B from no xxxx/89353
BM20B from no xxxx/86638

	AQ105A	AQ115A	AQ130A	AQ130B	AQ130C	AQ165A	AQ170A AQ170B,C
Cylinder head							
Height, measured from cylinder head contact face to face for bolt heads, mm (in.)				86.7 (3.413)			
Cylinder-head gasket, thin mm (in.)				0.8 (0.0315) [2]			
Cylinder-head gasket, thick mm (in.)				2.5 (0.098) [2]			
Crankshaft							
Crankshaft, end float, mm (in.)				0.047–0.138 (0.0019–0.0054)			
Main bearings, radial clearance mm (in.)				0.028–0.079 (0.0011–0.0031)			
Big-end bearings, radial clearance mm (in.)				0.029–0.071 (0.0011–0.0028)			
Main bearing journals							
Diameter, standard, mm (in.)				63.451–63.464 (2.4981–2.4986)			
0.010" undersize, mm (in.)				63.197–63.210 (2.4881–2.4886)			
0.020" undersize, mm (in.)				62.943–62.956 (2.4781–2.4786)			
Width on crankshaft for pilot bearing shell (”A” Fig. C6)							
Standard, mm (in.)				38.930–38.970 (1.5327–1.5343)			
Oversize 1(0.010" undersize shell), mm (in.)				39.031–39.072 (1.5367–1.5736)			
Oversize 2 (0.020" undersize shell), mm (in.)				39.133–39.173 (1.5407–1.5422)			
Main bearing shells							
Thickness, standard, mm (in.)				1.985–1.991 (0.0781–0.0784)			
0.010" undersize, mm (in.)				2.122–2.118 (0.0831–0.0834)			
0.020" undersize, mm (in.)				2.239–2.245 (0.0881–0.0884)			
Big-end bearing journals							
Width of bearing recess, mm (in.)				31.950–32.050 (1.2579–1.2618) [3] 29.95–30.05 (1.1791–1.1831) [4]			
Diameter, standard, mm (in.)				54.099–54.112 (2.1299–2.1304) [3] 53.987–54.000 (2.1255–2.1360) [4]			
0.010" undersize, mm (in.)				53.845–53.858 (2.1199–2.1204) [3]			
0.020" undersize, mm (in.)				53.591–53.604 (2.1099–2.1104) [3]			
undersize 0.25 mm (0.010")				53.733–53.746 (2.1155–2.1160) [4]			
undersize 0.50 mm (0.020")				53.479–53.492 (2.1055–2.1060) [4]			
Big-end bearing shells							
Thickness, standard, mm (in.)				1.833–1.841 (0.0722–0.0725) [3]			
0.010" undersize, mm (in.)				1.960–1.968 (0.0772–0.0725) [3]			
0.020" undersize, mm (in.)				2.087–2.095 (0.0822–0.0825) [3]			
Thickness, standard, mm (in.)				1.978–1.988 (0.0780–0.0783) [4]			
Oversize 0.25 mm (0.010")				2.105–2.115 (0.0829–0.0833) [4]			
Oversize 0.50 mm (0.020")				2.232–2.242 (0.0879–0.0883) [4]			
Connecting rods							
End float on crankshaft, mm (in.)				0.15–0.35 (0.006–0.014)			
Length, centre – centre, mm (in.)				144.9–145.1 (5.706–5.714)			
Max. permissible wt. deviation between connecting rods in the same engine, g (oz.)				6 (0.21)			
Flywheel							
Max. permissible axial throw, mm (in.)				0.05 (0.002) at a diameter of 150 (5.906)			
Ring gear (chamfer facing forwards), teeth				142		153	
Flywheel housing							
Max. axial throw for rear face, mm (in.)				0.05 (0.002) at a diameter of 100 (3.937)			
Max. radial throw for rear guide, mm (in.)				0.15 (0.006)			

[1] AQ 130B 2.5 mm

[2] Engines equiped with thick cylinder-head gasket is only marketed in countries where there is no premium petrol (gasoline) with an octane rating of at least 97 (Research Method).

[3] AQ115 to no 86908
AQ130 t.o no 87512
AQ170 to no 87712

[4] AQ115A from no xxxx/86909
AQ130C from no xxxx/87513
AQ170B from no xxxx/87713
AQ170C
BB1158 from no 97175
BB170B from no xxxx/89353
MB20B from no xxxx/86638

Camshaft	AQ105A	AQ115A	AQ130A	AQ130B	AQ130C	AQ165A	AQ170A AQ170B,C
Marking	C						
Number of bearings	3					4	
Front bearing journal, mm (in.)	46.975–47.000 (1.8494–1.8504)					46.975–47.000 (1.8494–1.8504)	
Centre bearing journal, mm (in.)	42.975–43.000 (1.6919–1.6929)					46.975–47.000 (1.8494–1.8504)	
Rear bearing journal, mm (in.)	36.975–37.000 (1.4557–1.4567)					46.975–47.000 (1.8494–1.8504)	
Radial clearance, mm (in.)	0.020–0.075 (0.0008-0.0030)						
End float, mm (in.)	0.020–0.060 (0.0008-0.0024)						
Valve clearance for check of camshaft setting (cold engine), mm (in.)	1.45 (0.057)						
Intake valve should then open at, ° T.D.C.	0						
Camshaft bearings							
Front bearing, mm (in.)	47.020–47.050 (1.8512–1.8524)					47.020–47.050 (1.8512–1.8524)	
Centre bearing, mm (in.)	43.025–43.050 (1.6939–1.6949)					47.020–47.050 (1.8512–1.8524)	
Rear bearing, mm (in.)	37.020–37.045 (1.8512–1.8524)					47.020–47.050 (1.8512–1.8524)	
Timing gears							
Crankshaft drive, teeth	21						
Camshaft gear, teeth	42						
Backlash, mm (in.)	0.04–0.08 (0.0016–0.0032)						
End float, camshaft, mm (in.)	0.20–0.06 (0.0008–0.0024)						
Valves							
Intake							
Valve head diameter, mm (in.)	42 (1.65)						
Stem diameter, mm (in.)	7.955–7.970 (0.3132–0.3138)						
Valve seat angle, °	44.5						
Seat angle in cylinder head, °	45						
Seat width in cylinder head, mm (in.)	2 (0.079)						
Clearance both warm and cold engine, mm (in.)	0.50–0.55 (0.020–0.022)						
Exhaust [2]							
Valve head diameter, mm (in.)	35 (1.38)						
Stem diameter, mm (in.)	7.925–7.940						
Valve seat angle, °	44,5						
Seat angle in cylinder head, °	45						
Seat width in cylinder head, mm (in.)	2 (0.079)						
Clearance, both warm and cold engine, mm (in.)	0.050-0.55 (0.020-0.022)						
Valve guides							
Length, exhaust, mm (in.)	59 (3.32)						
intake, mm (in.)	52 (2.05)						
Inner diameter, mm (in.)	8.000–8.022 (0.3150–0.3158)						
Height above upper face of cylinder head, mm (in.)	17.5 (0.6890)						
Clearance, valve stem-guide, intake, mm (in.)	0.030–0.067 (0.0012–0.0022)						
exhaust, mm (in.)	0.060–0.097 (0.0024–0.0038)						
Valve springs							
Length, unloaded, approx., mm (in.)	46 (1.81)					45 (1.77) [1]	
With load of 23.5-27.5 kp (51.4-61.020 lb) mm (in.)	40 (1.57)					39 (1.54) [1]	
With load of 62.5-69.5 kp (137.8-193.2 lb), mm (in.)	30 (1.18)					30.5 (1.20) [1]	

[1] From and including engine number. 1846, see 4 cylinder engine

[2] Pressed in exhaust valves withdrawn from and including engine no.;
AQ 115A, AQ130A, AQ130C, no. 15302/xxxx
AQ130B, MB20A, BB115A, no. 1401/xxxx
AQ170A, BB170A, no. 5923/xxxx

	AQ105A	AQ115A	AQ130A	AQ130B	AQ130C	AQ165A	AQ170A AQ170B,C
Lubricating system							
Oil capacity, including oil filter, l	3.75 (6 1/2 Imp pints = 8 US pints)					6.0 (3.4; 2.8)	
excluding oil filter, l	3.25 (5 ¾ Imp pints = 7 US pints)					5.2 (3.0; 2.5)	
Oil pressure at 2000 r.p.m. (with warm engine and new oil filter), kp/cm² (lb. /sq. in.)	2.5–6.0 (35.56–85.34)						
Oil grade	Multigrade oil Service MS						
Oil viscosity	SAE 10W-30 alt. 20W-40						
Oil filter							
Type	Full-flow filter						
Oil pump							
Type	Gear						
Number of teeth on each gear	9						
End float, mm (in.)	0.02–0.10 (0.0008–0.0040)						
Radial clearance. mm (in.)	0.08–0.14 (0.0032–0.0055)						
Backlash, mm (in.)	0.15–0.35 (0.0060–0.0140)						
Relief valve spring (in oil pump)							
Length, unloaded, mm(in.)	39.0 (1.54)						
Length, loaded with 4.6-5.4 kp (10.1-11.9 lb.), mm (in.)	26.3 (1.04)						
Length, loaded with 6.2-7.8 kp (13.6-17.2 lb.), mm (in.)	21.0 (0.83)						
Fuel system							
Fuel pump							
Type	Diaphragm pump						
Make	Pierburg: PE15572						
Fuel pressure, measured at same level as pump kp/cm² (p. s. i.)	0.22 (3.2)						
Carburetors							
No. of carburetors	1	1	2	2	2	3	3
AQ115A, AQ130C, AQ170A,B,C							
Type	Down-draught carburetors						
Make and designation	Solex 44 PAI						
Main jet	145						
Idling jet		55			70		70
Emulsion jet		145 E5			190 E5		210 E5
Pump jet	70						
Needle seating	2						
AQ105A, AQ130A,B, AQ165A							
Type	Horizontal carburetors						
Make and designation							
Zenith-Stromberg	150CD		175CDSE			175CDSE	
Metering needle marked	8B		3D			2AA	

[1] From and including engine no. 1846, see 4 cylinder engine

	AQ105A	AQ115A	AQ130A	AQ130B	AQ130C	AQ165A	AQ170A AQ170B,C
Float level (”A” Fig. F5), mm (in.)	17–18 (0.67–0.71)		15–17 (0.59–0.67)			15–17 (0.59–0.67)	
Float level (”B” Fig. F5), mm (in.)	14,5 (0.5716)		11,0 (0.4331)			11,0 (0.4331)	
Float needle valve, mm (in.)	2 (0.08)		1.5 (0.06)			1.5 (0.06)	
Washer thickness under float needle valve, mm (in.)	1.0 (0.04)		1.6 (0.06)			1.6 (0.06)	
Air valve spring colour marking	Red		Blue			Uncoloured	
Air valve spring coil thickness, mm (in.)	1.0 (0.040)		0.9 (0.036)			0.8 (0.032)	
Oil for damper	Same as in engine						
BATTERY							
Earthed	Negative terminal						
Voltage, V	12						
Battery capacity, standard, Ah	60						
Specific gravity of electrolyte:							
Fully charged battery, g/cm³	1.275–1.285						
When charging is necessary, g/cm³	1.230						
Recommended charging current, A	4.5						
DYNAMO/ALTERNATOR							
Type, Bosch	LJ/6EH 90/12	1800FR20	S.E.V. Motorola				
Voltage, V	12						
Rated output, W	90		450				
Max. current, A	7.5		38				
Earthed	Negative terminal						
Direction of rotation	Clockwise						
STARTER MOTOR							
Type, Bosch	Bosch 0 0001 311 032						
Voltage, V	12						
Earthed	Negative terminal						
Direction of rotation	Clockwise						
Output, hp	Approx. 1						
IGNITION SYSTEM							
Order of firing	1-3-4-2					1-5-3-6-2-4	
Spark plug type	Bosch W 225T35 or corresponding						
Spark plug gap, mm (in.)	0.7 (0.028)						
DISTRIBUTOR							
Type Bosch	0 231 153 012					0 231 152 060 0 231 121 008 [3]	
Dwell angle, °	59–65					37–43	
Breaker points, gap, mm (in.)	0.40-0.50 (0.016-0.020)					0.25–0,35	
Basic setting °, BTDC	9			12		12 (15[1])	
Stroboscope setting (2000 r.p.m.), °	22–24	24–26	27–29	26–28	27–29	22–24[2] 28–30[1]	25–27 32–34 [3] 28–30 [1]
COOLING SYSTEM							
Thermostat Type	Bellows thermostat						
Marked	54					55	
Börjar öppna vid, °C	51–56 (124–133)					53–56 (127–133)	
Fully open at, °C (°F)	67 (153)					66–70 (151–158)	

[1] AQ165-170A, engines equipped with thick cylinder-head gasket.
[2] AQ165A, with vacuum governor uncoupled.
[3] AQ170C

Wear tolerances	AQ105A	AQ115A	AQ130A	AQ130B	AQ130C	AQ165A	AQ170A AQ170B,C
Cylinders							
To be rebored when wear amounts to (if engine has abnormal oil consumption, mm (in.)				0.25 (0.010)			
Cranckshaft							
Max. permissible out-of-round on main bearing journals, mm (in.)				0.05 (0.0020)			
Max. permissible out-of-round on big-end bearing journals, mm (in.)				0.07 (0.0028)			
Max. crankshaft end float, mm (in.)				0.15 (0.0060)			
Valves							
Max. permissible clearance between valve stem and valve guide, mm (in.)				0.15 (0.0060)			
Max. permissible wear, valve stem, mm (in.)				0.02 (0.0008)			
Camshaft							
Permissible out-of-round (with new bearings), max., mm (in.)				0.07 (0.0028)			
Bearings, permissible wear, max., mm (in.)				0.02 (0.0008)			
Timing Gears							
Permissible backlash max., mm (in.)				0.12 (0.0048)			
Tightening torques, kpm (ft.lb.)							
Cylinder head				9	(65)		
Main bearings				12.5	(90)		
Big-end bearings				5.5	(40)		
Flywheel				5	(35)		
Spark plugs				4	(30)		
Camshaft nut				13–15	(95–108)		
Bolt for crankshaft belt pulley				7–8	(51–58)		
Nipple for oil filter 4.5-5.5				(38–40)			
Oil sump bolts				1.0–1.2	(7.3–8.7)		
Tensioning ring – flywheel casing				3.5	(25)		
Nut, oil cooler 3.0-3.5				(21.7–25.3)			
Centre bolt, oil cooler				1.2-1.4	(8.7–10.1)		
V-belt A. C. generator approx.				1.5 [1], 1.7 [2]	(10.85 [1] 12. 30 [2])		
V-belt D. C. generator approx.				0.9	(6.51)		

[1] AQ130A-C
[2] AQ165A-170A
[4] AQ115A from no xxxx/86909
AQ130C from no xxxx/87513
AQ170B from no xxxx/87713
AQ170C
BB1158 from no 97175
BB170B from no xxxx/89353
MB20B from no xxxx/86638