Workshop Manual

Engine Unit

C
2(0)

AQ125A, B
AQ145A, B

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.

⚠ 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 AQ125A, B – AQ145A, B. 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. 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.

Repair instructions

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.

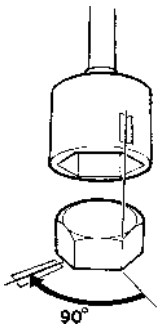
Bear in mind that most chemicals used on boats are harmful to the environment if used incorrectly. Volvo Penta recommends the use of biodegradable degreasing agents for cleaning engine components, unless otherwise stated in a workshop manual. Take special care when working on-board, that oil and waste 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	6	4.4
M6	10	7.4
M8	25	18.4
M10	50	36.9
M12	80	59.0
M14	140	103.3

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 trengths, 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.

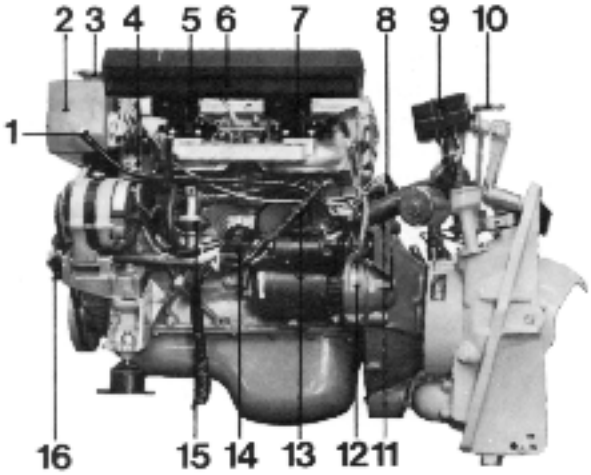
Two different basic types of agent are used on the engine and these are:

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. Old sealant can be removed using methylated spirits in all cases.

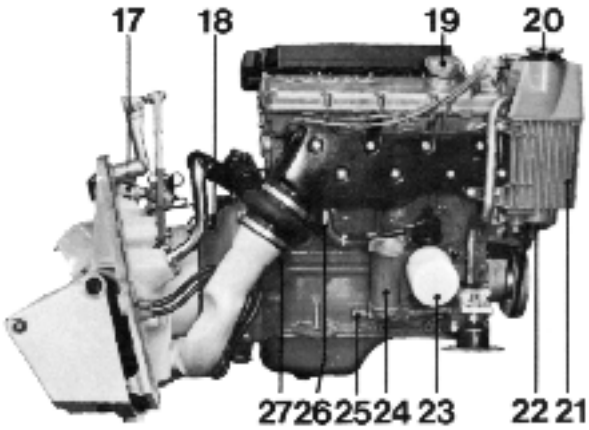
Anaerobic agents. These agents cure in an absence of air. They are used when two solid parts, for example cast components, are installed face-to-face without a gasket. They are also commonly used to secure plugs, threads in stud bolts, cocks, oil pressure switches and so on. The cured material is glass-like 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.

Presentation

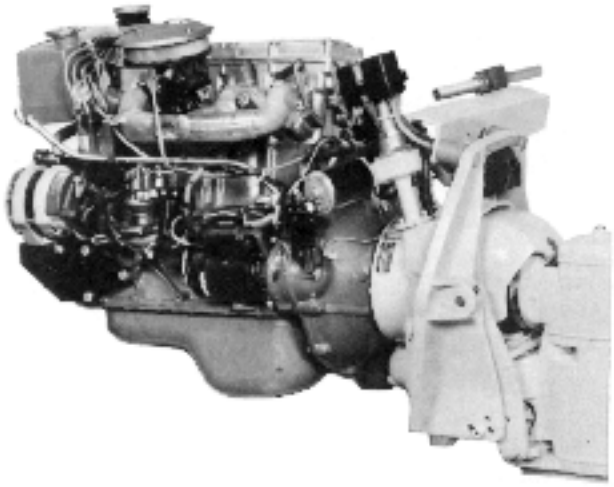
AQ145A



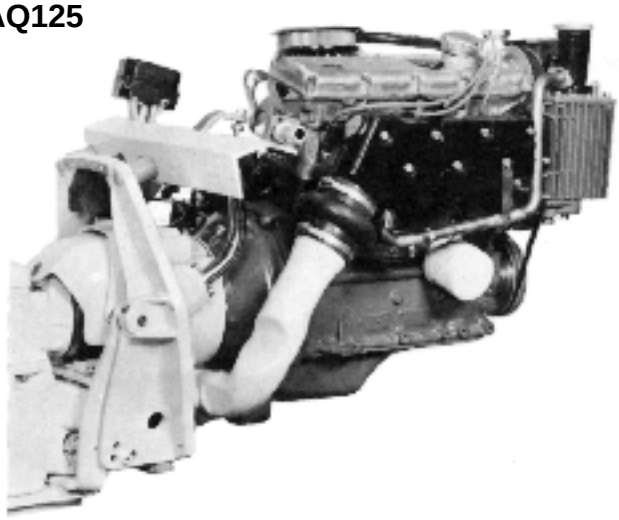
AQ145A



AQ125



AQ125

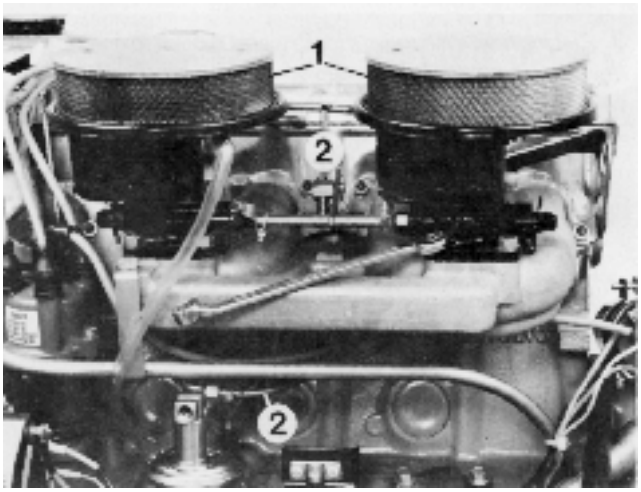


1. Oil dipstick
2. Fresh water tank
3. Filler cap, checking, fresh water
4. Distributor
5. Carburettor, front (AQ125 has only one)
6. Intake air silencer
7. Carburettor, rear
8. Ignition coil
9. Electro-mechanical lift device
10. Steering arm
11. Fuse box (exec. USA)
12. Serial number
13. Fuse (exec. USA)
14. Fuse (not USA)
15. Fuel pump
16. Sea water pump
17. Grease joint, upper steering shaft journal
18. Grease joint, drive shaft journal
19. Oil filler cap engine
20. Water filter
21. Heat exchanger
22. Draining, sea water
23. Luboil filter
24. Oil cooler (only AQ145A)
25. Draining, sea water
26. Draining, sea water
27. Draining, fresh water

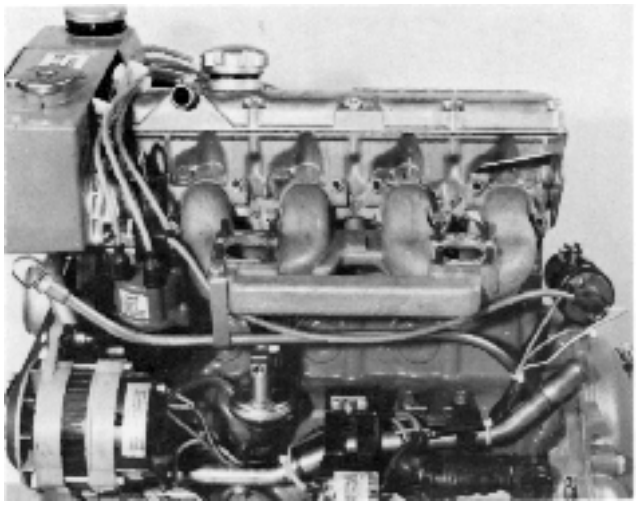
Repair Instructions

1. AQ145. Remove the four screws and pull the induction silencer to one side so that it comes free from the evacuation tube (1). AQ125. Remove the cover.

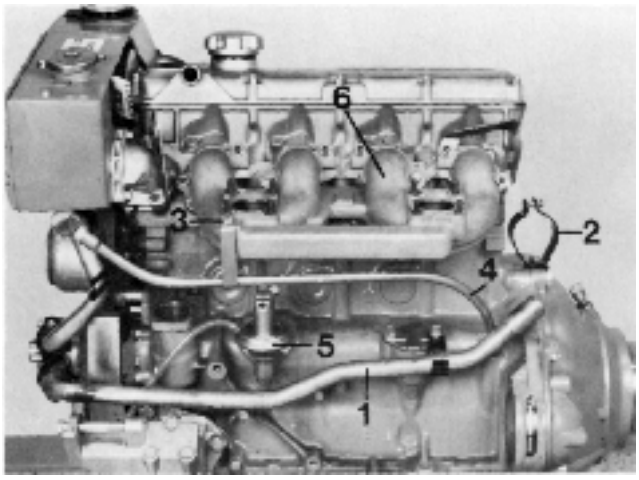
2. Remove the air filters (1), the fuel pipe (2) between the feed pump and the carburetors and unscrew the carburetors from the induction pipe. AQ125 has only one carburetor.



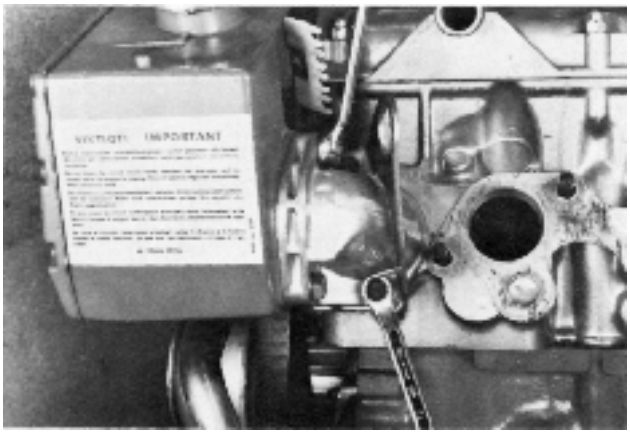
3. Remove the alternator, drive belt, cable harness, ignition coil, main fuse, starter motor, ignition cables and distributor. NOTE! Mark the cables before they are removed.



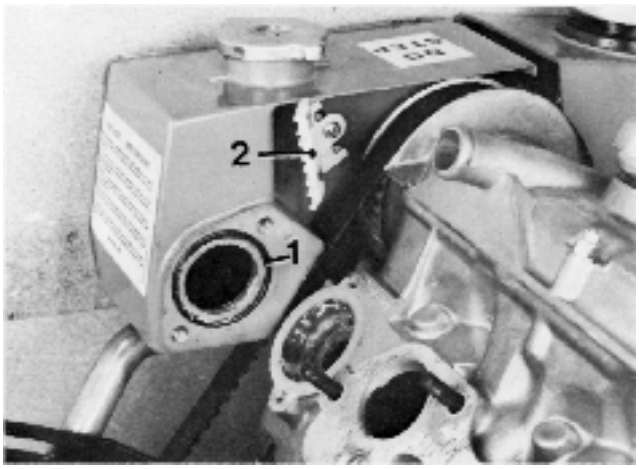
4. Remove the cooling water pipe (1), and the bracket for the ignition coil (2). Remove the screw (3) and draw up the dip stick with its tube (4). Then remove the feed pump (5) and the induction pipe (6). NOTE! There are double gaskets plus an intermediate washer on the feeder pump. There is a lifting eye in the induction pipes rear screws. There are no washers under the lifting eye.



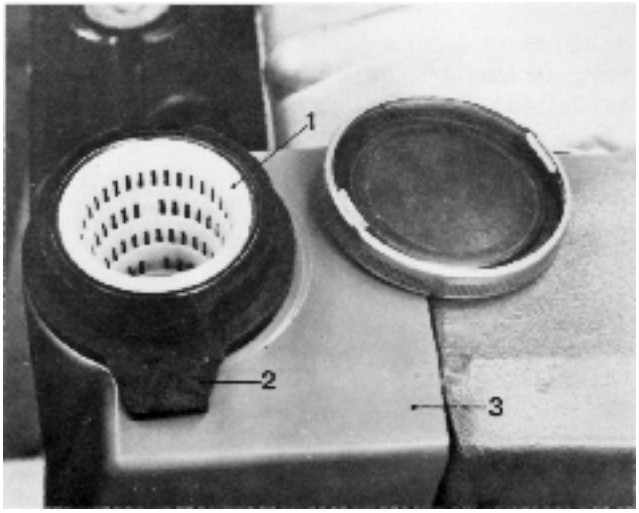
5. Remove the thermostat housing and lift out the thermostat.
NOTE! The forward lifting eye is screwed onto the thermostat housing.



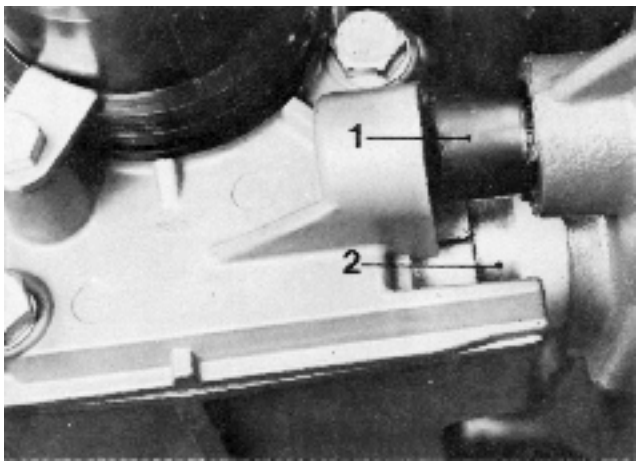
6. Remove and discard the O-ring (1) in the heat exchanger and if necessary, unscrew the holder (2) for the ignition cables. The holder is fixed with two guide pins.



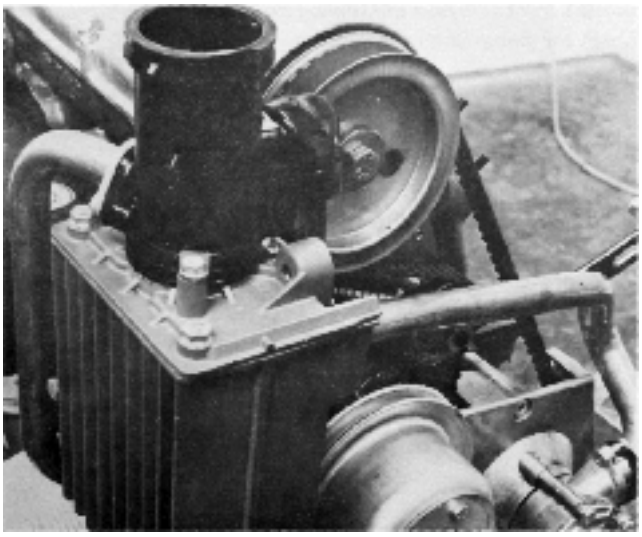
7. Remove the cap and lift out the strainer (1) from the heat exchanger. Then pull up the rubber ring's tongue (2). The tongue is marked "UP". The cover (3) is now loose and can be lifted up. (Not on AQ125.)



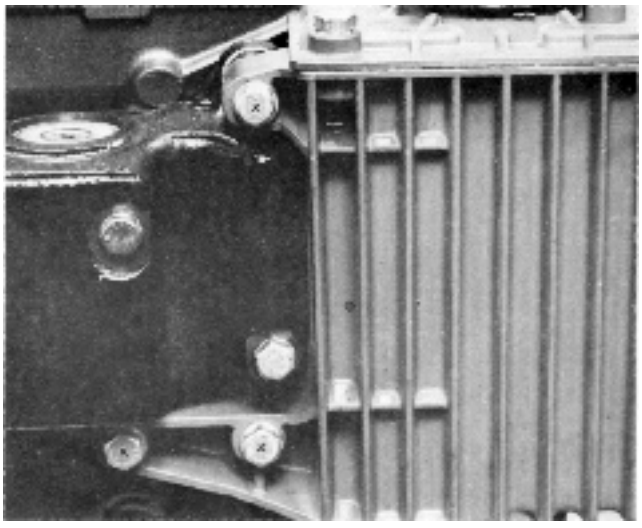
8. Pull the heat exchanger's fresh water section to one side. The fresh water section is mounted on a rubber bushing (1) and the water pipe (2), which seals against an O-ring.



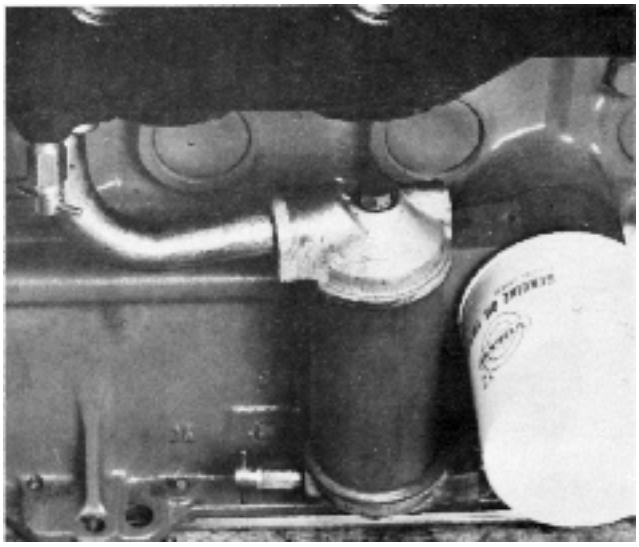
9. AQ145. Remove the cooling water pipes between the seawater pump and the heat exchanger and between the heat exchanger and the oil cooler. (Between the heat exchanger and the exhaust pipe on AQ125.)



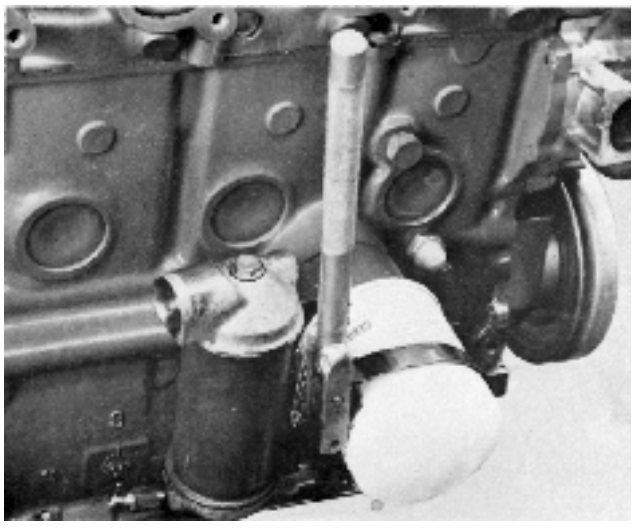
10. Remove the remaining three screws (X) on the heat exchanger and draw it to one side from the circulation pump.



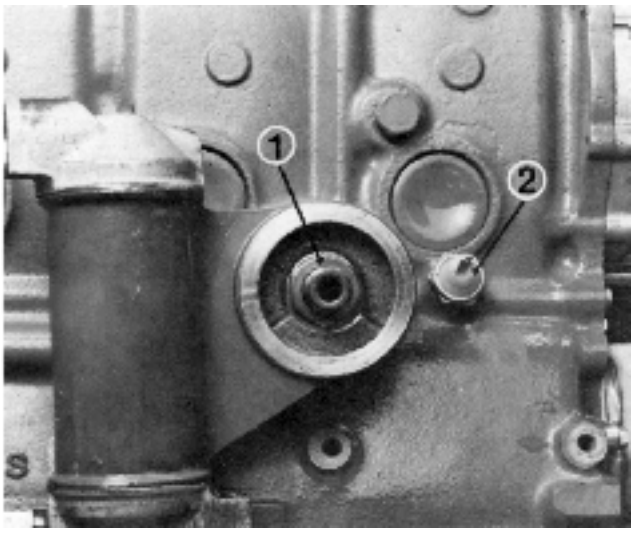
11. Remove the cooling water pipe between the oil cooler and the exhaust pipe. Not on AQ125. Then remove the exhaust pipe.



12. Unscrew the oil filter. Use tool 999 2903 or push a screwdriver through the filter and work it loose. NOTE! Be careful not to spill oil.



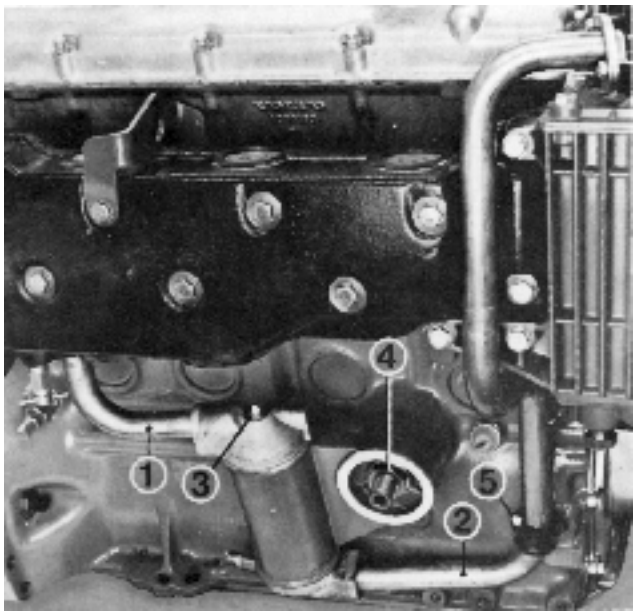
13. Remove the nut (1) and remove the oil cooler. Only AQ145. Spanner width = 28 mm. Remove the oil pressure



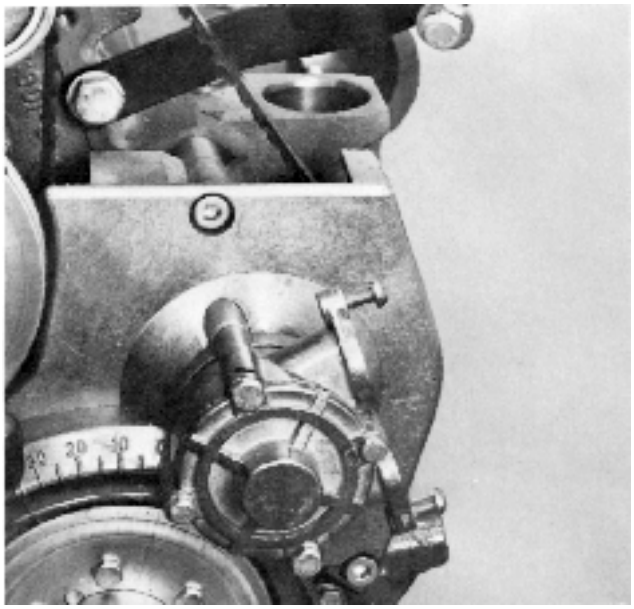
14. AQ145. If the oil cooler's channels are to be cleaned when the exhaust pipe is fitted on the engine the cooling water pipes (1) and (2) must be removed. Undo the oil cooler's screw (3) and remove the lower cover.

The oil filter is then removed and the centre nut (4) is loosened so that the oil cooler can be turned to a horizontal position.

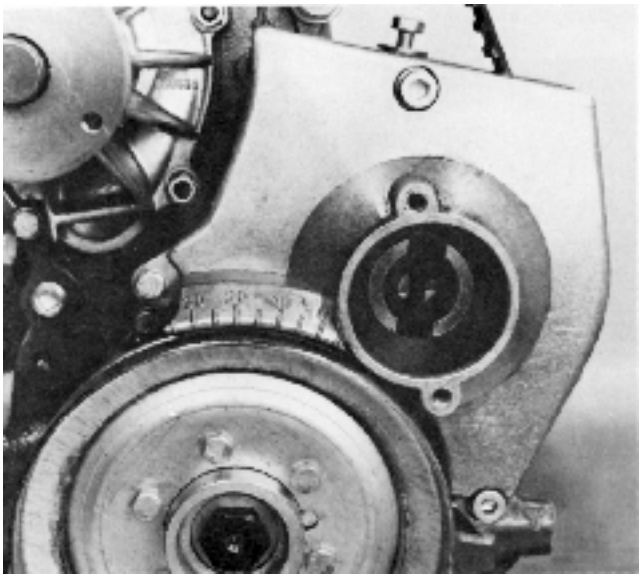
After this the insert's channels can be cleaned.



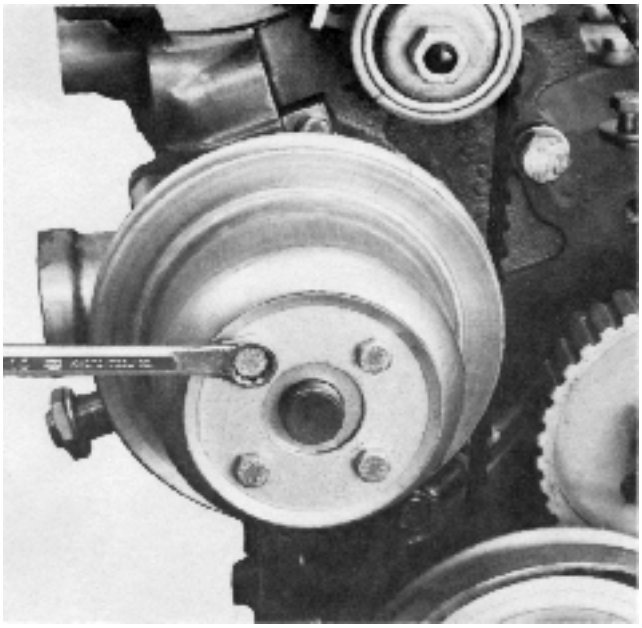
15. Remove the saltwater pump and the generator's tensioning bracket. The spanner width for the saltwater pump is 10 mm. The other screws which hold the cover have a spanner width of 8 mm. Check the impeller, the key and the packing on the pump's front side plus the sealing ring on the pump's rear side. Clean the pump and replace damaged parts.



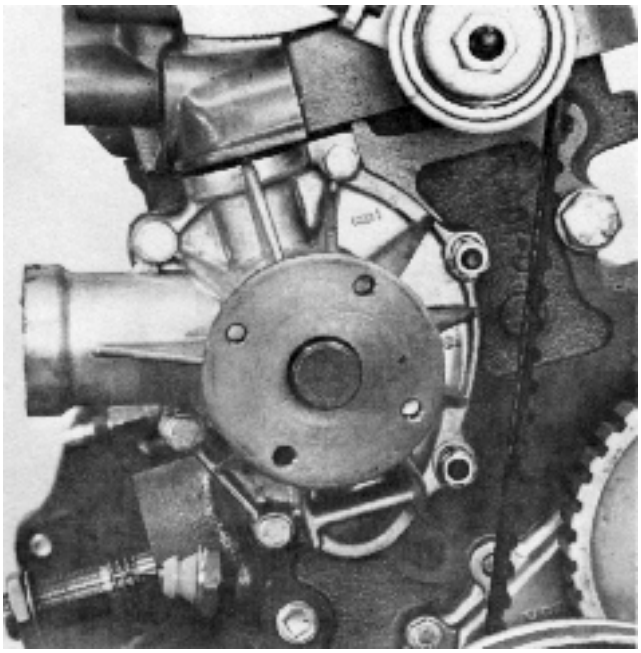
16. Undo the cover's two hexagonal socket screws (6 mm key) and hexagonal screw (spanner width 10 mm). NOTE! The cover's upper fixture is fitted with a guide which means that the cover must be withdrawn a few millimetres before it is free.



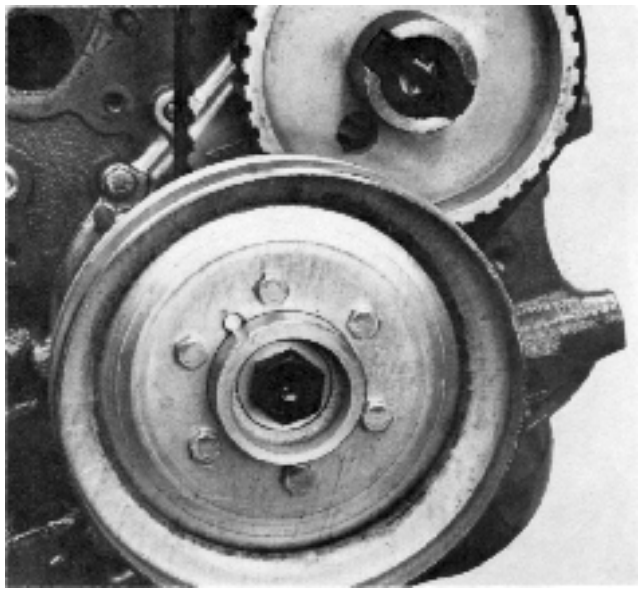
17. Remove the circulation pump's pulley. The spanner width is 10 mm.



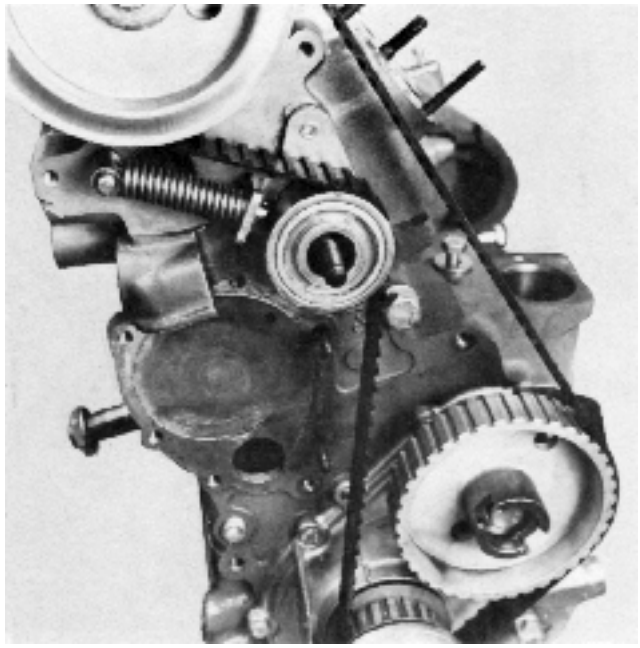
18. Remove the circulation pump. The spanner width is 10 mm. There are four screws and two nuts with washers. Discard the plain packing and the rubber seal. NOTE! The pump is to be changed as a complete unit if it has been damaged.



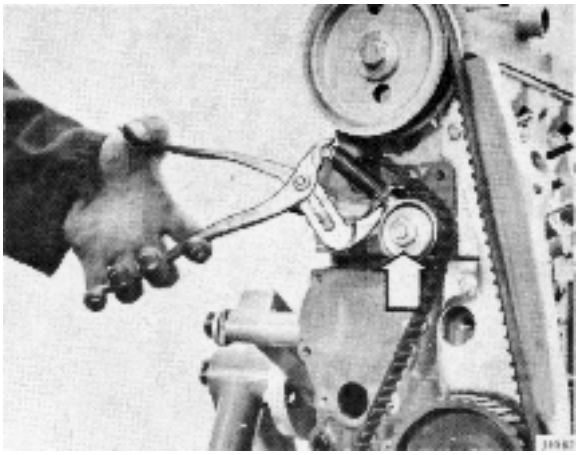
19. Remove the crankshaft pulley. Six screws. The spanner width is 10 mm.



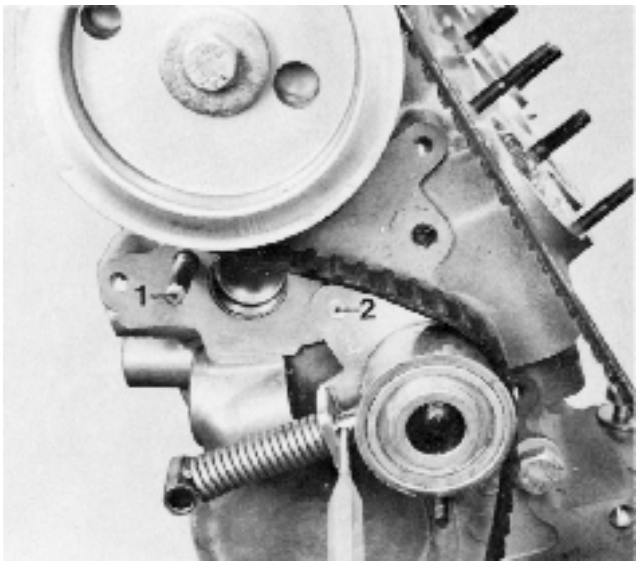
20. If the belt's markings have disappeared the belt is to be marked before it is removed. The marking of the belt is carried out as follows: Make a mark by the camshaft's pulley marking. Make a mark by the intermediate gear's marking and two marks on the crankshaft pulley's marking. Undo and remove the nut and washer for the belt tensioner.



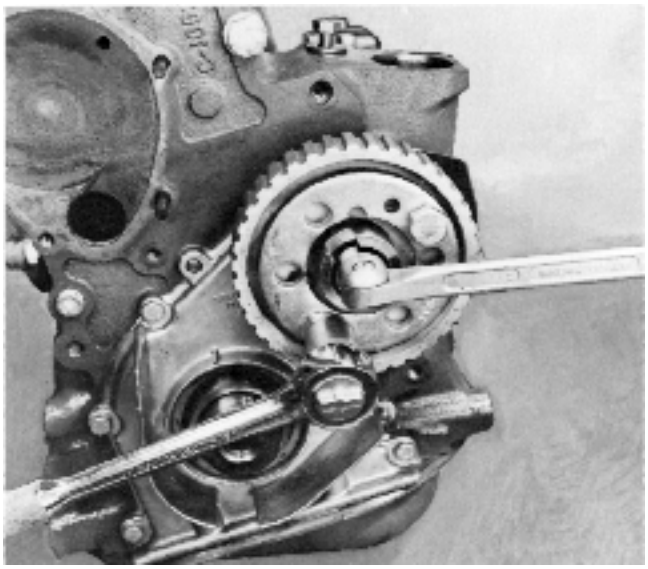
21. Slacken the belt by depressing the roller against the spring pressure. Lock the spring by inserting a 3 mm (0.118") pin (e.g. a drill) in the hole on the pressure pin.



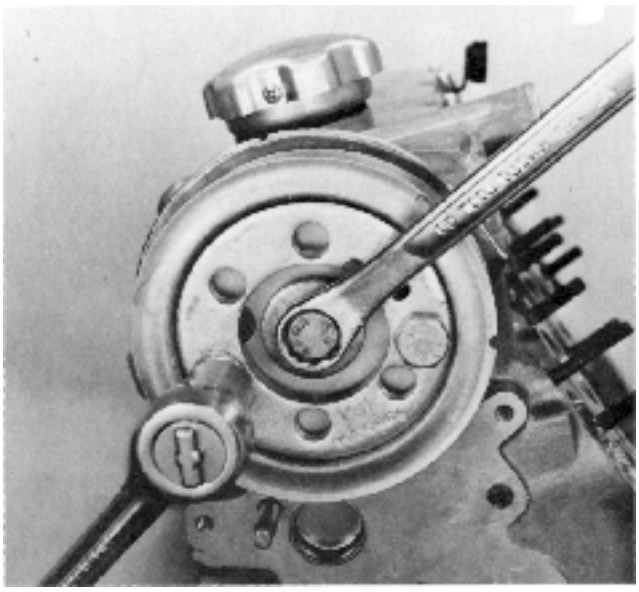
22. Remove the belt tensioner from the shaft (1). The belt tensioner's guide pin 2 is now free after which the belt tensioner is twisted and removed. Then remove the belt. The shaft (1) can be replaced by unscrewing it from the cylinder head. The timing belt is to be changed if the cord re-inforcement and the rubber are beginning to separate or if the tread on the timing belt is worn. The timing belt is to be changed every five hundred hours.



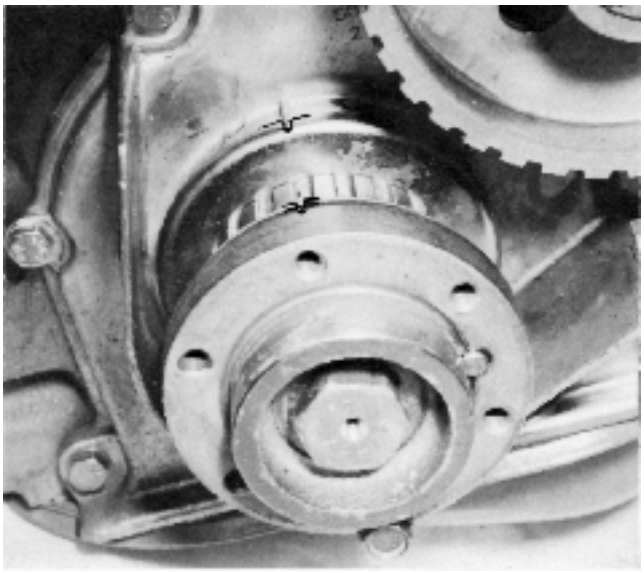
23. Remove the cross piece from the intermediate gear wheel. Check that cross piece is not damaged. Then remove the screw from the carrier. Use counterforce 999 5034. Remove the carrier and the pulley. Then remove the carrier from the pulley. Mild force from the rear with a wooden shaft or similar tool may be necessary.



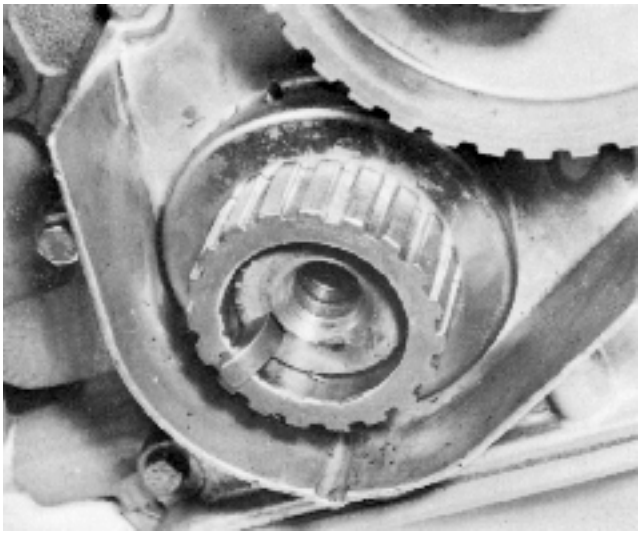
24. Remove the pulley from the camshaft. Use counterforce 999 5034. Remove the pulley by hand. Check that the outer and the inner guide plate's edges are not damaged so that these in turn can damage the belt.



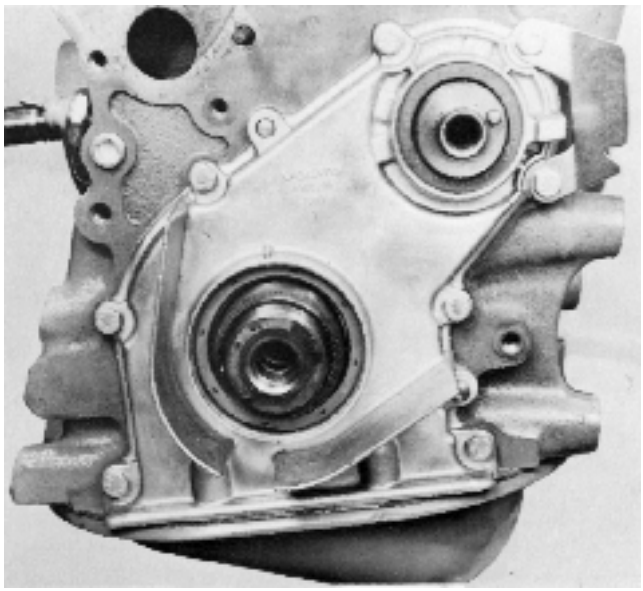
25. Remove the centre screw and pull off the carrier and outer guide plate from the crankshaft.



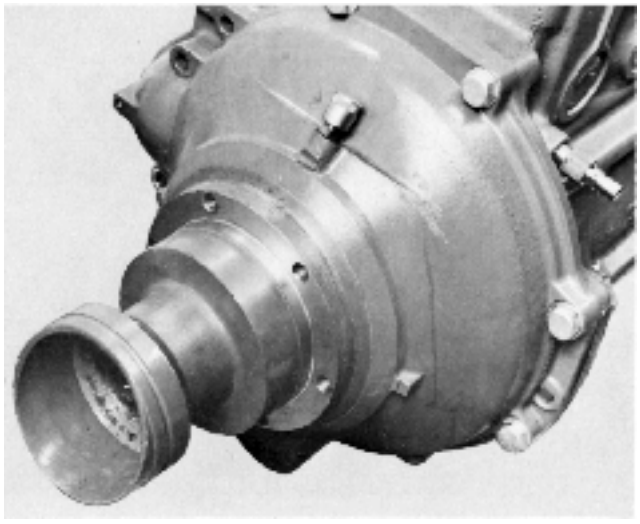
26. Remove the key and pull off the pulley and the inner guideplate from the crankshaft.



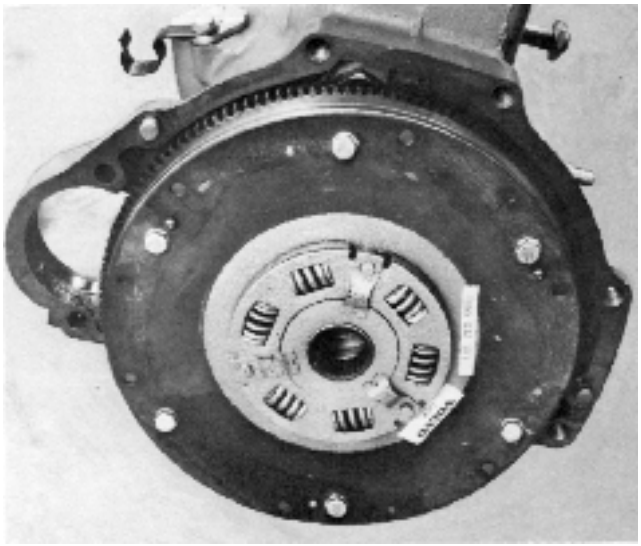
27. Remove the screws from the sealing flange. The flange is also tightened with two of the screws in the oil sump. Remove the flange plate and remove the seals. Use tool 999 5025 for the small seal and tool 999 5024 for the large seal.



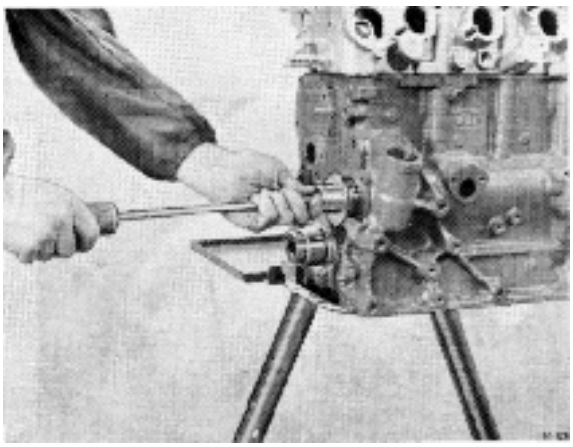
28. Unscrew the flywheel cover's four screws and the three screws which hold the protective plate on the underside between the cover and the cylinder block.



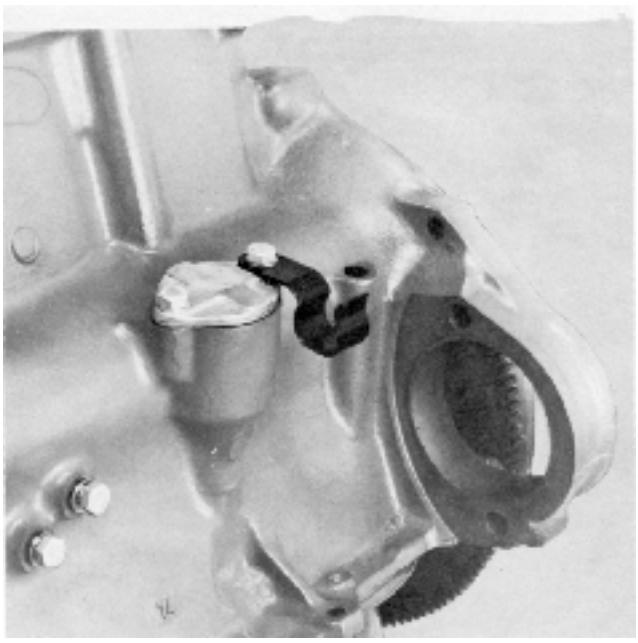
29. Remove the vibration damper's six screws. Spanner width 13 mm. Carefully remove the vibration damper from the three guide pins.



31. Pull out the intermediate shaft. Use the impact tool 999 4030 where necessary. NOTE! Be careful to make sure that the intermediate shaft's gearwheel does not damage the bushes in the cylinder block's bearings.

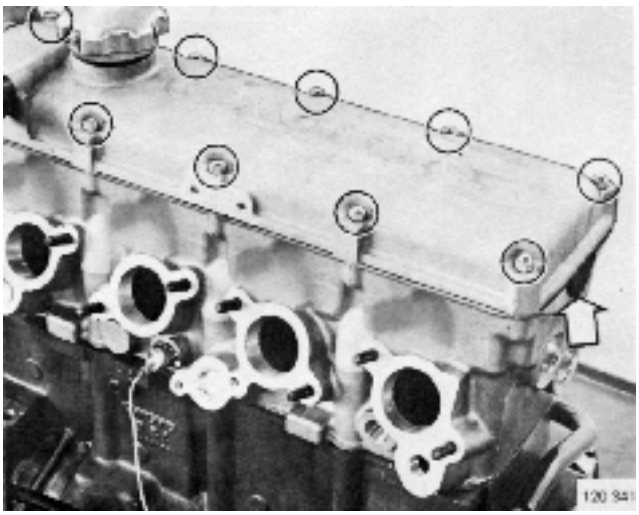


30. Remove the cover and the bracket for the oil pump drive. Then lift up the oil pump drive.

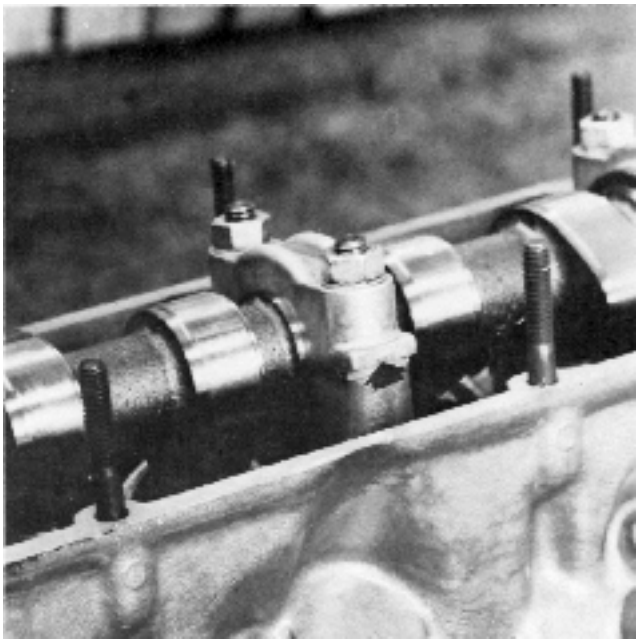


Cylinder head

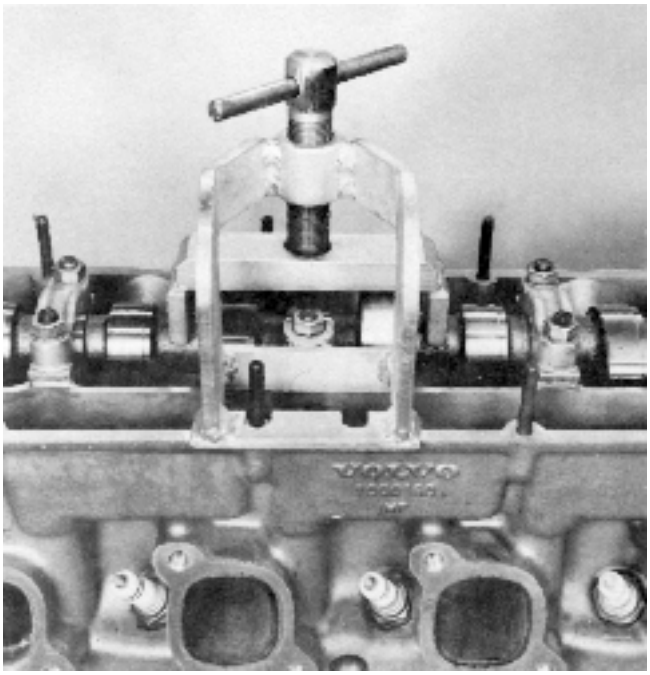
32. Remove the valve cover, the gasket and the crescent shaped rubber seal and check the marking on the camshaft bearing caps.



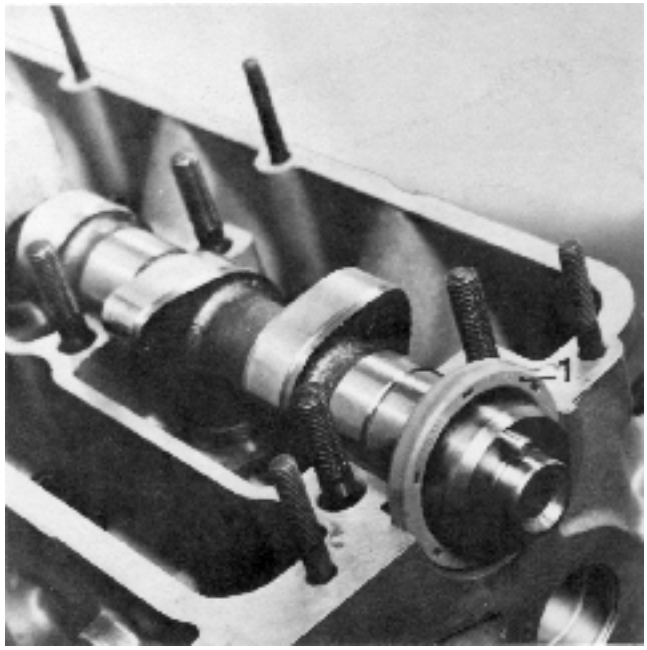
33. Remove the centre camshaft bearing cap. Spanner width 1/2". There are spring washers under the nuts. When necessary use a chisel or similar tool against the lug as shown by the arrow.



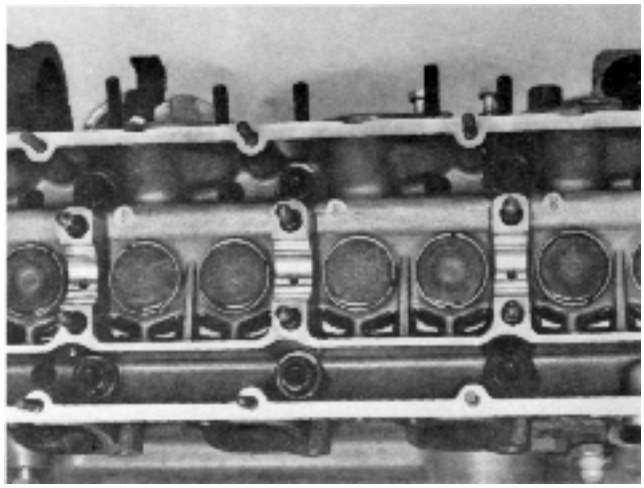
34. Fit tool 999 5021 on the camshaft. Use the bearing cap's nuts. The camshaft is held in position with the tool. Undo the other four camshaft bearing caps.



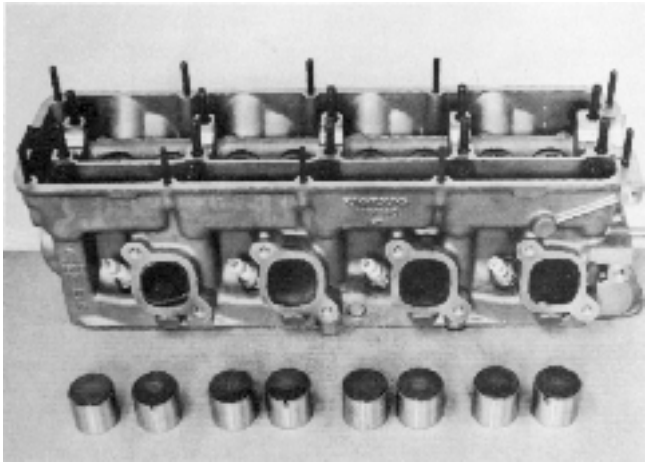
35. Remove the seal (1) from the camshaft. Then undo the tool spindle and release the camshaft. Remove the tool and lift out the camshaft.



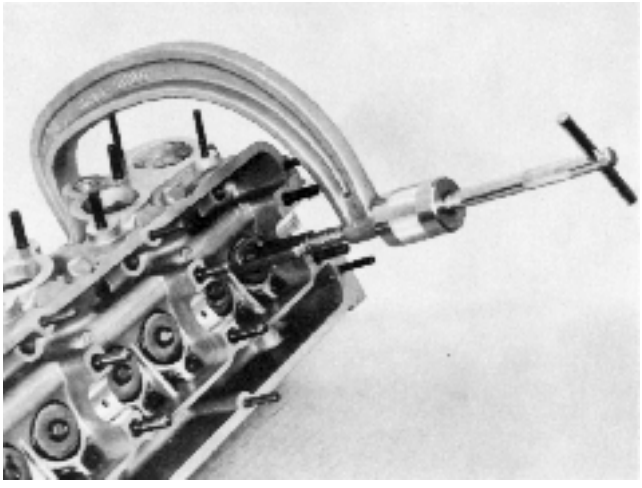
36. Remove the screws in the cylinder head. Use hexagonal socket key 10 mm. Lift away the cylinder head and remove the gasket. Remove the spark plugs.



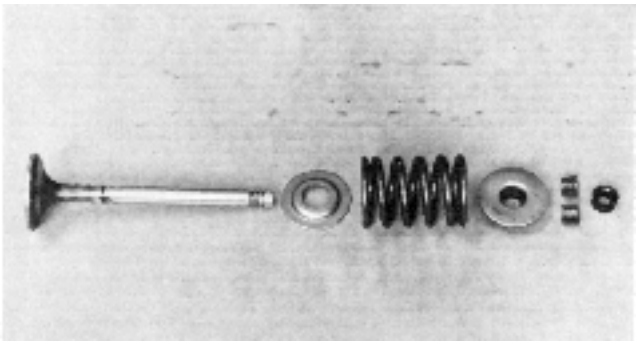
37. Lift up the valve pushers and place them in the same order as they fit in the cylinder head.



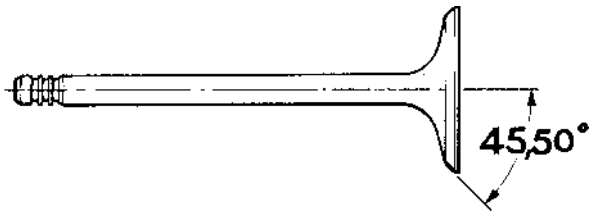
38. Remove the valves. Use valve spring compressor 884 580.



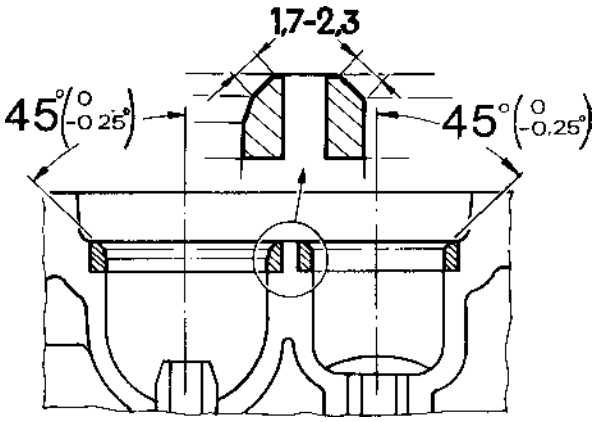
39. Remove the rubber ring, collets, upper washers, springs, lower washers and valves. Then remove the valve seals from the inlet valve guides. Clean all the parts. Remove carbon deposits from the combustion chamber and the valves.



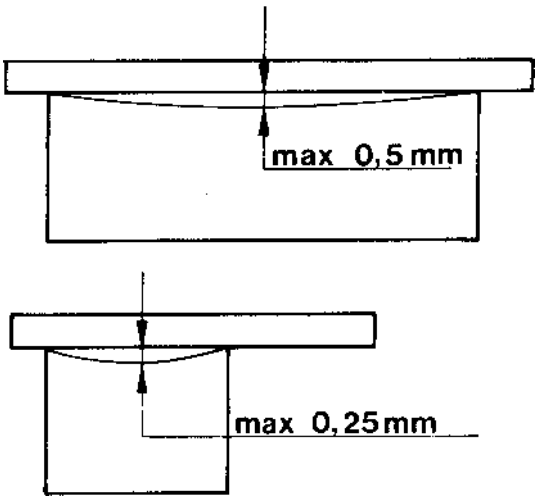
40. Grind the valves if necessary in a valve grinding machine. The angle is the same for both the exhaust and the inlet valves.



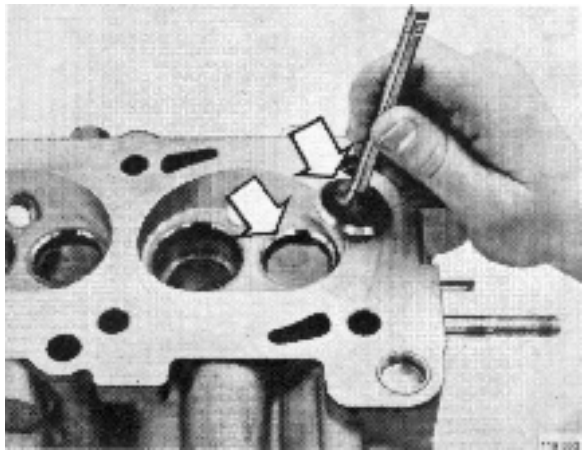
41. Mill or ream the valve seats. The angle is the same for the exhaust and inlet valve seats.



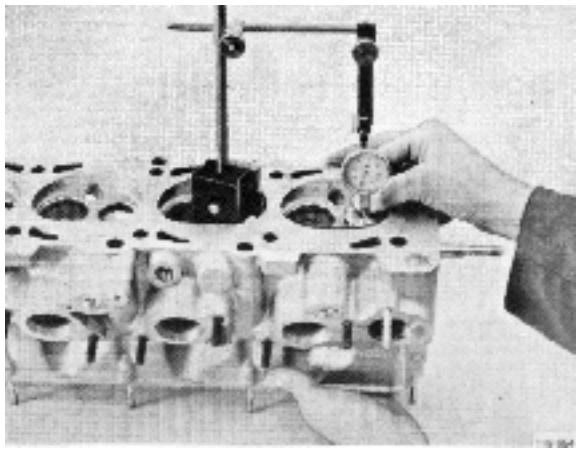
42. Check the flatness of the cylinderhead. Use a steel straight edge.



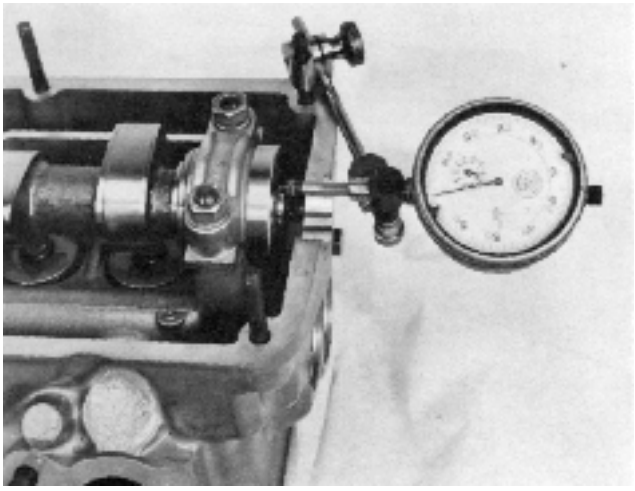
43. Check that all the valves and the valve seats are perfectly ground by marking the valve seat face and turning it against the valve seat with light pressure. If the marking is not evenly distributed on the whole of the seat (leaking valve) the valve is ground further and a new check is carried out until the result is satisfactory.



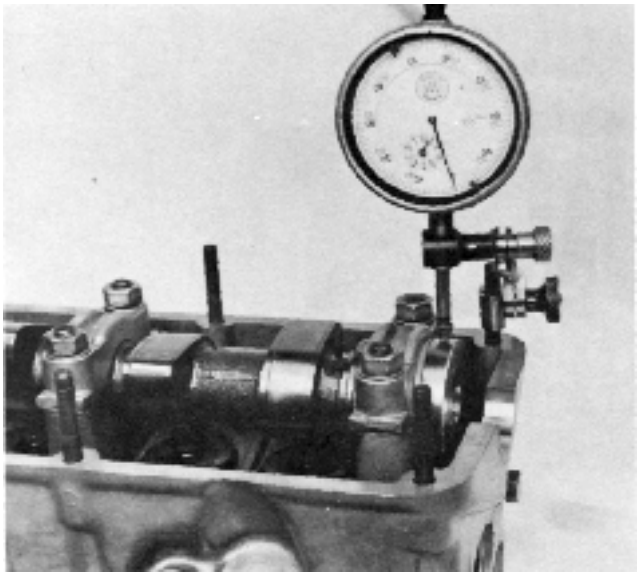
44. Check the wear of the valve and the valve guides. The play for the inlet valve is 0.030–0.060 mm (0.0012–0.0024") and for the exhaust 0.060–0.090 mm (0.0024–0.0035").



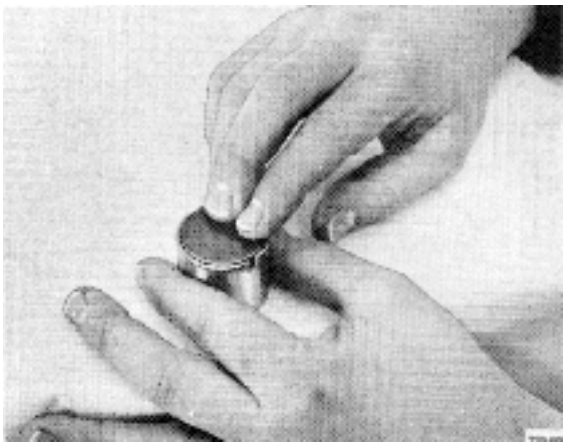
45. Replace the camshaft in the cylinder head and check the axial play which is 0.1–0.4 mm (0.004–0.016").



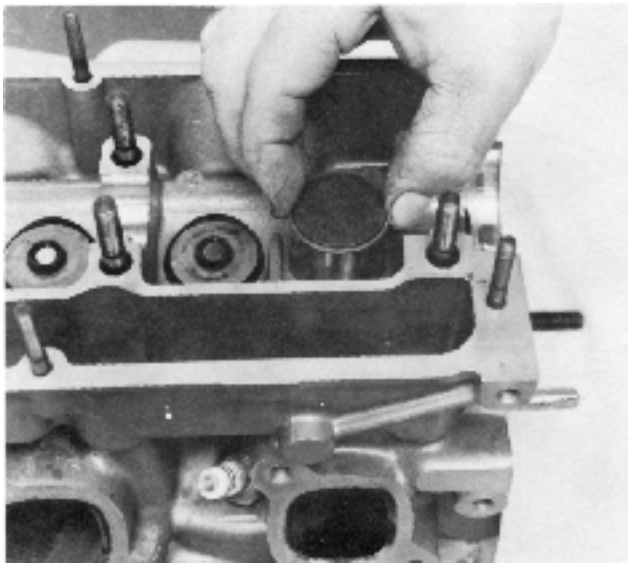
46. Check the radial play which is 0.030–0.071 mm (0.0012–0.0028").



47. Check that the shims do not have too much play in the valve pushers. If there are signs of wear on the plain surface of the shim it should be changed. The play between the shim and the valve presser is 0.009–0.068 mm (0.0004–0.0027).

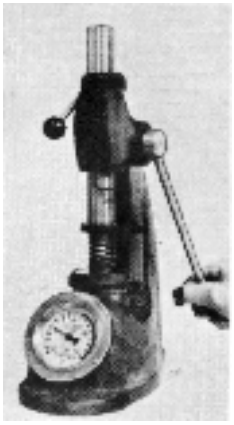


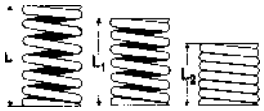
48. Replace the valve pressers in the cylinder head and check that the play is not too much or that they do not stick. The play between the valve pressers and the cylinder head is 0.030–0.075 mm (0.0012–0.0030").



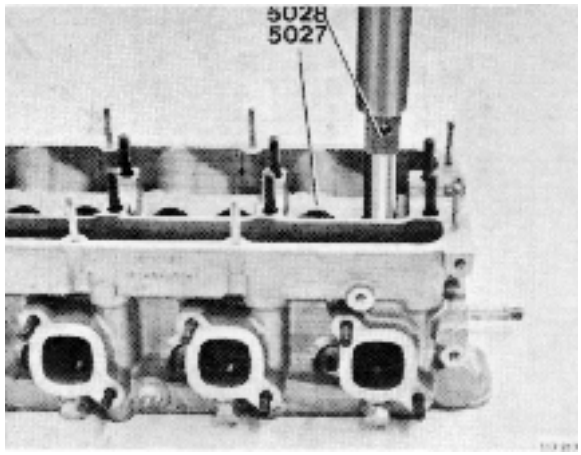
49. Check the valve springs.

Length unloaded	45 mm (1.77")
Length loaded with 300±20 N	(67.2±4.48 lbf.)
	38 mm (1.50")
Length loaded with 760±40 N	(170±8.96 lbf.)
	27 mm (1.06")



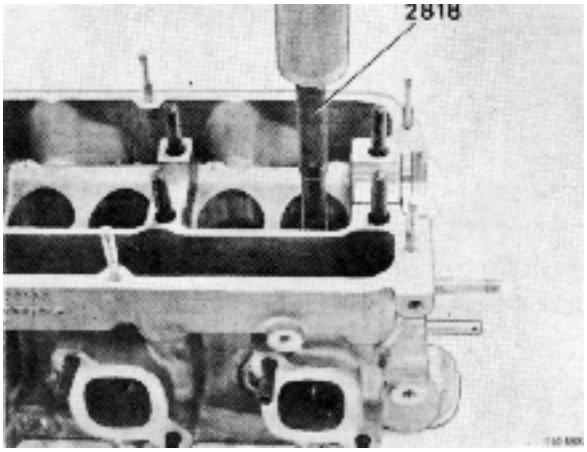


51. Fit the new valve guides. Use tool 999 5027 for the inlet valves and tool 999 5028 for the exhaust valves. The cylinder head is to be at room temperature. The pressing force for fitting the valve guides is to be at least 9000 N (900 kp) (2016 lbf). If this pressing force is not obtained for the guides the hole is to be reamed and a suitable oversized valve guide is to be fitted. Press the guide down until the tool comes up against the cylinder head. This gives the guide a height above the valves spring face around the guide of: 15.5±0.1 mm (0.610±0.004") for the inlet valve and 18.0±0.1 mm (0.708±0.004") for the exhaust valve.



Changing the valve guides

50. Press up the valve guides with tool 999 2818. Heat the cylinder head in 60°C (140°F) water.

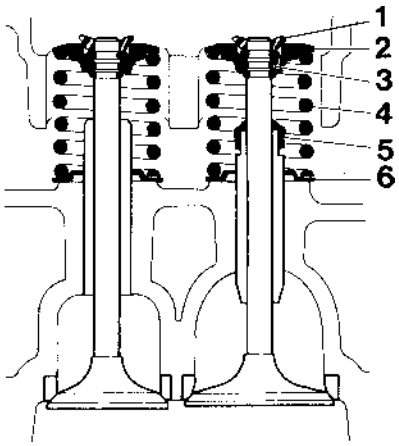


52. Refit the valves.

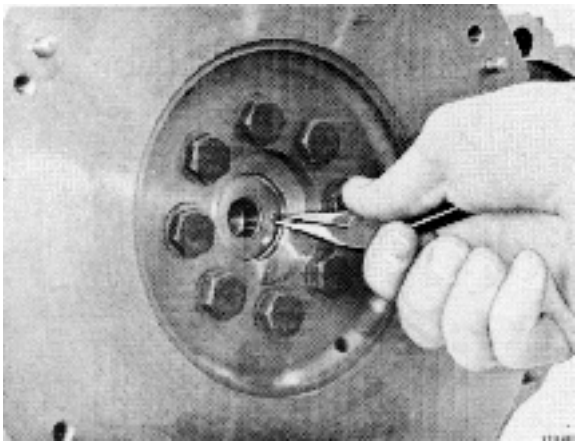
1. Rubber ring
2. Upper valve washer
3. Collets
4. Valve springs
5. Valve stem seal (inlet)
6. Lower valve spring washer

Then refit the spark plugs.

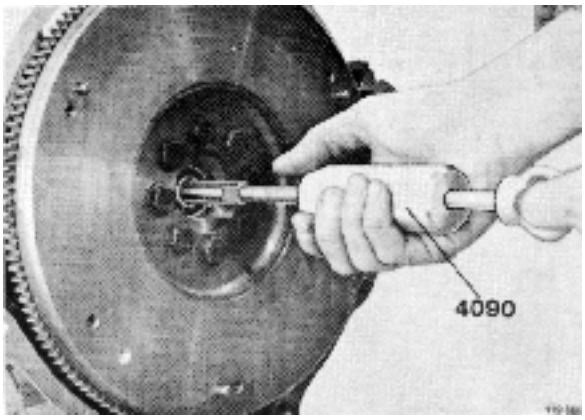
NOTE! Make sure that the spark plug thread screws in correctly so that the thread in the aluminium cylinder head is not damaged. The tightening torque is: 25–30 Nm (2.5–3.0 kpm) (18.4–22.1 lbf. ft.)



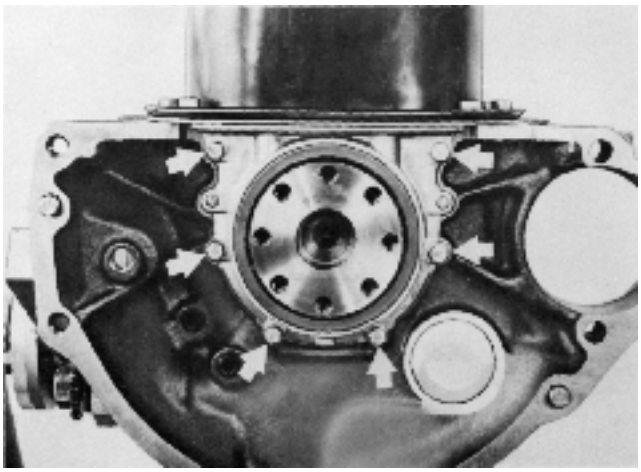
53. Remove the locking ring for the bearing on the input shaft.



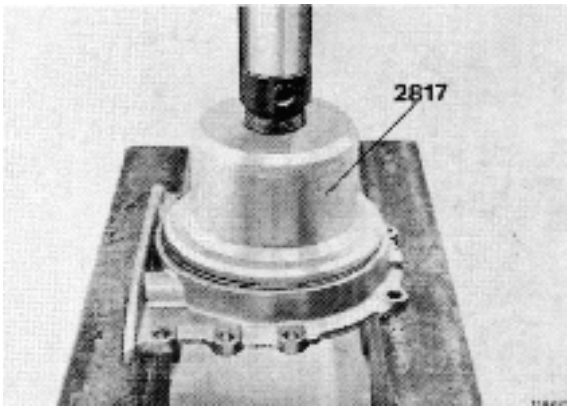
54. Remove the bearing for the input shaft. Use tool 999 4090. Remove the flywheel.



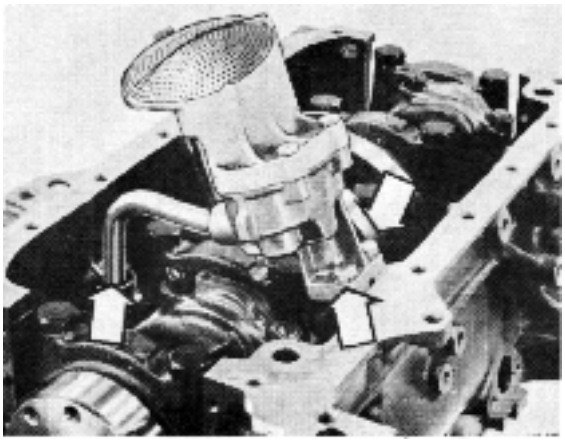
55. Remove the sealing flange. NOTE! Two screws from the sump must also be removed.



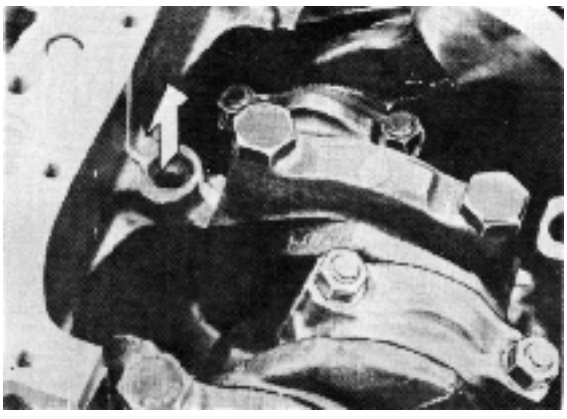
56. Remove the seal from the sealing flange with tool 999 2817.



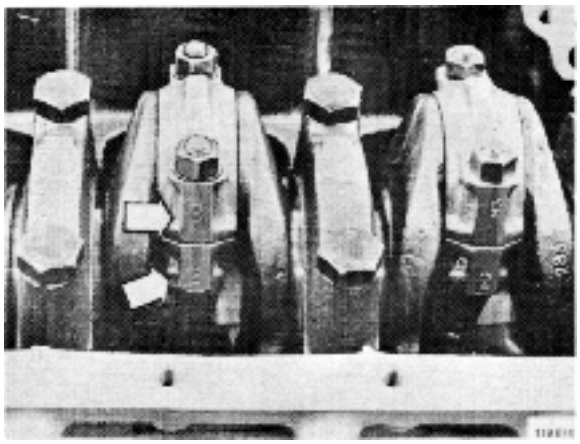
57. Undo the screws and remove the oil sump. Then remove the two screws in the lubricating oil pump and lift out the pump with the pipe.



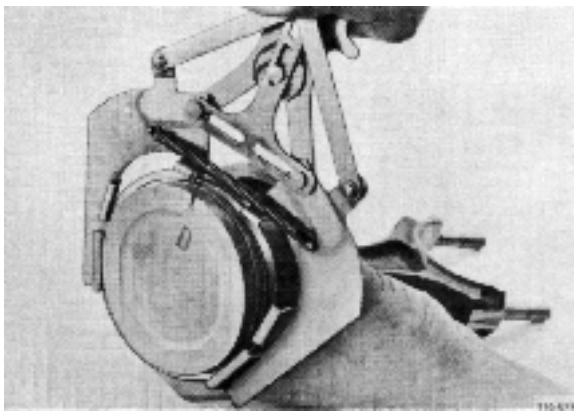
58. Remove the rubber ring for the oil pipe from the cylinder block (And from the pipe where necessary).



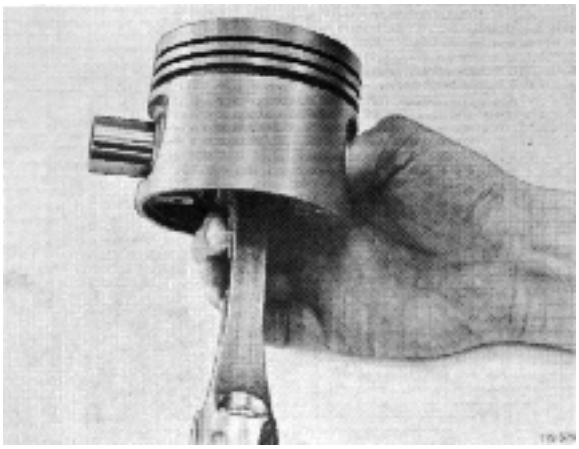
59. Note that the crankshaft and the crankshaft bearing caps are numbered. Then remove the bearing caps and remove the bearing shells.



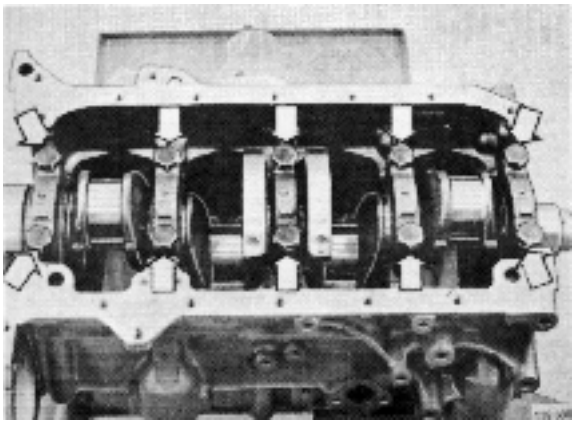
60. Press out of the pistons from the cylinders. Let the pistons fall on a soft surface so that they cannot be damaged. Then remove the piston rings. Use piston ring pliers.



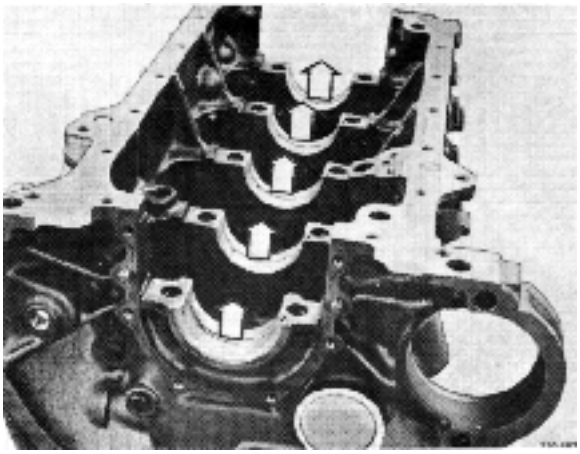
61. Remove the locking rings for the gudgeon pins and press the gudgeon pins out.



62. Note that there are markings for the main bearing caps. The bearing caps are marked 1–5 from the transmission side. Remove the main bearing caps.

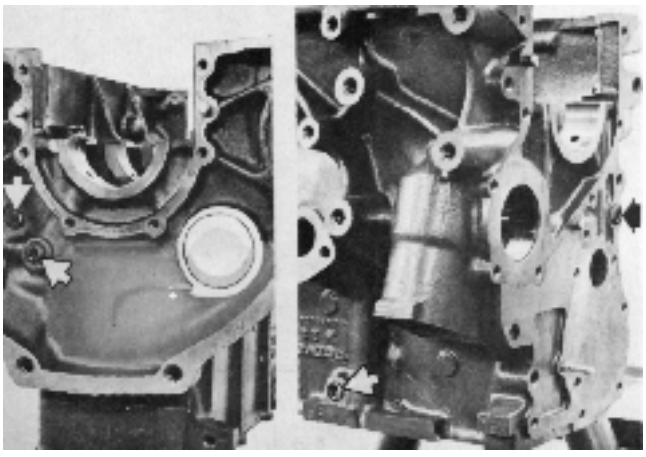


63. Lift out the crankshaft and remove the bearing shells from the block and the bearing caps.



CLEANING AND INSPECTION

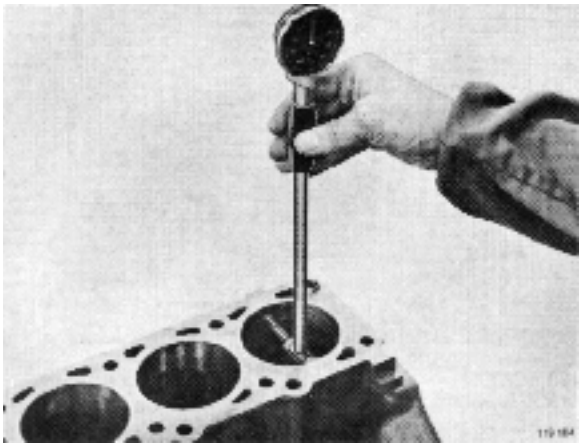
64. Clean and carefully inspect the cylinder block. The plugs for channels are to be removed before cleaning. Re-fit the plugs after cleaning has been completed. Tightening torque:
1/4 NPTF – 20 Nm (2 kpm) (14.7 lbf. ft.)
3/8 NPTF – 30 Nm (3 kpm) (22.1 lbf ft.)



65. Measure the cylinder liners with a special dial indicator. The measurement for greatest wear is carried out immediately below top dead centre and transverse to the engine. The measurement for minimum wear is carried out at bottom dead centre.

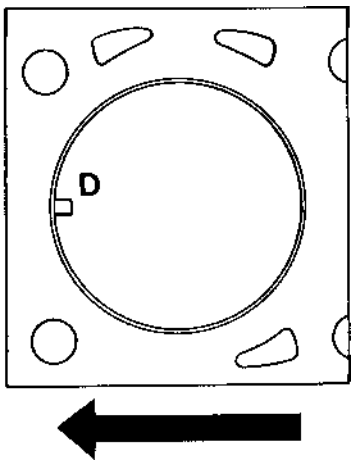
Standard cylinder diameter. AQ145
(C-marked): 96.00–96.01 mm (3.7795–3.7799 in.)
(D-marked). 96.01–96.02 mm (3.7799–3.7503 in.)
(E-marked): 96.02–96.03 mm (3.7803–3.7807 in.)
Oversize I: 96.300 mm (3.7973 in.)
II: 96.600 mm (3.8031 in.)

Standard cylinder diameter. AQ125
(D-marked): 92.01–92.02 mm (3.6224–3.6228 in.)
(G-marked): 92.03–92.04 mm (3.6232–3.6236 in.)
Oversize I: 92.500 mm (3.6417 in.)
II: 93.000 mm (3.6614 in.)



Classification marking

66. Each cylinder liner has a letter which indicates its and pistons class.
Oversizes indicated by nominal diameter measurement.

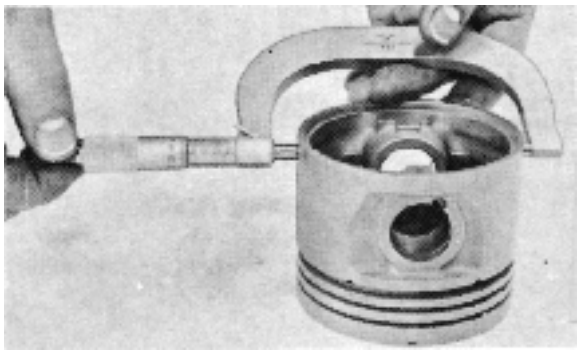


Pistons

67. Measure the pistons with a micrometer at right angles to the gudgeon pin hole and 6 mm (0.25") from the lower edge.

Piston diameter standard. AQ145
(C-marked): 95.940–95.950 mm (3.7776–3.7780 in.)
(D-marked): 95.950–95.960 mm (3.7787–3.7791 in.)
(E-marked): 95.960–95.970 mm (3.7780–3.7783 in.)
(G-marked): 95.980–95.990 mm (3.7787–3.7791 in.)
Oversize I: (0.3–96.245): 96.237–96.252
(0.0118–3.7892): 3.7889–3.7894"
II: (0.6–96.545): 96.537–96.552
(0.0236–3.8010): 3.8007–3.8013"

Piston diameter standard. AQ125
(D-marked). 91.990–92.000 mm (3.6216–3.6220 m.)
(G-marked). 92.020–92.030 mm (3.6228–3.6232 in.)
Oversize I: (0.5–92.480): 92.474–92.492
(0.0196–3.6409): 3.6407–3.6414 in.)
II: (1.0–92.980): 92.977–92.992
(0.394–3.6606): 3.6605–3.6611 in.)

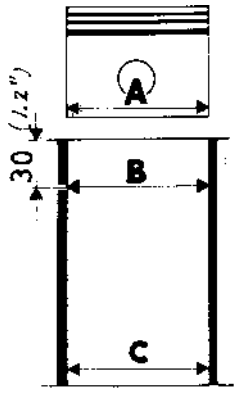


68. Piston play in cylinder: 0.05–0.07 mm (0.0020–0.0028").

a. Piston diameter (A) is measured as stated above.

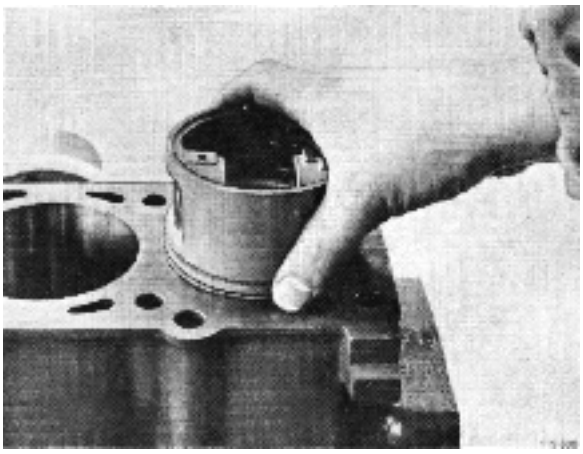
b. The cylinder diameter is measuredat several places crosswise to the engine and 30 mm (1.2") (B) from block face and downwards to bottom dead centre (C).

c. Calculate the piston's maximum and minimum clearances. (Deduct piston diameter to get cylinder liner's maximum and minimum diameters).



Piston rings

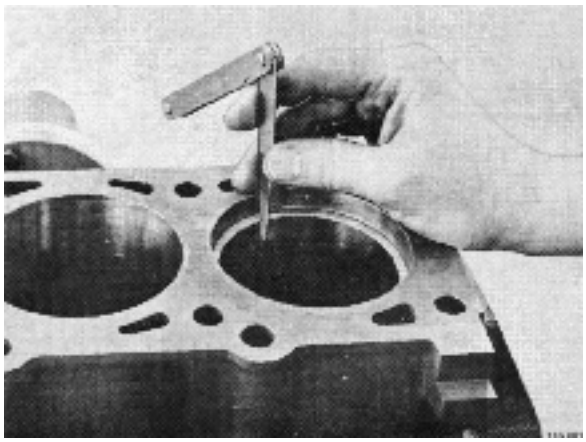
69. Insert piston rings, one after the other, in the liner. Use an inverted piston to fit the ring in the correct position.
NOTE! When fitting in a worn cylinder liner, the rings must be tested at bottom dead centre since the cylinder liner diameter is at a minimum there.



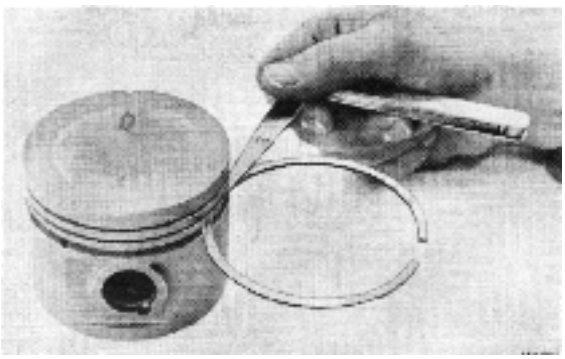
70. Measure the piston ring gap with a feeler gauge. Increase the gap with a special file where necessary.

The gap for AQ145 is to be:
Compression rings: 0.40–0.65 mm (0.0157–0.0256 in.)
Oil scraper ring: 0.30–0.60 mm (0.0118–0.0236 in.)

The gap for AQ125 is to be:
Compression rings: 0.35–0.55 mm (0.0138–0.0217")
Oil scraper ring: 0.25–0.40 mm (0.0098–0.0157")



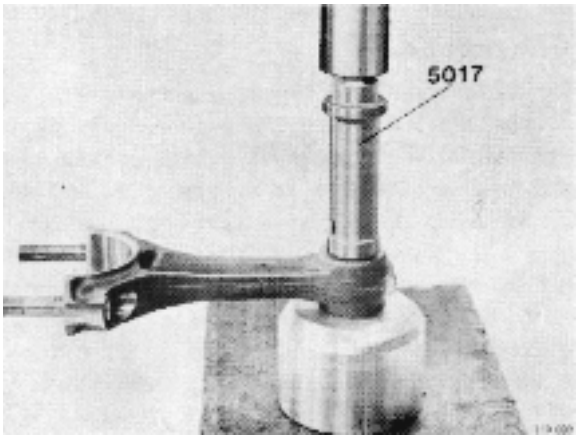
71. Measure the piston ring gap by rolling the piston rings in the groove. Check the play at several points with a feeler gauge. The play is:
Compression rings: 0.040–0.072 mm (0.0016–0.0028")
Oil scraper ring: 0.030–0.062 mm (0.0012–0.0024")



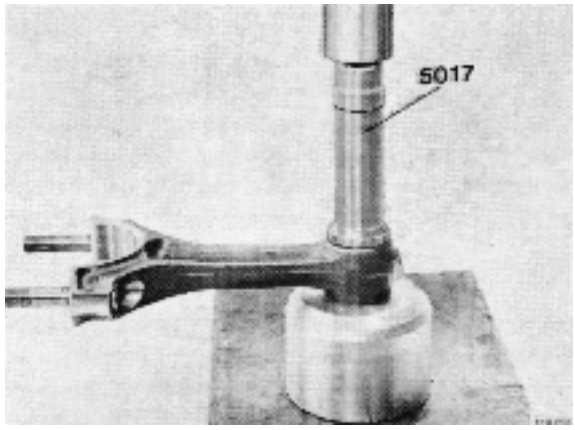
72. Check the play of the gudgeon pin in the piston. The play is correct when the gudgeon pin can be pushed through with light hand pressure. (Accurate running fit).

The gudgeon pins are available oversized 0.05 mm (0.0019"). If the gudgeon pin hole in the piston is worn so that an oversize gudgeon pin is needed the hole is reamed to the correct dimension. Use a reamer with a guide ring and make small cuts at a time.

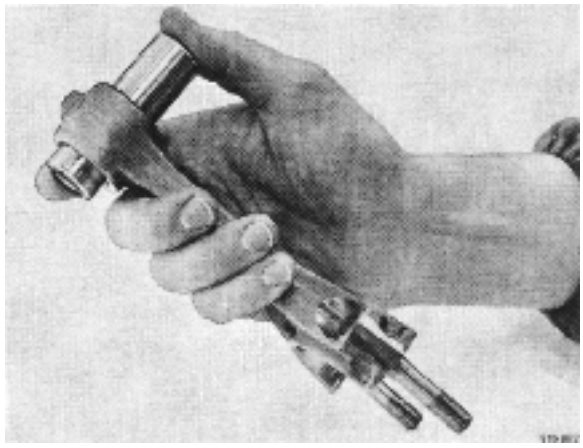
73. Press out the small end bush with tool 999 5017.



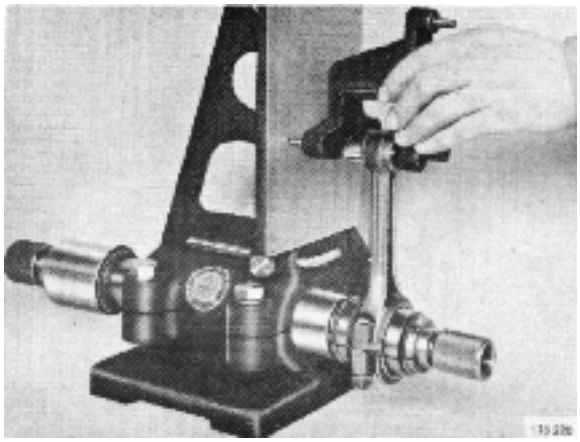
74. Press in the new bushing with tool 999 5017.



75. The gudgeon pin is to slide through the hole with light thumb pressure without any appreciable looseness. (Sliding fit). The bush is machined if necessary.

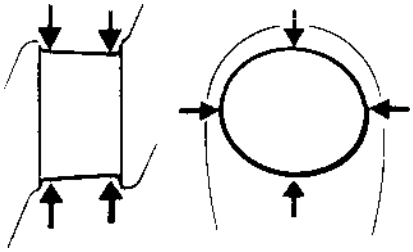


76. Check the connecting rods for straightness, torsion and possible s-bends. Use a connecting rod straightener. Nuts and screws are to be replaced when overhauling.



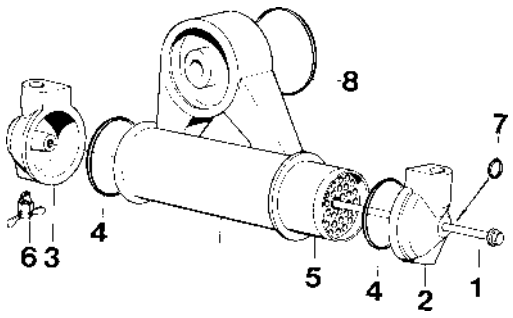
Crankshaft

77. Check the big end bearings and main bearing. Measurement with a micrometer is carried out at several points around the circumference and lengthwise. The ovality of the main bearing journals must not exceed 0.07 mm (0.0028") and on the connecting rod journals 0.05 mm (0.0019"). The conicity should not be greater than 0.05 mm (0.0019") for any of the journals. If the dimensions lie in the vicinity of or exceed the stated values for wear the crankshaft should be re-ground to the nearest undersize. Suitable bearing shells are available for two undersizes. See the technical data.



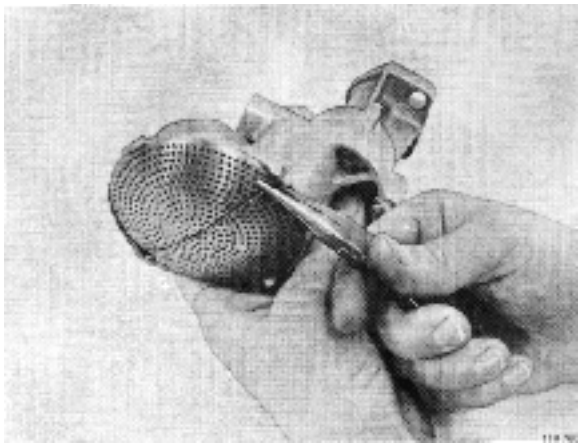
Overhauling the oil cooler (AQ145)

78. Remove the centre screw (1) and remove the end cover (2) and (3). Remove the O-rings (4) which remain on the insert. Then press out the insert (5) and be careful not to spill oil. Clean and blow through the insert with compressed air. Check that there is free flow in the drain tap (6). Re-fit the insert in the housing and slide on the O-rings. (Replace O-rings where necessary). Re-fit the end cover and tighten them with the centre screw. Replace the O-ring (7) if it is damaged. Check and replace the O-ring (8) where necessary.

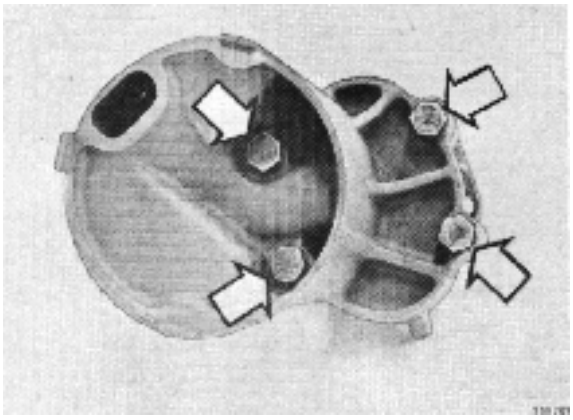


Overhauling the lubrication oil pump

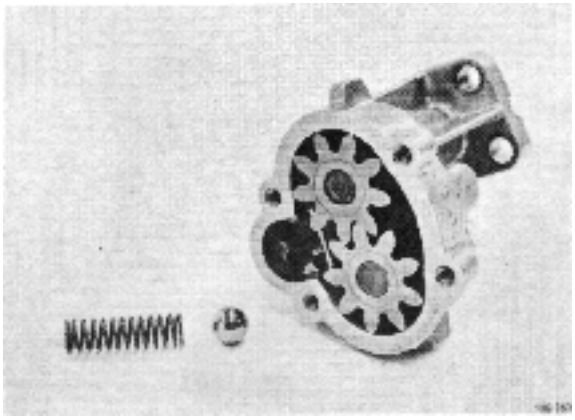
79. Remove the pipe from the pump, remove the locking clamp and remove the strainer. NOTE! The strainer cannot be disassembled on the later model.



80. Remove the four screws and remove the cover.

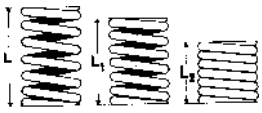


81. Remove the spring, ball and gears. Clean all parts and replace those damaged or worn.

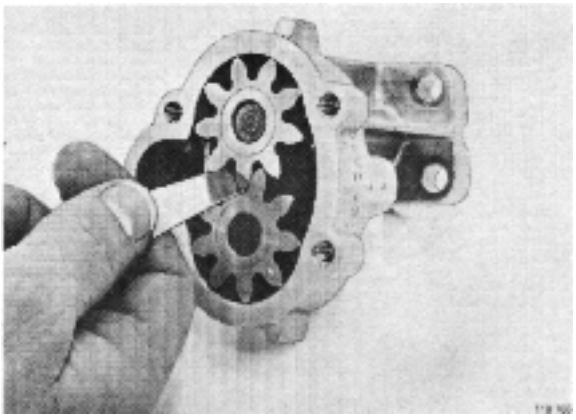


82. Check the spring for the pressure release valve.
Test data:

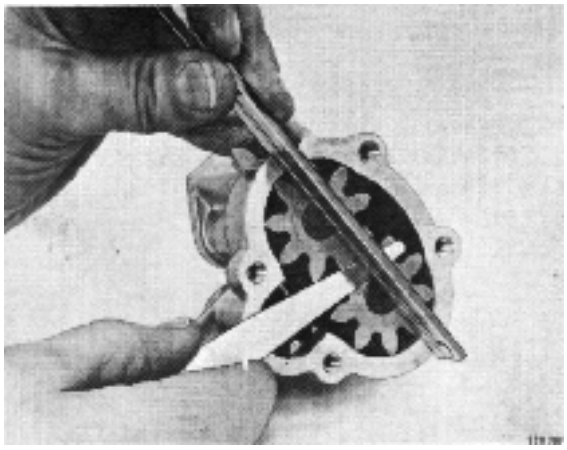
Length unloaded	47.6 mm (1.8740")
Length loaded with 44±4 N (4.4±0.4 kp) (32.43±2.95 lbf.ft.)	32.0 mm (1.260")
Length loaded with 61±6 N (6.1±0.6kp) (44.96±4.42 lbf.ft.)	26.0 mm (1.024")



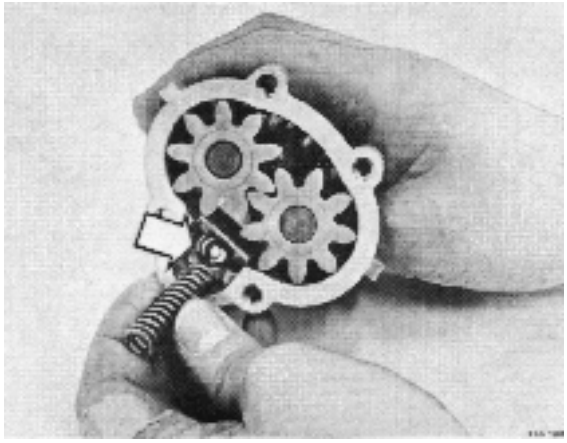
83. Refit the gear wheels and check the gear flank clearance which is 0.15–0.35 mm (0.0060–0.014").



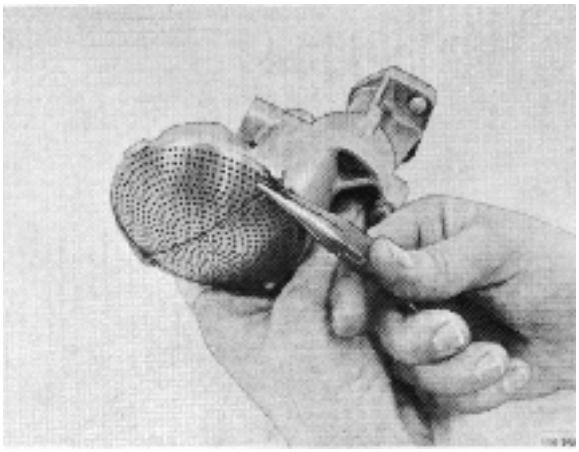
84. Check the axial clearance.
The axial clearance is 0.02–0.12 mm (0.008–0.0047").



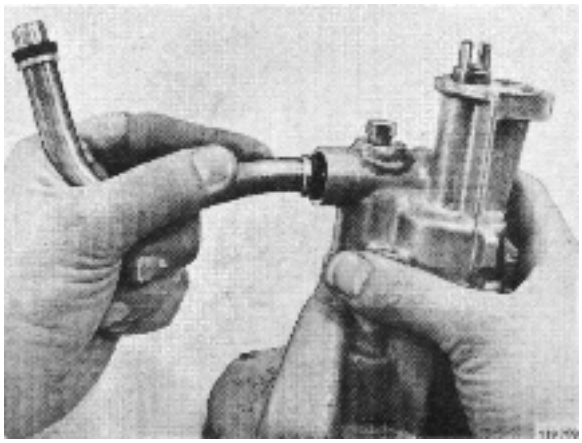
85. Lay the ball and the spring in position and refit the cover.



86. Refit the strainer and the locking clamp. (Applies only to the earlier model).



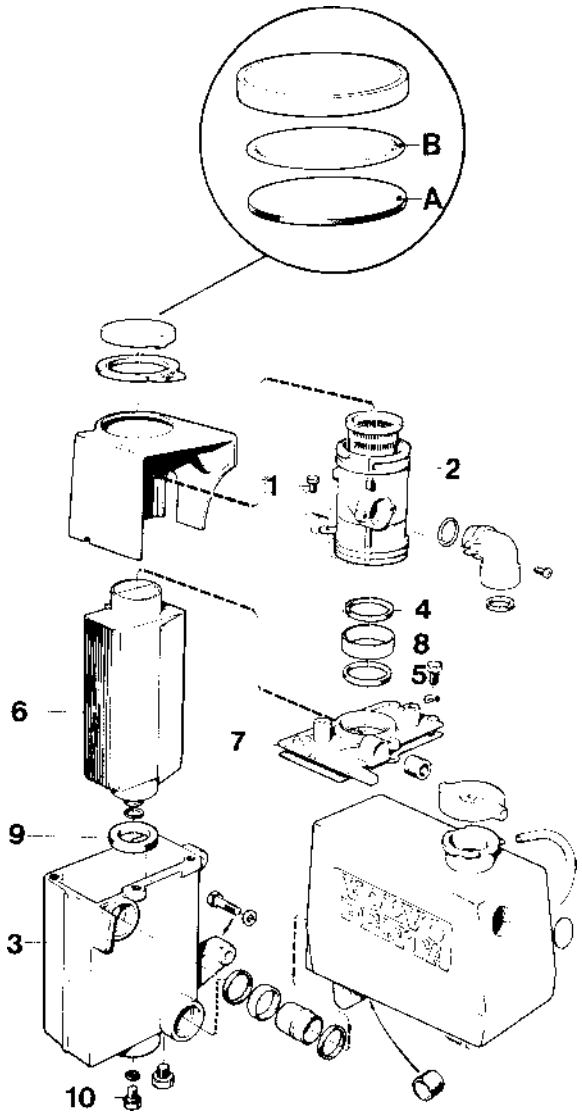
87. Fit new sealing rings and press the pipe into position in the pump.



Overhauling the heat exchanger.

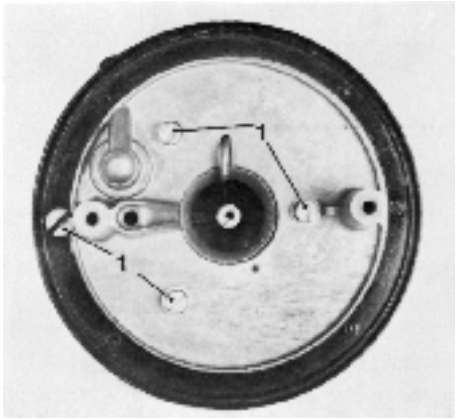
88. Remove the two screws (1) and remove the strainer housing (2) from the heat exchanger housing (3). Discard the sealing rings (4) and (5). Then remove the four screws in the heat exchanger's cover. Pull out the insert (6) and cover (7) from the heat exchanger housing. Put the spacer ring (8) in a safe place. Remove the cover from the insert. NOTE! Remove the support ring (9) which can remain in the bottom of the housing. Remove the bottom screw (10) on the insert. Discard the copper seal, the O-ring on the insert, the plain packing and the other sealing rings. Wash and rinse all parts including the expansion tank. Check that the insert's channels are free from contamination. Use compressed air. Change damaged parts. Assemble the heat exchanger in the opposite order, see the picture. Use new sealing rings, a new packing, a new copper washer, support ring and O-rings.

NOTE! The cover for the seawater strainer is to be lubricated on the inside. Remove the rubber washer A and the sealing disc B. Distribute grease evenly with a brush on the inside of the cover. Then replace the sealing disc and the rubber washer and screw the cover in position.

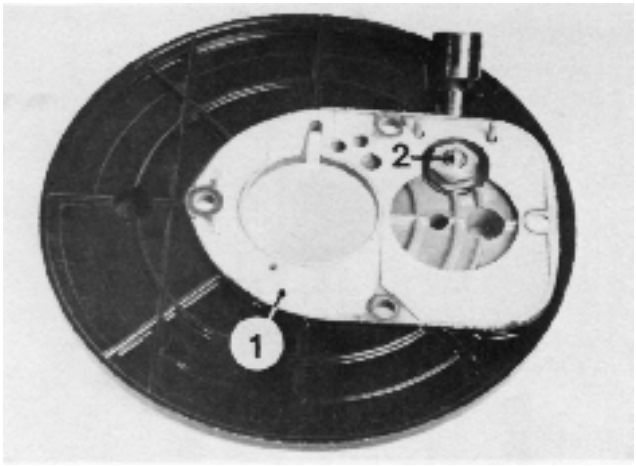


Overhaul and inspection of carburetor

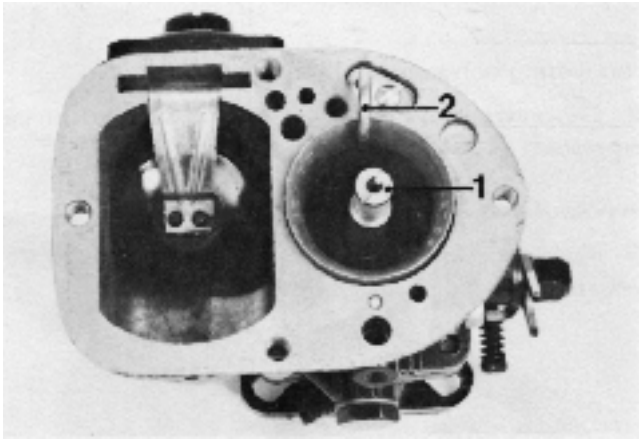
89. Remove the 4 screws (1) and lift off the upper part of the carburetor.



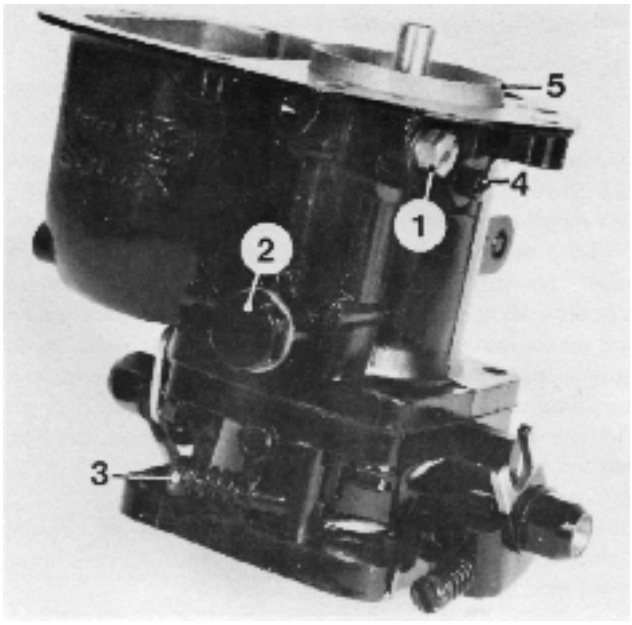
90. Remove the gasket (1) and disassemble the needle valve (2). Check that the needle valve does not bind or is worn (does not seal). Replace if necessary.



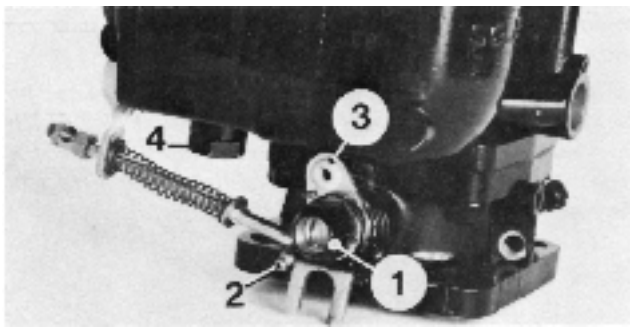
91. Lift out the float tube and check that it is tight. If the float is not tight the float level will be wrong. Unscrew the emulsifying jet (1) and the acceleration jet (2). NOTE! The gasket. Check and clean with compressed air. Replace worn or damaged parts if necessary.



92. Disassemble the idling jet (1) and holder (2) for the main jet. Unscrew the jet from the holder. Blow the jets clean and replace if necessary. Unscrew the mixing screw (3) and blow clean the duct. Screw (4) locks tight the air cone (5).



93. Rotate the throttle shaft (1) and press out the push rod (2) from the lever (3). Then rotate the push rod downwards and disassemble the check valve (4). Blow the check valve clean and the strainer. Clean and blow the carburetor and its ducts. Then re-fit the check valve and strainer. NOTE! Do not forget the copper washer. Rotate the throttle shaft somewhat and press the push rod into the lever.

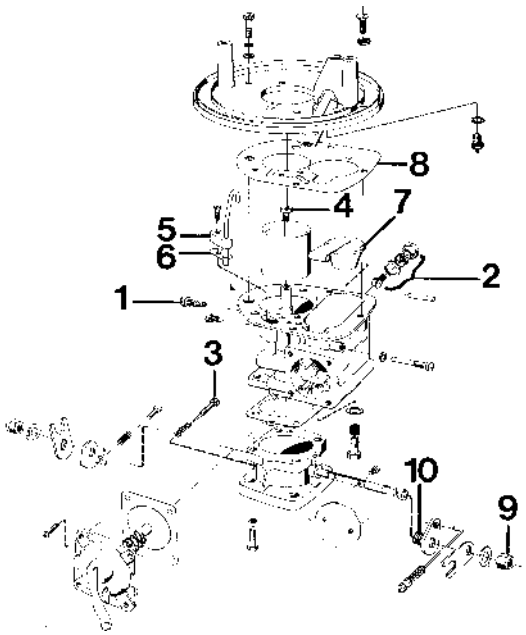


Assembling

94. Fit the idling jet (1), main jet (2)and mixing screw (3). NOTE! Copper washer on the main jet. Then fit the emulsifying jet (4), acceleration jet (5) and gasket (6). Place the float in the float housing and put on a new gasket (8) and screw on the upper part of the carburetor housing. Loosen the nut (9) and remove the levers. The spring can then be replaced.

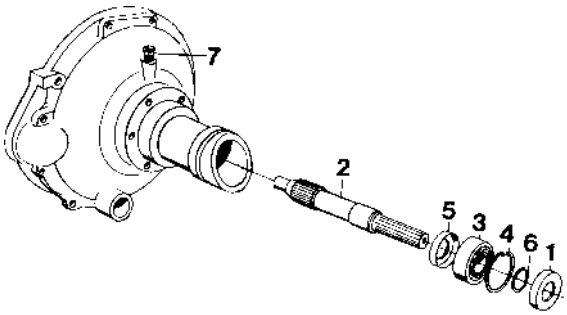
Adjusting the idling screws:
AQ145A. Screw in the screw until it comes into contact with the carburetor. Then screw it in a further 3/4 turn.
AQ125A. 1 1/4 turn.

Adjusting the venting screws:
AQ145A. Screw the venting screw right in. Then screw it out 1 turn.
AQ125A. 1 turn.



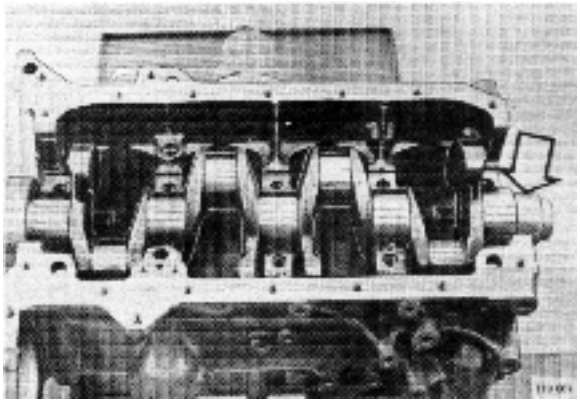
Overhauling the flywheel cover

95. Remove the sealing ring (1) in the flywheel cover. Check the primary shaft (2) and the bearing (3). If either one is damaged the lock rings (4) are to be undone and the shaft with bearings is to be pressed out. Remove the sealing ring (5) and remove the lock ring (6). Replace the damaged parts and then fit the lock ring (6) on the primary shaft and the sealing ring (5). Then press the bearing brackets (3) on the primary shaft (2). Press the shaft with bearing in the flywheel cover. Fit the lock rings (4) and the sealing ring (1). NOTE! Carefully lubricate the sealing rings before they are fitted. Press grease into the lubricating channel (7).

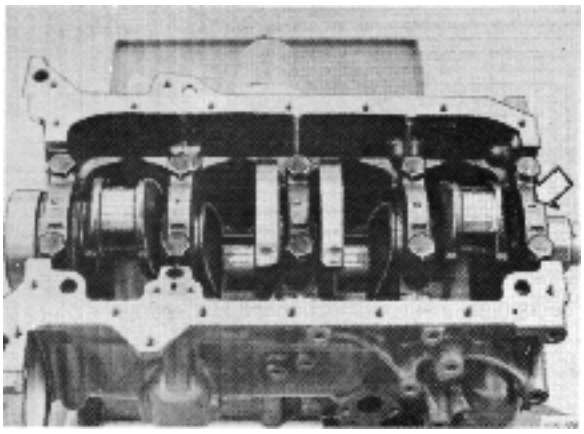


Assembling

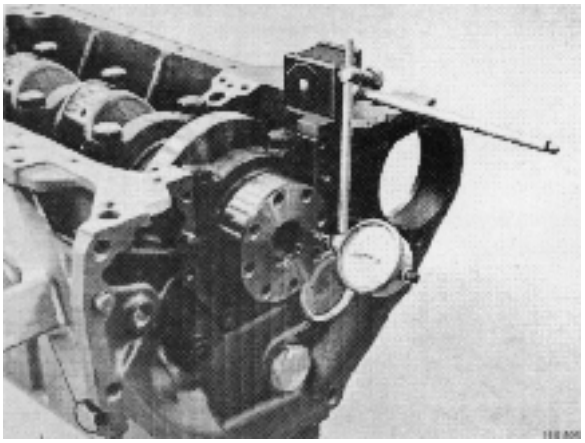
96. Put the main bearing shells in position in the block and the caps. If a spacer tube which has been removed is to be refitted, it is to be reversed.



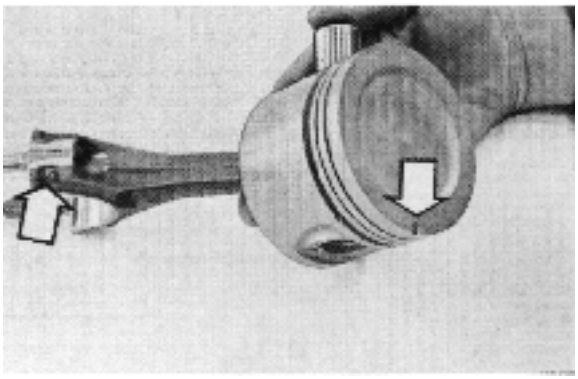
97. Fit the main bearing caps. NOTE! The main bearing caps are numbered 1–5 counted from the transmission end. Oil the screws' threads. Tighten with a torque wrench. The tightening torque is 110 Nm (11 kpm), (80 ft.lbf.)



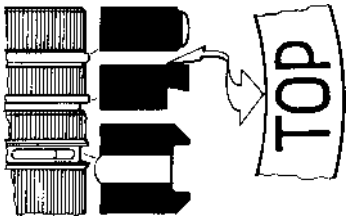
98. Check the axial clearance which is 0.037–0.147 mm (0.0014–0.0058").



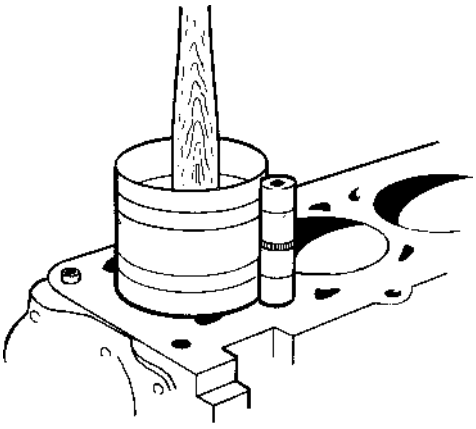
99. Refit the pistons and the connecting rods so that the marks on the pistons point forward in the engine when the figure marking on the connecting rods is turned towards the crankcase's starboard side (oil filter side). Fit the lock rings.



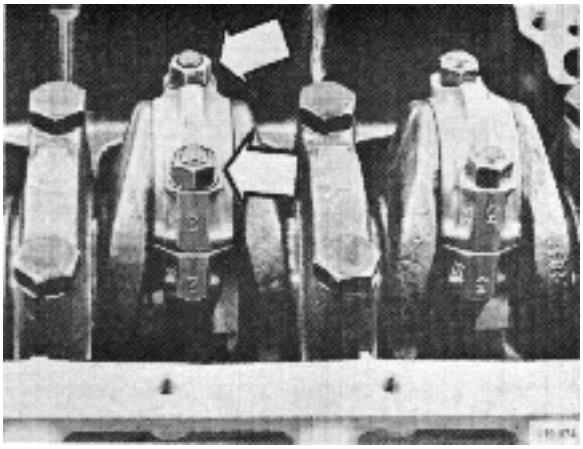
100. Fit the piston rings with piston ring pliers. The piston rings are to be fitted as shown in the picture. The upper ring is chromium-plated. The lower compression ring is marked "TOP". Turn the piston ring so that the gaps are at an angle of 120° from each other.



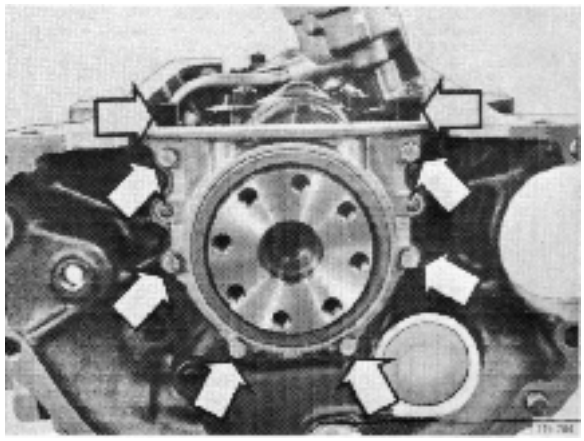
101. Fit the bearing shells in the connecting rods and the bearing caps. Oil the cylinder liners, pistons and big end bearings. Check that the markings on the pistons are directed towards the transmission cover when the piston is fitted in the cylinder. Use piston ring compressor.



102. Fit the big end bearings so that the markings on the cap agree with markings on the connecting rods. Oil the threads and tighten with a torque wrench. The tightening torque is: 63 Nm (6.3 kpm). (46.4 lbf. ft.). NOTE! When fitting new screws the tightening torque is 70 Nm (7.0 kpm). (51.6 lbf. ft.). Then check that the crankshaft can be turned.

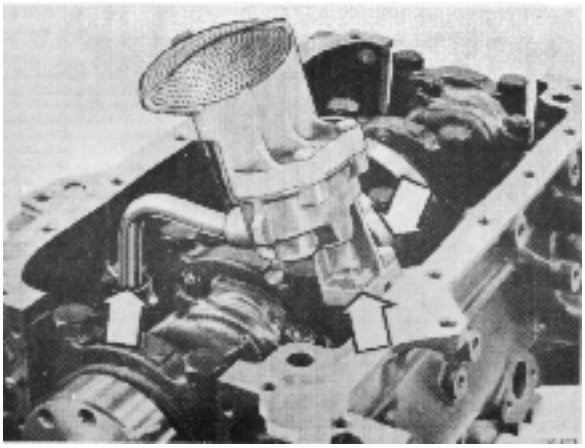


104. Fit a new sealing ring in the rear sealing flange. Use tool 999 2817. The sealing ring is to be pressed in sufficiently so that a new wear surface is obtained against the crankshaft. Then fit the sealing flange with a new seal against the engine. Lubricate the seal's rubber lip and the opposite surface on the crankshaft before fitting. Great care must be exercised so that the rubber lip is not damaged by the edge of the crankshaft or turned inside-out so that the spring jumps out of position. Cut off protruding parts on the seal.

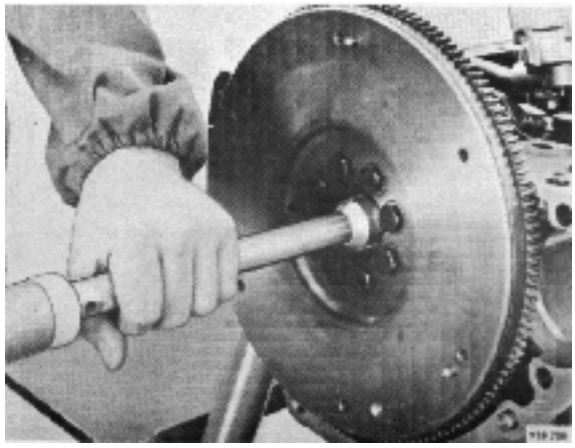


Oil pump

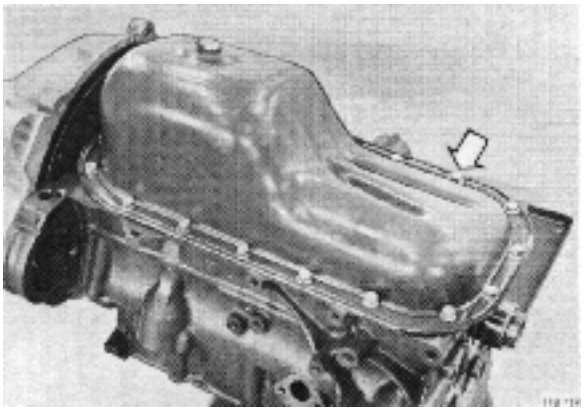
103. Fit a new sealing ring on the pipe for the oilpump. Where necessary also change the sealing ring at the other end of the pipe. Fit the pump. Make sure that the seals are not damaged. The pump is to mate properly with the crankcase before the screws are tightened.



105. Protect the inside of the flywheel with Tectyl or similar fluid and refit the flywheel. The tightening torque is 70 Nm (7 kpm) (51.6 lbf. ft.). Fit the bearing for the ingoing shaft with tool 999 1426 and then refit the washer and the lock ring for the bearing.

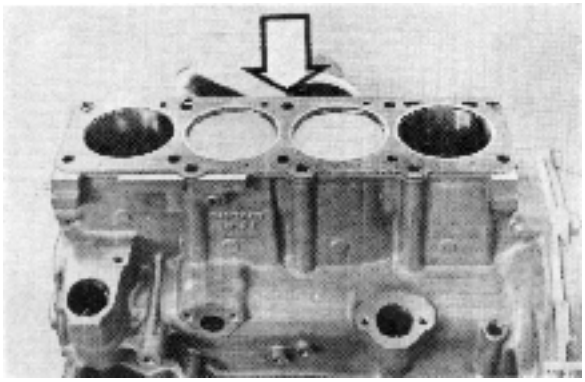


106. Fit a new gasket for the sump on the crankcase. Then replace the sump. Tighten all the screws except the four nearest the front sealing flange. The tightening force is 11 Nm (1.1 kpm) (8.1 lbf. ft.). Carefully protect the primary shaft in the flywheel cover against rust. Then refit the vibration damper and the flywheel cover and the protective plate on the flywheel cover's underside.



Cylinder head

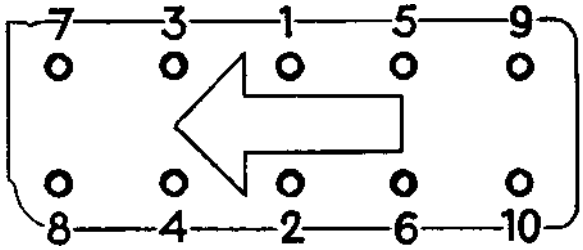
107. Clean the cylinder head surface carefully and fit a new cylinder head gasket. Then refit the cylinder head.



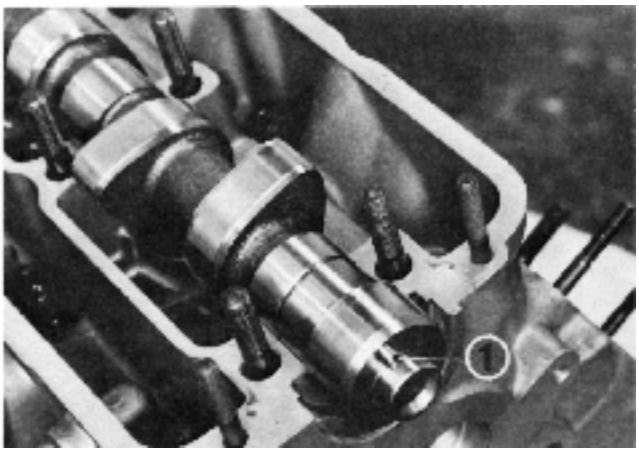
108. Lubricate the cylinder head screw threads and the washers then fit and tighten the screws. The tightening force is 90 Nm (9 kpm) (66 lbf. ft.). The tightening is to be carried out in two stages.

1. 60 Nm (6 kpm) (44.2 lbf. ft.)
2. 90 Nm (9 kpm) (66 lbf. ft.).

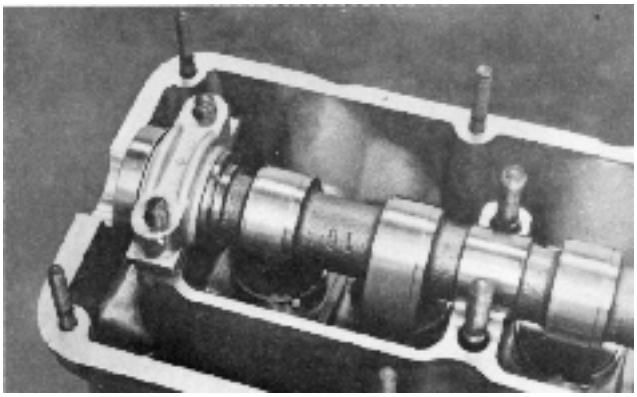
The screws are to be re-torqued after the engine has been warmed up and allowed to cool for 30 minutes. When retorquing, screws must first be loosened sufficiently so that they turn when being re-torqued. (Static friction must be overcome).



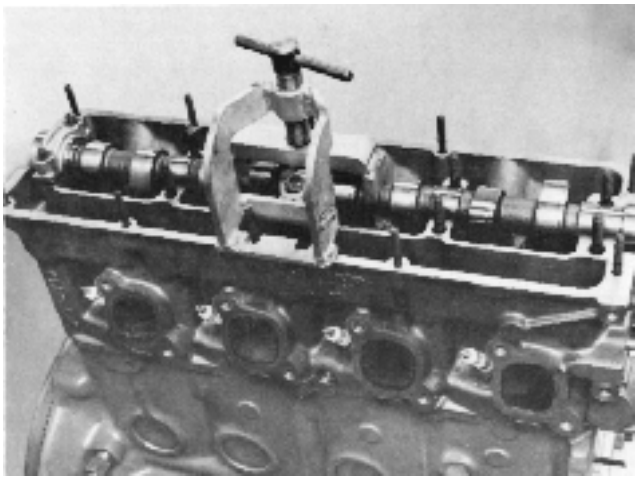
109. Oil the positions for the bearings on the camshaft. Lay the camshaft in position in the cylinder head. The pin (1) for the pulley is to be directed upwards.



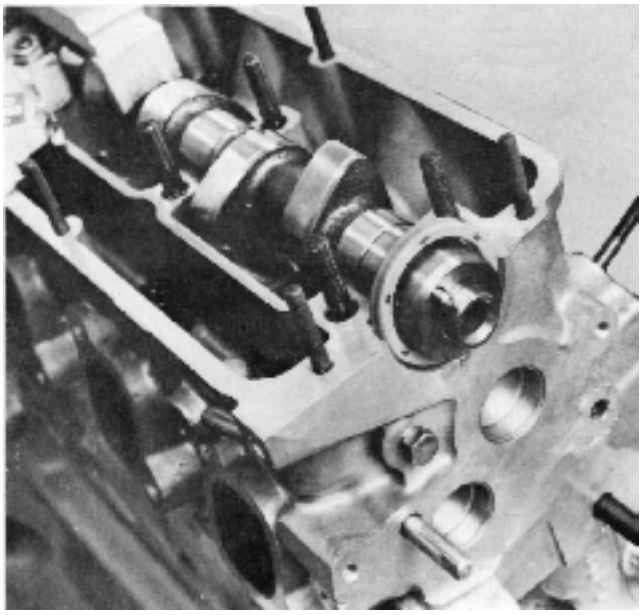
110. Oil and lay the bearing caps in position at the rear end (guide bearings).



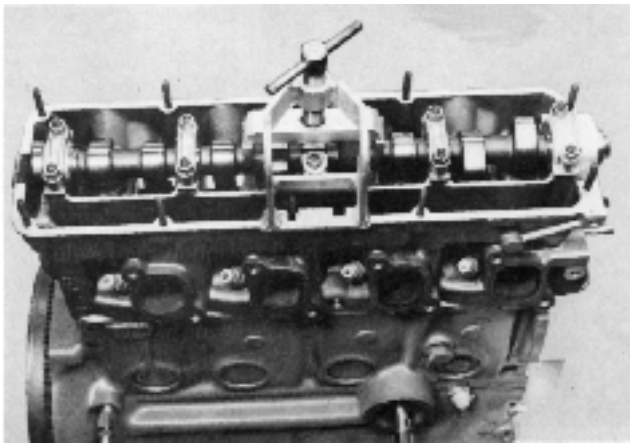
111. Fit tool 999 5021 and depress the camshaft.



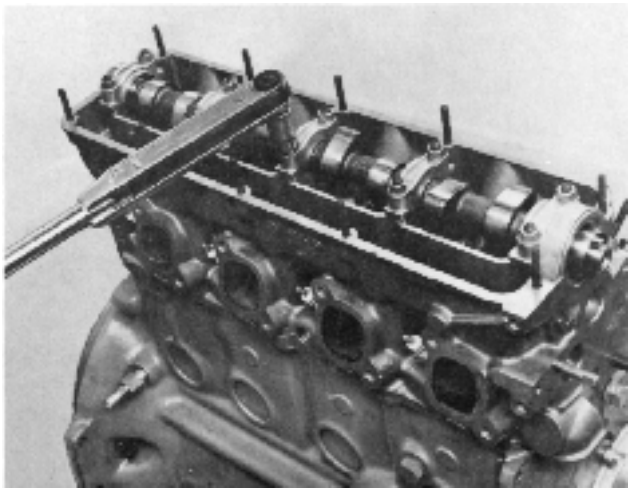
112. Lubricate the camshaft seal's rubber lip and fit it on the camshaft. Be careful so that the rubber lip is not damaged by the sharp edge when fitting it. Fit the sealing ring so that a new wear surface against the camshaft is obtained.



113. Oil and lay the other three bearing caps in position and fit the nuts for the four bearing caps. Tighten them somewhat NOTE! The forward bearing cap's surface against the cylinder head **is to be painted with sealing fluid** before it is fitted. Make sure that the seals fit correctly before the front bearing cap is tightened. Then remove the tool.

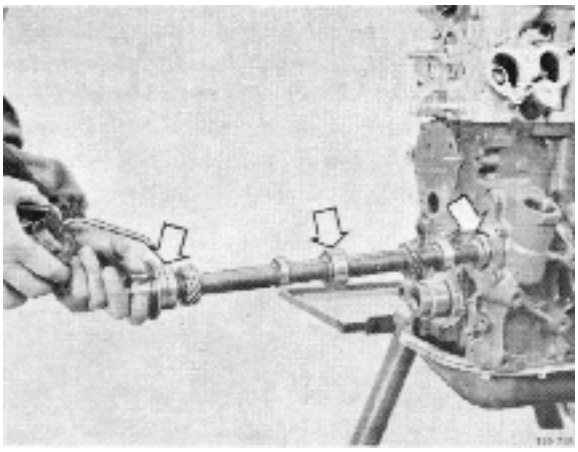


114. Oil and fit the last bearing cap. Then tighten all the nuts with a torque wrench. The tightening torque is 20 Nm (2.0 kpm) (14.7 lbf. ft.).

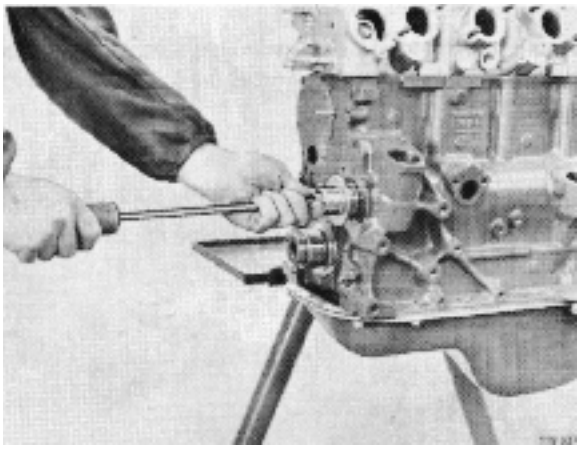


Transmission

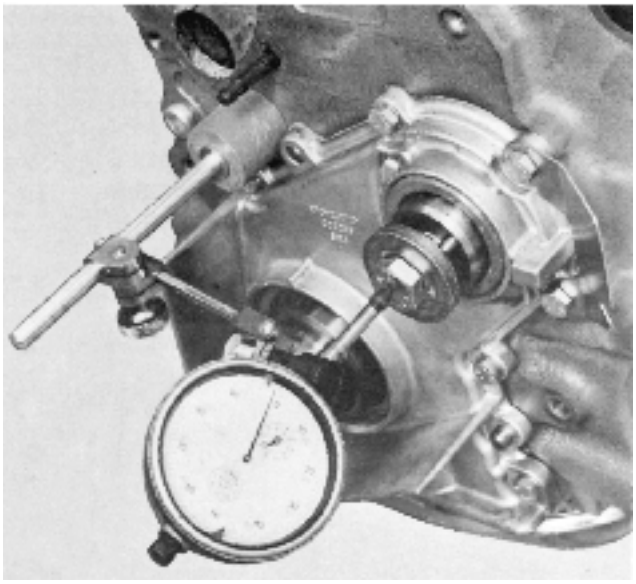
115. Oil the intermediate shaft bearings.



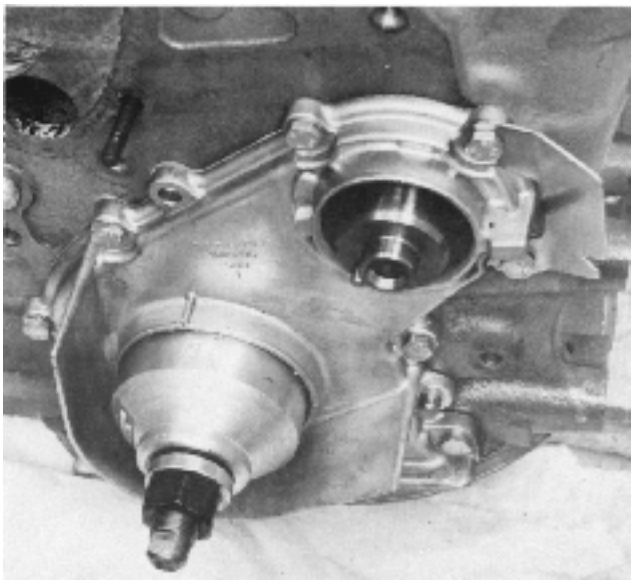
116. Push the intermediate shaft in carefully in the crankcase so that the intermediate shaft's gear wheel does not damage the bushings in the block. Use tool 999 4030.



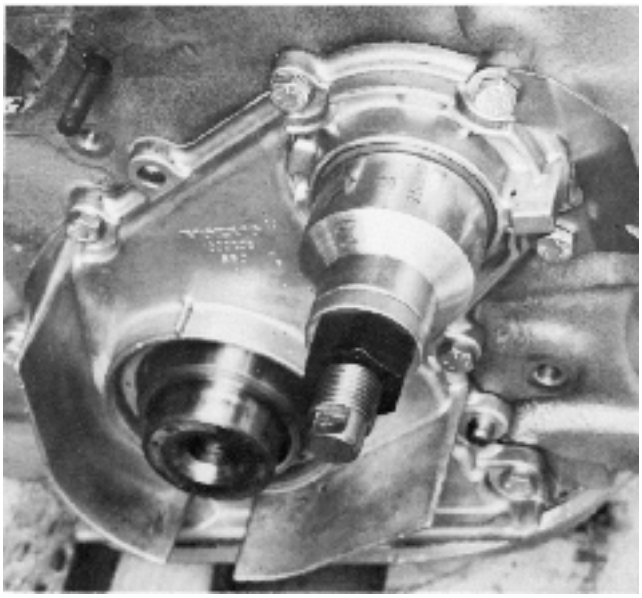
117. Fit the front sealing flange (and positioning plate) with a new gasket. The tightening torque is 10 Nm (1.0 kpm) (8.0 lbf. ft.). Then torque tighten the screws for the sump. The tightening torque is 10 Nm (1.0 kpm) (8.0 lbf.ft.).
Then check the intermediate shaft's axial clearance. The clearance is 0.20–0.46 mm (0.0079–0.0181 in.).



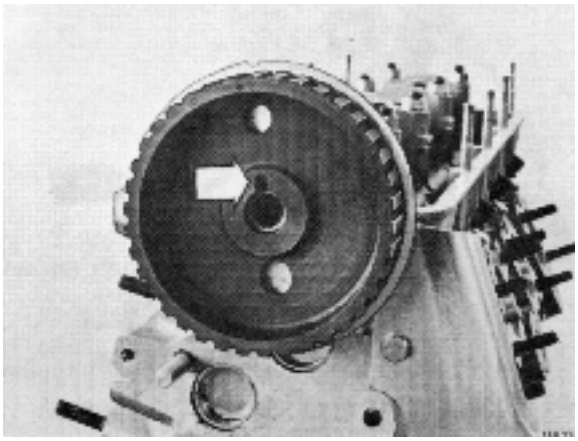
118. Fit the crankshaft seal with tool 999 5024. Lubricate the seal's rubber lip before fitting. If the spacer tube on the crankshaft has not been removed the position for the sealing ring is to be changed so that a new contact surface against the tube is obtained. Be careful when fitting the seal so that the rubber lip is not damaged and that the spring does not jump out of position.



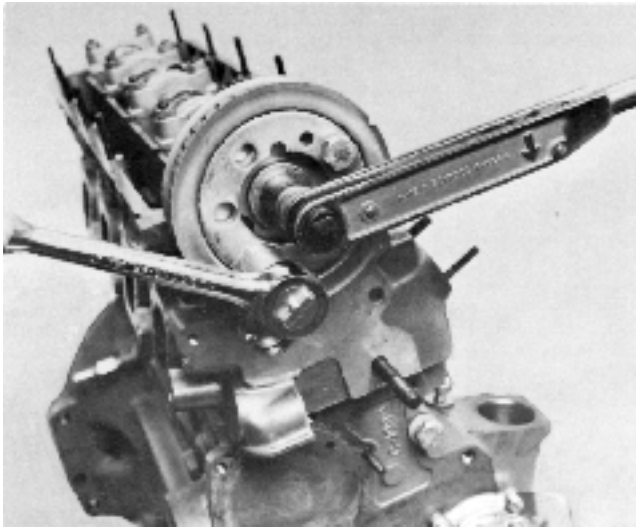
119. Fit the intermediate shaft seal with tool 999 5025. NOTE! Lubricate the seal's rubber lip before fitting. Alter the sealing ring's position in relation to its earlier position so that a new contact surface against the shaft is obtained. Be careful when fitting the seal.



120. Paint mineral grease or similar grease in the flywheel's hub and replace the flywheel and the guide plate on the camshaft. The flywheel's groove is to be fixed on the guide pin on the camshaft. NOTE! The guide plate's bend is to point backwards (against the seal).

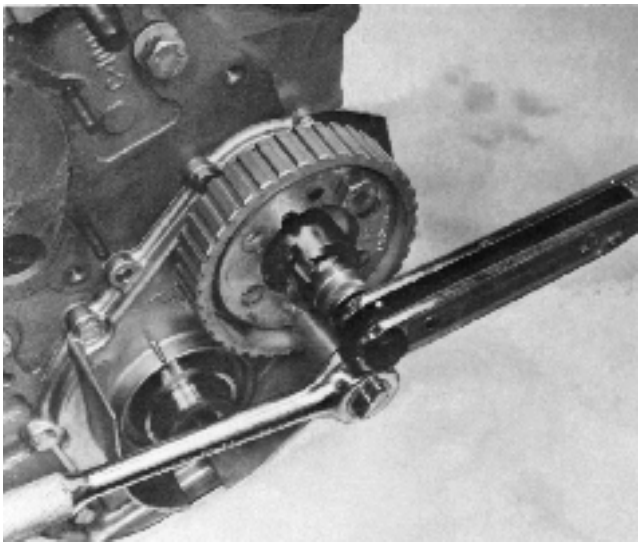


121. Fit the screw, the guide plate and the washer and tighten it with a torque wrench. Use tool 999 5034 as a counterforce. The tightening torque is 50 Nm (5.0 kpm). (36.9 lbf. ft.).

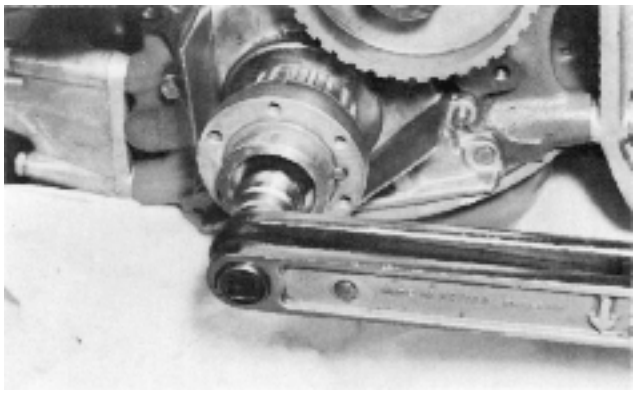


122. Paint mineral grease or similar lubricant in the pulley's hub and fit it in position on the intermediate shaft. Fit the screw and tighten it with a torque wrench.

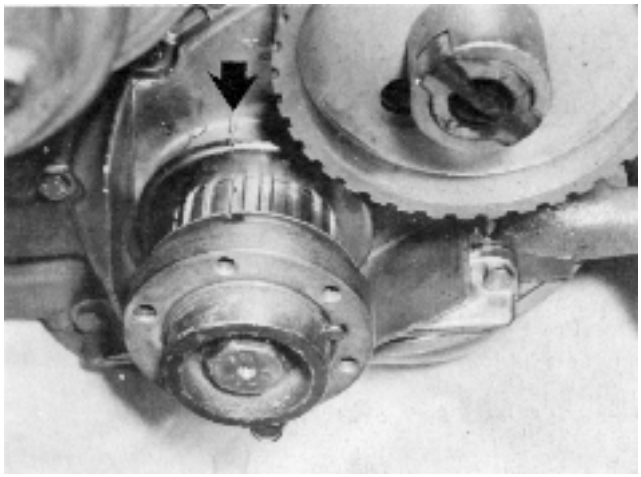
The tightening torque is 50 Nm (5.0 kpm) (36.9 lbf. ft.). Use tool 999 5034 as a counterforce. Then refit the cross piece.



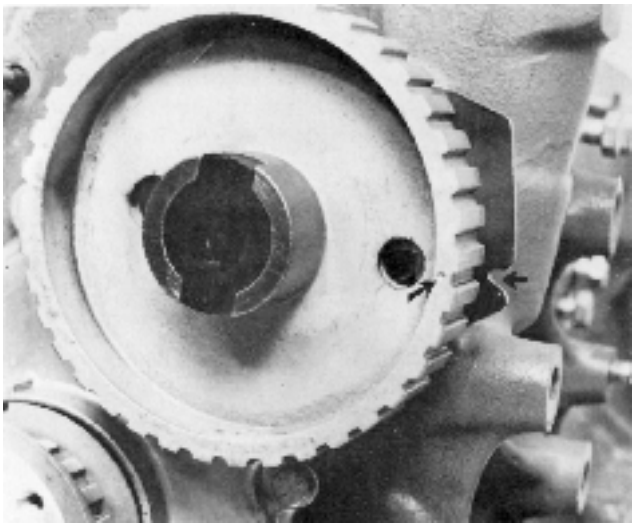
123. Paint mineral grease or similar lubricant in the hub on the crankshaft's pulley. Position the guide plate (turn the bend towards the seal) and fit the pulley on the crankshaft. Then refit the outer plate and the carrier and fit the screws. The tightening torque is 165 Nm (16.5 kpm) (122 lbf. ft.). Use a suitable counterforce.



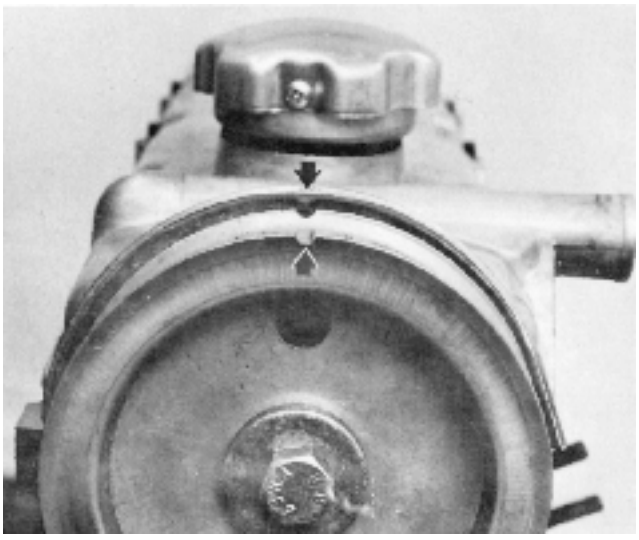
124. Turn the crankshaft into position after marking. Nick on the inner guide plate.



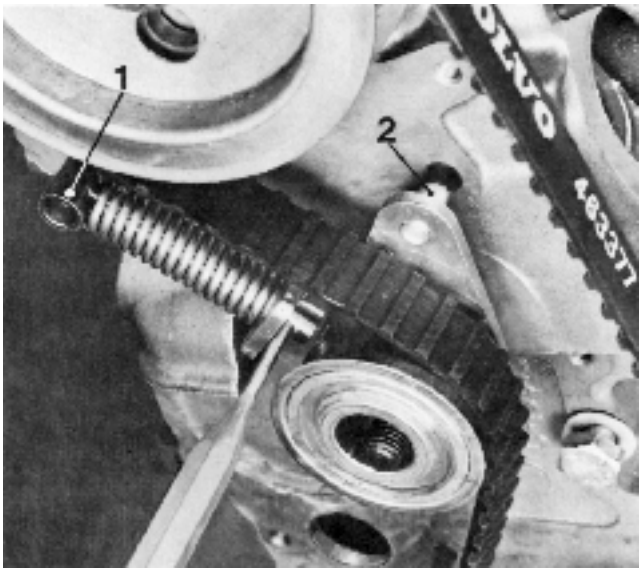
125. Turn the intermediate shaft into position after marking.



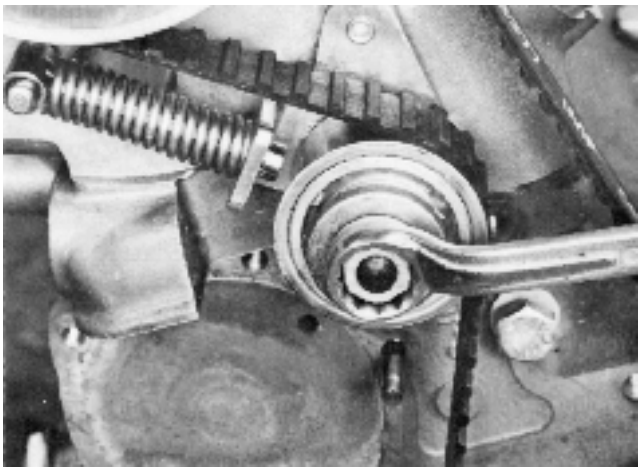
126. Place the valve cover in position without the gasket. Check that the camshaft's pulley's marking agrees with the marking on the valve cover.
Then check that the timing belt is in good condition. NOTE! Oil or grease must not be used on the belt. Coloured marks (stripes) are on the belt so that the adjustment can be checked. Line up the mark with two stripes against the crankshaft pulley's marking and then the marking with one stripe against the intermediate shaft pulley's marking and finally the marking with one stripe against the camshaft pulley's marking.



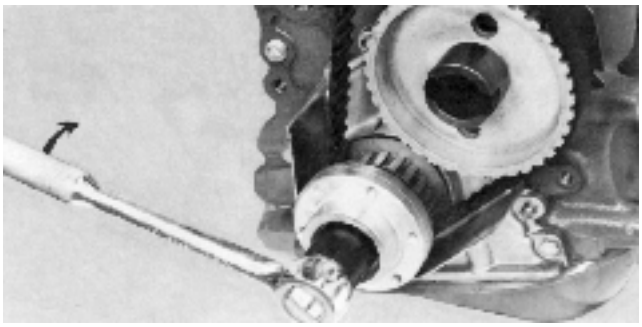
127. Then fit the belt tensioner carefully so that the belt is not damaged. Turn the belt tensioner so that the spring rod (1) can be pushed onto its shaft and the guide pin (2) can be pushed into the hole. Use no tools otherwise the belt can be damaged. Fit a washer and tighten the nut.



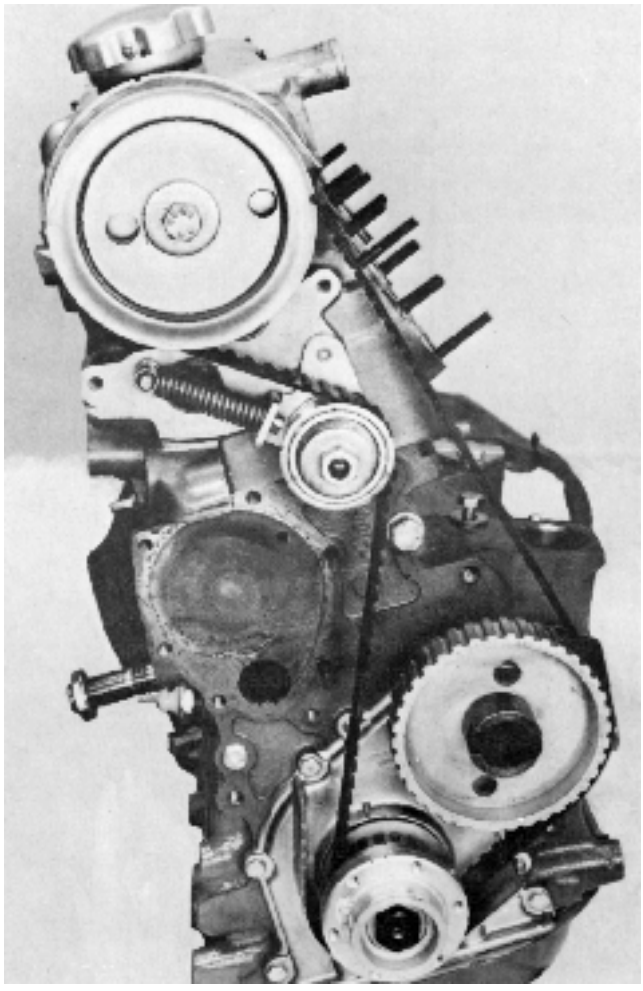
128. Compress the spring with a polygrip or similar tool and then remove the pin which has held the spring in the compressed position. Undo the nut so that the spring tensions the belt. Then tighten the nut.



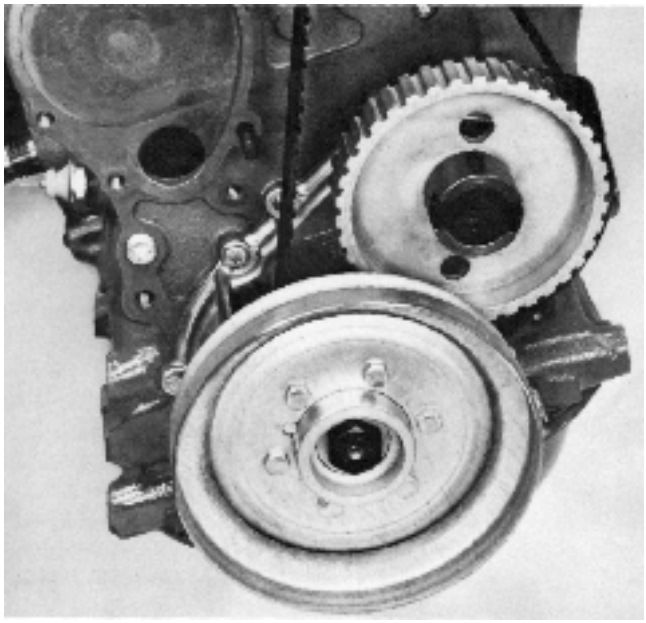
129. Turn the crankshaft clockwise a few degrees. This is to take up the backlash between the pulleys. NOTE! Do not turn the crankshaft anti-clockwise otherwise the belt can hop over teeth and alter the adjustment.



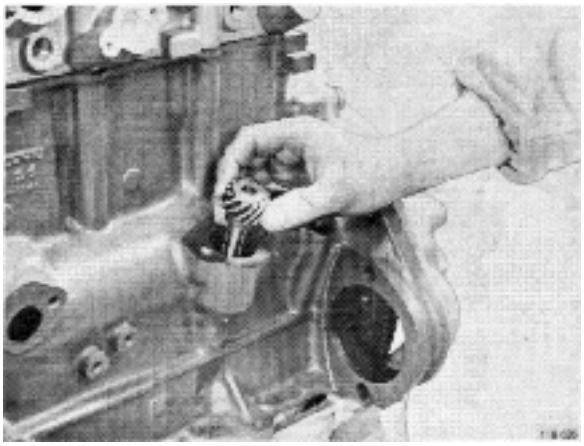
130. Loosen the nut on the belt tensioner againso that the spring tensions the belt. Check that the belt tensioner can move around its shaft. Then tighten the nut again. The tightening torque is 50 Nm (5.0 kpm) (36.9 lbf. ft.). Then rotate until the marking agrees for the crankshaft and check the marking for the intermediate shaft and the camshaft. The belt is to be tensioned once every season and to be changed every 500 hours.



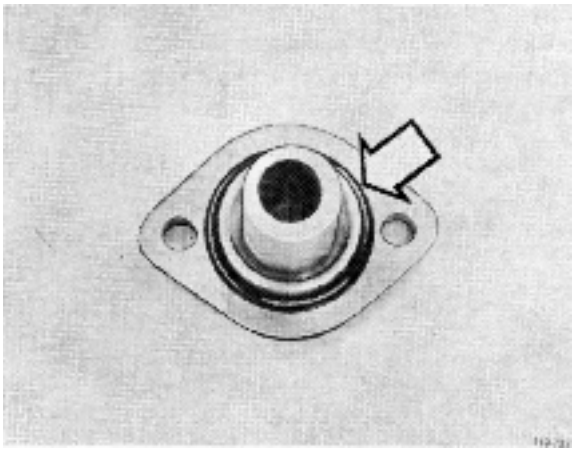
131. Refit the crankshaft pulley on the carrier.



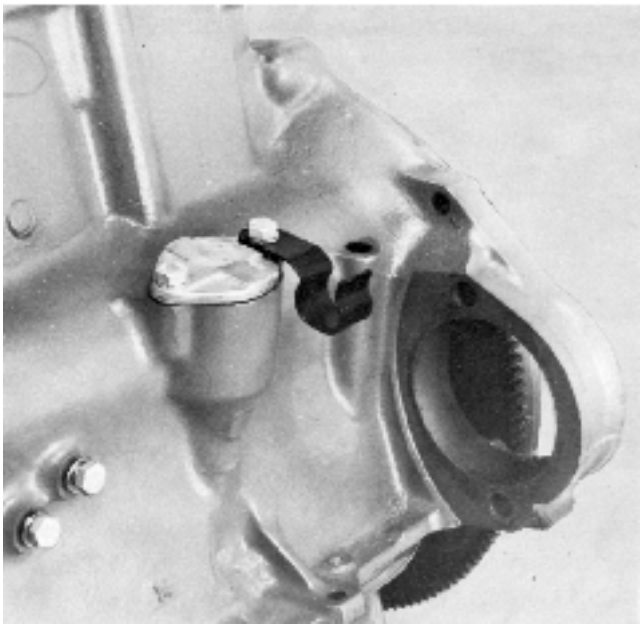
132. Fit the oil pump drive. It is possible that the crankshaft (intermediate shaft) may need to be turned somewhat so that the oil pump drive engages.



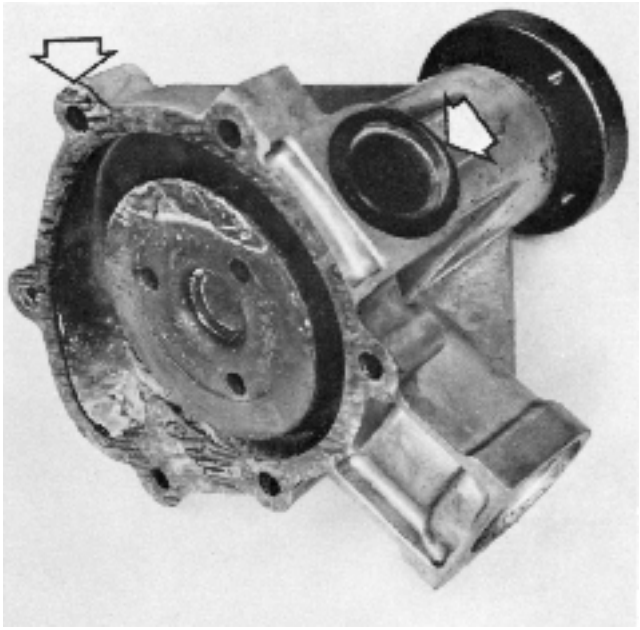
133. Fit a new O-ring on the cover for the oil pump drive.



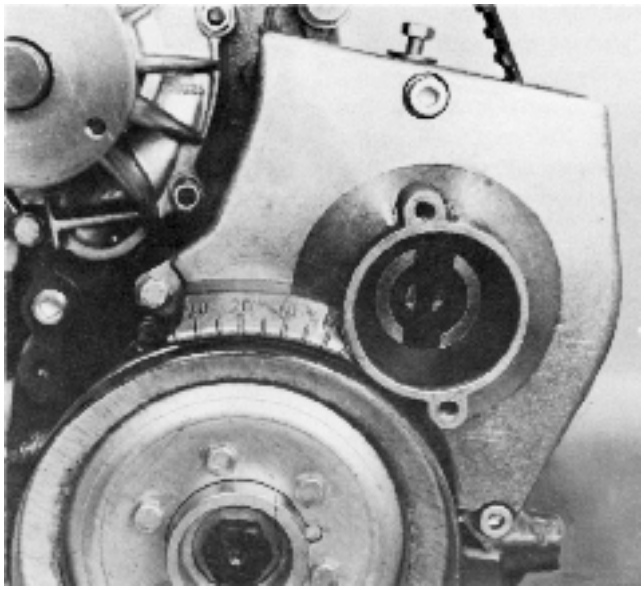
134. Fit the cover and the brackets for the cooling water pipe. NOTE! Check first that the cover's pressure surface (which presses against the oil pump drive) is not worn.



135. Fit a new rubber ring and gasket on the circulation pump. Fit the pump to the engine. Press the pump upwards against the cylinder head and tighten the screws and nuts.

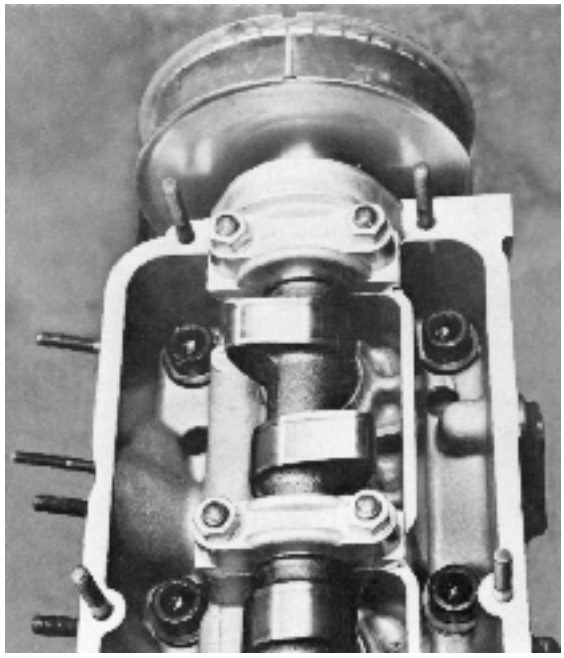


136. Fit the cover (with the firing position marking).



Valve adjustment

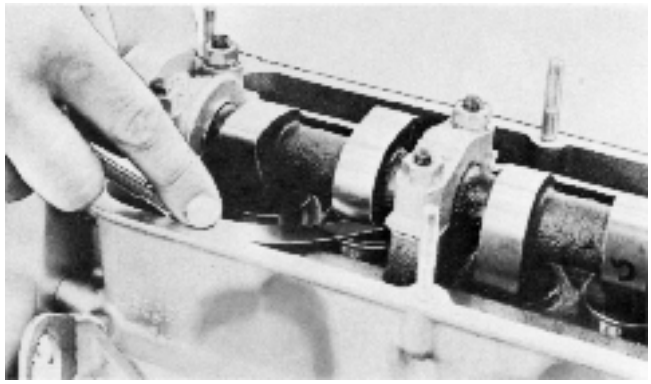
137. Lift off the valve cover. Turn the camshaft to the position for firing on No. 1 cylinder. Both the cams for No. 1 cylinder point obliquely upward at equal angles. The timing pulley's timing position is 0°. NOTE! Always turn on the crankshaft's centre screw.



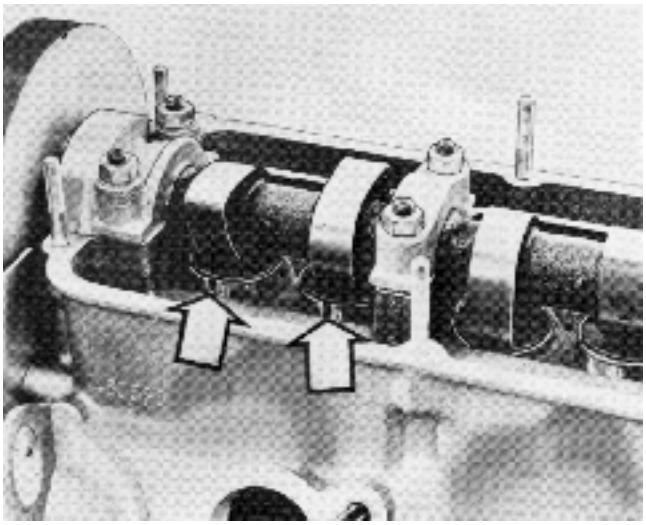
138. Measure the valve clearance with a feeler gauge for No. 1 cylinder.

Clearance when checking:
Cold engine: 0.25–0.45 mm (0.010–0.018 in.)
Hot engine: 0.30–0.50 mm (0.012–0.020 in.)
adjustment not necessary

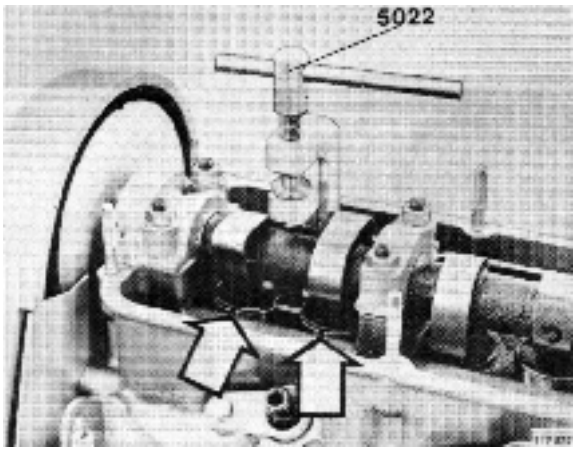
Clearance when adjusting:
Cold engine: 0.35–0.40 mm (0.014–0.016 in.)
Hot engine: 0.40–0.45 mm (0.016–0.018 in.)
The clearance is the same for inlet and exhaust valves.



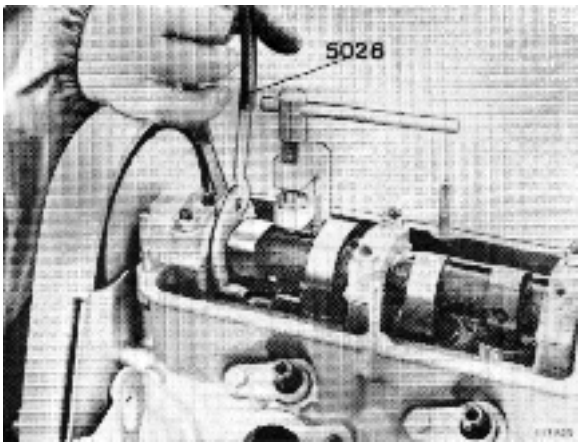
139. If the clearance is incorrect the adjustment shims are to be changed as follows: Turn the valve pusher so that the groove is at right angles to the camshaft's length.



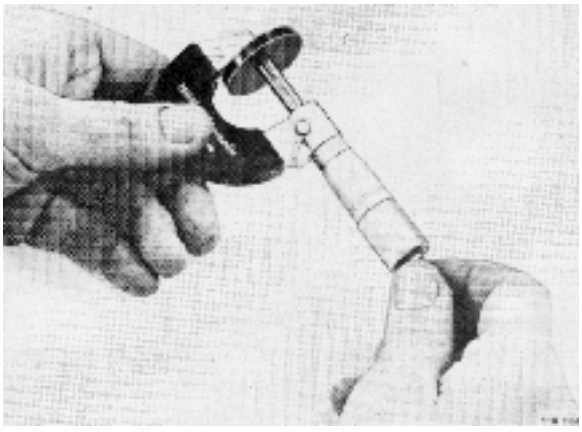
140. Fit tool 999 5022 and depress the valve pressers. Screw the tool spindle down and adjust its length so that the presser's groove lies over the edge and is accessible with the pliers.



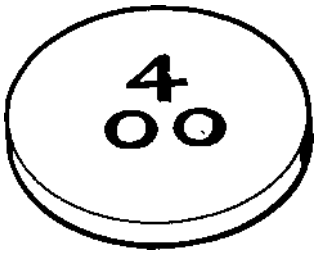
141. Remove the shim with pliers 999 5026.



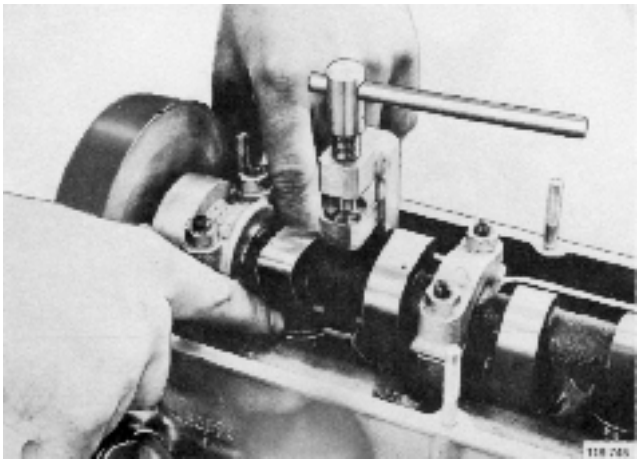
142. Measure the thickness of the shim with a micrometer. Calculate the thickness of the shim which gives the right clearance.
Ex: Measured clearance: 0.30 mm, (0.012 in.), correct clearance: 0.40 mm (0.016 in).
Clearance difference: –0.10 mm (0.004 in.).
Measured thickness on the existing shim: 3.80 mm (0.150 in.).
Correct thickness of the new shim: 3.80–0.10 = 3.70 mm. (0.150–0.004 = 0.146 in.).



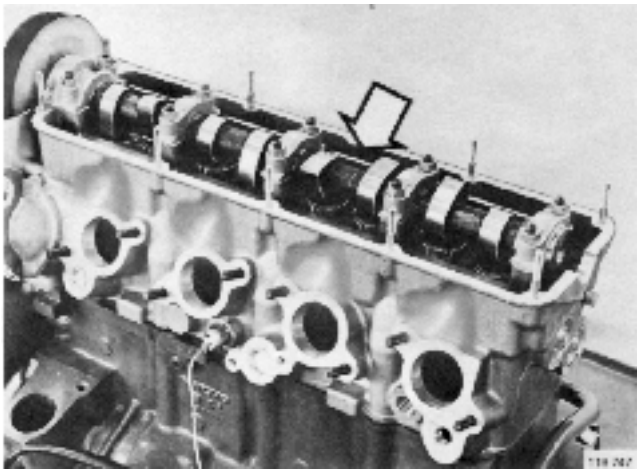
143. The shims are available in different thickness between 3.55–4.20 mm (0.140–0.166 in.) at intervals of 0.05 mm (0.02 in.).
NOTE! The shims are to be fitted with the marking downwards. Complete valve adjustment set. Part No. 884 516. (See page 61).



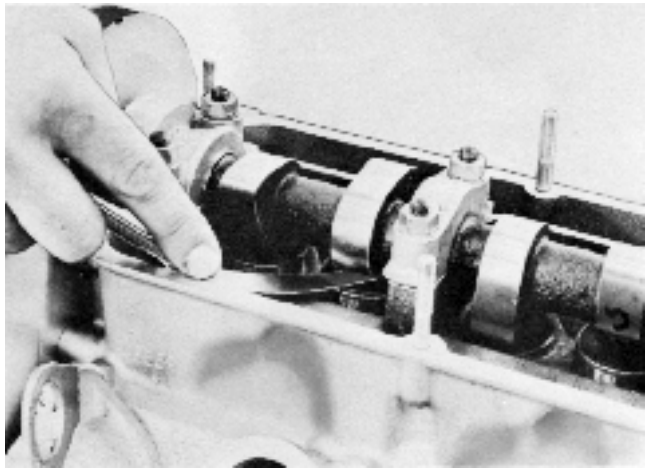
144. Oil the new shim and lay it in position.



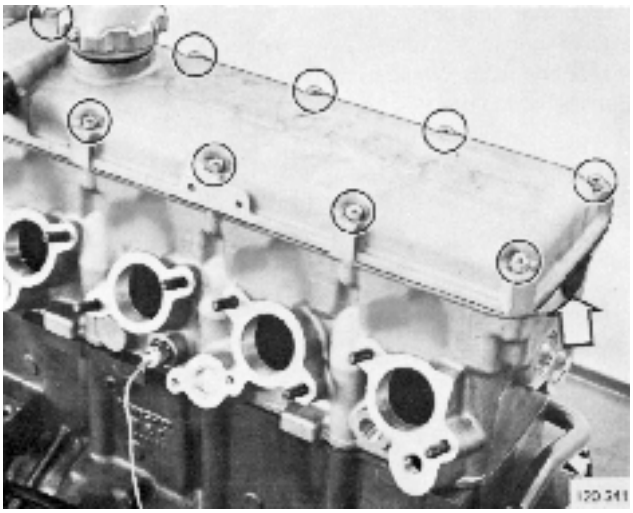
145. Remove tool 999 5022. Turn the cam position in the position for firing on cylinder No. 3. Measure the clearance with a feeler gauge and rectify where necessary according to the instructions above. Repeat the operations on cylinders No. 4 and 2 in the stated order.



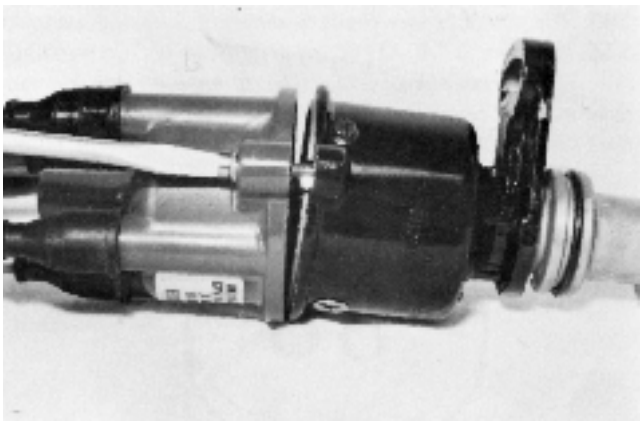
146. Check the clearance for all the valves. NOTE! Turn the camshaft a few times before checking.



147. Place the gasket and crescent-shaped rubber seal in position and fit the valve cover.

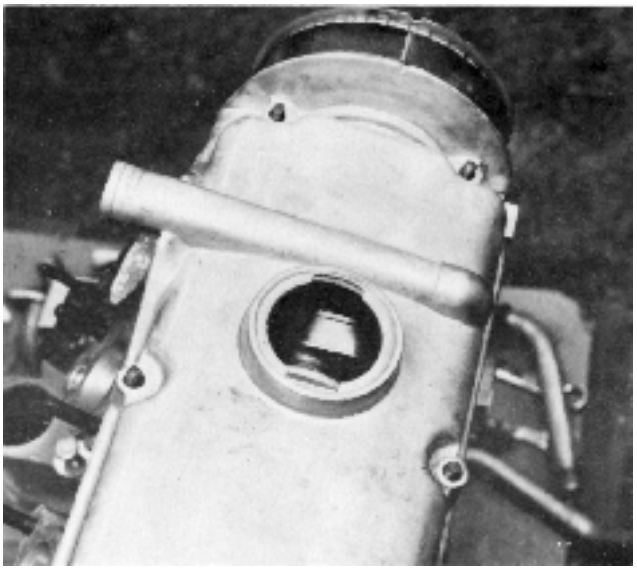


149. Remove the distributor cap.

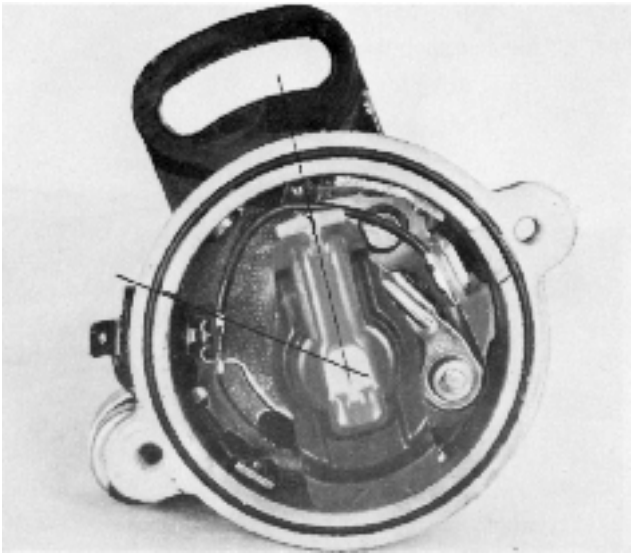


Distributor

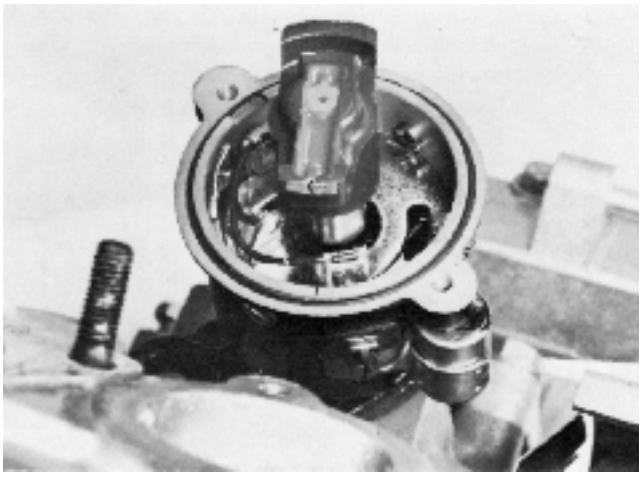
148. Turn the crankshaft to the firing position for No. 1 cylinder. Check this by unscrewing the oil filler cap and seeing how the camshaft's cams are positioned and by checking the marking on the pulley. See also point 138.



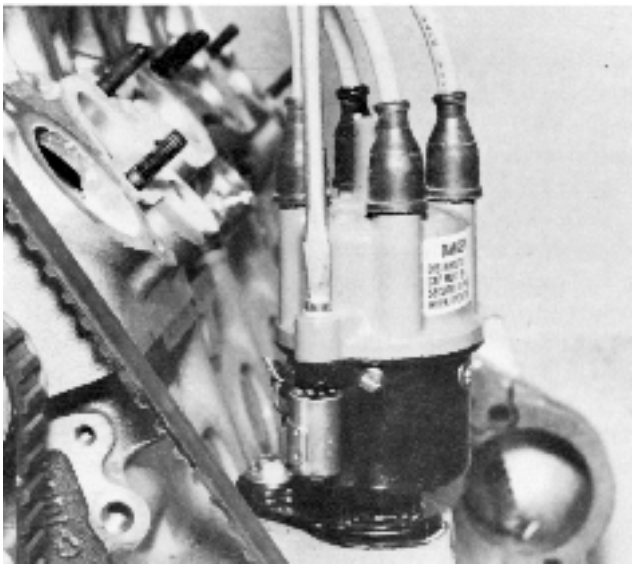
150. Turn the rotor so that the line on it is at 60° from the line on the distributor.



151. Press the distributor into position in the crankcase and check that the line on the rotor and the line on the distributor housing are opposite each other. Tighten the distributor in this position.

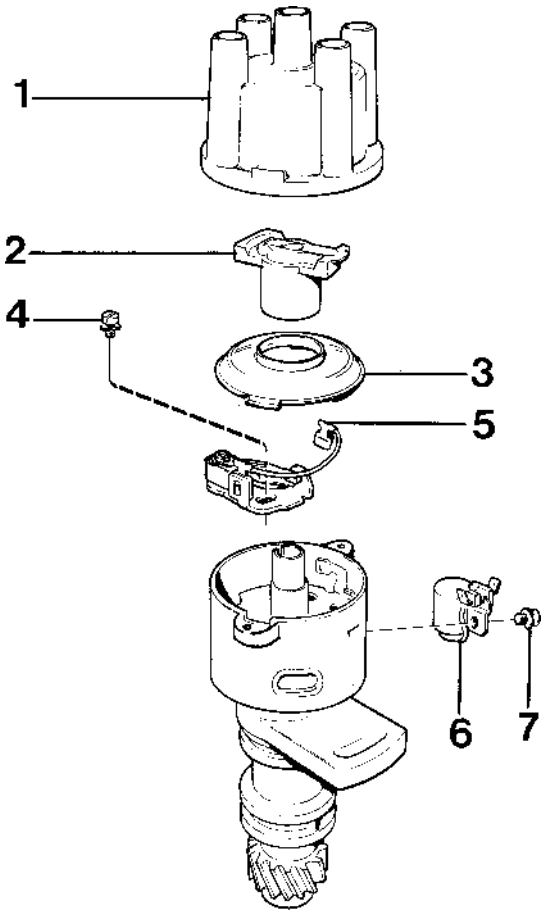


152. Fit the distributor cover.

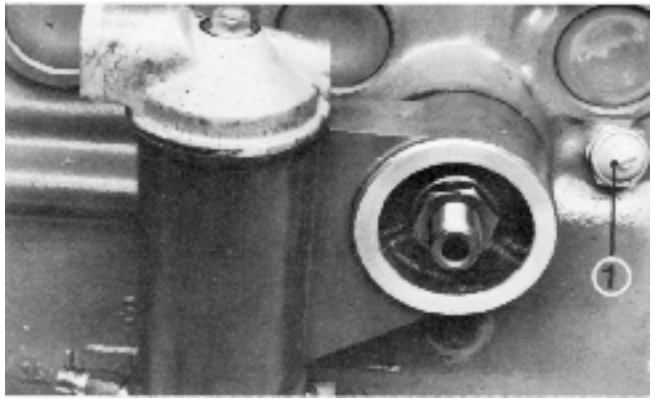


Replacing contact breakers

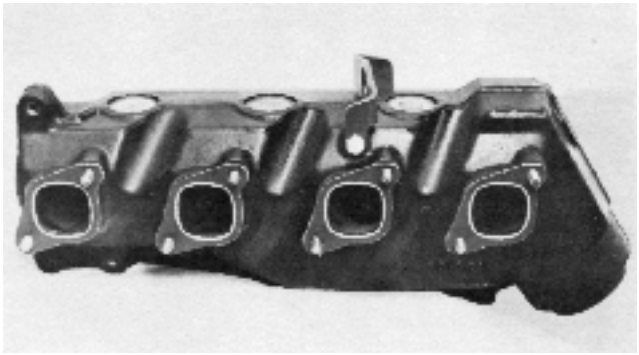
153. Remove the distributor cover (1), rotor(2) and the washer (3). Then undo the screw (4) and the tab connection (5) and then remove the contact breakers. Fit a new breaker set. The contact breaking gap is 0.40 mm (0.016 in.). Change the condenser (6) at the time by undoing the screw (7). Tighten a new condenser and connect the tab connection and replace the washer. Press the rotor in position and refit the distributor cap.
NOTE! The cam angle is checked and adjusted during test running. See “Technical Data”



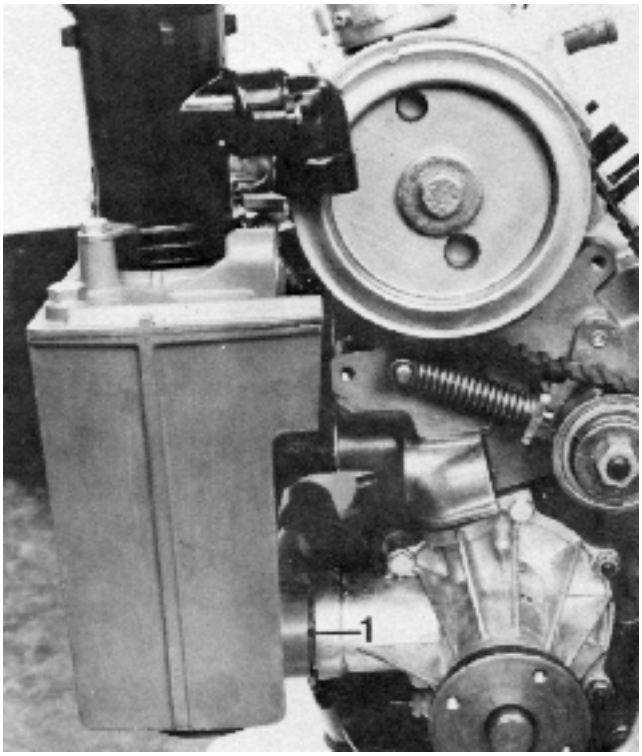
154. Fit the oil pressure sender (1). The tightening torque is 12 Nm (1.2 kpm) (8.9 lbf. ft.). Lay a new O-ring in the oil cooler’s groove and fit the oil cooler to the engine. Do not tighten the nut before the cooling water pipe has been fitted. Only AQ145.



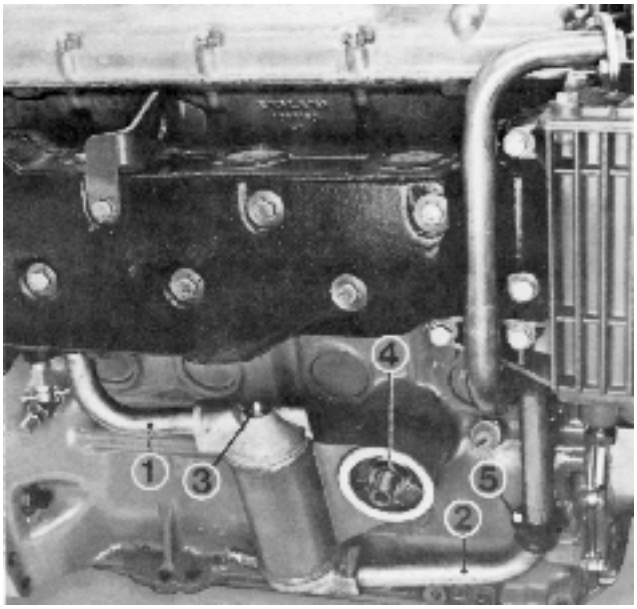
155. Place the screws in the exhaust pipe and hang the gasket in position. NOTE! The marking “UT” is turned outwards. Then fit the pipe to the engine. A lifting eye is fixed with one of the screws.



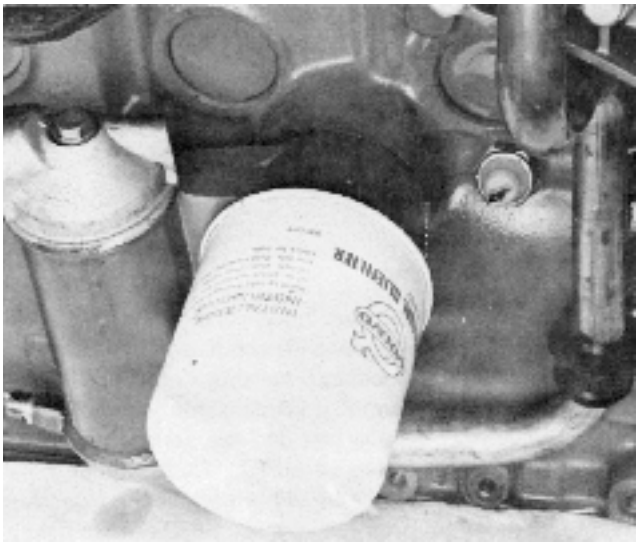
156. Lay a sealing ring on the heat exchanger’s pipe (1) and press the pipe into the circulation pump and screw the heat exchanger to the exhaust pipe.



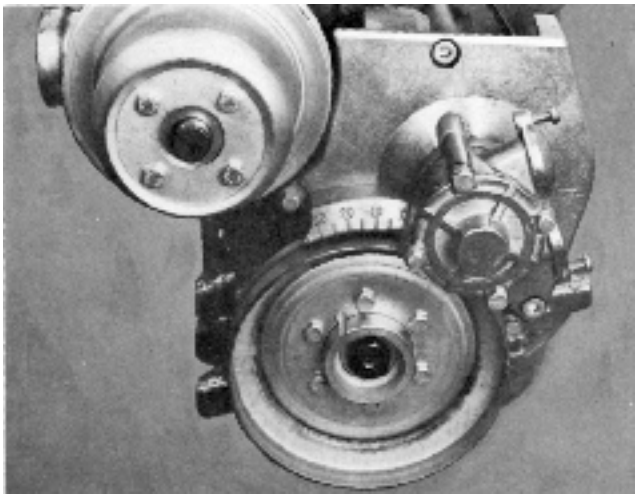
157. AQ145. Fit the cooling water pipes (1) and (2) between the oil cooler and the exhaust pipe and heat exchanger respectively. The cooling water pipe for AQ125 is connected from the exhaust pipe to the heat exchanger. It may be necessary to undo the centre screw (3) in the oil cooler’s cover in order to align the cooling water pipes. Then tighten all the screws. Tighten nut No. 4 as well. Fit the engine mountings. Make sure that the rubber bush 5 on the cooling water pipe comes into the right position.



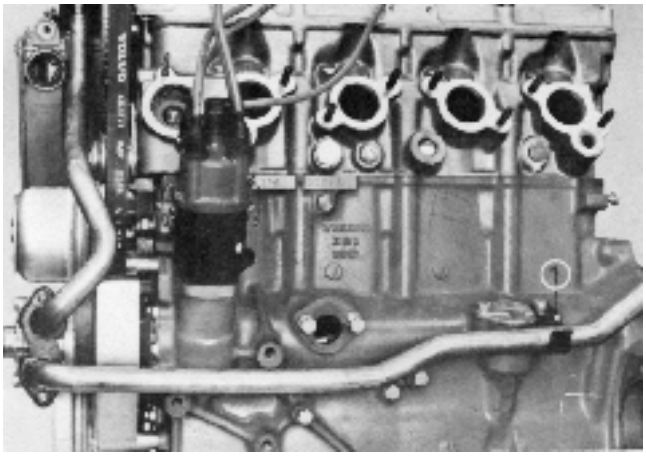
158. Oil the lubricating oil filter’s rubber packing and screw the filter in sufficiently so that the rubber packing just comes into contact with the engine body. Then screw it another half turn by hand. Check the oil pressure and for leakage around the oil filter during the first test run.



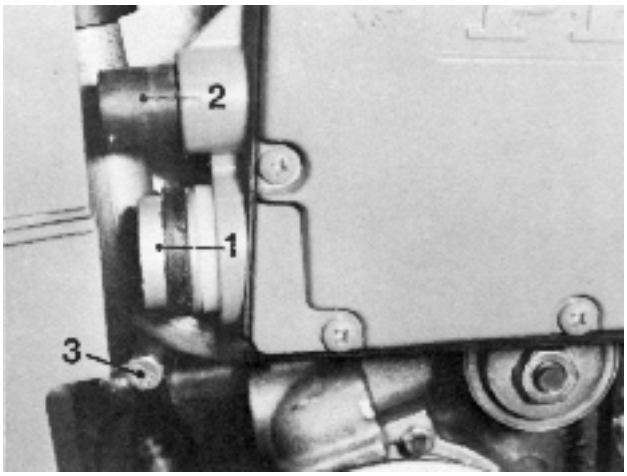
159. Fit the pulley on the circulation pump and then the seawater pump.



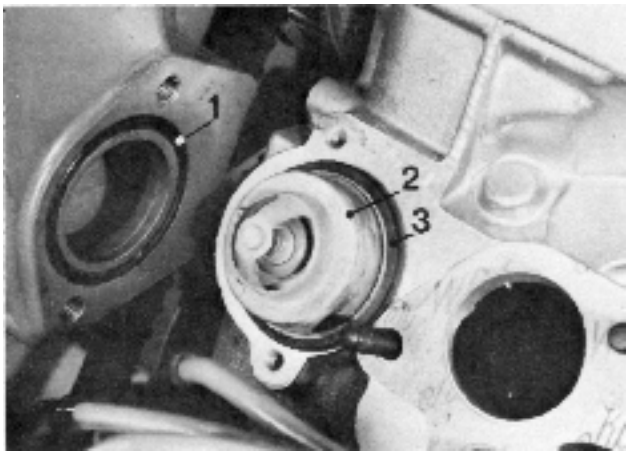
160. Fit the ingoing and outgoing cooling water pipes to the salt water pump and press the ingoing pipe into the bracket (1).



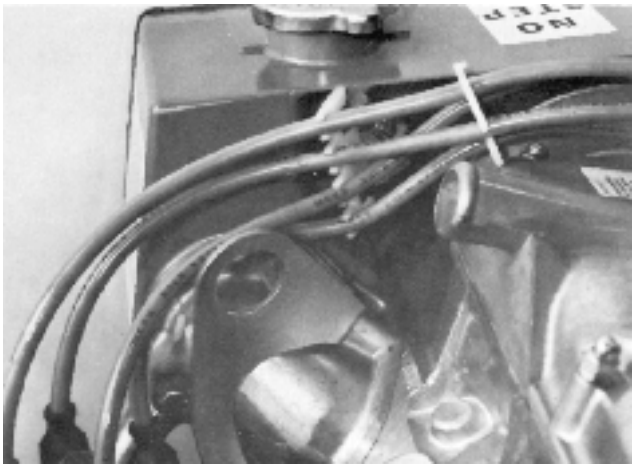
161. Fit a spacer ring and two sealing rings on the expansion tank's outgoing water pipe (1) and press in the tank's guide pin and pipes in the heat exchanger. The guide pin (2) is made of rubber. At the same time check that the support screw (3) has a plastic sleeve.



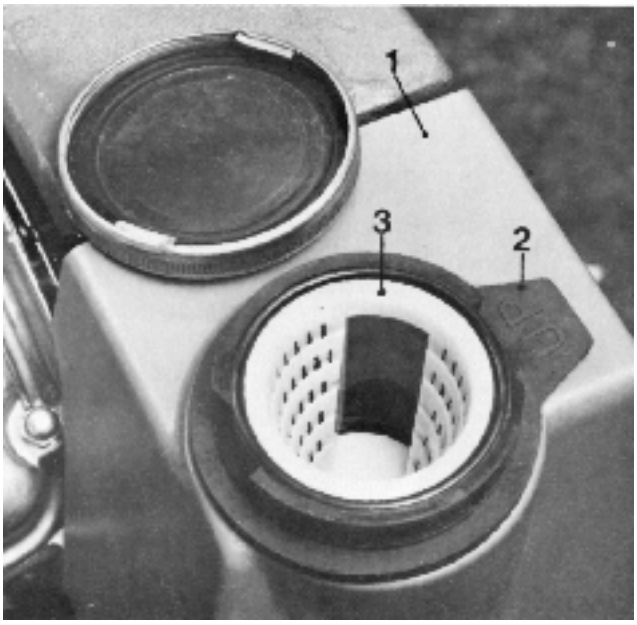
162. Place an O-ring (1) on the expansion tank and fit the thermostat (2). When necessary the opening temperature of the thermostat is checked by lowering it in hot water. At a temperature of 82°C (180°F) it must begin to open and must be fully open at 92°C (198°F). Check that the rubber seal (3) is not damaged when the thermostat is fitted. NOTE! The forward lifting eye is fitted on the thermostat housing.



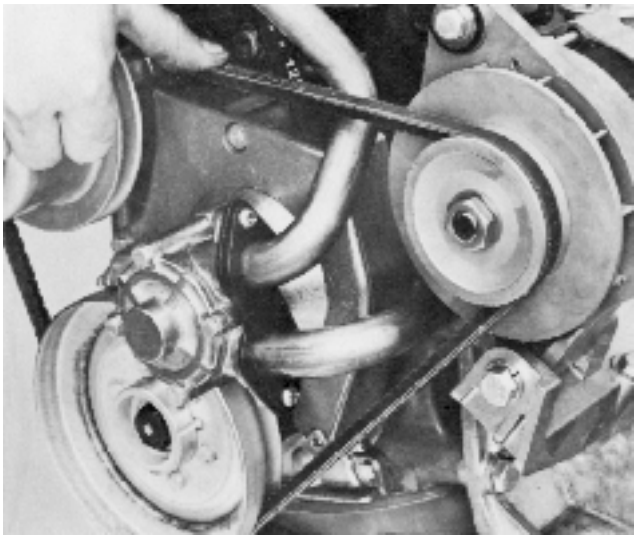
163. Connect the cables to the spark plugs.



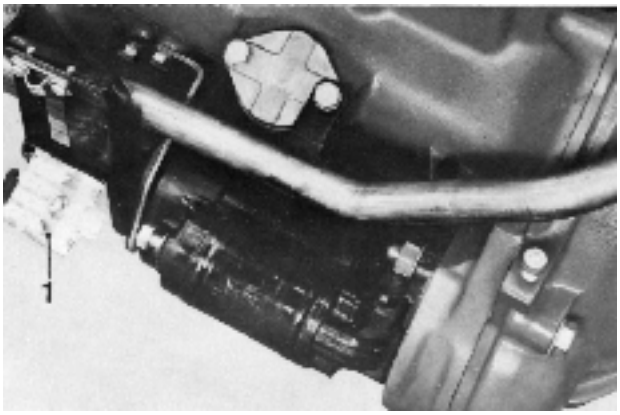
164. AQ145. Lay the cover (1) on the heat exchanger and slide over the rubber ring (2) so that the cover is held in position. NOTE! The rubber ring is to be turned with the marking “UP” upwards. Place the strainer (3) properly cleaned as shown in the picture. Screw on the cover. NOTE! If the strainer is incorrectly fitted the cover cannot be screwed in position.



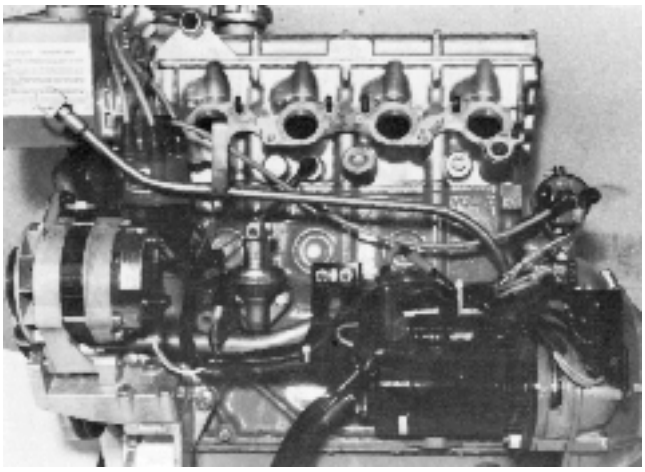
165. Fit the fuel pump. Use new gaskets. Fit the tensioning bar and the engine mounting with the bracket for the alternator. Then tighten the alternator in position and fit and tension the belt so that it can be depressed approximately 5 mm (0.2 in) with normal thumb pressure.



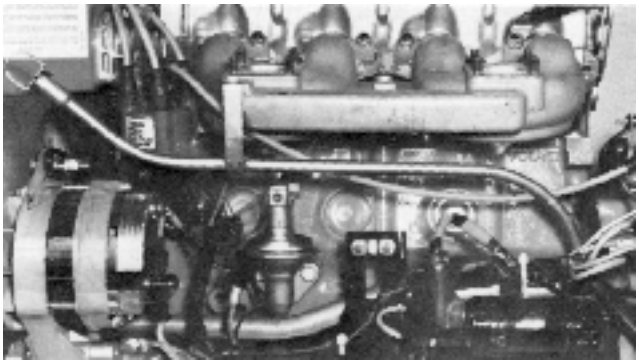
166. Fit the starter motor. The main fuse (1) is on the starter motor’s front bracket. The picture below shows the USA version.



167. Fit the oil dipstick sleeve in the crankcase. NOTE! The bracket for the ignition coil is to be fitted on the flywheel cover's upper side in the existing screw holes. (Screw diameter 5/16 UNC length 19 mm) (3/4"). Then fit the ignition coil and the cable loom. Connect all the cables and clamp the cable loom in position.

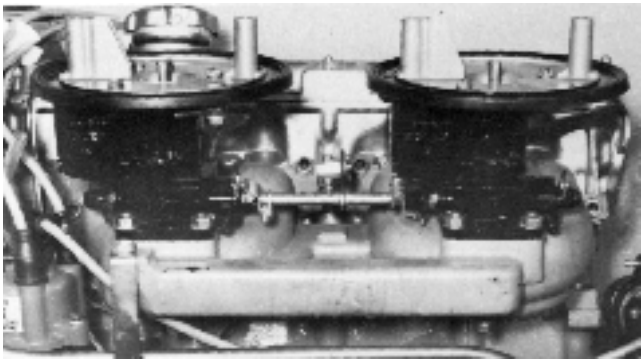


168. Lay the gaskets for the induction pipe in position. Fit the induction pipe with the lifting eye on the rear studs. Tighten the nuts with a torque of 20 Nm (2 kpm) (14.8 lbf. ft.). Fit the oil dipstick sleeve in the induction pipe.

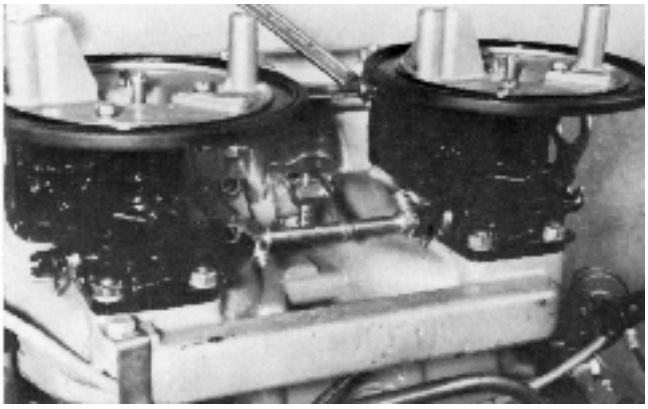


169. AQ145. Fit the carburetors to the induction pipe. Fit the throttle rod between the carburetors. Use new gaskets.

AQ125. Fit the carburettor to the induction pipe. Use new gasket. NOTE! On engines having main jet (165) and venturi jet (190) installed, a spacer washer with a gasket on each side must be installed between the carburetor and the inlet manifold.

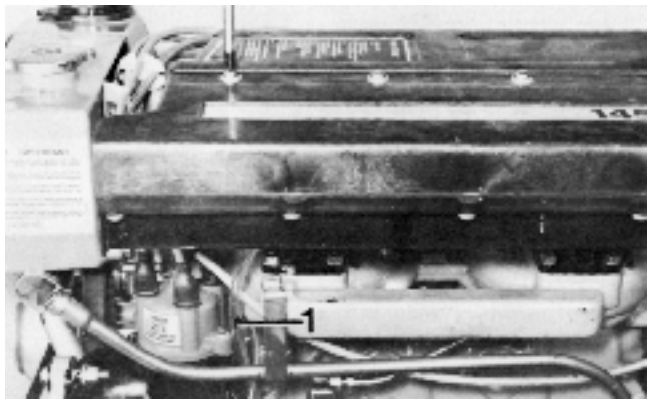


170. Fit the fuel pipe between fuel pump and the carburetor. Make sure that all sealing washers are fitted.



171. AQ145. Fit the rubber rings and place the air filter on the carburetors and also fit the induction silencer.

AQ125. Fit the rubber ring, the air filter and the cover on the carburetor. Connect the hose (1) between the fuel pump and the carburetor. Even AQ145.



172. Close all drain cocks. Replenish the oil and the water in the engine. See the instruction book for oil quality and viscosity.

Test run the engine and carry out all the necessary checks which are stated for delivery service in the warranty certificate.

ELECTRIC WIRING DIAGRAM
INSTRUMENT PANEL ENGINE

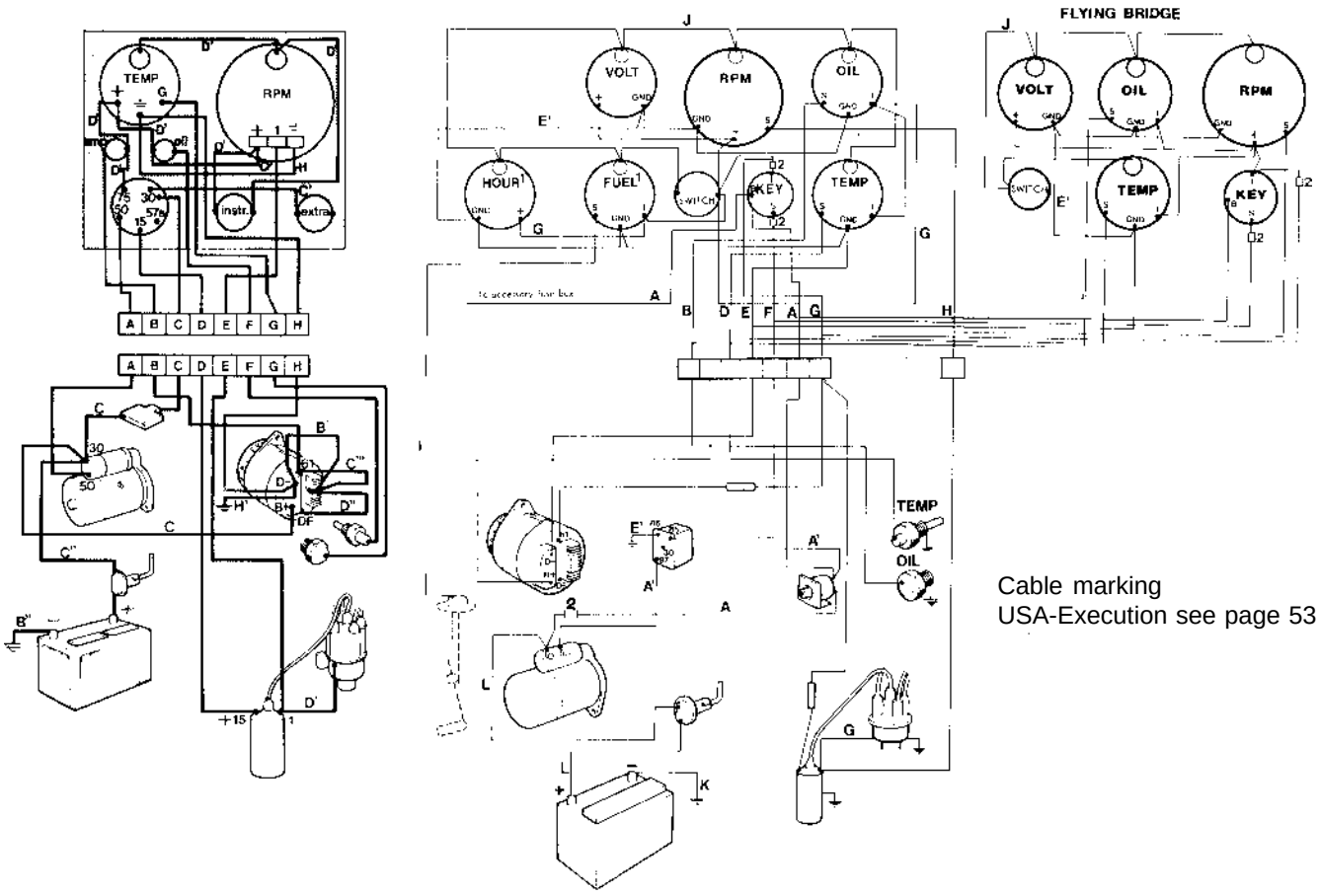
Position list

1. Key switch with start button
2. Switch for instrument lighting
3. Temperature gauge
4. Oil pressure warning lamp
5. Tachometer
6. Charging warning light
7. Switch (extra)
8. Junction box
9. Battery
10. Main switch
11. Starter motor
12. Charging regulator
13. Alternator
14. Fuse
15. Oil pressure sender
16. Temperature sender
17. Ignition coil
18. Distributor

Cable marking

Design.	AWG	Colour	mm²
A	9	Ivory	6
B	15	Black	1.5
B'	19	Black	0.6
C	9	Red	6
C'	13	Red	2.5
C''	1	Red	35
D	13	Green	2.5
D'	15	Green	1.5
D''	19	Green	0.6
E	15	Grey	1.5
F	15	Yellow	1.5
G	15	Brown	1.5
H	15	Blue	1.5
H'	11	Blue	4

USA-Execution



Cable marking
USA-Execution see page 53

Fault finding chart

Engines does not start	Engine stops	Engine does not reach correct speed at full throttle or engine knocking	Engine runs unevenly or vibrates abnormally	Engine becomes abnormally hot	CAUSE
X					Main switch not connected; discharged battery, break in electrical cables or main switch.
X	X				Empty fuel tank fuel cock closed, blocked fuel filter.
X	X		X		Water or contamination in the fuel.
X	X	X	X		Defective spark plugs.
X					Burnt contact breakers, moisture in the distributor and ignition cables.
	X		X		Idling speed not correctly adjusted.
		X			Defective tachometer.
		X			Boat abnormally loaded.
		X			Weed growth on the boat hull and on the outboard drive.
			X		Damaged propeller.
				X	Blockage in the cooling water intake, oil cooler (AQ145), cooling jackets, heat exchanger. Defect impeller or thermostat fluid level too low in the expansion tank.
		X			The fuel quality is not corresponding to the ignition setting.

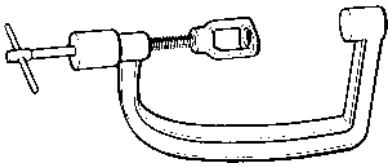
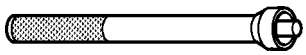
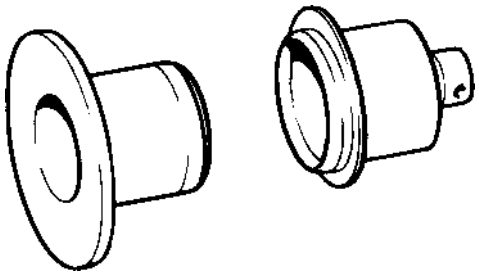
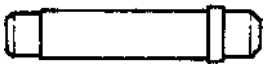
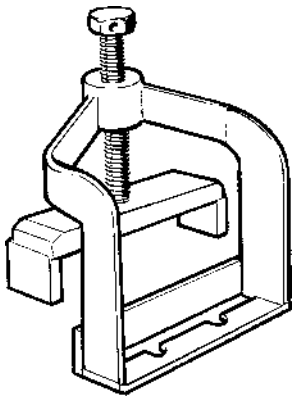
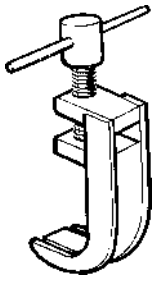
Cable Colour Code

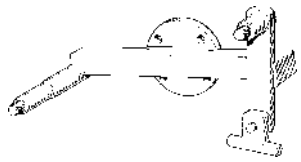
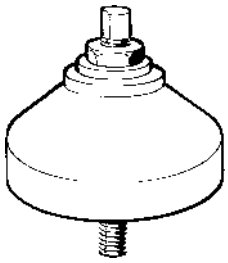
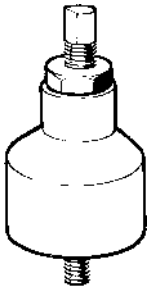
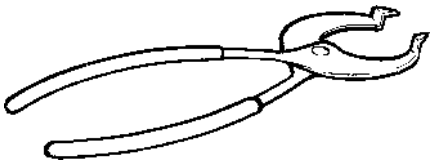
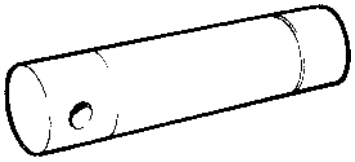
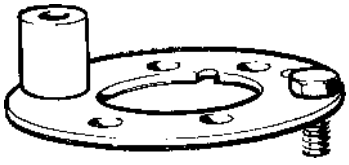
Marking	Colour	mm^2
A	Red	10.6
A'	Red	5.3
B	Light blue	1.3
C	Orange	5.3
D	Light brown	1.3
E	Black	5.3
E'	Black	1.3
F	Yellow/red stripes	5.3
G	Dark red	1.3
H	Grey	1.3
I	Light yellow	1.3
J	Dark blue	1.3
K	Black	42.4
L	Red	42.4

SW, Ignition switch: I = IGN, B = BAT, S = SOL
Bosch, Ignition switch: I = 15, 75, B = 30 S = 50

1) Hour meter or fuel gauge
2) Fuses

Special tools

884580		Valve spring compressor.
9991426		Drift for fitting ball bearing in flywheel.
9992817		Drift for fitting crankshaft oil seal on engine rear end.
9992818		Drift for removing valve guide.
9994090		Puller for ball bearing in flywheel.
9995017		Drift for removing and fitting bushing in connecting rod.
9995021		Press tool for removing and fitting crankshaft.
9995022		Tool for pressing down valve lifters.

9995023		Fixture for stand.
9995024		Drift for fitting crankshaft oil seal.
9995025		Drift for fitting intermediary shaft oil seal
9995026		Tool for adjusting spacer.
9995027		Drift for fitting valve guide (intake).
9995028		Drift for fitting valve guide (exhaust).
9995034		Counterhold for camshaft and inter-mediary

Technical Data

AQ145A, AQ125A

General

	AQ145A	AQ125A
Type designation		
Type of operation	4 stroke overhead	
Max. effekt[1] kW	99 (135 hp)	84 (115 hp)
Max. speed	91.7 r/s (5500 r/m)	80 r/s (4800 r/m)
Max. cruising speed	5–8 r/s (300–500 r/m) (below max. speed reached)	
Compression ratio	9.7:1	9.3:1
Compression pressure at starter motor speed	10–12 kp/cm^2 (146–174 lbf./in.^{2})	
No. of cylinders	4 in line	
Bore	96 mm (3,7795 in.)	92 mm (3,622 in.)
Stroke	80 mm (3.150 in.)	
Displacement	2.315 dm^3 (141.271 cu.in.)	2.127 dm^3 (129.798 cu.in.)
Weight incl. drive without oil and water, approx.	245 kg (529 lb.)[2]	240 (529 lb.)[2]
Idling speed	15 r/s (900 r/m)	

CYLINDER BLOCK

Material	Cast iron	
Bore, standard	96.00–96.03 mm (3.7795–3.7897")	92.01–92.02 mm 3.6224–3.6228 in.)
Bore, oversize 1	96.300 mm (3.7913 in.)	92.500 mm (3.6417 in.)
Bore, oversize 2	96.600 mm (3.8031 in.)	93.000 mm (3.6614 in.)

PISTONS

Material	Light alloy	
Height total	80.4 mm (3.165 in.)	71.0 mm (2.795 in.)
Height from gudgeon pin centre to piston top	46.4 mm (1.8268 in.)	46.0 (1.811 in.)
Piston clearance	0.05–0.07 mm (0.0020–0.0028 in.)	0.01–0.03 mm (0.0004–0.0012 in.)
Piston, standard size	95.940–95.990 mm (3.7772–3.7791 in.)[3]	91.991–92.000 mm (3.6217–3.6220 in.)[4]
Piston, oversize 1	96.237–96.252 mm (3.7889–3.7894 in.)	92.472–92.487 mm (3.6406–3.6412 in.)
Piston oversize 2	96.537–96.552 mm (3.8007–3.8013 in.)	92.972–92.978 mm (3.6603–3.6605 in.)

PISTON RINGS

Piston ring gap measures in the opening of the ring (oil rings)	0.30–0.60 mm (0.0118–0.0236 in.)	0.25–0.40 mm (0.0098–0.0157 in.)
" (compression ring)	0.40–0.65 mm (0.0157–0.0256 in.)	0.35–0.55 mm (0.0138–0.0217 in.)
Piston ring oversize 1	0.3 mm (0.0118 in.)	0.5 mm (0.0197 in.)
Piston ring oversize 2	0.6 mm (0.0236 in.)	1.0 mm (0.0394 in.)

Compression rings

Top ring chromed. Lower ring marked “TOP”

Number on each piston	2	
Height upper	1.728–1.740 mm (0.0680–0.0685 in.)	1.978–1.990 mm (0.0779–0.0783 in.)
Height lower	1.978–1.990 mm (0.0779–0.0783 in.)	1.978–1.990 mm (0.0779–0.0783 in.)
Piston ring clearance in groove, upper	0.060–0.092 mm (0.0024–0.0036 in.)	0.040–0.072 mm (0.0016–0.0028 in.)
Piston ring clearance in groove, lower	0.040–0.072 mm (0.0016–0.0028 in.)	0.040–0.072 mm (0.0016–0.0028 in.)

[1] Max. flywheel output acc. to SAE J-607.
[2] With Power Trim, 275 (606).
[3] See parts catalogue AQ145.
[4] See parts catalogue AQ125.

	AQ145A	AQ125A
Oil rings		
Number on each piston	1	
Height	3.975–3.990 mm (0.1565–0.1571 in.)	3.978–3.990 mm (0.1566–0.1571 in.)
Piston ring clearance in groove	0.030–0.065 mm (0.0012–0.0026 in.)	0.030–0.062 mm (0.0012–0.0024 in.)

GUDGEON PINS

Fully floating. Circlips at both ends in piston	
Fit. Connecting rod	Push fit
Fit. In piston	Close running fit
Diameter, standard	24.0 mm (0.9449 in.)
Dimension oversize	24.05 mm (0.9469 in.)

CRANKSHAFT

Crankshaft end float	0.037–0.147 mm (0.0015–0.0058 in.)
Main bearings, radial clearance	0.028–0.083 mm (0.0011–0.0033 in.)
Big-end bearings, radial clearance	0.024–0.070 mm (0.0009–0.0028 in.)

MAIN BEARINGS

Main bearing journals	
Diameter, standard	63.45–63.46 mm (2.4980–2.4984 in.)
0.25 mm (0.0100 in.) undersize	63.20–63.21 mm (2.4882–2.4886 in.)
0.50 mm (0.0200 in.) undersize	62.95–62.96 mm (2.4783–2.4787 in.)
Main bearings	
Diameter, standard	63.49–63.52 mm (2.4996–2.5008 in.)
0.25 mm (0.0100 in.) undersize	63.24–63.27 mm (2.4898–2.4909 in.)
0.50 mm (0.0200 in.) undersize	62.99–63.02 mm (2.4799–2.4811 in.)

BIG-END BEARINGS

Big-end bearing journals	
Width of bearing recess	24.75–24.85 mm (0.9744–0.9783 in.)
Diameter, standard	53.99–54.00 mm (2.1255–2.1260 in.)
0.25 mm (0.0100 in.) undersize	53.74–53.75 mm (2.1157–2.1161 in.)
0.50 mm (0.0200 in.) undersize	53.49–53.50 mm (2.1059–2.1063 in.)
Big-end bearing shells	
Thickness, standard	1.988 mm (0.0783 in.)
0.25 mm (0.0100 in.) undersize	2.115 mm (0.0833 in.)
0.50 mm (0.0200 in.) undersize	2.242 mm (0.0883 in.)

CONNECTING RODS

End float on crankshaft	0.15–0.35 mm (0.0059–0.0138 in.)
Length, centre-centre	144.9–145.1 mm (5.705–5.717 in.)

CAMSHAFT

No. of bearings	5
Bearing journals diameter	29.95–29.97 mm (1.1791–1.1799 in.)
Radial clearance: bearing journals	0.030–0.071 mm (0.0012–0.0028 in.)
Axial clearance	0.1–0.4 mm (0.004–0.016 in.)

CAMSHAFT BEARING

	AQ145A	AQ125A
Camshaft bearings, diameter	30.000–30.021 mm (1.1811–1.1819 in.)	

Transmission

Number of teeth, crankshaft gear	19	
Intermediate shaft gear	38	
Camshaft gear	38	
Timing belt	123	

Intermediate shaft

Number of bearings	3	
Diameter bearing journal, forward	46.975–47.000 mm (1.8494–1.8504 in.)	
Diameter bearing journal, centre	43.025–43.050 mm (1.6939–1.6949 in.)	
Diameter bearing journal, rear	42.925–49.950 mm (1.6900–1.6909 in.)	
Radial clearance	0.020–0.075 mm (0.0008–0.0029 in.)	
Axial clearance	0.20–0.46 mm (0.0079–0.0181 in.)	
Diameter of intermediate shaft bearings in block front	47.020–47.050 mm (1.8511–1.8524 in.)	
centre	43.070–43.100 mm (1.6957–1.6969 in.)	
rear	42.970–43.000 mm (1.6917–1.6929 in.)	

VALVES

Inlet

Valve head diameter	44.0 m (1.7323 in)
Stem diameter	7.95–7.97 mm (0.3130–0.3138 in.)
Valve seat angle	45.5°
Seat angle in cylinder head	44.75°
Seat width in cylinder head	1.7 mm (0.0669 in.)
Clearance, warm engine	See page 43
Clearance, cold engine	See page 43

Exhaust

Valve head diameter	35.0 mm (1.3780 in.)
Stem diameter	7.92–7.94 mm (0.3118–0.3126 in.)
Seat valve angle	45.5°
Seat angle cylinder head	44.75°
Seat width in cylinder head	2.3 mm (0.091 in.)
Clearance, warm engine	See page 43
Clearance, cold engine	See page 43

VALVE GUIDES

Length	52 mm (2.047 in.)
Inner diameter	8.00–8.02 mm (0.3150–0.3157 in.)
Clearance, valve stem-guide, inlet valve	0.03–0.06 mm (0.0012–0.0024 in.)
Clearance, valve stem-guide, exhaust valve	0.06–0.09 mm (0.0024–0.0035 in.)

VALVE SPRINGS

Length, unloaded approx	45.0 mm (1.77 in.)
Length with a load of 280–320 N (28–32 kp)(63–72 lbf.)	38.0 mm (1.50 in.)
Length with load of 710–790 N (160–178 lbf.) (71–79 kp)	27.0 mm (1.06 in.)

LUBRICATING SYSTEM

	AQ145A	AQ125A
Oilchange excl. filter	4.5 dm 3 (l) (7.9 UKp, 9.5 USp).	
Oilchange incl. filter	5.2 dm^3 (l) (9.2 UKp, 11 USp).	
Overhaul	5.7 dm^3 (l) (10 UKp. 12 USp).	
Oil pressure at maximum speed warm engine	2.5–6.0 kp/cm^2 (36–87 lbf/$in.^2$)	
Oil grade alternative 1	Volvo Penta engine oil for carburetor engines	
Oil grade alternative 2	Engine oil SE (MS)	
Viscosity	SAE 10 W/40	
Oil filter		
Type	Full flow filter	
Make	WIX	
Oil pump		
Type	Gear pump	
No. of teeth on each gear	9	
End float	0.02–0.12 mm (0.0008–0.0047 in.)	
Relief valves spring		
Length, unloaded	47.6 mm (1.8740 in)	
Length loaded with 40–48 N (4.0–4.8 kp) (8.81–10.58 lb.)	32.0 mm (1.2598 in)	
Length, loaded with 55–67 N (5.5–6.7 kp) (12.12–14.76 lb.)	26.0 mm (1.0236 in)	

FUEL SYSTEM

Fuel pump		
Type	Diaphragm pump	
Make	Carter	
Feed pressure	0.15–0.28 kp/cm^2 (2–4 psi)	
Carburetor		
Type	Down draught carburetor	
Make and designation	Solex 44 PAI-4	
Venturi	31	34
Main jet	145	155 (165)[1]
Idling jet	62	
Air jet	185	180 (190)[1]
Needle valve	1,5	1,7
Float, weight gr	7,3	
Acc. jet	60	70

[1] Later engines.

ELECTRICAL SYSTEM

Battery	
Earthed	Negative (–)
Voltage	12 V
Capacity	60 Ah
Specific gravity of electrolyte. Fully charged battery	1.275–1.285 g/cm^3 (0.0460–0.0464 lb/cu.in.)
Discharged battery	1.230 g/cm^3 (0.0444 lb/cu.in.)
Starter motor	
Type	Bosch 0 001 311 114
Output	0.8 kW (1.1 hp)
Alternator	
Output max. A(W)	50 (14 x 50)

IGNITION SYSTEM

	AQ145A	AQ125A
Marking of cylinder	4th nearest the flywheel	
Spark plugs	Bosch W6DC or corresponding	
Spark plug gap	0.7 mm (0.028 in.)	

Distributor

Distributor, Bosch type JF4	0231 178 017	
Ignition timing. regular gasoline min. 90 octane RON		
USA:		
Ignition timing, regular gasoline (RON+MON)/2 = min 87 octane		
Basic setting	8° BTD 0–12.5 r/s (0–750 r/m)	10° BTDC 0–12.5 r/s (0–750 r/m,
Stroboscopic setting	34° BTDC 70 r/s (4200 r/m)	36 BTD 70 r/s (4200 r/m)
Gap	0.40 mm (0.016 in.)	0,40 mm
Cam angle	62°±3°	62°±3°

COOLING SYSTEM

Thermostat	
Type Wax thermostat	
Start opening at	82°C (180°F)
Fully open at	92°C (198°F)

WEAR TOLERANCES

Cylinders

To be re-bored when wear amounts to (if engines has abnormal oil consumption)	0.30 mm (0.0118 in.)

Crankshaft

Max. permissible out of round on main bearing journals	0.05 mm (0.0020 in.)
Max. permissible out of round on big-end bearing journals	0.07 mm (0.0028 in.)
Max. crankshaft end float	0.037–0.147 mm (0.0015–0.0058 in.)

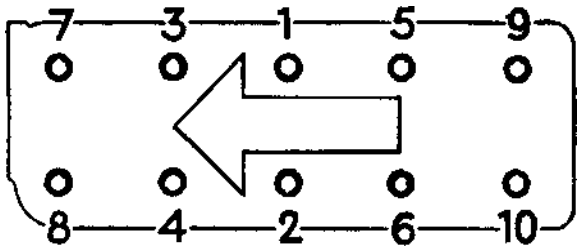
TIGHTENING TORQUES

Tightening torque applies to oiled screws and nuts.

Cylinder head screws	90 Nm (9 kpm) (66 lbf. ft.)
Big-end bearing screws	63 Nm (6.3 kpm) (46 lbf. ft.)
Main bearing bolts	110 Nm (11 kpm) (80 lbf. ft.)
Camshaft nut	50 Nm (5 kpm) (35 lbf. ft.)
Flywheel screws	70 Nm (7 kpm) (53 lbf. ft.)
Spark plugs	25 Nm (2.5 kpm) (18.5 lbf. ft.)
Intermediate shaft, forward	50 Nm (5.0 kpm) (35 lbf. ft.)
Camshaft bearings	20 Nm (2.0 kpm) (15 lbf. ft.)
Crankshaft, forward	165 Nm (16.5 kpm) (122 lbf ft)

Tightening sequence for cylinder head screws.
Tightening to be carried out in two stages.

1st stage: 60 Nm (6 kpm) (44.2 lbf.ft.)
2nd stage: 90 Nm (9 kpm) (66 lbf. ft.)



VALVE ADJUSTING KIT FOR AQ125A, AQ145A

Kit No. 884516

The kit is arranged to cover as large an adjustment range as possible and can be added to where necessary from Volvo Penta's spare parts department. The complete kit (884516) contains the following parts:

Part No.	Quantity	Designation	Thickness mm (in.)	
463551	2	Shim	3.55	(0.140)
463552	3	"	3.60	(0.142)
463553	6	"	3.65	(0.144)
463554	8	"	3.70	(0.146)
463555	12	"	3.75	(0.148)
463556	12	"	3.80	(0.150)
463557	12	"	3.85	(0.152)
463558	12	"	3.90	(0.154)
463559	12	"	3.95	(0.156)
463560	12	"	4.00	(0.158)
463561	8	"	4.05	(0.160)
463562	6	"	4.10	(0.162)
463563	3	"	4.15	(0.164)
463564	2	"	4.20	(0.166)

Technical data

AQ145B, AQ125B

General

	AQ145B	AQ125B
Type designation		
Type of operation	4 stroke overhead	
Max. effekt[1] kW (Hp)	102 (139 hp)	88 (120 hp)
Full throttle operation range	4800–5500 r/m	4700–5000 r/m
Max. cruising speed	200 r/m (below max. speed reached)	
Compression ratio	9.7:1	9.5:1
Compression pressure at starter motor speed[2]	9–11 kp/cm^2 (128–156 psi)	
No. of cylinders	4 in line	
Bore	96 mm (3.7795 in.)	
Stroke	80 mm (3.150 in.)	
Displacement	2.315 dm^3 (141.271 cu.in.)	
Weight incl. drive without oil and water, approx	250 kg (550 lb.)	240 kg (518 lb.)
Idling speed	(900 r/m)	

CYLINDERBLOCK

Material	Cast iron
Bore, standard	96.00–96.03 mm (3.7795–3.7898 in.)
Bore, oversize 1	96.300 mm (3.7913 in.)
Bore, oversize 2	96.600 mm (3.8031 in.)

The cylinder bores are to be rebored when the wear is 0.10 mm (0.004 in.) (if the engine has excessive oil consumption).

PISTONS

Material	Light alloy[3]
Height total	64.7 mm (2.547 in.)
Height from gudgeon pin centre to piston top	39.7 mm (1.563 in.)
Piston clearance	0.010–0.030 mm (0.0004–0.0012 in.)
Piston, standard size	95.980–96.010 mm (3.7787–3.7799 in.)[4][5]
Piston, oversize 1	96.277–96.292 mm (3.7904–3.7910 in.)
Piston, oversize 2	96.577–96.592 mm (3.8022–3.8028 in.)

[1] Max. flywheel output. acc. to SAE J-607.

[2] Only applies when the engine is hot, the valve completely open.

[3] Maximum weight difference between pistons in the same engine is 16 grammes (0.56 ounces).

[4] See parts catalogue AQ145.

[5] See parts catalogue AQ125.

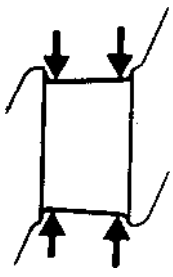
	AQ145B	AQ125B
Piston rings		
Piston ring gap measures in the opening of the ring (oil rings)	0.30–0.60 mm (0.0118–0.0236 in.)	0.25–0.50 mm (0.0098–0.0196 in.)
Piston ring gap measures in the opening of the ring (compression ring)	0.30–0.55 mm (0.0118–0.0217 in.)	
Piston ring oversize 1	0.3 mm (0.0118 in.)	
Piston ring oversize 2	0.6 mm (0.0236 in.)	
Compression rings		
Top ring chromed. Lower ring marked “TOP”		
Number on each piston	2	
Height upper	1.728–1.740 mm (0.0680–0.0685 in.)	
Height lower	1.728–1.740 mm (0.0680–0.0685 in.)	
Piston ring clearance in groove, upper	0.060–0.092 mm (0.0024–0.0036 in.)	
Piston ring clearance in groove lower	0.040–0.072 mm (0.0016–0.0028 in.)	
Oil rings		
Number on each piston	1	
Height	3.475–3.490 mm (0.1368-0.1374 in.)	

GUDGEON PINS

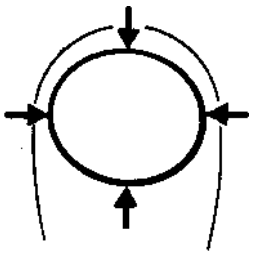
Fully floating. Circlips at both ends in piston	
Fit. Connecting rod	Close running fit
Fit. In piston	Push fit
Diameter, standard	23.0 mm (0.9055 in.)
Dimension oversize	23.05 mm (0.9075 in.)
Length	65 mm (2.5591 in.)

CRANKSHAFT

Crankshaft, end float	0.080–0.270 mm (0.0031–0.0106 in.)
Main bearings, radial clearance	0.024–0.072 mm (0.0009–0.0028 in.)
Big-end bearings, radial clearance	0.023–0.067 mm (0.0009–0.0026 in.)
Straightness, max. deviation	0.025 mm (0.0010 in.)



Taper



Ovality

MAIN BEARINGS

Main bearing journals	
Ovality	0.004 mm (0.00015 in)
Taper	0.004 mm (0.00015 in.)
Diameter, standard	54.987–55.000 mm (2.1648–2.1654 in.)
0.25 mm (0.0100 in.) undersize	54.737–54.750 mm (2.1550–2.1555 in.)
0.50 mm (0.0200 in.) undersize	54.487–54.500 mm (2.1452–2.1457 in.)
Width of bearing recess	22.9–25.1 mm (0.9016–0.9882 in.)

DISTANCE ON CRANKSHAFT FOR THE THRUST BEARINGS

	AQ145B	AQ125B
Standard	31.96–32.00 mm (1.2583–1.2598 in.)	
Oversize 1	32.27–32.25 mm (1.2687–1.2697 in.)	
Oversize 2	32.46–32.50 mm (1.2780–1.2795 in.)	

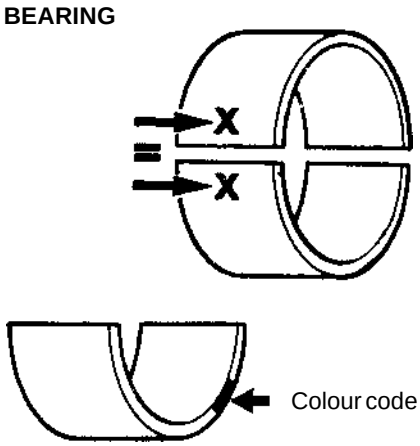
There are two makes of **main bearings** available. The upper and lower main bearing shells must be of the same make on each journal.

Classed connecting **rod bearings** are used in production. The shells are colour-coded, red–yellow–blue. They are fitted according to the following alternatives:

Alt. 1 Two yellow marked shells.

Alt. 2 One blue marked and one red marked shell. The blue bearing shell is used in the connecting rod and the red marked shell in the bearing cap.

NOTE! Only yellow marked bearing shells are available as replacement parts.



CONNECTING RODS

CONNECTING ROD BEARINGS

Connectingrod bearing journals

Ovality, max	0.004 mm (0.0002 in.)
Taper, max	0.004 mm (0.0002 in.)
Width of bearing recess	23.9–26.1 mm (0.9409–1.0276 in.)
Diameter, standard	48.984–49.005 mm (1.9285–1.9293 in.)
0.25 mm (0.0100 in.) undersize	48.734–48.755 mm (1.9187–1.9195 in.)
0.50 mm (0.0200 in.) undersize	48.484–48.505 mm (1.9088–1.9096 in.)
End float on piston	0.25–0.45 mm (0.0098–0.0177 in.)
Length, centre-centre	152 mm (5.9843 in.)
Maximum weight difference between connecting rods in the same engine is	20 grammes (0.7 ounces)

CAMSHAFT

No. of bearings	5
Bearing journals diameter	29.95–29.97 mm (1.1791–1.1799 in.)
Radial clearance bearing journals	0.030–0.071 mm (0.0012–0.0028 in.)
Max	0.15 mm (0.0059 in.)
Axial clearance	0.1–0.4 mm (0.004–0.016 in.)

CAMSHAFT BEARING

Camshaft bearings, diameter	30.000–30.021 mm (1.1811–1.1819 in.)

Transmission

Number of teeth, crankshaft gear	19
Number of teeth, intermediate shaft gear	38
Number of teeth, camshaft gear	38
Number of teeth, timing belt	123

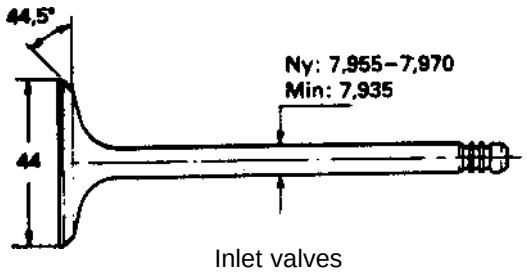
Intermediate shaft (auxiliary camshaft)	**AQ145B**	**AQ125B**
Number of bearings	3	
Diameter bearing journal, forward	46.975–47 000 mm (1.8494–1.8504 in.)	
Diameter bearing journal, centre	43.025–43.050 mm (1.6939–1.6949 in.)	
Diameter bearing journal, rear	42.925–42.950 mm (1.6900–1.6909 in.)	
Radial clearance	0.020–0.075 mm (0.0008–0.0029 in.)	
Axial clearance	0.20–0.46 mm (0.0079–0.0181 in.)	
Diameter of intermediate shaft bearings in block, front	47.020–47.050 mm (1.8511–1.8524 in.)	
centre	43.070–43.100 mm (1.6957–1.6969 in.)	
rear	42.970–43.000 mm (1.6917–1.6929 in.)	

REPLACEMENT

NOTE! New bearings must be line bored.

VALVES

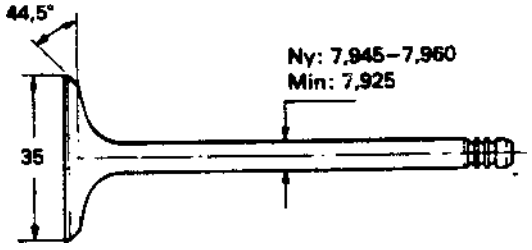
Inlet Valve head diameter	44.0 mm (1.7323 in.)
Stem diameter	7.95–7.97 mm (0.3130–0.3138 in.)
Valve seat angle	44.5°
Seat angle in cylinder head	45°
Seatwidth in cylinder head	1.3–1.9 mm (0.0512–0.0748 in.)



Inlet valves

Exhaust

Valve head diameter	35.0 mm (1.3780 in.)
Stem diameter	7.945–7.960 mm (0.3128–0.3134 in.)
Seat valve angle	44.5°
Seat angle cylinder head	45°
Seatwidth in cylinder head	1.7–2.3 mm (0.0669–0.0906 in.)



Exhaust valves

IMPORTANT! The valves have a stellite coating. Therefore, they are not to be cut or ground but only lapped into the seat.

	AQ145B	AQ125B
Clearance when checking:		
Cold engine	0.30–0.40 mm (0.0118–0.0157 in.)	
Hot engine	0.35–0.45 mm (0.0138–0.0177 in.)	
Clearance when adjusting:		
Cold engine	0.35–0.40 mm (0.0138–0.0157 in.)	
Hot engine	0.40–0.45 mm (0.0157–0.0177 in.)	

The clearance is the same for inlet and exhaust valves.

VALVE GUIDES

(Intake and Exhaust)

Length	52 mm (2.047 in.)
Inner diameter	8.00–8.02 mm (0.3150–0.3157 in.)
Clearance, valve stem-guide, inlet valve	0.03–0.06 mm (0.0012–0.0024 in.)
Clearance, valve stem-guide, exhaust valve	0.06–0.09 mm (0.0024–0.0035 in.)
Clearance, maximum wear	0.15 mm (0.0059 in.)

VALVE SPRINGS

Length, unloaded, approx	45.0 mm (1.7717 in.)
Length with a load of 280–320 N (28–32 kp) (63–72 lbf)	38.0 mm (1.4961 in.)
Length with load of 710–790 N (160–178 lbf) (71–79 kp)	27.0 mm (1.0630 in.)

LUBRICATING SYSTEM

Oilchange excl. filter	4.5 dm^3 (l) (7.9 UKp, 9.5 USp)
Oilchange incl. filter	5.2 dm^3 (l) (9.2 UKp, 11 USp)
Overhaul	5.7 dm^3 (l) (10 UKp, 12 USp)
Oil pressure at 2000 rpm, warm engine	2.5–6.0 kp/cm^2 (36–85 psi)
Oil grade alternative 1	Volvo Penta engine oil for carburetor engines
Oil grade alternative 2	Engine oil SE (MS) alt SF[2)]
Viscosity	SAE 10 W/40

Oilfilter

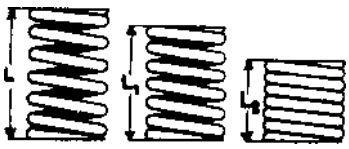
Type	Full flow filter

[2)] Oils of type SF/CC and SF/CD meet this specification.

Lubricating oil pump:

End float	0.02–0.12 mm (0.0008–0.0047 in.)
Radial clearance (excl. bearing clearance)	0.02–0.09 mm (0.0008–0.0035 in.)
Gear backslash (excl. bearing clearance)	0.15–0.35 mm (0.0059–0.0138 in.)
Bearing clearance, drive shaft	0.032–0.070 mm (0.0013–0.0028 in.)
Bearing clearance, idler shaft	0.014–0.043 mm (0.0006–0.0017 in.)

Relief valve spring's length with different loads:



Length	Load
39.2 mm (1.5433 in.)	ON
26.25 mm (1.0335 in.)	46–54 N (4.6–5.4 kp = 10.4–12 lb)
21.0 mm (0.8268 in.)	62–78 N (6.2–7.8 kp = 14–17.6 lb)

FUELSYSTEM

	AQ145B	AQ125B
Fuel pump		
Type	Diaphragm pump	
Feed pressure	0.15–0.28 kp/cm^2 (2–4 psi)	
Carburetor		
Type	Down draught carburetor	
Make and designation	Solex 44 PAI-4	
Venturi	31	34
Main jet	145	155 (165)[1)]
Idling jet	62	62
Air jet	185	180 (190)[1)]
Needle valve	1.5	1.7
Float, weight, gr	7.3	7.3
Acc. jet	60	70

[1)] Later engines.

ELECTRICAL SYSTEM

Battery	
Ground	Negative (–)
Voltage	12 V
Capacity	60 Ah
Specific gravity of electrolyte:	
Fully charged battery	1.275–1.285 g/cm^3 (0.0460–0.0464 lb/cu. in.)
Discharged battery	1.230 g/cm^3 (0.0444 lb/cu. in.)
Starter motor	
Type	Hitachi
Output	0.8 kW (1.1 hp)
Alternator	
Output max. A(W)	50 (14x50)

IGNITION SYSTEM

Marking of cylinder	4th nearest the flywheel
Spark plugs	Bosch W6DC or corresponding
Spark plug gap	0.7 mm (0.028 in.)
Distributor	
Distributor, Bosch type JF4	0231 178 017
Ignition timing, regular gasoline min. 90 octane RONG	
USA:	
Ignition timing: regular gasoline (RON+MON)/2 = min 87 octane	
Basic setting	6° BTD (0–750 r/m)
Stroboscopic setting	32°–35° BTDC (4200 r/m)
Gap	0.40 mm (0.016 in.)
Cam angle	62°±3°

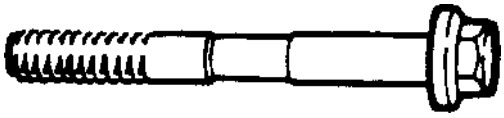
COOLINGSYSTEM

	AQ145B	AQ125B
Thermostat		
Type	Wax thermostat	
Start opening at	82°C (180°F)	
Fully open at	92°C (198°F)	

TIGHTENING TORQUE

Note! Cylinder head should always be torqued when the engine is completely cold.

The tightening torques only apply for oiled-in bolts and nuts. Degreased (washed) parts must be oiled-in before fitting.

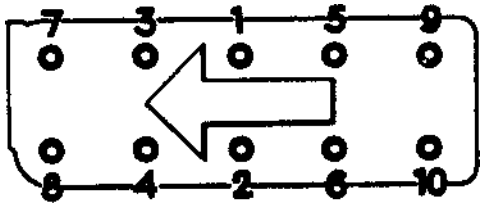


Cylinder head, torque in stages: .....

1 = 20 Nm (2.0 kpm = 15 Lbf ft)
2 = 60 Nm (6.0 kpm = 43 Lbf ft)
3 = angle-tighten 90°

- the bolts must be replaced if they show signs of stretching. This can be seen at the middle of the bolt where it has been stretched out.
- the bolts can only be re-used 5 times.

Replace the bolts if there is any doubt regarding these two points.



Tightening sequence for cylinder head screws

	(Nm)	(Kpm)	(Lbf ft)
Main bearings	110	(11.0)	81
Connecting rod bearings[1] stage 1	20	(2.0)	15
stage 2	60	(6.0)	43
stage 3	angle-tighten 90°		
Flywheel (use new bolts)	70	(7.0)	51
Spark plugs (do not oil-in)	25±5	(2.5±0.5)	18.5±3
Camshaft gear	50	(5.0)	36
Idler shaft gear	50	(5.0)	36
Camshaft cap	20	(2.0)	14.5
Crankshaft, pulley centre-bolt, stage 1	60	(6.0)	43
stage 2	angle-tighten 60°		

[1] Used bolts can be re-used if their length is max. 55.5 mm (2.185 in.).

Notes

Notes

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