Workshop Manual

Engine

C
2(0)

230, 250, 251DOHC
AQ131, AQ151, AQ171

Workshop Manual

230, 250, 251DOHC, AQ131, AQ151, AQ171

Index

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.

⚠ Engine with turbocharger: Never start the engine without installing the air cleaner (ACL). The rotating compressor in the Turbo can cause serious personal injury. Foreign objects entering the intake ducts can also cause mechanical damage.

⚠ 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.

⚠ Be extremely careful when tracing leaks in the fuel system and testing fuel injection nozzles. Use protective goggles! The jet ejected from a fuel injection nozzle is under very high pressure, it can penetrate body tissue and cause serious injury There is a danger of blood poisoning.

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

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

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

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

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

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

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

⚠ Use the lifting eyes mounted on the engine/reverse gear when lifting the drive unit.
Always check that lifting equipment is in good condition and has sufficient load capacity to lift the engine (engine weight including reverse gear and any extra equipment installed).

To ensure safe handling and to avoid damaging engine components on top of the engine, use a lifting beam to raise the engine. All chains and cables should run parallel to each other and as perpendicular as possible in relation to the top of the engine.

If extra equipment is installed on the engine altering its center of gravity, a special lifting device is required to achieve the correct balance for safe handling.

Never carry out work on an engine suspended on a hoist.

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

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

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

General information

About the workshop manual

This workshop manual contains technical specification, descriptions and instructions for repairing the standard versions of the following engines 230, 250, 251DOHC, AQ131, AQ151 and AQ171. The product designation and number should be given in all correspondence about the product.

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.

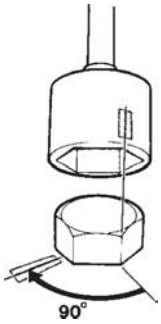
Bear in mind that most chemicals used on boats are harmful to the environment if used incorrectly. Volvo Penta recommends the use of biodegradable degreasing agents for cleaning engine components, unless otherwise stated in a workshop manual. Take special care when working on-board, that oil and waste 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 strengths, operating temperature ranges, resistance to oil and other chemicals and for the different materials and gap sizes in the engines.

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

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

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

Make sure that mating surfaces are dry and free from oil, grease, paint and anti-corrosion agent before applying sealant or locking fluid. Always follow the manufacturer's instructions for use regarding; temperature range, curing time and any other instructions for the product.

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

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

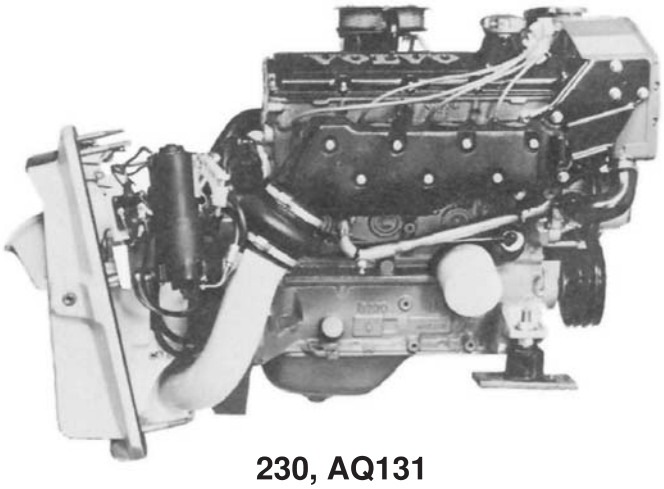
The following RTV agents are mentioned in the Service Manual: Loctite® 574, Volvo Penta 840879-1, Permatex® No. 3, Volvo Penta P/N 1161099-5, Permatex® No. 77. Old sealant can be removed using methylated spirits in all cases.

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

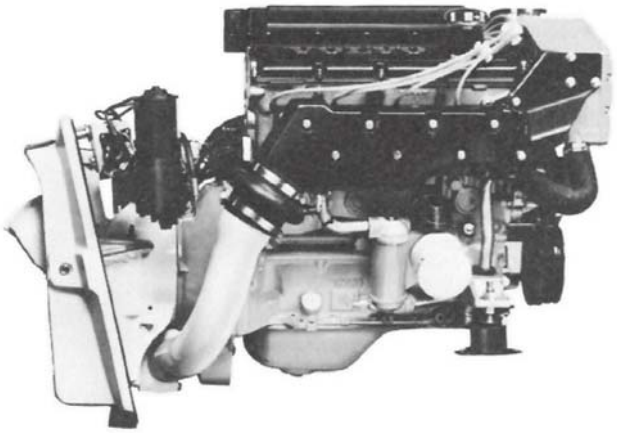
The following anaerobic agents are mentioned in the Service Manual: Loctite® 572 (white), Loctite® 241 (blue).

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

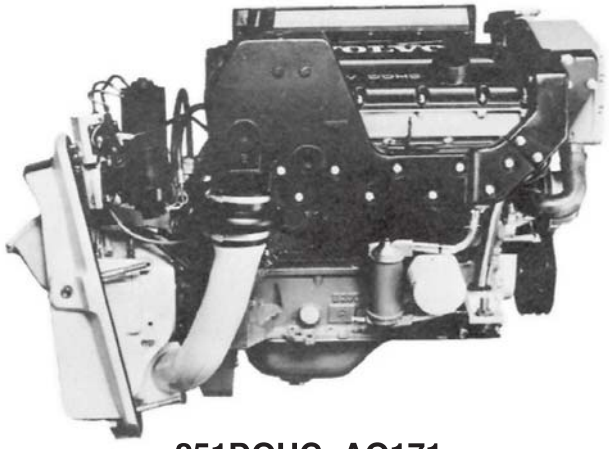
Presentation



230, AQ131



250, AQ151

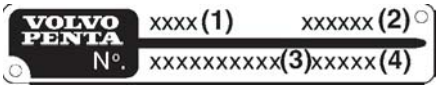


251DOHC, AQ171

The engines are 4 cylinder gasoline engines. All the engines are equipped with freshwater cooling in combination with seawater cooling. The seawater system is powered by a direct drive impeller pump. The thermostat controlled freshwater system is powered by a circulation pump.

The engines are manufactured with two different product designations. During 1989 Volvo Penta began designating engines based on their cylinder displacement according to the ISO norm 8665. The older product designations of AQ131, AQ151 and AQ171 (where the number provided an approximate indication of output) were withdrawn. The new designation 230 replaced AQ131, 250 replaced AQ151and 251DOHC replaced AQ171.

250, AQ151 and 251DOHC, AQ171 are equipped with an oil cooler. 230, AQ131 has a single carburettor and the others have twin carburettors. The exhaust system has seawater cooled exhaust pipes. 230, AQ131 and 250, AQ151 models have an overhead camshaft while 251DOHC, AQ171 has double overhead camshafts with hydraulic valve lifters. 251DOHC, AQ171 is a 16 valve engine. 230, AQ131 and 250, AQ151 models have conventional marine ignition systems while 251DOHC, AQ171 has electronic ignition.



Product plate

The product plate is located on the cylinder block beside the starter motor. The product plate provides the following information;

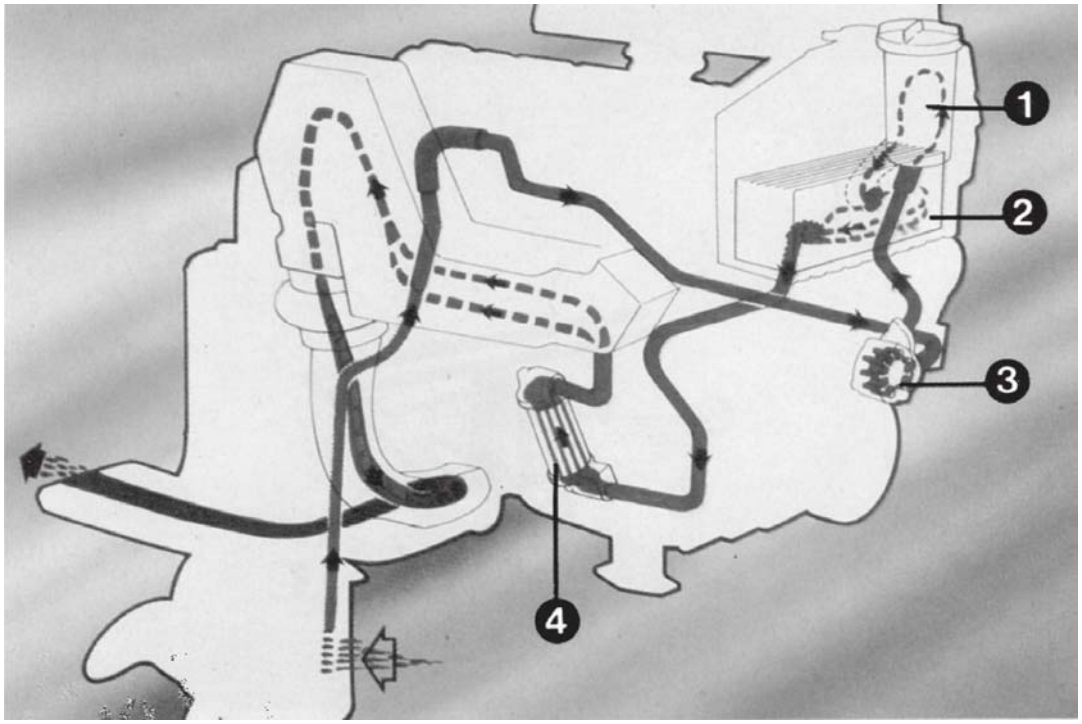
(1) Product designation, i.e. AQ131D

(2) Product number, i.e 867902

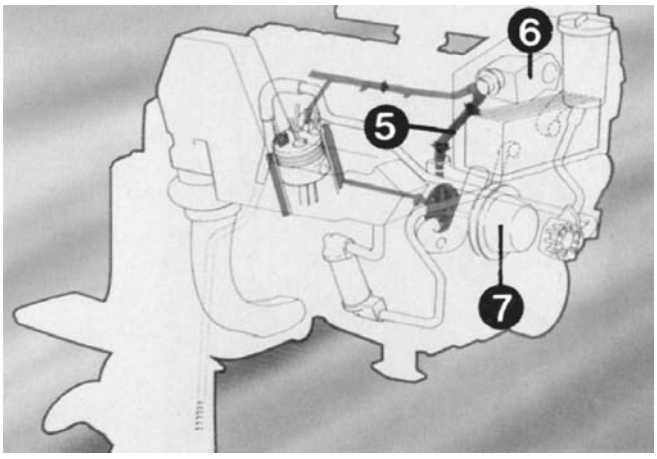
(3) Serial number (10 digit)

(4) Basic engine, serial number

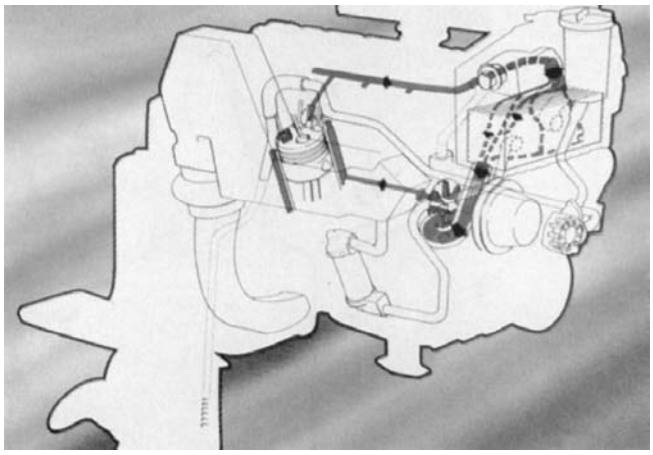
The Cooling System



The sea water cooling system



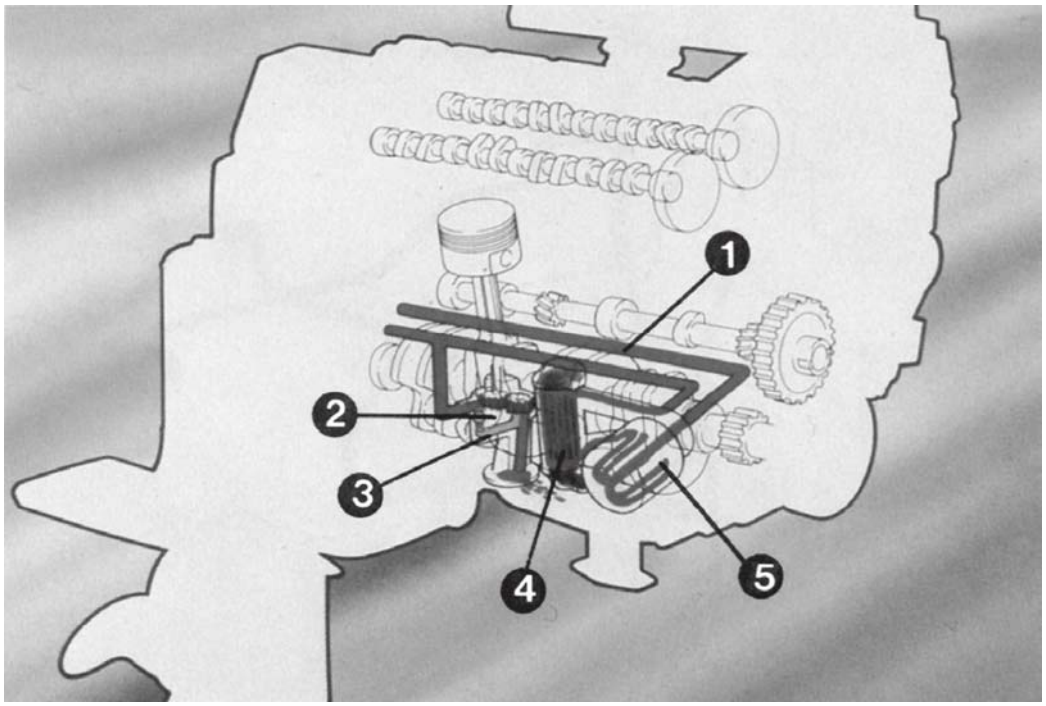
The fresh water cooling system, thermostat closed



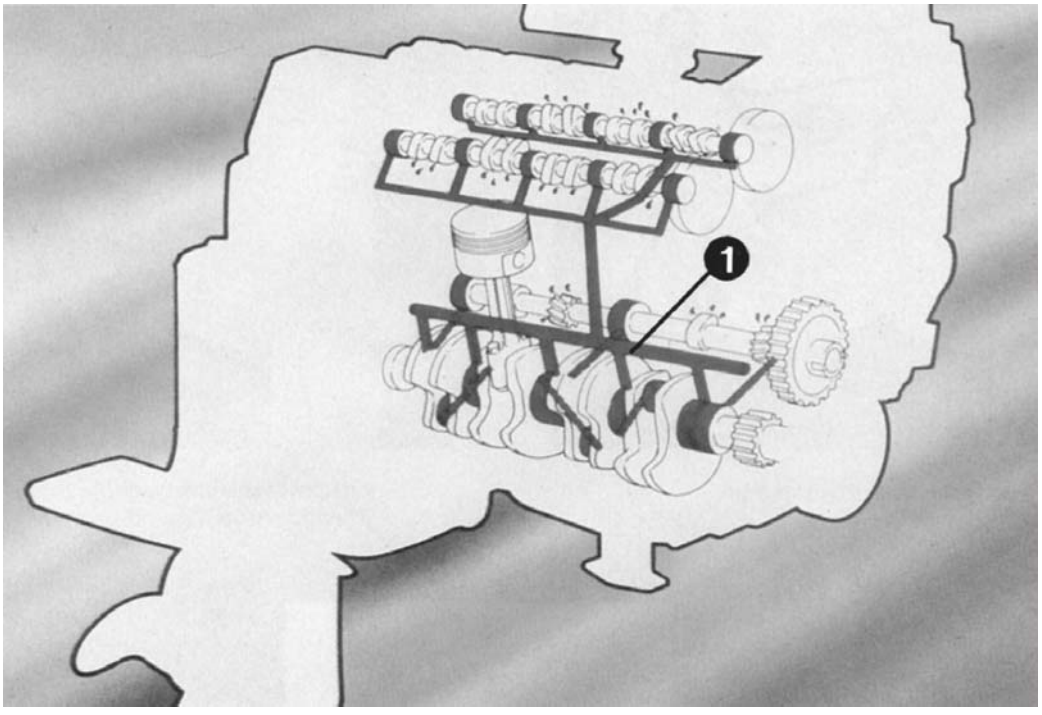
The fresh water cooling system, thermostat open

1 = Sea-water filter
2 = Heat exchanger
3 = Sea-water pump
4 = Oil cooler
5 = Bypass
6 = Thermostat house
7 = Circulation pump

The Lubricating System



The engine lubricating system from strainer to the main gallery



The engine lubricating system from the main gallery to the lubricating points.

1 = Main gallery
2 = Oil pump
3 = Return line
4 = Oil cooler
5 = Oil filter

Trouble-shooting Scheme

Engine does not start	Engine stops	Engine does not reach operating speed at full throttle	Engine runs rough or vibrates abnormally	Engine becomes abnormally hot	**Fault reason**
X					Main switch open. Battery discharged. Wires broken or fuse blown.
X	X				Empty fuel tank, closed fuel cock, clogged fuel filter.
X	X		X		Water or impurities in the fuel.
X	X	X	X		Faulty spark plugs.
X					Burned breaker points, moisture in distributor and ignition leads.
X		X			Faulty electronic unit 251DOHC, AQ171
	X		X		Idling speed not adjusted properly.
		X			Faulty tachometer.
		X			Boat loaded abnormally.
		X			Growth on boat bottom and sterndrive.
			X		Damaged propeller.
				X	Clogged cooling water intake, oil cooler (250, 251DOHC, AQ151, AQ171) waterjackets. Damaged impeller or thermostat. Too low coolant level in expansion tank
		X			Wrong fuel quality in relation to timing
X			X		Toothed belt faulty or not adjusted properly.

1. Overhaul Data

Technical Data
230, 250, 251DOHC
AQ131, AQ151, AQ171

General

Type designation	**230, AQ131**
Type of engine	4 stroke, overhead cam
Speed range full load	78.3–83.3 r/s (4700–5000 rpm)
Maximum cruising speed	3.33 r/s (200 rpm) lower than the max speed obtained
Compression ratio	9.7:1
Compression pressure at starter motor speed[1)]	10–12 kp/cm^2 (142–170 psi)
Number of cylinders	4 in line
Cylinder bore	96 mm (3.7795")
Stroke	80 mm (3.1496")
Swept volume (displacement)	2.315 dm^3 (141.3 in^3)
Weight, excluding water and oil, approx.	240 Kilos (529.1 lbs)
Idling speed	15 r/s (900 rpm)

General

Type designation	**250, AQ151**
Type of engine	4 stroke, overhead cam
Speed range full load	80–91.7 r/s (4800–5500 rpm)
Maximum cruising speed	3.33 r/s (200 rpm) lower than the max speed obtained
Compression ratio	9.7:1
Compression pressure at starter motor speed[1)]	10–12 kp/cm^2 (142–170 psi)
Number of cylinders	4 in line
Bore	96 mm (3.7795")
Stroke	86 mm (3.3858")
Swept volume (displacement)	2.49 dm^3 (151.9 in^3)
Weight, excluding water and oil, approx.	250 Kilos (551.2 lbs)
Idling speed	15 r/s (900 rpm)

General

Type designation	**251DOHC, AQ171**
Type of engine	4 stroke, overhead cams
Speed range full load	83.3–95 r/s (5000–5700 rpm)
Maximum cruising speed	3.33 r/s (200 rpm) lower than the max speed obtained
Compression ratio	9.7:1
Compression pressure at starter motor speed[1)]	10–12 kp/cm^2 (142–170 psi)
Number of cylinders	4 in line
Bore	96 mm (3.7795")
Stroke	86 mm (3.3858")
Swept volume (displacement)	2.49 dm^3 (151.9 in^3)
Weight, excluding water and oil, approx.	289 Kilos (637.15 lbs)
Idling speed	15 r/s (900 rpm)

[1)] Applies to hot engine, wide open throttle

Cylinder block

Material	Cast iron
Bore, standard	96.00–96.03 mm (3.7795–3.7807")
Bore, oversize 1	96.300 mm (3.79133")
Bore, oversize 2	96.600 mm (3.80315")

The cylinder bores should be bored at a wear depth of 0.10 mm (0.004 in) (in case the engine has an abnormal oil consumption).

Pistons

Material	Light alloy[3]
Overall height 230, AQ131	64.7 mm (2.54724")
Overall height 250, 251DOHC, AQ151, AQ171	61.7 mm (2.42913")
Height from gudgeon pin center to top of piston 230, AQ131	39.7 mm (1.56299")
Height from gudgeon pin center to top of piston 250, 251 DOHC, AQ151, AQ171	36.7 mm (1.44488")
Piston clearance, production	0.010–0.030 mm (0.0004–0.0012")
Piston clearance, service	max 0.080 mm (0.0031")
Piston, standard dimension	95.980–96.010 mm[4] (3.779–3.780")
Piston, oversize 1	96.280–96.290 mm (3.791–3.7909")
Piston, oversize 2	96.580–96.590 mm (3.802–3.803")

[3] Maximum weight difference between pistons in the same engine is 16 grams (0.56 oz).
[4] See the spare parts catalog for all the products.

Piston rings

Piston ring end gap (oil scraper ring)	0.30–0.60 mm (0.0118–0.0236")
Piston ring end gap (compression ring)	0.30–0.55 mm (0.0118–0.0217")
Oversize piston rings 1	0.3 mm (0.0118")
Oversize piston rings 2	0.6 mm (0.0236")

Compression rings

The upper ring is chromium plated. The lower ring is marked “TOP”.

Number of rings on each piston	2
Height, upper	1.728–1.740 mm (0.068–0.069")
Height, lower	1.728–1.740 mm (0.068–0.069")
Piston ring clearance in groove, upper	0.040–0.072 mm (0.0016–0.0028")
Piston ring clearance in groove, lower	0.040–0.072 mm (0.0016–0.0028")

Oil scraper rings

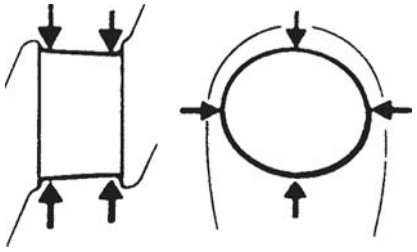
Number on each piston	1
Height	3.475–3.490 mm (0.1368–0.374")

Gudgeon pins

Full floating pin. Locked at both ends with circlips.

Fit in connecting rod	Light thumb pressure (push fit)
Fit in piston	Thumb pressure (slide fit)
Standard diameter	23.0 mm (0.906")
Oversize diameter	23.05 mm (0.907")
Length	65 mm (2.559")

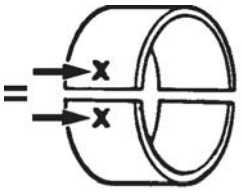
	AQ131A, 131B, 151A, 151B, 171A, 171B	AQ131C, 131D, 151C, 151D, 171C, 171D, 230, 250, 251DOHC
Crankshaft		
Crankshaft, axial clearance	0.080–0.270 mm (0.0031–0.0106")	0.080–0.270 mm (0.0031–0.0106")
Main bearing, radial clearance	0.024–0.072 mm (0.00094–0.00283")	0.024–0.064 mm (0.0009–0.0025")
Crank bearing, radial clearance	0.023–0.067 mm (0.00091–0.00264")	0.023–0.067 mm (0.00091–0.00264")
Straightness, maximum deviation	0.025 mm (0.00098")	0.025 mm (0.00098")



Taper Out-of-roundness

Main bearings		
Main bearing journals		
Out of roundness, max.	0.004 mm (0.00016")	0.004 mm (0.00016")
Taper, max.	0.004 mm (0.00016")	0.004 mm (0.00016")
Standard diameter	54.987–55.000 mm (2.1648–2.1654")	62.987–63.000 mm (2.4798–2.4803")
0.25 mm undersize (0,0098")	54.737–54.750 mm (2.1550–2.1555")	62.737–62.750 mm (2.4700–2.4705")
0.50 mm undersize (0,0197")	54.487–54.500 mm (2.1452–2.1457")	62.487–62.500 mm (2.4601–2.4606")
Seat width on crankshaft for thrust bearings		
Standard	31.96–32.00 mm (1.2583–1.2598")	35.46–35.50 mm (1.3961–1.3976")
Oversize 1	32.21–32.25 mm (1.2681–1.2697")	–
Oversize 2	32.46–32.50 mm (1.2780–1.2795")	–

The main bearings are available in two makes. The upper and lower main bearing shell on the same pivot must be of the same make.
In production matched **crankshaft bearing shells** are used. The bearing shells are color coded, red, yellow and blue. They are matched in accordance with one of the following alternatives:
Alternative 1: Two yellow-marked bearing shells.
Alternative 2: One blue-marked and one red-marked bearing shell. The blue-marked shell to be located on the crankshaft and the red-marked shell in the bearing cap.
NOTE! Only yellow-marked bearing shells are available for spare parts purposes.



Color code

Connecting rods	
Connecting Rod Bearings	
Bearing journals	
Out of roundness, max.	0.004 mm (0.00016")
Taper, max.	0.004 mm (0.00016")
Bearing seat width	23.9–26.1 mm (0.9409–1.0276")
Standard diameter	48.984–49.005 mm (1.9285–1.9293")
0.25 mm undersize (0.0098")	48.734–48.755 mm (1.9187–1.9195")
0.50 mm undersize (0.0197")	48.484–48.505 mm (1.9088–1.9096")
Axial clearance at the piston	0.25–0.45 mm (0.0098–0.0177")
Length, center to center	152 mm (5.9843")
Max. weight difference between connecting rods in the same engine	20 grams (0.7055 oz.)

Camshaft

Number of bearings	5
Bearing, diameter	29.95–29.97 mm (1.179–1.180")
Radial clearance	0.030–0.071 mm (0.0012–0.0028")
Maximum	0.15 mm (0.0059")
Axial clearance (end play)	0.1–0.4 mm (0.0039–0.0157")

Camshaft bearings

Camshaft bearing diameter	30.000–30.021 mm (1.1811–1.1819")

Timing gears, Models 230, 250, AQ131, AQ151

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

Timing gears, Models 251DOHC, AQ171

Number of teeth, crankshaft gear	19
Number of teeth, intermediate shaft gear	38
Number of teeth, camshaft gear	38
Number of teeth, toothed belt	146

Intermediate shaft

Number of bearings	3
Front bearing diameter	46.975–47.000 mm (1.849–1.850")
Middle bearing diameter	43.025–43.050 mm (1.694–1.695")
Rear bearing diameter	42.925–42.950 mm (1.690–1.691")
Radial clearance	0.020–0.075 mm (0.0008–0.0030")
Axial clearance (end play)	0.20–0.46 mm (0.0079–0.0181")
Intermediate shaft bearing diameter in block:	
Front	47.020–47.050 mm (1.851–1.852")
Middle	43.070–43.100 mm (1.696–1.697")
Rear	42.970–43.000 mm (1.692–1.693")

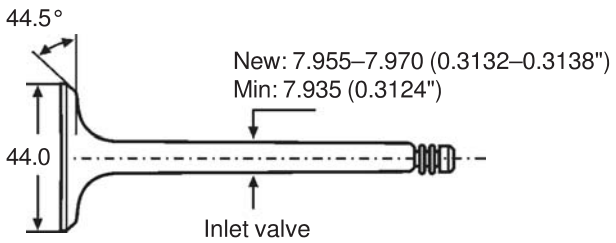
Changing the bearings

NOTE! New bearings must be line bored!

Valves 230, 250, AQ131, AQ151

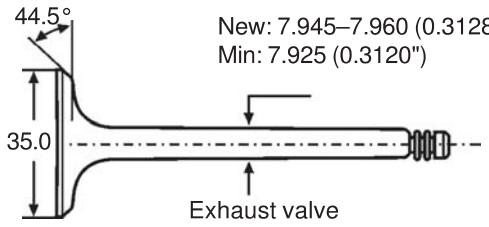
Inlet

Disc diameter	44.0 mm (1.7323")
Stem diameter	7.955–7.970 mm (0.3132–0.3138")
Valve seat angle	44.5°
Cylinder block seat angle	45°
Seat width in cylinder head	1.3–1.9 mm (0.0512–0.0748")



Exhaust

Disc diameter	35.0 mm (1.37795")
Stem diameter	7.945–7.960 mm (0.3128–0.3134")
Valve seat angle	44.5°
Cylinder block seat angle	45°
Seat width in cylinder head	17–2.3 mm (0.0669–0.0906")



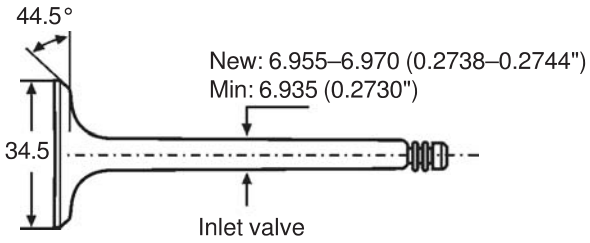
IMPORTANT! The valves are stellite coated. Therefore they must not be machined, only lapped against the seat!

Clearance when checking:
Cold engine ..... 0.30–0.40 mm (0.0118–0.0157")
Hot engine ..... 0.35–0.45 mm (0.0138–0.0177")
Clearance when adjusting:
Cold engine ..... 0.35–0.40 mm (0.0138–0.0157")
Hot engine ..... 0.40–0.45 mm (0.0157–0.0177")
The same clearance for inlet and exhaust valves.

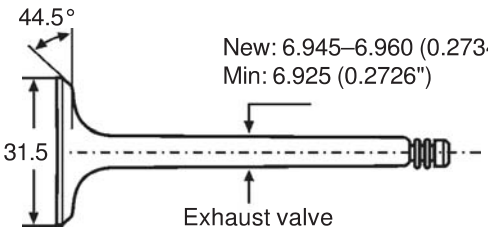
Valve guides (inlet & exhaust) 230, 250, AQ131, AQ151
Length ..... 52 mm (2.165")
Inner diameter ..... 8.00–8.02 mm (0.275–0.276")
Clearance, valve stem–valve guide, inlet valve ..... 0.03–0.06 mm (0.0012–0.00245")
Clearance, valve stem–valve guide, exhaust valve ..... 0.04–0.07 mm (0.0016–0.0028")
Clearance, maximum wear ..... 0.15 mm (0.0059")

Valve springs, 230, 250, AQ131, AQ151
Length, unloaded ..... 45.0 mm (1.772")
Length, loaded 285–325 N (28.5–32.5 kp) ..... 38.0 mm (1.496")
Length, loaded 725–805 N (72.5–80.5 kp) ..... 27.0 mm (1.063")

Valves 251DOHC, AQ171
Inlet
Disc diameter ..... 34.5 mm (1.358")
Stem diameter ..... 6.955–6.970 mm (0.2738–0.2744")
Valve seat angle ..... 44.5°
Cylinder block seat angle ..... 45°
Seat width in cylinder head ..... 1.3–1.9 mm (0.0512–0.0748")



Exhaust
Disc diameter ..... 31.5 mm (1.240")
Stem diameter ..... 6.945–6.960 mm (0. 2734–0.2740")
Valve seat angle ..... 44.5°
Cylinder block seat angle ..... 45°
Seat width in cylinder head ..... 1.7–2.3 mm (0.0669–0.0906")



IMPORTANT! The valves are stellite coated. Therefore they must not be machined, only lapped against the seat.

Valve clearance, 251DOHC, AQ171	Hydraulic valve tappets, no setting is required

Valve guides (inlet & exhaust) 251DOHC, AQ171

Length	55 mm (2.165")
Inner diameter	7.00–7.02 mm (0.275–0.276")
Clearance, valve stem–valve guide, inlet valve	0.03–0.06 mm (0.0012–0.0024")
Clearance, valve stem–valve guide, exhaust valve	0.04–0.07 mm (0.0016–0.0028")
Clearance, maximum wear	0.15 mm (0.0059")

Valve springs 251DOHC, AQ171

Length, unloaded	43.0 mm (1.6929")
Length, loaded 212–252 N (21.2–25.2 kp)	37.0 mm (1.45669")
Length, loaded 600–680 N (60–68 kp)	26.5 mm (1.0433")

Lubricating system

Changing oil, oil capacity, excluding filter	3.5 dm^3 (0.88 Imp gall./1.06 US gall.)
Changing oil, oil capacity, including filter	4.0 dm^3 (0.99 Imp gall./1.19 US gall.)
Oil pressure at 33.33 r/s (2000 rpm), hot engine	2.5–6.0 kp/cm^2 (35–85 psi)
Lubricating oil, alternative 1	Volvo Penta lubricating oil for gasoline engines
Lubricating oil, alternative 2	Lubricating oil SG
Viscosity	SAE 20 W/50

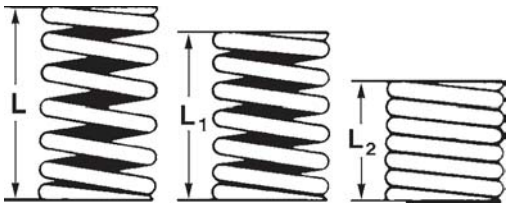
Oil filter

Type	Full flow filter

Lubricating oil pump

Axial clearance	0.02–0.12 mm (0.0008–0.0047")
Radial clearance (excluding bearing clearance)	0.02–0.09 mm (0.0008–0.0035")
Gear backlash (excluding bearing clearance)	0.15–0.35 mm (0.0059–0.0138")
Bearing clearance, drive shaft	0.032–0.070 mm (0.0013–0.0028")
Bearing clearance, idler shaft	0.014–0.043 mm (0.0006–0.0017")

Length of the relief valve spring at different loads:



Length:	**Load:**
47.6 mm (1.874")	No load
32.0 mm (1.26")	40–48 N (4.0–4.8 kp) (29.4–35.2 ft.lbs)
26.0 mm (1.024")	55–67 N (5.5–6.7 kp) (40.3–49.1 ft.lbs)

Fuel system

Fuel pump

Type	Diaphragm
Feed pressure	0.15–0.28 kp/cm^2 (2–4 psi)
Fuel flow	1.6–2.0 liter/minute (0.35–0.44 Imp.gal/min/0.375–0.475 US gal/min)

Carburetor 230, AQ131	AQ131A, 131B	AQ131C,131D, 230
Type	Down draught	Down draught
Designation	Model 44 PAI-5	Model 44 PAI-7
Venturi	34	34
Main jet	165	165
Idling jet	65	65
Air jet	185	185
Needle valve	1.7	2.0
Float, weight in grams (oz's)	7.3 (0.26)	7.3 (0.26)
Acceleration jet	70	70
Econostat jet	110	110

Carburetor 250, AQ151	AQ151A, AQ151B	AQ151C, AQ151D, 250
Type	Down draught	Down draught
Designation	Model 44 PAI-4	Model 44 PAI-7
Venturi	31	31
Main jet	145	145
Idling jet	62	62
Air jet	185	180
Needle valve	1.5	1.7
Float, weight in grams (oz's)	7.3 (0.26)	7.3 (0.26)
Acceleration jet	60	60
Econostat jet	–	–

Carburetor 251DOHC, AQ171	AQ171A, AQ171B	AQ171C, AQ171D, 251DOHC
Type	Down draught	Down draught
Designation	Model 44 PAI-5-6	Model 44 PAI-7
Venturi	32	32
Main jet	147	147
Idling jet	65	60
Air jet	190	200
Needle valve	1.7	1.7
Float, weight in grams (oz's)	7.3 (0.26)	7.3 (0.26)
Acceleration jet	70	70
Econostat jet	–	–

Electrical system

Battery

Grounding	Negative
Voltage	12 Volts
Capacity	60 Ah
Specific weight of the electrolyte	
Fully charged battery	1.275–1.285 grams/cm^3 (0.0460–0.0464 lb/cu.in.)
Discharged battery	1.230 grams/cm^3 (0.0444 lb/cu.in.)

Starter motor

Output	0.8 kW (1.1 hk)

Alternator

Output, maximum Amp (W)	50 (14x50)

Ignition system

Cylinder marking	No 4 closest to the flywheel
Spark plugs 230, 250, AQ131, AQ151	Part no 875820-3, Bosch W6DC or its equivalent
Spark plugs, 251DOHC, AQ171	Part no 876077-9, Bosch WR6DC or its equivalent
Spark plug gap	0.7 mm (0.0276")

Distributor 230, 250, AQ131, AQ151

Type	Breaker point system
Type Bosch JF4	0231 178 019

Setting for regular gasoline, min 91 octane ROT:

USA: Ignition setting for regular petrol (RON+MON)/2 = min 87 octane	
Basic setting	6° BTDC (0–14.17 r/s = 0–850 rpm)
Stroboscope setting	32–36° BTDC (70 r/s = 4200 rpm)
Contact gap	0.40 mm (0.01575")
Dwell angle	62±3°

Distributor, 251DOHC, AQ171

Type Bosch TVX4, Breakerless system	A 237 540 079

Setting for regular gasoline, min 91 octane ROT:

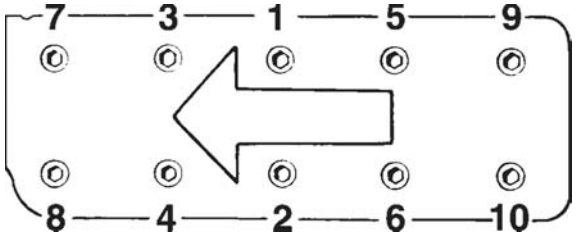
USA: Ignition setting for regular petrol (RON+MON)/2 = min 87 octane	
Basic setting	10° BTDC (0–15 r/s = 0–900 rpm)
Stroboscope setting (not adjustable)	23–25° BTDC (73.33 r/s=4400 rpm)

Cooling system
Thermostat

Type	Wax thermostat
Starts opening at	82°C (179.6°F)
Fully open at	92°C (197.6°F)

Tightening torques

NOTE! Always tighten the cylinder head bolts when the engine is cold. The torque values are valid for bolts and nuts being well oiled prior to installation.
Parts having been washed should be oiled prior to the assembly.



Tightening torque for cylinder head bolts:

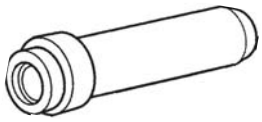
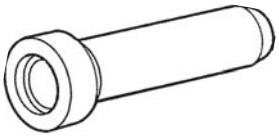
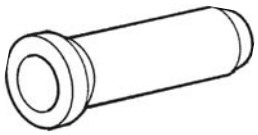
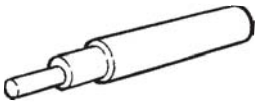
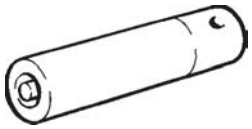
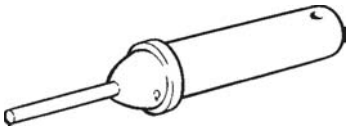
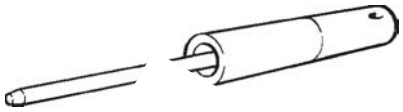
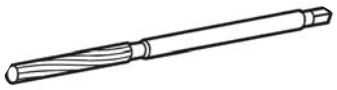
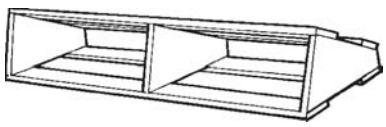
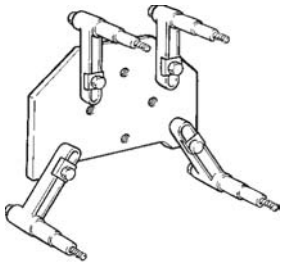
The cylinder head: To be tightened in stages	1 = 20 Nm (2.0 kpm) (15 ft.lbs.) 2 = 40 Nm (4.0 kpm) (29 ft.lbs.) 3 = Angle tighten through 120° in one operation!

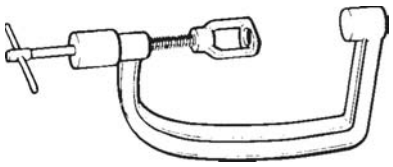
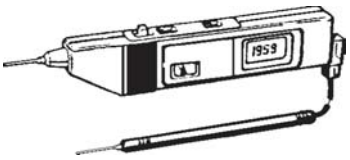
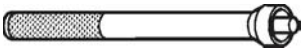
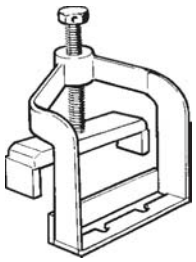
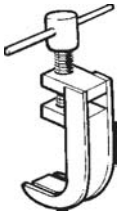
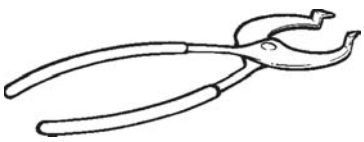
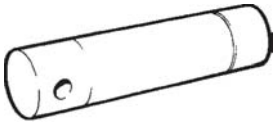
– Replace the cylinder head bolts if they show signs of being stretched. If a bolt is "stretched" can clearly be seen on the "waist" of the bolt, which is then elongated.
– The cylinder head bolts can be "re-used" max 5 times.
Replace the bolts if you feel uncertain on any of these points.

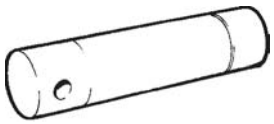
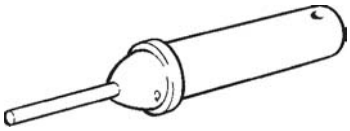
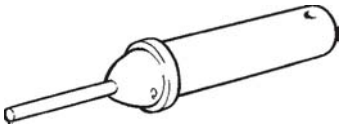
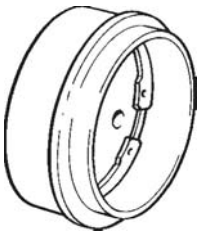
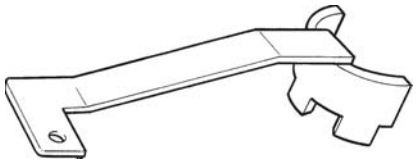
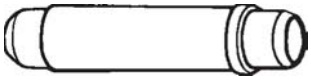
	Nm	Kpm	Ft.lbs.
Main bearings	110	11.0	79.5
Crank bearings, 1st stage[1)]	20	2.0	15
2nd stage[1)]	through 90°		
Flywheel (use new bolts)	70	7.0	51
Spark plugs (do not oil them!)	25±5	2.5±0.5	18
Camshaft gear	50	5.0	36
Intermediate gear	50	5.0	36
Camshaft bearing cap	20	2.0	15
Crankshaft, center bolt pulley, stage 1	60	6.0	43
stage 2	Angle tighten through 60°		

[1)] Old bolts can be used provided the length does not exceed 55.5 mm (2.185").

2. Special Tools

884359-1		Drift for the installation of the seal in the flywheel housing
884596-8		Drift for the installation of the primary shaft in the flywheel housing
884599-2		Drift for the installation of the seal in the flywheel housing
884958-0		Drift for the changing of valve guides 251DOHC , AQ171
884959-0		Drift for the changing of valve guides 251DOHC, AQ171
884960-6		Installation tool inlet valve seat 251DOHC, AQ171
884961-4		Installation tool exhaust valve seat 251DOHC, AQ171
884966-3		Drift for the changing of valve guides 251DOHC, AQ171
884967-1		Reamer valve guides 251DOHC, AQ171
884979-6		Cylinder head fixture 251DOHC, AQ171
885050-5		Stand fixture

9986052-0		Valve compressor
9988452-0		Digital probe tester
9991426-9		Drift for the installation of support bearing in the flywheel
9994090-0		Puller for support bearing in the flywheel
9995021-4		Press tool for the removal and assembly of the camshaft, AQ131, AQ151, 230, 250
9995022-2		Tool for depressing valve depressors, AQ131, AQ151, 230, 250
9995025-5		Installation tool for the intermediate shaft seal
9995026-3		Pair of pliers for adjustment shims AQ131, AQ151, 230, 250
9995027-1		Drift for the installation of valve guides (inlet), AQ131, AQ151, 230, 250

9995028-9		Drift for the installation of valve guides (exhaust), AQ131, AQ151, 230, 250
9995029-7		Installation tool for valve seats (inlet), AQ131, AQ151, 230, 250
9995034-7		Counterhold for the camshaft gear and intermediate gear
9995220-2		Installation tool for valve seats (exhaust), AQ131, AQ151, 230, 250
9995224-4		Reamer, valve guides AQ131, AQ151, 230, 250
9995276-4		Drift for the installation of sealing in the crankshaft rear end
9995283-0		Removal tool for the crankshaft front seal
9995284-8		Counterhold for crankshaft pulley
9995309-3		Drift for the removal and installation of bushing in the connecting rod
1159660-8		Tensioning tool for the toothed belt AQ171, 251DOHC

3. Electrical System

General

All engines have a single pole electrical system with an AC generator. The engine main wiring is fused with a thermic 40 A automatic fuse.

Ignition system

AQ131, AQ151, 230 and 250 have conventional breaker point ignition systems. See the “Technical Data” for the setting values. AQ171 and 251DOHC are equipped with breakerless electronic ignition systems. The ignition system memory unit has 63 optimal engine speed / ignition values programmed. The ignition points for other engine speeds is calculated based on these locked values.
Note! No ignition setting can be carried out on the distributor. The ignition system has the correct setting when all components are correctly installed. In order to obtain exact installation there is a certain amount of adjustment possible in the ignition setting sender. All operation based adjustment is stopped. All settings are permanently stored in the control module and are stable because of the absence of mechanicals (breaker points, mechanical ignition setting). The only task of the distributor has is to distribute the current to the spark plugs via the rotor.

Instrumentation

The engines were manufactured with two types of instrumentation. One earlier type 1 and the later type 2 (for version refer to wiring diagrams). Both the instrumentation types are equipped with two 8 A fuses for the system voltage (key switch in ignition position) and start voltage (key switch in start position). Instrumentation type 2 is equipped with 2 connectors for extra power outputs for accessories. One is fused via the 8 A fuse for system voltage and has a maximum permissible voltage output of 5 A (main panel + any flying bridge panel). The other connector has a maximum permissible voltage output of 20 A and is not separately fused (power supply is via the 40 A automatic fuse for the main wiring). There is also a connector for connecting instrument lighting for extra instruments (a fuel gauge for example) fused via the 8 A fuse for system voltage.

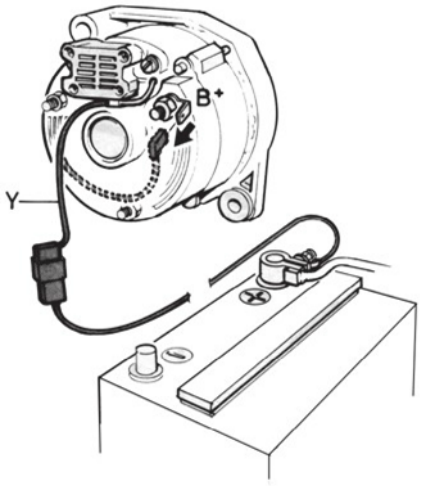
Starter motor

There are two versions. VALEO D6RA11 and Hitachi S114-237.

Minimum length of the brushes:
VALEO = 14 mm
Hitachi = 12 mm.

Generator

The alternating current generator is a 14 V 50 A VALEO. It is equipped with a charge sensor cable (yellow) which is connected to the generator (GEN) B+.

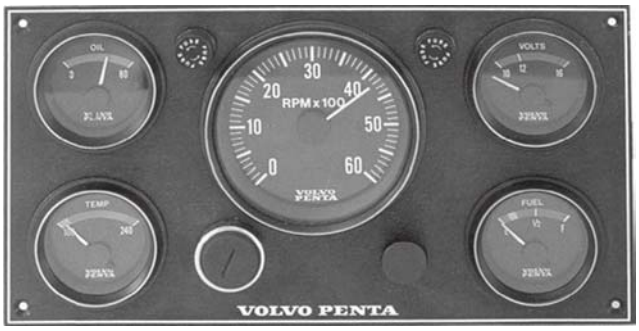


In those cases where the generator is required to charge several batteries (starter and operational batteries) the charge sensor cable should be disconnected from B+ and connected, using a 1.5 mm^2 extension, to the accessory battery + terminal using a double diode.

Minimum length of the brushes: 8 mm
Resistance rotor winding 4,0–6,0 Ω
Resistance stator winding 0,11–0,15 Ω

Wiring Diagram AQ131, AQ151, 230, 250

With Instrument panel alternative 1



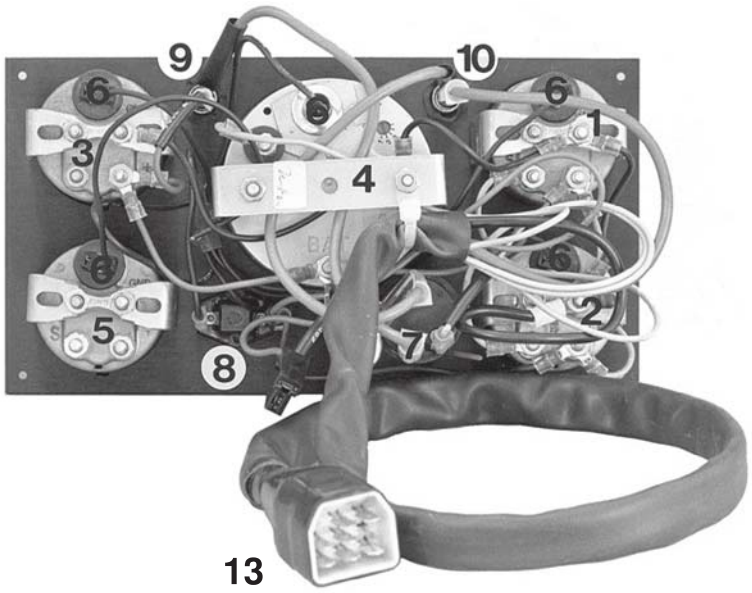
1. Oil pressure gauge
2. Temperature gauge, coolant
3. Voltmeter
4. Tachometer
5. Fuel gauge (alternative)
6. Instrument lighting
7. Key switch (B=30, S=50, I=15)
8. Switch, instrument lighting
9. Fuse 8 A
10. Fuse 8 A
11. Generator
12. Starter motor
13. Connector engine–instrumentation
14. Automatic fuse 40A
15. Main switch (option)
16. Battery
17. Temperature sensor
18. Oil pressure sensor
19. Distributor
20. Ignition coil
21. Relay
22. Resistor

Cable colour code

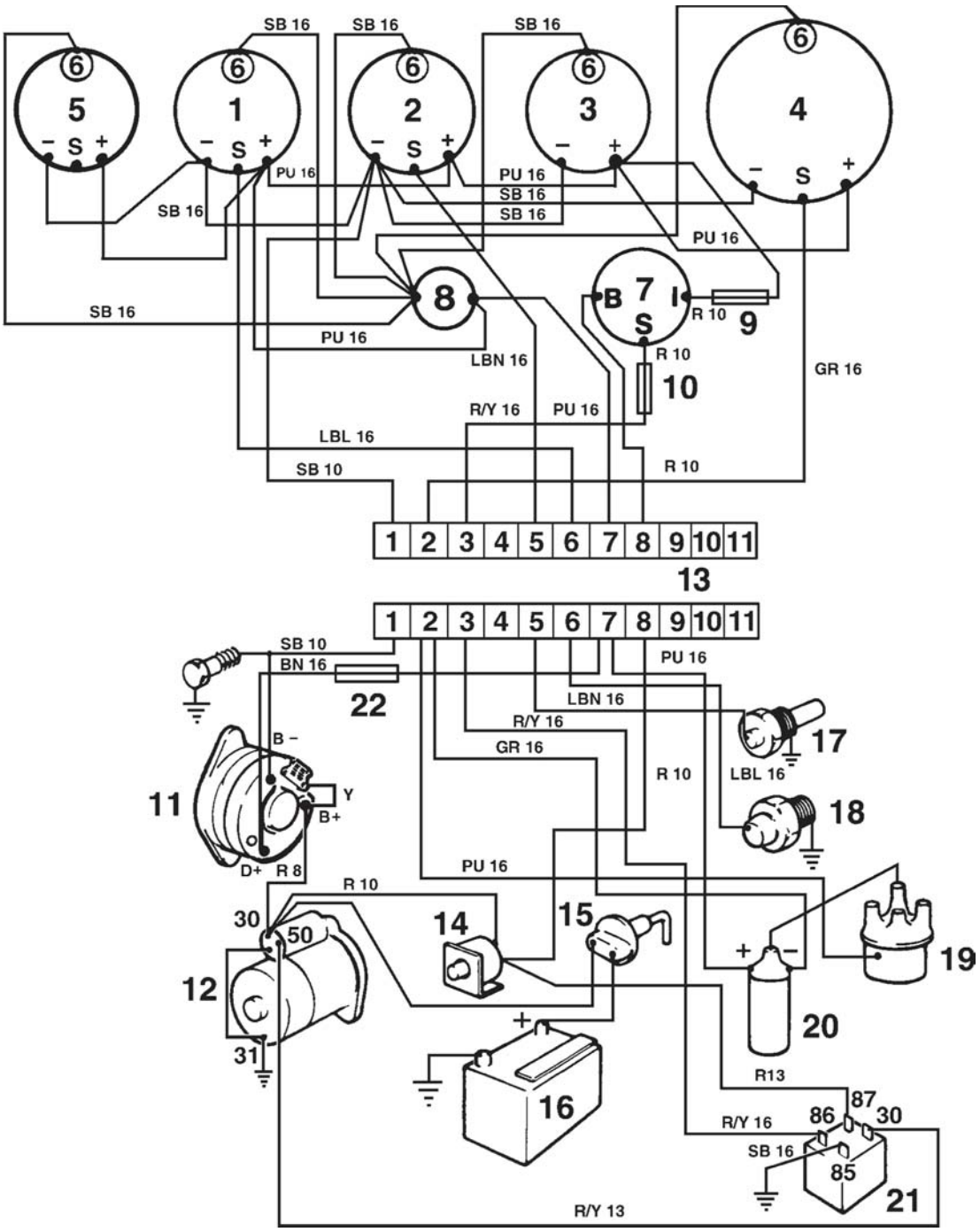
SB	=	Black
PU	=	Purple
LBN	=	Light brown
R	=	Red
GR	=	Grey
LBL	=	Light blue
R/Y	=	Red/Yellow
BN	=	Brown
W	=	White
Y	=	Yellow

Cable cross sections

AWG	mm^2
16	1.5
13	2.5
10	6.0
8	10.0

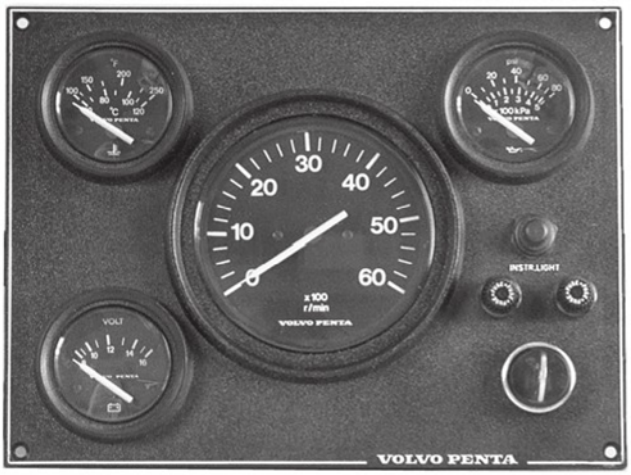


AQ131, AQ151, 230, 250 ALT. 1



Wiring Diagram 230, 250

With Instrument panel alternative 2



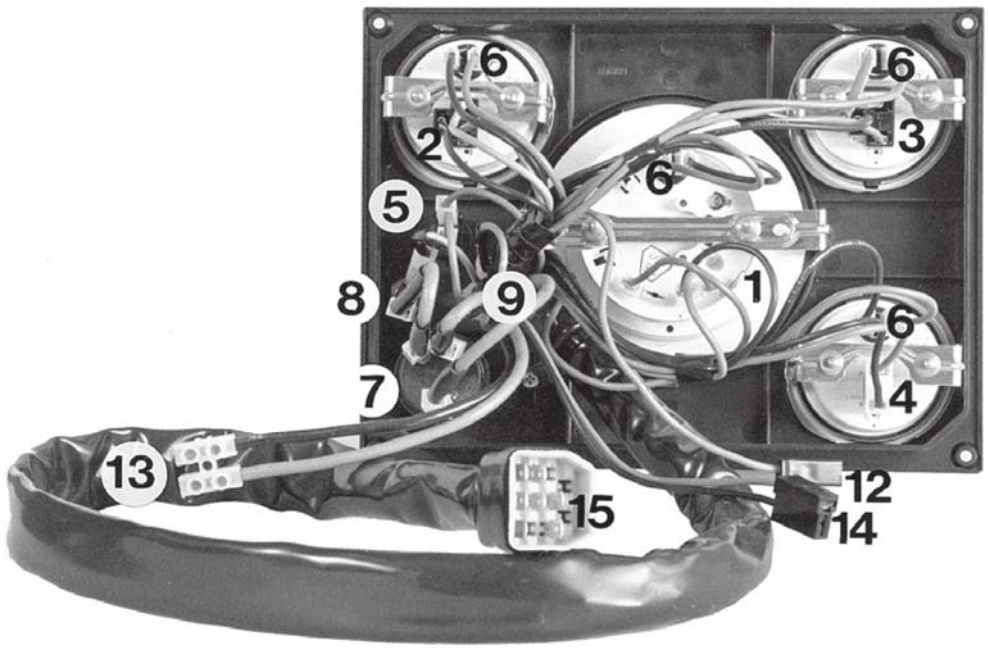
1. Tachometer
2. Oil pressure gauge
3. Temperature gauge, coolant
4. Voltmeter
5. Switch, instrument lighting
6. Instrument lighting
7. Key switch (B=30, S=50, I=15)
8. Fuse 8 A
9. Fuse 8 A
10. Contact terminal neutral position switch (option/accessory)
11. Contact terminal safety switch (accessory)
12. Connector instrument lighting accessory
13. Connector power output, maximum 20 A
14. Connector power output, maximum 5 A (main panel + flying bridge panel)
15. Connector, engine–instrumentation
16. Automatic fuse 40A
17. Main switch (option)
18. Battery
19. Temperature sensor
20. Oil pressure sensor
21. Distributor
22. Ignition coil
23. Starter motor
24. Relay
25. Generator
26. Resistor

Cable colour code

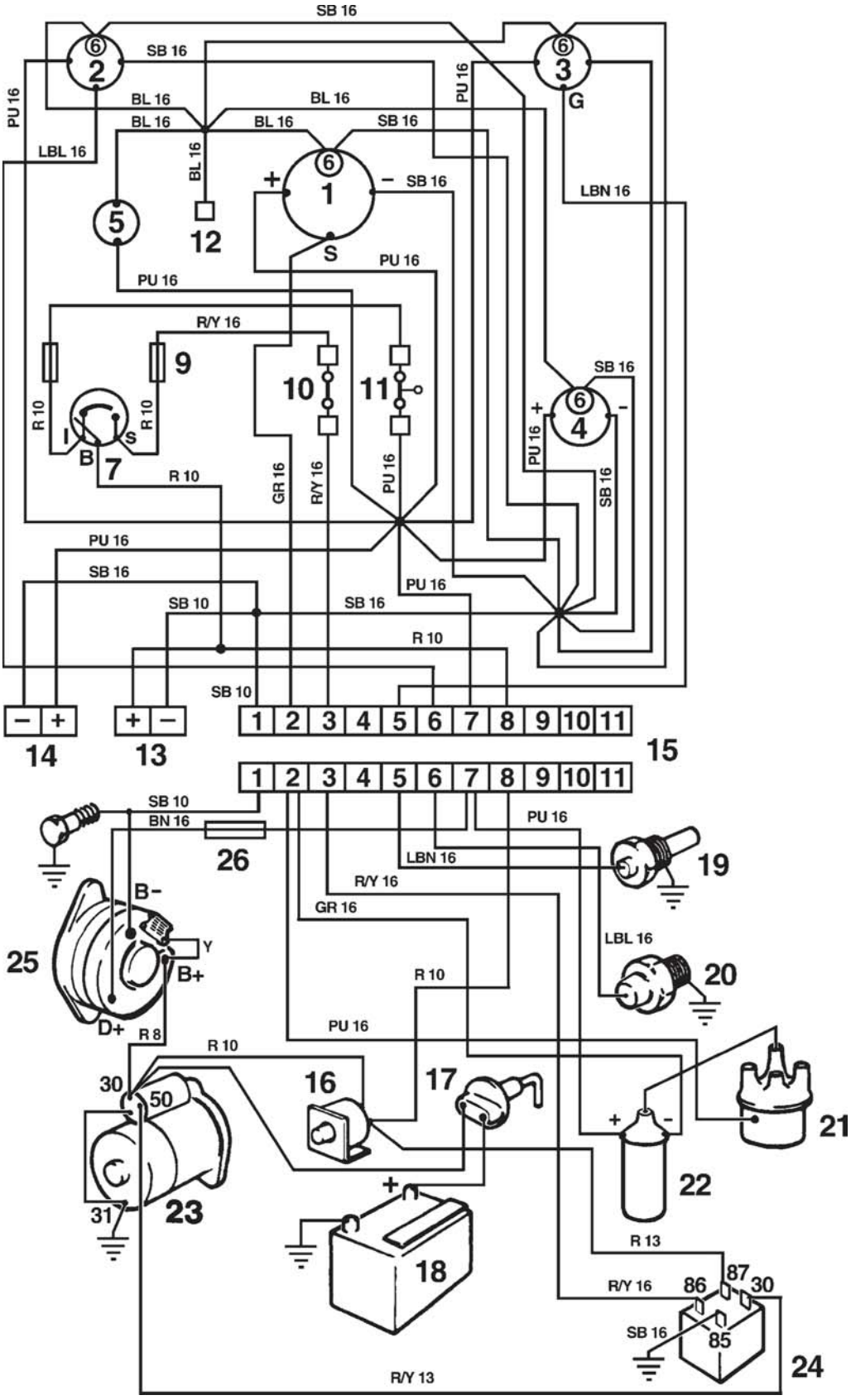
SB	=	Black
PU	=	Purple
LBN	=	Light brown
R	=	Red
GR	=	Grey
LBL	=	Light blue
R/Y	=	Red/Yellow
BN	=	Brown
W	=	White
Y	=	Yellow

Cable cross sections

AWG	mm^2
16	1.5
13	2.5
10	6.0
8	10.0

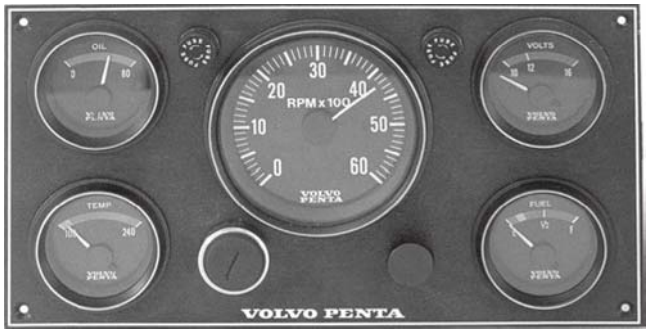


230, 250 ALT. 2


SB 16
SB 16
PU 16
BL 16
BL 16
BL 16
BL 16
SB 16
LBL 16
BL 16
SB 16
LBN 16
PU 16
PU 16
R/Y 16
R 10
R 10
R 10
GR 16
R/Y 16
PU 16
SB 16
PU 16
SB 16
PU 16
SB 10
SB 16
R 10
SB 10
BN 16
PU 16
LBN 16
R/Y 16
GR 16
LBL 16
R 10
R 8
R 10
PU 16
R 13
R/Y 16
SB 16
R/Y 13
1 2 3 4 5 6 7 8 9 10 11
1 2 3 4 5 6 7 8 9 10 11
B-
B+
D+
Y
30
50
31
S
I
B
+
-
G
12
14
13
15
16
17
18
19
20
21
22
23
24
25
26
85
86
87
30

Wiring Diagram AQ171, 251DOHC

With Instrument panel alternative 1



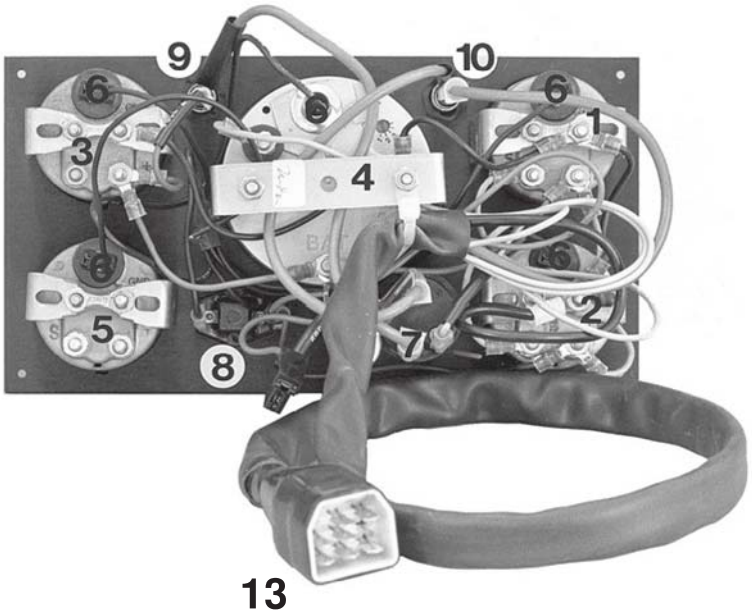
1 . Oil pressure gauge
2. Temp gauge
3. Voltmeter
4. Tachometer
5. Fuel gauge (alternative)
6. Instrument lights
7. Key switch (B = 30, S = 50, I = 15)
8. Switch, instrument lights
9. Fuse 8 Amp
10. Fuse 8 Amp
11. Alternator
12. Starter motor
13. Terminal block
14. Automatic fuse 40 Amp
15. Main switch (optional)
16. Battery (optional)
17. Temp sender
18. Oil pressure sender
19. Distributor
20. Electronic ignition unit
21. Relay
22. Resistor
23. Impulse sender, ignition unit
24. Ground (screw)
25. Solenoid valve

Cable colour code

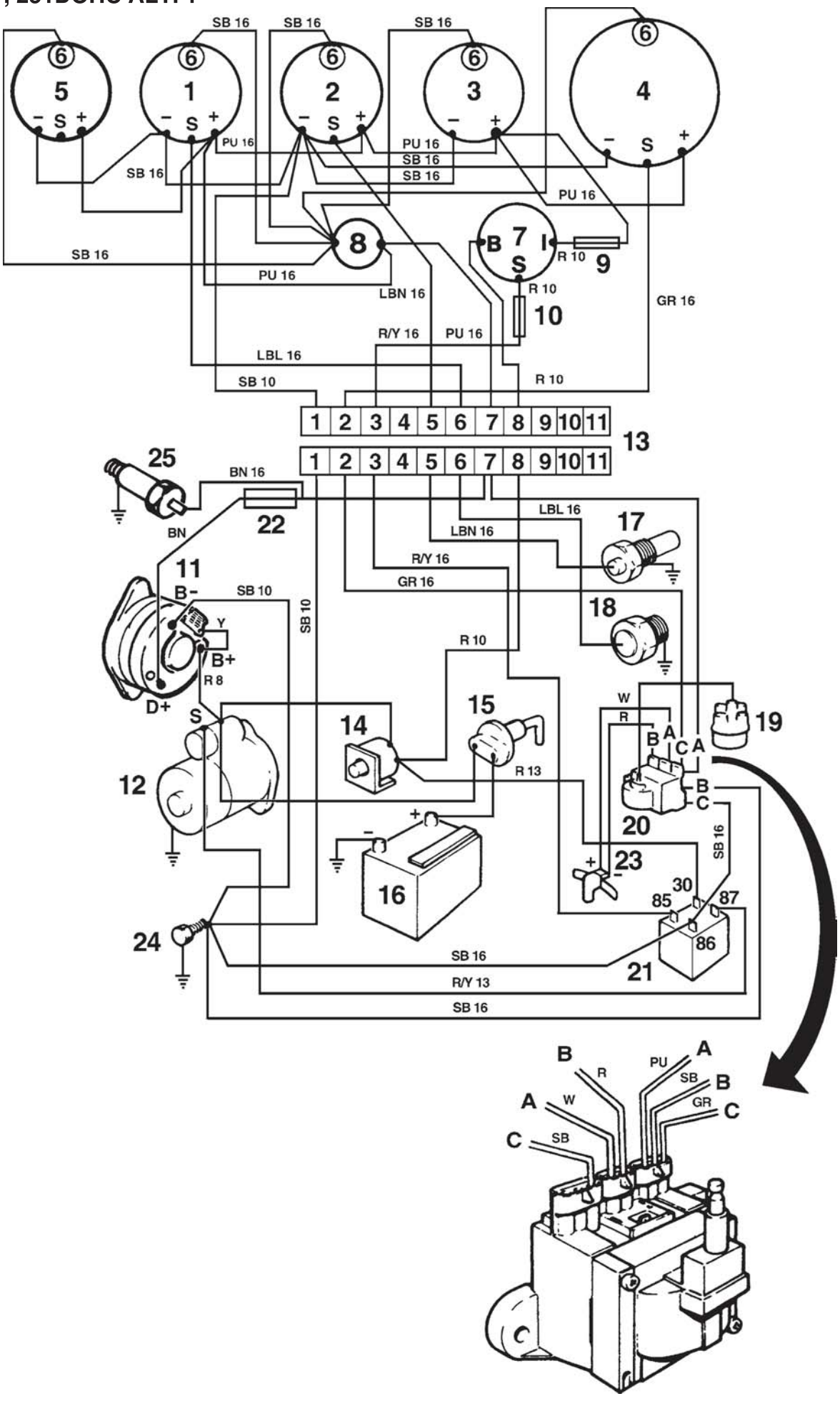
SB	=	Black
PU	=	Purple
LBN	=	Light brown
R	=	Red
GR	=	Grey
LBL	=	Light blue
R/Y	=	Red/Yellow
BN	=	Brown
W	=	White
Y	=	Yellow

Cable cross sections

AWG	mm^2
16	1.5
13	2.5
10	6.0
8	10.0



AQ171, 251DOHC ALT. 1



Wiring Diagram 251DOHC

With Instrument panel alternative 2

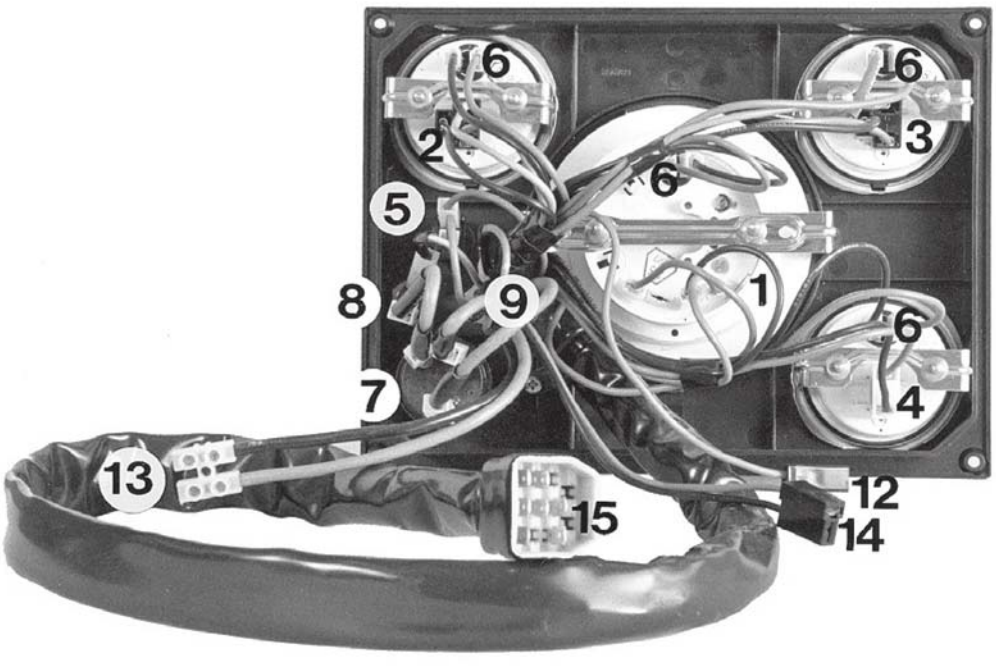
1. Tachometer
2. Oil pressure gauge
3. Temperature gauge, coolant
4. Voltmeter
5. Switch, instrument lighting
6. Instrument lighting
7. Key switch (B=30, S=50, I=15)
8. Fuse 8 A
9. Fuse 8 A
10. Contact terminal neutral position switch (option/accessory)
11. Contact terminal safety switch (accessory)
12. Connector instrument lighting accessory
13. Connector power output, maximum 20 A
14. Connector power output, maximum 5 A (main panel + flying bridge panel)
15. Connector, engine–instrumentation
16. Automatic fuse 40A
17. Main switch (option)
18. Battery
19. Temperature sensor
20. Oil pressure sensor
21. Distributor
22. Electronic ignition unit
23. Engine speed (RPM) sensor, ignition system
24. Relay
25. Starter motor
26. Generator
27. Ground terminal
28. Resistor
29. Solenoid valve, carburettor

Cable colour code

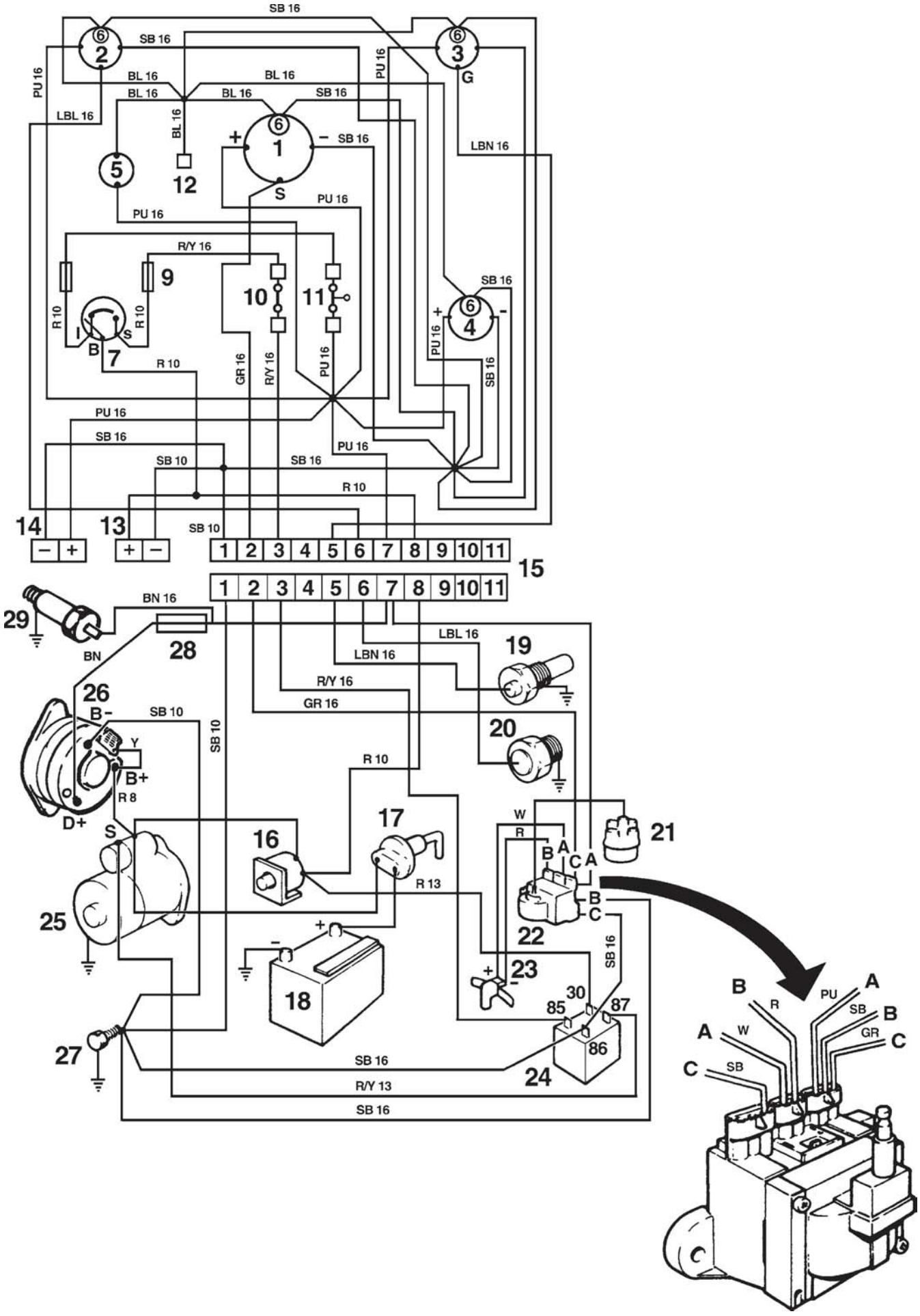
SB	=	Black
PU	=	Purple
LBN	=	Light brown
R	=	Red
GR	=	Grey
LBL	=	Light blue
R/Y	=	Red/Yellow
BN	=	Brown
W	=	White
Y	=	Yellow

Cable cross sections

AWG	mm^2
16	1.5
13	2.5
10	6.0
8	10.0



251DOHC ALT. 2



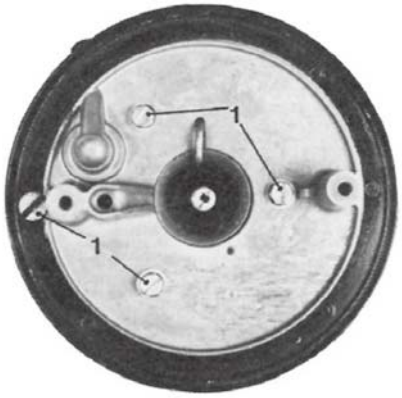
4A Cylinder Head

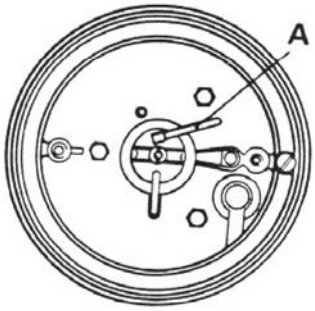
Trouble shooting and Remedies Fuel System

⚠ **IMPORTANT!** Always take the risk of fire into consideration and therefore always keep a fire extinguisher near by!

Causes / Symptoms	Difficult to start, cold engine	Difficult to start, hot engine	Starts but stops again	Runs rough at idle	Runs rough, the speed drops	Weak acceleration	Poor fuel economy	Backfires	Action to be taken
Empty tank	X	X							Fill the tank!
Closed fuel cock	X	X							Open the fuel cock!
Clogged fuel filter	X	X			X			X	Clean the filter or replace the filter insert
Fuel pump not pumping	X	X	X			X		X	Fuel pump diaphragm cracked. Replace it.
Fuel line blocked	X	X	X		X				Blow all lines clean
Carburetor overflowing		X	X	X					Needle valve not closing. Float level wrong. Leaking float. Adjust the level or replace the float.
Wrong idling setting	X	X	X	X					Adjust the idle accord. to “Technical Data”.
Wrong setting air screw	X	X	X	X					Set the screw and adjust till smooth running obtained
Clogged jets	X	X			X				Blow the jets. Never try to use hard objects in the jet holes.
Carburetor sucking additional air			X	X		X	X		Tighten the carburetor and if necessary replace the gasket. Check the throttle shaft clearance.
Intake manifold loose			X	X		X	X		Tighten the manifold and replace the gasket.
Acceleration jet clogged						X			Blow the jet clean.
Throttle does not open			X			X			Adjust the throttle linkage
Wrong jet			X			X	X		Check the marking in “Technical Data”
Bad compression			X			X	X		Take a compression test and then act according to results
Worn spark plugs									Change the spark plugs. See under “Technical Data”.
Wrong breaker points									Replace the breaker points and adjust dwell angle
Starting carburetor does not work properly	X						X	X	Arm to be in closed position when the engine is hot
Wrong ignition setting						X	X	X	Check setting with stroboscope and adjust if necessary
Toothed belt not installed properly				X				X	Check that the marking on the belt and gear wheel line up. Adjust immediately!
Faulty acceleration pump						X		X	With engine stopped. Check by opening up the throttle and see if fuel is spraying into the carburetor.

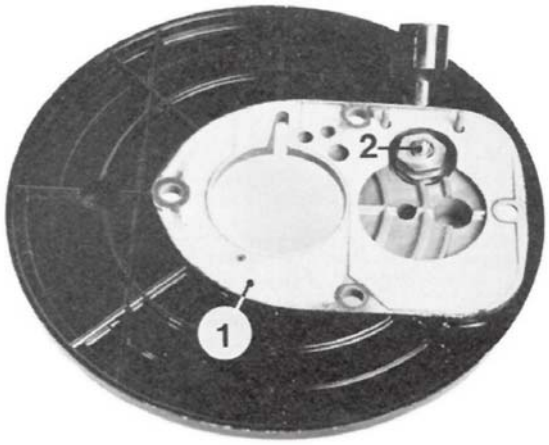
Overhauling and checking the carburetor



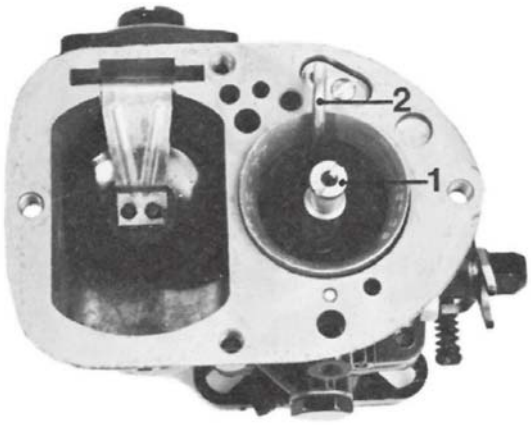


1. Remove the carburetor from the intake manifold. Notice the positioning of the plate in order to install it in the same way. Take care of the plate. Remove the screws (1) 4 pcs, and remove the top cover of the carburetor.

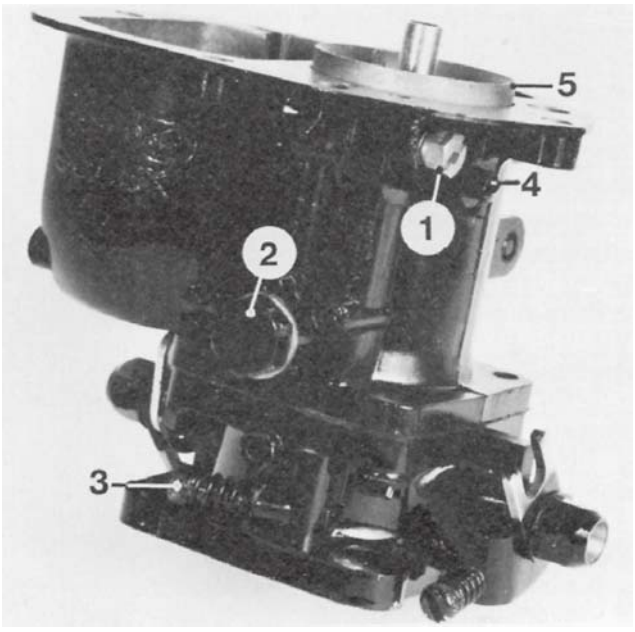
NOTE! The carburetor on the model 230 (AQ131) is equipped with a full speed jet (A), lower picture. This jet is pressed into the top cover of the carburetor and does not need to replaced unless damaged.



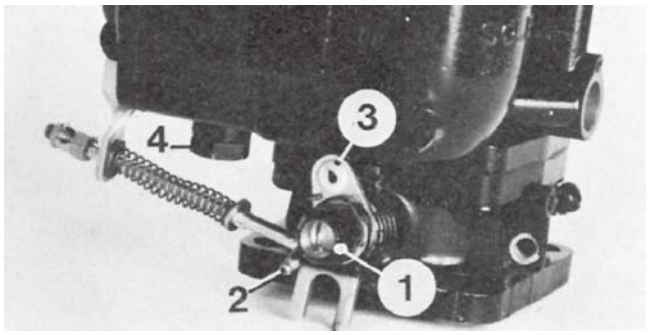
2. Remove the gasket (1) and needle valve (2). Check to make sure that the needle valve does not jam or that it's worn (not sealing). Replace if necessary.



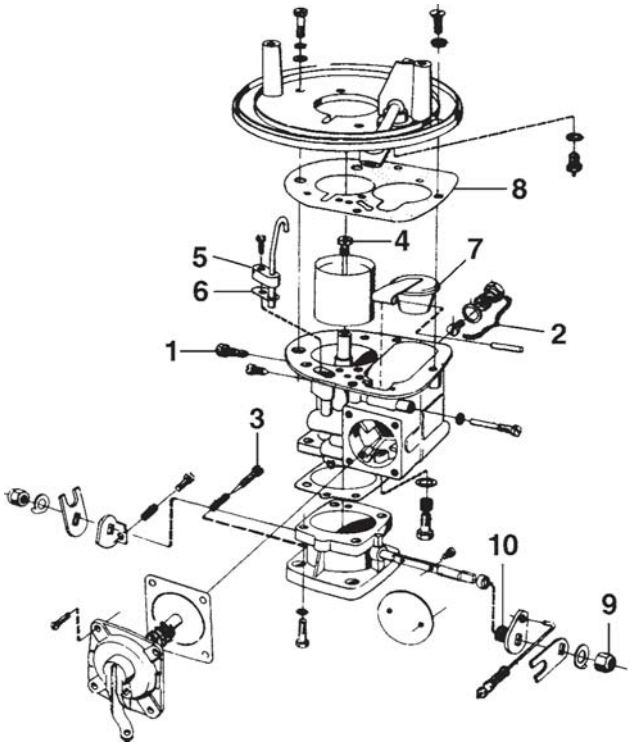
3. Lift out the float and check it for leakage. Should the float leak, the float level will not be correct. The weight of the float should be 7,3 grams (0,26 oz's). Remove the emulsion jet (1) and the acceleration jet (2).
NOTE! Don't forget the gasket! Check and blow clean with compressed air. Replace worn or damaged parts if necessary!



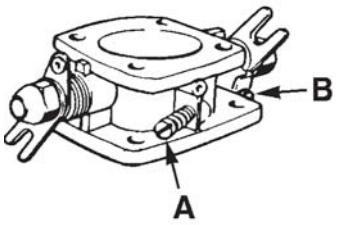
4. Remove the idle jet (1) and the main jet holder (2). Remove the jet from its holder. Clean the jets with compressed air. Replace if necessary. Remove the mixture screw (3) and blow the channel clean. The screw (4) is locking the venturi (5).



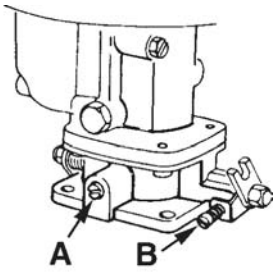
5. Turn the throttle spindle (1) and press out the thrust rod (2) from the lever (3). Then turn the thrust rod downward and remove the check valve (4). Use compressed air to clean the check valve and the strainer. Wash the carburetor and use compressed air to clean its channels. Then install the check valve and the strainer.
NOTE! Don't forget the copper washer! Turn the throttle shaft and press in the thrust rod into the lever.



6. Install the idle jet (1), the main jet (2) and the mixture screw (3).
NOTE! The copper washer on the main jet! Install the emulsion jet (4), the acceleration jet (5) and the gasket (6). Put the float (7) into the float housing and add a new gasket (8) and tighten the top cover of the carburetor to the carburetor housing. Remove the nut (9) and the levers to be able to replace the spring (10).



Early version



Late version

The Solex carburetor is available with earlier or later production versions of the butterfly valve housing. The setting of the idle screws differs between the earlier and later versions according to the chart.

Setting the idle screws (B):

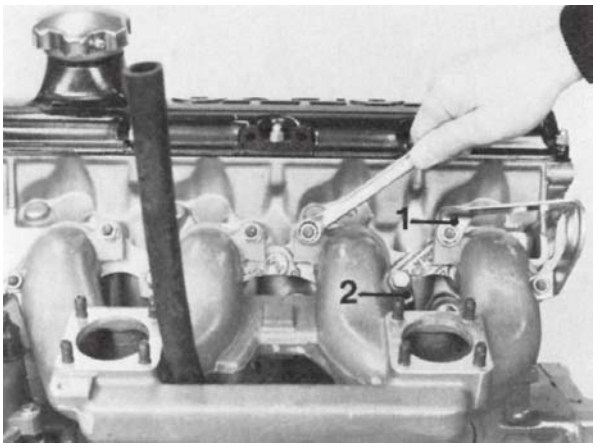
Tighten the screw until it touches the carburetor lever. Then tighten further according to the chart.

	Early version	Late version
AQ131	2	2
230	–	2
AQ151	1½	1
250	–	1
AQ171	1½	1¼
251DOHC	–	1¼

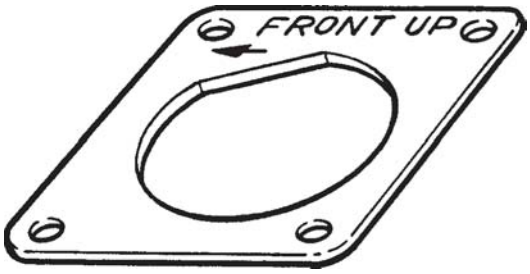
Setting of the idle mixture screws (A):

Bottom the screw lightly against the seat. Then back it out according to the chart.

	Early version	Late version
AQ131	2	9 ½
230	–	9 ½
AQ151	2	8
250	–	8
AQ171	2	10
251DOHC	–	10

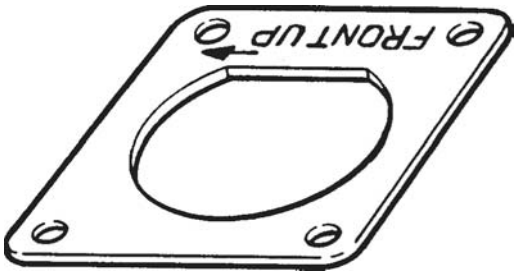


7. Install the intake manifold (if it has been removed).
NOTE! Don't forget the lifting eyelets (1) and the fuel pipe bracket (2). Pull up the hose from the oil trap through the opening in the intake manifold. Tightening torque for nuts and screws: 20 Nm (2.0 kpm/14.5 ft.lb). Tool width 12 mm.

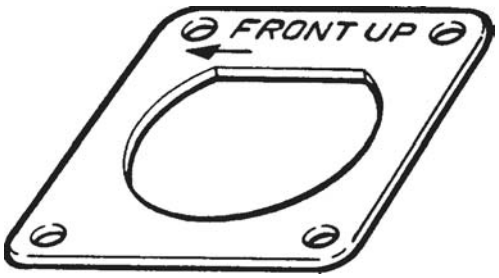


8. AQ131A. Place a gasket on each side of the plate and then onto the studs of the intake manifold.

IMPORTANT! Locate the plate the way the illustration indicates!

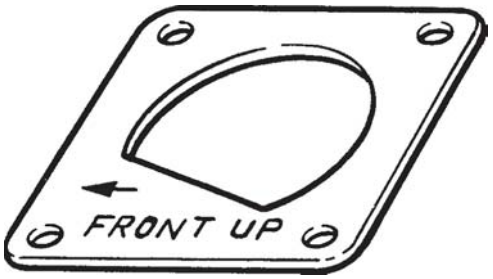


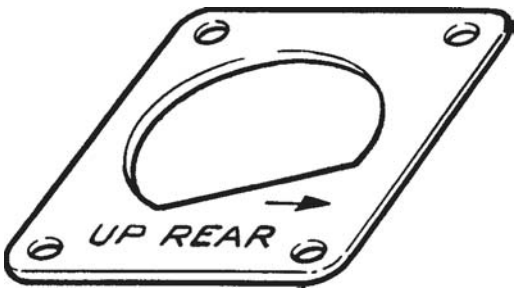
AQ131C, AQ131D earlier manufacture.



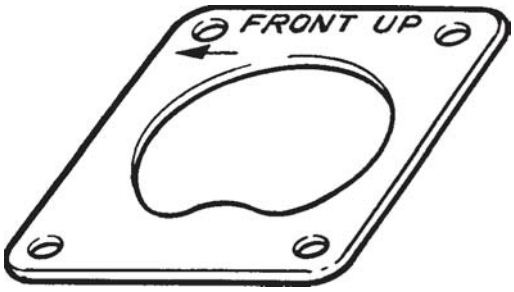
Late version of AQ131C, AQ131D, 230 = the text turned the right way up.

9. AQ131C, AQ131D, 230. These engines are equipped with a new plate.
NOTE! The plate is located with the text "upside down" (earlier manufacture). The plate is installed between 2 gaskets. On engines of later manufacture the text is turned the right way up.

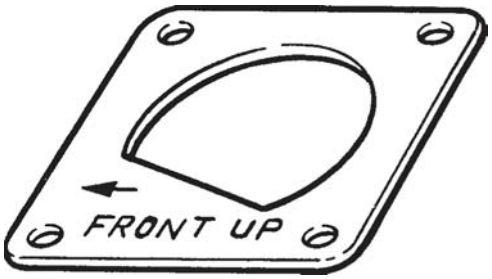




10. 250, AQ151C: Install the plate with a gasket on each side.
NOTE! The plate for the front carburetor is marked "FRONT" and consequently the rear one is marked "REAR". See the illustration!

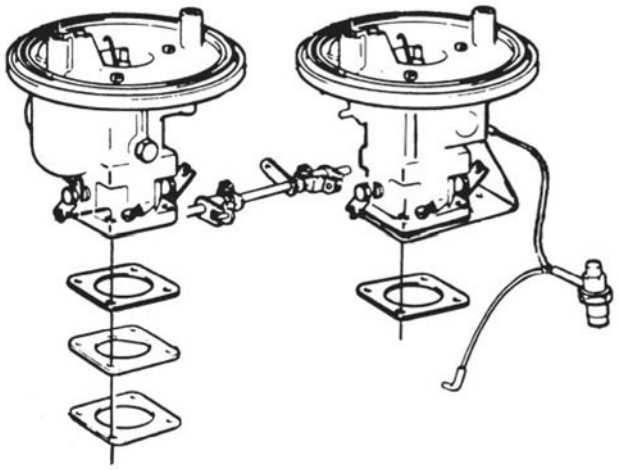


11. AQ171A. Install the plate with a gasket on each side of the plate on the front carburetor. Turn the text correctly. See the illustration!
NOTE! There is no plate on the rear carburetor, only a gasket is installed.

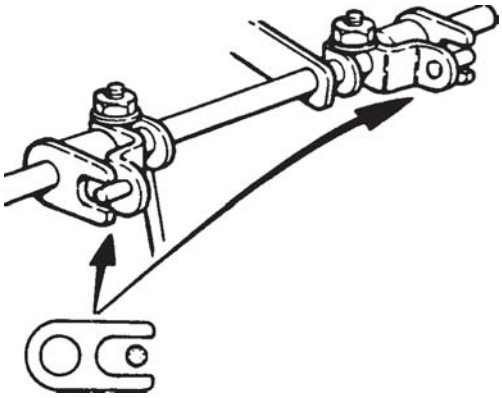


12. AQ171C, 251DOHC. Install the plate with a gasket on each side of it. Then place the plate along with the gaskets on the front carburetor location of the intake manifold.
NOTE! Turn the gasket in accordance with the illustration.

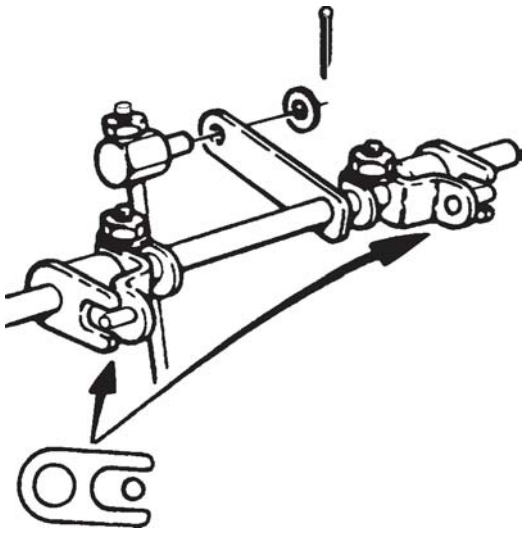
⚠ **IMPORTANT!** There is no plate on the rear carburetor. Only a gasket is installed on the rear carburetor.



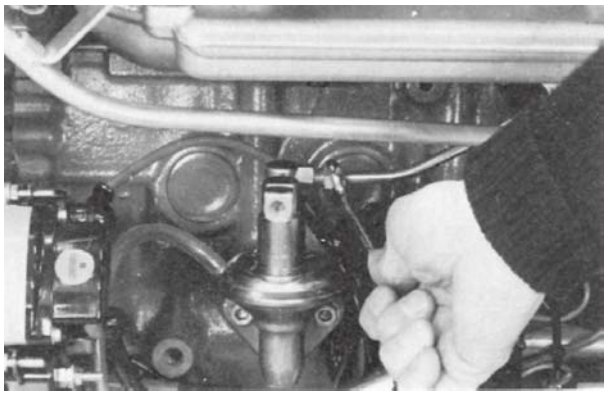
13. Check that the idle and air screws are set as per point 6. Then place the butterfly valve shaft between the carburetors and fit them to the intake manifold. 230 (AQ131) does not have a separate butterfly valve shaft.



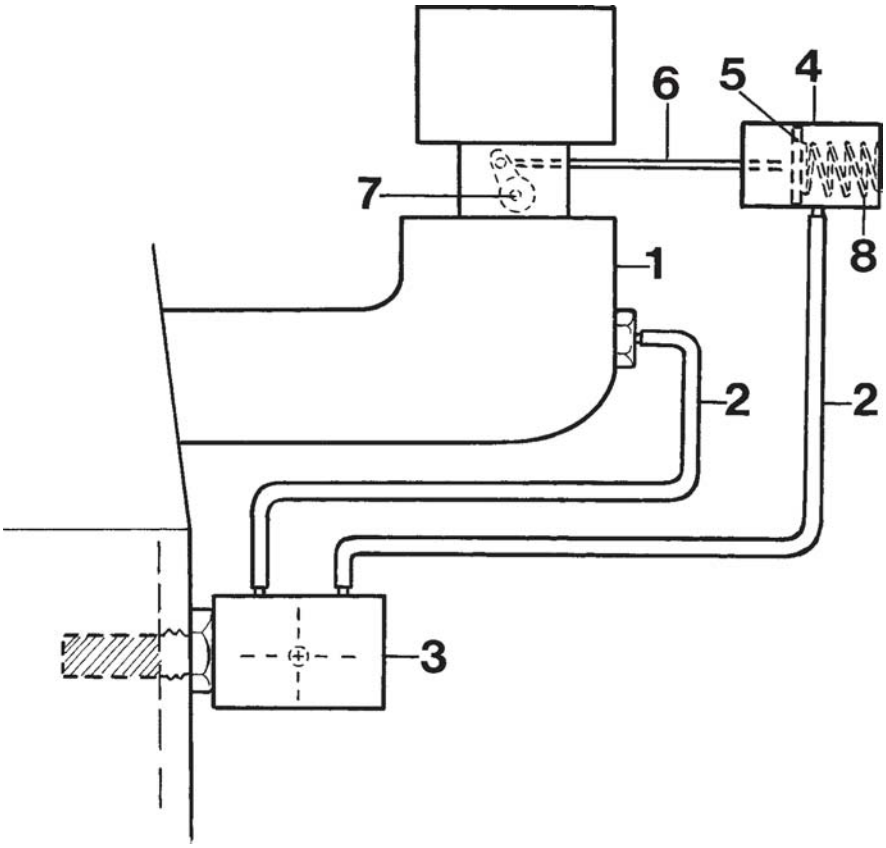
14. 250, 251DOHC (AQ151–171). Adjust and lock the lever so that both throttle levers are activated simultaneously.



15. 250, 251DOHC (AQ151–171). Adjust the position of the swivel on the control cable so that the pins on the levers are located in the middle of the lever gaps when connected. Tighten the swivel. Check while test running that fuel flows out from both the carburetors jets at the same time and that a “hissing/sucking” sound can be heard from the carburetors. Fine adjust if necessary.



16. Connect the fuel pipe to the fuel pump. Tool width 12 mm.



Cold start carburetor, function.

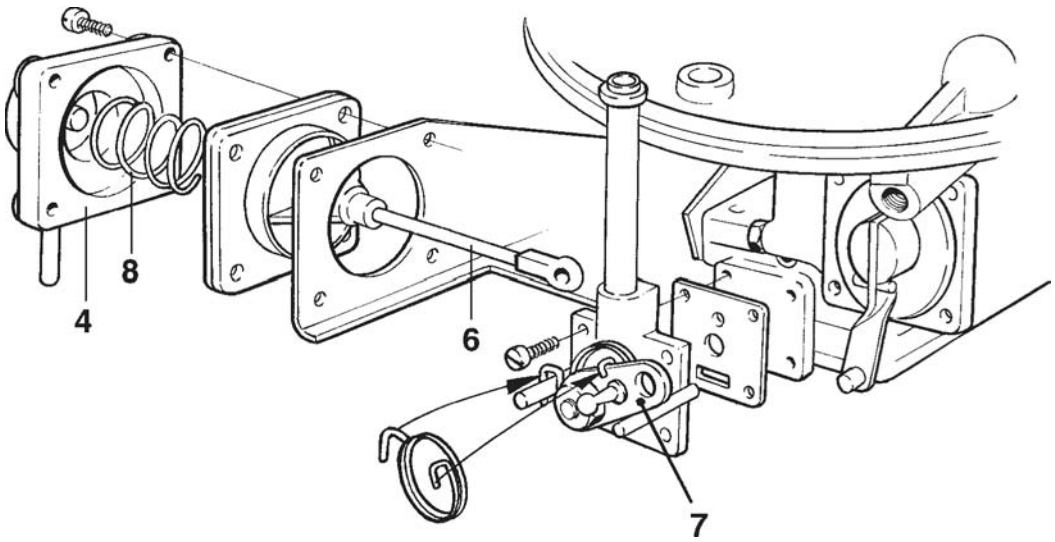
Start with cold engine.

When starting, a vacuum is built up in the intake manifold (1). This vacuum forces air to be sucked through the hoses (2) via a temperature controlled shut-off valve (3). The vacuum which is formed in the vacuum housing (4) affects the membrane (5) which pulls the rod (6) so that the spindle (7) turns and opens a fuel and an air channel in the carburetor. This way the engine gets an additional fuel/air supply.*

Start with hot engine.

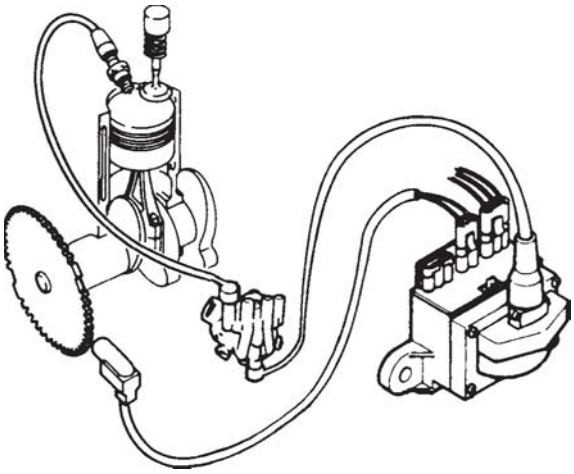
When the engine temperature is above 50°C (122°F) the shut-off valve (3) is closed. The vacuum in the vacuum housing (4) ceases and the rod (6) returns, by spring pressure, to its original position.

* If the engine speed is increased while the engine is cold, the vacuum in the vacuum housing is reduced and the spring (8) presses back the rod (6) shutting off the extra fuel/air supply.



4B Renix Ignition System

Trouble-shooting and repair ignition system 251DOHC, AQ171



Description

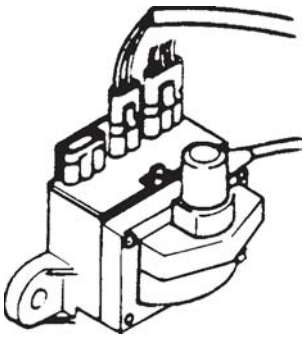
17. The 'Renix' ignition system is a fully electronic ignition system.

– Control unit with ignition coil

– Magnetic induction crankshaft position sender

– Specially machined flywheel

– Simple type of distributor

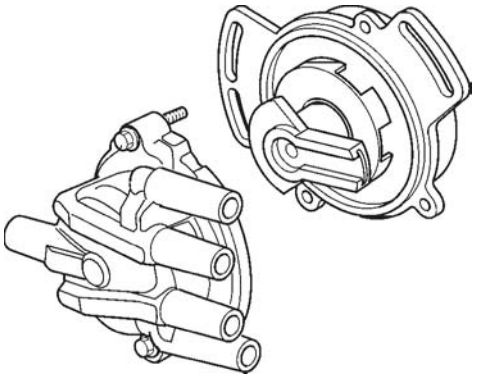


Control unit

18. The control unit consists of an electronic unit with power amplifier. The ignition coil is of the modern dry type and is replaceable.

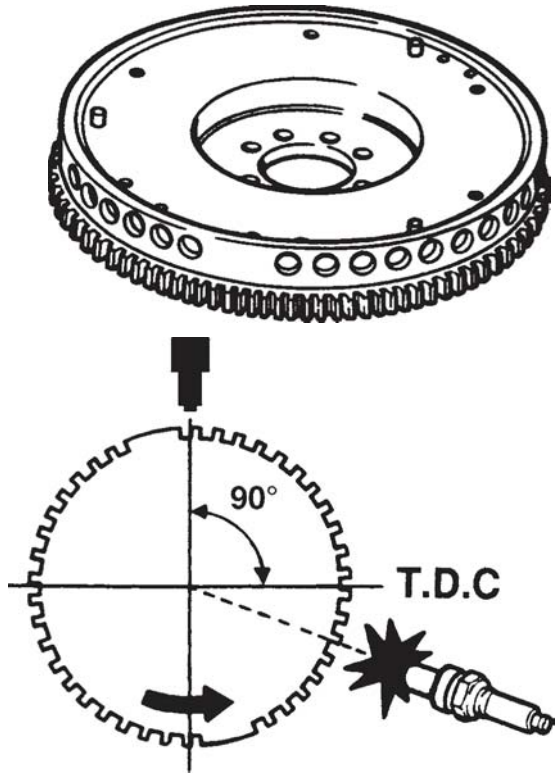
Ignition position sender

19. The crankshaft position sender is located at the rear of the engine and registers the position of the flywheel by reading the 'teeth' (machined holes) in the circumference of the flywheel.



The distributor

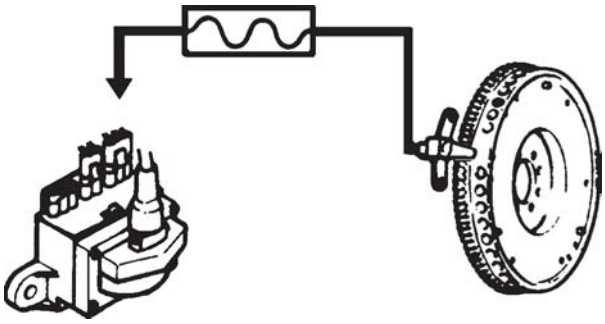
20. The flat distributor is mounted at the rear of the engine. The only task of the distributor is to deliver the high voltage current to the correct spark plug. The only internal part is the rotor.
NOTE! Timing adjustments cannot be made at the distributor.



The flywheel

21. 40 holes are machined in the circumference of the flywheel. The space between the holes act as teeth thus the flywheel can be regarded as a toothed wheel.

Since a 4 cylinder 4 stroke engine needs 2 sparks per revolution, the toothed wheel is divided into two halves. Each half has 20 teeth. Of these, 2 teeth in each half turn are double the others in size. These two big teeth are the reference points for the location of the upper and lower 'dead centers'. The points of reference are located 90° before the upper and lower 'dead centers' respectively.

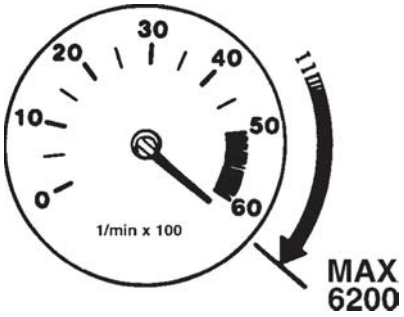


Signal Processing

22. The crankshaft position sender sends a signal each time a tooth passes by. It also provides the control unit with information when each of the 2 big teeth pass by. Thus the position of the upper 'dead center' is known since it is positioned 11 teeth after the long tooth.

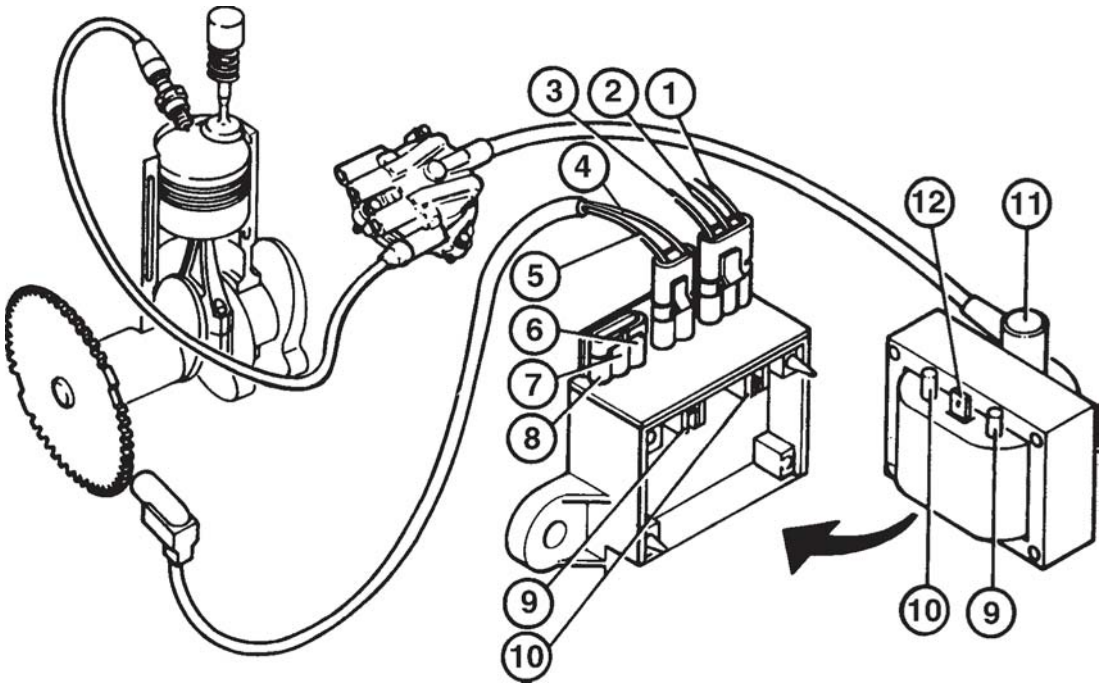
The function

23. Half a turn before each explosion cycle the control unit is calculating a very exact pre-ignition going out from the speed of the engine. There are 63 optimized engine speed values stored in the control unit's non-volatile memory. From these the control unit selects a suitable ignition time.



Speed Control

24. In order not to damage the engine by over revving it there is an electronic function available which reduces the dwell angle (the charging time of the ignition coil) at 103.33 r/s (6200 rpm). The system provides ignition but the output of the engine is so low that it cannot increase the engine speed.



⚠ **WARNING!** Ventilate the engine compartment carefully and check that there is no smell of gasoline or LPG-gas.

Trouble-shooting RENIX

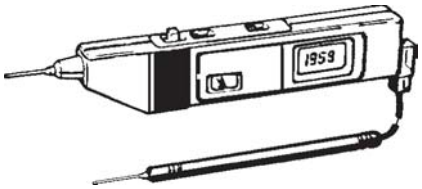
25. Control Unit

1 Tachometer connection
2 Ground connection
3 Feeding voltage (15+)
4 Firing position sender connection, red
5 Firing position sender connection, white
6 Is connected but not needed (speed control)
7 Not used (–3°) ground
8 Not used (+3°) ground
9 Ignition coil, primary winding
10 Ignition coil, primary winding
11 Ignition coil, secondary winding
12 Radio suppression connection

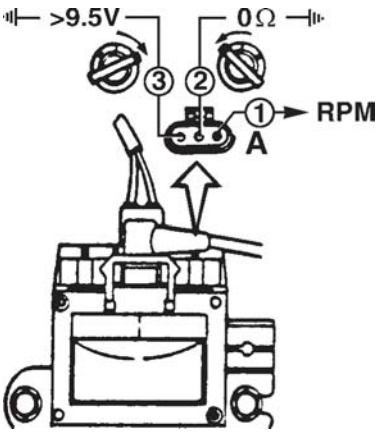
Trouble-shooting

A. The engine does not start (see para. 26 to 33).
B. The engine is running rough, starts with difficulty, low output. (See para. 34 to 40).
C. The engine starts but does not continue to run. (See para. 41 to 45).

Tools



26. Use Volvo Penta digital test instrument 9988452-0 when fault-tracing the RENIX ignition system.



Check the feed voltage

27. Remove the plug ‘A’. Switch the ignition on. Connect a voltmeter to check the voltage between ‘3’ and ground. The voltage should be at least 9.5 Volts.

Check the ground connection

28. Measure the resistance between ‘2’ and ground. The resistance should be 0 Ohm. The ground connection is a bolt behind and below the alternator. Should the resistance be higher than 0 Ohm. Check the ground connection and the wire harness.

Checking spark plugs, ignition leads, the distributor and rotor.

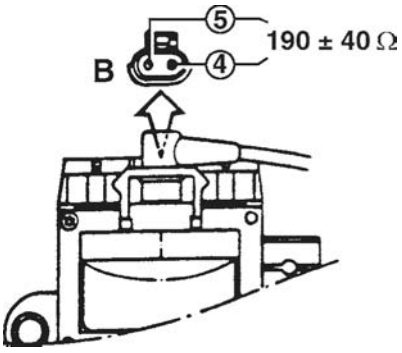
29. Spark plugs: Part no 875820 (Bosch W6DC) spark gap = 0.7 mm (0.02756"). Check to make sure that the sleeve at the connection is properly tightened.

- Ignition wires: Measure the resistance, should be between 1 and 4 kOhm. Check connections for corrosion. Check that the ignition wires are properly connected to the spark plugs.

- Distributor: Check the resistance center connection high voltage 75 Ohm. Pins connection, 0 Ohm. Check for corrosion, cracks and moisture.

- Rotor: Check the resistance. 1 kOhm, Check for corrosion and cracks.

- Check the basic setting of the distributor on the engine block. The ignition timing can not be altered at the distributor.

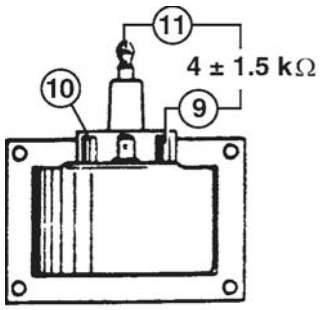


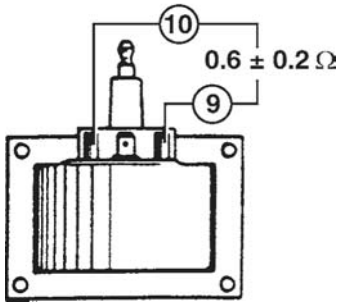
Check the crankshaft position sender

30. Remove plug ‘B’.
- Measure the resistance of the ignition position sender between connections ‘4’ and ‘5’.
The resistance should be 190 Ohm ± 40 Ohm.
- Check that the wire at ‘4’ is red. Check that the wire at ‘5’ is white.

NOTE! Reversing these wires will change the timing ±4°.

- Check that the crankshaft position sender and the flywheel are free from dirt.
- Should the resistance values be outside the tolerances: replace the sender!





Check the ignition coil

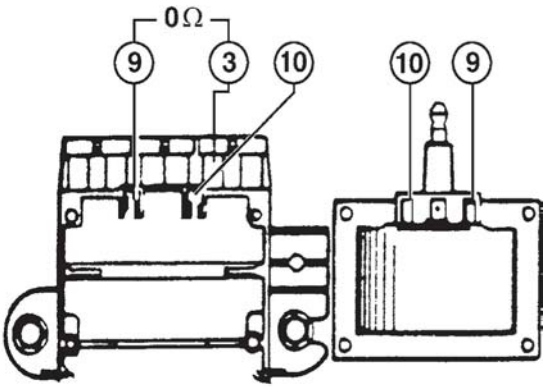
31. Remove the high voltage lead from the coil.

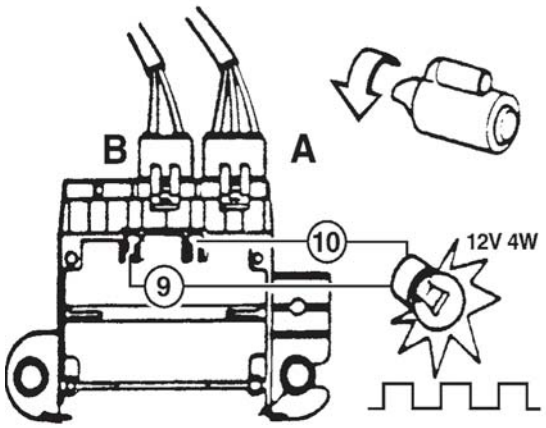
- Check that the contact points ‘9’ and ‘10’ are free from corrosion.

- Measure the resistance of the secondary winding between ‘9’ and ‘11’. Should be 4±1,5 kOhm.

- Measure the resistance of the primary winding between ‘9’ and ‘10’. Should be 0.6±0.2 Ohm.

- Should the resistance values be outside the tolerances: replace the ignition coil!





Checking the control unit

32 A. - The ignition coil removed.

- Check that the contact points 9 and 10 are free from corrosion.

- Measure the resistance between 3 and 9. The resistance should be 0 Ohm.

- Resistance higher than 0 Ohm: replace the unit.

B. - Install the plug connectors A and B. Switch on the ignition.

- Attach a 12 Volt test bulb, with a minimum rating of 4W, between 9 and 10.

- Run the starter motor: the test bulb should start flashing. No flashing: replace the control unit.

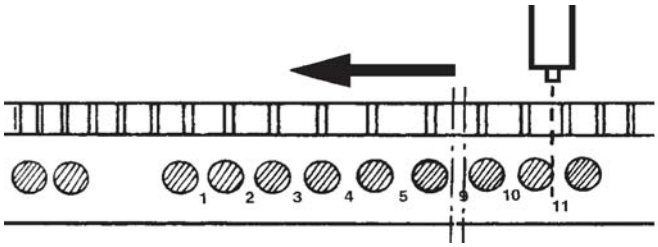
33. Lubricate the connections A and B. Use part no 870806-2

34. See paragraphs 26–27

35. See paragraphs 29 and 33.

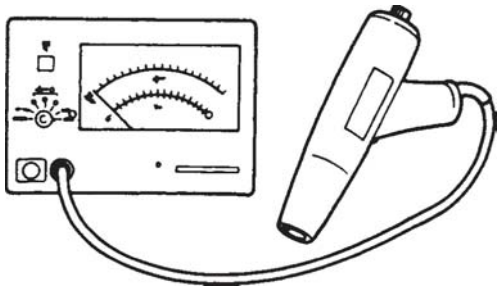
36. See paragraph 30.

37. Check that the tachometer is set properly for 4-cylinder gas engines by turning the screw (A) to position 3 and then to position 1.



Checking the setting of the crankshaft position sender

38. Set the engine on T.D.C. for no 1 cylinder. In this position the center of the iron core of the sender should be positioned straight above the front edge of the 11th 'tooth', (space between the holes), counted back from the 'long gap'. Should the sender not be at this setting, then check to make certain that the engine is really at T.D.C. For example, use a dial indicator gauge through the spark plug hole.



Checking the ignition

39. Use a stroboscope to check the setting as follows:

14.17r/s	(850 rpm)	10° ±2°
25 r/s	(1500 rpm)	14° ±2°
58.33 r/s	(3500 rpm)	23° ±2°
75 r/s	(4500 rpm)	24° ±2°
91.67 r/s	(5500 rpm)	31° ±2°

Checking the speed limit

40. Check (using a tachometer) that the engine's speed does not increase above 6200±100 rpm.

If the speed increases above 6200±100 rpm, then the control unit must be replaced.

Checking the toothed belt against the markings

41. Check that the timing belt is correctly installed so that the markings correspond. See page 73.

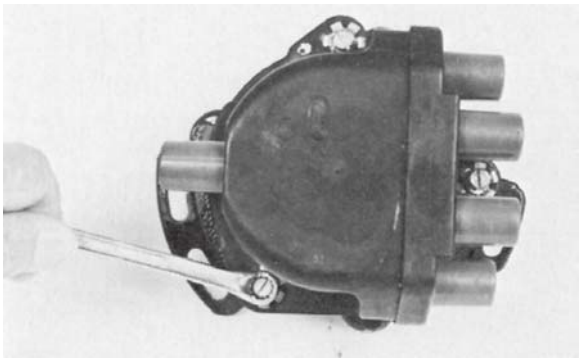
42. See paragraphs 26–27

43. See paragraphs 29 and 33.

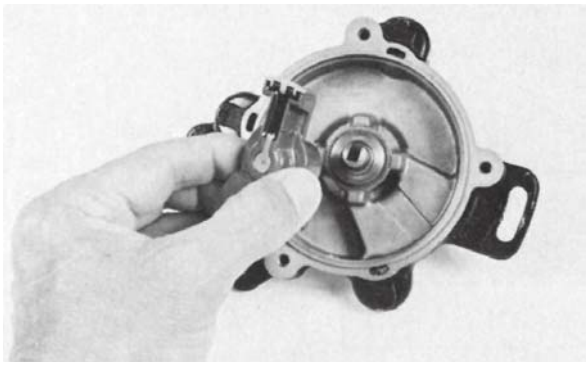
44. See paragraph 30.

45. See paragraph 38.

Changing the rotor 251DOHC, AQ171



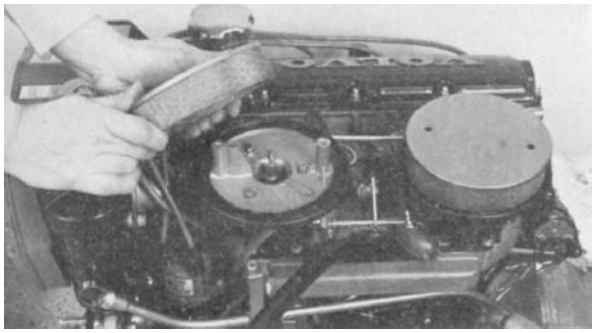
46. Remove the distributor cap, 3 screws. Tool width: 8 mm.



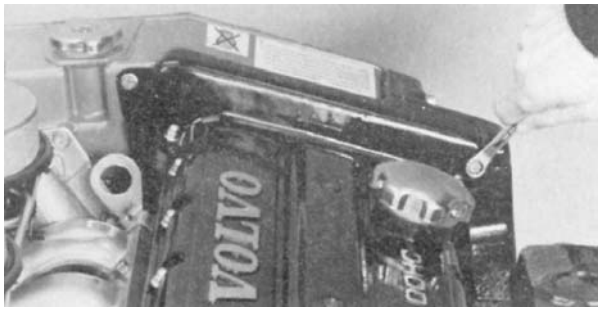
47. Remove and replace the rotor. Re-install the distributor cap.

Removal of the external components

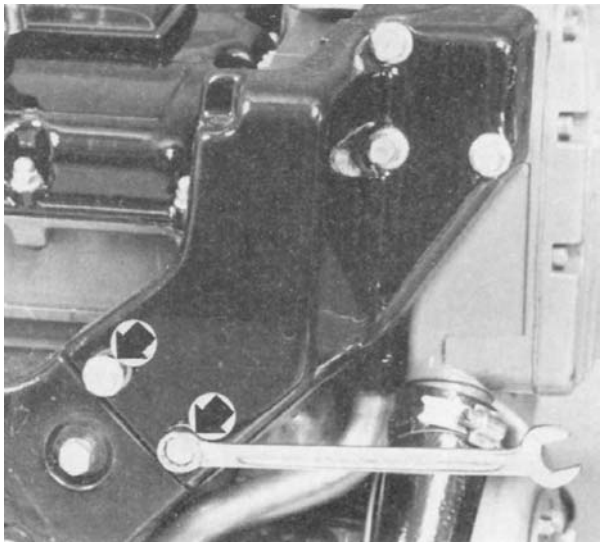
48. Remove the hose (1) from the oil trap and remove the intake cover. Tool width 10 mm. Take care of the flat washers and the spring washers.



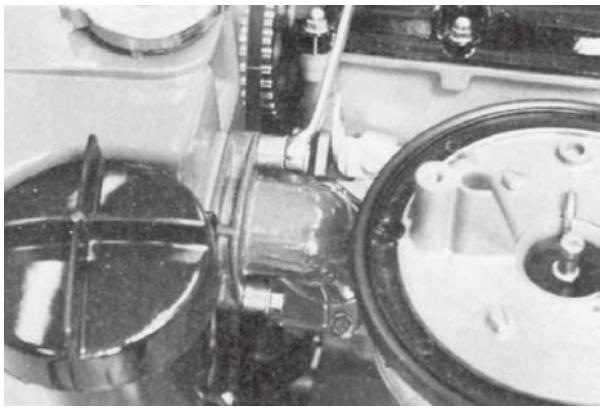
49. Remove the flame arresters and the spark plug wires from the spark plugs.



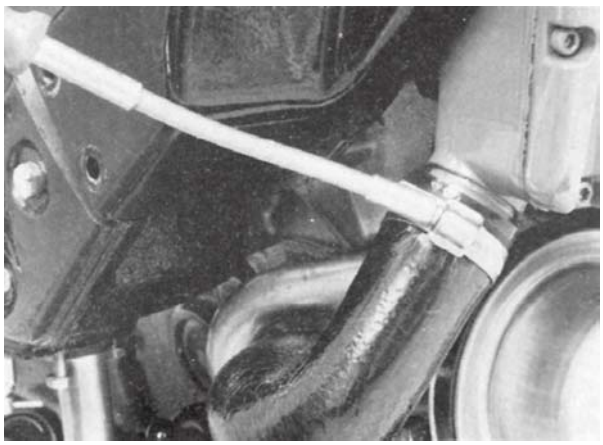
50. 251DOHC, AQ171. Remove the protective cover over the camshaft gear wheels. Tool width: 10 mm.



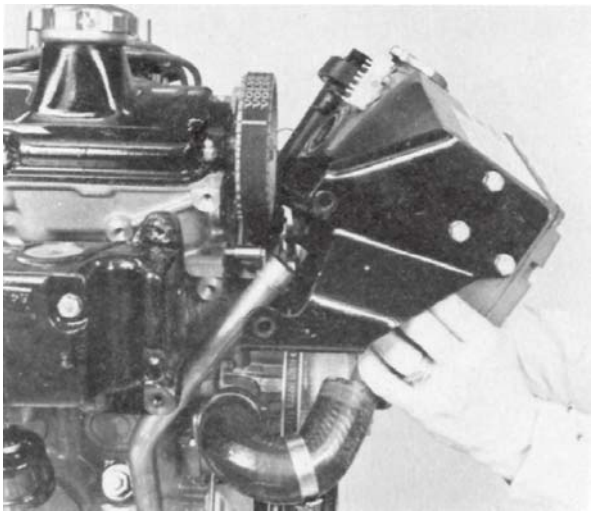
51. Remove the bolts from the heat exchanger bracket. Tool width: 12 mm.



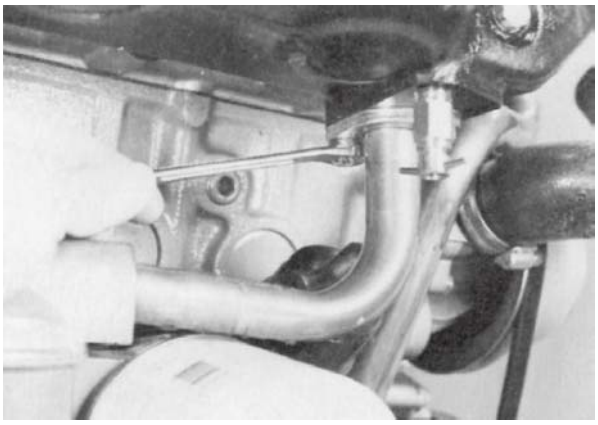
52. Remove the screws from the thermostat housing against the heat exchanger. Tool width: 12 mm.
NOTE! Take care of the spacer sleeves! (Not all manufactures).



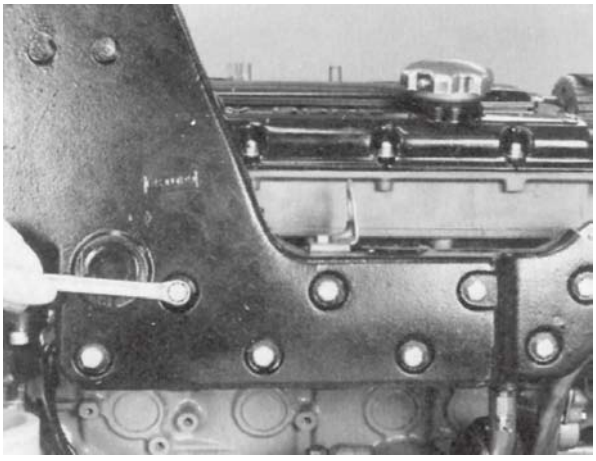
53. Remove the hose clamp and pull off the cooling water hose from the heat exchanger.



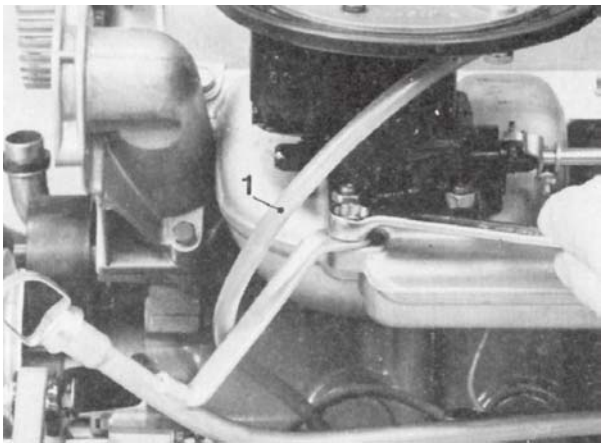
54. Pull the heat exchanger straight upwards from the cooling water pipes and the cooling water hose. Replace the O-ring on the heat exchanger and the sealing rings on the cooling water pipes.



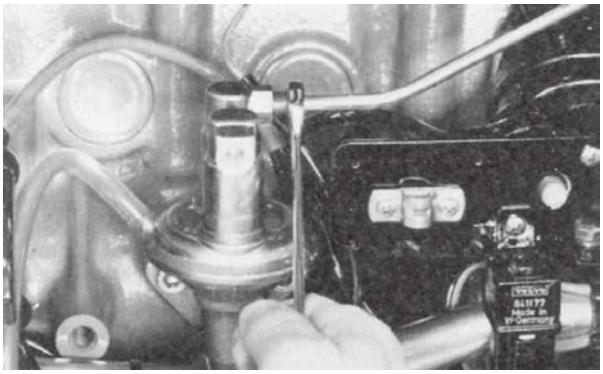
55. Remove the cooling water pipe between the exhaust manifold and the oil cooler. Tool width: 10 mm.



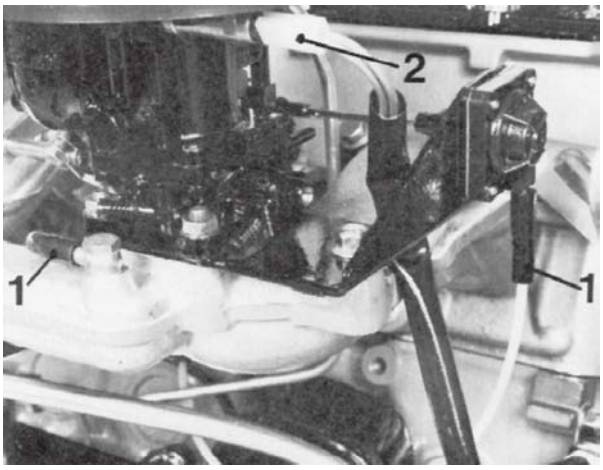
56. Remove the exhaust manifold. Tool width: 13 mm.



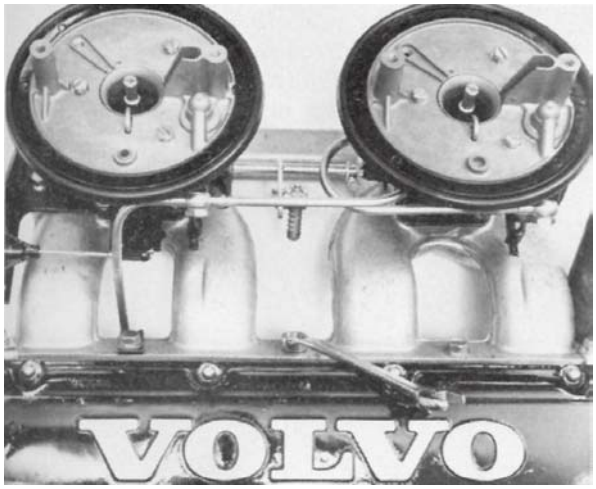
57. Pull off the hose (1) from the carburetor and remove the screw holding the oil dipstick tube. Tool width 1/2".



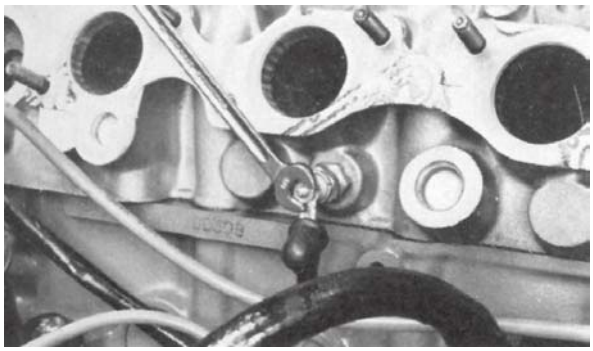
58. Remove the fuel pipe from the fuel pump. Tool width: 12 mm.



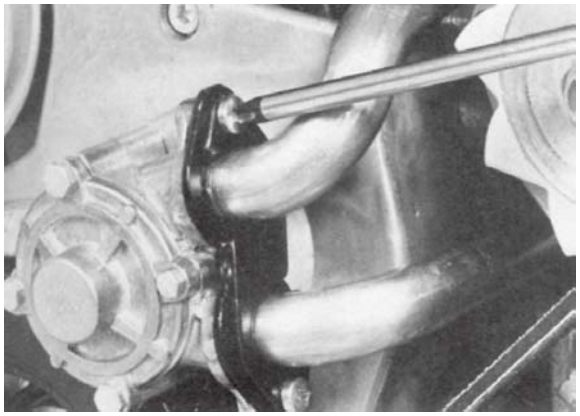
59. 251DOHC, AQ171. Pull off the vacuum hoses (1) from the intake manifold and the cold starting device as well as the connection (2) from the magnetic valve on the carburetor.



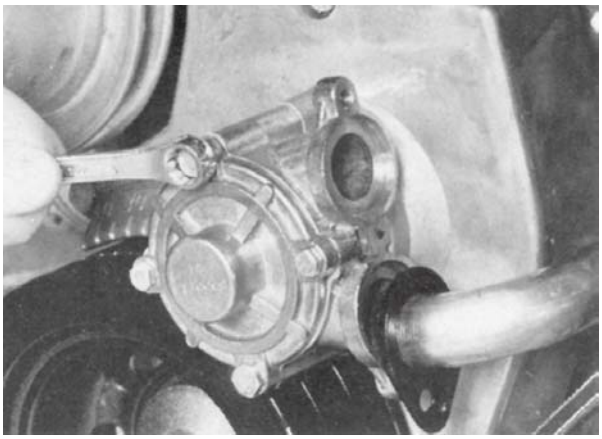
60. Remove the intake manifold. Tool width: 12 mm. The lifting eyelets are attached to the engine by the upper and outer screws.
NOTE! It is only necessary to loosen the lower screws a few turns only.



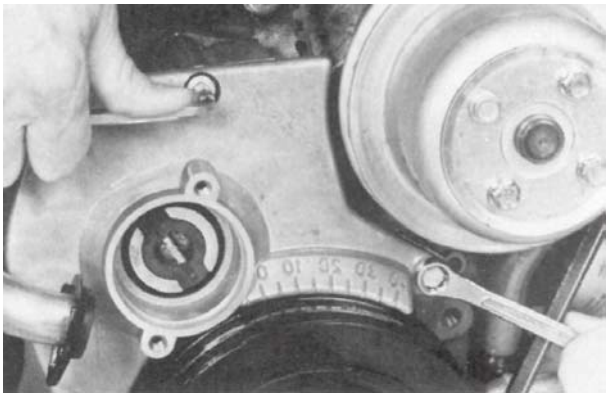
61. Remove the temp sender wire. Tool width 3/8".



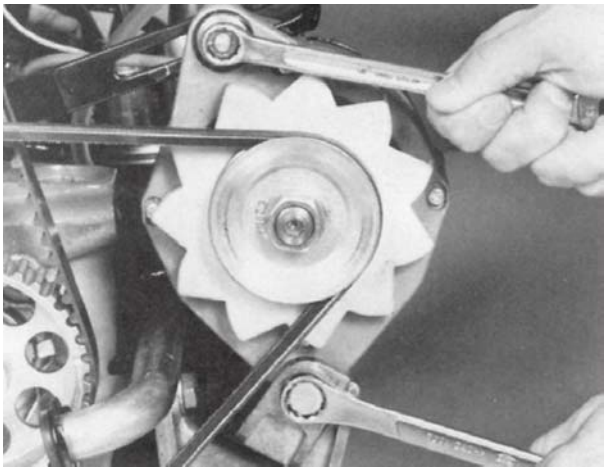
62. Remove the cooling water pipes from the sea water pump.



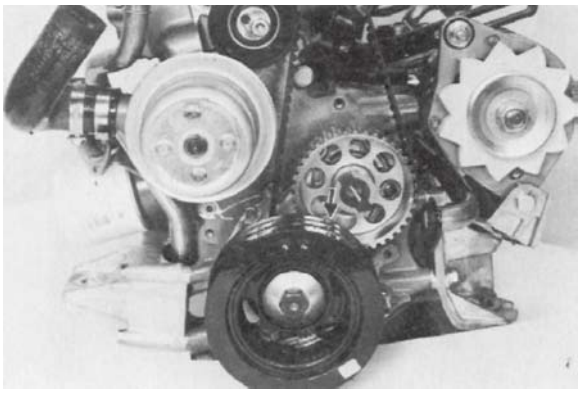
63. Remove the sea water pump. Tool width: 10 mm.



64. Remove the timing gear cover. Tool widths: Allen-key 6 mm and hexagonal 10 mm.

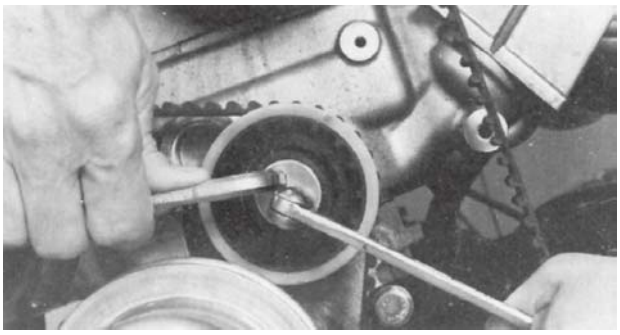


65. Remove the alternator and the V-belt. Tool widths: 13 and 16 mm.



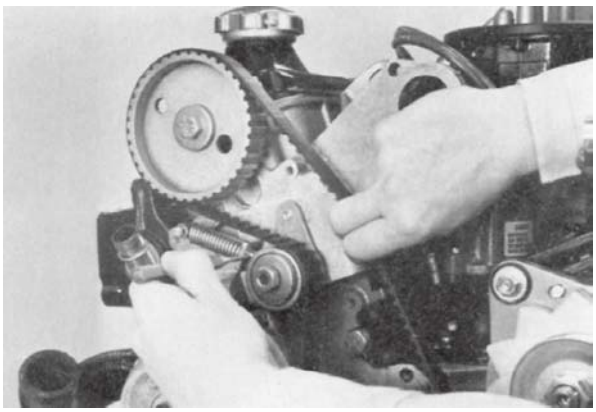
66. 251DOHC, AQ171.

⚠ **IMPORTANT!** Use the center bolt of the crankshaft to turn the crankshaft so that the markings on the toothed belt lines up with the markings of the camshaft gears and that of the crankshaft as follows: 2 yellow lines against the crankshaft marking (behind the pulley) and 1 line against each of the markings of the camshaft gear. The marking of the pulley should line up with 0° on the timing gear casing.

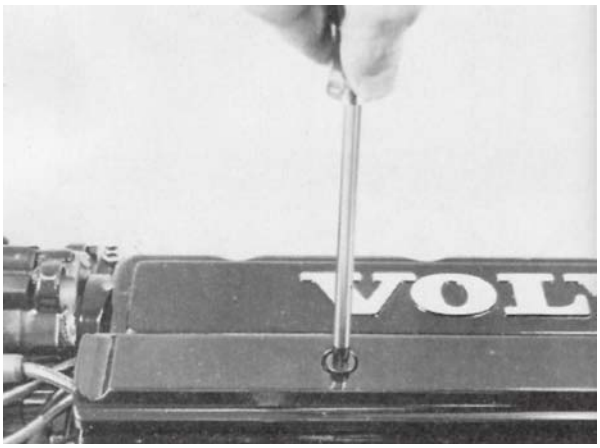


67. 251DOHC, AQ171. Loosen the Allen-head bolt and turn the belt tensioning device in order to slacken the belt tension. Allen head key 8 mm. Remove the belt.

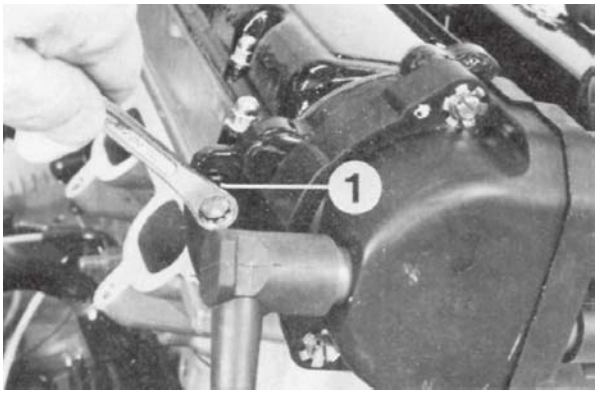
⚠ **IMPORTANT!** Do not turn the crankshaft or the camshaft while the toothed belt is removed. **The pistons can hit the valves!**



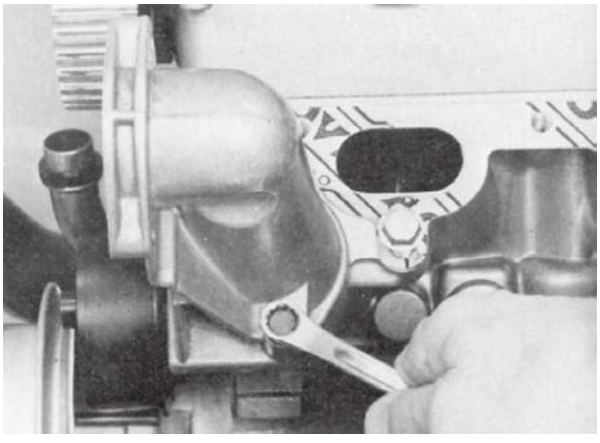
68. 230, 250, AQ131, AQ151. Bring the engine to TDC as under paragr. 66. Then ease off the nut of the belt tensioning roller. Tool width: 17 mm. Pull the belt and insert a 3 mm drill in the hole of the tensioning device. Then remove the belt.
NOTE! Do not turn either the crankshaft or the camshaft while the belt is removed. The pistons can hit the valves!



69. 251DOHC, AQ171. Remove the protective cover for the spark plugs and remove the leads from the spark plugs.



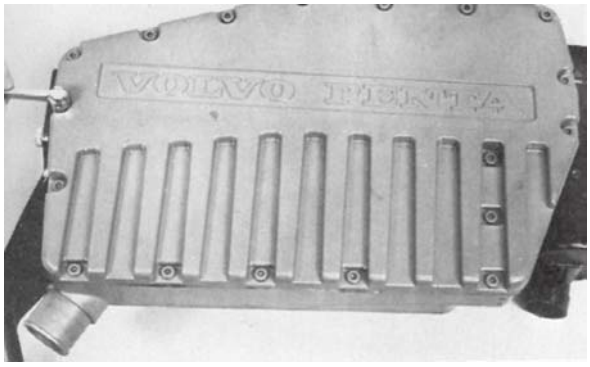
70. 251DOHC, AQ171. Remove the distributor. Tool width 10 mm. Pull the distributor off straight backwards.
NOTE! Take care of the guide bushing (1).



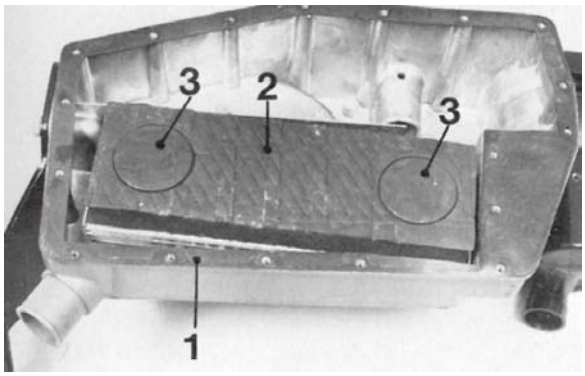
71. Remove the thermostat housing and the thermostat. Tool width: 10 mm.

4D Cooling System

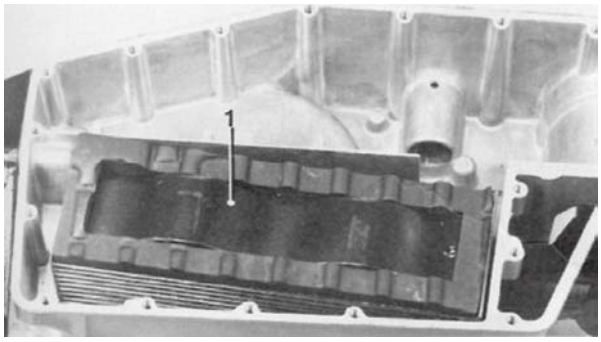
Overhauling the heat exchanger



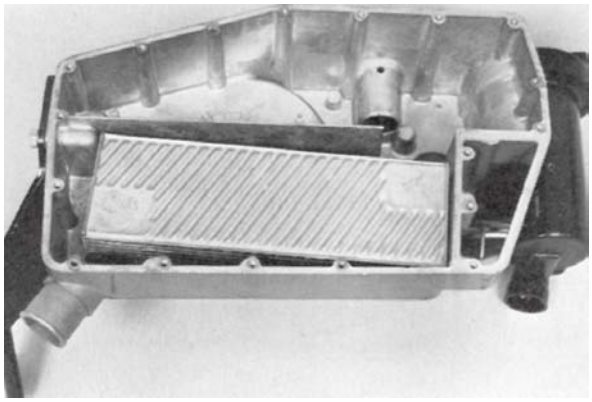
72. Remove the front part of the heat exchanger. Allen-key: 5 mm.



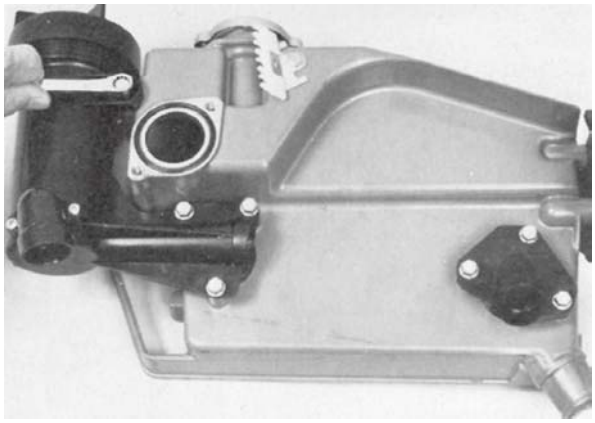
73. 250, AQ151. Remove the rubber gasket (1), the pressure pad (2) and the hard rubber pad (3).



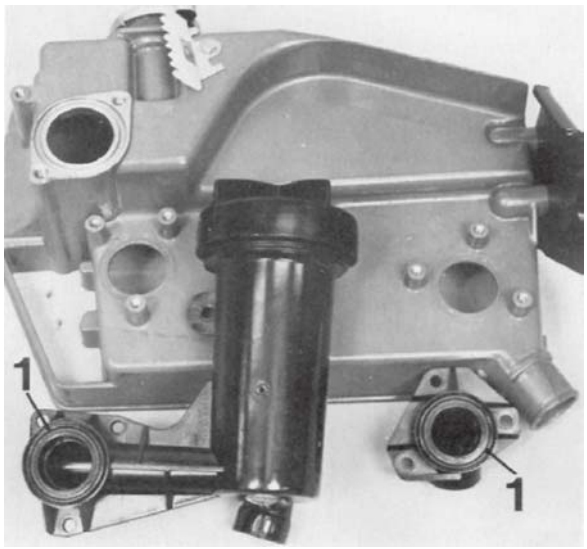
74. The only difference between the models 250, 251DOHC, AQ151, AQ171 is that the rubber pads on 250, AQ 151 have been replaced by a tension plate (1) on model 251DOHC, AQ171. Otherwise the same reconditioning method as for the heat exchanger applies.



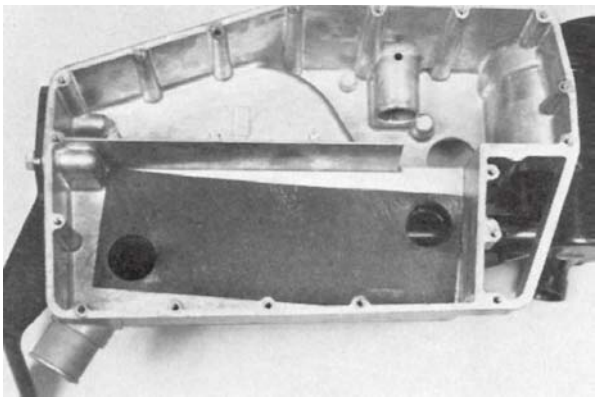
75. Lift out the cooling element and the insulating rubber mat from the housing. Pull the cooling element straight upwards. If necessary use a screwdriver to pry carefully. Clean all parts thoroughly.



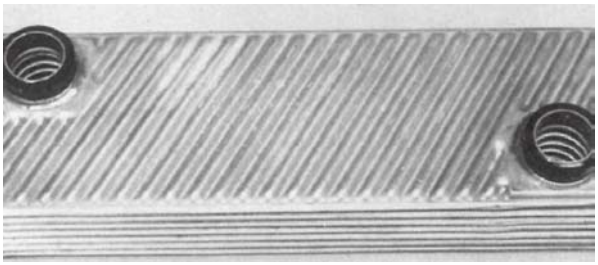
76. Remove the strainer housing and the tube connection from the heat exchanger housing. Tool width: 10 mm.



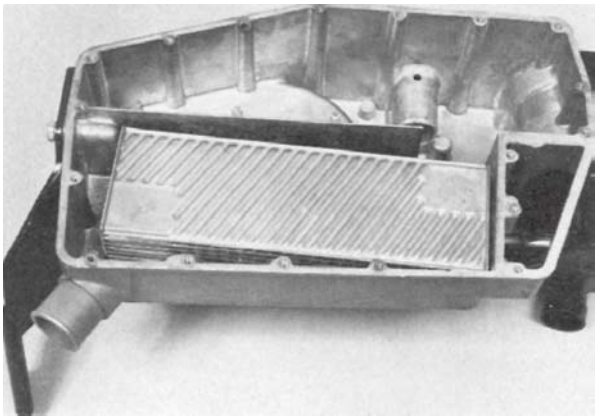
77. Install new O-rings (1) on the strainer housing and on the tube connection and install them on the heat exchanger housing. Tool width: 10 mm.



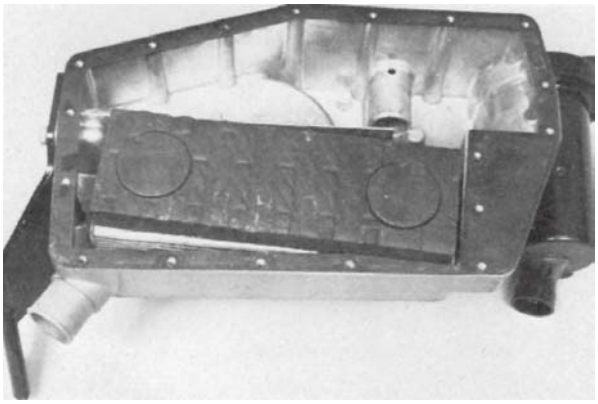
78. Insert the rubber mat in the heat exchanger housing.



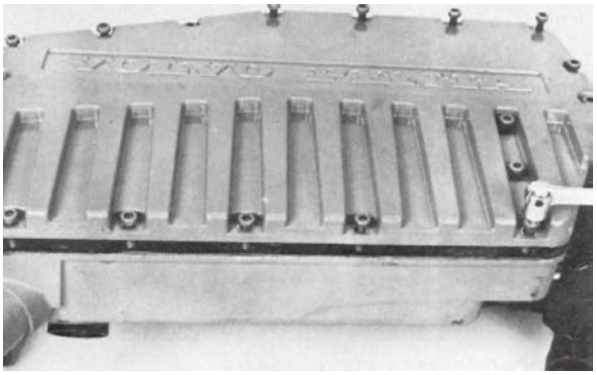
79. Put new seal rings on the cooling element. Lubricate the seal rings with oil to facilitate the installation of the element in the housing.



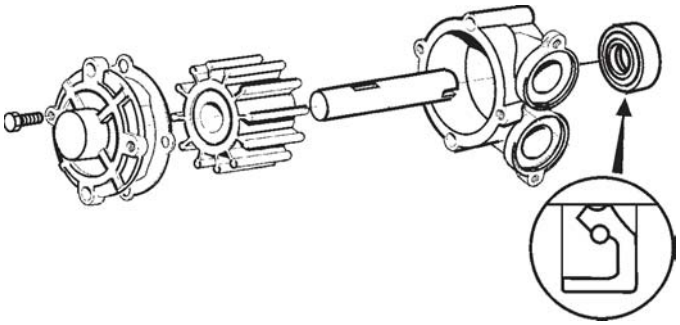
80. Center the cooling element carefully in the heat exchanger housing and push it home. Make sure that the rubber mat is properly clamped into its position.



81. Put the pressure pad, the hard rubber pad and the rubber gasket on the heat exchanger housing.

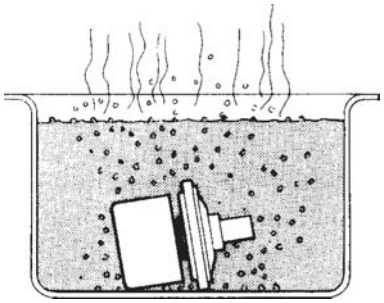


82. Install the cover and tighten the screws in a criss-cross pattern, a little at the time.
NOTE! The cover will be pressed down approximately 5 mm (0.25"). Allen key: 4 mm.



The sea water pump

83. Remove the cover on the sea water pump and use pliers to pull out the impeller. Take care of the key. Push out the seal ring. Install a new seal ring. Turn the seal lip facing the impeller. Grease the seal ring abundantly and carefully push the shaft into the seal ring. Insert the key and install a new impeller. Install the cover with a new gasket.

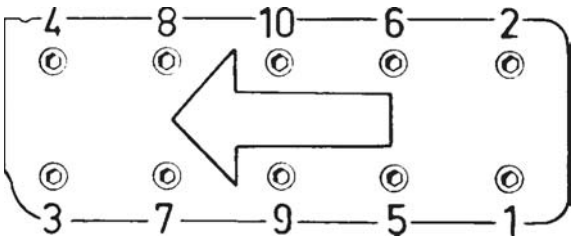


The thermostat

84. When necessary check the opening temperature of the thermostat by lowering it into warm water. It should begin opening at a temperature of 82°C (180°F). Can be fully open at 92°C (198°F). Check to make sure that the rubber seal is in good condition.

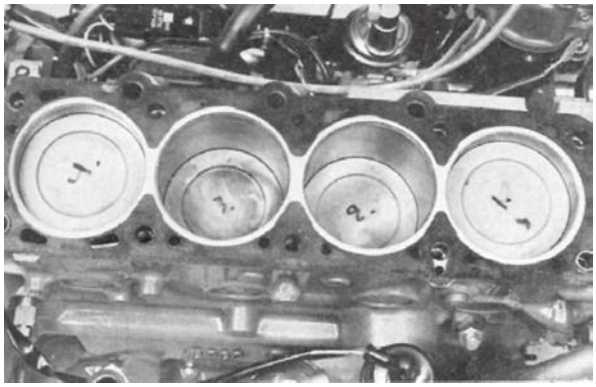
4E Overhauling the valve system

230, 250, AQ131, AQ151

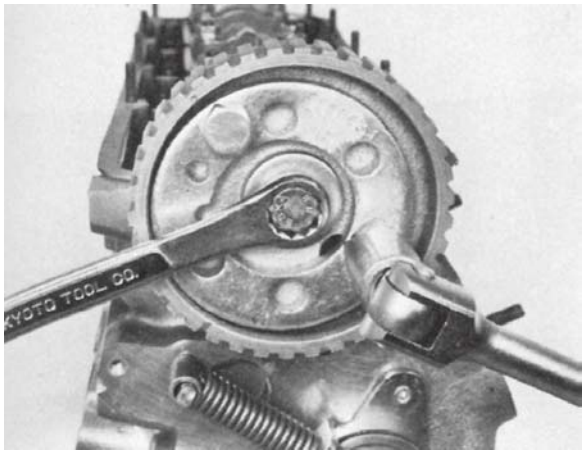


85. Remove the cylinder head. Tool width = 14 mm. Remove the bolts in the sequence shown in the picture.

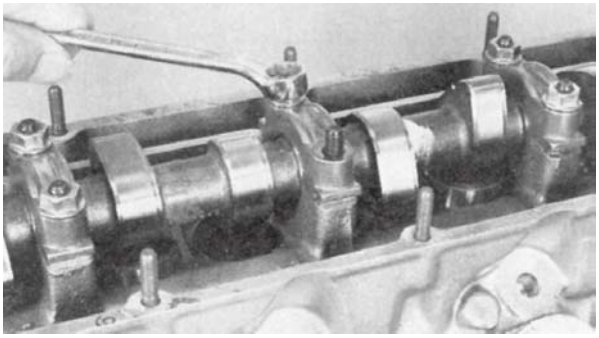
IMPORTANT! In order to avoid scratching the cylinder head it should be placed on wooden blocks.



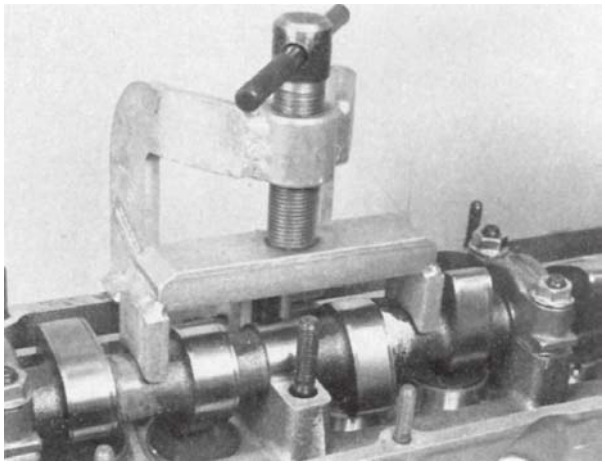
86. Remove the cylinder head gasket.



87. Remove the camshaft gear. Tool width: 17 mm. Use counterhold part no 9995034-7.
NOTE! Remove the washer behind the gear wheel.

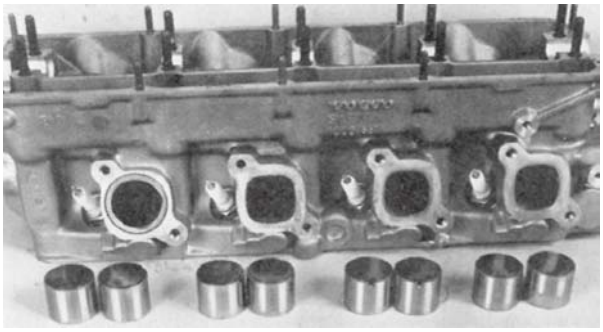


88. Remove the middle camshaft cap. Tool width: 1/2".

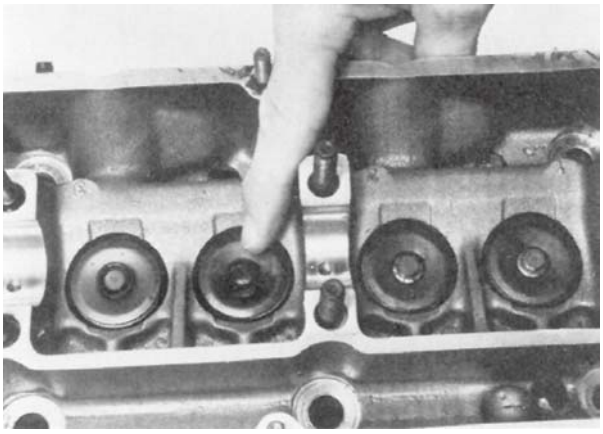


89. Install special tool part no 9995021-4 on the camshaft. Use the cap nut. The tool is keeping tension on the camshaft. Remove the remaining 4 camshaft caps.

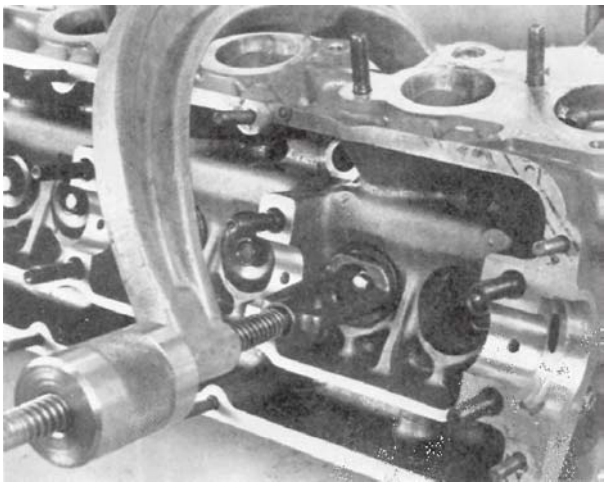
90. Remove the sealing (1) from the camshaft as well as the plug in the opposite end. Back off the special tool, releasing the camshaft. Remove the special tool and the camshaft.



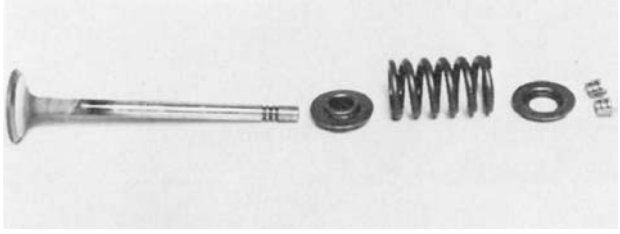
91. Remove the valve tappets and keep them in the same sequence as in the cylinder head.



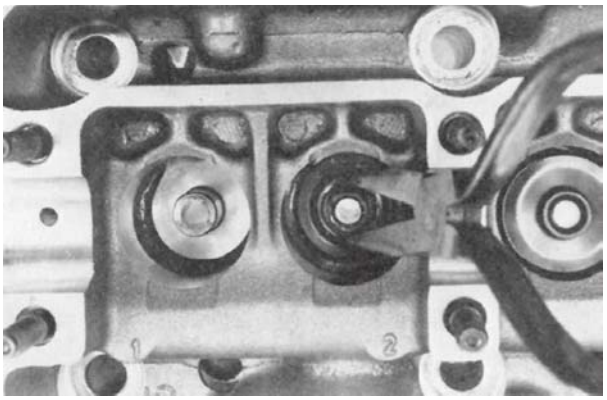
92. Remove the rubber seal from the valve stems.



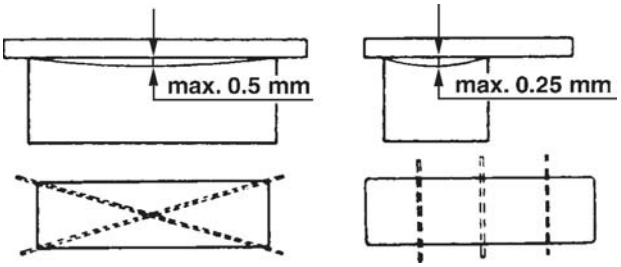
93. Use valve spring compressor part no 9986052-0 to compress the valve springs.



94. Remove the valve locks, retainers springs, the lower washers (exhaust) and the valves.
NOTE! Make sure not to mix the parts!



95. Remove the valve seals from the guides of the intake valves. Use a pair of pliers. Then remove the lower washer (intake).



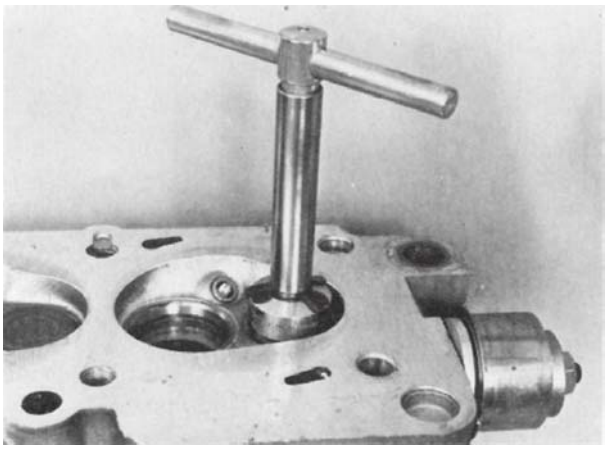
96. Clean the cylinder head and sealing surface. Use a metal ruler and feeler gauge. The warp must not exceed 0.5 mm (0.0197") lengthwise and 0.25 mm (0.0098") diagonally.

⚠ **IMPORTANT!** The cylinder head cannot be machined if the warp is greater than 1.00 mm (0.394") lengthwise or 0.5 mm (0.0197") diagonally.

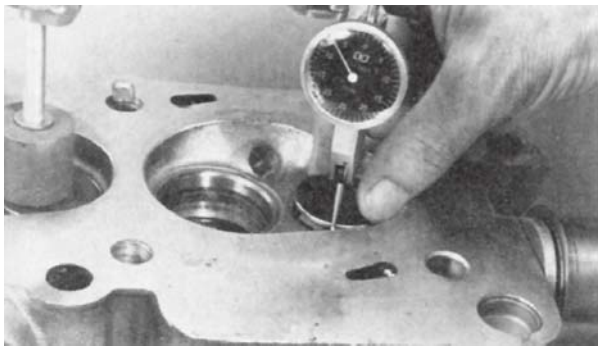
Cylinder head height, new ..... 146.1 mm (5.75197")

Cylinder head height, min after reworking ..... 145.6 mm (5.73228")

Reworking, totally = 0.5 mm (0.01969")

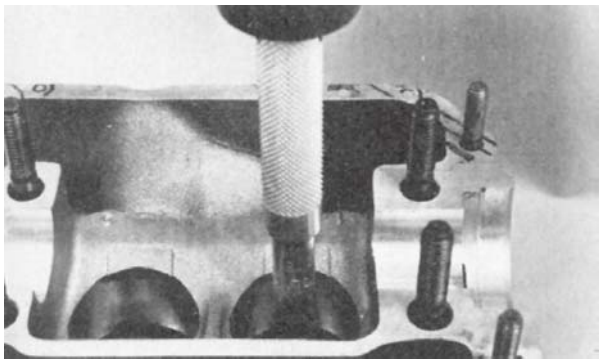


97. Clean the valve seats with a cutter. Remove carbon deposits from combustion chambers and the valves. The valve seats must not show signs of being cracked nor any other type of damage. Should this be the case, they must be replaced.



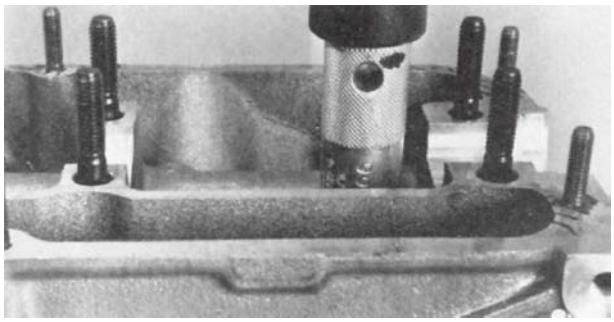
98. Check the wear of the valve guides. Use new valves and push up the valve 1–2 mm (0.03928–0.07874") with the finger while the measurement is taken. Clearance with a new valve and new valve guide, intake: 0.030–0.060 mm (0.00118–0.002362") and exhaust: 0.040–0.070 mm (0.0016–0.0028"). Maximum allowed clearance measured with new valve and old valve guide is 0.15 mm (0.005906") for intake as well as for exhaust.

Changing the valve guide



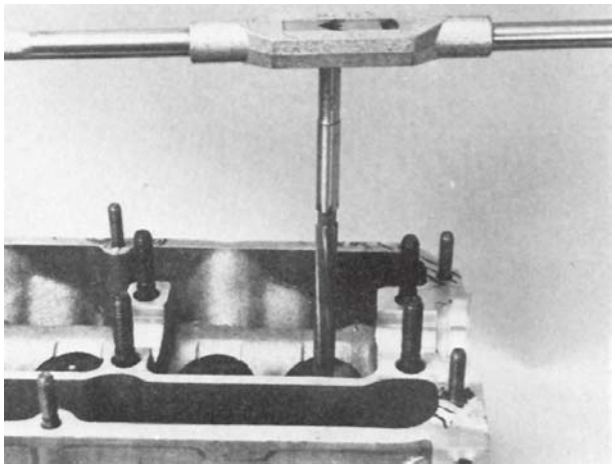
99. Heat the cylinder head in water to a temperature of 100°C (212°F) ± 10°C. Use a drift (part no 9995218-6) to press out the valve guides. Press the valve guides in the direction of the combustion chamber. Check to make sure that the valve guide has not been subject to seizing.

100. Valve guides in the standard size are available as spare parts.



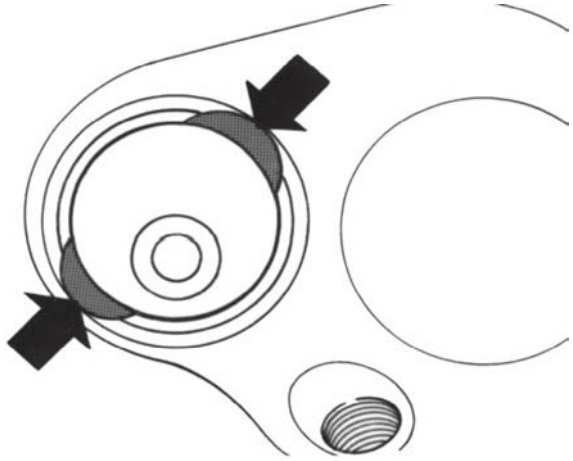
101. Press in new valve guides. The cylinder head should be at room temperature. Use drift part no 9995027-1 for the intake and part no 9995028-9 for the exhaust. Press the valve guides till the drift touches the cylinder head. This gives the valve guide the correct height.

⚠ **IMPORTANT!** The pressing force must be at least 9000 N (900 kp) (2016 lbf). Should the pressing force fall short the valve guide must be removed again.



102. Clean the valve guide internally. Use reamer part no 9995224-4. Reamer part no 9995164 can also be used.
NOTE! The valve and the seat must be lapped together after the valve guide has been replaced.

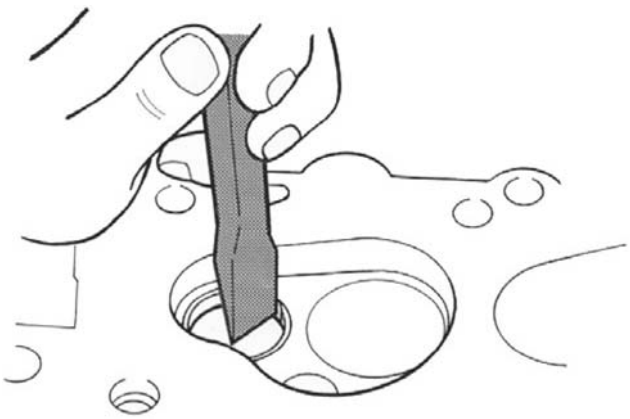
The valve seat



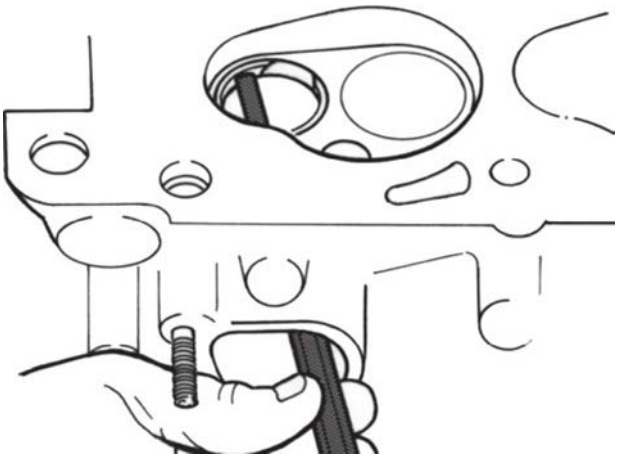
103.

⚠ **IMPORTANT!** Always replace the valve guides prior to removing the valve seat.

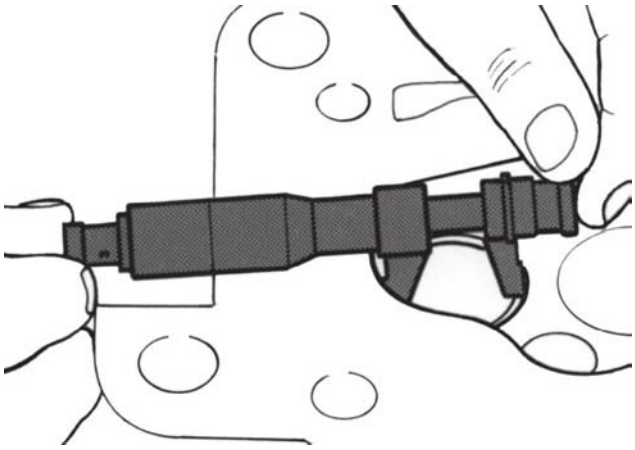
Grind two recesses in the old valve seat ring. These recesses will reduce the tension in the seat ring. Then grind a cut in the seat ring (in order to provide a hold for the chisel) Make sure not to damage the cylinder head!



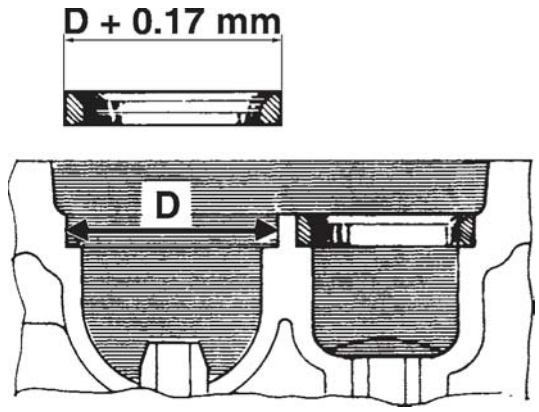
104. Crack the valve seat with a chisel. Use the chisel with extreme caution.



105. Knock out the valve seat with a long drift through intake port the cylinder head.

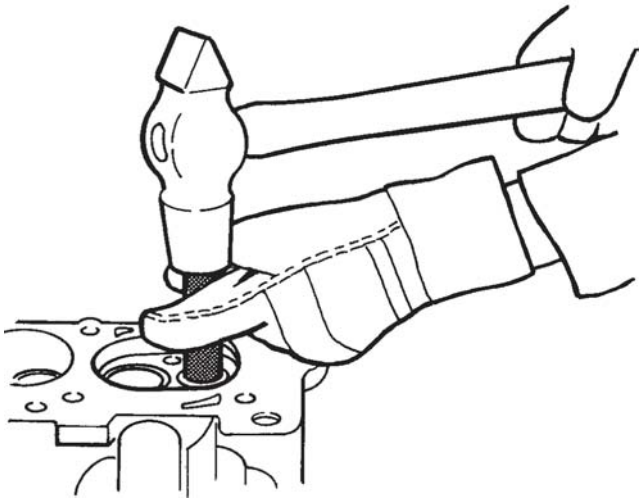


106. Check the position of the valve seat. Should the seat location be damaged, it has to be reamed (milled) to the closest oversize. Then measure the valve seat diameter. Use an internal micrometer.

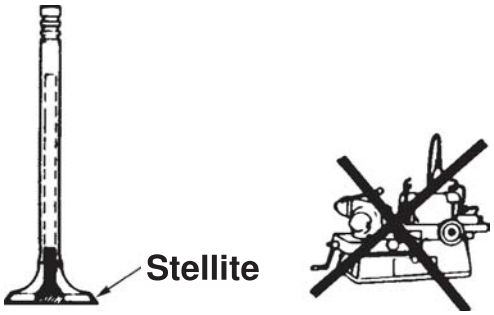


107. Find a valve seat with the correct dimension. The valve seats are not marked but have to be measured. The valve seats must be 0.17 mm (0.00669") bigger than the cylinder head location. Should the grip fit be less than 0.17 mm (0.00669") the seat location must be reamed to the closest oversize. Use a valve seat cutter.

Valve seat, diameter:		Intake:	Exhaust:
Standard,	mm	46.00	38.00
	(inches)	(1.811")	(1.496")
Oversize 2,	mm	46.50	38.50
	(inches)	(1.83")	(1.5157")

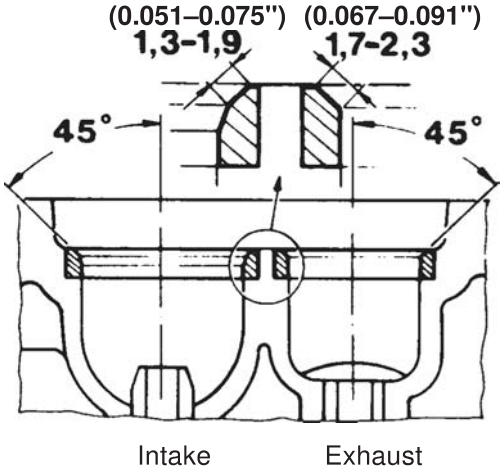


108. Heat the cylinder head in water to a temperature of approx. 100°C (212°F). Put the new valve seat on installation drift part no 9995029-7 (for the intake seat) and part no 9995220-2 (for the exhaust seat). Cool the valve seat to a temperature of –70°C (–94°F) by using carbon dioxide snow (dry ice) or its equivalent. Use protective gloves! Install the valve seat in the cylinder head. **This sequence must be done quickly and at least within 3 to 4 seconds.** This depends on the fact that the components must have their predetermined temperature at the time of assembly. Then check the fit of the seat. The seat should be fully home and held in position. Should the seat not be held in position, a seat with bigger dimensions must be installed.
NOTE! After having replaced the seat it must be milled and the valve lapped to seal.

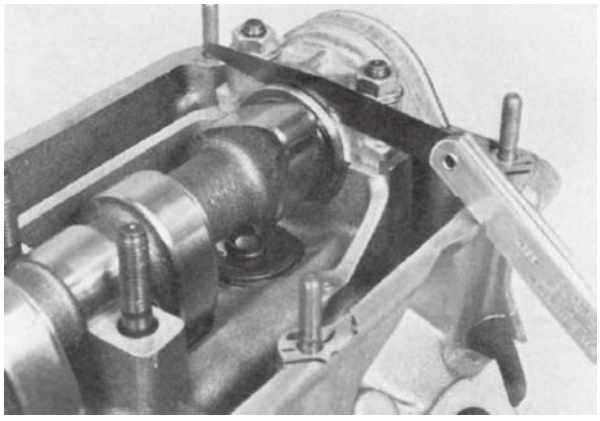


109.

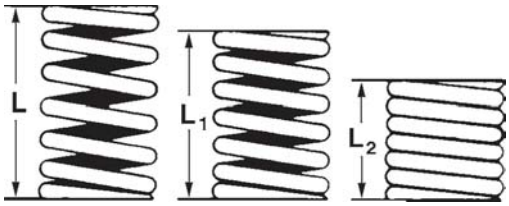
IMPORTANT! The exhaust valves are 'Stellite'-coated and must not be reworked! They must only be lapped to seal against the valve seat using grinding compound. In case they are reworked, the 'Stellite' coating is removed and thus the valves lose part of their heat protection.



110. Mill or ream the valve seats. The same angle for intake as for exhaust. The valve seat width, see the picture. Check the contact pattern of the valves against the seats. If necessary use grinding compound to grind the valves against the seats.

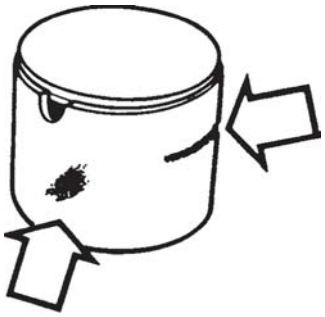


111. Put the camshaft in the cylinder head. Install the rear cap. Move the camshaft to and fro. The clearance should be 0.1–0.4 mm (0.00394–0.0157"). Measure the clearance with a feeler gauge. In case the clearance is too big, the cap must be replaced. Measure the clearance again. When the correct clearance has been obtained, remove the camshaft.



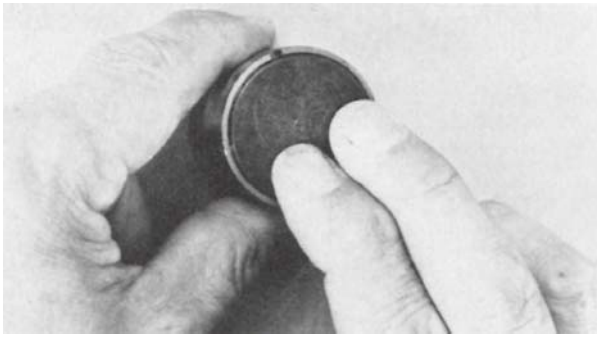
112. Check the valve springs in a spring tester.

Length, unloaded ..... 45 mm (1.77")
loaded 305±20N (67.2±4.48 lbf.) ..... 38 mm (1.50")
loaded 765±40N (170±8.96 lbf.) ..... 27 mm (1.06")

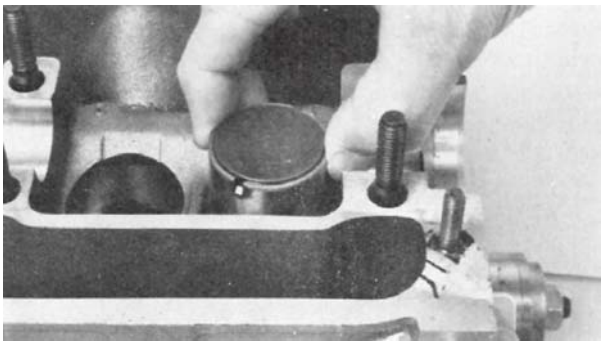


113. Check the valve tappets for scratches and other visible damage.

114. Check that the valves and valve seats are lapped perfectly by coating the chamfer of the valve discs with marking dye and then rotating them with light pressure against the valve seats. If the marking dye is not evenly distributed on the whole chamfered surface of the valve seat (the valve does not seat) the valve must be reground and checked until a completely satisfactory result has been obtained.

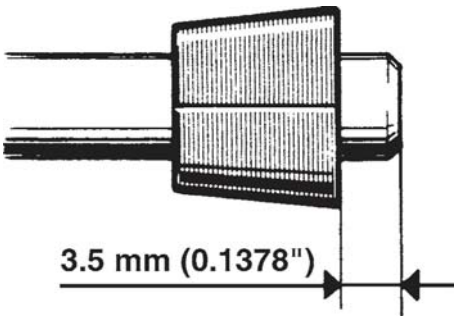


115. Check that the clearance of the adjustment washer in the valve tappet is not too big. If there are wear marks on the flat surface, it should be replaced. The clearance between the adjustment washer and the valve tappet should be 0.009–0.068 mm (0.000354–0.00268")



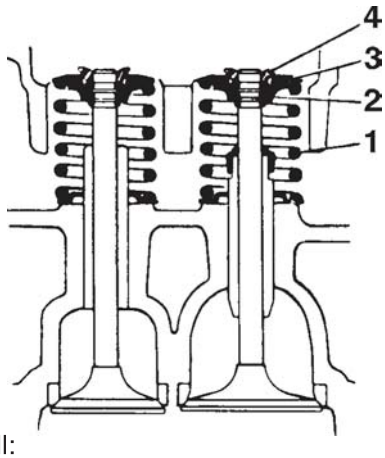
116. Place the valve tappets in the cylinder head and check that the clearance is not too big or that they seize.
NOTE! Do not mix the tappets. Put them in the same position as prior to the check. Clearance: valve tappet – cylinder head: 0.030–0.075 mm (0.001118–0.002953")

Assembling the cylinder head



117. Check to make sure that the distance between the valve lock and end of the valve stem is at least 3.5 mm (0.1378").

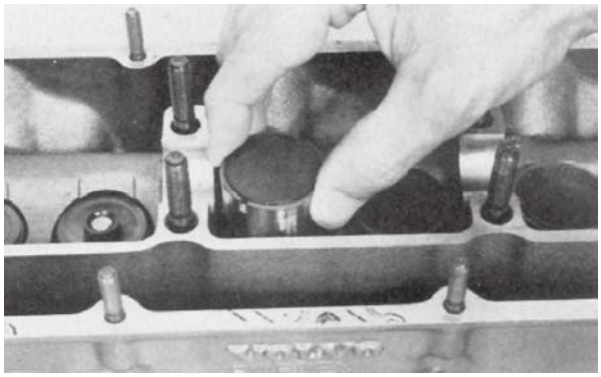
118. Place the valve spring seal in the cylinder head. Oil and install the valve. Install the seal. Only the intake valves have a valve stem seal!



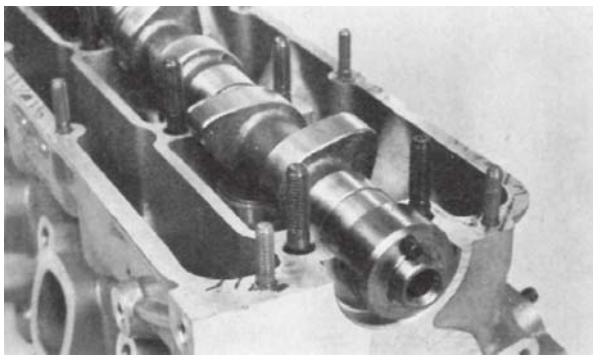
119. Install:

1. The valve spring.
2. The valve spring retainer.
3. The valve lock.
4. The rubber seal.

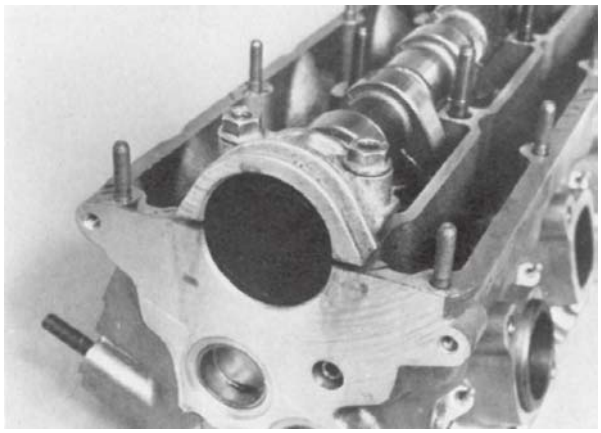
Use a valve spring compressor. Then install the spark plugs.
NOTE! Make sure that the spark plug thread enters properly in order not to damage the cylinder head thread. Tightening torque: 25–30 Nm (2.5–3.0 kpm/ 18–22 ft.lbs).



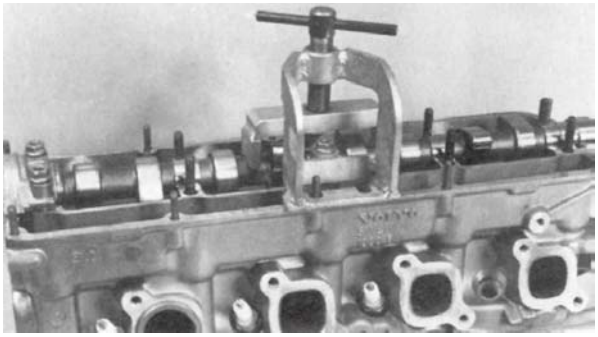
120. Oil and install the valve tappets along with the adjustment washers and in the same location as earlier.



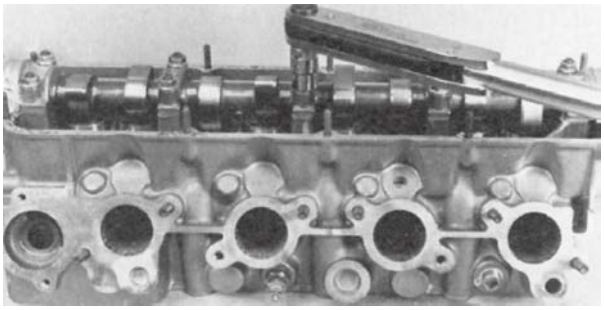
121. Oil the bearing halves, the camshaft lobes, the valve tappets and the adjustment washers and insert the camshaft. The guide pin for the toothed belt wheel should be turned facing upwards.



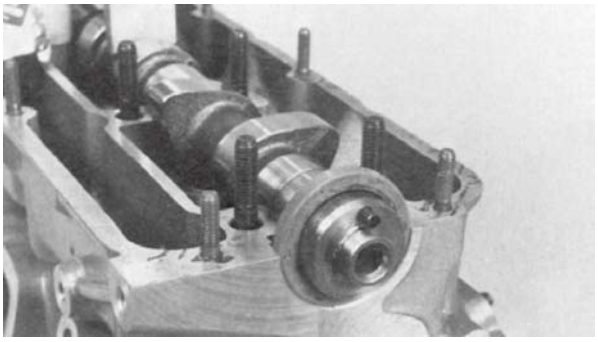
122. Coat the sealing surface of the rear camshaft bearing cap against the cylinder head with a gasket compound. Put the rear bearing cap (the axial bearing) and the rubber sealing in its location. Install the 2 nuts but without tightening them.



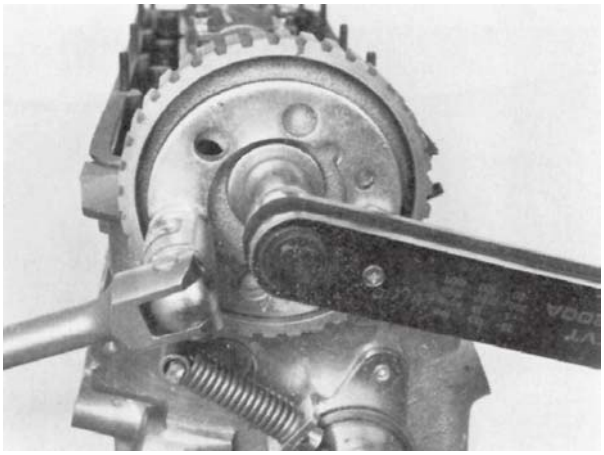
123. Install special tool part no 9995021-4 and press down the camshaft.



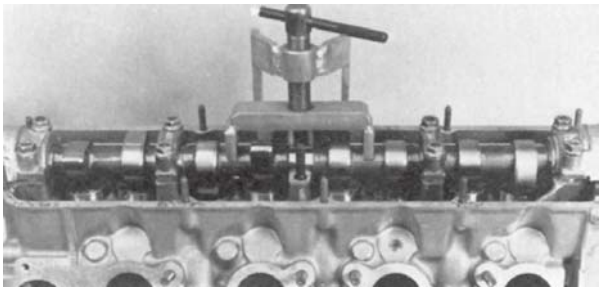
126. Oil and tighten the last bearing cap. Now tighten all the nuts with a torque wrench. Tightening torque: 20 Nm (2.0 kpm/15 ft.lbs).



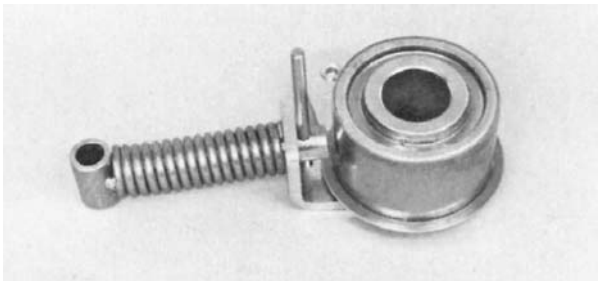
124. Lubricate the rubber lip of the camshaft sealing and install it on the camshaft. Make sure not to damage the rubber lip by the edge of the camshaft during the assembly.
NOTE! Install the sealing ring so that a new sealing surface against the camshaft is obtained.



127. Install the camshaft gear wheel and the spacer washer. Use counterhold part no 9995034-7. Tightening torque: 50 Nm (5.0 kpm/36 ft.lbs).

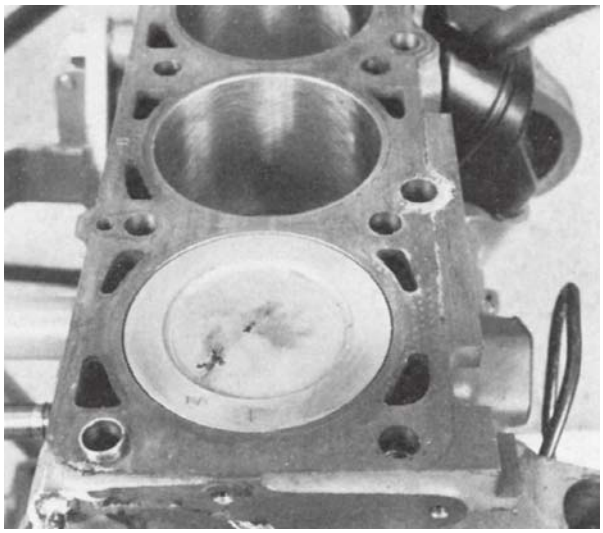


125. Oil and install the remaining 3 bearing caps. Install the nuts but without tightening them.
NOTE! Coat the contact surface of the front bearing cap against the cylinder head with a gasket compound. Make sure that the sealing is properly aligned prior to the tightening of the front bearing cap. Then remove the special tool.

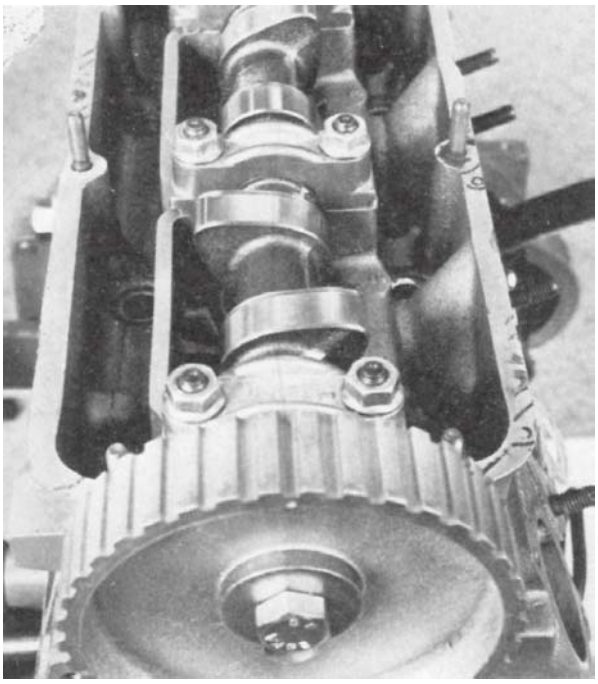


128. Check the belt tensioning device. The bearing should be free from play. Should the contact surface of the roller be damaged, the roller and the toothed belt must be replaced.

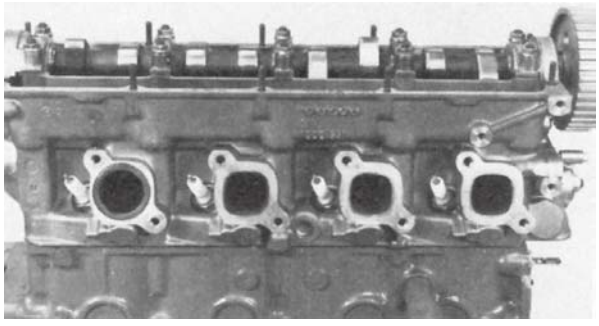
Compress the spring and lock it with a 3 mm drill and then install the belt tensioning device on the cylinder block.



129. Set the piston for cylinder no 1 at T.D.C. Check to make sure that the contact surface of the engine block is properly cleaned and install a new cylinder head gasket



130. Set the camshaft in position T.D.C. for cylinder no 1.

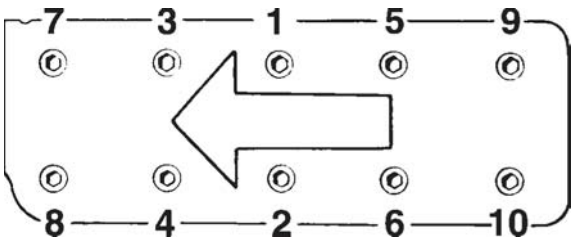


131. Install the cylinder head.

132.

⚠ **IMPORTANT!** Do not turn either the crankshaft for the camshaft. The pistons can now hit the valves!

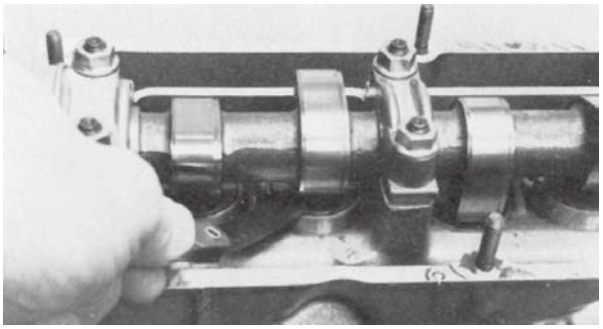
Replace the cylinder head bolts in case they show signs of elongation. If a bolt is elongated or not can be determined by checking the 'waist' of the bolt. If the bolt is elongated the waist of the bolt is stretched. It is allowed to re-use the bolts a maximum of 5 times. In case of uncertainty, always replace the bolts with new ones.



133. Oil the threads of the cylinder head bolts and install them. Tighten the cylinder head bolts in sequence and in 3 steps.

1 = 20 Nm (2.0 kpm/15 ft.lbs)
2 = 40 Nm (4.0 kpm/30 ft.lbs)
3 = angle tightening 120°.

Adjusting the valves 230, 250, AQ131, AQ151

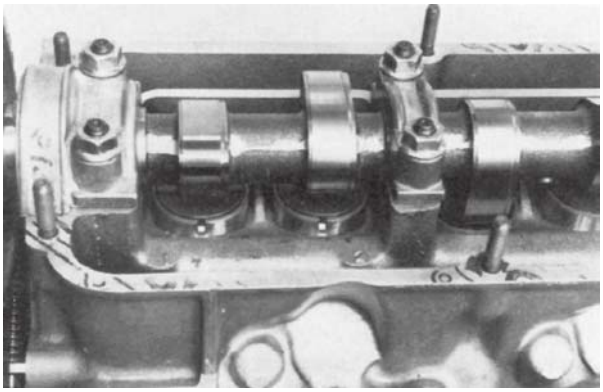


134. Measure the valve clearance for the number 1 cylinder, using a feeler gauge.

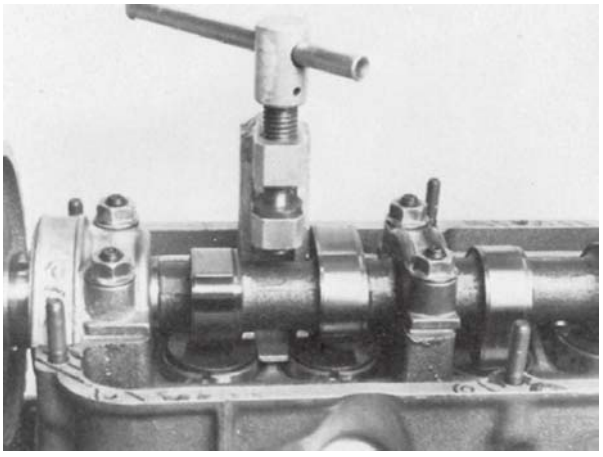
Clearance, cold engine: 0.35–0.40 mm (0.01378–0.01575")
Clearance, hot engine: 0.40–0.45 mm (0.01575–0.01772")
The same clearance for intake as for exhaust valves.

NOTE! Should the clearance when checking be between the values given below, adjustment is not necessary.

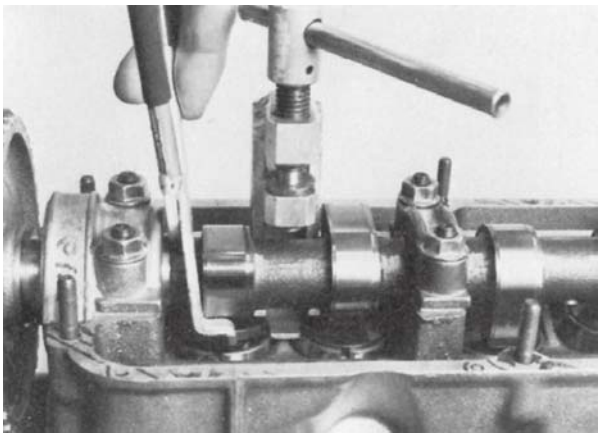
Cold engine: 0.30–0.40 mm (0.0118–0.01575")
Hot engine: 0.35–0.45 mm (0.01378–0.01772")



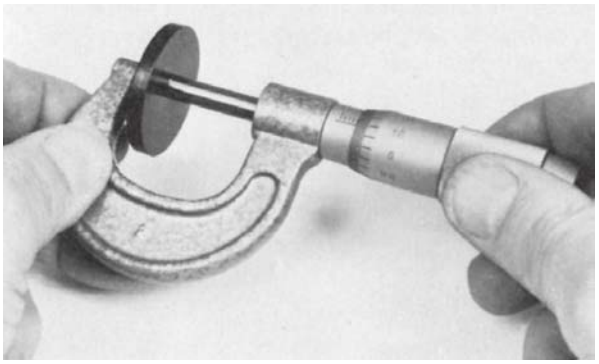
135. When necessary the adjustment washers are to be replaced as follows: Turn the valve tappet so that the grooves are aligned 90° to the length of the camshaft.



136. Install special tool part no 9995022-2 and press down the valve tappets. Tighten the tool spindle and adjust until the groove of the valve lifter is above the edge and thus accessible with a pair of pliers.



137. Use special tool part no 9995026-3 (pair of pliers) to lift out the washer.

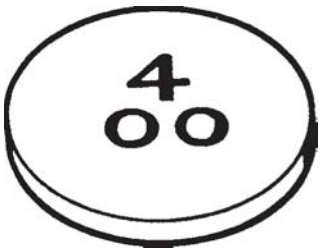


138. Measure the thickness of the washer with a micrometer. Calculate the thickness of the washer, giving the correct clearance.

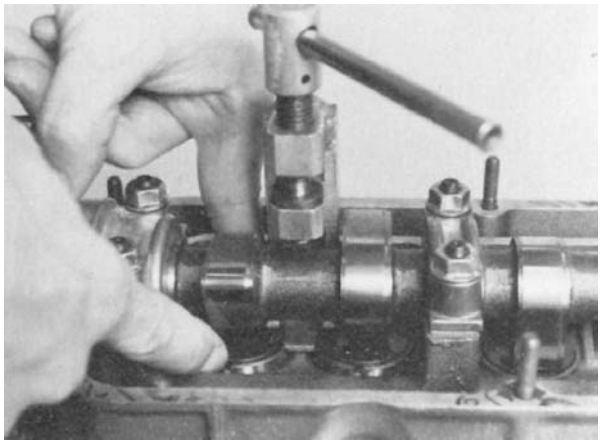
Example: The measured clearance is: 0.30 mm (0.0118"), the correct clearance is 0.40 mm (0.01575"), thus a difference of -0.10 mm (0.00394").

Measured thickness of existing washer: 3.80 mm (0.1496").

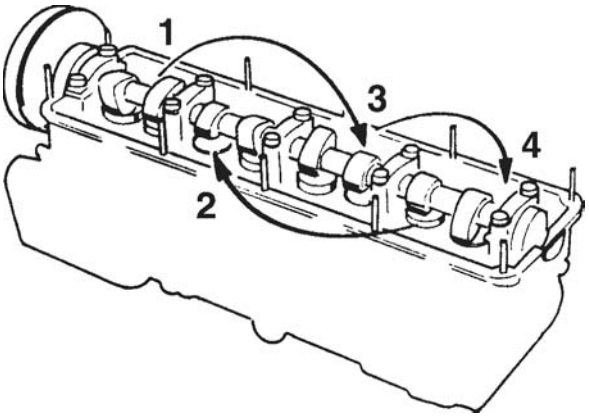
The correct thickness on a new washer: 3.80–0.10 = **3.70 mm (0.1496–0.003294" = 0.14567")**.



139. The washers are available in thicknesses between 3.30 (0.12992") and 4.5 mm (0.17717") at intervals of 0.05 mm (0.00197"). Always use new washers only. See page 60.



140. Oil the new washer and insert it with the marking facing downwards.



141. Remove the tool part no 9995022-2. Turn the camshaft in position for ignition of number 3 cylinder to fire. Measure the clearance with a feeler gauge and remedy if necessary in accordance with the above instructions. Repeat the procedure on number 4 and number 2 cylinders and in this order. Then turn the camshaft a couple of turns and check the clearances for all the valves.

Valve Adjustment Kit for 230, 250, AQ131, AQ151

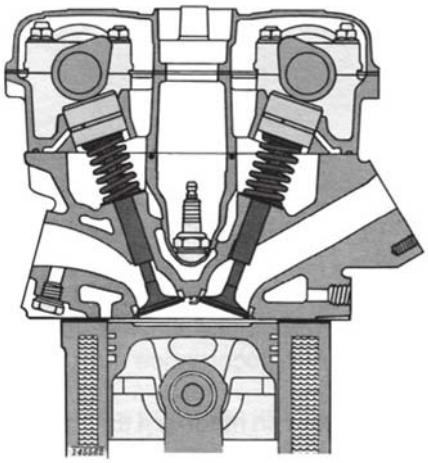
Kit No 884516-4

The kit contains a shim assortment to provide as large an adjustment range as possible. It can be complemented if necessary by ordering from the Volvo Penta Parts Department. The complete kit, part no 884516-4 contains the following parts:

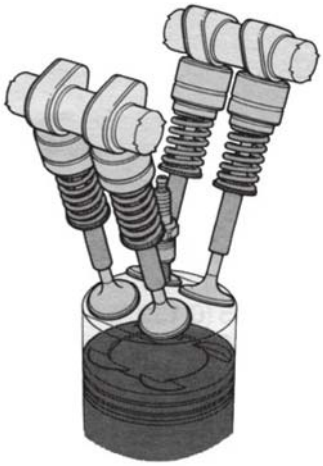
Part No:	Qty:	Designation:	Thickness mm (inch)
463551	6	Adjustment shim	3.55 (0.13976")
463552	6	Adjustment shim	3.60 (0.14173")
463553	6	Adjustment shim	3.65 (0.14370")
463554	6	Adjustment shim	3.70 (0.14567")
463555	6	Adjustment shim	3.75 (0.14764")
463556	12	Adjustment shim	3.80 (0.14960")
463557	12	Adjustment shim	3.85 (0.15157")
463558	12	Adjustment shim	3.90 (0.15354")
463559	12	Adjustment shim	3.95 (0.15551")
463560	6	Adjustment shim	4.00 (0.15748")
463561	6	Adjustment shim	4.05 (0.15945")
463562	6	Adjustment shim	4.10 (0.16142")
463563	6	Adjustment shim	4.15 (0.16339")
463564	6	Adjustment shim	4.20 (0.16535")
834557	1	Index	
834613	1	Tool box	
9995022	1	Depressing tool	
9995026	1	Pair of pliers	

Overhauling the valve system 251DOHC, AQ171

Technical Description

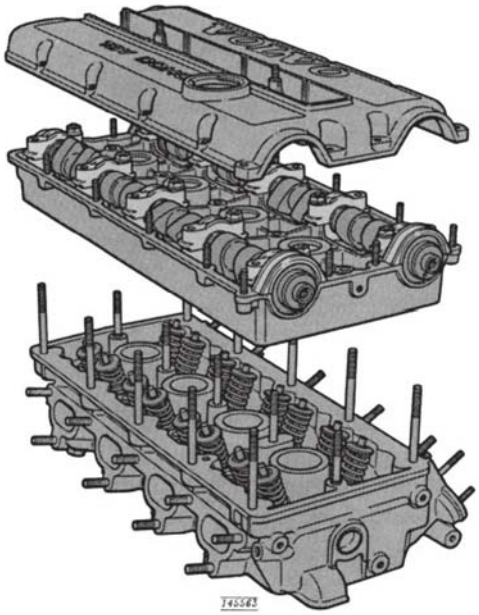


The engine has double overhead camshafts which open and close the valves via hydraulic valve tappets. The hydraulic valve tappets are filled with oil and are self-adjusting. The valve guides have a 19° angle to the cylinder head.



4 valves per cylinder

With two inlet and exhaust valves, the total valve area has increased by approx. 50% compared with the 230 and 250 (AQ131, AQ151). This improves the gas flow to the combustion chamber and the fuel/air mixture is burnt more effectively.



The camshafts are fitted in a special camshaft carrier fitted on the cylinder head. The seal between the camshaft carrier and the cylinder head is done in two ways. The spark plug wells are sealed by four O-rings between the camshaft carrier and cylinder head. The sealing of the flat surfaces between the camcylinder head is done using a sealing compound (Loctite).

The valve cover gasket is in two parts. One seals against the spark plug wells while the second part seals between the camshaft carrier and valve cover outer boarder.

Hydraulic valve tappets

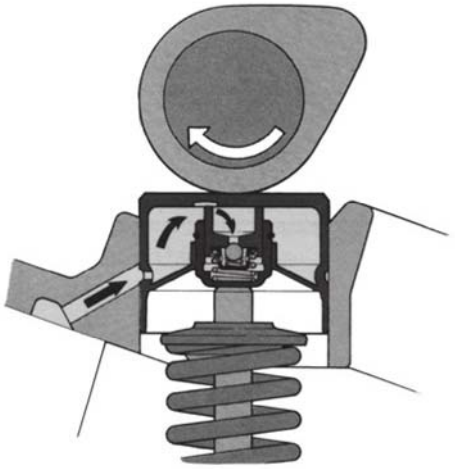
Between the camshaft and the hydraulic valve tappet there is normally a certain clearance. The clearance is greater when the engine is cold than when it is hot to allow for the lengthwise expansion of the

valve. A certain clearance is also required to ensure that the valve does not remain partly open, allowing combustion gases to pass and the valve to be damaged. Preferably, the clearance should be as close to zero as possible. This is possible with hydraulic valve tappets.

The solution chosen for the 251DOHC, AQ171 is a spring inside the valve tappet cylinder which holds the valve tappet against the camshaft, but at a lower pressure than the valve spring, to allow the valve to expand lengthwise.

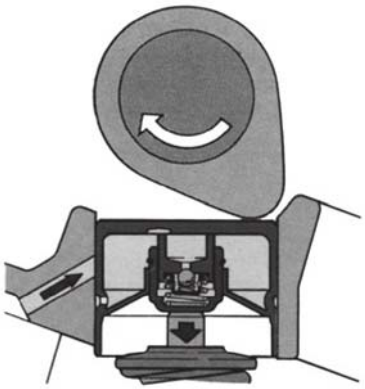
A check valve (ball) prevents oil from being pressed out when the camshaft pushes the hydraulic valve tappet and the oil pressure in the valve tappet cylinder is greater than the engine's oil pressure.

When a valve is pushed down with the engine stopped, oil will gradually leak out from the hydraulic valve tappet and the valve clearance will be greater when the engine is started and until the oil pressure has been built up. The distance between hydraulic valve tappet cylinder and the piston is therefore chosen to ensure mechanical safety.



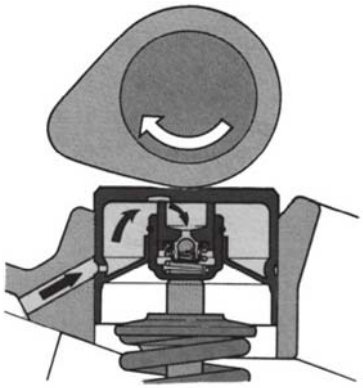
The hydraulic valve tappet on the camshaft's base circle

The oil for the tappets comes from the camshaft carrier and is pressed into the valve tappet via a groove and a hole in the side of the tappet. Oil passes through the slit in the top of the valve tappet and into the piston. As the engine's oil pressure is greater than the oil pressure in the hydraulic valve tappet, the oil passes the check valve (the ball).



The camshaft presses the valve tappet down

The oil pressure in the valve tappet cylinder then becomes greater than the engine's, the check valve closes and the hydraulic valve tappet works as one unit.



The valve tappet back on the camshaft's base circle

The engine's oil pressure is greater than the oil pressure in the valve tappet cylinder, the check valve opens and lets in pressure oil so that the valve tappet is pressed against the camshaft.

Fault-tracing valve tappets

The valve tappets are very reliable and faults are very rare. If the tappets are noisy, the cause is usually too high or too low oil level. Check the oil level!

Momentary noise may be heard when the engine is started. This is normal and is due to the oil being drained from the tappets when the engine has been stopped for a period. The tappets are refilled with oil a few seconds after starting.

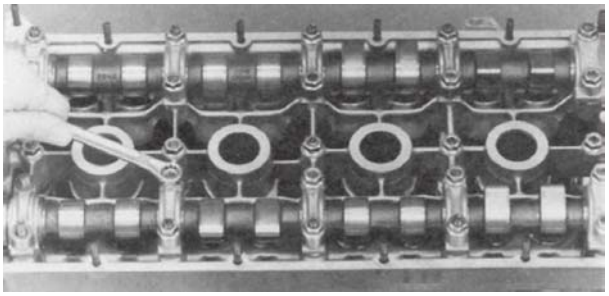
Noise at high engine speed, but quiet at low speed: Oil level above max on the oil dipstick – the crankshaft whips the oil to foam, which causes the noise in the tappets. Too low oil level – the oil pump sucks air at high engine speed or when the boat rolls. Air in the oil can cause noise in the tappets.

Spontaneous noise at idling, disappears with increased engine speed: This is an indication of worn valve ball or dirt in the tappets. **Noise at idling or when engine oil is hot, quiet at higher engine speed or with cold engine oil:** Tappets that leak a lot of oil.

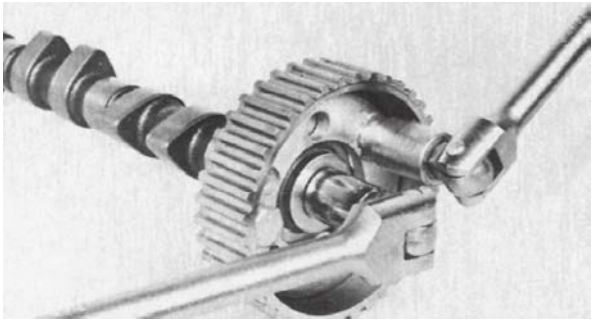
Overhauling the valve System 251DOHC, AQ171

⚠ **IMPORTANT! Do not turn either the crankshaft or the camshaft. The pistons can hit the valves!**

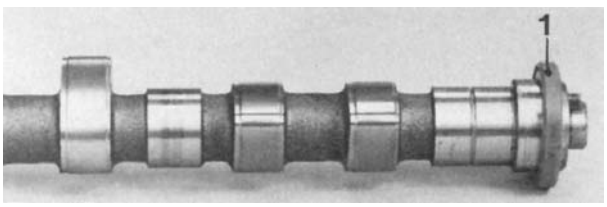
142. Remove the nuts and the valve cover. Tool width: 10 mm. Remove the gaskets.



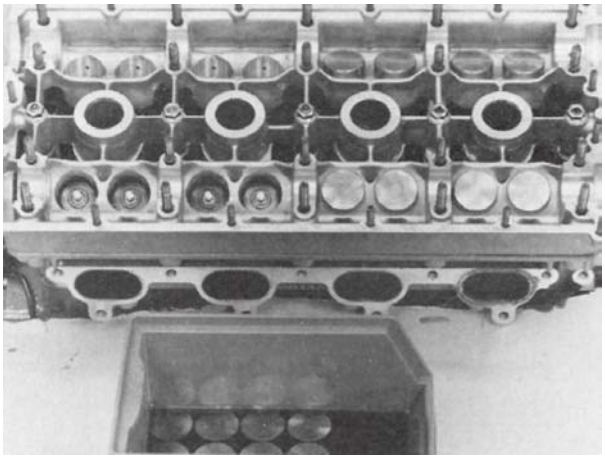
143. Remove the camshaft bearing caps. Tool width: 1/2". The caps are numbered from 1 to 10.
NOTE! Number 10 is marked with a 'zero' only. The caps numbers 1 to 5 are installed on the port camshaft, counted from the number 1 cylinder.



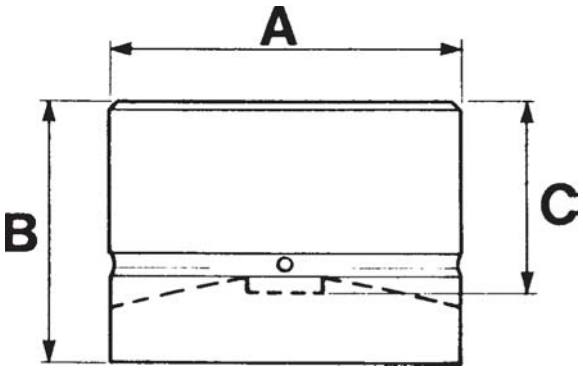
144. Lift out the camshaft and remove the camshaft gear wheel. Use special tool part no 9995034-7 as counterhold. Tool width: 17 mm.



145. Remove the sealing rings (1). Check the camshafts for wear. Replace them if necessary.



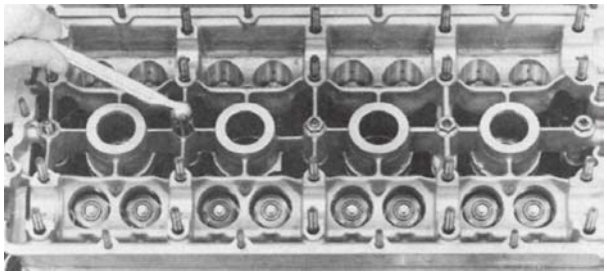
146. Lift out the hydraulic valve tappets and place them upside down in an oil bath. Use a magnet or suction cup as an aid when lifting out of the valve tappets.
NOTE! Be careful to place the tappets in the order they had in the engine. The tappets must be fitted in their respective bores. Do not mix them! Mark the oil bath vessel to ensure that the correct order is maintained.



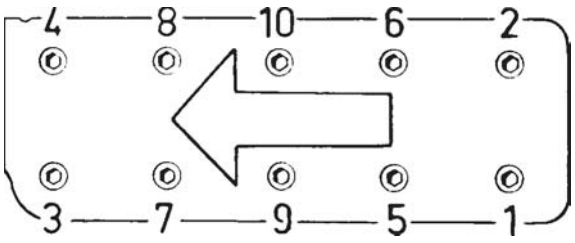
146A. Check the valve tappets for any wear. Measure if necessary.

Hydraulic valve lifter, measurement
A: External diameter, mm/in 35/1.378
B: External height, mm/in 26/1.024

Distance to top of valve tappet
C (1): Unloaded, mm/in 18.40/0.724
C (2): Compressed, mm/in 16.15/0.636

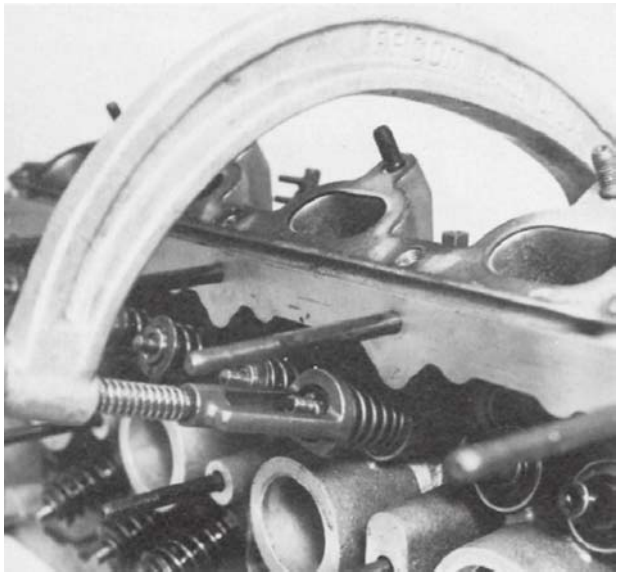


147. Remove the 5 nuts which attach the camshaft carrier to the cylinder head. Tool width: 1/2". Then lift out the camshaft carrier.
NOTE! Remove the O-rings between the cylinder head and the camshaft carrier (later production).

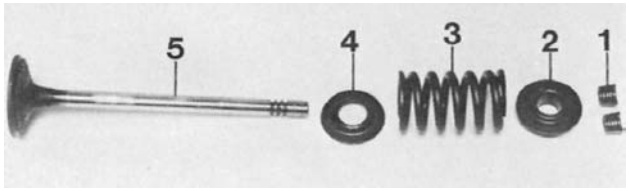


148. Remove the cylinder head by removing the cylinder head bolts in the sequence shown in the illustration. Spanner width: 14 mm. Then remove the cylinder head gasket.

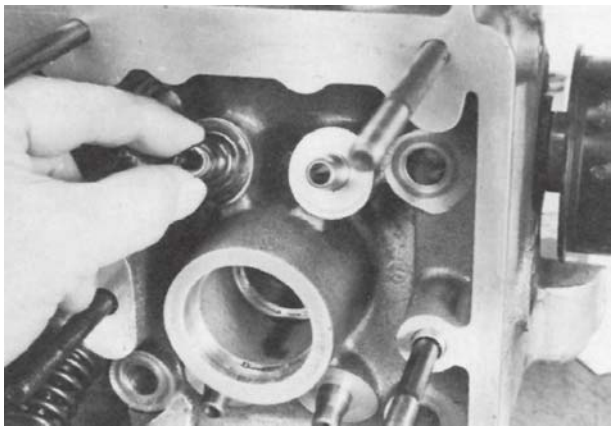
⚠ **IMPORTANT!** The cylinder head is made of aluminum. In order to avoid scratches etc, place the cylinder head on wooden blocks.



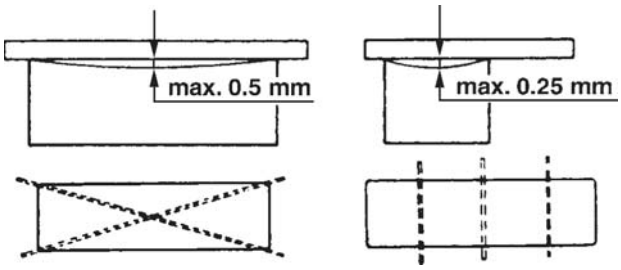
149. Remove the valves. Use special tool, part no 9986052-0.



150. Remove and place the valve locks (1), retainer (2), spring (3) and the lower washer (4) (exhaust) and the valve (5) in the same sequence as removed from the engine.
NOTE! Do not mix the parts!



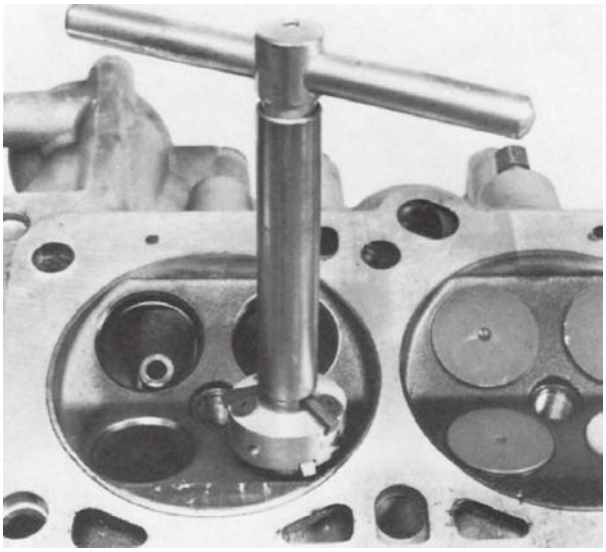
151. Remove the valve seals from the intake valves and then the lower washer.



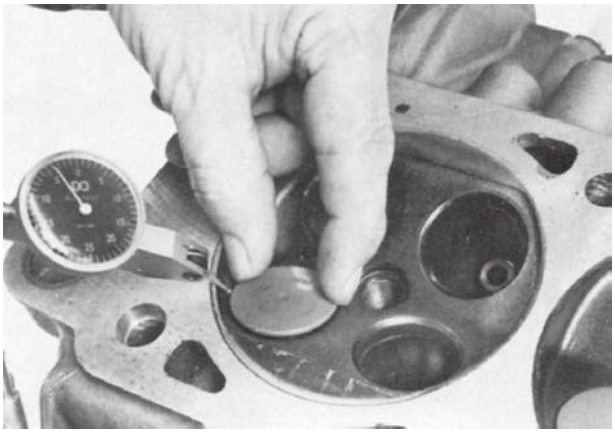
152. Clean the cylinder head and sealing surface. Use a metal ruler and a feeler gauge. The warp must not exceed 0.5 mm (0.0197") lengthwise and 0.25 mm (0.0098") diagonally.

⚠ **IMPORTANT!** The cylinder head cannot be machined if the warp is greater than 1.0 mm (0.0394") lengthwise or 0.5 mm (0.0197") diagonally.

Cylinder head height, new ..... 103.5 mm (4.0748")
Cylinder head height, min after reworking ..... 103.0 mm (4.055")
Reworking, total = 0.5 mm (0.0198")

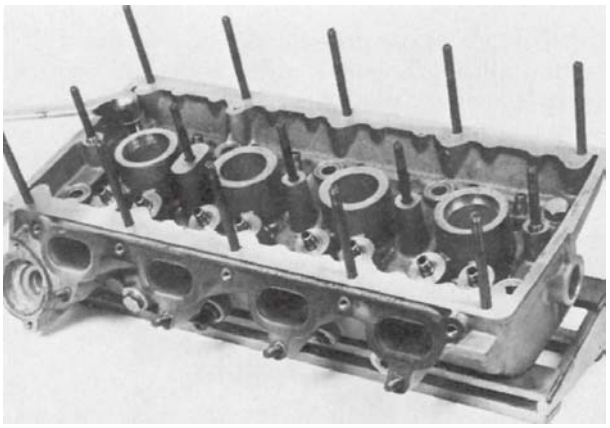


153. Use a cutter to clean the valve seats. Remove carbon deposits from the combustion chambers and the valves. Check the valves for cracks and other possible damages. Replace if necessary.

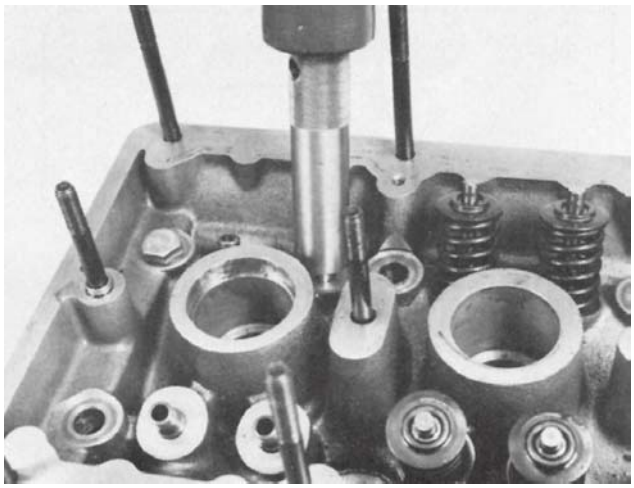


154. Check the wear in the valve guides. Use new valves and push up the valves 1–2 mm (0.0394–0.0787"), hold while measuring. Clearance with new valve and new valve guide, intake: 0.030–0.060 mm (0.00118–0.00236"), exhaust: 0.040–0.070 mm (0.00157–0.00276"). Maximum clearance allowed with new valve and old valve guide is 0.15 mm (0.0059") for intake as well as for exhaust.

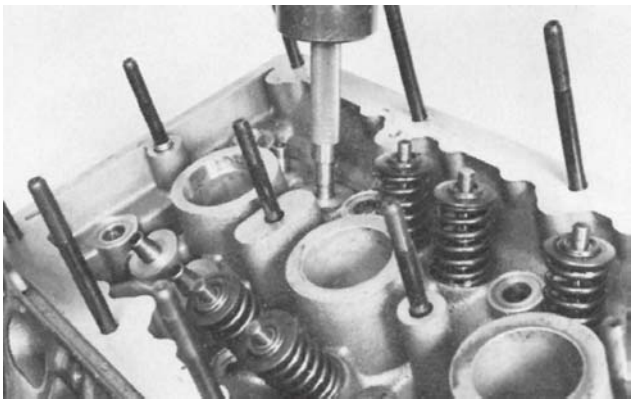
Changing the valve guides



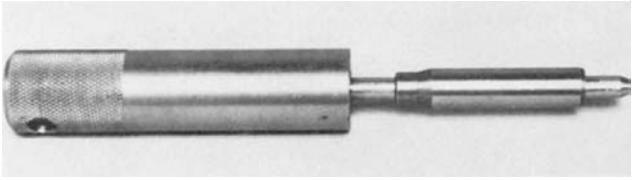
155. Place the cylinder head in special tool part no 884979-6 and hold it with 2 screws (M12).



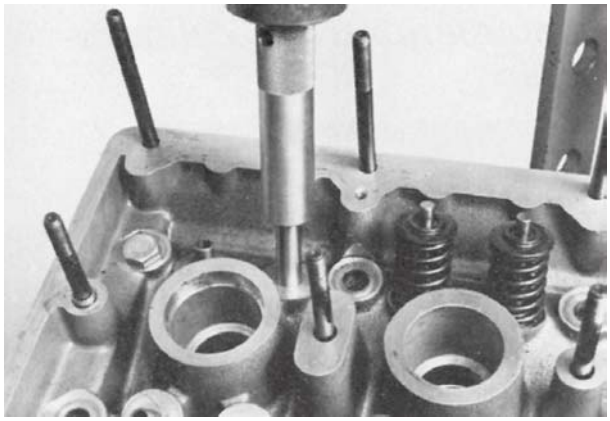
156. Use special tool part no 884959-0 to start pressing out the valve guide. Press until the tool bottoms.



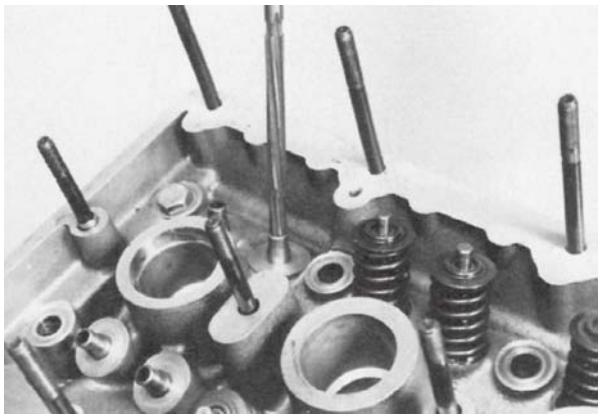
157. Change over to special tool part no 884958-0 and press until the tool bottoms.



158. Put the new valve guide on special tool part no 884966-3.



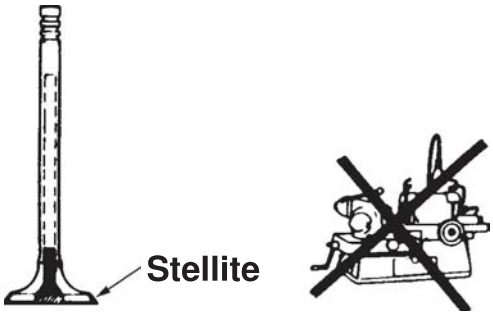
159. Press the new valve guide into the cylinder head. Press home the tool.
NOTE! The old valve guide is still in the cylinder head and is ‘guiding’ the tool with the new valve guide. The old valve guide will fall out of the cylinder head.



160. Ream the valve guide. Use special tool part no 884967-1.
NOTE! New valve must always be lapped against the valve seat.

Changing the valve seat

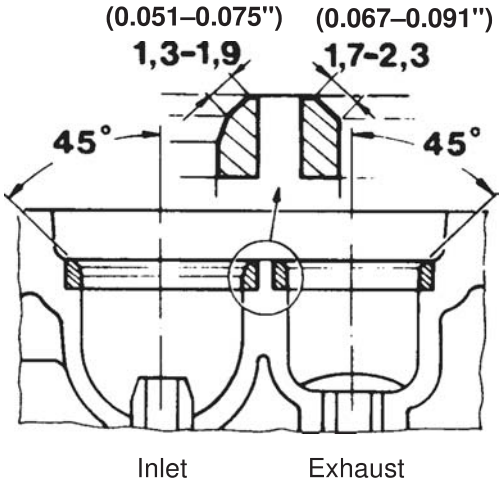
The valve seats should, in principle, be changed in accordance with paragraphs 103–108 on pages 53 and 54. Special tool part no 884960-6 for intake and part no 884961-4 for exhaust.



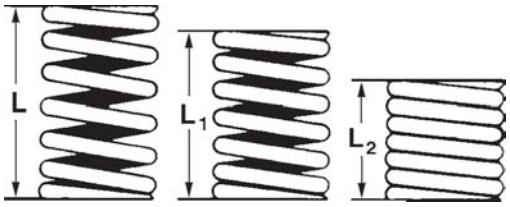
161.

⚠ **IMPORTANT**! The exhaust valves are ‘Stellite’ coated and therefore **cannot be machined**.

They can only be lapped to fit by using grinding compound. If they are machined the ‘Stellite’-coating is removed and the heat protection of the valve is reduced.

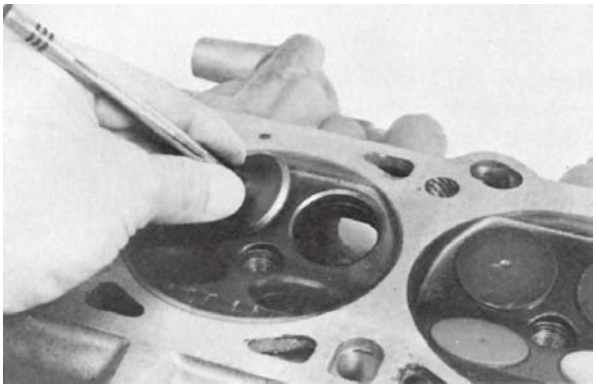


162. Machine the valve seats. The same angle for intake as for exhaust. The valve seat width = accordance with the illustration. Check the valve contact against the seat. If necessary lap the valves using grinding compound.



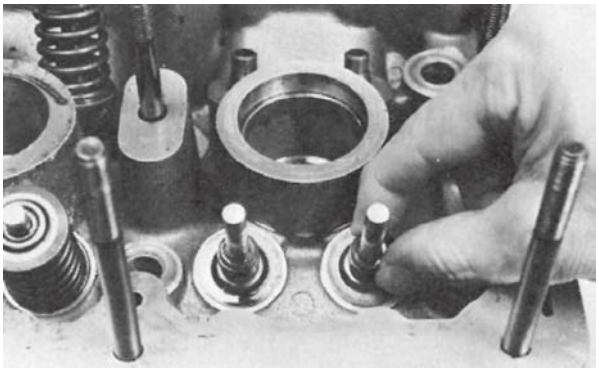
163. Check the valve springs with a spring tester.

Length, unloaded ..... 43 mm (1.6929")
loaded 232 N ± 20 N (51±4.48 lbf.) ..... 37 mm (1.4567")
loaded 640 N ± 40 N (141±8.96 lbf.) 26.5 mm (1.0816")

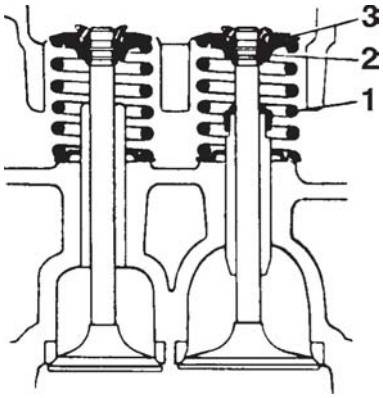


164. Check to make sure that valves and valve seats are seating correctly by coating the seat surface of the valve with marking dye and turn it with light pressure against the valve seat. Should the marking dye not be evenly distributed against the seat contact surface (the valve will not seal), the valve has to be lapped further and checked once more until a correct result has been obtained.

Assembling the cylinder head



165. Place the lower valve spring washer in the cylinder head. Oil and install the valve. Then install the seal on the intake valves only.



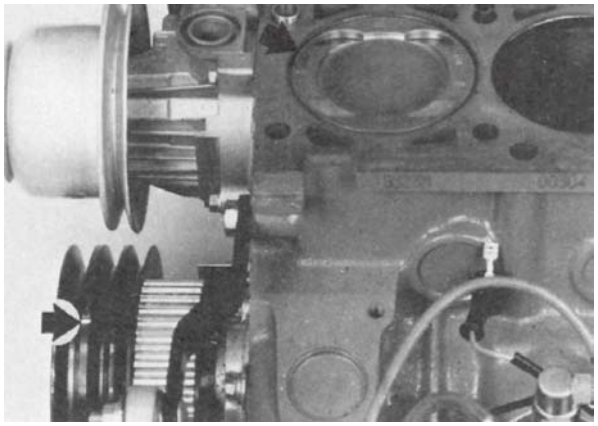
166. Install:

1. The valve spring
2. The upper valve spring retainer
3. The valve lock

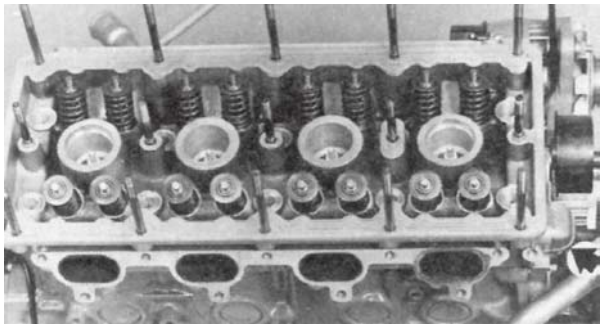
Use the valve spring compressor.

NOTE! Install the exhaust valves without seals. Then install the spark plugs.
NOTE! Make sure that the spark plug thread enters properly in order not to destroy the thread in the aluminum cylinder head. Tightening torque: 25–30 Nm (2.5–3.0 kpm/18–32 ft.lbs).

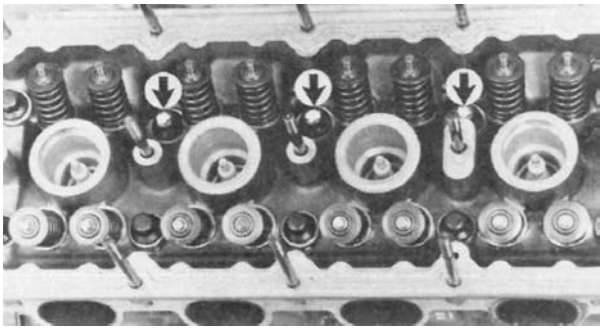
Assembly



167. Check to make sure that the number 1 piston is at T.D.C., with the pulley at 0°.

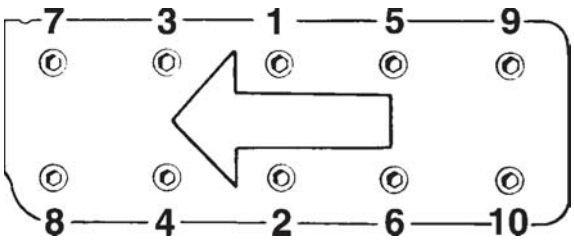


168. Check that the block and cylinder head contact surfaces are properly cleaned. Install a new cylinder head gasket and then install the cylinder head. Check to make sure that the gasket between the cylinder head and the water circulation pump is not damaged and correctly positioned.



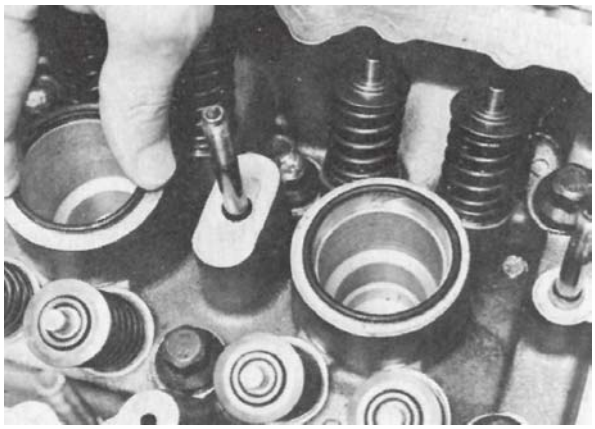
169. Install the cylinder head bolts in the cylinder head.
NOTE! The 3 short ones are to be positioned on the port side and between the front and rearmost bolts. They are marked 'white' in the illustration.

170. The cylinder head bolts must be replaced in case they show signs of elongation. Whether a bolt is elongated or not can be seen on the waist of the bolt. If the waist is elongated, then the bolt has to be replaced by a new one. The bolts can be re-used 5 times at the most. If uncertain, replace all bolts.



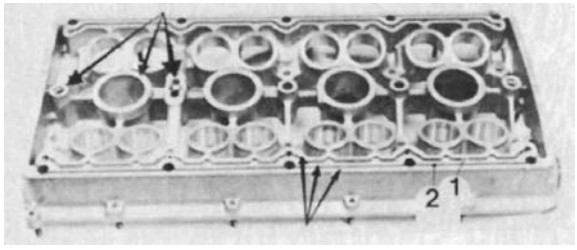
171. Tighten the bolts in sequence and in steps. See the illustration. Tool width: 14 mm.

1 = 20 Nm (2.0 kpm/15 ft.lbs)
2 = 40 Nm (4.0 kpm/30 ft.lbs)
3 = angle tightening through 120°.



172. Place the O-rings in their positions on the cylinder head.
NOTE! On engines of earlier make, there are no O-rings.

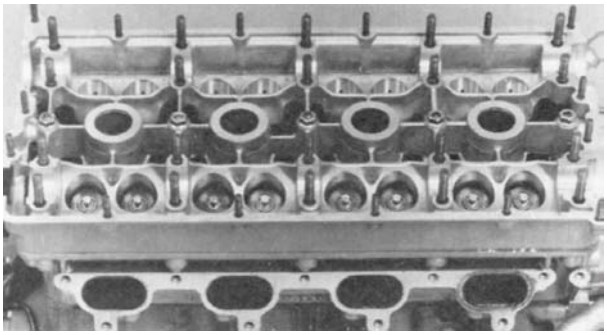
Sealant for the camshaft carrier



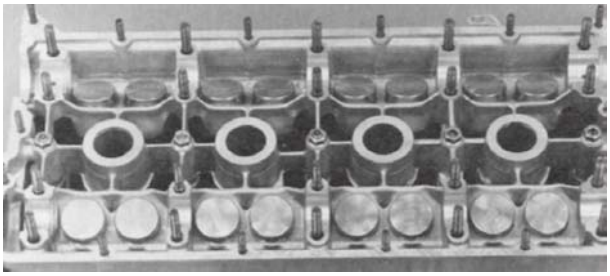
173A. Use trichloroethylene or an alkaline degreasing agent to clean the components carefully. Follow the instructions for the cleaning agent carefully.

Coat the contact surface of the camshaft mechanism with a thin layer of sealant (approx 0.05–0.10 mm 0.00197–0.00394"). Use 'Loctite 518' or its equivalent.
NOTE! Use a short fiber type of roller or a brush to apply the sealant.

⚠ **IMPORTANT!** Make sure that no sealant enters the oil channels (1) or the drain channel (2).

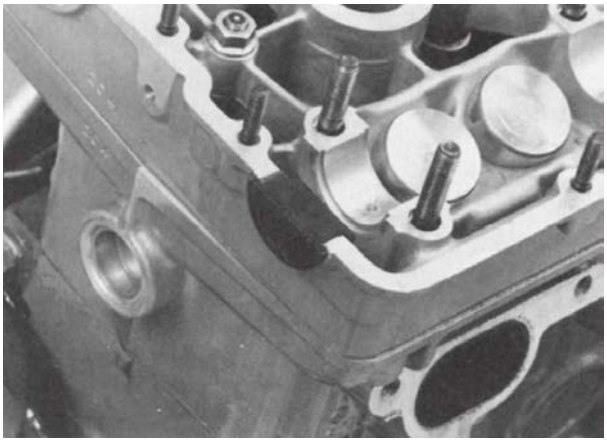


173B. Place the camshaft carrier on the cylinder head. Install the 5 nuts by hand. Make sure the carrier enters the end guides.

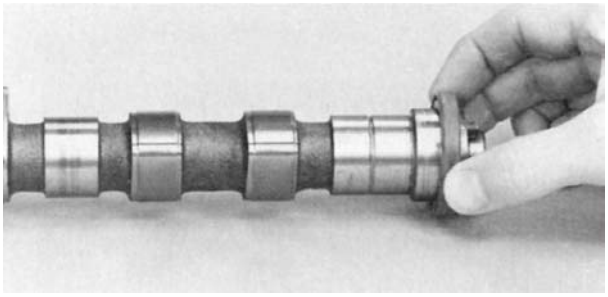


174. Place the hydraulic lifters in their exact previous locations.

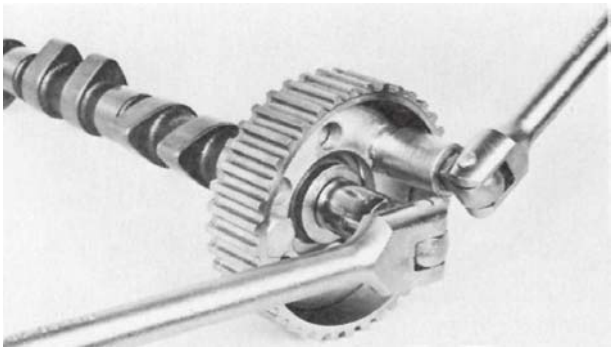
NOTE! Should any of the valve lifters be worn (do not function), it has to be replaced as a unit. Lower the lifter in clean oil and pump with the center plug until it feels 'hard'.



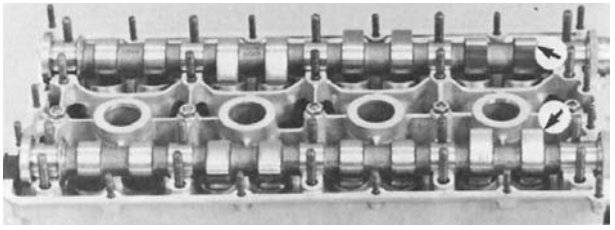
175. Check to make sure that the half-moon seal in the camshaft carrier is not damaged. Replace if necessary.



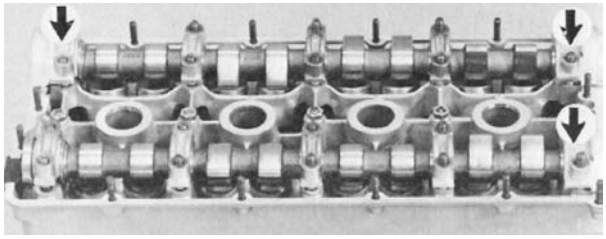
176. Grease the seal ring and install it carefully on the camshaft.
NOTE! Turn the 'smooth' side facing outwards (towards the front).



177. Install the camshaft gears on the camshaft. Use counterhold, part no 9995034-7. Tightening torque: 50 Nm (5.0 kpm/36 ft.lbs).



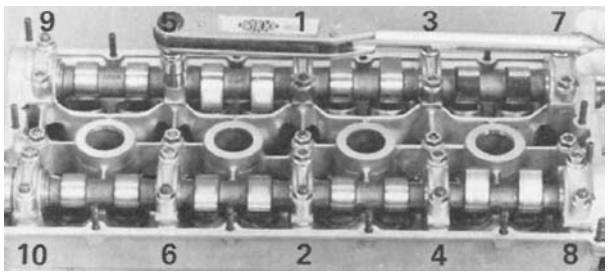
178. Place the camshafts in the camshaft carriers so that the front lobes (No 1) are turned facing upward and inward towards each other.
NOTE! The camshaft with a groove for the distributor drive, should be installed on the port side.
Check to make sure that the markings on the camshaft gears are pointing up.



179. Place the camshaft bearing caps 1 to 5 on the port camshaft.
NOTE! Caps no's 1, 5 and 6 should be coated with gasket compound. Then place the bearing caps no's 6 to 10 on the starboard camshaft. The number 10 bearing cap is marked with a 'zero' only.

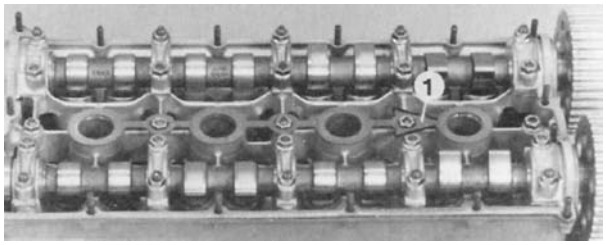
⚠ **IMPORTANT!** Make sure that the sealing rings at caps no's 1 and 6 are properly positioned.

⚠ **IMPORTANT!** Do not turn the crankshaft or the camshaft. The pistons will hit the valves.

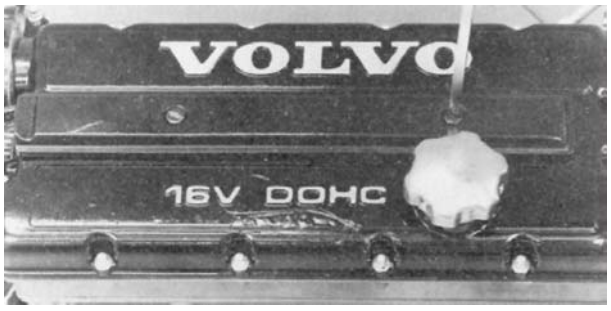


180. Install the nuts and tighten them with a torque of 20 Nm (2.0 kpm/15 ft. lbs). Tool width: 1/2". Tighten alternatingly and in sequence.
NOTE! Also tighten the nuts in the middle.

IMPORTANT! Do not turn the crankshaft or the camshaft! The pistons might hit the valves!



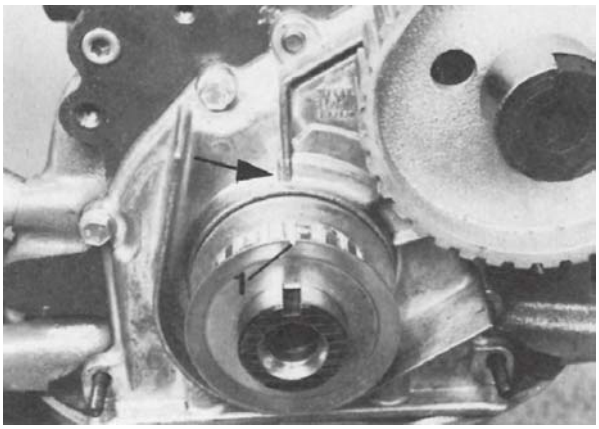
181. Install new gaskets on the camshaft carrier. The gasket in the middle of the picture can be installed in one way only. The arrow (1) should point at no 1 cylinder.



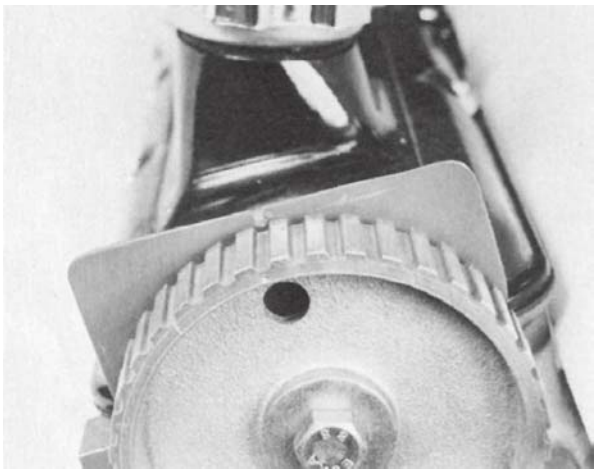
182. Install the valve cover and tighten it with the nuts. Tool width: 10 mm.

4F Installing the toothed belt

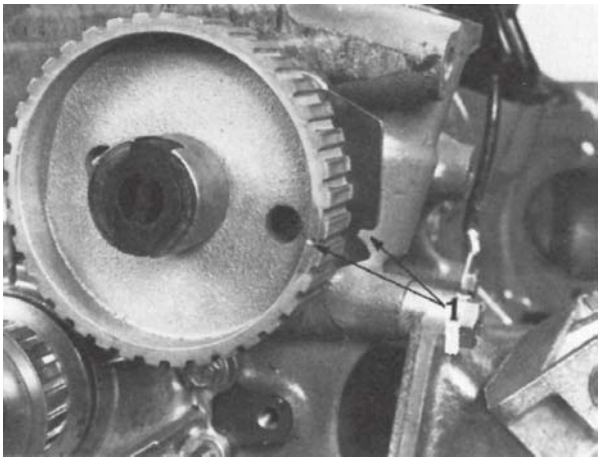
Installing the toothed belt 230, 250, AQ131, AQ151



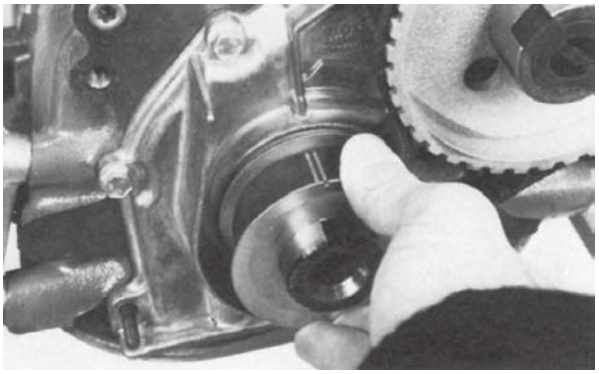
183. Check to make sure that the recess (1) of the outer guide plate coincides with the marking of the housing.



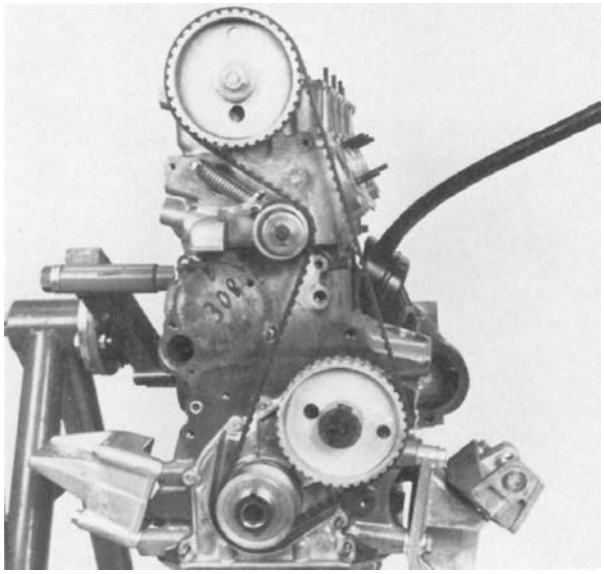
185. Place the valve cover without the gasket on the cylinder head. Position the marked plate on the two front stud bolts. Then make sure that the marking of the camshaft gear lines up with the plate marking. Note! not all engines have the marked plate.



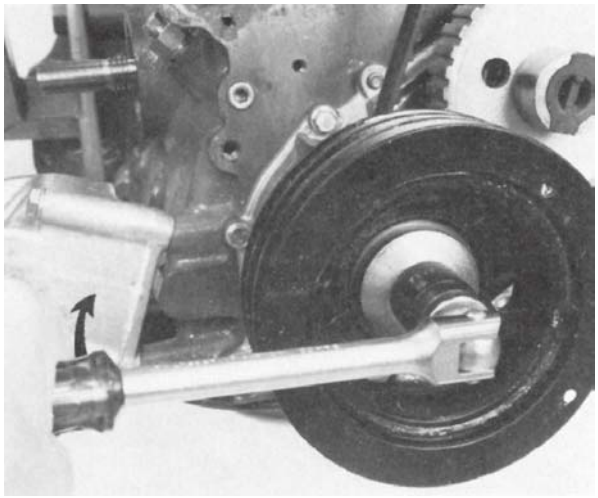
184. Align the intermediate shaft with the marking (1).



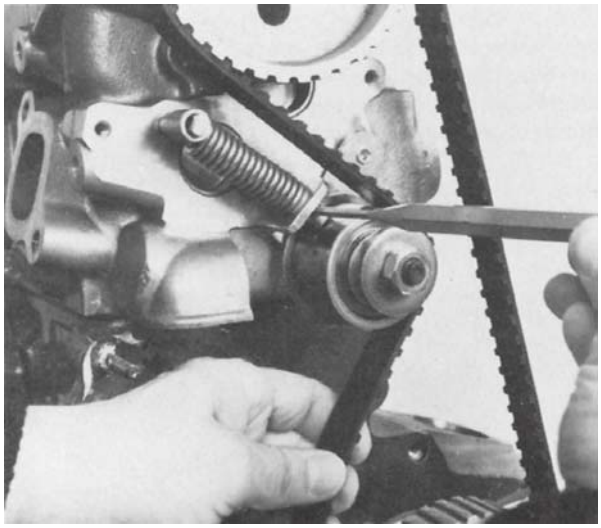
186. Check the condition of the toothed belt.
NOTE! Grease or oil must not be on the belt. Then adjust the markings of the belt as follows: Two lines against the marking of the crankshaft guide plate and one line against the marking of the intermediate wheel. The last marking, also one line, against the marking of the camshaft gear.
NOTE! At the crankshaft marking, the belt must be pushed down into the correct tooth gap for checking.



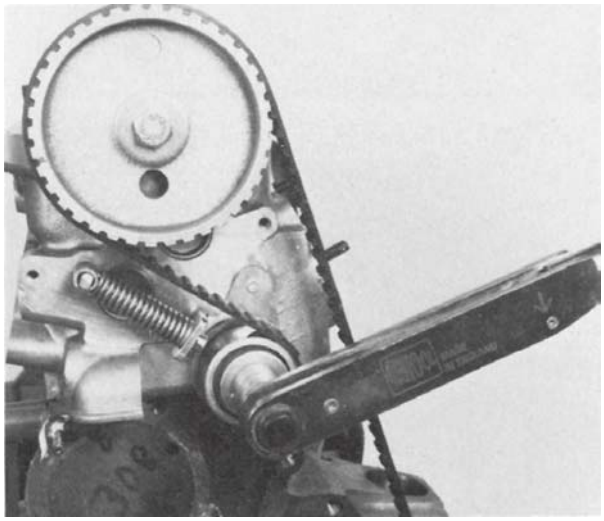
187. Carefully move the belt onto the belt tensioning roller being careful not to damage the belt.



189. Turn the crankshaft clockwise a few degrees. This is in order to remove the 'slack' between the belt wheels.
NOTE! Do not turn the crankshaft anti-clockwise. This will cause the belt to jump over giving an incorrect setting.



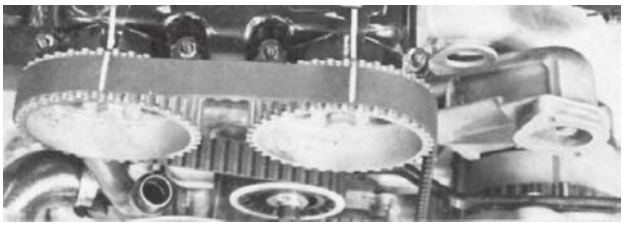
188. Make sure that the nut of the belt tensioner is not tightened. Compress the tensioner and remove the drill (or other tool) to allow the spring to tension the belt. Tighten the nut.



190. Back off the nut of the belt tensioner again to allow the spring to tension the belt again. Make sure that the belt tensioner is not seized in its pivot. Torque the nut 50 Nm (5.0 kpm/36 ft.lbs). The belt must be tensioned at least once per season and replaced every 500 hours of operation. Remove the valve cover and install the valve cover gasket.

Installing the toothed belt 251DOHC, AQ171

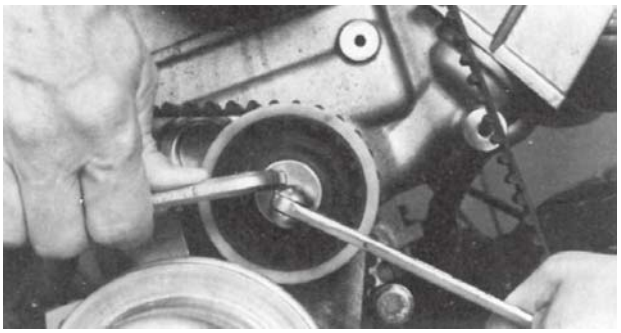
191. Inspect the belt tensioner. There should be no play in the bearing. If the contact surface of the roller is damaged, the roller and the belt must be replaced. Fine-adjust the camshaft gears and the crankshaft gear so that they will line up exactly with the respective markings on the valve cover and the seal holder behind the torsional damper.



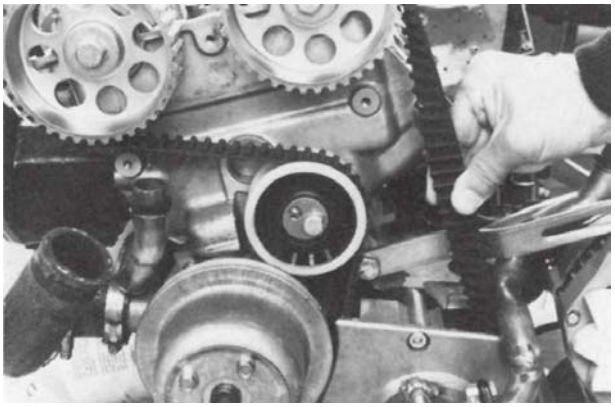
192. Install the belt so that the yellow (lines) markings align as follows:

2 lines against the crankshaft gear marking and 1 line against each of the camshaft gear markings. For the crankshaft gear marking, the belt has to be depressed somewhat into the correct tooth gap for checking. Also see under 250, AQ151).
NOTE! For the 250, AQ151 the belt must be installed on the belt tensioner prior to being installed on the camshaft gears, this because the belt tensioner is provided with guiding edges.

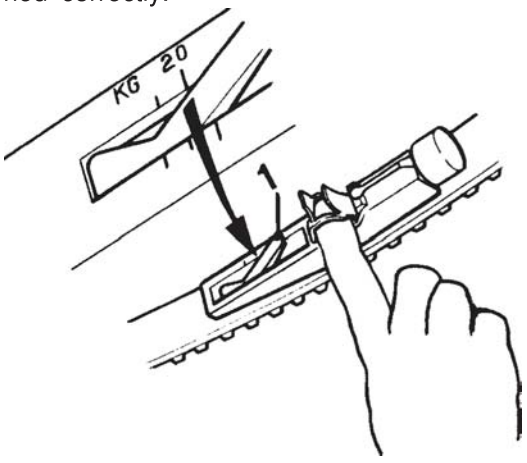
Check carefully that the belt is installed so that the markings line up.
NOTE! It is not necessary to adjust the marking of the intermediate wheel against the belt marking.



193. Turn the belt tensioner to tension the belt and then tighten the Allen-head screw. Tool width: 8 mm. The belt must be tensioned at least once per season and be replaced after every 500 hours of operation.

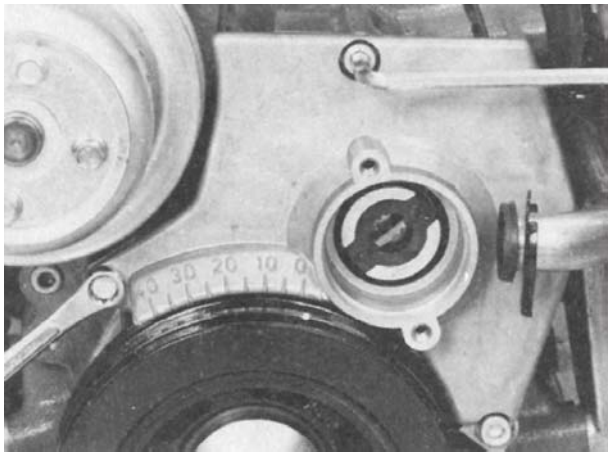


194. Method 1: Correct belt tension. Turn the crankshaft a few degrees counter clockwise and check that the marking on the belt (2 lines) coincide with the marking on the guide plate. Then turn the crankshaft a few turns clockwise. Take the belt between the index finger and the thumb and twist it. It should be possible to twist the belt 90° by hand. Increase or decrease the belt tension, should the belt not be tensioned correctly.

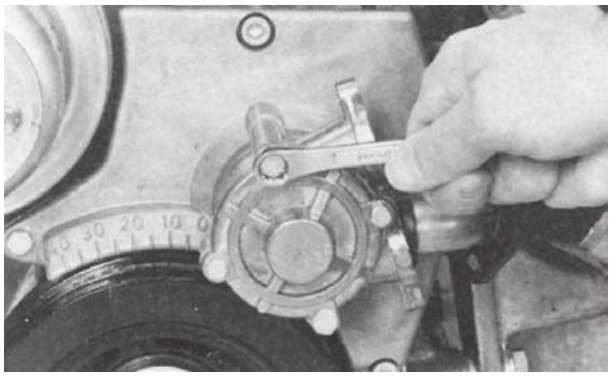


195. Method 2: Tension the belt and place special tool part no 1159660-8 on the belt. ‘Zero’ the instrument by depressing the lever (1). Then press the tool against the belt until a ‘click’ is heard. Note the value of the tool. The correct value should be 20 to 25 Kilos (44–55 lbs). Tension or loosen the belt as required.

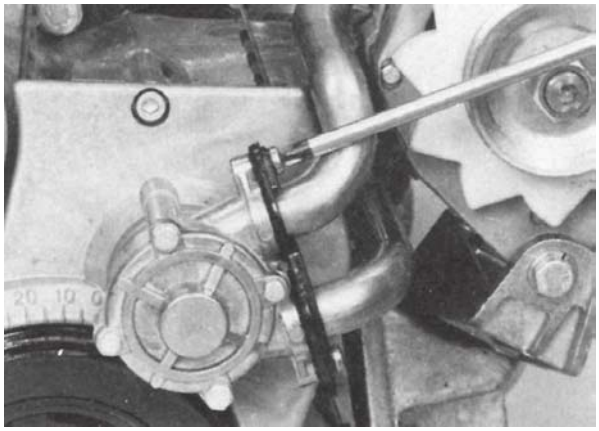
4G Installing the external components of the Cylinder Head



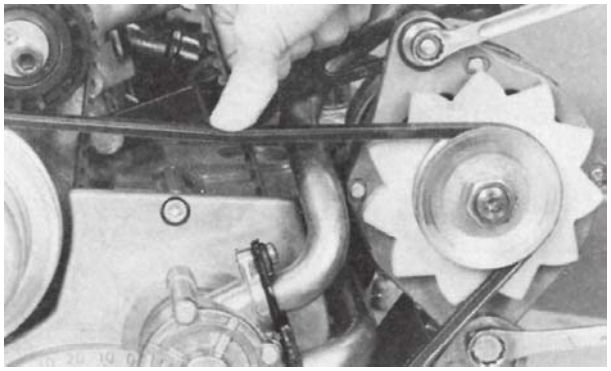
196. Install the timing gear cover. Tool width: Allen-head 6 mm and hexagonal 10 mm.



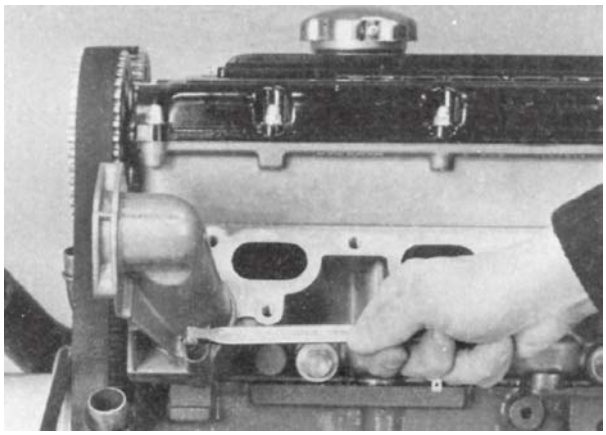
197. Install the sea water pump. Tool width: 10 mm. Make sure that the pump shaft engages the cross-piece carrier.



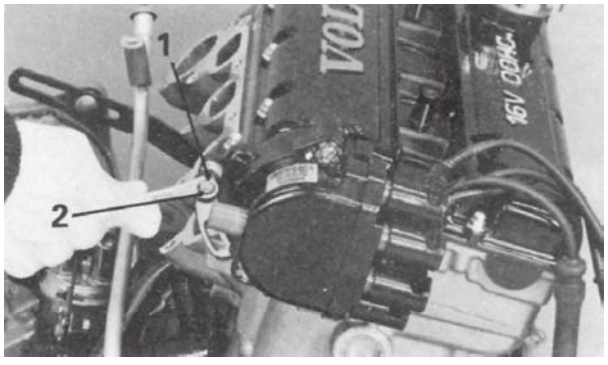
198. Install the cooling water pipes on the sea water pump. Check the seal. Replace if necessary.



199. Install the V-belt and tension it to allow it to be depressed approx. 5 mm (0.2") by normal thumb pressure. Tool width: 1/2" and 16 mm.
NOTE! Make sure the V-belt enters the correct groove on the crankshaft pulley.

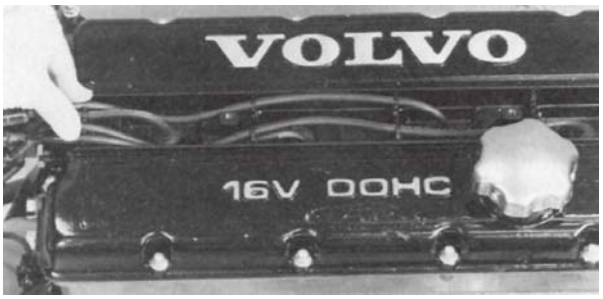


200. Install the thermostat along with a new gasket in the thermostat housing. Then install the thermostat housing on the engine. Tool width: 10 mm.

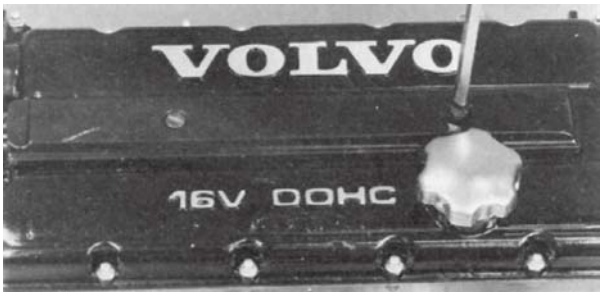


201. 251DOHC, AQ171. Make sure that the O-rings on the distributor are not damaged. Replace if necessary. Grease the distributor shaft and install the distributor on the engine. Tool width: 10 mm.

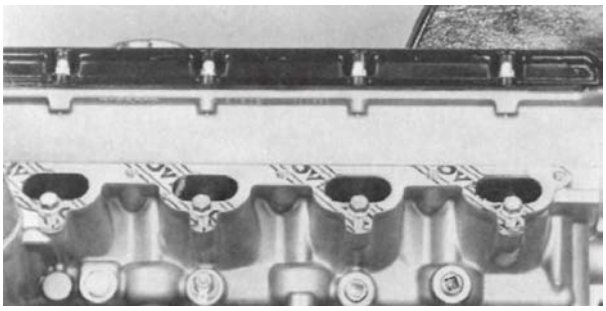
⚠ **IMPORTANT:** In order to position the distributor correctly, the plastic bushing (1) must be installed with the screw (2).



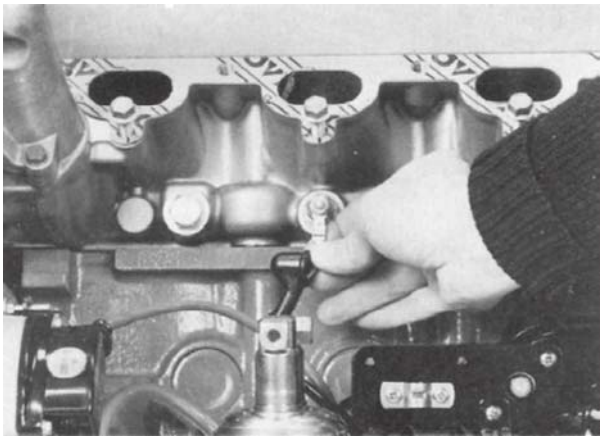
202. 251DOHC, AQ171. Install the spark plug leads on the spark plugs and push them into the lead holders.



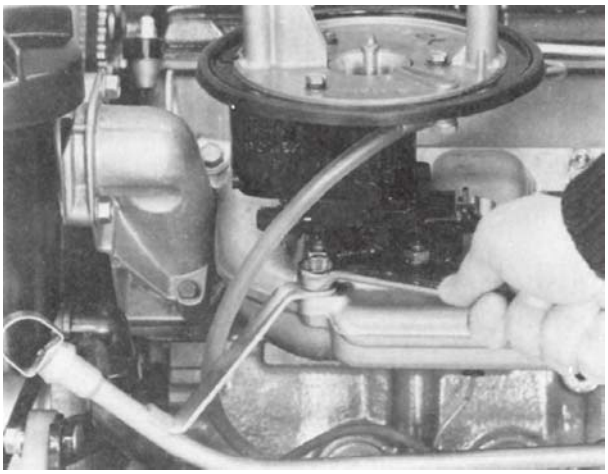
203. 251DOHC, AQ171. Install the protective cover for the spark plugs.



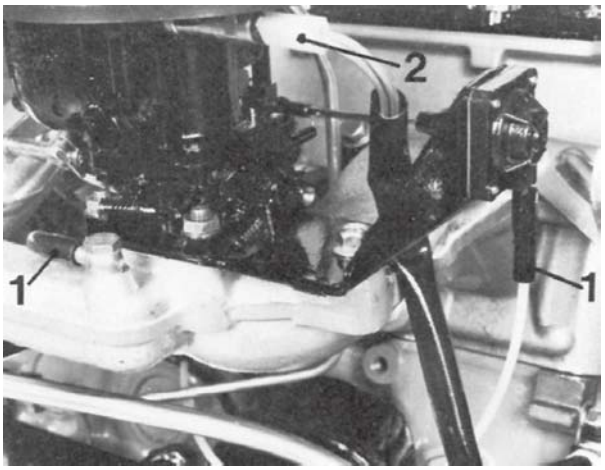
204. Put on a new gasket for the intake manifold on the cylinder head. Tighten the lower bolts slightly.



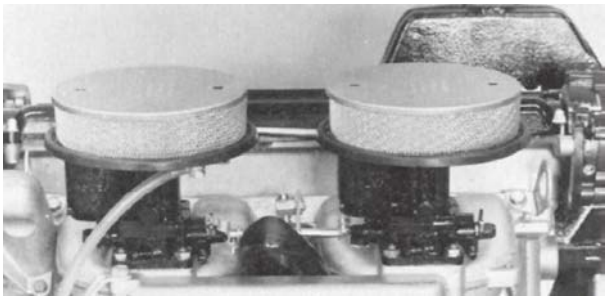
205. Make sure that the temp sender wire is not damaged and push on the protective cap.



206. Install the intake manifold together with the carburetor. Tighten the oil dipstick tube to the intake manifold. Tool width: 1/2" or 13 mm. Then install the hose between the fuel pump and the carburetor.

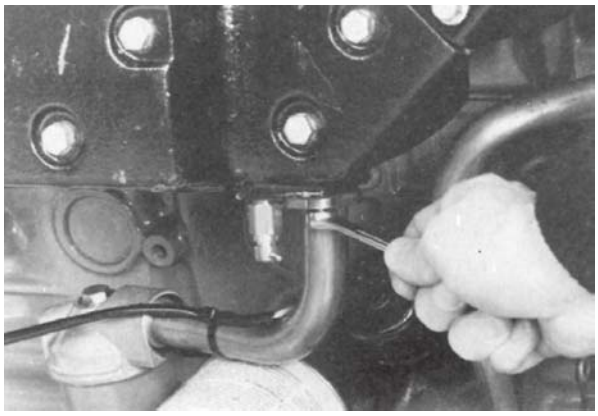


207. 251DOHC, AQ171. Install the vacuum hoses (1) from the intake manifold and the cold starting device and the connection (2) on the magnetic valve on the carburetor.

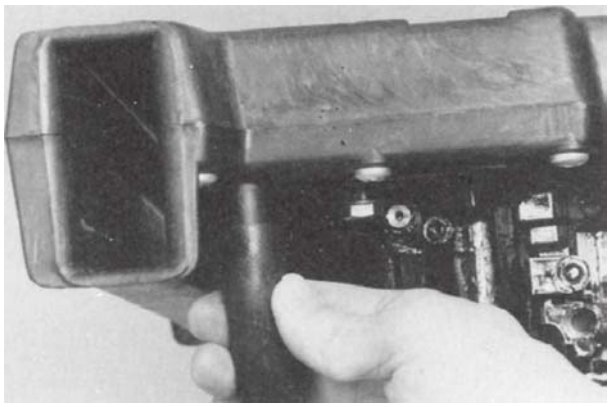


208. Install the rubber seals, the flame arrestors and the covers on the carburetors.

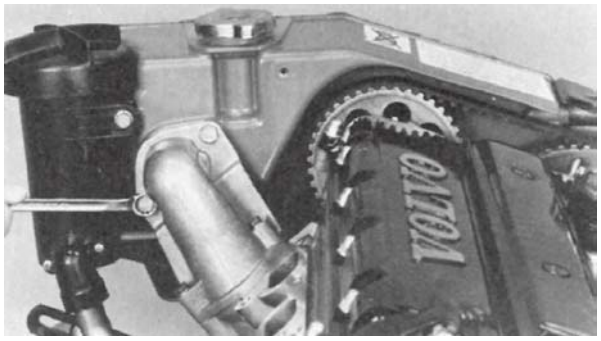
209. Install the frame arrester cover. Tool width: 10 mm.



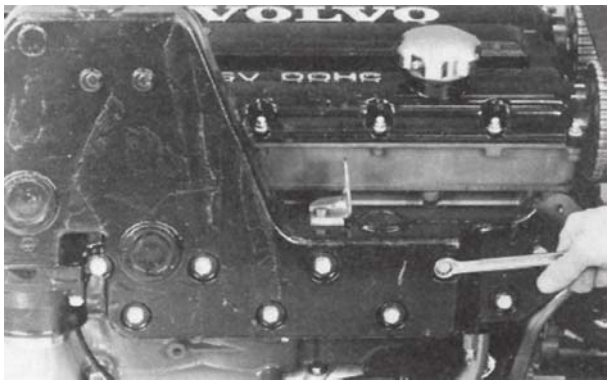
212. Install the pipe between the oil cooler and the exhaust manifold. Tool width: 10 mm. Check the sealings. Replace if necessary.



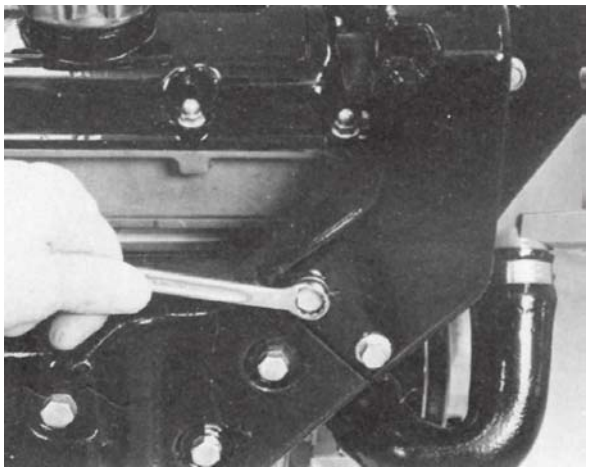
210. Connect the hose from the oil trap to the underside of the flame arrester.



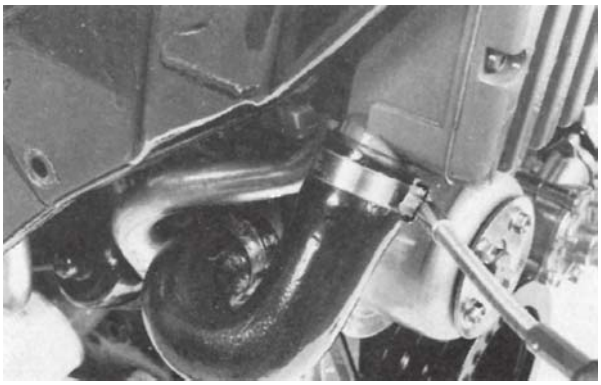
213. Put new sealings on the cooling water pipes and a new O-ring on the heat exchanger and install the heat exchanger to the pipes. Assemble the heat exchanger to the thermostat housing. Tool width: 12 mm.



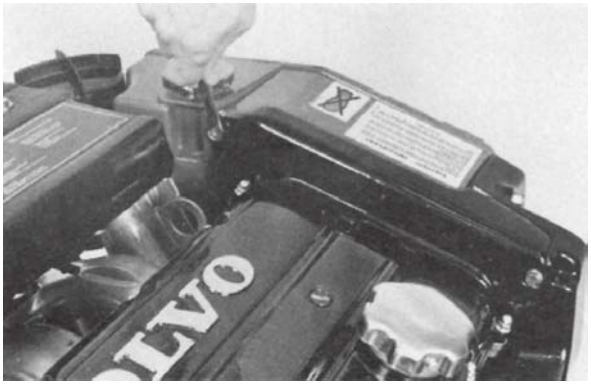
211. Install the exhaust manifold with a new gasket. Tool width: 1/2" or 13 mm.
NOTE! The gasket will only fit one way. The 2 short bolts to be installed up front.



214. Install the heat exchanger on the exhaust manifold. Tool width: 12 mm.



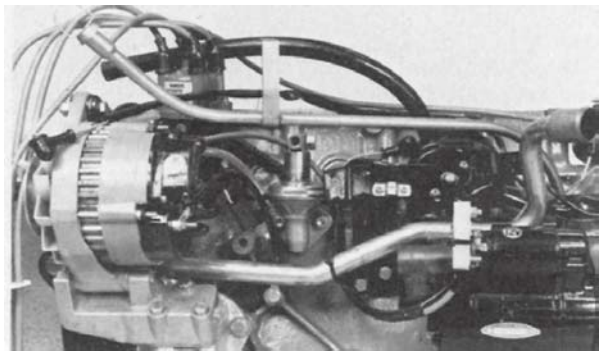
215. Install the cooling water hose on the heat exchanger. Tighten the hose clamp properly.



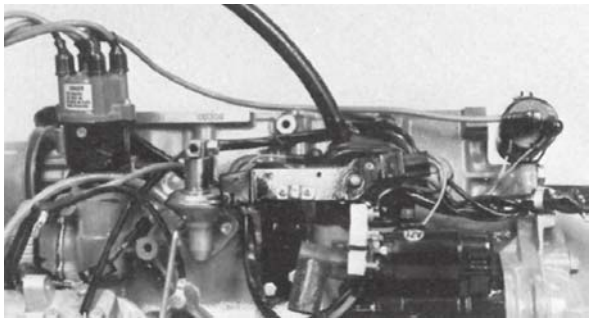
216. 251DOHC, AQ171. Install the protective cover over the toothed belt/camshaft gear wheels. Tool width: 10 mm.

5 The Cylinder Block

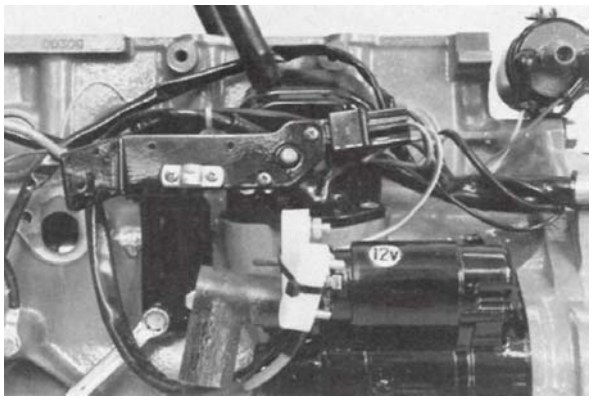
5A Removing the external components



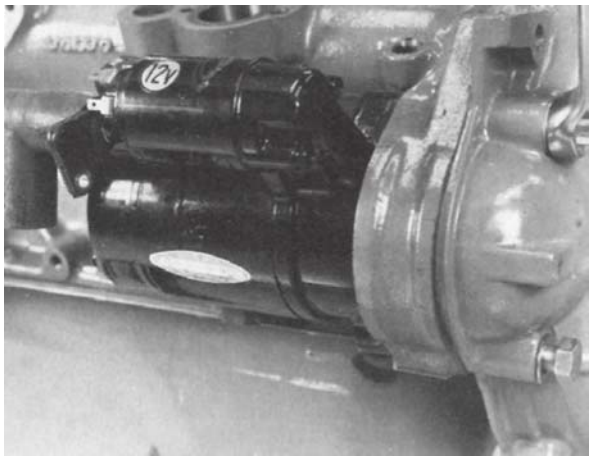
217. Remove the oil dipstick, oil dipstick tube, alternator and the cooling water pipe. Tool width for alternator wires: 10 and 18 mm.



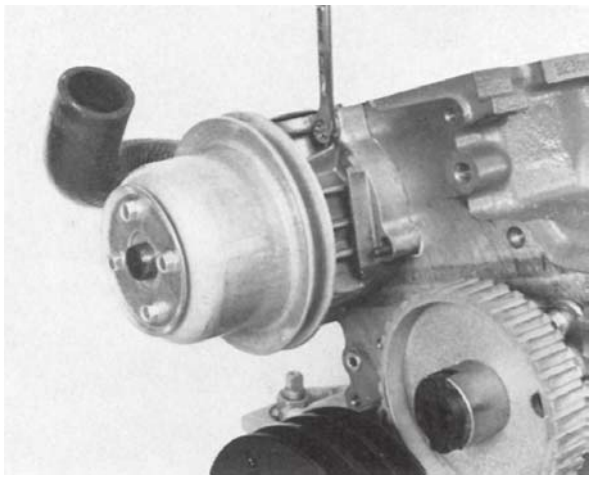
218. Remove the distributor. Tool width: 13 mm and the fuel pump, Allen-head key 6 mm.



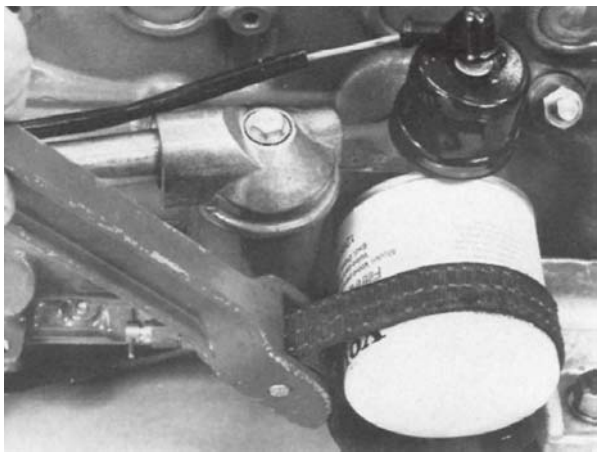
219. Remove the control bracket, ignition coil and the oil trap. Tool width: 13 mm.



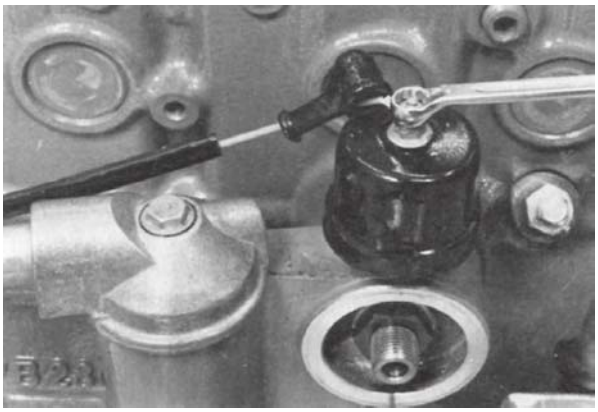
220. Remove the starter motor. Tool width: 19 mm.



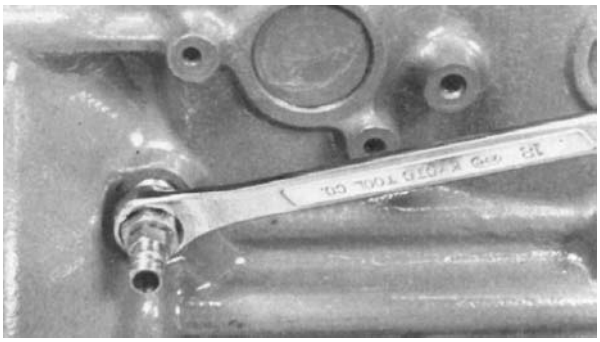
221. Remove the coolant circulation pump. Tool width: 10 mm. If the pump has been damaged, the pump must be replaced as a unit, except for the pulley which can be re-used.



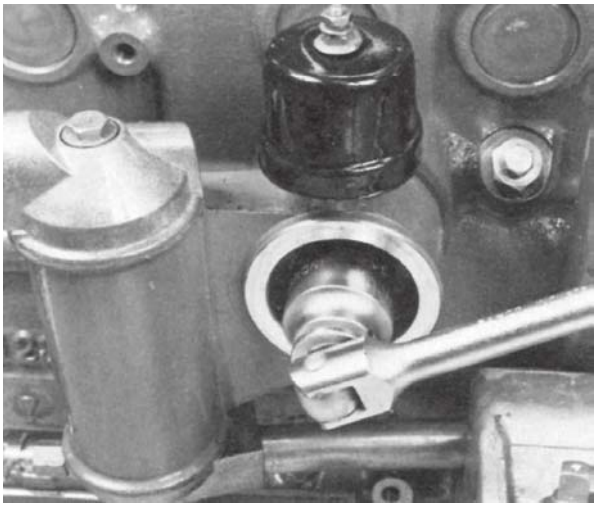
222. Remove the oil filter. Watch out for oil spillage!



223. Remove the wire from the oil pressure sender.

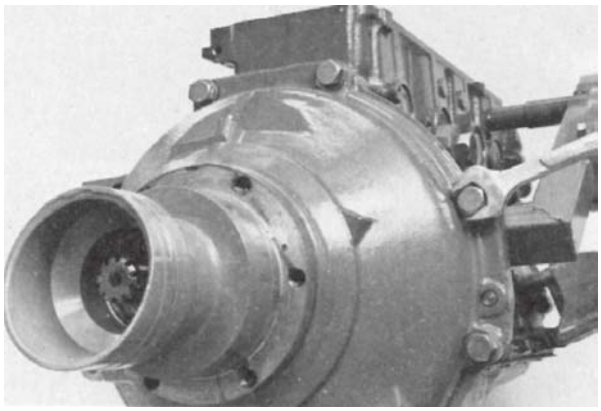


225. Remove the drain cock. Tool width: 18 mm. Clean and flush the cooling water jackets properly.

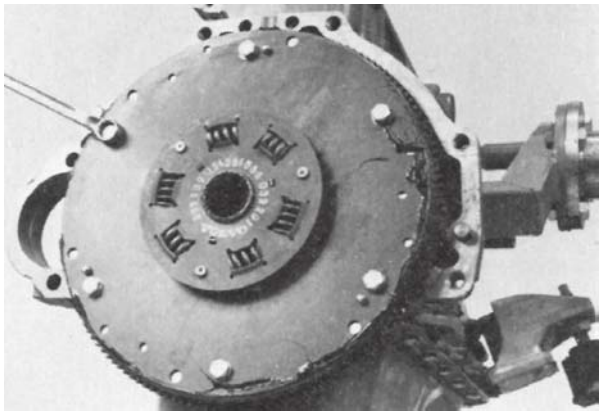


224. Remove the big nut on the oil cooler. Tool width: 29 mm. Then separate the cooling water tubes from the oil cooler and remove from the engine.

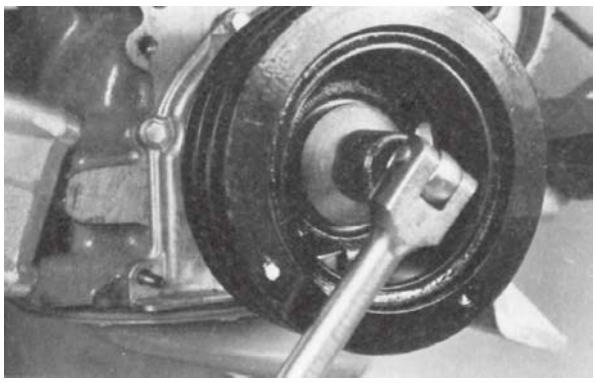
5B Overhauling the Crank Assembly



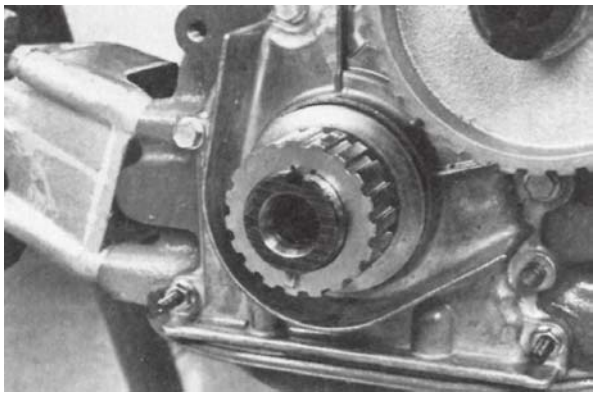
226. Remove the flywheel housing as well as the protective plate under the housing and the engine block. Tool width: 19 mm (3/4") and 13 mm.



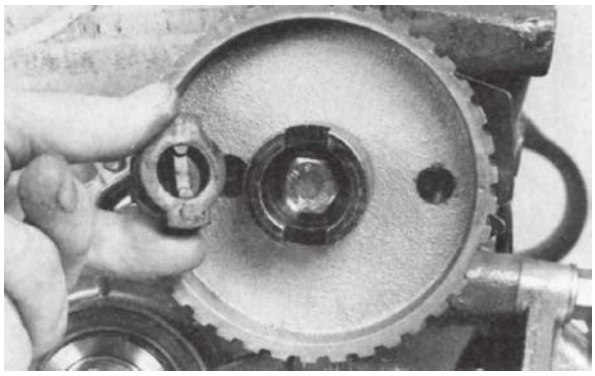
227. Remove the flywheel damper nuts, 6 pcs. Tool width: 13 mm. Carefully remove the damper from the 3 guide pins. Make sure that the splines are not worn, that the springs are not damaged. Check also that the spring package, including rivets etc., and the damper as a whole are free from cracks.



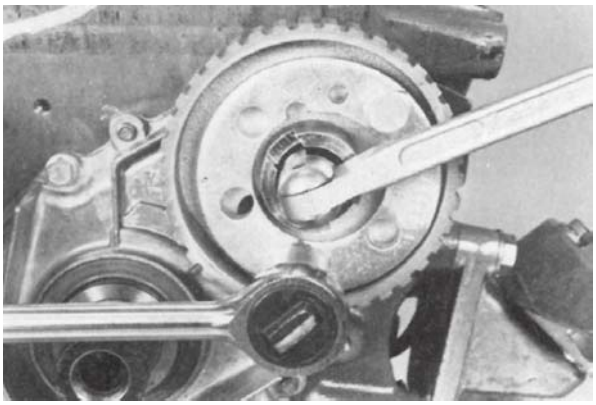
228. Remove the center bolt of the pulley and remove the pulley. Tool width: 24 mm.



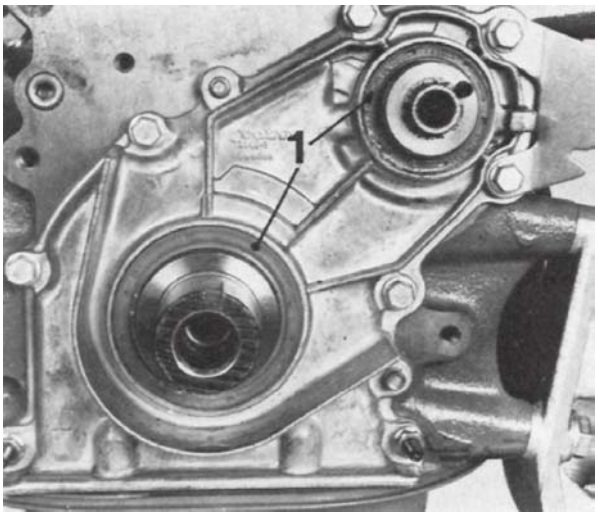
229. Remove the belt wheel and the inner guide plate from the crankshaft. Make sure not to damage the teeth of the belt wheel.



230. Remove the cross piece carrier from the intermediate wheel. Make sure that the cross piece carrier is not damaged.

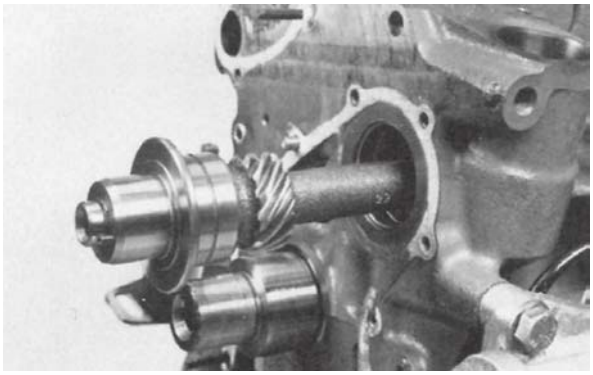


231. Remove the bolt holding the carrier. Use counterhold part no 9995034-7. Tool width: 17 mm. Pull off the carrier from the belt wheel.

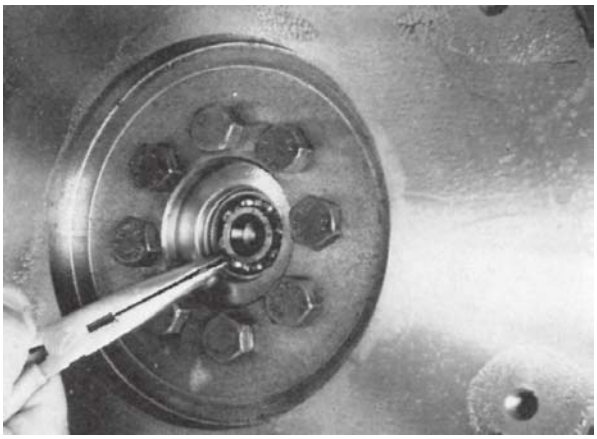


232. Remove the screws in the seal holder. Tool width: 10 mm. The plate is also fixed by two of the bolts holding the oil pan, spanner width: 12 mm. Remove the seal holder and then remove the seal (1). Use special tool part no 9995025-5 for the small seal and tool part no 9995283-0 for the large seal.

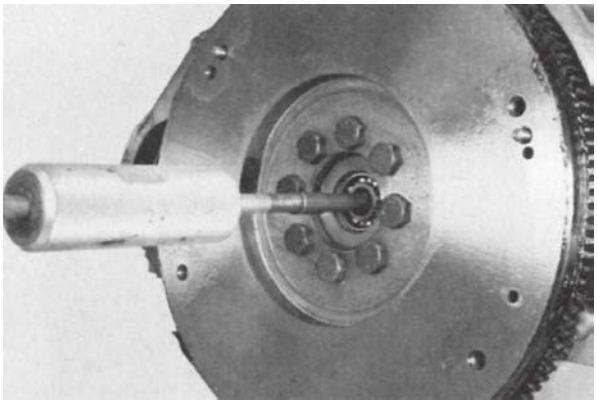
233. Lift up the oil pump gear wheel.



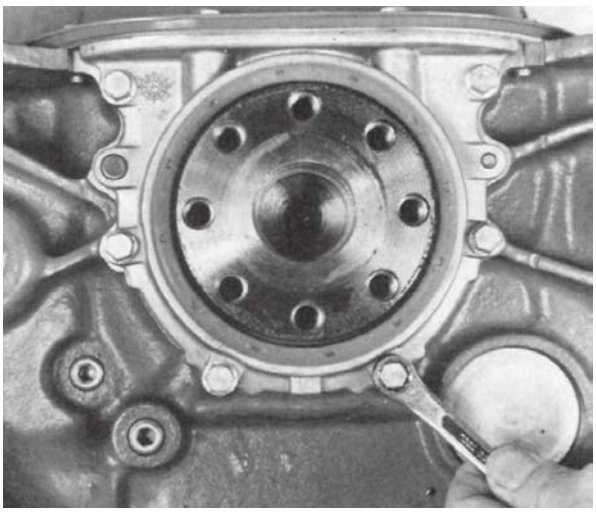
234. Pull out the intermediate shaft.
NOTE! Make sure that the teeth of the intermediate shaft gear do not damage the bearings in the engine block.



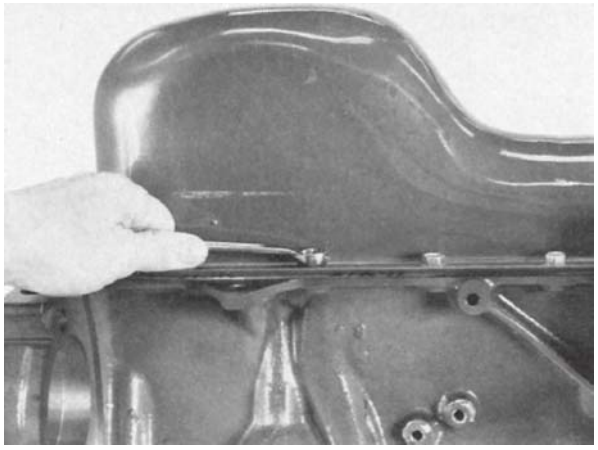
235. Remove the pilot bearing locking ring for the input shaft.



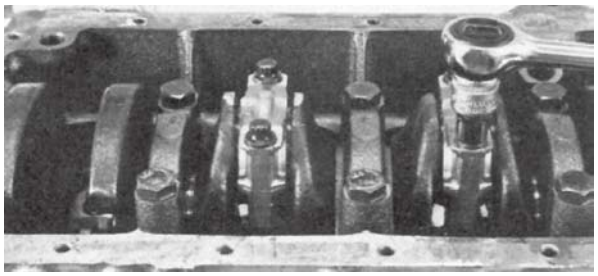
236. Use special tool part no 9994090-0 to remove the input shaft bearing. Then remove the flywheel. Tool width: 17 mm.



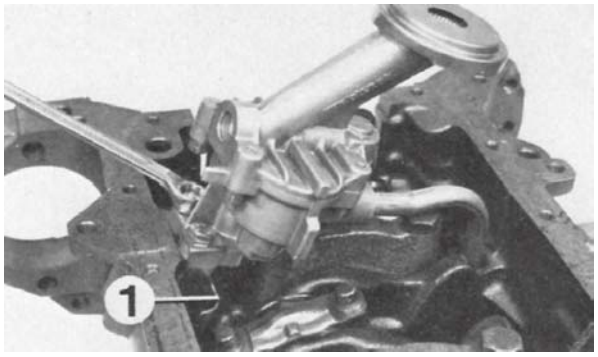
237. Turn the engine upside down. Remove the seal holder. Tool width: 10 mm.
NOTE! Also the 2 bolts holding the oil pan must be removed.



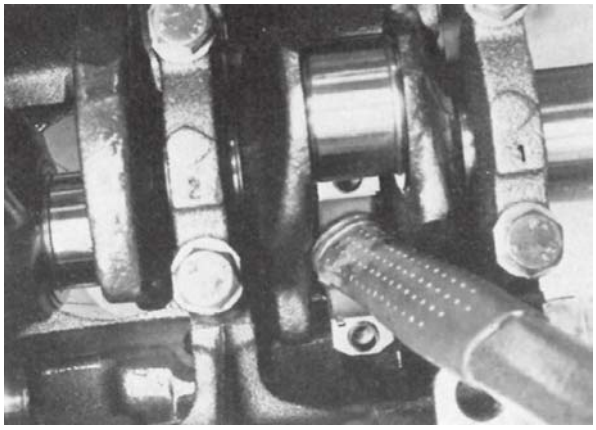
238. Remove the oil pan together with the gasket from the engine. Tool width: 12 mm.



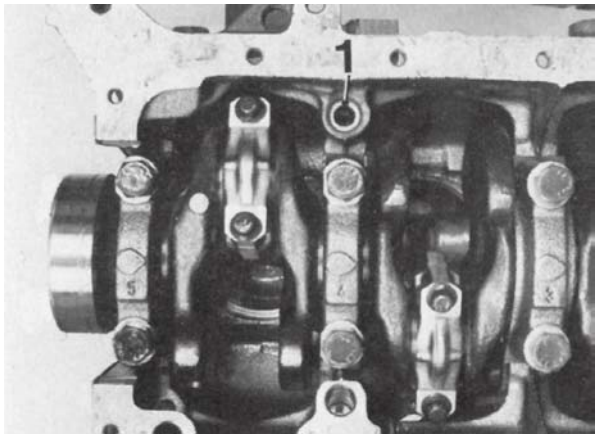
241. Remove the rod bearing caps. Tool width: 10 mm.
NOTE! The connecting rods and the connecting rod caps are numbered and must not be mixed!



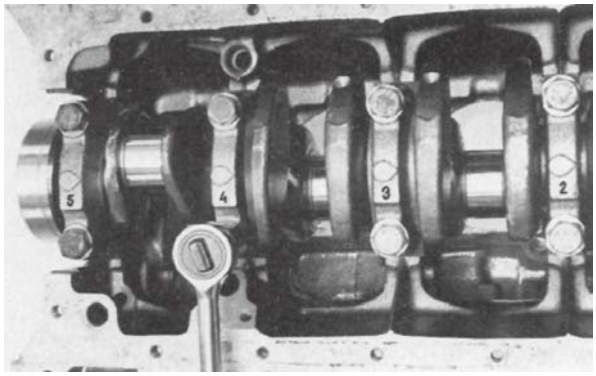
239. Remove the lubricating oil pump.
Tool width: 1/2".
NOTE! Take care of the bracket (1).



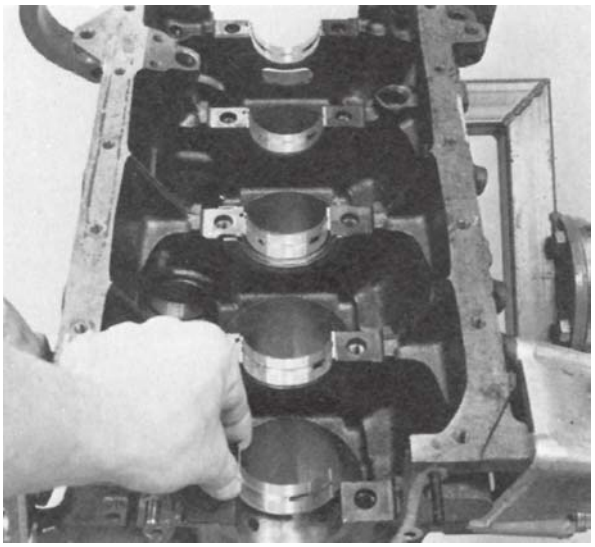
242. Push out the pistons from the cylinders, using a wooden or plastic handle. Let the pistons drop on some sort of soft material to prevent the pistons from being damaged.



240. Remove the seal ring (1). Do not leave it in the engine block.

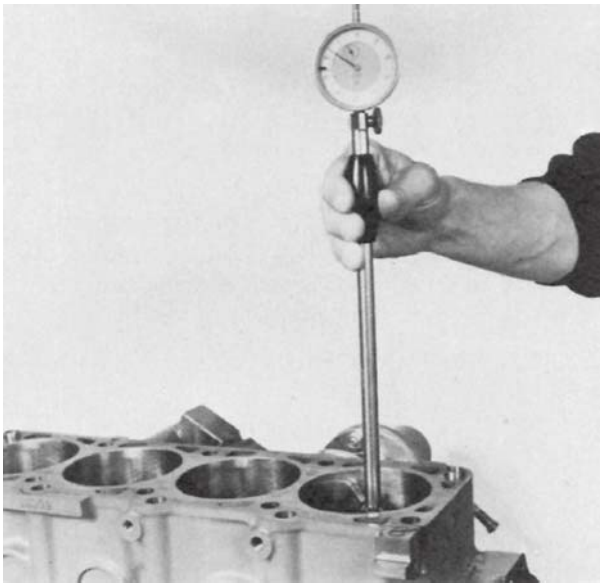


243. The main bearing caps are marked 1 to 5 counted from the timing gear end of the engine. Remove the bearing caps. Tool width: 19 mm.



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

The cylinder bores

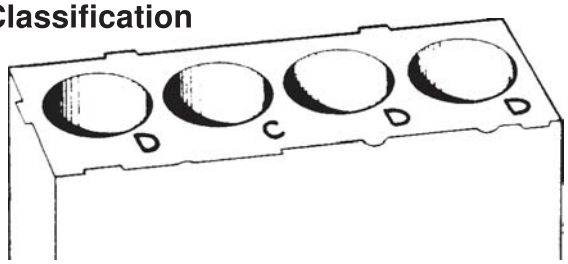


245. Measure the cylinders with a 'dial bore gauge'. Measure for greatest wear transversally, just below the T.D.C. Measure for smallest wear longitudinally at the B.D.C.

Cylinder diameter standard:
C-marked: 96.00–96.01 mm (3.77953–3.77992")
D-marked: 96.01–96.02 mm (3.77992–3.78031")
E-marked: 96.02–96.03 mm (3.78031–3.78071")
G-marked: 96.04–96.05 mm (3.78110–3.78150")

Oversize:
No 1: 96.3 mm (3.79134")
No 2: 96.6 mm (3.80315")

Classification

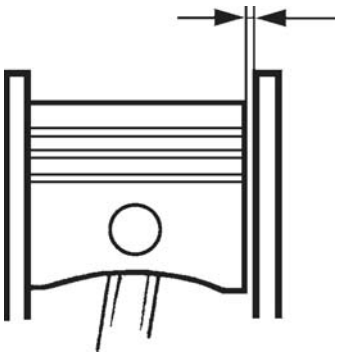


246. At each cylinder there is a letter punched into the block, giving the class of the bore and that of the piston. Oversizes are categorized as 'ÖD 1' and 'ÖD 2'. When reboring a cylinder, the new class must be punched in.

Pistons

247. Measure the pistons with a micrometer 90° to the gudgeon pin hole and 7 mm (0.2756") from the lower edge.

Piston diameter, standard:
(C-marked) = 95.940–95.950 mm (3.77717–3.77756")
(D-marked) = 95.950–95.960 mm (3.77756–3.77795")
(E-marked) = 95.960–95.970 mm (3.77795–3.77835")
(G-marked) = 95.980–95.990 mm (3.77874–3.77913")
('ÖD-1') = 96.237–96.252 mm (3.78886–3.78945")
('ÖD 2') = 96.537–96.552 mm (3.80067–3.80126")



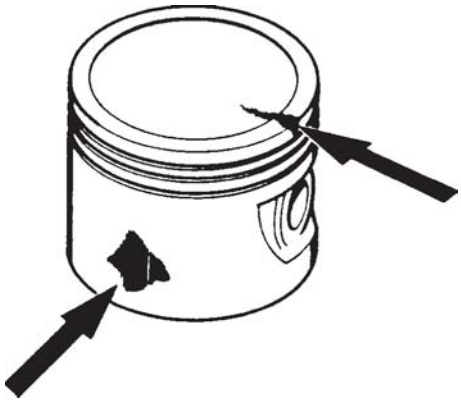
248. Calculate the piston clearance:

Example:

Measured cylinder bore ..... min. 96.025 (3.78051–3.7807")		max 96.030 mm
Measured piston diam. ..... (3.78012–2.77992")	max. 96.015	min. 96.010 mm
	0.010	0.020

The piston clearance should be max 0.080 mm (.0031") before overhaul is required, overhauled engines should have a clearance between 0.010 and 0.030 mm (.0004–.0012")

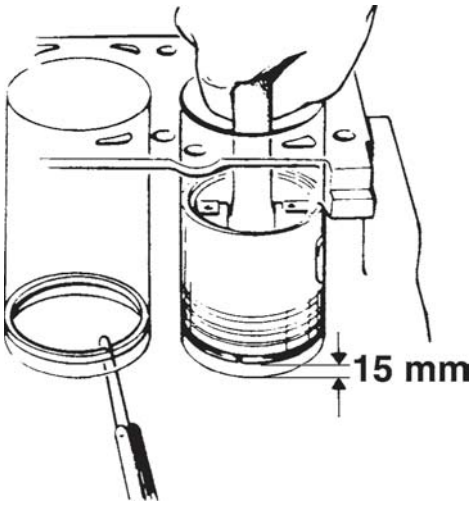
Piston rings



249. Remove the piston rings with piston ring pliers. Remove all carbon deposits. Use a groove cleaning tool to clean the piston ring grooves. A broken off piston ring, ground to shape, can also be used. Check carefully for damage, wear and cracks.

250. Check the axial wear of the piston rings. Use new piston rings.

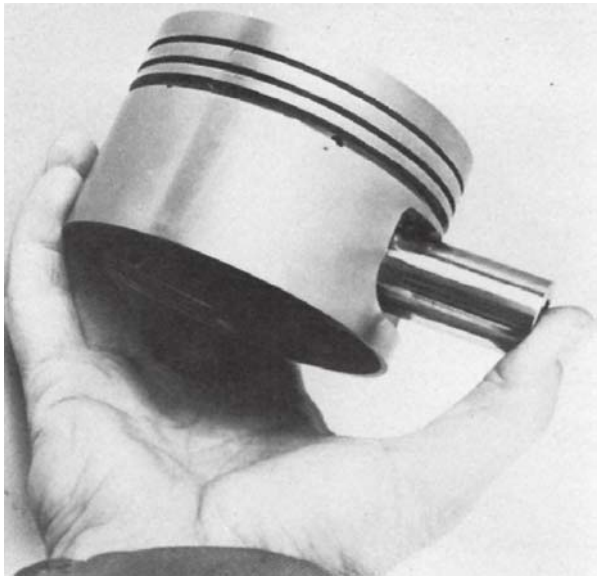
Upper compression ring ..... 0.060–0.092 mm (0.00236–0.00362")
Lower compression ring ..... 0.040–0.072 mm (0.00157–0.00283")
Oil scraper ring ..... 0.030–0.065 mm (0.00118–0.00256")



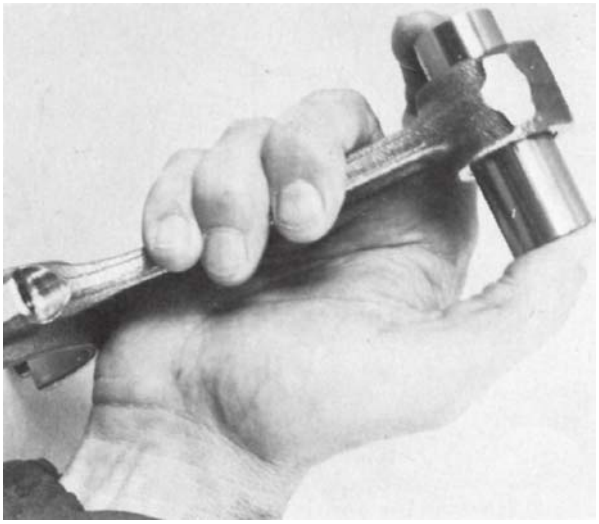
251. When measuring the piston ring gap, the piston ring should be inserted into the cylinder. Use a piston, upside down to correctly position the piston ring. Measure the gap with the ring 15 mm (0.591") above the lower edge of the cylinder. Use a feeler gauge.

Upper compression ring ..... 0.30–0.55 mm (0.0118–0.0217")
Lower compression ring ..... 0.30–0.55 mm (0.0118–0.0217")
Oil scraper ring ..... 0.30–0.60 mm (0.0118–0.0236")

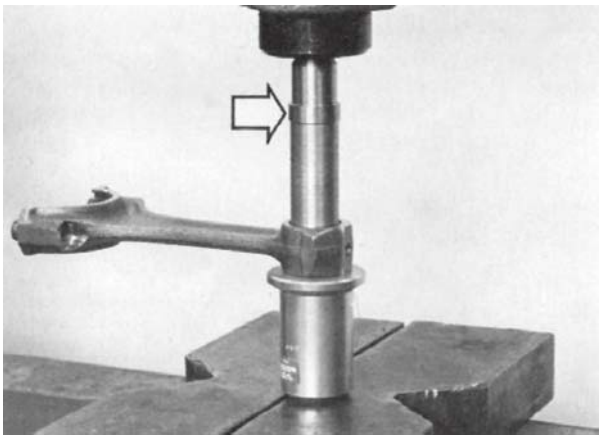
The piston pin



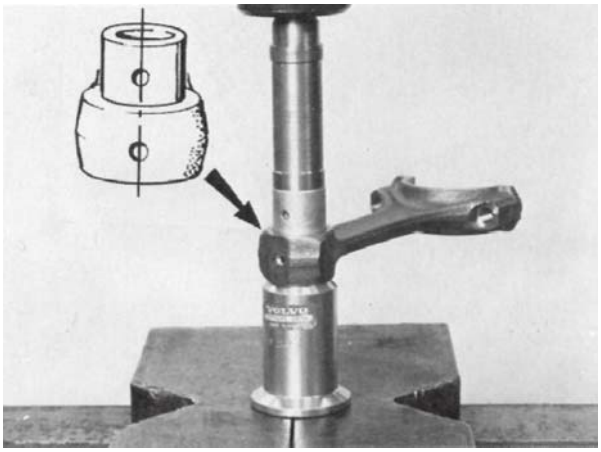
252. Check the clearance for the piston pin in the piston. The fit is correct when the piston pin can be pushed by the thumb though the piston pin hole without any noticeable play.



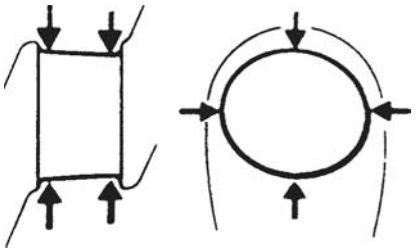
253. It should be possible, by light thumb pressure, to push the gudgeon pin through the connecting rod bushing (close running fit).



254. Use special tool part no 9995309-3 to press out the connecting rod bushing, if necessary.

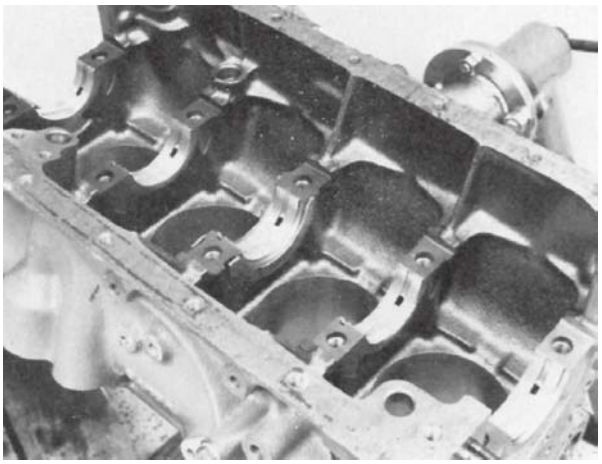


255. Press in the new bushing, using special tool part no 9995309-3.
NOTE! Make sure that the lubricating holes in the connecting rod and in the bushing line up with each other. Check the connecting rod for straightness and twist. If not straight, replace the connecting rod.

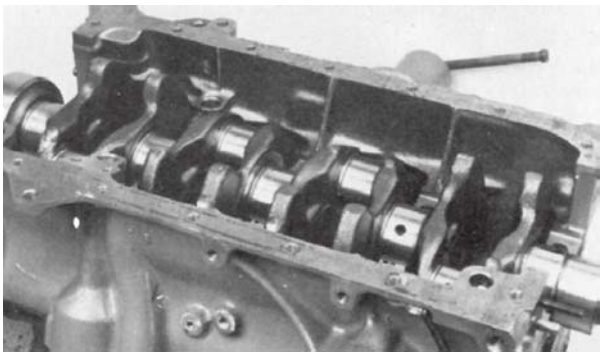


256. Check the crank bearings and the main bearing journals. Measure with a micrometer at several locations around the diameter and length. The 'out-of-round' on main and crank bearing journals must not exceed 0.004 mm (0.000157"). The taper must not exceed 0.004 mm (0.000157") on any of the journals. Should the measured values exceed the above given tolerances, the crankshaft should be ground to the closest undersize. See 'Technical Data'.

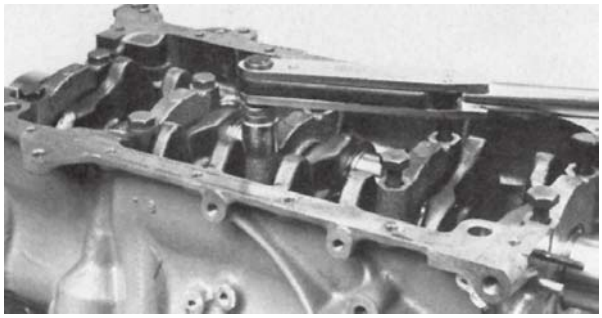
Assembly



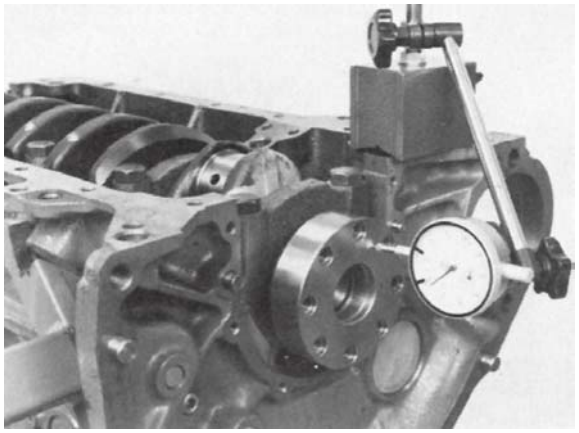
257. Place the main bearing shells in their positions in the block and in the caps. Then place the thrust bearings on each side of number 3 main bearing. The oil grooves should face outwards.



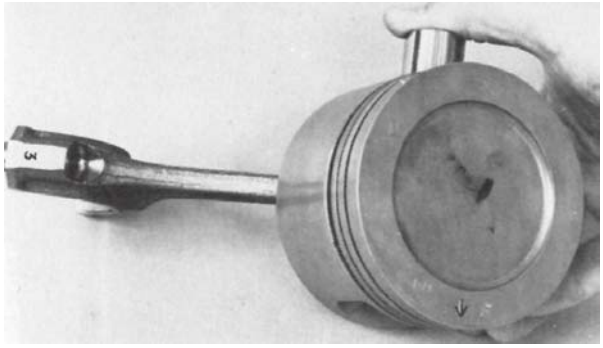
258. Oil the bearing shells and insert the crankshaft.



259. Install the main bearing caps.
NOTE! The main bearing caps are numbered 1 to 5, counted from the timing gear end. Oil the threads of the screws. Tighten with a torque wrench. Tightening torque: 110 Nm (11.0 kpm/79.5 ft.lbs).

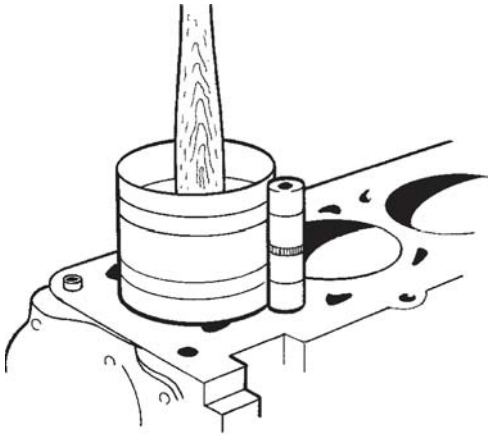


260. Check the axial clearance, which should be 0.080–0.270 mm (0.00315–0.01063").

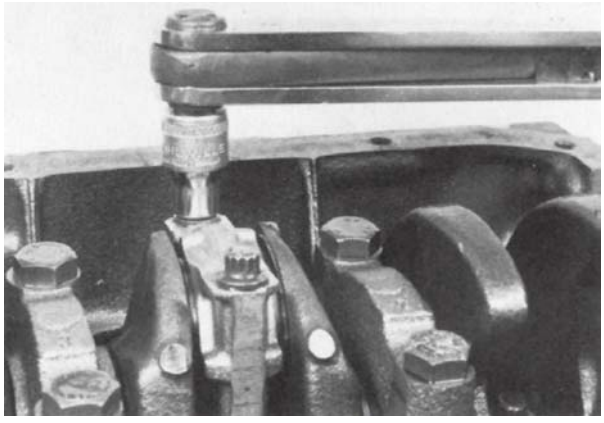


261. Assemble the pistons and connecting rods so that the marking on the piston points forwards when the number marking on the connecting rod is turned towards the starboard side of the engine (the oil filter side). Install the locking rings in the piston pins.

262. Use piston ring pliers to install the piston rings. Install the piston rings in accordance with the picture. The upper ring is chromium plated. The lower compression ring is marked 'Top'. Turn the piston rings on the piston so that the gaps are 120° apart from each other.

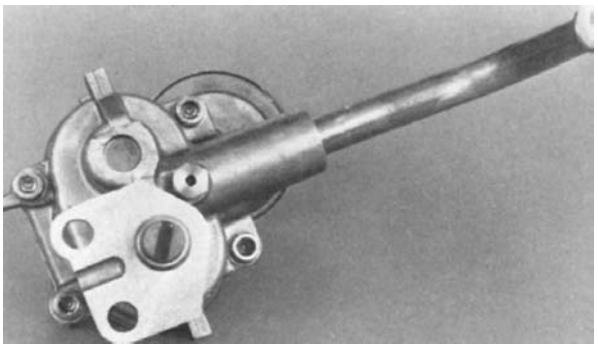


263. Install the bearing shells in the connecting rod and in the caps. Oil the cylinder bore, piston and the rod bearing. Check to make sure that the marking on the piston is facing the timing gear cover when the piston is installed in the cylinder. Use a piston ring compressor to facilitate the installation.
NOTE! Turn the crankshaft so that the crank journal for number 1 cylinder points straight downwards. Push down the piston using a hammer handle.

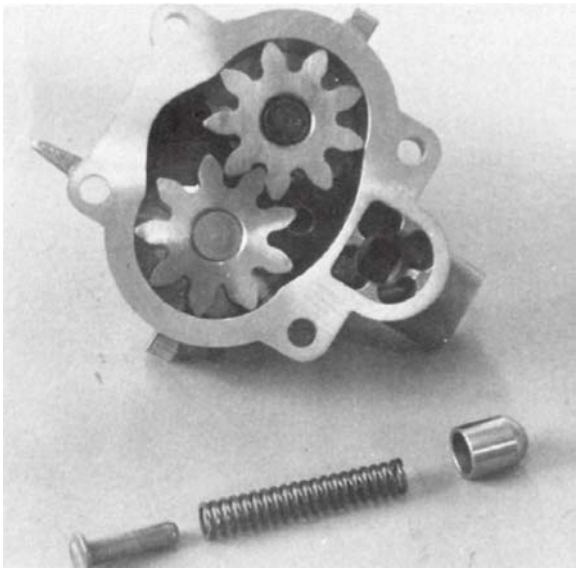


264. Install the crank bearing caps so that the marking matches with the one on the connecting rod. Oil the threads and use a torque wrench to tighten. Tighten in 2 steps. Step 1: 20 Nm (2.0 kpm/15 ft.lbs). Step 2: Angle tighten 90°.
NOTE! Use new bolts should the length of the bolts exceed 55.5 mm (2.185").

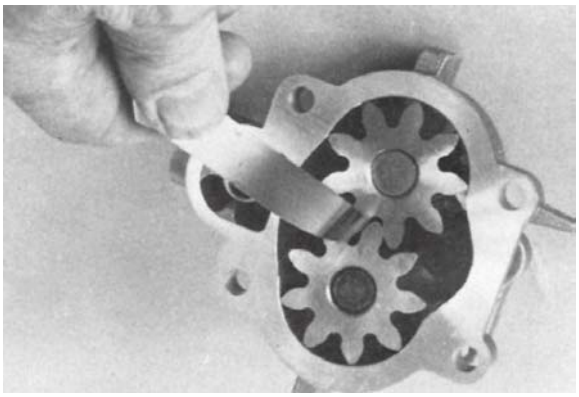
The lubricating oil pump
Overhauling



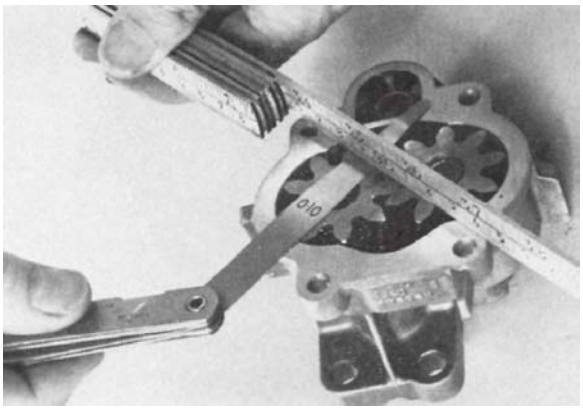
265. Remove the pipe from the lubricating oil pump and also the 4 screws. Allen key: 5 mm.



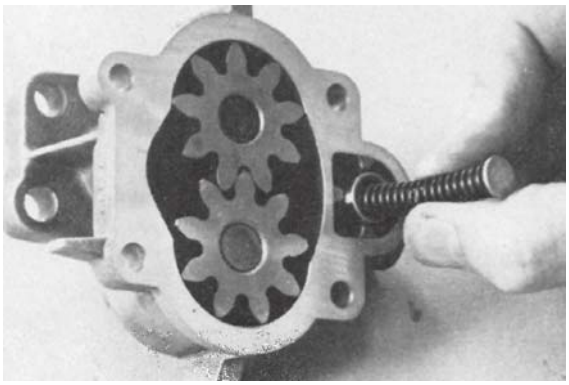
266. Remove the relief spring, guide pin, piston and the gear wheels. Clean all the parts and replace damaged or worn parts.



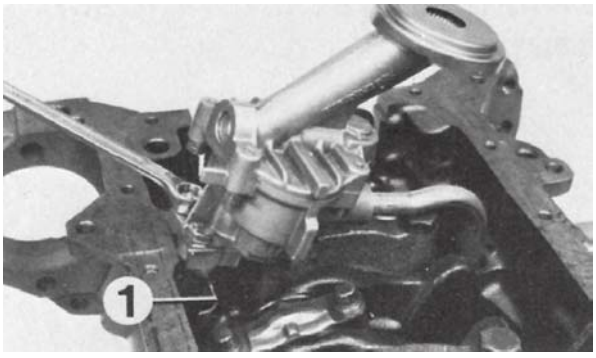
267. Install the gear wheels and check the gear backlash, which should be 0.15–0.35 mm (0.0059–0.0138").



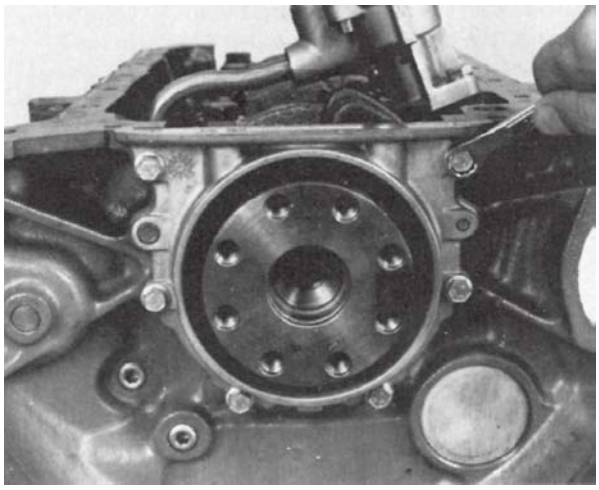
268. Check the axial clearance. It should be 0.02–0.12 mm (0.00079–0.0047").



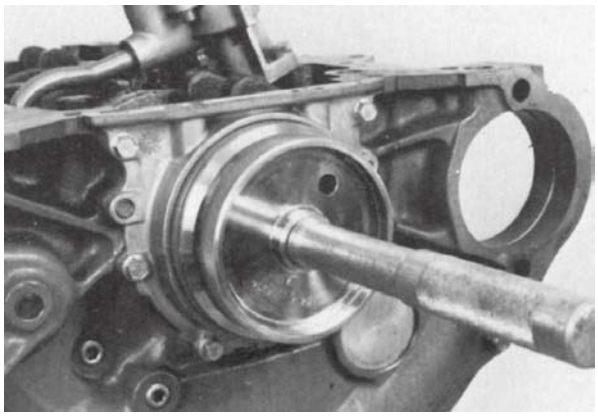
269. Insert the piston, spring, guide pin and assemble the lower part of the pump. Install new seal rings and the pipe.



270. Install new seal rings on the oil pump pipe. Install the pump and the attachment yoke (1) for the drainage of the oil trap. Tool width: 13 mm.



271. Install the seal holder along with a new gasket on the engine. Tool width: 10 mm.
NOTE! Cut off any protruding parts of the gasket.



272. Press in a new seal ring in the rear seal holder as follows:

A. Oil the contact surface of the seal, against the holder, and the seal ring lips.

B. Push the seal onto the drift, part no 9995276.

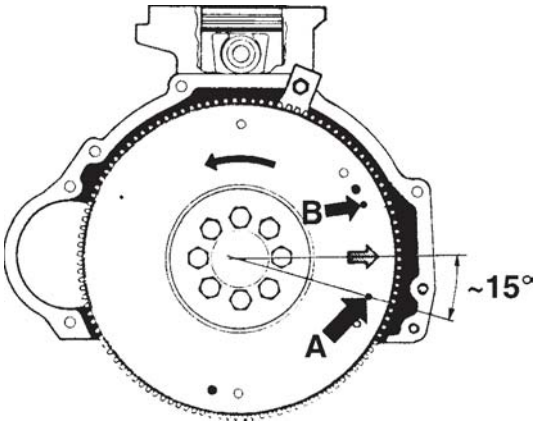
C. If the shaft shows sign of having a wear surface where the seal was previously installed, then press the seal a bit further into the holder.

D. Remove one spacer ring from the drift if the old sealing was flush with the seal holder.

E. Remove two spacer rings from the drift if the old seal was located 3 mm inside the seal holder.

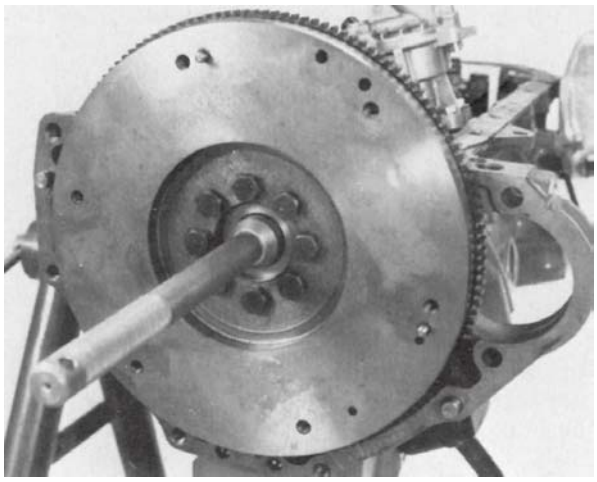
F. Let the spacer rings remain on the drift if the crankshaft is free from wear damage.

G. Knock in the seal ring till the drift bottoms against the crankshaft. Use standard drift part no 9991801.

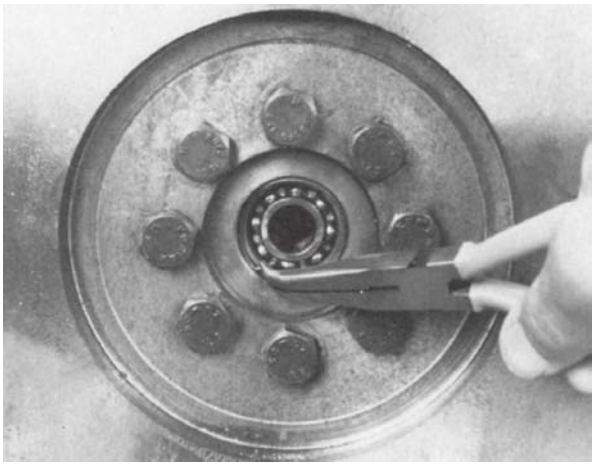


273. 230, 250, AQ131, AQ151: Coat the inside of the flywheel with an anti-rust agent, 'Tectyl' or its equivalent and install the flywheel. Tightening torque 70 Nm (7.0 kpm/51 ft.lbs).
NOTE! Always use new bolts.

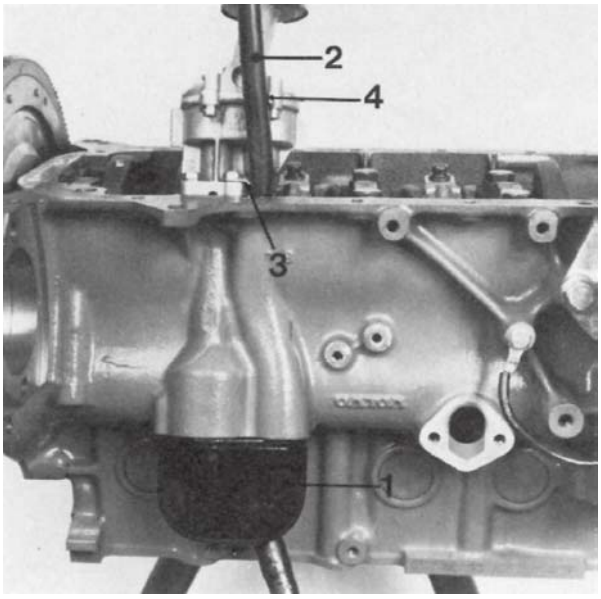
251DOHC, AQ171: Turn the crankshaft to the T.D.C. position for number 1 cylinder. Coat the inside of the flywheel with an anti-rust agent, 'Tectyl' or its equivalent. Then install the flywheel so that the hole 'A' on the inside of the flywheel will end up 15° below the horizontal line. Tightening torque: 70 Nm (7.0 kpm/51 ft.lbs).
NOTE! Always use new bolts.



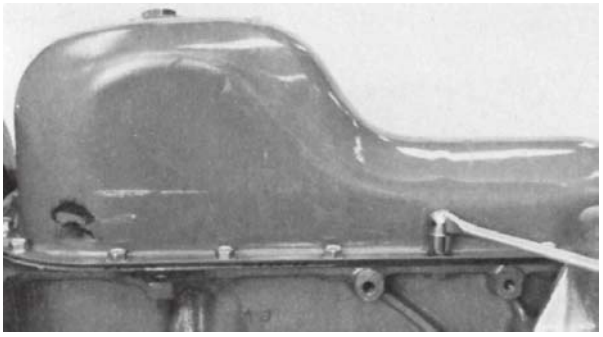
274. Install the support bearing for the input shaft, using special tool part no 9991426-9.



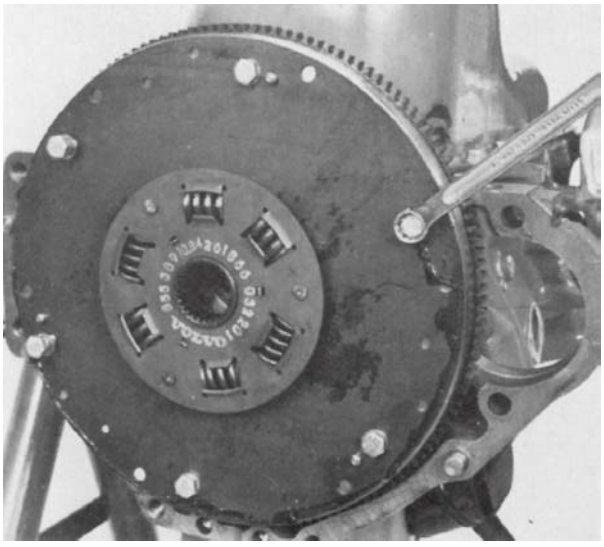
275. Secure the bearing with the locking ring.



276. Check that the O-ring on the underside of the oil trap is not damaged. Replace if necessary. Install the oil trap (1). Make sure that the hose (2) is held by the bracket (3) and the shoulder (4) on the pump. **NOTE!** Do not cut the hose!

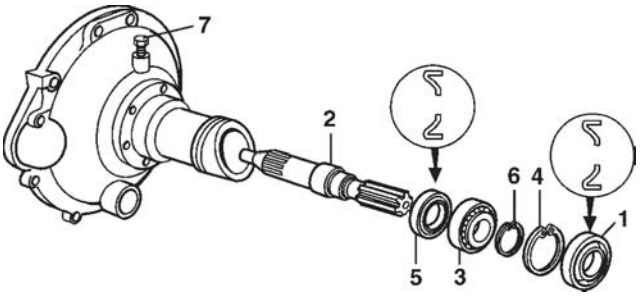


277. Install the oil pan with a new oil pan gasket. Tighten all bolts except the 4 closest to the front sealing flange. Tightening torque: 11 Nm (1.1 kpm/8 ft.lbs). Tool width: 12 mm.

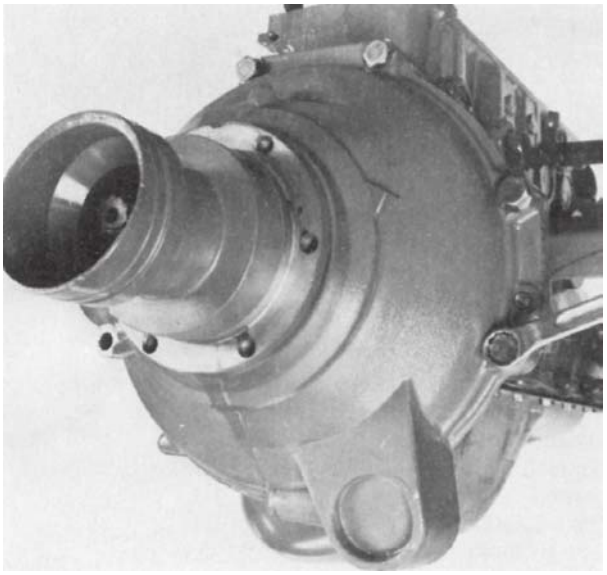


278. Install the flywheel damper. Do not forget the washers under the bolt heads. Tool width: 1/2".

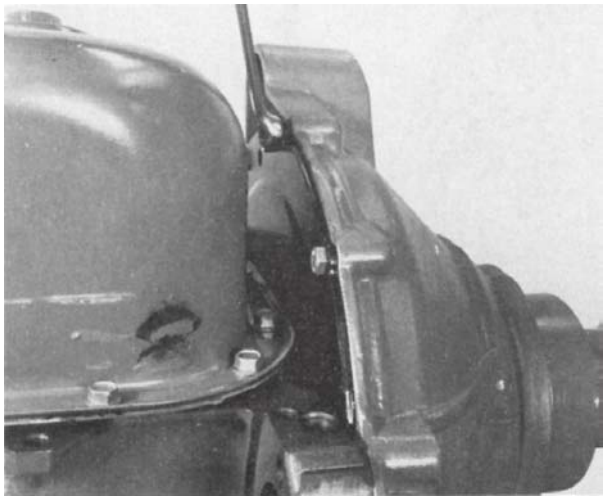
Overhauling the flywheel housing



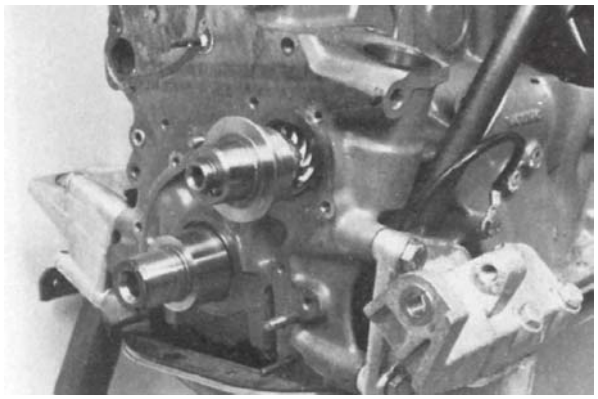
279. Inspect the flywheel housing and replace all faulty parts. Use the following special tools to remove and install bearings: Part no's 884359-4, 884596-7 and 884599-4. Make sure you know which way the different seal rings are facing prior to removing them. Remove the seal ring (1) from the flywheel housing. Check the primary shaft (2) and the bearing (3). Should any of them show any signs of damage, then remove the lock rings (4) and press out the shaft together with the bearing. Remove the seal ring (5) and the lock ring (6) from the primary shaft as well as the seal ring (5).
NOTE! Turn the seal ring facing the right way and press the bearing (3) onto the primary shaft (2). Press the shaft and the bearing into the flywheel housing. Install the lock rings (4) and the seal ring (1).
NOTE! To be installed with the "opening" facing outwards.
NOTE! Grease the seal rings abundantly prior to assembly. Press grease into the lubricating channel (7).



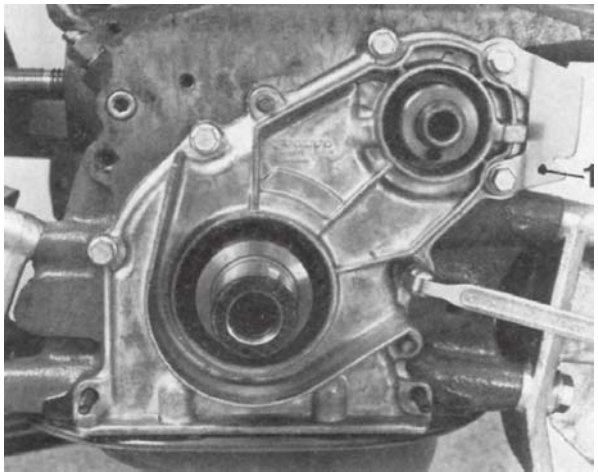
280. Carefully treat the primary shaft with an anti-rust agent prior to assembly. Install the flywheel housing. Tool width: 3/4".



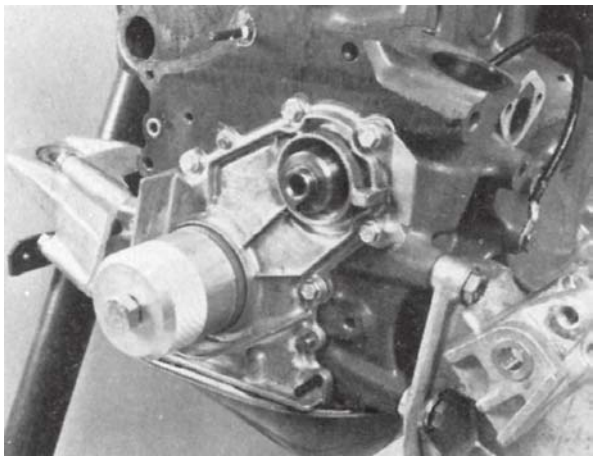
281. Install the protective plate on the underside of the flywheel housing. Tool width: 1/2". Turn the engine the right side up.



282. Oil the bearings of the intermediate shaft. Then carefully insert the intermediate shaft in the engine block avoiding any damage to the bearings.



283. Put a new gasket on the engine block. Cut off any protruding parts of the gasket. Install the front seal holder without seal rings. Install the timing mark plate (1). Install the front screws in the oil pan. Then tighten all the screws. Tightening torque 10 Nm (1.0 kpm/7.5 ft.lbs).

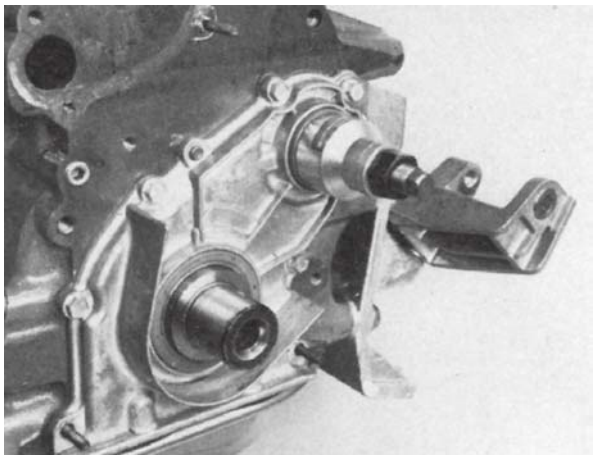


284. Grease the crankshaft seal abundantly and use special tool part no 9995283-0 to install it.

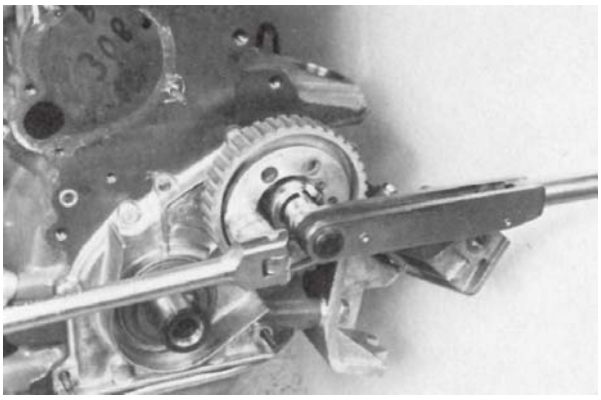
NOTE!

A. If the old seal ring has not left a wear surface on the crankshaft, the seal should be pressed in edge to edge with the flange.

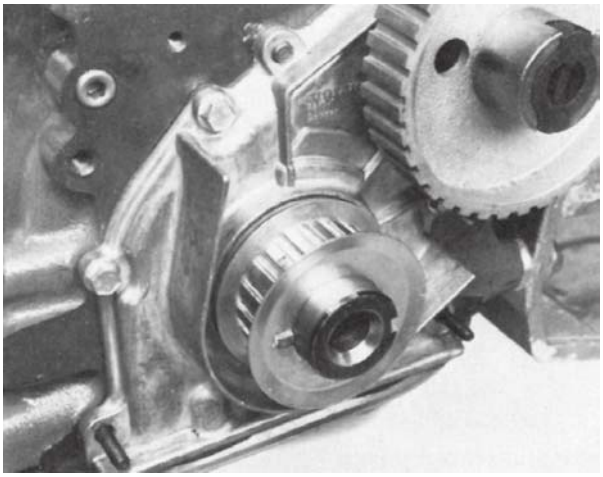
B. Should the old seal ring have left a wear mark on the crankshaft, the new seal ring is pressed in until the mark on the tool is edge to edge with the flange. Be careful not to damage the seal during installation.



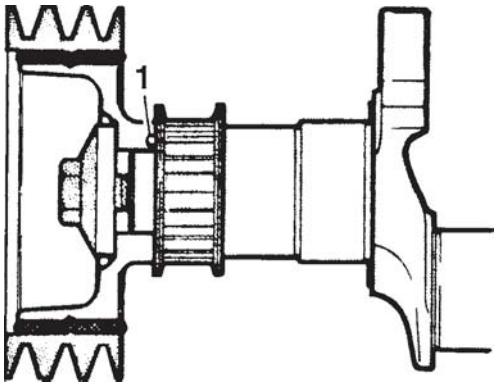
285. Grease the intermediate seal carefully and install it using special tool part no 9995025-5. Change the contact surface against the shaft to give the lip of the seal a new wear surface on the shaft. Be careful not to damage the sealing during installation.



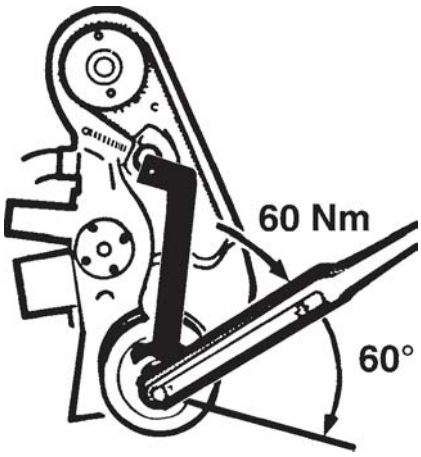
286. Coat the hub of the belt wheel with a mineral-based grease and install the belt wheel on the intermediate shaft. Install the carrier and the carrier screw. Tighten the screw with a torque of 50 Nm (5.0 kpm/36 ft.lbs). Use counterhold part no 9995034-7. Then install the cross piece carrier.



287. Install the inner guide plate on the crankshaft (turn the bevel towards the block). Coat the hub of the crankshaft belt wheel with mineral-based grease. Install the belt wheel on the crankshaft. Then install the outer guide plate (with the bevel facing outwards).

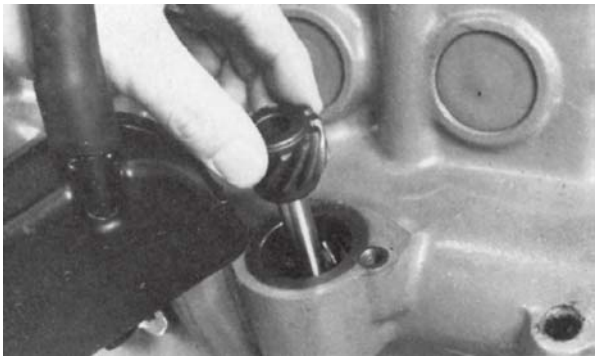


288. Then install the pulley.
NOTE! Make sure that the recess of the pulley coincides with the guide pin (1) of the belt wheel.



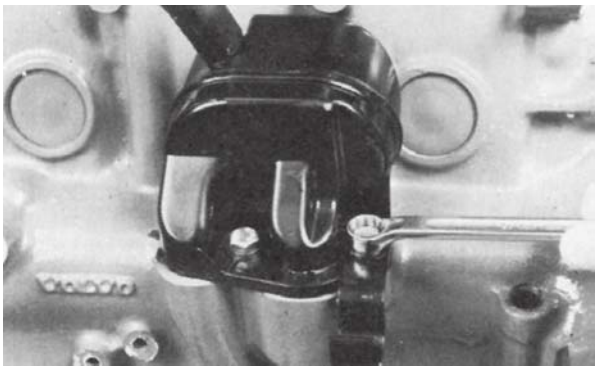
289. Install the cylinder head, see page 58, paragraphs 129–133 and pages 70–72, paragraphs 183–190 for 230, 250, AQ131, AQ151 and pages 68–70, paragraphs 167–182 as well as page 73, paragraphs 191–195 for 251DOHC, AQ171. Then remove the nut and the washer on the belt tensioner (alternatively the screw on 251DOHC, AQ171) and install counterhold part no 9995284-8. Install the thick washer on the pulley and tighten the screw as follows:

Step 1: 60 Nm (6.0 kpm/43 ft.lbs)
Step 2: Angle tightening 60°.

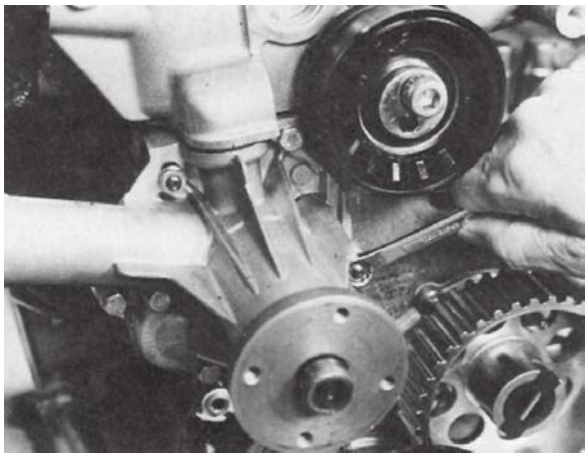


290. Carefully lift up the oil trap so that it can be turned. Then install the oil pump gear and carefully turn back the oil trap. Be careful so that the hose down to the oil pan does not come loose.

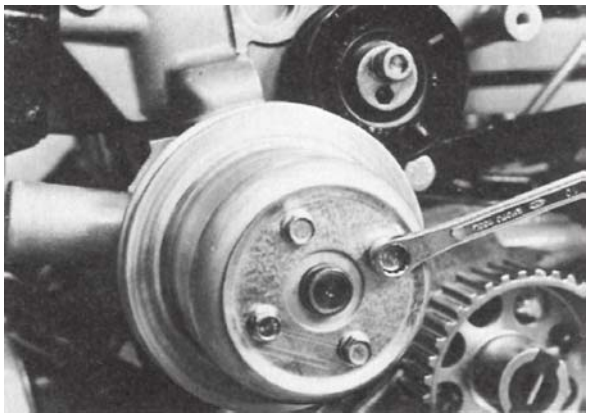
NOTE! Make sure that the oil pump gear reaches its bottom position in order to allow the oil trap to seal against the engine block.



291. Tighten the oil trap and at the same time the clamp of the cooling water pipe.



292. Check to make sure that the contact surfaces of the coolant circulation pump and the engine block are clean. Put a new seal ring on the pump and a new gasket on the engine block. Push the pump upwards against the cylinder head and tighten the screws and the nuts.

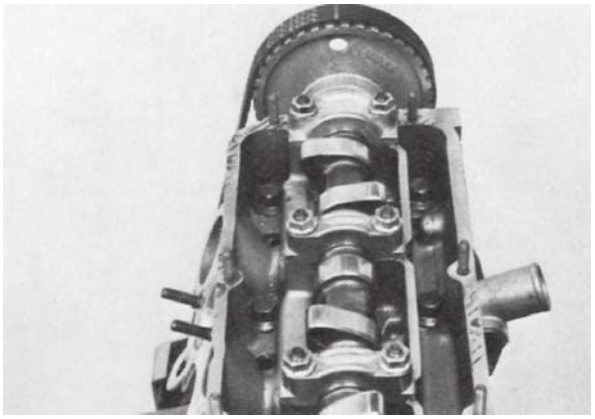


293. Install the pulley on the circulation pump. Then install the toothed belt, sea water pump, alternator and the V-belt.

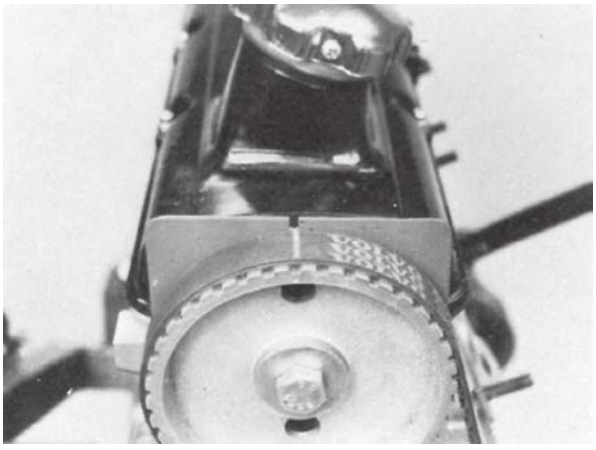
294. Install the cylinder head. See under chapter 4.

5C Installing the external components

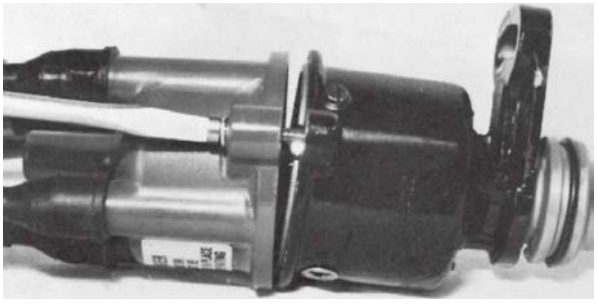
The distributor 230, 250, AQ131–151



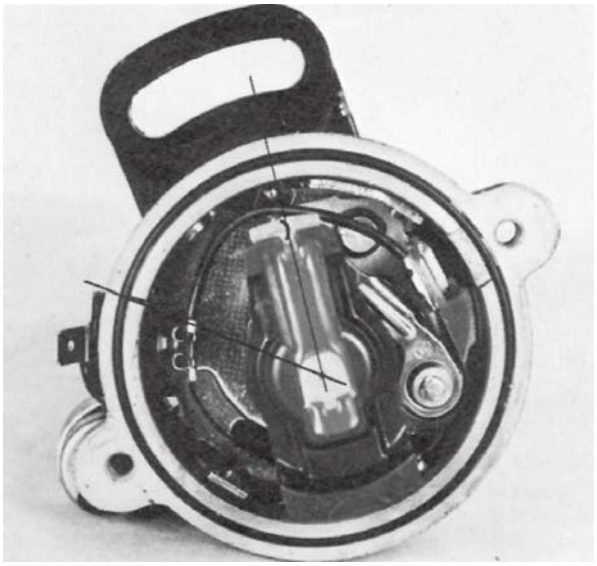
295. Turn the crankshaft to the firing position for number 1 cylinder. Check to make sure that the camshaft cams for number 1 cylinder are pointing away from each other and that the pulley marking is indicating ‘0’.



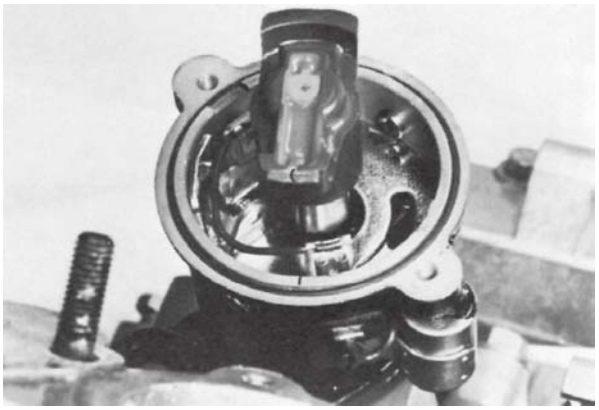
296. Put on a new gasket and install the valve cover and the plate for the belt marking. Make sure that the belt marking coincides with the recess of the plate. Adjust if necessary.



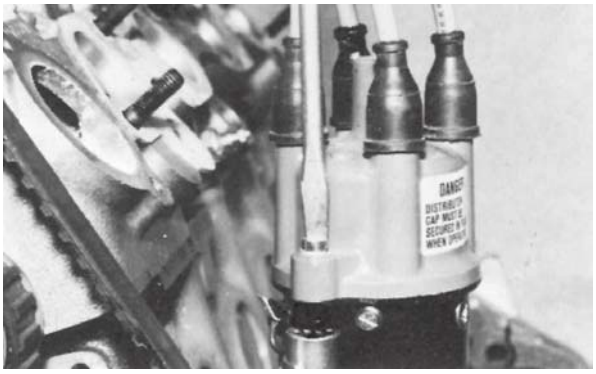
297. Remove the distributor cap.



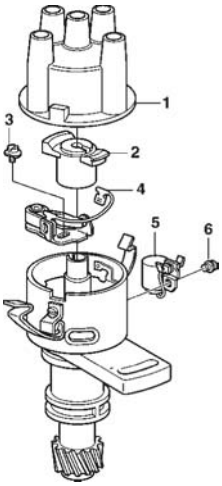
298. Turn the rotor so that the marking on the rotor is pointing approx. 60° away from the marking in the distributor.



299. Push the distributor down into its location in the engine block and make sure that the rotor lines up with the marking in the distributor housing. Tighten the distributor in this position.

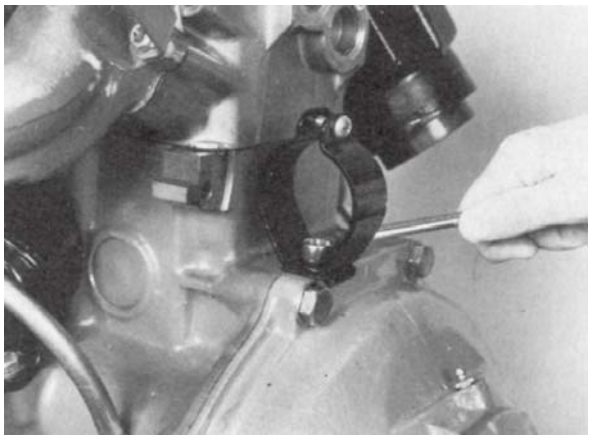


300. Install the distributor cap.

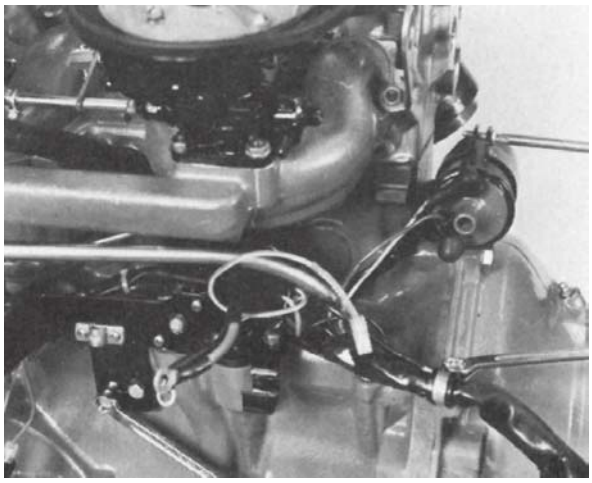


Changing the breaker points 230, 251, AQ131, AQ151

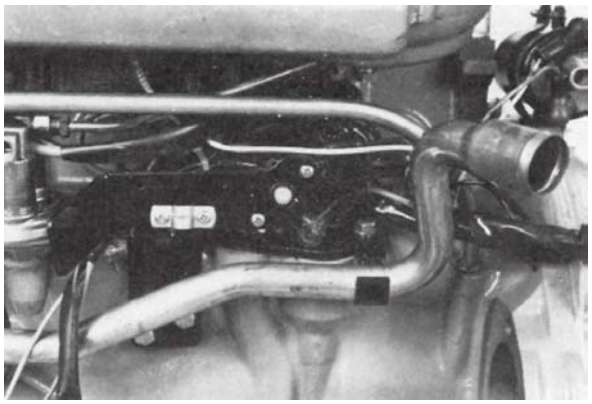
301. Remove the distributor cap (1) and the rotor (2). Then loosen the screw (3) and the flat terminal (4) and remove the breaker point set. Install a new breaker point set. The contact gap should be 0.40 mm (0.01575"). At the same time replace the condenser (5) by loosening the screw (6). Tighten the new condenser and connect the flat terminal. Push on the rotor and install the distributor cap.
NOTE! During the test run, check the dwell angle and adjust if necessary. See under “Technical Data”.



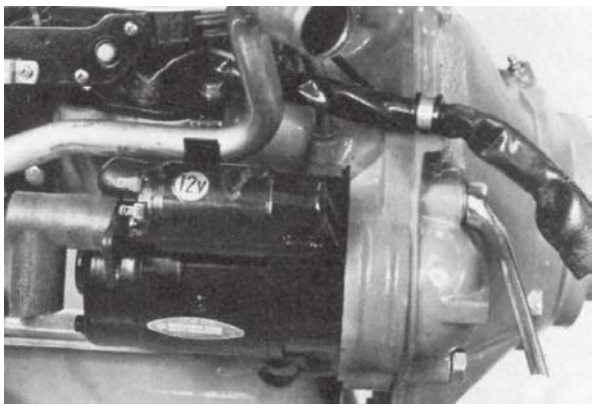
302. Install the bracket for the ignition coil on the engine.



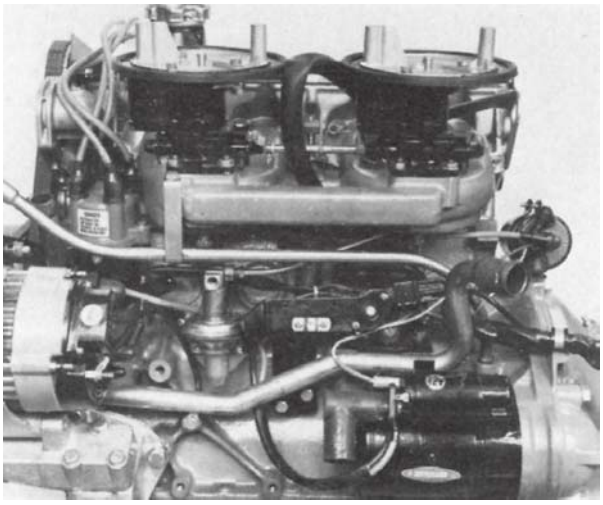
303. Install the fuse bracket and the wiring harness. Clamp the wiring harness to the flywheel housing and tighten the ignition coil to its bracket.



304. Install the cooling water pipe

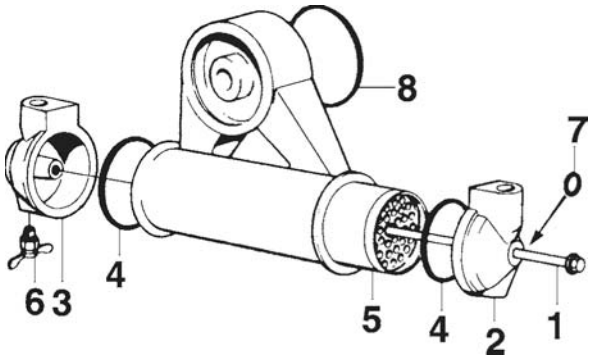


305. Install the starter motor.

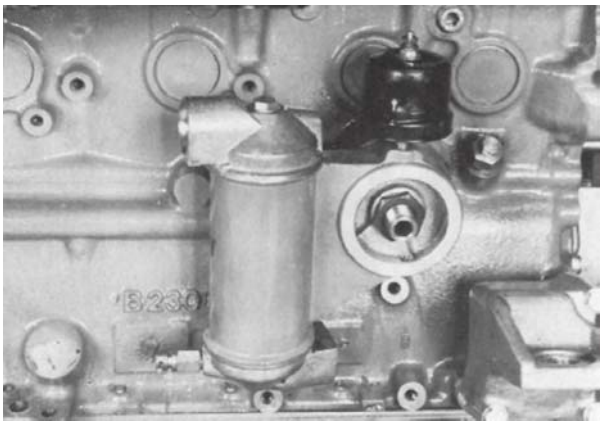


306. Connect all wires to the alternator, the starter motor and the temp sender. The wire to the oil pressure sender is connected later. Connect the ignition wires to the spark plugs and the ignition coil.

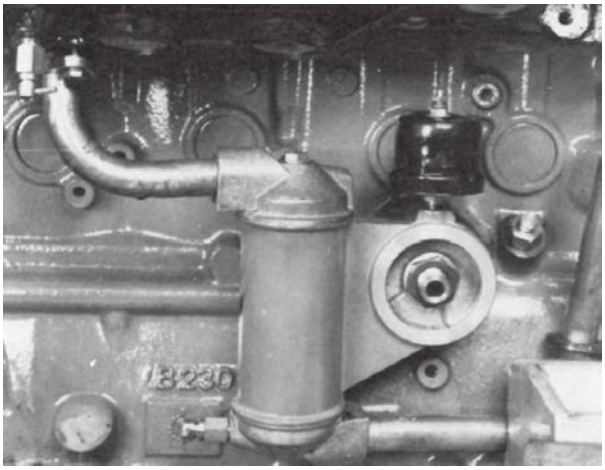
Overhauling the oil cooler 250, 251DOHC, AQ151, AQ171



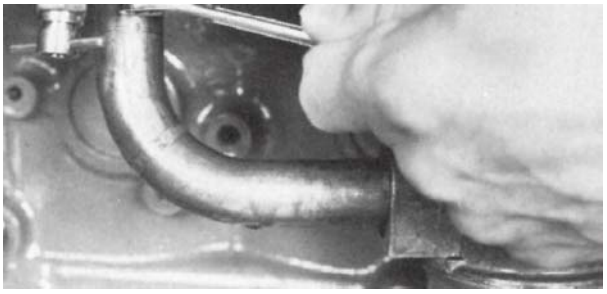
307. Remove the center screw (1) and remove both end covers (2) and (3). Remove the O-rings (4) installed on the cooler insert. Push out the insert (5). Watch out for oil spillage! Clean and use compressed air to blow out the insert internally. Check that the passage in the drain cock (6) is not clogged. Install the insert in the housing and install the O-rings on the insert. (Replace the O-rings if necessary!). Install the end covers and tighten them by the center screw. Replace the O-ring (7) should it be damaged. Check and replace the O-ring (8) if necessary.



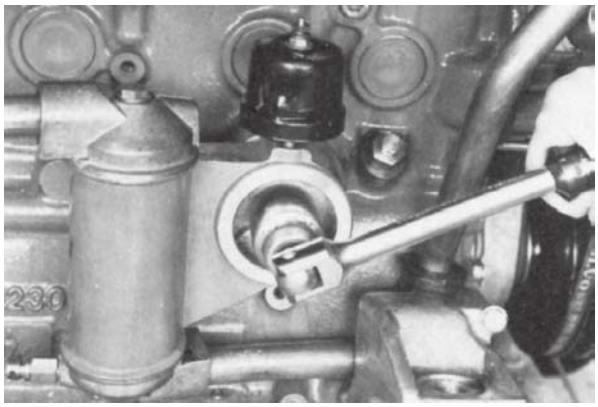
308. Install a new O-ring and install the oil cooler on the engine but do not tighten it.



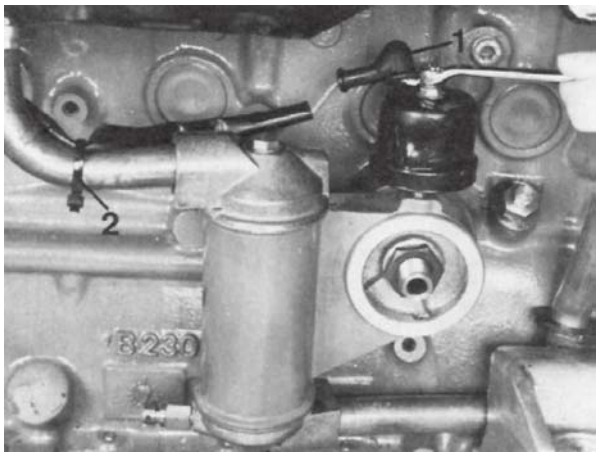
309. Connect the cooling water pipes along with new rubber sealings to the oil cooler. On model 230, AQ131 the cooling water pipe goes straight from the exhaust manifold to the heat exchanger. The picture shows model 250, AQ151.



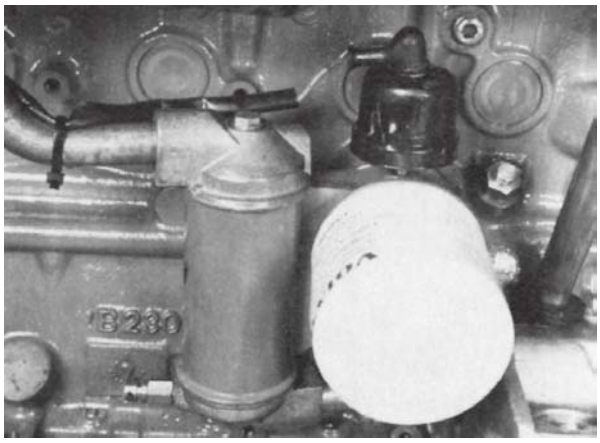
310. Tighten the cooling water pipe to the exhaust manifold. Tool width: 10 mm.



311. Tighten the oil cooler to the engine. Tool width: 29 mm.



312. Connect the wire to the oil pressure sender. Tool width: 3/8". Then pull over the protective rubber cap (1). Also clamp the wire to the cooling water pipe (2).



313. Oil the gasket of the oil filter and install the filter by hand until the rubber gasket touches the engine block. Then turn the filter by hand a further 1/2 turn. Check the oil pressure and also for leakages around the oil filter during the first test run.

References to Service Bulletins

Group No. Date Regarding

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