Fig. 67. Attaching the distributor
1. Bolt for retainer 4. Locking screw
2. Clamping bolt 5. Contact breaker points
3. Retainer 6. Rotor arm

Small part at the groove is turned to face obliquely upwards and rearwards and the groove is set at an angle of about 90° to the longitudinal axis of the engine, see A, Fig. 68. Make sure that the shaft engages properly in its slot in the pump shaft. (N.B. When the markings on the timing gears come opposite each other the piston in No. 4 cylinder is at top dead centre.)

Fitting the distributor
1. Check that the piston in No. 1 cylinder is at top dead centre and that the distributor drive pinion is correctly fitted in accordance with the description in the previous section.
2. Fit the distributor but do not tighten it in position.
3. Turn the distributor housing slowly clockwise until the contact breaker open for No. 1 cylinder. Tighten the distributor in this position. Make sure that the rotor arm points towards the contact in the distributor cap for No. 1 cylinder sparking plug, see Fig. 67.
4. Fit the cap and cables as shown in Fig. 68. The rotor arm rotates anti-clockwise.

Fig. 68. Connection of ignition cables
Firing order 1-3-4-2

5. Start the engine and adjust the ignition timing carefully as described below. Rough adjustment when fitting the distributor on the engine is only provisional and should always be finally checked with a stroboscope before running the engine.

Adjusting the ignition timing
The ignition timing should always be adjusted while the engine is running with the help of a stroboscope.
1. Disconnect the vacuum regulator by disconnecting its hose on the distributor.
2. Mark out the graduation 22±1° before top dead centre on the crankshaft belt pulley with chalk so that it is clearly visible.

Fig. 69. Graduation for ignition timing
3. Connect the lamp with the high-tension cable to the sparking plug in No. 1 cylinder and to the battery with the other cables, see Fig. 70.

4. Start the engine and run it up to 1500 r.p.m. Keep your hands clear of the fan.

5. Point the lamp towards the scale on the belt pulley. Slacken and turn the distributor so that ignition occurs when the chalk mark mentioned in point 2 comes opposite the pointer, and check the speed. Tighten the distributor and check that the setting has not altered.

6. Remove the lamp and fit the vacuum line.

**FUEL SYSTEM**

**Carburettor**

**CLEANING THE CARBURETTOR WHEN FITTED ON ENGINE**

Before cleaning the carburettor, always make sure that the sludge trap on the fuel pump has been cleaned out.

When cleaning the carburettor it is often sufficient merely to move the float chamber, take out the float, screw out the air jet for idling (4, Fig. 71) as well as the actual idling jet which is located under the air jet. Also remove the acceleration pump plunger and the idle fuel screw, this screw being on the carburettor housing. Remove the needle valve and check or clean it. Wash the parts concerned in white spirit or alcohol. Blow through all channels and jets with compressed air, including the hole for the idle fuel screw.

Check that the jets screwed out are clean by holding them up against the light.

Fit the parts, start the engine and adjust idling speed.

**Removing**

1. Blow the carburettor clean externally. Remove the upper part of the air cleaner. Disconnect the fuel line and vacuum hose.

2. Disconnect the throttle and choke controls on the carburettor.

3. Screw off the attaching nut and lift up the carburettor. Cover the hole in the intake manifold with masking tape.
Dismantling
1. Remove the float chamber by screwing out its attaching screws.
2. Remove the lock spring (1, Fig. 71) and lift up the float (2). Note the marking (TOP) on the lock spring.
3. Remove the emulsion block screws (9) and take out the block.
4. Screw out all the jets from the emulsion block, see Fig. 72.
5. Remove the acceleration pump plunger, spring, inlet valve, outlet valve and acceleration jet. See Fig. 71.
6. Remove the float valve and the economizer valve, Fig. 73. Screw out the idle fuel jet.
7. Clean all parts in white spirit or alcohol.

Assembling
Assembling is carried out in the reverse order to disassembling.
1. Check that all parts are in good condition and clean. Fit new washers and gaskets.
2. Check that the economizer valve disc (7, Fig. 75) is in good contact with its seat (5). The disc can be tapped in against the seat with fine grinding compound if necessary.
3. Fit the lock spring for the float with the "TOP" marking facing upwards. The spring under the pump plunger is pushed down so that it goes into the inlet valve in the bottom of the barrel. Check that the washer for the float has the correct thickness according to the specifications. It is not possible to adjust the level.
4. When the float bowl is fitted it should be pressed inwards and upwards when tightening the screws.

The emulsion block nozzle (6, Fig. 74) should be in contact with the stay across the venturi. If not, loosen the venturi screw and adjust its position.

Adjusting idling
The adjustment is carried out with a warm engine.
1. Adjust the idling speed to 600–700 r.p.m. by using the screw (8, Fig. 74) on the throttle flap lever.
2. Adjust the fuel/air mixture with the idle screw (7). First screw inwards (leaner mixture) until the engine begins to run roughly and then slowly outwards until the engine runs evenly.
3. Adjust engine speed if necessary by means of the screw on the throttle flap lever.

Adjusting the accelerator pedal
There should be a clearance of 1 mm (0.040") between the lever on the throttle flap and the
full throttle stop when the accelerator pedal is fully depressed. Adjustment is carried out by altering the length of the vertical push rod.
When the accelerator pedal is fully depressed, the force exerted by the foot of the driver will thus be taken up against the floorboard without exerting unnecessary loading on the throttle control system.

**Acceleration pump stroke**
The pump plunger can be set for a short or long stroke by means of the washer (6, Fig. 74). To alter the setting, lift the washer and give it half a turn. The normal setting is a short stroke, the highest cam lobe on the washer being turned to face the spring on the lever.

**Fitting**
Clean the face on the intake manifold and on the carburettor. Check that these faces are not distorted or damaged. Fit a new gasket and fit the parts in the reverse order to that used when removing.

**ADJUSTING RAPID IDLING**
Pull out the choke control fully and check that the front cam on the choke lever stops against the chock.

**AIR CLEANER**
**Air cleaner, type I with replaceable element**
The element should be replaced with a new one every 20,000 km (12,500 miles) if the vehicle is driven in districts with moderate air contamination. When driving in very dusty areas it may be necessary to carry out replacement at shorter intervals.

No cleaning of any sort may be carried out between changes. On no account must the element be moistened or oiled.

A sign of a blocked air cleaner is increased fuel consumption.

**REPLACING THE ELEMENT**
1. Loosen the upper hose clamp and remove the wing nut.
2. Lift off the upper section and remove the old element (3, Fig. 75).
3. Wipe carefully clean from dust and dirt inside the lower part of the cleaner by using a damp
Air cleaner, type III, with non-replaceable elements

The element is not replaceable but every 40,000 km (25,000 miles) the complete air cleaner should be replaced. When driving in very dusty areas, replacing should be done more frequently. No cleaning of any sort is permitted between the replacement intervals. On no account must the element be moistened or oiled.

REPLACING AIR CLEANER, TYPE III

Remove the air cleaner and discard it. Check the gasket on the carburetor and fit a new air cleaner.

FUEL PUMP

Cleaning the strainer

Release the retaining clip and remove the glass, type I. On types II and III the cover is removed. Take out the strainer and blow it clean. Check before fitting the glass or cover that the gasket is in good condition and seals properly. Replace it with a new one if necessary.

Checking the condition of the fuel pump

Before removing the fuel pump its condition should be checked with a fuel pressure gauge. Connect

Air cleaner, type II (oil-bath)

This air cleaner should normally be dismantled and cleaned every 10,000 km (6,000 miles). When driving in particularly dusty areas, however, it may be necessary to carry out cleaning more frequently, if the fuel consumption increases, this may be due to a blocked air cleaner.

CLEANING THE AIR CLEANER

AND CHANGING THE OIL

1. Loosen the upper hose clip and wing nut. Lift off the upper section (1, Fig. 76).
2. Lift up the inner container (2) and empty out the old oil. Wash the container in white spirit. Also wash the element and clean the other parts.
3. Lay the container in the lower section. Fill the container with oil up to the level mark. N.B. Only add oil to the container itself, not to the actual lower section. Use the same type of oil as in the engine.
4. Fit the upper section on the cleaner.
Replacing the diaphragm and/or valves

See under the heading "Reconditioning the fuel pump".

RECONDITIONING THE FUEL PUMP

Removing

Disconnect the fuel line connections and remove the pump.

Dismantling, type I

1. Separate the upper and lower parts of the pump.

2. Remove the diaphragm by pressing it down and turning it a quarter of a turn.

3. Remove one circlip for the rocker arm (8, Fig. 78) shaft (9). Press out the shaft, remove the rocker arm, spring, link arm (7) and washers.

4a. Replacing valves (earlier attaching arrangement), Fig. 80.

Unscrew the screws for the retainer. Remove the old valves. Clean the valve recesses. Place the new seals and the new valves in position and fit the retainer.

4b. Replacing valves (later attaching arrangement), Fig. 80.

Remove the old valves with a screwdriver or other suitable tool. Clean the valve recesses. Place the new seals and valves in position. Press down the new valves into their correct position with the help of a sleeve. A piece of tubing as shown in Fig. 79 can be used.

Fig. 79. Tools for fitting valves in fuel pump

Earlier attachment

Later attachment

Fig. 80. Fitting valves in fuel pump

Then peen over the material round each valve in four places with a punch, see Fig. 80. The type of punch is shown in Fig. 79.

Assembling, type I

1. Fit the link arm, washers, spring and rocker arm. Press in the shaft. Fit the circlips.

2. Fit the new valves and (early production) retainer. On late production, fit the new valves.
that the lever comes in the correct position above its cam.

**Dismantling, type II**

1. Make line-up marks on the upper part and lower part. Separate the upper part from the lower part.
2. Remove one circlip (15) from the lever pin (16). Press out the pin. Pull out the lever and spring (14) and (12).
3. Remove the diaphragm (6) with spring, guide (3) and rubber seal (2). The spring can be removed after the rubber seal has been pulled up over the nylon washer.
4. Unascrew the screw on the underside of the upper part, remove the stop arm (5) and spring valve (7). The inlet valve cannot be removed.

**Inspecting**

Check the diaphragm and gasket for leakage and the moving parts for wear. Replace any damaged or worn parts.

**Assembling, type II**

1. Fit the leaf spring as shown in Fig. 82 and the stop arm. Tighten the screw but no harder than so that the leaf spring contacts the pump housing properly.
2. Fit the spring (4) and guide (3), and pull on the rubber seal (2) with the flange downwards facing the guide.
3. Fit the diaphragm unit in the lower part of the pump. Press downwards so that the rubber seal comes into its correct position.
4. Press down the diaphragm, push in the lever (14) and make sure that it comes correctly in relation to the diaphragm rod. Fit the pin (16), circlips (15), spring retainer (19) and spring (12).
5. Fit the upper part in accordance with the line-up marks and tighten it. Fit the strainer and cover.

Test the pump. When fitting, make sure that the lever comes into its correct position above the cam.

**Dismantling, type III**

1. Remove the cover.
2. Make line-up marks on the upper and lower parts of the pump and separate them.
Anti-freeze fluid
During the winter, ethylene glycol with anti-corrosion agents should be added to the cooling water in order to prevent freezing. For necessary quantities, see the specifications. Methylated spirit should not be used since its boiling point is too low. It is also unsatisfactory from a corrosion point of view.

Thermostat
The thermostat can be tested, after being removed, in a vessel with water which is heated up. See Fig. 84. The thermostat should open and close at the temperatures shown in the specifications. Reject a faulty thermostat. Use a new gasket when refitting.

Water pump
Dismantling and checking
1. Pull out the locking spring.
2. Attach puller SVO 2462 to the hub with the bolts for the pulley and pull off the hub, see Fig. 85.
3. Place the pump in a press. Apply drift SVO 2463 on the bearing outer ring and press out the shaft, bearing and impeller, see Fig. 86.

Assembling fuel pump, type III
1. Assemble the link arm, rocker arm with washers (3) and rocker arm pin.
2. Insert the linkage system with return spring (16) into the housing.
3. Fit and lock the riders in the housing by peening with a suitable punch, see Fig. 83.

Cooling system
Always use as clean water as possible with the addition of anti-corrosion agent in the radiator. N.D. The water pump is made of light-alloy.
4. Inspect the impeller and bearing. If the bearing is worn and feels loose, or if it binds, discard the shaft and bearing.
(The bearing and shaft cannot be dismantled.) If the bearing is serviceable it should not be heated or washed in solvent since this can destroy the lubricant in it. If the impeller is removed it should be replaced with a new one since it will nearly always be found to be damaged. The sealing ring should always be replaced by a new one.

5. When separating the shaft and impeller, the sealing ring is pressed down and press washer SVO 0429 slid in under the impeller. The shaft is then pressed out with drift SVO 2266.

ASSEMBLING
Before assembling, check carefully that the parts are in good condition. The sealing surface of the impeller must be smooth and free from scratches. The bearing should rotate easily without binding but must not be loose. Replace damaged parts with new ones. The sealing ring must always be replaced with a new one.

1. Press down the shaft and bearing in the housing with drift SVO 2463 in a similar manner to that shown in Fig. 86 so that the locking wire can be inserted into its slot. Fit the locking wire.

2. Fit the deflector ring as shown in Fig. 87. Fit the sealing ring with drift SVO 2450 as shown in Fig. 88. Coat the contact surface of the carbon washer against the impeller with molybdenum disulphide mixed in SAE 30 mineral oil. The molybdenum disulphide should be completely dry before fitting.

3. Press on the impeller with drift SVO 2266 so that it comes flush with or down to 0.4 mm
(0.016") under the face of the pump housing. The lower end of the shaft should rest against a counterbore, see Fig. 89.

4. Turn the pump round. Apply a counterbore under the shaft end in the impeller hole and press on the hub with drift SVO 2296.

As a counterbore use, for example, puller SVO 2402 with the centre bolt screwed in so that it supports against the shaft. Press carefully so that the measurement B as shown in Fig. 90 is 105 ± 0.2 mm (4.134 ± 0.008").

5. Check that the pump can be rotated by hand without any excessive resistance and that no binding occurs.

**Fitting the Water Pump**

When fitting, make sure that the sealing rings on the upper side of the pump are positioned correctly. Also press the pump upwards against the cylinder head projection under the attaching point so that good sealing is obtained between the pump and cylinder head.

Ensure that the sealing rings on the water pipes are in good condition and press in the pipes well when attaching them.

**Assembling the Engine**

When assembling the engine follow the instructions for the parts concerned. The order of work is the reverse to that used when dismantling. Check the marking of the bearings as shown in Fig. 92. The main bearings are marked 1–5 and the big-end bearings 1–4 counting from the front. Check that all parts are clean and lubricate sliding surfaces with oil before assembling. Always use new gaskets, split pins and locking washers. Shellac should not be used as a sealing agent since it gradually dries and flakes off, so that the oilways can be blocked. No adhesive should be used on the gaskets.

The seals on the ends of both the oil pump delivery pipe and the water pump pipes are in the form of rubber rings. These rings, which seal
Fig. 91. Tightening sequence for cylinder head bolts

radially, are made of special rubber with very close tolerances. Only genuine Volvo parts should be used. Fitting is facilitated by coating the rings with soap solution.

The rings are fitted on the pistons and then pressed into their correct positions before the attaching bolts are tightened. The oil pump flange should lie flush against the cylinder block before tightening.

The timing gear casing and rear sealing flange must be accurately centered when fitting. See under "Replacing the timing gear casing" and "Fitting the rear sealing flange".

The big-end bearing bolts and nuts should be replaced with new ones when reconditioning.

The cylinder head is fitted with the help of guide pins SVO 2435. The bolts must be tightened in a certain sequence as shown in Fig. 91 in order to avoid unnecessary stresses. Check that the oil hole (1, Fig. 94) for lubricating the rocker arms is clear.

The pilot bearing (5, Fig. 95) should be lubricated before fitting with heat-resistant ball bearing grease. The bearing and protecting washer are held in position by a circlip (4).

The most important bolts and nuts should be tightened with a torque wrench, see "Tightening torques" in the specifications.

Fan belt tension

The fan belt should be tensioned so that the pulley starts to slip when a force of 8.0–11.0 kg (17.6–24.3 lb.) is applied at a point about 150 mm (6") from the centre of the hub.

Pull in the direction of rotation of the engine and use a spring-balance as shown in Fig. 96.

Fig. 92. Marking of main and big-end bearings
1. Main bearing No. 1
2. Main bearing No. 2
3. Big-end bearing No. 1

Fig. 93. Rear sealing flange
1. Flange
2. Drain hole

Fig. 94. Cylinder head
1. Oil hole
2. Rubber washer
INSTALLING THE ENGINE IN THE VEHICLE

Lifting tool SVO 2425 is used for installing the engine.

The order of work is the reverse of that used when removing, see under the heading "Removing the engine".

After all the parts have been fitted, fill up with coolant and oil.

Check that all the controls are connected correctly.

RUNNING-IN

An engine which has been completely or partially reconditioned must always be run carefully for a while, this being known as the running-in period.

The engine should not be run at excessively high speeds, but neither should it be run at low speeds under loading.

The engine oil should be changed at shorter intervals than usual. See the section concerned in the instruction book.

If extensive reconditioning has been carried out, it is advisable to run the engine on a test-bench if available.
# FAULT TRACING

<table>
<thead>
<tr>
<th>CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>The engine stalls or idles very unevenly</td>
<td>Check and replace sparking plugs and suppressors if necessary.</td>
</tr>
<tr>
<td>Faulty sparking plugs or suppressors.</td>
<td>Check for tightness. Replace faulty gaskets</td>
</tr>
<tr>
<td>Air leaks at carburettor connection.</td>
<td>Increase idling speed.</td>
</tr>
<tr>
<td>Idling speed too low.</td>
<td>Clean carburettor, particularly idling system.</td>
</tr>
<tr>
<td>Dirt in carburettor.</td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine runs jerkily (or coughs) during acceleration</td>
<td>Clean insulators.</td>
</tr>
<tr>
<td>Dirt on sparking plug insulators.</td>
<td>Check or replace sparking plugs.</td>
</tr>
<tr>
<td>Faulty sparking plugs.</td>
<td>Remove and clean or replace.</td>
</tr>
<tr>
<td>Dirty, faulty or wet distributor cap.</td>
<td>Check, clean or replace cables. See also</td>
</tr>
<tr>
<td>Faulty or wet cables.</td>
<td>Part 3.</td>
</tr>
<tr>
<td>Dirt in carburettor.</td>
<td>Remove float chamber and needle valve, clean</td>
</tr>
<tr>
<td></td>
<td>these parts.</td>
</tr>
<tr>
<td>Fuel/air mixture too lean.</td>
<td>Check carburettor settings.</td>
</tr>
<tr>
<td>Faulty fuel pump supplying too little fuel.</td>
<td>Check fuel pump pressure and capacity.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Low engine output</td>
<td></td>
</tr>
<tr>
<td>Air cleaner blocked.</td>
<td>Fit a new paper element or new air cleaner as the case may be. If an oil-bath type air cleaner is fitted, clean it.</td>
</tr>
<tr>
<td>Poor quality fuel, too low octane rating.</td>
<td>Check fuel grade, use correct fuel.</td>
</tr>
<tr>
<td>Faulty ignition timing setting.</td>
<td>Adjust ignition timing setting by using stroboscope. See &quot;Ignition setting&quot;.</td>
</tr>
<tr>
<td>Faulty settings on carburettor.</td>
<td>Check and adjust carburettor settings.</td>
</tr>
<tr>
<td>Faulty valve clearances.</td>
<td>Check and adjust valve clearance.</td>
</tr>
<tr>
<td>Low compression on a cylinder.</td>
<td>Measure compression pressure. In the case of excessively low values, remove cylinder head for closer investigation. Remove cylinder head for investigation. See Part 3.</td>
</tr>
<tr>
<td>Piston binding.</td>
<td></td>
</tr>
<tr>
<td>Binding, wheel bearings or faultly adjusted brakes.</td>
<td></td>
</tr>
<tr>
<td>Knocking from valve mechanism</td>
<td></td>
</tr>
<tr>
<td>Valve clearance too large.</td>
<td>Adjust valve clearances.</td>
</tr>
<tr>
<td>Worn or damaged parts in valve mechanism.</td>
<td>Recondition or replace parts where necessary.</td>
</tr>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

2—40
Heavy regular knocking, louder when engine is subjected to loading

Worn main bearings and big-end bearings, or worn piston and gudgeon pins.

Localize sound by short-circuiting sparking plugs, one at a time.

Low oil pressure

Blocked oil filter. (The engine runs for a longer time than usual after starting before pressure is registered.)
Low oil pressure at lowest idling speed after hard driving.
Faulty oil pressure gauge contact, faulty pressure gauge or gauge line.
Faulty spring in relief valve or pump worn.
One or more bearings worn.
High degree of general wear.

Replace oil filter.

No action necessary. The pressure is normally quite low under these conditions.
Measure pressure with a check gauge.
Replace faulty parts.
Remove oil pump. Check spring and pump.
Examine and replace bearing shells.
Replace or recondition engine.

Large oil consumption

Hard driving.

Leakage at joints.

Oil level too high.

Worn valve guides.

Worn piston rings.

No action necessary. Oil consumption can increase slightly when the engine is subjected to very hard driving.
Tighten bolts and screws, replace faulty or poor quality gaskets all round.
Do not top up with oil until level is down to lower mark on dipstick.
Recondition valve system.
Change piston rings.

Large fuel consumption

Hard driving on highways or intensive stop-and-go town driving.
Blocked air cleaner.

Carburettor flooding.

Faulty carburettor settings, fuel/air mixture too rich.
Faulty sparking plug suppressors, faulty contact breaker points.
Incorrect dwell angle and ignition timing setting.

No measures necessary. Normal in both these cases.
Fit a new paper element or new air cleaner as the case may be. If an oil-bath type air cleaner is fitted, clean it.
Check and replace float valve if necessary. Also check pump pressure.
Adjust settings.

Replace sparking plug suppressors.
Adjust distributor.
Adjust dwell angle and ignition timing setting. A stroboscope must be used to adjust the ignition setting.

Engine runs abnormally warm

Not enough cooling water.
Fan belt insufficiently tensioned.

Fill up with cooling water.
Adjust fan belt tension.
Faulty gauge.
Fuel with too low octane rating (knocking).
Faulty thermostat.
Faulty ignition timing setting.
Faulty carburettor setting (fuel air mixture excessively lean).
Cooling system blocked.
Cooling jackets blocked or distribution pipe in cylinder head blocked. Distribution pipe possibly not pushed in far enough.

Check and replace gauge if necessary.
Fill up with fuel of correct octane rating.
Replace thermostat.
Check and adjust ignition timing setting by using stroboscope.
Adjust carburettor settings.

Clean cooling system.
Measure cooling water temperature simultaneously at outlet on right of thermostat and at outlet for temperature gauge at rear of cylinder head. If the temperature obtained at the temperature gauge outlet at the rear is higher, the cylinder head should be removed and examined.

Loss of cooling water

Leaks at hose connections.
Faulty radiator filler cap.
Faulty cylinder head gasket (oil in cooling water).

Check hoses and clamps, replace if necessary.
Replace radiator filler cap.
Replace cylinder head gasket.
TOOLS

The following special tools are required when carrying out repair and service work on the engine.

Fig. 97. Tools for engine and water pump

SVO 1426 Tool for fitting pilot bearing
SVO 1456 Tool for removing valve guides
SVO 1806 Tool for removing and fitting gudgeon pins
SVO 1807 Tool for removing and fitting bush in rocker arm connecting rod
SVO 2176 Ring for fitting pistons, (standard size)
SVO 2256 Pulser for camshaft gear
SVO 2298 Tool for fitting valve guides
SVO 2436 Guide pins for fitting cylinder head (2)
SVO 2438 Centring sleeve for timing gear casing and fitting felt ring circlip
SVO 2439 Centring sleeve for rear sealing flange and fitting felt ring o-rings
SVO 2440 Pulser for crankshaft hub
SVO 2446 Pulser for crankshaft gear
SVO 2497 Press tool for fitting camshaft gear
SVO 2498 Press tool for fitting camshaft gear
SVO 2694 Grip tool for removing and fitting valve levers
SVO 3400 Pulser for pilot bearing
SVO 3405 Press tool for removing water pump impeller
SVO 2296 Tool for removing and fitting hub and impeller in water pump
SVO 2430 Tool for fitting seal in water pump
SVO 2492 Pulser for water pump hub
SVO 2493 Tool for fitting and removing water pump bearing.

Fig. 98. Tool for removing engine
SPECIFICATIONS

GENERAL
Type designation .................................................. B 18 A (406801 and 496814)*
Output, b.h.p. at r.p.m. (SAE) .................................. 75/400
(DIN) ...................................................................... 0.8/400
Max. torque, km (lb.ft) at r.p.m. (SAE) ...................... 14.0 (101) / 2800
(DIN) ...................................................................... 13.5 (93) / 2900
Compression pressure (warm engine) when turned over with starter
motor, 250–300 r.p.m., kg/cm² .................................. 11–13
lb./sq.in ................................................................. 155–185
Compression ratio ..................................................... 8.5:1
Number of cylinders .................................................. 4
Bore ...................................................................... 84.14 mm (3.312")
Stroke .................................................................... 80 mm (3.15")
Displacement ............................................................. 1.78 litres
Weight, including electrical equipment and carburettor ...... approx. 155 kg (341 lb.)

CYLINDER BLOCK
Material ................................................................. Special-alloy cast iron
Bore, standard .......................................................... 84.14 mm (3.313")
0.020" oversize ..................................................... 84.65 mm (3.333")
0.030" .................................................................. 84.90 mm (3.342")
0.040" .................................................................. 85.18 mm (3.353")
0.050" .................................................................. 85.41 mm (3.362")

PISTONS
Material ................................................................. Light-alloy
Permissible weight difference between pistons in same engine ........................................ 10 grammes (0.35 oz.)
Height, overall, early production ....................... 83.9 mm (3.29")
late production ...................................................... 71.0 mm (2.80")
Height from centre of gudgeon pin to piston crown ........................................... 46 mm (1.81")
Piston clearance ....................................................... 0.02–0.04" (0.0008–0.0015")

PISTON RINGS
Piston ring gap measured in ring opening .............. 0.025–0.50 mm (0.010–0.020")
Piston ring oversizes .............................................. 0.020", 0.040"
0.030", 0.050"

Compression rings
Marked "TOP", Upper ring on each piston chromed.
Number of rings on each piston ................................ 2
Height .................................................................... 1.98 mm (0.078")
Piston ring clearance in groove .......................... 0.054–0.081 mm (0.0021–0.0032")

Oil scraper rings
Number on each piston ........................................... 1
Height .................................................................... 4.74 mm (0.186")
Piston ring clearance in groove ....................... 0.044–0.072 mm (0.0017–0.0028")

* Conserve the engine type number and is stamped on the right-hand side of the engine (3, Fig. 1), where the front number indicates the type
and the rear one the consecutive manufacturing serial number.
GUDGEON PINS
Floating fit. Circlips at both ends in piston.
Fit:
<table>
<thead>
<tr>
<th>Diameter, standard</th>
<th>Close running fit</th>
</tr>
</thead>
<tbody>
<tr>
<td>In connecting rod</td>
<td>0.09 mm (0.0036&quot;)</td>
</tr>
<tr>
<td>In piston</td>
<td>22.29 mm (0.880&quot;)</td>
</tr>
<tr>
<td>0.05 mm (0.002&quot;)</td>
<td>22.09 mm (0.870&quot;)</td>
</tr>
<tr>
<td>0.10 mm (0.004&quot;)</td>
<td>22.20 mm (0.884&quot;)</td>
</tr>
<tr>
<td>0.20 mm (0.008&quot;)</td>
<td>22.20 mm (0.884&quot;)</td>
</tr>
</tbody>
</table>

CYLINDER HEAD
Height, measured from cylinder head contact surface to bolt level 88 mm (3.46")
Distance from upper surface of cylinder head to upper end of over-flow pipe (pipe located under thermostat) 35 mm (1.38")

CRANKSHAFT
Crankshaft and float
Main bearings, radial clearance 0.028"–0.077 mm (0.0011"–0.0030")
Big-end bearings, radial clearance 0.039"–0.081 mm (0.015"–0.032")

Main bearings

MAIN BEARING JOURNALS
Diameter, standard
<table>
<thead>
<tr>
<th>Diameter</th>
<th>Range (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>63.441–63.454 mm (2.4977–2.4992&quot;)</td>
<td></td>
</tr>
<tr>
<td>63.187–63.200 mm (2.4877–2.4892&quot;)</td>
<td></td>
</tr>
<tr>
<td>62.933–62.946 mm (2.4777–2.4792&quot;)</td>
<td></td>
</tr>
<tr>
<td>62.679–62.692 mm (2.4677–2.4692&quot;)</td>
<td></td>
</tr>
<tr>
<td>62.425–62.438 mm (2.4577–2.4592&quot;)</td>
<td></td>
</tr>
<tr>
<td>62.171–62.184 mm (2.4477–2.4492&quot;)</td>
<td></td>
</tr>
</tbody>
</table>

Width on crankshaft for flange bearing shell
<table>
<thead>
<tr>
<th>Standard</th>
<th>Range (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>38.930–38.970 mm (1.5327–1.5342&quot;)</td>
<td></td>
</tr>
<tr>
<td>38.931–38.972 mm (1.5327–1.5343&quot;)</td>
<td></td>
</tr>
</tbody>
</table>

MAIN BEARING SHELLS
Thickness, standard
<table>
<thead>
<tr>
<th>Thickness</th>
<th>Range (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.985–1.991 mm (0.0781–0.0784&quot;)</td>
<td></td>
</tr>
<tr>
<td>2.117–2.128 mm (0.0833–0.0834&quot;)</td>
<td></td>
</tr>
<tr>
<td>2.229–2.245 mm (0.0883–0.0884&quot;)</td>
<td></td>
</tr>
<tr>
<td>2.356–2.372 mm (0.0931–0.0934&quot;)</td>
<td></td>
</tr>
<tr>
<td>2.492–2.496 mm (0.0981–0.0984&quot;)</td>
<td></td>
</tr>
<tr>
<td>2.626–2.656 mm (0.1031–0.1034&quot;)</td>
<td></td>
</tr>
</tbody>
</table>

Big-end bearings

BIG-END BEARING JOURNALS
Bearing seat width 31.950–32.050 mm (1.2579–1.2618")
Diameter, standard 54.089–54.102 mm (2.1396–2.1330")

2–45
undertail 0.010"

<table>
<thead>
<tr>
<th>Thickness, standard</th>
<th>undersize 0.010&quot;</th>
<th>undersize 0.020&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.853&quot;–1.861&quot;</td>
<td>1.960&quot;–1.969&quot;</td>
<td>2.067&quot;–2.095&quot;</td>
</tr>
<tr>
<td>1.800&quot;–1.805&quot;</td>
<td>1.872&quot;–1.875&quot;</td>
<td>2.141&quot;–2.222&quot;</td>
</tr>
<tr>
<td>1.750&quot;–1.755&quot;</td>
<td>1.822&quot;–1.825&quot;</td>
<td>2.341&quot;–2.494&quot;</td>
</tr>
<tr>
<td>1.700&quot;–1.705&quot;</td>
<td>1.892&quot;–1.902&quot;</td>
<td>2.468&quot;–2.478&quot;</td>
</tr>
</tbody>
</table>

CONNECTING RODS

End float on crankshaft: 0.15–0.36 mm (0.006–0.014"
Length, centre–centre: 148±0.1 mm (5.810±0.004"
Maximum permissible difference in weight between connecting rods in same engine: 6 grammes (0.21 oz.)

FLYWHEEL

Permissible run-out, max.: 0.05 mm/150 mm diam.
Ring gear (chamfer facing forwards): 142 teeth

FLYWHEEL HOUSING

Permissible axial throw, max.: 0.06 mm/100 mm diam.
Max. radial throw for rear guide: 0.15 mm (0.006"

CAMSHAFT

Marked A
Number of bearings: 3
Front bearing journal, diameter: 46.975–47.050 mm (1.8494–1.8534"
Centre bearing journal, diameter: 42.975–43.050 mm (1.6919–1.6939"
Rear bearing journal, diameter: 36.975–37.050 mm (1.4557–1.4549"
Radial clearance: 0.050–0.075 mm (0.0020–0.0030"
End float: 0.020–0.060 mm (0.0008–0.0024"
Valve clearance for check of camshaft setting (cold engine): 1.1 mm (0.043"
Inlet valve should then open at 10° after T.D.C.

CAMSHAFT BEARINGS

Front bearing, diameter: 47.020–47.050 mm (1.8494–1.8534"
Centre bearing, diameter: 43.020–43.050 mm (1.6919–1.6939"
Rear bearing, diameter: 37.020–37.049 mm (1.4557–1.4536"

TIMING GEARS

Crankcase gear, number of teeth: 21
Camshaft gear, ( fibre), number of teeth: 42

2—46
Tooth flank clearance ............................................. 0.04–0.08 mm (0.0016–0.0032")
End float, camshaft .................................................. 0.02–0.06 mm (0.0008–0.0024")

**VALVES**

**Inlet**
- Disc diameter .................................................. 40 mm (1.58")
- Stem diameter .................................................. 8.685–8.700 mm (0.3419–0.3425")
- Valve seat angle .................................................. 44.5°
- Cylinder head seat angle ........................................ 45°
- Seat width in cylinder head .................................... 1.4 mm (0.055")
- Clearance, warm and cold engine ............................... 0.40–0.45 mm (0.016–0.018")

**Exhaust**
- Disc diameter .................................................. 36 mm (1.4")
- Stem diameter .................................................. 8.640–8.655 mm (0.3403–0.3409")
- Valve seat angle .................................................. 44.5°
- Cylinder head seat angle ........................................ 45°
- Seat width in cylinder head .................................... 1.4 mm (0.055")
- Clearance, warm and cold engine ............................... 0.40–0.45 mm (0.016–0.018")

**VALVE GUIDES**
- Length ............................................................. 63 mm (2.48")
- Inner diameter .................................................. 8.725–8.740 mm (0.3435–0.3441")
- Height above upper surface of head ........................... 21 mm (0.83")
- Clearance, valve stem-guide, inlet valves ..................... 0.025–0.055 mm (0.0010–0.0022")
- exhaust valves .................................................. 0.035–0.095 mm (0.0014–0.0037")

**VALVE SPRINGS**
- Length, unloaded, approx. ...................................... 44 mm (1.77") Early prod.
- loaded with 25.5±2 kg (55±4.5 lb.) .......................... 39 mm (1.54") Late prod.
- loaded with 66±3.5 kg (145±8 lb.) .......................... 30.5 mm (1.2")
- loaded with 29.5±2.3 kg (65±5 lb.) .......................... 40 mm (1.57")
- loaded with 82.5±4.3 kg (181.5±9.5 lb.) ..................... 30 mm (1.18")

**LUBRICATING SYSTEM**
- Oil capacity, including oil filter (Early prod.) .......... 3.75 litres (100 fl. oz.)
- excluding oil filter ............................................. 3.25 litres (90 fl. oz.)
- Oil pressure at 2000 r.p.m. (with warm engine and new oil filter) ........................................ 3.5–6.0 kg/cm² (50–85 lb./sq.in.)
- Lubricant viscosity below 0° C (32° F) ......................... Engine oil. “For Service MS”
- between 0° C (32° F) and 30° C (86° F) ...................... SAE 10 W
- above 30° (86° F) .................................................. SAE 30
- Full-flow Multigrade oil ......................................
- SAE 10 W–30
- Type ............................................................... Full-Flow
- Make ............................................................... Wix or Mann

2–47
Lubricating oil pump
Oil pump, type ................................................. 10
number of teeth on each gear ................................................. 10
end float ................................................. 0.05–0.10 mm (0.0020–0.0039\"")
radial clearance ................................................. 0.06–0.14 mm (0.0025–0.0055\"")
tooth flank clearance ................................................. 0.15–0.35 mm (0.0060–0.0140\"")

RELIEF VALVE SPRING (IN OIL PUMP)
Length, unloaded ................................................. 31.0 mm (1.22\")
loaded with 4.0±0.2 kg (8.8±0.44 lb.) ................................................. 27.5 mm (1.08\")
9.5±0.3 kg (21.0±0.66 lb.) ................................................. 22.5 mm (0.89\")
6.0±0.6 kg (13.6±1.35 lb.) ................................................. 22.5 mm (0.89\")

FUEL SYSTEM
Fuel pump
Fuel pump, type I diaphragm pump ................................................. AC–UG
Fuel pump, type II diaphragm pump ................................................. Pierburg APG
Fuel pump, type III diaphragm pump ................................................. AC–VD
Fuel pressure, measured at same height as pump min. 0.11 kg/cm² (1.5 lb/sq.in.)
max. 0.25 kg/cm² (3.5 lb/sq.in.)

Carburettor
Type ................................................. Down-draught
Make and designation ................................................. Zenith 36 VN
Venturi ................................................. 30
Main jet ................................................. 117
Compensation jet ................................................. 115
Idling jet ................................................. 70
Idling air jet ................................................. 70
Air jet for acceleration ................................................. 140
Acceleration jet ................................................. 40 (early prod.) 50 (late prod.)
Acceleration pump stroke ................................................. Short
Float valve ................................................. 1.75
Washer for float valve, thickness ................................................. 1 mm (0.04\")
Idling speed (warm engine) ................................................. 500–700 r.p.m.

IGNITION SYSTEM
Voltage ................................................. 12 V
Order of firing ................................................. 1–3–4–2
Ignition timing setting, 97 octane (Research Method) at 1500 r.p.m.
effective speed (vacuum regulator disconnected) ................................................. 21–23\° before T.D.C.
Sparking plugs ................................................. Bosch W 175 T1 or corresponding
Sparking plug gap ................................................. 0.7–0.9 mm (0.028–0.035\")
tightening torque ................................................. 3.5–4.3 kgm (28–32 lb ft)

Distributor
Make ................................................. Bosch
Contact breaker gap ................................................. 0.4–0.5 mm (0.016–0.019\")
Dwell angle ................................................. 8.4–8.8 kg (0.08–1.32 lb)
Direction of rotation ................................................. Anti-clockwise

2–48
COOLING SYSTEM

Type ................................................................. Pressure
Radiator cap valve opens at ........................................ 0.23–0.30 kg/cm² (3–4 lb./sq.in.)
Capacity ..................................................................... approx. 8.5 litres (2 US gallons)
Fan belt, designation ...................................................... \( -2 \frac{1}{4} \) US gallons.
Tension: the pulley should start slipping when the force applied is HC 36 x 35"
9.0–11.0 kg (17.6–24.3 lb.) at a lever of 150 mm (6")

Anti-freeze
Amount of glycol required for frost protection down to

\[ \begin{align*}
-10^\circ & C (14^\circ F) & \quad 2 \text{ litres (3} \frac{3}{4} \text{ imp. pints=4 US pints)} \\
-20^\circ & C (\sim -5^\circ F) & \quad 3 \text{ litres (5} \frac{1}{4} \text{ imp. pints=6 US pints)} \\
-30^\circ & C (\sim -22^\circ F) & \quad 4 \text{ litres (7 imp. pints=9 US pints)} \\
-40^\circ & C (\sim -40^\circ F) & \quad 4.5 \text{ litres (1 imp. gallon=1} \frac{1}{4} \text{ US gallons)}
\end{align*} \]

The maximum depression of freezing point, \(-56^\circ C (\sim -69^\circ F)\), is obtained by adding 5.1 litres (9 imp. pints=11 US pints) of ethylene glycol.

Thermostat
Type ................................................................. Fullen Sylphion 1–1700 D 3
Marking .................................................................... 170
Starts to open at ......................................................... 75–78°C (167–172°F)
Fully open at ............................................................. 86°C (187°F)

WEAR TOLERANCES

CYLINDERS
To be rebored when wear reaches (if engine shows abnormal oil consumption) ........................................ 0.25 mm (0.01")

CRANKSHAFT
Permissible out-of-round on main bearing journals, max. 0.06 mm (0.002")
Permissible out-of-round on big-end bearing journals, max. 0.07 mm (0.003")
Max. crankshaft end float .................................................... 0.15 mm (0.006")

VALVES
Permissible clearance between valve stems and valve guides 0.15 mm (0.006")
Valve stems, permissible wear, max. 0.02 mm (0.0008")

CAMSHAFT
Permissible out-of-round (with new bearings), max. 0.07 mm (0.003")
Bearings, permissible wear .............................................................. 0.02 mm (0.0008")

TIMING GEARS
Permissible backlash, max. .................................................... 0.12 mm (0.005")
<table>
<thead>
<tr>
<th>Component</th>
<th>Kgm</th>
<th>Lb.ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cylinder head</td>
<td>8.5—6.5</td>
<td>61—69</td>
</tr>
<tr>
<td>Main bearings</td>
<td>12—13</td>
<td>97—94</td>
</tr>
<tr>
<td>Big-end bearings</td>
<td>5.2—5.8</td>
<td>36—42</td>
</tr>
<tr>
<td>Flywheel</td>
<td>4.8—5.5</td>
<td>33—40</td>
</tr>
<tr>
<td>Sparking plugs</td>
<td>3.8—4.3</td>
<td>28—33</td>
</tr>
<tr>
<td>Camshaft nut</td>
<td>13—15</td>
<td>94—108</td>
</tr>
<tr>
<td>Crankshaft pulley bolts</td>
<td>7—8</td>
<td>51—58</td>
</tr>
<tr>
<td>Dynamo bolts (5/8&quot;—16)</td>
<td>3.5—4</td>
<td>25—29</td>
</tr>
<tr>
<td>Oil filter nipple</td>
<td>4.5—5.5</td>
<td>33—40</td>
</tr>
<tr>
<td>Sump bolts</td>
<td>6.8—1.1</td>
<td>6—8</td>
</tr>
</tbody>
</table>
Illustration 1. Sectional view of B 13 A engine

1. Water distributor pipe
2. Intake manifold
3. Sealing ring
4. Exhaust valve
5. Fuel inlet
6. Float chamber
7. Valve cover
8. Inlet valve
9. Oil filler cap
10. Carburettor
11. Upper valve washer
12. Valve spring
13. Valve guide
14. Rocker arm
15. Rocker arm shaft
16. Spring
17. Lower valve washers (rubber and steel washer, rubber washer or underneath, early production only)
18. Push rod
19. Bearing bracket
20. Rocker casing
21. Gasket
22. Cable terminal
23. Cylinder head
24. Vacuum line
25. Distributor (early production)
26. Valve tappet
27. Flywheel housing
28. Retainer
29. Cylinder block
30. Gear wheel
31. Circlip
32. Pilot bearing
33. Flywheel
34. Bush
35. Flange bearing shell
36. Sealing flange
37. Main bearing cap
38. Cover plate
39. Sump
40. Gasket
41. Main bearing shell
42. Oil pump
43. Delivery pipe
44. Crankshaft
45. Camshaft
46. Piston
47. Piston rings
48. Connecting rod
49. Circlip
50. Gudgeon pin
51. Big-end bearing shell
52. Connecting rod bush
53. Thrust washer and spacing ring
54. Crankshaft gear
55. Timing gear casing
56. Crankshaft gear
57. Hub
58. Washer
59. Belt pulley
60. Bolt
61. Fan
62. Key
63. Oil nozzle
64. Key
65. Locking washer
66. Cooling water inlet
67. Gasket
68. Water pump
69. Dynamo
70. Belt pulley
71. Gasket
72. Sealing ring
73. Tensioner
74. Cylinder head gasket
75. Thermocat
76. Thermocat
77. Cooling water outlet