VOLVO
SERVICE

CARS

Part 9 (91, 94)
INSTRUMENTS
HEATER SYSTEM
P 1800

SERVICE MANUAL

Contents

GROUP 91

INSTRUMENTS

DESCRIPTION

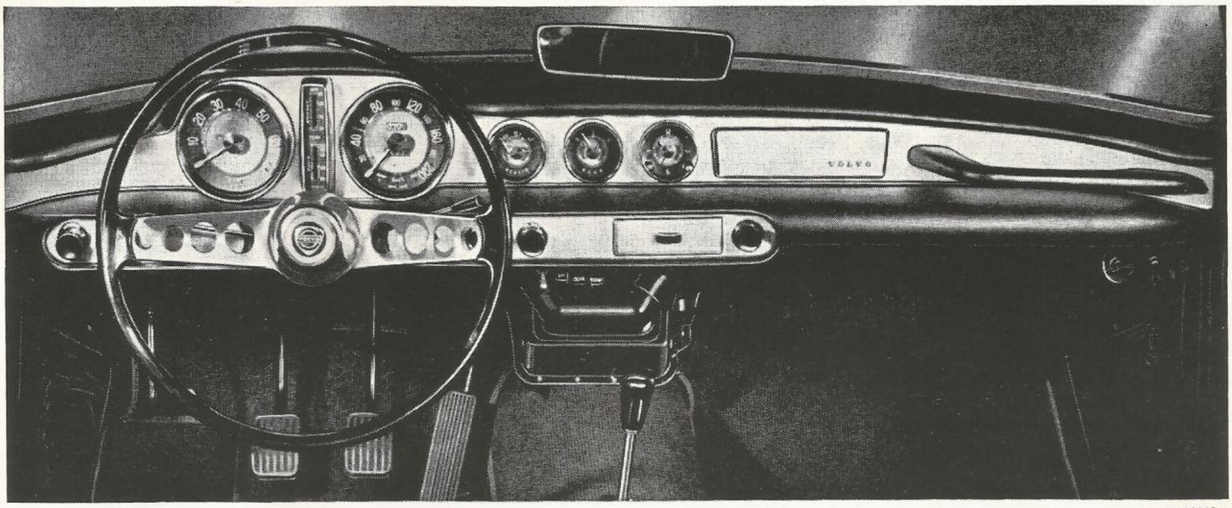


Fig. 1. **Instruments and controls.**

General

The instruments on the P 1800 include a revolution counter, coolant temperature gauge, oil temperature gauge, speedometer, fuel gauge, oil pressure gauge and electric clock. In addition to a mileometer and tripmeter, the speedometer also incorporates a charging control lamp, warning lamp for direction indicators and warning lamp for full-beam headlights. A description of the wiring and function of these warning lamps can be found in Part 3 (Electrical system).

FUEL GAUGE

The fuel gauge has two main parts. These consist of the tank fitting and the actual dial on the instrument panel. The tank fitting consists of a float which, through a lever, is connected with a contact plate which slides over an electrical resistor (rheostat). Any alteration of the fuel level in the tank causes either a smaller or larger part of the resistor windings to be in circuit. The instrument dial has two coils, one in series with the rheostat in the tank fitting, and one connected directly to earth. There is also a shunt which reduces to a minimum the sensitivity of the instrument to temperature variations.

In principle, the current can flow in two directions. One of these is through the series-connected coil of the instrument, through the rheostat of the tank fitting to earth and the other is through the coil which is connected to earth.

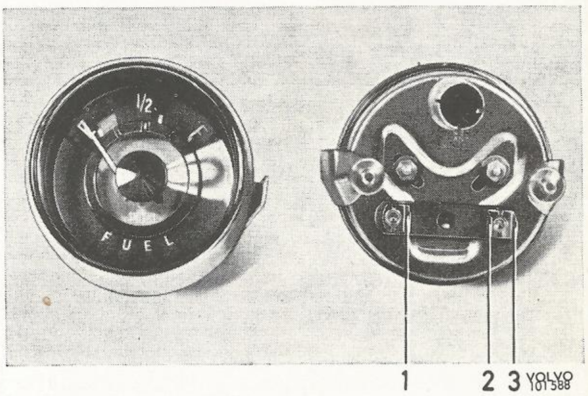


Fig. 2. Front and reverse sides of fuel gauge.

1. Connection for tank fitting
2. Current outlet
3. Connection to positive terminal of battery

When the fuel tank is empty, the current flows through the series-connected coil, passes through the tank fitting and then to earth. In this position only a few of the windings of the tank fitting rheostat are in circuit, so that there is only a small amount of resistance to the current. The magnetic force which arises when the current passes through the coil attracts the armature plate of the dial unit and the pointer goes over to "Empty". When filling the tank, a successively larger part of the rheostat comes into circuit, which means increased resistance for the current flowing through. An increasing part of the current will therefore tend to flow through the coil which is connected directly to earth. The armature of the dial unit is then influenced by this coil due to the larger number of windings which it has compared with the series-connected coil. The pointer then moves over from the "Empty" position and will give a reading on the scale in proportion to the amount of fuel filled in.

SPEEDOMETER

The speedometer is of the eddy current type. It is driven by means of a cable (speedometer cable) from a worm gear on the output shaft of the gearbox. To enable the speed to be read off on the instrument dial, the speedometer has a permanent magnet, a fitting disc and an aluminium rotor drum. The latter is connected to the pointer shaft of the instrument. The rotor drum is fitted on one end of the shaft and the pointer on the other. A counterbalance spring is also connected to the shaft, the purpose of which is to brake the movement of the rotor drum at the same time as it tends to move the pointer to the "O" position when the car is stopped. The numeral rollers of the mileometer and tripmeter are driven by means of a number of gears direct from the speedometer driving cable. The ratios of these gears are chosen so that the speedometer driving cable has to rotate 620 times to register one kilometre (992 times for 1 mile).

As mentioned above, the part of the speedometer which registers the speed operates magnetically. When the car begins to move, the driving cable begins to rotate, and thereby also the permanent magnet. This then generates a rotating magnetic field which gives rise to eddy currents in the rotor drum. The lines of magnetic force go over the fitting disc of the instrument.

The torque effect which the magnetic field has

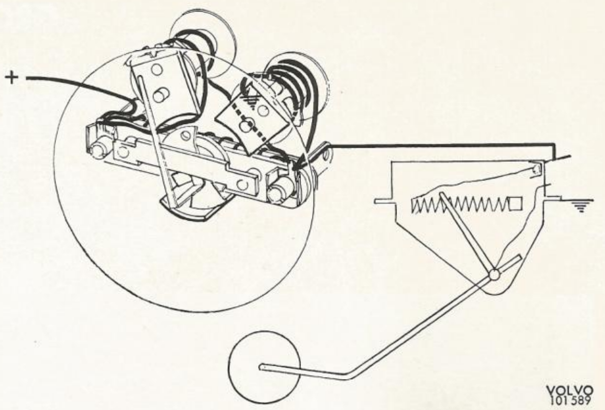


Fig. 3. Construction and function of the fuel gauge.

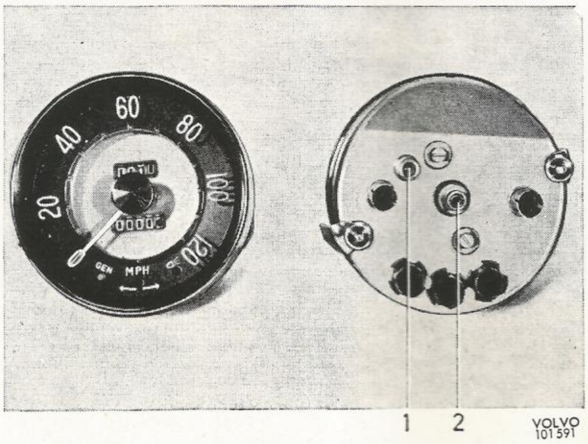


Fig. 4. Front and reverse sides of speedometer.

1. Connection for tripmeter control.
2. Connection for speedometer driving cable.

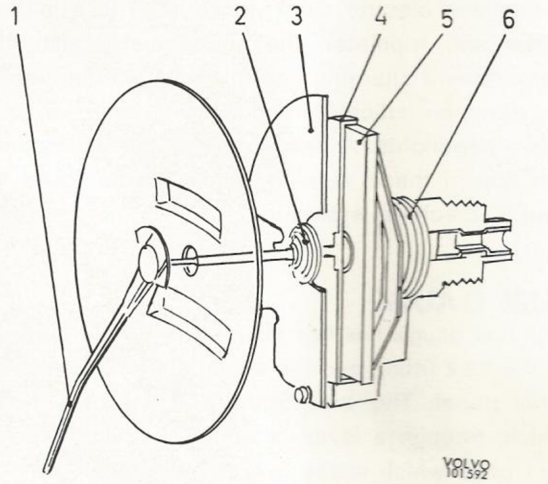


Fig. 5. Schematic view of speedometer.

1. Pointer
2. Counterbalance spring
3. Fitting disc
4. Rotor drum
5. Permanent magnet
6. Worm gear drive for mileometer and tripmeter

on the rotor drum, as well as the induced eddy currents, depend partly on the speed (increased dial reading at increased speed) and partly on the counteracting force of the counterbalance spring. The construction of the speedometer is shown in Fig. 5.

CLOCK

The clock is driven electrically. If the battery has been disconnected for any reason, the clock must be started by pressing in the setting knob. The clock drive consists of an electro-magnet which influences the balance wheel of the clock. In other respects, the clock is provided with an ordinary clockwork mechanism.

When the clock is started, which, as mentioned above, is done by pressing in the setting knob, the windings of the electro-magnet are connected directly to earth. The poles of the magnet then attract the balance wheel in such a way that the balance spring is tensioned. When the setting knob is released, the force of the electro-magnet ceases and the spring pulls back the balance wheel to the starting position. When this happens, a small contact pin on the front side of the balance wheel touches a contact spring. This closes the circuit again and the electro-magnet attracts the balance wheel, although not so strongly this time, at the same time tensioning the spring.

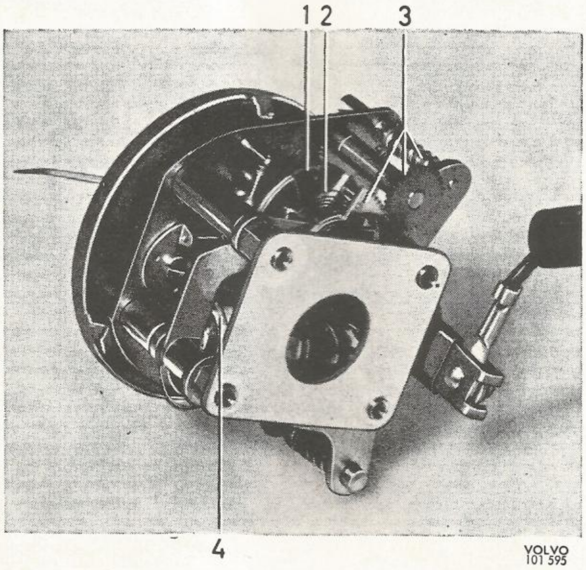


Fig. 6. Clock dismantled.

1. Balance wheel
2. Balance spring
3. "Fast", "slow" mechanism
4. Electro-magnet

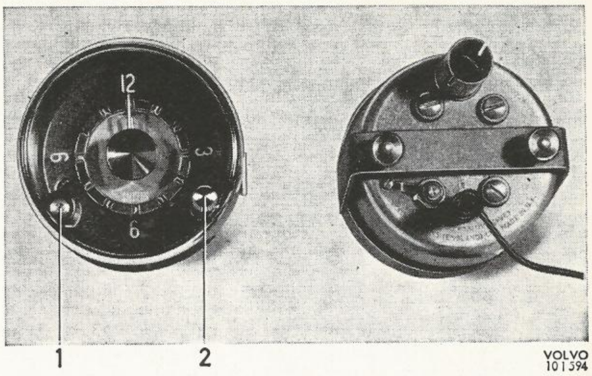


Fig. 7. Front and reverse sides of electric clock.

1. "Fast", "slow" screw
2. Setting knob

When turned, the contact pin separates from the spring, magnetization ceases, the spring moves the balance wheel back and the contact pin makes renewed contact, etc. This reciprocating movement then drives the clockwork mechanism in the usual manner.

Concerning the procedure for adjusting "fast" or "slow", see page 8.

OIL TEMPERATURE GAUGE AND COOLANT TEMPERATURE GAUGE

Both the temperature gauges are combined into a single vertically mounted unit. Each gauge consists of a pickup body and indiactor face. The construction of the gauges is similar so that the following description applies to both of them.

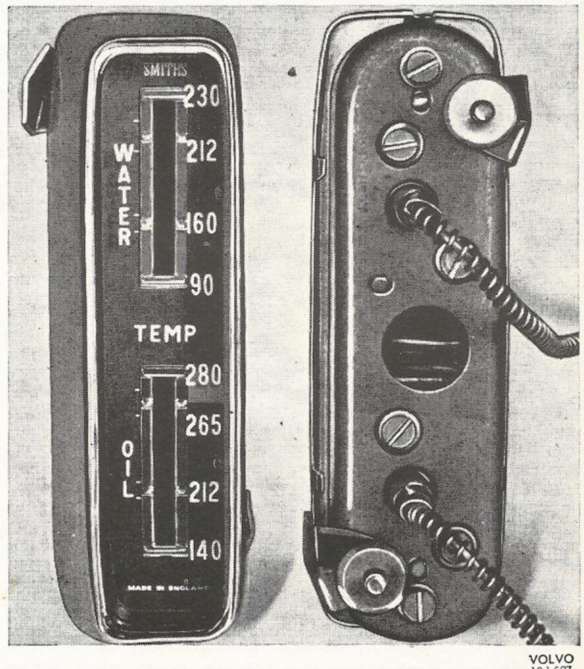


Fig. 8. Front and reverse sides of temperature gauges.

The pickup body and indicator face are connected to each other by means of a connecting pipe with a very small internal diameter. The pipe is sensitive to external influence and is therefore protected with a spiral casing which also prevents sharp bends from occuring in the pipe. The pickup body is in the shape of a small container. It is partly filled with a mixture of volatile liquids principally consisting of ether (acetone in the oil temperature gauge). When the temperature rises, the liquid in the pickup body causes an increase in pressure proportional to the temperature, which is transmitted in the above-mentioned connecting pipe to the tubular spring system in the indicator face part of the gauge. The flat tubular spring then tends to straighten itself out, moving a transmitting arm which influences the indicator of the instrument through a suitable reduction drive. The indicator is in the form of a band made of plastic material.
The indicator scale is graduated either in ° C or ° F. The coolant temperature pickup is fitted in the rear part of the cylinder head and the oil temperature pickup is connected to the engine sump.

OIL PRESSURE GAUGE

The oil pressure gauge is connected to the engine lubricating system by means of a thin pipe. Pressure alterations in the lubricating system are transmitted through the pipe to the oil pressure gauge. This is based on a tubular spring system constructed in such a way that the tubular spring tends to straighten itself out under pressure. This movement is transmitted through a lever to the pointer shaft. A torsion spring tends to move the pointer towards the "O" position. The maximum oil pres-

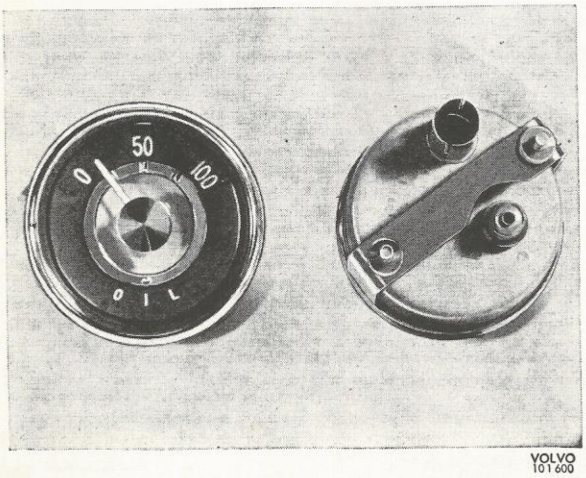


Fig. 9. Front and reverse sides of oil pressure gauge.

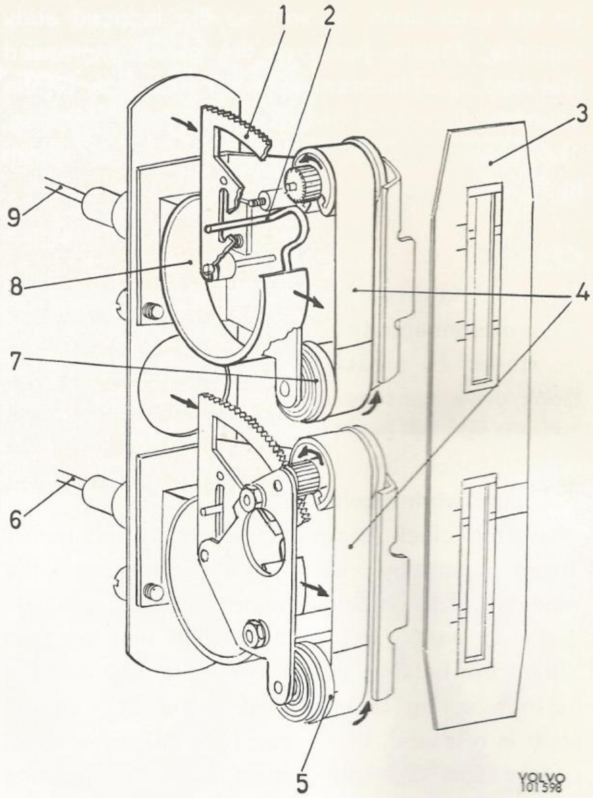


Fig. 10. Schematic view of temperature gauge.

1. Tooth segment
2. Transmitting arm
3. Indicator scale
4. Indicator band
5. Drum for band
6. Connection to oil temperature pickup
7. Torsion spring
8. Tubular spring
9. Connection to coolant temperature pickup

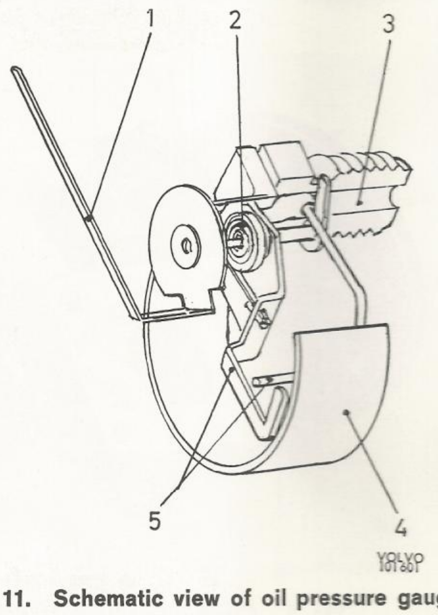


Fig. 11. Schematic view of oil pressure gauge.

1. Pointer
2. Torsion spring
3. Connection to lubricating system
4. Tubular spring
5. Stop device for maximum reading

sure reading of the instrument is limited by means of a stop deviçe to 6 kg/cm² or 100 lb/sq.in. respectively.

REVOLUTION COUNTER

There are three types of revolution counter, one early production and two late production. On the early production type, the pickup is placed in the air intake in front of the radiator. Late production revolution counters have built-in pickups. All of them have the same method of operation. They are connected to the low-tension side of the engine ignition system in such a way that they "sense" the number of impulses generated by the ignition coil. On the early production type, connection is made direct to the low-tension outlet of the distributor. O nthe late production types, the low-tension lead goes past the ignition coil-distributor up to the instrument where it forms a coil consisting of two turns. This coil is attached in a special contact bridge and functions as a primary winding in a transformer built into the instrument. When the contact breakers of the distributor close, the current passes through the above-mentioned coil and magnetizes the core of the transformer. When the contact breakers open, the current flow to the transformer is cut off and an impulse with a very short duration ocurs in the secondary winding of the transformer. This impulse is then fed into a multi-vibrator circuit which contains two interacting tranistors. The circuit finally energizes a moving coil meter, the pointer of which moves over a caibrated scale which indicates a direct reading in r.p.m.

Snice the breaker impulses with which the revolution counter operates are proportional to the engine speed, the current flowing through the instrument will vary, giving a larger or smaller reading respectively. A current of 0–25.0 milliamps passing through the instrument corresponds to a reading of 0–7000 r.p.m.

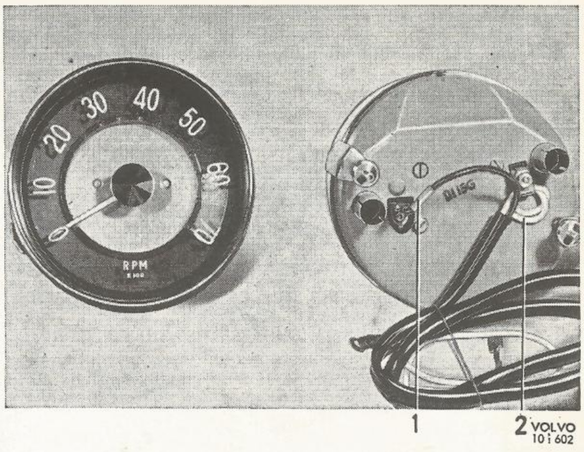


Fig. 12. Front and reverse sides of revolution counter.

1. Feed line from fusebox
2. Line, ignition coil — revolution counter — distributor

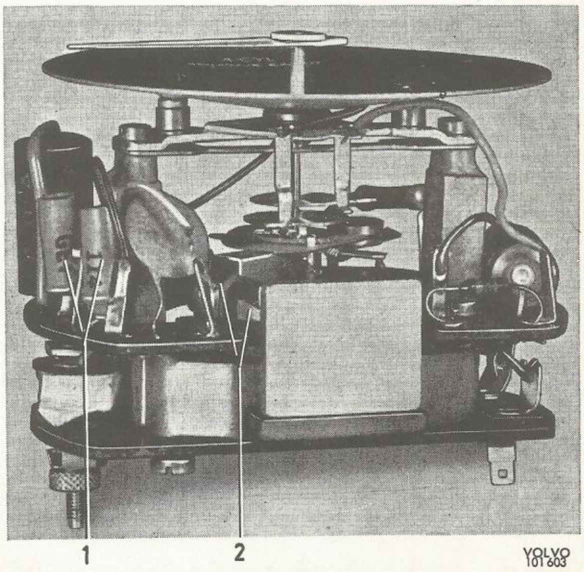


Fig. 13. Revolution counter dismantled

1. Transistors
2. Moving coil

REPAIR INSTRUCTIONS

General

Before removing or fitting any of the instruments, one of the battery connections must **always** be removed and lifted clear of the battery. This precautionary measure also applies to instruments which are not connected electrically, for example, the oil pressure gauge and temperature gauge. Otherwise the connecting lines, particularly those from the temperature gauge, can cause short-circuits which can be both difficult and expensive to repair. All the instruments are totally enclosed and can therefore not be dismantled without interfering with the rim of the instrument. In many cases, repairs can involve such extensive work that it is not justified when considering the continued reliability of the instrument or from a purely cost point of view compared with a new instrument. If, however, repairs have to be carried out for any particular reason, it is recommended that the work should be entruster to an authorized instrument repair workshop.

FUEL GAUGE

Before removing any component belonging to the fuel gauge, the fault should first be localized as described below.

First check the lead terminals of the instrument to ensure that they make good contact. Switch on the ignition. Check by means of a voltmeter or test lamp that there is voltage on the feed side of the instrument. When this has been ascertained, continue testing as follows.

The instrument shows "Empty"

1. Disconnect the lead terminal on the tank fitting and hold the lead away from the vehicle frame. Switch on the ignition. The fuel gauge should then show "Full".
2. If the instrument shows "Empty", disconnect the lead on the instrument (the lead which connects the actual instrument to the tank fitting). If the instrument now shows "Full", there is nothing wrong with it and the fault will either be in the tank fitting or in the connecting lead to the instrument.

The instrument shows "Full"

1. Disconnect the lead terminal on the tank fitting. Switch on the ignition.
2. Earth the lead connected to the tank fitting with the help of a test lead. If the pointer goes over to "Empty", there is nothing wrong with the lead or dial. The fault is to be found in the tank fitting.
3. If, when carrying out these tests, the pointer does not go over to "Empty", also disconnect the lead at the terminal on the instrument. Connect the contact screw to earth by means of a test lead. If the instrument is undamaged, the pointer should then go over to "Empty". Otherwise the fault is due either to poor contact on the terminals between the instrument and lead to the tank fitting or a breakage in the lead. A faulty instrument or tank fitting should be replaced with new parts.

Replacing the instrument

REMOVING

1. Disconnect one of the battery terminals.
2. Remove the leads. Mark the position of the leads.
3. Unscrew the nuts and bulb holder.
4. Lift out the instrument.

FITTING

1. Fit the retainers, spring washers and nuts. Tighten the nuts, at the same time pressing the instrument up against the instrument panel. Do not forget the earth connection.
2. Connect up the terminals.
3. Check the function of the instrument.

Replacing the tank fitting

REMOVING

1. Make sure that the ignition key is in the switched-off position.
2. Take out the spare wheel and turn back the mat.
3. Blow well clean round the tank fitting with compressed air.
4. Disconnect the lead, remove the screws which hold the tank fitting and lift it out.

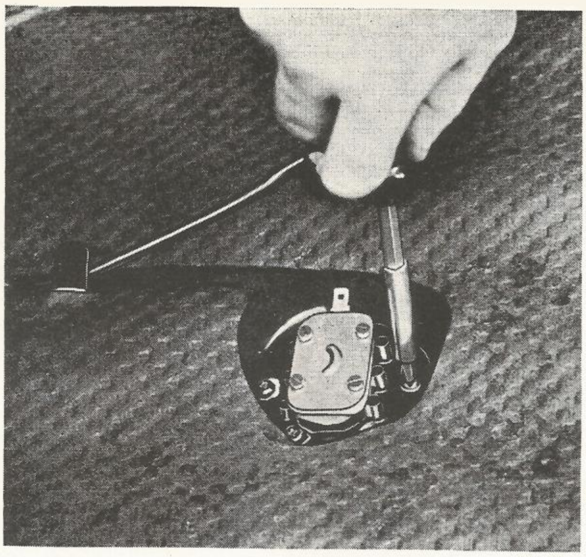
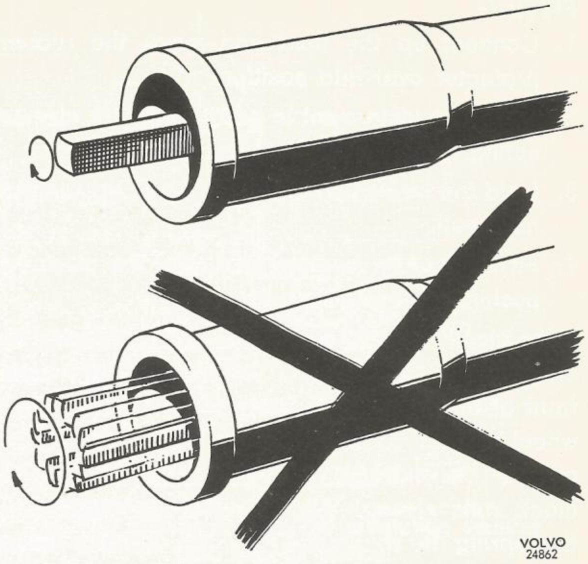


Fig. 14. Fitting the tank fitting.



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FITTING

Always use a new gasket in order to prevent leakage and petrol fumes inside the car.

1. The gasket should be coated on both sides with a sealing adhesive which does not affect rubber and which is not dissolved by petrol.
2. Place the gasket in position on the tank. Place the tank fitting in position, see Fig. 14, and tighten the screws well. Connect the lead.
3. Fit the remaining parts.

SPEEDOMETER

If the speedometer does not give a reading but the mileometer still functions, or vice versa, the fault is in the instrument. If neither the instrument nor the mileometer shows a reading, or if the pointer is unsteady, the speedometer drive cable should be replaced as it is probable that the cable is broken or binds in the outer casing.

Checking the speedometer cable

It is most important that the speedometer cable should be fitted correctly in order for the speedometer to function without trouble. The following should therefore be observed. At the connections on the gearbox and instrument, the cable must not be bent at less than 5 cm (2″) from the connection concrened. At no point must the bending radius of the speedometer cable be less than 15 cm (6″). If the bending radius is less than this, vibration can ocurr in the instrument. The driving cable should rotate concentrically in the outer casing, checking being carried out with the speedometer cable rotating as shown in Fig. 15.

Replacing the speedometer

REMOVING

1. Remove the bulb holders for the instrument lighting and warning lamps. Be careful that the guides for the instrument do not come out at the same time.
2. Disconnect the speedometer cable and control for the tripmeter. Release the instrument clamps and take out the instrument.

1. Place the instrument in position, fit on the retainers, washers, earth connections and nuts.
2. First tighten the nuts loosely and check the position of the instrument. Hold the instrument firmly in the correct position and tighten the nuts well.
3. Fit the speedometer cable, control for the tripmeter and the respectively bulb holders.
4. After fitting, check the function of all warning lamps and instrument lighting bulbs.

REPLACING THE CLOCK

REMOVING

1. Disconnect one of the battery terminals.
2. Remove the nuts on the respective clamp and lift of the earth connection. Remove the bulb holder.
3. Remove the connecting lead of the clock.

FITTING

1. Connect up the lead and move the rubber protector over into position.
2. Place the instrument in position, fit the clamps spring washers, earth connection and nuts.
3. Hold the instrument in position and tighten the nuts well.
4. Fit the battery terminal and start the clock by pushing in the setting knob.

If the clock runs fast or slow, it can be adjusted by means of the "fast", "slow" adjusting screw on the front of the clock. This finely adjusts the balance wheel spring. When turned clockwise, a larger part of the balance spring is engaged and the clock runs slower. When turned anti-clockwise, the spring is shortened and the reverse takes place. One graduation on the indicating scale corresponds to about 5 minutes per 24 hours.

OIL TEMPERATURE GAUGE AND COOLANT TEMPERATURE GAUGE

TESTING THE TEMPERATURE GAUGE AND REMOVING THE PICKUP BODY

If any fault is suspected in either of the temperature gauges, carry out the following check before removing.

1. In the case of both gauges it is necessary to lower the levels of the liquid before the pickups are removed. If the pickups have got stuck, prise them carefully backwards and forwards. Be careful with the measuring pipes.
2. Immerse the pickup body in a container filled with hot water. An ordinary and previously checked mercury thermometer is used for making comparative readings. In order to obtain good measuring results, both the pickup body and thermometer should be prevented from coming into contact with the bottom of the container.

Replacing the oil temperature gauge and coolant temperature gauge

REMOVING

1. Disconnect one of the battery terminals.
2. Remove the pickup concerned as described under the previous heading.
3. Unscrew the nuts and carefully pull out the instrument. Be careful not to make sharp bends in the delicate measuring pipes.

FITTING

1. Place the instrument in position.
2. Put the pickups through the rubber bushing and insert them through the bulkhead.
3. Tighten up the instrument. Do not forget the earth connection.
4. Fit the pickup bodies in their respective places.

When fitting, make sure that the terminations of the measuring pipes at their respective connections are coiled a couple of turns in order to absorb vibrations from the engine.

REPLACING THE OIL PRESSURE GAUGE

REMOVING

1. Disconnect the pipe from the oil pressure gauge.
2. Take out the bulb holder and remove the clamps which hold the instrument.

FITTING

1. Place the instrument in position and tighten it up.
2. Connect the oil pipe. Do not forget the sealing washer.
3. Start the engine and check the instrument for leakage.

REVOLUTION COUNTER

Function check

REVOLUTION COUNTER (early production)

In the event of any fault on the revolution counter, the function of the instrument can be checked by connecting an ammeter for 10 milliamps or more (maximum 100 milliamps) between the chassis (–) and terminal pin "M" (+).

At 2800 r.p.m. the ammeter should give a reading of 10 milliamps. The internal resistance of the ammeter must be less than 70 ohms within the measuring range concerned.

If the ammeter does not give any reading, first check that there is no fault in the leads. If the leads are intact, the trouble is probably in the pickup. In the case of a faulty pickup and/or instrument of early production, replace the instrument with one having a bulit-in pickup. This unit is wired up as shown in Fig. 17. The leads for the old pickup are removed.

N.B. The lead from the ignition coil to the distributor should be wired across the revolution counter, see further under "Description" on page 5.

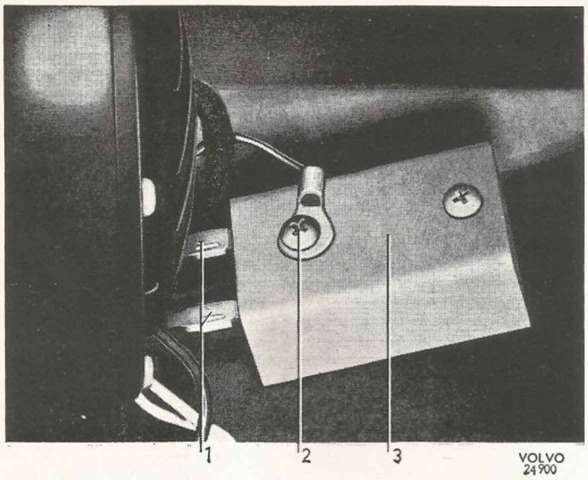


Fig. 16. **Pickup for revolution counter (early production.)**

1. Terminals
2. Earth lead
3. Pickup

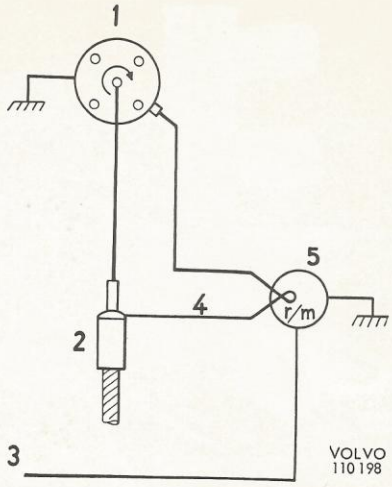


Fig. 17. Wiring diagram for revolution counter with built-in pickup.

1. Distributor
2. Ignition coil
3. Feed lead from fusebox
4. Lead, ignition coil – revolution counter – distributor
5. Revolution counter

REVOLUTION COUNTER (late production)

1. Switch on the ignition and check by means of a test lamp or voltmeter that there is voltage on the feed side of the instrument.
2. Connect up a reliable speed tester and make comparative readings.
3. The reading tolerance of the revolution counter is about ±100 r.p.m. within the range 0–3500 r.p.m., and double this amount on the remaining part of the instrument scale. When comparing the readings, also take into account the reading tolerance of the speed tester.

Replacing the revolution counter

REMOVING

1. Remove the bulb holders and disconnect the feed lead of the instrument.
2. Disconnect the contact yoke on the low-tension lead of the ignition coil.
3. Unscrew the nut, lift off the retainers and take out the instrument.

FITTING

1. Place the instrument in position, fit on the retainers, washers and nuts. Do not forget the earth connection.
2. Connect the low-tension lead and the feed lead of the instrument.

GROUP 94

HEATER SYSTEM

DESCRIPTION

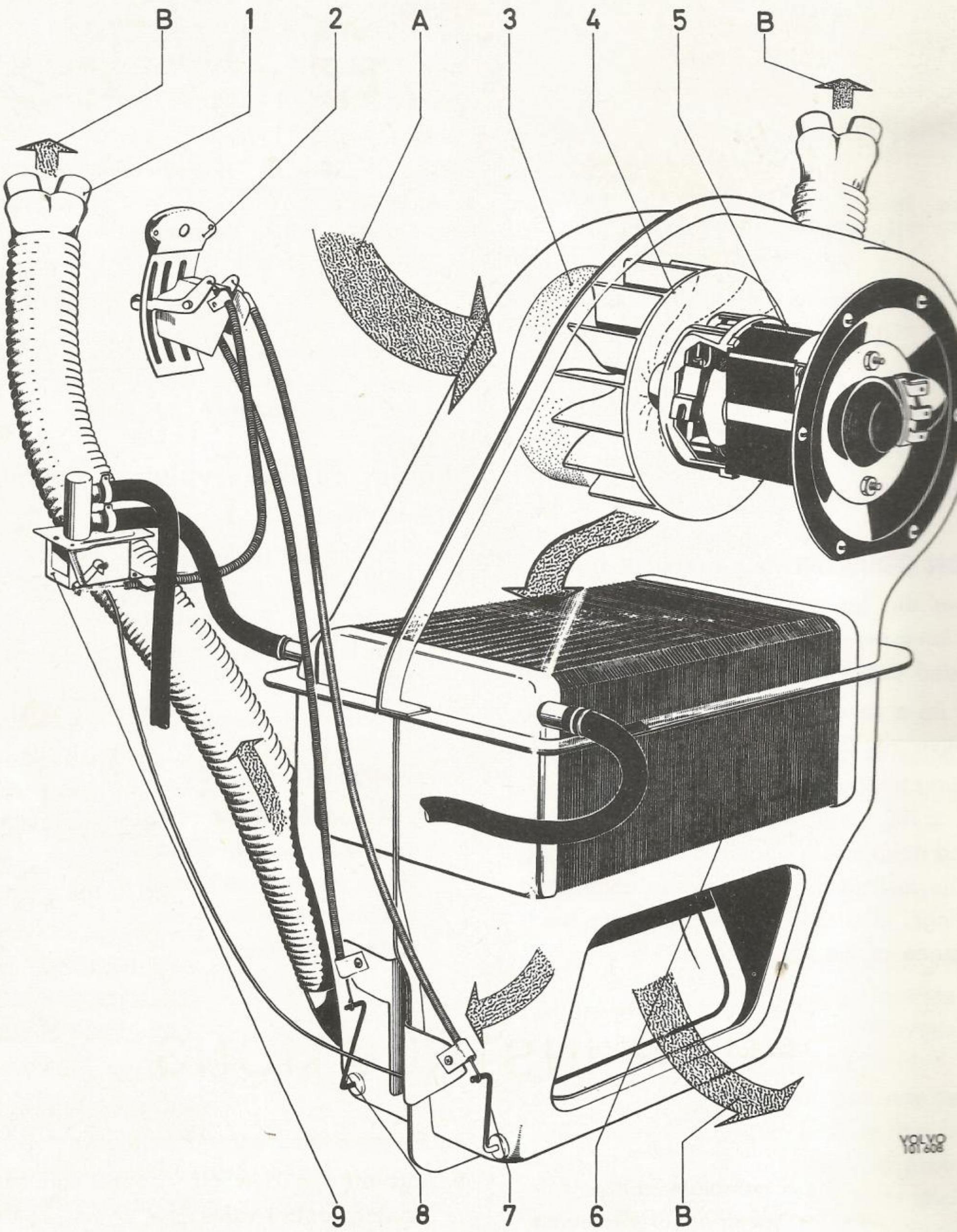


Fig. 18. Heater

1. Defroster nozzle
2. Control unit
3. Air intake
4. Fan wheel
5. Fan motor
6. Cell system
7. Lever for air shutter
8. Lever for defroster shutter
9. Heater control valve

A Incoming air
B Outgoing air

The heater, which is illustrated in Fig. 18, consist of the following main parts: fan housing with fan wheel and electric motor, cell system, distribution housing including shutters, heater control valve and controls.

The figure also shows the direction of air flow.

HEATER CONTROL VALVE

The purpose of the heater control valve is to control the supply of heated coolant to the cell system of the heater. This supply is controlled by the valve in two ways: both manually by means of the heater control (TEMP) and automatically through the thermostat arrangement. The function of the heater control valve is shown in Fig. 20.

When the heater control (TEMP) is moved downwards, the valve is opened and coolant supply to the cell system begins. When the temperature of the coolant rises, the air passing through the cell system also becomes warmer. After passing through the cell system, the air flows down to the lower part of the heater in which the shutter arrangements and sensitive coil of the thermostat are placed. When the air flowing through has reached a particular temperature, an increase in pressure ocurs in the sensitive coil. This causes the expansion body of the thermostat to expand and influences the valve in such a way that the coolant supply to the cell system is restricted, thereby reducing the heat transmitted to the air flowing through. The thermostat then begins to contract and the valve opens again. The continuous repetition of this process causes the temperature of the air flowing into the car to be maintained constant at the desired level.

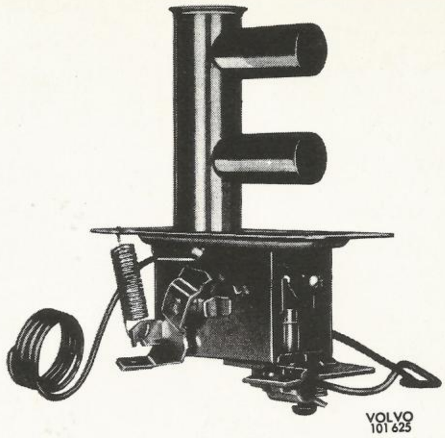


Fig. 19. Heater control valve

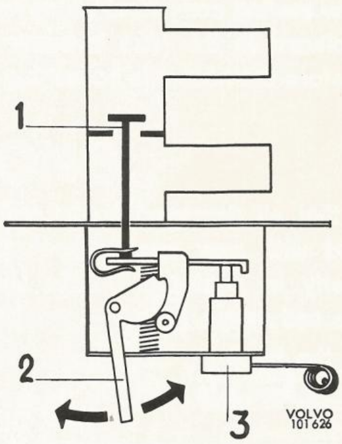


Fig. 20. Function of heater control valve
1. Valve
2. Lever for heater control
3. Thermostat

REPAIR INSTRUCTIONS

HEATER

The heater is removed as a complete unit as follows (this also applies for repairing or replacing the cell system):

1. Drain out the coolant.
2. Remove the rubber hoses on the cell system and heater control valve.
3. Disconnect the fresh air intake of the heater.
4. Remove the heater attaching nuts.
5. Lift off the defroster hoses and remove the heater control valve.
6. Lift out the heater from the car.

DISMANTLING

1. Unscrew the screws which hold the heater halves together and separate them.
2. Lift out the cell system.

Checking the cell system

Clean the cell system externally and lower it under pressure (max. 1.2 kg/cm²=17 lb/sq.in.) into water heated to about. 70–80° C (160–175° F). The joints in the cell system are soldered. The pipe connections are brazed. If any leakage is discovered, the place concerned should be cleaned very thoroughly so that the new solder can flow in properly.

After sealing has been completed, check the cell system again for leakage in accordance with the above instructions.

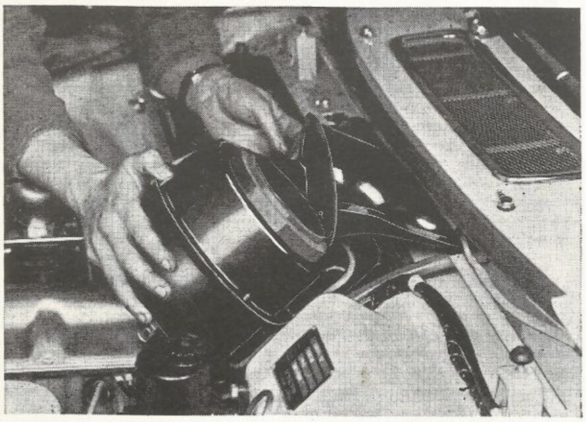
ASSEMBLING

1. Check the shutters for binding or looseness.
2. Place in the sensitive coil of the thermostat as shown in Fig. 22.
3. Apply new sealing compound where necessary. This is placed in the joint between the two halves before the heater is bolted together.

FITTING

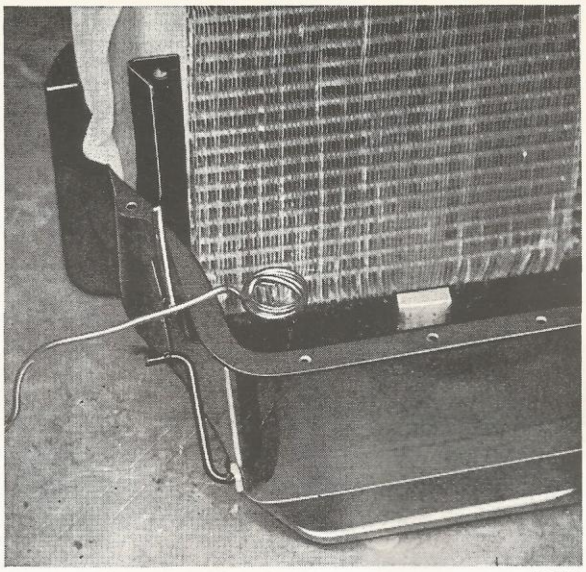
Make sure that all damaged hoses and gaskets are replaced with new ones. Check that they come properly in position. Handle the heater control valve and copper pipe with great care.

1. Place in the fresh air duct of the heater, see Fig. 21, and bolt it in position.
2. Bolt on the heater.
3. Fit the heater control valve and hoses.
4. Connect up the cables from the heater control unit in their respective places and connect the leads to the fan motor.



VOLVO 101 628

Fig. 21. Fitting the heater



VOLVO 101 627

Fig. 22. Assembling the heater

After fitting, check the function of the shutters, controls and fan motor. Make sure that the drain hose for the heater is open and correctly positioned. Fill up with the coolant which was previously drained off.

Start the engine and increase the speed sharply a sufficient number of times to expel the air in the system and then top up with the remaining coolant. Repeat this procedure until the cooling system is completely vented.

Replacing the heater controls

1. Unscrew the screws which hold the control unit.
2. Remove the bulb holder and disconnect the control cables.
3. Connect the cable to the new control unit, tighten it into position and fit the bulb holder.

ADJUSTING

Move up the controls to their closed positions. Then check the position of the shutters and heater control valve. If they are not fully closed in this position, they should be adjusted. This can be done after the outer casing of the cable has been loosened at the respective attaching point on the heater or heater control valve. After adjustment has been completed, move the controls up and down a few times to check the function.

Replacing the ventilation device with controls

1. Lift up the fresh air intake grille. Remove the splash guard insert. Make sure that none of the clips get lost in the heater.
2. Unscrew the nut which holds the pull control and push out the ventilation device from underneath upwards.
3. Before fitting, check that the shutter does not bind and that the sealing strip is in good condition and properly in position.

ADJUSTING

The shutter should be adjusted so that it closes against its sealing strip under light pressure when the pull control is pushed in fully.

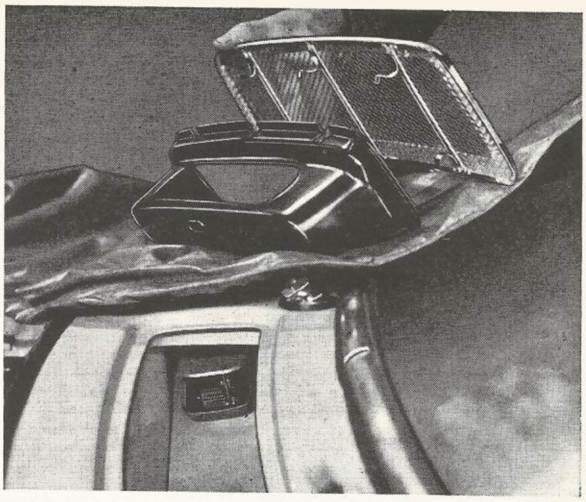


Fig. 23. Fresh air intake grille and splash guard.

SPECIFICATIONS

SPEEDOMETER GEARS
165—15 tyres

Rear axle ratio	Speedometer gears			Theoretical percentage error of mileometer
	Number of teeth		Ratio	
	Large gear	Small gear		
4.10:1 (10/41)	5	17	3.2/1	−0.23
4.56:1 (9/41)	5	19	3.6/1	+0.26

The percentage error in the above table is calculated for a rolling ratius of 309 mm ($12^5/_{32}$"), which is a standard value established by AB Volvo for this size of tyre at a vehicle speed of about 80 km.p.h. (50 m.p.h.).

References to Workshop Bulletins

TP 10263/1 A
3.000. 6. 1966
Engelska
Printed in Sweden

Handelstryckeriet, Göteborg