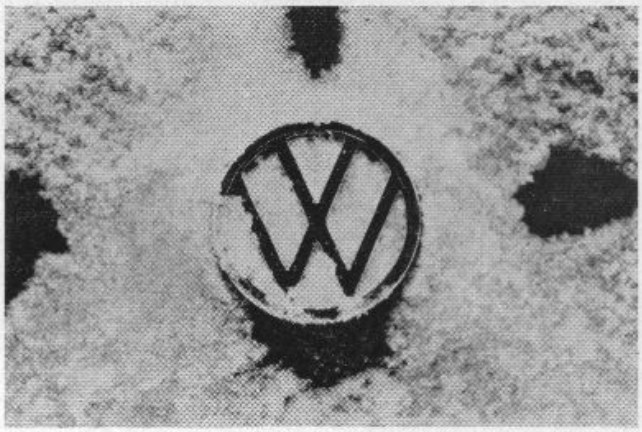
LOOK
LISTEN
DO IT BETTER

Eberspächer Heaters for Volkswagen Vehicles

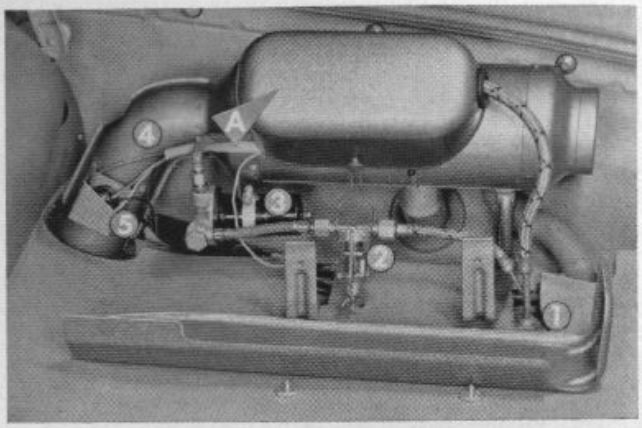
Slide Series No. 23

EBERSPÄCHER HEATERS FOR VOLKSWAGEN VEHICLES

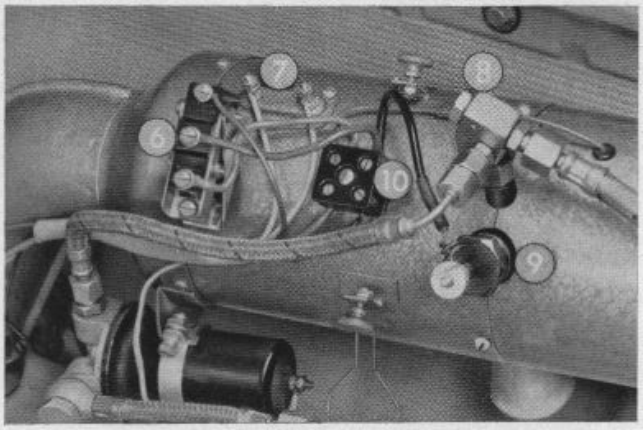
23/1 Customers who desire more heat in their vehicles can have an Eberspächer heater fitted. Do you know all the advantages of this heater? The interior of the body can be warmed up before moving off on a trip. The body is then nice and warm right from the start before the vehicle heating system developes its full capacity. The heater can also be used to supplement the vehicle heating if desired.



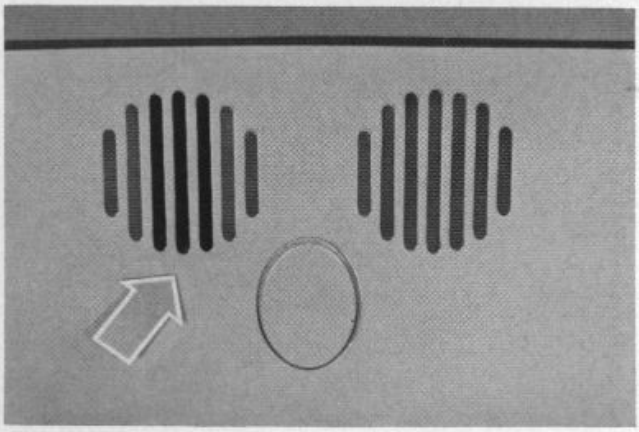
23/2 Here you see the heater fitted in the front luggage compartment of a Volkswagen 1500. Those of you who deal with vehicle maintenance and repair should know all about this heater and that is why we have produced this slide series which deals with the construction, operation and maintenance of the heater and also gives hints on trouble shooting.



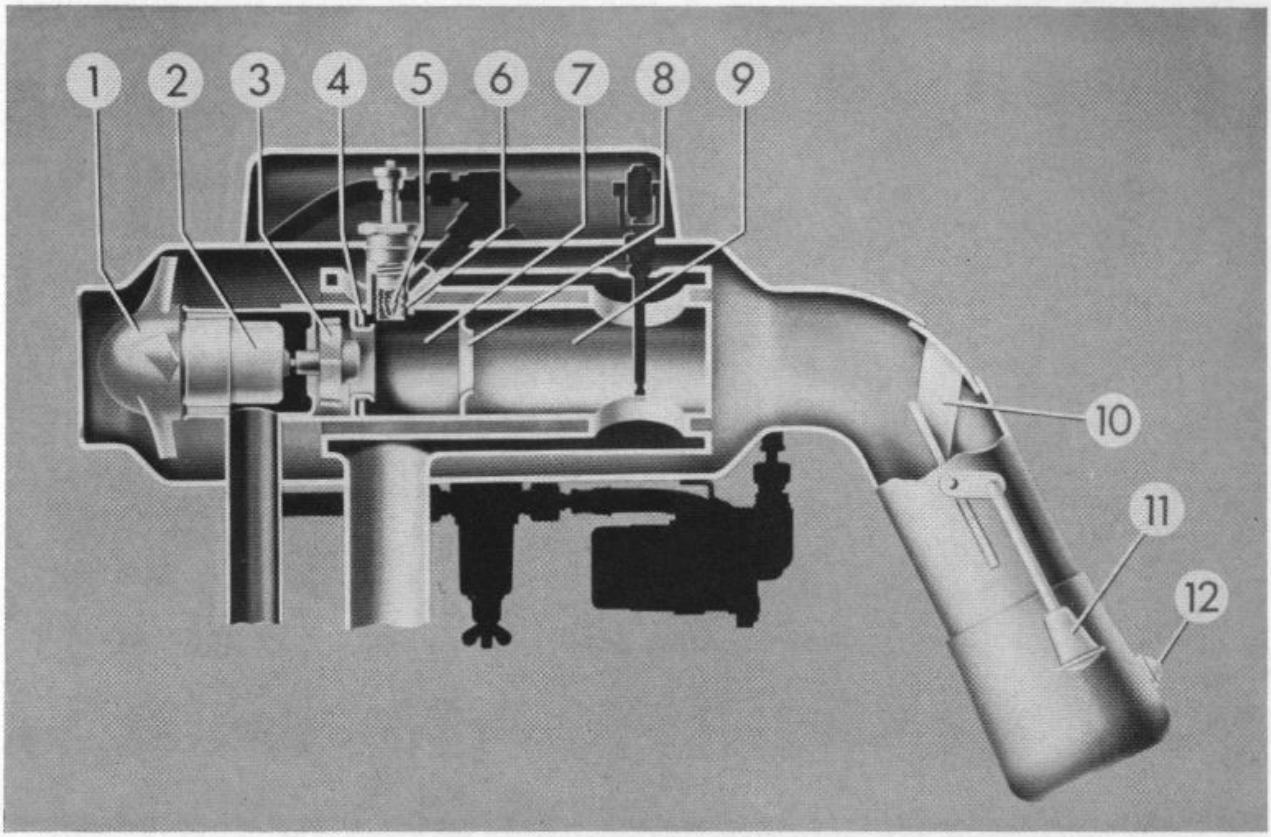
23/3 Here are the most important parts: 1 is the tank connection, 2 is the fuel filter, 3 is the electrical fuel pump. On the warm air duct 4 is the main switch 5. Under the cover A —.



23/4 Here it has been taken off, you will find the thermoswitch 6, the overheating switch 7, the jet carrier 8 and the heater plug 9. On the cable to the heater plug you can see spiral coils of the resistance. Number 10 is the junction box for the electric cables.

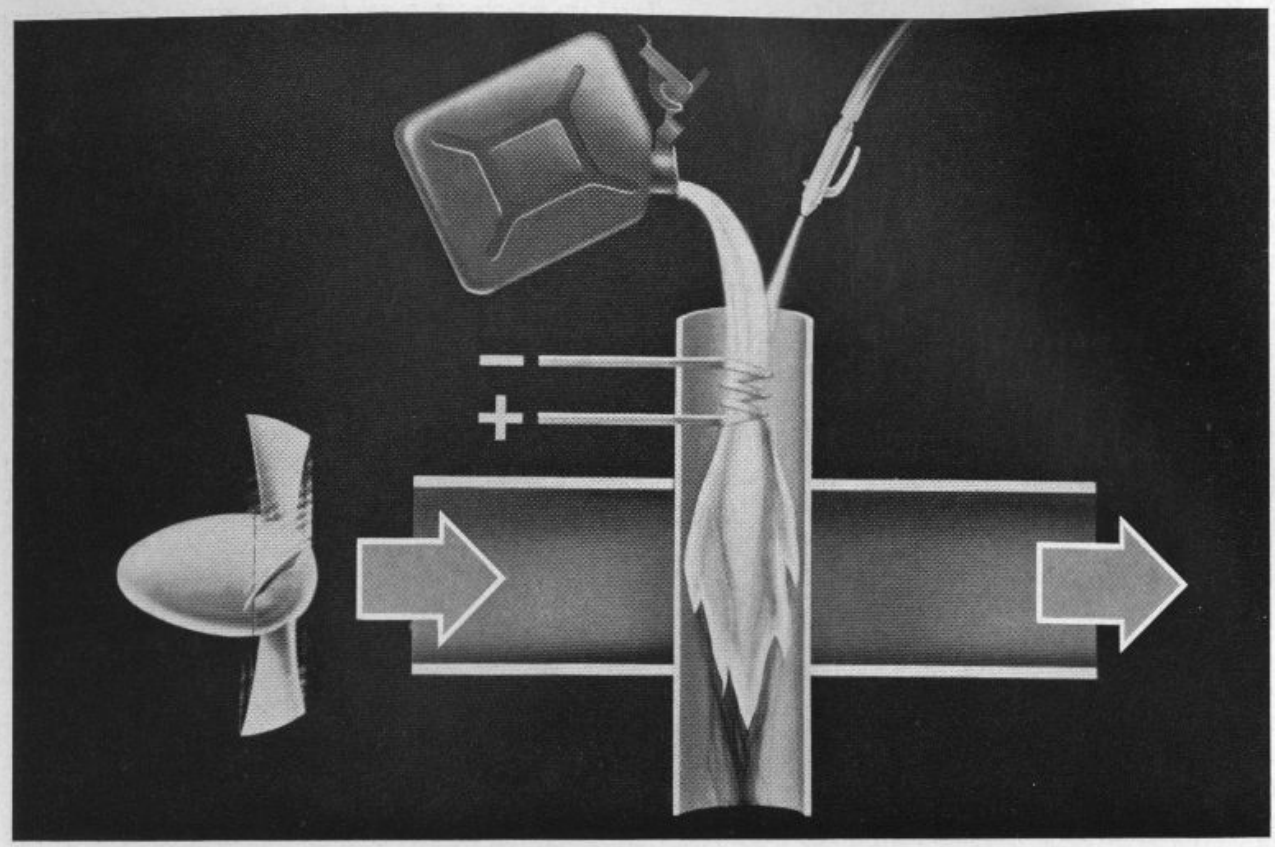


23/5 Now let us glance quickly at the front of the vehicle. At 3 of the slots in the right-hand sound opening, looking in direction of travel, the plastic foil has been removed. This ensures that fresh air for the heater can flow into the luggage compartment.

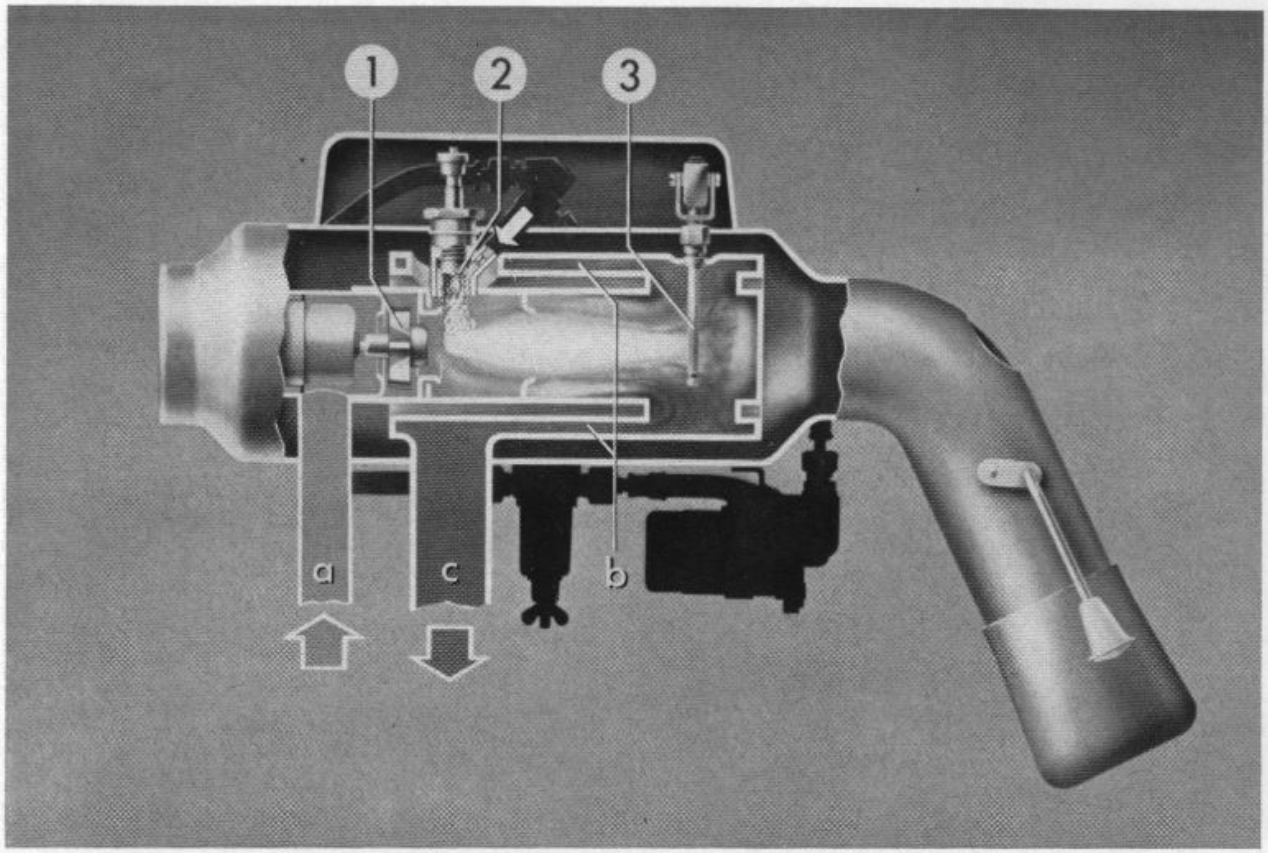


23/6 Here is a cross sectional view of the heater. On the left is the fresh air blower 1 and the electric motor 2 which also drives the combustion air blower 3. The safety ring 4 separates the motor and blower from the combustion part of the heater. The heater plug 5 is screwed into an adaptor which also serves as an ante-chamber 6. 7 is the combustion chamber in which the flame is formed, 8 is the flame jet and 9 the combustion chamber proper. Parts 5 to 9 form the inner part of the heat exchanger.

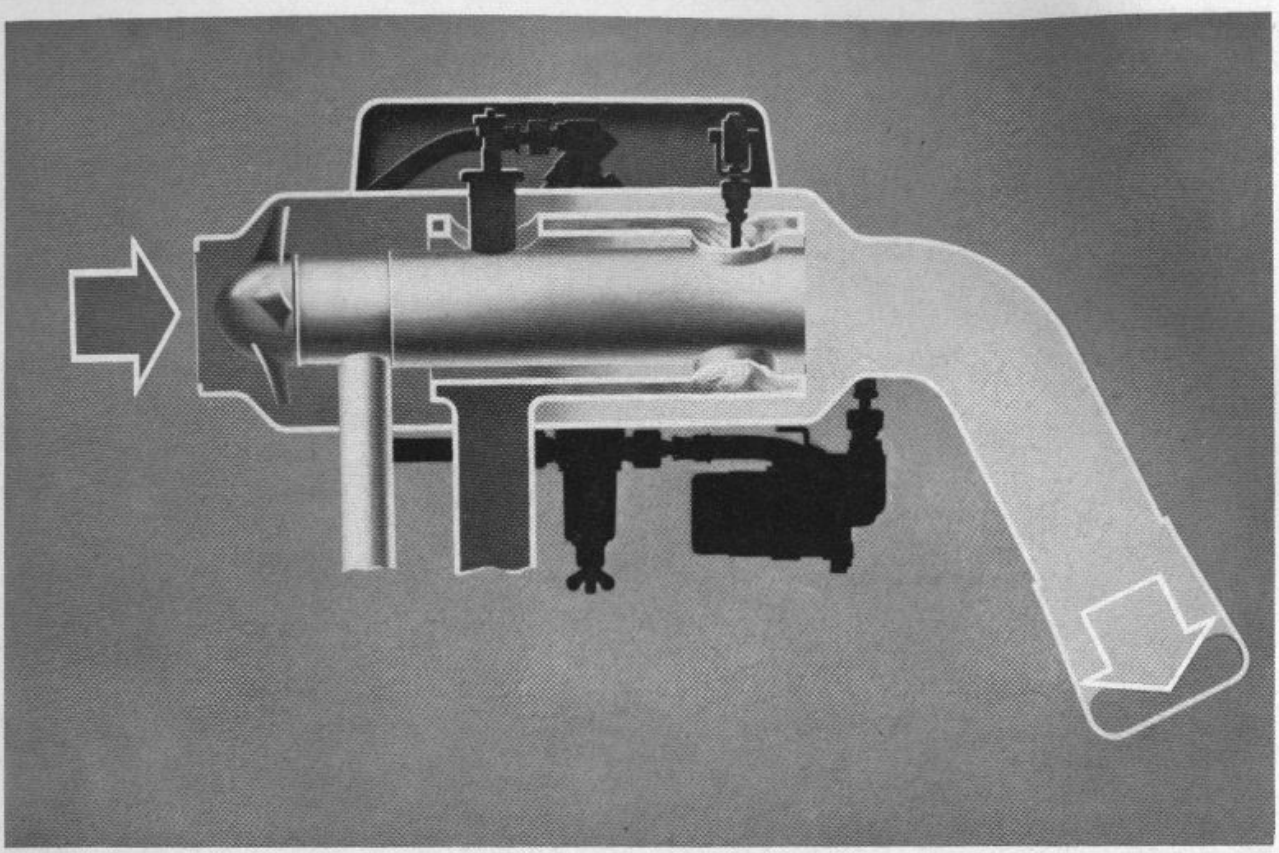
23/7 In the warm air duct on the right is the air control flap 10 which, together with the main switch, is operated by knob 11. When the flap is closed and the heater thus switched off, the hole in the top part of the duct is opened so that the air flowing during the run-on period passes into the luggage compartment. Number 12 is the warning lamp in the warm air duct.



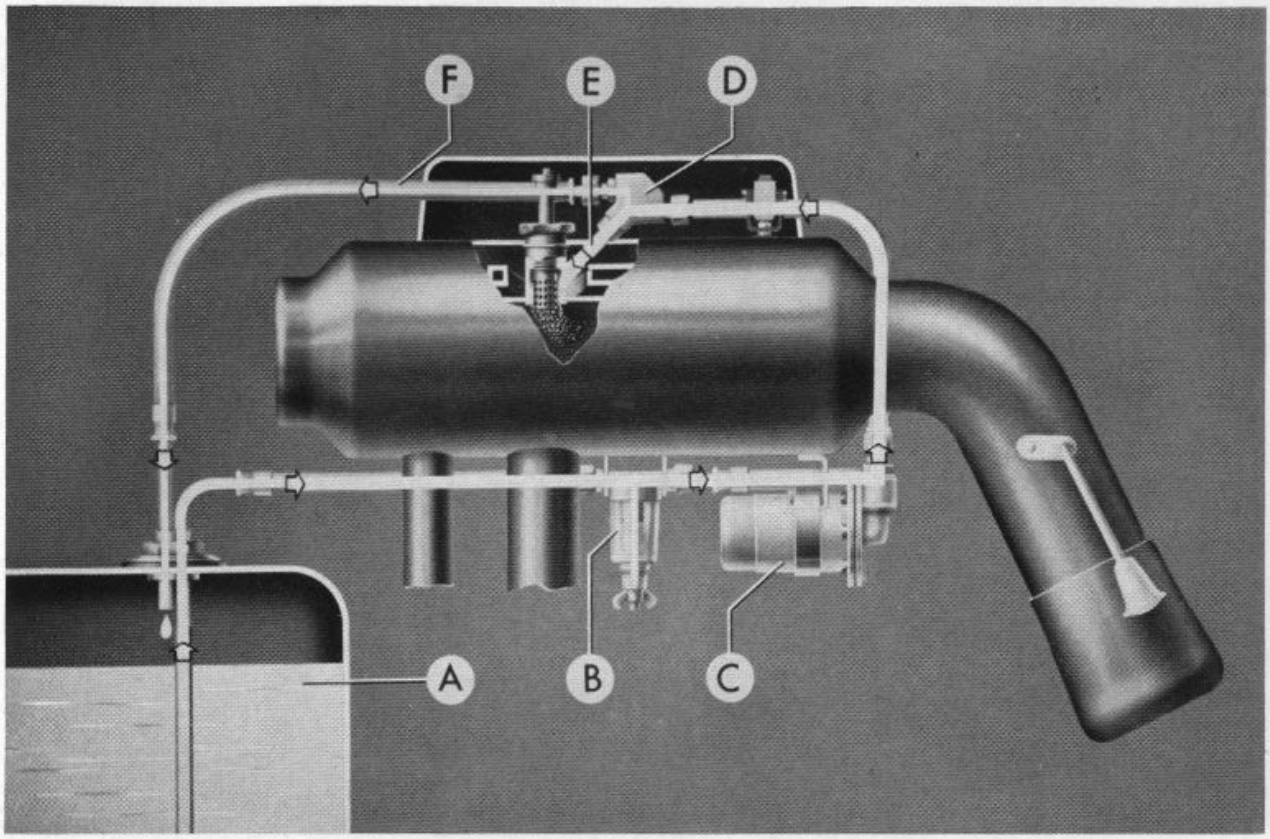
23/8 You have seen the way the heater is constructed and the main component parts. This picture shows you the working principles. Fuel and air are introduced into an enclosed chamber in the correct proportions and ignited by an electrical heater plug. The resultant flame heats the walls of the combustion chamber and then flows through an exhaust pipe into the open air. Fresh air is heated by being blown past the combustion chamber and is then routed into the vehicle interior. You will notice that one of the basic principles of the Eberspächer heater is the use of two separate air feeds. One for the combustion process inside the heat exchanger and the other for the fresh air which flows round the outside of the heat exchanger casing.



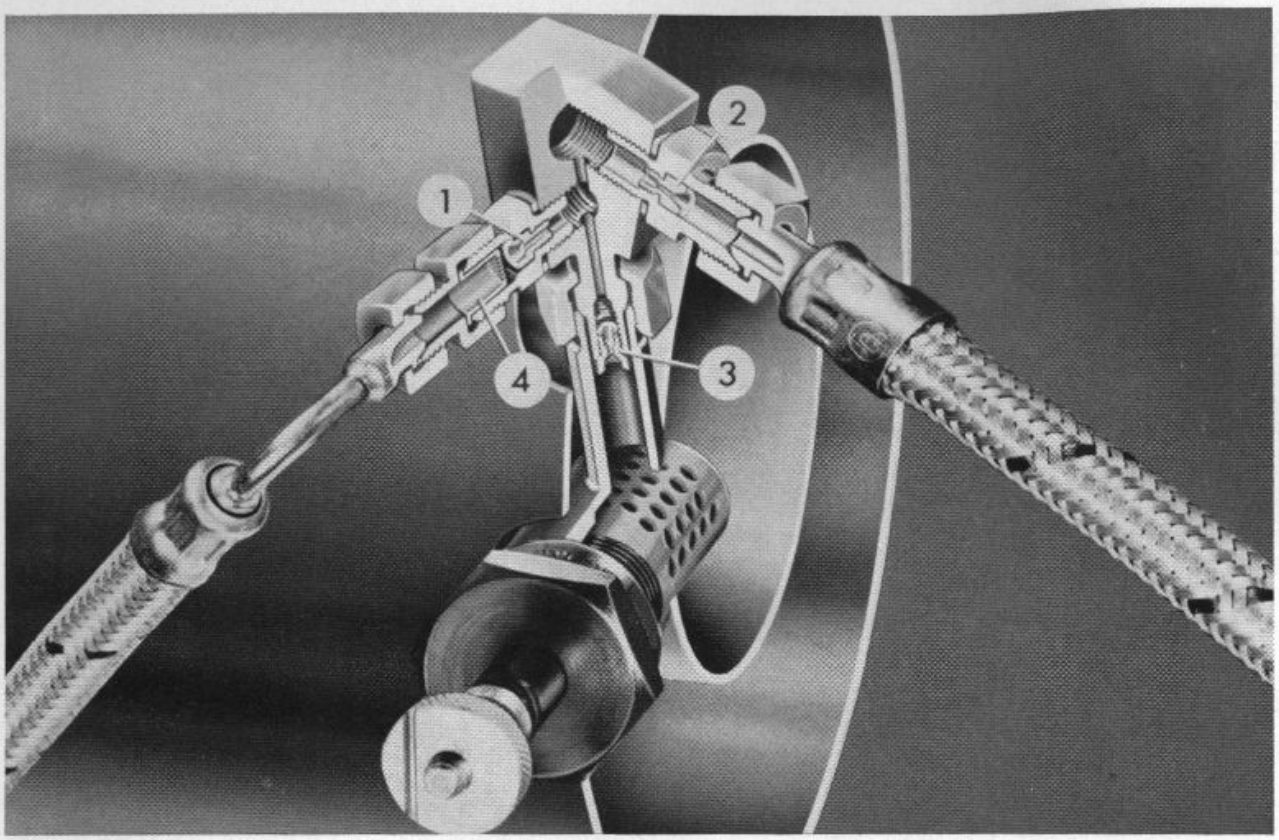
23/9 In actual practice it is not quite as simple as shown in the previous picture. Let us look at this section through the combustion air carrying parts of the heater. The electric motor drives the radial blower 1 which draws in air through the intake pipe (a) and blows it into combustion and ante-chambers. Fuel injected into the ante-chamber (white arrow) mixes with the combustion air and is ignited by the heater plug 2. The resultant flame passes through the combustion chamber and the outer part of the heat exchanger — the annular chamber — (b). The burnt gases pass through the exhaust pipe (c) into the open air. At the point where the flame is hottest the feeler tube of the thermo-switch (3) projects into the combustion space.



23/10 Fresh air is drawn in by the blower — shown on the left here — and passes over the outer surface of the heat exchanger. In doing this, it is warmed up to 90° C above the intake temperature. The hot air passes through the duct on the right into the vehicle body.

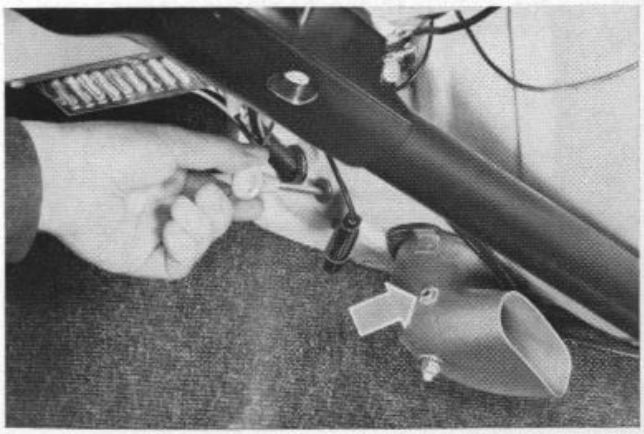


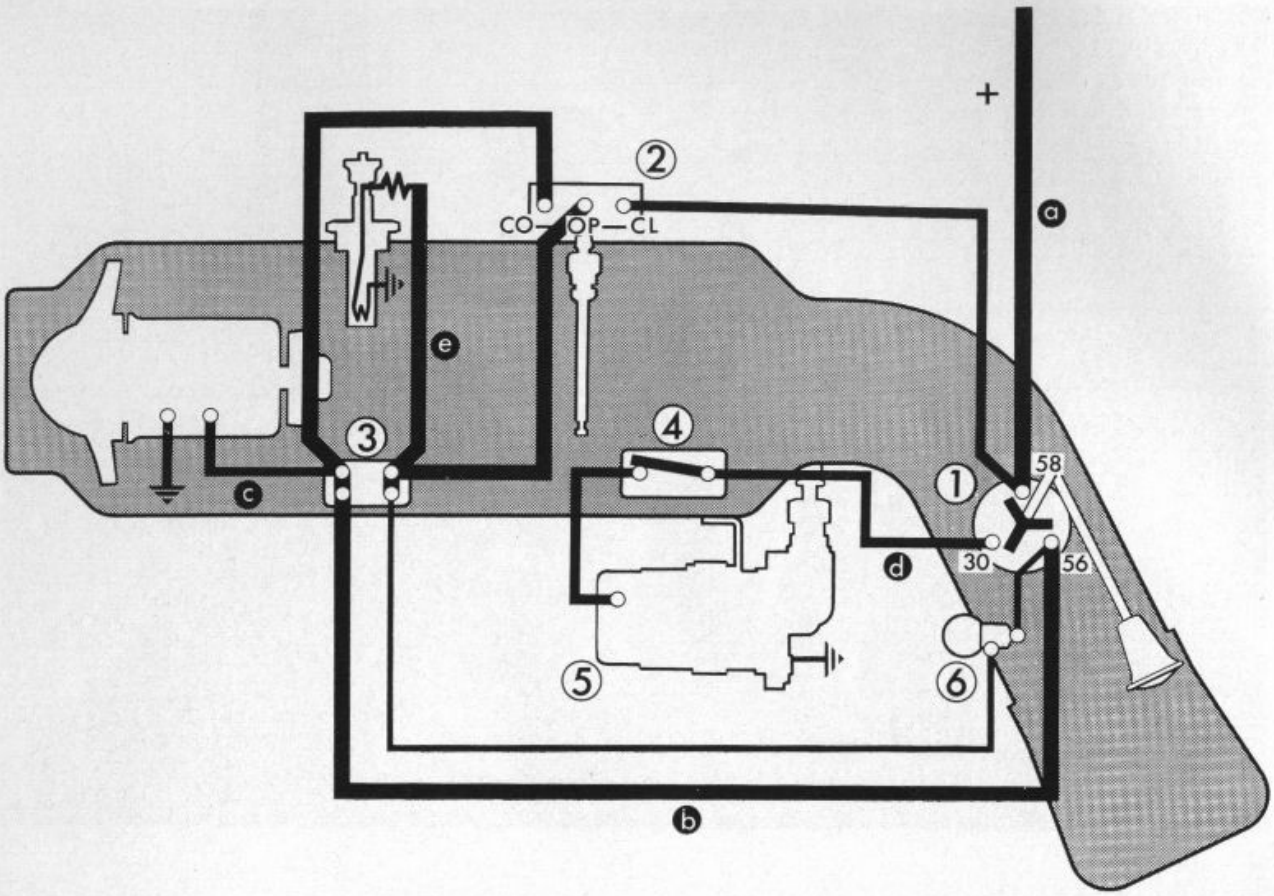
23/11 This picture shows the fuel circulation of the heater. A suction pipe connects the vehicle tank A to the electric fuel pump C via a filter B. The pump supplies the fuel to the jet carrier which contains a system of jets of different sizes and in turn supplies the correct amount of fuel to feed jet E which opens into the ante-chamber. Surplus fuel flows through the return pipe F back to the tank.



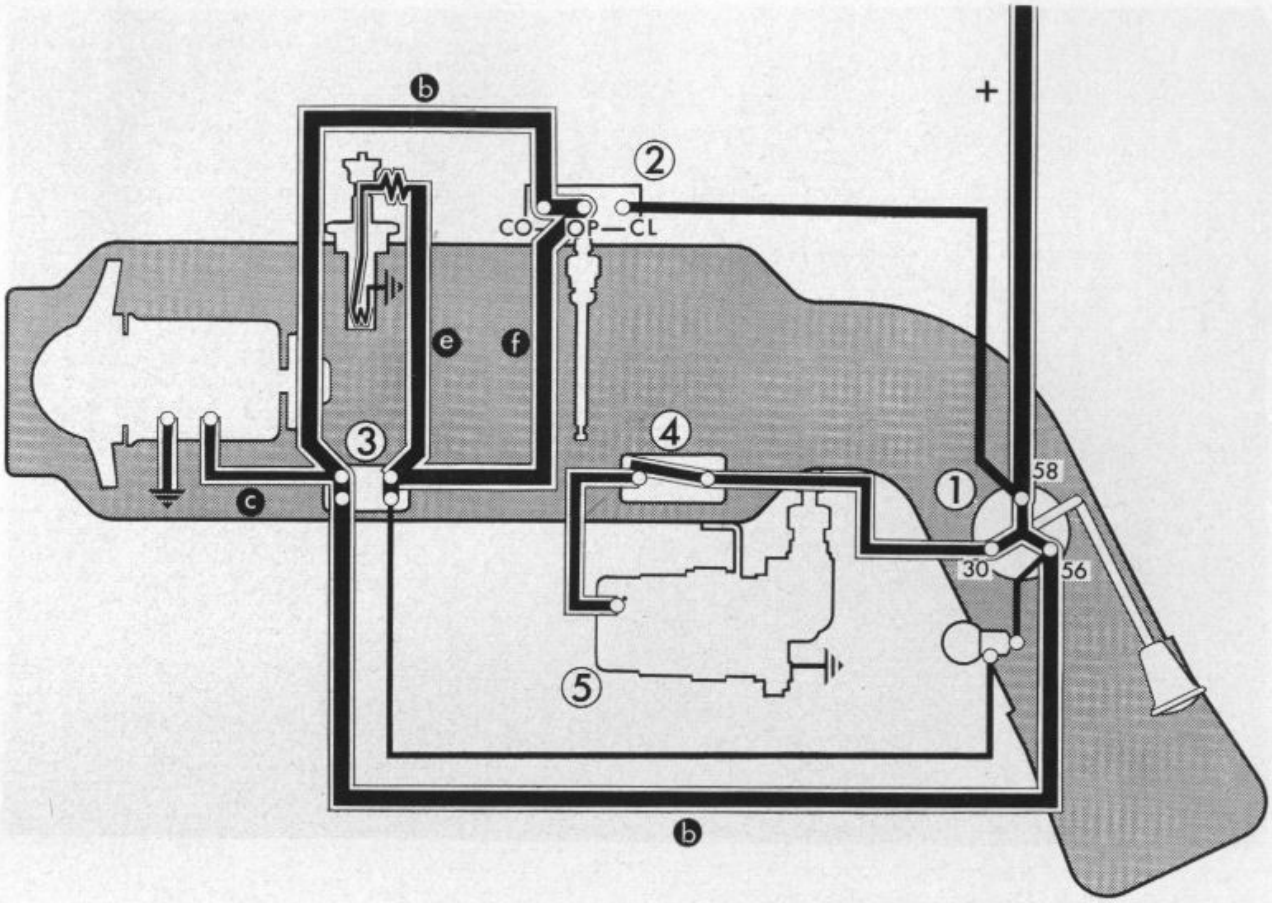
23/12 Here is a sectional view of the jet carrier. The regulating jet 1 controls the amount of fuel entering the jet carrier. The actual heater fuel usage is metered by the feed jet 3 which opens into the ante-chamber. Excess fuel flows through the overflow jet 2 back into the tank. All three jets are matched to one another in size and must not be interchanged. Jets 1 and 2 have a diameter of 0.325 mm and the overflow jet 2 has a diameter of 0.75 mm. A fine filter 4 in front of the regulating jet keeps back dirt in the fuel.

23/13 Before we go on with the function of the heater let us glance briefly at the controls: On the left under the instrument panel is a knob which must be pulled out fully to switch the heater on. After about 45 seconds the warning lamp in the warm air duct lights up and shows that the heater is working properly. To switch the heater off, just push the knob in again. This cuts off the flow of fuel to the heater but the blower continues to run. This is the so-called run-on which blows out the remaining traces of combustion gases and cools the heater down. The duration of this process is shown by the warning lamp which goes out after about 3 minutes and shows that the run-on process is finished. Please note that the heater must not be switched on again during the run-on period, that is, as long as the warning lamp is on. The reason for this will be clear when we have had a closer look at the electrical system. We shall come back to this question later.

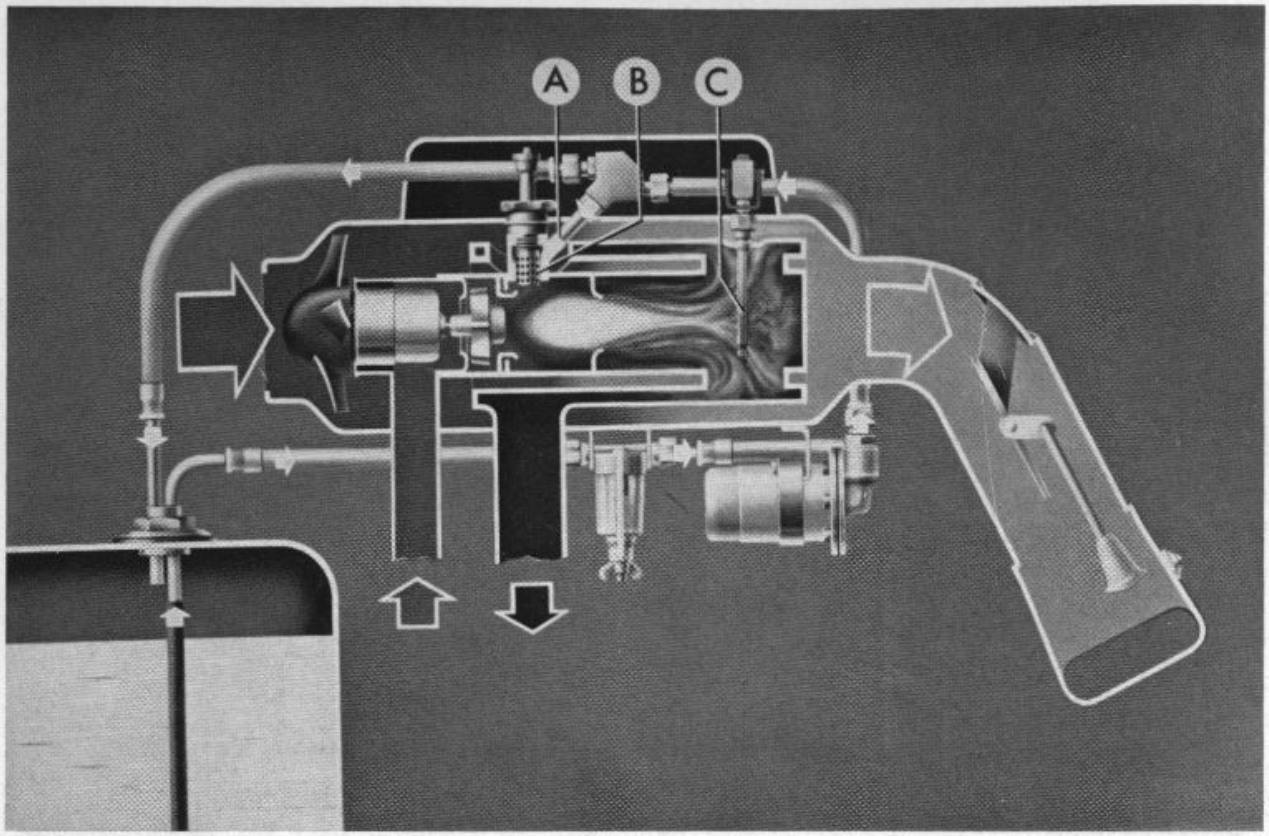




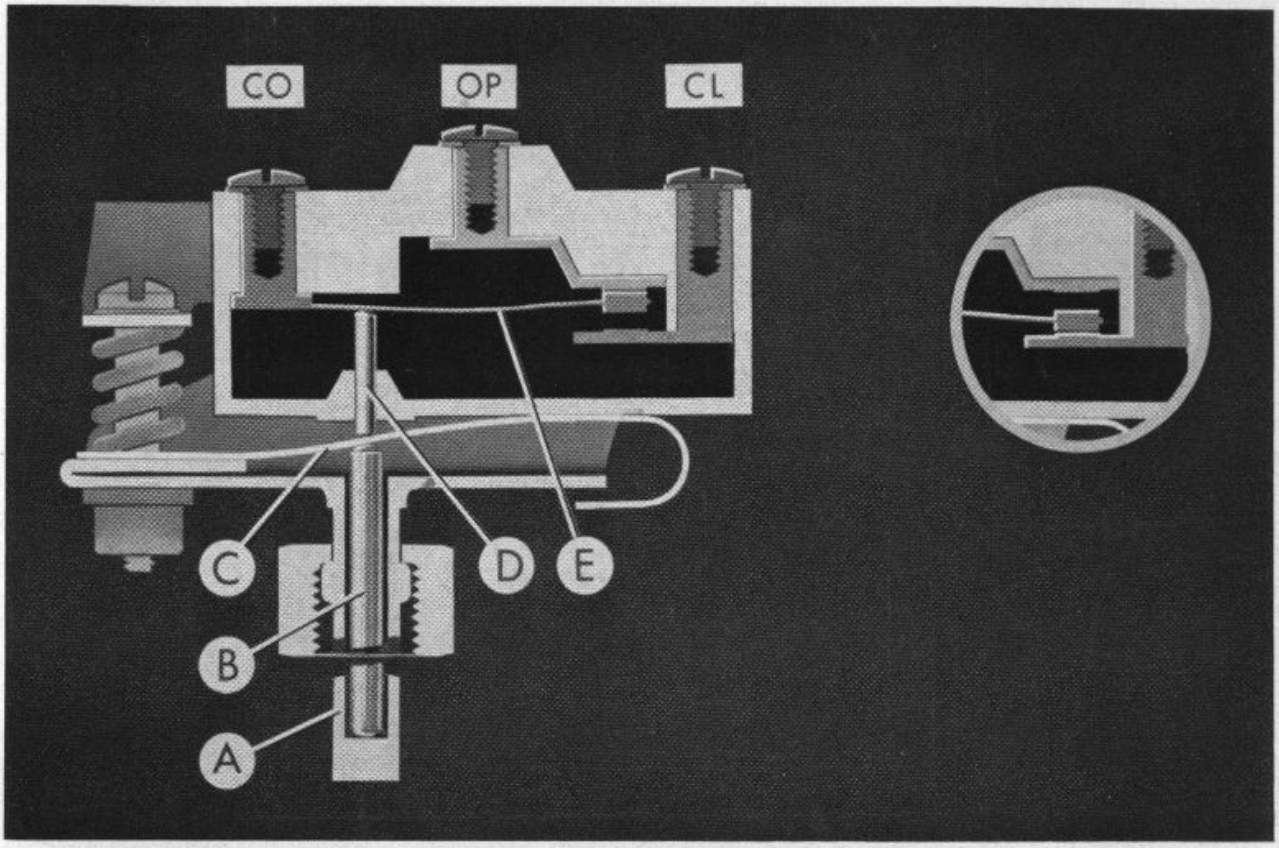
23/14 Most of the heater operations are controlled electrically. We must, therefore, understand the electrical system fully and can begin by looking at this wiring diagram. On the right is the main or delay switch 1 with a cable (a) leading from terminal 58 via a 25 Amp fuse fitted in the cable, to terminal 30 in the vehicle fuse box. 2 is the thermo-switch which is also connected to terminal 58 at the main switch. The other two terminals are connected to a small junction box 3. Most of the cables in the heater are connected to this junction box. From terminal 56 on the main switch, a cable (b) leads to the junction box and a cable (c) leads from there to the blower motor. From terminal 30 on the main switch, a cable (d) passes via the overheating switch 4 to the fuel pump 5. The warning lamp 6 is wired between terminal 56 on main switch and the junction box 3. The heater plug is also connected here with cable (e) and a series resistance. What happens when we operate the main switch by pulling out the knob under the instrument panel?



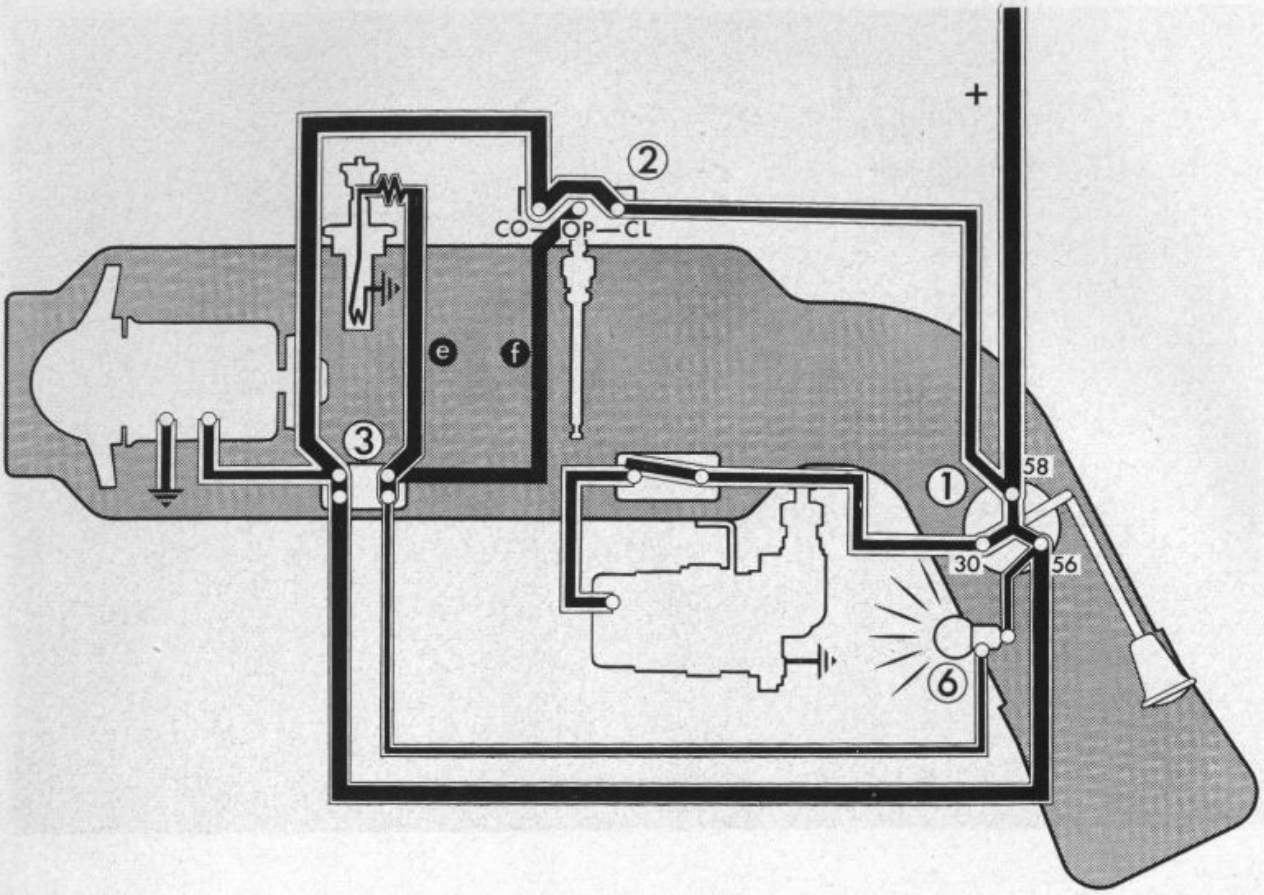
23/15 This picture shows you. To make it easier to understand, all current carrying cables are lined in white. In the main switch 1, the three terminals are connected and all carry current. Let us follow the circuit: The cable (b) passes from terminal 56 to junction box 3 where the blower motor is connected with cable (c). The motor receives current and starts to run. The cable (b) also leads to the thermo-switch 2 where, as the heater is still cold, terminals CO and OP are bridged. The cable (f) leads to junction box 3 and from there cable (e) passes to the heater plug via the serious resistance. The heater plug starts to glow. The fuel pump 5 is connected to terminal 30, which is also live, via the overheating switch 4 and also starts to work. The warning lamp cannot light up yet because it is connected between two points with the same voltage, that is terminal 56 on the main switch and junction box 3.



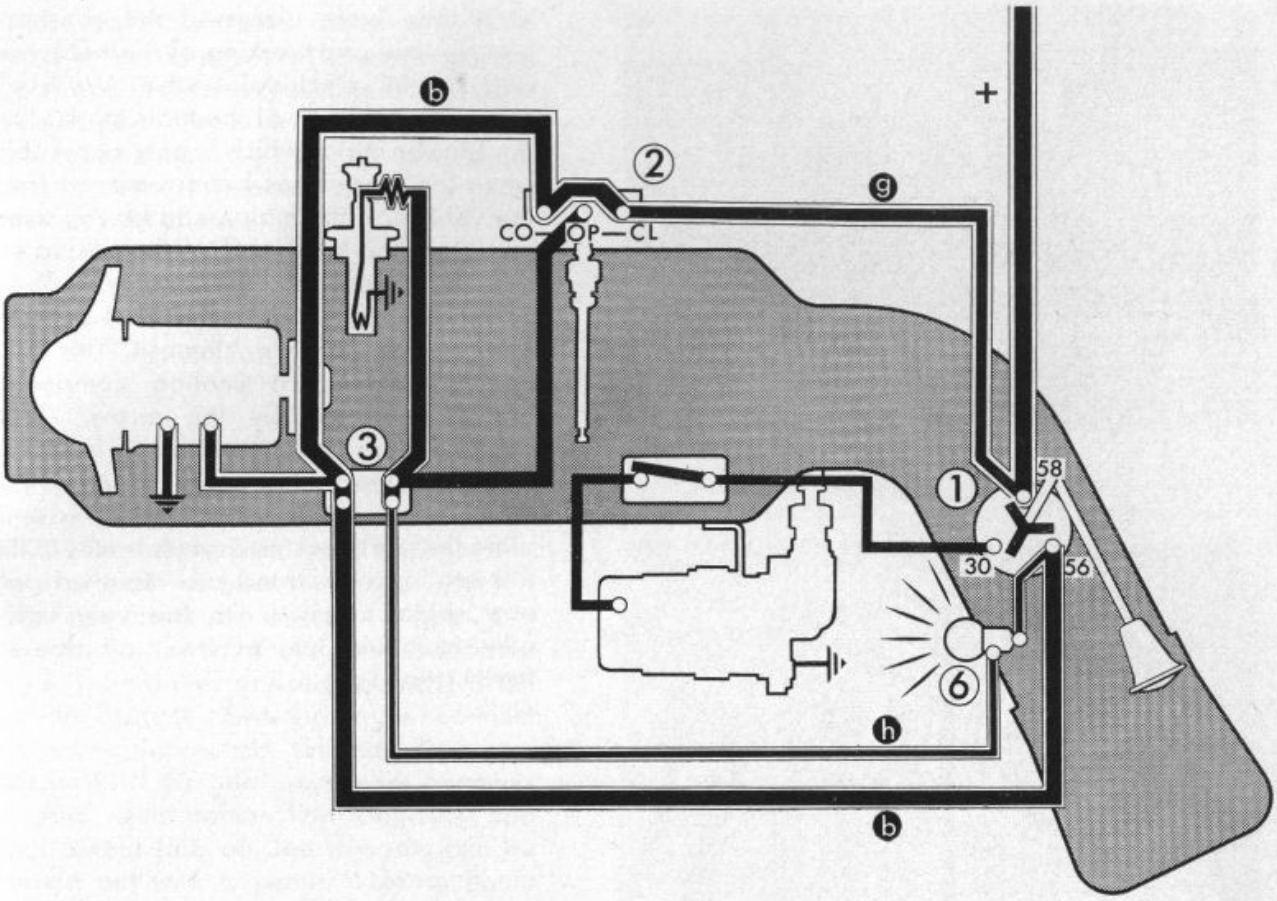
23/16 What has happened in the heater? The blower motor is running and air is being supplied to the combustion chamber and via the heat exchanger and warm air duct to the interior of the vehicle. The fuel pump delivers fuel to the jet carrier where it passes through the feed jet A into the ante-chamber, is mixed with the combustion air and ignited with the heater plug B. A flame is formed and starts to warm up the heat exchanger as well as the feeler tube C of the thermo-switch. Fresh air flowing into the heat exchanger also begins to warm up. The heating procedure has commenced.



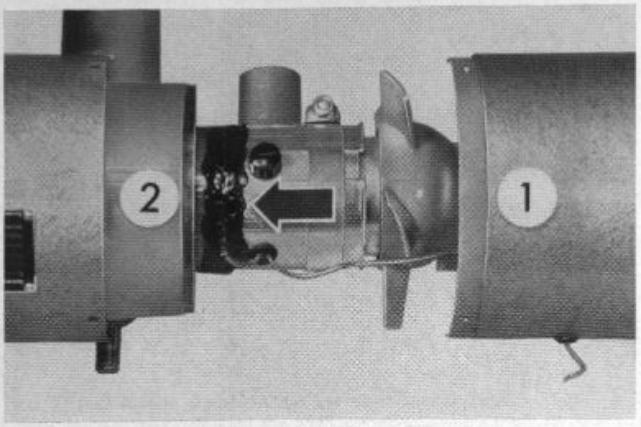
23/17 As we have already heard, the feeler tube of the thermo-switch is directly exposed to the flame. As the heat increases, the tube begins to expand towards its free end, that is, downwards. Inside the tube A is a freely moving quartz rod B which is pressed against the bottom of the tube by the switch spring C. As quartz expands very slightly, in relation to steel, even at very high temperatures, the quartz rod follows the movement of the expanding tube downwards. The small plunger D, loaded by the contact spring E also moves downwards. At a certain preset temperature, the switch operates and cuts off the flow of current to the heater plug. The heater plug is no longer required as the flame now continues to burn automatically. In the thermo-switch, the terminals CO-CL are now bridged as shown in the small circle on the right.



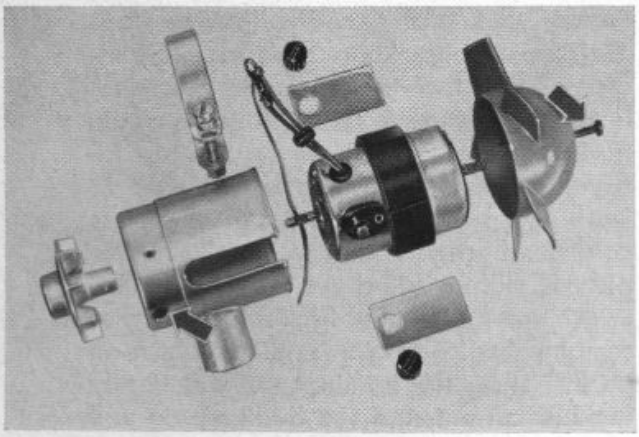
23/18 In the wiring diagram it looks like this: The terminal OP in the thermo-switch, the cable (f) and the heater plug cable (e) are no longer live. The heater plug is switched off so current can now flow from terminal 56 of the main switch 1 via the warning lamp to ground. The lamp lights up but as it has a high resistance, the flow of current is insufficient to make the heater plug glow. The lighting of the warning lamp indicates that the heater is operating properly. We can also tell that the thermo-switch is working as it should.



23/19 We said before that the blower motor continues to run after the heater has been switched off, so that the rest of the gas can be blown out and the heater cooled down. How is this run-on achieved? The knob is pushed right in to switch the heater off and this breaks the connection between the three contacts. The fuel pump is thus switched off and the heater flame goes out. The blower motor is now supplied with current from terminal 58 on the main switch which is connected to the positive side, via cable (g), the bridged contacts CO-CL in the thermo-switch and the cable (b) from terminal CO. The warning lamp which also continues to burn during the run-on period obtains its current in the same way. That is, via the cable (b) which connects terminal 56 and the junction box 3. The cable (h) for the warning lamp is connected at terminal 56 and leads to ground via the junction box and the heater plug. After about 3 minutes, the feeler tube has been cooled off so much that the thermo-switch operates and breaks the circuit between CL and CO. The blower stops and the warning lamp goes out. This indicates that the run-on period is ended. If the heater were to be switched on again during the run-on period, contrary to instructions, the fuel pump would start to work and pump fuel into the more or less cold combustion chamber. As the heater plug is still switched off by the thermo-switch, the fuel cannot ignite. If the heater remains switched on until the run-on period ends, the terminal OP will finally receive current and the heater plug will glow again. This would invariably cause a small explosion and a lot of smoke. It is, therefore, important that you and your customers remember this point in the instruction manual.

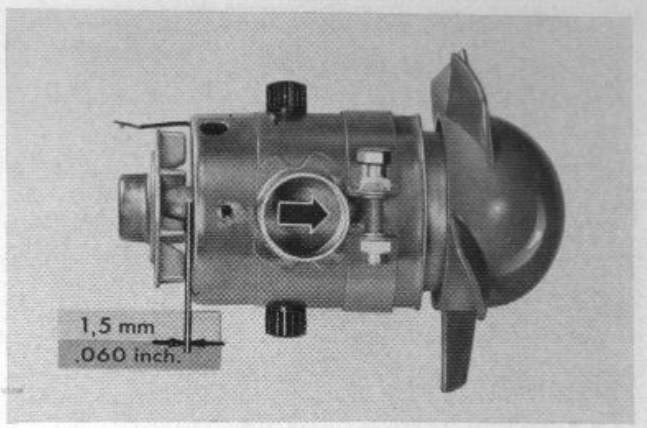


23/20 We have discussed the construction, control and working of the heater as well as the electrical system. We shall now go on to look at the main parts: first the blower motor which is only accessible when the heater has been removed from the vehicle. If the motor is to be replaced or tested, the front part of the casing (1) must be taken off. The motor support housing is sealed from the heat exchanger (2) with Teroson-Athmosit. This is a normal commercial sealing compound and is indicated by the arrow. Three screws secure the motor in the heat exchanger. After taking out these screws the motor can be withdrawn. Before assembling the parts, ensure that all traces of the old sealing compound are removed and new sealer applied. Do this very carefully to avoid loss of fresh air due to faulty sealing.

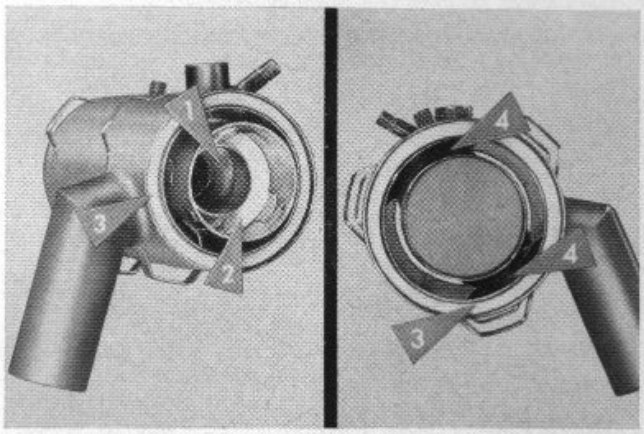


23/21 This picture shows the dismantled combustion air blower. The blower fan can be pressed off the shaft by turning a screw into the centering hole as shown by arrow at upper right. If the blower is damaged, it must be renewed. The screw securing the radial blower can be loosened through the hole marked with the lower left arrow and the radial blower taken off. Before taking the motor out of the support housing, take off the two screw caps for the carbon brushes. Then loosen the clamp and lever the motor out by inserting two screwdrivers into the slots in the side of the support housing. The motor should turn easily, not have excessive axial play and the radial play should be hardly detectable. If defects are found, a new motor should be fitted.

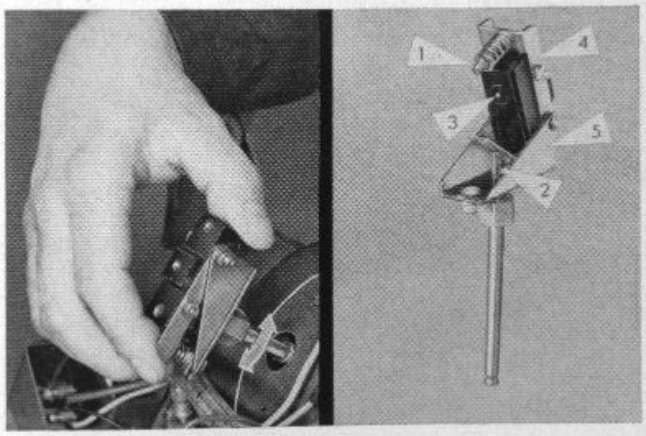
23/22 Assembly takes place in the reverse order. Ensure that there is 1.5 mm clearance between housing and radial blower. The rubber seal between motor and support housing must on no account project into the intake port at the point marked with an arrow.

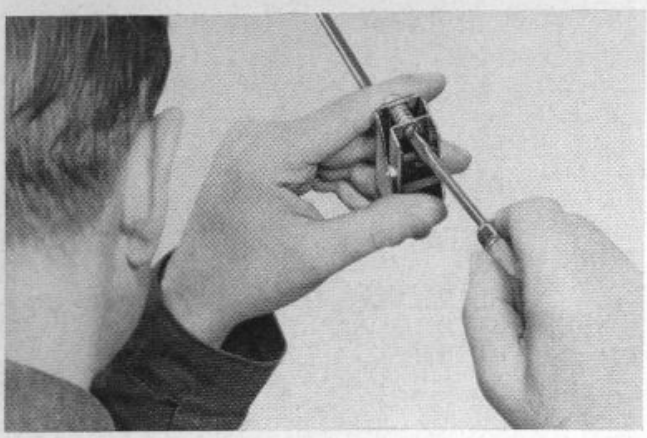


23/23 One of the most important parts in the heater is the heat exchanger which is show here from two different angles. 1 is the combustion chamber with the flame jet, 2 is the deflector housing and 3 is the annular space. Two passages connect the combustion and annular chambers (arrow 4). If the heat exchanger becomes blocked with combustion deposits and heat output falls off, the deposits can be burned out with a gentle welding flame and then blown out with compressed air.

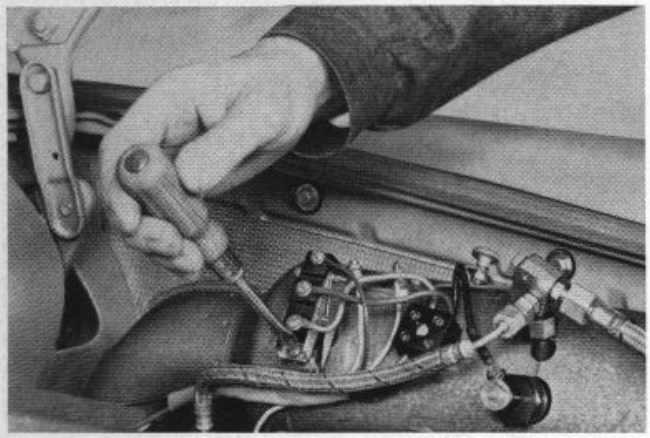


23/24 You already know how the thermo-switch works. In the left picture you can see how it is taken off the heater. The union nut under the switch is unscrewed and the switch withdrawn with a turning motion. If it is very tight, a rust solvent can be used. Be careful not to bend the tube as it is being pulled out.
On the right is the switch with the top part lifted up. Arrow 1 indicates the adjusting screw, 2 the quartz rod, pulled out of the tube slightly. Arrow 3 points to the operating plunger of the switch. The micro-switch is secured in the adjusting arm 4 which must move freely in the switch mounting 5. Be careful when dismantling the switch — the quartz rod is loose in the feeler tube and breaks easily.

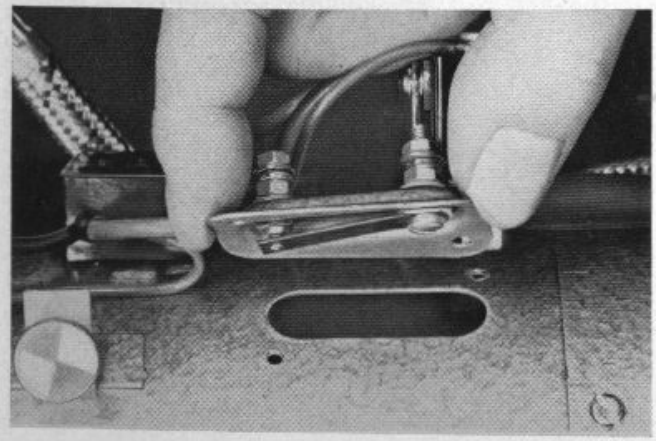




23/25 Before the thermo-switch is installed in the heater, it must be set by ear. The adjusting screw must be turned inwards until a clicking noise indicates the switching point. Now turn the screw out slowly until another click is heard. This means that the switch has operated again. From this point turn the screw in about 120° or 1/3 of a turn. The switch is now set roughly and can be installed.

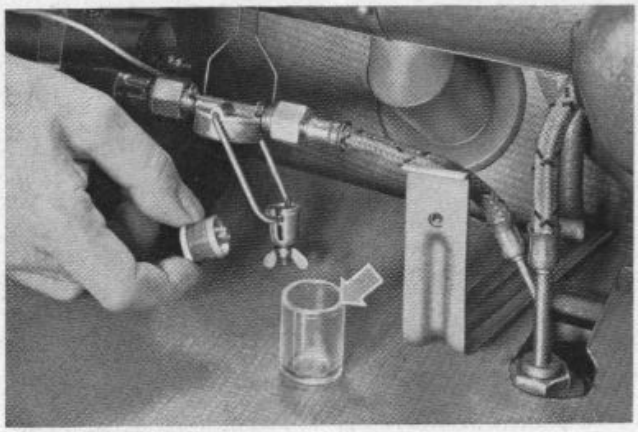


23/26 The fine adjustment is done on the vehicle with the heater warm. It is determined by the length of the run-on period which should be 3 minutes. Note that turning the screw in shortens the run-on time and turning out lengthens it. This adjustment also controls the heating up time after the heater is switched on. As we have already heard, this time, indicated by the lighting of the warning lamp, should be 45 seconds.



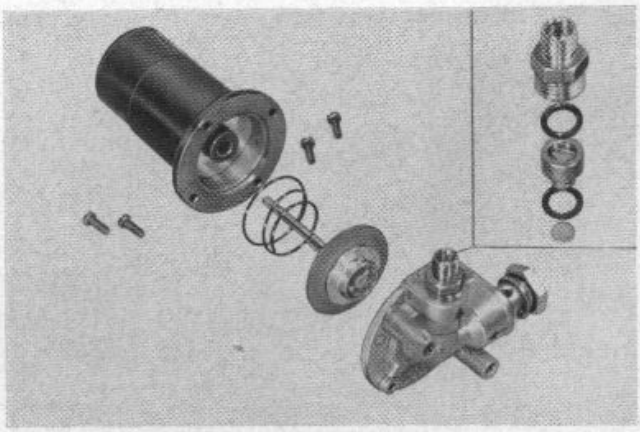
23/27 The heater is protected against overheating by a bi-metal switch in the fuel pump circuit. The switch is attached with two screws in an opening in the casing near the heat exchanger. If the heater gets too hot, as it can do if the fresh air feed is restricted, the switch operates and switches the fuel pump off. The flame goes out and the heater cools off. The overheating switch is constructed so that after cooling down it does not operate again and close fuel pump circuit until after the thermo-switch has worked. This switching sequence ensures that fuel is not delivered when the heater plug is switched off and ignition cannot take place. The overheating switch is set to a certain operating temperature by the manufacturer and must not be interfered with. If it gives trouble, it should be replaced.

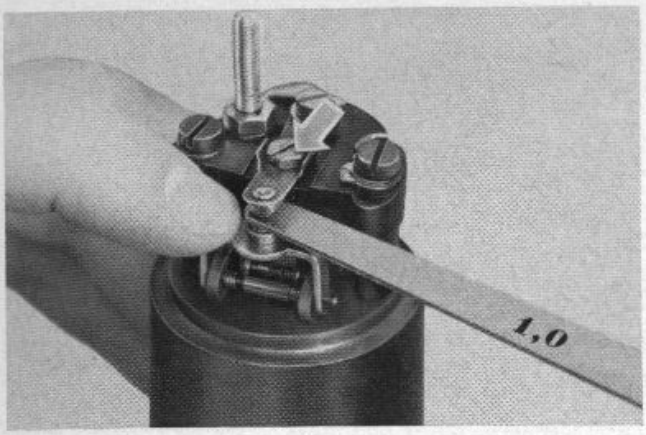
23/28 Let us now look at the fuel system. You all know what a fuel filter is. It should be cleaned at least once a year before the heater is put into use, or more often if found necessary. Ensure that the glass bowl seals properly. If the edge marked with an arrow is even slightly damaged, the bowl should be replaced. The small filter element can be screwed off and should be cleaned with compressed air.



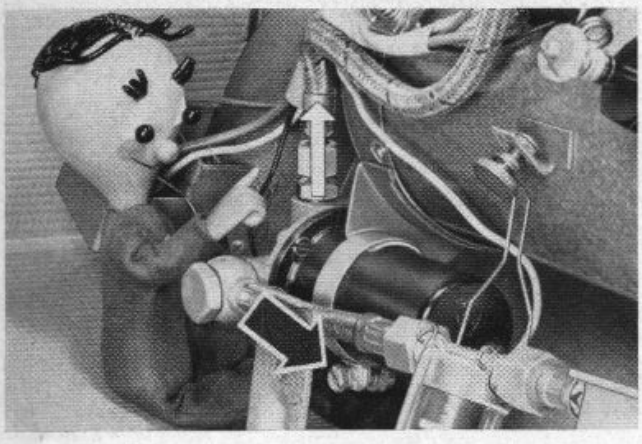
23/29 The fuel pump is an electrical diaphragm type as is used on many vehicles. When the heat output of a heater gives cause for complaint, check the noise made by the pump. When working properly, the pump strokes can be heard clearly at intervals of about 1 second. A pump which is drawing in air or has a defective diaphragm, has an irregular rhythm and clicks rapidly. Check the unions for leakage first, if they are in order, the pump must be removed and repaired.

23/30 Take the end plate off and screw out the diaphragm rod. If the diaphragm is replaced or the same diaphragm installed again, the pump stroke must be re-set. This is done by screwing the diaphragm rod in fully and then screwing it back exactly 3½ turns. With this setting the pump delivery capacity will be correct. In the corner, the parts of the valve are shown in the proper fitting sequence.

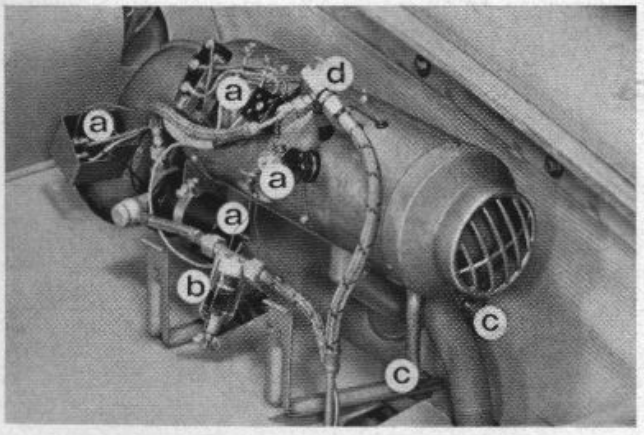




23/31 When checking or repairing the pump, the breaker contact gap must be measured. To do this, remove the plastic cap and press the lower contact down as shown here. The gap should then be 1 mm (.040″). It can be adjusted with the screw indicated. When doing this, lubricate the bearings and springs of the contact lever lightly with thin oil. If the contacts are very dirty they should be replaced.

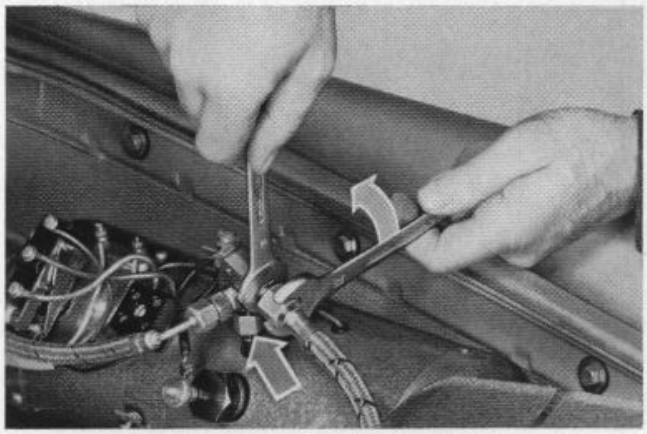


23/32 When the pump is installed, the union for the pressure line must be vertical as shown by the white arrow. This union contains the pump valve as we have already seen. The small valve plates are lifted by the pump pressure and must be able to fall back on to the seats properly under their own weight. If the pump position has to be rectified, loosen the clamp screw (black arrow) and turn the pump as required. When a new or overhauled pump is fitted it may be found that it does not suck fuel in straight away. When this happens, put a few drops of fuel into the pressure union.

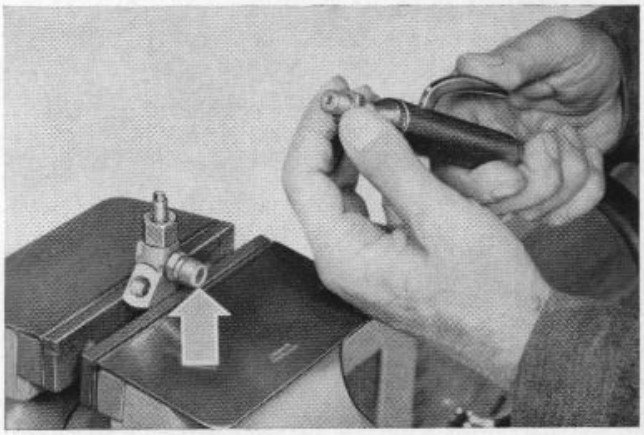


23/33 The Eberspächer heater requires a certain amount of maintenance just as the vehicle itself does. Once a year, at the beginning of the winter, the points shown here on the heater should be checked. All the cable connections, marked (a), must be tight and make good contact. The filter (b), should be cleaned and checked for leakage. The securing screws (c), should be checked for tightness. The jet carrier (d), must be removed and cleaned.

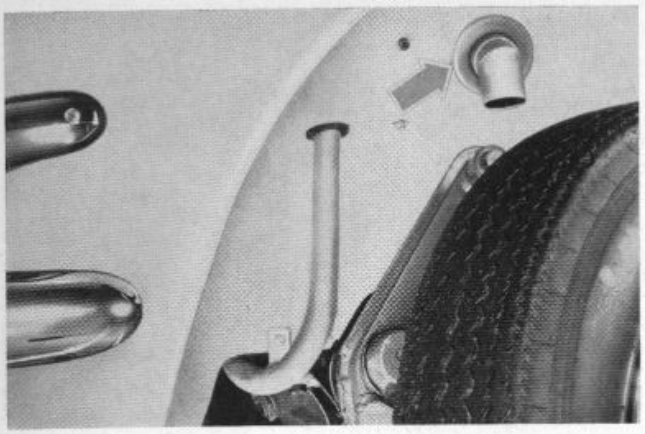
23/34 Do not forget to hold the unions with a second wrench when loosening the two hose nuts. The arrow points to the nut which secures the jet carrier to the threaded boss on the heat exchanger.



23/35 The jet carrier should be gripped in the vice, the jets taken out and cleaned with compressed air. In front of the regulating jet is a fine filter of plastic material, shown by the arrow. Take care not to damage this filter when taking it out. It should also be cleaned with compressed air or renewed if necessary. When installing the jet carrier, ensure that the fuel lines are fitted free of tension and twist.

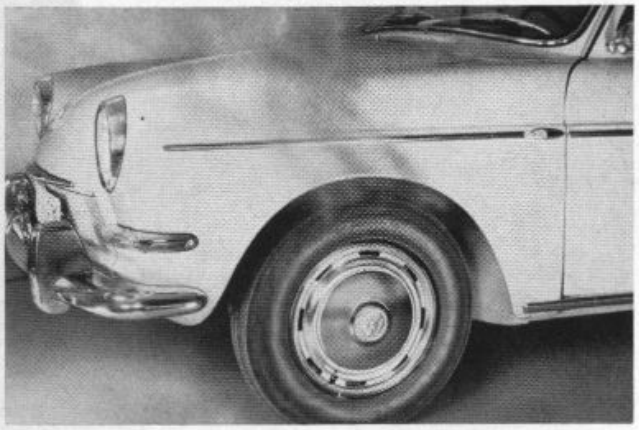


23/36 A further point to check is the heater plug. This is what a neglected heater plug looks like. Do not let the heater plug get into this condition or it will cause trouble sooner or later. If the coils of the plug are distorted they can be bent without damage if, about 4 volts, two cells of the battery for example, is applied while bending.



23/37 Glance at the combustion air intake pipe and the exhaust pipe under the left front wheel housing. The openings of these pipes must be clear at all times. They can become blocked with mud or, during the winter, with snow. They can also be damaged by flying stones. A visual check is sufficient. The arrow points to the silicon ring which seals the hole in the wheel housing through which the exhaust pipe passes. This ring is flexible and heat-resistant and should be checked very carefully. The ring must be replaced if damaged.

That is all there is to the maintenance of the Eberspächer heater. The reliability of the heater depends to a great extent on the care with which you carry out this maintenance work.



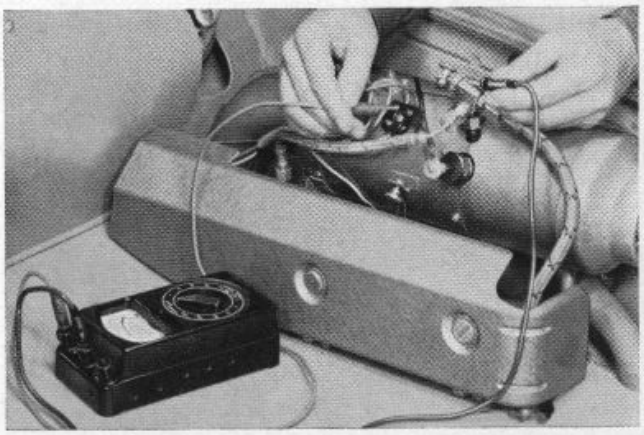
23/38 You now know the Eberspächer heater. You have heard and seen what maintenance the heater requires. To close, we wish to give you a few hints on trouble shooting. For example:

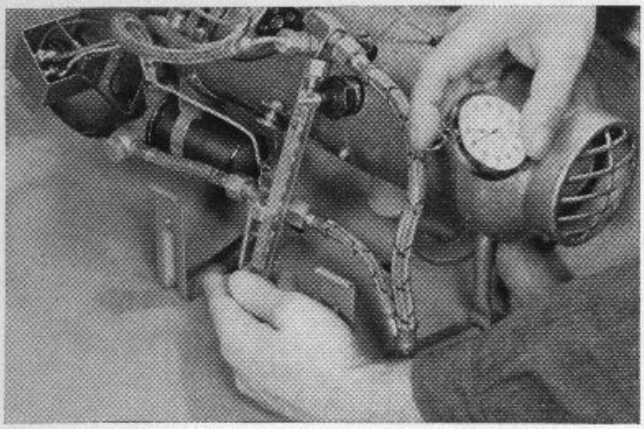
A vehicle is brought into the workshop with a heater which is smoking badly from the exhaust pipe. Where would you start to look for the trouble? The following remarks will help you:

To obtain clean combustion, the fuel and air must be mixed in the correct proportions. If the heater smokes, there is either too much fuel or not enough combustion air.

23/39 The amount of air available for combustion purposes is dependent on the speed of the blower. This should be between 4550 and 5400 rpm. If the speed is too low, insufficient air will be delivered. The heater will smoke and may even go out altogether. In the picture you can see how the blower speed is measured with a rev counter. In order to avoid false readings due to the battery being weak, it is advisable to run the engine at a fairly high speed while taking the reading.

23/40 If the blower speed is below the required value, check if the trouble is in the motor itself or in the electrical circuit. This is done by measuring the voltage at the junction box on the heater as shown in picture. The reading should be at least 5.8 volts or 11.6 volts with the 12 volt system. If the voltage at the junction box is adequate when the blower speed is too low, the motor must be removed and checked. There may be an electrical or a mechanical defect somewhere.





23/41 If the blower speed is correct, and assuming that the intake and exhaust pipes have been checked and are in order, the cause of the trouble can be excessive fuel. The picture shows how the fuel consumption is measured. We need a measuring glass with cubic centimeter graduations and a stopwatch. The jet carrier is then taken off the boss on the heat exchanger without taking the feed and return pipes off. Then hold the feed jet in the glass tube and have an assistant start the engine and switch the heater on. The amount of fuel delivered in one minute should be 4.5 cc. Assuming that the other possible sources of trouble have been eliminated, the amount of fuel delivered will be larger if the heater smokes. This can be caused by a blocked return fuel line or damaged or interchanged jets. In any case, if the amount of fuel delivered varies from the quantity laid down, the entire fuel system should be checked.

23/42 These remarks do naturally not cover all the possible defects which can occur on the heater. However, if you understand the construction of the heater and the way it works, it will not be difficult to diagnose troubles and carry out the necessary repairs. As usual, we have printed the text of this slide in a "Look, Listen, Do it Better" booklet so that you can read it through again any time. The Eberspächer manual is also available in your workshop. Please use these publications to improve or refresh your knowledge of the heater.