



VW Workshop Manual

This Manual deals with all VW types, models and versions
from 1967 onward.

F

Fresh air heating

List of Main Groups

- F 0 Workshop Bulletins
- F 3 BN 4 Heater for Type 2
- F 4 BN 2 Heater for Type 1 and 3

VOLKSWAGENWERK AKTIENGESELLSCHAFT · WOLFSBURG

Workshop Manual 1969

The Volkswagen Workshop Manual is divided into volumes, each of which deals with one unit group as follows:

Engine and clutch	M
Fuel system	K
Transmission and rear axle	H
Front axle and steering	V
Brakes, wheels, tires / hand and foot controls	B
Electrical system	E
Body	A
Fresh air heating	F

The binders have a transparent plastic pocket on the spine into which the appropriate title can be inserted.

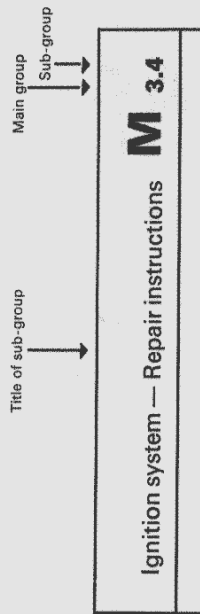
To make it easy to find the individual repair operations, each volume of this manual is divided into "Main Groups", "Sub-groups" and "Sections" with a very detailed table of contents.

The main groups are marked with the code letter of the appropriate unit and a serial number (e. g.: M 1, M 2, M 3 etc.).

The sub-groups within the main groups have a code number which is placed behind the main group number and separated from it by a period (e. g.: M 3.1, M 3.2 etc.).

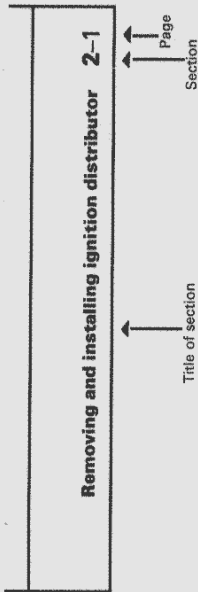
Main group numbers and sub-group numbers are printed next to the title of the sub-group at the top of each page.

Example



The section into which each sub-group is divided also have a serial number and a page number is added to a section number (e. g.: 1-1, 1-2, 2-1 etc.).

Section number and page number appear beside the title of the section at the bottom of each page.



Workshop Bulletins

The Main Group 0 (zero) in each Workshop Manual volume is for filing the Workshop Bulletins for this particular unit. It bears the code letter of the unit and is arranged in chronological order. Remarks in the margin of each Workshop Bulletin show to which section of the Workshop Bulletin the contents refer.

In addition, from time to time the numbers of all valid Workshop Bulletins will be printed in the list of contents behind the appropriate title section to which they belong. From the list of contents, therefore, it can be seen to which sections of the Workshop Manual the Workshop Bulletins belong and which Workshop Bulletins have been issued.

List of Bulletins and Introduction Data

Workshop Bulletin ...-0 contains a list of Workshop Bulletins published and all introduction data. These lists of Bulletins will be supplemented from time to time and published according to requirement for the individual Workshop Manual volumes. If, when Workshop Manual supplements are published, Workshop Bulletins are incorporated into these supplements or Workshop Bulletins become invalid, this is noted in the margin of the Workshop Bulletin ...-0. Workshop Bulletins that have been incorporated into the Manuals or have become invalid should be removed from the main group 0.

Supplements

Supplements deal mainly with technical innovations at the change of model year as well as considerable modifications to production models and contain pertinent repair instructions. Each supplement is marked with its publication number and the date of issue. Careful filing of the supplements is a prerequisite for keeping the Workshop Manual up to date at all times.

F 0 Workshop Bulletins

See Workshop Bulletin

F 3 BN 4 Heater for Type 2

3.1 — Description of heating system

- 1-1 Description
- 1-2 Controls
- 2-1 Operation
- 2-2 Maintenance and technical data
- 3-1 Description of parts
- 4-1 Wiring diagram and explanation

3.2 — Trouble shooting and testing instructions

- 1-1 List of possible faults
- 1-2 Heater does not work
- 2-1 Heater smokes / heat output insufficient / heater goes out
- 2-2 Run-on does not switch off / heater does not work at low outside temperatures

3.3 — Checking parts and adjusting

- 1-1 Tools
- 1-2 Overheating switch / ignition coil
- 1-3 Safety switch / combustion air blower motor / flame detector switch
- 1-4 Temperature regulating switch
- 1-5 Relay / glow plug and spark plug
- 1-6 Breaker points
- 2-1 Fuel pump
- 2-2 Solenoid valve and pressure regulator
- 2-3 Time switch

3.4 — Heater and warm air duct

- 1-1 Removing and installing

3.5 — Removing and installing parts

- 1-1 Overheating switch / ignition coil
- 1-2 Combustion air blower / heat exchanger
- 1-3 Temperature regulating switch
- 1-4 Relay
- 2-1 Safety switch / flame detector switch
- 2-2 Glow plug / spark plug / fuel pump
- 2-3 Pressure regulator / filter
- 2-4 Time switch

3.6 — Disassembling and assembling fuel pump

- 1-1 Disassembling and assembling

3.7 — Combustion air blower

- 1-1 Disassembling and assembling

3.8 — Solenoid valve and Pressure regulator

- 1-1 Disassembling and assembling

3.20 — Service installation

- 1-1 BN 4 Heater for Type 2

F 4 BN 2 Heater for Type 1

Sedan 111 and 113 (from August 1970)

See Workshop Bulletin

4.1 – Description of heating system

- 1-1 Description
- 1-2 Operation
- 2-1 Working principles
- 3-1 Maintenance and technical data
- 4-1 Description of parts
- 5-1 Wiring diagram and explanation, Type 3
- 5-3 Wiring diagram and explanation, Type 3

4.2 – Trouble shooting and testing instructions

- 1-1 List of possible defects
- 1-2 Heater does not work
- 1-4 Heater smokes (heater goes out)

4.3 – Checking and adjusting parts

- 1-1 Tools
- 1-2 Glow plug / flame detector switch / blower motor
- 1-3 Safety switch / dual relay
- 1-4 Fuel pump / Pressure regulator
- 2-2 Overheating switch / filter

4.4 – Heater and warm air ducts

- 1-1 Removing and installing

4.5 – Removing and installing parts

- 1-1 Combustion air blower / heat exchanger
- 1-2 Glow plug / flame detector switch
- 1-3 Safety switch / pressure regulator
- 1-4 Fuel pump / relay
- 1-5 Overheating switch / switch

4.6 – Fuel pump

- 1-1 Disassembling and assembling

4.7 – Combustion air blower

- 1-1 Disassembling and assembling

4.8 – Pressure regulator

- 1-1 Disassembling and assembling

4.20 – Service installation

- 1-1 Model Sedan 111
- 2-1 Model Sedan 113

F 4 Heater BN 2 in Type 1 / Sedans 111 and 113 and Type 3

See Workshop Bulletin

4.1 – Description of heating system

- 1-1 Description
- 1-2 Operation
- 2-1 Working principles
- 3-1 Maintenance and technical data
- 4-1 Description of parts
- 5-1 Wiring diagrams and explanations

4.2 – Troubleshooting and testing instructions

- 1-1 List of possible defects
- 1-2 Heater does not work
- 1-4 Heater smokes (heater goes out)

4.3 – Checking and adjusting parts

- 1-1 Tools
- 1-2 Glow plug / flame switch / blower motor
- 1-3 Safety switch / dual relay
- 1-4 Fuel pump / pressure regulator
- 2-2 Overheating switch / filter

4.4 – Heater and warm air ducts

- 1-1 Removing and installing

4.5 – Removing and installing parts

- 1-1 Combustion air blower / heat exchanger
- 1-2 Glow plug / flame switch
- 1-3 Safety switch / pressure regulator
- 1-4 Fuel pump / dual relay
- 1-5 Overheating switch / on-off switch

4.6 – Fuel pump

- 1-1 Disassembling and assembling

4.7 – Combustion air blower

- 1-1 Disassembling and assembling

4.8 – Pressure regulator

- 1-1 Disassembling and assembling

4.20 – Service installation

- 1-1 Type 1 / Sedan 111
- 2-1 Type 1 / Sedan 113
- 3-1 Type 3 / Models 31 and 36
- 4-1 Type 1 / Models 141 and 143

Description of Heating System F1.1

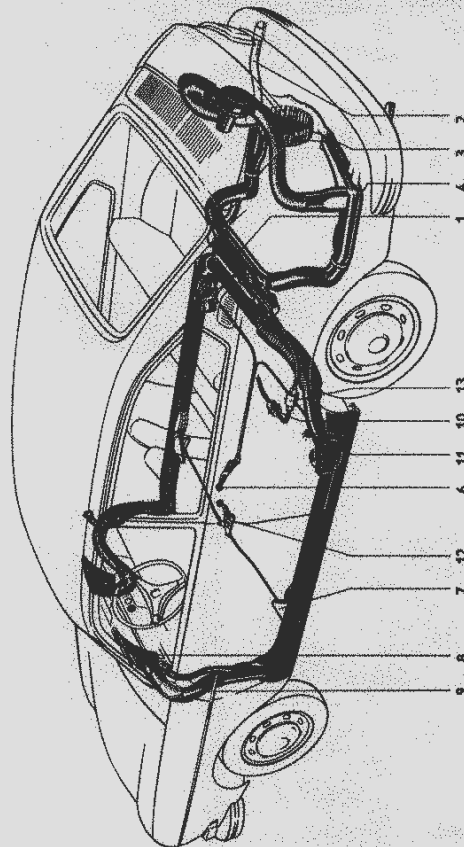
Description

The fresh air heating system combines the two engine heat exchangers and a heater booster. The fresh air is preheated in the engine heat exchangers and then passes on to the heater booster.

This booster, which is thermostatically controlled, increases the temperature of the fresh air to the desired level. The heat produced by the heater booster varies according to the temperature in the engine heat exchangers. The heater booster shuts off automatically when the engine supplies sufficient heat by itself.

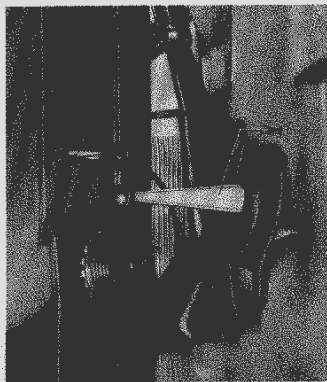
When the engine is not running, the heater booster alone heats the car.

The heater booster is supplied with gasoline from the vehicle fuel tank. The fuel consumption varies from .35 to 1 pint per hour according to heat output.



- 1 - Heater booster
- 2 - Exhaust pipe
- 3 - Heater air blower
- 4 - Engine heat exchanger
- 5 - Warm air duct in side member
- 6 - Outlets in footwell
- 7 - Fresh air and defroster vents in instrument panel
- 8 - Defroster vents for door windows
- 9 - Heater flap lever
- 10 - Temperature control switch
- 11 - Regulating lever for footwell heating
- 12 - Fuel pump
- 13 - Fuel filter
- 14 - Temperature regulator with time switch
- 15 - Fuel filter

Controls



Lever 1 - Heater flap operation

When vehicle is in motion

Pull heater flap lever to the rear as far as it will go. Turn knob of temperature regulating switch to the right to position "1". The green warning lamp in the switch knob lights up and shows that heater is working. The temperature can be adjusted from minimum to maximum by turning knob further to the right.

To switch off heating

Turn knob of regulating switch to the left to position "0". The warning lamp goes out.

Push heater flap lever fully forward.

Heating with vehicle stationary -

Engine not running:

Maximum heating time 10 minutes.

To switch heater on:

Depress knob of temperature regulating switch (which is combined with a timer) and turn it 90° to the right. The knob springs back out when released. Pull lever 1 to the rear as far as it will go.

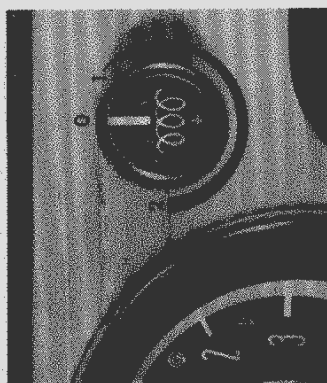
Adjust temperature by turning knob (1 - minimum heat; 2 - maximum heat).

Warning lamp lights up and shows that the heater is working.

To switch heater off -

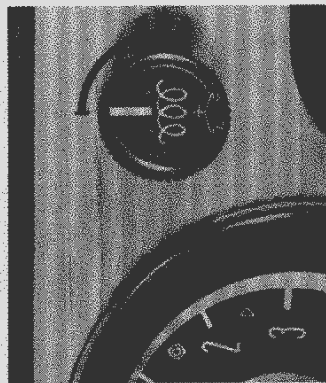
The timer in the temperature regulating switch will turn the heater off automatically after about 10 minutes and the warning lamp will go out.

You can however switch the heater off before the 10 minutes have elapsed, by turning the knob counterclockwise to position "1" or fully to the left to position "0". The timer then runs down operating the switch contacts.



Temperature regulating switch

0 Heat off
1 Heat on
1-2 Temperature regulation

**Note:**

When the heater is switched off, the fan and combustion motors continue to run until the heater has cooled down the combustion chamber has been purged. When it is extremely cold, the full battery capacity is required to start the engine. To avoid starting difficulties, it is advisable, under these conditions, to start the engine before switching on the heater.

Preselecting the time:

Turn the setting knob counterclockwise until the desired time is lined up with the mark. Switch-on sign "red" shows that the preselector control is switched on.

Pull heater flap lever up and set temperature with the temperature regulating switch knob. At the selected time the heater will switch on and work for about 15 minutes. After this time the heater will switch off again automatically. The heater will remain on if the ignition is switched on before the timer has run down. Terminal 15 then takes over the power supply for the control cable of the double relay.

To switch preselector control off: Turn the setting knob clockwise until "green" appears in the aperture. The preselector mechanism is then out of action. The heating can now only be switched on, when driving, with the temperature regulating switch.

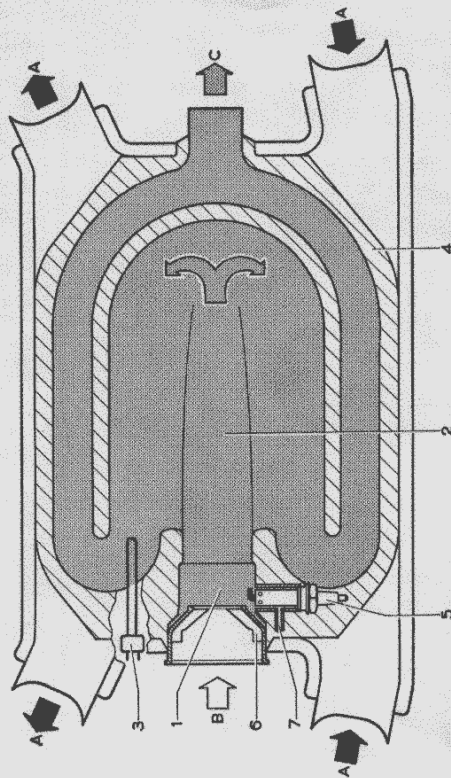
Day and night disc: Day section from 06.00-18.00 hours (6 A.M. to 6 P.M.) is white; night section from 18.00 to 06.00 hours (6 P.M. to 6 A.M.) in black. The transition from one section to the other is shown by an arrow.

If the clock is removed or replaced or the battery disconnected, ensure afterwards that the correct color shows in the aperture according to the time of day. If this is not the case, the correct color can be set by depressing and turning the clock setting knob. This is necessary because the selector mechanism has a 24 hour setting disc but the clock has only a 12 hour setting. When the disc does not correspond to the time of day (white or black), the heater will switch on 12 hours later than desired.

Operation**1 - Heating (vehicle engine stationary) ignition switched off**

All the heater functions are controlled by the heater flap lever in conjunction with the temperature regulating switch. The warning lamp in the switch knob lights up when the heating system is on.

Fuel is drawn through a T-piece in the vehicle engine fuel (return) line. It is forced through a filter and into the heater combustion chamber by a fuel pump. The air from the combustion air blower is swirled by a housing with vanes in front of the combustion chamber and the air and fuel then form a combustible mixture. The glow/spark plug, switched on at the same time as the fuel pump and the combustion air blower, ignites the air/fuel mixture. A flame is produced that heats the walls of the heat exchanger. The exhaust gases flow through an exhaust pipe to the atmosphere.



- 1 - Combustion chamber
- 2 - Heat chamber
- 3 - Thermo-switch
- 4 - Heat exchanger

- 5 - Glow/spark plug
- 6 - Housing with vanes
- 7 - Fuel line connection

- A - Warm air
- B - Combustion air
- C - Exhaust gases

The temperature sensor in the left warm air duct together with an electronic device and a setting regulator in the temperature regulating switch, keep the heater output temperature constant.

The air flowing from the heater air blower via the two engine heat exchangers and the open heater flaps passes through the heater. The heating chamber transfers its heat to the air passing through the heater booster. The hot air is then transferred through two hoses into the warm air ducts and to the outlets in the footwell and the instrument panel on both sides of the vehicle.

To switch the heating off, the heater flap lever is pushed forward until the warning lamp in the knob of the temperature regulating switch goes out. The heater air blower and the combustion air blower continue to run, however, until the heater cools down and all traces of exhaust gases have been purged from the combustion chamber (run-on).

2 - Engine heating only

When the engine is running, the exhaust gases on each side of the engine are led to the muffler through two pipes surrounded by sheet metal casings. Fresh air is continually blown through the sheet metal casings by the engine cooling fan and heated by the exhaust pipes. If the engine heat exchanger flaps are open, the heated air flows via the heater and the warm air ducts to the vehicle interior.

If the heater flap lever is pulled back fully, the heater air blower is switched on and the amount of air increased. The warning lamp in the knob of the temperature regulating switch lights up.

Depending on the driving conditions, the larger amount of air is produced either by the engine cooling fan at high speed or by the electrically-operated blower (city traffic).

3 - Engine heating and heater booster (vehicle engine running)

The air pre-heated in the engine heat exchanger flows around the heat exchanger of the heater booster and is heated further until the set temperature is reached. The heater air blower is always on at this point.

If the required temperature, regulated by the temperature control system is attained by the engine heating alone, the heater booster is turned off automatically. When the temperature of the engine heating drops below the pre-set temperature, the heater booster automatically comes into operation again.

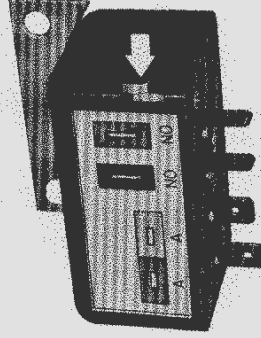
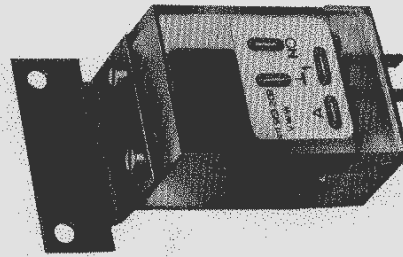
Maintenance

The following operations should be carried out regularly during the maintenance services:

- 1 - Start vehicle engine.
- 2 - Switch temperature regulating switch on and set to a medium temperature.
- 3 - Pull heater flap lever back fully. Warning lamp in the knob of the temperature regulating switch must light up.
- 4 - After about two minutes, check whether warm air flows from warm air vents equally on both sides in vehicle interior. Turn heating off. To do this, push heater flap lever forward until warning lamp goes out. As soon as the lamp has gone out, check that the blowers at the engine cooling air intake and in the heater continue to run for 120-240 seconds, to cool the heater and purge the combustion chamber.

Note:

If the heater booster is not used over a long period (during the summer for example), gummy deposits from the fuel may form in the fuel lines. Operational defects that could be caused by this can be avoided if the heating is switched on briefly with the vehicle engine cold about once a month during the summer. If, after about two minutes, the heating does not start to operate, the fuel in the pressure line between fuel pump and heater has probably evaporated. The time taken for the fuel pump to pump fuel into the combustion chamber in this case and for the fuel to ignite is too long and the safety switch has cut-in. The temperature regulating switch must be switched off. After five minutes, operate the lever on the safety switch in the engine compartment, then switch the heater booster on again. If the heater booster still does not operate, there is a defect in the heating system.

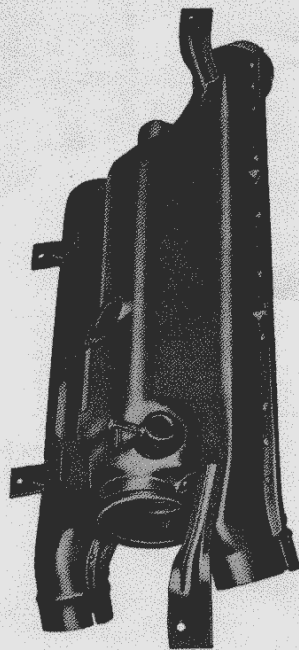


Heater booster - technical data

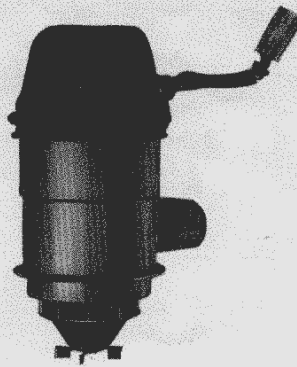
Heat output, infinitely variable	1000-3400 kcal/h
Fuel	Gasoline
Fuel consumption	0.2-0.6 liter/h (42-1.3 US pt./h)
Nominal voltage	12 volts
Current input	130 watts

Description of parts**Housing and heat exchanger**

The flat, large heat exchanger is made of special sheet metal and is surrounded by two riveted cases of corrosion-proof sheet steel. The front cylindrical part of the heat exchanger, the combustion chamber, contains the housing with vanes and the combustion air blower. In addition, a glow/spark plug, a thermo-switch, an ignition coil and an overheating switch are fitted to the heater.

**Combustion air blower**

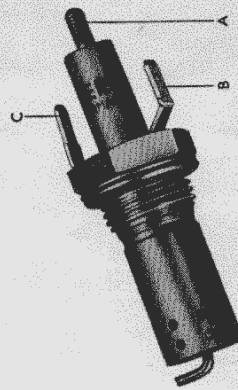
The combustion air is drawn in through an intake on the engine fan housing and transferred to the combustion chamber by a blower fan. The electrical impulses for the ignition and for the fuel pump are provided by two contact breakers mounted separately on the motor shaft.



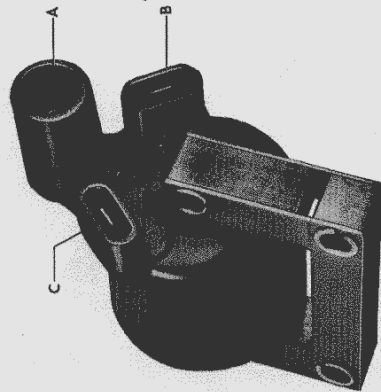
The combustion air blowers motors are made by Bosch and AEG. The pole housing of the AEG motor is painted black and the breaker contacts for the fuel pump and ignition are different. The complete motors can be interchanged.

Glow-spark plug

The glow-spark plug comprises a glow element and a spark plug with central electrode, contained in one unit. The plug protrudes into the combustion chamber. The cable from the ignition coil is connected to the glow-spark plug by a spark plug connector and a flat terminal is used for the glow element connection. The glow element operates for only a brief period when the heater is switched on, whereas the spark plug operates the entire time.



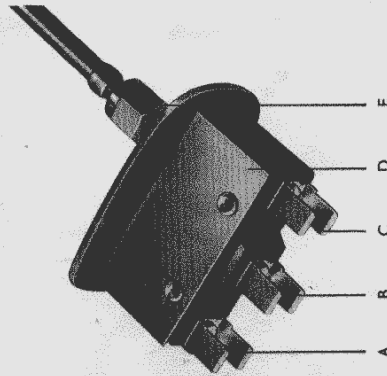
A - High tension connection
B - Glow element connection
C - Ground connection



Ignition coil

The ignition coil is secured to the heater casing. The primary and secondary windings are in a cast plastic housing on one arm of the iron core. A plate protects the coil from excessive heat. The coil remains on the entire time the heater is operating. The primary winding receives impulses from the contact breaker on the combustion air blower shaft and induces in the secondary winding a high tension ignition voltage which is passed on to the glow-spark plug via an ignition cable.

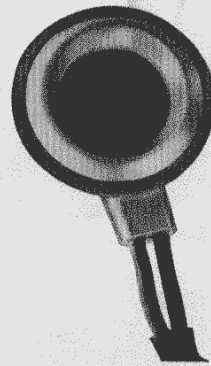
- A - High tension connection
- B - Terminal 15
- C - Terminal 1



Thermo-switch

The thermo-switch is secured to a screw connection on the heat exchanger by a union nut. The sensor tube of the thermo-switch protrudes into the combustion chamber. The thermo-switch controls the length of time the glow element and the safety switch resistance operate and also the heater run-on time.

- A - Permanent positive connection
- B - Glow/spark plug and safety switch connection
- C - Intermitent positive connection
- D - Switch housing
- E - Union nut



Overheating switch

The overheating switch is installed in the outer casing. It cuts off the current to the fuel pump via a fuse should a defect occur that would cause overheating.

Heated air blower

The air blower is mounted near the engine cooling air intake. This blower forces air automatically, alternating with the engine cooling fan, through the two engine heat exchangers and the heat exchanger of the heater into the vehicle interior. If the engine cooling fan produces more air (high engine speeds), the non-return flaps in the electric blower close. If the electric blower produces more air (low engine speeds), the flaps in the engine cooling fan housing close automatically to prevent the air from escaping through the engine cooling air intake.

The heater air blower installed in the Type 4/Wagon rotates in the opposite direction to the one on the Type 4/Sedan and has a single outlet.

Current draw (installed)

8 to 9 amps at 13 volts.

Safety switch

This switch cuts off the current to the heater (dual relay opens circuit) if the combustion system should become defective (fuel supply cut off, glow/spark plug defective) within a time limit of max. 230 seconds after being actuated.

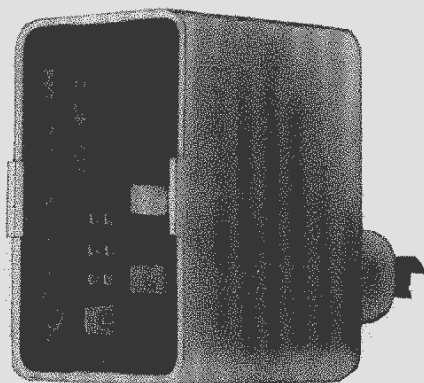
Switch response time

150-230 seconds at room temperature and 12 volts.

Electronic temperature regulating switch

This switch is combined with the time switch and main heater switch in one housing. The warning lamp is in the switch knob.

- 1 - Temperature regulation is done with electronic circuitry. Temperature-sensitive voltages are fed to the switch from a temperature sensor and the switch feeds two voltage conditions to the relay.
- 2 - A main heater switch is incorporated.
- 3 - It limits heater operation to 10 minutes when ignition is off.



Warning lamp

up to Chassis No. 412 2 064 917, July 1972
When the heater is switched on, the warning lamp in the knob of the temperature regulating switch lights up. When the parking lights or headlights are switched on as well, the intensity of the warning lamp is reduced by one half to reduce dazzle at night. This is done by an additional transistor in the temperature regulating switch via the cable between terminal 58 on switch and the parking warning light (see wiring diagram).

From Chassis No. 413 2 000 001, August 1972
The lamp in the knob of the heater switch is now wired as an illuminating light. The previous terminal 58 is now terminal 58b.

When the parking lights or headlights are turned on, the brightness of the warning light remains unchanged when the heater is turned on. It can be regulated along with the other instrument lights.

Regulating ranges

Upper range . . . 115–143° C (240–290° F)

Lower range . . . 30– 40° C (86–105° F)

(The switching points of the temperature regulating switch can only be roughly checked with electronic equipment.)

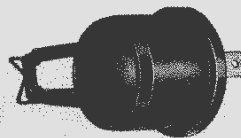
Temperature sensor

The temperature sensor supplies temperature-sensitive voltage to the temperature regulating switch.

The temperature sensor is a temperature-sensitive resistance which has a high resistance value at low temperatures and a low resistance value at high temperatures.

Resistance

Measured in water at 60° C (140° F)
3.5 to 5 k Ω .

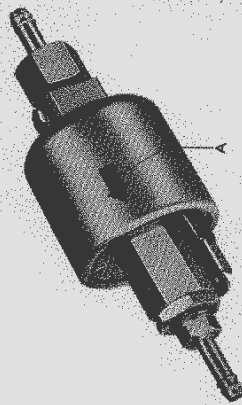


Fuel pump

The amount of fuel delivered by the electromagnetic metering pump is directly dependent on the speed of the combustion air blower. At every 33rd revolution of the motor shaft, the pump receives an electrical impulse via the breaker contacts so that the fuel-air mixture is always constant regardless of changes in the speed of the combustion air motor.

Delivery capacity

(To be measured at room temperature)
200 strokes = 11.8 to 12.5 cm³.



A - direction of flow

- | | |
|--|--|
| 1 - Warning lamp | 13 - Combustion air blower |
| 2 - Main switch | 14 - Contact breaker for pump |
| 3 - Electronic component | 15 - Contact breaker for ignition |
| 4 - Fuel pump | 16 - Overheating fuse 8 amp. |
| 5 - Temperature sensor | 17 - Heater air blower |
| 6 - Push-on terminal | 18 - Safety switch (response time 130-200 seconds) |
| 7 - Cable connector | 19 - Dual relay |
| 8 - Ignition coil | 20 - to terminal 30 in fuse box |
| 9 - Overheating switch (working temperature approx. 300° F/150° C) | 21 - End choke 4 -H. |
| 10 - Glow-spark plug | 23 - Temperature regulating switch 95-270° F (35-135° C) |
| 11 - Angled connector and cable | 27 - to parking light |
| 12 - Thermo-switch (run-on time 120-240 seconds) | 28 - to starter-ignition switch |
| | 29 - to starter, terminal 30 |

Current flows from fuse box terminal 30 to contact 30 in the temperature regulating switch (23) and passes via the switch to the warning lamp and to terminal 4 of the switch (23). This means that the current also reaches contact A on the relay (49) via terminals A-A of the safety switch (18).

When heater is first switched on, the temperature sensor (5) is surrounded by cold air, so that its resistance is high. The setting regulator of the temperature regulating switch is set to a relatively high flow temperature. The electronic component switches the heater on by grounding terminal 5 of the switch (23) via the outlet transistor.

Terminal 5 of the thermo-switch is connected to terminal B of the dual relay (19) so that the relay is energized. When the heater has reached the desired temperature, the switch (23) turns the dual relay off via terminal B. The current to the fuel pump is cut off and the heater stops burning until the temperature sensor reports "too cold," and the fuel supply is switched on again.

When the relay is energized, the heater and combustion air blowers (17 and 13) start to work. The current flows from terminal 30 on the starter through the connector (21) and terminals E-G of the dual relay to the heater air blower. Current also flows from terminal G of the relay via terminal C of the thermo-switch (12) to the combustion air blower.

The electrical fuel pump (4) is provided with voltage via relay contact E-F and via the short circuit fuse (16) and begins to pump fuel into the combustion chamber controlled by contact breaker (14) of the combustion air blower. The glow element in the glow/spark plug (10) is switched on via dual relay contact E-G, thermostat switch contact C-NO and dual relay contact D-C. The element heats up and pre-heats the air/fuel mixture being delivered to the combustion chamber by the combustion air blower.

At the same time as the glow/spark plug is energized, the ignition coil (8) also cuts in. The contact breaker (15) then breaks the primary circuit, as on the vehicle engine. The high tension of about 5000 volts induced in the secondary winding by this means passes to the glow/spark plug via an ignition cable with angled connector (111) and ignites the air/fuel mixture.

When the flame has heated the feeler tube of the thermo-switch, sufficiently contact C-NO of the thermo-switch opens and switches the glow-element off. The ignition system, however, continues to function.

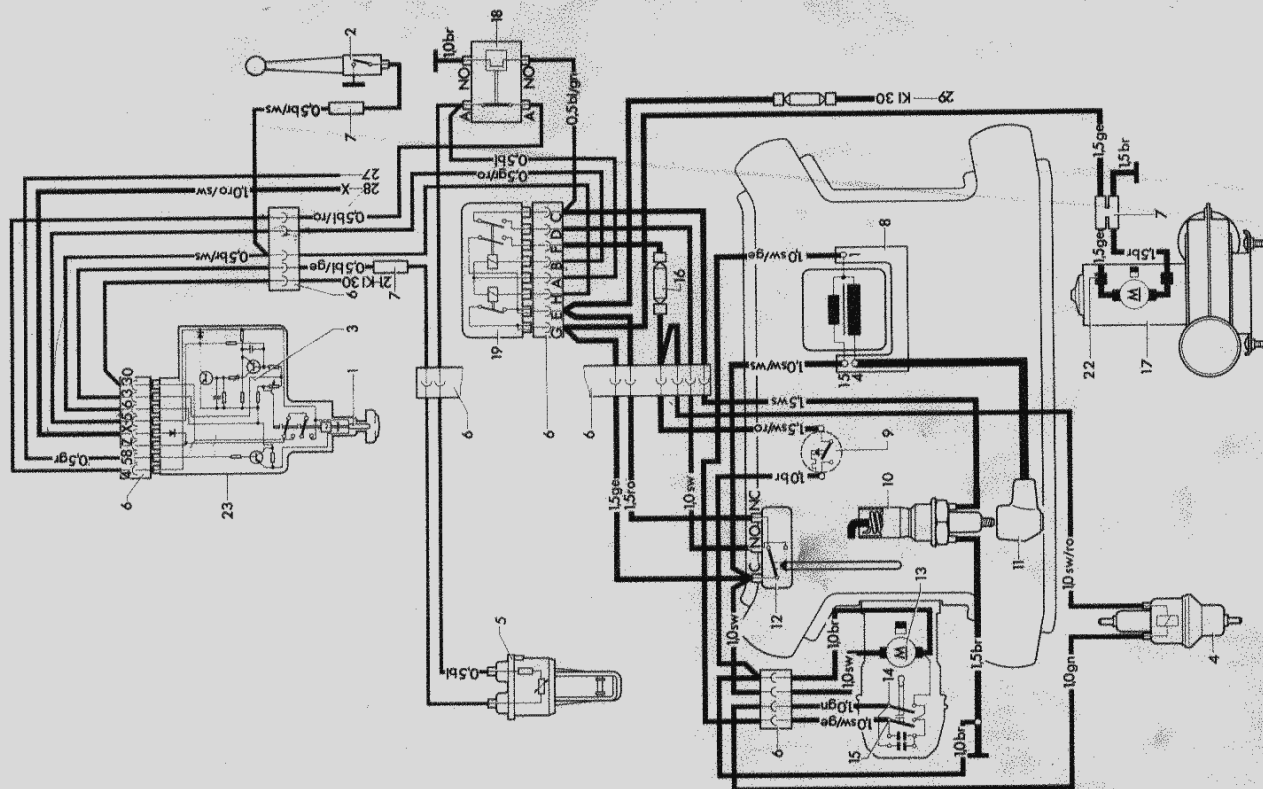
When the temperature regulating switch goes off, the heater and combustion air blowers continue to run and also continues to receive current. The ignition system

The heater air and combustion air blowers receive current via thermo-switch contact NC-C and continue to run until the heater has cooled down and all traces of exhaust gas have been blown out. (The contact in the thermo-switch is then in position C-NO again.)

The heater remains ready for action until the timer in the temperature regulating switch has run down (about 10 minutes) and the contacts have moved from position 30-4 to position X-4.

1 - If the ignition is switched on before the contact has moved to position 15-A, the heater can be switched off by turning the knob of the switch fully to the left.

2 - The heater can also be switched off by cutting off the retaining current for the dual relay via the contact on lever 2.



F1.1

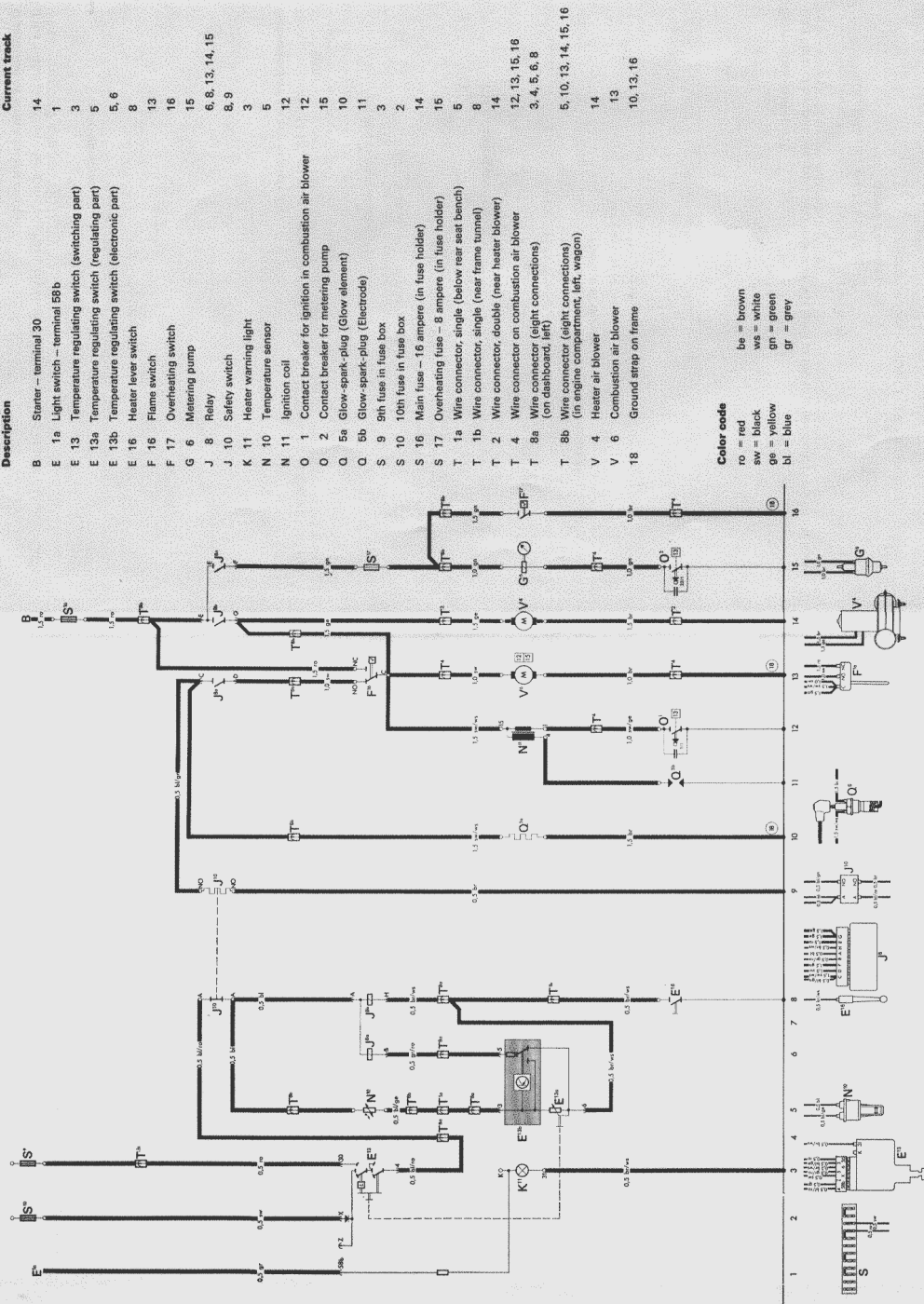
Description of Heating System

Explanation of wiring diagram (heater with temperature regulating switch and preselector control) (dotted lines in diagram)

The only difference in the function of the heating when operated with the temperature regulating switch or with the preselector control is in the control cable for the dual relay A-H. The dual relay and thus the heater is switched on as follows when the time is preset:

The contact in the temperature regulating switch (23) connects the terminals 2 and 4. The readiness switch (25) is closed and the red mark is showing in the aperture in the time disc. When the clock contacts (26) close, the control current can switch the relay on from the terminal 30 in the clock, via the clock contacts, the readiness switch, the temperature regulating switch contact 2-4 and safety switch contact A-A.

The heater remains on until the clock contacts break the circuit after about 15 to 20 minutes.



Current flow diagram and explanation Type 4 from Chassis No. 4132000 001, August 1972

Description

Current track

- B Starter - terminal 30
E 1a Light switch - terminal E8b
E 13 Temperature regulating switch (switching part)
E 13a Temperature regulating switch (regulating part)
E 13b Temperature regulating switch (electronic part)
E 16 Heater lever switch
F 16 Flame switch
F 17 Overheating switch
G 6 Metering pump
J 8 Relay
J 10 Safety switch
K 11 Heater warning light
N 10 Temperature sensor
N 11 Ignition coil
O 1 Contact breaker for ignition in combustion air blower
O 2 Contact breaker for metering pump
Q 5a Glow-spark-plug (Glow element)
Q 5b Glow-spark-plug (Electrode)
S 9 9th fuse in fuse box
S 10 10th fuse in fuse box
S 16 Main fuse - 16 amperes (in fuse holder)
S 17 Overheating fuse - 8 amperes (in fuse holder)
T 1a Wire connector, single (below rear seat bench)
T 1b Wire connector, single (near frame tunnel)
T 2 Wire connector, double (near heater blower)
T 4 Wire connector on combustion air blower
T 8a Wire connector (eight connections) (on dashboard, left)
T 8b Wire connector (eight connections) (in engine compartment, left, wagon)
V 4 Heater air blower
V 6 Combustion air blower
18 Ground strap on frame

Color code
ro = red
sw = black
gn = yellow
bl = blue
be = brown
wa = white
gn = green
gr = grey

Explanation

Switch heater on

- a - Pull heater lever switch (E 16) up until ground contact is closed.
b - Operate temperature regulating switch (E 13) to desired temperature.

Start-up

The heater ignites within 60 seconds if the air drawn in is at room temperature. The start-up process is terminated by the flame switch (F 16).

Voltage can be measured at:

- Terminal 30
Terminals A-A of safety switch (J 10)
Terminal A of relay (J 8a, J 8b)
Relay (J 8) operates contacts E-G, E-F and C-D.
Terminals of fuse (S 16)
Terminals E-G of relay (J 8)
The warm air motor (V 4) starts to work.
Terminal C of flame switch (F 16)
The combustion air blower motor (13) starts to work.
Terminal 15 of ignition coil (N 11)
At every revolution of the combustion air motor (V 6) the ignition coil (N 11) receives an impulse via the breaker contacts (O 1).

No voltage or a low voltage can be measured at:

- Heater lever switch (E 16)
Terminals 6-5 of temperature regulating switch (E 13b)
Terminal B of relay (J 8a) - about 3 volts -
Relay (J 8a) operates the contacts E-F and D-C.

Voltage can be measured at:

- Terminal NO of flame switch (F 16)
Terminals D-C of relay (J 8a)
The glow element of the glow-spark-plug (Q 5a) is energized. It warms the fuel-air mixture to make it readily combustible. It is then ignited by the sparks from the glow-spark-plug (Q 5a).
Terminals E-F of relay (J 8a)
Overheating fuse (S 17) 8 amperes
Terminal of metering pump (G 6)
The metering pump (G 6) starts to deliver fuel. At every 33rd revolution of the combustion air motor (V 6) the metering pump (G 6) receives an impulse via the contact breaker (O 6).

F 1.1

Description of Heating System

Heating

When the heater has ignited and warmed up, the flame switch (F 16) operates the contacts C-NC.

The following are de-energized:

- Terminal NO of safety switch (J 10)
- The glow element of the glow-spark plug (Q 5a)
- The safety switch (J 10) does not operate.

Regulating

During regulation there are two voltages at terminal 5 of the temperature regulating switch (E 13b). These voltages are controlled by the temperature selection via the electronic circuitry (E 13b) and the temperature sensor (N 10). When the heater reaches the high heat output, the temperature sensor (N 10) records a high temperature and the temperature regulating switch (E 13b) indicates a high voltage at terminal 5 as the switching value for the relay (J 8a).

Voltage can be measured at:

- Terminal 5 of temperature regulating switch (E 13b)
- Terminal B of relay (J 8a)
- The relay separates the contacts E-F and D-C.

The following are de-energized:

- Contact of fuse in overheating switch (S 17)
- Contact of metering pump (G 6)
- The metering pump (G 6) stops delivering fuel and combustion stops. As the heater cools down and before the flame switch sensor tube can cool off sufficiently to close contacts C-NC (less than 2 minutes), the temperature sensor (N 10) registers the lowered temperature and switches the heater on.

No voltage or a low voltage can be measured at:

- Terminal 5 of temperature regulating switch (E 13b)
- Terminal B of relay (J 8a)
- Relay (J 8a) connects the contacts E-F and D-C.

Voltage can be measured at:

- Terminal F of relay (J 8a)
- The metering pump (G 6) starts delivering fuel.

Operation of overheating circuit

If the heater should overheat, the overheating switch (F 17) closes and causes a short circuit which blows the 6 amp fuse (S 17).

This de-energizes:

- Contact of metering pump (G 6)
- The flame goes out and the run-on starts.

Operation of safety switch

The safety switch (J 10) responds when the flame switch (F 16) holds the contacts C-NO for longer than roughly two to four minutes because combustion has not taken place in the heater or because the thermostat (12) is defective.

Voltage can be measured at:

- Terminals C-NO of flame switch (F 16)
- Terminal NO of safety switch (J 10)
- The resistor element of safety switch (J 10) heats up for about two to four minutes and then the contact connection A-A is interrupted.

The following are de-energized:

- Contact A of relay (J 8)
- All connections in relay (J 8) are interrupted.
- Contact C of flame switch (F 16)
- The combustion air motor (V 8) stops.
- The ignition coil (N 11) is de-energized.
- The hot air blower (V 4) stops.
- Contact F of relay (J 8a)
- The metering pump (G 6) stops delivering fuel.

Switching heater off

Turn knob of temperature regulating switch (E 13) back to the stop position. Press heater lever switch down to open ground contact (E 16).

The following are de-energized:

- Contact A on relay (J 8)
- All connections in relay (J 8) are interrupted.

Run-on

The run-on lasts for about two minutes at an ambient temperature of 20° C (68° F) and is shorter at lower temperatures. The run-on is necessary in order to clear all traces of gas from the heat exchanger and cool it down. The flame switch limits the run-on period.

The following is de-energized:

- Contact F of relay (J 8a)
- The metering pump stops working.

Voltage can be measured at:

- Terminals NC-C of flame switch (F 16)
- The combustion air motor (V 6) operates.
- The hot air blower (V 4) delivers air.
- When the heat exchanger has cooled down, the flame switch (F 16) operates contacts C-NO.

The following is de-energized:

- Contact C of flame switch (F 16)
- Hot air blower (V 4) and combustion air blower (V 6) are de-energized and the run-on is finished.

Trouble shooting and testing installing heater

By subjecting the heating system to a systematic test, it is possible to localize a defect. For this reason, trouble shooting should always be carried out in the sequence given in the instructions.

Pull heater flap lever back and select temperature

The following functional defects could occur:

- A – Heater does not work (see F 1.2/1-2)
- B – No warm air flow (see F 1.2/1-4)
- C – Heater smokes (see F 1.2/1-4)
- D – Heat output insufficient (see F 1.2/1-5)
- E – Heater goes out (see F 1.2/1-5)

In addition, the following can occur:

- F – Blowers do not switch off (see F 1.2/1-6)
- G – Heater does not work at low outside temperatures (see F 1.2/1-6)

If one of the listed defects is found, check the heating system according to the following instructions (see test chart).

A - Heater does not work

First check the heater air and combustion air blowers visually to determine that they are operating, then check that the fuel pump is working (the pump ticks audibly). If these units are working, check the glow-spark plug (at the same time check whether fuel is pumped into the heater - check at exhaust pipe).

Defective units should be repaired or replaced with new ones.

If this check shows that the heater is not working at all, check as follows:

Operation	Possible defect	Remedy
1 - Check all heating system units and warm air ducts as well as electrical connections for tightness, check exhaust system for damage	a - Reduction in cross section of exhaust pipe and warm air ducts loose b - Loose connection in electrical system	a - Replace damaged parts with new ones b - Tighten loose push-on connections
2 - Check 16 amp. main fuse (no current at relay terminal E)	Short circuit in electrical system	disconnect cables at relay terminals G, E and F. Install new fuse and reconnect cables individually. If fuse blows, check appropriate cables and units and replace if necessary
3 - Check 8 amp. overheating fuse	a - Overheating due to failure of heater air blower b - Warm air duct blocked (fresh air and defroster vents or outlets in footwell) c - Heater flaps closed	a - Check heater air blower (see F 1.3/2.4) b - Check warm air duct for blockage c - Adjust heater flap cable
4 - Test battery voltage		Charge battery (if necessary start vehicle engine)
5 - Disconnect cables at fuel pump so that no fuel is delivered during further tests		

Operation	Possible defect	Remedy
6 - Disconnect cable at relay of terminal A, then reconnect cable (relay must be heard to work)	a - Safety switch has cut-in because of defect in fuel supply or in ignition system b - Temperature control switch defective (open circuit) c - Contact on heater flap lever does not close	a - Switch safety switch on and eliminate defect if necessary (see F 1.3/1-3) b - Check temperature regulating switch and temperature sensor (see F 1.3/1-4) c - Check contact
7 - Measure voltage at relay terminals C, D and G	If there is no voltage, relay is defective (open circuit)	Install new relay (see F 1.5/2-2)
8 - Check whether heater air blower forces air into vehicle interior	Blower fan loose	Check heater air blower and repair or replace if necessary (see F 1.3/2-3 and F 1.8/2-1)
9 - Disconnect cables on ignition coil and connect tachometer (see F 1.3/1-3). Measure off speed (6000-7100 rpm at nominal voltage)	a - If speed too low, voltage drop in plug for combustion air blower motor or in relay b - Armature burnt, brushes worn c - Bearing or winding damage	a - Test and install new relay if necessary b - Repair combustion air blower motor (see F 1.6/1-1) c - Replace combustion air blower motor (see F 1.5/1-2)
10 - Remove 16 amp. fuse. Push heater flap lever fully forward. Unscrew glow/spark plug. Reconnect cables, install fuse and operate heater flap lever. Sparks must jump between electrode and casing and glow element must glow (see F 1.3/2-1)	a - Thermo-switch defective (no current, glow time too short) b - Glow element open c - Glow/spark plug dirty d - Ignition contact breaker defective or maladjusted e - Ignition coil or cable defective	a - Install new thermo-switch (see F 1.5/2-1) b - Install new glow/spark plug (see F 1.5/2-2) c - Clean glow/spark plug (see F 1.3/2-1) d - Adjust contact breaker or replace if necessary (see F 1.3/2-2) e - Test ignition system and install new parts if necessary
11 - Turn heater off, remove pump and measure capacity (see F 1.3/2-4)	a - Contact breaker defective or maladjusted b - Open circuit in pump winding c - Maladjustment d - Fuel hoses, filter or strainer blocked e - Valve does not open	a - Check contact breaker, install new if necessary (see F 1.5/1-4) b - Install new pump (see F 1.5/2-3) c - Correct adjustment (see F 1.3/2-4) d - Clean parts e - Replace fuel check valve. Refill fuel quantity (see F 1.7/1-2 and F 1.7/2-1)

B - No warm air flow into vehicle interior (Heater air and combustion air blowers operate, fuel pump ticks)

Operation	Possible defect	Remedy
1 - Check warm air duct from heater to body for tightness	Clamps loose and hoses dropped down or damaged	Secure loose parts, replace damaged parts with new ones (see F 1.4/1-1)
2 - Loosen hose clamp, disconnect hose to heater briefly (2 secs.) at fuel pump, then check whether fuel is delivered by pump. Catch escaping fuel in a cloth	a - Check fuel supply b - Filter blocked c - Strainer dirty d - Fuel check valve blocked	a - Fill fuel tank b - Install new filter (see F 1.5/2-4) c - Clean strainer d - Replace fuel check valve and readjust delivery quantity (see F 1.3/2-4)
3 - Switch heater off. Remove glow/spark plug and check (see F 1.3/2-1)	a - Thermo-switch defective (no current, glow time too short) b - Glow element open c - Glow/spark plug dirty d - Ignition contact breaker defective or maladjusted e - Ignition coil or cable defective	a - Install new thermo-switch (see F 1.5/2-1) b - Install new glow/spark plug (see F 1.5/2-2) c - Clean glow/spark plug d - Adjust contact breaker or replace if necessary (see F 1.3/2-2) e - Test and replace defective parts if necessary

C - Heater smokes

Operation	Possible defect	Remedy
1 - Check exhaust pipe for damage (cross section reduced)	a - Mechanical damage b - Partially blocked	a - Install new exhaust pipe b - Clean exhaust pipe
2 - Check delivery quantity of fuel pump	Excessive fuel	Correctly adjust delivery quantity (see F 1.3/2-4)
3 - Check combustion air intake for free passage (visual check)	Intake blocked	Clean combustion air intake
4 - Check combustion air blower motor speed (see F 1.3/1-3)	a - Battery voltage too low b - Blower fan loose (chafes) c - Speed is not attained at nominal voltage (6400-7100 rpm)	a - Charge battery b - Remove combustion air blower, secure blower fan (note air gap of .039 in./1 mm) and install new blower fan if necessary (see F 1.6/1-5) c - Remove motor and check, install new one if necessary (see F 1.5/1-2)

D - Heat output insufficient

Operation	Possible defect	Remedy
1 - Check delivery quantity of fuel pump (see F 1.3/2-4)	a - Delivery quantity too small b - Filter blocked c - Strainer dirty d - Fuel check valve blocked	a - Adjust delivery quantity (see F 1.3/2-4) b - Install new filter c - Clean d - Install new fuel check valve (see F 1.7/1-2) and F 1.7/2-1)
2 - Check temperature regulation	Check temperature sensor (see F 1.3/1-4) Check temperature regulating switch (see F 1.3/1-4)	Replace temperature sensor (see F 1.3/2-1) Replace temperature regulating switch (see F 1.5/2-1)
3 - Check adjustment of heater flaps on engine heat exchanger	Bowden cable adjustment not correct	Adjust (see F 1.9/1-2)
4 - Non-return flaps in engine cooling air housing stiff or jammed	Not installed correctly	Remove cooling air fan and check flaps, replace if necessary (see F 1.8/1-1)

E - Heater goes out

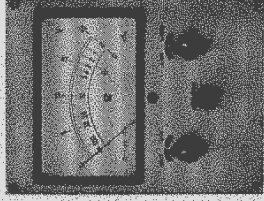
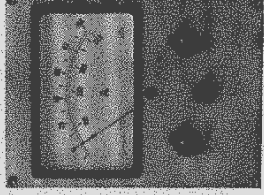
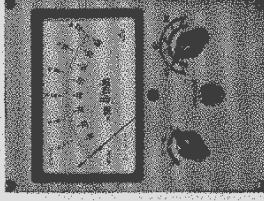
Operation	Possible defect	Remedy
1 - Check electrical connections for tightness	Loose connection	Check connections and secure
2 - Check exhaust pipe for obstructions	Exhaust pipe partially blocked	Clean exhaust pipe (note condition of water drain hole) and, if necessary, install new one
3 - Check cut-in time of glow element in glow/spark plug (at least 70 secs. at nominal voltage and 88° F (30° C) ambient temperature)	Thermo-switch defective (glow time too short)	Install new thermo-switch (see F 1.5/2-1)
4 - Check delivery quantity of fuel pump (see F 1.3/2-4)	Delivery quantity too small due to a - Maladjustment b - Filter dirty c - Strainer blocked d - Fuel check valve dirty	a - Corred adjustment (see F 1.3/2-4) b - Install new filter c - Clean strainer d - Install new fuel check valve

F - Run-on does not switch off

Operation	Possible defect	Remedy
Turn heater on with engine cold and let it run for 5 mins. Start stop watch and turn heater off. Check run-on time. Should be 120-240 secs.	Thermo-switch defective, contact sticks	Install new thermo-switch (see F 1.5/2-4)

G - Heater does not work at low outside temperatures

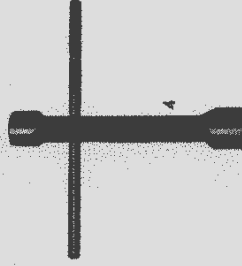
Operation	Possible defect	Remedy
1 - Measure battery voltage		Recharge battery if necessary
2 - Check fuel pump delivery quantity (see F 1.3/2-4)	Quantity too small due to a - Maladjustment b - Filter dirty c - Strainer blocked d - Fuel check valve dirty e - Combustion air blower motor speed too low	a - Correct adjustment (see F 1.3/2-4) b - Install new filter c - Clean strainer d - Install new fuel check valve e - Measure speed (see F 1.3/4-3) repair motor if necessary
3 - Remove glow/spark plug and check glow element	Open in glow element	Install new glow/spark plug (see F 1.5/2-2)
4 - Connect voltmeter to terminal NO of safety switch and to ground, then turn heater on with engine cold. Voltage must be held for at least 70 secs.	Thermo-switch defective (cut-in time too short)	Install new thermo-switch (see F 1.5/2-4)



3

2

1



4



5

No.	Description	Special tool	Remarks
1	Ohmmeter / voltmeter		range 0-20 volts
2	Ammeter		range 0-20 amps.
3	Tachometer		0-8000 rpm
4	Box wrench		22 mm A/F
5	Stop watch		

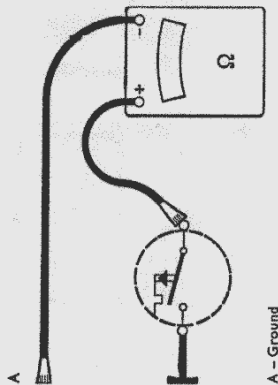
Testing overheating switch (installed)

If the 8 amp. fuse for the overheating switch has blown, check that the switch has moved to its original position before a new fuse is installed.

1 - Disconnect black-red cable from terminal with short circuiting fuse to overheating switch.

2 - Test overheating switch with an ohmmeter connected as shown. The switch must not have continuity.

3 - If, when the heater is cold, the overheating switch completes the circuit, the switch is defective and a new one must be installed.



A - Ground

Testing ignition coil

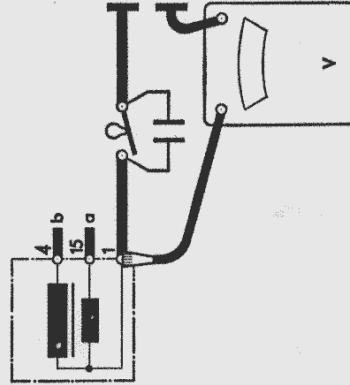
1 - Disconnect cables from fuel pump and from glow/spark plug.

2 - Install a 4 mm diameter screw in the angled connector of the ignition cable.

3 - Turn heater on. When screw is held at a distance of .28 in. (7 mm) from suitable ground, a continuous spark must jump across the gap. (Hold ignition cable with insulated pliers.)

Note:

If there is no spark, first measure the voltage at terminal 15 of the ignition coil with a voltmeter. The voltage must be at least 10 volts. If the measured voltage is lower, check whether there is voltage when the contact breaker is open and no voltage when it is closed, at terminal 1 of the ignition coil with a voltmeter or a test lamp. If the voltmeter needle does not move, even when the contact breaker is open (contact breaker is not shorted), the ignition coil has open circuit and a new coil must be installed.



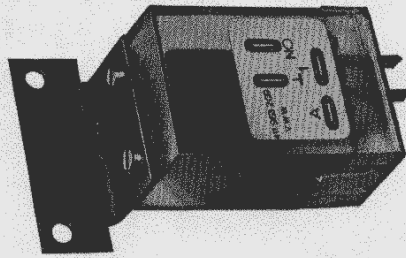
a - Thermo-switch terminal C
b - to glow/spark plug

Checking and adjusting safety switch

1 - Disconnect cables at fuel pump and glow element of glow/spark plug.

2 - Turn heater on. After about 130-200 seconds (at nominal voltage and about 68° F/20° C ambient temperature), the safety switch should break the circuit to the relay (contact A).

3 - If the safety switch has operated within the required time, press lever on safety switch in direction of arrow and turn heater on again.

**Note:**

(Honeywell safety switch only)

If a correction has to be made, move adjusting screw through slot in lever as follows:

Response time too long - turn screw clockwise

Response time too short - turn screw anti-clockwise

Testing combustion air blower

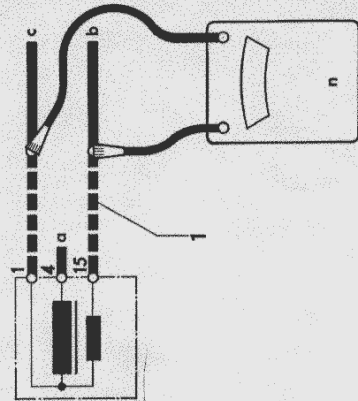
(Measuring speed)

1 - Disconnect cables from terminal 15 and from terminal 1 of ignition coil.

2 - Attach intermediate cables to ignition coil terminal and to appropriate cables disconnected from coil.

3 - Connect tachometer (see illustration) and turn heater on.

4 - At a working voltage of 12 volts, speed should be between 6400 and 7100 rpm. If speed deviates considerably, remove combustion air blower and test it.

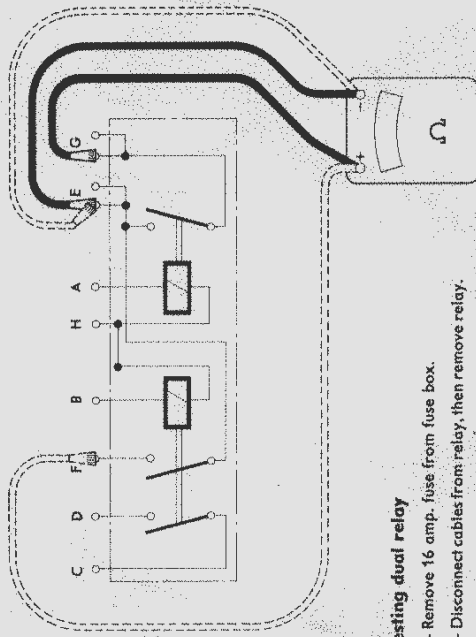


1 - Intermediate cable
a - to glow/spark plug
b - to thermo-switch terminal C
c - to contact breaker

Checking thermo-switch

(Run-on time)

- 1 - Turn heater on and regulate to full heat output. Let heater run five minutes.
- 2 - Push heater flap lever forward until warning lamp goes out. At the same time start stop watch.
- 3 - The heater air and combustion air blowers, controlled by the thermo-switch, should run-on 120-240 seconds. This time is for a nominal voltage of 12 volts and an outside temperature of about 68° F (20° C). The run-on time is shorter at lower outside temperatures.
- 4 - If the run-on time is too short or the heater does not switch off, install a new thermo-switch. The thermo-switch is not adjustable.

**Testing dual relay**

- 1 - Remove 16 amp. fuse from fuse box.
- 2 - Disconnect cables from relay, then remove relay.
- 3 - Apply 12 volts to relay terminals A-H and test terminals E-G for circuit with an ohmmeter.
- 4 - Apply 12 volts to relay terminals B-H (battery positive to terminal B) and test terminals E-F and C-D for circuit with an ohmmeter.

Note:

If an open circuit is found during tests 3 and 4, the relay must be replaced with a new one.

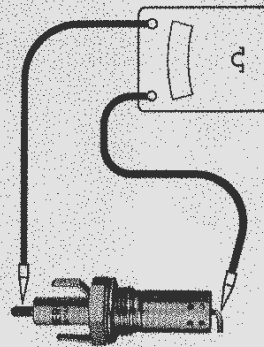
Testing glow/spark plug

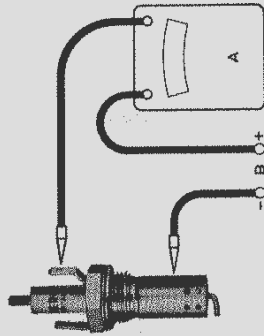
- 1 - Turn heater off.
- 2 - Unscrew plug and clean if dirty.
- 3 - Install angled connector and ignition cable as well as ground cable, then hold glow/spark plug with insulated pliers.
- 4 - Turn heater on. Sparks must jump across from central electrode to casing (ground).

**Note:**

The electrode gap can widen during operation due to natural erosion. The prescribed gap is .098 in. (2.5 mm) and it should be checked and then adjusted if necessary.

- 5 - The required suppression resistance of 5 kΩ is installed in the glow/spark plug. If, when measuring the resistance with an ohmmeter, a reading of more than 10 kΩ is obtained, install new plug.





- 6 - Test glow element for circuit. Connect ammeter as shown and apply 12 volts from a battery. If there is a current of 5.5 to 7 amps, the glow element is serviceable. If the ammeter gives no reading (open circuit) or if reading of more than 8 amps, is shown (short circuit), install a new glow/spark plug.

A - Ammeter
B - 12-volt battery

Checking and adjusting contact breaker points

In the course of time, erosion occurs at the points creating a pit and a build-up (material transfer). This does not normally affect operation. If the points are badly eroded, new ones must be installed.

Possible defects in the system can be determined by checking the points visually.

- 1 - Pit and build-up with clean contact surfaces:

- 2 - Gray contact surfaces:

- 3 - Breaker points blue:

- 4 - Burnt contact surfaces:

Normal erosion

Breaker point gap too small and pressure too low

Ignition coil or condenser defective

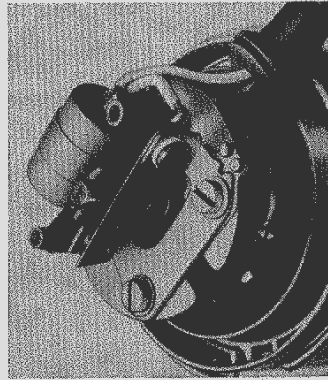
Dirty (grease)

Adjusting ignition contact breaker points (Bosch)

- 1 - Remove combustion air blower.
- 2 - Remove protective cap for motor and cover.
- 3 - Turn eccentric on motor shaft against thrust washer of breaker arm until breaker arm has moved to end of stroke. Loosen locking screw on contact breaker.
- 4 - Insert screwdriver between the two small pins on the contact breaker plate and in the slot at the end of the fixed point. Turn screwdriver until clearance of .016 in. (0.4 mm) is obtained. (Contact pressure should be about 160 grams/5.5 ounces - measure with spring balance.)
- 5 - Tighten locking screw.

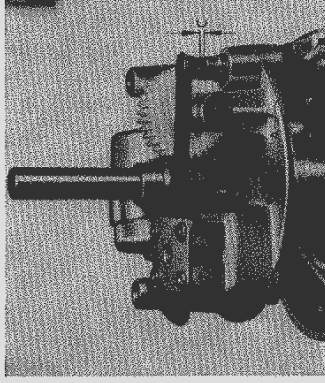
Note:

The breaker points should not come into contact with grease or oil (on the feeler gauge for example), otherwise premature wear will result.

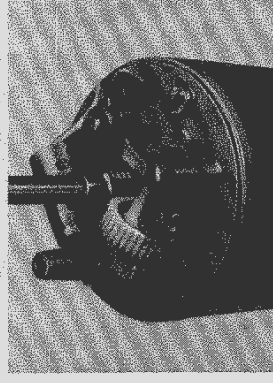


Adjusting fuel pump contact breaker points (Bosch)

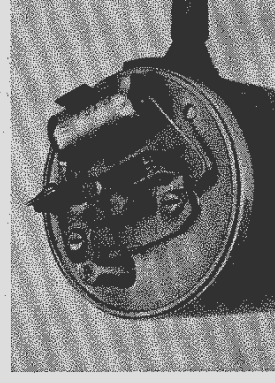
- 1 - Remove combustion air blower.
- 2 - Take off blower fan and spring tensioner. (Take fan off carefully. Do not apply load of more than 500 grams/18 ounces to motor shaft. See F 1.6/1-4.)
- 3 - Take motor out of its support housing and detach motor housing.
- 4 - Turn motor shaft until cam on gear shaft lifts breaker arm fully.
- 5 - Loosen clamp nut and adjust clearance to .016 in. (0.4 mm) with a feeler gauge by turning the contact point. Ensure that the setting does not alter when retightening the clamp nut. (Contact pressure is about 200 grams/7 ounces.)
- 6 - Assemble combustion air blower (see F 1.6/1-1).



A - Clamp nut
B - Contact breaker
C - Gap of .016 in. (0.4 mm)



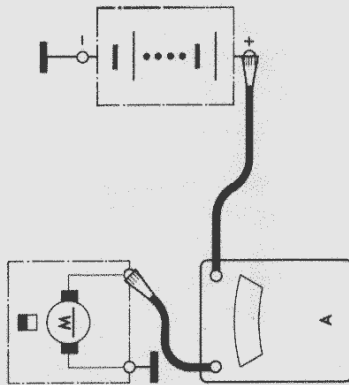
Contact for fuel pump



Contact for ignition

From 1st August 1969, Chassis No. 410 2000 001 combustion air blower motors from Bosch and AEG are installed.

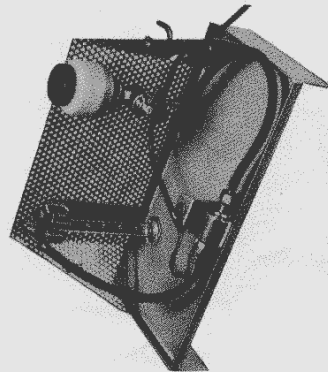
The complete motors can be interchanged. Repairs and adjustments on the AEG motors should be carried out in principle as for Bosch motors, the only difference being the removal and installation of the fuel pump breaker contact. Contrary to the Bosch motor on which the complete contact breaker plate is replaced, the contacts are replaced individually on the AEG motor.



Testing heater air blower

Measuring the motor speed and the fuel delivery quantity can only be done by measuring the current.

- 1 - Remove 16 amp. main fuse. Open footwell outlets and pull heater flap lever fully back.
 - 2 - Disconnect cables from heater air blower. Connect ammeter and battery as shown.
- For a 12-volt battery the current input is 6.5 to 7 amps. Deviations in readings are due to defects in the heater air blower.



Testing fuel pump

(Adjusting delivery quantity if necessary)

- 1 - Disconnect cables from fuel pump.
- 2 - Detach fuel hoses on suction and pressure lines and plug them.
- 3 - Remove fuel pump, secure to measuring device (VW 804) and connect. The cut-off tap should be in position "off".
- 4 - Lengthen fuel pump cables from vehicle with measuring device cable and connect to pump.
- 5 - Turn heater on.
- 6 - Move cut-off tap to "Operation" and allow 5 cc of fuel to flow through. Then start stop watch and measure delivered quantity. At a combustion air blower speed of 6000 rpm, the pump should deliver 24-5 cc per minute.

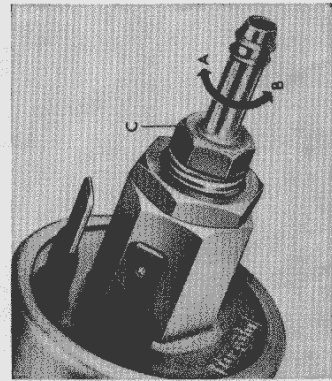
Note:

If necessary, the fuel consumption can be adjusted at the fuel check valve.

Increase consumption = Valve (C) anti-clockwise (arrow B).

Decrease consumption = Valve (C) clockwise (arrow A).

To do this, first back off nut and after adjusting, seal with paint.



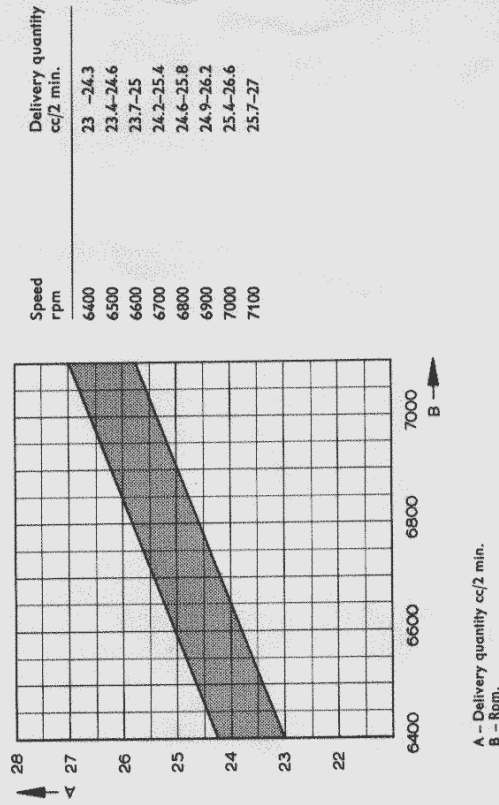
Technical data:

Speed of combustion air motor at 12 volts

New
+ 500 rpm
- 200
6600 rpm

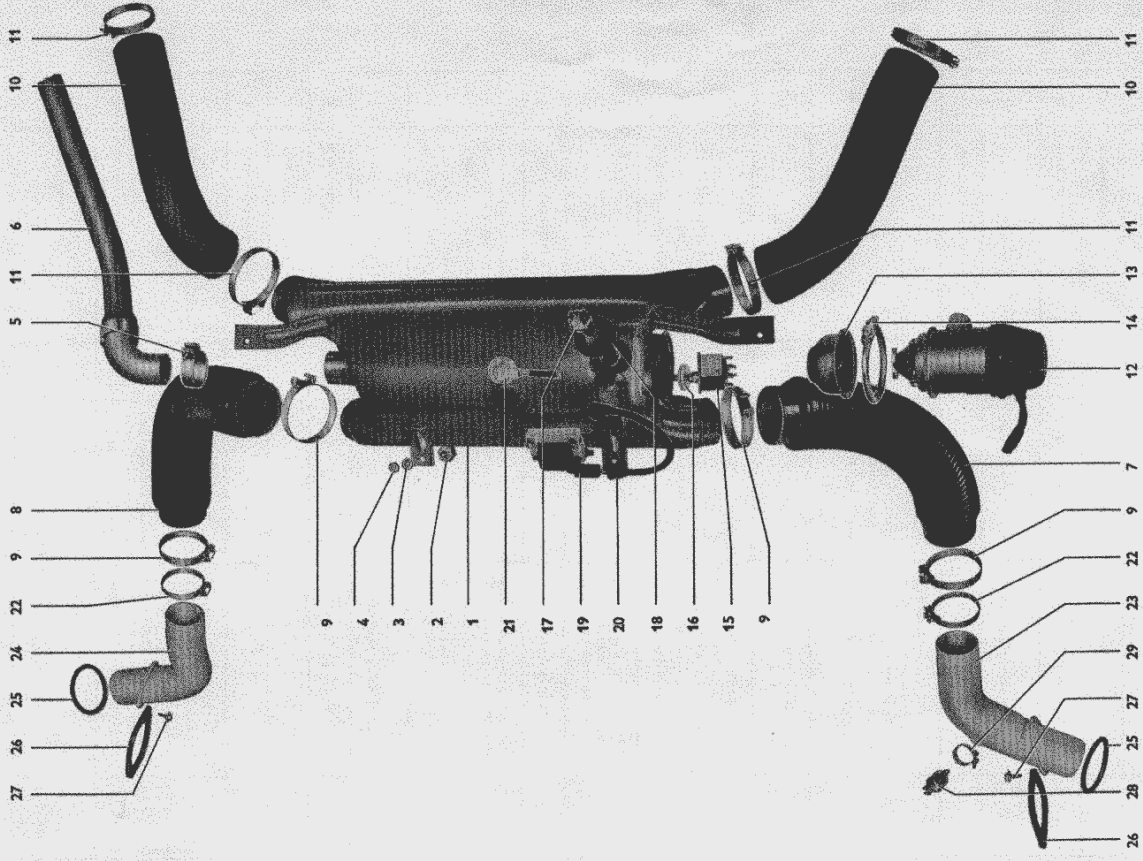
If, at a testing voltage of 12 volts, the speed varies considerably from the given data, replace the motor. The measurement should be carried out after a warm up time of 5 minutes.

Fuel pump adjustment



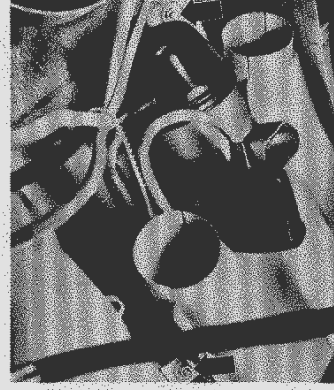
The graph and the chart contain the new fuel pump adjustment values. It is possible to adjust the pump at any speed of the combustion air motor within the tolerance range. The delivery quantity values in the graph are related to a measuring time of 2 minutes. To assess the delivery quantity accurately, we recommend that the measurement be repeated.

Heater and Warm Air Ducts F1.4



No.	Description	Qty.	removing	Note when installing	Detailed instructions see
1	Casing and heat exchanger	1	remove coil spring and shock absorber on left-hand side of rear axle	check casing for corrosion and heat exchanger for combustion deposits	F 1.4/1-3
2	Bonded rubber mounting	4		check bolt for tightness in rubber mounting	
3	Lock washer B 6	4			
4	Hexagon nut M 6	4			
5	Clamp for exhaust pipe	1			
6	Exhaust pipe	1	check for corrosion and deposits	ensure free movement	
7	Warm air hose, left (heater/vehicle interior)	1	check for leaks	ensure tightness of clamps and good sealing	
8	Warm air hose, right (heater/vehicle interior)	1	check for leaks	must not touch exhaust pipe, ensure good sealing	
9	Clamp for warm air hose	4		ensure clamp is tight	
10	Warm air hose (heat exchanger/heater)	2	check for leaks	right hose must not touch exhaust pipe, ensure good sealing	
11	Clamp for warm air hose	4		ensure clamp is tight	
12	Combustion air blower	1		check blower fan and vanes for wear and ensure ports are tightly installed	F 1.6/1-5
13	Housing with vanes	1		groove must engage in projection in heat exchanger	F 1.5/1-2
14	Clamp for blower	1			
15	Thermo-switch with union nut	1	if necessary, use solvent to loosen	do not bend sensor tube, adjust gap between switch location and union nut (31 in./8 mm)	F 1.5/2-1
16	Thermo-switch seal		replace damaged seal	ensure proper sealing	
17	Glow/spark plug	1	box wrench 22 mm A/F	clean and check operation	F 1.5/2-2 F 1.3/2-1
18	Plug bush seal	1	replace damaged seal	ensure proper sealing	
19	Ignition coil	1			F 1.5/1-1
20	Ignition cable	1			
21	Overheating switch and cable harness	1	if damaged, replace complete	test overheating switch for continuity	F 1.5/1-1 F 1.3/1-1

No.	Description	Qty.	removing	Note when installing	Detailed instructions see
22	Clamp for warm air pipe	2			
23	Warm air pipe, left with adapter for temperature	1		ensure firm connection and good sealing between adapter and temperature sensor	
24	Warm air pipe, right	1		ensure firm connection	
25	Seal for warm air pipe	2		replace damaged seal with new one	
26	Flange for warm air pipe	2		right and left flanges are symmetrically opposite	
27	Hexagon head bolt and washer for flange	4			
28	Temperature sensor	1			F 1.3/1-4 F 1.5/2-1
29	Clamp for temperature sensor	1			

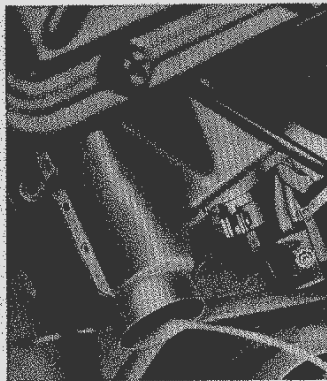


Removing and installing casing and heat exchanger

Removing

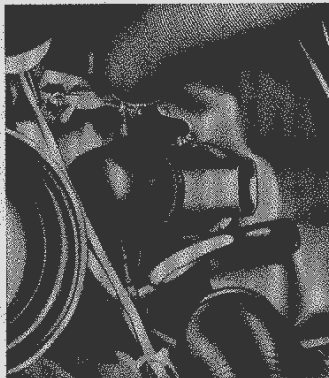
- 1 - Disconnect battery ground strap.
- 2 - Remove rear, left coil spring and shock absorber (see Rear Axle, Removing and installing Trailing Wishbones).
- 3 - Detach warm air hoses and exhaust pipe from heater.
- 4 - Disconnect heater cable harness at relay and pull through into space above transmission.
- 5 - Detach fuel hose at connection and close with plug. (Catch escaping fuel.)

- 6 - Remove four nuts and lock washers from the welded-on brackets on luggage compartment floor, lift heater and bonded rubber mountings and take out toward left.



Installing

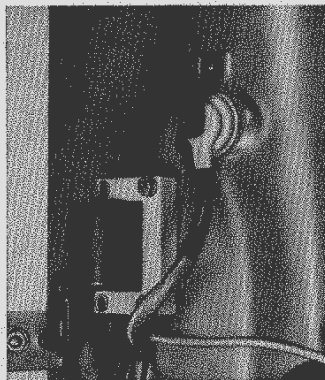
- 1 - First insert heater and bonded rubber mountings into front and then into rear brackets on luggage compartment floor. Secure with lock washers and nuts.
- 2 - Reattach fuel hose.
- 3 - Connect cables and secure exhaust pipe and warm air hoses to heater. Ensure rubber hoses (not illustrated) seal properly.
- 4 - Reinstall coil spring and shock absorber.
- 5 - Connect battery ground strap and check operation of heater.



Overheating switch with cable harness

Removing

- 1 - Disconnect battery ground strap, disconnect cables at dual relay and pull out of engine compartment, then remove heater.
- 2 - Turn tensioner on overheating switch to one side, then take overheating switch and cap out of housing.
- 3 - Disconnect cables from glow/spark plug, ignition coil, fuel pump and thermo-switch.
- 4 - Remove grommet on combustion air blower motor socket and disconnect push-on terminals.
- 5 - Open clamp for cable harness on heater and remove harness.



Installing

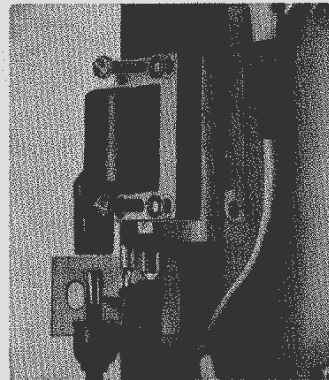
- 1 - Connect cables to heater units according to wiring diagram and secure cable harness with clamp.
- 2 - Carefully insert overheating switch and cap into housing and secure with tensioner.
- 3 - Install heater and pull cable harness through grommet into engine compartment. Connect cables to dual relay according to wiring diagram.
- 4 - Connect battery ground strap.

Removing and installing ignition coil

- 1 - Remove heater.
- 2 - Remove bolts and washers, the take ignition coil out.
- 3 - Install new ignition coil, install heater and check operation.

Note:

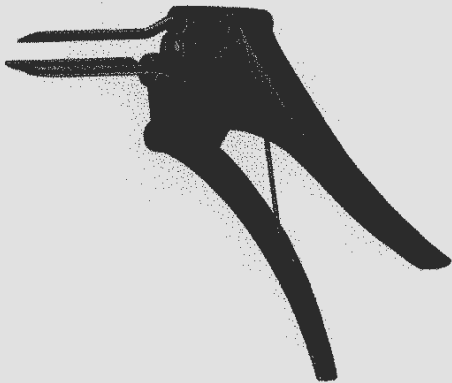
Pay attention to cable colors when connecting. See F 1.1/5-1.



Removing and installing combustion air blower

Removing

- 1 - Remove rubber grommet from blower plug with special pliers, then disconnect push-on connection.



- 2 - Loosen combustion air blower clamp and remove.
- 3 - Take out combustion air blower.



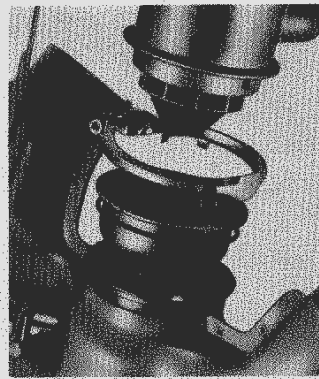
Installing

- 1 - Insert combustion air blower into heat exchanger so that combustion air intake is vertically downward. Secure blower with clamp.

Note:

Ensure that housing with vanes is correctly installed in heat exchanger. The groove in the housing with vanes must engage in the projection of the heat exchanger.

- 2 - Push plug and socket together and push rubber grommet over with special pliers.
- 3 - Turn header on and check operation.



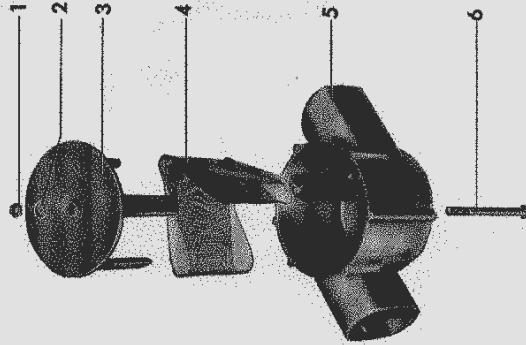
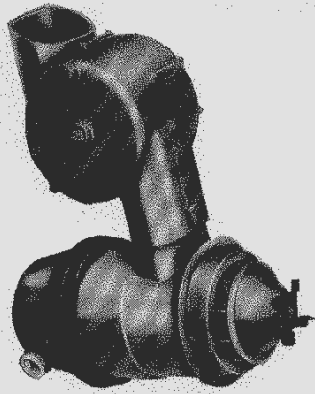
F1.5

Removing and Installing Parts

A mesh filter - Part No. 411 261 197 - is bolted onto the intake support for the combustion air fan.

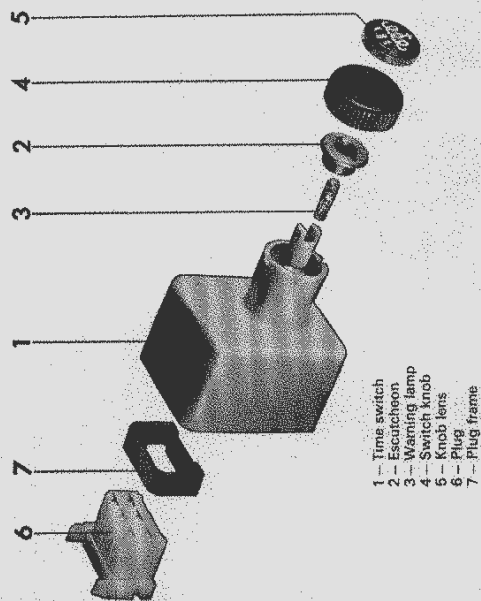
Note

The mesh should be cleaned before the arrival of cold weather. If the mesh is dirty insufficient combustion air is drawn in and the heat exchanger carbons up, which has a detrimental effect on the heat output.



- 1 - Nut
- 2 - Spring washer
- 3 - Mesh guide
- 4 - Mesh
- 5 - Mesh housing
- 6 - Bolt

Temperature regulating switch



- 1 - Time switch
- 2 - Escutcheon
- 3 - Warning lamp
- 4 - Switch knob
- 5 - Knob lens
- 6 - Plug
- 7 - Plug frame

Removing

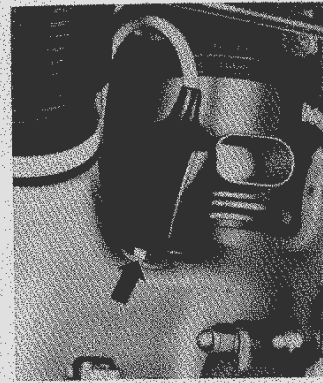
- 1 - Disconnect battery ground strap.
- 2 - Pull switch knob off and take bulb out.
- 3 - Pull connecting plug off.
- 4 - Remove escutcheon with special wrench VW 674/1 and pull switch out.

Installing

- 1 - Attach switch with special wrench VW 674/1.
- 2 - Install plug.
- 3 - Connect battery ground strap and check heater operation.

Temperature sensor

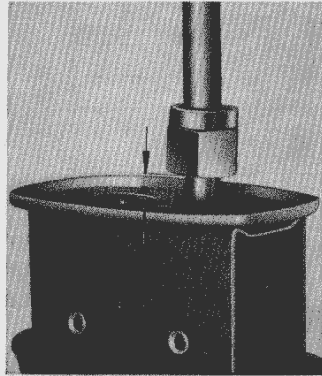
The sensor projects into the left warm air duct and is secured with a clamp.



Removing and installing thermo-switch

Removing

- 1 - Disconnect battery ground strap.
- 2 - With a 12 mm open end wrench unscrew union nut (arrow) and pull thermo-switch and cap out with a turning movement. If necessary use a suitable solvent to release it.
- 3 - Take cap off thermo-switch and disconnected cables.

**Installing**

- 1 – Install new double taper ring onto sensor tube. The distance between union nut and switch housing (a) should be adjusted to .31 in. (8 mm). Ensure that the sensor tube is not bent.
- 2 – Connect cable according to wiring diagram and install cap.
- 3 – Insert thermo-switch into adapter and secure. Ensure that thermo-switch seal in casing is correctly positioned. Maintain gap of .31 in. (8 mm).
- 4 – Connect battery ground strap and check heater operation. (Pay attention to run-on.)

Removing and installing dual relay and safety switch on the Type 441**Removing**

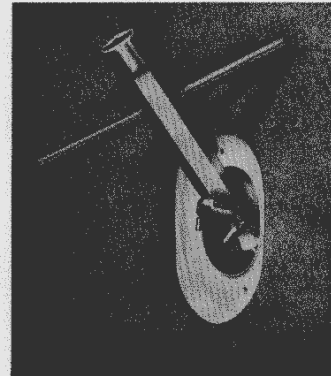
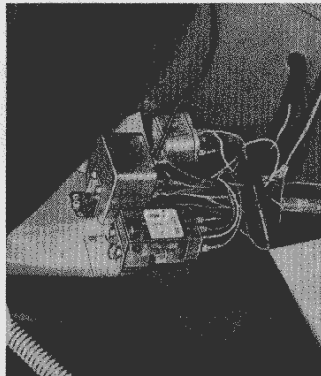
- 1 – Disconnect battery ground strap from negative terminal.
- 2 – Disconnect cables at relay, then remove relay.

Installing

When installing, ensure that cables are connected according to wiring diagram.

- 1 – Safety switch
- 2 – Dual relay

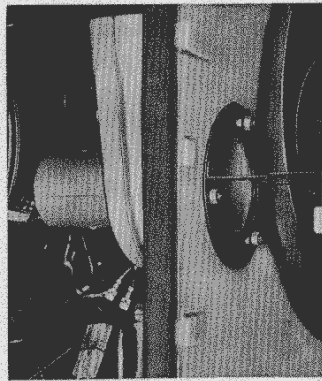
The dual relay, safety switch and overheating switch on the Type 461 are attached to a bracket under the rear seat.

**Removing and installing glow/spark plug****Removing**

- 1 – Take out cover in luggage compartment floor trim and remove cover plate.
- 2 – Disconnect cables at glow/spark plug.
- 3 – With a box wrench (22 mm A/F), unscrew glow/spark plug.

Installing

- 1 – Install plug and connect cables.
Ensure that the brown ground cable is pushed onto the ground connection tab.
- 2 – Secure cover plate and install cover in luggage compartment floor trim.

**Heater air blower****Removing**

- 1 – Disconnect cables.
- 2 – Detach warm air hoses on both sides of blower.
- 3 – Remove cooling air intake grille.
- 4 – Unscrew heater air blower nuts in cooling air intake and take blower out.

Installing

- 1 – Insert blower into cooling air intake so that the right blower connection is at the top. Secure blower with nuts and washers.
- 2 – Reinstall cooling air intake grille.
- 3 – Secure left and right warm air hoses to housing connections with clamps, then connect cables (note cable colors).

Note:

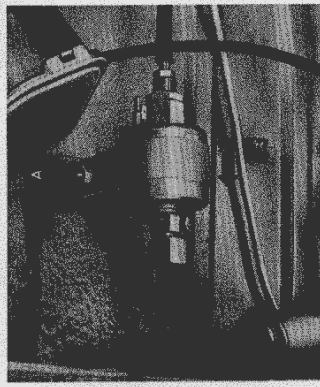
If the cables are installed in reverse order, this alters the rotational direction of the blower motor.

Fuel pump**Removing**

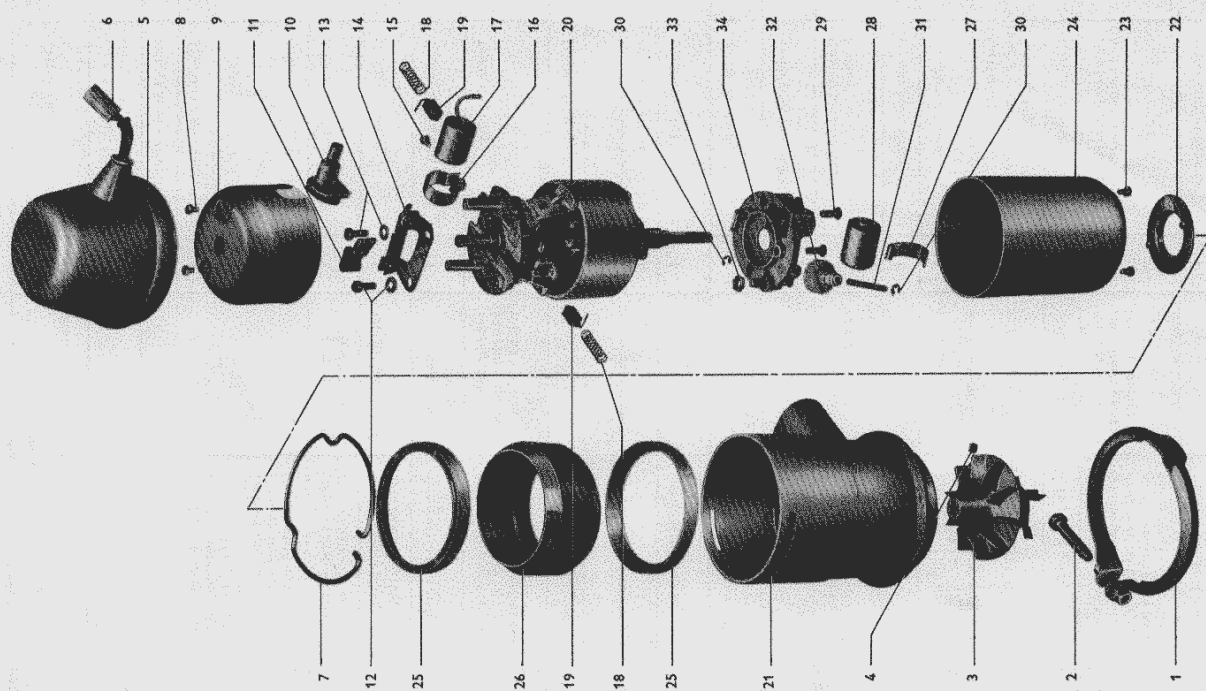
- 1 – Disconnect cables, detach suction and pressure lines and plug them.
- 2 – Loosen clamp nut (A) and pull pump out toward front (arrow).

Installing

- 1 – Insert fuel pump into clamp and tighten nut. (Note flow direction of pump.)
- 2 – Connect suction and pressure lines and electric cables. Ensure that the caps on the pump terminal tabs are correctly installed.



Combustion Air Blower F1.6



No.	Description	Qty.	disassembling	Note when assembling	Detailed instructions see
1	Combustion air blower clamp	1			
2	Fillister head screw				
3	Blower fan with vanes	1		adjust gap between blower fan and motor support housing to .039 in. (1 mm). Push carefully onto shaft (excessive pressure causes damage). Pressure must not exceed 500 grams/18 ounces	F 1.6/1-5
4	Socket head cap screw	1	back off with 2 mm Allen wrench	screw against flat on shaft, seal with Loctite	
5	Cap for motor	1	replace if damaged	ensure proper sealing, fits over tensioning ring	
6	Cable harness and plug	1	note colors when unsoldering	note markings in plug	
7	Tensioning ring	1	expand slightly, otherwise tension will be lost	press taper ring (No 23) far enough into motor support so that spring can be easily installed	
8	Fillister head screw	2		seal with paint	
9	Cap	1			
10	Rubber grommet	1			
11	Lubricating felt	1		lubricate felt with lithium grease	
12	Screw and washer	1		after installing, seal with paint	
13	Locking screw and washer	1		after installing, seal with paint	
14	Contact breaker for ignition	1	check for erosion and check gap	adjust gap to .016 in. (0.4 mm). No grease on points	F 1.6/1-3
15	Fillister head screw	1			
16	Condenser clamp	1		ensure good ground connection	
17	Condenser	1		test	
18	Brush spring	2			
19	Carbon brushes	2	check for wear	note pigtail guide	F 1.6/1-5
20	Pole housing, armature and brush holder	1	check for commutator erosion and bearing damage	axial play of armature max. .012 in. (0.3 mm). Motor shaft must not be loaded in axial direction more than 500 grams/18 ounces	
21	Motor support housing	1		clean; if damaged install new one	

No.	Description	Qty.	disassembling	Note when assembling	Detailed instructions see
22	Rubber support ring	1	replace if damaged	rubber ribs must engage in holes of motor housing	
23	Cheese head screw	2			
24	Motor housing	1			
25	Taper ring for motor support	2		push one taper ring, with its flat surface first, into motor support housing as far as it will go	F 1.6/1-1
26	Motor support rubber ring	1		insert rubber ring and taper ring into motor housing	
27	Condenser clamp	1		test	
28	Condenser			seal with paint	
29	Countersunk head screws for contact breaker plate	2			
30	Circlip	2			
31	Gear shaft	1			
32	Gear	1			F 1.6/1-4
33	Locknut				
34	Contact breaker plate with contact for fuel pump	1	check points for erosion; check gap	adjust breaker point gap (.016 in./0.4 mm)	

Ignition contact breaker (Bosch)

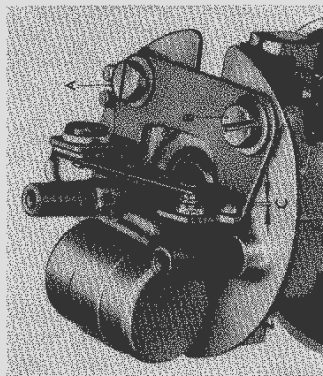
Removing

- 1 - Remove combustion air blower.
- 2 - Remove motor protective cap and cover.
- 3 - Unsolder cable at contact breaker.
- 4 - Remove securing and locking screws and take contact breaker out.

Installing

- 1 - Fill groove in thrust washer of contact breaker with lithium grease, then install contact breaker.

- 2 - Turn eccentric on motor shaft against thrust washer and adjust gap of 0.16 in. (0.4 mm). Tighten securing and locking screws and seal with paint. (The contact pressure should be about 160 grams/5.5 ounces).
- 3 - Lubricate felt with lithium grease if necessary. Grease must not come into contact with the breaker points.
- 4 - Solder cables from condenser onto contact breaker (use only rosin cored solder).
- 5 - Secure cap and seal screws with paint. Ensure that rubber grommet seals properly.
- 6 - Install protective cap for motor over tensioning ring, then install combustion air blower.

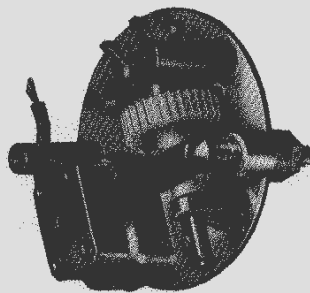


A - Locking screw
B - Securing screw
C - Breaker point gap .016 in. (0.4 mm)

Fuel pump contact breaker

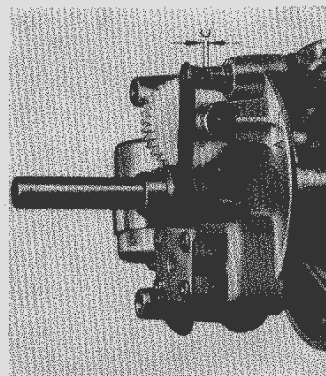
Removing

- 1 - Remove motor protective cap.
- 2 - Carefully pull blower fan off motor shaft (do not apply more than 500 grams/18 ounces to shaft).
- 3 - Mark position of motor to motor support housing, remove tensioning ring and pull motor out.
- 4 - Remove rubber support ring and securing screws. Pull pole housing out of motor housing.
- 5 - Unsolder cables at condenser, then remove contact breaker plate and gear.



Installing

- 1 - Install gear and check breaker point gap (.016 in./0.4 mm) and adjust if necessary (see F1.3/2-2).
- 2 - Install contact breaker plate and seal counter-sunk head screws with paint.
- 3 - Solder condenser on, install and secure motor support housing. Install rubber support ring.
- 4 - Push motor into support housing and secure with tensioning ring.
- 5 - Install blower fan with vanes on motor shaft, secure, then seal socket head cap screw with Loctite. Counterhold motor shaft at commutator end with a drift.
- 6 - Pull protective cap for motor over tensioning ring and reinstall blower.

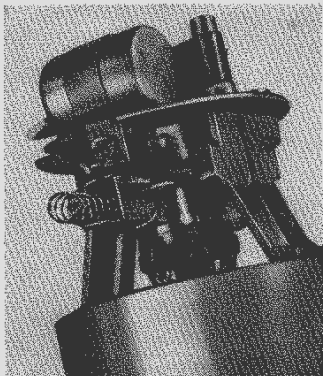


A - Locking nut
B - Contact
C - Breaker point gap .016 in. (0.4 mm)

Carbon brushes (Bosch)

Removing

- 1 - Remove combustion air blower and take motor out of motor support housing.
- 2 - Remove cover from motor housing.
- 3 - Unsolder carbon brush from terminal tab. Bend up tongue on brush holder and take out spring and brush.



Note:

Dirty laminations should be cleaned with a clean cloth moistened with gasoline. If the commutator is burnt, replace the complete pole housing and armature.

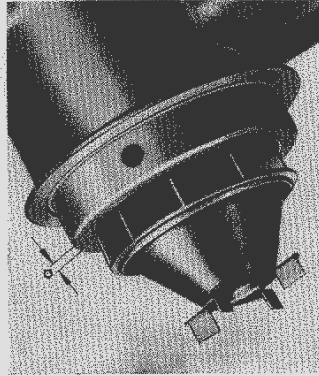
Installing

- 1 - Insert carbon brushes into brush holder, route contact pigtail through slot in brush holder to terminal tab and solder. Insert spring and bend tongue over.
- 2 - Assemble motor, insert into motor support housing and reinstall combustion air blower.

Blower fan with vanes (Bosch)

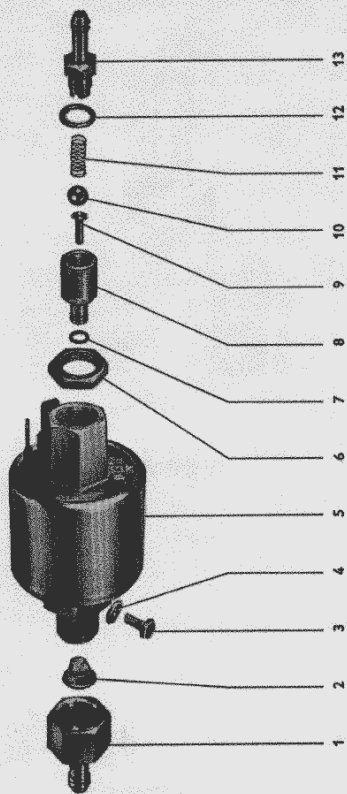
When removing and installing blower fan, ensure that the motor shaft is not loaded axially with more than 500 grams/18 ounces. Larger pressures or tensions cause damage to bearings.

When installing, leave a clearance of .04 in. (1 mm). Use a feeler gauge. The socket head cap screw for securing the blower fan should be sealed with Loctite.

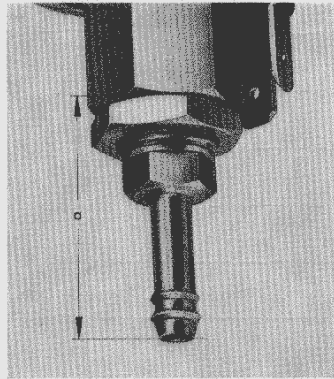


F1.7

Disassembling and Assembling Fuel Pump

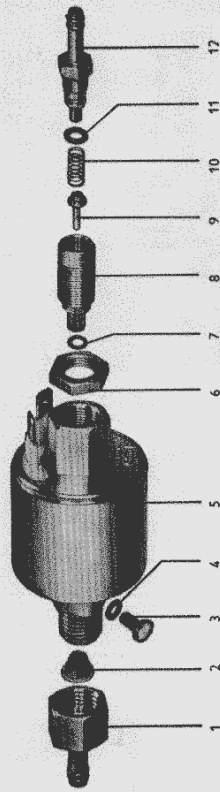


No.	Description	Qty.	Note when		Detailed instructions see
			disassembling	assembling	
1	Union	1	hold at pump housing with 17 mm open-end wrench		
2	Strainer	1		clean	
3	Bleeder screw	1			
4	Special ring seal	1		adhesive side to pump housing	
5	Pump housing	1		test winding for continuity; clean housing	
6	Locknut	1		after adjusting, seal with paint	
7	O-ring	1	check for damage	moisten with filtered gasoline	
8	Valve body	1			
9	Control valve	1			
10	Valve ball	1			F 1.3/2-4 F 1.7/1-2
11	Spring	1			
12	Copper seal	1		ensure good seating	
13	Valve connection	1		clean in acetone	

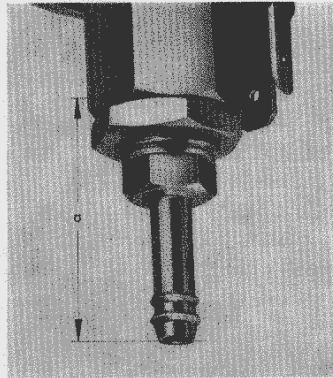


Installing and pre-adjusting fuel check valve

- 1 – Screw locknut onto fuel check valve.
- 2 – Screw fuel check valve into pump housing until there is a gap "a" of 1.18 in. (30 mm) between valve connection and pump housing.
- 3 – After assembling, adjust pump accurately on measuring device (see F 1.3/2-4).

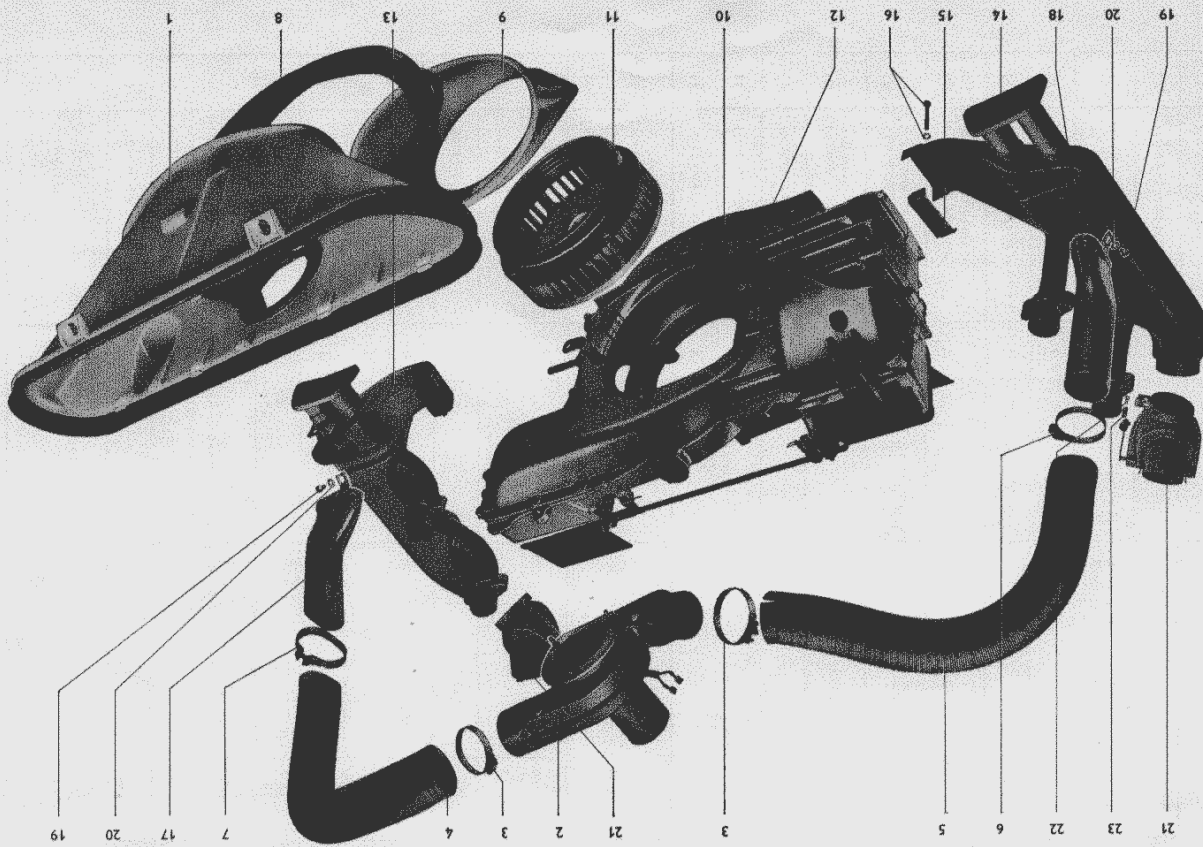


No.	Description	Qty.	Note when		Detailed instructions see
			disassembling	assembling	
1	Connection	1	hold at pump housing with 15 mm open end wrench		
2	Strainer	1		clean, replace if necessary	
3	Bleeder screw	1			
4	Special ring seal	1		adhesive side to pump housing	
5	Pump housing	1		test winding for continuity, clean housing	
6	Locknut	1		after adjusting, seal with paint	
7	O-ring, 4x1 mm	1	check for damage	moisten with filtered gasoline; if damaged, replace ring	
8	Valve body	1			F 1.3/2-4
9	Control valve	1		clean in acetone; if one part is damaged, install complete new fuel check valve	
10	Spring	1			
11	O-ring, 4 x 1.5 mm	1		moisten with filtered gasoline; if damaged, replace ring	
12	Valve connection	1		clean in acetone; counter-hold at valve body with 10 mm open end wrench	

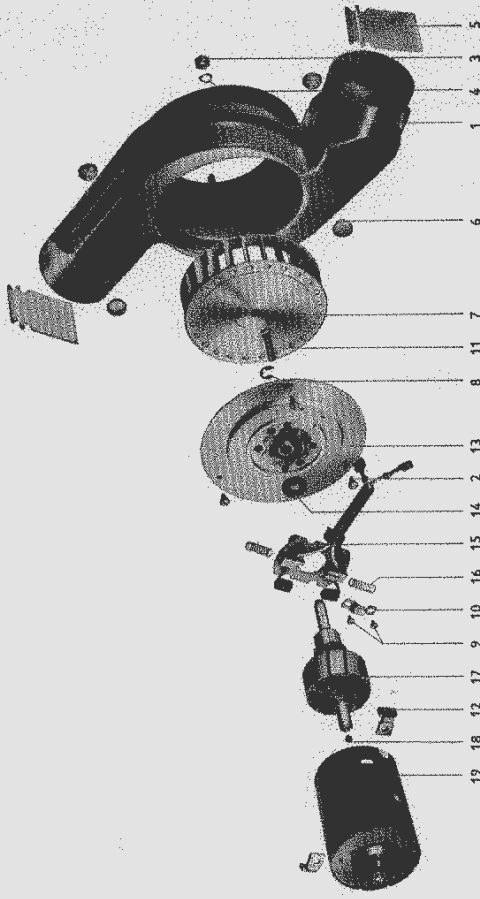


Installing and pre-adjusting fuel check valve

- 1 - Screw locknut onto fuel check valve.
- 2 - Screw fuel check valve into pump housing until there is a gap "a" of 1.38 in. (35 mm) between valve connection and pump housing.
- 3 - After assembling, adjust pump accurately on measuring device (see F 1.3/2-4).



No.	Description	Qty.	removing	Note when installing	Detailed instructions see
1	Cooling air intake	1			
2	Heater air blower with non-return flaps	1	first remove cooling air intake		F 1.3/2-3 F 1.5/2-3
3	Clamp	2		ensure clamp is tight	
4	Warm air hose, right	1			
5	Warm air hose, left	1			
6	Clamp	1		ensure clamp is tight	
7	Clamp, oval	1		ensure clamp is tight	
8	Boot	1			
9	Intake	1			
10	Cooling air intake housing	1			
11	Blower	1			
12	Non-return flaps	2	check for free operation		
13	Heat exchanger, right	1	install new ones if badly rusted		
14	Heat exchanger, left	1			
15	Heat exchanger cover	1			
16	Fillister head screw and washer	1			
17	Connecting pipe, right, for heater air blower	1			
18	Connecting pipe, left, for heater air blower	1			
19	Fillister head screw M 6 x 10	2			
20	Lock washer	2			
21	Flap boxes	2		ensure that flaps operate freely and seal properly	
22	Hexagon head screw M-5	2			
23	Pivot pin	2			

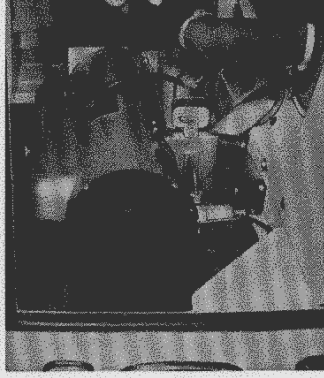


No.	Description	Qty.	disassembling	Note when assembling	Detailed instructions see
1	Housing with flaps	1		check flaps for free operation	F 1.5/2-3
2	Screw	3			
3	Hexagon nut	1	first remove housing with flaps	hold blower fan	
4	Washer	1			
5	Non-return flaps	2			
6	Plastic bearing	4			
7	Blower fan	1	check vanes for damage, note and mark relative position of fan to shaft		
8	Circclip	1			

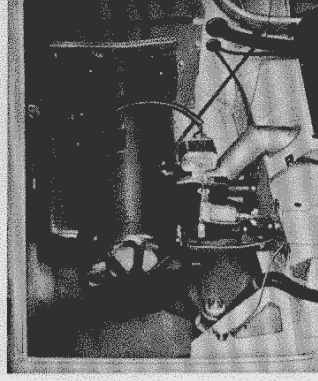
No.	Description	Qty.	Note when disassembling	Note when assembling	Detailed instructions see
9	Screw	2			
10	Clamp	1			
11	Fillister head screw	2		seal with paint	
12	Attaching bracket	2		outer arm faces blower fan	
13	End plate	1	mark position of pole housing to end plate	lubricate bearing with universal grease	
14	Plastic washer	1			
15	Brush holder and brushes	1	press rubber bush out of end plate	check brushes for wear	
16	Brush spring	2			
17	Armature	1		check commutator for damage and windings for open circuit and short circuit to ground	F 1.3/2-3
18	Thrust cone	1		lubricate with universal grease and insert into armature shaft	
19	Pole housing	1		lubricate bearing with universal grease	

BN 4 Circulating Air and Fresh Air Heaters for Type 2 vehicles**Description**

The gasoline heater works independently of the vehicle engine and is installed in the engine compartment. The heat range can be adjusted by a temperature regulating lever.



Recirculating heater

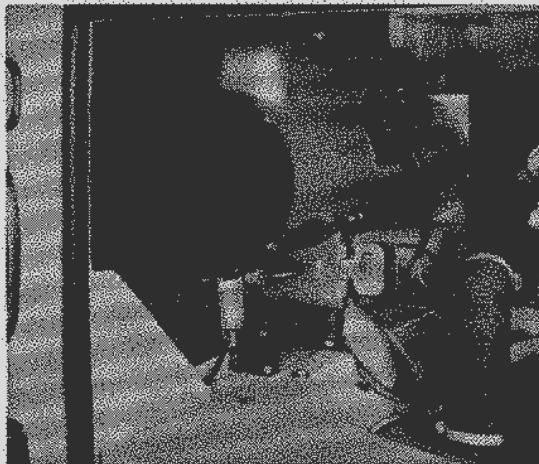


Fresh air heater

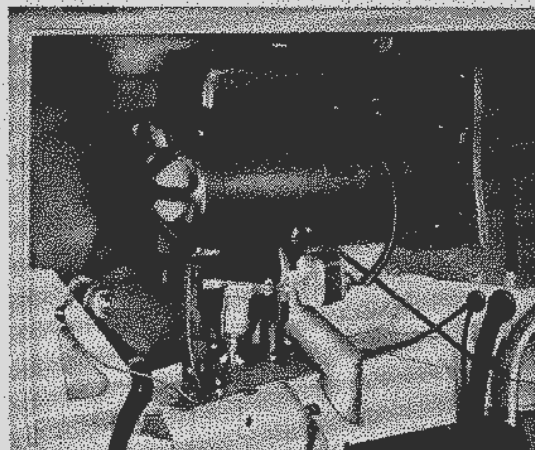
BN 4 Circulating Air and Fresh Air Heaters for Type 2 vehicles

Description

The gasoline heater works independently of the vehicle engine and is installed in the engine compartment. The heat range can be adjusted by a temperature regulating lever.



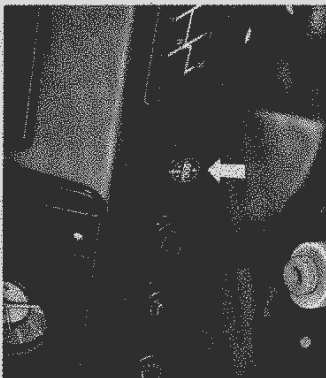
Recirculating heater



Fresh air heater

Controls

The heater is switched on with a time switch which is located in the instrument panel to the left of the ashtray.



The temperature regulating knob controls the temperature of the air from the heater. It can be regulated between 50 and 135° C (122° F - 275° F). It is located on the door side at the base of the driver's seat.



Warning

The heater must be turned off when filling the fuel tank.

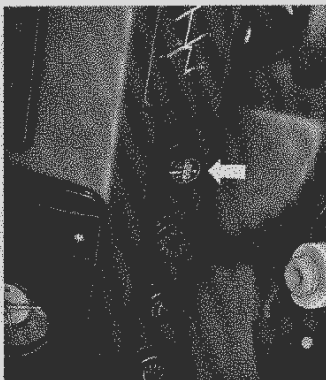
Note

- 1 - After the heater has been turned off, the combustion air blower continues to run (run-on) to cool the heater.
- 2 - To avoid running the battery down, it is recommended not to use the heater several times in succession. Start the engine up to keep the battery charged.

1-2 Controls

Type 2

The heater is controlled with a time switch (arrow).
Up to Chassis No. 212 2 246 946, July 1972.
The bulb in the heater switch knob will glow when the heater is in operation.
From Chassis No. 213 2 000 001, Aug. 1972.
The bulb in the heater switch knob is wired as an illuminating light. Its brightness is regulated together with the instrument panel illumination.



The temperature is regulated by pulling the knob (arrow) out.
(High temperature: knob pulled out as far as it will go.)



Note

- 1 - After the heater has been turned off, the combustion air blower continues to run (run-on) to cool the heater.
- 2 - To avoid running the battery down it is recommended not to switch the heater on several times in succession when the vehicle is parked. This applies particularly when outside temperatures are very low as then the full capacity of the battery is required to start the engine.

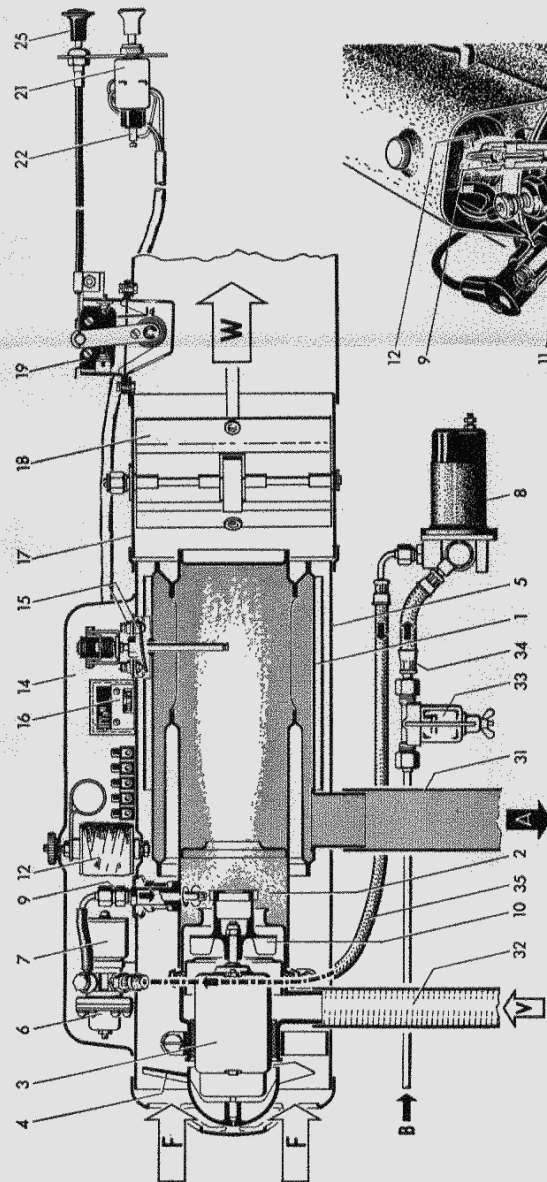
Warning

The heater must be turned off when filling the fuel tank.

F 3.1

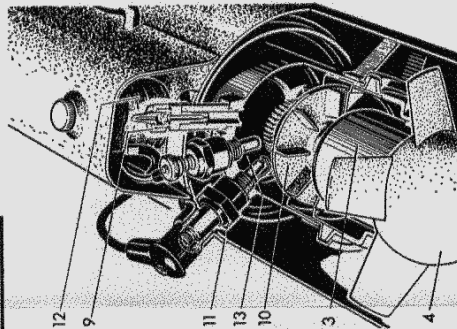
Description of Heating System

Operation



- 1 - Heat exchanger
- 2 - Combustion chamber
- 3 - Electric blower motor
- 4 - Fresh air blower fan
- 5 - Casing
- 6 - Pressure regulator
- 7 - Solenoid fuel valve
- 8 - Electric fuel pump
- 9 - Fuel jet
- 10 - Combustion air blower
- 11 - Spark plug, 2 pole
- 12 - Ignition coil
- 13 - Glow plug
- 14 - Flame detector switch
- 15 - Overpressure switch
- 16 - Safety switch
- 17 - Warm air outlet
- 18 - Bimetal spring flap (not on recirculating heater)
- 19 - Temperature regulating switch
- 20 - Time switch
- 21 - Warning light connection
- 22 - Knob for regulating switch
- 25 - Exhaust pipe
- 31 - Air intake pipe
- 32 - Fuel filter
- 33 - Fuel suction pipe
- 34 - Fuel pressure pipe
- 35 - Fuel pressure pipe

- A - Exhaust gas
B - Fuel
F - Combustion air
W - Warm air



When the time switch is turned on, the combustion air blower fan operates and begins to supply air. At the same time, the electric fuel pump forces fuel into the combustion chamber via the diaphragm pressure regulator, the solenoid valve and the fuel jet.

Here the fuel strikes against the blades on the combustion air blower fan and is atomized. The combustion air, which is swirled in a vanned housing, then mixes with the atomized fuel and forms a combustible mixture.

The glow plug heats up the mixture so that it will easily ignite.

The spark plug is energized via the ignition coil and ignites the fuel/air mixture. The resulting combustion is then sensed by the flame detector switch. The flame detector switch shuts the glow plug off when operating temperature has been reached. The spark plug operates as long as the heater is on.

The air drawn in by the fresh air blower fan is forced past the heat exchanger into the interior of the vehicle.

The temperature regulating switch in the warm air pipe is adjusted by a Bowden cable. The temperature of the warm air is controlled thermostatically.

Operation 2-1

Maintenance

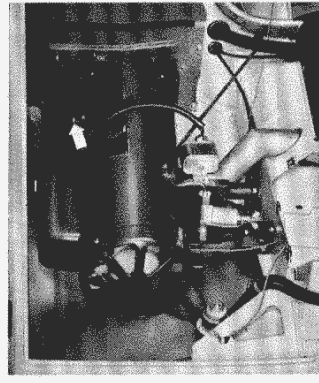
Deposits from the fuel can settle in the fuel lines if the heater is not used for long periods; for example, during the summer months. It is, therefore, advisable to operate the heater briefly about once a month when the heater is not in regular use.

Generally, the heater requires no special maintenance. Each year before the cold season starts, however, the glow plug and the spark plug should be checked. All electrical connections must be tight and not corroded.

During the winter or when driving over very poor roads, mud or snow may tend to accumulate on the exhaust and combustion air intake pipes. Have these pipes checked for blockage periodically.

If the heater does not begin to operate after 2-3 minutes, the safety switch has been energized. In such cases, reset the safety switch (arrow) on the heater.

If the heater still does not work, there is a fault in the heating system and repairs are necessary.



Technical data

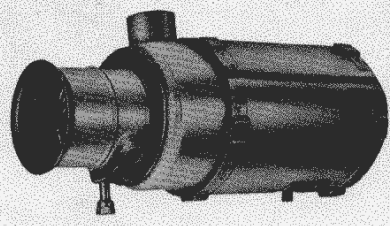
Heat output, variable from	1080-4000 kcal/h
Fuel	gasoline
Fuel consumption	0.2-0.65 liters per hour
Operating voltage	10 V-14 V
Nominal voltage	12 V
Current draw	50 Watts

Description of parts

Heat exchanger

The heat exchanger is made of stainless sheet steel. The cylindrical combustion chamber and the two annular chambers of the heat exchanger are connected by two openings (see sectional view, F 3.1/2).

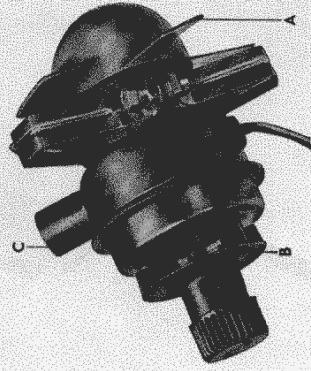
Spark plug, glow plug, flame detector switch and fuel jet are screwed into the heat exchanger.



Combustion air blower

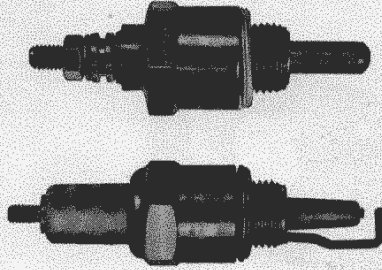
The combustion air blower is connected to one end of the heat exchanger. Two fans are connected to the shaft of the combustion air blower. The fresh air blower fan (A) delivers the warm air. The combustion air blower fan (B) draws the combustion air in through the air intake (C). The blades on the combustion air blower fan atomize the fuel.

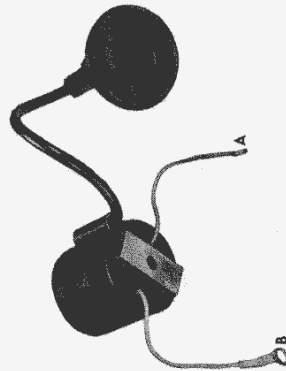
- A - fresh air fan
- B - combustion air blower fan
- C - air intake



Glow plug and spark plug

The glow plug and the spark plug protrude into the combustion chamber. The spark plug has a push-on connector and the glow plug has a screw-on connector. The glow plug works only for a brief period after the heater is turned off. The spark plug remains on the entire time the heater is in operation.

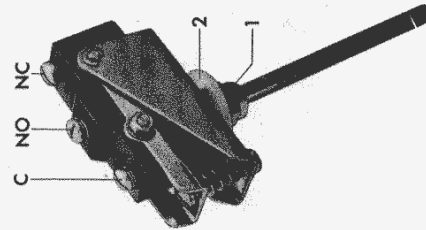




Ignition coil

The ignition coil is secured to the heater housing. The primary and secondary windings as well as the iron core are in a plastic housing. Voltage impulses are passed to the primary winding by the contact breaker on the combustion air blower motor shaft. The primary winding then induces ignition high voltage in the secondary winding. This voltage goes to the spark plug via an ignition cable.

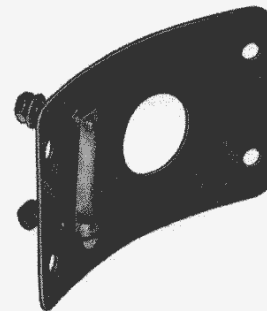
A – to contact breaker points
B – to condenser



Flame detector switch

The sensor of this switch is secured to the heat exchanger by a union nut. The sensor tube protrudes into the combustion chamber. The flame detector switch controls the cut-in time of the glow plug, the heater resistor, the safety switch and the run-on.

NC – normally closed
NO – normally open, safety switch and glow plug connection
C – common, combustion air blower fan
1 – Union nut
2 – Seal

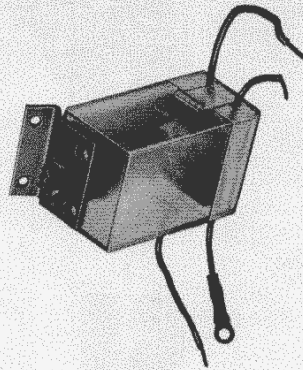


Overheating switch

The overheating switch is attached to the heater housing. If the temperature rises considerably above 150° C (302° F) the bi-metal switch interrupts the circuit to the fuel pump and to the solenoid valve.

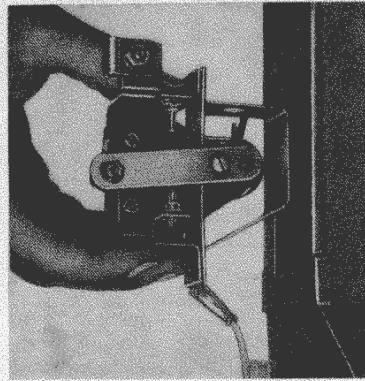
Safety switch

The safety switch is secured to the heater housing. It interrupts the flow of current to the heater if ignition has not taken place within four minutes after the heater has been switched on. The same applies if for some other reason combustion does not take place. The heat resistor in the safety switch activates a bi-metal strip. This bi-metal strip will move out of its normal position after three minutes because of the increase in temperature. This will then interrupt the current to the heater.



Temperature regulating switch

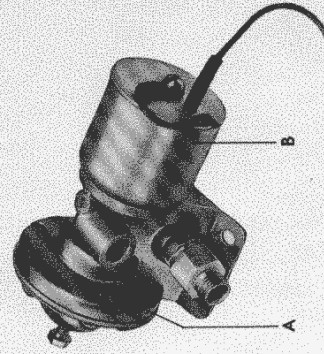
The bi-metal spring controls the heating air temperature via a micro switch for the fuel pump and solenoid valve. The control ranges are 42°–52° C (108°–125° F) at low heat output and 105°–135° C (221°–274° F) at high heat output.



Pressure regulator with solenoid valve

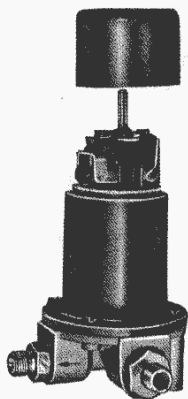
The diaphragm pressure regulator and the solenoid valve are secured to the heater housing. The fuel delivery quantity is adjusted and kept constant by the pressure regulator. When the heater is turned off the solenoid valve cuts off the fuel supply to the pressure regulator.

A – diaphragm pressure regulator
B – solenoid valve



Fuel pump

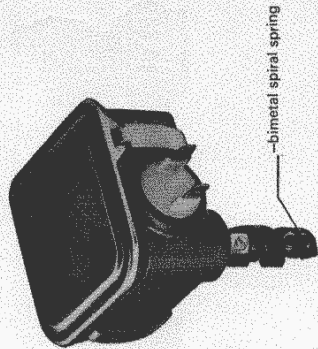
The fuel pump is secured to the upper part of the luggage compartment. It delivers fuel to the combustion chamber via the pressure regulator independently of the combustion air blower motor speed.



Temperature regulating switch

A cam-operated contact switches the current for the heating system on and off depending on the pre-set temperature.

When the cut-off temperature range is attained, the temperature regulating switch interrupts the current flow to the fuel pump. As the heated air cools down to the cut-in temperature range, the temperature regulating switch automatically switches on the current to the fuel pump. The regulating range is adjustable and depends on the position of the regulating linkage. This linkage is operated by a push-pull knob via a Bowden cable.



Type 1 / Model 118

Cut-in or cut-off temperature difference:
20° C (68° F).

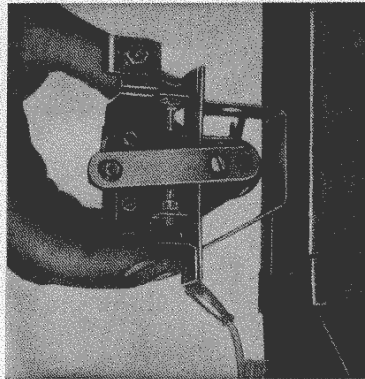
Cut-in temperature: approx. 60° C (140° F).

Cut-off temperature: approx.

Type 1 / Model 181 110–130° C (230–266° F)

Type 2 120–140° C (250–285° F)

These temperatures can be checked only with electronic instruments.



Type 2

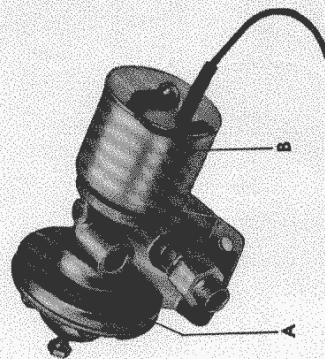
Pressure regulator with solenoid valve

Type 2 up to July 1971

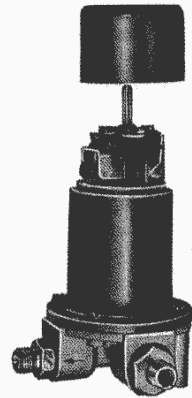
The diaphragm pressure regulator and the solenoid valve are attached to the heater housing. The fuel delivery quantity is controlled and kept constant by the pressure regulator. When the heater is turned off, the solenoid valve cuts off the fuel supply to the pressure regulator.

Delivery capacity

20 cm³ to 21 cm³ in 2 minutes at 12 volts.



A – diaphragm pressure regulator
B – solenoid valve



Fuel pump (Diaphragm pump)

Type 2 up to July 1971

This pump can only be used together with the diaphragm pressure regulator.

Installation position:

The adaptor on the pressure side (arrow) must be vertical as otherwise the valve may stick.



D — pressure connection
S — suction connection
K — locknut
E — adjusting screw

Fuel pump (metering pump)

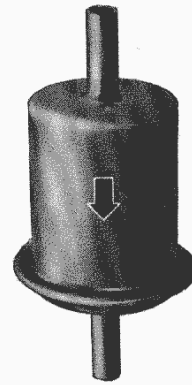
Type 1/Model 181

Type 2 from chassis No. 212 2 000 003, August 1971

The amount of fuel delivered by the electromagnetic metering pump is directly dependent on the speed of the combustion air blower. At every 33rd revolution of the motor shaft, the pump receives an electrical impulse via the breaker contacts so that the fuel-air mixture is always constant regardless of changes in the speed of the combustion air motor.

Delivery capacity:

200 strokes = 13.4 to 15.1 cm³.



Arrow = direction of flow

Fuel filter

Type 1/Model 181

Type 2 from chassis No. 212 2 000 003, August 1971

The filter with water separator is installed in BN 4 heaters with metering pump.

Time switch

This switch restricts the heater operating period to 25 minutes when ignition is switched off.

Modification

Type 1/Model 181

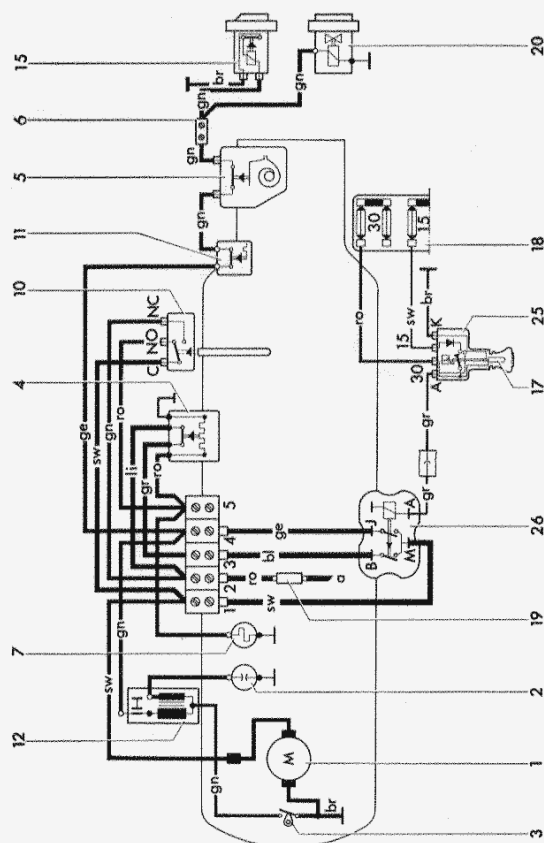
Type 2 from chassis No. 213 2 000 001, August 1972

6 terminals instead of 4 terminals previously.



F 3.1

Description of Heating System



Color code of wiring:

to = red
sw = black
ge = yellow

br = brown
gr = grey
ws = white

gn = green
li = lilac
a - to starter terminal 30

- 1 - Electric motor
- 2 - Spark plug
- 3 - Breaker contact
- 4 - Safety switch (response time 3-4 minutes)
- 5 - Regulating switch
- 7 - Glow plug
- 10 - Flame detector switch (run-on time 150-200 seconds)

- 11 - Overheating switch 150-200° C (300-390° F)
- 12 - Ignition coil
- 15 - Fuel pump
- 17 - Warning light
- 18 - Fuse box
- 19 - Fuse, 16 amp.
- 20 - Fuel solenoid valve
- 25 - Time switch
- 26 - Relay

Note

The switching times quoted refer to 12 volts and an ambient temperature of 68° F (20° C). At lower outside temperatures the run-on time is shorter and the response time of the safety switch longer.

Explanation to wiring diagram (with ignition off and vehicle stationary).

Terminal 2 of the terminal strip is always energized (normally closed).

When the time switch (25) is turned clockwise as far as possible (the timer mechanism is now wound up) terminal A of the relay (26) is energized via time switch contact 30/A. The relay operates and the warning light (17) comes on. The relay (26) closes contacts B/M and M/J.

From terminal 2 of the terminal strip (normally closed) current flows via the contact in the safety switch (4) to terminal 3. Terminal 3 of the terminal strip is energized by terminal 1 of the terminal strip via contact B/M of the relay (26) - (the relay is energized). The following are connected to terminal 1 of the terminal strip: the combustion air blower motor (1) and terminal C of the flame detector switch. The combustion air blower motor starts to operate. The glow plug (7) and heater resistor of the flame detector switch (4) are energized by terminal 1 of the terminal strip by terminals C/NO of the flame detector switch (4) and cable connector 5. The glow plug heats up and makes the mixture combustible. From the primary winding of the contact breaker (12) impulses are given to the ignition coil (3). The low tension part of the ignition coil is also connected to terminal 4 of the terminal strip.

Current flows from terminal 4 of the terminal strip via the overheating switch (11), to the temperature regulating switch (5) via terminal 6 to the solenoid valve and fuel pump.

The solenoid valve opens and the fuel pump delivers fuel through the solenoid valve and the pressure regulator to the jet.

When the heater has warmed up sufficiently, the flame detector switch (10) switches over. Contact NO is then ineffective. The glow plug and the heater resistor in the safety switch are switched off. Contacts NC-C in the flame detector switch conduct current from terminal 2 via terminal 1 to the heater unit.

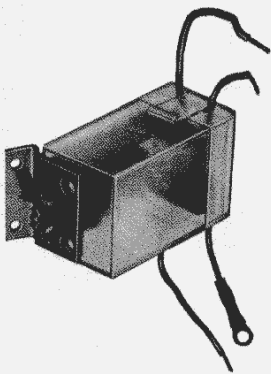
If the heater resistor of the safety switch is heated for 3-4 minutes the safety switch interrupts the circuit from terminal 2 to the heater unit.

When the heater is overheated the overheating switch interrupts the current for the fuel pump and the solenoid valve.

Note

1 - Time switch (25)

If the ignition system of the vehicle is **not** switched on before the timer has run down, the time switch shuts off the heater after about 25 minutes.



Warning

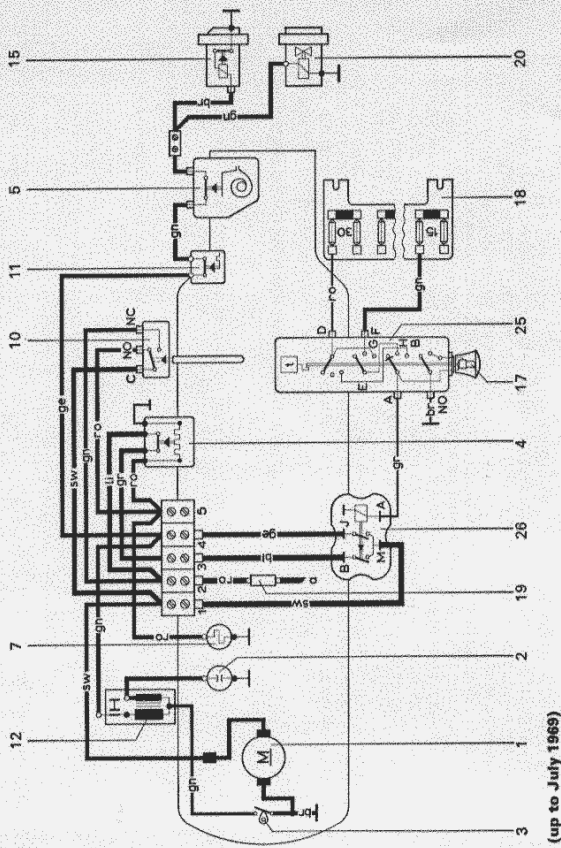
Do not operate the reset lever before the fault has been corrected.

2 - Safety switch 4

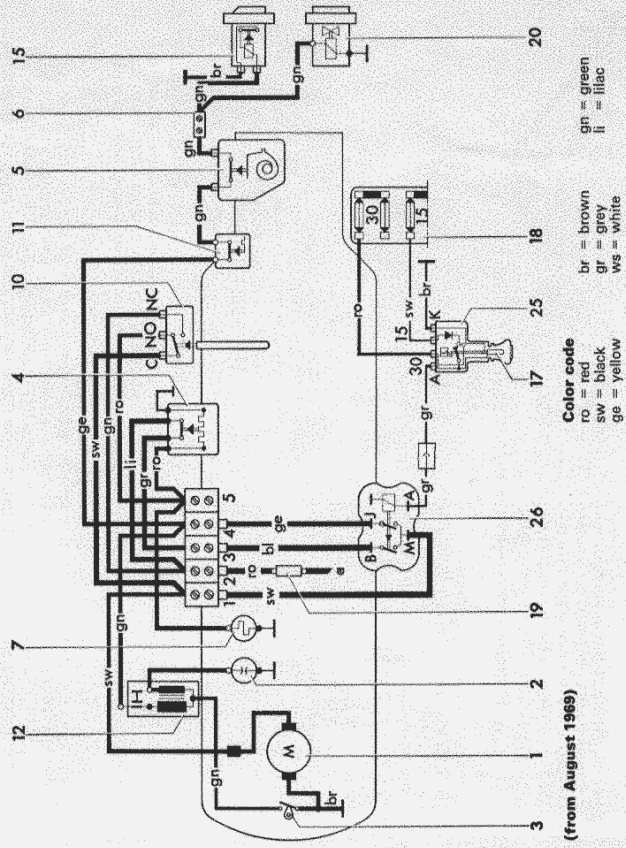
If the glow plug is faulty, no fuel is delivered. If combustion fails for some reason or other, the safety switch (response time 3-4 minutes) interrupts the current to the combustion air motor, fuel pump, solenoid valve, and ignition system. To turn the heating system on again, press the lever on the safety switch in direction of arrow (it springs back into its original position).

3 - Overheating switch (11)

If the blower fan fails to operate or the warm air ducts are blocked so that no air can pass through the heat exchanger and there is danger of overheating, the overheating switch interrupts the current to fuel pump and to solenoid valve (response temperature 150-200 °C (302-390 °F)).



(up to July 1969)



(from August 1969)

F 3.1 Description of Heating System

- | | |
|--|--------------------------|
| 1 – Electric motor | 12 – Ignition coil |
| 2 – Spark plug | 15 – Fuel pump |
| 3 – Breaker contact | 17 – Warning light |
| 4 – Safety switch (response time 3–4 minutes) | 18 – Fuse box |
| 5 – Temperature regulating switch 42°–135° C (108°–275° F) | 19 – Fuse, 16 amp. |
| 7 – Glow plug | 20 – Fuel solenoid valve |
| 10 – Flame switch (run-on time 150–200 seconds) | 25 – Time switch |
| 11 – Overheating switch 150°–230° C (300°–478° F) | 26 – Relay |

a – to starter terminal 30

Note

The switching times quoted refer to 12 volts and an ambient temperature of 20° C (68° F). At lower outside temperatures the run-on time is shorter and the response time of the safety switch longer.

Explanation to wiring diagram (with ignition off)

Terminal 2 of the terminal strip is always energized from starter terminal 30.

When the time switch (25) is turned clockwise as far as possible (the timer mechanism is now wound up) terminal A of the relay (26) is energized via time switch contact 30/A or via time switch contact D–A. The relay operates and the warning light (17) comes on. The relay (26) closes contacts B/M and M/J.

From terminal 2 of the terminal strip current flows via the contact (normally closed) in the safety switch (4) to terminal 3. Terminal 3 of the terminal strip is energized by terminal 1 of the terminal strip via contact B/M of the relay (26) – (the relay is energized). The following are connected to terminal 1 of the terminal strip: the combustion air blower motor (1) and terminal C of the flame switch. The combustion air blower motor starts to operate. The glow plug (7) and heater resistor of the safety switch (4) are energized by terminal 1 of the terminal strip by contacts C/NO of the flame switch (10) and terminal 5. The glow plug heats up and makes the mixture combustible. From the primary winding of the contact breaker (12) impulses are given to the ignition coil (3). The low tension part of the ignition coil is also connected to terminal 4 of the terminal strip.

Current flows from terminal 4 of the terminal strip via the overheating switch (11), through the temperature regulating switch (5) to the solenoid valve (20) and fuel pump (15).

The solenoid valve opens and the fuel pump delivers fuel through the solenoid valve and the pressure regulator to the jet. Combustion can start.

When the heater has warmed up sufficiently, the flame switch (10) switches over. Contact NO is then ineffective. The glow plug and the heater resistor in the safety switch are switched off. Contacts NC–C in the flame switch conduct current from terminal 2 via terminal 1 to the heater unit.

If the resistor element of the safety switch is heated for 3–4 minutes the safety switch interrupts the circuit from terminal 2 to the heater unit.

When the heater is overheated the overheating switch interrupts the current for the fuel pump and the solenoid valve.

1 – Time switch (25)

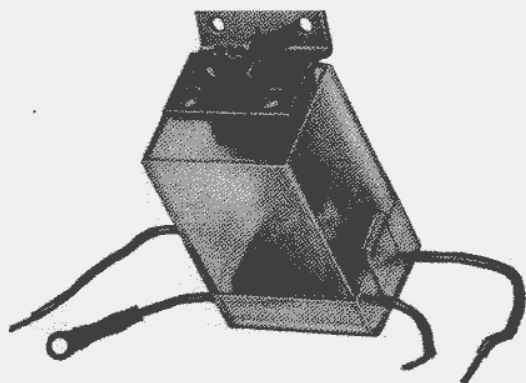
If the vehicle ignition system is **not** switched on before the clockwork mechanism has run down, the time switch cuts off the heater after about 25 minutes.

2 – Safety switch (4)

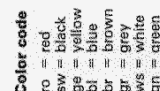
If the glow plug is defective, if no fuel is delivered or if combustion fails for some reason or other, the safety switch (response time 3–4 minutes) interrupts the current flow to the combustion air motor, fuel pump, solenoid valve and ignition system because the flame switch does not detect a flame at the sensor tube and the NC–C circuit cannot be energized via the flame switch. To switch the heater on again, the lever must be pressed in direction of arrow and reset. The lever must not be operated until the trouble has been rectified.

3 – Overheating switch (11)

If the blower stops or the ducts are blocked so that no air can be fed past the heat exchanger and there is a danger of overheating, the overheating switch interrupts the pump and solenoid valve circuit.



Description of Heating System



C ₁	-	Suppression condenser for ignition coil	- Capacity 0.47 μ F
T ₁	-	Temperature regulator	
T ₂	-	Temperature regulator	
T ₃	-	Cut-in temperature 45° C to 65° C (113° to 149° F)	
T ₄	-	Cut-off temperature 120° C to 140° C (248° to 284° F)	
T ₅	-	Time switch/Running time 25 minutes	
T ₆	-	Flame switch - Glow time less than 45 seconds, run-on time 110 to 150 seconds	
T ₇	-	Overheating switch	
T ₈	-	Response temperature 180° C to 210° C (356° to 410° F)	
T ₉	-	Metering pump - Delivery capacity 13.4 to 15.1 cm ³ per 200 strokes	
R ₁	-	Relay	
T ₁₀	-	Safety switch - Delay time 120 - 180 seconds at room temperature and 12 volts test voltage	
K ₁	-	Warning lamp	
N	-	Ignition coil - Voltage 12 V/5000 V	
S ₁	-	Glow-spark plug	
S ₂	-	Fuse box	
S ₃	-	Fuse 16 Amp	
S ₄	-	Overheating fuse - 8 Amp	
S ₅	-	Connector, single	
T ₁₁	-	Connector, double	
T ₁₂	-	Combustion air blower	

Terminal 30 – Connected to terminal 30 on starter

Wiring diagram and explanation	Type 2 from Chassis No. 212 2 000 001, August 1971	4-5

F 7th supplement (USA) Printed in Germany 3. 73

To switch heater on

- a – Pull knob of temperature regulating switch (E 13).
b – Operate heater switch (E 16).

Voltage can be measured at:

Terminals 15, 30, A on heater switch (E 16)

Warning lamp (K 11) lights up.

Start-up

The heater ignites within 45 seconds if the air being drawn in is at room temperature. The start-up process is terminated by the flame switch (F16).

Voltage can be measured at:

Terminal A of relay (J 8)

Relay (J 8) operates contacts B-M-J.

Terminals M-B of relay (J 8)

The combustion air blower (V 6) delivers warm air and combustion air.

Both terminals of overheating fuse (S 17)

The metering pump (G 6) delivers fuel.

Terminals C-NO of flame switch (F16)

The glow element of the glow-spark plug (Q 5) warms the fuel-air mixture to make it readily combustible. The spark electrodes of the plug (Q 5) then ignite the mixture.

Heating

When the heater has ignited and warmed up, the flame switch (F 16) operates the contacts C-NC. A uniform roaring noise should be heard at the exhaust pipe.

The following is de-energized:

Contact NO of flame switch (F16)

The glow element of glow-spark plug (Q 5) is switched off.

F 3.1 Description of Heating System

Regulation

The temperature regulating switch (E 13) stops the flow of fuel from the metering pump when the temperature of the hot air reaches the preset maximum.

The following are de-energized:

Contact A of relay (J 8)

Relay (J 8) separates the contacts B—M—J.

Both contacts overheating fuse (S 17)

The pump (G 6) stops delivering fuel. Combustion stops. When the heater has cooled down to the cut-in temperature of the temperature regulating switch (F 13), the fuel pump (G 6) start to deliver again.

Voltage can be measured at:

Terminal A of relay (J 8)

Relay (J 8) operates.

Fuel pump (G 6) delivers fuel.

Operation of safety switch (J 10)

The safety switch (J 10) responds when the flame switch (F 16) holds the contacts C—NO closed for longer than about two or three minutes because combustion has not taken place in the heater or because the flame switch (F 16) is defective.

Voltage can be measured at:

Terminal NO of flame switch (F 16)

Terminal NO of safety switch (J 10)

The contacts are separated in the safety switch (J 10) after about three minutes by heating up of the resistance.

The following are de-energized:

Contacts A, B, J of relay (J 8)

The combustion air blower (V 6) stops and heater cools down.

Operation of overheating circuit

If the heater gets too hot, the overheating switch (F 17) closes and causes a short circuit which blows the fuse (S 17) and stops the delivery of fuel.

The heater can overheat if the temperature regulating switch (E 13) fails to work properly or if there is insufficient air flowing past the heat exchanger (air circulation duct blocked).

Switching heater off

Turn knob of switch (E 16) back to the click stop position. The warning lamp (K 11) goes out. Or push knob of temperature regulating switch (E 13) in fully.

The following is de-energized:

Contact A of relay (J 8)

The relay (J 8) contacts are separated.

Run-on

The run-on lasts for about two minutes at an ambient temperature of 20 °C (68 °F) and is shorter at lower temperatures. The run-on is necessary in order to clear all traces of gas from the heat exchanger and cool it down. The flame switch limits the run-on period.

The following is de-energized:

Contacts of overheating fuse (S 17)

The fuel pump (G 6) stops working.

Voltage can be measured at:

Terminals NC—C of flame switch (F 16)

Terminal B of relay (J 8)

The combustion air blower (V 6) continues to work until the heater has cooled down and the flame switch (F 16) separates contacts C—NO.

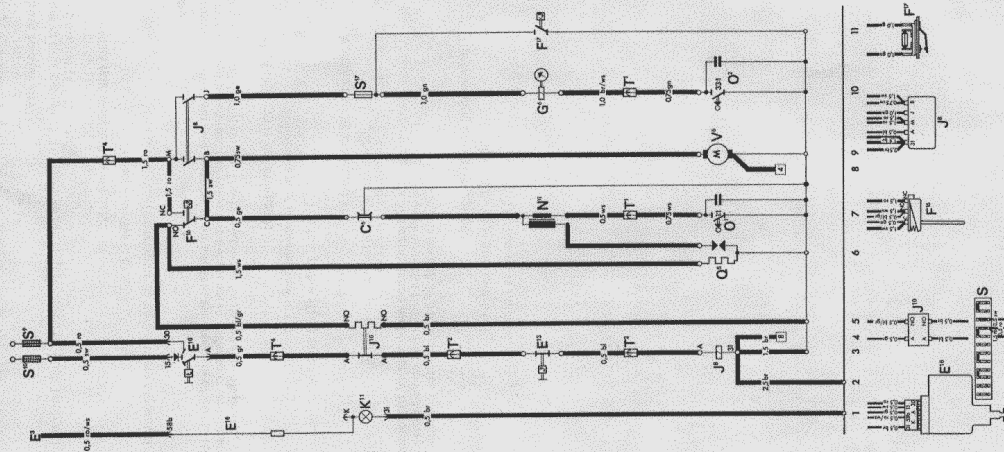
The following are de-energized:

Contacts C—NO of flame switch

The run-on is finished.

F 3.1

Description of Heating System

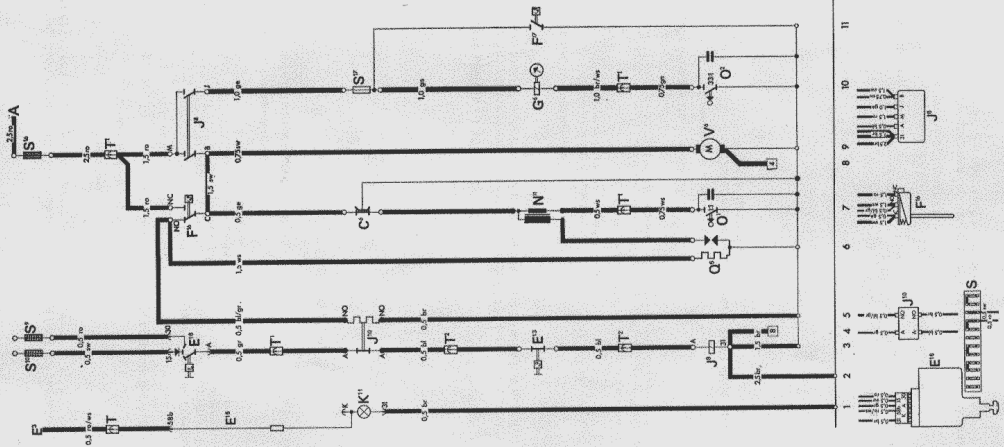


Current flow diagram and explanation

F 7th supplement (USA) Printed in Germany 3. 73

Type 1/Model 181

4 - 7



Type 2 from Chassis No. 213 2 000 001, August 1972

Explanation of current flow diagrams

Type 1/Model 181

Type 2 from August 1972

Description

- A - Terminal 30 of starter
- C - Suppression condenser for coil/capacity 0.47 µF
- E - From light switch terminal 58b
- E₁ - Temperature regulating switch
- E₂ - Heater switch/operating period 25 minutes
- F₁ - Flame switch
- F₂ - Overheating switch
- G - Metering pump
- H - Relay
- J₁ - Safety switch
- K₁ - Warning lamp
- N₁ - Ignition coil/voltage 12/5000
- O₁ - Ignition contact in combustion air blower (contact opens once per revolution)
- O₂ - Contact in combustion air blower for metering pump (contact opens once per 33 revolutions)
- Q₁ - Glow-spark plug
- S - Fuse box
- S₁ - 9th fuse in fuse box - terminal 30
- S₂ - 10th fuse in fuse box - X contact
- S₃ - Separate 16 amp fuse
- S₄ - Overheating fuse/8 amp
- T₁ - Wire connector, single
- T₂ - Wire connector, double
- T₃ - Wire connector, 3 pin
- T₄ - Wire connector, 4 pin
- V₁ - Combustion air blower

Color code

- ro = red
- sw = black
- gn = yellow
- bl = blue
- br = brown
- vs = white
- gn = green
- gr = grey

Current track

- 9
- 7
- 1
- 3
- 1: 3
- 7
- 11
- 10
- 3: 9; 10
- 3: 5
- 1
- 7
- 7
- 10
- 6
- 3: 4
- 4
- 3
- 9
- 10
- 9

F 3.1 Description of Heating System

Explanation

To switch heater on

- a – Pull knob of temperature regulating switch (E 13).
- b – Operate time switch (E 16).

Voltage can be measured at:

- Terminals 15, 30, A on heater switch (E 16)
- Warning lamp (K 11) lights up.
- Relay (J 8) operates.
- Contacts B–M–J are connected.

Start-up

The heater ignites within 45 seconds if the air being drawn in is at room temperature. The start-up process is terminated by the flame switch (F 16).

Voltage can be measured at:

- Terminal A–A of relay (J 8)
- Relay (J 8) operates contacts B–M–J.
- Terminals M–B or relay (J 8)
- The combustion air blower (V 6) delivers warm air and combustion air.
- Both contacts of overheating fuse (S 17)
- The metering pump (G 6) delivers fuel.
- Terminals C–NO of flame switch (F 16)
- The glow element of the glow-spark plug (Q 5) warms the fuel-air mixture to make it readily combustible. The spark electrodes of the plug (Q 5) then ignite the mixture.

Heating

When the heater has ignited and warmed up, the flame switch (F 16) operates the contacts C–NC. A uniform roaring noise should be heard at the exhaust pipe.

The following is de-energized:

- Contact NO of flame switch (F 16)
- The glow element of glow-spark plug (Q 5) is switched off

Regulation

The temperature regulating switch (E 13) stops the flow of fuel from the metering pump when the temperature of the hot air reaches the preset maximum.

The following are de-energized:

- Contact A of relay (J 8)
- Relay (J 8) separates the contacts B–M–J.
- Both contacts overheating fuse (S 17)

The pump (G 6) stops delivering fuel. Combustion stops. When the heater has cooled down to the lower response temperature of the temperature regulating switch (F 13), the fuel pump (G 6) starts to deliver again.

Voltage can be measured at:

- Terminal A of relay (J 8)
- Relay (J 8) operates.
- Fuel pump (G 6) delivers fuel.

Operation of safety switch (J 10)

The safety switch (J 10) responds when the flame switch (F 16) holds the contacts C–NO closed for longer than about two or three minutes because combustion has not taken place in the heater or because the flame switch (F 16) is defective.

Voltage can be measured at:

- Terminal NO of flame switch (F 16)
- Terminal NO of safety switch (J 10)
- The contacts are separated in the safety switch (J 10) after about three minutes by heating up of the resistance.

The following are de-energized:

- Contacts A, B, J of relay (J 8)
- The combustion air blower (V 6) stops and heater cools down.

Operation of overheating circuit

If the heater gets too hot, the overheating switch (F 17) closes and causes a short circuit which blows the fuse (S 17) and stops the delivery of fuel. The heater can overheat if the temperature regulating switch (E 13) fails to work properly or if there is insufficient air flowing past the heat exchanger (air circulation duct blocked).

Switching heater off

Turn knob of time switch (E 16) back to the stop position. Or push knob of temperature regulating switch (E 13) in fully.

The following is de-energized:

- Contact A of relay (J 8)
- The relay (J 8) contacts are separated.

Run-on

The run-on lasts for about two minutes at an ambient temperature of 20 °C (68° F) and is shorter at lower temperatures. The run-on is necessary in order to clear all traces of gas from the heat exchanger and cool it down. The flame switch limits the run-on period.

The following is de-energized:

- Contacts of overheating fuse (S 17)
- The fuel pump (G 6) stops working.

Voltage can be measured at:

- Terminals NC–C of flame switch (F 16)
- Terminal B of relay (J 8)
- The combustion air blower (V 6) continues to work until the heater has cooled down on the flame switch (F 16) separates contacts C–NO.

The following are de-energized:

- Contacts C–NO of flame switch
- The run-on is finished.

List of possible faults

In order to pinpoint a fault in the heating system it is important to troubleshoot systematically. Always follow the proper testing sequence.

Turn time switch knob clockwise as far as possible

The following faults can occur:

- A – heater does not work (see F 3.2/1)
- B – heater smokes (see F 3.2/2)
- C – heat output insufficient (see F 3.2/2)
- D – heater goes out (see F 3.2/2)
- E – run on does not switch off (see F 3.2/2)
- F – heater does not work at low outside temperatures (see F 3.2/2)

See respective trouble shooting chart if one of the above faults is found.

F 3.2

Trouble Shooting and Testing Instructions

A - Heater does not work

Operate safety switch (see F 3.1/2 and F 3.3/1). If the heater does not work, first check whether the combustion air blower is running and the fuel pump is working (listen for ticking sound).

If both these units are operating, then check the glow plug and spark plug. Also check whether the pump is delivering fuel into the heater by checking at the exhaust pipe for exhaust fumes.

Faulty components should be repaired or replaced if necessary. If when carrying out these tests the heater does not work, test it further as follows:

Check	Possible fault	Remedy
1 - Test all parts of heater and check warm air ducts as well as all electrical connections for tightness; check exhaust system for damage	a - Blockage in heater exhaust pipe or intake duct b - loose c - loose connection in electrical system	a - eliminate blockage b - tighten securing screws c - secure loose push-on connection
2 - Test 8 amp. fuse with ignition switched on	short circuit in heater electrical system	eliminate defect and replace fuse (see F 3.1/4)
3 - Test 16 amp. fuse	short circuit in vehicle electrical system	eliminate fault, replace fuse (see F 3.1/4)
4 - Test time switch for continuity with ignition switched on and off	switch contact defective	replace time switch (see F 3.5/2)
5 - Pull knob out as far as it will go and test temperature control switch for continuity (F 3.3/1)	a - bimetal strip defective b - contacts defective	a, b - replace temperature regulating switch (see F 3.5/1)
6 - When breaking contact at terminal A, relay must click audibly	no voltage in wire to terminal A, time switch has no continuity, relay defective	replace relay (see F 3.5/1) test time switch (see F 3.3/2)

1-2 Heater does not work

Trouble Shooting and Test Instructions

F 3.2

Check Possible fault Remedy

7 - Test relay terminal; if there is voltage at terminal B, terminals M and I must also have voltage after switching heater on	switch contacts defective (see F 3.3/1)	replace relay (see F 3.5/1)
8 - Check voltage at terminal 2 of terminal strip	nominal value 11.6 volts is not attained; battery is discharged too much	start vehicle engine to attain full generator voltage
9 - Test ignition coil (see F 3.3/1)	a - ignition coil insulation is defective b - breaker points of blower motor defective (see F 3.3/1) c - short circuit on condenser on contact breaker d - short circuit in suppression condenser	a - replace ignition coil b - clean combustion air blower breaker points (see F 3.7/1) c - replace condenser (see F 3.7/1) d - replace suppression condenser
10 - Check spark plug, but first disconnect wires from fuel pump (see F 3.3/1)	faulty or dirty spark plug	clean spark plug; check spark plug gap (0.08 in./2.5 mm) (see F 3.3/1)
11 - Test glow plug with fuel pump disconnected	plug must glow within one minute	replace glow plug (see F 3.3/1) (see F 3.5/2)
12 - Test flame detector switch	switch does not operate	adjust (see F 3.3/1)
13 - Check overheating switch	no continuity	replace (see F 3.5/1)
14 - Check filter (see F 3.3/2)	blocked	clean filters between fuel pump and jet (see F 3.3/2); filter between fuel pump and tank must be cleaned (see F 3.3/2)
15 - Check fuel jet	blocked or damaged	clean or replace (see F 3.3/2)

Heater does not work 1-3

Check	Possible fault	Remedy
16 – Test fuel pump and lines (see F 3.6/1)	a – breaker points dirty b – lines leak at connections c – pump clatters, pressure relief valve on outlet side of pump is dry and sticks	clean breaker points and readjust. Lubricate springs and pivot points (see F 3.3/2) disconnect pump outlet line and pour several drops of gasoline into pump connection (see F 3.6/1)
17 – Check pressure regulator and solenoid valve	incorrect adjustment	adjust pressure regulator (see F 3.3/2)
18 – Combustion air blower motor (listen to determine if motor is running) (see F 3.7/1)	a – bearing and winding defects b – fresh air fan contacts housing c – combustion air blower fan is damaged and has jammed in vaned housing d – too little combustion air, voltage too low (nominal value 11.6 volts) e – combustion air blower motor does not attain prescribed speed (nominal value 5000 rpm at nominal voltage)	a – replace combustion air blower; cannot be disassembled because air blower fan and motor are balanced together (see F 3.7/1) b – remove housing and tighten securing clamp of combustion air blower; (see F 3.5/1) c – replace complete combustion air blower (see F 3.5/1) d – check ground cable and test battery e – replace complete combustion air blower (see F 3.5/1)

B – Heater smokes

Check	Possible fault	Remedy
1 – Excess fuel	a – pressure regulator incorrectly adjusted b – fuel jet damaged	a – adjust pressure regulator (see F 3.3/2) b – replace fuel jet
2 – Combustion air motor: measure speed (see F 3.3/1)	a – voltage too low (nominal value 11.6 volts); lack of combustion air b – blower motor defective	a – check wires and test battery b – replace complete combustion air blower (see F 3.5/1)

C – Heat output insufficient

Check	Possible fault	Remedy
1 – Check delivery quantity of fuel pump	a – delivery quantity too small b – filter blocked	a – adjust pressure regulator (see F 3.3/2) b – clean (see F 3.5/2 and F 3.3/2)
2 – Test temperature regulating switch	bi-metal strip damaged (switching temperature altered)	replace (see F 3.5/1) or adjust (see F 3.3/1)

D – Heater goes out

Check	Possible fault	Remedy
1 – Check electrical system	loose connections	tighten
2 – Overheating switch faulty (see point 6)	a – contact dirty b – bi-metal strip worn	a – clean b – replace (see F 3.5/1)
3 – Check exhaust pipe for obstructions	blocked	clean (see F 3.4/1)
4 – Cut-in time of glow plug too short	flame detector switch incorrectly adjusted	adjust (see F 3.3/1)
5 – Check delivery quantity of fuel pump	filter dirty, valve blocked, jet blocked	clean or replace (see F 3.3/2)
6 – Overheating switch actuated	hot air ducting blocked	eliminate blockage

F 3.2 Trouble Shooting and Testing Instructions

E – Run-on does not switch off

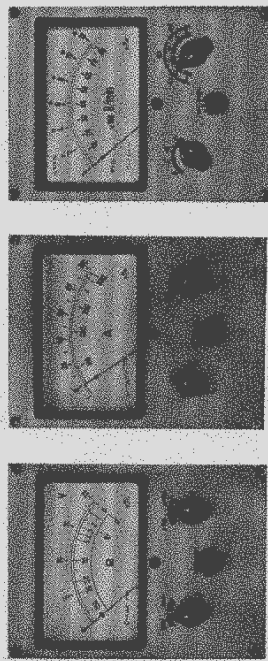
Check	Possible fault	Remedy
1 – Check flame detector switch	flame detector switch is incorrectly adjusted	readjust (see F 3.3/1)
2 – Quartz rod of flame detector switch broken		replace quartz rod and readjust flame detector switch (see F 3.5/2 and F 3.3/1)

F – Heater does not work at low outside temperatures

Check	Possible fault	Remedy
1 – Check battery voltage		if necessary, charge battery
2 – Check delivery quantity of pressure regulator (see F 3.3/2)	delivery quantity too low because a – improperly adjusted b – filter dirty c – strainer blocked d – valve guide dirty e – pressure regulator improperly adjusted	a – correct adjustment b – replace filter c – clean strainer d – replace pressure regulator e – adjust pressure regulator
3 a – Remove glow plug and check glow element b – check spark plug (see F 3.3/1)	a – glow element broken b – no circuit in suppression resistor electrode gap too large	replace glow plug (see F 3.5/2) replace spark plug (see F 3.5/2)
4 – Check flame detector switch	flame detector switch defective (cut-in time too short)	replace flame detector switch (see F 3.5/2)

2-2 Run-on does not switch off / Heater does not work at low outside temperatures

F 3.3 Checking Parts and Adjusting



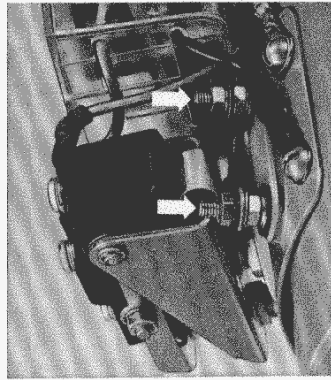
No.	Description	Special tool	Remarks
1	Ohmmeter/voltmeter		Range 0–20 volts
2	Ammeter		Range 0–20 amps.
3	Tachometer		0–8000 rpm
4	Box wrench		21 mm
5	Stop watch		

Tools 1-1

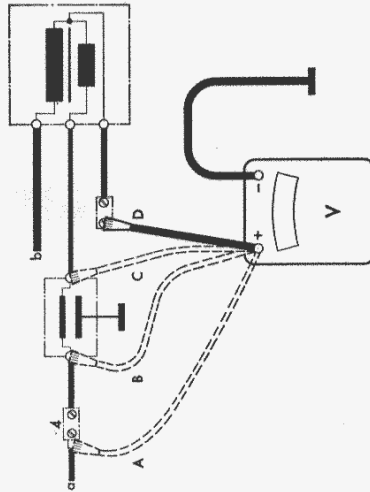
Testing overheating switch (installed)

Bridge connections (arrows). Reset safety switch. If the heater operates, the overheating switch is faulty.

The switch is also faulty if it does not shut off in the temperature range of 150–200° C (302–395° F). This temperature range will be reached under test conditions by restricting the intake air.



Testing ignition coil and suppression condenser



a — to terminal 1 of relay 19
b — to spark plug

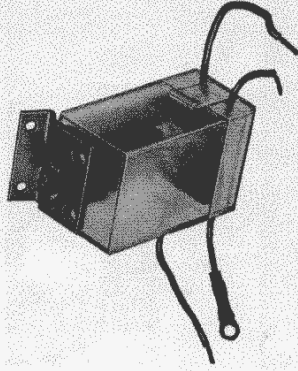
- 1 — Disconnect wires from fuel pump and from glow plug.
- 2 — Insert a .16 in. (4 mm) diameter screw into the angled connector of the ignition wire.
- 3 — Switch heater on. When screw is held at a distance of .28 in. (7 mm) from a good ground, a continuous spark must jump across the gap. (Hold ignition wire with insulated pliers.)
- 4 — If there is no spark, first measure voltage at terminal 4 of terminal strip (A of drawing). When doing this, disconnect cable from terminal 4 to suppression condenser. Voltage must be at least 10 volts.
- 5 — Reconnect cable to terminal 4 of terminal strip.
- 6 — If the voltage is above 10 volts, measure with voltmeter at points B, C and D shown in the drawing. If the ignition coil and/or suppression condenser are faulty, they must be replaced.
- 7 — Check breaker points (see page F 3.3/1–6).

Note

If the readings take longer than 3–4 minutes the safety switch shuts the heating system off. After a few minutes turn the heater on again by resetting the lever on the safety switch until the readings have been completed.

Checking safety switch

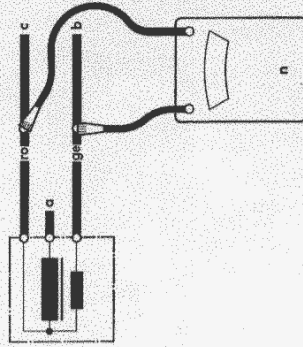
- 1 — Disconnect wires at pump so that fuel pump does not operate.
- 2 — Turn heater on. After 3–4 minutes (at nominal voltage and at about 20° C/68° F ambient temperature) the safety switch interrupts the heating system circuit.
- 3 — If the safety switch has operated within the specified time, the switch is OK. Reset lever on safety switch in direction of arrow.



Checking combustion air blower motor (Checking speed)

Connect tachometer as shown. Then turn heater on and check operating voltage.

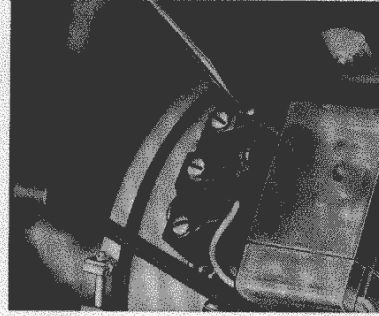
At an operating voltage of 12 volts the speed should be between 4875–5375 rpm. If the speed varies considerably, replace complete combustion air blower.

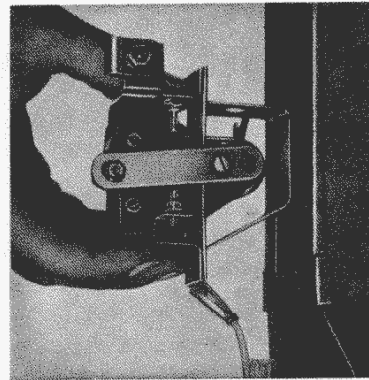


a — to spark plug
b — to suppression condenser
c — to breaker points

Flame detector switch (run-on)

- 1 — Turn heater on. Pull temperature regulator switch all the way out. Let heater run for five minutes.
 - 2 — Turn time switch knob into out-position warning light goes out. Start stop watch.
 - 3 — The combustion air blower fan, controlled by the flame detector switch, must continue running 150–210 seconds. This run-on time is based on a nominal voltage of 12 volts and an outside temperature of about 20° C (68° F). At lower temperatures the run-on time is shorter.
- If proper shut off time is not attained, the flame detector switch must be adjusted (if run on is too long, turn adjusting screw clockwise; if run-on is too short, turn screw counterclockwise). If the run-on does not shut off, the quartz rod could be broken. The quartz rod must be replaced.



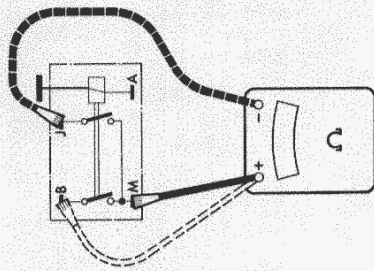


Check temperature regulating switch – adjust if necessary

- a – Check installation of bowden cable (on vehicle):
When pulling the knob, the the lever should move to the stop screws.
Do not adjust the stop screws.
- b – Check electrical contacts for continuity with an ohmmeter (in vehicle):
The fuel pump and solenoid valve must be energized via the temperature regulating switch, when the knob on the bowden cable is pulled out and the heater switched on (see wiring diagram F 3.1/4).

Checking relay

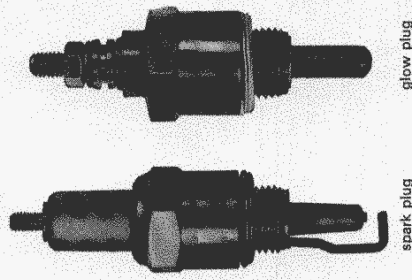
- 1 – Disconnect wires from terminals J, B and M at relay and turn on heater.
- 2 – Disconnect wire from terminal A. When doing this the relay armature de-energizes (listen for clicking sound). If there is no sound check voltage between ground and plug. If there is voltage at this point, measure between relay housing and terminal A with an ohmmeter. If the ohmmeter shows 0 ohm the relay winding is faulty.
- 3 – If the relay armature can be heard de-energizing when disconnecting terminal A, connect ohmmeter between terminals J–M and B–M.
Nominal value: ∞ ohm otherwise replace relay.
- 4 – Reconnect cable to terminal A. If the relay armature energizes audibly, check whether there is continuity from terminal J to terminal B. If there is no continuity with the relay switched on (∞ ohm), the relay must be replaced.



Checking glow plug and spark plug

The glow plug has a spiral element protected by a metal casing. Deposits can be carefully removed with a wire brush. The glow plug is serviceable if it glows bright red after one minute when connected to a 12 volt power source, otherwise the glow plug must be replaced.

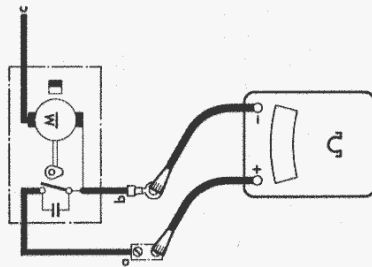
The spark plug can be cleaned with a wire brush. Check electrode gap (2.5 mm) .10 in. There is a 5 K Ω resistor installed in the spark plug. The resistor can be measured with an ohmmeter (connect terminals of ohmmeter between center electrode and ignition wire terminal). If the ohmmeter shows more than 10 K Ω , the spark plug must be replaced.



Testing breaker points

The breaker points can be tested with an ohmmeter with the heater shut off.

- 1 - Unscrew intake pipe.
- 2 - Disconnect wire connector between breaker point and ignition coil.
- 3 - Connect ohmmeter to wire connector (a) and to ground cable (b), turning the fan by hand. Breaker points must make/break once for each revolution of the motor (the ohmmeter must deflect between 0 and ∞).



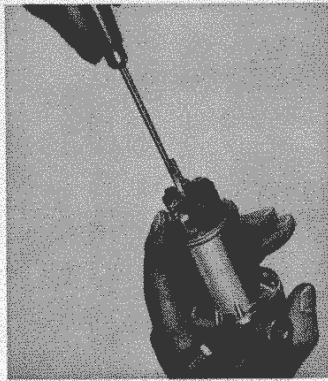
a - to ignition coil
b - ground
c - to terminal 1

Possible fault	Ohmmeter shows
Short circuit in condenser	0 Ω
Contact breaker points burnt. Partial short circuit in condenser	Deflection between $\infty \Omega$ and a resistance value (e.g. 10 Ω)
Open circuit in breaker point circuit (e.g.: connecting wire broken, breaker point gap too large)	$\infty \Omega$ only

The breaker point assembly of the combustion air blower can be repaired (see F 3.7/1).

Fuel pump

- 1 - Disconnect wire from fuel pump. Disconnect inlet and outlet lines. Remove both mounting bracket bolts.
- 2 - Remove the nut from the terminal post and take off cover. Check breaker points. Lightly lubricate moving parts and springs if necessary.



Note

The breaker point gap should be 1 mm (.04 in.) (hold lower contact breaker arm against housing). The points are set with adjusting screw.

- 3 - Remove four fillister head screws on housing and take pump housing off. Turn diaphragm bracket counterclockwise to remove it and check it visually.
- 4 - When reinstalling, first screw diaphragm bracket in, clockwise, as far as it will go. Then back off $2\frac{1}{2}$ turns counterclockwise. The correct delivery quantity of the fuel pump is then adjusted.

- 5 - The fuel pump must be installed so that the connection on the outlet is pointing upward as shown by the arrow. After installation, the fuel line on the outlet side may have to be bled. Also, moisten pressure valve with a few drops of gasoline (see F 3.6/1).

Note

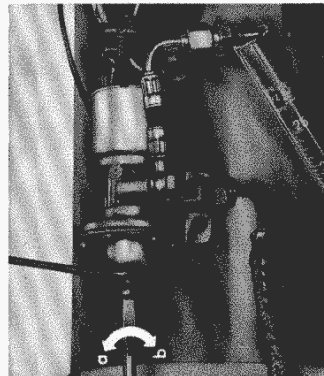
When assembling, ensure that the diaphragm is located in the groove and the winding housing is firmly bolted to the pump housing (the pump will not deliver fuel if air is drawn in at the side). (See F 3.6/1.)
There is a vent hole in the winding housing. Secure pump housing to winding housing with four fillister head screws with the outlet connection opposite vent hole (see F 3.6/1).

Pressure regulator and solenoid valve

Note

The fuel delivery quantity can only be set accurately by measuring the fuel consumption on the heater. The fuel quantity is measured at the fuel jet.
Before carrying out a consumption measurement or adjustment, clean the filters.

Part	Location	Remarks
Filter	between tank and fuel pump	clean (see F 3.5/2)
Screen	pressure regulator inlet side	clean (see F 3.8/1 part 25)
Screen	between union nut and jet	clean



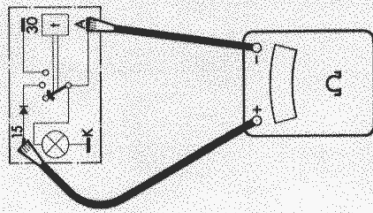
- 1 - Disconnect glow plug and spark plug. Bridge temperature control switch connections.
- 2 - Unscrew union nut from jet carrier.
- 3 - Unscrew jet from jet carrier and clean screen.
- 4 - Connect jet and screen to fuel hose and hold at the same height as when installed.
- 5 - Turn heater on. Fuel emitted is collected in a measuring glass for two minutes and should amount to 20-21 cm³.
- 6 - To adjust: Turn hex head screw counterclockwise (a). This decreases the fuel quantity delivered. Turning clockwise (b) increases the fuel quantity delivered.

Note

If, after performing these operations, the fuel delivery quantity is still insufficient, the valve screen (No. 10 on page F 3.8/1) is blocked.

Time switch

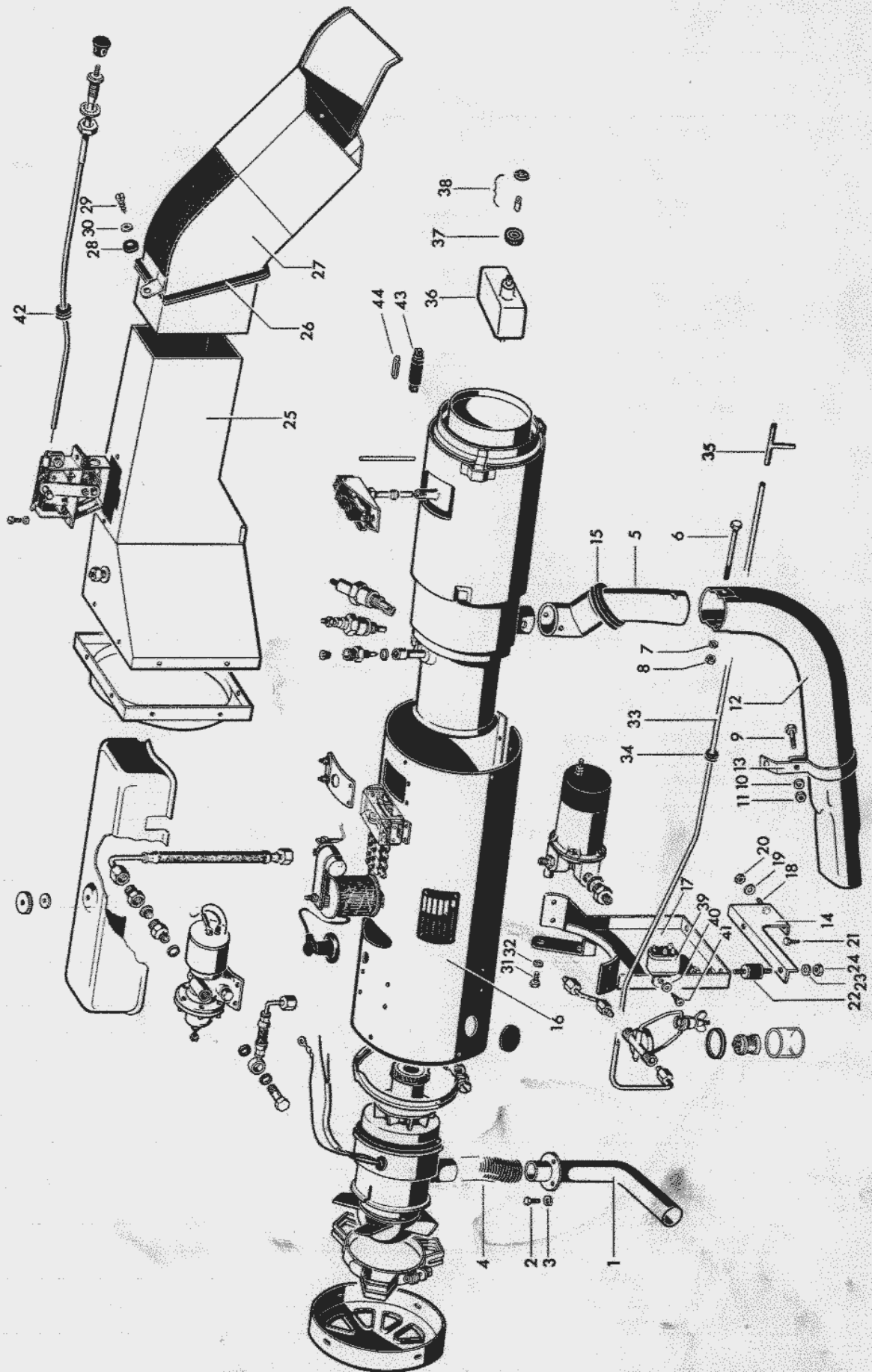
- 1 - Disconnect connector plug from time switch and remove switch.
- 2 - Turn knob to detent position.
 - a - Connect ohmmeter to terminals 15 and A of switch. Ohmmeter shows a certain reading (low or high resistance).
 - b - Change probes over. If the ohmmeter shows the same reading as at A, the diode is defective and the switch must be replaced.
- 3 - Turn knob clockwise as far as possible. Connect probe from terminal 15 to terminal 30. The resistance at terminals 30 and A must be 0 Ω.



Note

The time switch cannot be repaired. Only the warning light is replaceable (see F 3.5/2).

Heater and Warm Air Duct **F 3.4**



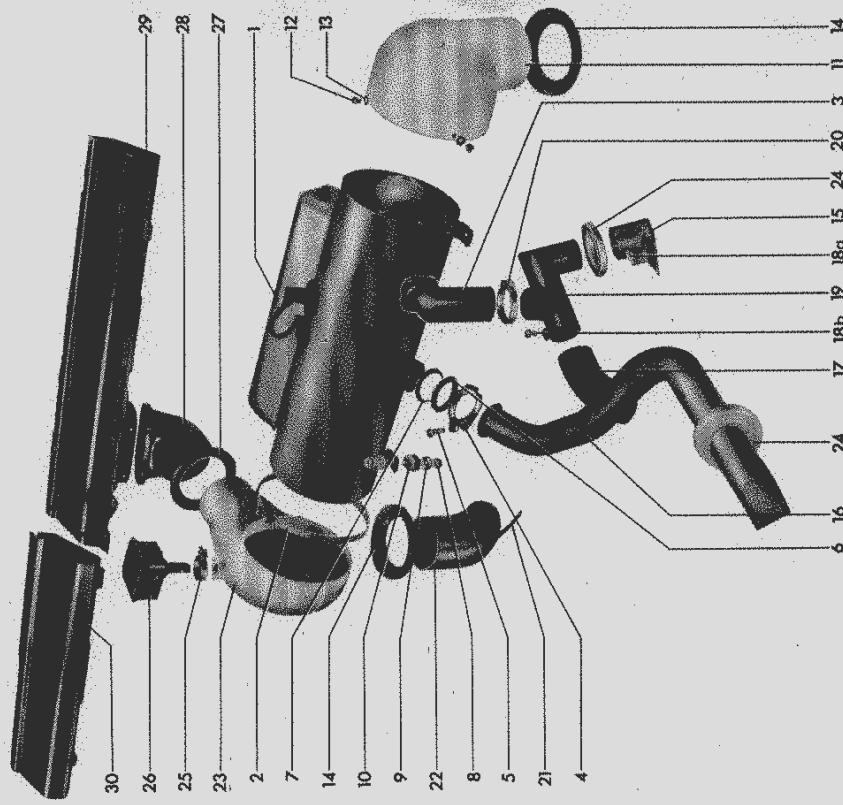
Removing and installing / Fresh air heater

1-1

F 3.4 Heater and Warm Air Duct

Heater and Warm Air Duct F 3.4

No.	Description	Qty.	removing	Note when installing	Special instructions see
1	Combustion air pipe	1	clean	angled part must be toward vehicle engine	
2	Hex. hd. bolt M 4×15	3			
3	Lock washer	3			
4	Hose for combustion air pipe	1		install firmly	
5	Exhaust pipe	1	clean		
6	Hex. hd. bolt 8M 5×50	1			
7	Lock washer B 5	1			
8	Hexagon nut M 5	1			
9	Hex. hd. bolt M 6×15	1			
10	Lock washer B 6	1			
11	Hexagon nut M 6	1			
12	Exhaust tail pipe	1			
13	Hanger for tail pipe	1			
14	Bracket for heater	1			
15	Seal for exhaust pipe	1			
16	Heater	1			
17	Support for housing	1			
18	Hex. hd. bolt	1			
19	Lock washer	1			
20	Hexagon nut	1			
21	Self tapping screw	1		install free of tension	
22	Bonded rubber mounting for support	2			
23	Lock washer	4			
24	Hexagon nut	4			
25	Hot air duct with flap and temperature regulating switch	1		adjust temperature regulating switch	F 3.1/2
26	Gasket for outlet	1			
27	Outlet	1			
28	Grommet	1			
29	Self tapping screw B 4.8×13	2			
30	Washer	1			
31	Bolt M 6×15	2			
32	Lock washer B 6	2			
33	Fuel line	1			
34	Grommet	1			
35	T connector	1			
36	Time switch	1			F 3.5/2
37	Knob	1			
38	Bulb and lens	1			
39	Relay	1			
40	Washer	1			
41	Self tapping screw	1			



1-2 Removing and installing

Removing and installing Type 1/Model 181 1-3

F 3.4 Heater and Warm Air Duct

No.	Designation	Qty.	removing	Note when installing	Special instructions see
1	Heater	1	remove nut and spring washers under luggage pan	axial fan must not contact heater casing	F 3.5/1
2	Clamp	1		ensure clamp is tight	
3	Combustion air pipe elbow	1	can be pulled out	the shoulder must seal the casing hole sufficiently	
4	Exhaust pipe clamp	1		ensure clamp is tight	
5	Screw M 6×35	1			
6	Conical seal	1	attached to heater pipe		
7	Exhaust pipe seal	1		replace damaged seals ensure good sealing	
8	Nut M 6	8			
9	Spring washer B 6	8			
10	Bonded rubber mounting	4		make sure that thread is tight in rubber	
11	Circulating air pipe	1	after removing heater detach intake pipe	before installing the heater attach the intake pipe. The intake pipe must be vertical and face downward	
12	Fillister head screw A11 5×11	4			
13	Spring washer A 5.3	4		the groove is pressed into the luggage pan (tip downward)	
14	Seal	2		before installing, check seal in luggage pan for tightness	
15	Intake pipe	1		before installing, check seal for damage and tightness	
16	Exhaust pipe	1			
17	Combustion air pipe hose	1			
18	a – Fillister head screw Bz 3.9×6.5 b – Fillister head screw Bz 4.8×9.5	2 1		before installing, check seal for damage and tightness	
19	Combustion air intake pipe	1		check for tightness	
20	Clamp	1			
21	Bowden cable linkage	1			
22	Outlet for footwell	1			
23	Warm air pipe	1	first disconnect linkage (21), then lift out	push into seal	
24	Seal for exhaust pipe and intake pipe	2	check for damage	press in from wheel housing	
25	Clamp	1			
26	Temperature regulating switch	1	lift out vertically		
27	Warm air pipe seal	1			
28	Elbow	1			
29	Warm air duct, left	1			
30	Warm air duct, right	1			

Removing and Installing Parts F 3.5

Overheating switch

Removing

- 1 – Disconnect battery ground strap.
- 2 – Remove heater (see F 3.4/1).
- 3 – Disconnect the three wires on the flame detector switch and the two wires on overheating switch. Each nut is secured by two lock washers.
- 4 – Unscrew flame detector switch union nut with 12 mm open-end wrench and pull flame detector switch out vertically by turning. If necessary, use solvent to loosen nut. (see F 3.5/2).
- 5 – Remove four round head screws, each securing one ground wire. The overheating switch can now be removed.

Installing

- 1 – Secure overheating switch and four ground wires each with two lock washers.
- 2 – Install flame detector switch (see F 3.5/2).
- 3 – Connect wires according to wiring diagram and install two lock washers under each nut securing wire leads.
- 4 – Install heater (see F 3.4/1).
- 5 – Connect battery ground strap and check operation of heater (pay attention to run-on).

Ignition coil

Removing

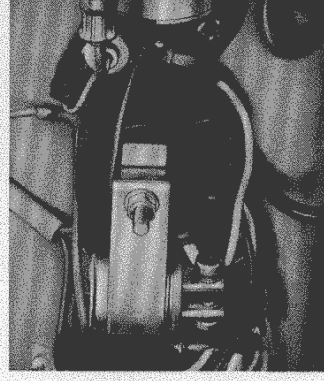
- 1 – Disconnect battery ground strap.
- 2 – Remove protective cover.
- 3 – Disconnect wire from breaker points at terminal strip.
- 4 – Remove spark plug connector.
- 5 – Loosen screw and detach lead from condenser.
- 6 – Remove brass nut on stud and remove condenser and coil.

Note

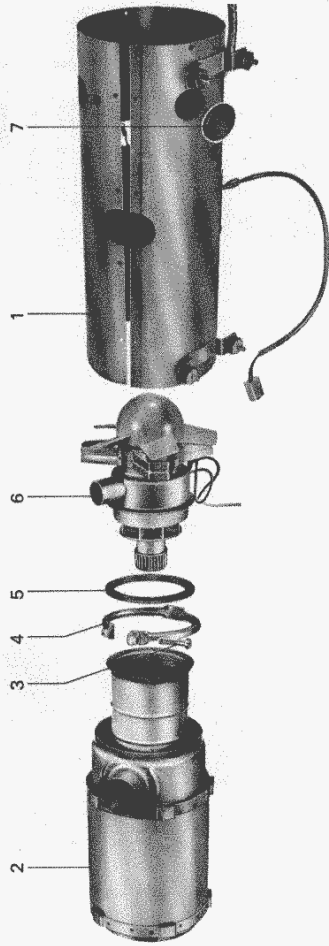
Ignition coil and condenser must **not** be repaired.

Installing

- 1 – Install ignition coil and condenser on studs and secure.
- 2 – Secure spark plug connector. Reconnect wire from breaker points to terminal strip. Secure lead to condenser (make sure lead is between spring washer and lock washer).
- 3 – Check operation of heater.



Combustion air blower, heat exchanger



No.	Description	Qty.	removing	Note when installing
1	Housing	1	pull housing apart, stand heater on end and lift housing off heat exchanger	pull combustion air blower cables through hole in housing; pull housing apart and slide over heat exchanger; ensure that fan does not rub on housing; tighten four round head screws
2	Heat exchanger	1	remove deposits	
3	Screw	1		screw must not be tightened until heater is assembled; first secure housing to heat exchanger then insert screwdriver through hole with grommet and tighten screw; due to this work sequence, screw must face combustion air intake pipe
4	Clamp	1		jaws of clamp must align with exhaust pipe connection
5	Seal	1	replace damaged seal	
6	Combustion air blower motor	1	do not tilt when lifting off	combustion air blower motor must be able to be turned with the heat exchanger until combustion air intake pipe is aligned with housing hole by turning
7	Plug	1		after tightening clamp, plug hole

Removing

- 1 - Disconnect battery ground strap.
- 2 - Remove heater (see F 3.4/1).
- 3 - Remove four screws and lock washers and take circulating air pipe off housing. Back off outlet line union nut, counter holding jet with 14 mm open-end wrench. Screw jet on (counter-hold with 14 mm open-end wrench on soldered-on jet carrier).
- 4 - Remove spark plug, glow plug, flame detector switch and overheating switch.
- 5 - Remove four round head screws and lock washers.

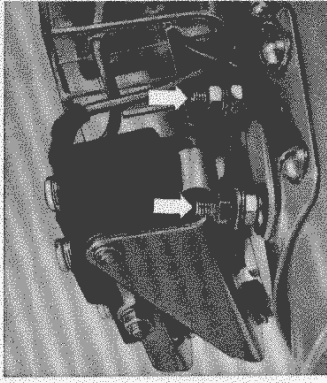
Installing

- 1 - Install circulating air pipe, jet, ignition coil, glow plug, flame detector switch and overheating switch.
- 2 - Install heater (see F 3.4/1).
- 3 - Connect battery ground strap and check operation of heater.

Overheating switch

Type 2 up to chassis No. 211 2 276 560, July 1971

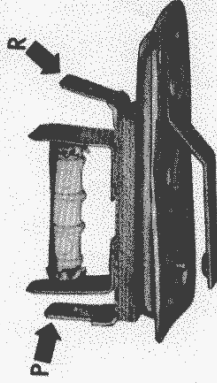
The connections (arrows) may be interchanged at installation without causing damage to the heater.



Type 1/Model 181

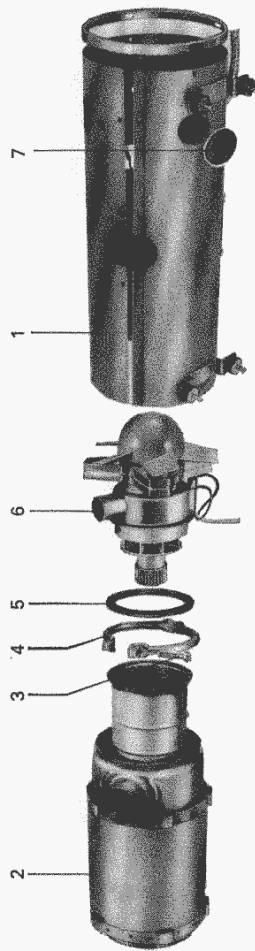
Type 2 from chassis No. 212 2 000 001, August 1971

Do **not** interchange wires.

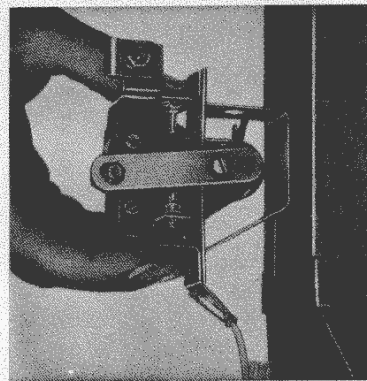


P - from metering pump
(connection on adjusting screw)

R - from relay



No.	Description	Qty.	Note when removing	Note when installing	Special instructions see
1	Housing	1	pull housing apart and lift housing off heat exchanger	pull combustion air blower wires through hole in housing; pull housing apart and slide over heat exchanger, ensure that fan does not rub on housing; tighten four round head screws	
2	Heat exchanger	1	remove deposits		
3	Screw	1		screw must not be tightened until heater is assembled; first secure housing to heat exchanger then insert screwdriver through hole with grommet and tighten screw; due to this work sequence, screw must face combustion air intake pipe	
4	Clamp	1		jaws of clamp must align with exhaust pipe connection	
5	Seal	1		replace damaged seal	
6	Combustion air blower motor	1	do not tilt when lifting off	combustion air blower motor must be able to be turned with the heat exchanger until combustion air intake pipe is aligned with housing hole by turning	
7	Plug	1		after tightening clamp, plug hole	



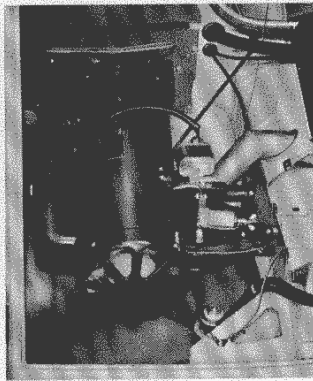
Temperature regulating switch

Removing

- 1 - Disconnect battery ground strap.
- 2 - Loosen bowden cable at temperature regulating switch.
- 3 - Take connector off at switch.
- 4 - Loosen bolts.
- 5 - Remove temperature regulating switch.

Installing

In reverse order.



Relay

Removing

Disconnect battery ground strap.

Installing

Connections:

- Terminal A - 1 mm² (SAE 17 gauge wire) green wire to time switch
- Terminal B - 1.5 mm² (SAE 14 gauge) black cable to terminal strip 3
- Terminal I - 1.5 mm² (SAE 14 gauge) yellow cable to terminal strip 4

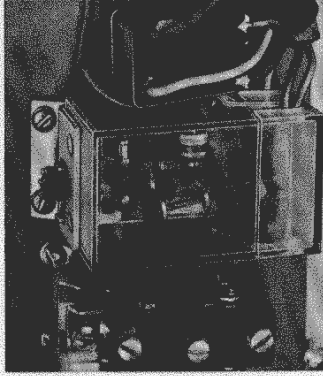
Safety switch

Removing

- 1 – Disconnect battery ground strap.
- 2 – Detach heater and swing slightly toward front.
- 3 – Remove two round head screws holding the switch.

Installing

- 1 – Connect wires according to wiring diagram (see F 3.1/4).
- 2 – Install heater.
- 3 – Connect battery ground strap and check operation of heater.



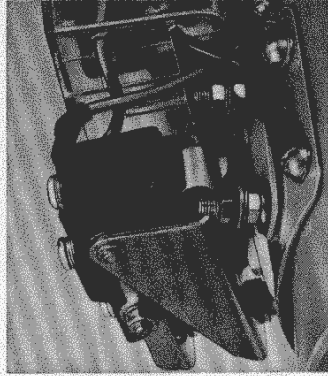
Flame detector switch

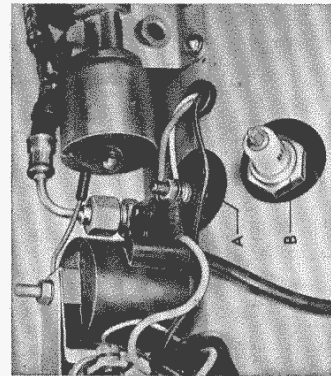
Removing

- 1 – Disconnect battery ground strap.
- 2 – Remove heater (see F 3.4/1).
- 3 – Disconnect three wire leads, each locked with two lock washers.
- 4 – Back off flame detector switch union nut with 12 mm open-end wrench, then turn switch to pull it out vertically (if necessary use solvent).

Installing

- 1 – Carefully insert flame detector switch into combustion chamber and tighten union nut. The hole in the heater housing is covered with the plug.
- 2 – Connect wires according to wiring diagram (see F 3.1/4).
- 3 – Install heater (see F 3.4/1).
- 4 – Connect battery ground strap and check operation of heater.





A - Glow plug
B - Spark plug

Glow plug, spark plug

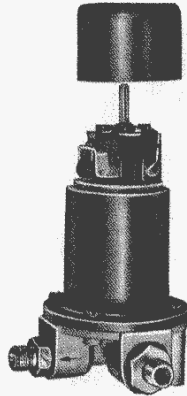
Removing

- 1 - Disconnect spark plug connector from spark plug. Remove glow plug terminal nut using an 8 mm open end wrench.
- 2 - Remove spark plug and glow plug with a 21 mm socket wrench.

Installing

Install plugs. Make sure that two lock washers are used for glow plug.

Fuel pump



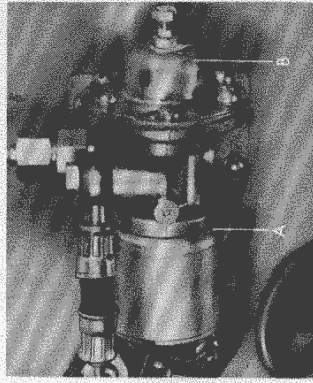
Removing

- 1 - Disconnect battery ground strap.
- 2 - Pull off inlet and outlet lines.
- 3 - Disconnect wire lead.
- 4 - Loosen the two retaining screws at the bracket and remove pump.
- 5 - Remove nut of the connector and remove cover.

Installing

- 1 - Assemble fuel pump. Make sure that the arrow at the outlet union (pressure side) points upward.
- 2 - After installing, bleed pump at the pressure side. Moisten the pressure valve with a few drops of gasoline.

Pressure regulator and solenoid valve



A - Solenoid valve
B - Pressure regulator

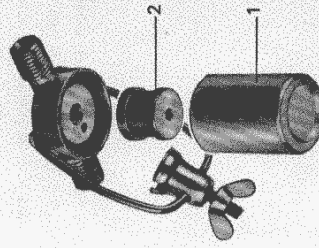
Removing

- 1 - Disconnect battery ground strap.
- 2 - Disconnect cable of solenoid valve from terminal 5.
- 3 - Disconnect fuel line between jet and pressure regulator, at regulator. The gland nut can be backed off with a 12 mm open-end wrench.
- 4 - Fuel line between pump and pressure regulator is disconnected at fuel pump while counterholding with a 14 mm open-end wrench. Catch leaking fuel.
- 5 - Remove four round head screws and washers. Take solenoid valve and pressure regulator off heater. The lead for the ground wire is secured by two round head screws.

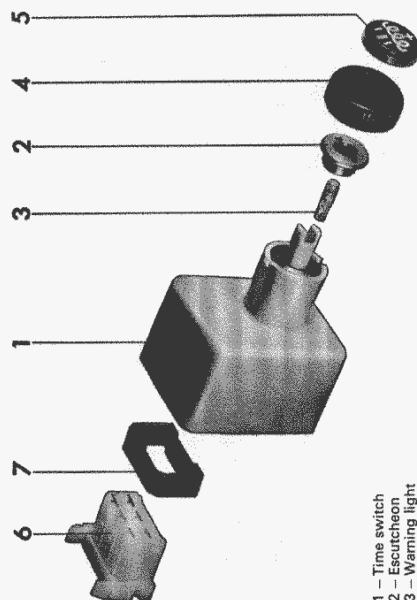
Installing

- 1 - Secure pressure regulator and solenoid valve with four round head screws and washers. Use two of the screws for securing the lead for the ground wire.
- 2 - Connect fuel lines. Hold locknut on fuel pump with a 14 mm open-end wrench.
- 3 - Connect solenoid valve wire to terminal 5. Connect battery ground strap and check operation of heater.

Filter



1 - Filter housing
2 - Filter screen



- 1 - Time switch
- 2 - Escutcheon
- 3 - Warning light
- 4 - Knob
- 5 - Lens
- 6 - Plug
- 7 - Plug frame

Time switch

Removing

- 1 - Disconnect battery ground strap.
- 2 - Pull knob off and take out bulb.
- 3 - Remove self tapping screw in instrument panel insert and open the insert.
- 4 - Disconnect wires at switch.
- 5 - Unscrew escutcheon with special wrench VW 674/1 and pull switch out.

Installing

- 1 - Secure escutcheon to time switch in instrument panel insert with special wrench VW 674/1.
- 2 - Connect wires according to wiring diagram (see F 3.1/3).
- 3 - Connect battery ground strap and check operation of heater.

Pressure regulator and solenoid valve

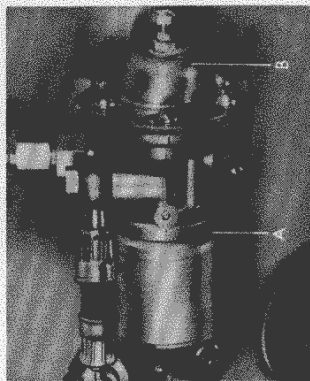
Type 2

Removing

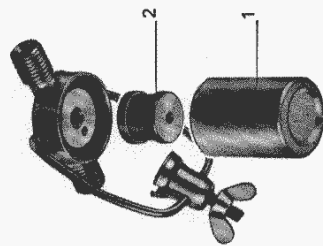
- 1 - Disconnect battery ground strap.
- 2 - Disconnect wire of solenoid valve from terminal 5.
- 3 - Disconnect fuel line between jet and pressure regulator at regulator. The gland nut can be backed off with a 12 mm open-end wrench.
- 4 - Fuel line between pump and pressure regulator is disconnected at fuel pump while counterholding with a 14 mm open-end wrench. Catch leaking fuel.
- 5 - Remove four round head screws and washers. Take solenoid valve and pressure regulator off heater. The lead for the ground wire is secured by two round head screws.

Installing

- 1 - Secure pressure regulator and solenoid valve with four round head screws and washers. Use two of the screws for securing the lead for the ground wire.
- 2 - Connect fuel lines. Hold locknut on fuel pump with a 14 mm open-end wrench.
- 3 - Connect wires according to wiring diagram. Connect battery ground strap and check operation of heater.



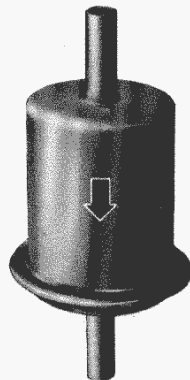
- A - solenoid valve
- B - pressure regulator



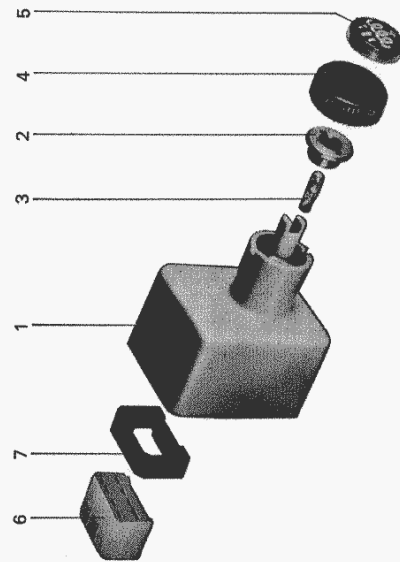
- 1 - filter housing
- 2 - filter screen

Filter

Ensure that the filter is installed properly.
The arrow on the housing shows the direction of flow.



Time switch

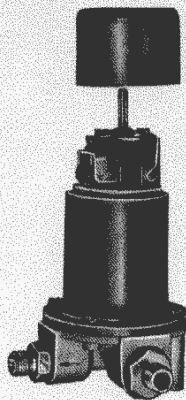


- 1 - time switch
- 2 - escutcheon
- 3 - warning light
- 4 - knob
- 5 - lens
- 6 - plug
- 7 - plug frame

Fuel pump

(Diaphragm pump)

Install pump so that pressure connection (with arrow) is vertical. After installation it may become necessary to bleed the pump. This is done by loosening union nut of pressure side and filling outlet union with a few drops of fuel and tightening union nut again.



Metering pump

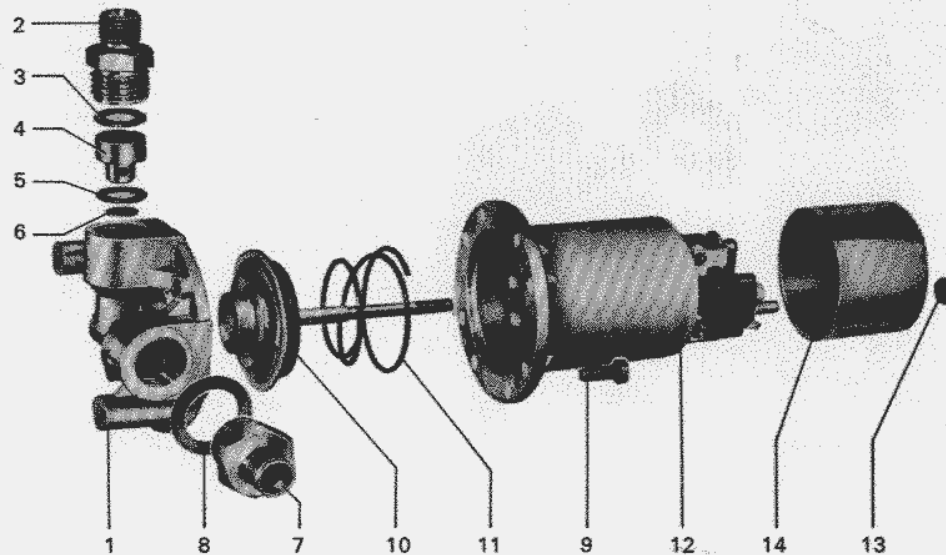
Always make sure that pump is installed horizontally. Otherwise the quantity of fuel delivered will change.



(Installation in Type 1/Model 181)

Disassembling and Assembling Fuel Pump **F 3.6**

Fuel pump



No.	Description	Qty.	Note when		Special instructions see
			disassembling	assembling	
1	Pump body	1		pump must be installed in vehicle with outlet union at top (arrow points outward)	F 3.5/2
2	Outlet union (pressure side)	1	12 mm wrench; look for damage; spherical surface must be smooth; outlet union has smaller drilling and is smaller across flats than intake union	if pump clatters, unscrew union nut and moisten outlet union with fuel; when assembling, ensure that inlet union and outlet union are not mistaken	F 3.3/2
3	Seal	1			
4	Pressure valve	1	make sure valve is not dirty		
5	Seal	1			
6	Suction valve	1	if pump clatters after moistening with fuel, suction valve is tilted and jammed	ensure that suction valve is in correct position	F 3.3/2
7	Inlet union	1	17 mm wrench; look for damage; spherical surface must be smooth; intake union has larger drilling and is larger across flats than outlet union		F 3.6/1
8	Seal	1			
9	Screw	4			

F 3.6

Disassembling and Assembling Fuel Pump

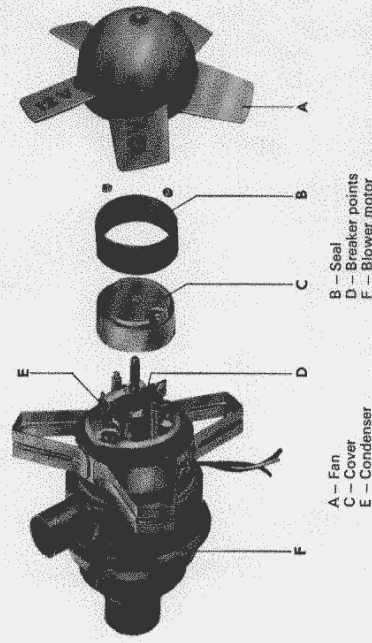
No.	Description	Qty.	disassembling	Note when assembling	Special instructions see
10	Diaphragm unit	1	unscrew counter-clockwise	delivery quantity adjustment: screw diaphragm unit in as far as possible, then back off 2 1/2 turns; the diaphragm also acts as seal between pump and winding housing, therefore make sure that the diaphragm is correctly positioned	F 3.3/2
11	Spring	1		ensure that spring is correctly installed	
12	Winding housing	1	vent hole must not be blocked	pump and winding housings as screwed together so that vent hole is opposite outlet union	F 3.3/2
13	Nut	2			
14	Bakelite cap	1			

F 3.7

Combustion Air Blower

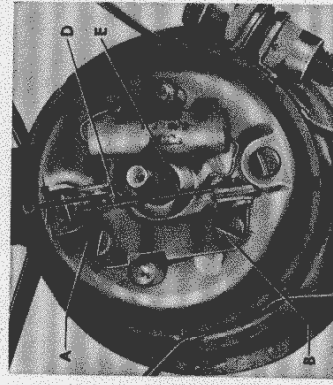
Disassembling and assembling combustion air blower

The breaker points in the combustion air blower are replaceable so that the complete blower assembly does not have to be replaced.



B - Seal
D - Breaker points
F - Blower motor

A - Fan
C - Cover
E - Condenser



A - Securing screw
B - Clamping screw
C - Gap of 0.14-0.02 in. (0.35-0.5 mm)
D - Projection on contact carrier
E - Cam and insulating strip

- 1 - Screw an M 4 screw into hole in center of fan and press off.
- 2 - Remove seal and take cover off.
- 3 - Unsolder the condenser and wire to ignition coil at breaker points.
- 4 - Remove securing screw and clamp screw and take breaker points out.
- 5 - Install new breaker points so that projection in contact carrier is pretensioned against end plate.
- 6 - Turn cam on motor shaft against insulating strip and set breaker point gap to .014-.02 in. (0.35-0.5 mm). Tighten securing screw and clamping screw and seal with paint. The contact pressure should be about 180 grams.
- 7 - Lubricate cam and insulating strip with multi-purpose grease. Grease must not contact the breaker point surfaces.
- 8 - Solder condenser and cable to ignition coil. The connecting cable between condenser and breaker points must have a gap of at least .08 in. (2 mm) between end plate, condenser clamp and cover. It is advisable to replace the condenser when replacing the breaker points.
- 9 - When assembling, ensure that the seal covers the joint between cover and motor.

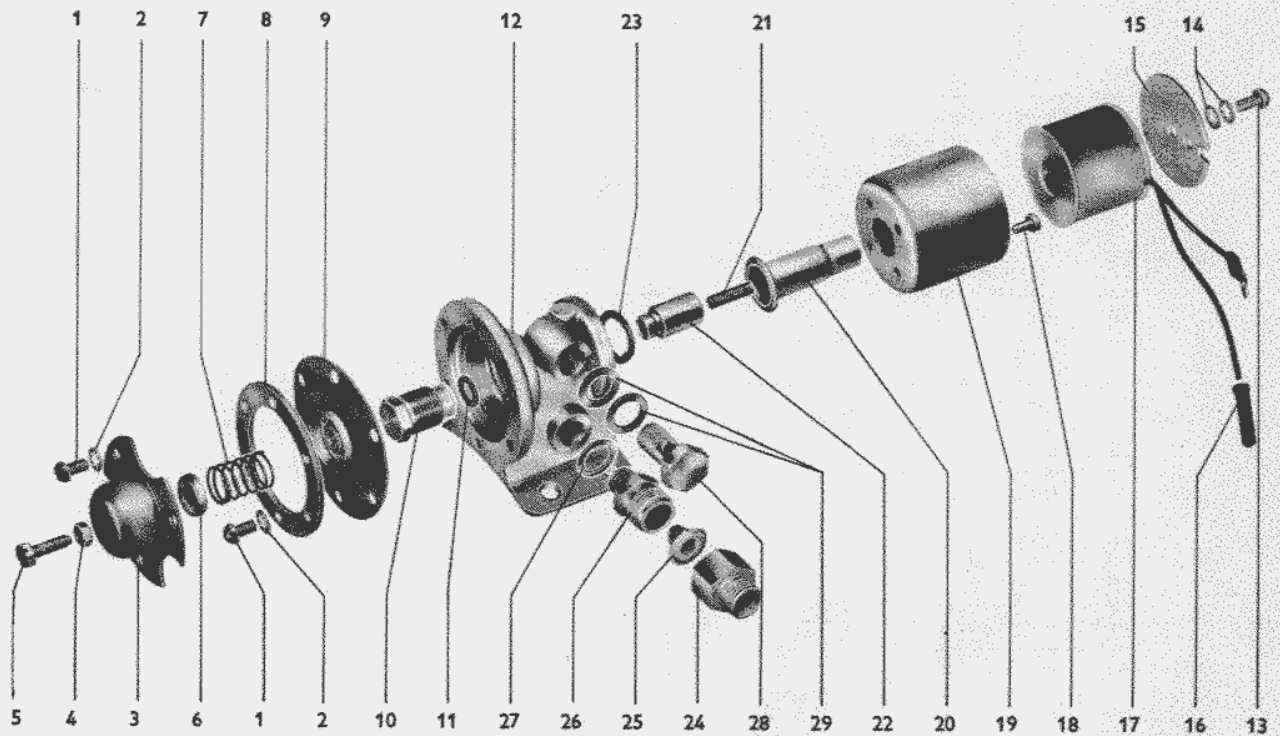
Testing:

Warning

When using the following test procedure, disconnect wires to fuel pump and glow plug (see F 3.3/1). Insert a screw into spark plug connector and hold screw about 7 mm (.3 in.) from ground at a motor speed of 5,000 rpm. A continuous spark must jump to ground.

Pressure regulator and Solenoid Valve **F 3.8**

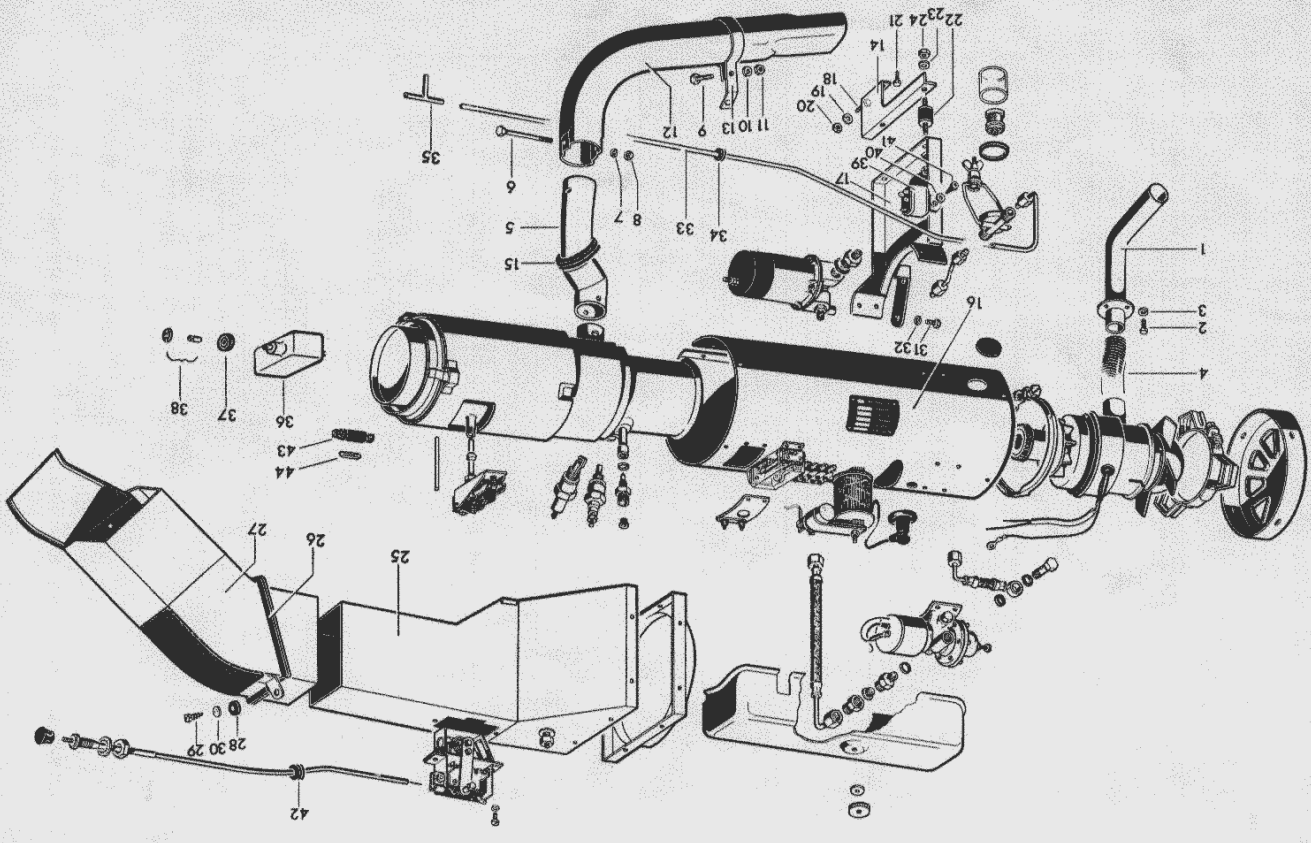
Pressure regulator and solenoid valve



No.	Description	Qty.	Note when		Special instructions see
			disassembling	assembling	
1	AM 4×6 round head screw	6			
2	Star washer	6			
3	Cap	1	vent hole must not be blocked	vent hole must face downward	
4	M 4 hexagon nut	1		after setting fuel delivery quantity, seal with paint	F 3.3/2
5	M 4 hexagon head screw	1		after setting fuel delivery quantity, seal with paint	F 3.3/2
6	Spring plate	1		hexagon head screw (5) must be inserted through hole	
7	Spring	1		spring must be held by spring plate and diaphragm cover	
8	Flange	1	lift carefully		
9	Diaphragm	1	after removal, place diaphragm in fuel	make sure that diaphragm is pre-soaked in fuel	
10	Valve filter	1		clean filter	
11	Seal	1			
12	Pressure regulator housing	1		clean with compressed air	
13	AM 4×6 round head screw	1			
14	Star washer	2		secure wire lead with toothed washer on each side	

No.	Description	Qty.	disassembling	Note when assembling	Special instructions see
15	Cover	1			
16	Rubber sleeve	1			
17	Winding	1			
18	AM 3 x 6 K round head Phillips screw	4			
19	Winding housing	1			
20	Guide sleeve	1			
21	Spring	1			
22	Valve	1			
23	Seal	1			
24	Union	1		clean	
25	Screen	1			
26	Union	1			
27	A 8 x 12 seal	1			
28	Gland nut	1			
29	A 8 x 12 seal	2			

Pressure regulator and solenoid valve are installed in one housing. The solenoid valve is open when an audible click can be heard when energizing it (about 12 volts). If it cannot be heard to operate, replace winding.



The BN 4 heater is installed in the engine compartment on the left side (from driver's position looking forward).

The kit contains the following parts:

Qty.	Description	Remarks	No.
1	Heater		16
1	Combustion air pipe		1
1	Hose	210 mm (8 ¹ / ₂ "	4
1	Exhaust		5
1	End pipe		12
1	Bracket	exhaust pipe	13
2	Bracket	heater	14, 17
1	Seal	exhaust pipe	15
2	Bonded rubber mounting		22
1	Seal	hot air outlet	25, 27
1	Hot air outlet		26
1	Seal	partition	—
1	Seal	side panel	—
1	Fuel line		33
1	Bowden cable	regulator switch	—
1	Sticker		—
1	Hose	500 mm long (19 ¹ / ₂ "	—
1	T piece		35
2	Hose	80 mm long (3 ¹ / ₂ "	—
3	Grommet		34, 42
6	Retaining strap		—
1	Connector		—
1	Knob	bowden cable	—
1	Time switch		36
1	Escutcheon		—
1	Heater on-off switch knob		37, 38
1	Relay		39
1	Plug		—
1	Cable	connector	—
1	Cable harness	heater	—
1	Cable harness	time switch	—
1	Cable adaptor		—
1	Fuse	16 amp	43, 44
3	Bolt	M 4×10	2
2	Bolt	M 6×15	9, 18, 31
2	Bolt	BM 5×50	6
2	Nut	M 5	8
6	Nut	M 6	11, 24
1	Nut	M 10×1	—
2	Tapping screw	B 4.8×13	—
4	Washer	A 3.5	30
3	Spring washer	B 4	3
2	Spring washer	B 5	7
6	Spring washer	B 6	10, 19, 23, 32
1	Lock washer	J 10.5	—
1	Lock washer	A 5.1	—
1	Hex. head tapping screw	B 6.3×13	21
2	Tapping screw	B 4.8×13	29
1	Tapping screw	B 4.8×9.5	—
1	Bulb	JG 12 V 1.2 W	38
1	Union nut	M 12×1.5	33

Note

Dealers who install numerous heaters are advised to cut templates out of durable material. The drawings give all the necessary measurements.

The edges of the templates are marked with a wide black border. These edges must be placed properly against the reference areas to ensure that the holes are located accurately.

Template 1

a = 115 mm (4⁵/₁₆"
 b = 95 mm (3⁷/₁₆"
 c = 73 mm (2⁷/₁₆"
 e = 8.5 mm (5/₁₆"
 f = 12 mm (1¹/₂" dia.
 g = 21 mm (7/₁₆"
 h = 5°
 i = 90 mm (3⁵/₁₆"
 j = 90 mm (3⁵/₁₆"
 k = 46 mm (1¹³/₁₆"
 l = 5 mm (1/₁₆" dia.
 m = 158 mm (6¹/₁₆"
 n = 48 mm (1⁷/₁₆"

o = 80 mm (3¹/₂"
 p = 10 mm (3/₁₆"
 q = 5 mm (1/₁₆"
 r = 41°
 s = 51 mm (2"
 t = 4°
 u = 69 mm (2³/₁₆"
 v = 54 mm (2¹/₁₆"
 w = 45 mm (1³/₁₆"
 x = 172 mm (6³/₁₆"
 y = 109 mm (4¹/₁₆"
 z = 2°

Template 2

a = 143 mm (5⁵/₁₆"
 b = 183 mm (7¹/₁₆"
 c = 102 mm (4"
 d = 30 mm (1¹/₁₆" dia.
 e = 5 mm (1/₁₆" dia.
 f = 71 mm (2⁷/₁₆"

g = 120°
 h = 20 mm (3/₁₆"
 i = 30 mm (1¹/₁₆"
 k = 20 mm (3/₁₆"
 l = 28 mm (1¹/₁₆"

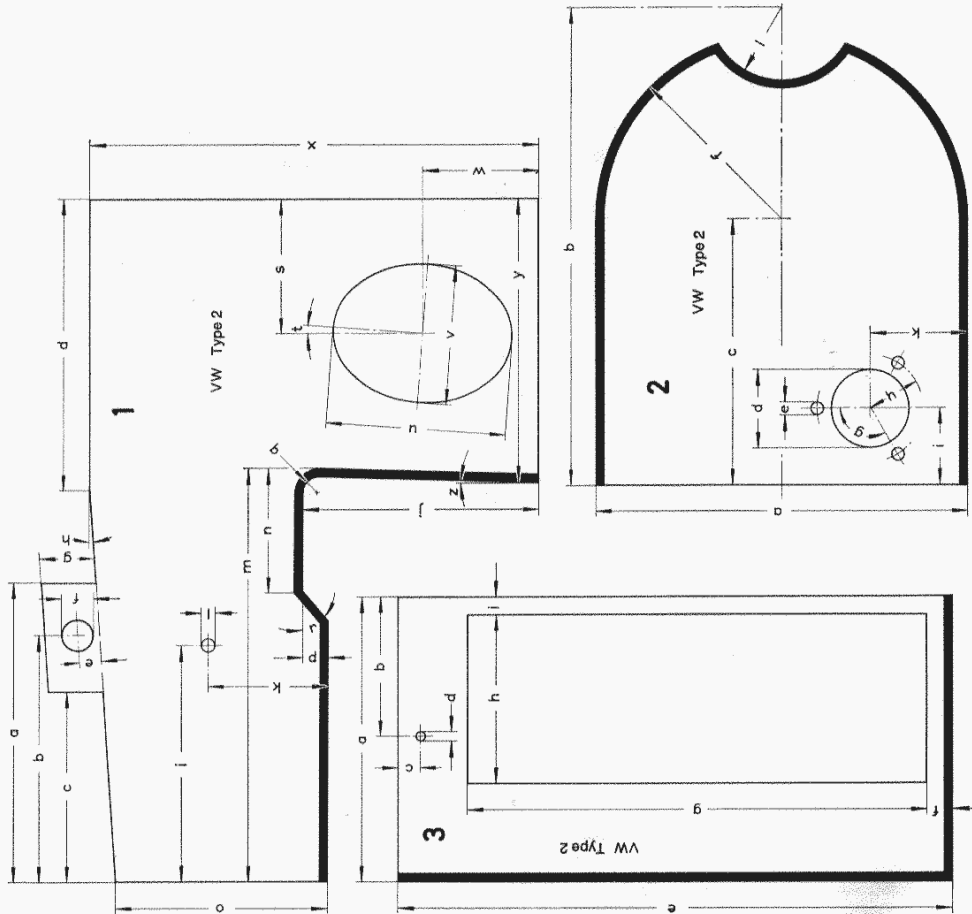
Template 3

a = 110 mm (4³/₁₆"
 b = 53 mm (2¹/₁₆"
 c = 9 mm (3/₁₆"
 d = 4 mm (1/₁₆" dia.
 e = 213 mm (8³/₁₆"

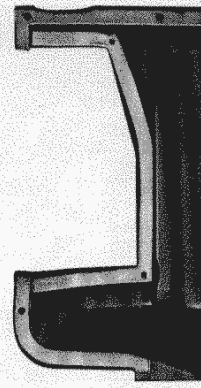
f = 10 mm (3/₁₆"
 g = 176 mm (6⁵/₁₆"
 h = 65 mm (2⁵/₁₆"
 i = 7 mm (1/₁₆"

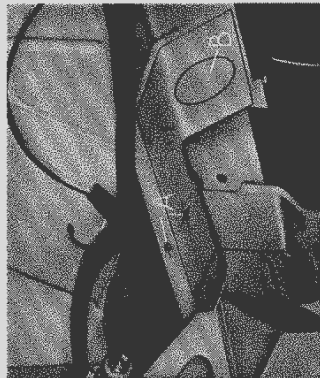
Work sequence

- 1 - Remove engine.
- 2 - Remove and cut off the rear cross panel. Reshape cut off part as shown.



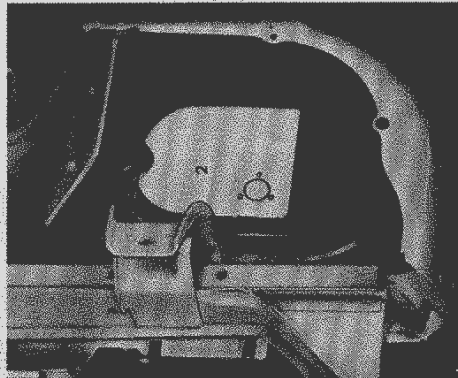
- 3 - Apply VW Plastic sealing compound to panel as shown.



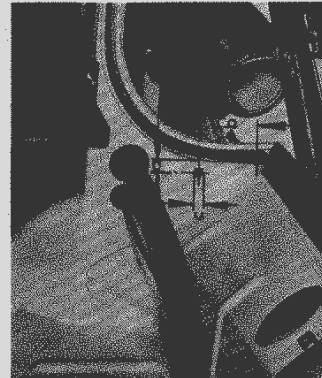


4 Cut the following holes in the engine compartment:

- A = Holes for heater brackets
- B = Hole for exhaust pipe (use template 1)

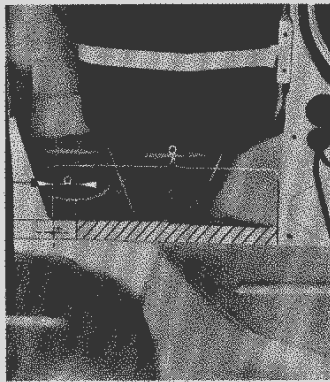


Holes for combustion air pipe and securing screws. (use template 2)



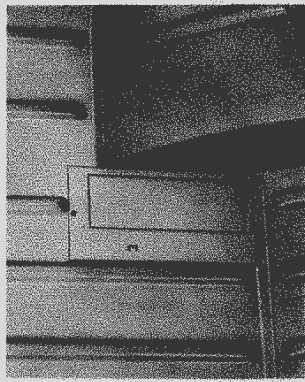
5 - Drill hole for fuel line.

- a = 13 mm (1/2")
- b = 65 mm (2 1/4")
- c = 10 mm (3/8") dia.



6 - Shorten bracket for engine cover plate left.

- a = remove
- b = 20 mm (3/4")



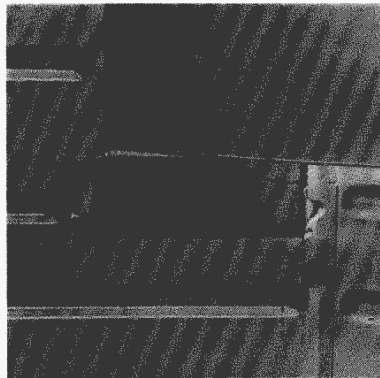
7 - Take rear seat out and remove carpet if installed.

8 - Mark off and cut hole for hot air outlet from inside body. (use template 3)

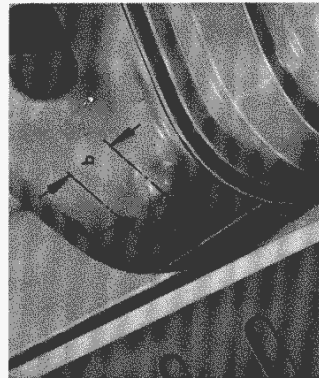


9 - Drill second hole for hot air outlet securing screws.

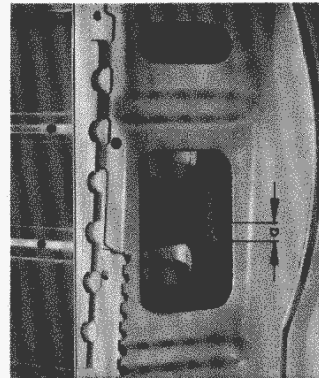
- a = 28 mm (1 1/4")
- b = 65 mm (2 1/4")



10 - Drill hole for bowden cable (with an angle drill). The hole is drilled 12 mm ($\frac{1}{2}$ "') to left and rear of the left edge of the hot air outlet hole. The illustration on the left shows the location of this hole.

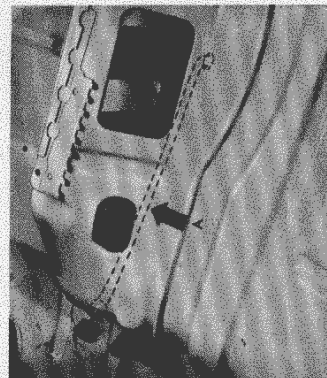


11 - Take driver's seat out.
12 - Drill hole for bowden cable.
a = 10 mm ($\frac{3}{8}$ "') dia.
b = 45 mm ($1\frac{7}{8}$ "')

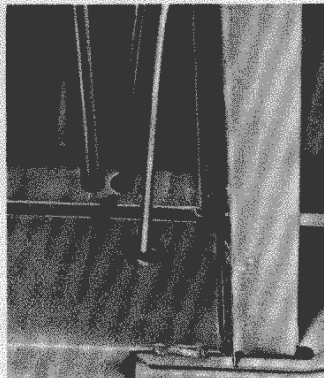


13 - Drill hole for bowden cable under the seat box.
a = 17 mm ($\frac{11}{16}$ "') dia.

Warning
Components of the brake system are below this location so do not drill deeper than 30 mm ($1\frac{1}{4}$ "').

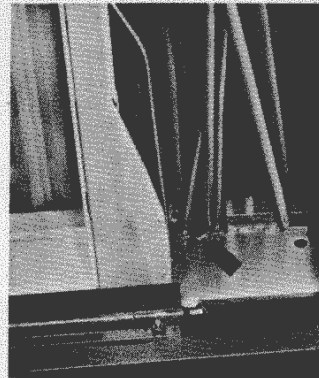


Installing
1 - Install bowden cable.
Insert grommet and route the bowden cable through the hole under the driver's seat first. Secure bowden cable and install knob.
A = bowden cable



2 - Pass the bowden cable through the holes in the frame cross members.

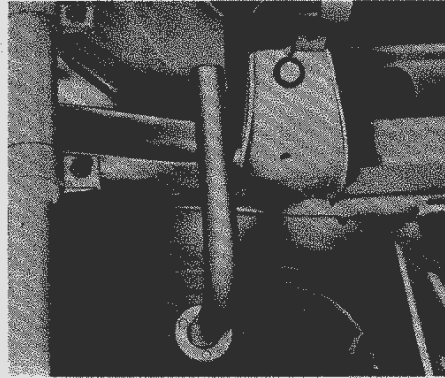
Note
Vehicles with a sliding roof have reinforcement plates welded in between the cross members but the holes mentioned above are still accessible. To facilitate the routing of the bowden cable through the holes it is advisable to pass a thin copper tube through the holes first and then attach the bowden cable to the tube and pull it through.



3 - Pass bowden cable through the hole near the hot air outlet into the engine compartment.



4 – Install heater brackets in engine compartment.



5 – Install the combustion air intake pipe. The intake opening in the pipe must be towards the engine.

6 – Install right portion of engine compartment cover plate.

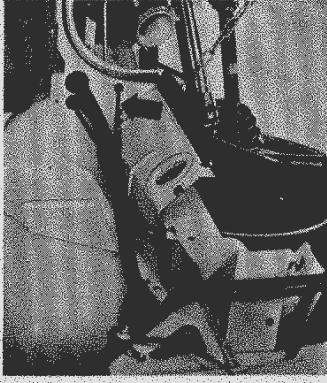
7 – Install time switch about 45 mm (1 7/8") to left of ashtray.

8 – Install cable harness for heater.

The cable from time switch to heater is routed parallel with the main harness as far as the engine compartment and then parallel with the engine harness to the heater. Install a 2.5 mm² (12 gauge) red cable in insulation sleeving from starter terminal 30 to heater (connector with fuse) parallel to engine harness.

9 – Cut fuel line to engine 120 mm (4 3/4") from the end and install a T-piece. Do not forget hose clamps.

10 – Install silicon sealing ring for exhaust pipe.



11 – Insert grommet and install fuel line to heater.

12 – Install heater provisionally but leave it back far enough so that the temperature regulating lever is easily accessible.

13 – Push bowden cable right in (at knob on cable under driver's seat).

14 – Press temperature regulating lever on to stop on heater and install bowden cable free of tension.

15 – Push heater assembly in to its stop and engage the lower pins through the two bonded rubber mountings into the holes in the heater brackets.

16 – Install the left cut-out portion of the engine compartment plate (3 tapping screws). Seal the joint between the two parts of the partition.

17 – Install hot air outlet from inside of vehicle but do not secure it.

18 – Insert two heater securing screws (tapping screws with washers) from the engine compartment through the cut-off portion of the plate.

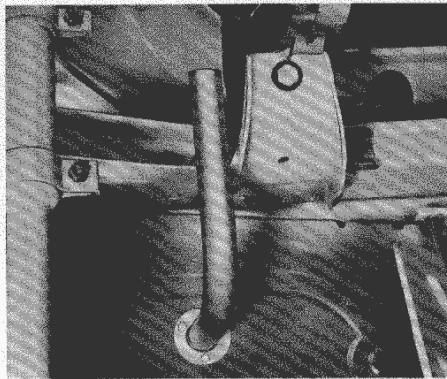
19 – Secure the hot air outlet.

20 – Connect the heater fuel line. Connect cables according to wiring diagram (F 3.20/1-12).

21 – Connect hose for combustion air intake pipe.

22 – Install engine.

- 23 - Attach bracket for exhaust pipe to the left engine mounting bolt in engine carrier.
- 24 - Install exhaust pipe from below and secure it.

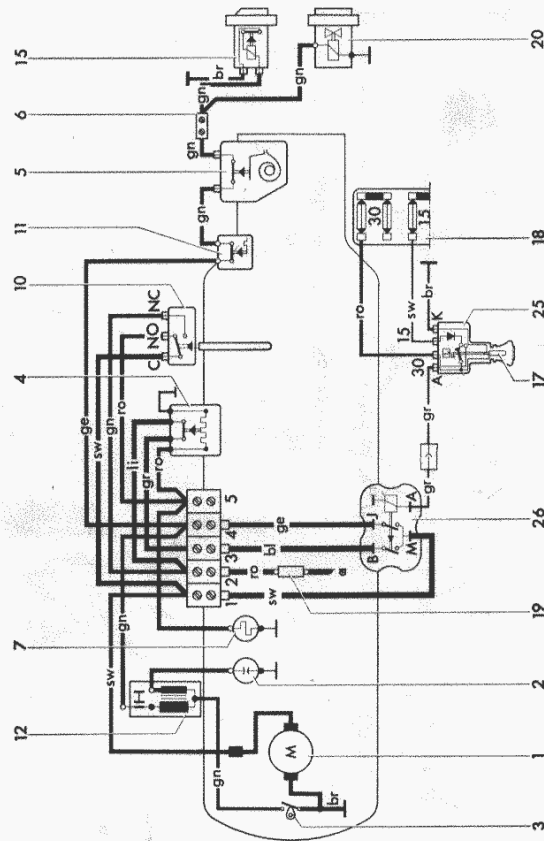
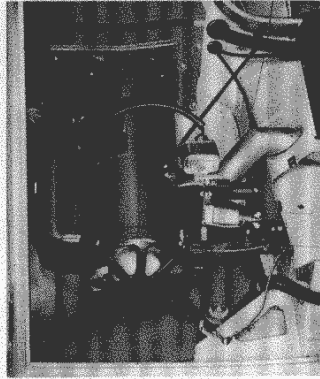


- 25 - Connect battery and check operation of heater.

Note

It may be necessary to switch "on" the safety switch if it has moved to the "off" position during handling.

- 26 - Install driver's seat and rear bench seat.



- 1 - Motor
- 2 - Spark plug
- 3 - Breaker contacts
- 4 - Safety switch
- 5 - Regulating switch
- 6 - Cable connector
- 7 - Glow plug
- 10 - Flame detector switch
- 11 - Overheat switch
- 12 - Coil
- 15 - Fuel pump
- 17 - Warning lamp
- 18 - Fuse box
- 19 - Fuse 18 amp.
- 20 - Fuel solenoid valve
- 25 - Time relay
- 26 - Relay

a = to starter terminal 30

ro = red
sw = black
ge = yellow

br = brown
gr = grey
ws = white

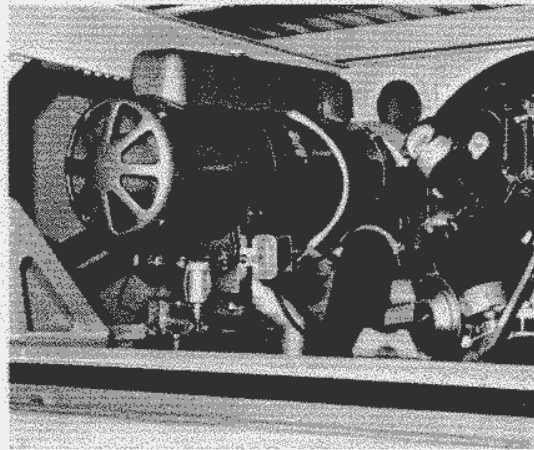
gn = green
li = mauve

General

The BN 4 heater can be service installed in the Pick-up with double cab.

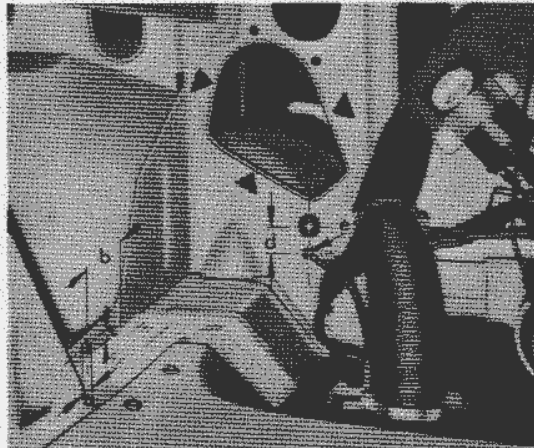
The kit contains the following parts:

- 1 Heater BN 4
- 1 Fuel line
- 1 Air outlet
- 1 Hose adaptor
- 1 Connecting sleeve
- 1 Tube
- 1 Intake pipe, complete
- 1 Exhaust pipe
- 1 Bowden cable
- Flexible pipes
- Electrical wiring



Work sequence

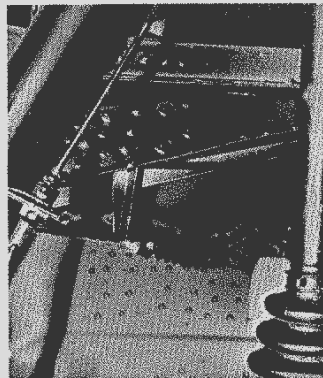
- 1 – Disconnect battery, clip fuel hose.
- 2 – Mark off and drill a 10 mm ($\frac{3}{8}$ in.) hole for the fuel line in the partition below the tank support. Clean up edges of hole.
- 3 – Cut hole for warm air duct as shown by arrows and clean up edges.
- 4 – Mark off, drill and clean up holes for exhaust pipe and mounting bracket bolts in left engine cover plate using template I (see page F 3.20/1–4).
- 5 – Drill second hole for bracket bolt to dimensions shown and clean up edges.



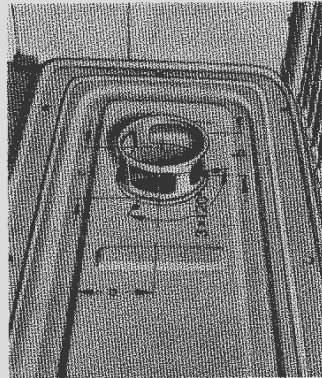
- a = 7 mm ($\frac{9}{32}$ in.)
- b = 145 mm ($5\frac{3}{4}$ in.)
- c = 6 mm ($\frac{1}{4}$ in.)
- d = 30 mm ($1\frac{3}{16}$ in.)
- e = 10 mm ($\frac{3}{8}$ in.)

- 6 – Place template II (see page F 3.20/1–4) under the engine compartment on the left as shown. Mark off and drill holes for combustion air pipe 28 mm ($1\frac{1}{8}$ in.) and for securing bolts 5 mm ($\frac{3}{16}$ in.). Clean up hole edges.
- 7 – Loosen bolt on engine mounting (see arrow). Install bracket and retighten bolt.



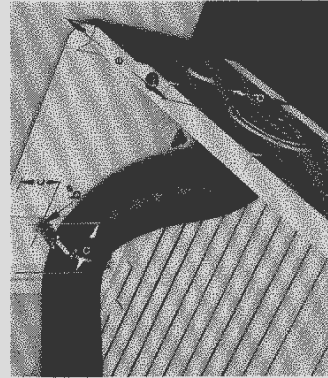


- 8 - Take flexible hose off left rear warm air duct. Drill a 10 mm ($\frac{3}{8}$ in.) hole in engine compartment for the Bowden cable.



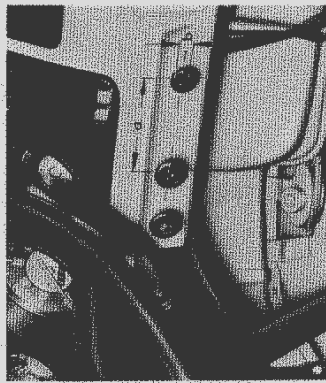
- 9 - Remove rear seat and partition under seat. Mark off, cut and clean up hole for sleeve as shown. Mark off, drill and clean up 6 mm ($\frac{1}{4}$ in.) holes for sleeve securing screws.

a = 75 mm ($2\frac{3}{4}$ in.)
b = 80 mm ($3\frac{1}{8}$ in.)
c = 100 mm ($3\frac{7}{8}$ in.)



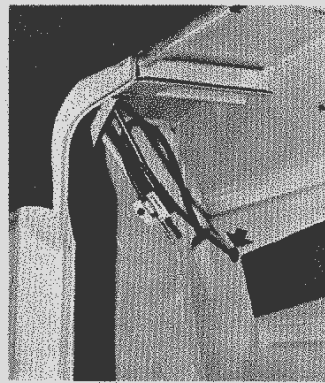
- 10 - Mark off and cut or drill 96 mm ($3\frac{7}{8}$ in.) hole for hose connection, 5 mm ($\frac{1}{8}$ in.) holes for securing screws and 8.5 mm ($\frac{5}{16}$ in.) holes for support in seat box frame. Clean up edges of holes. Install bracket and connection with outlet on seat box. Install hose 85 mm ($3\frac{3}{8}$ in.) long on the connection and secure to connection and bracket with hose clips.

a = 90 mm ($3\frac{5}{8}$ in.)
b = 8.5 mm ($\frac{5}{16}$ in.)
c = 80 mm ($3\frac{1}{8}$ in.)
d = 140 mm ($5\frac{5}{8}$ in.)
e = 280 mm ($11\frac{1}{8}$ in.)



- 11 - Mark off, drill and deburr hole for switch in instrument panel to dimensions shown.

a = 100 mm ($3\frac{9}{16}$ in.)
b = 8.5 mm ($\frac{5}{16}$ in.)



- 12 - Drill a 10 mm ($\frac{3}{8}$ in.) hole for the Bowden cable in the driver's seat base level with the vehicle heating control knob and 50 mm ($1\frac{13}{16}$ in.) away from it.
13 - Mark off and drill a 10 mm ($\frac{3}{8}$ in.) hole to take Bowden cable out of seat base. Deburr hole edges.

- 14 - Install sealing ring for exhaust pipe and grommets for fuel line. Install Bowden cable.

- 15 - Position heater with outlet in the hole in engine compartment partition and bolt the brackets down. Drill 7 mm ($\frac{1}{8}$ in.) holes for outlet securing bolts and remove burrs. Take heater out again and place grommets in the outlet holder.

- 16 - Place combustion air intake pipe in the hole at right angles to vehicle axis (intake opening to vehicle center) and secure it with 3 M 4 x 10 bolts, spring washers and nuts.

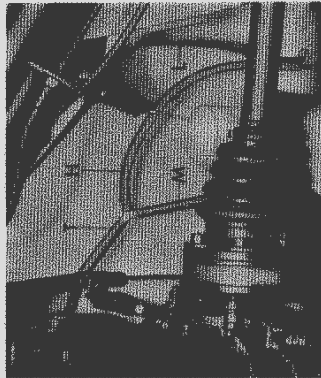
- 17 - Temporarily install exhaust pipe in sealing ring. Install heater with outlet in hole, and insert exhaust connection on heat exchanger into exhaust pipe. Secure bracket to side panel with an M 6 x 15 bolt, spring washer and nut. Place fuel pump ground cable under the Bz 6.3 x 13 sheet metal screw and secure to floor plate with bracket.

- 18 - Secure outlet to engine compartment partition with 2 M 6 x 15 bolts, washers and nuts.

- 19 - Place exhaust pipe on heater connection and secure it with an M 5 x 50 bolt, spring washer and nut. Push elbow through exhaust pipe bracket and install it on the exhaust pipe. Secure elbow to exhaust pipe and to bracket. Attach flexible pipe to the intake connection for the combustion air blower and to the combustion air pipe.

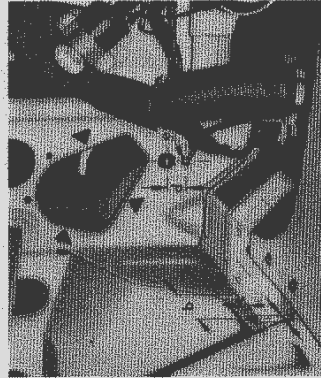
- 20 - Secure double contact relay to mounting bracket with sheet metal screw Bz 4.8 x 9.5 and lock washer A 5.1.

- 21 - Route long fuel line through the grommet in the engine compartment partition and connect to fuel filter on heater.



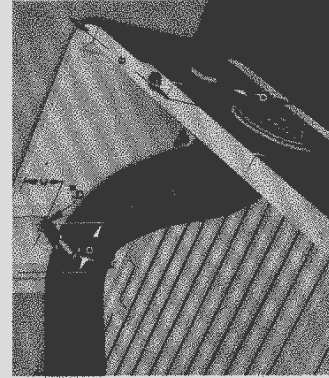
- 22 - Cut vehicle fuel line underneath the tank and install T piece as shown. Connect the hose supplied in kit from free end of T piece to the suction line to the heater. Remove clamp from hose so that fuel can flow.

T = from fuel tank
M = to engine
H = to heater
L = electrical cable



- 23 - Install switch in instrument panel. Install wire 5.15 m (20.3 in.) long and connect it as shown in wiring diagram on page F 3.1/4-1). Route the wire through the grommet installed in the engine compartment partition (above fuel line) along the side member parallel with wiring harness, into cab and connect it to switch.

- 24 - Pull Bowden cable through holes drilled in seat base (see page 3.20/2-3) and pass it into engine compartment through hole. Secure Bowden cable to seat base, screw knob on, connect to regulating switch and secure under vehicle floor plates with three cable clamps.



- 25 - Place flexible pipe 90 cm (35 3/8 in.) long on the heater outlet. Place connector sleeve on other end of pipe and secure it with a hose clamp. Route connector sleeve through the partition under the rear seat and secure it with three screws. Install partition.

- 26 - Place tube on free end of hose in seat base and secure with a hose clamp. Push tube into connecting sleeve and then install rear seat.

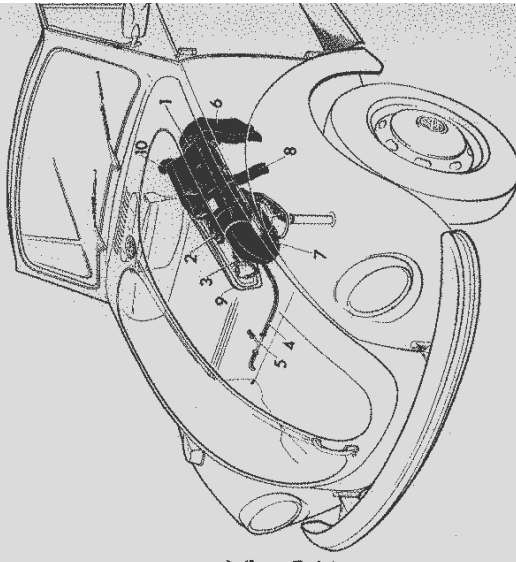
- 27 - Place a 16 amp fuse in the fuse holder and connect wire to vehicle regulator (B+) and to terminal 2 on heater. Connect battery ground strap and check operation of heater.

Description

The BN 2 heater is a gasoline burning unit which works independently of the vehicle engine. The heat output cannot be regulated.

Type 1/Sedan 113/1971 models

- 1 - Heater BN 2
- 2 - Diaphragm pump
- 3 - Filter with water trap
- 4 - Fuel hose
- 5 - T-piece
- 6 - Warm air outlet
- 7 - Air circulation pipe
- 8 - Exhaust pipe with cap
- 9 - Cover plate
- 10 - Combustion air intake pipe



Type 1/Sedan 113/1972 models

The diaphragm pump (2) has been replaced by a metering pump which is located on the cross panel.

Between fuel tank and metering pump is a filter which removes the water from the fuel. The filter with water trap (3) has been discontinued.

Type 3/1971 models

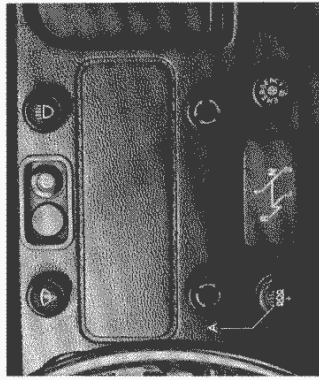


Type 3/1972 models

The diaphragm pump has been replaced by a metering pump which is located on the cross panel.

Between fuel tank and metering pump is a filter which removes the water from the fuel. The filter with water trap has been discontinued.

Operation



A - Knob of heater switch

To switch heater on

Pull knob A out.
The warning lamp lights up and shows that the heater is working.

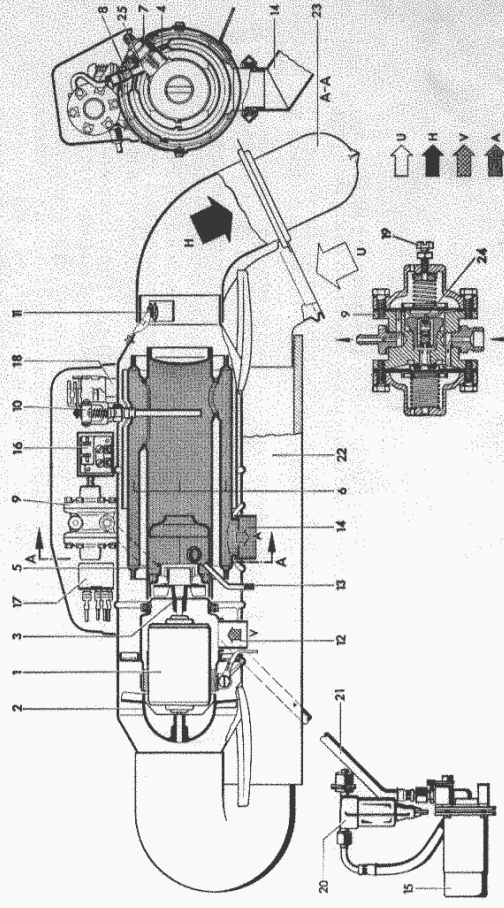
To switch heater off

Push knob A in.
Warning lamp goes out.

Notes

- 1 - When the heater is switched off, a 3 minute run-on period begins. During this period the combustion flame goes out, the combustion chamber is cleared of gas and the complete heater cooled down. At the end of the period the current circuit is interrupted by the thermostat and the blower stops turning.
- 2 - The heater must be switched off when filling the fuel tank. The warning lamp must be out but it is not necessary to wait until the run-on period has ended.
- 3 - To avoid running the battery down do not leave the heater on for hours at a time without starting the engine up to keep the battery charged.
- 4 - When it is very cold it is not advisable to switch the heater on until the vehicle engine is running.

Working principles



V - Combustion air A - Exhaust gas U - Circulating air H - Hot air

- 1 - Electric blower motor
- 2 - Hot air blower fan
- 3 - Combustion air blower fan
- 4 - Precombustion chamber
- 5 - Combustion chamber
- 6 - Heat exchanger
- 7 - Glow plug
- 8 - Fuel jet
- 9 - Pressure regulator
- 10 - Flame detector switch
- 11 - Overheating switch
- 12 - Combustion air intake pipe

- 14 - Exhaust pipe
- 15 - Fuel pump
- 16 - Safety switch
- 17 - Relay
- 18 - Fuse holder with 8 Amp. fuse
- 19 - Adjusting screw
- 20 - Fuel filter
- 21 - Fuel line
- 22 - Air circulation pipe
- 23 - Hot air outlet
- 24 - Regulating valve
- 25 - Flame arrester

The heater is switched on by pulling out the switch.

The electric motor for the hot air and combustion air blowers, the glow plug (via the flame detector switch) and the electric fuel pump are then energized.

The combustion air blower starts delivering air which mixes with the fuel which is supplied by the fuel pump via the pressure regulator. This mixture is then injected into the precombustion chamber. The glow plug warms the combustible fuel/air mixture in the precombustion chamber and ignites the mixture. Combustion then extends to the combustion chamber and starts to heat the heat exchanger. When the flame has heated the sensor tube of the flame detector switch to a certain point, the current flow from the flame detector switch to the glow plug is interrupted. Now the mixture continues to burn by self-ignition.

The hot air blower draws air from the vehicle interior and forces it past the heat exchanger where it is heated to approx. 194 °F (90 °C) above the intake temperature.

Due to the larger size of the hot air blower, the pressure on the hot air side of the heat exchanger is higher than the combustion pressure. This ensures that no exhaust gases can get into the hot air and thus into the vehicle interior even if the heat exchanger is leaking.

The heater is switched off by pushing the switch in. This stops the current flow to the fuel pump and combustion ceases.

The motor for the hot air and combustion air blower, however, continues to run. This cools the heater down evenly and blows all traces of gas out of the combustion chamber.

The warning lamp is out during the run-on period. After about 3 minutes the flame detector switch cuts off the current supply to the motor. The run-on is then completed and the heater out of operation.

The heater has an overheating switch which cuts the current supply to the fuel pump by shorting (blowing) the 8 ampere fuse. This will stop combustion in case the heater gets excessively hot.

Maintenance

Deposits from the fuel tend to settle in the fuel system of the heater when it is not used for long periods. To avoid trouble, it is advisable to operate the heater briefly about once a month when the heater is not in regular use.

Every year before starting to use the heater:

Check glow plug filament. Replace if necessary.

Clean fuel jet and fuel filter (see F 4.3/2)

Check electrical connections.

Check tightness of all nuts and bolts on the heater.

During winter and when driving over poor roads, mud or snow may tend to accumulate in the exhaust or combustion air intake pipes. Have these pipes checked for blockage from time to time so that the heater can always work properly.

If the heater does not work when it has been switched on, the safety switch may have operated. The lever of the safety switch on the heater (arrow) should be moved. If the heater does not start then, there is a defect in the system.



Technical Data

Heat output	7936 BTU (2000 kcal/h)
Fuel	Gasoline
Fuel consumption	1.5 pt. (0.32-0.38 liters) per hour
Current consumption (in working condition)	36 Watts
Current consumption (when heating)	about 200 Watts
Voltage	12 Volt
Voltage range at 68 °F (20 °C)	10 Volt - 14 Volt

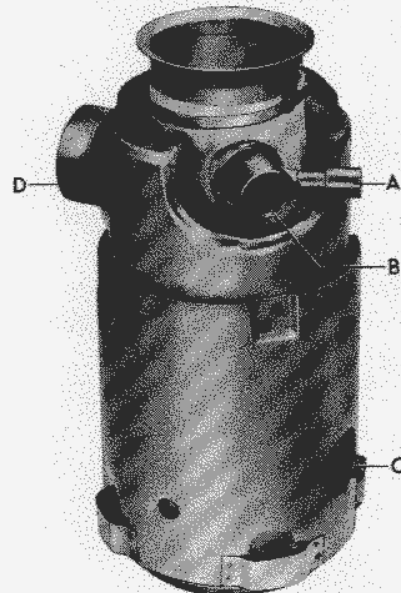
Description of parts

Heat exchanger

The heat exchanger is made of stainless steel. The cylindrical combustion chamber and the two annular chambers of the heat exchanger are connected by two openings (see sectional view, F 4.1/2-1).

The combustion air blower is connected to the heat exchanger. Glow plug, flame detector switch and fuel jet are screwed into the heat exchanger.

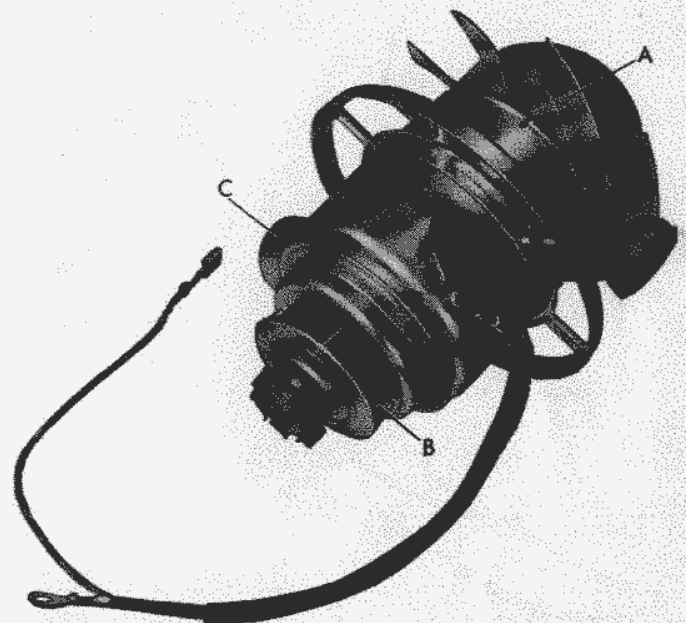
- A – Adapter for fuel jet
- B – Adapter for glow plug
- C – Adapter for flame detector switch
- D – Adapter for exhaust pipe



Combustion air blower

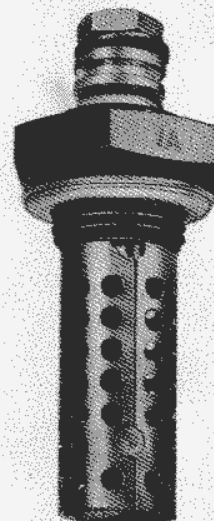
There are two fans connected to the shaft of the combustion air blower. The hot air fan (A) delivers the warm air and the combustion air fan (B) draws the combustion air in through the air intake (C). The vanes on the combustion air fan (B) atomize the fuel.

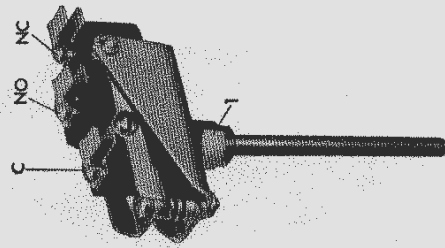
- A – hot air fan
- B – combustion air fan
- C – air intake



Glow plug

The glow plug protrudes into the combustion chamber. The glow plug works only for a brief period after switching on the heater and is then switched off by the flame detector switch.





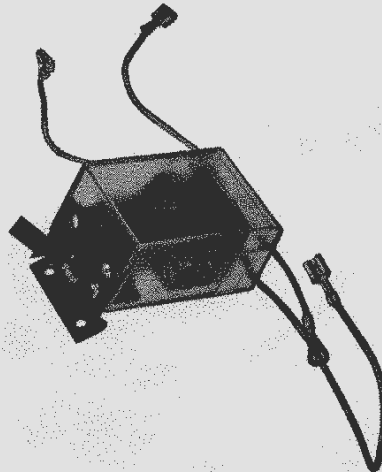
Flame detector switch

The flame detector switch is secured to a thread on the heat exchanger by a union nut. The sensor tube protrudes into the combustion chamber. The flame detector switch controls the cut-in time of the glow plug, the heater resistor, the safety switch and the run-on.

NC — normally closed
NO — normally open, safety switch, relay and glow plug
C — Common, combustion air blower
1 — Union nut

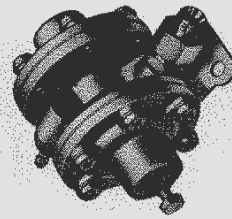
Safety switch

The safety switch is secured to the heater casing. It interrupts the flow of current to the heater if ignition has not taken place within four minutes after the heater has been switched on. The same applies if for some other reason combustion does not take place. The heat resistor in the safety switch activates a bi-metal strip. This bi-metal strip will move out of its normal position after three minutes because of the increase in temperature. This will then interrupt the current to the heater.



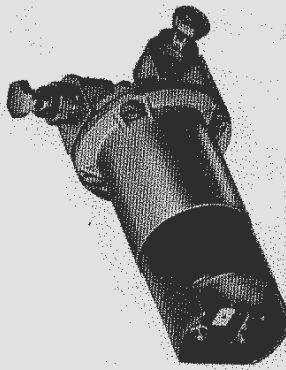
Pressure regulator

The pressure regulator is secured to the heater casing. It keeps the amount of fuel delivered at a constant level.



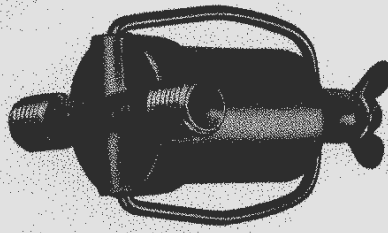
Fuel pump

The diaphragm fuel pump is secured to the heater casing. It delivers fuel to the combustion chamber via the pressure regulator independently of the combustion air blower motor speed.



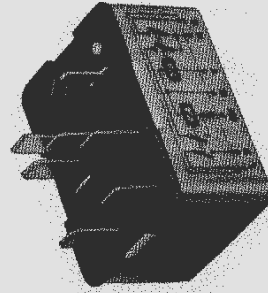
Filter

The fuel filter is located between the fuel tank T-piece and the fuel pump.

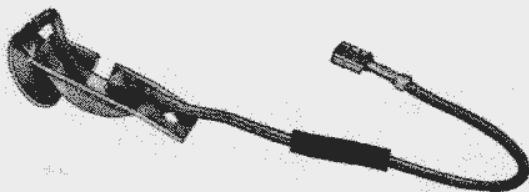


Relay

The relay is attached to the heater under the protective cover.

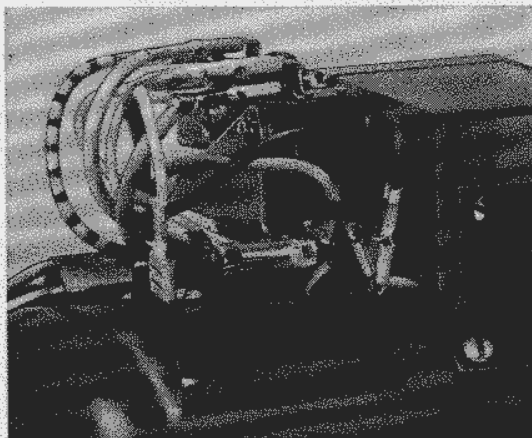


F 4.1 Description of Heating System



Overheating switch

The overheating switch is installed at the hot air outlet. If the temperature rises above 360°–425° F (180°–240° C), the switch closes. This shorts the circuit through the overheating switch and the fuse (see illustration). The sudden surge of current blows the fuse and the fuel pump stops delivering fuel.



F 4.1

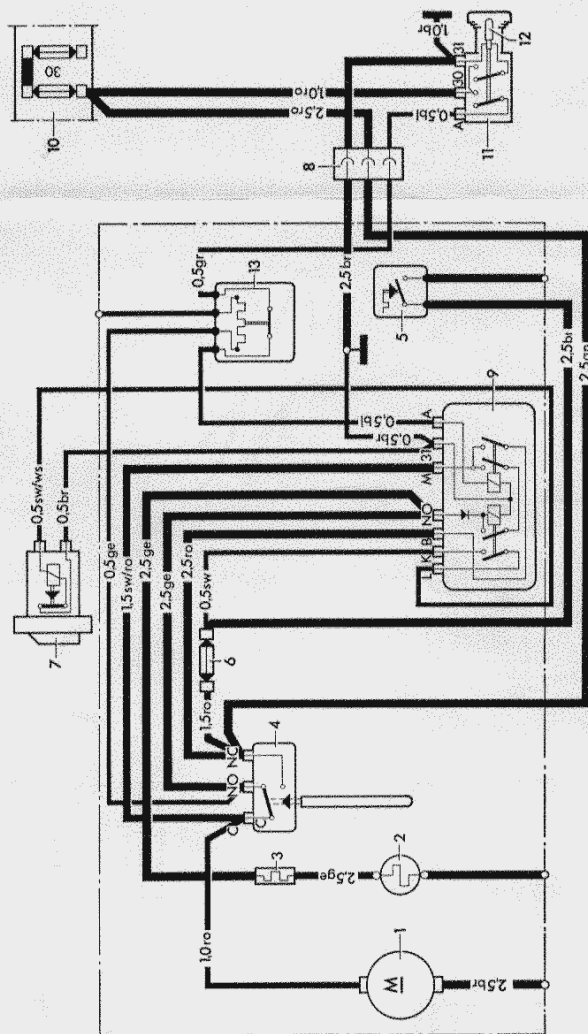
Description of Heating System

ro = red
sw = black
ge = yellow

br = brown
gr = grey
ws = white

gn = green

- 1 - Blower motor
- 2 - Glow plug
- 3 - Resistance
- 4 - Flame detector switch run-on time
- 5 - Overheating switch, response temperature 100-180 seconds
- 6 - Overheating switch, response temperature 360-425° F (180-240° C)
- 7 - Fuse, 8 ampere
- 8 - Fuel pump
- 9 - Connector housing
- 10 - Relay
- 11 - Fuse holder
- 12 - Switch
- 13 - Warning lamp
- 14 - Safety switch, response time 3-4 minutes



Explanation of wiring diagram

The switching times quoted are for 12 volts and an ambient temperature of 68° F (20° C). At lower temperatures the run-on time will be shorter and the response time of the safety switch longer.

When the heater is switched on, current flows to terminal A of relay (9) from terminal 30 of the fuse holder (10) via the switch (11) and the safety switch (13).

Current also flows continuously from terminal 30 of fuse holder (10) via fuse (6) to terminal K of the relay (9). From fuse (6) current also flows via NC terminal of flame detector switch (4) to terminal B of relay (9) so that terminals B, A and K on relay (9) are now all energized.

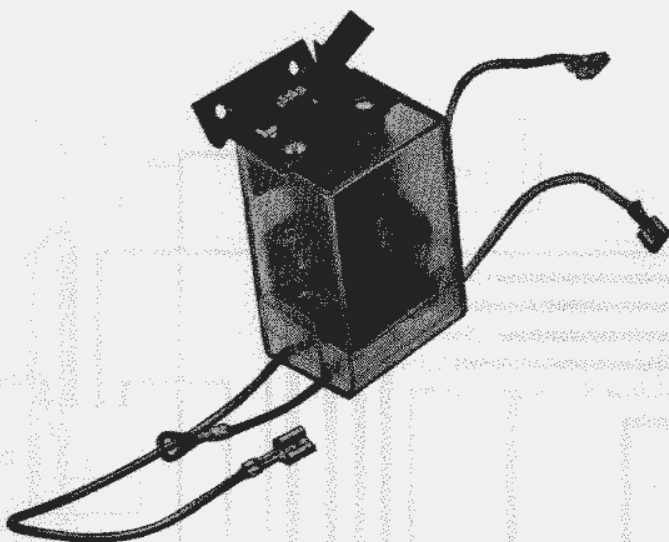
Current flows through the relay coil from terminal A to ground 31 and the relay is pulled in. From terminal B, current flows via terminal M to the blower motor (1). Current also flows via the C-NO contact in the flame detector switch (4) to contact NO on relay (9) and the second coil in the relay (9) is energized. The fuel pump (7) starts to deliver fuel.

The glow plug receives current from NO contact of flame detector switch (4) via the terminal NO of the relay (9). When the glow plug has ignited the mixture, the flame detector switch (4) switches over and bridges contacts C-NO to cut the current to the glow plug.

When the heater is switched off, the current supply to terminal A on the relay (9) is cut off. The contacts at B-M are released and this breaks the circuit to the second relay coil. No further current flows from contact K via contact L to the fuel pump (7). Only the blower motor continues to receive current from terminal 30 via NC-C in flame detector switch (4) until this switch resets back to C-NO as the heater cools down.

F 4.1

Description of Heating System

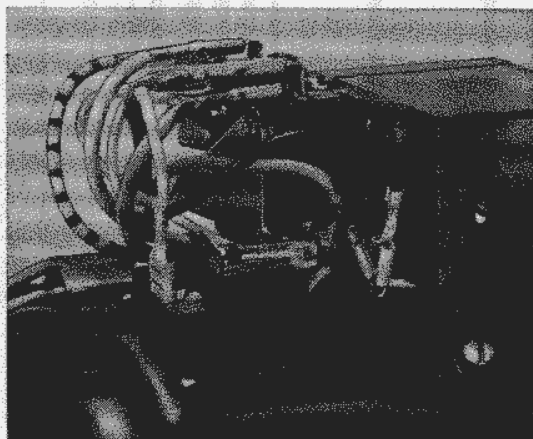


Safety switch

The safety switch (response time: three – four minutes) will interrupt the current to the relay if:

- a – the glow plug is defective.
- b – no fuel is delivered.
- c – any reason preventing combustion.

To switch the heater on again move lever in direction of arrow. It will spring back into its normal position. The lever must only be moved if the defect has been corrected.



Overheating switch

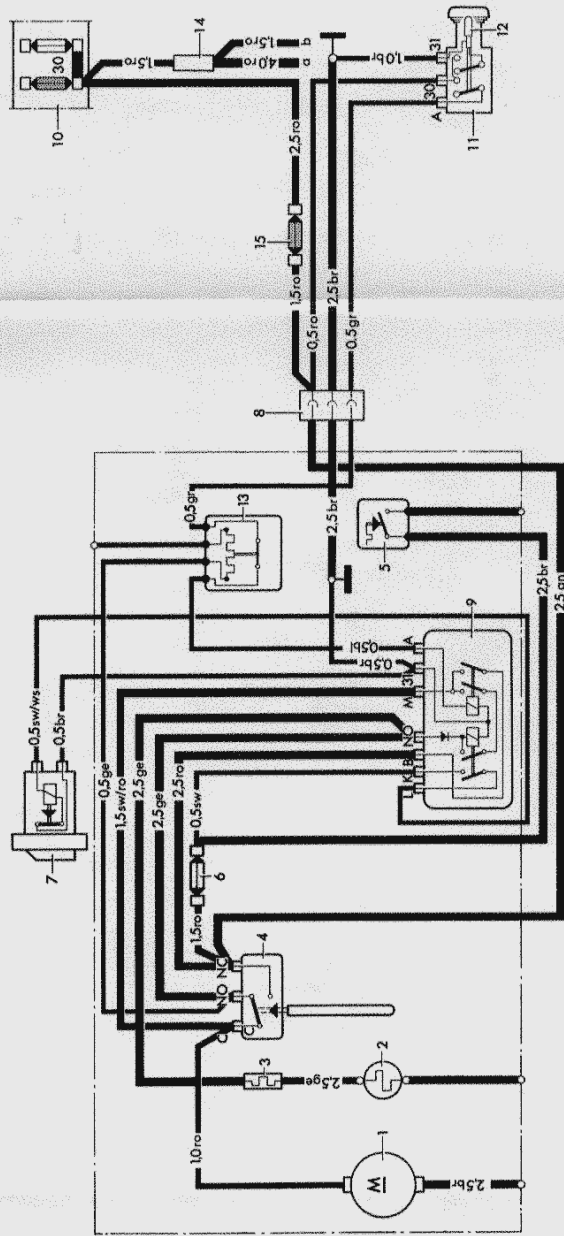
The overheating switch (response time: 360 °– 425 ° F (180 °–240 ° C) interrupts the current to the fuel pump in case of overheating. This may be caused by a lack of air passing through the heat exchanger.

In this case the 8 ampere fuse will blow (see illustration). The defect has to be corrected before the fuse is replaced.

5 - 2 Wiring diagram and explanation

F 4.1

Description of Heating System



ro = red
sw = black
ge = yellow

br = brown
gr = grey
ws = white

gn = green

- 1 - Blower motor
- 2 - Glow plug
- 3 - Resistance
- 4 - Flame detector switch run-on time 100-180 seconds
- 5 - Overheating switch, response temperature 360°-425° F (180°-240° C)
- 6 - Fuse, 8 ampere (for overheating switch)
- 7 - Fuel pump
- 8 - Relay
- 9 - Connector housing
- 10 - Fuse holder
- 11 - Switch
- 12 - Warning lamp
- 13 - Safety switch, response time 3-4 minutes
- 14 - Connector housing
- 15 - Fuse holder, 16 ampere

Explanation of wiring diagram

The switching times quoted are for 12 volts and an ambient temperature of 68° F (20° C). At lower temperatures the run-on time will be shorter and the response time of the safety switch longer.

When the heater is switched on, current flows to terminal A of relay (9) from terminal 30 of the fuse holder (10) via the switch (11) and the safety switch (13).

Current also flows continuously from terminal 30 of fuse holder (10) via fuse (6) to terminal K of the relay (9). From fuse (6) current also flows via NC terminal of flame detector switch (4) to terminal B of relay (9) so that terminals B, A and K on relay (9) are now all energized.

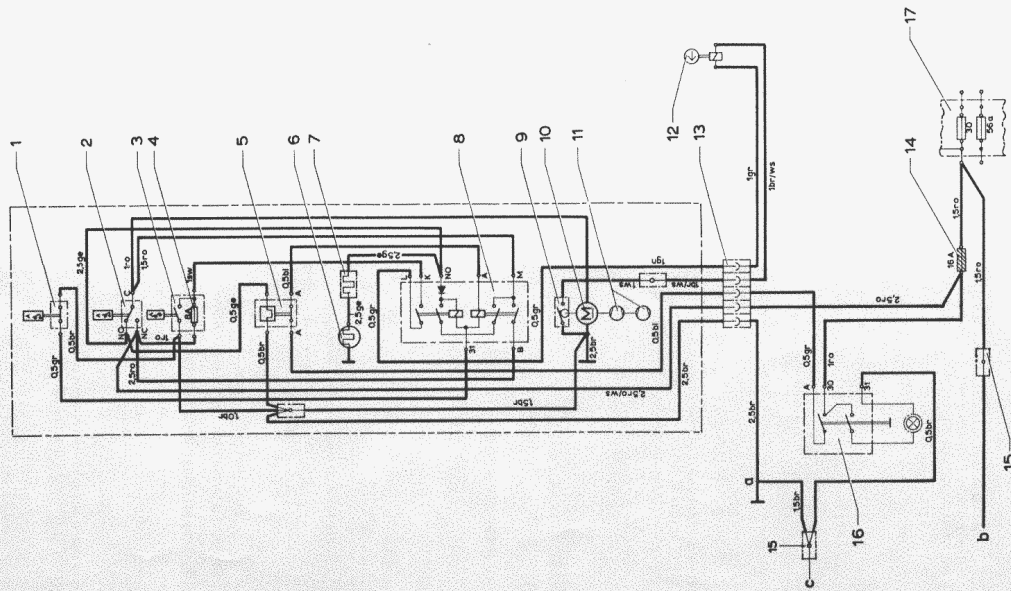
Current flows through the relay coil from terminal A to ground 31 and the relay is pulled in. From terminal B, current flows via terminal M to the blower motor (1). Current also flows via the C-NO contact in the flame detector switch (4) to contact NO on relay (9) and the second coil in the relay (9) is energized. The fuel pump (7) starts to deliver fuel.

The glow plug receives current from NO contact of flame detector switch (4) via the terminal NO of the relay (9). When the glow plug has ignited the mixture, the flame detector switch (4) switches over and bridges contacts C-NO to cut the current to the glow plug.

When the heater is switched off, the current supply to terminal A on the relay (9) is cut off. The contacts at B-M are released and this breaks the circuit to the second relay coil. No further current flows from contact K via contact L to the fuel pump (7). Only the blower motor continues to receive current from terminal 30 via NC-C in flame detector switch (4) until this switch resets back to C-NO as the heater cools down.

F 4.1

Description of Heating System



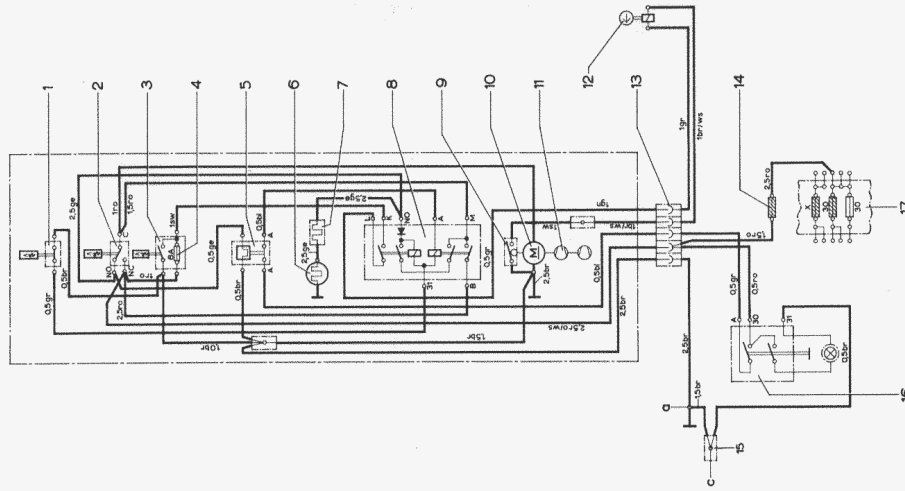
Type 1 / Sedan 111 and 113 from Chassis No. 112 2 109 226, September 1971

5 - 5

- 1 - Temperature regulating switch
- 2 - Flame switch
- 3 - Overheat switch
- 4 - Overheat fuse 8 amp.
- 5 - Glow plug
- 6 - Series resistance
- 7 - Relay
- 8 - Breaker contacts for metering pump
- 9 - Blower motor
- 10 - Metering pump
- 11 - Connector
- 12 - Fuse 16 amp
- 13 - Connector
- 14 - Switch with warning lamp
- 15 - Fuse box
- 16 - Ground connection to body
- 17 - to lighting switch, terminal 30
- c - Blower motor ground wire

Color Code

- br = brown
ro = red
sw = black
ge = yellow
bl = blue
- br = brown
ws = white
gn = green
gr = gray



Type 3 from Chassis No. 312 2 021 784, September 1971

Wiring diagram and explanation

F 4.1 Description of Heating System

Explanation

To switch heater on

Pull switch knob out. The heater starts up and the warning light comes on. Switch contacts 30-A are closed.

Start-up

The heater ignites within about 40 seconds. The start-up process is terminated by the flame switch (2).

Voltage can be measured at:

Fuse box (17) – unfused side
Separate fuse (14)
Terminals 30-A of switch (16)
Terminal 1 of safety switch (5)
Terminal A of relay (8)

The relay operates contacts M-B.

Terminal NC of flame switch (2)
Terminals B-M of relay (8)
Terminal C of flame switch (2)

The blower motor (10) starts to run.

Terminal NO of flame switch (2)
Terminal NO of relay (8)

The relay (8) operates contacts K-L, NO-M.

8 amp. fuse (4)
Terminals K-L of relay (8)
Metering pump (12)

The metering pump (12) starts to deliver fuel.

Series resistance (7)
Glow plug (6)

The glow plug (6) warms and ignites the fuel-air mixture.

Heating

When the heater has ignited and warmed up, the flame switch (2) operates the contacts C-NC and this stops the start-up process.

The following are de-energized:

Terminal NO of flame switch (2)
Terminal NO of relay (8)
Series resistance (7)

The glow plug 6 is switched off.

Temperature regulation

Before the air being delivered becomes too hot the temperature regulating switch (1) opens and the heater runs on until the flame switch responds again.
When the temperature regulating switch (1) opens, the relay (8) breaks the contacts.

The following is de-energized:

Terminal L on relay (8)

The fuel pump (12) stops delivering.
The heater starts to cool down.

After about two to three minutes the flame switch (2) operates contacts C-NO. The temperature regulating switch (1) has closed in the meantime and the heater starts up again.

Operation of overheating switch

If the heater gets too the overheating switch (3) closes and causes a short circuit which blows the fuse (4).

The following are de-energized:

Contact K and L in relay (8)

The pump (12) stops delivering fuel. The combustion air blower (10) continues to run to cool down the heater and blow out all traces of gas.
After about 3 minutes, the flame switch (2) operates contacts C-NO.

Voltage can be measured at:

Terminal of flame switch (2)
Terminal NO of flame switch (2)
Terminal NO of safety switch (5)

When the resistor of safety switch (5) heats for more than 3 minutes, the connection between switch contact A and relay contact A is broken.

The relay (8) breaks the connection M-B.

The following are de-energized:

Contact M of relay (8)
Contact C-NO of flame switch (2)

Blower motor (10) and glow plug (6) are switched off.

Operation of safety switch (5)

The safety switch (5) responds when the flame switch (2) holds the contacts C-NO closed longer than about 3 minutes because combustion has not taken place in the heater or because the flame switch (2) is defective.

Voltage can be measured at:

Terminal C of flame switch (2)
Terminal NO of safety switch (5)

When the resistor of safety switch (5) heats for more than 3 minutes, the connection between switch contact A and relay contact A is broken.

The relay (8) breaks the connection M-B.

The following are de-energized:

Contact M of relay (8)
Contact C-NO of flame switch (2)

Blower motor (10) and glow plug (6) are switched off.

To switch heater off

Press switch (16) in. The warning lamp goes out, contacts A-30 are separated and the run-on begins.

Run-on

The run-on lasts for about 3 minutes at an ambient temperature of 20° C (68° F) and is shorter at lower temperatures. The run-on is necessary in order to clear all traces of gas from the heat exchanger and cool it down.

The following are de-energized:

Contact A of safety switch (5)
Contact A of relay (8)

All contacts are separated in relay (8).

Contact L of relay (8)

Metering pump (12) stops delivering fuel.

Terminal NC-C of flame switch (2)

Voltage can be measured at:

Terminal NC-C of flame switch (2)

When the heat exchanger has cooled down the flame switch (2) operates the contacts C-NO and cuts current supply to blower motor.
The run-on is finished.

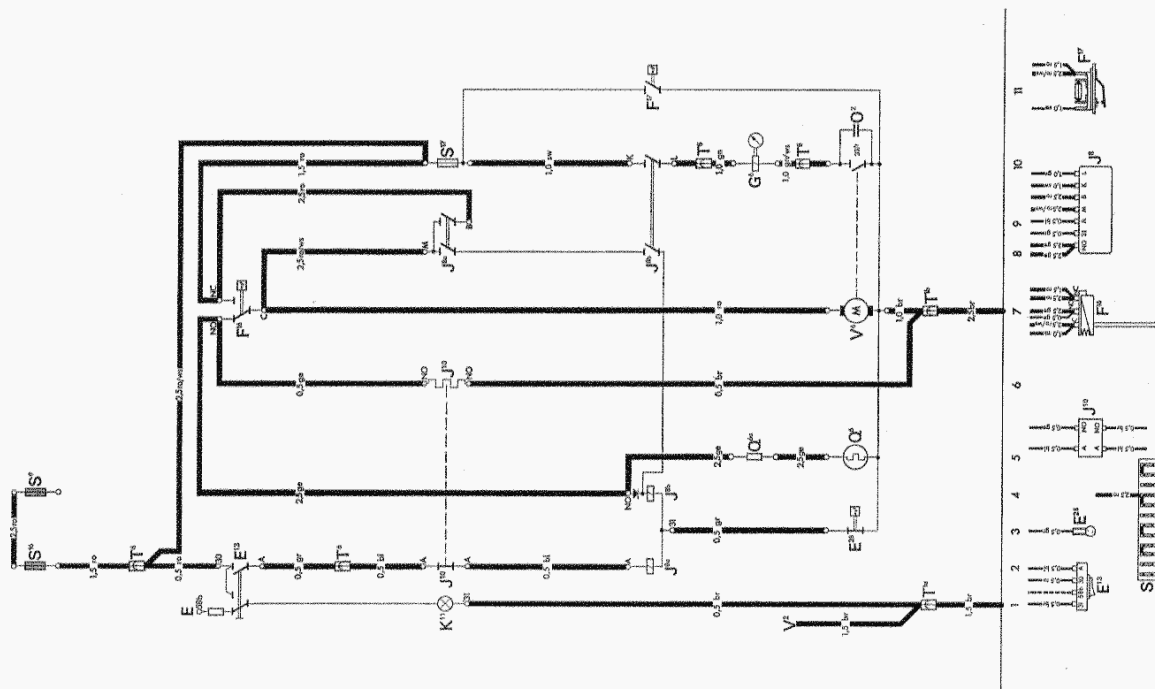
F 4.1

Description of Heating System

Description	Current track
E From light switch - terminal 58	1
E 12 Switch with warning lamp	2
E 28 Temperature regulating switch	3
F 16 Flame switch	7
F 17 Overheating switch	11
G 6 Metering pump	10
J 8 Relay	2; 4; 8; 9; 10
J 10 Safety switch	2; 6; 7
K 11 Warning light	1
Q 2 Contact for metering pump	10
Q 6 Glow plug	5
Q 6a Series resistance	5
S Fuse box	4
S 9 ninth fuse in fuse box - terminal 30	4
S 16 Fuse 16 amp	4
S 17 Fuse overheating switch (8 amp)	2
T 1a Connector, single - groundwire of blower motor	10
T 1b Connector, single - on top of heater	1
V 6 Connector, six connections	7
V 2 To fresh air blower	2; 10
V 6 Fresh air blower	7

Color code

gr = grey
ws = white
gn = green
ro = red
sw = black
ge = yellow
br = brown



F 4.1 Description of Heating System

Explanation

To switch heater on

Pull switch out. The heater starts up.
Switch contacts 30-A are closed.

Start up

Within 40 seconds the heater should ignite. The start up period is controlled by the flame switch (F 16).

Voltage can be measured at:

Fuse box (S 9) - input side
Terminals A-A of safety switch (J 10)

The relay (38a) operates contacts M-B.

Terminal NC of flame switch (F 16)
Terminal C of flame switch (F 16)

The blower motor (V 6) starts.

Terminal NO of flame switch (F 16)

The relay (J 8b) operates contacts K-L, NO-M.

8 amp. fuse (S 17)
Terminals K-L of relay (J 8b)

The fuel pump (G 6) starts to deliver fuel.

Series resistance (Q 6a)

The glow plug (Q 6) heats up and ignites the fuel-air mixture.

Heating time

When the mixture has ignited and the heater warms up, the flame switch (F 16) operates the contacts C-NC.

The following is then de-energized:

Contact NO of flame switch (F 16)

The current supply to the glow plug (Q 6) is cut off.

Temperature regulation

Before the air being delivered becomes too hot, the temperature regulating switch (E 28) opens and the heater runs on until the flame switch responds again.

When the temperature regulating switch (E 28) opens, the relay (J 8) breaks the contacts.

The following is de-energized:

Contact L on relay (J 8b)

The fuel pump (G 6) stops delivering.
The heater starts to cool down.

After about two to three minutes the flame switch (F 16) operates contacts C-NO.
The temperature regulating switch (E 28) has closed in the meantime and the heater starts up again.

Operation of overheating switch

If the heater overheats, the overheating switch (F 17) closes and causes a short circuit which blows fuse (S 17).

The following are de-energized:

The fuel pump (G 6) stops working. The combustion air blower (V 6) continues to supply air which cools down the heat exchanger and blows out all traces of gas.
After about 3 minutes the flame switch (F 16) switches contacts C-NO.

Voltage can be measured at:

Terminal C of flame switch (F 16)
Terminal NO of flame switch (F 16)

When the resistor of the safety switch (J 10) heats for more than 3 minutes, the connection between switch contact A and relay contact A is broken.

The relay (J 8a) breaks connection between contacts M-B.

The following are de-energized:

Contact M of relay (J 8a)

Blower motor (V 6) and glow plug (Q 6) are switched off.

Operation of safety switch

The safety switch (J 10) responds if the flame switch (F 16) holds the contacts C-NO closed longer than about 3 minutes because combustion has not taken place in the heater or because the quartz rod in the flame switch (F 16) is broken.

Voltage can be measured at:

Terminals C-NO of flame switch (F 16)
Terminal NO of safety switch (J 10)

When the resistor of the safety switch (J 10) heats for more than 3 minutes, the connection between switch contact A and relay switch A is broken.

The relay (J 8) breaks the connection between contacts M-B.

The following are de-energized:

Contact M of relay (J 8)
Contacts C-NO of flame switch (F 16)

Blower motor (V 6) and glow plug (Q 6) are switched off.

To switch heater off

Press switch (11) in. Switch contacts A-30 are separated and run-on begins.

Run-on

The run-on lasts about 3 minutes at a temperature of 20° C (68° F) and is shorter at lower temperatures. The run-on is necessary to cool the heat exchanger down and blow out all traces of gas.

The following are de-energized:

Contact A of safety switch (J 10)

All contacts in relay (J 8) are separated.

Contact L of relay (J 8)

The metering pump (G 6) stops working.

Voltage can be measured at:

Terminals NC-C of flame switch (F 16)

When the heat exchanger has cooled down, the flame switch (F 16) switches contacts C-NO.
The blower motor stops working. The run-on is finished.

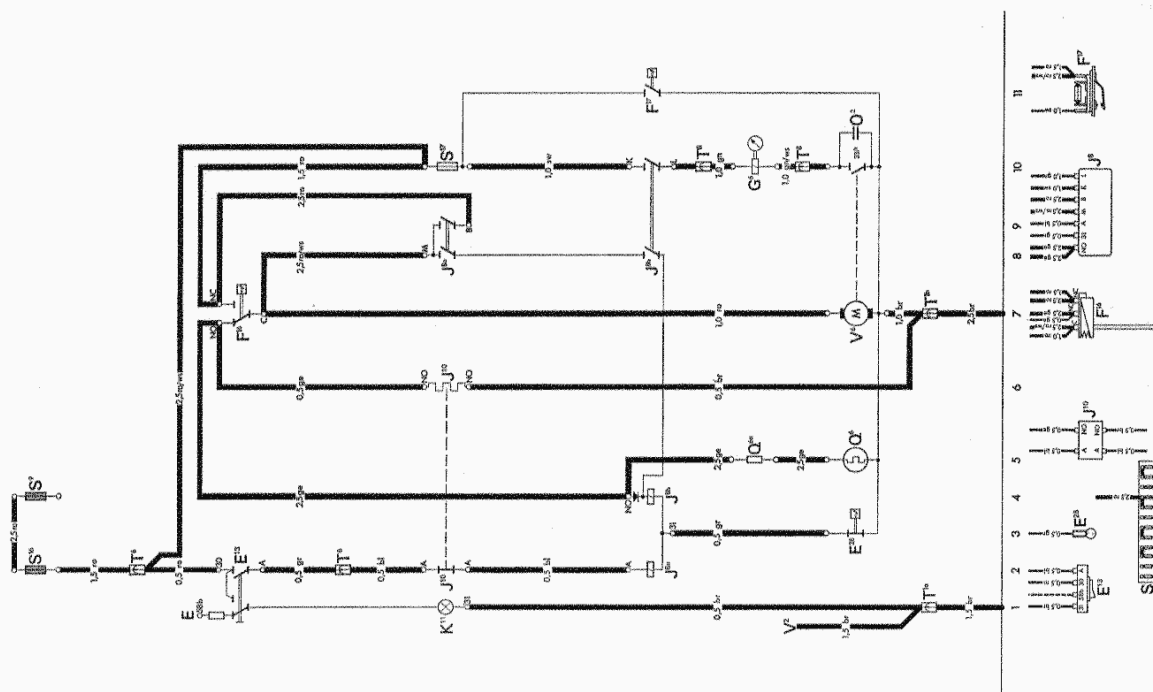
F 4.1

Description of Heating System

Description	Current track
E From light switch - terminal 58	1
E 12 Switch with warning lamp	2
E 28 Temperature regulating switch	3
F 16 Flame switch	7
F 17 Overheating switch	11
G 6 Metering pump	10
J 8 Relay	2; 4; 8; 9; 10
J 10 Safety switch	2; 6; 7
K 11 Warning light	1
Q 2 Contact for metering pump	10
Q 6 Glow plug	5
Q 6a Series resistance	5
S Fuse box	4
S 9 ninth fuse in fuse box - terminal 30	4
S 16 Fuse 16 amp	2
S 17 Fuse overheating switch (8 amp)	10
T 1a Connector, single - groundwire of blower motor	1
T 1b Connector, single - on top of heater	7
T 6 Connector, six connections	2; 10
V 2 To fresh air blower	1
V 6 Fresh air blower	7

Color code

gr = grey
ws = white
gn = green
to = red
sw = black
ge = yellow
br = brown



Trouble shooting with heater installed

To find a defect, a step by step test is necessary.

Switch heater on

The following can happen:

- A – Heater does not work
- B – Heater smokes
- C – Heater goes out

In case one of the above mentioned problems is found, the heater must be checked as follows:

A - Heater does not work

Check	Possible fault	Remedy
1 - Current supply interrupted, 16 ampere fuse blown	Short circuit in system	Check for wiring fault (see wiring diagram on page F 4.1/5). Rectify defect and replace 16 amp. fuse
2 - Safety switch has switched heater off (see wiring diagram, page F 4.1/5, item 13)	a - Flame detector switch has not operated b - Mixture has not ignited because glow plug is defective	a - Check switch and replace or adjust (see F 4.3/1) b - Replace glow plug (see F 4.5/1)
3 - 8 amp. fuse has blown (see F 4.1/5)	Heater has overheated and overheating switch has operated a - Hot air short circuit - the hot air from heater is drawn in again because the outlet is directing the hot air into the intake elbow b - Air ducts blocked	a - Turn the hot air outlet b - Clear the ducts
4 - Voltage drop	Battery voltage low	Start engine so that generator voltage is available. If necessary, remove and charge battery
5 - Glow plug (see F 4.3/1)	Glow plug filament broken	Replace glow plug (see F 4.5/1)
6 - Fuel	Tank empty	Fill tank
7 - a - Filter b - Strainer in pressure regulator (see F 4.8/1) c - Jet	a - Filter bowl full of water or strainer dirty b - Strainer blocked c - Jet blocked	a - Empty the bowl and clean with compressed air (see F 4.3/2) b - Clean strainer c - Clean jet with compressed air

1 - 2 Heater does not work

Heater does not work 1 - 3

Check	Possible fault	Remedy
8 - Fuel pump (see F 4.6/1)	a - Pump drawing in air (pump works unevenly or too fast) (see F 4.6/1) b - Pump not working (short circuited or contacts burnt) (see F 4.3/1) c - Valves in pump housing sticking	a - Check line from tank to pump for leakage b - Check contacts, clean and adjust. Replace pump if necessary. Check 8 amp. fuse (see F 4.1/5) c - Clean valves (see F 4.6/1)
9 - Flame detector switch	a - Flame detector switch not working in the specified period b - Flame detector switch not working	a - Adjust flame detector switch (see F 4.3/1) b - Replace flame detector switch (see F 4.5/1)
10 - Relay	a - Contacts defective b - Diode defective (see F 4.3/1)	a; b - Replace relay (see F 4.5/1)
11 - Blower motor	a - Motor does not attain prescribed speed b - Motor not working (see F 4.3/1)	a; b - Check motor, replace if necessary (see F 4.5/1 and 4.3/1)
12 - Shortage of combustion air	a - Intake pipe blocked b - Exhaust pipe blocked	a; b - Clean (see F 4.4/1)

F 4.2 Trouble Shooting

B — Heater smokes

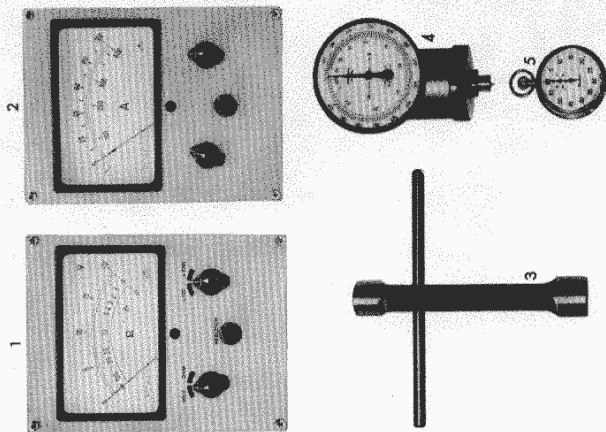
Check	Possible fault	Remedy
1 — Combustion air intake pipe or exhaust pipe blocked (see F 4.2/1)		
2 — Pressure regulator	a — Defective b — Incorrectly adjusted	a — Replace (see F 4.5/1) b — Check and adjust (see F 4.3/1)
3 — Fuel pump	Incorrectly adjusted	Adjust correctly (see F 4.3/1)

C — Heater goes out

Check	Possible fault	Remedy
1 — Heater not getting sufficient fuel (see F 4.2/1, point 7)		
2 — Shortage of combustion air (see F 4.2/1, point 12)		
3 — Overheating switch has operated — 8 amp. fuse blown (see F 4.2/1, point 3)		

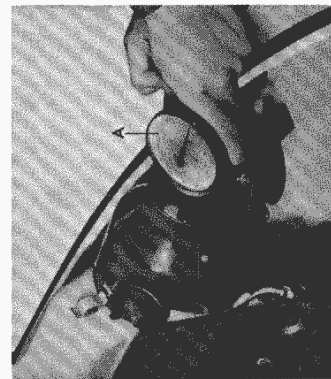
1-4 Heater smokes / Heater goes out

F 4.3

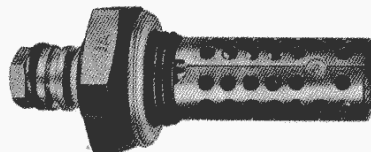


No.	Description	VW Special Tool No.	Remarks
1	Ohmmeter/voltmeter		range 0–20 volts
2	Ammeter		range 0–20 amps.
3	Box wrench		20 mm A/F
4	Tachometer		0–8000 rpm.
5	Stop watch		

Tools 1-1

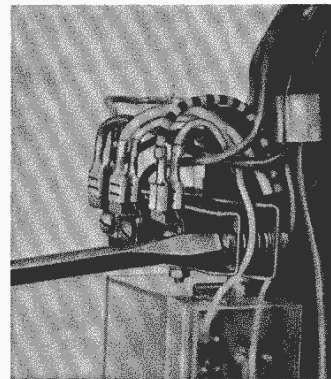


A - Tachometer



Glow plug

When a voltage of 4 volts is applied to the plug, it should glow bright red after one minute. If not, the plug should be replaced.

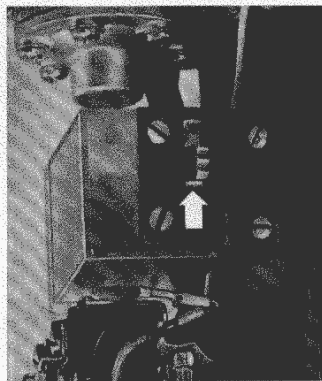


Blower motor (checking speed)

The speed can be measured with the motor installed. The supply cable to the motor is detached at terminal C on the flame detector switch. At a nominal voltage of 12 volts the speed should be $5700 \pm 5\%$. If the speed deviates considerably, the motor should be replaced.

Thermoswitch

- 1 - Switch heater on and let it run for at least 5 minutes.
- 2 - Switch off and start stop watch.
- 3 - The combustion air blower, controlled by the flame detector switch should run on for 100-180 seconds. This time is based on a nominal voltage of 12 volts and an outside temperature of 68°F (20°C). At lower temperatures the run-on period is shorter. If the run-on period is not correct, the flame detector switch must be adjusted. If the period is too long, turn adjusting screw to the right; if too short, turn screw to left. If the motor does not switch off, the sensor rod may be broken. If so, the sensor rod must be replaced.

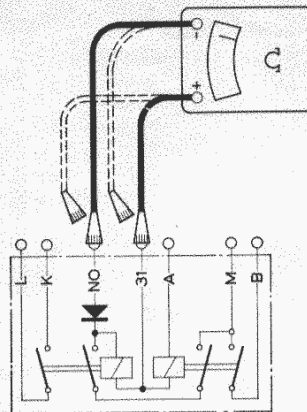


Checking and adjusting safety switch

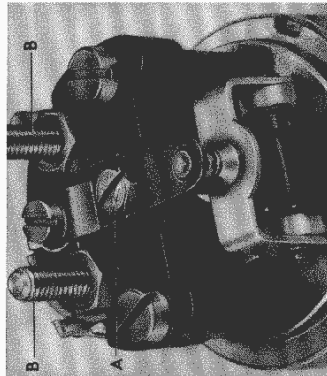
- 1 - Disconnect wires from pump and glow plug.
- 2 - Switch heater on. After about 3 to 4 minutes (at nominal voltage and ambient temperature of 68°F (20°C)) the switch should interrupt the circuit to the relay (contract A).
- 3 - If the switch operates within the specified time, push the switch lever in direction of arrow and switch heater on again.

Checking dual relay

- 1 - Remove 16 amp. heater fuse from the fuse box.
- 2 - Disconnect all wires from relay and take relay out.
- 3 - a) Connect ohmmeter to terminals NO and 31 on relay. The meter will show a certain reading (low or high resistance).
b) Change test probes (see dotted lines). If the ohmmeter shows the **same** reading as before, the diode is defective and the relay must be replaced.
- 4 - Apply 12 volts between the terminals M (+) - 31 (-), A (+) - 31 (-), L (+) - 31 (-) continuously during the check. Apply 12 volts briefly between terminals NO (+) - 31 (-).
Both relays are then energized. The voltmeter should now read 12 volts between terminal B (+) - 31 (-) and K (+) - 31 (-) but not between terminals NO (+) - 31 (-) otherwise the relay is defective and must be replaced.



Fuel pump



A – Adjusting screw
B – Contact screws

- 1 – Disconnect double connector plug from fuel pump. Disconnect suction and pressure lines.
- 2 – Remove two nuts from contact screws and remove cover. Check contact breaker points. Lubricate moving parts and springs sparingly if necessary (use neatfoot oil).

Note

The contact breaker gap should be .04 in./1 mm (press lower contact breaker arm against housing). Correct with adjusting screw.

- 3 – Remove four fillister head screws on coil housing and take pump housing off. Turn diaphragm bracket counter-clockwise to remove it and check it visually (see F 4.6/1).
- 4 – When reinstalling, first screw diaphragm bracket in clockwise as far as it will go. Then back off 2 1/2 turns counter-clockwise. This ensures that the fuel pump will now deliver the correct fuel quantity. (F 4.6/1)

- 5 – The fuel pump must be installed on the luggage pan so that the connection on the pressure side is vertically upward as denoted by the arrow. After installation, the fuel line on the pressure side may have to be bled. After this, moisten pressure valve with a few drops of gasoline (see F 4.5/1).

Caution

When assembling, ensure that the diaphragm is located in the groove and the coil housing is firmly bolted to the pump housing (the pump will not deliver if air is drawn in at the side). (See F 4.6/1.) There is a vent hole in the coil housing. Secure pump housing to coil housing with four fillister head screws. The pressure connection has to be opposite the vent hole (see F 4.6/1).

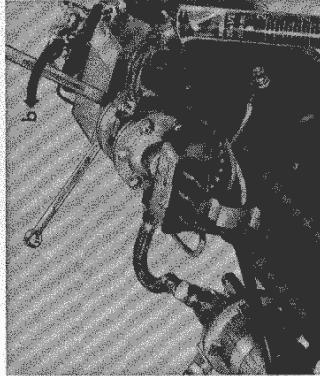
Pressure regulator

Note

The fuel delivery quantity can only be set accurately by measuring the fuel consumption on the heater. This is done at the fuel jet. Before carrying out a consumption test or adjustment, clean the filters.

Part	Location	Remarks
Filter	between tank and fuel pump	Clean (see F 4.3/2)
Strainer	inlet to pressure regulator	Clean (see F 4.8/2)

- 1 – Disconnect glow plug
- 2 – Screw jet off jet carrier and clean it with compressed air.
- 3 – Install jet on the fuel hose again then hold measuring glass under the jet (see illustration).
- 4 – Switch heater on and catch the fuel being pumped out for 2 minutes. The amount pumped in this time should be 10.7–12.7 cc.
- 5 – The amount of fuel can be corrected with the adjusting screw (see F 4.8/1) in the end cap as shown in illustration.

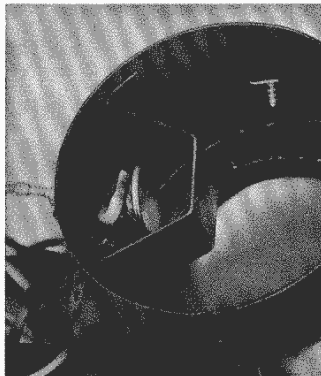


a – Turning to left: reduces amount of fuel
b – Turning to right: increases amount of fuel

Note

If an adequate supply of fuel is not attained, even after an adjustment, then the filter in the pressure regulator (F 4.8/2) is blocked or the fuel pump is not delivering sufficient fuel (see F 4.3/1).

F 4.3 Checking and Adjusting Parts of Heater



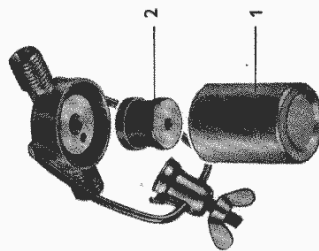
Overheating switch

Block about $\frac{1}{2}$ of the outlet elbow opening under the instrument panel and measure the switching temperature of the overheating switch. It should be $360^{\circ}\text{--}425^{\circ}\text{F}$ ($180^{\circ}\text{--}240^{\circ}\text{C}$).

A defective overheating switch must be replaced.

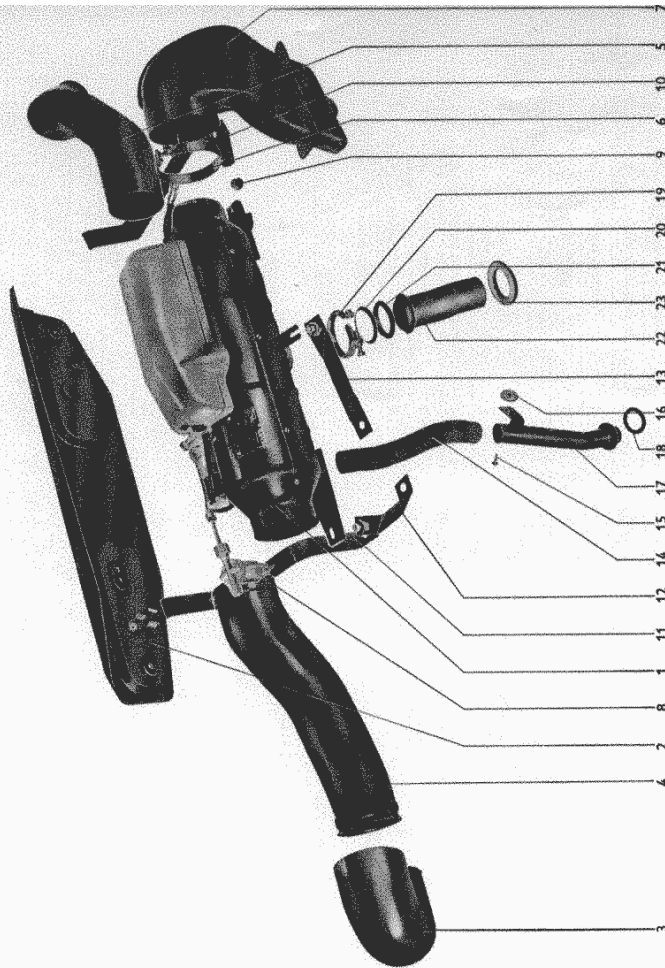
Filter

Water collects in the filter bowl (1) so it must be removed and emptied regularly (see F 4.1/3). At the same time the filter element (2) should be screwed off and cleaned with compressed air.



- 1 – Water collector
- 2 – Filter element

Header and Hot Air Ducts F 4.4

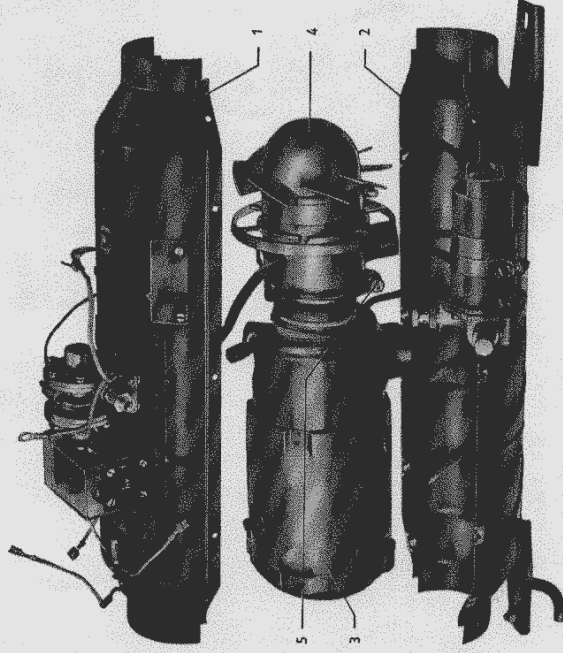


No.	Description	Qty.	disassembling	Note when assembling	Special instructions see
1	Heater and fuel pump	1	The heater is supported on two brackets and a pin with rubber bushing (item 9) which fits in a tube. This is only on heaters installed in Type 1 (Sedan 113) vehicles	Place bushing (9) on pin and insert in tube (10) then secure heater to the brackets (12 and 13). Attach fuel hose to filter (8) in wiring diagram	F 4.1/5
2	Cover plate	1			
3	Air circulating pipe	1			
4	Pipe	1			
5	Intake elbow	1		The intake elbow must engage in the hole in luggage pan	
6	Clamp	1			
7	Footwell outlet with seal	1			
8	Filter	1	clean	arrow shows fuel flow direction	F 4.20/1
9	Rubber bushing	1			
10	Rear heater bracket	1			
11	Front cover plate bracket	1			
12	Front heater	1			
13	Center heater bracket	1			
14	Flexible hose	1		this hose must not be kinked and must fit tightly on the intake pipe (17) and on the heater adapter	
15	Tapping screw	1			
16	Rubber washer	1			
17	Combustion air intake pipe	1			
18	Seal for intake pipe	1			
19	Clamp for exhaust pipe	1			
20	Tapered ring	1			
21	Sealing ring	1			
22	Exhaust pipe	1			
23	Grommet for exhaust pipe	1			

Combustion air blower and heat exchanger

Removing

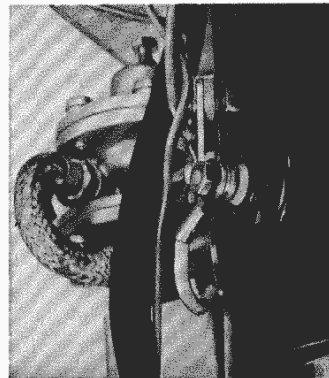
- 1 - Disconnect battery ground strap.
- 2 - Remove heater (see F 4.4/1).



No.	Description	Qty.	removing	Note when installing	Special instructions see
1	Upper part of casing	1	remove flame detector switch remove and clean jet remove glow plug	install flame detector switch and seal hole in casing with silicon washer screw jet in and secure hose with clamp screw plug in and seal hole in casing with a silicon seal	F 4.5/1 F 4.5/1
2	Lower part of casing	1	remove hose between pump and pressure regulator, remove 10 tapping screws	before installing hose, clean strainer on pressure regulator	F 4.8/2
3+4	Heat exchanger (3) combustion air blower (4)	1 +	the blower is attached to the heat exchanger by the clamp (5). Replace damaged seals	at the contact surface between heat exchanger and blower there is a sealing ring	

Installing

- 1 - Install heater (see F 4.4/1).
- 2 - Connect battery ground strap and check heater operation.



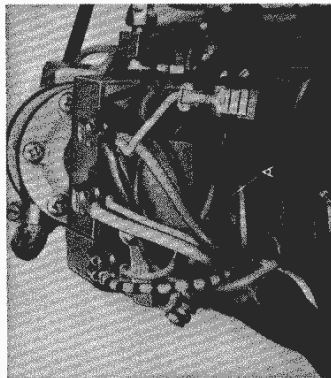
Glow plug

Removing

- 1 - Remove terminal nut (8 mm).
- 2 - Take silicon seal off.
- 3 - Screw plug out with a socket wrench (20 mm).

Installing

Screw plug in and connect cable, using the two lock washers. Press silicon seal over plug on to the casing.



Flame detector switch

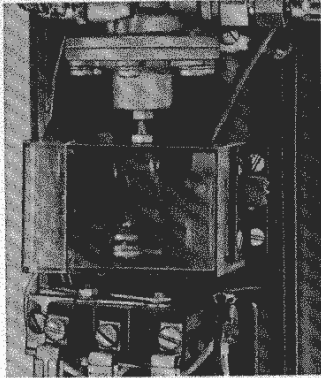
Removing

- 1 - Disconnect the battery ground strap.
- 2 - Remove heater (see F 4.4/1).
- 3 - Disconnect flame detector switch wires.
- 4 - Unscrew the union nut on switch with a 12 mm open-end wrench and withdraw switch vertically while turning back and forth (use solvent if necessary).

Installing

- 1 - Insert flame detector switch carefully and tighten union nut. The hole in the casing is covered with a seal.
- 2 - Connect wires as shown in wiring diagram (see F 4.1/5).
- 3 - Install heater (see F 4.4/1).
- 4 - Connect battery ground strap and check operation of heater.

A - seal



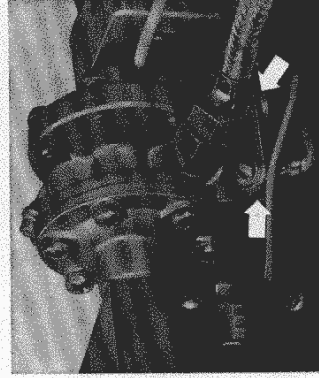
Safety switch

Removing

- 1 - Disconnect battery ground strap.
- 2 - Remove two screws holding the switch.

Installing

- 1 - Connect wires as shown in wiring diagram (see F 4.1/5).
- 2 - Connect battery ground strap and check operation of heater.



Pressure regulator

Removing

Disconnect the two hoses and remove four tapping screws.

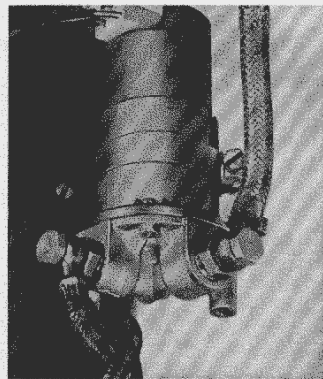
Installing

- 1 - Attach regulator with four tapping screws. Four plastic washers (see arrows) keep the regulator 4 mm away from the casing.

Note

The pressure regulator must not contact the casing because the heat will cause the volume of fuel to vary.

- 2 - The fuel hose between jet and hose connection is secured to the hose connection with a clamp.
- 3 - Hold the union with a 17 mm open-end wrench and tighten union nut on hose between pump and pressure regulator.



Fuel pump

Removing

- 1 - Pull electric plug out.
- 2 - Remove two union bolts.
- 3 - Loosen clamp.

Installing

- 1 - Secure the pump on the bracket so that the arrow on the pump housing points upward.
- 2 - Connect fuel hoses with the union bolts.
- 3 - Connect the electric plug.

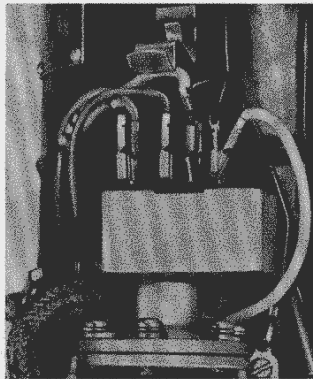
Relay

Removing

- 1 - Disconnect battery ground strap.
- 2 - Pull wires off and remove relay.

Installation

When installing the relay, ensure that the wires are connected according to wiring diagram (see F 4.1/5).



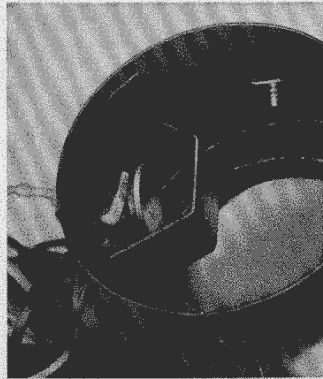
Overheating switch

Removing

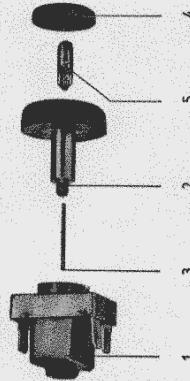
The overheating switch is attached to the heater casing with a tapping screw. When removing the switch, ensure that the silicon seal does not fall into the heater.

Installing

Secure the switch to the casing with a tapping screw and seal the hole with the silicon seal.



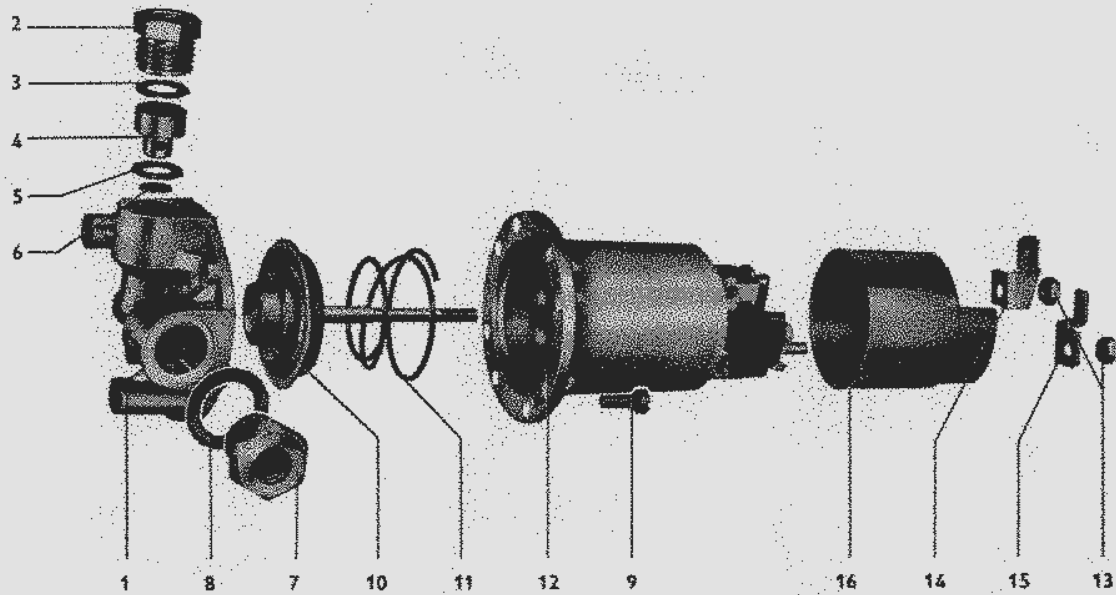
Switch



No.	Description	Qty.	removing	installing	Note when	Special instructions
1	Switch	1				see
2	Knob	1	screws off			
3	Pin, 1 mm	1	used to eject the bulb			
4	Lens	1	pry out of rubber collar with a screwdriver			
5	Bulb 1.2 watt	1				

Disassembling and Assembling Fuel Pump **F 4.6**

Fuel pump



F 4.6 Disassembling and Assembling Fuel Pump

No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
1	Pump body	1		pump must be installed in vehicle with pressure union at top (arrow points outward)	F 4.5/1
2	Outlet union (pressure side)	1	12 mm A/F; look for damage (outlet union has smaller drilling and is intake union)	if pump rattles, unscrew union nut and moisten outlet union with fuel; when assembling, ensure that intake union and outlet union are not mistaken	F 4.3/1
3	Seal	1			
4	Pressure valve	1		make sure valve is not dirty	
5	Seal	1			
6	Suction valve	1	if pump rattles, and moistening with fuel does not remedy it, suction valve is tilted and jammed	ensure that suction valve is in correct position	F 4.3/1
7	Intake union	1	17 mm A/F; look for damage (intake union has larger drilling and is larger across flats than outlet union)		F 4.6/1
8	Seal	1			
9	Screw	4			
10	Diaphragm unit	1	unscrew counter-clockwise	delivery quantity adjustment: screw diaphragm unit in as far as possible, then back off 2 1/2 turns; the diaphragm also acts as seal between pump and winding housing, therefore ensure that diaphragm is correctly positioned	F 4.3/1
11	Spring	1		ensure that spring is correctly installed	
12	Winding housing	1	vent hole must not be blocked	pump and winding housings are screwed together so that vent hole is opposite pressure union	F 4.3/1
13	Nut	2			
14	Terminal (+)	1		note pole designation on bakelite cap	
15	Terminal (—)	1		note pole designation on bakelite cap	
16	Bakelite cap	1			

1-2 Disassembling and assembling

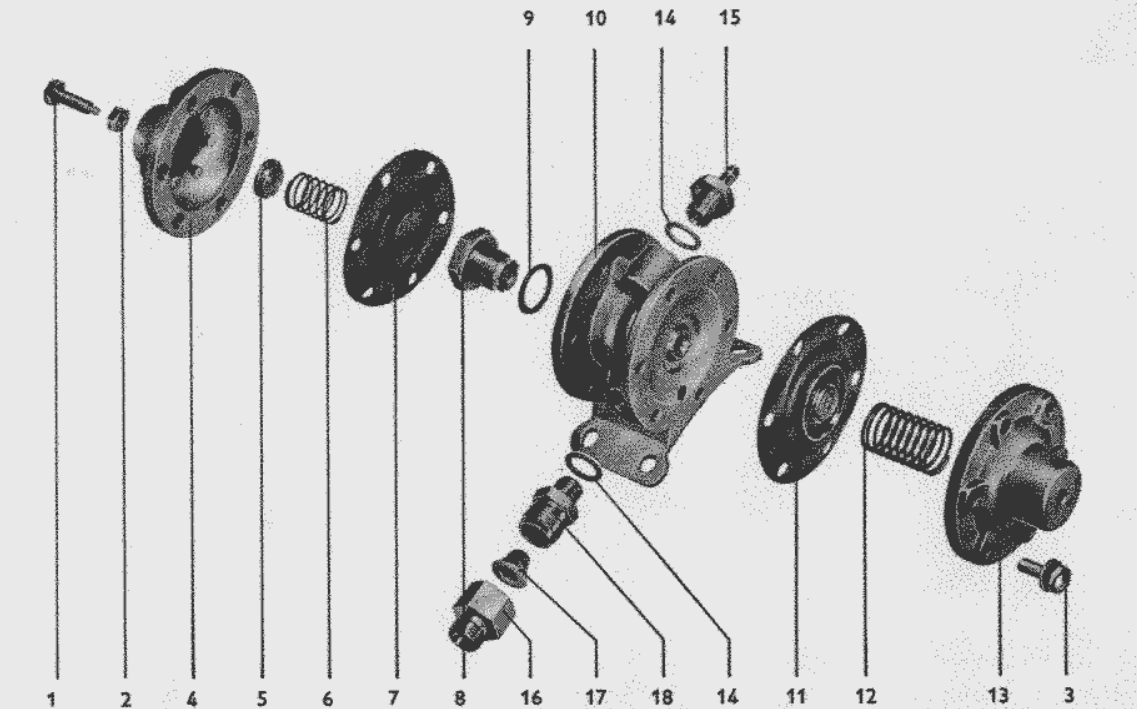
Combustion Air Blower F 4.7



No.	Description	Qty.	Note when removing	Note when installing	Special instructions see
1	Setscrew	1	can be unscrewed through hole in motor mounting (7)		
2	Combustion air fan	1			
3	Heater air fan	1	screw an M 4 bolt into hole in fan to press it off		
4	Seal	1			
5	Clamp	1			
6	Bolt M 6	1			
7	Motor mounting	1			
8	Motor	1			

Disassembling and assembling

Pressure regulator **F 4.8**



No.	Description	Qty.	Note when		Special instructions see
			removing	installing	
1	Bolt M 4	1		sealed with paint when delivery capacity has been set	F 4.3/1
2	Nut M 4	1		sealed with paint when delivery capacity has been set	F 4.3/1
3	Phillips screw M 4 and washer	12			
4	End cover	1		bolt (1) must be in hole in part 5	
5	Spring seat	1		must be located in spring	
6	Spring	1			
7	Regulating diaphragm, complete	1		metal washer must locate the spring	
8	Valve	1		clean filter	
9	Washer	1			
10	Regulator housing	1		clean with compressed air	
11	Closing diaphragm, complete	1		metal washer must locate the spring	
12	Closing spring	1			
13	End cover	1		do not interchange with part 4	
14	Washer	2			
15	Union	1			
16	Union nut	1			
17	Strainer	1		clean	
18	Union	1			

Installation instructions for Model 111

The Eberspächer BN 2 heater is installed in the front luggage compartment on the left side (from driver's position looking forward).

Note

These instructions do not apply to the Type 1 vehicles with the longer front end (Model 113).

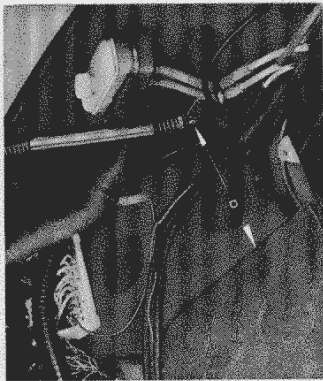
The kit contains the following parts:

Qty.	Description	Remarks
1	Heater with fuel pump	Type BN 2 / Model 20 13 86
1	Cover plate	
1	Fuel hose	5×2.5
2	Clips	
1	T-piece	
1	Filter	
1	Suction line	
1	Pressure line	
2	Sealing rings	Silicon for the exhaust pipe. Rubber for the combustion air intake pipe.
4	Brackets	
1	Exhaust pipe with cap	
1	Combustion air intake pipe	
1	Flexible elbow	
1	Intake elbow	
1	Outlet elbow	
1	Circulation pipe	
1	Warm air outlet	
1	Cable harness	
1	Switch	
1	Sticker	Stick on the fuel tank cap.

Work sequence

- 1 – Disconnect battery ground strap.
- 2 – Remove spare wheel and luggage compartment lining.
- 3 – Shorten felt padding as shown.

a = 260 mm (10¹/₄")



Note

Vehicles built before September 1970 have shorter brake lines which means that they pass by the location selected for the exhaust pipe hole. It is essential to lengthen and reroute the brake lines below the fluid reservoir so that they are far enough away from the exhaust pipe. The routing of the fluid lines is shown in picture.

A clamp (Part No. 111 255 487) holds the connecting hoses away from the exhaust pipe hole.

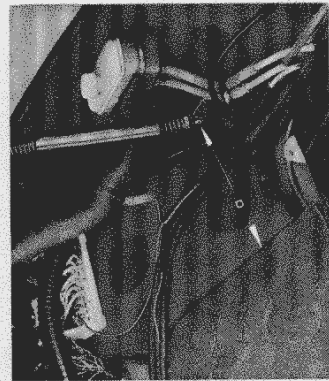
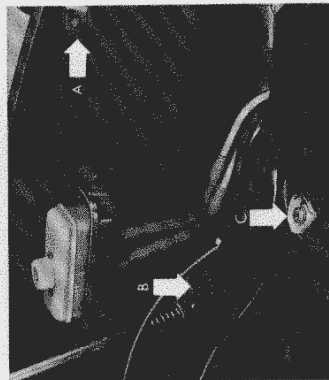
Description	to be removed	to be installed
1 – Line	113 611 805 H	113 611 805 L
2 – Line	113 611 806 B	113 611 806 L
3 – Two hoses	211 611 801 B	N 20 366.1

- 4 – The centers of the holes are marked off with a pair of dividers. Marking off is done from points A, B and C.

Note

The points A, B and C should be centerpunched lightly to hold the divider point better while marking off.

- Point A – Center of fender bolt
Point B – Center of spot weld on left bracket for hood support
Point C – Center of tank securing bolt



Hole for exhaust pipe
b₁ = 182 mm (7¹/₁₆") b₂ = 186 mm (7³/₁₆")
(See note on page F 4.20/1-2)

Hole for intake elbow
c₁ = 130 mm (5¹/₈") c₂ = 156 mm (6¹/₁₆")

Hole for front bracket
d₁ = 113 mm (4⁷/₁₆") d₂ = 302 mm (11⁷/₈")

Hole for center bracket
e₁ = 192 mm (7⁷/₁₆") e₂ = 194 mm (7²¹/₁₆")

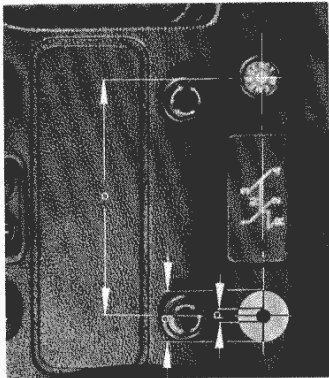
Hole for rear bracket
f₁ = 146 mm (5⁷/₁₆") f₂ = 246 mm (9¹¹/₁₆")

Hole for outlet elbow
g₁ = 234 mm (9⁷/₁₆") g₂ = 320 mm (12¹⁹/₁₆")

Hole for combustion air intake pipe
h₁ = 265 mm (10⁷/₁₆") h₂ = 160 mm (6³/₁₆")

5 – Cut and drill holes

- i = 85 mm (3³/₁₆")
k = 74 mm (2⁹/₁₆")
l = 35 mm (1³/₈")
m = 50 mm (1³/₈")
n = 7 mm (7¹/₁₆")



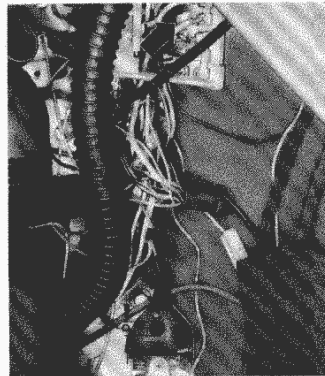
6 - Drill a 15 mm ($\frac{9}{16}$ ") hole in the instrument panel to the left of the ashtray for the heater switch.

The heater switch is installed 150 mm ($5\frac{7}{16}$ ") away from and level with the emergency flasher switch.

- o = 150 mm ($5\frac{7}{16}$ ")
- p = 15 mm ($\frac{9}{16}$ ")
- q = 25 mm (1")

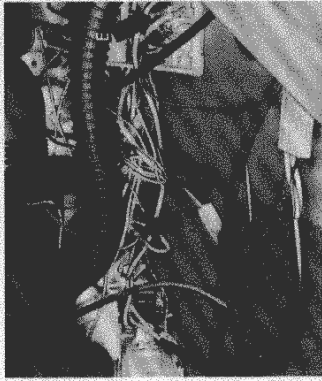
Note

The hole in the foam rubber padding must be enlarged to 25 mm (1") so that the escutcheon can be installed properly.



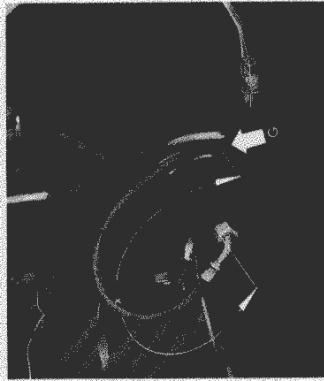
7 - Cut the switch securing slot - F - from the passenger compartment.

- P = 15 mm ($\frac{9}{16}$ ")
- E = Terminal 30
- F = Slot



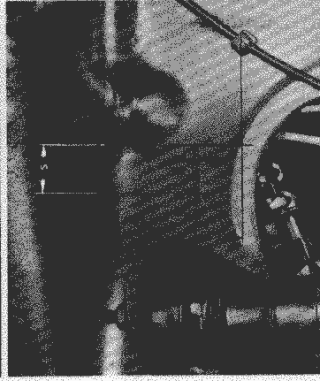
8 - Connect cables to switch (see wiring diagram F 4.1/5). Secure switch with escutcheon and screw in the switch knob complete with warning lamp.

- D = Ground terminal 31
- E = Terminal 30



9 - Pull fuel line through hole G. Place a clamp on the fuel hose to the engine and cut the hose about 100 mm (4") away from tank connection. Insert T-piece. Secure hoses on T-piece with clamps to prevent them from slipping off.

- G = Hole for fuel and brake fluid hoses
- x = 360 mm ($14\frac{3}{4}$ ") long

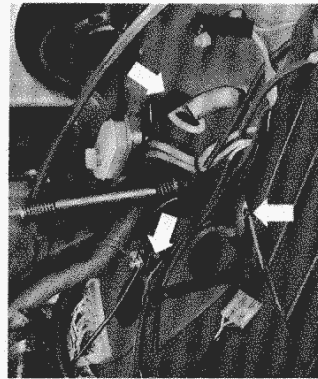


10 - Drill 4 mm ($\frac{5}{16}$ ") hole (t) for the screw which secures the combustion air intake pipe.

- r = 50 mm ($1\frac{31}{32}$ ")
- s = 40 mm ($1\frac{5}{8}$ ")
- t = 4 mm ($\frac{1}{4}$ ")

Insert rubber seal

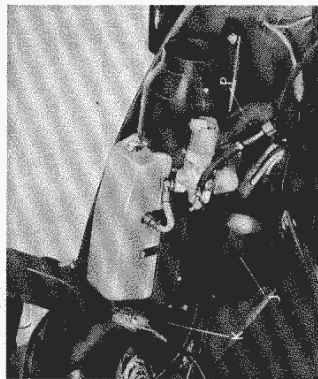
Q = Exhaust elbow



11 – Install the four brackets and insert sealing ring for exhaust pipe.



12 – Secure exhaust pipe on heater with clamp, sealing ring and tapered ring. Attach heater to three of the brackets.



13 – Install hose P on the combustion air pipe. Secure exhaust elbow Q to exhaust pipe (see 4.20/1). Connect wires shown in wiring diagram.

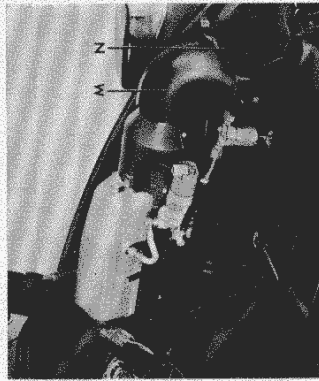


15 – Press the warm air outlet L into the outlet elbow from inside the body until it engages.

L – Warm air outlet

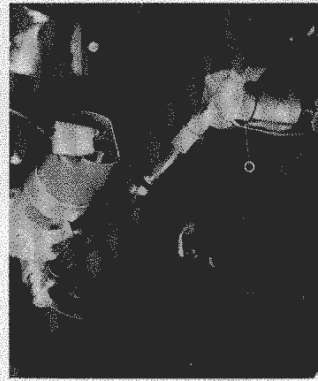
J – Intake elbow
K – Outlet elbow
P – Hose

14 – Press intake elbow J and outlet elbow K into the holes until they engage.



16 – Install air circulation pipe M. Secure bracket for cover plate with fender bolt.

M – Circulation pipe
N – Bracket



17 – Install fuel filter.

O – Fuel filter

Note

Ensure that the arrow showing the flow direction points toward the pump.



18 – Shorten luggage compartment lining by 260 mm – 10 3/4" – (a). (See F 4.20/1.) Secure cover plate.

19 – Connect battery ground strap and check operation of heater.

20 – Install sticker on flap over fuel tank cap.

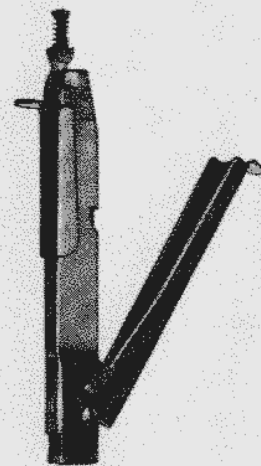
Installation instructions for Model 113

The Eberspächer BN 2 heater is installed in the front luggage compartment on the left side (from driver's position looking forward).

Note

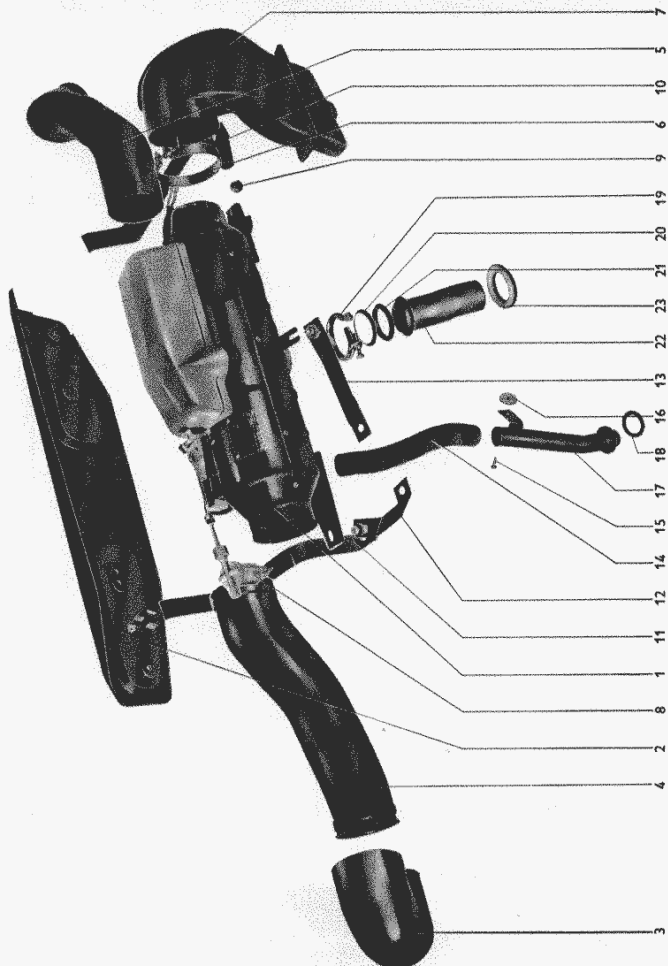
These instructions apply only to Type 1 vehicles with the longer front end (Model 113).

Tools



Sheet metal cutting tool

The kit contains the following parts:

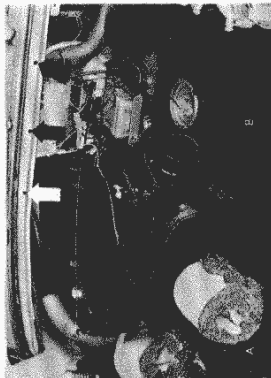


No.	Description	Qty.	Note when assembling	Special instructions see
1	Heater and fuel pump	1	Place rubber bush (9) on the pin and insert it into tube (10) before securing heater to brackets (12) and (13). Attach fuel hose to filter (8). Connect cables as shown in wiring diagram (see F 4.1/5-1)	F 4.20/2-9
2	Cover plate	1		
3	Circulation pipe	1		
4	Pipe	1		
5	Intake elbow	1	The elbow must fit tightly in the hole in luggage pan	
6	Clamp	1		
7	Footwell outlet with gasket	1		
8	Fuel filter	1	The arrow shows fuel flow direction	F 4.20/2-10
9	Rubber pad	1		
10	Rear bracket for heater and cover plate	1		
11	Front bracket for heater and cover plate	1		
12	Front bracket for heater	1		
13	Center bracket for heater	1		
14	Flexible hose	1	The hose must not be kinked and must fit tightly on combustion air intake pipe (17) and on heater	
15	Tapping screw	1		
16	Rubber washer	1		
17	Combustion air intake pipe	1		
18	Washer	1		
19	Clamp for exhaust pipe	1		
20	Tapered ring	1		
21	Seal for exhaust pipe	1		
22	Exhaust pipe	1		
23	Grommet for exhaust pipe	1		

Also included in the kit are:

- 1 cable harness,
- 1 switch,
- 1 sticker.

Work sequence



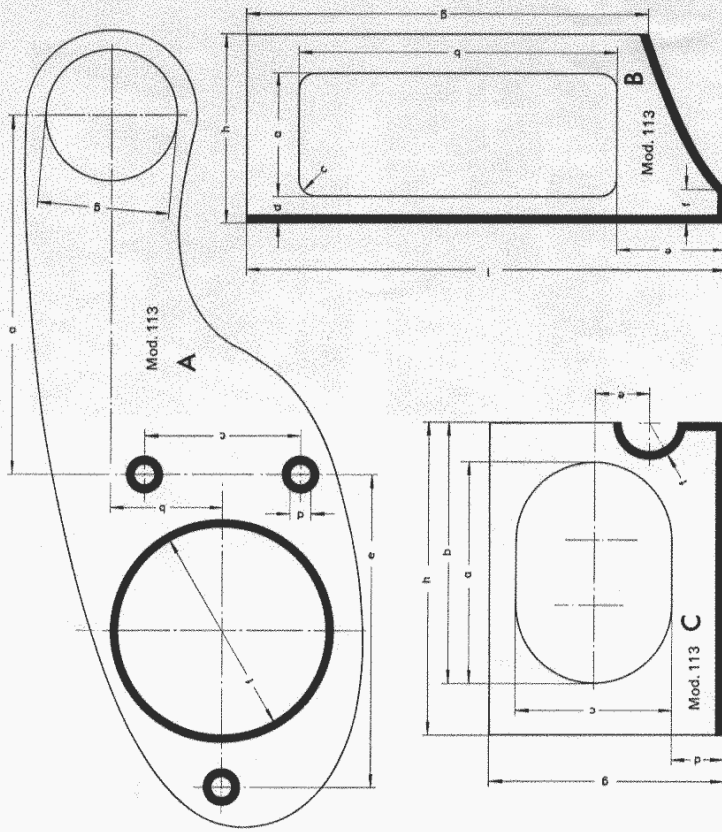
- 1 - Disconnect battery ground strap.
- 2 - Remove upper and lower luggage compartment lining.
- 3 - Remove fresh air box for blower. Take out three tapping screws (arrow) and loosen the clamp (B). Unsnap and remove the textile hoses.
- 4 - Remove fuel tank.

A - Fabric hoses
B - Clamp

Note

Dealers who install numerous heaters are advised to cut the templates out of durable material. The drawings give all the necessary measurements. The edges of the templates are marked with a wide black border. These edges must be placed properly against the reference areas to ensure that the holes are located accurately.

The flexible hoses for the center and left vents must be replaced. The left warm air hose (Part No. 113 819 723 A) and center warm air hose (Part No. 211 255 359) are included in the kit. (See F 4.20/2-6)



A - Hole for combustion air intake pipe

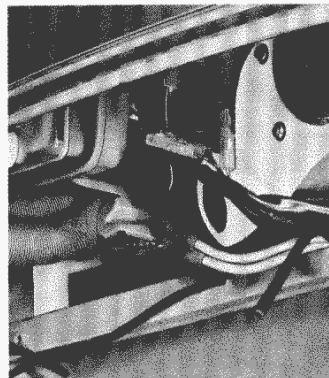
a = 138 mm (5 ⁷ / ₁₆ ")	e = 120 mm (4 ² / ₁₆ ")
b = 43 mm (1 ¹¹ / ₁₆ ")	f = 80 mm (3 ¹ / ₁₆ ") dia.
c = 60 mm (2 ² / ₁₆ ")	g = 50 mm (1 ¹ / ₁₆ ") dia.
d = 8 mm (5 ¹ / ₁₆ ") dia.	

B - Hole for footwell outlet

a = 47 mm (1 ⁷ / ₁₆ ")	e = 42 mm (1 ¹ / ₁₆ ")
b = 122 mm (4 ² / ₁₆ ")	f = 12 mm (1 ¹ / ₁₆ ")
c = 6 mm (1 ¹ / ₁₆ ")	g = 170 mm (6 ¹ / ₁₆ ")
d = 10 mm (3 ¹ / ₁₆ ")	h = 72 mm (2 ² / ₁₆ ")

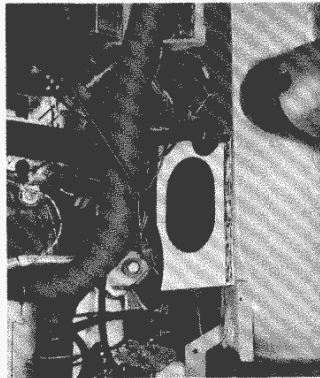
C - Hole for intake elbow

a = 85 mm (3 ¹ / ₁₆ ")	e = 21 mm (2 ¹ / ₁₆ ")
b = 100 mm (3 ¹ / ₁₆ ")	f = 11 mm (1 ¹ / ₁₆ ")
c = 60 mm (2 ² / ₁₆ ")	g = 90 mm (3 ¹ / ₁₆ ")
d = 20 mm (1 ¹ / ₁₆ ")	h = 120 mm (4 ² / ₁₆ ")

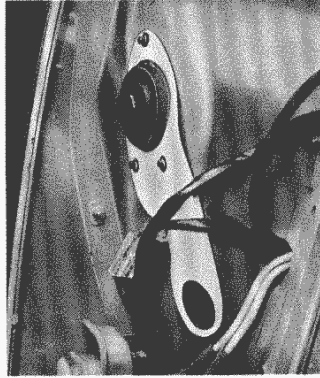


5 - Place template for footwell outlet in position, mark outline and cut hole with sheet metal cutter from inside passenger compartment.

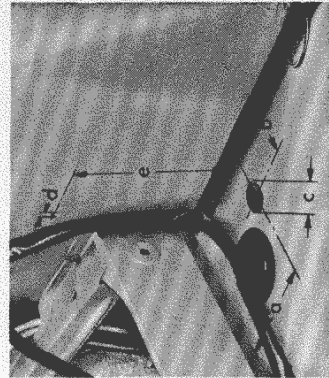
6 - Glue gasket (see F 4.20/2-3 item 7) on edges of hole for footwell outlet.



7 - Place template for intake elbow in position, mark off and cut hole.

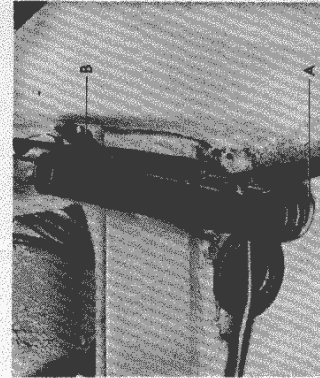


8 - Use template and cut hole for exhaust pipe.



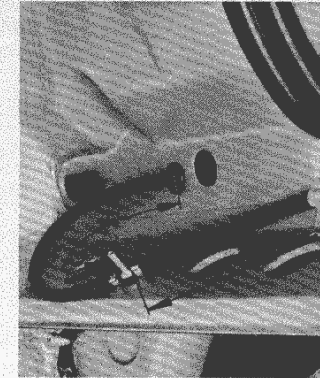
9 - Drill holes for combustion air intake pipe and pipe securing screw.

- a = 70 mm (2 7/8")
- b = 50 mm (1 3/4")
- c = 27 mm (1 1/4")
- d = 4 mm (1/8") dia.
- e = 130 mm (5 1/8")



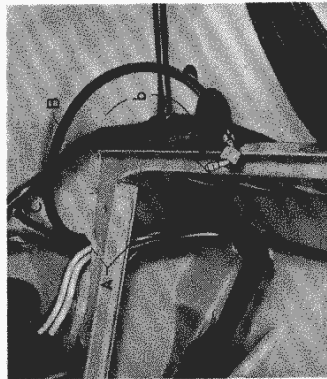
10 - When installing the combustion air intake pipe, ensure that the rubber washer (B) and the sealing washer (A) are used.

- A - Sealing washer for combustion air intake pipe
- B - Rubber washer



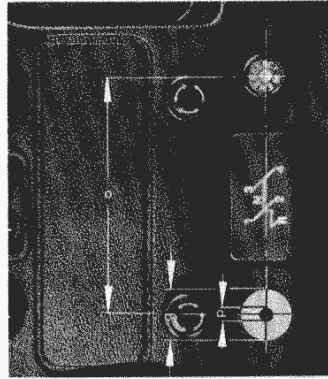
11 - Install T-piece in the fuel hose 24 cm (9 5/8") from the hole and secure with clamps.

- a = 24 cm (9 5/8")
- b = 120 cm (47 1/4")



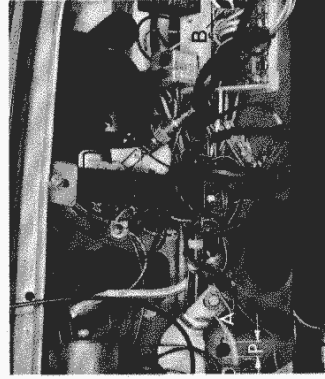
- 12 - Pass fuel hose 5x2.5 through hole A and secure it on T-piece with clamps.
- 13 - Connect tank and T-piece with a piece of 5x2.5 hose 18 cm (7¹/₂"') long and secure with clamps.
- 14 - Install tank. On the left side the tank is secured with two bolts which are also used to secure the front and rear brackets for the cover plate (see F 4.20/2-2).

b = 120 cm (47¹/₂"')
 A - Hole
 B - Fuel hose 5 x 2.5



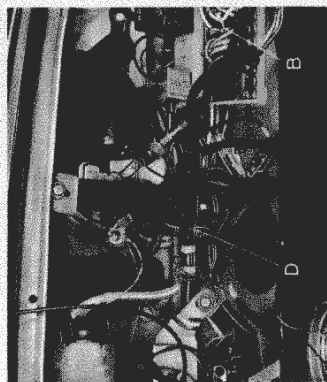
- 15 - Drill a 15 mm (5⁷/₈"') hole in the instrument panel to the left of the ashtray for the heater switch. The heater switch is installed 150 mm (5⁷/₈"') away from and level with the emergency flasher switch.

o = 150 mm (5⁷/₈"')
 p = 15 mm (5⁷/₈"')
 q = 25 mm (1")



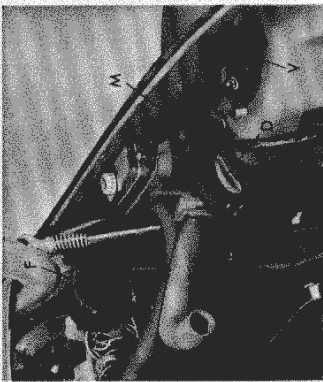
- 16 - Cut the switch securing slot A from inside the body.

A - Securing slot
 B - Terminal 30
 P - 15 mm (5⁷/₈"')



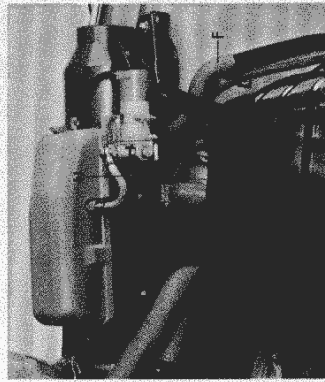
- 17 - Install switch and connect cables as shown in wiring diagram (see F 4.1/5-1).

B - Terminal 30
 D - Ground



- 18 - Install footwell outlet.
- 19 - Secure front bracket and center bracket.

D - Seal for exhaust pipe
 V - Front bracket for heater
 M - Center bracket for heater
 F - Footwell outlet with clamp



- 20 - Install grommet for exhaust pipe and coat it lightly with oil to facilitate installation of pipe.

- 21 - Install heater.

- 22 - Install flexible hose on combustion air connection on heater and ensure that hose is tight.

F - Flexible hose

Warning

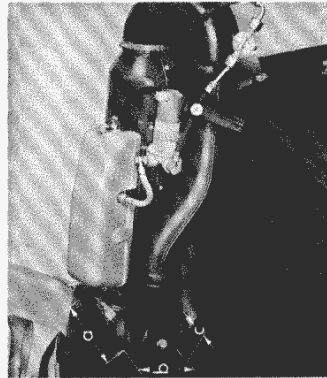
If the flexible hose comes off it will cause a pressure build up which will destroy the heater when it is used with vehicle in motion.



23 - Install fresh air control box.

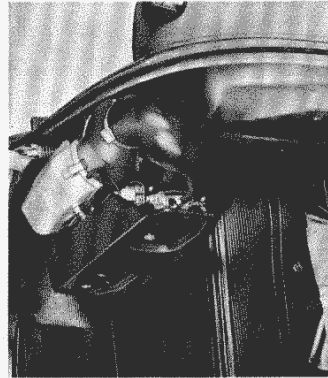
24 - Press intake elbow in until it engages, install pipe and secure circulation pipe on heater with a clamp.

25 - Install fuel filter, noting flow direction arrow. **The arrow must correspond with the fuel flow direction.**



26 - Cut luggage compartment lining.

a = 25 cm (1")
b = 12 mm (1/2")
c = 5 cm (2 1/4")

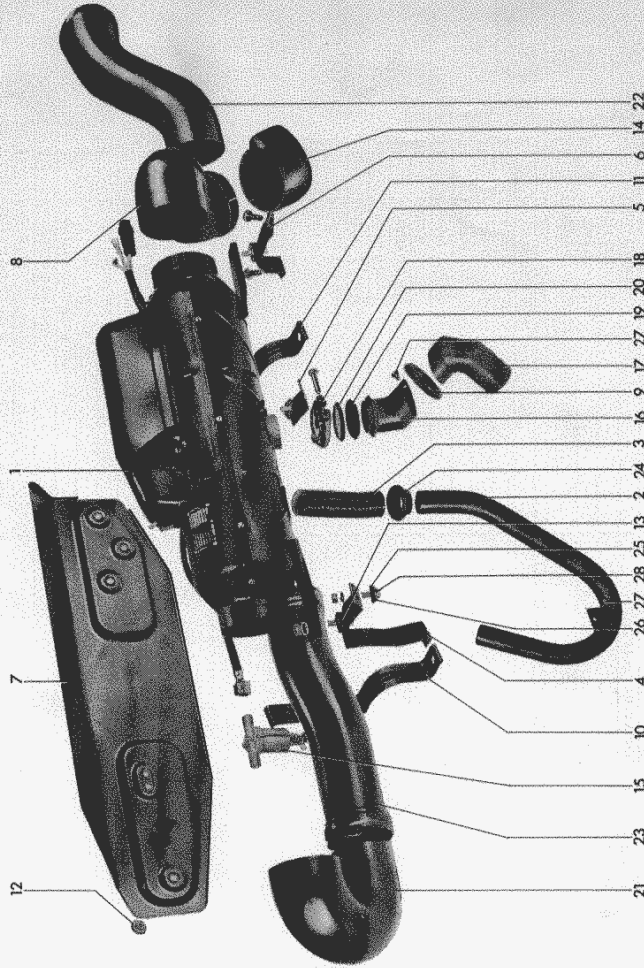


27 - Install sticker on flap over fuel tank cap.

28 - Connect battery ground strap and check operation of heater.

Installation instructions for Type 3 (model 31 and 36)

The Eberspächer BN 2 heater is installed in the front luggage compartment on the left side (from driver's position looking forward).

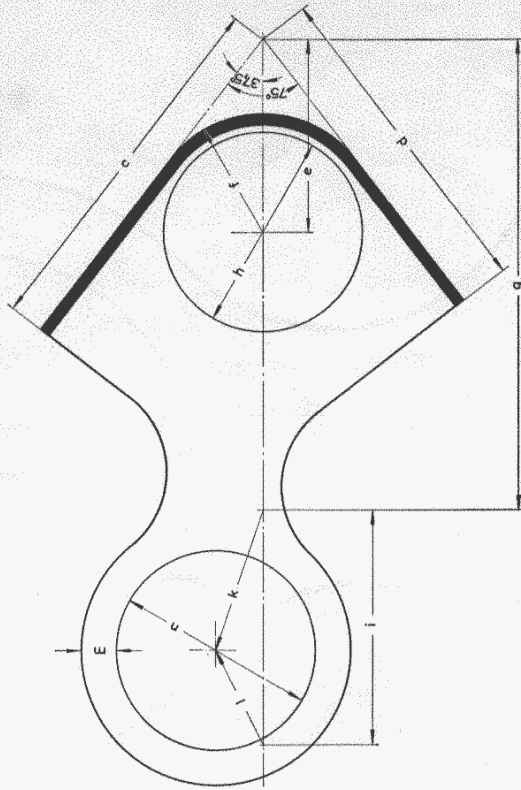


The kit contains the following parts:

No.	Description	Qty.	Note when installing	Special instructions see
	Hose clamp	1		
	Hose clamp	4		
1	Heater	1		
2	Combustion air pipe	1		F 4.20/3-7
3	Hose for combustion air pipe	1	check for tightness	
4	Front heater bracket	1		
5	Center heater bracket	1		
6	Rear heater bracket	1		
7	Cover plate	1		
8	Elbow for hot air	1		
9	Sealing ring for exhaust pipe	1	install from wheel housing side	
10	Front bracket for cover plate	1	secure with tank bolt	
11	Rear bracket for cover plate	1	secure with tank bolt	
	Branch pipe	1		
12	Knurled nut	2	used to secure cover plate	
13	Bonded rubber mounting	3	for brackets (No. 4, 5, 6)	
14	Warm air outlet	1		
	Suction line from T piece to fuel filter	1		F 4.20/3-7
15	Fuel filter (only up to July 1971)	1	arrow shows flow direction	F 4.20/3-10
16	Exhaust pipe, upper	1		
17	Exhaust pipe, lower	1		
18	Clamp	1		
19	Sealing ring for clamp	1		
20	Tapered ring for clamp	1		
21	Air circulation pipe, front part	1		
22	Air circulation pipe, rear part	1		
23	Air circulation pipe, center part	1		
	Warning sticker	1	stick on fuel tank flap	
24	Grommet for combustion air pipe	1		
25	Rubber washer	2	in wheel housing	
	Cable grommet	1		F 4.20/3-5
	Cable harness	1	connect as shown in wiring diagram	F 4.1/5-3
	Switch spindle	1		
	Cap	1		
	Escutcheon	1		
	Push/pull switch	1		
	Grommet	1	for fuel hose	
	Bolt M 6×35	1	for part 18	
	Nut M 6	8	for parts 13 and 28	
26	Washer A 6.4	2	for part 28	
	Washer 6.1	8	for parts 13 and 28	
	Spring washer B 6	2	for part 28	
	Washer A 8×11.5	2	for union	
	Hex. hd. sheet metal screw B 6.3×19	2	for part 6	
27	Fillister hd. screw B 4.8×13	2	for parts 2, 16 and 17	
	Fuse	1	16 amp.	
	Plug	1		
	Cable connector	1		
	Union A 2/3	1	for fuel pump	
28	Bolt M 6×15	2	for parts 4 and 5	

Note

The full-size template on the next page is intended for a few times usage only. Dealers who install numerous heaters are advised to cut the template out of more durable material. The drawing below gives all the necessary measurements. The side of the template marked with a wide black border must be placed properly against the reference areas to ensure that the holes are located accurately.



c = 155 mm (6 1/8")
d = 140 mm (5 1/2")
e = 82 mm (3 1/4")
f = 50 mm (2")
g = 200 mm (7 7/8")
h = 85 mm (3 3/8") dia.

i = 100 mm (3 7/8")
k = 63 mm (2 1/2")
l = 45 mm (1 3/4")
m = 15 mm (5/8")
n = 85 mm (3 3/8") dia.

Work sequence

- 1 - Disconnect battery ground strap.
- 2 - Remove upper and lower luggage compartment lining.
- 3 - Drill 16 mm ($\frac{5}{8}$ in.) hole (b) for the cable harness and install a grommet. Route cables through grommet.

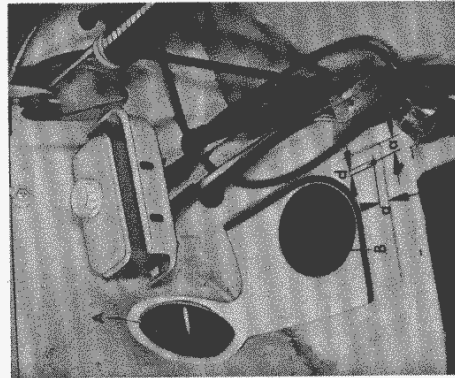
a = 50 mm ($1\frac{31}{32}$ in.)
b = 16 mm ($\frac{5}{8}$ in.)

- 4 - Drill 16 mm ($\frac{5}{8}$ in.) - a - hole for fuel hose through the cross panel.

a = 16 mm ($\frac{5}{8}$ in.) dia.
l = 250 mm ($9\frac{7}{8}$ in.)

Note

The hole for the fuel hose is in the side of the cross panel (factory installation). When service installing the heater, the hole a = 16 mm ($\frac{5}{8}$ in.) should be drilled in the top of the cross panel.



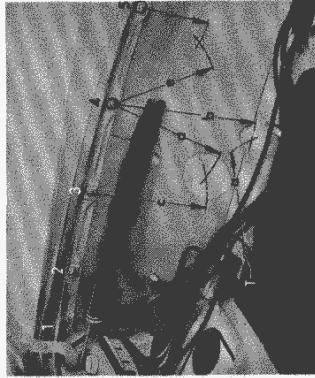
5 - Place template against upper edge of rib and cut holes.

A = Hole for rear part of air circulation pipe
B = Hole for front air elbow
C = 10 mm ($\frac{3}{8}$ in.) dia.
D = 5.0 mm ($\frac{1}{4}$ in.) dia.

Caution

Be careful not to damage the fresh air control box (on the other side of the panel) when cutting out the hole A.

6 - Drill 5.0 mm ($\frac{1}{4}$ in.) hole in rib.

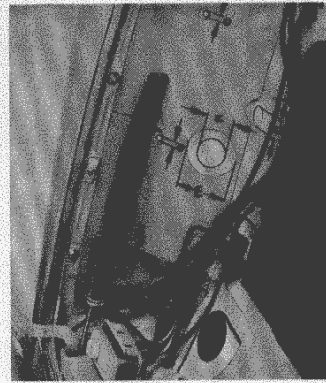


7 - The centers of the holes are to be marked from the centers of fender bolts 2, 3, 4, 5 and the fuel tank bolt T.

a = 200 mm ($\frac{77}{8}$ in.)
b = 253 mm ($\frac{99}{16}$ in.)
c = 220 mm ($\frac{87}{16}$ in.)
d = 213 mm ($\frac{83}{16}$ in.)
e = 193 mm ($\frac{77}{16}$ in.)
f = 123 mm ($\frac{49}{16}$ in.)



g = 182 mm ($\frac{69}{16}$ in.)
h = 218 mm ($\frac{85}{16}$ in.)
i = 136 mm ($\frac{53}{16}$ in.)
k = 145 mm ($\frac{57}{16}$ in.)



8 - Cut out and drill holes.

e = 7 mm ($\frac{7}{16}$ in.) dia.
m = 100 mm ($\frac{39}{16}$ in.) dia.
n = 49.8 mm ($\frac{197}{64}$ in.) dia.
o = 36 mm ($\frac{137}{32}$ in.) dia.

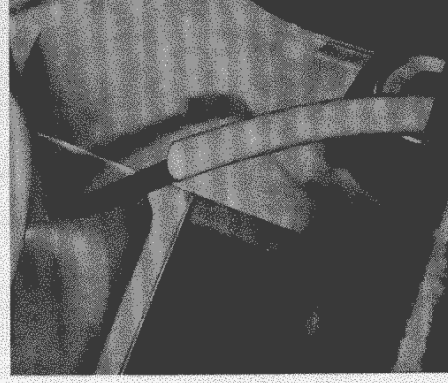
9 - The luggage compartment lining around the exhaust pipe hole must be cut out as shown (m = 100 mm).



10 - Install grommet for combustion air pipe (see page F 4.20/3-8).

11 - Drill 4 mm ($\frac{5}{16}$ in.) hole (p) for screw.

p = 4 mm ($\frac{5}{16}$ in.) dia.
r = 20 mm ($\frac{13}{16}$ in.)



12 - Place grommet in hole and pull fuel hose through to a length of 250 mm ($\frac{93}{4}$ in.) from luggage compartment side (see page F 4.20/3-5).

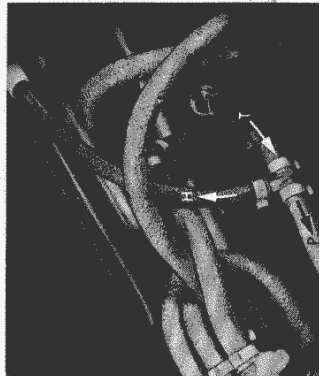
13 - A protective hose must be pushed over the fuel hose under the luggage compartment.

Note

The fuel for the heater may only be taken from the hose leading from the tank to the fuel pump of the engine.

The heater will go out if the fuel for the heater is taken from the return line of the injection system (vapor bubbles in the return line).

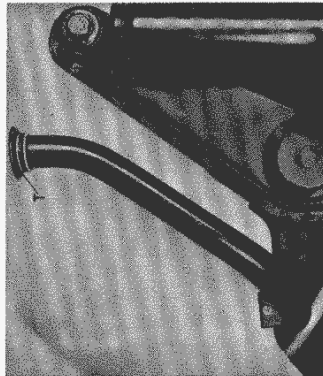
The heater will smoke if the fuel for the heater is taken from the pressure line of the system. (Pressure too high.)



14 - Clamp off the hose between tank and fuel pump (engine) and cut it.

T = from tank
P = to fuel pump
H = to heater

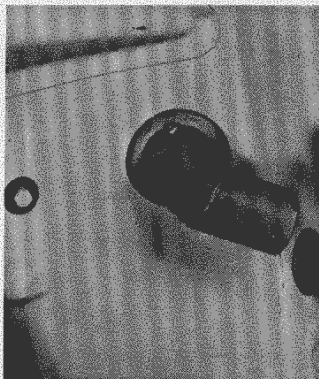
15 - Install T piece and secure hoses with clamps to prevent them from being pulled off.



16 - Install combustion air pipe.

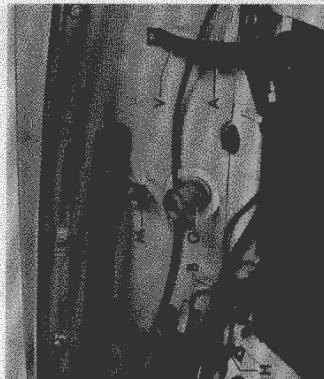
T = Grommet for combustion air pipe

17 - Install exhaust pipe and seal.

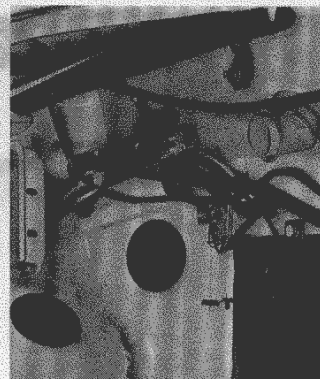


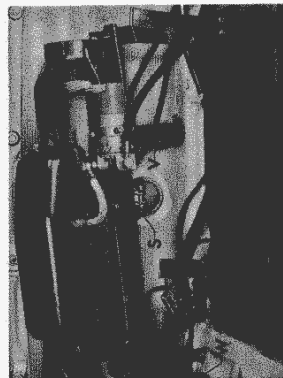
18 - Install three brackets for heater.

H = Rear bracket
M = Center bracket
V = Front bracket for cover plate
A = Front bracket for cover plate
B = Rear bracket for cover plate
G = Exhaust pipe, upper



19 - The two cover plate brackets A and B and heater bracket V are secured with the fuel tank bolts.



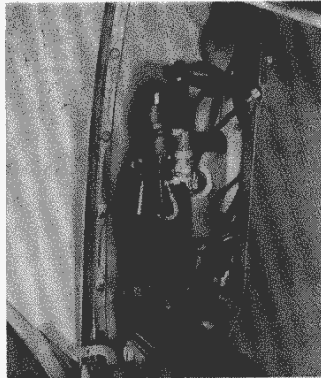


20 – Press hot air elbow in until it clicks.

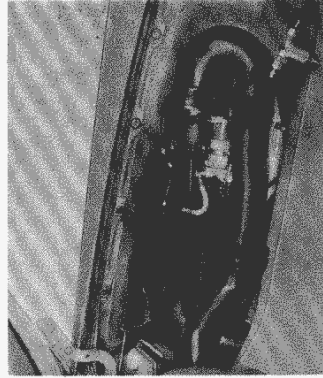
21 – Install hose V for combustion air (ensure that it is tight) and attach heater to three brackets.

22 – Secure exhaust pipe with clamp.

W = Hot air elbow
V = Combustion air hose
S = Exhaust pipe clamp



23 – Cut hole in luggage compartment lining and install lining.



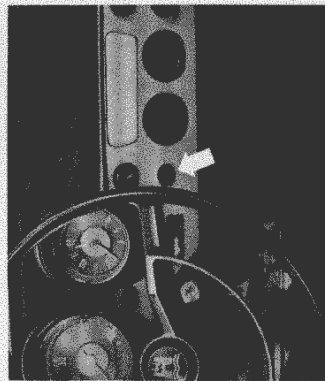
24 – Install air circulation pipe and hot air elbow.

25 – Install fuel filter.

Note

The arrow on the filter shows the flow direction.

26 – Connect cables as shown in wiring diagram (F 4.1/5-3).



27 – Secure switch and escutcheon in the hole provided (sealed with a plug).

28 – Connect cables to fuse box as shown by wiring diagram (page F 4.1/5-3).

Note

There are two cables on fuse box terminal 30 on the bridged side of the 16 amp. fuse.
Cable to lighting switch 1.5 mm² red.
Cable to ignition-starter switch 4 mm² red.

29 – Pull lighting and ignition cables off and connect them to the cable connector provided in the heater cable harness (see wiring diagram F 4.1/5-3).

30 – The 2.5 mm² red cable from the heater harness is then connected to the vacant connection of the 16 amp. fuse at terminal 30 (see wiring diagram F 4.1/5-3).

31 – Install cover plate and press filter into clip on cover.

32 – Connect battery ground strap and check heater operation.

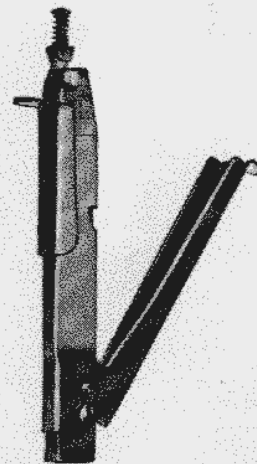
33 – Install sticker on fuel tank flap.



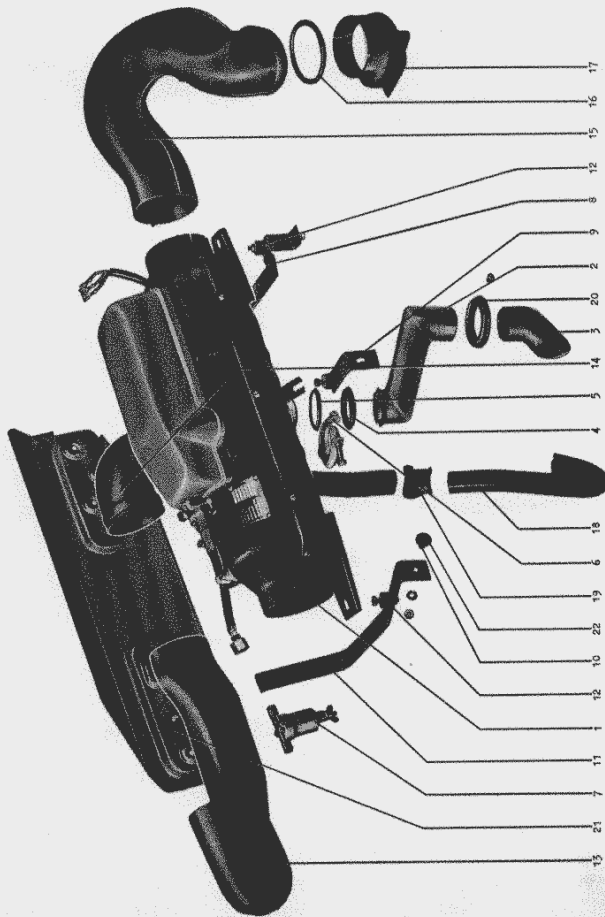
Installation instructions for Type 1, Models 141 and 143

The Eberspächer BN 2 heater is installed in the front luggage compartment on the left side (from driver's position looking forward).

Tools



Sheet metal cutting tool



No.	Description	Qty.	Note when assembling	Special instructions see
1	Heater	1		
2	Exhaust pipe	1	oil to facilitate installation	
3	Exhaust elbow	1	secure to item 2 with sheet metal screw	
4	Sealing ring, exhaust pipe	1		
5	Tapered ring, exhaust pipe	1		
6	Clamp	1		
7	Fuel filter	1	arrow shows flow direction	
8	Bracket, rear	1		
9	Bracket, center	1		
10	Sealing washer	2		
11	Bracket, front	1		
12	Bonded rubber mounting	3	attach to brackets, then install bracket	
13	Air circulation duct, front	1		
14	Air circulation duct, center	1		
15	Air circulation duct, rear	1		
16	Sealing ring for air circulation pipe	2		
17	Warm air outlet	1		
18	Combustion air pipe	1		
19	Seal	1	apply silicone spray to facilitate installation	
20	Seal for combustion air pipe	1		
21	Cover plate	1		
22	Bolt M 6x15	2		
	Grommet for fuel hose	1		
	Fuel hose	1		
	Switch	1		
	Cable harness	1		
	Escutcheon	1		
	T piece for fuel line	1		
	Clamp for fuel hose	3		
	Knurled nut	2		
	Hose 26.3x2	1		
	Bolt M 6x30	1		
	Nut	8		
	Washer M 6	8		
	Washer A 3.7	1		
	Washer A 6.4	2		
	Screw 33.5x9.5	2		
	Sealing ring A 8x11.5	2		
	Hose 5x2.5	1		
	Union	1		
	Sticker	1		

Preparation

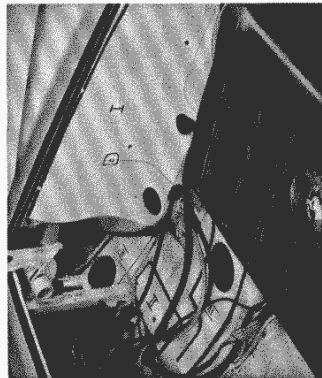
- 1 - Disconnect battery ground strap.
- 2 - Take both front wheels off.
- 3 - Take spare wheel out.
- 4 - Take luggage compartment lining out.
- 5 - Cut out the templates (see pages F 4.20/4-9 and 4-10).

Work sequence

Caution

While drilling holes always make sure that penetration does not cause damage.

- 1 - Place four templates in position. The vertical line on template I must be aligned with the centers of the tank securing bolts.

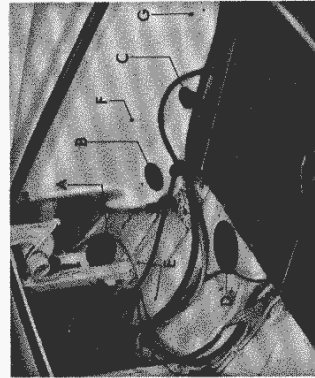


Note

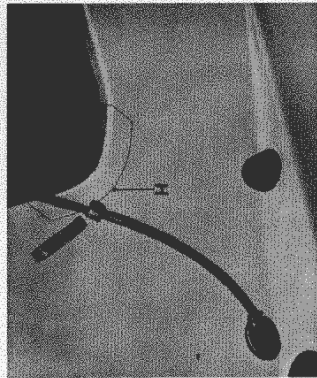
The templates on page F 4.20/4-9 and 4-10 are intended for a few times usage only. Dealers who install numerous heaters are advised to cut the templates out of more durable material. The sides of the templates marked with a wide black border must be placed properly against the reference areas to ensure that the holes are located accurately.

- 2 - Cut or drill the holes as follows:

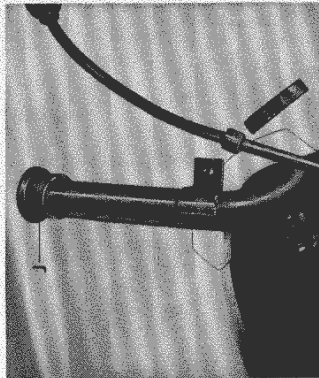
- A = Hole for rear air circulation duct.
- B = Hole for exhaust pipe.
- C = Hole for combustion air pipe.
- D = Hole for center air circulation duct.
- E = Two 7 mm ($\frac{7}{32}$ in.) holes for rear bracket screws.
- F = 7 mm hole for center bracket
- G = 7 mm hole for front bracket



- 3 - Drill 4 mm ($\frac{1}{8}$ in.) hole H.

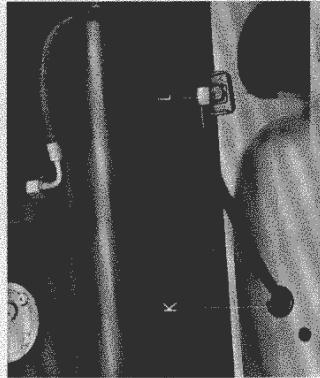


- 4 - Install the seal J. Oil the combustion air type, insert it and secure it with a sheet metal screw. The pipe must project at least 10 mm ($\frac{3}{8}$ in.) through the seal.



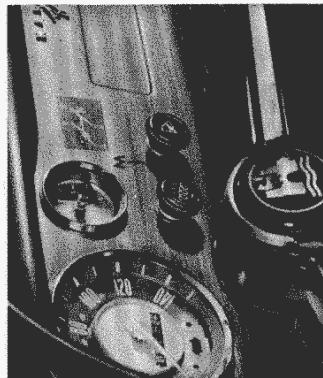
- 5 - Install fuel hose as shown.

- K = Grommet, inserted in 20 mm ($\frac{13}{16}$ in.) hole.
- L = Clamp securing fuel hose.



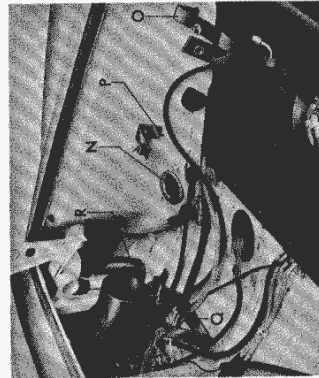
- 6 - Install T piece for fuel line underneath tank.

- 7 - Install fuel hoses and secure with clamps.



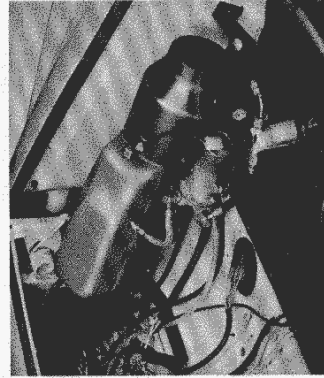
- 8 - Drill a 15 mm ($\frac{9}{16}$ in.) hole in instrument panel for heater switch.
- 9 - Connect wires to switch as shown in wiring diagram F 4.1.5-1.
- 10 - Secure switch in hole with escutcheon and screw knob on.

M = Knob for heater switch.



- 11 - Install three brackets for heater.
- 12 - Install exhaust pipe seal.
- 13 - Install rear air circulation duct.

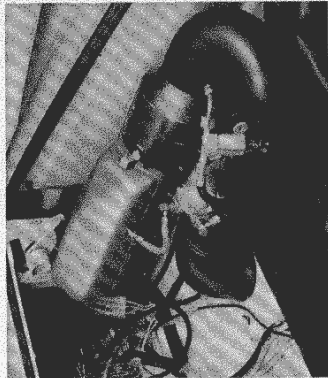
N = Seal
O = Front bracket
P = Center bracket
Q = Rear bracket
R = Air circulation duct, rear



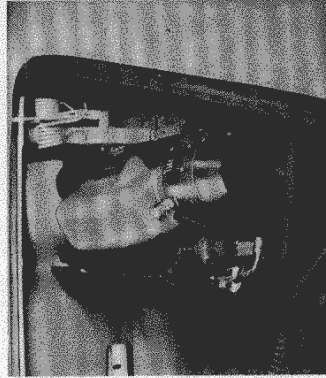
- 14 - Install heater on the three brackets.
- 15 - Install fuel filter.

Note

The arrow on the filter shows the flow direction.



- 16 - Connect rear air circulation duct complete with seal to heater. Connect front air circulation duct to front of heater. Slide center air circulation duct over rear of front duct. Attach center duct to compartment panel.



- 17 - Install luggage compartment lining, spare wheel and windshield washer container.
- 18 - Install heater cover plate.

- 19 - Install sticker on fuel tank flap.
- 20 - Connect battery ground strap.
- 21 - Check heater operation with vehicle engine running.

