



VW Workshop Manual

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

F-3

Fresh air heating

F 3 BN 4 Heater for Type 2

VOLKSWAGENWERK AKTIENGESELLSCHAFT • WOLFSBURG

Workshop Manual 1969

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

	Code letter
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.

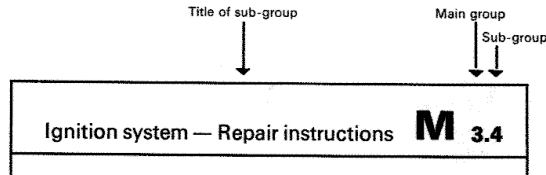
To make it easy to find the individual repair operations, each volume of this manual is divided into "Main Groups", "Sub-groups" and "Sections" with a very detailed table of contents.

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 sup-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.)

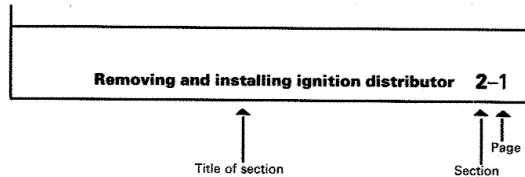
Main group numbers and sub-group numbers are printed next to the title of the sub-group at the top of each page.

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 Bulletins . . .-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

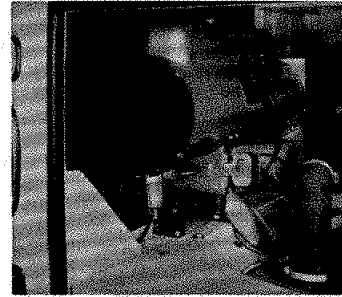
3.20 – Service installation

- 1 – 1 BN 4 Heater for Type 2

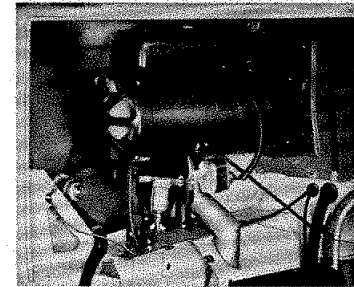
BN 4 Circulating Air and Fresh Air Heaters for Type 2 vehicles

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.

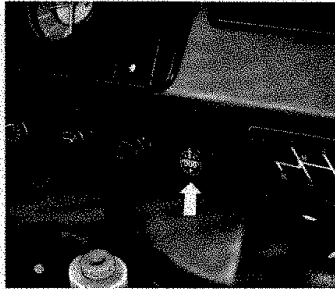


Recirculating heater



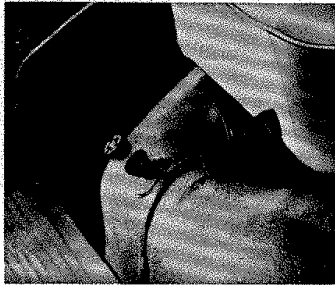
Fresh air heater

F 3.1 Description of Heating System



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.

Description of Heating System

F 3.1

Type 2

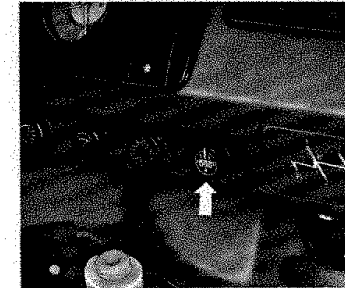
The heater is controlled with a time switch (arrow).

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

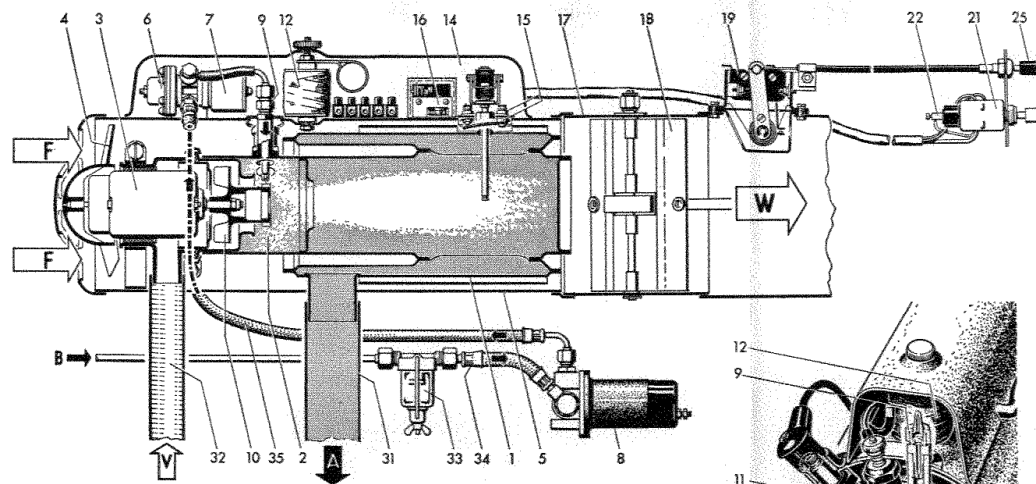
- 1 – After the heater has been turned off, the combustion air blower continues to run (run-on) to cool the heater.
- 2 – To avoid running the battery down it is recommended not to switch the heater on several times in succession when the vehicle is parked. This applies particularly when outside temperatures 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.

Description of Heating System **F 3.1**

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 - Overheating switch
- 16 - Safety switch
- 17 - Warm air outlet
- 18 - Bimetal spring flap (not on recirculating heater)
- 19 - Temperature regulating switch
- 21 - Time switch
- 22 - Warning light connection
- 25 - Knob for regulating switch
- 31 - Exhaust pipe
- 32 - Air intake pipe
- 33 - Fuel filter
- 34 - Fuel suction 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 vaned 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.

F 3.1 Description of Heating System

Maintenance

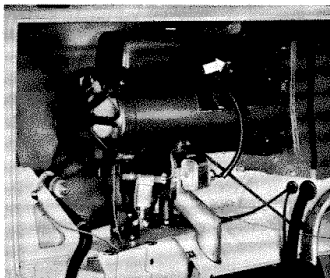
Deposits from the fuel can settle in the fuel lines if the heater is not used for long periods; for example, during the summer months. It is, therefore, advisable to operate the heater briefly about once a month when the heater is not in regular use.

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

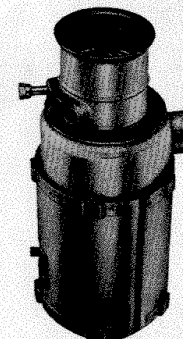
F 3.1 Description of Heating System

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).

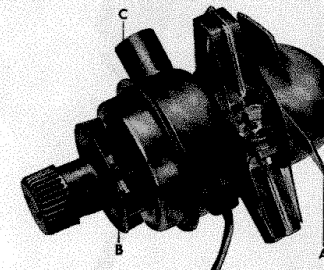
Spark plug, glow plug, flame detector switch and fuel jet are screwed into the heat exchanger.



Combustion air blower

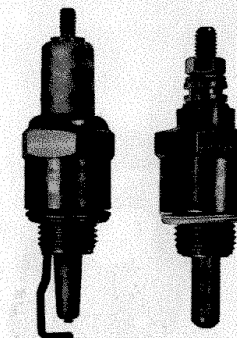
The combustion air blower is connected to one end of the heat exchanger. Two fans are connected to the shaft of the combustion air blower. The fresh air blower fan (A) delivers the warm air. The combustion air blower fan (B) draws the combustion air in through the air intake (C). The blades on the combustion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

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

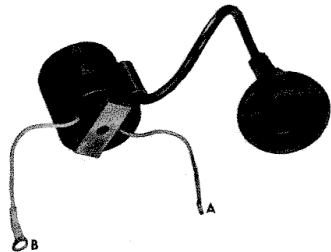


Glow plug and spark plug

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.



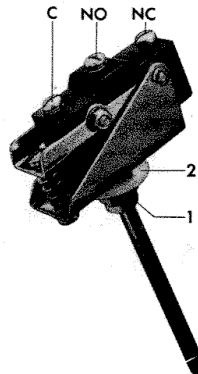
F 3.1 Description of Heating System



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



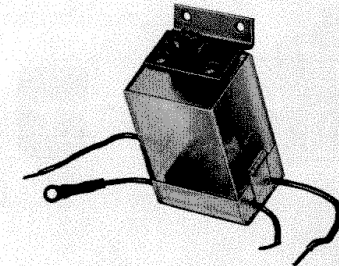
Overheating switch

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.

Description of Heating System F 3.1

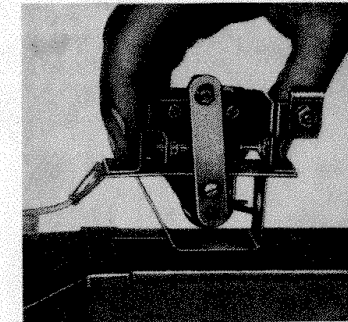
Safety switch

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

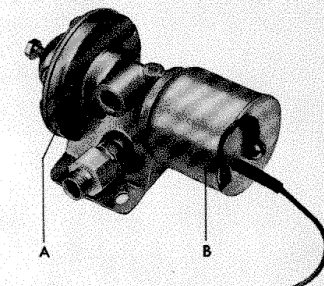
The bi-metal spring controls the heating air temperature via a micro switch for the fuel pump and solenoid valve. The control ranges are 42°–52° C (108°–125° F) at low heat output and 105°–135° C (221°–274° F) at high heat output.



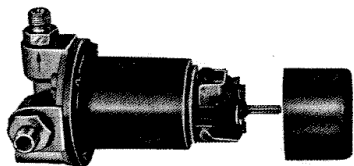
Pressure regulator with solenoid valve

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



F 3.1 Description of Heating System



Fuel pump

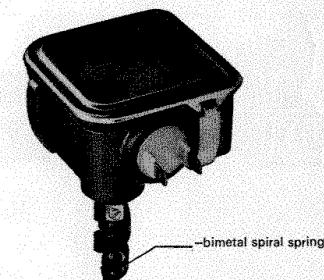
The fuel pump is secured to the upper part of the luggage compartment. It delivers fuel to the combustion chamber via the pressure regulator independently of the combustion air blower motor speed.

Description of Heating System F 3.1

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).

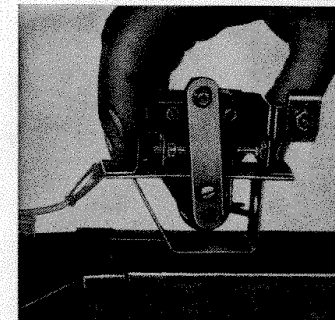
Cut-in temperature: approx. 60° C (140° F).

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

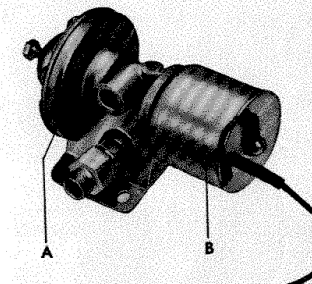
Pressure regulator with solenoid valve

Typ 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.

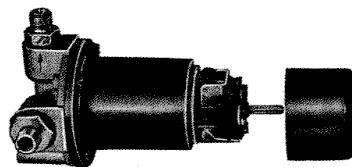
Delivery capacity

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



A – diaphragm pressure regulator
B – solenoid valve

F 3.1 Description of Heating System



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)

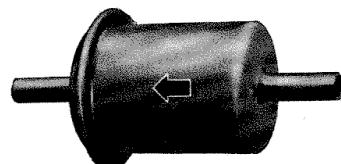
Type 1/Model 181

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.

Description of Heating System

F 3.1

Time switch

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

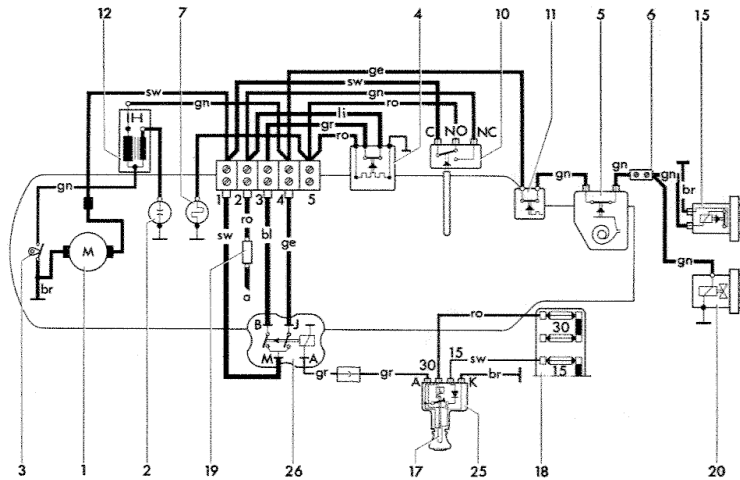
Modification

Type 1/Model 181

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

6 terminals instead of 4 terminals previously.



**Color code of wiring:**

ro = red	br = brown	gn = green
sw = black	gr = grey	li = lilac
ge = yellow	ws = white	a - to starter terminal 30

- | | |
|-------------------------------------------------------------|-------------------------------------------------|
| 1 - Electric motor | 11 - Overheating switch 150-200° C (300-390° F) |
| 2 - Spark plug | 12 - Ignition coil |
| 3 - Breaker contact | 15 - Fuel pump |
| 4 - Safety switch (response time 3-4 minutes) | 17 - Warning light |
| 5 - Regulating switch | 18 - Fuse box |
| 7 - Glow plug | 19 - Fuse, 16 amp. |
| 10 - Flame detector switch
(run-on time 150-200 seconds) | 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 safety switch (4) are energized by terminal 1 of the terminal strip by terminals C/NO of the flame detector switch (10) 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.

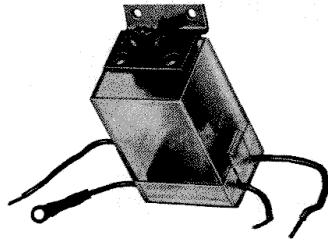
When the heater is overheated the overheating switch interrupts the current for the fuel pump and the solenoid valve.

F 3.1 Description of Heating System

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.

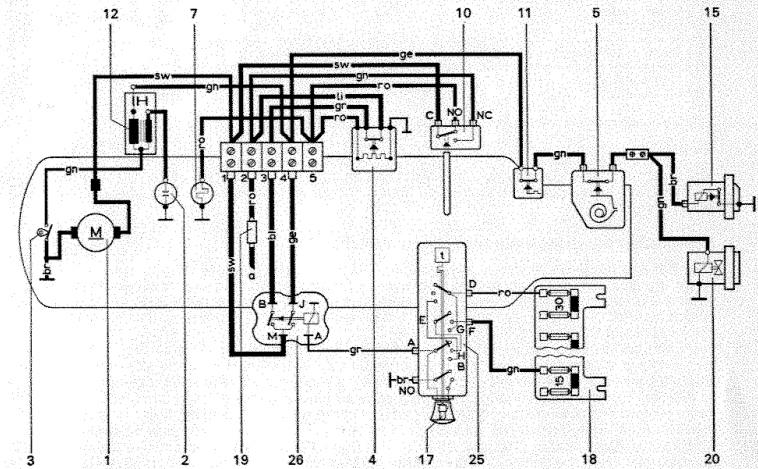
2 - Safety switch 4

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).

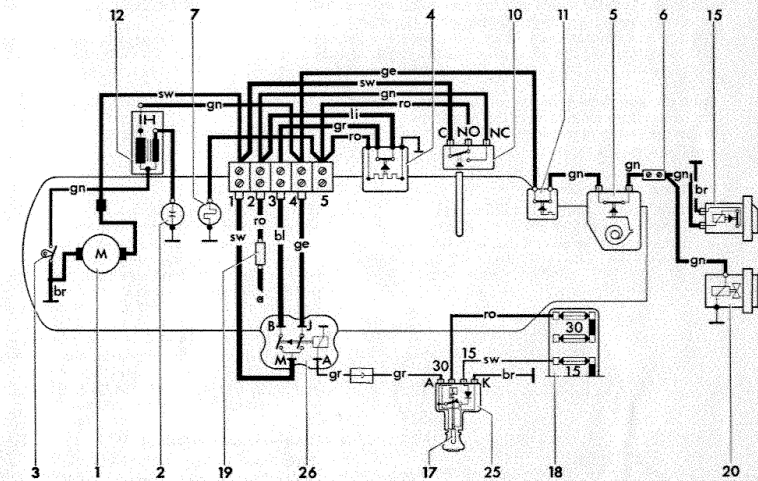
3 - Overheating switch (11)

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)).

Description of Heating System F 3.1



(up to July 1969)



(from August 1969)

Color code
 ro = red
 sw = black
 ge = yellow
 br = brown
 gr = grey
 ws = white
 gn = green
 li = lilac

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.

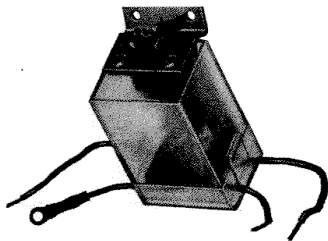
When the heater has warmed up sufficiently, the flame switch (10) switches over. Contact NO is then ineffective. The glow plug and the heater resistor in the safety switch are switched off. Contacts NC-C in the flame switch conduct current from terminal 2 via terminal 1 to the heater unit.

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.

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).

F 3.1 Description of Heating System

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.

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 of 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).

F 3.1 Description of Heating System

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 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.

Trouble Shooting and Testing Instructions **F 3.2**

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)

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 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 (.098 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)

F 3.2 Trouble Shooting and Testing Instructions

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)

1 - 4 Heater does not work

Trouble Shooting and Testing Instructions F 3.2

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

Heater smokes / Heat output insufficient / Heater goes out 2 - 1

F 3.2 Trouble Shooting and Testing Instructions

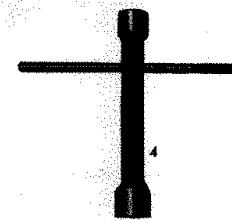
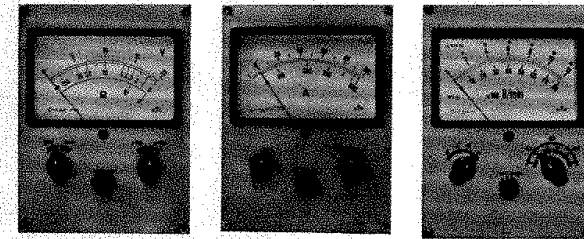
E – Run-on does not switch off

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	a – glow element broken	replace glow plug (see F 3.5/2)
b – check spark plug (see F 3.3/1)	b – no circuit in suppression resistor electrode gap too large	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)

Checking Parts and Adjusting F 3.3



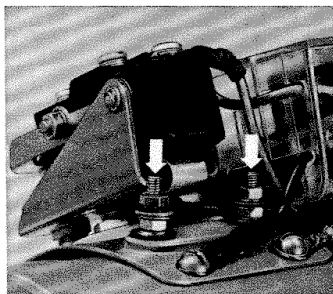
No.	Description	Special tool	Remarks
1	Ohmmeter/voltmeter		Range 0–20 volts
2	Ammeter		Range 0–20 amps.
3	Tachometer		0–8000 rpm
4	Box wrench		21 mm
5	Stop watch		

F 3.3 Checking Parts and Adjusting

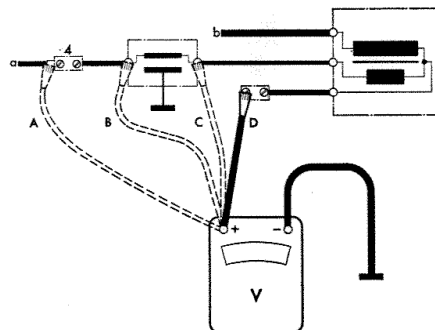
Testing overheating switch (installed)

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).

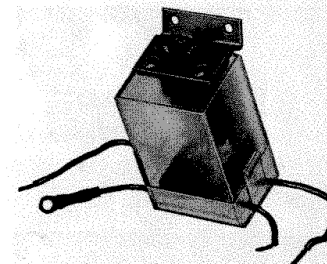
Note

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 Parts and Adjusting F 3.3

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.

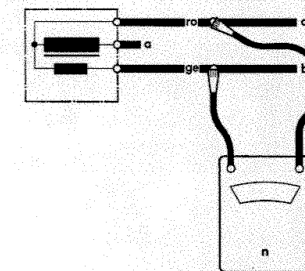


Checking combustion air blower motor (Checking speed)

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

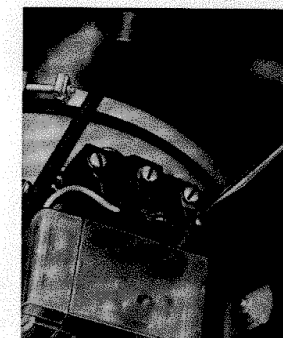
At an operating voltage of 12 volts the speed should be between 4875–5375 rpm. If the speed varies considerably, replace complete combustion air blower.

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

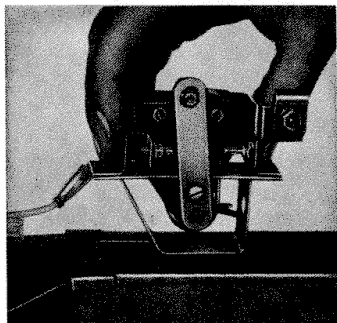


Flame detector switch (run-on)

- 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.



F 3.3 Checking Parts and Adjusting



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 Parts and Adjusting F 3.3

Checking relay

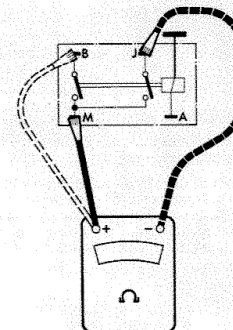
- 1 – Disconnect wires from terminals J, B and M at relay and turn on heater.

- 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.

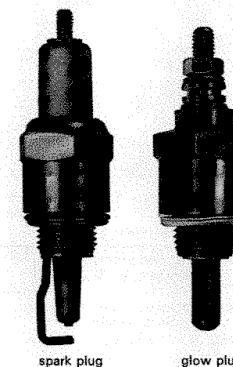
- 4 – Reconnect cable to terminal A. If the relay armature energizes audibly, check whether there is continuity from terminal J to terminal B. If there is no continuity with the relay switched on (∞ ohm), the relay must be replaced.



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.



spark plug

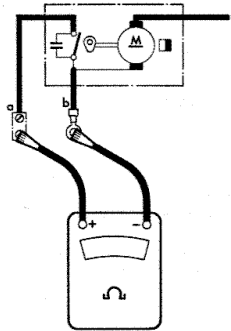
glow plug

F 3.3 Checking Parts and Adjusting

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

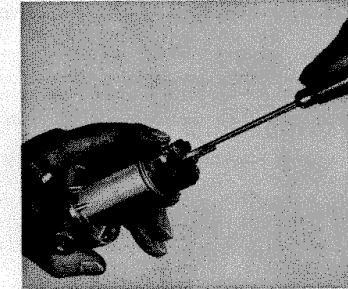
Possible fault	Ohmmeter shows
Short circuit in condenser	0 Ω
Contact breaker points burnt. Partial short circuit in condenser	Deflection between $\infty \Omega$ and a resistance value (e.g. 10 Ω)
Open circuit in breaker point circuit (e.g.: connecting wire broken, breaker point gap too large)	$\infty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

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

Checking Parts and Adjusting F 3.3

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 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).

F 3.3 Checking Parts and Adjusting

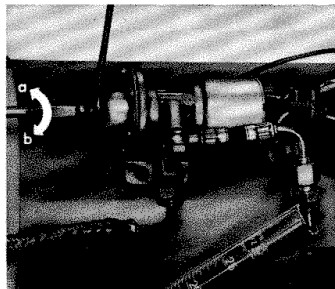
Pressure regulator and solenoid valve

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 counter-clockwise (a). This decreases the fuel quantity delivered. Turning clockwise (b) increases the fuel quantity delivered.

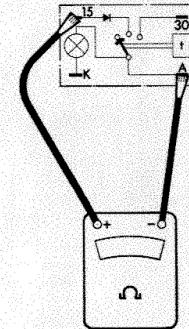
Note

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.

Checking Parts and Adjusting F 3.3

Time switch

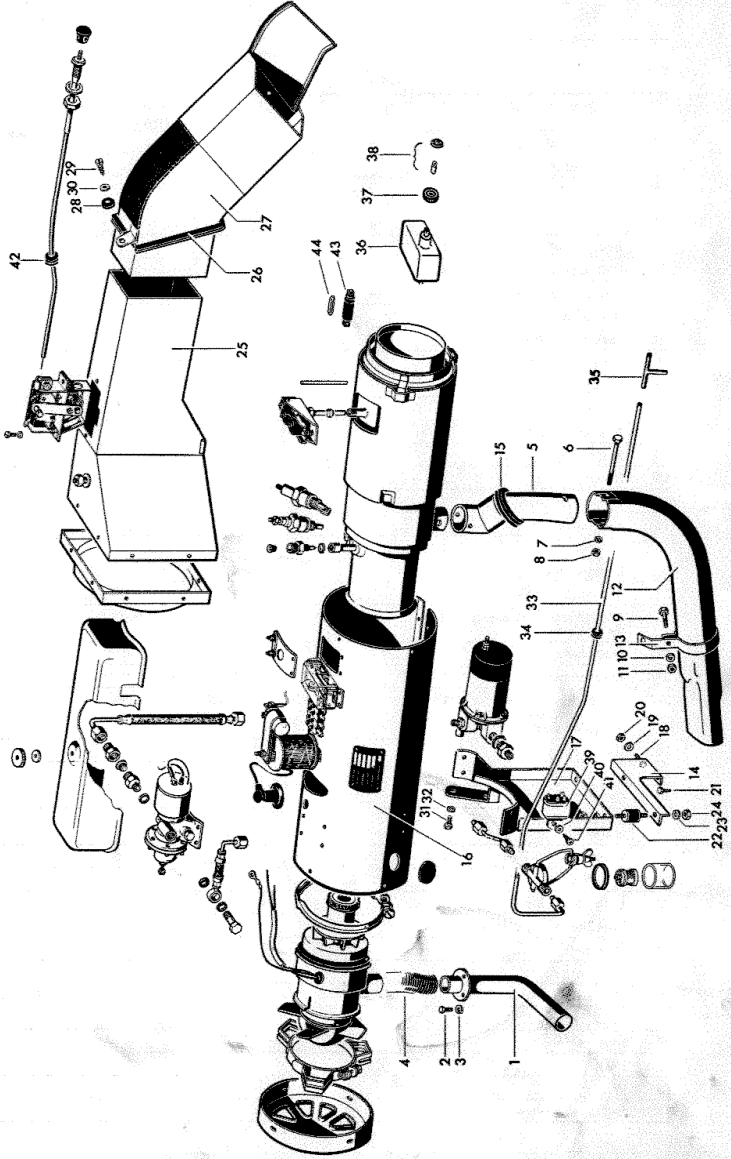
- 1 - Disconnect connector plug from time switch and remove switch.
- 2 - Turn knob to detent position.
 - a - Connect ohmmeter to terminals 15 and A of switch. Ohmmeter shows a certain reading (low or high resistance).
 - b - Change probes over. If the ohmmeter shows the same reading as at A, the diode 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**

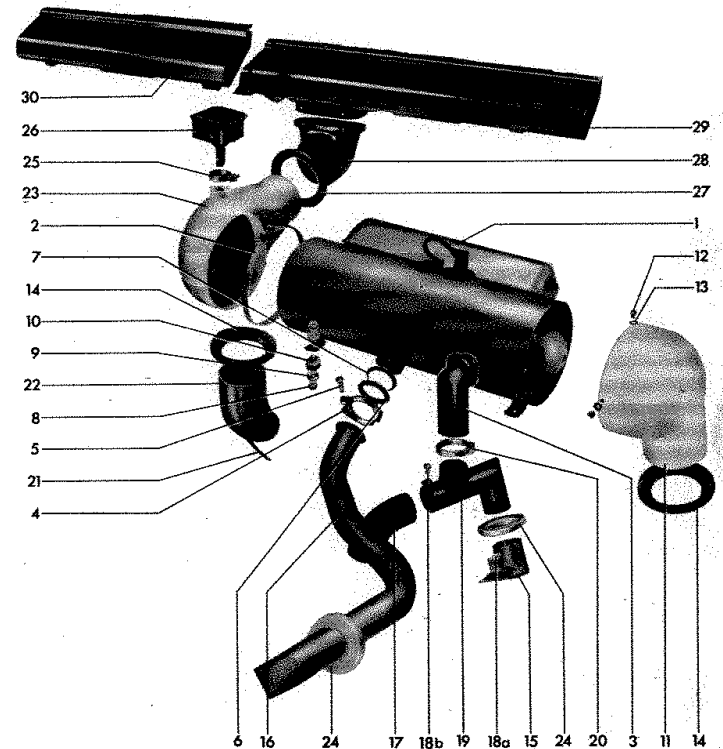


Removing and installing / Fresh air heater 1 - 1

F 3.4 Heater and Warm Air Duct

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 BM 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			
22	Bonded rubber mounting for support	2		install free of tension	
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			

Heater and Warm Air Duct F 3.4



F 3.4 Heater and Warm Air Duct

No.	Designation	Qty.	Note when		Special instructions see
			removing	installing	
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 AM 5×11	4			
13	Spring washer A 5.3	4			
14	Seal	2		the groove is pressed into the luggage pan (lip downward)	
15	Intake pipe	1		before installing, check seal in luggage pan for tightness	
16	Exhaust pipe	1		before installing, check seal for damage and tightness	
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			
19	Combustion air intake pipe	1		before installing, check seal for damage and tightness	
20	Clamp	1		check for tightness	
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

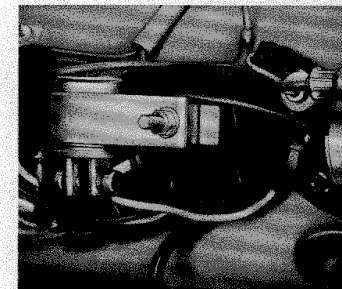
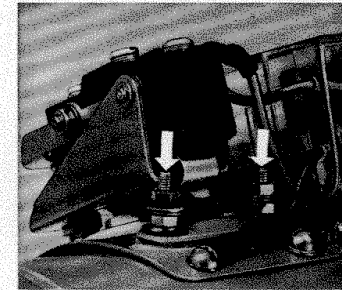
- 1 – Disconnect battery ground strap.
- 2 – Remove protective cover.
- 3 – Disconnect wire from breaker points at terminal strip.
- 4 – Remove spark plug connector.
- 5 – Loosen screw and detach lead from condenser.
- 6 – Remove brass nut on stud and remove condenser and coil.

Note

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

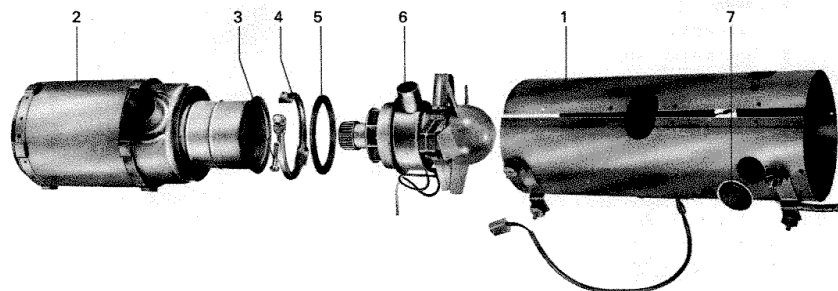
Installing

- 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.



F 3.5 Removing and Installing Parts

Combustion air blower, heat exchanger



No.	Description	Qty.	Note when	
			removing	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

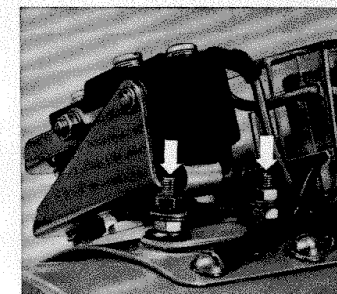
- 1 - Install circulating air pipe, jet, ignition coil, glow plug, flame detector switch and overheating switch.
- 2 - Install heater (see F 3.4/1).
- 3 - Connect battery ground strap and check operation of heater.

Removing and Installing Parts F 3.5

Overheating switch

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

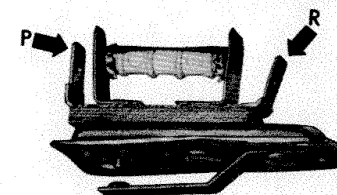
The connections (arrows) may be interchanged at installation without causing damage to the heater.



Type 1/Model 181

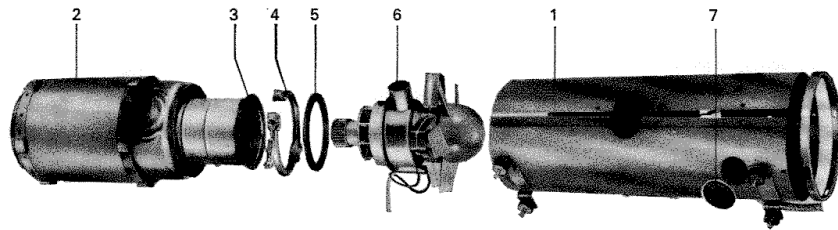
Type 2 from chassis No. 212 2 000 001, August 1971

Do **not** interchange wires.



P - from metering pump
(connection on adjusting screw)
R - from relay

F 3.5 Removing and Installing Parts



No.	Description	Qty.	Note when		Special instructions see
			removing	installing	
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 trough 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	

1 - 2 Combustion air blower / Heat exchanger

Removing and Installing Parts F 3.5

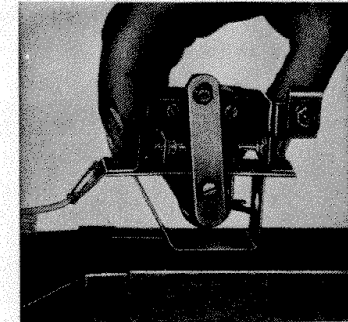
Temperature regulating switch

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

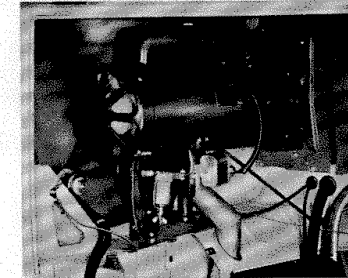
Removing

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



Temperature regulating switch / Relay 1 - 3

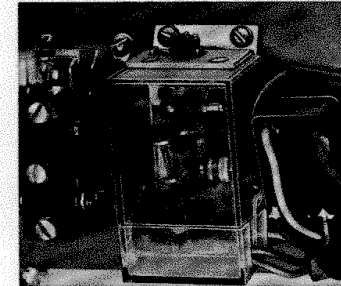
Safety switch

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.



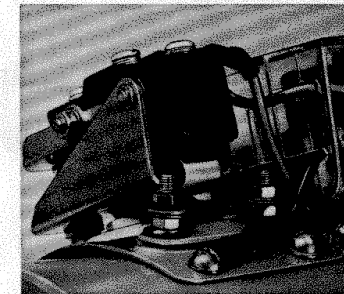
Flame detector switch

Removing

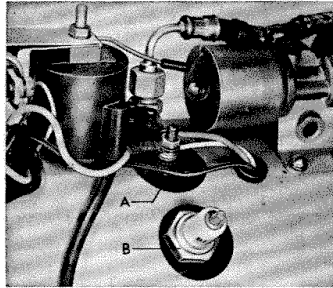
- 1 - Disconnect battery ground strap.
- 2 - Remove heater (see F 3.4/1).
- 3 - Disconnect three wire leads, each locked with two lock washers.
- 4 - Back off flame detector switch union nut with 12 mm open-end wrench, then turn switch to pull it out vertically (if necessary use solvent).

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.



F 3.5 Removing and Installing Parts



A - Glow plug
B - Spark plug

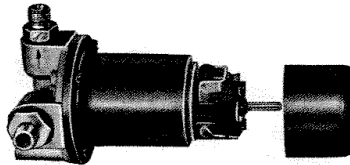
Glow plug, spark plug

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

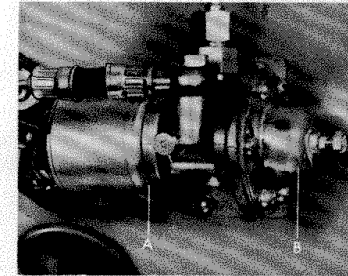
Removing

- 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.

Removing and Installing Parts F 3.5



A - Solenoid valve
B - Pressure regulator

Pressure regulator and solenoid valve

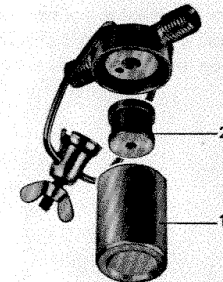
Removing

- 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

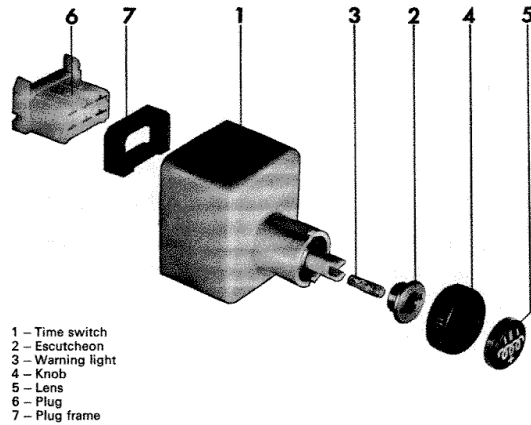
- 1 - Secure pressure regulator and solenoid valve with four round head screws and washers. Use two of the screws for securing the lead for the ground wire.
- 2 - Connect fuel lines. Hold locknut on fuel pump with a 14 mm open-end wrench.
- 3 - Connect solenoid valve wire to terminal 5. Connect battery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

Filter



1 - Filter housing
2 - Filter screen

F 3.5 Removing and Installing Parts



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.

Removing and Installing Parts F 3.5

Pressure regulator and solenoid valve

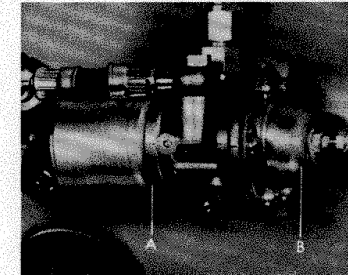
Type 2

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.

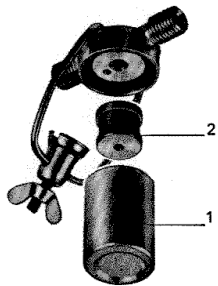
Installing

- 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.

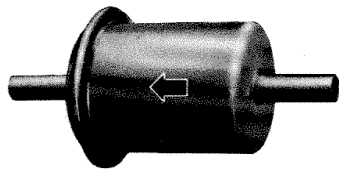


A - solenoid valve
B - pressure regulator

F 3.5 Removing and Installing Parts



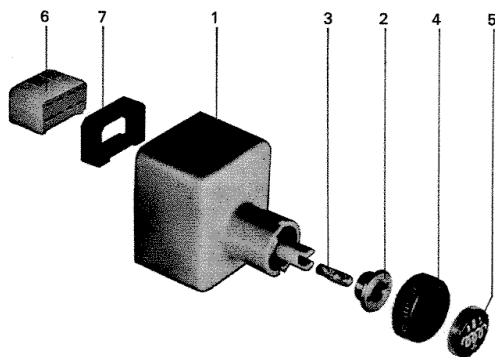
1 – filter housing
2 – filter screen



Filter

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

Time switch



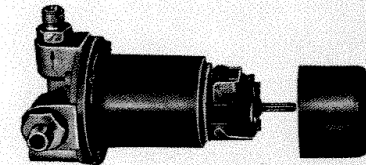
1 – time switch
2 – escutcheon
3 – warning light
4 – knob
5 – lens
6 – plug
7 – plug frame

Removing and Installing Parts F 3.5

Fuel pump

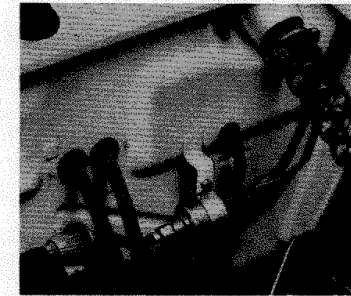
(Diaphragm pump)

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

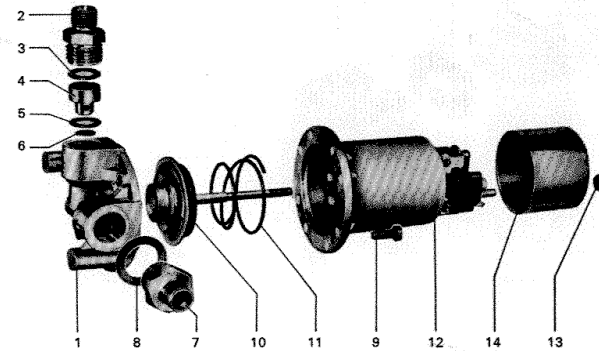
Always make sure that pump is installed horizontally. Otherwise the quantity of fuel delivered will change.



(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			

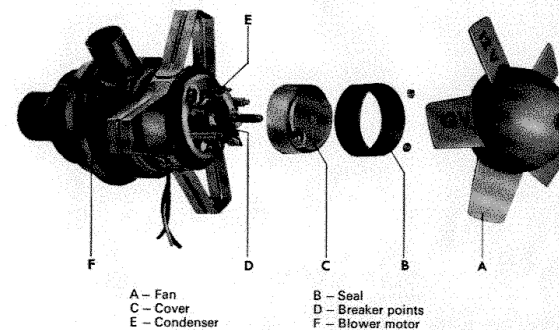
F 3.6 Disassembling and Assembling Fuel Pump

No.	Description	Qty.	Note when		Special instructions see
			disassembling	assembling	
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			

Combustion Air Blower F 3.7

Disassembling and assembling combustion air blower

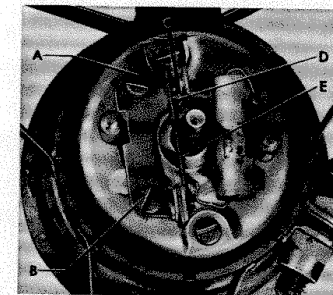
The breaker points in the combustion air blower are replaceable so that the complete blower assembly does not have to be replaced.



A - Fan
C - Cover
E - Condenser

B - Seal
D - Breaker points
F - Blower motor

- 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.



A - Securing screw
B - Clamping screw
C - Gap of 0.14-.02 in. (0.35-0.5 mm)
D - Projection on contact carrier
E - Cam and insulating strip

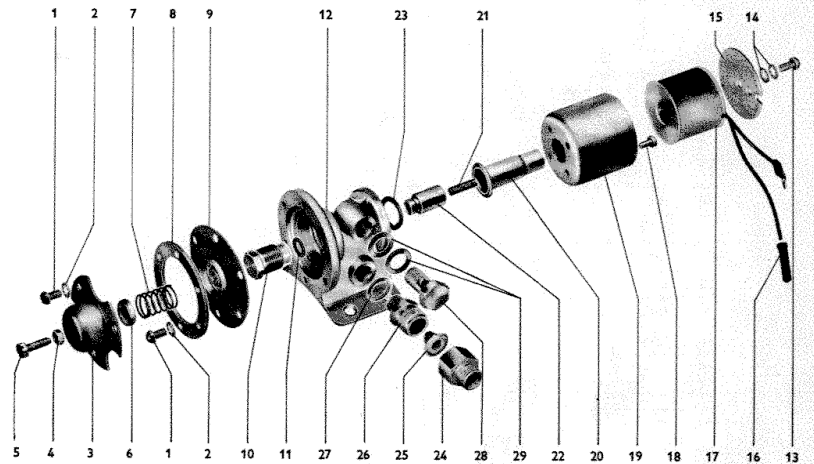
Testing:

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



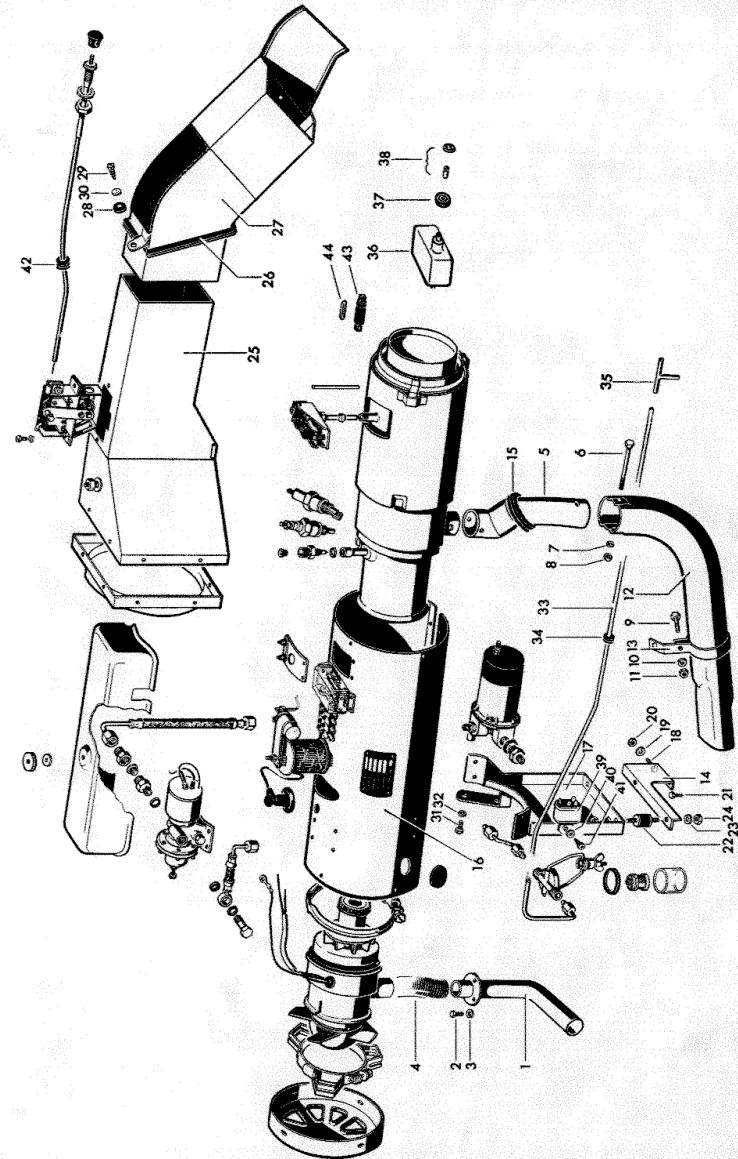
No.	Description	Qty.	Note when		Special instructions see
			disassembling	assembling	
1	AM 4×6 round head screw	6			
2	Star washer	6			
3	Cap	1	vent hole must not be blocked	vent hole must face downward	
4	M 4 hexagon nut	1		after setting fuel delivery quantity, seal with paint	F 3.3/2
5	M 4 hexagon 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	

F 3.8 Pressure Regulator and Solenoid Valve

No.	Description	Qty.	Note when		Special instructions see
			disassembling	assembling	
15	Cover	1			
16	Rubber sleeve	1			
17	Winding	1			
18	AM 3×6 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			
25	Screen	1		clean	
26	Union	1			
27	A 8×12 seal	1			
28	Gland nut	1			
29	A 8×12 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.

Service Installation F 3.20



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	—
1	Hot air outlet		25, 27
1	Seal	partition	26
1	Seal	side panel	—
1	Fuel line		33
1	Bowden cable	regulator switch	—
1	Sticker		—
1	Hose	500 mm long (19 ¹ / ₄ "')	—
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 (4¹/₂"')

b = 95 mm (3²/₂"')

c = 73 mm (2⁷/₈"')

e = 8.5 mm (5/₁₆"')

f = 12 mm (1¹/₂"') dia.

g = 21 mm (2¹/₂"')

h = 5°

i = 90 mm (3¹/₂"')

j = 90 mm (3¹/₂"')

k = 46 mm (1¹/₂"')

l = 5 mm (7/₁₆"') dia.

m = 158 mm (6¹/₂"')

n = 48 mm (1⁷/₈"')

o = 80 mm (3¹/₂"')

p = 10 mm (1¹/₂"')

q = 5 mm (7/₁₆"')

r = 41°

s = 51 mm (2''')

t = 4°

u = 69 mm (2²/₂"')

v = 54 mm (2¹/₂"')

w = 45 mm (1¹/₂"')

x = 172 mm (6²/₂"')

y = 109 mm (4¹/₂"')

z = 2°

Template 2

a = 143 mm (5¹/₂"')

b = 183 mm (7¹/₂"')

c = 102 mm (4''')

d = 30 mm (1¹/₂"') dia.

e = 5 mm (7/₁₆"') dia.

f = 71 mm (2¹/₂"')

g = 120°

h = 20 mm (2¹/₂"')

i = 30 mm (1¹/₂"')

k = 20 mm (2¹/₂"')

l = 28 mm (1¹/₂"')

Template 3

a = 110 mm (4¹/₂"')

b = 53 mm (2¹/₂"')

c = 9 mm (2/₈"')

d = 4 mm (2/₈"') dia.

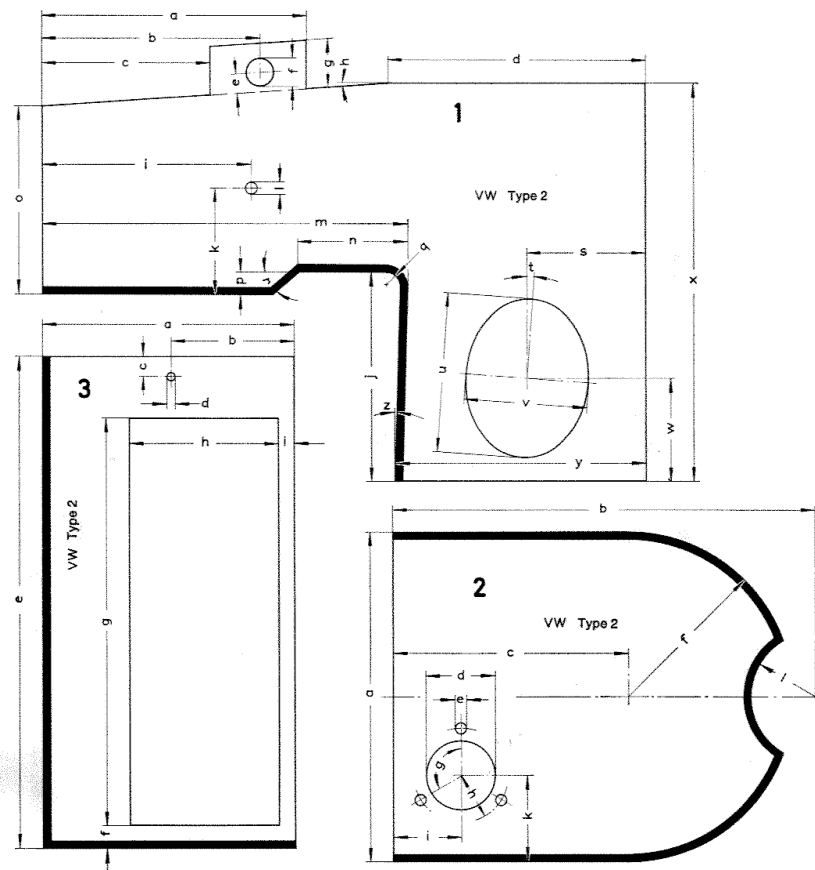
e = 213 mm (8¹/₂"')

f = 10 mm (1¹/₂"')

g = 176 mm (6¹/₂"')

h = 65 mm (2¹/₂"')

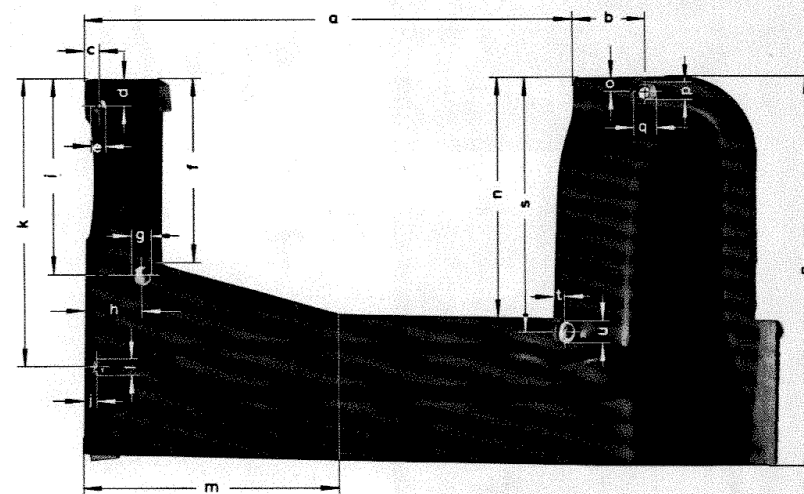
i = 7 mm (7/₁₆"')



1-4 Installation instructions for Type 2

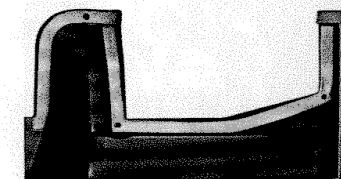
Work sequence

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



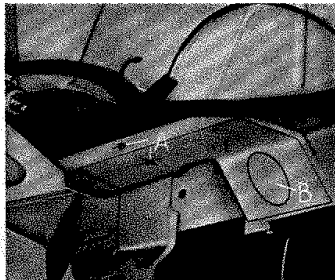
a = 227 mm (8 ¹¹ / ₁₆ "	g = 10 mm (3 ¹⁶ / ₁₆ "	m = 130 mm (5 ¹ / ₁₆ "	r = 165 mm (6 ¹¹ / ₁₆ "
b = 32 mm (1 ¹ / ₁₆ "	h = 27 mm (1 ¹ / ₁₆ "	n = 105 mm (4 ¹ / ₁₆ "	s = 115 mm (4 ¹¹ / ₁₆ "
c = 7 mm (7 ¹⁶ / ₁₆ "	i = 85 mm (3 ³ / ₁₆ "	o = 7 mm (7 ¹⁶ / ₁₆ "	t = 7 mm (7 ¹⁶ / ₁₆ "
d = 10 mm (13 ¹⁶ / ₁₆ "	j = 7 mm (7 ¹⁶ / ₁₆ "	p = 7 mm (7 ¹⁶ / ₁₆ "	u = 10 mm (13 ¹⁶ / ₁₆ "
e = 8 mm (8 ¹⁶ / ₁₆ "	k = 127 mm (5"	q = 10 mm (13 ¹⁶ / ₁₆ "	
f = 80 mm (3 ¹ / ₁₆ "	l = 8 mm (8 ¹⁶ / ₁₆ "		

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



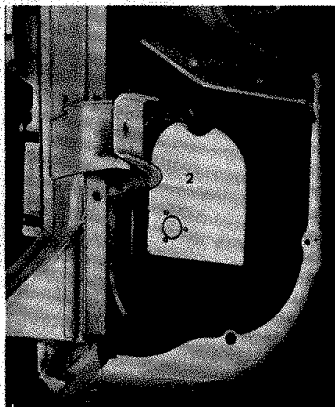
Installation instructions for Type 2 1-5

F 3.20 Service Installation

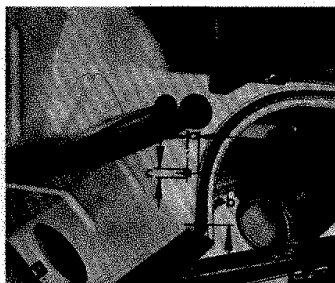


4 Cut the following holes in the engine compartment:

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



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



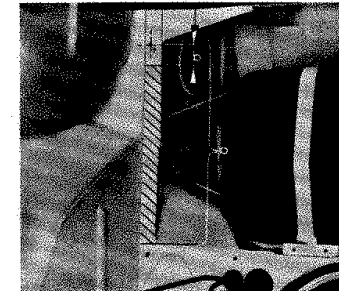
5 - Drill hole for fuel line.

- a = 13 mm ($1/2''$)
- b = 65 mm ($2\frac{1}{4}''$)
- c = 10 mm ($3/8''$) dia.

Service Installation F 3.20

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.

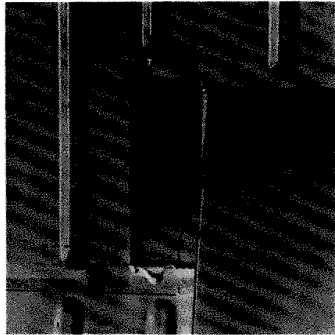
8 - Mark off and cut hole for hot air outlet from inside body.
(use template 3)



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

- a = 28 mm ($1\frac{1}{4}''$)
- b = 63 mm ($2\frac{1}{2}''$)





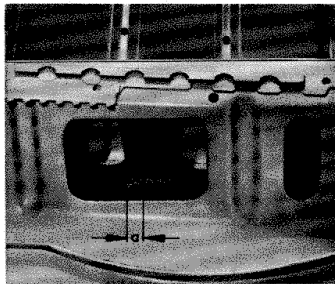
10 – Drill hole for bowden cable (with an angle drill). The hole is drilled 12 mm ($1/2''$) to left and rear of the left edge of the hot air outlet hole. The illustration on the left shows the location of this hole.



11 – Take driver's seat out.

12 – Drill hole for bowden cable.

a = 10 mm ($3/32''$) dia.
b = 45 mm ($1\frac{29}{32}''$)



13 – Drill hole for bowden cable under the seat box.

a = 17 mm ($11/16''$) dia.

Warning

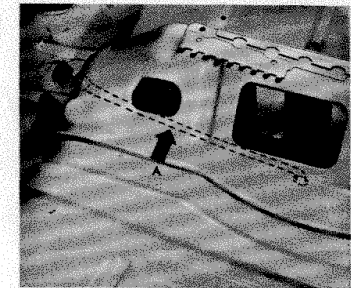
Components of the brake system are below this location so do not drill deeper than 30 mm ($1\frac{1}{16}''$).

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.

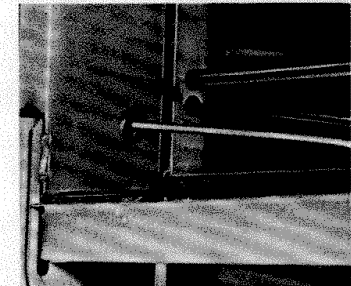
A = bowden cable



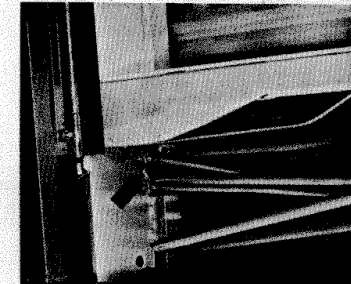
2 – Pass the bowden cable through the holes in the frame cross members.

Note

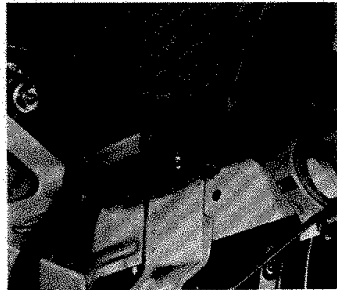
Vehicles with a sliding roof have reinforcement plates welded in between the cross members but the holes mentioned above are still accessible. To facilitate the routing of the bowden cable through the holes it is advisable to pass a thin copper tube through the holes first and then attach the bowden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



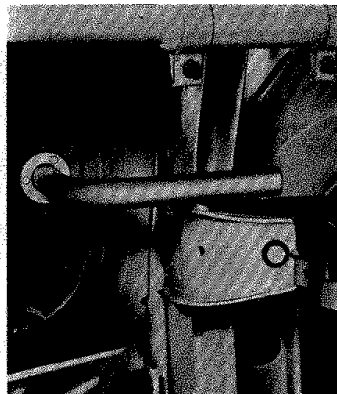
3 – Pass bowden cable through the hole near the hot air outlet into the engine compartment.



F 3.20 Service Installation



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 (1⁷/₃₂”) 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.

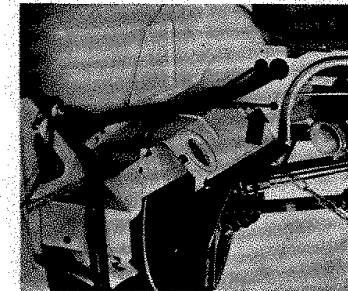
Install a 2.5 mm² (12 gauge) red cable in insulation sleeving from starter terminal 30 to heater (connector with fuse) parallel to engine harness.

9 – Cut fuel line to engine 120 mm (4³/₃₂”) from the end and install a T-piece. Do not forget hose clamps.

10 – Install silicon sealing ring for exhaust pipe.

Service Installation F 3.20

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-off 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.

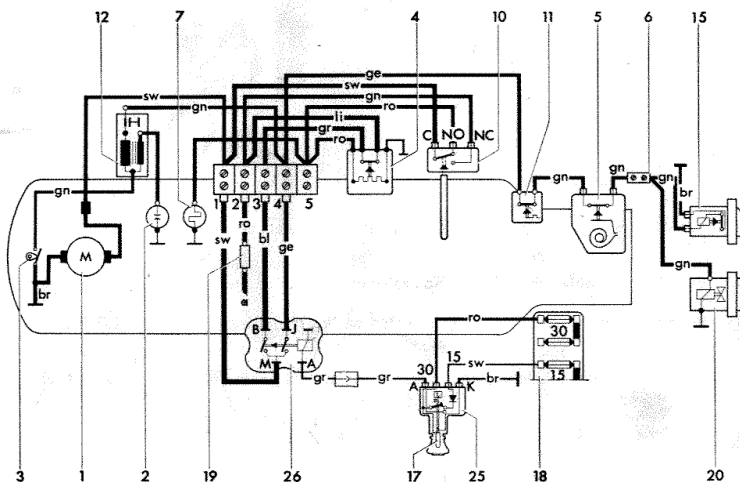
18 – Insert two heater securing screws (tapping screws with washers) from the engine compartment through the cut-off portion of the plate.

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.



- 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 - Overheating switch
- 12 - Coil

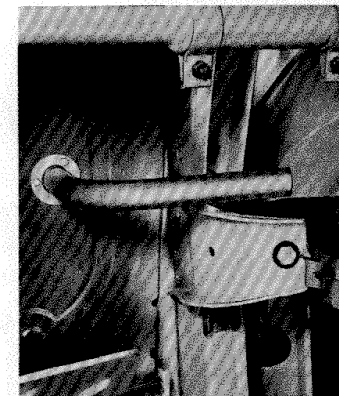
- 15 - Fuel pump
- 17 - Warning lamp
- 18 - Fuse box
- 19 - Fuse 18 amp.
- 20 - Fuel solenoid valve
- 25 - Time switch
- 26 - Relay

a = to starter terminal 30

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

23 - Attach bracket for exhaust pipe to the left engine mounting bolt in engine carrier.

24 - Install exhaust pipe from below and secure it.

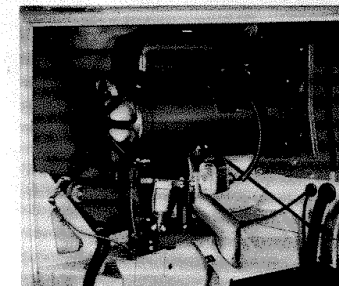


25 - Connect battery and check operation of heater.

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.

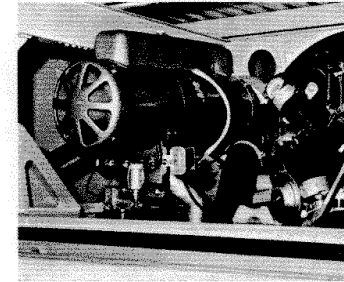


General

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

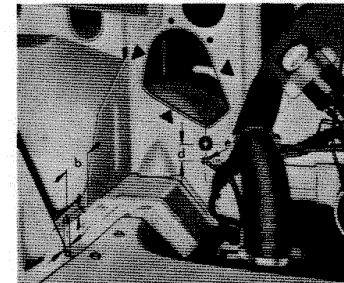
The kit contains the following parts:

- 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



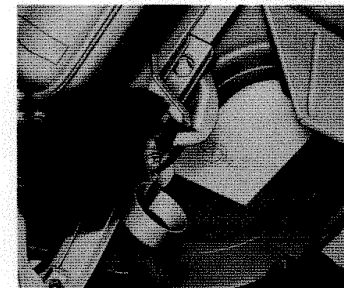
Work sequence

- 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.

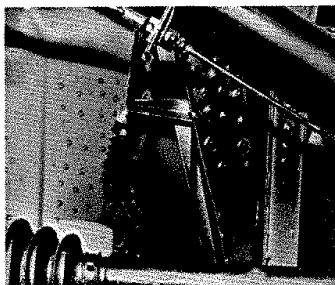


- a = 7 mm ($\frac{9}{16}$ in.)
- b = 145 mm ($5\frac{7}{8}$ in.)
- c = 6 mm ($\frac{1}{4}$ in.)
- d = 30 mm ($1\frac{1}{8}$ in.)
- e = 10 mm ($\frac{3}{8}$ in.)

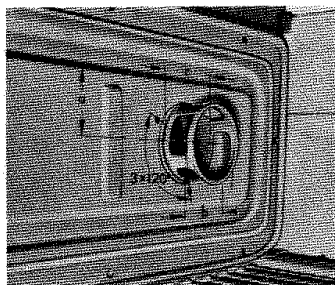
- 6 - Place template II (see page F 3.20/1-4) under the engine compartment on the left as shown. Mark off and drill holes for combustion air pipe 28 mm ($1\frac{1}{8}$ in.) and for securing bolts 5 mm ($\frac{1}{8}$ in.). Clean up hole edges.
- 7 - Loosen bolt on engine mounting (see arrow). Install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



F 3.20 Service Installation

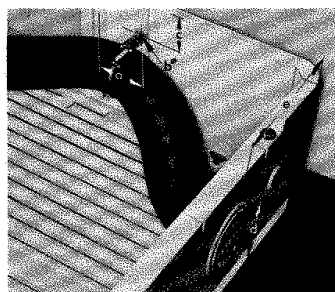


- 8 – Take flexible hose off left rear warm air duct. Drill a 10 mm ($\frac{3}{8}$ in.) hole in engine compartment for the Bowden cable.



- 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 ($2\frac{9}{16}$ in.)
 b = 80 mm ($3\frac{1}{8}$ in.)
 c = 100 mm ($3\frac{7}{8}$ in.)



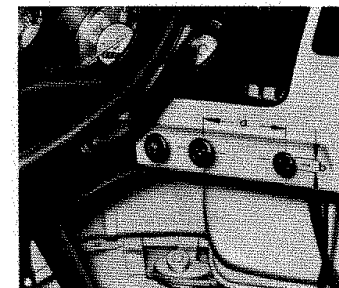
- 10 – Mark off and cut or drill 96 mm ($3\frac{25}{32}$ in.) hole for hose connection, 5 mm ($\frac{1}{32}$ in.) holes for securing screws and 8.5 mm ($\frac{5}{16}$ in.) holes for support in seat box frame. Clean up edges of holes. Install bracket and connection with outlet on seat box. Install hose 85 mm ($3\frac{11}{32}$ in.) long on the connection and secure to connection and bracket with hose clips.

a = 90 mm ($3\frac{11}{16}$ in.)
 b = 8.5 mm ($\frac{5}{16}$ in.)
 c = 80 mm ($3\frac{1}{8}$ in.)
 d = 140 mm ($5\frac{1}{2}$ in.)
 e = 280 mm ($11\frac{1}{8}$ in.)

Service Installation F 3.20

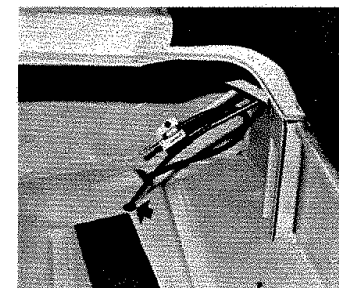
- 11 – Mark off, drill and deburr hole for switch in instrument panel to dimensions shown.

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 ($1\frac{13}{32}$ 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 ($\frac{1}{2}$ 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 4×10 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 6×15 bolt, spring washer and nut. Place fuel pump ground cable under the Bz 6.3×13 sheet metal screw and secure to floor plate with bracket.

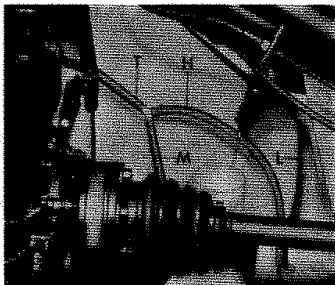
- 18 – Secure outlet to engine compartment partition with 2 M 6×15 bolts, washers and nuts.

- 19 – Place exhaust pipe on heater connection and secure it with an M 5×50 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 4.8×9.5 and lock washer A 5.1.

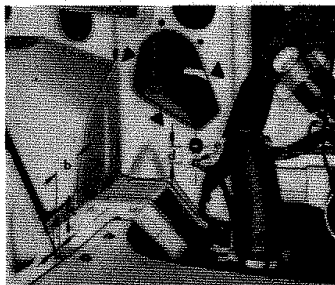
- 21 – Route long fuel line through the grommet in the engine compartment partition and connect to fuel filter on heater.

F 3.20 Service Installation



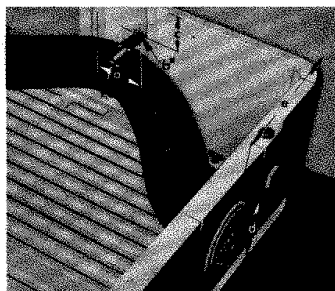
- 22 – Cut vehicle fuel line underneath the tank and install T piece as shown. Connect the hose supplied in kit from free end of T piece to the suction line to the heater. Remove clamp from hose so that fuel can flow.

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.



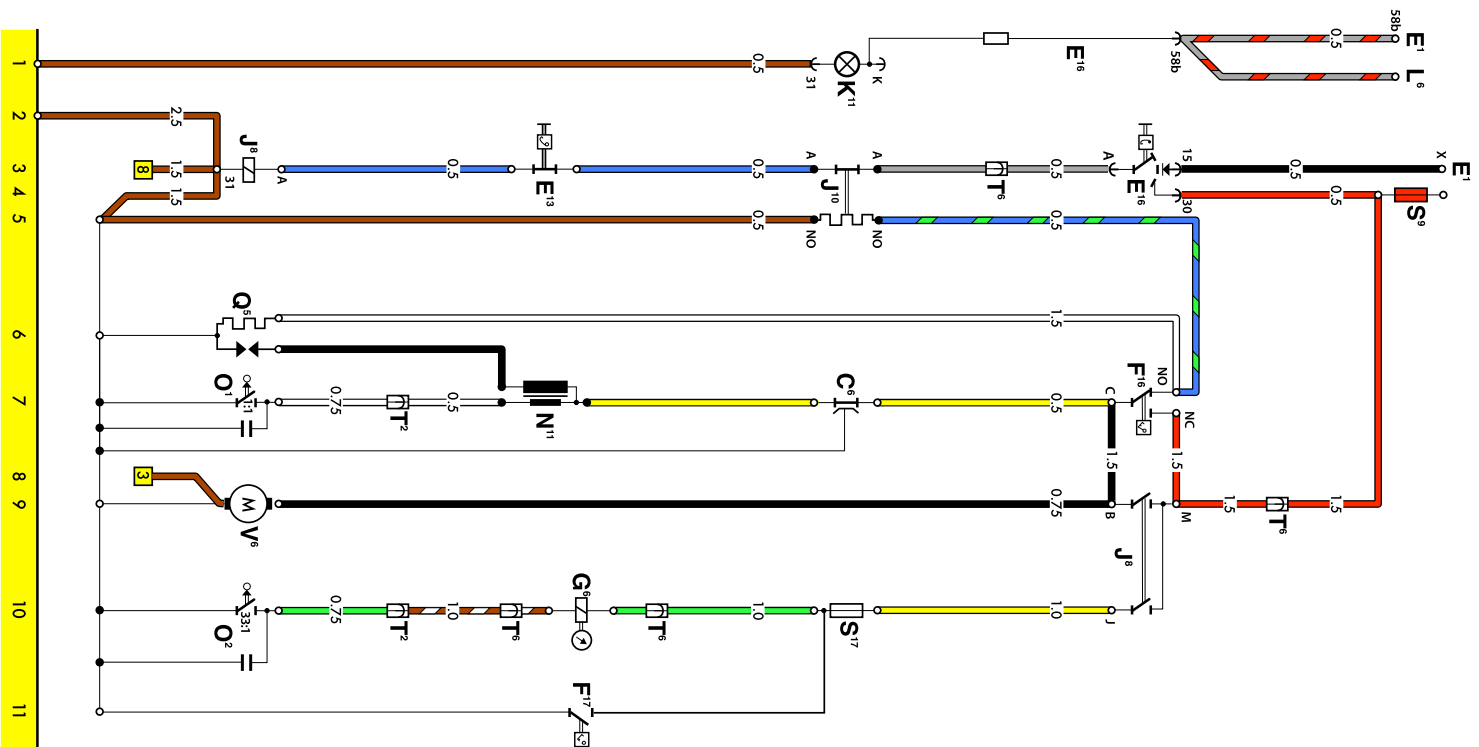
- 25 – Place flexible pipe 90 cm (35 3/8 in.) long on the heater outlet. Place connector sleeve on other end of pipe and secure it with a hose clamp. Route connector sleeve through the partition under the rear seat and secure it with three screws. Install partition.

- 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.

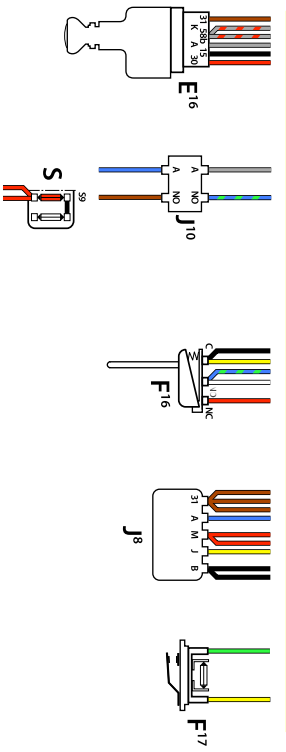
Eberspächer BN-4 Heater, Current Flow Diagram

Type 1 / Model 181 3.73



- | Description | Current track |
|----------------------------------------------------------------------------------------------------------|---------------|
| C ⁶ – Suppression condenser for coil / capacity 0.47 µF | 7 |
| E ¹ – From light switch terminal 58b (gray/red) | 1 |
| E ¹ – From light switch terminal X (black) | 3 |
| E ¹³ – Temperature regulating switch | 1, 3 |
| E ¹⁶ – Heater switch / operating period 25 minutes | 7 |
| F ¹⁶ – Flame switch | 11 |
| F ¹⁷ – Overheating switch | 10 |
| G ⁶ – Metering pump | 3, 9, 10 |
| J ⁸ – Relay | 3, 5 |
| J ¹⁰ – Safety Switch | 1 |
| K ¹¹ – Bulb, timer switch illumination | 1 |
| L ⁶ – from bulb, speedometer illumination | 7 |
| N ¹¹ – Ignition coil/voltage 10/5000 | 7 |
| O ¹ – Contact in combustion air blower, ignition (contact opens once per revolution) | 10 |
| O ² – Contact in combustion air blower, metering pump (contact opens once per 33 revolutions) | 6 |
| Q ⁵ – Glow-spark plug | 3, 4 |
| S – Fuse box | 4 |
| S ⁹ – 9th fuse in fuse box | 3 |
| S ¹⁷ – Overheating fuse/8 amp | 10 |
| T ² – Wire connector, double | |
| T ⁶ – Wire connector, 6 pin | |
| V ⁶ – Combustion air blower | |

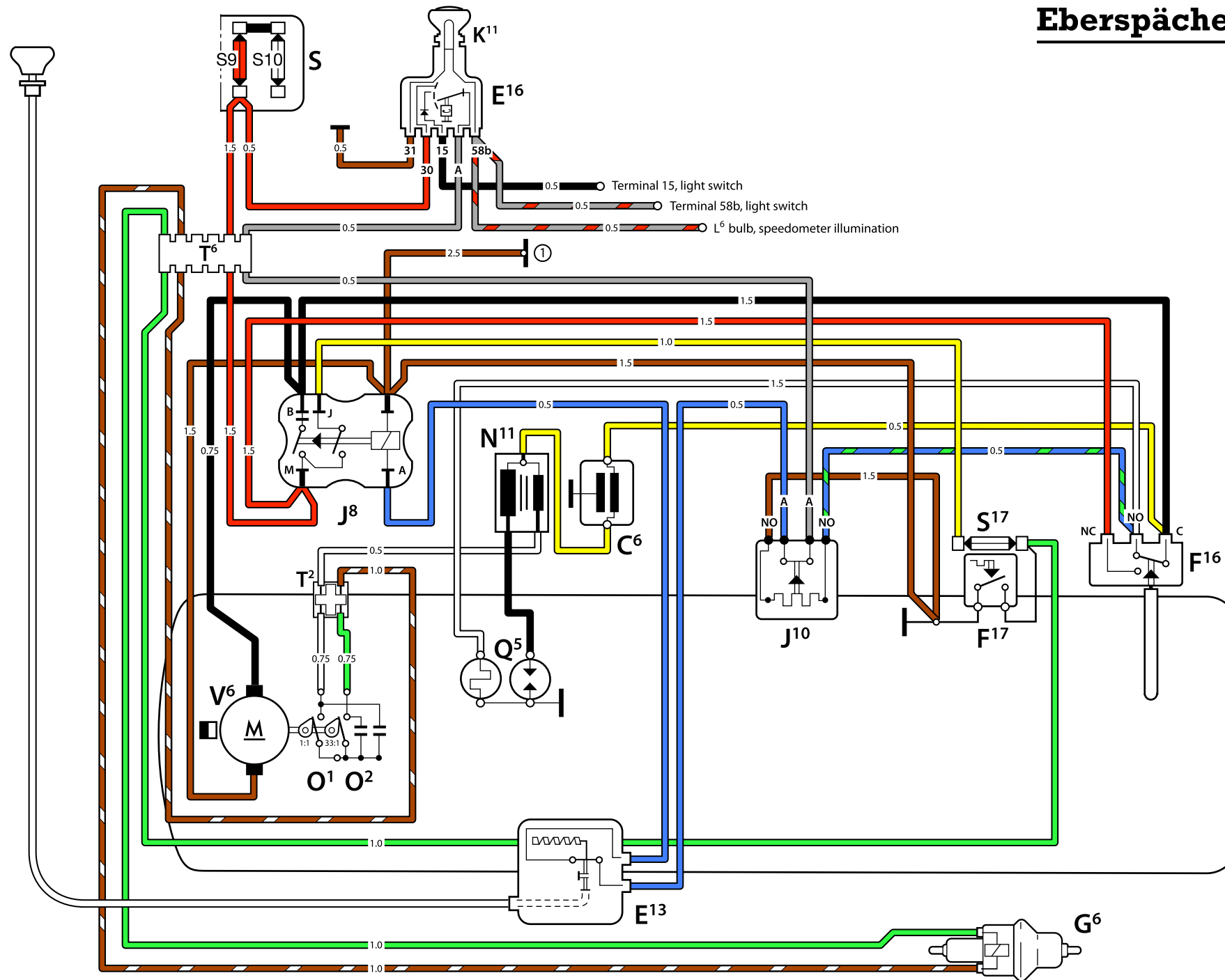
Current track
7
1
3
1, 3
7
11
10
3, 9, 10
3, 5
1
1
7
7
10
6
3, 4
4
3
10
9



Disclaimer:
 This drawing was made using a combination of reference materials. One is a VW current flow diagram marked "7th Supplement § F 3.1 (USA) 3.73". During the proofreading process, the new drawing was compared to the BN-4 heaters of two North American version 181s. Where discrepancies were found between both cars and the drawing, the drawing was amended in favor of the real life examples.

Eberspächer BN-4 Heater Wiring Diagram

Type 1 / Model 181 3.73



Description

- C⁶ – Suppression condenser for coil / capacity 0.47 μF
- E¹³ – Temperature regulating switch
- E¹⁶ – Heater switch / operating period 25 minutes
- F¹⁶ – Flame switch
- F¹⁷ – Overheating switch
- G⁶ – Metering pump
- J⁸ – Relay
- J¹⁰ – Safety Switch
- K¹¹ – Bulb, timer switch illumination
- N¹¹ – Ignition coil/voltage 10/5000
- O¹ – Contact points in combustion air blower, ignition (contact opens once per revolution)
- O² – Contact points in combustion air blower, metering pump (contact opens once per 33 revolutions)
- Q⁵ – Glow-spark plug
- S – Fuse box
- S⁹ – 9th fuse in fuse box – terminal 30
- S¹⁷ – Overheating fuse/8 amp
- T² – Wire connector, 2 pin
- T⁶ – Wire connector, 6 pin
- V⁶ – Combustion air blower
- ① – Ground connection, chassis, luggage compartment

Disclaimer:
 This drawing was made using a combination of reference materials. The general layout and components were modeled on a variety of BN-4 technical drawings, and the wire colors and layout were based on a BN-4 current flow diagram dated 3.73. During the proofreading process, this drawing was compared to the BN-4 heaters on multiple North American version 181s. Where discrepancies were found, the drawing was amended in favor of the real life examples.