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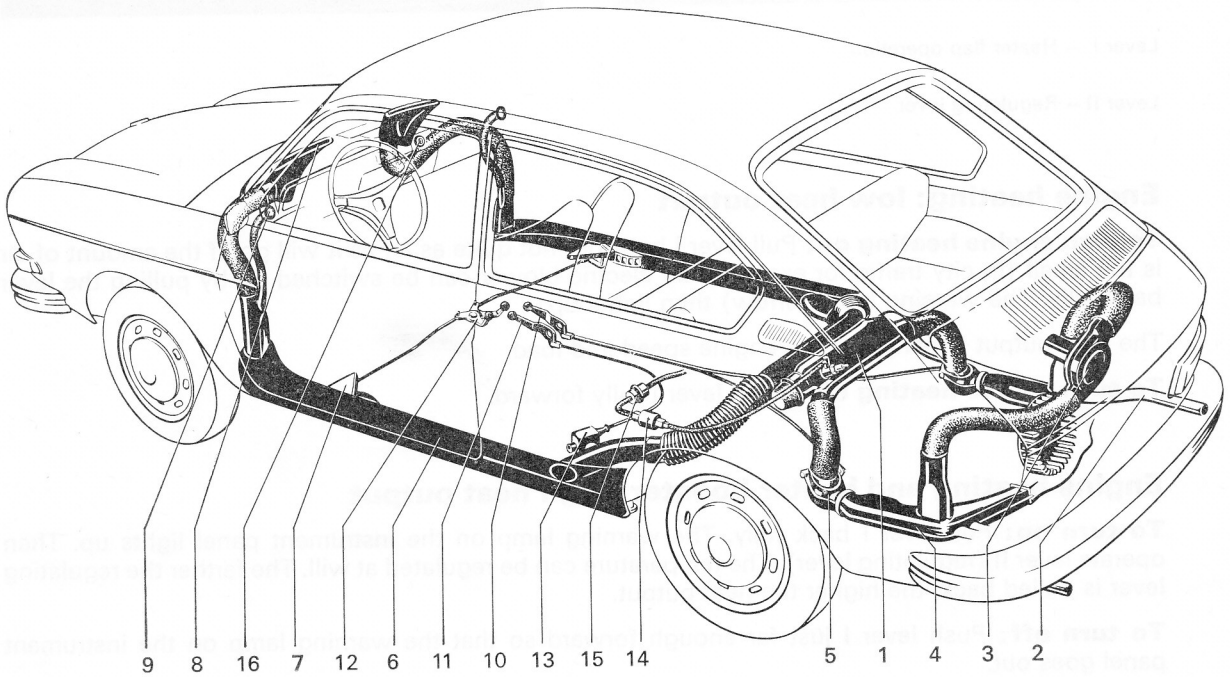
Description

The heating system is a combined engine-gasoline-fresh air system by which the fresh air is heated only by the heat given off by the exhaust gases or, when additional heat is required, also by the heater booster that operates independently of the vehicle engine. This thermostatically-regulated, infinitely variable heater booster is installed in the space between transmission and luggage compartment floor and can be operated also when the vehicle is stationary.



1 – Heater
2 – Exhaust pipe
3 – Heater air blower
4 – Engine heat exchanger
5 – Heater flaps
6 – Warm air duct in side member
7 – Outlets in footwell
8 – Fresh air and defroster vents in instrument panel
9 – Defroster vents for door windows
10 – Heater flap lever
11 – Regulating lever
12 – Regulating levers for footwells
13 – Temperature control switch
14 – Fuel pump
15 – Fuel filter
16 – Warning lamp

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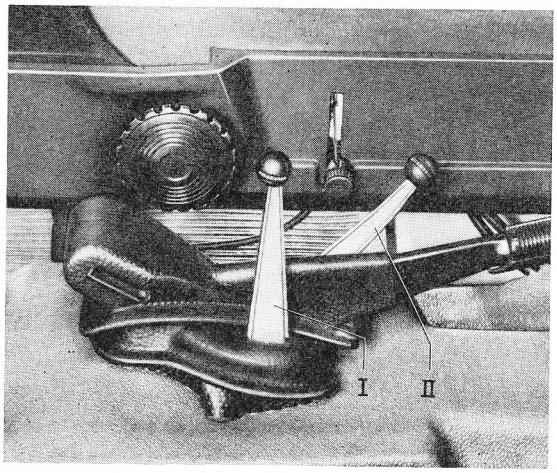
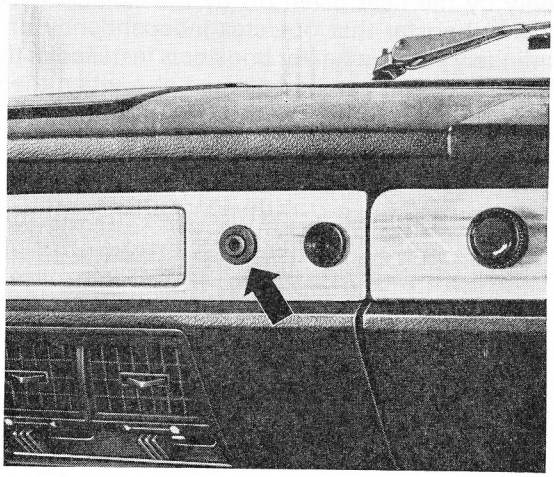
Controls





Lever I – Heater flap operation

Lever II – Regulating lever

Engine heating: low heat output

To turn engine heating on: Pull lever I back but not quite as far as it will go. If the amount of air is too small (in city traffic for example) an electric blower can be switched on by pulling the lever back fully. The warning lamp (arrow) then lights up.

The heat output depends on the engine speed and load.

To turn engine heating off: Push lever I fully forward.

Engine heating and heater booster: high heat output

To turn on: Pull lever I back fully. The warning lamp on the instrument panel lights up. Then operate lever II (regulating lever). The temperature can be regulated at will. The farther the regulating lever is pulled back, the higher the heat output.

To turn off: Push lever I just far enough forward so that the warning lamp on the instrument panel goes out.

Heating (vehicle engine stationary)

To turn heating on: First pull lever I right back, then move lever II to regulate required degree of heating. The warning lamp on the instrument panel lights up.

To turn heating off: Push lever I forward until the warning lamp on the instrument panel goes out.

Note:

When the heating is switched off, the heater air blower and the combustion air blower continue to run until the heater cools down and all traces of exhaust gases have been emitted from the combustion chamber.

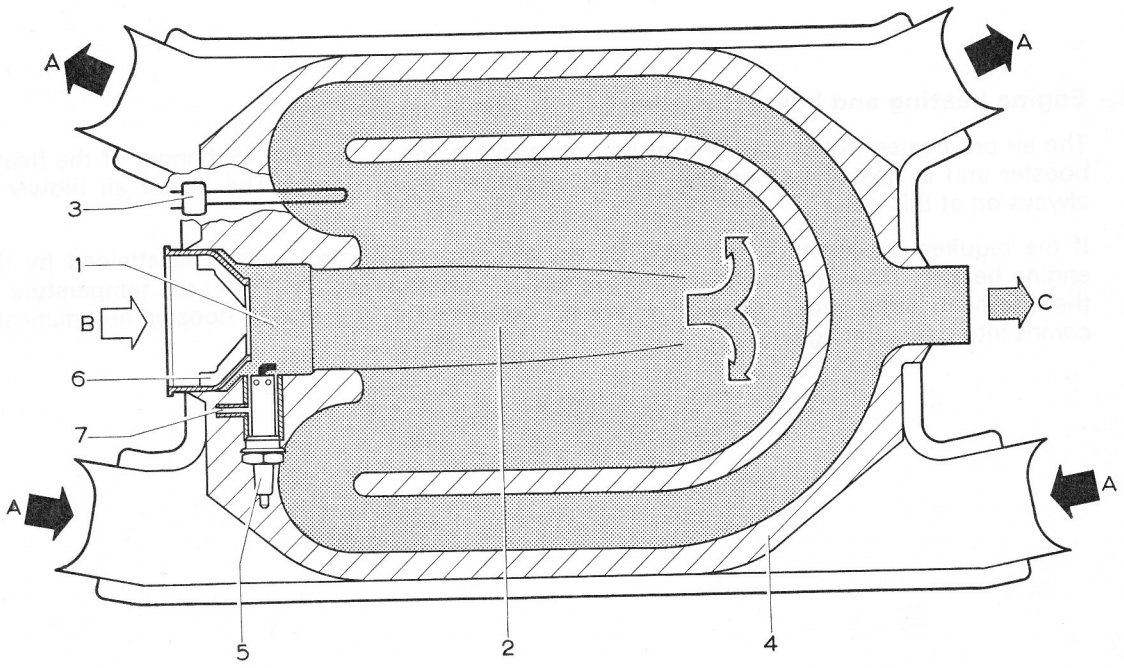
When temperatures are extremely low, the full battery capacity is required for starting the engine. To avoid starting difficulties under such conditions the heater booster should be switched on only after the engine has been started.

Operation

1 – **Heating** (vehicle engine stationary)

All the heater functions are controlled by the heater flap lever in conjunction with the regulating lever. The warning lamp in the instrument panel lights up.

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



1 – Combustion chamber
2 – Heat chamber
3 – Thermo-switch
4 – Heat exchanger
5 – Glow-spark plug
6 – Housing with vanes
7 – Fuel line connection
A – Warm air
B – Combustion air
C – Exhaust gases

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

The temperature control switch, installed in the left-hand warm air duct, is operated by a bowden cable connected to the regulating lever and regulates the exit temperature of the air thermostatically.

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

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2 – **Engine heating only**

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

If the heater flap lever is pulled back fully, the heater air blower is switched on and the amount of air increased. The warning lamp on the instrument panel lights up.

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

3 – **Engine heating and heater booster** (vehicle engine running)

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

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

Maintenance

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

1 – Start vehicle engine.

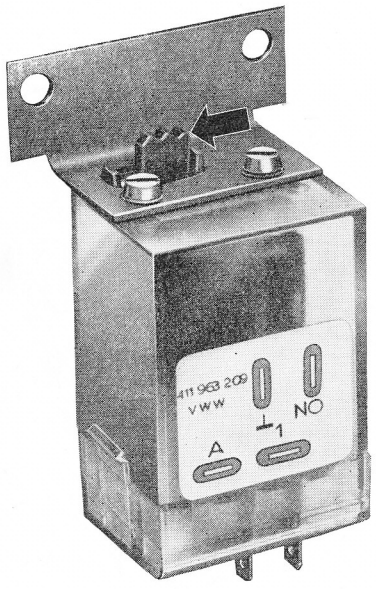
2 – Pull heater flap lever back fully. Warning lamp on instrument panel must light up.

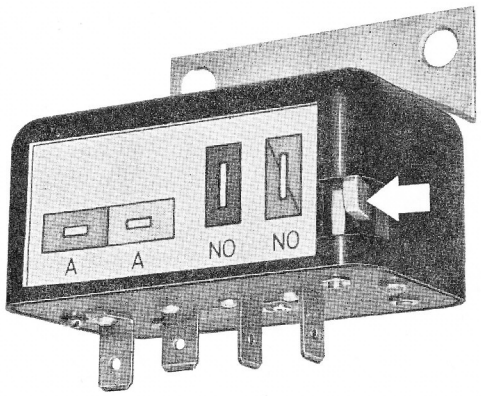
3 – Pull regulating lever back half way (half heat output).

4 – After about two minutes, check whether warm air flows from warm air vents equally on both sides in vehicle interior. Turn heating off. To do this, push heater flap lever forward until warning lamp goes out. As soon as the lamp has gone out, check that the blowers at the engine cooling air intake and in the heater run-on for 120–240 seconds, to cool the heater and emit all traces of exhaust gases from the combustion chamber.

Note:

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





Heater booster – technical data

Heat output, infinitely variable	1000–3400 kcal/h
Fuel	Gasoline
Fuel consumption	0.2–0.6 liter/h (.42–1.3 US pt./h) (.35–1 Imp. pt./h)
Nominal voltage	12 volts
Current input	130 watts

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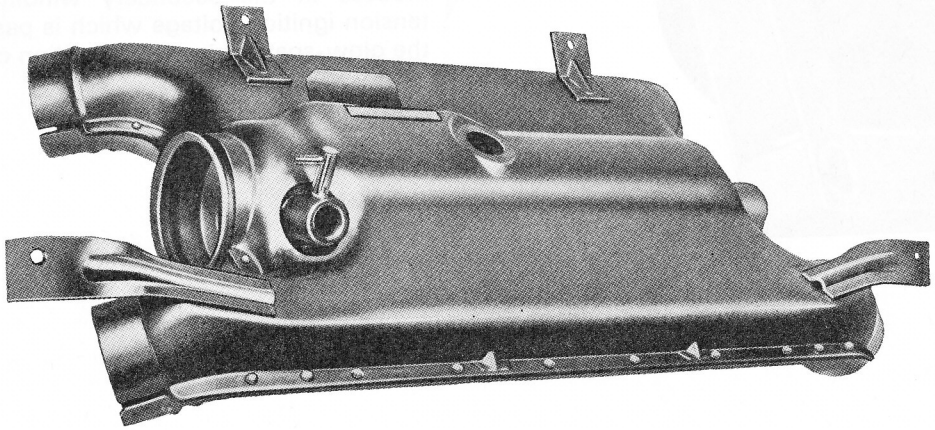
Description of parts

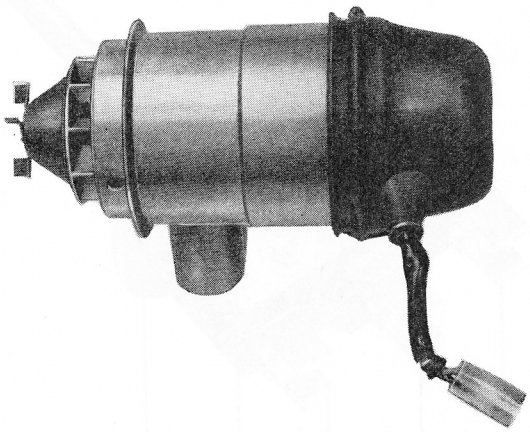
Housing and heat exchanger

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



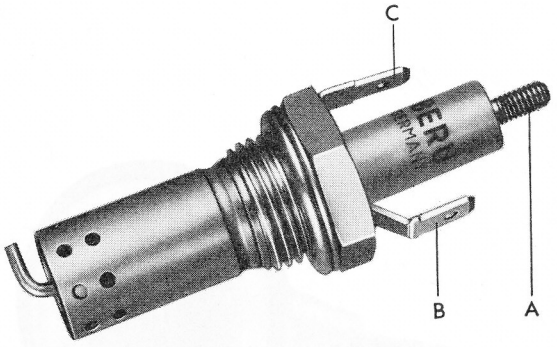
Combustion air blower

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



Glow-spark plug

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



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

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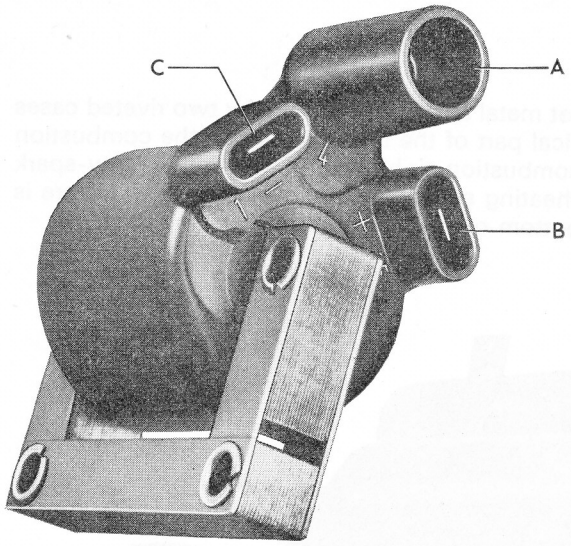
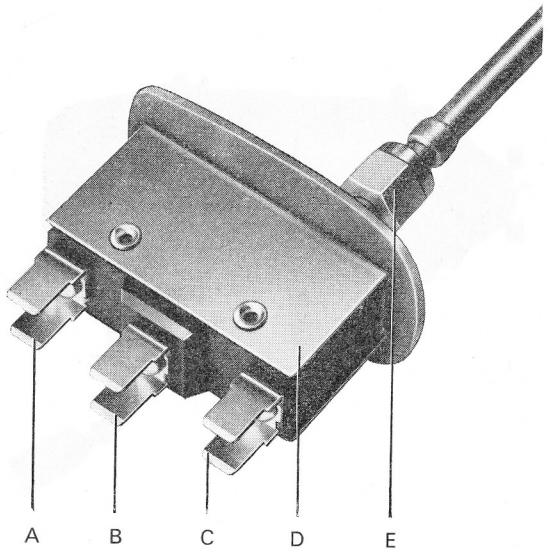


Ignition coil

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

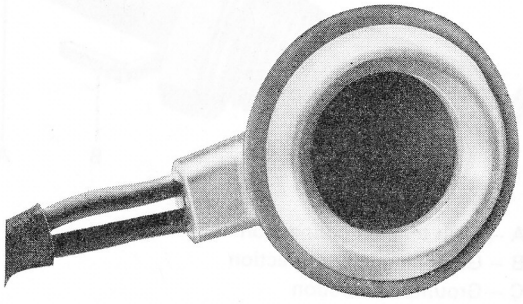
A – High tension connection
B – Terminal 15
C – Terminal 1



Thermo-switch

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

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

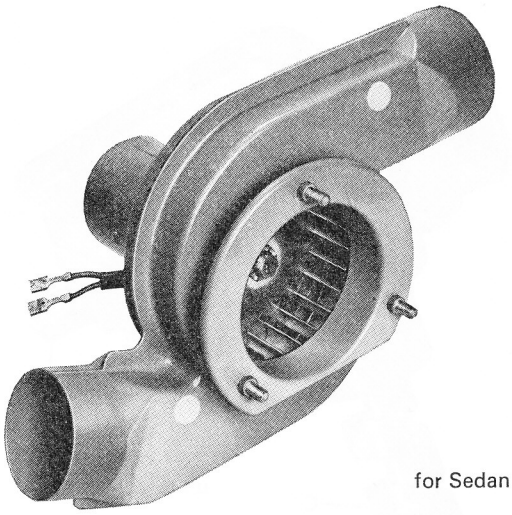


Overheating switch

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

Hot air blower

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



for Sedan

Description

There are two types of blower:

a – Standard blower
Diameter of motor – 60 mm

b – Blower for ribbed heat exchangers (m 202)
Diameter of motor – 74 mm
from 1 August 1972,
Chassis No. 412 2 000 001

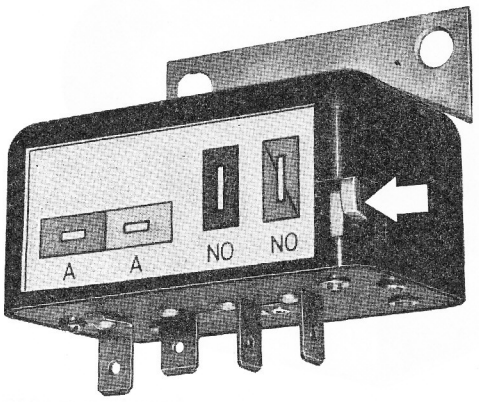
Current draw (when installed)

a – Standard blower – 8–9 amps at 13 volts

b – Blower for ribbed heat exchangers
12–14 amps at 13 volts

Safety switch

This switch cuts off the current to the heater should, for any reason (fuel supply cut off, glow-spark plug defective) combustion does not take place within 230 seconds of switching on.



Switch response time:

150–230 seconds at room temperature and 12 volts.

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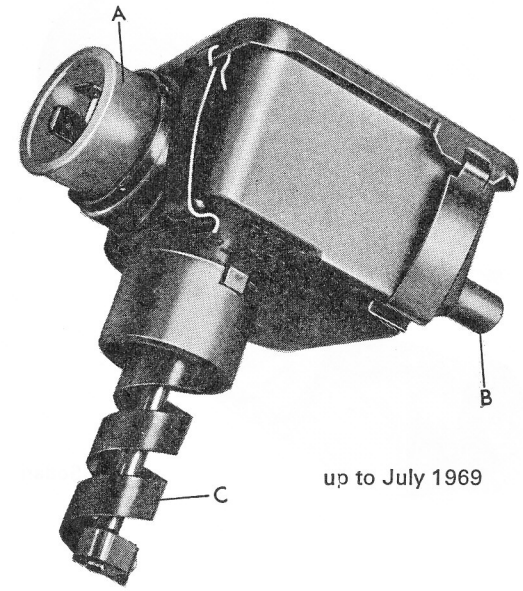


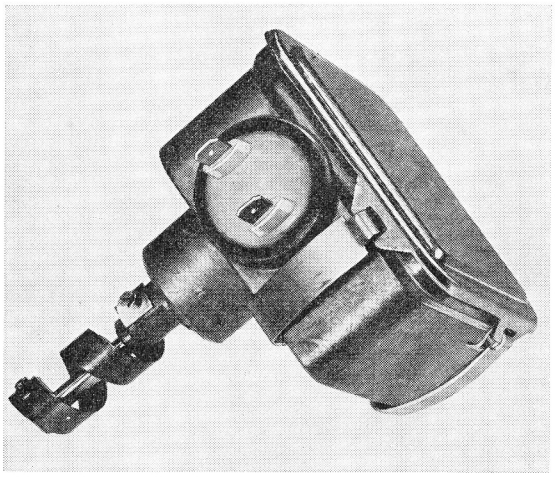
up to July 1969

Mechanical temperature regulating switch

up to July 1970

The bimetal spiral of the control switch protrudes into the left warm air duct and operates a contact via a cam when the temperature changes. This contact switches the fuel pump on and off via a relay depending on the pre-set temperature. The control range is adjustable between 35° and 125° C and is dependent on the position of the thermostat control linkage. The linkage is operated by the left-hand regulating lever via a bowden cable. The regulating lever also closes the cut-in contact of the operating relay at the same time.

A – Electrical cable connection
B – Bowden cable attachment
C – Bimetal spiral

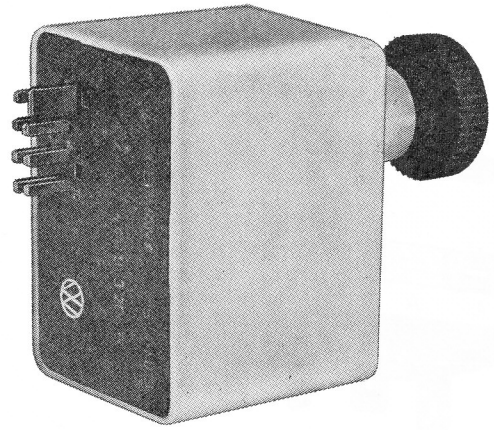


from August 1969 to July 1970

Electronic temperature regulating switch

from August 1970

This switch is combined with the time switch and main heater switch in one housing. A warning lamp (1.2 watt) is fitted in the switch knob.



from August 1970

1 – Temperature regulation is done with electronic circuitry. Temperature-sensitive voltages are fed to the switch from a temperature sensor and the switch feeds two voltage conditions to the relay.

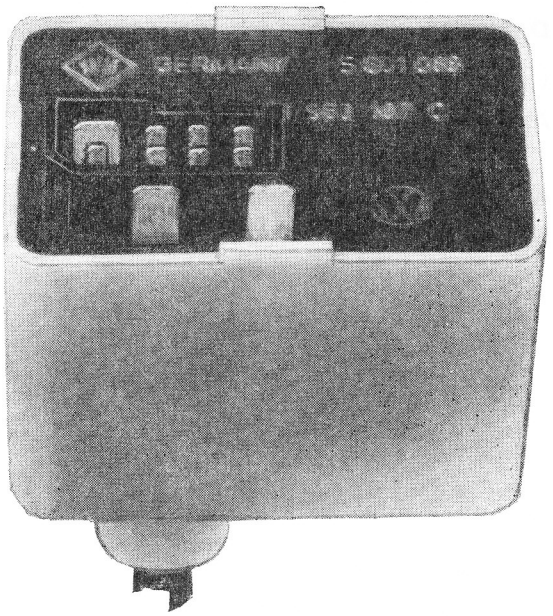
2 – A main heater switch is incorporated.

3 – It limits heater operation to 10 minutes when ignition is off.

Warning lamp

up to Chassis No. 412 2 064 916

When the heater is switched on, the warning lamp in the knob of the temperature regulating switch lights up. When the parking lights or headlights are switched on as well, the intensity of the warning lamp is reduced by one half to reduce dazzle at night. This is done by an additional transistor in the temperature regulating switch via the cable between terminal 58 on switch and the parking light (see wiring diagram).



Description:

From Chassis No. 413 2 000 001

Two terminals marked K and 31 have been fitted separate from the other terminals.

Regulating ranges:

Upper range ..... 115–143 °C

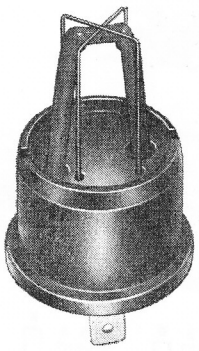
Lower range ..... 30–40 °C

(The switching points of the temperature regulating switch can only be checked roughly with electronic measuring instruments near the temperature sensor.)

Temperature sensor

from August 1970

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



Technical properties:

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

Resistance:

Measured in water at 60 °C ..... 3.5 to 5 kΩ

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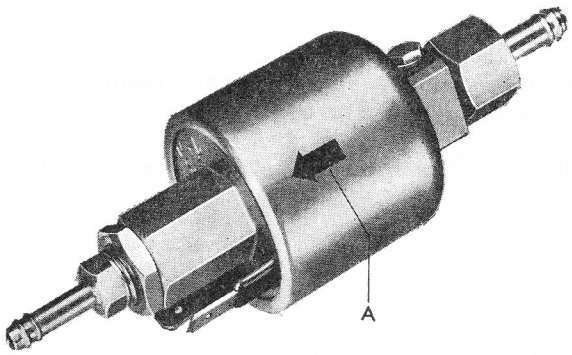


A–Flow direction

Fuel pump

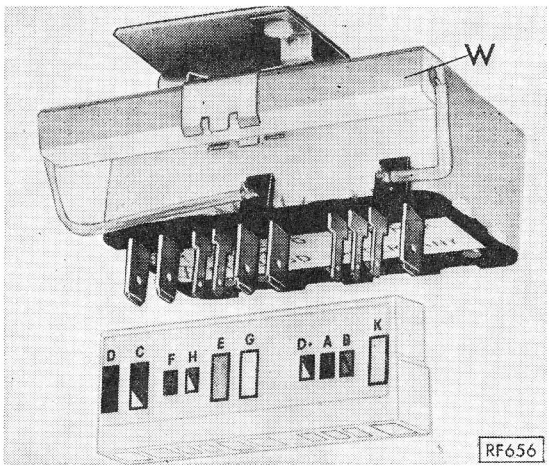
The amount of fuel delivered by the electro-magnetic metering pump is directly dependent on the speed of the combustion air blower. At every 33rd revolution of the motor shaft, the pump receives an impulse via the breaker contacts so that the fuel-air mixture is always constant regardless of changes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

Delivery capacity:

(To be measured at room temperature)

As produced up to July 1969:
200 strokes = 9.9 to 11 cm^3.

As produced from August 1969:
200 strokes = 11.8 to 12.5 cm^3.



A – Flow direction

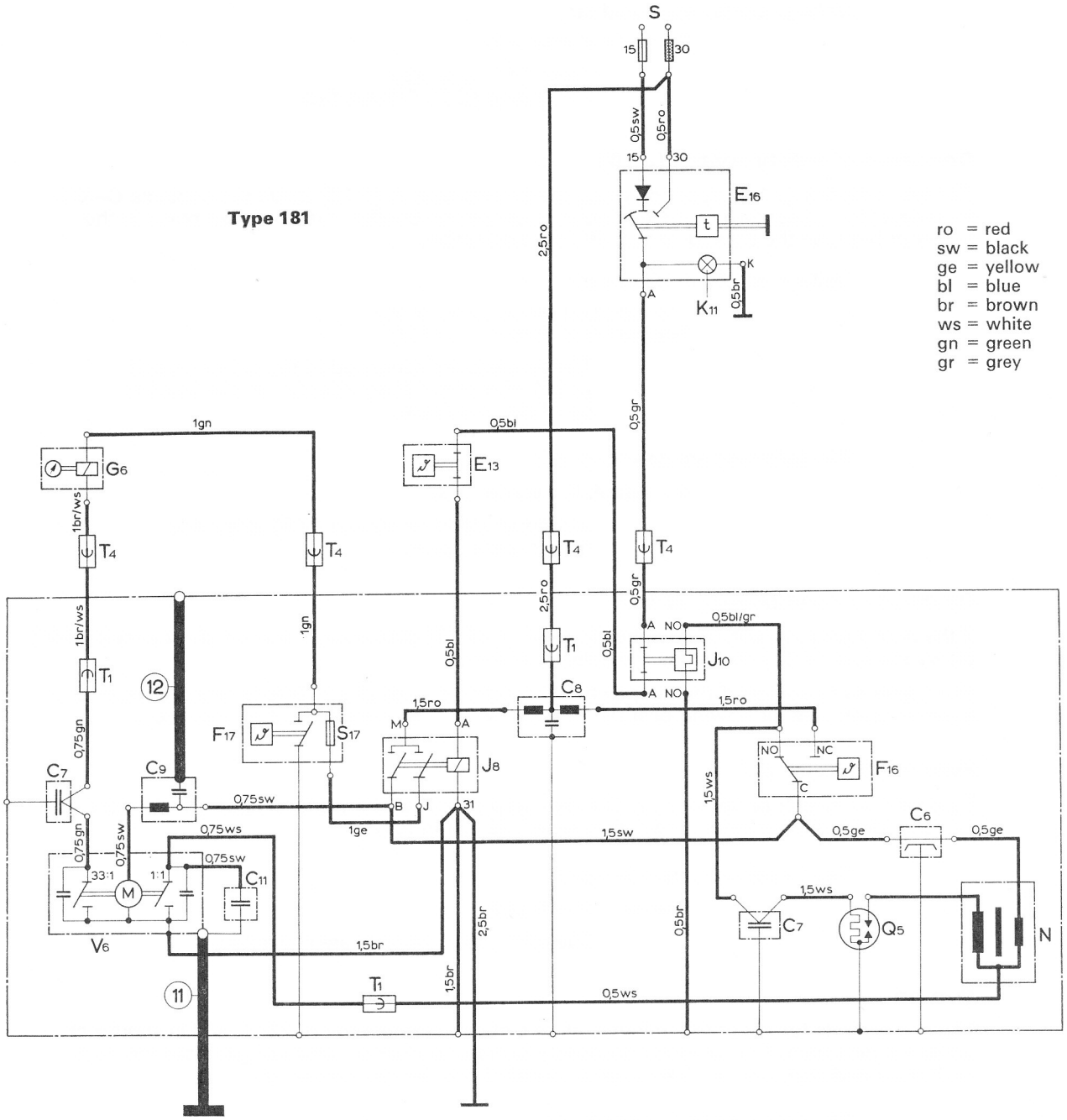
Relay

for heaters with high output heat exchangers.

Resistance:

Built-in series resistance (0.27 Ohm) for the warm air blower.
(Only installed on BA 4 heaters with stronger warm air blower and ribbed heat exchangers.)

Type 181

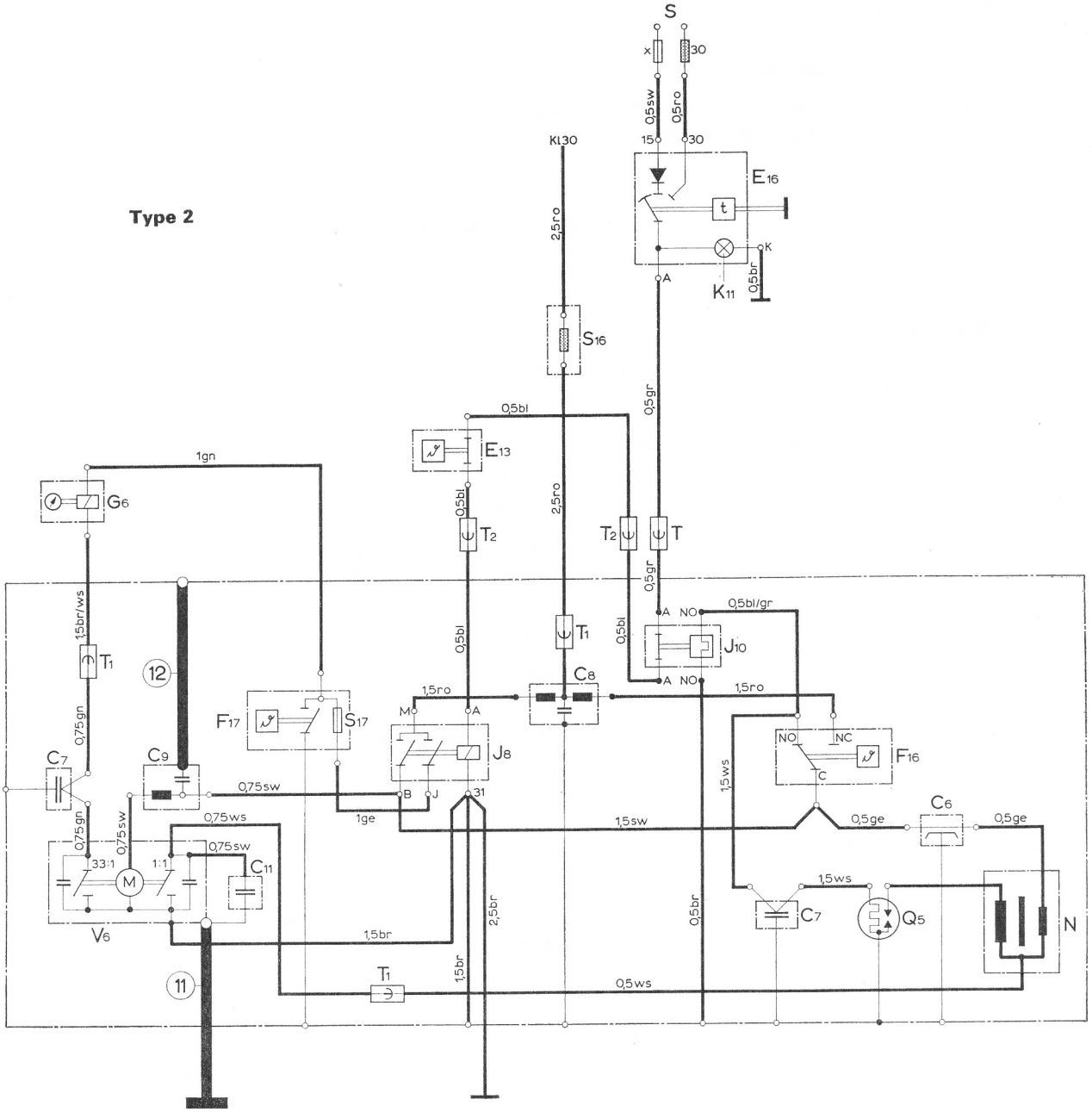


ro = red
sw = black
ge = yellow
bl = blue
br = brown
ws = white
gn = green
gr = grey

G_6 – Suppression condenser for coil/capacity 0.47 µF
C_7 – Suppression condenser for glow-spark plug and heater/capacity 2.2 µF
C_8 – Suppression filter on safety switch/capacity 1 µF/inductivity 2×3 µH
C_9 – Suppression filter for combustion air blower/capacity 1 µF/inductivity 2.5 µH
G_{11} – Suppression condenser on combustion air blower/capacity 0.16 µF
E_{13} – Temperature regulating switch
E_{16} – Heater switch/operating time 25 minutes
F_{16} – Thermo-switch
F_{17} – Overheating switch
G_6 – Metering pump
J_8 – Relay
J_{10} – Safety switch

K_{11} – Warning lamp, 1.2 W
N – Ignition coil/voltage 1
Q_5 – Glow-spark plug
S – Fuse box
S_{16} – Separate 16 amp fuse
S_{17} – Overheating fuse/8 a
T_1 – Cable connector, sing
T_2 Cable connector, dou
T_3 – Cable connector, 3 pi
T_4 – Cable connector, 4 pi
V_6 – Combustion air blowe

Type 2



2 Watt
ge 12/5000

fuse
e/8 amp
single
double
3 pin
4 pin
ower

⑪ – Ground strap – Combustion air blower to body
⑫ – Ground strap – Suppression filter to heater casing
Terminal 30 – Connection to terminal 30 on starter

Type 2: from 1 August 1971, Chassis No. 212 2 000 001

Explanation

To switch heater on

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

Voltage can be measured at:

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

Warning lamp (K 11) lights up.

Start-up

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

Voltage can be measured at:

Terminal A of relay (J 8)

Relay (J 8) operates contacts B–M–J.

Terminals M–B of relay (J 8)

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

Both contacts of overheating fuse (S 17)

The metering pump (G 6) delivers fuel.

Terminals C–NO of thermo-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 thermo-switch (F 16) operates the contacts C–NC. A uniform roaring noise should be heard at the exhaust pipe.

The following is de-energized:

Terminal NO of thermo-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.

G6
C7
C8
C9
G11
E13
E16
F16
F17
G6
J8
J10

The following are de-energized:

Terminal A of relay (J 8)

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

Both contacts of 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 thermo-switch (F 16) holds the contacts C–NO for longer than about two or three minutes because combustion has not taken place in the heater or because the thermo-switch (F 16) is defective.

Voltage can be measured at:

Terminal NO of thermo-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 the heating up of the resistance.

The following are de-energized:

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

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

Operation of overheating circuit

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

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

Switching heater off

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

The following is de-energized:

Terminal 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 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 thermo-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:

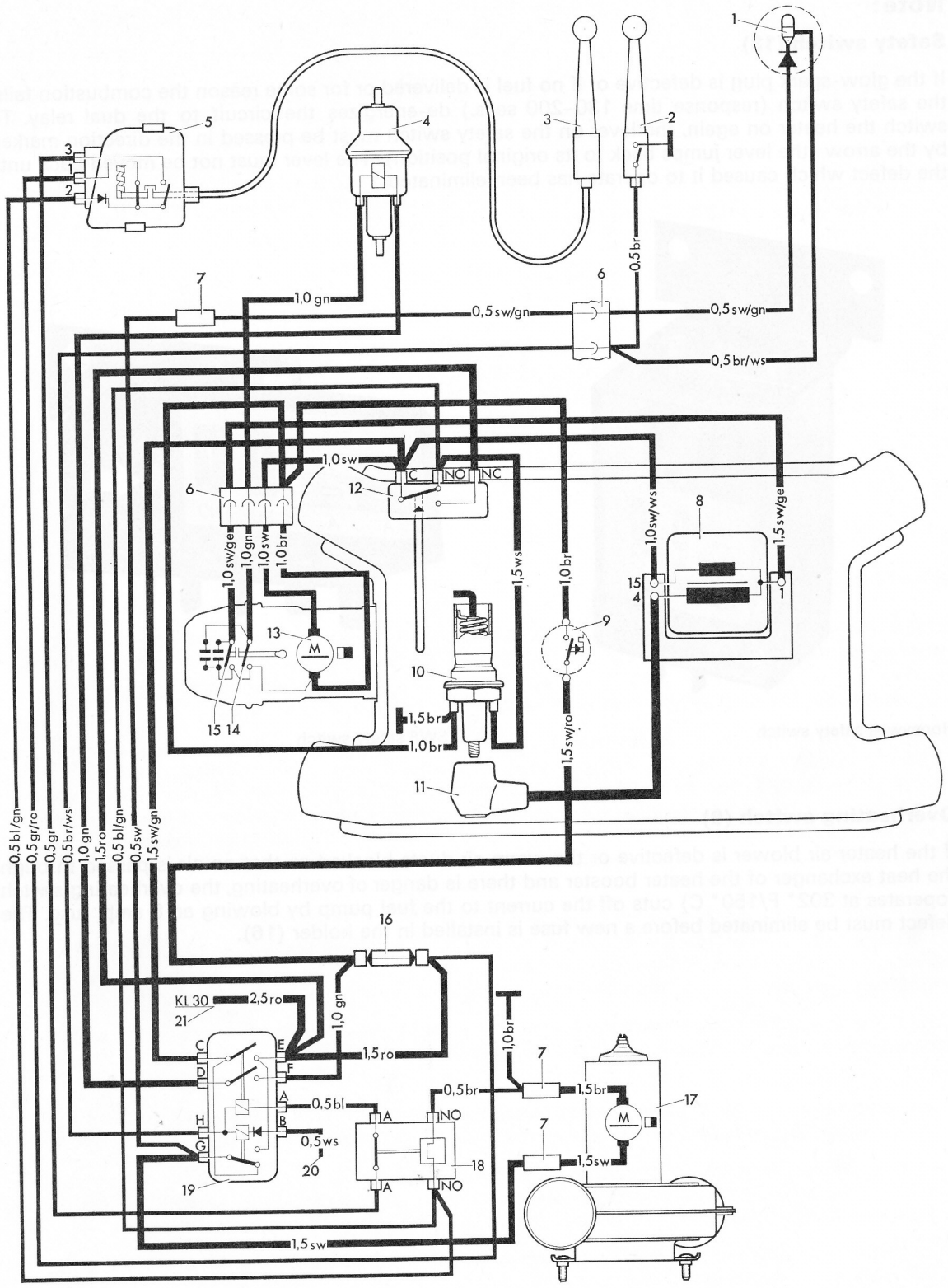
Terminals NC–C of thermo-switch (F 16)
Terminal B of relay (J 8)

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

The following are de-energized:

Contacts C–NO of thermo-switch (F 16)

The run-on is finished.



Cable colors:

ro – red	bl – blue	ws – white
sw – black	br – brown	gn – green
ge – yellow		

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1 – Warning lamp and diode
2 – Main switch (heater flap lever)
3 – Regulating lever
4 – Fuel pump
5 – Temperature control switch
(range 95–257° F / 35–125° C)
6 – Push-on terminal
7 – Cable connector
8 – Ignition coil
9 – Overheating switch
(cut-in temperature approx. 302° F / 150° C)
10 – Glow-spark plug
11 – Angled connector and ignition cable
12 – Thermo-switch (run-on time 120–240 secs.)
13 – Combustion air blower
14 – Contact breaker for pump
15 – Contact breaker for ignition
16 – 8 amp. short circuiting fuse
17 – Heater air blower
18 – Safety switch (response time 130–200 secs.)
19 – Dual relay
20 – to dual relay KL.E
21 – to terminal 30 of fuse box (16 amp. fuse)

Note:

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

Explanation of wiring diagram

When lever (3) is operated and at the same time the contact in lever (2) closed, the dual relay (19, connection A–H) is energized via contact 1–3 of the temperature control switch (5) and contact A–A of the safety switch (18). The warning lamp (1) on the instrument panel immediately lights up (energized by KL.G of the dual relay and via the contact in lever 2).

The heater air and combustion air blowers (17 and 13), switched on by relay contacts E–G and E–C, begin to operate. The electrical fuel pump (4) is provided with current via relay contact F–D and begins to pump fuel into the combustion chamber controlled by contact breaker (14) of the combustion air blower. The combustion air is swirled by the housing with vanes and forms a combustible mixture with the fuel. The glow element in the glow-spark plug (10) is provided with current via relay contact E–C and via the thermo-switch (12) – contact C–NO. The element heats up and pre-heats the air/fuel mixture.

At the same time as the glow-spark plug receives current, the ignition coil (8) also cuts in. The contact breaker (15) then breaks the primary circuit, as on the vehicle engine. The high tension of about 5000 volts induced in the secondary winding by this means passes to the glow-spark plug via an ignition cable with angled connector (11) and ignites the air/fuel mixture.

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

When the temperature set by the temperature control switch is attained, contact 1–2 cuts off the current to the relay. The relay is ineffective, the fuel pump is de-energized and combustion ceases.

The heater air blower remains in operation via contact E–G, as the relay winding B-H has not yet been de-energized. The combustion air blower remains in operation, energized via thermo-switch contact NC-C. In addition, the ignition system is also still supplied with current.

When the bimetal spiral of the temperature control switch cools down to below the pre-set temperature, the relay is energized again via contact 1–2–3 of the control switch and closes. The fuel pump begins to operate and combustion recommences.

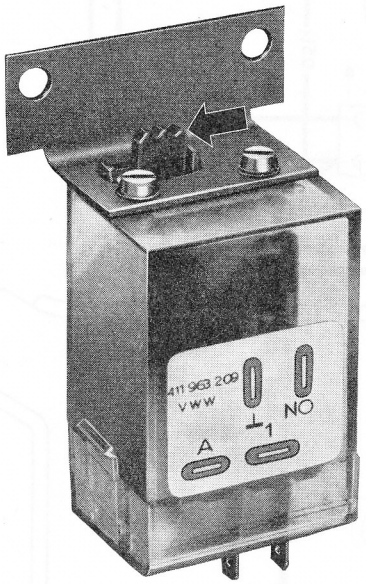
The heater remains on until the holding current of the relay is switched off by the contact in lever 2 (lever 2 far enough forward so that warning lamp goes out).

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

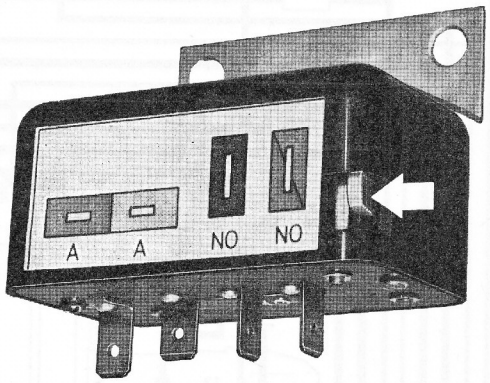
Note:

Safety switch (18)

If the glow-spark plug is defective or if no fuel is delivered or for some reason the combustion fails, the safety switch (response time 130–200 secs.) de-energizes the circuit to the dual relay. To switch the heater on again, the lever on the safety switch must be pressed in the direction marked by the arrow (the lever jumps back to its original position). The lever must not be moved back until the defect which caused it to operate has been eliminated.



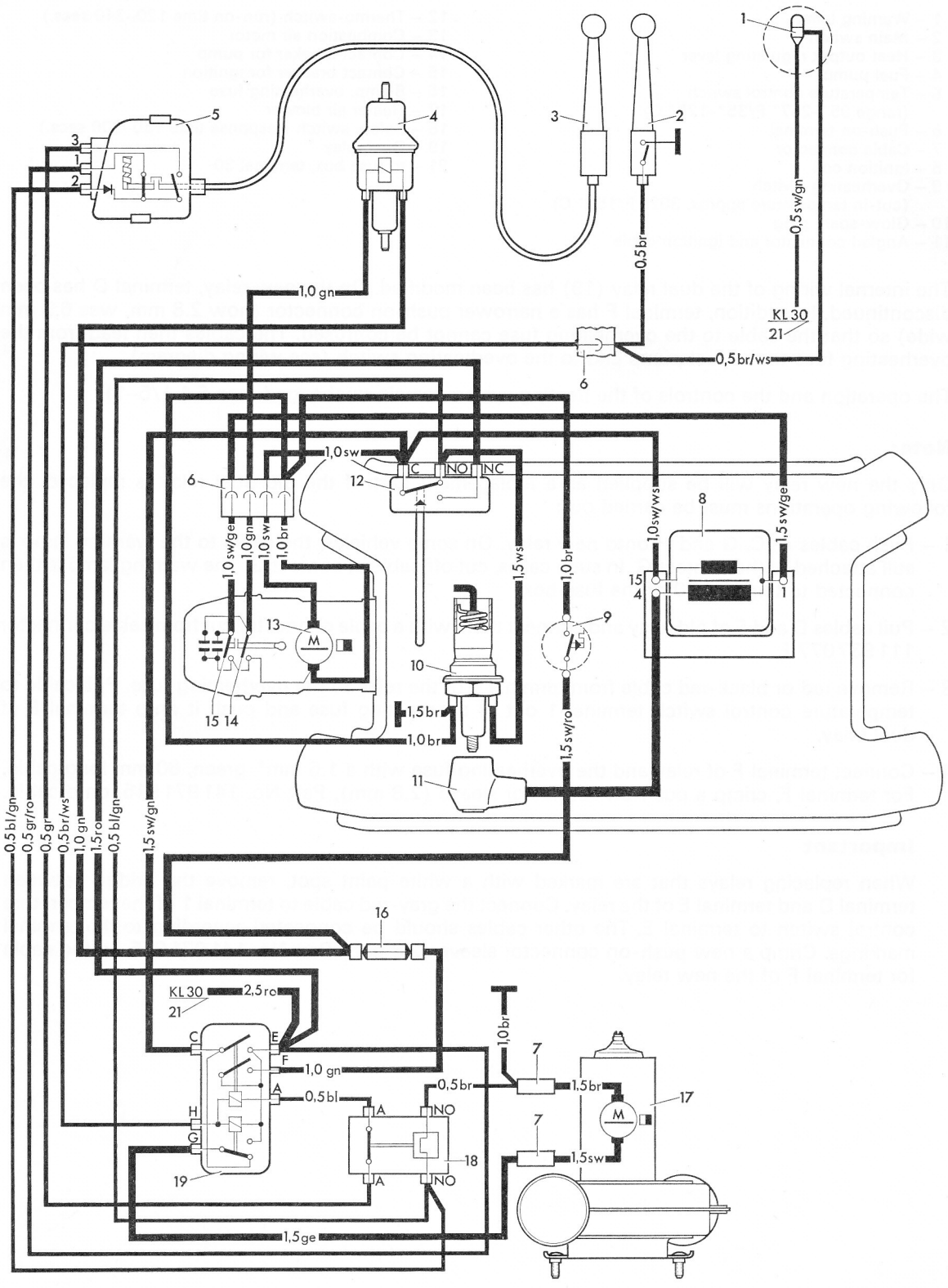
Honeywell safety switch



SWF safety switch

Overheating switch (9)

If the heater air blower is defective or the warm air ducts blocked so that no air is passed through the heat exchanger of the heater booster and there is danger of overheating, the overheating switch (operates at 302° F/150° C) cuts off the current to the fuel pump by blowing an 8 amp. fuse. The defect must be eliminated before a new fuse is installed in the holder (16).



Cable colors:

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

539.604.20 Printed in Germany 10.69

1 – Warning lamp
2 – Main switch
3 – Heat output regulating lever
4 – Fuel pump
5 – Temperature control switch (range 95°–257° F/35°–125° C)
6 – Push-on terminal
7 – Cable connector
8 – Ignition coil
9 – Overheating switch (cut-in temperature approx. 302° F/150° C)
10 – Glow-spark plug
11 – Angled connector and ignition cable
12 – Thermo-switch (run-on time 120–240 secs.)
13 – Combustion air motor
14 – Contact breaker for pump
15 – Contact breaker for ignition
16 – 8 amp. overheating fuse
17 – Heater air blower
18 – Safety switch (response time 130–200 secs.)
19 – Dual relay
21 – to fuse box, terminal 30

The internal wiring of the dual relay (19) has been modified. On the new relay, terminal D has been discontinued. In addition, terminal F has a narrower push-on connector (now 2.8 mm, was 6.3 mm wide) so that the cable to the overheating fuse cannot be confused. The cables then lead from the overheating fuse to the fuel pump and to the overheating switch (see wiring diagram).

The operation and the controls of the heating system remain unchanged (see F 1.1/5–1).

Note:

Only the new relay will be supplied as a replacement part. If the old dual relay is replaced, the following operations must be carried out:

1 – Push cables A, C, G and H onto new relay. On some vehicles, the cable to the warning lamp is still attached to the contact G. In such cases, cut off cable at contact G. The warning lamp is then connected to terminal 30 of the fuse box.

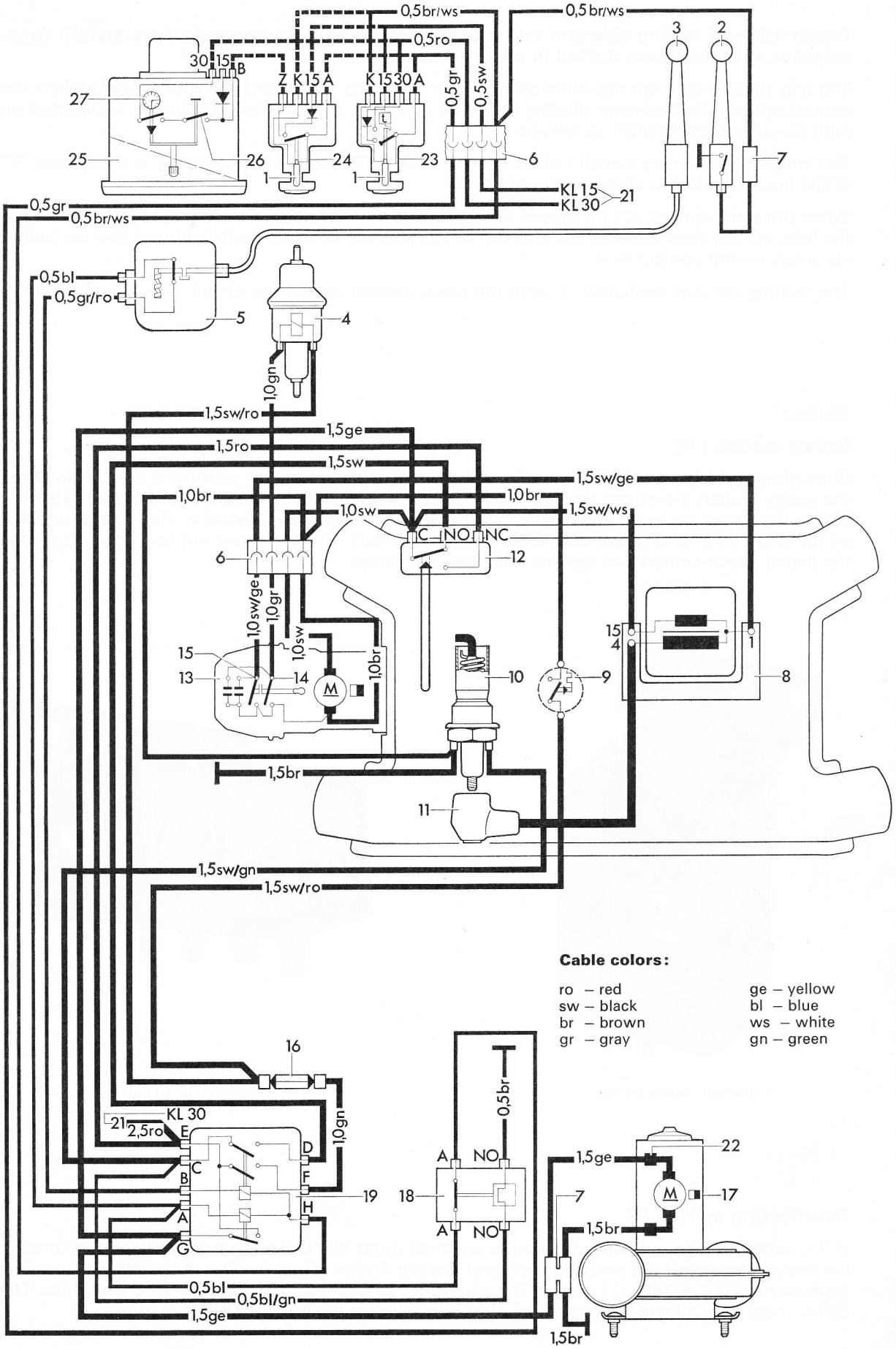
2 – Pull cables D and F of old relay and connect them with a cable connector cut from cable connector 111 937 077 E.

3 – Remove red or black-red cable from terminal E of the relay to the overheating fuse. Pull cable to temperature control switch terminal 1 out of overheating fuse and push it onto terminal E of dual relay.

4 – Connect terminal F of relay and the overheating fuse with a 1.5 mm², green, 80 mm long cable. For terminal F, crimp a push-on connector sleeve (2.8 mm), Part No. 141 971 945, onto cable.

Important

When replacing relays that are marked with a white paint spot, remove the bridge between terminal D and terminal E of the relay. Connect the gray-red cable to terminal 1 of the temperature control switch to terminal E. The other cables should be connected according to the terminal markings. Crimp a new push-on connector sleeve (2.8 mm) Part No. 141 971 945, to the cable for terminal F of the new relay.



Cable colors:

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

539.604.20 Printed in Germany 10.69

1 – Warning lamp
2 – Main switch
3 – Regulating lever
4 – Fuel pump
5 – Temperature control switch (range 95–257° F / 35–125° C)
6 – Push-on terminal (below instrument panel)
7 – Cable connector
8 – Ignition coil
9 – Overheating switch (cut-in temperature approx. 302° F / 150° C)
10 – Glow-spark plug
11 – Angled connector and ignition cable
12 – Thermo-switch (run-on time 120–240 secs.)
13 – Combustion air blower
14 – Contact breaker for pump
15 – Contact breaker for ignition
16 – 8 amp. overheating fuse
17 – Heater air blower
18 – Safety switch (response time 130–200 secs.)
19 – Dual relay
21 – to terminal 30 of fuse box
22 – 4 uH suppression choke
23 – Time switch
24 – Rotary switch
25 – Pre-selector switch

} M-equipment "M 557" only

When the time switch (23) is turned fully to the right (this winds up the clockwork mechanism) and the contact in the lever (2) is closed, winding A–H in the dual relay (19) is energized via time switch contact 30–A and contact A–A of the safety switch (18). Winding B–H of the dual relay is energized via the relay contact A and temperature regulating switch (5). The warning lamp (1) in the time switch immediately lights up (energized via terminal 30 of the time switch and the contact in the lever 2).

The heater air and combustion air blowers (17 and 13), switched on by dual relay contact E–G, begin to operate. The electrical fuel pump (4) is energized via relay contact E–F and overheating fuse (16) and begins to pump fuel into the combustion chamber controlled by contact breaker (14) of the combustion air blower. The bi-metal element in the glow-spark plug (10) is switched on via the following contacts: dual relay contact E–G, thermo-switch contact C–NO and dual relay D–C. The element heats up and, in turn, heats up the air/fuel mixture transferred to the combustion chamber by the combustion air blower.

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

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

When the temperature set with the regulating lever (3) is attained, the contact in the temperature control switch (5) cuts off the current to dual relay winding B–H. The relay is then ineffective, the fuel pump is de-energized and combustion ceases.

The heater air blower and the combustion air blower remain in operation via contact E–G, as relay winding A–H has not get been de-energized. The ignition system is also still energized. When the bimetal spiral of the temperature control switch cools down to below the pre-set temperature, the relay winding B–H is energized again via the control switch relay. The fuel pump begins to operate and combustion recommences.

The heater remains on until the clockwork mechanism in the time switch has run down (after about 10 mins.) and the contact has moved from 30–A to 15–A.

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

Note:

1. If the ignition is switched on before the contact has reached the 15–A position, the heater can only be switched off by turning the time switch knob as far as possible to the left.
2. The heater can also be switched off when the holding current for the dual relay is interrupted by the contact in lever 2.

Explanation of wiring diagram with rotary switch and pre-selector time switch (pre-selector switch shown dotted in wiring diagram)

The only difference in the operation of the heater with time switch and pre-selector switch is in the control cable of the dual relay winding A–H. The dual relay and, therefore, the heater, is switched on with the pre-selector switch as follows:

The contact in the rotary switch (24) is in position A–Z. The standby switch (26) is closed and "E" of the numbered disk is visible in the aperture.

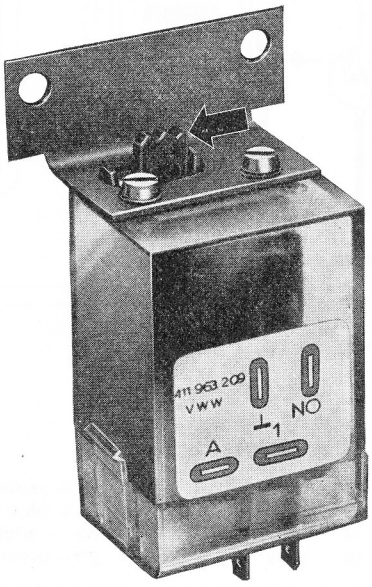
When the clock contact (27) is closed the current from terminal 30 of the time switch can energize the relay via the clock contact, the standby switch and via the rotary switch contact Z–A as well as via safety switch contact A–A.

The heating remains switched on until the clock contact breaks the circuit after 15–20 minutes.

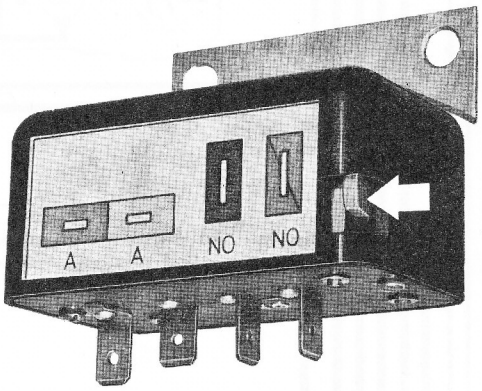
Note:

Safety switch (18)

If the glow-spark plug is defective or if no fuel is delivered or for some reason the combustion fails, the safety switch (response time 130–200 secs.) de-energizes the circuit to the dual relay. To switch the heater on again, the lever on the safety switch must be pressed in the direction marked by the arrow (the lever jumps back to its original position). The lever must not be moved back until the defect which caused it to operate has been eliminated.



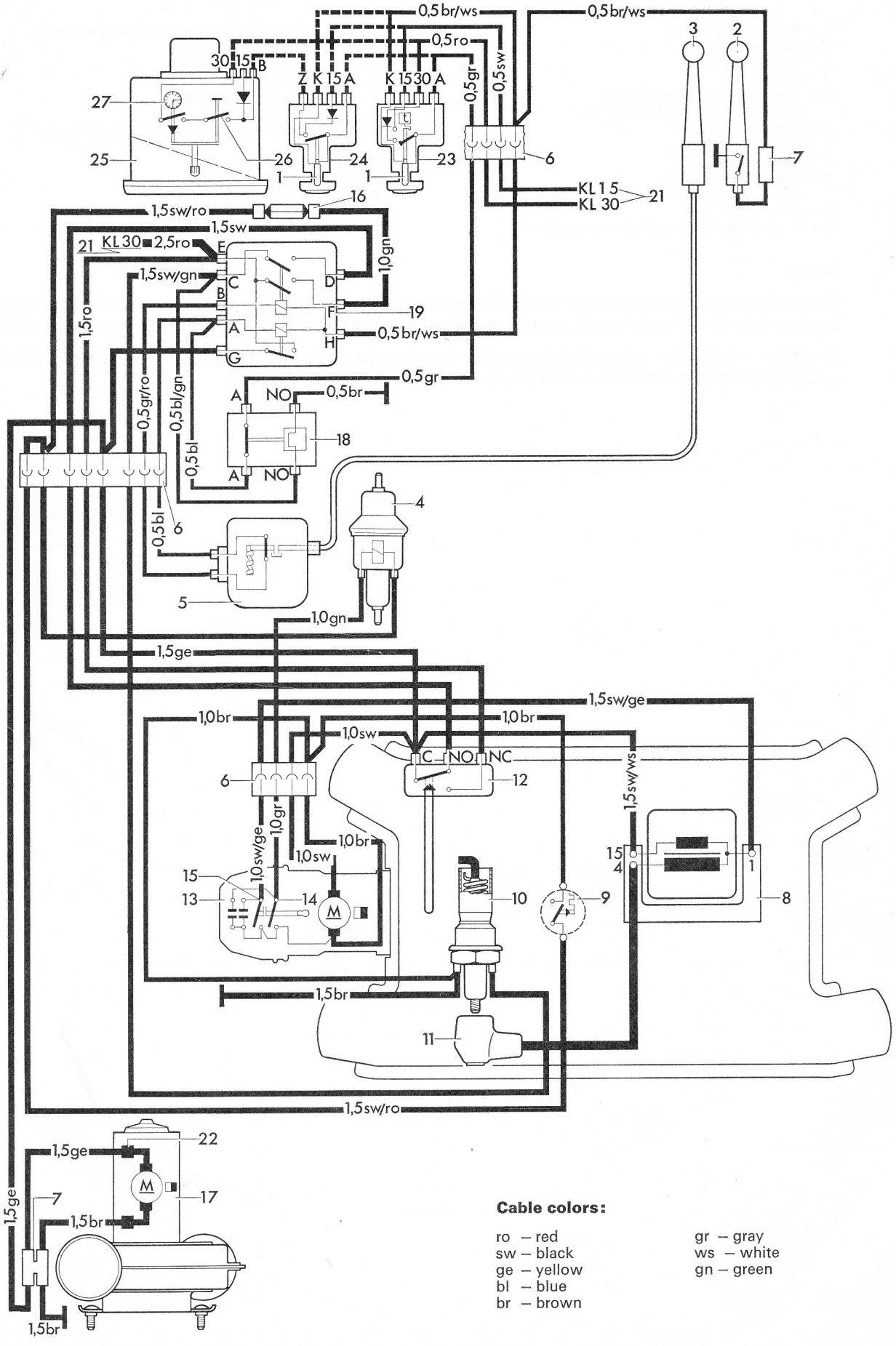
Honeywell safety switch



SWF safety switch

Overheating switch (9)

If the heater air blower is defective or the warm air ducts blocked so that no air is passed through the heat exchanger of the heater booster and there is danger of overheating, the overheating switch (operates at 302° F/150° C) cuts off the current to the fuel pump by blowing an 8 amp. fuse. The defect must be eliminated before a new fuse is installed in the holder (16).



Cable colors:

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

Wiring diagram and explanation – Squareback Sedan from Chassis No. 460 000 001 **5 - 11**

539.604.20 Printed in Germany 10.69

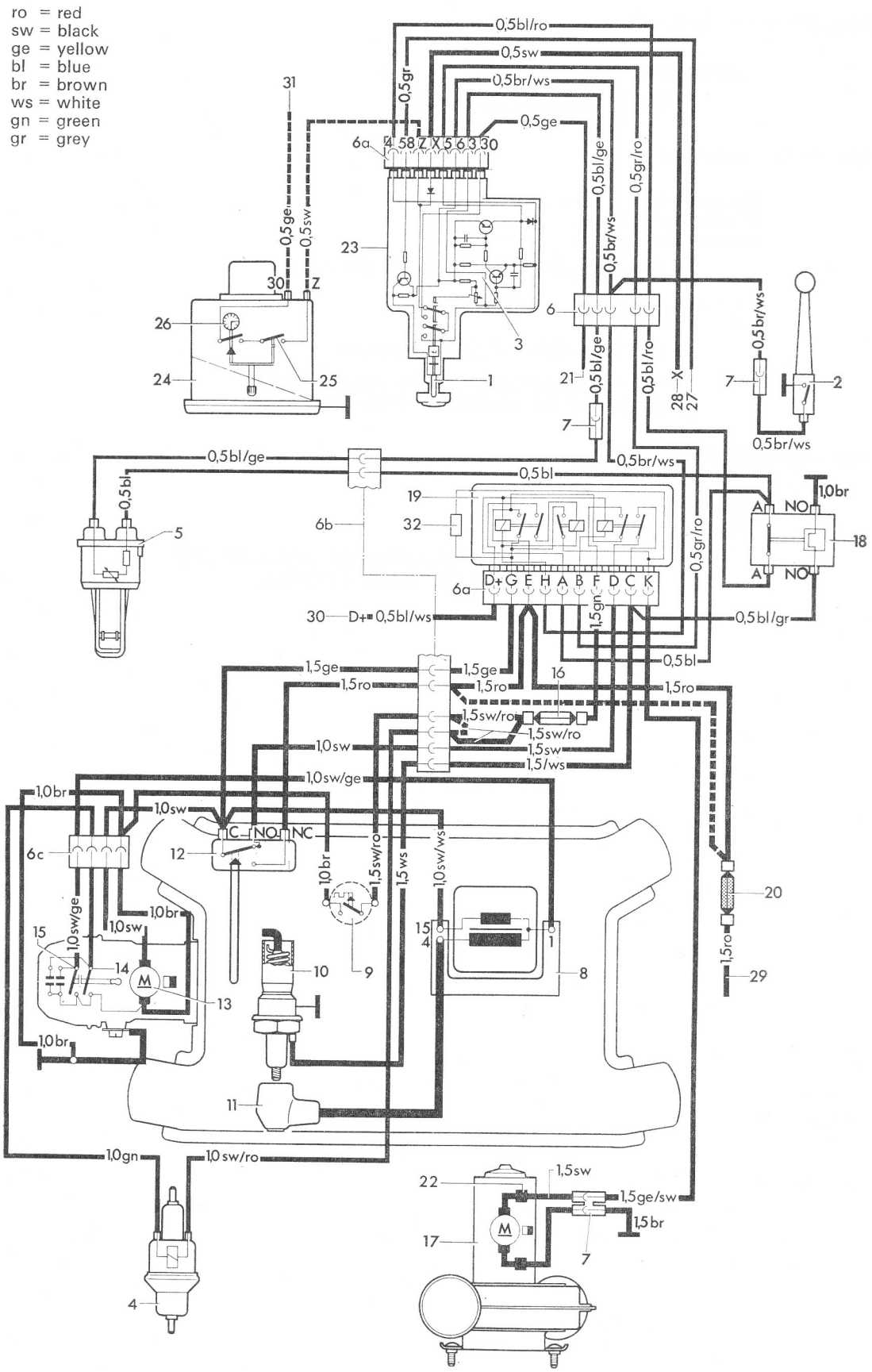
1 – Warning lamp
2 – Main switch
3 – Regulating lever
4 – Fuel pump
5 – Temperature control switch (range 95–257° F/35–125° C)
6 – Push-on terminal
7 – Cable connector
8 – Ignition coil
9 – Overheating switch (cut-in temperature approx. 302° F/150° C)
10 – Glow-spark plug
11 – Angled connector and ignition cable
12 – Thermo-switch (run-on time 120–240 secs.)
13 – Combustion air blower
14 – Contact breaker for pump
15 – Contact breaker for ignition
16 – 8 amp. overheating fuse
17 – Heater air blower
18 – Safety switch (response time 130–200 secs.)
19 – Dual relay
21 – to fuse box, terminal 30
22 – 4 μH suppression choke
23 – Time switch
24 – Rotary switch } M-equipment
25 – Pre-selector switch } "M 557" only

Note:

On the Type 4 Squareback Sedan the relays are under the rear seat. The cables are routed in the main harness into the engine compartment and from there to the heater via a push-on connector (6).

An explanation to the wiring diagram can be found on page F 1.1/5–5, as the heating system of the Sedan and Squareback Sedan models are the same.

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



Wiring diagram and explanation (from August 1971; Chassis No. 412 2 000 001)
BA 4 Heater with modified warm air blower and ribbed heat exchanger

3.48.539.807.20 F 7th Supplement Printed in Germany 10. 72

1 – Warning lamp
2 – Main switch
3 – Electronic circuitry
4 – Metering pump
5 – Temperature sensor
6 – Connector on column tube
6a) – Connector
6b) – Connector-Variant
6c) – Connector on combustion air blower
7 – Connector
8 – Ignition coil
9 – Overheating switch
10 – Glow-spark plug
11 – Plug connector and cable
12 – Thermo-switch
13 – Combustion air blower
14 – Contact breaker for pump
15 – Contact breaker for ignition
16 – Overheating fuse 8 amp.
17 – Warm air blower
18 – Safety switch
19 – Relay
20 – Separate fuse – 16 amp.
21 – to fuse box terminal 30
22 – Suppression choke
23 – Temperature regulating switch
24 – Time switch in clock – only optional extra "M 557"
25 – Readiness switch
26 – Clock contact
27 – to parking lights – terminal 58
28 – to starter-ignition switch – terminal X
29 – to starter terminal 30 (with 16 amp. fuse)
30 – to regulator – terminal D+
31 – to clock – terminal 30
32 – Series resistance on relay for warm air blower

The cables shown as dotted lines are on the Variant.

Explanation

To switch heater on

a – Pull main switch (2) up until ground contact is closed.
b – Operate temperature regulating switch (23) and set heat. The warning lamp (1) lights up. (Testing should always be carried out with the engine running at a fast idle.)

Start-up

The heater ignites within 60 seconds if the air drawn in is at room temperature. The start-up process is terminated by the thermo-switch (12).

Voltage can be measured at:

Terminal 30
Terminals 30–4 of temperature regulating switch (23)
Terminals A–A of safety switch (18)
Terminal A of relay (19)

Relay (19) operates contacts E–G and E–K.

Terminals of fuse (20) 16 amp.
Terminals E–K of relay (19)

The warm air blower (17) starts to work. The series resistance for the warm air blower (32) reduces the output when there is no voltage at terminal D+ on regulator. The resistance (32) is bridged by relay contact when there is no voltage at terminal D+ on relay.

Terminal C of thermo-switch (12)

The combustion air blower motor (13) starts to work.

No voltag

Voltage c

Heating

When the heater has i
This ends the start-up

The follo

Regulation

During regulation the
These voltages are co
temperature sensor (5
records a high temper
terminal 5 as the swit

Terminal 15 of ignition coil (8)

At every revolution of the combustion air motor (13) the ignition coil (8) receives an impulse via the breaker contacts (15).

No voltage or a low voltage can be measured at:

Main switch (2)
Terminals 6–5 of temperature regulating switch (23)
– about 3 volts –
Terminal B of relay (19)
– about 3 volts –

Relay (19) operates the contacts E–F and C–D.

Voltage can be measured at:

Terminal NO of thermo-switch (12)
Terminal D–C of relay (19)

The glow element of the glow-spark plug (10) is energized. It warms the fuel-air mixture to make it readily combustible. It is then ignited by the sparks from the glow-spark plug (10).

Terminals E–F of relay (19)
Overheating fuse (16) 8 amps
Terminal of fuel metering pump (4)

The fuel pump (4) starts to deliver fuel. At every 33rd revolution of the combustion air motor (13) the fuel pump (4) receives an impulse via the contact breaker (14).

Heating

When the heater has ignited and warmed up, the thermo-switch (12) operates the contacts C–NC. This ends the start-up process.

The following are de-energized:

Terminal NO of thermo-switch (12)
Terminal D–C of relay (19)
Terminal NO of safety switch (18)

The glow element of the glow-spark plug (10) is de-energized.
The safety switch (18) is out of action.

Regulation

During regulation there are two voltages at terminal 5 of the temperature regulating switch (23). These voltages are controlled by the temperature selection via the electronic circuitry (3) and the temperature sensor (5). When the heater reaches the high heat output, the temperature sensor (5) records a high temperature and the temperature regulating switch (23) indicates a high voltage at terminal 5 as the switching value for the relay (19).

Voltage can be measured at:

Terminal 5 of temperature regulating switch (23)
Terminal B of relay (19)

The relay separates the contacts E–F and D–C.

The following are de-energized:

Terminal F of relay (19)
Terminals of fuse (16)
Terminal of fuel pump (4)

The fuel pump stops delivering fuel and the heat exchanger cools down. The temperature of the warm air also drops. The heat exchanger does not, however, cool down so far during the regulating process that the thermo-switch can operate contacts C–NO because before this can happen the temperature sensor (5) registers the low temperature necessary for the switch-on process. Terminal 5 on the temperature regulating switch (23) receives a low voltage as switching current for the relay (19). Due to the internal resistance of the electronic circuitry (3) terminal 5 cannot reach the ground potential.

No voltage or a low voltage can be measured at:

Terminal 5 of temperature regulating switch (23)
– about 3 volts –
Terminal B of relay (19)
– about 3 volts –

Relay (19) connects the contacts E–F and D–C.

Voltage can be measured at:

Terminal F of relay (19)

The fuel pump (4) starts delivering fuel.

Operation of overheating circuit

If the heater should overheat, the overheating switch (9) closes and causes a short circuit which blows the 8 amp fuse (16).
The overheating switch (9) responds if insufficient warm air is flowing past the heat exchanger or the temperature regulating switch (23) does not regulate.

This de-energizes:

Terminal of fuel pump (4)

The flame goes out and the run-on starts.

Operation of safety swit

The safety switch (18) resp
longer than roughly two to
re-ignition has not taken pl

Voltage can be

The following

Switching heater off

Turn knob of temperature re
lamp (1) goes out. Press m

The following

Run-on

The run-on lasts for about t
lower temperatures. The ru
exchanger and cool it down

Operation of safety switch

The safety switch (18) responds when the thermo-switch (12) holds the contacts C–NO for longer than roughly two to four minutes because combustion has not taken place in the heater, re-ignition has not taken place after regulation, or because the thermo-switch (12) is defective.

Voltage can be measured at:

Terminals C–NO of thermo-switch (12)
Terminals D–C of relay (19)
Terminal NO of safety switch (18)

The glow element of safety switch (18) heats up for about two to four minutes and then the contact connection A–A is interrupted.

The following are de-energized:

Terminal A of relay (19)

All connections in relay (19) are interrupted.

Terminal G of relay (19)
Terminal C of thermo-switch (12)
Terminal K of relay (19)

The combustion air motor (13) stops.
The ignition coil (8) is de-energized.
The hot air blower (17) stops.

Terminal F of relay (19)

The fuel pump (4) stops working.

Switching heater off

Turn knob of temperature regulating switch (23) back to the click stop position, the warning lamp (1) goes out. Press main switch down to open ground contact (2).

The following are de-energized:

Terminal 4 on temperature regulating switch (23)
Terminal A–A on safety switch (18)
Terminal A on relay (19)

All connections in relay (19) are interrupted.

Run-on

The run-on lasts for about two minutes at an ambient temperature of 20° C 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 thermo-switch limits the run-on period.

The following is de-energized:

Terminal F of relay (19)

The fuel pump stops working.

Voltage can be measured at:

Terminals of fuse (29) 16 amp.
Terminal E of relay (19)
Terminals NC–C of thermo-switch (12)

The combustion air motor (13) delivers air.

Terminal G of relay (19)
Terminal K of relay (19)

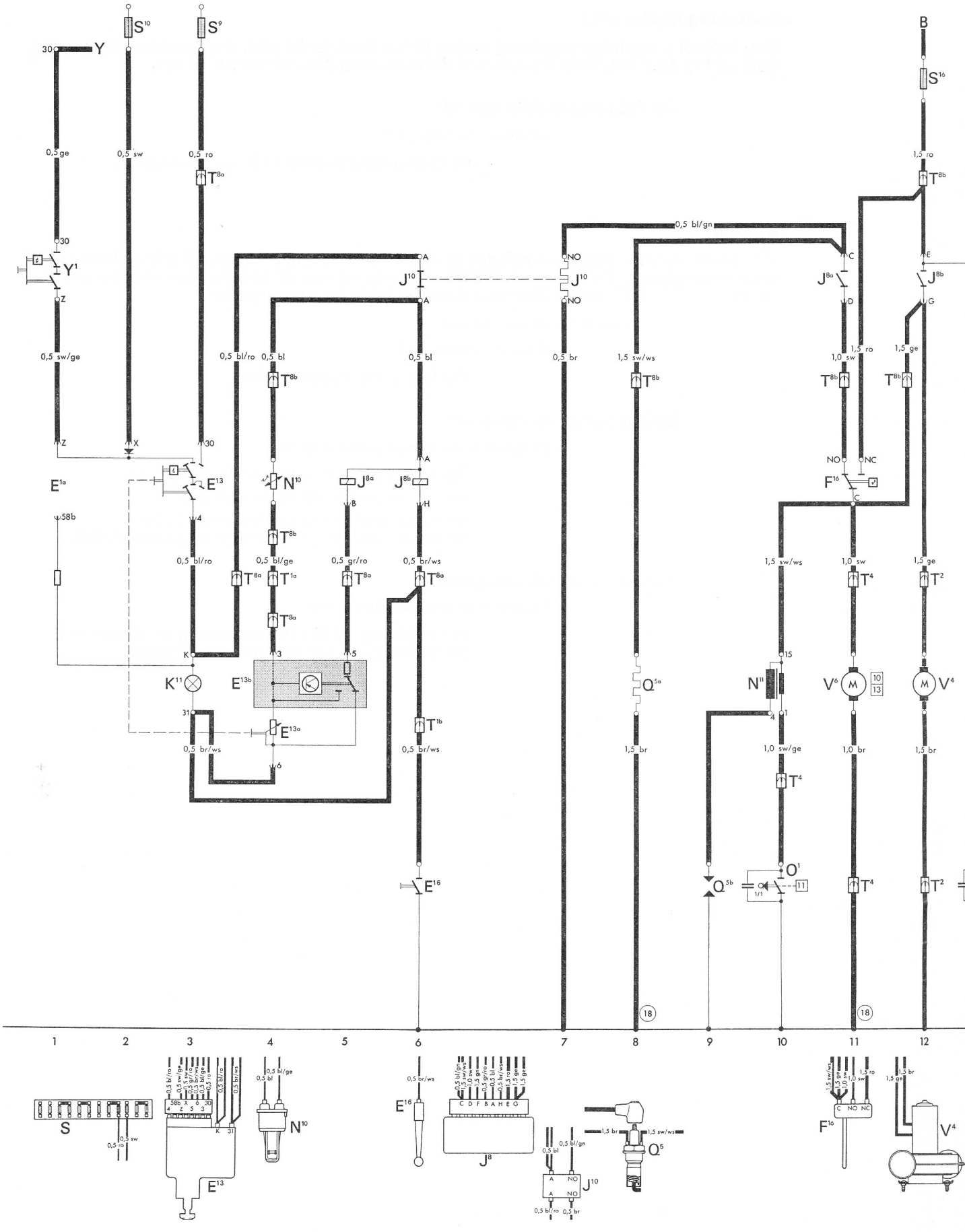
The hot air blower (18) delivers air.

When the heat exchanger has cooled down, the thermo-switch (12) operates contacts C–NO.

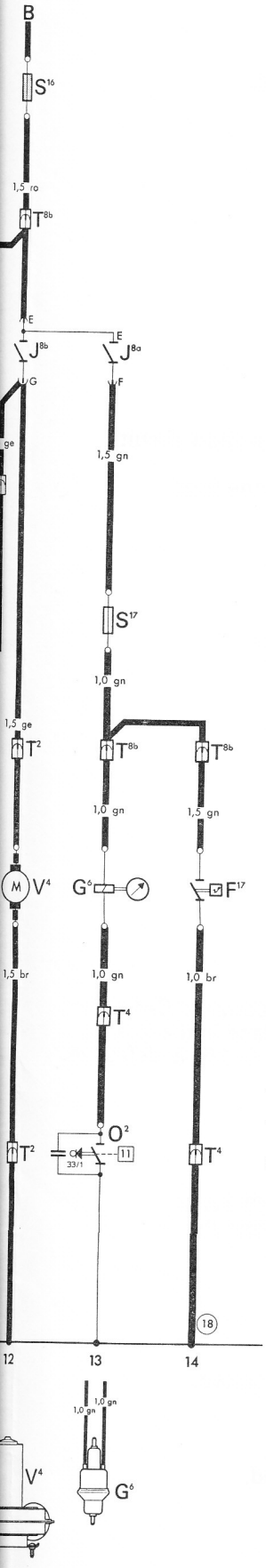
The following is de-energized:

Terminal C of thermo-switch (12)
Terminal K of relay (19)

Hot air blower (17) and combustion air blower (13) are de-energized and the run-on is finished.



Wiring diagram and explanation (from August 1972, Chassis No. 413 2 000 001) 5 - 17



Designation		in current track
B	– to starter-terminal 30	12
E^{1a}	– Terminal 58b is not used	1
E^{13}	– Temperature regulating switch (switch part)	3
E^{13a}	– Temperature regulating switch (regulating part)	4
E^{13b}	– Temperature regulating switch (electronic circuit)	4, 5
E^{16}	– Main switch	6
F^{16}	– Thermo-switch	11
F^{17}	– Overheating switch	14
G^{6}	– Metering pump	13
J^{8}	– Relay	5, 6, 11, 12, 13
J^{10}	– Safety switch	6, 7
K^{11}	– Warning lamp	3
N^{10}	– Temperature sensor	4
N^{11}	– Ignition coil	10
O^{1}	– Breaker contact in combustion air blower for coil (one impulse per revolution)	10
O^{2}	– Breaker contact in combustion air blower for fuel pump (one impulse every 33 revolutions)	13
Q^{5a}	– Glow-spark plug – Glow element	8
Q^{5b}	– Glow-spark plug – Electrodes	9
S^{9}	– Fuse No. 9 in fuse box	3
S^{10}	– Fuse No. 10 in fuse box	2
S^{16}	– Main 16 amp. fuse (separate)	12
S^{17}	– Overheating fuse – 8 amp. (separate)	13
T^{1a}	– Single connector (under rear seat)	4
T^{1b}	– Single connector (on frame tunnel)	6
T^{2}	– Connector, 2 pin (on hot air blower)	12
T^{4}	– Connector on combustion air blower	10, 11, 13
T^{8a}	- Connector, 8 pin (under instrument panel – left –)	3, 4, 5, 6
T^{6b}	– Connector, 8 pin (in engine compartment – left – Variant only)	4, 8, 11, 12, 13, 14
V^{4}	– Hot air blower	12
V^{6}	– Combustion air blower	11
Y	– to clock	1
Y^{11}	– Clock with time switch	1
⑱	– Ground strap (transmission – body)	10, 13, 16

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

Explanation

To switch heater o

a – Pull main switch (
b – Operate temperatu
(Testing should al

Start-up:

The heater ignites with
The start-up process is

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Explanation

To switch heater on:

a – Pull main switch (E 16) up until ground contact is closed
b – Operate temperature regulating switch (E 13) and set heat. The warning lamp (K 11) lights up.
(Testing should always be carried out with the engine running at a fast idle.)

Start-up:

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

Voltage can be measured at:

Terminals A–A of safety switch (J 10)
Terminal A of relay (J 8a; J 8b)

Relay (J 8) operates contacts E–G, E–F and C–D.

Terminals of fuse (S 16)
Terminals E–G of relay (J 8)

The warm air blower (V 4) starts to work.

Terminal C of thermo-switch (F 16)

The combustion air blower (V 6) starts to work.

Terminal 15 of ignition coil (N 11)

At every revolution of the combustion air motor (V 6) the ignition coil (N 11) receives an impulse via the breaker contacts (O 1).

No voltage or a low voltage can be measured at:

Main switch (E 16)
Terminals 6–5 of temperature regulating switch (E 13b)
– about 3 volts –
Terminal B of relay (J 8a)
– about 3 volts –

Relay (J 8a) operates the contacts E–F and D–C.

Voltage can be measured at:

Terminal NO of thermo-switch (F 16)
Terminals D–C of relay (J 8a)

The glow element of the glow-spark plug (Q 5a) is energized. It warms the fuel-air mixture to make it readily combustible. It is then ignited by the sparks from the glow-spark plug (Q 5b).

Terminals E–F of relay (J 8a)
Overheating fuse (S 17) 8 amps
Contact of fuel pump (G 6)

The fuel pump (G 6) starts to deliver fuel. At every 33rd revolution of the combustion air blower (V 6) the fuel pump (G 6) receives an impulse via the contact breaker (O 2).

Switching heater off:

Turn knob of temperature regulating switch (E 13) back to the click stop position, the warning lamp (K 11) goes out. Press main switch down to open ground contact (E 16).

The following is de-energized:

Terminal A on relay (J 8)

All connections in relay (J 8) are interrupted.

Run-on:

The run-on lasts for about two minutes at an ambient temperature of 20° C 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 thermo-switch limits the run-on period.

The following is de-energized:

Contact F of relay (J 8a)

The fuel pump stops working.

Voltage can be measured at:

Terminals NC–C of thermo-switch (F 16)

The combustion air motor (V 6) delivers air.

The hot air blower (V 4) delivers air.

When the heat exchanger has cooled down, the thermo-switch (F 16) operates contacts C-NO.

The following is de-energized:

Terminal C of thermo-switch (F 16)

Hot air blower (V 4) and combustion air blower (V 6) are de-energized and the run-on is finished.

Heating

When the heater has ignited and warmed up, the thermo-switch (F 16) operates the contacts C–NC. This ends the start-up process.

The following are de-energized:

Terminal NO of safety switch (J 10)

The glow element of the glow-spark plug (Q 5a) is de-energized.
The safety switch (J 10) is out of action.

Regulation

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

Voltage can be measured at:

Contact 5 of temperature regulating switch (E 13b)
Contact B of relay (J 8a)

The relay separates the contacts E–F and D–C.

The following are de-energized:

Contacts of fuse (S 17)
Contact of fuel pump (G 6)

The fuel pump stops delivering fuel and the heat exchanger cools down. The temperature of the warm air also drops. The heat exchanger however, cools down so far during the regulating process that the thermo-switch can operate contacts C–NO for less than two minutes. The temperature sensor (N 10) registers the low temperature necessary for the switch-on process and the heater starts working again. Contact 5 on the temperature regulating switch (E 13b) receives a low voltage as switching current for the relay (J 8a). Due to the internal resistance of the electronic circuitry (E 13b) terminal 5 cannot reach the ground potential.

No voltage or a low voltage can be measured at:

Contact 5 of temperature regulating switch (E 13b)
– about 3 volts –
Contact B of relay (J 8a)
– about 3 volts –

Relay (J 8a) connects the contacts E–F and D–C.

Voltage can be measured at:

Terminal F of relay (J 8a)

The fuel pump (G 6) starts delivering fuel.

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Operation of overheating circuit

If the heater should overheat, the overheating switch (F 17) closes and causes a short circuit which blows the 8 amp fuse (S 17).
The overheating switch (F 17) responds if insufficient warm air is flowing past the heat exchanger or the temperature regulating switch (E 13b) does not regulate.

This de-energizes:

Terminal of fuel pump (G 6)

The flame goes out and the run-on starts.

Operation of safety switch

The safety switch (J 10) responds when the thermo-switch (F 16) holds the contacts C–NO for longer than roughly two to four minutes because combustion has not taken place in the heater, re-ignition has not taken place after regulation, or because the thermo-switch (F 16) is defective.

Voltage can be measured at:

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

The glow element of safety swich (J 10) heats up for about two to four minutes and then the contact connection A–A is interrupted.

The following are de-energized:

Terminal A of relay (J 8)

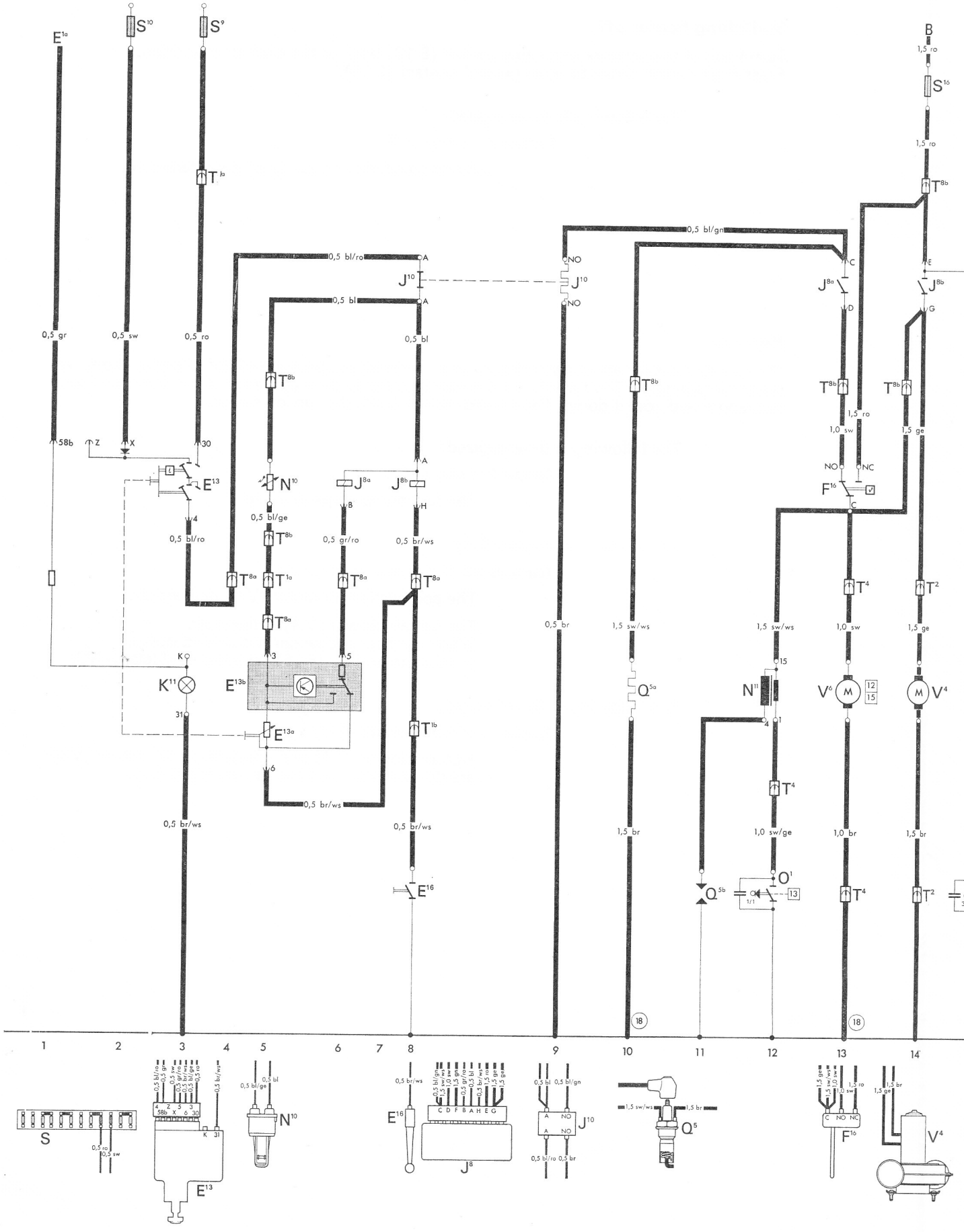
All connections in relay (J 8) are interrupted.

Terminal C of thermo-switch (F 16)

The combustion air motor (V 6) stops.
The ignition coil (N 11) is de-energized.
The hot air blower (V 4) stops.

Terminal F of relay (J 8a)

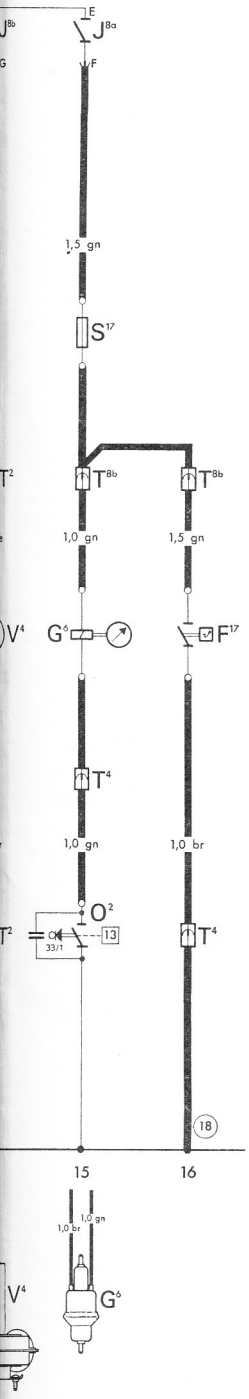
The fuel pump (G 6) stops working.



Wiring diagram and explanation (from August 1972, Chassis No. 413 2 000 001) US Version

8th Supplement Printed in Germany 1. 73

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



Designation		in current track
B	– to starter-terminal 30	14
E^{1a}	– to lighting switch – Terminal 58 b	1
E^{13}	– Temperature regulating switch (switch part)	3
E^{13a}	– Temperature regulating switch (regulating part)	5
E^{13b}	– Temperature regulating switch (electronic circuit)	5, 6
E^{16}	– Main switch	8
F^{16}	– Thermo-switch	13
F^{17}	– Overheating switch	16
G^{6}	– Metering pump	15
J^{8}	– Relay	6, 8, 13, 14, 15
J^{10}	– Safety switch	8, 9
K^{11}	– Warning lamp	3
N^{10}	– Temperature sensor	5
N^{11}	– Ignition coil	12
O^{1}	– Breaker contact in combustion air blower for coil (one impulse per revolution)	12
O^{2}	– Breaker contact in combustion air blower for fuel pump (one impulse every 33 revolutions)	15
Q^{5a}	– Glow-spark plug – Glow element	10
Q^{5b}	– Glow-spark plug – Electrodes	11
S^{9}	– Fuse No. 9 in fuse box	3
S^{10}	– Fuse No. 10 in fuse box	2
S^{16}	– Main 16 amp. fuse (separate)	14
S^{17}	– Overheating fuse – 8 amp. (separate)	15
T^{1a}	– Single connector (under rear seat)	5
T^{1b}	– Single connector (on frame tunnel)	8
T^{2}	– Connector, 2 pin (on hot air blower)	14
T^{4}	– Connector on combustion air blower	12, 13, 15, 16
T^{8a}	– Connector, 8 pin (under instrument panel – left –)	3, 4, 5, 6, 8
T^{8b}	– Connector, 8 pin (in engine compartment – left – Variant only)	5, 10, 13, 14, 15, 16
V^{4}	– Hot air blower	14
V^{6}	– Combustion air blower	13
(18)	– Ground strap (transmission – body)	10, 13, 16

Explanation

To switch heater on:

a – Pull main switch (E 1

b – Operate temperature r
(Testing should alwa

Start-up:

The heater ignites within
The start-up process is te

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Voltage can

Explanation

To switch heater on:

a – Pull main switch (E 16) up until ground contact is closed
b – Operate temperature regulating switch (E 13) and set heat.
(Testing should always be carried out with the engine running at a fast idle.)

Start-up:

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

Voltage can be measured at:

Terminals A–A of safety switch (J 10)
Terminal A of relay (J 8a; J 8b)

Relay (J 8) operates contacts E–G, E–F and C–D.

Terminals of fuse (S 16)
Terminals E–G of relay (19)

The warm air blower (V 4) starts to work.

Terminal C of thermo-switch (F 16)

The combustion air blower (V 6) starts to work.

Terminal 15 of ignition coil (N 11)

At every revolution of the combustion air motor (V 6) the ignition coil (N 11) receives an impulse via the breaker contacts (O 1).

No voltage or a low voltage can be measured at:

Main switch (E 16)
Terminals 6–5 of temperature regulating switch (E 13b)
– about 3 volts –
Terminal B of relay (J 8a)
– about 3 volts –

Relay (J 8a) operates the contacts E–F and D–C.

Voltage can be measured at:

Terminal NO of thermo-switch (F 16)
Terminals D–C of relay (J 8a)

The glow element of the glow-spark plug (Q 5a) is energized. It warms the fuel-air mixture to make it readily combustible. It is then ignited by the sparks from the glow-spark plug (Q 5b).

Terminals E–F of relay (J 8a)
Overheating fuse (S 17) 8 amps
Contact of fuel pump (G 6)

The fuel pump (G 6) starts to deliver fuel. At every 33rd revolution of the combustion air blower (V 6) the fuel pump (G 6) receives an impulse via the contact breaker (O 2).

Heating

When the heater has ignited and warmed up, the thermo-switch (F 16) operates the contacts C–NC. This ends the start-up process.

The following are de-energized:

Terminal NO of safety switch (J 10)

The glow element of the glow-spark plug (Q 5a) is de-energized.
The safety switch (J 10) is out of action.

Regulation

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

Voltage can be measured at:

Terminal 5 of temperature regulating switch (E 13b)
Terminal B of relay (J 8a)

The relay separates the contacts E–F and D–C.

The following are de-energized:

Terminals of fuse (S 17)
Terminal of fuel pump (G 6)

The fuel pump stops delivering fuel and the heat exchanger cools down. The temperature of the warm air also drops. The heat exchanger however, cools down so far during the regulating process that the thermo-switch can operate contacts C–NO for less than two minutes. The temperature sensor (N 10) registers the low temperature necessary for the switch-on process and the heater starts working again. Contact 5 on the temperature regulating switch (E 13b) receives a low voltage as switching current for the relay (J 8a). Due to the internal resistance of the electronic circuitry (E 13b) terminal 5 cannot reach the ground potential.

No voltage or a low voltage can be measured at:

Contact 5 of temperature regulating switch (E 13b)
– about 3 volts –
Contact B of relay (J 8a)
– about 3 volts –

Relay (J 8a) connects the contacts E–F and D–C.

Voltage can be measured at:

Terminal F of relay (J 8a)

The fuel pump (G 6) starts delivering fuel.

Operation of overheating circuit

If the heater should overheat, the overheating switch (F 17) closes and causes a short circuit which blows the 8 amp fuse (S 17).
The overheating switch (F 17) responds if insufficient warm air is flowing past the heat exchanger or the temperature regulating switch (E 13b) does not regulate.

This de-energizes:

Terminal of fuel pump (G 6)

The flame goes out and the run-on starts.

Operation of safety switch

The safety switch (J 10) responds when the thermo-switch (F 16) holds the contacts C–NO for longer than roughly two to four minutes because combustion has not taken place in the heater, re-ignition has not taken place after regulation, or because the thermo-switch (F 16) is defective.

Voltage can be measured at:

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

The glow element of safety switch (J 10) heats up for about two to four minutes and then the contact connection A–A is interrupted.

The following are de-energized:

Terminal A of relay (J 8)

All connections in relay (J 8) are interrupted.

Terminal C of thermo-switch (F 16)

The combustion air blower (V 6) stops.
The ignition coil (N 11) is de-energized.
The hot air blower (V 4) stops.

Terminal F of relay (J 8a)

The fuel pump (G 6) stops working.

Switchi

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Switching heater off:

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

The following is de-energized:

Terminal A on relay (J 8)

All connections in relay (J 8) are interrupted.

Run-on:

The run-on lasts for about two minutes at an ambient temperature of 20° C 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 thermo-switch limits the run-on period.

The following is de-energized:

Contact F of relay (J 8a)

The fuel pump stops working.

Voltage can be measured at:

Terminals NC–C of thermo-switch (F 16)

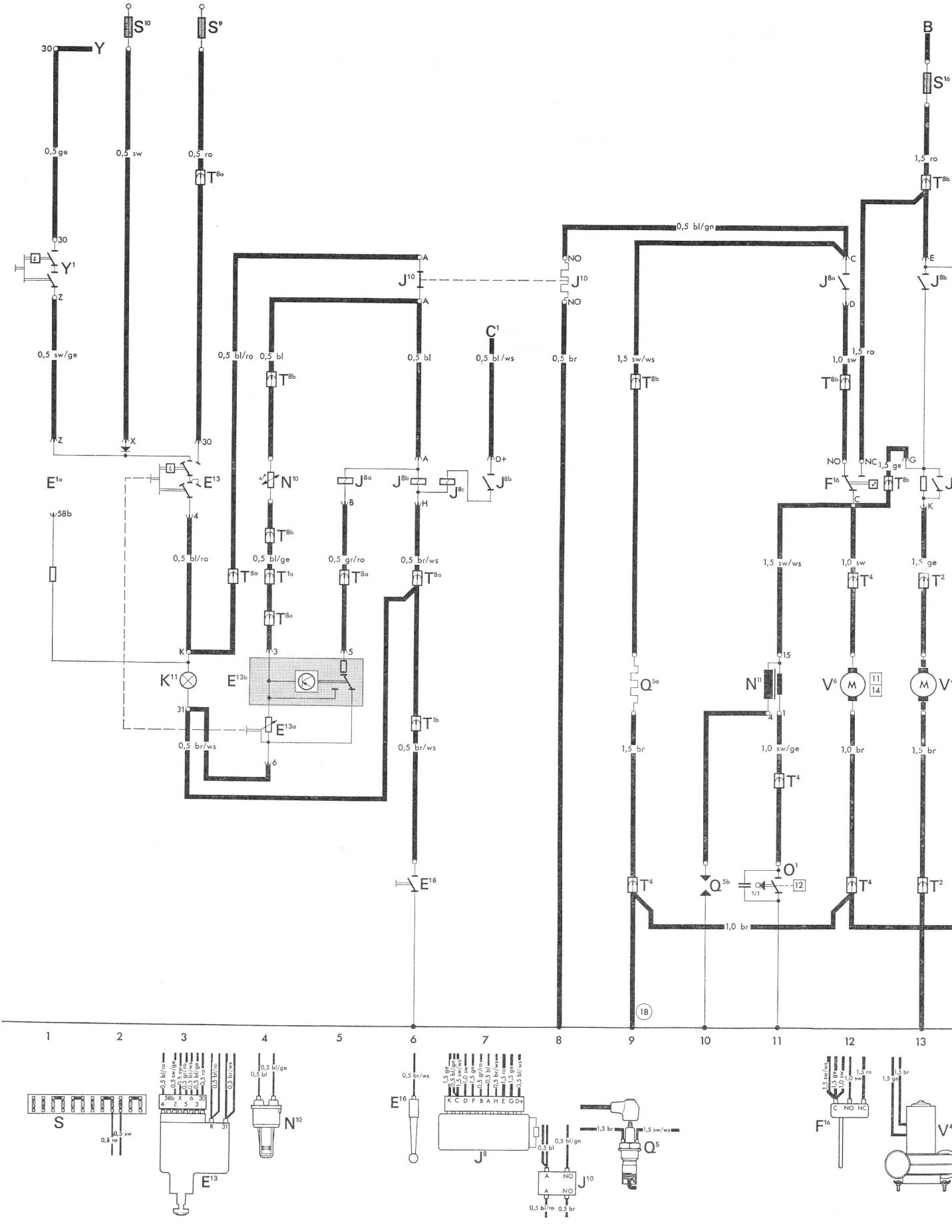
The combustion air motor (V 6) delivers air.

The hot air blower (V 4) delivers air.
When the heat exchanger has cooled down, the thermo-switch (F 16) operates contacts C–NO.

The following is de-energized:

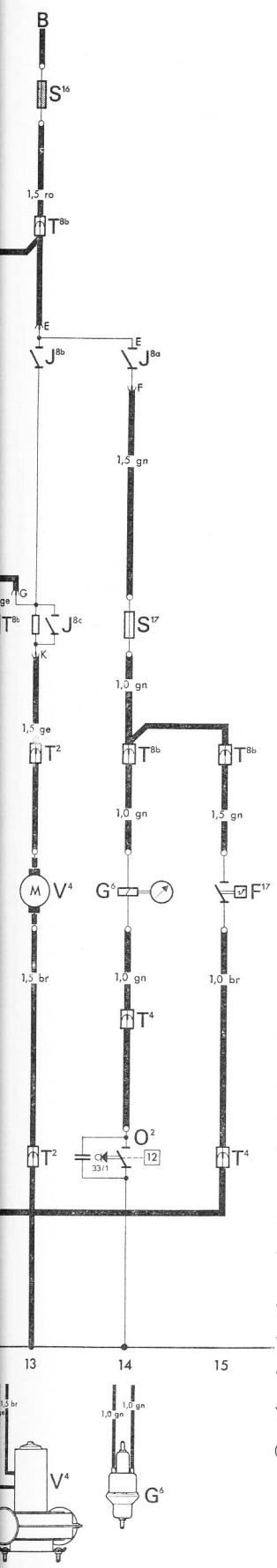
Terminal C of thermo-switch (F 16)

Hot air blower (V 4) and combustion air blower (V 6) are de-energized and the run-on is finished.



Wiring diagram and explanation (from August 1972, Chassis No. 413 2 000 001) **5 - 21**

BA 4 Heater with modified warm air blower for ribbed heat exchangers



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

Designation		in current track
B	– to starter-terminal 30	13
C^{1}	– to regulator D+	7
E^{1a}	– Terminal 58b is not used	1
E^{13}	– Temperature regulating switch (switch part)	3
E^{13a}	– Temperature switch (regulating part)	4
E^{13b}	– Temperature regulating switch (electronic circuit)	4, 5
E^{16}	– Main switch	6
F^{16}	– Thermo-switch	12
F^{17}	– Overheating switch	15
G^{6}	– Metering pump	14
J^{8a}	– Relay	5, 12, 14
J^{8b}	– Relay	6, 7, 13
J^{8c}	– Relay	6, 13
J^{10}	– Safety switch	6, 8
K^{11}	– Warning lamp	3
N^{10}	– Temperature sensor	4
N^{11}	– Ignition coil	11
O^{1}	– Breaker contact in combustion air blower for coil (one impulse per revolution)	11
O^{2}	– Breaker contact in combustion air blower for fuel pump (one impulse every 33 revolutions)	14
Q^{5a}	– Glow-spark plug – Glow element	9
Q^{5b}	– Glow-spark plug – Electrodes	10
S^{9}	– Fuse No. 9 in fuse box	3
S^{10}	– Fuse No. 10 in fuse box	2
S^{16}	– Main 16 amp. fuse (separate)	13
S^{17}	– Overheating fuse – 8 amp. (separate)	14
T^{1a}	– Single connector (under rear seat)	4
T^{1b}	– Single connector (on frame tunnel)	6
T^{2}	– Connector, 2 pin (on hot air blower)	13
T^{4}	– Connector on combustion air blower	9, 11, 12, 14, 15
T^{8a}	– Connector, 8 pin (under instrument panel – left –)	3, 4, 5, 6
T^{8b}	– Connector, 8 pin (in engine compartment – left – Variant only)	4, 9, 12, 13, 14, 15
V^{4}	– Hot air blower	13
V^{6}	– Combustion air blower	12
Y	– to clock	1
Y^{1}	– Clock with time switch	1
⑱	– Ground strap (transmission – body)	9

Explanation

To switch heater o

a – Pull main switch

b – Operate temperatu
(Testing should a

Start-up:

The heater ignites wit
The start-up process i

Voltage c

No voltag

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Explanation

To switch heater on:

a – Pull main switch (E 16) up until ground contact is closed.

b – Operate temperature regulating switch (E 13) and set heat. The warning lamp (K 11) lights up. (Testing should always be carried out with the engine running at a fast idle.)

Start-up:

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

Voltage can be measured at:

Terminals 30–4 of temperature regulating switch (E 13)
Terminals A–A of safety switch (J 10)

Relay (J 8) operates contacts E–G, hand E–K

Terminals of fuse (S 16)
Terminals E–K of relay (J 8b)

The warm air blower (V 4) starts to work.
The series. resistance for the warm air blower in relay reduces the output when there is no voltage at terminal D+ on regulator. The resistance in relay is bridged by relay contact (J 8c) when there is no voltage at terminal D+ on relay.

Terminal C of thermo-switch (F 16)

The combustion air blower (V 6) starts to work.

Terminal 15 of ignition coil (N 11)

At every revolution of the combustion air motor (V 6) the ignition coil (N 11) receives an impulse via the breaker contacts (O 1).

No voltage or a low voltage can be measured at:

Main switch (E 16)
Terminals 6–5 of temperature regulating switch (E 13b)
– about 3 volts –
Terminal B of relay (J 8a)
– about 3 volts –

Relay (J 8a) operates the contacts E–F and C–D.

Voltage can be measured at:

Terminal NO of thermo-switch (F 16)

The glow element of the glow-spark plug (Q 5a) is energized. It warms the fuel-air mixture to make it readily combustible. It is then ignited by the sparks from the glow-spark plug (Q 5b).

Overheating fuse (S 17) 8 amps

The fuel pump (G 6) starts to deliver fuel. At every 33rd revolution of the combustion air blower (V 6) the fuel pump (G 6) receives an impulse via the contact breaker (O 2).

Heating

When the heater has ignited and warmed up, the thermo-switch (F 16) operates the contacts C–NC. This ends the start-up process.

The following are de-energized:

Terminal NO of thermo-switch (F 16)

The glow element of the glow-spark plug (Q 5a) is de-energized.
The safety switch (J 10) is out of action.

Regulation

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

Voltage can be measured at:

Contact 5 of temperature regulating switch (E 13b)
Contact B of relay (J 8a)

The relay separates the contacts E–F and D–C.

The following are de-energized:

Contac F on relay (J 8a)
Contact of overheating switch (S 17)

The fuel pump stops delivering fuel and the heat exchanger cools down. The temperature of the warm air also drops. The heat exchanger however, cools down so far during the regulating process that the thermo-switch can operate contacts C–NO for less than two minutes. The temperature sensor (N 10) registers the low temperature necessary for the switch-on process.
Contact 5 on the temperature regulating switch (E 13b) receives a low voltage as switching current for the relay (J 8a). Due to the internal resistance of the electronic circuitry (E 13b) terminal 5 cannot reach the ground potential.

No voltage or a low voltage can be measured at:

Contact 5 of temperature regulating switch (E 13b)
– about 3 volts –
Contact B of relay (J 8a)
– about 3 volts –

Relay (J 8a) connects the contacts E–F and D–C.

Voltage can be measured at:

Terminal F of relay (J 8a)

The fuel pump (G 6) starts delivering fuel.

Operation of overh

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Voltage c

The follow

Switching heater of

Turn knob of temperatu
Press main switch (E 1

The follow

Operation of overheating circuit (J 10)

If the heater should overheat, the overheating switch (F 17) closes and causes a short circuit which blows the 8 amp fuse (S 17).
The overheating switch (F 17) responds if insufficient warm air is flowing past the heat exchanger or the temperature regulating switch (E 13b) does not regulate.

This de-energizes:

Terminal of fuel pump (G 6)

The flame goes out and the run-on starts.

Operation of safety switch (J 10)

The safety switch (J 10) responds when the thermo-switch (F 16) holds the contacts C–NO for longer than roughly two to four minutes because combustion has not taken place in the heater, re-ignition has not taken place after regulation, or because the thermo-switch (F 16) is defective.

Voltage can be measured at:

Terminals C–NO of thermo-switch (F 16)
Terminal D–C of relay (J 8 a)

The glow element of safety switch (J 10) heats up for about two to four minutes and then the contact connection A–A is interrupted.

The following are de-energized:

Terminal A of relay (J 8)

All connections in relay (J 8) are interrupted.

Terminal G of relay (J 8)
Terminal K of relay (J 8)

The combustion air blower (V 6) stops.
The ignition coil (N 11) is de-energized.
The hot air blower (V 4) stops.

Terminal F of relay (J 8)

The fuel pump (G 6) stops working.

Switching heater off:

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

The following is de-energized:

Terminal (4) on temperature regulating switch (E 13b)
Terminal A on relay (J 8)

All connections in relay (J 8) are interrupted.

Run-on:

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exchange

Run-on:

The run-on lasts for about two minutes at an ambient temperature of 20° C 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 thermo-switch limits the run-on period.

The following is de-energized:

Contact F of relay (J 8a)

The fuel pump (G 6) stops working.

Voltage can be measured at:

Terminals of fuse (S 16) 16 amps
Terminals NC–C of thermo-switch (F 16)

The combustion air blower (V 6) delivers air.

Terminal G of relay (J 8)
Terminal K of relay (J 8)

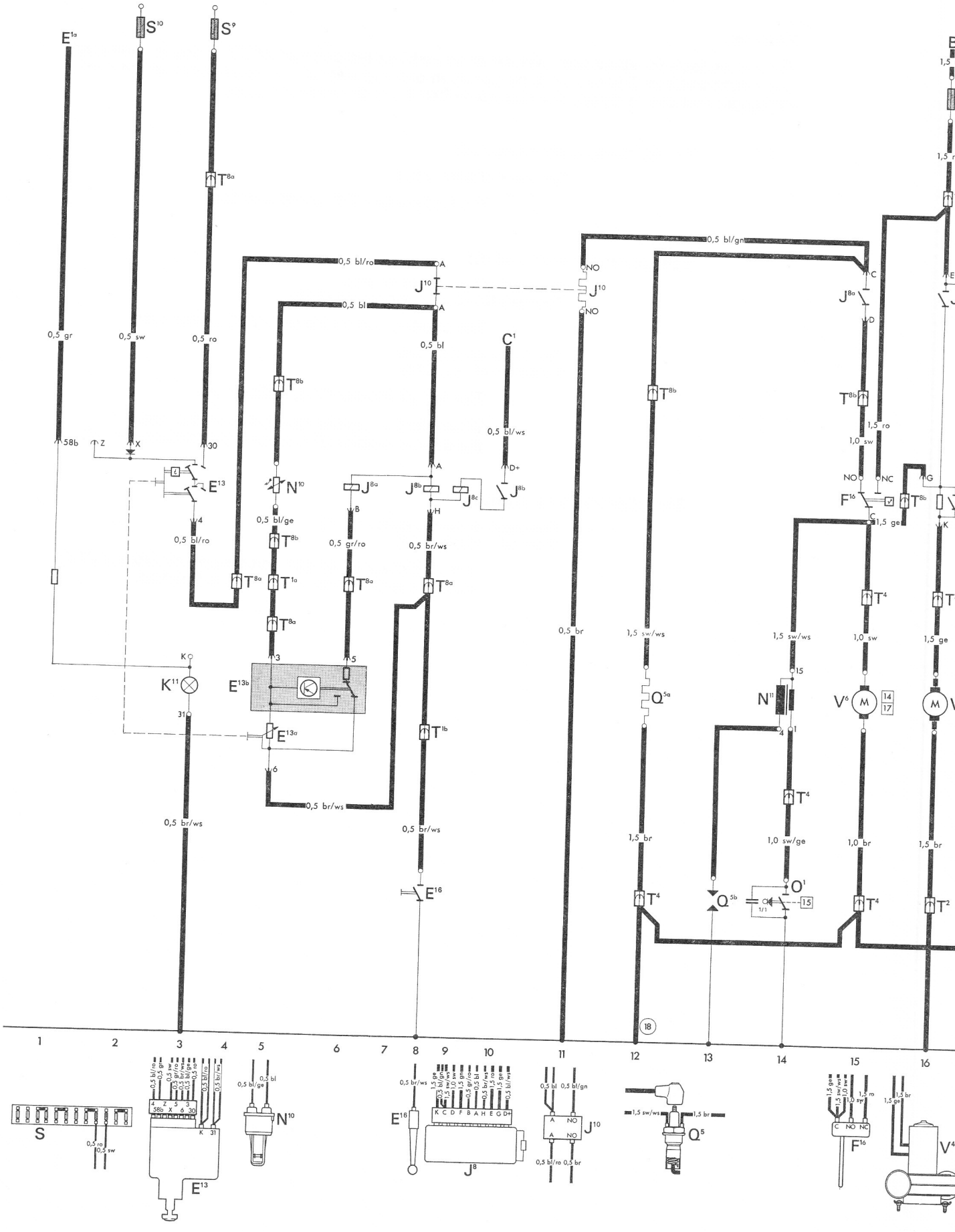
The hot air blower (V 4) delivers air.

When the heat exchanger has cooled down, the thermo-switch (F 16) operates contacts C–NO.

The following is de-energized:

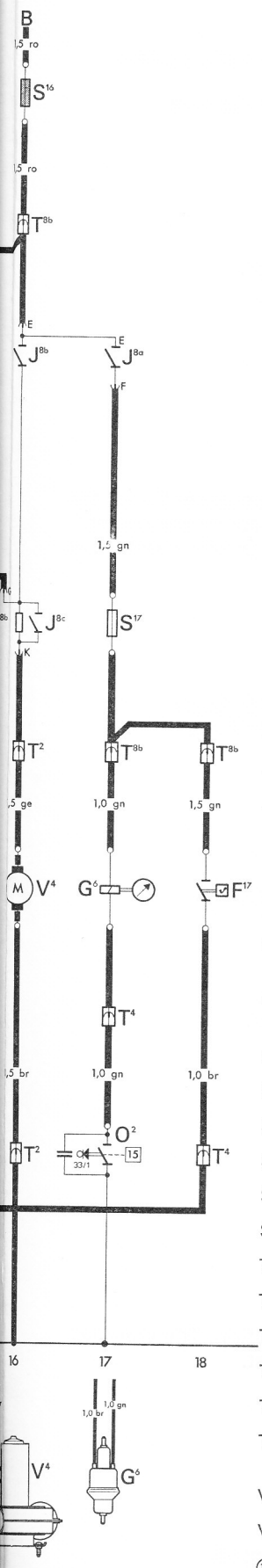
Terminal C of thermo-switch (F 16)
Terminal K of relay (J 8c)

Hot air blower (V 4) and combustion air blower (V 6) are de-energized and the run-on is finished.



Wiring diagram and explanation (from August 1972, Chassis No. 413 2 000 001) **5 - 23**

BA 4 Heater with modified warm air blower for ribbed heat exchangers Canadian Version



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

Designation		in current track
B	– to starter-terminal 30	16
C^{1}	– to regulator D+	10
E^{1a}	– to lighting switch terminal 58 b	1
E^{13}	– Temperature regulating switch (switch part)	3
E^{13a}	– Temperature regulating switch (regulating part)	5
E^{13b}	– Temperature regulating switch (electronic circuit)	5, 6
E^{16}	– Main switch	8
F^{16}	– Thermo-switch	15
F^{17}	– Overheating switch	18
G^{6}	– Metering pump	17
J^{8a}	– Relay	6, 15, 17
J^{8b}	– Relay	8, 10, 16
J^{8c}	– Relay	9, 16
J^{10}	– Safety switch	8, 11
K^{11}	– Warning lamp	3
N^{10}	– Temperature sensor	5
N^{11}	– Ignition coil	14
O^{1}	– Breaker contact in combustion air blower for coil (one impulse per revolution)	14
O^{2}	– Breaker contact in combustion air blower for fuel pump (one impulse every 33 revolutions)	17
Q^{5a}	– Glow-spark plug – Glow element	12
Q^{5b}	– Glow-spark plug – Electrode	13
S^{9}	– Fuse No. 9 in fuse box	3
S^{10}	– Fuse No. 10 in fuse box	2
S^{16}	– Main 16 amp. fuse (separate)	16
S^{17}	– Overheating fuse – 8 amp. (separate)	17
T^{1a}	– Single connector (under rear seat)	5
T^{1b}	– Single connector (on frame tunnel)	8
T^{2}	– Connector, 2 pin (on hot air blower)	16
T^{4}	– Connector on combustion air blower	14, 15, 17, 18
T^{8a}	– Connector, 8 pin (under instrument panel – left –)	3, 4, 5, 6, 8
T^{8b}	– Connector, 8 pin (in engine compartment – left – Variant only)	5, 8, 12, 15, 16, 17, 18
V^{4}	– Hot air blower	16
V^{6}	– Combustion air blower	15
⑱	– Ground strap (transmission – body)	12

Explanation

To switch heater on

a – Pull main switch (E
b – Operate temperatur
(Testing should alv

Start-up:

The heater ignites withi
The start-up process is

Voltage ca

No voltage

Voltage car

Wiring diagram and e
BA 4 Heater with modifi

Explanation

To switch heater on:

a – Pull main switch (E 16) up until ground contact is closed
b – Operate temperature regulating switch (E 13) and set heat. The warning lamp (K 11) lights up.
(Testing should always be carried out with the engine running at a fast idle.)

Start-up:

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

Voltage can be measured at:

Terminals 30–4 of temperature regulating switch (E 13)
Terminals A–A of safety switch (J 10)

Relay (J 8) operates contacts E–G and E–K.

Terminals of fuse (S 16) 16 amp.
Terminals E–K of relay (J 8b)

The warm air blower (V 4) starts to work.
The series resistance for the warm air blower in relay reduces the output when there is no voltage at terminal D+ on regulator. The resistance in relay is bridged by relay contact (J 8c) when there is no voltage at terminal D+ on relay.

Terminal C of thermo-switch (F 16)

The combustion air blower (V 6) starts to work.

Terminal 15 of ignition coil (N 11)

At every revolution of the combustion air blower (V 6) the ignition coil (N 11) receives an impulse via the breaker contacts (O 1).

No voltage or a low voltage can be measured at:

Main switch (E 16)
Terminals 6–5 of temperature regulating switch (E 13b)
– about 3 volts –
Terminal B of relay (J 8a)
– about 3 volts –

Relay (J 8a) operates the contacts E–F and C–D.

Voltage can be measured at:

Terminal NO of thermo-switch (F 16)

The glow element of the glow-spark plug (Q 5a) is energized. It warms the fuel-air mixture to make it readily combustible. It is then ignited by the sparks from the glow-spark plug (Q 5b).

Overheating fuse (S 17) 8 amps

The fuel pump (G 6) starts to deliver fuel. At every 33rd revolution of the combustion air blower (V 6) the fuel pump (G 6) receives an impulse via the contact breaker (O 2).

Heating

When the heater has ignited and warmed up, the thermo-switch (F 16) operates the contacts C–NC. This ends the start-up process.

The following are de-energized:

Terminal NO of thermo-switch (F 16)

The glow element of the glow-spark plug (Q 5a) is de-energized.
The safety switch (J 10) is out of action.

Regulation

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

Voltage can be measured at:

Contact 5 of temperature regulating switch (E 13b)
Contact B of relay (J 8a)

The relay separates the contacts E–F and D–C.

The following are de-energized:

Contact F of relay (J 8a)
Contacts of fuse (S 17)

The fuel pump stops delivering fuel and the heat exchanger cools down. The temperature of the warm air also drops. The heat exchanger however, cools down so far during the regulating process that the thermo-switch can operate contacts C–NO for less than two minutes. The temperature sensor (N 10) registers the low temperature necessary for the switch-on process.
Contact 5 on the temperature regulating switch (E 13b) receives a low voltage as switching current for the relay (J 8a). Due to the internal resistance of the electronic circuitry (E 13b) terminal 5 cannot reach the ground potential.

No voltage or a low voltage can be measured at:

Contact 5 of temperature regulating switch (E 13b)
– about 3 volts –
Contact B of relay (J 8a)
– about 3 volts –

Relay (J 8a) connects the contacts E–F and D–C.

Voltage can be measured at:

Terminal F of relay (J 8a)

The fuel pump (G 6) starts delivering fuel.

Operation of overhe

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Operation of safety

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Switching heater off

Turn knob of temperatu
lamp (K 11) goes out. P

The followi

Operation of overheating circuit

If the heater should overheat, the overheating switch (F 17) closes and causes a short circuit which blows the 8 amp fuse (S 17).
The overheating switch (F 17) responds if insufficient warm air is flowing past the heat exchanger or the temperature regulating switch (E 13b) does not regulate.

This de-energizes:

Terminal of fuel pump (G 6)

The flame goes out and the run-on starts.

Operation of safety switch

The safety switch (J 10) responds when the thermo-switch (F 16) holds the contacts C–NO for longer than roughly two to four minutes because combustion has not taken place in the heater, re-ignition has not taken place after regulation, or because the thermo-switch (F 16) is defective.

Voltage can be measured at:

Terminals C–NO of thermo-switch (F 16)
Terminals D–C of relay (J 8a)

The glow element of safety switch (J 10) heats up for about two to four minutes and then the contact connection A–A is interrupted.

The following are de-energized:

Terminal A of relay (J 8)

All connections in relay (J 8) are interrupted.

Terminal G of relay (J 8)
Terminal K of relay (J 8)

The combustion air blower (V 6) stops.
The ignition coil (N 11) is de-energized.
The hot air blower (V 4) stops.

Terminal F of relay (J 8a)

The fuel pump (G 6) stops working.

Switching heater off:

Turn knob of temperature regulating switch (E 13) back to the click stop position. The warning lamp (K 11) goes out. Press main switch (E 16) down to open ground contact.

The following is de-energized:

Terminal (4) on temperature regulating switch (E 13b)
Terminal A on relay (J 8)

All connections in relay (J 8) are interrupted.

Run-on

The run-
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Run-on:

The run-on lasts for about two minutes at an ambient temperature of 20° C 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 thermo-switch limits the run-on period.

The following is de-energized:

Terminal F of relay (J 8a)

The fuel pump (G 6) stops working.

Voltage can be measured at:

Terminals of fuse (S 16) 16 amps
Terminals NC–C of thermo-switch (F 16)

The combustion air blower (V 6) delivers air.

Terminal G of relay (J 8)
Terminal K of relay (J 8)

The hot air blower (V 4) delivers air.

When the heat exchanger has cooled down, the thermo-switch (F 16) operates contacts C–NO.

The following is de-energized:

Terminal C of thermo-switch (F 16)
Terminal K of relay (J 8)

Hot air blower (V 4) and combustion air blower (V 6) are de-energized and the run-on is finished.

Trouble shooting and testing installed heater

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

Pull heater flap lever right back and operate regulating lever

The following functional defects could occur:

A – Heater does not work (see F 1.2/1–2)

B – No warm air flow (see F 1.2/1–4)

C – Heater smokes (see F 1.2/1–4)

D – Heat output insufficient (see F 1.2/1–5)

E – Heater goes out (see F 1.2/1–5)

In addition, the following can occur:

F – Blowers do not switch off (see F 1.2/1–6)

G – Heater does not work at low outside temperatures (see F 1.2/1–6)

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

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A – Heater does not work

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

Defective units should be repaired or replaced with new ones.

If, when carrying out this check, the heater does not work at all, check as follows:

Operation	Possible defect	Remedy
1 – Check all heating system units and warm air ducts as well as electrical connections for tightness, check exhaust system for damage	a – Reduction in cross section Exhaust pipe and warm air ducts loose b – Loose connection in electrical system	a – Replace damaged parts with new ones b – Tighten loose push-on connections
2 – Check 16 amp. main fuse (no current at relay terminal E)	Short circuit in electrical system	Disconnect cables at relay terminals C, D and G. Install new fuse and reconnect cables individually. If fuse blows, check appropriate cables and units and replace if necessary
3 – Check 8 amp. overheating fuse (no current at relay terminal F)	a – Overheating due to failure of heater air blower b – Warm air duct blocked (fresh air and defroster vents or outlets in foot-well) c – Heater flaps closed	a – Check heater air blower (see F 1.3/2–3) b – Check warm air duct for blockages c – Adjust heater flap cable (see F 1.9/1–2)
4 – Test battery voltage with heavy discharger		Charge battery (if necessary start vehicle engine)
5 – Disconnect cables at fuel pump so that no fuel is delivered during further tests		

Operation	Possible defect	Remedy
6 – Disconnect cable at relay of terminal A, then reconnect cable (relay must be heard to work)	a – Safety switch has cut-in because of defect in fuel supply or in ignition system b – Temperature control switch defective (open circuit) c – Contact on heater flap lever does not close	a – Switch safety switch on and eliminate defect if necessary (see F 1.3/1–3) b – Check cut-in and regulating contact (see F 1.3/1–4) c – Check contact
7 – Measure voltage at relay terminals C, D and G	If there is no voltage, relay is defective (open circuit)	Install new relay (see F 1.5/2–2)
8 – Check whether heater air blower blows air into vehicle interior	Radial blower wheel loose	Check heater air blower and repair or replace if necessary (see F 1.3/2–3 and F 1.8/2–1)
9 – Disconnect cables on ignition coil and connect rev. counter (see F 1.3/1–3), then read off speed (5,500–6,500 rpm at nominal voltage)	a – If speed too low, voltage drop in plug for combustion air blower motor or in relay b – Armature burnt, brushes worn c – Bearing or winding damage	a – Test and install new relay if necessary b – Repair combustion air blower motor (see F 1.6/1–1) c – Replace combustion air blower motor (see F 1.5/1–2)
10 – Remove main fuse. Push heater flap lever fully forward, warning lamp goes out. Unscrew glow-spark plug. Reconnect cables, install fuse and operate heater flap lever. Sparks must jump between electrode and casing and glow element must glow (see F 1.3/2–1)	a – Thermo-switch defective (no current, glow time too short) b – Glow element open c – Glow-spark plug dirty d – Ignition contact breaker defective or maladjusted e – Ignition coil or cable defective	a – Install new thermo-switch (see F 1.5/2–1) b – Install new glow-spark plug (see F 1.5/2–2) c – Clean glow-spark plug (see F 1.3/2–1) d – Adjust contact breaker or fit new if necessary (see F 1.3/2–2) e – Test ignition system and install new parts if necessary
11 – Turn heater off, remove pump and measure capacity (see F 1.3/2–4) 1.3 US pt./1 Imp. pt. (0.6 liter) equals approx. 10 cc/min. at 6,000 rpm of combustion air blower motor	a – Contact breaker defective or maladjusted b – Open circuit in pump winding c – Maladjustment d – Fuel hoses, filter or strainer blocked e – Valve does not open	a – Check contact breaker, install new if necessary (see F 1.6/1–4) b – Install new pump (see F 1.5/2–3) c – Correct adjustment (see F 1.3/2–4) d – Clean parts e – Fit new valve guide Readjust delivery quantity (see F 1.7/1–2 and F 1.7/2–1)

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

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

C – Heater smokes

Operation	Possible defect	Remedy
1 – Check exhaust pipe for damage (cross section reduced)	a – Mechanical damage b – Partially blocked	a – Install new exhaust pipe b – Clean exhaust pipe
2 – Check delivery quantity of fuel pump	Excessive fuel	Correctly adjust delivery quantity (see F 1.3/2–4)
3 – Check combustion air intake for free passage (visual check)	Intake blocked	Clean combustion air intake
4 – Check combustion air blower motor speed (see F 1.3/1–3)	a – Battery voltage too low b – Radial blower wheel loose (chafes) c – Speed is not attained at nominal voltage (5,500–6,500 rpm)	a – Charge battery b – Remove combustion air blower, secure radial blower wheel (note air gap of .039 in./1 mm) and install new blower wheel if necessary (see F 1.6/1–5) c – Remove motor and check, install new one if necessary (see F 1.5/1–2)

D – Heat output insufficient

Operation	Possible defect	Remedy
1 – Check delivery quantity of fuel pump (see F 1.3/2–4)	a – Delivery quantity too small b – Filter blocked c – Strainer dirty d – Valve guide blocked	a – Adjust delivery quantity (see F 1.3/2–4) b – Install new filter c – Clean d – Install new valve guide (see F 1.7/1–2 and F 1.7/2–1)
2 – Remove and test temperature control switch (see F 1.3/1–4)	a – Bimetal spiral preload maladjusted b – Control contact cuts out too early	a, b – Install new temperature control switch (see F 1.5/2–1)
3 – Check adjustment of heater flaps on engine heat exchanger	Bowden cable adjustment not correct	Adjust (see F 1.9/1–2)
4 – Non-return flaps in engine cooling air housing stiff or jammed	Wrongly installed	Remove cooling air fan and check flaps, replace if necessary (see F 1.8/1–1)

E – Heater goes out

Operation	Possible defect	Remedy
1 – Check electrical connections for tightness	Loose connection	Check connections and secure
2 – Check exhaust pipe for obstructions	Exhaust pipe partially blocked	Clean exhaust pipe (pay attention to water drain hole) and, if necessary, install new one
3 – Remove temperature control switch and check regulating contact (see F 1.3/1–4)	Regulating contact sticks (does not cut in again)	Install new temperature control switch (see F 1.5/2–1)
4 – Check cut-in time of glow element in glow-spark plug (at least 70 secs. at nominal voltage and 86° F (30° C) ambient temperature)	Thermo-switch defective (glow time too short)	Install new thermo-switch (see F 1.5/2–1)
5 – Check delivery quantity of fuel pump (see F 1.3/2–4)	Delivery quantity too small due to a – Maladjustment b – Filter dirty c – Strainer blocked d – Valve guide dirty	a – Correct adjustment (see F 1.3/2–4) b – Install new filter c – Clean strainer d – Install new valve guide

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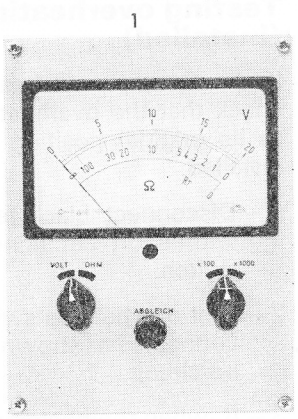
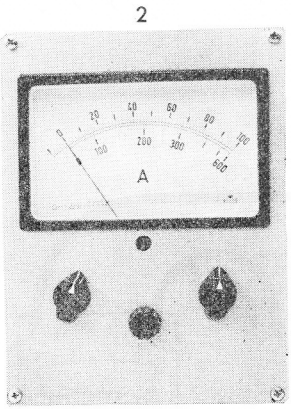
F – Run-on does not switch off

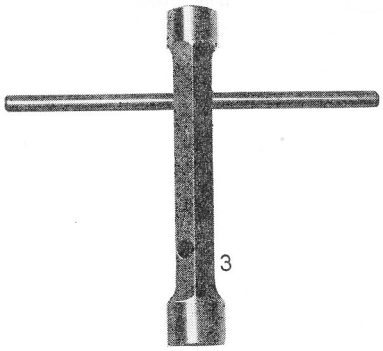
Operation	Possible defect	Remedy
Turn heater on with engine cold and let it run for 5 mins. Start stop watch and turn heater off. Check run-on time. Should be 120–240 secs.	Thermo-switch defective, contact sticks	Install new thermo-switch (see F 1.5/2–1)

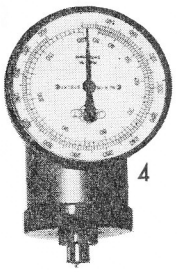
G – Heater does not work at low outside temperatures

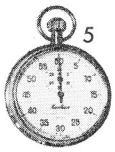
Operation	Possible defect	Remedy
1 – Measure battery voltage		Recharge battery if necessary
2 – Check fuel pump delivery quantity (see F 1.3/2–4)	Quantity too small due to a – Maladjustment b – Filter dirty c – Strainer blocked d – Valve guide dirty e – Combustion air blower motor speed too low	a – Correct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











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

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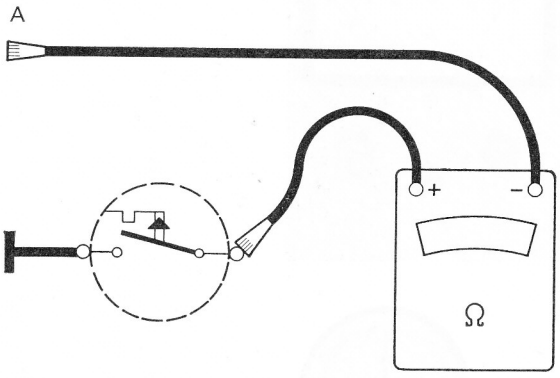


A – Ground

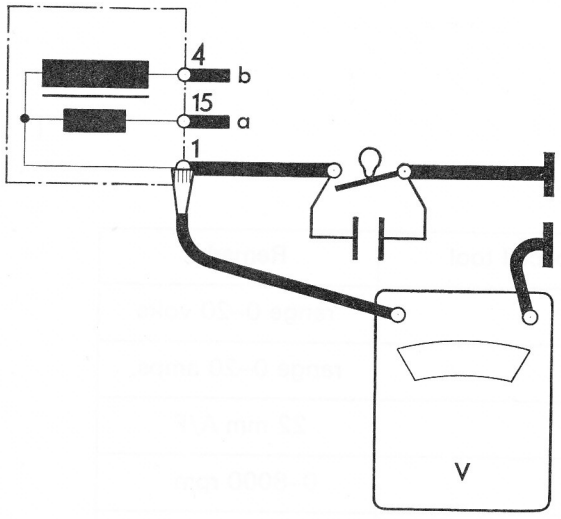
Testing overheating switch (installed)

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

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

2 – Test overheating switch with an ohmmeter connected as shown. The switch must have no circuit.

3 – If, when the heater is cold, the overheating switch makes contact (circuit), the switch is defective and a new one must be installed.



a – Relay terminal C
b – to glow-spark plug

Testing ignition coil

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

2 – Install a .16 in. (4 mm) diameter screw in the angled connector of the ignition cable.

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

Note:

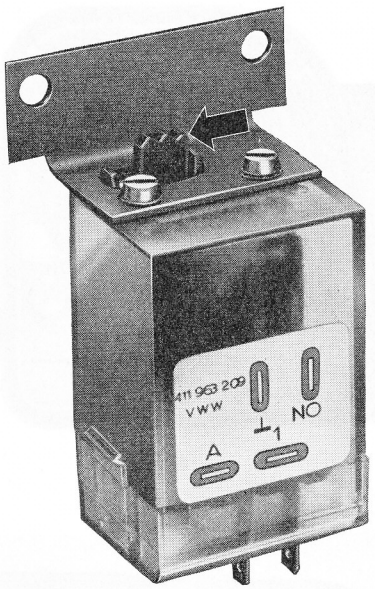
If there is no spark, first measure the voltage at terminal 15 of the ignition coil with a voltmeter. The voltage must be at least 10 volts. If the measured voltage is lower, check whether there is voltage when the contact breaker is open and **no** voltage when it is closed, at terminal 1 of the ignition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

Checking and adjusting safety switch

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

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

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



Note:
(Honeywell safety switch only)

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

Response time too long – turn screw clockwise
Response time too short – turn screw anti-clockwise

Testing combustion air blower

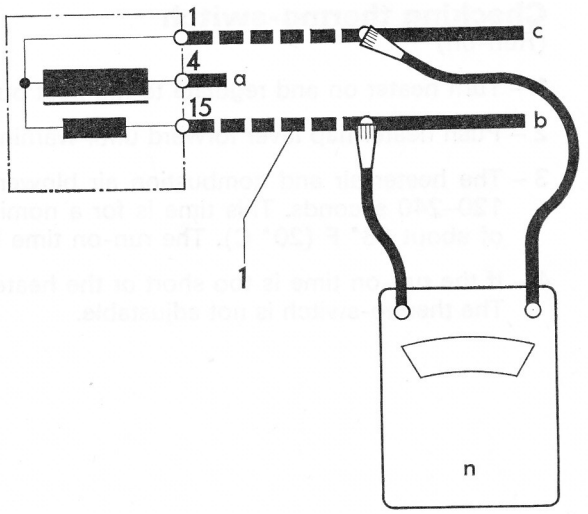
(Measuring speed)

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

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

3 – Connect revolution counter (see illustration) and turn heater on.

4 – At a working voltage of 12 volts, speed should be between 5,500 and 6,500 rpm. If speed deviates considerably, remove combustion air blower and test it.



1 – Intermediate cable (approx. 39 in./1 meter long)
a – to glow-spark plug
b – to relay terminal C
c – to contact breaker

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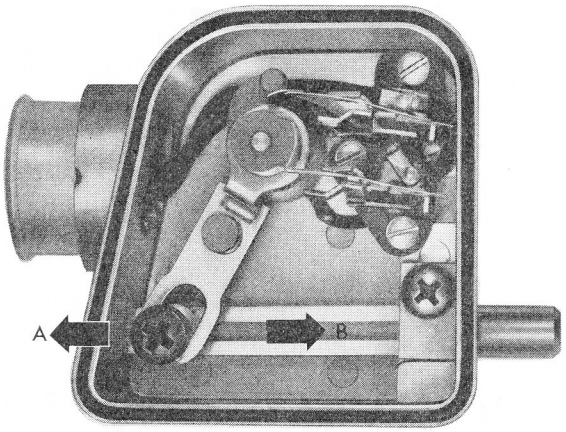
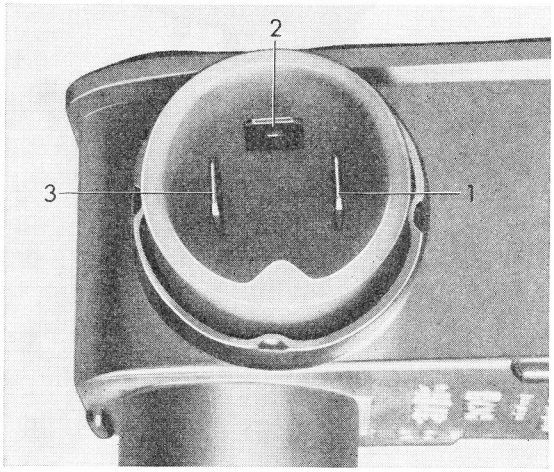




Testing temperature control switch

1 – Remove temperature control switch.

Note:

The bimetal spiral of the temperature control switch must not be turned by hand, otherwise the spiral will be permanently deformed and the control timing affected. The switch is then unserviceable.

2 – Remove cover (lever tensioning spring off with screwdriver) and check visually.

3 – Push thermostat control linkage in direction of arrow (A) as far as it will go.

4 – With an ohmmeter, test the following contact on the control switch **when cold.**

a – Contact 2–1, circuit
b – Contact 2–3, open

Note:

Always connect ohmmeter positive terminal to contact 2.

5 – Push thermostat control linkage .16 in. (4 mm) in direction of arrow (B). Contact 2–3 must be closed.

6 – If the prescribed switching positions are not attained, install new temperature control switch.

Checking thermo-switch

(Run-on)

1 – Turn heater on and regulate to full heat output. Let heater run five minutes.

2 – Push heater flap lever forward until warning lamp goes out. At the same time start stop watch.

3 – The heater air and combustion air blowers, controlled by the thermo-switch, should run-on 120–240 seconds. This time is for a nominal voltage of 12 volts and an outside temperature of about 68° F (20° C). The run-on time is shorter at lower outside temperatures.

4 – If the run-on time is too short or the heater does not switch off, install a new thermo-switch. The thermo-switch is not adjustable.

Testing dual relay

1 – Remove 16 amp. heater fuse from fuse box.

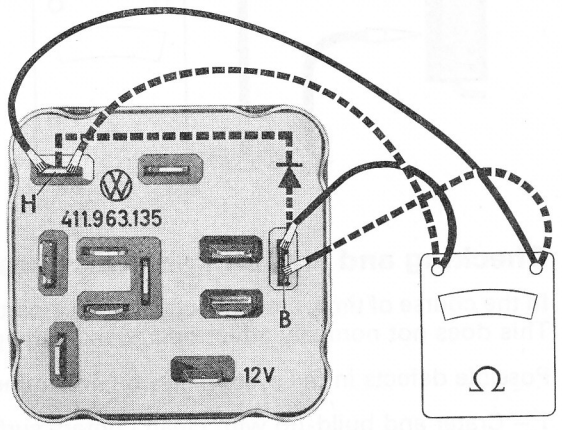
2 – Disconnect cables from relay, then remove relay.

3 – a) Connect ohmmeter to terminals B and H of the relay. Ohmmeter shows a certain reading (low **or** high resistance).

b) Change probes over (see dotted line). If the ohmmeter gives the **same** reading as at a), the diode is defective and the relay must be replaced with a new one.

4 – Apply 12 volts to relay terminals A–H and test terminals E–C, F–D and C–G for circuit with an ohmmeter.

5 – Apply 12 volts to relay terminals B–H (battery positive to terminal B) and test terminals E–G for circuit with an ohmmeter.



Note:

If an open circuit is found during tests 4 and 5, the relay must be replaced with a new one.

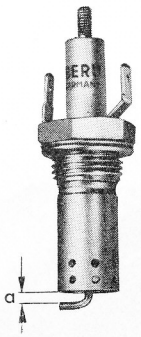
Testing glow-spark plug

1 – Turn heater off.

2 – Unscrew plug and clean dirty plug with wire brush and wood chip.

3 – Install angled connector and ignition cable as well as ground cable, then hold glow-spark plug with insulated pliers.

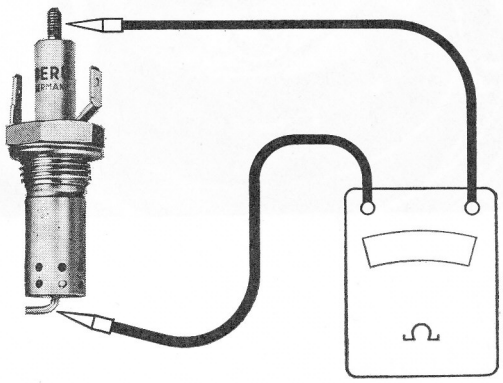
4 – Turn heater on. Sparks must jump across from central electrode to casing (ground).



Note:

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

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



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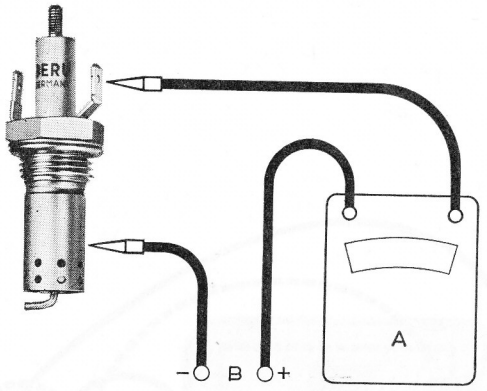


6 – Test glow element for circuit. Connect ammeter as shown and apply 12 volts from a battery. If there is a current of 5.5 to 7 amps. the glow element is serviceable. If the ammeter gives no reading (open circuit) or if reading of more than 8 amps. is shown (short circuit), install a new glow-spark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

A – Ammeter
B – 12-volt battery

Checking and adjusting contact breaker points

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

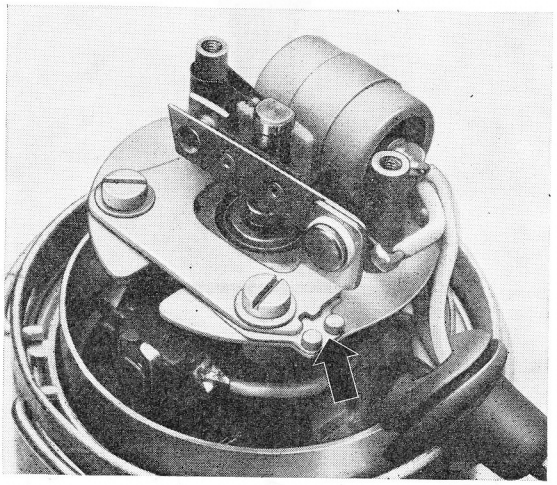
Possible defects in the system can be determined by checking the points visually.

1 – Crater and build-up with clean contact surfaces: Normal erosion

2 – Gray contact surfaces: Breaker point gap too small and pressure too low

3 – Breaker points blue: Ignition coil or condenser defective

4 – Burnt contact surfaces: Dirty (grease)



Adjusting ignition contact breaker points

1 – Remove combustion air blower.

2 – Remove protective cap for motor and cover.

3 – Turn eccentric on motor shaft against thrust washer of breaker arm until breaker arm has moved to end of stroke. Loosen locking screw on contact breaker.

4 – Insert screwdriver between the two small pins on the contact breaker plate and in the slot at the end of the fixed point. Turn screwdriver until clearance of .016 in. (0.4 mm) is obtained. (Contact pressure should be about 160 grams – measure with spring balance).

5 – Tighten locking screw.

Note:

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

Adjusting fuel pump contact breaker points

1 – Remove combustion air blower.

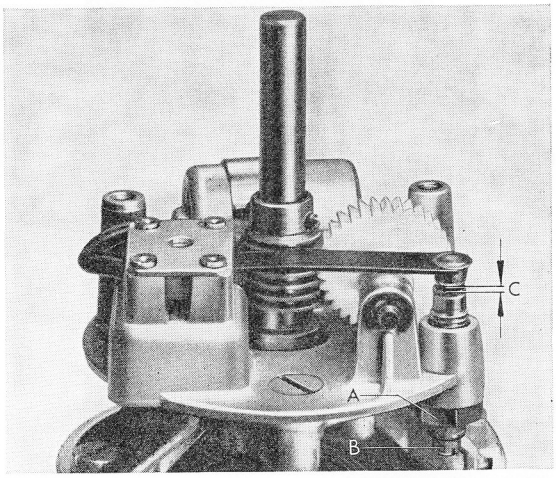
2 – Take off radial blower wheel and spring tensioner.
(Take wheel off carefully. Do not apply load of more than 500 grams to motor shaft. See F 1.6/1–1).

3 – Take motor out of its support housing and detach motor housing.

4 – Turn motor shaft until cam on gear shaft lifts breaker arm fully.

5 – Loosen clamp nut and adjust clearance to .016 in. (0.4 mm) with a feeler gauge by turning the contact point. Ensure that the setting does not alter when retightening the clamp nut. (Contact pressure is about 200 grams).

6 – Assemble combustion air blower (see F 1.6/1–1).



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

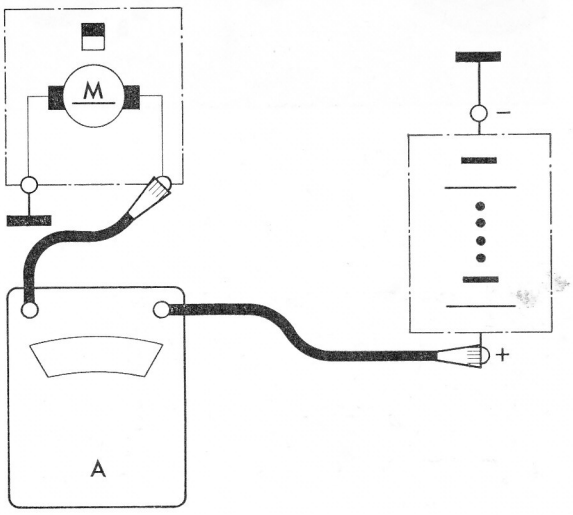
Testing heater air blower

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

1 – Remove 16 amp. main fuse. Open footwell outlets and pull heater flap lever fully back.

2 – Disconnect cables from heater air blower. Connect ammeter and battery as shown.

For a 12-volt battery the current input is 6.5–7 amps. Deviations in readings are due to defects in the heater air blower.



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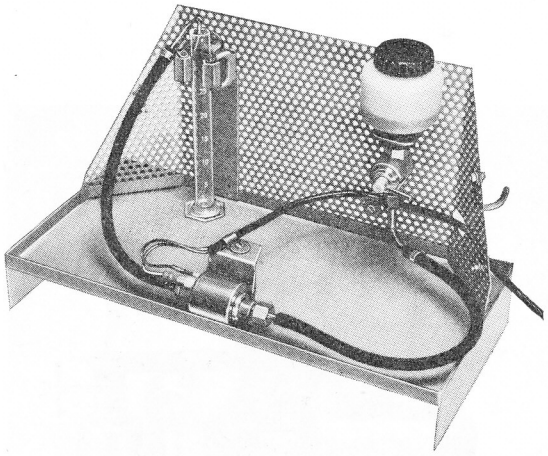
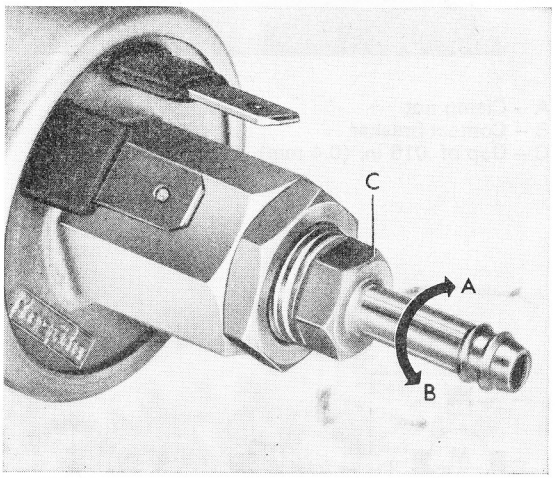




Testing fuel pump

(Adjusting delivery quantity if necessary)

1 – Disconnect cables from fuel pump.

2 – Detach fuel hoses on suction and pressure lines and plug them.

3 – Remove fuel pump, secure to measuring device (VW 804) and connect up. The cut-off tap should be in position "off".

4 – Lengthen fuel pump cables from vehicle with measuring device cable and connect to pump.

5 – Turn heater on.

6 – Move cut-off tap to "Operation" and allow 5 cc of fuel to flow through. Then start stop watch and measure delivered quantity. At a combustion air blower speed of 6,000 rpm, the pump should deliver 9-10 cc per minute.

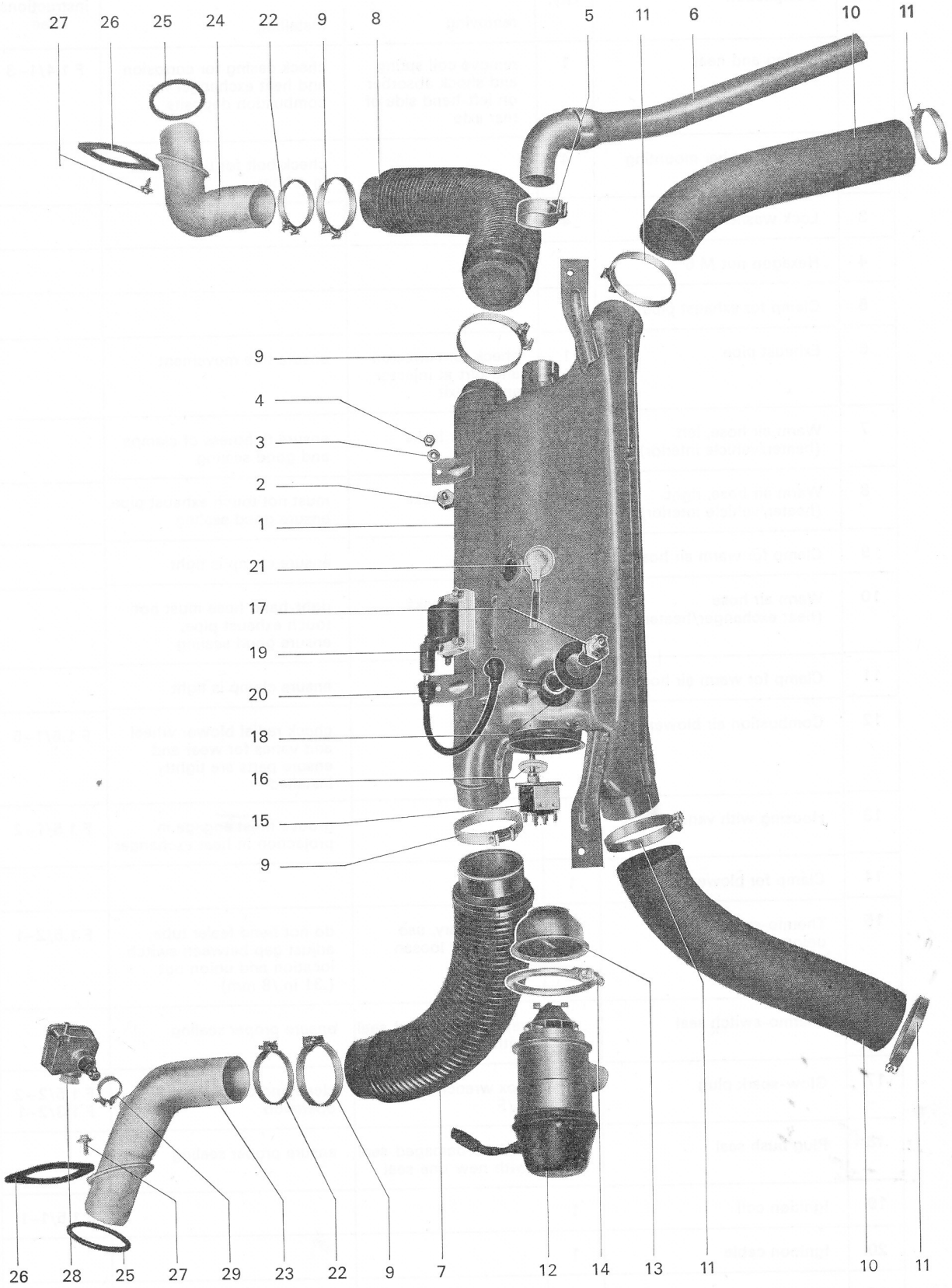
Note:

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

Increase consumption
= Valve guide anti-clockwise (arrow B)

Decrease consumption
= Valve guide clockwise (arrow A)

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



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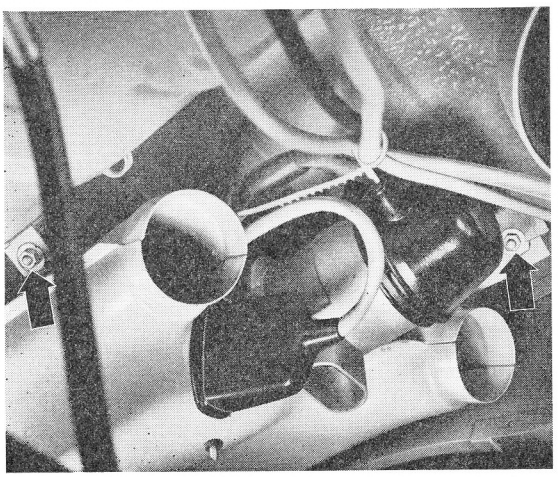
No.	Designation	Qty.	When		Detailed instructions see
			removing	installing	
1	Casing and heat exchanger	1	remove coil spring and shock absorber on left-hand side of rear axle	check casing for corrosion and heat exchanger for combustion deposits	F 1.4/1–3
2	Bonded rubber mounting	4		check bolt for tightness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

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

Removing and installing casing and heat exchanger

Removing



1 – Disconnect battery ground strap.

2 – Remove rear, left-hand coil spring and shock absorber (see Workshop Manual Rear Axle, Removing and Installing Trailing Wishbones).

3 – Detach warm air hoses and exhaust pipe from heater.

4 – Disconnect heater cable harness at relay and pull through into space above transmission.

5 – Detach fuel hose at connection and close with plug. (Catch escaping fuel).

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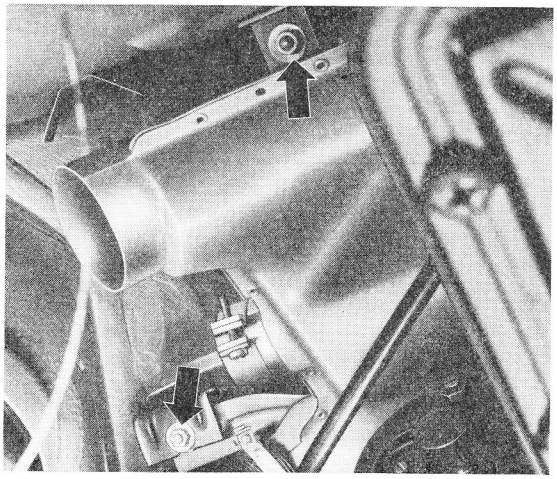
6 – Remove four nuts and lock washers from the welded-on brackets on luggage compartment floor, lift heater and bonded rubber mountings and take out toward left.



Installing

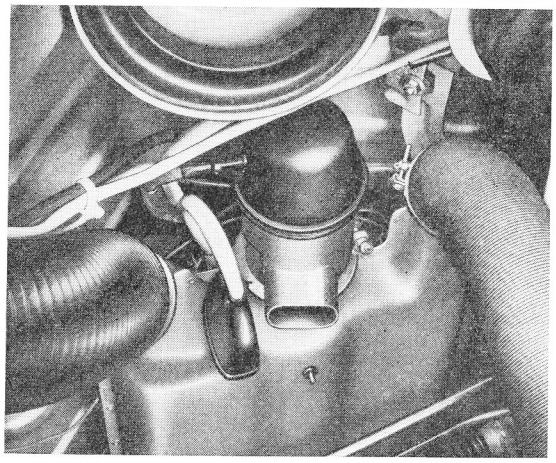
1 – First insert heater and bonded rubber mountings into front and then into rear brackets on luggage compartment floor. Secure with lock washers and nuts.

2 – Reattach fuel hose.

3 – Connect cables and secure exhaust pipe and warm air hoses to heater. Ensure rubber hoses (not illustrated) seal properly.

4 – Reinstall coil spring and shock absorber.

5 – Connect battery and check operation of heater.



Overheating switch with cable harness

Removing

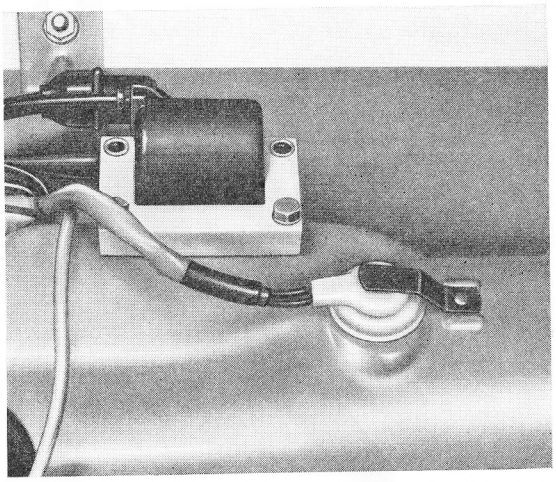
1 – Take 16 amp. main fuse out of fuse box, disconnect cables at dual relay and pull out of engine compartment, then remove heater.

2 – Turn tensioner on overheating switch to one side, then take overheating switch and cap out of housing.

3 – Disconnect cables from glow-spark plug, ignition coil, fuel pump and thermo-switch.

4 – Remove grommet on combustion air blower motor socket and disconnect push-on terminals.

5 – Open clamp for cable harness on heater and remove harness.



Installing

1 – Connect cables to heater units according to wiring diagram and secure cable harness with clamp.

2 – Carefully insert overheating switch and cap into housing and secure with tensioner.

3 – Install heater and pull cable harness through grommet into engine compartment. Connect cables to dual relay according to wiring diagram.

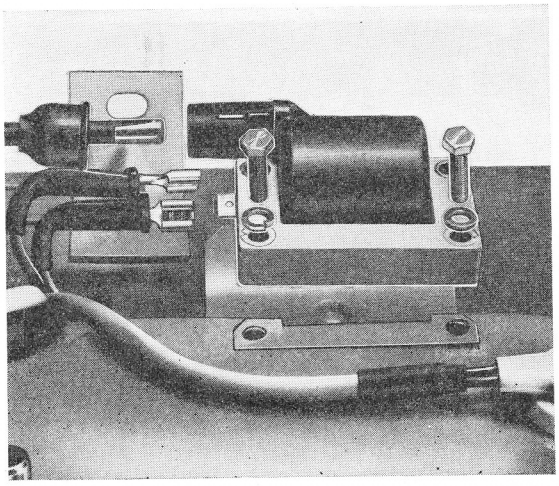
4 – Reinstall 16 amp. fuse and check heater operation.

Removing and installing ignition coil

1 – Remove heater.

2 – Remove screws and washers, then take ignition coil out.

3 – Install new ignition coil, install heater and check operation.



Note:

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

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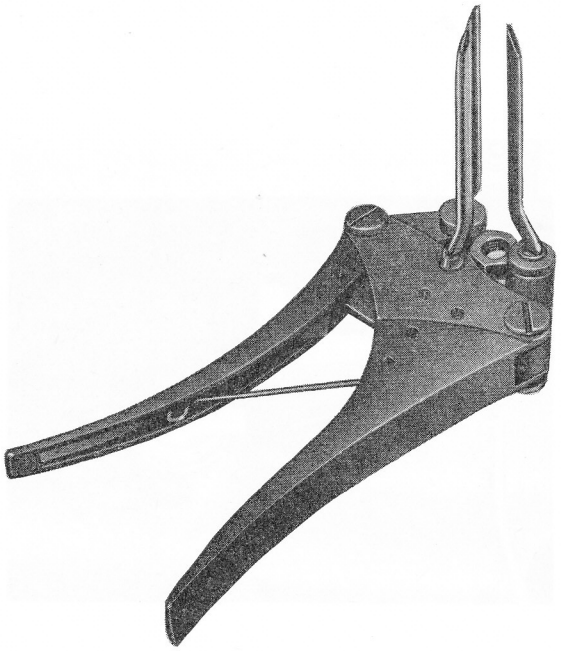
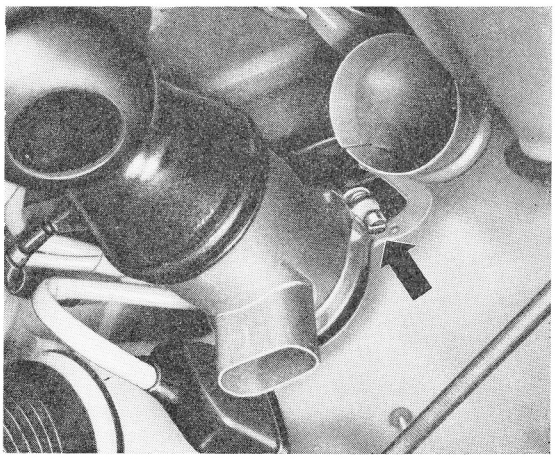
Removing and installing combustion air blower

Removing



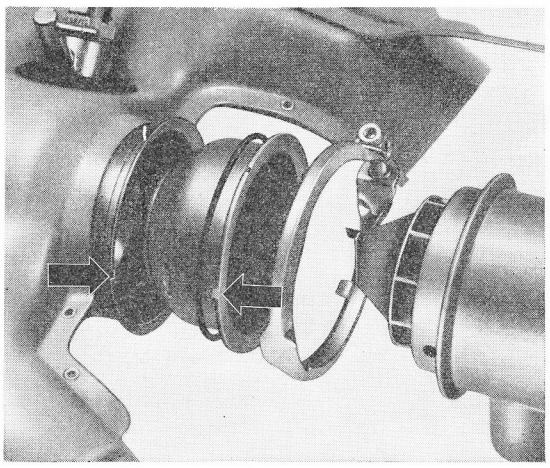
1 – Remove rubber grommet from blower plug with special pliers, then disconnect push-on connection.



2 – Loosen combustion air blower clamp and remove.

3 – Take out combustion air blower.

Installing



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

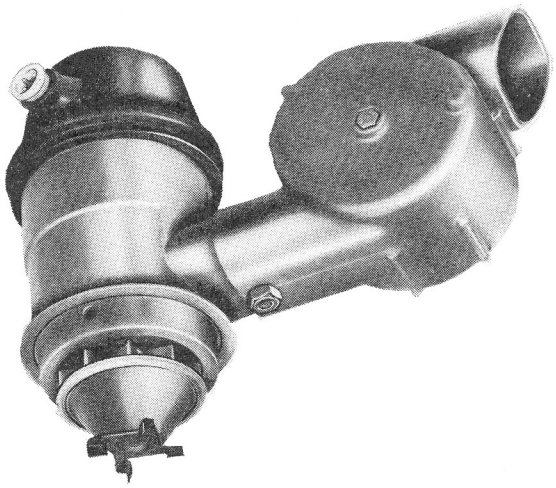
Note:

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

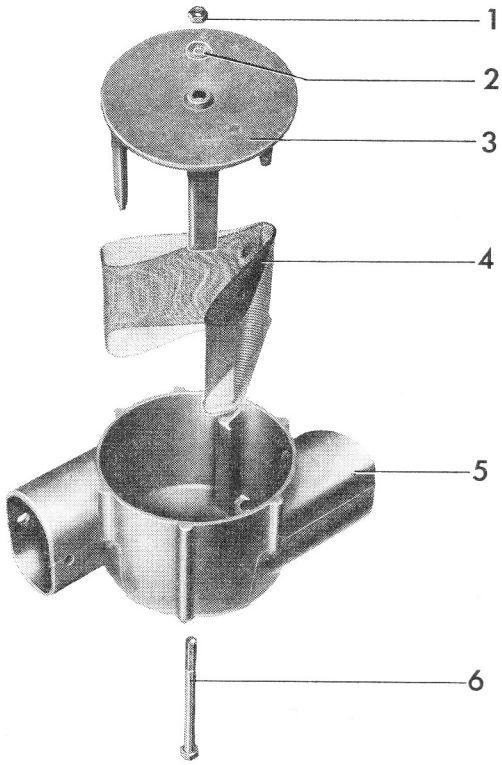
2 – Push plug and socket together and push rubber grommet over with special pliers.

3 – Turn heater on and check operation.

A filter is fitted to the intake pipe of the combustion air blower.



1 – Nut
2 – Spring washer
3 – Strainer frame
4 – Strainer
5 – Housing
6 – Bolt



Note:

The filter should be cleaned before the cold weather starts.

If the filter gets blocked, insufficient air will be drawn in and the heater will soot up. This will affect the heat output.

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Removing and installing temperature control switch

Removing

1 – Remove rubber cap and plug.

2 – Loosen clamp and pull temperature control switch out of warm air pipe.

3 – Lever springs off with screwdriver and take cover off.

4 – Back off screw (A) on thermostat control linkage and bowden cable screw (B), then pull bowden cable out.

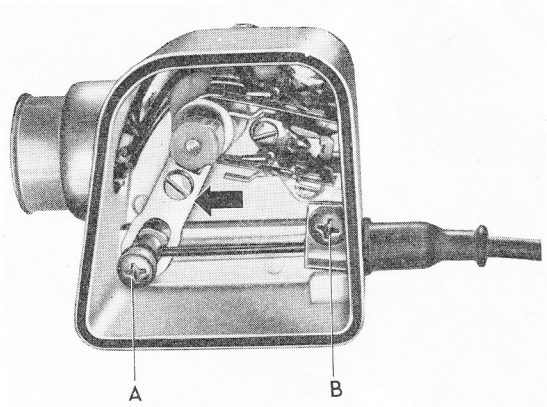
Installing

1 – Push regulating lever fully forward and insert bowden cable into temperature control switch. Push thermostat control linkage up to stop (arrow) and secure cable with screw (A). The bowden cable must have approximately the same bend as it has when installed. Clamp bowden cable with screw (B) and push rubber grommet over bowden cable connection.

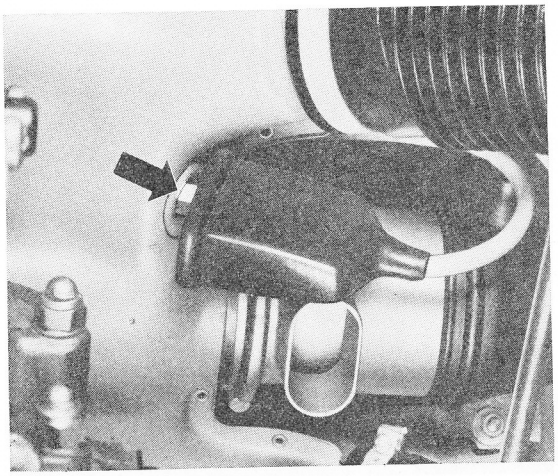
2 – Secure cover, ensuring that the seal is properly seated.

3 – Push plug and cables into socket and secure rubber cap.

4 – Insert temperature control switch into warm air pipe (make sure groove in connection of warm air pipe engages projection in temperature control switch) and secure with clamp.



Removing and installing thermo-switch



Removing

1 – Disconnect battery negative cable.

2 – With a 12 mm open end wrench unscrew union nut (arrow) and pull thermo-switch and cap out with a turning movement. If necessary use a suitable solvent to release it.

3 – Take cap off thermo-switch and disconnect cables.

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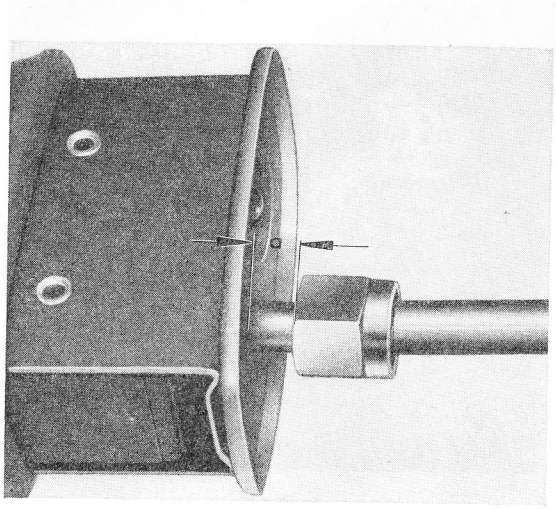


Installing

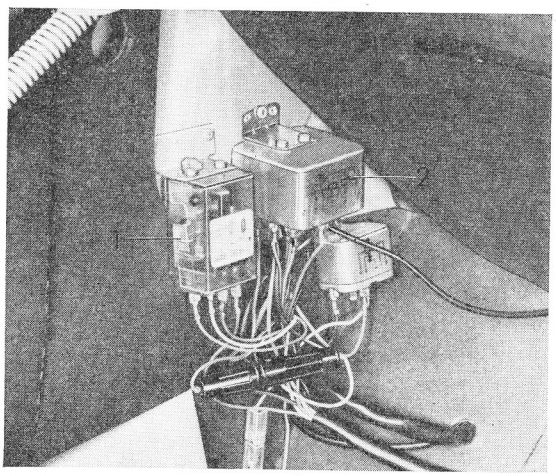
1 – Install new double taper ring onto feeler tube. The distance between union nut and switch housing should be adjusted to .31 in. (8 mm). Ensure that the feeler tube is not bent.

2 – Connect cable according to wiring diagram and install cap.

3 – Insert thermo-switch into connection and secure. Ensure that thermo-switch seal in casing is correctly positioned. Pay attention to gap of .31 in. (8 mm).

4 – Connect battery negative cable and check heater operation. (Pay attention to run-on).

Removing and installing dual relay and safety switch



Removing

1 – Disconnect battery ground strap from negative terminal.

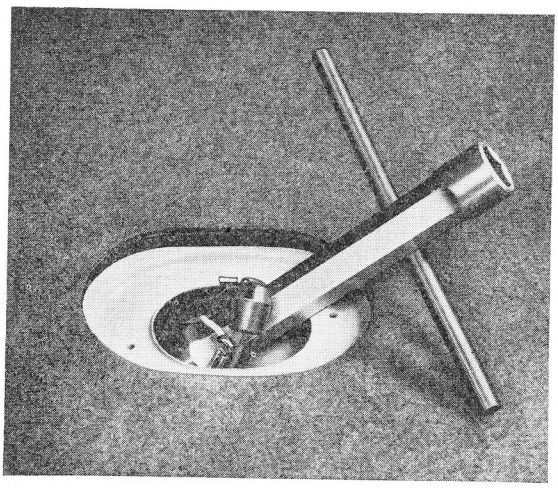
2 – Disconnect cables at relay, then remove relay.

Installing

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

1 – Safety switch
2 – Dual relay

Removing and installing glow-spark plug



Removing

1 – Take out cover in luggage compartment floor trim and remove cover plate.

2 – Disconnect cables at glow-spark plug.

3 – With a box wrench (22 mm A/F), unscrew glow-spark plug.

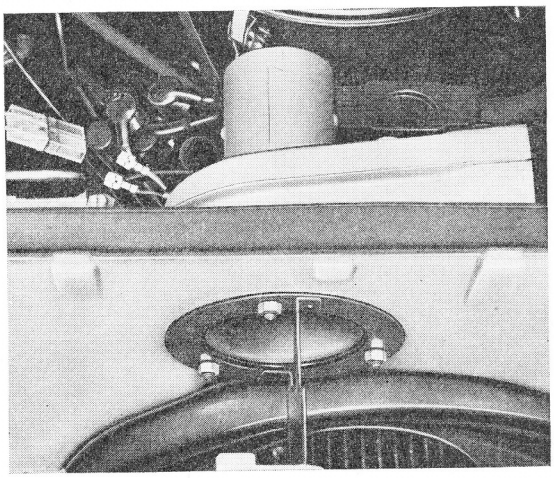
Installing

1 – Install plug and connect cables.

Ensure that the brown ground cable is pushed onto the ground connection tab.

2 – Secure cover plate and install cover in luggage compartment floor trim.

Heater air blower



Removing

1 – Disconnect cables.

2 – Detach warm air hoses on both sides of blower.

3 – Remove cooling air intake grille.

4 – Unscrew heater air blower nuts in cooling air intake and take blower out.

Installing

1 – Insert blower into cooling air intake so that the right-hand blower connection is at the top. Secure blower with nuts and washers.

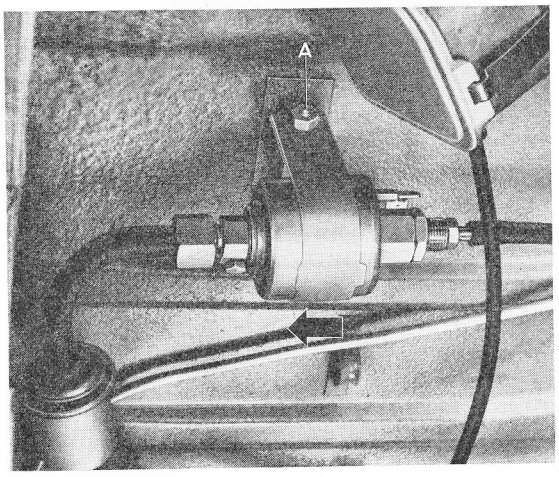
2 – Reinstall cooling air intake grille.

3 – Secure left and right warm air hoses to housing connections with clamps, then connect cables (note cable colors).

Note:

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

Fuel pump



Removing

1 – Disconnect cables, detach suction and pressure lines and plug them.

2 – Loosen clamp nut (A) and pull pump out toward front (arrow).

Installing

1 – Insert fuel pump into clamp and tighten nut. (Pay attention to flow direction of pump).

2 – Connect suction and pressure lines and electric cables. Ensure that the caps on the pump terminal tabs are correctly installed.

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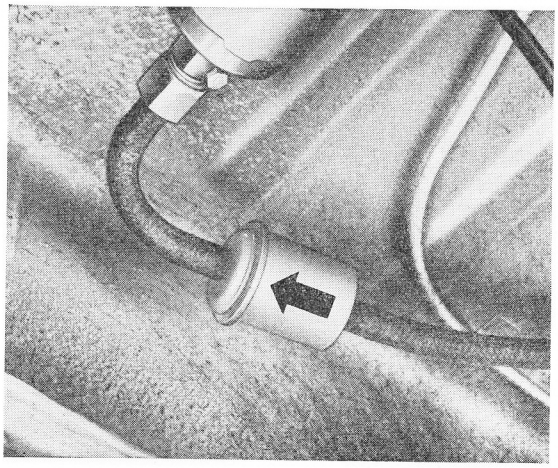


Filter

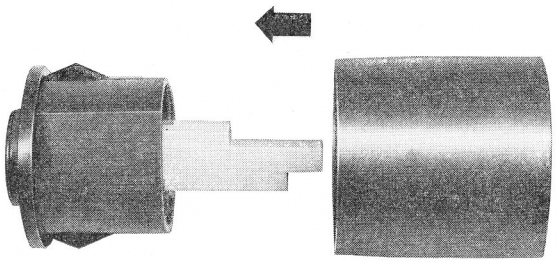
Removing

1 – Pinch fuel hose between filter and T-piece (in the vehicle engine fuel line) and detach.

2 – Detach fuel hose from filter to pump and plug it. Catch any escaping fuel.

Installing

When installing, ensure that the arrow denoting the direction of flow of fuel faces the pump.



Warning lamp

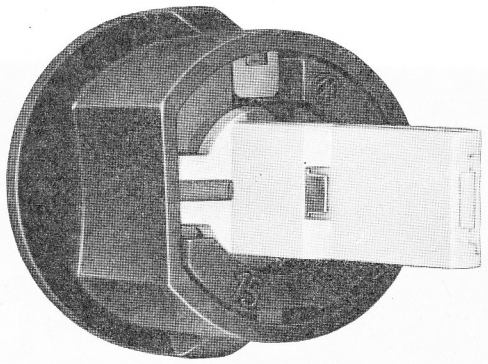
Removing

1 – Remove 16 amp. main fuse from fuse box and disconnect cables from terminals on bulb holder and lamp.

2 – Position a locally manufactured tube, (dimensions: I/D .83 in./21 mm, O/D max. 1 in./25 mm, length 1.18 in./30 mm), behind instrument panel and over warning lamp to press retaining springs together.

3 – Press holder and lamp out.

4 – Turn holder anticlockwise and pull out of lamp. Take bulb out.

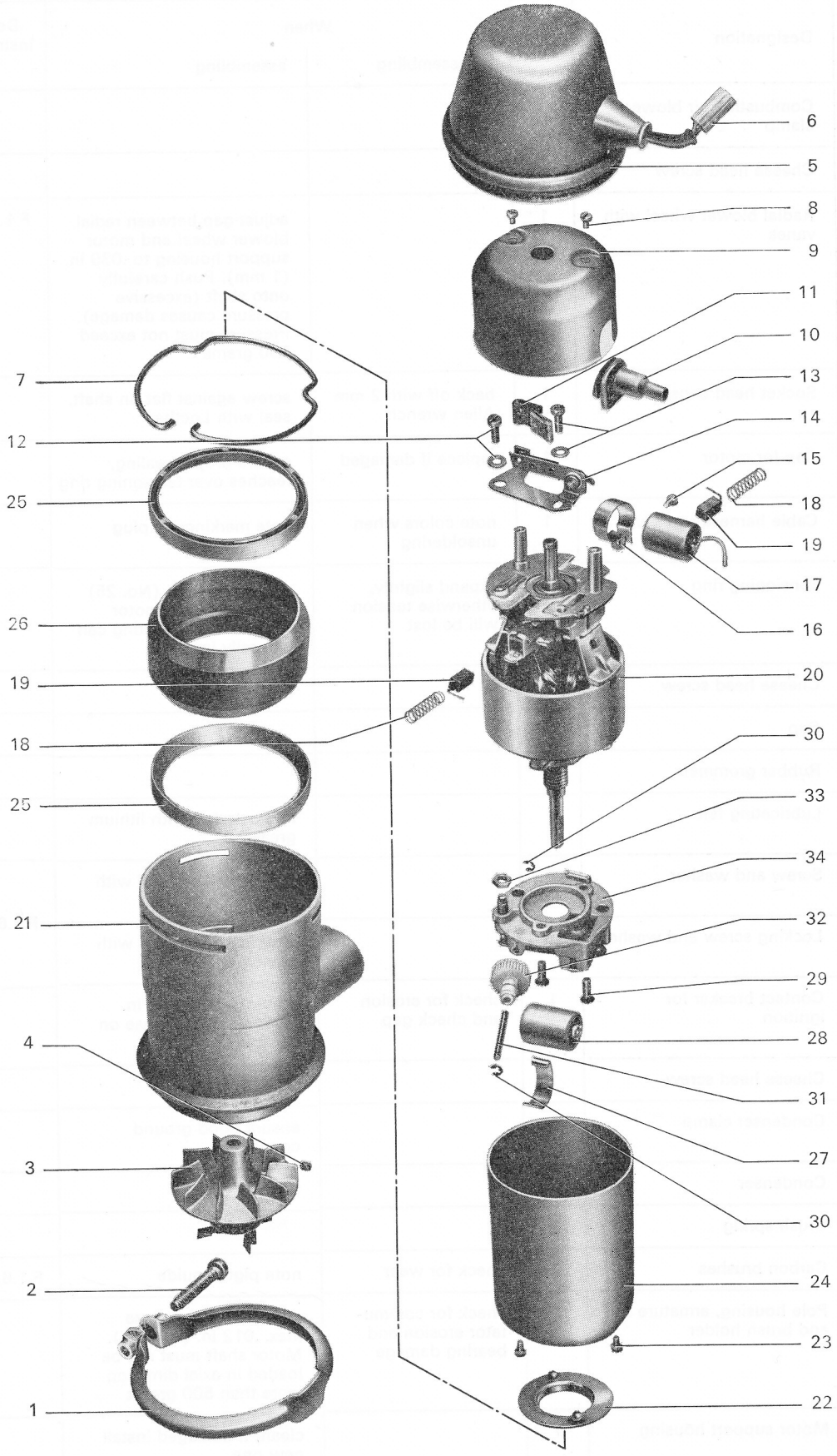


Installing

1 – Push bulb into holder and insert holder into lamp. Turn holder and bulb clockwise.

2 – Press warning lamp into instrument panel (flat side upward).

3 – Connect cables (brown-white cable to holder) and reinstall fuse.



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No.	Designation	Qty.	When		Detailed instructions see
			disassembling	assembling	
1	Combustion air blower clamp	1			
2	Cheese head screw				
3	Radial blower wheel with vanes	1		adjust gap between radial blower wheel and motor support housing to .039 in. (1 mm). Push carefully onto shaft (excessive pressure causes damage). Pressure must not exceed 500 grams	F 1.6/1–5
4	Socket head capscrew	1	back off with 2 mm Allen wrench	screw against flat on shaft, seal with Loctite	
5	Cap for motor	1	replace if damaged	ensure proper sealing, reaches over tensioning ring	
6	Cable harness and plug	1	note colors when unsoldering	note markings in plug	
7	Tensioning ring	1	expand slightly, otherwise tension will be lost	press taper ring (No. 25) far enough into motor support so that spring can be easily installed	
8	Cheese head screw	2		seal with paint	
9	Cap	1			
10	Rubber grommet	1			
11	Lubricating felt	1		lubricate felt with lithium grease	
12	Screw and washer	1		after installing, seal with paint	F 1.6/1–3
13	Locking screw and washer	1		after installing, seal with paint	
14	Contact breaker for ignition	1	check for erosion and check gap	adjust gap to .016 in. (0.4 mm). No grease on points	
15	Cheese head screw	1			
16	Condenser clamp	1		ensure good ground connection	
17	Condenser	1		test	
18	Brush spring	2			
19	Carbon brushes	2	check for wear	note pigtail guide	F 1.6/1–5
20	Pole housing, armature and brush holder	1	check for commutator erosion and bearing damage	axial play of armature max. .012 in. (0.3 mm). Motor shaft must not be loaded in axial direction more than 500 grams	
21	Motor support housing	1		clean; if damaged install new one	

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

Ignition contact breaker

Removing

1 – Remove combustion air blower.

2 – Remove motor protective cap and cover.

3 – Unsolder cable at contact breaker.

4 – Remove securing and locking screws and take contact breaker out.

Installing

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

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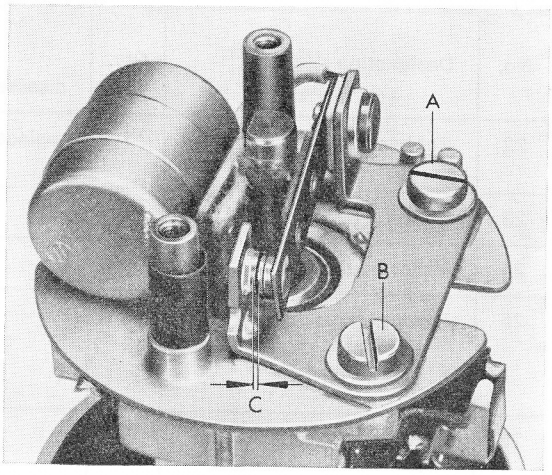
2 – Turn eccentric on motor shaft against thrust washer and adjust gap of 0.16 in. (0.4 mm). Tighten securing and locking screws and seal with paint. (The contact pressure should be about 160 grams).

3 – Lubricate felt with lithium grease if necessary. Grease must not come into contact with the breaker points.

4 – Solder cables from condenser onto contact breaker (use only cored solder).

5 – Secure cap and seal screws with paint. Ensure that rubber grommet seals properly.

6 – Install protective cap for motor over tensioning ring, then install combustion air blower.



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

Fuel pump contact breaker

Removing

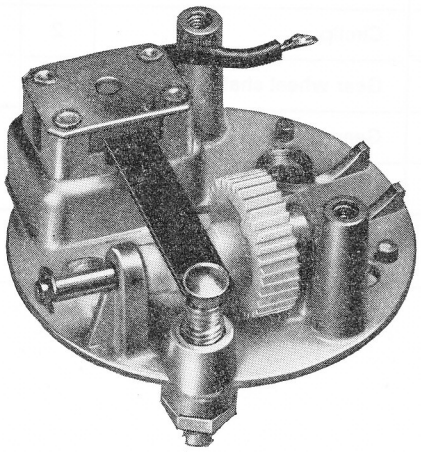
1 – Remove motor protective cap.

2 – Carefully pull radial blower wheel off motor shaft (do not apply more than 500 grams to shaft).

3 – Mark position of motor to motor support housing, remove tensioning ring and pull motor out.

4 – Remove rubber support ring and securing screws. Pull pole housing out of motor housing.

5 – Unsolder cables at condenser, then remove contact breaker plate and gear wheel.



Installing

1 – Install gear wheel and check breaker point gap (.016 in./0.4 mm) and adjust if necessary (see F 1.3/2–2).

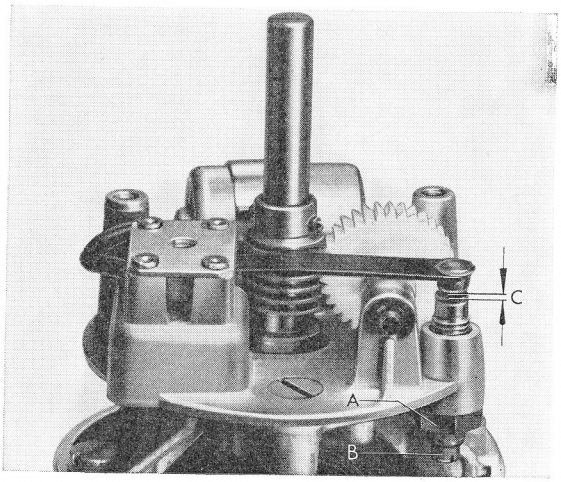
2 – Install contact breaker plate and seal countersunk head screws with paint.

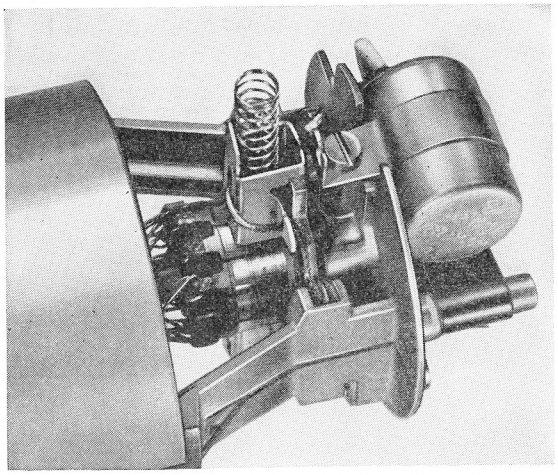
3 – Solder condenser on, install and secure motor support housing. Install rubber support ring.

4 – Push motor into support housing and secure with tensioning ring.

5 – Install radial blower wheel with vanes on motor shaft, secure, then seal socket head capscrew with Loctite. Counterhold motor shaft at commutator end with a drift.

6 – Pull protective cap for motor over tensioning ring and reinstall blower.





Carbon brushes

Removing

1 – Remove combustion air blower and take motor out of motor support housing.

2 – Remove cover from motor housing.

3 – Unsolder carbon brush from terminal tab. Bend up tongue on brush holder and take out spring and brush.

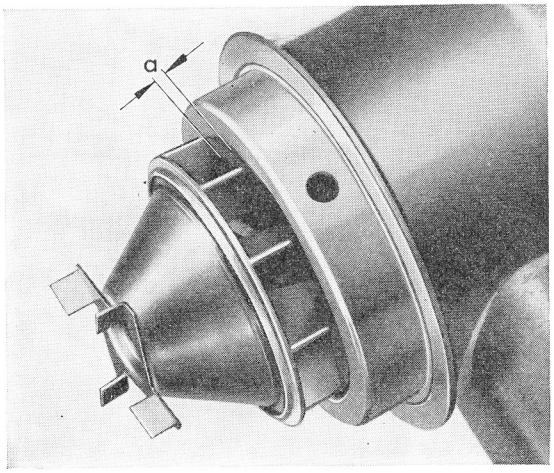
Note:

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

Installing

1 – Insert carbon brushes into brush holder, route contact pigtail through slot in brush holder to terminal tab and solder. Insert spring and bend tongue over.

2 – Assemble motor, insert into motor support housing and reinstall combustion air blower.



Radial blower wheel with vanes

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

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

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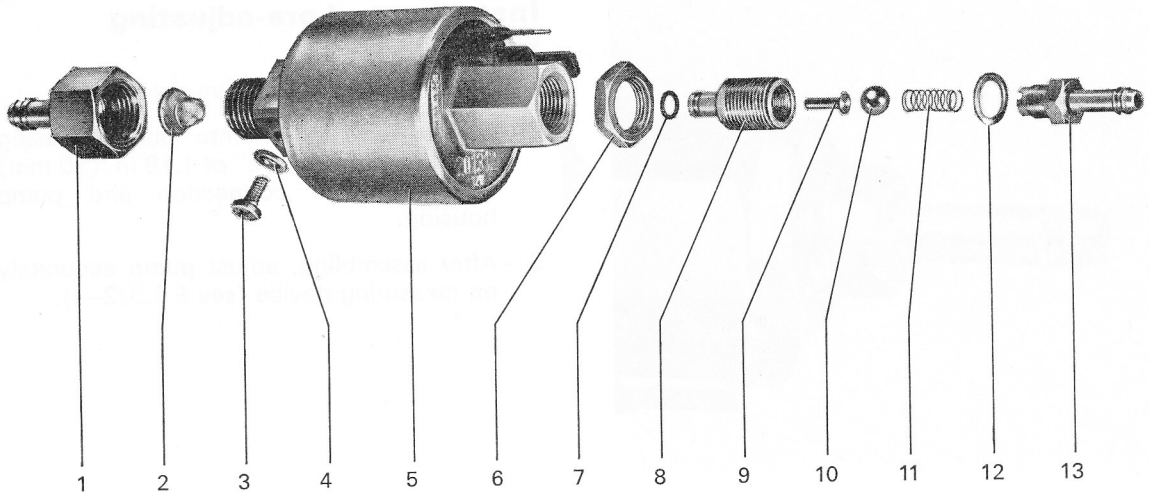
Disassembling and Assembling Fuel Pump



No.	Designation	Qty.	When		Detailed instructions see
			disassembling	assembling	
1	Union	1	counterhold at pump housing with 17 mm open-end wrench		
2	Strainer	1		clean	
3	Bleeder screw	1			
4	Special ring	1		adhesive side to pump housing	
5	Pump housing	1		test winding for circuit; clean housing	
6	Locknut	1		after adjusting, seal with paint	
7	O-ring	1	check for damage	moisten with filtered gasoline	
8	Valve body	1		clean in acetone; if one part is damaged, install complete new valve guide and readjust	F 1.3/2–4 F 1.7/1–2
9	Control valve	1			
10	Valve ball	1			
11	Spring	1			
12	Copper seal	1		ensure good sealing	
13	Valve connection	1		clean in acetone	

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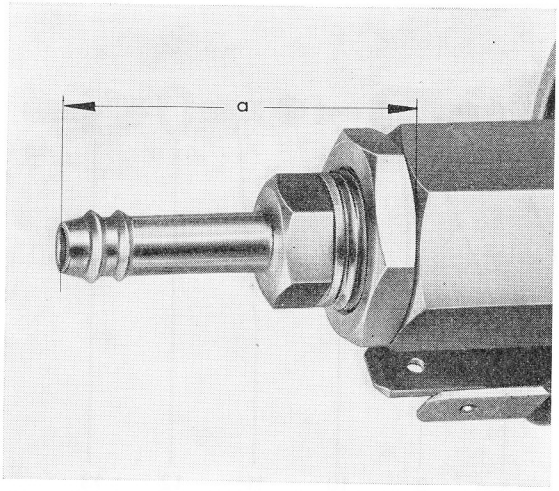
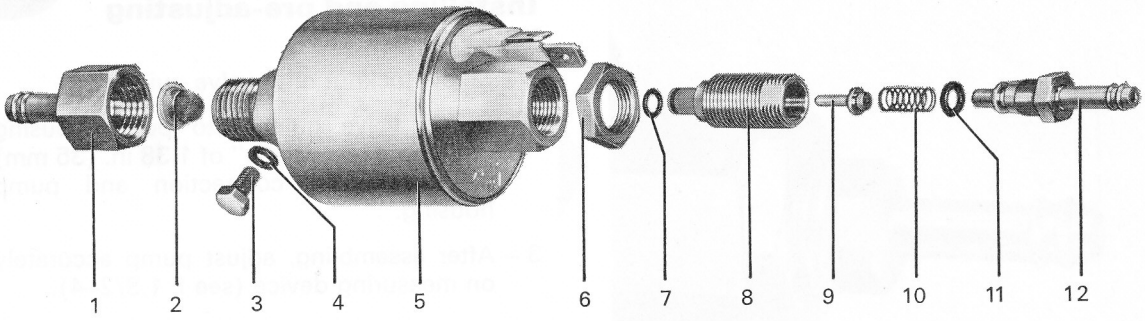


Installing and pre-adjusting valve guide

1 – Screw locknut onto valve guide.

2 – Screw valve guide into pump housing until there is a gap "a" of 1.18 in. (30 mm) between valve connection and pump housing.

3 – After assembling, adjust pump accurately on measuring device (see F 1.3/2–4).



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

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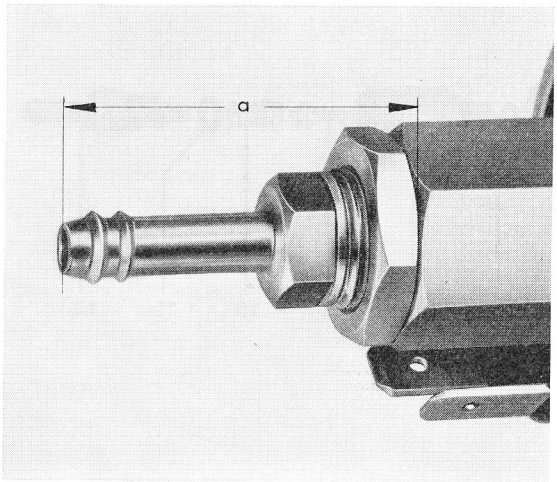
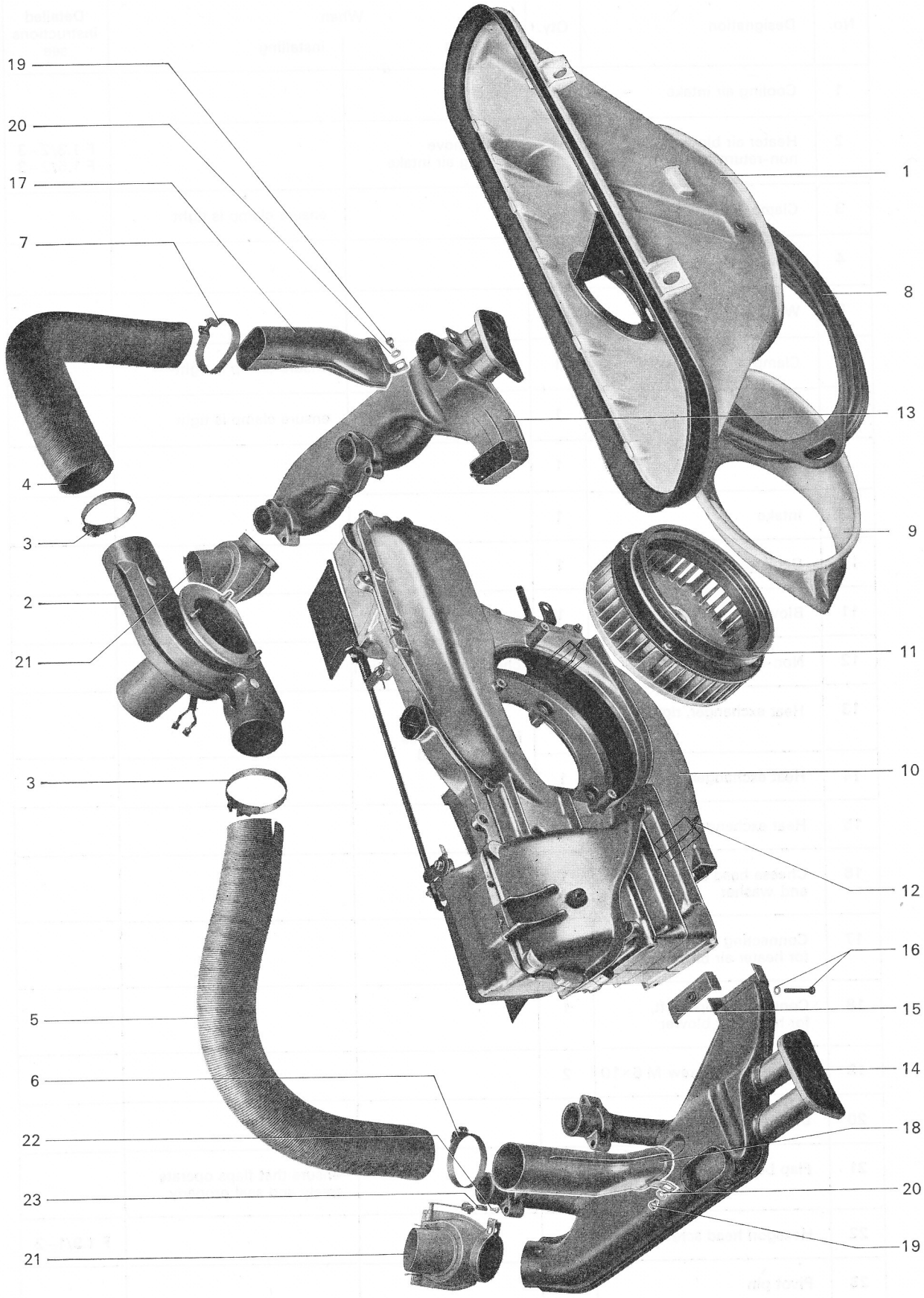


Installing and pre-adjusting valve guide

1 – Screw locknut onto valve guide.

2 – Screw valve guide into pump housing until there is a gap "a" of 1.38 in. (35 mm) between valve connection and pump housing.

3 – After assembling, adjust pump accurately on measuring device (see F 1.3/2–4).



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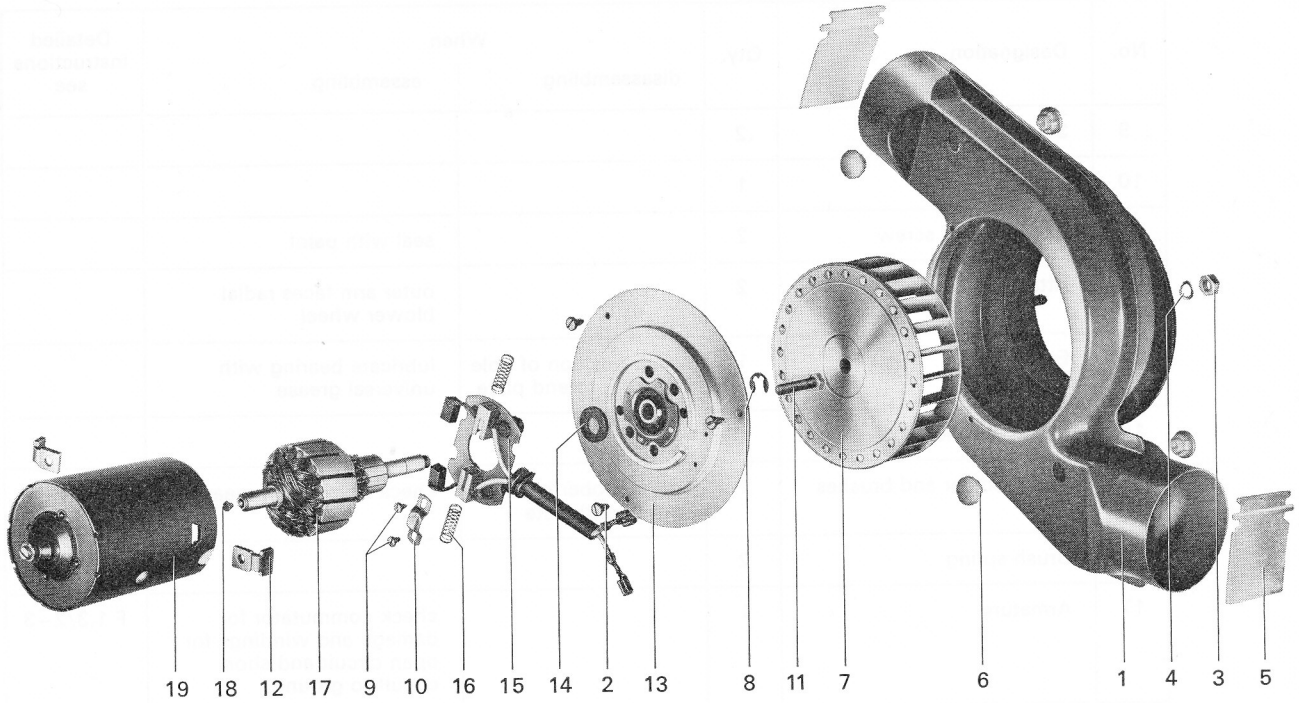
No.	Designation	Qty.	When removing	When installing	Detailed instructions see
1	Cooling air intake	1			
2	Heater air blower with non-return flaps	1	first remove cooling air intake		F 1.3/2–3 F 1.5/2–3
3	Clamp	2		ensure clamp is tight	
4	Warm air hose, right	1			
5	Warm air hose, left	1			
6	Clamp	1		ensure clamp is tight	
7	Clamp, oval	1		ensure clamp is tight	
8	Boot	1			
9	Intake	1			
10	Cooling air intake housing	1			
11	Blower	1			
12	Non-return flaps	2	check for free operation		
13	Heat exchanger, right	1	install new ones if badly rusted		
14	Heat exchanger, left	1			
15	Heat exchanger cover	1			
16	Cheese head screw and washer	1			
17	Connecting pipe, right, for heater air blower	1			
18	Connecting pipe, left, for heater air blower	1			
19	Cheese head screw M 6×10	2			
20	Lock washer	2			
21	Flap boxes	2		ensure that flaps operate freely and seal properly	
22	Hexagon head screw M 5	2			F 1.9/1–2
23	Pivot pin	2			



No.	Designation	Qty.	When		Detailed instructions see
			disassembling	assembling	
1	Housing with flaps	1		check flaps for free operation	F 1.5/2–3
2	Screw	3			
3	Hexagon nut	1	first remove housing with flaps	hold radial blower wheel	
4	Washer	1			
5	Non-return flaps	2			
6	Plastic bearing	4			
7	Radial blower wheel	1	check vanes for damage, note and mark relative position of wheel to shaft		
8	Circlip	1			

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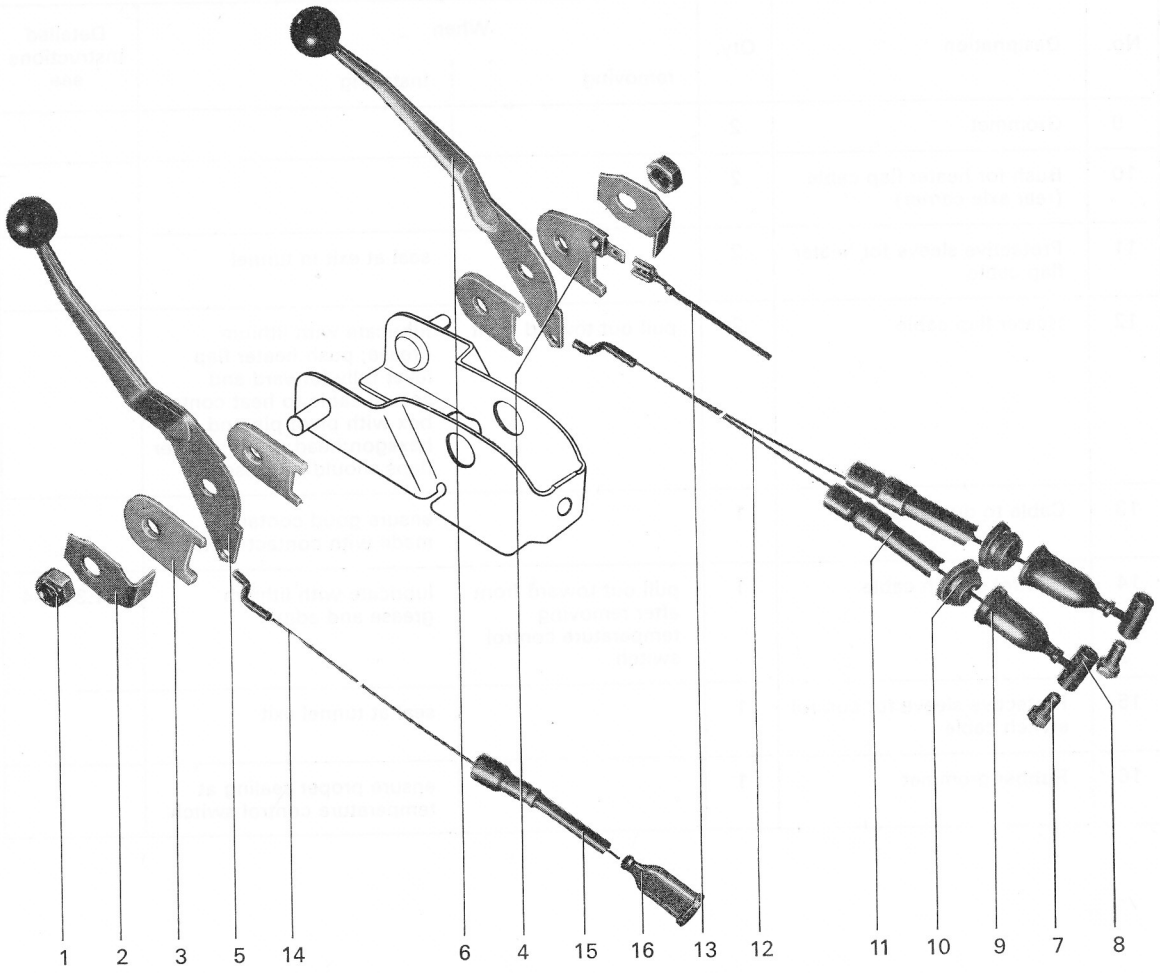
No.	Designation	Qty.	When		Detailed instructions see
			disassembling	assembling	
9	Screw	2			
10	Clamp	1			
11	Cheese head screw	2		seal with paint	
12	Attaching bracket	2		outer arm faces radial blower wheel	
13	End plate	1	mark position of pole housing to end plate	lubricate bearing with universal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

Heater Flap Lever and Regulating Lever



No.	Designation	Qty.	When		Detailed instructions see
			removing	installing	
1	Hexagon nut M 8	2		torque to 3.6 lb.ft. (0.5 mkg)	
2	Stop bracket	2		angled end faces inward and engages in cutout in friction disc	
3	Friction disc	3		place wedge-shaped surfaces together so that the outer surfaces are parallel	
4	Contact plate	1		terminal tab faces rear	
5	Regulating lever	1		before installing lever attach cable so that angled part of hook faces inward	
6	Heater flap lever	1			
7	Hexagon head screw M 5	2		after adjusting levers and cables, torque to 3.6 lb.ft. (0.5 mkg) max.	F 1.9/1–2
8	Pivot pin				

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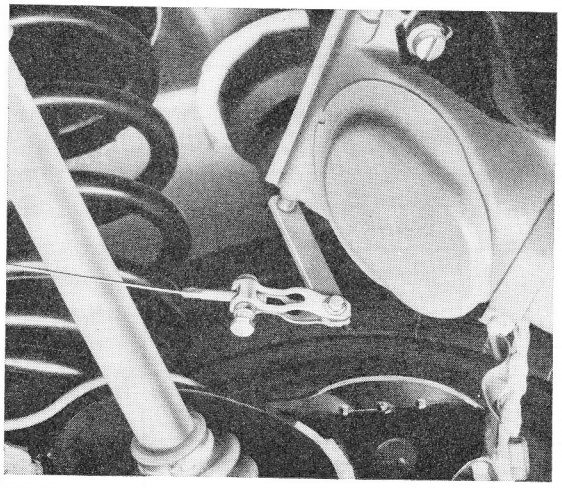
No.	Designation	Qty.	When		Detailed instructions see
			removing	installing	
9	Grommet	2			
10	Bush for heater flap cable (rear axle carrier)	2			
11	Protective sleeve for heater flap cable	2		seal at exit in tunnel	
12	Heater flap cable	2	pull out toward front	lubricate with lithium grease; push heater flap lever fully forward and secure cable to heat control box with pivot pin and hexagon head screw; heater flaps should be closed	
13	Cable to dual relay	1		ensure good contact is made with contact plate	
14	Control switch cable	1	pull out toward front after removing temperature control switch	lubricate with lithium grease and adjust	F 1.3/1–4
15	Protective sleeve for control switch cable	1		seal at tunnel exit	
16	Rubber grommet	1		ensure proper sealing at temperature control switch	



Adjusting heater flap cables

Prior to installation, check flaps and levers in heat control boxes for free operation.

1 – Push heater flap lever fully forward.

2 – Insert pivot pin and hexagon head screw into heat control box lever and push cable into pivot pin. Torque hexagon head screw to max. 3.6 lb.ft. (0.5 mkg).