

# **Section F**

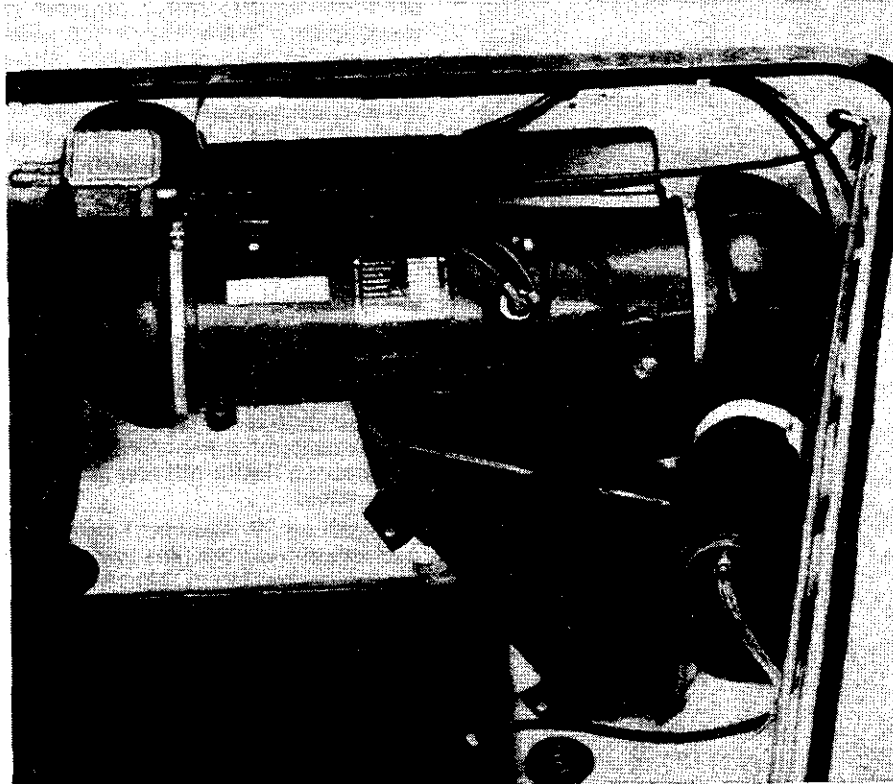
# **Gas Heater**

- 3.1 Description of Heater
- 3.5 Trouble Shooting Heater
- 3.3 Testing and Adjusting
- 3.4 Air Ducts
- 3.5 Assembly and Disassembly
- 3.6 Fuel pump
- 3.7 Combustion Blower

## BN 4 Recirculating Air and Fresh Air Heaters

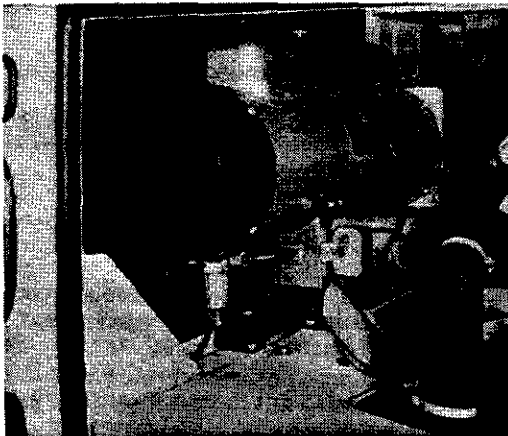
### **Description : Type 1/Model 181**

The gasoline-electric recirculating heater operates independently of the vehicle engine and is installed in the front luggage compartment. The heater is thermostatically controlled and can be used without running the engine.

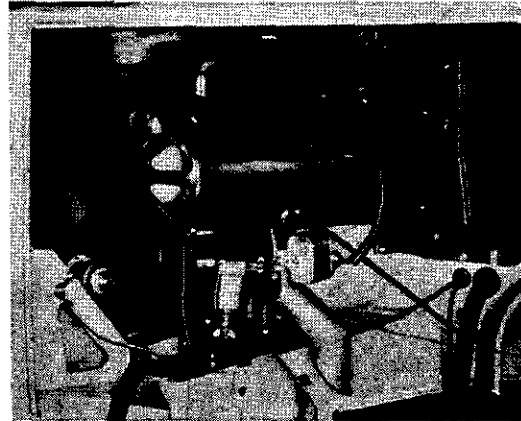


### **Description: Type 2**

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



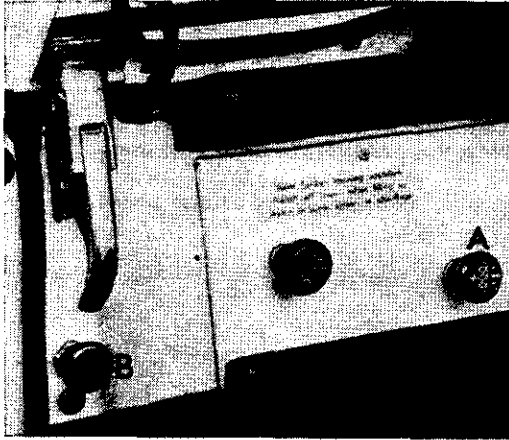
Recirculating heater



Fresh air heater

On the fresh air version a thermostatically operated flap is necessary to prevent cold air flowing from the engine compartment to the passenger compartment when the heater is not operating.

# F 3.1 Description of Heating System



A – time switch knob  
B – temperature regulating switch knob

## Type 1/Model 181

### 1 – With engine running

**To switch heater on:** Pull control switch knob (B) out slightly. Turn time switch knob (A) clockwise until switch engages. The green warning lamp in the time switch knob lights up when the head- or parking lights are switched on.

**To switch heater off:** Turn time switch knob (A) as far as possible counter-clockwise. With the parking- or headlights turned on the brightness of warning light in knob A and B can be regulated like the instrument light.

### 2 – With engine not running

**To switch heater on:** Pull regulating switch knob (B) out. Turn time switch knob (A) clockwise as far as possible.

**To switch heater off:** The clockwork mechanism in the time switch automatically switches the heater off after about 30 minutes.

During these 30 minutes, the clockwork mechanism turns the time switch knob back to its original position. If the engine is started with the time switch knob in this position, the heater switches itself on again automatically and remains on until the ignition is switched off.

When the heater is used with the vehicle parked it can be switched off at any time by turning the time switch knob counter-clockwise to the engaged position or turning it counter-clockwise as far as possible to the zero position. The clockwork mechanism then runs down.

### Regulating warm air temperature

Pull temperature regulating switch knob (B) out.

The further the temperature regulating switch knob (B) is pulled out, the higher the temperature of the circulated hot air will be.

### Note

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

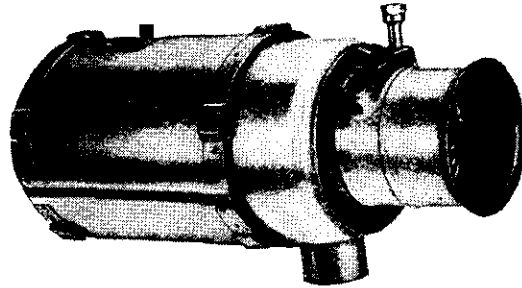
### Warning

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

**Heat exchanger**

The heat exchanger is made of stainless sheet steel. The cylindrical combustion chamber and the two annular chambers of the heat exchanger are connected by two openings.

Spark plug, glow plug, flame switch and fuel jet are attached to the heat exchanger.

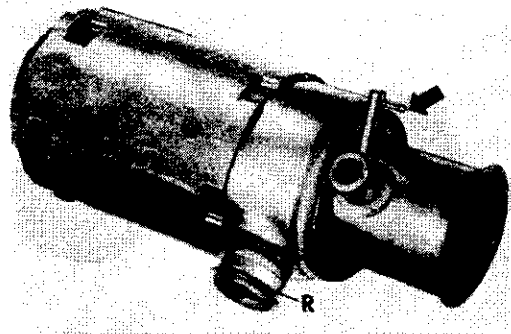


Up to July 1971

**Type 2**

from August 1971

The heat exchanger can be recognized by the connection for the fuel hose (arrow) and by the single adapter for the glow-spark plug.

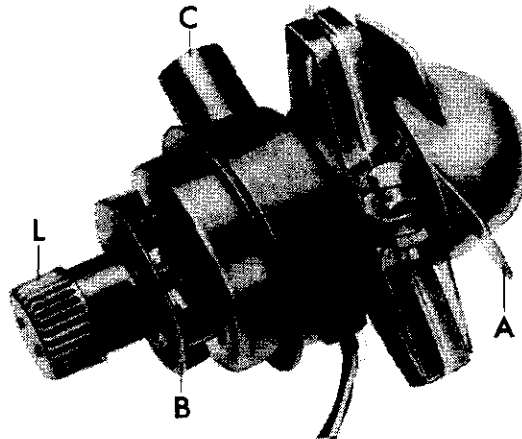


R – tapered ring / Type 1 / Model 181 only

**Combustion air blower**

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

Ignition of the mixture is controlled by a set of contacts that make/break with each revolution of the motor.



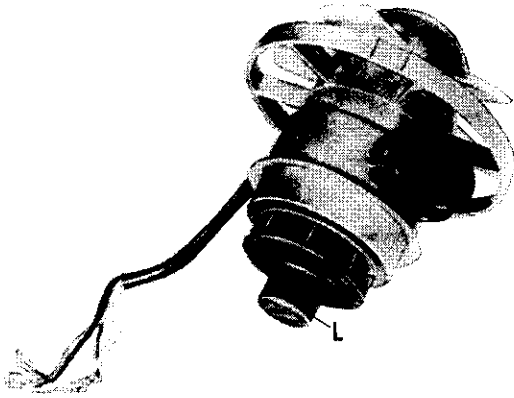
A – fresh air fan  
B – combustion air blower fan  
C – air intake  
L – air deflection cylinder with indentation  
(up to July 1971)

**Type 2**

from August 1971

The metering pump is operated by an electrical impulse received from the contact points after every 33rd revolution of the combustion air blower.

# F 3.1 Description of Heating System



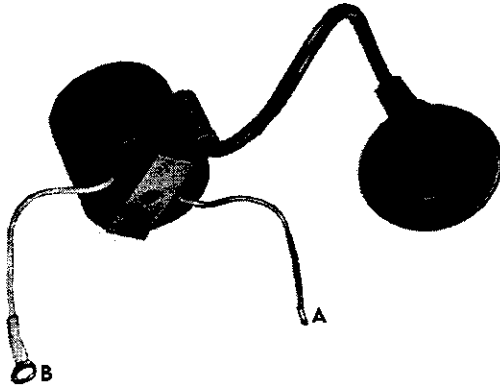
L – Air deflection cylinder

## Type 1/Model 181 and Typ 2

Combustion air blower with diaphragm pump has three connecting wires.  
Combustion air blower with metering pump has four connecting wires.

## Speed

4875 rpm to 5325 rpm at 12 volts.

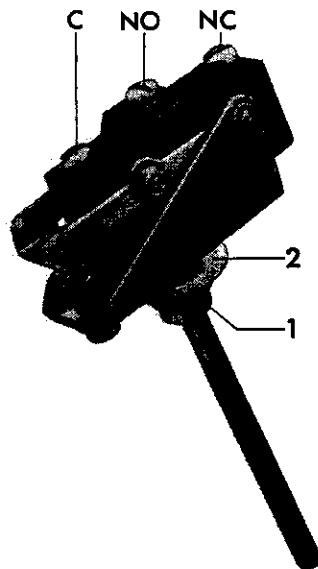


## Ignition coil

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

A – to contact breaker points of combustion air blower  
B – to condenser

Initial voltage: 12 volts  
High voltage: 5000 volts



## Flame switch

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

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

from August 1971

## Cut-in time:

Less than 45 seconds at room temperature.

## Run-on time:

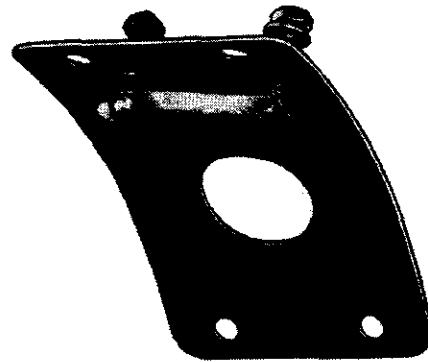
110–150 seconds at room temperature.

**Overheating switch**

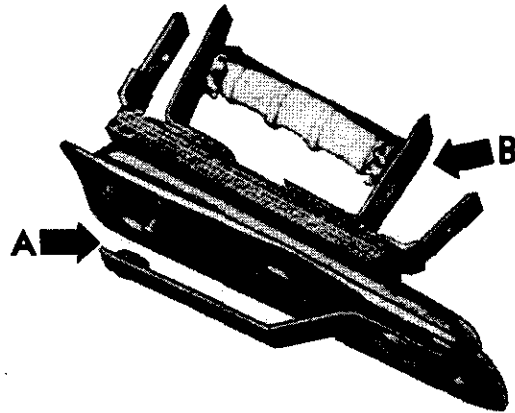
The overheating switch is attached to the heater housing. If the temperature rises considerably the bimetal switch interrupts the circuit to the fuel pump and to the solenoid valve.

**Conditions causing operation of overheating switch:**

- a – temperature regulation defective
- b – hot air outlets plugged
- c – fuel mixture too rich.

**Overheating switch with fuse holder****Type 1/Model 181 and Type 2**  
from August 1971

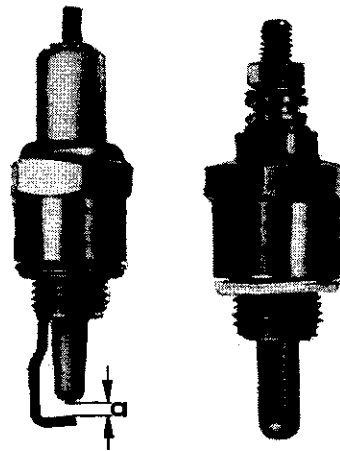
On combustion air blowers with metering pump the contact closes when the heater temperature is too high. This closed contact blows the fuse and cuts-off the operation of the fuel pump (see wiring diagram).



A – overheating switch  
B – fuse holder

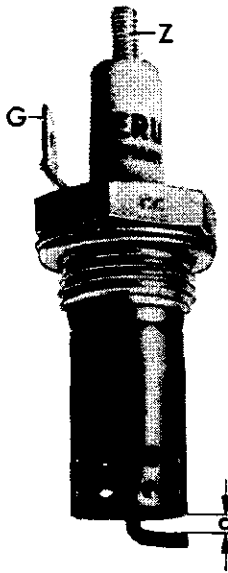
**Glow plug and spark plug**  
**Type 2 up to July 1971**

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



a = 2.5 mm (0.1 in.)

# F 3.1 Description of Heating System



G – low voltage connection  
Z – high voltage connection  
a = 2.5 mm (0.1 in.)

**Glow-spark plug**  
**Type 1/Model 181 and Type 2**  
from August 1971

### Caution

The glow-spark plug of the BN 4 heater must **not** be installed in BA 4 heaters because the BA 4 heater requires the special ground connection. It is possible, however, to install the plug from the BA 4 heater in a BN 4 heater.

### Technical data

**spark plug**

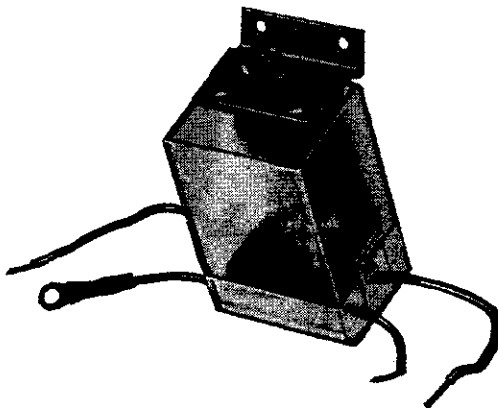
high voltage = 5000 volts  
resistance = 5 k $\Omega$

### glow plug

voltage = 12 volts  
resistance = 2.5 k $\Omega$   
current draw = 5 amps

### glow-spark plug

voltage = 12 volts and 5000 volts  
resistance = 4–6 k $\Omega$   
current draw = less than 6.5 amps



### Safety switch

This switch interrupts current flow to the heater if, for any reason (fuel supply cut off, glow-spark plug defective), combustion does not start within 180 seconds after turning heater on.

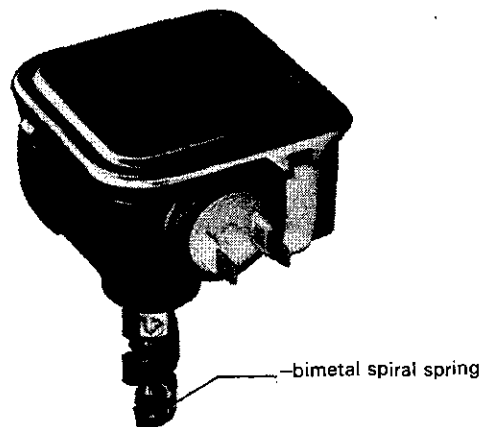
### Switch response time

120–180 seconds at 12 volts

**Temperature regulating switch**

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

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



Type 1 / Model 118

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

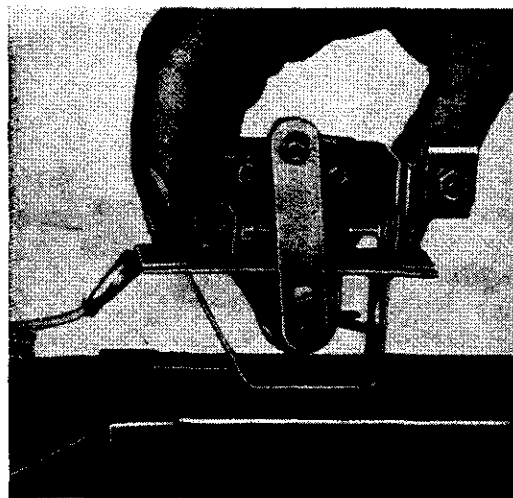
Cut-in temperature: approx. 60° C (140° F).

Cut-off temperature: approx.

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

Type 2 120–140° C (250–285° F)

These temperatures can be checked only with electronic instruments.



Type 2

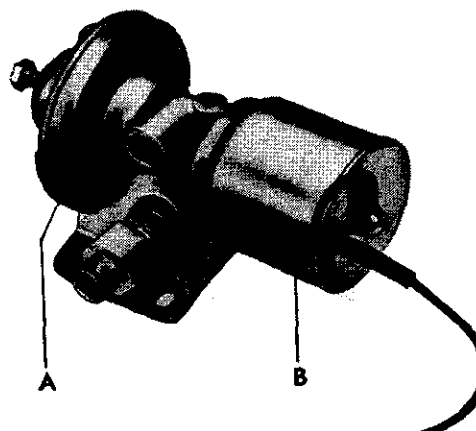
**Pressure regulator with solenoid valve**

**Typ 2** up to July 1971

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

**Delivery capacity**

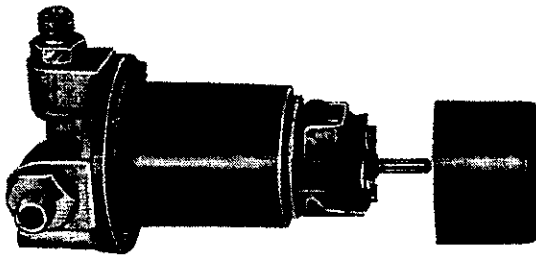
20 cm<sup>3</sup> to 21 cm<sup>3</sup> in 2 minutes at 12 volts.



A – diaphragm pressure regulator  
B – solenoid valve



# F 3.1 Description of Heating System



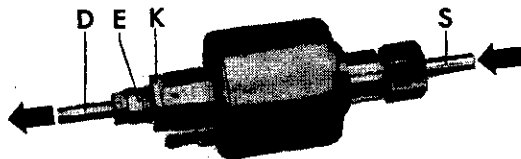
## Fuel pump (Diaphragm pump)

**Type 2** up to July 1971

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

Installation position:

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



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

## Fuel pump (metering pump)

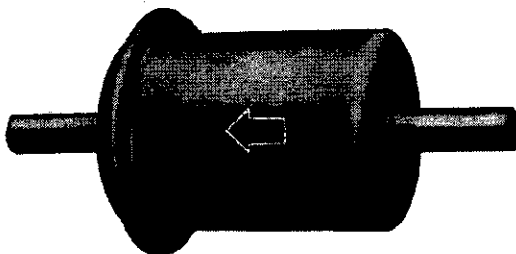
**Type 1/Model 181**

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

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

**Delivery capacity:**

200 strokes = 13.4 to 15.1 cm<sup>3</sup>.



Arrow = direction of flow

## Fuel filter

**Type 1/Model 181**

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

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

### Time switch

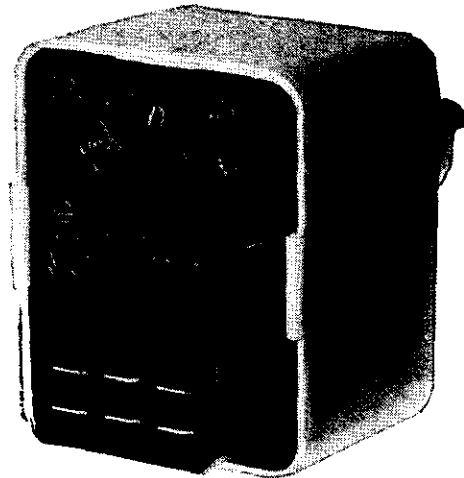
This switch restricts the heater operating period to 25 minutes when ignition is switched off.

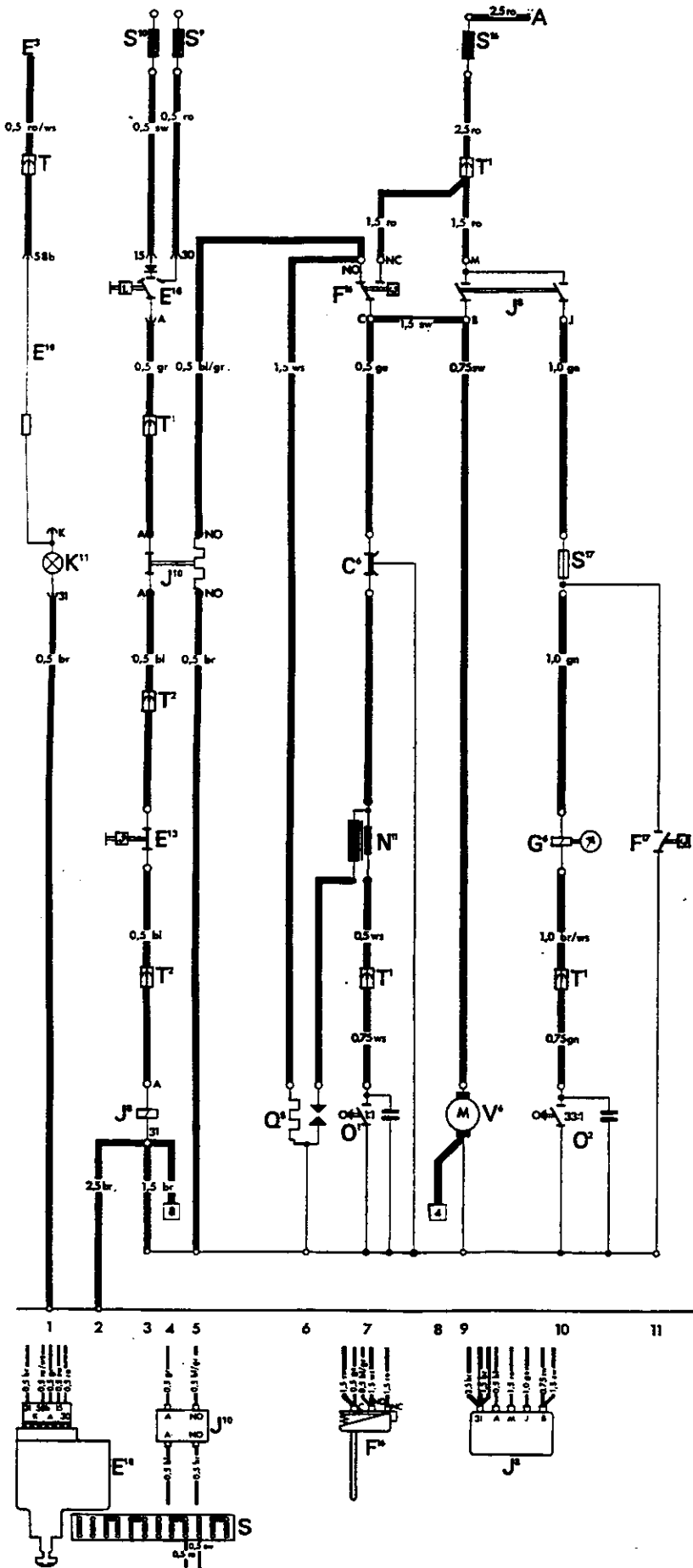
#### **Modification**

**Type 1/Model 181**

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

6 terminals instead of 4 terminals previously.





## Explanation of current flow (

**Type 1/Model 181**

**Type 2 from August 1972**

### Description

- A - Terminal 30 of starter
- C<sub>4</sub> - Suppression condenser for coil/capacitor
- E<sub>3</sub> - From light switch terminal 58 b
- E<sub>15</sub> - Temperature regulating switch
- E<sub>16</sub> - Heater switch/operating period 25 min
- F<sub>16</sub> - Flame switch
- F<sub>17</sub> - Overheating switch
- G<sub>6</sub> - Metering pump
- J<sub>6</sub> - Relay
- J<sub>10</sub> - Safety switch
- K<sub>11</sub> - Warning lamp
- N<sub>11</sub> - Ignition coil/voltage 12/5000
- O<sub>1</sub> - Ignition contact in combustion air blow (contact opens once per revolution)
- O<sub>2</sub> - Contact in combustion air blower for n (contact opens once per 33 revolution)
- O<sub>5</sub> - Glow-spark plug
- S - Fuse box
- S<sub>9</sub> - 9th fuse in fuse box - terminal 30
- S<sub>10</sub> - 10th fuse in fuse box - X contact
- S<sub>16</sub> - Separate 16 amp fuse
- S<sub>17</sub> - Overheating fuse/8 amp
- T<sub>1</sub> - Wire connector, single
- T<sub>2</sub> - Wire connector, double
- T<sub>3</sub> - Wire connector, 3 pin
- T<sub>4</sub> - Wire connector, 4 pin
- V<sub>4</sub> - Combustion air blower

### Color code

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



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## Explanation

### To switch heater on

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

Voltage can be measured at:

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

### Start-up

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

Voltage can be measured at:

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

### Heating

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

The following is de-energized:

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

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

The following are de-energized:

Contact A of relay (J 8)

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

Both contacts overheating fuse (S 17)

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

Voltage can be measured at:

Terminal A of relay (J 8)

Relay (J 8) operates.

Fuel pump (G 6) delivers fuel.

## **Operation of safety switch (J 10)**

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

Voltage can be measured at:

Terminal NO of flame switch (F 16)

Terminal NO of safety switch (J 10)

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

The following are de-energized:

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

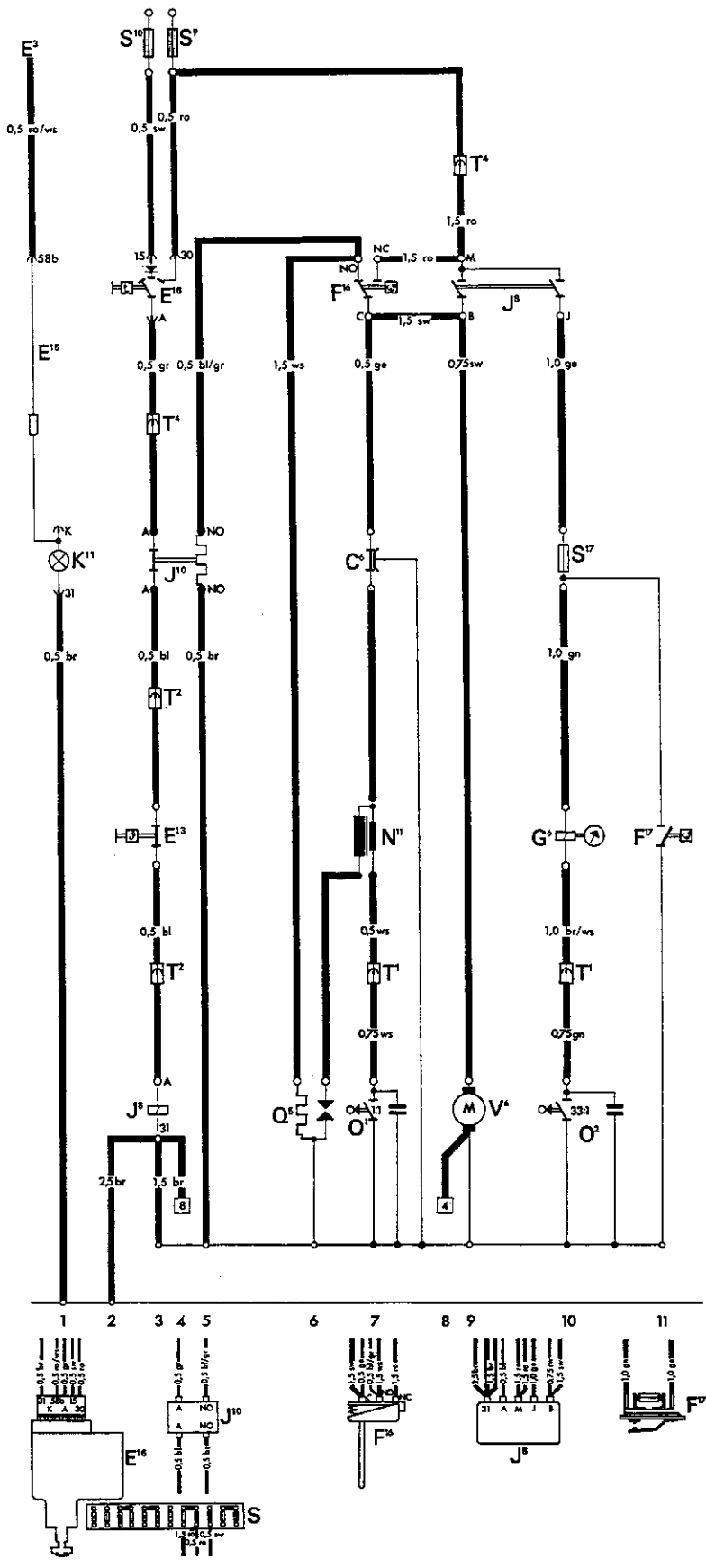
The combustion air blower (V 6) stops and heater cools down.

## **Operation of overheating circuit**

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

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

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**Current flow diagram and explanation**

**Type 1/Model 181**

# F 3.1 Description of Heating System

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## Switching heater off

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

The following is de-energized:

Contact A of relay (J 8)

The relay (J 8) contacts are separated.

## Run-on

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

The following is de-energized:

Contacts of overheating fuse (S 17)

The fuel pump (G 6) stops working.

Voltage can be measured at:

Terminals NC-C of flame switch (F 16)

Terminal B of relay (J 8)

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

The following are de-energized:

Contacts C-NO of flame switch

The run-on is finished.



## List of possible faults

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

### **Turn time switch knob clockwise as far as possible**

The following faults can occur:

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

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

# F 3.2 Trouble Shooting and Testing Instructions

## A – Heater does not work

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

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

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

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

<b>Check</b>	<b>Possible fault</b>	<b>Remedy</b>
7 – Test relay terminal; if there is voltage at terminal B, terminals M and I must also have voltage after switching heater on	switch contacts defective (see F 3.3/1)	replace relay (see F 3.5/1)
8 – Check voltage at terminal 2 of terminal strip	nominal value 11.6 volts is not attained; battery is discharged too much	start vehicle engine to attain full generator voltage
9 – Test ignition coil (see F 3.3/1)	a – ignition coil insulation is defective b – breaker points of blower motor defective (see F 3.3/1) c – short circuit on condenser on contact breaker d – short circuit in suppression condenser	a – replace ignition coil b – clean combustion air blower breaker points c – replace condenser (see F 3.7/1) d – replace suppression condenser
10 – Check spark plug, but first disconnect wires from fuel pump (see F 3.3/1)	faulty or dirty spark plug	clean spark plug; check spark plug gap (.098 in./2.5 mm) (see F 3.3/1)
11 – Test glow plug with fuel pump disconnected	plug must glow within one minute	replace glow plug (see F 3.3/1) (see F 3.5/2)
12 – Test flame detector switch	switch does not operate	adjust (see F 3.3/1)
13 – Check overheating switch	no continuity	replace (see F 3.5/1)
14 – Check filter (see F 3.3/2)	blocked	clean filters between fuel pump and jet (see F 3.3/2); filter between fuel pump and tank must be cleaned (see F 3.3/2)
15 – Check fuel jet	blocked or damaged	clean or replace (see F 3.3/2)

# F 3.2 Trouble Shooting and Testing Instructions

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

**B – Heater smokes**

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

**C – Heat output insufficient**

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

**D – Heater goes out**

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

# F 3.2 Trouble Shooting and Testing Instructions

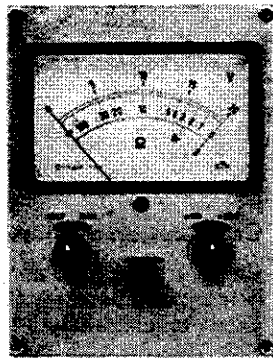
## E – Run-on does not switch off

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

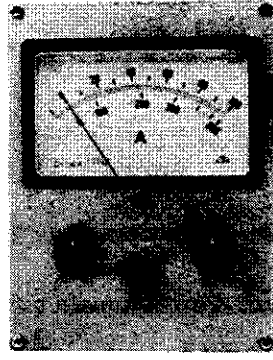
## F – Heater does not work at low outside temperatures

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

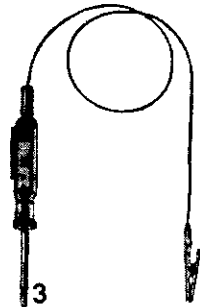
# Checking Parts and Adjusting **F 3.3**



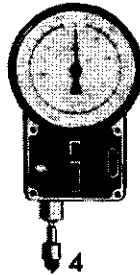
1



2



3



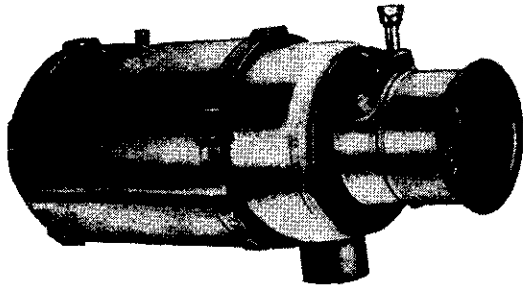
4



5

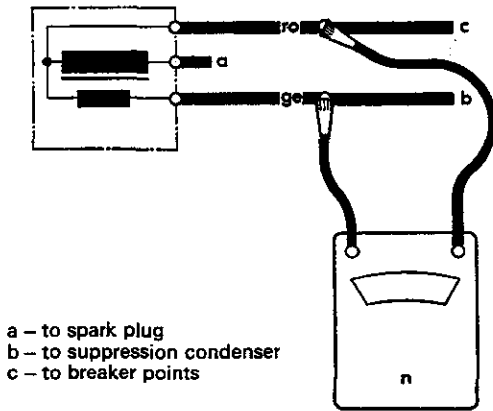
No.	Description	Special tool	Remarks
1	Ohmmeter/voltmeter		Range 0–20 volts
2	Ammeter		Range 0–20 amps.
3	Tachometer		0–8000 rpm
4	Test lamp		12 volts
5	Stop watch		

# F 3.3 Checking Parts and Adjusting



## Heat exchanger

Check combustion chamber for damages (overheating, corrosion etc.) and soot. Damaged or soot covered units must be replaced.



## Combustion air blower

Check blower for damages caused by overheating and bearings for free movement. Connect tachometer as shown and check speed.

## Counting revolutions

The contacts in the combustion air motor give one audible impulse for the metering pump every 33 revolutions of motor shaft.

**Count impulses in one minute and multiply by 33 = Speed.**

Speed:  
running for 10 minutes at 12 volts:  
4875-5325 rpm.



## Flame switch

### Measuring voltage

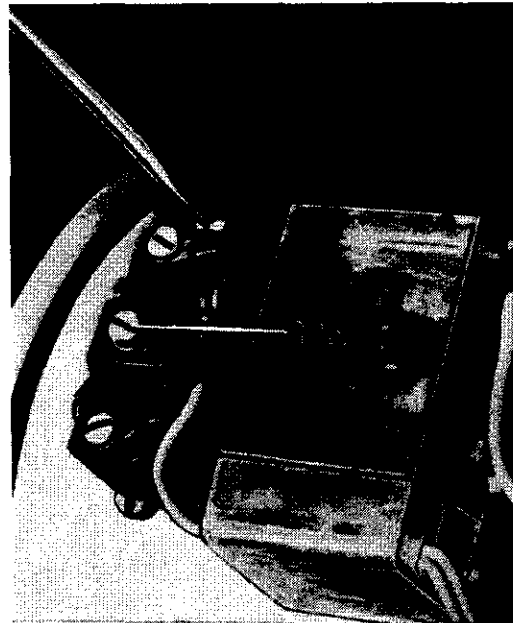
The flame switch requires 45 seconds to start to operate after the heater ignites. A uniform roaring noise should be heard at the exhaust pipe. The flame switch is "ok" if terminal NO is pulled off, held against ground and the switch is de-energized within 45 seconds.

If the operating limit is delayed the flame switch must be adjusted, or if necessary replaced.

### Adjusting

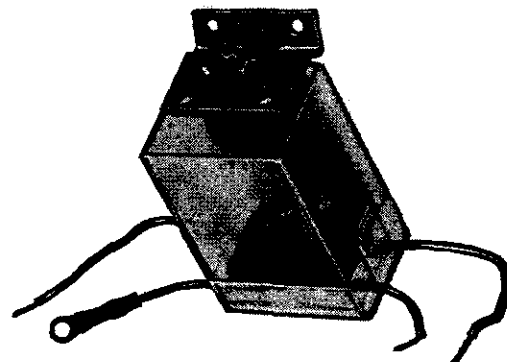
- 1 – Turn heater on. Pull temperature regulator switch all the way out. Let heater run for five minutes.
- 2 – Turn time switch knob back until warning light goes out. Start stop watch.
- 3 – The combustion air blower fan, controlled by the flame switch, must continue running 110–150 seconds. This run-on time is based on a nominal voltage of 12 volts and an outside temperature of about 20° C (68° F). At lower temperatures the run-on time is shorter.

If proper shut off time is not attained, the flame switch must be adjusted (if run-on is too long, turn adjusting screw clockwise; if run-on is too short, turn screw counter-clockwise).

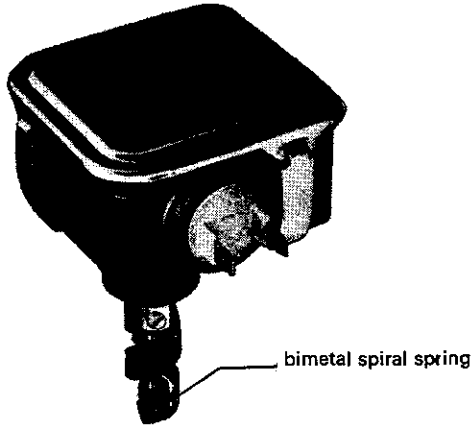


## Safety switch

- 1 – Disconnect wires at pump so that fuel pump does not operate.
- 2 – Turn heater on. After 120–180 seconds (at nominal voltage and at about 20° C (68° F) ambient temperature) the safety switch interrupts the heating system circuit.
- 3 – If the safety switch has operated within the specified time, the switch is "OK." Reset lever on safety switch in direction of arrow.



# F 3.3 Checking Parts and Adjusting



Type 1/Model 181

## Temperature regulating switch

### Type 1/Model 181

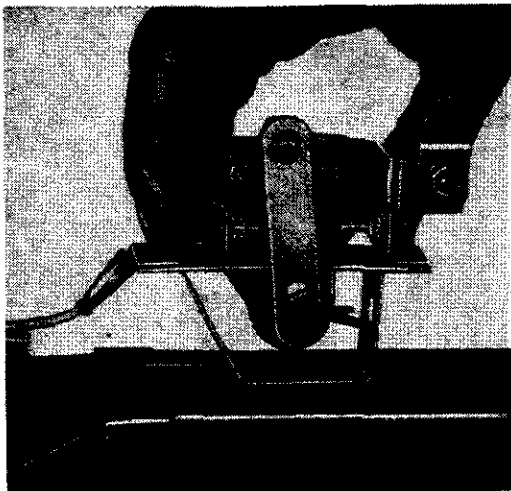
The linkage is lubricated with a special oil. Therefore the linkage must always be kept clean otherwise the switch will not operate with in the adjusted limits.

### Checking temperature limits

#### Type 1/Model 181 and Type 2

To check the temperature for correct operation, use an electronic temperature measuring device (a mercury thermometer is too slow).

Position device close to bimetallic spring (do not touch spring).



Type 2

## Working instructions

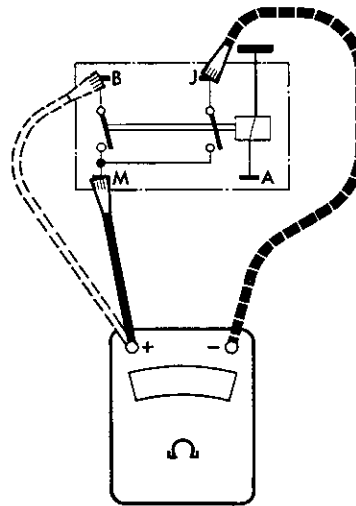
- 1 – Switch heater on and wait until heater has regulated 3 times.
- 2 – Pull knob for temperature regulating switch all way out and measure the temperature when the switch stops operating.  
Cut-off temperatures: approx.  
Type 1/Model 181: 110–130° C  
(230–266° F)  
Type 2 120–140° C (250–285° F)
- 3 – Push knob halfway in and measure temperature difference during one regulation stage.  
Approx.: 20° C (68° F).
- 4 – Push knob allway in and measure cut-in temperature.  
Approx.: 60° C (140° F).

## Note

If the measured temperatures show a tolerance of more then 20° C (68° F) the temperature regulating switch must be replaced.

**Checking relay**

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

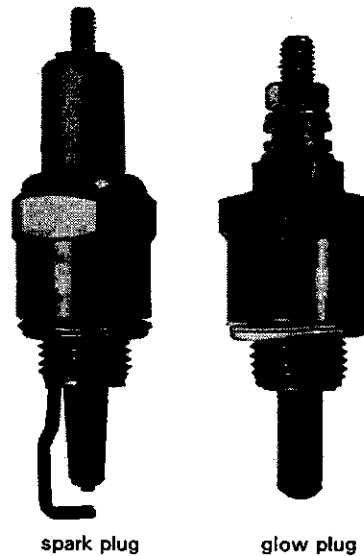


**Checking glow plug and spark plug**

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

The spark plug can be cleaned with a wire brush. Check electrode gap (2.5 mm) .10 in.

There is a 5 K  $\Omega$  resistor installed in the spark plug. The resistor can be measured with an ohmmeter (connect terminals of ohmmeter between center electrode and ignition wire terminal). If the ohmmeter shows more than 10 K  $\Omega$ , the spark plug must be replaced.

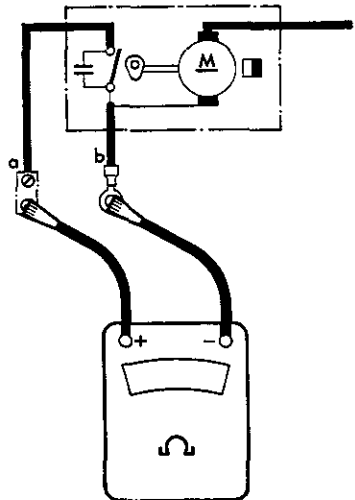


# F 3.3 Checking Parts and Adjusting

## Testing breaker points

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

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



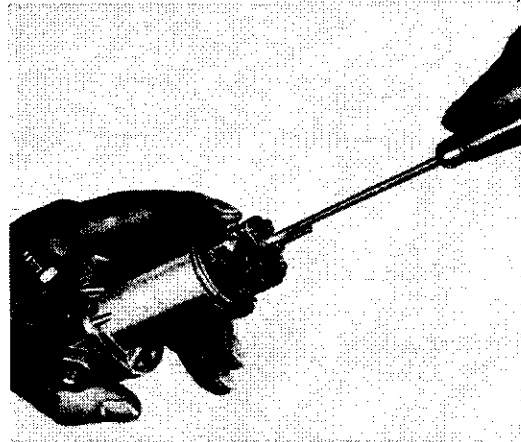
a – to ignition coil  
b – ground  
c – to terminal 1

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

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

### Diaphragm pump

- 1 – Remove pump.
- 2 – Remove the nut from the terminal post and take off cover. Check breaker points. Lightly lubricate moving parts and springs if necessary.



#### Note

The breaker point gap should be 1 mm (0.04 in.) (hold lower contact breaker arm against housing). The points are set with adjusting screw.

- 3 – Remove four fillister head screws on housing and take pump housing off. Turn diaphragm bracket counterclockwise to remove it and check it visually.
- 4 – When reinstalling, first screw diaphragm bracket in, clockwise, as far as it will go. Then back off  $2\frac{1}{2}$  turns counterclockwise. The correct delivery quantity of the fuel pump is then adjusted.
- 5 – The fuel pump must be installed so that the connection on the outlet is pointing upward as shown by the arrow. After installation, the fuel line on the outlet side may have to be bled. Also, moisten pressure valve with a few drops of gasoline (see F 3.6/1).

#### Note

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

# F 3.3 Checking Parts and Adjusting

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## Metering pump

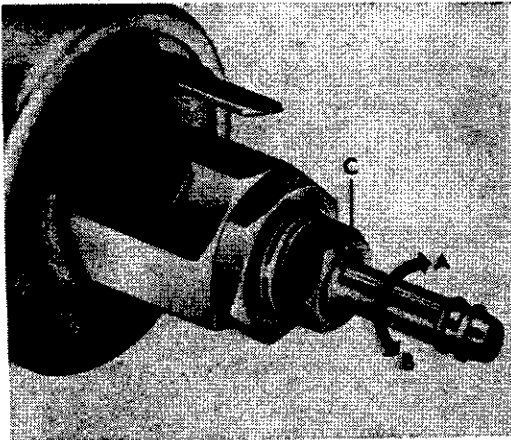
- 1 – Pull hose off on pressure side connection.
- 2 – Disconnect glow-spark plug.  
(Safety reasons.)
- 3 – Switch heater on.
- 4 – Count **200 strokes** of the metering pump (ticking noise). The amount of fuel ejected must be within **13.4 to 15.1 cm<sup>3</sup>**.

## Note

The strokes can be counted as follows:

- a – Write down the numbers 1–20 one under the other.
- b – After each 10 strokes (ticks), cross out a number. It is thus only necessary to count from 1 to 10 and when all the numbers have been crossed out, 200 strokes have been counted.

If the amount delivered is not within the tolerance given, the pump must be adjusted.



## Adjusting delivery quantity

Increase consumption

= Turn valve counter-clockwise (B)

Decrease consumption

= Turn valve clockwise (A)

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

## Pressure regulator and solenoid valve

### Adjusting

#### Note

The fuel delivery quantity can only be set accurately by measuring the fuel consumption on the heater. The fuel quantity is measured at the fuel jet.

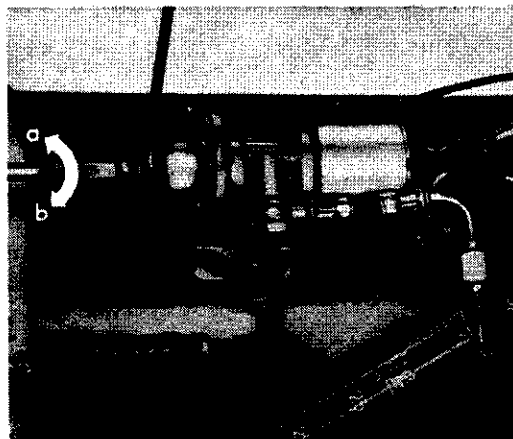
Before carrying out a consumption measurement or adjustment, clean the filters.

Part	Location	Remarks
Filter	between tank and fuel pump	replace (see F 3.5)
Screen	pressure regulator inlet side	clean
Screen	between union nut and jet	clean

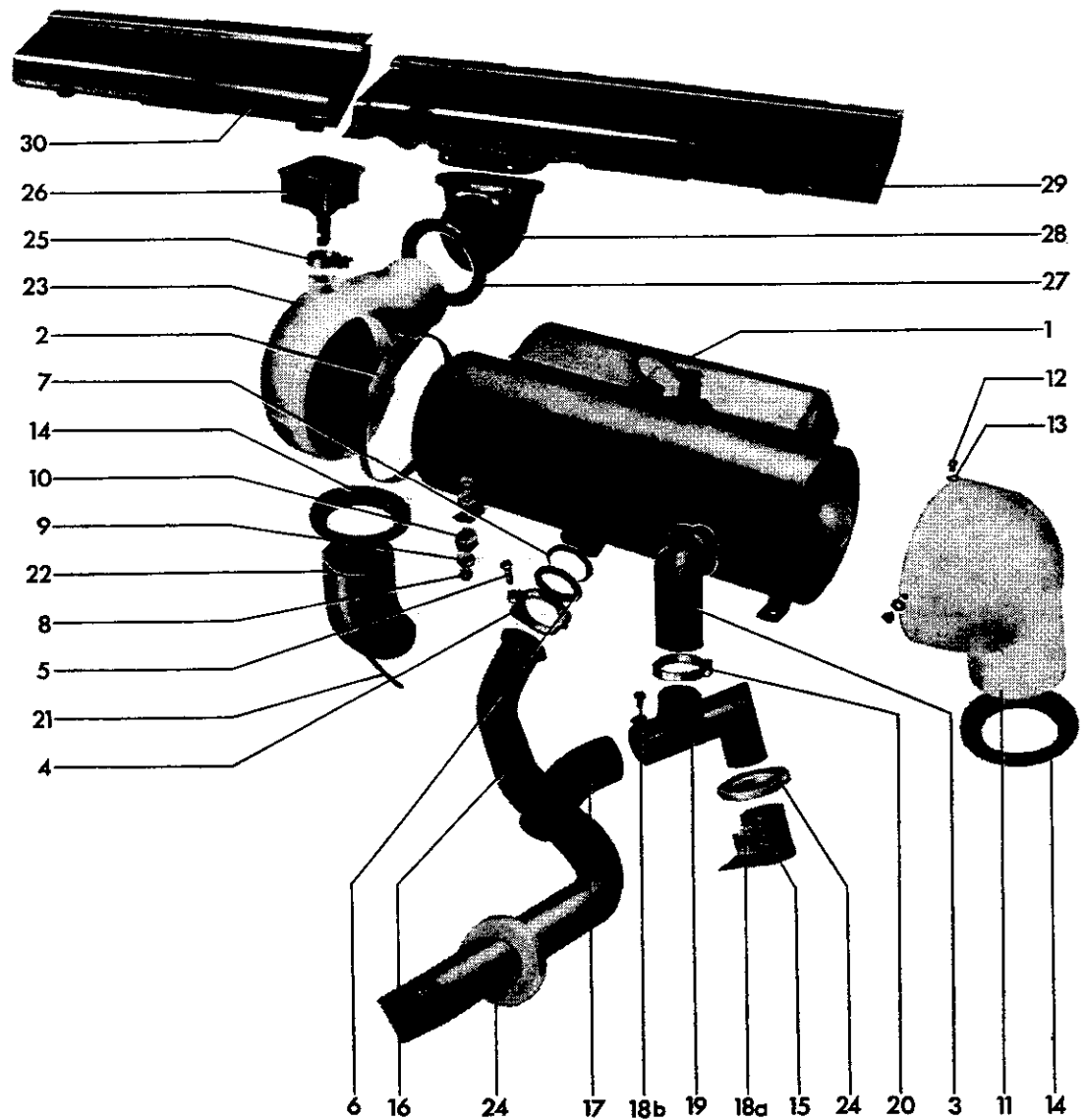
- 1 – Disconnect glow plug and spark plug. Bridge temperature control switch connections.
- 2 – Loosen union nut from jet carrier.
- 3 – Remove jet from jet carrier and clean screen.
- 4 – Connect jet and screen to fuel hose and hold at the same height as when installed (see illustration).
- 5 – Turn heater on. Fuel emitted is collected in a measuring glass for two minutes and should amount to 20–21 cm<sup>3</sup>.
- 6 – To adjust: Turn screw counterclockwise (a) to decrease the fuel quantity delivered. Turn clockwise (b) to increase the fuel quantity delivered.

#### Note

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



# Heater and Warm Air Duct **F 3.4**





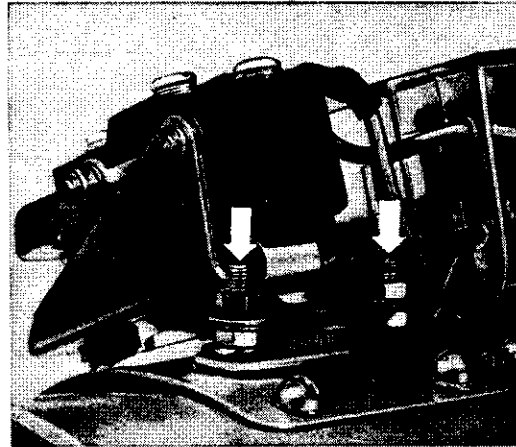
# F 3.4 Heater and Warm Air Duct

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

## Overheating switch

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

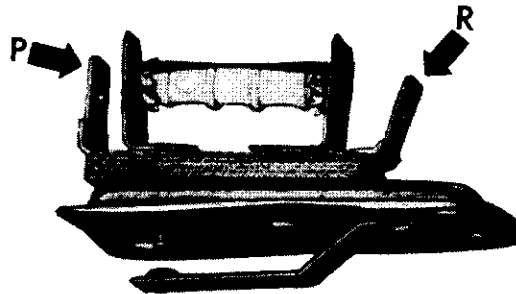
The connections (arrows) may be inter-  
changed at installation without causing  
damage to the heater.



### **Type 1/Model 181**

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

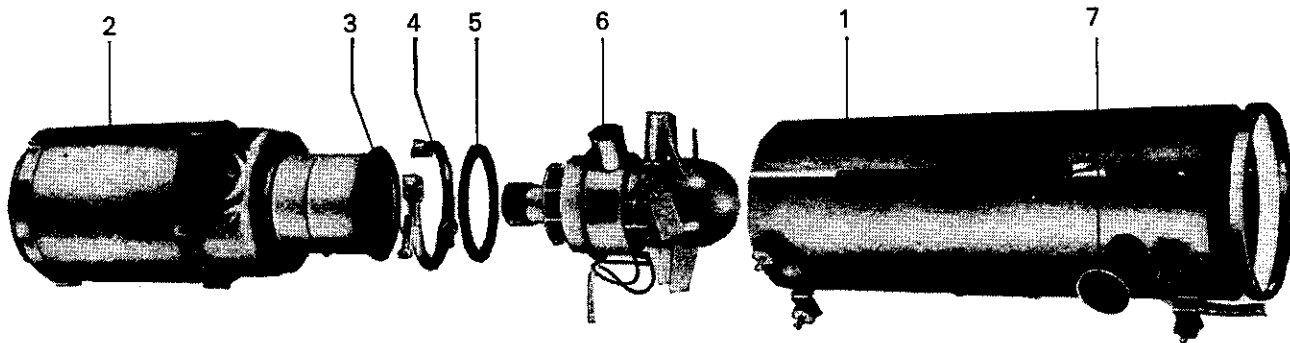
Do **not** interchange wires.



P – from metering pump  
(connection on adjusting screw)

R – from relay

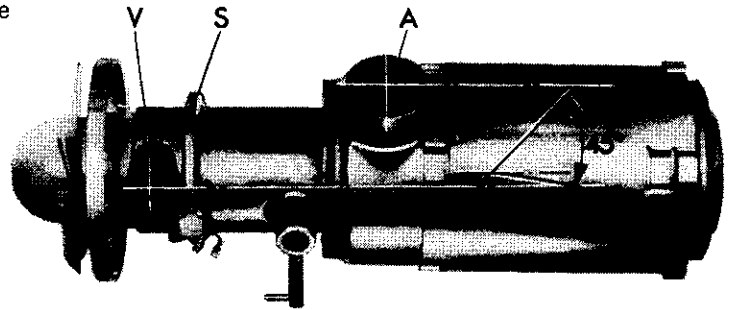
# F 3.5 Removing and Installing Parts



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

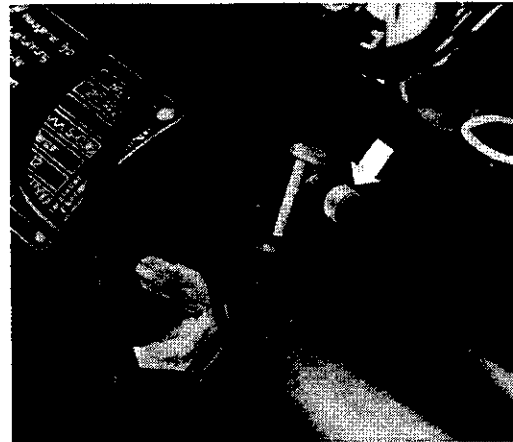
**Installation instructions**

- a – The combustion air blower must be attached to the heat exchanger so that the combustion air connection (V) is offset 45° to the right from the exhaust connection (A).



V – combustion air connection  
S – clamp  
A – exhaust connection

- b – The fuel hose must be secured on the pipe with a clamp (arrow).



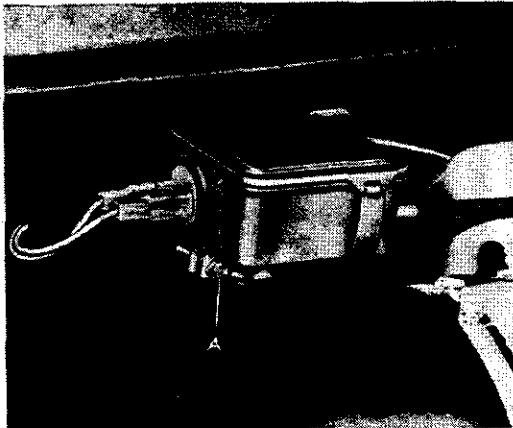
# F 3.5 Removing and Installing Parts

## Temperature regulating switch

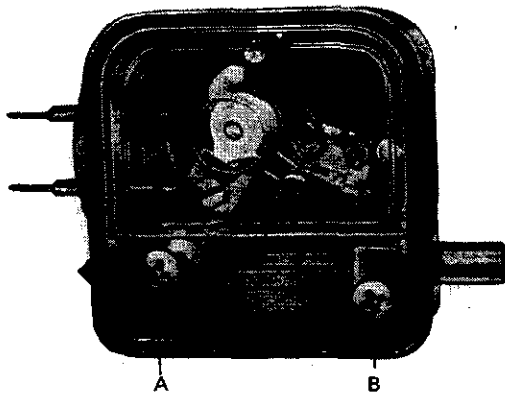
### Type 1/Model 181

#### Do not touch the bimetal spiral spring

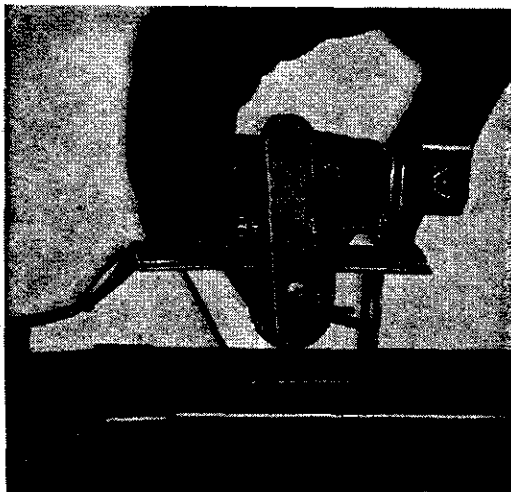
The linkage is lubricated with special oil. Therefore always keep the linkage clean; otherwise the switch will not operate within the adjusted limits.



A – clamp



A – inner cable clamping screw  
B – outer cable securing screw



### Type 2

The temperature regulating switch can be removed only, after the complete heater is removed from the vehicle.

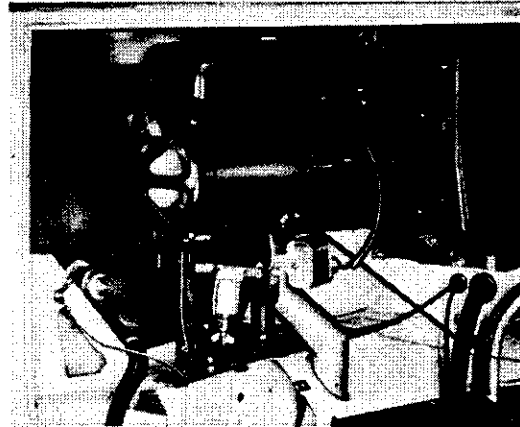
**Relay**  
**Type 2**

**Removing**

- 1 – Disconnect battery ground strap.
- 2 – Disconnect wires on relay and remove relay.

**Installing**

Ensure that wires are connected according to wiring diagram (see F 3.1/4).



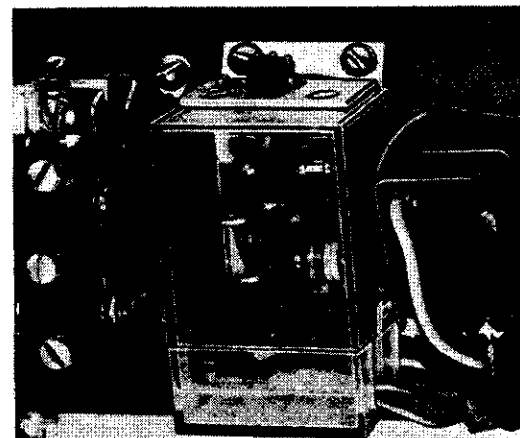
**Safety switch**  
**Type 1/Model 181 and Type 2**

**Removing**

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

**Installing**

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



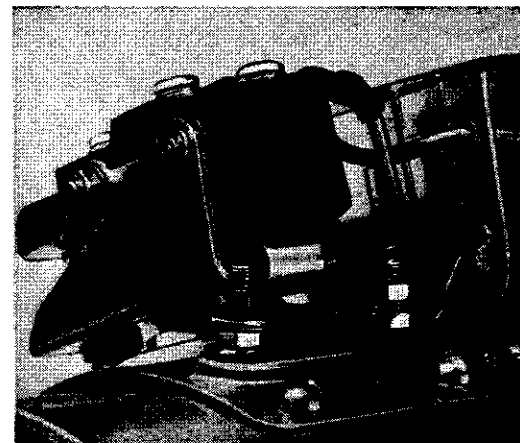
**Flame switch**  
**Type 1/Model 181 and Type 2**

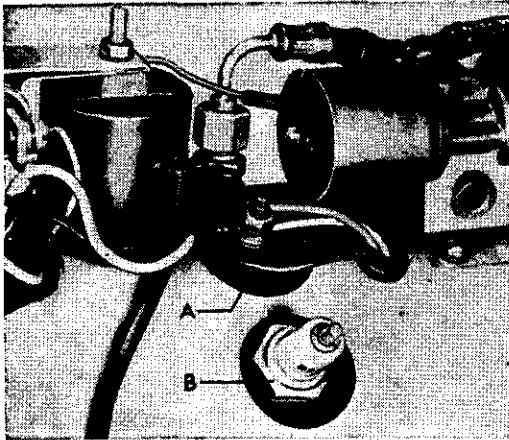
**Removing**

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

**Installing**

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





A - glow plug  
B - spark plug

## Glow plug / spark plug

### Type 2

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

### Removing

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

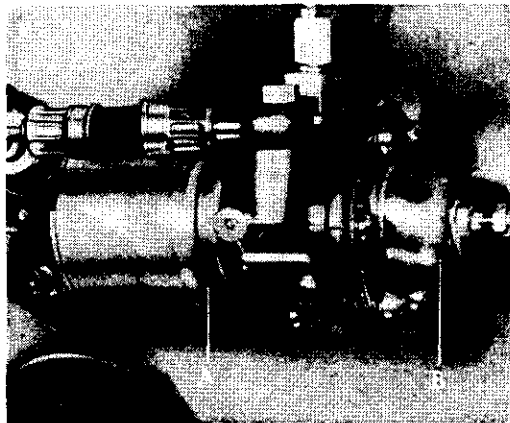
### Installing

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

## Pressure regulator and solenoid valve

### Removing

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

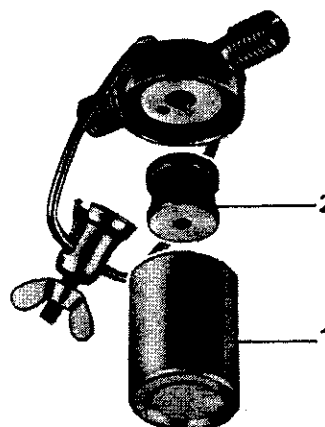


A – Solenoid valve  
B – Pressure regulator

### Installing

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

## Filter

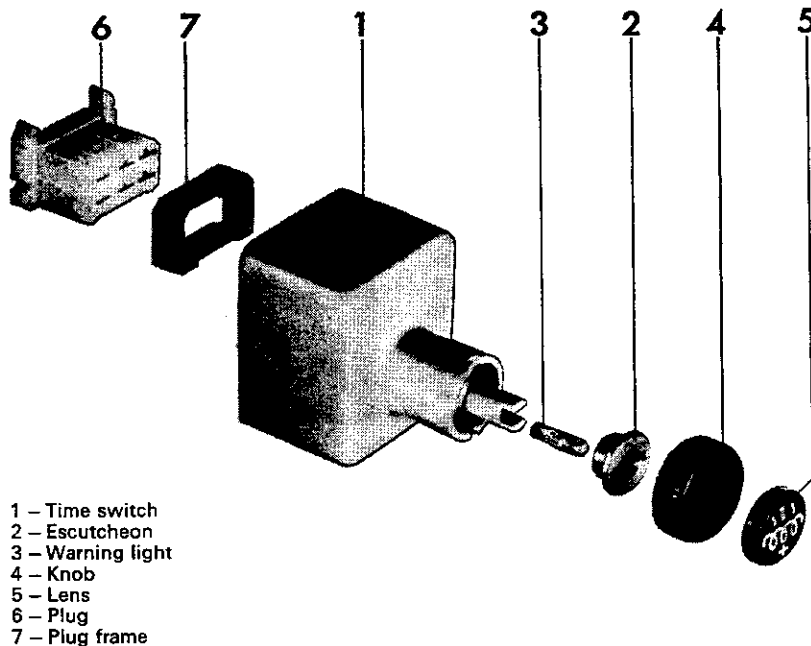


1 – Filter housing  
2 – Filter screen



## F 3.5 Removing and Installing Parts

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### Time switch

#### Removing

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

#### Installing

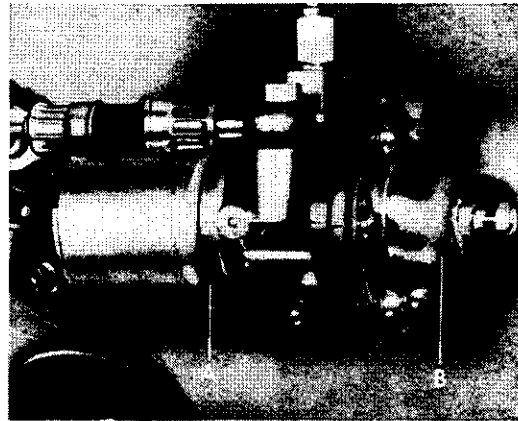
- 1 – Secure escutcheon to time switch in instrument panel insert with special wrench VW 674/1.
- 2 – Connect wires according to wiring diagram (see F 3.1/3).
- 3 – Connect battery ground strap and check operation of heater.

## Pressure regulator and solenoid valve

### Type 2

#### Removing

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

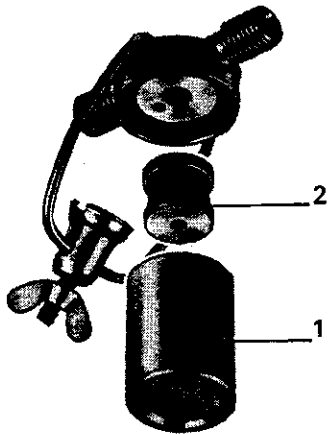


A – solenoid valve  
B – pressure regulator

#### Installing

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

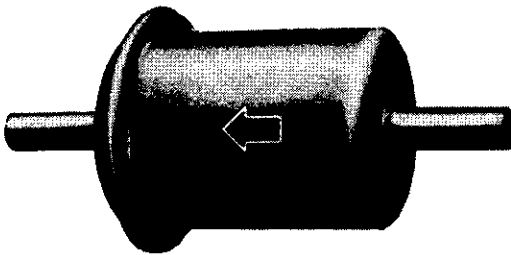
# F 3.5 Removing and Installing Parts



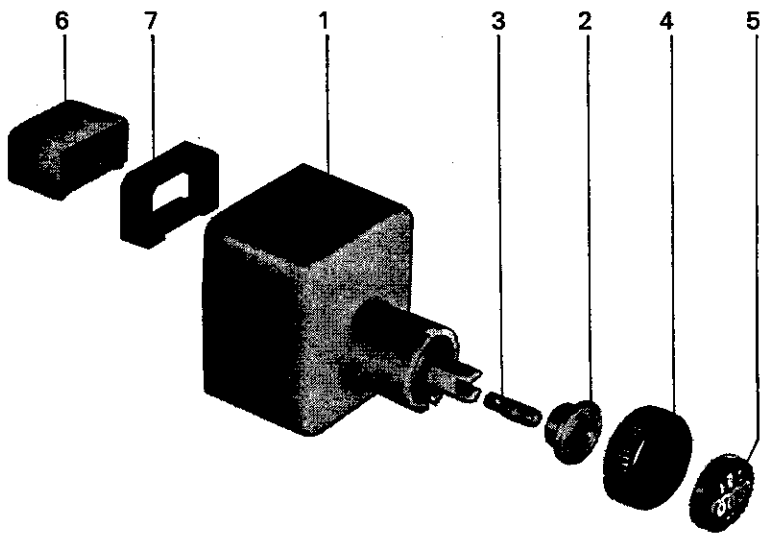
- 1 – filter housing
- 2 – filter screen

## Filter

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



## Time switch

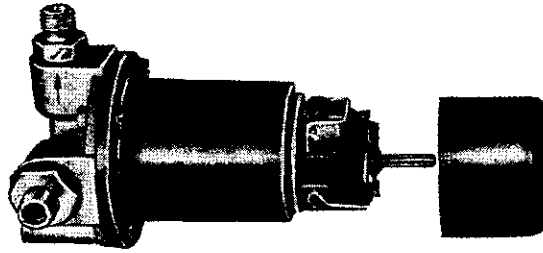


- 1 – time switch
- 2 – escutcheon
- 3 – warning light
- 4 – knob
- 5 – lens
- 6 – plug
- 7 – plug frame

## Fuel pump

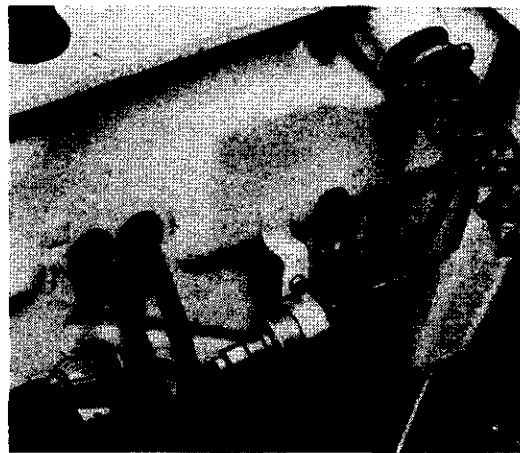
### (Diaphragm pump)

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



### Metering pump

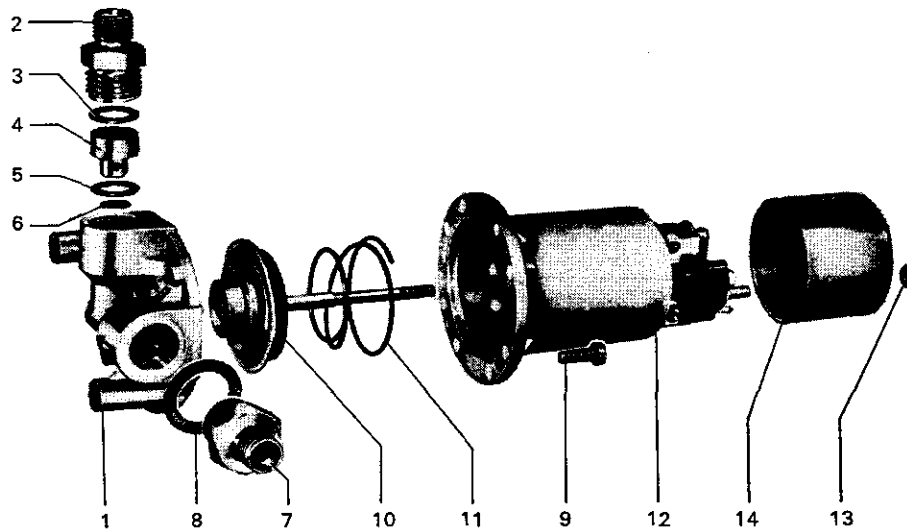
Always make sure that pump is installed horizontally. Otherwise the quantity of fuel delivered will change.



(Installation in Type 1/Model 181)

# Disassembling and Assembling Fuel Pump **F 3.6**

## Fuel pump



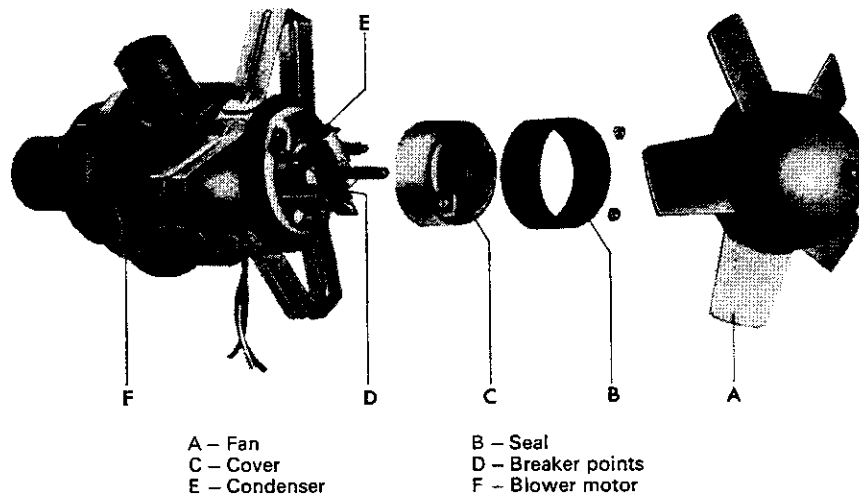
No.	Description	Qty.	Note when		Special instructions see
			disassembling	assembling	
1	Pump body	1		pump must be installed in vehicle with outlet union at top (arrow points outward)	F 3.5/2
2	Outlet union (pressure side)	1	12 mm wrench; look for damage; spherical surface must be smooth; outlet union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

# F 3.6 Disassembling and Assembling Fuel Pump

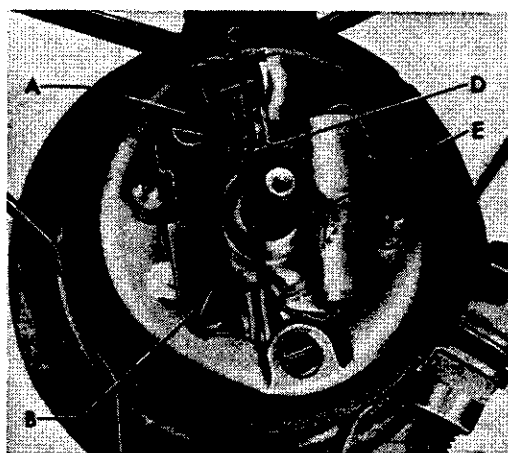
No.	Description	Qty.	Note when		Special instructions see
			disassembling	assembling	
10	Diaphragm unit	1	unscrew counter-clockwise	delivery quantity adjustment: screw diaphragm unit in as far as possible, then back off 2 <sup>1</sup> / <sub>2</sub> turns; the diaphragm also acts as seal between pump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

## Disassembling and assembling combustion air blower

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



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



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

- 8 - Solder condenser and cable to ignition coil. The connecting cable between condenser and breaker points must have a gap of at least .08 in. (2 mm) between end plate, condenser clamp and cover. It is advisable to replace the condenser when replacing the breaker points.
- 9 - When assembling, ensure that the seal covers the joint between cover and motor.

### Testing:

### Warning

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