Description of the BN-4 Ventilating Combustion Heater

General

The BN-4 ventilating combustion heater, Test Code S-036, is manufactured by the Eberspächer Company of Esslingen, Germany.

The heater is a special order item. It can be installed in the space behind the spare tire in the front compartment of the below listed types of cars commencing with serial numbers as follows:

Coupe,	from Chassis Serial No. 117 601
Convertible,	from Chassis Serial No. 155 601
Hardtop,	from Chassis Serial No. 201 601

The BN-4 heater is a self-contained heat generating unit operating independently of the car's combustion engine and, consequently, will produce heat regardless whether the car is in motion or the engine running. However, when using the heater with the car parked, battery charge level should be taken into consideration since the battery supplies the electrical energy for the heater.

The operating voltage is 6 Volts DC and power draw is approx. 50 Watts, meaning that the drain on the battery equals $\frac{50}{6} = 8.4$ Ah. Correspondingly, when using a battery with a capacity of 84 Ah, and assuming that the battery is only half-charged, the heater will operate with the car at standstill for only $\frac{42}{8.4} = 5$ hours, at which time the battery would be fully discharged.

The BN-4 heater is standard equipment on Type 356 B/2000 GS (Carrera 2) cars. The operating voltage of heaters supplied for these cars is 12 Volts.

Technical Data

Heat output	progressively variable from	1080 to 4000	kcal/h
Ventilating air flow	approx.	150	kg/h
Fuel		carburetor fuel	
Fuel consumption	min.	0,2	l/h
	max.	0,65	l/h
Power draw		50	Watts
Operating voltage		6	Volts DC
Weight	approx.	11	kg
Warm air temperature		40 to 100	°C

progressively variable

as shown in heat output diagram on page S TRA 6

Heat Output Diagram

Heat output diagram for Type BN-4 ventilating heater (1 kcal = 3.96 BTU)

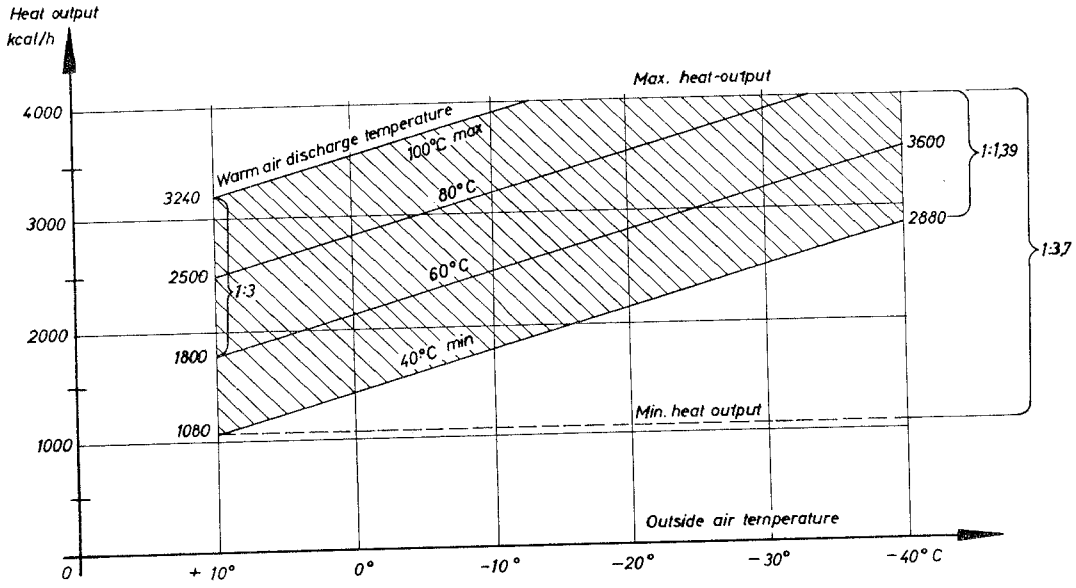

Fig. 1

Explanatory notes to the heat output diagram

The above heat output diagram shows the temperatures of outside air prior to heating, from $+10^{\circ}$ C to -40° C (X-coordinate), and the rate of heat output up to 4000 kcal/h (Y-coordinate). The diagonal lines in the diagram represent values of constant discharge air temperature from 40° C to 100° C. As may be seen, the diagram shows a limit of maximum heat output of 4000 kcal at the top of the diagram. The minimum heat output is 1080 kcal with a discharge air temperature of 40° C at an outside air temperature of $+10^{\circ}$ C. Accordingly, this represents a maximum variability ranging from 1080 to 4000 kcal, or a ratio of 1:3.7. Variability range at -40° C is 1:1.39, i.e., 2800 to 4000 kcal. The indicated discharge air temperatures apply only to readings obtained at the heater since a temperature drop occurs during the transfer of the heated air to the car's interior.

Fresh air flowing at the rate of 150 kg/h, at an outside temperature of $+10^{\circ}$ C, will receive a maximum of only 3240 kcal because a top limit of 100° C is set for the heated air discharge temperature. The maximum transfer of heat to ventilating air occurs at an outside temperature of -11° C. The heat output of 4000 kcal remains constant at lower outside air temperatures, and decreases to 3240 kcal at higher outside air temperatures of between -11° C and $+10^{\circ}$ C. At 0° C outside air temperature the heat output is 3600 kcal with a heated air temperature of 100° C. The decrease in generation of heat at rising outside air temperatures is of an advantage inasmuch that less energy is required to heat warmer outside air.

The diagram is based on an air flow of approximately 150 kg/h, a maximum temperature differential of 110° C, and a maximum heat output of 4000 kcal/h, with warm air discharge temperature variability ranging from 40° C to 100° C.

Cross-Sectional View of the BN-4 Heater

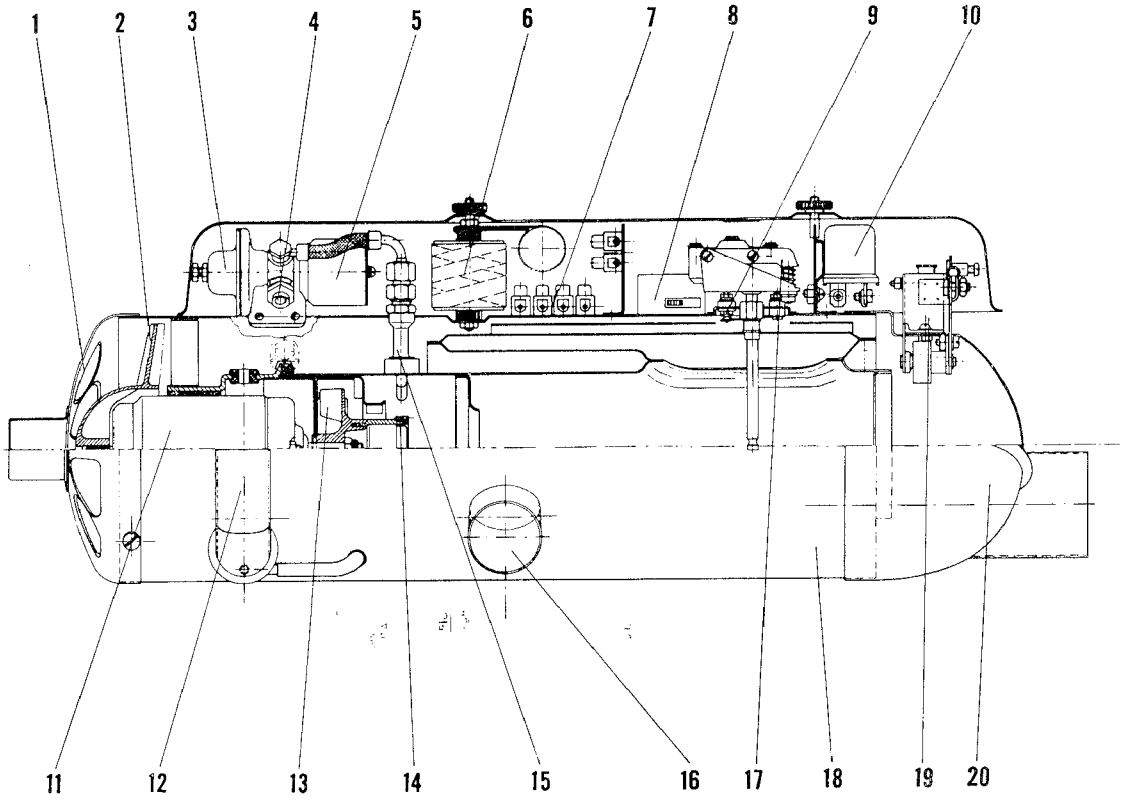

Fig. 2

1. Ventilating air intake
2. Ventilating air blower
3. Pressure regulator
4. Fuel line connector
5. Fuel solenoid
6. Ignition coil
7. Junction block
8. Safety switch
9. Overheat switch
10. Relay switch
11. Blower motor
12. Combustion air intake
13. Combustion air blower
14. Diffuser
15. Nozzle
16. Exhaust duct
17. Thermoswitch with heat sensor
18. Outside shell
19. Heat control switch
20. Warm air distributor

Heat system components

The heat exchanger is enclosed by a cylindrical jacket of 150 mm diameter, and consisting of a central cylinder with a concentric annular area. Located in the front end of the heat exchanger is the combustion chamber and an electric motor with blower fans for combustion and ventilating air. A sheetmetal shell encases the heater assembly. Mounted on the shell is a pressure regulator with a fuel solenoid valve. The fuel flows from the electric fuel pump to the pressure regulator and the fuel solenoid, then to a nozzle which is located in a vertically positioned tube.

Upper lever (for ventilator and temperature control)

Position 4: Ventilator and heater turned off.
Position 5: Ventilator blowing fresh air into car's interior (for ventilation at slow speeds or when parking). The lower lever must be anywhere between Position 2 and 3.
Position 6: Heater turned on. By moving the lever anywhere between Position 6 and 7, the required temperature setting is made for temperatures ranging from approx. 40° C to approx. 80° C.

The lower lever controls the flow of air to the defrosters or the floor area, or to both.

Lower lever

Position 1: With lever fully to the right, the flow of air is completely shut off. The heater will not operate when the lever is in this position.
Position 2: Warm air is directed to the defrosters.
Position 3: Warm air is directed to the floor area.

By moving the lever anywhere between Position 2 and 3, an appropriate distribution of air to both, the defrosters and the floor area is effected.

By moving the upper lever to Position 6, all appropriate heater components are put into operation, as follows:

The motor driving the blowers for combustion and ventilating air receives current. The coil is energized. The glow plug receives current through the thermoswitch. The electric fuel pump and fuel solenoid receive current. Thus, all electric components of the heater are provided with current and the heater begins to operate. The combustion air blower forces air into the combustion chamber. The electric fuel pump forces fuel through the pressure regulator and fuel solenoid to the nozzle which sprays the fuel onto the rotating diffuser. The atomized mixture combines with combustion air in the combustion chamber and is ignited by the spark plug, or the glow plug. The flame spreads and combustion gases flow through the combustion chamber and the heat exchanger. The ventilating air blower draws air through the louvered vent below the windshield and forces the air to pass along the jacket of the heat exchanger, causing the air to heat up in the process.

It should be noted that the spark plug operates continuously since the breaker points are actuated by the blower motor.

To maintain the pre-set temperature, the heater has to work intermittently, that is, when the warm air which leaves the heater reaches the pre-set temperature, the fuel solenoid is closed and the generation of heat discontinued. The fuel solenoid is governed by the heat control switch which operates in accordance with settings made or heat required.

To ensure a maximum safety of operation, the heater has been equipped with the following safety devices:

1. Overheat switch

   This switch controls the flow of current to the fuel solenoid. If the temperature in the heater should rise to a predetermined maximum, the overheat switch will shut off the fuel.

2. Thermoswitch (purge switch)

   When the heater is turned off, the thermoswitch allows the blower motor to run for a short period of time to facilitate cooling and purging the heat exchanger. The thermoswitch also controls the flow of current to the glow plug and safety switch at the initial engagement of the heater.

3. Safety switch

The safety switch comes into action when, for instance, the heater should fail to ignite or warm up, in which instance the safety switch shuts off the flow of current to the fuel solenoid and, thus, interrupts the flow of fuel to the combustion chamber.

Subsequent Installation of the BN-4 Heater

General:

The BN-4 heater may be subsequently installed into all cars commencing with the following chassis serial numbers:

Coupe	Chassis Serial No.	117 601
Convertible	Chassis Serial No.	155 601
Hardtop	Chassis Serial No.	201 601

Parts needed for installation of the heater in 6 Volt systems are available under Part No. 644.572.001.06, for 12 Volt systems under Part No. 644.572.002.02. The installation kits consist of the following parts:

1	each	Control unit for heating and ventilation, complete
1	each	Heating and ventilation unit
1	each	Fuel pump
1	each	Fuel line with "T" joint
1	each	Fuel hose, fuel cock to fuel pump A 6x240 SN 710
1	each	Hose strap 140 SN 907
1	each	Holding clamp
2	each	Rubber support for fastening heating unit
1	each	Rubber support for fastening exhaust duct
3	each	Hexagon bolt M 6x8 DIN 933-8G gal Zn 9
3	each	Hexagon nut M 6 DIN 934-6S gal Zn 9
6	each	Spring washer B 6 DIN 137
1	each	Sealing plate
1	each	Sealing rubber
1	each	Felt strip
1	each	Clamp
1	each	Support for heating and ventilation unit
2	each	Tapping screw, hexagon head, galvanized BZ 4,8x13 DIN 7976
2	each	Washer, galvanized A 5,3 DIN 9021-St
2	each	Mecano speed nut SNU-0537-B
1	each	Warm air hose, 1500 mm long
1	each	Warm air hose, 1400 mm long
2	each	Contact relay
1	each	Relay support
1	each	Cheese-head screw, galvanized AM 5x20 DIN 84-5S
3	each	Spring washer A 5 DIN 137
2	each	Hexagon nut, M 5 DIN 934-6S gal Zn 9
1	each	Cable set for heating unit

The following work must be performed to install the heater:

1. Remove both floor boards.

2. Withdraw rubber seal for battery cable located in conduit tube accessible from the front compartment; the seal is embedded in the tube for about 1 cm.

3. Working from the front compartment side, insert cable strand for heater into the battery cable conduit tube and guide it into the car's interior. Make certain that the undivided cable strand end (with 5 cable terminals) is inserted. To simplify the insertion of the cable, join the loose five ends with adhesive tape. The cable strand should be guided alongside the battery cable, through the rectangular opening on right tunnel side up to the tunnel middle, then to the forward part of the tunnel parallel to the cable strand which leads to the fuse box, up to behind the instrument panel. The red cable end is to be guided through the transverse panel of the front compartment, along the cable strand up to the fuse box, and fastened to No. 3 terminal in the fuse box. The black cable end (snap-on connector) is to be connected with No. 54 terminal at the ignition/starter switch.

4. Disconnect Bowden cables at both fresh air ducts. Remove clock and ventilation controls.

5. Install new heater and ventilation controls taking care not to bend the Bowden cables. Located about 25 mm below the cable strand passage in the transverse panel of the front compartment, and covered with sound-proofing material, is an opening for the heater Bowden control cable. Punch a hole through the material and guide the cable through it. Connect the three remaining cable ends of the cable strand to like colored terminals in the heater control unit. Reinstall clock. Attach and adjust Bowden cables to fresh air ducts as outlined on page SB 11.

6. Remove the three sheetmetal covers in the front compartment by gently tapping with a hammer from the axle tube side (one cover is for access to the fuel pump, the other two for exhaust and intake ducts).

7. Drill three holes for mounting the relay support (see Fig. 4 and 5). Mount support so that the angular end faces up. Mount both relay switches so that the terminal side points to left (driver's side).

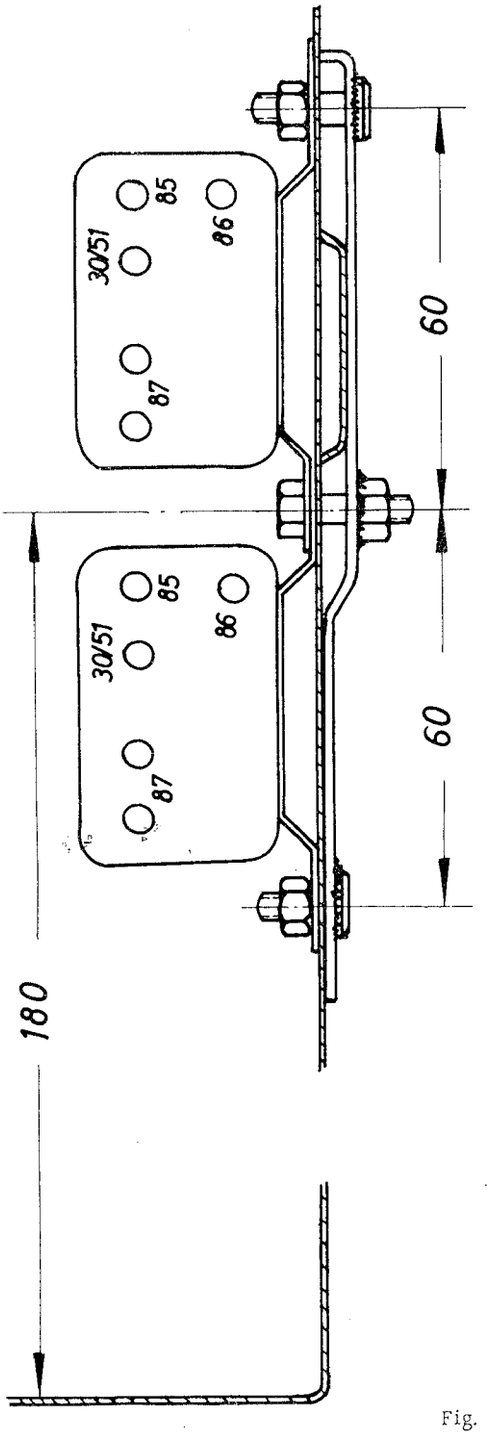

Fig. 4

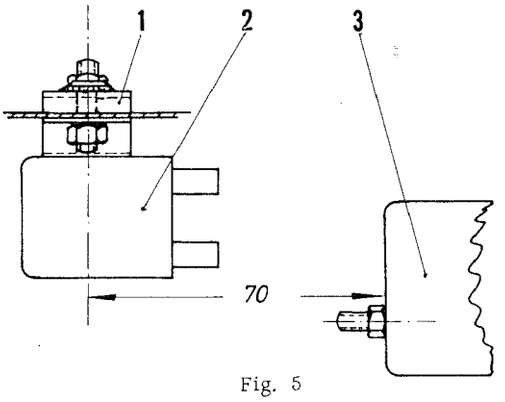

Fig. 5

1 Relay support
2 Relay switch
3 Electric fuel pump

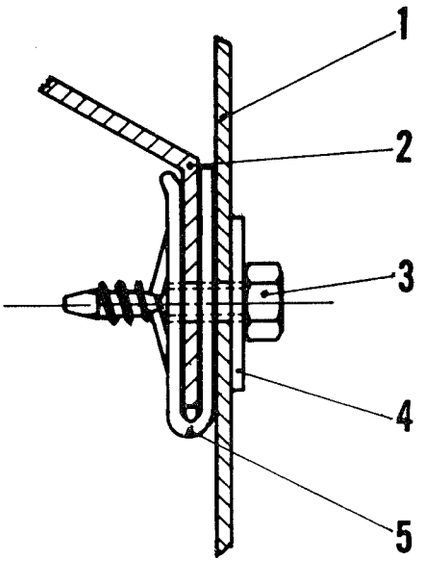

Fig. 6

8. Remove both plastic plugs from the front compartment transverse panel and fasten the angular heater support with both speed nuts; place bolts and washers from outside (see Fig. 6 and 7).

1 Front compartment transverse panel
2 Heater support
3 Tapping screw
4 Washer
5 Speed nut

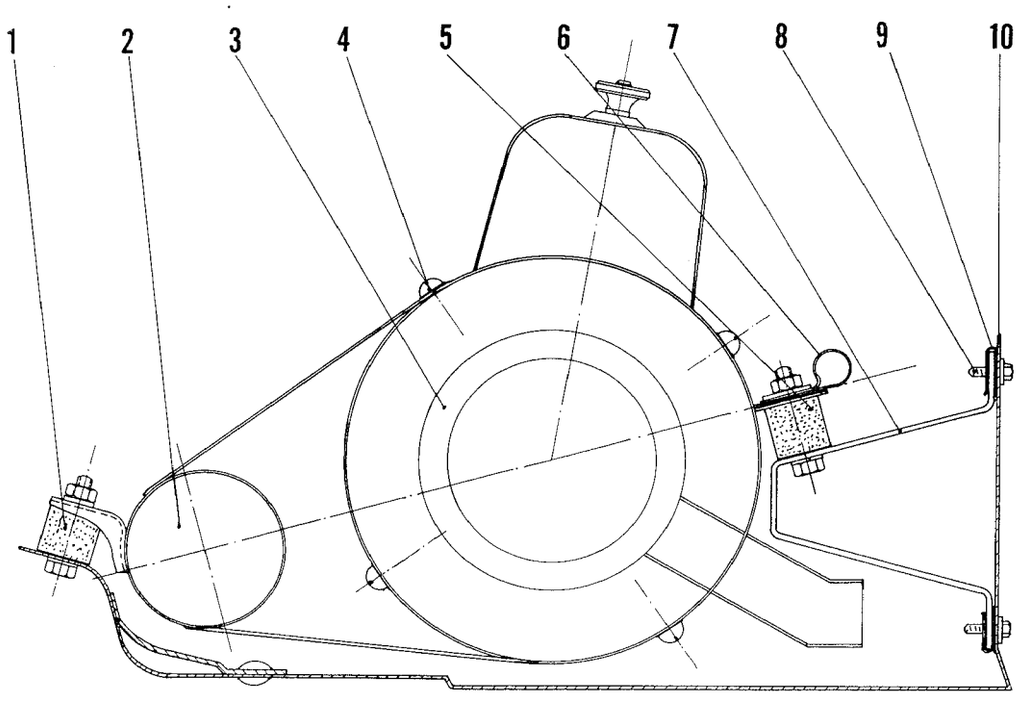

Fig. 7

1 Rubber support
2 Warm air distributor
3 Heater
4 Distributor retaining screw
5 Rubber support
6 Holding clamp
7 Heater support
8 Tapping screw
9 Speed nut
10 Front compartment transverse panel

9. Remove the 6 mm plastic plug from spare tire recess. Install rubber support by placing the M 6x8 bolt from underneath.

10. Mount the other rubber support at the rectangular opening in the angular support. Altogether, three rubber supports are required for mounting - 1 for the exhaust duct and 2 for the heater; the shorter rubber support is for the exhaust duct.

11. Apply some talc powder to the rubber mount at the left wheel skirt. Make certain that the exhaust and intake ducts are properly centered in the openings provided in the body, horizontally as well as vertically. The horizontal adjustment (for height) may be made by loosening the four screws (slotted) which secure the warm air distributor.

12. Replace fuel line from fuel cock (Part No. 644.201.921.00) with fuel line with "T" joint (Part No. 644.201.095.00) which is included in the heater kit.

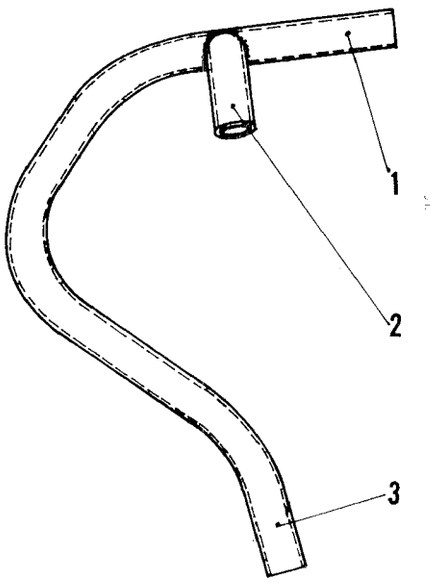

Fig. 8

1 To electric fuel pump for heater
2 From fuel cock
3 To mechanical fuel pump at engine

13. Insert sealing rubber and plate at the heater fuel pump inlet, fasten fuel line connector with coupling nut at fuel pump inlet so that the bent end points upward. Slide fuel hose (24 cm long) onto the fuel line connector; slide other end of hose onto the free connector of fuel line described in Point 12. Fasten fuel pump to support bracket with clamp. Remember to insert felt pad between support bracket and fuel pump. Secure fuel hose to bracket on bottom side of fuel tank with hose strap.

Note: Inlet and outlet connectors on heater fuel pump are marked with arrows.

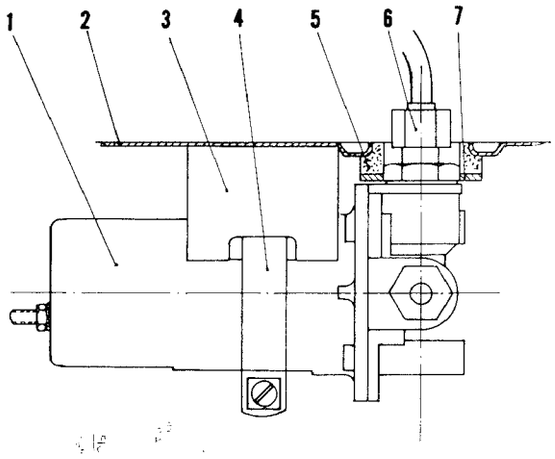

Fig. 9

1 Electric fuel pump
2 Front compartment panel
3 Support bracket
4 Clamp
5 Sealing rubber
6 Coupling nut
7 Sealing plate

14. Secure fuel line between fuel pump and heater. The long fuel line is mounted between pump and filter, the short between filter and heater. The filter and fuel line are mounted at the right rubber support at the heater (see Fig. 10).

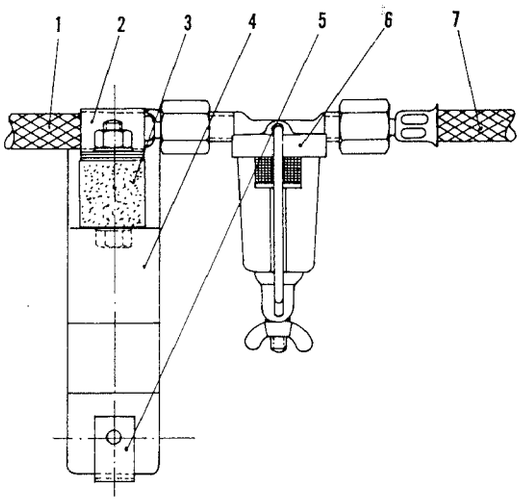

Fig. 10

1 Fuel line from fuel pump
2 Clamp
3 Rubber support
4 Heater support
5 Speed nut
6 Fuel filter
7 Fuel line to fuel solenoid

15. Fasten exhaust and intake ducts. Insert intake duct and rubber seal into sheetmetal sleeve (see sketch) until the seal comes to rest against the compartment panel; the exhaust duct opening must point upward. Secure duct by bending sheetmetal ears on body (see sketch). A plastic ring is utilized on the exhaust duct. The metal ring is also slid on from the outside, and the sheetmetal ears are bent to secure the unit.

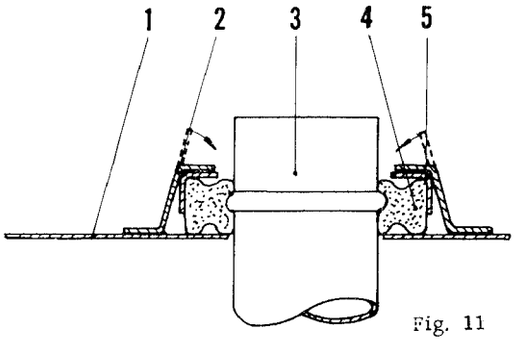

Fig. 11

1 Compartment panel
2 Sheetmetal ear
3 Intake duct
4 Rubber seal
5 Sheetmetal sleeve

16. Remove stabilizing bar bushing covers, move stabilizing bar down. Fasten the short rubber support at the bottom of the exhaust duct. Insert the exhaust duct into the exhaust tube in heater. Fasten rubber support to the diagonal chassis member through hole provided, making certain that the exhaust duct does not block the parking brake lever shaft. Drill a 3.2 mm hole, from the bottom, in the exhaust duct (see Fig. 12), and screw in a 4 mm sheetmetal screw to keep the duct from loosening or turning. Reinstall stabilizing bar.

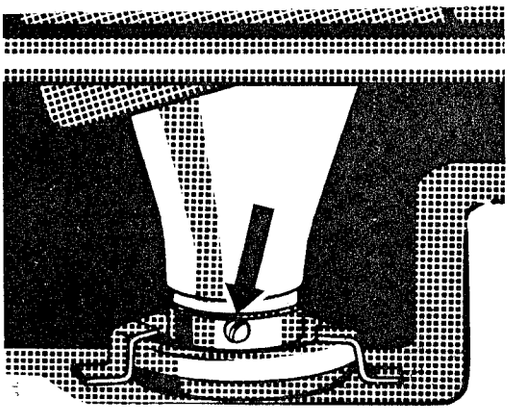

Fig. 12

17. Following the wiring diagram, connect cable terminals to the fuel pump, relay switches, and heater. The upper relay switch is designated No. 2, the lower switch is No. 1. Both relay switches are identical. See Fig. 13 for relay switch terminals. Wiring diagram applicable to the heater is shown on page S TRA 17.

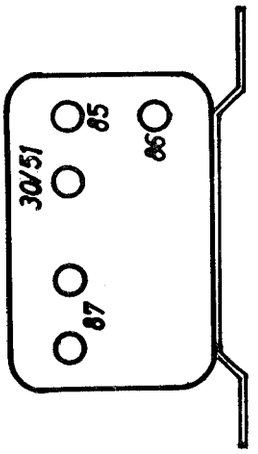

Fig. 13

18. Connect heater Bowden control cable. The cable should be placed underneath the front compartment mat and secured with a clamp utilizing a fuel tank securing bolt, then guided through a rubber grommet in the forward transverse panel of the front compartment to the heater unit (see Fig. 14).

Caution: Do not bend the Bowden cable. Fasten cable conduit tube securely with the clamp.

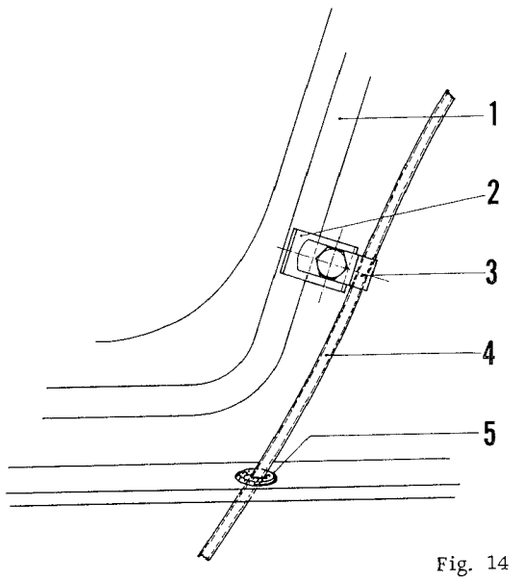

Fig. 14

1 Fuel tank
2 Fuel tank bracket
3 Clamp
4 Bowden cable
5 Grommet

19. Move heater control lever in control assembly to Position 4 (see Fig. 15). Move control lever on heater control switch to the "AUS" ("OFF") position and fasten Bowden cable to the arm with the terminal screw (see Fig. 16).

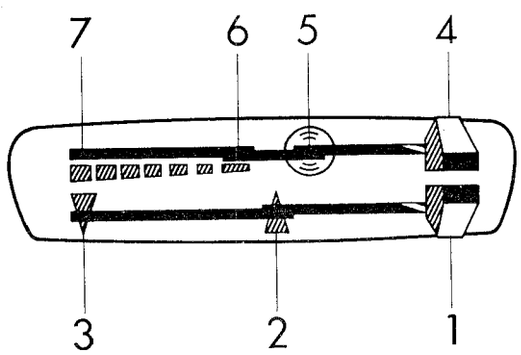

Fig. 15

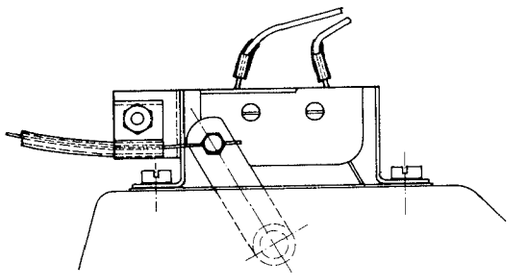

Fig. 16

20. Remove screens from fresh air ducts and install warm air hose, by placing it under the compartment mat, between the heater and the ducts, shorten if necessary.

21. Remove sponge rubber stoppers from the floor air vents.

22. Check heater and ventilator for proper operation.

23. Check fuel connections for leaks.

24. Reinstall floor boards.

25. Reinstall rubber seal in battery cable conduit tube (see Point 2).

26. Install heater cover.

Wiring Diagram for the BN-4 Heater

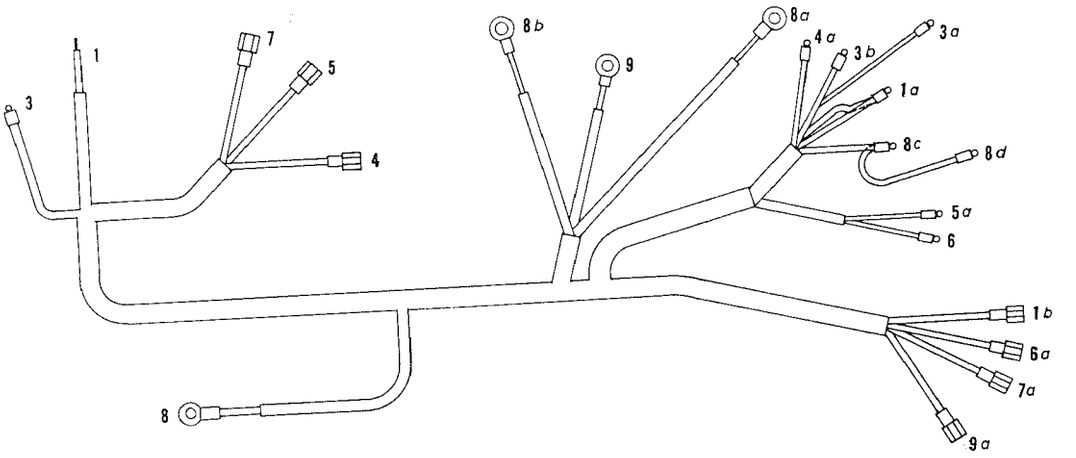

Fig. 17

No.	Color	Connecting Terminal
1	red	Fuse No. 3
1 a	red	Relay switch No. 1, terminal 30/51
1 b	red	Heater, terminal 2
3	black	Ignition/starter switch, terminal 54
3 a	black	Relay switch No. 2, terminal 85
3 b	black	Relay switch No. 1, terminal 85
4	red/white	Control unit
4 a	red/white	Relay switch No. 1, terminal 87
5	blue/white	Control unit
5 a	blue/white	Relay switch No. 2, terminal 30/51
6	blue	Relay switch No. 2, terminal 87
6 a	blue	Heater, terminal 1
7	green/white	Control unit
7 a	green/white	Heater, terminal 4
8	brown	Ground, at chassis
8 a	brown	Ground, at heater
8 b	brown	Ground, at fuel pump
8 c	brown	Ground, at relay switch No. 1, terminal 86
8 d	brown	Ground, at relay switch No. 2, terminal 86
9	green	Fuel pump
9 a	green	Heater, terminal 3