

TECHNICAL DESCRIPTION AND INSTALLATION INSTRUCTIONS



HEATERS X3, X7, X12

For heating and ventilating purposes for universal installations operated with diesel oil

Type X3

Type X7

Type X12

Serial No. 20 14 77 122

Serial No. 20 14 70 122

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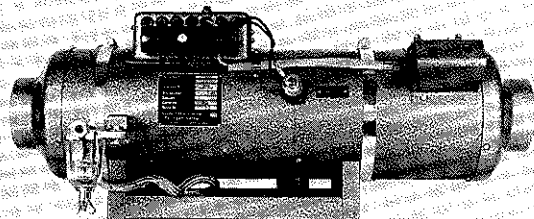
HEATERS

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TECHNICAL DESCRIPTION

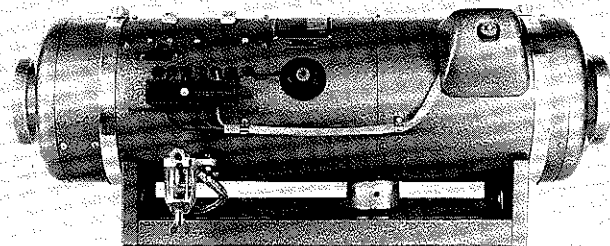
The Eberspächer-heaters X3, X7, and X12 are diesel oil operated heating and ventilating units with their own

heating source. They can be operated independently from the vehicle motor.



3/3285

X3



3/9759

X7/X12

TECHNICAL DATA

	X 3	X 7	X 12
Heat output (BTU/h)	655/830	1130/1640	1765/2770
Heat air input (lbs./h)	350	600	1100
Fuel	Diesel fuel/special oil		
Fuel consumption (hours/Imp.gallon)	12, 5/9	7/4, 5	4/2, 8
Current consumption (Watt)	65/70	90/95	120/125
Voltage (Volt)	12 or 24	12 or 24	12 or 24
Weight (lbs.)	approx. 16, 5	approx. 39	approx. 48, 5

DESIGN AND OPERATION

The complete heater consists of a basic unit and the accessories for air-ducting, exhaust system, fuel supply, mounting, and operation.

After the heater has been switched ON to the "Full" position, the combustion air blower (14) will start to supply combustion air, the fuel solenoid valve (2) will open, and the gear pump (15) will supply fuel through the hollow motor shaft to the atomizer (13). At the same time the glow plug (7) will be energized and ignites the fuel-air mixture in the combustion chamber (11). The combustion gases flow through the heat exchanger (10) and affect the sensor-rod of the thermoswitch (8) which will initiate the following operations approx. 60 seconds after the heater had been turned on:

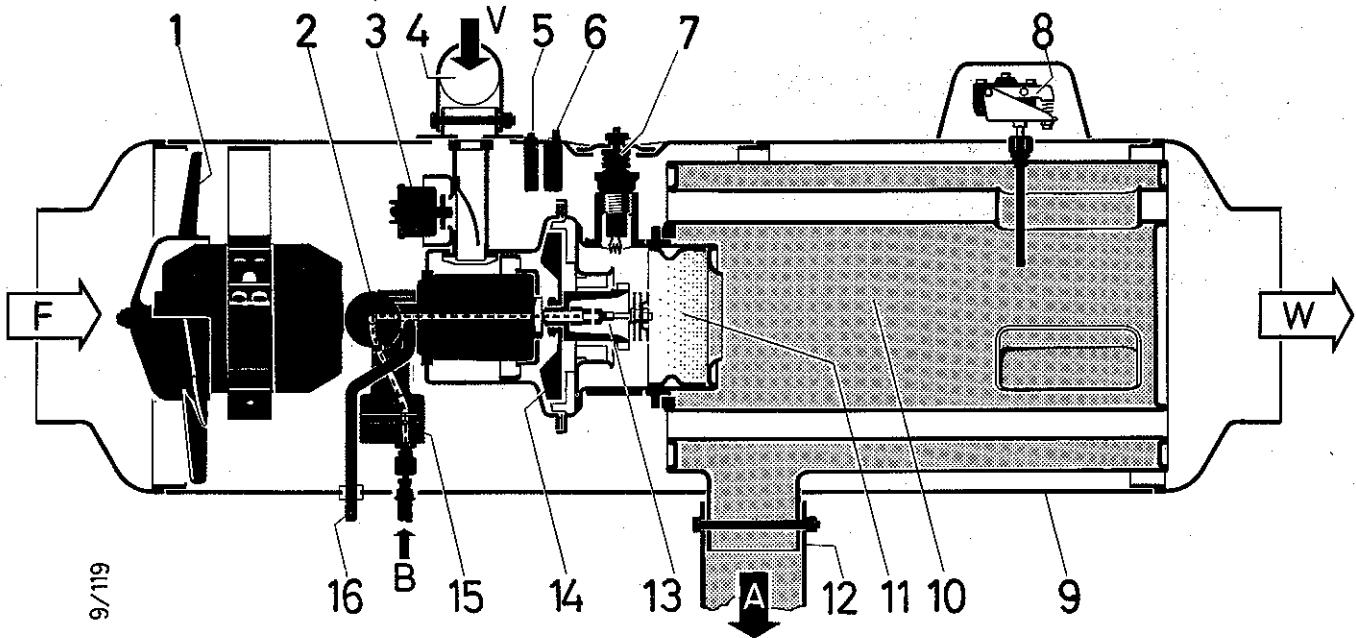
1. The glow-plug is turned off, the combustion continues by self-ignition.
2. The resistor in the safety switch (6) is turned off.
3. The fresh air blower (1) is turned on and supplies fresh air through ducts in the heat exchanger into the passenger room (10). By starting the fresh air supply only after the heat exchanger had become hot, no cold air

will enter the passenger room.

4. The combustion-air solenoid-valve (3) of the heaters X7/X12 is energized and opens. The rich mixture for the starting process gets leaner in order to assure a sootless combustion. With the heater X3, the additional air is supplied through an opening in the combustion air intake pipe.
5. The control light in the lever switch is turned on and indicates that the heater is in full operation.

Less heat can be obtained by turning the switch to the "Half" position. With the same fresh air input, the fuel and combustion air supply will be reduced. After turning the switch OFF, the fresh air blower will supply air until the heat exchanger has been cooled off to approx. 100° F and until any remaining gases have been blown out. The thermo-switch will then switch the fresh air blower off and close the combustion air valve of the heaters X7 and X12. The control light goes out, the heater is out of operation and may be restarted again.

Schematic drawing X7/X12



The most important components of the basic equipment are as follows:

- | | | |
|--|------------------------|--------------------------------------|
| 1. Fresh air blower | 6. Safety switch | 12. Exhaust pipe |
| 2. Fuel solenoid valve | 7. Glow-Plug | 13. Fuel atomizer |
| 3. Combustion air solenoid valve (for X7/X12 only) | 8. Thermostwitch | 14. Combustion air blower (impeller) |
| 4. Combustion air intake pipe | 9. Casing | 15. Fuel pump |
| 5. Automatic fuse | 10. Heat exchanger | 16. Fuel drain pipe |
| | 11. Combustion chamber | |

OPERATION

The heater is operated by a lever switch with the positions "FULL", "HALF", and "OFF".

To turn ON the heater

Turn switch to position "FULL". After the control light in the switch goes on (approx. 60 seconds), the switch may be turned at random during the heating operation from "FULL" to "HALF", and vice versa. Move the lever, swiftly without stopping at the central position "OFF".

To turn OFF the heater

Turn the switch to the "OFF" position. After completion of the purging cycle (approx. 3 minutes) the control light will go out. Only then the heater may be restarted again.

Ventilation

With the push-pull switch positioned above the lever switch the fresh air blower can be turned on independently from the heating operations. It can be used for the ventilation of the passenger room.

Prior to the initial operation, the fuel lines have to be vented: disconnect the glow-plug, turn lever switch to position "FULL" until the fuel filter is filled with fuel. In case of an extended fuel line pay attention that the safety switch is energized after approx. 3 minutes. Repeat as required. Start heater after connecting the glow-plug.

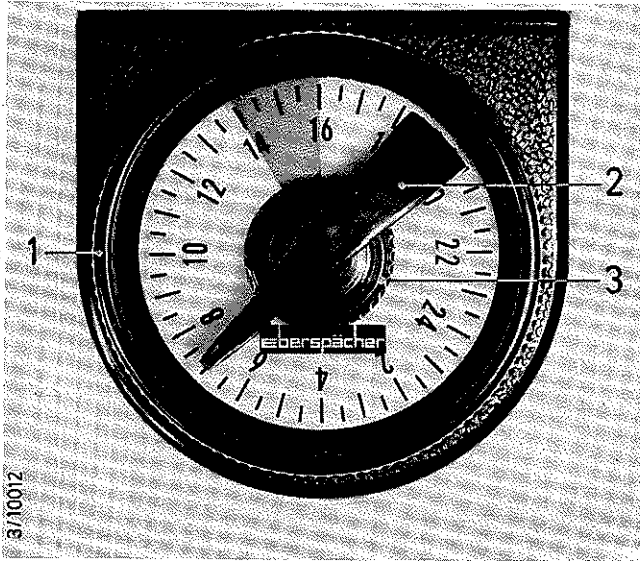
After an extended operation on position "HALF" it is recommended to operate the heater approx. 20 minutes on position "FULL" in order to prevent carboning up the glow plug.

CAUTION:

Do not operate the heater in closed rooms without sufficient ventilation.

Maintenance:

Clean glow-plug every year prior to the heating season, replace as required. Remove oil carbonization residues from the combustion chamber; clean fuel filter; check fuel and electric lines for tight fit.



A preselection of the heating operation can be arranged by a timer which is obtainable as accessory. It will permit a preselection to start the heater up to 19 hours in advance.

This timer will turn on the heater on time and will turn it off after a 2-hours operation unless the heater has been turned off manually in the meantime.

INSTALLATION INSTRUCTIONS

There is a wide range of applications of Eberspächer heaters. Consequently there are many ways of installing it. Several general rules, however, should always be observed to assure a properly functioning heater to serve the intended purpose. You should therefore raise several questions before installing a heater; we will assist you in answering these questions by the following hints:

1. Which is the correct type of heater?
2. What accessories are required?
3. Recirculating air or fresh air operation?
4. Where can the heater be mounted?
5. How is exhaust gas removed and combustion air supplied?
6. How can the heating air ducts be installed?
7. How is the fuel supplied to the heater?
8. How should the electric system be installed?

1. Which is the correct type of heater?

The selection of the correct heater depends on the required heat output. Fuel must be available. For the X-heaters: Diesel fuel, or extra light oil. The voltage on board, 12 or 24 volt, must correspond with the voltage specified on the name plate of the heater. The following should be provided for each cubic yard of space to be heated:

- approx. 1200 BTU/h for motor vehicles
- approx. 300 BTU/h for sporting vessels
- approx. 600 BTU/h for vessels operated all the year

This results in the following ranges of applications for heaters:

- X 3 - 655/830 BTU/h
for truck cabs, small busses, motor boats, etc.
- X 7 - 1130/1640 BTU/h
- X12 - 1765/2770 BTU/h
for large vehicles, busses, vessels, etc.

2. What accessories are required?

Our delivery range under the above parts numbers covers the following:

- 1 Basic heater
- 1 Fuel filter with fuel line between filter and basic heater
- 1 Combustion air pipe, mounting material

Additional accessories needed for the mounting, air ducting, exhaust system, fuel supply, and electric installation will vary depending on the type of installation. Please select the suitable items from our accessory catalog.

3. Recirculating air or fresh air operation?

Depending on the available space it is to be determined whether the heater should be operated by fresh air or by recirculating air.

When operating with fresh air, the heating air will be sucked from outside; recirculating air operation takes the air from the passenger room.

The following features - in addition to the different installation of ducts - will result from the above:

Recirculating air operation

Faster heating up, reduced drying of the air in the rooms to be heated, less problems to install the exhaust lines. The operation with fresh air necessitates the removal of the exhaust in such a way that it cannot flow to the intake for the heating air neither when the vehicle stops nor during its operation. In case you still want the possibility to use fresh air when operating with recirculating air you must provide a flap in the intake line which will be set for fresh-air if desired.

Fresh air operation

In boats it is often desired to use the heating also for the drying of air in the rooms to be heated. In this case the fresh air arrangement should be provided.

The outside-air with a certain moisture content (in the extreme case saturated) will be sucked in and heated in the heater. The warmer air can now still absorb some moisture from the rooms in the vessel and move it to the outside through leakages, air ducts, or partially opened windows.

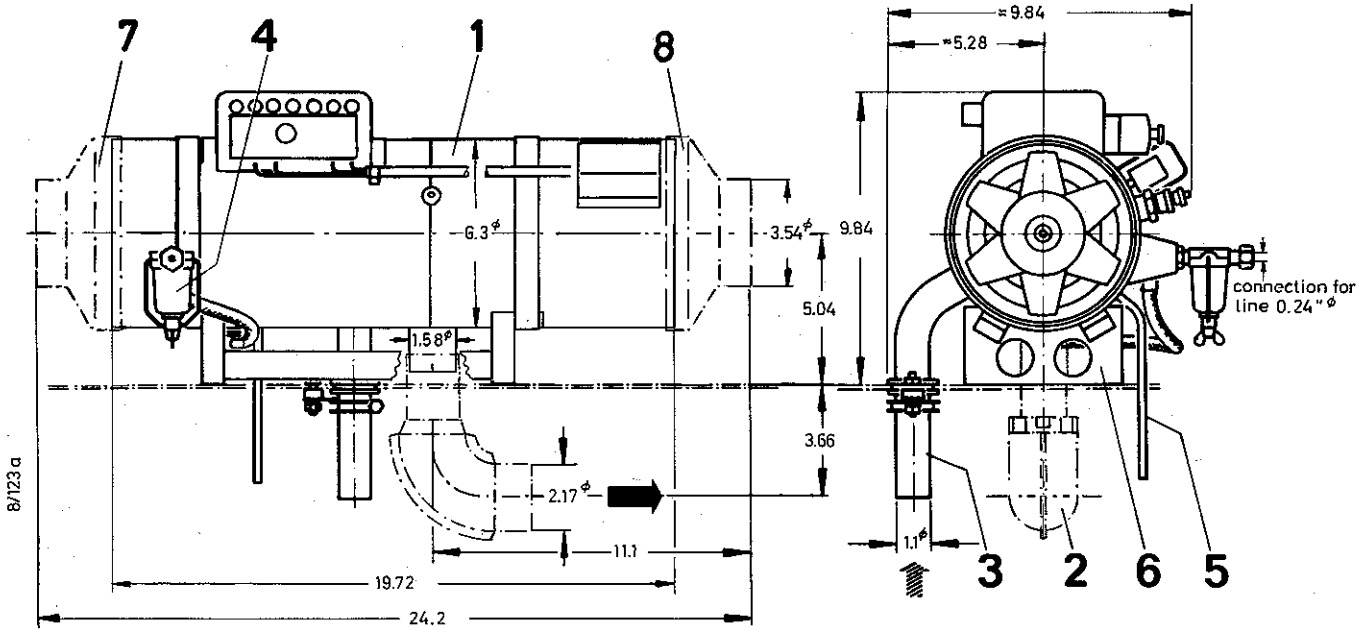
4. Where can the heater be mounted?

The main dimensions and connecting data which are important for the selection of the place to install the heater are shown in the following diagrams. The heaters should be installed, if possible, in horizontal position, and the exhaust outlet should be directed downwards. Deviations around the longitudinal axis are acceptable up to 15° to

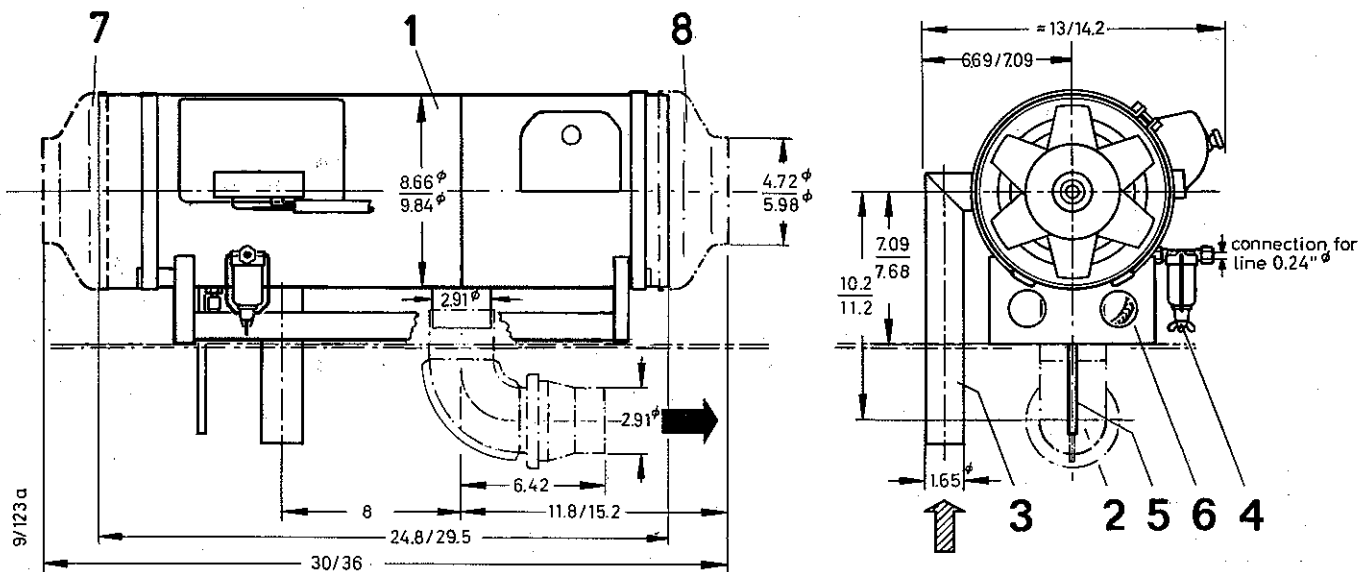
both sides.

Several examples for the installation of heaters in commercial vehicles are shown below the diagrams.

X 3



X7/X12



- 1 Heater
- 2 Exhaust manifold with injector (accessory)
- 3 Combustion air pipe
- 4 Fuel filter

- 5 Drain pipe
- 6 Heater support (accessory)
- 7 Intake scoop (accessory)
- 8 Outlet scoop (accessory)

All installations were completed with special care to assure that glow-plug, thermostitch, fuel filter and the

reset buttons of the safety switch and the automatic fuses are readily accessible.

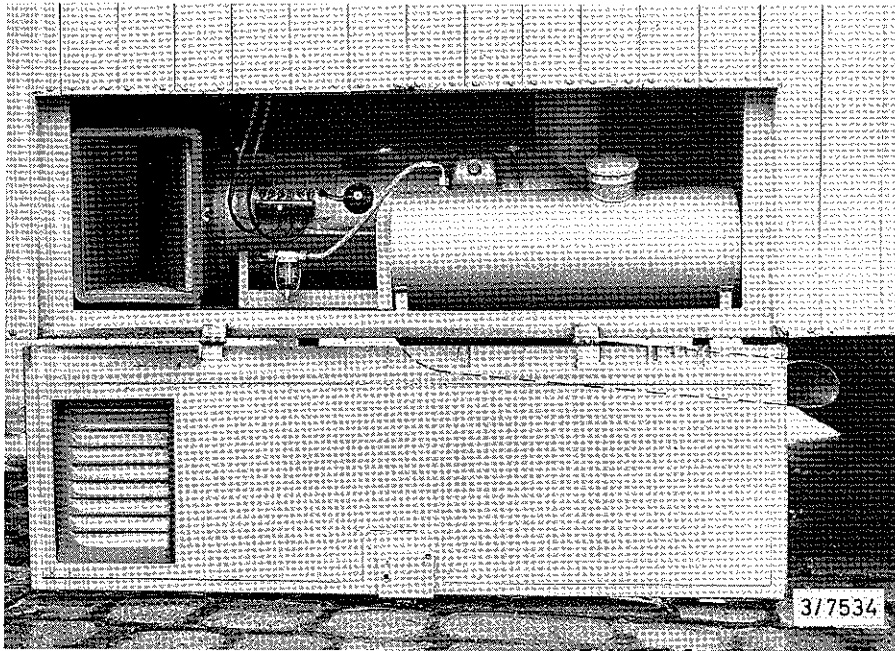


Fig. 1

Fig. 1 shows a heater X7 for the heating of a personnel carrier. Heater and tank are installed in the tool-box on the left side of the vehicle.

The heater is operated by fresh air which is sucked in through an air-filter, heated up, and directed into the interior of the vehicle from below.

In order to assure that the exhaust gases are kept away from the fresh air intake, the exhaust elbow with injector has been extended. The combustion air is sucked through the supplied combustion air pipe.

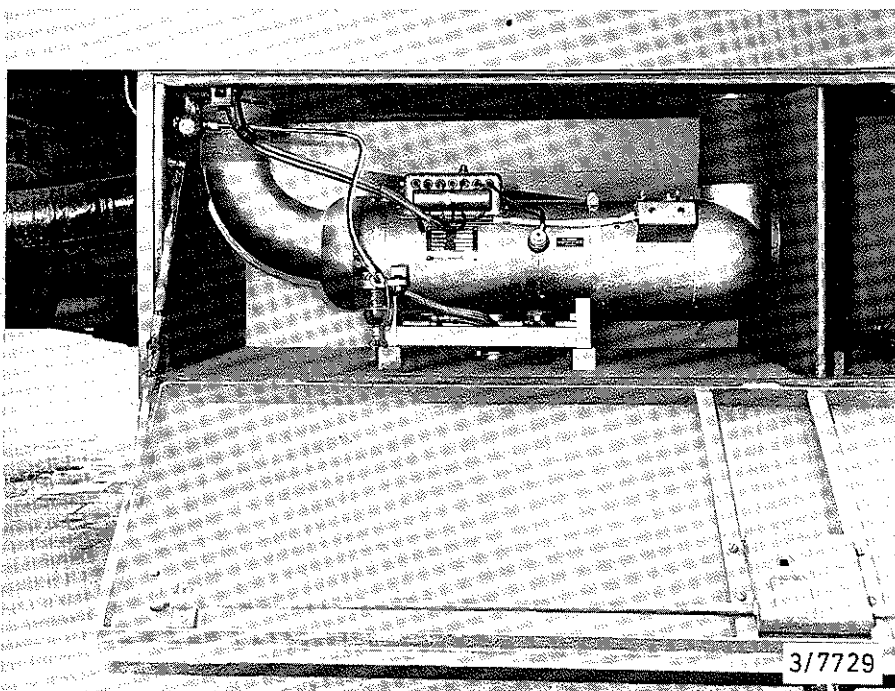


Fig. 2

Fig. 2 shows a similar installation of the heater X3. This heater is operated by recirculating air which allows a specifically fast heating up of the interior.

The exhaust is removed through an extended injector; fuel is supplied from the vehicle tank.

Figures 3 and 4 show heaters for the heating of truck cabs with heater X 3.

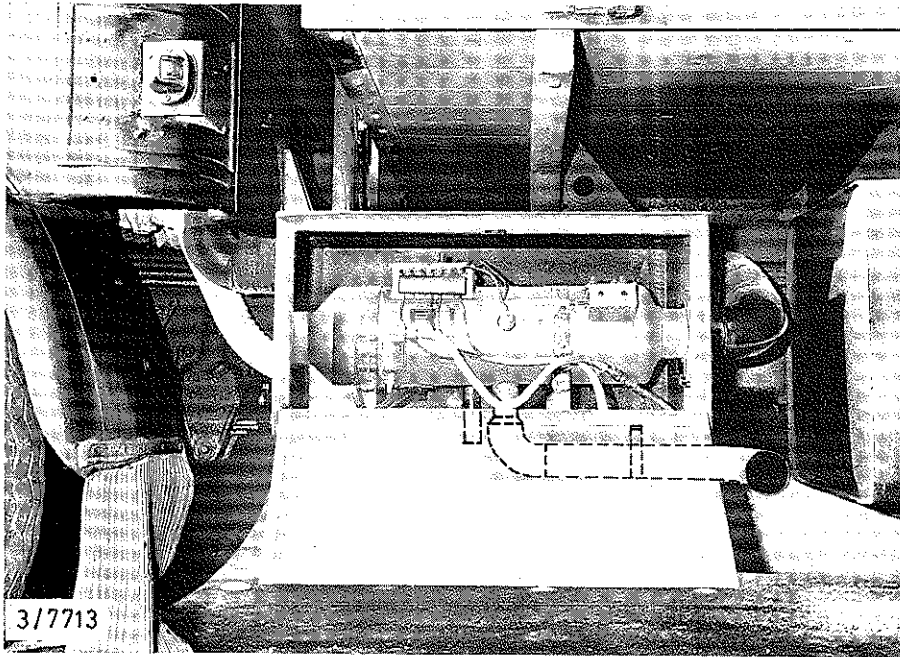


Fig. 3

Fig. 3 shows the heater installed in a metal box on the left side of the vehicle. By this arrangement, too, the exhaust is removed through an extended injector.

The hot air enters the driver's cab from below through a flexible line, insulated, to prevent loss of heat.

The fuel is supplied by the vehicle tank; the combustion air is sucked through a combustion air pipe.

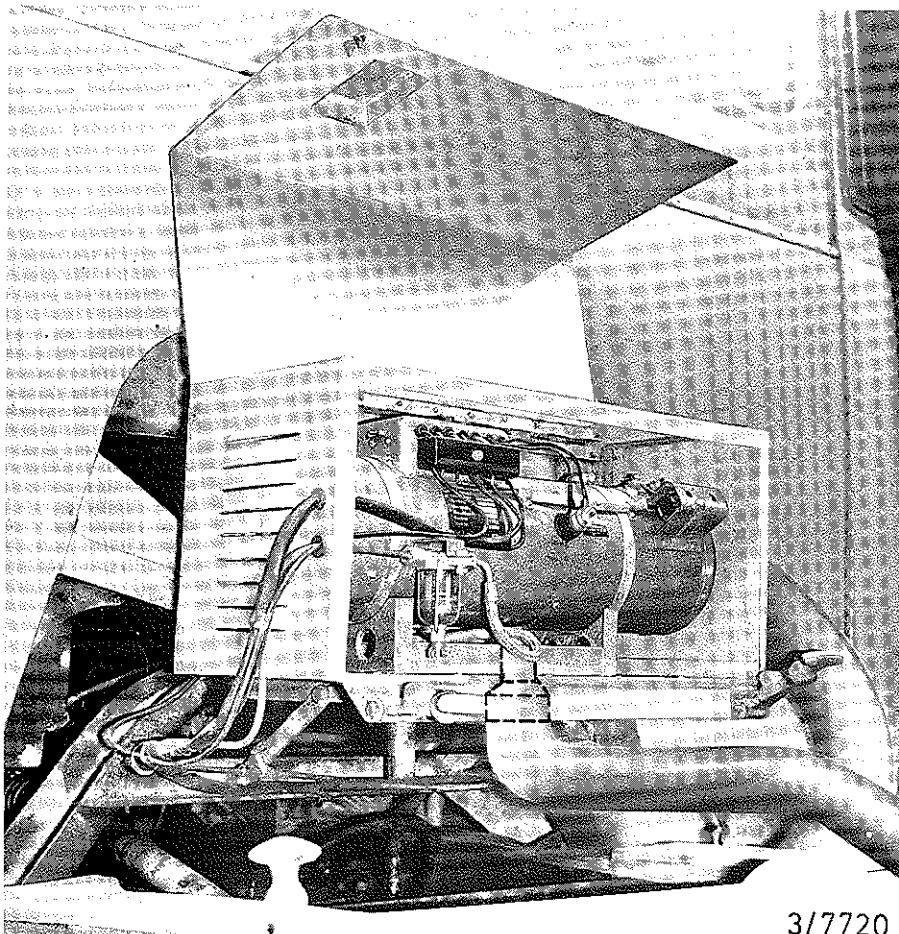


Fig. 4

Figure 4 shows the heater installed in a metal box located behind the rear wall of the driver's cab.

The exhaust is removed through an elbow with injector which is extended by a pipe; the combustion air is supplied through a combustion air pipe.

Since the heater is installed at a height not exceeding the lowest fuel-level by 30", the suction capacity of the gear pump is still sufficient to take the fuel directly from the vehicle tank.

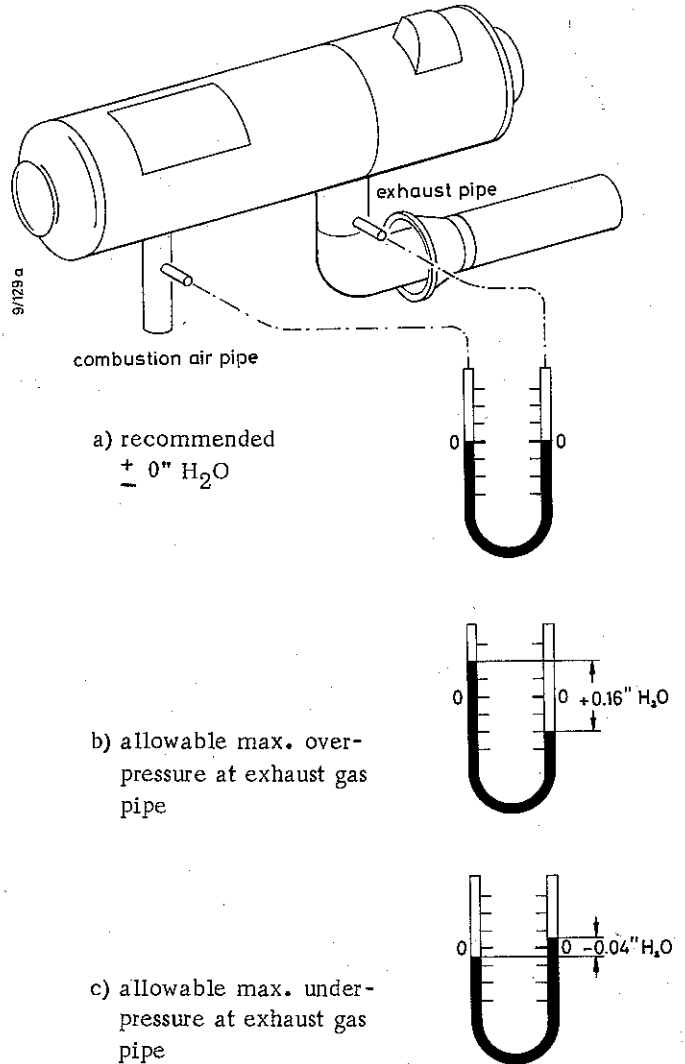
5. How is exhaust gas removed and combustion air supplied?

Exhaust gas line and combustion air supply must be properly coordinated to assure smooth, sootless combustion. Please, pay attention to the following:

- a. The supplied exhaust elbow, with injector, will permit the connection of an exhaust line up to a length of 3 yard. When installing the heater in vessels, an exhaust blower should be installed instead of the exhaust elbow in order to support the exhaust gas removal and to eliminate influence caused by wind. Without injector, you may connect to the exhaust gas stack of the heater a pipe not exceeding a length of 12".
- b. Exhaust outlet and combustion air intake must be positioned in such a manner that exhaust gases cannot be sucked in. The cross section of pipes must not be reduced.
- c. The opening of the exhaust pipe and combustion air pipe must be located in the same pressure area with any speed, the pressure differential between combustion air inlet and exhaust outlet shall not exceed $-0.04'' \text{H}_2\text{O}$ (underpressure at exhaust pipe) and $+0.16'' \text{H}_2\text{O}$ (overpressure at exhaust pipe). The pressure differential can be measured as follows:

Solder one tube, $\frac{1}{16}$ in. inside diameter, to the combustion air pipe, and one to the exhaust pipe, and provide it with a $\frac{1}{16}$ '' ϕ boring. The boring is to be deburred. Connect tubes by hoses with a gauge (e.g. U-pipe) which will indicate the pressure differential. The measuring points must be near the heater and not at the extended exhaust pipe. At least 2'' pipe length must follow the measuring point.

By moving the combustion air pipe and exhaust pipe to another spot the pressure differential can be influenced. Do not install the exhaust pipe facing the driving direction.



6. How can the heating air ducts be installed?

The flow resistance of the heating air ducts is composed of wall-friction and deflection losses. It should not exceed a static pressure of 0.2" H₂O when using the X3 heater, and 0.3" H₂O when using the X7/X12 heater. For this reason the ducts for fresh air and hot air must be as short as possible and should be installed with a minimum of curvatures.

Based on a given flow-rate of 6.5 - 9 yards/s, resulting from the diameter of the pipe and the air output, the following should be considered as a guide:

a. For wall-friction losses per yard of flexible tubes:

- 3.54" ϕ \approx 0.06" H₂O
- 4.72" ϕ \approx 0.04" H₂O
- 5.90" ϕ \approx 0.03" H₂O

b. For deflection losses under a curvature radius R=2 D:

- 90° Bow \approx 0.03" H₂O
- 45° Bow \approx 0.02" H₂O

When operating with fresh air, the fresh air should be taken in on a higher level and not near the exhaust from an aerea which is not exposed to an impact pressure or underpressure and should be supplied to the heater through an air filter.

When operating with recirculating air, the air inlet should be positioned in such a manner that the escaping hot air cannot be sucked in again. Any hot air ducts installed outside should be insulated to prevent loss of heat. The cross section of the heating ducts must not be smaller than the cross section at the outlet of the heater. The entire cross section of all outlet openings should be, at least, 50 % larger than the cross section at the outlet scoop

7. How is fuel supplied to the heater?

It is advisable to use a special fuel tank. Install it, if possible, with the heater in the installation housing. This will allow the use of special oil, and the short intake line will assure proper fuel supply without any additional equipment.

If the tank has to be installed farther away from the heater, or if the intake line is connected to the vehicle fuel tank (tapping of fuel line to the engine is not recommended because the high intake capacity of fuel pump will impair the fuel supply to the heater), the following shall be observed:

1. The maximum length of the suction line is 4 yard if tank and heater are positioned at the same level. The max. lift of the fuel pump installed in the heater is 30" with suction lines up to 1 yard length. If these limits must be exceeded install an electric fuel pump and a level equalizer. Direct the ventilating line of the level equalizer downwards into the open air. When installed in vessels the vent line should be directed outboards.

of the heater. If it should be necessary to provide a connection from a round to a square cross section, you can determine the equivalent square cross section-which due to the increased resistance must be larger than the round one-with the following chart. It is based on the following rough calculation:

The square cross section, in the relation round ϕ : small square-side, must be larger than the round cross section.

Example: round ϕ = 3.6", small square side at 2" is possible; how large must be the square cross section?

3.6" : 2" = 1,8, consequently the square cross section must be 1,8 times as large as the round one: 10 sq inches times 1,8 = 18 sq inches.

Consequently the large square side at 18" : 2" = 9".

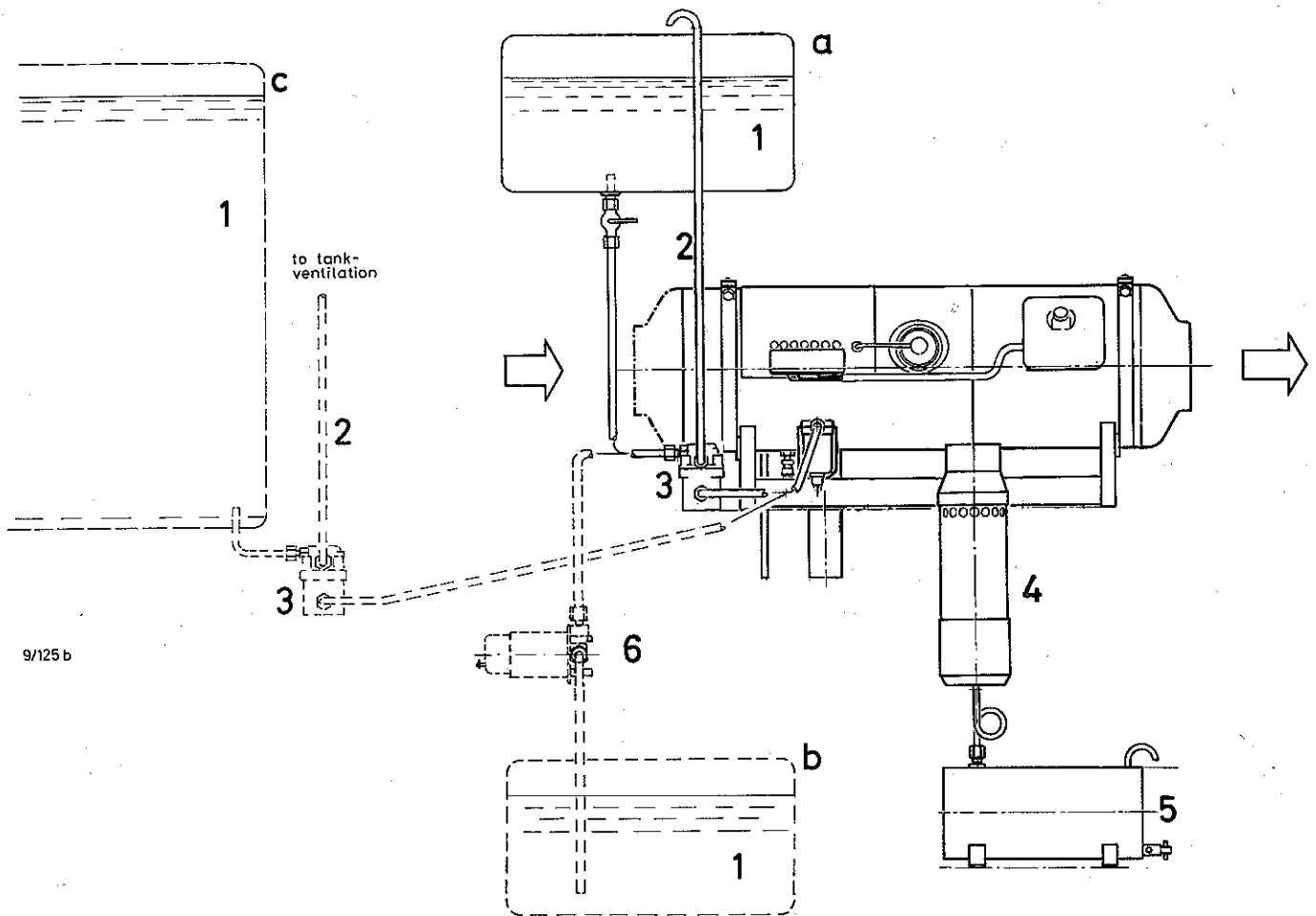
Round ϕ	Small square side	Large square side
3.6"	1.6"	14.2"
	2"	9"
	2.4"	6.3"
	2.8"	4.7"
	3.2"	3.5"
4.7"	2.4"	14.6"
	2.8"	10.8"
	3.2"	8.2"
	3.5"	6.5"
5.9"	4"	5.3"
	3.2"	16.3"
	3.5"	12.8"
	4"	10.4"
	4.3"	8.7"
	4.7"	7.3"

2. If the maximum fuel level should exceed the top edge of the heater, install an level equalizer. The ventilation line of the level equalizer should end above the tank.
3. The maximum interior diameter of fuel lines exceeding 1 yard length is 0.157" dia. in order to reduce the bleeding process.

Any fuel accumulating in the combustion-chamber in case of ignition failures will escape through the exhaust pipe until the safety-switch is activated. If you cannot install the exhaust line inclined to the outside (installation of heaters in vessels), insert a nipple, M 10x1, at the lowest point and connect a copper pipe which is directed with several turns to the overflow container placed under the heater. The nipple is already installed on exhaust blowers.

Diagram:

- a. Fuel supply from tank positions at higher level with level-equalizer.
- b. Fuel supply from tank positioned lower by use of additional electric fuel pump with level equalizer (dotted line).
- c. Fuel supply from a tank if the fuel-level may be as well above as below the heater (installation in vessels). The level-equalizer has to be installed below the lowest tank level in all cases.



9/125 b

- 1 Fuel tank
- 2 Ventilation line from level-equalizer
- 3 Level-equalizer
- 4 Exhaust blower (for installation in vessels)
- 5 Overflow container
- 6 Electric fuel pump

8. How should the electric system be installed?

The heater should be connected to the power supply on board (observe the voltage) according to the wiring diagram.

The following is shown:

1. The standard diagram (additional connection to timer is shown by dotted line).
2. Diagram with room thermostat, exhaust blower, and additional electric fuel pump.
3. Diagram with additional electric fuel pump without room thermostat.

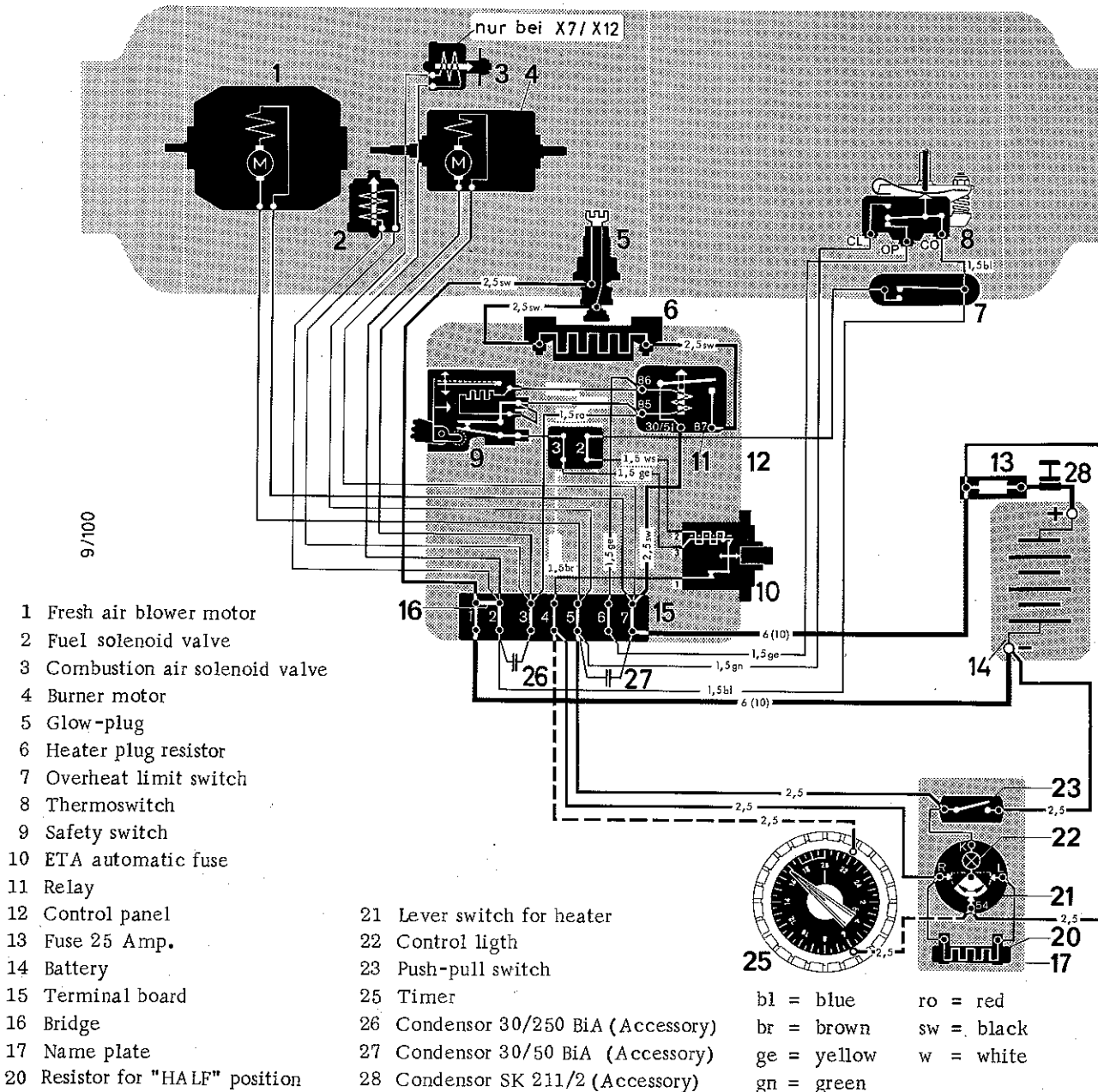
Older designs of heaters X3, X7, and X12 differ from the above by the wiring system. Special wiring diagrams are available.

Standard Design

The 3 condensers shown in the diagram can be supplied as radio suppression kit for FM operation and should be installed as follows:

The condensers 26 and 27 are secured to the inside of the heater housing at the level of the fresh air blower motor with the supplied bracket.

The condenser 28 is wired into the plus cable and secured according to the position of the battery to the vehicle. When operating with exhaust blower, additional suppression of that blower will be required.



Wiring diagram with thermostat control, exhaust blower, and additional electric fuel pump.

a. Thermostat control

The following additional parts are required:

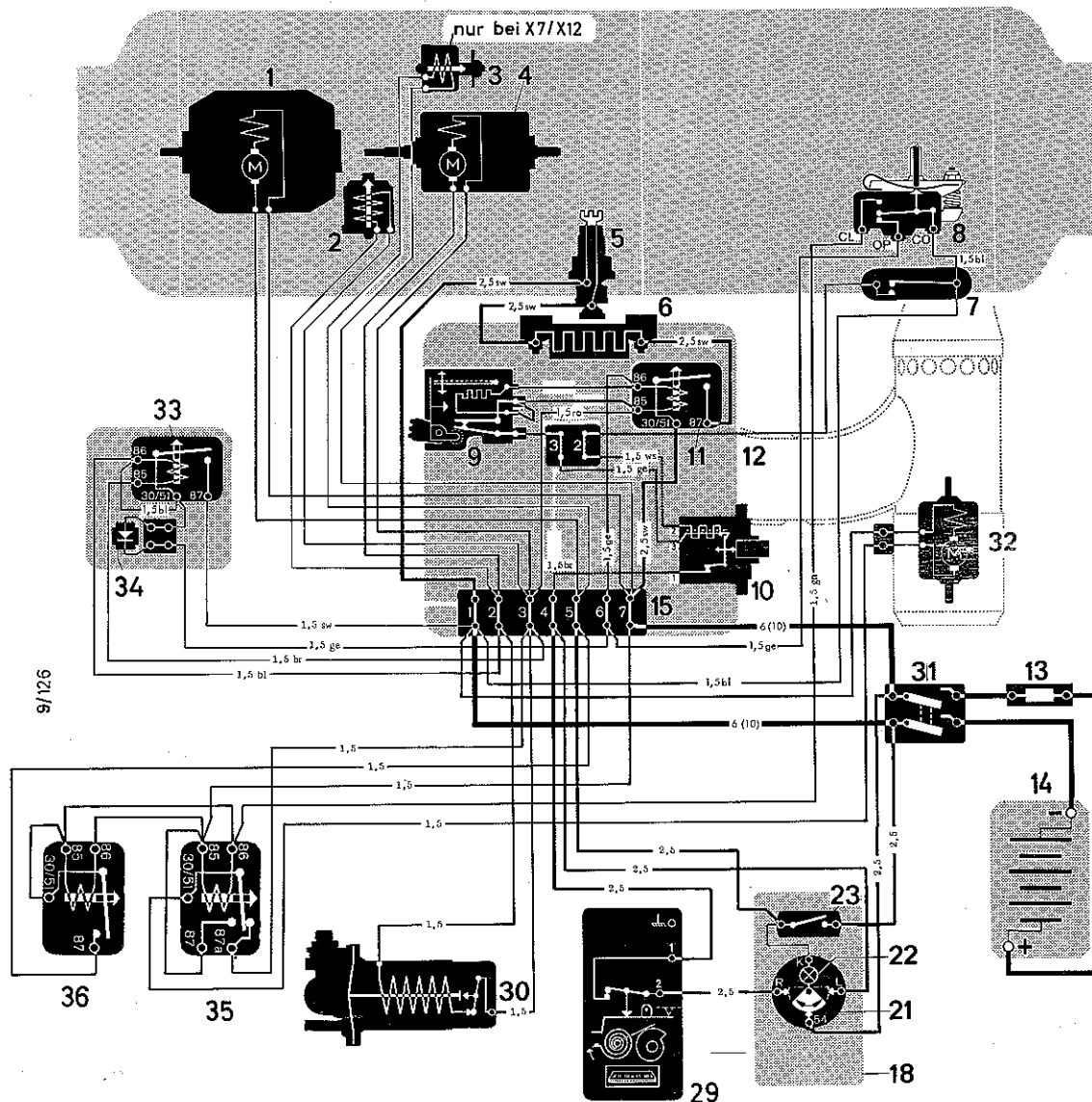
1. Room thermostat
2. Operating device for thermostat-control including switch (21) and (23), operating panel (18), and the parts for the recycling control (relay 33 and diode 34). These are to be connected according to the wiring diagram. The bridge (16) between terminal 1 and terminal 2 on the terminal board (15) must be removed. The wire 1,5 bl (from overheat limit switch) must be moved from terminal 2 to terminal 1. Lever switch to position "ON-THERMOSTAT": The heater will be operated by the thermostat. Lever switch to position "ON-CONTINUOUS": The heater will operate permanently providing full heating output. Lever switch to position "OFF": The heater is turned off.

b. Exhaust blower

The exhaust blower should run already when starting, during operation of heater, and during the purging cycle. The relay (35) is required for this operation.

In order to preclude that the exhaust gas blower is also turned on for ventilating operating, relay (36) is provided.

c. An additional electric fuel pump should be connected to the terminals 2 and 3 of the heater. The pump must be insulated. When operating with a room thermostat, a wire from the pump-housing to terminal 2 of the heater instead of the ground connection of the electric fuel pump should be installed.



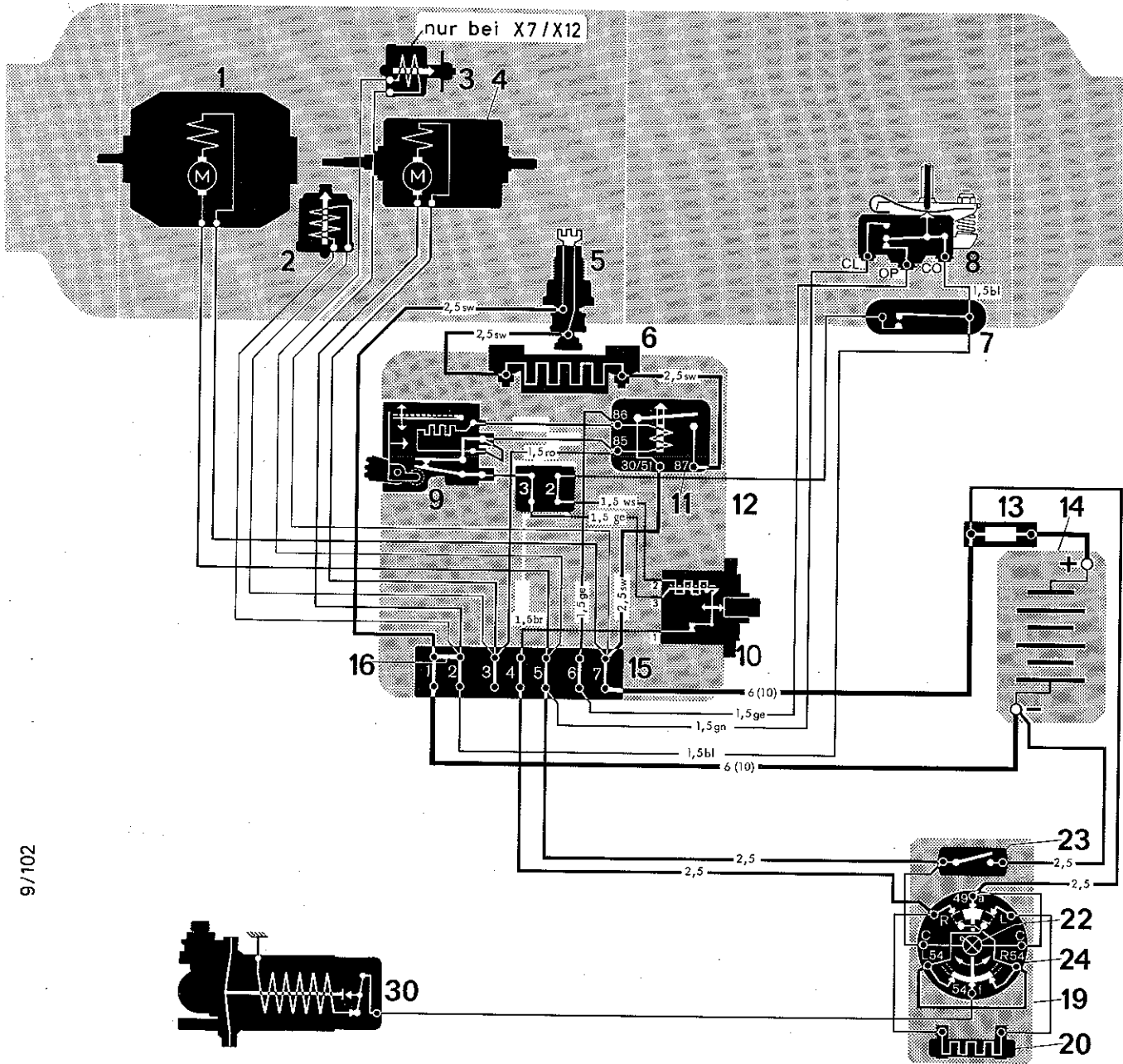
Additional items to standard equipment:

- | | | |
|--------------------------------|--------------------------------|--------------------------------|
| 18 Operation instruction panel | 31 Battery main switch | 34 Diode for recycling control |
| 29 Room thermostat | 32 Exhaust blower | 35,36 Relay for exhaust blower |
| 30 Electric fuel pump | 33 Relay for recycling control | |

Wiring diagram with additional electric fuel pump

If it is required to connect an additional electric fuel pump to a heater which is NOT controlled by a room thermostat, use the accessory kit "fuel supply unit" consisting of pump and two-circuit blinker-switch. The latter

one is required to feed full voltage to the pump even when operated on "HALF" position.



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Additional items to the standard equipment:

- 19 Operation instruction panel
- 24 Two-circuit blinker-switch
- 30 Electric fuel pump.

