Title: ELECTRICAL HEATING DEVICE FOR VEHICLES

Abstract: Electrical heating device for heating a liquid in a vehicle, consisting of a container (15) and a heating plate (24), where the container (15) is produced from a thermoplastic material such as PA66 and where the heating plate (24) contains a number of PTC elements which are connected to an electrical energy source. The container (15) is connected to the system for the liquid with connection nipples (16, 17) arranged on the intermediate sides (37, 40) of the container (15).
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Electrical heating device for vehicles

Field of invention.

The invention is related to an electrical heating device for the heating of a liquid in a vehicle, a special field of use is for heating a cooling liquid for a vehicle engine.

Earlier known technique.

It is commonly known, that when a vehicle is not driven, to use an electrical add on heater for the vehicle engine, so that the engine is easier to start in cool weather. Such heaters are connected to an electrical energy source external to the vehicle.

The publication US 4.770.134 is showing such a heater for the cooling liquid of an engine, where the heater is arranged in the hose system for the cooling liquid. The heater consists of a horizontal tube in which a heating element is located. The cooling liquid is taken in at one end of the tube and passes out at the other end of the tube.

The publication US 2006/0144376 is showing and describing a device for heating a flowing gas or liquid, for example at a crank case venting system for an engine. The device consists of a unit
arranged in the hose system for the crank case ventilation system. The unit has a recess, which is not in contact with the moving gas, in which there is arranged a heating element which consists of so called PTC element.

**Brief description of the invention.**

The purpose of the invention is to obtain a device for heating a liquid in a vehicle where the device is easy to manufacture, has small dimensions, has a low weight, has good efficiency and is easy to install in the vehicle.

The purpose of the invention is obtained by manufacturing units of the device of a thermoplastic material, that the heating of the liquid is obtained by PTC elements so that control equipment is not necessary and by that the heater is arranged in the hose or pipe system for the liquid.

**Brief description of drawings.**

With reference to the enclosed drawings there follows a detailed description of an embodiment of the invention as an example. On the drawings are shown by

- figure 1 a view of the heater mounted in a hose system,
- figure 2 a section along the line A-A in figure 1,
- figure 3 a section along the line B-B in figure 2 and
- figure 4 a perspective view of the heater when the three main units are separated.
Detailed description of a preferred embodiment.

The illustrated device on the drawings show a heater (10) which is mounted in a hose system (11) in a vehicle, for example in a hose system for the cooling liquid for a vehicle engine. The heater (10) can be fixed to the engine of the vehicle or a suitable part of the vehicle with fixing elements, which are arranged through holes (12) in the heater if a fixation of the heater (10) is necessary. The heater (10) is connected to an electrical energy source external to the vehicle by electrical conductors (13) arranged in a protective cover (14).

The heater (10) consists of a container (15) which has a first connection nipple (16) to which a part of the hose system (11) is connected for supply of liquid to be heated in the container (15). The container (15) has a second connection nipple (17) to which a part of the hose system (11) is connected to transport the heated liquid from the container (15). The hose system (11) is fixed to the first connection nipple (16) and the second connection nipple (17) with suitable hose clamps (18). The first connection nipple (16) and the second connection nipple (17) are arranged as far away from each other as possible so that the distance the liquid has to flow through the container is as long as possible.

To allow mounting of the heater (10) in the very often much limited spaces that are available in a modern vehicle the container (15) of the heater (10) has a mainly flat shape. By arranging the first connection nipple (16) and the second connection nipple (17) on the sides which are between the mainly flat sides of the container (15) the dimensions have been reduced maximally. In the shown preferred design the heater (10) has a width between the two mainly flat sides which is only somewhat larger than the outer dimension of the, to the heater (10), connected hoses.
The container (15) has on one side a connection flange (19) to which a cover (20) is fixed. The cover (20) has a connection (21) for the protective cover (14) which surrounds the electrical conductors (13). The cover (20) is fixed to the connection flange (19) on the container (15) with suitable fixing elements (22) such, as for example, screws.

The electrical conductors (13) are connected to a number of heating elements (23) located in a heating plate (24), so designed that the heating elements (23) will not be in direct contact with the liquid in the container (15). The heating elements (23) consist of so called PTC elements which have been positioned next to each other to achieve good heat transfer to the heating plate (24) as well as to give the heating plate (24) a desired flat shape. PTC elements transmit an amount of energy which is depending on the temperature and the elements do not transmit any energy at a temperature over a selected predetermined temperature. Heating element (23) consisting of PTC elements can therefore be used without any control equipment. The design of PTC elements and their connection to electrical conductors is a known technique and will therefore not be explained here.

The heating plate (24) for the heating elements (23) is designed as a mainly rectangular plate with a first flat side (25) and a second flat side (26) as well as four intermediate sides, a first long side (27) and a second long side (28) as well as a first short side (29) and a second short side (30). At the first short side (29) a flange (31) is arranged. The flange (31) is surrounded by a washer (32). The heating plate (24) has at that side which is surrounded by the flange (31), a recess (33) so that the heating elements (23) can be placed in the heating plate (24).

The heating plate (24) is positioned in the inner space of the container (15) which is accessible by an opening (34) arranged on that side of the container (15) where the connection flange (19) is situated. The flange (31) of the heating plate (24) with the washer (32) is designed to connect to the connection flange (19) of the container (15).
The inner space of the container (15) is customized so that the distance between the outer surfaces of the heating plate (24) and the internal surfaces of the container (15) are at a predetermined distance from each other. The container (15) therefore also has the shape of a mainly rectangular plate with a first flat side (35) and a second flat side (36) as well as four intermediate sides, a first long side (37) and a second long side (38) as well as a first short side (39) and a second short side (40). The connection flange (19) of the container (15) is arranged at the first short side (39).

In that embodiment shown in figure 1 the container (15) is placed so that the connection flange (19) is downwards and the first connection nipple (16) for the intake of the liquid is positioned near to the connection flange (19). The second connection nipple (17) for the exit of the liquid from the container (15) is positioned on the second short side (40) of the container (15), which is facing away from the connection flange (19) With that design a good self-circulation of the liquid in the system is obtained. To achieve best possible flow arrangement for the liquid in the container (15) the first connection nipple (16) is positioned so that the liquid is flowing in towards one of the four intermediate sides (27, 28, 29, 30) on the heating plate (24), preferably towards one of the long sides (27, 28), which has a small width. The stated position of the first connection nipple (16) and second connection nipple (17) causes the liquid to obtain the longest and best flow arrangement past the heating plate (24). That means that when the liquid is flowing past the heating plate (24) the energy uptake from the heating plate (24) is evenly distributed over the surface of the heating plate (24), which means that the temperature over the whole surface of the heating plate (24) will be substantially the same.

The container (15) is manufactured from a thermoplastic material such as, for example, PA66. Thermoplastic materials lose their ability to maintain their shape and their strength at a relatively slight increase of the temperature, therefore it is of importance that the temperature of the liquid in the container (15) at any location does not exceed the temperature at which the chosen thermoplastic material’s dimensional stability and strength decrease below a predetermined value. If the container (15) for any reason is not full of the liquid it is of importance that the
container is so designed that the heat radiation from the heating plate (24) does not cause the temperature of the thermoplastic material in the container (15) to reach that temperature when the thermoplastic material loses the necessary dimensional stability and strength.

The use of a thermoplastic material in the parts of the heater, such as the container (15) and cover (20), leads to a weight reduction of the heater (10) of approximately 30% in relation to a similar heater of metal.

The liquids which are used for heating a unit such as the engine of a vehicle are normally based on water therefore the working temperature for a heater normally will not exceed 80° C when the heater is in operation. When the engine is running the liquid will reach a temperature of approximately 100° C. Thermoplastic material such as PA66 can under short periods cope with temperatures up to approximately 200° C therefore it is of importance that the container (15) is designed so that the liquid which passes through the container (15) does not at any location reach a temperature above that value where the material loses its dimensional stability and strength. With heating elements (23) which together produce 600W the temperature of the liquid which leaves the container (15) will reach approximately 80° C if the temperature of the entering liquid is approximately 20° C. With heating elements of 600W an increase of the temperature of approximately 60° C is achieved. If the liquid in the container (15) does not circulate, or if the container (15) is not fully filled with liquid, an increase of the temperature will occur.

The distance between the internal surfaces of the container (15) and the external surfaces of the heating plate (24) are arranged so that an even flow of the liquid through the container (15) is obtained and in a situation when the container (15) is not fully filled with liquid the heat transfer from the heating plate (24) to the container (15) does not create a temperature in the thermoplastic material in the container (15) at which the thermoplastic material loses its dimension stability and its strength. That is achieved when the distance between the inner surfaces of the container (15) and the outer surfaces of the heating plate (24) is more than 3mm.
In the description of the preferred embodiment has been stated an area of use for the heater (10) according to the invention, but the heater (10) can be used for heating liquids in a vehicle for other use than to heat the vehicle engine. The heater (10) can, for example, be used to heat a liquid which is heating a device in the vehicle which requires heating even when the vehicle is driven. For such a usage the energy to the heater, for example, can be taken from an energy source outside the vehicle when the vehicle is not driven and from the battery when the vehicle is driven.

The parts for the heater are simple to manufacture and the putting together is also very simple to carry out as the three main components, the container (15), the heating plate (24) for the heating elements (23) and the cover (20), are held together by four fixing elements (22).

Even if the invention has been described with reference to one preferred embodiment, the device can be modified in many ways within the frame of the inventive idea as it is presented in the present patent claims.
Patent claims.

1. Electrical heating device for heating a liquid in a vehicle, consisting of a container (15) and a heating plate (24), where the liquid in the container (15) is flowing past the heating plate (24) and where the heating plate (24) is connected to an energy source via electrical connectors (13) characterized by that the heating plate (24) contains a number of PTC elements and that the container (15) is produced from a thermoplastic material.

2. Device according to claim 1 characterized by that the container (15) has two opposing mainly flat sides (35, 36) and four intermediate sides (37, 38, 39, 40), an opening (34) surrounded by a connection flange (19) is positioned at one of the intermediate sides.

3. Device according to claim 2 characterized by that a first connection nipple (16) is positioned on one of the intermediate sides (37, 38, 39, 40).

4. Device according to claim 3 characterized by that the first connection nipple (16) is arranged on one of the intermediate sides (37, 38) which starts from that side (39) where the opening (34) and connection flange (19) are positioned.

5. Device according to claim 4 characterized by that the first connection nipple (16) is positioned in the vicinity of the connection flange (19).

6. Device according to claim 2 characterized by that a second connection nipple (17) is positioned at that intermediate side (40) which is opposite to that intermediate side (39) where the opening (34) and connection flange (19) of the container (15) are positioned.
7. Device according to claim 1 characterized by that the heating plate (24) has two opposing mainly flat sides (25, 26) and four intermediate sides (27, 28, 29, 30), a recess (33) surrounded by a flange (31) is arranged at one of the intermediate sides (27, 28, 29, 30).

8. Device according to claim 7 characterized by that the flange (31) of the heating plate (24) is interacting with the connection flange (19) of the container (15) so that the opening (34) of the container (15) is closed.

9. Device according to claim 8 characterized by that the flange (31) of the heating plate (24) is held in position against the connection flange (19) on the container (15) by a cover (20) which is fixed to the connection flange (19) of the container (15) by fixing elements (22).

10. Device according to claim 1 characterized by that the distance between the internal surfaces of the container (15) and the outer surfaces of the heating plate (24) is more than 3 mm.

11. Device according to the claim 2 to 6 characterized by that the distance between the two mainly flat surfaces (35, 36) of the heater (10) correspond approximately to the outer diameter of the connected tubes or hoses (11).

12. Device according to claim 9 characterized by that the cover (20) has a connection (21) for interconnection with a protective cover (14) which surrounds the electrical connectors (13) that connects the heating plate (24) to an electrical energy source.
INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2010/000197

A. CLASSIFICATION OF SUBJECT MATTER
IPC: see extra sheet
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
IPC: F01M, F02N, H05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
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Form PCT/ISA/2 I/O (second sheet) (July 2009)
Continuation of: second sheet

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