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(72) Inventor: **FERLAY, Benjamin**
96476 Bad Rodach (DE)

(74) Representative: **Valeo Systèmes Thermiques**
Service Propriété Intellectuelle
ZA l'Agiot, 8 rue Louis Lormand
CS 80517
La Verrière
78322 Le Mesnil-Saint-Denis Cedex (FR)

(71) Applicant: **Valeo Klimasysteme GmbH**
96476 Bad Rodach (DE)

(54) **A TUBE FOR AN ELECTRIC HEATER**

(57) A tube 20 for an electric heater, comprising two side walls 24 connecting the large walls 21, and a heating element 50 located between the walls 21, 24, character-

ized in that the heating element 50 is suspended within and fixed with respect to the tube 20 by means of a filling component 60.

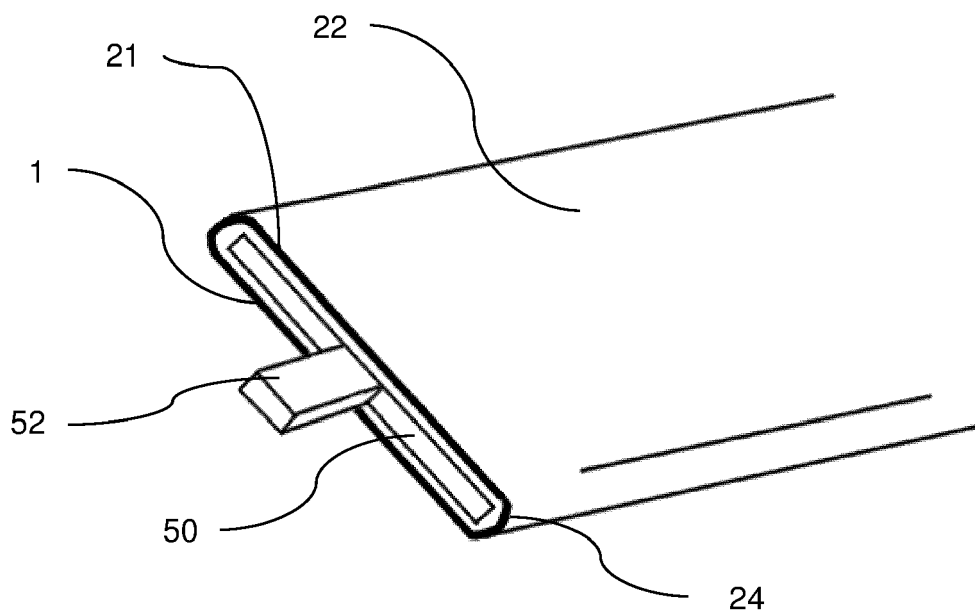


Fig. 2

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Description

FIELD OF THE INVENTION

[0001] The field of the present invention is that of devices for heating and circulating a fluid for vehicles. The invention applies more particularly to a tube for electric heating and/or air-conditioning devices for motor vehicles comprising such devices.

BACKGROUND OF THE INVENTION

[0002] It is known that the heating of the air intended for heating the passenger compartment of a motor vehicle, or for demisting or defrosting, is provided by the passage of a flow of air through a heat exchanger, more precisely by a heat exchange between this flow of air and a fluid circulating inside the exchanger. This may in particular be the cooling fluid in the case of a heat engine.

[0003] In the case of an electric vehicle, it is also known to use an air-conditioning loop operating in heat pump mode for air heating. However, this mode of air heating can also be unsuitable or insufficient.

[0004] This is because the performance of the air-conditioning circuit in heat pump mode depends on the outdoor climatic conditions. For example, when the outside air is too cold, the air cannot be heated to a temperature sufficient to warm the passenger compartment. In this context, it is known to add to the fluid circulation loops an additional electric device for thermal conditioning of the fluid such as an additional electric heating device. Such an additional electric heating device can be adapted to heat a suitable fluid upstream of the heat exchanger. In a known way, such an electric additional heating device comprises one or more thermal modules in contact with the fluid to be heated. More precisely, and as may be disclosed in particular in document WO15082434, a thermal module may comprise a core and a heating element surrounding the core, both being spaced apart in order to define a fluid circulation space between the core and the inner surface of the heating element. The heating element is a source of thermal energy. The heating element has electric heating means, e.g. one or more heating resistors serigraphically formed as serigraphic resistive tracks on the outer surface of the heating element. A fluid circulation in the circulation space between the core and the heating element ensures a heat transfer between the heating element and the fluid. In order to obtain sufficient heating power for the desired operation, it may be necessary to multiply the thermal modules in the same additional electric heating device.

[0005] Fluid circulation is facilitated by a pump, which is arranged upstream or downstream of the heat exchanger on a fluid circulation pipe.

[0006] The present invention relates to a tube for an electric heating block, such as a heating block for a motor vehicle. Electric heating block comprising tubes for receiving heating elements are known as electric heating

blocks. Such heating elements include, for example, PTC (positive temperature coefficient) resistors. Such heating blocks also include heat sinks, e.g. fins, in thermal contact with the heating elements. The tubes serve to electrically insulate the heating elements from the outside while allowing thermal conduction between the heating elements and the heat sinks.

[0007] One of the challenges of manufacturing the abovementioned tube is a correct placement of the heating element inside the tube. It may be problematic to arrange the heating element so that is correctly positioned and it remains electrically insulated from the metal material of the tube.

[0008] The object of the invention is to provide a tube for an electric heater, which would allow for facilitation of the manufacturing process.

SUMMARY OF THE INVENTION

[0009] The object of the invention is, among others, a tube for an electric heater, comprising two side walls connecting the large walls, and a heating element located between the walls, characterized in that the heating element is suspended within and fixed with respect to the tube by means of a filling component.

[0010] Preferably, the filling component fixes the heating element to the large walls.

[0011] Preferably, the filling component fixes the heating element to the side walls.

[0012] Preferably, the inner volume of the tube between the heating element and the large walls comprises a first section filled with the filling component and a second section not filled with the filling component.

[0013] Preferably, the inner volume of the tube between the heating element and the side walls comprises a first section filled with the filling component and a second section not filled with the filling component.

[0014] Preferably, the synthetic component fills the entirety of the tube's inner volume.

[0015] Preferably, the heating element extends outside the tube.

[0016] Preferably, the filling component is a resin.

[0017] Another object of the invention is an electric heater comprising a tube according to any preceding claim.

[0018] Another object of the invention is a process for manufacturing a tube for an electric heater, characterized in that it comprises steps of: providing a tube; arranging the tube so that one end of the tube is higher with respect to the ground than the other end; introducing heating components into the tube so that they are held distanced from the tube at any point; introducing synthetic material to the tube so that it fills the tube and surrounds the heating component.

[0019] Preferably, the process further comprises a step of curing the synthetic material so that it solidifies.

BRIEF DESCRIPTION OF DRAWINGS

[0020] Examples of the invention will be apparent from and described in detail with reference to the accompanying drawings, in which:

Fig. 1 shows an example of an electric heater;

Fig. 2 shows an electric heater tube according to the invention;

Fig. 3 shows a diagram of a process according to the invention.

DETAILED DESCRIPTION OF EMBODIMENTS

[0021] As illustrated in Figure 1, the invention relates to an electric heating block 1. The said heating block 1 is intended to be supplied with electric current to heat a fluid passing through the said block 1.

[0022] The electric heating block 1 advantageously presents a substantially parallelepipedal configuration. It is intended to exchange heat with a fluid passing between an inlet 2, between and around tubes 20, and outlet 3.

[0023] The heating block 1 comprises at least one channel, through which a fluid, in particular coolant, is to flow, and at least one tube 20 with one or more electric heating elements 50. The tubes 20 are mounted in headers 5 and 6, i.e. in the openings 11 of the headers 5, 6, which in turn are connected by a top plate 4. To the top plate 4 there are connected also the inlet 2 and the outlet 3 for the fluid. In particular, the top plate 4 comprises raised portions 4a and 4b, which are connected to each other by a connecting portion 4c. Since the raised portions 4a and 4b are located at a different distance from the tubes 20 than the connecting portion 4c, i.e. at the greater distance from the tubes 20, the fluid is enabled to flow more freely in the vicinity of the inlet 2 and the outlet 3, thereby facilitating its distribution between and around the tubes 20. The channel for the fluid is closed by two side plates and a bottom plate (not shown), so that the fluid path is limited and an efficient heat exchange with the tubes 20 can take place. Preferably, the side and bottom plates are connected directly to the headers 5, 6.

[0024] The heating block 1 here comprises several tubes 20 and, preferably, several fins alternately stacked in a stacking direction as shown in the figure (the fins are not shown). The tubes 20 are positioned parallel to each other. These tubes 20 are used to electrically insulate and protect the heating element(s) 50 from the outside. The fins form heat sinks, which increase the heat exchange surface with the fluid. Heating elements 50 are, for example, PTC resistors (for positive temperature coefficient). Each tube 20 may have several heating elements, which may be arranged one after the other in a direction of the tube 20. The heating elements 50 are preferably distributed evenly along the tubes 20.

[0025] The tubes 20 together with the heating elements

50 form heating units. The heating units are preferably supplied with power selectively. This means that the heating elements 50 of each heating unit are supplied with current independently of the heating elements 50 of the other heating units and can therefore be supplied with a different current, in particular in terms of its intensity, from the current flowing through the other heating units.

[0026] The heating units also have electrodes 52 on both sides of the heating elements 50 for their power supply. The said heating units further comprise electrically insulating and thermally conductive material, the said layers being located between one of the electrodes 52 and a large wall 21 of the tube 20. In this way, the tube 20 is electrically insulated from the electrodes 52 and the heating elements 50 but thermally in contact with them.

[0027] Preferably, in each of the heating units, said heating elements 50 are electrically connected in parallel, in particular by means of the electrodes 52.

[0028] The fins are in thermal contact with the tubes 20. The said fins are positioned between the said tubes 20, in particular between the large walls 21 of the said tubes 20.

[0029] The tubes 20 have two side walls 24 connecting the large walls 21. The large walls 21 each have an external face 22 to which the fin 10 may be fixed and an internal face intended to come into thermal contact with the heating elements 50. Thermal contact involves heat exchange between the elements, even if the elements are not in direct physical contact with each other. The function of the large walls 21 is to transmit the heat generated by the electric heating elements 50 to the fins. The tube 20 can be made of any material suitable for use in an electric heating block 1. In particular, tube 20 is made of aluminium and/or aluminium alloy.

[0030] Advantageously, the inner faces of the side walls 24 of the tube 20 have a substantially vertical profile, if necessary slightly rounded.

[0031] Both the large walls 21 and the side walls 24 are made from the material of the tube 20. Even if several parts are defined, the tube is a single piece.

[0032] Fin is advantageously attached to one or both of the large walls 21 of tube 20 by brazing. This fin fixing technique has several advantages. First of all, brazing the fins to tube 20 improves the heat exchange between the heating elements 50 and the fins. In addition, once tube 20 has been brazed, the material of tube 20, for example aluminum, will be more malleable and more easily deformable than before the brazing step, even after it has cooled to room temperature. This reduces the elastic relaxation that the material may have after deformation. In addition, this state of material guarantees a tight contact between the tube 20 and the heating elements 50 and therefore a better heat exchange. Brazing also ensures a longer life for tube 20 as it will be less sensitive to temperature changes and relaxation during the life of heating block 1.

[0033] As stated above, a heating block 1 according

to the invention allows the use of fins less resistant and more thermally efficient than in a conventional heating block. Advantageously, the fins of the heating block 1 are flexible before assembly. They are in particular corrugated fins. Another advantage is that the fins may include louvers to promote heat exchange. Another option is to use turbulator plates instead of fins, with the same purpose.

[0034] Fig. 2 shows an electric heater tube according to the invention. The tube 20 comprises two side walls 24 which are connecting the large walls 21. A heating element 50 is located between the walls 21, 24. The heating element 50 is suspended within and fixed with respect to the tube 20 by means of a filling component 60. In other words, the heating element 50 is not in direct contact with the walls 21, 24 of the tube 20.

[0035] The filling component is preferably resin, for example epoxy resin. Once it is introduced into the volume of the tube 20, it may be cured so that it solidifies.

[0036] The filling component 60 fixes the heating element 50 to the large walls 21.

[0037] Preferably, the filling component 60 fixes the heating element 50 to the side walls 24.

[0038] In one embodiment, the filling component 60 fills the entire volume of the tube 20 remaining after insertion of the heating element 50. In such case, the filling component 60 fixes the heating element to all the walls 21, 24 of the tube 20.

[0039] In another embodiment, the inner volume of the tube 20 between the heating element 50 and the large walls 21 comprises a first section filled with the filling component 60 and a second section not filled with the filling component.

[0040] Alternatively or additionally, the inner volume of the tube 20 between the heating element 50 and the side walls 24 comprises a first section filled with the filling component 60 and a second section not filled with the filling component.

[0041] In case, the filling component 60 may be selectively introduced into the tube 20 and not fill the whole volume. This may allow to more selectively transfer heat within tube 20 and/or save the material.

[0042] As seen in Fig. 2, the heating element 50 may extend outside the tube 20. It may however also be contained completely within the volume of the tube 20 defined between its walls 21, 24.

[0043] Fig. 3 shows a diagram of a process for manufacturing a tube 20 for an electric heater. It comprises a step of providing 101 a tube 20, e.g. a tube 20 with two side walls 24 connecting the large walls 21. Next, in step 102 the tube 20 is arranged so that one of its ends is higher with respect to the ground than the other end. For example, the tube 20 may be arranged vertically. In this way, the filling component 60 may be injected to the tube 20 and propagate inside thanks to gravity. In next step 103, heating components 50 is introduced into the tube 20 so that they are held distanced from the tube 20 at any point. In the next step 104, the filling component 60

is introduced to the tube 20 so that it fills the tube 20 and surrounds the heating component at selected sections, or it fills the entire volume. Subsequently, the filling component 60 can be cured so that it solidifies, e.g. in case of liquid resin acting as the filling component 60.

[0044] Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of drawings, the disclosure, and the appended claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to the advantage.

Claims

1. A tube 20 for an electric heater, comprising two side walls 24 connecting the large walls 21, and a heating element 50 located between the walls 21, 24, **characterized in that** the heating element 50 is suspended within and fixed with respect to the tube 20 by means of a filling component 60.
2. A tube 20 according to any preceding claim, wherein the filling component 60 fixes the heating element 50 to the large walls 21.
3. A tube 20 according to any preceding claim, wherein the filling component 60 fixes the heating element 50 to the side walls 24.
4. A tube 20 according to any preceding claim, wherein the inner volume of the tube 20 between the heating element 50 and the large walls 21 comprises a first section filled with the filling component 60 and a second section not filled with the filling component.
5. A tube 20 according to any preceding claim, wherein the inner volume of the tube 20 between the heating element 50 and the side walls 24 comprises a first section filled with the filling component 60 and a second section not filled with the filling component.
6. A tube 20 according to any of claims 1-3, wherein the synthetic component 60 fills the entirety of the tube's 20 inner volume.
7. A tube 20 according to any preceding claim, wherein the heating element 50 extends outside the tube 20.
8. A tube 20 according to any preceding claim, wherein the filling component 60 is a resin.
9. An electric heater comprising a tube 20 according to any preceding claim.
10. A process for manufacturing a tube for an electric

heater, **characterized in that** it comprises steps of:

- providing 101 a tube 20;
- arranging 102 the tube 20 so that one end of the tube 20 is higher with respect to the ground than the other end;
- introducing 103 heating components into the tube so that they are held distanced from the tube 20 at any point;
- introducing 104 synthetic material to the tube 20 so that it fills the tube 20 and surrounds the heating component.

11. A process according to claim 10, **characterized in that** it further comprises a step of curing 105 the synthetic material so that it solidifies.

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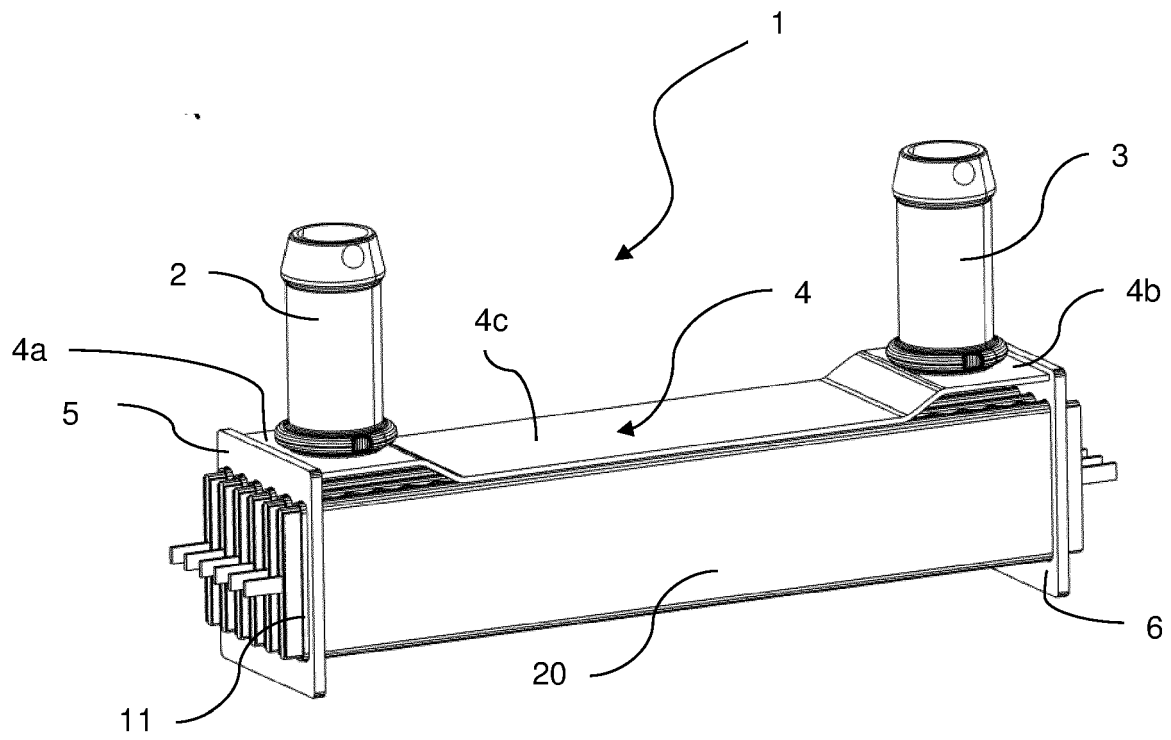


Fig. 1

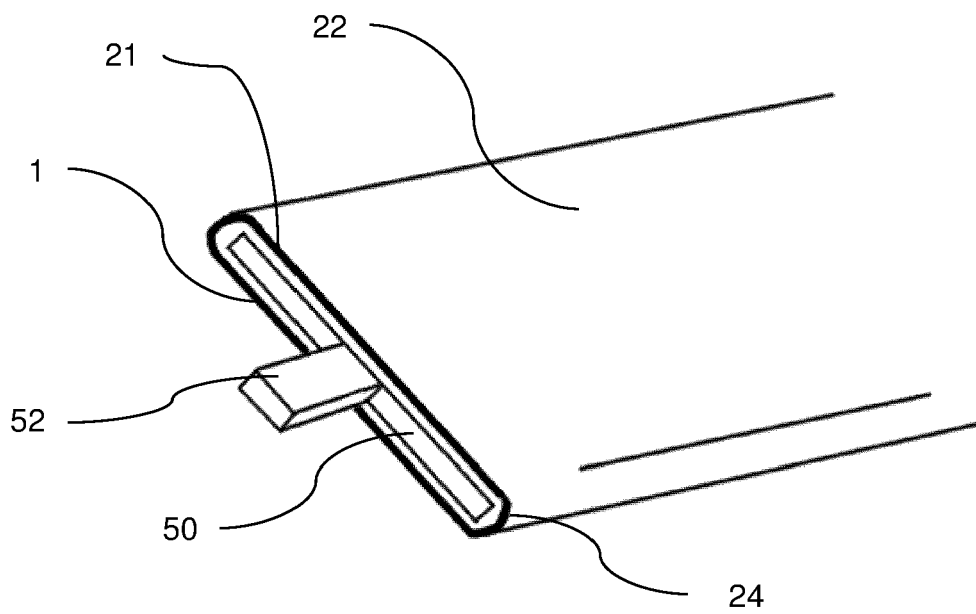


Fig. 2

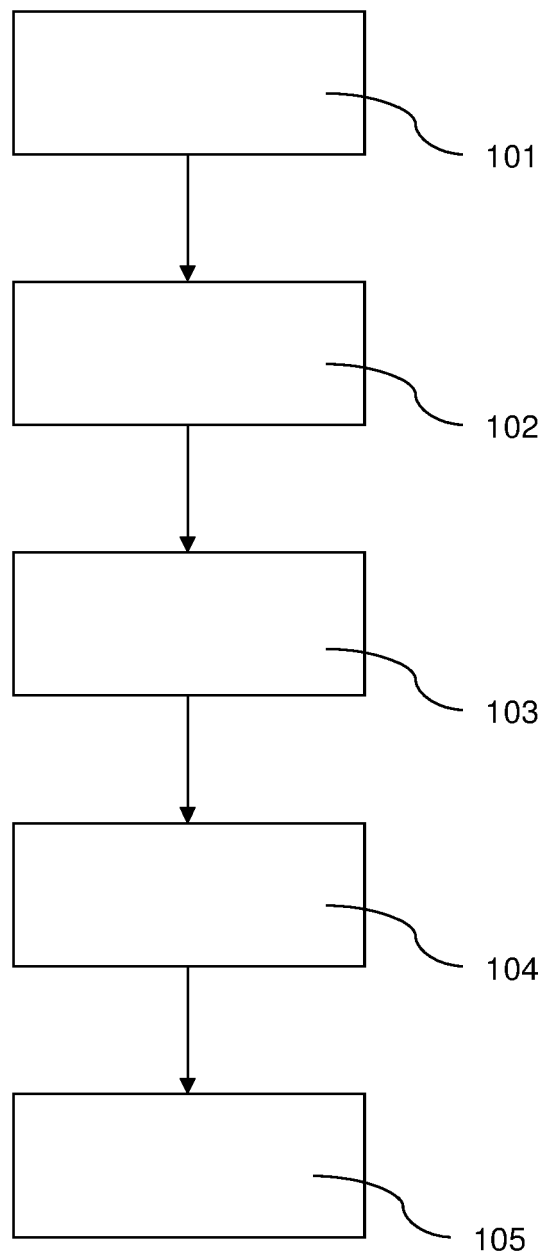


Fig. 3



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Application Number
EP 20 18 7808

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Place of search Munich		Date of completion of the search 15 December 2020	Examiner Garcia, Jesus
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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