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

(57) A tube 20 for an electric heater, comprising a heating component 50 within, characterized in that the tube 20 is made of a single metal sheet which is bent around the heating component 50 so that it compresses the heating component 50, wherein the tube 20 comprises a side wall 24 comprising at least two layers 24a, 24b of the metal sheet joined together by brazing.

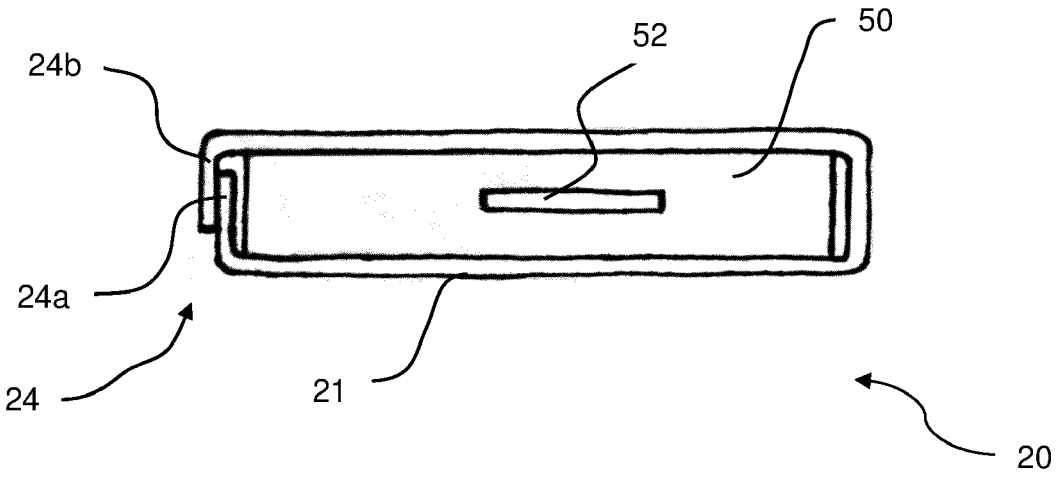

Fig. 2

EP 3 945 748 A1

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 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] Manufacturing of tubes with a heating component may be problematic in terms of cost and process.

[0008] It would be desirable to provide a tube for an electric heater and a method of manufacturing such a tube that would enable for more flexibility in terms of cost reduction and process selection.

SUMMARY OF THE INVENTION

[0009] The object of the invention is, among others, a tube for an electric heater, comprising a heating component within, characterized in that the tube is made of a single metal sheet which is bent around the heating component so that it compresses the heating component, wherein the tube comprises a side wall comprising at least two layers of the metal sheet joined together by brazing.

[0010] Preferably, the tube comprises two large walls and two side walls, wherein at least one large wall is bent towards the heating component.

[0011] Preferably, the bending point of the large wall is adjacent to the middle portion of the heating element.

[0012] Preferably, both large walls are bent towards the heating element.

[0013] Preferably, a first layer of the side wall is sandwiched with a second layer of the side wall.

[0014] Preferably, one of the layers is in contact with the heating element.

[0015] Alternatively, both layers are in contact with the heating element.

[0016] Alternatively, none of the layers is in contact with the heating element.

[0017] Preferably, the sandwiched section of layers constitutes at least a half of the side wall height.

[0018] Another object of the invention is a process for making a tube for an electric heater, comprising steps of:

- providing a heating element onto a surface of a metal sheet;
- bending the metal sheet so that the heating element is in contact with the metal sheet along at least two opposite sides thereof, which form larger walls of the tube, so that the larger walls compresses the heating element;
- bending two layers of the metal sheet so that they are sandwiched on a side forming one of the sidewalls of the tube;
- brazing together the layers of the side wall.

BRIEF DESCRITPTION OF DRAWINGS

[0019] Examples of the invention will be apparent from and described in detail with reference to the accompanying drawings, in which:

Fig. 1 shows an exemplary electric heater;

Fig. 2 shows a tube according to the invention;

Figs. 3a-3b present the tube in various stages of the manufacturing process;

Fig. 4 presents the process according to invention.

DETAILED DESCRIPTION OF EMBODIMENTS

[0020] 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.

[0021] 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.

[0022] 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, which in turn are connected by 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.

[0023] The heating block 1 here comprises several tubes 20 and, preferably, several fins alternately stacked in a vertical 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.

[0024] 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 layers, the said layers 54 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] Fig. 2 shows a tube according to the invention. 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 is 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. The tube 20 is made of a single metal sheet which is bent around the heating component 50 so that it compresses the heating component 50. The tube 20 comprises a side wall 24 comprising at least two layers 24a, 24b of the metal sheet joined together by brazing. The first layer 24a of the side wall 24 is sandwiched with the second layer 24b of the side wall 24. Preferably, the sandwiched section of layers 24a, 24b constitutes at least a half of the side wall 24 height.

[0032] At least one large wall 21 is bent towards the heating component 50. Preferably, the bending point of the large wall 21 is adjacent to the middle portion of the heating element 50. In one embodiment, both large walls 21 are bent towards the heating element 50.

[0033] In one option, one of the layers 24a, 24b is in contact with the heating element 50. In fact, both layers 24a, 24b are in contact with the heating element 50. Alternatively, none of the layers 24a, 24b is in contact with the heating element 50.

[0034] 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 aluminium, 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.

[0035] Figs. 3a-3b present the tube in various stages of the manufacturing process, while Fig. 4 presents the process according to invention. The process for making a tube for an electric heater comprises a step of providing 101 a heating element 50 onto a surface of a metal sheet as shown in Fig. 3a.

[0036] Subsequently, in step 102 the metal sheet is bent so that the heating element 50 is in contact with the metal sheet along at least two opposite sides thereof, which form larger walls 21 of the tube, so that the larger walls 21 compresses the heating element 50, as seen in Fig. 3b.

[0037] Next, in step 103 two layers 24a, 24b of the metal sheet are bent so that they are sandwiched on a side forming one of the sidewalls 24 of the tube 20. Next, in step 104 the layers 24a, 24b of the side wall 24 are brazed together.

[0038] 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 a heating component 50 within, **characterized in that** the tube 20 is made of a single metal sheet which is bent around the heating component 50 so that it compresses the heating component 50, wherein the tube 20 comprises a side wall 24 comprising at least two layers 24a, 24b of the metal sheet joined together by brazing.

2. A tube 20 according to preceding claim, wherein the tube 20 comprises two large walls 21 and two side walls 24, wherein at least one large wall 21 is bent towards the heating component 50.

3. A tube 20 according to claim 2, wherein the bending point of the large wall 21 is adjacent to the middle portion of the heating element 50.

4. A tube 20 according to claim 2 or 3, wherein both large walls 21 are bent towards the heating element 50.

5. A tube 20 according to any of the preceding claims, wherein a first layer 24a of the side wall 24 is sandwiched with a second layer 24b of the side wall 24.

6. A tube 20 according to claim 5, wherein one of the layers 24a, 24b is in contact with the heating element 50.

7. A tube 20 according to claim 5, wherein both layers 24a, 24b are in contact with the heating element 50.

8. A tube 20 according to claim 5, wherein none of the layers 24a, 24b is in contact with the heating element 50.

9. A tube 20 according to any of claims 5-8, wherein the sandwiched section of layers 24a, 24b constitutes at least a half of the side wall 24 height.

10. A process for making a tube for an electric heater, comprising steps of:

    - providing 101 a heating element 50 onto a surface of a metal sheet;
    - bending 102 the metal sheet so that the heating element 50 is in contact with the metal sheet along at least two opposite sides thereof, which form larger walls 21 of the tube, so that the larger walls 21 compresses the heating element 50;
    - bending 103 two layers 24a, 24b of the metal sheet so that they are sandwiched on a side forming one of the sidewalls 24 of the tube 20;
    - brazing 104 together the layers 24a, 24b of the side wall 24.

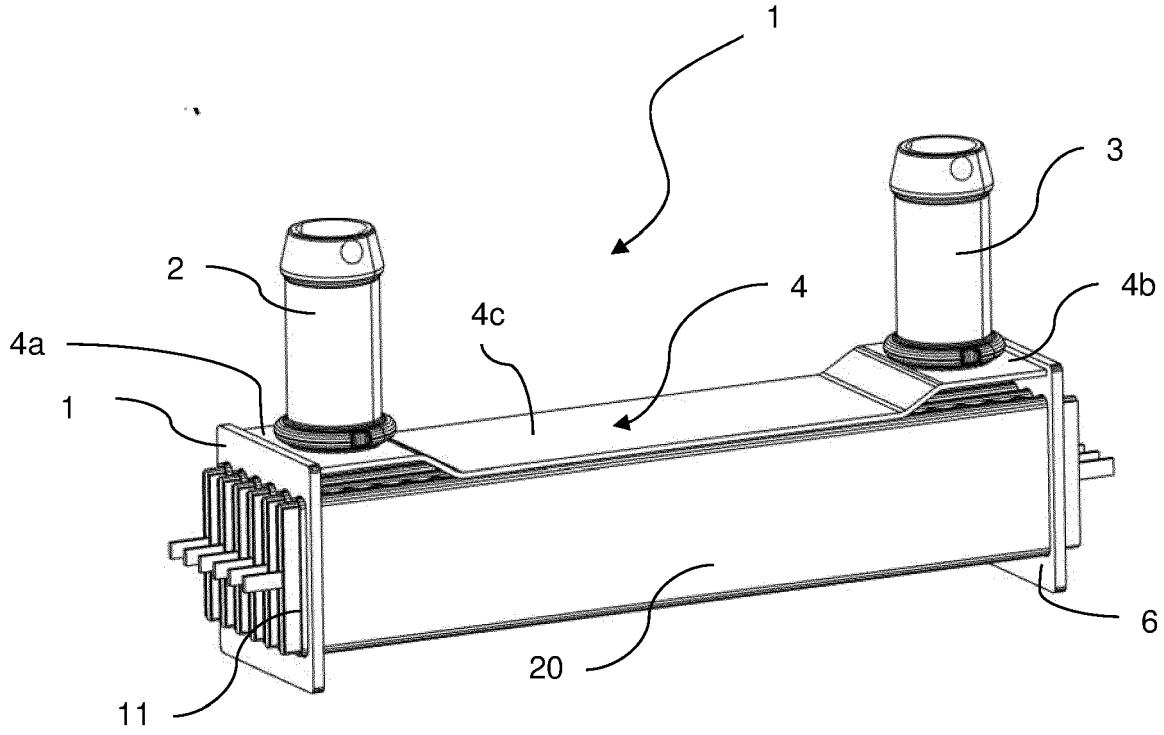

Fig. 1

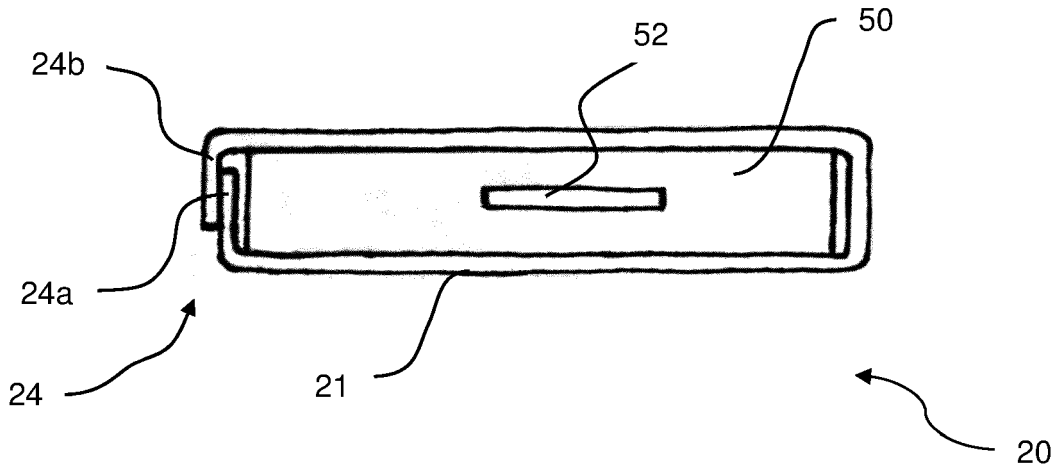

Fig. 2

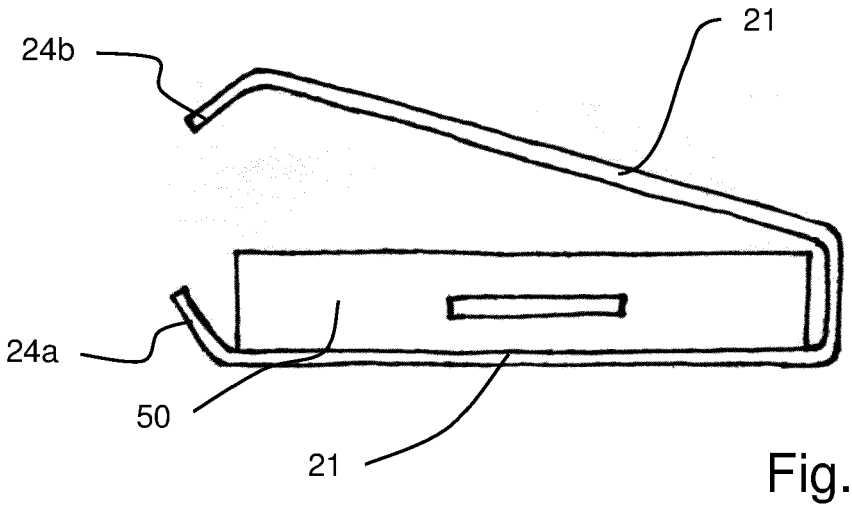

Fig. 3a

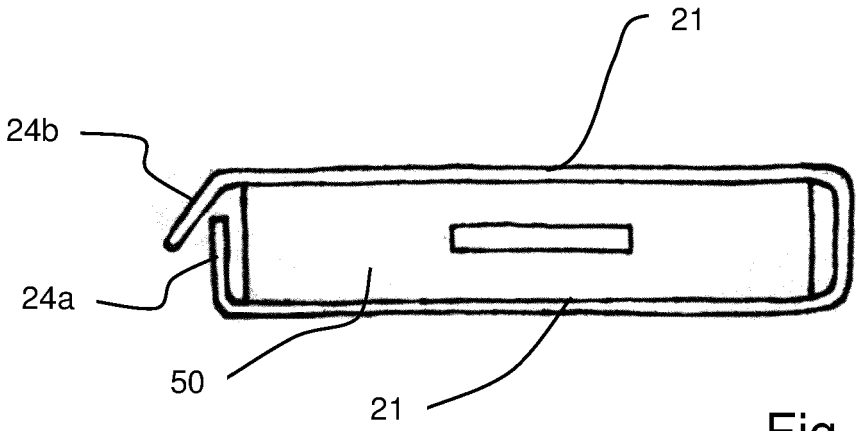

Fig. 3b

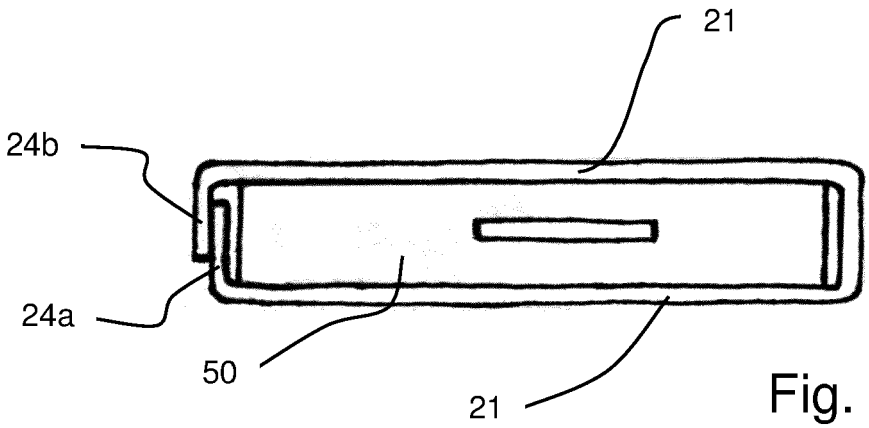

Fig. 3c

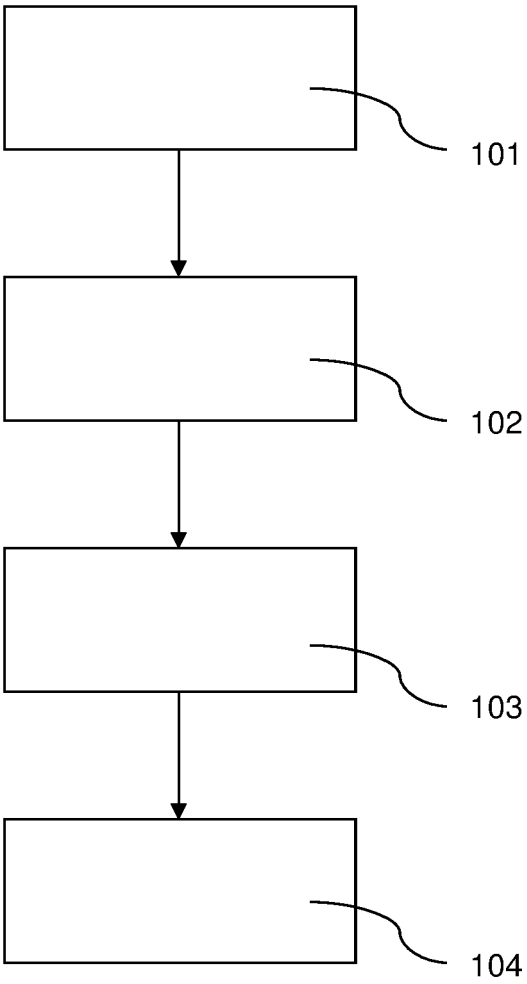

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 20 18 7807

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2012/061366 A1 (KOHL MICHAEL [DE] ET AL) 15 March 2012 (2012-03-15) * abstract; claim 1; figures 6-9 * * paragraph [0085] *	1-10	INV. H05B3/50 B60H1/00 B60H1/22
A	US 2020/033064 A1 (DZIUBINSCHI OREST ALEXANDRU [US] ET AL) 30 January 2020 (2020-01-30) * abstract; claim 1; figures 3-4 *	1	
A	DE 198 35 229 A1 (DENSO CORP [JP]) 11 February 1999 (1999-02-11) * abstract; claim 1; figures 1-6 *	1	
A	US 2007/169926 A1 (WATANABE HARUHIKO [JP] ET AL) 26 July 2007 (2007-07-26) * abstract; claim 1; figures 1-13 *	1	
A	EP 1 705 446 A1 (BEHR GMBH & CO KG [DE]) 27 September 2006 (2006-09-27) * abstract; claim 1; figures 1-16 *	1	

TECHNICAL FIELDS SEARCHED (IPC)

H05B
B60H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	11 December 2020	Garcia, Jesus

CATEGORY OF CITED DOCUMENTS

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11-12-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2012061366 A1	15-03-2012	CN 102434968 A	02-05-2012
		EP 2428746 A1	14-03-2012
		US 2012061366 A1	15-03-2012
US 2020033064 A1	30-01-2020	KR 20200011356 A	03-02-2020
		US 2020033064 A1	30-01-2020
		WO 2020022738 A1	30-01-2020
DE 19835229 A1	11-02-1999	DE 19835229 A1	11-02-1999
		JP 3794116 B2	05-07-2006
		JP H1148758 A	23-02-1999
		US 5995711 A	30-11-1999
US 2007169926 A1	26-07-2007	CN 101008558 A	01-08-2007
		JP 2007198623 A	09-08-2007
		US 2007169926 A1	26-07-2007
EP 1705446 A1	27-09-2006	DE 102005013777 A1	28-09-2006
		EP 1705446 A1	27-09-2006

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 15082434 A **[0004]**