(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 849 276 A1**

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
14.07.2021 Bulletin 2021/28

(21) Application number: **20150674.8**

(22) Date of filing: **08.01.2020**

(51) Int Cl.:
H05B 3/06 *(2006.01)* ***F24H 9/18*** *(2006.01)*
H05B 3/22 *(2006.01)* ***F24H 3/04*** *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
KH MA MD TN

(71) Applicant: **Mahle International GmbH**
70376 Stuttgart (DE)

(72) Inventors:
- **DAUDON, Guillaume**
  88470 La Bourgonce (FR)
- **MAGNIER, Gilles**
  90110 Rougemont-le-Chateau (FR)

(74) Representative: **BRP Renaud & Partner mbB**
Rechtsanwälte Patentanwälte
Steuerberater
Königstraße 28
70173 Stuttgart (DE)

(54) PTC HEATER

(57) The invention relates to PTC heater (1) comprising a plurality of PTC thermistors (2) and comprising two electrically conductive contact plates (3a, 3b). The respective PTC thermistor (2) is plate-like and has two large surfaces (4a, 4b), which are located opposite one another in the height direction (HR). The PTC thermistors (2) are arranged in the height direction (HR) between the contact plates (3a, 3b) and are electrically contact-connected thereto at the large surfaces (4a, 4b). The PTC thermistors (2) are arranged next to one another and spaced apart from one another in the longitudinal direction (LR), so that the respective contact plate (3a, 3b) is divided into a plurality of contact areas (5a, 5b), which overlap with the PTC thermistors (2) in the height direction (HR), and into a plurality of transition areas (6a, 6b), which connect the contact areas (5a, 5b).

According to the invention, the respective transition areas (6a, 6b) of the respective contact plate (3a, 3b) in the width direction (BR) are several times smaller than the respective contact areas (5a, 5b) of the respective contact plate (3a, 3b) in the width direction (BR).

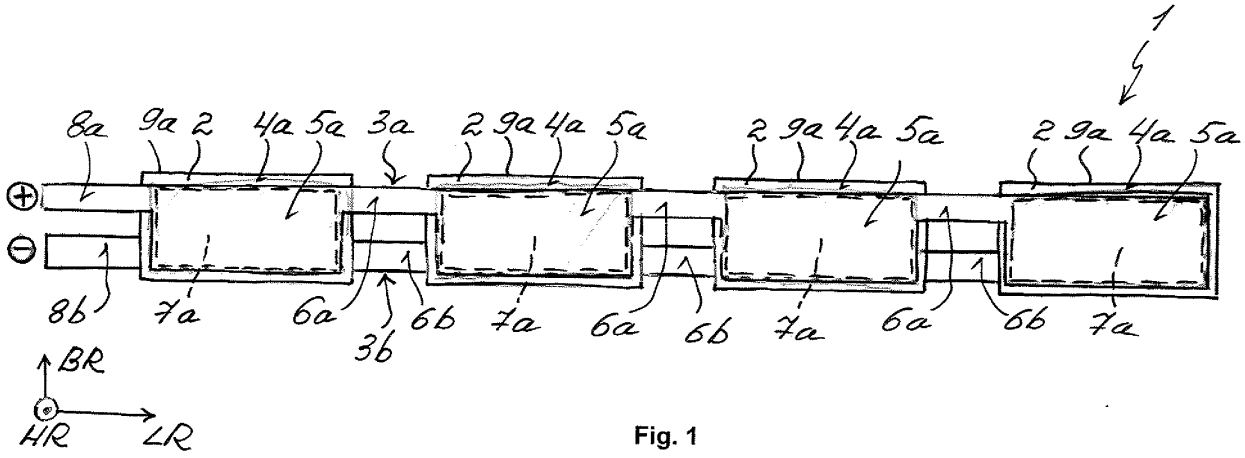

Fig. 1

EP 3 849 276 A1

Description

[0001] The invention relates to a PTC heater comprising a plurality of PTC thermistors according to the preamble of claim 1.

[0002] PTC heaters (PTC: Positive Temperature Coefficient) are already known, for example, from DE 10 2016 107 032 A1. A PTC heater usually has a plurality of PTC thermistors and two contact plates, between which the PTC thermistors are then arranged next to one another. Via the contact plates, voltage is applied to the PTC thermistors, whereby the latter develop heat. The PTC thermistors are usually cuboid-shaped and abut with their large surfaces on the two contact plates in an electrically conductive manner. The height of the PTC thermistors thereby specifies the creep distance between the two contact plates and is not to fall below a predetermined value for this reason. Disadvantageously, the efficiency of the PTC thermistors and thus of the PTC heater decreases with the height. PTC thermistors with the height of approx. 2 mm are currently used, and the efficiency of the PTC thermistors and of the PTC heater is thus reduced to approx. 70%. As the height of the PTC thermistors increases, so does the parasitic capacitance in the PTC heater. An electromagnetic coupling can further be created in the PTC thermistors. If, for example, two PTC thermistors are arranged symmetrically to one another, an inductive and a capacitive connection can establish between them. The signals in these PTC thermistors can thus influence one another, which is known as diaphony effect.

[0003] It is thus the object of the invention to specify an improved or at least alternative embodiment for a PTC heater of the generic type, in the case of which the described disadvantages are overcome.

[0004] This object is solved according to the invention by means of the subject matter of independent claim 1. Advantageous embodiments are subject matter of the dependent claims.

[0005] A PTC heater has a plurality of PTC thermistors and two electrically conductive contact plates. The respective PTC thermistor is plate-like and has two large surfaces, which are located opposite one another in the height direction. The PTC thermistors are arranged in the height direction between the contact plates and are electrically contact-connected thereto at the large surfaces. The PTC thermistors are thereby arranged next to one another and spaced apart from one another in the longitudinal direction, so that the respective contact plate is divided into a plurality of contact areas, which overlap with the PTC thermistors in the height direction, and into a plurality of transition areas, which connect the contact areas. In other words, the contact areas of the respective contact plates and the large surfaces of the respective PTC thermistors are arranged so as to overlap in the height direction, and the transition areas of the respective contact plates and the large surfaces of the respective PTC thermistors are arranged so as not to overlap in the height direction. According to the invention, the respective overlap areas of the respective contact plate in the width direction are several times smaller than the respective contact areas of the respective contact plate in the width direction.

[0006] The respective PTC thermistor is plate-like and preferably cuboid-shaped. In connection with the present invention, the term "plate-like" means that the dimensions of the respective PTC thermistor in the height direction are several times smaller than in the width direction and in the longitudinal direction. The height direction, the longitudinal direction, and the width direction are thereby aligned perpendicular to one another. Here and below, the terms "width" or "height" or "length" of an element in the PTC heater in each case refer to the dimensions of this element in the width direction or in the height direction or in the longitudinal direction. The term "several times smaller" means that the width of the respective transition area is at least two times smaller than the width of the respective contact area. Due to the fact that the individual PTC thermistors are connected to one another over the transition areas of the contact plates, and the width of the transition areas is small, the negative effect of the PTC thermistors on one another can be reduced.

[0007] It can advantageously be provided that the surface of the respective contact area is smaller than the large surface of the respective PTC thermistor. The respective contact area thereby protrudes circumferentially to the inside from an edge of the large surface of the respective PTC thermistor. In the case of a consistent height of the PTC thermistors, the creep distance between the two contact plates is thus increased. The height of the PTC thermistors can thus be selected independently of the specified creep distance, and the efficiency of the PTC heater can thus be increased. It goes without saying that the surface of the respective contact area and the respective large surface are to be determined transversely to the height direction. If the surface of the respective contact area and the respective large surface are rectangular, they are determined by the respective width and the respective length.

[0008] It can advantageously be provided that the height of the respective PTC thermistor is between 1.1 mm und 1.8 mm. The respective PTC thermistor has thus a lesser height than the conventional PTC-Thermistor which has the height over 1.8 mm. Thereby, the efficiency of the PTC heater can be increased.

[0009] To be able to connect the respective contact plates to an external voltage source, a connecting area of the contact plate can connect integrally to a contact area, which is last in the longitudinal direction. The connecting area is thereby several times smaller in the width direction than this last contact area in the width direction. In other words, the connecting area has a width, which is several times smaller than the width of this last contact area. It is conceivable that the respective connecting area is embodied identical to one of the respective transition areas. In other words, the respective connecting area

can have the same length and the same width as one of the respective transition areas. It is further also conceivable that the connecting areas of the two contact plates are embodied on a longitudinal end of the PTC heater. It is also conceivable, however, that the connecting areas of the two contact plates are embodied on opposite longitudinal ends of the PTC heater.

[0010] It can advantageously be provided that, on width ends of the adjacent contact areas, the respective transition area connects integrally to them and thus connects the respective contact areas to one another in a bridge-like manner. If the respective adjacent contact areas are connected to one another in a bridge-like manner, they form a straight edge and a step-shaped edge at the respective contact plate, together with the respective transition area in the longitudinal direction. It can advantageously be provided that the transition areas of the two contact plates do not overlap one another in the height direction. The air gap between the two contact plates can thus be increased.

[0011] It can advantageously be provided that all contact areas of the respective contact plate are of identical width in the width direction. In the alternative or in addition, it can be provided that all transition areas of the respective contact plate are of identical width in the width direction. It can advantageously be provided that all contact areas and/or all transition areas of the respective contact plate are in each case embodied identical to one another. The two contact plates can advantageously be embodied identically and can be arranged so as to be rotated relative to one another by 180° in the longitudinal direction. The production of the contact plates and also the assembly thereof to the PTC thermistors can thus be simplified.

[0012] In the case of an advantageous further development of the PTC heater, it is provided that an electrically conductive coating is arranged between the respective contact area of the contact plate and the respective assigned large surface of the PTC thermistor. The electrically conductive coating then connects the large surface of the PTC thermistor and the contact area of the contact plate in an electrically conductive manner. The contact area of the contact plate can thereby abut completely on the coating. The surface of the coating and the surface of the respective contact area can advantageously be the same size.

[0013] The surface of the respective coating can advantageously be smaller than the large surface of the respective PTC thermistor. In addition, the respective coating can protrude circumferentially to the inside from an edge of the respective large surface of the PTC thermistor. In the case of a consistent height of the PTC thermistors, the creep distance between the coatings, which are located opposite one another, is thus increased. The height of the PTC thermistors can thus be selected independently of the specified creep distance, and the efficiency of the PTC heater can thus be increased. The creep distance between the two contact plates is further also increased due to the coating.

[0014] In summary, the height of the PTC thermistors in the PTC heater can be reduced. The material costs can thus be reduced and the efficiency of the PTC heater can advantageously also be increased. The negative effects of the PTC thermistors on one another and the parasitic capacitance in the PTC heater can further also be reduced.

[0015] Further important features and advantages of the invention follow from the subclaims, from the drawings, and from the corresponding figure description on the basis of the drawings.

[0016] It goes without saying that the above-mentioned features and the features, which will be described below, cannot only be used in the respective specified combination, but also in other combinations or alone, without leaving the scope of the present invention.

[0017] Preferred exemplary embodiments of the invention are illustrated in the drawings and will be described in more detail in the description below, whereby identical reference numerals refer to identical or similar or functionally identical components.

[0018] In each case schematically,

Fig. 1 shows a top view onto a PTC heater according to the invention;

Fig. 2 shows a layered sectional view of a portion of the PTC heater shown in Fig. 1;

Fig. 3 shows a sectional view of a portion of the PTC heater shown in Fig. 1;

Fig. 4 shows a view of a PTC thermistor of the PTC heater shown in Fig. 1.

[0019] Fig. 1 shows a top view onto a PTC heater 1 according to the invention. A layered sectional view of a portion of the PTC heater 1 is shown in Fig. 2. Fig. 3 furthermore shows a sectional view of the portion of the PTC heater 1 shown in Fig. 2. With reference to Fig. 1, Fig. 2, and Fig. 3, the PTC heater 1 has a plurality of PTC thermistors 2 and two contact plates 3a and 3b. The respective PTC thermistor 2 is cuboid-shaped and extends in the height direction HR, the longitudinal direction LR, and in the width direction BR. The respective PTC thermistor 2 thereby has two large surfaces 4a and 4b, which are located opposite one another in the height direction HR. The individual PTC thermistors 2 are arranged spaced apart next to one another in the longitudinal direction LR and between the contact plates 3a and 3b in the height direction HR. As can in particular be seen in Fig. 2 and Fig. 3, the respective contact plate 3a or 3b, respectively, is electrically contact-connected to the respective PTC thermistor 2 on its large surface 4a or 4b, respectively, via a coating 7a or 7b, respectively. Fig. 4 shows the PTC thermistor 2 with the coating 7a, which is applied to the large surface 4a. In Fig. 1, the PTC heater

1 is shown facing the contact plate 3a, and the coating 7a, which is located below the contact plate 3a, is suggested by means of broken lines.

[0020] The respective contact plate 3a or 3b, respectively, is divided into contact areas 5a or 5b, respectively, and into transition areas 6a or 6b, respectively. The respective contact plate 3a or 3b, respectively, and the large surface 4a or 4b, respectively, of the respective PTC thermistor 2 overlap one another in the respective contact area 5a or 5b, respectively, in the height direction HR. The respective transition areas 6a or 6b, respectively, connect the individual contact areas 5a or 5b, respectively, to one another in a bridge-like manner. The respective contact plate 3a or 3b, respectively, and the large surface 4a or 4b, respectively, of the respective PTC thermistor 2 do not overlap one another in the respective transition area 6a or 6b, respectively, in the height direction HR. In the contact areas 5a or 5b, respectively, the contact plate 3a or 3b, respectively, abuts on the respective coating 7a or 7b, respectively, and is thus connected to the PTC thermistor 2 in an electrically conductive manner. According to the invention, the width of the respective transition areas 6a or 6b, respectively, is several times smaller than the width of the respective contact areas 5a or 5b, respectively. With reference to Fig. 1, a connecting area 8a or 8b, respectively, is embodied on the respective contact plate 3a or 3b, respectively. The shape of the connecting area 8a or 8b, respectively, thereby corresponds to the respective transition area 6a or 6b, respectively. The PTC heater 1 can be connected to an external voltage source via the connecting areas 8a and 8b, and the PTC thermistors 2 can be supplied with voltage.

[0021] As can in particular be seen in Fig. 3 and Fig. 4, the surface of the respective coating 7a or 7b, respectively, is smaller than the large surface 4a or 4b, respectively, of the respective PTC thermistor 2. The coating 7a or 7b, respectively, thereby protrudes to the inside from an edge 9a or 9b, respectively, of the large surface 4a or 4b, respectively. As can in particular be seen in Fig. 2 and Fig. 3, the surface of the respective contact area 5a or 5b, respectively, is also smaller than the large surface 4a or 4b, respectively, of the respective PTC thermistor 2. The contact area 5a or 5b, respectively, thereby protrudes to the inside from the edge 9a or 9b, respectively, of the large surface 4a or 4b, respectively. The respective contact area 5a or 5b, respectively, thereby advantageously follows the respectively assigned coating 7a or 7b, respectively. In this exemplary embodiment, the surface of the respective contact area 5a or 5b, respectively, corresponds to the surface of the assigned coating 7a or 7b, respectively. It is conceivable, however, that the two surfaces differ from one another. As can in particular be seen in Fig. 1 and Fig. 2, the transition areas 6a and the transition areas 6b do not overlap one another in the height direction HR. As is identified in Fig. 3, the creep distance KS_B between the two coatings 7a and 7b is thus increased in the PTC heater 1 and can be varied independently of the height of the PTC thermistor 2. The creep distance KS_K between the contact plates 3a and 3b is also increased.

[0022] The two contact plates 3a and 3b are made of a single piece and are made of an electrically conductive material, such as, for example, metal. The PTC thermistors 2 can be made, for example, of a PTC ceramic. Advantageously, the coating 7a and 7b is electrically conductive. The contact areas 5a and 5b as well as the transition areas 6a and 6b are in each case embodied identical to one another. The connecting areas 8a and 8b are also identical to one another. The two contact plates 3a and 3b are further embodied identical to one another and are arranged on the PTC thermistors 2 so as to be rotated relative to one another by 180° about the longitudinal direction LR.

[0023] In summary, the creep distance KS_K between the contact plates 3a and 3b is increased in the PTC heater 1, and the height of the PTC thermistors 2 can be reduced. Advantageously, the height of the respective PTC thermistor can be between 1.1 mm und 1.8 mm and lesser than the height of the conventional PTC-Thermistor, which has the height over 1.8 mm. The material costs in the PTC heater 1 can thus be reduced and the efficiency of the PTC heater 1 can also be increased. The negative effect of the PTC thermistors 2 on one another can further also be reduced.

Claims

1. A PTC heater (1) comprising a plurality of PTC thermistors (2) and comprising two electrically conductive contact plates (3a, 3b),

- wherein the respective PTC thermistor (2) is plate-like and has two large surfaces (4a, 4b), which are located opposite one another in the height direction (HR),
- wherein the PTC thermistors (2) are arranged in the height direction (HR) between the contact plates (3a, 3b) and are electrically contact-connected thereto at the large surfaces (4a, 4b),
- wherein the PTC thermistors (2) are arranged next to one another and spaced apart from one another in the longitudinal direction (LR), so that the respective contact plate (3a, 3b) is divided into a plurality of contact areas (5a, 5b), which overlap with the PTC thermistors (2) in the height direction (HR), and into a plurality of transition areas (6a, 6b), which connect the contact areas (5a, 5b),

characterized in

that the respective transition areas (6a, 6b) of the respective contact plate (3a, 3b) in the width direction (BR) are several times smaller than the respective contact areas (5a, 5b) of the respective contact plate

(3a, 3b) in the width direction (BR).

2. The PTC heater according to claim 1, **characterized in**

- **that** the surface of the respective contact area (5a, 5b) is smaller than the large surface (4a, 4b) of the respective PTC thermistor (2), and
- **that** the respective contact area (5a, 5b) protrudes circumferentially to the inside from an edge (9a, 9b) of the large surface (4a, 4b) of the respective PTC thermistor (2).

3. The PTC heater according to claim 1 or 2, **characterized in**
that the transition areas (6a, 6b) of the two contact plates (3a, 3b) do not overlap one another in the height direction (HR).

4. The PTC heater according to one of claims 1 to 3, **characterized in**
that a connecting area (8a, 8b) of the contact plate (3a, 3b) connects integrally to a contact area (5a, 5b), which is last in the longitudinal direction (LR), with said connecting area being several times smaller in the width direction (BR) than this last contact area (5a, 5b) in the width direction (BR).

5. The PTC heater according to one of claims 1 to 4, **characterized in**
that, on width ends of the adjacent contact areas (5a, 5b), the respective transition area (6a, 6b) connects integrally to them and thus connects the respective contact areas (5a, 5b) to one another in a bridge-like manner.

6. The PTC heater according to one of claims 1 to 5, **characterized in**
that all contact areas (5a, 5b) of the respective contact plate (3a, 3b) are of identical width in the width direction (BR).

7. The PTC heater according to one of claims 1 to 6, **characterized in**
that all transition areas (6a, 6b) of the respective contact plate (3a, 3b) are of identical width in the width direction (BR).

8. The PTC heater according to one of claims 1 to 7, **characterized in**
that the two contact plates (3a, 3b) are embodied identically and are arranged so as to be rotated relative to one another by 180° in the longitudinal direction (LR).

9. The PTC heater according to one of claims 1 to 8, **characterized in**
that an electrically conductive coating (7a, 7b) is arranged between the respective contact area (5a, 5b) of the respective contact plate (3a, 3b) and the large surface (4a, 4b) of the respective PTC thermistor (2), which electrically conductive coating connects the contact plate (3a, 3b) in the respective contact area (5a, 5b) and the large surface (4a, 4b) of the respective PTC thermistor (2) in an electrically conductive manner.

10. The PTC heater according to claim 9, **characterized in**

- **that** the surface of the respective coating (7a, 7b) is smaller than the large surface (4a, 4b) of the respective PTC thermistor (2), and
- **that** the respective coating (7a, 7b) protrudes circumferentially to the inside from an edge (9a, 9b) of the large surface (4a, 4b) of the respective PTC thermistor (2).

11. The PTC heater according to claim 9 or 10, **characterized in**
that the surface of the coating (7a, 7b) and the surface of the respective contact area (5a, 5b) are of the same size.

12. The PTC heater according to one of claims 2 to 11, **characterized in**
that the height of the respective PTC thermistor (2) in the height direction (HR) is between 1.1 mm und 1.8 mm.

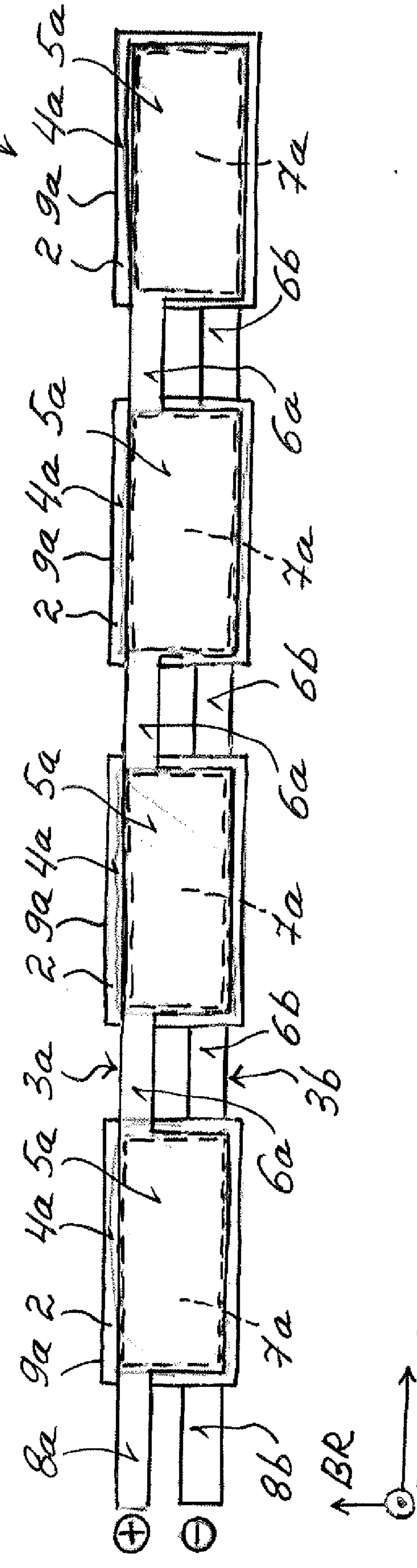

Fig. 1

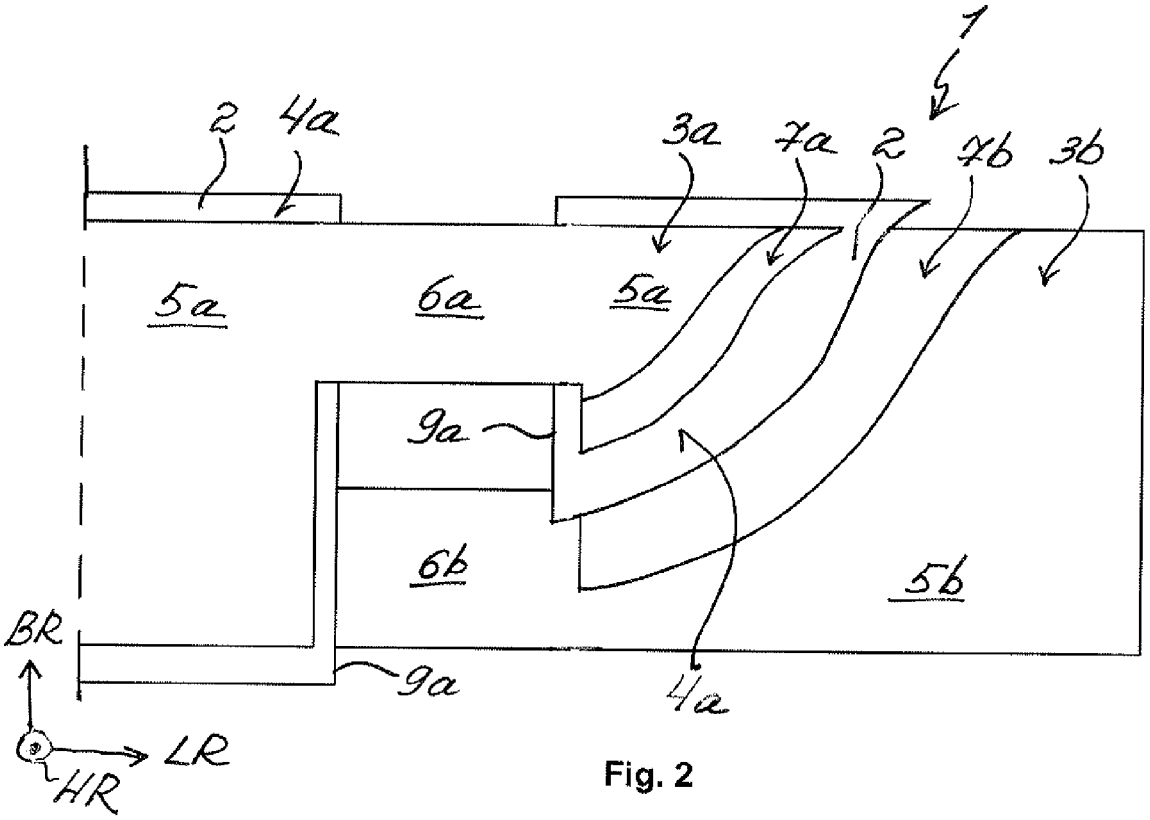

Fig. 2

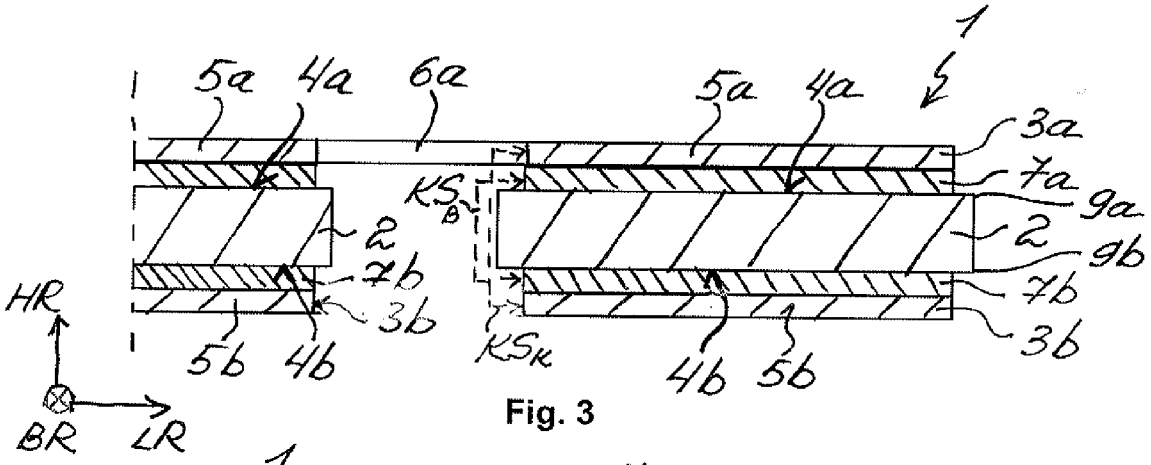

Fig. 3

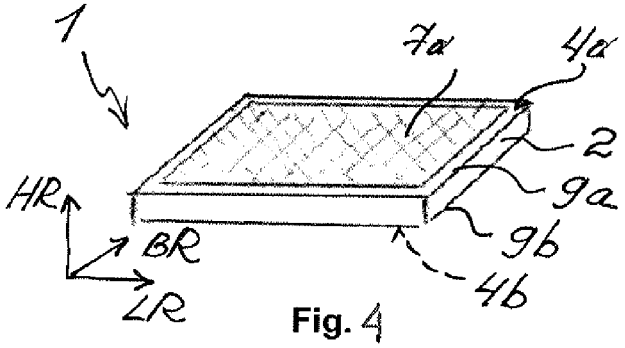

Fig. 4

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 20 15 0674

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 Y	US 2017/303339 A1 (MAHER ANTHONY [IE] ET AL) 19 October 2017 (2017-10-19) * paragraphs [0016], [0028], [0032]; figure 1 * -----	1,4-7,9, 11,12 2,3,8,10	INV. H05B3/06 F24H9/18 H05B3/22 F24H3/04
Y	FR 3 077 459 A1 (VALEO SYSTEMES THERMIQUES [FR]) 2 August 2019 (2019-08-02) * page 15, line 14 - line 15; figures 2,3,7 * -----	2,3,8,10	

TECHNICAL FIELDS SEARCHED (IPC)

H05B
F24H
H01C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	6 July 2020	Garcia Congosto, M

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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 15 0674

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

06-07-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2017303339 A1	19-10-2017	CN 107360638 A	17-11-2017
		DE 102016107043 A1	19-10-2017
		US 2017303339 A1	19-10-2017
FR 3077459 A1	02-08-2019	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- DE 102016107032 A1 **[0002]**