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(54) PTC HEATING ARRANGEMENT

(57) The invention relates to a PTC heating arrangement (1) comprising at least one PTC module (2). The at least one PTC module (2) has an elongated PTC heating element (3) and a rib structure (4) comprising a plurality of ribs (16), which is arranged on the PTC heating element (3) so as to transfer heat. The PTC heating element (3) thereby has a cuboid housing (5) and at least one PTC thermistor (9), which is arranged in the housing (5). The housing (5) has two opposite heat dissipating walls (6), which are connected to one another by means of two opposite side walls (7), and which extend in the longitudinal direction (8) of the PTC heating element (3). The at least one PTC thermistor (9) is secured in the housing (5) on the inner side on the heat dissipating walls (6) so as to transfer heat.

According to the invention, the PTC heating element (3) is arranged at least area by area in an accommodating space (12) of the rib structure (4) in its longitudinal direction (8). The rib structure (4) further surrounds the PTC heating element (3) in the area of the accommodating space (12) in the circumferential direction. The heat dissipating walls (6) and the side walls (7) of the housing (5) of the PTC heating element (3) are thereby secured on the outer side in the area of the accommodating space (12) on an inner surface (13) of the accommodating space (12) so as to transfer heat.

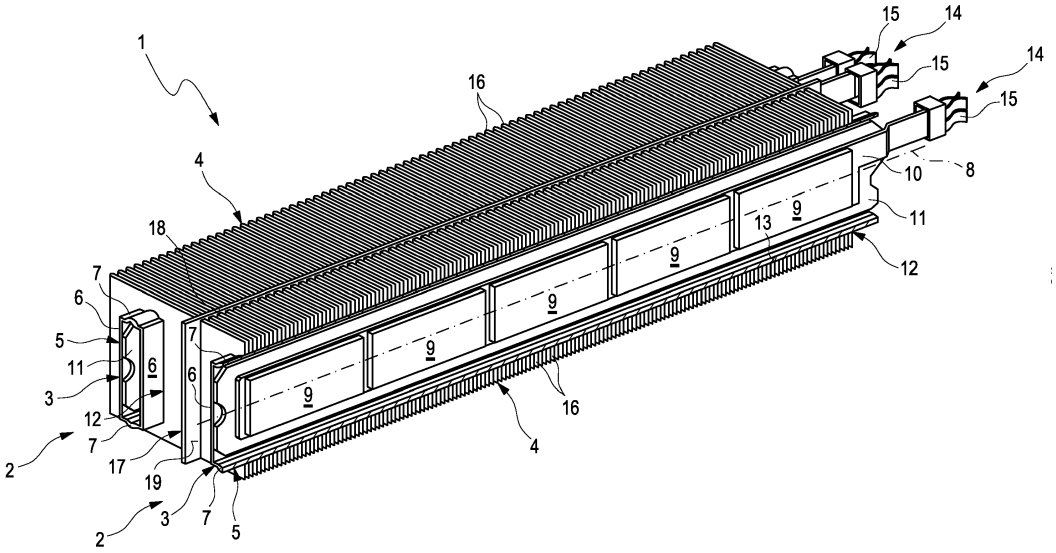

Fig. 1

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Description

[0001] The invention relates to a PTC heating arrangement comprising at least one PTC module according to the preamble of claim 1.

[0002] A PTC module (PTC: Positive Temperature Coefficient) typically has a plurality of thermistors of a ceramic PTC thermistor, which are arranged between two printed circuit boards in an electroconductive manner. The printed circuit boards and the thermistors are typically arranged in a metallic housing so as to transfer heat and are electrically insulated by it. If a voltage is applied to the thermistors, the Ohmic resistance of the PTC thermistors increases. The heat generated thereby in the thermistors is then dissipated to a surrounding fluid - such as air, for example - via the printed circuit boards and via the housing. To intensify the heat dissipation, a rib structure, which enlarges a heat-dissipating surface of the housing, is secured to the respective housing on both sides. The rib structure is typically metallic and is adhered to the metallic housing.

[0003] The quality of the housing and of the rib structure is significant for the heat-conducting contact in the PTC module. If the rib structure or the housing are deformed during the production or during use, the heat-conducting contact between the housing and the rib structure cannot be ensured. The heat output of the PTC module decreases accordingly.

[0004] It is thus the object of the invention to specify an improved or at least an alternative embodiment for a PTC heating arrangement of the generic type, in the case of which the described disadvantages are overcome.

[0005] According to the invention, this object is solved by means of the subject matter of independent claim 1. Advantageous embodiments are the subject matter of the dependent claims.

[0006] A generic PTC heating arrangement has at least one PTC module. The at least one PTC module thereby has an elongated PTC heating element and a rib structure comprising a plurality of ribs, which is arranged on the PTC heating element so as to transfer heat. The PTC heating element has a cuboid housing and at least one PTC thermistor, which is arranged in the housing. The housing thereby has two opposite heat dissipating walls, which are connected to one another by means of two opposite side walls, and which extend in the longitudinal direction of the PTC heating element. The at least one PTC thermistor is thereby secured in the housing on the inner side on the heat dissipating walls so as to transfer heat. According to the invention, the PTC heating element is arranged at least area by area in an accommodating space of the rib structure in its longitudinal direction, and the rib structure surrounds the PTC heating element in the area of the accommodating space in the circumferential direction. The heat dissipating walls and the side walls of the housing of the PTC heating element are further secured on the outer side in the area of the accommodating space on an inner surface of the accommodating space so as to transfer heat.

[0007] In the PTC heating arrangement according to the invention, the PTC heating element of the PTC module is surrounded by the rib structure in the area of the accommodating space, so that the heat-transferring contact between the rib structure and the PTC heating element can take place across a total outer surface of the housing - thus across the heat dissipating walls and across the side walls - in the area of the accommodating space. In particular, the heat dissipation between the PTC module and the surrounding fluid can thus be improved and the heat output of the PTC heating arrangement can thus be increased as well.

[0008] To improve the heat-transferring contact with the outer surface of the housing of the PTC heating element and the rib structure in the PTC module, provision can advantageously be made for the housing of the PTC heating element to be secured on the heat dissipating walls and/or on the side walls in the area of the accommodating space to the inner surface of the accommodating space by means of a substance-to-substance bond, preferably by means of adhesion. For this purpose, a heat-conductive adhesive can be used, for example, which supports a heat transfer between the housing of the PTC heating element and the rib structure in the respective PTC module. In the alternative or in addition, provision can be made for the housing of the PTC heating element to be mechanically clamped in the accommodating space of the rib structure. The PTC heating element can thereby in particular be secured in the rib structure in a secure manner and additional fastening or bracing means, respectively, can be avoided. A stable heat-transferring connection can further be attained between the rib structure and the PTC heating element, so that the production of the PTC heating arrangement can be simplified, and the quality can be improved.

[0009] Provision can advantageously be made for the accommodating space to penetrate the rib structure and for the PTC heating element to protrude from the accommodating space of the rib structure on both sides in the longitudinal direction. The PTC heating element in particular remains accessible from the outside on its longitudinal ends in this way, for example for maintenance or for electrically connecting to an external voltage source. Provision can advantageously be made for the at least one PTC thermistor of the PTC heating element to be capable of being electrically connected to the outside by means of a connection arrangement comprising contact elements. The contact elements of the connection arrangement can thereby protrude to the outside from the housing of the PTC heating element and from the accommodating space of the rib structure.

[0010] In an advantageous further development of the PTC heating arrangement according to the invention, provision can be made for the ribs of the rib structure to protrude perpendicularly to the outside from the heat dissipating walls and/or from the side walls of the housing of the heating element. Hollow spaces, which are direct-

ed perpendicular to the outside and which provide for an inflow and outflow of the surrounding fluid all the way to the housing of the PTC heating element, are created between the ribs of the rib structure in this way. The heat output between the respective PTC module and the surrounding fluid can be intensified in this way.

[0011] Provision can advantageously be made for the accommodating space to be arranged at right angles to the longitudinal direction of the PTC heating element in the middle of the rib structure, so that a length of the ribs, which protrude to the outside from the two heat dissipating walls, is identical and/or a length of the ribs, which protrude to the outside from the two side walls, is identical. The heat dissipation to each of the heat dissipating walls and/or to each of the side walls can be balanced in this advantageous way. The at least one PTC thermistor, which is secured in the respective PTC module, can in particular heat evenly or can cool evenly by means of the heat dissipation, respectively, and the heat output of the respective PTC module can thus be increased as well.

[0012] Provision can advantageously be made for the rib structure to be embodied in one piece. The rib structure can be formed by a shaped sheet metal part, which is made of a single piece of sheet metal by means of undulated or zig-zag-shaped forming. Due to its heat-conducting properties, the one-piece rib structure made of sheet metal provides for an even heat dissipation to the surrounding fluid and the heat output of the PTC heating arrangement can be increased.

[0013] At least two PTC modules can be stacked against one another in the PTC heating arrangement, wherein the rib structures of the respective PTC modules are secured to one another so as to transfer heat. Provision can additionally be made for the rib structures of the PTC modules, which are stacked against one another, to be connected via a support plate so as to transfer heat, wherein an outer surface of the respective rib structure, which corresponds to the heat dissipating wall, is secured to a connecting surface of the support plate so as to transfer heat. A heat-transferring layer - for example a heat-conducting film or a heat-conducting paste, can further be arranged at least area by area between the respective outer surface of the respective rib structure and the connecting surface of the support plate.

[0014] In summary, the PTC heating element of the PTC module is surrounded by the rib structure in the area of the accommodating space in the PTC heating arrangement according to the invention, wherein the heat dissipation between the PTC module and the surrounding fluid is improved and the heat output of the PTC heating arrangement can thus be increased as well.

[0015] Further important features and advantages of the invention follow from the subclaims, from the drawings, and from the corresponding figure description by means 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 partial sectional view of a PTC heating arrangement according to the invention comprising two PTC modules;

Fig. 2 shows a side view of the PTC heating arrangement shown in Fig. 1;

Fig. 3 shows a view of a rib structure in the PTC heating arrangement shown in Fig. 1;

Fig. 4 shows a view of the PTC heating arrangement shown in Fig. 1.

[0019] Fig. 1 and Fig. 4 show views of a PTC heating arrangement 1 according to the invention. The PTC heating arrangement 1 thereby has two PTC modules 2, which are stacked against one another. Fig. 1 shows one of the PTC modules 2 in section. The respective PTC module 2 thereby has a PTC heating element 3 and a rib structure 4, which is secured to the respective PTC heating element 3 so as to transfer heat. The PTC heating element 3 has a cuboid housing 5 comprising two opposite heat dissipating walls 6, which are connected to one another by means of two opposite side walls 7. The heat dissipating walls 6 and the side walls 7 thereby extend in the longitudinal direction 8 of the PTC heating element 3. At least one PTC thermistor 9 - in this exemplary embodiment five PTC thermistors 9 - are arranged next to one another and are connected to one another and are electrically connected to the outside by means of the contact plates 10 in the respective housing 5. An insulating plate 11 electrically insulates the respective PTC thermistor 9 and the contact plate 10 from the respective heat dissipating wall 6 of the housing 5. The insulating plate 11 is advantageously made of a heat-conducting material and provides for a heat-transferring contact of the respective PTC thermistor 9 and the respective contact plate 10 with the housing 5, so that the heat generated in the respective PTC thermistor 9 can be guided into the rib structure 4 via the respective contact plate 10, the respective insulating plate 11, and the heat dissipating wall 6 of the housing 5.

[0020] For this purpose, the respective PTC heating element 3 is arranged area by area in an accommodating space 12 of the respective rib structure 4 in the longitudinal direction 8 and the respective rib structure 4 surrounds the respective PTC heating element 3 in the area of the accommodating space 12 in the circumferential direction. The heat dissipating walls 6 and the side walls

7 of the housing 5 of the PTC heating element 3 are secured to an inner surface 13 of the accommodating space 12 so as to transfer heat on the outer side in the area of the accommodating space 12, as can be seen in particular in Fig. 2. In this exemplary embodiment, the housing 5 of the PTC heating element 3 is mechanically clamped in the accommodating space 12 of the rib structure 4 and the PTC heating element 3 penetrates the accommodating space 12 of the rib structure 4. The contact plates 10 of the PTC heating element 3 and thus the PTC heating element 3 can be electrically connected to an external voltage source by means of a connection arrangement 14 comprising contact element 15. The contact elements 15 of the connection arrangement 14 are connected to the respective contact plates 10 in an electroconductive manner and protrude to the outside from the housing 5 of the PTC heating element 3 and from the accommodating space 12 of the rib structure 4, so that the electrical connecting is simplified.

[0021] The respective rib structure 4 - as can in particular be seen in Fig. 3 - has a plurality of ribs 16 and can be made in one piece, for example as a shaped sheet metal part. The ribs 16 of the rib structure 4 thereby protrude perpendicularly to the outside from the heat dissipating walls 6 and from the side walls 7 of the housing 5 of the PTC heating element 3, so that the surrounding fluid between the individual ribs 16 can be guided all the way to the housing 5 of the PTC heating element. The heat output between the respective PTC module 2 and the surrounding fluid can thus in particular be intensified. The accommodating space 12 is further arranged at right angles to the longitudinal direction 8 of the PTC heating element 3 in the middle of the rib structure 4 - as can in particular be seen in Fig. 2. A length of the ribs 16, which protrude to the outside from the two heat dissipating walls 6, and a length of the ribs 16, which protrude to the outside from the two side walls 7, are thereby identical. The heat dissipation at the heat dissipating walls 6 and at the side walls 7 can thus be balanced and the PTC thermistors 9 can heat evenly or can cool evenly, respectively, by means of the heat dissipation. The heat output of the PTC heating arrangement can thus in particular be increased.

[0022] In the PTC heating arrangement 1 shown here, the two PTC modules 2 are stacked against one another and are connected to one another via a support plate 17 so as to transfer heat. An outer surface 18 of the respective rib structure 4, which corresponds to the heat dissipating wall 6, is thereby secured to a connecting surface 19 of the support plate 17 so as to transfer heat. In this exemplary embodiment, two PTC modules 2 are stacked against one another in the PTC heating arrangement 1.

[0023] On principle, more than two PTC modules 2 can also be stacked to form the PTC heating arrangement 1.

[0024] In the PTC heating arrangement 1 according to the invention, the PTC heating element 3 of the PTC module 2 is surrounded by the rib structure 4 and the heat dissipation between the respective PTC module 2 and the surrounding fluid is improved. The heat output of the PTC heating arrangement 1 is also increased accordingly. A stable heat-transferring connection is further attained between the rib structure 4 and the PTC heating element 3, so that the production can be simplified and the quality of the PTC heating arrangement 1 can be improved.

Claims

1. A PTC heating arrangement (1) comprising at least one PTC module (2),

   - wherein the at least one PTC module (2) has an elongated PTC heating element (3) and a rib structure (4) comprising a plurality of ribs (16), which is arranged on the PTC heating element (3) so as to transfer heat,
   - wherein the PTC heating element (3) has a cuboid housing (5) and at least one PTC thermistor (9), which is arranged in the housing (5),
   - wherein the housing (5) has two opposite heat dissipating walls (6), which are connected to one another by means of two opposite side walls (7), and which extend in the longitudinal direction (8) of the PTC heating element (3), and
   - wherein the at least one PTC thermistor (9) is secured in the housing (5) on the inner side on the heat dissipating walls (6) so as to transfer heat,

   characterized in

   - **that** the PTC heating element (3) is arranged at least area by area in an accommodating space (12) of the rib structure (4) in its longitudinal direction (8), and the rib structure (4) surrounds the PTC heating element (3) in the area of the accommodating space (12) in the circumferential direction, and
   - **that** the heat dissipating walls (6) and the side walls (7) of the housing (5) of the PTC heating element (3) are secured on the outer side in the area of the accommodating space (12) on an inner surface (13) of the accommodating space (12) so as to transfer heat.

2. The PTC heating arrangement according to claim 1, **characterized in**
   that the housing (5) of the PTC heating element (3) is secured on the heat dissipating walls (6) and/or on the side walls (7) in the area of the accommodating space (12) to the inner surface (13) of the accommodating space (12) by means of a substance-to-substance bond, preferably by means of adhesion.

3. The PTC heating arrangement according to claim 1 or 2,
characterized in
that the housing (5) of the PTC heating element (3) is mechanically clamped in the accommodating space (12) of the rib structure (4).

4. The PTC heating arrangement according to one of the preceding claims,
characterized in
that the accommodating space (12) penetrates the rib structure (4) and the PTC heating element (3) protrudes from the accommodating space (12) of the rib structure (4) on both sides in the longitudinal direction (8).

5. The PTC heating arrangement according to one of the preceding claims,
characterized in
that the ribs (16) of the rib structure (4) protrude perpendicularly to the outside from the heat dissipating walls (6) and/or from the side walls (7) of the housing (5) of the PTC heating element (3).

6. The PTC heating arrangement according to one of the preceding claims,
characterized in
that the accommodating space (12) is arranged at right angles to the longitudinal direction (8) of the PTC heating element (3) in the middle of the rib structure (4), so that a length of the ribs (16), which protrude to the outside from the two heat dissipating walls (6), is identical and/or a length of the ribs (16), which protrude to the outside from the two side walls (7), is identical.

7. The PTC heating arrangement according to one of the preceding claims,
characterized in
that the rib structure (4) is embodied in one piece.

8. The PTC heating arrangement according to claim 7,
characterized in
that the rib structure (4) is formed by a shaped sheet metal part, which is made of a single piece of sheet metal by means of undulated or zig-zag-shaped forming.

9. The PTC heating arrangement according to one of the preceding claims,
characterized in
that at least two PTC modules (2) of the PTC heating arrangement (1) are stacked against one another, wherein the rib structures (4) of the respective PTC modules (2) are secured to one another so as to transfer heat.

10. The PTC heating arrangement according to claim 9,
characterized in
that the rib structures (4) of the PTC modules (2), which are stacked against one another, are connected via a support plate (17) so as to transfer heat, wherein an outer surface (18) of the respective rib structure (4), which corresponds to the heat dissipating wall (6), is secured to a connecting surface (19) of the support plate (17) so as to transfer heat.

11. The PTC heating arrangement according to one of the preceding claims,
characterized in

- **that** the at least one PTC thermistor (9) of the PTC heating element (3) is capable of being electrically connected to the outside by means of a connection arrangement (14) comprising contact elements (15), and
- **that** the contact elements (15) of the connection arrangement (14) protrude to the outside from the housing (5) of the PTC heating element (3) and from the accommodating space (12) of the rib structure (4).

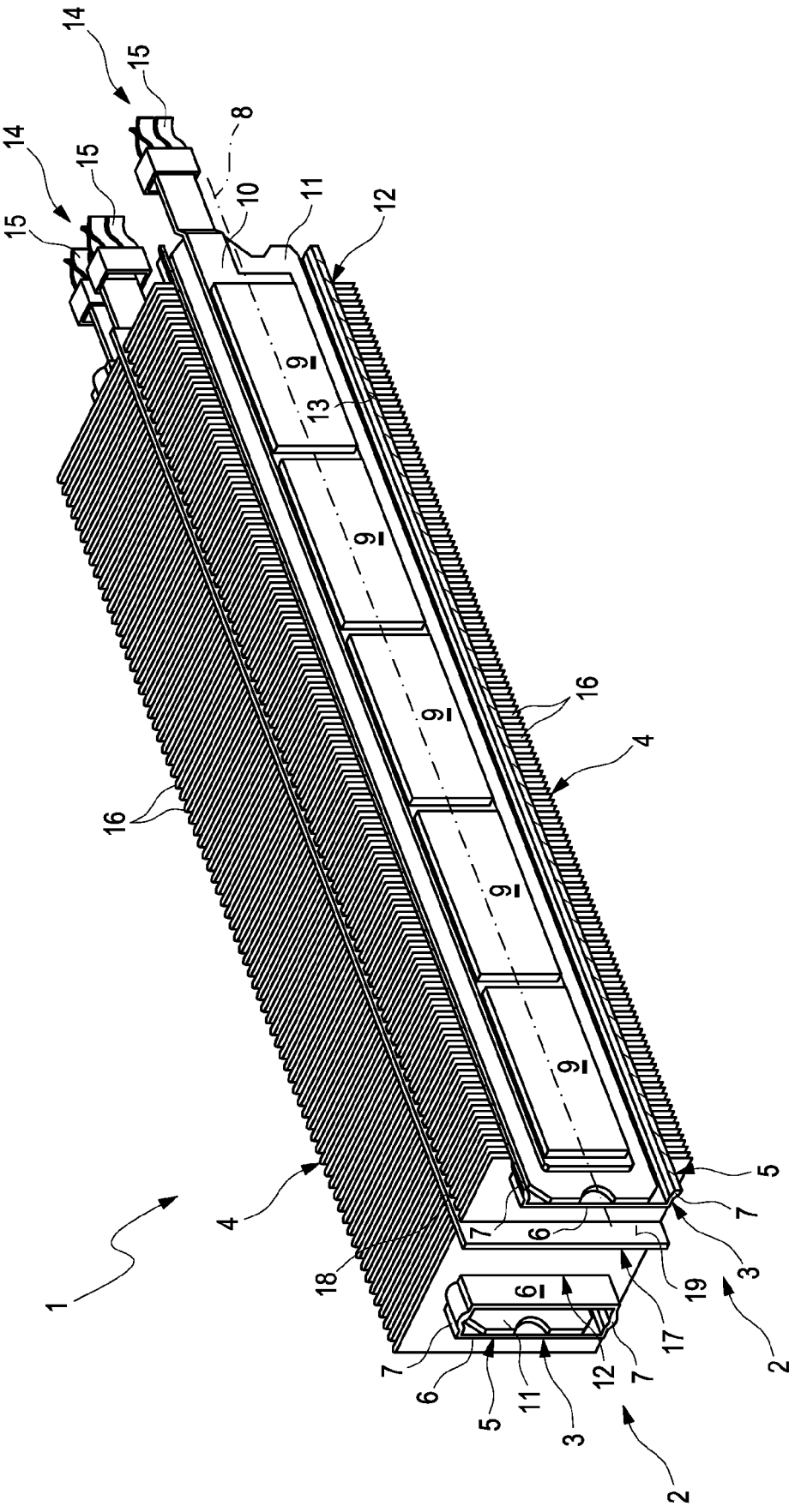

Fig. 1

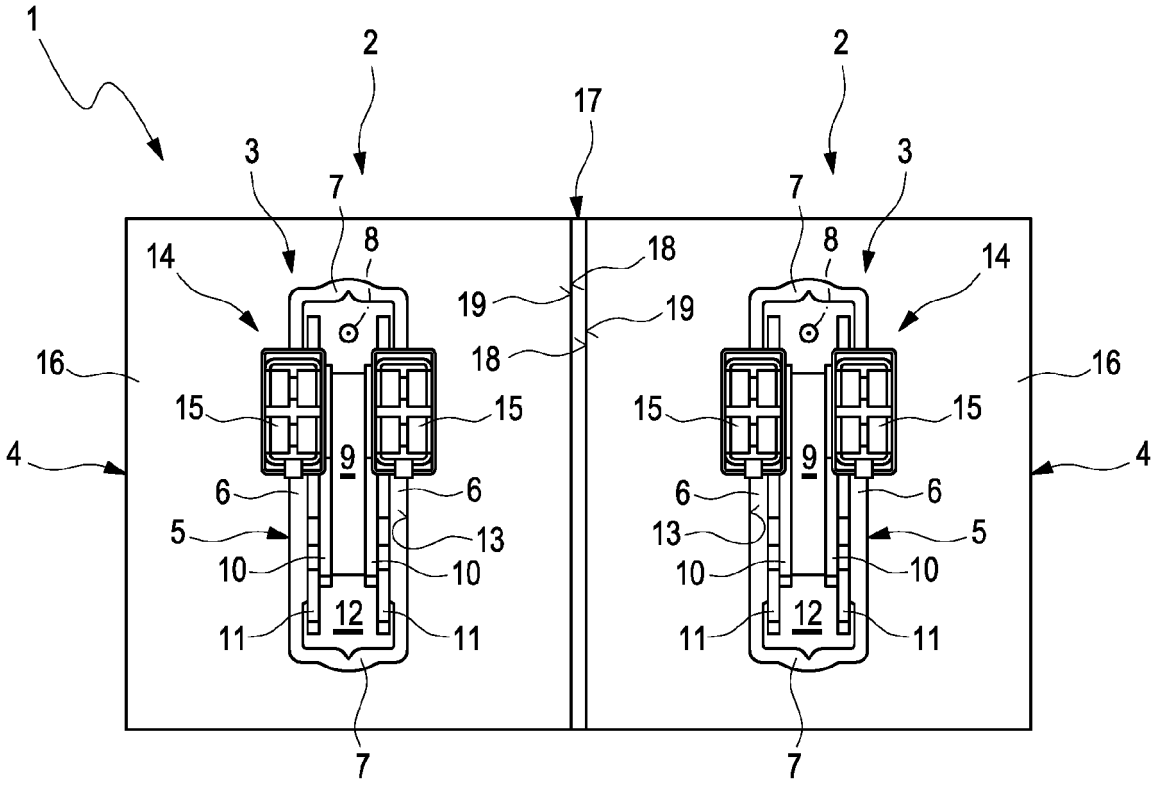
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Fig. 2

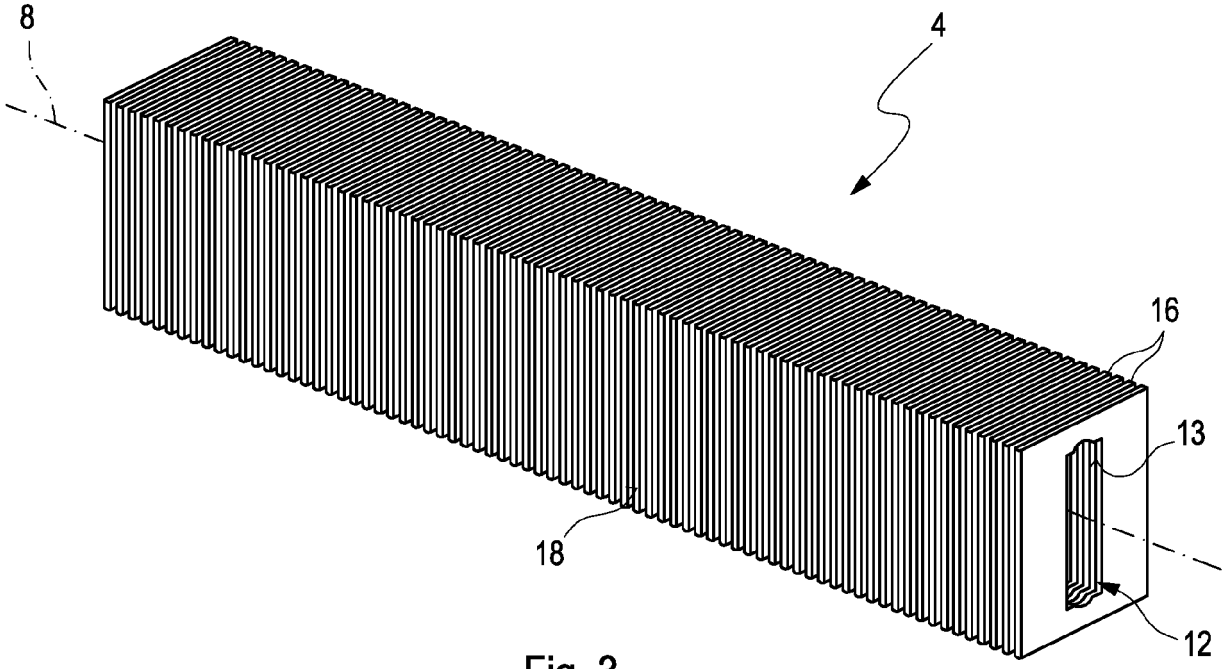
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Fig. 3

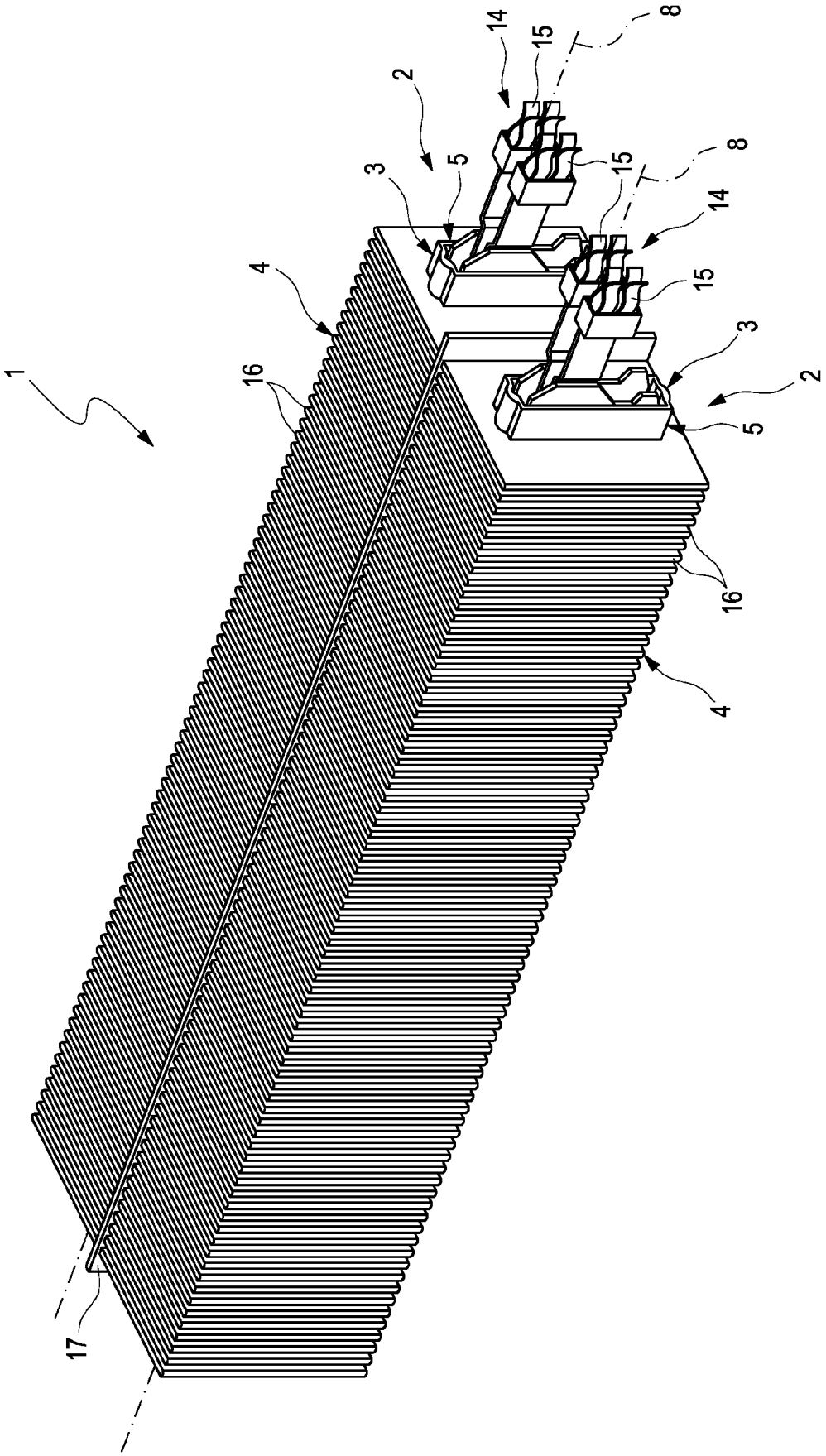

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 18 17 7323

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	11 December 2018	Pantelidis, D

CATEGORY OF CITED DOCUMENTS

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