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(54) **ELECTRIC HEATER**

(57) The invention relates to an electric heater (1, 51, 101) having a web (2, 52) of a plurality of heating elements (3, 53, 103) which are each electrically contacted on a first side (4, 54) by a respective metallic sheet element (5, 55, 102), the assembly of the heating elements (3, 53, 103) and the respective metallic sheet element (5, 55, 102) is considered as a heating-emitting element (6, 57), furthermore undulating fin elements (7, 58) are provided such that an undulating fin (7, 58) element is contacting the respective heating element (3, 53, 103) on a second side (8, 56) adjacent of the first side (4, 54) with a first side of the undulating fin element (7, 58), wherein the undulated fin element (7, 58) is furthermore contacting a metallic sheet element (5, 55, 102) with a second side (8, 56) of the undulating fin element (7, 58), such that the metallic sheet element (5, 55, 102) contacted by the undulating fin element (7, 58) is a metallic sheet element (5, 55, 102) of an adjacent heat-emitting element (6, 57), wherein the heating elements (3, 53, 103) are glued to the metallic sheet element (5, 55, 102) and to the undulating fin element (7, 58) and the undulating fin elements (7, 58) are furthermore glued to the respective metallic sheet elements (5, 55, 102) of the adjacent heat-emitting elements (6, 57).

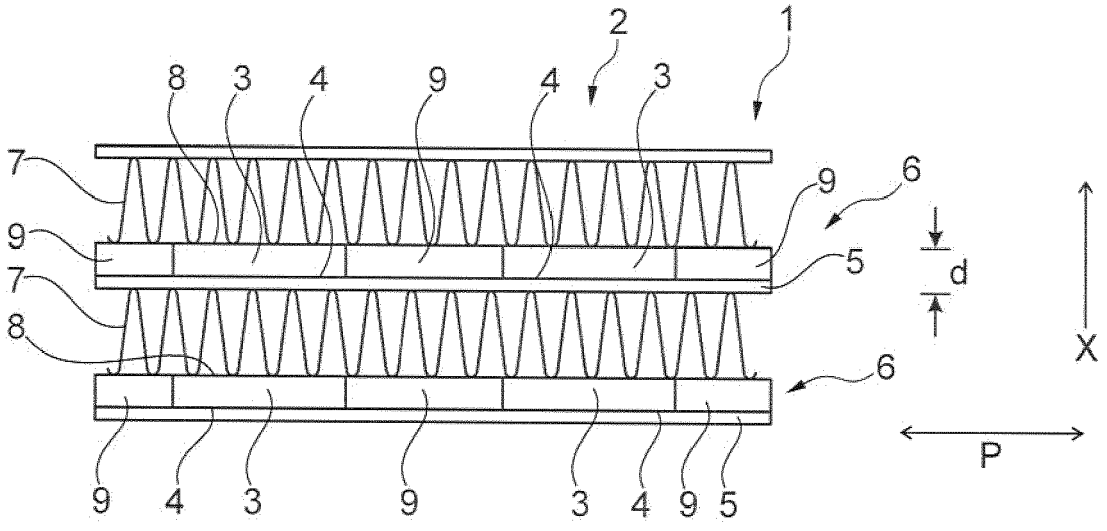

Fig. 1

EP 3 530 503 A1

Description

Field of the invention

[0001] The invention relates to an electric heater, especially as auxiliary heater of an air-conditioning unit of a motor vehicle.

Description of the related art

[0002] Electric heaters are known in the art EP 0 350 528 A1 discloses a web of ceramic heating elements which are each located between two metallic sheet elements to electrically contact the ceramic heating elements. The assembly of the ceramic heating elements and the two respective metallic sheet elements is considered as a heating-emitting element. Typically, an electric heater contains a plurality of such heat-emitting elements while between two of such heat-emitting elements an undulating fin element is located thermally contacting the two heating members such that the undulating fin element contacts two metallic sheet elements of adjacent heat-emitting elements. On the outer length sides of the web metallic sheet elements are arranged to provide side members for the adjacent located spring means. The web is arranged in a frame structure having elastic spring means to compress the web perpendicular to the length direction of the heat-emitting elements in order to achieve both a good electrical contact between the ceramic heating elements and the respective contacting metallic sheet elements and a good thermal contact between the metallic sheet elements and the respective undulating fin element.

[0003] Such an electric heater uses a high number of parts necessary for thermal and electrical properties which have to be assembled. Therefore the above described electric heater is quite expensive in terms of production and logistics.

Object of the invention, solution, advantages

[0004] Therefor it is the object of the present invention to provide an electric heater which allows a less expensive manufacturing of the electric heater and which allows a reduction of weight to reduce CO_2-creation of the vehicle using such an electric heater.

[0005] The object is achieved by an electric heater according the features of claim 1.

[0006] According to an embodiment of the invention an electric heater is provided having a web of a plurality of heating elements which are each electrically contacted on a first side by a respective metallic sheet element, the assembly of the heating elements and the respective metallic sheet element is considered as a heating-emitting element, furthermore undulating fin elements are provided such that an undulating fin element is contacting the respective heating element on a second side adjacent of the first side with a first side of the undulating fin element, wherein the undulated fin element is furthermore contacting a metallic sheet element with a second side of the undulating fin element, such that the metallic sheet element contacted by the undulating fin element is a metallic sheet element of an adjacent heat-emitting element, wherein the heating elements are glued to the metallic sheet element and to the undulating fin element and the undulating fin elements are furthermore glued to the respective metallic sheet elements of the adjacent heat-emitting elements. Therefore, it is possible to reduce the amount of parts used to reduce manufacturing costs of the electric heater and to reduce weight. Accordingly, the electric heater leads to a reduction of CO_2 creation.

[0007] In an advantageous embodiment at least one electrically non-conducting spacer or a plurality of electrically non-conducting spacers is/are provided which is/are located between the respective metallic sheet element and the undulating fin element laterally between heating elements or adjacent to a heating element. This allows a strong and rigid structure since the undulating fin elements have a defined position even between the heating elements.

[0008] Furthermore, it is of advantage that the spacer or the spacers has/have at least almost the same thickness as the adjacent heating element, wherein the thickness is measured in the direction perpendicular of the plane of the larger dimensions of the heating element. Therefore, the undulating fin element has the same shape contacting the spacer or contacting the heating element and no unavoided structural changes occur.

[0009] It is of advantage that the spacer is made of a plastic material. Therefore, the spacer is not electrically conducting and can be manufactured by cost efficient methods and techniques.

[0010] In another embodiment it is of advantage that a plurality of spacers are connected using connecting ribs between two respective spacers. Therefore, the spacers of a row respectively of a heat-emitting element can be made as one piece in order to allow a more efficient assembling.

[0011] Furthermore, it is of advantage that the connecting ribs and the spacers are made in one piece e.g. by means of extrusion. This allows a cost efficient manufacturing.

[0012] The object is furthermore achieved by an electric heater according the features of claim 7.

[0013] According to an embodiment of the invention an electric heater is provided having a web of a plurality of heating elements which are each electrically contacted on a first side by a respective metallic sheet element and on a second side by another respective metallic sheet element, the assembly of the heating elements and the respective metallic sheet elements is considered as a heating-emitting element, furthermore undulating fin elements are provided such that an undulating fin element is contacting the respective metallic sheet elements, wherein the heating elements are glued to the metallic sheet elements and the metallic sheet elements are

glued to the undulating fin elements, wherein at least one electrically non-conducting spacer or a plurality of electrically non-conducting spacers are provided which is/are located between the respective metallic sheet elements laterally between heating elements or adjacent to a heating element. This allows a more stable construction with a reduced number of heating elements in the heat-emitting elements.

[0014] According to an embodiment, it is of advantage that the spacer or the spacers has/have at least almost the same thickness as the adjacent heating element, wherein the thickness is measured in the direction perpendicular of the plane of the larger dimensions of the heating element. This allows a good thermal contact between the metallic sheet elements and the undulating fin elements since the metallic sheet elements are in contact with an almost flat surface of the heating elements and the spacers such that they are additionally almost flat.

[0015] Furthermore, it is of advantage that the length of a spacer located between two heating elements is larger than the length of a heating element in the length direction of the heating element. Therefore, this allows a more even heat distribution along the heat-emitting element.

[0016] It is of advantage that the length of a spacer located between two heating elements is the double or more than the double of the length of a heating element in the length direction of the heating element.

[0017] Furthermore, it is of advantage that the spacer is made of a plastic material. This allows a more efficient manufacturing of the spacer using a more cost-efficient material.

[0018] Furthermore, it is of advantage that a plurality of spacers are connected using connecting ribs between two respective spacers.

[0019] Additionally it is of advantage that the connecting ribs and the spacers are made in one piece e.g. by means of extrusion.

[0020] Further preferable embodiments of the invention are described in the claims and the following description of the drawings.

Description of the drawings

[0021] The invention is explained in detail below by means of an exemplary embodiment and with reference to the drawings, in which:

Figure 1 shows a schematic side view of a part of an embodiment of an electric heater,

Figure 2 shows a view of a heat-emitting element from above,

Figure 3 shows a perspective view of a heat-emitting element,

Figure 4 shows a view of another embodiment of a heat-emitting element from above,

Figure 5 shows a perspective view of the other embodiment of the heat-emitting element of Figure 4,

Figure 6 shows a view of another embodiment of a heat-emitting element from above,

Figure 7 shows a schematic side view of a part of another embodiment of an electric heater,

Figure 8 shows a view of a heat-emitting element of the electric heater from above,

Figure 9 shows an arrangement of elements of a heat-emitting element and

Figure 10 shows an arrangement of elements of another embodiment of a heat-emitting element.

Preferred embodiments of the invention

[0022] Figure 1 shows a schematic side view of a part of an embodiment of an electric heater 1.

[0023] The electric heater 1 comprises a web 2 of a plurality of heating elements 3 which are each electrically contacted on a first side 4 by a respective metallic sheet element 5. The metallic sheet element 5 is typically made as metal strip, especially made from aluminum. The metallic sheet element 5 contacts the heating elements 3 from a row of heating elements 3.

[0024] The assembly of the heating elements 3 and the respective metallic sheet element 5 is considered as a heating-emitting element 6.

[0025] The web 2 furthermore comprises undulating fin elements 7 which are provided such that an undulating fin element 7 is contacting the respective heating element 3 or the heating elements 3 of a row of heating elements 3 on a second side 8 adjacent of the first side 4 with a first side of the undulating fin element 7.

[0026] The undulating fin element 7 is furthermore contacting a metallic sheet element 5 with a second side of the undulating fin element 7, such that the metallic sheet element 5 contacted by the undulating fin element 7 is a metallic sheet element 5 of an adjacent heat-emitting element 6.

[0027] For a good stability and thermal and electrical contact the heating elements 3 are glued to the respective metallic sheet element 5 and to the respective undulating fin element 7 and the undulating fin elements 7 are furthermore glued to the respective metallic sheet elements 5 of the adjacent heat-emitting elements 6.

[0028] As can be seen from Figure 1 the heat-emitting elements 6 comprise furthermore at least one electrically non-conducting spacer 9. Alternatively, a plurality of electrically non-conducting spacers 9 might be provided

which is/are located between the respective metallic sheet element 5 and the undulating fin element 7 and laterally between heating elements 3 or adjacent to a heating element 3 of a row of heating elements 3.

[0029] Therefore, the heating elements 3 and the spacers 9 are arranged in the same plane. They are contacted by the metallic sheet elements 5 on one side and by the undulating fin elements 7 on the other side.

[0030] In order to achieve a rigid structure, it is of advantage that the spacer 9 or the spacers 9 has/have at least almost the same thickness d as the adjacent heating element 3, wherein the thickness is measured in the direction x perpendicular of the plane p of the larger dimensions of the heating element 3. Therefore, the undulating fin elements 7 and the metallic sheet elements 5 are contacting the heating elements 3 and the spacers 9 in a plane respectively.

[0031] The spacers 9 are made of a plastic material e. g. by plastic extrusion or molding.

[0032] As can be seen from Figures 2 and 3 a plurality of spacers 9 are provided which are connected using connecting ribs 10 between two respective spacers 9. The location of the ribs 10 is such that only one rib is provided between two adjacent spacers 9. The ribs 10 are located alternatively on a front edge or on a back edge of the metallic sheet element 5.

[0033] The connecting ribs 10 and the spacers 9 of one heat-emitting element 6 are made in one piece e.g. by means of extrusion or molding.

[0034] As can be seen from Figures 4 and 5 a plurality of spacers 9 are provided which are connected using connecting ribs 10 between two respective spacers 9. The location of the ribs 10 is such that only one rib is provided between two adjacent spacers 9. The ribs 10 are located on one side or edge of the metallic sheet element 5 such that they are located aligned in one line.

[0035] Figure 6 shows another embodiment, where only three heating elements 3 are provided such that one end 11 of the heat-emitting element 6 is provided without a heating element 3.

[0036] As can be seen in Figures 2 to 6, a connecting portion 12 is provided at one end of the metallic sheet elements 5 to allow electric and mechanic contact to a power supply. The connecting portion 12 is riveted to the metallic sheet element 5 using a rivet element 13. Other connecting techniques are possible too, like crimping, welding, soldering etc.

[0037] Figure 7 shows a schematic side view of a part of another embodiment of an electric heater 51. The electric heater 51 comprises a web 52 of a plurality of heating elements 53 which are each electrically contacted on a first side 54 by a respective metallic sheet element 55 and on a second side 56 by another respective metallic sheet element 55.

[0038] The assembly of the heating elements 53 and the respective metallic sheet elements 55 on both sides of the heating elements 53 is considered as a heating-emitting element 57.

[0039] As can be seen, undulating fin elements 58 are provided such that an undulating fin element 58 is contacting the respective metallic sheet elements 55. The undulating fin element 58 is on both sides connected by a metallic sheet element 55 of two different heat-emitting elements 57.

[0040] The heating elements 53 are glued to the metallic sheet elements 55 and the metallic sheet elements 55 are glued to the undulating fin elements 58.

[0041] At least one electrically non-conducting spacer 59 or a plurality of electrically non-conducting spacers 59 is/are provided which is/are located between the respective metallic sheet elements 55 and laterally between heating elements 53 or adjacent to a heating element 53.

[0042] In an embodiment the spacer 59 or the spacers 59 has/have at least almost the same thickness d as the adjacent heating element 53, wherein the thickness d is measured in the direction X perpendicular of the plane P of the larger dimensions of the heating element 53.

[0043] As can be seen from Figure 8 the length L of a spacer 59 located between two heating elements 53 is larger than the length l of a heating element 53 in the length direction Y of the heating element 53.

[0044] It is of advantage that the length L of a spacer 59 located between two heating elements 53 is the double or more than the double of the length l of a heating element 53 in the length direction Y of the heating element 53.

[0045] The spacer 59 is made of a plastic material.

[0046] As can be seen, a plurality of spacers 59 are connected using connecting ribs 60 between two respective spacers 59. The location of the ribs might be as described above with respect to Figures 2 to 6.

[0047] Furthermore, the connecting ribs 60 and the spacers 59 are made in one piece e.g. by means of extrusion or molding.

[0048] Figures 9 and 10 show embodiments of two-dimensional arrangements of heating elements 103 between metallic sheet elements 102 of electric heaters 101. The heating elements 103 are surrounded by electrically non-conducting frame elements 105 which have almost the same thickness d in height direction as the heating elements 103.

[0049] The frame elements 105 have openings which are aligned in lines as shown in Figure 10 or which are located offset to each other as can be seen in Figure 9.

Claims

1. Electric heater (1, 51, 101) having a web (2, 52) of a plurality of heating elements (3, 53, 103) which are each electrically contacted on a first side (4, 54) by a respective metallic sheet element (5, 55, 102), the assembly of the heating elements (3, 53, 103) and the respective metallic sheet element (5, 55, 102) is considered as a heating-emitting element (6, 57),

furthermore undulating fin elements (7, 58) are provided such that an undulating fin element (7, 58) is contacting the respective heating element (3, 53, 103) on a second side (8, 56) adjacent of the first side (4, 54) with a first side of the undulating fin element (7, 58), wherein the undulated fin element (7, 58) is furthermore contacting a metallic sheet element (5, 55, 102) with a second side of the undulating fin element (7, 58), such that the metallic sheet element (5, 55, 102) contacted by the undulating fin element (7, 58) is a metallic sheet element (5, 55, 102) of an adjacent heat-emitting element (6, 57), wherein the heating elements (3, 53, 103) are glued to the metallic sheet element (5, 55, 102) and to the undulating fin element (7, 58) and the undulating fin elements (7, 58) are furthermore glued to the respective metallic sheet elements (5, 55, 102) of the adjacent heat-emitting elements (6, 57).

2. Electric heater (1, 51, 101) according to claim 1, wherein at least one electrically non-conducting spacer (9, 59) or a plurality of electrically non-conducting spacers (9, 59) are provided which is/are located between the respective metallic sheet element (5, 55, 102) and the undulating fin element (7, 58) laterally between heating elements (3, 53, 103) or adjacent to a heating element (3, 53, 103).

3. Electric heater (1, 51, 101) according to claim 2, **characterized in that** the spacer (9, 59) or the spacers (9, 59) has/have at least almost the same thickness as the adjacent heating element (3, 53, 103), wherein the thickness is measured in the direction perpendicular of the plane of the larger dimensions of the heating element (3, 53, 103).

4. Electric heater (1, 51, 101) according to claim 2 or 3, **characterized in that** the spacer (9, 59) is made of a plastic material.

5. Electric heater (1, 51, 101) according to claims 2, 3 or 4, **characterized in that** a plurality of spacers (9, 59) are connected using connecting ribs (10, 60) between two respective spacers (9, 59).

6. Electric heater (1, 51, 101) according to claim 5, **characterized in that** the connecting ribs (10, 60) and the spacers (9, 59) are made in one piece e.g. by means of extrusion or molding.

7. Electric heater (1, 51, 101) having a web (2, 52) of a plurality of heating elements (3, 53, 103) which are each electrically contacted on a first side (4, 54) by a respective metallic sheet element (5, 55, 102) and on a second side (8, 56) by another respective metallic sheet element (5, 55, 102), the assembly of the heating elements (3, 53, 103) and the respective metallic sheet elements (5, 55, 102) is considered as a heating-emitting element (6, 57), furthermore undulating fin elements (7, 58) are provided such that an undulating fin element (7, 58) is contacting the respective metallic sheet elements (5, 55, 102), wherein the heating elements (3, 53, 103) are glued to the metallic sheet elements (5, 55, 102) and the metallic sheet elements (5, 55, 102) are glued to the undulating fin elements (7, 58), wherein at least one electrically non-conducting spacer (9, 59) or a plurality of electrically non-conducting spacers (9, 59) are provided which is/are located between the respective metallic sheet elements (5, 55, 102) laterally between heating elements (3, 53, 103) or adjacent to a heating element (3, 53, 103).

8. Electric heater (1, 51, 101) according to claim 7, **characterized in that** the spacer (9, 59) or the spacers (9, 59) has/have at least almost the same thickness as the adjacent heating element (3, 53, 103), wherein the thickness is measured in the direction perpendicular of the plane of the larger dimensions of the heating element (3, 53, 103).

9. Electric heater (1, 51, 101) according to claims 7 or 8, **characterized in that** the length of a spacer (9, 59) located between two heating elements (3, 53, 103) is larger than the length of a heating element (3, 53, 103) in the length direction of the heating element (3, 53, 103).

10. Electric heater (1, 51, 101) according to claim 9, **characterized in that** the length of a spacer (9, 59) located between two heating elements (3, 53, 103) is the double or more than the double of the length of a heating element (3, 53, 103) in the length direction of the heating element (3, 53, 103).

11. Electric heater (1, 51, 101) according to claims 7, 8, 9 or 10, **characterized in that** the spacer (9, 59) is made of a plastic material.

12. Electric heater (1, 51, 101) according to claims 7, 8, 9, 10 or 11, **characterized in that** a plurality of spacers (9, 59) are connected using connecting ribs (10, 60) between two respective spacers (9, 59).

13. Electric heater (1, 51, 101) according to claim 12, **characterized in that** the connecting ribs (10, 60) and the spacers (9, 59) are made in one piece e.g. by means of extrusion or molding.

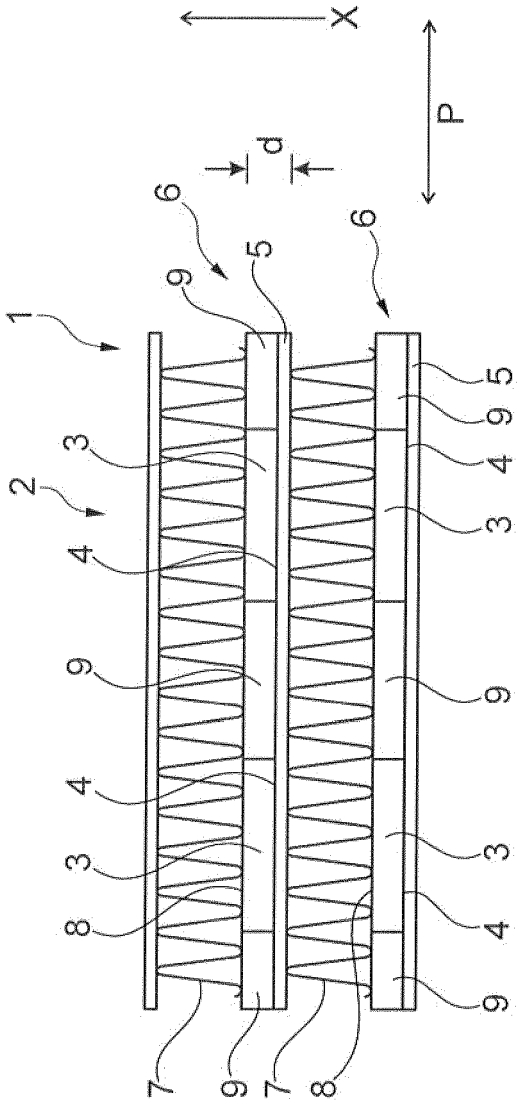

Fig. 1

Fig. 2

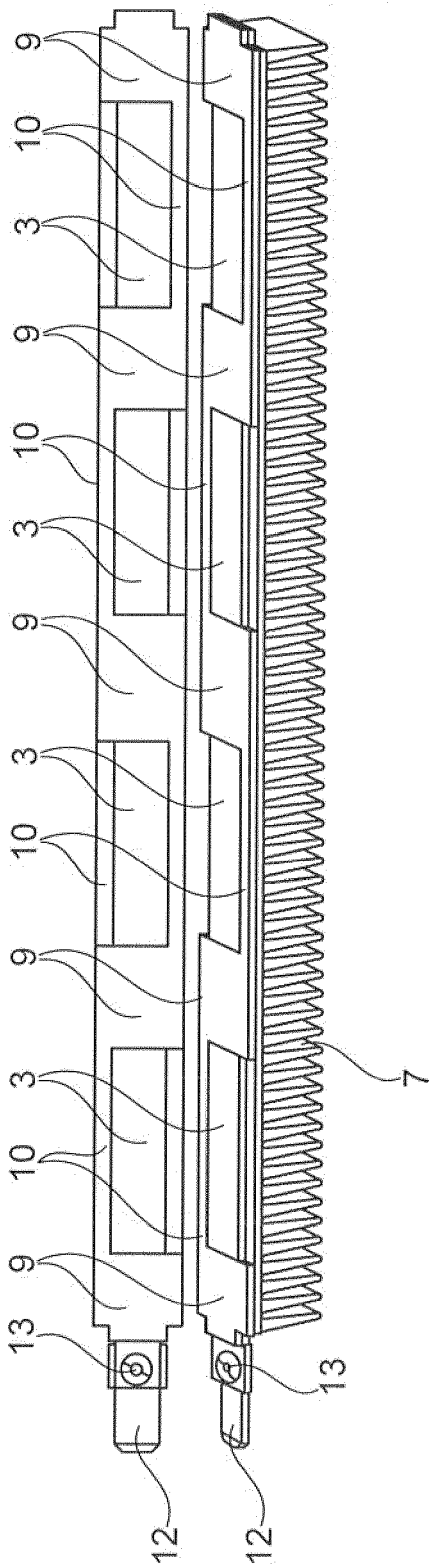

Fig. 3

Fig. 4

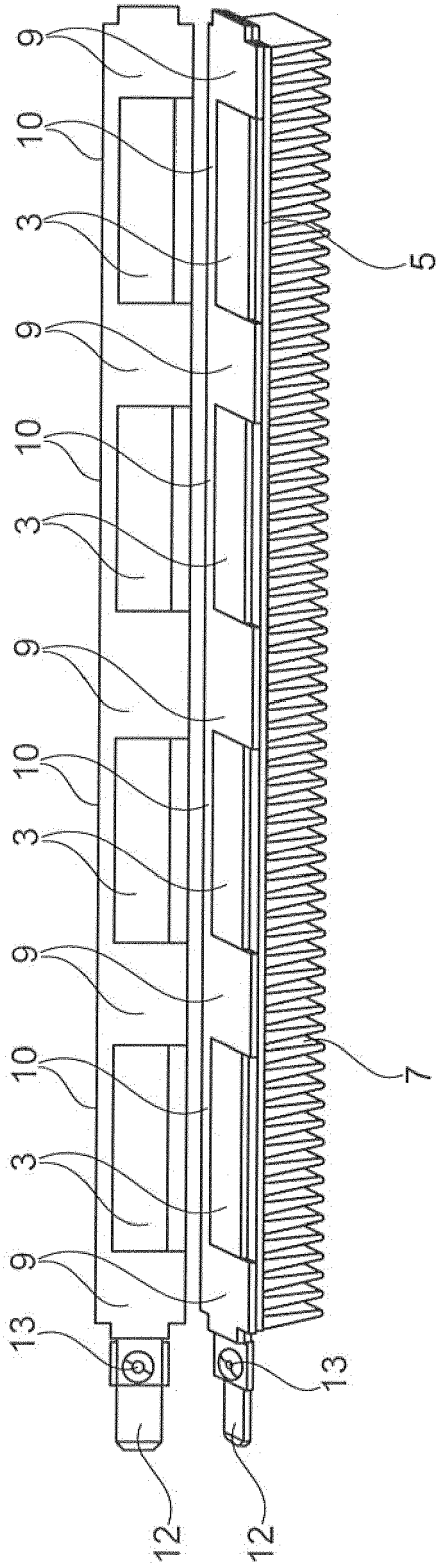

Fig. 5

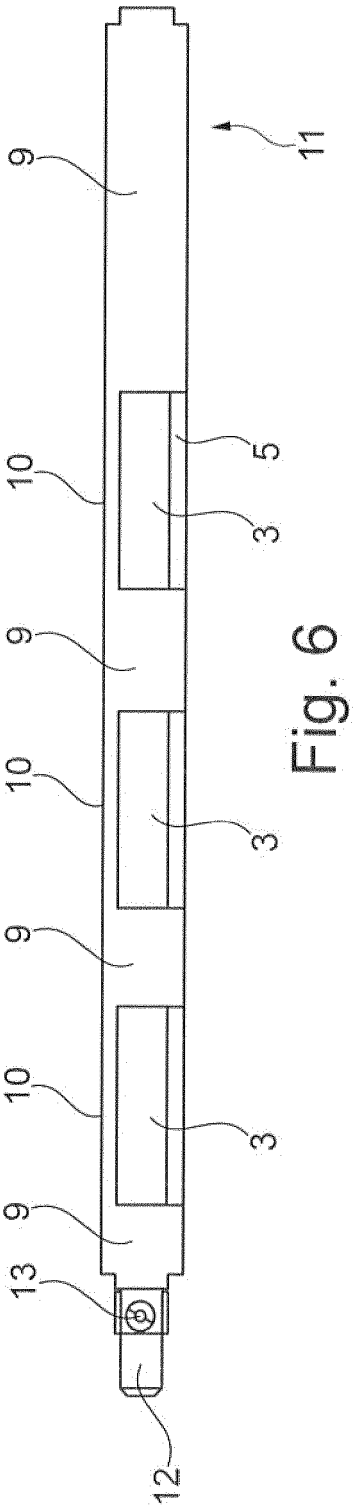

Fig. 6

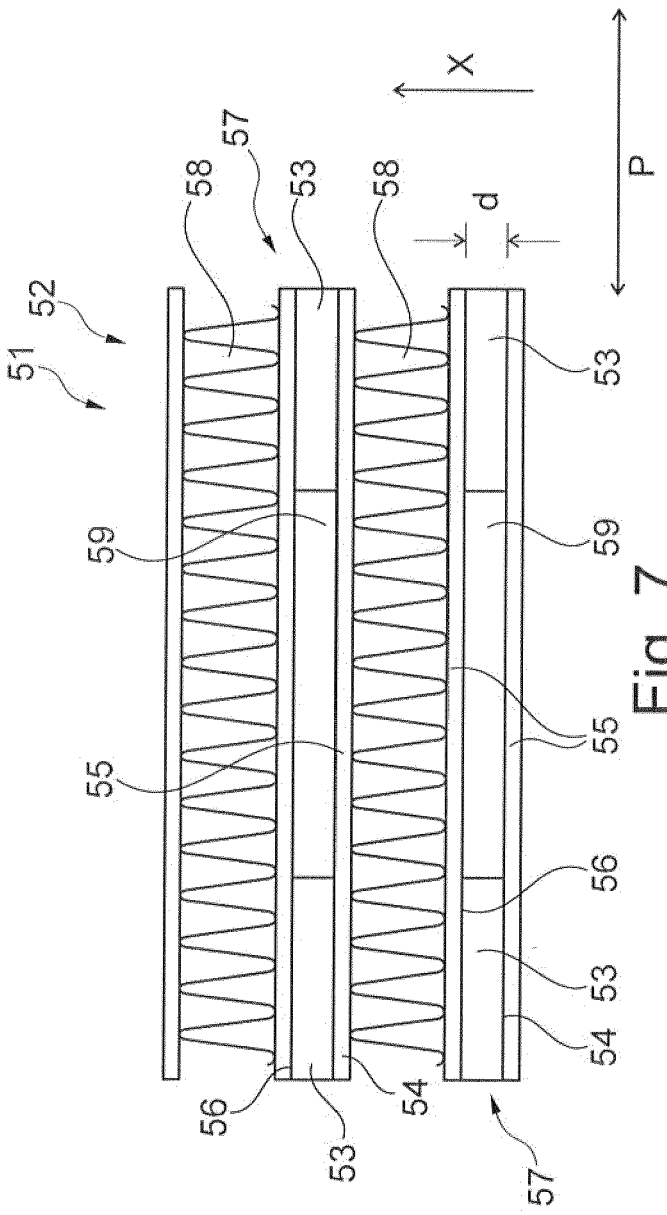

Fig. 7

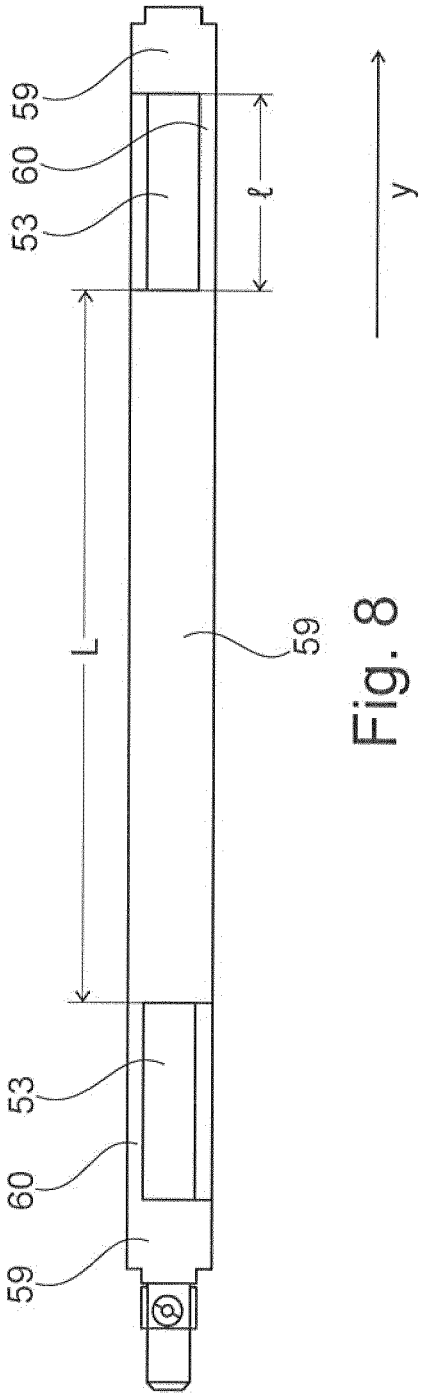

Fig. 8

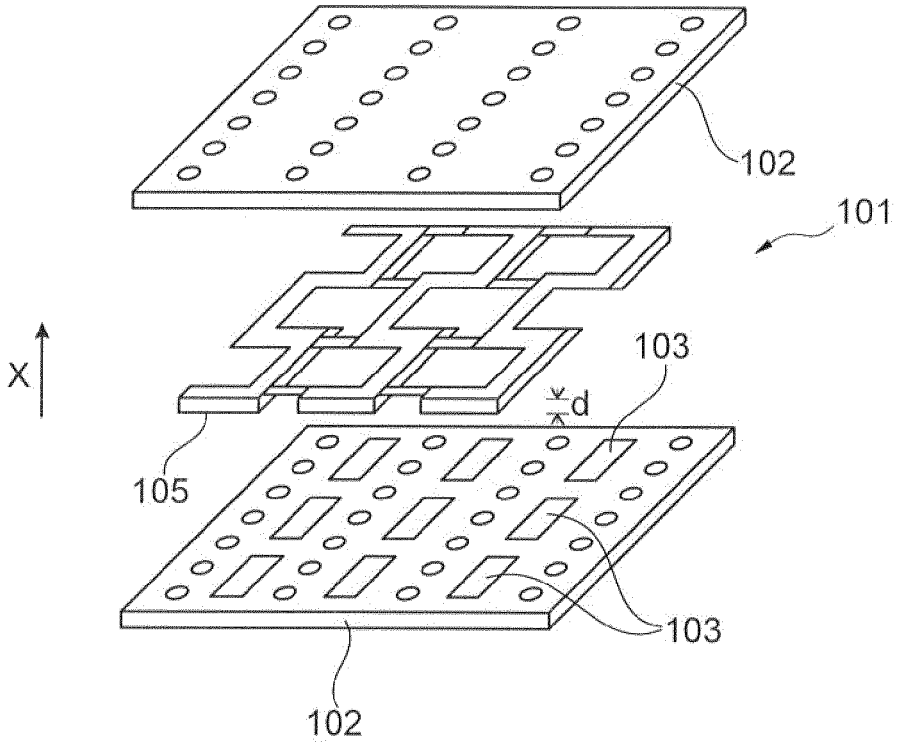

Fig. 9

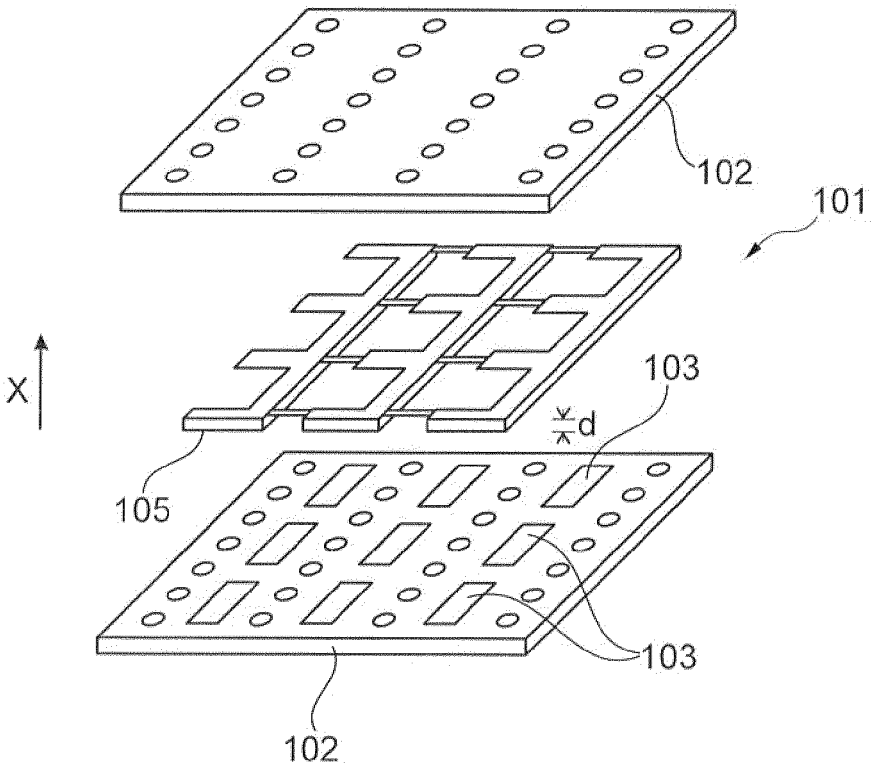

Fig. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 18 15 8516

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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
Munich	2 August 2018	Barzic, Florent

CATEGORY OF CITED DOCUMENTS

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