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(54) Heating device and mounting method of said device

(57) The present invention concerns a heating device (1) connectable to a power supply, comprising a support frame (2), one or more radiating elements (3), each comprising a containment tube (31), having an inner surface, said containment tube (31) being capable to operate as an electrode and being connectable to said power supply, a longitudinal housing (32), made of insulating material, arranged within said containment tube (31), open at the top and having a lower base (32"), a longitudinal electrode (33), connectable to said power supply and arranged within said longitudinal housing (32), so as to be isolated from said containment tube (31), heat generating means (34), as one or more PTC (Positive Temperature Coefficient) elements, each one inserted in said containment tube (31) and arranged between, and in contact with, said longitudinal electrode (33) and said containment tube (31), so that, by applying an electric current between said containment tube (31) and said longitudinal electrode (33), said heat generating means (34) generate heat, compression means (35), located in said longitudinal housing (32), interposed between said longitudinal housing (32) and said longitudinal electrode (33), and one or more dissipation fins (4) arranged in said support frame (2), suitable to dissipate the heat generated from said radiating elements (3), characterized in that said longitudinal housing (32) comprises a plurality of seats (32') on said base (32"), and in that said compression means comprise a plate (35) on which a plurality of tabs or springs (35') are obtained, each one insertable in a respective seat (32') of said longitudinal housing (32), said plate (35) being capable to assume a rest position, in which said tabs or springs (35') are inserted in said seats (32'), and an operating position, in which said plate (35) is shifted longitudinally with respect to said longitudinal housing (32), so that said tabs or springs (35') are in compression, such that said heat generating means (34) are held in thermal and electrical contact with said inner surface of said containment tube (31) in which they are inserted, by means of the force exerted by said tabs or springs (35').

The present invention also concerns a method for mounting of a heating device (1).

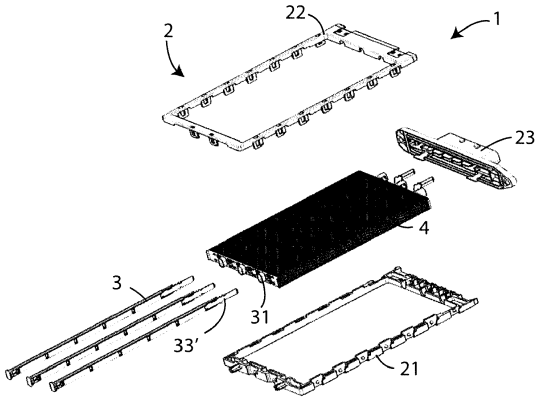

Fig. 1

EP 2 840 329 A1

Description

[0001] The present invention relates to a heating device, in particular for heating the passenger compartment of an automobile, and mounting method of said device.

[0002] More specifically, the invention concerns a heating device, or heater, for the passenger compartment of an automobile, studied and realized in particular to allow a high operating efficiency and an optimized construction.

[0003] In the following, the description will be directed to the use of the device in the passenger compartment of an automobile, but it is clear that the same should not be considered limited to this specific use.

[0004] As it is well known at present internal combustion engines, in particular diesel engines, takes some time to heat up. Therefore, to ensure an appropriate comfort in the passenger compartment from the start, especially in the winter months, heating devices are installed in the passenger compartments of the cars, suitable to allow an immediate early heating of the passenger compartment.

[0005] The electric energy absorbed by the heater is converted into heat in its turn used to ensure greater comfort to the users of vehicle. The air flow through the heater, cooling the radiant mass, heated, typically, by PTC (Positive Temperature Coefficient) pads, reaches the air vents on the car dashboard with a temperature of 10-15 °C higher than that of the environment.

[0006] Examples of heating devices according to the prior art are given by the patent applications DE 102007032 896 A and FR2826829.

[0007] The described heating devices have construction problems for industrial production, as they have complications in the arrangement of the electrode-PTC pads assembly.

[0008] The Applicant, to overcome such constructive limits, has developed the solutions described in European patent application n. 13425027.3, in which systems for preloading compression springs are provided, for releasing them once the assembly of the radiating element were completed and inserted between the fins. This solution, although it overcomes the limits of the cited prior art, makes it difficult, in the series production that characterizes these devices, to prepare assemblies of parts with preloaded items. It has been found, in fact, that any offset in the construction cannot-properly preload the springs, this implying production downtimes.

[0009] In light of the above, it is, therefore, object of the present invention to provide a heating device that allows an assembly as simple and effective as possible, which can make more reliable series production phases of the device.

[0010] It is therefore specific object of the present invention a heating device connectable to a power supply, comprising a support frame, one or more radiating elements, each comprising a containment tube, having an inner surface, said containment tube being capable to operate as an electrode and being connectable to said power supply, a longitudinal housing, made of insulating material, arranged within said containment tube, open at the top and having a lower base, a longitudinal electrode, connectable to said power supply and arranged within said longitudinal housing, so as to be isolated from said containment tube, heat generating means, as one or more PTC (Positive Temperature Coefficient) elements, each one inserted in said containment tube and arranged between, and in contact with, said longitudinal electrode and said containment tube, so that, by applying an electric current between said containment tube and said longitudinal electrode, said heat generating means generate heat, compression means, located in said longitudinal housing, interposed between said longitudinal housing and said longitudinal electrode, and one or more dissipation fins arranged in said support frame, suitable to dissipate the heat generated from said radiating elements, characterized in that said longitudinal housing comprises a plurality of seats on said base, and in that said compression means comprise a plate on which a plurality of tabs or springs are obtained, each one insertable in a respective seat of said longitudinal housing, said plate being capable to assume a rest position, in which said tabs or springs are inserted in said seats, and an operating position, in which said plate is shifted longitudinally with respect to said longitudinal housing, so that said tabs or springs are in compression, such that said heat generating means are held in thermal and electrical contact with said inner surface of said containment tube in which they are inserted, by means of the force exerted by said tabs or springs.

[0011] Always according to the invention, said seats of said longitudinal housing could have the side wall intended to interfere with said tabs or springs when said plate passes from said rest position to said operative position.

[0012] Still according to the invention, said seats could be defined by a lateral wall, which is inclined with respect to said base and intended to interfere with said tabs or springs when said plate passes from said rest position to said operative position, by a bottom wall, and a horizontal wall, facing said lower wall, so that its tab or spring inserted in the respective is at least partially inserted between said lower wall and said horizontal wall, when said plate is in said rest position.

[0013] Advantageously according to the invention, said radiating element could comprise a plurality of separating elements, made of plastic material, which are co-molded together with said longitudinal electrode and said plate, and spaced each other so as to allow the arrangement between each pair of them of said heat generating means.

[0014] Further according to the invention, said support frame could comprise a first support and a second support coupled with said first support, said fins being arranged between the first support and said second support, and an electrical connector, connectable to a power

supply of the automobile, in which said heating device is installed, said longitudinal electrodes and said containment tube being electrically connected to said electrical connector.

[0015] Always according to the invention, said longitudinal electrodes could be connected to a first polarity, preferably the positive polarity of said power supply, and said containment tubes could be connected to a second polarity, opposite to said first polarity, preferably the negative polarity of said power supply.

[0016] It is further object of the present invention a method for mounting of a heating device as defined above, comprising the following steps: (A) inserting said containment tube through said dissipation fins; (B) fixing said dissipation fins to said containment tube; and (C) assembling said radiating elements.

[0017] Always according to the invention, said step (C) comprises the substeps of: (C1) placing said plate and said longitudinal electrode in said longitudinal housing, so that said springs or tabs are each placed in a respective seat of said base of said longitudinal housing and maintained in the mounting position by said horizontal wall and said lower wall; (C2) arranging said heat generating means in contact with said longitudinal electrode; (C3) inserting said longitudinal housing in said containment tube, and (C4) applying a longitudinal movement along a first direction (A) to said plate, so as to cause the passage of said plate from said rest position to said operative position, wherein said tabs or springs are extracted from said seats and are compressed along said inclined lateral wall, such that said heat generating means, only by vertical movement, are kept in thermal and electrical contact with said inner surface of said containment tube, in which they are inserted, by means of the force exerted by said tabs or springs, thus avoiding the sliding with said containment tube and said electrode.

[0018] Still according to the invention, said step (C1) includes the following substep: co-molding said separating elements with said longitudinal electrode and said plate, said separating elements being spaced each other so as to allow the arrangement between each pair of them, of said heat generating means.

[0019] The present invention will be now described, for illustrative but not limitative purposes, according to its preferred embodiments, with particular reference to the figures of the enclosed drawings, wherein:

figure 1 shows an exploded perspective view of a first embodiment of the heating device according to the present invention;
figure 2 shows an exploded view of a radiating element of the heating device according to figure 1;
figure 3 shows a side sectional view of an assembly step of two parts of the radiating element of the heating device according to figure 1;
figure 4 shows a side sectional view of a further assembly step of two parts of the radiating element of the heating device according to figure 1;
figure 5 shows a side sectional view of another assembly step of two parts of the radiating element of the heating device according to figure 1;
figure 6 shows a plan view of the assembly step of two parts of the radiating element according to figure 5;
figure 7 shows a further exploded view of the radiating element of the heating device according to figure 1;
figure 8 shows the mounting of the radiating element of the heating device according to figure 1;
figure 9 shows the insertion of the radiating elements in a respective containment tube of the heating device according to the present invention;
figures 10, 11 and 12 show the fixing steps of the radiating elements to the respective containment tube;
figure 13 shows an exploded view of a radiating element of a second embodiment of a heating device according to the present invention;
figure 14 shows an exploded view of an assembly step of two parts of the radiating element according to figure 13; and
figure 15 shows a perspective view of another assembly step of two parts of the radiating element according to figure 13.

[0020] In the various figures, similar parts will be indicated by the same reference numbers.

[0021] Referring to figure 1, a heating device 1 according to the present invention can be seen.

[0022] Said heating device 1 comprises a support frame 2, one or more radiating elements or bars 3, installed on said support frame 2, and a plurality of dissipation fins 4 in thermal contact with said radiating bars 3, as will be better described in the following.

[0023] Said support frame 2 comprises a first support 21 and a second support 22 coupled together, and an electrical connector 23, connectable to a plug of the car, in which said heating device 1 is installed.

[0024] Said radiating bars 3, which in this embodiment are three, are arranged to generate heat, which is radiated from the dissipation fins 4, contained between said first support 21 and said second support 22 of the frame 2.

[0025] Said radiating bars 3 also comprise a containment tube 31, hollow inside and made of a material capable of conducting heat and electric current, so that said containment tube 31 can also operate as electric terminal, and a longitudinal housing 32, arranged within said containment tube 31. Said longitudinal housing 32 is upwardly open and has a plurality of seats 32' obtained on the surface of said base 32", the function of which will be better clarified in the following.

[0026] Said radiating bars comprise 3 inside a longitudinal electrode 33 having a terminal 33', which protrudes from said containment tube 31 when it is inserted into it. Said longitudinal electrode 33 is arranged so as not to come into contact with said containment tube 31, and it

is connected with said connector 23.

[0027] Furthermore, said radiating bars 3 comprise a plurality of PTC (Positive Temperature Coefficient) elements 34, which pads are made of ceramic, arranged in series to one another, and a plate 35, on which a plurality of compression means or springs 35' are obtained by carving, each made in the form of resilient tongues, said plate 35 being arranged between said longitudinal electrode 33 and the base of said longitudinal housing 32.

[0028] The operation of the heating device 1 described above is as follows.

[0029] When the car, in which the heating device 1 is installed, is started, electricity is supplied to the heating device 1 by means of the electrical connector 23.

[0030] The radiating tubes 31, which, as said, also operate as electrical terminals, are connected to a power supply polarity of said car, while the terminals 33' of each electrode 33 of the longitudinal radiating bars 3, which, as said, is isolated from the containment tube 31 due to the longitudinal housing 32, in which it is placed, are connected to the other power supply polarity.

[0031] In this way, by means of the assembly described above, the electric current passes through said longitudinal electrodes 33 of said radiating bars 3 and through said PTC elements 34, which are kept in contact with the inner surface of said radiating tubes 31 by the force exerted by said springs 35', which are in compression.

[0032] These PTC elements 34 each act as electrical resistance to the passage of the current, so as to generate heat that is transmitted to said containment tubes 31, which are also thermally conductive, and from the latter to said dissipation fins 4 which dissipate it. The electrical circuit is just closed with said PTC elements 34 in contact with the containment tube 31, which as said are connected to a power supply polarity of said car.

[0033] The heat produced by said PTC elements 34 is dissipated by the dissipation fins 4 and is conveyed inside the passenger car possibly by means of a fan, so that the air flow passes through said dissipation fins 4, thus warming.

[0034] Referring now to figures 3-12, the different steps of the assembly method of the heating device 1 according to the present invention are shown.

[0035] A first assembly step (not shown in the figures) is to place and to fix the radiating tubes 31 through the fins 4. In particular, fins 4 are mutually stacked and have holes through which passes a containment tube 31. Each containment tube 31 is expanded mechanically, by means of an ogive or similar means, so as to adhere the dissipation fins 4 to the containment tube 31. In this way, a mechanical interference between the containment tube 31 and the dissipation fins 4, which ensures mechanical connection, is obtained.

[0036] Subsequently, the remaining part of the radiating element 3 is assembled. In particular, referring to figures 3, 4, 5, 6, 7 and 8:

- plate 35 is placed in said longitudinal housing 32, and said springs 35' are each inserted in a one respective of said seats 32';
- the longitudinal electrode 33 is then placed on said plate 35; and
- PTC elements 34 are arranged on said longitudinal electrode 33, in series to one another, possibly simply spaced.

[0037] The resulting assembly, shown in figure 8, is inserted, each, in a respective containment tube 31, as shown in figure 9.

[0038] In figures 10, 11 and 12, it is shown as then, for each radiating element 3, the respective longitudinal terminal 33 and the respective plate 35 are moved or shifted in the direction indicated by arrow A. This causes the longitudinal translation of the plate 35 relative to the longitudinal housing 32, which then passes from a rest position (springs not compressed) to an operative position and then the simultaneous extraction of each spring 35' from the respective seat 32', which follows the path marked by the arrow C, with its consequent compression and the lifting, in the direction of arrow B, of the plate 35, the electrode 33 and, therefore, the PTC elements 34, thus guaranteeing a correct pressure between each PTC element 34 and the inner surface of said containment tube 31.

[0039] Said seats 32' are identified by a lateral wall 32"', inclined with respect to said base 32" and intended to interfere with said tongues or springs 35', when the plate 35 moves from said rest position to said operative position, so as to facilitate said passage, by a lower wall 32^{V} and by a horizontal wall 32^{IV}, facing said lower wall 32^{V}, so that the tongue or spring 35' inserted in the respective 32' is at least partially inserted between said lower wall 32^{V} and said horizontal wall 32^{IV}, when said plate 35 is in said rest position. In this way, when said plate 35 is in said rest position and each of said tabs or springs 35' is inserted in the respective seat 32' below the horizontal wall 32^{IV} of said seat 32', said plate 35 is maintained in a stable way in mounting position with respect to said longitudinal housing 32.

[0040] Figures 13-15 show the structure, operation, and the assembly steps of a second embodiment of the heating device 1 according to the present invention.

[0041] In particular, unlike the previous embodiment, in this case, said radiating element 3 comprises separator elements 36, made of plastic material, which are comolded together with said longitudinal electrode 33 and said plate 35 and spaced so as to allow the arrangement between each pair of them, of a PTC element 34.

[0042] The assembly comolded between said longitudinal electrode 33, said plate 35 and said separator elements 36 is coupled with the longitudinal support 32 and then the PTC elements 34 are inserted, each one between a pair of separator elements 36, so as to remain spaced one from the other.

[0043] The steps of placing the assembly formed by said longitudinal electrode 33, said plate 35, said longi-

tudinal support 32 and the PTC elements 34 and of compressing the springs 35' are the same as those of the heating device 1 according to the first described embodiment.

[0044] An advantage of the present invention is, from one side, the fact that in the assembly steps, there are no elements or springs that are preloaded, thus avoiding any construction and execution problems, and on the other side, the fact that the parts that compose it are less complex.

[0045] The present invention has been described for illustrative but not limitative purposes, according to its preferred embodiments, but it is to be understood that modifications and/or changes can be introduced by those skilled in the art without departing from the relevant scope as defined in the enclosed claims.

Claims

1. Heating device (1) connectable to a power supply, comprising
a support frame (2),
one or more radiating elements (3), each comprising a containment tube (31), having an inner surface, said containment tube (31) being capable to operate as an electrode and being connectable to said power supply,
a longitudinal housing (32), made of insulating material, arranged within said containment tube (31), open at the top and having a lower base (32"),
a longitudinal electrode (33), connectable to said power supply and arranged within said longitudinal housing (32), so as to be isolated from said containment tube (31),
heat generating means (34), as one or more PTC (Positive Temperature Coefficient) elements, each one inserted in said containment tube (31) and arranged between, and in contact with, said longitudinal electrode (33) and said containment tube (31), so that, by applying an electric current between said containment tube (31) and said longitudinal electrode (33), said heat generating means (34) generate heat,
compression means (35), located in said longitudinal housing (32), interposed between said longitudinal housing (32) and said longitudinal electrode (33), and
one or more dissipation fins (4) arranged in said support frame (2), suitable to dissipate the heat generated from said radiating elements (3),
characterized
in that said longitudinal housing (32) comprises a plurality of seats (32') on said base (32"), and
in that said compression means comprise a plate (35) on which a plurality of tabs or springs (35') are obtained, each one insertable in a respective seat (32') of said longitudinal housing (32), said plate (35) being capable to assume a rest position, in which said tabs or springs (35') are inserted in said seats (32'), and an operating position, in which said plate (35) is shifted longitudinally with respect to said longitudinal housing (32), so that said tabs or springs (35') are in compression, such that said heat generating means (34) are held in thermal and electrical contact with said inner surface of said containment tube (31) in which they are inserted, by means of the force exerted by said tabs or springs (35').

2. Heating device (1) according to claim 1, **characterized in that** said seats (32') of said longitudinal housing (32) have the side wall intended to interfere with said tabs or springs (35') when said plate (35) passes from said rest position to said operative position.

3. Heating device (1) according to anyone of the preceding claims, **characterized in that** said seats (32') are defined by a lateral wall (32"'), which is inclined with respect to said base (32") and intended to interfere with said tabs or springs (35') when said plate (35) passes from said rest position to said operative position, by a bottom wall (32^{V}), and a horizontal wall (32^{IV}), facing said lower wall (32^{V}), so that its tab or spring (35') inserted in the respective (32') is at least partially inserted between said lower wall (32^{V}) and said horizontal wall (32^{IV}), when said plate (35) is in said rest position.

4. Heating device (1) according to anyone of the preceding claims, **characterized in that** said radiating element (3) comprises a plurality of separating elements (36), made of plastic material, which are co-molded together with said longitudinal electrode (33) and said plate (35), and spaced each other so as to allow the arrangement between each pair of them of said heat generating means (34).

5. Heating device (1) according to anyone of the preceding claims, **characterized in that** said support frame (2) comprises a first support (21) and a second support (22) coupled with said first support (21), said fins (4) being arranged between the first support (21) and said second support (22), and an electrical connector (23), connectable to a power supply of the automobile, in which said heating device (1) is installed, said longitudinal electrodes (33) and said containment tube (31) being electrically connected to said electrical connector (23).

6. Heating device (1) according to anyone of the preceding claims, **characterized in that**
said longitudinal electrodes (33) are connected to a first polarity, preferably the positive polarity of said power supply, and
said containment tubes (31) are connected to a second polarity, opposite to said first polarity, preferably

the negative polarity of said power supply.

7. Method for mounting of a heating device (1) according to anyone of claims 1-6, comprising the following steps:

(A) inserting said containment tube (31) through said dissipation fins (4);
(B) fixing said dissipation fins (4) to said containment tube (31); and
(C) assembling said radiating elements (3, 3a).

8. Method according to claim 7, **characterized in that** said step (C) comprises the substeps of:

(C1)placing said plate (35) and said longitudinal electrode (33) in said longitudinal housing (32), so that said springs or tabs (35') are each placed in a respective seat (32') of said base (32"') of said longitudinal housing (32) and maintained in the mounting position by said horizontal wall (32^{IV}) and said lower wall (32^{V});
(C2) arranging said heat generating means (34) in contact with said longitudinal electrode (33);
(C3) inserting said longitudinal housing (32) in said containment tube (31), and
(C4) applying a longitudinal movement along a first direction (A) to said plate (34), so as to cause the passage of said plate (35) from said rest position to said operative position, wherein said tabs or springs (35') are extracted from said seats (32") and are compressed along said inclined lateral wall (32"'), such that said heat generating means (34), only by vertical movement, are kept in thermal and electrical contact with said inner surface of said containment tube (31), in which they are inserted, by means of the force exerted by said tabs or springs (35'), thus avoiding the sliding with said containment tube (31) and said electrode (33).

9. Method according to claim 8, **characterized in that** said step (C1)includes the following substep:

- co-molding said separating elements (36) with said longitudinal electrode (33) and said plate (35), said separating elements (36) being spaced each other so as to allow the arrangement between each pair of them, of said heat generating means (34).

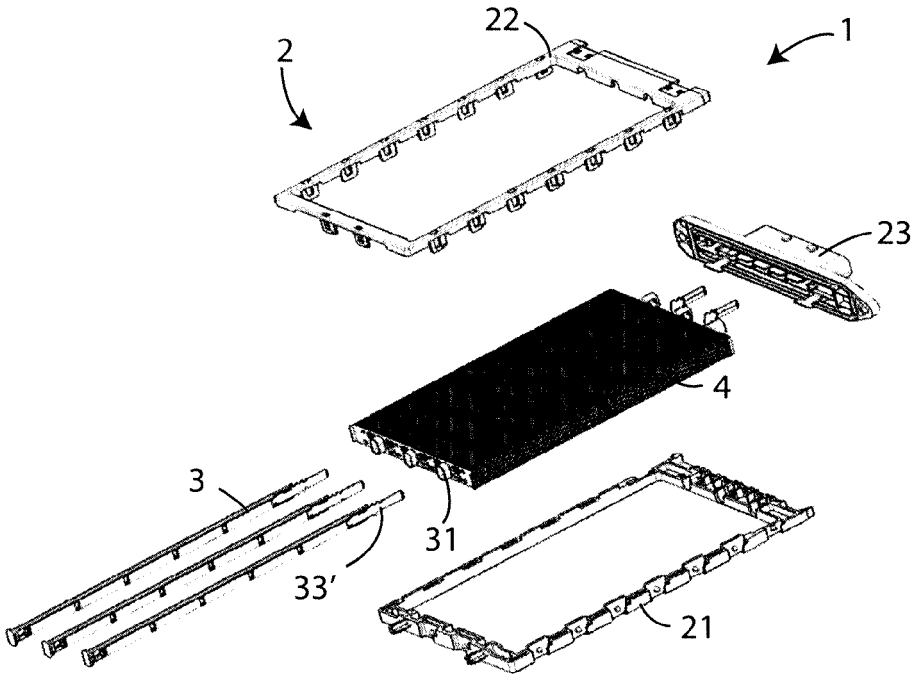

Fig. 1

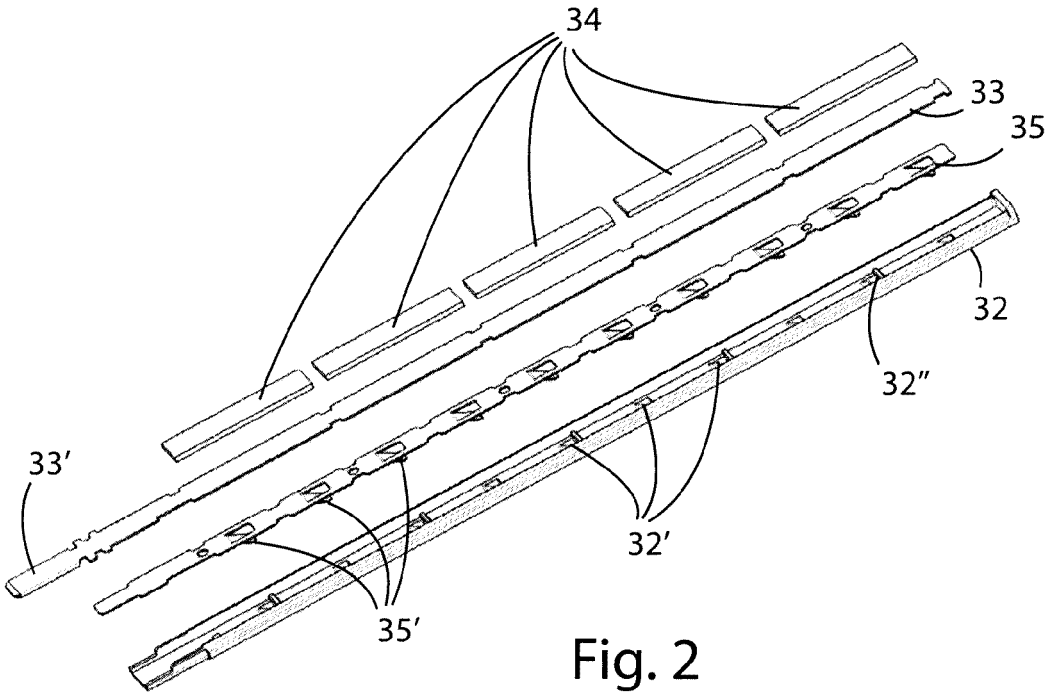

Fig. 2

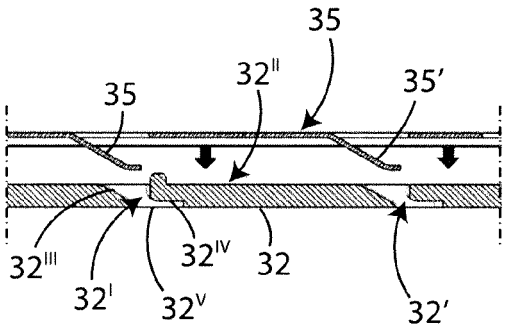

Fig. 3

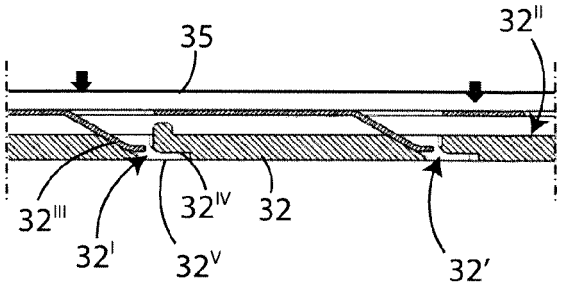

Fig. 4

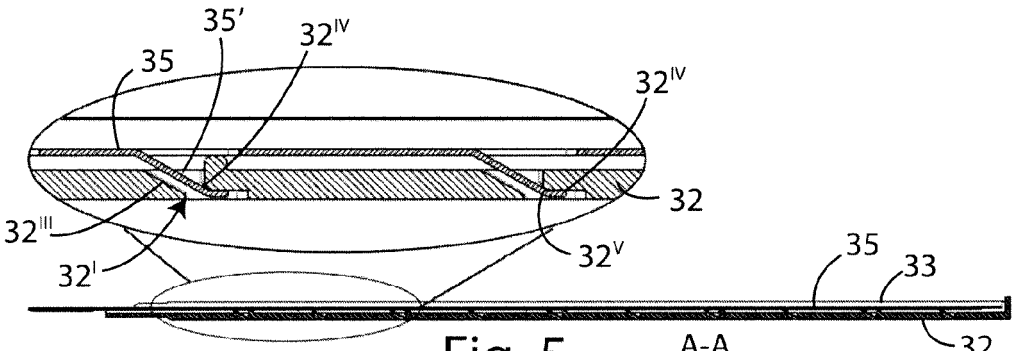

Fig. 5

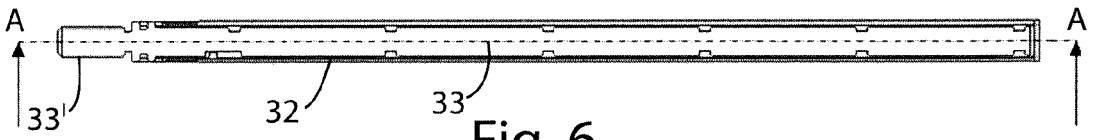

Fig. 6

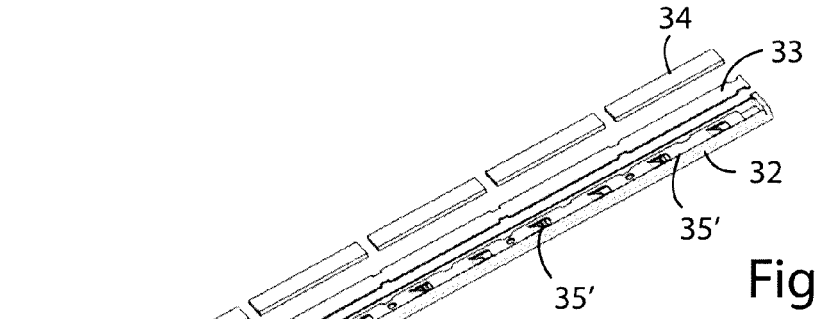

Fig. 7

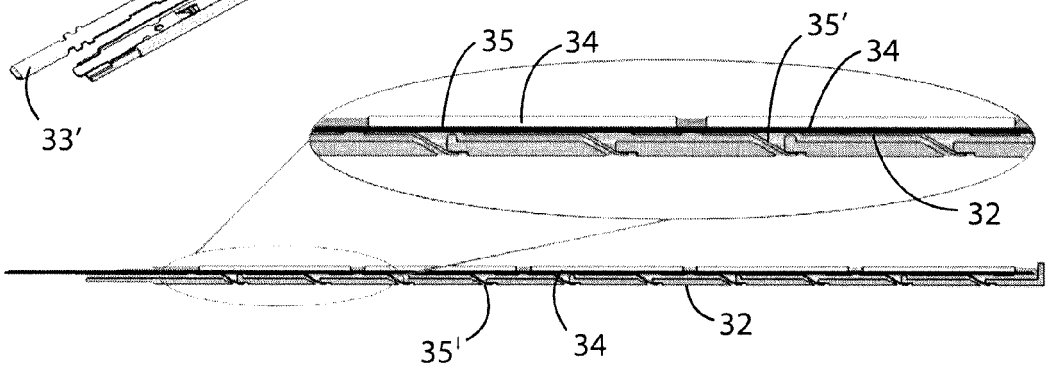

Fig. 8

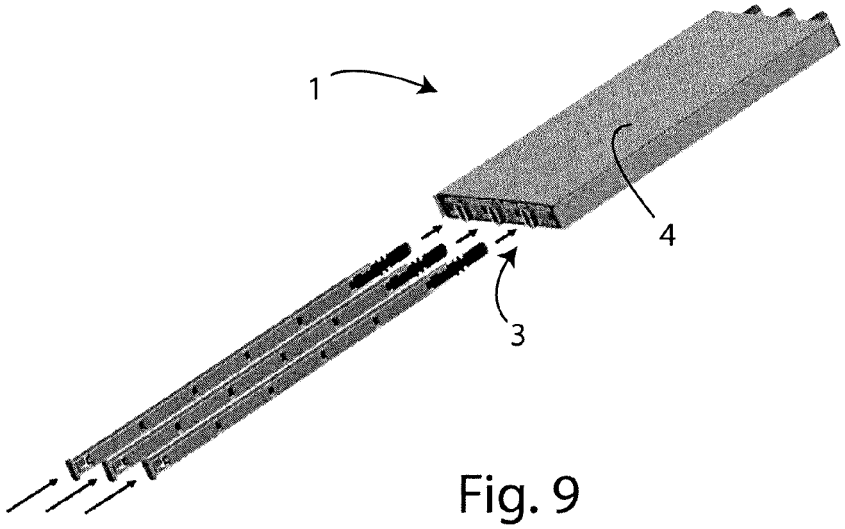

Fig. 9

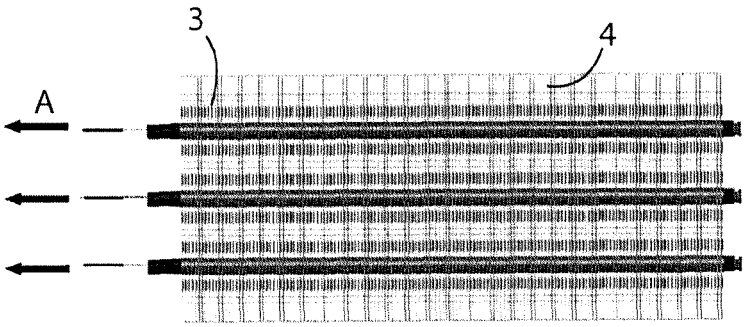

Fig. 10

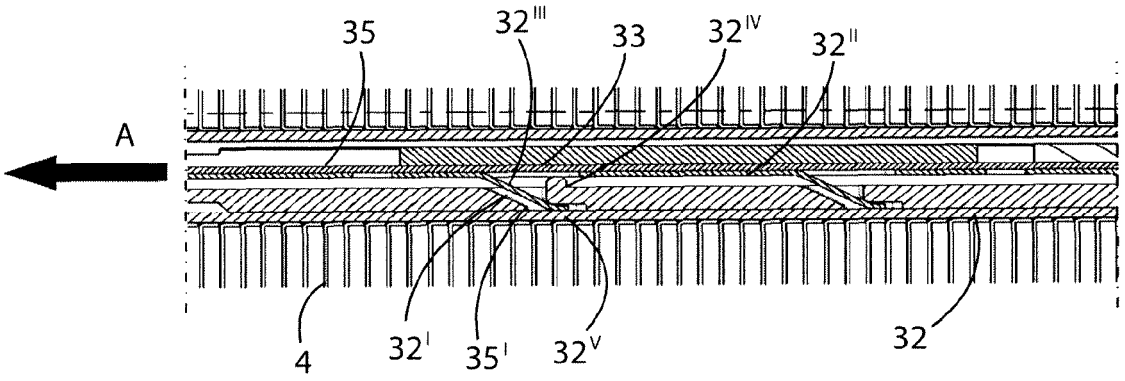

Fig. 11

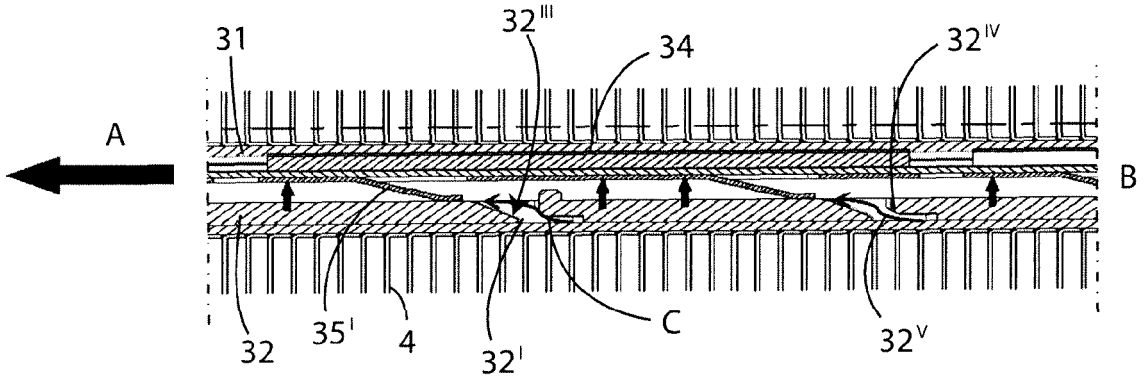

Fig. 12

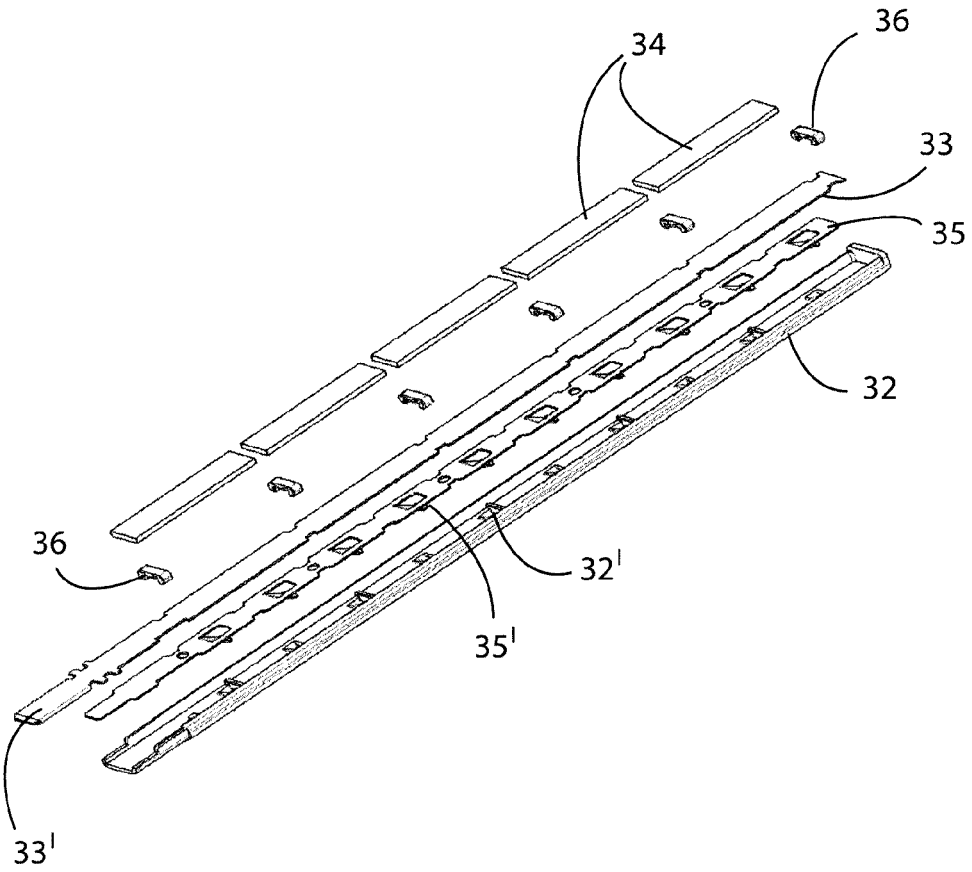

Fig. 13

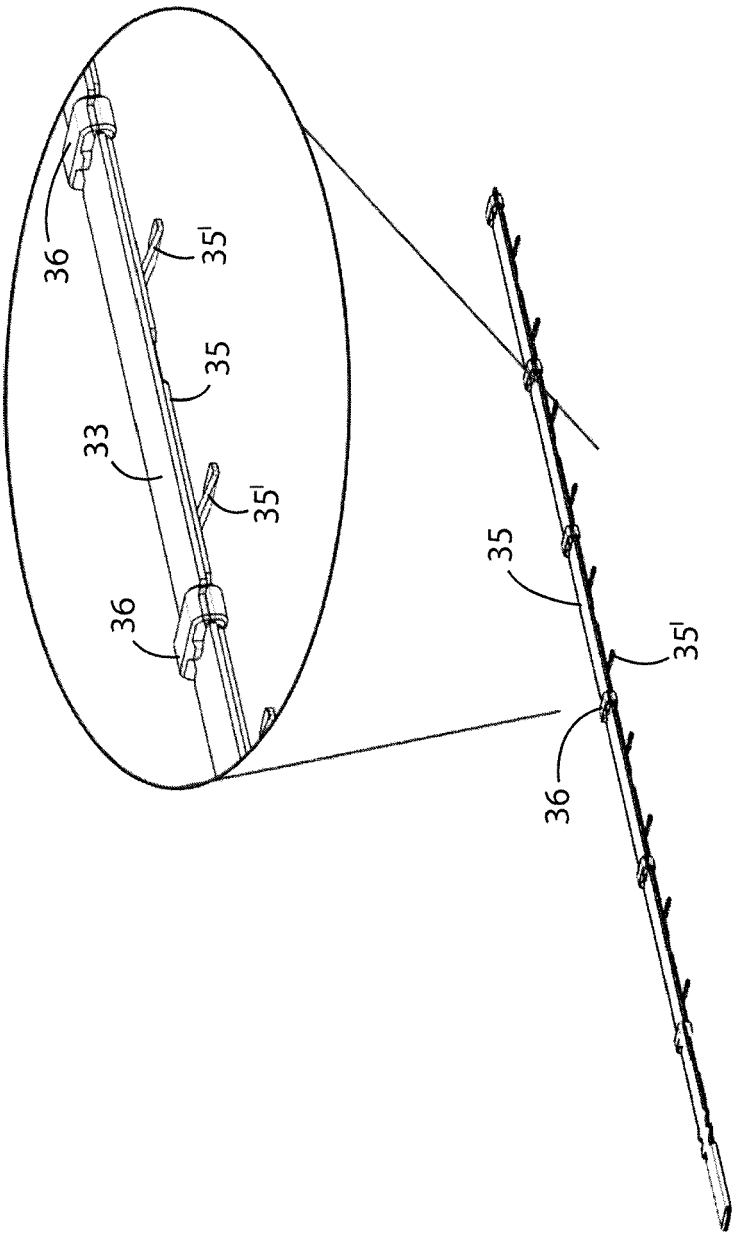

Fig. 14

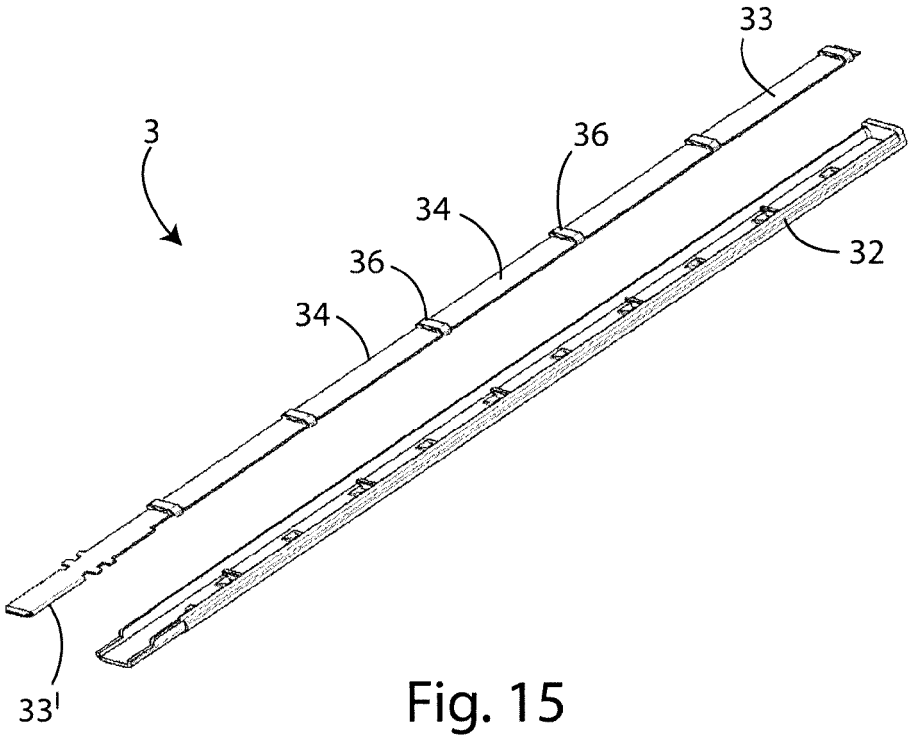

Fig. 15

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EUROPEAN SEARCH REPORT

Application Number
EP 14 42 5092

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H05B
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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	16 January 2015	Arndt, Markus

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