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(54) HIGH VOLTAGE AIR HEATER INCLUDING A CONTROL HOUSING AND METHOD FOR THE ASSEMBLY THEREOF

(57) Disclosed is a high voltage air heater comprising pre-assembled heater steps which each comprise a middle component and two outer lamella elements. The heater steps further comprise a frame and are fastened at a distance to each other via a respective end portion and via a respective rotatable locking ring to a control housing of the high voltage air heater. In the control housing, high voltage switching elements are, by a respective clamp element, clamped against a respective heat dissipation element, wherein the arrangement of voltage switching element, clamp element, and heat dissipation element is disposed at a common side of a printed circuit board assembly.

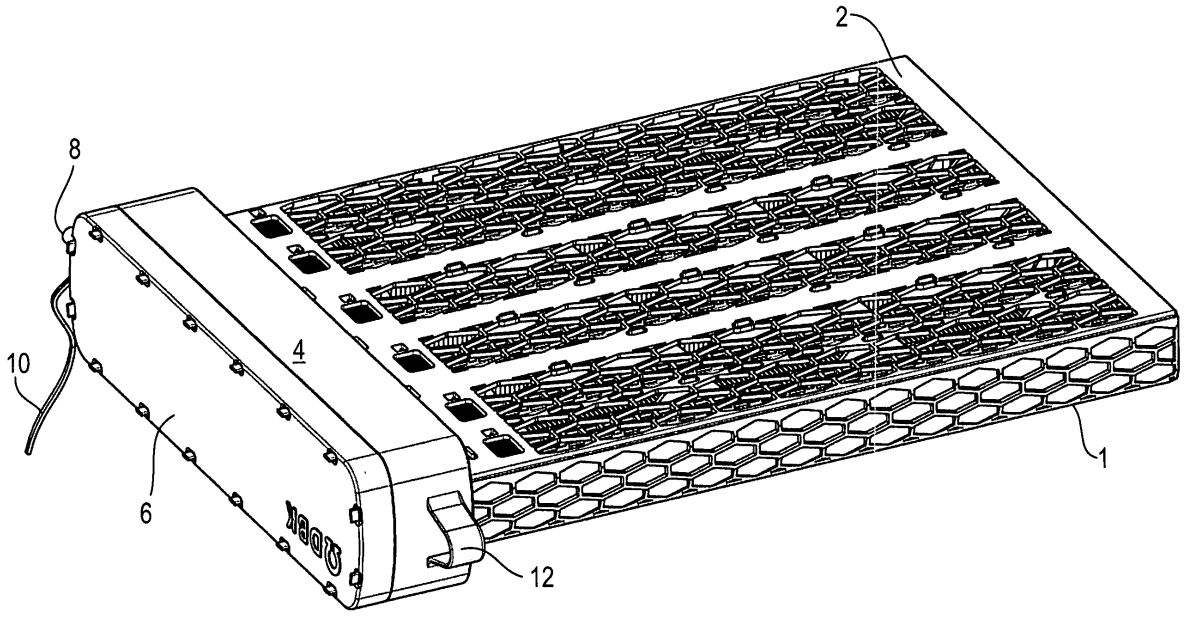


Fig. 1

EP 3 310 127 A1

Description

[0001] The invention relates to a high voltage air heater in accordance with the preamble of claim 1 and to a method for the assembly thereof.

[0002] With air heaters, for instance, for heating the air of vehicle passenger compartments it is known to dissipate the heat of energized PTC elements via lamella elements to the air which is guided through the lamella elements and then into the vehicle passenger compartment. PTC elements have a positive temperature coefficient and are therefore self-regulating PTC thermistors building up increasing electrical resistance with increasing heat, so that the electrical power absorbed and hence also the heating power are reduced.

[0003] Documents EP 1 327 834 B1 and EP 1 445 553 A1 each disclose such air heaters for vehicles in which several heat-generating PTC elements are arranged in elongate housings which are in turn in close succession in contact with the heat-dissipating elongate lamella elements. Disadvantages of such air heaters are their adaptability for low voltages and their limited power.

[0004] In EP 2 607 121 A1 an air heater is illustrated in which the housings with the PTC elements are likewise in close succession in layered contact with the lamella elements and thus form a cuboidal throughflowable block encompassed in a correspondingly cuboidal frame. A control housing in which a printed circuit board assembly and power switches are arranged is provided at one of the two shorter front sides. The power switches are clamped against a respective cooling body via a respective pressure element.

[0005] The disadvantage of such air heaters is that the pressure elements penetrate the printed circuit board assembly to support themselves on a cover of the control housing. The results of this are disadvantageous restrictions with respect to the size and usability of the surface and with respect to the mounting of the printed circuit board assembly.

[0006] Compared with this it is an object of the invention to provide an air heater and a method for the assembly thereof in which the disadvantages mentioned are reduced or avoided.

[0007] This object is solved by a high voltage air heater with the features of claim 1 and by a method for the assembly thereof with the features of claim 15.

[0008] The claimed high voltage air heater comprises a control housing via which several PTC elements can be energized, wherein a printed circuit board assembly and several high voltage switching elements are arranged in the control housing. The high voltage switching elements are clamped in a heat-conducting manner against a respective heat dissipation element by a respective mechanical clamp element. In accordance with the invention the clamp elements and the high voltage switching elements are arranged at a common first side of the printed circuit board assembly. Thus, the pressure elements or clamp elements, respectively, do not penetrate the printed circuit board assembly. This results in advantages with respect to the usability of the surface and with respect to the mounting of the printed circuit board assembly.

[0009] High voltage means in the scope of this document at least 100 Volt, preferably at least 500 Volt.

[0010] The device technology and the assembly technique are simple if the clamp elements are manufactured of spring steel sheet, preferably are folded and bent.

[0011] The clamp elements are preferably arranged at a distance to the printed circuit board assembly. Then, the clamp elements manufactured of electrically conducting spring steel sheet do not disturb the electronic functions of the printed circuit board assembly.

[0012] Further advantageous developments of the invention are described in the dependent claims.

[0013] The device technology is simple and space is saved if the clamp elements are arranged between the printed circuit board assembly and the respective high voltage switching element, and/or if the clamp elements support themselves directly on the respective heat dissipation element.

[0014] If the heat dissipation elements comprise a respective contact face for the respective high voltage switching element, it is preferred if the clamp elements engage behind the respective contact face at opposing sides and/or edge regions of the contact face.

[0015] The production is simple if the clamp elements each comprise a contact portion which is arranged approximately parallel to the contact face of the heat dissipation element and if the clamp elements each have two lateral portions extending from the contact portion in the direction of the respective heat dissipation element.

[0016] The two lateral portions may be arranged approximately rectangular to the contact portion.

[0017] In order to achieve a safe contact of the high voltage switching elements with the respective heat dissipation element it is preferred if the contact faces are encompassed by a respective rectangular edge and/or frame. The dimension thereof may correspond in a fixing direction to a corresponding dimension of the associated high voltage switching element, and the dimension thereof may be larger in a shifting direction than a corresponding dimension of the associated high voltage switching element. Thus, it is possible to readjust the positions of the high voltage switching elements in the shifting direction during assembly, e.g. if their pins are to be inserted through corresponding recesses of the printed circuit board assembly. Or, due to the flexibility provided, different models of the high voltage air heater in accordance with the invention may, despite different positions of the heat dissipation elements, be provided with the same printed circuit board assemblies.

[0018] The PTC elements may be accommodated in components referred to as step cores, to the two outer surfaces of which a lamella element each is fastened - preferably glued - in a heat-conducting manner, thus forming pre-assembled heater steps.

[0019] In order to be able to easily assemble the heater steps in the high voltage air heater in accordance with the invention or to reduce the resistance during the throughflowing thereof with air, the heater steps may be arranged with a respective distance - preferably a parallel distance - to each other in the interior of a main body housing.

[0020] For dissipation of the heat of the high voltage switching elements with high thermal transfer efficiency the heat dissipation elements may have cooling ribs extending through a wall of the control housing into the interior of the main body housing, wherein preferably openings are provided in the main body housing for throughflowing and cooling of the cooling ribs. It is particularly preferred if, for the cooling ribs of each heat dissipation element, an own pair of opposing openings is provided, so that the cooling ribs are arranged in the flow direction of the air between the openings of the pair and are cooled optimally.

[0021] Redundancy can be accomplished with an additional (especially 4^{th}) high voltage switching element to shut off the entire high voltage air heater even if the PTC elements possess no safety issue due to its self regulating properties.

[0022] The cooling ribs and the pairs of openings may be arranged between the spaced-apart heater steps.

[0023] For a tight closure of the control housing it may comprise a substantially two-dimensional control housing cover extending over the entire side of the control housing which faces away from the heater steps.

[0024] Preferably, recesses are formed on the control housing cover through which projections or pivots of the control housing extend, wherein the projections and/or pivots are connected with the recesses by welding or by plastic expansion of the projections and/or pivots.

[0025] For optimal sealing the pairs of recesses and projections and/or pivots are preferably distributed evenly at the circumference of the control housing and the control housing cover.

[0026] In particular if the electronics in the control housing enables that the power input of the high voltage air heater in accordance with the invention is adjusted with sufficient fineness, electric conductors may be provided which connect the heater steps pairwise with a common positive pole and pairwise with a common negative pole. The electric conductors and the poles are arranged in the interior of the control housing. Preferably, the electric conductors are arranged at the first side of the printed circuit board assembly which faces the high voltage switching elements and the clamp elements and the heat dissipation elements. In an embodiment which is simple with respect to device technology the electric conductors are stamped parts.

[0027] In a concrete embodiment the high voltage air heater comprises three high voltage switching elements and six heater steps and three common negative poles and three common positive poles and six electric conductors.

[0028] In a further development which is simple with respect to device technology the common negative poles and/or the common positive poles are further developed as integral supports for the printed circuit board assembly by which the printed circuit board assembly is retained in the control housing.

[0029] The high voltage switching elements are preferably insulated-gate bipolar transistors (IGBTs) or metal oxide semiconductor field-effect transistors (MosFets).

[0030] The method according to the invention serves to assemble the above-described high voltage air heater and comprises the following steps in the order mentioned:

- contacting of the high voltage switching elements with the respective heat dissipation element,
- clamping of the high voltage switching elements by means of the respective clamp element, and
- inserting of the printed circuit board assembly in the control housing.

[0031] An embodiment of the high voltage air heater in accordance with the invention is illustrated in the Figures. The invention will now be explained in detail by means of the Figures.

[0032] There show:

Figure 1 the embodiment of the high voltage air heater in accordance with the invention in a perspective view,
Figure 2 the embodiment of figure 1 in an exploded view,
Figure 3 the embodiment of figure 1 in a further exploded view,
Figure 4 the embodiment of figure 1 in plan view,
Figure 5 a section of the embodiment of figure 1 in longitudinal section,
Figure 6 a heater step of the embodiment of the high voltage air heater of figure 1 in a perspective view,
Figure 7 the heater step of figure 6 in an exploded view,
Figure 8 the heater step of figure 6 in a perspective cross-section,
Figure 9 the assembly of a locking ring of the heater step of figure 6 in four perspective individual views,
Figure 10 the assembled locking ring of figure 9 in a perspective sectional view, and
Figures 11 to 14 the high voltage air heater with an open control housing in perspective views.

[0033] Figure 1 shows the embodiment of the high voltage air heater in accordance with the invention in a perspective view. It comprises a main body housing 1 which is covered by an approximately two-dimensional main body housing cover 2. Thus, an approximately cuboidal interior is formed which will be explained in detail with reference to the further figures.

[0034] A likewise approximately cuboidal control hous-

ing 4 which is covered by a control housing cover 6 is fastened to the front side of the main body housing 1. The two parts 4, 6 are formed as two shell parts, with the control housing 4 being larger than the control housing cover 6. At the two front sides of the control housing 4 a screw fixation 12 each is formed integrally; only one screw fixation 12 thereof is illustrated in the figure. An electronic arrangement in the interior of the control housing 4 is energized by a power cable 8 and controlled by a signal wire 10.

[0035] In operation the high voltage air heater in accordance with the invention is placed in an airflow which is directed approximately perpendicular to the main body housing cover 2 and which is guided into the interior of an electrically driven vehicle. The high voltage air heater is fixed by the two screw fixations 12 and is energized via the power cable 8 with a voltage of e.g. 350 Volt from the on-board electrical system of the vehicle.

[0036] Figure 2 illustrates the high voltage air heater of figure 1 in an exploded view. In the interior of the main body housing 1 six elongate heater steps 14 are arranged spatially in parallel to each other, by which the current is electrically converted to heat and which will be explained in detail with reference to the following figures. Each heater step 14 is, with its end portion (positioned at the left in figure 2), connected with the control housing 4 through a bayonet lock. Each bayonet lock has a coupling projection 16 formed integrally with the control housing 4 and a locking ring 18 positioned at the respective heater step 14, wherein the bayonet lock will be explained in detail with respect to the following figures. Furthermore, figure 2 illustrates that a printed circuit board assembly 20 which the power cable 8 is connected to via two connections 22 is accommodated in the interior of the control housing 4.

[0037] From the control housing 4, pivots 24 which are distributed evenly at the rim extend in the direction to the control housing cover 6. In the assembled state of the control housing 4 these pivots 24 penetrate respective through-recesses 26 of the control housing cover 6, and the end portions of the pivots 24 are welded or shaped with the control housing cover 6.

[0038] Figure 2 further illustrates that the main body housing 1 and the main body housing cover 2 are each penetrated by a plurality of hexagonal through-recesses 28 through which the airflow to be heated is guided.

[0039] The main body housing 1 and the main body housing cover 2 can be connected with each other by means of clips or by welding or shaping. According to figure 2, pivots 29 are distributed evenly at the rim of the main body housing cover 2 and extend in the direction to the main body housing 1 to be welded or shaped there.

[0040] Figure 3 illustrates the high voltage air heater according to the preceding figures in a further exploded view. The changed perspective reveals a first side of the printed circuit board assembly 20 which faces the heater steps 14 and at which three high voltage switching elements 30 are arranged at a distance to the printed circuit board assembly 20. The high voltage switching elements 30 are in contact with a respective heat dissipation element 32 manufactured of aluminum or copper, wherein only respective groups of cooling ribs 34 of the heat dissipation elements 32 are illustrated in figure 3. They project through the control housing 4 into the main body housing 1 and are arranged between always two coupling projections 16.

[0041] In accordance with figure 2 three respective openings 36 are provided in each the main body housing 1 and the main body housing cover 2, said openings 36 being arranged pairwise before and behind the groups of cooling ribs 34 such that the high voltage switching elements 30 dissipate their heat via the heat dissipation elements 32 and further via their respective group of cooling ribs 34 to the airflow, so that the high voltage switching elements 30 are optimally cooled and thus contribute to the heating of the airflow.

[0042] Furthermore, in figures 2 or 3, each in the main body housing 1 and in the main body housing cover 2 six through-recesses 38 are illustrated which are also positioned pairwise consecutively in the flow direction. The through-recesses 38 serve to cool connection points between the heater steps 14 and respective electric connections (crimp places) to the printed circuit board assembly 20.

[0043] Figure 4 shows a plan view of the control housing cover 6.

[0044] Figure 5 shows a longitudinal section according to the section plane A-A of figure 4 through a part of the high voltage air heater in accordance with the invention. More precisely, the control housing 4 and a part of the main body housing 1 are illustrated.

[0045] Each of the six heater steps 14 has two terminal tabs, wherein only one respective terminal tab 40 thereof is illustrated in figure 5. Two equally polarized terminal tabs 40 of two different heater steps 14 are each electrically connected with a joint electric contact 44 of the printed circuit board assembly 20 via respective crimp places and a joint (basically y-shaped) electric conductor 42. Of the total of six electric conductors 42 only three end portions are illustrated which are plugged into associated electric contacts 44 of the printed circuit board assembly 20. Thus, two heater steps 14 are each energized jointly and equally. The printed circuit board assembly 20 enables that the heating power of each pair of heater steps 14 is selected and controlled finely.

[0046] Due to the pairwise grouping of always two heater steps 14 only three high voltage switching elements 30 are required which are illustrated in section in the figure along with a respectively associated heat dissipation element 32. Moreover, three respective pins 46 of the high voltage switching elements 30 can be recognized which extend at an angle in parallel to the section plane of figure 5 and the end portions of which are inserted in corresponding recesses of the printed circuit board assembly 20 and are soldered there.

[0047] Figure 6 illustrates a heater step 14 with its cir-

cumferential frame 48 at the end portion of which the locking ring 18 is arranged rotatably.

[0048] Figure 7 illustrates the heater step 14 of figure 6 in an exploded view. The frame 48 is formed of a circumferential step housing 50 and a likewise circumferential step housing cover 52. The locking ring 18 is attached rotatably at the step housing 50.

[0049] The step housing 50 and the step housing cover 52 clamp a series of PTC elements 54 in a component formed of two cover plates 60. More precisely, the PTC elements 54 are clamped between two contact plates 56 to which the two terminal tabs 40 (mentioned with reference to figure 5) are also fastened. Outside of the two contact plates 56 respective insulation plates 58 are provided, at the outer sides of which in turn a respective one of the two cover plates 60 is arranged. Respective lamella elements 62 are glued to the outer sides of the two cover plates 60 and thus to the two outer sides of the component.

[0050] These lamella elements 62 are folded and/or bent from a long metal strip, so that a plurality of two-dimensional fins are formed which extend substantially away from the cover plates 16 and hence also away from the component of the heater steps 14 so as to be able to dissipate the heat of the PTC elements 54 optimally to the air.

[0051] Figure 8 illustrates a perspective sectional view of one of the heater steps 14, six of which have been incorporated in the embodiment of the high voltage air heater in accordance with the invention according to the preceding figures.

[0052] As was explained with reference to figure 7, the PTC elements 54 are contacted electrically on both sides via the respective contact plate 56. At the outer sides thereof the two insulation plates 58 and the two cover plates 60 are arranged, wherein, at the outwardly facing surfaces of the cover plates 60 to which also the respective lamella element 62 is glued, retaining grooves 66 are provided into which respective projections 68 of the step housing 50, on the one hand, and of the step housing cover 52, on the other hand, are inserted.

[0053] The connection of the step housing 50 with the step housing cover 52 is performed via projections 70 distributed on the outer circumference of the thus-formed frame 48, which are inserted in corresponding through-recesses 72 and are secured and connected there by means of welding, e.g. ultrasonic welding or by shaping.

[0054] In order to seal the energized inner region of the heater step 14 and/or its component from moisture, a respective seal 73 is arranged between the (in figure 8 upper) cover plate 60 and the step housing cover 52 and between the (in figure 8 lower) cover plate 60 and the step housing 50. Finally, a seal 75 is also arranged between the step housing 50 and the step housing cover 52. The three seals 73, 75 and the frame 48 consisting of the step housing 50 and the step housing cover 52 are approximately rectangular and elongate and comprise the entire component of the heater step 14.

[0055] Figure 9 illustrates (in a succession of four individual views from the left to the right) the assembly and/or fastening of the heater step 14 and/or its frame 48 to the control housing 4 through the bayonet lock. The bayonet lock has, on the one hand, an approximately circular cylindrical coupling projection 16 which is formed integrally on the control housing 4 and, on the other hand, a rotatable locking ring 18 which is arranged on the frame 48. The coupling projection 16 has two semicircular retaining webs 74 opposing each other and directed radially outwardly, while the locking ring 18 comprises correspondingly two semicircular retaining webs 76 opposing each other and directed radially inwardly. Each retaining web 74, 76 extends over somewhat less than 90 degrees at the circumference of the corresponding component 16, 18. An axial corrugation is provided at the outer circumference of the locking ring 18 such that, during assembly and electric contacting of the heater step 14 at the control housing 4, the locking ring 18 is first of all shifted in axial direction over the coupling projection 16 and then locked by a rotation about approximately 90 degrees.

[0056] In the interior of the locking ring 18 the terminal tabs 40 (which are hidden in figure 9) extend (cf. figure 7). In order to seal them and other energized components in the interior of the coupling projection 16 from moisture, a radial sealing element 78 is inserted in a groove at the outer circumference thereof.

[0057] Figure 10 illustrates in a perspective, partially sectional view in particular the interior of the coupling projection 16, wherein the frame 48 of the heater step 14 is fastened to the control housing 4 through the bayonet lock. In this process, the retaining webs 76 of the locking ring 18 engage behind the retaining webs 74 of the coupling projection 16. For sealing, an axial sealing element 79 is, beyond the radial sealing element 78 mentioned with reference to figure 9, clamped between a front side of the coupling projection 16 and a corresponding contact of the frame 48. The locking ring 18 comprises an anti-twist protection which is formed by an axial corrugation at the outer circumference of the locking ring 18 and of a lug 81 which is fastened to the control housing 4 and snaps into the corrugation. One of the two terminal tabs 40 and the electric contacting thereof is illustrated in the interior of the coupling projection 16.

[0058] Figure 11 illustrates the high voltage air heater and/or in particular the opened control housing 4 in a perspective view. For each heater step 14 (which is not illustrated in detail in figure 11) the two terminal tabs 40 and their electric contacting can be recognized. Due to the pairwise grouping of the heater steps 14 only three high voltage switching elements 30 are required which are each illustrated in the state not yet assembled, while the respective associated heat dissipation elements 32 are already assembled in the interior of the control housing 4.

[0059] Each heat dissipation element 32 has a contact face 80 which is surrounded by a rim 82. The rim 82 is

in a so-called shifting direction (which runs from the left to the right in figure 11) larger than the associated voltage switching element 30.

[0060] Furthermore, a total of six electric contacts 44 are illustrated in figure 11, which have already been explained with reference to figure 5.

[0061] Figure 12 illustrates the high voltage switching elements 30 in their state in contact with the contact face 80 of the heat dissipation elements 32. Furthermore, three clamp elements 84 are illustrated which are manufactured of spring steel sheet and by which the high voltage switching elements 30 are clamped against the contact faces 80. For this purpose the clamp elements 84 encompass the high voltage switching elements 30 and engage with their respective lugs 86 behind the contact faces 80.

[0062] Figure 13 illustrates the assembled state of the clamp elements 84 by their clamping the high voltage switching elements 30 against the (in figure 13 underlying) heat dissipation elements 32.

[0063] The heat dissipation elements 32 with the high voltage switching elements 30 and the clamp elements 84 are positioned in an (in figure 13 lower) area of the control housing 4 which faces the heater steps 14. In this area the electric conductors 42 (mentioned with reference to figure 5) are also used, which - as already explained - electrically connect always two terminal tabs 40 of two different heater steps 14 jointly with one of the electric contacts 44.

[0064] Figure 14 illustrates an assembly state of the electronics in the interior of the control housing 4 which follows the one of figure 13. The printer circuit board assembly 20 is placed in the control housing 4 and electrically connected with the electric contacts 44 by which it is also retained mechanically. Thus, the heat dissipation elements 32 with the high voltage switching elements 30 and the clamp elements 84 are all arranged at a first side (in figure 14 beneath) of the printed circuit board assembly 20. At a second side (which is visible in figure 14) of the printed circuit board assembly 20 which is opposite to the first side, the power cable 8 with the two connections 22 and the signal wire 10 are arranged. The control housing cover 6 (cf. figure 4) is finally fitted over the pivots 24.

[0065] Disclosed is a high voltage air heater comprising pre-assembled heater steps which each comprise a middle component and two outer lamella elements. The heater steps further comprise a frame and are fastened at a distance to each other via a respective end portion and via a respective rotatable locking ring to a control housing of the high voltage air heater. In the control housing, high voltage switching elements are, by a respective clamp element, clamped against a respective heat dissipation element, wherein the arrangement of voltage switching element, clamp element, and heat dissipation element is disposed at a common side of a printed circuit board assembly.

List of reference signs

[0066]

1	main body housing
2	main body housing cover
4	control housing
6	control housing cover
8	power cable
10	signal wire
12	screw fixation
14	heater step
16	coupling projection
18	locking ring
20	printed circuit board assembly
22	connection
24	pivot
26	through-recess
28	through-recess
29	pivot
30	high voltage switching element
32	heat dissipation element
34	group of cooling ribs
36	opening
38	through-recess
40	terminal tab
42	electric conductor
44	electric contact
46	pin
48	frame
50	step housing
52	step housing cover
54	PTC element
56	contact plate
58	insulation plate
60	cover plate
62	lamella element
64	fin
66	retaining groove
68	projection
70	projection
72	through-recess
73	seal
74	retaining web
75	seal
76	retaining web
78	radial sealing element
79	axial sealing element
80	contact face
81	lug
82	rim
84	clamp element
86	lug

Claims

1. A high voltage air heater comprising a control hous-

ing (4) via which several PTC elements (54) can be energized, wherein a printed circuit board assembly (20) and at least one high voltage switching element (30) is arranged in the control housing (4), and wherein the high voltage switching element (30) is clamped in a heat-conducting manner against a heat dissipation element (32) by a clamp element (84), **characterized in that** the clamp element (84) and the high voltage switching element (30) are arranged at a common first side of the printed circuit board assembly (20).

2. The high voltage air heater according to claim 1, wherein the clamp element (84) supports itself on the heat dissipation element (32).

3. The high voltage air heater according to any of the preceding claims, wherein the heat dissipation element (32) comprises a contact face (80) for the high voltage switching element (30), and wherein the clamp element (84) engages behind the contact face (80) at opposing sides.

4. The high voltage air heater according to claim 3, wherein the clamp element (84) comprises a contact portion which is arranged approximately parallel to the contact face (80) of the heat dissipation element (32), and wherein the clamp element (84) has two lateral portions extending from the contact portion in the direction of the heat dissipation element (32).

5. The high voltage air heater according to claim 3 or 4, wherein the contact face (80) is surrounded by a respective rectangular edge (82) whose dimension in a fixing direction corresponds to a dimension of the associated high voltage switching element (30), and whose dimension in a shifting direction is larger than a dimension of the associated high voltage switching element (30).

6. The high voltage air heater according to any of the preceding claims, wherein the PTC elements (54) are accommodated in components, to the two outer faces of which a lamella element (62) each is fastened in a heat-conducting manner, thus forming heater steps (14).

7. The high voltage air heater according to claim 6, wherein the heater steps (14) are arranged in the interior of a main body housing (1) at a respective distance to each other.

8. The high voltage air heater according to claim 7, wherein the heat dissipation element (32) has cooling ribs (34) extending through a wall of the control housing (4) into the interior of the main body housing (1).

9. The high voltage air heater according to claim 8, wherein openings (36) for throughflowing and cooling of the cooling ribs are provided in the main body housing (1).

10. The high voltage air heater according to any of claims 6 to 9, wherein the control housing (4) comprises a control housing cover (6) arranged on an side of the control housing (4) which faces away from the heater steps (14).

11. The high voltage air heater according to any of claims 6 to 10, wherein electric conductors are arranged at the first side of the printed circuit board assembly (20) which faces the one or more high voltage switching elements (30), said electric conductors connecting the heater steps (14) pairwise with a common positive electric contact (44) and pairwise with a common negative electric contact (44), wherein the electric conductors and the electric contacts (44) are arranged in the interior of the control housing (4).

12. The high voltage air heater according to claim 11, comprising three high voltage switching elements (30) and six heater steps (14) and three common positive electric contacts (44) and three common negative electric contacts (44) and six electric conductors.

13. The high voltage air heater according to claim 11 or 12, wherein the common positive electric contacts (44) and/or the common negative electric contacts (44) are further developed as supports for the printed circuit board assembly (20).

14. The high voltage air heater according to any of the preceding claims, wherein the high voltage switching elements (30) are IGBTs or MosFets.

15. A method for assembling a high voltage air heater according to any of the preceding claims, comprising the following steps in the order mentioned:

- contacting of the high voltage switching elements (30) with the respective heat dissipation elements (32),
- clamping of the high voltage switching elements (30) by means of the respective clamp element (84); and
- inserting of the printed circuit board assembly (20) in the control housing (4).

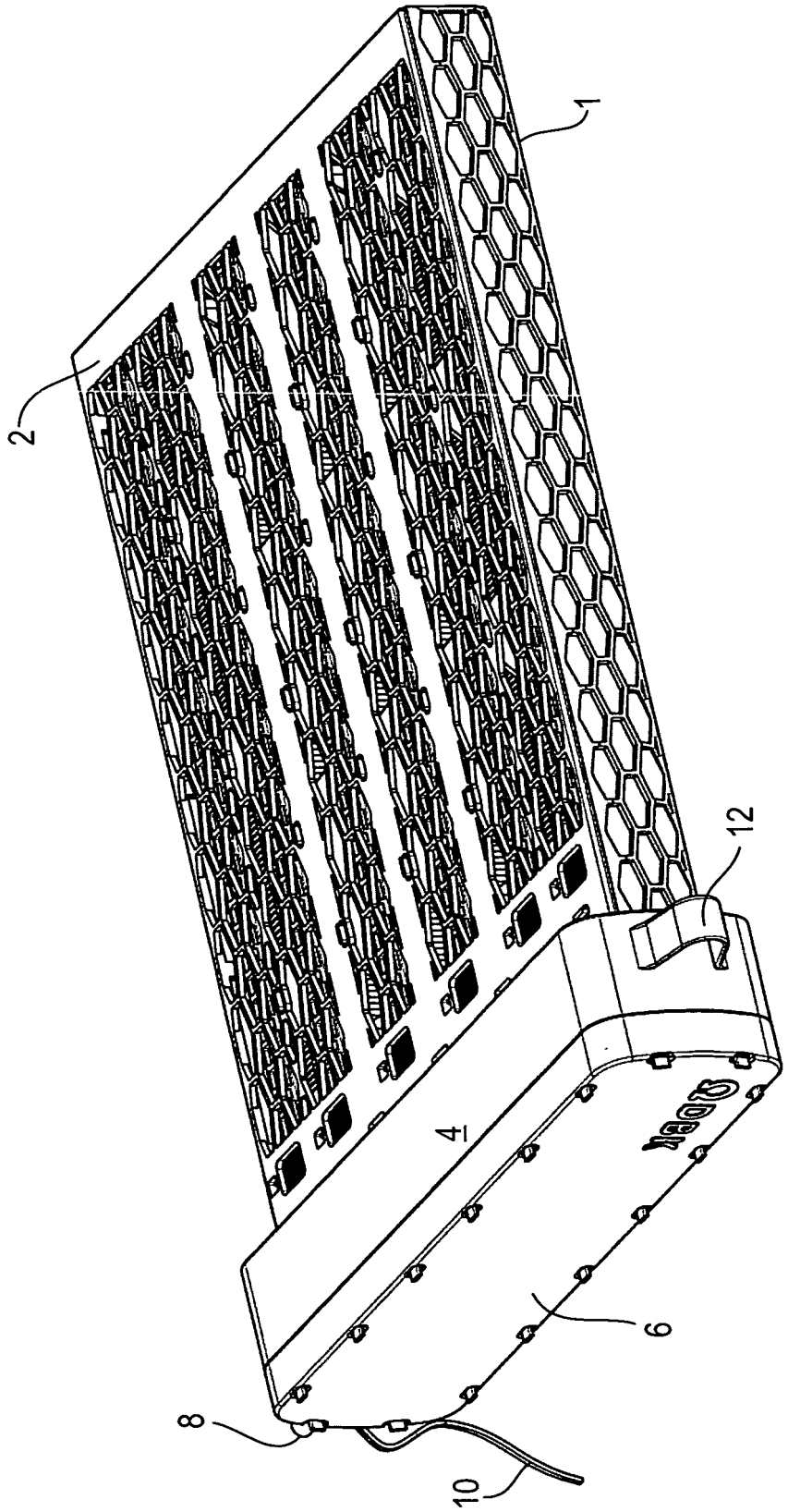


Fig. 1

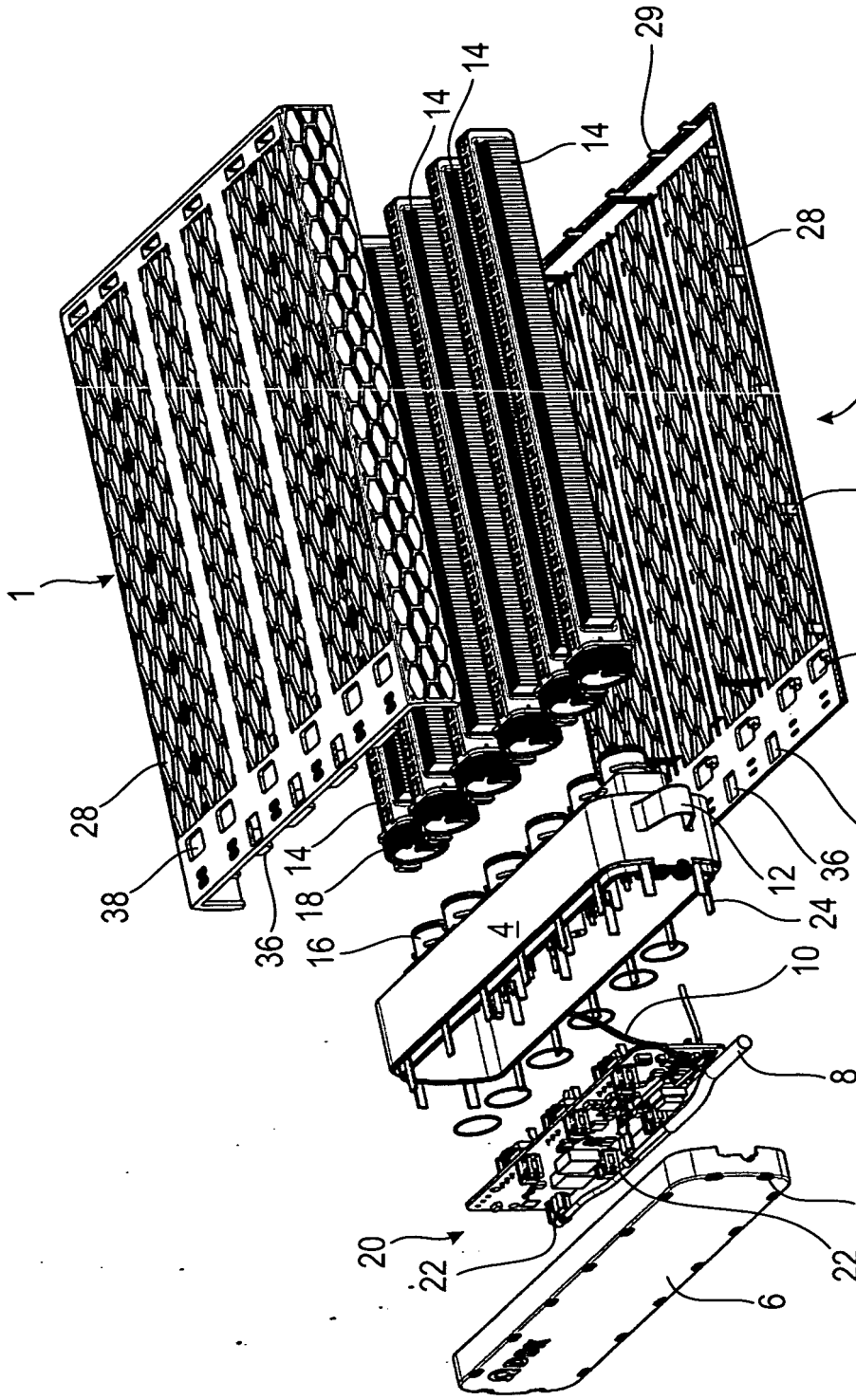


Fig. 2

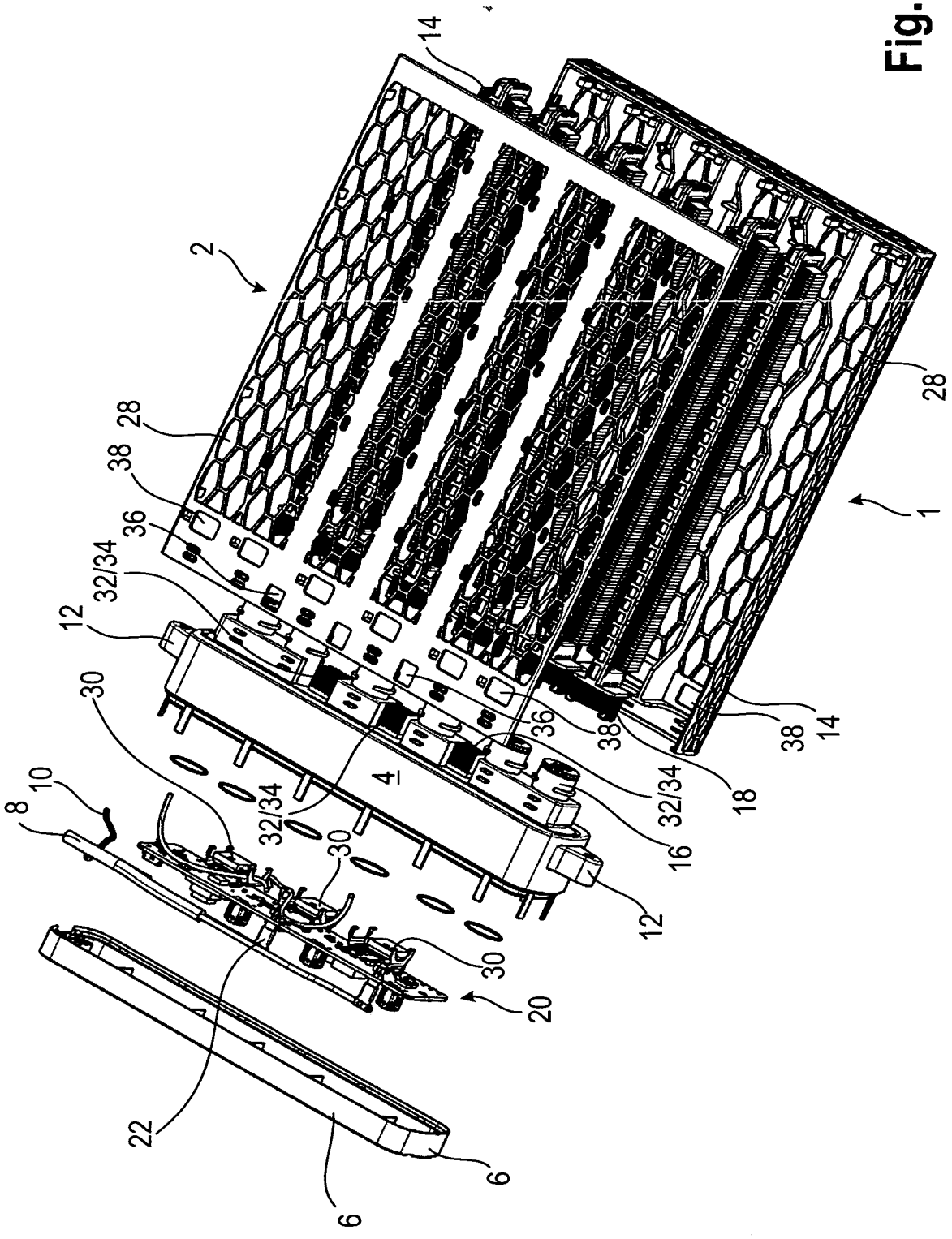


Fig. 3

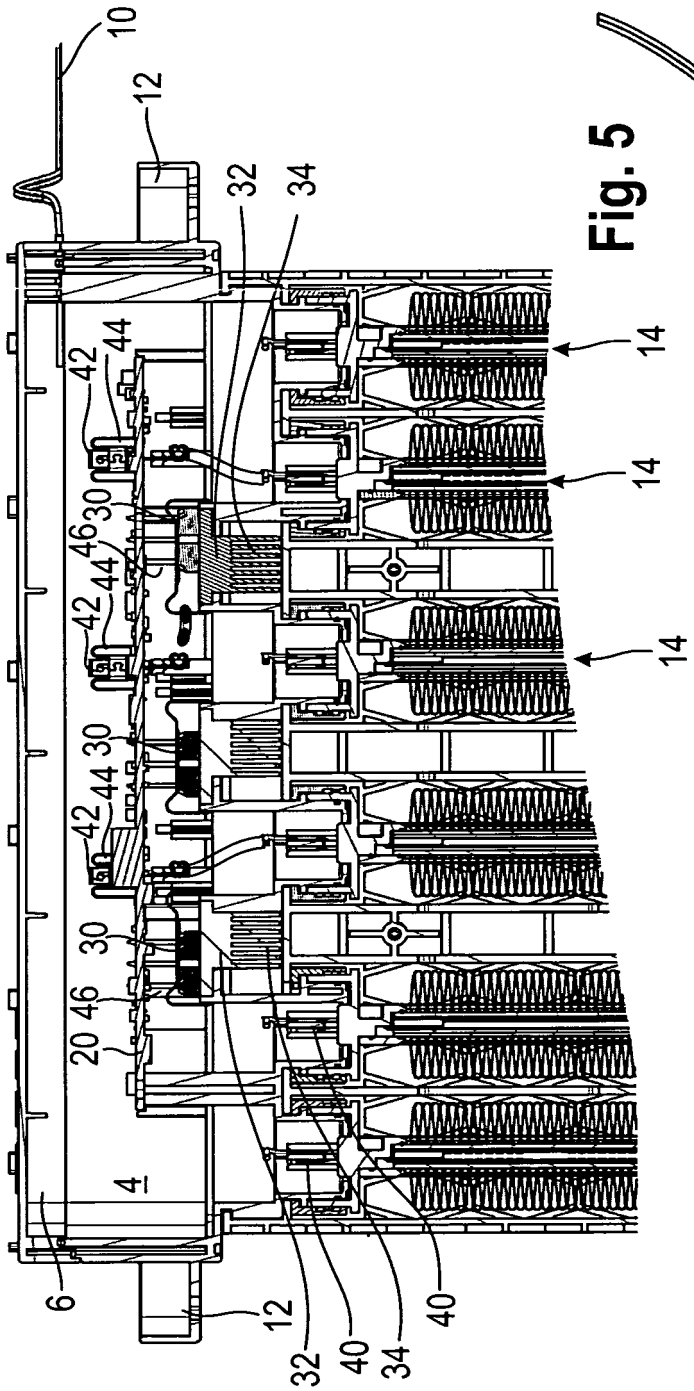


Fig. 5

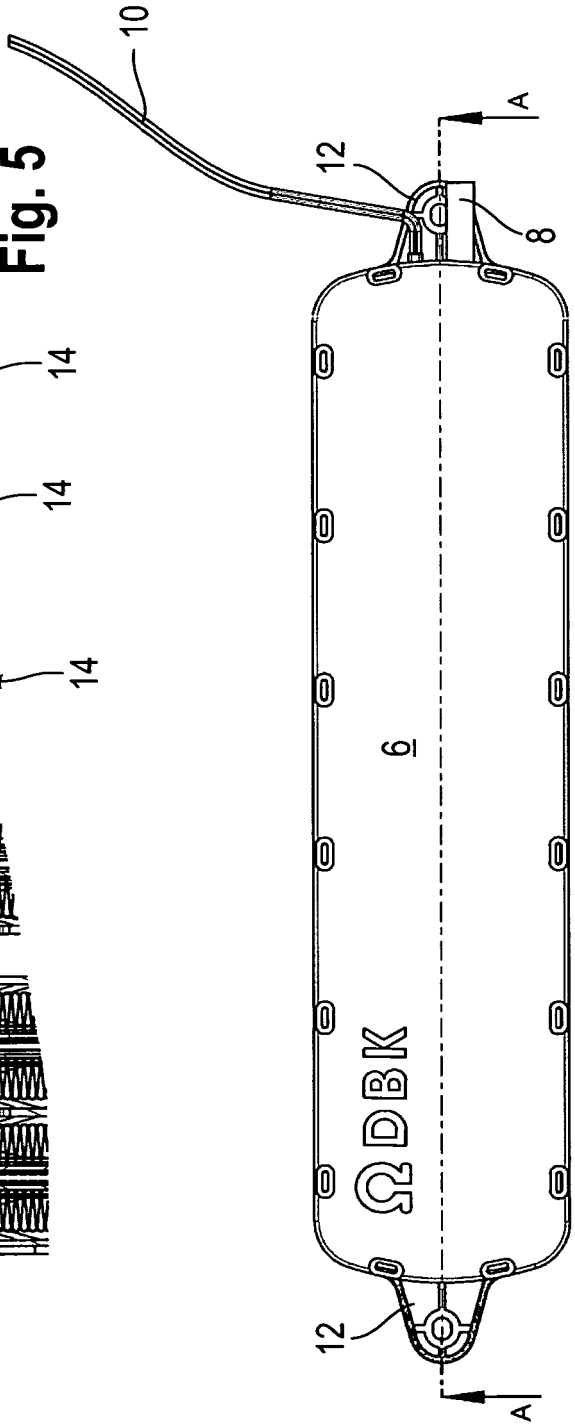


Fig. 4

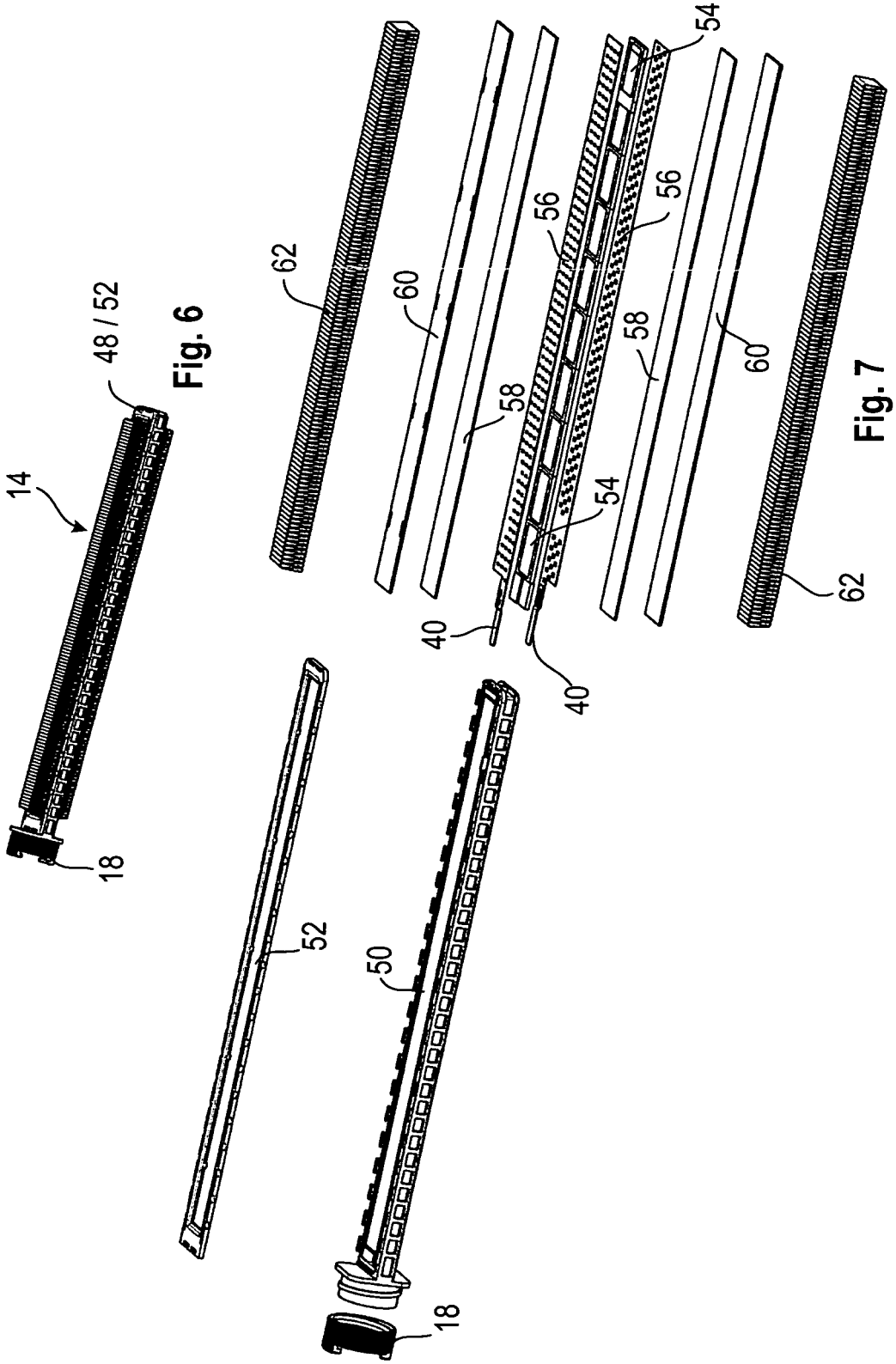


Fig. 6

Fig. 7

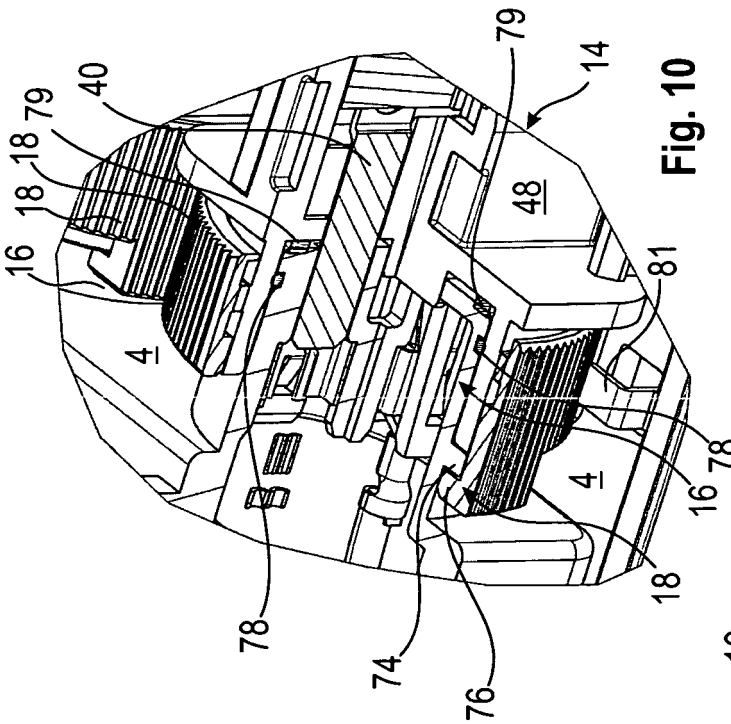


Fig. 10

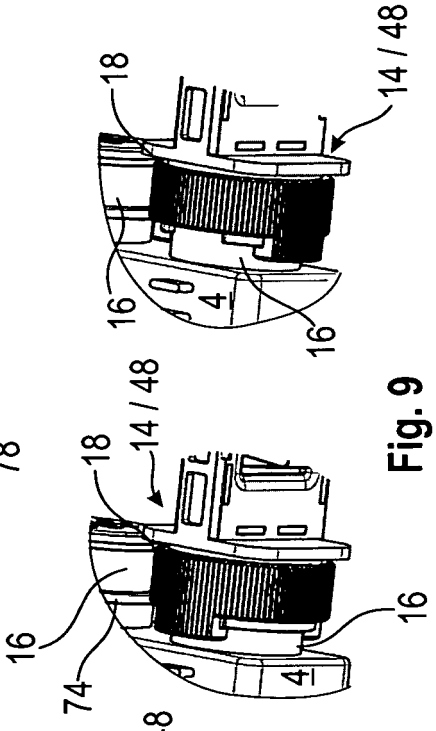


Fig. 9

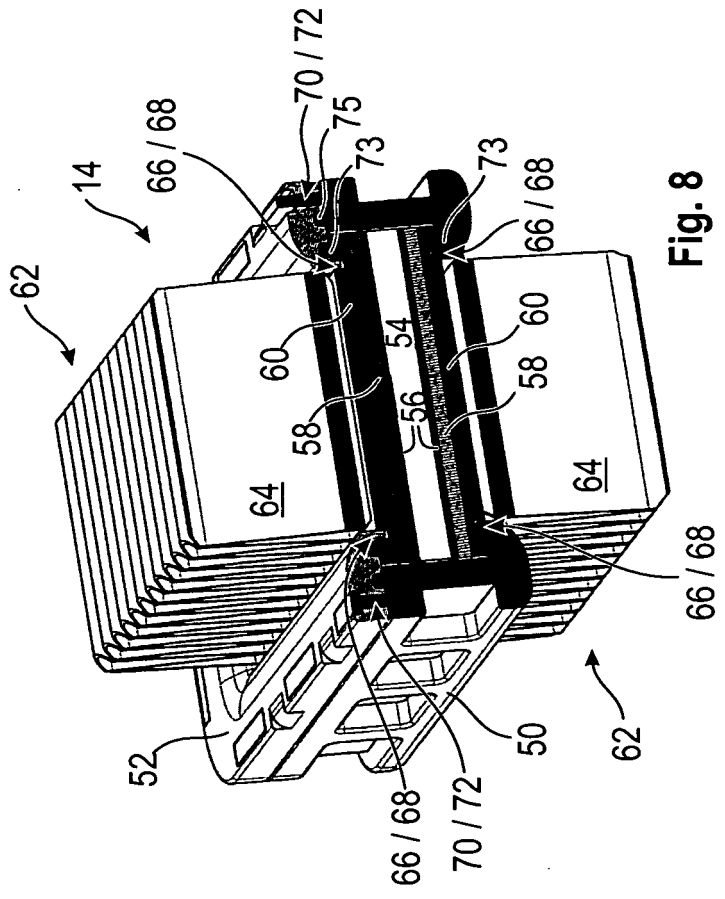


Fig. 8

Fig. 11

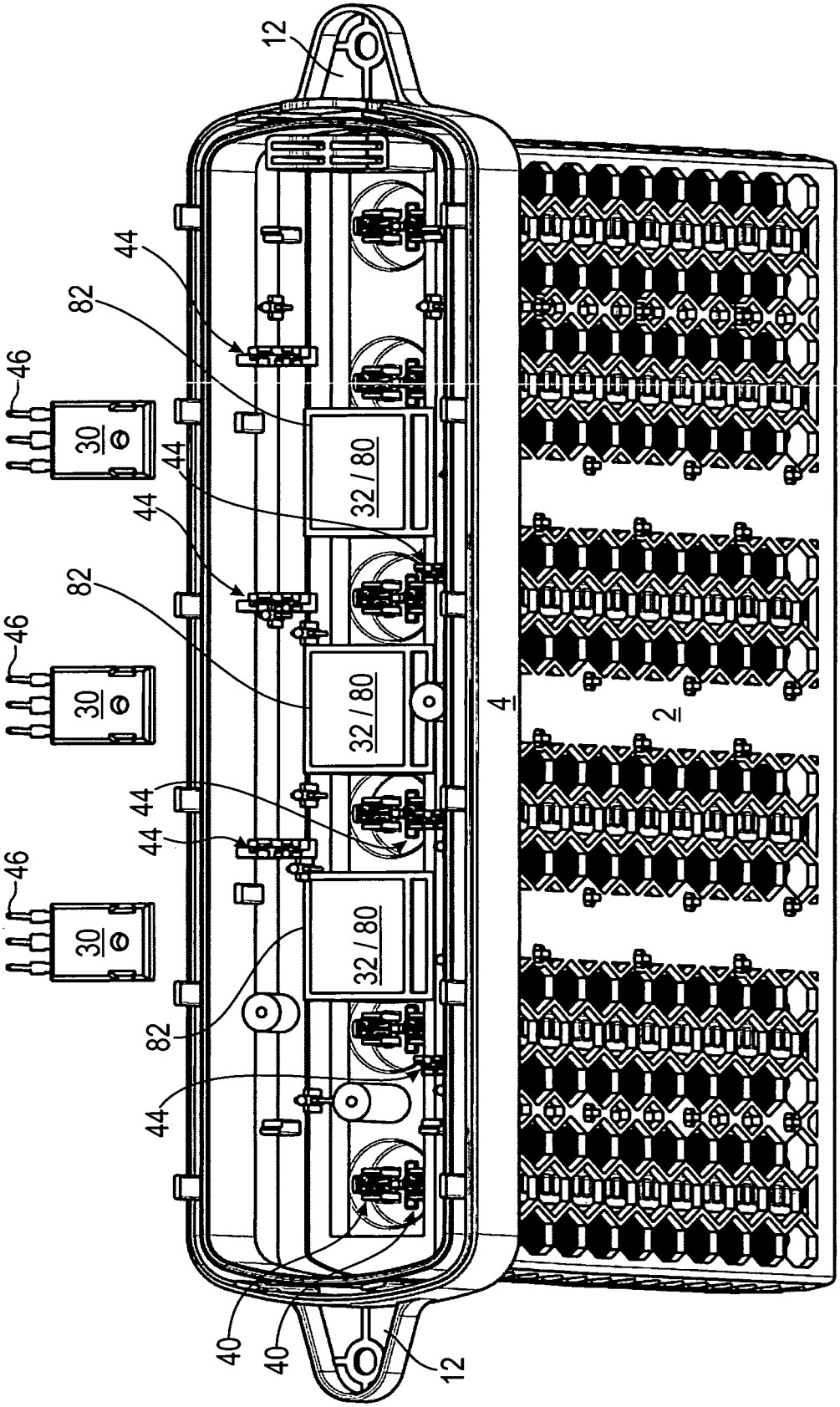


Fig. 12

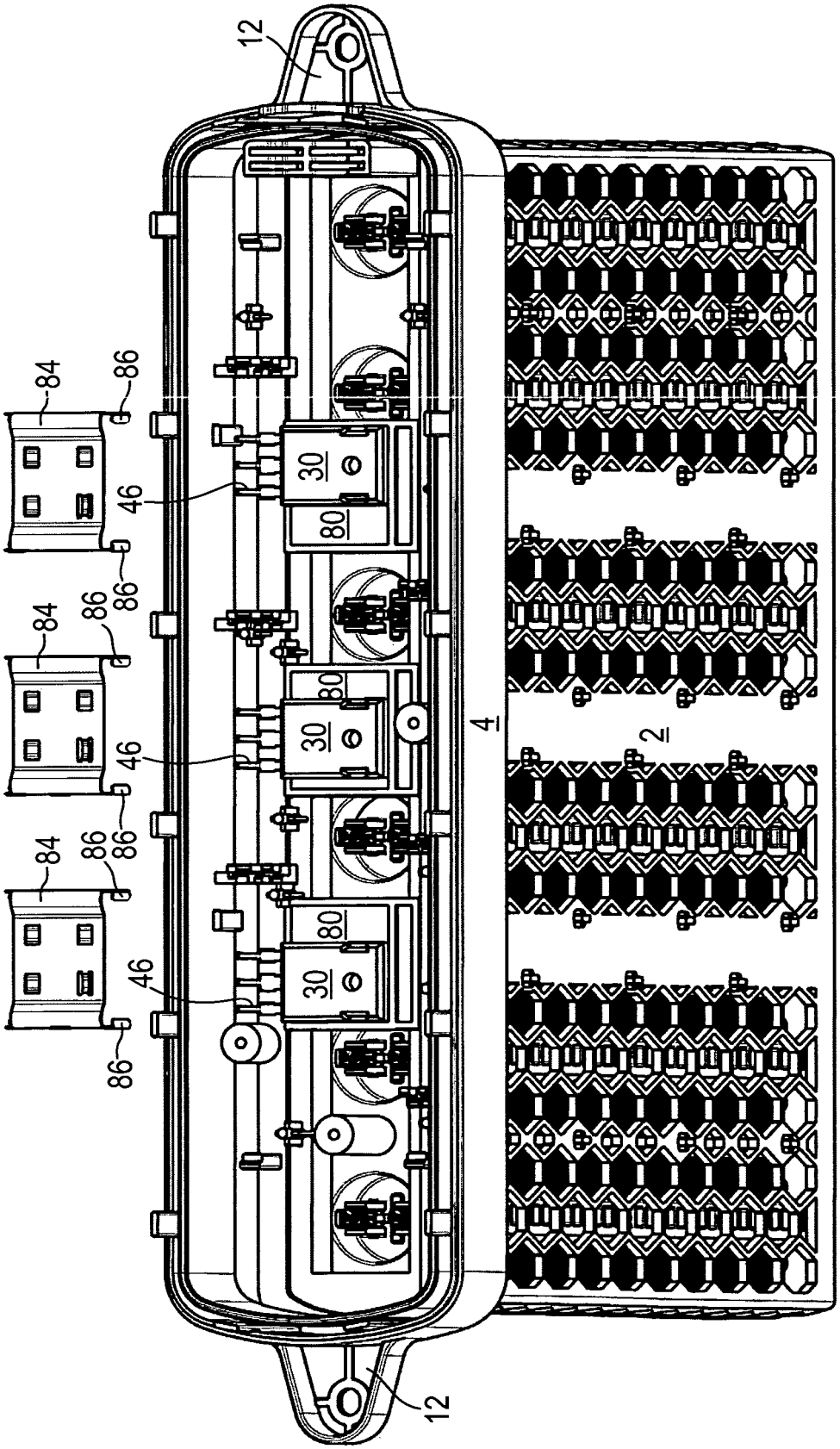
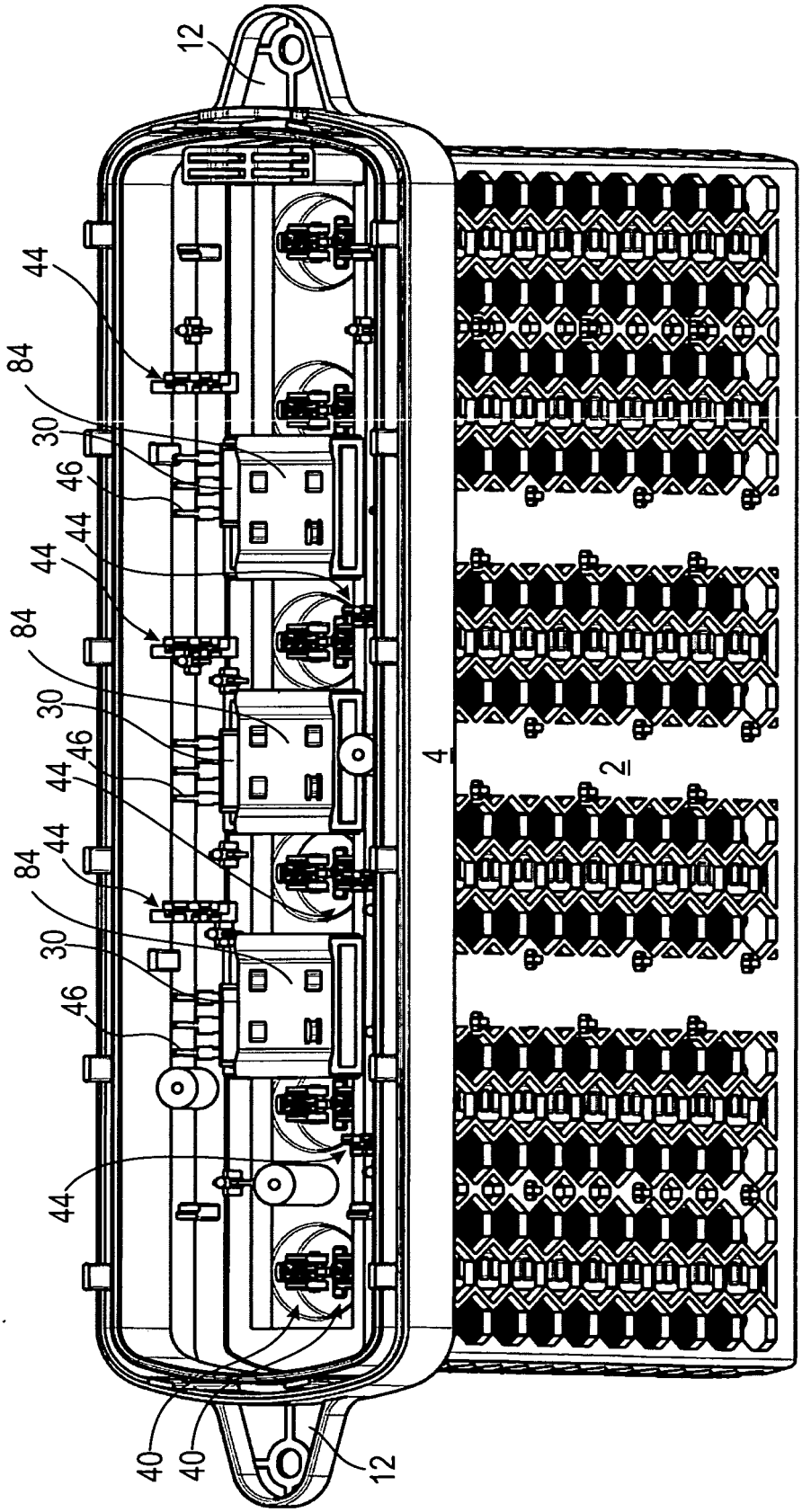


Fig. 13



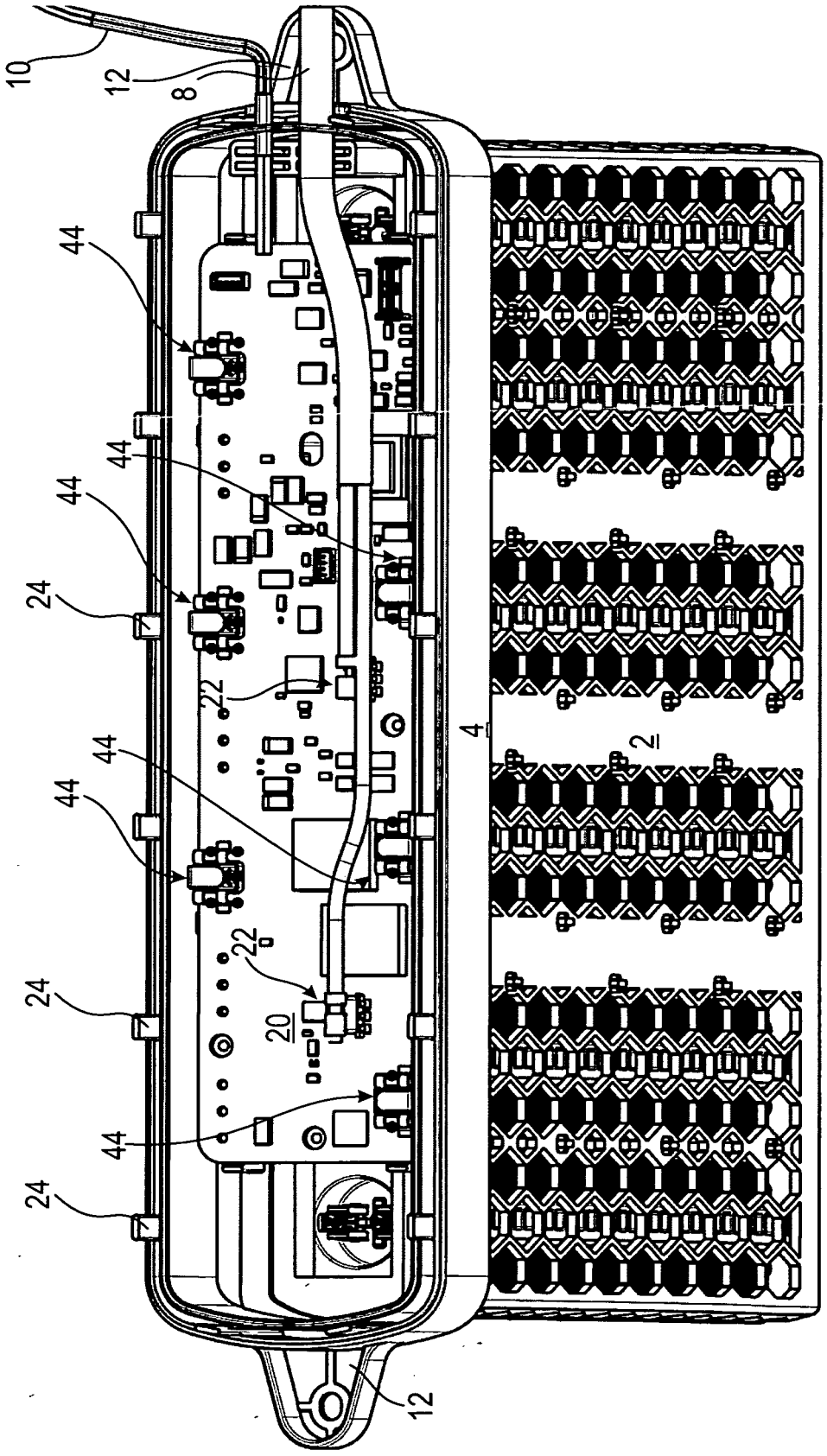


Fig. 14

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EUROPEAN SEARCH REPORT

Application Number
EP 16 19 3321

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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	31 March 2017	Garcia, Jesus

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