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(54) **HIGH VOLTAGE AIR HEATER INCLUDING LAMELLA ELEMENTS 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.

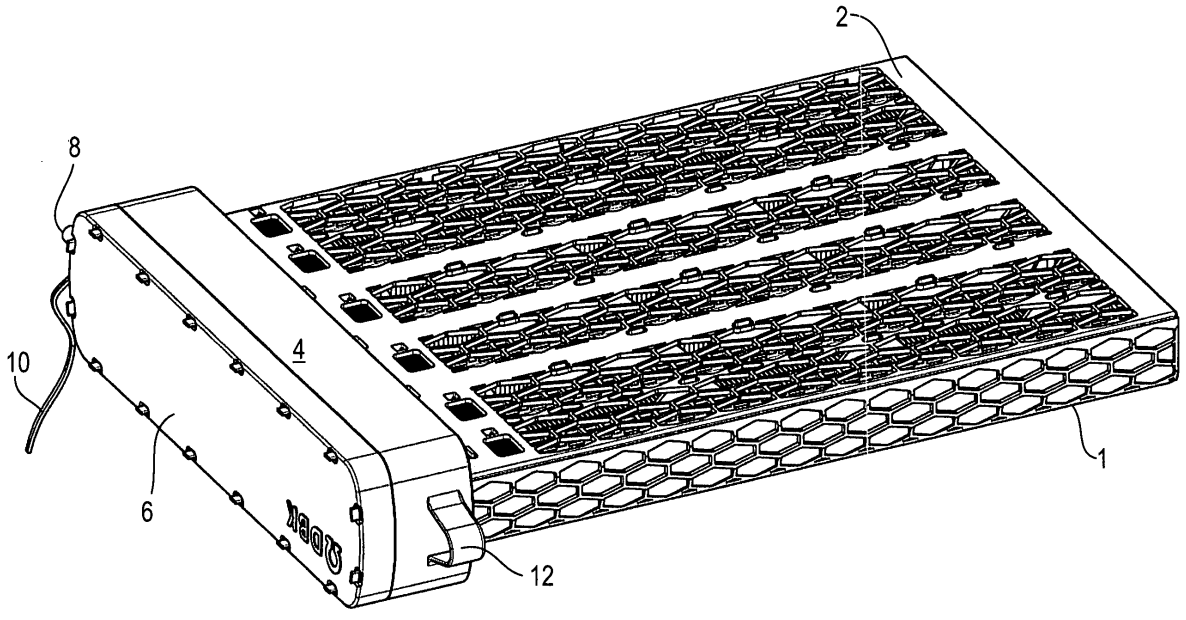

Fig. 1

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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 components 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] Document EP 2 608 633 A1 discloses a high voltage air heater in which the components with the PTC elements and the lamella elements are also in contact with each other in close succession and thus form a cuboidal throughflowable block enclosed in a correspondingly cuboidal frame. A housing with electric contacts is provided at one of the two shorter front sides of the frame.

[0005] The disadvantage of such high voltage air heaters is that the assembly of the lamella elements and of the housings and/or components with the PTC elements, due to their layering and enclosure in the frame, causes much effort with respect to device technology and assembly technique.

[0006] Compared with this it is an object of the invention to provide a high voltage 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 16.

[0008] The claimed high voltage air heater has several elongate components referred to as step cores which each accommodate several PTC elements. The PTC elements are provided to convert current to heat, wherein, for the dissipation of their heat to the air, at least one lamella element is in heat-conducting contact with each component and extends substantially along the component. In accordance with the invention, one component and two lamella elements are respectively grouped to form a heater step and are fixedly connected with each other, preferably glued. This facilitates the final assembly of the components and of the lamella elements since they are grouped to form heater steps in a prior assembly step, before a reduced number of heater steps - e.g. six heater steps - are incorporated in the high voltage air heater in a final assembly step.

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

[0010] Further advantageous embodiments of the invention are described in the dependent claims.

[0011] In a further development the heater steps are arranged at a distance to each other. Thus, the air resistance during throughflowing is reduced as compared to the state of the art and/or the lamella elements are electrically decoupled from each other if they are energized.

[0012] For constructional reasons a parallel distance which preferably extends approximately transversely to a throughflow direction of the air is preferred in the spacing apart of the heater steps. The lamella elements of two adjacent heater steps may face each other such that the distance between two heater steps corresponds to the distance of the two lamella elements facing each other.

[0013] Preferably, the heater steps are surrounded by a main body housing. In a particularly preferred manner the heater steps are surrounded on all sides, i.e. they are completely enclosed. For this purpose the main body housing may form a five-side cover while a control housing covers the sixth side.

[0014] With the high voltage heater of the state of the art the heat dissipation to the air is not optimal since the outermost lateral lamella elements over their entire length and, furthermore, all lamella elements with their front side are in contact with the massive frame. At these contact faces the heat dissipation of the lamella elements to the air is reduced or prevented. In accordance with a further development of the invention it is therefore preferred if the lamella elements are arranged to be spaced apart also from the main body housing.

[0015] In a preferred further development of the components referred to as step cores they each have an inner layer comprising the PTC elements, and contact plates which are in contact with the outer sides thereof. Insulation plates (e.g. of Al2O3 ceramic) are in contact with the outer sides of the contact plates, and cover plates are in turn in contact with the outer sides of the insulation plates. The two lamella elements are fastened to the outer sides of the two cover plates. Thus, the heater steps are electrically insulated and de-energized (zero-potential).

[0016] For intensified electrical insulation the cover plates or the lamella elements may comprise oxide ceramic or other insulation layers on their surfaces.

[0017] Preferably, the heater steps are energizable via the control housing, wherein the heater steps are fastened at one side via a respective end portion to the control housing.

[0018] For sealing the interior of the control housing and the interior of the component it is preferred if a radial sealing element and/or an axial sealing element is/are provided between the end portions of the heater steps and the control housing.

[0019] For reasons of stability it is preferred if the heater steps comprise a respective support and/or clamping

frame. The frame preferably defines a frame plane which, for throughflow optimization, is oriented perpendicular to the throughflow direction.

[0020] For mechanical reasons it is further preferred if the frames are sealingly fastened to the control housing by a respective locking ring.

[0021] For reasons of assembly technique the frames may each comprise a step housing and a step housing cover which jointly encompass and preferably clamp the associated component.

[0022] The step housing and the step housing cover may be connected with each other by projections or pivots extending through respective recesses. The projections and/or pivots are connected with the recesses by welding or by plastically expanding the projections and/or pivots.

[0023] For an optimal sealing of the step housing with minimal effort with respect to device technology, the pairs of projections and/or pivots and recesses are distributed evenly over the circumference of the frame.

[0024] The projections and/or pivots may be disposed on the step housing and the recesses on the step housing cover.

[0025] For sealing the interior of the component it is preferred if a seal is provided between the step housing and the step housing cover.

[0026] For sealing the interior of the component it is further preferred if a seal is provided between the step housing and one of the two cover plates and a further seal is provided between the step housing cover and the other of the two cover plates.

[0027] For reasons of stability of the high voltage air heater in accordance with the invention it is preferred if at least one of the frames comprises, at its end portion facing away from the control housing, a mechanical support connection with the main body housing.

[0028] The method for assembling the above-described high voltage air heater in accordance with the invention comprises a pre-assembly of its heater steps.

[0029] In accordance with a first version the pre-assembly may comprise the following steps in the order mentioned:

- curing of the heater step, i.e. component (step core) and lamella element, and
- inserting of the heater step in the support and/or clamping frame.

[0030] In accordance with a second version the pre-assembly may comprise the following steps in the order mentioned:

- curing of the component (step core),
- inserting of the component in the support and/or clamping frame, and
- fastening of the two lamella elements to the component, preferably by gluing.

[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 housing 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 circumferential 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 several elongate components which each accommodate several PTC elements (54), wherein, for dissipating their heat to the air, at least one lamella element (62) is in heat-conducting contact with each component, **characterized in that** one component and two lamella elements (62) are grouped to form a heater step (14) and are fixedly connected with each other.

2. The high voltage air heater according to claim 1, wherein the heater steps (14) are arranged at a distance to each other.

3. The high voltage air heater according to any of the preceding claims, wherein the heater steps (14) are enclosed by a main body housing (1).

4. The high voltage air heater according to claim 3, wherein the lamella elements (62) are arranged to be spaced apart from the main body housing (1).

5. The high voltage air heater according to any of the

preceding claims, wherein each component comprises an inner layer with the PTC elements (54), contact plates (56) in contact with the outer sides thereof, insulation plates (58) in contact with the outer sides thereof, and cover plates (60) in contact with the outer sides thereof, and wherein the two lamella elements (62) are fastened to the respective outer sides of the two cover plates (60).

6. The high voltage air heater according to claim 5, wherein the cover plates (60) or the lamella elements (62) comprise oxide ceramic on their surfaces.

7. The high voltage air heater according to any of the preceding claims, wherein the heater steps (14) can be energized via a control housing (4), and wherein the heater steps (14) are fastened on one side via a respective end portion to the control housing (4).

8. The high voltage air heater according to claim 7, wherein a respective radial sealing element (78) and/or a respective axial sealing element (79) is/are provided between the end portions of the heater steps (14) and the control housing (4).

9. The high voltage air heater according to any of the preceding claims, wherein the heater steps (14) comprise a respective frame (48).

10. The high voltage air heater according to claim 9, wherein the frames (48) are sealingly fastened to the control housing (4) via a respective locking ring (18).

11. The high voltage air heater according to claim 9 or 10, wherein the frames (48) each comprise a step housing (50) and a step housing cover (52) which jointly encompass the associated component.

12. The high voltage air heater according to claim 11, wherein the step housing (50) and the step housing cover (52) are connected with each other via projections (70) or pivots extending through recesses (72), and wherein the projections (70) or pivots are connected with the recesses (72) by welding or by shaping.

13. The high voltage air heater according to claim 11 or 12, wherein a seal is provided between the step housing (50) and the step housing cover (52).

14. The high voltage air heater according to claim 5 or 6 and according to any of claims 11 to 13, wherein a seal is provided between the step housing (50) and one of the two cover plates (60), and wherein a seal is provided between the step housing cover (52) and the other of the two cover plates (60).

15. The high voltage air heater according to claim 3 or 4 and according to any of claims 9 to 14, wherein at least one of the frames (48), at its end portion facing away from the control housing (4), comprises a mechanical support connection with the main body housing.

16. A method for assembling a high voltage air heater according to any of the preceding claims comprising a pre-assembly of the heater steps (14) and a final assembly of the heater steps (14) in or at the high voltage air heater.

17. The method according to claim 16, wherein the pre-assembly of the heater steps (14) comprises the following steps in the order mentioned:

- curing of the heater step (14), and
- inserting of the heater step (14) in a frame (48).

18. The method according to claim 16, wherein the pre-assembly of the heater steps (14) comprises the following steps in the order mentioned:

- curing of the component,
- inserting of the component in a frame (48), and
- fastening of the two lamella elements (62) to the component.

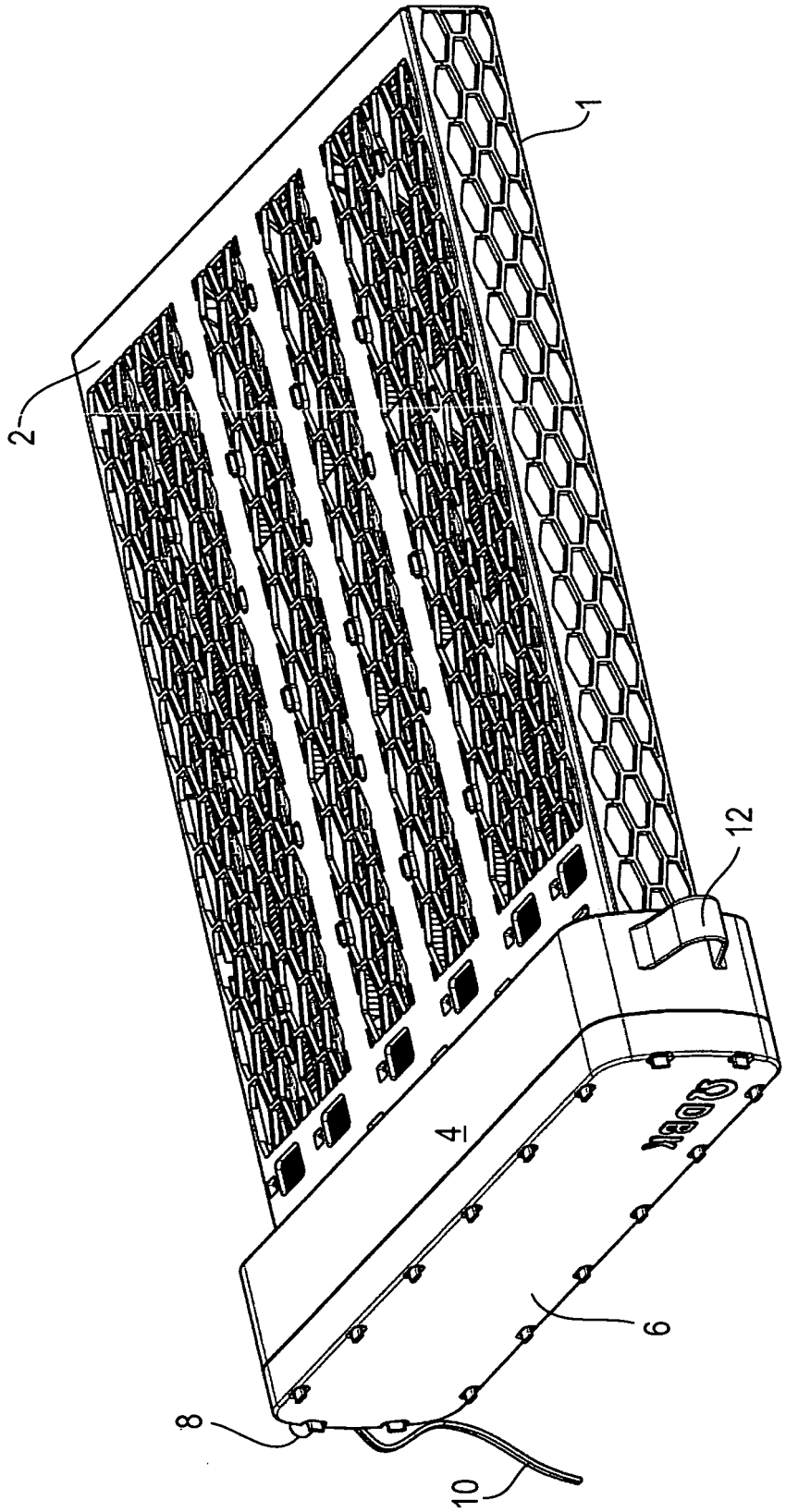

Fig. 1

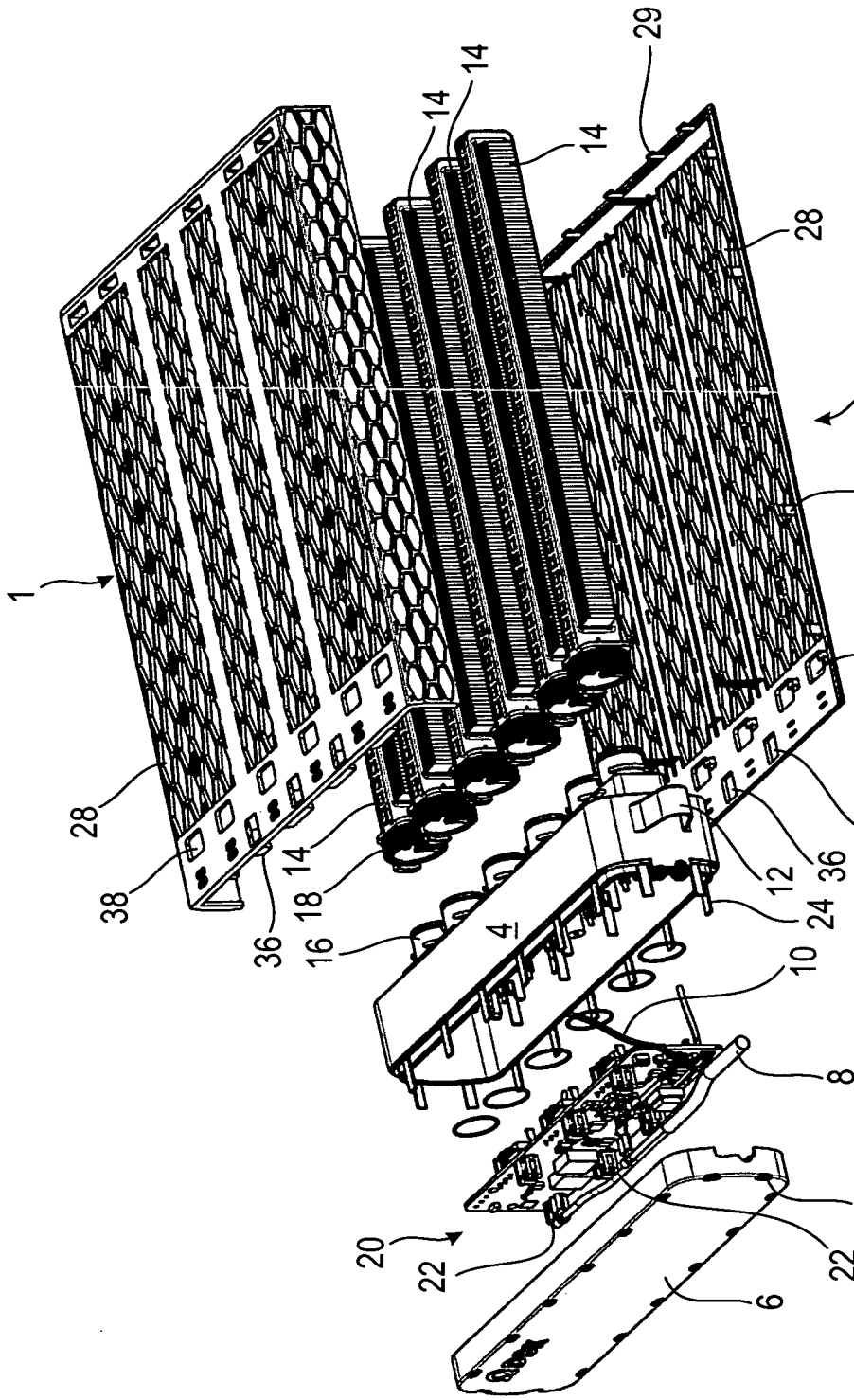

Fig. 2

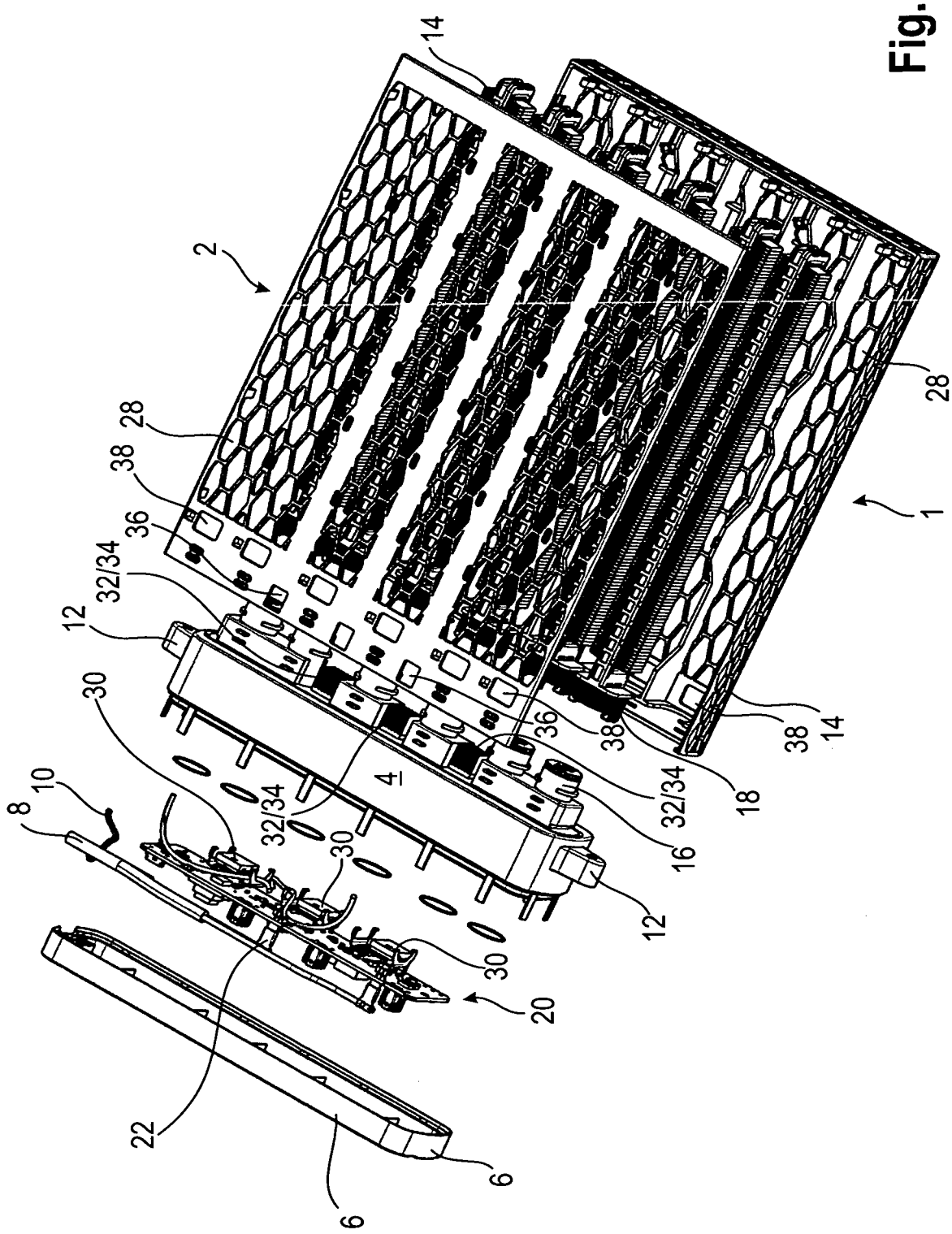

Fig. 3

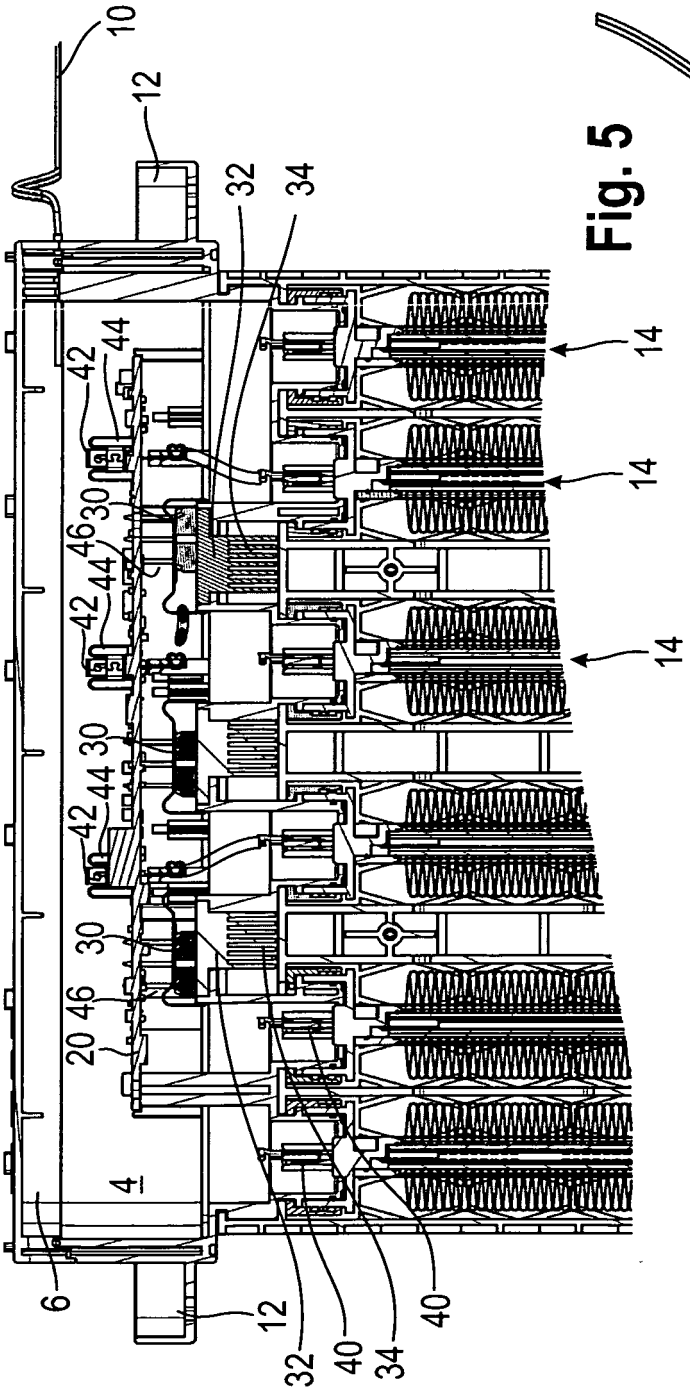

Fig. 5

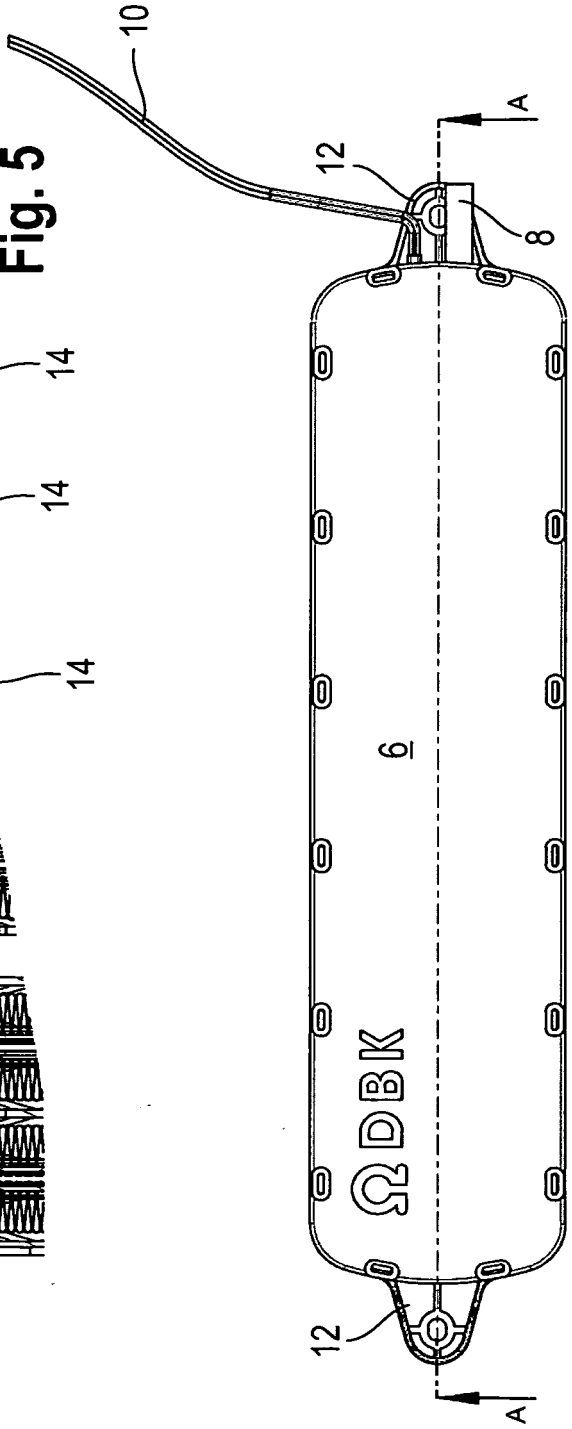

Fig. 4

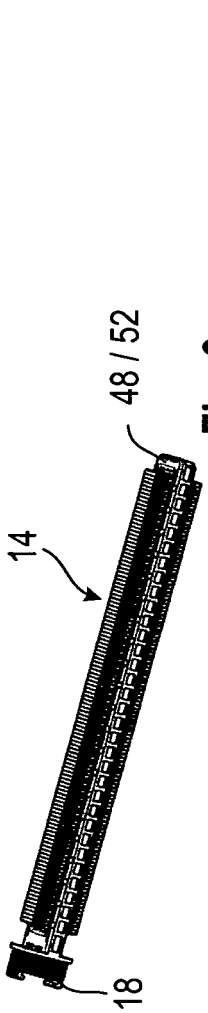

Fig. 6

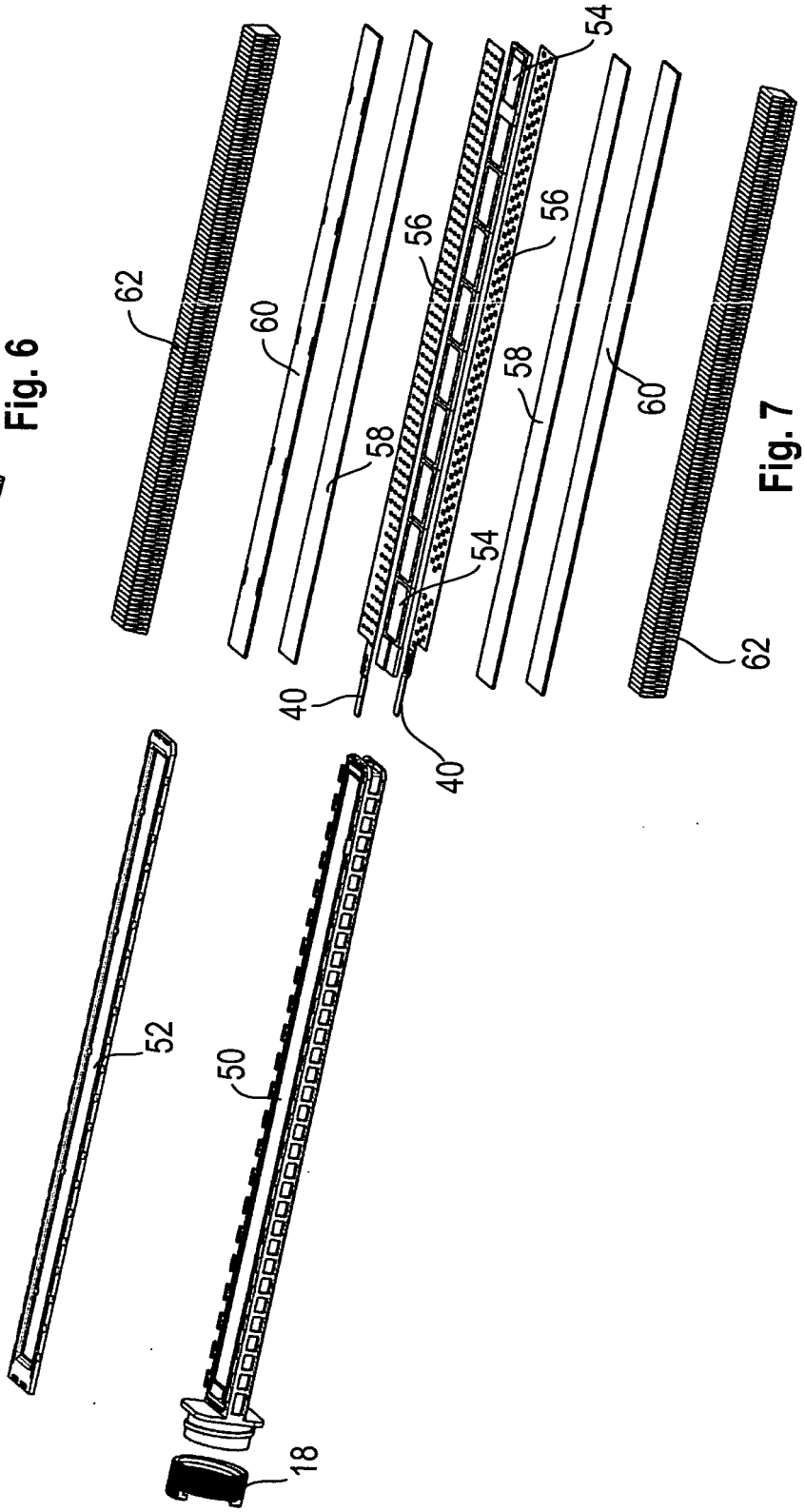

Fig. 7

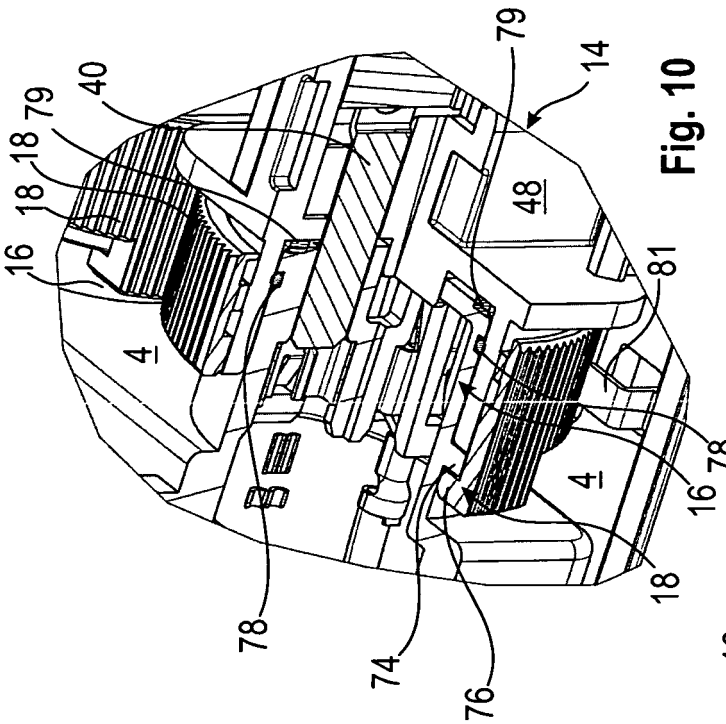

Fig. 10

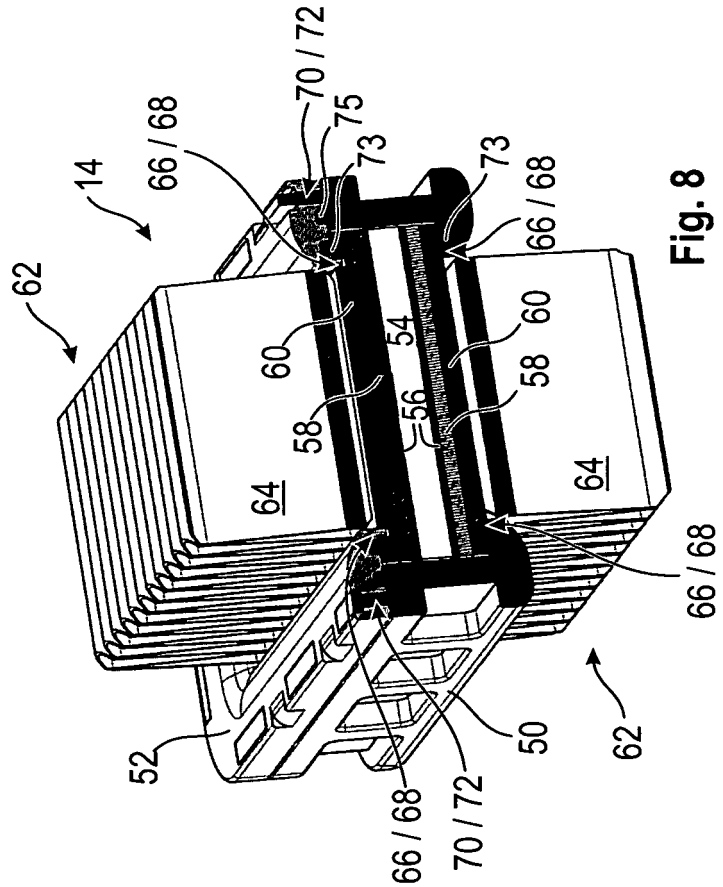

Fig. 8

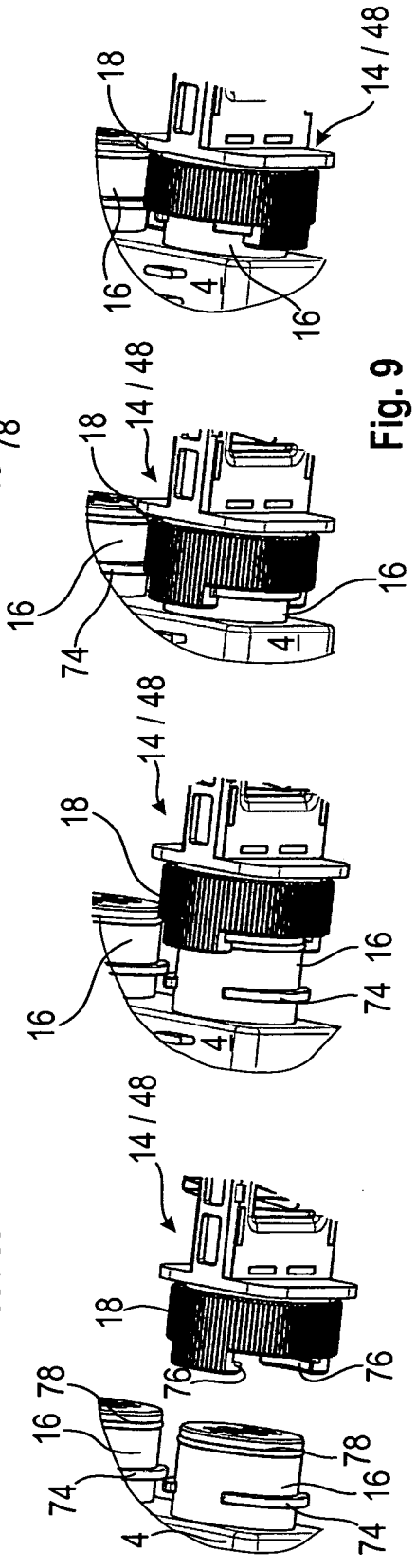

Fig. 9

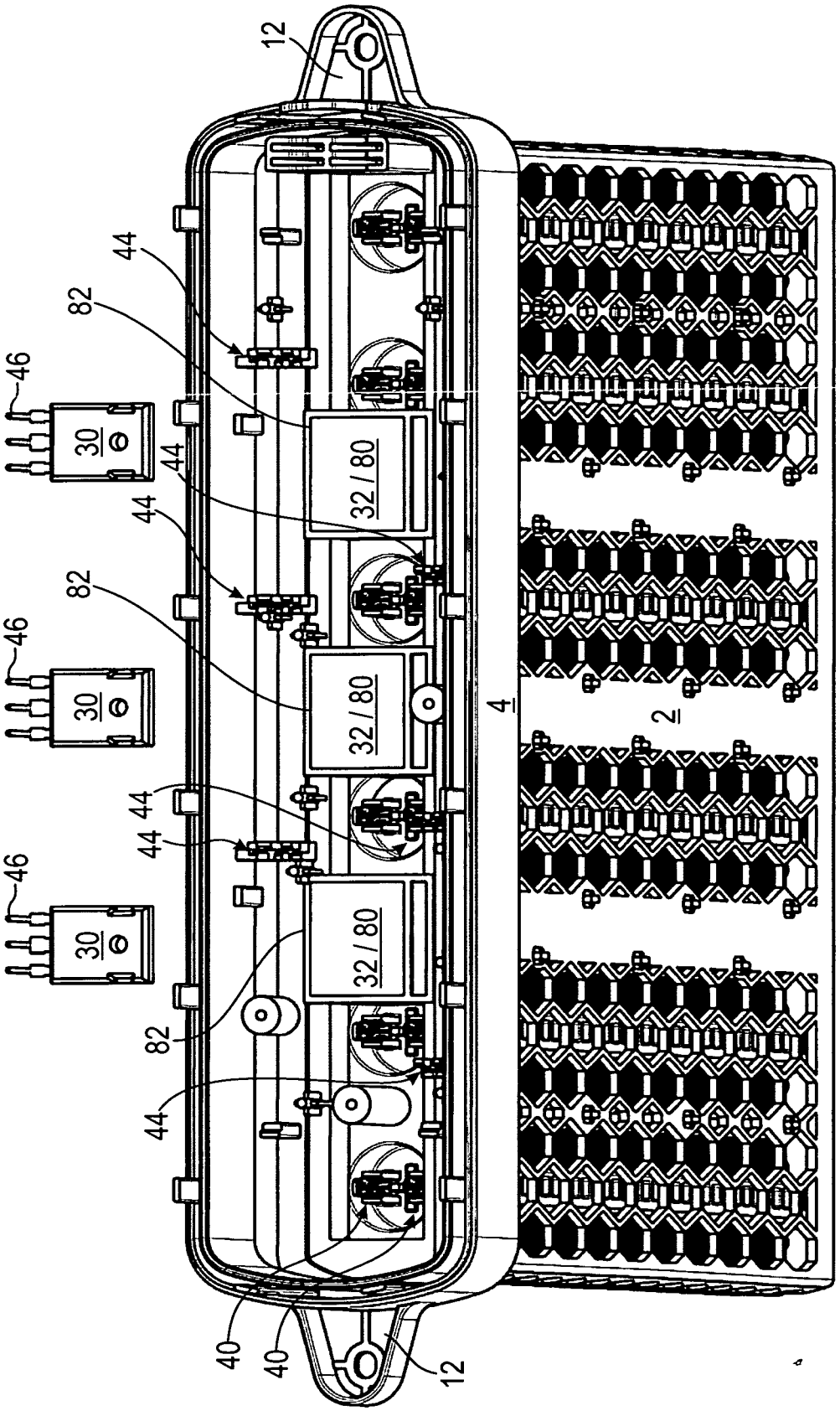
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Fig. 11

Fig. 12

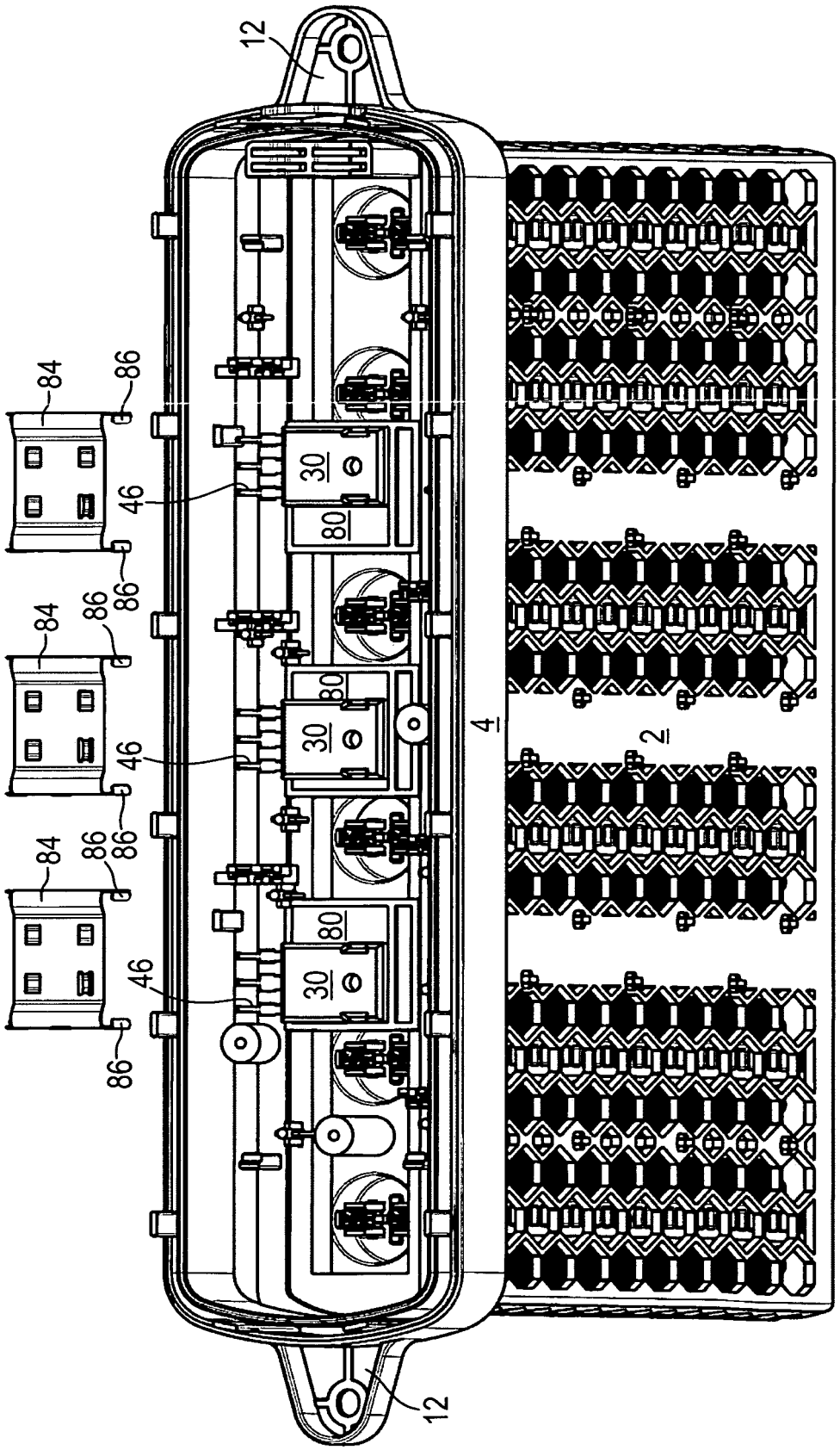
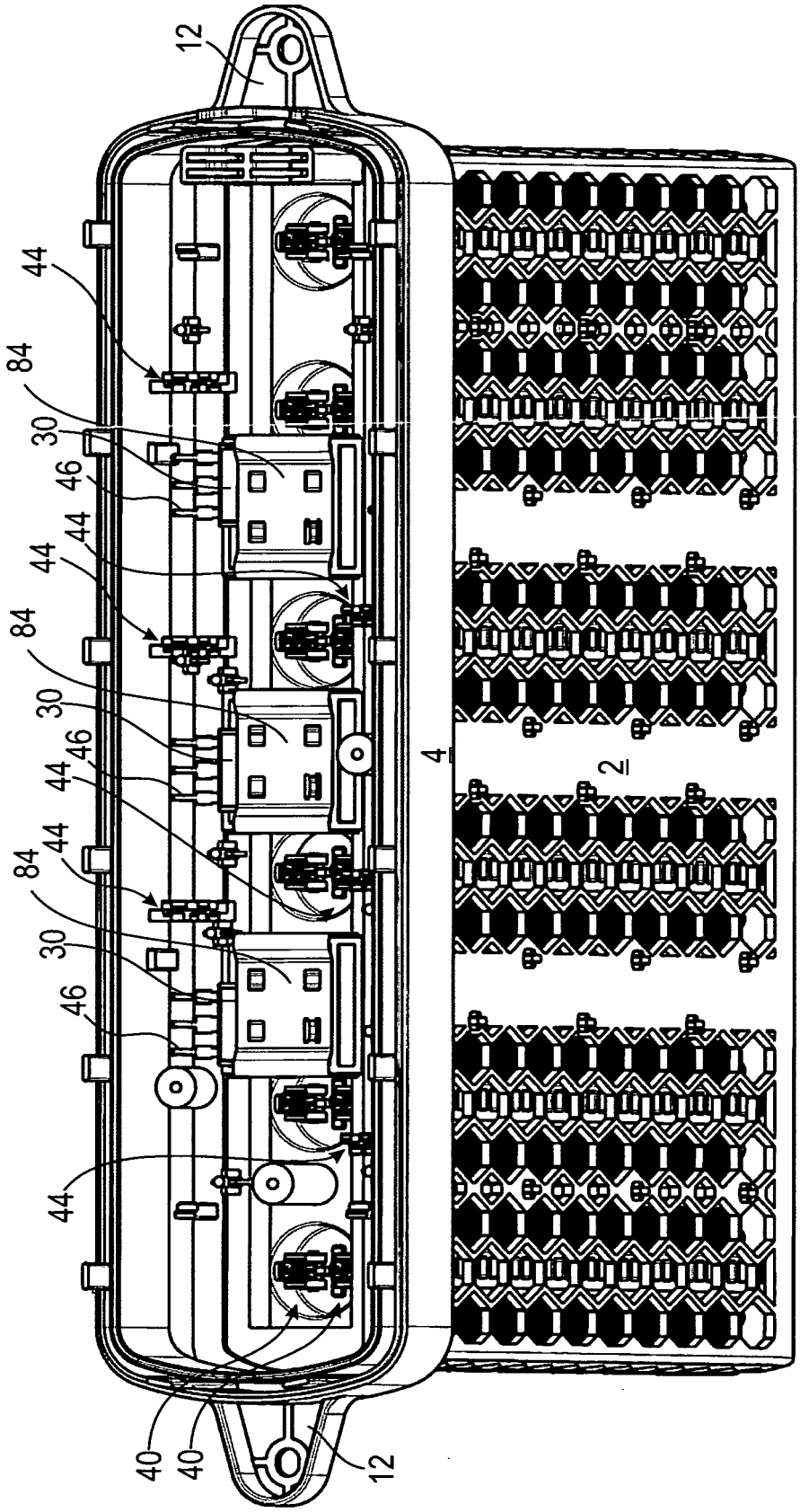


Fig. 13



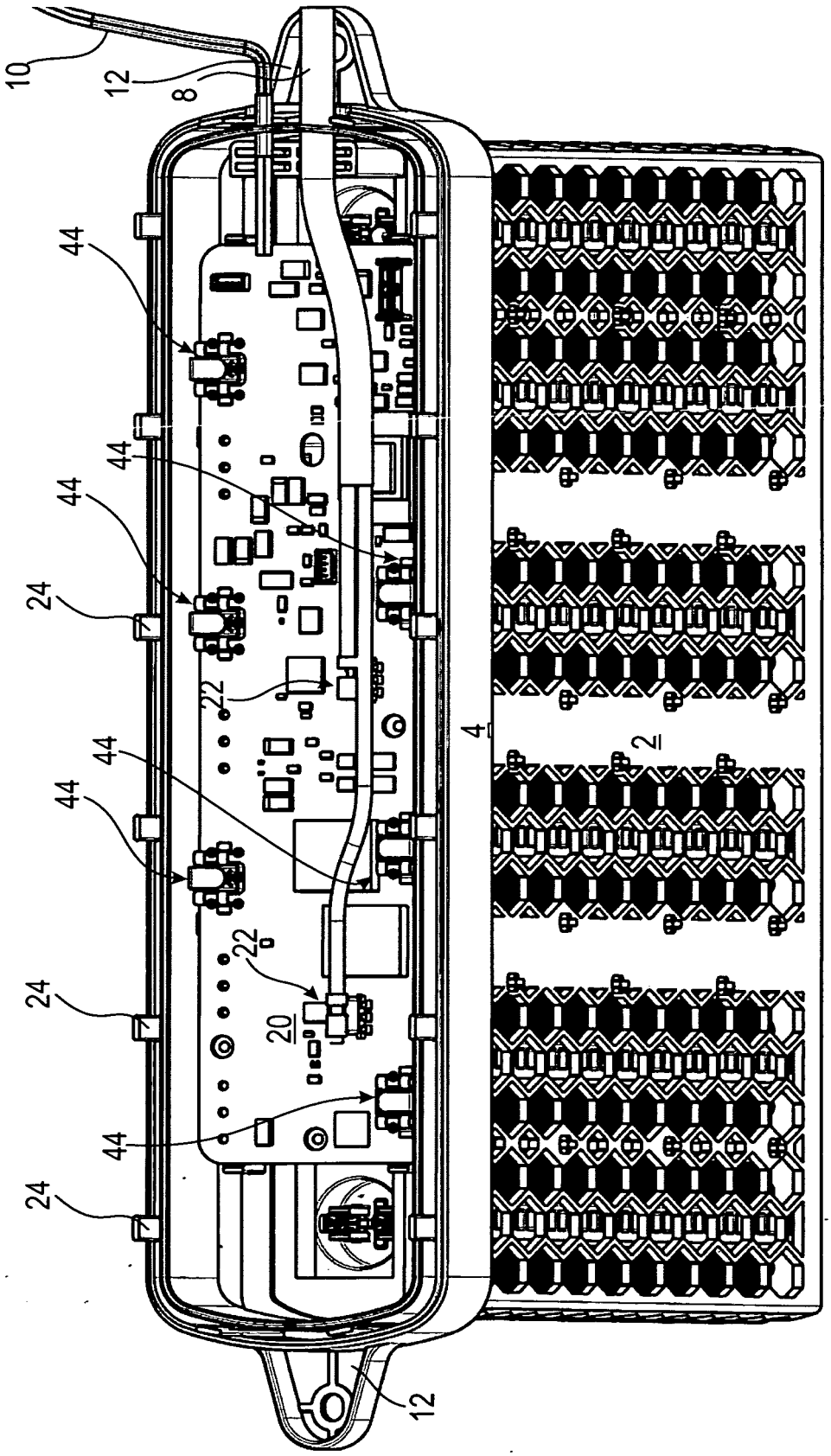


Fig. 14

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EUROPEAN SEARCH REPORT

Application Number
EP 16 19 3317

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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	30 March 2017	Garcia, Jesus

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