



(11) **EP 2 346 302 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
20.07.2011 Bulletin 2011/29

(51) Int Cl.:
H05B 3/06 (2006.01) H05B 3/50 (2006.01)

(21) Application number: **10290020.6**

(22) Date of filing: **14.01.2010**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL
PT RO SE SI SK SM TR**
Designated Extension States:
AL BA RS

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(54) **Heater for a vehicle**

(57) A heater for a vehicle comprises at least one PTC heating element (104) comprising an electrical contact section and at least one output of a power switch of

a heater controller circuit (102). The at least one output of the power switch is hard fastened to the electrical contact section of the at least one PTC heating element by a fastening process based on heat or pressure.

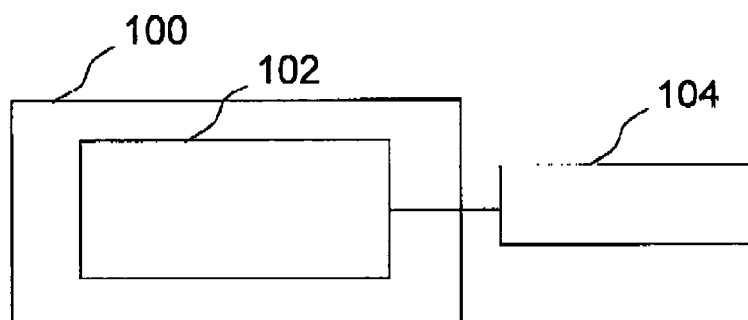


FIG 1

Description

[0001] The present invention relates to a heater and a method for manufacturing a heater, which may be used for an air conditioning of a vehicle.

[0002] An air conditioning system comprising a heater based on PTC heaters (PTC = positive temperature coefficient) can be used for heating the interior of a passenger cabin of a car or vehicle. A controller is used to control the PTC heaters.

[0003] Existing PTC heaters are connected to the controller with female and male connectors. During the assembly process, the connection is submitted to important mechanical stress due to the mounting of the male connector into the female connector. The connecting area is outside of the components (controller heater). Thus, it is difficult to adapt the connecting area to high voltage application or sealed application. The current carriers are not sealed or protected and may cause insulation failures or fretting corrosion due to humidity or water. Due to environmental influences, like humidity or temperature, the connector has to fulfill a high level of requirement to prevent any failure on lifetime.

[0004] Therefore it is the object of the present invention to provide an improved heater for a vehicle and an improved method for manufacturing a heater for a vehicle. This object is achieved by a heater according to claim 1 and by a method for manufacturing a heater according to claim 12.

[0005] The present invention is based on the finding that each output of a power switch of the heater controller may be linked directly to the corresponding electric heating element, in particular a PTC level, to avoid mechanical stress. Compared to existing solutions, there is less material used because of removing the bus bar being conventionally used to connect the power switch and the PTC level. By removing the bus bar additional components and connections providing an additional risk potential are avoided.

[0006] Thus, the inventive approach provides a connection between a PTC controller and a PTC heater. Each output of the PTC heater may be connected directly to the corresponding stage of the PTC without female or male connectors. This connection may be located in a waterproofed box.

[0007] This new direct connection may be located in the same area as a printed circuit board (PCB) of the controller to avoid undesired effects due to electrolytic phenomena between the poles. The connection can be easily closed with a cover as in the regulator PCB area, so that high voltage surfaces are less accessible to human contact. The direct connection may be provided by a connector providing a hard connection, being not removable, in order to avoid all the connection weakness. The connection may be realized with soldering, welding, bonding, or other hard fastening and can be covered with seating material.

[0008] The inventive approach allows a very safe con-

nection with no mechanical stress and protection against humidity. Further, the applied process is well known.

[0009] The present invention provides a heater for a vehicle, comprising: at least one PTC heating element comprising an electrical contact section; and at least one output of a power switch of a heater controller circuit, wherein the at least one output of the power switch is hard fastened to the electrical contact section of the at least one PTC heating element by a fastening process based on heat or pressure. The PTC heating element may be a PTC heater resistor. Such heater resistors are suited for heating air in an air conditioning system of a vehicle like an automobile or for water conditioning.

[0010] The PTC heating element may comprise two electrical contacts which typically are arranged on opposite end sections of the heating element or the resistor. The electrical contact sections of the heating element may be formed by end sections of the heating element itself. Alternatively the electrical contact sections may be formed by conductor parts being rigidly coupled to the heating element. The end sections may be formed by stiff metal parts extending from a main body of the heating element. The heater controller may be configured to control a current flowing through the electrical heating element. Thus, a thermal output of the heating element can be controlled by the controller. The controller circuit may comprise at least one switching element which may be a power electronic element. The switching element may be a high-side switch. A current flow through the heating element may be controlled by the switching element. For controlling the switching element, the heater controller may comprise a control element which is capable of processing signals and outputting control signals to the at least one switching element. The control element may be an electronic component like a digital signal processor, a microprocessor, an application specific integrated circuit, or the like. The heater controller circuit may be arranged on a circuit board. The heater controller may be used to control one or a plurality of heating elements which may be rigidly fixed to the heater controller. The connection to the contact section of the heating element may be realized by soldering, welding or bonding. Further, the contact section may be covered with sealing material. Thus, the risk of a loose connection between the heating element and the heater controller can be reduced.

[0011] According to an embodiment, the electrical contact section of the PTC heating element may comprise an angular end section of a side rail of the PTC heating element and a contact sheet being connected to the end section of the side rail. The at least one output of the power switch may be hard fastened to the contact sheet by a fastening process based on heat or pressure. The end section of the side rail may be inserted through an opening of a side panel of a housing of the heater and may be bent towards an inner side of the side panel. The contact sheet may be plugged between an inner side of the side panel and the end section of the side rail and

may comprise an angular section extending into the interior of the housing away from the side panel.

[0012] The heater may comprise a housing with an interior which is adapted to carry the heater controller circuit. A side panel of the housing may comprise at least one opening suitable for inserting the electrical contact section of the PTC heating element through. The interior of the housing may have a form which is adapted to the heater controller circuit which means that the heater controller circuit can be placed into the interior of the box and can be fixed within the housing. The interior of the housing may have a contour, fixing elements or supporting elements which cause the controller circuit to be securely fixed within the interior when the housing is closed. The housing may comprise a base panel and side panels. Further, the housing may comprise an upper panel which may seal the interior of the housing after the controller circuit has been arranged within the housing. The at least one opening of the side panel may have a form being adapted to an outer profile or cross section of the electrical contact section of the electric heating element. Thus, the electrical contact section can be pushed from outside the housing, through the opening such that at least a part of the electrical contact section is arranged in the interior of the housing. The electrical contact section may be used to fasten the heating element mechanically to the side panel of the housing. The electrical contact section of the electric heating element may comprise two parts, wherein a first part directly connected to the heating element may be inserted through the opening and the second part is connected to the first part after the first part is through the opening. Thus, the first part, for example an end section of a side rail or side panel of the heating element, may be used for a mechanical connection of the heating element, to the housing and for an electrical connection to the heater controller via the second part. The interior of the housing may be adapted such that an output of a power switch of the heater controller circuit, if the heater controller circuit is arranged within the housing, is arranged adjacent to the electrical contact section of the heating element, if the electrical contact section is inserted through the opening, or adjacent to the first end section of the electrical conductor. A current provided by the output of the switch can be directly fed into the electrical conductor or the heating element. Thus, a wiring section between the output of the switch and the heating element can be as short as possible. There is no need for a long wiring system comprising flexible wires.

[0013] The housing may comprise an inner panel for separating the interior of the housing into a first space and a second space, wherein at least one electrical conductor may be arranged through the inner panel, such that a first end section of the electrical conductor is arranged within the first space and a second end section of the electrical conductor is arranged within the second space. The heater controller circuit may be arranged within the first space such that the output of the power

switch of the heater controller circuit is arranged adjacent to the first end section of the electrical conductor. The electrical contact section of the PTC heating element may be inserted into the second space. A middle section of the electrical conductor may be firmly connected to the inner panel. The heater controller may be arranged within the first space and the electrical contact section may be inserted into the second space. The inner panel may be in parallel to side panels of the housing. The electrical conductor may be a stiff metal part being arranged through a through-hole of the inner panel, such that both end sections of the electrical conductor extend from opposite surfaces of the inner panel. The electrical conductor is configured to carry a current intended for the heating element.

[0014] The inner panel may be arranged in parallel to the side panel comprising the at least one opening. Thus, the at least one electrical conductor may be aligned to the at least one opening. The electrical conductor may be a rigid part functioning as an extension for the electrical contact section of the electric heating element.

[0015] According to an embodiment, the at least one electrical conductor is formed by a metal plate. A metal plate allows a strong mechanical connection between the electrical conductor and the electrical contact section of the electric heating element. Further, the metal plate is suitable for carrying a high current.

[0016] The second end section of the electrical conductor may be exposed. Thus, the second end section may be apart from panels of the box and, for example, surrounded by air.

[0017] The second end section of the electrical conductor may be arranged adjacent to the electrical contact section and may be hard fastened to the electrical contact section of the at least one PTC heating element by a fastening process based on heat or pressure. Thus, the second end section and the contact section may be in direct contact such that a current may flow from the electrical conductor to the heating element or vice versa.

[0018] The housing may comprise a support element for supporting a conductor plate of the heater controller circuit, wherein the support element is arranged within the first space adjacent to the inner panel and wherein the first end section of the electrical conductor is arranged on a surface of the support element facing the conductor plate. Thus, an output of the switch may be on a bottom side of the conductor plate, adjacent to the first end section of the electrical conductor, when the conductor plate is arranged in the box. The support element may be a ledge of the inner panel.

[0019] The present invention further provides a method for manufacturing a heater for a vehicle, comprising the following steps: providing at least one PTC heating element comprising an electrical contact section; providing at least one output of a power switch of a heater controller circuit; arranging the electrical contact section and the output adjacent to each other; and hard fastening the electrical contact section and the output by a fastening

process based on heat or pressure.

[0020] The present invention provides a housing for a heater controller for supervising an electric heating element in a vehicle, the housing comprising the following features: a box comprising an interior which is adapted to carry a heater controller circuit, wherein a side panel of the box comprises at least one opening suitable for inserting an electrical contact section of the electric heating element through.

[0021] Embodiments of the present invention will be described below more precisely with respect to the following figures in which

Fig. 1 a schematic view of a heater, according to an embodiment of the present invention;

Fig. 2 a housing for a heater controller, according to an embodiment of the present invention;

Fig. 3 a housing for a heater controller, according to a further embodiment of the present invention;

Fig. 4 a housing for a heater controller, according to a further embodiment of the present invention;

Fig. 5 a further view of the housing shown in Fig. 4; and

Fig. 6 a housing for a heater controller according to a further embodiment of the present invention.

[0022] Fig. 1 shows a schematic view of a heater, according to an embodiment of the present invention. The heater comprises a housing 100, a heater controller 102 and at least one heating element 104. The housing 100 may be an injection molding part the heater controller 102 is placed within. The heater controller 102 may be configured to control a current flowing through the at least one electrical heating element 104. Therefore, the at least one heating element 104 is mechanically connected to the housing 100 and electrically connected to the heater controller 102. The controller circuit may comprise at least one switching element to provide a current to the at least one heating element 104. For controlling the switching element, the heater controller 102 may comprise a control circuit being capable of processing signals and outputting control signals to the at least one switching element. The housing 100 may comprise external electrical connectors. Via the external electrical connectors signals may be provided to the heater controller 102. Further, an electrical current may be provided through the external electrical connectors for the at least one heating element 104 via the heater controller 102.

[0023] Fig. 2 shows a housing 100 for a heater controller and six heating elements 104, according to an embodiment of the present invention.

[0024] The six heating elements 104 are parallel arranged and are grouped into three pairs of heating ele-

ments. More or less than six heating elements 104 may be used and the heating elements 104 may be arranged unpaired. The two heating elements 104 of each pair of heating elements are arranged adjacent to each other.

The pairs of heating elements are spaced apart from each other. Each heating element 104 may comprise a PCT resistor element with a wavelike radiator element arranged between two parallel rails. The heating elements 104 extend orthogonally from a side wall or side panel 210 of the housing 100. The side panel 210 is arranged on a ground element of the housing 100. The ground element may extend on both sides of the side panel 210. An outer part of the ground element may form a support surface for the heating elements 104. Each heating element 104 comprises a contact sheet 212 which extends through the side panel 210 of the housing 100 into an inner space of the housing 100. According to an embodiment, one rail of each heating element 104 may extend through the side panel 210 of the housing 100. An end section of the rail, being inside the housing 100, may be bent toward the inner side of the side panel 210 and may contact the inner side of the side panel 210 such that the heating element 104 is mechanically fixed to the housing 100. The contact sheet 212 may be mechanically fixed to the end section of the rail and extend right-angled from the side panel 210 into the interior of the housing 100. The contact sheet 212 may be an angular part, wherein a first part is parallel to the side panel 210 and arranged between the inner side of the side panel 210 and the end section of the rail and wherein a second part extends toward the inner panel 310. The contact sheet 212 may be made from a stripe of metal. Alternatively the contact sheet 212 may be arranged outside the housing 100.

[0025] An electrical current for the heating elements 104 may be provided by a heater controller (not shown in Fig. 2) arranged in the housing 100 to the heating elements 104. The heater controller may be arranged within the housing such that a current output of the heater controller, for example an output contact of a switch, is adjacent to each of the contact sheets 212. The housing 100 may have two connectors 214 for connecting the heater controller to power lines which provide an electrical current for the heating elements 104. The housing 100 may further comprise a connector 216 to provide control signals to the heating controller. The connectors 214, 216 may be arranged on a side panel being arranged opposite to the side panel 210. Further panels connect to the side panels. A cover element (not shown in Fig. 2) may be used to close the housing 100. A sealing may be used to protect the interior of the housing against humidity. The housing 100 comprises mounting elements 218 which may be used to mount the housing within a vehicle.

[0026] A connection to the contact sheets 212 may be realized with soldering, welding, bonding, or other hard fastening and can be covered with sealing material. This assembly may be realized between each output of the power switch, or an area on the printed circuit board (PCB) of the heater controller dedicated to the output of

a power switch, and the contact sheet 212 of the corresponding PTC level 104.

[0027] Fig. 3 shows a housing 100 for a heater controller and six heating elements 104, according to a further embodiment of the present invention. Compared to the embodiment shown in Fig. 2, the housing 100 shown in Fig. 3 comprises an inner panel 310 which may be arranged parallel to the side panel 210. The inner panel 310 separates the interior of the housing 100 into a first space and a second space. The heater controller may be arranged within the first space. The contact sheets 212 may be arranged in the second space. The first space may be covered by a first cover element and the second space may be covered by a separate cover top element or left uncovered. The first space may be sealed by the first cover element against humidity.

[0028] Aligned to each contact sheet 212 an electrical conductor 312 is arranged through the inner panel 310. A first end section of each of the electrical conductors 312 extends into first space and a second end section of each of the electrical conductors 312 extends into the second space. The contact sheets 212 and the electrical conductors 312 and their longitudinal and lateral alignment may be on the same level or in the same plane. The longitudinal and lateral extension of the contact sheets 212 and the electrical conductors 312 may be parallel to the ground panel. There may be a gap between each contact sheet 212 and its corresponding electrical conductor 312. Electrical connectors may be provided to bridge the gaps such that there is an electrical connection between each contact sheet 212 and its corresponding electrical conductor 312. The electrical conductors 312 may be formed by metal stripes. End sections of the electrical conductors 312 and the contact sheets 212 may extend from middle parts of the inner panel 310 and the side panel 210. Thus the end sections may be spaced apart from a ground element and a top element of the housing 100.

[0029] End sections of the electrical conductors 312 extending into the first space are arranged on a support structure 320. The support structure 320 forms a surface which extends as a stripe alongside the inner panel 310. The surface extends parallel to the ground plane and right-angled to the inner panel 310. The end sections of the electrical conductors 312 may be arranged on the surface or inserted into the surface of the support structure 320. Current outputs of the heater controller, for example output contacts of switches, may be in direct contact with the end sections of the electrical conductors 312 when the heater controller is arranged in the housing 100.

[0030] Compared to the embodiment shown in Fig. 2, the configuration of the regulators is slightly different, in which there is a physical separation between the outputs of the PCB and the contact sheets 212 of the PTC levels 104. This permits to reuse many process tools of existing products and to separate the electronic part from the PTC heater.

[0031] Figures 4 and 5 show a housing 100 for a heater

controller and six heating elements 104 according to a further embodiment of the present invention. Compared to the embodiment shown in Fig. 3, the end sections of the electrical conductors 312 extend further into the second space toward the side panel 210. Thus, end sections of corresponding contact sheets 212 and electrical conductors 312 overlap and may be in direct contact. A connection between the contact sheets 212 and the corresponding electrical conductors 312 may be realized with soldering, welding, bonding, or other hard fastening and can be covered with sealing material. The ground element may have one or more through holes. According to this embodiment, the ground element comprises one through hole under each pair of adjacent electrical conductors 312.

[0032] Fig. 6 shows a housing 100 for a heater controller and six heating elements 104, according to a further embodiment of the present invention. Compared to the embodiment shown in Fig. 3, the form and alignment of the contact sheets 212 and the electrical conductors 312 is different. According to the embodiment shown in Fig. 4, the longitudinal and lateral extension of the contact sheets 212 and the electrical conductors 312 may be parallel to side faces 610 of the housing 100. End sections of corresponding contact sheets 212 and electrical conductors 312 overlap and may be in direct contact. A connection between the contact sheets 212 and the corresponding electrical conductors 312 may be realized with soldering, welding, bonding, or other hard fastening and can be covered with sealing material.

[0033] The inventive concept of connection allows a direct integration of the electronic controller on the PTC heater. The concept can be used on standard networks (12V) as well as on hybrid and electrical vehicles (HV). Any additional "connector" material specific for a connector is avoided and the PCB output is fastened directly to the PTC. The inventive approach allows a hard fastening in a sealed or not sealed configuration depending on the application.

[0034] It should be noted that the previous mentioned features are usable not only in the respectively indicated combination, but also in further combinations or taken alone, without departing from the scope of the present invention.

Claims

1. Heater for a vehicle, comprising:

at least one PTC heating element (104) comprising an electrical contact section (212); and at least one output (312) of a power switch of a heater controller circuit (102), wherein the at least one output of the power switch is hard fastened to the electrical contact section of the at least one PTC heating element by a fastening process based on heat or pressure

2. Heater according to claim 1, wherein the PTC heating element (104) is a PTC heater resistor.
3. Heater according to claim 1 or 2, wherein the electrical contact section (212) of the PTC heating element (104) comprises an angular end section of a side rail of the PTC heating element and a contact sheet being connected to the end section of the side rail and wherein the at least one output (312) of the power switch is hard fastened to the contact sheet by a fastening process based on heat or pressure.
4. Heater according to one of the previous claims, comprising a housing (100) with an interior which is adapted to carry the heater controller circuit (102), wherein a side panel (210) of the housing comprises at least one opening suitable for inserting the electrical contact section (212) of the PTC heating element (104) through.
5. Heater according to claim 4, comprising an inner panel (310) for separating the interior of the housing (100) into a first space and a second space, wherein at least one electrical conductor (312) is arranged through the inner panel, such that a first end section of the electrical conductor is arranged within the first space and a second end section of the electrical conductor is arranged within the second space and wherein the heater controller circuit (102) can be arranged within the first space such that the output of the power switch of the heater controller circuit is arranged adjacent to the first end section of the electrical conductor (312) and wherein the electrical contact section (212) of the PTC heating element (104) can be inserted into the second space.
6. Heater according to claim 5, wherein the inner panel (310) is arranged in parallel to the side panel (210) comprising the at least one opening.
7. Heater according to one of claims 5 or 6, wherein the at least one electrical conductor (312) is aligned to the at least one opening.
8. Heater according to one of claims 5 to 7, wherein the at least one electrical conductor (312) is formed by a metal plate.
9. Heater according to one of claims 5 to 8, wherein the second end section of the electrical conductor (312) is exposed.
10. Heater according to one of claims 5 to 9, wherein the second end section of the electrical conductor (312) is arranged adjacent to the electrical contact section (212) and is hard fastened to the electrical contact section of the at least one PTC heating element (104) by a fastening process based on heat or

pressure.

11. Heater according to one of claims 5 to 10, comprising a support element (320) for supporting a conductor plate of the heater controller circuit (102), wherein the support element is arranged within the first space adjacent to the inner panel (310) and wherein the first end section of the electrical conductor (312) is arranged on a surface of the support element facing the conductor plate.

12. Method for manufacturing a heater for a vehicle, comprising the following steps:

providing at least one PTC heating element (104) comprising an electrical contact section (212);
 providing at least one output (312) of a power switch of a heater controller circuit (102);
 arranging the electrical contact section (212) and the output (312) adjacent to each other; and
 hard fastening the electrical contact section (212) and the output (312) by a fastening process based on heat or pressure.

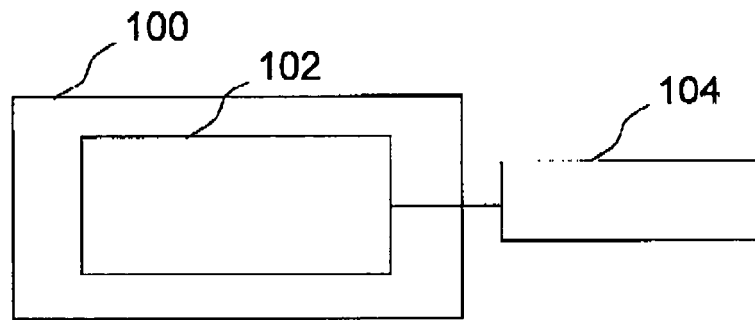


FIG 1

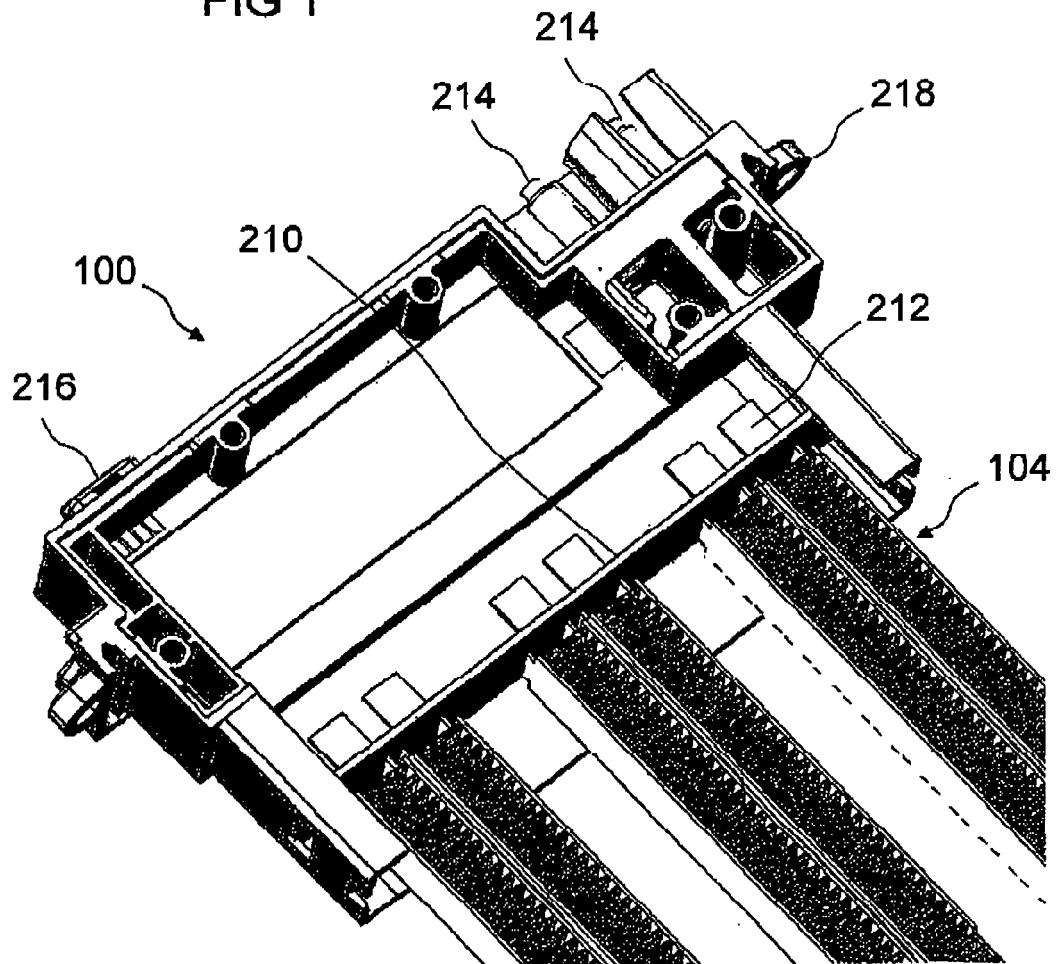


FIG 2

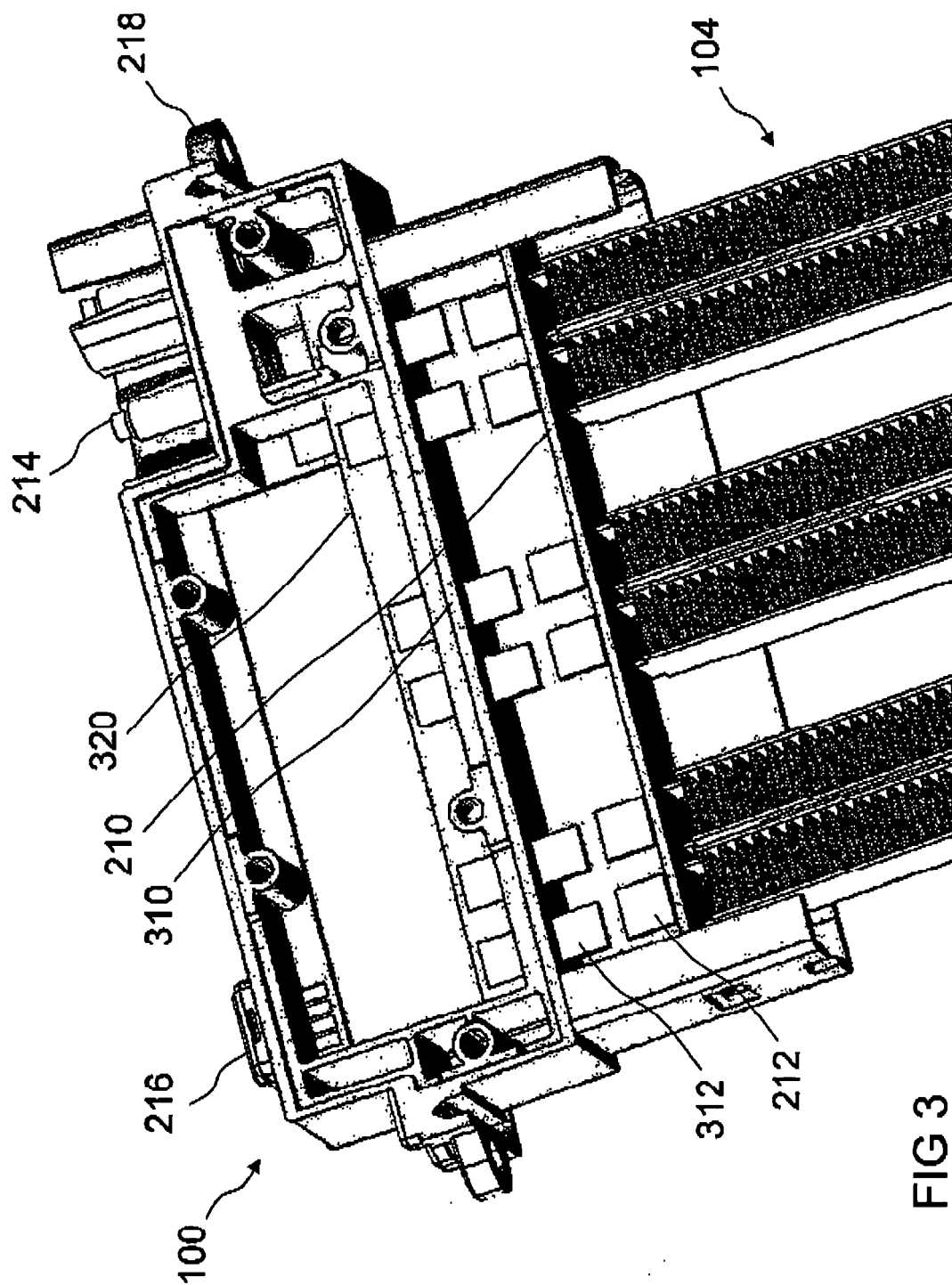
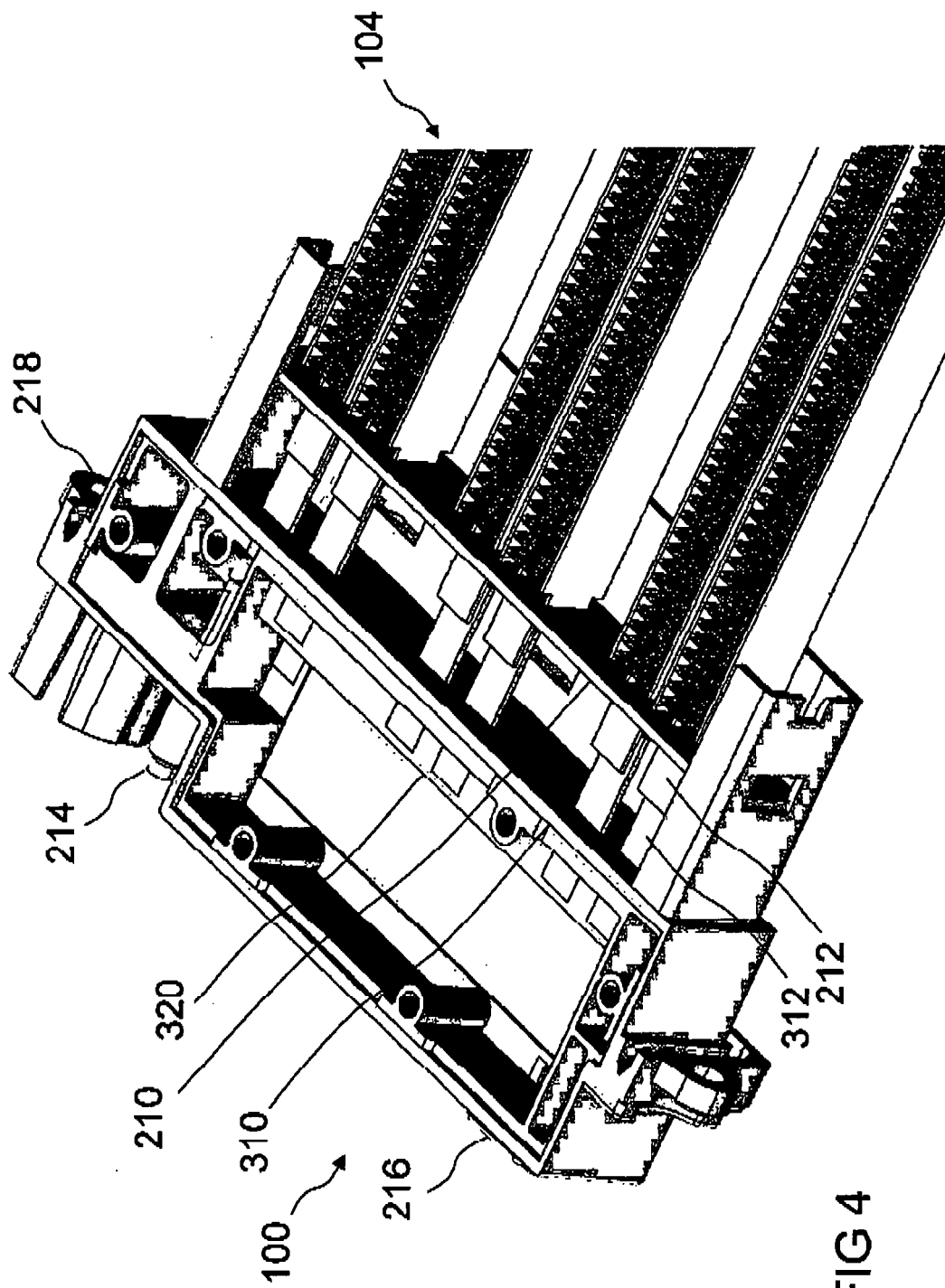
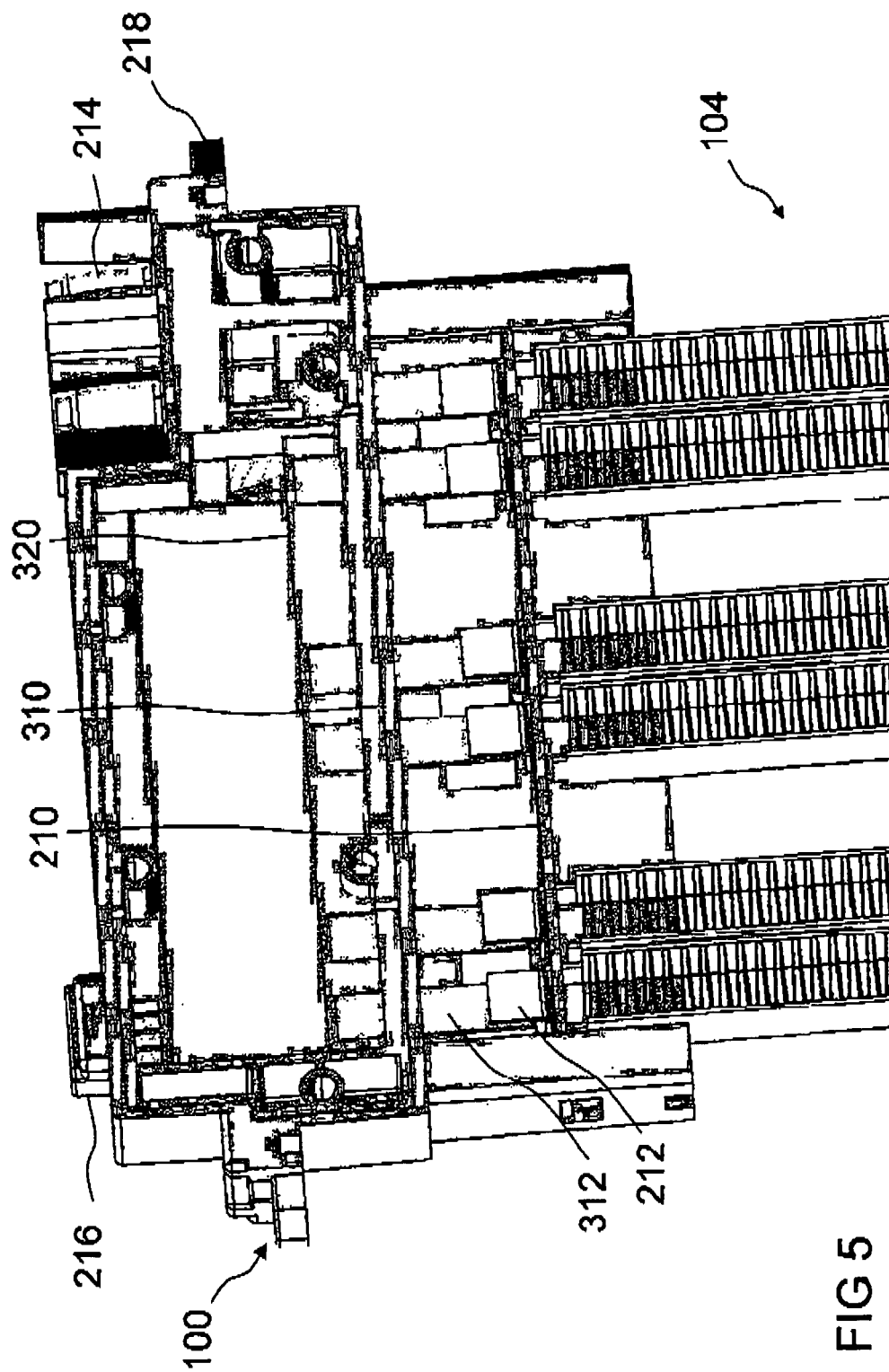
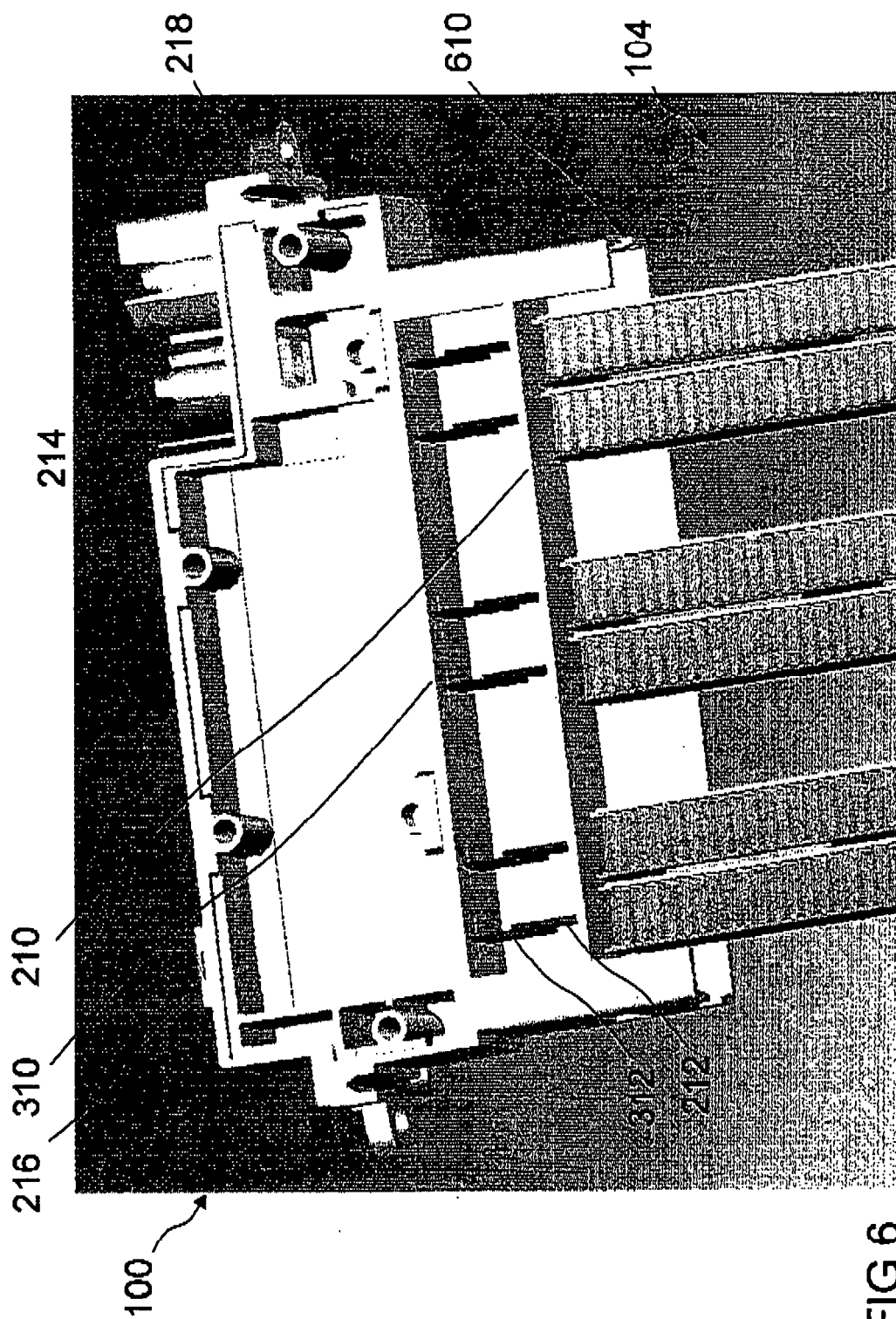


FIG 3









EUROPEAN SEARCH REPORT

Application Number
EP 10 29 0020

DOCUMENTS CONSIDERED TO BE RELEVANT			
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 27 May 2010	Examiner Tasiaux, Baudouin
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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