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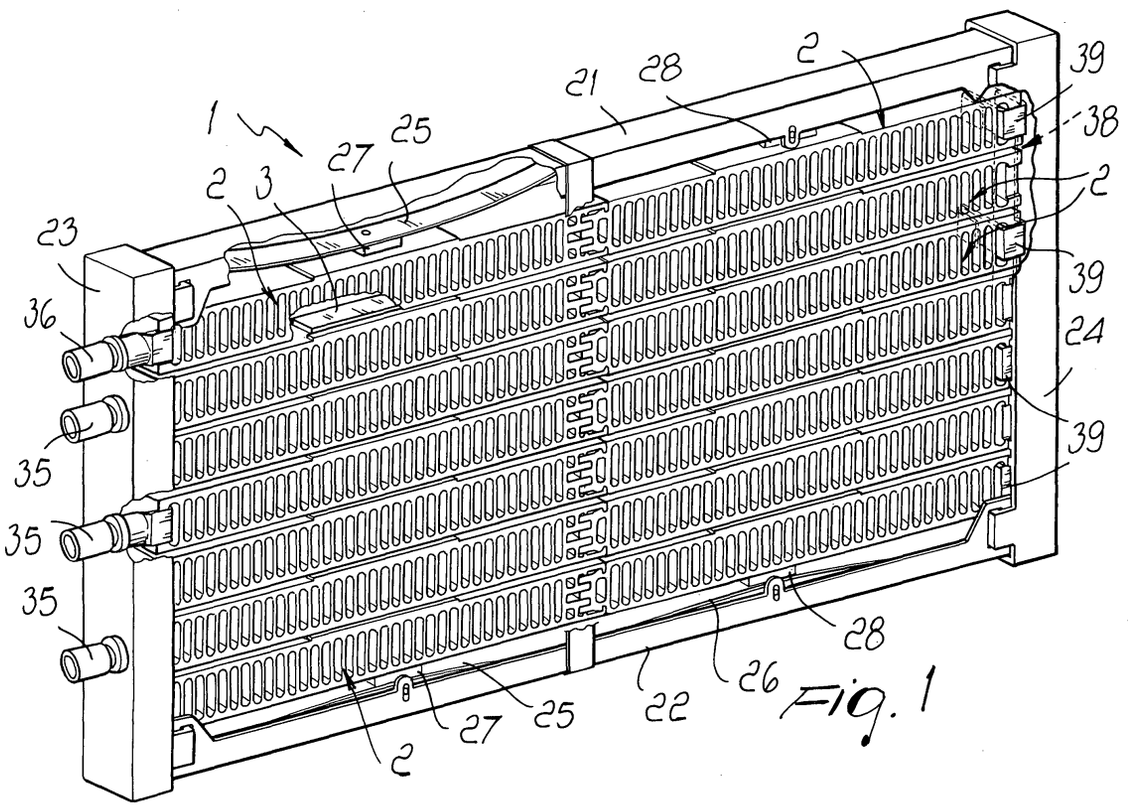
(54) Electric heater with ptc elements, particularly for motor vehicle cabin ventilation systems

(57) An electric heater with PTC elements, particularly for motor vehicle cabin ventilation systems, comprising at least one radiating element (2) and at least one PTC element (3) that can be supplied with electric power and is adapted to transmit heat to the radiating element (2), the radiating element comprising an extruded body that has a plurality of fins (4) in order to increase its heat exchange surface, the provision of the radiating element (2) as an extruded body producing greater compactness, better efficiency in transmission of the generated heat, and simpler assembly of the heater.



EP 1 370 117 A2

Description

[0001] The present invention relates to an electric heater with PTC elements, particularly for motor vehicle cabin ventilation systems.

[0002] Electric heaters with PTC thermistors, commonly termed PTC elements, are known and are used to heat the air that is circulated within the cabin of motor vehicles.

[0003] These heaters generally comprise a frame that supports and holds together a plurality of radiating elements, which are usually arranged side by side and superimposed and between which the PTC elements are interposed.

[0004] The PTC elements are generally formed in the shape of plates or pads and have the property of warming when they are supplied with electric power by means of electrical contacts applied to their two opposite faces. PTC elements inherently have an electrical resistance that increases as the temperature increases and therefore are unable to become hotter than a given temperature. Because of this property, PTC elements are used in all applications in which one wishes to avoid dangers of overheating or fire with absolute safety. Use in motor vehicles is a typical application of PTC elements, in view of the high safety required against the danger of fire.

[0005] In this type of heater, the radiating elements, which are heated by conduction by the PTC elements, are designed to provide the heat generated by the PTC elements with a large heat exchange surface so as to achieve rapid heating of the air that strikes them.

[0006] For this reason, the radiating elements are generally made of a metal that has excellent thermal conductivity and are usually shaped like a contoured and/or folded lamina in order to offer a large heat exchange surface despite a small overall space occupation.

[0007] In many cases, the radiating elements are constituted by folded laminas interposed between conducting plates that provide electrical and thermal contact with the PTC elements. The radiating elements are further used very often to connect the PTC elements to the electrical power supply connectors.

[0008] These heaters have problems and drawbacks.

[0009] The radiating elements, with their folded-lamina structure, are rather complicated to assemble and significantly increase the overall production costs of the heater.

[0010] Furthermore, again due to the folded-lamina structure of the radiating elements, the region of contact between the radiating elements and the conducting plates or the PTC elements is limited, leading to reduced efficiency in the transmission of heat from the PTC elements to the radiating elements.

[0011] Another drawback arises from the need to contain, by means of a frame usually made of plastics, the PTC elements arranged between the folded-lamina radiating elements. The presence of these elements for containing the PTC elements in practice reduces the passage section of the air to be heated.

[0012] Furthermore, the folding of the radiating elements, as well as the regions of contact between the radiating elements and the conducting plates, can cause the retention of dust or dirt, which may induce leakage of current on the surface of the containment frames of the PTC elements.

[0013] The aim of the present invention is to solve the problems cited above by providing an electric heater with PTC elements, particularly for motor vehicle cabin ventilation systems, that ensures high efficiency in transmitting the generated heat.

[0014] Within this aim, an object of the invention is to provide an electric heater with PTC elements that is compact, mechanically strong and simple to assemble.

[0015] Another object of the invention is to provide an electric heater with PTC elements that is highly reliable in operation and offers adequate assurances of safety.

[0016] Another object of the invention is to provide an electric heater with PTC elements that can be manufactured at competitive costs.

[0017] This aim and these and other objects that will become better apparent hereinafter are achieved by an electric heater with PTC elements, particularly for motor vehicle cabin ventilation systems, comprising at least one radiating element and at least one PTC element that can be supplied with electric power and is adapted to transmit heat to the radiating element, characterized in that said radiating element comprises an extruded body that has a plurality of fins in order to increase its heat exchange surface.

[0018] Further characteristics and advantages of the invention will become better apparent from the description of a preferred but not exclusive embodiment of the heater according to the invention, illustrated by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a partially cutout perspective view of the heater according to the invention;
Figure 2 is a perspective view of a radiating element of the heater according to the invention, to which two PTC elements are applied;
Figure 3 is a perspective view of a constructive variation of a radiating element according to the invention, with two PTC elements applied thereto;
Figure 4 is a partially sectional front elevation view of a component of the heater according to the invention;
Figure 5 is a perspective view of a constructive variation of the component of Figure 4;
Figure 6 is a perspective view of another constructive variation of the component of Figure 4.

[0019] With reference to the figures, the heater according to the invention, generally designated by the reference numeral 1, comprises at least one radiating ele-

ment 2 and at least one PTC element 3 that can be supplied with electric power and is arranged so as to transmit heat to the radiating element 2.

[0020] According to the invention, the radiating element 2 comprises an extruded body that has a plurality of fins 4 in order to increase its heat exchange surface.

[0021] Preferably, the radiating element 2 is constituted by at least one extruded body made of aluminum or aluminum alloy so as to have excellent thermal and electrical conductivity.

[0022] According to a preferred configuration, the radiating element 2 is shaped like an elongated bar, with a substantially rectangular transverse cross-section that is delimited on two opposite longitudinal sides by two side walls 5 and 6 that face each other and are connected by a plurality of fins 4. Said fins 4 are formed by a plurality of holes 7 of the extruded body of the radiating element 2, which are arranged side by side sequentially along the longitudinal extension of the extruded body of the radiating element 2.

[0023] It should be noted that the extrusion of the body of the radiating element 2 occurs along a direction that is perpendicular to the longitudinal extension of the radiating element 2 in its final configuration. Substantially, a bar in which a plurality of holes 7 are formed internally is extruded continuously and said bar is then cut transversely in order to obtain the extruded body of the radiating element 2.

[0024] Preferably, in order to avoid having an excessively large extrusion die, the radiating element 2 is constituted by two extruded bodies, respectively a first body 8 and a second body 9, which are aligned and coupled, by way of an interlocking coupling 10, at one of their longitudinal ends.

[0025] Preferably, the two outer faces of the side walls 5 and 6, on which the PTC elements 3 are meant to be rested, are substantially flat.

[0026] Each PTC element 3 is constituted in a per se known manner by a plate-like body that rests, with one of its two larger faces, against one of the outer faces of the side walls 5 or 6 of the radiating element 2.

[0027] The heater 1 preferably comprises a plurality of radiating elements 2, stacked so that the outer faces of the side walls 5 and 6 of the various radiating elements 2 face each other and so that multiple PTC elements 3 are interposed.

[0028] In the illustrated embodiment there are seven radiating elements 2 with two PTC elements 3 interposed for every two contiguous radiating elements of the stack of radiating elements. Substantially, in the illustrated heater there are seven radiating elements 2 and ten PTC elements 3. The PTC elements 3 are arranged in an intermediate region of the extension of each body 8 and 9 that composes a radiating element 2.

[0029] The radiating elements 2 are in direct contact with the PTC elements 3 and are electrically connected to them so as to allow the supply of electric power to the PTC elements 3 through said radiating elements 2, as will become better apparent hereinafter.

[0030] Conveniently, there are means for positioning the PTC elements 3 on the outer faces of the side walls 5 of the radiating elements 2.

[0031] More particularly, as shown in particular in Figures 1 and 2, said positioning means comprise a positioning seat 11 that is formed on the outer face of the side wall 5 of the radiating elements 2 and is adapted to accommodate partially at least one PTC element 3. The positioning seat 11 can be obtained by machining in a protrusion that can be provided during the extrusion of the bodies 8 and 9 on the outer face of the side wall 5.

[0032] As an alternative, as shown in Figure 3, the positioning means can also be constituted by a positioning bracket 12, which is interposed between two contiguous radiating elements 2 in the stacked arrangement and forms at least one positioning seat 13 that is adapted to accommodate partially a PTC element 3. In the embodiment shown in Figure 3, the positioning bracket 12 lies on the outer face of the side wall 5 of the bodies 8 and 9 that compose a radiating element 2 and has two positioning seats 13 for as many PTC elements 3. The positioning bracket 12 is provided with positioning fins 14 that can engage the front and rear side of the radiating elements 2, between which it is inserted so as to keep the PTC elements 3 correctly positioned. The positioning of the PTC elements 3, in the variation shown in Figure 3, can be completed by means of shoulders formed by protrusions 15 provided for this purpose on the outer face of the side wall 5.

[0033] The heater according to the invention comprises a supporting frame for containing and supporting the plurality of radiating elements 2 and of PTC elements 3.

[0034] Said supporting frame is substantially composed of two longitudinal side walls 21 and 22 that respectively face the outer face of the side wall 5 of the radiating element 2 located at the top of the stack of radiating elements 2 and, in a downward region, the outer face of the side wall 6 of the radiating element 2 located at the lower end of the stack of radiating elements 2. The longitudinal side walls 21 and 22 of the frame are connected by two heads 23 and 24 that partially contain the longitudinal ends of the radiating elements 2.

[0035] Conveniently, presser means are provided that act on the stack of radiating elements 2 in order to reinforce the contact of the radiating elements 2 with the PTC elements 3.

[0036] Said presser means comprise elastic means, which are preloaded during the assembly of the heater according to the invention.

[0037] As shown in Figure 1, said presser means comprise at least one, but preferably two, leaf springs 25 and 26 that are interposed between the side wall 21 of the frame and the side wall 5 of the radiating element 2 located at the top of the stack of radiating elements 2. Two leaf springs 25 and 26 can be provided, in a similar manner, also between the side wall 22 of the frame and the outer face of the side wall 6 of the radiating element

2 located at the lower end of the stack of radiating elements 2. The leaf springs 25 and 26 are arranged so as to apply maximum compression at the region of the radiating elements 2 that is affected by the PTC elements 3.

[0038] Optionally, in order to increase the pressure on the stack of radiating elements 2, it is possible to provide one or more blocks that are interposed between the side wall 21 and 22 of the frame and the outer face of the side wall 5 and 6 of the radiating element 2 that faces it.

[0039] In the example shown in Figures 1 and 4 there are two blocks 27 and 28 that are interposed between the leaf springs 25 and 26 and an intermediate region of the outer face of the side wall 5 of the radiating element 2 that faces the side wall 21 of the frame. Likewise, it is possible to provide blocks 27 and 28 also between the leaf springs 25 and 26 that are arranged between the side wall 22 of the frame and the radiating element 2 located at the lower end of the stack of radiating elements 2.

[0040] The blocks 27 and 28 are preferably arranged in alignment with the regions of the radiating elements 2 that make contact with the PTC elements 3.

[0041] As an alternative, as shown in Figure 5, it is possible to provide on the outer face of the side walls 21 and/or 22 of the frame a leaf spring 29 that presses said side wall 21 and/or 22 toward the radiating elements 2 and is retained by a strap 30.

[0042] Also as an alternative, as shown in particular in Figure 6, it is possible to provide a single leaf spring 31 arranged on the outer face of the side walls 21 and/or 22, which is loaded by the assembly of the side walls 21 and 22 with the heads 23 and 24.

[0043] Optionally, in order to reinforce the assembly of the frame, one can provide a strap 30 also for the embodiments shown in Figures 1 and 6, said strap connecting one another the side walls 21 and 22 of the frame at an intermediate region of their longitudinal extension.

[0044] The heads 23 and 24 are used conveniently to accommodate the electrical connections for feeding the PTC elements 3.

[0045] More particularly, the head 23 supports electrical power supply connectors 35 of the quick-coupling type, for example of the type commonly known as Faston, which are connected electrically to some of the radiating elements 2, and an electrical power supply connector 36 of a similar kind, which is connected electrically to the other radiating elements 2.

[0046] More particularly, the connector 36 is connected electrically to the radiating element 2 located at the top of the stack of radiating elements 2 and the radiating elements 2 that are arranged below said top radiating element are connected alternately to one of the connectors 35 or to the radiating element 2 that constitutes the top of the stack. The electrical connection between the radiating element 2 located at the top of the stack and the other radiating elements (in this case the third, fifth and seventh from the top) is provided by way of electrical connection elements that are accommodated within the head 24. Said electrical connection elements are constituted by a plate 38 made of electrically conducting material, which is provided with elastically deformable feet 39 that are kept in contact with the corresponding radiating elements 2 to be mutually connected. Preferably, the feet 39 are inserted with an elastic engagement in one of the holes 7 located at the longitudinal end of the corresponding radiating element 2.

[0047] The connectors 35 and 36 also can be connected to the corresponding radiating element 2 by means of feet that are associated with the corresponding connector and inserted with an elastic engagement within one of the holes 7 located at the corresponding longitudinal end of the radiating element 2 to be connected.

[0048] In this manner, two contiguous radiating elements 2, between which the PTC elements 3 are arranged, are supplied electrically with opposite polarities so as to correspondingly supply, with opposite polarities, the two faces of the PTC elements 3 inserted between them.

[0049] It should be noted that the electrical connection between the various radiating elements 2 can also be provided by way of other means of a known type, which are not illustrated for the sake of simplicity.

[0050] The operation of the electric heater according to the invention is evident from what has been described and illustrated. In particular, by supplying the PTC elements 3, preferably by means of the radiating elements 2 themselves, said PTCs 3 are heated. The heat generated by the PTC elements 3 is transmitted by conduction to the radiating elements 2 and from there, by convection, is transferred to the air that is conveyed through the holes 7 so as to strike the fins 4.

[0051] Thanks to the particular structure of the radiating elements 2, excellent contact is achieved between the PTC elements 3 and the radiating elements 2, and therefore one obtains an excellent efficiency in the transmission of heat from the PTC elements 3 to the radiating elements 2. Furthermore, again thanks to the structure of the radiating elements 2, one obtains a large heat exchange surface between the radiating elements 2 and the air that strikes them, therefore obtaining an excellent heat exchange efficiency.

[0052] The provision of the radiating elements 2 by means of extruded bodies also allows to simplify and speed up the operations for assembling the heater and to obtain an excellent mechanical strength of the heater as a whole.

[0053] In particular, the assembly of the heater according to the invention is particularly quick and easy, since it is sufficient to stack the radiating elements 2, interposing the PTC elements 3 between them, and then assemble the side walls 21 and 22 with the heads 23 and 24, simultaneously engaging the electrical power supply connectors 35 and 36 and the feet 39 of the el-

ements for electrical connection to the radiating elements 2.

[0054] In practice it has been found that the heater according to the invention fully achieves the intended aim, since due to the fact that the radiating elements are constituted by extruded bodies one obtains high efficiency in the transmission of the heat generated by the PTC elements, simpler assembly, high mechanical strength and containment of the overall manufacturing costs of the heater.

[0055] The heater thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims; all the details may further be replaced with other technically equivalent elements.

[0056] In practice, the materials used may be any according to requirements and to the state of the art, although aluminum or an aluminum alloy is preferred for the execution of the radiating elements 2.

[0057] The disclosures in Italian Patent Application No. MI2002A001226 from which this application claims priority are incorporated herein by reference.

[0058] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. An electric heater with PTC elements, particularly for motor vehicle cabin ventilation systems, comprising at least one radiating element (2) and at least one PTC element (3) that can be supplied with electric power and is adapted to transmit heat to the radiating element (2), **characterized in that** said radiating element (2) comprises an extruded body that has a plurality of fins (4) in order to increase its heat exchange surface.

2. The heater according to claim 1, **characterized in that** said radiating element (2) is constituted by at least one extruded body made of aluminum or aluminum alloy.

3. The heater according to claims 1 and 2, **characterized in that** said radiating element comprises two mutually facing side walls (5,6) that are connected by a plurality of fins (4).

4. The heater according to one or more of the preceding claims, **characterized in that** said radiating element (2) has an elongated shape and is composed of at least two aligned extruded bodies (8,9) that are coupled by interlocking (10) at one of their longitudinal ends.

5. The heater according to one or more of the preceding claims, **characterized in that** said fins (4) are formed by a plurality of holes (7) formed in said extruded body and arranged side by side sequentially along the longitudinal extension of said extruded body.

6. The heater according to one or more of the preceding claims, **characterized in that** the two outer faces of said side walls (5,6) of the radiating element (2) that are arranged on opposite sides one another are substantially flat.

7. The heater according to one or more of the preceding claims, **characterized in that** said at least one PTC element (3) is constituted by a plate-like body that rests against one of said outer faces of said side walls (5,6) of the radiating element (3).

8. The heater according to one or more of the preceding claims, **characterized in that** it comprises a plurality of radiating elements (2), which are stacked so that the outer faces of the side walls (5,6) of the various radiating elements face each other and have PTC elements (3) interposed.

9. The heater according to one or more of the preceding claims, **characterized in that** said radiating elements (2) are in direct contact with said PTC elements (3) and electrically connected thereto.

10. The heater according to one or more of the preceding claims, **characterized in that** two contiguous radiating elements (2), in their stacked arrangement with at least one PTC element interposed (3), can be supplied with electric power with opposite power supply polarities in order to supply electric power correspondingly to the two opposite faces of the at least one interposed PTC element (3).

11. The heater according to one or more of the preceding claims, **characterized in that** it comprises means (11,12) for positioning the at least one PTC element (3) on the outer faces of said side walls (5,6) of the radiating elements (2).

12. The heater according to one or more of the preceding claims, **characterized in that** said positioning means comprise a positioning seat (11) that is formed on the outer face of at least one (5) of the side walls of the radiating element and is adapted to accommodate partially said at least one PTC element (3).

13. The heater according to one or more of the preceding claims, **characterized in that** said positioning

means comprise a positioning bracket (12) that can be interposed between two contiguous radiating elements (2) in the stacked arrangement, said bracket (12) forming a positioning seat (13) that is adapted to accommodate partially said at least one PTC element (3).

14. The heater according to one or more of the preceding claims, **characterized in that** it comprises a supporting frame (21,22) for said plurality of radiating elements (2).

15. The heater according to one or more of the preceding claims, **characterized in that** said supporting frame comprises two longitudinal side walls (21,22), which are substantially parallel and can be superimposed on the outer faces of the side walls (5,6) of the radiating elements (2) located at the ends of the stack of radiating elements (2), and two heads (23,24), which connect one another said pair of side walls (21,22) of the frame (21,22) and face the longitudinal ends of the radiating elements (21).

16. The heater according to one or more of the preceding claims, **characterized in that** it comprises presser means (25,26) that act on the stack of radiating elements (2) in order to reinforce the contact of said radiating elements (2) with said PTC elements (3).

17. The heater according to one or more of the preceding claims, **characterized in that** said presser means comprise elastic means (25,26,31).

18. The heater according to one or more of the preceding claims, **characterized in that** said presser means comprise at least one leaf spring (29) that is interposed between at least one of said side walls (21,22) of the frame and said heads (23,24) and is adapted to press said at least one side wall (21,22) of the frame toward the stack of radiating elements (2) enclosed by said frame.

19. The heater according to one or more of the preceding claims, **characterized in that** said presser means comprise at least one leaf spring (25,26) that is interposed between at least one side wall (21) of the frame and the outer face of the side wall (5) of the radiating element (2) of the stack of radiating elements that face said at least one side wall (21) of the frame.

20. The heater according to one or more of the preceding claims, **characterized in that** said presser means comprise at least one block (27,28) that is interposed between at least one side wall (21,22) of the frame or the leaf spring (25,26) and the outer face of the side wall (5) of the radiating element (2) that faces it.

21. The heater according to one or more of the preceding claims, **characterized in that** said block (27,28) is arranged in alignment with the PTC elements (3) interposed between said radiating elements (2).

22. The heater according to one or more of the preceding claims, **characterized in that** it comprises electrical power supply connectors (35,36) that are supported by one (23) of said heads and are connected to said radiating elements (2).

23. The heater according to one or more of the preceding claims, **characterized in that** it comprises elements (38) for connecting electrically part of said radiating elements (2).

24. The heater according to one or more of the preceding claims, **characterized in that** said power supply connectors (35,36) and/or said electrical connection elements (38) engage by elastic contact one of said holes (7) of said radiating elements (2).

25. The heater according to one or more of the preceding claims, **characterized in that** it comprises a strap (30) for connecting an intermediate region of the longitudinal extension of said two side walls (21,22) of the frame.

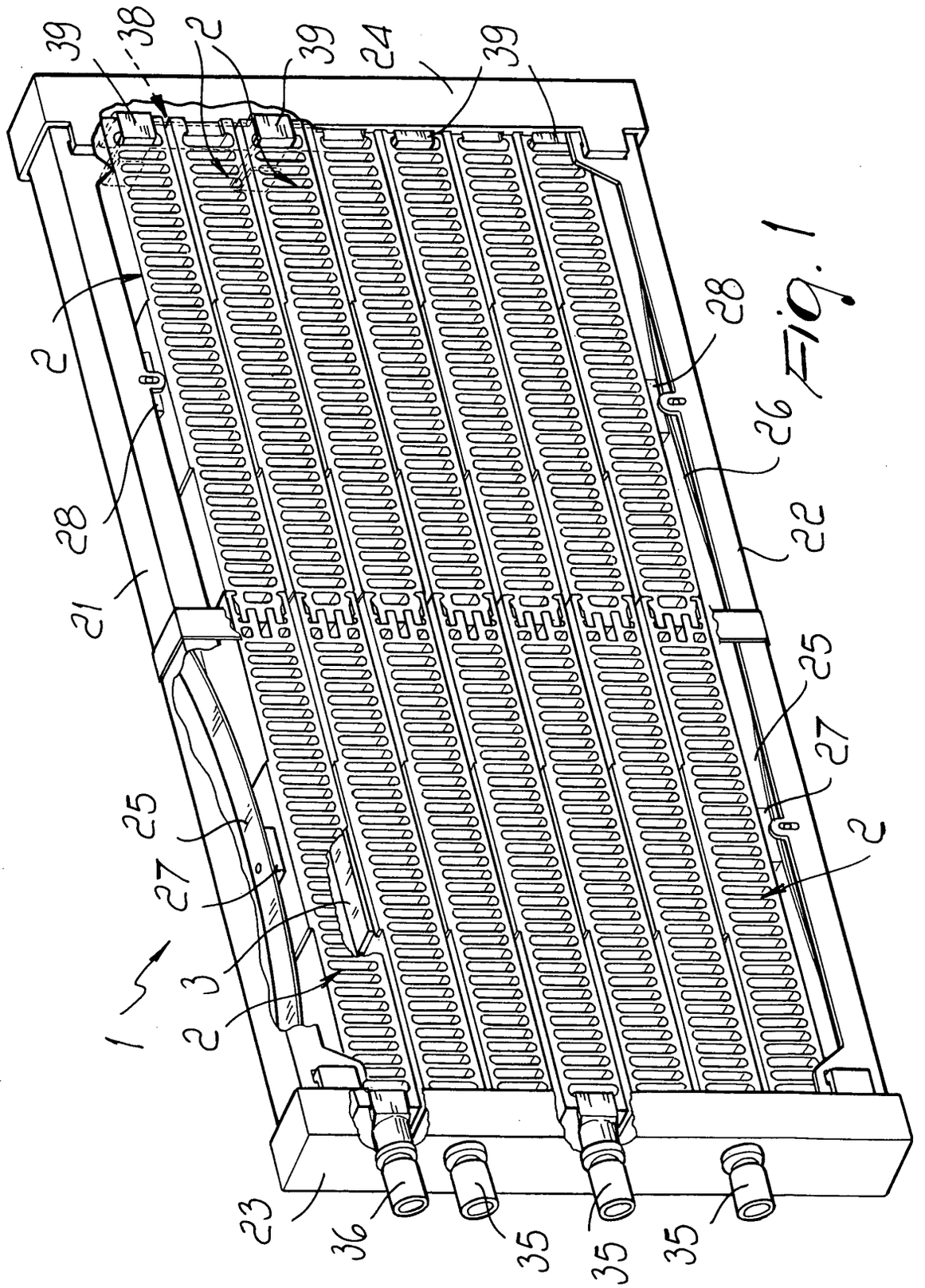


Fig. 1

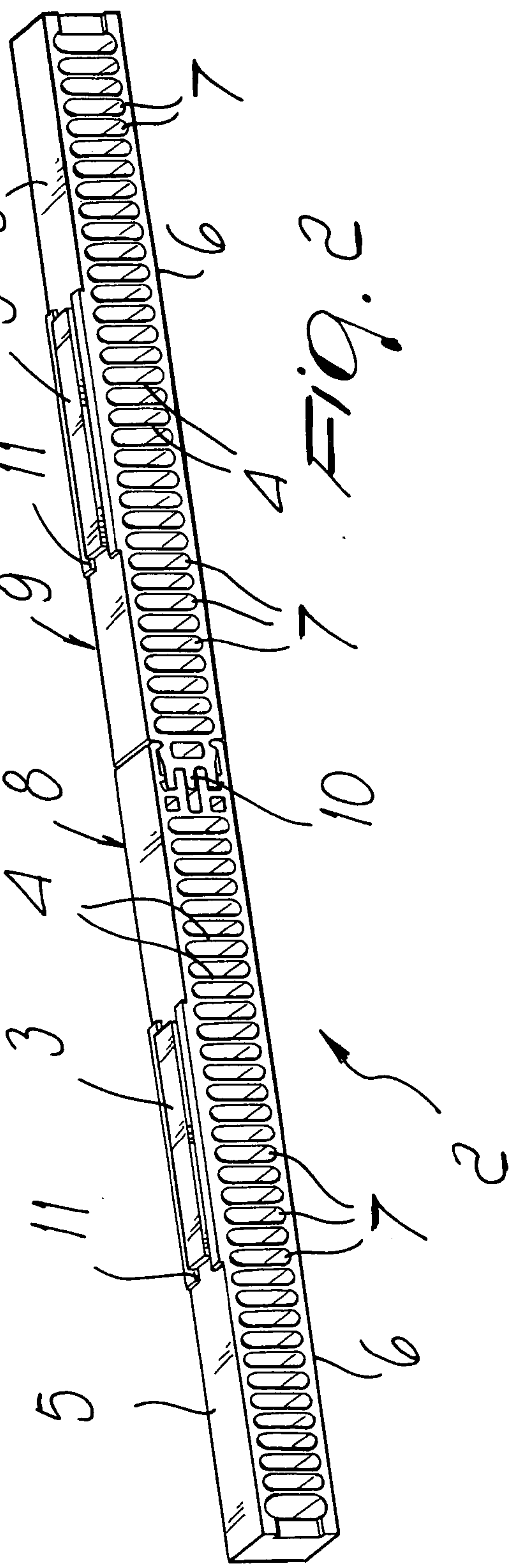

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Fig. 2

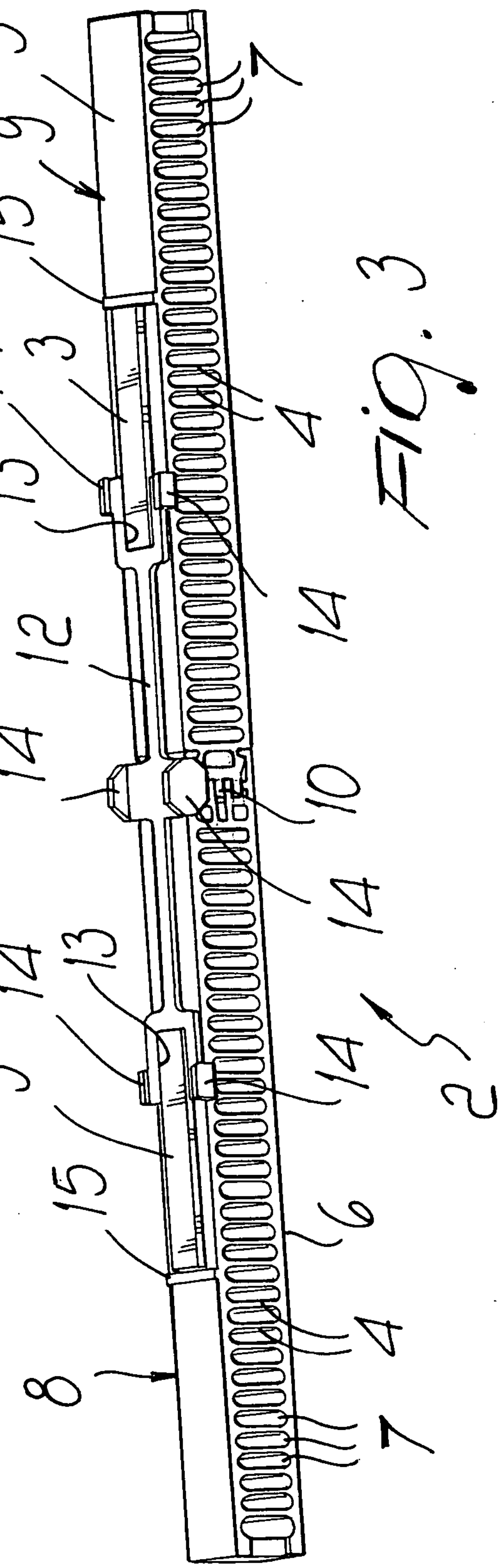
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Fig. 3

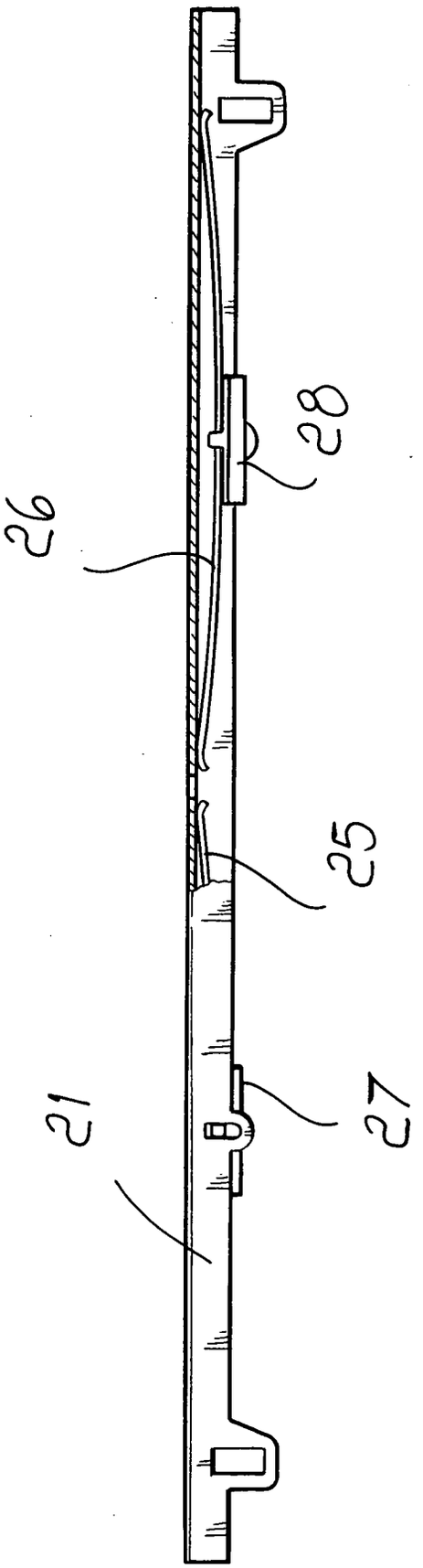

Fig. 4

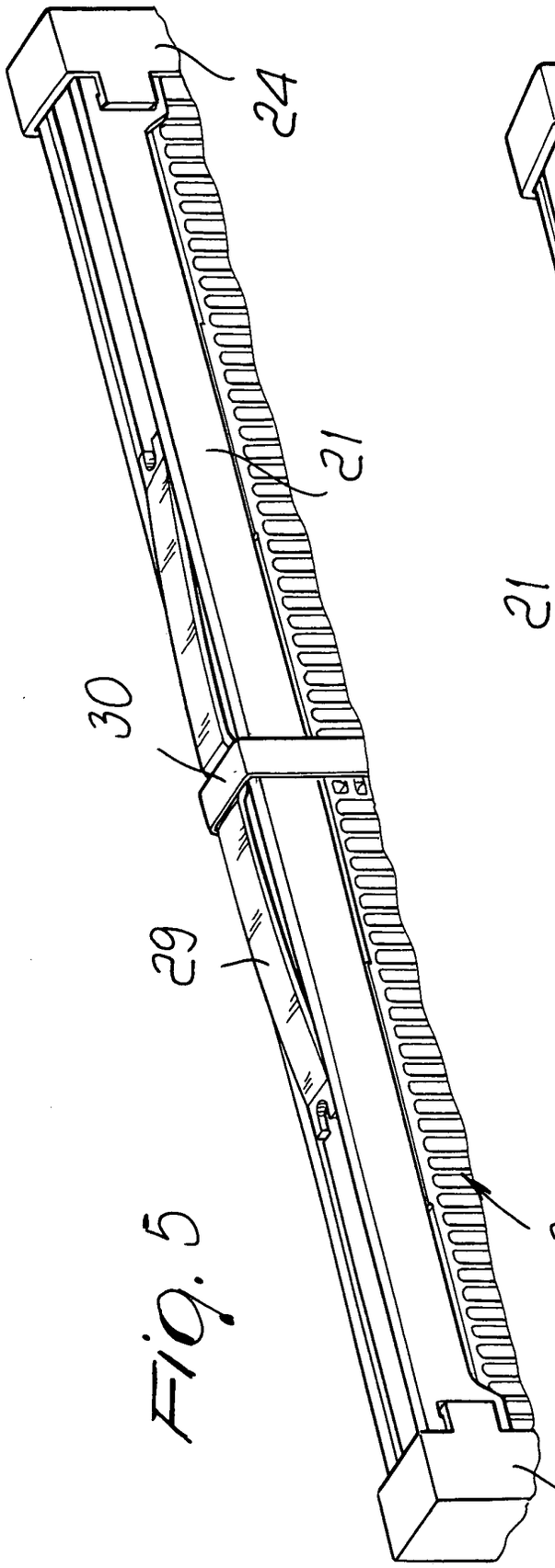

Fig. 5

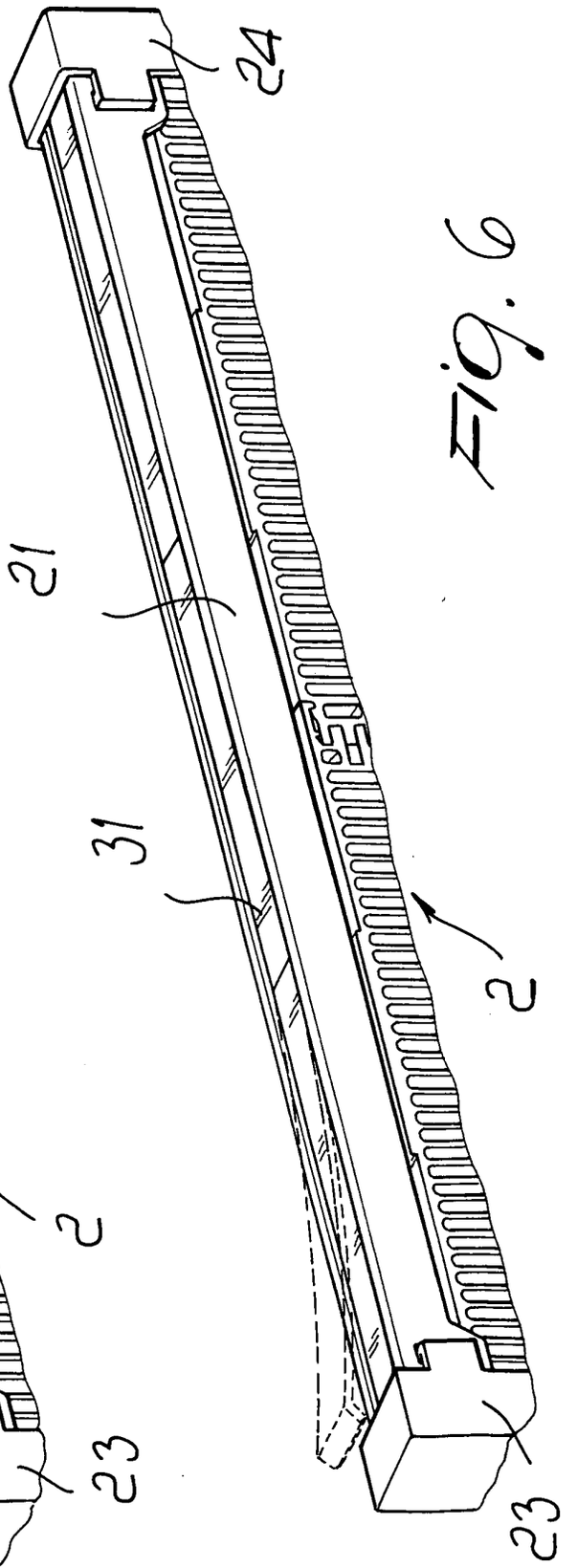

Fig. 6