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Remarks:
Amended claims in accordance with Rule 137(2) EPC.

(54) Electric heater for vehicle ventilation systems

(57) The heater comprises a stack of elongate heating elements (10) containing PTC plates (32) in thermal and electric contact with elongate fretted radiators (12) alternating therewith. The heating elements and the radiators have a plurality of aligned transverse holes (28, 40) defining respective transverse passages, in which are received respective helical springs (20) that are hooked at their opposite ends to rods (18) extending parallelly along the two longitudinal sides of the stack. Two brackets (22, 24) close the opposite ends of the stack and have holes (58, 60) in which the opposite ends of said rods (18) are received and retained.

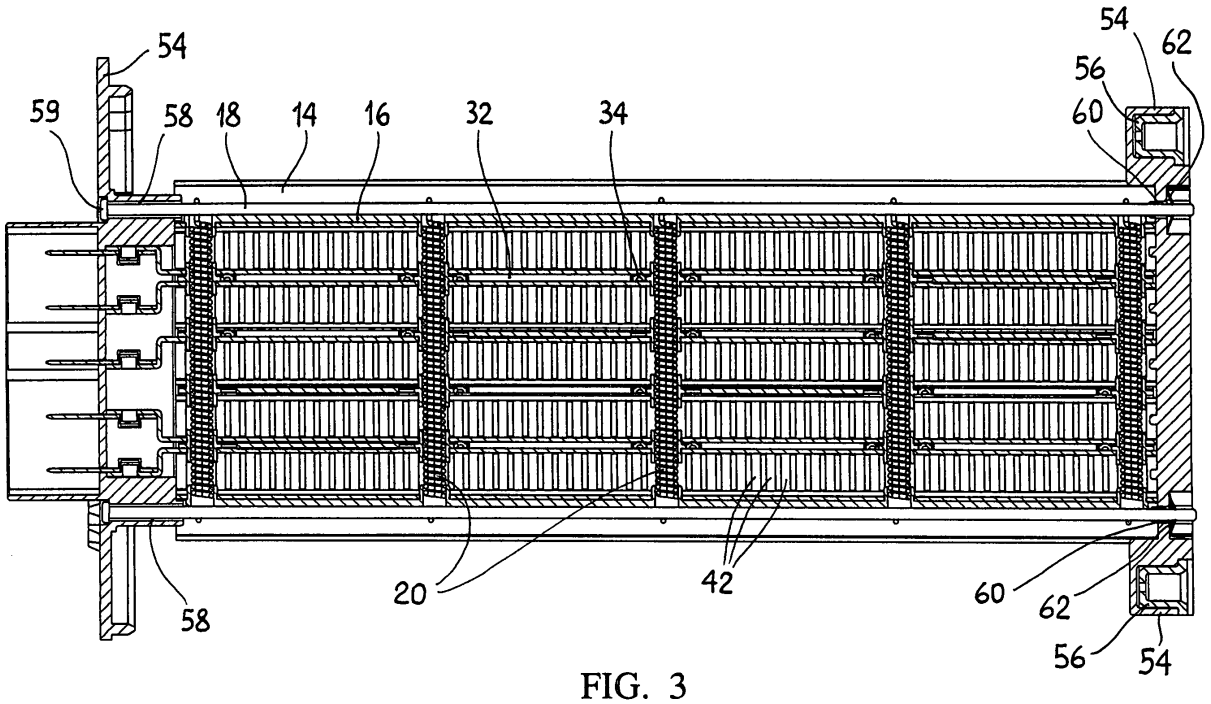

FIG. 3

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Description

[0001] This invention is concerned with electric heaters for vehicle ventilation systems.

[0002] Electric heaters are installed nowadays as auxiliary heaters in the air duct of the ventilation system, so that they are traversed by the ventilation airflow, and are generally active only for a short time at initial startup of the motorcar, in order to provide an immediate heating before the usual heating obtained from cooling the vehicle engine becomes effective. Such auxiliary heaters generally comprise a stack of heat radiators alternating with heating elements and enclosed in a frame which keeps the stack assembled and compressed, so that the electric and thermal contact between the radiators and the heating elements is insured. In order to prevent the temperature from overshooting a threshold that could be potentially dangerous for the ventialtion system, which is conventionally made of a plastic material, the heating elements are based on thermistors having a positive temperature coefficient (PTC elements), which are rated for limiting the heat delivered (due to a sharp increase of their electric resistance) when a given temperature threshold is reached. Heaters of this type are disclosed, for instance, in EP-o 350 528 (DBK), in US-5 256 857 (Texas), in GB-2 076 270 (Matsushita), in EP 1462 733 (Valeo), or in EP-1574 791 (CEBI).

[0003] It is now the principal object of this invention to provide an electric heater of the type discussed above, which provides a more efficient thermal exchange and a more dependable electric contact, also in a wet and aggressive atmosphere, while reducing its manufacturing cost with respect to the prior art.

[0004] The above object, as well as other objects and advantages, such as will appear from the following disclosure, are attained by invention with an electric heater having the features set forth in claim 1, whereby the dependent claims recite other advantageous features of the invention.

[0005] The invention will now be described in more detail, with reference to a few preferred, though non-exclusive embodiments, which are shown, by way of example and not of limitation, in the attached drawings, wherein:

Fig. 1 is an exploded perspective view of an electric heater according to a preferred embodiment of the invention;

Fig. 2 is a perspective view of the heater of Fig. 1, such as it appears when assembled;

Fig. 3 is a view of the heater of Fig. 1, in cross-section made along the middle longitudinal plane of the heater;

Fig. 4 is a broken-away, perspective view of a heating element that is used in a heater according to the invention;

Fig. 5 is a broken-away, perspective view of a fretted sheet constituting a blank for a heat-exchange radiator used in the heater of Figs. 1-3;

Fig. 6 is a slightly enlarged view in transverse cross-section of the blank of Fig. 5 after it has been bent to form a radiator; and

Fig. 7 is a broken-away, perspective view of a complete radiator as obtained from the blank of Fig. 5;

Fig. 8 is a broken-away, perspective view of a different embodiment of a radiator that can be used in lieu of the radiator of Fig. 7.

[0006] With reference to Figs. 1-3, an electric heater according to the invention essentially comprises a stack of four identical, elongate heating elements 10, alternating with five identical, elongate radiators 12 and with two beams 14 which are respectively arranged on both longitudinal sides of the stack and which accommodate two cradles 16 supporting respective rods 18. Four helical springs 20 extend between the rods through passages made in the above mentioned stack, as further explained below. At the opposite ends of the stack are arranged respective closing brackets 22 and 24 (not shown in Fig. 1), also as explained below in more detail.

[0007] With particular reference to Fig. 4, each of the four heating elements 10 comprises a strip 26 of an insulating material such as a glassfiber-loaded polyamidic resin, having five holes or passages 28, surrounded by projecting bushings 30. Four rectangular windows are also cut in strip 26, and respective PTC plates 32, encased in respective U-shaped ring gaskets 34 of an elastomeric material are accommodated in the windows, for purposes that will appear below. The main opposite sides of PTC plates 32 are polished and metallized as known in the art. Depending on design requirements, some of the windows may accommodate insulating plates instead of PTC plates.

[0008] Having now reference to Figs. 5-7, each radiator 12 is a fretted, hollow prismatic body, made by successive bends made to a blank 36 comprising a metal sheet that has been fretted to comprise a central strip 38, cut with four spaced holes such as 40, and two parallel sets of slits with intervening posts 42. By means of two square bends made on both sides of central strip 38, blank 36 is converted into a hollow elongate body as shown in transverse cross-section on Fig. 6. A tang 44 is riveted or soldered to the elongate body to act as an electric contact plug (Fig. 7) to obtain a radiator as shown on Fig. 7, which is fretted so that an air stream can flow in heat exchange with the metallic material of the body. Moreover, the radiator has upward and downward, flat metallic surfaces for both electric and thermal contact, as explained below. The holes 40 are aligned and sized so that they receive respective bushings 30 of the heating elements when the overall heater is assembled as shown

in Figs. 2 e 3.

[0009] With more particular reference to Figs. 1-3, the heating elements and the radiators shown on Figs. 4-7 are stacked on one another, while metal ribbons 46 are interposed near the open sides of radiators 12, in order to improve the thermal and electric contact among the parts. Metal ribbons 46 are also bored as the other parts.

[0010] Alternatively, instead of the radiator of Fig. 7, a radiator as shown in Fig. 8 could be used, comprising two profiles according to Fig. 6, having abutting open sides and continuous flat surfaces facing the heating elements. Since this radiator has continuous surfaces on both sides, it does not require metal ribbons 46.

[0011] Beams 16 are respective U-shaped metal channels opening outwardly of the stack and bored with five holes 48 that are aligned with holes 28, 40 in the other parts of the heater. Within beams 16 are received the respective cradles 18. The cradles also have holes surrounded by bushings such as 50, which are inserted in holes 48 of the beams. The cradles have respective grooves made in their outward sides, in which rods 18 rest, as described above.

[0012] Brackets 22, 24 are also made of an insulating material such a a fiberglass-loaded polyamidic resin. Bracket 22 has an internal cavity accommodating terminal tangs 44 projecting from respective radiators, and a flange 52 for mounting onto an air duct (not shown) as known to the person skilled in the art. The opposite bracket 24 has two bosses 54, which are capable of engaging respective posts (not shown) in the air duct with the help of elastic-dampers 56, in order to position the heater, as known per se.

[0013] Brackets 22, 24 have respective pairs of holes 58, 60, in which the opposite ends of rods 18 extend. The rods have enlarged heads 59 at one end for retention in holes 58 of bracket 22, and they are retained at the other end by toothed elastic rings 62 in the holes of the opposite bracket 24.

[0014] The reader will appreciate from the above description and the drawings that the transverse holes in the several parts of the heater togethor form five continuous passages from one side of the heater to the other side, through which passages the helical springs 20 extend freely, though without contact with the metal parts. The tension of the springs will maintain a strong contact pressure between the surfaces of the radiators and of the PTC plates, which have the task of transmitting the heat and the electric current.

[0015] After the heater has been assembled, gaskets 34 are squeezed between the contact surfaces of the adjacent radiators, and therefore isolate the PTC plates from the ambient atmosphere, thereby avoiding that the ambient humidity, particularly if saline, may oxidize their metallized surfaces.

[0016] The operation of the electric heater for motor vehicles as described above will be obvious for the person skilled in the art. The heater is transversely inserted through the ventilation air duct, so that the air stream will flow through the slits in the radiators, and is supplied selectively through tangs 44 in order to obtain different levels of heat.

[0017] Both the cost and weight of the above described heater are smaller, for equal effectiveness, than heaters of the prior art, because the heater does not require sturdy reaction members such as stiff frames or reinforcing belts, such as are generally present in prior art heaters. This is due to the tension springs, which bias rods 18 directly against the stack, without a necessity for reaction supports, and also to the fact that the end brackets 22, 24 do not have to absorb any stress, and may therefore be of a reduced weight and size. Moreover, radiators 12 are made of a thin sheet and can therefore be manufactured by simple cutting and bending techniques.

[0018] Numerous changes may be made to the preferred embodiments described above, within the teachings of the invention. In particular, although the radiators made of thin sheet as disclosed are optimal in many aspects, such as efficiency, cost and lightness, other forms of radiators can also be envisaged, if they allow transverse passages to be provided for the springs. The helical springs could be replaced with other types of elastic tension links, and their number could be different. Also, the design of the end brackets could be changed, depending on the requirements of the air duct in which the heater is to be installed. The beams 14 could also be fretted similarly to radiators 12. The scope of the invention should be defined only by the attached claims.

Claims

1. Electric heater for vehicle ventilation systems, comprising a stack of elongate heating elements (10) containing PTC plates (32) in thermal and electric contact with elongate fretted radiators (12) alternating therewith, **characterized in that** the heating elements and the radiators have a plurality of aligned transverse holes (28, 40) defining respective transverse passages, and **in that** in said passages are received respective elastic tension links (20) that are hooked at their opposite ends to rods (18) extending parallelly along the two longitudinal sides of the stack.

2. The electric heater of claim 1, **characterized in that** said elastic tension links are helical springs (20).

3. The electric heater of claim 1 or 2, **characterized in that** it further comprises two beams (14) extending along both longitudinal sides of said stack and accommodating respective cradles (16) which support said respective rods, the beams and the cradles being cut with holes aligned with said holes in the radiators and the heating elements.

4. The electric heater of any of claims 1 to 3, **charac-**

terized in that it further comprises two brackets (22, 24) resting against the opposite ends of the stack of radiators and heating elements and having holes (58, 60) in which the opposite ends of said rods (18) are received and retained.

5. The electric heater of any of claims 1 to 4, **characterized in that** each of said heating elements (10) comprises an insulating strip (26) having said aligned holes (28) and a plurality of windows in which respective PTC plates are received.

6. The electric heater of any of claims 1 to 5, **characterized in that** said PTC plates (32) are enclosed in respective gaskets of a soft elastomeric material (34).

7. The electric heater of any of claims 5 or 6, **characterized in that** said holes in the insulating strip (26) are surrounded by projecting bushings (30) inserted in corresponding holes (40) of the adjacent radiators (12).

8. The electric heater of any of claims 1 to 7, **characterized in that** each of said radiators (12) comprises at least one metal sheet (36) that has been fretted and bent to form an elongate hollow body having slits allowing a transverse air flow and having said transverse holes (40).

Amended claims in accordance with Rule 137(2) EPC.

1. Electric heater for vehicle ventilation systems, comprising a stack of elongate heating elements (10) containing PTC plates (32) in thermal and electric contact with elongate fretted radiators (12) alternating therewith, the heating elements and the radiators having a plurality of aligned transverse holes (28, 40) defining respective transverse passages, **characterized in that** in said passages are received respective elastic tension links (20) that are hooked at their opposite ends to rods (18) extending parallelly along the two longitudinal sides of the stack.

2. The electric heater of claim 1, **characterized in that** said elastic tension links are helical springs (20).

3. The electric heater of claim 1 or 2, **characterized in that** it further comprises two beams (14) extending along both longitudinal sides of said stack and accommodating respective cradles (16) which support said respective rods, the beams and the cradles being cut with holes aligned with said holes in the radiators and the heating elements.

4. The electric heater of any of claims 1 to 3, **characterized in that** it further comprises two brackets (22, 24) resting against the opposite ends of the stack of radiators and heating elements and having holes (58, 60) in which the opposite ends of said rods (18) are received and retained.

5. The electric heater of any of claims 1 to 4, **characterized in that** each of said heating elements (10) comprises an insulating strip (26) having said aligned holes (28) and a plurality of windows in which respective PTC plates are received.

6. The electric heater of any of claims 1 to 5, **characterized in that** said PTC plates (32) are enclosed in respective gaskets of a soft elastomeric material (34).

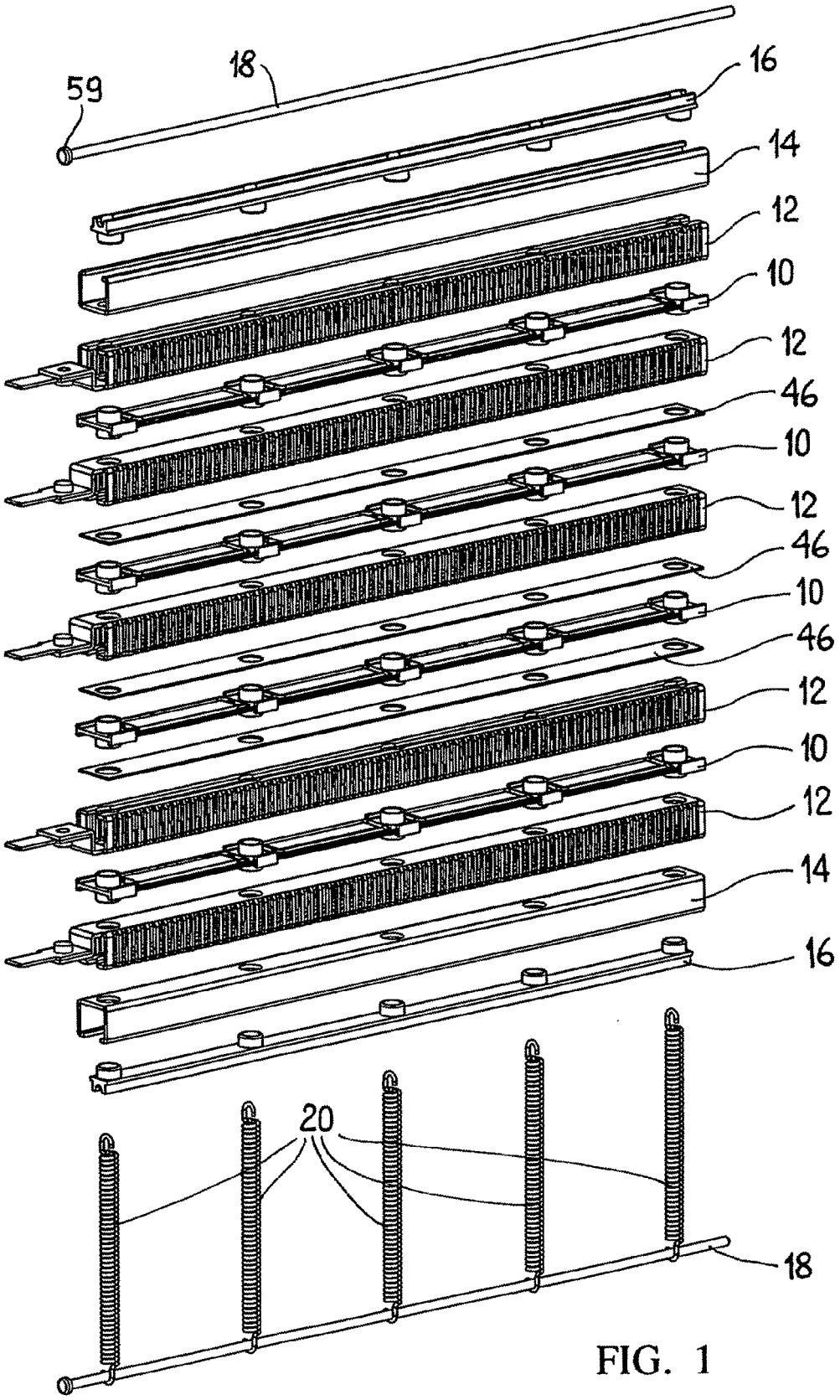

FIG. 1

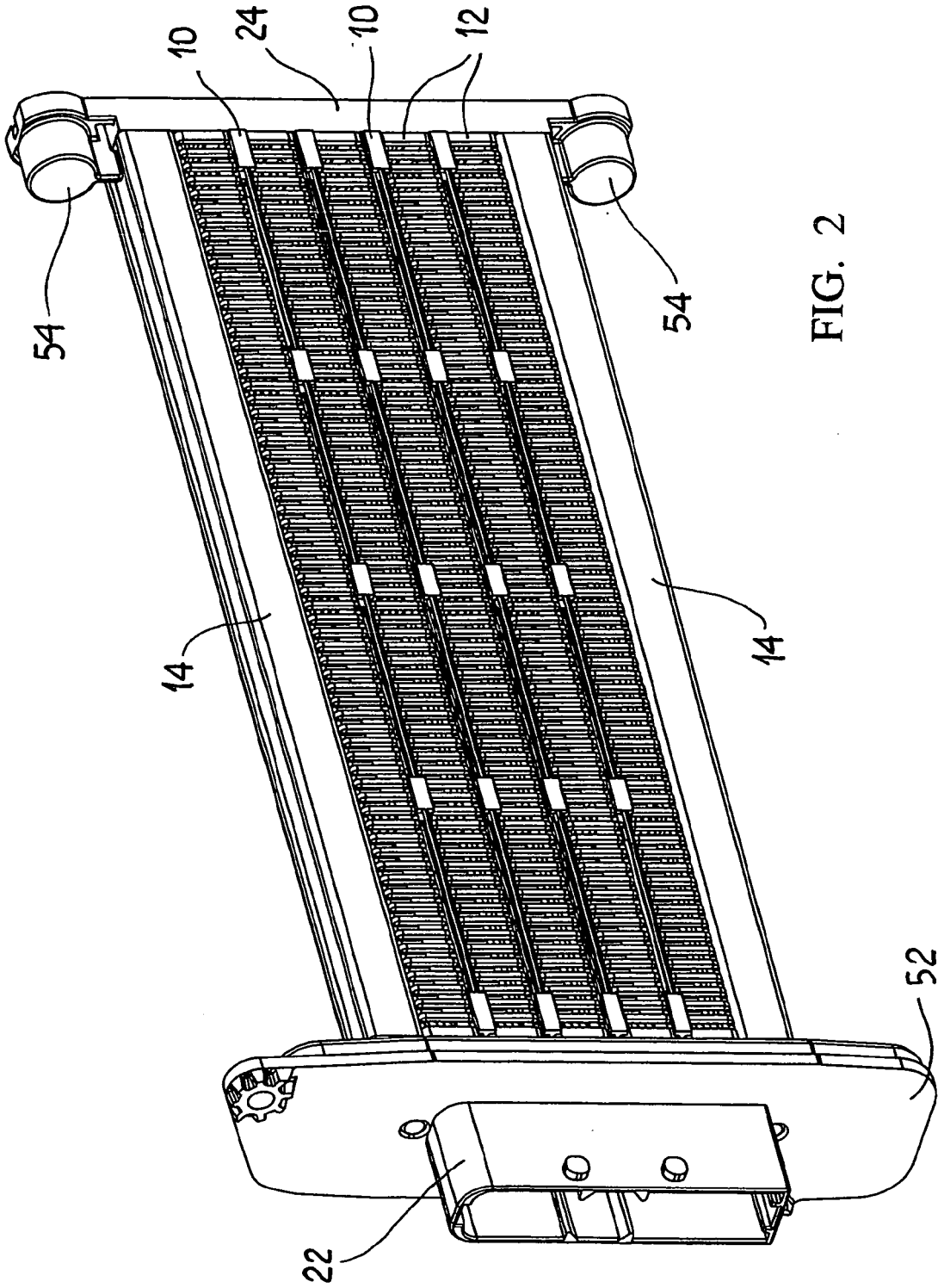

FIG. 2

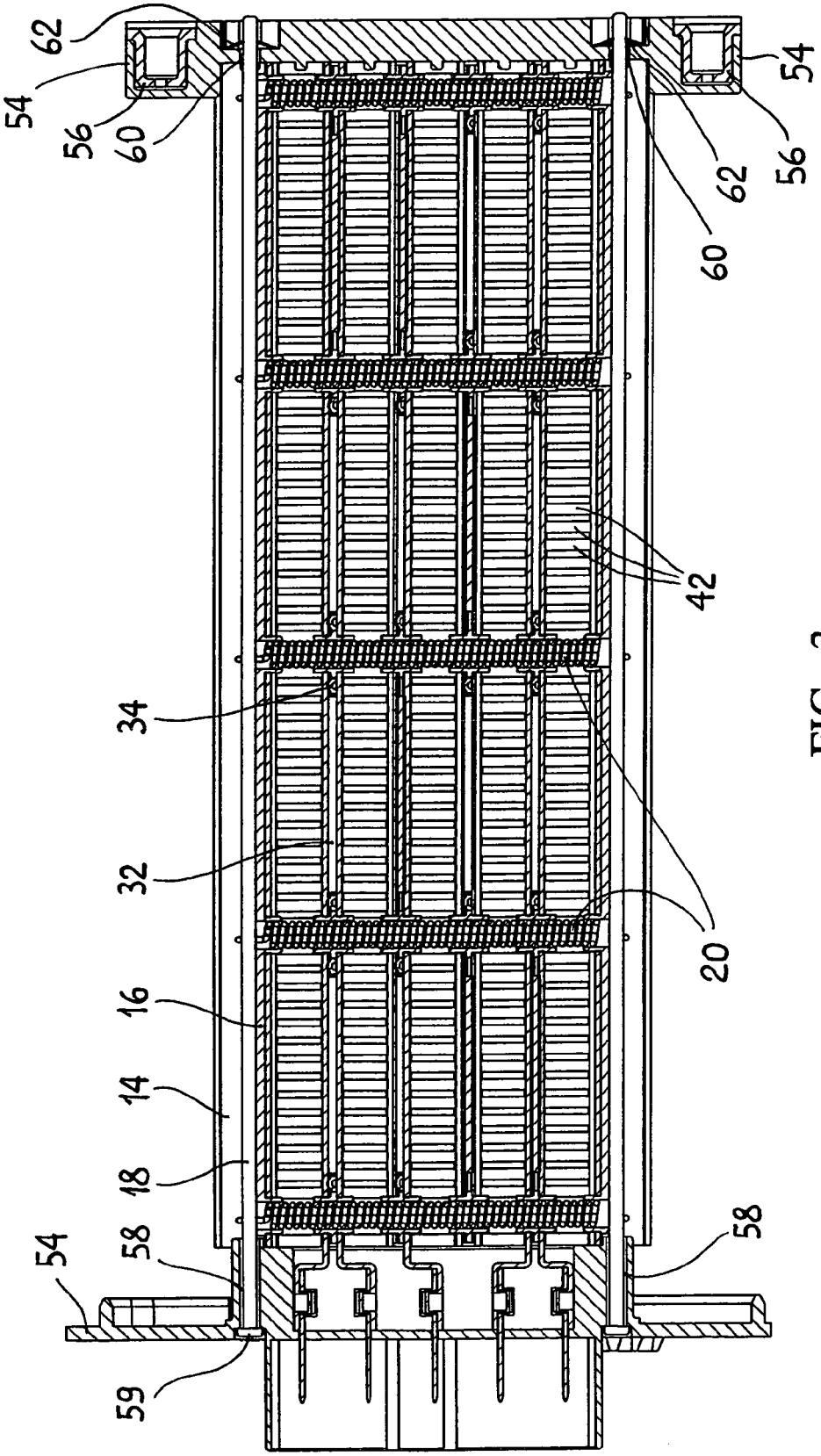

FIG. 3

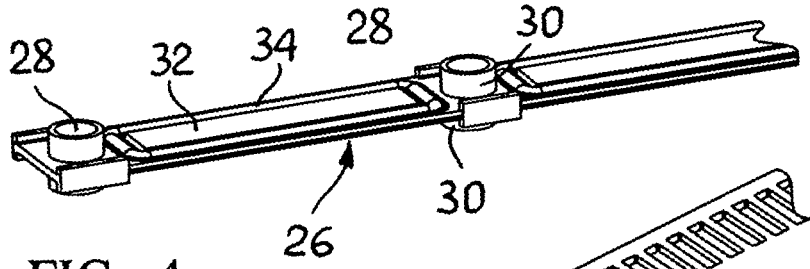

FIG. 4

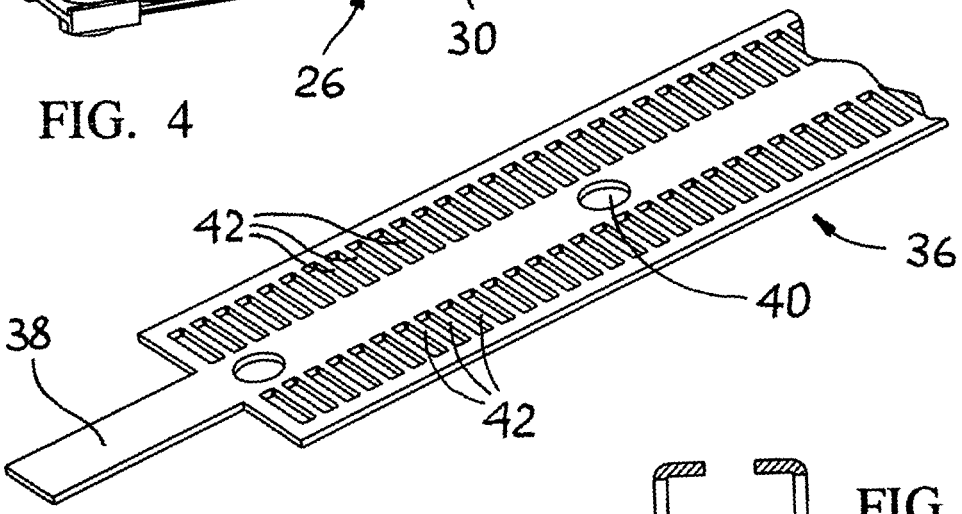

FIG. 5

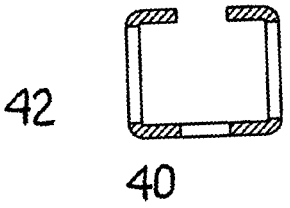

FIG. 6

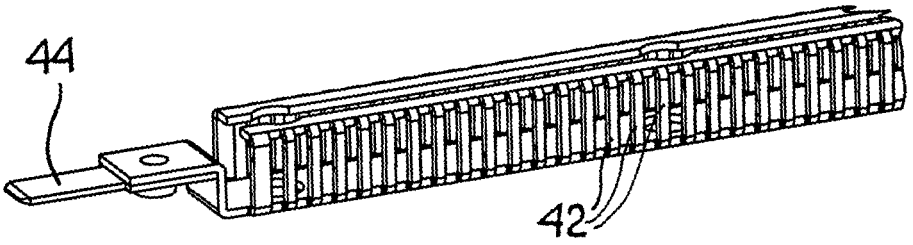

FIG. 7

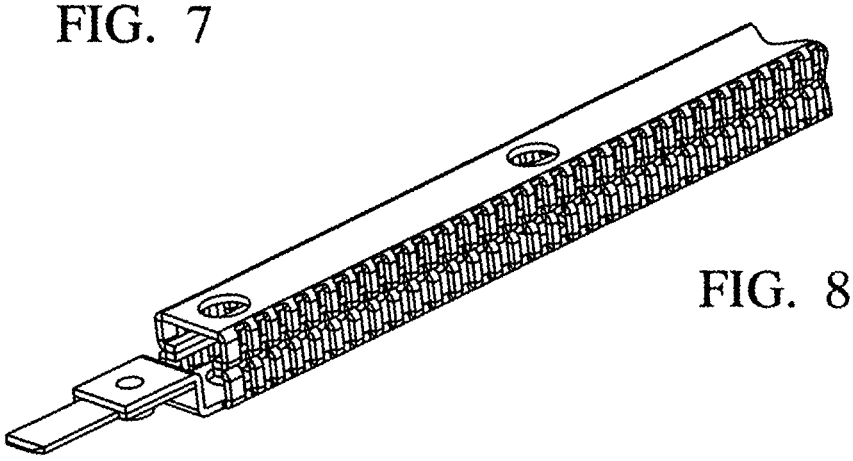

FIG. 8

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Application Number
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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	27 June 2007	GARCIA MONCAYO, O

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