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(54) Electric heater for automobile ventilation systems

(57) The heater comprises a stack of elongated fretted radiators (10, 12, 14, 16, 18, 20) in thermal and electrical contact with PTC pellets (36) clamped between adjacent radiators, and at least one stiff elastic slat (40, 42) interposed between a respective pair of adjacent radiators, the facing surfaces of the latter having complemen-

tary ridges (24) and recesses (26, 28) whereby the slat is elastically deformed. The stack of radiators, with the PTC pellets and the slats, are sandwiched between two longitudinal beams (43) biased against the outermost radiators (10, 20) by two brackets (44, 46) that are attached to the opposite ends of the stack of radiators, in order to maintain the unit assembled.

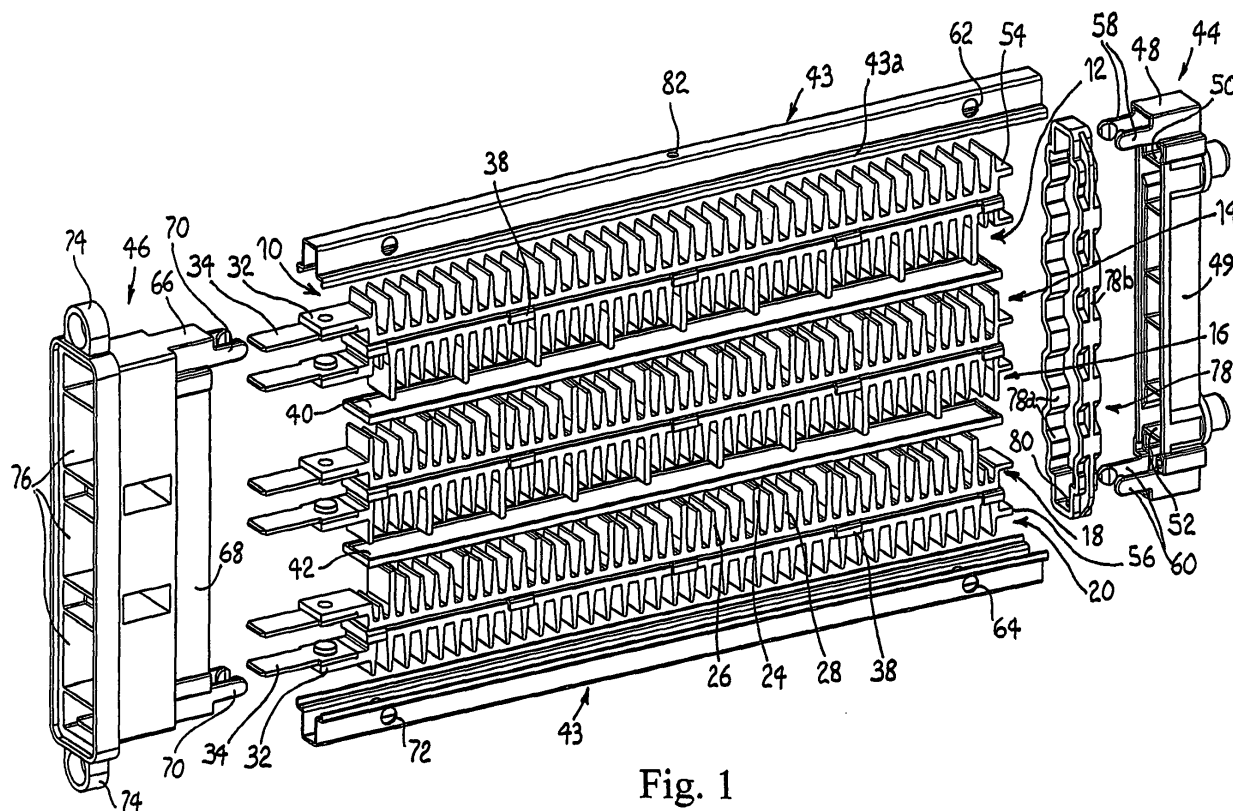


Fig. 1

Description

[0001] This invention relates to an electric heater for automobile ventilation systems.

[0002] Car passenger compartments have been traditionally heated by heat exchangers placed in the air path of the compartment ventilation system and connected in the hydraulic circuit of the cooling system of the vehicle engine. More recently, in order to have an immediately effective heating also at initial start of the car, heat exchangers are supplemented more and more with electric heaters, generally using

[0003] PTC resistors (also called thermistors) as heating sources. These electric heaters are installed in the air conduit within the ventilation cabinet to be traversed by the ventilation airflow, and they are usually turned on for transient periods.

[0004] European Patent Application No. 04425157.7 discloses an electric heater of the above type, in which PTC pellets are clamped between stacked radiators consisting of aluminum bars fretted with comb fins, which also lead the electric current to the PTC pellets and are in thermal and electric contact therewith. Steel slats are arranged between the mutually facing combs of the inner radiators, and operate as leaf springs acting to bias the radiators against each other in a crosswise direction for a good contact with the sandwiched PTC pellets. A pair of brackets attached to the opposite ends of the stack maintain the inner radiators, as well as the PTC pellets and the steel slats, sandwiched between the outermost radiators. To this purpose, the outermost radiators have a rigid profile with closed windows which are internally shaped as a comb along the inward side of the radiator, and are smooth along the opposite side.

[0005] As known, the single radiators are manufactured by cutting transversely at intervals suitably profiled extruded aluminum bars. However, the outermost radiators, because of their closed profile, have the drawback of requiring more complex and expensive extrusion techniques employing floating core extruders.

[0006] Furthermore, after extrusion, both the outermost radiators and the inner radiators tend to bend, because their comb-shaped walls become cool slowly than the opposite walls. However, while this drawback can be tolerated as far as the inner radiators are concerned, because the latter have a flexible profile which allows them to come back rectilinear when subjected to the pressure of the springs, the outermost radiators, on the contrary, are required to be rectilinear for a good electric and thermal contact between the radiators and the PTC pellets. In fact, the inner radiators are biased against the outermost radiators by the leaf springs, so that, if the outermost radiators are bent, the inner radiators will be bent too, which circumstance affects the good contact between the radiators and the PTC pellets.

[0007] On the other hand, removing this defect from the outermost radiators after extrusion would require an additional machining consisting of flattening the inner

side of the radiator, with overall weakening of the structure and considerable rise of the manufacturing costs.

[0008] Therefore, it is a main object of the present invention provide an electric heater of the above type, which overcomes the above drawbacks of the electric heaters of the prior art, in order to achieve a more efficient heat exchange and a more reliable electric contact, without increasing the manufacturing costs.

[0009] The above and other objects and advantages, such as will appear from the following disclosure, are achieved by the invention with an electric heater having the features set out in claim 1, while the dependent claims recite other advantageous features of the invention.

[0010] The invention will now be described in more detail with reference to a few preferred, though non-exclusive, embodiments, 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 electric heater of Fig. 1 as it appears when assembled,

Fig. 3 is an exploded perspective view of an electric heater according to an alternative embodiment of the invention, where some parts have been removed for better clarity of illustration,

Fig. 4 shows a detail to an enlarged scale of the electric heater of Fig. 3.

[0011] With reference to the above listed Figures, an electric heater according to a preferred embodiment of the invention comprises six elongated radiators 10, 12, 14, 16, 18, 20, which are arranged one above another to form a stack. Each radiator is a bar of aluminum or of a similar conductive material, that is fretted to allow air to flow across it.

[0012] More specifically, each of the radiators is flat on one side and is fretted with comb fins such as 24, 26, 28 on the opposite side. The comb fins of the four innermost radiators 12, 14, 16, 18 are uneven in length, with longer fins such as 24 alternating with groups of shorter fins such as 26, 28, while the comb fins of the outermost radiators 10, 20 are equal in length. Each of the six radiators is provided with a respective electric terminal, preferably made as an integral lug such as 32, carrying a swaged metal tongue 34.

[0013] The six radiators are arranged in parallel pairs 10 and 12, 14 and 16, 18 and 20, with mutually facing flat surfaces in each pair. In a known way, between the flat surfaces in each pair, a number of PTC pellets (not shown) are clamped to be in thermal and electric conduction with each radiator of the associated pair. Each

[0014] PTC pellet is encased in a respective rectangular gasket such as 38, made of a soft synthetic material

such as a silicone resin, which makes a tight contact with the adjacent flat surfaces of the encompassing radiators, so that the PTC pellet is protected from the flow of air and therefore from oxidation which might be caused by humidity and pollutants.

[0015] The combs of radiators 12 and 14, as well as the combs of radiators 16 and 18, also face each other, and the uneven comb fins are designed so that in each radiator a longer fin 24 will be aligned with a short fin 26, 28 of the adjacent radiator. Steel slats 40, 42 are arranged between the facing combs of radiators 12, 14 and 16, 18, respectively, so that they will be elastically deformed by the interplay of the longer and shorter fins of the facing combs, to operate as a leaf spring acting to expand the stack of radiators in a crosswise direction and to bias the facing flat surfaces in each pair of radiators against each other, for a good contact with the sandwiched PTC pellets.

[0016] The stack of radiators, with the PTC pellets and the steel slats, are sandwiched between two rigid, U-shaped longitudinal beams 43 which are biased with their open side against the crests of the combs of the outermost radiators 10, 20 by two brackets 44, 46 that are attached to the opposite ends of the stack of radiators, in order to maintain the unit assembled. Longitudinal beams 43 are shaped with overhanging longitudinal edges 43a which laterally overlap the crests of the comb fins to retain the radiator laterally.

[0017] Brackets 44, 46 are preferably molded in a rigid synthetic material. As shown in Fig. 2, bracket 44 is provided with abutments 48 to retain longitudinal beams 43 at their ends, as well as with lateral guides 49 to confine the stack of radiators laterally. Bracket 44 is also provided with transoms 50, 52 abutting on respective ledges 54, 56 projecting at the ends of the outermost radiators 10, 20. Bracket 44 also has two pairs of latches 58, 60, which grasp by snap action respective holes 62, 64 at the ends of the longitudinal beams on the side walls thereof.

[0018] Bracket 46 is similar to bracket 44 in having abutments 66 to retain longitudinal beams 43 at their ends, lateral guides 68 to retain the stack of radiators laterally, projections (not shown) abutting on respective lugs 32 of the outermost radiators 10, 20, and elastic latches 70 grasping holes 72 made in the longitudinal beams. However, bracket 46 is also provided with mounting eyelets 74 for mounting the heater within the ventilation system. Moreover, bracket 46 has openings such as 76 to house the contact terminals 34 for connection to external circuitry not shown.

[0019] A ring 78 molded in a composite material, preferably a polyammiidic resin reinforced with glass fibers, surrounds the assembled stack, comprising the longitudinal beams and the radiators, as well as the PTC pellets and the steel slats, at a middle position. Ring 78 is suitably sized to tightly enclose the stack in order to prevent the longitudinal beams from bending, and is shaped with undulations 78a which provide it with a limited elastic compliance, and with a stiffening, peripheral ridge 78b on its

outer surface. Ring 78 also has a pair of bosses 80 on its inner surface, which are arranged to restrainedly engage by snap action respective holes 82 made on the back of the longitudinal beams in a middle position thereof.

[0020] As a person skilled in the art will appreciate, the rigid longitudinal beams may be manufactured in a easy and inexpensive way by extrusion or by bending suitably profiled steel sheets. Furthermore, the total height of each one of the outermost radiators in association with the corresponding longitudinal beam substantially equals the height of the outermost radiators of the electric heaters of the prior art, so that the sizes are not increased.

[0021] Finally, the assembly can be set up so that it is simple and quick, as a person skilled in the art will readily appreciate. The stack comprising the longitudinal beams, the radiators and the PTC pellets, may be formed in a jig by merely placing the several parts one above the other, and then the heater is completed by fitting the ring onto the stack and by shoving it until the bosses engage the central holes in the longitudinal beam, and by approaching the brackets to the ends of the stack and pushing until the latches click into engagement.

[0022] An alternative embodiment of the invention in shown in Figs. 3, 4, where a Ω -shaped elongated insert 86 is arranged between longitudinal beams 10, 12 and the combs of the corresponding outermost radiators 10, 20. The insert is received between overhanging edges 43a of longitudinal beam 43, and is arranged with its middle ridge 86a projecting into longitudinal beam 43. An elongated elastic blade 88 is arranged between longitudinal beam 43 and elongated insert 86 in an elastically deformed configuration astride middle ridge 86a, with its longitudinal edges biased against the longitudinal edges of elongated insert 86 by the longitudinal corners 43b defined in the concavity of longitudinal beam 43, in such a way as to bias insert 86 against the radiator. The above elastic assemblies act to make the pressure of the longitudinal beams more uniform along the total length of the corresponding outermost radiators, in order to further improve the contact with the sandwiched PTC pellets.

[0023] Several changes may be made to the above described preferred embodiment within the teachings of the invention. For instance, although U-shaped longitudinal beams are preferred because of their high flexural strength and ease of manufacturing, other profiles might also be used for the longitudinal beams, provided that they give an adequate rigidity to the structure. Furthermore, the stiffening ring might be useful but not-essential for the invention, because the U-shaped longitudinal beams have a high flexural strength per se.

Claims

1. An electric heater for automobile ventilation systems, comprising a stack of elongated fretted radiators (10, 12, 14, 16, 18, 20) in thermal and electrical

- contact with PTC pellets (36) clamped between adjacent radiators, and at least one stiff elastic slat (40, 42) interposed between a respective pair of adjacent radiators, the facing surfaces of the latter having complementary ridges (24) and recesses (26, 28) whereby the slat is elastically deformed, **characterized in that** the stack of radiators, with the PTC pellets and the slats, are sandwiched between two longitudinal beams (43) biased against the outermost radiators (10, 20) by two brackets (44, 46) that are attached to the opposite ends of the stack of radiators in order to maintain the unit assembled.
2. The electric heater of claim 1, **characterized in that** said brackets (44, 46) has abutments (48, 66) to retain the ends of the longitudinal beams (43) for maintaining the unit assembled.
 3. The electric heater of claim 1 or 2, **characterized in that** each bracket has lateral guides (49, 68) to confine the stack laterally.
 4. The electric heater of any of claims 1 to 3, **characterized in that** each bracket has snap-action latches (58, 60, 70) engaging respective holes (62, 72) made on the longitudinal beams.
 5. The electric heater of any of claims 1 to 4, **characterized in that** said longitudinal beams (43) have a U-shaped profile with overhanging longitudinal edges (43a) which laterally and partially overlap the corresponding outermost radiators to retain them laterally.
 6. The electric heater of any of claims 1 to 4, **characterized in that** said longitudinal beams (43) have a longitudinal concavity open to the radiators in which are defined opposite longitudinal corners (43b), and **in that** between each longitudinal beams (10, 12) and the corresponding outermost radiator (10, 20) is housed an elongated insert (86) provided with a longitudinal ridge (86a) toward the inside of the longitudinal beam, and an elongated elastic blade (88) arranged between longitudinal beam (43) and elongated insert (86) in an elastically deformed configuration astride middle ridge (86a) and subjected to the pressure of said corners (43b) to bias the insert against the radiator.
 7. The electric heater of claim 6, **characterized in that** said elongated insert (86) has a Ω -shaped profile and said elongated elastic blade (88) is arranged astride the middle ridge (86a) of the Ω with its longitudinal edges biased against the longitudinal edges of the insert (86).
 8. The electric heater of claim 6 or 7, **characterized in that** each of said longitudinal beams (43) have a U-shaped profile with overhanging longitudinal edges (43a), and **in that** said elongated insert (86) and said elastic blade (88) are arranged between the overhanging edges (43a) of the respective longitudinal beam (43).
 9. The electric heater of any of claims 1 to 8, **characterized in that** it comprises a ring (78) surrounding the stack transversely at a middle position, and means of mutual engagement on the ring and on the longitudinal beams, which cooperate to maintain the ring in position with respect to the stack.
 10. The electric heater of claim 9, **characterized in that** said ring (78) is made of a polyammidic resin reinforced with glass fibers.
 11. The electric heater of claim 9 or 10, **characterized in that** said ring (78) is shaped with undulations (78a) which provide it with a limited elastic compliance, and with a stiffening, peripheral ridge (78b).
 12. The electric heater of claim 9, **characterized in that** said means of mutual engagement comprise at least a boss (80) on the inner surface of the ring (78), arranged to engage by snap action a respective hole (82) made on the respective longitudinal beam at a middle position thereof
 13. The electric heater of any of claims 1 to 12, **characterized in that** the outermost radiators (10, 12) have outwardly projected comb fins which are equal in length and are abutted against the longitudinal beams.

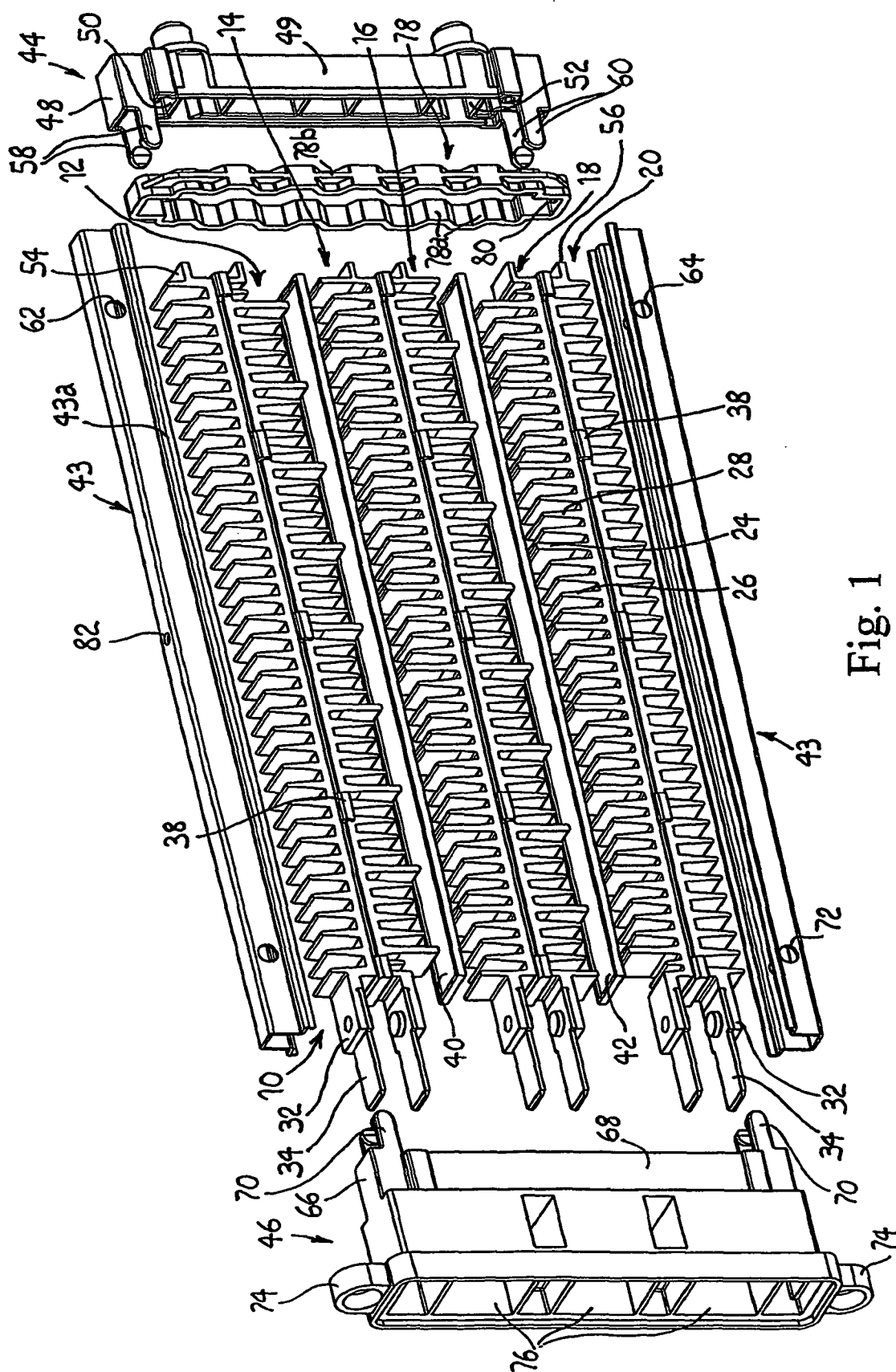


Fig. 1

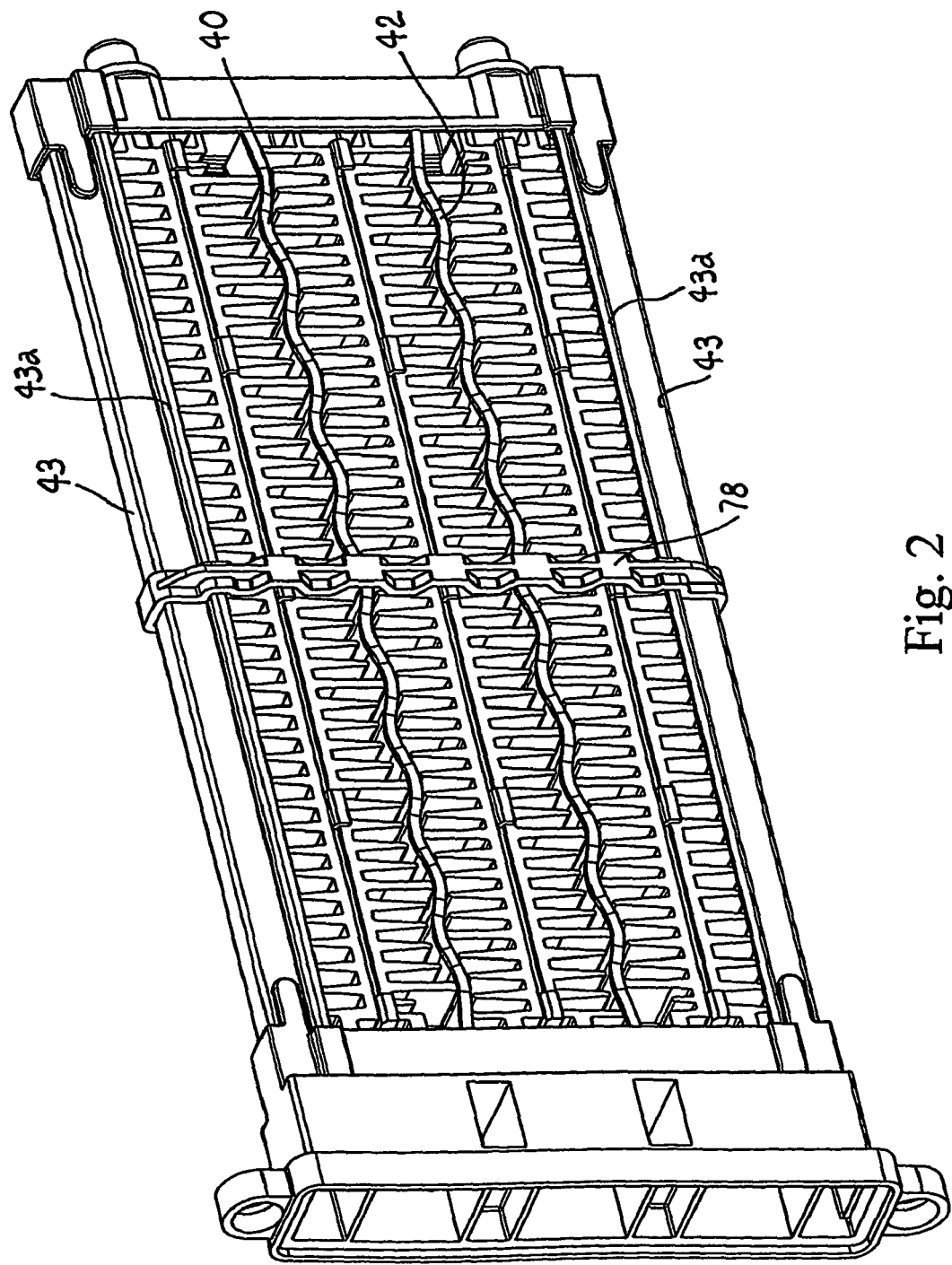
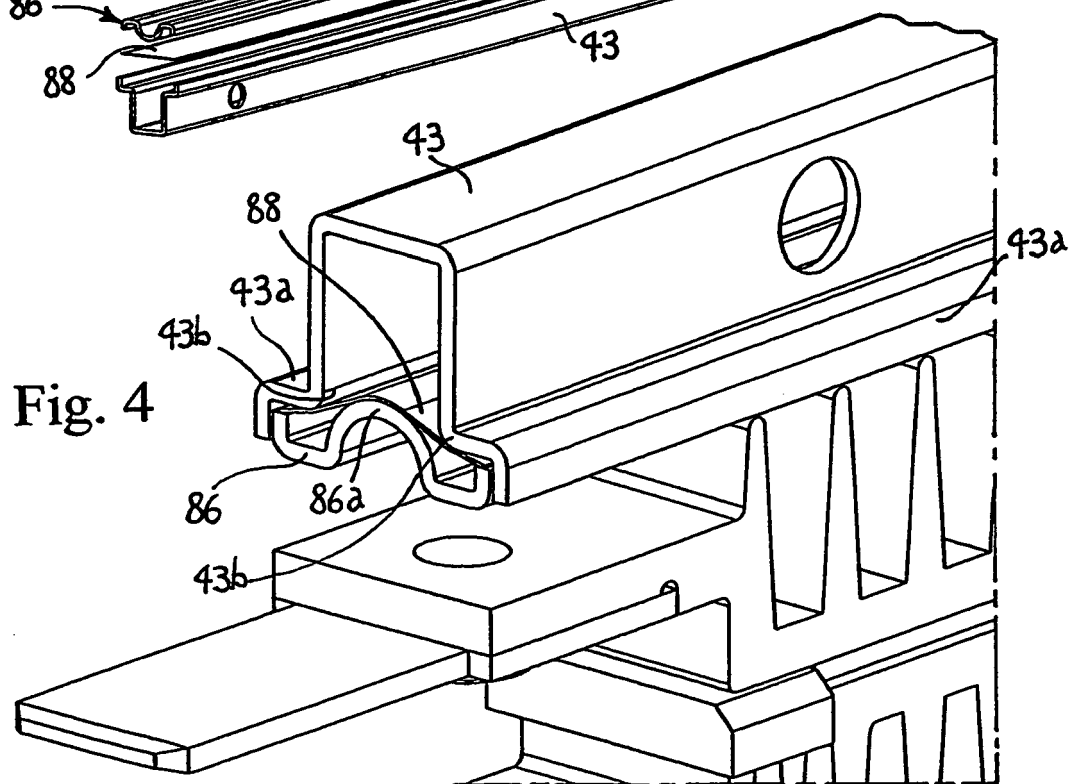
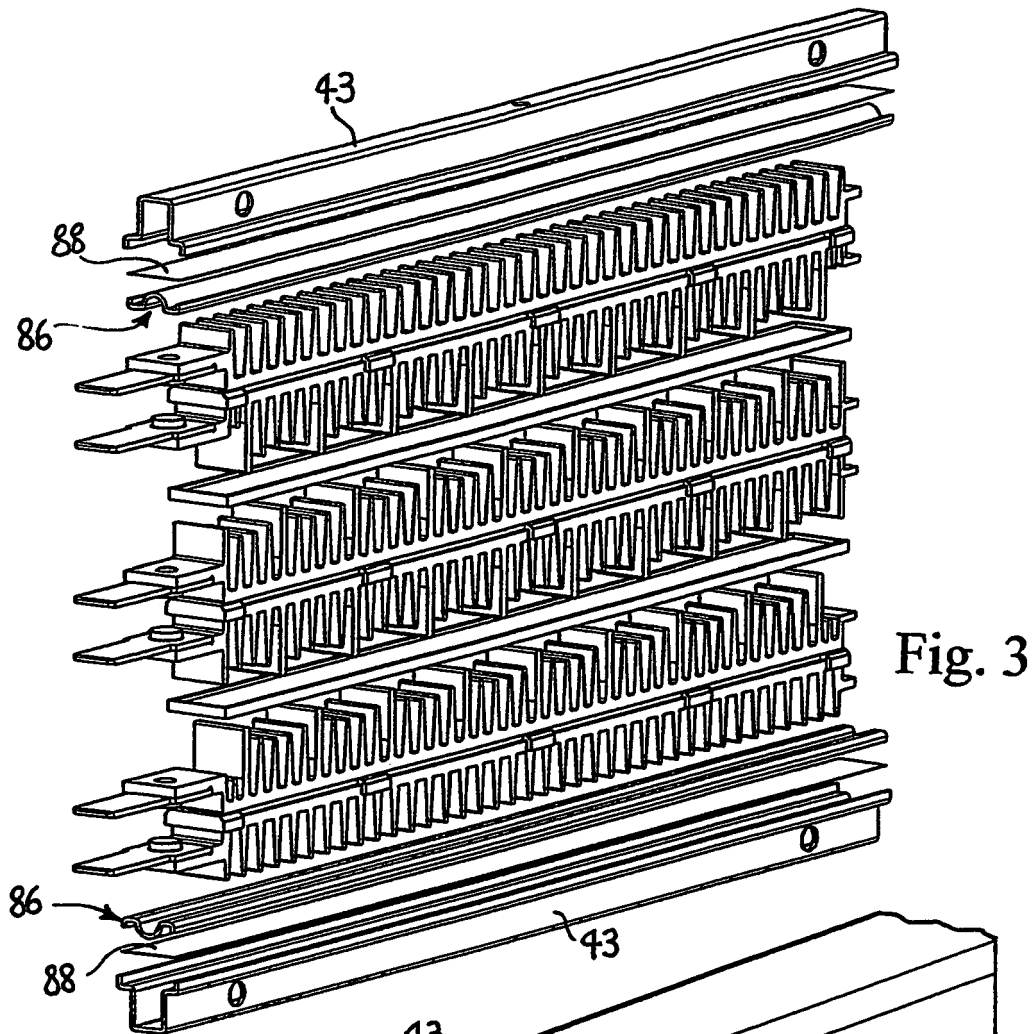


Fig. 2





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 05 42 5415

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	EP 1 370 117 A (CEBI S.P.A) 10 December 2003 (2003-12-10) * figures *	1-4,9	F24H3/04
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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 3 November 2005	Examiner Van Gestel, H
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 05 42 5415

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03-11-2005

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