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(54) Electric heater for automobile ventilation system

(57) A number of stacked, elongated radiators (10, 12, 14, 16, 18, 20), fretted with a comb profile, are in thermal and electrical contact with PTC pellets (36) clamped between adjacent radiators. One or more stiff steel slats (40, 42) are interposed between at least adjacent radiators, and the facing surfaces of the latter have complementary ridges (24) and recesses (26, 28), such as longer and shorter comb fins, which deform elastically the steel slat.

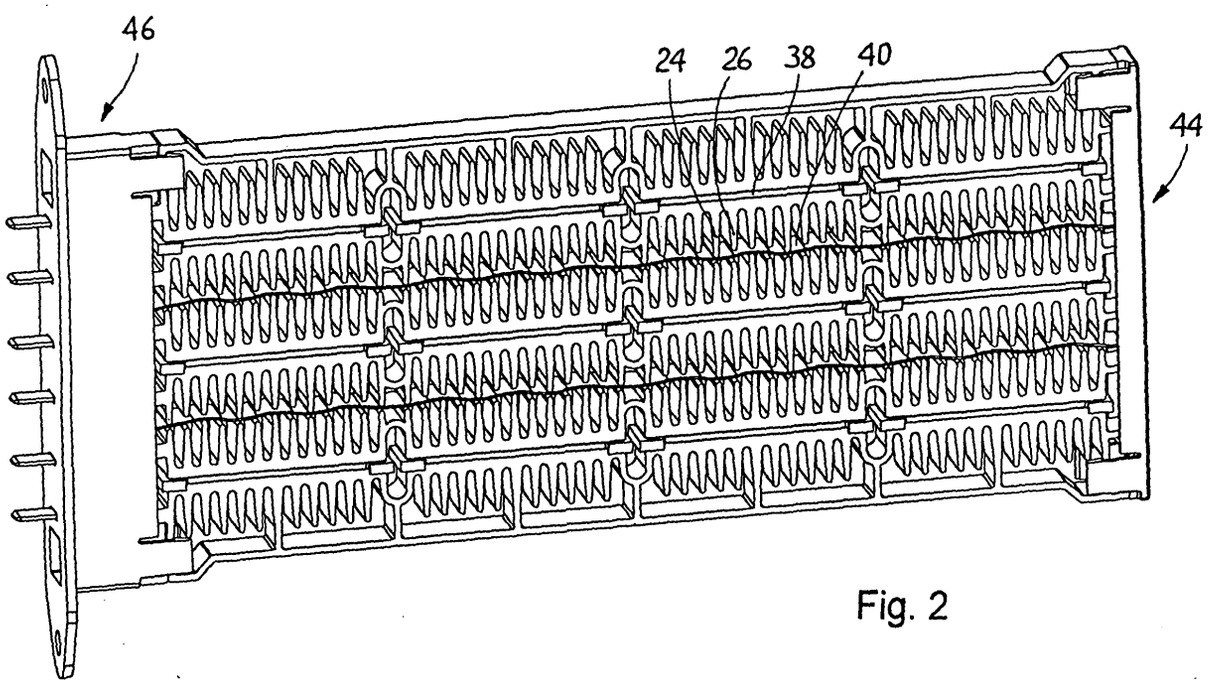

Fig. 2

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Description

[0001] This invention is concerned with 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 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.

[0003] EP-1 370 117 discloses an electric heater of the above type, in which PTC pellets are clamped between stacked radiators consisting of fretted aluminum bars which also lead the electric current to the PTC pellets and are in thermal and electric contact therewith. The stack of radiators is encased in a rectangular frame comprising leaf springs acting on both sides of the stack to compress it in order to maintain an efficient conduction between the radiators and the PTC pellets.

[0004] The main object of this invention is now to provide an electric heater of the above type, which is less complex, less expensive and more efficient than the electric heaters of the prior art. More particular aims of the invention are to reduce the number of parts of the heater, to simplify its assembly, and to increase the total heat exchange surface between the heater and the flow of air crossing the heater.

[0005] 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.

[0006] The invention will now be described in more detail with reference to a preferred, though non-exclusive, embodiment, 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; and

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

[0007] With reference to the above listed Figures, an electric heater according to the 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 or windowed to allow air to flow across it.

[0008] More specifically, each of the four innermost radiators 12, 14, 16, 18 has a flat surface 22 on one side and is fretted with comb fins such as 24, 26, 28 on the opposite side. The flat surface 22 has spaced recesses such as 30, and the comb fins are uneven in length, with longer fins such as 24 alternating with groups of shorter fins such as 26, 28. The outermost radiators 10, 20 are fretted with closed windows, the internal profile of each window also being comb-shaped. 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.

[0009] The six radiators are arranged in parallel pairs 10 and 12, 14 and 16, 18 and 20, with mutually facing flat surfaces 22 in each pair. Between the flat surfaces in each pair, a number of PTC pellets such as 36 are clamped to be in thermal and electric conduction with each radiator of the associated pair. Each 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.

[0010] 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 bias the facing flat surfaces in each pair of radiators against each other, for a good contact with the sandwiched PTC pellets.

[0011] Two brackets 44, 46, preferably moulded in a rigid synthetic material, are attached to the opposite ends of the stack comprising the six radiators, as well as the PTC pellets and the steel slats, to maintain the unit assembled. As best seen on Fig. 2, bracket 44 is provided with longitudinal guides 48 to retain the stack of radiators laterally, and 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 crosspieces 62, 64 at the ends of each of the outermost radiators 10, 20.

[0012] Bracket 46 is similar to bracket 44 in having lateral guides 66 to retain the stack of radiators laterally, projections 68 abutting on respective lugs 32 of the outermost radiators 10, 20 and elastic latches 70 grasping crosspieces 72 on the outermost radiators. However, bracket 46 is also provided with a mounting flange 74 for mounting the heater within the ventilation system. Moreover, bracket 46 has slots such as 76 to house the

contact terminals 34 for connection to external circuitry not shown.

[0013] As a person skilled in the art will appreciate, no separate, rigid longitudinal beams are required in the above described electric heater, because that function is performed by the outermost radiators themselves, and their width, as well as the width of the associated leaf springs has therefore become available as an additional room for the radiators. Consequently, the radiators of this invention occupy the entire height of the heater, the useful heat exchange area having therefore been broadened, for an increased overall efficiency.

[0014] Moreover, the heater of the invention can be manufactured more economically, since the number of parts is smaller than in prior art heaters and the parts themselves are generally less complex. The individual radiators are preferably manufactured by cutting transversely at intervals suitably profiled extruded aluminum bars, while the elastic compression of the stack is obtained by simple, straight steel slats which only need to be cut to size, without any bending or punching operations. The brackets are easily mouldable, single-piece parts.

[0015] Finally, the assembly itself can be set up so that it is simple and quick, as a person skilled in the art will readily appreciate. The stack of radiators and PTC pellets may be formed in a jig by merely placing the several parts one above the the other, and then the heater is completed by approaching the brackets to the ends of the stack and pushing until the latches click into engagement.

[0016] Several changes may be made to the above described preferred embodiment within the teachings of the invention. For instance, although the comb-shaped radiators are preferred because of their high heating efficiency, other designs might be used,the only requirement being that the radiators sandwiching the steel slats have uneven facing surfaces, i.e. surfaces having ridges and recesses interplaying with each other to elastically deform the steel slat. Also, different locking means might be used between the end brackets and the stack, and the snap-action latches might be replaced by other fastening means such as screws. The number of radiators or of PTC pellets in the stack might also be different from what has been described and shown in the preferred embodiment.

Claims

1. An electric heater for automobile ventilation systems, comprising a number of stacked, elongated, fretted radiators (10, 12, 14, 16, 18, 20) in thermal and electrical contact with PTC pellets (36) clamped between adjacent radiators, **characterized in that** at least one stiff elastic slat (40, 42) is interposed between at least one pair of adjacent radiators, and that the facing surfaces of the latter have complementary ridges (24) and recesses (26, 28) whereby said slat is elastically deformed.

2. The electric heater of claim 1, **characterized in that** said stiff elastic slat (40, 42) is a flat slat of spring steel.

3. The electric heater of claim 1 or 2, **characterized in that** the facing surfaces of said pair of adjacent radiators are comb-shaped with uneven fins (24, 26, 28).

4. The electric heater of any of claims 1 to 3, **characterized in that** it further comprises two brackets (44, 46) extending transversely at respective ends of the stack of radiators, each having abutments (50, 52, 68) retaining the ends of the outermost radiators to maintain the stack assembled.

5. The electric heater of claim 4, **characterized in that** each bracket has lateral guides (48, 66) to confme the stack laterally.

6. The electric heater of claim 4 or 5, **characterized in that** each bracket has snap-action latches (58, 60, 70) engaging respective crosspieces (62, 72) at the opposite ends of the outermost radiators in the stack.

7. The electric heater of any of claims 1 to 6, **characterized in that** each radiator has an electrical terminal (32, 34) at one end, and that one of the brackets has slots (74) for housing the respective terminals.

8. The electric heater of claim 7, **characterized in that** each electrical terminal comprises a lug (32) extending integrally from the radiator and a metal tongue (34) swaged on the lug.

9. The electric heater of any of claims 1 to 8, **characterized in that** each PTC pellet is encased in a gasket (38) in tight engagement with the flat surfaces of the adjacent radiators.

10. The electric heater of claim 9, **characterized in that** said gasket (38) is made of a silicone resin.

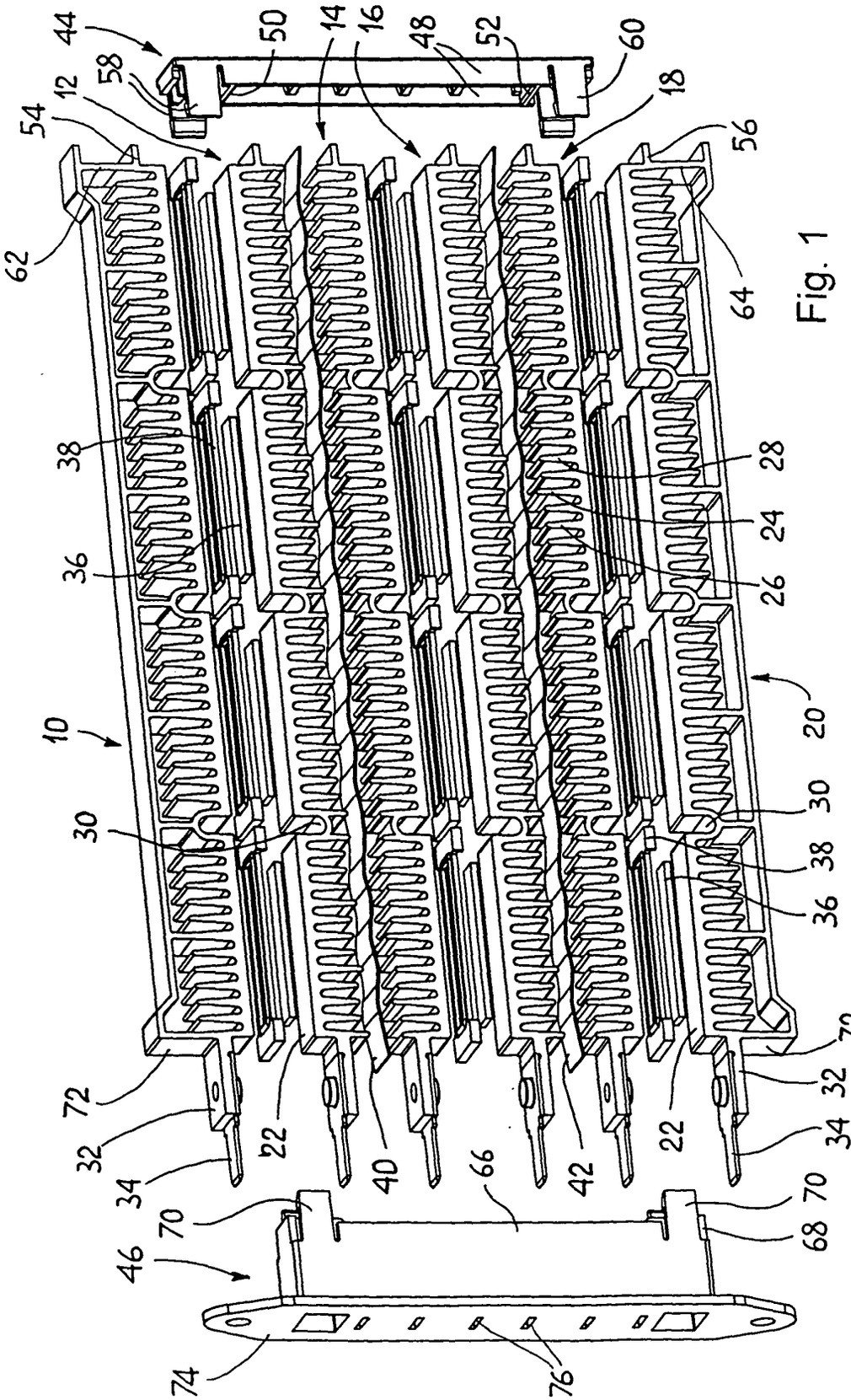
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Fig. 1

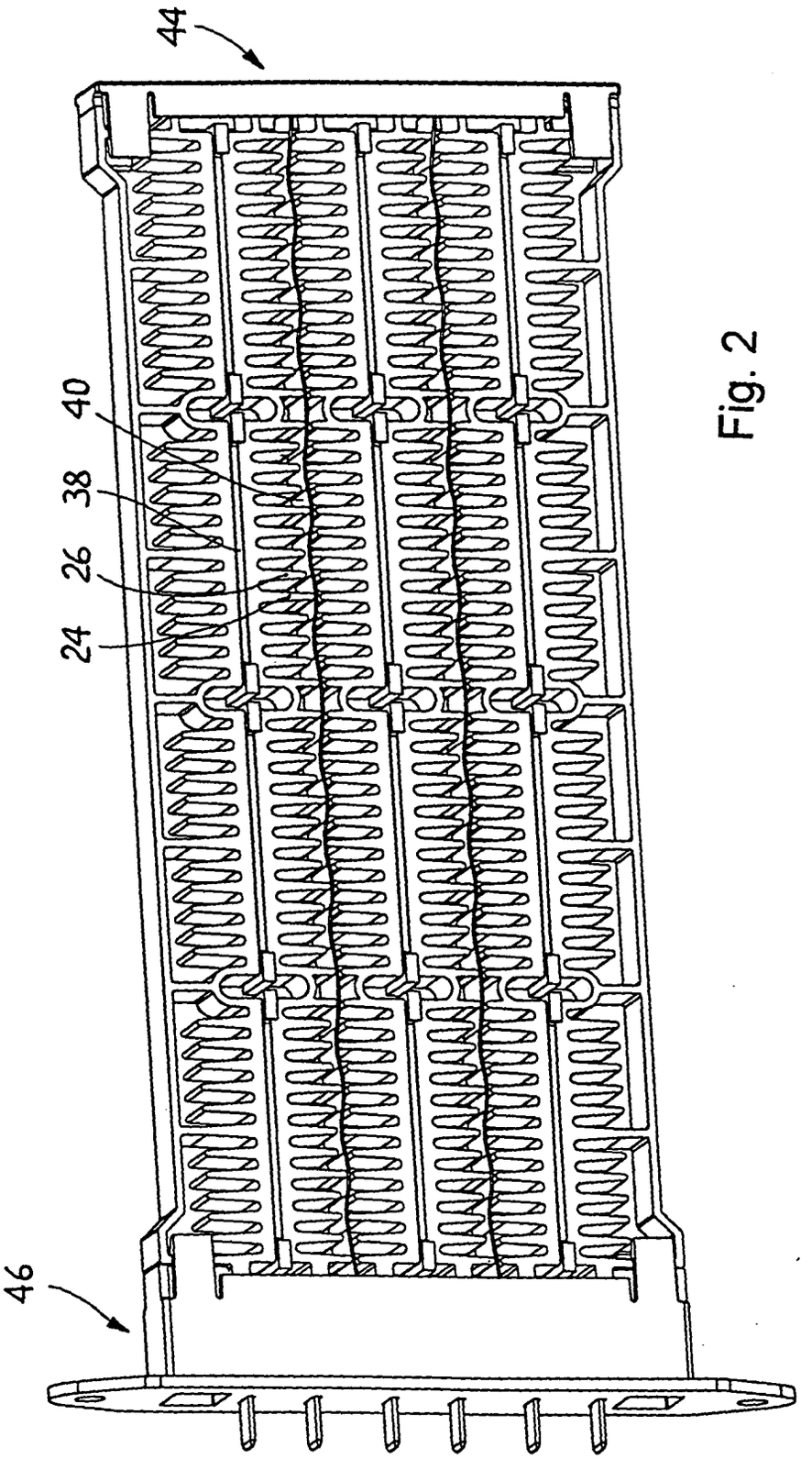

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 04 42 5157

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

F24H
H05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	24 August 2004	Garcia, J

CATEGORY OF CITED DOCUMENTS

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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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