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(54) HEAT EXCHANGER UNIT PARTICULARLY EFFICIENT

(57) The present invention relates to a unit for a heat exchanger comprising a coil with pipes designed so as to increase the performance to make it similar to that of a heat exchanger with pipes made of copper and fins

made of aluminium. In particular, the invention relates to a coil with an increase of efficiency per surface unit of heat exchange obtained through a simple and reliable construction.

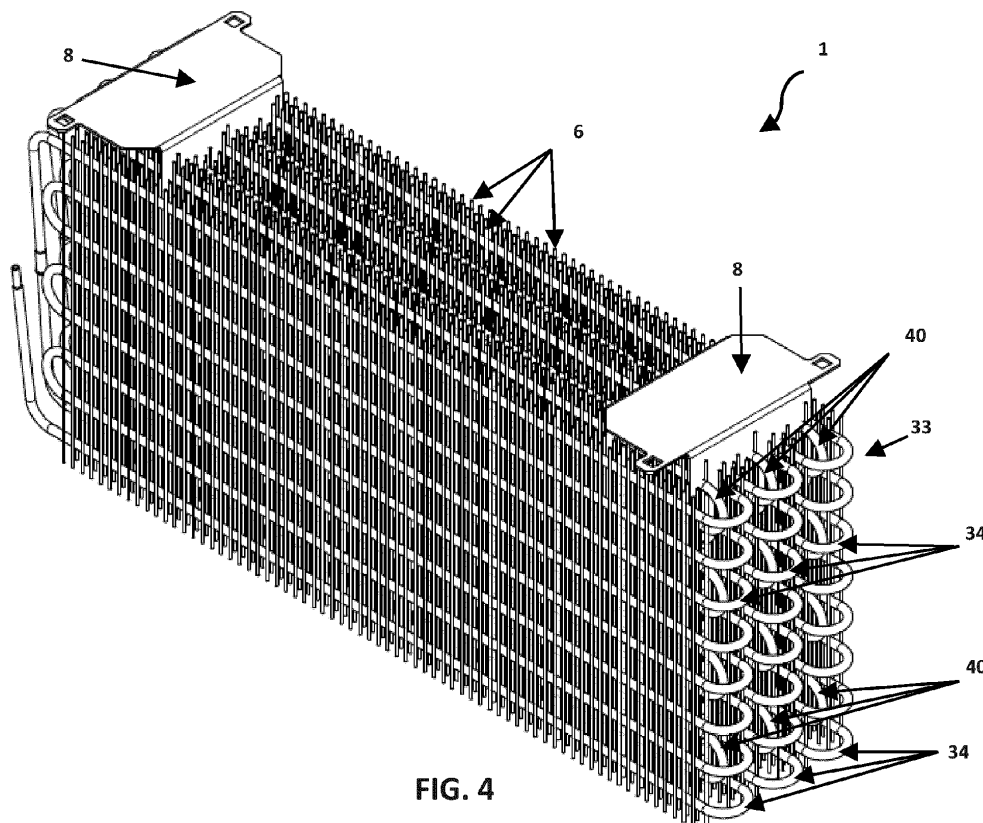


FIG. 4

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to a unit for a heat exchanger comprising a coil with pipes designed so as to increase the performance making it similar to that of a heat exchanger with pipes made of copper and fins made of aluminium. In particular, the invention relates to a coil with an increase of efficiency per surface unit of heat exchange obtained through a simple and reliable construction.

BACKGROUND OF THE INVENTION

[0002] In the refrigeration industry some gases considered highly harmful to the environment have long since been banned and they have been replaced by gases deemed ecological such as for example R290, R32 and R744. However, these gases have the major drawback of being inflammable while at the same time being explosive in some cases and operating at ultra-high-pressure values in others. Therefore, the amount in the refrigerating circuits is reduced for safety reasons. However, the reduction of the amount obviously negatively affects the performance too. Therefore, as a result there arises the need to develop new systems for enhancing the performance of a heat exchanger.

[0003] Generally, heat exchange systems use fluidic circuits which are based on two structures: the first consists of a coil whose ducts normally have an inner diameter of 5-16 mm to which there are fixed aluminium strips to increase the heat dispersion ability thereof; the second consists of a steel/carbon coil whose ducts normally have an inner diameter of 2.6-6.6 mm and they are held together to form a single flat wall or side board through numerous metal wires welded transversely with respect to the longitudinal extension of the ducts.

[0004] Systems using copper coils have a markedly greater heat exchange performance with respect to systems using steel/carbon coils, and therefore they are preferred to overcome the aforementioned drawback. On the other hand, such systems entail a much more complex and expensive construction given that the copper pipes are arranged parallel on a plane and connected to the ends by curved sections welded to said ends. It is therefore clear that carrying out a given amount of double welding operations for each connection requires considerable work and use of energy. Furthermore, if the welding operations are not carried out perfectly, they could cause leaks, and therefore entail drop in performance.

[0005] In addition, copper coils comprise several strips which represent a hindrance when cleaning the exchanger to clear the dust of the environment which tends to build up between the strips, especially exchangers which provide for heat dispersion fans. In addition, the cleaning could damage both the strips to the extent of limiting and/or diverting the through-flow of air thereof and the

weak points of the pipes represented by the welding operations causing the possible leakage of the refrigerant from the circuit.

[0006] A solution to the problems of using copper coils could lie in increasing the thermal exchange surface of the steel/carbon coil systems, which are formed by a single thin duct, by bending the coil on itself. A similar solution is for example described by the United States Patent US 6640885 in which a single duct is first bent on a plane to form a surface with numerous parallel longitudinal sections and subsequently bent on itself three times.

[0007] Although such solution seems advantageous, it actually reveals drawbacks; as a matter of fact, the operations regarding the bending of the coil are basically limited by the volume and constrictions that may occur. The bending operations shown in the aforementioned patent actually cannot be such to make the structure compact specifically due to the fact that the material would be crushed at the curves such to jeopardise the circulation of the fluid in the duct. Furthermore, in order to however keep the bent layers close, one has to use systems such as tensioners, considerably complicating the structure as well as the assembly thereof. As a result, the capacity per volume unit cannot be increased much, even due to the overall dimensions of the corresponding equipment.

[0008] Alternatively, units can be built with several single side boards joined together. In this case, the thermal exchange capacity can be increased but to the detriment of processing given that such construction entails a number of welding operations equal to the number of side boards of the unit. Furthermore, a large number of welding operations increases the risk of leakage, if the latter are not carried out perfectly.

SUMMARY OF THE INVENTION

[0009] Therefore, the object of the present invention is to provide a coil for heat exchangers of the single steel/carbon pipe type having all the performance advantages of the copper coils while overcoming the drawbacks of both systems described above.

[0010] Therefore, a first object of the invention is to provide a coil for a heat exchanger comprising an assembly of several steel/carbon ducts designed to enhance the performance per volume unit while minimising the risk of leakage in the circuit load.

[0011] A second object is to provide a coil with a small number of welding operations in order to minimise the possibility of leakage of the refrigerant into the environment.

[0012] A third object is to provide a coil whose assembly allows to avoid the build-up of dust.

[0013] A further object is to provide a coil whose structure allows great modularity capable of adapting to various performance and space needs.

BRIEF DESCRIPTION OF THE FIGURES

[0014] Advantages, characteristics and other objects of the invention will be apparent from the following description, provided by way of non-limiting example, with reference to the attached figures, wherein:

- figure 1 shows a front view of a unit of a coil for a heat exchanger according to the present invention;
- figure 2 shows an upper view of the unit of figure 1;
- figure 3 shows a top axonometric view of the unit of figure 1;
- figure 4 shows a bottom axonometric view of the unit of figure 1;
- figure 5 shows a view from one side of the unit of figure 1;
- figure 6 shows an axonometric view of a support for the unit of figure 1.

DETAILED DESCRIPTION OF THE INVENTION

[0015] With reference to figures 1 and 2, a unit for a heat exchanger comprising a plurality of coils 2 connected in series according to a specific conformation, is indicated with number 1. In particular, the unit 1 comprising (figure 2) a plurality of first coils 3 formed by single pipes connected to each other in series, wherein each pipe is firstly bent in a zig-zag shape on a single plane and then it is bent on itself to form a first thermal exchange wall 30 and a second thermal exchange wall 31 so as to delimit a space 5, in which there is positioned a second coil 4 whose pipe is bent in a zig-zag shape to form a single thermal exchange wall, said second coil being connected in series between two of said first coils 3.

[0016] The straight and parallel sections of each wall of each coil 3, 4 are held together using metal wires 6 welded on both faces of each wall and arranged transversely with respect to said straight sections of the coils (figure 1).

[0017] Furthermore, the first 30 and second 31 walls of the first coils 3 are connected along a first edge 33 through bends 34 of the pipe which are orthogonal to said walls (figures 2 and 4), while along a second opposite edge 35 each of said walls has a plurality of bends 36 which lie on the same plane of the respective walls (figures 1 and 4).

[0018] Advantageously, a second coil 4 is inserted into said space 5 with the aim of increasing the thermal exchange surface per volume unit. As a matter of fact, the space 5 defined, as explained, by the bending of the first coils 3 represents a lost space which is generally not exploited optimally. Even the multiple bending using tensioners is affected by the aforementioned drawback of not being able to compact an exchanger much, especially at the bending. On the contrary, according to the present invention, was designed to insert a second coil without exacerbating the bending of the first coil, therefore avoiding the risk of constrictions or damage with leakage of

refrigerant and structural complications.

[0019] Furthermore, given that the second coils 4 are bent on the same plane, there are formed straight and parallel sections connected by curves 40 (figure 1) on two opposite edges which lie on the same plane and they are at each of the edges of the first 33 and second 35 edges of the first coils 3.

[0020] As shown in the figures 1-5 relating to an embodiment of the invention, the unit 1 comprises three first coils 3 whose internal spaces 5 are occupied by three respective second coils 4. A unit thus formed is orderly and particularly efficient.

[0021] Then, it should be observed that the arrangement of the first 30 and second 31 walls of each first coil 3 is vertically staggered when the unit is in operative position (figures 1, 3 and 5). Similarly, even the wall of each second coil 4 is staggered with respect to both aforementioned first and second walls at least of the first adjacent coils into which it is inserted. In this manner, especially the longitudinal sections of the walls of the coils are directly impacted by the air, or - in other words - they are not shielded with respect to each other; therefore, there is optimal heat dissipation.

[0022] Furthermore, advantageously, as better shown in figures 3 and 5, there are a total of five weldings 7 between the pipes 2 of a unit, having a total of nine walls. Normally, the nine-wall units according to the prior art which envisages single walls connected to each other, would require not less than nine weldings. As a result, the processing would increase by 30% and, therefore, would increase the risk of leakage, if the welding operations were not to be carried out perfectly.

[0023] According to a preferred embodiment of the invention, the unit 1 comprises at least one support 8 for fixing into an appropriate compartment (not shown) of a heat exchanger (not shown). As shown in figure 6, the support is an element comprising a flat base 80 provided with two edges 81 from which there rises two comb-like walls 82 parallel to each other and orthogonal to said base. In particular, the walls 82 show grooves 83 that are parallel and with different depth, arranged in a mirror-like fashion between the two facing walls. Preferably, the grooves are divided into first 84 alternated by two second 85 grooves, the former being more extended than the latter; in this manner, the walls of the first 3 and second 4 coils can be received and supported therein at different heights so as to maintain the staggered arrangement described above (figures 1 and 5). In addition, the support 8 may be provided with drilled appendages 86 which allow fixing to the compartment which houses the heat exchanger.

[0024] A further advantage of the unit of the invention lies in the fact that several units can be assembled using the aforementioned supports 8 so as to create batteries of the heat exchanger with greater or smaller power depending on the needs. As a matter of fact, the compactness of each unit makes it specifically adapted to the assembly by stacking or arranging them side by side.

[0025] Preferably, the pipes of the coils are made of steel/carbon. As a matter of fact, this material provides greater robustness with respect to materials such as aluminium and copper with the advantage of being able to withstand higher operating pressure required when using the aforementioned gases. Furthermore, the robustness allows to further compact the coils with narrower curves without the danger of it collapsing causing pressure drops, if not leakage of gas into the environment.

[0026] In the light of the above, it is clear that the drawbacks of the coils of the heat exchangers of the prior art have been overcome while achieving significant advantages. In particular, the concentration of primary and secondary surfaces in the space unit, that is thermal exchange per cm³, was maximised.

[0027] The number of soldering operations and therefore the risk of leakage of the refrigerant into the environment was reduced without affecting the heat exchange efficiency.

[0028] The possibility of connecting several single and bent coils in parallel, where necessary, allows to reduce pressure drops in the fluid which flows therein.

[0029] The structure is modular in terms of size with extension height-wise, length-wise and width-wise which can be obtained by changing the size of the single wall, both by implementing the walls inserted into the supports and by connecting the units to each other in a repeatable and/or scalable manner.

[0030] Modularity is obtained even in terms of thermal exchange capacity through the possibility of connecting all the walls or side boards in series, obtaining several circuits on a single module with connections in series/parallel and/or in parallel/parallel. The joining of different single modules allows to create different diagrams.

[0031] In addition, the unit of the invention allows to provide primary and secondary heat exchangers with different conformation so as to further maximise thermal exchange both on the refrigerant side and on the air side (corrugated pipes, grooved pipes, various diameters, secondary pipes finned or turbulence flow pipes).

[0032] Furthermore, the unit is compatible - both when used on the condensation side and on the evaporation side and still after depositing an anticorrosive film given that there is water condensation on the evaporator side with very moist air and low evaporation temperatures - with a refrigeration system/heat pump both for domestic and industrial use.

[0033] The pipes may measure from 2mm to 16 mm in terms of internal dimensions so as to meet several use needs.

[0034] They are easier to maintain with respect to prior art systems due to the optimal resistance to deposit of external elements conveyed by the air flows.

of first coils (3) formed by single pipes (2) connected to each other in series, wherein each pipe (2) is firstly bent in a zig-zag shape on a single plane and then it is bent on itself to form a first thermal exchange wall (30) and a second thermal exchange wall (31) so that to create a space (5) therebetween, **characterized in that** said space (5) is occupied by a second coil (4) whose pipe is bent in a zig-zag shape to form a single thermal exchange wall, said second coil being connected in series between two of said first coils (3).

2. Unit (1) according to claim 1, wherein the first (30) and second (31) walls of the first coils (3) are connected along a first edge (33) through bends (34) of the pipe which bends are orthogonal to said walls, while along a second opposite edge (35) each of said walls has a plurality of bends (36) which lie on the same plane of the respective walls.

3. Unit (1) according to claim 1 or 2, comprising three first coils (3) whose inner spaces (5) are occupied by three respective second coils (4).

4. Unit (1) according to any one of claims 1 to 3, wherein the position of the first (30) and second (31) walls of each first coil (3) is vertically staggered when the unit is in an operative mode.

5. Unit (1) according to claim 4, wherein the wall of each second coil (4) is staggered with respect to both said first (30) and second (31) walls of at least the adjacent first coils (3).

6. Unit (1) according to any one of claims 1 to 5, further comprising at least one fixing support (8) provided with a flat base (80) having two edges (81) from which two walls (82) shaped as a comb protrude parallel to each other and orthogonal to said base for supporting separately and staggered at least the adjacent walls of the first (3) and second (4) coils.

7. Unit (1) according to any one of claims 1 to 6, wherein said single pipes (2) are made from steel/carbon.

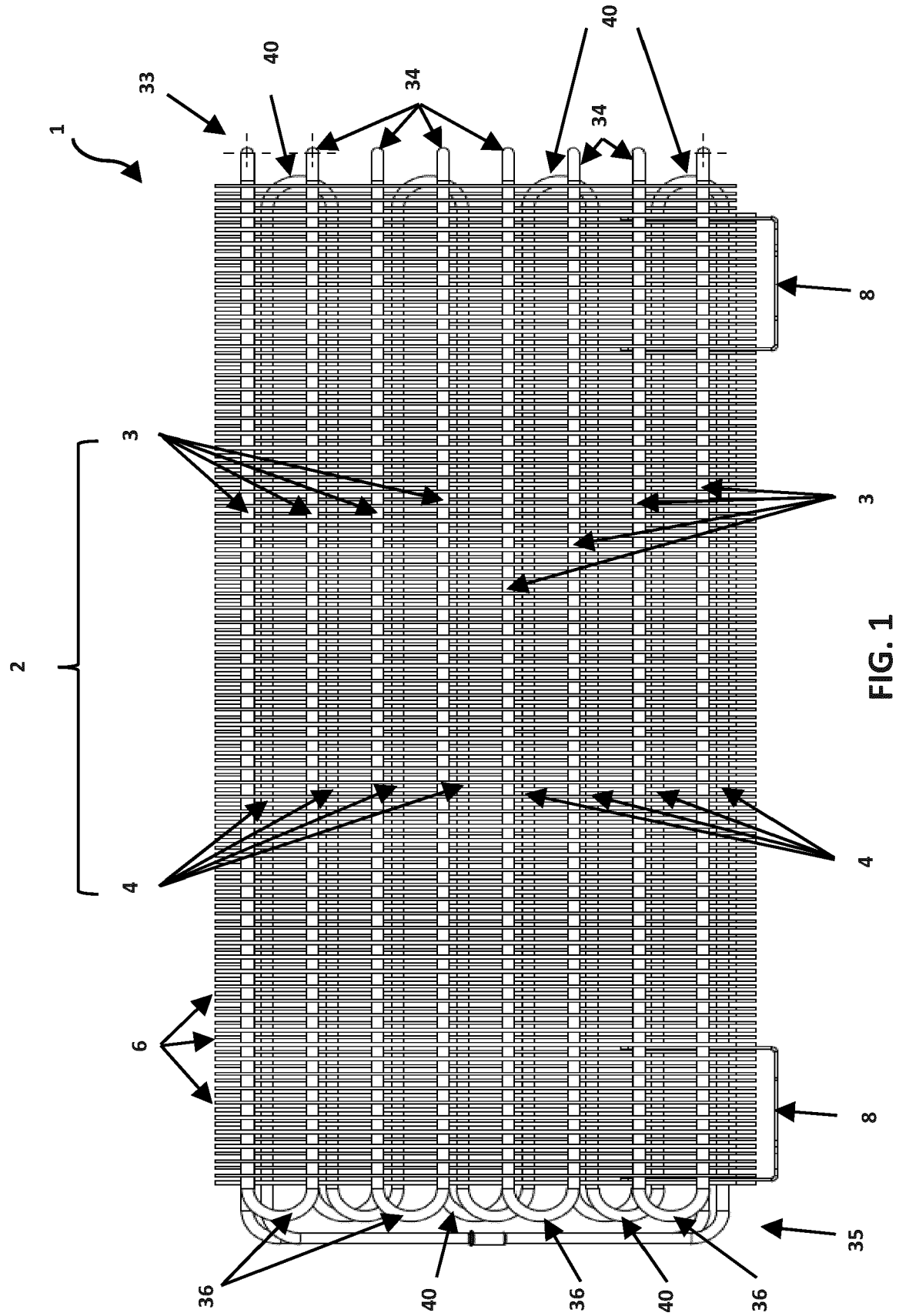
8. Heat exchanger comprising at least one unit (1) according to any one of preceding claims.

9. Heat exchanger according to claim 8, comprising a plurality of units (1) connected to each other in series and/or parallel.

10. Heat exchanger according to claim 9, wherein said units (1) are stacked and/or side by side.

Claims

1. Unit (1) for a heat exchanger, comprising a plurality



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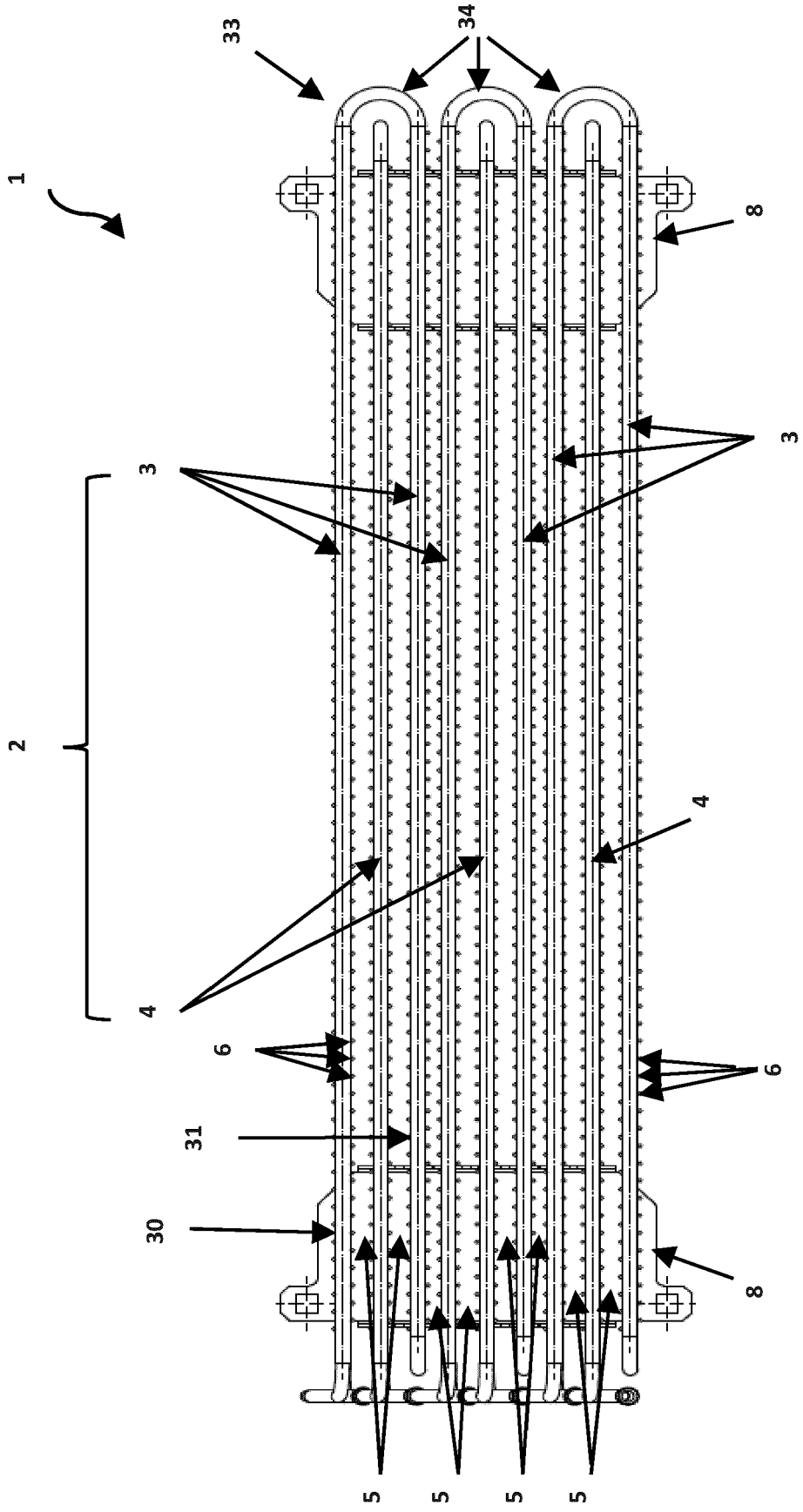


FIG. 2

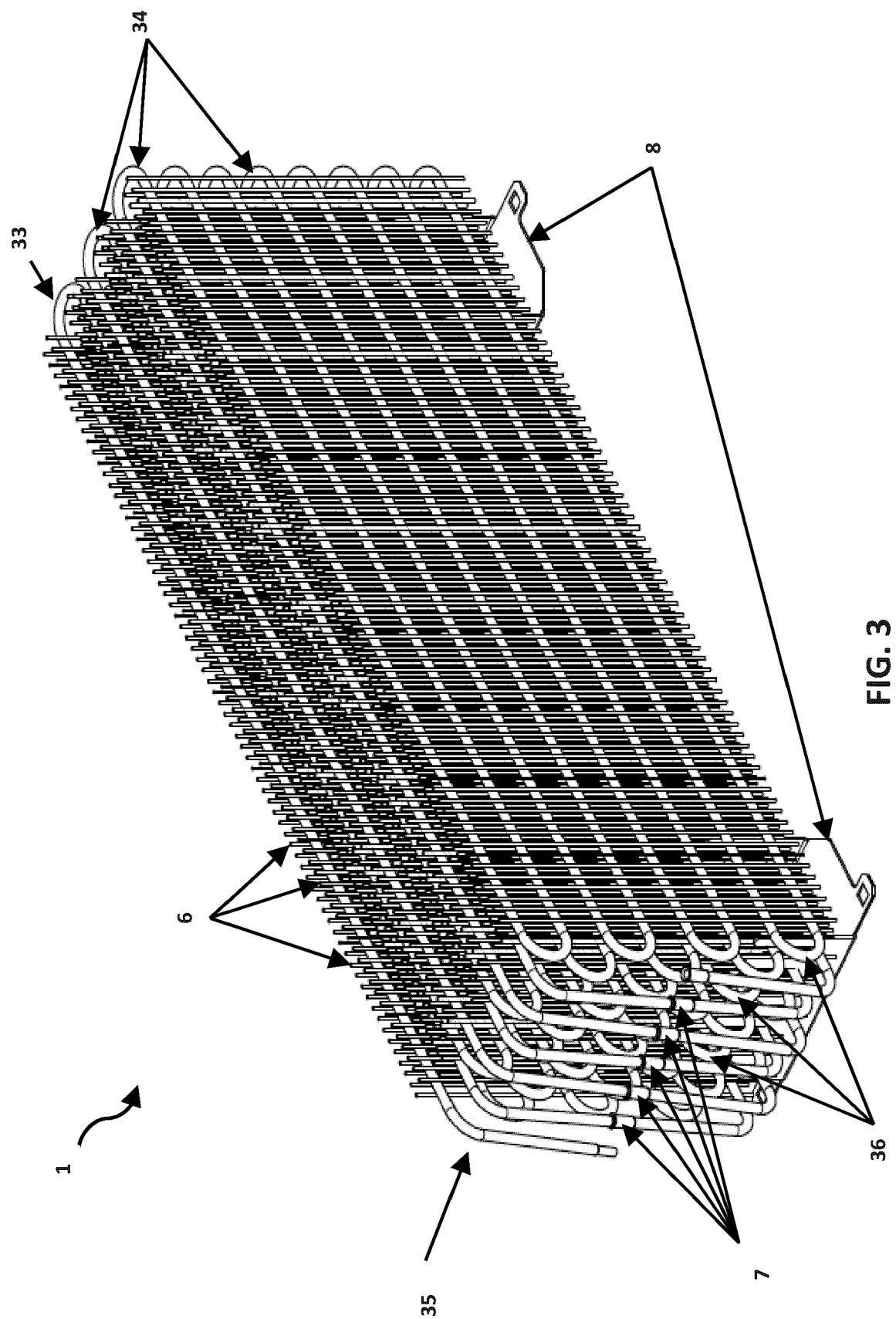


FIG. 3

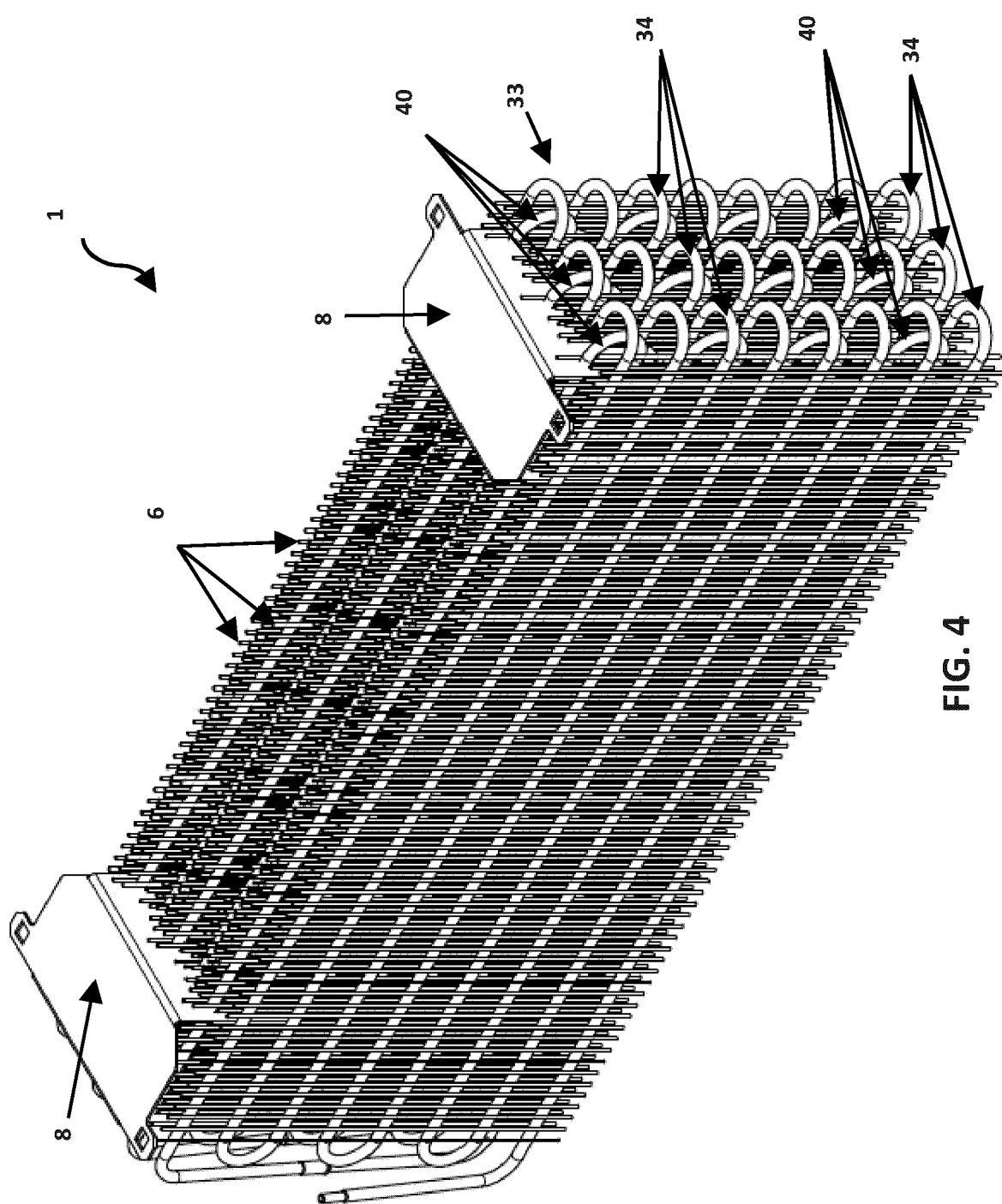


FIG. 4

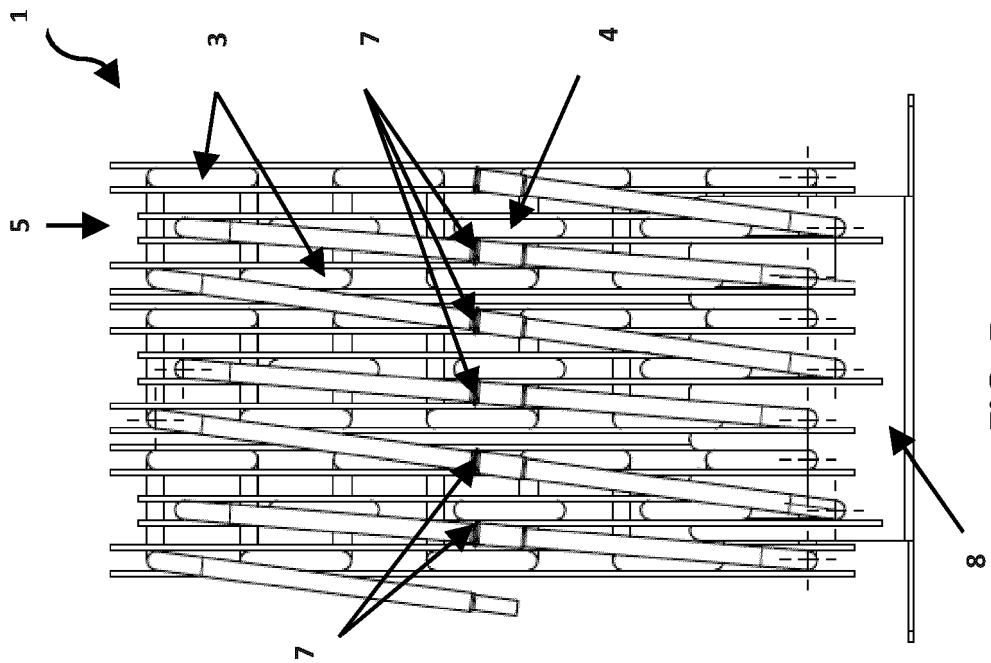


FIG. 5

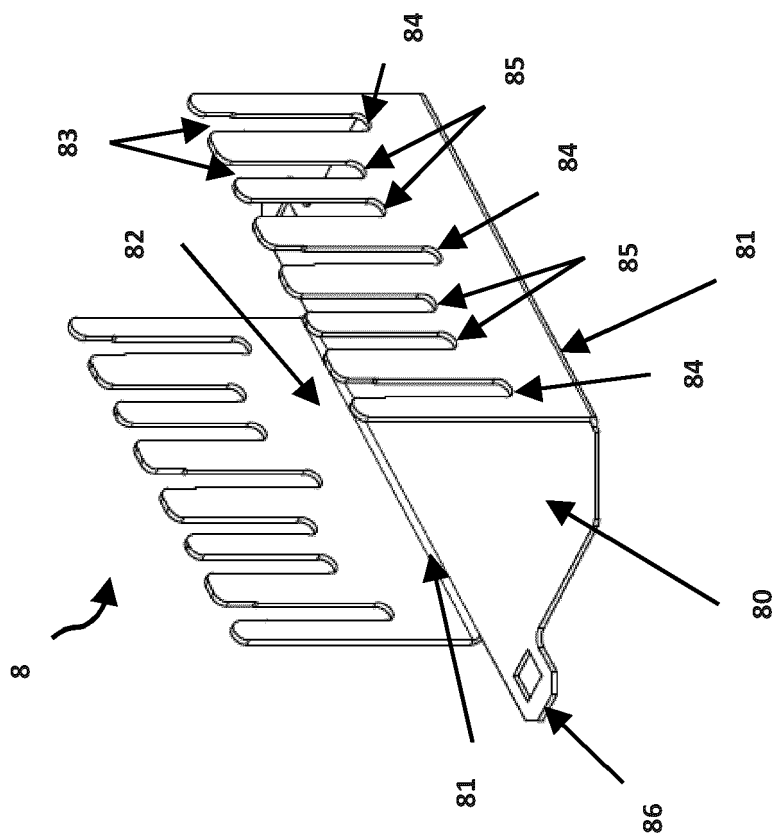


FIG. 6



EUROPEAN SEARCH REPORT

Application Number

EP 22 17 7649

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Place of search		Date of completion of the search	Examiner
Munich		27 October 2022	Mellado Ramirez, J
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

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