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(71) Applicant: **Sanden Corporation**
Isesaki-shi, Gunma 372-8502 (JP)

(72) Inventors:
• **Watanabe, Akimichi**
Isesaki-shi, Gunma 372-8502 (JP)
• **Chiba, Tomohiro**
Isesaki-shi, Gunma 372-8502 (JP)

(74) Representative: **Haley, Stephen**
Gill Jennings & Every,
Broadgate House,
7 Eldon Street
London EC2M 7LH (GB)

(54) **Stacked type multi-flow heat exchanger**

(57) A stacked type multi-flow heat exchanger (1) includes a plurality of heat transfer tubes (2) and fins (3) stacked alternately, and upper front (31a) and an upper rear tank (31b), a lower front (32a) and a lower rear tank (32b). The heat exchanger (1) includes partitions (33,34) provided at the lower front and rear tanks (32a, b), respectively, and a communication path (36) communicating between the same side ends of the lower

front and rear tanks (32a,b). A communication header (38) forming the communication path (36) is formed integrally with the outermost heat transfer tube (2b). Liquid refrigerant flows at a greater amount through the central portion of the heat exchanger core (1a), whereas high temperature refrigerant flows through the edge portions of the heat exchanger core (1a). A uniform temperature distribution of air having passed through the heat exchanger (1) may be achieved.

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Description

[0001] The present invention relates to a stacking type multi-flow heat exchanger suitable for use in an air conditioner for vehicles, and, more particularly, to an improved structure of a stacking type multi-flow heat exchanger having tanks on its upper and lower sides, respectively.

[0002] A stacking type multi-flow heat exchanger, for example, used as a condenser or as an evaporator for an air conditioner in vehicles, may be constructed, for example, as depicted in Fig. 18. Such a heat exchanger is disclosed in Japanese Utility Model Laid-Open HEI 7-12778. In Fig. 18, heat exchanger 100 includes a plurality of heat transfer tubes 101 and fins 102 stacked alternately. On both sides of stacked tubes 101 and fins 102, side plates 103 and 104 are provided. Each heat transfer tube 101 is formed by a pair of tube plates 105 and 106 connected to each other, as depicted in Fig. 19. Upper front tank 107, upper rear tank 108, lower front tank 109 and lower rear tank 110 are formed by stacked heat transfer tubes 101, and disposed relative to air flow direction A, respectively.

[0003] As depicted in Fig. 20, partitions 111 and 112 are provided in upper front and rear tanks 107 and 108 at their central portions in their longitudinal directions, respectively. Heat exchange medium, for example, refrigerant, is introduced into heat exchanger 100 through inlet port 113, provided at one end of upper rear tank 108. The heat exchange medium circulates in the interior of heat exchanger 100 along the fluid route formed in heat exchanger 100, in the directions shown by arrows in Fig. 20. The heat exchange medium is then discharged to the exterior of heat exchanger 100 through outlet port 114, provided at the same side end of upper front tank 107. The other side ends of upper front and rear tanks 107 and 108 are communicated by communication path 115. Communication path 115 is formed by cover member 116, as depicted in Fig. 18. In more detail, the heat exchange medium circulates from inlet port 113 to outlet port 114, through the path in upper rear tank 108, heat exchange portion 121, the path in lower rear tank 110, heat exchange portion 122, the path in upper rear tank 108, communication path 115, the path in upper front tank 107, heat exchange portion 123, the path in lower front tank 109, heat exchange portion 124 and the path in upper front tank 107.

[0004] In such a known structure of heat exchanger 100, however, there are the following problems. For example, among gas/liquid mixing-phase refrigerant introduced into upper rear tank 108 through inlet port 113, in the area of heat exchange portion 121, refrigerant containing a greater amount of liquid phase (hereinafter, simply referred to as "liquid refrigerant") tends to flow into tubes 101, which are disposed at upstream-side positions, at an amount greater than that in the other tubes 101, which are disposed at downstream-side positions, because of gravity. In the area of heat exchange portion

122, liquid refrigerant tends to flow into tubes 101, which are disposed at downstream-side positions, at an amount greater than that in the other tubes 101, which are disposed at upstream-side positions, because of force of inertia. Therefore, in rear side heat exchange portions 121 and 122, high temperature portions 131 and 132, in which a relatively small amount of liquid refrigerant flows, may be generated at central portions of heat exchanger 100, as depicted in Fig. 21. Similarly, in front side heat exchange portions 123 and 124, high temperature portions 133 and 134 may be generated at central portions of heat exchanger 100. Thus, in such a known heat exchanger 100, all of high temperature portions 131, 132, 133 and 134 concentrate at a central portion of heat exchanger 100. Because of the generation of such concentrated high temperature portions 131, 132, 133 and 134, a remarkable, great temperature distribution may be generated in the air flow having passed through heat exchanger 100.

[0005] In order to solve such a problem, JP-A-HEI 9-170850 proposes an improved structure, wherein the areas of high temperature portions of a front side heat exchange portion and a rear side heat exchange portion are shifted from each other.

[0006] However, in practical use, a heat exchanger is usually installed in a unit case having front and rear openings, which are defined at the central portions of front and rear walls of the unit case so that air may pass through the central portion of the heat exchanger. Moreover, usually the openings are narrower than the heat exchange portion of the heat exchanger. Therefore, with the velocity of air passing through the heat exchange portion, the velocity of air passing through the central portion of the heat exchange portion may be greater than the velocity of air passing through the edge portion of the heat exchange portion. Consequently, the heat exchange in the central portion may be insufficient, and the temperature of air passing through the central portion of the heat exchange portion may be higher than the temperature of air passing through the edge portion. In the structure as disclosed in JP - A-HEI 9-170850, wherein a high temperature portion is formed at the central portion of the heat exchange portion corresponding to the positions of the openings of a unit case, it may be difficult to achieve a satisfactory heat exchange of air passing through the heat exchanger, and to prevent the generation of a great temperature distribution in air having passed through the heat exchanger.

[0007] Further, in a known heat exchanger such as heat exchanger 100 depicted in Fig. 18, because communication path 115 is formed by providing cover member 116 prepared as a separate member, the numbers of parts and processes for assembly may increase, thereby increasing the cost for the manufacture of the heat exchanger.

[0008] Accordingly, it would be desirable to provide an improved structure of a high-performance stacking type multi-flow heat exchanger which may prevent the gen-

eration of a great temperature distribution of air passing through the heat exchanger in its practical use.

[0009] Further, it would be desirable to provide a stacking type multi-flow heat exchanger which may decrease the number of parts, and may improve the efficiency of its assembly, thereby decreasing the cost for the manufacture of the heat exchanger.

[0010] A stacking type multi-flow heat exchanger according to the present invention is herein provided. The stacking type multi-flow heat exchanger includes a plurality of heat transfer tubes and fins stacked alternately, and an upper front tank, an upper rear tank, a lower front tank, and a lower rear tank, formed by the stacked heat transfer tubes and disposed relative to an air flow direction. The heat exchanger comprises a first partition provided in the lower front tank at its central portion in a longitudinal direction of the lower front tank, and a second partition provided in the lower rear tank at its central portion in a longitudinal direction of the lower rear tank; a communication path communicating between a first end of the lower front tank and a first end of the lower rear tank; and an inlet port for heat exchange medium provided at a second end of one of the lower front and rear tanks, and an outlet port for heat exchange medium provided at a second end of the other of the lower front and rear tanks.

[0011] In the stacking type multi-flow heat exchanger, a side tank forming fluid introduction and discharge paths may be provided on a side of a heat exchanger core comprising the stacked heat transfer tubes and fins. The fluid introduction and discharge paths of the side tank are communicated with the lower front and rear tanks via the inlet and outlet ports, respectively.

[0012] The communication path may be formed by a communication header. The communication header may be formed integrally with an outermost heat transfer tube. When the outermost heat transfer tube is formed by a pair of tube plates, the communication header may be formed integrally with an outer plate of the pair of tube plates. Alternatively, the communication header may be formed integrally with both of said pair of tube plates. The outermost heat transfer tube may be formed in a substantially same outline as that of the other heat transfer tubes. Further, when the outermost heat transfer tube is formed by a pair of tube plates, at least an outer plate of the pair of tube plates may be thicker than tube plates forming the other heat transfer tubes.

[0013] The present invention provides another improved structure of a stacking type multi-flow heat exchanger. The stacking type multi-flow heat exchanger includes a plurality of heat transfer tubes and fins stacked alternately, and an upper front tank, an upper rear tank, a lower front tank, and a lower rear tank, formed by the stacked heat transfer tubes and disposed relative to an air flow direction. The heat exchanger comprises: a communication header forming a communication path communicating between a first end of the lower front tank and a first end of the lower rear tank, or

between a first end of the upper front tank and a first end of the upper rear tank. The communication header is formed integrally with an outermost heat transfer tube.

[0014] Also in this stacking type multi-flow heat exchanger, when the outermost heat transfer tube may be formed by a pair of tube plates, the communication header may be formed integrally with an outer plate of the pair of tube plates, or may be formed integrally with both of the pair of tube plates. The outermost heat transfer tube may be formed in a substantially same outline as that of the other heat transfer tubes. When the outermost heat transfer tube is formed by a pair of tube plates, at least an outer plate of the pair of tube plates may be thicker than tube plates forming the other heat transfer tubes.

[0015] In the stacking type multi-flow heat exchanger according to the present invention, a specified particular route for refrigerant is formed in the heat exchanger by the specified disposition of the first and second partitions, the communication path, and the inlet and outlet ports. In this route, a liquid refrigerant may flow into a central portion of the heat exchanger core, at an amount greater than that in a known structure such as one depicted in Figs. 18, 20 and 21. Therefore, a high temperature area may not be generated in the central portion of the heat exchanger core. Because this central portion of the heat exchanger core corresponds to central openings of a unit case in position, when the heat exchanger is installed in the unit case. The velocity of air passing through the central portion of the heat exchanger core is greater than that of air passing through the other portions of the heat exchanger core, because of the central openings of the unit case. However, because a high temperature area is not formed in the central portion of the heat exchanger core, the efficiency of the heat exchange in the central portion of the heat exchanger core with a high velocity of the passing air may be increased. Consequently, the temperature distribution of air having passed through the heat exchanger may be uniform.

[0016] Moreover, generally air may pass through the edge portions of a heat exchanger core at an amount smaller than the amount of air passing through a central portion of the heat exchanger core, because the edge portions are covered by the walls of a unit case in practical use. Therefore, particularly when the temperature of refrigerant in the heat exchanger is low, frost formation is likely to occur in the edge portions. In the heat exchanger according to the present invention, however, high temperature portions may be formed on the areas of the edge portions of the heat exchanger core, such a frost formation may be prevented by forming the high-temperature edge portions.

[0017] Further, in the present invention, the communication path may be formed integrally with the outermost heat transfer tube. A separate cover member for forming a communication path may not be necessary. Therefore, the number of parts of the heat exchanger may be decreased, and the working efficiency for the

assembly of the heat exchanger may be increased.

[0018] Further objects, features, and advantages of the present invention will be understood from the following detailed description of the preferred embodiments of the present invention with reference to the accompanying figures.

[0019] Embodiments of the invention are now described with reference to the accompanying figures, which are given by way of example only, and are not intended to limit the present invention.

[0020] Fig. 1 is a perspective view of a heat exchanger according to a first embodiment of the present invention.

[0021] Fig. 2 is an elevational view of the heat exchanger depicted in Fig. 1.

[0022] Fig. 3 is a bottom view of the heat exchanger depicted in Fig. 1.

[0023] Fig. 4 is an exploded perspective view of a heat transfer tube of the heat exchanger depicted in Fig. 1.

[0024] Fig. 5 is an exploded perspective view of the heat exchanger depicted in Fig. 1.

[0025] Fig. 6 is an enlarged, vertical sectional view of an end of a lower tank of the heat exchanger depicted in Fig. 1.

[0026] Fig. 7 is an elevational view of a tube plate forming an outermost heat transfer tube of the heat exchanger depicted in Fig. 1.

[0027] Fig. 8 is an elevational view of another tube plate forming the outermost heat transfer tube of the heat exchanger depicted in Fig. 1.

[0028] Fig. 9 is a schematic perspective view of the heat exchanger depicted in Fig. 1, showing a route of refrigerant flow.

[0029] Fig. 10 is a schematic perspective view of the heat exchanger depicted in Fig. 1, showing high temperature portions generated.

[0030] Fig. 11 is an elevational view of the heat exchanger depicted in Fig. 1, showing a state in which the heat exchanger is installed in a unit case.

[0031] Fig. 12 is an elevational view of a heat exchanger according to a second embodiment of the present invention.

[0032] Fig. 13 is a bottom view of the heat exchanger depicted in Fig. 12.

[0033] Fig. 14 is an exploded perspective view of the heat exchanger depicted in Fig. 12.

[0034] Fig. 15 is an enlarged, vertical sectional view of an end of a lower tank of the heat exchanger depicted in Fig. 12.

[0035] Fig. 16 is an elevational view of a tube plate forming an outermost heat transfer tube of the heat exchanger depicted in Fig. 12.

[0036] Fig. 17 is an elevational view of another tube plate forming the outermost heat transfer tube of the heat exchanger depicted in Fig. 12.

[0037] Fig. 18 is a perspective view of a known heat exchanger.

[0038] Fig. 19 is an exploded perspective view of a heat transfer tube of the heat exchanger depicted in Fig.

18.

[0039] Fig. 20 is a schematic perspective view of the heat exchanger depicted in Fig. 18, showing a route of refrigerant flow.

[0040] Fig. 21 is a schematic perspective view of the heat exchanger depicted in Fig. 18, showing high temperature portions generated.

[0041] Referring to Figs. 1-11, a heat exchanger of the present invention is provided according to a first embodiment. Heat exchanger 1 is constructed as a stacking type multi-flow heat exchanger. In Figs. 1-3, heat exchanger 1 includes a plurality of heat transfer tubes 2 and a plurality of fins 3 stacked alternately. Stacked heat transfer tubes 2 and fins 3 form heat exchanger core 1a. Side plates 4 and 5 are provided on both sides of heat exchanger core 1a, respectively. On one side of heat exchanger core 1a, and on side plate 4, side tank 6 is provided for forming fluid introduction and discharge paths 6a and 6b. Flange 7 is attached to side tank 6 via flange stay 8 for introducing a heat exchange medium, for example, refrigerant, into fluid introduction path 6a and discharging the heat exchange medium from fluid discharge path 6b. In this embodiment, expansion valve 9 is attached to flange 7.

[0042] Heat transfer tubes 2, other than a heat transfer tube disposed at a central position in the tube stacking direction and an outermost heat transfer tube disposed on a side opposite to the side of side tank 6, are formed as depicted in Figs. 4 and 5. Heat transfer tube 2 is formed by a pair of tube plates 10 and 11, which are connected to each other. Projecting hollow portions 12, 13, 14 and 15 are formed on the respective corner portions of tube plate 10. Projecting hollow portions 16, 17, 18 and 19 are formed on the respective corner portions of tube plate 11. Path forming portions 20 and 21, extending in parallel to each other in the longitudinal direction of tube plate 10, are formed on tube plate 10. Path forming portions 22 and 23, extending in parallel to each other in the longitudinal direction of tube plate 11, are formed on tube plate 11. Path forming portions 20 and 22 form refrigerant path 24, extending vertically, in heat transfer tube 2. Path forming portions 21 and 23 form refrigerant path 25, extending vertically, in heat transfer tube 2, respectively.

[0043] Upper front tank 31a, upper rear tank 31b, lower front tank 32a, and lower rear tank 32b are formed by stacked heat transfer tubes 2. Upper front tank 31a is formed by connecting adjacent projecting hollow portions 14 and 18. Upper rear tank 31b is formed by connecting adjacent projecting hollow portions 13 and 17. Lower front tank 32a is formed by connecting adjacent projecting hollow portions 15 and 19. Lower rear tank 32b is formed by connecting adjacent projecting hollow portions 12 and 16. In heat transfer tube 2a disposed at a central position in the tube stacking direction, partitions 33 and 34 are provided at positions corresponding to projecting hollow portions 12 and 15 of tube plate 10a, which is one of a pair of tube plates forming heat transfer

tube 2a. Partition 33 forms a first partition provided in lower front tank 32a at its central portion in the longitudinal direction of lower front tank 32a. Partition 33 divides the interior of lower front tank 32a into two parts. Partition 34 forms a second partition provided in lower rear tank 32b at its central portion in the longitudinal direction of lower rear tank 32b. Partition 34 divides the interior of lower rear tank 32b into two parts. In this embodiment, inner fin 35 is inserted into each heat transfer tube 2.

[0044] As depicted in Fig. 6, on the side of heat exchanger core 1a opposite to the side provided with side tank 6, communication path 36 is formed for communicating a first end, that is an end positioned on the side opposite to the side provided with side tank 6, of lower front tank 32a and a first end of lower rear tank 32b. In this embodiment, communication path 36 is formed by outer plate 37 of a pair of tube plates forming outermost heat transfer tube 2b. In this embodiment, outer plate 37 has a protruded portion at its bottom portion, and this protruded portion forms communication header 38 for forming communication path 36. Namely, communication header 38 extends between the first end of lower front tank 32a and the first end of lower rear tank 32b, as depicted in Fig. 7. In this embodiment, the other plate of the pair of tube plates forming outermost heat transfer tube 2b is formed as the same plate as tube plate 10, as depicted in Fig. 8. Further, in this embodiment, outermost heat transfer tube 2b is formed substantially in the same outline as that of the other heat transfer tubes 2. Further, outer plate 37 may be thicker than the other tube plates, as depicted in Fig. 6.

[0045] The above-described respective parts are assembled as depicted in Fig. 5. The flow route of refrigerant is formed as depicted in Fig. 9. Inlet port 39 for introducing refrigerant into heat exchanger core 1a is provided at a second end of lower rear tank 32b. Outlet port 40 for discharging refrigerant from heat exchanger core 1a is provided at a second end of lower front tank 32a, as depicted in Fig. 9. The refrigerant introduced from introduction path 6a of side tank 6 is introduced into chamber 41, which is one of chambers of lower rear tank 32b divided by partition 34, through inlet port 39. The refrigerant is then sent from chamber 41 to the interior of upper rear tank 31b through heat transfer tubes 2 positioned within an area 45 formed by a half of the rear portion of heat exchanger core 1a, relative to air flow A. After the refrigerant flows in upper rear tank 31b, the refrigerant is sent to the other chamber 42 of lower rear tank 32b through heat transfer tubes 2 positioned within an area 46, which is formed by the other half of the rear portion of heat exchanger core 1a. The refrigerant is then sent from chamber 42 to chamber 43, which is one of chambers of lower front tank 32a divided by partition 33, through communication path 36. The refrigerant is then sent from chamber 43 to the interior of upper front tank 31a through heat transfer tubes 2 positioned within an area 47, which is formed by a half of the front portion of

heat exchanger core 1a. After the refrigerant flows in upper front tank 31a, the refrigerant is sent to the other chamber 44 of lower front tank 32a through heat transfer tubes 2 positioned within an area 48, which is formed by the other half of the front portion of heat exchanger core 1a. Then, the refrigerant is discharged from chamber 44 into fluid discharge path 6b of side tank 6 through outlet port 40.

[0046] In heat exchanger 1 having such a route for refrigerant flow, refrigerant flows in a state depicted in Fig. 10. The refrigerant, whose pressure has been reduced by expansion valve 9, may be in a gas/liquid mixing condition. With respect to the refrigerant introduced into chamber 41, gaseous refrigerant tends to flow in heat transfer tubes 2 near inlet port 39 within area 45 at an greater amount, and liquid refrigerant tends to flow in heat transfer tubes 2 far from inlet port 39 within area 45 at an greater amount, due to a difference in inertias between the gaseous and the liquid phases of the refrigerant. Therefore, high temperature portion 49 may be formed in an upper end portion of area 45. Similarly, high temperature portion 50 may be formed in a lower end portion of area 46 at a position opposite to the position of high temperature portion 49. High temperature portion 51 may be formed in an upper end portion of area 47 at the same-side position as the position of high temperature portion 50. High temperature portion 52 may be formed in a lower end portion of area 48 at the same-side position as the position of high temperature portion 49.

[0047] As depicted in Fig. 11, heat exchanger 1 may serve as, for example, an air conditioner for vehicles, by installing it in unit case 60. Unit case usually has openings 61 and 62 on its front and rear walls at its central portion. Openings 61 and 62 usually may be formed smaller than the portion of heat exchanger core 1a. Therefore, a velocity distribution of passing air may be generated in a direction perpendicular to air flow direction A. The velocity is greater in the central portion of heat exchanger core 1a, corresponding to the positions of openings 61 and 62. The velocity is smaller in the edge portions of heat exchanger core 1a, corresponding to the portions covered with the walls of unit case 60. By such a velocity distribution, the heat exchange of air passing through the central portion of heat exchanger core 1a tends to become insufficient, and tends to become high temperature, as compared with air passing through the edge portions of heat exchanger core 1a.

[0048] In the embodiment of the present invention, however, the liquid refrigerant flows in the central portion of heat exchanger core 1a at a greater amount, and high temperature portions 49, 50, 51 and 52 are not formed in the central portion. Therefore, air passing through the central portion may be heat exchanged at a sufficient efficiency. Consequently, a desired, uniform temperature distribution of air having passed through heat exchanger 1 may be ensured.

[0049] Because the edge portions of heat exchanger

core 1a are covered by the walls of unit case 60, the velocity of air passing through the edge portions tends to become small, and a frost formation is likely to occur. In the embodiment of the present invention, however, because high temperature portions 49, 50, 51 and 52 are formed on the edge portions of heat exchanger core 1a, such a frost formation may be prevented.

[0050] Moreover, because communication header 38 is formed integrally with outer plate 37 of outermost heat transfer tube 2b, a separate member for forming a communication header is not necessary. The number of parts for heat exchanger 1 may be decreased, and the working efficiency for the assembly of heat exchanger 1 may be increased.

[0051] Further, as depicted in Fig. 5, because outermost heat transfer tube 2b is formed substantially in the same outline as that of other heat transfer tubes 2, the working efficiency for the assembly of heat exchanger 1 may be further increased.

[0052] Further, as depicted in Fig. 6, because outer plate 37 of outermost heat transfer tube 2b is thicker than the other tube plates forming other heat transfer tubes 2, the strength of outermost heat transfer tube 2b, ultimately, the strength of the entire heat exchanger 1, may be increased.

[0053] Figs. 12-17 depict heat exchanger 71 according to a second embodiment of the present invention. The structures of heat exchanger 71 other than an outermost heat transfer tube forming a communication path are substantially the same as those of heat exchanger 1 of the first embodiment. Therefore, the parts of heat exchanger 71 except the portion of the outermost heat transfer tube are attached with the same labels as those in the first embodiment, and a detailed explanation is omitted.

[0054] In this embodiment, outermost heat transfer tube 2c is formed by a pair of tube plates 72 and 73 depicted in Figs. 16 and 17. In outer plate 72, protruded portion 74 is formed at its bottom portion, integrally with outer plate 72. Protruded portion 74 extends between a first end of lower front tank 32a and a first end lower rear tank 32b. In the other plate 73, protruded portion 75 is formed at its bottom portion, integrally with plate 73. Protruded portion 75 also extends between the first end of lower front tank 32a and the first end lower rear tank 32b. Protruded portion 75 has openings 76 and 77 which communicate with the interior of lower front tank 32a and lower rear tank 32b, respectively. Protruded portion 74 and protruded portion 75 form communication header 78 forming communication path 79, by connecting the pair of plates 72 and 73. Communication path 79 communicates the ends of lower front tank 32a and lower rear tank 32b. In this embodiment, outermost heat transfer tube 2c is formed substantially in the same outline as that of other heat transfer tubes 2. Further, both of plates 72 and 73 are thicker than other plates forming other heat transfer tubes 2.

[0055] In this embodiment, because communication

header 78 is formed integrally with outermost heat transfer tube 2c, a separate member for forming a communication header is not necessary. The number of parts for heat exchanger 71 may be decreased, and the working efficiency for the assembly of heat exchanger 71 may be increased. Because communication header 78 is formed by both the pair of plates 72 and 73, the cross section of communication path 79 may be enlarged. By the large flow area of communication path 79, the pressure loss of circulated refrigerant may be reduced.

[0056] Further, as depicted in Fig. 14, because outermost heat transfer tube 2c is formed substantially in the same outline as that of other heat transfer tubes 2, the working efficiency for the assembly of heat exchanger 1 may be further increased.

[0057] Further, as depicted in Fig. 15, because tube plates 72 and 73 of outermost heat transfer tube 2c are thicker than the other tube plates forming other heat transfer tubes 2, the strength of outermost heat transfer tube 2c, ultimately, the strength of the entire heat exchanger 71, may be increased.

Claims

1. A stacking-type multi-flow heat exchanger including a plurality of heat transfer tubes and fins stacked alternately, an upper front tank, an upper rear tank, a lower front tank, and a lower rear tank, said heat exchanger formed by said stacked heat transfer tubes and disposed relative to an air flow direction, said heat exchanger comprising:

a first partition provided in said lower front tank at its central portion in a longitudinal direction of said lower front tank, and a second partition provided in said lower rear tank at its central portion in a longitudinal direction of said lower rear tank;

a communication path communicating between a first end of said lower front tank and a first end of said lower rear tank; and

an inlet port for heat exchange medium provided at a second end of one of said lower front and rear tanks, and an outlet port for heat exchange medium provided at a second end of the other of said lower front and rear tanks.

2. The stacking type multi-flow heat exchanger of claim 1, wherein a side tank forming fluid introduction and discharge paths is provided on a side of a heat exchanger core comprising said stacked heat transfer tubes and fins, and said fluid introduction and discharge paths are communicated with said lower front and rear tanks via said inlet and outlet ports, respectively.

3. The stacking type multi-flow heat exchanger of

claim 1 or 2, wherein said communication path is formed by a communication header, and said communication header is formed integrally with an outermost heat transfer tube.

4. The stacking type multi-flow heat exchanger of claim 3, wherein said outermost heat transfer tube is formed by a pair of tube plates, and said communication header is formed integrally with an outer plate of said pair of tube plates.

5. The stacking type multi-flow heat exchanger of claim 3, wherein said outermost heat transfer tube is formed by a pair of tube plates, and said communication header is formed integrally with both of said pair of tube plates.

6. The stacking type multi-flow heat exchanger of claim 3 or 4, wherein said outermost heat transfer tube is formed in a substantially same outline as that of the other heat transfer tubes.

7. The stacking type multi-flow heat exchanger of any of claims 3 to 6, wherein said outermost heat transfer tube is formed by a pair of tube plates, and at least an outer plate of said pair of tube plates is thicker than tube plates forming the other heat transfer tubes.

8. A stacking type multi-flow heat exchanger including a plurality of heat transfer tubes and fins stacked alternately, an upper front tank, an upper rear tank, a lower front tank, and a lower rear tank, said heat exchanger formed by said stacked heat transfer tubes and disposed relative to an air flow direction, said heat exchanger comprising:

a communication header forming a communication path communicating between a first end of said lower front tank and a first end of said lower rear tank, or between a first end of said upper front tank and a first end of said upper rear tank, said communication header formed integrally with an outermost heat transfer tube.

9. The stacking type multi-flow heat exchanger of claim 8, wherein said outermost heat transfer tube is formed by a pair of tube plates, and said communication header is formed integrally with an outer plate of said pair of tube plates.

10. The stacking type multi-flow heat exchanger of claim 8, wherein said outermost heat transfer tube is formed by a pair of tube plates, and said communication header is formed integrally with both of said pair of tube plates.

11. The stacking type multi-flow heat exchanger of any of claims 8 to 10, wherein said outermost heat trans-

fer tube is formed in a substantially same outline as that of the other heat transfer tubes.

12. The stacking type multi-flow heat exchanger of any of claims 8 to 11, wherein said outermost heat transfer tube is formed by a pair of tube plates, and at least an outer plate of said pair of tube plates is thicker than tube plates forming the other heat transfer tubes.

FIG. 1

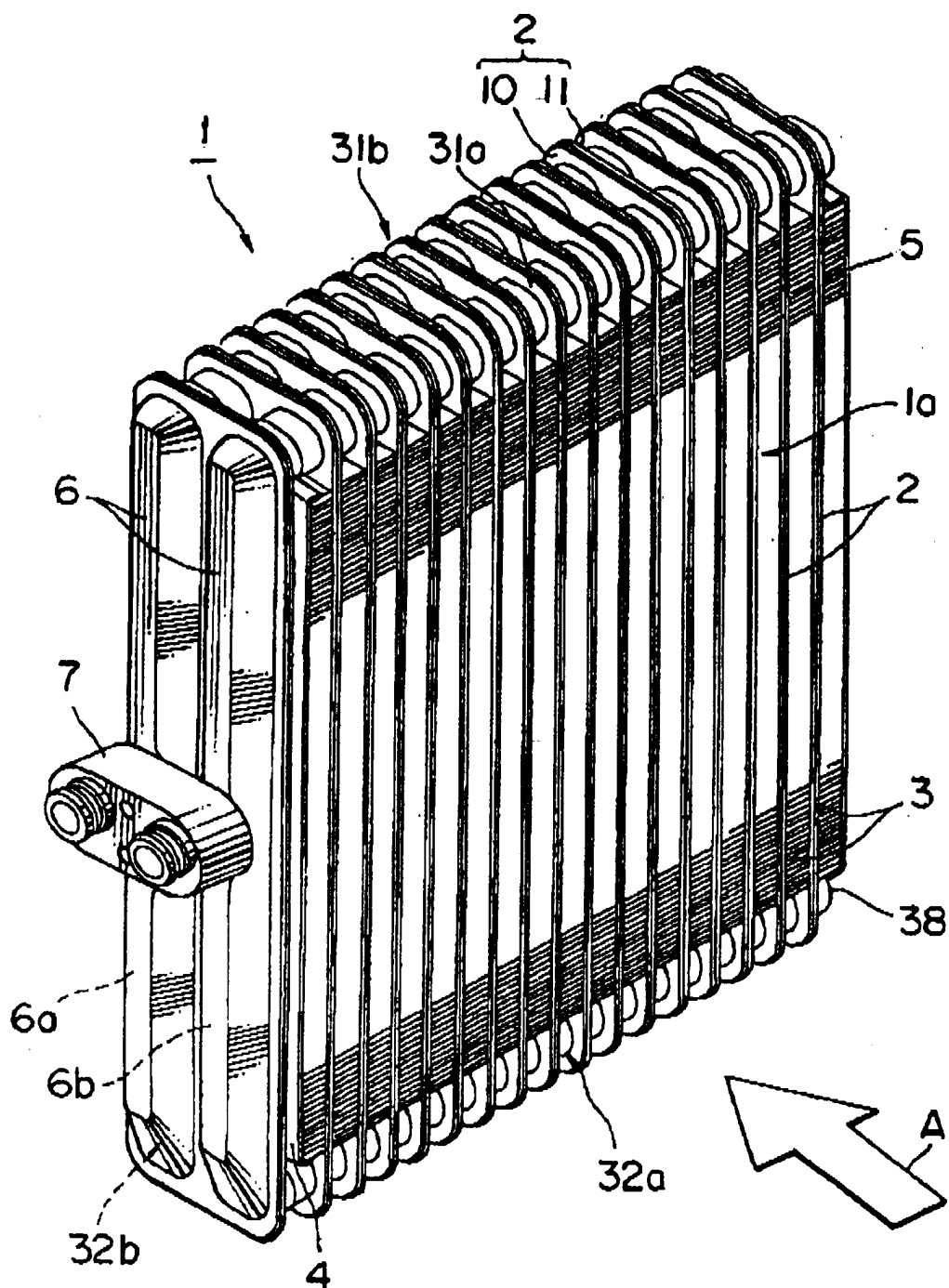


FIG. 2

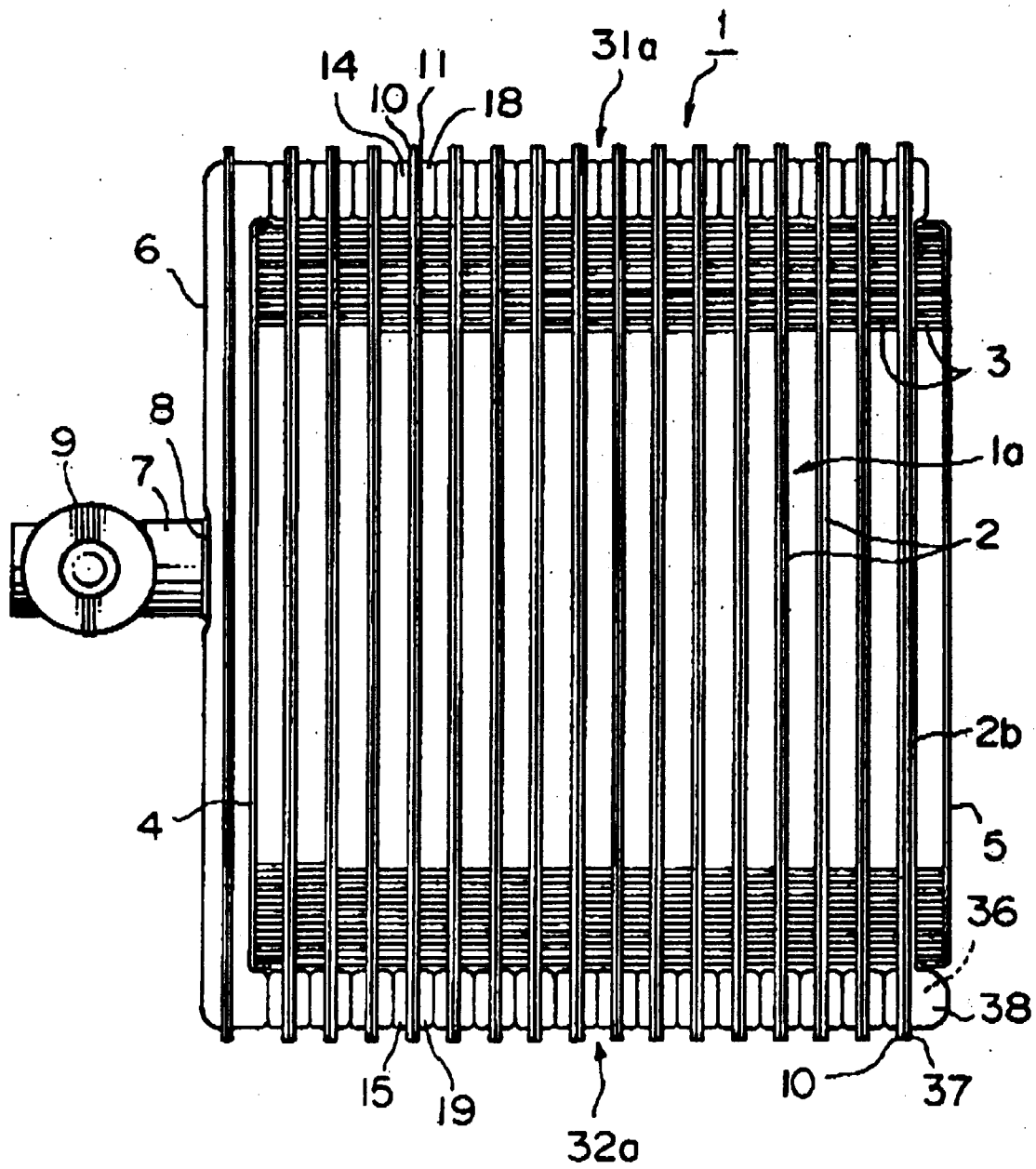


FIG. 3

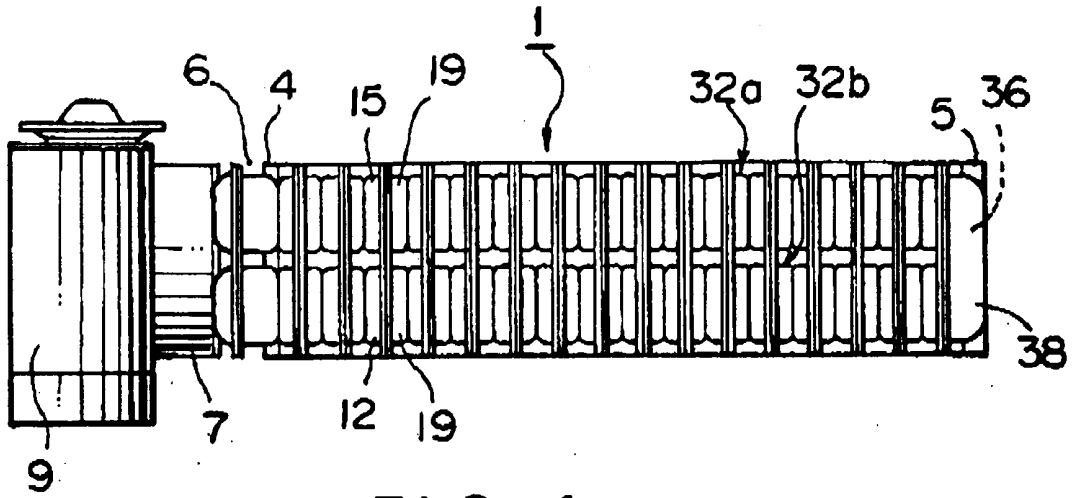
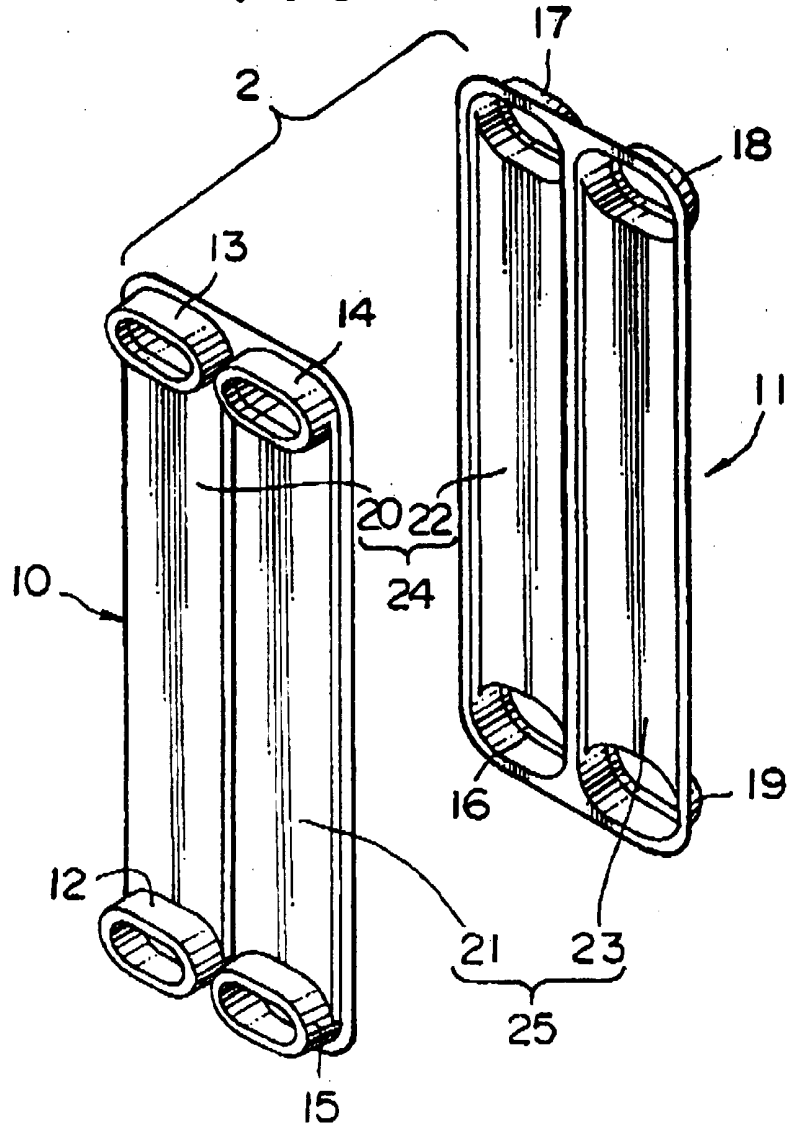


FIG. 4



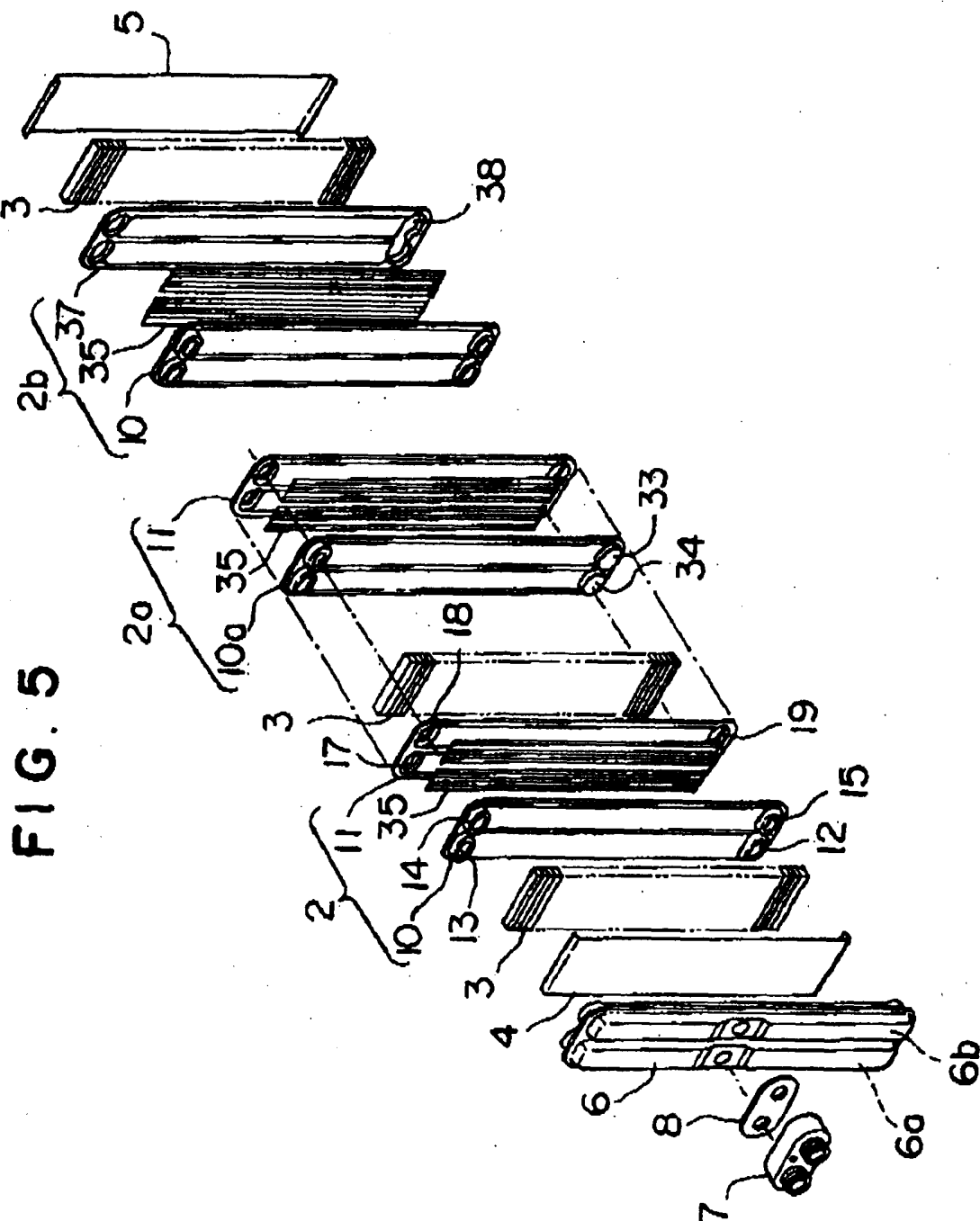


FIG. 6

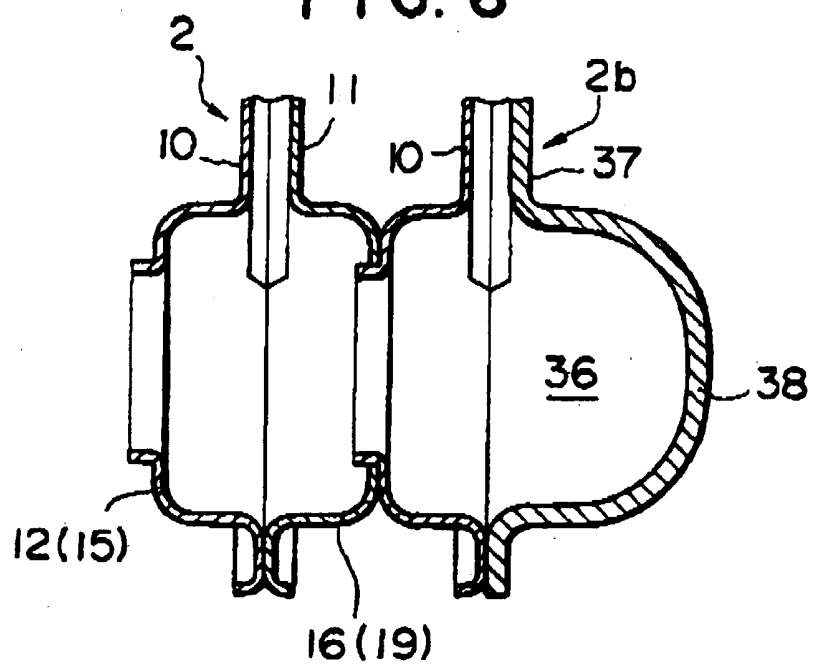


FIG. 7

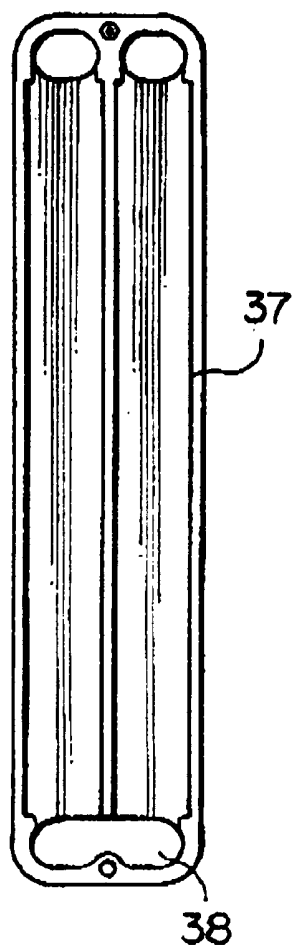


FIG. 8

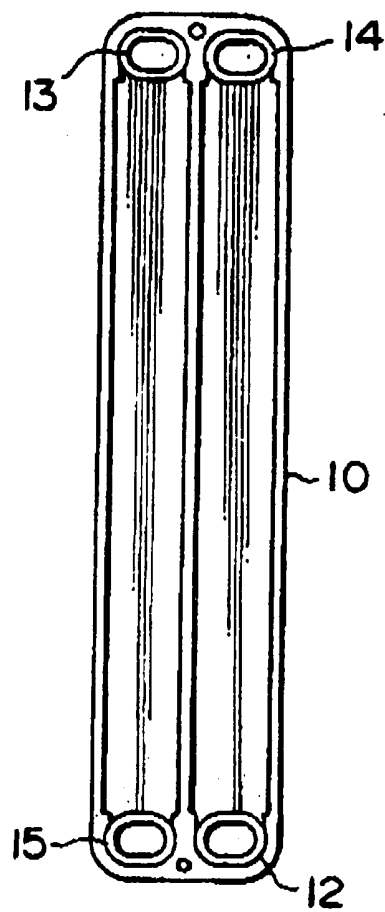


FIG. 9

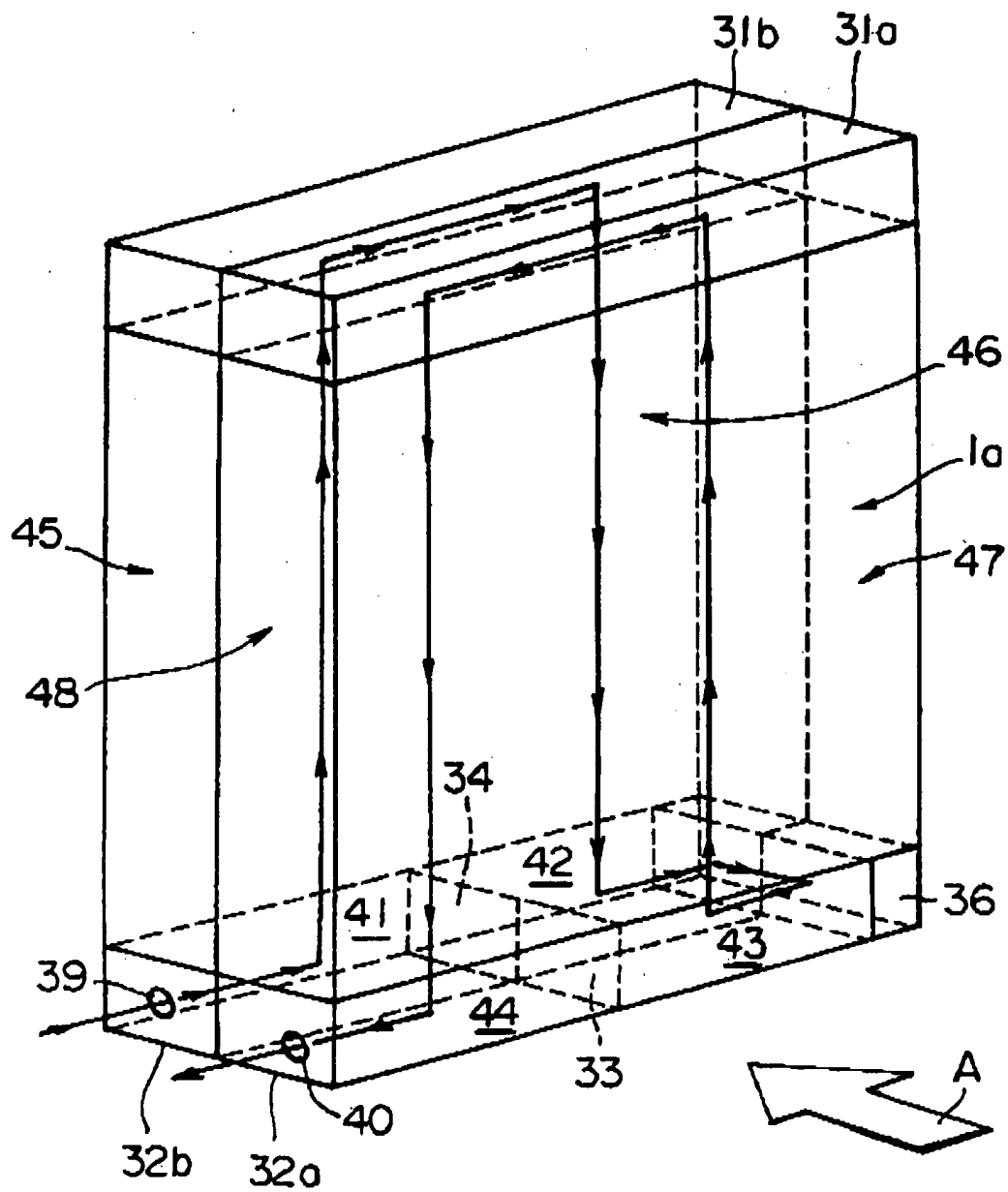


FIG. 10

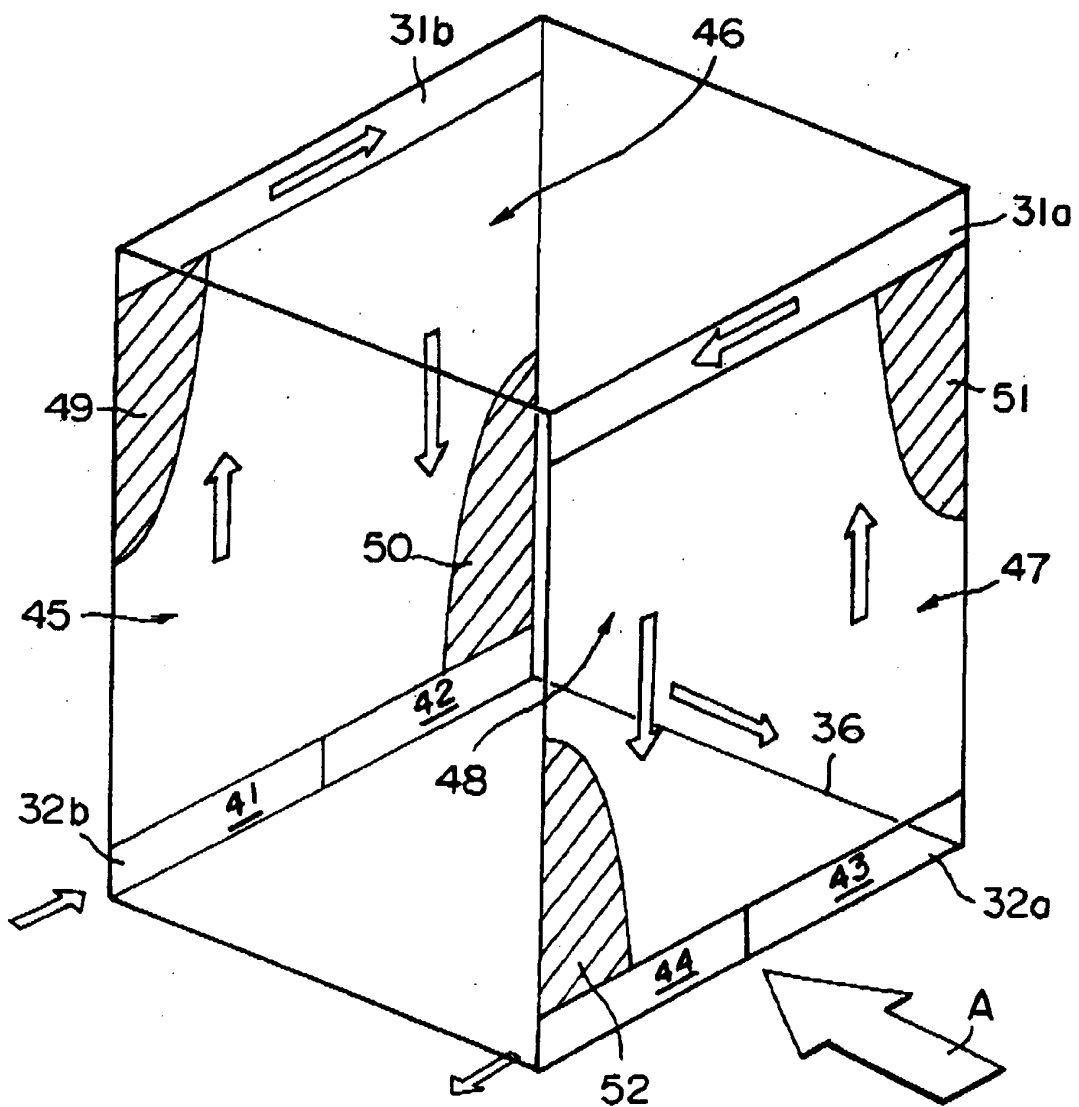


FIG. 11

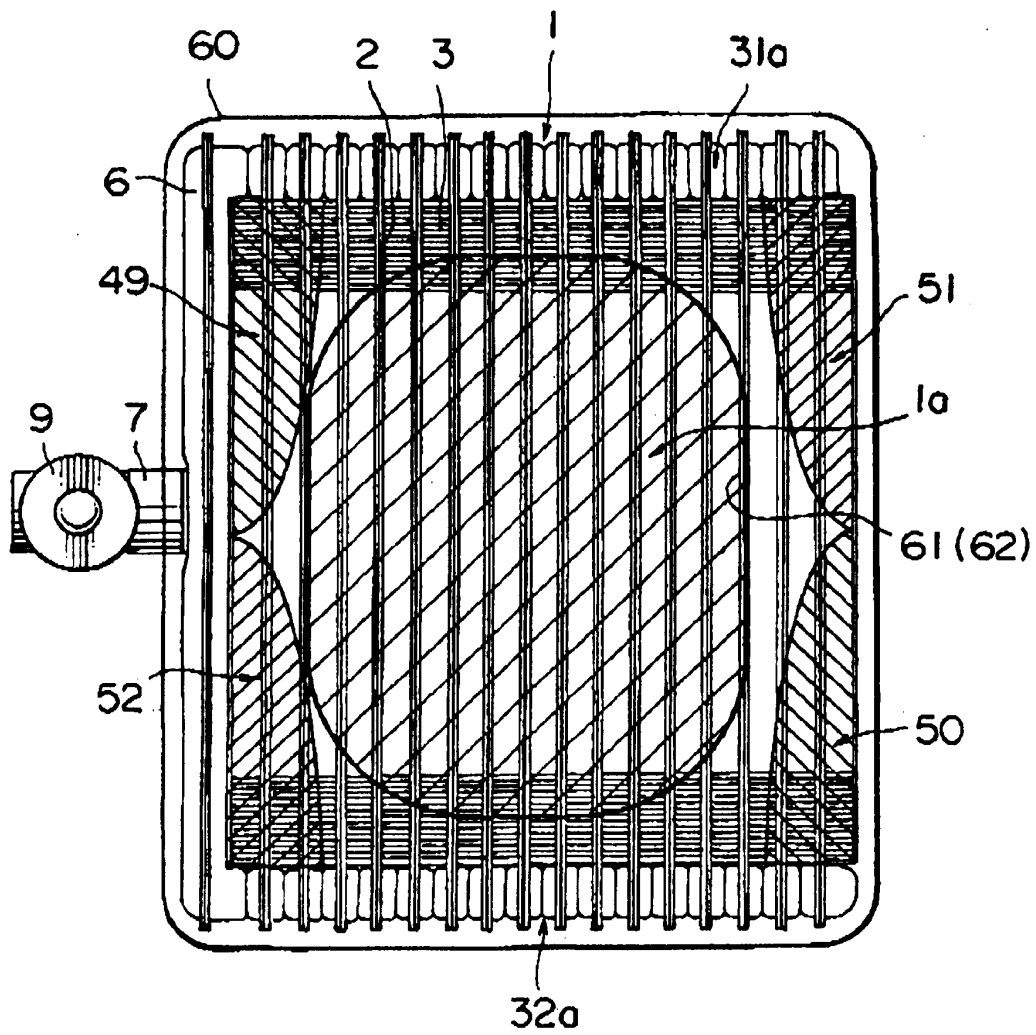


FIG. 12

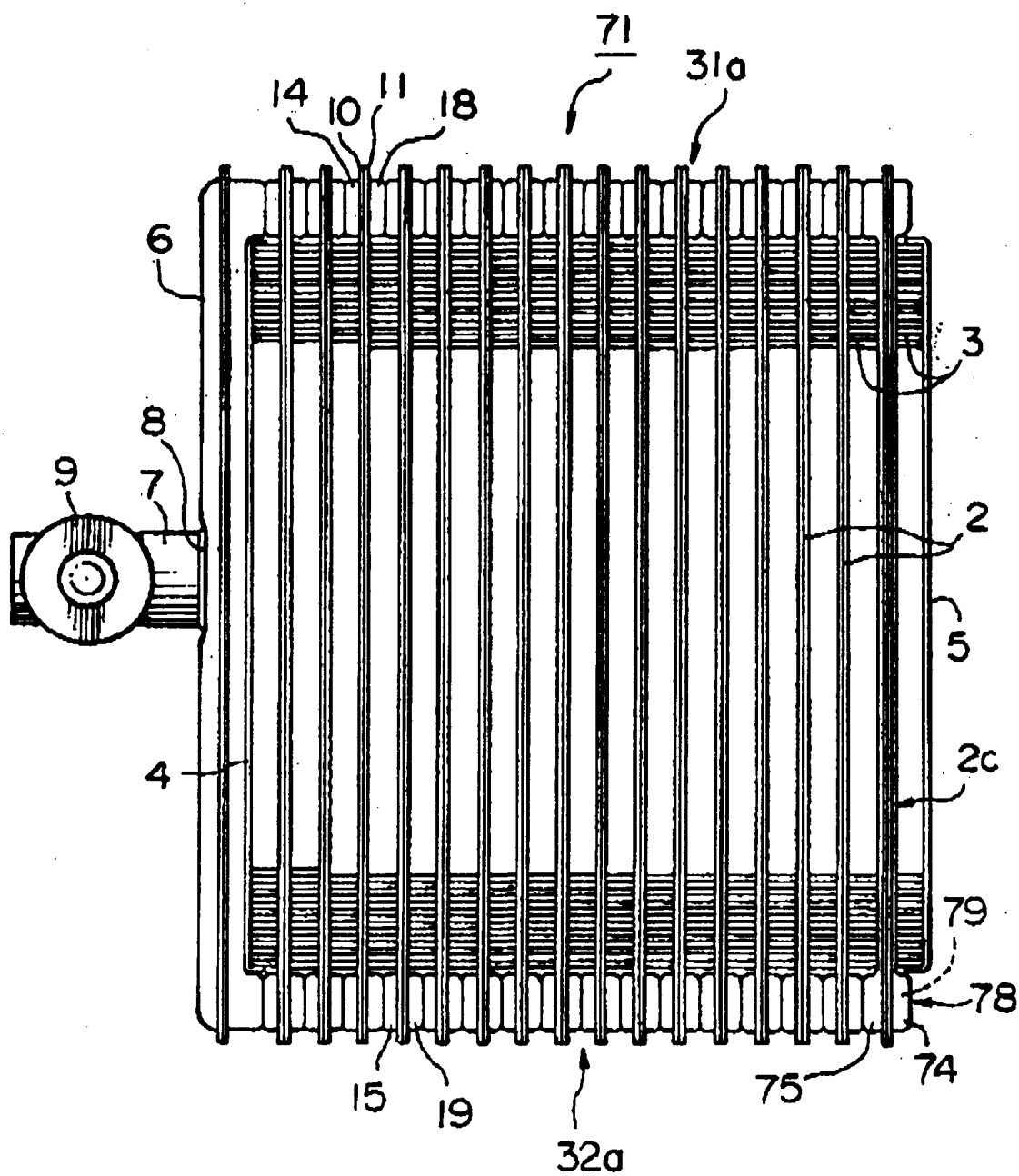
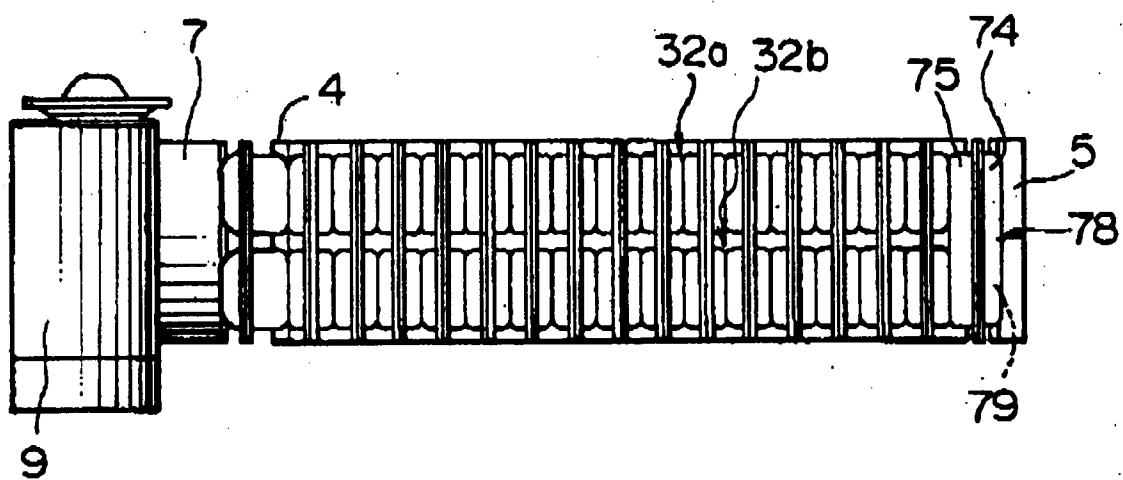


FIG. 13



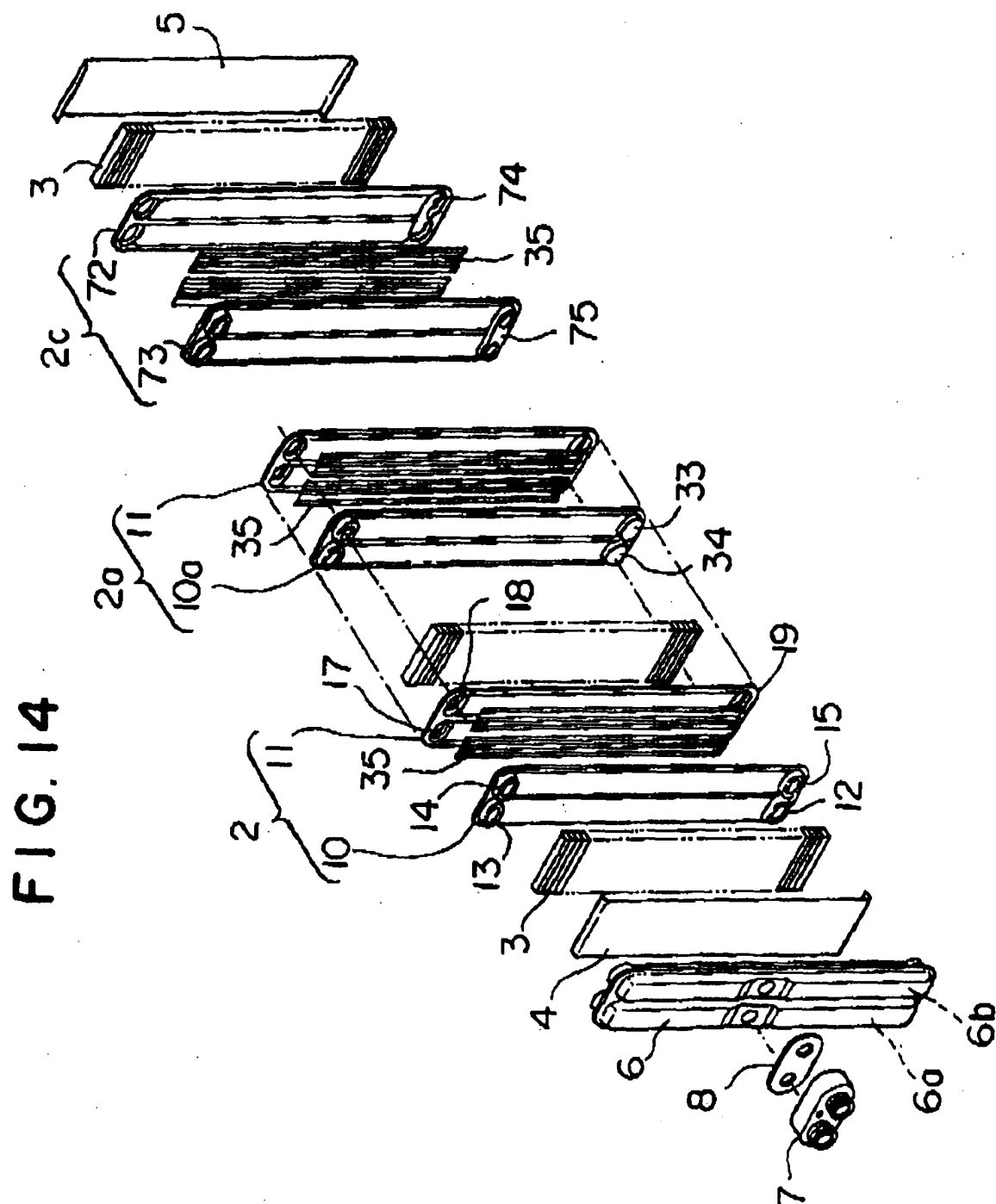


FIG. 15

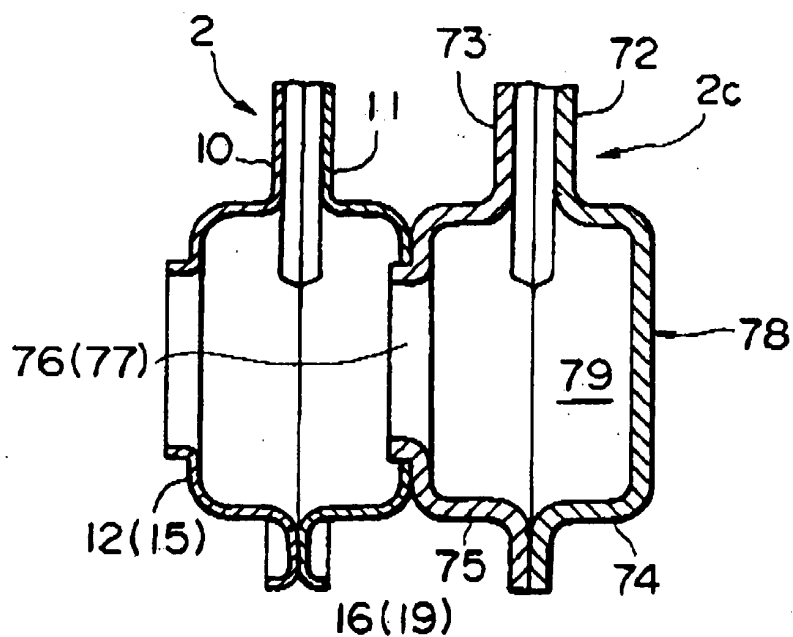


FIG. 16

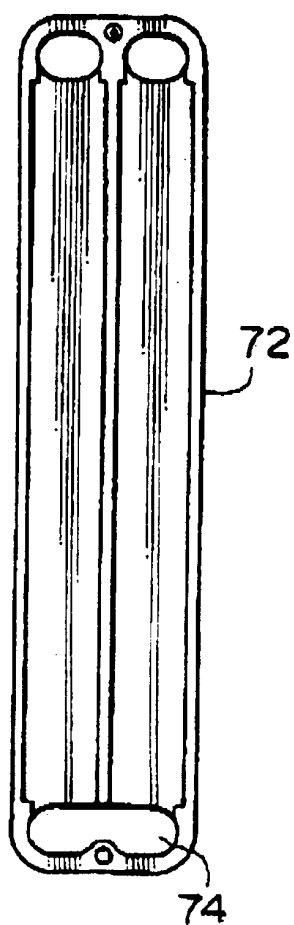


FIG. 17

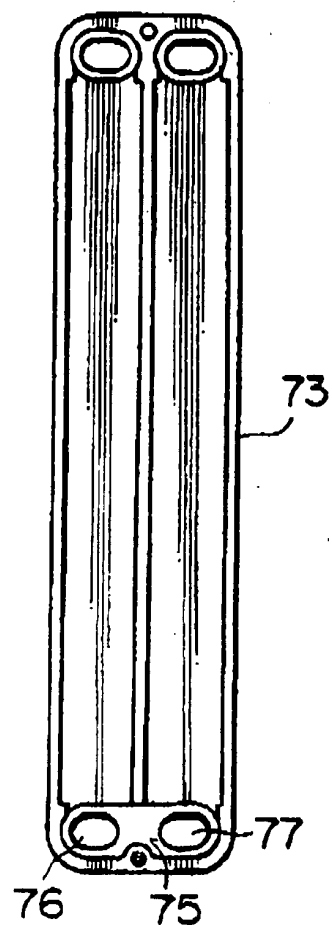


FIG. 18

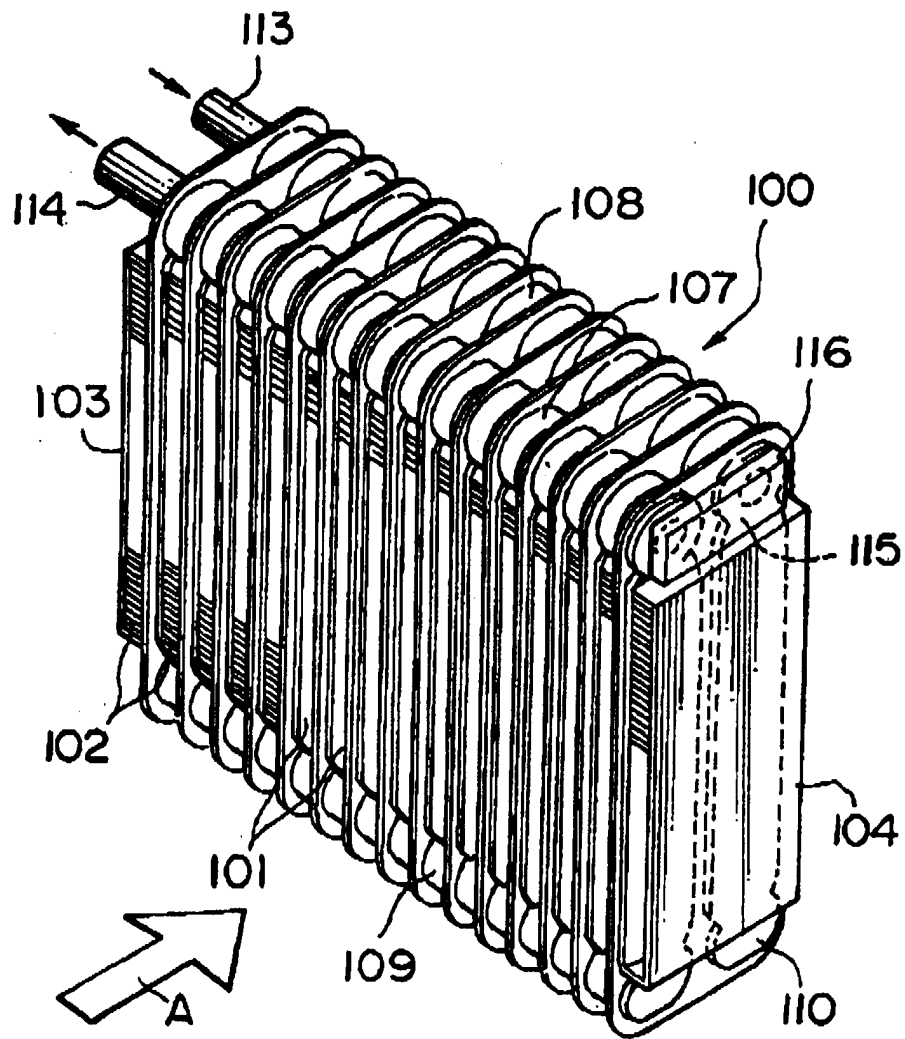


FIG. 19

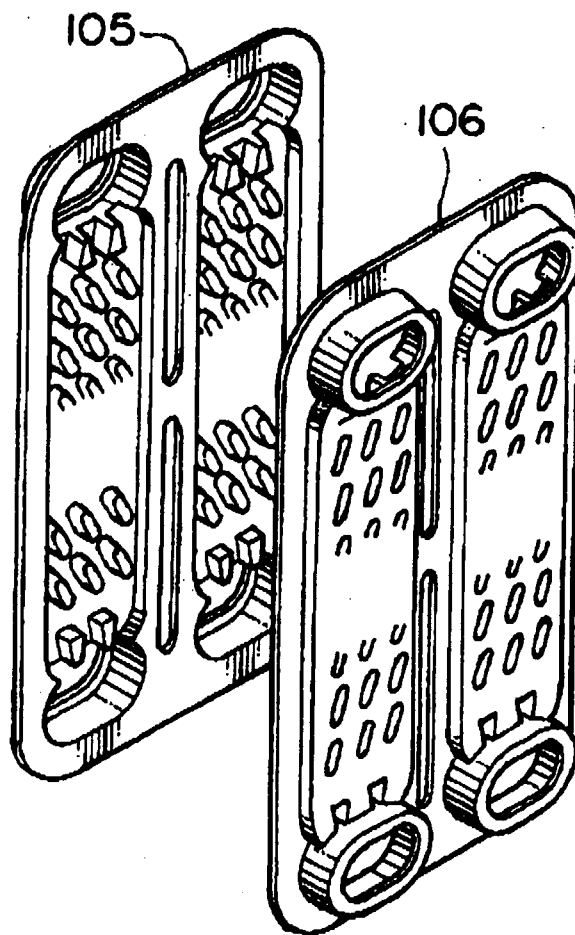


FIG. 20

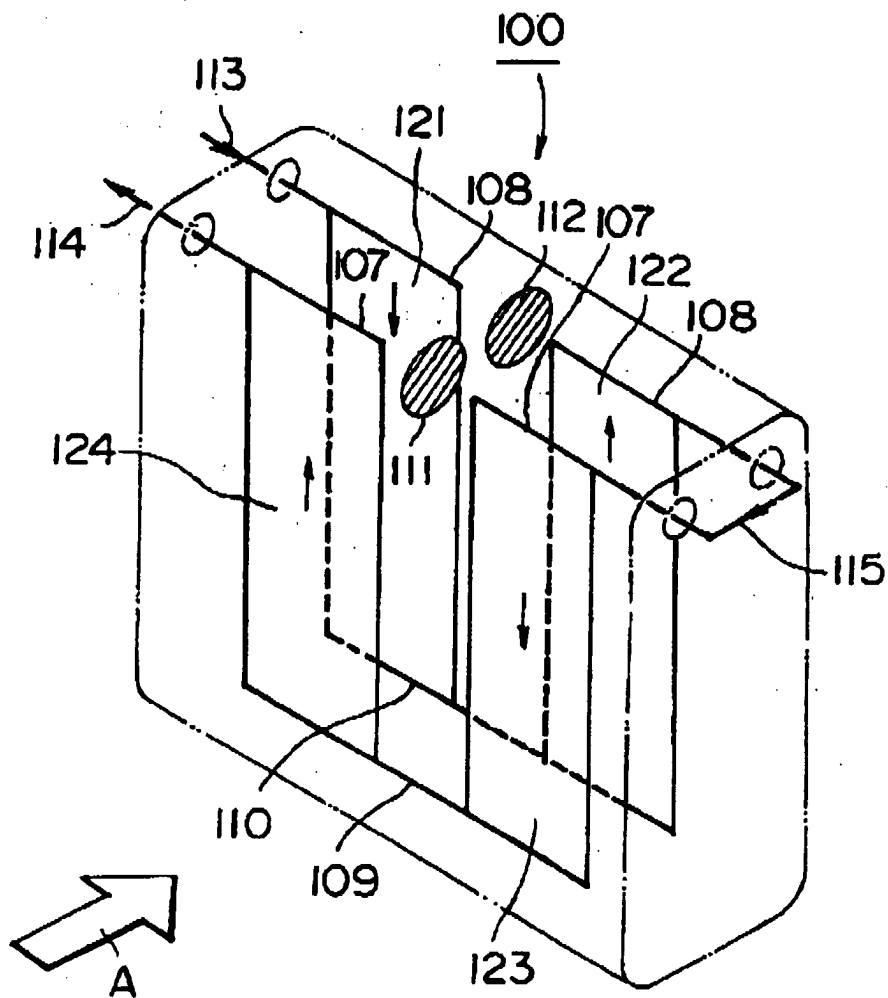


FIG. 21

