

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 872 698 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
21.10.1998 Bulletin 1998/43

(51) Int Cl.⁶: **F28D 1/03, F28F 9/04**

(21) Application number: **98302413.4**

(22) Date of filing: **30.03.1998**

(84) Designated Contracting States:
**AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC
 NL PT SE**
 Designated Extension States:
AL LT LV MK RO SI

(74) Representative: **Matthews, Howard Nicholas et al**
Page Hargrave,
Temple Gate House
Temple Gate, Bristol BS1 6PL (GB)

Remarks:

A request for correction to the numbering of the Claims has been filed pursuant to Rule 88 EPC. A decision on the request will be taken during the proceedings before the Examining Division (Guidelines for Examination in the EPO, A-V, 3.).

(30) Priority: **15.04.1997 JP 113397/97**

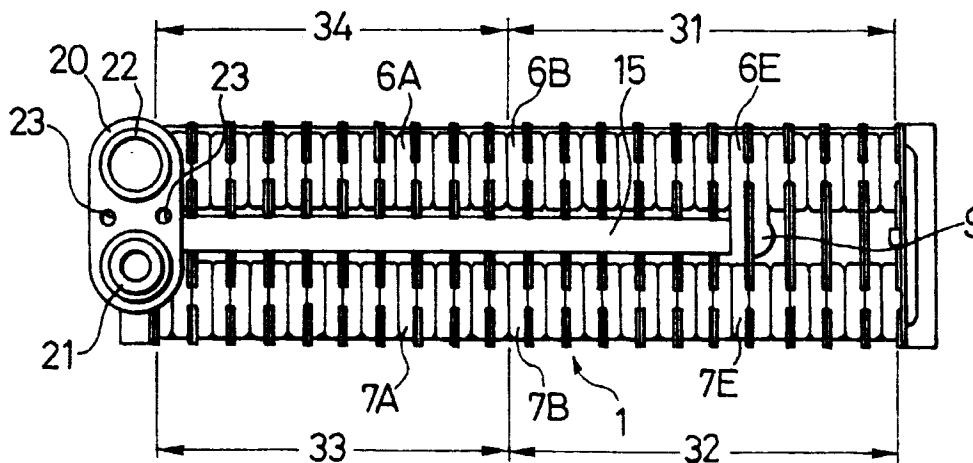
(71) Applicant: **ZEXEL CORPORATION**
Tokyo (JP)

(72) Inventor: **Inoue, Seiji, c/o Zexel Corporation**
Konan-machi, Saitama (JP)

(54) Laminated heat exchanger

(57) The intake / outlet portion (10) which is to be connected to the block type expansion valve (20) is constituted of a first intake / outlet formation portion (10A) for forming a coolant intake (53) and a coolant outlet (54) that is secured at the outside in the direction of lamination of the tube element (2) located at one of the outermost ends in the direction of the lamination and a second intake / outlet formation portion (10B) that is bonded

face-to-face with the first intake / outlet formation portion (10A) in the direction of the lamination to form a coolant intake passage (63) communicating with the coolant intake and a coolant outlet passage (64) communicating with the coolant outlet. Tube elements (2), fins (3), the first and second intake / outlet formation portions (10A, 10B) and end plates (4,5) are temporarily assembled and then brazed in a furnace to be formed as an integrated unit.

FIG. 1B

EP 0 872 698 A2

Description

The present invention relates to a heat exchanger employed in an air conditioning system for vehicles, and in particular, it relates to a laminated heat exchanger employed as an evaporator.

In the laminated heat exchanger in the prior art disclosed in Japanese Unexamined Utility Model Publication No. H7-41259, a through chamber that allows the heat exchanging medium to pass through by communicating between end portions of flow passages at one side of adjacent tube elements at the two sides and a distribution / collection chamber for distributing and collecting the heat exchanging medium by communicating between the end portions of the flow passages at the other side of the adjacent tube elements at the two sides and further communicating them to an opening portion for connecting a supply pipe via a bypass passage formed around the through chamber are provided at least at either side of the manifold in order to achieve a laminated heat exchanger that affords a great degree of freedom in piping layout so that a so-called counter flow can be achieved with ease even when heat exchanging medium is supplied from the upwind side, with the direction of the coolant flow at the intake / outlet portion matching the direction of the airflow in the heat exchanger.

In addition, one of the laminated heat exchangers disclosed in Japanese Unexamined Patent Publication No. H8-271177 is provided with an intake / outlet portion at one end in the direction of the lamination, with the direction of the coolant flow at the intake / outlet portion matching the direction of the lamination. Another laminated heat exchanger disclosed in this publication is provided with an intake / outlet portion that is formed to achieve an integrated unit together with a tube element, with the direction of the coolant flow at the intake / outlet portion matching the direction of the air flow in the heat exchanger.

However, in one of the laminated heat exchangers disclosed in Japanese Unexamined Patent Publication No. H8-271177, since the intake / outlet portion for the coolant opens in the direction of the lamination, a block type expansion valve must be mounted in the direction of the lamination, presenting a problem in that this type of laminated heat exchanger cannot be installed with ease in vehicles in which sufficient space cannot be obtained in the direction of the lamination.

In addition, since the laminated heat exchanger disclosed in Japanese Unexamined Utility Model Publication No. H7-41259 and the other laminated heat exchanger disclosed in Japanese Unexamined Patent Publication No. H8-271177 are each provided with coolant intake / outlet portions formed in the direction of the airflow at the heat exchanger with a specific distance allowed between the coolant intake / outlet portions, it is necessary to provide piping extending from the coolant intake / outlet portions to the mounting position of the

expansion valve, thereby increasing the number of required parts and necessitating a space for the piping.

Accordingly, an object of the present invention is to provide a laminated heat exchanger which requires less space to be occupied by the coolant intake / outlet portion and achieves simplification in the structure of the coolant intake / outlet portion, with an expansion valve mounted in a direction perpendicular to the direction of the lamination.

Thus, in the laminated heat exchanger according to the present invention, which is constituted by laminating a plurality of tube elements each having a pair of tanks formed at one end in the lengthwise direction and a U-shaped passage communicating between the pair of tanks, alternately with fins, constituting a plurality of tank groups by causing tanks that are adjacent to each other in the direction of the lamination to communicate over specific ranges, fluidly connecting tank groups in series and the U-shaped passages corresponding to the tank groups to form a coolant flow path and providing a coolant intake that communicates with a tank group located at the upstream end of the coolant flow path and a coolant outlet that communicates with the tank group located at the downstream end of the coolant flow path at the outside in the direction of the lamination, of a tube element located at one of the outermost ends in the direction of the lamination, the intake / outlet portion is mounted at the outside in the direction of the lamination, of a tube element located at one of the outermost ends in the direction of the lamination and is constituted of a first intake / outlet formation portion for forming the coolant intake and the coolant outlet and a second intake / outlet formation portion, to form a coolant intake passage to communicate with the coolant intake and a coolant outlet passage to communicate with the coolant outlet, to be bonded face-to-face with the first intake / outlet formation portion in the direction of the lamination.

Consequently, according to the present invention, since the intake / outlet portion that is to be connected with the block type expansion valve is constituted of the first intake / outlet formation portion for forming the coolant intake and the coolant outlet to be secured to the outside in the direction of the lamination of the tube element located at one of the outermost ends in the direction of the lamination, and the second intake / outlet formation portion for forming the coolant intake passage to communicate with the coolant intake and the coolant outlet passage to communicate with the coolant outlet, to be bonded face-to-face with the first intake / outlet formation portion in the direction of the lamination, and a temporary assembly of the tube elements, the fins, the first and second intake / outlet formation portions and end plates can be braised in a furnace to achieve an integrated unit, the object described above is achieved.

In addition, according to the present invention the first intake / outlet formation portion may be formed as an integrated part of one of the formed plates constituting the tube element located at one of the outermost

ends in the direction of the lamination, i.e., the form plate located toward the outside in the direction of the lamination, with the second intake / outlet formation portion formed as an integrated part of an end plate provided at one of the outermost end in the direction of the lamination. This achieves a reduction in the number of required parts, and temporary assembly of the intake / outlet portion is facilitated.

Furthermore, according to the present invention, it is desirable that the intake / outlet portion open in a direction perpendicular to the direction of the lamination. This will make it possible to mount the block type expansion valve at a position at one end of the laminated heat exchanger, perpendicular to the direction of the lamination to improve the degree of freedom in layout.

The above and other features of the invention and the concomitant advantages will be better understood and appreciated by persons skilled in the field to which the invention pertains in view of the following description given in conjunction with the accompanying drawings which illustrate preferred embodiments. In the drawings:

FIG. 1A is a front view of the laminated heat exchanger in a first embodiment of the present invention and FIG. 1B is its bottom view;

FIG. 2A is a partial enlargement of the vicinity of the intake / outlet portion in the first embodiment viewed from the outside in the direction of the lamination, and FIG. 2B is a partial enlargement viewed from its side;

FIG. 3A is a front view of the first intake / outlet formation portion in the first embodiment and FIG. 3B is its side elevation;

FIG. 4A is a front view of the second intake / outlet formation portion in the first embodiment and FIG. 4B is its side elevation;

FIG. 5A is a partial enlargement of the vicinity of the intake / outlet portion in a second embodiment viewed from the outside in the direction of the lamination, and FIG. 5B is a partial enlargement viewed from its side;

FIG. 6A is a front view of the first intake / outlet formation portion in the second embodiment and FIG. 6B is its side elevation;

FIG. 7A is a front view of the second intake / outlet formation portion in the second embodiment and FIG. 7B is its side elevation;

FIG. 8A is a partial enlargement of the vicinity of the intake / outlet portion in a third embodiment viewed from the outside in the direction of the lamination, and FIG. 8B is a partial enlargement viewed from

its side;

FIG. 9A is a front view of the first intake / outlet formation portion in the third embodiment and FIG. 9B is its side elevation; and

FIG. 10A is a front view of the second intake / outlet formation portion in the third embodiment and FIG. 10B is its side elevation.

The following is an explanation of the preferred embodiments of the present invention in reference to the drawings.

A laminated heat exchanger 1 illustrated in FIGS. 1A and 1B is constituted by alternately laminating a plurality of tube elements 2 (2A, 2B, 2C, 2D and 2E) with fins 3, with a pair of end plates 4 and 5 provided at two ends in the direction of the lamination and an intake / outlet portion 10 according to the present invention formed at one of the end portions in the direction of the lamination, and brazing a temporary assembly of the tube elements 2, the fins 3 and the intake / outlet portion 10 in a furnace. It is to be noted that reference number 20 indicates a block type expansion valve mounting plate employed for mounting a block type expansion valve (not shown), and it is secured to the opening portions of the intake / outlet portion 10 during the furnace brazing mentioned above or through torch brazing implemented after the furnace brazing. In addition, the block type expansion valve mounting plate 20 is provided with an intake pipe portion 21 that communicates with the outlet side of the block type expansion valve and an outlet pipe portion 22 that communicates with the intake side of the block type expansion valve, with screw holes 23 formed therein for securing the block type expansion valve.

The tube elements 2A among the tube elements 2 are each formed by bonding face-to-face a pair of formed plates, having a pair of tanks 6A and 7A formed at one end in the lengthwise direction each having communicating holes formed at both sides, and a U-shaped passage 8 communicating between the pair of tanks 6A and 7A. The tube element 2B, which is provided at approximately the center in the direction of the lamination, is provided with a tank 6B having a communicating hole formed at only one side in the direction of the lamination, a tank 7B having a communicating hole formed at both sides in the direction of the lamination and a U-shaped passage 8 communicating between the tanks 6B and 7B. The tube elements 2C and 2D which are provided at the two ends in the direction of the lamination, are respectively constituted by bonding flat plates 17 and 18 to formed plates identical to those constituting the tube elements 2A from the outside in the direction of the lamination, and have half the capacity of the other tube elements. The tube element 2E, which is positioned approximately half way between the tube element 2B and the tube element 2D, is provided with a tank 6E having

a communicating hole at both sides in the direction of the lamination and an enlarged portion 9 extending out toward the other tank, and a tank 7E having a communicating hole at both sides in the direction of the lamination and a U-shaped passage 8 communicating between the tanks 6E and 7E.

With this, in the laminated heat exchanger 1, the tanks 6A, 6B and 6E at one side of the tube elements 2 adjacent in the direction of the lamination are made to communicate over specific ranges to constitute two tank groups 31 and 34 that are cut off from each other at the tank 6B, whereas the tanks 7A, 7B and 7C at the other side of the tube elements 2 are made to communicate to constitute two tank groups 32 and 33 that are in communication fluidly. Thus, a coolant flow path which is made to communicate in series with the tank group 31, the U-shaped passage communicating between the tank group 31 and the tank group 32, the tank group 32, the tank group 33 which is made to communicate fluidly with the tank group 32, the U-shaped passage 8 communicating between the tank group 33 and the tank group 34 and the tank group 34, is constituted.

In addition, at the flat plate 17 of the tube element 2C in the tank group 34, a first through hole 41 that communicate with the enlarged portion 9 of the tube element 2E in the tank group 31 and a second through hole 42 which communicates with the tank group 34 are formed as illustrated in FIG. 2A, with the first through hole 41 and the enlarged portion 9 made to communicate through a communicating pipe 15.

The intake /outlet portion is constituted by bonding face-to-face a pair of formed plates, i.e., a first intake /outlet formation portion 10A and a second intake /outlet formation portion 10B, as illustrated in FIGS. 2A and 2B, and is provided with a coolant intake passage 43 which communicates with the first through hole 41 at which the communicating pipe 15 is fitted and a coolant outlet passage 44 that communicates with the second through hole 42, with a coolant intake 45 and a coolant outlet 46 opening perpendicular to the direction of the lamination and an intake pipe 21 and an outlet pipe 22 formed at the block type expansion valve mounting plate 20 inserted at the coolant intake 45 and the coolant outlet 46 respectively and secured through brazing.

As illustrated in FIGS. 3A and 3B, in the first intake /outlet formation portion 10A, an opening portion 51 communicating with the first through hole 41, into which the communicating pipe 15 is fitted and an opening portion 52 that communicates with the second through hole 42 are formed, a first distended portion for coolant intake passage formation 53 which defines one side of the coolant intake passage 43 and a first distended portion for coolant outlet passage formation 54 which defines one side of the coolant outlet passage 44 are formed and a first distended portion for coolant intake formation 55 for forming one side of the coolant intake 45 and a first distended portion for coolant outlet formation 56 for forming one side of the coolant outlet 46 are formed. In

addition, a first brazing margin 57 is formed around these portions.

In the second intake /outlet formation portion 10B illustrated in FIGS. 4A and 4B which is to be bonded face-to-face with the first intake /outlet formation portion 10A, a second brazing margin 67 which is to be brazed to the first brazing margin 57 is provided, a first distended portion for coolant intake passage formation 63 that defines the other side of the coolant intake passage 43 and a first portion for coolant outlet passage formation 64 that defines the other side of the coolant outlet passage 44 are formed and a second distended portion for coolant intake formation 65 for forming the other side of the coolant intake 45 and a second distended portion for coolant outlet formation 66 for forming the other side of the coolant outlet 46 are formed.

The first and second intake /outlet formation portions 10A and 10B constituting the intake /outlet portion 10 are clamped between the tube element 2C located at an end in the direction of the lamination and one of the end plates, i.e., the end plate 4, and are temporarily assembled together with the tube elements 2, the fins 3 and the end plates 4 and 5 before being brazed in a furnace to achieve an integrated unit. With this, since the coolant intake 45 and the coolant outlet 46 at the intake /outlet portion 10 open perpendicular to the direction of the lamination at one end of the laminated heat exchanger in the direction of the lamination, the block type expansion valve can be mounted perpendicular to the direction of the lamination via the block type expansion valve mounting plate 20, thereby making it possible to mount a block type expansion valve in a vehicle in which sufficient space cannot be obtained in the direction of the lamination without having to draw the piping around.

In the second embodiment illustrated in FIGS. 5A and 5B, a first intake /outlet formation portion 10A' is formed as an integrated part of the flat plate 17 and is brazed with a second intake /outlet formation portion 10B' to constitute an intake /outlet portion 10'. In the following description, the same reference numbers are assigned to portions identical to or portions fulfilling the same functions as those in the first embodiment to preclude the necessity for repeated explanation thereof.

In the first intake /outlet formation portion 10A' in the second embodiment, which is illustrated in FIGS. 6A and 6B and is formed as an integrated part of the flat plate 17, an opening portion 51' communicating with the first through hole 41, in which the communicating pipe 15 is fitted and an opening portion 52' that communicates with the second through hole 42 are formed and a first distended portion for coolant intake formation 55' which defines one side of the coolant intake 45 and a first distended portion for coolant outlet formation 56' which defines one side of the coolant outlet 46 are formed.

In the second intake /outlet formation portion 10B', which is illustrated in FIGS. 7A and 7B, a brazing margin 67' to be brazed at a specific position of the flat plate 17

is provided, a distended portion for coolant intake passage formation 63' which, together with the flat surface portion of the flat plate 17, defines the coolant intake passage 43 and a distended portion for coolant outlet passage formation 64' that, together with the flat surface portion of the flat plate 17, defines the coolant outlet passage 44 are formed and a second distended portion for coolant intake formation 65' for forming the other side of the coolant intake 45 and a second distended portion for coolant outlet formation 66' for forming the other side of the coolant outlet 46 are formed.

Thus, while achieving the same advantage as that achieved in the first embodiment, the number of parts is reduced compared to that required in the first embodiment.

In the third embodiment illustrated in FIGS. 8A and 8B, a second intake / outlet formation portion 10B", too, is formed as an integrated part of one of the end plates, i.e., the end plate 4, and an intake / outlet portion 10" is formed by brazing the second intake / outlet formation portion 10B" together with the first intake / outlet formation portion 10A" which is formed as an integrated part of the flat plate 17. In the following description, the same reference numbers are assigned to portions identical to, or portions fulfilling the same function as, those in the first and second embodiments to preclude the necessity for repeated explanation thereof.

In the first intake /outlet formation portion 10A" in the third embodiment illustrated in FIGS. 9A and 9B, which is formed as an integrated part of the flat plate 17, as in the second embodiment explained earlier, an opening portion 51" communicating with the first through hole 41, into which the communicating pipe 15 is fitted and an opening portion 52" that communicates with the second through hole 42 are formed and a first distended portion for coolant intake formation 55" which defines one side of the coolant intake 45 and a first distended portion for coolant outlet formation 56" which defines one side of the coolant outlet 46 are formed.

In the second intake /outlet formation portion 10B", which is illustrated in FIGS. 10A and 10B and is formed as an integrated part of one of the end plates, i.e., the end plate 4, a brazing margin 67" to be brazed at a specific position of the flat plate 17 is provided, a distended portion for coolant intake passage formation 63" which, together with the flat surface portion of the flat plate 17, defines the coolant intake passage 43 and a distended portion for coolant outlet passage formation 64" that, together with the flat surface portion of the flat plate 17, defines the coolant outlet passage 44 are formed and a second distended portion for coolant intake formation 65" for forming the other side of the coolant intake 45 and a second distended portion for coolant outlet formation 66" for forming the other side of the coolant outlet 46 are formed.

Thus, while achieving the same advantage as that achieved in the first and second embodiments, the number of parts can be further reduced compared to that

required in the second embodiment. Moreover, the temporary assembly process is facilitated and the alignment of the positions of the first and second intake /outlet formation portions is facilitated.

As has been explained, according to the present invention, by bonding face-to-face the first and second intake /outlet formation portions to constitute the intake /outlet portion located at one end of the laminated heat exchanger in the direction of the lamination, it becomes possible to mount a block type expansion valve perpendicular to the direction of the lamination. Consequently, a block type expansion valve can be mounted even in a vehicle in which sufficient space cannot be obtained in the direction of the lamination without having to draw the piping around.

In addition, by forming the first intake /outlet formation portion as an integrated part of the flat plate that constitutes the tube element located at an outermost end position and / or forming the second intake /outlet formation portion as an integrated part of an end plate, the number of required parts can be reduced and since this also facilitates the temporary assembly process, the number of work steps is reduced as well.

Claims

1. A laminated heat exchanger comprising:

a plurality of tube elements (2A) each constituted by bonding face-to-face a pair of formed plates and having a pair of tanks (6A, 7A) formed at one end in the lengthwise direction and a U-shaped passage (8) communicating between said pair of tanks (6A, 7A);
a pair of tube elements (2C, 2D) located at two ends in the direction of lamination of said tube elements (2A) each constituted of one of said formed plates and a flat plate (17) which blocks off said formed plate from the outside in said direction of lamination;
fins (3) alternately laminated with said tube elements (2); and
a pair of end plates (4, 5) provided at two ends in said direction of lamination of said tube elements (2) and said fins (3) further provided with;
a plurality of tank groups (31, 32, 33, 34) constituted by causing tanks (6A, 7A) adjacent in said direction of lamination to communicate over specific ranges;
a coolant flow path formed by fluidly connecting in series said tank groups (31, 32, 33, 34) and U-shaped passages (8) corresponding to said tank groups (31, 32, 33, 34);
a first through hole (41) formed at said flat plate (17) and communicating with the upstream side of said coolant flow path; and
a second through hole (42) formed at the lower

end of said flat plate (17) and communicating with the downstream end of said coolant flow path;

characterized in that:

an intake / outlet portion (10) secured at the outside in said direction of lamination of one of said tube element (2C) located at an outermost end in said direction of lamination, having a coolant intake (45) and a coolant outlet (46) both opening in a direction perpendicular to said direction of lamination, a coolant intake passage (43) communicating between said first through hole (41) and said coolant intake (45) and a coolant outlet passage (44) communicating between said second through hole (42) and said coolant outlet (46), is provided.

2. A laminated heat exchanger according to claim 1, characterized in that:

one of the tanks (6B) in a tube element (2B) located at the approximate center in said direction of lamination is provided with a communicating hole only at one side in said direction of lamination to divide a tank group (31, 34) at one side into a tank group (31) located at said upstream side of said coolant flow path and a tank group (34) located at said downstream side of said coolant flow path with a tank groups (32, 33) at another side being in communication throughout, and one tank (6E) located at the approximate center in said tank group (31) at said upstream side of said coolant flow path is provided with an enlarged portion (9) extending out toward the other tank with said first through hole (41) made to communicate with said enlarged portion (9) via a communicating pipe (15) and said second through hole (42) directly opening at a tank located at an end in said direction of lamination in said tank group (34) at said downstream side of said coolant flow path.

3. A laminated heat exchanger according to claim 1, characterized in that:

said intake / outlet portion (10) is clamped between said flat plate (17) and one of said end plate (4).

4. A laminated heat exchanger according to claim 1, characterized in that:

an intake pipe (21) and an outlet pipe (22) formed at a block type expansion valve mounting plate (20) are inserted at said coolant intake (45) and said coolant outlet (46).

5. A laminated heat exchanger according to any of the preceding claims, characterized in that:

said intake / outlet portion (10) is constituted of; a first intake / outlet formation portion (10A) secured to a tube element (2C) at one end in said direction of lamination and having a first distended portion for coolant intake passage formation (53), a first distended portion for coolant outlet passage formation (54), a first distended portion for coolant intake formation (55) and a first distended portion for coolant outlet formation (56); and

a second coolant intake / outlet formation portion (10B) having a second distended portion for coolant intake passage formation (63) to form said coolant intake passage (43), a second distended portion for coolant outlet passage formation (64) to form said coolant outlet passage (44), a second distended portion for coolant intake formation (65) to form said coolant intake (45) and a second distended portion for coolant outlet formation (66) to form said coolant outlet (46) when said second coolant intake / outlet formation portion (10B) is bonded face-to-face with said first intake / outlet formation portion (10A).

7. A laminated heat exchanger according to any of the preceding claims, characterized in that:

said first coolant intake / outlet formation portion 10A' is formed as an integrated part of said flat plate (17).

8. A laminated heat exchanger according to any of the preceding claims, characterized in that:

said second coolant intake / outlet formation portion (10B') is formed as an integrated part of said end plate (4).

FIG. 1 A

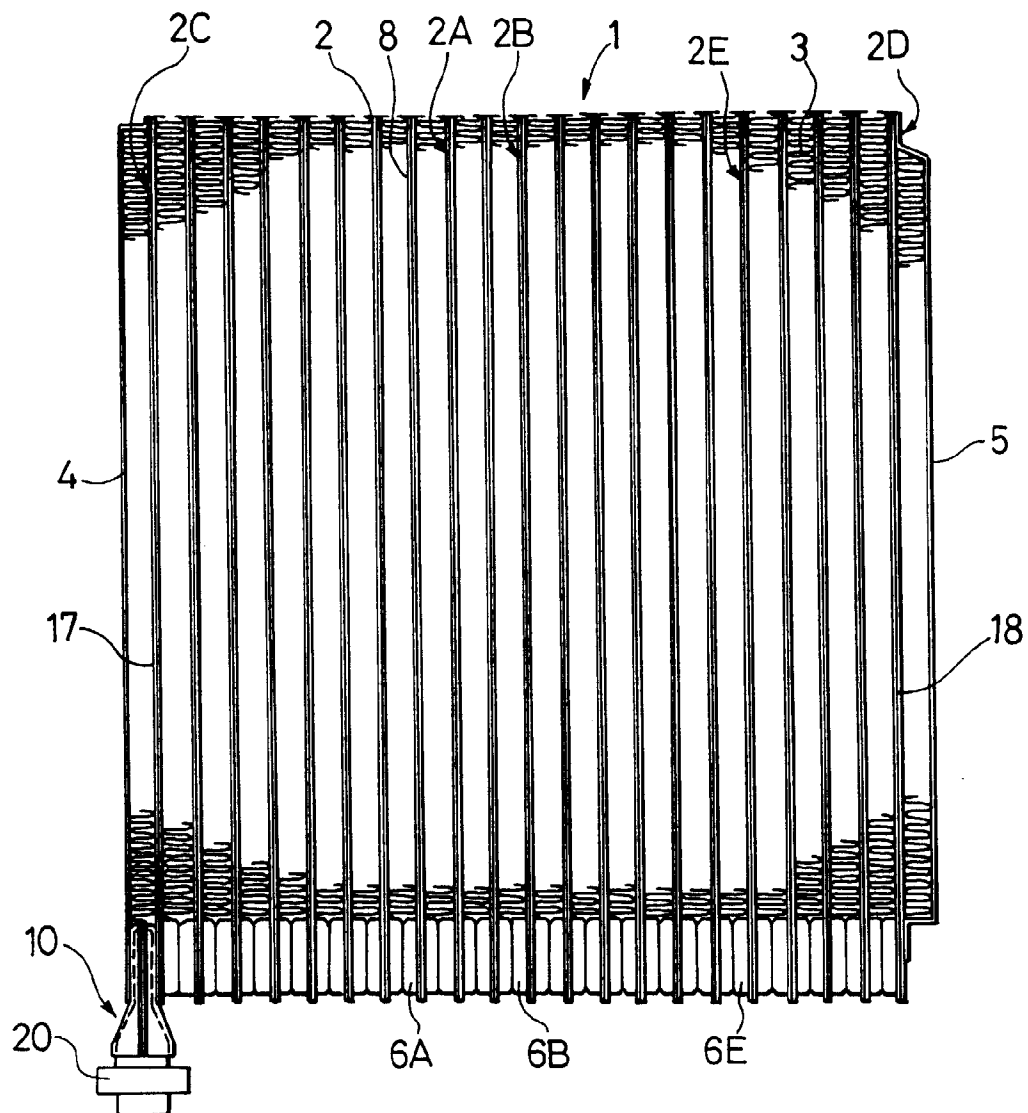


FIG. 1 B

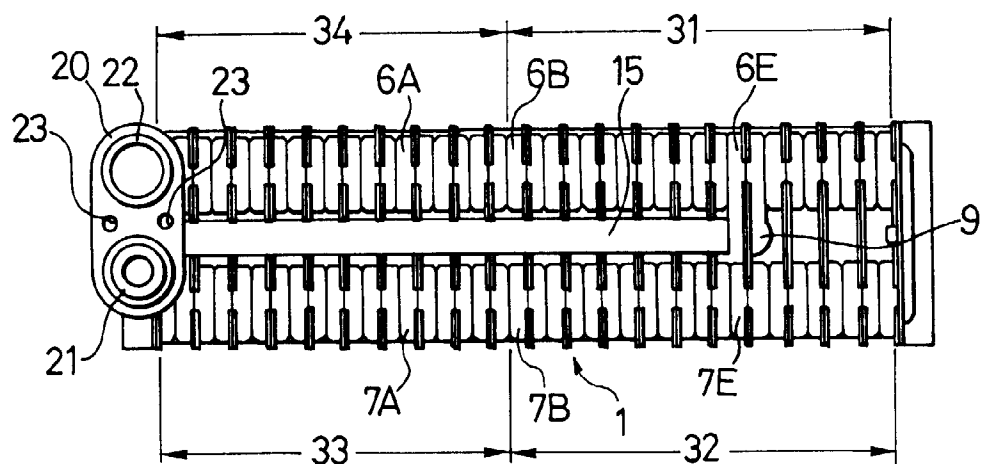


FIG. 2A

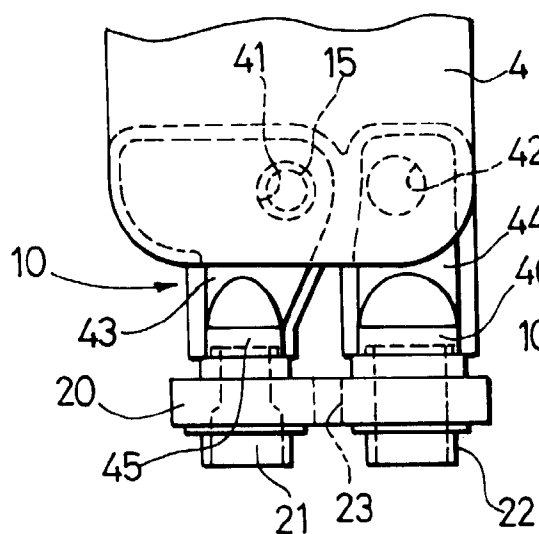


FIG. 2B

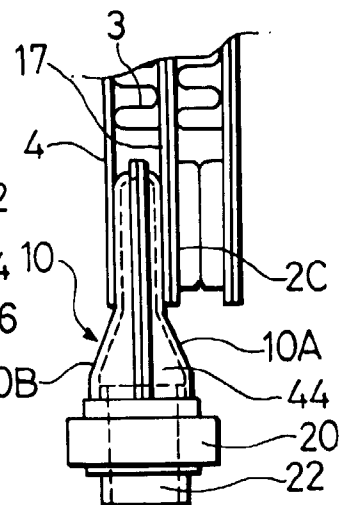


FIG. 3A

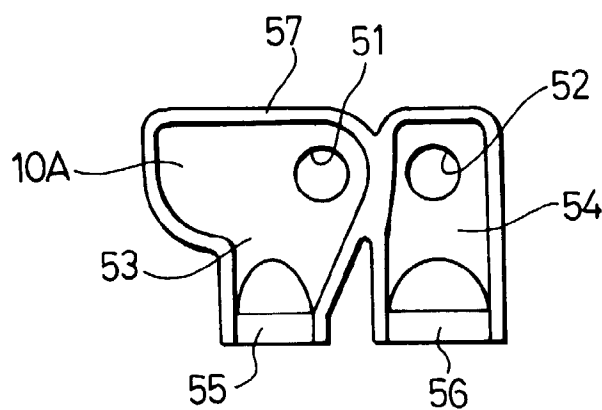


FIG. 3B

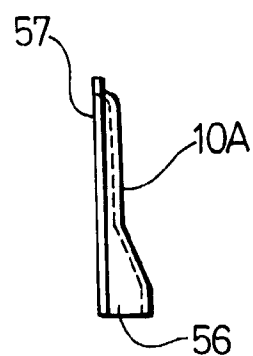


FIG. 4A

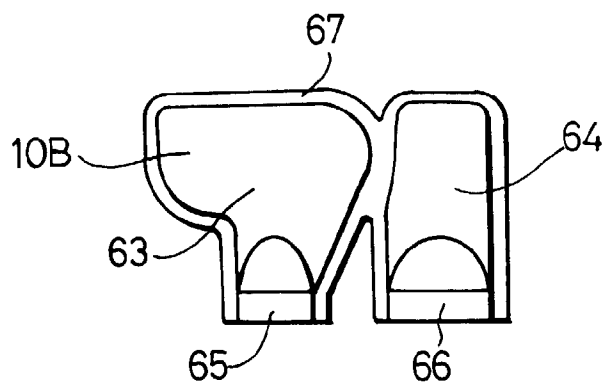


FIG. 4B

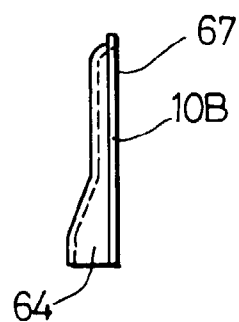


FIG. 5A

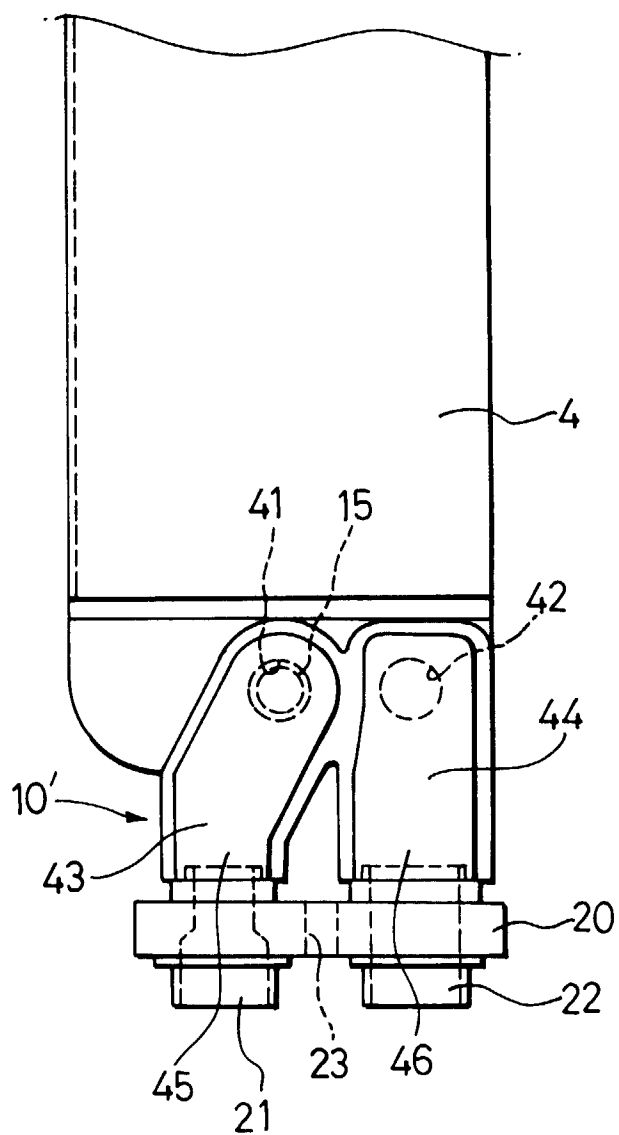


FIG. 5B

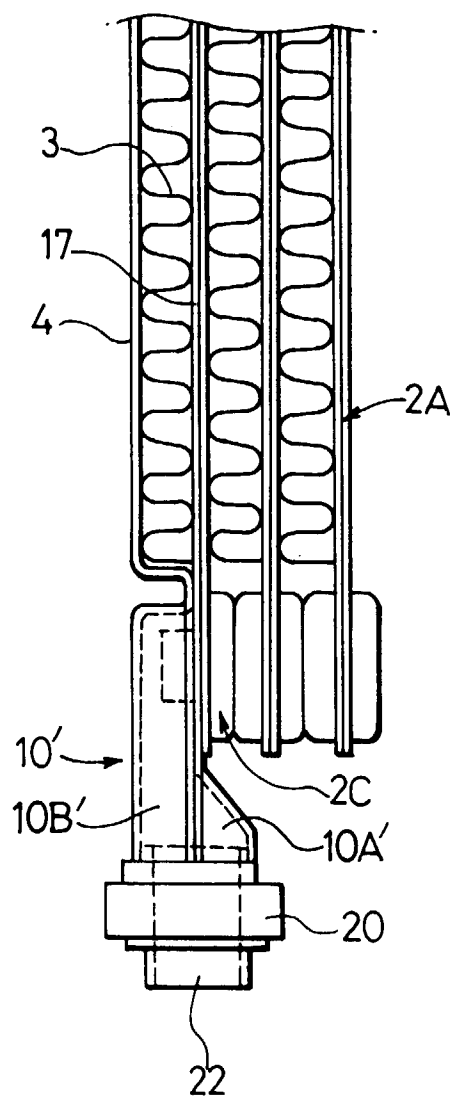


FIG. 6A

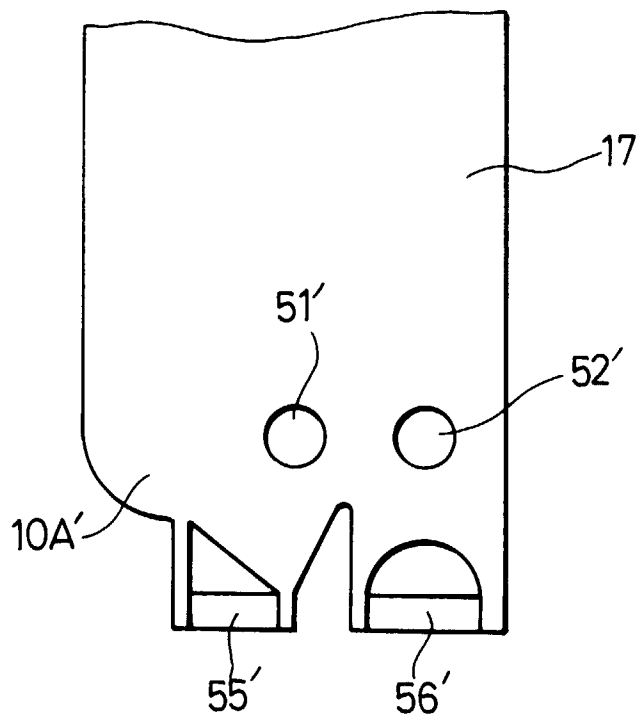


FIG. 6B

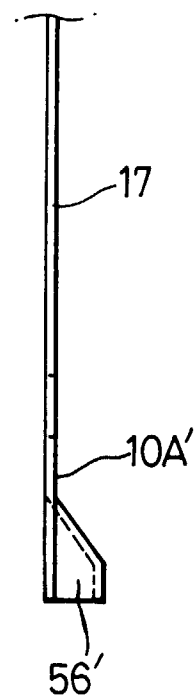


FIG. 7A

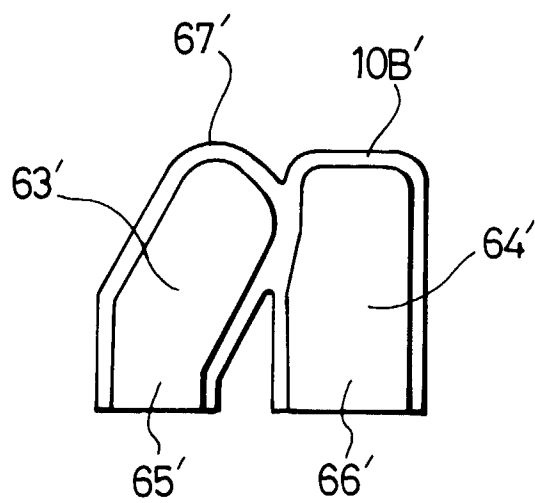


FIG. 7B

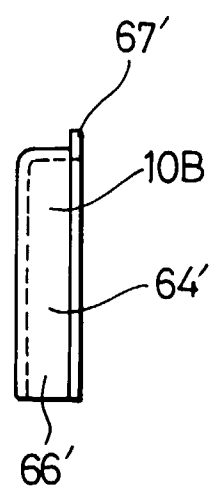


FIG. 8A

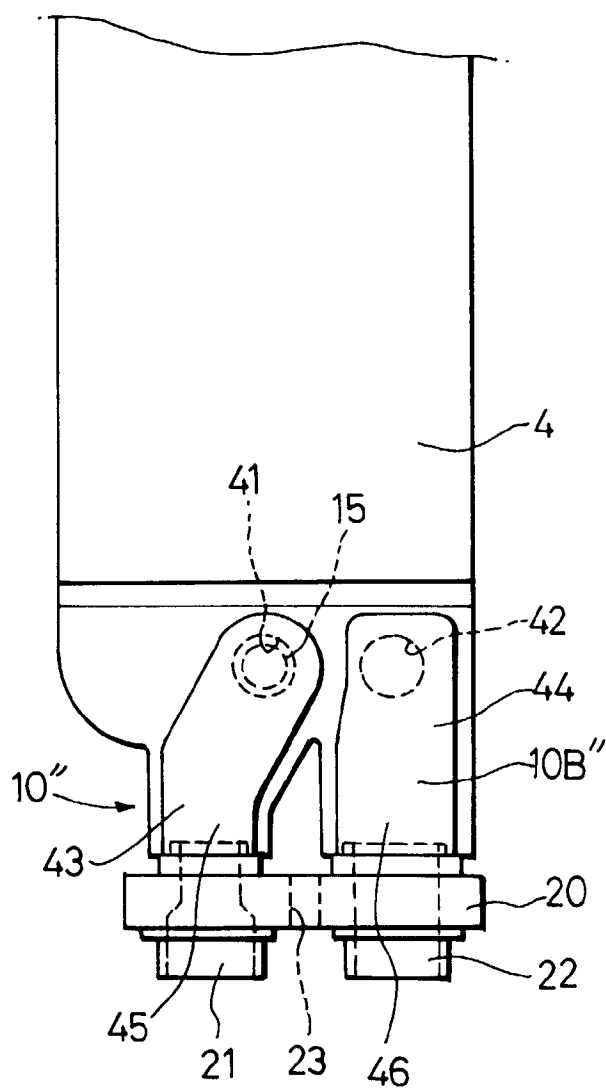


FIG. 8B

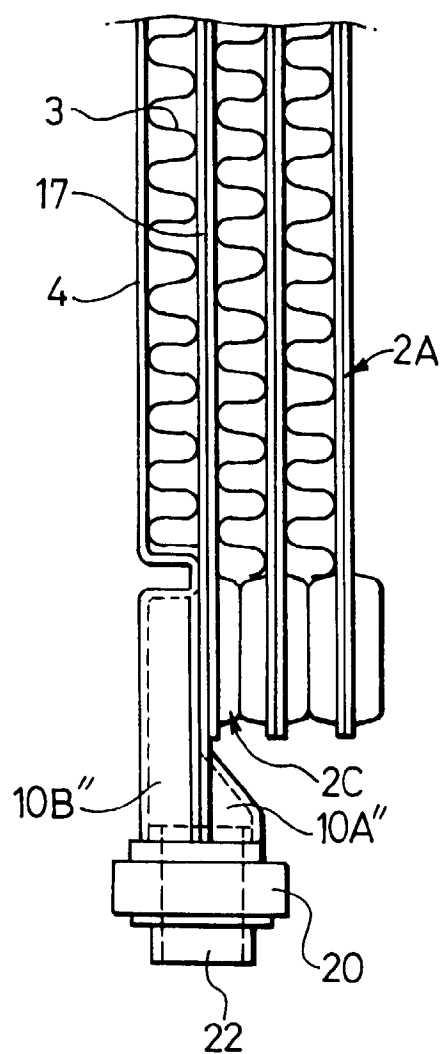


FIG. 9A

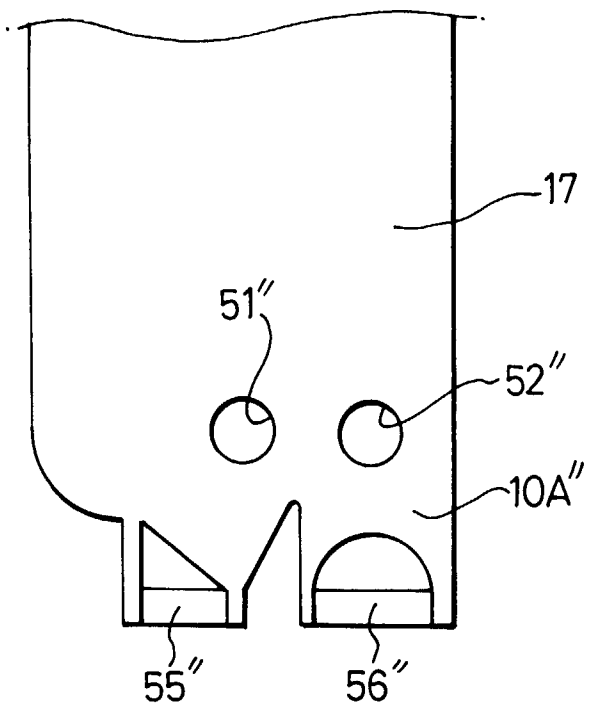


FIG. 9B

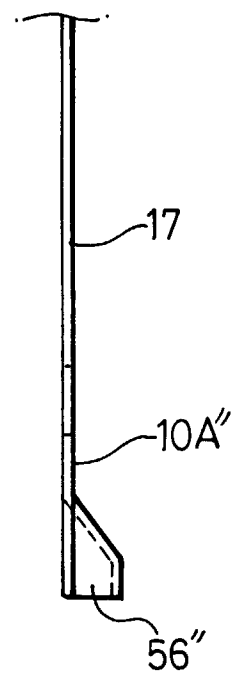


FIG. 10A

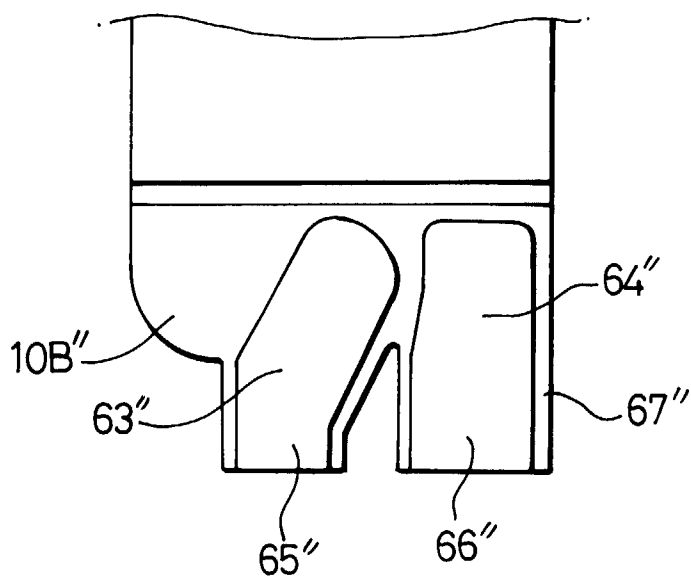


FIG. 10B

