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(72) Inventor: **Ohno, Takayuki**  
**Isesaki-shi**  
**Gunma 372-8502 (JP)**

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

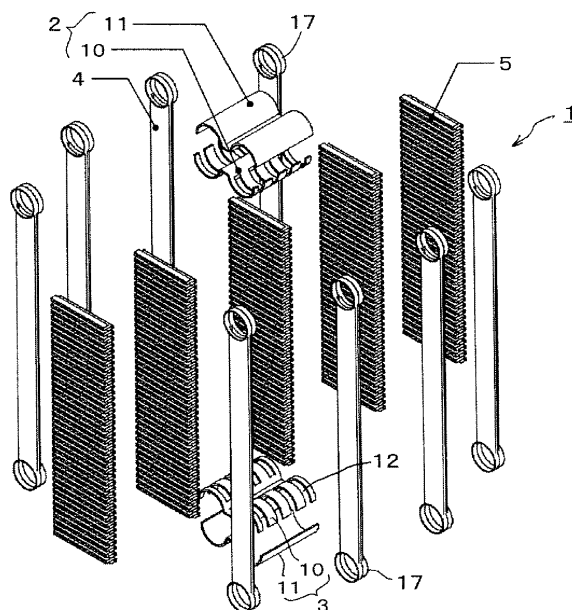
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(71) Applicant: **Sanden Corporation**  
**Isesaki-shi,**  
**Gunma 372-8502 (JP)**

(54) **Heat exchanger**

(57) A heat exchanger (1) includes a header (2, 3) and a plurality of heat exchange tubes (4), the header (2, 3) is formed from a header member A (10) and a header member B (11) formed dividedly from each other and connected to each other, the header member A (10) being formed as a comb-like shape with slits (12) each corresponding to a tube insertion hole and the header member B (11) being abutted to the header member A (10) to complete the whole shape of the header (2, 3), a flange (17) is formed on an end portion of each heat exchange tube (4), and each heat exchange tube (4) is connected to at least the header member A (10) at a condition where the flange (17) extends on both side portions of each slit (12) and the flange (17) is hung from the header member A (10). Assembling can be facilitated, and desirable brazing becomes possible without severe management of dimensions of parts.

**FIG. 2**



## Description

**[0001]** The present invention relates to a heat exchanger, and, more specifically, to a structure of a heat exchanger such as an evaporator used in a refrigeration cycle of an air conditioning system for vehicles, which can be improved in assembling property and which can be manufactured at a high accuracy.

**[0002]** Various heat exchangers are known wherein, for example, a heat exchanger comprises heat exchange tubes (for example, flat tubes) and a header with tube insertion holes into each of which an end portion of each heat exchange tube is inserted (for example, JP-B-7-121451 and JP-A-2003-214794). In the manufacture of such a heat exchanger, for example, the heat exchanger is assembled by inserting respective end portions of a plurality of heat exchange tubes into respective corresponding tube insertion holes provided on a header, as needed by stacking outer fins and tubes alternately, and the whole of the assembled heat exchanger is brazed in a furnace at a time.

**[0003]** However, such a heat exchanger generally has the following problems.

(1) It is necessary to manage dimensions of parts severely.

(i) If the insertion portion on the end portion of the tube is too large as compared with the tube insertion hole of the header, it becomes impossible to assemble the tube to the header, and if too small, a gap between the insertion portion of the tube and the tube insertion hole becomes greater and there is a case where the brazing cannot be carried out properly.

(ii) If a pitch of the tube insertion holes of the header is larger than a design value, there is a fear that the outer fins cannot be brazed, and if smaller than the design value, there is a fear that the outer fins cannot be inserted between tubes.

(2) Because a clearance between a heat exchange tube and a tube insertion hole of a header is formed usually at a small size, frequently it becomes difficult to insert the end portion of the tube into the tube insertion hole.

**[0004]** It would be desirable to provide a structure of a heat exchanger which can be properly brazed without severe management of dimensions of parts and which can be easily assembled before brazing.

**[0005]** A heat exchanger according to the present invention comprises a header and a plurality of heat exchange tubes an end portion of each of which is inserted into each of tube insertion holes formed on the header, and is characterized in that the header is formed from a header member A and a header member B formed dividedly from each other and connected to each other,

the header member A being formed as a comb-like shape so that each of slits of the comb-like shape is defined so as to correspond to each of the tube insertion holes and the header member B being abutted to the header member A to complete substantially the whole shape of the header, a flange is formed on the end portion of each of the heat exchange tubes, and each of the heat exchange tubes is connected to at least the header member A at a condition where the flange extends on both side portions of each of the slits of the header member A and the flange is hung from (engaged to) the header member A.

**[0006]** In the heat exchanger, a structure may be employed wherein the comb-like shape of the header member A is formed so that each of the slits has an opening end which opens toward an outer side of the header member A, each of the heat exchange tubes is inserted into each of the slits from the outer side of the header member A through the opening end, and after insertion, the flange is hung from the header member A at the both side portions of each of the slits.

**[0007]** Further, in the heat exchanger, a structure may be employed wherein the flange is formed as an annular shape, and the flange is connected (brazed) to both the header member A and the header member B.

**[0008]** Further, in the heat exchanger, a structure may be employed wherein a projection fitted into the opening end of each of the slits is provided on the header member B at a position corresponding to each of the slits of the header member A. In such a structure, by fitting between the slit and the projection, the header member A and the header member B are positioned relative to each other more accurately and more easily.

**[0009]** Although the shape of the heat exchange tube is not particularly limited, in order to obtain greater advantage according to the present invention, it is preferred that each of the heat exchange tubes is formed as a flat tube. Further, an inner fin may be provided in each of the heat exchange tubes in order to achieve a more excellent heat exchange performance.

**[0010]** Further, in the heat exchanger, a structure may be employed wherein an outer fin is interposed between each of adjacent heat exchange tubes, namely, an alternately stacking structure of outer fins and heat exchange tubes may be employed.

**[0011]** In such a heat exchanger according to the present invention, it is possible to braze the heat exchanger in a furnace at a time after respective parts are assembled.

**[0012]** Although use of the heat exchanger according to the present invention is not particularly limited, a great advantage according to the present invention can be obtained particularly in a case where the present invention is applied to a heat exchanger manufactured at a condition of mass production for an air conditioning system for vehicles such as an evaporator used in a refrigeration cycle of the air conditioning system for vehicles.

**[0013]** Thus, in the heat exchanger according to the present invention, because the structure is employed

wherein the heat exchange tube with the flange processed at its end portion is hung from the header member A formed as a comb-like shape, assembling of the tubes and the header is extremely facilitated. In particular, because the end portion of the heat exchange tube can be inserted into the slit of the comb-like shape of the header member A from the outer side of the header member A, the insertion working can be greatly facilitated as compared with a conventional working for inserting the tube end portion into a conventional tube insertion hole. Moreover, because a severe dimensional accuracy is not required for a fitting structure between the slit and the tube end portion, management of the dimensions of parts may be facilitated, and at such a condition, a desirable brazing becomes possible.

**[0014]** Further, because the structure is employed wherein the flange is connected (brazed) to the inner surface of the header (the inner surface of the header member A, or, the inner surfaces of both the header member A and the header member B), it becomes possible to enlarge the area for brazing between the tube and the header, and therefore, occurrence of improper brazing may be surely prevented.

**[0015]** Further 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, of which:

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

Fig. 2 is a partial, exploded, perspective view of the heat exchanger depicted in Fig. 1.

Fig. 3 is an enlarged perspective view of a header member A of the heat exchanger depicted in Fig. 2.

Fig. 4 is an enlarged perspective view of a header member B of the heat exchanger depicted in Fig. 2.

Fig. 5 is an enlarged, exploded, perspective view of a heat exchange tube of the heat exchanger depicted in Fig. 2.

Fig. 6A is an enlarged, partial, elevational view of the heat exchange tube depicted in Fig. 5, and Fig. 6B is an enlarged, partial, side view of the heat exchange tube depicted in Fig. 5.

Fig. 7 is an enlarged, partial, perspective view of the heat exchanger depicted in Fig. 1, showing a state at the time of assembling the heat exchanger depicted in Fig. 1.

Fig. 8 is an enlarged, partial, vertical sectional view of the heat exchanger depicted in Fig. 1, showing a state at the time after assembling and brazing of the heat exchanger depicted in Fig. 1.

Fig. 9 is a partial, exploded, perspective view of a heat exchanger according to a second embodiment of the present invention.

**[0016]** Figs. 1 to 8 depict a heat exchanger according

to a first embodiment of the present invention. In Figs. 1 and 2, heat exchanger 1 comprises a pair of headers 2 and 3, a plurality of heat exchange flat tubes 4 an end portion of each of which is inserted into each of tube insertion holes formed on headers 2 and 3, outer fins 5 disposed between adjacent heat exchange tubes 4 and at outer positions of the respective outermost tubes 4 which are stacked alternately with tubes 4, and side plates 6 and 7 disposed at outer positions of the respective outermost outer fins 5. In this embodiment, each of headers 2 and 3 is formed as a twin tank structure, and inlet pipe 8 and outlet pipe 9 for fluid (for example, refrigerant) are provided on the upper-side header 2 depicted in Fig. 1.

**[0017]** Each of headers 2 and 3 is formed from two members divided from each other, also as depicted in Figs. 3 and 4. Namely, the whole shape of each of headers 2 and 3 is completed substantially from a header member A (10) and a header member B (11) connected to each other. Among these members, as shown in Fig. 3, header member A (10) is formed in a form of twin type structure in which two portions each having a semi-circular cross-sectional shape are connected to each other and the header member A (10) is formed as a comb-like shape having slits 12. Each of slits 12 corresponds to each of the tube insertion holes. In this embodiment, because header member A (10) is formed as a twin type structure, in accordance with this structure, the comb-like shape is formed toward each of both sides of header member A(10).

**[0018]** The comb-like shape is formed so that each of slits 12 has an opening end 13 which opens toward an outer side of header member A (10), each of heat exchange tubes 4 is inserted into each of slits 12 from the outer side of header member A (10) through opening end 13, and after insertion, a flange of heat exchange tube 4 is hung from header member A (10) at both side portions of each of slits 12, as described later. In Fig. 3, a dimension C, which is a width of each slit 12 and each opening end 13, is set at a dimension which is slightly larger than the thickness of each heat exchange tube 4 determined at its both outer surfaces. However, it is not necessary to control this dimension so severely.

**[0019]** As shown in Fig. 4, header member B (11) formed in a form of twin type structure in which two portions each having a semi-circular cross-sectional shape are connected to each other, and this header member B (11) does not have slits. The whole shape of each of headers 2 and 3 is completed by connecting header member A (10) and header member B (11) to each other, namely, by connecting header member A (10) and header member B (11) to each other so that each semi-circular cross-sectional portion of header member A (10) and each semi-circular cross-sectional portion of header member B (11) are abutted to each other to form a circular cross-sectional shape.

**[0020]** Each heat exchange tube 4 is formed in this embodiment, as depicted in Fig. 5. A pair of tube plates

14a and 14b are stacked and connected to each other so as to form a flow path 15 therein extending in the longitudinal direction of the tube, and a wave-type inner fin 16 is inserted into flow path 15. A flange 17 is formed on each longitudinal end portion of heat exchange tube 4 integrally with heat exchange tube 4, also as shown in Figs. 6A and 6B. Flange 17 is formed so that, when heat exchange tube 4 is inserted into slit 12 of header member A (10) from outer side of header member A (10), the flange 17 can extend on both side portions of slit 12 and the flange 17 can be hung from header member A (10). In this embodiment, this flange 17 is formed as a structure in which respective flange forming portions 17a and 17b formed on the end portions of respective tube plates 14a and 14b are connected to each other. Further, as shown in Fig. 6B, a dimension D of flange 17 in its thickness direction is set larger than a thickness E of a tube portion of heat exchange tube 4. Therefore, after heat exchange tube 4 is inserted into slit 12 at a portion having the thickness E, flange 17 is surely hung at both side portions of slit 12.

[0021] Further, in this embodiment, flange 17 is formed as an annular shape in its cross section. In such an annular flange 17, as depicted in Figs. 7 and 8, when header member B (11) is abutted to header member A (10) after flange 17 is inserted into slit 12 of header member A (10), the flange 17 is brought into contact with both of inner surfaces of header member A (10) and header member B (11). Since flange 17 is brazed to the inner surface of the header in such a condition, a connected portion 18 between flange 17 and the inner surface of the header is formed so as to extend over the entire circumference of the inner surface of the header. The respective parts assembled as shown in Fig. 8 are brazed in a furnace at a time.

[0022] In the heat exchanger 1 thus constructed, since each heat exchange tube 4 with flange 17 at its longitudinal end portion is inserted into slit 12 of the comb-like shape of header member A (10) from the outer side of header member A (10) and the inserted heat exchange tube 4 is hung from header member A (10) at both side portions of slit 12 via the engagement of flange 17 with the inner surface of header member A (10), even if the dimension of slit 12 and the thickness of heat exchange tube 4 are not controlled and managed so severely, heat exchange tube 4 can be inserted surely and easily. Further, because the contact area with header member A (10), or the contact area with header member A (10) and header member B (11), is ensured to be great by flange 17, an improper brazing between the tube and the header can be surely prevented. Namely, the management of dimensions of parts can be facilitated, the assembling can be facilitated, and the brazing property can be improved.

[0023] Fig. 9 depicts a connecting portion between a header and a heat exchange tube of a heat exchanger according to a second embodiment of the present invention. In this embodiment, a projection 22 fitted into each

opening end 13 of each slit 12 is formed on header member B (21) integrally with header member B (21) at each position corresponding to each slit 12 of header member A (10). By fitting each projection 22 into each opening end 13 of each corresponding slit 12, header member B (21) can be surely and easily set at a desirable position relative to header member A (10). The other structures are substantially the same as those in the first embodiment aforementioned.

[0024] The present invention can be applied to any heat exchanger, and particularly it is suitable as a heat exchanger used in an air conditioning system for vehicles, which is manufactured at a condition of mass production, and for which an easy and proper brazing is required, such as an evaporator for refrigerant.

## Claims

1. A heat exchanger comprising a header and a plurality of heat exchange tubes an end portion of each of which is inserted into each of tube insertion holes formed on said header, **characterized in that** said header is formed from a header member A and a header member B formed dividedly from each other and connected to each other, said header member A being formed as a comb-like shape so that each of slits of said comb-like shape is defined so as to correspond to each of said tube insertion holes and said header member B being abutted to said header member A to complete substantially the whole shape of said header, a flange is formed on said end portion of each of said heat exchange tubes, and each of said heat exchange tubes is connected to at least said header member A at a condition where said flange extends on both side portions of each of said slits of said header member A and said flange is hung from said header member A.
2. The heat exchanger according to claim 1, wherein said comb-like shape of said header member A is formed so that each of said slits has an opening end which opens toward an outer side of said header member A, each of said heat exchange tubes is inserted into each of said slits from said outer side of said header member A through said opening end, and after insertion, said flange is hung from said header member A at said both side portions of each of said slits.
3. The heat exchanger according to claim 1 or 2, wherein said flange is formed as an annular shape, and said flange is connected to both said header member A and said header member B.
4. The heat exchanger according to any preceding claim, wherein a projection fitted into said opening end of each of said slits is provided on said header

member B at a position corresponding to each of said slits of said header member A.

5. The heat exchanger according to any preceding claim, wherein each of said heat exchange tubes is formed as a flat tube. 5
6. The heat exchanger according to any preceding claim, wherein an outer fin is interposed between adjacent heat exchange tubes. 10
7. The heat exchanger according to any preceding claim, wherein said heat exchanger is brazed in a furnace at a time after respective parts are assembled. 15
8. The heat exchanger according to any preceding claim, wherein said heat exchanger is a heat exchanger used in an air conditioning system for vehicles. 20

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FIG. 1

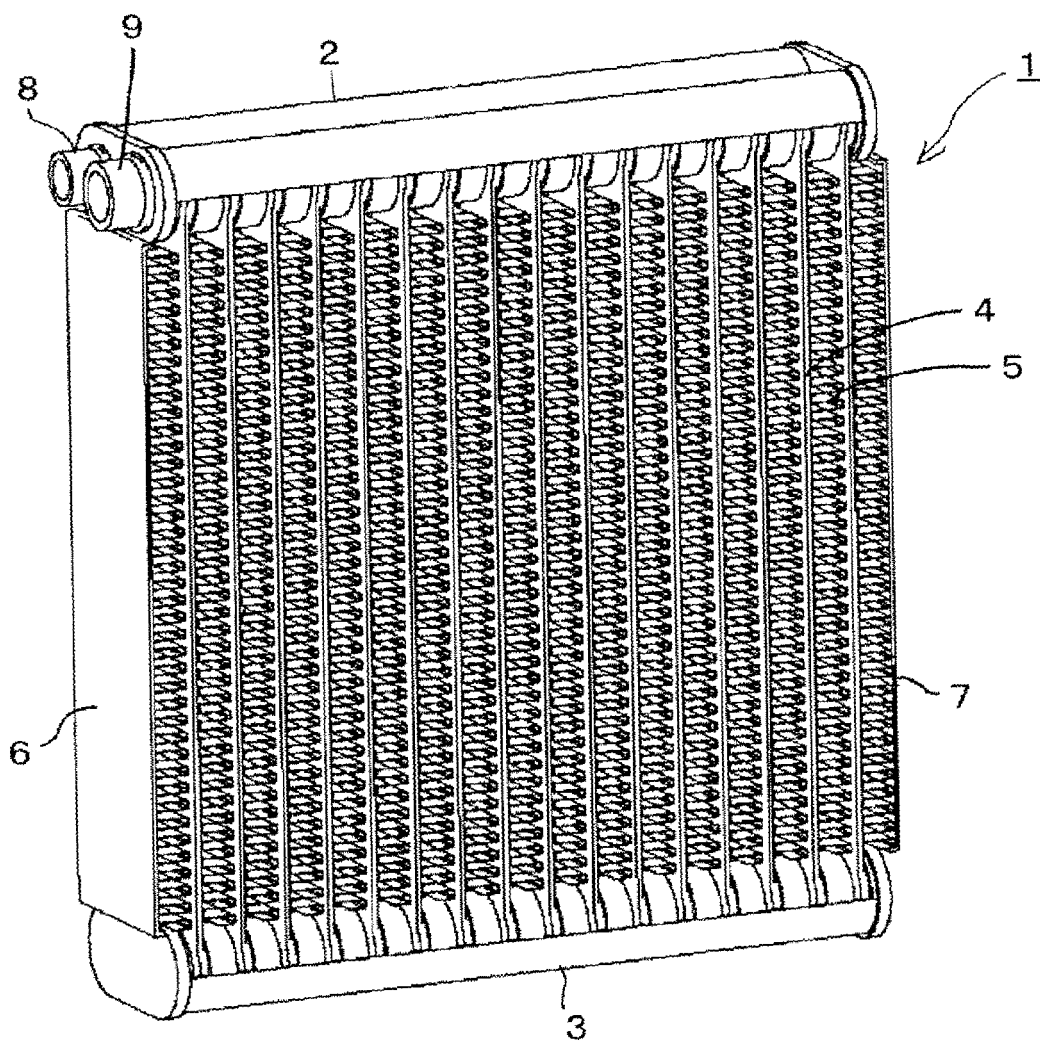
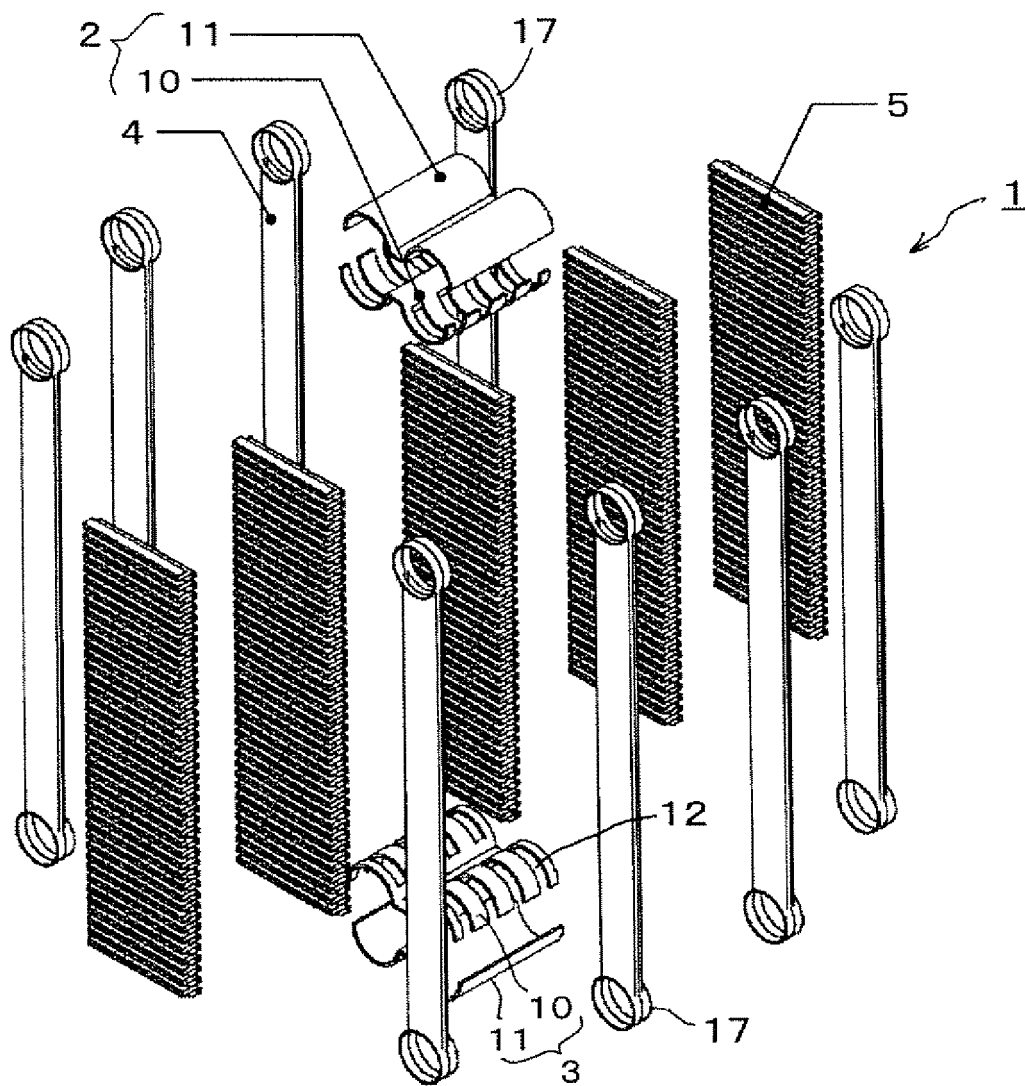
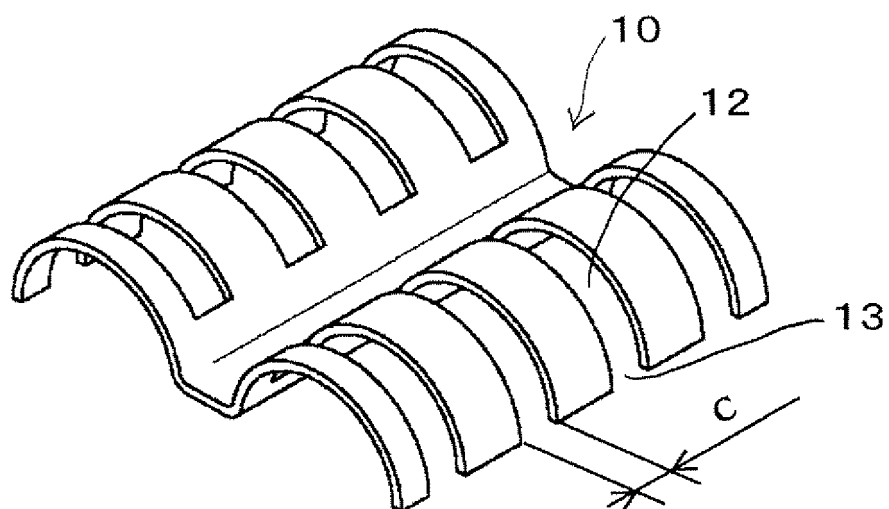


FIG. 2



**FIG. 3**



**FIG. 4**

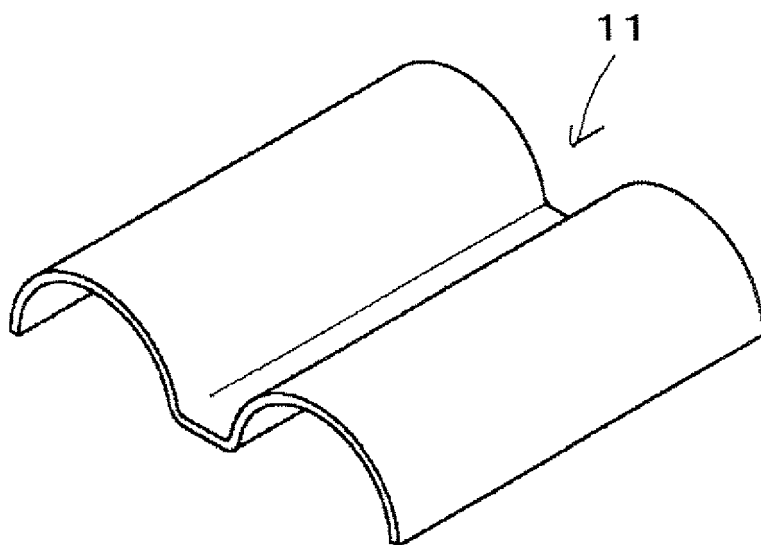




FIG. 5

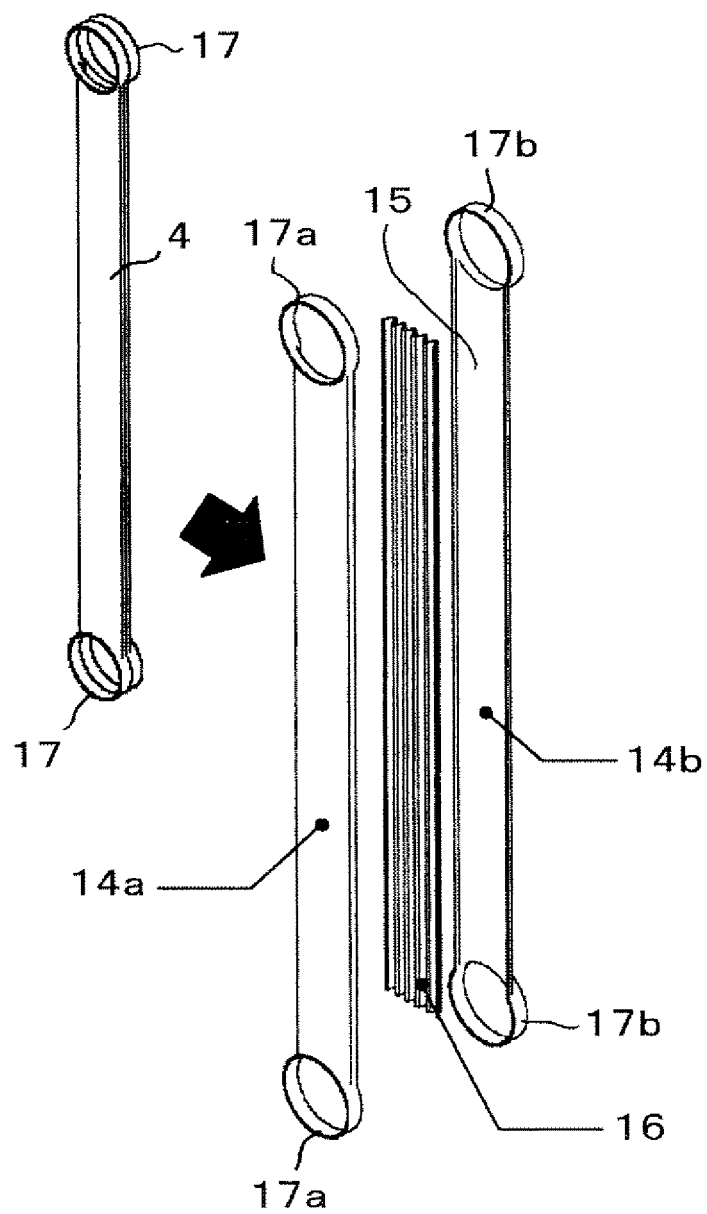


FIG. 6A

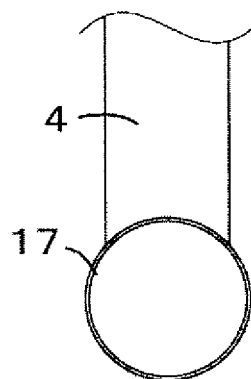


FIG. 6B

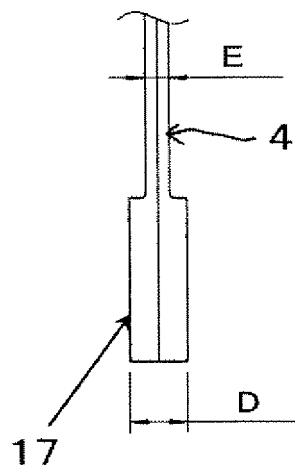


FIG. 7

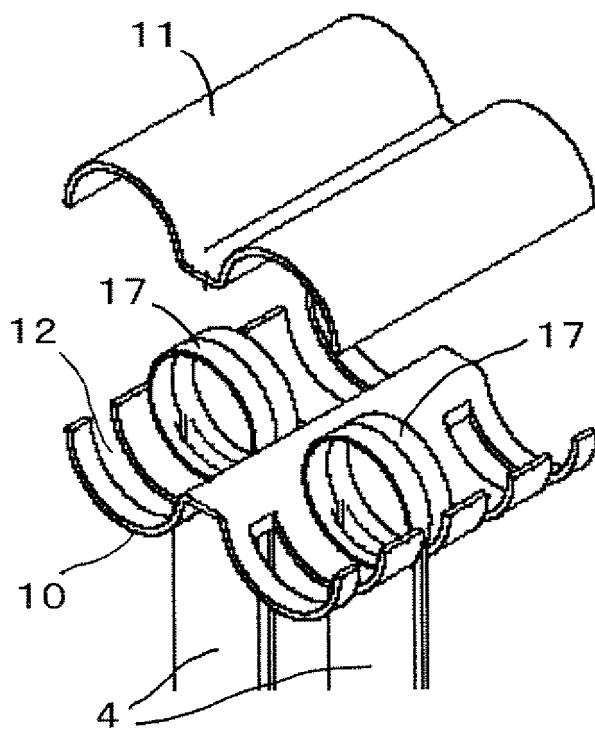


FIG. 8

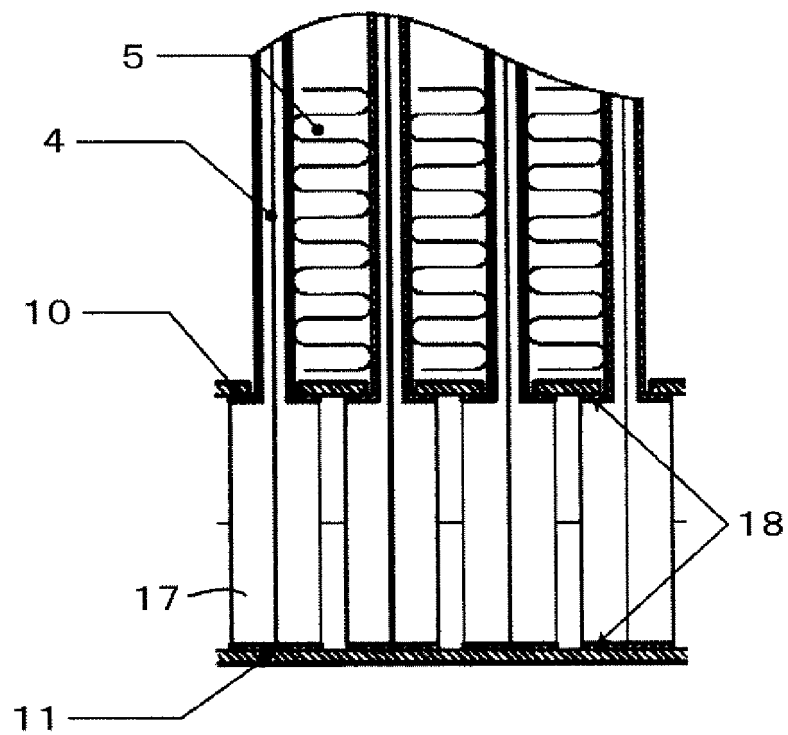
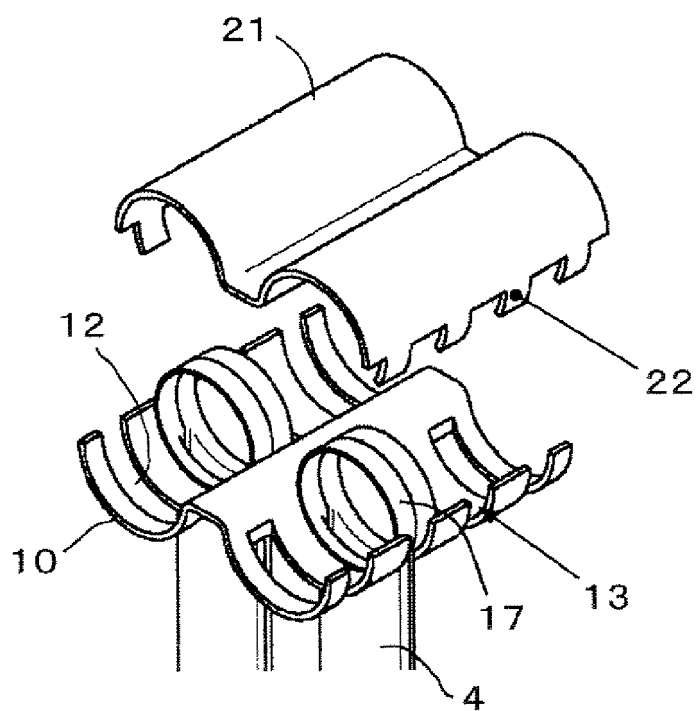


FIG. 9



**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

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