

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 822 381 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

04.02.1998 Bulletin 1998/06(51) Int Cl.⁶: **F28D 1/03**(21) Application number: **97305236.8**(22) Date of filing: **15.07.1997**

(84) Designated Contracting States:

AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE

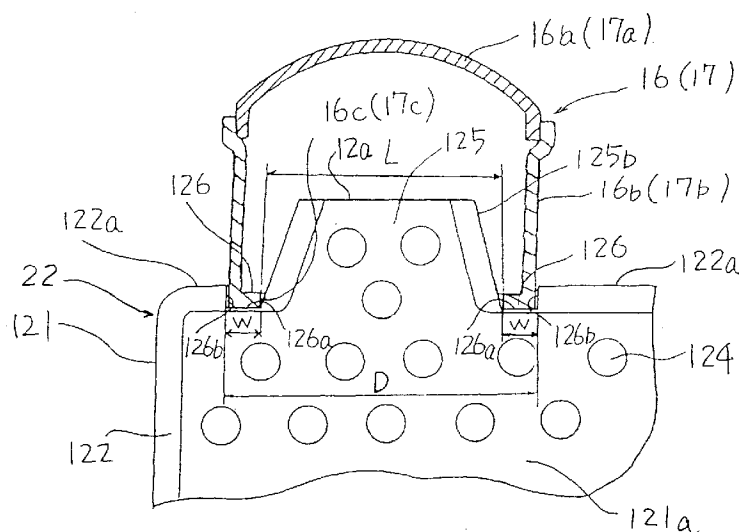
Designated Extension States:

AL LT LV RO SI(30) Priority: **31.07.1996 JP 217983/96**(71) Applicant: **SANDEN CORPORATION****Iseaki-shi Gunma, 372 (JP)**(72) Inventor: **Shinmura, Toshiharu****Iseaki-shi, Gunma 372 (JP)**(74) Representative: **Jackson, Peter Arthur****GILL JENNINGS & EVERY****Broadgate House****7 Eldon Street****London EC2M 7LH (GB)**(54) **Heat exchanger**

(57) A heat exchanger (10) comprises at least one conduit (16,17) which has a plurality of slots (16C,17C) therein. A plurality of tube units (12,22) each has at least one open end (12A,22A) thereof. The open end (12A, 22A) of each the tube units (12,22) is fixedly and hermetically coupled to the slots (16C,17C) of at least one conduit (16,17). The tube units (12,22) in fluid communication with the interior of the conduit (16,17) through the open end (12A,22A) of each tube unit (12,22). A lim-

iting mechanism (126,226) is provided adjacent to the open end (12A,22A) of the tube units (12,22) for limiting the conduit (16,17) to have a predetermined position without inclining related to the tube units (12,22).

Thereby, the heat exchanger (10) could be temporarily assembled without any relative sliding motion between the plurality of tubes and tanks while simultaneously non-decreasing the efficiency of manufacturing costs of the heat exchanger.

FIG.7**EP 0 822 381 A2**

Description

The invention relates to a heat exchanger, and more particularly, to an evaporator for an automotive air conditioning refrigeration circuit.

Heat exchanger for use in an automotive air conditioning refrigerant circuits are well known in the art. For example, U.S. Patent No. 5,314,013 issued to Shinmura, Unexamined Japanese Patent publication No. SHO-48-49054 and Unexamined Japanese patent publication No. HEI-4-177094 are incorporated herein references.

Figure 1 discloses an overall construction of a heat exchanger, such as a drain-cup type heat exchanger 10. Heat exchanger 10 is generally used in an automotive air conditioning system. Heat exchanger 10 includes a plurality of tubes unit 12 of aluminum or aluminum alloy functioning as the heat medium conducting elements, which forms a heat exchanger area of heat exchanger 10 together with corrugated fins 13. Each of tube unit 12 includes a pair of tray-shaped plate 121 having a clad construction where brazing metal sheet is formed on a core metal.

Heat exchanger 10 further includes a pair of parallel closed generally first and second tanks 16 and 17 situated above the upper surface of tube units 12. First tank 16 is positioned in front of second tank 17. One end of inlet pipe 18 is fixedly and hermetically connected to first tank 16, for example, by a separate brazing process. Inlet pipe 18 is provided with a conventional union joint (not shown) at the other end thereof. Similarly, one end of outlet pipe 19 is fixedly and hermetically connected to first tank 16 in the same manner as inlet pipe 18. Outlet pipe 19 is similarly provided with a conventional union joint (not shown) at the other end thereof. Partition plate 20 is fixedly disposed at an intermediate location within the interior region of first tank 16 so as to divide the interior region of first tank 16 into a right side section and a left side.

The heat exchanger area 100 of heat exchanger 10 is formed by laminating together a plurality of tubes unit 12 and inserting corrugated fins 13 within the intervening space between the adjacent tube unit 12. A pair of side plate 14 and 15 are attached to the right and left sides of tube unit 12 of heat exchanger 10 such that corrugated fins 13 disposed between side plate 14 and 15 and laminated tube unit 12, respectively. Respective tube units 12, corrugated fins 13 and side plate 14 and 15 are fixedly attached to one another by any conventional manner, such as brazing, for example.

With referring to Figure 2, each of tray-shaped plates 121 includes shallow depression 121a defined therein, a flange 122 formed around the periphery thereof, and a narrow wall 123 formed in the center region thereof. Narrow wall 123 extends downwardly from an upper end of plate 121 and terminates approximately one-fifth of the length of plate 121 away from the lower end thereof. A plurality of cylindrical projections 124

projects from the inner bottom surface of shallow depression 121a. Projection 124 are uniformly located around the inner bottom surface of shallow depression 121a of plate 121, and are arranged to diagonally aligned with one another. Thus, cylindrical projection 124 are utilized in order to reinforce the mechanical strength of plate 121.

Each of tray-shaped plates 121 further includes a pair of connecting tongues 125 projecting upwardly from upper end portion 122a thereof. Tongue 125 includes taper 125b formed at both sides thereof in order to be smoothly inserted into slots 16c and 17c of first and second tanks 16 and 17.

One of tongues 125 is disposed on the right of narrow wall 123, and other tongue 125 is disposed the left thereof. A depression 125a is formed in the center of tongues 125, and longitudinally extends from the upper end to the lower end thereof, and is linked to shallow depression 121a of plate 121. The bottom surface of depression 125a is formed even with the plate of this bottom surface of shallow depression 121a. A plurality of diagonally arranged cylindrical projection 124 also project from the inner bottom surface of depression 125a to reinforce the mechanism strength of tongues 125.

The flat top surface of narrow wall 123, the flat top end surface of each of tongues 125, and the plane surface of circular flat top end portion 124a of projection 124 are preferably substantially even with the plate surface of flange 121. Therefore, when the part of tray-shaped plates 121 are joined, the pair of tongues 125 form a pair of cylindrical hollow connecting portions 12a, U-shaped passage U is defined therebetween, narrow walls 123 of each plate 121 contacts with one another. Flange 121, narrow walls 123 and projections 124 are fixedly attached to each other at their mating surfaces, for example, brazing.

Referring to Figure 3 and 4, tanks 16 and 17 includes upper tank members 16a and 17a and lower tank members 16b and 17b coupled each other, respectively. A plurality of generally oval-shaped slots 16c and 17c are formed along the flat bottom surface of tanks 16 and 17 at equal intervals. Generally, oval shaped slots 16c of first tank 16 are aligned with oval-shaped slot 17c of second tank 17 so as to receive an open end 12a formed by a pair of cylindrical tongues 125. Each of open end 12a is inserted into slots 16c or 17c of tanks 16 or 17 until the side surface of taper 125b formed at an outer surface of an upper region of flange 121 is contacted with an edge portions of slots 16c or 17c of tanks 16 or 17. Open ends 12a are fixedly attached to slots 16c or 17c of tanks 16 or 17 by brazing, respectively.

After, the temporally jointed tube unit 12 is prepared, the temporally jointed tube unit 12, corrugated fin 13, tanks 16 and 17, side plate 14 and 15 and partition plate 20 are all temporally assembled with one another at the same time.

Finally, having temporally assembled heat ex-

changer 10, the entire exterior surface of heat exchanger 10 is spray coated with flux dissolved in water. After this, assembled heat exchanger 10 is transported from an assembly line top furnace in which a brazing process is carried out.

In this arrangement, these parts of the heat exchanger facilitate to be disengaged or to have non-standard configuration because of the relative sliding of parts when the brazing process is complete in the furnace. Then, it should be noted that in pre-assembly, it is important to maintain desirable relative configuration of the parts of the heat exchanger in order to prevent defects of brazing in the assembly process.

Various techniques have been used in the prior art to resolve the problem, in particular, it is known to use a fastening tool which is temporally attached to the temporally assembled condenser so as to firmly fasten the parts each other. The fastening tool is detached from the heat exchanger after completion of the brazing process. However, the steps of attaching the fastening tool to the temporarily assembled heat exchanger and detaching the fastening tool from the brazed heat exchanger after completion of the brazing process complicates the manufacturing process of the heat exchanger.

Hence, the efficiency of manufacturing the heat exchanger is decreased. Furthermore, the provision of the fastening tool increases the manufacturing costs of the heat exchanger.

Furthermore, tapered portion 125b of tongue 125 is naturally formed as tapered shape in order to be smoothly inserted into slots 16c and 17c of tanks 16 and 17. Thereby, if tapered portion 125b and slots 16c or 17c had undesirable designed size after production process, the insertion of tongue 125 terminate before slots 16c or 17c of tank 16 or 17 dose not reach the root of tongue 125. Therefore, the tapered shape of tongue 125 facilitates to fluctuate the insert margin created between tongue 125 and tanks 16 and 17 or to cause undesirable relative inclination between tube unit 12 and tanks 16 and 17.

One attempt to these problems is disclosed in Unexamined Japanese Patent publication No.SHO-63-19890. This invention discloses the stopper which limits the margin created between end of tube and interior surface of tank when the tube is inserted into the tank. However, the invention dose not resolve the above problem since it dose not have a function of maintaining desirable relative configuration between the tube and the tank.

These and other problems with prior art air conditioning systems are sought to be addressed by the following preferred embodiments.

It is an object of the present invention to provide a simply manufactured heat exchanger having a proper configuration and completely hermetic connections between a plurality of tubes and tanks.

It is another object of the present invention to pro-

vide a heat exchanger which can be temporally assembled without any relative sliding motion between the plurality of tubes and tanks while simultaneously non-decreasing the efficiency of manufacturing costs.

According to the present invention, a heat exchanger comprises at least one conduit which has a plurality of slots therein. A plurality of tube units each has at least one open end thereof. The open end of each the tube units is fixedly and hermetically coupled to the slots of at least one conduit. The tube units in fluid communication with the interior of the conduit through the open end of each tube. A limiting device is provided adjacent to the open end of the units for limiting the conduit to have a predetermined position without inclining related to the tube units.

In the accompanying drawings:-

Figure 1 is a perspective view of a heat exchanger, such as an evaporator, in accordance with a prior art.

Figure 2 is an enlarged plane view of a tube unit of the heat exchanger in shown in Figure 1.

Figure 3 is an expanded perspective view of the heat exchanger in Figure 2

Figure 4 is an enlarged cross-sectional view of tank member in accordance with the prior art.

Figure 5 is an enlarged plane view of a tube unit of the heat exchanger in accordance with a first embodiment of a present invention.

Figure 6 is an expanded perspective view of the heat exchanger in accordance with a first embodiment of a present invention.

Figure 7 is an enlarged cross-sectional view of tank member in accordance with the first embodiment of a present invention.

Figure 8 is a schematic view illustrating a refrigerant flow in the heat exchanger in accordance with the first embodiment of a present invention.

Figure 9 is an enlarged cross-sectional view of tank member in accordance with a second embodiment of a present invention.

Figure 10 is an enlarged cross-sectional view of a flat tube in accordance with the second embodiment of a present invention.

Referring to Figure 5 and 6 depicts a tube unit of drain-cup type heat exchanger used for an evaporator of an automotive air conditioning refrigerant circuit in accordance with a first embodiment of the present invention. In the drawings, like reference numerals are used to denote elements corresponding to these shown in Figure 1-4, so that a further explanations thereof is omitted.

Referring to Figure 7, tray-shaped plate 121 includes a pair of cut-out portions 126 formed in upper end portion 122a and at the root of both sides of tongue 125. Each of cut-out portion 126 forms a quadrilateral shape which has downwardly a depth H along taper 125b of tongue 125, and has horizontally a width W. Where each of slits 16c and 17c of lower tank member 16b and 17b has length L, and each of lower tank mem-

bers 16b and 17b has width D themselves. Width W of cut-out 126 is designed such that the following inequality is realized.

$$(D - L)/2 < w$$

Namely, open end 12a of tube unit 12 is inserted into slits 16c or 17c of tank 16 or 17 such that the bottom wall of lower tank member 16b or 17b engages to cut-out portion 126.

Thus, the preferred manufacturing process of evaporator 10 of the embodiment is described in detail below with Figure 2.

First, tray-shaped plate 121 is formed from a rectangular aluminum or aluminum alloy sheet(not shown) by, for example, press work by simultaneously forming the shallow depression 121a, flange 122, narrow wall 123 and the pair of connecting tongues 125.

Secondly, a plurality of projection portions 124 are formed at the heat exchanger includes a plurality of adjacent, essentially flat tubes bottom surface of shallow depression 121a of plate 121 by punching.

Finally, flange 121, narrow walls 123 and projections 124 of tray-shaped plates 121 are fixedly attached to each other at their mating surfaces, for example, by brazing. Thereby, a pair of tray shaped plates 121 collectively forms tube unit 12 as same as the prior art.

Referring to Figure 8, during operation of the automotive air conditioning refrigerant circuit, the refrigerant flows from a condenser (not shown) of the refrigerant circuit via a throttling device, such as expansion valve, through inlet pipe 16 into right side section of the interior of first tank 16. The refrigerant flowing into right side section of the interior region of first tank 16 concurrently flows through the interior of tongues 125 and into the upper right of U-shaped passage U in each of tube unit 12. The refrigerant in the upper right region of U-shaped passage U then flows downwardly to the lower right region of U-shaped passage U in a complex flow path, which includes diagonal and straight flow paths as shown by the solid arrows in Figure 5, while exchanging heat with the air passing along corrugated fin 13 in the direction as indicated by arrow "A". The refrigerant located in the lower right region of U-shaped passage U is turned at the terminal end of narrow wall 123 and directed from the right to the left side of U-shaped passage U, as shown by the solid arrows in Figure 5. That is, the refrigerant flows from the front to the rear of U-shaped passage U, then flows upwardly to the upper left region of U-shaped passage U in a complex flow path while further exchanging heat with the air passing along corrugated fin 13, and then finally flows out of U-shaped passage U in each of tube units 12 through tongues 125. The refrigerant flowing out of U-shaped passage U from each of tube units 12 combines in the interior region of second tank 17 and flows therethrough in a direction from the right side to the left side thereof.

The refrigerant flowing through the interior of the left side of second tank concurrently flows into the upper left region of U-shaped passage U in each of tube units 12 through tongues 125. The refrigerant then flows downwardly to the lower left region of U-shaped passage U in a complex flow path and exchanges heat with the air passing along corrugated fins 13. The refrigerant located in the lower left region of U-shaped passage U is turned at the terminal end of narrow wall 123 and directed from the left side to the right side of U-shaped passage U. That is, the refrigerant flows from the rear to the front of U-shaped passage U, then flows upwardly to the upper right region of U-shaped passage U in complex flow path while further exchanging heat with the air passing along corrugated fins 13, and finally flows out of U-shaped passage U from each of tube units 12 through tongue 125. The refrigerant flowing from U-shaped passage U in each of tube units 12 combines in the left side section of the interior region of first tank 16. The gaseous phase refrigerant located in the left side section of the interior region of first tank 16 flows thorough outlet pipe 19 to the suction chamber of a compressor (not shown) in the refrigerant circuit.

In this arrangement, when open end 12a of tube unit 12 is inserted into slots 16c or 17c of tanks 16 or 17 such that the bottom surface of lower tank member 16b or 17b is contacted with bottom portion 126a of cut-out portion 126, a pair of cut-out portions 126 functions to prevent tank 16 or 17 from inclining relative to tube unit 12 according as taper 125b of tongue 125 and side wall 126b of cut-out portion 126 supports the peripheral portion of slots 16c and 17c of tanks 16 and 17 and the outer surface of lower tank member 16b. Further, the insertion margin of which open end 12a of tube unit 12 protrude from inner surface of tank 16 or 17 is limited by amount of depth H of cut-out portion 126.

Therefore, the arrangement could exactly maintain desirable relative configuration between tube unit 12 and tanks 16 or 17 in pre-assembly.

Accordingly, when the brazing process of heat exchanger is completed, the possibility of the brazed heat exchanger having a nonstandard configuration is substantially reduced.

Figure 9 and 10 illustrates a second embodiment of the present invention. In the second embodiment, the heat exchanger includes a plurality of adjacent, essentially flat tube 22 which has a cross-sectional oval body 221, a pair of flange portion 222 integrally extending from both sides of oval body 221 and open ends 22a vertically formed on both ends thereof. Open end 22a of tube 22 is formed so as to vertically protrude from flange portion 222 of flat tube 22.

Further, flat tube 22 includes cut-out portion 226 formed on flange portion 222 so as to extend toward the center thereof along oval body 221. Cut-out portion 226 has its depth or width as same as the first embodiment.

Thus, open end 22a of flat tube 22 allows a refrigerant fluid to flow therethrough. A plurality of flat tubes

22 are fixedly connected to tank 16 or 17, may be connected to header pipe(not shown), and have a plurality of fluid path 225 formed by a plurality of partitions 224. Flat tube 22 is preferably made of an aluminum or aluminum alloy through an extrusion molding process.

In the pre-assembly of the heat exchanger, each flat tubes 22 is inserted into the interior of tank 16 or 17 through each slot 16c or 17c. The insertion of flat tube 22 is terminated when the bottom surface of tank 16 or 17 is contacted with bottom portion of cut-out portion 226 of flat tube 22. The bottom surface of tanks 16 or 17 engages cut-out portion 226 of tubes 22.

Thereby, a pair of cut-out portions 226 functions to prevent tank 16 or 17 from inclining relative to flat tubes 22 according as three inner wall of cut-out portion 226 supports the peripheral portion of slots 16c and 17c of tanks 16 and 17 and the outer surface of lower tank member 16b or 17b.

Substantially, the same advantages are realized in the first and second embodiments, so details of the advantages are not repeated.

Claims

1. A heat exchanger (10) comprising;

at least one conduit (16, 17) having a plurality of slots (16c, 17c) therein;

a plurality of tube units (12, 22) each having at least one open end (12a, 22a) thereof, said open end (12a, 22a) of each said tube units (12, 22) fixedly and hermetically coupled to said slots (16c, 17c) of at least one said conduit (16, 17), said tube units (12, 22) in fluid communication with an interior of said conduit (16, 17) through said open end (12a, 22a) of each said tube (12, 22) ;

characterized in that limiting means (126, 226) is provided adjacent to said open end (12a, 22a) of said tube units (12, 22) for limiting said conduit (16, 17) to have a predetermined position without inclining related to said tube units (12, 22).

2. The heat exchanger recited in claim 1, wherein said limiting means (126, 226) further limits insertion margin which said tube units (12, 22) has during inserting into an interior of said conduit.

3. The heat exchanger recited in claim 1, wherein said limiting means (126, 226) is a pair of cut-out portions (126, 226) formed on a peripheral of said tube units (12, 22) .

4. The heat exchanger recited in claim 1, wherein said conduit (16,17) further comprises a cover member (16a, 17a) and a seat member(16b, 17b) connected

to each other to form a tank, and said seat member (16b, 17b) including a bottom wall, a plurality of equal interval slots (16c, 17c) formed on said bottom wall and a side wall perpendicularly extending from both ends of said bottom wall.

5. The heat exchanger recited in claim 4, wherein a pair of said cut-out portion (126, 226) engages edges of said slot and side walls of said seat member of said conduit (16, 17).

6. The heat exchanger recited in claim 1, wherein said open ends (12a, 22a) of said tube units (12, 22) are brazed to said conduit (16, 17).

7. The heat exchanger recited in claim 1, wherein said heat exchanger (10) further includes a plurality of fin members (13) disposed between adjacent said tube units (12, 22) .

8. The heat exchanger recited in claim 1, wherein said heat exchanger (10) includes a pair of conduit (16, 17) interconnected by a plurality of said tube units (12, 22) .

9. The heat exchanger recited in claim 1, wherein said tube units (12, 22) is laminated tubes having a main body (221) , a pair of flange portion (222) integrally extending from both sides of said main body (221) and open ends (22a) formed on both ends of said mainbody.

10. A heat exchanger comprising:

a plurality of said tube units (12) each having a pair of plates (121) joined together to define therebetween a fluid passageway and at least one generally tubular opening (12a) projecting upward from a top surface of said plates (121) and linked in fluid communication with said fluid passageway;

at least one conduit (16, 17) disposed on an upper surface of said a plurality of tube units (12), at least one said conduit (16, 17) including a cover member (16a, 17a) and a seat member (16b, 17b) connected to each other to form a tank, and said seat member (16b, 17b) including a bottom wall, a plurality of equal interval slots (16c, 17c) formed on said bottom wall and a pair of side walls perpendicularly extending from both ends of said bottom wall;

characterized in that a pair of cut-out portions (126) respectively are formed at both root sides of said tongue (125) of said plate (121) so as to limit said header pipe (16, 17) having a predetermined position without inclining related to said tube units (12, 22) by engaging edges of said slot and said

side walls of said seat member of said conduit.

11. The heat exchanger recited in claim 10, wherein each of said plates (121) further includes a shallow depression (121a) defined therein, a flange (122) extending about the periphery therefor, and a wall (123) disposed at an intermediate location therein and extending a majority of the length of said plate (121), said wall (123) thereby defining a left side and right side of said plate (121). 5 10
12. The heat exchanger recited in claim 10, wherein each of said plate (121) includes a plurality of projections (124) extending from a bottom surface of said depression (121a). 15
13. The heat exchanger recited in claim 10, wherein said plate (121) is made of an aluminum or aluminum alloy. 20
14. A heat exchanger comprising:

a first and second header pipes (16, 17) including a plurality of openings (16c, 17c);
a plurality of tubes (22) each having including an main body (221), a pair of flange portions (222) extending from a peripheral surface of said main body (221) and opposite open ends (22a) thereof, said tubes (22) in fluid communication with an interior of said header pipes (16, 17) through said open ends (22a) so that said opposite open ends (22a) of said tubes (22) is disposed through said opening (16c, 17c) of said header pipe (16, 17) and fixedly and hermetically coupled to said header pipes (16, 17); 25 30 35

characterized in that a pair of cut-out portions (226) respectively are formed on a pair of said flange portion (222) so as to limit said header pipe (16, 17) having a predetermined position without inclining related to said tube units (22) by engaging an edge of said slot (16c, 17c) and a side wall of said seat member (16b, 17b) of said header pipe (16, 17). 40 45
15. The heat exchanger recited in claim 14, wherein a plurality of said tubes (22) includes a plurality of partitions (224) integrally formed in said main body (221) and a plurality of passages (225) defined by said a plurality of said partitions (224). 50
16. The heat exchanger recited in claim 14, wherein said tube (22) is made of an aluminum or aluminum alloy. 55

FIG. 1
(Prior Art)

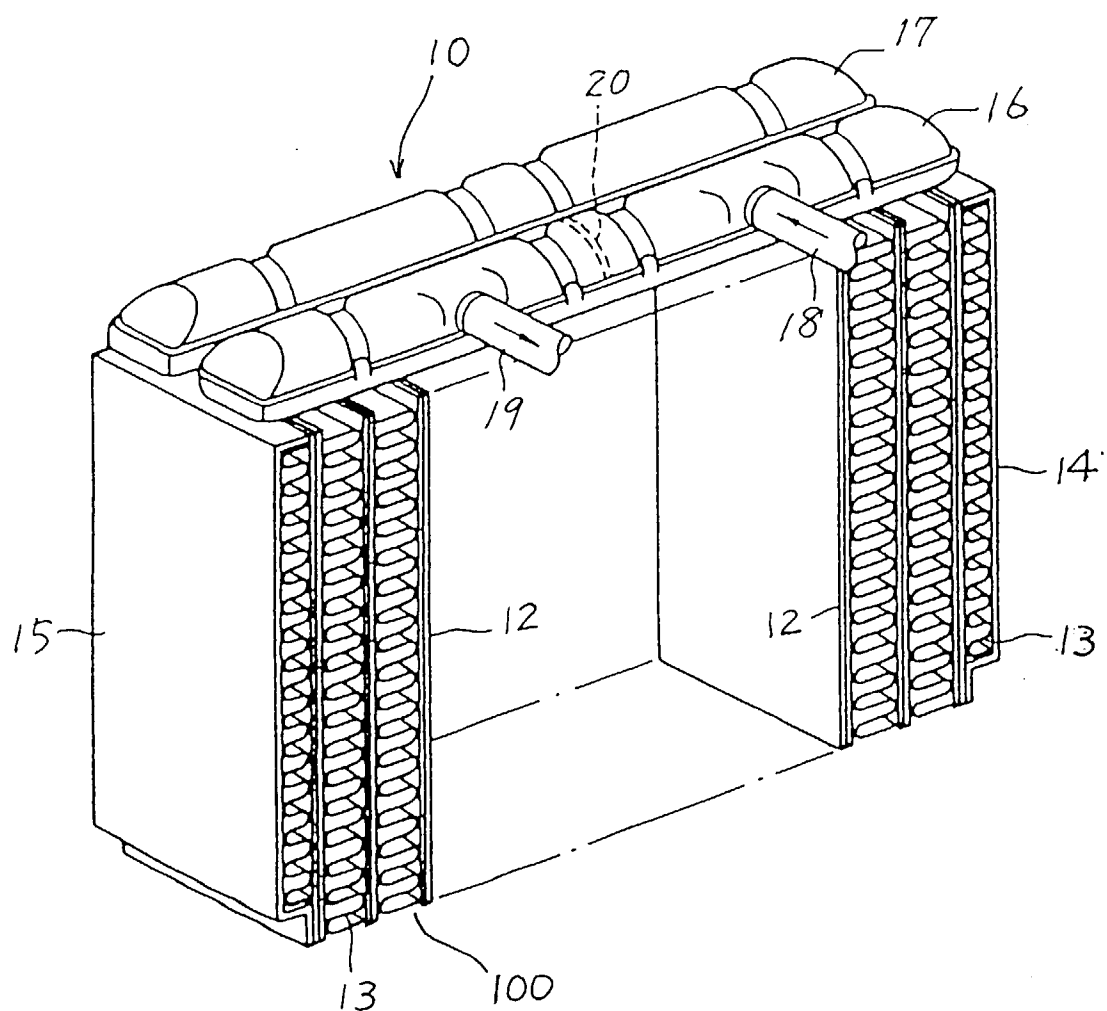


FIG. 2
(Prior Art)

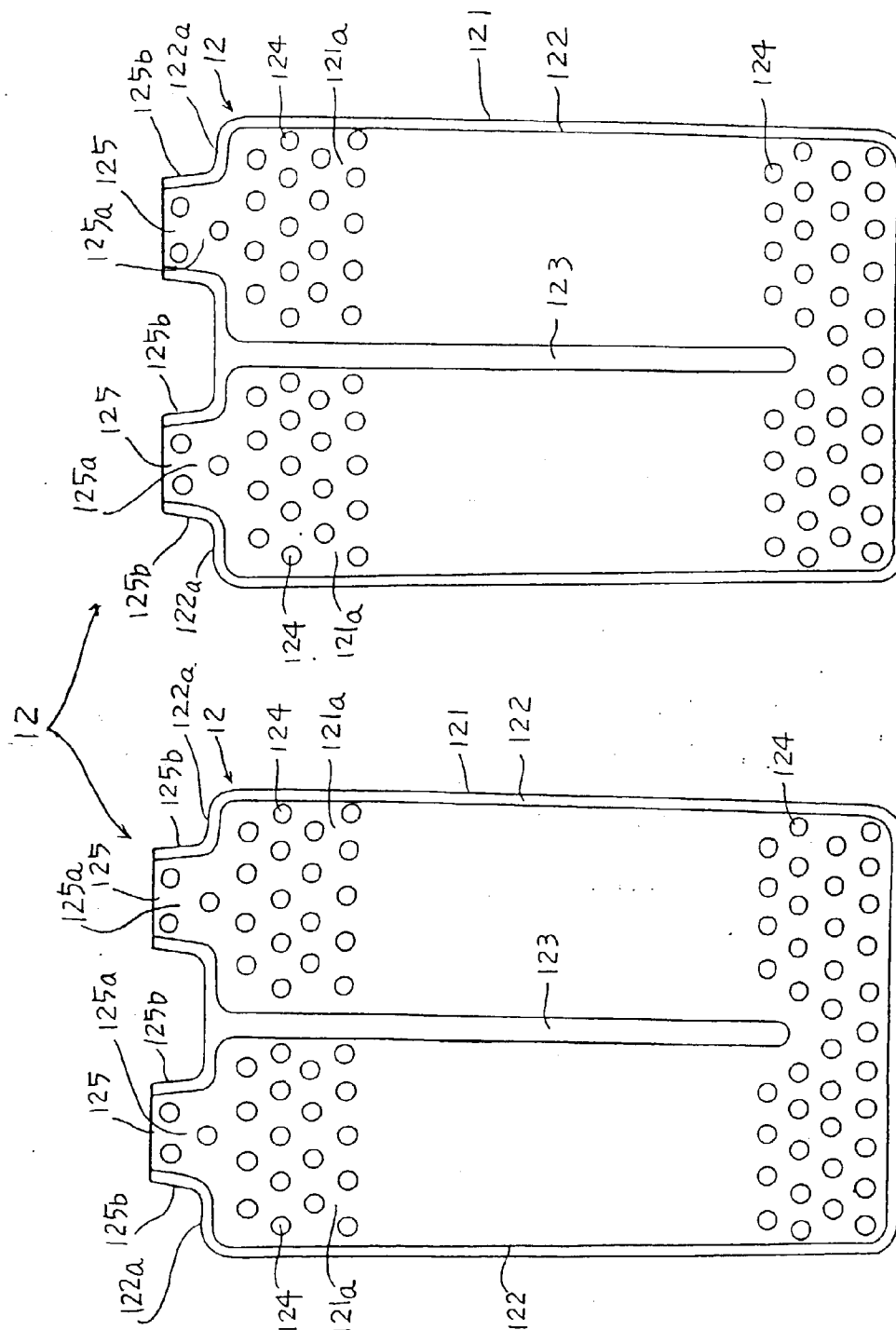


FIG. 3
(Prior Art)

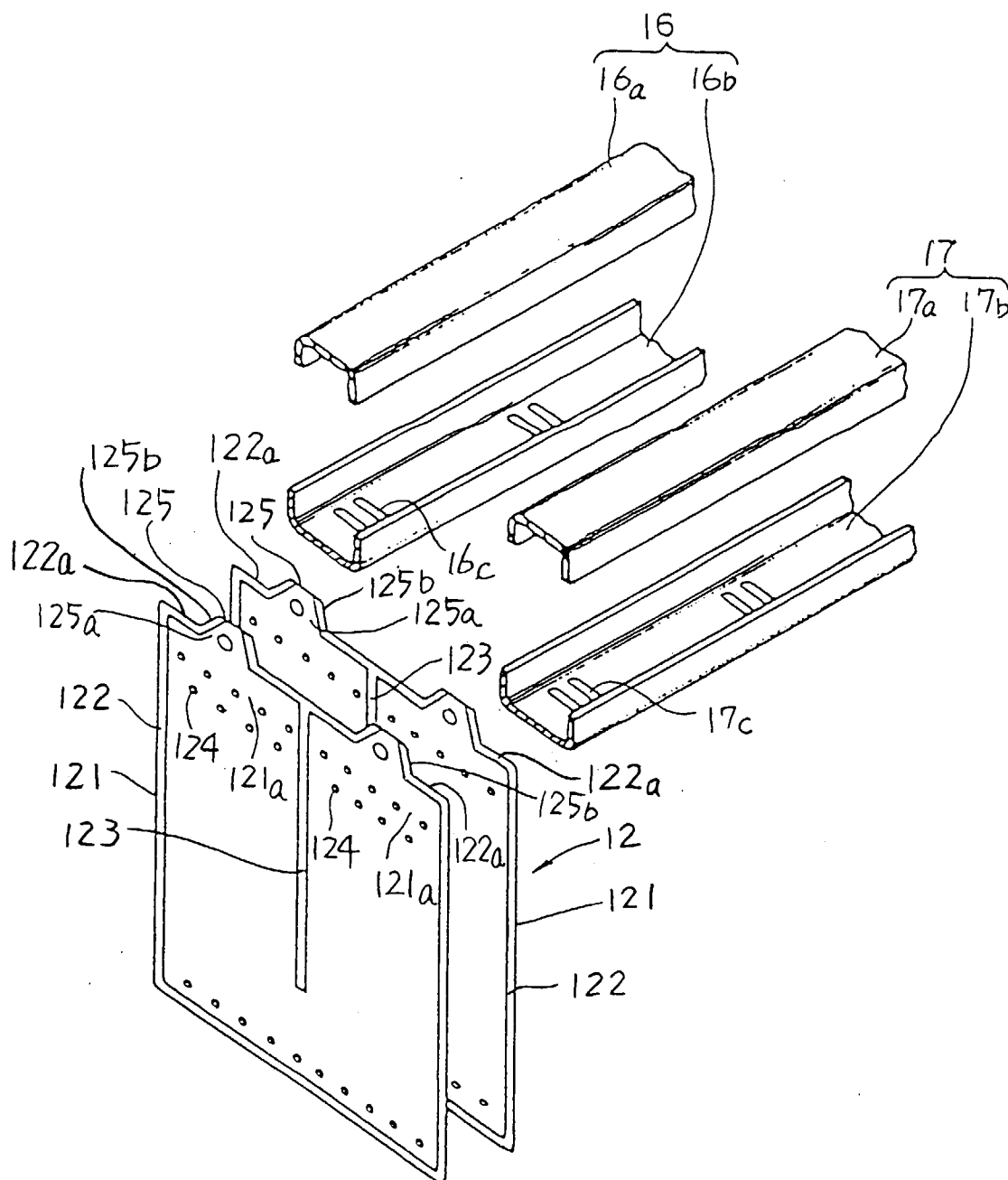


FIG. 4
(Prior Art)

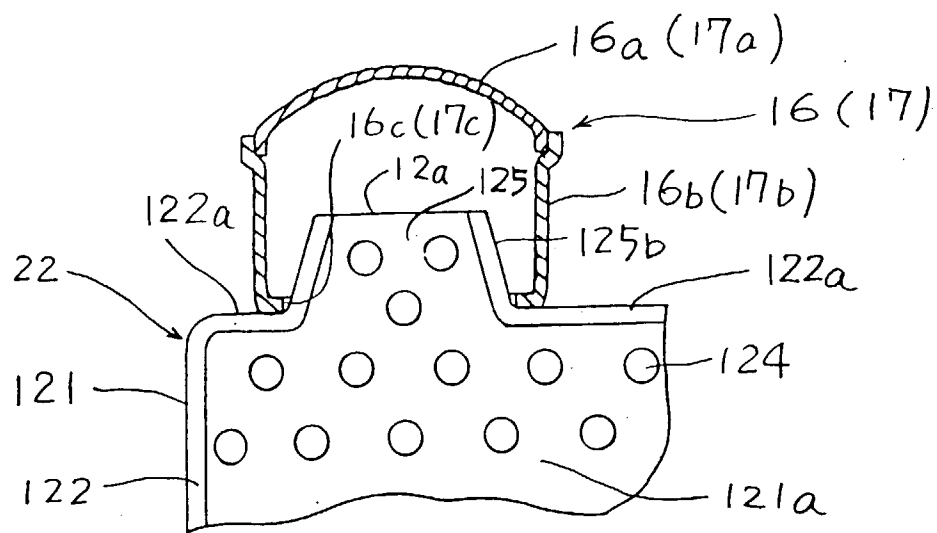


FIG. 5

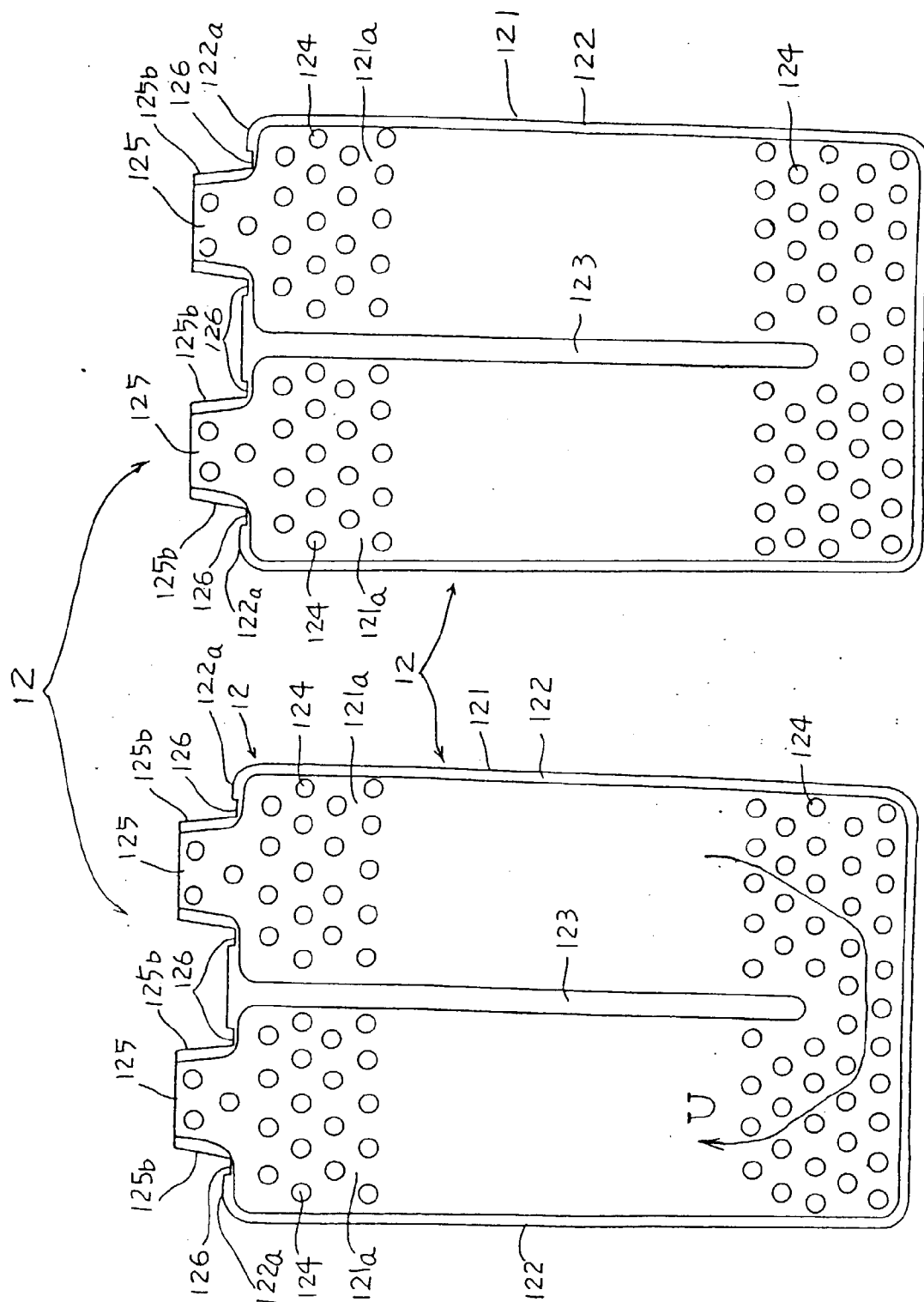


FIG. 6

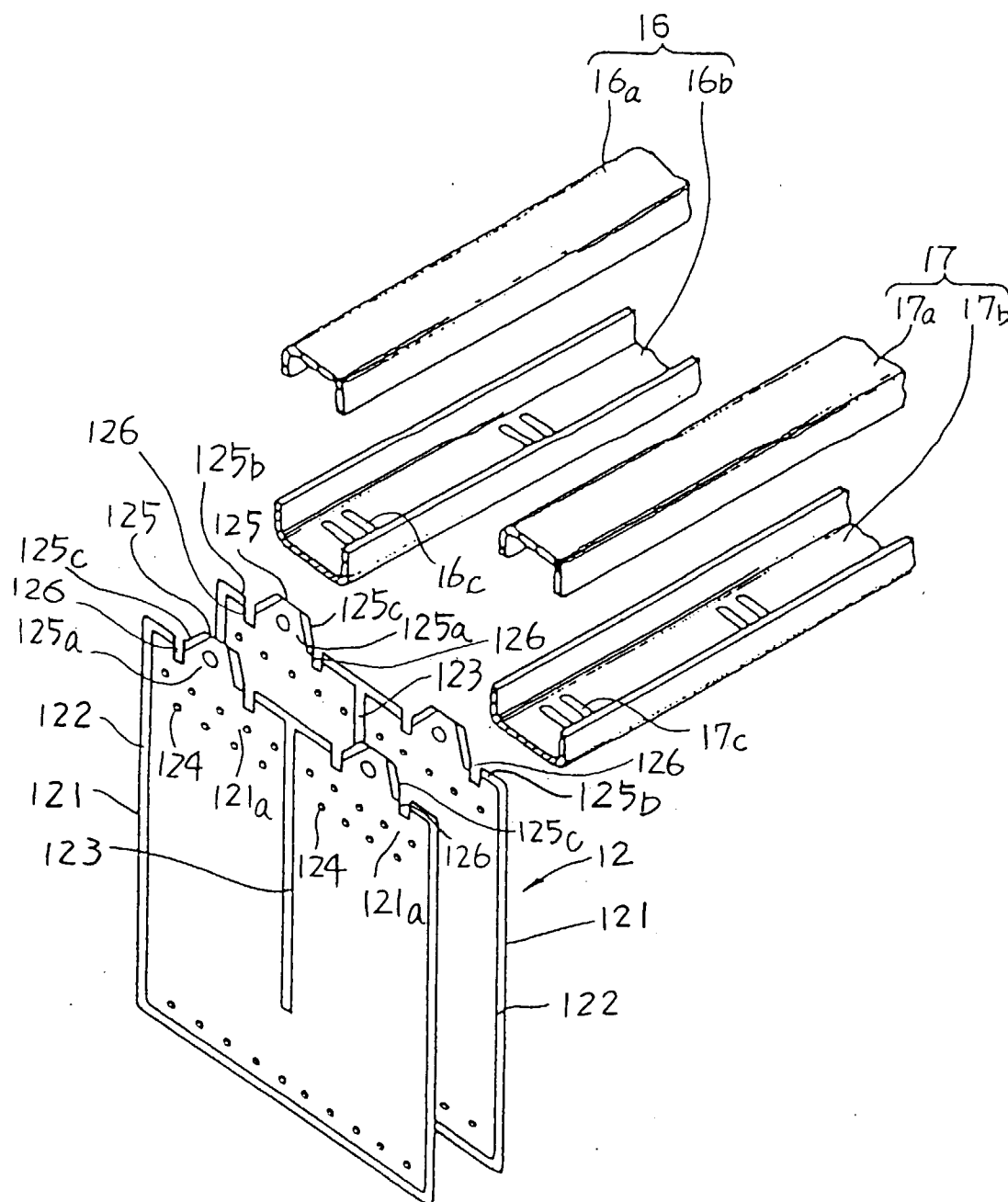


FIG. 7

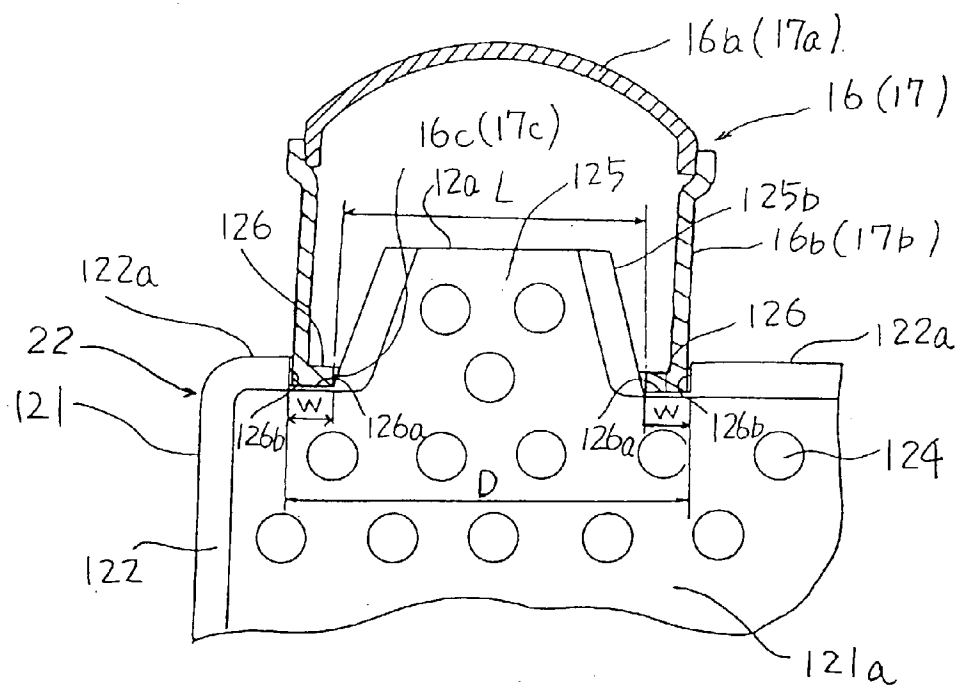


FIG. 8

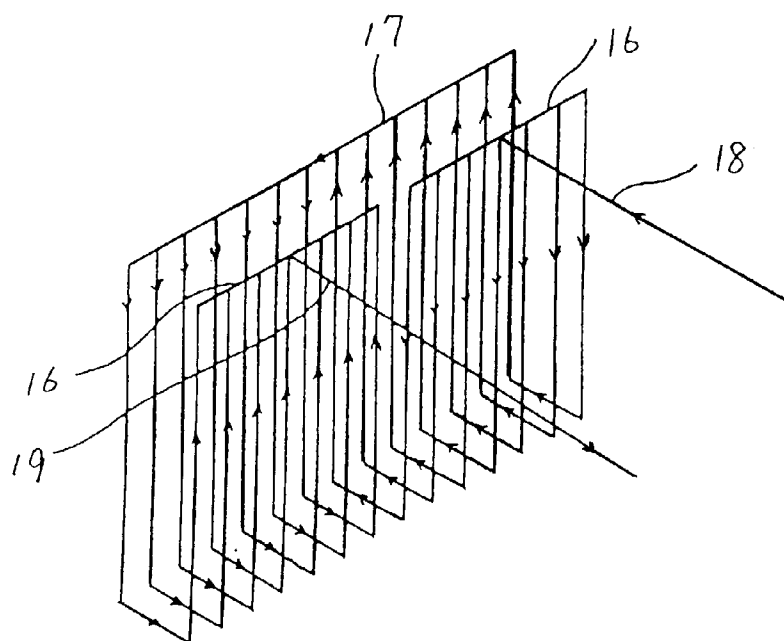


FIG. 9

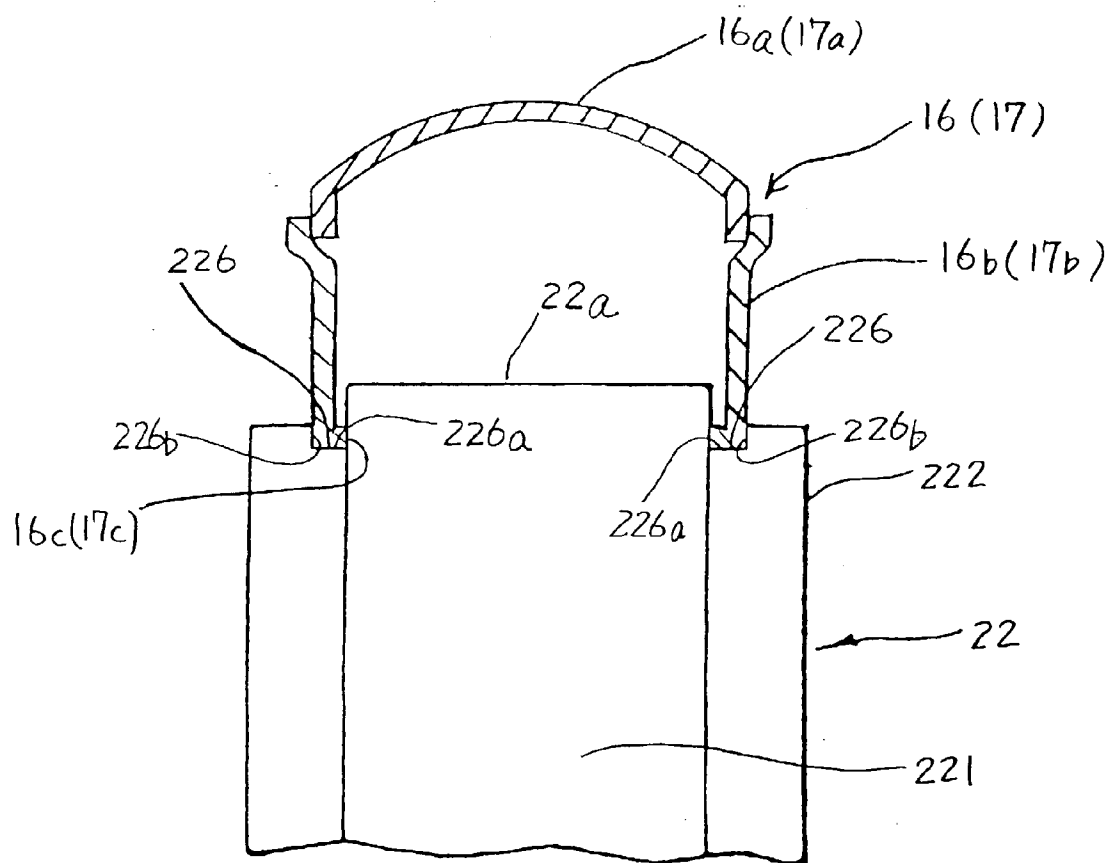


FIG. 10

