



(11) Publication number : **0 544 214 A1**

(12)

## EUROPEAN PATENT APPLICATION

(21) Application number : **92119958.4**

(51) Int. Cl.<sup>5</sup> : **F25B 43/00**

(22) Date of filing : **24.11.92**

(30) Priority : **27.11.91 JP 97491/91 U**

(43) Date of publication of application :  
**02.06.93 Bulletin 93/22**

(84) Designated Contracting States :  
**DE FR GB IT SE**

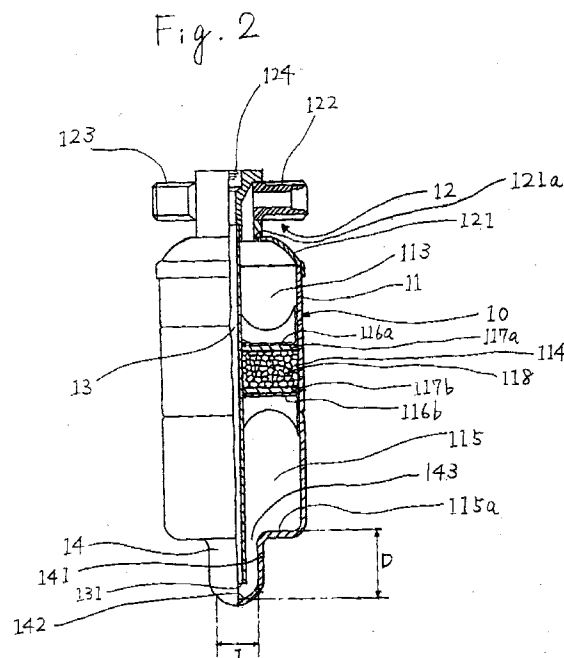
(71) Applicant : **SANDEN CORPORATION**  
**20 Kotobuki-cho**  
**Isesaki-shi Gunma, 372 (JP)**

(72) Inventor : **Yoshii, Yasuo, c/o Sanden Corporation**  
**20 Kotobuki-cho**  
**Isesaki-shi, Gunma 372 (JP)**  
Inventor : **Kawai, Toshiyuki, c/o Sanden Corporation**  
**20 Kotobuki-cho**  
**Isesaki-shi, Gunma 372 (JP)**

(74) Representative : **Prüfer, Lutz H.**  
**PRÜFER & PARTNER, Patentanwälte,**  
**Harthausen Strasse 25d**  
**W-8000 München 90 (DE)**

(54) **Accumulating device for use in refrigerant circuit.**

(57) This invention discloses an improved receiver-dryer for use in a refrigerant circuit which prevents gas or mixed refrigerant liquid and gas from entering a tube member (13) and which can reduce the quantity of the refrigerant charged within the refrigerant circuit. The receiver-dryer includes a cylindrical body (11), a fluid inlet port (122), and a fluid outlet port (123). The inside of cylindrical body (11) is separated into first, second and third chambers (113, 114, 115) from the top thereof. The bottom portion (115a) of the third chamber (115) is flat, around a hollow (14) projecting downwardly from the bottom portion (115a) of the chamber (115). The hollow (14) has a predetermined inner diameter (I) and depth (D). And the cross-sectional area of the inside of the hollow (14) is smaller than the cross-sectional area of the inside of cylindrical body (11). The third chamber (115) communicates with the fluid outlet port (123) through the tube member (13) which passes vertically within the cylindrical body (11). An opening (13) formed at the end of the tube member (13) is disposed within the hollow (14). In the above construction, a small volume of liquid refrigerant can accumulate to the height of opening (131) of the tube member (13).



## BACKGROUND OF THE INVENTION

The present invention relates to a refrigerant circuit, and more particular, to an accumulating device for use in the refrigerant circuit.

A refrigerant circuit is generally provided with an accumulating device, such as a receiver-dryer disposed between a condenser and an expansion device each of which forms a part of the refrigerant circuit.

Figure 1 illustrates an overall construction of one prior art accumulating device, such as a receiver-dryer for use in a refrigerant circuit. With reference to Figure 1, receiver-dryer 10 includes cylindrical casing 11 and header 12 which is fixedly connected to an upper opening end of cylindrical casing 11 by welding. Bottom plate 115a is fixedly connected to a lower opening end of cylindrical casing 11 also by welding. Header 12 comprises a cup-shaped cover plate 121 having a central opening 121a, fluid inlet port 122 and fluid outlet port 123 these which are fixedly connected to the central opening 121a. An inner hollow space of receiver-dryer 10 is divided into first, second and third chambers 113, 114 and 115. Second chamber 114 is formed between partition plates 116a and 116b which respectively separate second chamber 114 from first chamber 113 and third chamber 115 and oppose at a regular interval. Filter members 117a and 117b are set on the inside of partition plates 116a and 116b. An inner hollow space formed between filter members 117a and 117b is filled with dehydrant 118. Bottom plate 115a includes a flat portion 115b formed at a central region thereof. Third chamber 115 communicates with fluid outlet port 123 through an axially extending cylindrical tube 13 which penetrates the inside of cylindrical body 11 upward and downward. A lower opening end 131 of cylindrical tube 13 is immersed in the liquefied refrigerant accumulated at a bottom portion of third chamber 115. Lower opening end 131 of tube 13 is adjacent to an inner surface of flat portion 115b of bottom plate 115a. In addition, a sight glass 124 is fixedly disposed at the top end of header 12 in order to be able to observe an accumulating condition of receiver-dryer 10.

In the above construction of receiver-dryer 10, the refrigerant liquefied by a condenser (not shown) which forms a part of the refrigerant circuit is led into first chamber 113 through fluid inlet port 122, and is continuously led into second and third chambers 114 and 115. When the liquefied refrigerant passes through second chamber 114, filtration and dehydration are carried out by means of filter members 117a and 117b, and dehydrant 118. The liquefied refrigerant led into third chamber 115 accumulates at the bottom portion of third chamber 115. The liquefied refrigerant accumulating at the bottom portion of third chamber 115 is sucked into tube 13 through lower opening 131 of tube 13, and flows to fluid outlet port 123, and then flows out to an expansion device which

forms a part of the refrigerant circuit.

However, as bottom plate 115a is formed flatly and the diameter of bottom 115a almost equals the inside diameter of cylindrical casing 11, it is difficult to accumulate the liquefied refrigerant to the height of opening 131 when the rotation of the compressor reduces and the refrigerant filled within the refrigerant circuit is a small quantity. In the above operation, as opening 131 absorbs the liquefied refrigerant near on the surface of liquefied refrigerant accumulating, the opening also absorbs the gas together with the liquefied refrigerant. Therefore, the refrigerant ability of the air conditioning apparatus reduces. In addition, as the liquefied refrigerant led into third chamber 115 falls on the surface of liquefied refrigerant accumulating in a condition of a drop, the waves and the bubbles are formed near on the surface of liquefied refrigerant accumulating. Therefore, opening 131 absorbs the refrigerant mixed liquid and gas.

It is an object of this invention to provide an improved accumulating device for use in a refrigerant circuit of which prevented suction tube from absorbing the gas or the refrigerant mixed liquid and gas.

It is another object of this invention to provide an improved accumulating device for use in a refrigerant circuit which can reduce the quantity of the refrigerant filled within the refrigerant circuit.

An accumulating device, such as a receiver-dryer for use in a refrigerant circuit comprises a cylindrical body, a fluid inlet port and a fluid outlet port disposed on the cylindrical body and respectively communicating between the external refrigerant circuit and the inside of the cylindrical body. A tube member penetrates upward and downward within the cylindrical body, and communicates an inner hollow space of the cylindrical body with the fluid outlet port.

A hollow projects downwardly from the bottom of the cylindrical body and has a predetermined inner diameter and depth thereof. The tube member of which the end forms the opening disposed within the hollow.

## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a longitudinally sectional view of a receiver-dryer in accordance with one prior art embodiment.

Figure 2 is a longitudinally sectional view of a receiver-dryer in accordance with a first embodiment of this invention.

Figure 3 is a graph showing a relationship between the longitudinally sectional area of a hollow difference and quantity of the refrigerant charged within the refrigerant circuit difference in accordance with the receiver-dryer shown in Figure 1.

Figure 4 is an enlarged partial longitudinally sectional view of the lower part of a receiver-dryer in accordance with a second embodiment of this inven-

tion.

Figure 5 is an enlarged partial longitudinally sectional view of the lower part of a receiver-dryer in accordance with a third embodiment of this invention.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Figure 2, the receiver-dryer 10 includes cylindrical body 11 with an upper opening, and header 12 which is disposed and welded on the upper opening. Header 12 comprises a cover plate 121 having a central opening, and fluid inlet port 122 and fluid outlet port 123 fixed on the central opening. The inside of cylindrical body 11 is separated into first, second and third chambers 113, 114 and 115 from a top side thereof. Second chamber 114 is formed between partition plates 116a and 116b which respectively separates second chamber 114 from first chamber 113 and third chamber 115 and oppose at regular interval. Filter members 117a and 117b to eliminate the dust from the liquefied refrigerant are respectively set at the inside of partition plates 116a and 116b. The space formed between filter members 117a and 117b is filled with dehydrant 118 to eliminate the moisture from the liquefied refrigerant. Bottom plate 115a of third chamber 115 is formed flatly, and the diameter of bottom plate 115a almost equals the inner diameter of cylindrical body 11. Bottom plate 115a forms a hollow 14 projecting downward from the portion of bottom plate 115a. Side wall 141 of hollow 14 is formed vertically, and the bottom 142 of hollow 14 is of curved shape. Hollow 14 has a predetermined inner diameter I and depth D. An inner diameter I indicates the distance between opposite side walls 141 and 141. The depth D indicates the distance between opening 143 and bottom 142. The inner diameter I is determined far shorter than the inner diameter of cylindrical body 11. And the cross-sectional area of the inside of hollow 14 is far smaller than the cross-sectional area of the inside of cylindrical body 11. The inside of third chamber 115 communicates with fluid outlet port 123 through cylindrical tube 13 which penetrates the inside of cylindrical body 11 upward and downward. An opening 131 formed at the end of tube 13 and to absorb liquefied refrigerant accumulating within hollow 14 is disposed near above bottom 142. In addition, sight glass 124 to see through the inside of tube 13 is set on the top of header 12.

In the above construction of receiver-dryer 10, the liquefied refrigerant absorbed through fluid inlet port 122 into first chamber 113 is led into second chamber 114. The dust in the liquefied refrigerant within second chamber 114 is eliminated by filter members 117a, 117b and the moisture by dehydrant 118, and then the liquefied refrigerant is led into third chamber 115 and accumulates within hollow 14. The liquefied refrigerant accumulating within hollow 14 is

absorbed from opening 131 into the inside of tube 13 and is led into fluid outlet port 123, and then is discharged toward an expansion device which forms a part of the automotive air conditioning system.

As the cross-sectional area of hollow 14 is far smaller than the cross-sectional area of the inside of cylindrical body 11, the liquefied refrigerant led into third chamber 115 rapidly accumulates within hollow 14 and the level of the liquefied refrigerant also increases rapidly. And as opening 131 is disposed near above bottom 142, opening 131 easily sinks in the liquefied refrigerant which rapidly accumulates within hollow 14. Therefore, the above fixed level of the liquefied refrigerant accumulating within hollow 14 is usually kept, and opening 131 is prevented from absorbing gas together with liquefied refrigerant.

In addition, as opening 131 is usually sinking in the liquefied refrigerant accumulating within hollow 14 and the side wall 141 covers the circumference of lower part of suction tube 13 and the most of the liquefied refrigerant falling from second chamber 114 in a condition of a drop reaches on the surface of the liquefied refrigerant accumulating within hollow 14 by flowing on bottom 115a and side wall 141, the liquefied refrigerant which falls on the surface of the liquefied refrigerant accumulating within hollow 14 from second chamber 114 in a condition of a drop is difficult to form the wave and the bubble on the surface of the liquefied refrigerant. Therefore, opening 131 is prevented from absorbing the refrigerant mixed liquid and gas.

In the above construction and operation, when the inner diameter I is greater than the depth D, the cross-sectional area and the area of opening 143 of hollow 14 increase. Therefore, as it is difficult to accumulate the liquefied refrigerant to the height of opening 131 and the liquefied refrigerant which falls on the surface of the liquefied refrigerant accumulating within hollow 14 easily forms the waves and the bubbles, opening 131 easily absorbs the refrigerant mixed liquid and gas. It is desirable that the inner diameter I is determined to equal the depth D or to be shorter than the depth D from the above effect.

The inner diameter of cylindrical body 11 or receiver-dryer 10 for use in an automotive air conditioning system is generally determined at 45 mm - 120 mm. It is desirable that inner diameter I is determined to equal the depth D or to be smaller than the depth D, and that inner diameter I is determined at 15mm - 30mm and depth D is determined at 20mm - 30mm. In such a condition, it is difficult for the liquefied refrigerant to be mixed liquid and gas. Therefore, hollow 14 prevents the liquefied refrigerant mixed liquid and gas from reducing the refrigerant ability of an automotive air conditioning system.

Figure 3 is a graph showing a relationship between the longitudinally sectional area of a hollow 14 difference and the quantity of refrigerant filled within

refrigerant circuit difference in accordance with this invention. Data illustrated on a graph is an effect which the inventors of this invention got by observing a receiver-dryer shown in Figure 4.

Referring to Figure 3, in case of satisfying the condition that the inner diameter of cylindrical body 11 is determined at 45mm - 120mm and the inner diameter I is determined to equal the depth D or to be shorter than the depth D and that the inner diameter I is determined at 15mm - 30mm and the depth D is determined at 20mm - 30mm, when the longitudinally sectional area of hollow 14 (product of the inner diameter I and the depth D) is determined at about 510mm<sup>2</sup>, the quantity of the refrigerant charged within the refrigerant circuit is reduced extremely.

On the other hand, in case of gradual increasing the longitudinally sectional area of hollow 14 from 510mm<sup>2</sup>, as it is difficult to accumulating the liquefied refrigerant to the height of opening 131 and to keep a predetermined level of the liquefied refrigerant, opening 13 is liable to also absorb the gas together with the liquefied refrigerant.

Therefore, when the worker charges the refrigerant within the refrigerant circuit observing the condition of the liquefied refrigerant within tube 13 from sight glass 124, the worker concludes that quantity of the refrigerant charged within the refrigerant circuit is deficient, and is liable to charge excessive quantity of refrigerant within refrigerant circuit. Particularly, in case of increasing the longitudinally sectional area of hollow 14 greater than 900mm<sup>2</sup>, it is more difficult to accumulate the liquefied refrigerant to height of opening 131 and to keep the predetermined level of the liquefied refrigerant accumulating. Therefore, quantity of the refrigerant which worker charges within the refrigerant circuit increases more than the prior quantity of the refrigerant (about 495 g).

Moreover, in case of gradual decreasing the longitudinally sectional area of hollow 14 from 510mm<sup>2</sup>, as the liquefied refrigerant accumulating within hollow 14 easily goes over the height of the depth D and the surface of the liquefied refrigerant extends on bottom 115a, the liquefied refrigerant falling from second chamber 114 in the condition of a drop is liable to straightly fall on the surface of the liquefied refrigerant and the waves and the bubbles are easily formed near on the surface of liquefied refrigerant accumulating.

Therefore, when the worker charges refrigerant within the refrigerant circuit seeing the condition of liquefied refrigerant within tube 13 from sight glass 124, the worker concludes that the quantity of refrigerant charged within the refrigerant circuit is deficient, and is liable to charge excessive quantity of the refrigerant to the height in which opening 131 doesn't absorb the refrigerant mixed liquid and gas caused by the waves and the bubbles. Particularly, in case of decreasing the longitudinally sectional area of hollow

14 smaller than 300mm<sup>2</sup>, the waves and the bubbles are strongly formed near on the surface of liquefied refrigerant accumulating. Therefore, the quantity of refrigerant which the worker charges within the refrigerant circuit increases more than prior quantity of the refrigerant (about 495 g), and the reduction of quantity of the refrigerant charged within the refrigerant circuit isn't achieved.

Referring to Figure 4, a hollow of a receiver-dryer in accordance with a second embodiment of this invention is shown. The same construction is accorded like numerals as shown with respect to Figure 2 and the description of some of identical elements is substantially omitted.

Side wall 141 is formed vertically and bottom 142 is formed flatly. The inner diameter I indicates the distance between opposite side walls 141 and 141, the depth D indicates the distance between opening 143 and bottom 142. The above shape of hollow 14 considers the properties of the industrial process and utility.

Referring to Figure 5, a hollow of a receiver-dryer in accordance with a third embodiment of this invention is shown. The same construction is accorded like numerals as shown with respect to Figure 2 and the description of some of identical elements is substantially omitted.

The side wall 141 is formed the curved shape inwardly, bottom 142 is also formed the curved shape. The inner diameter I indicates the distance between the opposite side walls 141 and 141 at a position which is as high as the height disposing opening 131. The depth D indicates the distance between opening 143 and bottom 142. The above shape of hollow 14 considers the strength toward the pressure of liquefied refrigerant accumulating within hollow 14.

## Claims

1. Accumulating device for use in a refrigerant circuit comprising a cylindrical body (11), a fluid inlet port (122) and a fluid outlet port (123) disposed on said cylindrical body (11) and respectively communicating between the external refrigerant circuit and an inner hollow space of said cylindrical body, a tube member (13) penetrating upward and downward within said cylindrical body and communicating said inner hollow space of said cylindrical body (11) with said fluid outlet port (123), the improvement comprising:

a hollow (14) projecting downwardly from said bottom (115a) of said cylindrical body (11) and having a predetermined inner diameter (I) and depth (D), said tube member (13) of which the end forms the opening disposed within said hollow (14).

2. The accumulating device of claim 1 wherein the inner diameter (I) of said hollow (14) is determined to be equal the depth (D) or to be smaller than the depth (D) of said hollow (14).  
5
3. The accumulating device of claim 1 or 2, wherein the inner diameter of said cylindrical body (11) is determined at 45mm - 120mm, and the inner diameter (I) of said hollow (14) is determined at 15mm - 30mm, and the depth (D) of said hollow (14) is determined at 20mm - 30mm.  
10
4. The accumulating device of one of claims 1 to 3, wherein the longitudinally sectional area indicated by the product of said inner diameter (I) and the depth (D) of said hollow (14) is determined at about 510mm<sup>2</sup>.  
15
5. The accumulating device of one of claims 1 to 4, wherein a side wall (141) of said hollow (14) is formed vertically and the bottom (142) has a curved shape.  
20
6. The accumulating device of one of claims 1 to 4, wherein said side wall (141) of said hollow (14) is formed the curved shape inwardly, and said bottom (142) of said hollow (14) is formed the curved shape.  
25
7. The accumulating device of one of claims 1 to 4, wherein said side wall (141) and said bottom (142) of said hollow (14) are respectively formed vertically and flatly.  
30

35

40

45

50

55

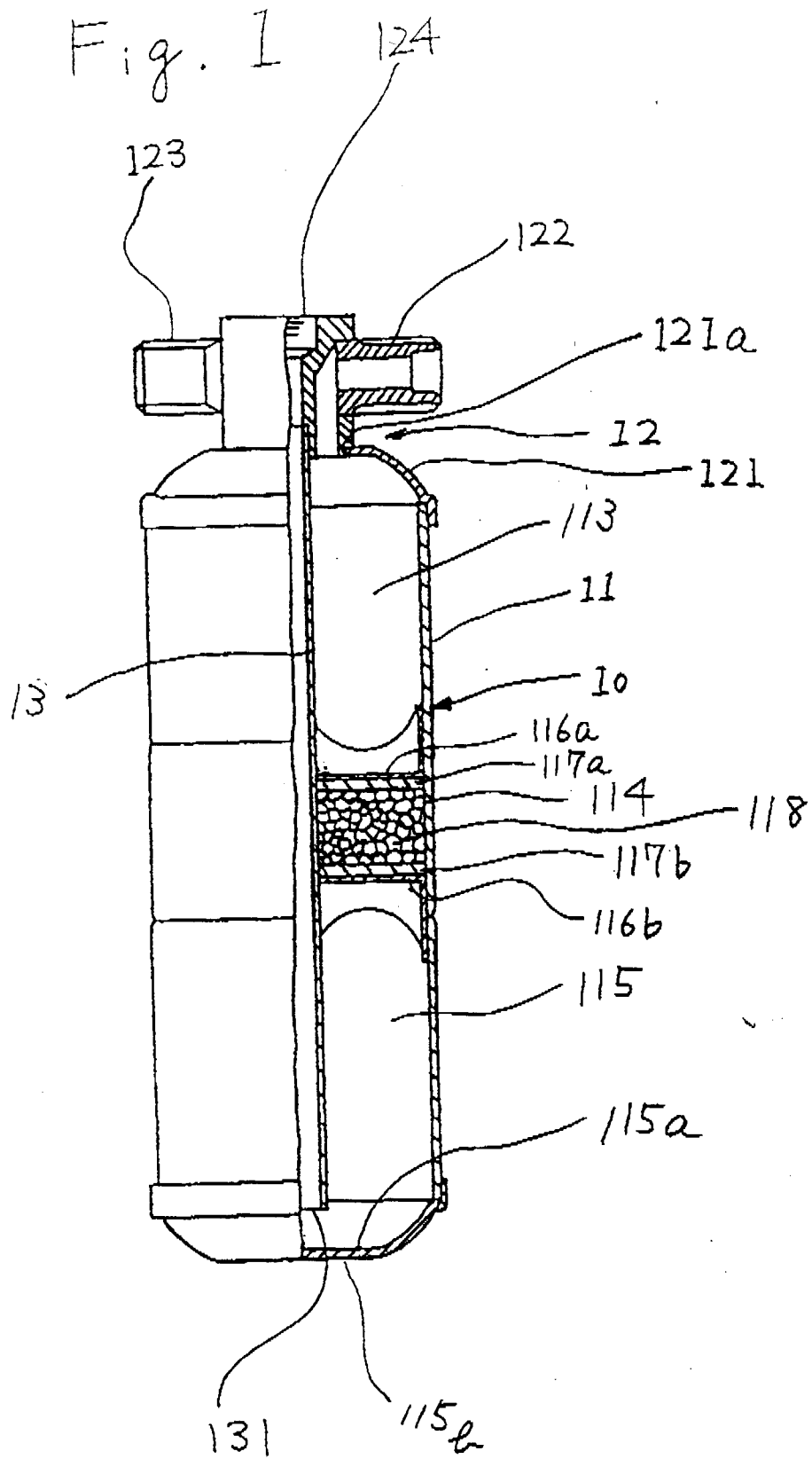


Fig. 2

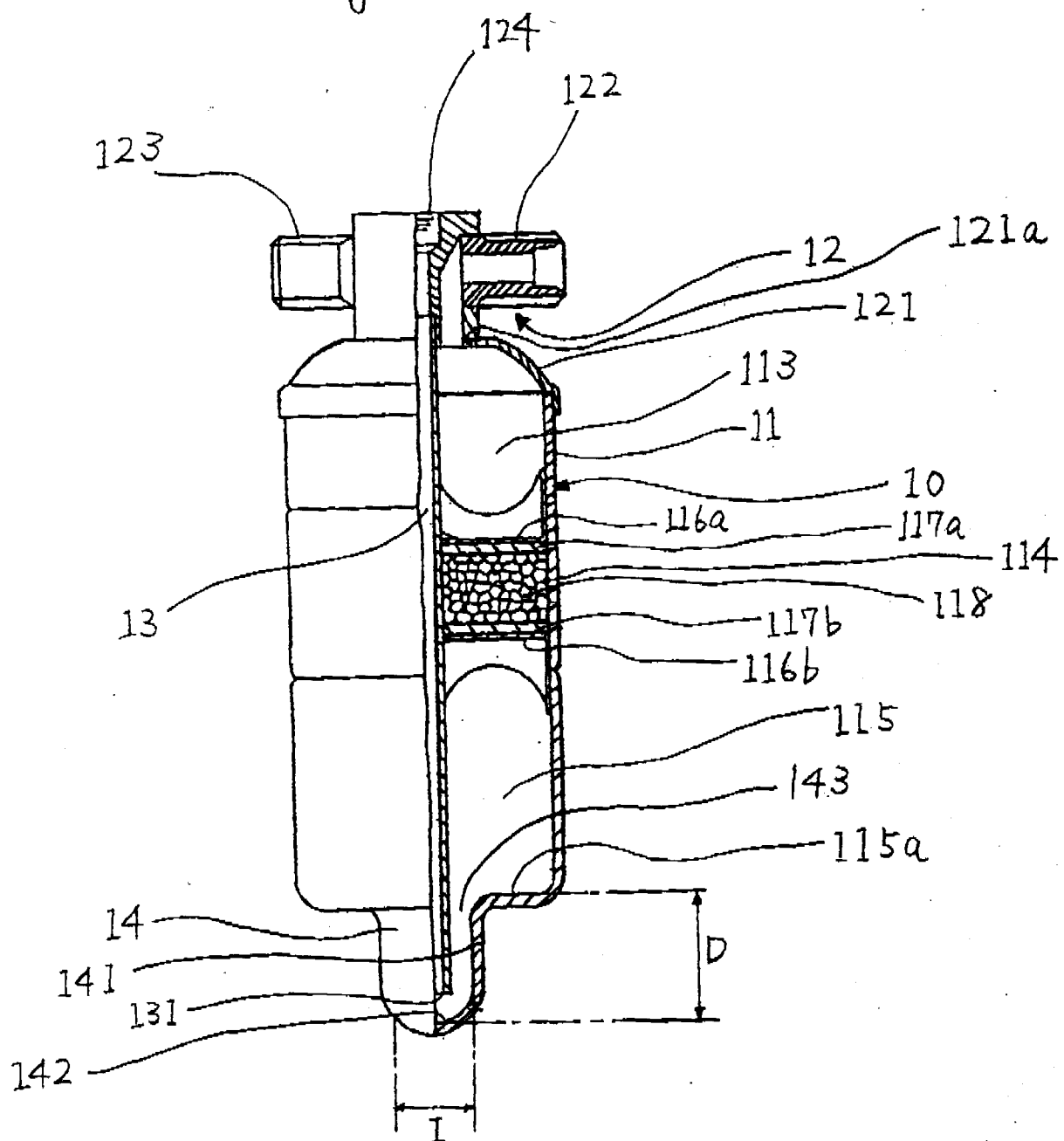


Fig. 3

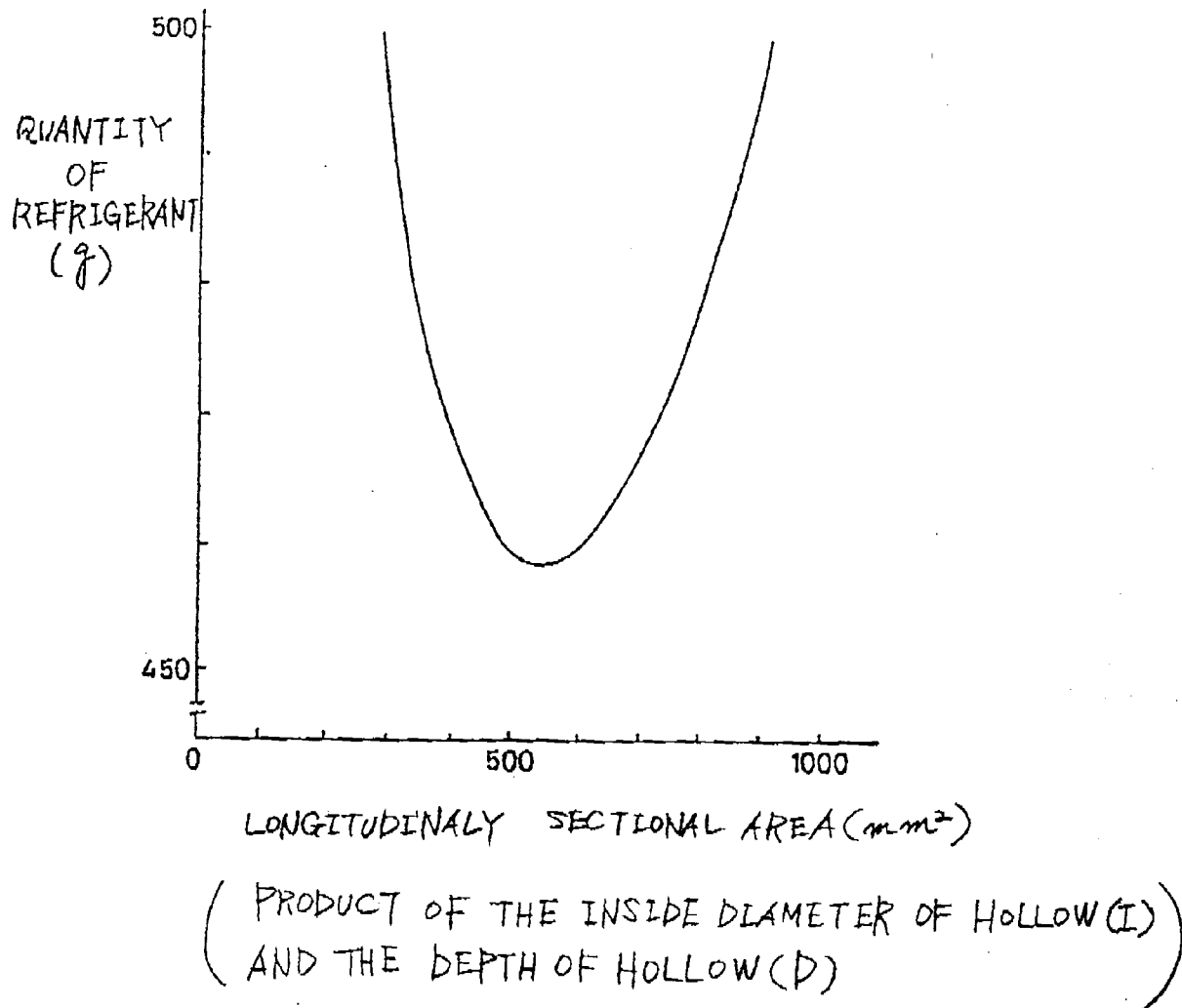


Fig. 4

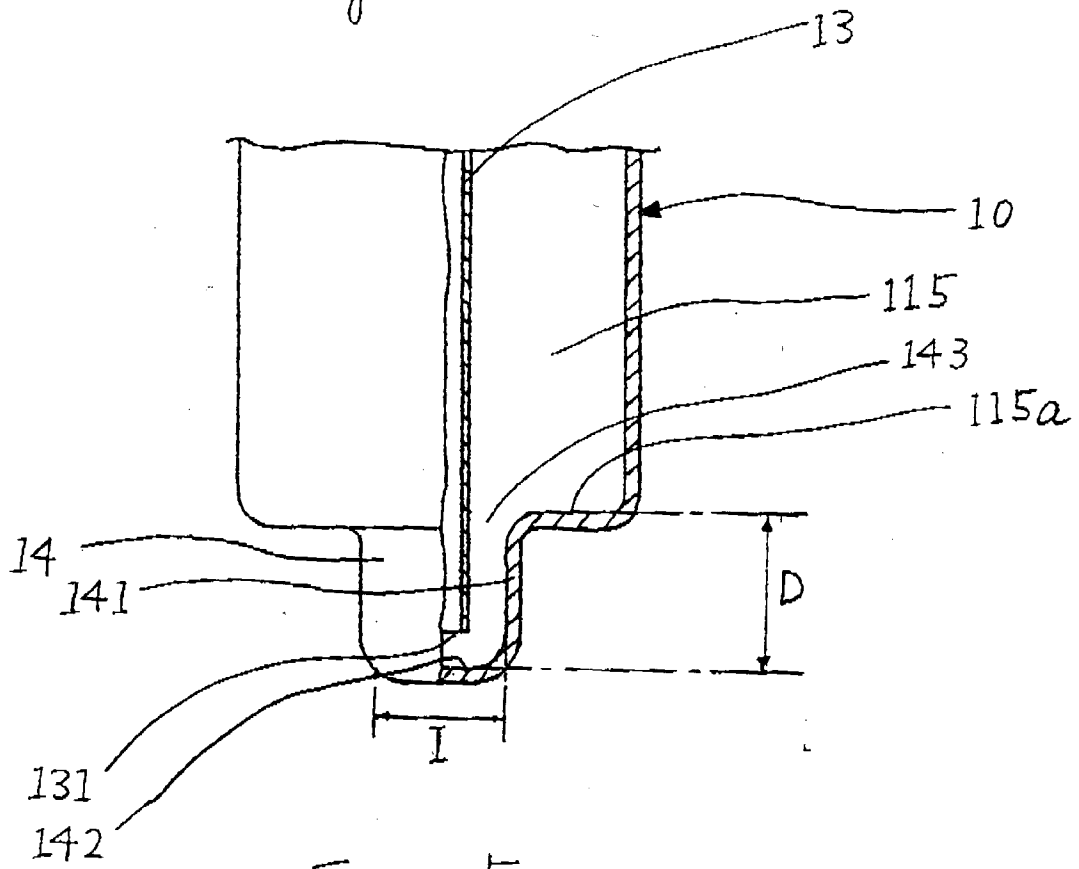
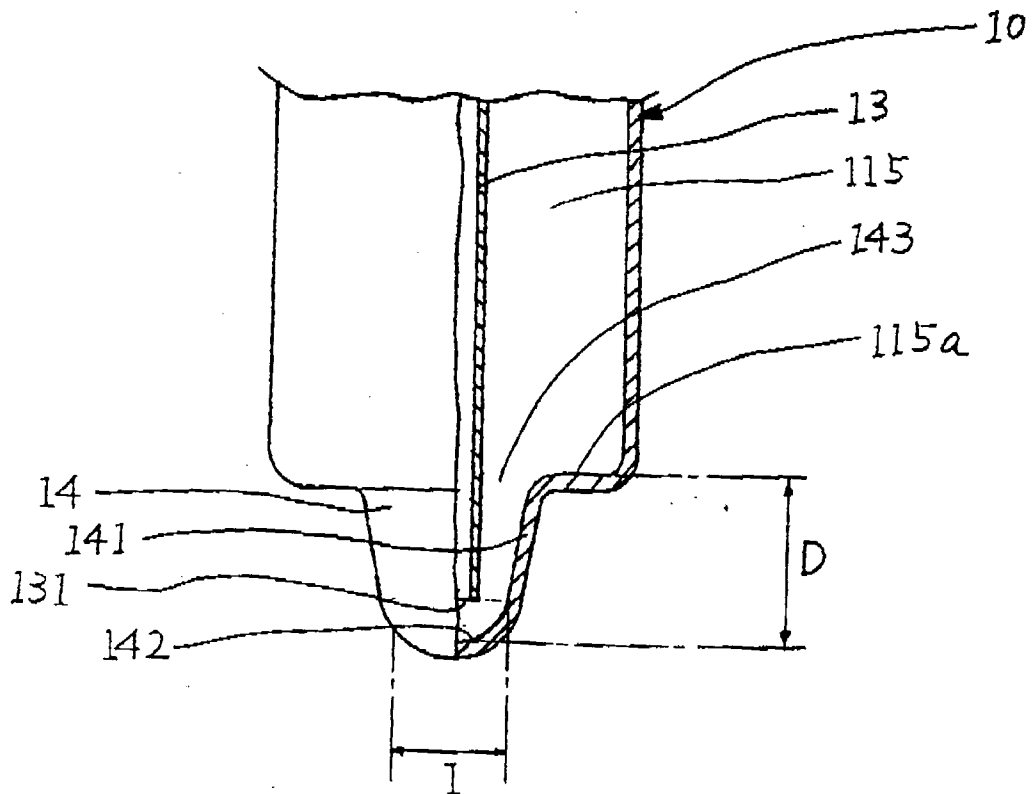


Fig. 5





European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number

EP 92 11 9958

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                           |                                                      |                                               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|------------------------------------------------------|-----------------------------------------------|
| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Citation of document with indication, where appropriate, of relevant passages             | Relevant to claim                                    | CLASSIFICATION OF THE APPLICATION (Int. Cl.5) |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | US-A-4 920 766 (YAMAMOTO)<br>* column 7, line 10 - line 29; figure 12 *                   | 1                                                    | F25B43/00                                     |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | DE-A-3 543 206 (BELLINO)<br>* column 3, line 60 - column 4, line 46;<br>figures 1-2 *     | 1                                                    |                                               |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | DE-A-3 936 251 (SHOWA ALUMINUM)<br>* column 2, line 67 - column 3, line 22;<br>figure 5 * | 1                                                    |                                               |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | US-A-5 038 582 (TAKAMATSU)                                                                |                                                      |                                               |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | EP-A-0 104 750 (AVERY)                                                                    |                                                      |                                               |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | DE-B-1 230 445 (HANSA METALLWERKE)                                                        |                                                      |                                               |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | US-A-2 835 114 (SHOEMAKER)                                                                |                                                      |                                               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                           |                                                      | TECHNICAL FIELDS SEARCHED (Int. Cl.5)         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                           |                                                      | F25B                                          |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                           |                                                      |                                               |
| Place of search<br>THE HAGUE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                           | Date of completion of the search<br>04 FEBRUARY 1993 | Examiner<br>BOETS A.F.J.                      |
| <p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>X : particularly relevant if taken alone<br/> Y : particularly relevant if combined with another document of the same category<br/> A : technological background<br/> O : non-written disclosure<br/> P : intermediate document</p> <p>T : theory or principle underlying the invention<br/> E : earlier patent document, but published on, or after the filing date<br/> D : document cited in the application<br/> L : document cited for other reasons</p> <p>&amp; : member of the same patent family, corresponding document</p> |                                                                                           |                                                      |                                               |

EPO FORM 1503 03-82 (P0401)