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(54) Refrigerant condenser with a built-in receiver

(57) In a condenser (1), an outlet header pipe and a receiver are formed in a single body as a receiver-integral type outlet header pipe (7) including a outlet header pipe portion (3) and a receiver (13) integrally formed in fluid communication. The outlet header pipe portion (3) is inserted with a plurality of heat exchange tubes (4) at a side thereof in a tube inserting direction and connected to the heat exchange tubes (4), and includes a partition plate inserted thereinto at the opposite side in a partition inserting direction (A). The receiver portion (13) extends from the outlet header pipe portion (3) in a direction (B) perpendicular to the partition inserting direction (A). The receiver portion (13) and the outlet header pipe portion (3) are serially arranged in a direction (C) of the air flow to be heat exchanged.

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Description

This invention relates to a condenser for use in a refrigerant circuit of an automotive air-conditioning system and, in particular, to a condenser with a built-in receiver for temporarily accumulating a refrigerant condensed to a liquid state.

A conventional condenser with a built-in receiver of the type is disclosed, for example, in United States Patent No. 5,088,294. The condenser comprises an inlet header pipe connected to an inlet pipe for introducing a refrigerant, an outlet header pipe connected to an outlet pipe for discharging the refrigerant, a plurality of flat heat exchange tubes disposed in parallel to one another between the inlet and the outlet header pipes and inserted in and connected to the inlet and the outlet header pipes, and a plurality of corrugated fins arranged between every adjacent ones of the heat exchange tubes.

In the above-mentioned condenser, the outlet header pipe is provided with a receiver for temporarily accumulating a refrigerant condensed to a liquid state to conduct the liquid refrigerant to the outlet pipe. Generally, the receiver is prepared as a separate element and is fixedly attached to the outlet header pipe. Specifically, the heat exchange tubes are inserted into axially arranged holes in a side of a pipe wall of the outlet header pipe in a tube inserting direction and sealed and fixed to the pipe wall. The receiver is attached to the opposite side surface of the outlet header pipe in a direction opposite to the tube inserting direction.

In an assembling process of the condenser with such a built-in receiver, a partition plate is arranged in each of the header pipes to define the flow path of the refrigerant to and from the heat exchange tubes. Generally, the partition plate is inserted into the header pipe at the side opposite to the heat exchange tubes in a partition inserting direction opposite to the tube inserting direction. As for the outlet header pipe, the receiver is located at the partition plate insertion side, that is, in the partition inserting direction. Therefore, in the assembling process of the condenser, the partition plate is inserted into and bonded to the outlet header pipe before the receiver is attached to the outlet header pipe. Thus, the assembling process is complicated.

Alternatively, it is assumed that the partition plate is inserted into the header pipe at the same side as the exchange tubes, that is, in the partition inserting direction which is coincident with the tube inserting direction in order to simplify the assembling process. In this case, in a preparation process of header pipes, a partition insertion slot for inserting the partition plate and tube insertion slots for inserting the heat exchange tubes are punched in the outlet header pipe at the same side in the same direction. As a result, the partition insertion slot is formed in the close vicinity of the tube insertion slots. Therefore, it is very difficult to perform the punching operation insuring sufficient mechanical strength and the correct shape of each slot.

In the above-mentioned structure in which the receiver is disposed to the header pipe at the opposite side of the heat exchange tubes in the tube inserting direction, a size of the condenser in the tube inserting direction is increased by a width of the receiver so that the heat exchanging area of the condenser is reduced when a space for installing the condenser is limited.

It is therefore an object of this invention to provide a REFRIGERANT condenser with a built-in receiver, which enables a partition plate to be easily arranged in an outlet header pipe without degradation in machinability of insertion slots and in mechanical strength, which can be easily assembled, and which can avoid reduction of an effective heat exchange area.

This invention is applicable to a refrigerant condenser with a built-in receiver including an outlet header pipe, a plurality of heat exchange tubes connected to the outlet header pipe through a side wall thereof, the outlet header pipe having therein one or more partition plate for controlling flow of the refrigerant to define a refrigerant flow path, the partition plate being inserted into the outlet header pipe at an opposite side of the heat exchange tubes in a partition inserting direction, and the receiver being provided to the outlet header pipe for temporarily accumulating the refrigerant condensed into a liquid state. According to this invention, the refrigerant condenser is characterized in that the outlet header pipe is in a type of a receiver-integral structure comprising a portion of the outer header pipe and a receiver portion integrally formed and beinq in fluid communication with the outer header pipe portion. The receiver portion extends from the outlet header portion in a direction perpendicular to the partition inserting direction.

In a further aspect, the receiver-integral type header pipe has first and second flow paths separated by an axially extending internal partition wall with a gap formed at one end thereof. The first flow path is a liquid refrigerant flow path in the receiver portion while the second flow path is the outlet header pipe portion and is further separated by the partition plate into the heat exchanging flow path for the refrigerant to and from the heat exchange tubes and an accumulating portion for the receiver portion for accumulating the refrigerant in a liquid state.

Preferably, the receiver-integral type header pipe having the first and the second flow paths is formed by an extruded blank pipe having two axial cavities.

In a further aspect, the receiver portion is connected with an outlet pipe outwardly extending from the receiver portion in a direction perpendicular to the partition inserting direction for conducting the liquid refrigerant to an exterior.

In the accompanying drawings:-

Fig. 1 is a side sectional view of a characteristic part of a conventional condenser with a built-in receiver;
Fig. 2 is a front view of a condenser with a built-in receiver according to one embodiment of this inven-

tion;

Fig. 3 is a plan view of the condenser illustrated in Fig. 2;

Fig. 4 is a vertical sectional view of a receiver-integral header pipe of the condenser illustrated in Fig. 3, taken along a line IV-IV;

Fig. 5 is a perspective view of the header pipe illustrated in Fig. 4; and

Fig. 6 is an enlarged perspective view of the header pipe illustrated in Fig. 4 with a part cut away.

In order to facilitate an understanding of this invention, description will at first be made about a conventional condenser with a built-in receiver.

Referring to Fig. 1, the conventional condenser with a built-in receiver comprises a plurality of heat exchange tubes 101 (only one being shown in Fig. 1) which are inserted into axially arranged holes in a side of a pipe wall of an outlet header pipe 102 in a tube inserting direction and connected to the outlet header pipe 102. A receiver 103 is fixedly attached to the outlet header pipe 102 at the opposite side in a direction opposite to the tube inserting direction.

The above-mentioned structure, however, results in various problems in an assembling process of the condenser or a machining process of parts. Specifically, in the assembling process, at least one partition plate 100 is arranged in the outlet header pipe 102. Generally, the partition plate 100 is inserted into the outlet header pipe 102 in a direction depicted at A in the figure. However, the receiver 103 is located forward in the direction A. In presence of the receiver 103, it is quite difficult to insert the partition plate 100. Under the circumstances, in the assembling process, the partition plate 100 is inserted into and bonded to the outlet header pipe 102 before the receiver 103 is attached to the outlet header pipe 102. Thus, the assembling process is complicated.

Alternatively, it is assumed that the partition plate 100 is oppositely inserted into the outlet header pipe 102 that is, in the direction same as the tube inserting direction in order to simplify the assembling process. In this case, in the machining process, a partition insertion slot for inserting the partition plate 100 and tube insertion holes for inserting the heat exchange tubes 101 are both punched in the pipe wall of the outlet header pipe 102 at the same side in the same direction. As a result, the partition insertion slot is formed in the close vicinity of the tube insertion holes. Therefore, it is very difficult to perform the punching operation insuring sufficient mechanical strength and the correct shape of each slot.

Taking the above into consideration, it is proposed to form the partition insertion slot in the outlet header pipe 102 at a different position angularly offset from the tube inserting direction and also apart from the location of the receiver 103. For example, the partition insertion slot is formed in the pipe wall of the outlet header pipe 102 at a position in a direction B perpendicular to the tube inserting direction A. Then, the partition plate 100 is inserted into the outlet header pipe 102 in the direction B. In this event, the tube insertion holes and the partition insertion slot are formed in the pipe wall of the outlet header pipe 102 in an orthogonal relationship. Such structure results in difficulty in punching operation and degradation in mechanical strength.

More specifically, if the tube insertion holes and the partition insertion slot are formed in the pipe wall of the outlet header pipe 102 in the orthogonal relationship, those slot and holes are too close to each other. In this event, it is difficult to avoid serious degradation in mechanical strength. In addition, mutual interference in punching operation deteriorates dimensional accuracy of the slot and holes. This results in difficulty in subsequent insertion and assembling of the heat exchange tubes 101 and the partition plate 100 to the outlet header pipe 102. Therefore, the method of punching out the slot and holes in the orthogonal relationship is not adopted because of the above-mentioned disadvantages. As traditionally, the tube insertion holes and the partition insertion slot are formed at positions angularly spaced by 180° to each other in the manner described above.

In the above-mentioned condenser with the built-in receiver, the receiver 103 is disposed at the opposite position of the outlet header pipe 102 to the heat exchange tubes 102 in the tube inserting direction. Therefore, a size of the refrigerant condenser increases in the tube inserting direction by the width of the receiver. This means that when the space for installing the condenser is limited, the efficient heat exchange area is reduced by presence of the receiver.

Under the circumstances, it is desired to achieve an improved condenser with a built-in receiver which enables a partition plate to be easily inserted into the outlet pipe in an ordinary direction or at the side opposite to the heat exchange tubes without degradation in machinability of insertion slots and in mechanical strength, which can be easily assembled, and which can avoid reduction of an effective heat exchange area.

Referring to Fig. 2, a condenser 1 with a built-in receiver according to an embodiment of this invention is basically similar in structure to the conventional condenser described in the foregoing. Specifically, the condenser 1 comprises an inlet header pipe 2 connected to an inlet pipe 8 for introducing a refrigerant, an outlet header pipe 3 connected to an outlet pipe 9 for discharging the refrigerant, a plurality of flat heat exchange tubes 4 disposed in parallel to one another between the inlet header pipe 2 and the outlet header pipe 3 and inserted in and connected to the inlet and the outlet header pipes, a pair of reinforcing plates 6 arranged at opposite sides of an array of the heat exchange tubes 4, and a plurality of corrugated fins arranged between every adjacent ones of the heat exchange tubes 4 and between the heat exchange tubes 4 and the reinforcing plates 6.

The condenser 1 is of a so-called multiflow type. A partition plate 10 is inserted into and bonded to the inlet header pipe 2. Likewise, a partition plate 11 is inserted into and bonded to the outlet header pipe 3. These partition plates 10 and 11 are for defining the flow path of the refrigerant to and from the heat exchange tubes 4. Herein, the outlet header pipe 3 is a portion of a receiver-integral type header pipc 7 which has also a receiver portion 13 integrally formed with and being in fluid communication with the outlet header pipe portion 3.

In the receiver-integral type header pipe 7, the receiver portion 13 generally extends from the outlet header pipe portion 3 in a direction B perpendicular to a partition inserting direction A, as illustrated in Fig. 3. The outlet pipe 9 for conducting the liquid refrigerant to the exterior extends continuously from the receiver portion 13 in a direction shown at C perpendicular to the partition inserting direction. The inlet pipe 8 and the outlet pipe 9 are jointed to and communicate with the inlet header pipe 2 and the outlet header pipe 3 illustrated in Figs. 2 and 3, respectively. Those inlet and outlet pipes can be formed integrally with the corresponding header pipes as single bodies, respectively.

In the receiver-integral type header pipe 7, the outlet header pipe portion 3 is provided with tube insertion holes 12 for inserting the heat exchange tubes 4 at a side opposite to the partition plate insertion slot, as illustrated in Figs. 3, 4 and 5.

In more detail, the receiver-integral type header pipe 7 has first and second axially-extending flow paths separated by an internal partition wall 16 with a gap 17 formed at one end thereof, generally providing the receiver portion 13 and the outlet header pipe 3, respectively. More specifically, the first flow path shown at 14 generally serves as a portion for guiding the liquid refrigerant in the receiver portion 13 to the outlet pipe 9. The second flow path is further separated by the radially-extending partition plate 11 into an upper heat exchanging flow path for the refrigerant to and from the heat exchange tubes 4 and a lower portion which is also connected to the one or more heat exchange tubes 4.

The receiver-integral type header pipe 7 is closed at opposite ends by caps, a lower one of which is shown at 18 in Fig. 6.

The lower portion of the second flow path and the lower portion of the first flow path 14 communicate with each other through the gap 17 and serve as an accumulating portion 15 of the receiver portion 13 for accumulating the liquid refrigerant. The receiver-integral type header pipe 7 having the above-mentioned two flow paths is formed as an integral element from an extruded pipe blank having two axial cavities.

Referring back to Fig. 2, the refrigerant in a gas/liquid mixed phase (in a misty state) flows into the inlet header pipe 2 through the inlet pipe 8. The refrigerant flows into the outlet header pipe portion 3 via one or more (two in the figure) of the heat exchange tubes 4. As depicted by dotted lines in the figure, the refrigerant further flows through other heat exchange tubes 4 (three in the figure) back into the inlet header pipe 2, from which the refrigerant flows through the other heat exchange tubes 4 (three in the figure) into the accumulating portion 15 of the receiver-integral header pipe 7. Flowing through the heat exchange tubes 4, the refrigerant releases heat to be cooled via the corrugated fins 5. As a result of such heat exchanging operation, the refrigerant is condensed to a liquid state completely. The liquid refrigerant accumulated in the accumulating portion 15 flows out from the outlet pipe 9 through the first flow path 14.

In the receiver-integral type header pipe 7, the receiver portion 13 and the outlet pipe 9 extend from the outlet header pipe portion 3 in the direction B perpendicular to the tube inserting direction and the partition inserting direction A. With this structure, in the assembling process, the partition plate 11 can be easily inserted into the outlet header pipe portion 3 in the partition inserting direction A at the opposite side against the heat exchange tube without any trouble.

It will be understood that the partition insertion slot can be formed in the outlet header pipe portion 3 of the receiver-integral type header pipe 7 in the manner similar to the ordinary punching operation in the conventional condenser shown in Fig. 1. Through the partition insertion slot, the partition plate 11 can easily be inserted and bonded by brazing. Although the partition insertion slot is formed in the pipe wall of the outlet header pipe portion 3 at the side opposite to the tube insertion holes 12, the receiver-integral type header pipe 7 has such a structure that the receiver portion 13 is formed integral with the outlet header pipe portion extending from the outlet header pipe 3 in the direction B perpendicular to the tube inserting direction and the partition inserting direction and has a relatively thick side wall. Accordingly, upon punching the tube insertion holes 12 and partition insertion slots, neither the mechanical strength of the outlet header pipe portion 3 nor the dimensional accuracy of the insertion holes and slot is deteriorated.

Accordingly, in the receiver-integral type header pipe 7, the partition plate 11 is easily arranged in the outlet header pipe 3 without deterioration in machinability of the insertion slots and in mechanical strength. Therefore, the condenser 1 itself can be easily manufactured.

In the above-described condenser 1, the receiver portion 13, the outlet header pipe portion 3, and the outlet pipe 9 in the receiver-integral type header pipe 7 are serially arranged in the direction C of the air flow to be heat exchanged, as seen from Fig. 3. Therefore, an effective heat exchange area of a heat exchanging region extending in the direction perpendicular to the direction C is not reduced by presence of the receiver 13. Although the condenser 1 of this invention has the built-in receiver, the efficient heat exchange area is equivalent to that obtained in the condenser having no built-in receiver.

Although the foregoing description is directed to the multiflow-type condenser 1 with the built-in receiver, the structure with the receiver-integral type header pipe 7 of this invention is applicable to various other types of condensers having built-in receivers. The receiver-integral type header pipe 7 can be formed not only by the extruded pipe blank with two cavities but by any other appropriate materials. For example, use can be made of a member comprising a combination of semicylindrical pipe members or another member having a clad structure using a brazing material.

Claims

1. A refrigerant condenser with a built-in receiver including an outlet header pipe, a plurality of heat exchange tubes connected to said outlet header pipe through a side wall thereof, said outlet header pipe having therein one or more partition plate for controlling flow of the refrigerant to define a refrigerant flow path, said partition plate being inserted into said outlet header pipe at an opposite side of said heat exchange tubes in a partition inserting direction, and the receiver being provided to said outlet header pipe for temporarily accumulating the refrigerant condensed into a liquid state, wherein said outlet header pipe is in a type of a receiver-integral structure comprising a portion of said outer header pipe and a receiver portion integrally formed and being in fluid communication with said outer header pipe portion, said receiver portion extending from said outlet header portion in a direction perpendicular to said partition inserting direction.

2. A refrigerant condenser with a built-in receiver as claimed in Claim 1, wherein said receiver-integral type header pipe has first and second flow paths separated by an axially extending internal partition wall with a gap formed at one end thereof, said first flow path being a liquid refrigerant flow path in said receiver portion while said second flow path being said outlet header pipe portion and being further separated by said partition plate into the heat exchanging flow path for the refrigerant to and from said heat exchange tubes and an accumulating portion for said receiver portion for accumulating said refrigerant in a liquid state.

3. A refrigerant condenser with a built-in receiver as claimed in Claim 2, wherein said receiver-integral type header pipe having the first and the second flow paths is formed by an extruded blank pipe having two axial cavities.

4. A refrigerant condenser with a built-in receiver as claimed in Claim 1, wherein said receiver portion is connected with an outlet pipe outwardly extending from said receiver portion in a direction perpendicular to said partition inserting direction for conducting the liquid refrigerant to an exterior.

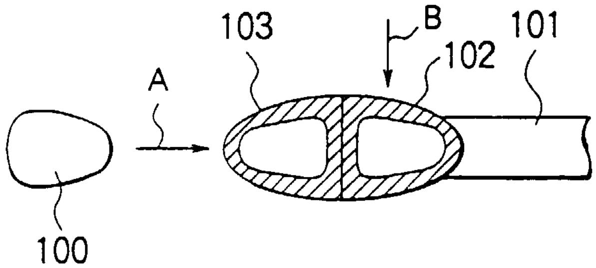

FIG. 1
PRIOR ART

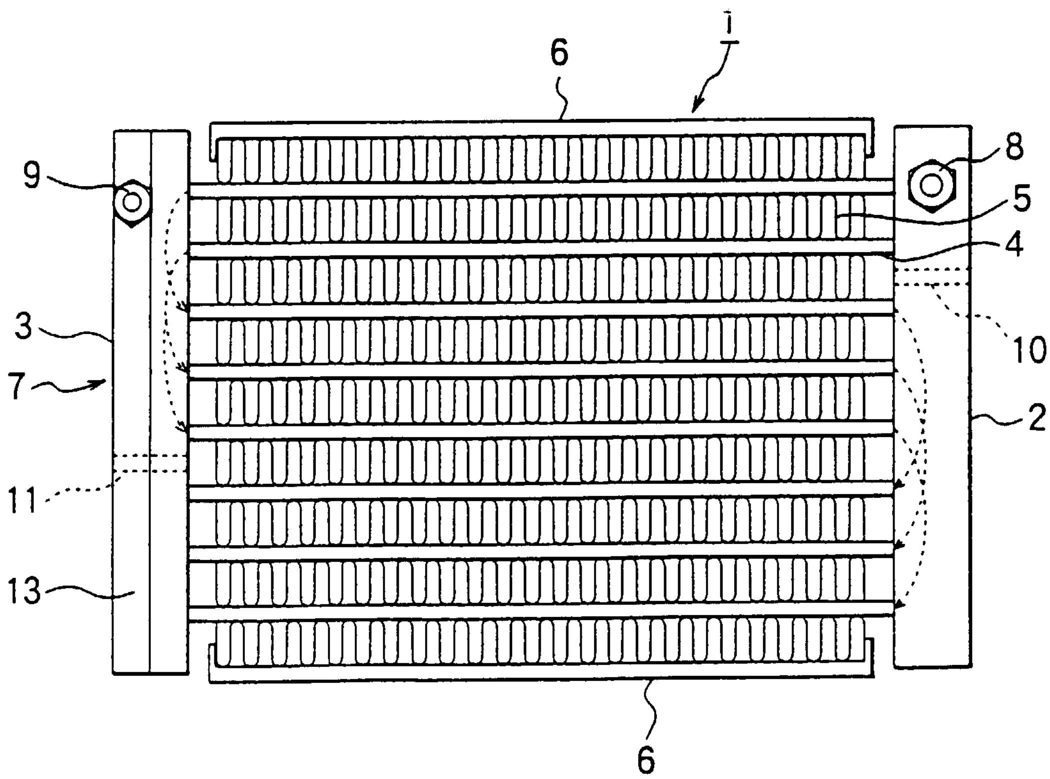

FIG. 2

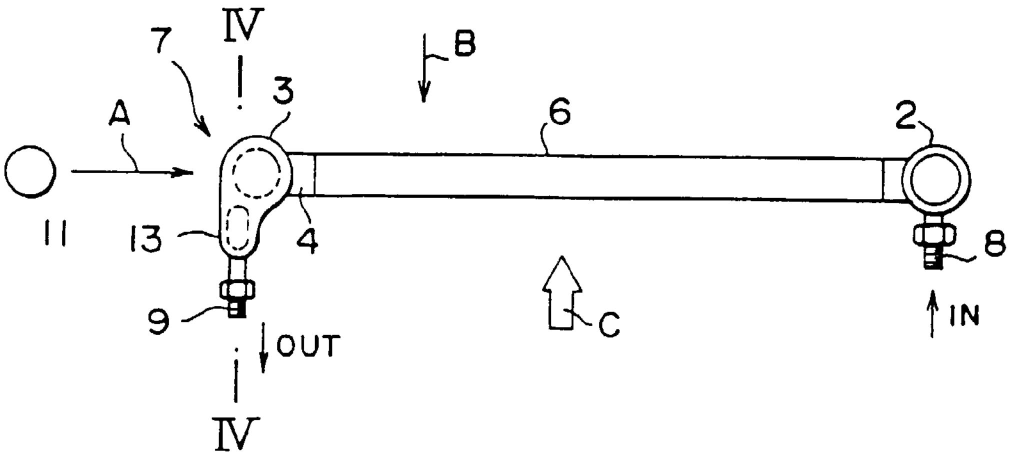

FIG. 3

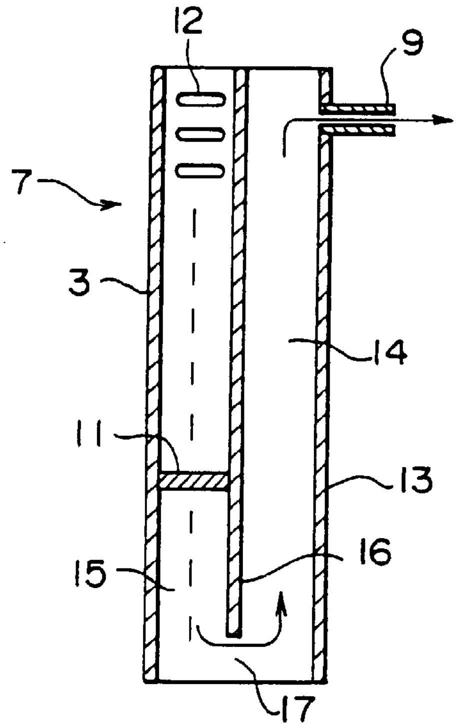

FIG. 4

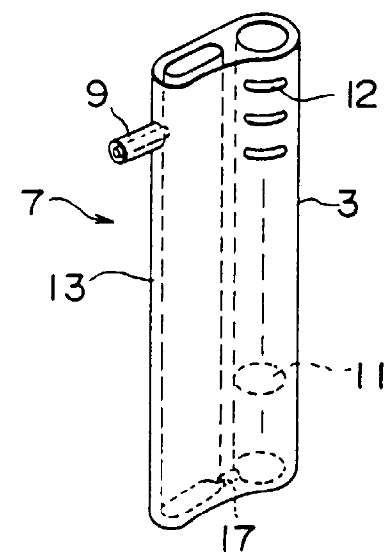

FIG. 5

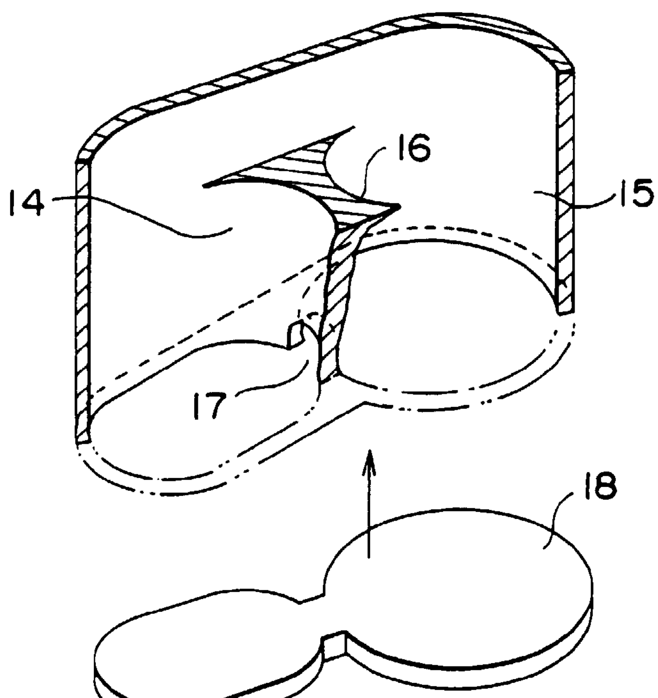

FIG. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 97 30 2587

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.6)
Y	PATENT ABSTRACTS OF JAPAN vol. 096, no. 002, 29 February 1996 & JP 07 280389 A (NIPPONDENSO), 27 October 1995, * abstract; figures 1,2,5,7,10 *	1	F25B39/04 F28F9/02
Y	PATENT ABSTRACTS OF JAPAN vol. 095, no. 004, 31 May 1995 & JP 07 012492 A (SANDEN), 17 January 1995,	1	
A	* abstract; figure 2 *	4	
A	PATENT ABSTRACTS OF JAPAN vol. 018, no. 363 (M-1635), 8 July 1994 & JP 06 094330 A (ZEXEL), 5 April 1994, * abstract *	1-4	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

F25B
B60H
F28F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29 August 1997	Goeman, F

CATEGORY OF CITED DOCUMENTS

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