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(54) Scroll for scroll compressor

(57) In a scroll compressor, strength of a spiral wall in a scroll is improved, without deteriorating workability or increasing liquid leakage due to internal compression. A part of a spiral in a mobile scroll (as well as in a fixed scroll) around the central inner end (as well as around the outer end) formed by a curve approaching the origin of an involute forming the inner surface of the spiral and by a curve approaching the origin of an involute forming the outer surface of the spiral is shaped differently from that of conventional examples, its wall being thicker at the base and tapered toward the edge. Therefore, strength of the spiral wall in a scroll is improved as compared with a conventional example, and neither compression nor sealing capacity is affected since neither of the parts of the spiral with tapered walls mentioned above acts as a sealing surface.

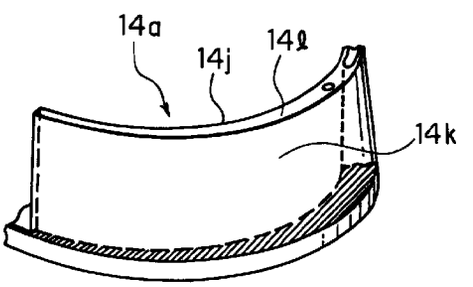

FIG. 7

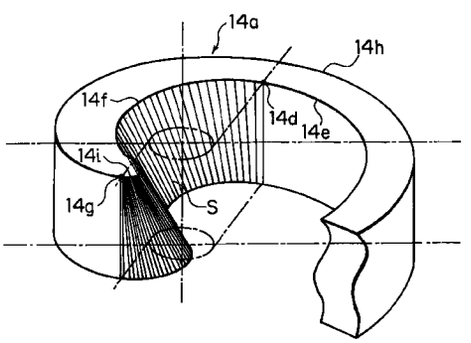

FIG. 6B

EP 0 855 508 A1

Description

Background of the Invention:

This invention relates to a scroll with improved durability for use in a scroll compressor.

The former conventional scrolls for use in scroll compressors provide the following structures for their spirals.

(1) A structure in which a fixed scroll and a mobile scroll are used in combination, where both scrolls have a spiral whose wall thickness is uniform from the base to the edge (a straight wall) along the entire circumference.

Fig. 1A shows an example of this structure where a spiral 13a of a fixed scroll 13 is used in combination with a spiral 14a of a mobile scroll 14.

(2) A structure in which a fixed scroll and a mobile scroll are used in combination, where both scrolls have a spiral whose wall thickness is uniform from the base to the edge but reduces gradually along the circumference as the angle of the curve increases.

This structure is disclosed in, for example, Japanese Unexamined Patent Publications (JP-A) Nos. 13184/1983 and 279785/1992.

(3) A structure in which spirals of both fixed and mobile scrolls are tapered from the base toward the edge, along the entire circumference.

An example of this structure is disclosed in Japanese Unexamined Patent Publication (JP-A) No. 225002/1991. Furthermore, Fig. 1B shows an example in which the spiral 13a of the fixed scroll 13 is used in combination with the spiral 14a of the mobile scroll 14.

With respect to the wall thickness of a spiral of a scroll, the structure shown in (3) above is more rational than those shown in (1) and (2), from the view point of optimization of strength distribution along the height of the wall. In other words, the strength per scroll meat of the structure having the tapered wall shown in (3) is stronger than that of the structure having the straight wall shown in (1) and (2).

However, the structure shown in (3) with the wall of the spiral tapered along the entire circumference poses difficulty concerning workability and control of the dimensional accuracy as compared with the structures in (1) and (2) with straight walls. Furthermore, as shown in an exaggerated manner in Figs. 2A and 2B, fluid leakage due to internal compression from axial clearance C at the sealed parts between the fixed scroll 13 and the mobile scroll 14 do not differ significantly among the structures in (1), (2), and (3). Here, sealing member 21 is attached to edge surfaces of both spirals 13a and 14a of the fixed scroll 13 and the mobile scroll 14, respectively, and the sealing members 21 for both spirals adjust the axial clearance C and maintain sealing capacity. However, for the structure in (3), liquid leakage due to internal compression from the clearance D in the direction of spiral walls between the wall 13a of the fixed scroll 13 and the wall 14a of the movable scroll 14 is greater as compared with that of the structures in (1) and (2). Namely, the total volume of liquid leakage of the structure having the tapered wall shown in (3) is more than that of the structure having the straight wall shown in (1) and (2), when the liquid leakage due to the internal compression from the clearance D is taken into account.

Summary of the Invention:

It is therefore an object of this invention to improve the strength of spiral walls in a scroll of a scroll compressor, without deteriorating workability for the walls in a scroll, and furthermore without increasing liquid leakage due to internal compression.

According to this invention, there is provided a scroll compressor having a scroll equipping a spiral wall, the spiral wall having a tapered form at the central inner end portion thereof which does not affect compression or sealing capacity.

Also according to this invention, there is provided a scroll compressor having a scroll equipping a spiral wall, the spiral wall having a tapered form at the outer end portion thereof which does not affect compression or sealing capacity.

Furthermore, according to this invention, there is also provided a scroll compressor having a scroll equipping a spiral wall, the spiral wall having a tapered form at the central inner end and the outer end portions thereof which do not affect compression or sealing capacity.

Brief Description of the Drawing:

Fig. 1A is a sectional view of the main part of a conventional scroll compressor whose spirals have straight walls;

Fig. 1B is a sectional view of the main part of a conventional scroll compressor whose spirals have tapered walls;

Fig. 2A is a sectional view showing a clearance between the walls of the fixed and movable scrolls shown in Fig. 1A;

Fig. 2B is a sectional view showing clearances between the walls of fixed and movable scrolls shown in Fig. 1B;

Fig. 3A is a plan view of a mobile scroll (with which a fixed scroll is identical) of the conventional scroll compressor;

Fig. 3B is a perspective view of the part b (around the outer end of a spiral) shown in Fig. 3A;

Fig. 4 is a sectional view of an entire scroll compressor mechanism according to an embodiment of this invention;

Fig. 5 is a plan view of a movable scroll (with which a fixed scroll is identical) according to the embodiment of this invention;

Fig. 6A is an enlarged plan view of the part a (around the inner end at the center of the spiral) shown in Fig. 5;

Fig. 6B is an enlarged perspective view of the part a (around the inner end at the center of the spiral) shown in Fig. 5; and

Fig. 7 is a perspective view of the part b (around the outer end of the spiral) shown in Fig. 5.

Description of the Preferred Embodiment:

Referring to Figs. 4 to 7, the description will proceed to a preferred embodiment of this invention.

At first, the entire mechanism of a scroll compressor according to a preferred embodiment of this invention will be outlined.

In Fig. 4, the scroll compressor has a compressor housing 10 comprising a front end plate 11 onto which a cup-shaped portion 12 is fixed.

Within the compressor housing 10 a fixed scroll 13 and a mobile scroll 14 are placed. The fixed scroll 13 comprises a side plate 13b, a spiral 13a formed on one side of the side plate 13b, and a base 13c placed on the side plate 13b opposite to the spiral 13a. The base 13c is fixed onto an inner wall of a bottom end 12a of a cup-shaped portion 12, by means of a bolt 15 screwed into the cup-shaped portion 12 from the outer surface of the cup-shaped portion 12. On the other hand, the gap between the outer surface of the side plate 13b of the fixed scroll 13 fixed inside the cup-shaped portion 12 and the inner surface of the cup-shaped portion 12 is sealed with a sealing material 23, thus partitioning an exhaust chamber 16 and an intake chamber 17 inside the cup-shaped portion 12.

The mobile scroll 14 comprises a side plate 14b and a spiral 14a formed on one side of it. The spiral 14a and the spiral 13a of the fixed scroll 13 are arranged so as to exert compression strength on fluid. A shaft 18 of the scroll compressor passes through the frond end plate 11 and is supported so as to allow free rotation. The mobile scroll 14 is fixed onto the shaft 18 so that it revolves around a circular orbit as the shaft 18 rotates, without rotating on its own axis. The mechanism to allow revolution of the mobile scroll 14 while suppressing the rotation on its own axis is not detailed here, since numerous examples of such a mechanism have already been proposed and published.

When the mobile scroll 14 is motivated by the shaft 18, liquid flows into the intake chamber 17 inside the compressor housing 10, through an intake port 19 formed on the cup-shaped portion 12. From here, the liquid is taken into a pocket formed between the spirals 13a and 14a. Furthermore, the liquid is sent to the central part of the mechanism while being pressurized gradually by the motion of the mobile scroll 14, pressed into the exhaust chamber 16 through an exhaust port 13d opened on the side plate 13b of the fixed scroll 13, and then sent out of the compressor housing 10 through an exhaust port 20.

Further, the description will proceed to the form of a spiral of a mobile scroll in a scroll compressor, referring to Figs. 5 to 7. It should be noted that since a fixed scroll is matched with a mobile scroll, the form of the fixed scroll is symmetrical with that of the mobile scroll.

Fig. 5 shows the mobile scroll 14 according to the embodiment of this invention, which is an improved version of the conventional mobile scroll 14 shown in Figs. 3A and 3B.

(1) Inner end at the center of a spiral (part a)

Referring to Figs. 6A and 6B which show a mobile scroll 14 according to the embodiment of this invention, a portion of the spiral 14a having an inner wall formed as an involute 14e and an outer wall as an involute 14h is identical in form with its counterpart in the conventional example shown in Fig. 3A, and functions as a sealing surface. Here, 14c is a base circle for the involute.

The portion of the spiral 14a of the mobile scroll 14 according to an embodiment of this invention formed by a curve 14f approaching an origin 14d of the involute for the inner surface and a curve 14i approaching an origin 14g of the involute for the outer surface is shaped differently from its counterpart in the conventional example shown in Fig. 3A, since the wall of the spiral 14a is tapered from its base toward the edge at this portion (i.e., the surface S indicated in Figs. 6A and 6B). Therefore, the strength of the wall of the spiral 14a is greater than that of the conventional example. Furthermore, neither compression nor sealing capacity is affected since the surface S formed by the curve 14f approaching the origin 14d of the involute for the inner surface and by the curve 14i approaching the origin 14g of the involute for the outer surface is not a sealing surface.

(2) Outer end of a spiral (part b)

In Fig. 7, the outer end of the spiral 14a of the mobile scroll 14 according to the embodiment of this invention has an inner wall surface 14j, which is formed identically with that of the conventional example shown in Fig. 3B and is a sealing surface. An outer wall surface 14k has an edge surface 14l formed identically with that of the conventional example, but the wall thickness increases toward the base. That is, the surface 14k is slightly tapered. The outer wall surface 14k is not a sealing surface, so neither compression nor sealing capacity is affected. Therefore, working accuracy is not so strict as that required for a sealing surface. Casting surface is also acceptable for the outer wall surface 14k.

According to the foregoing description, it is apparent that the following effects can be obtained according

to the present invention.

(1) The strength of the wall of a spiral is increased without modifying compressor diameter, intake capacity of a pocket formed between the spirals of fixed and mobile scrolls, pitch of the spiral, wall thickness, etc., and without lowering productivity.
(2) All the parts of a spiral of a scroll which bear compression and sealing capacity is that of a straight wall, therefore facilitating processing and management.
(3) Parts of a spiral wall which would not bear compression or sealing capacity are tapered, thus improving not only the strength per scroll meat but also the durability of the spiral in the scroll, since the wall around the central inner end of the spiral that must bear the greatest load under high temperature and pressure when the compressor is being motioned, as well as the wall around the outer end that must bear the greatest load when liquid is being compressed, can be strengthened.

Claims

1. A scroll compressor having a scroll equipping a spiral wall, said spiral wall having a tapered form at the central inner end portion thereof which does not affect compression or sealing capacity.

2. A scroll compressor having a scroll equipping a spiral wall, said spiral wall having a tapered form at the outer end portion thereof which does not affect compression or sealing capacity.

3. A scroll compressor having a scroll equipping a spiral wall, said spiral wall having a tapered form at the central inner end and the outer end portions thereof which do not affect compression or sealing capacity.

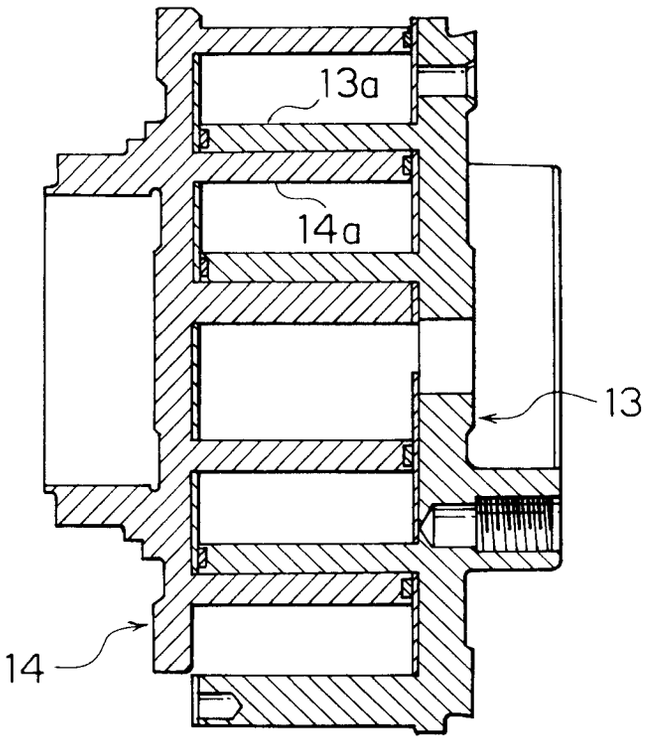

FIG. 1A
PRIOR ART

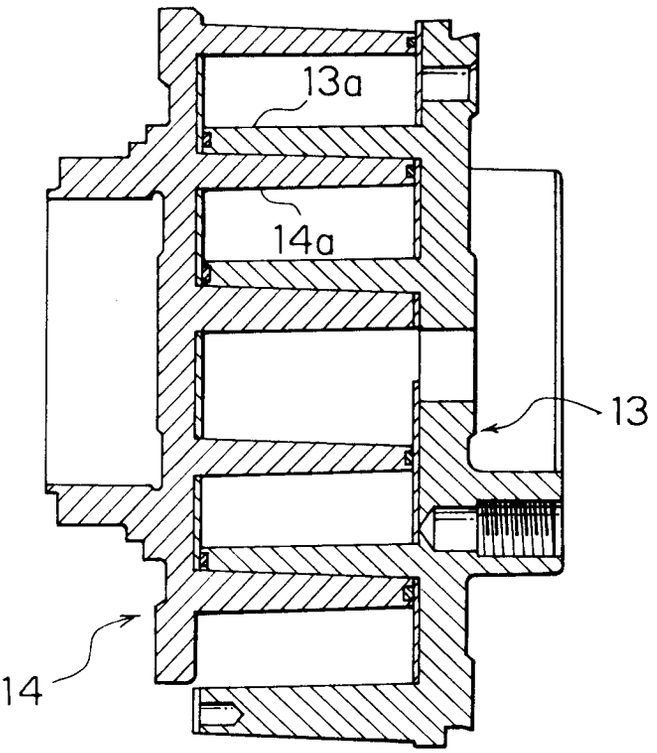

FIG. 1B
PRIOR ART

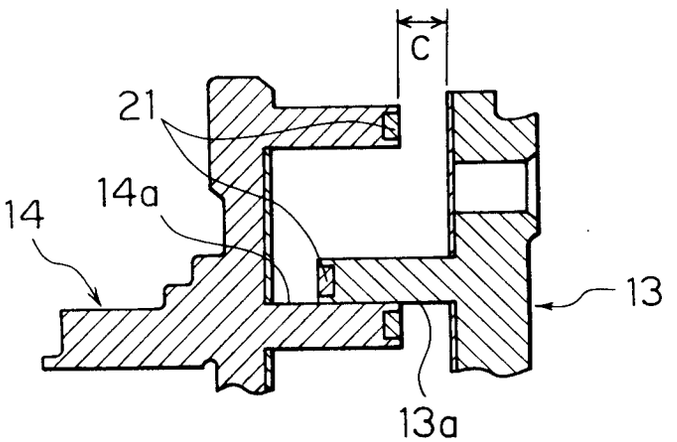

FIG. 2A
PRIOR ART

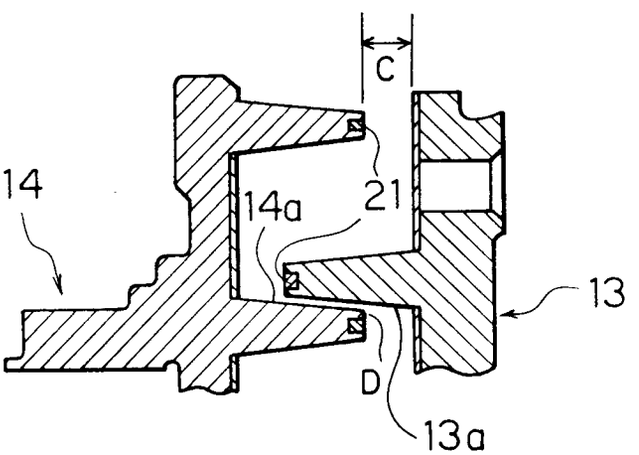

FIG. 2B
PRIOR ART

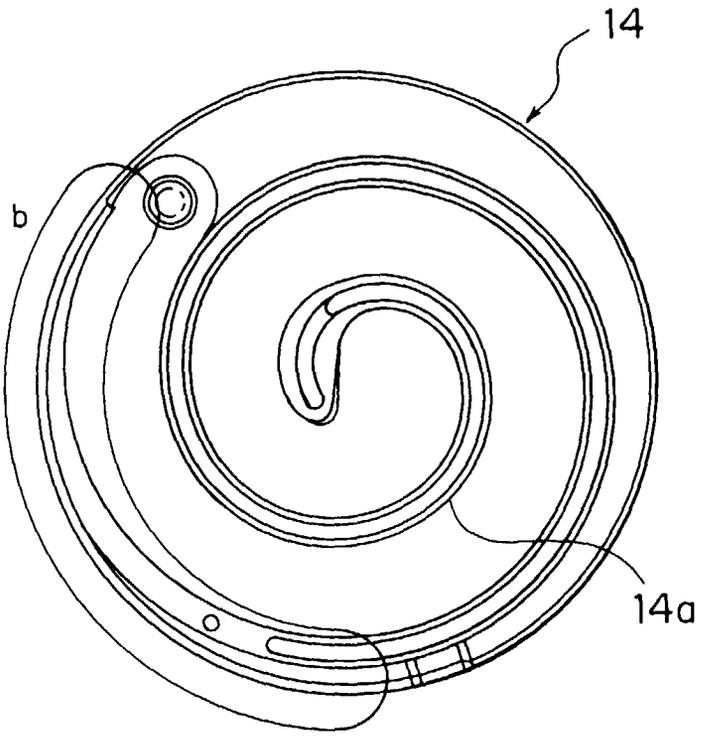

FIG. 3A
PRIOR ART

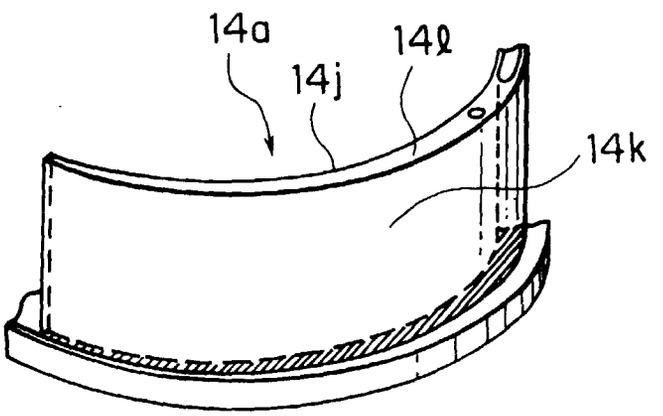

FIG. 3B
PRIOR ART

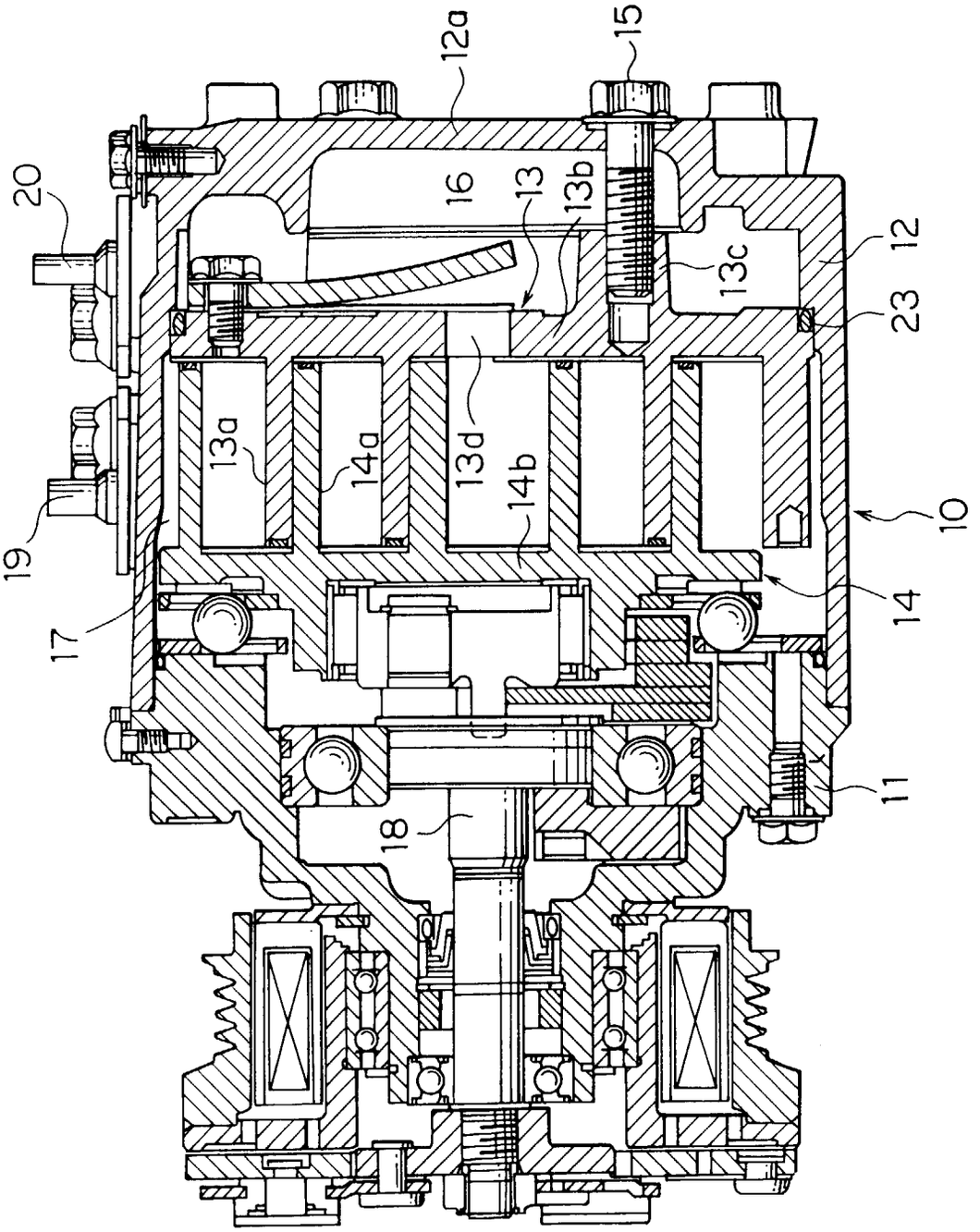

FIG. 4

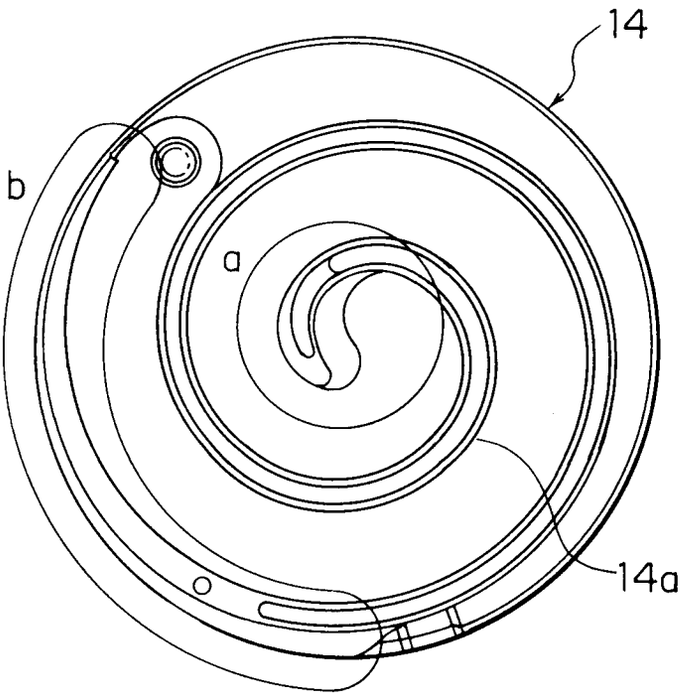

FIG. 5

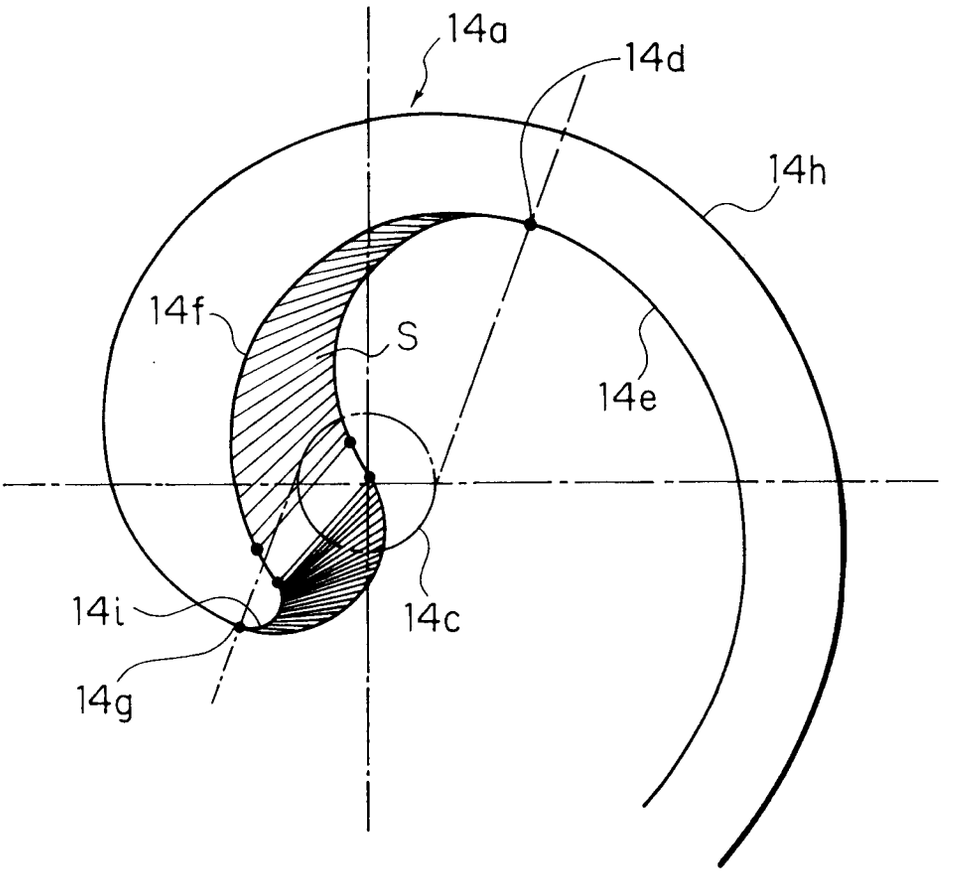

FIG. 6A

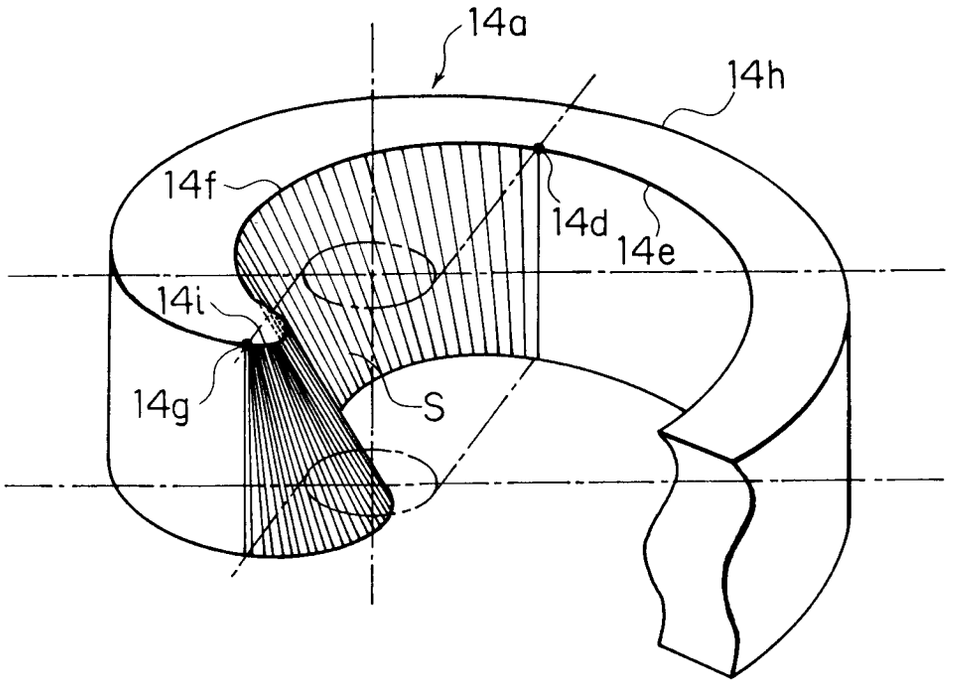

FIG. 6B

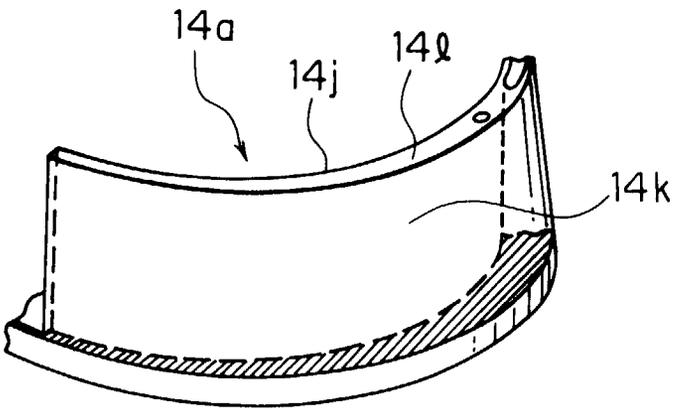

FIG. 7

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 10 0894

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)
X Y	US 5 037 279 A (SUEFUJI ET AL.) * claim 1; figure 2 * ---	1 3	F04C18/02
X	PATENT ABSTRACTS OF JAPAN vol. 13, no. 376 (M-862) '3724! , 21 August 1989 & JP 01 130083 A (SANYO ELECTRIC CO LTD.), 23 May 1989, * abstract * ---	1	
X Y	EP 0 392 975 A (AGINFOR AG) * claim 1; figure 1 * ---	2 3	
A	EP 0 106 288 A (SANDEN CO.) * claim 1; figure 9 * ---	1,3	
A	US 5 059 102 A (TOKUMITSU ET AL.) * claim 1; figures 2,5 * ---	2,3	
A	PATENT ABSTRACTS OF JAPAN vol. 8, no. 9 (M-268) '1446! , 14 January 1984 & JP 58 172405 A (HITACHI SEISAKUSHO K.K.), 11 October 1983, * abstract * -----	2,3	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

F04C
F01C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	1 April 1998	Dimitroulas, P

CATEGORY OF CITED DOCUMENTS

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