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(54) Scroll type compressor in which an oil seal is formed between an involute wall and an end plate confronting with the involute wall in an axial direction

(57) There is provided a scroll type compressor using lubricant oil and including a pair of scroll members (20, 30) confronting with each other in an axial direction. Each of the scroll members has an end plate (22, 32) extending perpendicular to the axial direction and an involute wall (21, 31) having a first and a second axial end which are opposite to each other in the axial direction. The first axial end is connected to the end plate. The second axial end confronts with the end plate of a counterpart one of the scroll members. In the scroll type compressor, the second axial end has a shallow groove (26, 36) with a depth for suitably holding therein the lubricant oil to form an oil seal between the second axial end and the end plate that confronts with the second axial end.

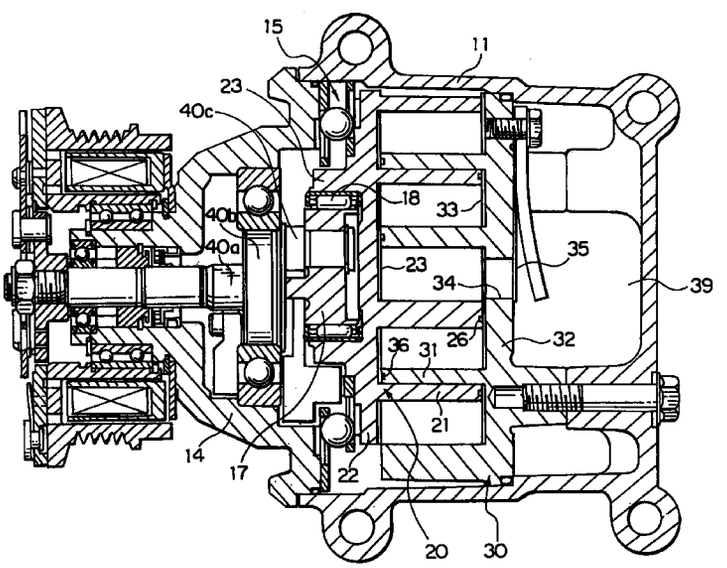

FIG. 3

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Description

Background of the Invention:

[0001] The present invention relates in general to a compressor used for refrigerating air conditioners and more particularly to a scroll type compressor known in the art.

[0002] A conventional scroll type compressor includes a fixed scroll member and a movable scroll member confronting with the fixed scroll member in an axial direction. The fixed scroll member is fixed to a casing and comprises an end plate extending perpendicular to the axial direction and an involute wall connected integral with the end plate. The movable scroll member is unrotationally but orbitally moved in the casing and comprises an end plate extending perpendicular to the axial direction and an involute wall connected integral with the end plate. A plurality of compression spaces or chambers are defined between the fixed and the movable scroll members in the manner known in the art.

[0003] Referring to Fig. 1, a hatched portion 1 represents one of the compression chambers. There are additional five compression chambers (not hatched) are formed in the drawing. The compression chambers thus formed become smaller in size as it goes to the center of the involutes and, in other words, the gas taken from the outer circumferential portion (hatched portion) is compressed and become a compressed gas at the compression chamber located at the central portion.

[0004] There will be no problem if the fixed and the movable scroll members are balanced in mutual engagement or parallel relation during a driving operation of the movable scroll member. Actually, it is assumed that a gap is produced between the involute wall 2 of the movable scroll member and the involute wall 3 of the fixed scroll member due to degradation of balanced parallel relation of the involute walls 2 and 3. Consequently, the compressed gas is released unexpectedly through the gap.

[0005] In such a case as described above, there will be a serious problem of reduction of compression efficiency, that is, reduction of property in the compressor. Particularly, at the central portion of the scroll walls where the pressure is elevated, leakage of the compressed gas is of great amount. In view of the foregoing situation, an attempt has generally been made to use a chip seal method which will presently be described.

[0006] Referring to Fig. 2, the involute wall 2 of the movable scroll member is provided with a deep groove 4 at its upper end surface. A chip seal 5 is placed in the deep groove 4 for filling a gap relative to a bottom plate 6 which is placed between the end plate 7 of the fixed scroll member and the involute wall 2 of the movable scroll member. Therefore, a gas is prevented from leakage thereof by the application of the chip seal 5. A similar construction is applied between the involute wall of the fixed scroll member and the end plate of the movable scroll member.

[0007] However, the chip seal method requires more parts and elements and results in some trouble and difficulty in assembly of the elements and also results in higher cost in production. Further, working of the deep groove 4 for the chip seal 5 requires an advanced technique and longer time of working. In addition, the chip seal method requires the deep groove 4 to be engraved for snugly fitting therein the chip seal 5, for example, as deep as 1.4 mm in case of a chip seal groove for compressor of a refrigerating air conditioner. Therefore, a relatively long time needs for working and processing. Further, use of the chip seal 5 requires a great number of parts and elements to be assembled and more steps for assembly and, therefore, results in an increase of the cost for production and assembly.

[0008] Examples of the scroll type compressor without employing a chip seal as described above will be shown in Japanese Patent Publication Nos. 9-21390 and 7-259761, for example. In the former case of the publications, suggestions are made to set a base plate having a projection on to the end plate of the involute members, and to dispose a resilient seal member and a base plate of a lubricant material. The suggestions described above need no processing or working step of high precision as required in the method of using the chip seal. In the latter case, a suggestion is made to provide involute members made of ceramic particle reinforced aluminum matrix composition. Reportedly, this suggestion requires no chip seal.

[0009] However, these examples can not be manufactured by the use of a conventional manufacturing method and apparatus which is developed for manufacturing the conventional scroll type compressor having the chip seal. Therefore, it is necessary to develop a new manufacturing method and apparatus. This results in higher cost in production.

Summary of the Invention:

[0010] It is an object of the present invention to provide a scroll type compressor in which a compressed gas can be prevented from leakage thereof without using a chip seal.

[0011] It is another object of the present invention to provide a scroll type compressor of the type described, which can be manufactured by the use of a conventional manufacturing method and apparatus.

[0012] Other objects of the present invention will become clear as the description proceeds.

[0013] A scroll type compressor to which the present invention is applicable uses lubricant oil and includes a pair of scroll members confronting with each other in an axial direction. Each of the scroll members comprises an end plate extending perpendicular to the axial direction and an involute wall having a first and a second axial end which are opposite to each other in the axial direction. The first axial end is connected to the end

plate. The second axial end confronts with the end plate of a counterpart one of the scroll members. In the scroll type compressor, the second axial end of at least one of the scroll members has a shallow groove with a depth for suitably holding therein the lubricant oil to form an oil seal between the second axial end and the end plate that confronts with the second axial end.

Brief Description of the Drawing:

[0014]

Fig. 1 is an explanatory view of a conventional scroll type compressor;
Fig. 2 is an enlarged sectional view of a part of the conventional scroll type compressor;
Fig. 3 is a sectional view of a scroll type compressor according to an embodiment of the present invention;
Fig. 4 is an enlarged sectional view of a part of the scroll type compressor shown in Fig. 3;
Fig. 5 is a plan view of a movable scroll member included in the scroll type compressor of Fig. 3;
Fig. 6 is an explanatory view for describing the scroll type compressor shown in Fig. 3;
Fig. 7 is a plan view of a modification of the movable scroll member of Fig. 5;
Fig. 8 is a plan view of another modification of the movable scroll member of Fig. 5;
Fig. 9 is a sectional view of a combination of a fixed and a movable scroll member included in a scroll type compressor according to another embodiment of the present invention; and
Fig. 10 is a sectional view of a part of a scroll type compressor according to a still another embodiment of the present invention; and
Fig. 11 is a plan view of a part of a movable scroll member included in the scroll type compressor of Fig. 10.

Description of the Preferred Embodiments:

[0015] With reference to Fig. 3, description will be made as regards a scroll type compressor according to an embodiment of the present invention. The scroll type compressor comprises a casing 11 and movable and fixed scroll members 20 and 30 which are contained in the casing 11 and confront with each other in an axial direction. The movable and the fixed scroll members 20 and 30 have involute members 26 and 36 end plates 22 and 32, respectively. Each of the involute walls 21 and 31 has a first and a second axial end which are opposite to each other in the axial direction. In each of the movable and the fixed scroll members 20 and 30, the first axial end is connected integral with each of the end plate. The second axial end confronts with the end plate of a counterpart one of the movable and the fixed scroll members 20 and 30. In the manner known in the art, bottom plates 23 and 33 are placed on the end plates 22 and 32.

[0016] The movable and the fixed scroll members 20 and 30 are engaged with each other in a confronting relation with their involute curves offset at 180 angular degrees with each other. As a result, a plurality of compression spaces are defined between the movable and the fixed scroll members 20 and 30 in the manner known in the art.

[0017] The fixed scroll member 30 is fixed in the casing 11. The movable scroll member 20 is unrotationally but orbitally movably supported, in a front housing 14, on the side opposite to the side of the involute member 21 of the end plate 22 through a rotation-preventive mechanism 15. So that, the movable scroll member 20 provides an orbital motion along its orbital way. A boss portion 23 in the form of projection is disposed nearer to the central portion of the end plate 22 of the movable scroll member 20.

[0018] The driving mechanism comprises an enlarged portion 40b disposed at an end of the driving shaft 40a, an eccentric pin 40c disposed on the opposite side of the driving shaft 40a of the enlarged portion 40b, and an eccentric bush 17 disposed in the boss portion 23 through a drive bearing 18 to permit an orbital motion of the movable scroll member 20. The boss portion 23 serves to rotatably support the eccentric bush 17 through the drive bearing 18.

[0019] When the movable scroll member 20 is orbitally moved, a fluid is sucked in each compression space and is compressed by the revolution-preventive, orbital motion of the movable scroll member 20 relative to the fixed scroll member 30 with movement to a central portion of the involute members 21, 31. Thereafter, the fluid is discharged from the discharge hole 34 disposed at a center of the end plate 32 into a discharge chamber 39. At the discharge hole 34 is provided a discharge valve 35 known in the art.

[0020] Referring to Figs. 4 and 5 in addition, a shallow groove 26 is provided along the second axial end of the involute wall 21 of the movable scroll member, a hatched portion representing the shallow groove 26. The shallow groove 26 continuously extends from a center portion of the involute wall 21 towards a peripheral portion thereof to form an involute shape known in the art. The shallow groove 26 is cooperated with the bottom plate 33 to form a space for storing therein a lubricant oil generally used in the scroll type compressor. So that, an oil seal is formed by the lubricant oil between the second axial end of the involute member 26 and the bottom plate 33 to prevent a gas leakage.

[0021] With reference to Fig. 6, the description will be directed to the oil seal designated by a reference numeral 41. The oil seal 41 is formed by the lubricant oil extending from the shallow groove 26 between the involute wall 21 of the movable scroll member and the bottom plate 33 of the fixed scroll member. It was found that the oil seal 41 serves to prevent leakage of a com-

pressed gas housed in the compression space 42 defined between the movable and the fixed scroll members. Now, it will be essential that the shallow groove 26 has such a depth as to provide an oil reservoir and, in addition, the oil seal 41 in order to obtain the effects and advantages as described above.

[0022] If the shallow groove 26 is too deep, all of the lubricant oil is gathered in the shallow groove 26 so that a gaseous layer is formed over the shallow groove 26, resulting in failure in forming of the oil seal.

[0023] On the other hand, if the shallow groove 26 is too shallow, no oil seal can be formed. Thus, the shallow groove 26 should be designed to have a desired depth that it is capable of capturing effect of the lubricant oil and formation of the oil seal.

[0024] Namely, the depth of the shallow groove 26 is required to provide a function of serving as an oil reservoir and a condition of forming the oil seal and it was found that desirable range of the depth is about 0.02mm-0.2mm. The shallow groove 26 is easily formed since it has less depth. In the case of a compressor for a refrigerator, an experimental test of performance proved to be substantially equivalent to that of the convention structure when the depth of the shallow groove 26 is 0.05mm.

[0025] The description will be directed to a mobility of the lubricant oil. When a flow-in and flow-out of the lubricant oil to and from the shallow groove 26 are balanced with each other, it is considered that a sort of a mobile or movable seal is formed depending upon a relation between a viscosity of the lubricant and a flowing speed of it. When the balanced relation described above is defected or imbalanced, the oil seal is broken to result in formation of a flow of an air layer (refrigerant) in a gap and/or reduction or damage of a function as the oil reservoir.

[0026] Returning back to Fig. 3, a shallow groove 36 is provided along the second axial end of the involute wall 31 of the movable scroll member 30. The shallow groove 36 has a structure which is similar to that of the shallow groove 26 described above. Therefore, detail description will be omitted as regards the shallow groove 36.

[0027] With reference to Fig. 7, the description will be made as regards a modification of the shallow groove 26. A hatched portion represents the shallow groove 26. In the modification, the shallow groove 21 is made only at a central portion of the involute wall 21 of the movable scroll member 20.

[0028] With reference to Fig. 8, the description will be made as regards another modification of the shallow groove 26. Hatched portions represent the shallow groove 26. In the modification, the shallow groove 26 intermittently extends from the central portion of the involute wall 21 towards the peripheral portion thereof. In other words, the shallow groove 26 comprises a plurality of groove portions 43 which are adjacent to each other along an involute curve of the involute wall 21 with a ungrooved stop 44 between the adjacent groove portions 43.

[0029] In the example of Fig. 5 in which the long and continuous groove 26 is formed, a gas leakage is prevented at not only a central one of the compression chambers but also an outer one of the compression chambers.

[0030] In the example of Fig. 7 in which the shallow groove 26 is formed at the central portion only, gas leakage prevention is concentrated on the prevention of leakage of the compressed gas. This is because a gas pressure is not so large at the compression chambers located at the outer circumferential portion of the involute members 1 and therefore possibility of gas leakage at these low pressure compression chambers is not so high.

[0031] In the example of Fig. 8 in which the shallow groove 26 is intermittently or discontinuously formed. So that, when a compressed gas in the central portion is fed into the shallow groove 26, the gas is prevented from flowing toward the outer circumferential portion of low pressure through the shallow groove 26.

[0032] A gas pressure becomes increased toward a central portion and, therefore, there is possibility that gas at the central portion is flown into the shallow groove 26 by the influence of gas pressure to discharge the lubricant oil. Thus, it is preferable that an oil supplying arrangement is provided to the central portion for supplying the lubricant oil in the manner that will presently be described.

[0033] Referring to Fig. 9, two lubricant supply holes 46 and 47 are formed as the oil supplying arrangement to penetrate the fixed scroll member 30. One of the lubricant supply holes 46 is for connecting the shallow groove 26 of the movable scroll member 20 with the discharge chamber 39. Another of the lubricant supply holes 46 is for connecting the shallow groove 36 of the fixed scroll member 30 with the discharge chamber 39. With this structure, the lubricant oil is supplied from the discharge chamber 39 to the shallow grooves 26 and 36 through the lubricant supply holes 46 and 47. More particularly, the discharge chamber 39 has a higher pressure than the shallow grooves 26 and 36 and, therefore, permits the gas containing the lubricant oil flows to the shallow grooves 26 and 36 so that the lubricant oil can be supplied to the shallow grooves 26 and 36. Here, each of the lubricant supply holes 46 and 47 is designed to have a diameter large enough not to decrease the compression properties.

[0034] Referring to Figs. 10 and 11, lubricant supply grooves 48 and 49 are formed as the oil supplying arrangement at central end portions of the involute walls 21 and 31 to connect the compression chamber 42 with the shallow grooves 26 and 36, respectively. Each of the lubricant supply grooves 48 and 49 has a depth and a width so that the compression properties are not decreased. With this structure, the lubricant oil is supplied from the compression chamber 42 to the shallow

grooves 26 and 36 through the lubricant supply grooves 48 and 49. It is satisfactory that a thin groove is merely formed at the central portion of the involute walls 21 and 31 so that the groove is connected between each of the shallow grooves 26 and 36 and the compression chamber 42. Therefore, it requires no special working technique and less working time.

[0035] A sealing effect can be obtained without providing a chip seal and complex assembly steps are not required. Further, the number of parts and elements can be reduced and consequently assembly time and cost can be reduced with improvement in cost performance. Further, since mere replacement of the conventional chip seal groove with a new shallow groove in the production step of the involute members is quite satisfactory to provide the inventive structure of the scroll type compressor, the production step and procedure can be used without any change. By a mere change or replacement of the relatively deep groove for the chip seal, that is, about 1.4 mm, with the shallow groove as described above, a lubricant can be stored in the shallow groove. So that, the oil seal is produced, and consequently, gas leakage can be prevented effectively.

[0036] While the present invention has thus far been described in connection with a few embodiments thereof, it will readily be possible for those skilled in the art to put this invention into practice in various other manners. For example, only one of the shallow grooves may be omitted.

Claims

1. A scroll type compressor using lubricant oil and including a pair of scroll members confronting with each other in an axial direction, each of said scroll members comprising an end plate extending perpendicular to said axial direction and an involute wall having a first and a second axial end which are opposite to each other in said axial direction, said first axial end being connected to said end plate, said second axial end confronting with the end plate of a counterpart one of said scroll members, said second axial end of at least one of said scroll members having a shallow groove with a depth for suitably holding therein said lubricant oil to form an oil seal between said second axial end and said end plate that confronts with said second axial end.

2. A scroll type compressor as claimed in claim 1, wherein said scroll members are cooperated with each other to produce a compressed gas therebetween, said oil seal serving to prevent said compressed gas from leakage thereof through a gap left between said second axial end and said end plate that confronts with said second axial end.

3. A scroll type compressor as claimed in claim 1 or 2, wherein each of said scroll members has oil supplying means for supplying said lubricant oil to said shallow groove.

4. A scroll type compressor as claimed in claim 3, wherein said oil supplying means comprises a lubricant supply hole penetrating said involute wall and said end plate to open in said shallow groove.

5. A scroll type compressor as claimed in claim 3, wherein said oil supplying means comprises a lubricant supply groove extending from said shallow groove along said second axial end of the involute wall.

6. A scroll type compressor as claimed in one of claims 1 to 5, wherein said shallow groove extends along said involute wall to form an involute shape.

7. A scroll type compressor as claimed in one of claims 1 to 6, wherein said shallow groove continuously extends from a central portion of said involute wall towards a peripheral portion thereof.

8. A scroll type compressor as claimed in one of claims 1 to 6, wherein said shallow groove intermittently extends from a central portion of said involute wall towards a peripheral portion thereof.

9. A scroll type compressor as claimed in one of claims 1 to to 6, wherein said shallow groove made only at a central portion of said involute wall.

10. A scroll type compressor as claimed in one of claims 1 to 9, wherein the depth of said shallow groove has a range of 0.02mm to 0.2mm.

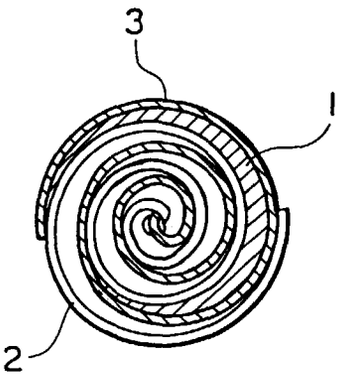

FIG. 1 PRIOR ART

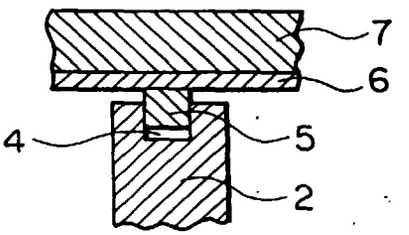

FIG. 2 PRIOR ART

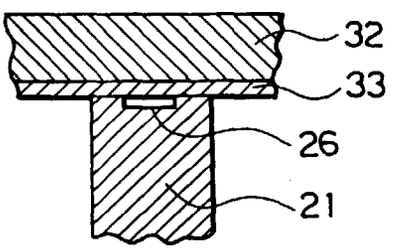

FIG. 4

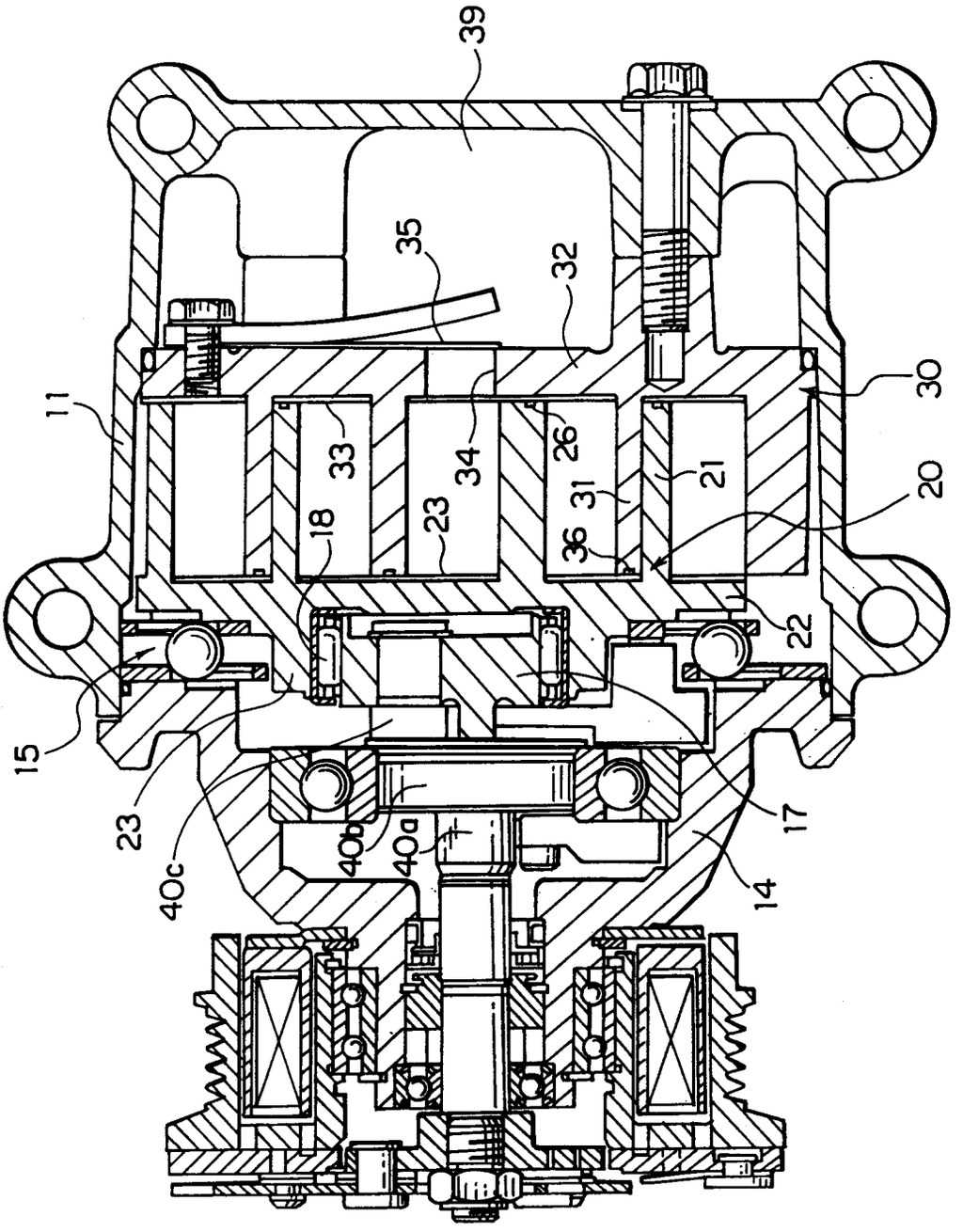

FIG. 3

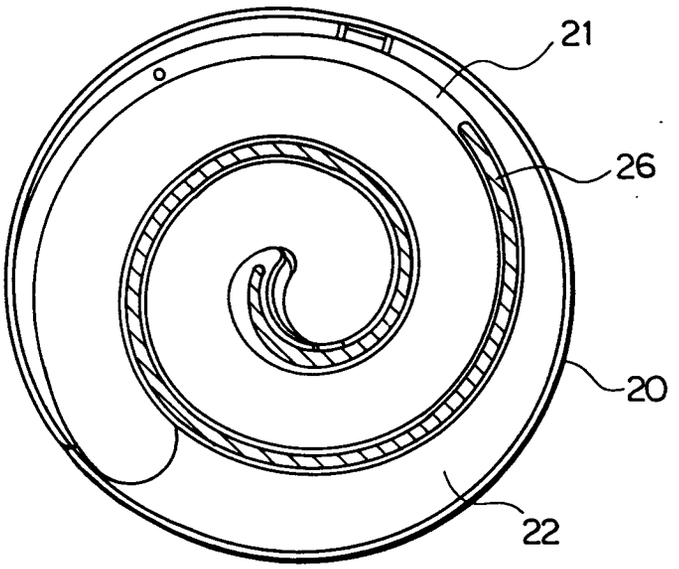

FIG. 5

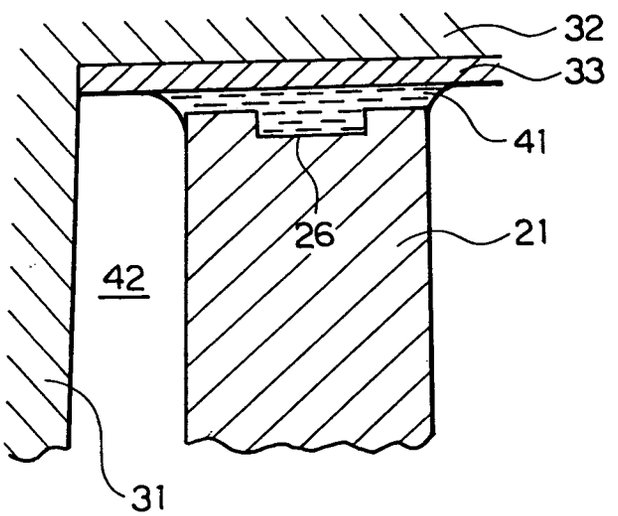

FIG. 6

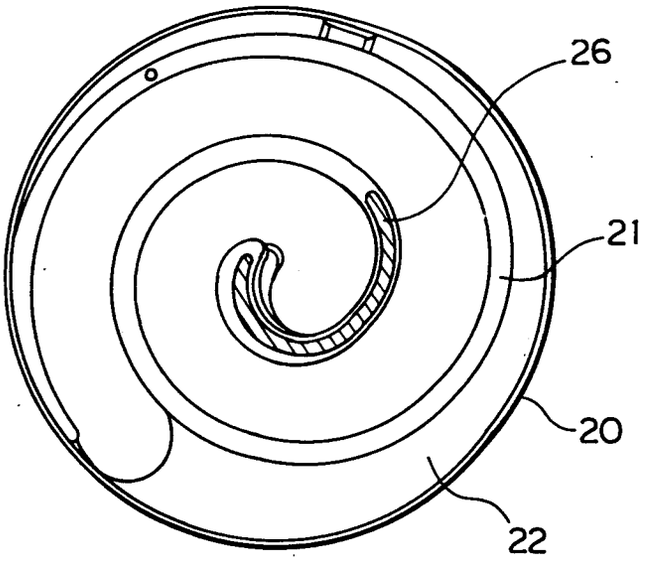

FIG. 7

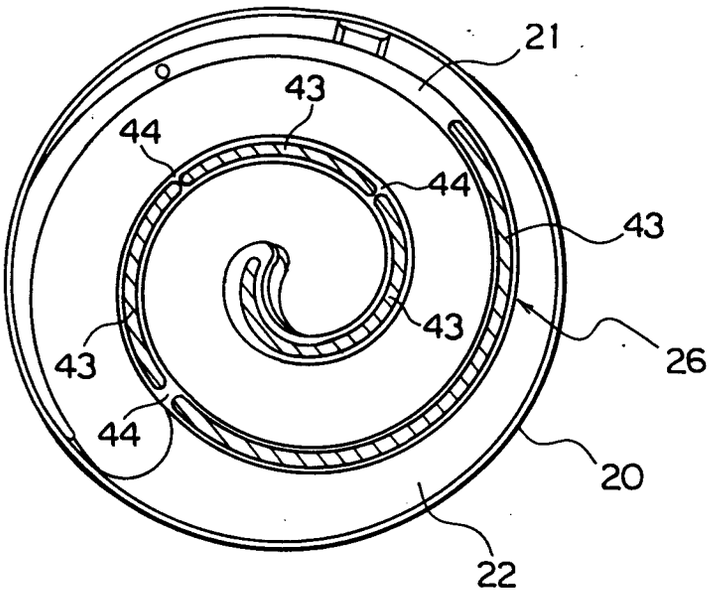

FIG. 8

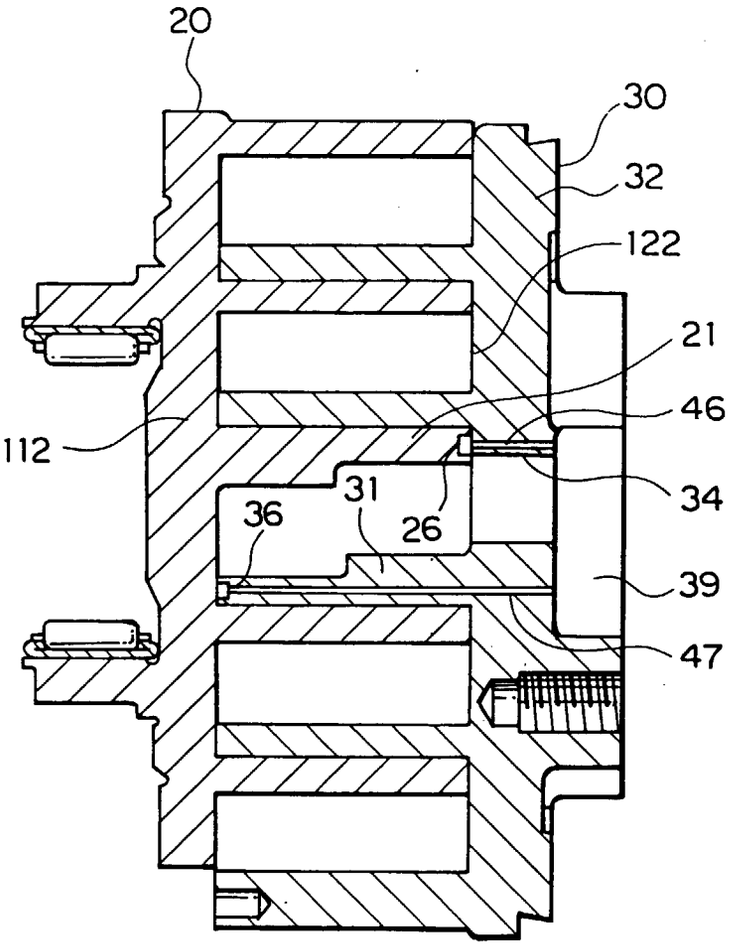

FIG. 9

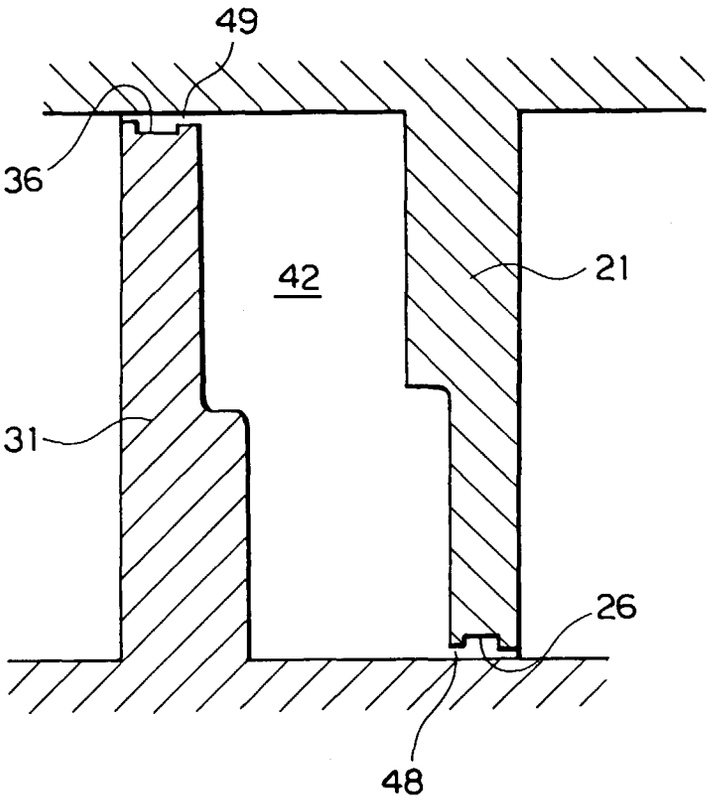

FIG. 10

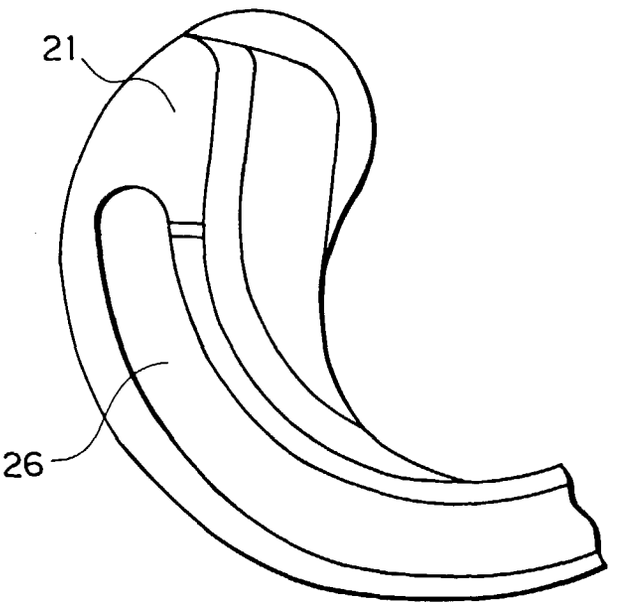

FIG. 11

European Patent Office

EUROPEAN SEARCH REPORT

Application Number EP 99112107.0

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	EP 0 840 012 A (CARRIER) 06 May 1998 * the whole document * --	1-10	F04C18/02 F04C27/00
X	US 5 421 707 A (DANIELS) 06 June 1995 * the whole document * --	1-10	
A	US 5 562 434 A (MAKINO) 08 October 1996 * the whole document * ----	1-10	

TECHNICAL FIELDS SEARCHED (Int. Cl. 6)

F04C18/00
F04C27/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	30-08-1999	WERDECKER

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Patent document cited in search report		Publication date	Patent family member(s)		Publication date
EP A1	840012	06-05-1998	CN A	1185540	24-06-1998
			JP A2	10141254	26-05-1998
			US A	5833443	10-11-1998
			US A	5873711	23-02-1999
US A	5421707	06-06-1995	none		
US A	5562434	08-10-1996	JP A2	8284851	29-10-1996

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