(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 924 432 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
23.06.1999 Bulletin 1999/25

(51) Int Cl.6: **F04C 29/00**, F04C 18/02

(21) Application number: **98123092.3**

(22) Date of filing: **10.12.1998**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **15.12.1997 JP 36253897**

(71) Applicant: **Sanden Corporation**
Isesaki-shi, Gunma 372-8502 (JP)

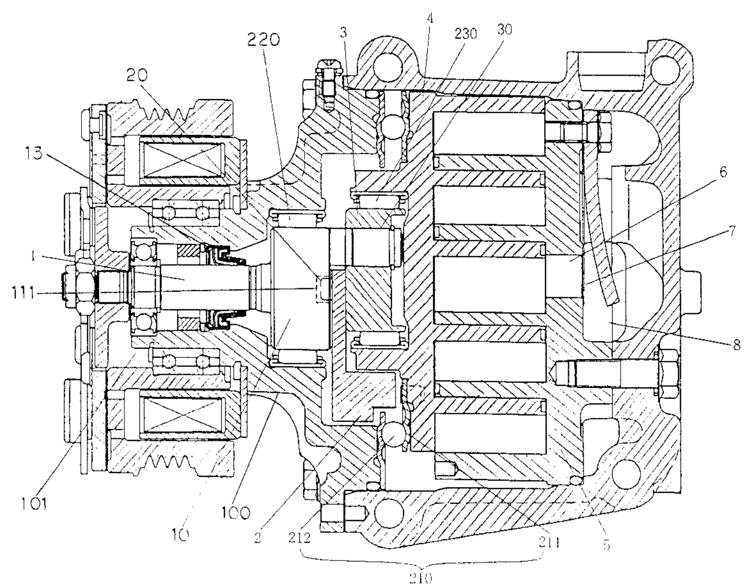
(72) Inventor: **Iizuka, Jiro**
Isesaki-shi, Gunma 372-8502 (JP)

(74) Representative: **Prüfer, Lutz H., Dipl.-Phys. et al**
PRÜFER & PARTNER GbR,
Patentanwälte,
Harthauser Strasse 25d
81545 München (DE)

(54) **Swing-link mechanism of a scroll-type compressor**

(57) A swing-link mechanism of a scroll-type compressor having an disk-shaped bushing (3) that is common for both a clockwise rotational species and a counterclockwise rotational species of a compressor, and a lubrication passageway that penetrates from a large diameter part (10) to a disk-shaped bushing (3) is disclosed. The disk-shaped bushing according to the present invention is provided with two rivet holes and one lubrication hole that are positioned symmetrically with respect to a line that passes through the center of a crank pin hole (30) and the center of the disk-shaped bushing. Because the disk-shaped bushing according to the present invention can be used for both of rotational species of the compressor, the number of parts that are stocked will be reduced, simplifying the stock management. Further, due to the lubrication passageway that penetrates from the large diameter part to the disk-shaped bushing, refrigerant gas will circulate around the swing-link mechanism during the operation of the compressor. Thus, the lubrication of the shell-type needle bearing (230) disposed between the disk-shaped bushing (3) and the boss of the orbiting scroll is greatly improved, resulting in an increased lifespan for the compressor.

Fig. 5



EP 0 924 432 A1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a scroll-type refrigerant compressor used in an automotive air conditioning system, and, more particularly, to a swing-link mechanism of a scroll-type compressor.

2. Description of the Related Art

[0002] Before proceeding with a detailed description of the present invention, the structure and operation of a known scroll-type compressor will be briefly explained.

[0003] Referring to **Fig. 1**, a known scroll-type compressor is shown. The shell of scroll-type compressor 300 comprises cup-shaped housing 9 and front housing 100. Cylindrical part 101 is integrally formed with front housing 100. Oil seal 13 is disposed within cylindrical part 101, and is mounted around drive shaft 1. Oil seal 13 prevents oil from leaking from the inside of compressor 300. Large diameter part 10 is formed integrally with drive shaft 1. Large diameter part 10 and drive shaft 1 are rotatable around axis 99, and are supported by bearings 221 in cylindrical part 101 and by bearing 220 in front housing 100, respectively.

[0004] Crank pin 110 is formed on the right side end surface of large diameter part 10. Crank pin 110 is formed integrally with large diameter part 10, and is positioned at some distance from axis 99. Accordingly, when dnve shaft 1 rotates, crank pin 110 orbits around axis 99. Crank pin 110 engages crank pin hole 30 of disk-shaped bushing 3. Disk-shaped bushing 3 can rotate around crank pin 110. The actual range of the possible rotation of the disk-shaped bushing 3 around the crank pin 110 is, however, designed to be considerably small.

[0005] When crank pin 110 orbits about axis 99, it draws disk-shaped bushing 3, which also orbits. In order to eliminate the shaking action due to the orbiting motion of the mass of disk-shaped bushing 3, counterweight 2 is fixed to disk-shaped bushing 3. At the center of the right side end surface of large diameter part 10, restriction hole 111 is provided. Cylindrical protrusion 20 is formed integrally with counterweight 2, so as to engage restriction hole 111 loosely. Disk-shaped bushing 3 is combined with counterweight 2. Accordingly, the possible rotationally possible rotation of disk-shaped bushing 3 with respect to crank pin 110 is limited by the engagement of protrusion 20 with restriction hole 111. It is designed such that the diameter of restriction hole 111 is slightly greater than the diameter of protrusion 20 (e.g., by about 0.4 mm). So, the actual range of the possible rotation of disk-shaped bushing 3 around crank pin 110 is considerably small.

[0006] Orbiting scroll 4 and fixed scroll 5 are accommodated in housing 9. Fixed scroll 5, which comprises scroll element 50 and end plate 51, is fixed within housing 9 by a plurality of bolts 150. Orbiting scroll 4 comprises scroll element 40, end plate 41, and boss 42. Disk-shaped bushing 3 engages boss 42 of orbiting scroll 4 via shell-type needle bearing 230. Between orbiting scroll 4 and front housing 100, a spin inhibition mechanism 210, comprising **two pieces of rings 212 and plurality of balls 211,** is provided. Spin inhibition mechanism 210 inhibits spin motion of orbiting scroll 4, and is well-known in the art. Scroll element 40 of orbiting scroll 4 is offset from scroll element 50 of fixed scroll 5 by 180 degrees. Through the combination of the both orbiting scroll 4 and fixed scroll 5, a plurality of enclosed compression chambers C1, C2, etc., are formed therebetween.

[0007] At the center of end plate 51 of fixed scroll 5 is provided discharge hole 6, its opening and shutting regulated by discharge valve 7. Between fixed scroll 5 and housing 9 is formed discharge chamber 8.

[0008] The transmission of driving power to drive shaft 1 is controlled by electromagnetic clutch 250.

[0009] With the above-described structure, compressor 300 operates as follows. Driving power from a power source (not shown) is transmitted to drive shaft 1 when electromagnetic clutch 250 is activated. Due to the rotation of drive shaft 1, crank pin 110 of large diameter part 10 rotates about axis 99. Due to the motion of crank pin 110, disk-shaped bushing 3 also rotates about axis 99. The motion of disk-shaped bushing 3 causes an orbiting motion of orbiting scroll 4. Refrigerant gas flowing into compressor 300 through an inlet port (not shown) will enter the outermost compression chamber C1, which is formed by fixed scroll 5 and orbiting scroll 4, and then enclosed. Due to the orbiting motion of orbiting scroll 4, compression chamber CI will be displaced toward axis 99, being rotated around axis 99, while being simultaneously compressed. The compressed refrigerant gas that reaches axis 99 pushes on and opens discharge valve 7 in order to flow into discharge chamber 8. The refrigerant gas will be pushed out via discharge port (not shown) to an external refrigerant circuit (not shown).

[0010] Referring to **Fig. 2**, known large diameter part 10, counterweight 2, and disk-shaped bushing 3 are shown. Drive shaft 1, large diameter part 10, and crank pin 110 are formed integrally. At the center of the end surface of large diameter part 10 is provided restriction hole 111. Protrusion 20 of counterweight 2 fits loosely within restriction hole 111. Crank pin 110 engages crank pin hole 30 of disk-shaped bushing 3, and disk-shaped bushing 3 being rotatable with respect to crank pin 110. Rivet holes 21 and 31 are provided in counterweight 2 and disk-shaped bushing 3.

[0011] Referring to **Fig. 3(a)**, plan views of these parts are shown. In **Fig. 3(b)**, a plan view of the assembly of these parts is shown.

[0012] There are two rotational species, or types, or compressors; one being driven in a counterclockwise direction, the other being driven in a clockwise direction. Referring to **Fig. 3(a)**, since large diameter part 10 is rotationally symmetrical, it may be used for both rotational species of compressor. As can be seen from the figure, however, since disk-shaped bushing 3 and counterweight 2 are not rotationally symmetrical, they cannot be used in both rotational species of compressors.

[0013] In actual manufacturing process, in addition to the necessity of preparing parts for the two rotational species of compressors, there is a further consideration regarding disk-shaped bushing 3.

[0014] **Fig. 4** shows a plan view of assembly of shell-type needle bearing 230 and orbiting scroll 4, as seen from the drive shaft side. It is known to use a thin shell-type needle bearing in order to prevent an increase in the overall thickness of boss 42 of orbiting scroll 4. when assembling, shell-type needle bearing 230 will be pressure inserted into boss 42. However, shell-type needle bearing 230 is structurally weak against external forces. Broken line D indicates a diameter of an enveloping circle which touches every needle bearing. Due to the pressure insertion of shell-type needle bearing 230 into boss 42, the resultant diameter D uncontrollably deviates from its intended value.

[0015] As explained before, disk-shaped bushing 3 engages within shell-type needle bearing 230. The smoothness of the mutual sliding of disk-shaped bushing 3 and shell-type needle bearing 230 greatly affects the lifespan of the compressor. Therefore, it is desired to reduce or prevent any unnecessary stress from existing in shell-type needle bearing 230. For that purpose, several kinds of disk-shaped bushings 3, each having slightly different diameters that appropriately fit the actual inner diameter D, are prepared. About 8 kinds of disk-shaped bushings are typically produced, each differing by about 5 micrometers in diameter.

[0016] Thus, with the known scroll-type compressor, two types of disk-shaped bushing 3 must be produced, one for the counterclockwise rotational species, and one for the clockwise rotational species. For each type of disk-shaped bushing 3, eight different sizes are produced. Consequently, the total number of disk-shaped bushings produced may be 16. The management of the stock of the 16 kinds of the disk-shaped bushing 3 and the management of the supply of them to the compressor line are difficult, and results in an increase in the overall cost of the compressor.

[0017] Therefore, a need has arisen to improve the structure of the swing-link mechanism to resolve the problem of the troublesome management of the stock of many kinds of disk-shaped bushings.

[0018] Furthermore, and with reference to **Fig. 1**, because the space adjacent recess 33 of disk-shaped hushing 3 is a closed space, a path of lubrication stream for shell-type needle beanng 230 was blocked. As a result, the lubrication of shell-type needle bearing 230 was insufficient. Therefore, it has been desired to improve the structure for the lubrication of the swing-link mechanism in order to lengthen the lifespan of the compressor.

SUMMARY OF THE INVENTION

[0019] Accordingly, it is an object of the present invention to provide a structure for the swing-link mechanism that reduces the overall number of species of disk-shaped bushings for the scroll-type compressor that must be produced. To that end, the present invention provides a common disk-shaped bushing that may be used in both the counterclockwise-driven compressor and the clockwise-driven compressor, so that the number of kinds of disk-shaped bushings can be reduced in half.

[0020] It is another object of the present invention to provide a swing-link mechanism with an improved structure for lubricating the shell-type needle bearing.

[0021] A swing-link mechanism of a scroll-type compressor is disclosed. The swing-like mechanism includes a large diameter part that is formed integrally with a drive shaft, a disk-shaped bushing that is engaged rotatably with a crank pin that protrudes from the end surface of the large diameter part. The disk-shaped bushing has two rivet holes that are formed therethrough. The swing-like mechanism also includes a counterweight that is combined with the disk-shaped bushing by rivets. The counterweight has two nvet holes formed therethrough. The two nvet holes that are formed in the disk-shaped bushing are provided at symmetrical positions with respect to a first line that passes through the center of the crank pin hole and a center of the disk-shaped bushing.

[0022] According one embodiment of the present invention, a tongue part that is elongated in an opposite side from the weight body of the counterweight is provided. One of the two rivet holes formed in the counterweight is provided in the tongue part.

[0023] In another embodiment, a swing-link mechanism of a scroll-type compressor includes a large diameter part that is formed integrally with a drive shaft, a disk-shaped bushing that is engaged rotatably with a crank pin that protrudes from the end surface of the large diameter part, and a counterweight that is combined with the disk-shaped bushing by a plurality of rivets. A first lubrication hole is provided in the disk-shaped bushing so that the center of the first lubncation hole lies on a first line that passes through the center of the crank pin hole and the center of the disk-shaped bushing. A second lubrication hole is provided in the large diameter part so that the center of the second lubrication hole lies on a second line that passes through the center of the crank pin and the center of the large diameter part. A third lubrication hole is provided in the counterweight so that the third lubrication hole overlaps both the first lubrication hole and the second lubrication hole simultaneously in order to establish communication from the first lubncation hole to the second lubrication hole.

[0024] Other objects, features, and advantages of this invention will be understood from the following detailed description of preferred embodiments with reference to the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] **Fig. 1** is a longitudinal cross-sectional view of a known scroll-type compressor.

[0026] **Fig. 2** is a perspective view of a known swing-link mechanism.

[0027] **Fig. 3(a)** is a plan view of the parts constituting the known swing-link mechanism.

[0028] **Fig. 3(b)** is a plan view of the assembly of the known swing-link mechanism.

[0029] **Fig. 4** is a plan view of assembly of an orbiting scroll.

[0030] **Fig. 5** is a longitudinal cross-sectional view of a scroll-type compressor according to the present invention.

[0031] **Fig. 6** is a plan view of large diameter part according to the present invention.

[0032] **Fig. 7(a)** is a plan view of a counterweight of a clockwise rotational species.

[0033] **Fig. 7(b)** is a plan view of a counterweight of a counterclockwise rotational species.

[0034] **Fig. 8(a)** is a plan view of disk-shaped bushing of a clockwise rotational species.

[0035] **Fig. 8(b)** is a plan view of a disk-shaped bushing of a counterclockwise rotational species, identical to that one shown in **Fig. 8(a)**.

[0036] **Fig. 9** is a plan view of the parts constituting the swing-link mechanism according to the present invention.

[0037] **Fig. 10** is a plan view of the assembly of the swing-link mechanism according to the present invention.

[0038] **Fig. 11** is an enlarged longitudinal cross-sectional view of the swing-link mechanism according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0039] Referring to **Fig. 5**, a longitudinal cross-section of a scroll-type compressor equipped with a swing-link mechanism according to the present invention is shown. The swing-link mechanism according to the present invention comprises large diameter part 10, counterweight 2, and disk-shaped bushing 3. In this figure, like numbers denote the like parts in **Fig. 1,** so an explanation of such parts is therefore omitted.

[0040] Referring to **Fig. 6,** large diameter part 10 is provided crank pin 110, restriction hole 111, and lubrication hole 112. It is designed so that center L2 of crank pin 110 and center L3 of lubrication hole 112 may be aligned on Line L, which passes through center L1 of large diameter part 10. Center of the restriction hole 111 coincides with the center L1 of large diameter part 10.

[0041] **Fig. 7(a)** and **Fig. 7(b)** show the **clockwise** rotational species and the counterclockwise rotational species, respectively, of counterweight 2. At the opposite side to weight body 27 of counterweight 2 is provided tongue part 29. In the top of tongue part 29, and near center C of protrusion 20, nvet holes 21a and 21b are provided. Line V is defined as a line that passes through center C of protrusion 20, and divides weight body 27 in half. At approximately a symmetric position against rivet hole 21b with respect to vertical line V in the figure, lubrication hole 22 is provided. The exact position of lubrication hole 22 will be explained later.

[0042] **Fig. 8(a)** and **Fig. 8(b)** show the clockwise rotational species and counterclockwise rotational species, respectively, of disk-shaped bushing 3. The two disk-shaped bushings are identical to each other. The equality in shape for both species is one of the essences of the present invention. Two rivet holes 31a and 31b are disposed at exactly symmetrical positions with respect to line M, which passes through center D2 of crank pin hole 30 and center D1 of disk-shaped bushing 3. Lubrication hole 32 is provided such that center D3 of lubrication hole 32 is located on line M. Because of these structures, disk-shaped bushing 3 becomes completely symmetrical with respect to line M; thus disk-shaped busing 3 for either the rotational species shown in **Fig. 8(a)** or the rotational species shown in **Fig. 8(b)** are identical. While the known art required two rotational species for disk-shaped bushing 3, the present invention requires only one species of disk-shaped bushing 3. Even if several different diameters are taken into account, 16 kinds of disk-shaped bushing can be reduced in half, i.e., to 8 kinds. This benefits the manufacturer of the compressor. This is a considerable merit for the management of the stock of disk-shaped bushing and for the management of the manufacturing line of the compressor.

[0043] In **Fig. 9**, parts of the swing-link mechanism for one rotational species are shown placed side-by-side. As mentioned in above, the only part that requires the production of two rotational species is counterweight 2. Two rivets (not shown) are inserted in rivet holes 31a, 31b of **disk-shaped bushing** 3 and 21a, 21b of counterweight 2, in order to combine them.

[0044] Protrusion 20 of counterweight 2 engages loosely with restriction hole 111 of large diameter part 10. Crank pin 110 of large diameter part 10 engages with crank pin hole 30 of disk-shaped bushing 3, disk-shaped bushing 3 being rotatable with respect to crank pin 110.

[0045] **Fig. 10** is the plan view of the assembly of the three parts. Lubrication hole 32 of disk-shaped bushing 3 partially overlaps lubrication hole 22 of counterweight 2. Lubrication hole 22 of counterweight 2 partially overlaps lubrication hole 112 of large diameter part 10. The position of lubrication hole 22 of counterweight 2 may be designed such that lubrication hole 22 partially overlaps both lubrication hole 32 of disk-shaped bushing 3 and lubrication hole 112 of large diameter part 10 simultaneously. Thus, refrigerant gas is permitted to pass freely from lubrication hole 112 of large diameter part 10 to lubncation hole 32 of disk-shaped bushing 3 via lubrication hole 22 of counterweight 2.

[0046] Referring to **Fig. 11,** space R1 is enclosed by oil seal 13 and front housing 100 and large diameter part 10. Space R3 is enclosed by front housing 100 and orbiting scroll 4. Space R2 is enclosed by recess 33 of disk-shaped bushing 3 and the bottom of boss 42 of orbiting scroll 4. When the compressor is started, the swing-link mechanism begins to rotate. A fluid stream, which passes through three lubrication holes 112, 22, and 32, indicated by the arrows in the figure, will be generated by means known in the art. By the occurrence of the circulation (indicated by the arrows) of the refrigerant gas containing the lubrication oil, both needle bearing 220 and shell-type needle beanng 230 will be lubricated.

[0047] Thus, the present invention has provided rivet holes symmetrically disposed on the disk-shaped bushing and at the same time, has provided lubrication holes for each of the disk-shaped bushing, the counterweight, and the large diameter part. As a result, the total number of the stock of the disk-shaped bushing can be reduced, and the lubrication around the swing-link mechanism can be effectively improved.

[0048] This invention has been described in detail in connection with preferred embodiments. These embodiments, however, are merely for example only and the invention is not restricted thereto. It will be understood by those skilled in the art that other variations and modifications can easily be made within the scope of this invention, as defined by the appended claims.

Claims

1. A swing-link mechanism of a scroll-type compressor, comprising:

a large diameter part formed integrally with a drive shaft;
a disk-shaped bushing that is engaged rotatably with a crank pin protruding from an end surface of said large diameter part, said disk-shaped bushing having two rivet holes formed therethrough; and
a counterweight combined with said disk-shaped bushing by a plurality of rivets, said counterweight having two rivet holes formed therethrough;
wherein said two rivet holes formed in said disk-shaped bushing are provided at symmetrical positions with respect to a first line, said first line passing through a center of a crank pin hole and a center of said disk-shaped bushing.

2. The swing-link mechanism of a scroll-type compressor of claim 1,
wherein said counterweight comprises:

a weight body; and
a tongue part of said counterweight, said tongue part being elongated to a side opposite said weight body of said counterweight.

3. The swing-link mechanism of a scroll-type compressor of claim 2,
wherein one of said two rivet holes formed in said counterweight is provided in said tongue part of said counterweight.

4. The swing-link mechanism of a scroll-type compressor of one of claims 1 to 3,

wherein a first lubrication hole is provided in said disk-shaped bushing in such a manner that a center of said first lubrication hole lies on said first line;
a second lubrication hole is provided in said large diameter part in such a manner that a center of said second lubrication hole lies on a second line, said second line passing through a center of said crank pin and a center of said large diameter part; and
a third lubrication hole is provided in said counterweight in such a manner that said third lubrication hole overlaps simultaneously both said first lubrication hole and said second lubrication hole in order to establish communication from said first lubrication hole to said second lubrication hole.

5. A swing-link mechanism of a scroll-type compressor, comprising:

a large diameter part formed integrally with a drive shaft;
a disk-shaped bushing that is engaged rotatably with a crank pin protruding from an end surface of said large diameter part; and
a counterweight combined with said disk-shaped bushing by a plurality of rivets;
wherein a first lubrication hole is provided in said disk-shaped bushing in such a manner that a center of said first lubrication hole lies on a first line, said first line passing through a center of a crank pin hole and a center of said disk-shaped bushing;
a second lubrication hole is provided in said large diameter part in such a manner that a center of said second lubrication hole lies on a second line, said second line passing through said center of said crank pin and a center of said large diameter part; and
a third lubrication hole is provided in said coun-

terweight in such a manner that said third lubrication hole overlaps simultaneously both said first lubrication hole and said second lubrication hole in order to establish communication from said first lubrication hole to said second lubrication hole.

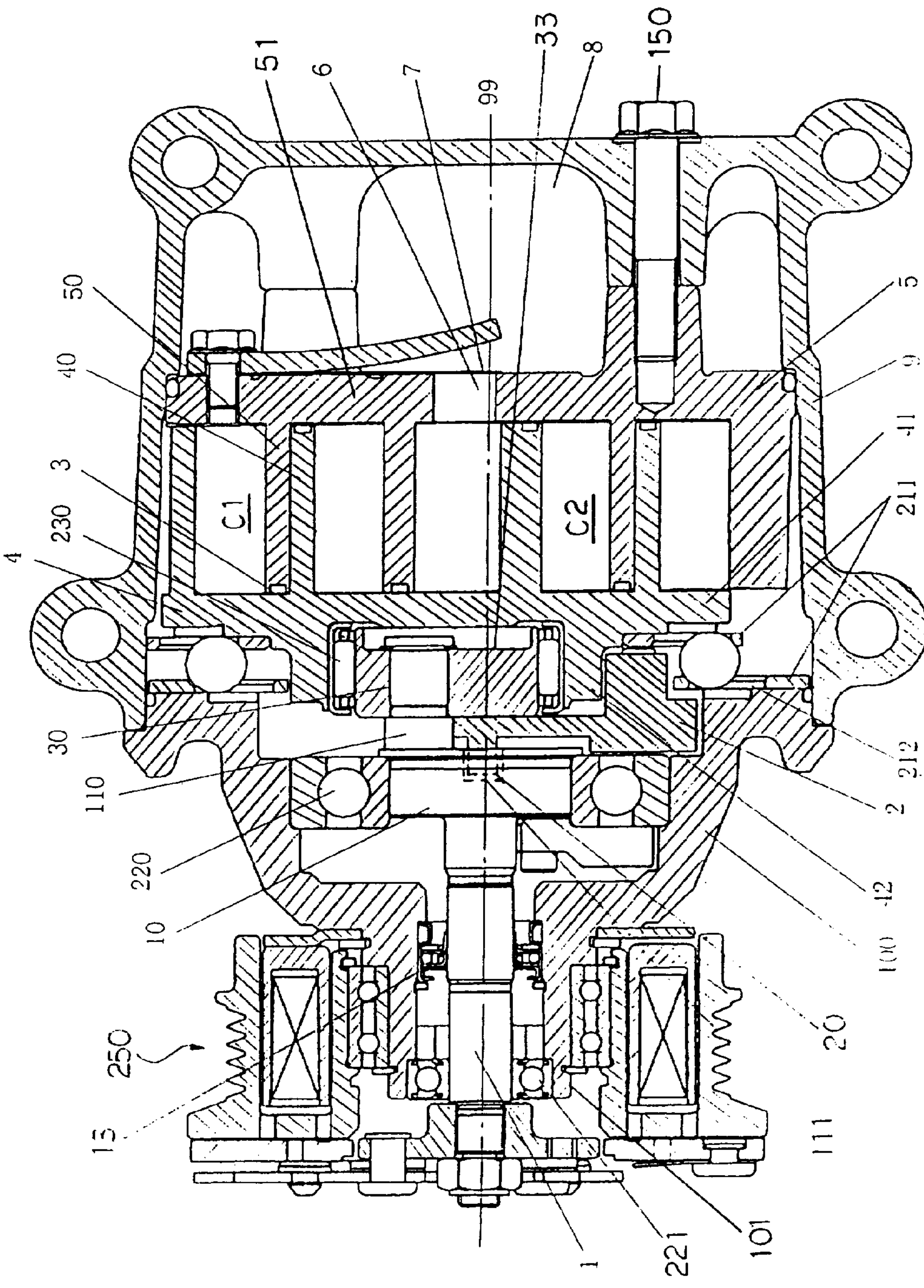


Fig. 1
(PRIOR ART)

Fig. 2
(PRIOR ART)

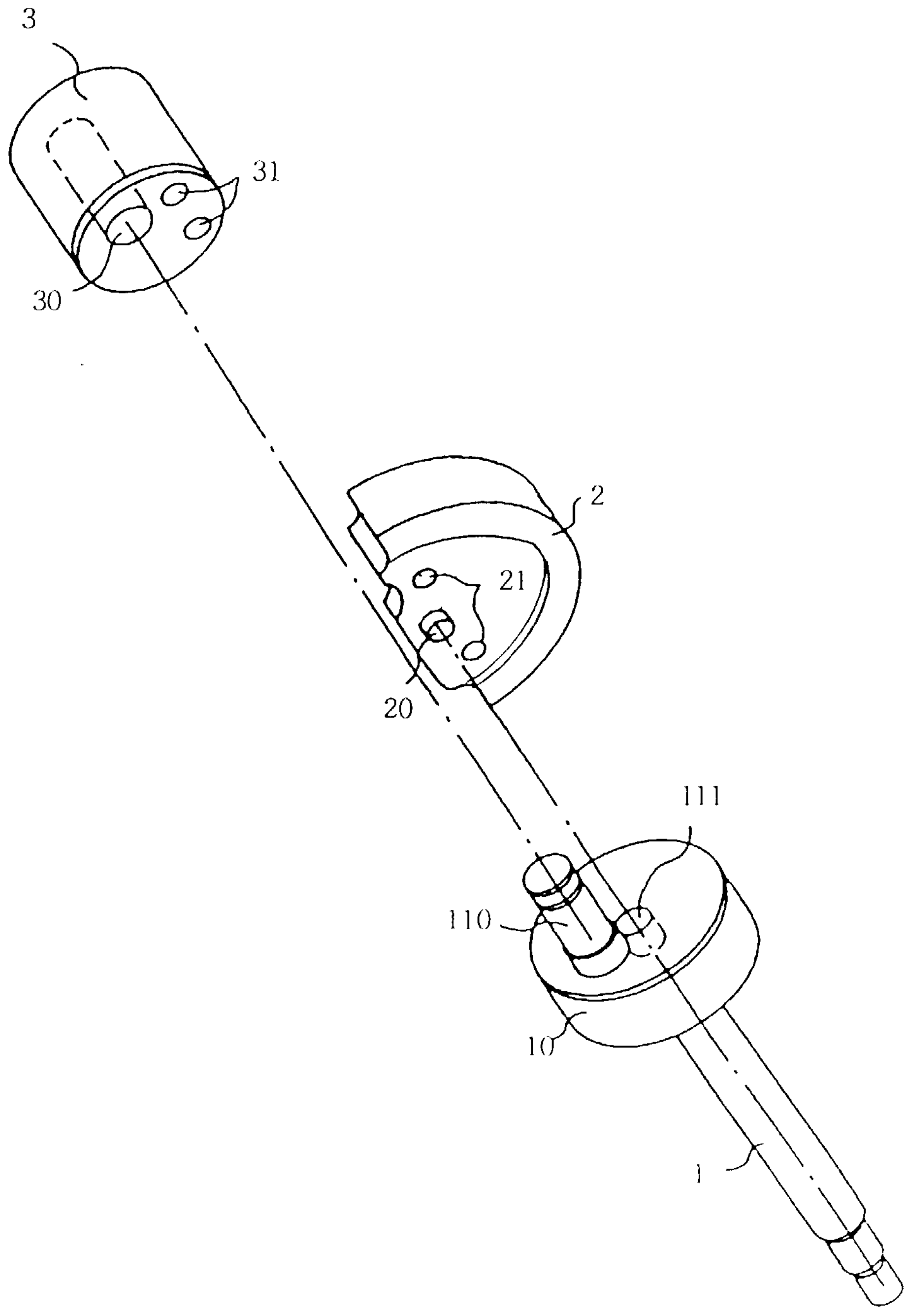


Fig . 3(a)
(PRIOR ART)

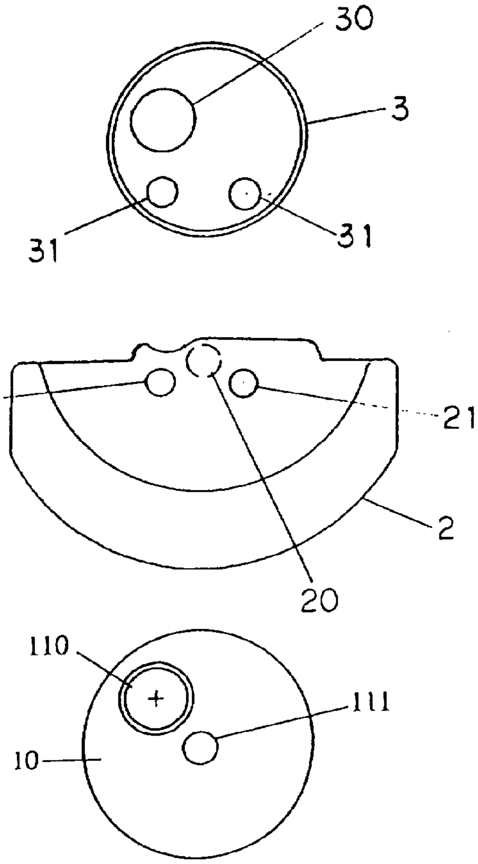


Fig . 3(b)
(PRIOR ART)

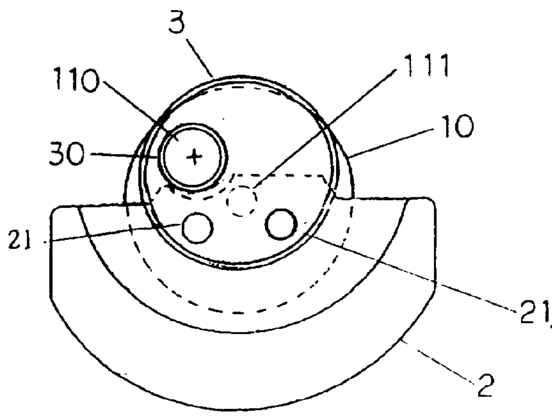


Fig. 4
(PRIOR ART)

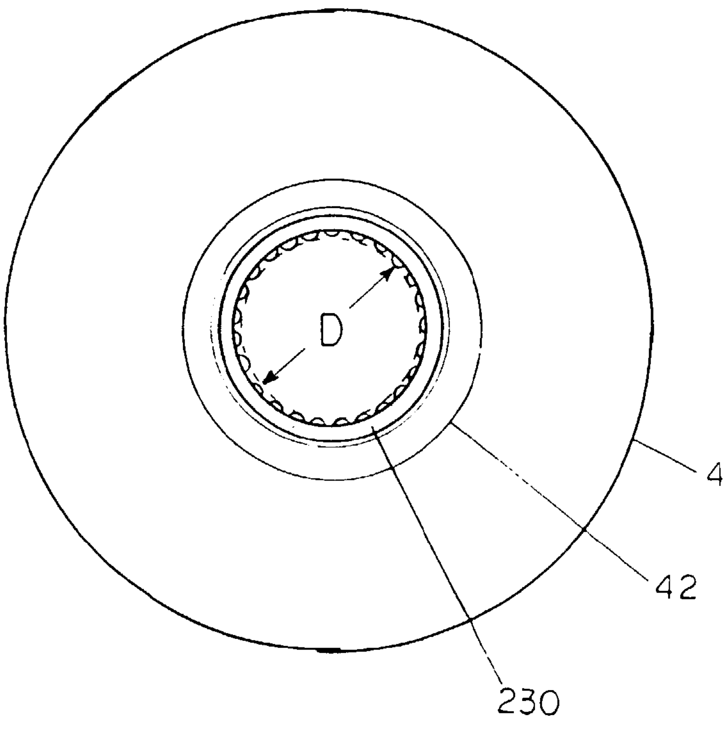


Fig. 5

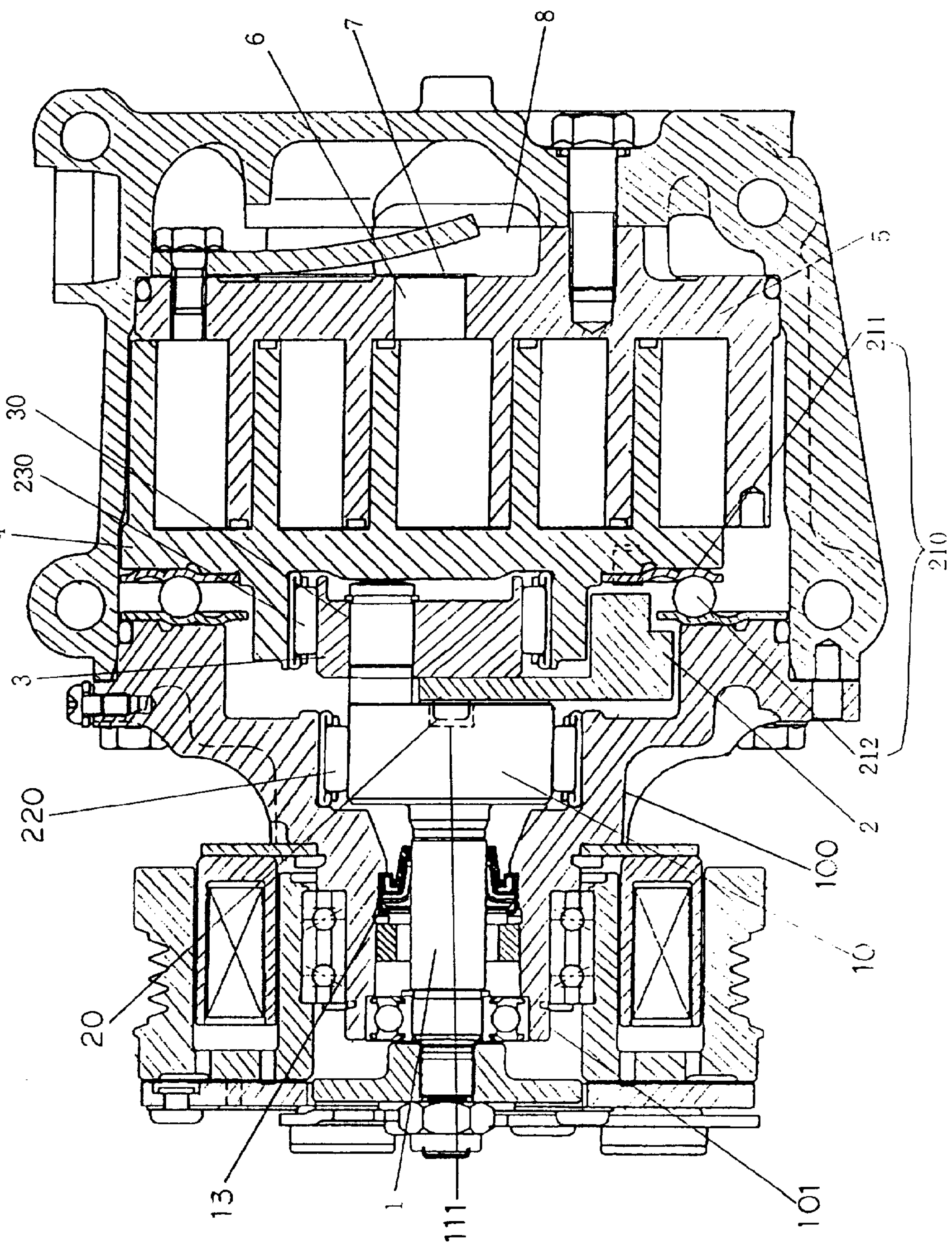


Fig . 6

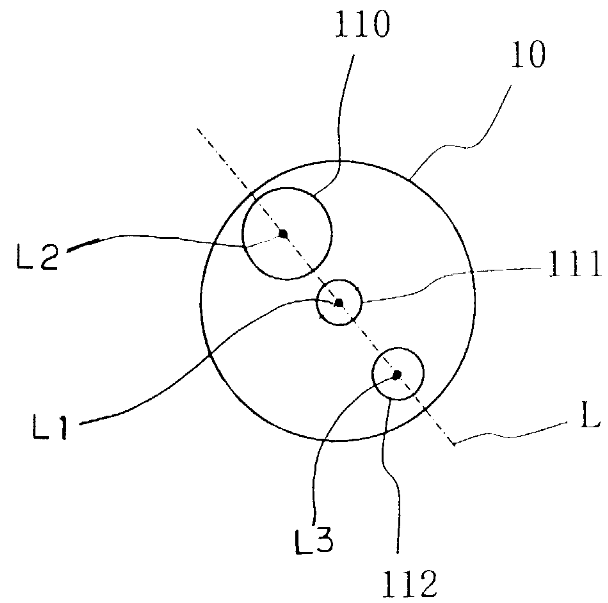


Fig . 7 (a)

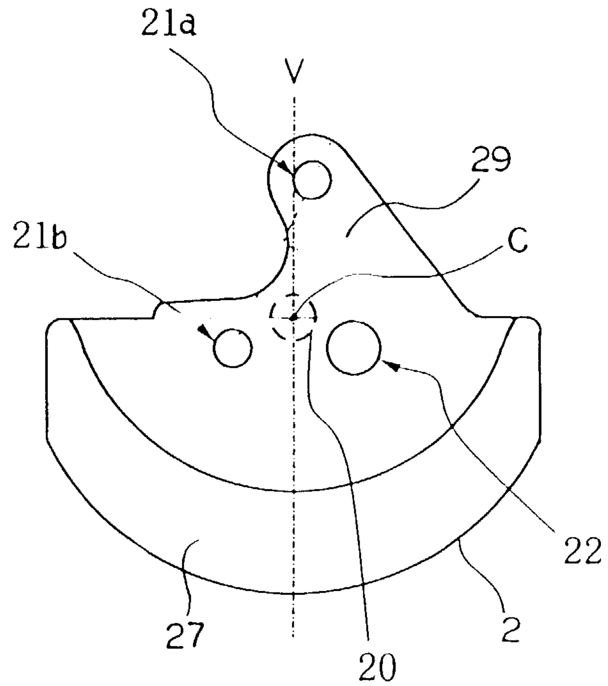


Fig . 7 (b)

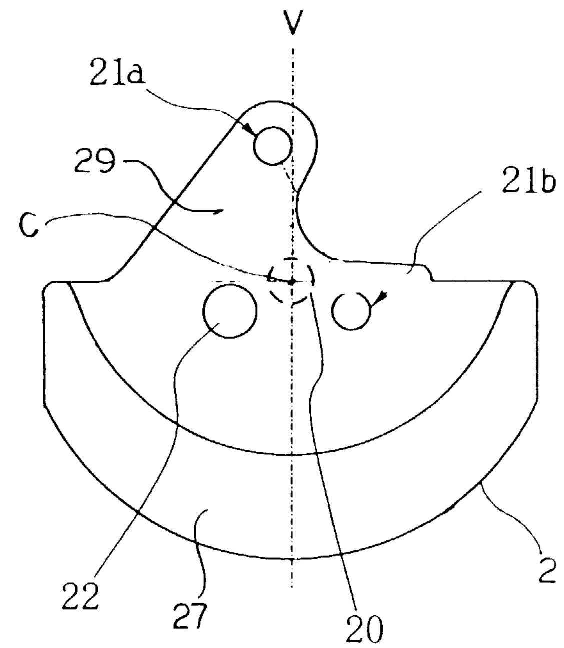


Fig. 8 (a)

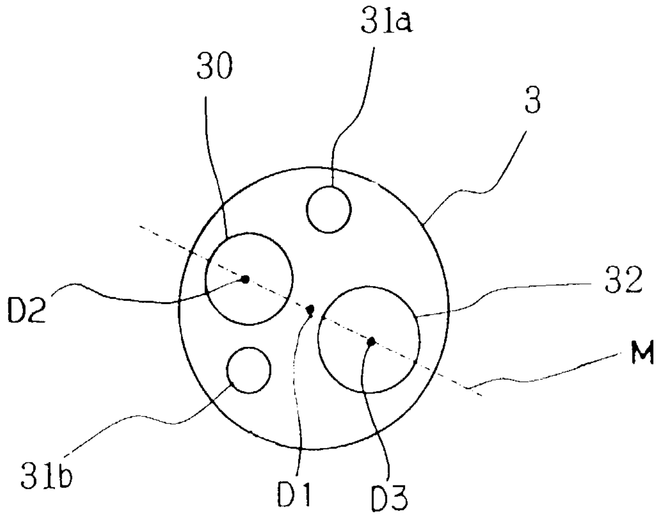


Fig. 8 (b)

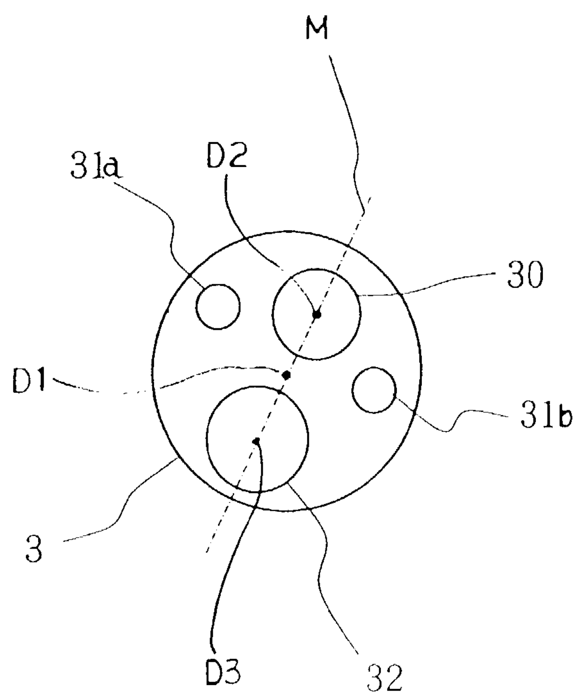


Fig. 9

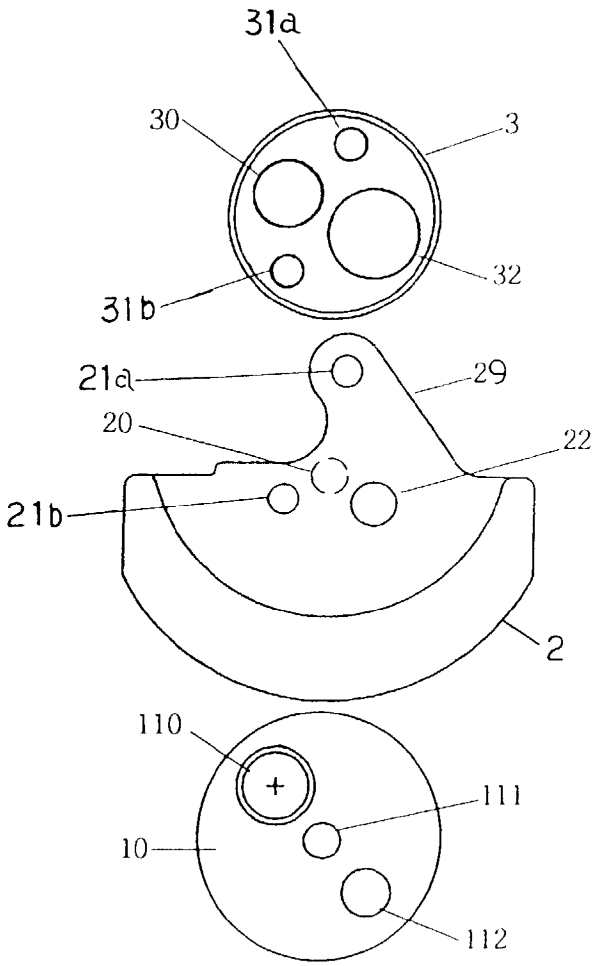

31a
30
3
32
31b
21a
29
20
22
21b
2
110
111
10
112

Fig. 10

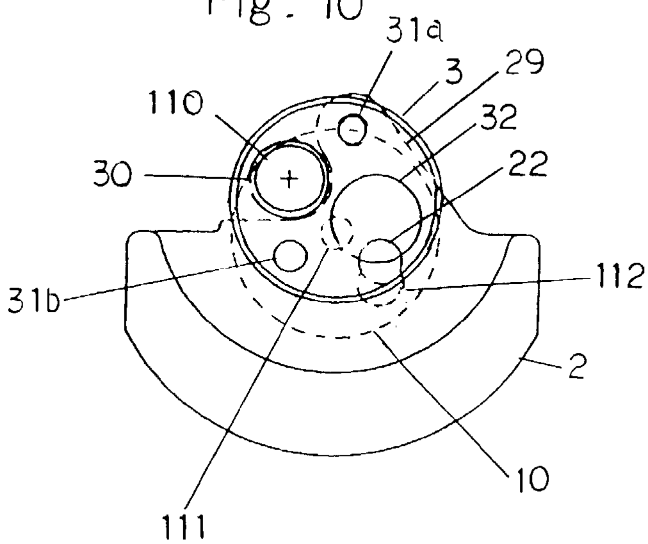
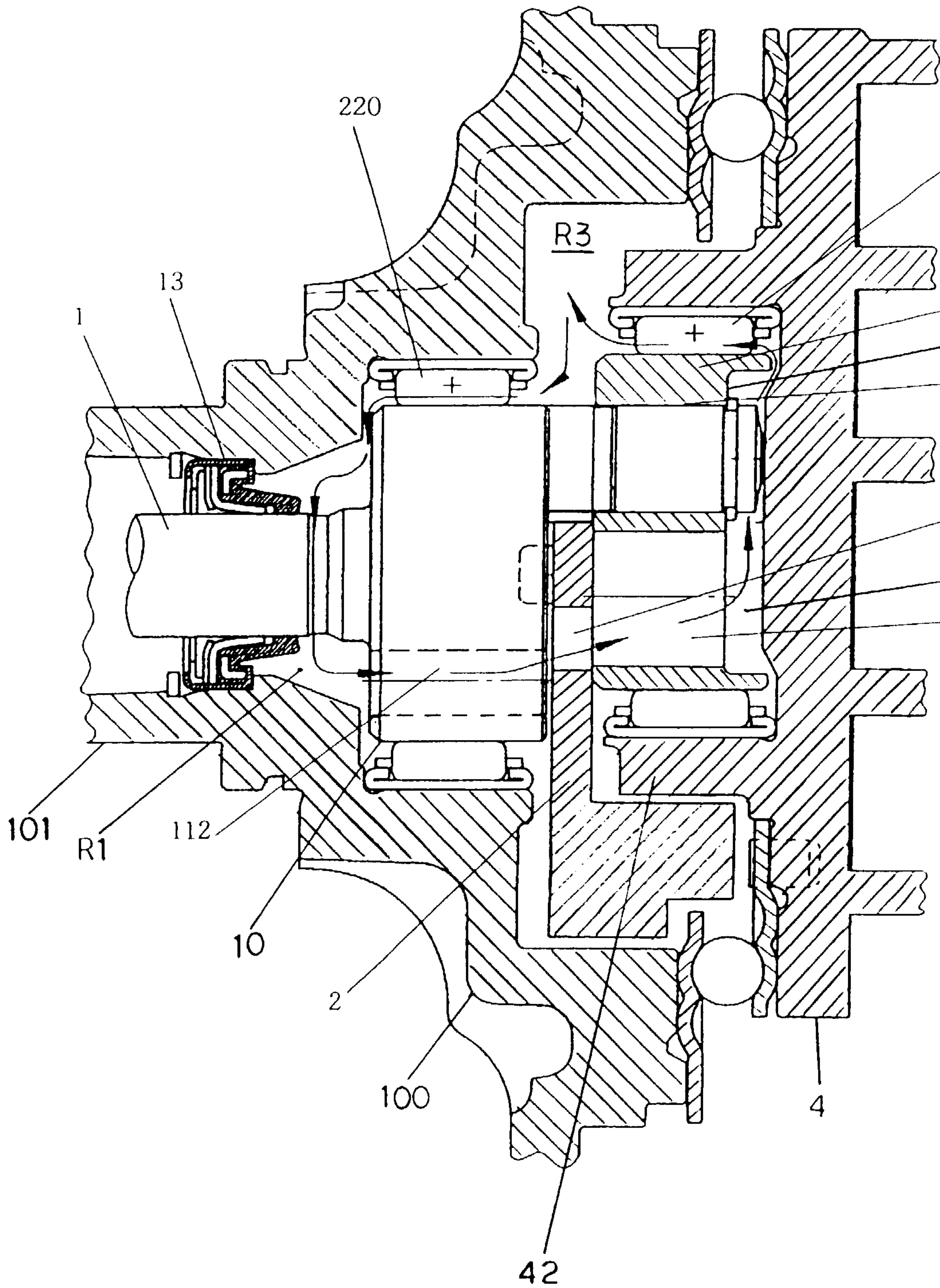

31a
3
29
110
32
30
22
31b
112
2
10
111

Fig . 11



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 12 3092

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)
A	EP 0 806 570 A (SANDEN) 12 November 1997 * column 4, line 1 - column 5, line 22; figures 2-7 * ---	1	F04C29/00 F04C18/02
A	EP 0 052 461 A (SANKYO ELECTRIC) 26 May 1982 * page 11, last paragraph - page 13, line 24; figures 1-3 * * page 15, last paragraph - page 16, line 11; figures 5,7 * -----	1	

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	24 March 1999	Kapoulas, T

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 98 12 3092

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

24-03-1999

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 806570 A	12-11-1997	JP 9303275 A	25-11-1997
		BR 9703111 A	08-09-1998
		CN 1170086 A	14-01-1998
EP 52461 A	26-05-1982	AU 547870 B	07-11-1985
		AU 7621681 A	20-05-1982
		CA 1311454 A	15-12-1992
		US 4439118 A	27-03-1984

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82