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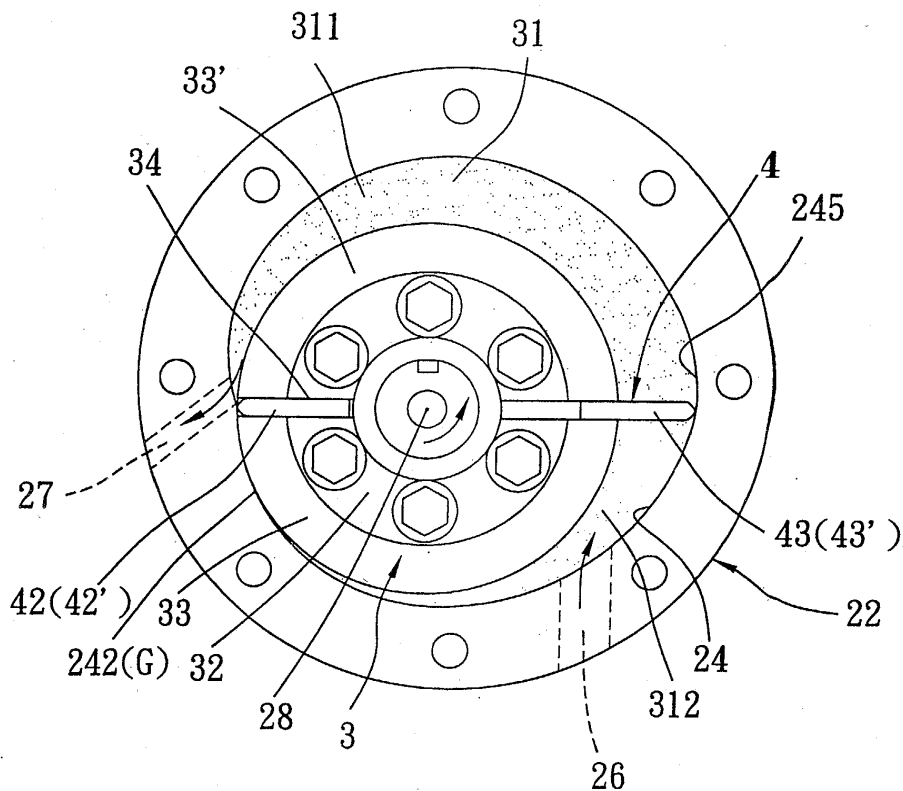
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(54) **Sliding vane compressor**

(57) A rotary compressor includes a cylinder (22) formed with an inlet (26) and an outlet (27), a rotor (3) disposed eccentrically and rotatably in the cylinder (22) and formed with a sliding space (34) that extends in a radial direction through the rotating axis (28) of the rotor (3), and a sliding vane (4) disposed slidingly in and span-

ning the sliding space (34). The cylinder (22) cooperates with the rotor (3) to define a chamber (31) therebetween. The sliding vane (4) divides the chamber (31) into intake and discharging segments (312, 311) that are respectively in fluid communication with the inlet (26) and the outlet (27).



**FIG. 3**

## Description

**[0001]** This invention relates to a rotary compressor, more particularly to a rotary compressor having a rotor with a sliding vane that extends radially through the rotating axis of the rotor.

**[0002]** A conventional sliding-vane type rotary compressor normally includes a cylinder formed with an inlet and an outlet, and a rotor disposed eccentrically and rotatably in the cylinder and formed with a plurality of angularly spaced apart slots. The cylinder and the rotor cooperatively define a chamber therebetween. A plurality of vanes are respectively and slidably received in the slots so as to divide the chamber into a plurality of independent sub-chambers. Each sub-chamber receives fluid from the inlet upon passing by the inlet. The fluid in each sub-chamber is gradually compressed when the sub-chamber approaches to the outlet, and is discharged at the outlet to an external container. A pressure-regulating valve is connected to the container for controlling the pressure in the container.

**[0003]** The aforesaid conventional rotary compressor is disadvantageous in that friction among the vanes and an inner wall of the cylinder is relatively large during rotation of the rotor, which results in high temperature of the rotary compressor, which has an adverse effect on the performance of the rotary compressor, and which can result in a shorter service life for the rotary compressor.

**[0004]** Therefore, the object of the present invention is to provide a rotary compressor that can overcome the aforementioned drawback of the prior art.

**[0005]** According to the present invention, there is provided a rotary compressor that comprises: a cylinder having an inner wall that defines an inner space therein, and formed with an inlet that is in fluid communication with the inner space, and an outlet which is spaced apart from the inlet and which is in fluid communication with the inner space; a rotor mounted rotatably in the inner space and defining a sliding space, the rotor and the inner wall of the cylinder cooperatively defining a chamber therebetween, the rotor being rotatable about an axis in a rotating direction, the chamber being in fluid communication with the inlet and the outlet, the sliding space being in spatial communication with the chamber, extending through the axis in a radial direction relative to the axis, and having two opposite ends opposite to each other in the radial direction, the rotor being eccentrically disposed in the inner space and being in close proximity to a portion of the inner wall at a position between the inlet and the outlet; and a sliding vane mounted slidably in the sliding space, extending in the radial direction, and having two opposite ends that are opposite to each other in the radial direction and that extend oppositely to the inner wall of the cylinder so as to divide the chamber into at least a discharging segment that is in fluid communication with the outlet and that extends in the rotating direction from one of the opposite ends of the sliding

vane to the outlet, and an intake segment that is in fluid communication with the inlet and that is isolated from the discharging segment, the sliding vane being slidable in the sliding space in the radial direction upon rotation of the rotor in such a manner that said one of the opposite ends of the sliding vane abuts slidably against the inner wall of the cylinder, thereby preventing back flow of fluid from the discharging segment.

**[0006]** In drawings which illustrate an embodiment of the invention,

Fig. 1 is an exploded perspective view of a rotary compressor embodying the present invention;

Fig. 2 is a sectional side view of the rotary compressor of Fig. 1;

Fig. 3 is a top view of the rotary compressor of Fig. 1, which illustrates rotation of a sliding vane to a first position;

Fig. 4 is a top view of the rotary compressor of Fig. 1, which illustrates rotation of the sliding vane to a second position;

Fig. 5 is a sectional top view of the rotary compressor of Fig. 1, which illustrates rotation of the sliding vane to a third position; and

Fig. 6 is a top view of the rotary compressor of Fig. 1, which illustrates rotation of the sliding vane to a fourth position.

**[0007]** Figs. 1 to 6 illustrate the preferred embodiment of a rotary compressor according to the present invention. The rotary compressor includes: a cylinder 22 having an inner wall 24 that defines an inner space 20 therein, and formed with an inlet 26 that is in fluid communication with the inner space 20, and an outlet 27 which is angularly spaced apart from the inlet 26 and which is in fluid communication with the inner space 20; a rotor 3 mounted rotatably in the inner space 20 and defining a sliding space 34, the rotor 3 and the inner wall 24 of the cylinder 22 cooperatively defining a chamber 31 therebetween, the rotor 3 being rotatable about an axis 28 in a rotating direction, the chamber 31 being in fluid communication with the inlet 26 and the outlet 27, the sliding space 34 being in spatial communication with the chamber 31, extending through the axis 28 in a radial direction relative to the axis 28, and having two opposite ends opposite to each other in the radial direction, the rotor 3 being eccentrically disposed in the inner space 20 and being in close proximity to a portion 242 of the inner wall 24 at a position between the inlet 26 and the outlet 27 and adjacent to the outlet 27 such that the rotor 3 and the portion 242 of the inner wall 24 cooperatively define a clearance (G) therebetween and that the clearance (G) converges and is substantially closed at the portion 242 of the inner wall 24; and a sliding vane 4 mounted slidably in the sliding space 34, extending in the radial direction, and having two opposite ends 42, 43 that are opposite to each other in the radial direction and that extend oppositely to the inner wall 24 of the

cylinder 22 so as to divide the chamber 31 into at least a discharging segment 311 that is in fluid communication with the outlet 27 and that extends in the rotating direction from one of the opposite ends 42, 43 of the sliding vane 4 to the outlet 27, and an intake segment 312 that is in fluid communication with the inlet 26 and that is isolated from the discharging segment 311, the sliding vane 4 being slidable in the sliding space 34 in the radial direction upon rotation of the rotor 3 in such a manner that said one of the opposite ends 42, 43 of the sliding vane 4 abuts slidably against the inner wall 24 of the cylinder 22, thereby preventing back flow of fluid from the discharging segment 311. A middle segment 313 is formed between the discharging segment 311 and the intake segment 312 immediately after one of the opposite ends 42, 43 of the sliding vane 4 passes by the inlet 26, and becomes the next discharging segment when moved to communicate with the outlet 27.

**[0008]** The sliding vane 4 is in the form of a plate that has an H-shaped portion 40 which includes parallel first and second leaves 42', 43' and a middle rib 41 interconnecting the first and second leaves 42', 43'. The first and second leaves 42', 43' are opposite to each other in the radial direction, and respectively define the opposite ends 42, 43 of the sliding vane 4.

**[0009]** The cross-section of the chamber 31 gradually increases from a position proximate to the portion 242 of the inner wall 24 to an opposite position 245 diametrically opposite to the portion 242 of the inner wall 24, and gradually decreases from the opposite position 245 to the outlet 27.

**[0010]** The rotor 3 is cylindrical in shape, and includes first and second halves 33, 33' which cooperatively define the sliding space 34 therebetween. The cylinder 22 has opposite upper and lower open ends 221, 222 and upper and lower sealing flanges 23, 21 that are fixed sealingly and respectively to the upper and lower open ends 221, 222 and that are respectively formed with central openings 230, 210. The first and second halves 33, 33' of the rotor 3 are indented in an axial direction relative to the rotor 3 to form opposite upper and lower recesses 330. The rotary compressor further includes upper and lower bearings 231, 211 that are respectively received in the central openings 230, 210 in the upper and lower flanges 23, 21, and upper and lower journals 32 that respectively have upper and lower limiting flanges 320 which are respectively received in the upper and lower recesses 330 and which are secured to the rotor 3, and upper and lower shafts 322 which extend respectively and outwardly of the cylinder 22 from the upper and lower limiting flanges 320 through the upper and lower bearings 231, 211. Each of the upper and lower limiting flanges 320 has a periphery edge 3201, and a pair of opposite radial slits 321 that extend inwardly and radially from the periphery edge 3201. The first and second leaves 42', 43' of the sliding vane 4 have upper and lower ends that are respectively received in the slits 321 in the upper and lower limiting flanges 320. A pulley 5

is connected to the upper shaft 322 of the upper journal 32 for driving the latter.

**[0011]** Each of the first and second halves 33 (33') of the rotor 3 has opposite outer and inner surfaces 339 (339'), 331 (331') extending angularly of the rotor 3, and opposite first and second ends 337 (337'), 338 (338') opposite to each other in the radial direction. The first and second ends 337 (337'), 338 (338') of each of the first and second halves 33 (33') of the rotor 3 respectively confront the first and second leaves 42', 43' of the sliding vane 4. The rotor 3 further includes first and second tubular elements 335, 335', and is formed with a first channel 38 (see Fig. 5) that is disposed adjacent to and that is associated with the first leaf 42', and a second channel 39 that is disposed adjacent to and that is associated with the second leaf 43'. The first channel 38 has a first segment 381 that is formed in the first half 33 of the rotor 3, and a second segment 382 that is formed in the second half 33' of the rotor 3. The first segment 381 of the first channel 38 has an inlet port 336 that is formed in the outer surface 339 of the first half 33 of the rotor 3, and a first connecting port 334 that is formed in the inner surface 331 of the first half 33 of the rotor 3. The second segment 382 of the first channel 38 has a second connecting port 333' that is formed in the inner surface 331' of the second half 33' of the rotor 3 and that is connected to and that is in fluid communication with the first connecting port 334 through the first tubular element 335, and an outlet port 332' that is formed in the first end 337' of the second half 33' of the rotor 3 and that confronts the first leaf 42' of the sliding vane 4. The second channel 39 has a first segment 391 that is formed in the second half 33' of the rotor 3, and a second segment 392 that is formed in the first half 33 of the rotor 3. The first segment 391 of the second channel 39 has an inlet port 336' that is formed in the outer surface 339' of the second half 33' of the rotor 3, and a first connecting port 334' that is formed in the inner surface 331' of the second half 33' of the rotor 3. The second segment 392 of the second channel 39 has a second connecting port 333 that is formed in the inner surface 331 of the first half 33 of the rotor 3 and that is connected to and that is in fluid communication with the first connecting port 334' of the second channel 39 through the second tubular element 335', and an outlet port 332 that is formed in the second end 338 of the first half 33 of the rotor 3 and that confronts the second leaf 43' of the sliding vane 4. The inlet port 336 (336') of the first segment 381 (391) of each of the first and second channels 38 (39) is disposed anteriorly of the respective one of the first and second leaves 42', 43' in the rotating direction, while the outlet port 332 (332') of the second segment 382 (392) of each of the first and second channels 38 (39) is disposed posteriorly of the respective one of the first and second leaves 42', 43' in the rotating direction. During rotation of the rotor 3 in the cylinder 22, compression of the fluid in the discharging segment 311 results in a force that pushes the respective one of the first and

second leaves 42', 43' (which is the second leaf 43' when the rotor 3 rotates to the position shown in Fig. 5) in a direction opposite to the rotating direction, which, in turn, can result in an unbalanced sliding vane 4. However, with the inclusion of the first and second channels 38, 39, the unbalanced problem can be eliminated. In the example shown in Fig. 5, the fluid enters into the second channel 39 through the inlet port 336' and is discharged at the outlet port 332, which results in a counter force that pushes the second leaf 43' in the rotating direction, and which offsets the aforesaid force, thereby maintaining balance of the sliding vane 4 during rotation of the rotor 3.

**[0012]** As compared to the aforementioned conventional rotary compressor, only one of the first and second leaves 42', 43' of the sliding vane 4 is in sliding contact with the inner wall 24 of the cylinder 22, thereby significantly reducing the friction between the sliding vane 4 and the inner wall 24 of the cylinder 22 and wearing of the cylinder 22 as commonly encountered in the aforementioned conventional rotary compressor. Moreover, the weight of the sliding vane 4 is relatively light by virtue of its configuration so as to reduce the momentum of the sliding vane 4 when sliding in the sliding space 34.

**[0013]** The inner wall 24 of the cylinder 22 is divided into different segments which have different curvatures in such a manner that the sliding vane 4 can smoothly rotate from a first position shown in Fig. 6 through a second position shown in Fig. 3 (where the sliding vane 4 passed by the outlet 27 in the cylinder 22) to a third position (where the sliding vane 4 passes by the portion 242 of the inner wall 24 of the cylinder 22) shown in Fig. 4, and that the rotary compressor can be operated quietly.

## Claims

### 1. A rotary compressor characterized by:

a cylinder (22) having an inner wall (24) that defines an inner space (20) therein, and formed with an inlet (26) that is in fluid communication with said inner space (20), and an outlet (27) which is spaced apart from said inlet (26) and which is in fluid communication with said inner space (20);

a rotor (3) mounted rotatably in said inner space (20) and defining a sliding space (34), said rotor (3) and said inner wall (24) of said cylinder (22) cooperatively defining a chamber (31) therebetween, said rotor (3) being rotatable about an axis (28) in a rotating direction, said chamber (31) being in fluid communication with said inlet (26) and said outlet (27), said sliding space (34) being in spatial communication with said chamber (31), extending through said axis (28) in a radial direction relative to said axis (28), and

having two opposite ends opposite to each other in said radial direction, said rotor (3) being eccentrically disposed in said inner space (20) and being in close proximity to a portion (242) of said inner wall (24) at a position between said inlet (26) and said outlet (27); and

a sliding vane (4) mounted slidably in said sliding space (34), extending in said radial direction, and having two opposite ends (42, 43) that are opposite to each other in said radial direction and that extend oppositely to said inner wall (24) of said cylinder (22) so as to divide said chamber (31) into at least a discharging segment (311) that is in fluid communication with said outlet (27) and that extends in said rotating direction from one of said opposite ends (42, 43) of said sliding vane (4) to said outlet (27), and an intake segment (312) that is in fluid communication with said inlet (26) and that is isolated from said discharging segment (311), said sliding vane (4) being slidable in said sliding space (34) in said radial direction upon rotation of said rotor (3) in such a manner that said one of said opposite ends (42, 43) of said sliding vane (4) abuts slidably against said inner wall (24) of said cylinder (22), thereby preventing back flow of fluid from said discharging segment (311).

2. The rotary compressor of Claim 1, **characterized in that** said sliding vane (4) is in the form of a plate that has an H-shaped portion (40) which includes parallel first and second leaves (42', 43') and a middle rib (41) interconnecting said first and second leaves (42', 43'), said first and second leaves (42', 43') being opposite to each other in said radial direction and respectively defining said opposite ends (42, 43) of said sliding vane (4).

3. The rotary compressor of Claim 1, **characterized in that** the cross-section of said chamber (31) gradually increases from a position proximate to said portion (242) of said inner wall (24) to an opposite position (245) opposite to said portion (242) of said inner wall (24), and gradually decreases from said opposite position (245) to said outlet (27).

4. The rotary compressor of Claim 3, further **characterized in that** said rotor (3) is cylindrical in shape, and includes first and second halves (33, 33') which cooperatively define said sliding space (34) therebetween.

5. The rotary compressor of Claim 4, further **characterized in that** said cylinder (22) has opposite upper and lower open ends (221, 222) and upper and lower sealing flanges (23, 21) that are fixed sealingly and respectively to said upper and lower open

ends (221, 223) and that are respectively formed with central openings (230, 210), said first and second halves (33, 33') of said rotor (3) being indented in an axial direction relative to said rotor (3) to form opposite upper and lower recesses (330), said rotary compressor further comprising upper and lower bearings (231, 211) that are respectively received in said central openings (230, 210) in said upper and lower sealing flanges (23, 21), and upper and lower journals (32) that respectively have upper and lower limiting flanges (320) which are respectively received in said upper and lower recesses (330) and which are secured to said rotor (3), and upper and lower shafts (322) which extend respectively and outwardly of said cylinder (22) from said upper and lower limiting flanges (320) through said upper and lower bearings (231, 211), each of said upper and lower limiting flanges (320) having a periphery edge (3201), and a pair of opposite radial slits (321) that extend inwardly and radially from said periphery edge (3201), said first and second leaves (42', 43') having upper and lower ends that are respectively received in said slits (321) in said upper and lower limiting flanges (320).

- 6. The rotary compressor of Claim 4, further **characterized in that** each of said first and second halves (33, 33') of said rotor (3) has opposite outer and inner surfaces (339, 339', 331, 331') extending angularly of said rotor (3), and opposite first and second ends (337, 337') opposite to each other in said radial direction, said first and second ends (337, 337') of each of said first and second halves (33, 33') of said rotor (3) respectively confronting said first and second leaves (42', 43') of said sliding vane (4), said rotor (3) further including first and second tubular elements (335, 335'), and being formed with a first channel (38) that is disposed adjacent to and that is associated with said first leaf (42'), and a second channel (39) that is disposed adjacent to and that is associated with said second leaf (43'), said first channel (38) having a first segment (381) that is formed in said first half (33) of said rotor (3), and a second segment (382) that is formed in said second half (33') of said rotor (3), said first segment (381) of said first channel (38) having an inlet port (336) that is formed in said outer surface (339) of said first half (33) of said rotor (3), and a first connecting port (334) that is formed in said inner surface (331) of said first half (33) of said rotor (3), said second segment (382) of said first channel (38) having a second connecting port (333') that is formed in said inner surface (331') of said second half (33') of said rotor (3) and that is connected to and that is in fluid communication with said first connecting port (334) through said first tubular element (335), and an outlet port (332') that is formed in said first end (337') of said second half (33') of said rotor (3) and that

confronts said first leaf (42') of said sliding vane (4), said second channel (39) having a first segment (391) that is formed in said second half (33') of said rotor (3), and a second segment (392) that is formed in said first half (33) of said rotor (3), said first segment (391) of said second channel (39) having an inlet port (336') that is formed in said outer surface (339') of said second half (33') of said rotor (3), and a first connecting port (334') that is formed in said inner surface (331') of said second half (33') of said rotor (3), said second segment (392) of said second channel (39) having a second connecting port (333) that is formed in said inner surface (331) of said first half (33) of said rotor (3) and that is connected, to and that is in fluid communication with said first connecting port (334') of said second channel (39) through said second tubular element (335'), and an outlet port (332) that is formed in said second end (338) of said first half (33) of said rotor (3) and that confronts said second leaf (43') of said sliding vane (4), said inlet port (336, 336') of said first segment (381, 391) of each of said first and second channels (38, 39) being disposed anteriorly of the respective one of said first and second leaves (42', 43') in said rotating direction, said outlet port (332, 332') of said second segment (382, 392) of each of said first and second channels (38, 39) being disposed posteriorly of the respective one of said first and second leaves (42' 43') in said rotating direction.

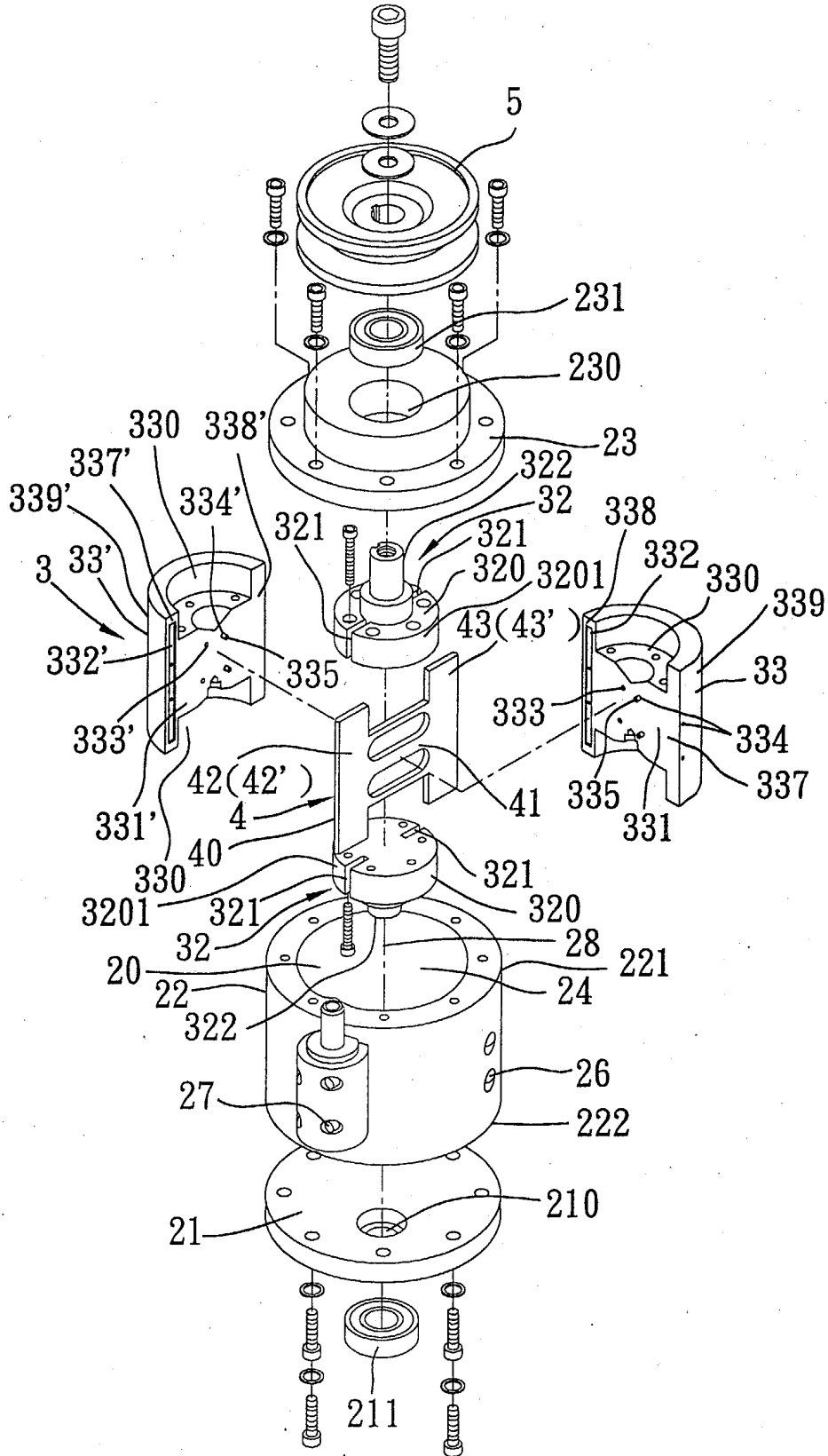


FIG. 1

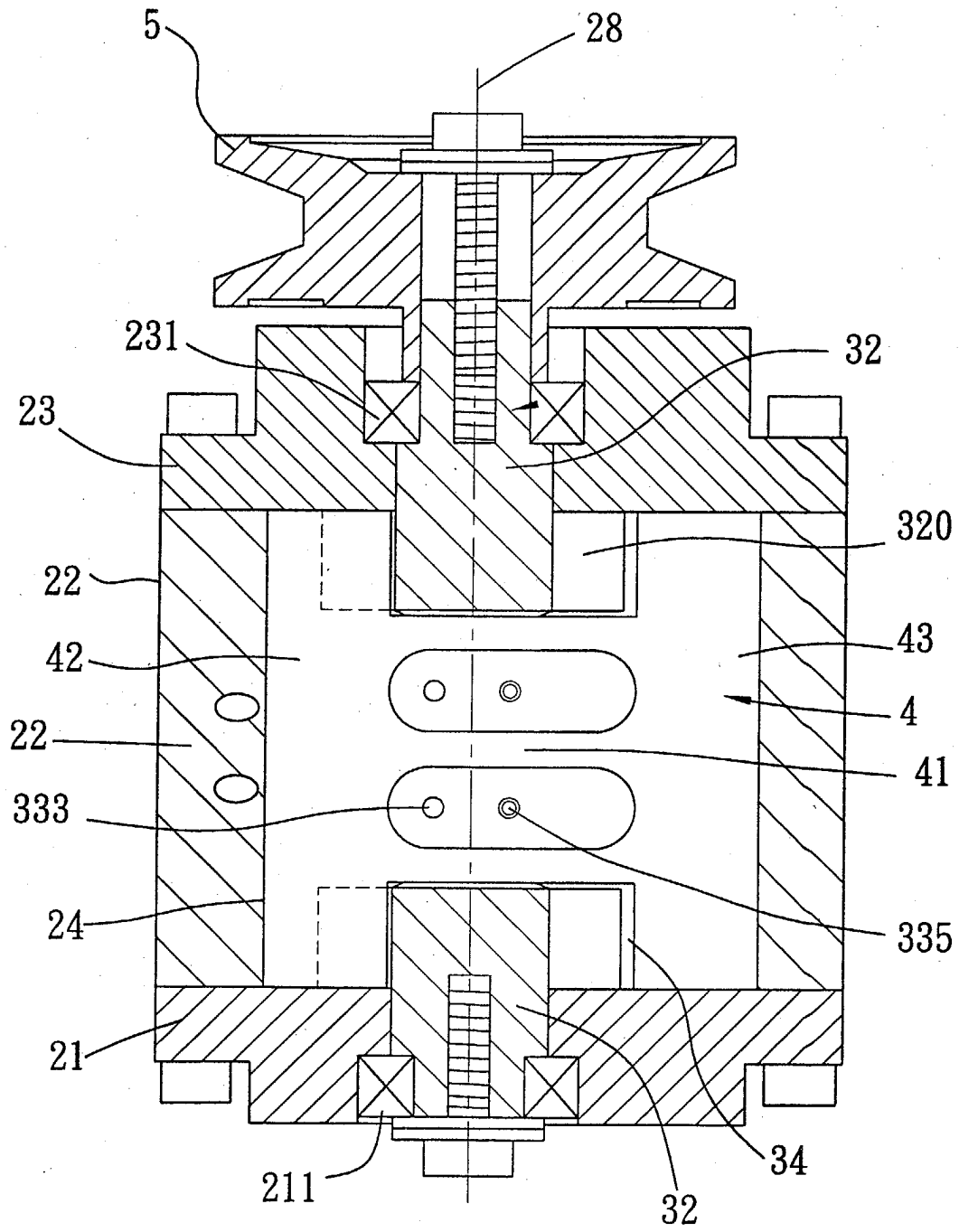


FIG. 2

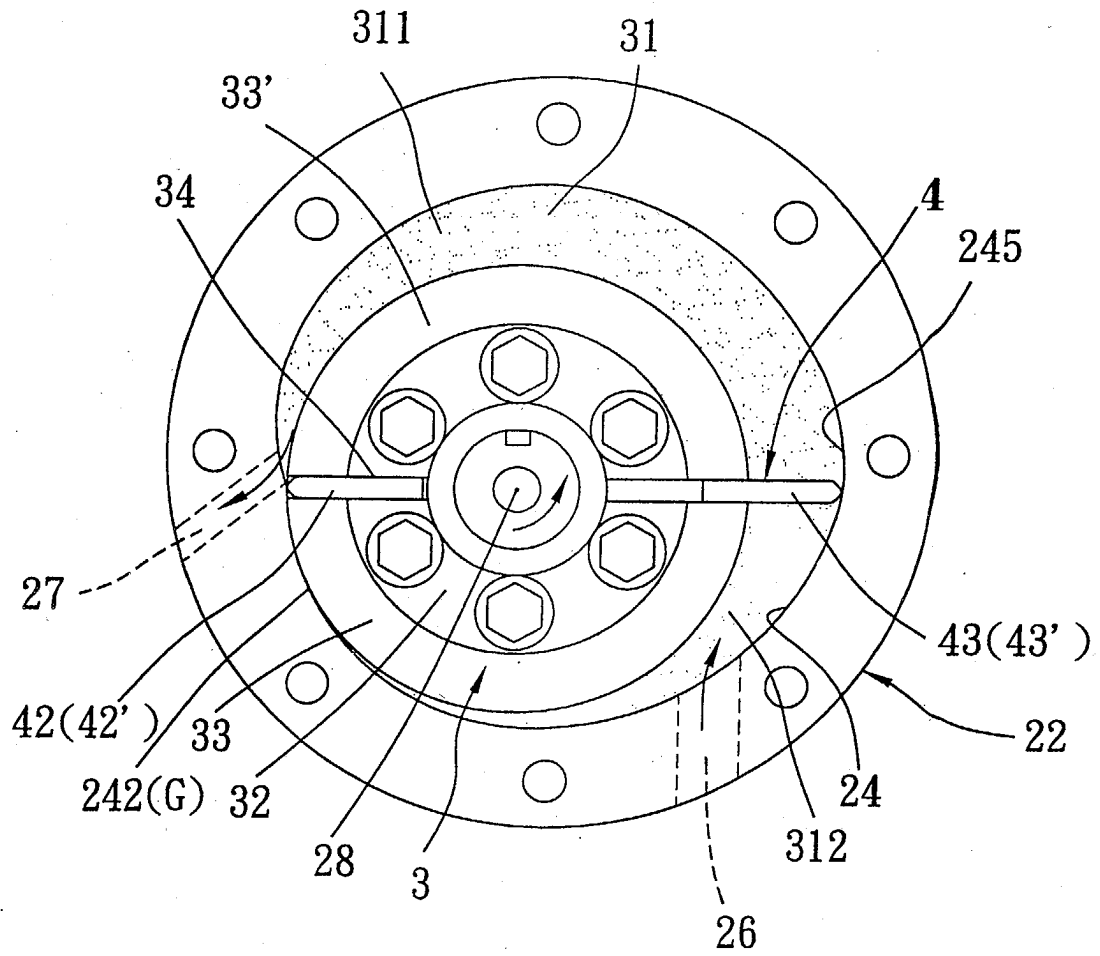


FIG. 3

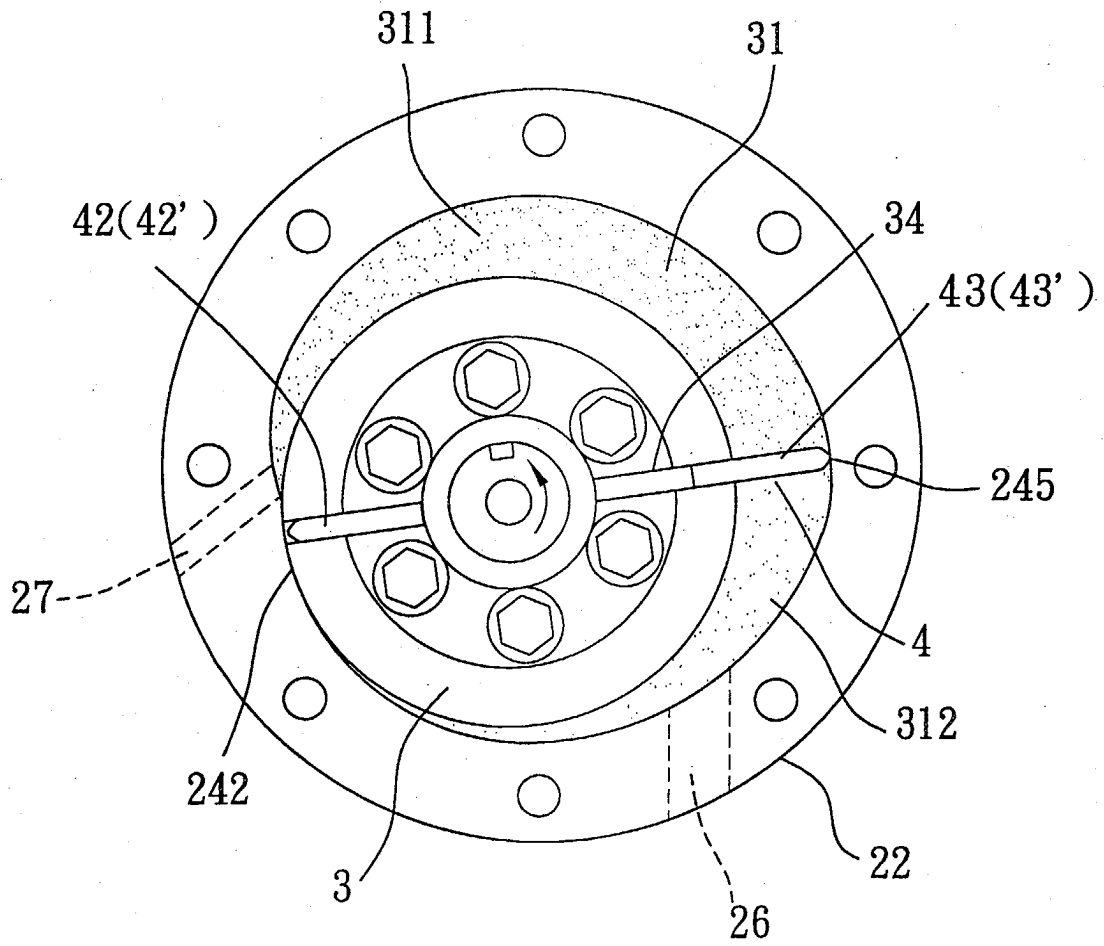


FIG. 4

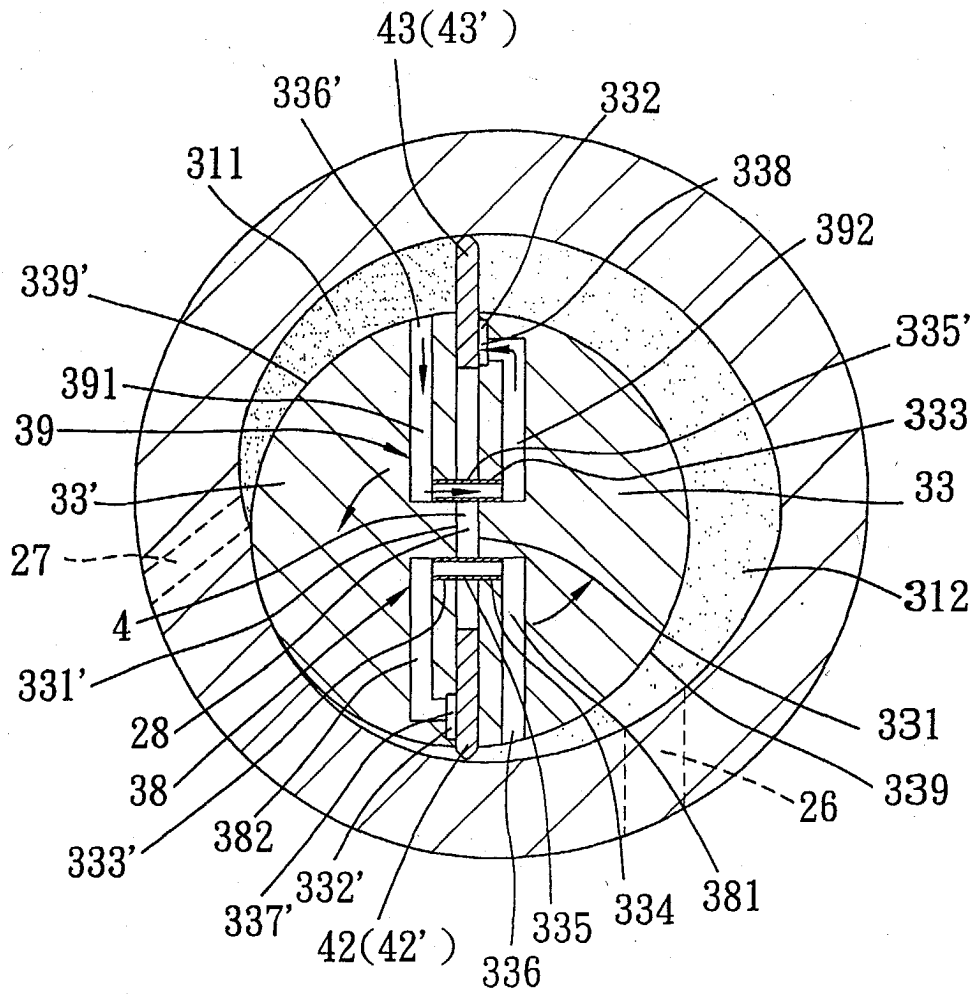


FIG. 5

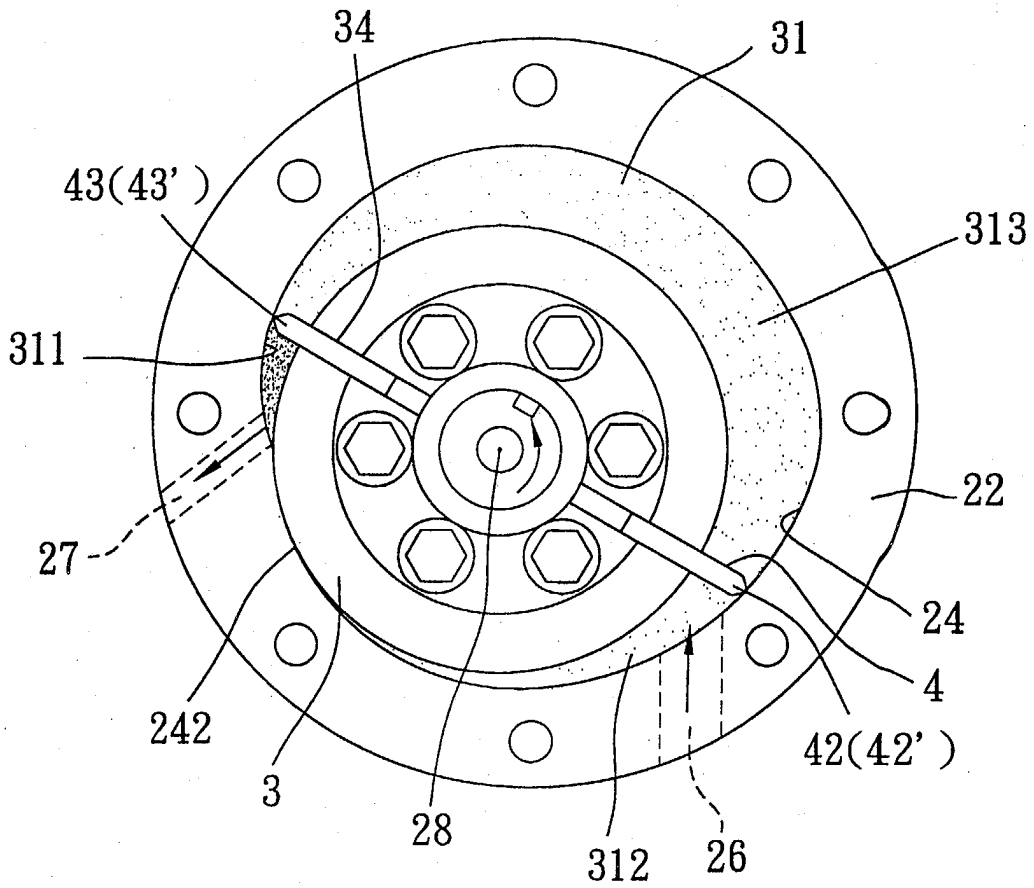


FIG. 6



European Patent  
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EUROPEAN SEARCH REPORT

Application Number  
EP 03 25 3261

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.7)
X	US 5 758 501 A (JIRNOV ALEXEI ET AL) 2 June 1998 (1998-06-02) * abstract; figures 3-5 *	1-4	F04C2/344
X	US 2 282 642 A (CURTIS WILLIAM H) 12 May 1942 (1942-05-12) * the whole document *	1-4	
X	EP 0 264 778 A (BARMAG BARMER MASCHF) 27 April 1988 (1988-04-27) * column 3, line 1 - column 3, line 47; figure 2 *	1,3	
X	DE 200 18 958 U (JOMA HYDROMECHANIC GMBH) 21 March 2002 (2002-03-21) * abstract; figure 1 *	1,3	
A	GB 528 034 A (GAVIN RALSTON) 21 October 1940 (1940-10-21) * page 2, line 19 - page 3, line 116; figure 3 *	1-6	
A	GB 22712 A A.D. 1911 (SILVESTRI GIULIO) 30 November 1911 (1911-11-30) * the whole document *	1-6	TECHNICAL FIELDS SEARCHED (Int.Cl.7)  F01C F04C
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 17 September 2003	Examiner Descoubes, P
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ON EUROPEAN PATENT APPLICATION NO.

EP 03 25 3261

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17-09-2003

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5758501 A	02-06-1998	US 5511525 A	30-04-1996
		US 5713210 A	03-02-1998
		US 5996355 A	07-12-1999
		US 5558509 A	24-09-1996
US 2282642 A	12-05-1942	NONE	
EP 0264778 A	27-04-1988	DE 3766931 D1	07-02-1991
		EP 0264778 A2	27-04-1988
		JP 63109293 A	13-05-1988
		JP 63109294 A	13-05-1988
DE 20018958 U	21-03-2002	DE 20018958 U1	21-03-2002
		CN 1317644 A	17-10-2001
		EP 1134417 A2	19-09-2001
		EP 1327778 A2	16-07-2003
		US 2002136656 A1	26-09-2002
GB 528034 A	21-10-1940	NONE	
GB 191122712 A		NONE	

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