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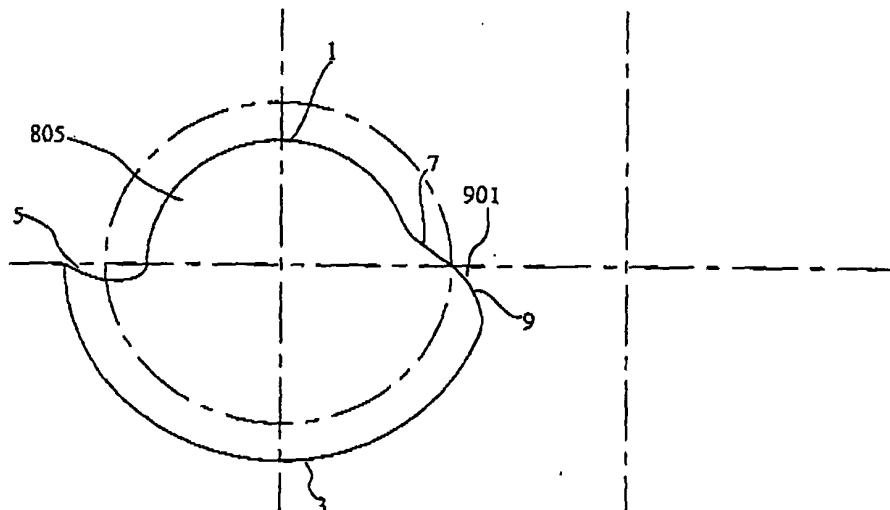
(54) **SCREW ROTOR AND SCREW TYPE FLUID MACHINE**

(57) The object of the invention is to provide a screw type fluid machine in which leak of gas is kept in constant, in other words, in which a gap between the screw rotors is kept substantially in constant in a discharging chamber during operation. In a screw type fluid machine, screw rotor having a cross-sectional shape (805) of a tooth profile with respect to an axial direction thereof includes an arc (1) forming a dedendum portion, and an arc (3) forming an outer circumferential portion, wherein one (5) of two curves connecting the outer circumferential portion and the dedendum portion is defined by a trochoid curve

created based on a point on an outer circumference of a mating screw rotor and

the other of these two curves, which is divided equally into two sections constituted by a section between a pitch circle and the outer circumferential portion and a section between the pitch circle and the dedendum portion, is defined by a predetermined curve for one (7) of the sections and a fitting curve for the other (9) of the sections that is created so as to correspond to the predetermined curve for the one of the sections divided equally into two in the mating screw rotor during meshing.

FIG. 10



DescriptionTECHNICAL FIELD

5 **[0001]** This invention relates to a screw rotor in a screw fluid machine such as screw type compressor, screw type vacuum pump and screw type extension machine. The invention particularly relates to a profile curve of the screw rotor.

BACKGROUND ART

10 **[0002]** Conventionally, as a screw fluid machine (hereinafter, a screw type dry vacuum pump is described as an example.), there has been known a screw type dry vacuum pump in which a pair of screw rotors are mounted in a housing through bearings and one of the screw rotors is driven by a motor such that the screw rotors are rotated without interfere therebetween by meshing one timing gear attached to one of the screw rotors and the other timing gear attached to the other of the screw rotors to each other, whereby discharge gas is sucked from a suction port formed on the housing at one end side along the axial directions of the screw rotors and then the sucked discharge gas is transferred and discharged from a discharge port formed at the other end side of the screw rotors. While various combinations of such screw rotors in a screw type dry vacuum pump are known, a screw rotor in which a cross-sectional shape of the screw rotor with respect to the axial direction is constant therealong is described in this application. A tooth profile curve of the conventional screw rotor has been made, as shown by the tooth profile curve of the screw rotor in Patent Document 1 for example, so as to hermetically form a transfer chamber in a space defined by both screw rotors and the housing in which the screw rotors are housed, as well as so as to improve sealing performance.

15 **[0003]** A cross sectional shape of the tooth profile of the screw rotor shown in Patent Document 1 with respect to a rotary axis of the screw rotor is formed by an outer circumferential portion defined by an arc centered by the rotational center of the screw rotor, a dedendum portion of an arc centered by the rotational center of the screw rotor and two curve portions connecting the outer circumferential portion and the dedendum portion. One of the curve portions is defined by a trochoid curve created based on a point A on an outer circumference of the mating screw rotor. The other of the curved portion is defined by a sine curve or by two involute curves.

20 Patent Document 1: JP 08-277790A

25 DISCLOSURE OF THE INVENTION

Problems to be Solved by Invention

30 **[0004]** In the screw rotors in the conventional screw type dry vacuum pump, the tooth profiles are defined only by curves identified by particular functions such as a sine curve and two involute curves. In tooth profiles formed by such curves, a meshing phase where the screw rotors are interfered with each other is unavoidably created during the rotation of the screw rotors. Therefore, it is not possible that the screw rotors are meshed to each other with no gap or with a constant gap over all meshing phases. Accordingly, there has been a problem that a large amount of discharge gas to be transferred could be leaked through the large gap that is formed between the screw rotors in a part of the meshing phases according to the rotation of the screw rotors. As a result, a considerable amount of the discharge gas could be reversed toward a discharging chamber, and it is therefore difficult to improve discharge rate of the discharge gas in such a conventional screw type dry vacuum pump.

35 The invention has been made in view of the problem of the background art as described above. The screw type fluid machine of the invention can suppress the amount of the discharge gas that is leaked and reversed toward a suction side in a transferring process. In other words, the object of the invention is to provide a screw type fluid machine in which a gap between the screw rotors is kept substantially in constant in a transfer chamber formed in a discharging chamber during operation.

Means for Solving the Problems

40 **[0005]** According to claim 1, there is provided a screw rotor having a cross-sectional shape of a tooth profile with respect to an axial direction including an arc forming a dedendum portion, an arc forming an outer circumferential portion and two curves connecting the outer circumferential portion and the dedendum portion, characterized in that one of these two curves connecting the outer circumferential portion and the dedendum portion is defined by a trochoid curve created based on a point on an outer circumference of a mating screw rotor and the other of said two curves, which is divided equally into two sections constituted by a section between a pitch circle and the outer circumferential portion and a section between the pitch circle and the dedendum portion, is defined by a predetermined curve for one of the sections and a fitting curve for the other of the sections that is created so as to correspond to the predetermined

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curve for the one of the sections divided equally into two in the mating screw rotor during meshing.

[0006] The other curve of two curves connecting the outer circumferential portion and the dedendum portion may be divided equally into even number along a radial direction between the outer circumferential portion and the dedendum portion in the cross section of the screw rotor with respect to an axial direction and may be defined by a predetermined curve for a half of the sections divided into this even number and a fitting curve based on a predetermined curve that is

[0007] According to claim 2, there is provided a screw rotor having a cross-sectional shape of a tooth profile with respect to an axial direction including an arc forming a dedendum portion, an arc forming an outer circumferential portion and two tooth profile curves connecting the outer circumferential portion and the dedendum portion, characterized in that one of the tooth profile curves connecting the outer circumferential portion and the dedendum portion is defined by such a tooth profile curve that a transfer chamber isolated from other spaces is formed without interfering with a meshing portion of the mating screw rotor, and the other of the tooth profile curves, which is divided equally into two sections constituted by a section between a pitch circle and the outer circumferential portion and a section between the pitch circle and the dedendum portion, is defined by a predetermined curve for one of the sections and a fitting curve created so as to correspond to the predetermined curve for the one of the sections divided equally into two in the mating screw rotor during meshing.

[0008] For one of these two tooth profile curves connecting the outer circumferential portion and the dedendum portion, it is the best way to select a trochoid curve created based on a point on the outer circumference of the mating screw rotor in a case the invention is applied to a screw type vacuum pump. However, the invention is not limited by such a construction. For the other of the tooth profile curves, the tooth profile may be formed by a curve that is divided equally into even number along a radial direction between the outer circumferential portion and the dedendum portion in the cross section of the screw rotor with respect to an axial direction and may be defined by a predetermined curve for a half of the sections divided into this even number and a fitting curve created based on a predetermined curve that is created as a predetermined curve for the mating screw rotor for the other of the sections, respectively.

[0009] According to claim 3, the invention may be characterized in that the predetermined curve portion that is defined for one of the sections equally divided into two is formed by an arc and a straight line. The combination of the arc and straight line is not specifically limited in terms of number of combined elements as long as the arc or straight line forming one of the sections equally divided into two are disposed or arranged so as to be connected smoothly with the dedendum portion or the outer circumferential portion and also to be connected smoothly with the other of the section equally divided into two. Further, the curve portion is not limited to consist of the arc and the straight line only.

[0010] According to claim 4, the invention may be characterized in that the predetermined curve portion is formed by a sine curve. The number of sine curves to be combined is not limited as long as sine curves forming one of the sections equally divided into two are disposed and arranged so as to be connected smoothly with the dedendum portion or the outer circumferential portion and also to be connected smoothly with the other of the sections equally divided into two. Further, the curve portion is not limited to consist of the sine curves only. However, to manufacture the tooth profile, the process can be simplified if one of the sections equally divided into two is formed by a single curve.

[0011] According to claim 5, there is provided a screw type fluid machine including a pump housing having a suction port and a discharge port, and a pair of screw rotors rotatably mounted in the pump housing so as to be rotated while meshing with each other, wherein a plurality of transfer chambers are formed among the pump housing and the pair of the screw rotors so as to be partitioned from one another by meshing portions of the screw rotors and to be transferred from a suction side to a discharge side in accordance with rotation of the screw rotors, characterized in that a cross sectional shape of a tooth profile of the screw rotors with respect to an axial direction includes an arc forming a dedendum portion, an arc forming an outer circumferential portion and two curves connecting the outer circumferential portion and the dedendum portion, wherein one of said two curves connecting the outer circumferential portion and the dedendum portion is defined by a trochoid curve created based on a point on the mating screw rotor and the other of said two curves, which is divided equally into two sections constituted by a section between a pitch circle and the outer circumferential portion and a section between the pitch circle and the dedendum portion, is defined by a predetermined curve for one of the sections and a fitting curve for the other of the sections that is created so as to correspond to the predetermined curve for the one of the sections divided equally into two in the mating screw rotor during meshing.

[0012] The tooth profile may be formed by the other of these two curves connecting the outer circumferential portion and the dedendum portion that is divided into even number along a radial direction between the outer circumferential portion and the dedendum portion in the cross section of the screw rotor with respect to an axial direction and is defined by a predetermined curve for a half of the sections equally divided into the even number and a fitting curve created based on the predetermined curve for the mating screw rotor for the other of the sections equally divided.

[0013] According to claim 6, there is provided a screw type fluid machine including a pump housing having a suction port and a discharge port, and a pair of screw rotors rotatably mounted in the pump housing so as to be rotated while meshing with each other, wherein a plurality of transfer chambers are formed among the pump housing and the pair of

the screw rotors so as to be partitioned from one another by meshing portions of the screw rotors and to be transferred from a suction side to a discharge side in accordance with rotation of the screw rotors, characterized in that a cross sectional shape of a tooth profile of the screw rotors with respect to an axial direction includes an arc forming a dedendum portion, an arc forming an outer circumferential portion and two curves connecting the outer circumferential portion and the dedendum portion, wherein one of the tooth profile curves connecting the outer circumferential portion and the dedendum portion is defined by such a tooth profile curve that a transfer chamber isolated from other spaces is formed without interfering with a meshing portion of the mating screw rotor, and the other of the tooth profile curves, which is divided equally into two sections constituted by a section between a pitch circle and the outer circumferential portion and a section between the pitch circle and the dedendum portion, is defined by a predetermined curve for one of the sections and a fitting curve created so as to correspond to the predetermined curve for the one of the sections divided equally into two in the mating screw rotor during meshing

[0014] For one of these two tooth profile curves connecting the outer circumferential portion and the dedendum portion, it is the best way to select a trochoid curve created based on a point on the outer circumference of the mating screw rotor in a case the invention is applied to a screw type vacuum pump. However, the invention is not limited by such a construction. For the other of the tooth profile curves, the tooth profile may be formed by a curve that is divided equally into even number along a radial direction between the outer circumferential portion and the dedendum portion in the cross section of the screw rotor with respect to an axial direction and may be defined by a predetermined curve for a half of the sections divided into this even number and a fitting curve created based on a predetermined curve that is created as a predetermined curve for the mating screw rotor for the other of the sections, respectively.

[0015] According to claim 7, the invention may be characterized in that the predetermined curve portion that is one of the sections equally divided into two is formed by an arc and a straight line. The combination of the arc and straight line is not specifically limited in terms of number of combined elements as long as the arc or straight line forming one of the sections equally divided into two are disposed or arranged so as to be connected smoothly with the dedendum portion or the outer circumferential portion and also to be connected smoothly with the other of the section equally divided into two. Further, the curve portion is not limited to consist of the arc and the straight line only.

[0016] According to claim 8, the invention may be characterized in that the predetermined curve portion is formed by a sine curve. The number of sine curves to be combined is not limited as long as sine curves forming one of the sections equally divided into two are disposed and arranged so as to be connected smoothly with the dedendum portion or the outer circumferential portion and also to be connected smoothly with the other of the sections equally divided into two. Further, the curve portion is not limited to consist of the sine curves only. However, to manufacture the tooth profile, the process can be simplified if one of the sections equally divided into two is formed by a single curve.

Advantage of the Invention

[0017] According to claim 1, it is possible to form a tooth profile of a screw rotor easily such that the gap between the screw rotors is constant irrespective of the rotational angle of the screw rotors when the screw rotors are meshed and rotated.

[0018] According to claim 2, it is possible to form a tooth profile of a screw rotor easily such that the gap between the screw rotors is constant irrespective of the rotational angle of the screw rotors when the screw rotors are meshed and rotated.

[0019] According to claim 3, it is possible to form a tooth profile of a screw rotor easily that is smoothly connected with the dedendum portion or the outer circumferential portion by using an arc for a connecting portion in one of the sections equally divided into two by the pitch circle.

[0020] According to claim 4, it is possible to form a tooth profile of a screw rotor easily that is smoothly connected with the dedendum portion or the outer circumferential portion by forming one of curves equally divided into two easily by the pitch circle with at least one curve.

[0021] According to claim 5, it is possible to provide a screw type fluid machine having a tooth profile of a screw rotor easily such that the gap between the screw rotors is constant irrespective of the rotational angle of the screw rotors when the screw rotors are meshed and rotated.

[0022] According to claim 6, it is possible to provide a screw type fluid machine having a tooth profile of a screw rotor easily such that the gap between the screw rotors is constant irrespective of the rotational angle of the screw rotors when the screw rotors are meshed and rotated.

[0023] According to claim 7, it is possible to provide a screw type fluid machine having a tooth profile of a screw rotor easily that is smoothly connected with the dedendum portion or the outer circumferential portion by using an arc for a connecting portion in one of the sections equally divided into two by the pitch circle.

[0024] According to claim 4, it is possible to provide a screw type fluid machine having a tooth profile of a screw rotor easily that is smoothly connected with the dedendum portion or the outer circumferential portion by forming one of

curves equally divided into two easily by the pitch circle with at least one curve.

BEST MODE FOR CARRYING OUT THE INVENTION

[0025] Hereinafter, an embodiment of the invention will be described with reference to the drawings.

Embodiment 1

[0026] Fig. 1 shows an embodiment of a screw type dry vacuum pump 100 in which screw rotors according to the invention are employed.

[0027] The screw type dry vacuum pump 100, as shown in Fig. 1, are provided with two shafts 101, 102 supported in a casing 110 through bearings 111,112,113,114. Screw rotors 103, 104 having screw grooves are provided on the shafts 101, 102. One shaft 101 is driven by a motor 105 and this rotation is transmitted through a timing gear 106 attached to the shaft 101 by meshing with the a timing gear 115 attached to the other shaft 102. That is, the screw rotors 103, 104 are rotated in synchronism with each other by means of the timing gears 106,115. The casing 110 is provided with a suction port 107 for introducing a discharge gas in a discharging chamber therefrom and a discharge port 108 for discharging the exhaust gas in a discharging chamber that is transferred from a side of the suction port 107. By the above construction, the screw rotors 103, 104 are rotated in opposite directions in synchronism with each other so that the discharge gas which are hermetically caught in a transfer chamber in the discharging chamber defined by the screw rotors 103, 104 and the casing 110 is transferred and discharged by moving the discharge gas along the axial direction of the screw rotors 103, 104 by the rotation thereof.

[0028] Operation of the screw type dry vacuum pump includes a suction step in which a gas is sucked to the discharging chamber from the suction port 107, a transfer step in which the gas in the discharging chamber is transferred and a discharge step in which the gas is discharged from the discharge port 108.

[0029] The suction port 107 may be located on an upper surface of the housing as described in Fig. 1, but it may be located on a side surface of the housing so that the suction port is overlapped with the screw rotors when viewed from a direction perpendicular to the axial direction. Turning to the discharge port at one end, it is possible to adjust a communication timing between the transfer chamber and outside atmosphere on the discharge side by changing the location and the size of the discharge port, if gaps between an upper surface of a discharge side flange 109 and end faces of the screw rotors on the discharge side are formed small enough similarly to those between the screw rotors and the housing. As a result discharge pressure of the discharge gas can be changed. Further, in a case that the discharge port is formed on a side surface of the housing, it is possible to form the discharge port and a discharge passage can be formed large. This construction increases the convenience for maintenance operation.

[0030] Further, in a case that the screw type dry vacuum pump is employed in a system which does not allow to incorporate impurities therein such as semiconductor manufacturing apparatus, axial seals 116,117,118, 119 are provided on the discharge side of the housing so as to be interposed between the shaft and the housing so that lubricant or the like for lubricating the bearing 111,112,113,114 and the timing gear 106,115 would not enter into the discharging chamber.

[0031] In the discharging chamber, transfer chambers each of which is hermetically closed among the pair of the screw rotors and the housing are formed in plural in accordance with the number of threads and the number of turn of the screw rotors. the discharge gas sucked from the suction port 107 is hermetically caught in each of the transfer chambers and transferred to the discharge port 108 according to the rotation of the screw rotors so that the discharge gas is discharged from the discharge port 108.

[0032] In operation, the discharge performance of the screw type dry vacuum pump depends considerably on hermetic level of the transfer chambers formed in the discharging chamber. In other words, since the discharge gas is transferred from a high pressure side to a low pressure side, the discharge gas that should be hermetically caught within the transfer chambers could be leaked out toward the suction port 107 before the discharge gas is transferred from the suction port 107 to the discharge port 108 if the hermetic level of the transfer chambers is low.

[0033] Hermetic condition of the transfer chambers depends on sealing lines formed along boundaries between the outer circumferential portions of the screw rotors and the housing, boundaries between the dedendum portions of one screw rotor and the outer circumferential portions of the other screw rotor and boundaries between the outer circumferential portions of the one screw rotor and the dedendum portion of the other screw rotor.

[0034] Next, cross sectional shapes of the screw rotors with respect to the rotary axis will be described with reference to Fig. 2. In Fig. 2, a section AB, a section CD, a section BC and a section AD are an outer circumferential portion, a dedendum portion and two curves connecting the outer circumferential portion and the dedendum portion, respectively. The section BC is defined by a trochoid curve. The section AD is defined by a combination of curves one of which is a curve combined with an arc and a straight line extending from a pitch circle 201 as the boundary which is centered at the rotary axis O toward a dedendum side 203, the other of which is a fitting curve created for an outer circumferential

side 205

[0035] If the gap is large on a part of the sealing line, the discharge gas could be leaked through the gap from the transfer chambers and the discharge performance is deteriorated. In the tooth profiles of the screw rotors, the trochoid curves by which the screw rotors can be operated with a constant gap therebetween can be formed along the gap formed between the outer circumferential portion CD and the housing along the sealing line, the gap between the dedendum portion of one screw rotor and the outer circumferential portion of the other screw rotor and the gap between the outer circumferential portion of the one screw rotor and the dedendum portion of the other screw rotor. However, according to conventional screw rotors, the gap is changed in the meshing portions along the section AD connecting the outer circumferential portion and the dedendum portion. Therefore, the gap at the smallest in this section is set to be equivalent to the constant gap that is set for the other sections, a large gap is formed on the opposite side in this section and hence the discharge gas in the transfer chamber can be leaked through this large gap. As a result, a considerable amount of the discharge gas is reversed and therefore the discharge performance is deteriorated. On the other hand, according to this embodiment, the section defined along the dedendum side 203 from the pitch circle 201 as the boundary is formed by a combined curve of an arc and a straight line, and the section defined along an outer circumferential side 205 from the pitch circle 201 as the boundary is formed by a fitting curve created for the outer circumferential side 205. Accordingly, since the fitting curve can be set in a flexible way, the tooth profiles can be formed in which the gap is constantly kept the same as the other sections during the operation. As a result, the screw type dry vacuum pump having extremely good sealing performance can be provided.

[0036] Next, the description will be made to the forming steps of screw tooth profile according to the present embodiment with reference to Figs. 3 through 10

[0037] Fig. 3 shows the cross section of the screw rotor with respect to the rotary axis. The section AB as the dedendum portion is defined by an arc centered at the rotary axis O of the screw rotor, the section CD as the outer circumferential portion is defined by an arc centered at the rotary axis O of the screw rotor, and the section BC is defined by a trochoid curve, before the tooth profile curve in the section AD is defined.

[0038] Subsequently, as shown in Fig. 4, a circle 301 is defined so as to be circumscribed with the dedendum arc on the dedendum side 203 and centered on the circumference of the pitch circle 201 that is centered at the rotary axis O such that the circle 301 has a diameter identical to a difference between the outer circumferential arc and the dedendum arc.

[0039] Then, as shown in Fig. 5, a straight line portion 403 is formed so as to be in contact with the dedendum portion and so as to pass an intersecting point P between the pitch circle and a line L bisecting an angle 2θ formed between a line connecting the center O of the screw rotor with a circumscribing point between the circle 301 and the dedendum arc and a line connecting the center O of the screw rotor with an end point D of the outer circumferential portion. As shown in Fig. 6, a tooth profile on the dedendum side 203 is defined by an arc of the circle 301 between the circumscribing point to the dedendum arc and a tangential point with a straight line portion 403 and this straight line portion 403 formed between a contact point to the pitch circle 201 and the tangential point with circle 301.

[0040] Next, as shown in Fig. 7, a screw rotor 703 which has the same shape as a screw rotor 701 is disposed at a position apart from the screw rotor 701 with a distance identical to the diameter of the pitch circle 201 and with and 180° phase difference therebetween.

[0041] As shown in Fig. 8, the one screw rotor 701 is fixed and the other screw rotor 703 is rotated around the one screw rotor 701 by degrees while changing the meshing phase therebetween so that the screw rotors maintain their positional relationship during the operation.

[0042] At this point, as shown in Fig. 9, an outer circumferential tooth profile is formed between the section from P to D by a fitting curve created interconnecting points corresponding to the tool profile of a dedendum side tooth 903 at each of which an outer circumferential side tooth portion 901 does not interfere with the tooth profile on the dedendum side of the mating screw rotor.

[0043] As described above, a screw rotor 805 is provided with the tooth profile defined by the cross sectional shape with respect to the rotary axis as shown in Fig. 10, which is an ideal tooth profile by which the gap formed between the mating screw rotor is substantially 0 mm in any meshing phase. Incidentally, it is necessary to form a constant gap (0.05 - 0.3 mm) between the screw rotors since the screw rotors are expanded in the direction perpendicular to the tooth surface due to the friction between the screw rotors and the compression of the discharge gas in a case that the machine is operated without oil. In this case, a uniform gap is formed in any meshing phase by modifying the tooth profile to shrink the ideal tooth profile having the gap of substantially 0 mm by a constant amount (0.025 - 0.15 mm) in the direction perpendicular to the tooth surface.

[0044] In conventional tooth profile, the part of the tooth profile where the minimum gap is formed at which an interference may be caused is set to have a minimum design gap. Therefore, a larger gap than the minimum design gap is unavoidably formed in the other meshing phase. On the other hand, the screw type dry vacuum pump having screw rotors according to the present embodiment, the gap between the screw rotors is formed in uniform regardless of the meshing phase. Therefore, an optimum design can be obtained in view of the discharge performance and the heat

expansion or the like. As a result, leak of the discharge gas through the gap can be suppressed in minimum so that the discharge performance can be improved and power consumption can be decreased.

BRIEF DESCRIPTION OF THE DRAWINGS

[0045]

Fig. 1 shows a screw type dry vacuum pump according to the invention.

Fig. 2 shows a cross sectional shape of a screw rotor according to the invention with respect to a rotary axis thereof.

Fig. 3 shows a first step to form the cross sectional shape of the screw rotor according to the invention with respect to the rotary axis thereof.

Fig. 4 shows a second step to form the cross sectional shape of the screw rotor according to the invention with respect to the rotary axis thereof.

Fig. 5 shows a third step to form the cross sectional shape of the screw rotor according to the invention with respect to the rotary axis thereof.

Fig. 6 shows a fourth step to form the cross sectional shape of the screw rotor according to the invention with respect to the rotary axis thereof.

Fig. 7 shows a fifth step to form the cross sectional shape of the screw rotor according to the invention with respect to the rotary axis thereof.

Fig. 8 shows a sixth step to form the cross sectional shape of the screw rotor according to the invention with respect to the rotary axis thereof.

Fig. 9 shows a seventh step to form the cross sectional shape of the screw rotor according to the invention with respect to the rotary axis thereof.

Fig. 10 shows an eighth step to form the cross sectional shape of the screw rotor according to the invention with respect to the rotary axis thereof.

DESCRIPTION OF THE REFERENCE NUMERALS

[0046]

100	screw type dry vacuum pump
110	casing
101,102	shaft
111, 112, 113, 114	bearing
103, 104	screw rotor
106, 115	timing gear
107	suction port
108	discharge port
109	discharge side flange
116,117,118,119	axial seal
201	pitch circle

Claims

1. A screw rotor having a cross-sectional shape of a tooth profile with respect to an axial direction thereof comprising:

an arc forming a dedendum portion;

an arc forming an outer circumferential portion; and

two curves connecting the outer circumferential portion and the dedendum portion,

characterized in that

one of said two curves connecting the outer circumferential portion and the dedendum portion is defined by a trochoid curve created based on a point on an outer circumference of a mating screw rotor and

the other of said two curves, which is divided equally into two sections constituted by a section between a pitch circle and the outer circumferential portion and a section between the pitch circle and the dedendum portion, is defined by a predetermined curve for one of the sections and a fitting curve for the other of the sections that is created so as to correspond to the predetermined curve for the one of the sections divided equally into two in the mating screw rotor during meshing.

2. A screw rotor having a cross-sectional shape of a tooth profile with respect to an axial direction thereof comprising:

an arc forming a dedendum portion;
 an arc forming an outer circumferential portion; and
 two tooth profile curves connecting the outer circumferential portion and the dedendum portion,
characterized in that

one of the tooth profile curves connecting the outer circumferential portion and the dedendum portion is defined by such a tooth profile curve that a transfer chamber isolated from other spaces is formed without interfering with a meshing portion of the mating screw rotor, and
 the other of the tooth profile curves, which is divided equally into two sections constituted by a section between a pitch circle and the outer circumferential portion and a section between the pitch circle and the dedendum portion, is defined by a predetermined curve for one of the sections and a fitting curve created so as to correspond to the predetermined curve for the one of the sections divided equally into two in the mating screw rotor during meshing.

3. A screw rotor according to claim 1 or 2, **characterized in that** the predetermined curve portion that is defined for one of the sections equally divided into two is formed by an arc and a straight line.

4. A screw rotor according to claim 1 or 2, **characterized in that** the predetermined curve portion is formed by a sine curve.

5. A screw type fluid machine comprising:

a pump housing having a suction port and a discharge port; and
 a pair of screw rotors rotatably mounted in the pump housing so as to be rotated while meshing with each other, wherein a plurality of transfer chambers are formed among the pump housing and the pair of the screw rotors so as to be partitioned from one another by meshing portions of the screw rotors and to be transferred from a suction side to a discharge side in accordance with rotation of the screw rotors,

characterized in that

a cross sectional shape of a tooth profile of the screw rotors with respect to an axial direction thereof includes an arc forming a dedendum portion;
 an arc forming an outer circumferential portion; and
 two curves connecting the outer circumferential portion and the dedendum portion, wherein one of said two curves connecting the outer circumferential portion and the dedendum portion is defined by a trochoid curve created based on a point on the mating screw rotor and
 the other of said two curves, which is divided equally into two sections constituted by a section between a pitch circle and the outer circumferential portion and a section between the pitch circle and the dedendum portion, is defined by a predetermined curve for one of the sections and a fitting curve for the other of the sections that is created so as to correspond to the predetermined curve for the one of the sections divided equally into two in the mating screw rotor during meshing.

6. A screw type fluid machine comprising:

a pump housing having a suction port and a discharge port; and
 a pair of screw rotors rotatably mounted in the pump housing so as to be rotated while meshing with each other, wherein a plurality of transfer chambers are formed among the pump housing and the pair of the screw rotors so as to be partitioned from one another by meshing portions of the screw rotors and to be transferred from a suction side to a discharge side in accordance with rotation of the screw rotors,

characterized in that

a cross sectional shape of a tooth profile of the screw rotors with respect to an axial direction thereof includes an arc forming a dedendum portion;
 an arc forming an outer circumferential portion; and
 two curves connecting the outer circumferential portion and the dedendum portion, wherein one of the tooth profile curves connecting the outer circumferential portion and the dedendum portion is defined by such a tooth profile curve that a transfer chamber isolated from other spaces is formed without interfering with a meshing portion of the mating screw rotor, and
 the other of the tooth profile curves, which is divided equally into two sections constituted by a section between a pitch circle and the outer circumferential portion and a section between the pitch circle and the dedendum

portion, is defined by a predetermined curve for one of the sections and a fitting curve created so as to correspond to the predetermined curve for the one of the sections divided equally into two in the mating screw rotor during meshing.

- 5 7. A screw type fluid machine according to claim 5 or 6, **characterized in that** the predetermined curve portion that is one of the sections equally divided into two is formed by an arc and a straight line.
8. A screw type fluid machine according to claim 5 or 6, **characterized in that** the predetermined curve portion is formed by a sine curve.
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FIG. 1

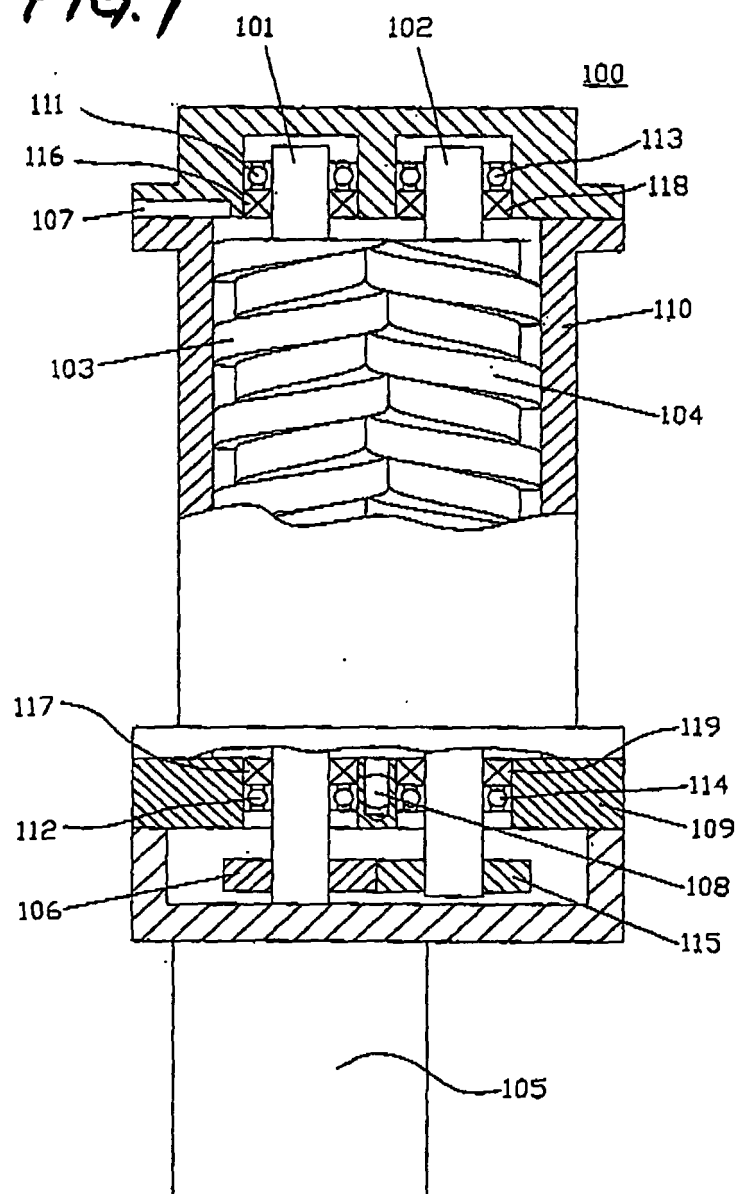


FIG. 2

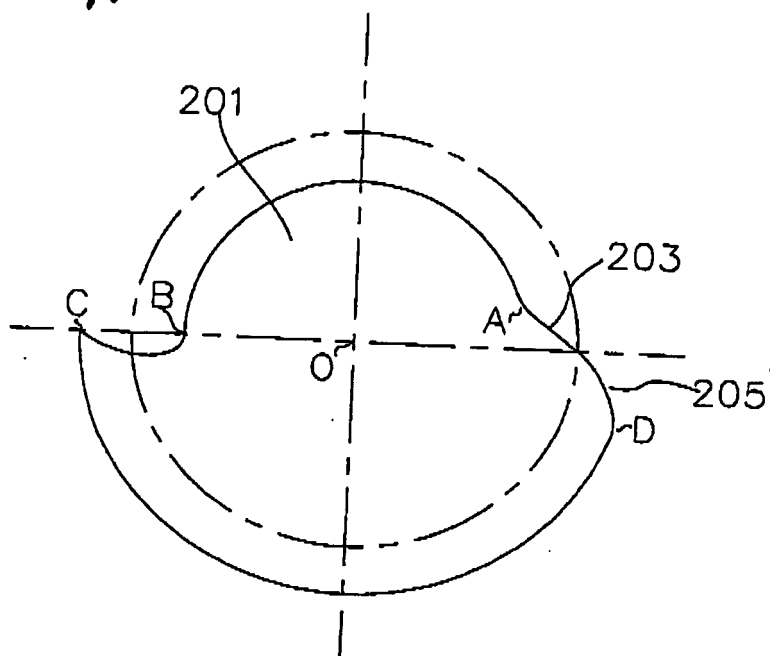


FIG. 3

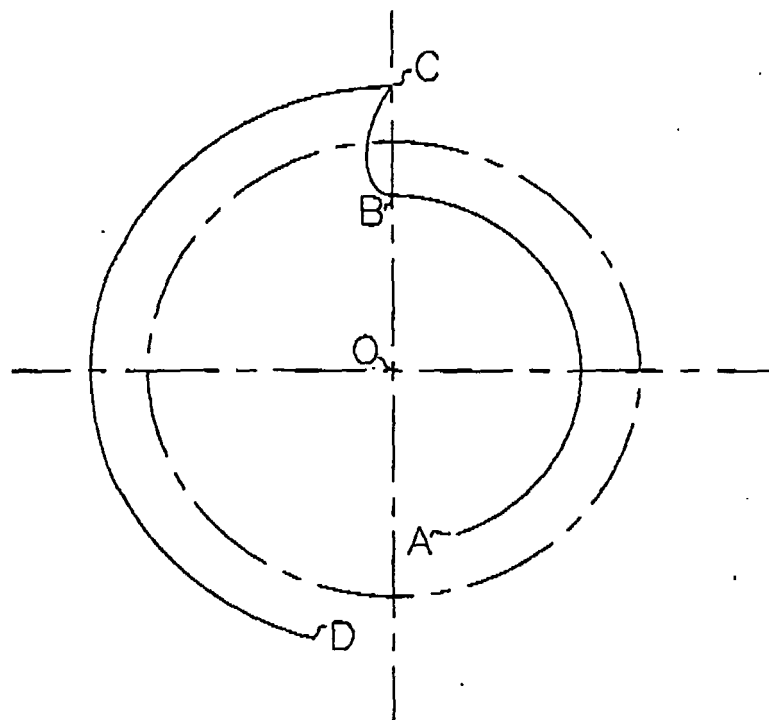


FIG. 4

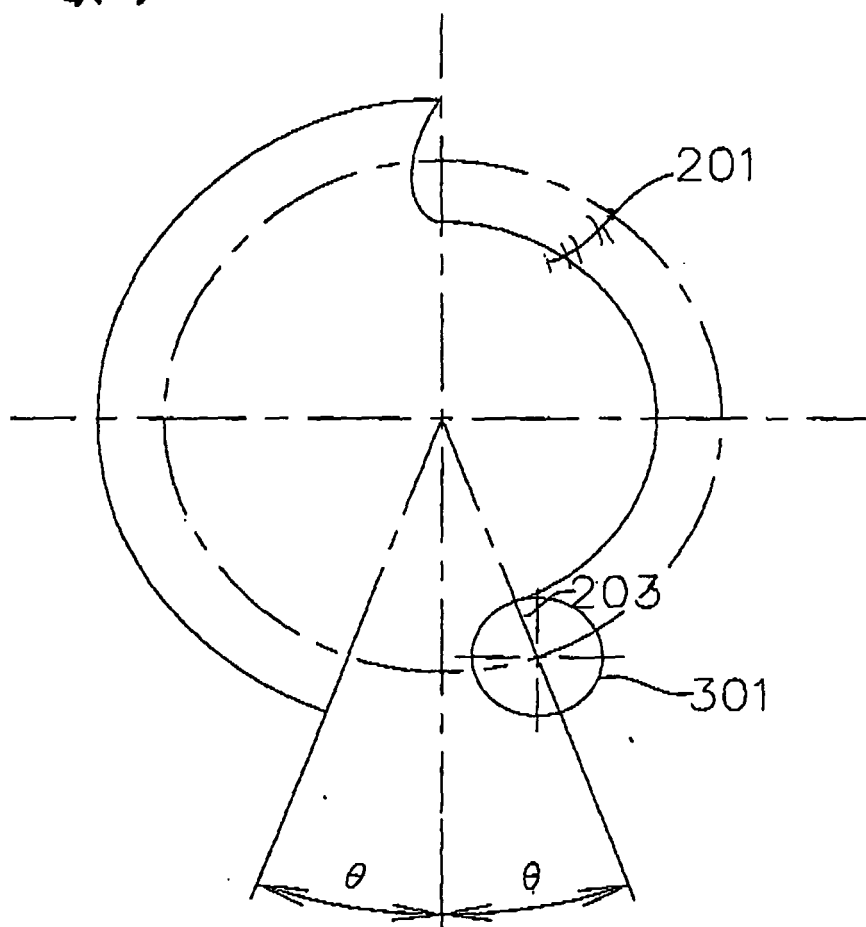


FIG. 5

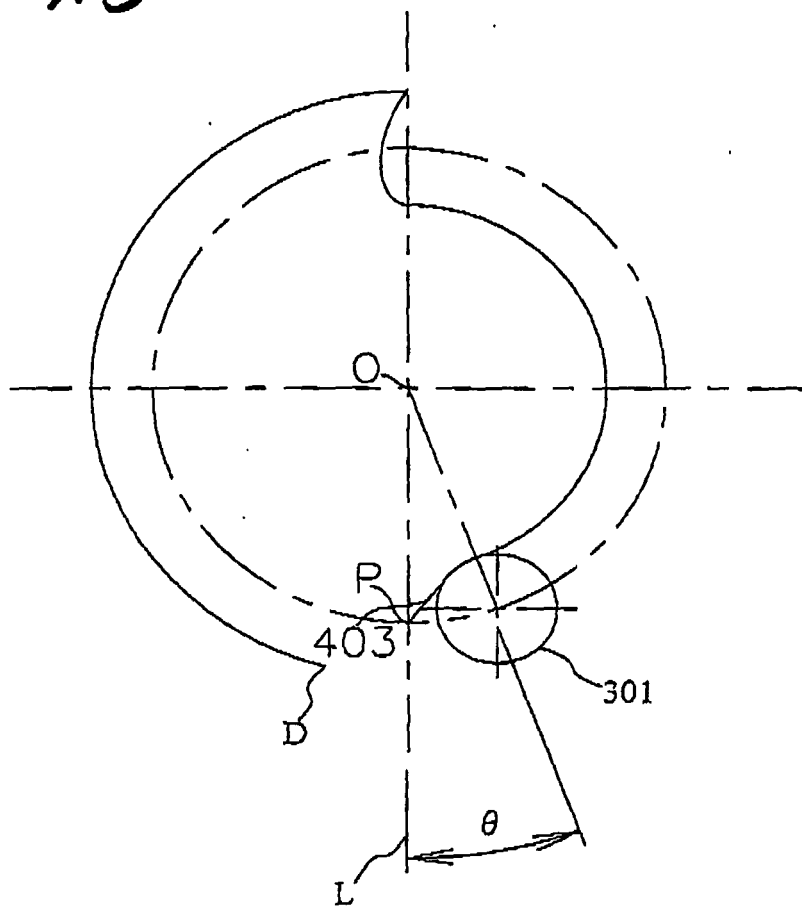


FIG. 6

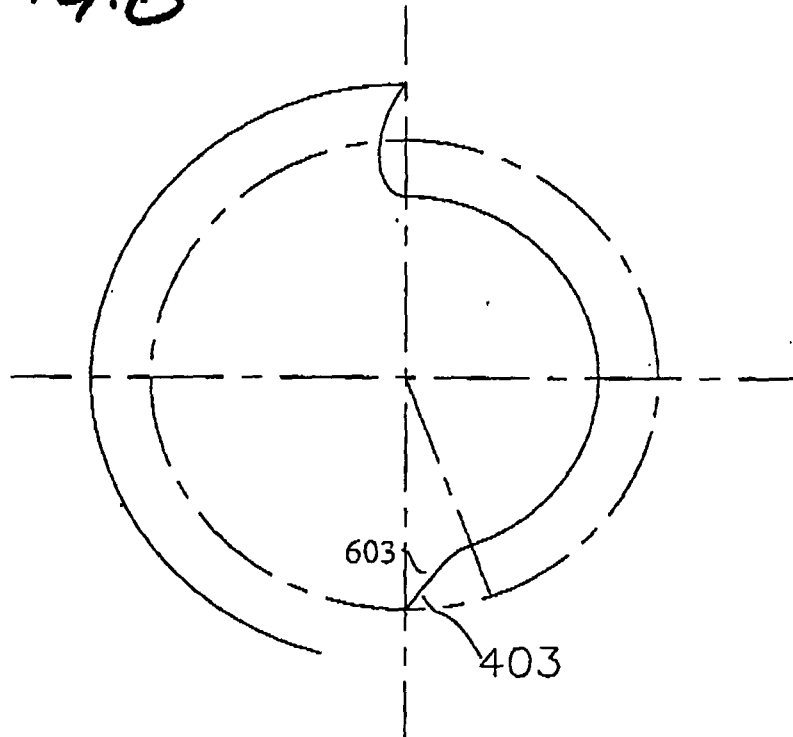


FIG. 7

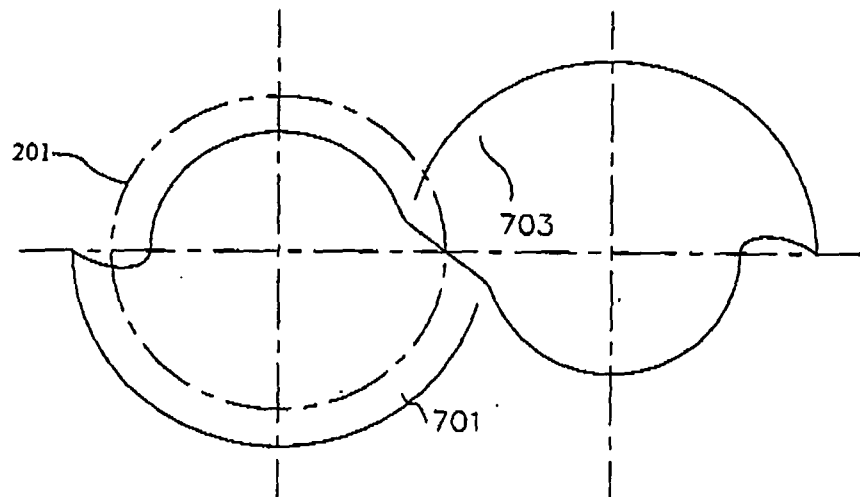


FIG. 8

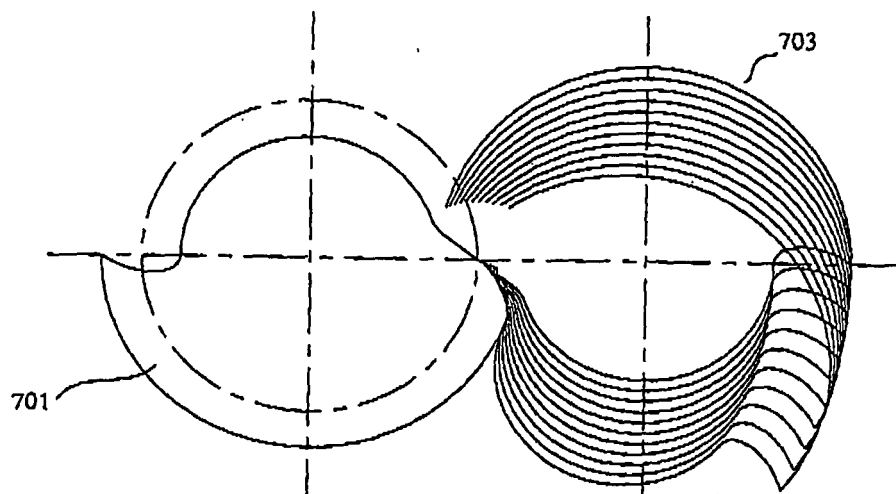


FIG. 9

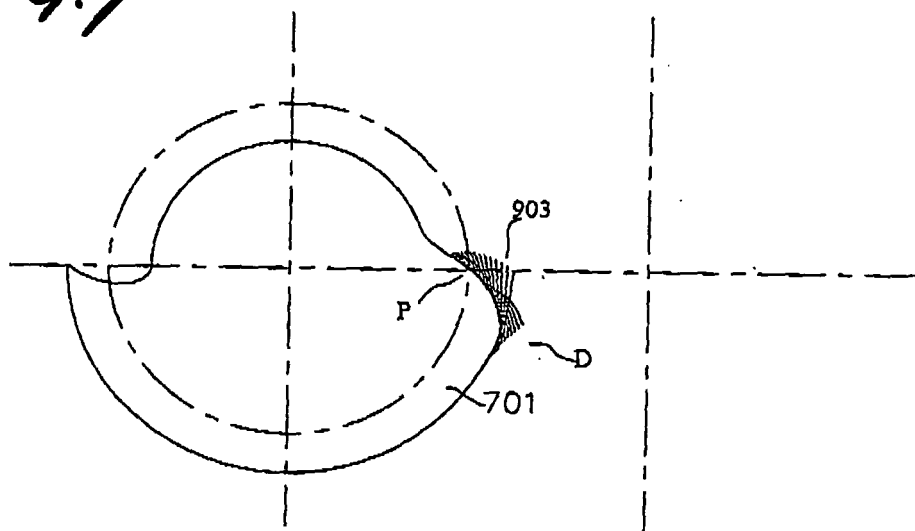
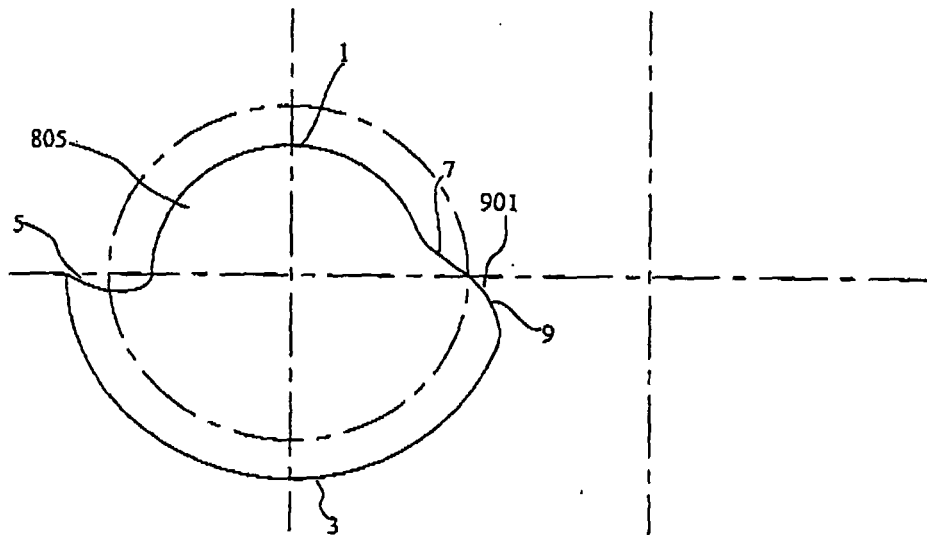


FIG. 10



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/009415

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl. ⁷ F04C18/16, 25/02		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) Int.Cl. ⁷ F04C18/16, 25/02, 2/16		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2005 Kokai Jitsuyo Shinan Koho 1971-2005 Toroku Jitsuyo Shinan Koho 1994-2005		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	WO 2004/031585 A1 (EBARA DENSAN LTD.), 15 April, 2004 (15.04.04), Page 9, line 5 to page 12, line 24; Figs. 3A to B (Family: none)	1, 2, 4-6, 8 3, 7
Y A	JP 2001-263276 A (Teijin Seiki Co., Ltd.), 26 September, 2001 (26.09.01), Par. Nos. [0015] to [0021]; Figs. 1 to 4 & US 6386848 B2 & EP 1134357 B1	1, 2, 4-6, 8 3, 7
Y A	JP 8-277790 A (Ebara Corp.), 22 October, 1996 (22.10.96), Par. No. [0028]; Figs. 4 to 5 & EP 0736667 B1 & US 5697772 A1	4, 8 3, 7
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
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Date of the actual completion of the international search 12 July, 2005 (12.07.05)		Date of mailing of the international search report 02 August, 2005 (02.08.05)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/009415

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 8-189485 A (Ebara Corp.), 23 July, 1996 (23.07.96), Par. Nos. [0022] to [0026]; Figs. 1 to 4 (Family: none)	1-8
A	JP 57-46083 A (Shigenobu NAGATA), 16 March, 1982 (16.03.82), Page 2, lower right column, line 1 to page 3, upper right column, line 1; Figs. 1 to 2 (Family: none)	1-8

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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