US 20020150489A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2002/0150489 A1

Kim (43) Pub. Date: Oct. 17, 2002

(54) ROTARY VANE TYPE VACUUM PUMP ROTOR

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(21) Appl. No.: 09/921,906

(22) Filed: Aug. 6, 2001

(30) Foreign Application Priority Data

Apr. 12, 2001 (KR) 2001-19420

Publication Classification

(51) Int. Cl.[7] F04C 23/00

(52) U.S. Cl. 418/13; 418/212

(57) ABSTRACT

The present invention relates to a rotor of a rotary vane type vacuum pump capable of enhancing a durability, decreasing a processing and assembling time and a fabrication cost, increasing a productivity and decreasing a maintenance. In the rotor of a rotary vane type vacuum pump according to the present invention, the vane groove is extended to a support shaft portion which is a connection potion of the rotor body and the first and second rotors, and one end of the same includes a slot having an opened end, a sleeve which is a cylindrical bearing is inserted onto an outer portion of the support shaft portion which is a connection portion of the first and second rotors, and the first and second rotors are connected by a connection coupling which includes an engaging protrusion inserted into an opening end groove formed when the vane groove is formed and the sleeve is assembled.

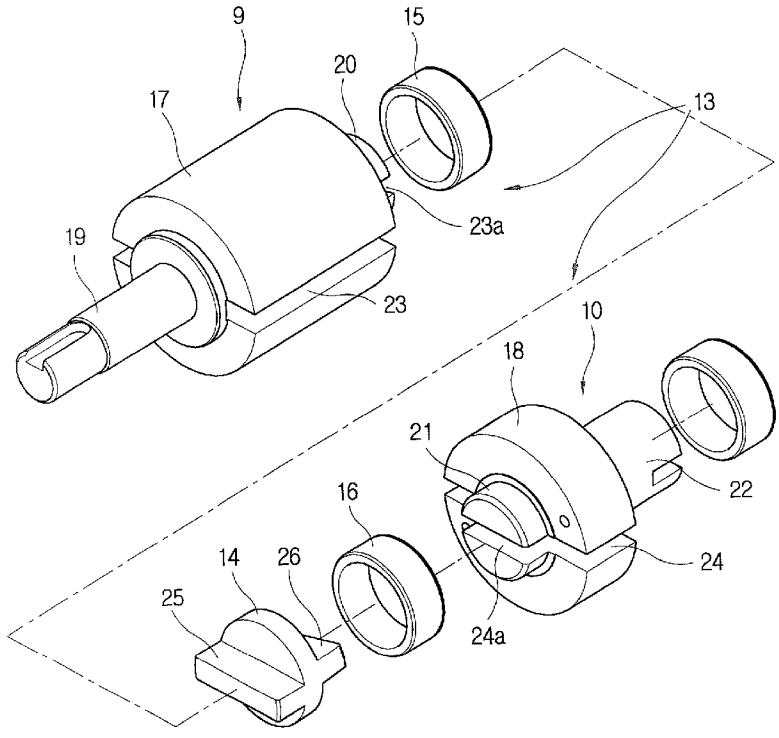


Fig.1

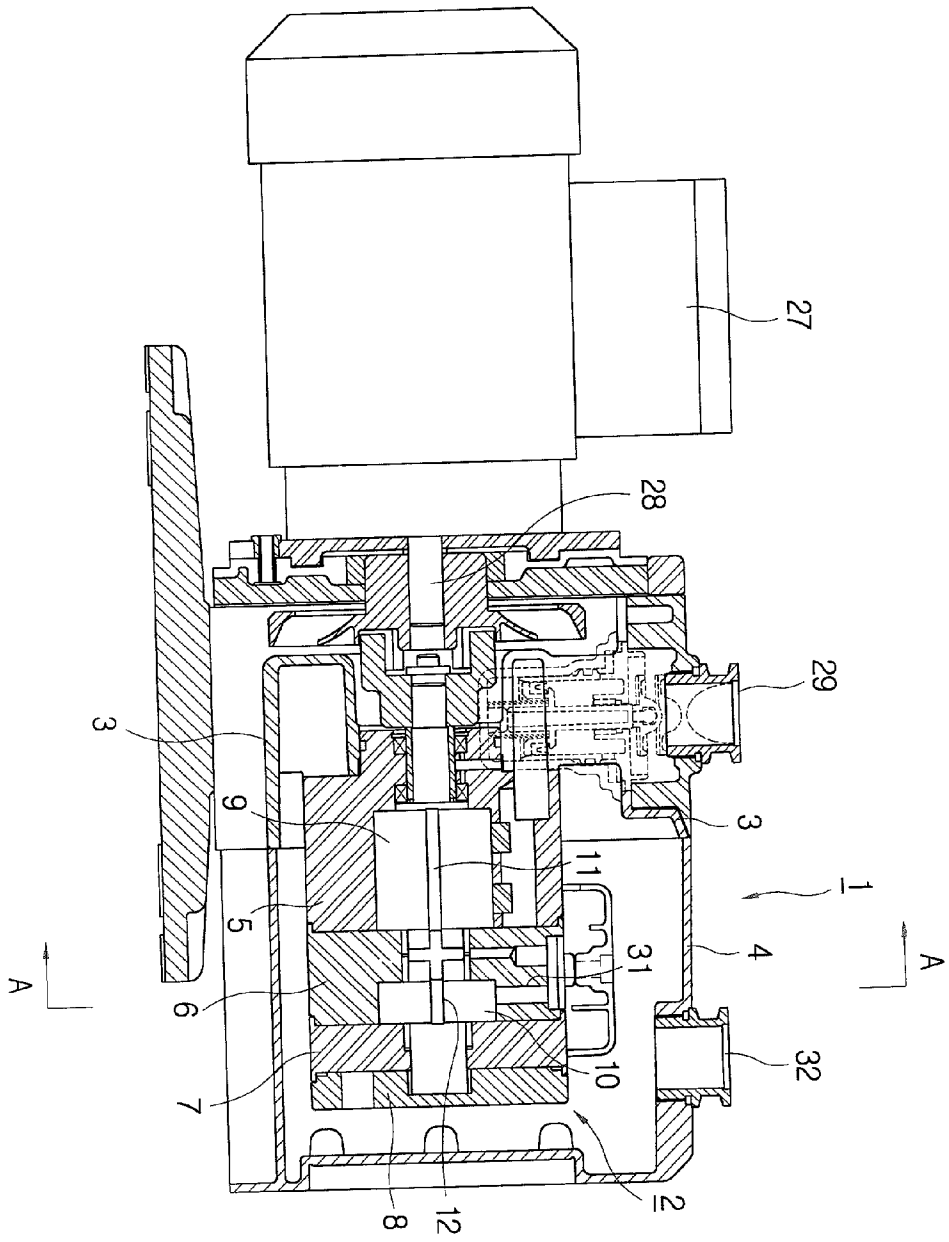


Fig.2

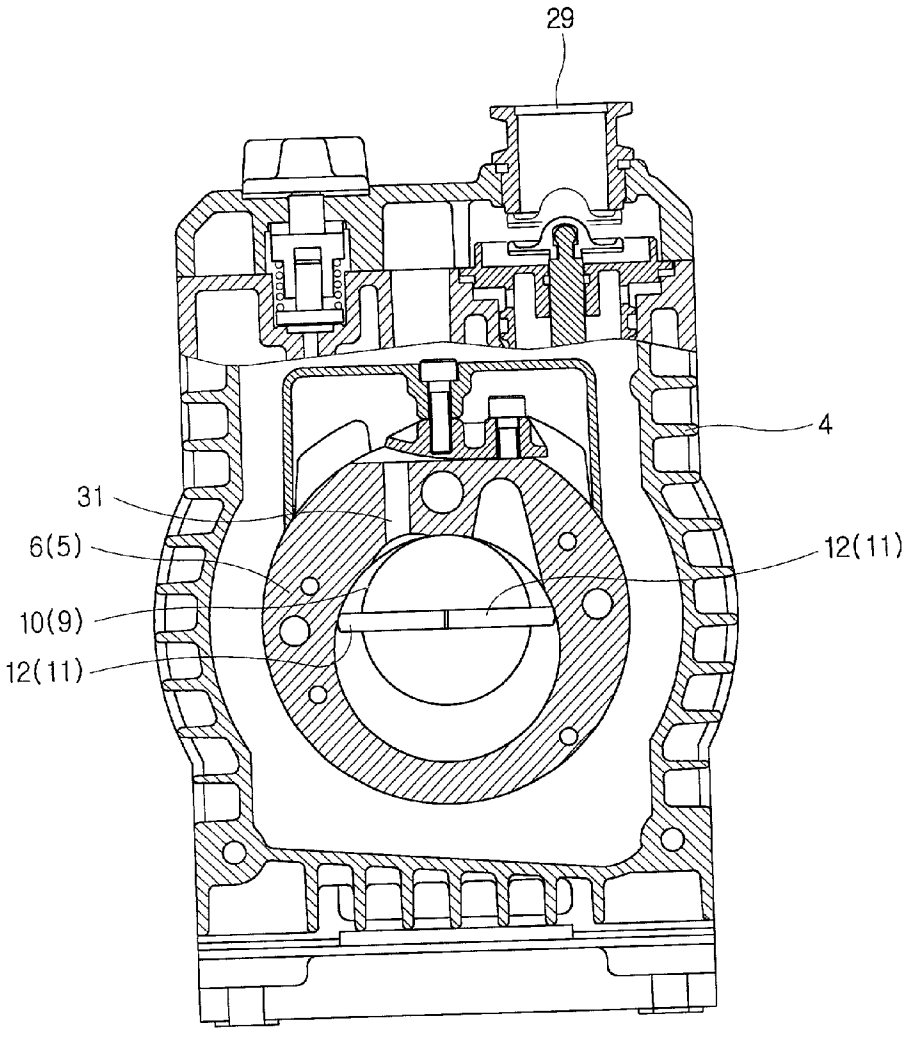


Fig.3

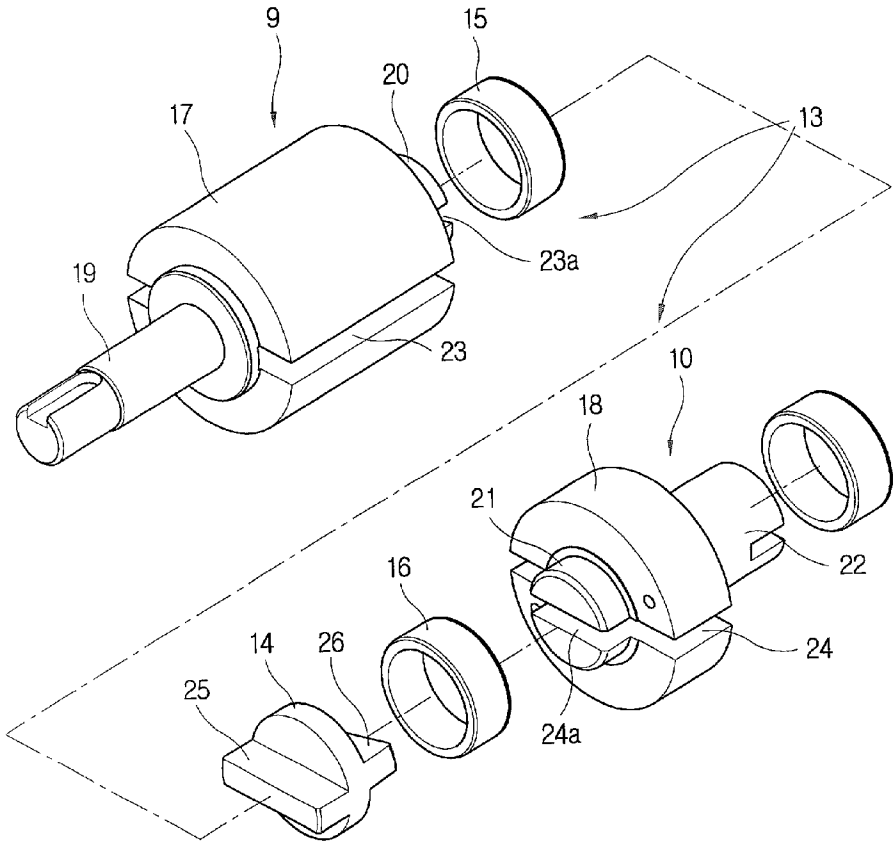


Fig.4

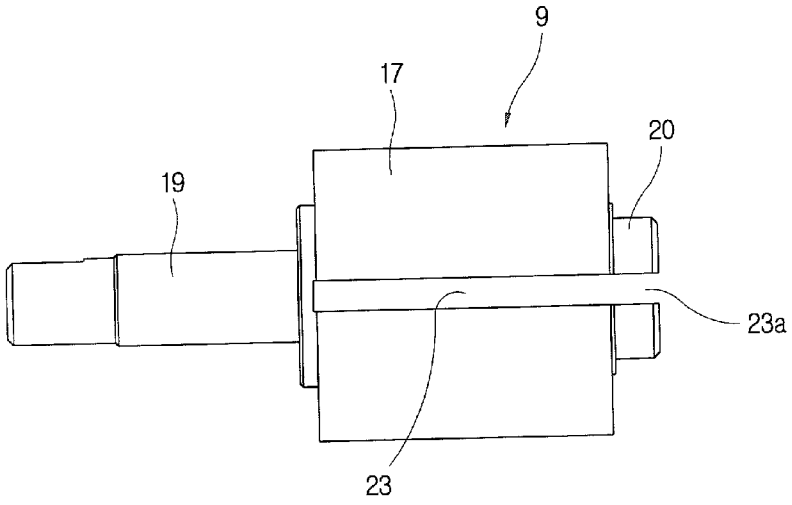


Fig.5

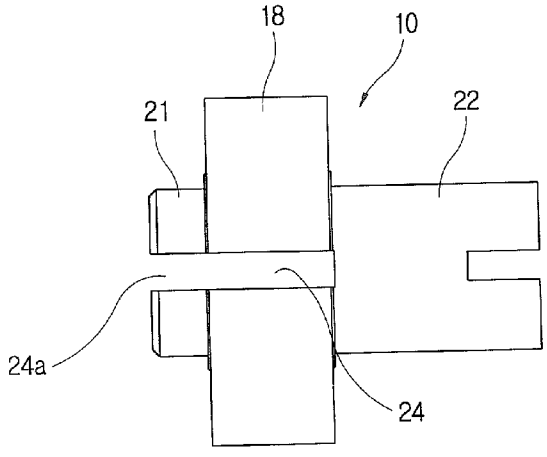


Fig.6

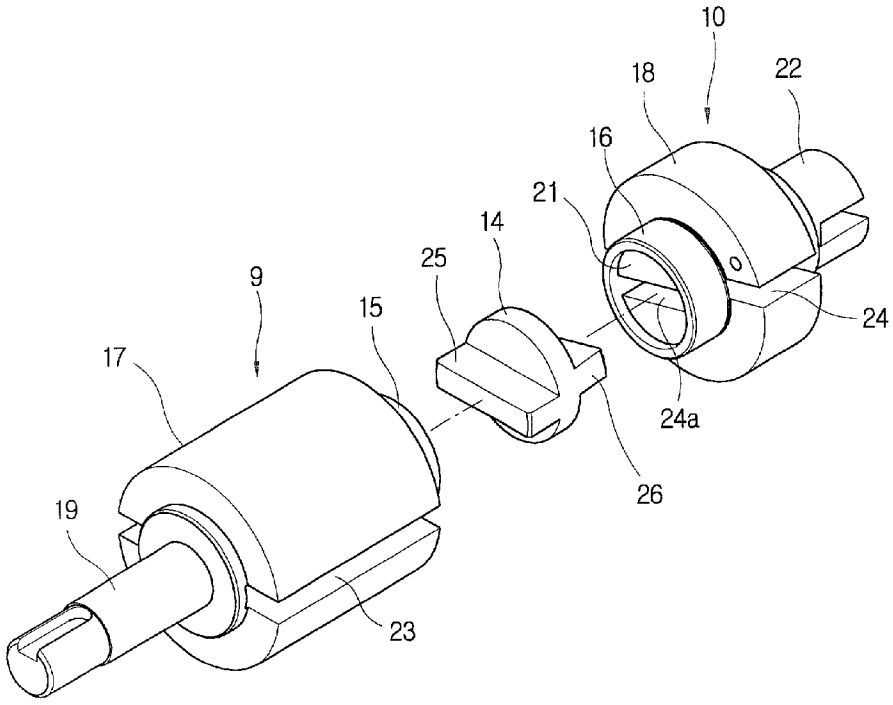


Fig.7

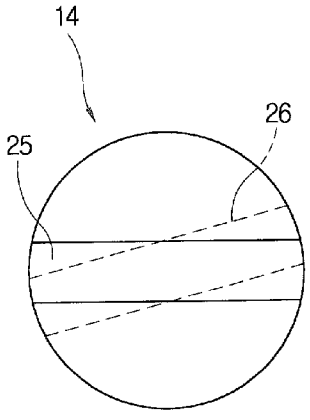


Fig.8

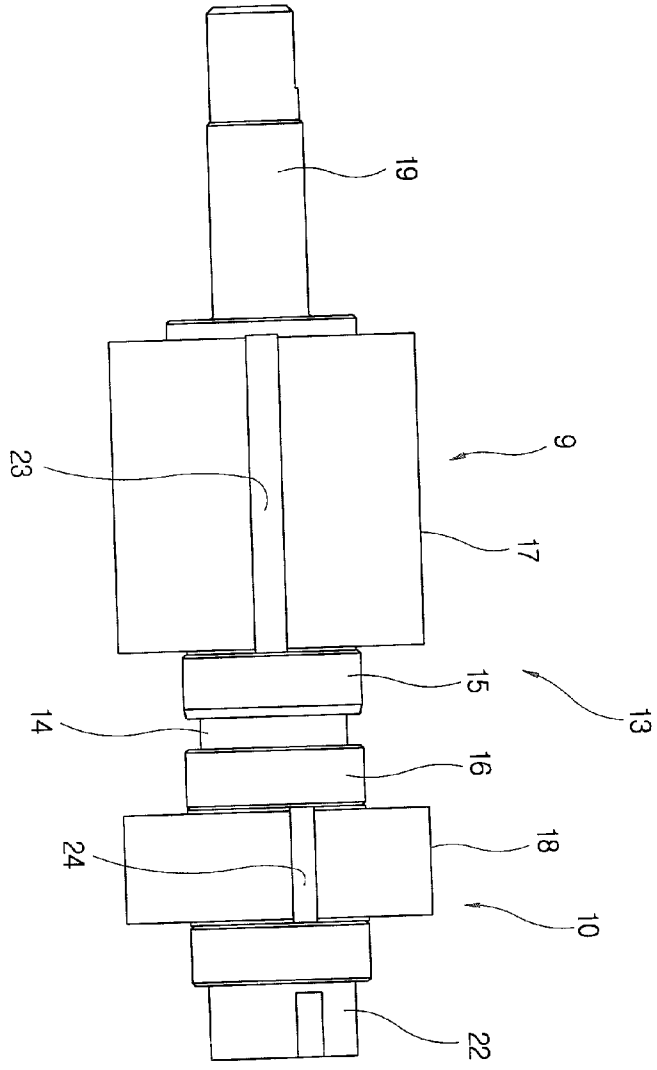


Fig.9 (Prior Art)

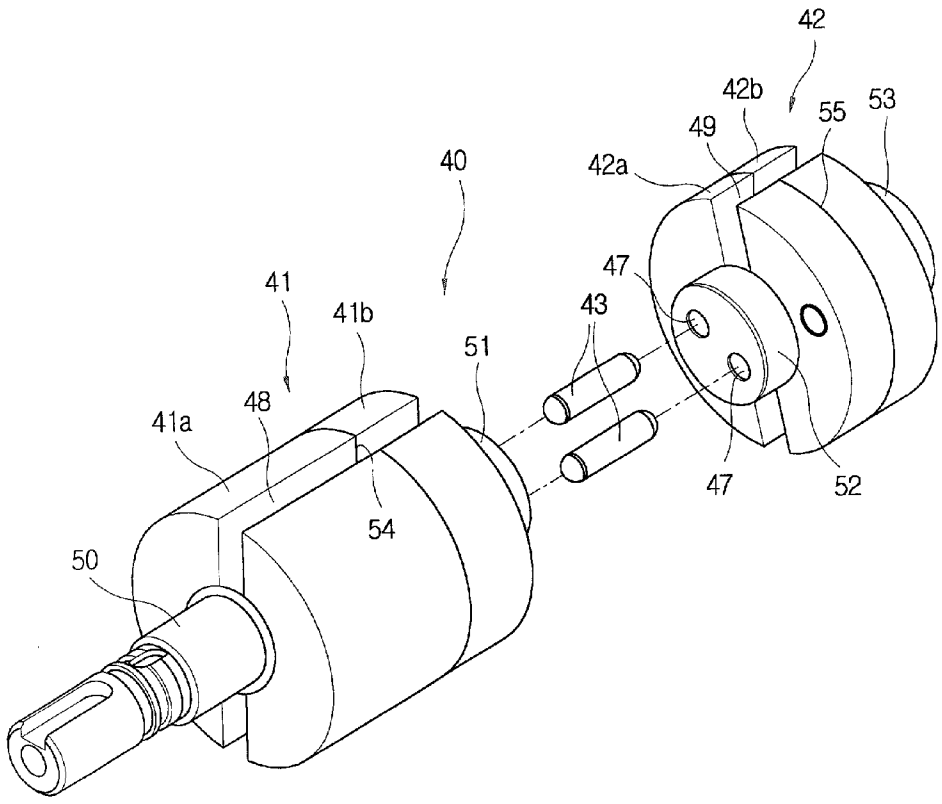
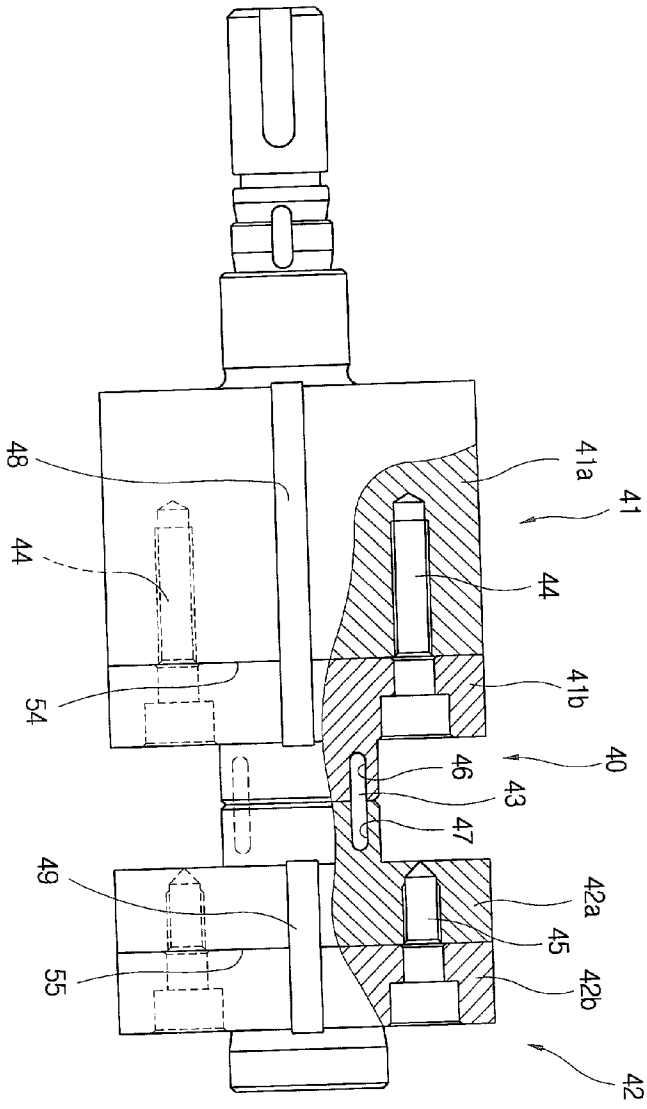


Fig. 10 (Prior Art)



ROTARY VANE TYPE VACUUM PUMP ROTOR

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a rotary vane type vacuum pump rotor, and in particular to an improved rotary vane type vacuum pump rotor which is capable of enhancing a durability of the system, decreasing a fabrication cost, increasing a productivity and decreasing a maintenance cost.

[0003] 2. Description of the Background Art

[0004] A rotary vane type pump implements a vacuum state in such a manner that when a motor is operated, a rotor connected with the motor is rotated, and a vane inserted in a groove of the rotor is tightly contacted with an inner surface of a cylinder and is rotated based on a centrifugal force for thereby sucking a certain gas from a certain apparatus which needs a vacuum state through a pump suction port, compressing the sucked gas and discharging through a discharging port by opening a discharging valve, so that the apparatus connected with a vacuum pump becomes a vacuum state based on a repeated operation. The rotor which contacts with the inner surface of the cylinder and is rotated is a key element of the pump. The performance of the motor is determined based on the rotor. Therefore, the rotor must have an accurate processing performance and durability.

[0005] The rotor needs a long processing time and must have a good durability after a fabrication of the rotor. The capacity of the pump is determined based on a suction amount and compression ratio of the gas. In order to increase the compression ratio, as shown in **FIGS. 9 and 10**, a rotor **40** constructed in a two-tier structure of a first rotor **41** and a second rotor **42** is generally used.

[0006] In the conventional rotor **40**, the first rotor **41** and the second rotor **42** are separately fabricated and assembled using a rotor pin **43**. The first and second rotors **41** and **42** are separated into two bodies **41***a*, and **41***b*, and **42***a* and **42***b*, respectively. The separated bodies **41***a*, **41***b*, **42***a*, and **42***b* are assembled using bolts **44** and **45** for thereby fabricating the first and second rotors **41** and **42**.

[0007] The first rotor **41** and second rotor **42** are connected in such a manner that the rotor pin **43** is inserted into the pin holes **46** and **47** for thereby fabricating a rotor **40**.

[0008] The rotors **41** and **42** are separated into two bodies **41***a*, **41***b*, **42***a* and **42***b* and then assembled for the reasons that it is impossible to form square shaped vane grooves **48** and **49** which have both ends closed by support shafts **50**, **51**, **52** and **53** and are formed to pass through the rotors **41** and **42** using a slot cutter for forming the vane grooves **48** and **49** into which the vanes **12** (**FIG. 2**) are inserted in each rotor **41** and **42**. In this case, the productivity is significantly decreased. Therefore, the rotors **41** and **42** are separated into two bodies **41***a*, **41***b*, **42***a* and **42***b*, and a groove having an opened end is formed in each rotor and is contacted with boundary surfaces **54** and **55** for thereby assembling the same using bolts **44** and **45**, as shown in **FIG. 10**, whereby the square-shape closed vane grooves **48** and **49** are formed. However, in the above-described assembling operation of the conventional rotor **40**, since the first and second rotors **41** and **42** are fabricated into two bodies **41***a*, **41***b*, **42***a*, and **42***b* and then assembled each other, a processing time is extended, and a fabrication cost is high. In addition, since the boundary surfaces **54** and **55** are accurately processed, and the assembling operation is needed using the bolts **44** and **45**, a drilling and tapping operation must be performed with respect to each body. Furthermore, a plurality of drilling holes **46** and **47** are processed for inserting a plurality of rotor pins **43**, so that the strengths of the support shaft portions **51** and **52** are decreased due to the formed holes. Since the support shaft portions **51** and **52** operate as a sliding bearing, a heat treatment must be performed with respect to the entire elements for enhancing a hardness and strength, so that the fabrication cost of the rotor **40** is increased, and the productivity is decreased. When the support shaft portions **51** and **52** are worn-out, the entire constructions of the rotors **41** and **42** are changed for thereby increasing the maintenance cost.

SUMMARY OF THE INVENTION

[0009] Accordingly, it is an object of the present invention to provide a rotary vane type vacuum pump rotor which is capable of enhancing a durability of the system, decreasing a fabrication cost, increasing a productivity and decreasing a maintenance cost.

[0010] To achieve the above object, there is provided a rotary vane type vacuum pump rotor in which the vane groove is extended to a support shaft portion which is a connection potion of the rotor body and the first and second rotors, and one end of the same includes a slot having an opened end, a sleeve which is a cylindrical bearing is inserted onto an outer portion of the support shaft portion which is a connection portion of the first and second rotors, and the first and second rotors are connected by a connection coupling which includes an engaging protrusion inserted into an opening end groove formed when the vane groove is formed and the sleeve is assembled in the rotor of a rotary vane type vacuum pump which includes a rotor body having a vane groove, and first and second rotors each having a support shaft portion formed at both ends of the body and connected each other.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The present invention will become better understood with reference to the accompanying drawings which are given only by way of illustration and thus are not limitative of the present invention, wherein;

[0012] **FIG. 1** is a cut-away cross-sectional view illustrating a rotary vane type vacuum apparatus in which a rotor is installed according to the present invention;

[0013] **FIG. 2** is a cross-sectional view taken along line A-A of a vacuum pump apparatus according to the present invention;

[0014] **FIG. 3** is a disassembled perspective view illustrating parts of a rotor according to the present invention;

[0015] **FIG. 4** is a front view illustrating a first rotor according to the present invention;

[0016] **FIG. 5** is a front view illustrating a second rotor according to the present invention;

[0017] **FIG. 6** is a perspective view illustrating an assembling procedure of a rotor and a state that a sleeve is inserted according to the present invention;

[0018] **FIG. 7** is a side view illustrating a connection coupling according to the present invention;

[0019] **FIG. 8** is a front view illustrating a state that a rotor is assembled according to the present invention;

[0020] **FIG. 9** is a disassembled perspective view illustrating a conventional rotor; and

[0021] **FIG. 10** is a front view illustrating a state that a conventional rotor is assembled.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0022] The present invention will be explained with reference to the accompanying drawings.

[0023] **FIG. 1** is a cut-away cross-sectional view illustrating a rotary vane type vacuum apparatus in which a rotor is installed according to the present invention, **FIG. 2** is a cross-sectional view taken along line A-A of a vacuum pump apparatus according to the present invention, and **FIG. 3** is a disassembled perspective view illustrating parts of a rotor according to the present invention. As shown in **FIG. 1**, the pump apparatus **2** which sucks, compresses and discharges the gas is surrounded by a pump housing **3** and an oil storing casing **4**, and an inner space of the oil storing casing **4** stores a lot oil.

[0024] The pump apparatus **2** (hereinafter the pump apparatus represents a unit surrounded by the pump housing and the oil storing casing differently from the vacuum pump apparatus which represents the entire apparatus) includes a first cylinder **5**, a second cylinder **6**, an oil pump housing **7**, an oil pump cover **8** and first and second rotors **9** and **10**. The vanes **11** and **12** are moved to the outer portions of the vane grooves by a centrifugal force generated when the rotors **9** and **10** including the vanes **11** and **12** in the vane grooves of the rotors are rotated in such a manner that the vanes **11** and **12** are closely contacted with the inner surfaces of the cylinders **5** and **6**. The gas is sucked into the cylinders **5** and **6** from the vacuum apparatus (not shown) connected with the pump suction port **29** and is compressed. The above-described operation is repeatedly performed based on a regular cycle for thereby implementing a vacuum state in a certain apparatus.

[0025] As shown in **FIG. 3**, the rotor according to the present invention is constructed in such a manner that the first rotor **9** and the second rotor **10** are connected by the connection coupling **14** and the sleeves **15** and **16**. The first rotor **9** and the second rotor **10** include bodies **17** and **18** which are rotated in the first and second cylinders **5** and **6** and support shaft portions **19**, **20**, **21** and **22** extended from both ends of the bodies **17** and **18** for transferring a rotation force. The vane grooves **23** and **24** are extended to the end portions of the support shaft portions **20** and **21** in the connection center portion into which the bodies **17** and **18**, namely, the sleeves **15** and **16** are inserted.

[0026] When processing the vane grooves **23** and **24**, the bodies **17** and **18** are formed in two divided portions like a fork. At this time, two divided portions may be widened by a stress applied thereto during the process. The sleeves **15** and **16** which are the sliding bearing are inserted into the outer portions of the support shaft portions **20** and **21** for thereby preventing the widening of two divided portions of the bodies **17** and **18**. In a state that the sleeves **15** and **16** are inserted into the support shaft portions **20** and **21**, when seeing from the side of the support shafts **20** and **21**, square-shaped opening end grooves **23***a* and **24***a* having four closed sides are formed. Both longer sides of the opening end grooves **23***a* and **24***a* are formed in a circle which has the same diameter as the inner diameters of the sleeves **15** and **16**. The engaging protrusions **25** and **26** which correspond to the opening end grooves **23***a* and **24***a* are tightly inserted, and the first and second rotors **9** and **10** are integrated by the sleeves **15** and **16** and the connection coupling **14**.

[0027] The engaging protrusions **25** and **26** protruded from both ends of the connection coupling **14** may be formed at the same height and, as shown in **FIG. 7**, may be formed in a X-shape at the same height for thereby enhancing a distribution effect of the rotation inertia force and increasing a stability of the engagement since an operation point of the force applied to the sleeves **15** and **16** is deviated. Since the sleeves **15** and **16** which operate as a sliding bearing are heat-treated, when the elements are worn-out, only the sleeves **15** and **15** are changed.

[0028] In the present invention, the first and second rotors **9** and **10** of the rotor **13** are formed in an integrated body, and the vane grooves **23** and **24** each having one opened end are cut-processed, and the first rotor **9** and the second rotor **10** are connected by the sleeves **15** and **16** and the connection coupling **14**. When the motor **27** is driven, the first rotor **9** is rotated by the support shaft portion **19** connected with the motor shaft **28**, and the second rotor **10** connected by the first rotor **9** by the sleeves **15** and **16** and the connection coupling **14** is rotated for thereby sucking a gas from a vacuum apparatus (not shown) through the pump suction port **29** and compressing the same and discharging the same to the outside through the discharging ports **30** and **31**.

[0029] As described above, in the present invention, the vane grooves of the first and second rotors are formed in such a manner that one end of each of the first and second rotor is opened and passes through the rotor body, and a cylindrical sleeve which operates as a sliding bearing is inserted onto an outer surface of the support shaft portion which is divided into two parts by a vane groove formation for thereby preventing a widening. A square hole having all closed sides is formed, and the first rotor and second rotor are assembled using a connection coupling. Therefore, in the present invention, it is possible to significantly decrease the numbers of parts and fabrication processes and a fabrication time compared to the conventional art in which the bodies of the first and second rotors are divided into two parts and then are assembled, for thereby enhancing a productivity of the rotor at a lower cost. In addition, the heat treatment of the entire rotor elements is omitted, and it is possible to easily change the sleeve for thereby decreasing a maintenance cost.

[0030] As the present invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, it should also be understood that the above-described embodiments are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be construed broadly within its spirit and scope as defined in the appended claims, and therefore all changes and modifications that fall within the meets and

bounds of the claims, or equivalences of such meets and bounds are therefore intended to be embraced by the appended claims.

What is claimed is:

1. In a rotor of a rotary vane type vacuum pump which includes a rotor body having a vane groove, and first and second rotors each having a support shaft portion formed at both ends of the body and connected each other, a rotor of a rotary vane type vacuum pump in which the vane groove is extended to a support shaft portion which is a connection potion of the rotor body and the first and second rotors, and one end of the same includes a slot having an opened end, a sleeve which is a cylindrical bearing is inserted onto an outer portion of the support shaft portion which is a connection portion of the first and second rotors, and the first and second rotors are connected by a connection coupling which includes an engaging protrusion inserted into an opening end groove formed when the vane groove is formed and the sleeve is assembled.

2. The rotor of claim 1, wherein said engaging protrusion formed at both ends of the connection coupling is formed in a X-shape and includes a plane surface.

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