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(54) **Automotive vane-type vacuum pump**

Flügelzellenvakuumpumpe für Automobile

Pompe à vide à ailettes pour automobiles

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## Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

**[0001]** The present invention relates to an improvement of an automotive vane-type vacuum pump.

2. Description of the Related Art

**[0002]** Fig. 11 is a side view, which is partly a sectional view, showing a part of a conventional automotive vane-type vacuum pump disclosed in, for example, International Publication No. WO00/36303. Fig. 12 is a sectional view taken along the line E-E of Fig. 11. Referring to Fig. 11 and Fig. 12, the conventional automotive vane-type vacuum pump has an inlet 1, an outlet 2, and a sealed space formed by a substantially cylindrical housing 4 with a bottom and a bracket 5 that are coupled by a bolt 3, the housing 4 and the bracket 5 being made of aluminum. The bracket 5 rotatably supports a shaft 21 by a bearing portion 8.

**[0003]** The shaft 21 is provided with a rotor 24 that is eccentrically accommodated in the housing 4 and allowed to rotate in the housing 4. The rotor 24 formed of aluminum is provided with vane slots 10 radially formed, and a vane 11 is retractably disposed in the vane slots 10.

**[0004]** As the rotor 24 rotates, the vane 11 rotates together with the rotor 24 with the outer edge thereof slidably in contact with the inner peripheral surface of the housing 4 in an attempt to jut out radially outward from the vane slots 10 due to a centrifugal force. As the rotor 24 rotates, the rotor 24 and the vane 11 together draw in a fluid through the inlet 1 and forcibly feed the fluid to discharge it through the outlet 2. The shaft 21 is equipped with a coupling 13 so as to enable torque to be input from a vehicle.

**[0005]** In such a vane-type vacuum pump, the shaft portion of the shaft 21, which is as long as the full axial length of the housing 4 of a shaft main body 22, is provided with two fin-like protuberances 23 that extend in an axial direction and project in a radial direction, the two protuberances 23 being disposed at positions where they oppose each other in the radial direction. The rotor 24 has two axial grooves 25 in which the two fin-like protuberances 23 fit so that torque can be transmitted via the fin-like protuberances 23 and the axial grooves 25.

**[0006]** The rotor 24 is integrally formed on the shaft 21 by one-piece casting, so that there is no play between the shaft main body 22 of the shaft 21 and the rotor 24. The rotor is integrally formed by one-piece molding by, for example, aluminum die casting or plastic molding.

**[0007]** In such an automotive vane-type vacuum pump, when torque is transmitted from a coupling 13 to the shaft 21, the rotor 24 rotates at a decentered position in the housing 4. This causes the vane 11 on the rotor 24 to be rotated by the eccentric rotation while slidably contacting the inner peripheral surface of the housing 4 in an attempt to project radially outward from the rotor 24 by a centrifugal force, thereby drawing in a fluid through the inlet 1 and forcibly feeding the fluid to discharge it through the outlet 2.

**[0008]** In the automotive vane-type vacuum pump having the construction described above, the movement of the rotor 24 and the shaft 21 in an axial direction has been restricted by the contact between the side surfaces of the rotor 24 and the housing 4 and the bracket 5. More specifically, the side surfaces of the rotor 24 slidably contact the housing 4 and the bracket 5 thereby to restrict the movement of the rotor 24 and the shaft 21 in the axial direction.

**[0009]** The rotor 24, the housing 4, and the bracket 5 are all formed of the same metal, namely, aluminum. This has been presenting a problem of seizure.

**[0010]** EP 1 055 823 describes the features of the preamble of claim 1.

**[0011]** US 3,819,309 describes a rotary axial vane compressor assembly by which the compressor is adaptable to a range of load applications. Rotor surfaces comprise cavities of specified size carrying a quantity of pressurized fluid into an intake cycle so as to prevent discharge thereof.

SUMMARY OF THE INVENTION

**[0012]** Accordingly, the present invention has been made with a view toward solving the problem mentioned above, and it is an object of the present invention to provide an automotive vane-type vacuum pump free of the problem of seizure between an axial end surface of a rotor and a case, thus permitting higher quality and reliability, and improved durability.

**[0013]** To this end, according to one aspect of the present invention, there is provided an automotive vane-type vacuum pump for forcibly feeding a fluid from an inlet to an outlet, including a bottomed cylindrical case having an inlet and an outlet, a rotor eccentrically accommodated in the case, a shaft that is secured to the rotor, having both ends thereof rotatably supported by both bottom surfaces of the case, and rotates the rotor by an external driving force, and a vane that rotates slidably in contact with the inner peripheral surface of the case while moving radially in and out of the rotor as the rotor rotates, wherein the axial movement of the shaft is restricted by slidable contact between axial movement restricting stepped portions provided on both ends of the shaft and the case, and a very small gap is formed between an axial end surface of the rotor and the case.

**[0014]** In a preferred from of the automotive vane-type vacuum pump in accordance with the present invention, the shaft and the case are formed of different metals.

**[0015]** In another preferred form, an oil reservoir is provided on the axial end surface of the rotor.

**[0016]** In still another preferred form, the oil reservoir is formed at the same time when the rotor is formed by

one-piece molding.

**[0017]** In a further preferred form, the rotor is cast integrally with the shaft by insert molding, and the shaft is provided with a slippage-proof groove in its peripheral direction.

**[0018]** In another preferred form, a lubricant groove is formed in a bearing portion of the case.

**[0019]** In yet another preferred form, a drive transmitting means is provided outside the bearing portion of the shaft, and the bearing portion has a length that has been set so that the drive transmitting means does not contact the case even if the bearing portion expands or contracts due to heat.

**[0020]** In a further preferred form, a portion of an axial restriction flange provided on the shaft that is associated with a vane slot is cut so that it is smaller than the innermost diameter of the vane slot in a radial direction and larger than the width of the vane slot in the peripheral direction.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0021]**

Fig. 1 is a side view, which is partly a sectional view, showing an embodiment of an automotive vane-type vacuum pump in accordance with the present invention;

Fig. 2 is a front view of the embodiment viewed from A of Fig. 1, partly showing the sections of a rotor and a shaft;

Fig. 3 is a sectional view taken along the line B-B of Fig. 2;

Fig. 4 is a rear view of a rotor and a shaft of another embodiment of the automotive vane-type vacuum pump in accordance with the present invention;

Fig. 5 is a side view showing the section of the rotor, taken along the line C-C of Fig. 4;

Fig. 6 is a front view of the rotor and the shaft;

Fig. 7 is a rear view showing a rotor and a shaft of yet another embodiment of the automotive vane-type vacuum pump in accordance with the present invention;

Fig. 8 is a side view showing the section of the rotor, taken along the line D-D of Fig. 7;

Fig. 9 is a front view of the rotor and the shaft;

Fig. 10 is a side view, which is partly a sectional view, showing an essential section of another embodiment of the automotive vane-type vacuum pump in accordance with the present invention;

Fig. 11 is a side view, which is partly a sectional view, showing a conventional automotive vane-type vacuum pump; and

Fig. 12 is a sectional view taken along the line E-E of Fig. 11.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

### First Embodiment

**[0022]** Fig. 1 is a side view, which is partly a sectional view, showing a first embodiment of an automotive vane-type vacuum pump in accordance with the present invention. Fig. 2 is a front view of the embodiment viewed from A of Fig. 1, partly showing the sections of a rotor and a shaft. Fig. 3 is a sectional view taken along the line B-B of Fig. 2.

**[0023]** The automotive vane-type vacuum pump according to the first embodiment includes a substantially cylindrical bottomed housing 4, which has an inlet 1 and an outlet 2, and a bracket 5 that covers an opening of the housing 4, the housing 4 and the bracket 5 being coupled by a bolt 3. The housing 4 and the bracket 5 form a sealed space of a cylindrical case 30 having bottom surfaces at its both ends. The housing 4 and the bracket 5 are made of aluminum. A shaft 21 is disposed such that it penetrates the case 30, and its both ends are rotatably supported by both bottom surfaces of the case 30. The shaft 21 is composed of carbon steel or alloy steel or the like.

**[0024]** A side surface of the housing 4 includes a lubricating port 27. A lubricant is supplied through the lubricating port 27. The lubricating port 27 is in communication with an inner surface of the housing 4 via a shaft end of the shaft 21.

**[0025]** One end of the shaft 21 that is close to the lubricating port 27 is provided with a stepped portion 28 serving as a stepped portion for restricting axial movement. The other end of the shaft 21 is provided with a flange 29 also serving as the stepped portion for restricting axial movement. The stepped portion 28 slidably contacts the inner surface of the housing 4 so that its movement to the left in Fig. 1 is restricted, while the flange 29 slidably contacts the inner surface of the bracket 5 so that its movement to the right in Fig. 1 is restricted. A spiral lubricant groove 21b is formed in a bearing portion of the bracket 5.

**[0026]** A rotor 24 that is eccentrically accommodated in the housing 4 and able to rotate in the housing 4 is secured to the shaft 21, the rotor 24 being made of aluminum. A very small gap is formed between an axial end surface of the rotor 24 and the inner surface of the housing 4, and another very small gap is formed between the axial end surface of the rotor 24 and the inner surface of the bracket 5. This means that both axial end surfaces of the rotor 24 are not in contact with the housing 4 and the bracket 5 constituting the case 30. The rotor 24 has vane slots 10 radially arranged, and a vane 11 retractably disposed in the vane slots 10.

**[0027]** As the rotor 24 rotates, the vane 11 rotates together with the rotor 24 with the outer edge thereof slidably in contact with the inner peripheral surface of the housing 4 in an attempt to jut out radially outward from the vane slots 10 due to a centrifugal force. As the rotor

24 rotates, the rotor 24 and the vane 11 together draw in a fluid through the inlet 1 and forcibly feeds the fluid to discharge it through the outlet 2. The shaft 21 is equipped with a coupling 13 serving as a drive transmitting means so as to enable torque to be input from a vehicle. The drive transmitting means may be a gear, a sprocket, a pulley, or the like in place of the coupling 13.

**[0028]** The rotor 24 is integrally formed and installed on the shaft 21 by one-piece casting, so that there is no play between a shaft main body 22 of the shaft 21 and the rotor 24. The rotor 24 is integrally formed by one-piece molding by, for example, casting, forging, aluminum die casting or plastic molding. As shown in Fig. 2 and Fig. 3, an oil reservoir 24a is provided on an axial end surface of the rotor 24. The other end surface of the rotor 24 at the rear side is also provided with the oil reservoir 24a. The oil reservoirs 24a are formed at the same time when the rotor 24 is integrally formed as mentioned above.

**[0029]** In such an automotive vane-type vacuum pump described above, when torque is transmitted from the coupling 13 to the shaft 21, the rotor 24 rotates at a decentered position in the housing 4. This causes the vane 11 on the rotor 24 to be rotated by the eccentric rotation while slidably contacting the inner peripheral surface of the housing 4 in an attempt to project radially outward from the rotor 24 due to a centrifugal force, thereby drawing in a fluid through the inlet 1 and forcibly feeding the fluid to discharge it through the outlet 2.

**[0030]** A lubricant is supplied through the lubricating port 27 to lubricate the shaft ends of the shaft 21, then the lubricant reaches the inner surface of the housing 4. The lubricant then gathers in the oil reservoir 24a to perform lubrication between the rotor 24 and the housing 4. Thereafter, the lubricant passes through a hollow portion of the rotor 24 to reach the other side, and gathers in the oil reservoir 24a on the other side to perform lubrication between the rotor 24 and the bracket 5. Then, the lubricant gathers in the lubricant groove 21b formed in the bearing portion of to perform lubrication between the shaft 21 and the bracket 5.

**[0031]** An automotive vane-type vacuum pump constructed as described above includes the bottomed cylindrical case 30 having the inlet 1 and the outlet 2, the rotor 24 eccentrically accommodated in the case 30, the shaft 21 that is secured to the rotor 24, having both ends thereof rotatably supported by both bottom surfaces of the case 30, and rotates the rotor 24 by an external driving force, and the vane 11 that rotates slidably in contact with the inner peripheral surface of the case 30 while moving in and out of the rotor 24 as the rotor 24 rotates. The axial movement of the shaft 21 is restricted by the slidable contact between axial movement restricting stepped portions, namely, the stepped portion 28 and the flange 29, which are provided on both ends of the shaft, and the case 30. A very small gap is formed between the axial end surface of the rotor 24 and the case 30. This arrangement restrains seizure from taking place between the axial end surface of the rotor 24 and the case 30, thus leading to higher quality and reliability, and improved durability.

**[0032]** The shaft 21 and the case 30 are made of different metals. To be more specific, the shaft 21 is composed of carbon steel, alloy steel, or the like, while the case 30 is composed of aluminum. Hence, seizure between the axial end surface of the rotor 24 and the case 30 can be further restrained, resulting in higher quality and improved durability.

**[0033]** The oil reservoirs 24a are provided on the axial end surfaces of the rotor 24. Therefore, seizure between the axial end surface of the rotor and the case can be further restrained, permitting higher quality and improved durability to be achieved. Moreover, there will be less friction, allowing rotational load to be reduced.

**[0034]** The oil reservoirs 24a are formed at the same time when the rotor 24 is fabricated by one-piece molding. Hence, the oil reservoirs 24a can be easily formed, permitting a reduction in cost.

**[0035]** The lubricant groove formed in the bearing portion of the case restrains wear on the shaft, so that durability can be improved, and friction can be reduced with resultant reduced rotational load.

Second Embodiment

**[0036]** Fig. 4 is a rear view of a rotor and a shaft of a second embodiment of the automotive vane-type vacuum pump in accordance with the present invention. Fig. 5 is a side view showing the section of the rotor, taken along the line C-C of Fig. 4. Fig. 6 is a front view of the rotor and the shaft.

**[0037]** In the second embodiment, a rotor 24 is integrally cast with a shaft 21 by insert molding, as in the case of the first embodiment. The shaft 21 is, however, provided with a slippage-proof groove 24c formed along the full periphery thereof to prevent slipping off. This arrangement securely prevents the shaft 21 from coming off the rotor 24, leading to higher reliability.

**[0038]** The slippage-proof groove 24c, however, may not necessarily be formed over the full periphery. The same advantage can be obtained by, for example, intermittently forming the slippage-proof groove 24c in the peripheral direction.

Third Embodiment

**[0039]** Fig. 7 is a rear view showing a rotor and a shaft of a third embodiment of the automotive vane-type vacuum pump in accordance with the present invention. Fig. 8 is a side view showing the section of the rotor, taken along the line D-D of Fig. 7. Fig. 9 is a front view of the rotor and the shaft.

**[0040]** A shaft 21 in this embodiment is provided with an axial restriction flange 29 for restricting the lateral movement (in Fig. 8) of the shaft 21, as in the case of the first embodiment. Furthermore, in the third embodi-

ment, the portion of the axial movement restriction flange 29 that is associated with a vane slot 10 is provided with a cutout 29a that is smaller than the innermost diameter of the vane slot 10 in a radial direction and larger than the width of the vane slot 10 in the peripheral direction.

**[0041]** Generally, a vane slot is integrally cast with the shaft 21 by insert molding, then finished by machining. In the third embodiment, the provision of the cutout 29a permits easy insertion and removal of a cutting tool in an axial direction. This allows easier machining of the vane slot 10, allowing reduced cost to be achieved.

Fourth Embodiment

**[0042]** Fig. 10 is a side view, which is partly a sectional view, showing an essential section of a fourth embodiment of the automotive vane-type vacuum pump in accordance with the present invention. In the fourth embodiment, a gear 31 serving as a drive transmitting means is secured, by shrink fitting, outside a bearing portion 21a of a shaft 21. The length of the bearing portion 21a is set so that the gear 31 will not contact a bracket 5 even if the bearing portion 21a expands or contracts due to heat.

**[0043]** More specifically, an axial length Y of the bearing portion 21a is set such that a difference in thermal expansion coefficient between the bracket 5 and the shaft 21 does not cause the length Y to relatively become smaller than a thickness X of the bracket 5. With this arrangement, the rotation of the bearing portion 21a will not be restricted by being caught between a shaft main body 22 and the gear 31. Accordingly, the reliability can be improved.

**[0044]** Thus, the automotive vane-type vacuum pump for forcibly feeding a fluid from an inlet to an outlet in accordance with the present invention includes a bottomed cylindrical case having an inlet and an outlet, a rotor eccentrically accommodated in the case, a shaft that is secured to the rotor, having both ends thereof rotatably supported by both bottom surfaces of the case, and rotates the rotor by an external driving force, and a vane that rotates slidably in contact with the inner peripheral surface of the case while moving in and out of the rotor as the rotor rotates, wherein the axial movement of the shaft is restricted by slidable contact between axial movement restricting stepped portions provided on both ends of the shaft and the case, and a very small gap is formed between an axial end surface of the rotor and the case. This arrangement restrains seizure from taking place between the axial end surfaces of the rotor and the case, leading to higher quality and reliability, and improved durability.

**[0045]** The shaft and the case are formed of different metals. This will further restrains seizure from taking place between the axial end surfaces of the rotor and the case, resulting in higher quality and improved durability.

**[0046]** An oil reservoir is provided on the axial end surface of the rotor. This will further restrain the seizure from taking place between the axial end surface of the rotor and the case, permitting higher quality and improved durability to be achieved. Moreover, there will be less friction, allowing rotational load to be reduced.

**[0047]** The oil reservoir is formed at the same time when the rotor is fabricated by casting or forging. Hence, the oil reservoir can be easily formed, permitting a reduction in cost.

**[0048]** The rotor is cast integrally with the shaft by insert molding, and the shaft is provided with a slippage-proof groove formed in the peripheral direction. This arrangement makes it possible to securely prevent the shaft from slipping off the rotor, leading to higher reliability.

**[0049]** The lubricant groove formed in the bearing portion of the case restrains wear on the shaft, so that durability can be improved, and friction can be reduced, with resultant reduced rotational load.

**[0050]** A drive transmitting means is provided outside the bearing portion of the shaft, and the bearing portion has a length that has been set so that the drive transmitting means does not contact the case even if the bearing portion expands or contracts due to heat. Therefore, the rotation of the bearing portion will not be restricted by being caught between a shaft main body and a drive transmitting means, allowing higher reliability to be achieved.

**[0051]** A portion of an axial restriction flange provided on the shaft that is associated with a vane slot is cut so that it is smaller than the innermost diameter of the vane slot in a radial direction and larger than the width of the vane slot in the peripheral direction. This arrangement permits easier machining of the vane slot, with a consequent reduction in cost.

## Claims

1. An automotive vane-type vacuum pump for forcibly feeding a fluid from an inlet (1) to an outlet (2), comprising:

   a bottomed cylindrical case (30) having the inlet (1) and the outlet (2);
   a rotor (24) eccentrically accommodated in the case (30);
   a shaft (21) that is secured to the rotor (24), having both ends thereof rotatably supported by both bottom surfaces of the case (30), and rotates the rotor (24) by an external driving force; and
   a vane (11) that rotates slidably in contact with the inner peripheral surface of the case (30) while moving radially in and out of the rotor (24) as the rotor (24) rotates,
   **characterized in that** the axial movement of the shaft is restricted by slidable contact between axial movement restricting stepped portions (28, 29) provided on both ends of the shaft (21) and

the case (30), and a very small gap is formed between an axial end surface of the rotor (24) and the case (30).

2. An automotive vane-type vacuum pump according to Claim 1, **characterized in that** the shaft (21) and the case (30) are formed of different metals.

3. An automotive vane-type vacuum pump according to Claim 1 or 2, **characterized in that** an oil reservoir (24a) is provided on the axial end surface of the rotor (24).

4. An automotive vane-type vacuum pump according to Claim 3, **characterized in that** the oil reservoir (24a) is formed at the same time when the rotor (24) is formed by one-piece molding.

5. An automotive vane-type vacuum pump according to any one of Claims 1 to 4, **characterized in that** the rotor (24) is cast integrally with the shaft (21) by insert molding, and the shaft (21) is provided with a slippage-proof groove (24c) in its peripheral direction.

6. An automotive vane-type vacuum pump according to any one of Claims 1 to 5, **characterized in that** a lubricant groove (21b) is formed in a bearing portion of the case (30).

7. An automotive vane-type vacuum pump according to any one of Claims 1 to 6, **characterized in that** drive transmitting means is provided outside the bearing portion of the shaft (21), and the bearing portion has a length that has been set so that the drive transmitting means does not contact the case (30) even if the bearing portion expands or contracts due to heat.

8. An automotive vane-type vacuum pump according to any one of Claims 1 to 7, **characterized in that** a portion of an axial movement restriction flange (29) provided on the shaft (21) that is associated with a vane slot (10) is cut so that it is smaller than the innermost diameter of the vane slot (10) in a radial direction and larger than the width of the vane slot (10) in the peripheral direction.

**Patentansprüche**

1. Automobil-Flügelzellenvakuumpumpe zum erzwungenen Zuführen eines Fluids von einem Einlass (1) zu einem Auslass (2), mit:

einem zylindrischen Gehäuse mit Boden (30), mit dem Einlass (1) und dem Auslass (2);
einem Rotor (24), der in dem Gehäuse (30) exzentrisch aufgenommen ist;
einer Welle (21), die an dem Rotor (24) gesichert ist, bei welcher beide Enden durch beide Bodenflächen des Gehäuses (30) drehbar gelagert sind, und die den Rotor (24) durch eine externe Antriebskraft dreht; und
einem Flügelrad (11), das sich gleitbar in Kontakt mit der Innenumfangsfläche des Gehäuses (30) dreht, während es sich radial in und aus dem Rotor (24) bewegt, wenn sich der Rotor (24) dreht,
**dadurch gekennzeichnet, dass** die Axialbewegung der Welle durch Gleitkontakt zwischen Axialbewegungs-begrenzenden Stufenabschnitten (28, 29), die an beiden Enden der Welle (21) vorgesehen sind, und dem Gehäuse (30) begrenzt ist, und ein sehr kleiner Spalt zwischen einer axialen Endfläche des Rotors (24) und dem Gehäuse (30) ausgebildet ist.

2. Automobil-Flügelzellenvakuumpumpe nach Anspruch 1, **dadurch gekennzeichnet, dass** die Welle (21) und das Gehäuse (30) aus unterschiedlichen Metallen ausgebildet sind.

3. Automobil-Flügelzellenvakuumpumpe nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** ein Ölreservoir (24a) auf der axialen Endfläche des Rotors (24) vorgesehen ist.

4. Automobil-Flügelzellenvakuumpumpe nach Anspruch 3, **dadurch gekennzeichnet, dass** das Ölreservoir (24a) zur gleichen Zeit ausgebildet wird, wenn der Rotor (24) durch einstückiges Formen gebildet wird.

5. Automobil-Flügelzellenvakuumpumpe nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** der Rotor (24) integral mit der Welle (21) durch Einsatzformen gegossen wird und die Welle (21) mit einer Schlupf-sicheren Vertiefung (24c) in ihrer peripheren Richtung versehen ist.

6. Automobil-Flügelzellenvakuumpumpe nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** eine Schmiermittelvertiefung (21b) in einem Lagerabschnitt des Gehäuses (30) ausgebildet ist.

7. Automobil-Flügelzellenvakuumpumpe nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet, dass** ein Antriebsübertragungsmittel außerhalb des Lagerabschnitts der Welle (21) vorgesehen ist und der Lagerabschnitt eine Länge aufweist, die so festgelegt worden ist, dass das Antriebsübertragungsmittel nicht mit dem Gehäuse (30) in Kontakt gelangt, selbst wenn sich der Lagerabschnitt in Folge von Wärme ausdehnt oder zusammenzieht.

**8.** Automobil-Flügelzellenvakuumpumpe nach einem der Ansprüche 1 bis 7, **dadurch gekennzeichnet, dass** ein Abschnitt eines Axialbewegungsrestriktionsflanschs (29), der an der Welle (21) vorgesehen ist, der einer Flügelnut (10) zugeordnet ist, so geschnitten ist, dass er kleiner als der innerste Durchmesser der Flügelnut (10) in einer Radialrichtung ist und größer als die Breite der Flügelnut (10) in der peripheren Richtung ist.

**Revendications**

**1.** Pompe à vide automobile de type à palettes destinée à l'alimentation forcée d'un fluide d'une admission (1) à un refoulement (2), comprenant :

un carter cylindrique à fond (30) comportant l'admission (1) et le refoulement (2) ;
un rotor (24) logé excentriquement dans le carter (30) ;
un arbre (21) qui est fixé au rotor (24), ayant ses deux extrémités supportées en rotation par les deux surfaces de fond du carter (30), et qui fait tourner le rotor (24) par une force d'entraînement externe ; et
une palette (11) qui tourne de façon coulissante en contact avec la surface périphérique interne du carter (30) tout en se déplaçant radialement dans et hors du rotor (24) à mesure que le rotor (24) tourne,
**caractérisée en ce que** le mouvement axial de l'arbre est restreint par un contact coulissant entre des portions étagées de restriction de mouvement axial (28, 29) fournies sur les deux extrémités de l'arbre (21) et du carter (30), et un très petit écartement est formé entre une surface d'extrémité axiale du rotor (24) et le carter (30).

**2.** Pompe à vide automobile de type à palettes selon la revendication 1, **caractérisée en ce que** l'arbre (21) et le carter (30) sont formés de métaux différents.

**3.** Pompe à vide automobile de type à palettes selon la revendication 1 ou 2, **caractérisée en ce qu'**un réservoir d'huile (24a) est fourni sur la surface d'extrémité axiale du rotor (24).

**4.** Pompe à vide automobile de type à palettes selon la revendication 3, **caractérisée en ce que** le réservoir d'huile (24a) est formé en même temps que le rotor (24) est formé par moulage monobloc.

**5.** Pompe à vide automobile de type à palettes selon l'une quelconque des revendications 1 à 4, **caractérisée en ce que** le rotor (24) est coulé solidairement avec l'arbre (21) par moulage par insertion, et l'arbre (21) est pourvu d'une rainure antipatinage (24c) dans sa direction périphérique.

**6.** Pompe à vide automobile de type à palettes selon l'une quelconque des revendications 1 à 5, **caractérisée en ce qu'**une rainure de lubrification (21b) est formée dans une portion portante du carter (30).

**7.** Pompe à vide automobile de type à palettes selon l'une quelconque des revendications 1 à 6, **caractérisée en ce qu'**un moyen de transmission d'entraînement est fourni en dehors de la portion portante de l'arbre (21), et la portion portante a une longueur qui a été établie de sorte que le moyen de transmission d'entraînement n'entre pas en contact avec le carter (30) même si la portion portante se dilate ou se contracte en raison de la chaleur.

**8.** Pompe à vide automobile de type à palettes selon l'une quelconque des revendications 1 à 7, **caractérisée en ce qu'**une portion d'une bride de restriction d'un mouvement axial fournie sur l'arbre (21) qui est associée à une encoche de palette (10) est découpée de façon à être plus petite que le diamètre le plus intérieur de l'encoche de palette (10) dans une direction radiale et plus grande que la largeur de l'encoche de palette (10) dans la direction périphérique.

FIG. 1

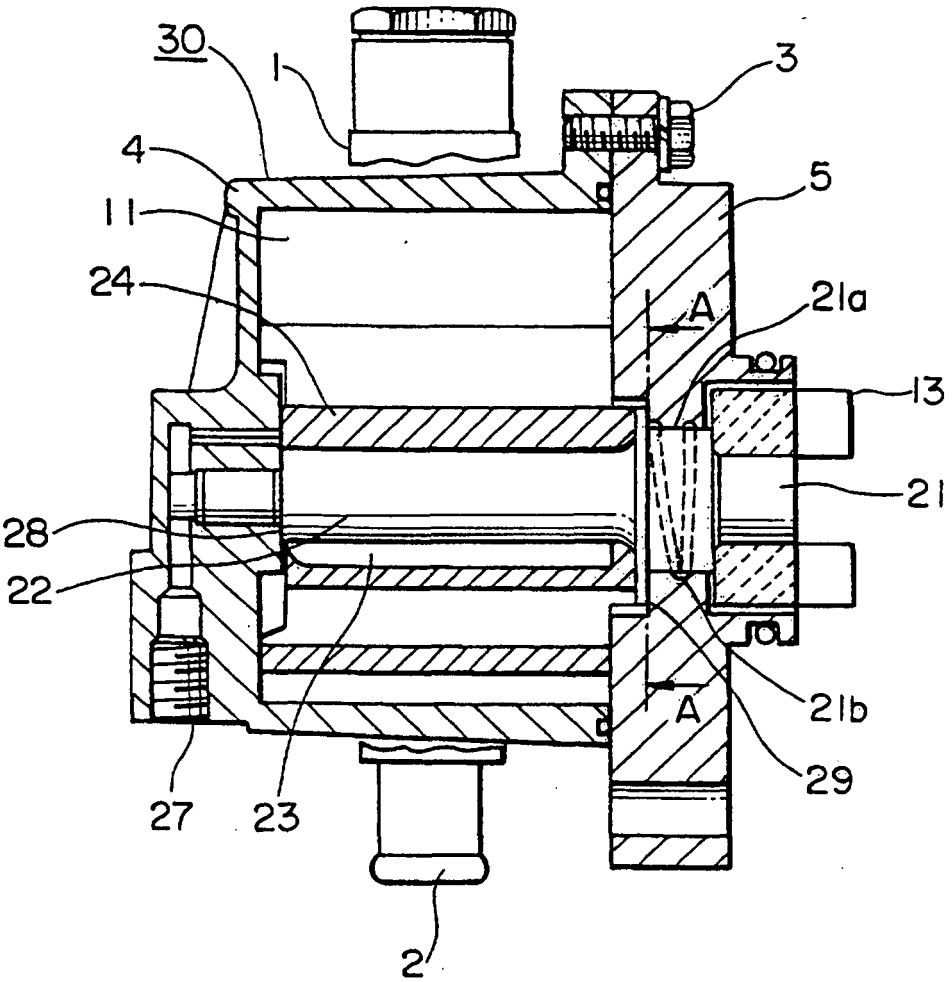


FIG. 2

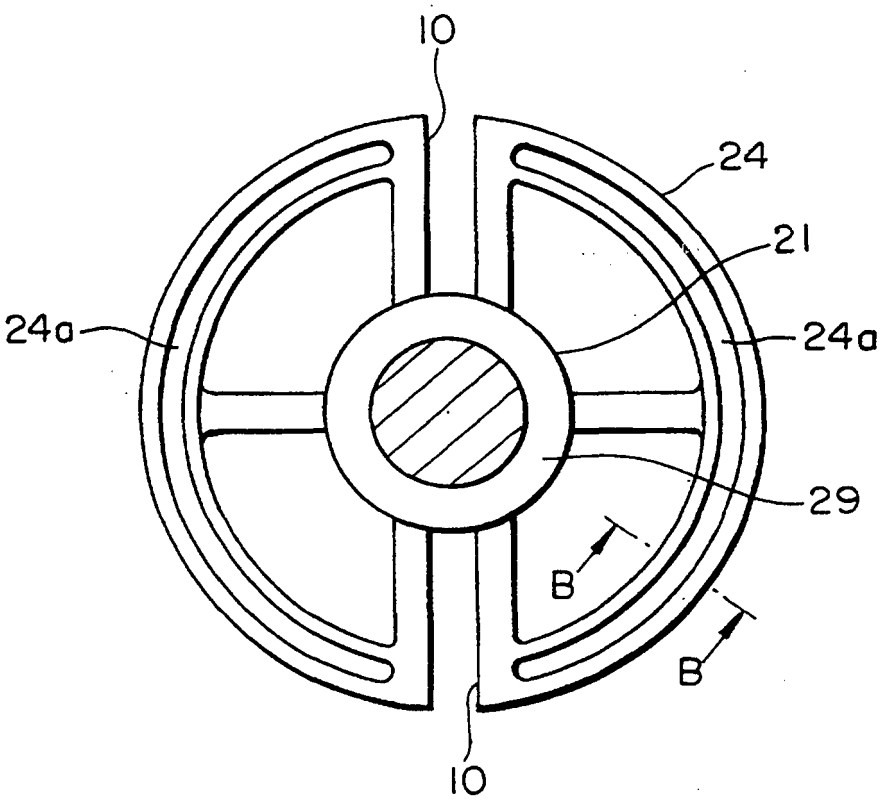



FIG. 3

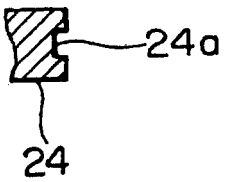


FIG. 4

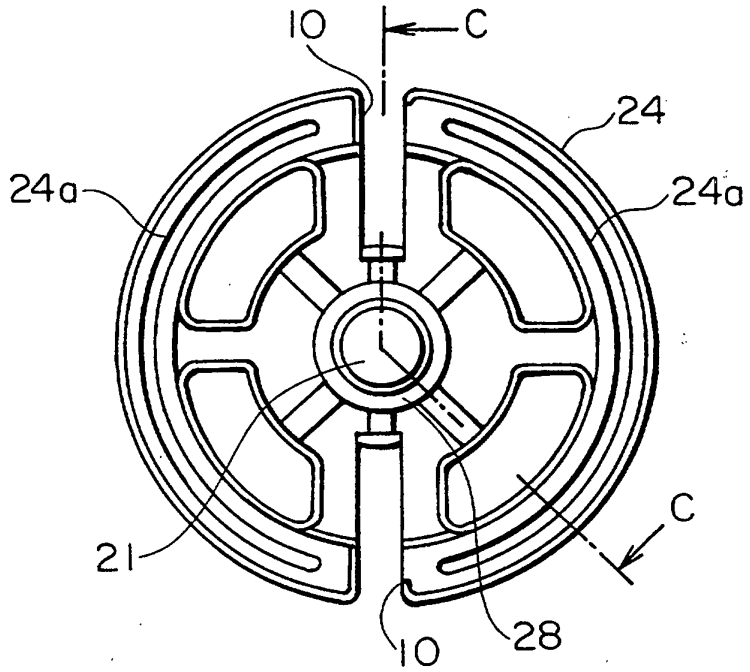



FIG. 5

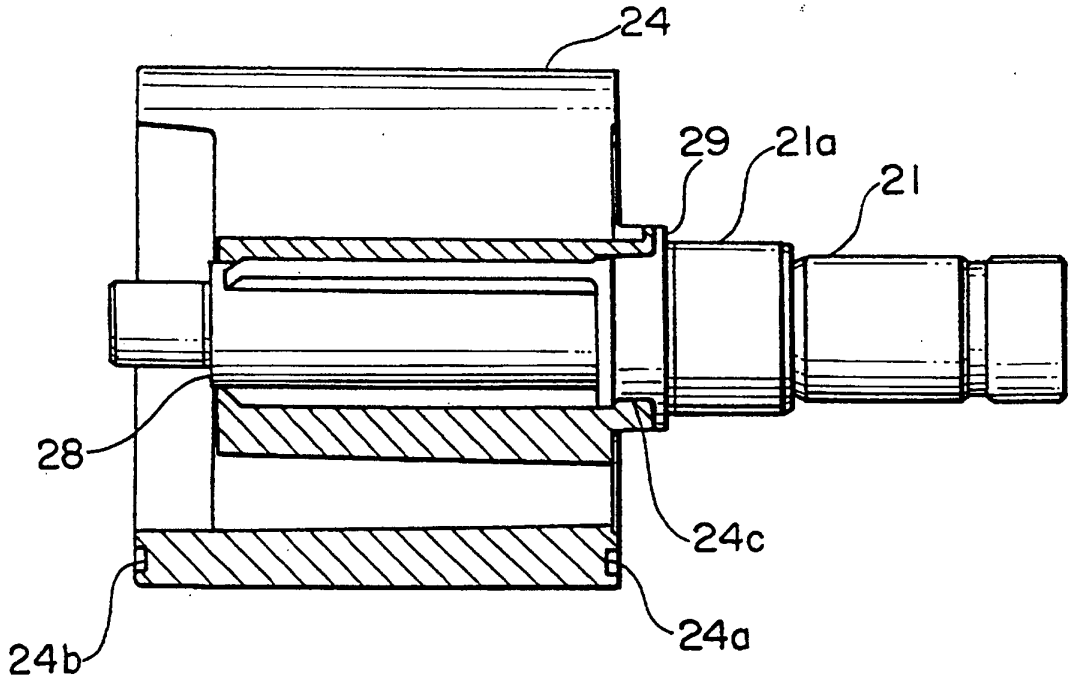


FIG. 6

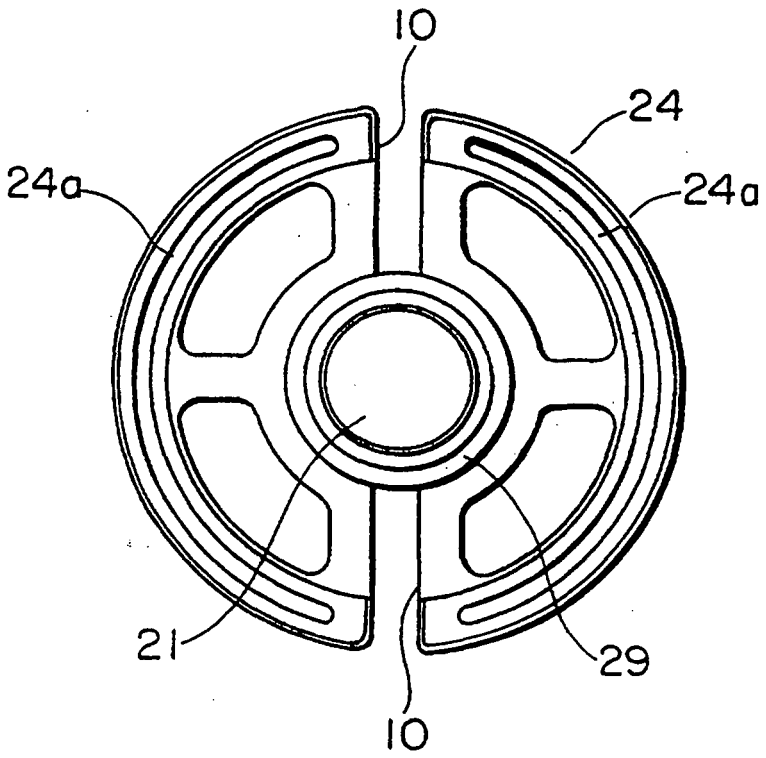


FIG. 7

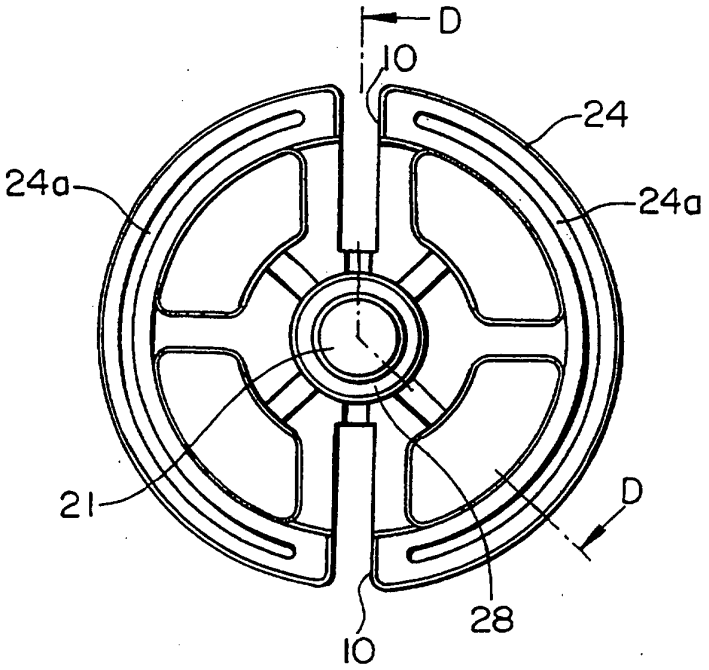



FIG. 8

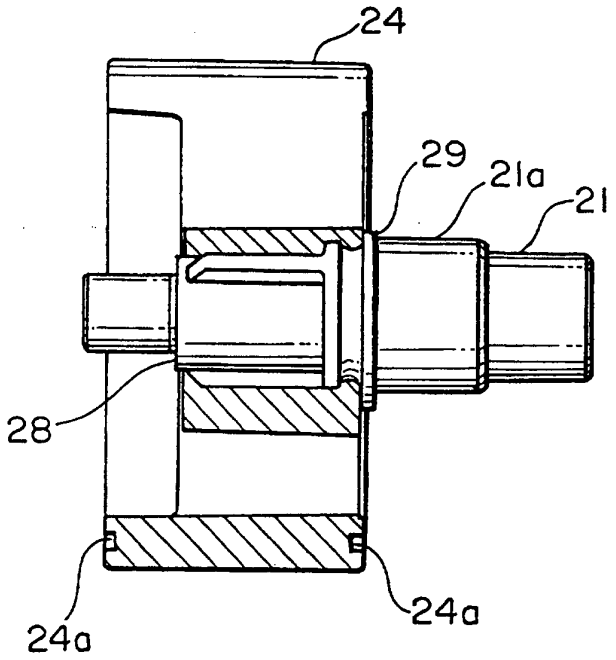


FIG. 9

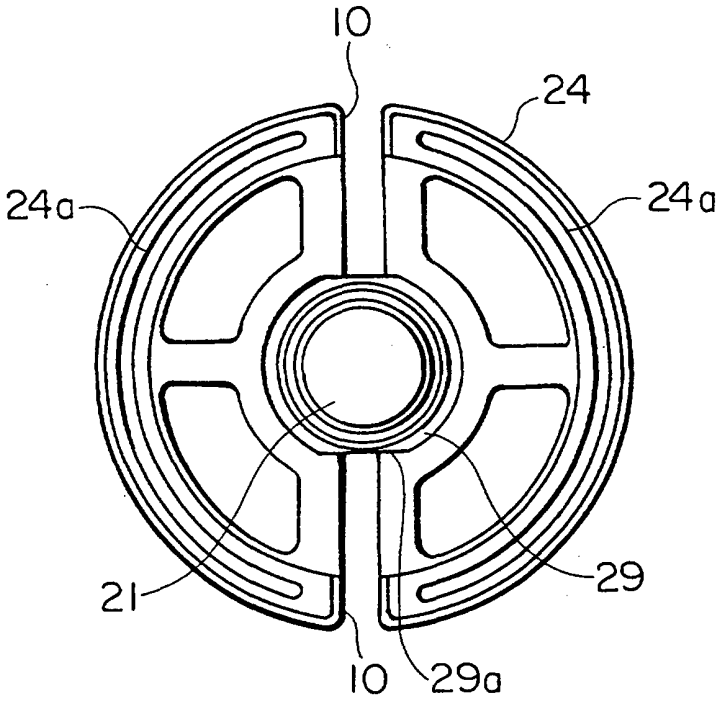



FIG. 10

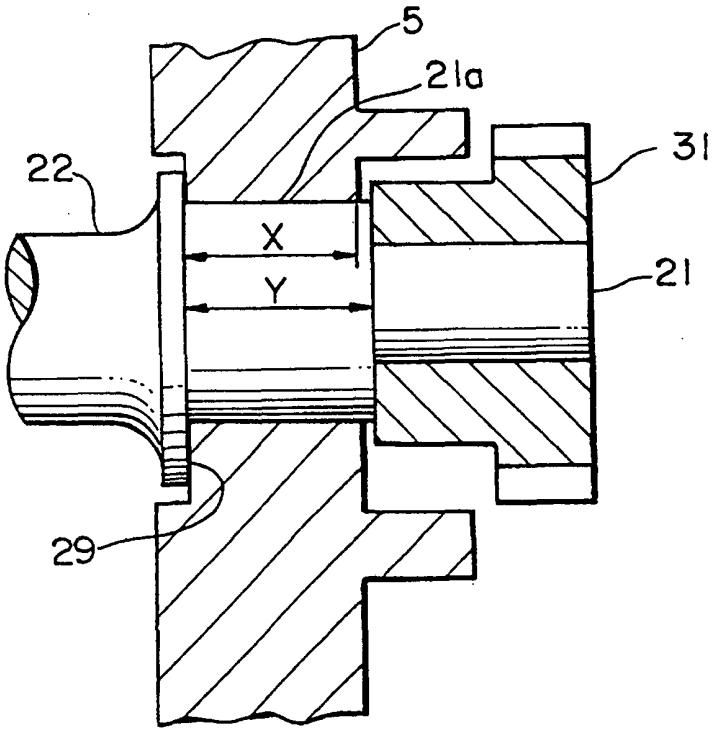


FIG. 11
PRIOR ART

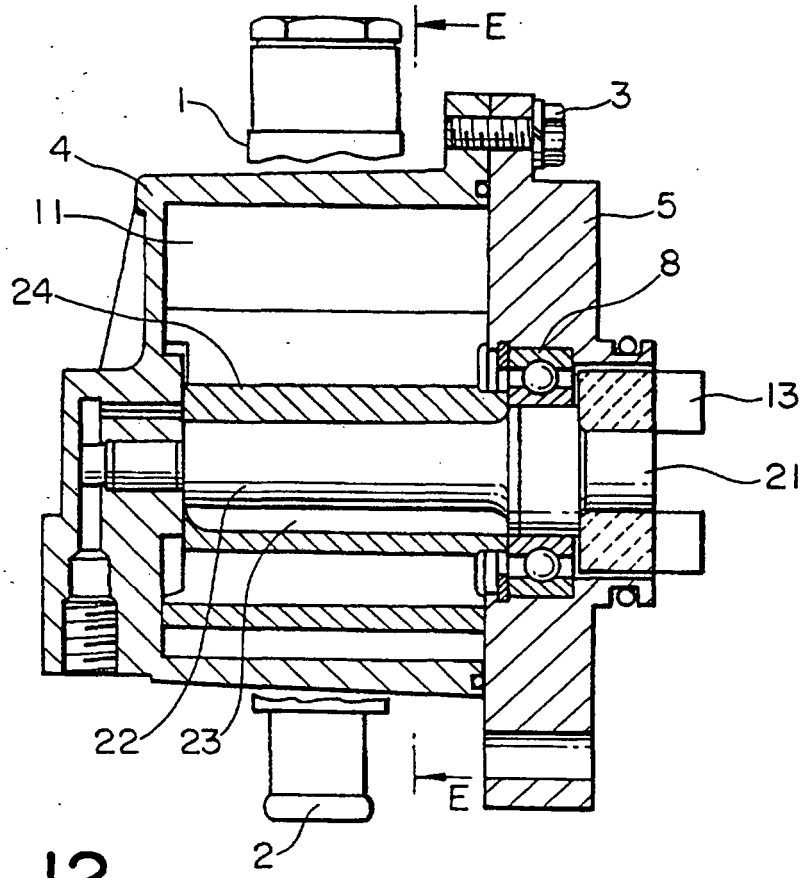
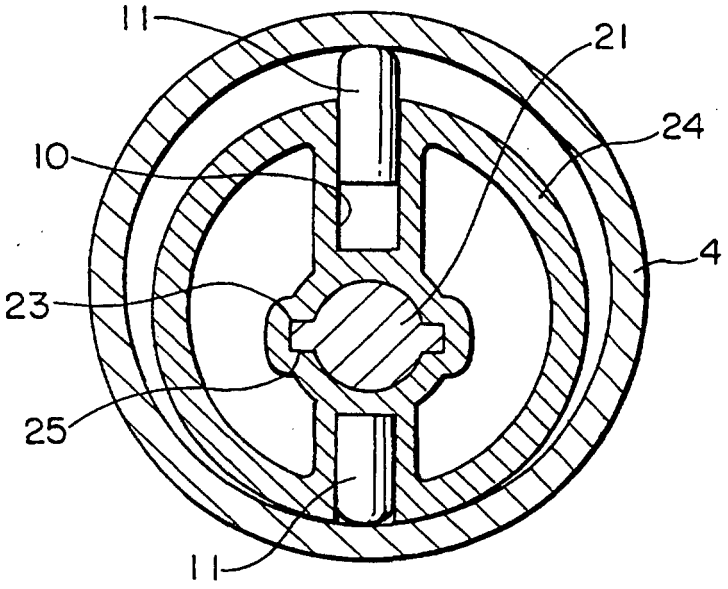



FIG. 12
PRIOR ART



## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


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- EP 1055823 A **[0010]**
- US 3819309 A **[0011]**