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Kramer et al.

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[54] **ROTARY MOTOR WITH FLUID PRESSURE BIASED VANE**

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Related U.S. Application Data

[63] Continuation of Ser. No. 178,623, Sept. 8, 1971, abandoned.

[52] **U.S. Cl.** **418/82**

[51] **Int. Cl.** **F01c 21/00**, F03c 3/00

[58] **Field of Search** 418/79, 82, 267, 268

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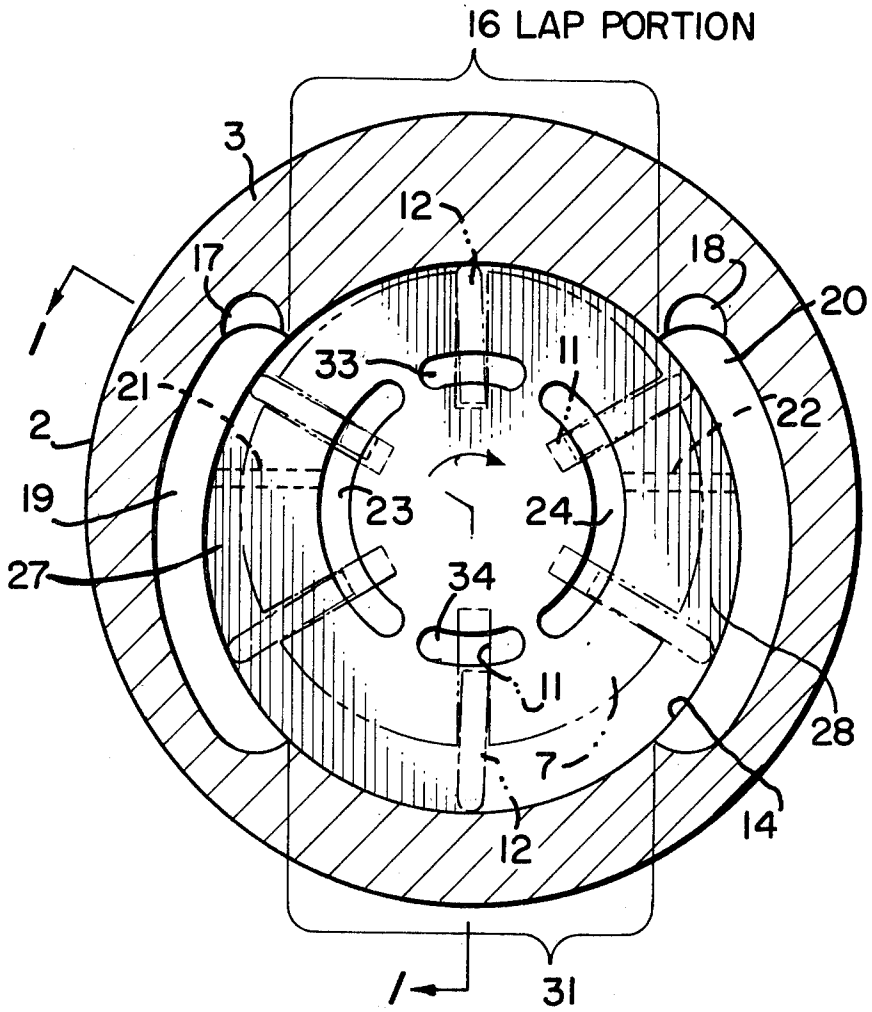
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[57] **ABSTRACT**

A vane-type air motor including a cylinder, opposite end walls and an eccentric rotor rotating within the cylinder and carrying radially moving vanes sliding in slots. Pockets are provided in the end walls for accumulating and storing substantial volumes of air under pressure to urge the vanes outwardly against the cylinder as they are traveling in portions of the cylinder between the high and low pressure portions of the motor chamber. Such pockets are separate from the high and low pressure portions of the motor chamber and are arranged to avoid interconnecting such pressure portions to prevent forming direct leakage paths between said pressure portions.

5 Claims, 3 Drawing Figures



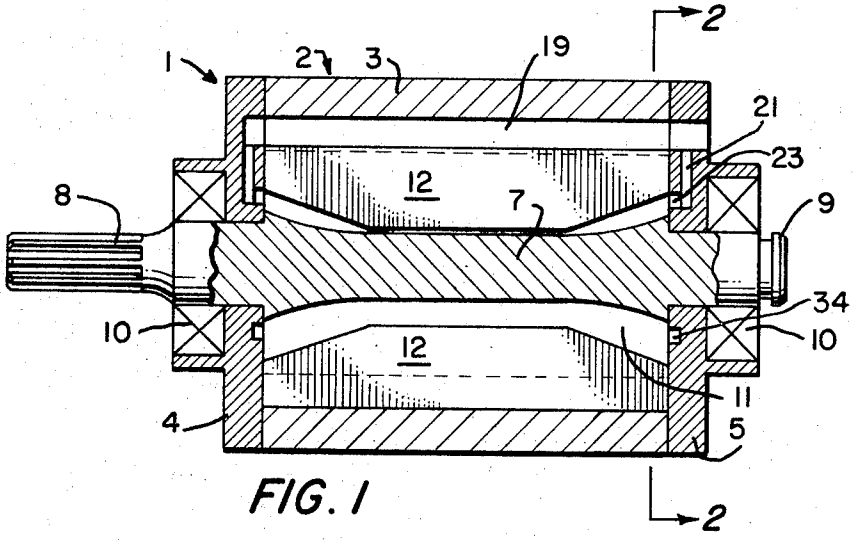


FIG. 1

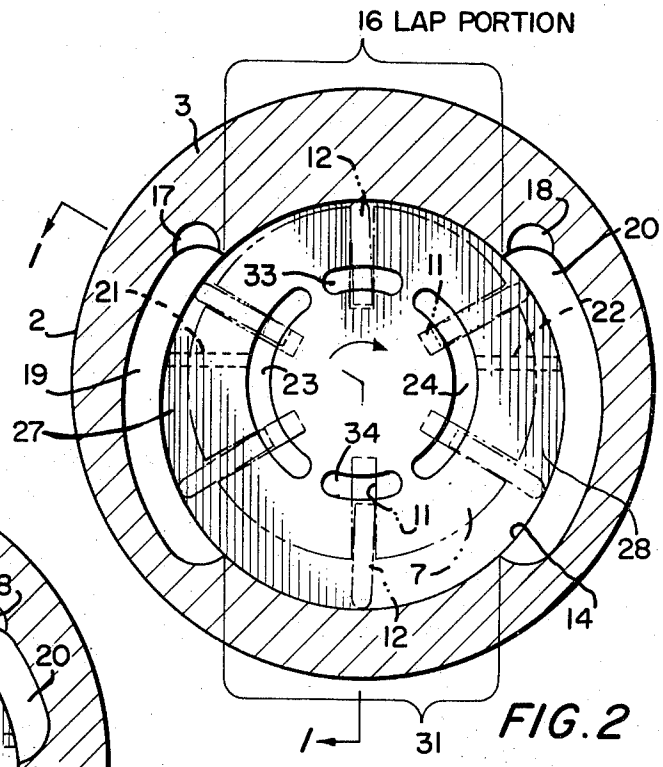


FIG. 2

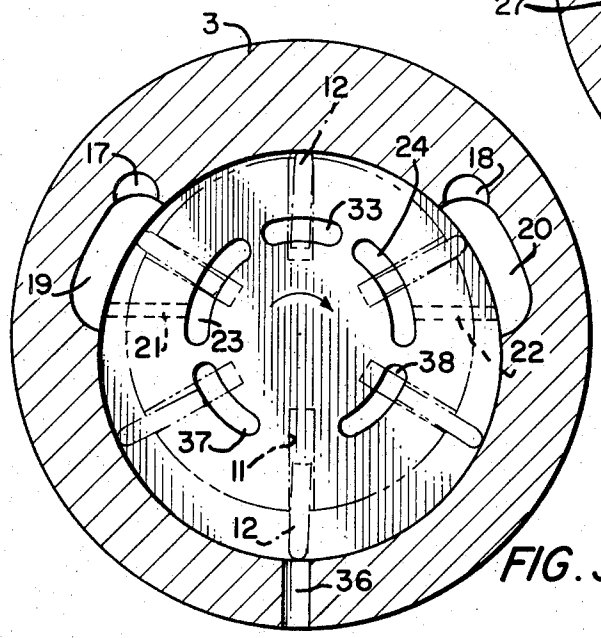


FIG. 3

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ROTARY MOTOR WITH FLUID PRESSURE BIASED VANE

This is a continuation of application Ser. No. 178,623, filed Sept. 8, 1971, and now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to improvements in fluid motors and more particularly to rotary motors having vanes sliding in a slotted rotor.

Heretofore, vane-type rotary fluid motors have had unsatisfactory operating characteristics at low speeds. While centrifugal forces urge the vanes outwardly against the cylinder at high speeds, such forces are unavailable at low speeds and the radial positions of the vanes are unpredictable. In general, at low speeds when the vanes are not moved outwardly against the cylinder with sufficient force, excessive leakage or "blow-by" occurs across the vanes reducing the torque or power of the motor and generally causing erratic motor performance. Attempts to solve this problem include the application of fluid pressure beneath the vanes by means of kidney-shaped ports located in the end walls of the motor chamber, but this has not been entirely successful. Such ports cannot be extended to continue to feed pressure beneath a vane while the vane is traveling in an area between the high and low pressure portions of the cylinder without resulting in excessive leakage between such pressure portions. As a result, at low speeds the vanes usually fail to remain extended outwardly against the cylinder to seal between the high and low pressure portions of the motor chamber while moving between these portions. It is also important for the vanes to be fully extended during the power stroke of the motor to avoid the loss of torque and power.

SUMMARY OF THE INVENTION

The principal object of this invention is to substantially eliminate or minimize the foregoing problems in prior art fluid motors.

Another important object of the invention is to provide means for insuring that the vanes of a vane motor are moved outwardly against its cylinder while traveling between high and low pressure portions of the motor chamber, to avoid excessive leakage or blow-by occurring across the vanes and to improve the torque and power output of the motor.

In general, the foregoing objects of the invention are attained by providing pockets or spaces in the end walls of a motor located between and spaced from the high and low pressure portions of the motor chamber and communicating with the vane slots as they travel between the high and low pressure portions. The pockets accumulate and retain a sufficient volume of fluid under pressure to apply such pressure beneath the vane as it travels past the pocket for maintaining the vane extended during such passage thereby insuring that the vane maintains a seal between the high and low pressure portions of the motor chamber to prevent excessive leakage or blow-by and to insure that the vane rides on the cylinder during its power stroke.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is described in connection with the accompanying drawings wherein;

FIG. 1 is an axial section of an air motor containing an embodiment of the invention and is taken on the line 1—1 in FIG. 2;

FIG. 2 is a cross section taken on the line 2—2 in FIG. 1; and

FIG. 3 is an axial section of a second embodiment of the invention.

DESCRIPTION OF PREFERRED EMBODIMENT

The air motor 1 shown in the drawing includes a casing 2 formed by a cylinder 3 and a pair of end plates 4 and 5 closing the ends of the cylinder 3. The end plates 4 and 5 are attached to the cylinder by suitable means such as bolts (not shown).

A cylindrical rotor 7 is mounted eccentrically within the cylinder 3 and contains a pair of shaft ends 8 and 9 extending from opposite ends of the rotor through and rotatably mounted within bearings 10 supported on the respective end plates 4 and 5. The rotor 7 includes a series of angularly spaced radially extending slots 11, each housing a sliding vane 12 adapted to engage the interior periphery 14 of the cylinder 3. The ends 15 of the rotor 7 are flat and seat against the end plates 4 and 5 with slight clearances therebetween allowing the rotor 7 to rotate freely but substantially preventing fluid leakage across the rotor ends 15.

The portion of the cylinder 3 that is located closest to the eccentric rotor 7 is known as the "lap point" and is designated the lap portion 16, being shown in FIG. 2 by a brace symbol. A pair of fluid passages 17 and 18 are provided in the end plate 5 and terminate in respective fluid ports 19 and 20 located on opposite sides of the lap portion 16. The ports 19 and 20 are connected to respective branch passages 21 and 22 extending to respective kidney ports 23 and 24 for feeding pressure from the respective ports 19 and 20 to the vane slots 11 beneath the vanes 12 for urging such vanes outwardly as they pass a respective port. The passages 17 and 18 are connected to a conventional valve system (not shown) whereby one of the passages 17 and 18 is connected to a high pressure air source and the other to atmosphere. The two ports 19 and 20 generally define two spaced pressure portions designated 27 and 28 extending around the rotor 7, as shown in FIG. 2. The portion of the cylinder 3 opposite the lap portion 16 and between the pressure portions 27 and 28, where the vanes 12 are fully extended and where the power stroke of the motor takes place, is shown by the brace 31. The particular connection of the passages 17 and 18 to the pressure source and to the atmosphere will determine the direction of rotation of the motor. For example, if the port 20 is connected to the air pressure source, the rotor 7 will rotate in a clockwise direction as shown in FIG. 2.

Looking at FIG. 2, it will be recognized that the pressure in the kidney ports 23 and 24 may be effective to move each vane 12 outwardly as it is passing a kidney port, but such pressure is not connected to the vane slot 11 while the vane is moving between the two pressure portions 27 and 28, for example, moving through the lap portion 16. If the vane 12 does not remain engaged with the cylinder while passing between the two pressure portions 27 and 28, it will fail to provide a proper seal between the pressure portions and, as a result, excessive blow-by of the air will occur from the high pressure portion to the pressure portion connected to atmosphere. In addition, if the vane 12 does not engage the cylinder during the power stroke of the motor, the torque and power of the motor is greatly reduced.

Although there is a small volume of air pressure in the bottom of the slot **11** and some air leaks into the bottom of the vane slot **11** while it is moving between the two pressure portions, such pressure is ineffective to assure extension of the vanes **12** at slow speeds. The purpose of this invention is to solve this problem by insuring that the vanes remain engaged against the cylinder periphery **14** while they are passing between the pressure portions **27** and **28,** for example, across the lap portion **16** or across the other portion **31** of the cylinder.

This invention includes the provision of pockets **33** and **34** in the end plates **4** and **5** located between the ends of each of the kidney ports **23** and **24,** closed by the rotor ends **15** and spaced from such kidney ports, thus eliminating direct communication between the pockets and the kidney ports. The pockets **33** and **34** are essentially closed spaces or chambers. These pockets accumulate and trap substantial volumes of fluid under pressure flowing between the high and low pressure portions **27** and **28** of the motor chambers. Such trapped air volumes are effective to expand and urge the vanes **12** outwardly against the cylinder **3** as they are passing the pockets **33** and **34.** We such found that the use of such pockets is an extremely effective answer to the very difficult problem of attaining good low speed characteristics in vane-type air motors. The conventional vane-type air motor is generally unpredictable and uncontrollable at speeds below 100 RPM whereas our invention provides an air motor that can be operated at speeds down from 5 to 10 RPM without encountering excessive blow-by problems, loss of torque and power, and erratic operating characteristics.

Designers of previous motors attempting to attain good low speed performance have attempted to maintain a very small clearance at the lap portion **16,** for example, in the range of 0.001 to 0.003 inches that sometimes caused such motors to seize, particularly when operating under wide temperature conditions or dusty conditions. This invention eliminates the need for such small lap portion clearances and we have found that we can use clearances in the range of 0.015 to 0.02 inches without harming the performance of the motor.

EMBODIMENT OF FIG. 3

The embodiment of FIG. **3** shows the use of the novel pockets of this invention with a motor having a primary exhaust port **36** located midway between the two pressure ports **19** and **20.** In a motor of this type, the pressure ports **19** and **20** cover a much smaller arc of the motor since pressure on the rotor vanes is essentially relieved by the primary port **36** as the vanes cross the point where they are fully extended. In this embodiment we locate a pocket **33** in the lap portion **16** of the motor and a pair of pockets **37** and **38** spaced from the kidney ports **23** and **24** and also spaced on opposite sides of the primary exhaust port **36.** Here again the pockets do not extend into either the pressure portions **27** and **28** or the area where the vane **12** crosses the primary exhaust port **36** in order that such pockets cannot serve as a passage for interconnecting the high and low pressure areas of the motor chamber. The pockets **37** and **38** serve to "pop" the vanes **12** out against the cylinder during the power stroke of the motor.

While several embodiments of the invention are shown and described in detail, this invention is not limited simply to the specifically described embodiments; but contemplates other embodiments and variations utilizing the concepts and teachings of this invention.

We claim:

1. A sliding vane fluid motor comprising:
- a cylinder including an opposed pair of spaced end walls;
- a rotor mounted to rotate in said cylinder between said end walls about an axis eccentric to the axis of said cylinder and having a series of vane slots extending longitudinally and outwardly toward the cylinder;
- a vane sliding in each of said vane slots for engaging the cylinder as the rotor rotates;
- a pair of angularly spaced kidney ports in one of the cylinder end walls located in spaced angular relationship about the axis of the rotor and communicating with the ends of the vane slots as the rotor rotates to supply fluid to and exhaust fluid from the vane slots; and
- at least one closed pocket provided in each of said end walls in opposed relationship and angularly located about the rotor axis between and spaced from both of said ports, said pocket being effective to trap a volume of fluid under pressure for urging the vanes outwardly as the vane slots travel past said pocket.

2. A sliding vane rotary air motor comprising:
- a cylinder including an opposed pair of spaced end walls;
- a rotor mounted to rotate in said cylinder between said end walls about an axis eccentric to the axis of said cylinder and cooperating with said cylinder and end walls to form a fluid chamber having separate high and low pressure portions that are angularly spaced from each other around said rotor;
- at least one vane sliding in said rotor to project from the circumference of the rotor and engage said cylinder for sealing between said high and low pressure portions of said chamber;
- means for applying fluid pressure beneath said vane uring it outwardly against said cylinder while it is traveling through a portion of said chamber located between said high and low pressure portions of said chamber; and
- said means including a pocket provided in each of said end walls in opposed relationship and separated from both said high and low pressure portions of said chamber, said pocket being closed except for its opening in said each end wall and being effective to trap a volume of the pressure fluid in said chamber and to apply it to said vane to urge said vane outwardly as it travels between said high and low pressure portions of said chamber.

3. The motor of claim **2** wherein:
- said pocket is located in the angular portion of said end wall relative to the axis of the rotor that includes the lap portion of said chamber.

4. The motor of claim **2** wherein:
- said pocket is located in the angular portion of said end wall relative to the axis of the rotor where the vane is substantially fully extended radially against said cylinder.

5. The motor of claim **2** wherein:
- said pocket is located in the angular portion of said end wall relative to the rotor between the inlet and exhaust ports of the motor.

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