

June 29, 1965

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3,191,503

ROTOR ASSEMBLY FOR FLUID-HANDLING DEVICE

Filed Dec. 5, 1963

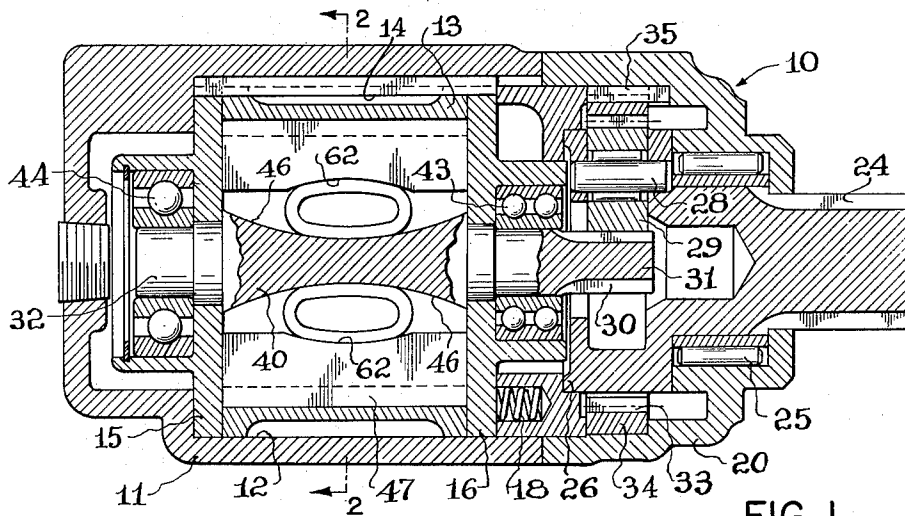


FIG. 1

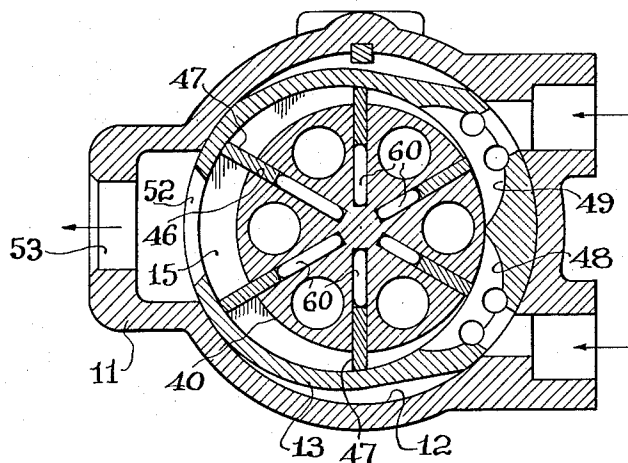


FIG. 2

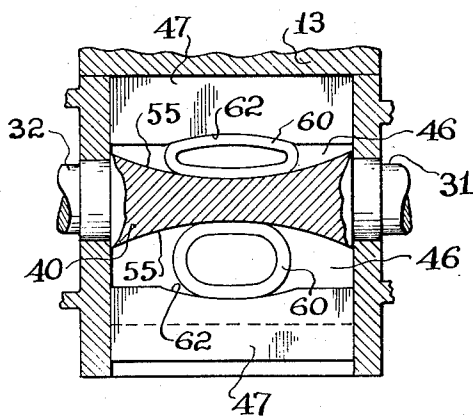


FIG. 3



FIG. 5

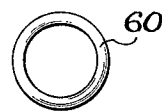


FIG. 4

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ROTOR ASSEMBLY FOR FLUID-HANDLING DEVICE

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Filed Dec. 5, 1963, Ser. No. 328,405

8 Claims. (Cl. 91-140)

This invention relates to fluid-handling devices, and more particularly to an improved, simplified, and more reliable rotor assembly for use in such devices providing assurance of reliable operation under wide range operating conditions and particularly during starting and slow speed operations.

Fluid handling devices of the type to which this invention relates are those employing eccentrically supported rotors eccentrically supported for rotation within an operating chamber and carrying moveably supported vane means engaging the chamber walls and having a fluid seal therewith. When operating at any except slow speeds, centrifugal forces acting on the vanes are usually adequate to maintain a seal between the outer edges of the vanes and the cavity walls. At start up and slow speeds reliance must be had on some means for holding the vanes pressed outwardly against the cavity walls for efficient operation. It has long been customary to employ mechanical spring arrangements of various characters and designs for this purpose.

Efforts have been made by designers for many years to overcome deficiencies of these springs and improve the design and operating characteristics of such springs which must be stiff enough to accomplish their intended purpose and yet not so strong that when the additional effect of centrifugal forces during normal operating speed and higher does not produce objectionable wear of the vanes and of the cavity walls contacted thereby. These and other conflicting and antagonistic requirements have provided frustrating problems for designers and have led to rather elaborate and costly rotor assembly designs requiring much costly machining and the provision of multiple springs and associated components interposed between the rotor and the inner edges of the vanes. These various components are invariably made of metal and are subject to wear and need for adequate lubrication. They are also subject to breakage and malfunctioning requiring costly repair and inspection operations to leave unmentioned loss of the services of the fluid handling device requiring repair services.

The present invention provides a highly satisfactory solution for these various problems and is characterized by its marked simplicity and the substitution of a single, non-metallic component for multiple mechanical spring components heretofore found necessary to provide the same end results as the present invention.

More specifically, this invention is characterized by the provision of a highly resilient elastomeric O-ring interposed in an elliptically distorted configuration between the bottom of the vane groove and the inner edge of the vane where it is effective to urge the vane resiliently outward into contact with the cavity wall particularly during standstill and initial starting operation. The resilient support for the vanes so provided is easily held centered in its proper operating position by simple but appropriate contouring of the groove bottom and of the inner edge of the vane. The elastomeric ring is compounded from material substantially immune to attack by either lubricants or by the fluid being handled. The O-ring itself requires no lubrication and the lubricants normally employed for the vanes do not adversely affect the O-ring and even serve beneficially in lubricating portions of the O-ring in contact with the rotor and its vanes.

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Accordingly, it is a primary object of the present invention to provide an improved, simplified, rugged rotor assembly characterized by long, trouble-free service life and utilizing a simple, inexpensive non-metallic spring means interposed between each blade and the bottom of its seating slot.

Another object of the invention is the provision of a rotor assembly having vane seating slots therein and utilizing an elastomeric ring immune to lubricants and fluids handled by the rotor assembly and effective to urge the vanes into contact with the chamber walls of an operating environment for the rotor assembly.

Another object of the invention is the provision of a fluid-handling device having an eccentric rotor assembly provided with one or more sealing vanes held in sealing position when the rotor is stationary or operating at low speed comprising non-metallic, one-piece elastomeric spring means between the bottom of the rotor slots and the vanes seated therein.

These and other more specific objects will appear upon reading the following specification and claims and upon considering in connection therewith the attached drawing to which they relate.

Referring now to the drawing in which a preferred embodiment of the invention is illustrated:

FIGURE 1 is a longitudinal sectional view through a typical fluid-handling device incorporating the present invention;

FIGURE 2 is a transverse sectional view taken along line 2-2 on FIGURE 1;

FIGURE 3 is a fragmentary cross-sectional view taken along a different diagonal plane than FIGURE 1; and

FIGURES 4 and 5 are views of the elastomeric O-ring prior to assembling in the rotor assembly.

Referring more particularly to FIGURES 1 and 2 of the drawing, there is shown a typical illustrative embodiment of the invention incorporated in a pneumatic motor designated generally 10. This motor is typical of numerous fluid-handling devices having eccentrically supported rotor assemblies wherein the principles of this invention have utility.

Motor 10 includes the usual components including a cup-shaped main housing 11 here shown as having a cylindrical cavity 12 supporting a tubular cage 13. Cage 13 is keyed by key 14 to housing 11 and has a fluid-tight fit with cavity 12. A pair of end cap members 15, 16 are held assembled against the opposite ends of cage 13 in the manner made clear by FIGURE 1, there being several stiff coil springs 18 (FIG. 1) bearing against the exterior of end cap 16 to apply pressure against the cage components and urge them together and toward the inner end of housing 11.

An end cap 20 for the right hand end of housing 11 is held assembled thereto by cap screws or other suitable means not shown and encloses sungear speed reduction means of suitable design. As shown, this speed reduction includes an output splined shaft 24 supported on anti-friction bearing means 25 axially of end cap 20. Output shaft 24 has a cup-shaped enlargement 26 integral with its inner end. Journalled on a shaft 28 carried near the periphery of enlargement 26 is a sungear 29 having its teeth mating with teeth 30 formed about the periphery at one end of rotor shaft 31. The periphery of sungear 29 projects outwardly through a peripheral opening in enlargement 26 with its teeth mating with teeth 33 on the inner periphery of a ring 34 held against rotation in end cap 20 by key 35.

It will be evident from the foregoing that, as rotor shaft 31 rotates about its axis, sungear 29 is forced to rotate bodily about its supporting shaft 31 thereby rotating output shaft 24 at a very substantially slower speed than the speed of rotor 40.

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The cylindrical rotor 40 has trunnion shafts 31, 32 projecting from its opposite ends respectively journaled in anti-friction bearings 43, 44 carried by end caps 15, 16. As shown, rotor 40 is provided with pairs of diametrically opposed radial slots 46 each seating a similar vane 47 of any suitable long-wearing abrasion resistant material having its outer longitudinal edges appropriately chamfered in accordance with customary practice. Preferably vanes 47 are precisely the same or of slightly greater length than rotor 40 with their ends sealing against the accurately finished adjacent surfaces of end cap members 15, 16.

The described rotor assembly rotates past duplicate pressurized, separately-controlled air inlet ports 48, 49 spaced closely adjacent one another as shown in FIGURE 2. It will be observed that the rotor is in sealing contact with the internal interior cylindrical surface of cage 13 at a point between the adjacent edges of inlet ports 48, 49. Accordingly, the pressurized air entering these ports from a suitably controlled pressurized supply is effective to rotate the rotor in a direction dependent upon which port is energized. The spent air exhausts from the motor housing through opening 52 in cage ring 13 and through an outlet 53 in housing 11.

Desirably, the bottom surface of slots 46 is concave or arcuate-shaped longitudinally of the slots to provide a firm self-centering seat for elastomeric O-rings 60. It is also desirable that the inner longitudinal edge of vanes 47 be provided with a similarly or otherwise appropriately contoured curvate surface 62 mutually cooperating with slot bottoms 55 in holding the O-rings self-centered in slots 46.

O-rings 60 form a most important feature of this invention and are formed of any suitable elastomeric material compounded to resist attack by the fluids being handled and are essentially immune to attack by lubricants commonly employed to lubricate the other components. A particularly suitable material is polyurethane. This material has an excellent memory characteristic, is highly resistant to abrasion, inexpensive, and is not subject to attack by lubricants. However, it is to be understood that the invention is not necessarily restricted to this specific elastomeric material since other compounds will be found equally or even more suitable when handling certain fluids.

It is important that the O-rings have a diameter slightly less than the width of slots 46 so as not to be restrained by contact with their side walls and yet freely moveable while moving between its semi-collapsed and semi-expanded operating positions and typically illustrated on the opposite side of the rotor shaft in FIGURE 3. To be observed is the fact that the novel vane biasing means is automatically self-centering both as respects the rotor and the vanes carried thereby. Furthermore, owing to the uniform cross-sectional area of the O-rings, uniform spring pressure is applied over a wide longitudinal portion of the vane edge and each end of the vane is urged into sealing contact with the cavity wall by the same pressure. It is not necessary to assemble the resilient rings in any particular position or orientation but they are simply dropped into the central portion of the slots in advance of the vane itself and thereafter automatically gravitate, if necessary, to the proper central position along the length of slot bottoms 55.

While the particular rotor assembly for fluid-handling device herein shown and disclosed in detail is fully capable of attaining the objects and providing the advantages hereinbefore stated, it is to be understood that it is merely illustrative of the presently preferred embodiment of the invention and that no limitations are intended

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to the details of construction or design herein shown other than as defined in the appended claims.

I claim:

1. A rotary fluid-handling device comprising, a main housing having a cylindrical chamber provided with inlet and outlet passages, a rotor journaled eccentrically of the longitudinal axis of said chamber, said rotor having at least one radial slot opening through its periphery, vane means having a close sliding fit with said slot and its outer perimeter edge being adapted to form a sliding fit with the juxtaposed surfaces of said cylindrical chamber, and an endless loop of resilient non-metallic material interposed between the bottom edge of said slot and the inner edge of said vane means effective to urge the latter outwardly into light pressure engagement with the periphery of said cylindrical chamber.

2. A fluid-handling device as defined in claim 1 characterized in that the edges of said slot and of said vane means are so shaped as to mutually cooperate with the juxtaposed contacting surfaces of said resilient loop to hold said resilient loop disposed centrally between the opposite ends of said vane means.

3. A fluid-handling device as defined in claim 1 characterized in that said endless loop comprises an O-ring of elastomeric material having a diameter substantially greater than the distance between the bottom of said slot and the adjacent inner edge of said vane means.

4. A fluid-handling device as defined in claim 1 characterized in that the bottom of said slot and the adjacent inner edge of said vane means are non-parallel and bow away from one another intermediate their opposite ends, and being further characterized in that said resilient loop comprises an elastomeric O-ring supported loosely in said slot and distorted into elliptical shape with one flattened side bearing against the bottom of said slot and the opposite flattened side bearing against the inner longitudinal edge of said vane means.

5. A rotor assembly for rotary support eccentrically of a generally cylindrical chamber, said rotor assembly having a plurality of slots extending axially of said rotor and distributed about the axis thereof, vane means co-extensive in length with said rotor and having a close sliding fit in said slots, and an elastomeric O-ring inserted between the bottoms of said slots and the adjacent inner edge of the associated vane means effective to urge said vane means resiliently outwardly away from the bottoms of said slots.

6. A rotor assembly as defined in claim 5 wherein the cross-sectional diameter of said O-rings corresponds approximately to the width of said slots thereby permitting said O-rings to flex freely within said slots.

7. A rotor assembly as defined in claim 5 characterized in that the bottoms of said slots bow inwardly between the opposite axial ends thereof and function to hold said O-rings disposed centrally between the ends of said slots without need for retainer or the like means.

8. A rotor assembly as defined in claim 5 characterized in that said O-rings are compounded of elastomeric material substantially immune to attack by lubricants and the fluid mediums passing in contact with said rotor assembly in its operating environment.

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