

United States Patent

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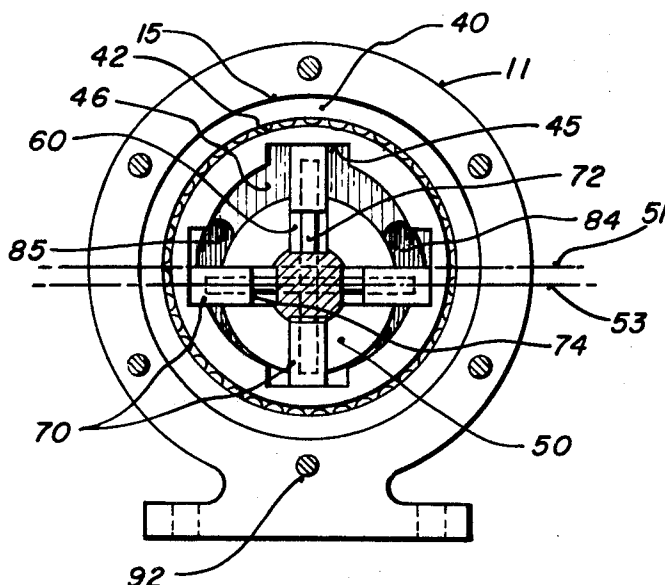
[54] **ROTARY FLUID DEVICE**
13 Claims, 6 Drawing Figs.

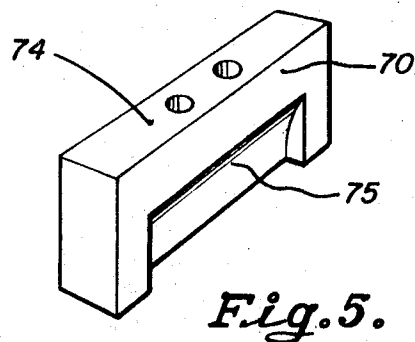
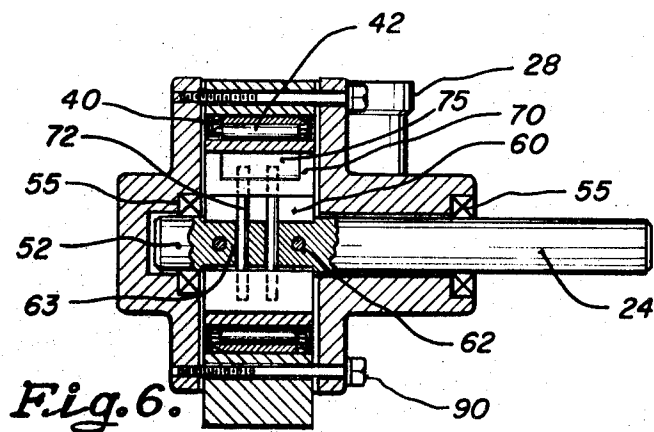
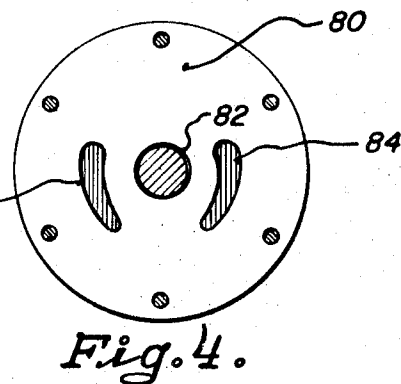
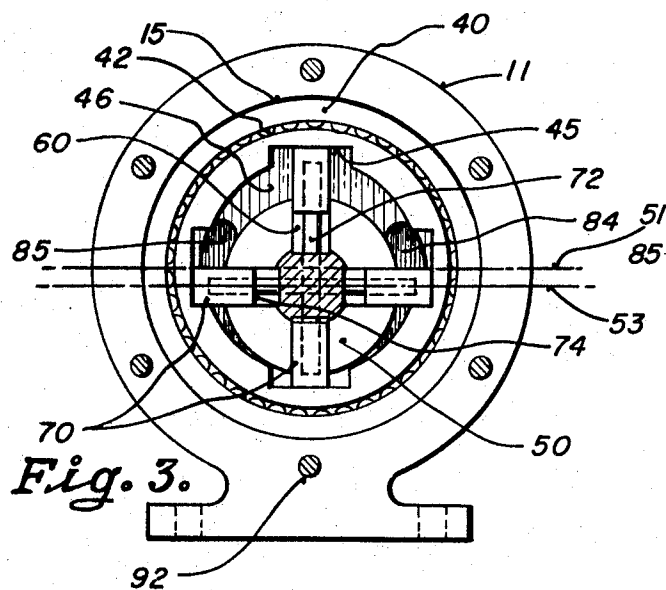
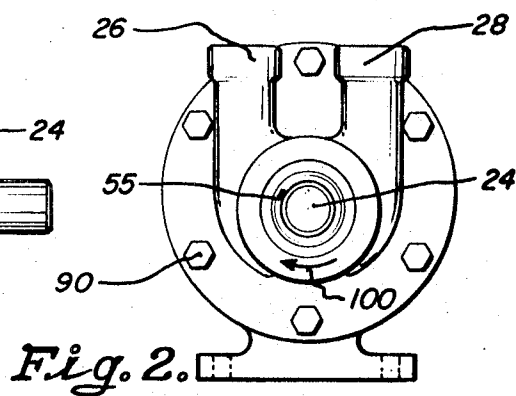
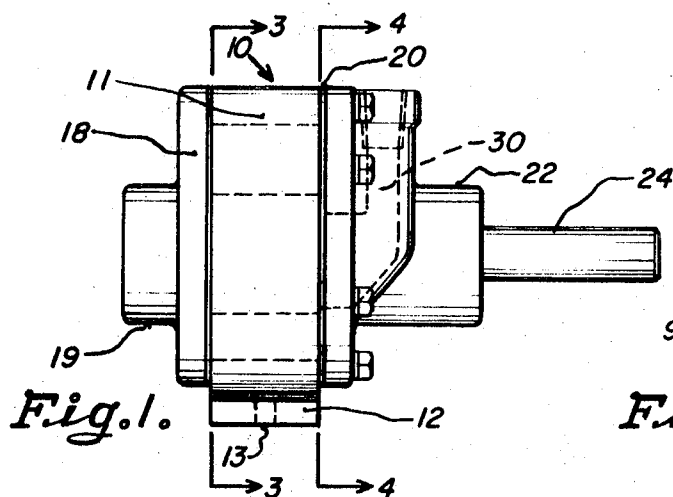
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137, 138; 230/140, 153; 418/173

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ABSTRACT: A rotary fluid device of the vane type useful as a pump or motor or brake which utilizes a journaled rotor ring movable therewith to eliminate frictional forces between the vanes and the stationary part while permitting an oscillatory pumping action for improved fluid device performance.





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ROTARY FLUID DEVICE

My invention relates to the rotary fluid devices and more particularly to an improved rotary fluid pump or motor of the vane type.

Apparatus of this type is well known and in use. In the past it has taken a variety of forms, and such prior structures have been limited by frictional forces and centrifugal forces on the vane elements to restrict speed of operation and increase leakage and maintenance problems therewith.

In the present invention an improved rotary fluid device of the vane type is provided in which the rotor element with vanes is mounted in a rotor ring for restricted movement relative therein and with the rotor element and rotor ring are journaled for movement through a bearing structure in the recess of the cylindrical body of the device. In the improved rotary fluid device the vanes are mounted in grooves in the rotor element. They contact and are restrained in similar recess surfaces in the rotor ring with the rotor element being mounted eccentric to the rotor ring and simultaneously rotated therewith to provide an oscillatory wiping action of the vanes on the rotor ring and a pumping action or sweeping action of the vanes on the fluid in the recess of the rotor ring. In the improved pump, portion of the fluid to the rotor ring is provided through an end plate which connects to the passages in the manifold on the body of the device. The improved structure provided for a minimum of wearing action and frictional drag between rotating elements for improved operation as a pump or motor.

Therefore, it is the principal object of this invention to provide an improved rotary fluid device of the vane type.

Another object of this invention is to provide a rotary fluid type device of the vane type in which the vanes and rotor element are mounted in a rotor ring which is in turn journaled through a bearing cage in the body of the pump or device.

Another object of this invention is to provide an improved vane pump of this type in which a minimum of wiping movement of the vanes relative to a contacting surface is provided to reduce frictional losses therebetween.

An additional object of this invention is to provide a rotary fluid device of the type in which movement of the fluid is affected by both pumping action of the vanes in the rotor member and rotational movement of the entire member.

A still further object of this invention is to provide a device of this type which is simple in design, relatively low in cost and easy to maintain.

These and other objects of this invention will become apparent from reading the attached description together with the drawings wherein:

FIG. 1 is a plan view of the improved rotary fluid device;

FIG. 2 is an end elevation view of the improved rotary fluid device showing the inlet and outlet passages thereto;

FIG. 3 is a sectional view of the rotary fluid device of FIG. 1 taken along the lines 3-3 therein;

FIG. 4 is a sectional view of the rotary fluid device of FIG. 1 taken along the lines 4-4 therein;

FIG. 5 is a perspective view of the vanes with the improved rotary fluid device; and

FIG. 6 is a sectional view of the rotary fluid device of FIG. 3 taken along the lines 5-5 therein.

My improved rotary fluid device is shown in the drawings generally at 10. It may be used as a pump or a motor or as a fluid brake where desired. As will be seen in the drawings, the device is comprised of a body member 11 which is generally cylindrical in form and has a mounting flange or frame section 12 formed integral therewith on one side thereof for the purpose of securing the structure through apertures therein, such as is indicated at 13. The cylindrical body is hollow to define a cylindrical recess 15 therethrough which recess defines a first axis or center for the device. Attached to one end of the body is an end cap 18 having a hub 19 thereon which, as will be later noted, mounts the bearing structure from the operating shaft. The opposite end of the body includes an end cap 20 defining the manifold extremity of the body with a hub 22 thereon through which an operating shaft 24 extends. The

manifold portion includes ports 26 and 28 defining inlet and outlet passages respectively for the device which may be interchanged depending upon the operation of the same. The ports or passages communicate through passages, indicated in phantom at 30, to the interior or the recess of the body as will be hereinafter noted.

The interior of the fluid device, as best seen in FIG. 3, includes an annular bearing member 40 of the needle-bearing type which extends the width of the cylindrical body and is press-fitted or similarly mounted into the recess 15 of the body for the purpose of mounting a rotor ring 42 therein. The rotor ring has a plurality of recesses surfaces from the interior peripheral or cylindrical surface, such as is indicated at 45, each of which are generally rectangular with a flat surface opposing the geometric center of the ring and with such flat surface being normally lapped or specially machined and extending across the width of the rotor ring which is also of the same width dimension as the bearing and the body 11. In the drawings, four such recesses 45 are shown, but the number of recesses and vanes may vary in balanced pairs. The cylindrical recess 46 defined by the annular rotor ring off of which the recesses 45 extend, defines the working area for the fluid device. In this recessed area is positioned a rotor member 50 which is generally cylindrical in form and mounts at the extremities of the same shaft members 52 and 24, the shaft members being journaled in the hub portions 19 and 22 of the end caps 18 and 20 through suitable bearings such as indicated at 55, in FIG. 6. Seals for the shaft 24 are omitted for simplicity. As indicated in the drawings shaft 24 extends through the hub and beyond the end of the same where it may be splined or otherwise connected to a driven or driving device depending upon the operation of the structure.

The axis of the shafts and rotor member is offset from the geometrical center or axis of the rotor ring 42, bearing 40 and body 11 to provide the generally eccentric location of the rotating element for fluid devices of this type. Thus, it will be seen that in the drawings, numeral 5 identifies a center line drawing through the geometric center of the rotor element and shafts 52 and 24. The rotor member 50 also includes a plurality of diametrically opposed recesses 60 which extend the width of the rotor and are generally rectangular in cross section and symmetrical in form. At the base of these recesses are positioned bores or apertures 62 and 63 which are longitudinally offset from one another across the width of the rotor element and connect diametrically opposed recesses 60 so that they do not interfere with one another. Positioned in the recesses are vane members 70 which are rectangular in cross section and snugly fit into the recesses being larger than the respective recesses so that a portion of the same extends out of the recesses as will be seen in FIG. 3. Diametrically opposed vanes are connected together by means of pins, such as is indicated at 72, for the purpose of mechanically coupling the same in the diametrically opposed recesses for simultaneous movement. The exposed end surface of the vanes, such as indicated at 74, are preferably lapped and adapted to fit into the recesses 45 in the rotor ring. In addition, the vane members 70 have a recess surface, such as indicated at 75, in one side thereof with the vane members being positioned in the rotor element such that the recesses therein face in the same direction and with the recesses extending from the end of the vane members positioned within the recesses 60 in the rotor member to a position on the side surface of the vane members above or outside of the recess in the rotor member such that this passage will always be opened with oscillatory movement of the vane members in their respective recesses.

Fluid is directed into and out of the recess 46 in the rotor ring adjacent the rotor member 50 and the vanes from the ports 26 and 28 of the manifold and the passages 30 connected thereto by means of a porting plate 80 having an aperture 82 therein designed to loosely fit around the operating shaft 24 of the rotor member and porting recesses or ports 84 and 85 respectively which extend through the plate and communicate or connect the passages 30 with the interior of the

cylindrical body. These ports or passages are symmetrical in construction being generally elliptical in shape, and curved such as indicated in FIG. 4 to be disposed on opposite sides of the rotor shaft and generally equally disposed on either side of the center line, such as 53 passing, through the axis of the shafts and the rotor member. As such, with the fluid device mounted on its mounting flange 12 in a horizontal position, the areas of the ports 84 and 85 will be generally disposed in the lower half of the fluid device and at an area where fluid will be directed generally into the recess 46 outside of the rotor member proper and in the area swept by the vanes as the rotor member with the vanes in rotated.

This assembly of parts together with suitable gaskets (not shown) positioned between the body 11 and the end caps 18 and 20 are held in assembled relationship by a plurality of bolt members 90 which extend through apertures 92 in the cylindrical body 11 and terminate in tapped surfaces in the end cap 18 to hold the structure in assembled relationship.

In the improved rotary fluid device, operation as a pump required rotation of the shaft 24 from an outside source. Fluid to be pumped will be directed into the pump at the port 26 and the arrow indicated at 100 in FIG. 2 shows the direction of rotation of the shaft in the pumping operation. Rotation of the shaft will rotate the rotor member 50 and the vanes thereon with the rotor ring 42 which will be journaled in the cylindrical body 11 by the bearing cage or bearing 40. Because of the eccentricity between the rotor ring and the rotor member, the vane members 70 will slide into and out of their mounting recesses in the rotor element to move fluid introduced at the ports 26 between the inlet and outlet of the device. The diametrically opposed vane members, being mechanically connected together and spaced apart a predetermined distance, will always maintain contact with the flat surface of the recesses 45 in the rotor ring. Movement of the vane members back and forth in the recesses of the rotor member provide the pumping action for the fluid entering behind the vanes in the rotor member which will be moved out of the same by the oscillatory movement through the grooves 75 in each of the vane members and ahead of the direction of movement of the rotor member. The individual vane members being lapped at their outer surface will be in contact with a similar lapped surface in the rotor ring and will describe a slightly oscillatory translational movement within the width of the recess back and forth across the surface of the same with a minimum of frictional contact since the fluid will form a cushioning surface or lubricating surface for the same. Thus, the normal frictional engagement of the vane members with a stationary element is substantially eliminated and the rotating action of the vanes will provide the normal pumping action of the vane-type pump or motor without this frictional load. In addition, the rotor ring is journaled in an enclosing bearing which will greatly reduce the frictional forces and permit a relatively higher speed of rotation of the structures without wear. The vanes in addition, perform a supplemental pumping action for any fluids moving into the recesses to add to the pressure of the fluid being pumped. Any leakage beyond the rotor ring into the bearing area merely serves to lubricate the bearing and improve performance of the fluid device.

When the rotary fluid device is used as a motor, fluid under pressure will be introduced to the inlet port 26 and through the porting plate 80 to the interior of the device causing rotation of the rotor element and rotor ring with the result of simultaneous rotation of the exposed shaft portion 24 to provide a driving operation from the fluid device with the fluid being moved out of the cylindrical body through the return port and outlet passage and port in the manifold. Bearings 55 supporting the shaft reduces frictional force at this point to provide an overall improved rotary fluid device. In addition, the structure may be used as a rotary fluid brake by reversing the direction of flow to the same and attaching the input shaft 24 to the device to be braked. The overall structure is simple in design and provided for a minimum of moving parts and wear engaging surfaces while affording an appreciably higher input or driven speed of rotation.

What I claim is:

1. A rotary fluid device comprising a cylindrical body having a cylindrical recess therein, an annular bearing member positioned in the cylindrical recess of the body, an annular rotor ring positioned in and mounted on the annular bearing to be journaled thereby, said rotor ring having a plurality of diametrically opposed recessed surfaces extending from the interior opening therein, a cylindrical rotor member journaled in said body about an axis eccentric with the axis of the recess in the body and the rotor ring, said cylindrical rotor member having a plurality of diametrically opposed grooves corresponding to the grooves in the rotor ring, vane members slidably mounted in the grooves of the rotor member with diametrically opposed vanes being mechanically connected to move simultaneously with said vanes being aligned with the grooves in the rotor member and continuously positioned therein, a manifold including inlet and outlet passages communicating with the interior of the rotor ring and positioned at one axial end of the cylindrical body adjacent the rotor member with the passages therein positioned in direct communicating relationship with an axial end of the recess of the annular rotor ring to direct flow of fluid into and out of the recess in the rotor ring, and shaft means connected to the rotor member and journaled in the cylindrical body extending therefrom being movable with operation of the fluid device.

2. The rotary fluid device of claim 1 in which the vane members are generally rectangular in cross section and extend the width of the rotor member.

3. The rotary fluid device of claim 2 in which the vane members have recessed surfaces on corresponding similar sides with the recessed surfaces extending from the bottom edge of the vane members positioned within the recesses of the rotor member to a position removed from the top edge of a vane member and such that the recessed surfaces extend out of the recesses in the rotor member.

4. The rotary fluid device of claim 3 in which the recesses in the rotor ring are substantially rectangular and extend across the width of the rotor ring to provide a mating surface with the exposed edge of the vane members.

5. The rotary fluid device of claim 4 in which the annular bearing is a cylindrical bearing ring of the needle-bearing type having a width dimension equal to the width dimension of the rotor ring and the rotor member.

6. The rotary fluid device of claim 5 in which the manifold includes inlet and outlet ports extending through the cylindrical body from one end thereof, and including a manifold porting plate aligned therewith and positioned at one side of the rotor ring to provide a restricted fluid entrance from the ports to the recess in the rotor ring.

7. The rotary fluid device of claim 6 in which the ports in the manifold plate are generally arcuate in shape and disposed on either side of a plane extending through the axis of the rotor member and shaft connected thereto and with a major portion of the areas of such ports being disposed below a similar plane normal to the first named plane and passing through the axis of the recess in the cylindrical body member.

8. The rotary fluid device of claim 7 in which the device is a pump with the fluid to be pumped being introduced through the inlet passage in the manifold and the shaft rotated from an external means to provide a flow of the fluid from the outlet passage under increased pressure.

9. The rotary fluid device of claim 7 in which the device is a motor with motive fluid being introduced at the inlet passage under pressure and returned through the outlet passage with rotational movement of the rotor member being transmitted externally through the shaft.

10. A rotary fluid device comprising, a body member having a cylindrical recess therein, an annular rotor ring positioned in the cylindrical recess of the body and journaled for rotational movement therein about a first axis of rotation, a cylindrical rotor member positioned in the cylindrical recess of the annular rotor ring and journaled in the body about an axis eccentric with the axis of recess of the body and the rotor ring, said cylindrical rotor member having a plurality of grooves posi-

tioned therein, vane members slidably mounted in the grooves of the rotor member with diametrically opposed vanes being mechanically connected together to move simultaneously into and out of the grooves in the rotor member, said vane members being adapted to continuously contact the inner surface of the rotor ring, means included in the rotor ring and cooperating with the exposed ends of the vane members to preclude continuous rotation of the rotor member and the vanes relative to the rotor ring, a manifold including inlet and outlet passages positioned adjacent one end of the recess in the rotor ring and communicating with the interior of the recess of the rotor ring and the grooves in the rotor member to direct fluid into and out of the recess in the rotor ring, and shaft means connected to the rotor member and journaled in the cylindrical body extending therefrom being movable with rotation of the rotor ring and rotor member positioned therein.

11. The rotary fluid device of claim 10 in which the means

included in the rotor ring are a plurality of recessed surfaces extending from the interior recess and being flat to cooperate with flat extremities on the vane members restricting movement of the vane members to the recesses and providing oscillation of the vane members in the recesses with rotation of the rotor member and rotor ring in the cylindrical body.

12. The rotary fluid device of claim 11 in which the vane members include grooved surfaces to provide for flow of fluid from the grooves in the rotor member to the interior of the rotor ring.

13. The rotary fluid device of claim 12 in which the inlet and outlet passages include characterized ports connecting the passages to the interior of the rotor ring and in which the ports are disposed symmetrically about the axis of the rotor member and the shaft means connected thereto and substantially removed from a symmetrical location about the axis of the cylindrical recess in the body.

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