

July 10, 1956

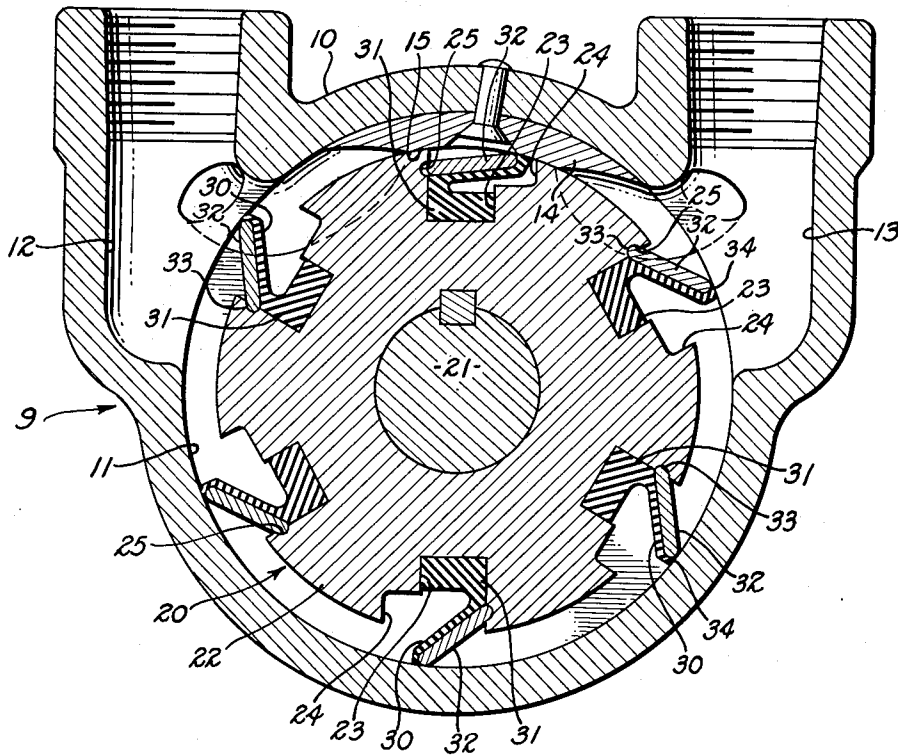
M. A. GARRISON
ROTARY MOTOR OR PUMP

2,753,809

Filed Jan. 12, 1953

2 Sheets-Sheet 1

Fig. 1



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By

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2 Sheets-Sheet 2

Fig. 2

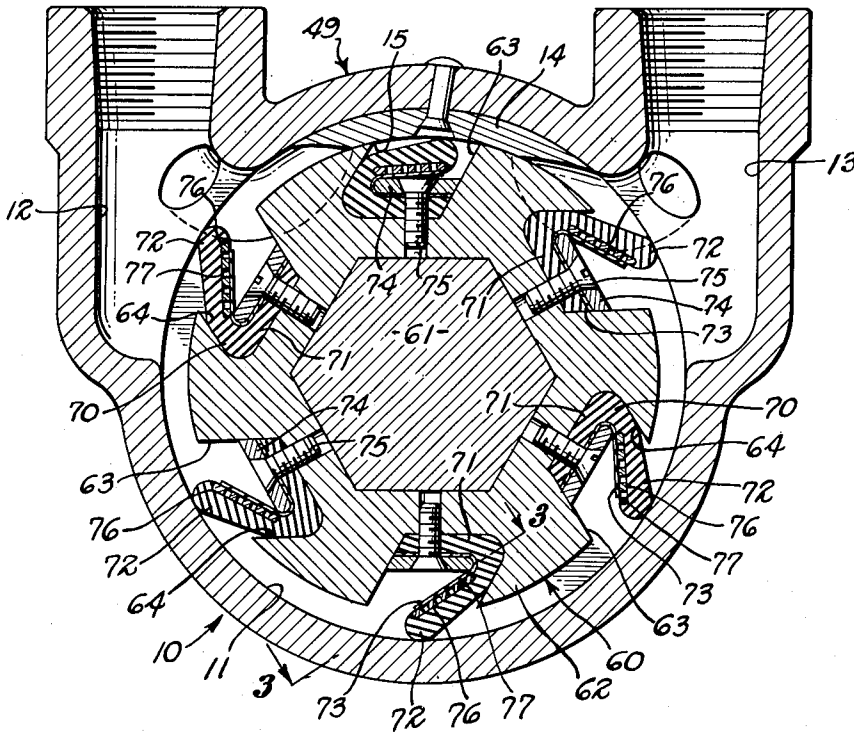
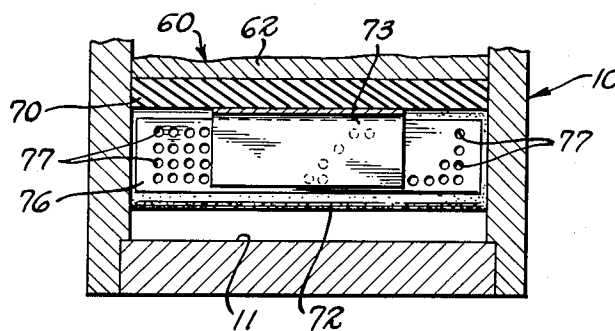


Fig. 3



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2,753,809

ROTARY MOTOR OR PUMP

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Application January 12, 1953, Serial No. 330,662

8 Claims. (Cl. 103—117)

The present invention relates in general to motors or pumps of the radial vane type and, more particularly, to a motor or pump having an impeller rotatable in an impeller chamber of variable radius and having vanes hingedly connected to the core or hub of the impeller, the vanes preferably being hingedly connected to the core of the impeller by forming them of a flexible material such as rubber, which material is particularly adapted for use where the motive fluid, or the fluid to be pumped, is abrasive. It will be understood that the term "rubber" is intended to include not only natural rubbers, but any of the various suitable synthetic or other materials having the same general properties.

Since rubber is inherently relatively deformable, prior motors or pumps of the foregoing general character have been limited to low pressure or negative pressure operation. High pressure operation, either as a motor, or as a pump, is impossible with such prior devices because of the fact that the rubber vanes are subject to severe deformation when the operating pressure is increased above a relatively low maximum value.

The primary object of this invention is to provide a rotary motor or pump of the foregoing general character which is capable of operating at high pressures, e. g., 1000 p. s. i. or more.

More particularly, an object of the invention is to provide an impeller which includes reinforcing elements of relatively nondeformable material carried by the vanes to limit deformation of the rubber, or other relatively deformable material of which the vanes are formed, under pressure.

Another object is to provide an impeller which includes backing plates of metal, or other relatively nondeformable material, carried by the vanes on either the low pressure or the high pressure side thereof to resist deformation of the rubber incorporated in the vanes. A related object is to provide backing plates which are substantially coextensive with the vanes themselves so as to minimize any tendency of the rubber to flow around the edges of the backing plates under pressure.

The reinforced vanes pivot relative to the core of the impeller between flexed and unflexed positions as they encounter the different radii of the impeller chamber, and an important object of the invention in connection with one embodiment thereof is to provide the core of the impeller with longitudinal grooves therein in which the inner edges of the respective backing plates are seated when the vanes are in their unflexed positions, the backing plates being on the low pressure sides of the vanes in this embodiment. Seating of the inner edges of the backing elements in these grooves prevents movement of the vanes beyond their unflexed positions under the influence of high pressures applied to the vanes, which is an important feature. However, the vanes are free to move into their flexed positions in response to the action of a decreasing chamber radius thereon, the inner edges of the backing plates unseating as the vanes move into

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their flexed positions because of the action of the decreasing radius of the chamber thereon.

An object in connection with the presently preferred embodiment of the invention is to provide the vanes with such backing plates on the high pressure sides thereof and to provide spring means for biasing the vanes outwardly into positive engagement with the peripheral wall of the impeller chamber, the spring means acting on the backing plates. Another object in connection with this embodiment is to dispose the flexible vanes in grooves having inclined side walls against which the vanes are biased by the spring means, the inclined side walls serving to back up the vanes under pressure.

Another object is to provide a rotary motor or pump having the foregoing features which is of simple and rugged construction for minimum cost and maximum service.

The foregoing objects and advantages of the present invention, together with various other objects and advantages thereof which will become apparent, may be attained with the exemplary embodiments of the invention which are illustrated in the accompanying drawings and which are described in detail hereinafter.

Referring to the drawings:

Fig. 1 is a cross-sectional view of a rotary motor or pump which embodies the invention;

Fig. 2 is a similar cross-sectional view of the presently preferred embodiment of the invention; and

Fig. 3 is a fragmentary sectional view taken as indicated by the arrowed line 3—3 of Fig. 2.

Referring to Fig. 1 of the drawings, the rotary motor or pump illustrated therein is identified by the numeral 9 and includes a housing 10 having therein a generally cylindrical impeller chamber 11 and having therein ports 12 and 13 which communicate with the impeller chamber. When the device operates as a motor, the port 12 serves as an inlet or intake port and the port 13 serves as an outlet or exhaust port. Conversely, when the device is being utilized as a pump, the port 13 serves as the intake or inlet port and the port 12 serves as the outlet or exhaust port. The ports 12 and 13 are separated by a seal 14 which, in effect, provides the impeller chamber 11 with a circumferentially extending zone 15 of reduced radius, the seal 14 being shown as nonintegral with and connected to the housing 10. However, this seal 14 may be an integral part of the housing 10 if desired.

Rotatable in the impeller chamber 11 is an impeller 20 fixed on a shaft 21 the axis of which coincides with the axis of the impeller chamber in the particular construction illustrated, the shaft 21 being mounted in suitable bearings, not shown, at the ends of the housing 10 in the usual manner for pumps of this general character. When the device is utilized as a pump, the shaft 21 is driven by any suitable means, not shown. Conversely, when the device is being utilized as a motor, the shaft may drive any suitable apparatus connected thereto.

The impeller includes a hub or core 22. Relatively deep grooves or recesses 23 extending longitudinally of the core 22 from one end thereof to the other are provided in the core, the recesses 23 respectively opening outwardly into and communicating with shallower and wider recesses 24. One wall of each recess 24 is provided with a groove 25 therein, the recesses 24 and the grooves 25 also extending from one end of the core 22 to the other.

The impeller 20 also includes generally radially extending, flexible vanes 30 of a relatively deformable material such as rubber, the vanes having base portions 31 disposed in the respective recesses 23 and suitably secured therein, as by bonding them to the material of the core 22, which may be metallic in the particular construction illustrated. The rubber or other relatively deformable

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material of which the vanes 30 are formed is relatively thin throughout the vanes proper and at the junctions of the vanes to the base portions 31 so that the vanes may pivot freely relatively to the core 22 between flexed and unflexed positions. The uppermost vane 30 in the drawing is shown in its flexed position, being pivoted into this position by the action of the reduced-radius zone 15 of the impeller chamber 11 during rotation of the impeller 20. As will be apparent, the vanes 30 are retracted into the recesses 24 when in their flexed positions, the periphery of the core 22 preferably contacting the reduced-radius zone 15. The remaining vanes 30 are shown in their unflexed positions.

The impeller 20 includes reinforcing elements of relatively nondeformable material carried by the vanes for limiting deformation of the rubber or other relatively deformable material of which the vanes are formed when pressure is applied to the vanes in the operation of the device as either a motor or a pump. These reinforcing elements comprise metallic backing plates 32 in the particular construction illustrated, these backing plates being carried by the vanes 30 on the low pressure sides thereof and preferably being bonded or otherwise secured to the vanes. The backing plates are substantially coextensive with the vanes 30 and are respectively provided with inner and outer edges 33 and 34, the outer edges being in engagement, or at least substantially in engagement, with the peripheral wall of the impeller chamber 11. Similarly, the ends of the backing plates 32 engage, or substantially engage, the end walls of the impeller chamber 11. The inner edges 33 of the backing plates 32 are seated in the grooves 25, respectively, when the vanes are in their unflexed positions, thereby preventing movement of the vanes beyond their unflexed positions. As illustrated by the uppermost vane in the drawing, when the vanes are in their flexed positions, the inner edges 33 of the backing plates 32 are unseated from the grooves 25, the vanes pivoting freely from their unflexed positions into their flexed positions. Preferably, the vanes are inclined at acute angles to the peripheral wall of the impeller chamber 11 when in their unflexed positions to minimize binding.

With this construction, the backing plates 32 prevent deformation of the vanes 30 under pressure and, by making the backing plates substantially coextensive with the vanes, any tendency of the material of which the vanes are formed to flow past the backing plates is minimized, which are important features of the invention. Thus, all the advantages of a motor or pump with flexible impellers are attainable with the present invention and, in addition, the present invention attains the new result of operating under much higher pressures than any hitherto attainable. For example, the present invention will operate successfully at pressures of 1000 p. s. i., or more.

As will be apparent, when the present invention is being utilized as a pump, the impeller 20 is driven in the clockwise direction, the port 13 being the inlet port and the port 12 being the outlet port under such circumstances. Conversely, when the invention is being utilized as a motor, fluid under pressure is admitted into the impeller chamber 11 through the port 12 and rotates the impeller in the counterclockwise direction, the spent fluid exhausting through the port 13. Thus, whether the invention is employed as a motor or as a pump, the backing plates 32 are always on the low pressure sides of the vanes to prevent deformation of the vanes under the applied or developed pressure.

While the impeller 20 has been illustrated as having a nonintegral core and vanes, it will be understood that the vanes and core may be integral and formed of rubber, or the like, if desired.

Considering now the presently preferred embodiment of the invention illustrated in Figs. 2 and 3 of the drawings, the rotary motor or pump illustrated therein is identified generally by the numeral 49 and includes a hous-

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ing which is identical to the housing 10 of the motor or pump 9. Consequently, the housing of the motor or pump 49 is also identified by the numeral 10 and the reference numerals employed for the various elements of the housing are identical to those employed previously.

Rotatable in the impeller chamber 11 of the motor or pump 49 is an impeller 60 fixed on a shaft 61 the axis of which coincides with the axis of the impeller chamber in the particular construction illustrated, the shaft 61 being mounted in suitable bearings, not shown, at the ends of the housing 10 in the usual manner for pumps of this general character. When the device is utilized as a pump, the shaft 61 is driven by any suitable means, not shown. Conversely, when the device is being utilized as a motor, the shaft may drive any suitable apparatus connected thereto.

The impeller 60 includes a hub or core 62 and relatively deep grooves or recesses 63 extend longitudinally of the core 62 from one end thereof to the other. Sides 64 of the recesses 63 are inclined or slanted relative to the axis of rotation of the impeller 60 for a purpose to be described, the slanted sides 64 being located on the low pressure sides of vanes which are disposed in the recesses 63 and which are discussed in the following paragraphs.

The impeller 60 also includes generally radially extending, flexible vanes 70 of a relatively deformable material, such as rubber. The vanes 70 are of generally L-shaped cross section, as are the vanes 30 previously described, and have base portions 71 disposed in the respective recesses 63. The vanes 70 also have blade portions 72 which project from the recesses 63 and which are engageable with the peripheral wall of the impeller chamber 11, the blade portions 72 being disposed adjacent the slanted sides 64 of the recesses 63 and being backed up thereby when pressure is applied to the high pressure sides of the vanes. The blade portions 72 of the vanes 70 are biased toward their extended positions by angle-shaped leaf springs 73 which are inserted under plates 74 secured by screws 75 threaded into the core 62 and which bear against backing plates 76 located on the high pressure sides of the blade portions 72 of the vanes. The backing plates 76 are bonded or otherwise secured to the blade portions 72 of the vanes 70 and are provided with perforations 77 therein to receive portions of the rubber material of which the blade portions 72 are formed, thereby attaining a more positive bond. As in the case of the motor or pump 9, the backing plates 76 are substantially coextensive with the blade portions 72 of the vanes 70 to provide maximum reinforcement therefor, the backing plates being slightly smaller than the blade portions to keep the backing plates out of contact with the end and peripheral walls of the impeller chamber 11.

Considering the operation of the motor or pump 49, the backing plates 76 prevent deformation of the vanes 70 under pressure and, by making the backing plates substantially coextensive with the blade portions 72 of the vanes, maximum support for the blade portions is provided. Additionally, under extreme pressures applied to the high pressure sides of the blade portions 72, the blade portions tend to seat against the slanted sides 64 of the recesses 63 so that the slanted sides serve to back up the blade portions of the vanes under such conditions, which is an important feature. The leaf springs 73, by biasing the blade portions 72 of the vanes 70 outwardly at all times, insure positive engagement of the outer ends of the blade portions 72 with the peripheral wall of the impeller chamber 11. With this construction, even if one or more vanes remain in contact with the zone 15 of reduced diameter for prolonged periods of time with the device 49 idle, these vanes will promptly be extended by the springs 73 as soon as the device is put into operation again, which is an important feature.

The device 49 has several advantages over the device 9, one of these being that there is far less tendency in the

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device 49 for abrasive particles in the fluid to cause wear, which is an important feature. Another feature is that the springs 73 insure positive engagement between the blade portions 72 and the peripheral wall of the impeller chamber 11 at all times. Also, the recesses 63 are less likely to become filled with accumulations of drilling mud, or the like, when the device is used for pumping such materials, which is another feature.

Although I have disclosed exemplary embodiments of my invention herein for purposes of illustration, it will be understood that various changes, modifications and substitutions may be incorporated in the embodiments disclosed without departing from the spirit of the invention as defined by the claims which follow.

I claim as my invention:

1. A rotary motor or pump including a housing provided with an impeller chamber therein and including an impeller rotatable in said chamber about an impeller axis, said chamber having a peripheral wall which includes one zone nearer to said axis than another zone thereof, said housing having inlet and outlet ports therein which communicate with said chamber on opposite sides, respectively, of said one zone, said impeller including a core and including vanes extending outwardly from said core and having outer edges engaging said wall, said vanes being formed of a flexible, resilient material so as to provide for flexure of said vanes along their inner edges as their outer edges engage and disengage successive ones of said zones, said vanes carrying rigid reinforcing elements which extend substantially from the outer edges of said vanes to the inner edges thereof to substantially prevent flexure of said vanes between said outer and inner edges thereof while providing for flexure of said vanes along said inner edges thereof.

2. A rotary motor or pump as defined in claim 1 wherein said core and said vanes are nonintegral, said core having recesses therein respectively containing vane bases, said vane bases being integral with said vanes, respectively, and said inner vane edges being located at the respective junctions of said vanes and vane bases.

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3. A rotary motor or pump as defined in claim 2 including means for securing said vane bases in said recesses.

4. A rotary motor or pump as defined in claim 1 wherein said core and said vanes are nonintegral, said core having recesses therein provided with side walls against which said vanes are seated, respectively.

5. A rotary motor or pump as defined in claim 4 wherein said side walls of said recesses make acute angles with the bottoms of said recesses, respectively.

6. A rotary motor or pump as defined in claim 4 wherein said side walls of said recesses are provided with grooves therein in which inner edges of said reinforcing elements are seated, respectively.

7. A rotary motor or pump as defined in claim 1 including spring means engaging said vanes for biasing said vanes outwardly to maintain said outer edges of said vanes in engagement with said peripheral wall of said chamber.

8. An impeller for a rotary motor or pump including a core and including vanes extending outwardly from said core and having inner and outer edges, said vanes being formed of a flexible material so as to provide for flexure of said vanes along their inner edges, said vanes carrying rigid reinforcing elements which extend substantially from said outer edges of said vanes to said inner edges thereof to substantially prevent flexure of said vanes between said outer and inner edges thereof while providing for flexure of said vanes along said inner edges thereof.

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