Dec. 14, 1943. W. C. YEATMAN 2,336,580

ARTERY TYPE ROTARY PUMP

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FIG. 1.

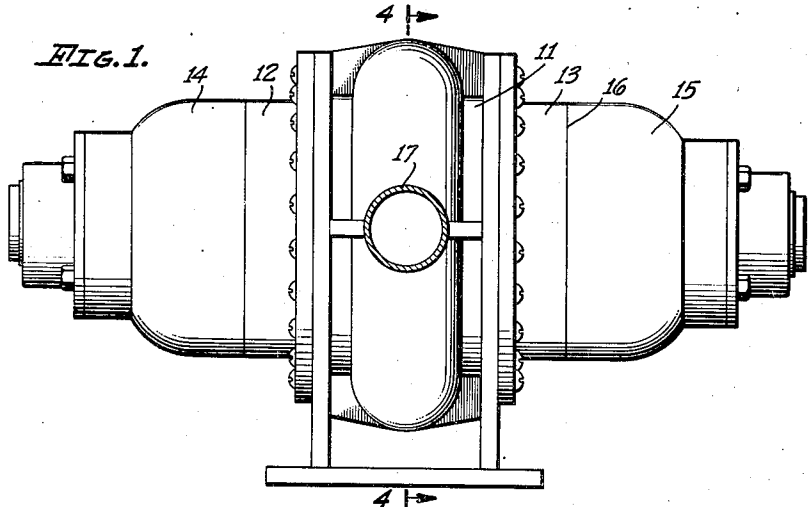
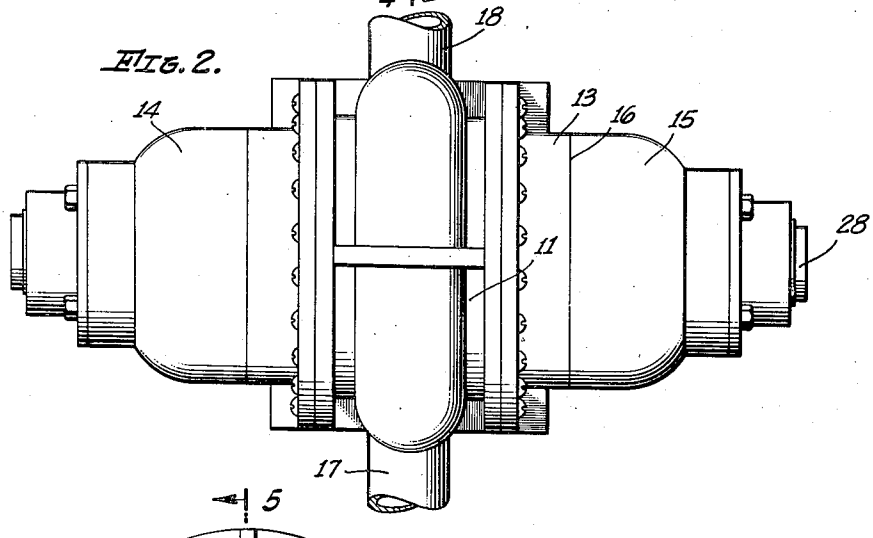


FIG. 2.



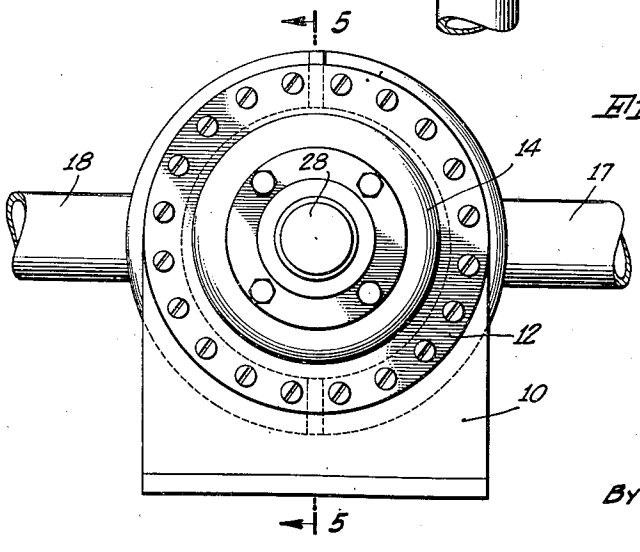


FIG. 3.

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ARTERY TYPE ROTARY PUMP

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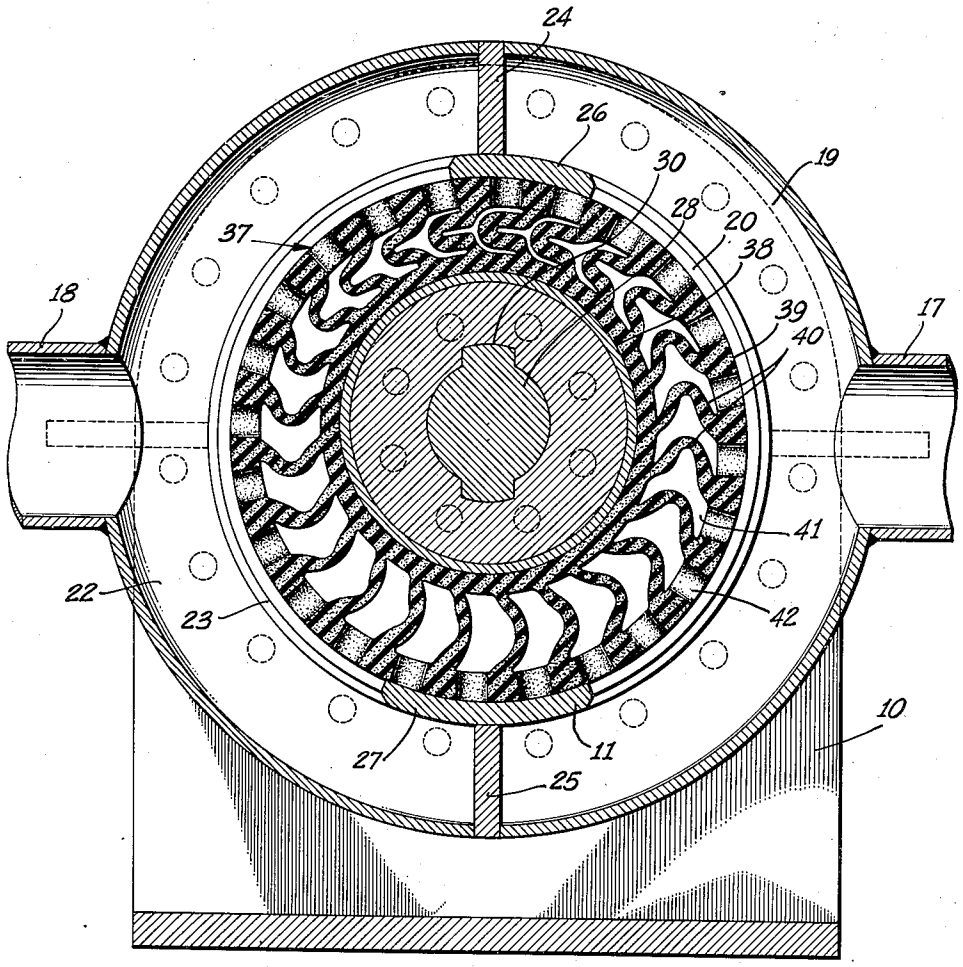


FIG. 4.

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ARTERY TYPE ROTARY PUMP

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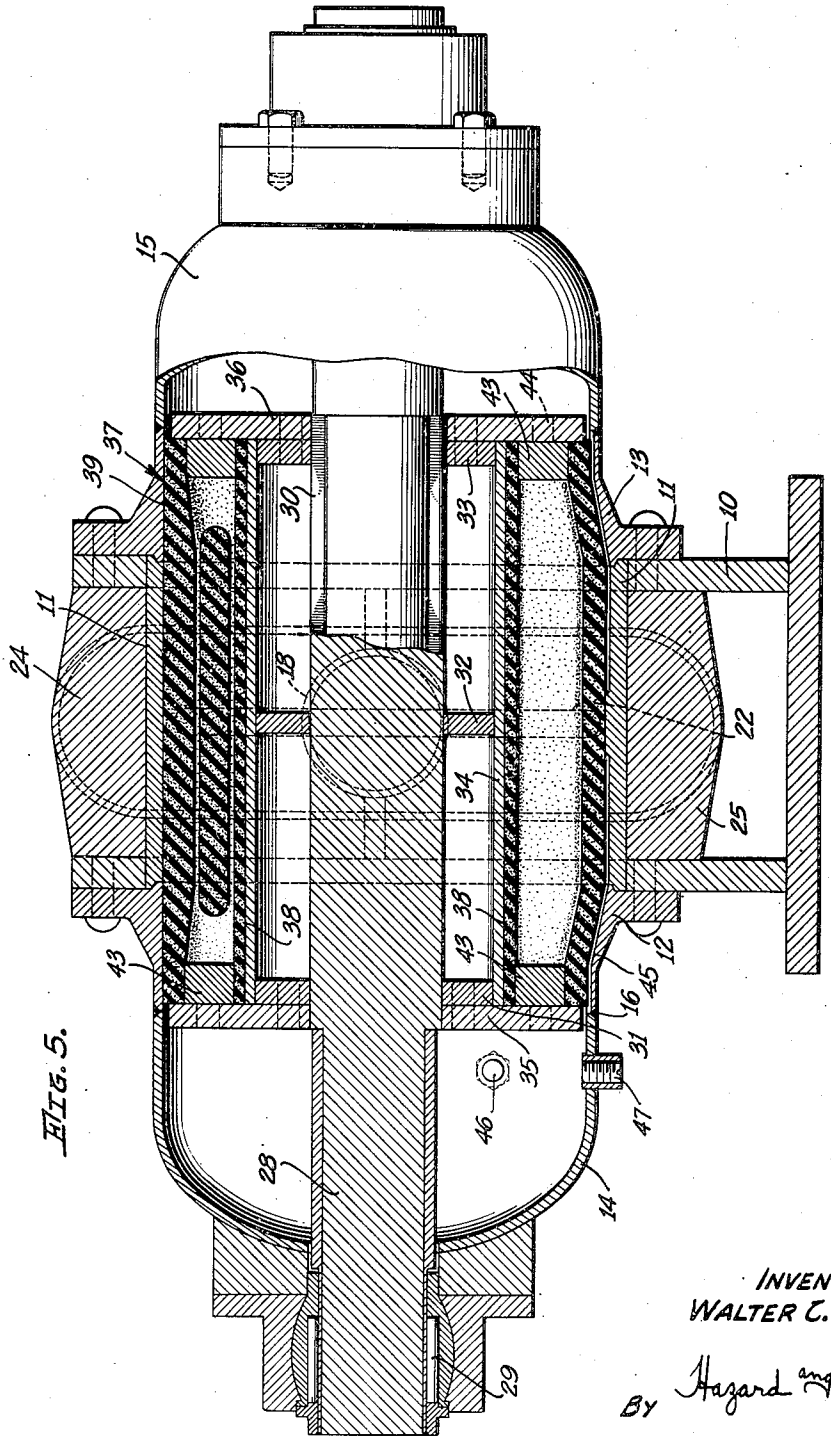


FIG. 5.

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ARTERY TYPE ROTARY PUMP

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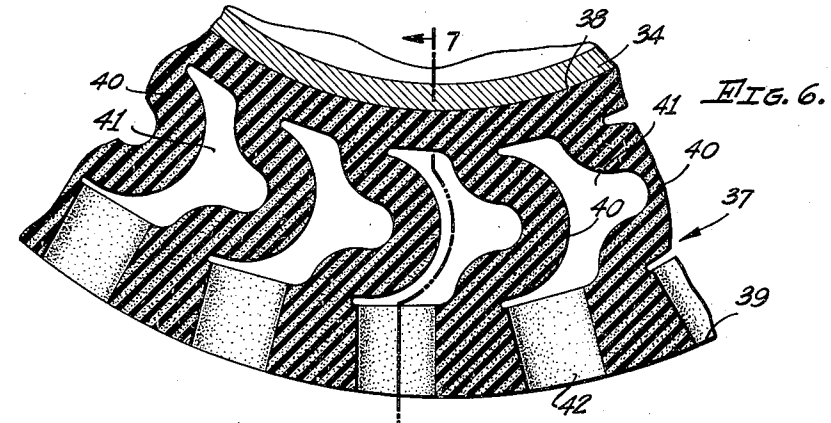


FIG. 6.

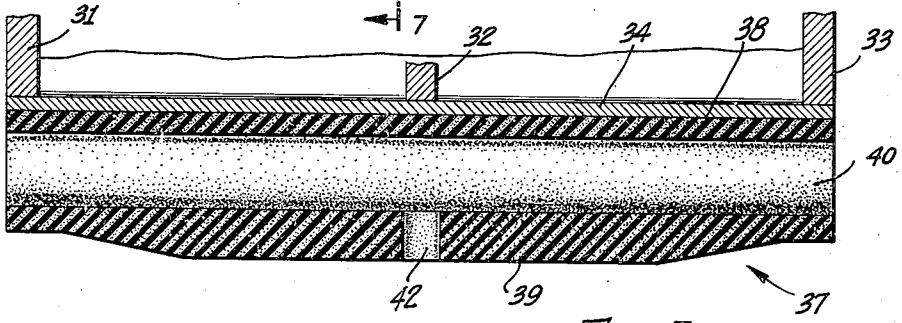


FIG. 7.

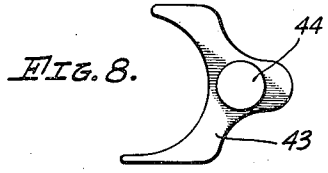


FIG. 8.

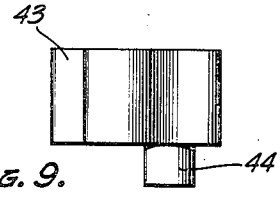


FIG. 9.

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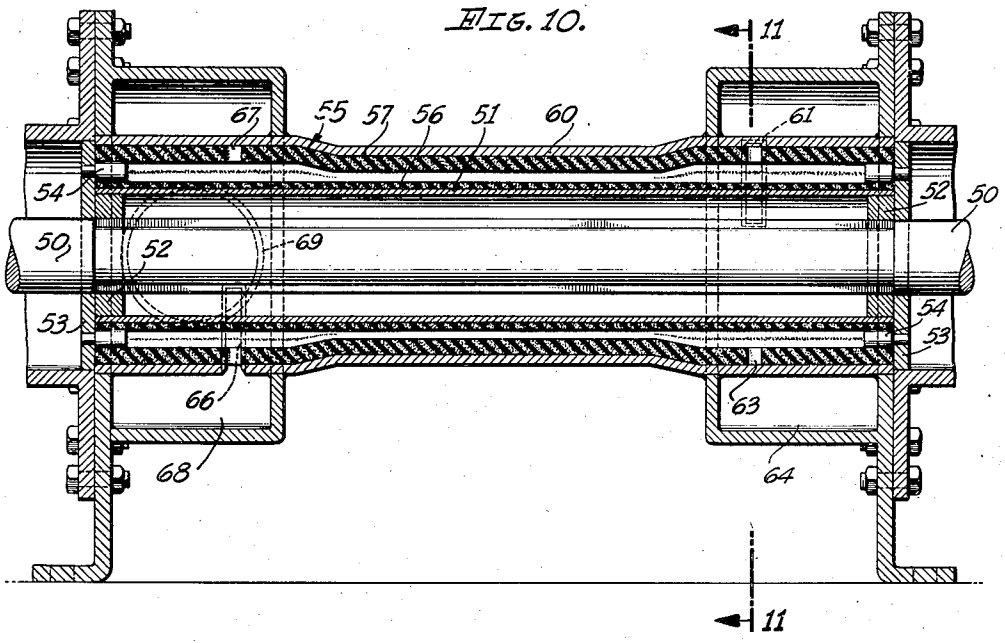
ATTORNEYS.

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ARTERY TYPE ROTARY PUMP

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FIG. 10.



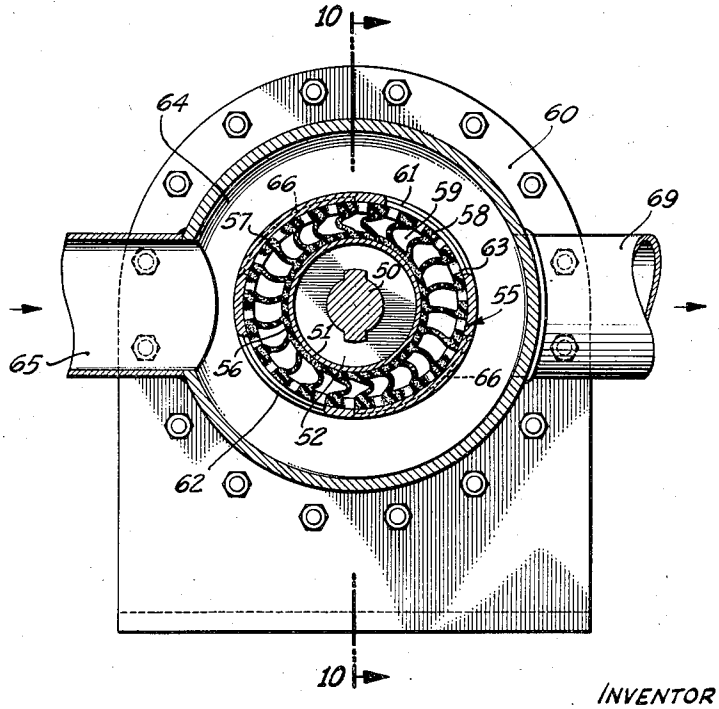


FIG. 11.

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Patented Dec. 14, 1943

2,336,580

UNITED STATES PATENT OFFICE

2,336,580

ARTERY TYPE ROTARY PUMP

Walter C. Yeatman, Los Angeles, Calif.

Application December 8, 1941, Serial No. 422,092

6 Claims. (Cl. 103—121)

This invention relates to improvements in rotary pumps.

An object of the invention is to provide an improved rotary pump comprising a housing having an inlet and an outlet, a rotor rotatable within the housing, the rotor being characterized by having a plurality of cavities formed therein open on the periphery of the rotor so as to be accessible to the inlet and outlet during rotation, the cavities having deformable or flexible side walls. By this construction the number of moving parts on the rotor is materially reduced and the wear of such parts is eliminated. The variation in the effective size or capacity of each cavity is accomplished by the flexing of the material of the rotor itself. In this aspect of the invention the rotary pump may be regarded as an artery type pump in that the pumping action is accomplished by the expansion and contraction of cavities on the rotor during the rotation of the rotor.

Another object of the invention is to provide an improved rotary pump which is of very simple and highly durable construction and which may be manufactured from parts most of which are of conventional construction or from stocks of parts now readily available.

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawings for an illustrative embodiment of the invention, wherein:

Figure 1 is a view in side elevation of the pump embodying the present invention;

Fig. 2 is a top plan view of the same;

Fig. 3 is a view in end elevation of the pump embodying the present invention;

Fig. 4 is a sectional view through the pump taken substantially upon the line 4—4 upon Fig. 1;

Fig. 5 is a view largely in vertical section taken substantially upon the line 5—5 upon Fig. 3;

Fig. 6 is a sectional view through a portion of the rotor illustrating the rotor in its normal position or condition prior to its being inserted into the housing;

Fig. 7 is a sectional view through a portion of the rotor taken substantially upon the line 7—7 upon Fig. 6;

Fig. 8 is a view in end elevation of one of the plugs or ends that provide end walls for the cavities in the rotor and which assist in maintaining the rubber of the rotor in proper position thereon;

Fig. 9 is a view in side elevation of the plug shown in Fig. 8;

Fig. 10 is a longitudinal section of a modified form of construction and may be considered as having been taken upon the line 10—10 upon Fig. 11; and

Fig. 11 is a transverse sectional view taken substantially upon the line 11—11 upon Fig. 10 in the direction indicated.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, the improved pump comprises a suitable housing supported on a base 10 and having a central ring or band 11 equipped with ends 12 and 13 to which are applied caps 14 and 15 which may be welded thereto such as by welds 16. An inlet to the pump is indicated at 17 and an outlet therefrom is arranged diametrically opposite as indicated at 18. The inlet 17 leads into a semi-circular passage 19 which is open through the ring or band 11 by means of a slot 20 formed in the ring or band. This slot extends nearly halfway around the ring 11 so that the inlet afforded by the inlet pipe 17 and the semi-circular passage 19 are open to the interior of the housing throughout nearly one-half of the internal circumference. In a similar manner a semi-circular passage 22 which leads to the outlet 18 is open to the opposite side of the rotor through ring 11 by means of the slot 23 that extends nearly halfway around the interior of the housing. The passages 19 and 22 are separated from each other by partitions 24 and 25 and adjacent the inner ends of these partitions the ring or band 11 is unslotted and imperforate as indicated at 26 and 27, respectively.

The interior of the ring or band 11 is cylindrical and a rotary shaft 28 extends longitudinally therethrough. This shaft is rotatably supported on anti-friction bearings 29 at the outer ends of the caps 14. Within the housing the shaft is provided with external keys or feathers 30 and on the keyed or feathered portion of the shaft there are disposed circular plates 31, 32, and 33. These plates are welded or are otherwise secured to a cylindrical drum 34. On the outer sides of the plates 31 and 33 there are secured end plates 35 and 36. Between the end plates 35 and 36 there is disposed on the drum 34 a rubber sleeve generally designated at 37. This sleeve comprises one of the important features of the present invention. It provides a cylindrical inner wall 38 fitting snugly about the drum 34 and may be, if desired, vulcanized or cemented to the drum. It has a spaced outer

wall 39 which is relatively thick so as to be stiff tending to maintain its cylindrical shape. The inner and outer walls 38 and 39 are connected together by a plurality of relatively thin side walls 40 which extend from end to end of the sleeve. These side walls, as clearly shown in Fig. 4, are readily bendable and are quite flexible defining deformable cavities 41 around the periphery of the rotor. In the outer wall 39 of the sleeve there are formed openings 42, there being one opening for each cavity and these openings are preferably arranged in the center of the sleeve so as to be disposed opposite or in registration with the slots 20 and 23 in the ring or band 11 as the rotor rotates.

The ends of the cavities are closed by plugs 43 illustrated in detail in Figs. 8 and 9. These plugs have studs 44 that extend into apertures in the end plates 35 and 36. In shape they conform largely to the normal shape of the cavities 41.

As will be noted from an inspection of Fig. 4, the axis of rotation of the shaft 28 is slightly off-center or eccentric with respect to the center of the band or ring 11, or, in other words, the housing may be regarded as eccentric with respect to the axis of rotation of the shaft. Consequently, although the sleeve 37 is initially molded or formed so that when in its released or normal condition, all cavities 41 will have the same size and shape as illustrated in Figs. 6 and 7. On insertion of the rotor within the housing the outer wall 39 of the sleeve will be forced inwardly toward the inner wall 38, thus bending those partitions or side walls 40 which are at the top of the rotor as illustrated in Fig. 4. As the outer wall 39 is relatively thick and consequently comparatively stiff, it tends to remain truly cylindrical with the result that the lower portion of the outer wall 39 is maintained in engagement with the bottom of the ring or band 11 and the bottom partitions or walls 40 are straightened or possibly stretched as indicated in Fig. 4. With this arrangement it will be noted that those cavities 41 that are opposite the slot 20 are continually increasing in effective size from the top of slot 20 to its bottom. These constantly increasing cavities thus take on charges from the inlet passages 17 and 19. When the cavities have their entrances 42 encounter the blanked off portion 27 in the ring or band 11 the fluid in the cavities is effectively entrapped therein for a short period of movement. When the entrances 42 come opposite the slot 23, the cavities are then opened to the outlet passages 22 and 18 and as they progress from the bottom of slot 23 to its top, it will be noted that the cavities decrease in effective size, thus expelling fluid from the cavities and causing it to flow through the outlets. The entrances to the cavities are then closed and opened by the blanked off portion 26 completing one cycle of the pump.

The plugs 43 at the ends of the cavities provide end walls for the cavities and assist in causing the sleeve to rotate with the body of the rotor. They also cooperate with the end plates 35 and 36 in holding the ends of the rotor and consequently the ends of the deformable cavities against deformation and on an annulus concentric with respect to the axis of rotation of the rotor. The ends 12 and 13 at their outer ends provide inner cylindrical walls which are concentric with respect to the axis of rotation of the rotor while the central band or ring 11 provides a cylindrical wall which is eccentric with respect to the axis of rotation of the rotor. The portions of the ends 12 and 13 between the outer concentric walls thereof and the eccentric walls of the band or ring 11 provide inner surfaces that gradually merge from the outer concentric walls to the inner eccentric walls of the ring. Consequently, while the ends of the rotor are maintained cylindrical at all times and concentric with respect to the axis of rotation, the intermediate or central portions of the stiff but flexible outer walls of the cavities are flexed and are consecutively moved radially inward and outward with respect to the axis of rotation of the rotor as the rotor rotates.

When the pump is pumping water or fluid containing water, the water present in the fluid serves to provide a certain amount of lubricant between the rubber exterior of the sleeve 37 and the metal interior of the housing. To assist in lubricating the surfaces between the housing and the sleeve, lubricating grooves 45 may be formed in the bottom of the band or ring 11 and the ends 12 and 13. These lubricating grooves may be supplied with water or other lubricating fluid maintained in the caps 14 and 15 and supplied through filling openings 46. 47 indicates normally closed outlet openings for draining lubricating fluid or water within the end caps 14 and 15.

In Figs. 10 and 11 a slightly modified form of construction is illustrated. In this construction the rotor shaft is indicated at 50 which rotates a cylindrical sleeve 51. Rings 52 space the sleeve 51 from the rotor shaft and key it thereto. End plates 53 also rotate with the rotor and carry plugs 54 similar in shape to the plugs 43. On the rotor there is mounted a rubber sleeve generally indicated at 55 having an inner wall 56 fitting snugly about the sleeve 51, and a relatively heavy but flexible outer wall 57. The outer wall is connected to the inner wall by flexible partitions 58 defining cavities 59 that extend longitudinally of the rotor between the plugs 54 which close the ends of the cavities. The housing 60, instead of being eccentrically arranged with respect to the rotor as in Figs. 1 to 9, is symmetrically arranged with respect to the axis of rotation of the rotor shaft 50. However, as will be observed from an inspection of Fig. 11, this housing, instead of being cylindrical on its interior, is ovate in form. At one end of the housing there are formed two slots 61 and 62, which are arranged diametrically opposite each other, or 180° apart. Each slot extends slightly less than 90° around the circumference of the housing. These slots provide inlet ports communicating with holes 63 formed in the outer wall 57 opposite the slots. An annular chamber 64 surrounds this end of the housing and provides an inlet chamber being supplied with fluid to be pumped through an inlet pipe 65. At the other end of the housing there are formed two slots 66. These slots are arranged 180° from each other and are in alignment with a series of apertures 67 formed in the outer wall 57 of the rotor. The slots 66, however, are oriented 90° from their companion slots 61 and 62 and they communicate with an angular chamber 68 which in turn leads to an outlet pipe 69.

This form of pump may be regarded as a two cycle pump. Thus, in the construction illustrated in Figs. 1 to 9, the cavities are filled with fluid and have the fluid expelled therefrom once per revolution of the rotor. In the construction illustrated in Figs. 10 and 11, each cavity is filled

or enlarged and has the fluid expelled therefrom twice per revolution of the rotor, due to the ovate form of the housing.

As the rotor rotates fluid enters the collapsed but enlarging cavities through the ports 61 and 62 entering the cavities through the apertures 63. During continued rotation of the rotor the fluid is expelled from the cavities through the apertures 67 and the ports 66 at the other end of the pump housing and passes out through the outlet pipe 69. Thus, the fluid undergoes a longitudinal travel through the cavities 59 entering at one end of these cavities and being expelled at the other. This form of construction has the advantage in that forces acting upon the rotor on opposite sides thereof during compression or collapse of the cavities is neutralized or balanced, thus reducing stresses imposed upon the rotor shaft 50 and on the bearings for the rotor shaft.

It will be appreciated that by increasing the number of portions of the housing that are eccentrically arranged with respect to the rotor that the number of cycles per revolution of the rotor shaft can be increased. Ordinarily, however, there is very little to be gained by making the pump operate with more than two cycles per revolution.

From the above described construction it will be appreciated that the improved pump is very simple in construction and is highly durable in that there are very few moving parts. The action of the rotor is such that the cavities are consecutively expanded when opposite the inlet and are consecutively contracted when opposite the outlet. The effective capacity of each cavity, however, is varied not by a moving part but by the mere flexing or bending of its side walls caused by the outer wall 39 of the rotor moving toward and away during its rotation in continual engagement with the housing that is disposed eccentrically with respect to the axis of rotation of the rotor. The rotor may be turned at any desired speed and the pump will deliver fluids at relatively high pressures. If extremely high pressures are desired, it is possible to readily compound the pump by running two or more pumps in series. No severe strains are imposed upon the partitions or side walls 40 and the major action of these side walls is to merely bend and straighten during the rotation of the rotor so that the pump has a very long life before any parts require renewal or replacement. Even when replacement is required it can be easily accomplished by removing an end 12 or 13 and its associated structure and the insertion of a new rotor.

While I have described the sleeve 37 as being formed of rubber, this term as used herein and in the appended claims contemplates the use of any rubber-like substance which may either be vulcanized, natural rubber, or any synthetic rubber or rubber substitute possessing the properties of high flexibility and some elasticity.

Various changes may be made in the details of construction without departing from the spirit or scope of the invention as defined by the appended claims.

I claim:

1. A rotary pump comprising a rotor having spaced inner and outer annular walls, the outer wall being flexible intermediate its ends, flexible partitions connecting the inner and outer walls defining cavities therebetween, there being ports through the outer wall communicating with said cavities, means closing the ends of the cavities, and means providing a housing about the rotor having annular walls concentric with respect to the axis of rotation of the rotor engageable by the ends of the outer wall of the rotor, and annular walls between the concentric walls that are eccentric with respect to the axis of rotation of the rotor and which are engageable by said outer wall intermediate its ends, said housing having inlet and outlet passages adapted to be brought into and out of communication with said ports.

2. A rotary pump comprising a rotor having ends concentric with respect to the axis of rotation of the rotor, means providing a stiff but flexible outer wall on the rotor between the ends, means defining a plurality of deformable cavities inwardly of the outer wall between said ends, there being ports in the outer wall communicating with the cavities, and means providing a housing around the rotor having annular walls engageable with the ends of the rotor and concentric with respect to the axis of rotation of the rotor, and annular walls therebetween which are eccentric with respect to the axis of rotation of the rotor and which are engageable by said flexible outer wall, there being inlet and outlet passages in the housing adapted to be brought into and out of communication with said ports as the rotor rotates.

3. A rotary pump comprising a rotor having a plurality of deformable cavities formed therein, said rotor providing a deformable outer wall, means for holding the ends of the outer wall against deformation, there being ports on the rotor establishing communication between the cavities and the periphery of the rotor, and a housing providing walls concentric with respect to the axis of rotation of the rotor engageable with the ends of the outer wall, and walls engageable with the deformable portion of the outer wall for moving the deformable portions of the outer wall radially with respect to the axis of rotation of the rotor as the rotor rotates, there being passages in the housing adapted to be brought into and out of communication with said ports as the rotor rotates.

4. A rotary pump comprising a rotor having a plurality of deformable cavities formed therein, each cavity being ported to communicate with the periphery of the rotor, means for holding the ends of the cavities concentric with respect to the axis of rotation of the rotor, and a housing fitting about the rotor having passages adapted to be brought into and out of communication with the ports of the cavities and providing walls around the ends of the cavities which are concentric with respect to the axis of rotation of the rotor, and means for moving portions of the outer walls of the cavities radially with respect to the axis of rotation of the rotor as the rotor rotates.

5. A rotary pump comprising a rotor having a plurality of deformable cavities formed therein, each cavity being ported to communicate with the periphery of the rotor, means for holding the ends of the cavities concentric with respect to the axis of rotation of the rotor, a housing fitting about the rotor having passages adapted to be brought into and out of communication with the ports of the cavities and providing walls around the ends of the cavities which are concentric with respect to the axis of rotation of the rotor, and means for moving portions of the outer walls of the cavities radially with respect

to the axis of rotation of the rotor as the rotor rotates, said passages and ports being located adjacent the ends of the cavities in those portions which are held concentric with respect to the axis of rotation of the rotor.

6. A rotary pump comprising a rotor having a plurality of deformable cavities formed therein, each cavity being ported adjacent its center to communicate with the periphery of the rotor, means for holding the ends of the cavities concentric with respect to the axis of rotation of the rotor, and a housing fitting about the rotor providing walls around the ends of the cavities which are concentric with respect to the axis of rotation of the rotor and walls around the center portions of the cavities which are eccentric with respect to the axis of rotation of the rotor and form bearing surfaces for outer wall portions of said rotor cavities, there being passages in the housing opposite the eccentric walls thereof adapted to be brought into and out of communication with the ports of the cavities as the rotor rotates.

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