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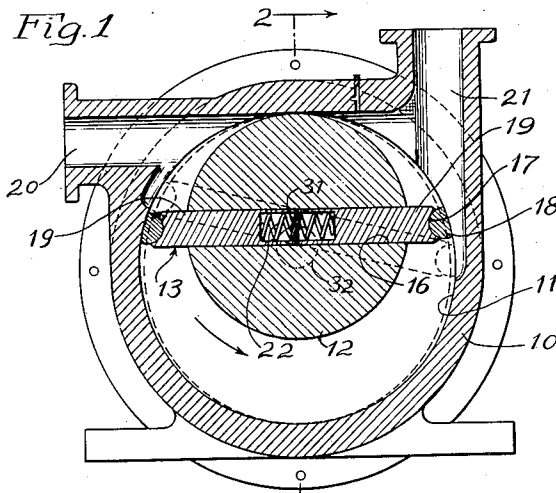
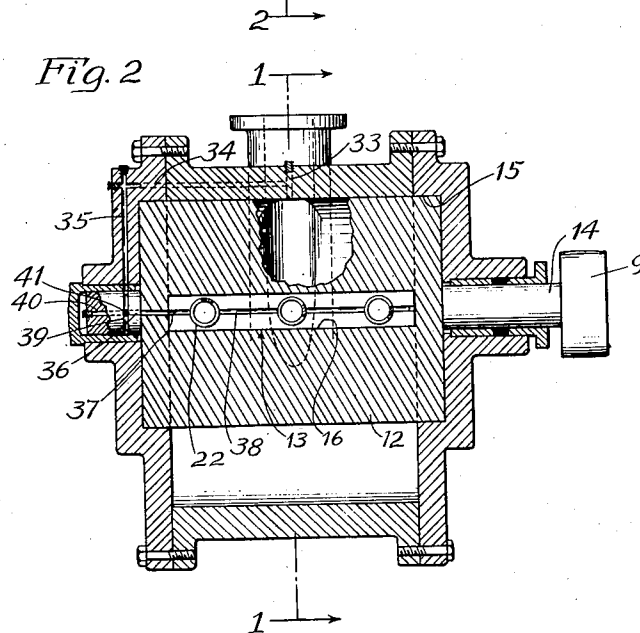
G. D. BRADSHAW

1,972,864

ROTARY PUMP

Filed Oct. 15, 1930

2 Sheets-Sheet 1



Inventor:
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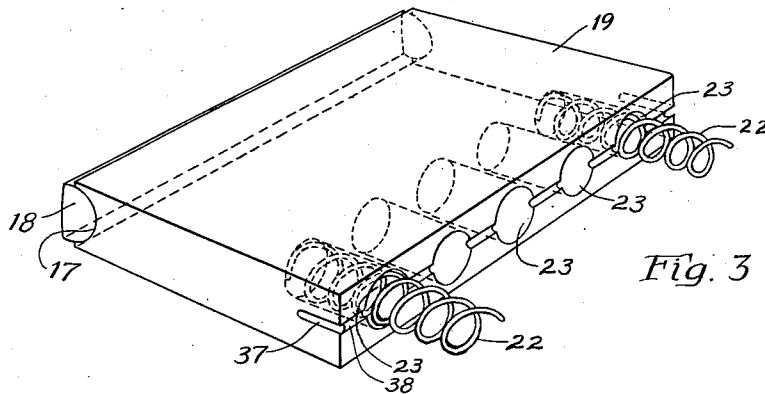
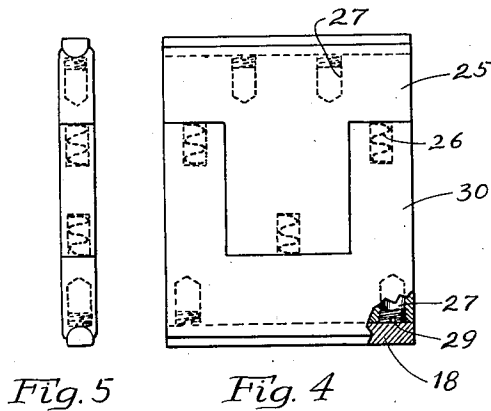
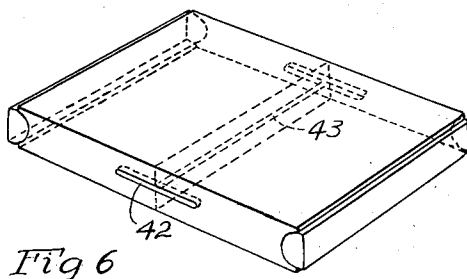
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

1,972,864

ROTARY PUMP

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Application October 15, 1930, Serial No. 488,819

5 Claims. (Cl. 103—137)

This invention relates to rotary pumps, and has for its object providing improvements in certain types of rotary pumps, so as to decrease the friction and wear of the pump and also the leakage, and to otherwise improve the operation and efficiency of such pumps. Another object is to reduce the noise resulting from the operation of the pumps and also to reduce the power required to operate the pump.

Of the accompanying drawings, Fig. 1 is a sectional view of a rotary pump, along the line 1—1 of Fig. 2, which embodies features of my invention; Fig. 2 is a sectional view of the pump along the line 2—2 of Fig. 1; Fig. 3 is an enlarged perspective view of one section of the impeller blade of the pump; Fig. 4 is an elevation of a modified form of a complete blade; Fig. 5 is an edge view of the blade of Fig. 4; and Fig. 6 is a perspective view of a blade of modified form.

The pump which I have illustrated comprises a frame 10 forming a casing and having a somewhat cylindrical chamber 11. Rotatably and eccentrically mounted in the chamber is a rotor 12. The rotor is mounted on a shaft 14 which is operated in any suitable manner, by means of a pulley 9, or otherwise. The rotor is mounted in the chamber 11, so that the upper surface of the rotor as it rotates is in contact with the upper surface of the chamber and, as the diameter of the rotor is less than that of the chamber, the lower surfaces are spaced a material distance apart. For preventing leakage and the like, the ends of the rotor are mounted in cylindrical recesses 15 in the side walls of the frame.

A diametric slot 16 extends from one end to the other of the bore of the chamber and, in this slot, is slidably mounted the blade 13. The surface of the bore is not strictly cylindrical, but forms a limaçon curve. Hence, it is of such a form as is described by the edges of the blade as the rotor is rotated, so that the edges of the blade at all times are substantially in contact with the surface of the bore.

The outer edges of the blade are provided with semi-circular seats 17, and in each seat is arranged a strip of packing material 18, which is substantially semi-cylindrical, but with the outer side slightly convex to conform to the curve of the bore. These strips 18 are rotatably mounted in the seats 17 of the blade, so that, as the blade rotates, the strips will rotate slightly in the seats 17, and the outer surfaces of the strips will conform to the surface of the bore. As the packing strips rock one way or the other, they will automatically increase or decrease slightly the length of the blade, and will, therefore, provide somewhat for the varying radius of curvature of the wall of the bore or any imperfections therein. As the rotor is rotated in the direction of the arrow, the fluid being operated on will be forced by the

impeller blade 13 from the inlet 20 around to the outlet 21, and it may thus be forced into any container connected with the outlet.

I have found that, in the operation of ordinary pumps of this nature, when a one-piece blade is used, extending from one side to the other of the bore, the packing does not satisfactorily compensate for irregularities in the formation of the curve of the bore, or for wear of the packing or bore surface. Also the centrifugal force acting on the blade tends to force the edges towards and away from the bore surface, depending on the angular position of the rotor; and abnormal vibrations of the blade are produced. As the center of mass of the one-piece blade passes from side to side through the center of rotation, the direction of the centrifugal force is changed with each revolution. This causes more or less pounding, and increases the friction and the leakage and also the power required to operate the rotor.

To eliminate these objectionable features, I provide a split blade in the slot 16. I divide the blade into two sections 19, the sections projecting from opposite sides of the rotor, with the inner edges of the sections substantially in contact. The two sections thus act substantially as a single blade but, being divided into two sections, the center of mass of each will be a material distance from the axis of the rotor and the centrifugal force acting on each section tends at all times to force it outwardly against the surface of the bore. As a consequence, each strip of packing 18 is at all times kept snugly in contact with the bore, and any wear by use is thus automatically taken care of, and the pounding, vibrating, and the like are eliminated or materially reduced.

As the rotor operates, the center 31 of the blade as a whole revolves around the circle 32 passing through the center of the bore and the center of the rotor. Hence, the blade sections are affected by various forces. The centrifugal force tends at all times to move the sections outwardly. This varies with the mass and angular velocity. The bore surface opposes the centrifugal force and causes the sections to reciprocate inwardly and outwardly in the rotor, each rotation through an amplitude equal to the maximum distance between the rotor periphery and the wall of the bore. Owing to inertia, this continuously varies the momentum of the sections, and alternately tends to force them towards and away from the bore surface. This varies also as the mass and velocity, but alternately assists and opposes the centrifugal force. Gravity also has more or less effect, depending on the position of the sections. Also, the lateral fluid pressure, and as well the wall friction effect, varies with the position of the sections from the maximum to zero, the fluid pressure varying also with the speed of rotation.

Because of these various forces, much noise, wearing and leakage ordinarily results in the operation of the rotor, with the one-piece blades. These undesirable effects are largely eliminated by the use of my split blade. But I have found by tests that certain modifications are desirable even with the split blade, and that these modifications depend upon various conditions, such as the fluid operated on, whether liquid or gas, dense or rare, the speed of rotation, the diameter of the bore and rotor, the material and the shape of the split blade, and other factors.

It is sometimes desirable to provide a positive force tending at all times to force the sections outwardly. For this purpose, yielding means may be provided, which tend at all times to accomplish this purpose. I prefer to provide such means which are effective between the sections tending to push them apart. For this purpose, yielding means may be made effective between the blades, such as the compression springs 22, mounted in holes 23. By the use of these springs, properly adjusted for the purpose, the packings will at all times be forced suitably against the surface of the bore. But it will be understood that the shape of the holes or the springs may be varied if desired. Or other holes may be formed, with springs mounted in the holes or not, as desired. By increasing the mass removed, the ratio of the centrifugal force effect to the inertia effect is increased.

However, it is sometimes desirable, particularly when yielding means are used for forcing the blade sections apart, to eliminate, or at least reduce, the centrifugal force, so that the pressure on the walls for all positions of the blade sections will be more uniform, depending mainly upon the spring force. In order to reduce the amount of centrifugal force acting on the blade sections, I prefer to divide the blade into sections 25 and 30, so that a portion of each section extends materially beyond each side of the center of rotation of the rotor. In this way, the center of mass of each section is positioned not far from the axis of the rotor. The exact form of the blades is not material, but in this way the centrifugal force tending to force the outer edges of the sections will be very materially decreased and may be entirely eliminated, at least at some positions of the sections.

Also, to reduce the centrifugal effect, and also to reduce the inertia effect, which may be advisable under some conditions, I reduce the mass in the outer edges of the blade sections. Preferably, this is done by drilling holes 27. If these holes are drilled underneath the packing strip, leakage of fluids or oil into the holes will be substantially eliminated. If the pump is to be used with liquids, or in any event if desired, the holes may be closed by means of plugs 29. Obviously, the larger and deeper the holes, the more the centrifugal force will be reduced as the mass is removed from the side of the center of rotation towards which the force acts. Also, the more the inertia and gravity effects will be reduced.

In case of blades, the sections of which are formed as indicated in Fig. 4, springs 26 may be used or not, as desired, for forcing the sections apart and, in this manner, with the centrifugal force substantially eliminated, the pressure will be substantially uniform at all positions of the blade sections. By the use of springs, the sections may be formed if desired so that, for some

positions of the blade, the centrifugal force will tend slightly to move one section inwardly.

It will thus be seen that I have provided means for suiting the pressure against the wall of the bore to the particular requirements. Although the centrifugal force with low speeds is not very material, yet, the leakage then is greater, and the symmetrical sections of Fig. 3 may be preferable. But for high speeds and, hence, high centrifugal forces and less leakage, sections reducing the centrifugal force to a minimum are often desirable. In general, by the means which I have provided, the ratio of the centrifugal force to the inertia of the sections may be materially varied by varying the shape of the sections, and the various effects may be varied further very materially by the use of yielding means for forcing the sections outwardly.

In some cases I prefer to provide hydraulic or pneumatic means for forcing the sections outwardly. One way of accomplishing this is to provide communicating means between the outlet of the pump and the space between the sections. Such means may be provided for by forming in the frame and rotor the openings 33, 34, 35 and 36 and the grooves 37 and 38; also a groove 39 in the periphery of the axle, and passageways 40 and 41 in the axle. In this way, fluid under pressure higher than at the inlet will act continuously to force the blades against the bore surface. Such means may be used with or without the springs 22.

Fig. 6 illustrates a simple form of split blade which has neither springs nor mass removing openings. The grooves 42 and 43 may be formed in this blade if desired. It will be understood that the grooves 37 and 42 are used to keep open communication between the grooves 36 and 38, or 43, when the blade is shifted outwardly on one side of the rotor more than on the other side.

I claim as my invention:

1. In a rotary pump having a limaçon-shaped bore with an inlet and an outlet, a rotor rotatably mounted in the bore, said rotor having a diametric slot extending from one side to the other, and a blade slidably mounted in said slot with its outer edges substantially in contact with the wall of the bore, said blade comprising two aligned sections, the inner edges thereof being continuously substantially in contact.

2. In a rotary pump as claimed in claim 1, said sections being symmetrical, with their inner edges substantially midway of the walls of the bore.

3. In a rotary pump as claimed in claim 1, each of said sections having a portion of its inner edge extending inwardly materially beyond the center of the bore.

4. In a rotary pump, a casing having a bore and an inlet and an outlet, a rotor eccentrically and rotatably mounted in said bore, and a fluid impelling blade diametrically and slidably mounted in said rotor, said blade comprising two aligned sections, the inner edges of said sections being substantially in contact at all times, the radius of curvature of that portion of the bore lying at the ends of the diameter of the bore midway between the inlet and outlet being greater than elsewhere.

5. In a rotary pump as claimed in claim 4, the said radius being least at the ends of a cord of the bore passing diametrically through the rotor and at right angles to said diameter.

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