June 2, 1936. F. E. BRADY 2,042,499

ROTARY PUMP

Filed Sept. 15, 1933

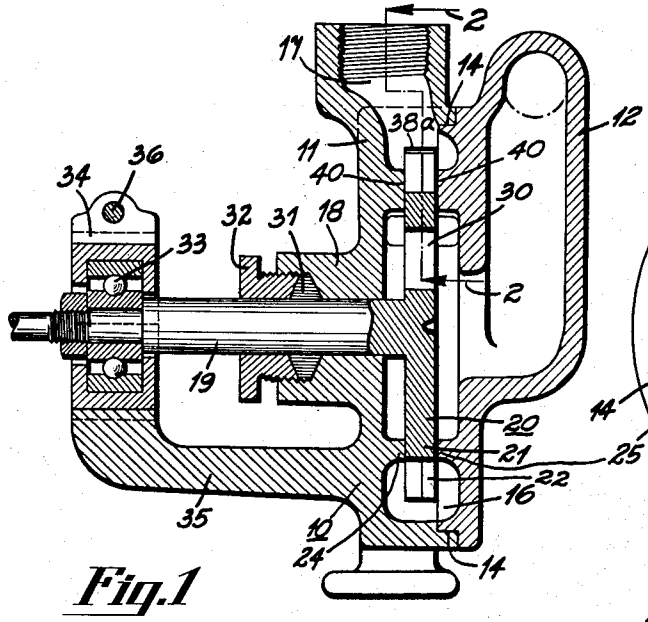


Fig.1

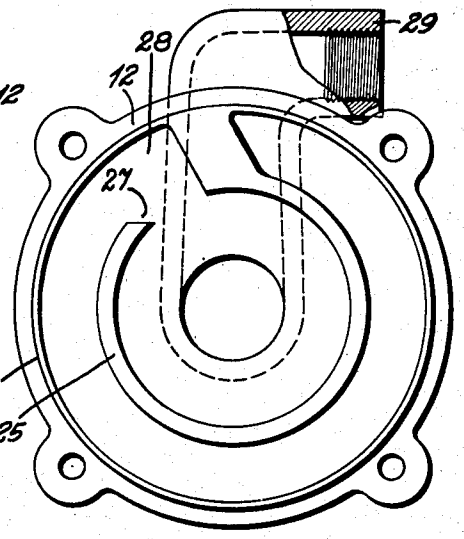


Fig.3

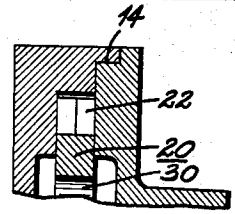


Fig.4

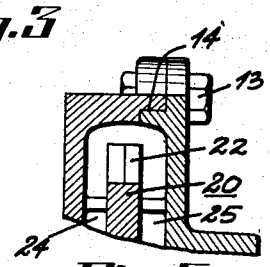


Fig.5

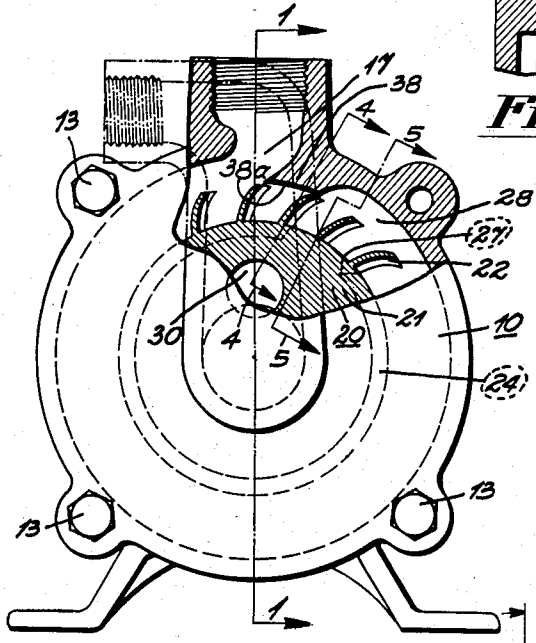


Fig.2

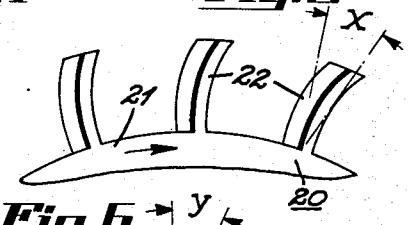


Fig.6

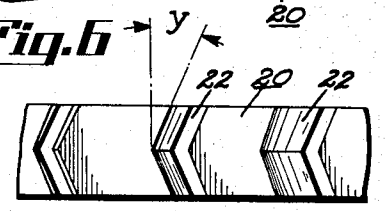


Fig.7

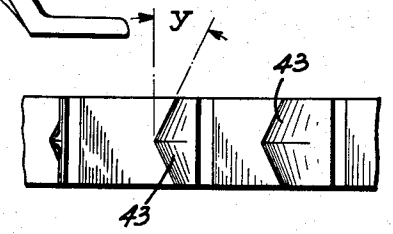


Fig.9

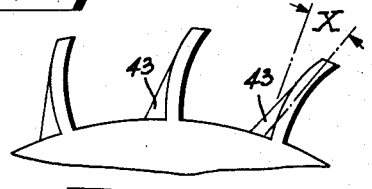


Fig.8

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ROTARY PUMP

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Application September 15, 1933, Serial No. 689,607

9 Claims. (Cl. 103—96)

This invention relates to pumps, and more particularly to pumps adapted for operation on liquids and embodying a rotor rotatable in a pump casing.

One object of the invention is the provision of a pump having a rotor, the blades of which operate in a concentric passage in the casing, the portions of the blades which effectively engage the liquid in the casing passage being so inclined as to produce an impelling force which is substantially in the direction of the passage.

Another object of the invention is the provision of a rotary pump having a novel form of blade on the rotor, and especially adapted for operation at very high pressures.

Another object of the invention is the provision of a rotary pump of the character mentioned, in which the fluid is supplied in an outward direction to the annular passage in the casing at a position closely adjacent the inner ends of the blades, which have forwardly inclined fluid engaging portions operable in the annular passage adapted to build up high pressures at the outlet side of the pump.

Other objects and advantages of the invention will be apparent from the following description, the appended claims and the accompanying drawing, in which

Fig. 1 is a central vertical section through a pump, embodying the present invention;

Fig. 2 is a side elevation of a pump shown partly in section on the line 2—2 of Fig. 1;

Fig. 3 is a side elevation of one of the pump casing sections;

Fig. 4 is a section on the line 4—4 of Fig. 2, taken through the restriction provided between the inlet and outlet ends of the annular passage;

Fig. 5 is a section on the line 5—5 of Fig. 2, taken through the inlet opening of the annular passage;

Fig. 6 is an enlarged side elevation of the rotor showing the forward inclination of the blades;

Fig. 7 is an end view of a portion of the rotor, illustrating the forward and lateral outward inclination of the blade sides;

Fig. 8 is a side elevation of a portion of a rotor having a modified form of blade construction; and

Fig. 9 is an end view of the rotor corresponding to Fig. 8.

Referring more particularly to the drawing by reference numerals, 10 designates generally a pump casing, embodying casing sections 11 and 12, secured together by means of bolts 13 and provided with suitable interfitting flanged faces 14. Each section of the casing is concentrically grooved so that they together provide an annular channel 16 extending to an outlet passage 17. This is preferably threaded in a suitable manner so that it may be readily connected to a discharge pipe.

Rotatably mounted in the hub portion 18 of the casing section 11 is a rotor shaft 19, which carries the rotor 20. The rotor embodies a disk like body portion 21 on which is arranged an annular series of blades 22 operating in the annular passage 16 of the pump casing. The blades 22 project outwardly from the cylindrical end of the body portion 21 of the rotor, which extends substantially to the inner side of the annular passage 16 as shown in Fig. 1.

On the casing section 11 is an annular rib 24 extending from the inlet end of the annular passage 16 and somewhat past the outlet opening 17. A similar rib 25 is provided on the casing section 12. The inner faces of the two ribs 24 and 25 are only very slightly spaced from the sides of the rotor body 21 and cooperate with the rotor body to prevent substantial flow of liquid from the annular passage 16 toward the center of the pump casing between the inlet and outlet ends of passage. The ribs 24 and 25, however, are interrupted as indicated at 27 in Fig. 3 to provide a passage leading from the central portion of the casing to the inlet end 28 of the passage 16. Water or other liquid to be pumped is supplied through the inlet pipe 29 and flows into the central portion of the casing, some of it passing through the several openings 30 in the rotor disk, the liquid then passing through the spaces or interruptions in the ribs 24 and 25 and into the passage 16, it being noted that the liquid is supplied to the passage 16 at a position closely adjacent the inner ends of the rotor blades.

Any substantial leakage of liquid along the rotor shaft 19 is prevented by packing 31. Beyond the packing nut 32 is preferably arranged an antifriction bearing 33, the inner race of which is secured to the rotor shaft while the outer race is held clamped in a strap 34, the two sides of the strap forming integral continuations of a bracket arm 35 provided on the side of the casing section 11. The split ends of the strap 34 are held together by a suitable bolt 36 in order to position the antifriction bearing in some definite position in which the rotor is centered in the casing However, when the bolt 36 is loosened the bearing cage may be moved endwise in the supporting bracket for adjustment of the position of the rotor with respect to the ribs 24 and 25 of the casing.

Between the inlet end 28 of the annular passage and the outlet opening 17, the casing is provided with a projection 38 which extends down so as to leave only clearance space between the ends of the blades and the cylindrically formed surface 38a at the end of the projection. The sides of the passage 16 are also restricted as indicated

at 40 adjacent this point, so that free flow of fluid from the end 28 of the annular passage directly to the outlet opening 17 is prevented.

The blades 22 of the rotor are so spaced as to produce a comparatively large impelling force in the direction of the length of the annular passage in order that very high pressures are produced at the pump outlet. It will be understood that the passage 16 and the internal inlet chamber of the pump casing are maintained full of the liquid being pumped as the liquid is drawn into the inlet and passes around the annular channel and is then discharged. The blades impact against the water or other liquid in the channel, the peripheral edge and side edge portions of the blades being effective in producing an impelling force productive of a circular movement of liquid toward the discharge opening.

As shown in Figs. 2, 6 and 7 in which a preferred form of the blade arrangement is presented, the blades incline forwardly as viewed from the side, at an angle of about 25 degrees to the radial line, this angle being indicated by the letter X in Fig. 6. The blades may be substantially straight, although they are preferably slightly curved so that the outermost ends of the blades furthest from the axis of rotation have a somewhat greater angle of inclination in the direction of rotation than those portions of the blades closer to the axis of rotation. This angle X is of the order of 25 degrees, and preferably does not exceed that particular value more than a few degrees, nor should it be substantially less than 18 degrees. It should be less than 30 degrees since greater angles of inclination would produce an impelling force on the liquid which would be in such a direction as to create losses of efficiency.

The blades are also preferably substantially V-shaped as viewed from the end, as shown in Fig. 7, the side portions of the blades being forwardly and laterally outwardly inclined from the blade centers at an angle also of the order of 25 degrees. This angle is represented in Fig. 7 by the letter Y, and should be less than 30 degrees, and may be somewhat less than the 25 degree figure referred to but preferably not substantially less than 18 degrees. The impelling force is an effective resultant of the centrifugal force radially outwardly and which tends to create an outflow of fluid substantially radially from the blade, and the force due to the impact of the water which is substantially normal to the forward surface of the blades. Thus with the blades inclined both forwardly and also so arranged that their sides extend laterally outwardly and forwardly from the blade center the impelling force produced both at the peripheral outer ends and the sides of the blades, all of which are in effective engagement with the body of water in the annular passage, produces an impelling force on the body of water in the passage which is substantially in the direction of the length of the passage. A high liquid head is therefore produced at the discharge end of the pump.

It will also be observed that with the blades arranged as shown in Figs. 6 and 7, the rear sides of the blades, at the side portions thereof, are sloped inwardly toward the center so as to reduce the obstruction to the flow of liquid toward an inner portion of a following blade. The manner in which the blades are inclined forwardly at the angle X as shown in Fig. 6 also assists the liquid in reaching an inner portion of a blade after passing the preceding blade. Thus substantially more than the very edges of the blades are effective in producing the impelling force on the annular body of liquid in the channel 16. This blade formation is also effective in ridding the pump of air, since any air present is trapped by the blades as they move downwardly and is carried around to the outlet passage.

Figs. 8 and 9 show a modified form of blade construction, the blades being forwardly inclined and preferably curved as viewed from the side and as will be apparent from Fig. 8. The forward inclination of the blades is at an angle X of the order of 25 degrees as previously defined. The forward side of these blades is, as shown, substantially straight across in a lateral direction as evident from Fig. 9, but the rear sides of the blades are filleted as indicated at 43; the sides of the fillet, and thus the rear sides of the blades, extending forwardly and laterally outwardly from the blade center at an angle Y, also of the order of 25 degrees as defined above, so that the water may flow smoothly after passing one blade toward an inner portion of a following blade. This arrangement increases the efficiency of the pump as it increases the impelling force and produces very high pressures at the discharge outlet.

The pump rotor is adapted to rotate at any suitable speed, and is capable of operating at extremely high speeds that may be as much as 3450 revolutions per minute or even higher. The forward inclination of the outer portions of the blades would have a tendency to resist an inflow of water into the annular channel 16 if the supply was directed inwardly toward the blades as is the case in a peripheral inflow passage, especially when the rotor is operating at extremely high speeds. In accordance with the preferred construction, however, as herein shown, the water flows outwardly into the annular channel 16 from an inner portion of the casing. The flow outward is such that the entrance of the water or other liquid being pumped is at a position adjacent the inner ends of the blades. The inner ends of the blades contact with the inflowing stream passing through the break of the annular ribs 24 and 25, and the impelling force here is in an outward direction due to the centrifugal force effect so that the blades even when operating at high speed do not have a blocking tendency against free entrance of the water into the channel 16. The pump is thus capable of operating at very high speeds to draw water or other liquid from one point and force it under a very high head. The varying rates of output are, of course, dependent upon the restriction offered in the discharge pipe, as the rotor can continue operating even if a flow of fluid is prevented from the pump.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In a rotary pump of the character described, a casing, a shaft rotatably mounted in said casing, said casing having a fluid passage extending concentrically with said shaft from an inlet to an outlet opening, a rotor on said shaft having an annular body, said casing having an annular rib closely adjacent the side of the rotor and cooperating closely with said body to prevent substantial flow of fluid inwardly from said passage

but interrupted to provide an inlet opening into one end of said passage from a central portion of the casing and at a position adjacent the inner ends of the blades, blades on said body adapted to operate in said passage, said blades being inclined forwardly in the direction of rotation at an angle of the order of 25 degrees and each having a rear side extending forwardly and laterally outwardly from the blade center at an angle of the order of 25 degrees to a radial plane through the shaft axis.

2. In a rotary pump of the character described, a casing, a shaft rotatably mounted in said casing, said casing having a fluid passage extending concentrically with said shaft from an inlet to an outlet opening, a rotor on said shaft having an annular body cooperating closely with said casing to prevent substantial flow of fluid inwardly from said passage between the inlet and outlet openings, blades on said body adapted to operate in said passage, said blades being substantially V-shaped as viewed from the end with an angle of the order of 130 degrees between the sides of the V, the blades also being inclined forwardly from the rotor body in the direction of rotation at an angle of the order of 25 degrees to a radial line.

3. A pump rotor adapted for operation in a concentric annular passage comprising a rotor body having blades extending outwardly from the peripheral portion thereof, said blades being substantially V-shape with an angle of the order of 130 degrees between the sides of the V, the blades also extending forwardly in the direction of rotor rotation at an angle of the order of 25 degrees from a radial line.

4. In a rotary pump of the character described, a casing having an annular passage, a rotor having blades operable in said passage, said blades inclining forwardly in the direction of rotation at an angle of the order of 25 degrees to a radial line and being exposed at both sides and at their peripheral ends to the fluid in said passage, each blade having a side portion inclined forwardly and outwardly, said casing having an annular rib closely adjacent each side of the rotor but interrupted to provide an inlet opening into an end of said passage from a central portion of the casing and at a position adjacent the inner ends of the blades, a supply passage extending to the central portion of said casing, and a discharge passage in said casing communicating with the discharge end of said annular passage.

5. In a rotary pump of the character described, a casing having an annular passage, a rotor having blades operable concentrically in said passage and exposed at both sides and at their peripheral ends to the fluid in said passage, said blades inclining forwardly in the direction of rotation and having sides inclining forwardly and outwardly, said casing having an annular rib closely adjacent a side of the rotor and cooperating with the rotor to seal the passage against flow of liquid toward the center of the casing but interrupted to provide an inlet opening into one end of said passage from a central portion of the casing and at a position adjacent the inner ends of the blades.

6. In a rotary pump of the character described, a casing having an annular passage a rotor having blades operable concentrically in said passage, said blades having forwardly and outwardly curved front faces and having side portions extending forwardly and laterally outwardly from the blade center, with the forward blade faces inclining forwardly in the direction of rotation at an angle of the order of 25 degrees to a radial line, said casing having an annular rib closely adjacent a side of the rotor and cooperating with the rotor to seal the passage against flow of liquid toward the center of the casing but interrupted to provide an inlet opening into one end of said passage from a central portion of the casing and at a position adjacent the inner ends of the blades.

7. In a rotary pump of the character described, a casing, a shaft rotatably mounted in said casing, said casing having a fluid passage extending concentrically with said shaft from an inlet to an outlet opening, a rotor on said shaft having an annular body cooperating closely with said casing to prevent substantial flow of fluid inwardly from said passage between the inlet and outlet openings, blades on said body adapted to operate in said passage said blades being inclined forwardly in the direction of rotation at an angle of the order of 25 degrees to a radial line and each blade extending laterally outwardly and forwardly to the side of the body at an angle of the order of 25 degrees to a radial plane through the shaft axis.

8. In a rotary pump of the character described, a casing, a shaft rotatably mounted in said casing, said casing having a fluid passage extending concentrically with said shaft from an inlet to an outlet opening, a rotor on said shaft having an annular body cooperating closely with said casing to prevent substantial flow of fluid inwardly from said passage between the inlet and outlet openings, blades on said body adapted to operate in said passage, each exposed at both sides and at its peripheral end to the fluid in said passage, and each being substantially V-shaped as viewed from the end with an angle of the order of 130 degrees between the sides of the V, the blades also being inclined forwardly from the rotor body in the direction of rotation at an angle of the order of 25 degrees to a radial line.

9. In a rotary pump of the character described, a casing, a shaft rotatably mounted in said casing, said casing having a fluid passage extending concentrically with said shaft from an inlet to an outlet opening, a rotor on said shaft having an annular body cooperating closely with said casing to prevent substantial flow of fluid inwardly from said passage between the inlet and outlet openings, blades on said body adapted to operate in said passage, the space between blades being substantially open from side to side of the rotor, said blades being substantially V-shaped and exposed at both sides and at their peripheral ends to the fluid in said passage, the peripheral ends of the blades being inclined forwardly in the direction of rotation and the side ends of the blades being inclined forwardly and outwardly with respect to a radial plane extending through the shaft axis so that a large impelling force is exerted on the fluid in said passage substantially in the direction of said passage along both sides and along the peripheral end of each blade.

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