June 2, 1942. J. R. BETTS 2,284,632

CENTRIFUGAL PUMP

Filed May 31, 1939

Fig. 2

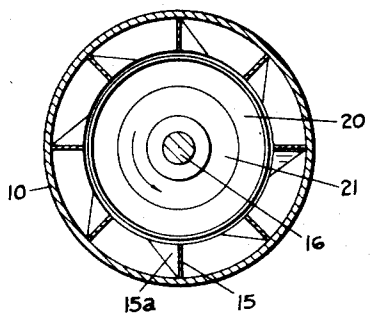


Fig. 4

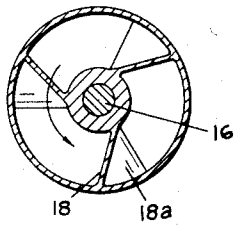


Fig. 5

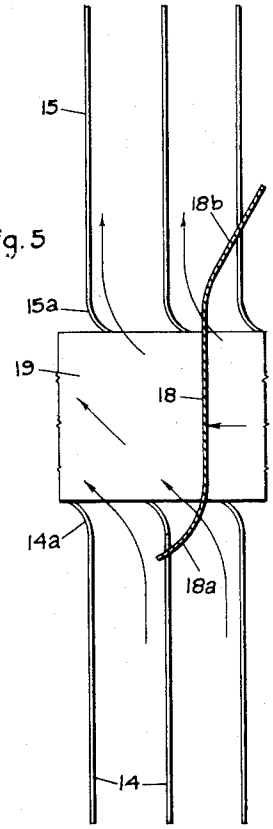


Fig. 3

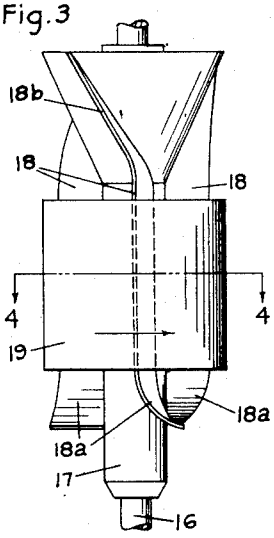


Fig. 1

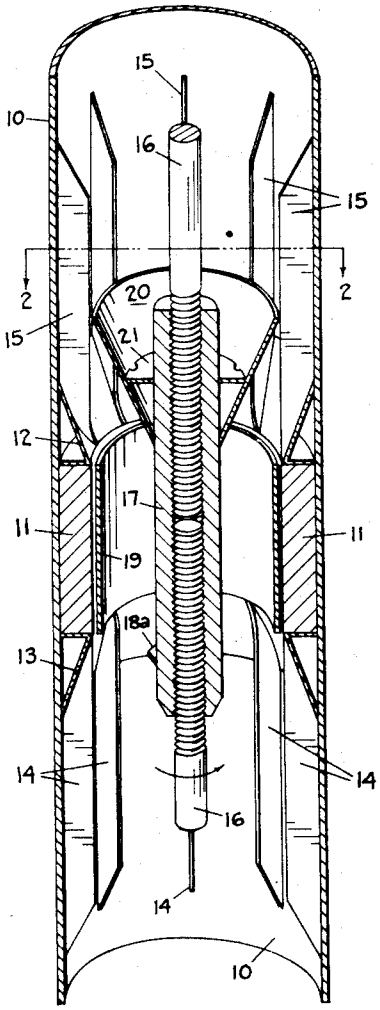


Fig. 6

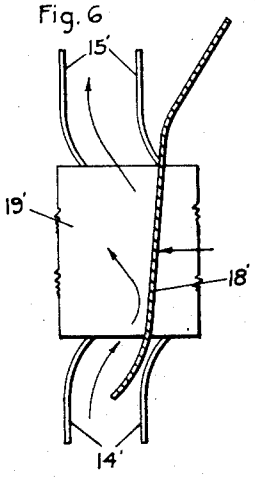
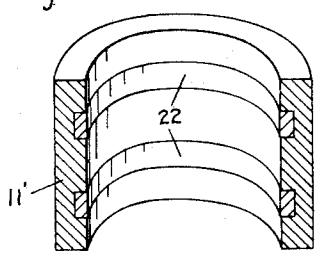


Fig. 7



INVENTOR.
John R. Betts
BY Emil F. Lange
ATTORNEY.

Patented June 2, 1942

2,284,632

UNITED STATES PATENT OFFICE

2,284,632

CENTRIFUGAL PUMP

John R. Betts, Aurora, Nebr.

Application May 31, 1939, Serial No. 276,657

8 Claims. (Cl. 103—90)

My invention relates to centrifugal pumps, one of the objects being the provision of a centrifugal pump which may be assembled or disassembled with the expenditure of the least amount of time and trouble.

Another object is the provision of a centrifugal pump including a rotor having a peripheral bearing inside the stator, each having a uniform diameter throughout its length whereby the rotor may be removed from the stator without the necessity of disassembling either the stator or the rotor.

Another object is the provision of a well casing having bearings fixed thereto on the inner side thereof at uniformly spaced intervals, and impellers assembled with lengths of shafting in a manner such that the impellers will be spaced the same distance apart as the distance between bearings whereby the impellers will all be seated in the bearings.

Another object is the provision of a centrifugal pump having a rotating shroud with an impeller secured to the shroud on the inner side thereof, the shroud having a peripheral bearing and water guiding blades above and below the bearing, the radial width of the blades and bearing being such that the shroud may be slidably withdrawn from or inserted into the well casing.

Another object is the provision of a rotary pump having an impeller with a peripheral bearing, and having an inverted hollow cone which functions during the operation of the pump as a deflector for the water currents and during the starting of the pump as a lubricator for the pump.

Another object is the provision of a rotary pump including an impeller having a peripheral bearing and an inverted cone above the bearing, the cone being adapted to hold water while the pump is stationary to be thrown out centrifugally at the beginning of the operation of the pump to drain down into and to lubricate the bearing.

Another object is the provision of a centrifugal pump having a bearing for a rotating shroud whereby the upward currents of water pass upwardly through the shroud, combined with blades on the inner surface of the well casing and forming channels for receiving the curvilinear streams of water from the shroud and causing it to travel upwardly in substantially straight channels.

Another object is the provision of a rapidly rotating shroud having a peripheral water lubricated bearing in a well casing whereby most of the water will pass upwardly through the shroud, combined with means below the bearing for importing an initial curvilinear impulse to the stream of water immediately on its entrance into the shroud, and a means above the shroud for straightening out the stream of water as it leaves the shroud.

Another object is the provision of an inverted cone above a water lubricated bearing of an impeller, a disc for bracing the cone and having one or more apertures in the disc for increasing the water carrying capacity of the cone while the pump is out of operation.

Having in view these objects and others which will be pointed out in the following description, I will now refer to the drawing, in which

Figure 1 is an oblique view of a vertical section of well casing with one of the pumping units.

Figure 2 is a view in horizontal section on the line 2—2 of Figure 1, looking in the direction of the arrows.

Figure 3 is an elevational view of the rotor.

Figure 4 is a view in horizontal section on the line 4—4 of Figure 3 looking in the direction of the arrows.

Figure 5 is a diagrammatic view showing the relation between the runner or impeller blades and the stator, the view showing the positions of the various parts as seen when looking outward from the inside and with portions of the rotor and stator flattened out.

Figure 6 is a view similar to Figure 5 but showing several slight modifications.

Figure 7 is an oblique sectional view showing a modified form of bearing for the shroud ring.

The pump casing is shown at 10, having an annular bearing 11 which is secured in place by means of two annular shelves 12 and 13. The blades 14 are secured to the pump casing below the shelf 13 to project inwardly, and the blades 15 are similarly secured to the well casing above the shelf 12, the blades 14 and 15 being secured also to the shelves 13 and 12 respectively. The casing 10, the bearing 11, the shelves 12 and 13, and the blades 14 and 15 together constitute the stator. Detailed description of these parts and their functions will follow.

Centrally positioned in the casing 10 is a shaft 16 in the form of sections joined together by means of couplings 17. These couplings have runner or impeller blades 18 secured thereto as best indicated in Figures 3 and 4. Surrounding the blades 18 is a shroud ring 19 which is also preferably secured to the blades 18. The shaft 16, the coupling 17, the blades 18, and the shroud ring 19 together constitute the rotor and they

are integral with each other in function and construction, except that the shaft 16 is releasable from the coupling 17.

The relation of the stationary guiding blades 14 and 15 is indicated diagrammatically in Figure 5, bearing in mind that the figure represents a fragment of the guiding blade assembly flattened out and as it appears when viewed from inside the casing and looking toward the rear. The guiding blades 14 are radial and vertical in their lower portion so that the movement of the water will be directly vertical throughout the straight portion of the guiding blades 14. The upper end portions of the blades are curved at 14a to guide the streams of water into the shroud ring 19 and to give these streams an initial whirling motion immediately before they enter the shroud ring. Just before the water enters the shroud ring, it is seized by the impeller blades 18 which are designed with scoops 18a for both lifting the water into the shroud ring and giving the water a tangential impulse, the blades 18 being in tangential relation to their axes of rotation. Within the shroud ring the blades 18 are straight and substantially vertical, thus causing neither upward nor downward pressure of the water. Since the streams of water are confined to move through the rotating shroud ring, the water must acquire the motion of the shroud ring, and since the shroud ring rotates at a very high rate of speed, the outward pressure of the water reaches explosive proportions by the time it passes out of the shroud ring. The outward throw of water by centrifugal force, at the top of the shroud, would create a vacuum inside of and at the top of the shroud, and causes a heavy suction on the water as it enters the shroud at the bottom and thus aid very materially in drawing the water into the pump casing. The blades 18 are "laid back" at 18b, and this, together with a sudden radial enlargement of the cylinder of rotation, relieves the excessive pressure by converting much of the outward component of the pressure into an upward component for lifting the water in the stationary conduits between the guiding blades 15. These blades are similar to the blades 14 but they are positioned reversely since their function is the opposite of that of the blades 14. They are curved at their lower extremities to form scoops 15a to seize the rapidly whirling streams of water and to change the direction of flow into the vertical.

In Figure 6 I show diagrammatically a structure which embodies several modifications. The blades 18' are similar to the blades 18 except that instead of being vertical, the intermediate portions of the blades 18' are slightly inclined in the general direction of the remainder of the blades. The blades 15' are similar to the blades 15 but the blades 14' differ from the blades 14 in the curvature of the upper portions of the blades. Whereas the upper portions of the blades 14 carry the stream of water in the curvilinear direction which is established by the impeller blades 18', the upper portions of the blades 14' hold the water streams against the blades 18', causing the streams to bounce off to change their direction of motion as shown in Figure 6.

As shown in Figure 1, a conical deflector 20 is secured in inverted position to the coupling 17 and is further secured and braced to the coupling by means of a perforated washer 21 to provide a secure connection and to prevent vibration. The outer surface of the cone 20 cooperates with the scoops 15a to direct the streams of water into the passageways between the guiding blades 15 but the cone has an additional and very important function. The only lubricant employed in the bearing is water which flows upwardly through the bearing while the pump is in operation. When the rotation of the rotor is stopped, the stopping will be gradual because of the inertia of a high speed rotor with its load of water. The water will run down in the conduits between the guiding blades 15 and much of it will flow into the cup formed by the cone 20. When the pump is not in operation, the cup will always be full of water. When the pump is again operated, the water in the cone 20 will be thrown out by centrifugal force into the conduits between the blades 15 whence it will flow down through the bearing to lubricate the pump. The lubrication of the pump will always be automatic.

Since the pump is designed for water lubrication, it is important that the bearing be made of a material for which water is a natural lubricant. The bearing 11 may be made of lignumvitae or of impregnated hard maple or of a similar material. In Figure 7 I show a modified form of bearing 11' made of steel or other suitable metal and adapted to be secured between shelves similar to the shelves 12 and 13. The bearing 11' is provided with one or more annular grooves for the reception of rings 22 of hard rubber or other material suitable for water lubrication.

The pump is designed for sectional installation and use, the overall length depending on the depth to water and the length of the sections depending largely on air pressure at the site. Ordinarily the length of the section will be from 8 to 10 feet but they may be either longer or shorter within a wide range of lengths. For obvious reasons, the distances between the bearings 11 must be equal to the distances between the shroud rings 19 and these distances should be uniform throughout the length of the assembled pump.

The arrangement has great advantage in the manufacture of the pump, in transportation and in installation. The pump casing 10 with its uniformly spaced bearings 11 may be sectional, the sections to be assembled on the job by any of the various methods familiar to those skilled in installing pumps. The rotor with its shafting is then lowered into the pump casing, the sections being secured together through the couplings 17. The rotors are all uniform and integral in construction so that the workman may select any of the rotors without rummaging through the stock to find a particular rotor. The rotor is secured to the shaft and is then lowered until the next above rotor must be connected to the shafting. The work proceeds until the desired depth has been reached, at which time the registration of a bearing 11 and a shroud ring 19 may be checked. If one bearing registers with a shroud ring, similar relation exists throughout the length of the pump. It should be here noted that the radial width of the guiding blades 14 and 15 is such that the inner edges of these blades are in alignment with the inner surface of the bearing 11 so that all parts of the rotor may pass into and through the bearing and the guiding blades. The upper ends of the guiding blades are bevelled as shown in Figure 1 to facilitate the centering of the rotor when it is being lowered in the well casing. The lower ends of the blades 14 are similarly bevelled to facil-

itate the lifting out of the rotor and shaft assembly when making repairs.

Having thus described my invention in such full, clear, and exact terms that its construction and operation will be readily understood by others skilled in the art to which it pertains, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A pump including a well casing having a water lubricated bearing secured to the inner side thereof, an impeller adapted to rotate at high speed within said bearing, said impeller including a cylindrical casing and a plurality of vertical impeller blades secured therein, each of said blades being curved abruptly at its lower end portion in the direction of rotation of said impeller for impelling the water into the said impeller.

2. A pump including a well casing having a water lubricated bearing secured to the inner side thereof, an impeller adapted to rotate at high speed within said bearing, said impeller including a cylindrical casing and a plurality of impeller blades secured therein, each of said blades being curved abruptly at its lower end portion in the direction of rotation of said impeller for impelling the water into the said impeller and being curved gradually at its upper end portion away from the direction of rotation to relieve the centrifugal pressure as the water passes upwardly out of said casing.

3. In combination, a rotatable impeller having a water lubricated bearing and means positioned above said impeller and rotatable therewith for retaining the water during the stopping of said impeller and for centrifugally discharging the water in starting the impeller whereby the water will flow downwardly to lubricate said bearing.

4. A pump including a well casing having a water lubricated bearing secured to the inner side thereof, an impeller including a cylindrical casing having a plurality of impeller blades therewithin, said impeller being journalled in said bearing, stationary means above said bearing for guiding the upward flow of water above said bearing, and means including a cone shaped deflector disposed above said impeller and rotatable therewith, the lowermost point of said cone shaped deflector being immediately above the upper end of said cylindrical impeller casing, said means including said cone shaped deflector acting to direct the water upwardly and outwardly from the projected cylinder of rotation of said impeller into cooperative relation with said guiding means.

5. A pump including a well casing having a bearing secured to the inner side thereof, an impeller adapted to rotate at high speed within said bearing, said impeller including a cylindrical casing and a plurality of impeller blades and an inverted cone secured thereto, each of said blades being curved abruptly at its lower end portion in the direction of rotation of said impeller for impelling the water into said impeller and being curved gradually at its upper end portion away from the direction of rotation to relieve the centrifugal pressure as the water passes upwardly out of said casing, said cone functioning to direct the stream of water outwardly as the water is discharged from said cylindrical casing.

6. A pump including a casing of uniform diameter, a fixed bearing of uniform inside diameter in said casing and reducing the diameter of the water passage through said casing, an impeller of uniform outside diameter rotatable in said bearing, means for rotating said impeller at high speed in a direction such as to cause said impeller to force the water upwardly through said casing, and relatively long flat blades secured to said casing above said impeller and projecting vertically upwardly from said bearing for conducting the water from said impeller vertically upwardly through channels of larger radius than the radius of the impeller, said blades having their lower end portions curved opposite to the direction of the rotation of said impeller.

7. A pump including a casing having a water lubricated bearing secured to the inner side thereof and an impeller adapted to rotate at high speed within said bearing, said impeller including a cylindrical casing and means positioned above said impeller and rotatable therewith for deflecting the water leaving said impeller casing, for returning water during the stopping of said impeller, and for centrifugally discharging the water in starting the impeller whereby the water will flow downwardly to lubricate said bearing.

8. A pump including a casing, a rotatable impeller for carrying a stream of water upwardly through said casing, a water lubricated bearing surrounding said impeller and of less internal diameter than said casing, and a hollow, inverted cone shaped deflector above said impeller and rotatable therewith, said deflector being adapted to direct the water upwardly and outwardly from the projected cylinder of rotation of said impeller, and said deflector further serving to retain the water during the stopping of said impeller and to centrifugally discharge the water in starting the impeller whereby the water will flow downwardly to lubricate the bearing.

JOHN R. BETTS.