D. W. BLAIR.

CENTRIFUGAL PUMP.

APPLICATION FILED OCT 2, 1909.

976,340. **Patented Nov. 22, 1910.**

Fig. 4.

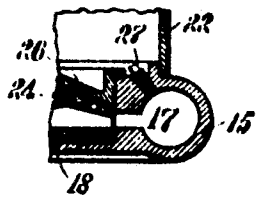


Fig. 3.

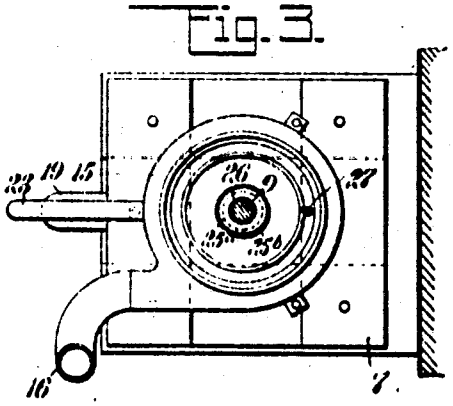


Fig. 2.

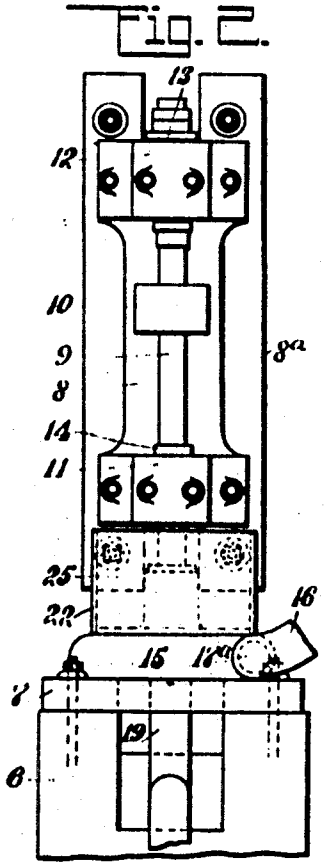
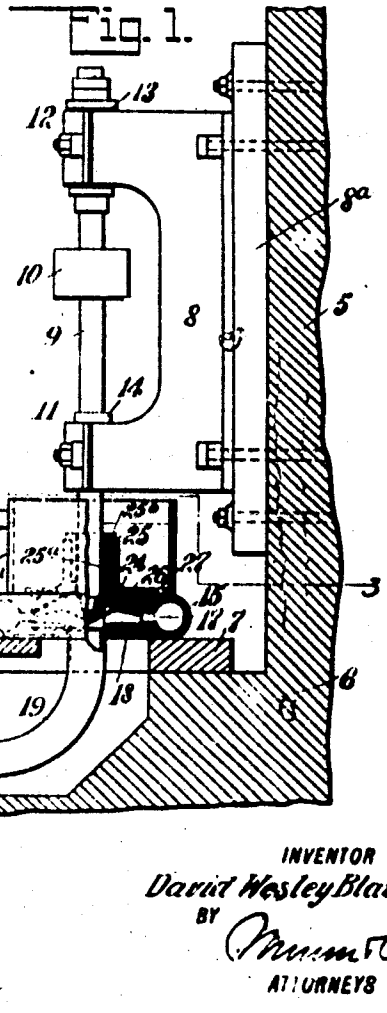
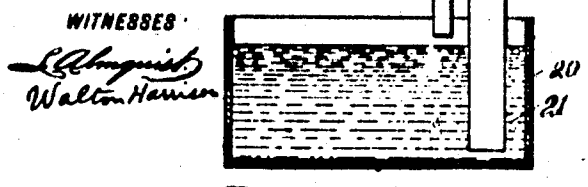


Fig. 1.





WITNESSES:

L. A. Hungerford

Walter Harrison

INVENTOR

David Wesley Blair

BY

Munn & Co

ATTORNEYS

UNITED STATES PATENT OFFICE.

DAVID WESLEY BLAIR, OF NEW YORK, N. Y.

CENTRIFUGAL PUMP.

976,340. Specification of Letters Patent. Patented Nov. 22, 1910.

Application filed October 2, 1909. Serial No. 520,623.

To all whom it may concern:

Be it known that I, DAVID WESLEY BLAIR, a citizen of the United States, and a resident of the city of New York, borough of Manhattan, in the county and State of New York, have invented a new and Improved Centrifugal Pump, of which the following is a full, clear, and exact description.

My invention relates to centrifugal pumps, and more particularly to the provision of a so-called liquid packing for certain movable parts thereof, my special purpose being to enable the centrifugal action of the pump to oppose or overbalance the tendency of a liquid to escape between a stationary part and a revoluble part, and thereby prevent an escape of liquid which might otherwise take place owing to the looseness of the revoluble part relatively to the fixed part.

While my invention is adapted for general use in connection with centrifugal pumps and analogous devices, it is of peculiar value in connection with centrifugal pumps used for handling acids and other corrosive liquids, such, for instance, as are employed in sulfite works.

My invention further comprehends means for forming and using the liquid packing in a plurality of different ways, depending upon the back pressure of a column of liquid forced out by the pump, and also upon the speed of the impeller.

Stated more specifically, my invention comprehends a centrifugal pump provided with a stationary casing and a rotary impeller mounted within said casing, and a stationary sleeve mounted rigidly upon the casing and extending upwardly therefrom, so as to encircle the impeller shaft, and means for manipulating the flow of the liquid generated upon, so as to oppose the tendency of the liquid to escape under pressure by conferring upon it a countertendency to escape in the opposite direction because of centrifugal force imparted to it.

Reference is to be had to the accompanying drawings forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 is a view partly in side elevation and partly in section, showing the centrifugal pump, the supply pipe leading to it, and the discharge pipe leading away from it, this view further showing the impeller, the revoluble shaft carrying the same, and the stationary sleeve encircling the shaft; Fig. 2 is an elevation of the parts appearing in Fig. 1; Fig. 3 is a substantially horizontal section on the line 3—3 of Fig. 1, looking in the direction of the arrow, and showing particularly the outside construction of the pump; and Fig. 4 is a detail showing in cross section the removable plug for controlling the discharge of a liquid from the pump casing, for the purpose of forming or modifying the liquid packing.

Connected with a wall 5 is a step 6, and resting upon the latter is a base plate 7. A hanger 8, mounted upon a plate 8^a, is connected rigidly with the wall 5. A revoluble shaft 9, carrying a pulley 10, is journaled in bearings 11, 12, carried by the hanger 8.

At 13, 14 are collars rigidly mounted upon the shaft 9 and serving to support the latter.

At 15 is the pump casing having generally the proximate form of an endless tube or cylinder. This casing rests directly upon the plate 7.

Connected directly with the casing and extending upwardly therefrom is a discharge pipe 16. The casing is provided with a slot 17 having a general annular form, and merging into an annular bore 17^a, and the casing is further provided with a disk-like bottom 18, connected centrally with which is a supply pipe 19. This pipe extends downwardly into a tank 20 containing the liquid 21 to be raised by the pump.

Mounted upon the casing 15 is a tank 22, and connected with the latter and leading downwardly therefrom to the tank 20 is an overflow pipe 23. Located within the casing 15 is an impeller 24 which is mounted securely upon the revoluble shaft 9. Encircling this shaft is a cylindrical sleeve 25 provided at its bottom with a bell-shaped portion 26 which partially encircles the impeller. The cylindrical sleeve 25 and the bell-shaped portion 26 are essentially parts of the casing, and my purpose is to form a liquid seal between these parts and the revoluble members they inclose. The impeller and its shaft fit loosely within the bell-shaped portion 26 of the cylinder 25, so as to leave a space encircling the lower end of the shaft and the upper portion of the impeller, this space extending from the slot 17 to the open air, as will be understood from Fig. 1. The cylinder 25, the impeller 24 and the shaft 9, are made of lead antimony alloy, or otherwise rendered acid-proof. A

collar 25^a, of bronze, copper, or other suitable material, is detachably fitted into the upper end of the cylinder 25, and is provided with an annular shoulder 25^b for holding it accurately in position. This collar 25^a is especially adapted to stand wear in connection with acid. That is to say, the impeller 24 and sleeve 25, because of the material of which they are made, are capable of withstanding corrosion from the acid used, but when subjected to the action of the acid, they are incapable of standing much wear due to the rotation of the shaft. The collar 25^a, because of its material, is capable of withstanding considerable wear, even when subjected to the action of acid. I find, therefore, that the collar 25^a is exceedingly useful in reducing the total amount of destruction taking place at this point in the mechanism. I find, moreover, that as a consequence I can, by aid of the collar 25^a, so reduce the space between this collar and the shaft 9 as to greatly cut down the tendency of air to enter between the cylinder and the shaft at times when otherwise there might be more or less tendency for the apparatus to induct such air. The reduced annular space around the shaft, rendered practicable by the use of the collar 25^a, also reduces the amount of energy lost or wasted in moving the liquid through this annular space, incidental to the circulation of the liquid, as elsewhere described.

Removably mounted in the casing 15 is a plug 27 which constitutes a closure member. When this plug is removed, the tank 22 is in free communication with the casing 15 through the hole normally occupied by the plug.

Where acids, or other corrosive liquids, are to be pumped, the various parts exposed directly to the liquid should be made of acidproof material. It will be understood, of course, that in handling acids and other corrosive liquids, it is impracticable to maintain any ordinary packing in a pump and it is partly upon this account that I desire to form a liquid packing in the pump above described.

The operation of my device is as follows: The parts being assembled as indicated in Figs. 1 and 2, and the shaft 9 being turned by aid of the pulley 10, the impeller 24, rotating with the shaft, creates a partial vacuum in the middle portion of the casing 15 and thereby causes the liquid 21 to travel upwardly through the supply pipe 19 and through the impeller 24 and casing 15, out into the discharge pipe 16 whereby it may be raised to a considerable height. Suppose, now, that the discharge pipe 16 is quite short, and that the shaft 9 is running at a high speed. The liquid being thus acted upon quite energetically by the impeller, is forced violently outward through the discharge pipe 16. The back pressure due to the head of liquid in the discharge pipe being quite small, the travel of all the liquid in contact with the impeller is outward through the slot 17. It is true that the back pressure of the liquid in the discharge pipe 16 has some tendency to force a portion of the liquid up through the space between the sleeve 25 and the shaft 9, but this tendency is outweighed by the centrifugal motion of the liquid within, and in contact with, the impeller. Hence, no liquid rises in the cylindrical sleeve 25. If, however, the plug 27 be now removed, a portion of the liquid in the casing 16 makes its escape through the hole previously occupied by the plug. The liquid thus escaping passes upwardly into the tank 22 and nearly fills the same, so as to cause an overflow to take place through the overflow pipe 23. Since the level of the liquid in the tank 22 (being controllable by the position of the overflow pipe 23) is higher than the upper end of the sleeve 25, a portion of the liquid finds its way downwardly between the sleeve 25 and the shaft 9. The centrifugal motion of the impeller draws this portion of liquid downward and thus establishes and maintains continuously a circulation through the sleeve 25. That is to say, liquid is constantly passing upwardly through the hole normally occupied by the screw plug 27 and into the tank 22, thence downwardly through the sleeve 25 and below the bell-shaped portion 26 and slot 17 to the point whence it started. The shaft 9 is thus effectively packed and sealed by a portion of the liquid, and to all intents and purposes is rendered air-tight in so far as the escape of liquid is concerned. Suppose, however, that the discharge pipe 16 extends upwardly a considerable distance, and that the head of liquid contained in it is considerable. In this event the rotary motion of the impeller is slower than usual, owing to the superposed pressure of liquid in the discharge pipe 16. The back pressure of this liquid tends to force a small portion of the liquid up around the shaft 9, and if this pressure exceeds a certain limit (which is varied by the speed of the impeller), the liquid tends, notwithstanding the centrifugal force affecting it, to rise up around the shaft 9 and to overflow from the top of the sleeve 25. In this event it is desirable to insert the plug 27, thereby cutting off direct communication from the tank 22 to the casing 15. This being done, the liquid now escapes from the top of the sleeve 25 and, nearly filling the tank 22, overflows through the pipe 23.

Under ideal conditions, the back pressure in the discharge pipe 16 may be so balanced relatively to the speed of rotation of the impeller 24, that a very small volume of liquid finds its way either upward or down-

ward, as the case may be, around the shaft 9, and the waste of power necessary to form the liquid packing and to cause the same to seal, is negligible. As a general rule, the greater the speed of the impeller, the greater may be the height of the discharge pipe 16, and consequently, the greater may be the pressure of the liquid discharged through this discharge pipe, the waste of liquid through the sleeve 25 being maintained at a minimum.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. The combination of a casing provided with a cylindrical member, an impeller revolubly mounted within said casing, a shaft fitting loosely into said cylindrical member and connected with said impeller for the purpose of turning the latter, a fluid receptacle encircling said shaft and said cylindrical member for the purpose of storing a quantity of fluid discharged from said casing by aid of movements of said impeller, and means controllable at will for governing the flow of said fluid from said casing into the said receptacle in order to enable said fluid to form a liquid seal between said cylindrical member and said shaft.

2. In a centrifugal pump, the combination of a casing, an impeller mounted therein, a shaft extending into said casing and connected with said impeller for turning the latter, a receptacle mounted upon said casing and adapted to hold a small quantity of liquid discharged from said casing while said pump is in action, said liquid thus stored encircling said shaft where it enters said pump, forming a liquid seal for preventing the escape of liquid around said shaft, and an overflow pipe connected with said receptacle for removing excess of liquid contained within the same.

3. The combination of a pump casing provided with an opening and further provided with a member of substantially cylindrical form, an impeller mounted within said casing and adapted when in action to raise a liquid, and also to discharge a small quantity of said liquid through said opening, a shaft fitting loosely into said substantially cylindrical member and connected with said impeller for the purpose of turning the latter, a receptacle mounted upon said casing and connected with said opening for the purpose of receiving from said opening the fluid discharged therefrom, said receptacle extending upwardly to a greater altitude than the top of said member of substantially cylindrical form for guiding said liquid contained within said receptacle into the space between said member of substantially cylindrical form and said shaft in order to form a liquid seal.

4. The combination of a pump casing provided with an opening, a closure plug detachably fitting into said opening and removable therefrom at the will of the operator, a supply pipe and a discharge pipe connected with said casing, an impeller mounted within said casing and adapted to receive a liquid from said supply pipe and to force the bulk of said liquid into said discharge pipe, a receptacle mounted upon said casing and adapted to receive therefrom a small quantity of liquid discharged through said opening, a shaft extending into said casing and connected with said impeller for the purpose of turning the latter, and means for enabling said quantity of liquid contained in said receptacle to form a liquid seal between said shaft and said casing.

5. The combination of a casing provided with an opening and further provided with a substantially cylindrical portion, an impeller mounted within said casing, a shaft extending through said cylindrical portion and connected with said impeller for turning the latter, a discharge pipe, and a supply pipe connected with said casing, a receptacle disposed adjacent to said cylindrical portion and in direct open communication with the interior of said casing, and means controllable at will for reversing the direction of travel of a liquid flowing between said shaft and said cylindrical portion.

6. The combination of a casing, an impeller mounted therein, a receptacle disposed adjacent to said casing and in communication therewith by two paths, for the purpose of permitting interchange of a liquid between said casing and said receptacle, and means controllable at will for closing one of said paths in order to reverse the direction of travel of said liquid.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

DAVID WESLEY BLAIR.

Witnesses:

WALTON HARRISON,

PHILIP D. ROLLHAUS.