No. 832,651. PATENTED OCT. 9, 1906.

W. I. BETTIS.

CENTRIFUGAL PUMP.

APPLICATION FILED FEB. 13, 1905.

2 SHEETS—SHEET 1.

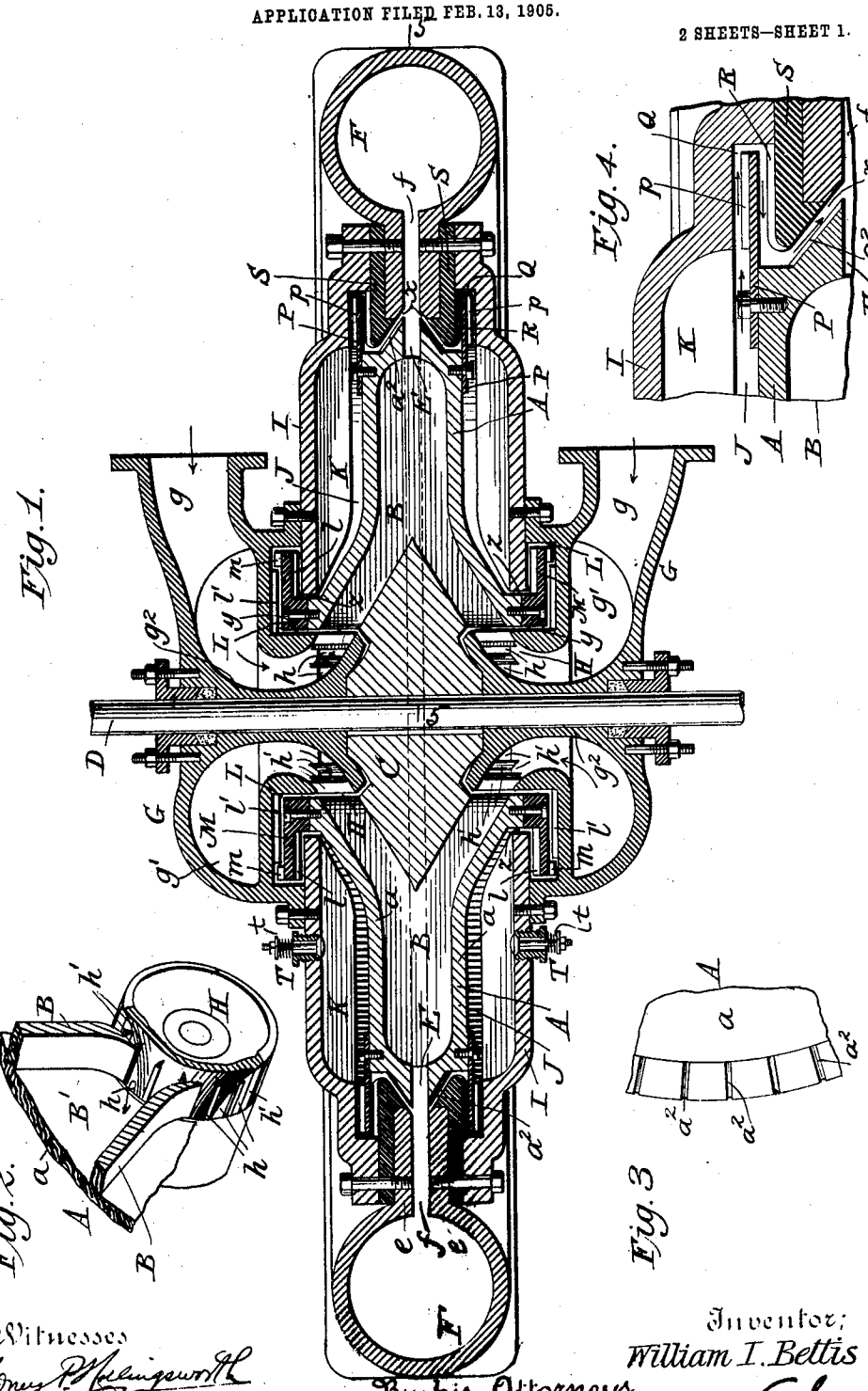


Fig. 1.

Fig. 4.

Fig. 2.

Fig. 3

Witnesses

Sidney P. Hollingsworth

Kate F. Leary

Inventor;

William I. Bettis

By his Attorneys

Baldwin & Wright.

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2 SHEETS—SHEET 2.

Fig. 5.

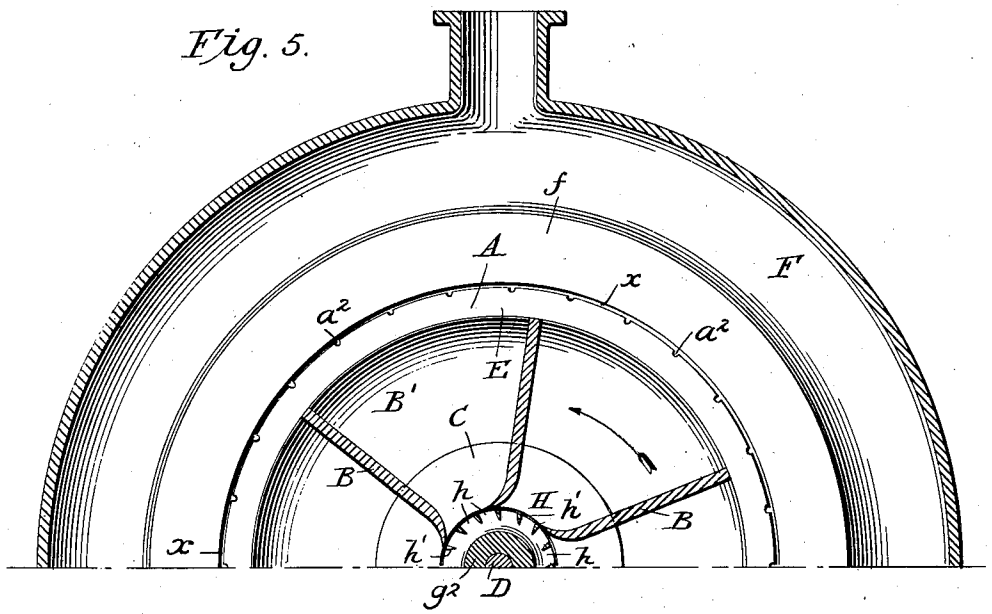


Fig. 6.

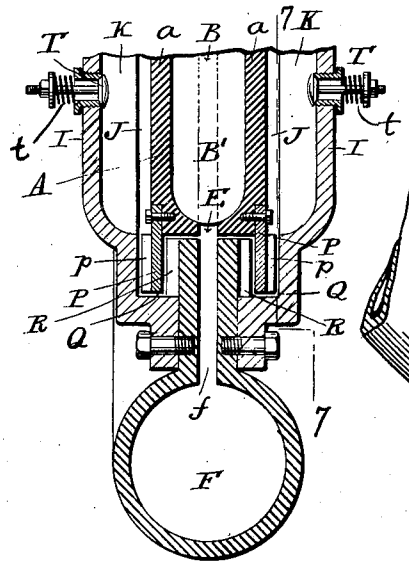
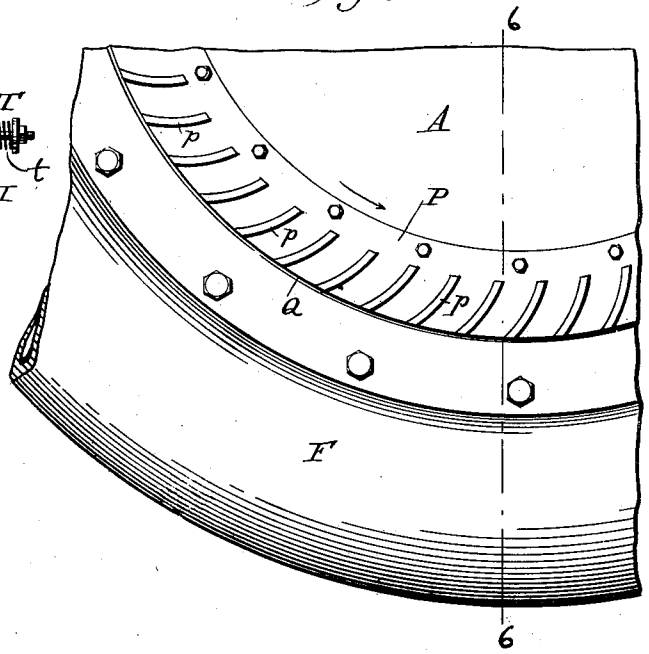


Fig. 7.



Witnesses

Sidney P. Hollingsworth

Kate F. Gary

Inventor

William I. Bettis;

By his Attorneys

Baldwin & Wright

UNITED STATES PATENT OFFICE.

WILLIAM IRVIN BETTIS, OF HOUSTON, TEXAS, ASSIGNOR OF ONE-HALF TO HUGH HAMILTON, OF HOUSTON, TEXAS.

CENTRIFUGAL PUMP.

No. 832,651. Specification of Letters Patent. Patented Oct. 9, 1906.

Application filed February 13, 1905. Serial No. 245,517.

To all whom it may concern:

Be it known that I, WILLIAM IRVIN BETTIS, a citizen of the United States, residing at Houston, in the county of Harris and State of Texas, have invented certain new and useful Improvements in Centrifugal Pumps, of which the following is a specification.

My invention relates to centrifugal pumps of the class in which a rotary impeller having a fluid-entrance at the eye empties into a surrounding discharge-chamber.

In my application for patent, Serial No. 241,666, filed January 18, 1905, I have shown a centrifugal pump of this general class in which an incased impeller composed of side disks and intervening substantially radial vanes receives fluid at the eye and discharges it into a surrounding volute or annular chamber which communicates with chambers formed in a fixed casing inclosing the incased impeller.

One of the features of novelty of the pumps shown in my aforesaid application is the provision of means for removing the fluid from and producing and maintaining a vacuum in the chambers of the inclosing casing, whereby the impeller is relieved of the side pressure and friction incident to other pumps of this class.

In my prior application the pump is shown as so constructed as not only to empty the side chambers of the fluid used in priming, but the periphery of the impeller is so formed as to cause any fluid that might tend to flow into the side chambers from the discharge-chamber while the pump is in operation to be thrown back to the discharge-chamber by centrifugal force.

According to my present invention I provide the impeller with vanes arranged outside the periphery of the impeller-vanes and working in annular chambers interposed between the discharge chamber and the side chambers of the pump and which operate not only to empty said side chambers, but also to produce a centrifugal force greater than that produced by the main or usual vanes of the impeller and prevent fluid from reëntering said side chambers.

Other features of invention used in connection with those above outlined will be hereinafter pointed out.

In the accompanying drawings, Figure 1 shows a horizontal central section of a centrifugal pump embodying my present improvements. Fig. 2 is a detail view in perspective, illustrating the relation between the vanes of the impeller and the stationary or inlet vanes through which the fluid passes from the supply-passage to the impeller. Fig. 3 is a detail view of a portion of the rim or periphery of the impeller constructed in the form shown in Fig. 1. Fig. 4 is a detail view, in section and on an enlarged scale, of the devices constructed in accordance with my present invention to empty the side chambers of the pump and prevent fluid from reëntering them. Fig. 5 shows a vertical section on the line 5 5 of Fig. 1. Fig. 6 shows a vertical transverse section of a portion of a pump embodying my improvements with some of the parts constructed differently from those shown in Fig. 1. Fig. 7 shows a vertical section on the line 7 7 of Fig. 6.

Many parts of the pump shown in the drawings are similar to those shown in my prior application; but for clearness the general construction and arrangement of the pumps shown will be described, as well as the special parts embodying my present improvements.

The impeller A (shown in Fig. 1) is composed of two side plates or disks *a*, arranged a suitable distance apart and connected by intervening vanes B, which divide the space between the disks into a series of chambers B′, through which the fluid passes. The vanes are connected with a centrally-arranged hub C, fast on the driving-shaft D. The outer edges of the disks are arranged a suitable distance apart to form a contracted annular discharge orifice or throat E, which runs close to the throat *f* of corresponding width in the volute or annular discharge-chamber F. In the pump having a double supply, as illustrated in Fig. 1, the vanes B are branched or bifurcated and extend inwardly on opposite sides of the hub C. The outer portions of the chambers B′ are of approximately the same width from the edge of the hub C to the throat E, the inner sides of the disks being nearly parallel until they approach close to the throat, where the sides are curved or tapered toward the throat. In this way the chambers are made wide just inside the throat, and a pressure is produced at the throat, while the radial velocity of the fluid is greatly reduced.

As the velocity of the fluid within the impeller is reduced at the outer portion of the impeller-chambers the friction of the fluid on the walls of the impeller-chambers is materially reduced, and thus the efficiency of the pump is enhanced.

The fluid enters the impeller through the supply-passages at opposite sides thereof. These passages on each side are formed in a casing G, provided with an entrance-port *g*, which communicates with a chamber *g'*, surrounding the driving-shaft D and having a hub g^2 extending within the plane of the impeller and beyond the inner edges of the impeller-vanes to the hub C. The fluid which enters at *g* passes into the annular chamber *g'* and is directed into the impeller in such manner as to partake of the direction of movement of the impeller and to be delivered at the general angle in which the impeller-vanes are arranged. In this way the loss of energy due to shock of entrance is avoided or at any rate very materially reduced.

In the drawings I have shown a series of inlet-vanes H in the supply-passages at the inner ends of the impeller-vanes, which is so constructed as to reduce the area of the entrance-port, and consequently increase the initial velocity of the fluid. The construction is also such as to change the direction of flow of the fluid to the impeller in the manner before stated, and thus reduce or obviate entirely the loss of energy due to the shock of entrance. The form of the inlet-vanes is clearly indicated in Fig. 2, where, as will be seen, the casing G is provided with an annular series of openings *h*, through which the fluid passes, these openings being separated by vanes *h'*, which are properly inclined to direct the fluid in the proper direction in the manner before described. The construction of the casings of the entrance-passages and of the vanes on opposite sides of the pump are precisely the same.

The impeller is inclosed in a fixed casing consisting of two annular frame-pieces or sections I on opposite sides of the impeller. At their periphery the casing-sections are bolted to the flanges *e* of the volute or annular discharge-chamber F; but between these flanges and the plates are interposed rings S for a purpose hereinafter described. In Fig. 1 I have shown the periphery of the impeller as tapered in the manner described in my prior application, and I have also shown the tapered periphery as formed with radial grooves a^2.

The edges of the casing-sections are inclined or tapered correspondingly with the tapered periphery of the impeller, being parallel therewith, but arranged a short distance therefrom, leaving a clear but narrow space for the passage of fluid from the chambers J of the fixed casing to the discharge-chamber F.

The chambers J of the casing are annular and in Fig. 1 are on opposite sides of the impeller. They communicate with the throat E and also the throat *f* at the periphery of the impeller through the narrow annular passages *x*, above referred to. The casing-sections carry radially-arranged ribs K, which are for the purpose of preventing a rotary movement of the fluid within the chamber J when the pump is first started.

In Fig. 1 I have shown an impeller formed with a tapered periphery, and this, as described in my prior application, operates to throw back by centrifugal force any fluid that may tend to pass from the discharge-chamber to the side chambers of the pump; but in lieu of this construction (see Fig. 6) or as supplementary to it, as shown in Fig. 1, I provide the following devices: To opposite sides of the impeller near its periphery are secured flat rings or annular plates P, each of which projects outward beyond the periphery of the impeller and carries a series of substantially radial vanes *p*, which are preferably curved in the manner shown in Fig. 7. These vanes rotate in paths outside the path described by the outer edges of the vanes B of the impeller, and thus generate a greater centrifugal force than the vanes B.

The rings P and their vanes *p* operate in annular chambers Q, formed in the fixed casing-sections I around the chambers J, and they communicate with the discharge-chamber F through the passages *x* and *f*. The vanes *p* of each plate are arranged close to one wall of the chamber Q, and the opposite wall of each chamber Q is provided with stationary radial ribs R. Preferably the ribs R are formed on rings S, which are interposed between the flanges *e* of the discharge-chamber and the casing-sections I, as by this construction the parts may be more easily assembled.

To avoid any possibility of leakage at the eye, the casing G on each side of the pump is formed with an annular chamber L, within which is arranged an annular plate or ring M, bolted to the impeller and rotating therewith. The annular plate extends into the chamber L beyond the inner edges of the casing-section, and it is formed with radial ribs *l*, arranged close to, without touching, the outer side of the casing-section next the chamber L. The casing G within the annular chamber L is formed with stationary radial ribs *l'*, lying close to the outer face of the plate M. These ribs terminate a short distance from the outer wall of the chamber L and are overlapped by small radial ribs *m* on the plate M. Any fluid which may leak at the joint *y* will pass into the chamber L and will tend to pass around the outer edge of the plate M and into the chamber J through the joint *z*. This is the only way by which the fluid can enter the chamber J; but this is prevented in the fol-

lowing way: As the impeller rotates, any fluid which may pass out of the joint *y* and into the chamber L will be thrown outward by centrifugal force and carried around at the outer end of the chamber L, and this centrifugal force is such that no fluid will pass down into the joint *z*. In this way a rotary fluid seal is formed which will absolutely prevent any fluid entering at the eye of the pump from passing into the chambers of the casing.

It might happen that if a complete vacuum is formed in the chambers J the fluid would tend to enter them, and it may be desirable to admit air to the chambers to displace fluid after the fluid has been withdrawn therefrom and after the pressure in the chambers has been reduced to a predetermined amount. For this purpose I provide each chamber with a loaded valve T, of any suitable construction, which is so constructed that normally it will be held closed, but after the pressure within the chambers has been reduced to a sufficient amount the valves will automatically open to admit air, and thus prevent the entrance of fluid.

In Fig. 6 the construction of the pump is shown as substantially the same as that shown in Fig. 1, the most important difference being that the periphery of the impeller is not tapered, as the centrifugal force generated by the vanes *p* is sufficient to prevent the backflow of fluid from the discharge-chamber to the chambers of the pump-casing. In this case also the plates S are omitted, and the ribs R are formed on or secured to the flanges *e* of the discharge-chamber.

In the operation of my improved pump the impeller, casing-chambers, and supply-passages are all first completely filled with the fluid to be pumped in order to prime the pump. Then a rotary movement is imparted to the impeller, and the fluid is discharged through the throat of the impeller. The chambers J being at this time filled with the fluid, a side pressure is exerted on the impeller and also a detrimental side friction which it is desirable to avoid. In my improved pump soon after the rotary movement of the impeller commences the fluid in the chambers J passes out through the passages *x* by gravity and also and principally by the centrifugal force generated by the vanes *p*. This centrifugal force is also aided by the injector force caused by the rush of fluid through the throats E and *f*, and in the construction shown in Fig. 1 the action is further aided by the tapered and grooved periphery of the impeller. In this way the chambers J are quickly emptied, and the air-pressure within them is reduced, thus relieving the impeller entirely from friction on its sides.

Normally the valves T are closed, and they are so weighted as to remain closed while the chambers J are being emptied; but when the vacuum in the chambers J exceeds the tension of the springs *t* the valves automatically open and admit air to the chambers J.

If by reason of increased pressure in the discharge-chamber or any other cause the fluid tends to pass inwardly through the passages *x* to the chambers J, it will be prevented from entering said chambers by the rotary vanes *p*, which by their centrifugal action will hold any fluid which tends to enter the chambers J within the annular chambers Q and will force back into the discharge-chamber such fluid should it tend to enter the chambers J in large amounts.

In order to prevent the fluid from rotating in the chambers Q between the inner sides of the plates P and the casing, the ribs R, before referred to, are employed. These act as baffle-plates, but permit the fluid to pass easily into the passages *x*.

It will be understood that many features of the pump herein shown and described are similar to those described and claimed in my before-mentioned application.

The claims in the present application relate to the vanes *p* and parts coöperating therewith and also to the valves T, which permit the air to enter the chambers J at the proper time.

In the drawings I have shown an admission at the eye on opposite sides of the impeller; but obviously my invention is not limited to a pump having a double admission of this kind.

I claim as my invention—

1. A centrifugal pump comprising a rotary impeller, a discharge-chamber with which it communicates, a fixed chambered casing for the impeller also communicating with the discharge-chamber and a series of vanes carried by the impeller which traverses a path outside that traversed by the main impeller-vanes.

2. A centrifugal pump comprising a rotary impeller, divided into chambers by vanes, a discharge-chamber communicating with the chambers of the impeller, a fixed casing for the impeller having side chambers also communicating with the discharge-chamber and vanes carried by the impeller interposed between the side chambers and the discharge-chamber and which rotate at a greater speed than that of the impeller-vanes for the purpose specified.

3. A centrifugal pump comprising a rotary impeller composed of side disks or plates and interposed vanes dividing the impeller into a series of chambers, a discharge-chamber communicating with the chambers of the impeller, a fixed casing having a chamber at the side of the impeller also communicating with the discharge-chamber and having also an annular chamber outside the path traversed by the impeller-vanes and a series of vanes carried by the impeller in said annular

chamber and which travel at a greater speed than the impeller-vanes.

4. In a centrifugal pump of the class in which a fixed chambered casing incloses a rotary chambered impeller discharging into a surrounding chamber, the combination with the impeller, of vanes carried thereby which traverse a path in the chamber of the casing outside the path traversed by the periphery of the impeller and thus rotate at a higher speed than the impeller-vanes.

5. A centrifugal pump comprising an impeller having an annular contracted discharge-throat formed in its tapered periphery, a discharge-chamber surrounding the impeller and communicating therewith, a fixed chambered casing inclosing the impeller and having a tapered or inclined communication between its chamber and the discharge-chamber and a series of vanes carried by the impeller which travel at a greater speed than the impeller-vanes and are interposed between the chamber in the fixed casing and the discharge-chamber.

6. A centrifugal pump comprising an impeller having a contracted discharge-throat formed in its periphery, a discharge-chamber surrounding the impeller and communicating therewith, a fixed chambered casing inclosing the impeller and communicating with the discharge-chamber and a series of vanes carried by the impeller which travel at a greater speed than the impeller-vanes and are interposed between the chamber of the fixed casing and the discharge-chamber.

7. A centrifugal pump comprising a rotary impeller communicating with a discharge-chamber surrounded by a casing and provided with vanes on its periphery traveling at a greater speed than the impeller-vanes and operating to prevent the backflow of fluid from the discharge-chamber to the inside of the casing.

8. In a centrifugal pump, the combination of a rotary impeller, a discharge-chamber with which it communicates, a chambered casing inclosing the impeller and communicating with the discharge-chamber, devices carried by the impeller which travel at a greater speed than the impeller-vanes and prevent the backflow of fluid to the chambered casing and a valve for admitting air to the inside of the chambered casing when the pressure therein has been reduced to a predetermined extent.

In testimony whereof I have hereunto subscribed my name.

WILLIAM IRVIN BETTIS.

Witnesses:
ALLEN PAUL,
J. LOEWENSTEIN.