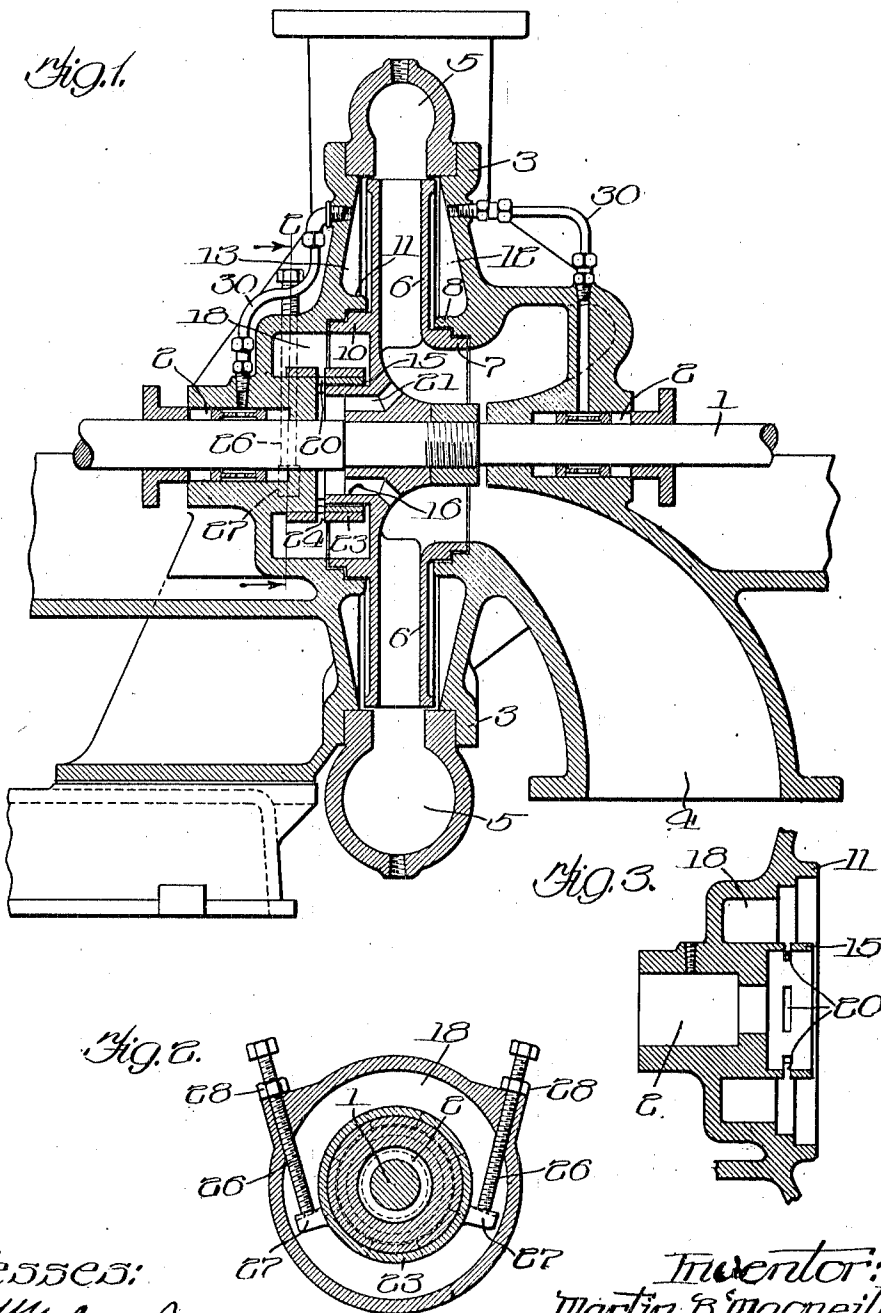


M. B. MACNEILL.
CENTRIFUGAL PUMP.
APPLICATION FILED AUG. 2, 1912.

1,105,807.

Patented Aug. 4, 1914

3 SHEETS-SHEET 1.



Witnesses:
J. H. Kelley Jr.
Edward B. Nelson

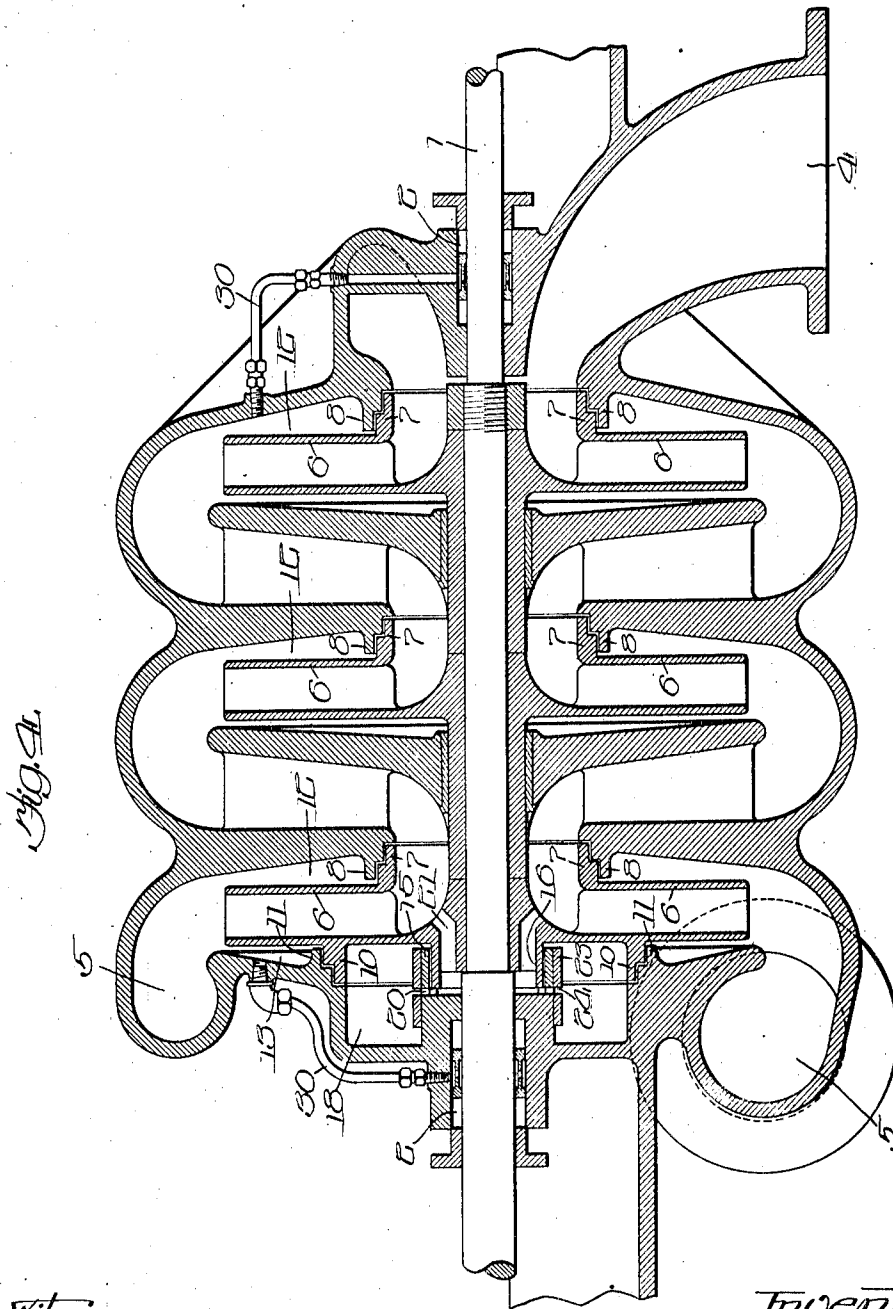
Inventor:
Martin B. Macneill.
By Cheever & Cox
Attys.

M. B. MACNEILL.
CENTRIFUGAL PUMP.
APPLICATION FILED AUG. 2, 1912.

1,105,807.

Patented Aug. 4, 1914

3 SHEETS-SHEET 2.

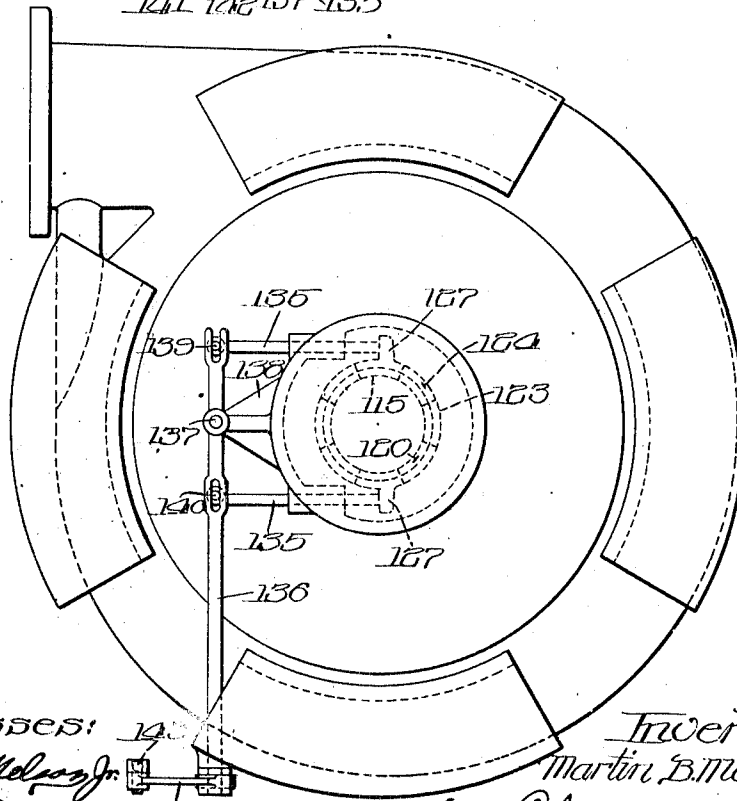


Witnesses:
J. M. Nelson Jr.
Edwin Nelson

Inventor:
Martin B. Macneill.
By Cheever & Cox
Attys.

1,105,807.

3 SHEETS—SHEET 3.



Witnesses:

J. M. McLean Jr. 
 Edwin Wilson

Inventor:

Martin B. Macneill.
By Cheever & Cox
Attys.

UNITED STATES PATENT OFFICE.

MARTIN B. MACNEILL, OF BELOIT, WISCONSIN, ASSIGNOR TO FAIRBANKS, MORSE & COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

CENTRIFUGAL PUMP.

1,105,807.

Specification of Letters Patent.

Patented Aug. 4, 1914.

Application filed August 2, 1912. Serial No. 712,980.

To all whom it may concern:

Be it known that I, MARTIN B. MACNEILL, a citizen of the United States, residing at Beloit, in the county of Rock and State of Wisconsin, have invented a certain new and useful Improvement in Centrifugal Pumps, of which the following is a specification.

The present invention has reference to centrifugal or turbine pumps of the single or multi stage type arranged for either horizontal or vertical operation and relates more particularly to an improved adjustable and automatic end thrust counter-balancing device which, when applied to pumps of the character mentioned, serves a double purpose, first, of neutralizing the end thrust, thereby increasing the efficiency by reason of the absence of a thrust bearing; second, in permitting the shaft stuffing box on the high pressure side of the pump to operate under a pressure only slightly in excess of that at the pump suction, thereby obviating the troubles and friction losses of a high pressure shaft packing.

I accomplish my objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a longitudinal central section through a horizontal single stage centrifugal pump. Fig. 2 is a transverse section on line 2—2, of Fig. 1. Fig. 3 is a detail section of part of the casing as shown in Fig. 1. Fig. 4 is a longitudinal central section through a horizontal three stage centrifugal pump. Fig. 5 is a longitudinal central section through a vertical single stage centrifugal pump. Fig. 6 is an inverted plan of the pump shown in Fig. 5.

Similar numerals refer to similar parts throughout the several views.

Referring first to the horizontal single stage form of pump shown in Figs. 1, 2 and 3. The shaft 1 passes through stuffing boxes 2 in the pump casing 3. The casing is provided with an inlet 4 and the circumferential discharge passage 5 in the usual manner. Rigidly secured to said shaft is an impeller having radial or approximately radial passages 6 through which the water is caused to flow from the inlet to said discharge passage. On the inlet or suction side of the rotary impeller is formed an annular flange 7 making a running joint with a cooperating annular flange 8 located on the casing. On the rear

side of the impeller opposite to the inlet an annular flange 10 is formed on the impeller which forms a running joint with a cooperating annular flange 11, formed upon the casing. A pressure chamber 12 is formed between the casing and the impeller on the front side of the impeller while a similar pressure chamber 13 is formed between the impeller and the casing on the rear side of the impeller. The stuffing boxes 2 are each connected by a duct 30 to the nearest one of the pressure chambers 12, 13. By this means the stuffing boxes are water sealed. On the rear side of the impeller an annular flange 15 projects forward from the casing and circumferentially incloses the hub 16 formed on the rear of the impeller. Flange 15 is appreciably smaller in diameter than flange 10 and in consequence a balancing chamber 18 is formed between them behind the impeller. One or more ports 20 are formed in the stationary ring or flange 15 and these communicate with one or more passages 21 formed within the impeller hub and forming a communication between the ports 20 and the suction or front side of the impeller.

Fitting over the ring 15 is a sleeve 23 provided with ports 24 which cooperate with the ports 20 to control the flow of liquid from the balancing chamber 18 to the passages 21. Said sleeve is rotary and controlled by means of set screws 26 mounted in the casing in position to engage ears 27 which project from said sleeve. Said screws are locked in any desired position by lock nuts 28 which abut the surface of the casing.

In operation, after the pump is primed by being filled with water and the impeller is set in motion, a pressure is generated within the pump casing in the chambers 12 and 13 nearly equal to the pressure in the discharge passage 5. If this pressure were exerted on the entire area at the rear of the impeller it would create a greater axial thrust than that exerted on the front or inlet side, due to the area on the inlet side being reduced by the portion cut away to form the inlet. As a result there will be an axial thrust set up in the direction of the pump suction, or toward the right of Fig. 1. In consequence of the construction of my pump, however, this tendency is neutralized partly at will and partly automatically. There is a certain amount of

leakage between the flanges 7 and 8 and between the flanges 10 and 11. That which leaks between the flanges 7 and 8 is immediately repumped. That which leaks between the flanges 10 and 11 enters the balancing chamber 18. Now, in my device the pressure in said chamber 18 may be regulated at will by properly adjusting the set screws 26 and thereby throttling to the proper degree the flow of water through the ports 20 and 24 into the passages 21 leading through the impeller hub to the inlet. The automatic control arises from the fact that the annular flange 16 at the impeller hub projects to a point approximately even with the inner side of port 20, whereby any lateral motion of the rotating element will either throttle or open said ports, thus increasing or diminishing the pressure in the balancing chamber 18 and causing the impeller to return to neutral position. To illustrate, controlling sleeve 23 will first be manually adjusted to the position where, under ordinary running conditions, the end thrust will be approximately neutralized. Any remaining end thrust will be automatically overcome by flange 16, for if the thrust is toward the suction due to excessive pressure in the balancing chamber 18, the impeller with its flange 16 will move slightly to the right, Fig. 1, thus opening up the ports 20, 24, and permitting freer flow from the balancing chamber which will reduce the pressure therein. In my pump therefore, the balancing device is partly manual and partly automatic, the automatic control supplementing and assisting the manual control and enabling the pump to automatically take care of variations due to increased or decreased speed, et cetera.

It will be noted that with my construction the friction losses at the rear stuffing box (at the left, Fig. 1) are greatly reduced. This stuffing box is adjacent to the balancing chamber and as said chamber is in direct communication with the pump suction and there is a partial throttling between said chamber and the pump discharge regions, the pressure in the chamber will be only slightly in excess of that at the suction or inlet to the pump. Therefore the stuffing box does not have to deal with high pressures and consequently the stuffing box glands do not have to be drawn up nearly as tightly as they otherwise would.

The form of pump shown in Fig. 4 is similar as regards its balancing mechanism to that shown in Fig. 1, hereinabove described. It is of the multistage type having a plurality of impellers secured to a common shaft and having the discharge from the first or inlet impeller arranged to deliver water to the inlet of the next adjacent impeller, according to the well known manufacture. The balancing mechanism is as-

sociated with the last impeller, to-wit, the impeller at the final discharge end of the pump.

In Figs. 5 and 6, I have shown a vertical type of pump and means for adjusting the controlling elements of the balancing device when the pump is running submerged or in deep dry wells or such places as will render the adjusting mechanism shown in Figs. 1 and 4 impractical. Here the shaft 101 stands vertical and passes through a stuffing box 102 in the casing 103. The casing is provided with an inlet 104 and a discharge passageway 105 lying horizontal and circumferentially inclosing the impeller 106. On the upper, suction side, an annular flange 107 makes a running joint with an annular flange 108 on the casing. On the lower or rear side the annular flange 110 on the impeller makes a running joint with the annular flange 111 on the casing. Pressure chambers 112 and 113 are formed on the upper and lower sides respectively of the impeller. A flange 115 fits over a flange 116 on the impeller hub and a balancing chamber 118 is formed between flanges 110 and 115. A port 120 is formed in flange 115 and leads to a passage 121 formed in the impeller hub and leading up through it to the inlet side of the impeller. A controlling sleeve 123 is rotatably mounted upon flange 115 and is provided with one or more ports 124 registering with the ports 120. The function and principle of operation of these parts is the same as the analogous parts hereinabove described, there being an added element to be taken into consideration, however, to-wit, the weight of the rotating element. This weight tends to partially counterbalance the up thrust toward the suction. In this form shown in Figs. 5 and 6, the set screws are replaced by plungers 135 which slide within the casing in position to engage the ears 127 formed upon the rotary sleeve. These plungers are operated by a lever 136 fulcrumed upon a pin 137 mounted in a bracket 138 extending from the casing. Said lever is articulately connected, preferably by slot and pin connection, at the points 139, 140, to the plungers 135. Said lever is rotated about its fulcrum by a bell crank lever 141 fulcrumed upon a stationary pin 142, one arm of said lever being articulately connected to lever 136 and the other end to the controlling rod 143 which rises to the top of the well or to other convenient position where it may be reached by the attendant. The parts are so constructed that the raising or lowering of rods 143 will rotate the sleeve valve 123. It will be understood that when the proper setting for the sleeve valve has once been determined it will not be frequently altered and will never be moved a great amount. It is convenient, therefore, to pro-

vide means for maintaining the position of the controlling rod when once adjusted; for example, a stationary beam 144 is provided. Through this passes a rod 143 provided with a nut 145 screwing on rod 143 and resting on the top of said beam.

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

1. In a machine of the class described the combination of a rotary impeller having a passage through the hub thereof, a casing having an inlet and a discharge passage, said casing having a balancing chamber on the rear side of the impeller, an annular flange on the casing fitting over the impeller hub, a port in said flange leading from the balancing chamber to the passage through the impeller hub, and a manually controlled valve for controlling the flow through said port.

2. In a machine of the class described the combination of a rotary impeller having a passage through the hub thereof, a casing having an inlet and a discharge passage, said casing having a balancing chamber on the rear side of the impeller in limited communication with the discharge, an annular flange on the casing fitting over the impeller hub, a port in said flange leading from the balancing chamber to the passage through the impeller hub, a rotary sleeve fitting over said flange for controlling the port opening and manually operated means for rotating said sleeve.

3. In a machine of the class described the combination of a rotary impeller having a passage through the hub thereof, a casing having an inlet and a discharge passage, said casing having a balancing chamber on the rear side of the impeller, an annular flange on the casing fitting over the impeller hub, a port in said flange leading from the balancing chamber to the passage through the impeller hub, a valve for said port, ears upon said valve for operating it, and longitudinally movable elements engaging said ears and extending to a point outside of the casing whereby they may be manually adjusted.

4. In a rotary pump, the combination of a rotary impeller, a casing therefor having an inlet and a discharge passage, a balancing chamber communicating with said discharge passage, a port between said balancing chamber and the inlet, a flange on the impeller hub adapted to automatically control the flow through said port, and a manually operated valve also adapted to control the flow through said port, the control being therefore dependent upon two independent factors, one of which is automatic and the other manual.

5. In a machine of the class described, the combination of a rotary impeller having a

passage through the hub thereof, a casing having an inlet and a discharge passage, said casing having a balancing chamber on the rear side of the impeller in limited communication with the discharge, an annular flange on the casing fitting over the impeller hub, a port in said flange leading from the balancing chamber to the passage through the impeller hub, a rotary sleeve fitting over said flange for controlling the port opening, ears on said sleeve on opposite sides of the axis of rotation thereof, and longitudinally movable elements engaging said ears and extending through to the outside of the casing whereby they may be manipulated at will.

6. In a centrifugal pump the combination of a rotary impeller, a casing therefor having an inlet and a discharge passage, a hub on said impeller projecting rearwardly and having a passage extending through it from the rear to the inlet side of the impeller, an annular flange on the casing fitting over the projecting impeller hub and having a port at the end of said hub whereby axial movement of the impeller will increase and diminish the port opening, there being a chamber in the casing outside of the said hub and its inclosing annular flange, said chamber having limited communication with the discharge, and a manually controlled valve for coöperating with the impeller hub to control the flow through said port.

7. In a centrifugal pump the combination of a rotary impeller, a casing therefor having an inlet and a discharge passage, a hub on said impeller projecting rearwardly and having a passage extending through it from the rear to the inlet side of the impeller, an annular flange on the casing fitting over the projecting impeller hub and having a port at the end of said hub whereby axial movement of the impeller will increase and diminish the port opening, there being a chamber in the casing outside of the said hub and its inclosing annular flange, said chamber having limited communication with the discharge, and a rotary sleeve fitting over the annular flange on the casing and having an aperture adapted to register with said port for controlling the flow through it.

8. In a centrifugal pump the combination of a rotary impeller, a casing therefor having an inlet and a discharge passage, a hub on said impeller projecting rearwardly and having a passage extending through it from the rear to the inlet side of the impeller, an annular flange on the casing fitting over the projecting impeller hub and having a port at the end of said hub whereby axial movement of the impeller will increase and diminish the port opening, there being a chamber in the casing outside of the said hub and its inclosing annular flange, said chamber having limited communication with the dis-

charge, a rotary sleeve fitting over the annular flange on the casing and having an aperture adapted to register with said port for controlling the flow through it, ears on said sleeve on opposite sides of the axis of rotation thereof, and longitudinally movable elements engaging said ears and projecting through to the outside of the casing to afford manual control of the sleeve.

9. In a centrifugal pump the combination of a rotary impeller having annular flanges, a casing having an inlet and a discharge passage and having flanges making running joints with the flanges on the impeller whereby pressure chambers are formed on the front and rear sides of the impeller, which pressure chambers are in limited communication with the discharge, a projecting

hub on said impeller having a passage extending from the rear to the inlet side of the impeller, a flange on the casing interfitting with said impeller hub and cooperating therewith and with the first mentioned flanges to form a balancing chamber on the rear side of the impeller, a port leading from said balancing chamber to the passage in the impeller hub and a rotary element adapted to control the opening through said port.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

M. B. MACNEILL.

Witnesses:

W. C. ACKLEY,
FRED T. MERRILL.