July 3, 1923. 1,460,428

L. F. MOODY

PUMP AND METHOD OF REGULATING THE SAME

Filed July 3, 1919 2 Sheets-Sheet 1

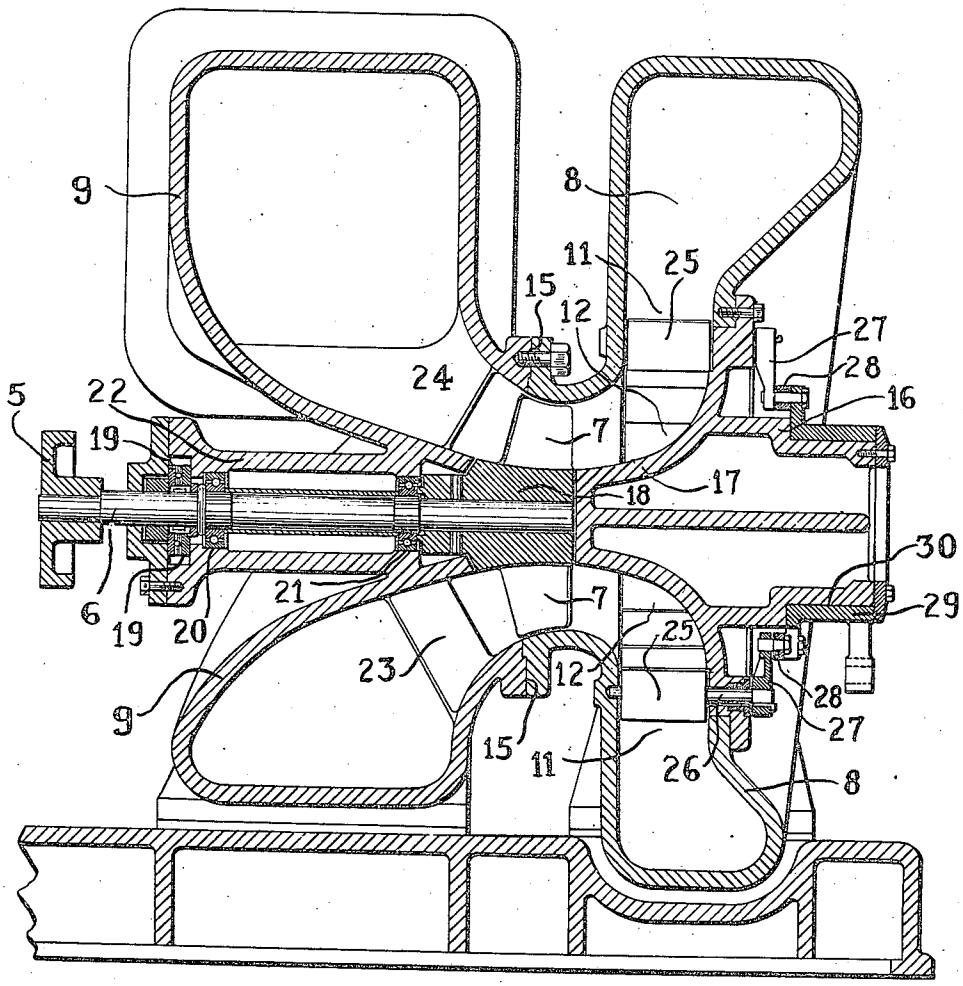

Fig. 1.

INVENTOR
Lewis F. Moody
BY
Edwards, Sager & Richmond
ATTORNEYS

July 3, 1923. 1,460,428

L. F. MOODY

PUMP AND METHOD OF REGULATING THE SAME

Filed July 3, 1919 2 Sheets-Sheet 2

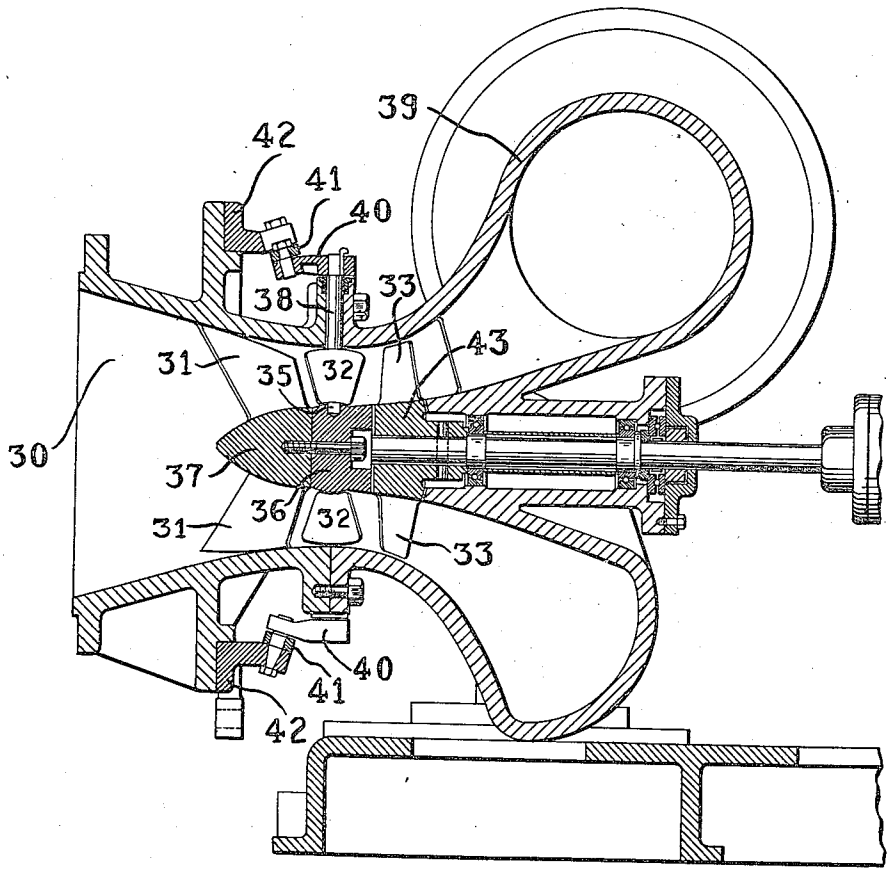

Fig. 2.

INVENTOR
Lewis F. Moody
BY
Edwards, Sager & Richmond
his ATTORNEYS

Patented July 3, 1923. 1,460,428

UNITED STATES PATENT OFFICE.

LEWIS FERRY MOODY, OF PHILADELPHIA, PENNSYLVANIA.

PUMP AND METHOD OF REGULATING THE SAME.

Application filed July 3, 1919. Serial No. 308,607.

To all whom it may concern:

Be it known that I, LEWIS F. MOODY, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Pumps and Methods of Regulating the Same, of which the following is a specification.

This invention relates to hydraulic pumps and methods for regulating the same and particularly to such pumps having a rotary impeller. The object of the invention is to provide a pump and method of control therefor whereby the amount of water pumped may be regulated within wide limits while maintaining highly efficient flow conditions at all adjustments.

A common method of regulating pumps is by means of a gate valve or some similar valve in the discharge pipe for throttling the flow after the water has left the pump. Such a valve usually reduces the flow by interposing a loss of head and thus controls the pump mainly by reducing its efficiency. In the pump of this invention regulating means is provided in the pump inlet leaving the outlet free from obstruction and supplying the impeller with a widely variable quantity of water in such manner that efficient conditions of flow at both the inlet and outlet are maintained at all dgrees of opening.

Other objects and advantages of the invention will appear in the following description taken in connection with the accompanying drawings in which:

Fig. 1 is a vertical section of a pump illustrating one embodiment, and

Fig. 2 is a vertical section of a modified form of pump.

In the pump shown in Fig. 1 power is supplied from coupling 5 and shaft 6 to rotate impeller blades 7 which are of the axial screw type and draw water from the inlet casing 8 and drive it through outlet casing 9. The inlet casing 8 is spiral or volute in form narrowing the flow and directing it radially inward through the gate space 11 to the transition space 12 where it is turned into the axial direction to pass to the impeller blades 7. In the outlet casing 9 the flow from the impeller is turned into radial planes and gradually broadened in section. In passing through the pump the flow in the inlet is increased in velocity so that it has its pressure head transformed largely into velocity head at the impeller blades 7 while in the outlet the velocity of flow is gradually reduced retransforming the velocity head into pressure head much higher in degree, of course, than that at the inlet. The inlet casing 8 is bolted to the outlet casing as at 15 and has a detachable head 16 with its inner end 17 conical and curved to form the central guiding surfaces of the transition space 12. The hub 18 of the impeller has its surfaces curved to merge smoothly with these transition surfaces and outlet passage as shown and the impeller shaft 6 runs in bearings 19, 20 and 21 in tubular housing 22 integral with the outlet casing 9. Stationary vanes 23 and 24, shaped to conform to the paths of flow, reinforce the outlet casing walls.

In order to regulate the output of the pump, movable guide vanes or wicket gates 25 are interposed in the inlet to vary the amount of water supplied to the impeller. These vanes are pivotally mounted in bearings in the casing 8 and head 16 and their spindles 26 pass through head 16 and are keyed to cranks 27 for adjustment, the cranks in turn being linked at 28 to the rotatable adjusting ring 29 fitted to the cylindrical bearing 30 of the head 16. The adjusting ring would be moved by an extension arm and a draw rod connected to a piston or hand wheel as desired and all of the vanes are moved in exactly similar manner and are therefore given equal relative angular positions at all openings. The guide vanes 25 may be arranged both to close to smaller amounts of opening than their normal position and to open to positions for greater discharge than normal and their number and length are preferably such that they may be closed to shut off the supply to the pump altogether.

The water is brought to the wicket gates in the spiral passage of the inlet casing and after passing through the wicket gates 25 in a radial inward flow direction and being given an additional whirling motion by the gates, the water is guided into a substantially axial flow direction where it enters the impeller in a continuous revolv-

ing stream of substantially uniform velocity around the circumference. By this means the flow through the pump is regulated without loss of head and without substantial variation in efficiency at the different adjustments; for the only difference in conditions of efficiency introduced by this adjustment is the slightly variant angle at which the lines of flow of the axial stream enter the impeller due to variations of the adjusted angles of the movable vanes. Another advantage of the structure of this invention in regulating the flow in the inlet is that it leaves the outlet clear of obstruction and free to be designed to secure the most efficient transformation of the velocity head at the impeller into pressure head at the outlet. Adjustable guide vanes in this outlet passage would break up the continuity of the diffusion and introduce wasteful disturbances; for the passages through the guide vanes are too short in comparison with their width to be effective as diffusers and, if very long vanes are used, the heavy mechanical load required to adjust them makes them impractical and the additional friction due to the large aggregate amount of surface on the vanes would introduce serious hydraulic losses. These objections are not involved when the vanes are placed on the entrance side of the impeller since at this point in a pump the water is being accelerated and the passages between the vanes contract in area instead of expanding. The vanes may be formed to give highly efficient flow conditions at all angles of opening, acting simply to vary the amount of the flow and imparting a slightly variant angle of impact at the impeller blades.

In the structure illustrated in Fig. 1 the radial flow inlet passage permits the gate vanes to be set on parallel axes and controlled by the simple adjusting mechanism shown. Where it is desirable to use an axial flow inlet passage the gate vanes may be of the axial flow type with axes radiating from the axis of the pump as shown in Fig. 2. The water enters this pump in an axial direction at the inlet 30, is given an initial whirling motion by a series of fixed vanes 31, and is discharged from these vanes into the wicket gates 32 which further continue the guidance and discharge the water with an increased amount of whirl in the space between the wicket gates and the impeller 33. It is essential that a sufficient space be provided between the entrance vanes and impeller to allow the water to come together in a continuous revolving mass of substantially uniform velocity around the circumference before it enters the impeller. The guide vane axes in Fig. 2 are shown in the same plane although they might be equally well contained in a conical surface having its apex in the pump axis. In the structure shown the inner vane spindles 35 are journaled in a ring 36 carried by the central guiding cone 37 which in turn is supported by the fixed guide vanes 31 of inlet casing 30. The outer spindles 38 of vanes 32 are continued through bearings formed between inlet casing 30 and outlet casing 39 and are provided with levers 40, an adjusting ring 42 and intermediate links 41, the end pins of which are inclined so that all their axes intersect the pump axis at the same point as the intersection of the spindle axes. Therefore, in all positions of the wicket gates the pins mounted on the levers will continue to intersect the same fixed point and a correct fit at all the pivots may be maintained.

The cone 37, ring 36 and the hub 43 of the impeller merge smoothly in contour with each other and with the central walls of the outlet casing 39. The outer walls of the inlet and outlet casings are also formed to merge with each other and gradually decrease the section and increase the velocity of the inflow to the impeller and then conversely increase the section and decrease the velocity of the outflow therefrom to retransform the velocity head into pressure head at the outlet. The guide vanes 32 are formed with their outer edges shaped to fit the inlet casing walls 30 when they are closed; and with their inner edges shaped to fit the ring 36 which is made spherical in the portion coming in contact with the vanes.

It will be understood that the invention is not confined to the arrangements shown and described, but is intended to cover such modifications thereof as fall within the scope of the appended claims.

I claim:—

1. The method of regulating the flow through a rotary pump comprising increasing the velocity of the inflow in the direction of flow and simultaneously varying the angle of whirl thereof.

2. The method of regulating the flow through a rotary pump comprising imparting an initial whirl to the inflow and subsequently increasing this whirl in variable manner.

3. The method of regulating the flow through a rotary pump comprising directing the inflow on whirling lines around the impeller axis as a center, and increasing the velocity of the inflow and variably changing the angle of whirl in advance of the impeller to regulate the flow through the pump.

4. The method of pumping a fluid comprising directing said fluid on initially whirling lines around an impeller axis, varying the angle of whirl to regulate the flow through the pump, and applying an impeller to increase the whirl, and guiding the whirl-

ing flow away from the impeller in an axially progressing spiral course of expanding cross section.

5. The method of pumping a fluid comprising directing said fluid on initially whirling lines around an impeller axis, increasing the whirl in variable manner, and applying an impeller to increase the whirl, and guiding the whirling flow away from the impeller in an axially progressing spiral course of expanding cross section.

6. In a rotary hydraulic pump the combination with an impeller, of inlet means adapted to form the inflow into an axially progressing stream whirling around the impeller axis, and means for varying the angle of whirl of said stream to regulate the flow through the pump.

7. In a pump the combination with an impeller, of an inlet casing imparting a whirl to the inflow and directing it axially with increasing velocity as it approaches said impeller, and means for varying the angle of whirl of the inflow to regulate the pump.

8. A rotary hydraulic pump having in combination an impeller, an inflow conduit, and an outflow conduit, said conduits and the impeller being disposed so that the course of the water flow through the pump shall be in a continuously advancing helical path first converging to its smallest cross section at or near the impeller and then diverging therefrom, the inflow conduit having means to impart a variable angle of whirl to the flow so as to regulate the flow through the pump.

9. In a rotary hydraulic pump the combination with a radially directed inflow conduit having means to impart a variable whirl to the inflow, of guiding means forming a transition space turning the flow from radial to axial and axially advancing the flow and delivering it to an impeller of the axial flow type.

10. In a rotary hydraulic pump the combination with a radially directed inflow conduit having means to impart a variable whirl to the inflow, of guiding means forming a transition space turning the flow from radial to axial and axially advancing the flow and delivering it to an impeller, and an outflow conduit adapted to discharge the flow along divergent helical paths with decreasing velocity.

11. In a pump the combination with a rotary impeller, of an inlet directing the inflow axially to said impeller, and movable guide vanes regulating the flow through said inlet, all of said guide vanes being linked to a single operating ring to be similarly adjusted thereby, said movable guide vanes turning on axes parallel to the axis of said operating ring.

12. In a pump the combination with inlet and outlet casings bolted together, of central guiding means carried by said inlet casing, a rotary impeller also having central guiding surfaces merging with the central guiding surfaces of said inlet casing, central guiding surfaces in said outlet casing merging with the contour of said impeller so that the flow is first narrowed and then expanded in section, and means in said inlet for varying the direction of the flow therethrough.

13. In a pump the combination with an impeller, of an inflow passage gradually narrowing in section to increase the velocity of flow, and an outlet passage provided by a volute casing of increasing cross section, and means in said inflow passage for controlling the flow through said pump comprising a series of adjustable gate vanes adapted to impart a whirl to the inflow.

14. In a pump the combination with an impeller of the axial flow type, of an inflow passage narrowing in section to increase the velocity of flow, an outlet passage provided by a volute casing of increasing cross section, and means in said inflow passage for controlling the flow through said pump comprising a series of adjustable gate vanes adapted to impart a whirl to the inflow.

15. In a hydraulic pump the combination with an axial flow impeller, of guiding means forming a converging transition space in advance thereof, adapted to guide the flow in an axial direction and inwardly directed guiding means in advance of said transition space adapted to impart a whirl to the flow so that the inflow is in the form of a continuous whirling stream of decreasing cross-sectional area turning into the axial direction at the entrance to the impeller.

16. In a hydraulic pump the combination with an axial flow impeller, of guiding means forming a converging transition space in advance thereof, adapted to guide the flow in an axial direction and inwardly directed guiding means of greater diameter than said impeller in advance of said transition space adapted to impart a whirl to the flow so that the inflow is in the form of a continuous whirling stream of decreasing cross-sectional area turning into the axial direction at the entrance into the impeller.

17. In a hydraulic pump the combination with an axial flow impeller, of guiding means forming a converging vane-free transition space in advance thereof, adapted to guide the flow in an axial direction and inwardly directed guiding means in advance of said transition space adapted to impart a whirl to the flow so that the inflow is in the form of a continuous whirling stream of decreasing cross-sectional area turning into the axial direction at the entrance to the impeller.

18. In a pump the combination with an impeller of an inlet conduit adapted to impart a whirl to the inflow and a series of guide vanes arranged in the path of said inflow and adapted to increase the whirl.

19. In a pump the combination with an impeller of an inlet conduit adapted to impart a whirl to the inflow and a series of inwardly directed guide vanes arranged in the path with said inflow and adapted to increase the velocity and whirl thereof.

20. In a pump the combination with an impeller of an inlet conduit adapted to impart a whirl to the inflow, a series of inwardly directed guide vanes arranged in the path with said inflow and adapted to increase the velocity and whirl thereof, means for adjusting the position of said vanes to regulate the flow.

21. In a pump the combination with an impeller of an inlet conduit adapted to impart a whirl to the inflow and a series of inwardly directed guide vanes arranged in the path of said flow and adapted to increase the velocity and whirl thereof, said inlet conduit being formed with a transition space between said vanes and impeller wherein the flow may merge into a solid stream.

22. In a hydraulic pump the combination with an impeller, of means for guiding the flow thereto comprising a radial intake passage adapted to impart a whirl to the flow, and a transition space between said passage and said impeller adapted to turn the flow toward the axial direction.

LEWIS FERRY MOODY.