July 29, 1924. 1,502,865

L. F. MOODY

HYDRAULIC PUMP

Filed Aug. 21, 1920

Fig. 1.

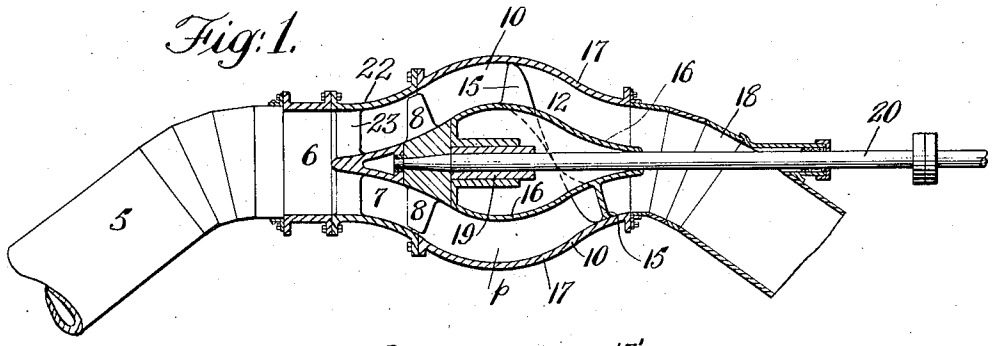


Fig. 2.

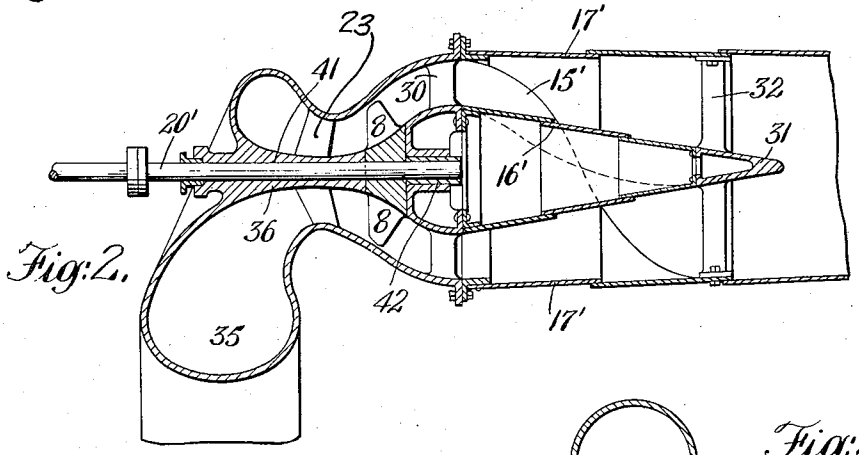


Fig. 3.

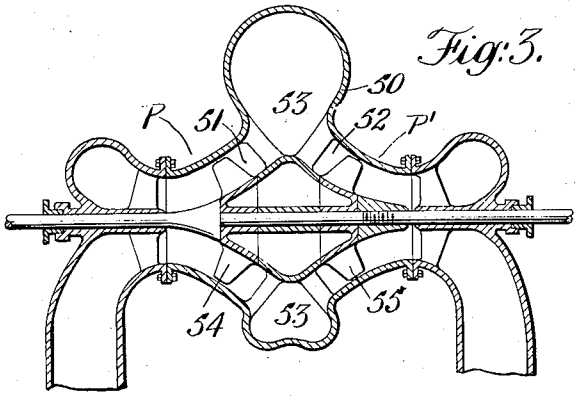
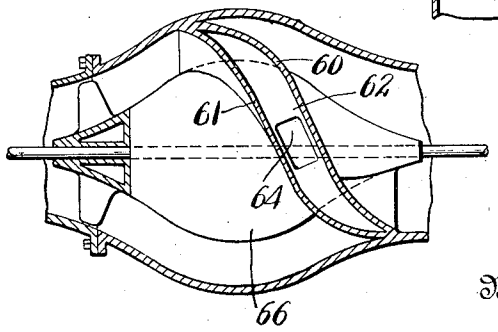


Fig. 4.



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UNITED STATES PATENT OFFICE.

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HYDRAULIC PUMP.

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To all whom it may concern:

Be it known that I, LEWIS FERRY 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 Hydraulic Pumps, of which the following is a specification.

This invention relates to rotary hydraulic pumps and particularly to the discharge passages of such pumps. The chief object of the invention is to provide a pump well adapted for arrangement in the horizontal shaft position, and one in which the outflow will be gradually decelerated along smooth spiral lines and without losses due to eddies and disturbances and sudden changes of direction of the flow.

The usual method of recovering the discharge velocity from the impeller of a pump by the use of a large number of small diffusion vanes is either very inefficient or completely ineffective. In order to recover velocity head of water efficiently it is necessary to use long gradually tapering passages in order that the velocity may be reduced very gradually. If the rate of velocity reduction is too great the water will refuse to follow the walls of the passage and energy consuming eddies will be created; and furthermore, the desired velocity reduction will not be secured beyond the reduction due to loss of energy. If a large number of diffusion vanes are used, and it is endeavored to accomplish the diffusion by making each passage long in comparison with its cross-section so that the velocity reduction may be sufficiently gradual, it will then follow that a very large amount of surface friction will be introduced. A comparison between the use of a large number of smaller passages and a few large passages may also be viewed by comparing the efficiency of a small hydraulic machine with a large one of homologous design. The efficiency of hydraulic machines increases materially as the size is increased. This is true even of simple conduits or pipes. In order to realize the high efficiency of large water conduits in a pump of relatively small size it will, therefore, be of great value to use a small number of large passages for regaining the velocity head at discharge from the impeller rather than to provide many smaller passages for this purpose. In the present invention, it is proposed to accomplish the velocity reduction by wrapping either a single large diffusion passage around the circumference of the discharge space from the impeller or to use a small number of such diffusion spaces, such as two.

In the accompanying drawings illustrating the invention—

Fig. 1 is a vertical sectional view of one embodiment in a pump having an axial intake and discharge, and

Figs. 2, 3 and 4 are similar views of modifications.

In the embodiment of the invention shown in Fig. 1 the supply pipe 5 which may be coaxial with the pump or may approach the pump at a moderate angle as shown, brings the inflow into the axial direction at 6 where it is spread by the conical nose 7 and guided on slightly diverging lines to the impeller 8. Here the flow is engaged by the rotating impeller blades and driven to the right. The discharge from the impeller has a whirl around the axis and an annular diffusion space 10 is provided containing no vanes and in which the water can whirl freely. This chamber diverges from the axis and gradually curves into the axial direction. When the water reaches the point p farthest from the axis the whirl will have been decreased by the principle of the conservation of moment of momentum in accordance with which rc_u=a constant, r being the radius and c_u the velocity of whirl. At the point p the diffuser 10 curves so as to approach the axis once more in a convergent passage 12.

If the convergent passage 12 remained free the whirling of the discharge would increase again according to the relation just mentioned between radius and whirl. To continue the diffusing action, and produce a gradual decrease in velocity in place of the increase that would otherwise take place, a helical wall 15 is provided producing long spiral helical chambers wrapped around the surface of revolution 16 forming the core or inner boundary of the diffuser.

In the form shown in Fig. 1 this wall 15 is a single helicoidal wall or plate of varying pitch, wrapped around the central wall 16 of conoidal form. The diameter across the helix, that is the diameter across the central wall, varies from point to point along the helix. The pitch of the helical wall increases in the direction of flow suffi-

ciently to produce the desired diffusion. The diffuser passage is bounded on the outside by a second conoidal casing 17, the word "conoidal" here being used to denote broadly a surface of revolution. The helicoidal wall 15, if a single one is used will be wrapped a considerable distance, such as 360°, around the axis or, if necessary, to obtain the required velocity reduction, it will be wrapped around more than a complete revolution. The diffusion space will then continue until the velocity has been reduced sufficiently to permit the discharge velocity head to be passed into the discharge pipe 18 without a material loss in head. In this way the whirling component of the discharge velocity from the impeller will be reduced to a low value along smooth lines efficiently converting the velocity head of whirl into effective pressure head in the discharge.

The pump parts may be made of castings bolted together as shown with the core 16 supported from the outer casing 17 by the spiral rib 15. The core 16 in turn supports the bearing 19 for the pump shaft 20 which may also be supported by the base of nose 7 supported from the outer casing 22 by stays 23. The pump shaft may either be arranged with the impeller overhung or the shaft may be oppositely directed and pass through a stuffing box on the suction side (Fig. 2), the motor or drive being on the opposite side from that shown in Fig. 1.

The diffusion chamber may also be made largely of plate steel 17′ (Fig. 2) the helical wall 15′ and core 16′ being made of the same material. In this arrangement the beginning of the helical wall 15′ is shown as a short cast iron baffle or nose piece 30 and the core 16′ will have a cast iron cap 31 supported by stay vanes 32 from the casing 17′ which merely conform to the flow lines and are intended solely for mechanical support. In Fig. 2 the intake 35 is a contracting volute casing having a central core 36 for the shaft 20′ so that the pump impeller is supported between two bearings 41 and 42. In the form shown in Fig. 2 not only will the whirling component of the flow be reduced in the manner above set forth but by reason of the constantly expanding passage the component of flow which is directed along the axis of the pump will be reduced and converted into pressure head.

In Fig. 3 two oppositely directed pumps P and P′ discharge into a casing 50 having two diffusion spaces 51, 52 merging into a single outlet volute 53 carried around the axis of the pump impellers 54, 55 in a position midway between them.

In the modification illustrated in Fig. 4 the helical guiding wall 60 is made double having a front 61 and a rear 62 tapering together at each end but separated at the middle to permit an inspection opening 64 to be provided. By this the space within the core or inner body 66 is left open to access from outside the pump.

In the construction shown in Fig. 1 the pitch of the helical wall 15 should progressively increase in order to provide a passage of sufficiently increasing cross-sectional area at right angles to the flow lines to cause a decrease in velocity, the increasing pitch of the helical wall causing the flow lines to become more and more axial in direction so that though the cross sectional areas at right angles to the axis may decrease the cross sectional areas across the flow lines will progressively increase. In the construction shown in the remaining figures the diffusion passage as it progresses becomes what may be termed "deeper," that is, the distance between the central core and the outer wall becomes greater. In such a case a progressive "widening" of the passage by increasing the pitch of the helical side wall may not in all cases be necessary.

The diffusion action in all cases would be produced first by an enlarging, diverging, annular chamber free of vanes, then a continuation of this chamber containing if necessary for mechanical reasons stay vanes designed to conform to the flow and to interfere as little as possible with it, and finally a long helical diffusion space wound around the circumference of the inner boundary wall of the space. The outflow by these means is continuously and gradually decelerated as to all its components so that a maximum portion of its veocity head is efficiently converted into effective pressure head in the discharge. In pumps of the spiral type to which this invention applies the recovery of the energy of the water discharged from the impeler is an extremely important part of the hydraulic action of the pump, since this energy represents a value, in high speed pumps of this type, which is large compared to the net head against which the pump is delivering.

I claim:

1. In a hydraulic pump the combination with a rotary impeller, of a diffuser receiving the discharge therefrom and comprising an annular vane-free passage followed by a plurality of helical passages, the discharge from each of said helical passages being directed along the axis of the helix.

2. In a hydraulic pump the combination with a rotary impeller, of a diffuser receiving the discharge therefrom and comprising an annular spreading vane-free passage followed by a plurality of helical passages, the discharge from each of said helical passages being directed along the axis of the helix.

3. In a hydraulic pump the combination with a rotary impeller, of a diffuser receiving the discharge therefrom and comprising an annular passage alternately diverging

and converging and containing a curved guiding wall in said converging portion so that said portion of the passage is gradually enlarging at all points in the direction of flow to continuously decelerate the outflow and reconvert its velocity head into pressure head.

4. In a hydraulic pump in combination with a rotary impeller, a diffuser receiving the discharge therefrom and comprising an annular passage continuously increasing in area in the direction of flow and having a helical wall interposed therein to gradually decelerate the flow.

5. In a hydraulic pump in combination with a rotary impeller, a diffuser receiving the discharge therefrom and comprising an annular passage continuously increasing in area in the direction of flow and having a helical wall of varying pitch interposed therein to gradually decelerate the flow.

6. An annular diffuser for a hydraulic pump having its passage gradually enlarging in the direction of flow and comprising a central core member tapering toward the impeller axis in the direction of the discharge.

7. An annular diffuser for a hydraulic pump having its passage gradually enlarging in the direction of flow and comprising a central core member tapering toward the impeller axis in the direction of the discharge, and a helical wall surrounding said core member.

8. An annular diffuser for a hydraulic pump having its passage gradually enlarging in the direction of flow and comprising a central core member tapering toward the impeller axis in the direction of the discharge, and a helical wall of varying pitch surrounding said core member.

9. In a hydraulic pump the combination with a rotary impeller receiving the flow from an axial throat passage, of a diffuser receiving the discharge from said impeller and comprising an annular passage diverging at its inner surface to a diameter greater than the outer wall of said throat and then converging and adapted at all points to continuously decelerate the outflow and convert its velocity head into pressure head.

10. A diffuser for a hydraulic pump comprising means for guiding the discharge from the impeller outward away from the axis and means for guiding said discharge back toward the axis, comprising means for continuously decelerating the outflow while guiding it.

11. Apparatus for regaining the velocity head of the discharge from a rotary pump impeller comprising means for guiding said discharge outward away from the impeller axis, gradually turning said discharge parallel to said axis and then directing said discharge inward toward the axis, said guiding means being adapted to gradually and continuously decelerate the flow.

12. Apparatus for regaining the velocity head of the discharge from a rotary pump impeller comprising means for guiding said discharge outward away from the impeller axis, gradually turning said discharge parallel to said axis and then directing said discharge inward toward the axis on helical lines, said guiding means being adapted to gradually and continuously decelerate the flow.

13. Apparatus for regaining the velocity head of the discharge from a rotary pump impeller comprising means for guiding said discharge outward away from the impeller axis, gradually turning said discharge parallel to said axis and then directing said discharge inward toward the axis on helical lines of varying pitch, said guiding means being adapted to gradually and continuously decelerate the flow.

14. Apparatus for regaining the velocity head of the discharge from a rotary pump impeller comprising means for guiding said discharge outward away from the impeller axis, gradually turning said discharge parallel to said axis and then directing said discharge inward toward the axis on helical lines of varying pitch to continuously decelerate said discharge.

15. In a hydraulic pump the combination with an outer casing having a portion enlarging in the direction of flow, a pump impeller within said casing and in proximity to said enlarging portion thereof, and means for decelerating the discharge from said impeller comprising inner and outer walls and an intermediate helical wall in said casing interposed in the flow and having both of its surfaces in contact with the flow.

16. In a hydraulic pump the combination with an outer casing having a portion enlarging in the direction of flow, a pump impeller within said casing and in proximity to said enlarging portion thereof, and means for decelerating the discharge from said impeller comprising a core member and a helical wall between said core member and said casing.

17. In a hydraulic pump the combination with a pump impeller having a diagonally outward discharge, of a diffuser chamber receiving said discharge and guiding it outward on diverging lines and means for subsequently decelerating said discharge comprising a casing bounded by inner and outer surfaces of revolution and containing helical guiding means interposed in the flow and having both of its surfaces in contact with the flow.

18. A diffuser for a hydraulic pump comprising a portion diverging from the axis followed by a portion converging toward the axis, said diverging portion being vane-free,

but said converging portion containing helical guiding vanes.

19. A diffuser for a hydraulic pump comprising a portion diverging from the axis followed by a portion converging toward the axis, said diverging portion being vane-free, but said converging portion containing a small number of helical guiding vanes.

20. A hydraulic pump having a casing formed with a contracting volute intake passage and a discharge passage formed with a central core, a rotary impeller having a shaft journaled in the wall of said intake passage and in said core and a helical wall surrounding said core and forming a diffusing passage which gradually enlarges in the direction of flow.

21. A hydraulic pump having a casing formed with a contracting volute intake passage and a discharge passage formed with a central core therein, a rotary impeller having a shaft journaled in the wall of said intake passage and in said core and a helical wall of increasing pitch surrounding said core and forming a diffusing passage which gradually enlarges in the direction of flow.

22. A hydraulic pump having a volute intake casing contracting to a neck and then expanding into an annular passage, an impeller in said passage, a shaft on which said impeller is mounted, the wall of said casing being extended inwardly to provide a bearing for said shaft, stay vanes connecting said bearing with the wall of said casing and a plurality of helical discharge passages communicating with said annular passage.

23. In a pump the combination with a rotary high speed impeller, of a diffuser receiving the discharge therefrom and comprising an annular vane-free passage followed by a plurality of helical passages, the discharge from each of said helical passages being directed along the axis of the helix.

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