No. 717,096. Patented Dec. 30, 1902.

E. G. HARRIS.

CENTRIFUGAL PUMP.

(Application filed Oct. 19, 1901.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1,

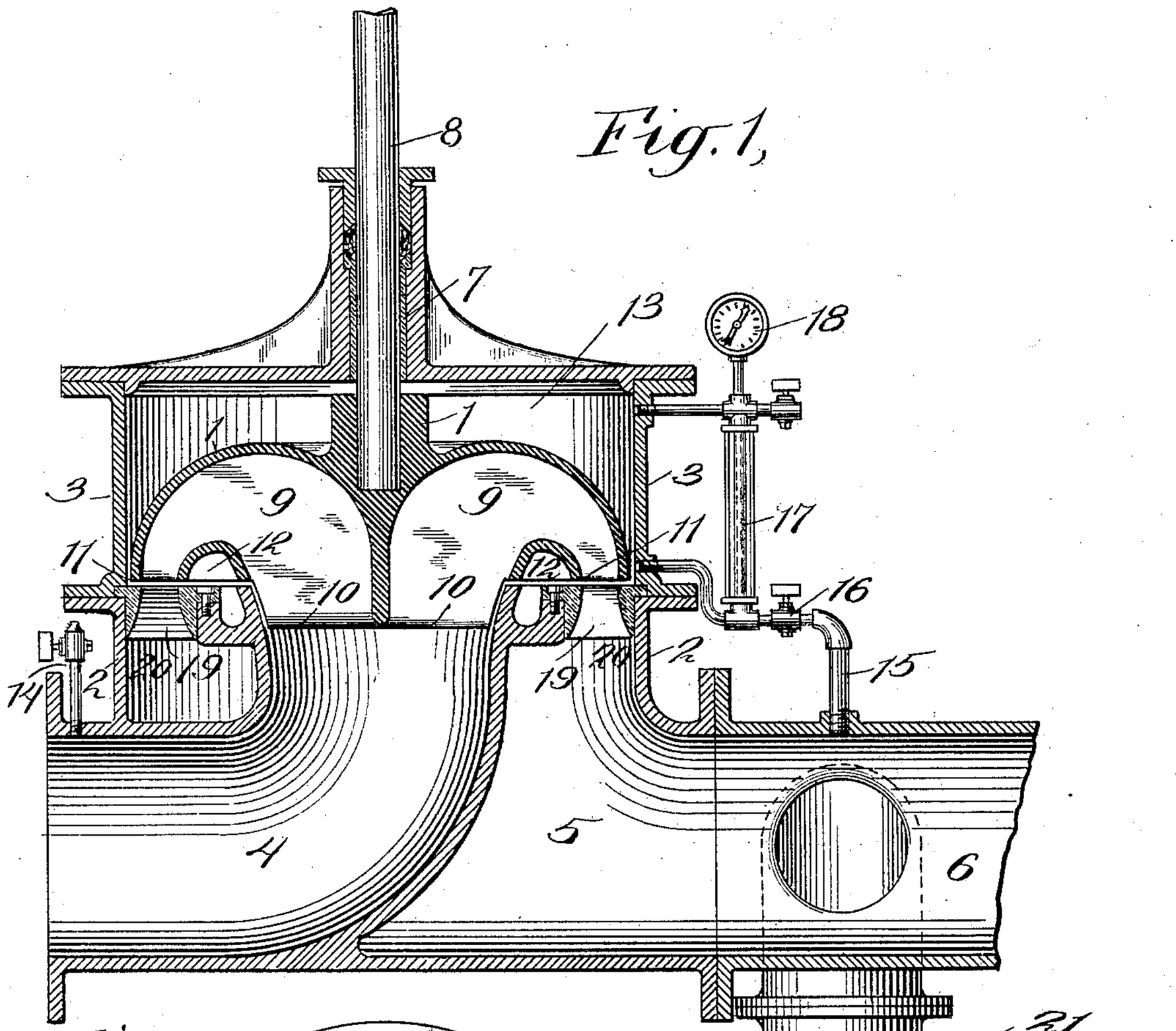

Fig. 2,

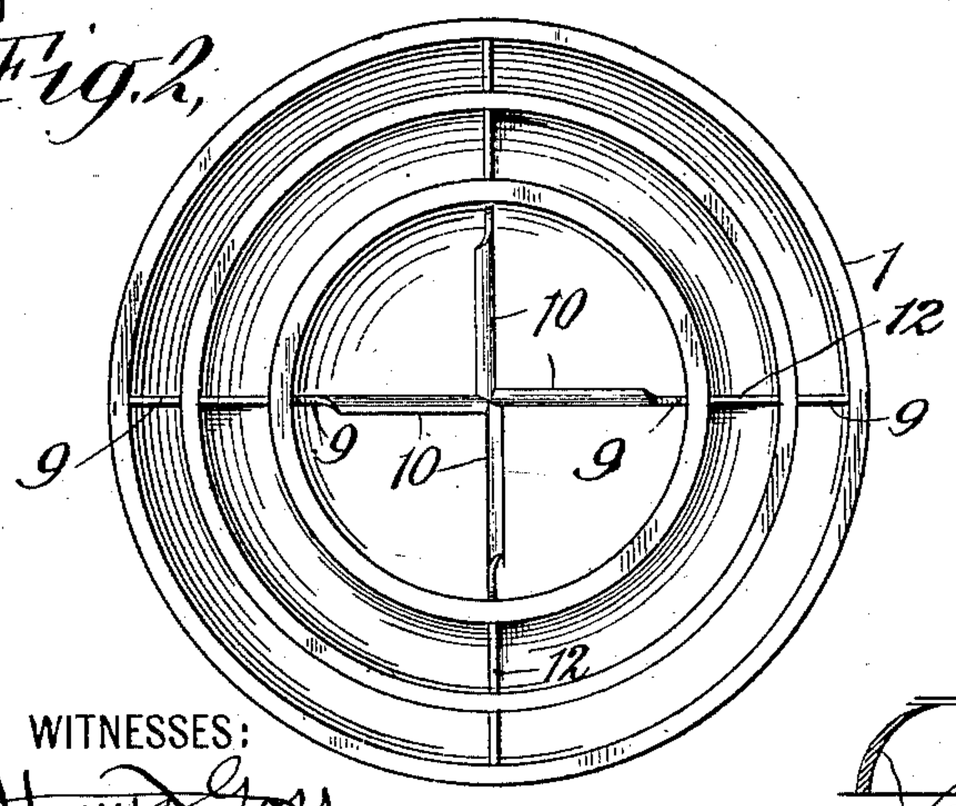

Fig. 3

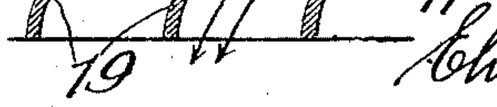

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Fig. 4,

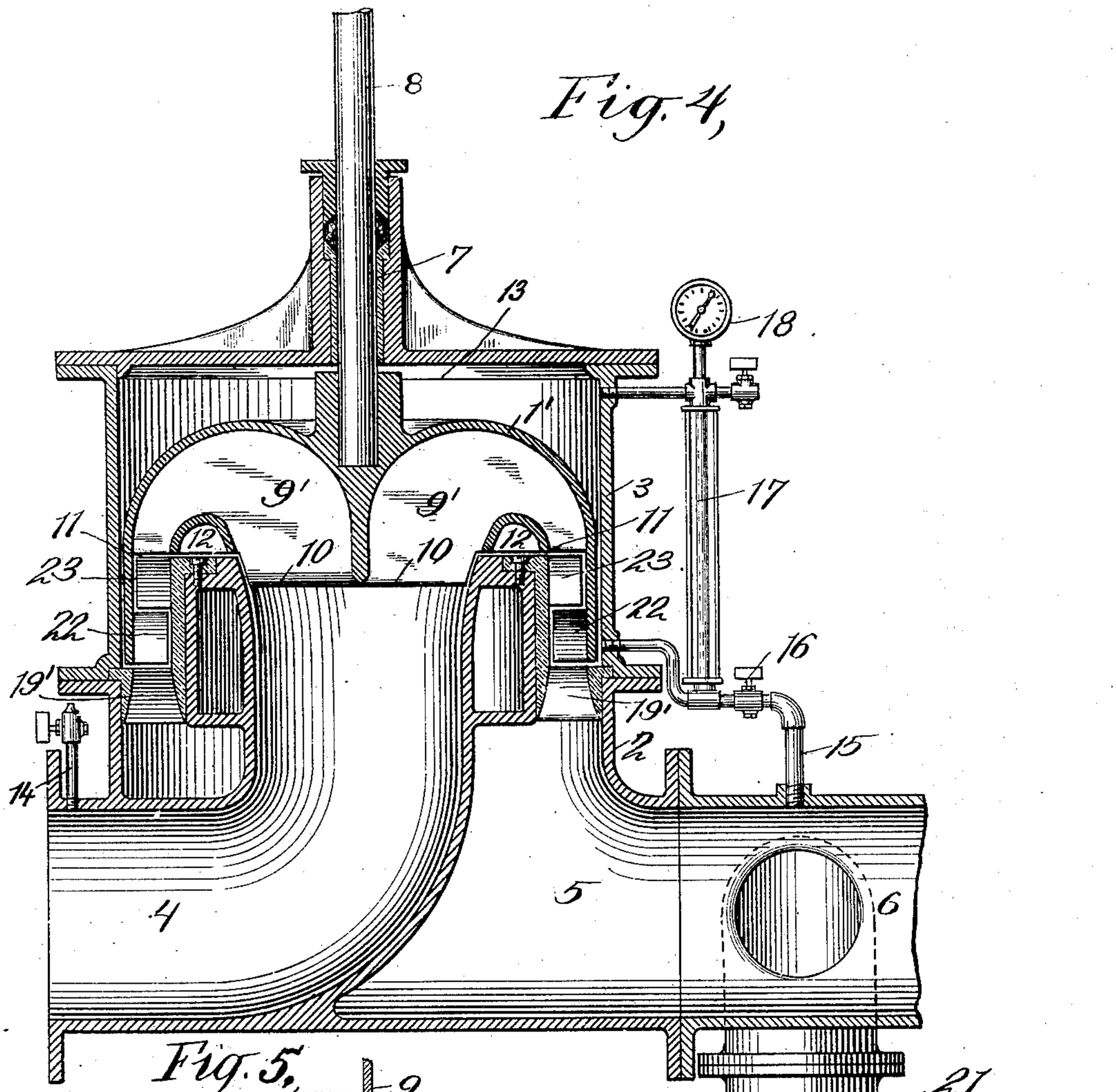
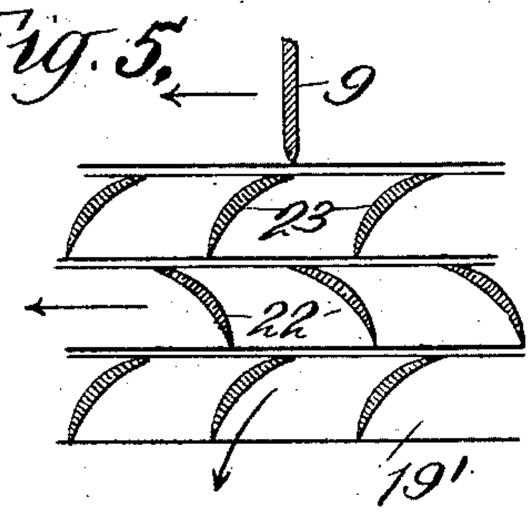
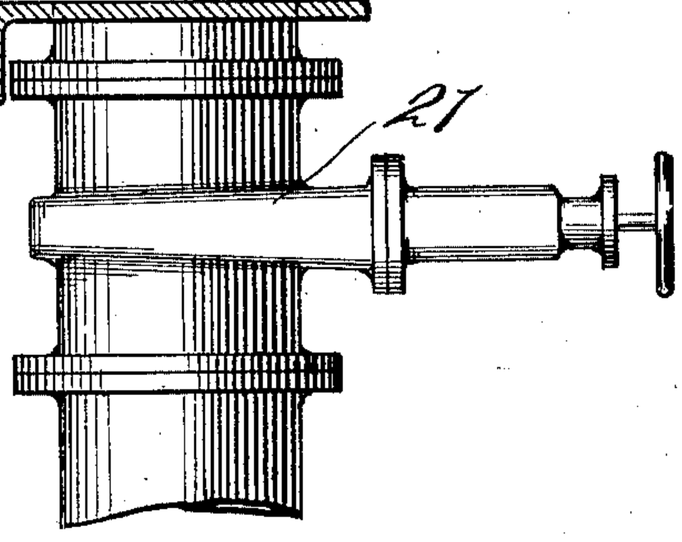


Fig. 5,





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UNITED STATES PATENT OFFICE.

ELMO G. HARRIS, OF ROLLA, MISSOURI.

CENTRIFUGAL PUMP.

SPECIFICATION forming part of Letters Patent No. 717,096, dated December 30, 1902.

Application filed October 19, 1901. Serial No. 79,194. (No model.)

To all whom it may concern:

Be it known that I, ELMO G. HARRIS, a citizen of the United States of America, and a resident of Rolla, in the county of Phelps and State of Missouri, have invented certain new and useful Improvements in Centrifugal Pumps, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

My invention relates to improvements in centrifugal pumps; and it consists in the novel means employed for removing water from the space on the rear or inactive side of the propelling-wheel and for preventing accumulation of water therein during the operation of the pump, in the novel means for compounding the pump, in the novel means employed for preventing backflow of water through the joint between the propelling-wheel and the casing, and in many other features, as hereinafter pointed out in the claims.

The objects of my invention are to reduce friction in centrifugal pumps, and particularly friction between the water and the parts of the pump, to prevent in an improved manner accumulation of water on the rear or inactive side of the propelling-wheel, to obtain the advantages of compounding in a single structure and without material increase in size, cost, or space occupied, to avoid the use of packed joints or packing-rings in the joint between the propelling-wheel and the casing, and generally to improve the efficiency of centrifugal pumps and to obtain increased economy therefrom.

I will now proceed to describe certain forms of centrifugal pumps embodying my invention and will then point out the novel features thereof in claims.

In the accompanying drawings, Figure 1 is a central vertical section of one form of centrifugal pump embodying my invention. Fig. 2 is a detail view of the propelling-wheel looking from the bottom upward. Fig. 3 is a detail view illustrating the arrangement of the guide-blades in the discharge-throat. Fig. 4 is a view similar to Fig. 1 of a compound pump similar in other respects to the pump shown in Fig. 1, and Fig. 5 is a detail view illustrating the arrangement of the guide-blades of the compound pump.

Referring first to the form of pump shown in Fig. 1, the said pump has a casing inclosing the revoluble propelling-wheel 1, which casing is formed in two sections 2 and 3, of which 2 contains the inlet-passage 4 and the annular discharge-chamber 5, adapted to be connected to the discharge-pipe 6. The other section 3 of the casing contains the principal portion of the propelling-wheel and has a stuffing-box bearing 7, through which passes the driving-shaft 8 of the propelling-wheel.

The propelling-wheel has blades or vanes 9, which extend from the center or axis of revolution of the wheel to the discharge-openings thereof. It is not essential that the blades extend to the center of the wheel; but it is preferable that such shall be the case, as the water can be given a steady rotary motion with fewer blades than when the latter do not extend to the center. The outer tips of the blades are at right angles to the plane of revolution, as shown in Fig. 3. This also is preferable, but not essential. The inner edges of the blades incline forwardly, so as to part the approaching water without causing eddies, as indicated by shading at 10 10, Figs. 1 and 2.

In the pumps shown in Figs. 1 and 4 the joint at 11 11 between the propelling-wheel and the lower section of the casing is a loose joint and no attempt is made to render it water-tight by the use of packing-rings or the like; but instead the blades 9 of the wheel project below the said joint, and small supplementary blades 12 are provided on the under side of the wheel, where they will act on water in the space between the wheel and the lower section of the casing. The centrifugal effect on the water is the same whether it is passing through the joint 11 11 or through the main channels of the wheel between the blades 9, and therefore backflow of water through the joint 11 11 is prevented. The water-friction in the joint 11 11 is inconsiderable.

An important feature of this invention is the means employed for keeping the chamber 13 upon the rear or inactive side of the wheel free from water during the operation of the pump. For this purpose I introduce into said chamber air derived from the water passing

through the pump. The water pumped often contains considerable air, existing therein as entangled bubbles, and if such is not the case air may be introduced into the water through a valved pipe 14, connected with the suction-passage 4 of the pump. Air in the water tends to accumulate at the top of the discharge-passage 6, where there is a pipe 15, forming substantially an air-dome and which may be of any desired size. This pipe or dome 15 is connected, through a valve 16, with the chamber 13 at a point near the lower edge of the wheel, where said chamber is in communication with the discharge-chamber 5 of the wheel and also through a gage-glass 17 with the chamber 13 at a higher point.

The pressure in the chamber 13 is that of the water at the point where it passes from the wheel into the discharge-chamber 5. At this point the velocity is high, and therefore the pressure in chamber 13 is less than the pressure in the chamber 5 and discharge-passage 6. This is in accordance with well-known laws of hydraulics. The air in the dome 15, the pressure in which is that of the water in discharge-pipe 6, is capable, therefore, of displacing water in the chamber 13, and will do so when the valve 16 is opened.

The gage-glass 17 is employed to indicate what water, if any, is within the chamber 13. A pressure-gage 18 may be provided to show what pressure exists in chamber 13. Its use is not necessary; but the information it gives is desirable.

In another application for Letters Patent, filed August 17, 1900, Serial No. 27,167, I have described a centrifugal pump wherein water within the chamber on the rear or inactive side of the wheel is displaced by air admitted from the outside through a suitable air-cock by reason of the fact that the velocity head of the water on leaving the wheel is greater than the head at the discharge-outlet of the pump, against which the pump works, so that suction is produced tending to draw water from the said chamber on the rear side of the wheel. In the pump above described, however, it is not essential that the velocity head shall be greater than such head against which the pump works, since water in the chamber 13 is expelled therefrom not by suction, but by air under pressure derived from the water flowing through the pump.

The dome 15 may be located at any convenient point at which air tends to collect. The amount of air required is very small, and if the water carries naturally any considerable quantity of air or other gas no air-pipe 14 is necessary.

I preferably employ guide or deflecting vanes 19, which encounter the water as it leaves the wheel. These vanes deflect the water downward, thus stopping its revolution and checking its absolute velocity as soon as it escapes from the propelling-vanes, thereby reducing friction loss. In dredge-pumps, however, these guide-vanes should be omitted and the throat 20, in which they are located, should be shortened.

A centrifugal pump cannot begin to discharge under a head which it is capable of maintaining after the discharge is started. Therefore to aid in starting the pump I connect to the discharge side of the pump at a point between the pump and the check-valve in the discharge-pipe (if any such check-valve be employed) a waste-valve 21, which may be opened partly or completely when the pump is first started, thereby temporarily reducing the head against which the pump works, and as the speed of the wheel and the flow of water increase the valve 21 may be closed gradually until the pump is working against the full head.

In the operation of this pump water is drawn up through the supply-passage 4 by reason of the water above being forced out through centrifugal force generated by the revolution of the propelling-wheel, air being drawn in through the pipe 14 and mixed with the entering water if the water does not already contain sufficient air or other gas. The water so rising has motion imparted to it by the blades of the revolving propelling-wheel and passes out through the passage of the wheel into the throat 20 and discharge-chamber 5, and so into the discharge passage or pipe 6. As the water emerges from the wheel it encounters the deflecting-blades 19 and is deflected downward thereby, its rotative motion being stopped and its absolute velocity checked, and therefore its pressure increased. The air carried by the water rises to the top of the discharge-passage, entering the dome 15 and thence passing through the valve 16 into the chamber 13, displacing any water therein and causing it to flow into the discharge-chamber of the wheel. Excess of air, if any, in passage 6 passes out with the discharge-water.

The valve 16 may be kept open only at such times as water appears in the gage-glass. At other times the valve 16 may be kept closed, if desired. A small portion of the water rising through the admission-passage 4 will pass out through the joint 11 11, circulation being maintained and backflow of water prevented by reason of the projection of the blades 9 below the joint 11 in the admission-passage and also by reason of the action of the auxiliary blades 12. The use of a packed joint between the wheel and casing or of packing-rings in such joint is thereby avoided.

In Fig. 4 I have illustrated a pump similar in all respects to that shown in Fig. 1, except that the wheel is provided with two sets of blades operating successively upon the water, between which are deflecting-blades which do not revolve with the wheel. The pump is therefore compound. The outer rim of the wheel projects below the joint 11 11 and carries blades 22 in addition to the usual blades

9′, corresponding in all respects to the blades 9 of Fig. 1. Between the blades 9′ and 22 are stationary blades 23, preferably curved like the blades 19 of Fig. 1, and below the blades 22 are blades 19′, corresponding in all respects to blades 19 of Fig. 1. In the operation of this pump the water after leaving the blades 9′ is deflected downward and has its rotative velocity checked by the blades 23. Next it encounters the revolving vanes 22, and again it has rotary motion imparted to it, the vanes 22 at the same time forcing it down with increased velocity, because of the angle and curve, and, finally, the rotative velocity thus imparted to the water is again checked, and it is deflected downward with added pressure by the blades 19′. In this way the pump is enabled to operate efficiently against a much greater head than would be possible otherwise. There may be as many sets of deflecting-vanes and revolving propelling-blades as desired, and by increasing the number of such sets the pump may be compounded to any extent desired with little increase in cost or space occupied.

What I claim is—

1. In a pump, the combination with a rotary propelling-wheel and a casing having inlet and outlet passages and inclosing a chamber between itself and said wheel, of a passage connecting said chamber with a portion of the outlet-passage in which air or other gas carried by the water may collect.

2. In a pump, the combination with a rotary propelling-wheel and a casing having inlet and outlet passages and inclosing a chamber between itself and said wheel, of an air-dome communicating with the outlet-passage at a point where air or other gas carried by the water tends to collect, and means connecting said air-dome and chamber.

3. In a pump, the combination with a rotary propelling-wheel and a casing having inlet and outlet passages and inclosing a chamber between itself and said wheel, of a passage connecting said chamber with a portion of the outlet-passage in which air or other gas carried by the water may collect, and means for introducing air into the entering water.

4. In a pump, the combination with a rotary propelling-wheel and a casing having inlet and outlet passages and inclosing a chamber between itself and said wheel, of a passage connecting said chamber with a portion of the outlet-passage in which air or other gas carried by the water may collect, and an air-pipe connected with the inlet-passage.

5. In a pump, the combination with a rotary propelling-wheel and a casing having inlet and outlet passages and inclosing a chamber between itself and said wheel, which chamber communicates, past the edge of said wheel, with the space into which fluid emerging from the wheel is discharged, of a passage connecting said chamber with a portion of the outlet-passage in which air or other gas carried by the water may collect.

6. In a pump, the combination with a rotary propelling-wheel and a casing having inlet and outlet passages and inclosing a chamber between itself and said wheel, of a passage connecting said chamber with a portion of the outlet-passage in which air or other gas carried by the water may collect, and a gage-glass indicating the height of liquid in said chamber.

7. In a pump, the combination with a rotary propelling-wheel having a central inlet and annular discharge-outlet, and having blades for imparting motion to the fluid, of a casing having inlet and outlet passages, an auxiliary passage connecting said inlet and outlet passages being provided between the wheel and casing, the blades of the wheel projecting into the inlet-passage, thereby tending to cause fluid to pass from the inlet to the outlet, both through the wheel and through the passage between the wheel and the casing.

8. In a pump, the combination with a rotary propelling-wheel having a central inlet and annular discharge-outlet, and having blades for imparting motion to the fluid, of a casing having, on one side of said wheel, inlet and outlet passages, and auxiliary blades carried by said wheel and located in the space between the wheel and the casing, the passages between said auxiliary blades communicating only with the inlet and outlet passages of the casing.

9. In a pump, the combination with a rotary propelling-wheel having a central inlet and annular discharge-outlet, and having blades for imparting motion to the fluid, of a casing having, on one side of said wheel, inlet and outlet passages, the blades of the wheel projecting into the inlet-passage, and auxiliary blades carried by the wheel and located in the space between the wheel and the casing.

10. In a pump, the combination with a casing having inlet and outlet passages, of a rotary propelling-wheel within said casing, having intake propelling-blades arranged to receive the fluid from the inlet-passage, and having also an annular rim substantially longitudinal with respect to the axis of rotation, and carrying other propelling-blades projecting from it, and deflecting-vanes interposed between such successive series of propelling-blades.

11. In a pump, the combination with a casing having inlet and outlet passages, of a rotary propelling-wheel within said casing arranged to deliver the fluid in substantially the direction of the axis of rotation, and having intake propelling-blades and a rim projecting in substantially the direction of the axis of rotation and carrying other propelling-blades, and deflecting-vanes interposed between such successive series of propelling-blades.

12. In a pump, the combination with a casing having a central inlet-passage and an annular discharge-passage, of a rotary propelling-wheel within said casing, having intake propelling-blades arranged to receive the fluid from the inlet-passage, and having also a rim surrounding the inlet-passage and carrying other propelling-blades, and deflecting-vanes interposed between such successive series of propelling-blades, and located upon the outside of the inlet-passage.

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