No. 705,347. Patented July 22, 1902.

E. G. HARRIS.

CENTRIFUGAL PUMP.

(Application filed Aug. 17, 1900.)

(No Model.) 2 Sheets—Sheet 1.

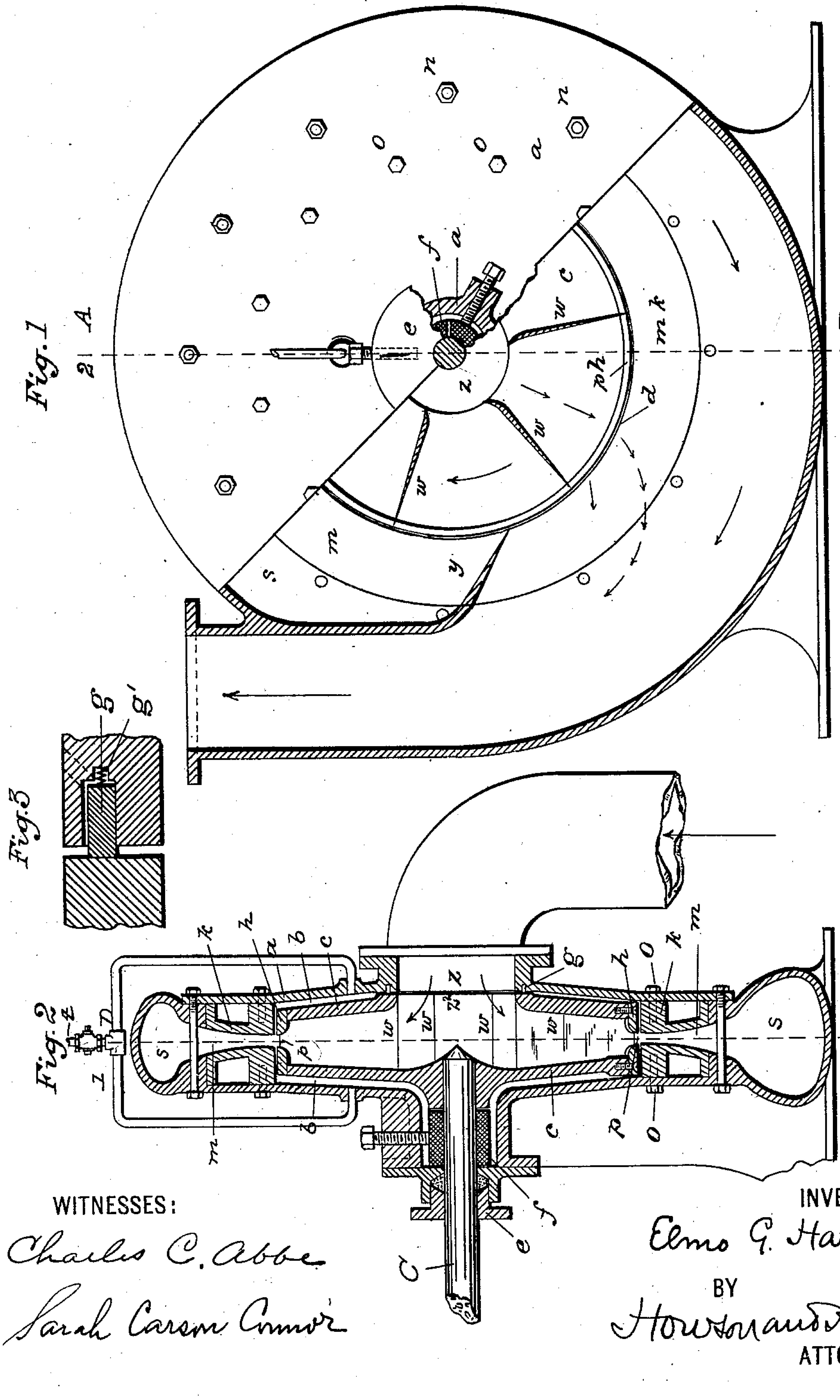

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Fig. 4

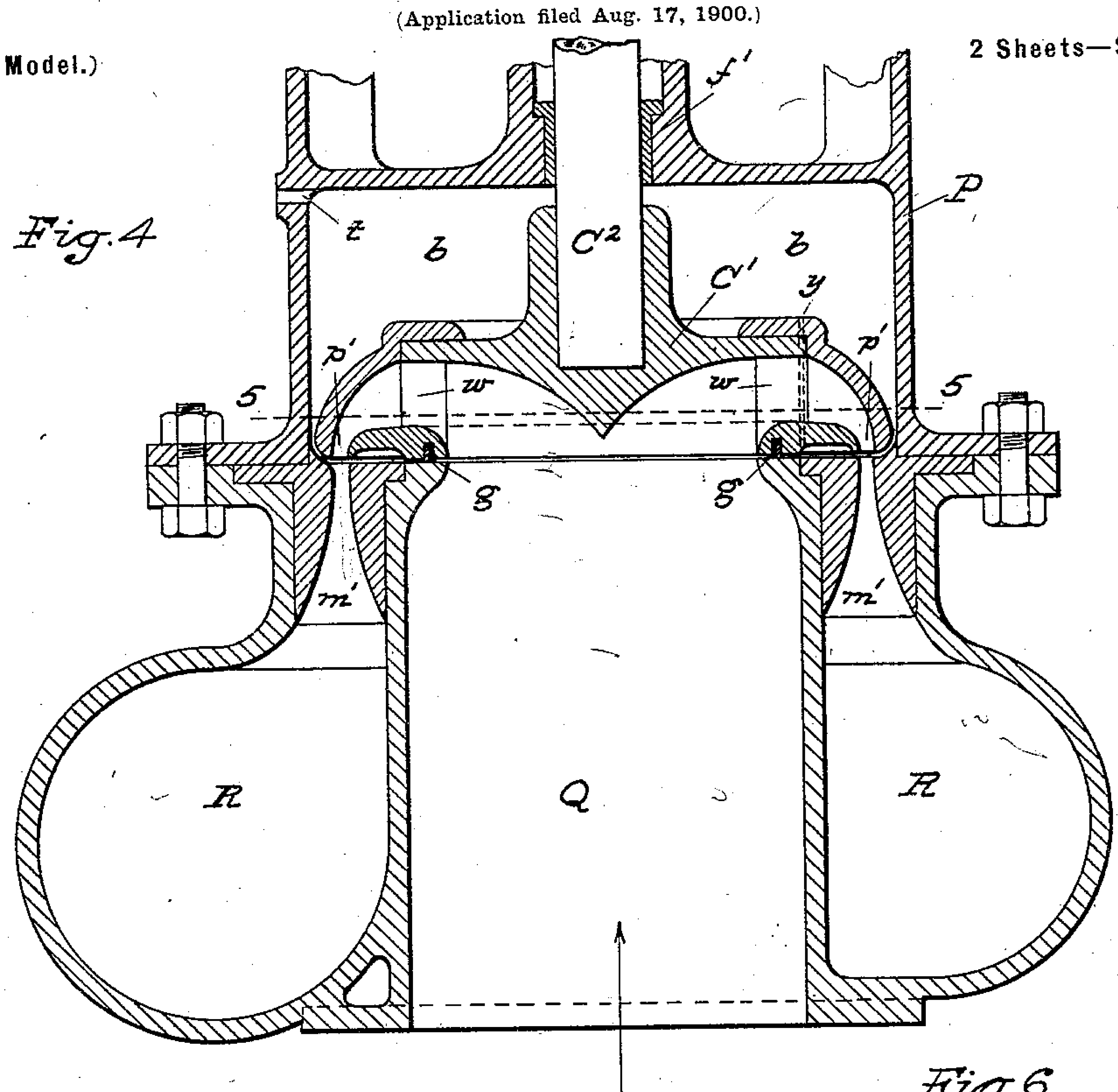


Fig. 5

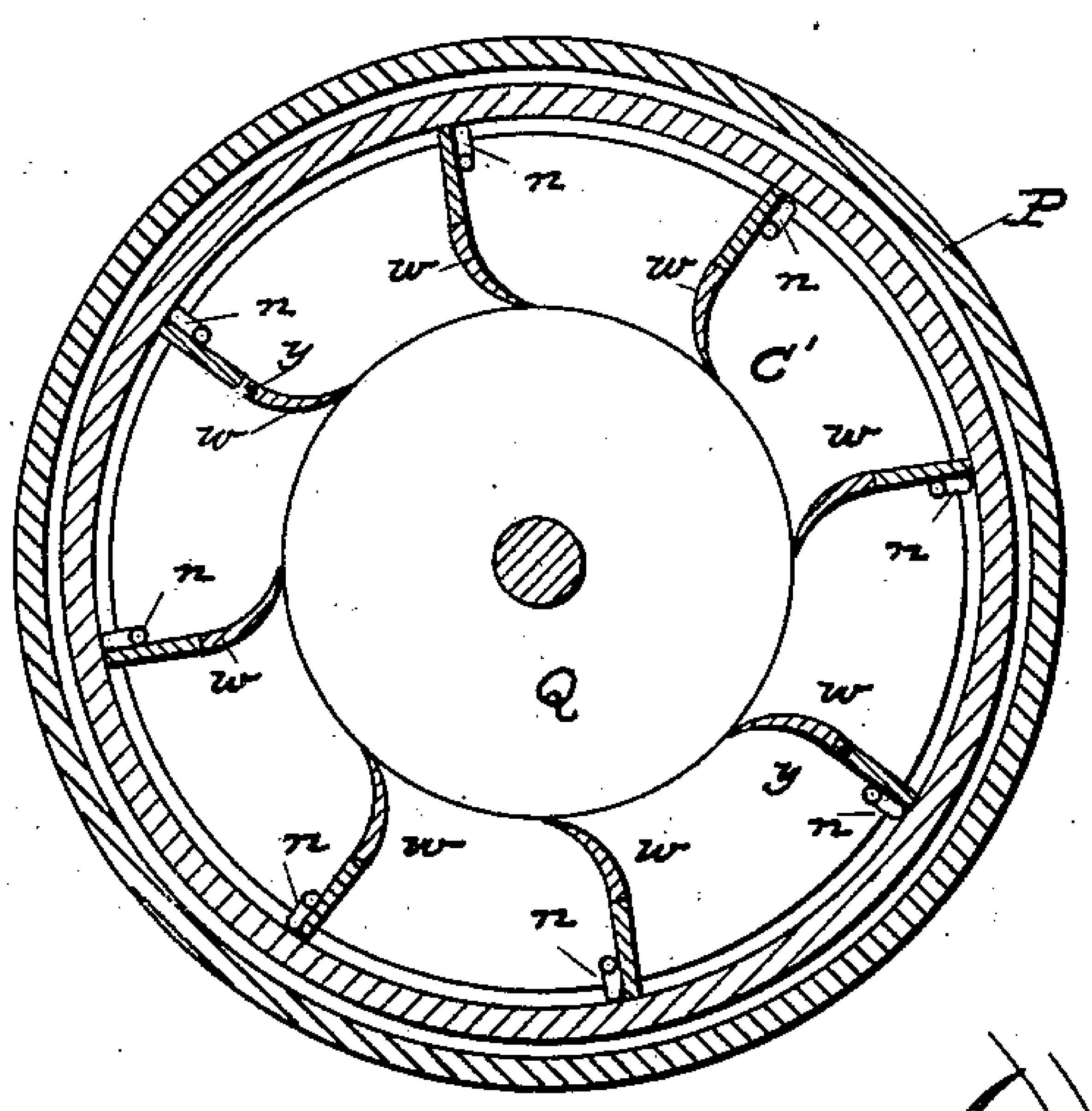


Fig. 6

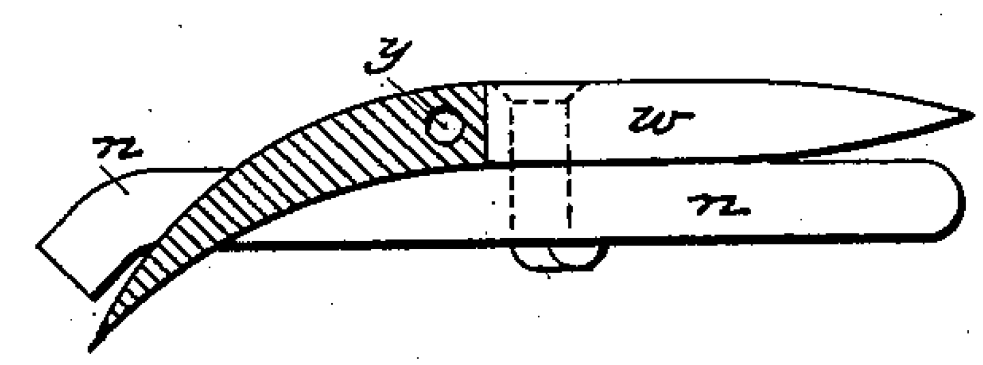


Fig. 7

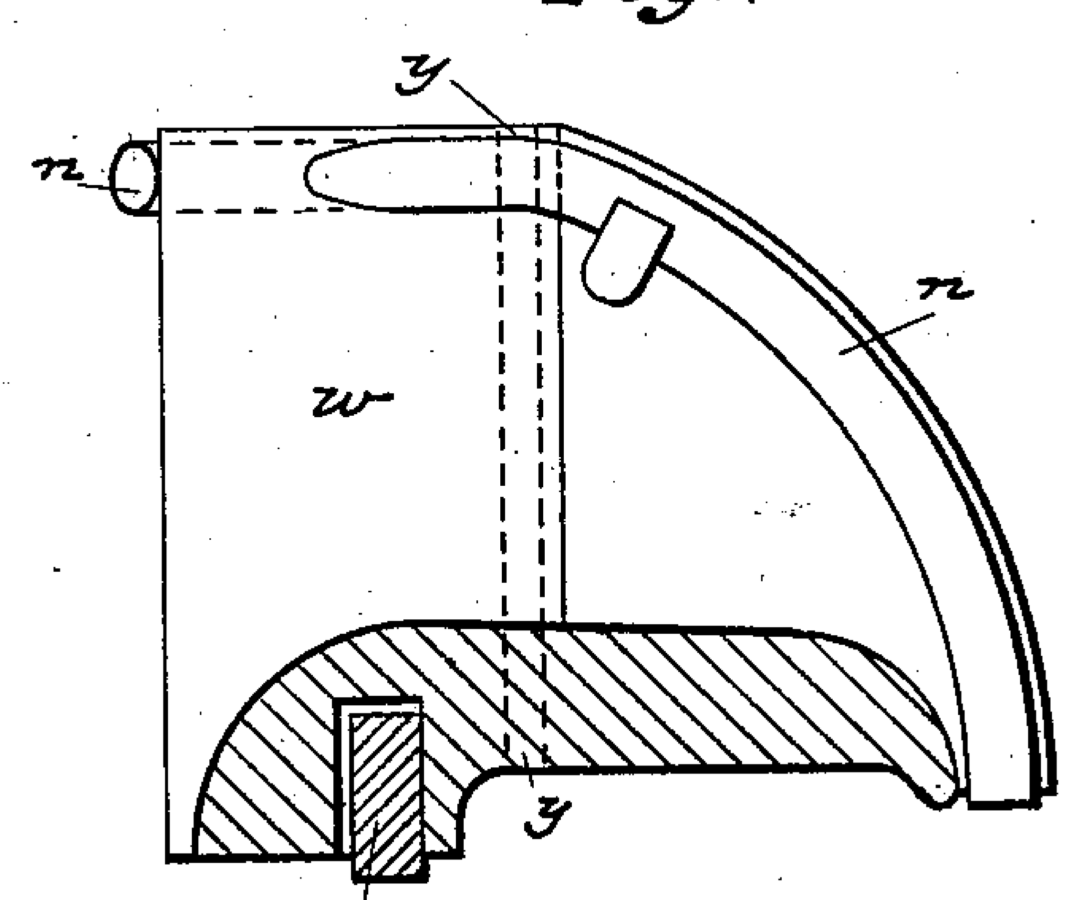
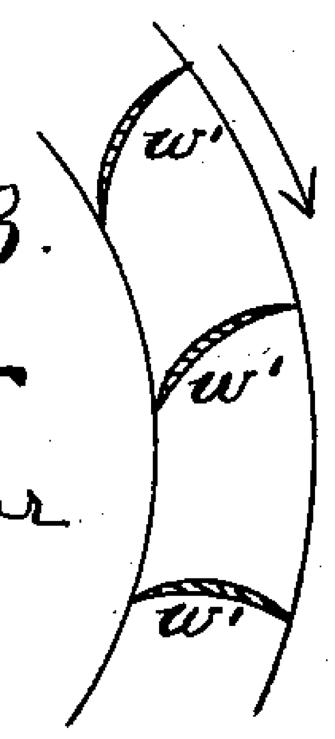


Fig. 8



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UNITED STATES PATENT OFFICE.

ELMO G. HARRIS, OF ROLLA, MISSOURI.

CENTRIFUGAL PUMP.

SPECIFICATION forming part of Letters Patent No. 705,347, dated July 22, 1902.

Application filed August 17, 1900. Serial No. 27,167. (No model.)

To all whom it may concern:

Be it known that I, ELMO G. HARRIS, a citizen of the United States of America, residing in Rolla, in the county of Phelps, State of Missouri, have invented Improvements in Centrifugal Pumps, of which the following is a specification.

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 accumulation of water upon the rear or inactive side of the propelling-wheel, to obtain increased delivery in proportion to size of pump and speed of revolution as compared with present practice, to regulate the delivery without throttling of the discharge and without varying the speed of the pump, to prevent accumulation of air in the water-passages of the pump, to prevent leakage between the fixed casing and the revolving propelling-wheel of the pump, and generally to improve the design, construction, and operation of centrifugal pumps.

I will now proceed to describe an apparatus embodying my invention and will then point out the novel features in claims.

In the drawings which accompany and form a part of this specification, Figure 1 is a side elevation, partly in section, on the line 1 1, Fig. 2, of one form of my improved pump. Fig. 2 is a vertical section on the line 2 2, Fig. 1. Fig. 3 is an enlarged sectional view of a detail. Fig. 4 is a vertical section of a modification. Fig. 5 is a sectional plan on the line 5 5, Fig. 4. Fig. 6 is an enlarged plan view of one of the vanes. Fig. 7 is a corresponding side elevation, and Fig. 8 is a sectional view showing a modified form of vane.

In the construction shown in Figs. 1 and 2, a is a fixed inclosing casing with the inlet at z and the annular discharge-pipe at s, as is common in such pumps. Within the casing a is the revolving propelling-wheel c, mounted on a shaft C, which passes out through a stuffing-box e in the casing and is mounted in suitable bearings f. The wheel c is a closed shell except at its inlet z^2 opposite the inlet z and the contracted annular outlet p. Between the two walls of the wheel c and rigidly attached thereto are the propelling-vanes w, beginning at the periphery of the inlet z^2 and extending to the outlet p. These vanes may be of the shape shown in Fig. 1, but are preferably curved forwardly or concave to the forward direction, as indicated at w' in Fig. 8.

As centrifugal pumps are ordinarily constructed no provision is made for preventing the accumulation of water between the casing of the pump and the rear or inactive side of the propelling-wheel or for ejecting from such space water which may enter it. As a result water enters such space, and when the propelling-wheel is revolved the friction of this water against the wheel and the casing increases materially and unnecessarily the resistance to revolution of the wheel, thereby reducing the efficiency of the pump. Such wasteful friction I avoid in the following way: As shown in Fig. 2 and likewise in Fig. 4, (to which reference will be made hereinafter,) the annular discharge-outlet p of the wheel is much contracted in cross-sectional area. Water emerging from this annular discharge-outlet enters an outwardly-flaring receiving-throat m, leading to the discharge-passage s. The contraction of the discharge-outlet p is such that the water emerges therefrom at a very high velocity as compared with the velocity with which water leaves the propelling-wheels of pumps as ordinarily constructed and with a velocity-head not less and usually greater than the head at the discharge-outlet, against which the pump works, and, entering the flaring portion of the receiving-throat m, produces suction in the casing of the wheel, if the velocity of the water is such that the velocity-head is greater than the head at the discharge-outlet, against which the pump works, such suction being due to the velocity of the water and the flaring nature of the throat. Such suction draws from the space b between the casing and the rear or inactive side of the propelling-wheel any water which may be therein, so emptying said space of water and preventing water from entering it while the pump is in operation. If entrance of air into this space be prevented after the water has been withdrawn therefrom, a partial vacuum will be produced, so that not only is there no water-friction on the rear side of the propelling-wheel to resist its rotation, but even the air in said space is rarefied and offers little frictional resistance.

In order to admit air into the space b, I provide an air-cock t. In the operation of the pump in order to draw off water within the space b said air-cock may be opened, thereby permitting the water to flow out through the space between the periphery of the wheel and the casing under the influence of the suction produced as above described. After the water has escaped from the space b and the cock t is again closed some of the imprisoned air may escape through the throat m; but a state of partial exhaustion will soon be reached that can be carried no further under the conditions. Then the water will pass from the revolving outlet p into the fixed receiving-throat m without break or leakage of water outwardly or of air inwardly, though considerable space be left between the outlet and the receiving-throat. Thus the wheel will revolve in air (usually somewhat rarefied) and there will be no "slip" of the wheel relatively to the water and no "threshing" of the water by the vanes. The water will pass out nearly radially (the shortest path) relatively to the wheel in which it is inclosed. Hence the frictional resistance will be reduced to a minimum. At the same time the presence of suction at the discharge from wheel, instead of back pressure from the lift, will cause the water to flow out with high velocity, thereby giving a great discharge from a small wheel.

The air-cock t is a convenient and effective means for regulating the discharge of the pump without throttling the discharge and without varying the speed, for if the air-cock be open air will be drawn into the pump through said cock, thereby reducing the suction. The air thus taken in will be forced out with the water, the delivery of the water by the pump being reduced more or less, according as much or little air is permitted to be drawn into the pump.

In the modification shown in Figs. 4 and 5 I have illustrated a construction in which the wheel c is fixed to a vertical axis and the inlet is a central vertical tube Q. The annular discharge or outlet p' of the wheel instead of being radially outward is downward and parallel to the axis, the water passage through the wheel being curved, as shown by Fig. 4. In the fixed casing is provided an annular receiving-throat m' opposite to the discharge and flaring outwardly into the discharge-pipe R for the purpose already explained. One advantage of this construction as compared with that shown in Figs. 1 and 2 is that the weight of wheel c will be partly or entirely supported by the reaction of the water escaping through p' and also by the deflection of the column of water rising up through the inlet Q. Another advantage is that there will be less difficulty in keeping the two nozzles p' and m' opposite each other. In other respects this construction will operate in the manner already described.

In the constructions shown it is intended that the action of the pump shall be dependent chiefly on centrifugal force. With that view I make the volume of the interior of the wheel c as large as convenient to reduce velocity and to allow the passing water time to get the revolution of the wheel; but I provide a contracted outlet proportioned to give the required discharge. Now if by any means some air gets into the water entering a wheel thus proportioned displacement of such air by the heavier water will cause it to collect about the axis of revolution of the wheel, so as to interfere with the proper action of the pump unless provision be made to carry it out. To take this air out, I provide a tube n of nearly constant cross-section, open at both ends, passing from within the inner limit of the vane w to the discharge p'. A little attention to the laws of centrifugal force will show that in such a tube there will be no tendency to force the air back to the center of revolution, but rather a tendency to suck or draw in an outward direction more water or air all along the length of the tube. Hence the air will pass out through the tube.

In these centrifugal pumps (illustrated in two modifications by Figs. 1 and 2 and Figs. 4 and 5) I prefer to place a metallic ring g in the joint at entrance between the fixed casing and the revolving wheel to reduce liability to leakage into the space b through that joint. This ring is cut through or split at one place and is elastic. When unstrained, it will rest loosely in the groove; but if in operation water tends to escape outward it will press the spring out till it rests firmly against the wall of its groove, while its edge remains touching the opposite face of the joint, thus securing a close joint. In the modification Figs. 1 and 2 it may be necessary to put light springs g', Fig. 3, behind the ring to hold it against the opposite face; but in the modification Fig. 4 the weight of the spring will suffice. It may be observed that suction on both sides of this ring may be equal, or nearly so. Hence there will never be a great difference of pressure tending to cause leakage.

I have shown the contracted passages p and m and p' and m' as being made of properly-shaped rings attached to the wheel or casing, as the case requires. This construction is desirable in order that these pieces may be made of special metals, given special polish, and changed with changing conditions.

I claim as my invention—

1. In a pump, the combination with a rotary propelling-wheel having a central inlet and a contracted annular discharge-outlet, of a casing therefor, said casing inclosing a chamber between itself and the said propelling-wheel, which chamber is normally closed against the admission of fluid thereto, but into which chamber a passage leads from the said propelling-wheel contracted discharge-outlet, whereby, when the pump is operating, the pressure in said chamber may be maintained, at or below atmospheric pressure.

2. In a pump, the combination with a rotary

propelling-wheel having a central inlet and a contracted annular discharge-outlet, of a casing therefor, said casing inclosing a chamber between itself and the said propelling-wheel, which chamber is normally closed against the admission of fluid thereto, and said casing having an outwardly-flaring receiving-throat opposite the discharge-outlet; the said pump having means therein for producing a rarefied condition of the fluid within said inclosed chamber.

3. In a pump, the combination with a rotary propelling-wheel having a central inlet, and an annular discharge-outlet so contracted that the velocity-head at the point of delivery will be not less than the head at the discharge-outlet against which the pump works, of a casing therefor, said casing inclosing a chamber between itself and the said propelling-wheel, which chamber is normally closed against the admission of fluid thereto, but into which chamber a passage leads from the said propelling-wheel contracted discharge-outlet, whereby, when the pump is operating, the pressure in said chamber may be maintained, at or below atmospheric pressure.

4. In a pump, the combination with a rotary propelling-wheel having a central inlet, and an annular discharge-outlet so contracted that the velocity-head at the point of delivery will be greater than the head at the discharge-outlet against which the pump works, of a casing therefor, said casing inclosing a chamber between itself and the said propelling-wheel, which chamber is normally closed against the admission of fluid thereto, but into which chamber a passage leads from the said propelling-wheel contracted discharge-outlet, whereby, when the pump is operating, the pressure in said chamber may be maintained, by eduction, below atmospheric pressure.

5. In a pump, the combination with a rotary propelling-wheel having a central inlet and a contracted annular discharge-outlet, of a casing therefor, said casing inclosing a chamber between itself and the said propelling-wheel, which chamber is normally closed against the admission of fluid thereto, and said casing having an outwardly-flaring receiving-throat opposite the said discharge-outlet; and a valved inlet to said chamber.

6. In a pump, the combination with a rotary propelling-wheel having a central inlet, a contracted discharge-outlet, vanes, and a passage of undiminished cross-sectional area from its inner to its outer end, leading from the inner limits of the vanes to the line of discharge, of a casing for said wheel.

7. In a pump, the combination with a rotary propelling-wheel having a central inlet, a contracted discharge-outlet, and vanes, and provided with a passage leading from the inner limit of the vanes to the line of discharge, having substantially the same cross-sectional area throughout, of a casing for said wheel.

8. In a pump, the combination with a rotary propelling-wheel having a central inlet, a contracted annular discharge-outlet, and vanes, and provided with a passage leading from within the inner limits of the vanes to the line of discharge, having substantially the same cross-sectional area throughout, of a casing for said wheel having an outwardly-flaring receiving-throat opposite the discharge-outlet of the wheel, the contraction of said outlet being so proportioned that the velocity-head at the point of delivery will be not less than the head at the discharge-outlet against which the pump works.

9. In a pump, the combination with a rotary propelling-wheel having a central inlet and a contracted discharge-outlet, of a casing therefor, and a tube, as shown, leading from the interior of the wheel to the line of discharge.

10. A pump, comprising an inclosing casing and a rotary propelling-wheel therein, said wheel having a central inlet, vanes and a contracted annular outlet formed of two detachable rings set on the wheel, and the casing having an outwardly-flaring annular throat, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ELMO G. HARRIS.

Witnesses:

W. D. JONES,

CYRUS H. JONES.