L. BELLOT.

CENTRIFUGAL PUMP.

APPLICATION FILED SEPT. 1, 1904.

903,658.

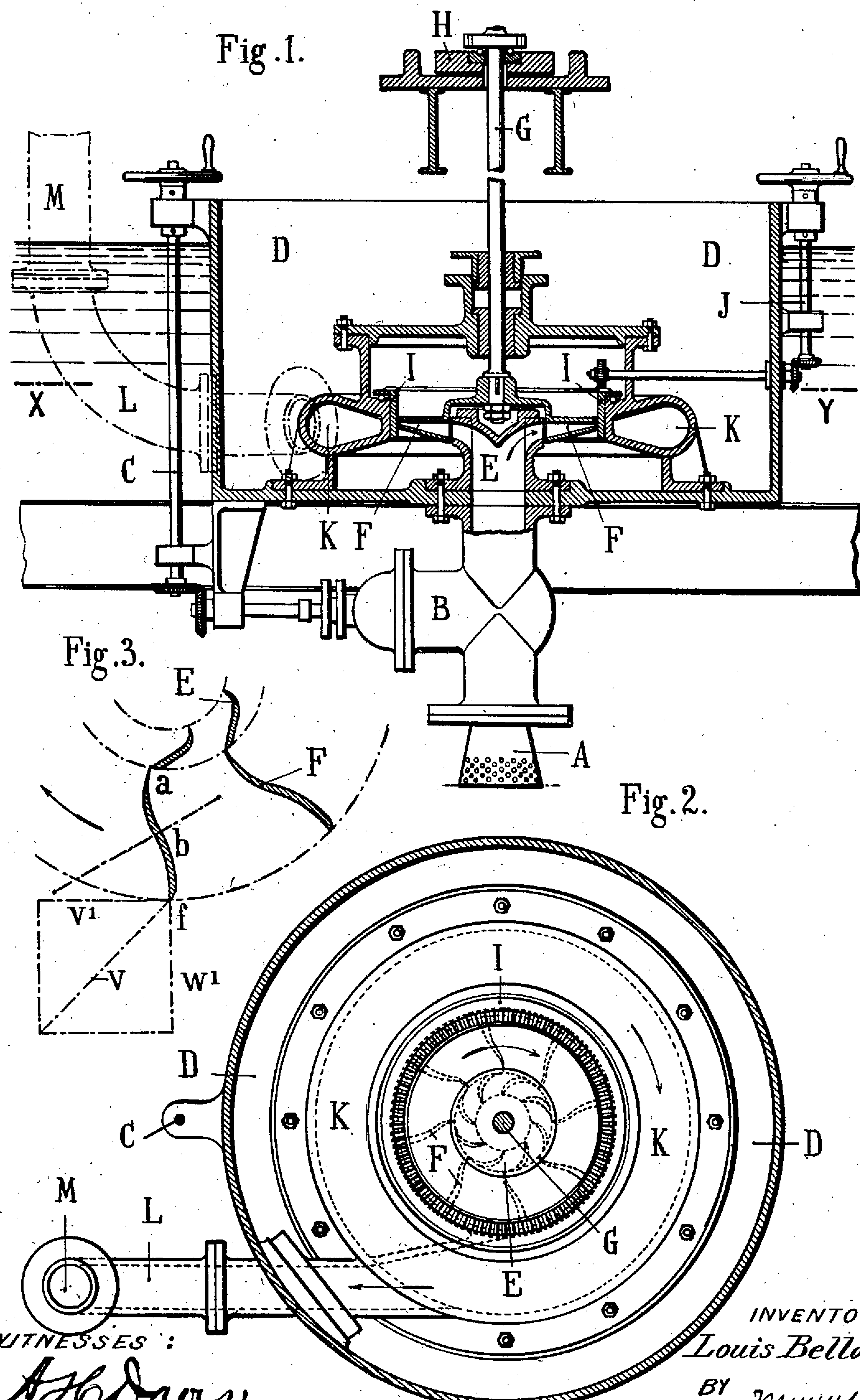
Patented Nov. 10, 1908.

2 SHEETS—SHEET 1.

Fig. 1.

Fig. 3.

Fig. 2.



WITNESSES:

A. H. Davis

Isaac B. Owens.

INVENTOR

Louis Bellot

BY Munn & Co

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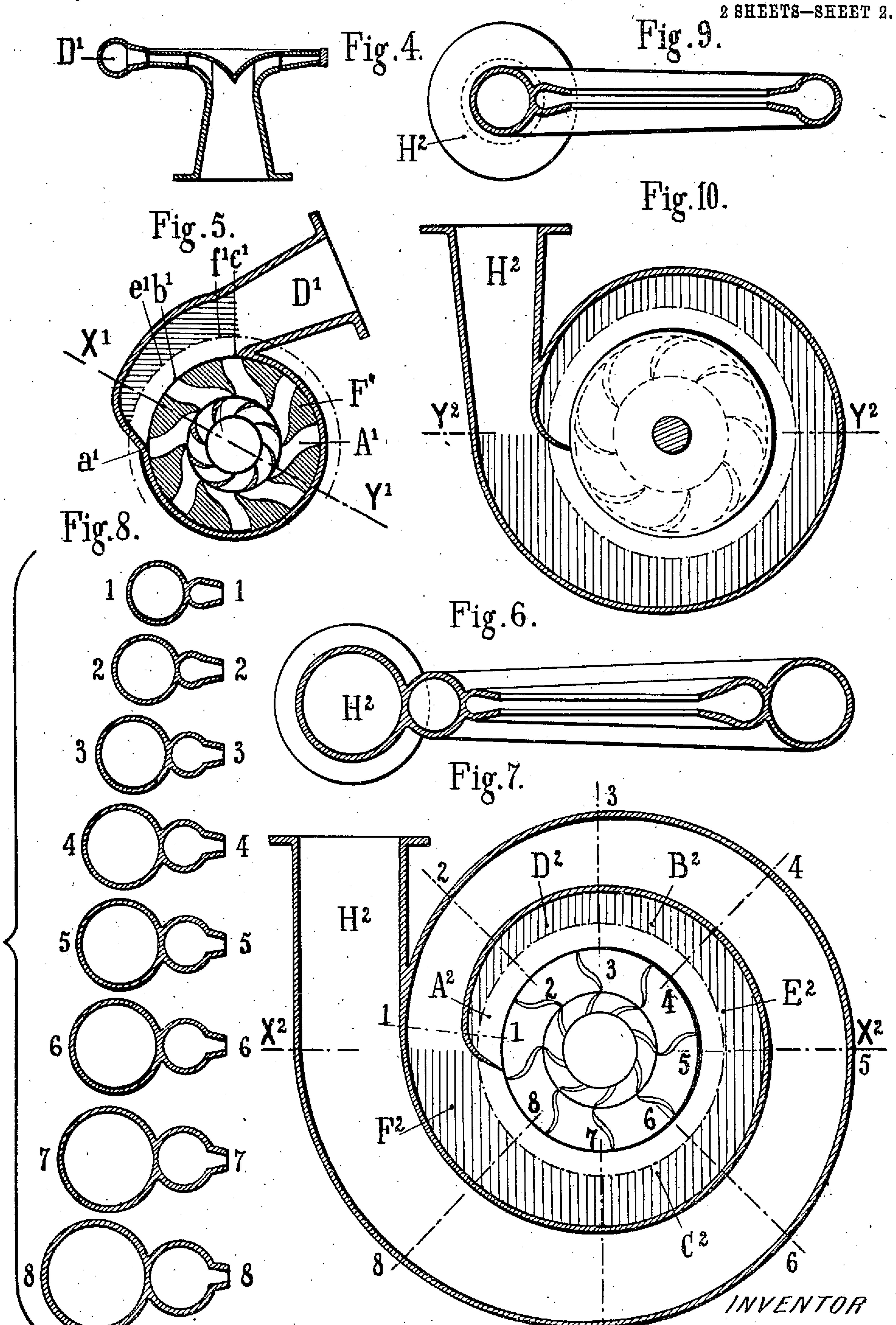

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UNITED STATES PATENT OFFICE.

LOUIS BELLOT, OF PARIS, FRANCE.

CENTRIFUGAL PUMP.

No. 903,658. Specification of Letters Patent. Patented Nov. 10, 1908.

Application filed September 1, 1904. Serial No. 222,992.

To all whom it may concern:

Be it known that I, LOUIS BELLOT, of 3 Boulevard Richard Lenoir, in the city of Paris, Republic of France, civil engineer, have invented Improvements in and Relating to Centrifugal Pumps, of which the following is a full, clear, and exact description.

Experience has demonstrated that: (1) the efficiency of centrifugal pumps is so much the greater according as the suction height is less; (2) that the maximum height at which the water is maintained in the suction column during working does not exceed 8 meters; (3) that above this height of 8 meters pumps lose their priming notwithstanding the presence of a foot-valve.

From the above it may be concluded that, if during the operation of the pumps, water rises in the suction pipes to a maximum height of 8 meters it is because the vacuum produced in this pipe balances a column of water 8 meters high. It is therefore apparent that a pump which is submerged and thus utilizes hydrostatic pressure, has greater efficiency than one not submerged and into which liquid must be drawn by air pressure alone; and this result is promoted by directing the liquid currents into the pump by guides construbted and arranged as hereinafter described.

If, now we assume that the pump is immersed in the water that it is desired to suck and that this pump is acting, the practical velocity with which the water will leave the guide vanes will be equal to

$$\sqrt{2g \times (8 \text{ meters} + h)},$$

8 meters being the maximum reduction of pressure found previously and h the vertical distance from the level of the water that is to be sucked to the center of the distribution apertures. If now h is made equal to 1 meter, 2 meters, 3 meters, 4 meters, 5 meters, the practical generating charge of the velocity of discharge of the water in the orifices of the distributer will be 10 meters, 11 meters, 12 meters, 13 meters, etc. But if it is considered that the pump is completely submerged, that no readmission of air is possible and that no liberation of air contained in suspension in the water can take place in its passage through the orifice of the distributer, the conclusion will be arrived at that the practical charge is, in this case, exactly equal to the theoretical charge, 11, 33,— 12, 33,— 13, 33,— 14, 33,— 15, 33 meters.

Having given this preliminary explanation, in order that this pump may be readily and clearly understood, I will now describe the same with reference to the accompanying drawing, in which it is given by way of example, and in which:

Figure 1 represents the pump in vertical section. Fig. 2 is a horizontal section on the line X Y of Fig. 1. Fig. 3 is in part a diagrammatic view of a portion of the pump, illustrating also the theory of the operation. Fig. 4 shows the form of pump in question in vertical section on the line X′ Y′ of Fig. 5. Fig. 5 is a horizontal section through the same pump. Fig. 6 represents a system of transformer in vertical section on the line X^2 X^2 of Fig. 7 and forming part of this kind of pump. Fig. 7 is a horizontal section. Fig. 8 represents cross sections taken on the line 1—1,— 2—2,— 3—3,— 4—4,— 5—5,— 6—6,— 7—7,— and 8—8 of this transformer. Fig. 9 shows a modification of this transformer in vertical section on the line Y^2 Y^2 of Fig. 10, and Fig. 10 is another horizontal section.

As shown in Fig. 1, in this form of centrifugal pump, a sieve or enlarged perforated pipe A is surmounted by a casing B containing a slide cock which may be operated by a horizontal gear through the medium of a vertical shaft C, having a hand-wheel at the top. The pump body, properly so called, is arranged within a cylindrical casing or receptacle D, made preferably of cast iron and arranged at a lower level than the water which is to be raised. The water enters the fixed vertical distributer E and is sent outward into the movable annular hollow rim having guides or buckets as hereinafter explained, and adapted to rotate with a vertical hanging shaft G supported upon a ball bearing H and provided with a pulley which may be driven from a motor of any suitable kind. The pump also comprises an annular gate or shutter, constructed preferably of bronze, supported upon antifriction balls and provided with a beveled crown. The opening or closing movement of the gate is given by means of a horizontal shaft and a vertical shaft J geared therewith and having a hand-wheel for rotating it. Exterior to the said gate I, is arranged a hollow annulus K from which water is discharged into a conduit L, M, the latter indicating the vertical portion, and which is in practice provided with a stop cock. As shown in Figs. 2 and 3 of the drawing, the guides or pallets F have a double curvature, the face being concave from *a* to *b* and convex from *b* to *f*.

From point *b* to point *f*, which constitutes the outer portion of the guides, the impinging current of water exerts very little force. This convex part *b f*, which joins the concave part *a b* tangentially, acts practically as a piston, forcing before it the impinging current of water as it is about leaving the turbine.

In the diagrammatic representation, Fig. 3, the dotted line W′ of the parallelogram may indicate the speed with which the water traverses the outlet of the turbine, and V′ the speed of rotation, while the diagonal V represents the resultant of the two speeds or velocities, W′, V′.

In the form of pump represented in Figs. 4 and 5, the passages A′ have sides which are curved practically upon the same line as the guides F before described, but the passages are slightly contracted from the inner ends outward and the portions intervening the passages are solid as shown by hatching. In consequence of this contraction of the passages A′, the discharge of liquid is diminished correspondingly in volume. In Fig. 5 the outlet has a portion only of the circumference of the wheel, it being the arc indicated at *a*′, *b*′, *c*′. The adjacent and exterior passage has a diverging wall so that the area for passage of water constantly increases from *c*′ to *f*′ as indicated by the cross hatching. The nozzle D′ into and through which the liquid discharges, is tapered or enlarged correspondingly, and by this form of the outlet passage or evacuation path, provision is made for flow of the liquid so that there is no shock or loss of power and effect between the streams discharged from the wheel proper into the passage. It is obvious, however, that owing to the increasing area of the discharge passage from its inception to the outer end of the tapered nozzle D′, the velocity must gradually decrease corresponding to the progressive enlargement.

As specified in Fig. 5, the construction of the casing is such that discharge of water takes place from a portion only of the pump. This form of pump may be employed whenever the column of water to be lifted is very light. The outlets are relatively large, so that their obstruction by foreign bodies, such as small pebbles, in the water, is avoided.

Instead of making the nozzle of conical form as in Fig. 5, it might be made of curvilinear form concentric with the pump and of greater or less development.

In order to obtain a maximum efficiency with the said centrifugal pumps it is not sufficient to effect the admission without shock and the discharge with the greatest possible velocity in order to balance the greatest height of ascensional column, it is particularly necessary that at the discharge, the liquid streams should not encounter with shock the other liquid streams in movement in the evacuation passage. This result is obtained with the form of transformer which is hereinafter described.

As shown in the drawing (Figs. 6 and 7) this transformer is constituted by an annular crown surrounding and concentric with the pump proper and provided with diverging walls of rectilinear or curvilinear form in such a manner that all the liquid streams issuing from the pump traverse this crown of constant section with an equal velocity. This velocity in passing through the annular zone represented by the circle A^2 B^2 C^2 (Fig. 7) is a function of the cross section and may be, according to circumstances 2, 3, 4, 5 . . . . 10 times less than that with which the liquid streams have left the pallets of the pump. In other words, the annular zone referred to is the neck or throat through which the water enters the scroll or volute passage represented in Fig. 6, and at the right hand side of the drawings constituting Fig. 8, and the speed at the passage may be two, three, four, five, or even ten times weaker than that with which the water left the pallets of the pump, such result being due to the two divergent walls of the first path of evacuation which gives a passage two to ten times larger than the issuing section of the turbine.

In order that there may be no shock against the liquid streams issuing from the zone A^2 B^2 C^2 and those in movement in the evacuation path, it is necessary that the velocity of these latter streams should be exactly the same as that of the former. This result is obtained by giving to the first part of the evacuation path D^2 E^2 F^2 an increasing section proportionate to the volume which flows into it. Thus the streams leaving the pump proper and discharging around it in the annular zone A^2, B^2, C^2, moves with the same velocity as the volume of liquid that flows in the zone indicated by hatch lines at A^2, D^2, E^2, and F^2—see Fig. 7.

From the point F^2 to the outlet H^2 of the second evacuation path, the section increases progressively in such a manner as to obtain a continuous reduction of velocity so that at the point H^2 the velocity has become the minimum and equal to that which the water should have in the ascending column. The arrangement represented in Figs. 6, 7 and 8 is particularly applicable to pumps which are intended to force liquid to a great height.

The modification represented in Figs. 9

and 10 of the drawing, is based upon the same principle as the above but it is more particularly applicable to pumps for forcing liquid to lesser heights. In this case, discharge velocity of the pump being considerably less, the second evacuation path is replaced by a conical nozzle the section of which increases gradually in such a manner that the velocity of flow into H^2 is equal to that of the liquid in the ascensional column. It will of course be understood that this transformer may be applied equally well to the said pumps mounted upon vertical or horizontal shafts.

The forms, details, accessories, materials and dimensions of this form of pump may of course vary without thereby in any way changing the principle of this invention. Thus, for example, the pump may be arranged upon a horizontal shaft in placing it at a higher level. It is also possible to employ two or more circular forcing crowns, in mounting them one upon the other or in rendering them rigid with the vertical or horizontal shaft.

I claim—

In a centrifugal pump of the class indicated, the combination, of a fixed central distributer E and a hollow annular impeller F, provided with a series of guides arranged in a general radial direction and having a special double curvature as described, the concave portions of the guides being arranged contiguous to the said central distributer, so as to utilize the first impact of the liquid while the outer convex part of the guides serves as a piston, the whole being arranged and operated as described.

The foregoing specification of my improvements in and relating to centrifugal pumps, signed by me this 19th day of August, 1904.

LOUIS BELLOT.

Witnesses:

HANSON C. COXE,

MAURICE H. PINUET.