(No Model.) 2 Sheets—Sheet 1.

G. W. PRICE.

CENTRIFUGAL PUMP.

No. 517,529. Patented Apr. 3, 1894.

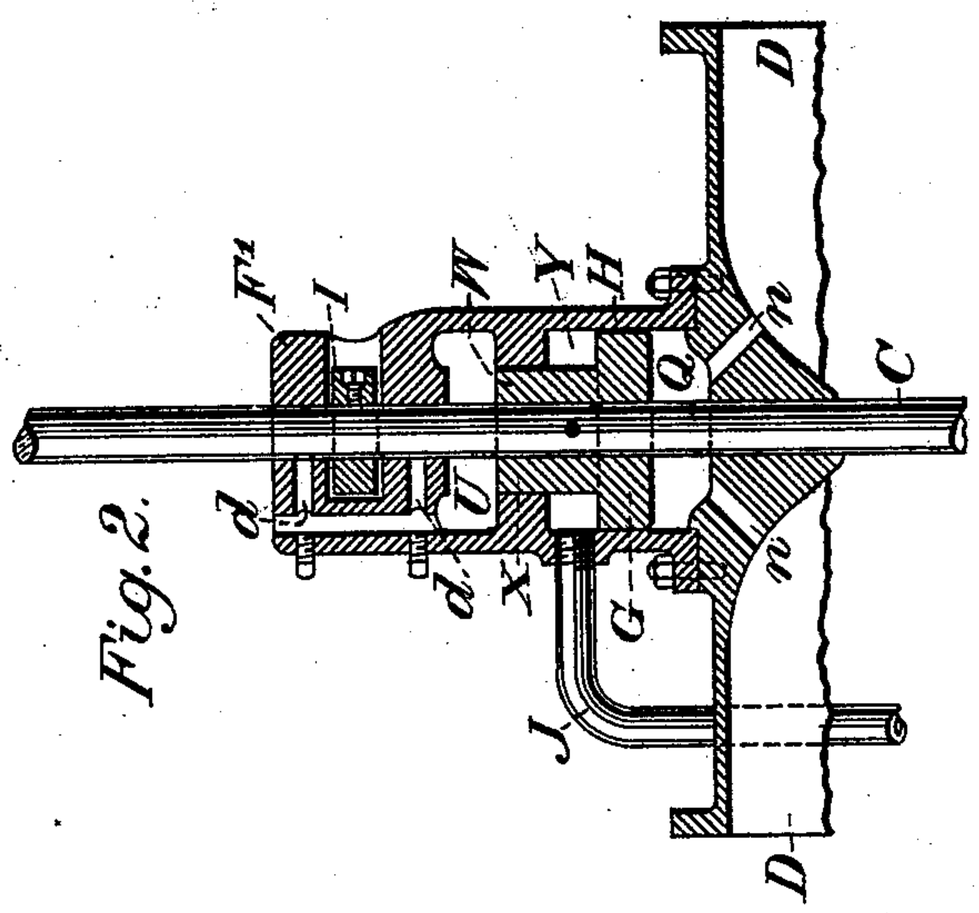

Fig. 2.

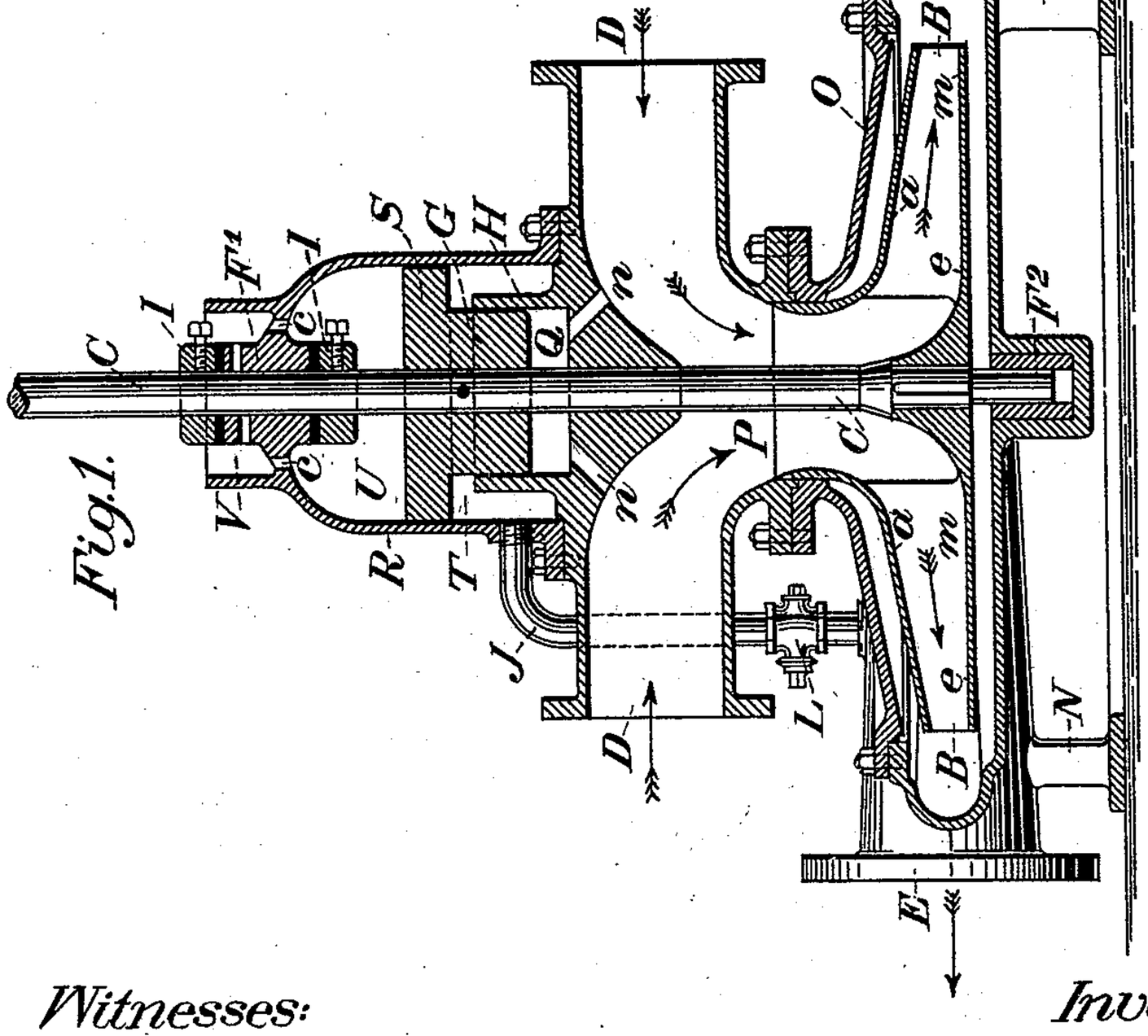

Fig. 1.

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(No Model.)

2 Sheets—Sheet 2.

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Fig. 4.

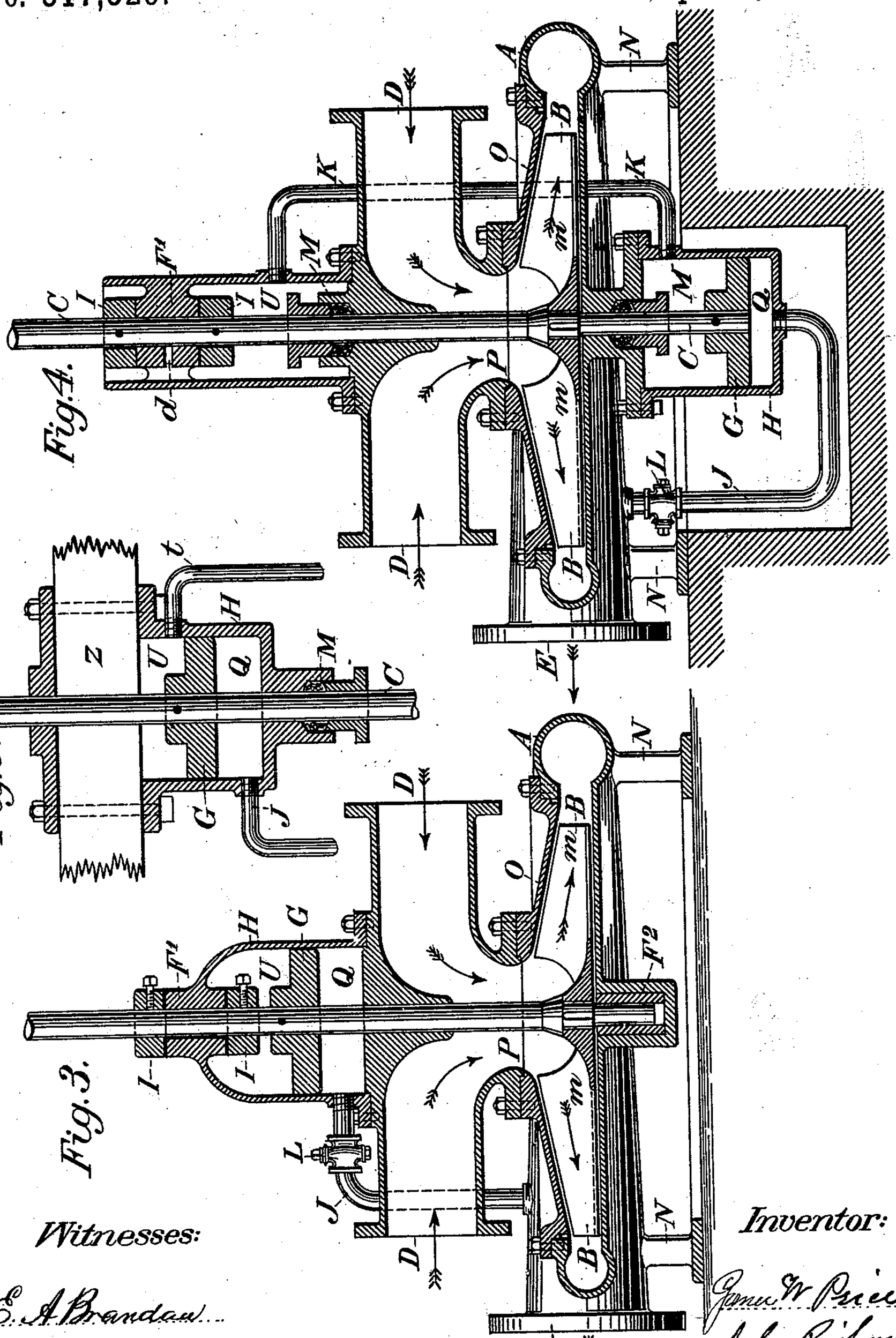

Fig. 5.

Fig. 3.

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UNITED STATES PATENT OFFICE.

GOMER W. PRICE, OF SAN FRANCISCO, CALIFORNIA.

CENTRIFUGAL PUMP.

SPECIFICATION forming part of Letters Patent No. 517,529, dated April 3, 1894.

Application filed August 14, 1893. Serial No. 483,113. (No model.)

To all whom it may concern:

Be it known that I, GOMER W. PRICE, a citizen of the United States, residing at the city and county of San Francisco, State of California, have invented certain new and useful Improvements in Centrifugal Pumps, as set forth in the accompanying specification and the drawings therewith, which I declare to be a full, clear, and exact description of my improvements.

My invention relates to centrifugal pumps for raising and impelling fluids, especially when such pumps are arranged with their axes vertical, as in raising water from pits and wells, but it is also applicable to pumps with incased wheels or impellers, and their axes placed horizontally.

My improvements consist in the application to spindles or shafts of such pumps, pistons attached thereto and subjected to hydrostatic pressure produced by the pump itself or by gravity, so as to place the running parts in equilibrium in respect to weight and water thrust, or as nearly so as is desirable. Such pistons being applied in various ways as the arrangement of the pumps and the nature of their intended duty may require.

The object of my invention is to provide a variable and controllable compensating or counter thrust on the spindles or shafts of such pumps and thus avoid the friction and wear of the journals and bearings, which in the case of high heads and pressures is such as to cause great difficulty in operating centrifugal pumps when unbalanced. Such pumps being made under many modifications, and varying in construction to suit for different heads and other conditions of use, the drawings herewith are amplified to explain the application of my invention in various cases, the mode of operating and the essential parts remaining, however, the same in each case.

Referring to the drawings: Figure 1 is a vertical section through a pump having an incased or inclosed wheel or impeller, and provided with my improved apparatus for balancing the pump when the upward water thrust is not enough to sustain the weight of the running parts thereof. Fig. 2 is a partial section through the same pump, showing an application of my invention when the gravity of the running parts is not sufficient to overcome the upward water thrust. Fig. 3 is a vertical section through a centrifugal pump having an open wheel or impeller, and when there is only the gravity of the running parts to sustain, also provided with my improvements placed above the pump as in Figs. 1 and 2. Fig. 4 is another section through the same pump shown in Fig. 3 having my improved balancing apparatus applied beneath the pump. Fig. 5 is a partial section showing my improved balancing devices applied at a distance above the pump, as at the top of a pit or well, or such other height above the pump at which the water pressure will afford the required sustaining force.

Similar letters of reference on the different figures of the drawings indicate corresponding parts thereof.

In describing the drawings the following notation is employed for the principal parts.

A is a main pump casing or chamber; B, pump wheel or impeller; C, driving spindle or shaft; D D, suction pipes to the pump; E, discharge nozzle of the pump; F′, top bearing of the pump spindle; F^2, bottom bearing of the pump spindle; G, hydrostatic balancing pistons; H, hydrostatic balancing cylinders; I I, thrust collars on the pump spindle; J, pipes to hydrostatic balancing pistons; K, overflow pipes from hydrostatic cylinders; L, regulating cocks for the hydrostatic cylinders; M, packing glands on the pump spindles; N, standards to attach and support the pumps; O, removable plate for inserting the impellers; P, inlet to the wheels or impellers.

In operating centrifugal pumps with inclosed or incased wheels or impellers that receive the water at one side only, there is a lateral force on the impellers equal to the distance of suction multiplied into the area of the suction inlet, also a lateral thrust in the same direction equal to head pumped against, or the discharge pressure multiplied into the area of the suction inlet. This can be illustrated by referring to the drawings, Fig. 1, where A is the casing or main pump chamber and B the impeller consisting of the web plates *a* and *e* with vanes *m* between. With an impeller of this form the whole interior of the casing A is subjected to a pressure equal to the discharge head, so also the exterior of

the plates *a* and *e* of the impeller B, except the area of the inlet at P, consequently there is a lateral or up thrust on the impeller B and the driving shaft C equal to the area at P multiplied by both the suction and discharge pressures, and as this area P is made large enough to permit easy or slow admission of the water the upthrust becomes a serious matter when pumping against high heads. For example, if the whole head against which the water is raised be fifty feet and the inlet P is eight inches in diameter the lateral thrust on the impeller B and upward thrust on the spindle C will exceed one thousand pounds. This thrust is in the case of vertical pumps opposed by the gravity of the running parts, consisting of the impeller B and shaft C extending to the top of the pit with any driving gearing fitted thereon. Referring still to Figs. 1 and 2, the pump casing A is shown of the volute form, resting on standards N, and provided with a removable plate O on the top, which gives access to the interior of the pump and permits the placing and removal of the impeller B.

The suction inlet pipes D D are placed at the top of the pump to allow access to them, also to permit if necessary the removal or escape of air or gas in the water. These suction pipes D D, either one or both of them are extended downward into tube wells or a sump in the usual manner. On the top of these suction pipes D D is formed integrally therewith as in Fig. 1, or bolted thereon as in Fig. 2, a short cylinder H in which is placed a piston G attached to and revolving with the pump spindle C. The diameter of this cylinder H is preferably made the same as the diameter of the inlet P, and communicates by the apertures *n* with the suction pipes D D so the chambers Q are subjected to a vacuum, or negative pressure equal to that exerted by the inlet P, and thus the impeller B is put into equilibrium in so far as the force of the suction thereon. Referring still to Fig. 1, an outer casing or second cylinder R is bolted to the suction pipes D D, and fitting in this is an enlarged extension S of the piston C. This forms a second chamber or annulus T connecting by a pipe J to the main pump casing A so this chamber T sustains a hydrostatic pressure equal to the head pumped against. This upward pressure on the piston S which is made of the required area, sustains the weight of the running parts of the pump, putting all the parts in equilibrium. To keep the parts in their proper positions at starting and before the hydrostatic forces act, I place on the pump spindle C, thrust collars I I above and below the top bearing F′. As some water escapes past the piston S this fills the chamber U and from there flows up through the apertures *c* into the cup V, so the bearing F′ and collars I I are lubricated and kept cool. If the area of the annulus T is too great for the weight to be supported, or if it is not desirable to balance the whole weight of the running parts, the cock L is nearly closed so the water passing into the chamber T is less than leaks past the piston S, and thus reduces the upward thrust on the piston S accordingly. If the weight of the running parts of the pump is less than the up-thrust of the water on the impeller B and shaft C, I insert the hydrostatic balancing chamber as shown in Fig. 2, so the pressure of the water from the pipe J will act downward instead of upward, as in Fig. 1, the suction balancing piston G remaining, however, the same. In this latter case I form on the piston G a trunk extension W, fitting through a diaphragm X, so the water from the pipe J acts on the annulus Y. Any water escaping around the trunk extension W passes into the chamber U and thence up through the apertures *d* to the bearing F′ of the pump spindle C.

When the impeller wheels are open or consisting of vanes only, the conditions of pumping are, in so far as the main casing and water pressure, much changed. There is then no lateral thrust on the impeller wheel, and the unbalanced force to be dealt with is the weight of the running parts only. In deep pits or wells such weight becomes a formidable difficulty because of maintaining bearings at high velocity and under so much pressure. In such cases I apply my improvement to the pump spindles as shown in Figs. 3, 4 and 5, which will be clear after the explanations that have preceded, the same letters of reference applying to parts having like functions in the several cases.

Referring to Fig. 3, the piston G is subjected to the discharge pressure of the pump, conveyed through the pipe J. Any leak past the piston passes up and through the bearing F′ as before, the cock L serving to regulate pressure, if adjustment is required, the same as before explained in connection with Fig. 1.

In Fig. 4 the balancing cylinder H and piston G are placed beneath the pump, as is necessary in some cases, the water being supplied through a pipe J and cock L as before, the leak or overflow being carried up by a pipe K and discharged into the chamber U and thence to the bearing F′, as indicated in the drawings.

In some cases it is expedient to apply the balancing cylinder and piston to the driving shaft at some point between the pump and the top of a pit or well, as shown in Fig. 5. The cross beam Z can be placed at any height to suit the pressure of the water in the chamber Q, and the load to be sustained thereby. Other details will be understood from corresponding parts hereinbefore described, except that in this case a waste pipe *t* is required to carry off any water accumulating in the chamber U.

Having thus explained the nature and objects of my invention and the mode of its application in the several forms of pumps to which it may be applied, what I claim as new, and desire to secure by Letters Patent, is—

1. In a centrifugal pump, the combination of the pump-casing, the pump wheel, its shaft, a balancing piston secured on the shaft, a cylindrical casing surrounding said piston and a water pipe leading to the balancing piston from the discharge, substantially as described.

2. In a centrifugal pump, the combination of the pump casing having suction pipes and a discharge, a pump impeller within the casing, a pump shaft, a balancing piston secured on the shaft, a cylinder surrounding it and communicating with the suction pipes and another casing surrounding an extension of the aforesaid piston, together with the pipe leading to the piston from the water discharge, substantially as described.

3. In a centrifugal pump, a balancing piston and cylinder, the former attached to and the second surrounding the pump spindle, the piston subjected to water pressure from the pump discharge, such pressure applied on either side of the balancing piston, as the unbalanced force may require, and as the weight of the running parts may determine; passages for conducting waste water that passes the piston, up to and around the pump spindle bearing, in the manner substantially as set forth and described.

4. In a centrifugal pump, a balancing piston and cylinder as herein described, the piston attached to and the cylinder surrounding the pump spindle; a pipe connecting to the pump discharge water, and to the balancing piston, as the gravity of the running parts or other unbalanced forces on the pump impeller or spindle may require, a cock to regulate the flow of water and waste ways connecting to the upper pump bearing any water passing the balancing piston, in the manner substantially and for the purposes described.

5. In a centrifugal pump, the combination of the pump-casing having suction pipes and a discharge, the pump wheel in said casing, its shaft, a balancing wheel secured on the shaft above the suction pipes, a cylinder surrounding it and communicating through ports with the suction pipes, another casing surrounding the extension of the aforesaid piston, a pipe leading to the piston from the water discharge and passages for conducting waste water that passes the piston, up to and around the pump spindle bearing at the top, substantially as described.

In testimony whereof I have hereunto affixed my signature in the presence of two witnesses.

GOMER W. PRICE.

Witnesses:
ALFRED A. ENQIST,
WILSON D. BENT, JR.