No. 845,816. PATENTED MAR. 5, 1907.

R. S. PRINDLE.

# CENTRIPETAL CENTRIFUGAL PUMP AND CONDENSER.

APPLICATION FILED MAR. 5, 1902.

2 SHEETS—SHEET 1.

Fig. 1

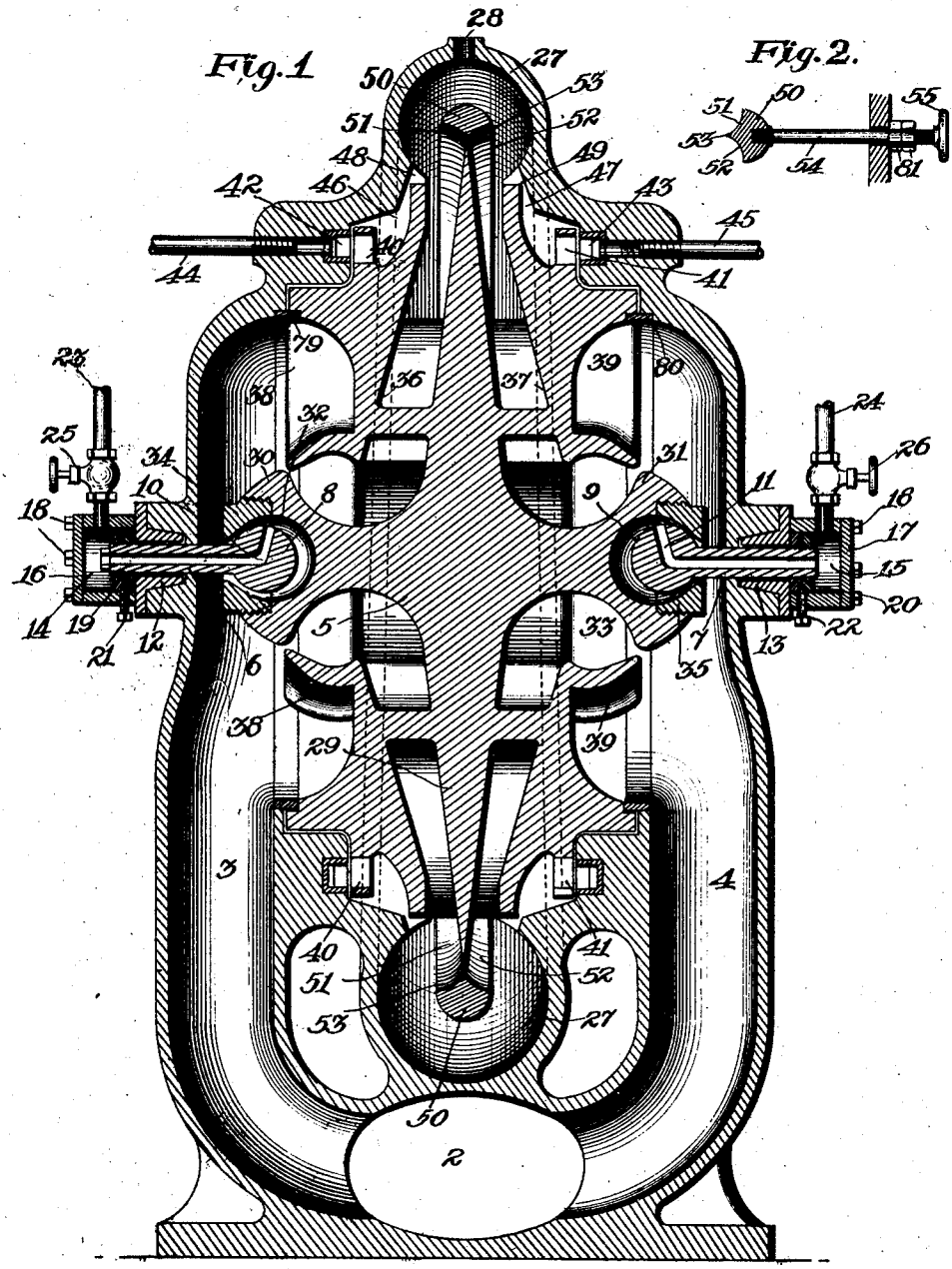


Fig. 2.




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2 SHEETS—SHEET 2.

Fig. 3.

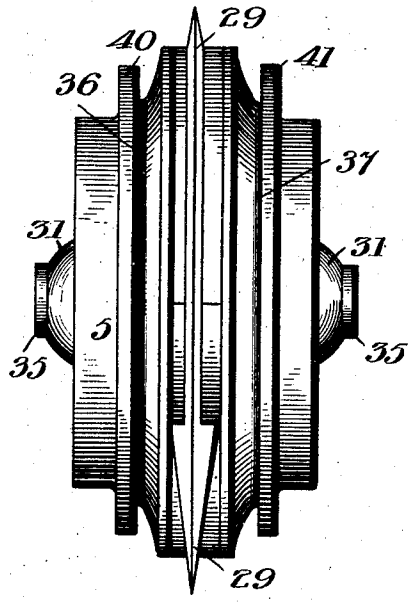
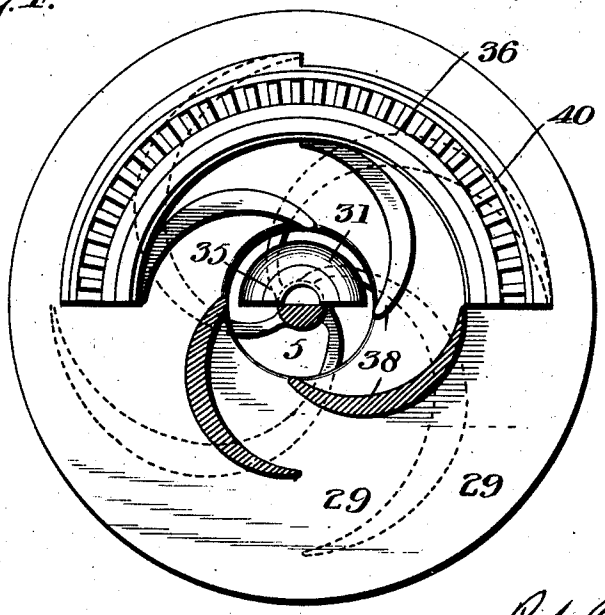



Fig. 4.

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## CENTRIPETAL-CENTRIFUGAL PUMP AND CONDENSER.

No. 845,816. Specification of Letters Patent. Patented March 5, 1907.

Application filed March 5, 1902. Serial No. 96,826.

*To all whom it may concern:*

Be it known that I, ROSCOE S. PRINDLE, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Centripetal-Centrifugal Pumps and Condensers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in centripetal and centrifugal pumps combined with condensers; and the object of my invention is to produce a device of this character which will first draw the liquid acted on by the power toward the center and then discharge it from the center, which may be run by a belt or steam-turbine or any other desired motive power and which may also be used as a condenser for other engines, as a vacuum-pump, an air-pump, and for other purposes.

With these objects in view my invention consists in the construction and combination of parts as hereinafter described and claimed.

In the accompanying drawing, Figure 1 is a cross-section of my improved pump, showing it driven directly by a steam-turbine. Fig. 2 is a detail view of the means for adjusting the pressure-ring shown in Fig. 4. Fig. 3 is a side elevation of the runner shown in Fig. 4. Fig. 4 is a cross-section thereof on two different planes.

In Fig. 1 the runner is directly driven by means of a steam-turbine wheel made a part thereof and having the central discharge between the two inlets at the side of the casing. In this modification, 2 represents the inlet-pipe, which is divided into branch pipes 3 and 4, which deliver to the runner near the center. The runner itself, 5, is supported while at rest upon the short hollow shafts 6 and 7; but while in motion it is supported upon the water bearings and by means hereinafter described.

The hollow shafts 6 and 7 terminate in enlargements 8 and 9 at their inner ends, and the perforations therein at the end are turned upwardly, as shown in 10 and 11, for the purpose of discharging a current of water up into the bearings and lifting the runner off the shafts 6 and 7 and supporting it upon liquid bearings. The shafts 6 and 7 pass through extensions in the casing and through bearings 12 and 13 into boxes 14 and 15, which have removable heads 16 and 17 screwed thereto by bolts 18. The shafts are held in position by nuts 19 and 20, secured in position by bolts 21 and 22. The outer end of each shaft is squared to receive the end of a wrench, whereby it may be turned into any desired position. Pipes 23 and 24, provided with valves 25 and 26, deliver the liquid into the boxes 14 and 15, being preferably connected with the discharge-chamber of the pump. This discharge-chamber 27 is arranged in the form of a volute, as common in centrifugal pumps, preferably largest at the bottom, and is provided with a passage 28, used in priming the pump and ordinarily closed by a pipe with the ejector-fitting in common use for the purpose of priming the pump.

The runner 5 is provided with a central vane 29 in the form of a circular cone. The runner is also provided with projections 30 and 31, in which are cut out spherical portions 32 and 33 for the reception of the ends of the hollow shafts. Nuts 34 and 35 secure said shaft in said runner when the machine is assembled. Substantially parallel to the central vane 29 are the wings 36 and 37, and curved arms, like the arms *y* in Fig. 3, connect said vane and wings, the number, shape, and position of said arms being varied to suit the varying requirements. On the extensions 30 and 31 are mounted sets of arms 38 and 39, curved in the opposite direction. These arms act to draw the liquid in toward the center of the pump centripetally, while the arms between the wings 36 and 37 and the central vane serve to discharge it centrifugally into the discharge volute or chamber 27. The use of the arms 38 and 39, which act centripetally, is to supply a constant flow or feed of water to the centrifugal arms, thereby rendering it possible to run the centrifugal pump at a very high speed and obviating the necessity of having a separate pump to feed the high-speed centrifugal pump, as is now a common practice. It must be understood, however, that a single centrifugal pump may be so designed that it will not require a separate pump to feed

it, even while running at high speeds; but such a pump has very serious objections from a practical point of view, because it necessitates the building of a very large machine, and especially the provision of exceedingly large inlet-pipes and exceedingly small outlet-passages in the runner, thereby enormously increasing the liquid friction and being therefore very difficult to balance and exceedingly wasteful of power.

Circular guide-plates 79 80 are let into the casing in proximity to the arms 38 39, but without touching said arms or any part of the runner. These plates serve to guide the liquid in toward the center of the runner and prevent it from working up between the runner and casing to condense the steam before it strikes the impeller-blades 40 and 41.

In Fig. 1 the runner is driven by a steam-turbine. On extensions on the wings 36 and 37 are mounted rings of impeller-blades 40 and 41, one ring on each side to preserve a perfect balance. Secured in extensions on the casing or carried thereby in any suitable way are rings of diverting-blades 42 and 43 and pipes 44 and 45, delivering steam thereto, thus causing the runner to revolve. After passing through the impeller-blades the steam enters the spaces 46 and 47 between the wings 36 and 37 and the casing, which chambers communicate, by means of passages 48 and 49, with the discharge-passage 27.

The liquid passing out into the passage 27 by the wings 36 and 37 draws with it the steam through the passages 48 and 49 and condenses it by the constant stream of water which exists in the discharge-passage 27. It also draws along with it any air that there may be in the beginning within the casing and any air that may enter the casing by leakage or from being entrained with the steam.

I have shown on each side of the central vane 29 only one ring of impeller-blades and one ring of diverter blades or vanes; but it is obvious that I may compound these to any extent, the diverter-blades being of course fixed to the casing and the impeller-blades being fixed to the runner, whereby I am enabled to take advantage of the principles of impact, reaction, or expansion, or any combination thereof in driving the runner.

The runner is supported in water bearings, so as to run practically without friction. In fact, all friction is avoided except the mere skin friction due to the passage of the liquid through the runner.

It will be noted that in the construction shown the runner is built symmetrically, so that it is practically perfectly balanced. The central vane 29, which projects into the discharge-passage 27, automatically acts to center the runner, or rather to prevent it from oscillating or wabbling sidewise while the runner is in rotation, thereby keeping its plane of rotation practically constant independent of its plane of gravity, if on account of variations in the material, for example, these two planes do not exactly coincide. In addition I have shown in Fig. 1 a means for centering the runner-wheel in rotation independent of the hollow shafts 6 and 7. This means consists of a ring 50, provided with two slightly-concaved inner faces 51 and 52, terminating in a sharp edge 53 in proximity to the edge of the central vane 29. This ring is eccentrically mounted in relation to the runner 5, or rather the central vane thereof, 29, and is supported on rods 54, passing through screw-threaded nuts 81 and openings in the casing, and provided with hand-wheels 55. Any number of these rods may be used, and they may be used in any desired position. I prefer, however, to use at least three, two of these being located below the center of the runner and one above. By merely varying the adjustment of this ring—that is to say, for example, by bringing its lower portion closer to the vane 29—the pressure in the discharge-passage may be varied and an upward pressure created, due to the reaction of the stream discharged by the runner, whereby the downward pressure caused by the weight of the runner will be counteracted and whereby the thrust caused by the rotation of the runner will also be compensated for. It should be noted that when this adjustment has been once made it need not be varied, even if the speed of revolution of the runner varies widely, the result being that the runner after the adjustment has once been made automatically balances itself during rotation. Instead of this ring adjustably mounted eccentrically to the central vane 29 I may of course use a fixed ring concentrically with said vane, which ring is provided with movable pivoted vanes nearly balanced and arranged to be adjusted back and forth either by contact with the runner or externally through the case by means of rods and hand-wheels. Moreover, the ring 50 instead of being made separate from the central vane 29 may be made integral therewith. The result of this construction is that any variation from the proper position of rotation would be automatically corrected. For example, if the runner should tend to settle, owing to a diminution in speed, for instance, the resultant pressure would be increased at the top and diminished at the bottom, producing a lifting effect which will counterbalance the settling tendency, this lifting effect being caused by the columns of liquid discharged against the inner periphery of the ring, the pressure being greatest where the clearance for the discharge columns of liquid is the smallest.

The pump may be primed in the usual manner by means of a steam-ejector at-

tached to the top of the discharge-passage 73 or to the outer part of the inclosing casing 71, which receives the exhaust-steam.

Variations in the amount of the exhaust-steam caused by variations in the load under which the main engine works may be compensated for in the well-known ways of throttling the amount of water circulating through the pump or by reducing or increasing the speed of the pump itself. The important feature of this means for condensing which I have described is that the steam is brought into contact with a rotating mass of water, whereby this rotating stream will absorb more heat units than if it were at rest or discharged in the usual type of jet or surface condenser, therefore requiring a less amount of water to effect the condensation and doing away with the air-pump and the large amount of piping now required in condensers of the usual type. My apparatus can also be used as an air-compressor or positive blower or fan, and when used as an air-compressor or pressure-blower the compression takes place adiabatically, the heat due to compression being continuously removed by the flowing stream of water and being separated from the air in the usual manner by being discharged into a tank and settling to the bottom thereof, thereby carrying with it the heat due to compression. This heat is permitted to escape by radiation, or in some instances a renewed supply of cold water is introduced to take it up. The extra casing shown in Fig. 4 may also be applied to the modification shown in Fig. 1 or to any similar type of machine wherein the condensing-ports are swept by a moving liquid.

While I have thus described my invention, I wish it to be distinctly understood that I do not limit myself to the exact details shown and described, for it will be obvious to any one skilled in the arts of hydraulics and steam-engineering that many variations might be made without departing from the spirit of my invention.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination of a casing having an extension thereon acting as a discharge-chamber, said casing having an inlet-opening for gas and liquid, and a rotor or runner in said casing, acting to force said gas or liquid, into said extension, said rotor being provided with means for drawing in fluid centripetally and discharging it centrifugally, substantially as described.

2. The combination of a casing having an extension thereon in the form of a volute which acts as a discharge-chamber, said casing having an inlet-opening for gas and liquid, and a rotor or runner in said casing acting to force said gas and liquid into said extension, said rotor being provided with means for drawing in fluid centripetally and discharging it centrifugally, substantially as described.

3. The combination of a casing having a volute extension thereon acting as a discharge-chamber, said casing having an inlet-opening for gas and liquid, a fluid-supported rotor or runner in said casing, acting to force said gas and liquid into said extension, and means for driving said rotor, substantially as described.

4. The combination of a casing having a volute extension thereon acting as a discharge-chamber, said casing having an inlet-opening for gas and liquid, a fluid-supported rotor or runner in said casing acting to force said gas and liquid into said extension, said rotor being provided with means for drawing in fluid centripetally and discharging it centrifugally, and means for driving said rotor, substantially as described.

5. The combination of a casing having a volute extension thereon acting as a discharge-chamber, said casing having openings for the admission of exhaust-steam, a rotor or runner therein, said rotor being provided with means for drawing in fluid centripetally and discharging it centrifugally, and said casing being provided with means for admitting fluid thereto, substantially as described.

6. The combination of a casing having an extension thereon acting as a discharge-chamber, a rotor or runner therein, means for supporting said rotor or runner entirely out of contact with said casing, said rotor or runner being provided with means for drawing in fluid centripetally and discharging it centrifugally and said casing being provided with inlets for liquid and gas, substantially as described.

7. The combination of a casing provided with an extension acting as a discharge-chamber, and a combined rotor or runner and turbine-wheel therein, said rotor being provided with means for drawing in fluid centripetally and discharging it centrifugally and said casing being provided with two sets of openings, one for gas and the other for liquid, substantially as described.

8. The combination of a stationary casing provided with a volute extension acting as a discharge-chamber, a revoluble combined runner or rotor and turbine-wheel in said casing, said rotor being provided with means for drawing in fluid centripetally and discharging it centrifugally, said casing being provided with two sets of openings, one for gas and the other for liquid, and means for automatically balancing said rotor and taking its weight off from its supports when in operation, substantially as described.

9. The combination of a casing provided with a volute extension, a combined rotor and turbine-wheel in said casing, fluid supporting-bearings on which said rotor is mount-

ed, and means for automatically balancing said combined rotor and turbine when in operation, substantially as described.

10. The combination of a casing having steam-inlets and a volute extension serving as a discharge-chamber, a combined rotor and turbine-wheel supported in said casing, bearings for supporting said rotor and wheel when at rest, means for forcing fluid in through said bearings during the operation, and an adjustable ring centrally surrounding said combined rotor and turbine-wheel, whereby the latter is automatically balanced when in operation, substantially as described.

11. The combination of a casing having inlets for liquid and gas and a volute extension acting as a discharge-chamber, a combined rotor and turbine-wheel located in said casing and having recessed portions and a thin central edge, an adjustable ring surrounding said edge, and perforated bearings having spherical ends, said ends entering into the recesses in said combined rotor and wheel, substantially as described.

12. The combination of a casing provided with inlets for liquid and gas and with a volute extension acting as a discharge-chamber, a combined rotor and turbine-wheel located in said casing and provided with spherical-shaped cavities on opposite sides and with vanes for the liquid and the gas to impinge against, an adjustable circular ring centrally surrounding said rotor and wheel, and perforated bearings having spherical ends, which ends enter into the spherical recesses in said combined rotor and wheel, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

ROSCOE S. PRINDLE.

Witnesses:
CLARENCE A. BATEMAN,
GUSTAVE R. THOMPSON.