No. 685,167.

Patented Oct. 22, 1901.

G. McKAY.

CENTRIFUGAL PUMP.

(Application filed June 23, 1899.)

(No Model.)

Fig: 1.

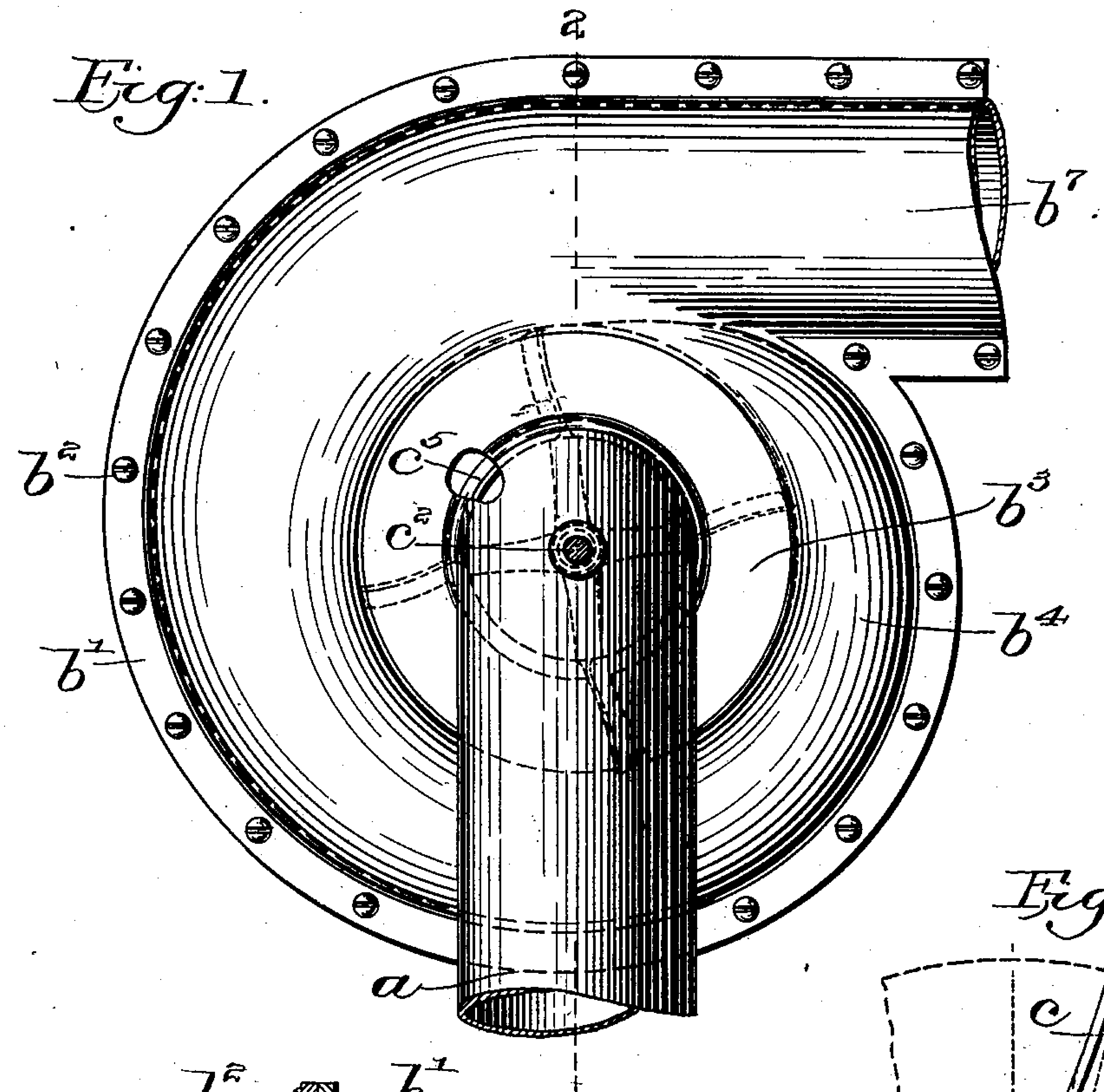


Fig: 2.

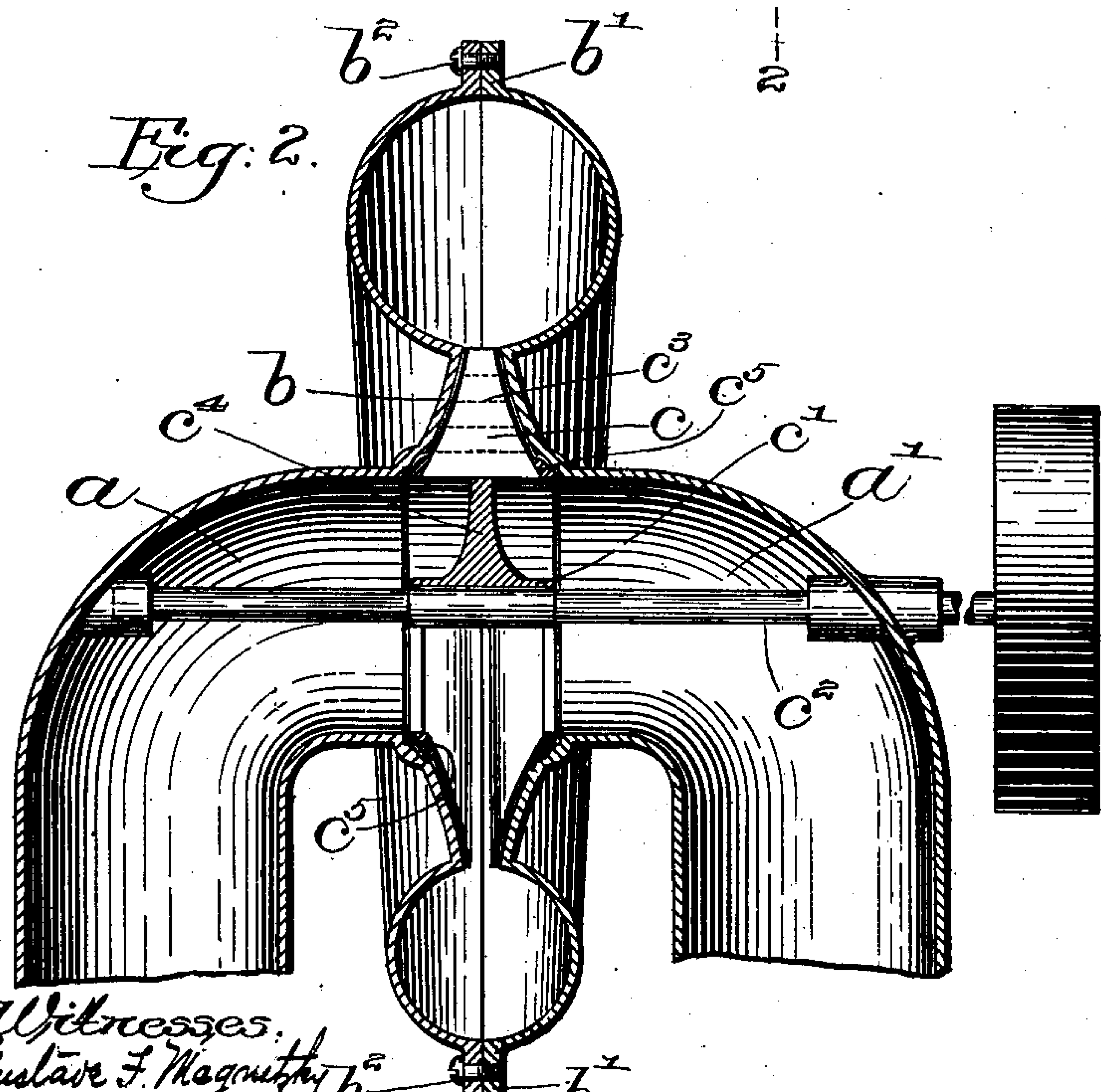
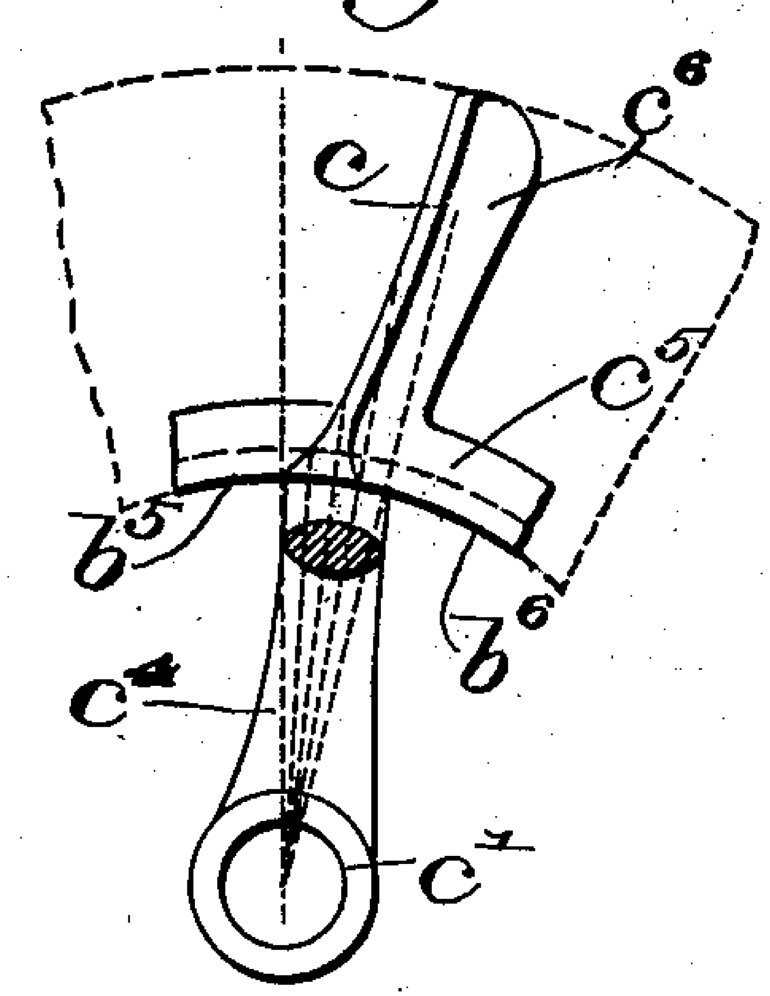


Fig: 3.



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UNITED STATES PATENT OFFICE.

GORDON McKAY, OF NEWPORT, RHODE ISLAND.

CENTRIFUGAL PUMP.

SPECIFICATION forming part of Letters Patent No. 685,167, dated October 22, 1901.

Application filed June 23, 1899. Serial No. 721,516. (No model.)

To all whom it may concern:

Be it known that I, GORDON McKAY, of Newport, county of Newport, State of Rhode Island, have invented an Improvement in Centrifugal Pumps, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

My invention is an improved centrifugal pump which while following the general arrangement long employed in this class of pumps differs from those heretofore devised by having the rotary blades constructed in general upon a curve approximating a parabola or the line a body projected horizontally assumes in falling and in having the water-passages of such shape and area, as will presently be explained, as will give greatly-increased water volume and pressure and in having the outlet-passage leading to the discharge of special construction for conserving the advantages secured by the special constructions already mentioned.

The various constructional details of my improved pump and further advantages thereof will be pointed out and the invention more fully explained in the following description, reference being had to the accompanying drawings, illustrative of a preferred embodiment of the invention, and the latter will be more particularly defined in the appended claims.

In the drawings, Figure 1 shows my improved pump in side elevation. Fig. 2 is a vertical cross-section thereof on the line 2 2, Fig. 1; and Fig. 3 shows the blade in edge elevation, the figure being also partly diagrammatic and partly sectional.

I prefer to employ two opposite inlet-passages a a' for supplying the water or other liquid to the pump proper. The latter comprises a casing b, preferably constructed of opposite complementary castings secured in any suitable manner, as by flanges b' and bolts b^2, and within the casing are a series of fan-like blades c, carried at the free ends of a central hub or spider c', mounted on a shaft c^2. The casing has a central circular portion b^3, having an internal water-passage conforming in general in cross-section to the peculiar shape of the blades c, and a peripheral spiral portion b^4 beyond the path of movement of the blades and opening from the water-passage of the internal part b^3, said spiral portion also having a special shape coöperating with the central part of the pump for securing the greatest effects with minimum power.

My aim in constructing the blades c is to give them a curve approximating more or less a parabola, as shown in Fig. 3—that is, approximating a curve assumed by a body when projected horizontally—such curve of the blade serving to give the water a constantly-increasing velocity somewhat analogous to the effect exerted by gravity on a falling body when horizontally projected.

It will be seen that the parabolic shape of the blade is modified by the fact that its ordinates are not parallel, but radial, which is required by the rotation of the blades, and it is also evident that by changing the generating line of the parabolic—*i. e.*, the path it is desired to give to a particle of water in passing between the inner circle b^5 b^6, Fig. 3, to the free end of the blade—from a radial line to one advancing or rotating a different direction can be given to the water when leaving the free end of the blades and that in whatever direction it is desired to project the water from the tip of the blades into the spiral conduit the same principle of causing the blade to act on the water with a uniform pressure is obtained through the parabolic curve so generated.

Referring to Fig. 3, where I have shown the plan of construction of my improved pump-blade, and it being premised that the unit of measurement is five thirty-seconds of an inch, I lay off on the circle b^5 b^6 four units from the commencement of the curve and then draw radial lines through each of the points thus marked. Then I measure longitudinally along the lines thus drawn the squares of the numbers of these units—*i. e.*, "0, 1, 4, 9, 16," the units themselves being "0, 1, 2, 3, 4" from said starting-point. The last measurements locate the curve of the blade, and a blade having this curve when driven by the rotating shaft c^2 will carry the water from the lower extremity of the blade at "0" to the tip of the blade with an increasing velocity.

Now, viewing Fig. 2, in which I have shown the blade in elevation and also have shown the water-passage of the pump casing or chamber b in cross-section, I make the area of the entire water-passage at the commencement of the curve of the blade—*i. e.*, the area of the cylinder generated by the inner edge of a blade c in its revolution—equal to the combined sectional areas of the two induction-pipes $a\ a'$, and I bring the walls of the casing together toward the periphery, as shown in said figure, so as to diminish in a constant ratio the area of successive cylinders generated by successive lines c^3 at equal distances apart of the blade toward its free end until the area of the last cylinder—*i. e.*, the one generated by the free end of the blade—is the same as that of the exit-pipe b^7. Likewise the spiral passage b^4 increases in area from its smaller end to the exit end at b^7 by a constant ratio.

I am aware that a spiral surrounding a central chamber is not new in this class of pumps, and I wish it understood that I do not seek to claim any novelty in this idea broadly; but my improvement in regard to this part of the pump resides in giving the spiral a constant increment in areas.

The blades, it will be observed, are carried by arms c^4, which are somewhat elliptical in cross-section, being slightly sharpened at their forward edges, so as to offer as little resistance as possible to forward movement, and are supported at their opposite inner corners or wings by plates or rings c^5 and lateral flanges or wings c^6 to prevent any tendency to vibrate and insure rigidity and great strength. The rings c^5 and lateral flanges c^6 also serve to make a practically tight joint between the rotating part of the pump and the casing, for it may be desirable when a pump is to be used in gritty water to incase the blades, as indicated by dotted lines, Fig. 3, with a thin metal cover riveted to the flanges and circular band c^6 and c^5 of the blades and revolving with them, and in this case removing the case-casting a sufficient distance from the blade-casing to give free room for any sand, stones, or gravel that may be in the water.

I do not restrict myself to the form of apparatus precisely as shown. For instance, the blades may be secured to the arms or formed as a part thereof, and instead of arms as such a central disk or plate may be used in connection with a hub more or less conical, as shown, so as to have the effect of carrying the water into the water-chamber, beginning at the inner periphery of the casing b, and if the blades are formed separately from the arms or hub said arms will be cast or fastened onto the back part of the blade, so as not to interfere with the motion of the water. Also I do not limit myself as to the size of the blades, provided the principles of construction herein set forth are employed. It is also obvious that the same form and curve of blades may be applied to a fan-blower for giving blast of air and that air, being an elastic substance, can be blown directly from the tip of the blades into a general reservoir, from which it can be taken by conductors as required, thus dispensing with the spiral.

In operation the blades are rotated in the direction of the hands of a clock, as in Fig. 1, and serve to throw the water outwardly into the spiral passage b^4, the water entering freely to the blades through the central aperture of the pump, being supplied by the inlet-pipes $a\ a'$. By reason of the special curvature of the blades, as already definitely described, the water is given a constantly-increasing velocity, due to the pressure exerted on it of the surfaces of the blades. Furthermore, the cross-sectional shape of the water-passage in the central chamber b^3 is such as to cause the uniform resistance to the directly radial flow of the water, which I have found most desirable for preventing any improper rush of the water out at any one point, the construction shown being such that a uniform flow of water from the peripheral water-passage of the central chamber is obtained exactly such as is required to dispose of the amount of water admitted by the inlet-pipes and capable of being discharged by the outlet-pipe, this water thus driven from the central chamber being received by the spiral b^4, and by reason of the constantly-increasing areas of the latter it is carried uniformly by the latter to the discharge-pipe, so that the entire apparatus may be said to be exactly balanced, each part coöperating with the other parts with a maximum of efficiency. The result is that this pump will dispose of a very large amount of water and with a minimum of power as compared with other pumps on the market, so far as I am aware.

I do not intend to restrict my invention to the precise details herein shown and described, as various changes may be made within the scope of my invention.

To exemplify more fully the fundamental distinction between vanes formed on the lines or curves of a parabola having radial ordinates and vanes curved on the arcs of circles, let it be assumed that a particle of water at rest is acted on at the base of the blade or vane in Fig. 3, that the blade or vane is moving in a straight line at substantially uniform velocity, and, further, assume that the curve of the blade or vane is that of a true parabola, the said curve being that described by a body projected through space and free to fall under the influence of gravity. Then the said particle will move from a condition of rest in the first unit of time a distance along the blade or vane depending upon the curve of the latter and will also move with the vane a distance depending upon both the curve and velocity of movement thereof. In other words, the resultants of the forces acting on the particle will move the particle along and with the vane in a similar manner to a falling body projected through space. In the next unit of time, however, the blade or vane acts on the particle of water in motion, as above described, and if the curve of the blade or vane at the part thereof which now acts upon the particle remained the same as that just previously acting the particle of water would have imparted to it precisely the same movement as first imparted, with the result that its movement along the vane or blade, as well as the movement with the vane or blade in the direction of movement thereof, would remain substantially the same, whereas under the changing curve of the parabolic form the particle of water in motion would be given an increment of movement along the vane, while movement with the vane would remain the same, the conditions being precisely those of a falling body projected through space where gravity acting continually with the same force whether the body be at rest or moving increases its falling velocity, while its velocity under the projecting force may remain substantially the same, retarding air and frictional forces being disregarded, only in the present assumed case the parabolic curve gives the movement, while in a falling body projected through space it is the resultant of the forces. It will be seen from this that the assumed construction imparts throughout the length of the vane or blade a constant increment of movement of the particle along the blade, whereas in a blade or vane having a circular curve or, in fact, any other than a parabolic curve there is no such increment of movement imparted. Since the blades of the pump move in a circular path and not in a straight line, as assumed in the above illustration of operation, it has become necessary to modify the parabolic curve to meet these changed conditions of movement, and I have found by experience that when the curve of the blades is made as herein described, which curve in some respects resembles a parabola, but wherein the ordinates are radial and not parallel, as in the parabola, the desired movement of the particles of water is secured in a rotary pump, as herein described.

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

1. A centrifugal pump having a rotating shaft carrying a series of radially-extending blades each having a curve, substantially as described, with radial ordinates, a central chamber within which said blades revolve, inlet-pipes leading to said chamber and a surrounding spiral passage into which said central chamber opens, said spiral passage terminating in a discharge-pipe, said spiral passage having its equidistant cross-sectional areas increasing by a constant increment toward the discharge end thereof.

2. In a centrifugal pump, a central water-passage having a central inlet thereto, a shaft extending transversely to said water-passage, and a series of blades extending radially from said shaft, said blades at their front faces being curved in the form substantially as described, having radial ordinates, substantially as and for the purpose set forth.

3. In a centrifugal pump, a central water-passage having a central inlet thereto, a shaft extending transversely to said water-passage, and a series of blades extending radially from said shaft, said blades at their front faces being curved in the form substantiully as described, the ordinates of which curve radiate from said shaft, the said blades and said water-passage being tapered from the inner edge of the blades to the free ends thereof, so that successive cylindrical areas generated by successive equidistant portions of the blade from the inner end thereof toward the periphery, increase by a constant increment.

4. A centrifugal pump comprising a central water-chamber having means at its center for supplying water thereto, a peripheral spiral terminating at its larger end in a discharge-pipe, and a rotating series of blades within said chamber, said blades being curved substantially as described and having radial ordinates, the cylindrical area of said central chamber generated by the inner edges of said blades being the same as the entire inlet area, and the cylindrical area of said central chamber generated by the outer ends of said blades being the same as the cross-sectional area of said discharge-pipe, substantially as described.

5. A centrifugal pump having an annular fluid-passage provided with a central inlet at opposite sides thereof and an outlet, a shaft extending transversely of said fluid-passage, the blades extending radially from said shaft to revolve throughout the extent of said fluid-passage by the rotation of said shaft, said blades being curved substantially as described and narrowed in width toward their free ends, and said fluid-passage being contracted from the inside outward to present at its periphery an area equal to the outlet-pipe, the said curvature and shape of the blades and the said narrowing of the fluid-passage giving a constant and equal pressure to the fluid at all parts of its passage over the blades.

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

GORDON McKAY.

Witnesses:
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