C. A. KAISER.

PUMP.

APPLICATION FILED JAN. 7, 1907. RENEWED APR. 2, 1910.

974,974. Patented Nov. 8, 1910.

2 SHEETS—SHEET 1.

Fig. 2.

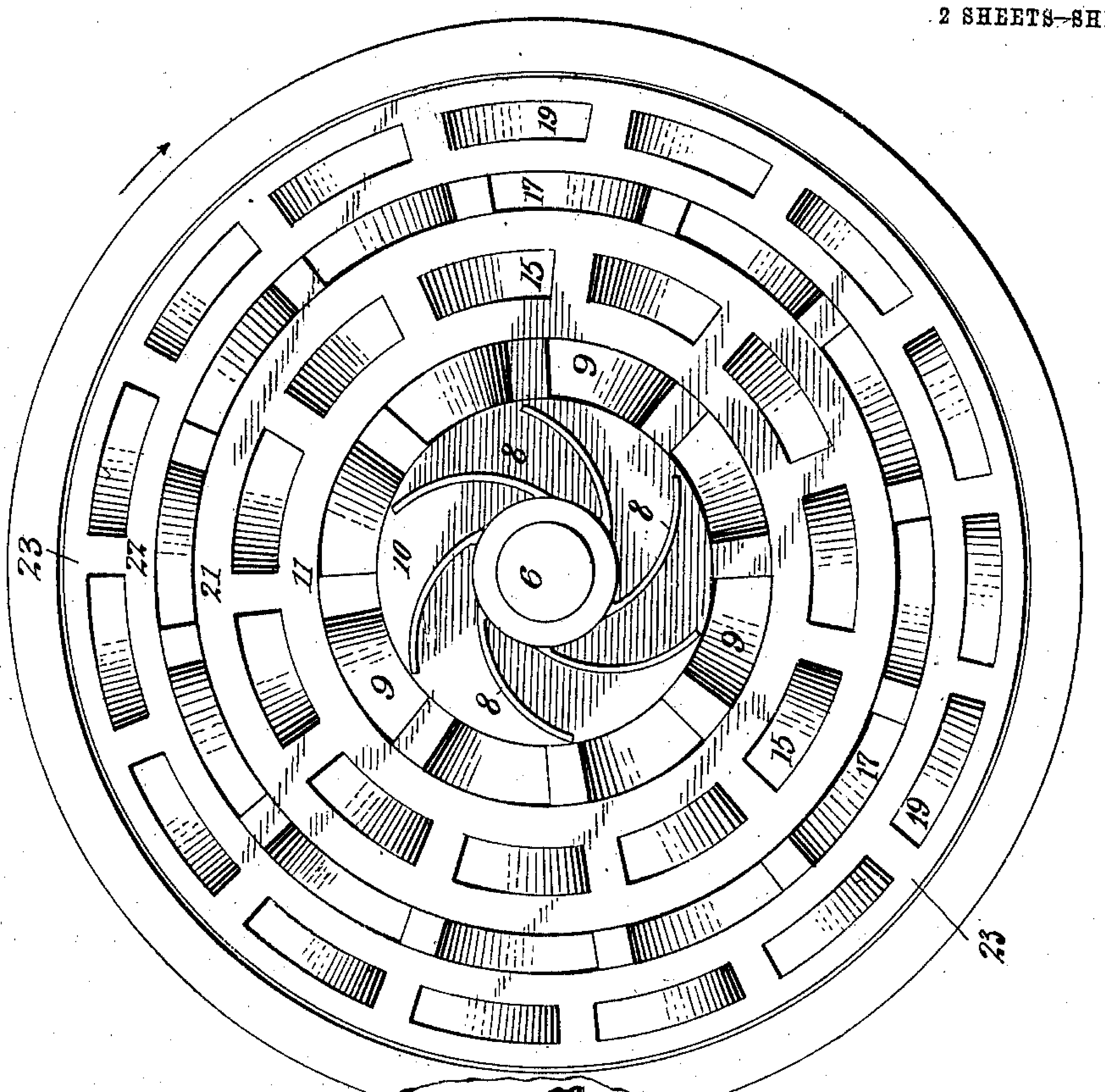
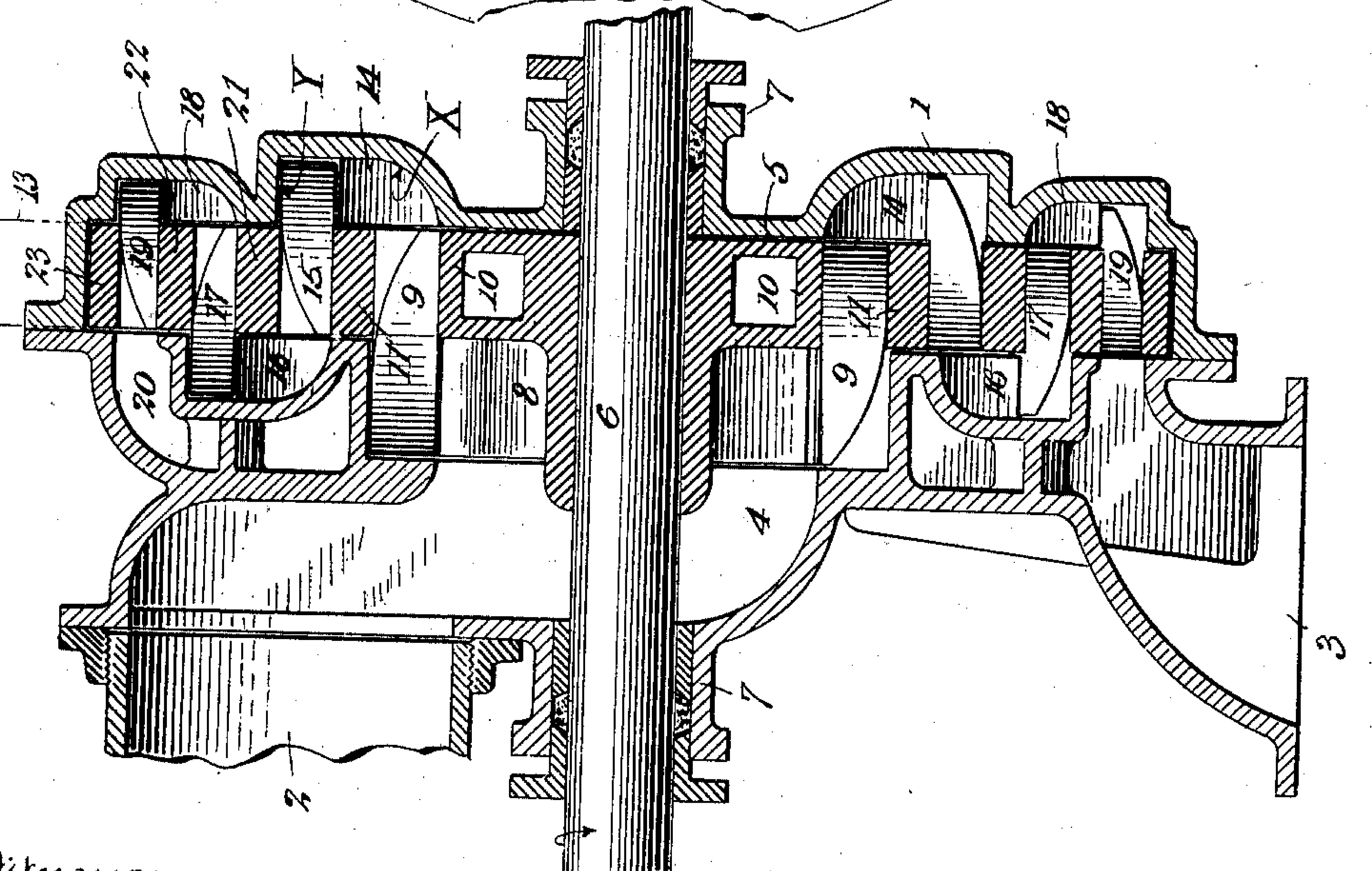


Fig. 1.



Witnesses

Francis Ober

Waldo M Chapin

Inventor

Charles A. Kaiser.

By his Attorneys

Rosenbaum & Stockbridge

THE NORRIS PETERS CO., WASHINGTON, D. C.

C. A. KAISER.

PUMP.

APPLICATION FILED JAN. 7, 1907. RENEWED APR. 2, 1910.

974,974.

Patented Nov. 8, 1910.

2 SHEETS—SHEET 2.

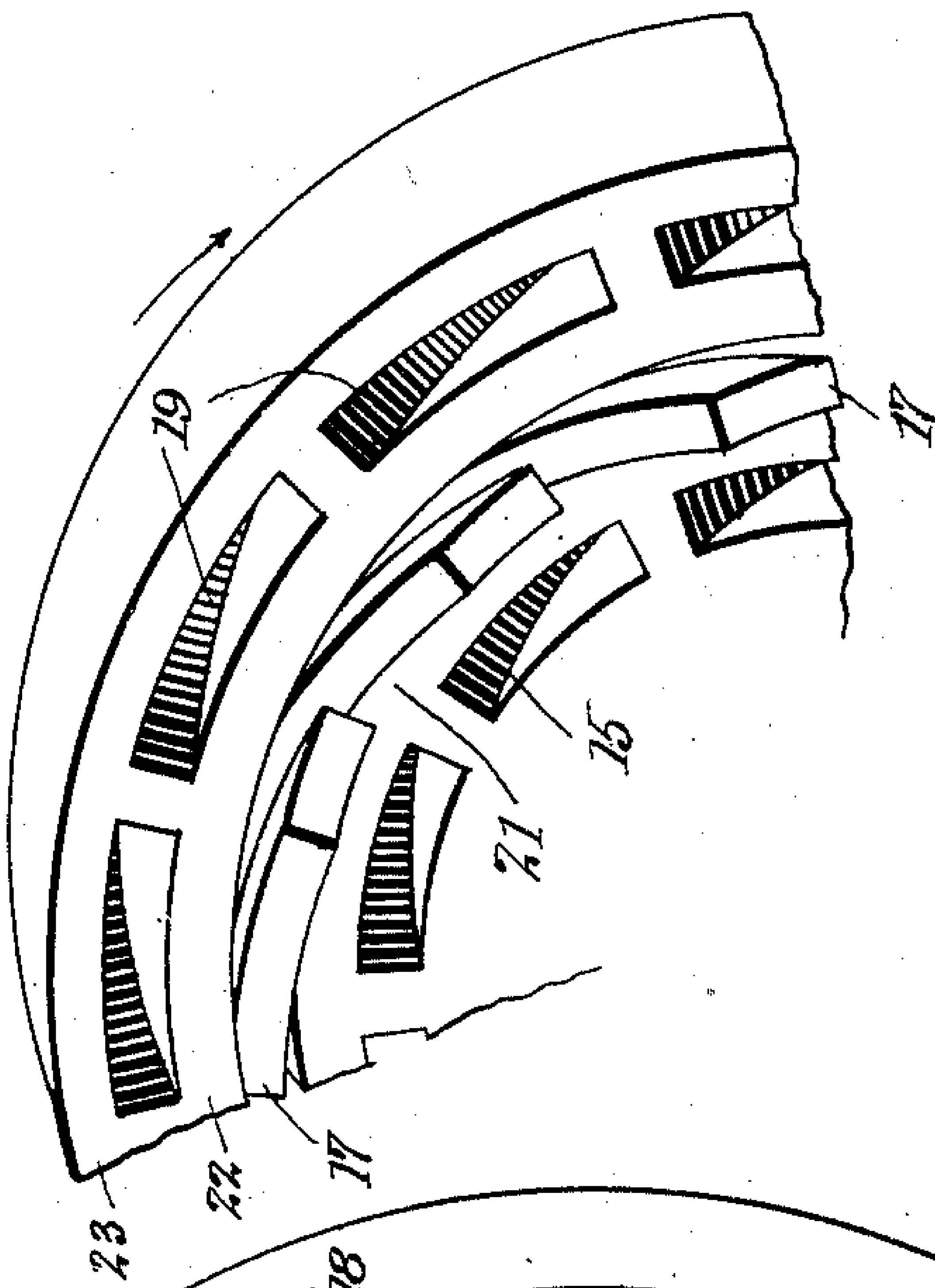


Fig. 4.

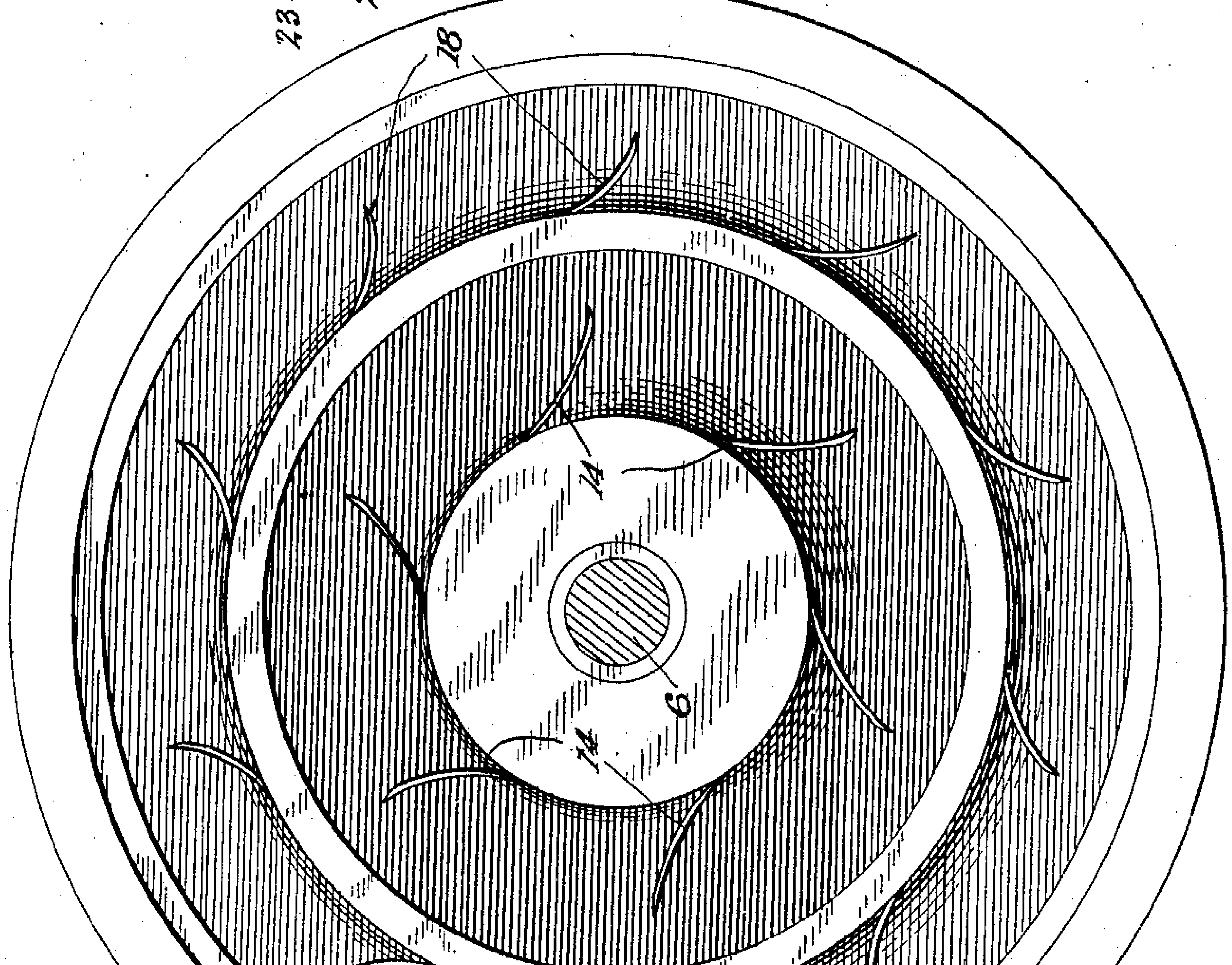


Fig. 3.

Witnesses
Frank A. Ober.
Waldo M. Chapin

Inventor
Charles A. Kaiser.
By his Attorneys
Rosenbaum & Stockbridge

UNITED STATES PATENT OFFICE.

CHARLES A. KAISER, OF NEW YORK, N. Y., ASSIGNOR OF ONE-THIRD TO FRANK N. DAVISON, OF NEW YORK, N. Y., AND ONE-THIRD TO HIRAM H. HIRSCH, OF PHILADELPHIA, PENNSYLVANIA.

PUMP.

974,974. Specification of Letters Patent. **Patented Nov. 8, 1910.**

Application filed January 7, 1907, Serial No. 351,075. Renewed April 2, 1910. Serial No. 553,099.

To all whom it may concern:

Be it known that I, Charles A. Kaiser, a citizen of the United States, residing at New York city, in the borough of Brooklyn and State of New York, have invented certain new and useful Improvements in Pumps, of which the following is a full, clear, and exact description.

My invention relates to pressure pumps for fluids, particularly of that class having a plurality of vanes which act upon a fluid in a plurality of successive steps or stages so as to attain any predetermined pressure depending on the number of such stages.

In one of the aspects the invention consists of a single revolving wheel or element which coöperates with the casing in which it rotates to successively impel the fluid into a stage of higher pressure than that preceding, the arrangement and disposition of the passages being such that the fluid has openings of sufficient cross sectional area to accommodate the particular velocity and direction thereof at every point or stage of the action.

In another aspect the invention consists in an arrangement of alternate fixed and movable blades which act upon the fluid with the very greatest efficiency, and with the least possible influence by fixed walls and frictional surfaces to impede the action. The invention further consists in the features of construction and combination hereinafter set forth and claimed.

In the drawings: Figure 1 is a longitudinal sectional view of a pump embodying the principles of my invention; Fig. 2 is a transverse sectional view of the revoluble element; Fig. 3 is a view looking into the right-hand half of the casing in Fig. 1; Fig. 4 is a fragmentary perspective view of the revoluble element.

The essential principle of the present pump depends upon the fact that fluid may be impelled into a condition of motion by the action of inclined blades or vanes thereagainst, and that in such state of motion it has a kinetic energy which may be transformed into pressure or potential energy. This action may be repeated as often as desired, and at each repetition the pressure is increased by a certain amount. The fluid is designed to be finally delivered from the pump at a moderate velocity of flow, and a high pressure suitable to forcing it into a reservoir, or to a point of any desired altitude. In order to attain this pressure it is necessary that the fluid be, at several stages, impelled into a condition of high velocity, and that at each stage this velocity be transformed into pressure. The velocity attained at the intermediate steps of the action bears no relation to the velocity of flow of the fluid as it finally issues from the pump. The velocity of the issuing fluid stream is designed to be substantially the same as that of the entering stream, and corresponding to a convenient flow. The velocity of the fluid at the various intermediate stages of the action is temporarily increased, but is at each stage again reduced with an accompanying increment of pressure.

Referring to the drawings in which like parts are designated by the same reference sign, 1 indicates a frame or casing, having an inlet pipe or connection 2, and an outlet pipe or connection 3. The cross sectional areas of these pipes is made suitable to accommodate a uniform and convenient flow of fluid. The passage 2 leads to a chamber 4, near the center of the pump, and this chamber has communication with a revoluble element 5, journaled in the pump casing on a shaft 6.

7 indicate glands or stuffing boxes for making a fluid tight connection between the shaft and the casing. The revoluble element 5 is formed at its central portion with a plurality of curved blades 8, and the fluid is free to enter the spaces between these blades from the chamber 4. The revoluble element rotates continuously in use in the direction of the arrow, so that the blades 8 act upon the fluid to impel the same radially outward in all directions. The action at this stage is analogous to any centrifugal pump. After the fluid has been acted upon by the blades 8 to start the same radially outward, it passes into the path of certain additional vanes or blades which are moving with sufficient rapidity to engage the fluid with a considerable impact and impart a movement thereto at high velocity. These blades or vanes are designated at 9 in the drawing, and are attached to, or integral

with, the revoluble element 5. They are most conveniently made in the form of spokes between the central part 10 of the revoluble element and a ring 11, co-axially surrounding said central part. The blades 9 are spiral, that is to say, they are inclined circumferentially at an angle of about 45° with the elements of the cylindrical surface on which they are mounted. The ring 11 and the central portion 10 are bounded by the planes 12 and 13, but the vanes or blades 9 project considerably and to the left of the plane 12. In this relation they extend beyond the curved blades 8 and are adapted to receive the fluid therefrom. The fluid from the vanes 9 passes into contact with the fixed vanes 14, and from thence to another set of movable vanes 15, quite similar to the vanes 9 except smaller, and located in an opposite sense of position and direction. 16 indicate another set of fixed vanes similar to the fixed vanes 14, and 17 are another set of movable vanes similar to 14 and 15, and particularly like 14, being exactly corresponding thereto in all respects, except of smaller size. 18 denote additional fixed blades similar to 14 and 16, and 19 are a final set of movable blades, similar to blades 17, 15 and 9, and more particularly like 15, being exactly the same, except of smaller size. It is evident that these series of fixed and movable vanes may be continued indefinitely, or to any desired extent, depending on the pressure which it is desired to obtain by the pump.

20 denotes an annular passage or chamber of the pump casing which extends around and communicates with the outlet opening 3, as clearly shown in Fig. 1.

All of the movable vanes 4, 15, 17 and 19, form a part of or are rigidly attached to the revoluble element 5, being contained between the ring portions 11, 21, 22 and 23 thereof. The blades 9 and 17 project to the left beyond these rings; in other words, beyond the plane 12, and the vanes 15 and 19 project to the right beyond the right-hand side faces of the rings, or, in other words, beyond the plane 13. The casing 1 is recessed to accommodate these projecting portions of the movable vanes, such recessed portions also serving to contain the fixed vanes 14, 16 and 20, which are in close proximity to the projecting portions of the movable vanes in every case, and are designed to deliver the fluid thereto.

The operation is as follows: Fluid enters the opening 2 and passes into chamber 4 at any given pressure, and is acted upon by the blades 8 to move outwardly against the vanes 9. The vanes 9 form a part of the revoluble element and rotate with a definite speed so as to impigne against the fluid delivered from the blades 8. As a result of the impact, the fluid is projected laterally and into the cavity of the outer casing which contains the fixed blades or vanes 14. The velocity with which the fluid enters the cavity of the vanes 14 is theoretically identical with the circumferential velocity of the vanes 9, assuming that the latter have a 45° inclination. If this inclination is less than 45°, the velocity of delivery is greater. This velocity corresponds to an exactly ascertainable pressure determined by the well known Bernouli's *Theorem* when the velocity of the fluid has been arrested in an inclosed cavity. The velocity of the fluid injected into the cavities of the fixed vanes 14 is partly axial and partly circumferential in direction, and this velocity is transformed into increased pressure. The fluid in the cavities of the fixed blades 10 has, therefore, its original pressure in the chamber 4, plus a certain additional pressure. The fluid does not have its movement entirely checked in the cavities of the fixed vanes 14. The form of the cavity and the inclination of the fixed vanes 14 is such that the fluid is directed upward and radially outward into the path of the second set of movable vanes 15. These act in exactly the same way as the vanes 14 act on the initial fluid supply, so that the fluid is again projected into the cavity of the fixed vanes 16 with a high velocity corresponding to the circumferential velocity of the movable vanes 15. This velocity is again transformed into an increased pressure, and the fluid issuing radially outward from the fixed vanes 16 is again acted upon by the movable vanes 17, and so on, by successive stages, until it finally issues into the annular passage 20. While the size of the vanes is successively less as the diameter of the wheel increases, this is exactly compensated for by their increased number, on account of the greater circumferential extent at the large diameters. The outer vanes impinge against the fluid with greater violence than the central ones because of their higher speed, and accordingly result in greater pressure increases at the latter stages than at the initial stages of the action. In order to get the best efficiency, it is important that the fluid be impelled into motion at each stage purely by the impact of the vanes, and not by restricting the channel. The mere restriction of the channel through which the fluid passed at any stage of the action would result in an increase in velocity, but this would be at the expense of its pressure. The increase in velocity must not be obtained in this way, but purely by the impact of the movable vanes. The requirements of the fixed vanes and the cavities in which they are positioned is that they arrest the rapidly moving fluid delivered thereto without spattering, and also without producing eddy currents and cross currents, or any other flow which absorbs the force of the velocity by heat, rather than by the production of a flow at lower velocity and at greater pressure. It is important that the flow be not entirely arrested by the fixed vanes, because such absolute arrest would mean that the energy had been lost. What is desired is to have a reduction of the velocity of flow and increase in the pressure, so that the energy is not changed by the fixed vanes. I have found that this result is secured in practice as well as in theory by the form of fixed vanes illustrated in Figs. 1 and 3. The wall Y and the curved surface X coöperate with one another and have an important influence on the action. The surface X acts to deflect the rapidly moving stream through an angle of 90°, but this surface X does not in itself theoretically have any effect to reduce the velocity of the fluid. But the wall Y is presented squarely across the deflected path of the fluid which is now moving radially, and the wall Y is the one which is most effective in reducing the velocity of the fluid at the added increase of its pressure. It will be observed that the wall Y is so positioned that the fluid moving thereagainst is in the path of impact of the movable blades in every case, so that it is impinged against or scooped up for a new stage of the action before it has had time to develop eddy currents, or otherwise lose its pressure energy in the form of heat.

What I claim, is:—

1. A pump having a plurality of movable vanes and having a cavity containing fixed vanes, said cavity terminating in a wall normal to the direction of the fluid flow therein, and additional movable vanes moving through said cavity so as to impinge against the fluid and project it into movement at points immediately adjacent to said wall.

2. A pump having a plurality of movable vanes and having an annular cavity into which the fluid is propelled by said vanes, said cavity terminating in a wall normal to the direction of the fluid flow therein, and additional movable vanes moving through said cavity closely adjacent to said wall so as to impinge against the fluid and project it into movement at the instant that it has its velocity arrested by said wall.

3. A pump having a plurality of movable vanes and having a cavity containing fixed vanes annularly arranged adjacent to said movable vanes, said cavity having a curved wall by which the fluid is deflected, and an additional wall normal to the path of the fluid flow in the cavity, and additional movable vanes moving through said cavity adjacent to said last mentioned wall so as to impinge against the fluid and project it into movement with the additional pressure due to its arrest by said wall.

4. A pump having a plurality of movable vanes and having an annular cavity containing fixed vanes, said cavity having a rounded wall against which the fluid initially strikes under the impulse of the movable vanes, and having an additional wall normal to the direction of the fluid flow by which the velocity of the fluid is checked and its pressure increased, and additional movable vanes revolving with said first mentioned vanes and moving closely adjacent to said last mentioned wall, so as to impinge against the fluid and again project it into movement.

5. In a pump, a revoluble element having a plurality of annular series of vanes, said vanes being inclined to the direction of movement of the element and projecting laterally beyond the revoluble element first on one side thereof and then on the other, and a casing having cavities into which said vanes project.

6. In a pump, a revoluble element having concentric series of vanes each inclined to its direction of movement, the different series projecting first on one side and then on the other of the revoluble element, and a casing having cavities containing fixed vanes into which said vanes on the revoluble element project.

7. In a pump, a revoluble element having concentric series of vanes inclined to their direction of rotation so as to impel fluid axially through the element first in one direction and then in the other, and a casing having cavities adjacent to said vanes and into which the fluid is successively projected thereby.

8. In a pump, a revoluble element having concentric series of vanes inclined to the direction of movement, the successive series being oppositely inclined whereby the fluid is projected axially first in one direction and then in the other, and a casing having cavities into which the fluid is projected from said vanes, said cavities having fixed vanes, and the vanes of said movable element projecting into said cavities closely adjacent to said fixed vanes.

9. In a pump, a revoluble element having concentric series of blades the different series projecting first on one side and then on the other of the element, and a casing having annular cavities on either side of the revoluble element, said vanes projecting into the respective cavities, and each cavity having a rounded wall to deflect the fluid projected therein, and an additional wall normal to the direction of the fluid flow in said cavity, the vanes on said movable element moving in close proximity to said last mentioned wall whereby the fluid is projected into movement by the vanes at the instant that its velocity has been checked by said wall.

10. In a pump, a hollow casing, a revoluble element therein having a series of con-

centric rings separated by vanes forming spokes therefor, said casing having an annular passage of uniform radius which extends around one side face of the revoluble element opposite the outer series of vanes and which communicates with an outlet opening.

In witness whereof, I subscribe my signature, in the presence of two witnesses.

CHARLES A. KAISER.

Witnesses:
ALFRED W. PROCTOR,
WM. M. STOCKBRIDGE.