

1,000,464.

Patented Aug. 15, 1911.

3 SHEETS-SHEET 1.

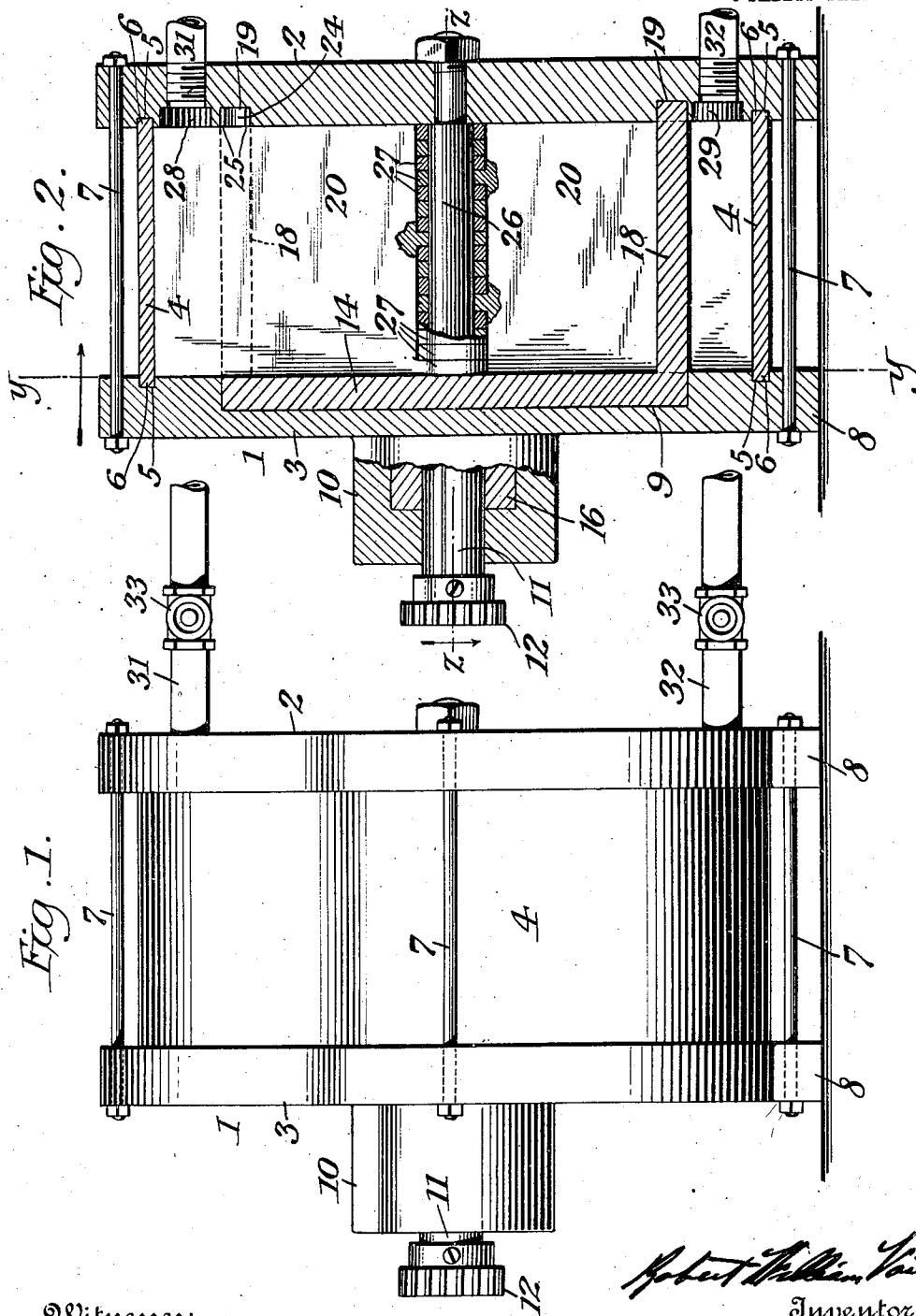


Fig. 1.

Fig. 2.

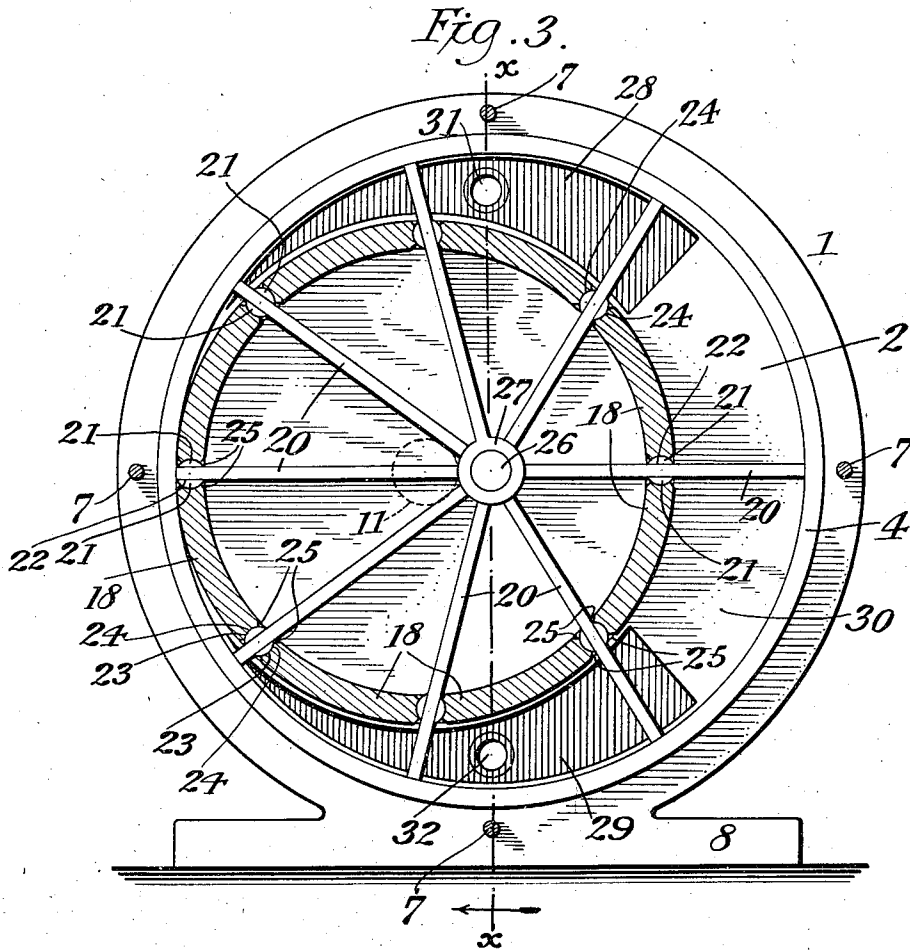
Witnesses:
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3 SHEETS—SHEET 2.



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 ROTARY PUMP.
 APPLICATION FILED OCT. 12, 1910.

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3 SHEETS—SHEET 3.

Fig. 4.

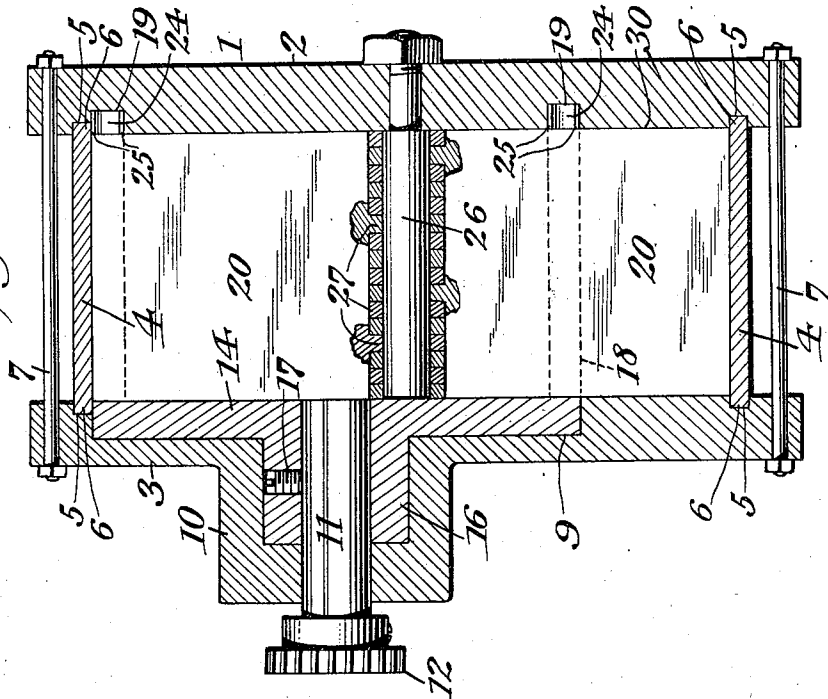
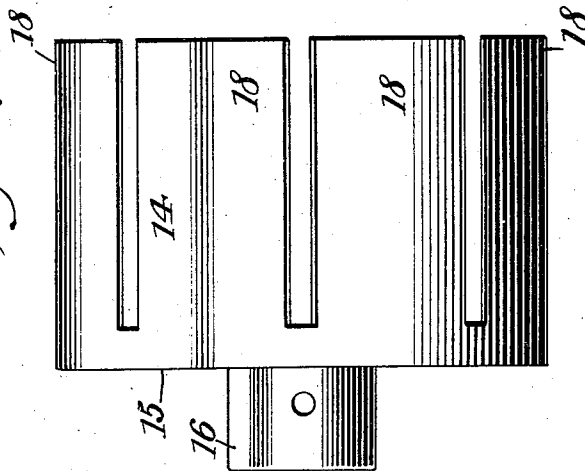


Fig. 5.



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UNITED STATES PATENT OFFICE.

ROBERT WILLIAM VAIL, OF NEW YORK, N. Y.

ROTARY PUMP.

1,000,464.

Specification of Letters Patent. Patented Aug. 15, 1911.

Application filed October 12, 1910. Serial No. 586,670.

To all whom it may concern:

Be it known that I, ROBERT WILLIAM VAIL, a citizen of the United States, and resident of New York, in the county and State of New York, have invented certain new and useful Improvements in Rotary Pumps, of which the following is a specification.

This invention relates to rotary pumps, and it has for its object to provide a simple and improved apparatus which will possess advantages in effective power and capacity with relation to the percentage of operative force required.

It will be understood that the improved apparatus constituting my invention is adapted to a wide range of variable uses, other than its operation as a pump, for instance, as a mechanism for maintaining a circulation of water or air, and as a turbine water motor.

In the drawings—Figure 1 is a side elevation of the apparatus. Fig. 2 is a vertical transverse sectional view, taken on the line $x-x$, Fig. 3. Fig. 3 is a vertical sectional view, taken on the plane of the cylindrical compass of the casing, on the line $y-y$, Fig. 2. Fig. 4 is a horizontal sectional view, taken on the line $z-z$, Fig. 2. Fig. 5 is a side view of the rotary cylindrical member which is eccentrically mounted within the casing.

Corresponding parts in all the figures are denoted by the same reference characters.

Referring to the drawings, 1 designates a casing which incloses the operative parts of the apparatus. This casing comprises side plates or members, 2 and 3, and a cylindrical member, 4, extending between said side plates. In the preferred constructional organization of the casing, the side plates 2 and 3 are provided with annular grooves, as at 5, corresponding to and receiving the side edges, 6, of the cylindrical member 4, said joint being suitably maintained in an air-tight status, and the casing parts are secured together by a series of transverse bolts, 7, passing through portions of the side plates which project beyond the cylindrical member 4 and operating to clamp and bind the casing members 2, 3 and 4 securely together. The casing is mounted and retained upon a suitable supporting frame, which is preferably constituted by foot extensions of said side plates, as at 8, which extensions may be bolted or otherwise suitably secured

to a base upon which the apparatus is mounted in fixed position.

The side plate 3 is provided at its inner face with a circular recess, 9, of lesser diameter than the interior cylindrical compass of the casing member 4 and in eccentric relation to the cylindrical compass of the latter, and said plate 3 is also provided with a lateral extension, 10, at its outer side, centrally located with relation to said recess 9. A rotary shaft, 11, is journaled in suitable bearings in said extension 10, and carries at its outer protecting portion a gear or band-wheel, 12, for the application of power to or the transmission of power from said shaft. It will be understood that the shaft 11 is thus eccentrically-mounted with relation to the interior cylindrical compass of the casing member 4, its longitudinal plane being at one side of the true central transverse plane of the latter, and this shaft carries a cylindrical member, 14, which revolves with the shaft and is concentric therewith and is therefore eccentric with relation to the interior cylindrical compass of the casing. Said cylindrical member 14 is of somewhat less diameter than the interior cylindrical compass of the casing, and in its preferred constructional organization comprises a circular plate, 15, corresponding to and fitting in the recess 9, and an extension or sleeve, 16, projecting from said plate and fitting within the extension 10 and surrounding the shaft 11 and secured in fixed connection therewith by a key, 17, or in any other suitable manner, and the main cylindrical portion of the member 14 projects from the peripheral portion of said circular plate 15 transversely across the interior area of the casing. It will thus be understood that the circular plate 15 has a revoluble movement within its corresponding recess 9, and its seat within said recess is suitably maintained in an air-tight status, and in the relative position and arrangement the inner face of said revoluble plate 15 is on a plane coincident with the plane of the inner face of the side plate 3. The cylindrical main part of the rotary cylindrical member 14 is preferably constituted by a series of segmental plates, 18, collectively forming the cylindrical contour of said member 14 and spaced apart to form intervening slots existing transversely with relation to the interior area of the casing, and the annular edge of said main cylindrical part of the

member 14, which is constituted by said segmental plates 18, is received by and travels in a corresponding annular recess, 19, provided in the inner face of the side plate 2 of the casing, said seat within the recess 19 being suitably maintained in an air-tight manner. Roller-bearing members are operatively mounted in the space existing between the respective segmental plates 18, and provide slot openings for a slidable operative connection with a series of radial plates, 20, to be hereinafter described. In the preferred construction, said roller-bearing members are preferably constituted by two sections, 21--21, between which exists a slot space, 22, through which said plates 20 project, said sectional members 21 having convex outer surfaces, 23, bearing against a corresponding concave surface, 24, upon the edge of the segmental plates 18, and said edge is preferably notched, as at 25, at opposite sides of the bearing surface 24, to permit play of the plates 20 under the rolling action of the sectional members 21. The bearing joints between the parts 20 and 21 are suitably maintained in an air-tight status.

26 designates a fixed supporting shaft, by which the plates 20 are revolvably sustained. Said shaft 26 projects on a plane concentric with relation to the interior cylindrical compass of the casing, and is thus eccentric to the revolving cylinder 14 and to the plane of the revolving shaft 11 which carries said cylinder 14, and said fixed shaft 26 is preferably secured to the side plate 2 and supported thereby and projects across the true center of the interior cylindrical compass of the casing. The plates 20 radiate from the shaft 26 and have a revoluble support thereon by means of bearing rings or hubs, as at 27, by which the plates 20 are respectively and individually carried. The plates 20 have a slidable bearing connection with the cylindrical member 14 which is eccentric to the radial axial center of said plates, as above described, and said plates extend from side to side of the interior area of the casing and to contact with the inner face of the cylindrical member 4 of the casing. Thus, the side edges of the plates 20 respectively contact with the inner face of the side casing plate 2 and the inner face of the side casing plate 3 and the inner face of the circular plate 15 of the rotary cylindrical member 14, and their outer edges contact with the inner face of the cylindrical casing member 4, at all times during the operation of the apparatus, and said edge contacts are suitably maintained in an air-tight status.

In the operative effect of the relationship of concentric and eccentric parts as above described, it will be understood that, during the rotary movement of the cylindrical member 14, which latter is eccentric to the in-

terior cylindrical compass of the casing, the radial plates 20 will be carried by said member 14 but will always maintain their regular projecting relationship to the inner cylindrical face of the casing, said plates 20 being mounted upon an axis concentric with the interior cylindrical compass of the casing and eccentric to the axial center of the revolving member 14, these conditions of operation being permissible by reason of the sliding connection between said plates 20 and the member 14 through which said plates project, under the action of the roller-bearing members which are socketed in said member 14, and during the action of said plates 20 with relation to the rotary movement of the eccentrically-mounted cylindrical member 14 said plates will continuously divide the increasing and diminishing space between the circumference of the member 14 and the interior cylindrical compass of the casing into separate chambers.

In the side plate 2 of the casing are provided chambers, as at 28 and 29, respectively coincident with the segmental diminishing spaces which exist at opposite sides of the cylindrical member 14 between the circumference of the latter and the inner surface of the cylindrical casing by reason of the eccentric location of the cylinder 14 within the casing. These chambers 28 and 29 are located at opposite sides of a section of the inner surface area of the side plate 2 which is at the central or largest part of said space just above referred to, and which central section forms an area, as at 30, which is on the normal plane of the inner surface of said side plate 2. Said chambers 28 and 29 are thus related to the chambers which are formed between the plates 20, and at certain points afford communication between said latter chambers at the circumference of the cylindrical member 14. An inlet pipe, 31, communicates with the chamber 28, and an outlet or exhaust pipe, 32, communicates with the chamber 29, these pipes being preferably provided with suitable controlling valves, as at 33.

It will be understood that the internal chambers of the cylindrical casing, formed by the plates 20, gradually increase and diminish in size under the movement of the plates 20 caused by the rotary movement of the eccentrically-mounted cylindrical member 14, their maximum size being reached at the area 30 of the side plate 2 which is intermediate of the chambers 28 and 29 in said side plate, and that during the operation of the apparatus the series of such chambers within the casing which are increasing in size are conjointly in communication with the inlet-end chamber 28 while the series of such chambers which are decreasing in size are conjointly in communication with the outlet or exhaust cham-

ber 29, but said respective sets of increasing and decreasing chambers are not in communication, by reason of the air-tight closure effected by the plate 20 which is at the side of the eccentrically-mounted cylindrical member 14 which is in close relation to the inner surface of the cylindrical member 4 of the casing and by reason of the closure between the respective sets of said chambers which is effected at the area 30 of the side plate 2 existing between the chambers 28 and 29. The relative construction is such that at said area 30 two of the plates 20 will, in the operation of the apparatus, successively form a closed air-tight chamber existing between said plates 20, the circumference of the cylindrical member 14 and the inner surface of the cylindrical member 4 of the casing, and the area or plane surface 30 of the side plate 2 and the inner face of the side plate 3.

The general operation and advantages of the apparatus as herein described will be readily understood by those skilled in the art to which it appertains.

In the employment and operation of the apparatus as a rotary pump, to draw water from wells or mines or to raise water to required heights or for other desired purposes, the water is adapted to enter the casing 1 through the inlet pipe 31, which extends down to the supply of water in the well or mine or at any other point from which the water is to be pumped. Power is applied to revolve the shaft 11, which carries with it in its revolution the cylindrical member 14 and thus also the plates 20, which latter in their operation have an air-tight contact with the inner surface of the cylindrical casing and successively have an air-tight contact with the area 30 of the side plate 2 which is intermediate of the chambers 28 and 29. It will be understood that the structural and operative conditions are such that an air-tight condition always exists in the chambers which are successively formed at said area 30, so that no air can at any time of the operation pass back into the chamber 28 into which the water enters, and that the plate members 20 operate to constantly and successively form an air-tight chamber at the area 30, the successive formation of which chambers draws or exhausts the air from the inlet chamber 28. This exhaust of air creates a complete or partial vacuum in the inlet chamber 28 and in the chambers formed by the plates 20 and which are constantly increasing in size and are the communication through said inlet chamber 28, and therefore the atmospheric pressure upon the water supply with which the feed pipe 31 communicates causes the water to rise in said pipe and flood the inlet chamber 28 and the constantly increasing chambers in communication therewith.

Under the continued action of the apparatus, the exhaust of air from said inlet chambers is of course maintained and the water constantly floods said inlet chambers and is carried by the constantly forming chambers produced by the action of the plate members 20 at the area 30 to a point beyond said area and is ejected from said carrying chamber into the outlet chamber 29, in which the water pressure is established by the constantly decreasing conditions of the chambers which are formed by the action of the plates 20 and which are in communication through the chamber 29, and the water is let off under pressure at the outlet pipe 32 and utilized at the desired point.

In the employment of the apparatus as a mechanism for maintaining a circulation of water or air, the operation is substantially the same as that just described, the revolution of the cylindrical member 14 and the action of the plate members 20 produced thereby causing the formation successively and constantly of a series of chambers which gradually and regularly increase in area as they approach the area 30 at the side plate 2 and gradually and regularly decrease in area as they recede from said area 30, the series of gradually increasing chambers being in communication by means of the inlet chamber 28 at one side of said area 30 and the series of gradually decreasing chambers being in communication by means of the outlet chamber 29 at the other side of the area 30. An operative air-tight chamber of maximum area, closed from communication with the series of other chambers, is thus constantly and successively formed at the area 30, by which the water or air entering at the inlet 31 and taken up by the series of gradually increasing chambers is carried in the air-tight chamber formed at the area 30 and passed beyond said closed area 30 to the series of gradually decreasing chambers and outlet chamber 29 and forced out under pressure at the exhaust or outlet 32. Thus, when the inlet and outlet pipes 31 and 32 are in communication with water in a reservoir the action of the apparatus, under the exhaust conditions produced by the air-tight chamber formed at the area 30, will cause a circulation of the water in a series of pipes or coils in connection with the inlet or outlet pipes 31 and 32 and arranged as desired, and it will be understood that under substantially the same conditions of operation the apparatus will effect a circulation of air or of any fluid or liquid elements entering at the inlet 31 and exhausting at the outlet 32.

In the general operation of the apparatus as a circulator, it will be understood that the action of the gradually increasing chambers, under the air-tight conditions hereinbefore described, causes the air to be

exhausted therefrom as the chambers reach the point of maximum area at the area 30 and then become an individual air-tight chamber, thus causing a suction action at the inlet side, and that the air thus withdrawn is forced out at the exhaust side by the action of the gradually decreasing chambers, a continuous suction action being thus effected during the continued operation of the apparatus.

In the employment of the apparatus as a turbine water motor, the head of water may be fed at the inlet 31, or, if desired, the top portion of the cylindrical casing member 4 may be open so that the head of water enters the casing directly under the force of the source of supply, as will be readily understood. Under the latter circumstances, a section of the top portion of the cylindrical member 4 may be made removable, to adapt the apparatus for substitute uses, and when such open top conditions are employed the inlet pipe 31 will be closed off. The action of the weight or head of water, in the chambers at the top of the apparatus, against the plate members 20, will cause the revolution of the cylindrical member 14 and the consequent revolution of the shaft 11, from which latter the power can be transmitted at the gear or band-wheel 12. Coincident with the revolution of the cylinder 14 and its associate parts, by action of the weight or head of water in the top chambers of the apparatus, the water is continuously carried off by the closed chambers which are formed by action of the plate members 20 at the area 30 and is passed therefrom to the outlet side of the apparatus and off at the inlet pipe 32. The operative action of the weight or head of water filling the top chambers of the apparatus, upon the plate members 20, for the employment of the apparatus as a power motor, results from the eccentric mounting of the cylinder 14 with relation to the cylindrical compass of the casing, and the location of the inlet with relation to the plane of the radial axial center of the plates 20, which axial center is concentric with the interior cylindrical compass of the casing, whereby the preponderance of the force exerted by the water is at one side of a perpendicular plane passing through the true center of the cylindrical compass of the casing and therefore at the side of the axis of the eccentrically-mounted rotary cylinder 14.

I do not desire to be understood as limiting myself to the detail construction and arrangement of parts as herein shown and described, nor to the particular uses and employment of the apparatus as herein set forth, as it is manifest that variations and modifications therein may be resorted to, in the adaptation of my invention to varying conditions of use, and that the apparatus

is operatively adaptable to other uses and purposes, without departing from the spirit and scope of my invention and improvements. I therefore reserve the right to all such variations and modifications as properly fall within the scope of my invention and the terms of the following claims.

Having thus described my invention, I claim and desire to secure by Letters Patent:

1. An improved apparatus of the class described, comprising a cylindrical casing, a rotary shaft eccentric with relation to the interior area of said casing, a rotary cylindrical member carried by said shaft and concentric therewith and operating within said casing, a fixed shaft concentric with relation to the interior area of said casing and eccentric with relation to said rotary cylindrical member, said fixed shaft being permanently mounted in connection with the casing to maintain a fixed projective position eccentric to the rotary cylindrical member, a series of plate members all of which are revolvably mounted upon said fixed shaft and slidably projective through said rotary cylindrical member to form chambers between the circumference of the latter and the interior walls of the casing, said revolvably-mounted plate members being all projective so that their outer edges contact with the interior walls of the cylindrical casing at all points during the revoluble movement of the plate members therein concurrent with the movement of said rotary cylindrical member, whereby the complete set of plate members are at all times sustained between the interior walls of the casing and their revolvable bearing upon said fixed shaft, supplementary chambers opening to the interior area of the casing and communicating with the chambers which are formed by the plate members between the circumference of the rotary cylindrical member and the interior walls of the casing, said supplementary chambers being provided respectively at the points where said chambers between the plate members are of gradually increasing and gradually decreasing area and being extended so that they afford intercommunication between a plurality of said chambers between the plate members respectively at the points where said last named chambers are of gradually increasing and gradually decreasing area, and means intermediate of said supplementary chambers and at the point where said chambers formed by the plate members are of maximum area for closing intercommunication between said last named chambers, said means being in extent so related to said supplementary chambers that a single chamber between the plate members will be entirely closed during its period of maximum volume as it passes from one of said supple-

mentary chambers to the other of said supplementary chambers during the successive movement of said series of plate members.

2. An improved apparatus of the class described, comprising a cylindrical casing, a rotary shaft eccentric with relation to the interior area of said casing, a rotary cylindrical member carried by said shaft and concentric therewith and operating within said casing, a fixed shaft concentric with relation to the interior area of said casing and eccentric with relation to said rotary cylindrical member, said fixed shaft being permanently mounted in connection with the casing to maintain a fixed projective position eccentric to the rotary cylindrical member, a series of plate members all of which are revolubly mounted upon said fixed shaft and slidably projective through said rotary cylindrical member to form chambers between the circumference of the latter and the interior walls of the casing, said revolubly-mounted plate members being all projective so that their outer edges contact with the interior walls of the cylindrical casing at all points during the revoluble movement of the plate members therein concurrent with the movement of said rotary cylindrical member, whereby the complete set of plate members are at all times sustained between the interior walls of the casing and their revoluble bearing upon said fixed shaft, supplementary chambers at the side of the casing and opening to the interior area thereof so that they communicate laterally with the chambers which are formed by the plate members between the circumference of the rotary cylindrical member and the interior walls of the casing, said lateral supplementary chambers being provided respectively at the points where said chambers between the plate members are of gradually increasing and gradually decreasing area and being extended so that they afford lateral intercommunication between a plurality of said chambers between the plate members respectively at the points where said last named chambers are of gradually increasing and gradually decreasing area, and means intermediate of said lateral supplementary chambers and at the point where said chambers formed by the plate members are of maximum area for closing intercommunication between said last named chambers, said means being in extent so related to said lateral supplementary chambers that a single chamber between the plate members will be entirely closed during its period of maximum volume as it passes from one of said supplementary chambers to the other of said supplementary chambers during the successive movement of said series of plate members.

3. An improved apparatus of the class described, comprising a cylindrical casing,

a rotary cylindrical member eccentric with relation to the interior area of said casing and operating therein, a series of members slidably projective through said rotary cylindrical member to form chambers between the circumference of the latter and the interior walls of the casing, all of said projective members being revolubly mounted upon a fixed bearing concentric with said casing and eccentric to the rotary cylindrical member and being all projective so that their outer edges contact with the interior walls of the cylindrical casing at all points during the revoluble movement of the projective members therein concurrent with the movement of said rotary cylindrical member, whereby the complete set of projective members are at all times sustained between the interior walls of the casing and their revoluble mounting upon said fixed bearing, supplementary chambers opening to the interior area of the casing and communicating with the chambers which are formed by the projective members between the circumference of the rotary cylindrical member and the interior walls of the casing, said supplementary chambers being provided respectively at the points where said chambers between the projective members are of gradually increasing and gradually decreasing area and being extended so that they afford intercommunication between a plurality of said chambers between the projective members respectively at the points where said last named chambers are of gradually increasing and gradually decreasing area, and means intermediate of said supplementary chambers and at the point where said chambers formed by the projective members are of maximum area for closing intercommunication between said last named chambers, said means being in extent so related to said supplementary chambers that a single chamber between the projective members will be entirely closed during its period of maximum volume as it passes from one of said supplementary chambers to the other of said supplementary chambers during the successive movement of said series of projective members.

4. An improved apparatus of the class described, comprising a cylindrical casing, a rotary cylindrical member eccentric with relation to the interior area of said casing and operating therein, a series of members slidably projective through said rotary cylindrical member to form chambers between the circumference of the latter and the interior walls of the casing, all of said projective members being revolubly mounted upon a fixed bearing concentric with said casing and eccentric to the rotary cylindrical member and being all projective so that their outer edges contact with the interior walls

of the cylindrical casing at all points during the revoluble movement of the projective members therein concurrent with the movement of said rotary cylindrical member, whereby the complete set of projective members are at all times sustained between the interior walls of the casing and their revoluble mounting upon said fixed bearing, supplementary chambers at the side of the casing and opening to the interior area thereof so that they communicate laterally with the chambers which are formed by the projective members between the circumference of the rotary cylindrical member and the interior walls of the casing, said lateral supplementary chambers being provided respectively at the points where said chambers between the projective members are of gradually increasing and gradually decreasing area and being extended so that they afford lateral intercommunication between a plurality of said chambers between the projective members respectively at the points where said last named chambers are of gradually increasing and gradually decreasing area, and means intermediate of said lateral supplementary chambers and at the point where said chambers formed by the projective members are of maximum area for closing intercommunication between said last named chambers, said means being in extent so related to said supplementary chambers that a single chamber between the projective members will be entirely closed during its period of maximum volume as it passes from one of said supplementary chambers to the other of said supplementary chambers during the successive movement of said series of projective members.

5. An improved apparatus of the class described, comprising a cylindrical casing constituted by side members having annular grooves at their inner faces and an intermediate cylindrical member entering said grooves and clamped between said side plates, one of said side plates having a supplementary annular groove and the other having a circular recess at their respective inner faces, a rotary cylindrical member constituted by a plate fitting said circular recess and a cylindrical projecting portion extending from said plate and entering said supplementary annular groove, said rotary cylindrical member being eccentric to the interior area of said casing and operating therein, a rotary shaft projecting from said plate side of the rotary cylindrical member and extending through the casing side plate having said circular recess, said rotary shaft being eccentric with relation to the interior area of said casing and concentric to said rotary cylindrical member, a fixed shaft carried by the other side plate of the casing and projecting within said rotary cylindrical member, said fixed shaft being concentric

with relation to the interior area of the casing and eccentric to said rotary cylindrical member, a series of plate members all of which are revolubly mounted upon said fixed shaft and slidably projective through said rotary cylindrical member to form chambers between the circumference of the latter and the interior walls of the casing, supplementary chambers opening to the interior area of the casing and communicating with the chambers which are formed by the plate members between the circumference of the rotary cylindrical member and the interior walls of the casing, said supplementary chambers being provided respectively at the points where said chambers between the plate members are of gradually increasing and gradually decreasing area and being extended so that they afford intercommunication between a plurality of said chambers between the plate members respectively at the points where said last named chambers are of gradually increasing and gradually decreasing area, and means intermediate of said supplementary chambers and at the point where said chambers formed by the plate members are of maximum area for closing intercommunication between said last named chambers, said means being in extent so related to said supplementary chambers that a single chamber between the plate members will be entirely closed during its period of maximum volume as it passes from one of said supplementary chambers to the other of said supplementary chambers during the successive movement of said series of plate members.

6. An improved apparatus of the class described, comprising a cylindrical casing constituted by side members having annular grooves at their inner faces and an intermediate cylindrical member entering said grooves and clamped between said side plates, one of said side plates having a supplementary annular groove and the other having a circular recess at their respective inner faces, a rotary cylindrical member constituted by a plate fitting said circular recess and a cylindrical projecting portion extending from said plate and entering said supplementary annular groove, said rotary cylindrical member being eccentric to the interior area of said casing and operating therein, a rotary shaft projecting from said plate side of the rotary cylindrical member and extending through the casing side plate having said circular recess, said rotary shaft being eccentric with relation to the interior area of said casing and concentric to said rotary cylindrical member, a fixed shaft carried by the other side plate of the casing and projecting within said rotary cylindrical member, said fixed shaft being concentric with relation to the interior area of the casing and eccentric to said rotary

5 cylindrical member, a series of plate mem-
bers all of which are revolubly mounted
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tive through said rotary cylindrical member
10 to form chambers between the circumference
of the latter, and the interior walls of the
casing, supplementary chambers in one of
the side plates of the casing and opening
to the interior thereof so that they com-
15 municate laterally with the chambers which
are formed by the plate members between
the circumference of the rotary cylindrical
member and the interior walls of the casing,
said lateral supplementary chambers being
20 provided respectively at the points where
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are of gradually increasing and gradually
decreasing area and being extended so that
they afford lateral intercommunication be-
25 tween a plurality of said chambers between
the plate members respectively at the points
where said last named chambers are of

gradually increasing and gradually decreas-
ing area, and means intermediate of said
lateral supplementary chambers and at the 25
point where said chambers formed by the
plate members are of maximum area for
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last named chambers, said means being in
extent so related to said lateral supple- 30
mentary chambers that a single chamber be-
tween the plate members will be entirely
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ume as it passes from one of said supple-
mentary chambers to the other of said supple- 35
mentary chambers during the successive
movement of said series of plate members.

In testimony whereof I have signed my
name in the presence of the subscribing
witnesses.

ROBERT WILLIAM VAIL.

Witnesses:

BESSIE COSTIGAN,
LAURA HAMMOND.

BEST AVAILABLE COPY