G. C. McFARLANE.

ROTARY COMPRESSOR.

APPLICATION FILED AUG. 21, 1916.

1,262,533.

Patented Apr. 9, 1918.

3 SHEETS—SHEET 1.

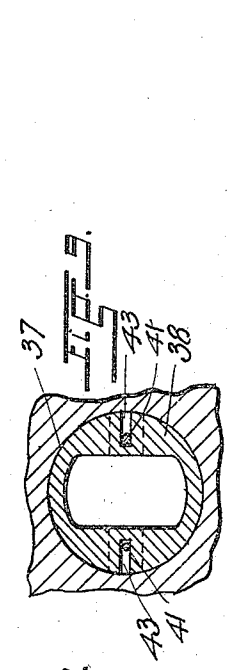


FIG. 3.

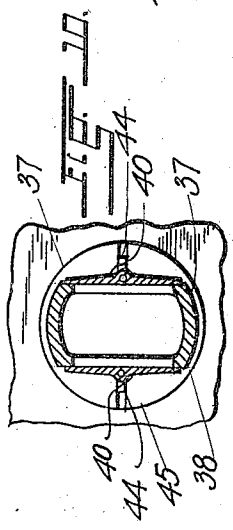


FIG. 4.

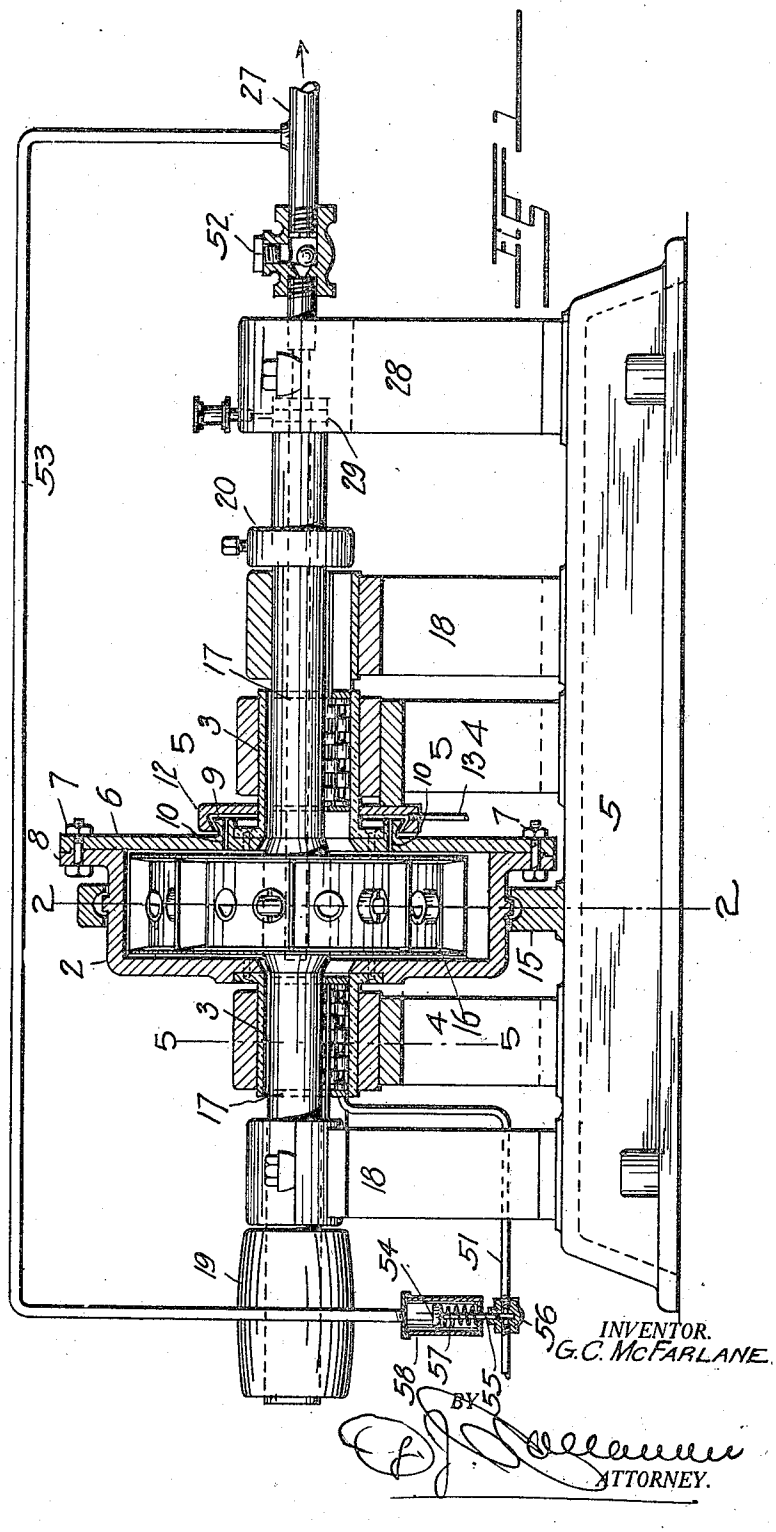


FIG. 1.

WITNESS:

F. H. Cuno.

L. Rhoades

INVENTOR.

G. C. McFARLANE.

BY

ATTORNEY.

BACKETT & WILHELMS CORP. N.Y.

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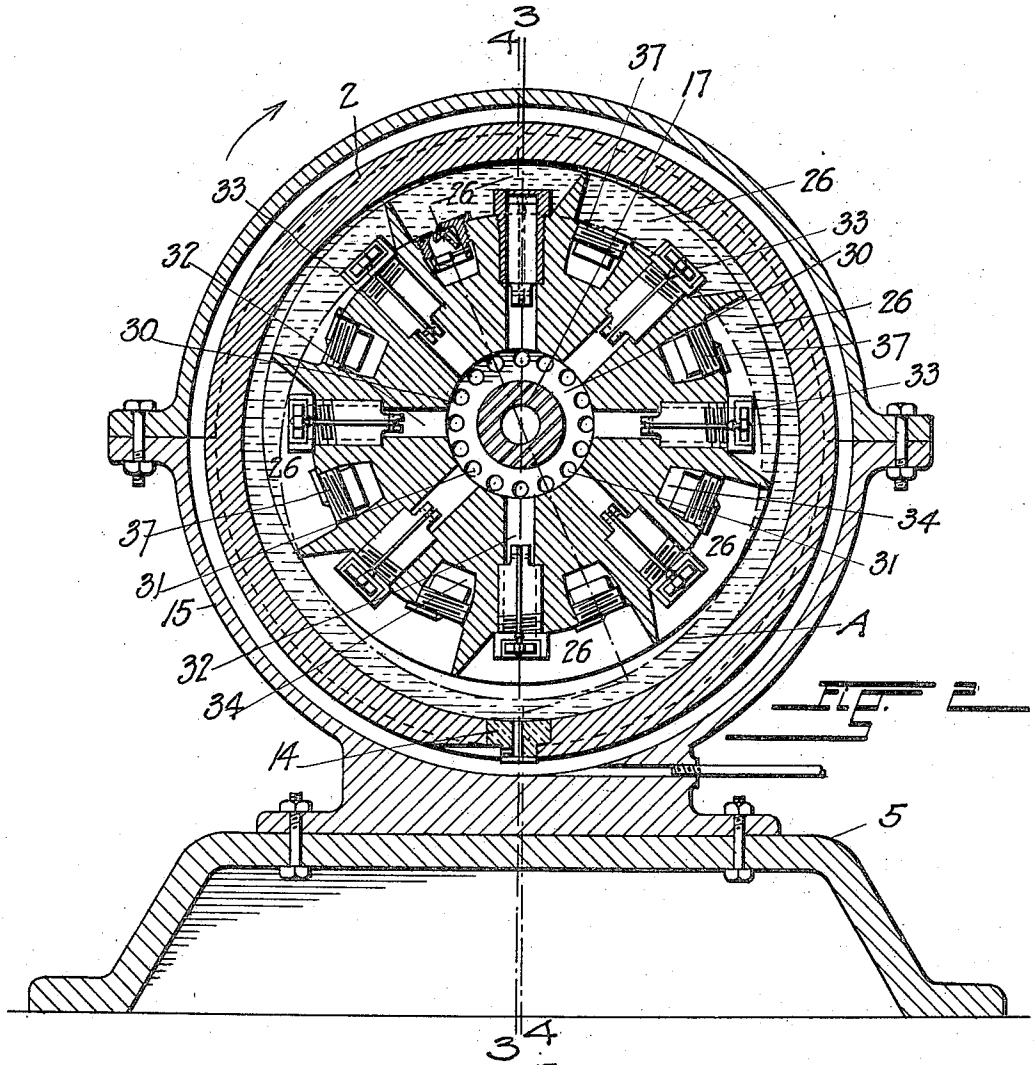


FIG. 2

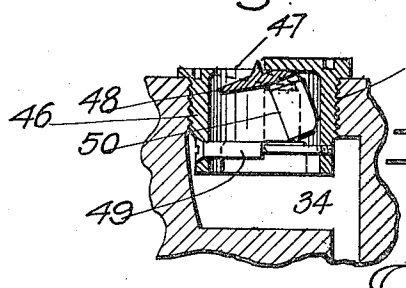


FIG. 11.

WITNESS:

F. H. Gunn.

L. Rhodes

INVENTOR.

G. C. McFARLANE.

BY

ATTORNEY.

G. C. McFARLANE.

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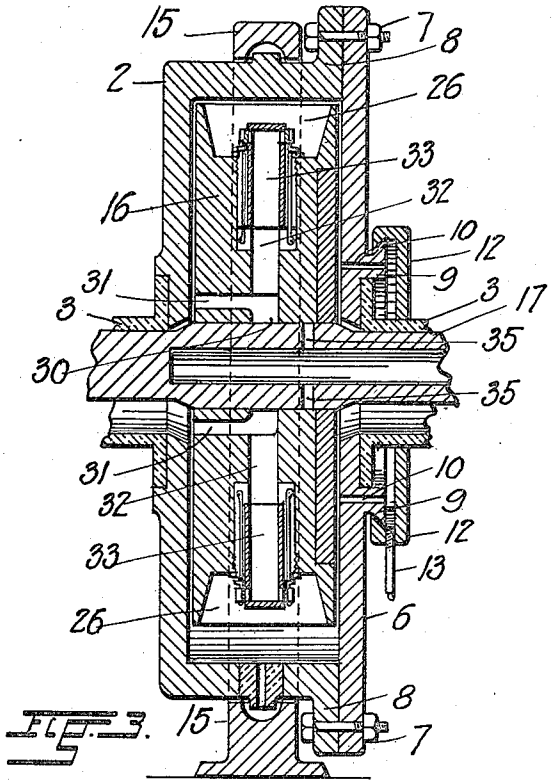


FIG. 3.

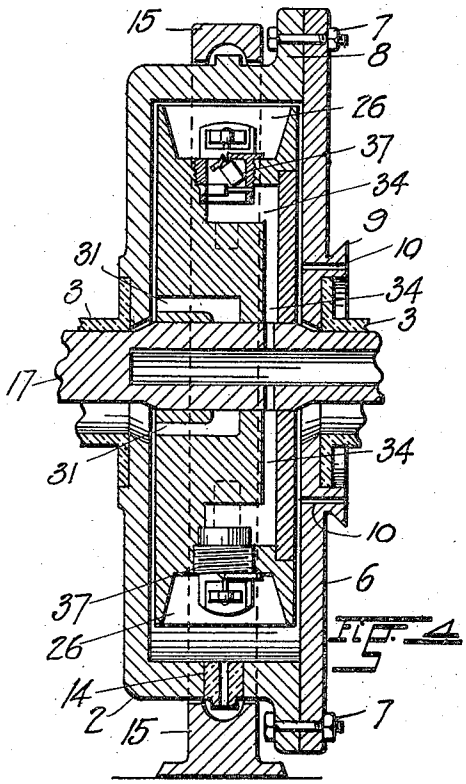


FIG. 4.

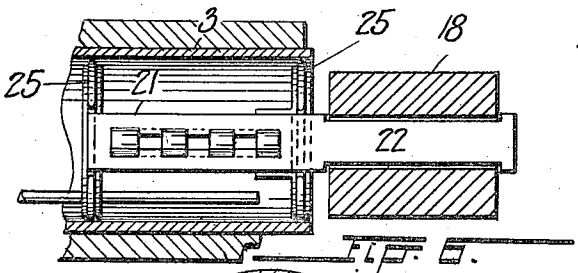


FIG. 6.

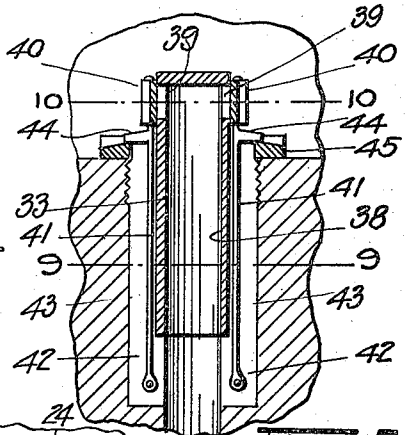


FIG. 8.

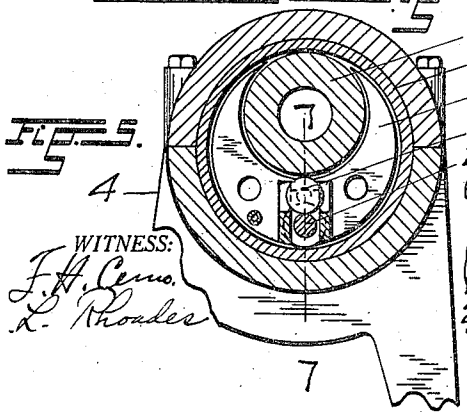


FIG. 5.

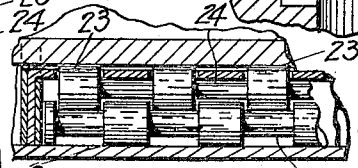


FIG. 7.

WITNESS:
F. H. Cerno.
L. Rhoades

INVENTOR.
G. C. McFARLANE.

BY

ATTORNEY.

UNITED STATES PATENT OFFICE.

GEORGE C. McFARLANE, OF DENVER, COLORADO.

ROTARY COMPRESSOR.

1,262,533. Specification of Letters Patent. Patented Apr. 9, 1918.

Application filed August 21, 1916. Serial No. 116,029.

To all whom it may concern:

Be it known that I, GEORGE C. McFARLANE, a citizen of the United States, residing at Denver, in the county of Denver and State of Colorado, have invented certain new and useful Improvements in Rotary Compressors, of which the following is a specification.

This invention relates to improvements in rotary machines for the compression of elastic fluid and more particularly to air-compressors of the type shown and described in my United States Patent No. 1,177,959, issued April 4, 1916.

It is the primary object of the present invention to provide in a compressor of the character mentioned, valves of novel construction for the admission and discharge of air to and from the peripheral pockets of a rotor which is eccentrically mounted in a rotary cylindrical casing.

A further object of the invention is to provide antifriction roller-bearings of novel construction for the purpose of relieving the main bearings of the machine from the thrust of compression, and still another object of the invention resides in the provision of automatic means for regulating the inflow of liquid into the rotary cylinder, in proportion to the pressure of the compressed fluid delivered in the operation of the machine.

The above and other objects all of which will be fully disclosed in the course of the following description, I attain by the features of construction, arrangements of parts and combinations of devices shown in the accompanying drawings in the various views of which like parts are similarly designated and in which,

Figure 1 is a sectional elevation of my improved rotary compressor,

Fig. 2, a vertical section along the line 2—2, Fig. 1, drawn to an enlarged scale,

Fig. 3, a section taken along the line 3—3, Fig. 2,

Fig. 4, a section along the line 4—4, Fig. 2,

Fig. 5, an enlarged section taken along the line 5—5, Fig. 1,

Fig. 6, a plan view of one of the roller-bearings upon which the rotor of the compressor is supported,

Fig. 7, a section taken along the line 7—7, Fig. 5,

Fig. 8, a longitudinal section of one of the intake valves included in my invention,

Fig. 9, a transverse section along the line 9—9, Fig. 8,

Fig. 10, a transverse section along the line 10—10, Fig. 8, and

Fig. 11, a section through one of the discharge valves comprised in the invention.

Referring more specifically to the drawings, my improved compressor consists of a cylindrical casing 2 provided with hollow trunnions 3 for its rotary support in journal boxes or pedestals 4 mounted upon a base 5.

The casing 2 which is mounted to move about a horizontal axis, is at one of its sides closed by a plate or head 6 which by means of a plurality of bolts 7 is detachably secured to a flange 8 on the circumferential wall of the same.

The head has exteriorly of the trunnion which is centrally secured thereto, a circular enlargement 9 provided with a concentric series of apertures 10 for the outlet of liquid into a recess formed by a flanged cap 12, which is secured to the adjacent pedestal 4 in spaced relation to the outer surface of the enlargement of the head.

A pipe 13 screwed into an aperture of the cap is provided for the slow discharge of the liquid with which the recess becomes filled during the operation of the machine.

A plug 14 fitted in an opening in the circumferential wall of the casing, has a central bore for the outflow of liquid from the interior of the same and furthermore provides a ready means for affording access to the valves on the rotor within the casing.

The liquid passing through the bore of the plug is received in an annular concavity of a splash-ring 15 which is rigidly mounted upon the base and surrounds the casing in spaced relation to its exterior circumferential surface.

Eccentrically disposed within the casing is a rotor consisting of a cylindrical body 16 which is movably fitted between the sides of the casing and is rigidly secured upon a shaft 17 extending through a hollow trunnion of the same.

The shaft projecting through and beyond the trunnions, is rotatably supported in

journal bearings on pedestals 18 mounted on the base in close proximity to the pedestals upon which the casing 2 is mounted.

A pulley 19 secured upon an end of the shaft 17 adjacent one of the pedestals 18 provides means for its operative connection with a motor or other motive agent, and a set collar 20 placed upon the shaft adjacent the other pedestal 18 coöperates with the pulley in holding the shaft and the rotor carried thereon, against axial displacement.

The bearings in which the shaft is supported, are relieved of the thrust of compression produced in the operation of the machine, by means of roller bearings of novel construction which are placed within the hollow trunnions of the casing beneath the portions of the shaft extending therethrough.

In the operation of the compressor the rotor and the surrounding casing rotate at different velocities, and to obtain a perfect rolling contact it is essential that the parts of the roller bearing which engage the shaft and the trunnion, likewise move at different rates of speed.

With this end in view, each of my improved roller-bearings consists of an elongated box or cage 21 which is positioned within the respective trunnion of the casing beneath the portion of the shaft extending therethrough and which is firmly held in place by a tail-piece 22 which is fitted in a slot of the adjacent journal bearing in which the shaft 17 is supported.

Rotatably disposed within the cage 21 are two series of spaced rollers 23 formed integrally upon parallel shafts 24.

The rollers of the upper series which engage the circumferential surface of the shaft, alternate with the rollers of the lower series which engage the inner surface of the trunnion, and the rollers of each series are in frictional contact with the shaft of the other series to rotate in unison therewith.

The diameters of the rollers and shafts of the two series are proportioned so that the velocity of the lower series of rollers is to the velocity of the upper series as is the known velocity of the casing 2 to the known velocity of the rotor 16, and the constant rolling contact consequently maintained between the trunnions and the portions of the shaft extending therethrough, relieves the main bearings of the machine of much of the friction and thrust to which they are ordinarily subjected, owing to the great pressure developed by the compression of gases in the operation of the machine.

A pair of felt washers 25 connected with the cage of the roller bearings, close the ends of the trunnions in which the bearings are positioned, to exclude dust and dirt from the rollers.

The washers are provided with openings for the passage of air to the inlet openings in the side of the casing, and with an aperture to receive the pipe which conducts water to the interior of the casing, as will hereinafter be described.

The cylindrical body of the rotor has a series of equidistantly disposed peripheral recesses 26 which provide buckets for the reception of gas and liquid when the machine is in operation.

The shaft of the rotor has an axial bore which is closed at one end and open at its opposite end for the conveyance of the compressed gases, said open end of the shaft being in communication with a conduit 27 connecting with a reservoir in which the compressed gases are stored for future consumption.

The communication between the bore of the shaft and the conduit 27 is established through the intermediary of a bearing on a pedestal 28 supported upon the base, in which the ends of the shaft and the conduit are fitted in axial alinement with relation to each other, the end of the rotating shaft within the bearing being preferably provided with one or more packing rings 29 to insure an air-tight contact during its rotary movement.

The rotor has around the portion of the shaft upon which it is mounted an annular recess 30 which connects with the atmosphere by means of a concentric series of passages 31 which open in one of the end faces of the body.

The recess 30 also connects with a series of radial ducts 32 which extend to the buckets in the periphery of the rotor for the admission of air at atmospheric pressure thereto.

The ducts are enlarged at their outer ends for the reception of intake valves 33 the construction of which will be hereinafter more fully described.

The body of the rotor has a second series of radial ducts 34, best shown in Fig. 4 of the drawings, which at their inner ends connect with the axial bore of the shaft through the medium of a corresponding number of radial passages 35 which extend from said bore to the circumferential surface of the shaft within the bore of the body 16 in which it is fitted.

The ducts comprised in the second series, likewise open in the peripheral buckets of the rotor and are enlarged at their outer ends for the application of valves 37 which serve in the operation to control the discharge of compressed air from the buckets into the ducts which connect with the bore of the shaft.

The intake valves shown in detail in Figs. 8, 9 and 10 of the drawings are each composed of a hollow cylinder 38 which by means of an external screw thread, is se-

cured in the enlargement at the outer end of one of the series of radial ducts 32 formed in the body of the rotor.

The cylinder 38 is closed at its outer end and has in its circumferential wall adjacent said end, two opposite ports 39 for the intake of air into its interior. The ports are normally closed by flap-valves 40 secured at the ends of slender stems 41 which are pivoted at their lower extremities on extensions 42 at the lower end of the cylindrical body.

The stems move in slots 43 formed longitudinally in the outer surface of the cylinder 38 and they have adjacent their upper ends, outwardly extending lids 44 which cover the slots and thereby prevent the escape of air.

The cylinder of the intake valve has between its ports and its threaded portion, an outwardly projecting flange 45 which by engagement with the bottom surface of the pocket to which the valve is applied, determines its relative position and which furthermore provides a guide and support for the lids on the valve stems.

It will be seen that the valves thus mounted to swing through a small arc about a distant center, are highly sensitive and will open by slight variations in the pressure, against the centrifugal force to which they are constantly subjected in the operation of the machine.

To still further insure the ready movement of the valves by a variation of pressure within the hollow cylinder, the cylinder is disposed in the duct so that its ports are in planes parallel to the plane of rotation of the rotor and the stems intersect the axis of rotation of the same.

The discharge valve 37 shown in detail in Fig. 11 of the drawings, are each composed of a flanged housing 46 which by means of an external screw-thread, is secured in the enlargement at the outer end of each of the ducts 34 of the rotor.

The housing has in its outer end a port 47 of reduced area the flow through which is controlled by a counter-weighted valve 48 which has a rolling movement within the housing.

The valve in its closing position abuts against a shoulder on a pin 49 secured transversely of the housing, and in moving to its open position, engages the inner surface of the housing as shown in the drawing.

The counterweight 50 of the valve is disposed and proportioned to normally hold it in an open position and it serves in the operation to permit the valve to open by an inward pressure of less force than the pressure which tends to maintain it in its closed position.

Water is injected into the casing 2 through a pipe 51 which extends into one of the trunnions 3 and the flow of water through this pipe is automatically controlled by the air-pressure in the reservoir connected with the conduit 27.

The latter is to this end provided with a check-valve 52 designed to obstruct the passage of fluid through the conduit when an excess of pressure exists in the outer portion thereof.

A by-pass pipe 53 connects the conduit at a point between the check-valve and the reservoir, with an air-tight cylinder 58 in which a piston 54 is fitted for reciprocation.

This piston is connected with a gate-valve 55 having a sliding motion in a housing 56 to control the flow through the water-supply pipe 51, and a spring 57 disposed in the cylinder 58 at one side of the piston, serves to normally maintain the gate valve in its open position.

Having thus described the mechanical construction of my improved compressor, its operation which is substantially the same as that of the machine described in the above-mentioned patent, will be readily understood.

The rotor is rotated at a high velocity by means of its pulley and the water constantly fed into the casing through the pipe 51 in following the motion of the rotor, masses at the inner circumferential surface of the casing in a ring-like form and by its frictional contact with both the rotor and the casing, converts the rotary motion of the one into a similar movement of the other at a reduced rate of speed.

The eccentrically mounted rotor is tangent to the interior surface of the casing at the apex thereof and it runs at the bottom of the same free from the annular body of water which in Fig. 2 of the drawings has been designated by horizontal shading within a dash-dot circle A.

The rotor moving in the direction of the arrow in Fig. 2, the buckets at its descending side in emerging from the annular water body, discharge their liquid contents with the result that a partial vacuum is formed which causes the respective intake-valves to open for the admission of atmospheric air supplied to the valves through the communicating ducts and passages.

The buckets are thus slowly filled with air at atmospheric pressure which when at the ascending side of the rotor they enter the liquid annulus, is compressed into the bottom portions of the buckets until its expansive force is sufficient to overcome the pressure of the compressed air against the opposite side of the respective discharge valves and permit the latter to open assisted by gravitation of their counterweights.

It will be understood that the presence of the counterweights permits the valves to open before the air-pressure in the respective buckets is equal to the pressure in the ducts 34 which connect with the bore of the rotor-

shaft and that as a result the water which previously had entered the ducts is forcibly ejected in the form of a spray, into the pockets and cools the parts which were heated by compression.

During further movement of the rotor, the ascending buckets gradually fill with water which forces the compressed air past the open-discharge valves into the respective ducts through which it passes into the bore of the rotor-shaft which communicates with the reservoir in which the air is stored subject to consumption.

The discharge valves remain open until all the air is thus expelled from the buckets when by the pressure of the water having escaped into the discharge duct 34 augmented by the centrifugal force upon the counterweights at the descending side of the rotor, they are returned to their closing position.

The water expelled from the buckets is constantly forced into the spaces between the opposite sides of the rotor and the casing and prevents their frictional contact while at the same time obstructing the escape of air.

The water is constantly discharged from the casing through the bleed-passage in the plug 14 to compensate for the continuous supply, and the excess liquid passes through the openings 10 into the recess provided by the cap 12 from which it is slowly discharged through the pipe 13.

When by insufficient consumption or other causes, the air-pressure in the reservoir connecting with the conduit 27 exceeds a predetermined degree, the check-valve 52 closes and the air flowing through the by-pass 53 into the cylinder 58, moves the gate valve 55 connected with the piston, to its closing position against the pressure of the spring 57. The water-supply is in consequence discontinued and the rotor of the machine will run idle until the pressure in the reservoir has been restored to its normal maximum degree.

Having thus described my invention what I claim and desire to secure by Letters-Patent is:

1. In a compressor of the character described, the combination of a rotary container, a rotor eccentrically disposed therein, a mass of liquid maintained by motion of the rotor against the inner circumferential surface of the container, said rotor having peripheral buckets which enter said liquid mass during its rotary movement, intake-ducts connecting said buckets with the atmosphere, and discharge-ducts which connect the buckets with an air-exit, an intake-valve in each bucket, adapted to open the intake duct of the same by a partial vacuum within the bucket, and comprising a hollow member having ports connected with the intake-duct, flap-valves covering said ports, and stems on said valves, which are pivoted at points remote therefrom, and a discharge-valve in each bucket, adapted to open the discharge-duct of the same by a pressure of air in the bucket, in predetermined ratio to the pressure of air in said duct.

2. In a compressor of the character described, the combination of a rotary container, a rotor eccentrically disposed therein, a mass of liquid maintained by motion of the rotor against the inner circumferential surface of the container, said rotor having peripheral buckets which enter said liquid mass during its rotary movement, intake-ducts connecting said buckets with the atmosphere, and discharge-ducts which connect the buckets with an air-exit, an intake-valve in each bucket, adapted to open the intake-duct of the same by a partial vacuum within the bucket, and comprising a hollow member having ports connected with the intake-duct in planes parallel to the plane of rotation of the rotor, flap-valves covering said ports, and stems on said valves, which are pivoted at points remote therefrom, and a discharge valve in each bucket, adapted to open the discharge-duct of the same by a pressure of air in the bucket, in predetermined ratio to the pressure of air in said duct.

3. In a compressor of the character described, the combination of a rotary container, a rotor eccentrically disposed therein, a mass of liquid maintained by motion of the rotor against the inner circumferential surface of the container, said rotor having peripheral buckets which enter said liquid mass during its rotary movement, intake-ducts connecting said buckets with the atmosphere, and discharge-ducts which connect the buckets with an air-exit, valves in each bucket, controlling the flow of air into and from said bucket through the respective ducts, a splash ring spaced from the exterior of the container, said container having an outlet for the outflow of liquid at its periphery into said ring, and an outlet for discharging an excess of liquid at a point nearer its axis of rotation, and an annular channel disposed to receive said excess liquid and provided with an outlet for discharging the same.

4. In a compressor of the character described, the combination of a rotary container, a rotor eccentrically disposed therein a mass of liquid maintained by motion of the rotor against the inner circumferential surface of the container, said rotor having peripheral buckets which enter said liquid mass during its rotary movement, intake-ducts connecting said buckets with the atmosphere, and discharge-ducts which connect the buckets with an air-exit, valves in each bucket controlling the flow of air into and from said bucket through the respective ducts, said container having an outlet for

the outflow of liquid at its periphery, and an outlet for discharging an excess of liquid at a point nearer its axis of rotation, and an annular channel disposed to receive said excess liquid, and provided with an outlet for discharging the same.

5. In a compressor of the character described, the combination of a support, bearings thereon, a container having hollow trunnions rotatably supported in said bearings, a shaft extending eccentrically through the container and its trunnions, a rotor on said shaft within the container, a mass of liquid maintained by motion of the rotor against the inner circumferential surface of the container, said rotor having peripheral buckets which enter said liquid mass during its rotary movement, intake-ducts connecting said buckets with the atmosphere and discharge ducts connecting said buckets with an air-exit, valves in each bucket controlling the flow of air to and from said bucket through the respective ducts, and roller-bearings supporting said shaft within the trunnions.

6. In a compressor of the character described, the combination of a support, bearings thereon, a container having hollow trunnions rotatably supported in said bearings, a shaft extending eccentrically through the container and its trunnions, a rotor on said shaft within the container, a mass of liquid maintained by motion of the rotor against the inner circumferential surface of the container, said rotor having peripheral buckets which enter said liquid mass during its rotary movement, intake-ducts connecting said buckets with the atmosphere and discharge-ducts connecting said buckets with an air-exit, valves in each bucket controlling the flow of air to and from said bucket through the respective ducts, and roller bearings supporting said shaft within the trunnions, and each composed of two series of rollers spaced on parallel shafts, the rollers of each series engaging the shaft of the other series, and the diameters of the rollers and shafts being proportioned so that when rotated by engagement with the trunnions and the rotor-shaft, their velocities will be in ratio to the difference in velocities of the casing and the rotor.

7. In a compressor of the character described, the combination of a support, bearings thereon, a container having hollow trunnions rotatably supported in said bearings, a shaft extending eccentrically through the container and its trunnions, a rotor on said shaft within the container, a mass of liquid maintained by motion of the rotor against the inner circumferential surface of the container, said rotor having peripheral buckets which enter said liquid mass during its rotary movement, intake-ducts connecting said buckets with the atmosphere and discharge-ducts connecting said buckets with an air-exit, valves in each bucket controlling the flow of air to and from said bucket through the respective ducts, and roller-bearings supporting said shaft within the trunnions, and each composed of two members which respectively engage the shaft and the respective trunnion and which are adapted to rotate in unison at different velocities in ratio to the difference in velocities of the casing and the rotor.

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

GEORGE C. McFARLANE.

Witnesses:
G. J. ROLLANDET,
L. RHOADES.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."