

F. W. MACHLET.

PUMP, &c.

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902,501.

Patented Oct. 27, 1908.

4 SHEETS—SHEET 1.

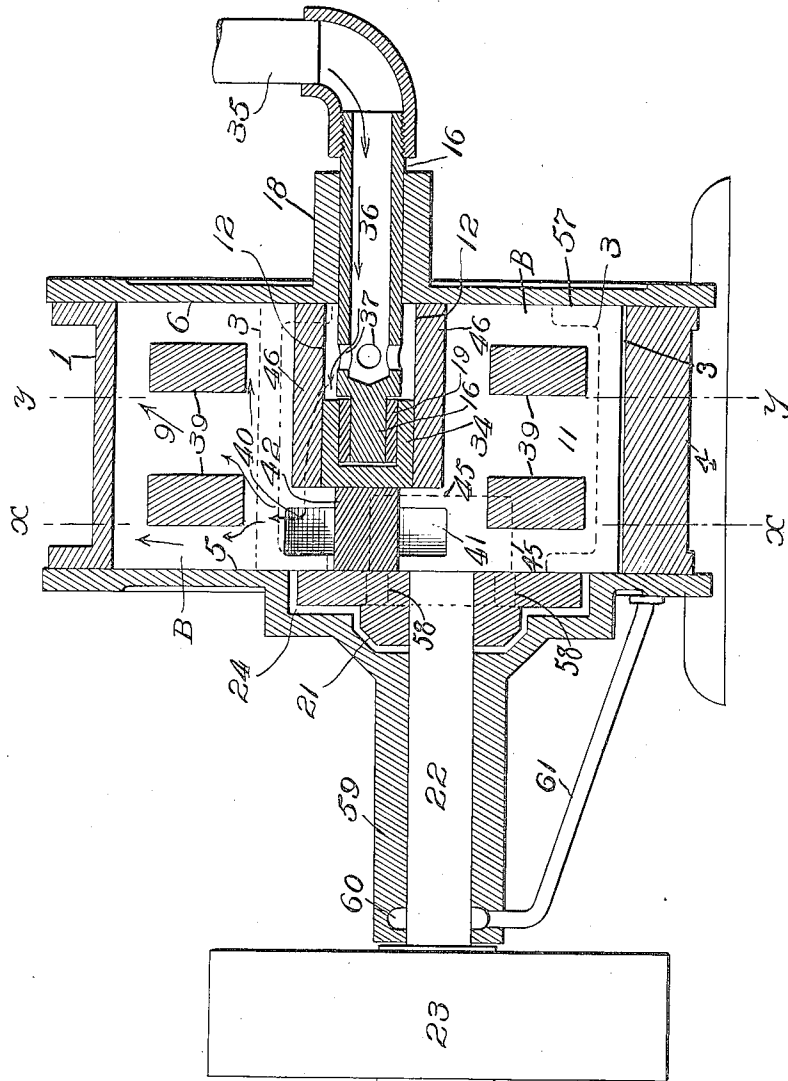


Fig. 1.

WITNESSES

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4 SHEETS—SHEET 2.

Fig. 3.

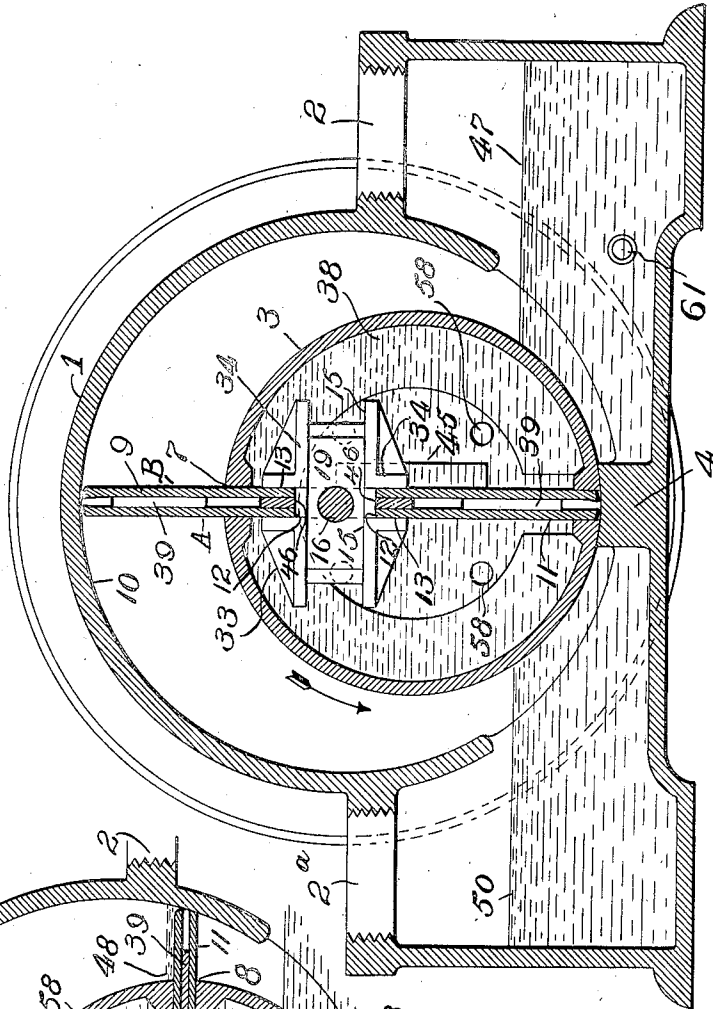
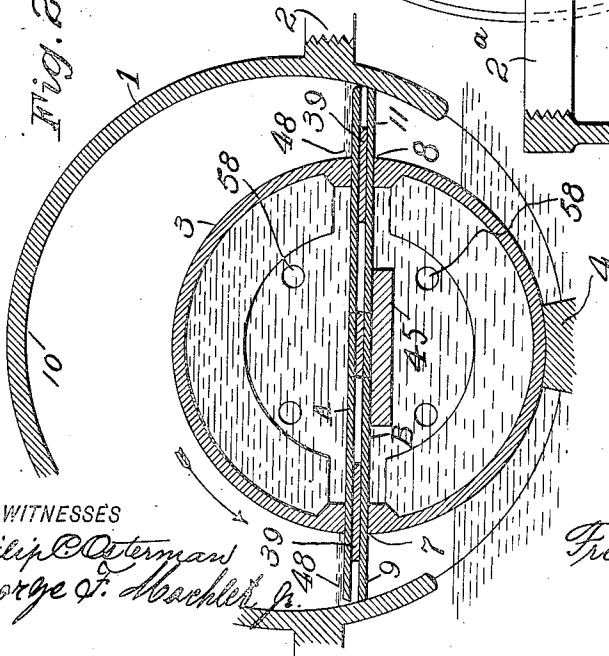


Fig. 2.



WITNESSES

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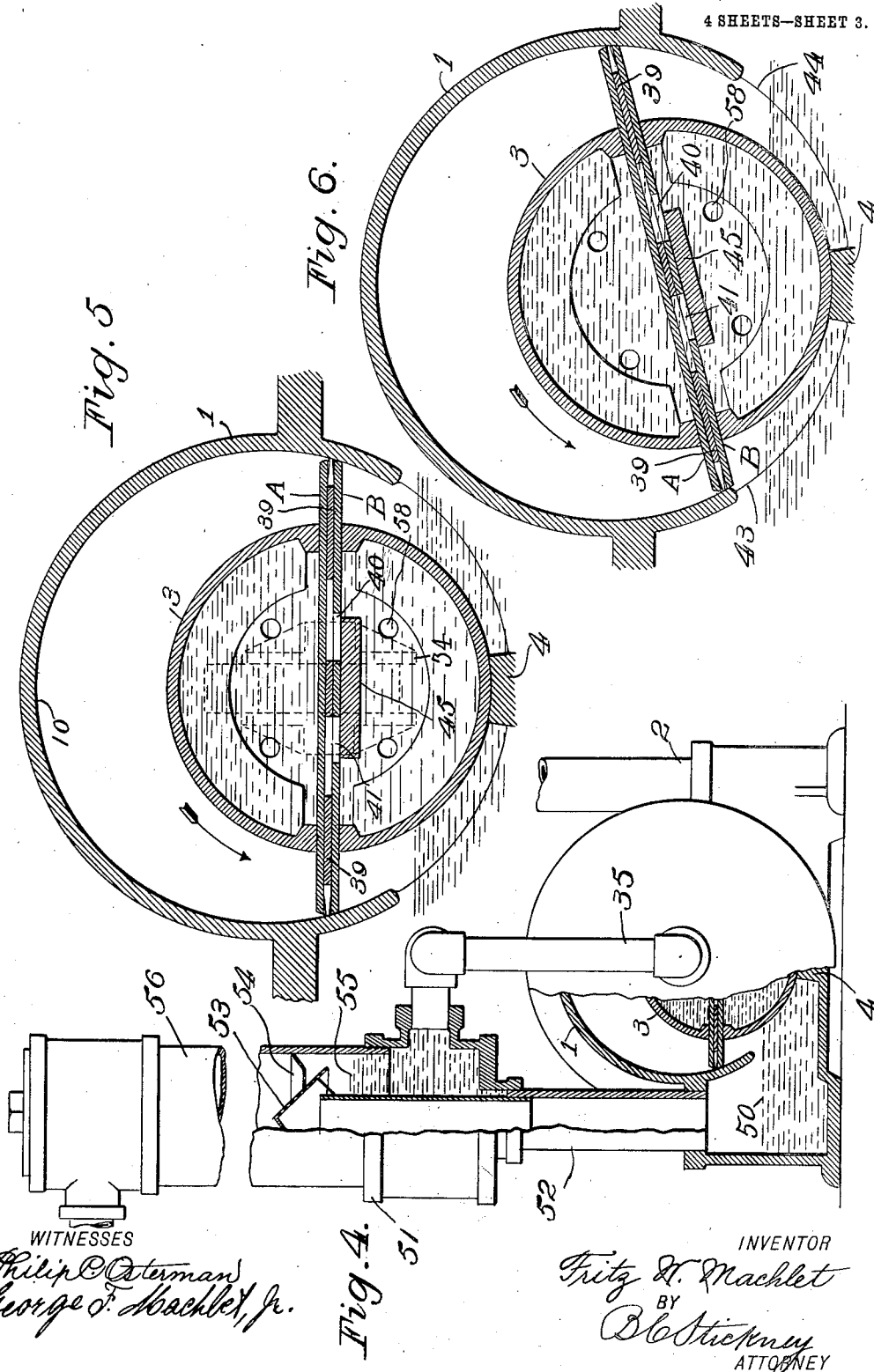
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4 SHEETS—SHEET 4.

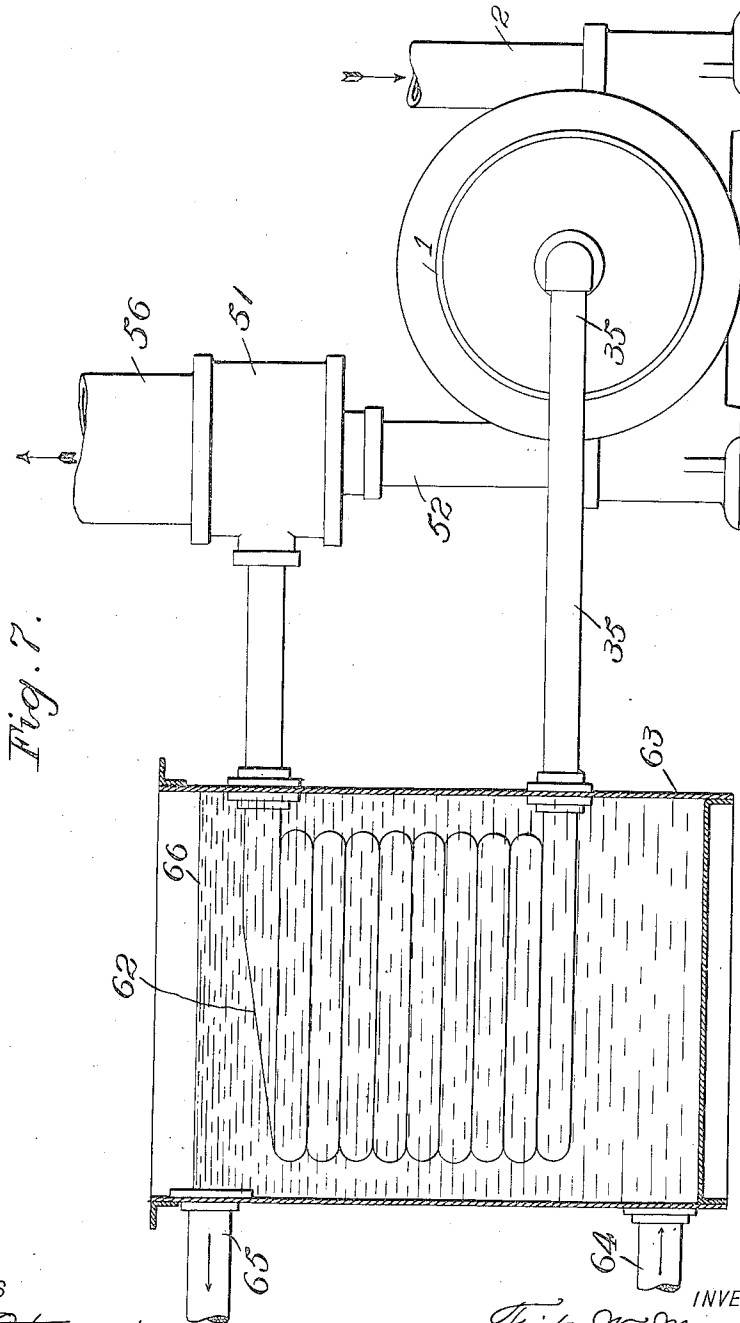


Fig. 7.

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UNITED STATES PATENT OFFICE.

FRITZ W. MACHLET, OF ELIZABETH, NEW JERSEY.

PUMP, &c.

No. 902,501.

Specification of Letters Patent.

Patented Oct. 27, 1908.

Application filed November 20, 1907. Serial No. 402,957.

To all whom it may concern:

Be it known that I, FRITZ W. MACHLET, a citizen of the United States, residing in Elizabeth, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Pumps, &c., of which the following is a specification.

This invention relates principally to liquid seals or packings for the pistons of pumps, blowers, engines, etc., especially those of the rotary type, and particularly to blowers or air compressors; and it further relates to means for cooling the air compressors or pumps.

I illustrate my invention in connection with a rotary pump of the type shown in United States Patent No. 825,671 granted to me July 10, 1906, in which is disclosed a cylindraceous drum within which is mounted eccentrically to the drum a cylinder having a double vane or piston adapted to project alternately from opposite sides of said cylinder during each revolution thereof; the face-wise or revolving movements of the double vane being controlled by said cylinder while the radial movements of the vane in and out of the cylinder are controlled by a hub acting in cooperation with a fixed stud. While there is a large demand for low pressure air pumps of many kinds, including the type disclosed in said patent, still it has not heretofore been found practicable to secure by means of said pumps a greater pressure than about four pounds per square inch. I have devised means whereby pumps of this general class may be caused to deliver air steadily at a pressure of many more than four pounds to the square inch, and even as high as twenty pounds. The capacity of pumps of this class has heretofore been limited because of the escape of air past the pistons and through the other joints of the pump, whenever it has been attempted to produce three or four pounds pressure. I have devised means whereby a constant flow of liquid is effected from a service pipe to the edges of the piston or pistons of a rotary pump, to seal said pistons sufficiently to enable pressure of the delivered air to be raised far above that which has heretofore been found practicable, and have thus converted a low pressure blower to a moderate-pressure air compressor.

In the form of the invention illustrated in the drawings, the sealing liquid is introduced through the stud and passes thence

through internal passages formed in the piston or vane to the edges of the latter, said edges having recesses which are filled by the liquid, thus forming a seal sufficient to hold the air up to twenty or even more pounds pressure per square inch. This liquid, of course, escapes and gradually collects on the delivery side of the pump or compressor, and I preferably arrange a separator to collect the liquid at the delivery side of the pump, and the collected liquid is led back from the separator into the pump through said stud and again begins its circulation. It will be understood that the pressure of the delivered air is sufficient to force the liquid back through the stud and the piston or vane into the drum of the pump, so that the circulation is practically unintermittent, and little or no opportunity is given for leakage of air past the piston. The liquid is also forced by the same means through other joints in the pump to seal all of them, with great resultant economy of operation. Preferably a cooling coil is inserted between said separator and said stud, so that the sealing liquid is cooled before again entering the pump, and this suffices to counteract the heating tendency of the air compressing operation, so that the same flow of liquid serves both to seal the moving parts and cool the entire pump. The invention may be applied to various other forms and types of pumps, compressors, blowers and engines, including engines driven by compressed air or steam.

In the accompanying drawings, Figure 1 is a longitudinal sectional view of a rotary pump or compressor provided with my improvements. Fig. 2 is a transverse section about the line X—X of Fig. 1, but showing the double vane or piston in a horizontal position, instead of the vertical position seen at Fig. 1. Fig. 3 is a transverse sectional view showing the double vane in a vertical position, and also illustrating the manner of connecting the same to its controlling stud. This view is taken about at the line Y—Y of Fig. 1. Fig. 4 illustrates a separator provided at the delivery side of the pump and delivering the collected liquid back to the cylinder and piston of the latter. Fig. 5 is a view similar to Fig. 2, but taken at about the line Y—Y of Fig. 1. Fig. 6 is a view similar to Fig. 5 but showing the piston in inclined position. Fig. 7 illustrates a cooling apparatus.

As set forth in said patent, the cylindraceous drum 1 is provided with an inlet 2 and an outlet 2^a, between which is mounted a revolvable cylinder 3 eccentric to the drum and running in contact with a saddle or abutment 4. The cylinder extends the full length of the drum and fits closely between the side walls 5, 6 thereof. Mounted in peripheral slots 7, 8 in the cylinder is a diametrical plate structure, one end portion 9 of which is seen at Fig. 3 projecting from the cylinder and extending to the inner periphery 10 of the drum, while the other portion 11 of said plate or piston is drawn into the cylinder. Said portions 9 and 11 constitute opposite pistons or vanes, and may be regarded as forming a double vane. It extends from wall 5 to wall 6 of the drum, Fig. 1.

The double vane is formed with a central rectangular recess 12, the opposite edges of which fit into mortises 13 formed radially in opposite sides of a hub member or shoe 33, having a pair of flanges 34, in which are formed said mortises 13. The hub member is rigidly secured to the double vane and controls the endwise or radial position thereof, being to this end provided with a transverse slot 15, which is perpendicular to the plane of the double vane, and extends upon opposite sides thereof within the cylinder 3, that is, said slot is continuous through the recess 12 in the double vane. In engagement with this slot is a revolvable slide 19 fitted upon a stationary stud 16, which projects inwardly from the vertical wall 6 of the drum. Said stud extends in through a boss 18 formed on the outer side of the drum head. The cylinder 3 has a hub 21 mounted upon a shaft 22 provided with a fly-wheel 23, said hub occupying a cup-like depression or recess 24 formed in the head 5.

As the cylinder 3 rotates, the double vane 9, 10 is carried around facewise thereby, while owing to the connection of the stud 16 with the slotted hub or shoe 33, the tips of the vanes 9, 11 are always equidistant from the said stud 16. As the cylinder rotates, the vanes move radially in and out relatively thereto, the radial positions of the vanes being always positively controlled by the stud 16 independently of the inner periphery of the drum 1, said inner periphery being of cylindraceous contour to correspond to the path taken by the tips or outer edges of the double vane. The stud 16 is about central of the drum. The tips of the vanes may clear the inner periphery 10 of the drum by a few thousandths of an inch, so that friction at this point may be eliminated.

The liquid, for sealing the piston and other joints, enters through a pipe 35 and passes through a bore 36 formed in the stud 16, and escapes directly into the cylinder 3 through orifices 37, and fills the interior of said cylinder 3, as indicated at 38. From thence the

liquid oozes through passages in the double vane or piston to the edges thereof to seal the same. For this purpose, the piston is preferably formed of two similar plate-like cheeks A and B connected by intervening blocks 39, which may be riveted or otherwise secured to the plates. The open spaces between the plates serve as passages for the liquid, and it will be seen that said open spaces extend to the heads 5, 6 of the drum and also to the outer edges of the double vane, and form crevices or recesses running around the edges of the double vane to be filled with the liquid for the purpose of sealing the latter. The liquid passes from the cylinder into the interior of the piston through ports 40 and 41 formed in cheek B. Said ports are separated by a block 42 corresponding with the blocks 39 and filling the space between the cheeks A and B, so that the passages in one vane are out of communication with the passages in the other vane.

At Fig. 6, one end of the piston is shown as having completed its delivery stroke, and its port 41 is closed, so that liquid shall not pass therethrough until this end of the double piston has passed the delivery and intake ports 43 and 44 of the pump, to avoid excessive loss of the liquid or false movements thereof. The port 41 is self-closing, since the face of the cheek B slides in contact with a plate 45 projecting inwardly from the head 21 of the cylinder 3 and rigidly secured thereto, said plate forming a gate or valve for said port. The gate 45 serves also for the port 40, and during the rotation of the pump the valves 40 and 41 are opened and closed in alternation, owing to the endwise movements of the double piston in and out of the cylinder 3. As will be understood by reference to Figs. 5 and 6, the port 40, which is closed until the piston passes the port 44, gradually opens as the piston rises, and is fully open when the latter stands vertically, and from that point gradually closes until the piston reaches the port 43. The ports 40 and 41 are both preferably on the one side of the double piston, and the gate 45 lies alternately under and over the double piston, but other forms of ports and valves may be employed and otherwise operated. The edges of the double piston along the recess 12 are closed by filling blocks 46 extending from the head 6 of the drum to the inner end of said recess, to prevent the liquid from flowing from the cylinder 3 into the internal passages of the piston, except through the ports 40 and 41.

The liquid, which is supplied to the pump under pressure, oozes out from the edges of the piston, and tends to flow towards the intake or low pressure side of the pump and there to accumulate, as at 47. The succeeding blade of the piston picks up some of the accumulated liquid at 47, as indicated at 48, to carry the same over to the delivery side of

the pump; and it also sweeps along any liquid that gathers on the inner periphery 10 and walls of the drum. Any liquid that drops on to either piston, as at 48 or 49, is also carried over to the delivery side; the accumulation at the latter point being indicated at 50. This accumulation is preferably disposed of by means of a separator 51, into which the delivery pipe 52 of the pump delivers the mixed air and fluid. The separator has a baffle-cone 53 and one or more baffles 54, which cause the liquid to be precipitated at 55 in the bottom of the separator; and from thence it is led through the pipe 35 back into the pump; the pressure of the delivered air in the air-drum 56 or the separator being ample to force the liquid to ooze through the passages in the piston to the intake or low pressure side of the pump, so that constant circulation is maintained and the pump is enabled to deliver air at many times the pressure that has heretofore been found practicable in this general class of pumps.

Owing to the pressure behind the liquid which is within the cylinder 3, the liquid tends constantly to ooze out between the annular flange 57 at one end thereof and the head 6 of the drum, whereby this end of the cylinder is likewise sealed. In the other end of the cylinder may be provided one or more perforations 58 through which the liquid may flow into the space 24 in which the hub 21 of the cylinder revolves. From said space, the liquid oozes out between the head 5 of the drum and this end of the cylinder, thereby sealing the latter, and it also oozes along between the shaft 22 and its bearing 59, and near the end of said shaft collects in an annular pocket 60, from which may lead a duct 61 to the intake or low pressure side of the pump, as seen at Fig. 3. The liquid in the cylinder 3 also oozes out between the sides of the piston or vane and the walls of the slot 7, 8, to seal this joint, thus completing the provision against leakage of air. It will be understood that the shoe 34 is not only rigid with the double piston, but also abuts against the edges of the cheeks at the inner end of the recess 12, thereby closing the space between the cheeks.

At Fig. 1 it will be understood that the liquid passes from the pipe 36 constantly through all of the orifices 37 directly into the body of the revolving cylinder 3; and (as indicated by the arrows) from there it enters through port 40 into the space between the cheeks of the double piston 9, filling all of said space and oozing out from the tip and sides of the piston. When the piston is turned through half a revolution from the Fig. 1 position, the liquid enters from the cylinder through port 41 between the cheeks of the double piston 11, with like results.

At Fig. 6 liquid is seen entering from the piston 3 through the port 40 between the

cheeks A and B of the piston, filling all of the space between said cheeks except that occupied by the filler blocks 39. The latter are seen in their largest dimensions at Fig. 1; and they occupy but a small portion of the surface of the piston cheek.

Preferably a cooling coil 62, Fig. 7, is inserted between the separator 51 and the pipe 35, to cool the circulating liquid, and thereby reduce the temperature of the pump due to the air-compressing operation. The coil may be inserted in a tank 63 having a suitable inlet 64 and outlet 65 for a cooling liquid 66.

Variations may be resorted to within the scope of the invention, and portions of the improvements may be used without others.

It will be seen that the principal or only function of gate 45 is to prevent loss of liquid from the tips of the double piston as they pass the low-pressure port in the main drum 1; but in cases where no openings are provided in these tips, there can be no such loss, and hence the gate 45 may be omitted. It will be understood that in some cases the openings may be omitted from the tips, since the latter may carry up enough liquid or drip from the bottom of the drum to effect the desired sealing of the tips, that is, of those edges of the piston that are parallel with and at the greatest distance from its axis of revolution.

Having thus described my invention, I claim:

1. A rotary air or gas pump comprising a drum, a hollow cylinder revolving therein, a vane or piston sliding in and out of said cylinder and fitting to the interior of the drum, and means for conducting liquid from the cylinder to the edges of the vane to form a seal or packing for the latter

2. A rotary air or gas pump comprising a drum, a hollow cylinder revolving therein, vanes or pistons sliding in and out of said cylinder and fitting to the interior of the drum, means for supplying liquid to the interior of the cylinder, and means for conducting the liquid from the cylinder to the edges of the vanes to form seals or packings for the latter.

3. A rotary air or gas pump comprising a drum, a hollow cylinder revolving therein, means for supplying liquid to the interior of said cylinder, and a vane or piston sliding in and out of said cylinder and fitting to the interior of the drum, said vane having internal passages for the liquid from the cylinder to the edges of the vane.

4. A rotary air or gas pump comprising a drum, a hollow cylinder revolving therein, means for supplying liquid to the interior of said cylinder, a vane or piston sliding in and out of said cylinder and fitting to the interior of the drum, said vane comprising opposing plates slightly separated from each other, one of said plates having a port for the passage of liquid from the cylinder into the space be-

tween the plates, and suitable recesses or openings being provided at the edges of the vanes in communication with the space between the plates to enable the liquid to escape and form a seal or packing for the vane.

5. A vane or piston for a rotary air or gas pump, comprising two plates slightly separated from each other, to form an internal passage for a liquid from the hub portion of the vane to the edge portions thereof.

6. A rotary air or gas pump comprising a drum, a hollow cylinder revolving therein, means for supplying liquid to the interior of said cylinder, a vane or piston sliding in and out of said cylinder and fitting to the interior of the drum, said vane comprising opposing plates slightly separated from each other, to form a passage for the liquid from the cylinder to the edges of the vanes to form a seal or packing for the latter.

7. A rotary air or gas pump, blower or the like comprising a drum, a vane or piston within the drum and fitting to the inner wall thereof, a revolving support for the piston, and means for forcing liquid from the revolving support to the edges of the piston to form a seal or packing therefor.

8. A rotary air or gas pump, blower or the like comprising a drum, a vane or piston within the drum and fitting to the inner wall thereof, a revolving support for the piston, and means for forcing liquid into the pump through said revolving means and to the edge of the piston to form a seal or packing therefor.

9. A double vane or piston for a rotary air or gas pump comprising two plates slightly separated from each other to form internal passages for liquid from the hub portions of the vanes to the edge portions thereof, the passages in one vane being out of communication with the passages in the other vane.

10. A vane or piston for a rotary air or gas pump, comprising two plates slightly separated from each other, to form an internal passage for a liquid from the hub portion of the vane to the edge portions thereof; said plates being joined by studs or unions well within the contour of the vane, to leave crevices or recesses around the edges of the vane.

11. A double vane or piston for a rotary air or gas pump comprising two plates slightly separated from each other to form internal passages for liquid from the hub portion of the double vane to the edge portions thereof, said plates being united by means of intermediate studs or plates including one at the middle portion of the double vane, which serves to break communication from one vane to the other.

12. A vane or piston for a rotary air or gas pump, comprising two plates slightly separated from each other, to form an internal passage for liquid from the hub portion of

the vane to the edge portions thereof; one of said plates being formed at its hub portion with a port for the admission of liquid.

13. A double vane or piston for a rotary air or gas pump comprising two plates slightly separated from each other to form internal passages for liquid from the hub portion of the double vane to the edge portions thereof, said plates being united by means of intermediate studs or plates including one at the middle portion of the double vane, which serves to break communication from one vane to the other, each vane formed near its hub portion with a port for the admission of liquids.

14. The combination with a rotary air or gas pump or the like comprising a drum, a hollow cylinder revolving therein, a vane or piston sliding in and out of said cylinder and fitting to the interior of the drum, said vane comprising opposing plates slightly separated from each other to form a passage for liquid, and one of said plates having a port opening into said cylinder, of means for forcing liquid into said cylinder and between said plates to the edge of the piston to form a seal or packing for the latter.

15. The combination with a rotary air or gas pump or the like comprising a drum, a hollow cylinder revolving therein, a double vane or piston sliding in and out of opposite sides of said cylinder and fitting to the interior of the drum, said double piston comprising two opposing plates slightly separated from each other to form internal passages, a plate or partition being provided at the middle of said double vane to break communication between said passages, ports being provided on opposite sides of said partition to effect communication between the interior of the cylinder and the passages in the double piston, of means for forcing liquid into said cylinder and through said ports and passages to the edges of the pistons to form seals for the latter.

16. A rotary air or gas pump comprising a drum having intake and delivery ports, a vane or piston revolving within the drum and fitting to the interior walls thereof, means for forcing liquid along the vane to the edges thereof to form a seal or packing for the vane, and means for cutting off the flow of liquid along the vane while the latter is passing the intake port.

17. A rotary air or gas pump comprising a drum having intake and delivery ports, a vane or piston revolving within the drum and fitting to the interior walls thereof, means for forcing liquid along the vane to the edges thereof to form a seal or packing for the vane, and means for cutting off the flow of liquid along the vane while the latter is passing both of said ports.

18. A rotary air or gas pump comprising a drum having intake and delivery ports, a

vane or piston revolving within the drum and fitting to the interior walls thereof, said vane provided with a port and passage for liquid to form a seal or packing for the vane, and means for closing said vane port when the vane is passing a drum port.

19. A rotary air or gas pump comprising a drum, a hollow cylinder revolving therein, a vane or piston sliding in and out of said cylinder and fitting to the interior of the drum, a port in said vane within said cylinder, a passage extending from said port through the vane to the edge thereof, means for supplying liquid to the interior of said cylinder, and means for closing said port when the vane is passing the intake and delivery ports provided in the drum.

20. A rotary air or gas pump comprising a drum, a hollow cylinder revolving therein, a double vane or piston sliding in and out of opposite sides of said cylinder and fitting to the interior of the drum, a port in each of said vanes within said cylinder, passages extending from said ports through the vanes to the edges thereof, said passages being out of communication with each other, and means for closing said ports in alternation to cut off supply of liquid to each passage when its vane is passing a port provided in the drum.

21. A rotary air or gas pump comprising a drum, a hollow cylinder revolving therein, a vane or piston sliding in and out of said cylinder and fitting to the interior of the drum, a port in said vane within said cylinder, a passage extending from said port through the vane to the edge thereof, means for supplying liquid to the interior of said cylinder, and means for closing said port when the vane is passing the intake and delivery ports provided in the drum; said closing means being in the form of a valve or closure rigid with the cylinder and having sliding engagement with said piston.

22. A rotary air or gas pump comprising a drum, a hollow cylinder revolving therein, a double vane or piston sliding in and out of opposite sides of said cylinder and fitting to the interior of the drum, a port in each of said vanes within said cylinder, passages extending from said ports through the vanes to the edges thereof, said passages being out of communication with each other, and means for closing said ports in alternation to cut off supply of liquid to each passage when its vane is passing a port provided in the drum; said ports being upon the same side of the double vane and said closing means comprising a valve or closure rigid with said cylinder and having sliding engagement with said double vane to close either of its ports while opening the other.

23. A rotary air or gas pump comprising a drum, a hollow cylinder revolving therein and having heads fitting to the drum heads, a double vane or piston sliding in and out of

opposite sides of said cylinder and fitting to the interior of the drum, a port in each of said vanes within said cylinder, passages extending from said ports through the vanes to the edges thereof, said passages being out of communication with each other, and means for closing said ports in alternation to cut off supply of liquid to each passage when its vane is passing a port provided in the drum; said ports being upon the same side of the double vane and said closing means comprising a valve or closure rigid with said cylinder and having sliding engagement with said double vane to close either of its ports while opening the other; said valve or closure fixed to one of the heads of the cylinder and projecting therefrom towards the other head thereof, the vane ports being close to the head of the cylinder which carries said closure.

24. A rotary air or gas pump or the like, comprising a revolving hollow cylinder having a head, said cylinder fitting closely between the heads of a drum, a vane or piston sliding in and out of said cylinder and fitting to the walls of the drum, and means for supplying liquid to the interior of the cylinder; said head of the cylinder having a perforation to permit exudation of the liquid to form a seal or packing between the cylinder-head and the drum head, passages or ducts leading from the interior of the cylinder along the piston to its edges for the flow of liquid to said edges to seal or pack the same.

25. A rotary air or gas pump or the like, comprising a hollow cylinder having a head, a drum within which said cylinder revolves, a vane or piston sliding in and out of said cylinder and fitting to the walls of the drum, and means for supplying liquid to the interior of the cylinder; said cylinder-head being perforated to permit exudation of the liquid to form a seal between the cylinder-head and the drum-head, and passages or ducts for the liquid leading from the interior of the cylinder to the edges of the piston to seal or pack the latter.

26. A rotary air or gas pump or the like, comprising a cylindraceous drum, a cylinder within said drum to revolve eccentrically thereto, a vane or piston sliding in and out of the drum, an interior stud projecting from a head of the drum, and having means to control said piston, said stud being hollow and having a perforation within the cylinder, and means for supplying liquid through said stud to the interior of the cylinder; means being provided to lead the liquid from the cylinder to the edges of the piston to form a seal or packing therefor.

27. A rotary air or gas pump or the like, comprising a cylindraceous drum, a cylinder within said drum to revolve eccentrically thereto, a vane or piston sliding in and out of the drum, an interior stud projecting from a

head of the drum, and having means to control said piston, said stud being hollow and having a perforation within the cylinder, means being provided to lead the liquid from the cylinder to the edges of the piston to form a seal or packing therefor, a separator connected to the delivery side of the pump, and a conduit for the separated liquid leading back from the separator to said stud, to enable the pressure of the delivered air to force the separated liquid through the cylinder.

28. The combination with a rotary air or gas pump having a revolving piston or vane, of a separator connected to the delivery side of the pump, and a conduit for the separated liquid leading back from the separator and communicating with the vane or piston, the latter having a passage for the liquid to its edges, so that the pressure of the delivered air or gas forces the separated liquid to the edges of the vane to seal the same.

29. A rotary air or gas pump or the like, comprising a cylindraceous drum, a cylinder within said drum to revolve eccentrically thereto, a vane or piston sliding in and out of the drum, an interior stud projecting from a head of the drum, said stud being hollow and having a perforation within the cylinder, means being provided to lead the liquid from the cylinder to the edges of the piston to form a seal or packing therefor, a separator connected to the delivery side of the pump, and a conduit for the separated liquid leading back from the separator to said stud, to enable the pressure of the delivered air to force the separated liquid through the cylinder; a cooling coil or refrigerator being included in said conduit.

30. A rotary air or gas pump or the like, comprising a hollow cylinder having a head, a drum within which said cylinder revolves, a vane or piston sliding in and out of said cylinder and fitting to the walls of the drum, a separator connected to the delivery side of the pump, a conduit for the separated liquid leading back from the separator to said cylinder to enable the pressure of the delivered air to force the separated liquid through the cylinder; passages or ducts for the liquid leading from the interior of the cylinder to the edges of the piston to seal or pack the latter; said cylinder-head being perforated to permit exudation of the liquid to form a seal between the cylinder-head and the drum-head; a shaft secured to said cylinder-head, a bearing for said shaft, and a duct leading from said shaft to the intake side of the pump.

31. In combination, a pump or compressor having a piston, the latter having passages for the flow of liquid to its edges to seal the same, a separator for the liquid connected to the delivery side of the pump, a cooling

coil connected to said separator, and means for conducting the liquid from the cooling coil to said piston.

32. The combination with a pump or compressor, of a cooling coil forming part of a circulating apparatus, which also includes the piston of the pump, so that the liquid circulates through the piston and seals the same and then passes through said cooling coil and back to the piston.

33. A rotary air or gas pump or engine comprising a drum, a vane or piston fitting the interior walls of the drum, a revolving support for said vane or piston, and means for forcing liquid through said revolving support to the edges of said vane or piston to seal the same.

34. A rotary air or gas pump or engine comprising a drum, a vane or piston fitting the interior walls of the drum, a revolving support for said vane or piston, and means for forcing liquid through said revolving support to the edges of said vane or piston to seal the same; means being provided at the delivery side of the pump or engine to separate the liquid, and means to conduct it back to said revolving support.

35. A rotary air or gas pump or engine comprising a drum, a hollow revolving piston-carrying cylinder or member within said drum and fitting at its ends thereto, the cylinder having openings at its ends and forming part of a circulatory system for liquid to seal said ends, said circulatory system including both a separator at the delivery side of the pump or engine and means to collect the separated liquid and cause it to be forced back into said cylinder.

36. A rotary air or gas pump or engine comprising a drum, a piston having ends fitted to the ends of the drum, a revolving member carrying said piston, said revolving member forming part of a circulatory system for liquid to seal said ends of the piston, means being provided for conducting the liquid from said revolving member to said ends of the piston, and said circulatory system including both a separator on the delivery side of the pump or engine and means to cause the liquid collected by said separator to flow back through said revolving member to said ends of said piston to seal the same again.

37. A rotary air or gas pump or engine comprising a revolving piston device, a shaft upon which it is secured, said shaft having a bearing, said revolving device forming part of a circulatory system, means being provided to conduct liquid from the interior of said revolving device to its ends to seal the same, and said circulatory system including both a separator at the delivery side of the pump or engine, and means to collect and conduct the separated liquid back to said revolving member; a duct leading from the

outer extremity of said bearing back to the low-pressure side of the pump or engine.

38. A rotary air or gas pump or engine, comprising a revolving piston device included in a circulatory system, means being provided to conduct liquid from the interior of said revolving device to its ends to seal the same, and said circulatory system also including both a separator at the delivery side of the pump or engine and means to collect and con-

duct the separated liquid back to said revolving member, and a valve device being provided in said circulatory system to open and close during the revolution of said piston device to prevent waste of sealing fluid.

FRITZ W. MACHLET.

Witnesses:

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PHILIP C. OSTERMAN.