

March 26, 1940.

H. E. ADAMS

2,195,375

PUMP

Filed Dec. 30, 1935

4 Sheets-Sheet 1

Fig. 1.

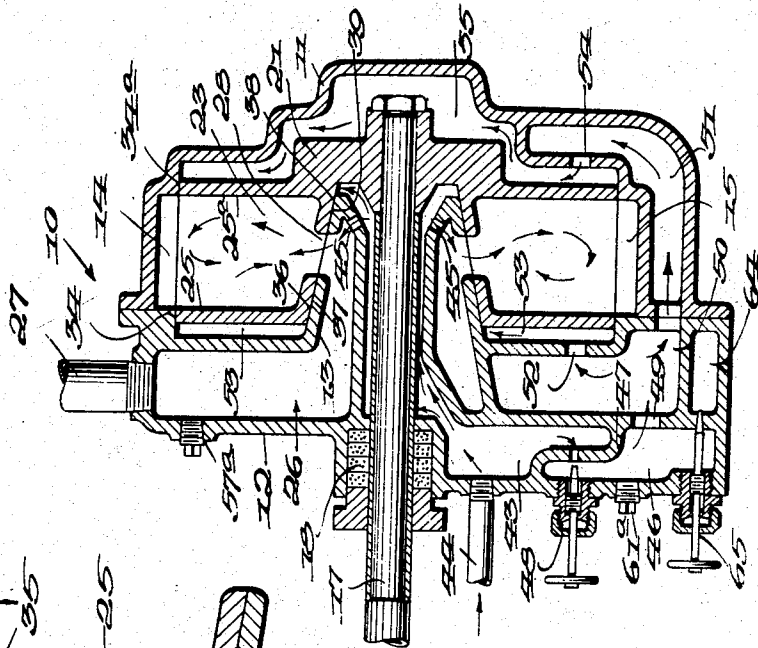


Fig. 8.

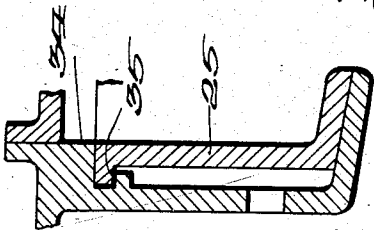
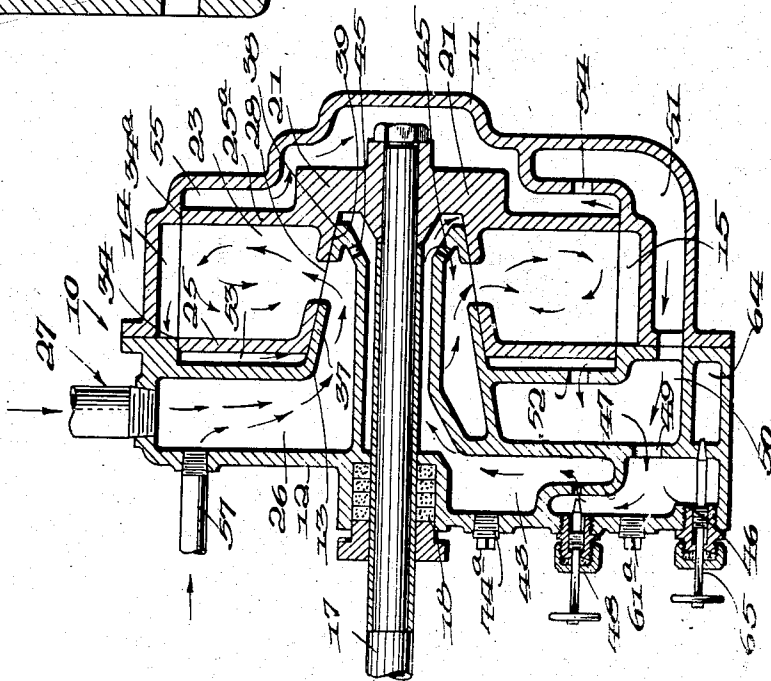


Fig. 2.



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Fig. 4.

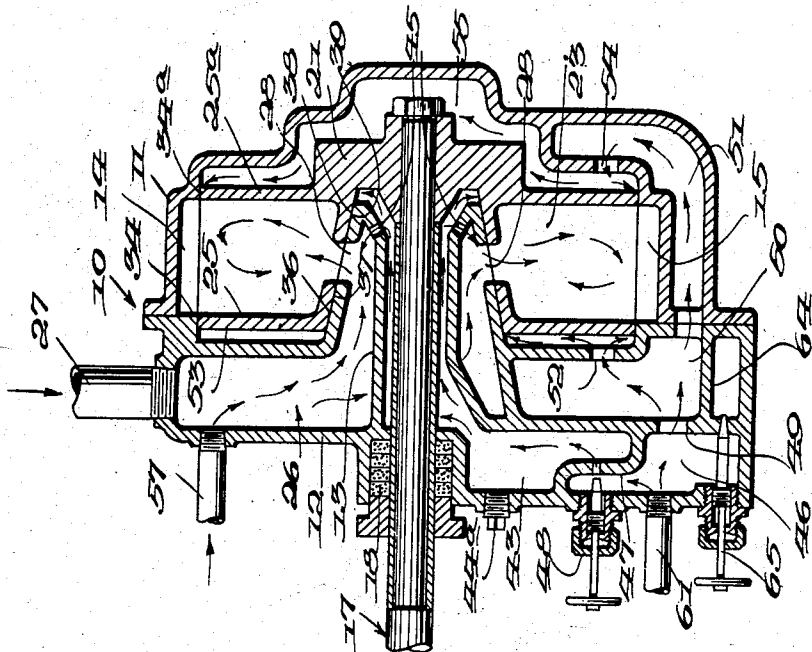
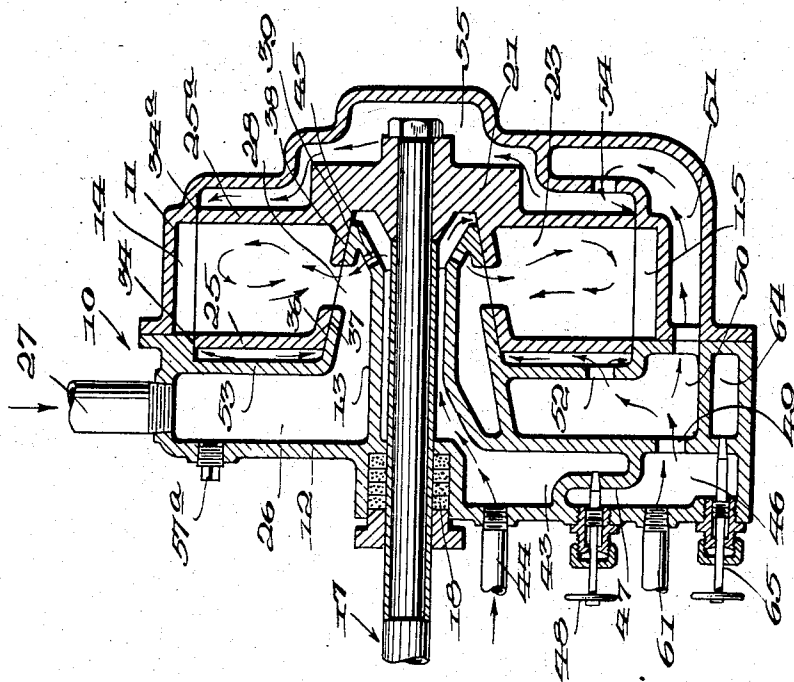


Fig. 3.



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Fig. 6

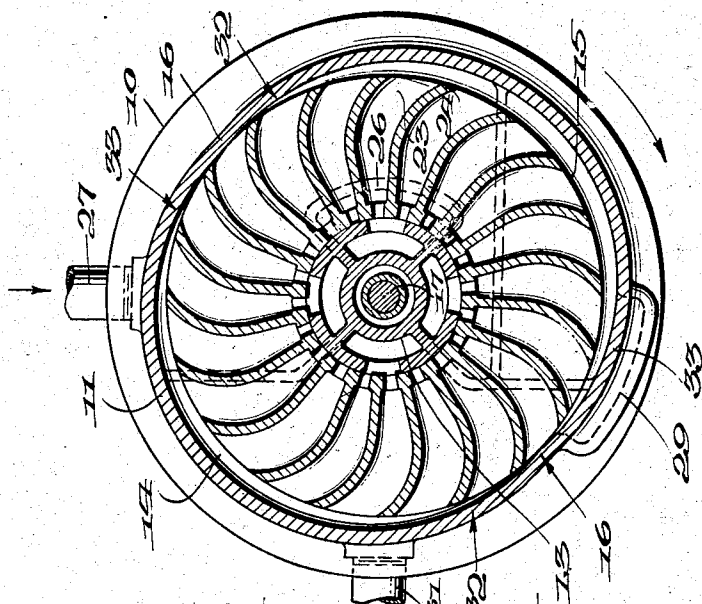
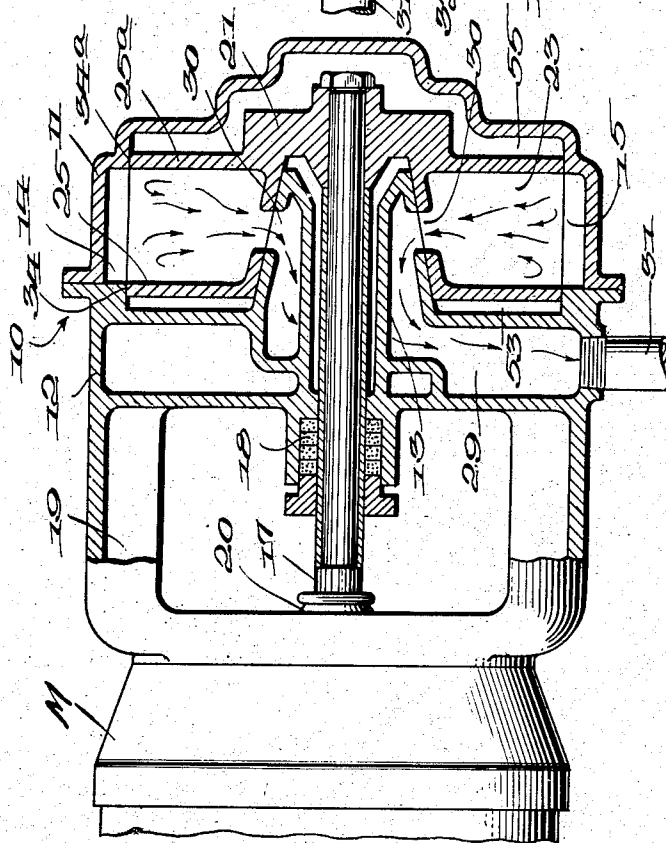


Fig. 5



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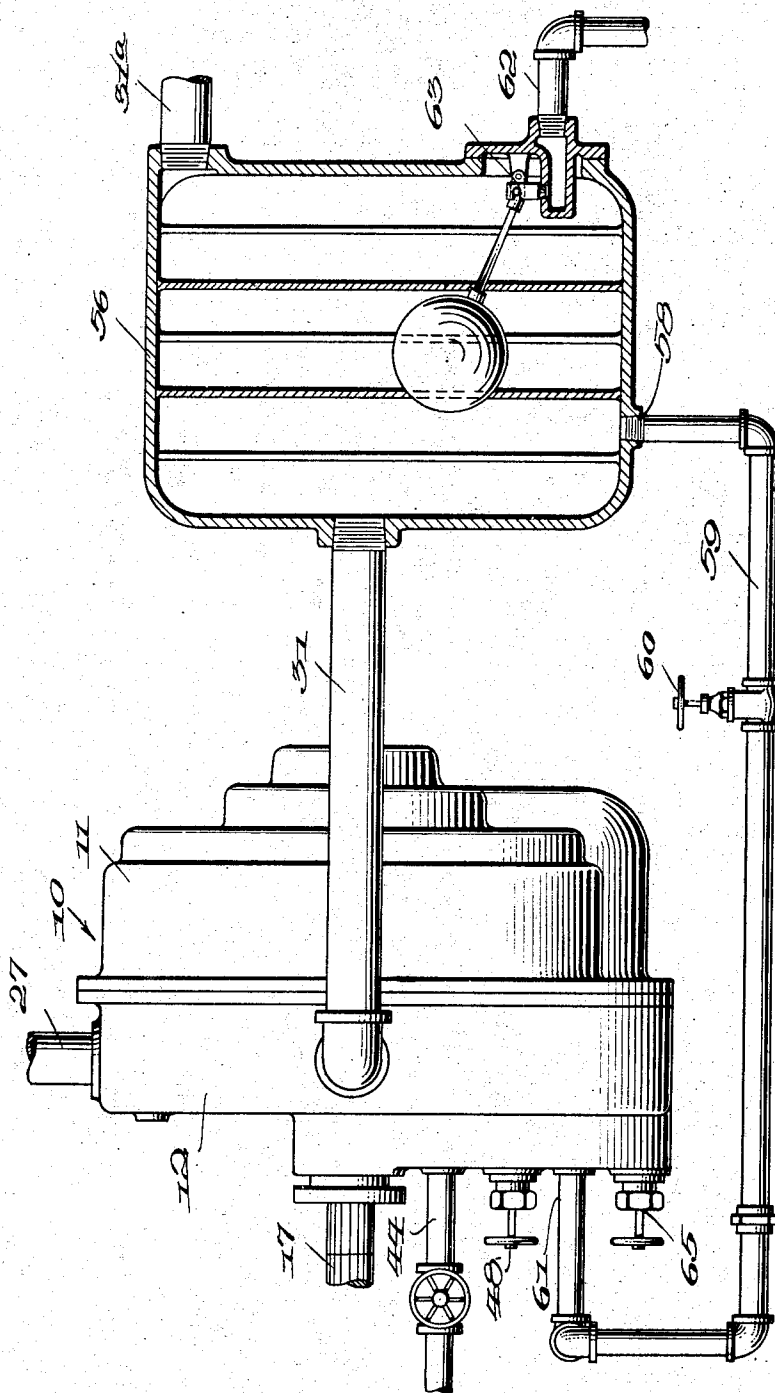
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Fig. 7.



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UNITED STATES PATENT OFFICE

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PUMP

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Application December 30, 1935, Serial No. 56,813

26 Claims. (Cl. 230—79)

This invention relates to pumps or compressors and more particularly to hydro-turbine pumps of the type employing a rotating, water or other liquid ring as a pumping or displacement medium.

The well known "Nash" type of compressor is a good illustration of the structure to which this invention is applicable. More specifically, the invention relates to improvements and developments in pump structures as described in the patents to Adams No. 1,847,548 and No. 1,847,586 of March 1, 1932, wherein a circular rotor operates within an eccentric casing, and cooperates with a pair of tapered or conical port members extending into opposite side portions of the rotor.

The invention herein is not limited specifically to this type of pump, as it may be applied to earlier types of Nash pump, provided with ports opening directly out of the side members of the rotor to the pump casing. In fact, the pump described herein is constructed with but one conical port member, rather than two, as disclosed in said patents.

Pumps of this nature have been found very satisfactory in the handling of air and gas, also in the handling of the combination of light and dense fluids such as a gas and a liquid.

In order to prevent the rotor from binding, it is necessary to have a running clearance between parts, and even with the greatest accuracy of manufacture, this clearance is enough to result in leakage from high pressure regions adjacent the discharge from the pump, back into low pressure regions adjacent the inlet, the leakage of air or gas being of course many times greater than the leakage of a denser medium.

Accordingly, it is an important object of the present invention to seal these points at which leakage may occur.

It is another object to seal these points by the use of liquid such as is used in the make-up of the fluid piston of the pump.

A still further object is to reduce leakage of the operating liquid, or fluid piston, and to replenish same during normal operations, simultaneously with the sealing effect.

Other objects include the provision of sealing means and methods which permit continuous efficient operation, regardless of wear occasioned by the handling of gritty material or by corrosion; and the supply of sealing liquid by recirculation of liquid directly from a lobe of the pump or from an extraneous source such as the discharge separator of the pump.

Specifically an important improvement resides in an arrangement whereby more adequate sealing is provided to confine the rotating liquid ring within its operating channels, and to more effectively direct the sealing liquid, to the por-

tions of the pump where leakage of the gas or liquid might occur between high and low pressure regions. This invention also provides more effective utilization of the liquid seal by various direct and indirect methods of recirculation, than heretofore available.

To the attainment of the foregoing and other objects which will appear, reference may be made to the accompanying sheets of drawings, showing certain forms and modifications of the invention, and in which:

Fig. 1 is a vertical cross section of the compressor, taken through the inlet and water seal chambers, illustrating one method of directing the water seal;

Fig. 2 is a similar cross section, illustrating a variation in the method of directing the water seal;

Fig. 3 is a similar cross section illustrating another variation;

Fig. 4 is a similar cross section illustrating a still different variation;

Fig. 5 is a horizontal cross section of the compressor taken through the discharge chambers thereof;

Fig. 6 is a sectional end view of the compressor shown in Figs. 1 to 5, illustrating the relative positioning of the inlet and outlet ports and other principal features of the compressor;

Fig. 7 is a side elevation showing the compressor assembly, and illustrating a separator in section, and connections for recirculation of the sealing liquid; and

Fig. 8 is an enlarged detail in section illustrating a variation in the sealing arrangement from that of the earlier figures.

In the operation of compressors or pumps of this nature, the rotor of the pump operates in a liquid ring within an eccentrically shaped casing. The path of the liquid ring during its rotation, is constrained by the outer casing, and because of the eccentric shape of the casing, the liquid is caused first to recede from the center of the rotor, i. e., from the displacement buckets, which constitutes the suction stroke of the compressor, drawing in air, gas or other medium which is to be handled by the pump. Thereafter, as the periphery of the rotor approaches the minor axis of the eccentric casing, the operating liquid ring is forced inwardly of the rotor to perform the compression stroke. This action may take place several times, depending upon the number of lobes in the pump. The illustrated embodiment, discloses a two lobe construction, the lobes being separated by lands at the extremities of the minor axis of the casing. Between the point where the casing approaches the periphery of the rotor, i. e., a land, and the point where it recedes from the rotor, there is built up a differential in pressure somewhat

greater than the pressure differential between the inlet to the pump and its outlet, as built up by the compressor at its final discharge connection.

If there is leakage between the low pressure and high pressure regions, there will be a corresponding loss in efficiency. This leakage may occur at a number of points, and as stated, it is a primary object of this invention to prevent such leakage and permit the building up of a higher pressure differential than heretofore thought possible in a pump of this nature.

Referring now to the drawings, in which like reference numerals refer to like parts, it will be seen that the pump comprises generally a stator 10 including an eccentric body or lobe casing 11, which functions as the pumping chamber, a head 12 therefor and a tapered hub or cone 13, which projects into the casing 11. The casing 11 has enlarged portions or lobes 14 and 15, separated by lands 16—16 at opposite sides of the casing.

Although but two lobes are illustrated, it will be obvious that the invention is applicable to pump casings having any desired number of lobes.

A driving shaft 17 is provided with a stuffing box 18 in head 12, and in the construction shown is supported by bearings in motor M, Fig. 5. The frame 12 is provided with supporting arms 19, by means of which the pump is secured to a driving motor M, Fig. 5. The shaft 17 extends axially through the hub or cone 13, and serves to drive the rotor 21. Inasmuch as the hub is tapered or cone shaped, and the rotor is similarly shaped to mate therewith, it will be evident that adjustment for wear can be readily effected by adjustment of the bearings in the motor M which support the shaft 17. The rotor is generally cylindrical in cross section and is provided with a number of peripheral buckets or displacement chambers 23, formed by radial vanes or blades 24, the outer edges of which are forwardly curved to facilitate circulation of the operating liquid into and out of the buckets. The blades may not be limited to this form but may be formed with different curvature than that shown, or may even have straight radial blades, according to the particular requirements of the service for which the pump is designed. In the preferred construction the blades 24 will be connected by shrouds 25 and 25a.

The inwardly extending tapered hub portion 13 with which the rotor cooperates, is constructed to form inlet and discharge passages for the pump, the displacement chambers or buckets 23 being suitably ported at their bases for cooperation therewith.

The inlet passage 26 connected to the pump inlet 27, is suitably ported at 28 for cooperation with the ported bottoms of the rotor buckets, and the outlet or discharge passage 29 is similarly ported at 30, and connected to the discharge outlet 31.

At the two lands 16, the displacement chambers 23 are filled with the operating liquid. As the rotor advances, the liquid is not only turned by the rotor, but also is thrown out into the lobe by centrifugal force, and the air, gas or other medium being handled, is drawn in through the ports 28. Upon further advancement, the shape of the casing forces the operating liquid back into the displacement chambers, and this liquid in each bucket or chamber compresses and forces such medium out through the discharge ports 30.

As shown in Fig. 6, the rotation of the compressor is clockwise, and the points at which the

operating liquid starts to recede from the rotor is indicated at 32. The points at which the water is finally crowded back into the rotor buckets by the converging of the casing is indicated at 33. The lands 16, are extremities of the shortest axis of the elliptical casing, and the differential in pressure above referred to occurs as a maximum between the low pressure area 32 and the high pressure area 33.

Unless the operating liquid is forced into the rotor buckets at the high pressure point 33, without leakage, there will be a corresponding loss in pressure, and a feature of this invention involves the provision of adequate sealing means to prevent the escape or by-passing of this liquid from the high pressure area to the low pressure area, thus obtaining maximum efficiency and enabling the building up of higher pressure differentials than heretofore thought possible with this type of compressor.

Heretofore the importance of the prevention of uncontrolled leakage from the areas 33 to the areas 32 has not been recognized as the principal limiting factor in the application of this compressor to high pressure service. The pressure possibilities in the prior art were recognized as not exceeding twenty or thirty pounds gage with reasonable efficiency. By the application of the present invention, the pressure range of this type of compressor may be extended without difficulty to one hundred pounds gage.

The principal source of leakage from the high pressure area 33, to the low pressure area 32 occurs around the periphery of the shrouds 25—25a, at the points 34—34a and to offset this, liquid under pressure is directed to the leaks as a means of building up a counteracting sealing pressure on the opposite side.

There are also points at which leakage of the air or gas being compressed is likely to occur, these points being between the regions of high and low pressure around the conical ported hub adjacent the ports in the bottom of each rotor bucket. To prevent excessive leakage at these points, sealing surfaces 36, 37, 38 and 39 are provided, all of which are adequately supplied with sealing liquid to fill the clearance spaces at these points. The seal is under greater pressure than that causing the leak, and hence tends to leak inwardly, thus preventing the outward leakage of volatile air or gas, it being well recognized that a liquid such as water will not leak as readily as a less dense medium, such as air, and hence the introduction of a sealing liquid under suitable pressure is very effective. The provision for sealing the surfaces around the cone or hub is in some respects similar to that described in the aforesaid patent, No. 1,847,586, but the manner in which the liquid seal is delivered to these sealing surfaces, as well as the peripheral seals previously discussed, distinguishes this invention from that referred to in said patent.

The compressor requires an initial priming with sufficient liquid to form a fluid piston or operating ring effective to give the pumping or compressing action. The initial supply of liquid absorbs the heat of compression, but in order to maintain continuous operation of the compressor, it is necessary to maintain a continuous circulation of liquid through the compressor for cooling purposes. In addition to the cooling liquid required to remove heat of compression, an additional quantity of liquid should be circulated through the compressor to take care of leakage past the sealing surfaces previously re-

ferred to. The availability of suitable cooling and sealing liquid, together with the pressure at which it can be supplied, varies widely with different installations, and hence various modifications representing typical installations designed to accommodate various conditions that may be met in the field with respect to water supply, are illustrated.

Fig. 1 illustrates a typical arrangement wherein an abundant supply of liquid for sealing purposes, at sufficient pressure is available. The head portion 12 of the stator is formed with a sealing liquid chamber 43 tapped at 44 to permit ingress of sealing liquid, which being supplied under pressure furnishes cooling and make-up liquid directly into the displacement chambers of the rotor through ports 45 which establish direct communication between the chamber 43 and the inlet passage 26. This incoming liquid also seals the surfaces 38 and 39, as well as supplying a seal around the driving shaft 17 and stuffing box 18.

A second sealing chamber 46 is provided in the head 12, and separated from the chamber 43 by a ported web 47. A valve 48 controls the port in the web 47 to permit sealing liquid to flow freely from the chamber 43 into the chamber 46. From the chamber 46 the liquid flows through a port 49 into additional chambers 50 and 51 which communicate with each other for the purpose. The chamber 50 is ported at 52, to permit delivery of sealing liquid under pressure to the annular space 53 between the shroud 25 and the pump casing. The fluid thus held under pressure in this annular space 53 seals the peripheral points 34 at one side of the rotor.

The liquid seal in the annular space 53 acts in opposition to possible leakage from the high pressure area of the lobe at 33, thus preventing or reducing leakage at this point, depending upon whether the pressure in the space 53 is greater or less than the outward pressure exerted at the point 33.

It also provides leakage from the annular space 53 through the clearance at the point 34, at the point of low pressure 32. Such inward leakage is not detrimental to the operation of the pump, but on the contrary may be beneficial.

The fluid under pressure in the annular space 53 also provides a seal for clearances between the points 36 and 37, thus preventing the leakage between high and low pressure areas around the cone.

The sealing liquid passing from chamber 50 to chamber 51 is delivered under pressure through a port 54 into the annular space 55 at the outer side of the rotor, surrounding the end shroud 25a and the hub of the rotor. The liquid under pressure thus delivered to the annular space 55 supplies a seal to the outer peripheral surfaces 34a in a manner exactly similar to that delivered to the corresponding sealing surfaces 34 at the inner side of the rotor. Any excess of liquid supplied through the opening or tap 44 is finally discharged from the compressor, together with the compressed air or other material handled by the pump, through the discharge passage 29 and outlet connection 31.

The air and liquid delivered from the discharge 31 may be delivered to a separator 56 as shown in Fig. 7, where the liquid is separated from the air and discharged to waste, while the air is delivered to the point required for its use, through the outlet 31a.

Where greater differentials require it, or where it is impractical to supply counter-acting sealing liquid at sufficient pressure, a sealing joint at the points 34-34a may be provided by additionally utilizing a labyrinth form of sealing as indicated at 35 (Fig. 8).

The upper part of the inlet passage 26 is plugged at a point 57a for a purpose hereinafter described.

Fig. 2 is illustrative of a variation in the handling of a water seal where the compressor is operating over relatively low pressure differentials, and where the sealing liquid is supplied at a relatively low pressure. In this arrangement, the tap 44 is removed and the opening plugged as at 44a. A tap 57 is substituted for the plug 57a and sealing liquid delivered therethrough directly into the inlet passage 26, where it combines with the air or gas being compressed, and is aspirated by the velocity of the incoming air, directly into the displacement chambers of the rotor. The liquid at the periphery of the rotor in this case is allowed to leak through the clearance spaces between the shrouds 25-25a and the stator at the points 34-34a, from the high pressure region 33, where it circulates in a reverse order from that described in connection with Fig. 1. The liquid leaking through the peripheral clearances serves to seal the cone surfaces at points 36 and 37, 30 passing into chambers 50 and 51 through ports 52 and 54, and thence through port 49 into the chamber 46. From chamber 46 it flows past the valve 48 into the chamber 43, to supply additional liquid through the ports 45 directly to the displacement chambers of the rotor. This liquid from chamber 43 also serves to seal the smaller cone surfaces at 38 and 39 as well as points adjacent the stuffing box 18.

Fig. 3 represents an application of the invention where the supply of liquid is limited, but is available at a pressure slightly above that of the compressor inlet pressures. The liquid enters the tapped opening 44 in a manner similar to that described in connection with Fig. 1, and is delivered to the displacement chambers of the rotor in a manner exactly the same as that described in Fig. 1, but instead of using this supply of water to seal the various points of leakage, liquid is taken from the bottom of the separator 56 (Fig. 7) which is tapped at 58 for delivery through a pipe line 59 and control valve 60. The pipe line 59 extends to a tap 61 (shown plugged at 61a in Figs. 1 and 2) into the sealing liquid chamber 46. The valve 48 will be closed in this instance.

The sealing liquid recirculated from the separator 56 to the chamber 46 is delivered to the chambers 50 and 51 in a manner exactly as described in the arrangement of Fig. 1.

It will be noted in this embodiment, that only such liquid as is required for removing the heat of compression is delivered through the supply tap 44, and the same amount is drained to waste through the separator drain 62 which is controlled by a float valve 63. The water required for sealing the clearance spaces in the compressor is drawn through the pipe line 59 under discharge pressures, and regulated in amount by manipulation of the valve 60. The air or gas handled by the pump, passes from the separator under discharge pressures through the outlet 31a.

In Fig. 4 still another method is disclosed, for use where the supply is available only in limited

quantities and at a pressure but slightly greater than that of the inlet to the compressor.

In this arrangement the liquid required for the removal of heat of compression is delivered through the tap 57 directly into the compressor inlet passage 26 where it mixes with air or gas coming in through the compressor inlet 27. The small amount of make-up fluid introduced in this manner is picked up by the air and carried through the inlet ports 28 in the cone, directly into the displacement chambers of the rotor, by the aspirating action of the air as it is drawn through the suction or inlet passages.

The liquid required for sealing the clearance spaces and for accommodating other leakage losses in the compressor is obtained by recirculation from the separator in a manner similar to that described in connection with Fig. 3, the water being delivered to the chamber 46 through the tap 61. In this case, however, the valve 48 is opened to supply additional liquid for delivery through the ports 45 directly into the displacement chambers of the rotor, as well as to supply liquid for sealing the small end of the cone as described in connection with Fig. 1.

The fluid delivered to the chamber 46 flows to the chambers 50 and 51 and eventually to the sealing surfaces exactly as described in connection with Figs. 1 and 3. The liquid is discharged with the air or gas through the outlet passage 29 and outlet 31 to the separator where it is recirculated, as described above, excess make-up water being discharged through the drain 62 to waste.

The foregoing methods are but illustrative, and there are many variations in the manner in which liquid for cooling, make-up purposes and sealing can be delivered to the essential points in the compressor. For example, chamber 64 may be provided, in communication with the bottom of the discharge passage 29 of the compressor. A valve 65 may likewise be provided to control a port between the chamber 64 and the sealing liquid chamber 46.

A partial separation of the liquid from the air is obtained in the discharge passage 29, and this liquid, gravitating to the bottom of the passage, drains into the chamber 64. A sufficient supply of water for sealing purposes may be drawn from the chamber 64 by properly controlling the valve 65, instead of resorting to an outside separator for this supply.

As a further variation, this arrangement may be amplified to include provision for complete separation of liquid and air, with the regulating valve 65 plus an excess liquid, float controlled valve built into the structure.

Having thus described the invention the operation and advantages thereof will be readily apparent.

Once the pump is in operation, the tendencies toward leakage both of gas or other material being handled, and of the operating liquid, are offset by supplying a sealing liquid to the points where such leakage may occur, and at higher pressure than is present at such points.

In brief this invention accomplishes three major advantages, first minimization of leakage, making it possible to greatly increase built up pressures within the pump; second, constant replenishment of normal losses in the operating medium, the sealing liquid serving as a "make-up" liquid for the fluid piston; and third, constant cooling of the pump.

Having thus described my invention, what I

claim as new and desire to secure by Letters Patent of the United States, is:

1. In a hydro-turbine pump of the type using liquid in its pumping action, the combination with a stator having an inlet passage and an outlet passage, and a rotor operable within the stator having displacement chambers cooperative with the stator and the pumping liquid to create a pressure differential between the inlet and outlet regions of the pump, of means to seal the inlet region from the outlet region, adjacent peripheral points of the rotor, comprising conduits within the stator extending to points of clearance between the periphery of the rotor and the stator, and means to introduce a sealing liquid into said conduits for flow to said clearance points.

2. In a hydro-turbine pump of the type using liquid in its pumping action, the combination with a stator having an inlet passage and an outlet passage, and a rotor operable within the stator having displacement chambers cooperative with the stator and the pumping liquid to create a pressure differential between the inlet and outlet regions of the pump, of means to seal the inlet region from the outlet region, adjacent peripheral points of the rotor, comprising conduits within the stator extending to points of clearance between the periphery of the rotor and the stator, and means to introduce a sealing liquid into said conduits under pressure at least as great as said pressure differential, for flow to said clearance points.

3. In a hydro-turbine pump of the type using liquid in its pumping action, the combination with a stator having an inlet passage and an outlet passage, and a rotor operable within the stator having displacement chambers cooperative with the stator and the pumping liquid to create a pressure differential between the inlet and outlet regions of the pump, of means to confine the pumping liquid within its operating channel and to direct sealing liquid to points of leakage between the inlet and outlet regions adjacent peripheral points of the rotor comprising conduits within the stator extending to points of clearance between the periphery of the rotor and the stator and to points of inlet to the inlet region, and means to introduce a sealing liquid into said conduits for flow to all of said points.

4. In a hydro-turbine pump of the type using liquid in its pumping action, the combination with a stator having an inlet passage and an outlet passage, and a rotor operable within the stator having displacement chambers cooperative with the stator and the pumping liquid to create a pressure differential between the inlet and outlet regions of the pump, of means to circulate a portion of the pumping liquid through said inlet and outlet passages, through the inlet and outlet regions, and past points of clearance between the rotor and stator, adjacent peripheral points of the rotor, whereby to seal the inlet and outlet regions against leakage.

5. In a hydro-turbine pump of the type using liquid in its pumping action, the combination with a stator having an inlet passage and an outlet passage, and a rotor operable within the stator having displacement chambers cooperative with the stator and the pumping liquid to create a pressure differential between the inlet and outlet regions of the pump, of means to introduce liquid to the interior of the pump comprising conduits within the stator extending to the inlet and outlet regions and to points of clearance be-

tween the stator and rotor, adjacent peripheral points of the rotor, whereby to seal the inlet and outlet regions against leakage, to make up losses in pumping liquid and to lower the operating temperatures of the pump.

6. In a hydro-turbine pump of the type using liquid in its pumping action, the combination with a stator having an inlet passage and an outlet passage, and a rotor operable within the stator having displacement chambers cooperative with the stator and the pumping liquid to create a pressure differential between the inlet and outlet regions of the pump, of a separator connected to the outlet passage, and means to recirculate liquid passing from the pump to the separator back to the interior of the pump, comprising conduits within the stator extending to the inlet and outlet regions and to points of clearance between the stator and rotor, adjacent peripheral points of the rotor, whereby to seal the inlet and outlet regions against leakage, to make up losses in pumping liquid and to lower the operating temperatures of the pump.

7. The combination with a hydro-turbine pump of the type using liquid in its pumping action, and a separator connected to the outlet thereof, of means to recirculate liquid passing from the pump to the separator, back to the pump, comprising conduits within the stator extending to the inlet and outlet regions and to points of clearance between the stator and rotor of the pump, adjacent peripheral points of the rotor, whereby to seal the inlet and outlet regions against leakage, and means to introduce additional liquid to the inlet of the pump to make up losses in pumping liquid and to lower the operating temperatures of the pump.

8. In a hydro-turbine pump of the type using liquid in its pumping action, a stator provided with passages for the reception of sealing liquid, and having means in communication with points of leakage between the inlet and outlet regions of the pump, means to introduce sealing liquid to said passages, and valve means to control the direction of flow of said sealing liquid through said passages.

9. In a hydro-turbine pump of the type using liquid in its pumping action, a stator provided with passages for the reception of sealing liquid, a tapered hub within the stator, a rotor cooperative with said hub, means establishing communication between said passages and running clearances between said rotor and hub, and between said passages and running clearance adjacent the periphery of said rotor, means to introduce liquid under pressure to said passages, whereby to seal all running clearances between said rotor and stator against leakage, and means to introduce additional liquid under pressure to supplement the sealing action, to make up losses in pumping liquid and to lower the operating temperatures of the pump.

10. In a hydro-turbine pump of the type using liquid in its pumping action, the combination with a stator having an eccentric pumping chamber and a rotor operable within the stator having peripheral displacement chambers cooperative with the stator and the pumping liquid, of means to seal running clearances between the periphery of the rotor and the walls of the eccentric chamber, comprising conduits within the stator extending to said running clearances, and means to recirculate a portion of the pumping liquid from a point of maximum pressure within the pumping chamber through said conduits and

back to the interior of the chamber, in opposition to pressures developed at the periphery of the rotor.

11. In a hydro-turbine pump of the type using liquid in its pumping action, the combination with a stator having an eccentric pumping chamber and a rotor operable within the stator having peripheral displacement chambers cooperative with the stator and the pumping liquid, of means to seal running clearances between the periphery of the rotor and the walls of the eccentric chamber, comprising conduits within the stator extending to said running clearances, and means to recirculate a portion of the pumping liquid from a point of maximum pressure within the pumping chamber through said conduits and back to the interior of the chamber, in opposition to pressures developed at the periphery of the rotor, and valve means to control volume and direction of flow through said conduits.

12. In a hydro-turbine pump of the type using liquid in its pumping action, a stator provided with passages for the reception of sealing liquid, a tapered hub within the stator, a rotor cooperative with said hub, means establishing communication between said passages and running clearances between said rotor and hub, and between said passages and running clearance adjacent the periphery of said rotor, means to introduce liquid under pressure at least as great as the discharge pressure of the pump, to said passages, to seal running clearances between said rotor and stator against leakage, and means to introduce additional liquid to the inlet side of the pump under pressures approximating the inlet pressure within the stator, to make up losses in pumping liquid and to lower the operating temperatures of the pump.

13. The method of sealing a rotary liquid ring pump against leakage between inlet and outlet regions, at points approximating maximum pump pressures supplying losses in operating medium and maintaining low operating temperatures, which comprises recirculating a portion of the operating medium under pressures at least as great as the maximum discharge pressure of the pump to said points, and introducing additional fluid to the inlet region of the pump at pressures approximating inlet pressures.

14. The method of sealing a rotary liquid ring pump against leakage at points between the inlet and outlet regions, supplying losses in operating medium and maintaining low operating temperatures, which comprises recirculating a portion of the operating medium under pressures at least as great as the maximum discharge pressure of the pump to said points, and introducing additional fluid to the inlet region of the pump at pressures approximating inlet pressures, and recirculating said additional fluid as part of the operating medium.

15. In a hydro-turbine pump of the type using liquid in its pumping action, a stator provided with passages for the reception of sealing liquid, a hub within the stator, a rotor cooperative with said hub, means establishing communication between said passages and running clearances at the sides of the rotor adjacent its periphery and at points about the periphery thereof, and means to introduce liquid under pressure to said passages, whereby to seal said running clearances between the rotor and stator against leakage.

16. In a hydro-turbine pump of the type using liquid in its pumping action, a stator provided with passages for the reception of sealing liquid,

a hub within the stator, a rotor cooperative with said hub, means establishing communication between said passages and running clearances between said rotor and hub, and between said passages and running clearances at the sides of the rotor adjacent its periphery and at points about the periphery thereof, and means to introduce liquid under pressure to said passages, whereby to seal said running clearances between the rotor and stator against leakage.

17. In a hydro-turbine pump of the type using liquid in its pumping action, the combination with a stator having an inlet passage and an outlet passage, and a rotor operable within the stator having displacement chambers cooperative with the stator and the pumping liquid to create a pressure differential between the inlet and outlet regions of the pump, of means to seal the inlet region from the outlet region at points about and adjacent said displacement chambers, comprising conduits within the stator extending to points of clearance between the rotor and stator adjacent said chambers, and means to introduce a sealing liquid into said conduits for flow to said clearance points.

18. In a hydro-turbine pump of the type using liquid in its pumping action, the combination with a stator having an inlet passage and an outlet passage, and a rotor operable within the stator having displacement chambers cooperative with the stator and the pumping liquid to create a pressure differential between the inlet and outlet regions of the pump, of means to seal the inlet region from the outlet region at points about and adjacent said displacement chambers, comprising conduits within the stator extending to points of clearance between the rotor and stator adjacent said chambers, and means to introduce a sealing liquid into said conduits under pressure at least as great as said pressure differential, for flow to said clearance points.

19. In a hydro-turbine pump of the type using liquid in its pumping action, the combination with a stator having an inlet passage and an outlet passage, and a rotor operable within the stator having displacement chambers cooperative with the stator and the pumping liquid to create a pressure differential between the inlet and outlet regions of the pump, of means to confine the pumping liquid within its operating channel and to direct sealing liquid to points of leakage between the inlet and outlet regions about and adjacent said displacement chambers, comprising conduits within the stator extending to points of clearance between the rotor and stator adjacent said chambers, and to points of inlet to the inlet region, and means to introduce a sealing liquid into said conduits for flow to all of said points.

20. In a hydro-turbine pump of the type using liquid in its pumping action, the combination with an eccentric casing, and a rotor therein having blades forming displacement chambers cooperative with the pumping liquid to create a pressure differential between the inlet and outlet sides of the pump, of means to seal the inlet side of the pump from the outlet side thereof, comprising means to direct a sealing liquid to clearances between the rotor and the casing, at points across the surfaces of the blades whereby to minimize leakage between the inlet and outlet sides of the pump.

21. In a hydro-turbine pump of the type using liquid in its pumping action, the combination with an eccentric casing, a rigid hub extending

therewithin, and a rotor journaled on said hub and having displacement chambers cooperative with the pumping liquid to create a pressure differential between the inlet and outlet sides of the pump, of means to seal the inlet side of the pump from the outlet side thereof comprising means to direct a sealing liquid to clearances between the rotor and the hub, and to clearances adjacent the periphery of the rotor whereby to minimize leakage between the inlet and outlet sides of the pump.

22. In a hydro-turbine pump of the type using liquid in its pumping action, the combination with a lobe casing and a rotor in said casing having peripheral displacement chambers cooperative with the pumping liquid, of means, operative in opposition to the normal pressure differential of the pump, to seal clearances adjacent the periphery, sides and hub of the rotor, thereby to control leakage between the intake and discharge sides of the pump.

23. In a hydro-turbine pump, the combination with a casing having a ported hub, inlet and discharge passages extending through said hub, a rotor journaled on said hub and having blades forming displacement chambers cooperative with the ported hub, of means for directing a sealing fluid to running clearances between said rotor and hub, and across the surfaces of said blades whereby to minimize leakage within the pump past said clearances.

24. In a hydro-turbine pump, the combination with a casing having a hub extending inwardly thereof, inlet and discharge passages extending through said hub, a rotor journaled on said hub and having displacement chambers, said chambers and hub being formed with cooperating ports for inlet to and discharge from the pump, of means for directing a sealing fluid to the space between the sides and periphery of the rotor and the casing, including a fluid receiving passage extending through the hub, and means effective to establish communication between said passage and space.

25. In a hydro-turbine pump of the type using liquid in its pumping action, the combination with an eccentric casing, and a rotor therein having blades forming displacement chambers cooperative with the pump liquid to create a pressure differential between the inlet and outlet sides of the pump, of means to seal the inlet side of the pump from the outlet side thereof, comprising means to direct a sealing liquid to clearances between the rotor and the casing at points adjacent the periphery of the rotor and at points adjacent the hub of the rotor, in opposition to said pressure differential, whereby to minimize leakage between the inlet and outlet sides of the pump.

26. In a hydro-turbine pump of the type using liquid in its pumping action, the combination with an eccentric casing, and a rotor therein having a supporting hub, and blades forming displacement chambers cooperative with the pump liquid to create a pressure differential between the inlet and outlet sides of the pump, of means to seal the inlet side of the pump from the outlet side thereof, comprising means to direct a sealing liquid to clearances between the rotor and the casing at points adjacent the periphery of the rotor, and at points across the surfaces of the blades, whereby to minimize leakage between the inlet and outlet sides of the pump.

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