Oct. 5, 1965 I. C. JENNINGS 3,209,987

LIQUID RING PUMP

Original Filed Feb. 20, 1961 6 Sheets-Sheet 1

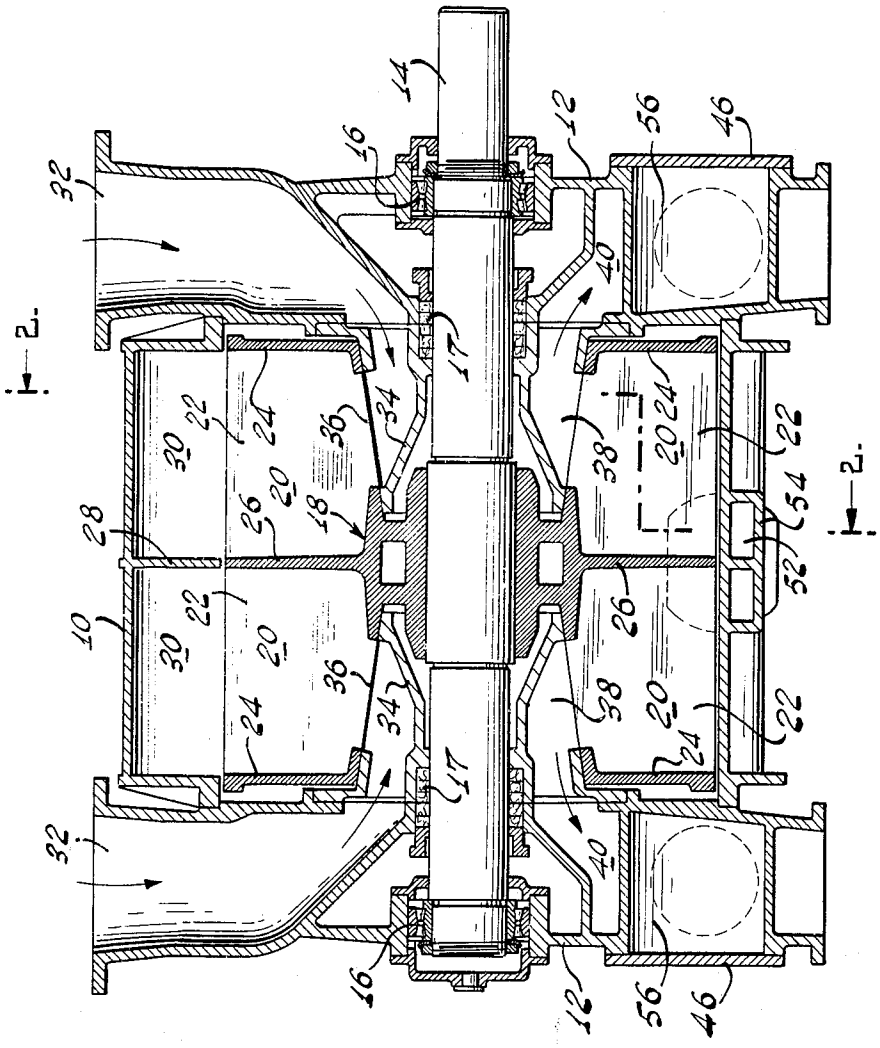


Fig. 1.

INVENTOR.
IRVING C. JENNINGS
BY

ATTORNEYS

Oct. 5, 1965 I. C. JENNINGS 3,209,987

LIQUID RING PUMP

Original Filed Feb. 20, 1961 6 Sheets-Sheet 2

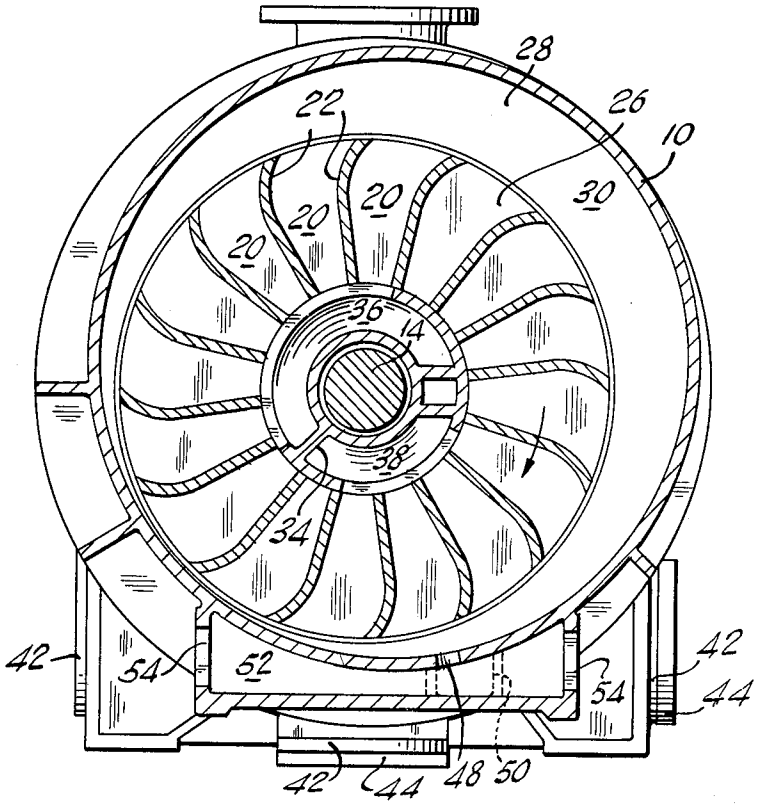


FIG. 2.

INVENTOR
IRVING C. JENNINGS
BY

ATTORNEYS

Oct. 5, 1965 I. C. JENNINGS 3,209,987

LIQUID RING PUMP

Original Filed Feb. 20, 1961 6 Sheets-Sheet 3

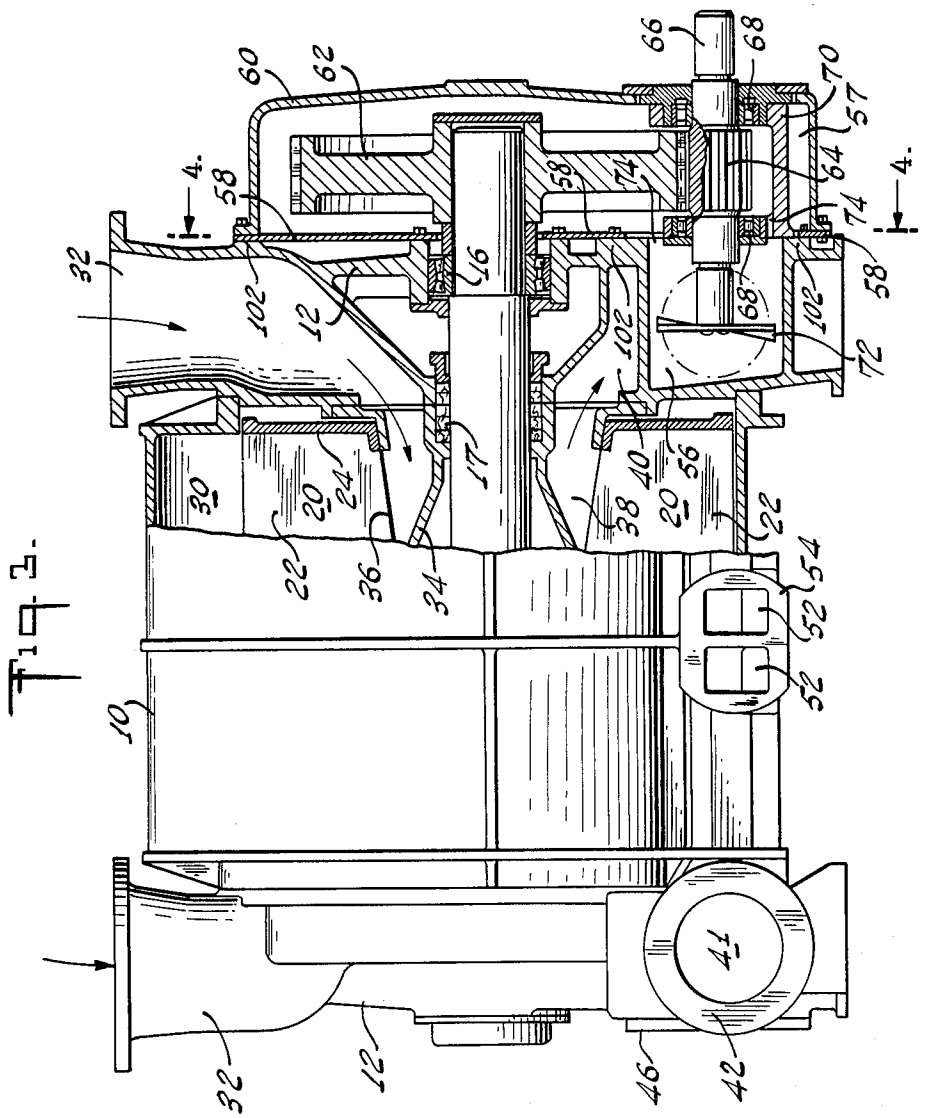


Fig. 1.

INVENTOR.
IRVING C. JENNINGS

BY

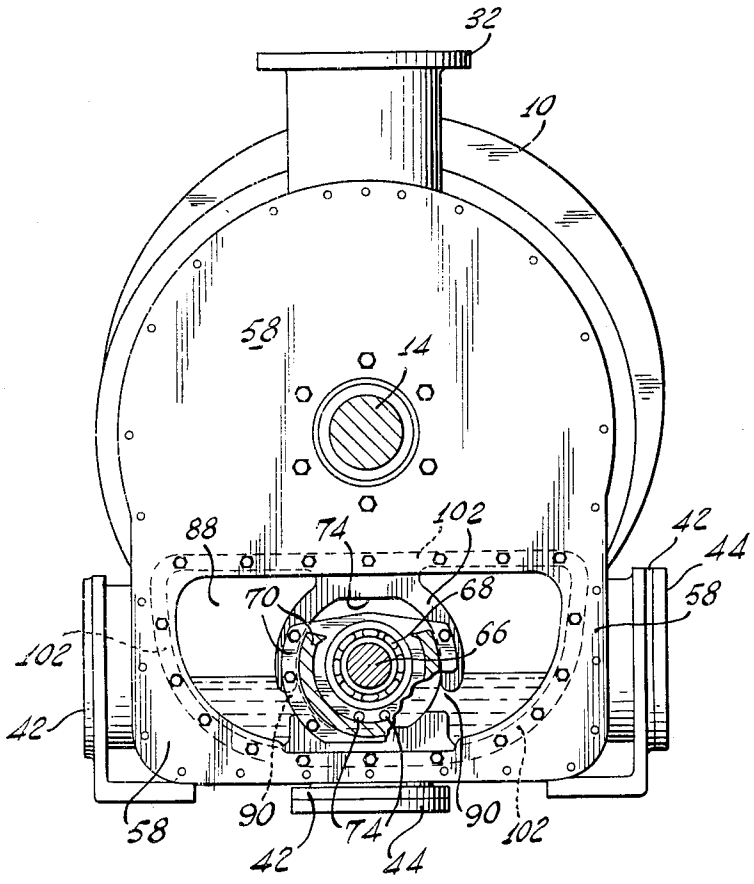
ATTORNEYS

Oct. 5, 1965 I. C. JENNINGS 3,209,987

LIQUID RING PUMP

Original Filed Feb. 20, 1961 6 Sheets-Sheet 4

FIG. 4.



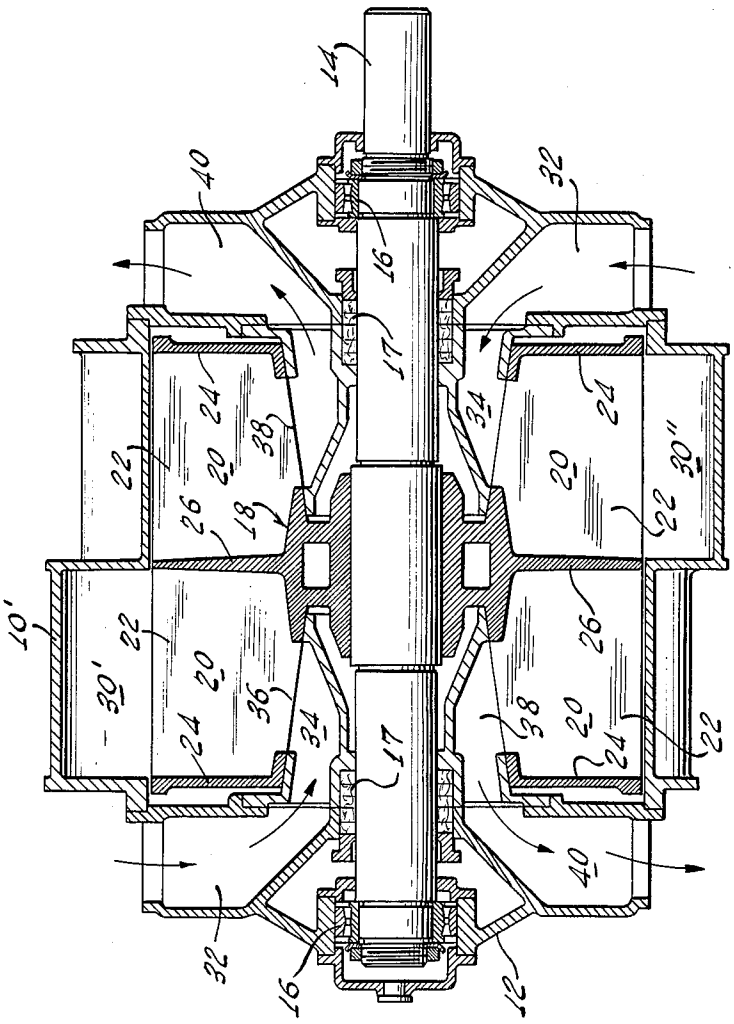
INVENTOR
IRVING C. JENNINGS
BY
ATTORNEYS

Oct. 5, 1965 I. C. JENNINGS 3,209,987

LIQUID RING PUMP

Original Filed Feb. 20, 1961 6 Sheets-Sheet 5

Fig. 5.



INVENTOR.
IRVING C. JENNINGS
BY
Moses, Nolte, & Nolte
ATTORNEYS

Oct. 5, 1965 I. C. JENNINGS 3,209,987

LIQUID RING PUMP

Original Filed Feb. 20, 1961 6 Sheets-Sheet 6

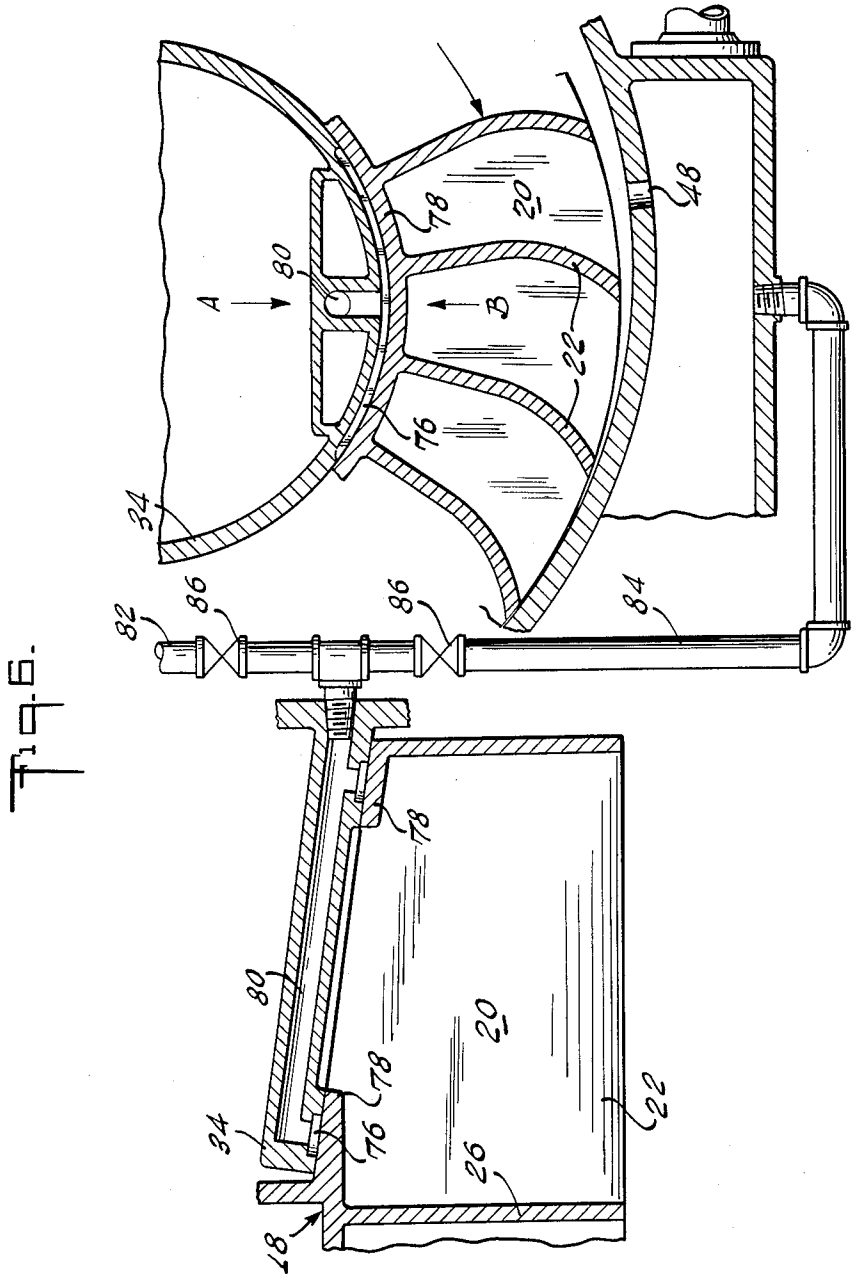


Fig. 6.

INVENTOR.
IRVING C. JENNINGS
BY

ATTORNEYS

United States Patent Office

3,209,987
Patented Oct. 5, 1965

3,209,987

LIQUID RING PUMP

Irving C. Jennings, South Norwalk, Conn., assignor to The Nash Engineering Company, South Norwalk, Conn., a corporation of Connecticut

Original application Feb. 20, 1961, Ser. No. 90,287, now Patent No. 3,154,240, dated Oct. 27, 1964. Divided and this application Jan. 9, 1964, Ser. No. 345,822

7 Claims. (Cl. 230—79)

This application is a division of application Serial No. 90,287 which matured into Patent No. 3,154,240 granted October 27, 1964.

This invention relates to liquid ring pumps in general and in particular to improvements in the construction of single lobe liquid ring pumps.

In pumps of this type, water or other liquid is revolved in a circular path within a casing by a rotor containing a plurality of blades which form displacement chambers. The liquid, following the casing due to centrifugal force, alternately recedes from and is forced back into the displacement chambers within the rotor. Stationary inlet and outlet ports cooperate with the rotor displacement chambers to permit the air or gas to be drawn into and discharged from the chambers after compression. This type of pump is well known in the art and is fully described by way of example in applicant's prior Patent No. 1,797,980, dated March 24, 1931, and in Patent No. 1,718,294 dated June 25, 1929.

Pumps of this type have preferably been designed with an elliptical or double lobe casing. The advantage of this type design was always believed to reside in the fact that a greater volumetric capacity could be obtained from a given structure at a given speed by having the pumping action take place twice in one revolution, with the added benefit that the radial pressure against the rotor was balanced because the compression cycles take place simultaneously on opposite sides of the rotor.

However, pumps with an eccentric casing or single lobe have certain potential advantages over the double lobe type, particularly at high rates of compression. In single lobe pumps, because a single compression cycle takes place only once per revolution, there is more time for the water to enter and leave the displacement chambers and because the water has a smoother passage around the casing (which may be cylindrical), the pump may be run at a considerably higher r.p.m. In fact, one such example of a single lobe pump according to applicant's construction has a capacity of 6,000 cubic feet per minutes which is at least 50% more capacity than the same size pump in the previous double lobe construction, and is capable of producing a much higher vacuum equivalent in performance to two stage pumps in the prior art.

Up to the present time, it has not been thought practical to introduce stationary central port members extending axially into the rotor in single lobe pumps for the reason that the unbalanced side thrust against the rotor dictated a wide clearance between the port member and the rotor due to the deflection of the shaft. Large operating clearances between these ports produce a corresponding loss of efficiency. However, a feature of applicant's present invention is the reduction of unbalanced forces upon the rotor and its shaft so that the port to rotor clearances may be made small. The force balancing techniques of the invention thereby allow the construction of a practical and highly efficient single lobe pump design. Single lobe pumps are advantageous because the central port member may be made in a much smaller diameter than in the prior art double lobe pump due to the fact that only one set of inlet and outlet passages are required therein instead of the usual four passageways of a double

lobe pump. This economy of space in a single lobe central port member makes possible the construction of a rotor containing deeper displacement chambers with consequent greater capacity. In actual practice, the average diameter of the port member can be made smaller than one-half the diameter of the rotor, while still providing ample area for the inlet and outlet passages therein.

A further feature of applicant's construction is the provision of identical head members upon opposite ends of the pump casing to provide manufacturing economy. The head members are of unique construction and incorporate multiple outlet discharge apertures to provide connection flexibility. Also included is a recessed portion therein which provides an oil reservoir in contact with the cool discharge passageways in the head to enhance the cooling of the lubricant employed when the pump is gear driven.

Yet another feature of the invention is the positioning of the lobe around the rotor in such a way that the weight of the rotor tends to balance the side pressure against the stationary port member.

Another embodiment of applicant's invention contains a modified form of casing member having two single lobe pump portions eccentric to the rotor but angularly indexed approximately 180° with respect to each other. In this manner the working forces created by one compression cycle substantially oppose and cancel out the compressive force created by its adjacent single lobe portion.

Another feature of applicant's single lobe pump construction is the provision of an arcuate groove upon the outer periphery of the central port member which when supplied with fluid under pressure, exerts a compression counterbalancing force upon adjacent flange portions of the rotor.

The novel features which are believed to be characteristic of the invention are set forth with particularity in the appended claims, but the invention itself will best be understood by reference to the following description taken in connection with the cacompanying drawings, in which:

FIG. 1 is a vertical cross section of one form of the invention;

FIG. 2 is a cross sectional view taken along the line 2—2 of FIG. 1;

FIG. 3 is a view partially in cross section of another form of the invention employing a gear drive;

FIG. 4 is an end view partially in section taken along lines 4—4 of FIG. 3;

FIG. 5 is a horizontal section of yet another embodiment of the pump according to applicant's invention; and

FIG. 6 is a fragmentary schematic view, partially in section, showing a method of compensating for unbalanced forces upon the rotor.

Referring to the drawings in particular, a single lobe pump according to the invention includes a cylindrical or other shaped single lobed casing member **10** having a pair of identical casing enclosing heads **12** secured at either end. A main drive shaft **14** rotationally mounted in a pair of bearings **16** supports a rotor **18** which is suitably keyed to the shaft. A pair of liquid sealing packing and gland assemblies **17** are fitted into the heads **12** and the ports **34** to prevent liquid seepage about the rotating shaft. The rotor **18** is of the duplex variety containing a plurality of radially extending pumping chambers **20** defined therein by blades **22**, side shrouds **24** and a central partition wall **26**, which is in line with a corresponding partition wall **28** in the casing **10** to form adjacent crescent shaped lobed pumping chambers **30**. Disposed at each end of the pump are a pair of inlet passages **32** formed in the head member **12** which direct inlet air or gas to right and left hand port members **34**. The port members include inlet passages **36** in communication with the pumping chambers **20** within the rotor

and discharge passages 38 also in communication therewith. The discharge passageways 38 communicate with a header chamber 40 formed in each head 12 to provide access to several alternate discharge port flanges 42 located on the lower sides and bottom of the head. As shown in FIGS. 1 and 4, suitable cover plates 44 are attached to the bottom and right hand flanges 42 to direct all of the pump discharge from header 40 through passageway 41 (FIGS. 3 and 4) to the left hand flange port 42. However, it should be appreciated that the location of the cover plates 44 may be altered to provide any desired discharge direction.

Formed in the end surface of each head 12 is a recess chamber 56 which may be covered by a plate 46 (FIG. 1). The recess chamber 56 does not communicate with the interior pump passageways but its function will be explained hereafter in relation to the gear drive embodiment of FIG. 3.

Horizontally disposed in an axial direction along the bottom portion of the casing 10, are two unloader passageways 50 in communication through apertures 48 with the interior respectively of each crescent shaped pumping chamber of the casing 10. Intersecting the passageways 50 and extending transversely across the bottom of the casing, are joining passageways 52 terminating in exit ports 54 on each side of the pump. These passageways function to provide an unloading or drain connection to the pump by virtue of valves and piping not shown connected to the flange portion 54 so that the passageways 50, 52 may be opened to atmosphere whenever it is desired to unload the pump or completely drain the fluid therefrom. However, it should be appreciated that during normal operation the chamber 52 and ports 54 are sealed by means not shown to provide proper pumping operation.

In operation, this form of the invention performs as a liquid ring vacuum pump wherein the receding of liquid within chambers 20 in the area of the intake port 36 creates a suction in passageway 32, and when forced back toward the center of the rotor produces compression through port 38.

Referring to FIG. 2, the lobe 30 is located in such a position that the maximum unbalanced thrust, due to compression, is up from the bottom of the pump in direct opposition to the weight of the rotor, which in the case of a large pump, may be several thousand pounds. This compressive thrust tending to deflect the pump shaft 14 in an upward direction is thereby opposed by the weight of the rotor and effectively canceled. The reduced bending moment on the shaft 14 allows much closer operating tolerances between the rotor surfaces and the port members to yield higher pumping efficiency.

Referring to FIG. 3, wherein like numerals indicate like elements in FIG. 1, a cover plate 58 is attached to a raised boss 102 on the end surface of the head 12 to provide a mounting surface for a gear chamber cover 60. Within the drive gear chamber 57 formed thereby is a gear 62 suitably keyed to the end of shaft 14 in driving engagement with a pinion gear 64 and a pinion shaft 66 mounted in bearings 68, 68 and supported by a bracket 70 to the end surface of the head 12. This specific arrangement of pinion gear mounting directly upon the surface of the pump head is described more fully in applicant's recently issued Patent 2,974,538, dated March 14, 1961. In the arrangement of FIG. 3, the pinion shaft 66 is provided with a portion extending to the left into the recess chamber 56 which has been uncovered by the removal of plate 46, shown in FIG. 1. The chamber 56 acts as an oil reservoir for the lubricant within the gear case, which lubricant is cooled by the contacting relation of the walls of the chamber 56 with the adjacent pump discharge passages 40, 41 which are continually conveying relatively cool seal liquid therethrough. The cooling of the lubricant within the recess 56 is further enhanced by the provision of a propeller or agitator blade 72 affixed to the end of the pinion shaft 66 which creates a continual flow of lubricant within the chamber past the cool walls. Oil cooled within the chamber 56 may readily circulate to the gear chamber 57 through the multiple passageways 74 about and through the bracket 70.

Referring to FIG. 4, additional oil cooling area is provided by surfaces 88 of generally triangular shape which are defined in the head 12 on either side of the recess chamber 56 by portions of the raised boss 102. Relieved portions 90 are formed in the portion of the boss 102 about the opening of the recess chamber 56 to further enhance oil circulation between the chambers. The cover plate 58 contains an enlarged oval aperture 100 to provide direct contact of the oil in chamber 57 with the surfaces 88.

Referring to the embodiment shown in FIG. 5 wherein like numerals indicate elements having like functions with the previous embodiments, it may readily be seen that the casing 10' is provided with opposed lobe chambers 30' and 30''. The left hand lobe 30' is formed in the casing 10' to be angularly indexed approximately 180° from the right hand lobe portion 30''. In this manner, because of the indexing of the lobe portions with respect to each other, the compression forces upon the rotor and shaft are caused to take place in equal and opposite directions thereby effectively balancing the bending moment upon the shaft. It should be appreciated that in this embodiment of the invention, due to the angular rotation of the lobe portions, corresponding adjustments are made to the central port members 34 to provide proper timing of the ports with respect to the lobed areas of the casing.

Referring to FIG. 6, yet another feature which may be embodied into applicant's novel single lobe pump is disclosed wherein an arcuate groove 76 is recessed into a peripheral portion of the port member 34 adjacent the sealing flange portions 78 of the rotor. A connecting passageway 80 communicates with the arcuate groove 76 and further connects through shut-off valves 86 to alternate pressure supply pipes 82, 84 which may be connected respectively to either an independent source of outside pressure or to the unloading passageway 52 below the casing of the pump. The liquid in chamber 52 communicates with the seal liquid within the casing through the unloading port 48 and it may readily be appreciated that during operation of the pump this liquid is under considerable pressure due to centrifugal force and the conduit 84 will transmit this pressure back to the inside of the pump via the passageway 80 and arcuate grooves 76 to effectively provide a downward force in the direction of the arrows A to effectively cancel the upward compressive force in the direction of the arrow B.

While various specific embodiments of the invention have been shown and described in detail to illustrate the application of the invention principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

I claim:

1. A duplex single lobe liquid ring pump comprising a casing, said casing having oppositely offset lobed portions, a shaft extending through said casing, a rotor having a plurality of radially extending displacement chambers mounted upon said shaft, said rotor including partition means dividing the displacement chambers into first and second adjacent pumping portions, said first and second adjacent pumping portions being respectively in radial alignment with each of said casing offset portions, a pair of non-rotating central port means about said shaft extending axially into opposite ends of said rotor, each of said port means including inlet and discharge portions in communication with said rotor pumping portions, and head means closing the ends of said casing having inlet and discharge passageways in communication with said port means inlet and discharge portions.

2. A pump according to claim 1 including a gear upon

an end portion of said shaft, a pinion gear pivotally mounted upon a portion of said head means in mesh with said gear, cover means cooperating with said head means enclosing said gear and pinion gear to form a lubricant chamber, whereby the lubricant in said chamber is in continual contact with the relatively cool discharge passageways within said head means.

3. A pump according to claim 2 wherein said head means includes a recessed chamber in communication with and forming a part of said lubricant chamber to provide an enlarged heat transfer surface between the lubricant and the head means.

4. A pump according to claim 3 including agitation means in said recessed chamber operated by the rotation of said pinion gear to further enhance the heat transfer between the lubricant and the head means.

5. A pump according to claim 1 wherein each of said central port means is frusto-conical in shape and has a mean outside diameter substantially less than one half the diameter of said rotor.

6. A liquid ring pump comprising a casing, said casing including a pair of adjacent cylindrical inside portions having their central axes parallel but offset to each other, a shaft extending into said casing, parallel to the axes of said inside portions, a rotor having first and second axially spaced means defining a first and second plurality

of radially extending displacement chambers mounted upon said shaft for rotation therewith with the outer periphery of said first chambers in non-contacting eccentric clearance relationship with said first inside portion and with the outer periphery of said second chambers in non-contacting eccentric clearance relationship with said second inside portion, central port means axially aligned with said shaft and extending axially within said rotor and having inlet and discharge portions in communication with the inner ends of said rotor displacement chambers, and head means enclosing said casing having inlet and discharge passageways in communication with said port means inlet and discharge portions.

7. A pump according to claim 6 wherein said central port means is frusto-conical in shape and has a mean outside diameter less than one half the outside diameter of said rotor.

References Cited by the Examiner

UNITED STATES PATENTS

2,364,370	12/44	Jennings	230—79
2,974,538	3/61	Jennings	74—421

LAURENCE V. EFNER, *Primary Examiner.*

WARREN E. COLEMAN, *Examiner.*