C. V. KERR.

WET VACUUM PUMP.

APPLICATION FILED AUG. 23, 1915.

1,319,776.

Patented Oct. 28, 1919.

4 SHEETS—SHEET 1.

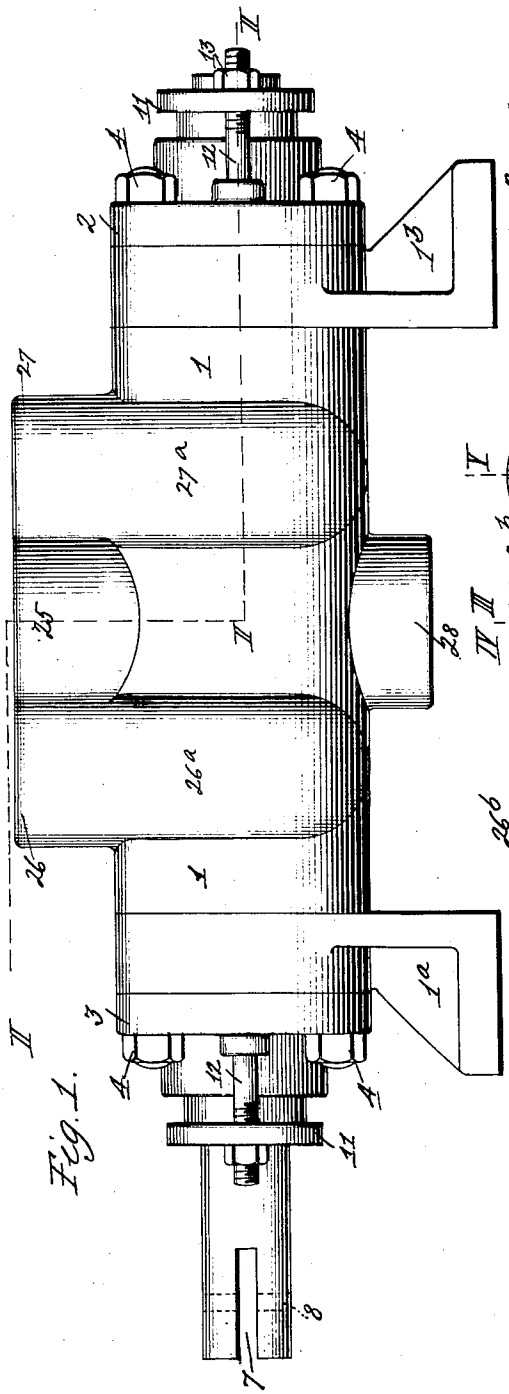


Fig. 1.

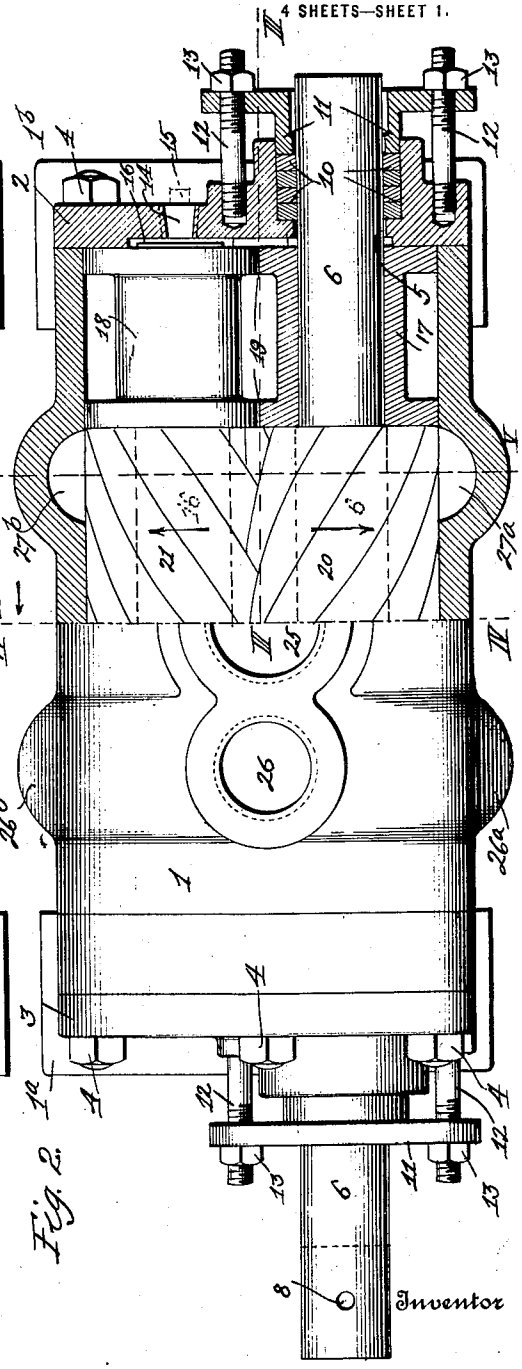


Fig. 2.

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4 SHEETS—SHEET 2.

Fig. 3.

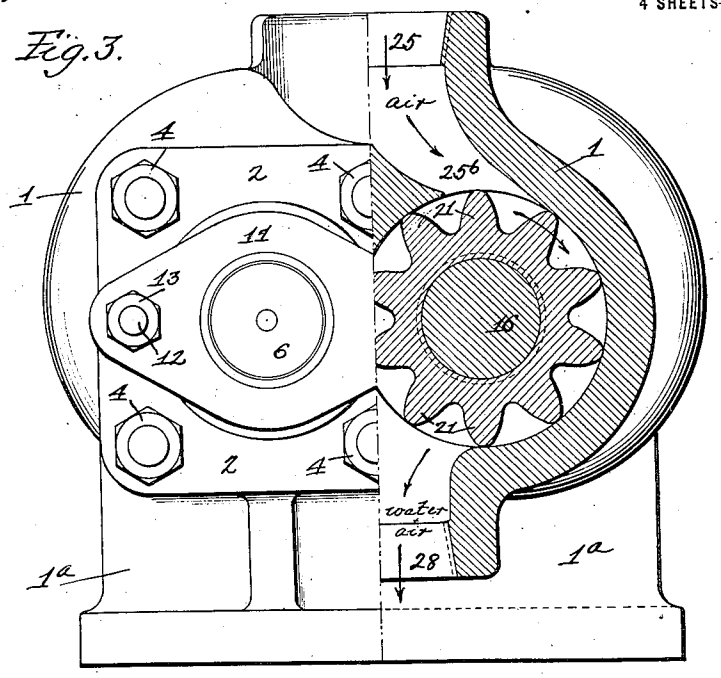
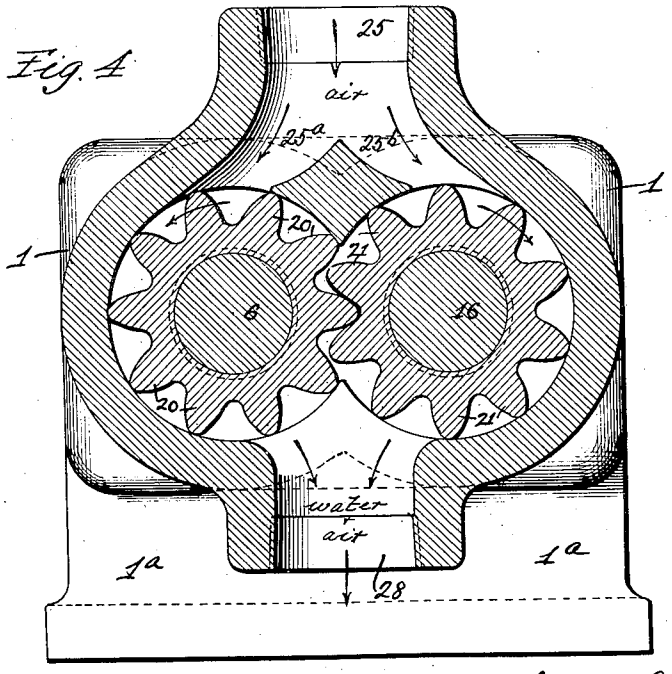


Fig. 4



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4 SHEETS—SHEET 3.

Fig. 5.

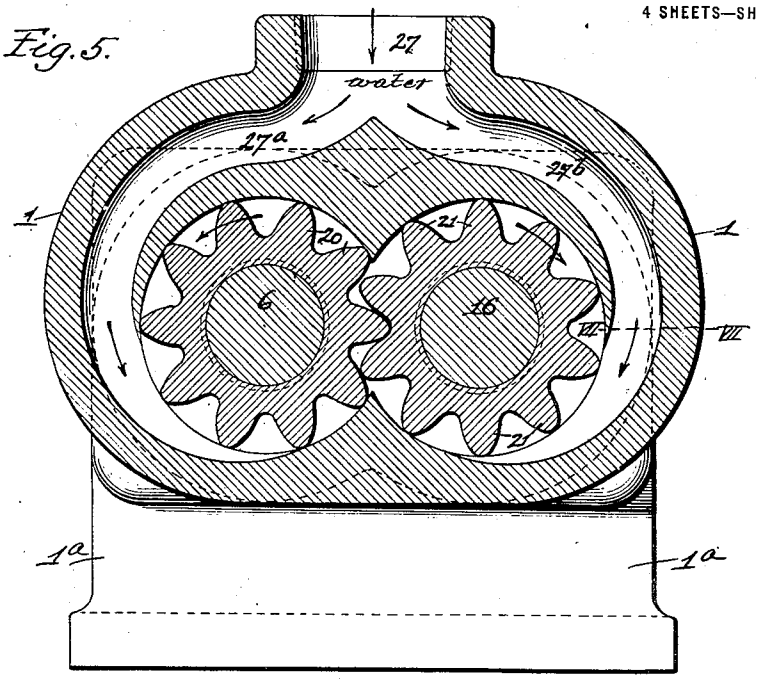
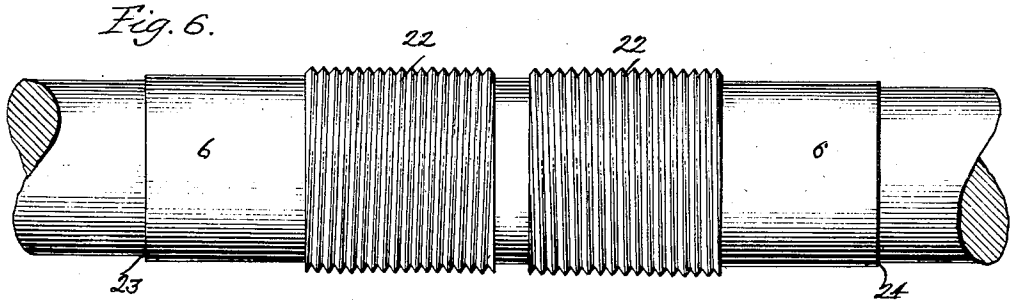


Fig. 6.



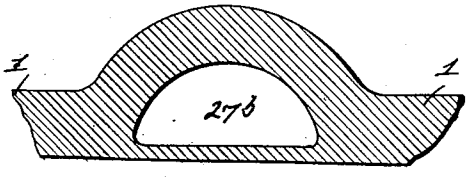
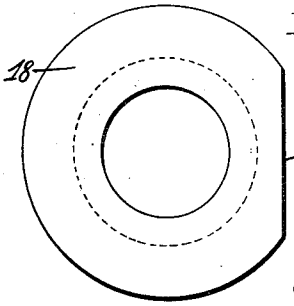


Fig. 7.

Fig. 8.



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4 SHEETS—SHEET 4.

Fig. 9.

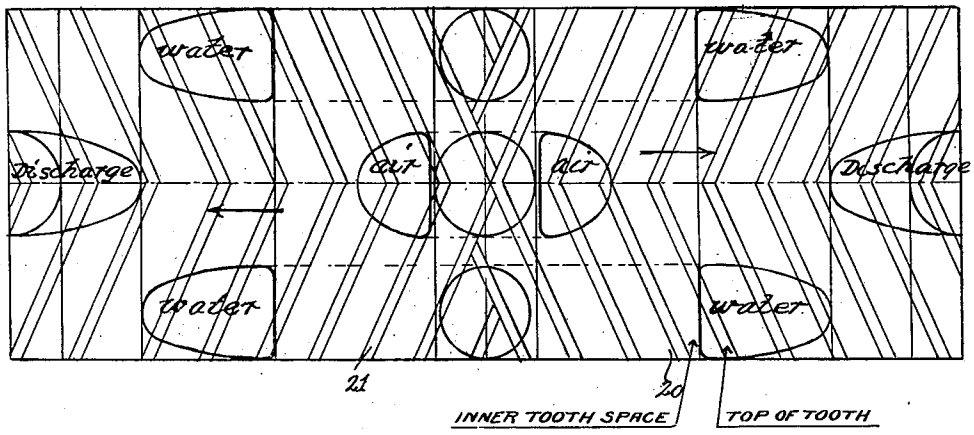
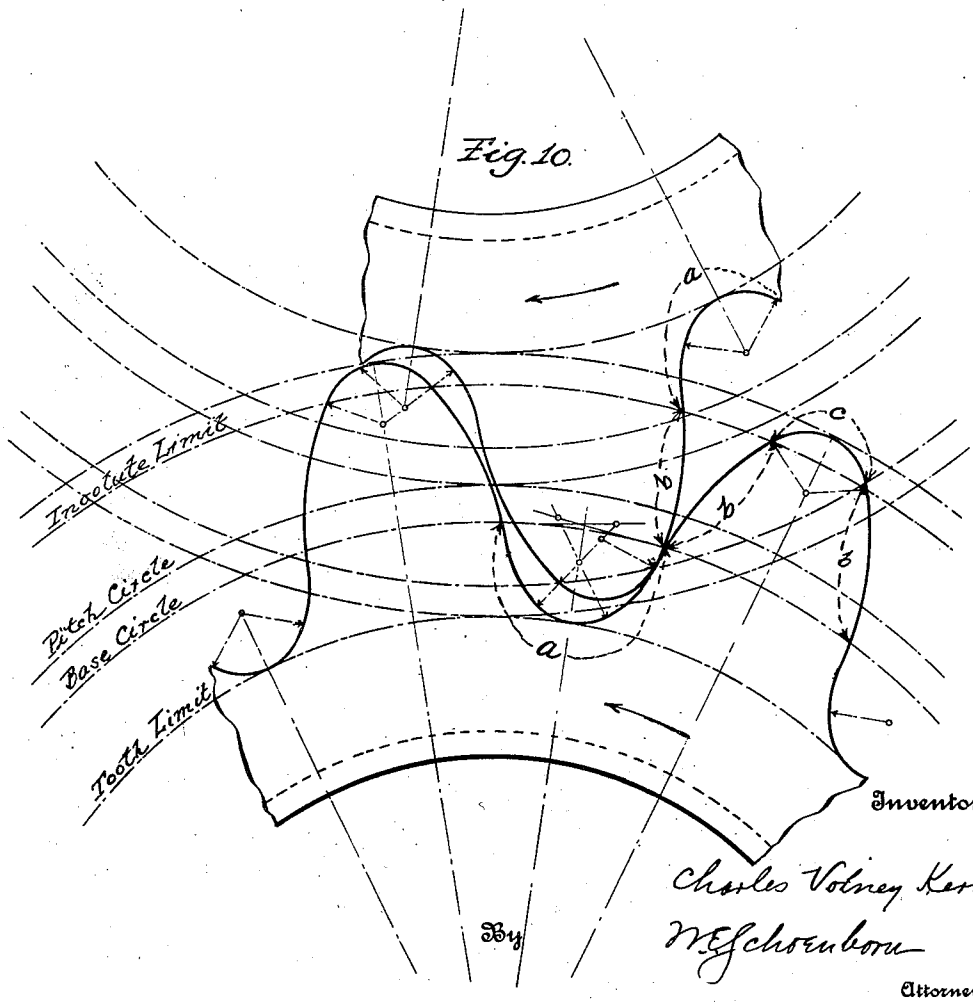


Fig. 10.



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UNITED STATES PATENT OFFICE.

CHARLES VOLNEY KERR, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE AMERICAN WELL WORKS, OF AURORA, ILLINOIS, A CORPORATION OF ILLINOIS.

WET VACUUM-PUMP.

1,319,776. Specification of Letters Patent. Patented Oct. 28, 1919.

Application filed August 23, 1915. Serial No. 46,840.

To all whom it may concern:

Be it known that I, CHARLES VOLNEY KERR, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Wet Vacuum-Pumps, of which the following is a specification.

My invention relates to wet vacuum pumps which may be driven either by a steam turbine, electric, or other form of high speed motor, as the condition requires in connection with surface or atmospheric condensers, vacuum heating and ventilating system, and the like.

The objects of my invention are:

First, to construct a high speed, compact and efficient gear pump which in a single unit or one piece of apparatus will operate efficiently on both air and water or other fluids at a comparatively high rotary speed for a pump of this character and yet maintain a high vacuum.

Second, to construct a pump of the character above designated in which the helical gears are peculiarly constructed and arranged, so that they not only run smoothly but are provided practically with no clearance or backlash.

Third, to construct and arrange the separate inlets for the air and water and an outlet for mingled air and water with respect to the surfaces of the coöperating gears in such a manner, that the point of contact on the teeth during engagement of the gears moves from the outside toward the center of the gears, the air is taken in at the middle of the gears first, the space between the teeth is closed before the entrance of the water at the outside begins, and the water inflow is complete before the discharge of the air and water begins.

Fourth, to construct and arrange the rotary shafts carrying the gears and their bearings with respect to the casing, stuffing boxes and heads of the casing, so that the driving shaft is self alined and balanced and free from end thrust, a close running clearance between the shafts and gears is maintained, and the space between the gears and the sections of the driving shaft through the stuffing boxes are well sealed and lubricated by the grease lubricant inserted between the casing heads and bearings.

Fifth, other advantages and objects of the invention will appear from the detailed description and mode of operation to be hereinafter given.

The invention consists of structural characteristics and relative arrangement of elements which will be hereinafter more fully stated and particularly pointed out in the appended claims.

In the four sheets of drawings, in which similar reference characters indicate the same parts in the several figures,

Figure 1, is a side elevation of the improved pump;

Fig. 2, is a sectional view on line II—II of Fig. 1, partly in elevation;

Fig. 3, is a sectional view on line III—III of Fig. 2;

Fig. 4, is a sectional view on line IV—IV of Fig. 2;

Fig. 5 is a sectional view on line V—V of Fig. 2;

Fig. 6 is an enlarged and fragmentary view of one of the shafts;

Fig. 7, is an enlarged and sectional view on line VII—VII of Fig. 5;

Fig. 8 is an enlarged end view of one of the removable bearings or spools for the shaft;

Fig. 9, is a view representing a development of the gear surface and showing the relation of the separate inlets for the air and water and outlet of the mingled air and water, and

Fig. 10, is a fragmentary and enlarged side view of the coöperating teeth of the gears.

In the drawings 1 is the pump casing made integral with the base sections 1^a and 1^b and having open end closed by the heads 2 and 3, said heads being of the same general construction and held to the ends of the casing by means of bolts 4, 4, as shown in Figs. 1, 2 and 3. The heads 2 and 3 are provided with openings or recesses 5, through which pass a driving shaft 6 (see Fig. 6) one end of which is provided with a slot 7 and pin receiving hole 8 or other satisfactory construction readily suggested, for suitably connecting said shaft 6 with any approved form of turbine, or electric motor. Any form of packing 10 is inserted in said recesses 5 about the ends of the shaft 6, projecting through the heads 2 and 3, said packing 10 being held in position and forced against the ends of the shaft 6, by the common form of glands 11, adjustably held by means of the bolts 12, and nuts 13. A smaller opening 14, closed

by a screw plug 15 is also provided in the heads 2 and 3 for the introduction of a lubricant or grease for purposes to be hereinafter described. 16 is a second shaft within the casing 1, having no ends projecting from the casing and arranged parallel to the driving shaft 6, said shafts 6 and 16, being properly and rotatably supported in the casing and spaced from each other by removable spools 17 and 18 non-rotatably seated in end sockets or recesses within the casing, each of said spools 17 and 18 being provided with a flattened rim section 19, as shown in Fig. 8, which sections 19 engage each other near the ends of the casing, as shown in Fig. 2, and prevent said spools 17 and 18 from rotating with the shafts 6 and 16. Interposed between the spools 17 and 17 on the driving shaft 6 and spools 18 and 18 on the shaft 16 are intermeshing helical gears 20 and 21, respectively, which may be attached to said shafts 6 or 16 by engagement with right and left hand screw threads 22 and 22 as shown for example in Fig. 6, or any other means as a common and well known slot and key connection if so desired. In order to prevent any lateral displacement or movement of the shafts 6 and 16 shoulders 23 and 24 are provided on said shafts (see Fig. 6) which engage the inner sides of the spools 17 and 18, as shown in dotted lines in Fig. 2. Said interlocking helical gears 20 and 21 are formed by providing involute teeth in which the middle section *b* of each tooth, as will be seen by reference to Fig. 10 of the drawing, is in the form of an involute, while the bottom section *a* is elliptical and the top or upper end *c* is circular. While I have shown, described and prefer this form of the intermeshing gears, I do not limit myself to this specific construction, as my invention can be efficiently operated by providing the intermeshing helical gears 20 and 21, with the ordinary involute tooth with flat top and bottom, if cut to run without a clearance and found clearly within the scope of the present invention. Furthermore the teeth of the intermeshing helical gears 20 and 21, are so cut, arranged and operated with respect to each other, that the gears run with the outer point forward, which makes the point of contact during the engagement of the intermeshing gears 20 and 21 and operation of the pump, move from the outside toward the center, as will be clearly understood from the development of the gear surface shown in Fig. 9.

The pump casing 1, at its top, is provided with a central air opening or inlet 25, which is subdivided into two branches 25^a and 25^b, which branches lead to the interior of the casing and top side of the gears 20 and 21, see Figs. 2, 3 and 4, and two water inlets 26 and 27 arranged one on each side of the air inlet 25, each of which water inlets 26 and 27 is also subdivided into two arcuate shaped branches 26^a, 26^b, and 27^a and 27^b, respectively, and lead to the bottom and outer side of each of said gears 20 and 21, as shown in Figs. 2, 5 and 7. At the lower side of the casing and directly below the air inlet is provided an outlet or opening 28, see Figs. 1, 3 and 4, for the discharge of the mingled air and water after passing through the pump. While I prefer the arrangement as herein shown and described, in having the separate air and water inlets at the top and the discharge for the mingled water and air at the bottom, said arrangement being particularly adapted for surface condenser application in which the air and water may feed into the pump by gravity, I do not limit myself to this particular disposition as said inlets and outlet can be changed without departing from the essential features of the present invention.

The parts being constructed, and arranged, as herein described and the air inlet 25 and water inlets 26 and 27 being connected by any suitable piping with the air and water sources to be exhausted, the operation of the invention is as follows:

The shaft 6 being rapidly and properly rotated by any suitable motor, transmits its rotation to the helical gear 20, which in turn rotates the intermeshing helical gear 21. A small quantity of water is first permitted to pass into the casing 1 and about the gears 20 and 21 for the purpose of priming the pump, when the air will be drawn into the central air feed opening 25 into the pump. The air being taken in at the middle inlet 25 first, each inter-tooth space between the intermeshing gears 20 and 21 is closed by the casing before the water inlet 26 or 27 at either side of the air inlet 25 is in communication with said space. This arrangement provides an entrainment area through which the air is drawn into the inter-tooth spaces. Then, by sealing the gears with water admitted at the proper point and by completing the inflow of both air and water before discharge begins, the efficient and complete discharge of air mingled with water through the lower opening 28 in the bottom of the casing 1 is secured.

From the foregoing described operation, it will be seen that the compression of the air or gas is effected by the rolling contact of the teeth of the gears going into mesh, while driving the sealing water or liquid ahead of the point of contact, thereby making this function of compression a part of the normal action of the gears. Furthermore, by the present invention of forming the gears and arranging the separate and independent inlets for the gas and liquid with respect to the outlet of the commingled liquid and compressed gas, the outer points of the active teeth of the gears are in advance

or ahead of the points of contact of the teeth with each other and make the points of contact for discharge begin on the outside and roll like a wheel from either side toward the center, thus effecting a high compression of the gas and complete discharge of the commingled liquid and compressed gas.

This combined arrangement of air and water inlets, large arc of contact between the helical gears 20 and 21, and water sealing at the proper point in the path of the air through the pump, enables me to secure an almost perfect vacuum.

Furthermore by arranging the bronze bearing spools 17 and 18 at the ends of each of the shafts 6 and 16 and in pairs, and having the rims of said spools or bearings flattened where the gears 20 and 21 are in mesh, said spools or bearings 17 and 18 are capable of not only moving freely endwise on said shafts, but also maintaining a close running clearance between the said bearings and the helical gears, by simply providing a lubricant packing as grease between the spool bearings 17 and 18 and heads 2 and 3. This arrangement of the spools or bearings, shafts, gears and heads, secures self-alinement of the shafts 6 and 16, and avoids the annoyances usually following with an outside bearing supported by a removable head. Also by extending the ends of the driving shaft 6 through the casing heads 2 and 3, as shown in Fig. 2, a balance of pressure on the ends of said shaft 6 is effected and prevents any possibility of an end thrust being developed and unnecessary wear on the parts usually following from such unbalanced forces. The insertion of the grease or lubricant between the casing heads 2 and 3 and spools or bearings 17 and 18, seals the driving shaft 6 where it extends through the packing 10 of the stuffing boxes, and it is found that some of the lubricant will work through and around the spools or bearings 17 and 18 and assist in not only sealing the gears for efficient pumping, but at the same time lubricating said gears. It will also be seen that by providing the oppositely disposed screw threads 22 and 22 on the shafts 6 and 16, the helical gears 20 and 21 tighten against each other on their respective shafts by the pressure produced during rotation, and insure against any displacement of said gears on their shafts, or leakage of the air and water between the gears.

The herein described pump is capable of many applications and may be used in connection with steam heating and ventilating systems, and in such use eliminates all possibilities of the steam wasting through the automatic valves used on the radiators, as either the air or steam alone, or both together, could be admitted into the central inlet 25 of the pump, and the steam in the mixture would be condensed by the water and then be returned to the boiler. With vertical steam tubes, as shown for example in my pending application for surface condensers, Serial No. 796,747, filed October 23, 1913, it is feasible to use the present invention in a surface condenser, in which air is used instead of water for condensing the steam, in which case coils similar to those used in warm blast heating would be employed.

From the foregoing disclosure of construction and operation of the pump, it will be seen that all the functions and advantages of the device set up in the statement of invention are fully and efficiently carried out at a minimum cost of manufacture, installation and operation.

It will also be understood that in the use of the terms gas and water in the claims, other gases than steam or air, and other liquids beside water are contemplated to be employed and covered by the invention.

What I claim is:

1. A gear pump comprising a casing, intermeshing gears provided with helical teeth having rolling contact within the casing, said teeth being circular at their upper end, involute at the middle section and elliptical at the bottom, separate gas and liquid inlets leading into the casing and arranged with respect to said gears to feed said gas and liquid to the intermeshing gears, and drive the liquid in advance or ahead of the point of contact of the teeth of said gears and compress the gas by the rolling contact of the teeth of said gears going into mesh, and an outlet in the casing for the discharge of the mingled liquid and compressed gas.

2. A gear pump comprising a casing provided with an inlet and an outlet, heads closing the ends of the casing, a rotary drive shaft having its ends passing through the heads of the casing, a gear in the casing secured to the drive shaft, a second shaft within the casing, a gear secured on the second shaft and meshing with the gear of the driving shaft, and bearing spools removably surrounding the shafts adjacent to the gears and non-rotatably seated in the casing.

3. A gear pump comprising a casing provided with an inlet and an outlet, heads closing the ends of the casing, a rotary drive shaft having its ends passing through the heads of the casing, a gear in the casing and secured to the drive shaft, a second shaft within the casing, a gear secured on the second shaft and meshing with the gear of the driving shaft, and bearing spools surrounding the shafts between the gears and heads and seated in the casing, and means within the casing for receiving a lubricant grease between the heads and outer ends of the bearing spools.

4. A gear pump comprising a casing provided with an inlet and an outlet, heads clos-

ing the ends of the casing, a rotary drive shaft having its ends passing through the heads of the casing, a gear secured to the drive shaft, a second shaft within the casing, a gear secured on the second shaft and meshing with the gear of the driving shaft, and bearing spools having flattened rim sections adjacent to and engaging each other and removably surrounding the ends of the shafts adjacent to the gears and seated in the casing.

5. A binary fluid gear pump comprising a casing, rotary shafts therein, helical gears on the shafts and arranged with respect to the direction of rotation so that the points of contact between the gears move axially toward a central plane, a central suction inlet for air having branches arranged to deliver the air tangentially to the rotating gears, a suction inlet for water on each side axially of the air inlet and each water inlet having branches arranged to deliver the water tangentially to the rotating gears, and a discharge opening for mingled air and water opposite the air inlet.

6. A binary fluid gear pump comprising a casing, rotary shafts therein, gears on the shafts having oppositely inclined helical teeth and arranged with respect to the direction of rotation so that the points of contact between the teeth move axially toward a central plane, a central suction inlet arranged to deliver air to the rotating gears, a suction inlet on each side axially of the air inlet and each of these inlets arranged to deliver water to the rotating gears, and a discharge opening for mingled air and water opposite the air inlet.

7. A binary fluid gear pump comprising a casing, rotary shafts therein, helical gears on the shafts and arranged with respect to the direction of rotation so that the points of contact between the gears move axially toward a central plane, a central suction inlet arranged to deliver air to the rotating gears, a suction inlet for water on each side axially of the air inlet and arranged to deliver water to the rotating gears only after the space between consecutive gear teeth is closed for admission of air, and a discharge opening for mingled air and water opposite the air inlet.

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

CHARLES VOLNEY KERR. [L. S.]

Witnesses:

CHAS. T. ROCKCASTLE,

K. H. ROCKCASTLE.