

March 11, 1924.

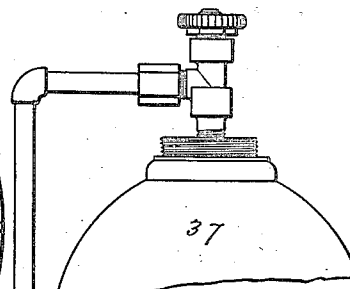
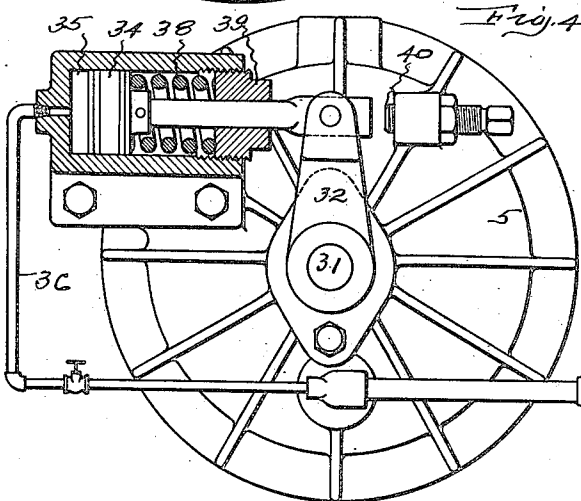
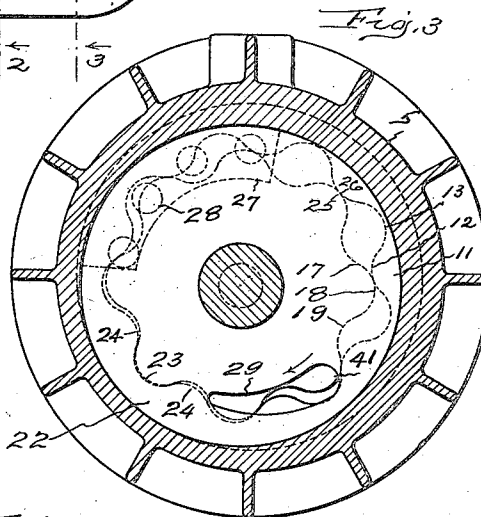
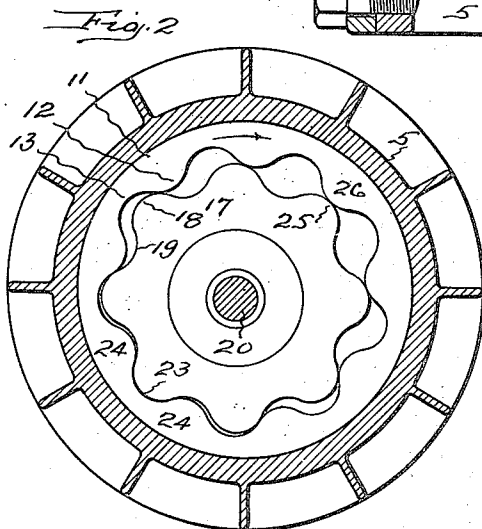
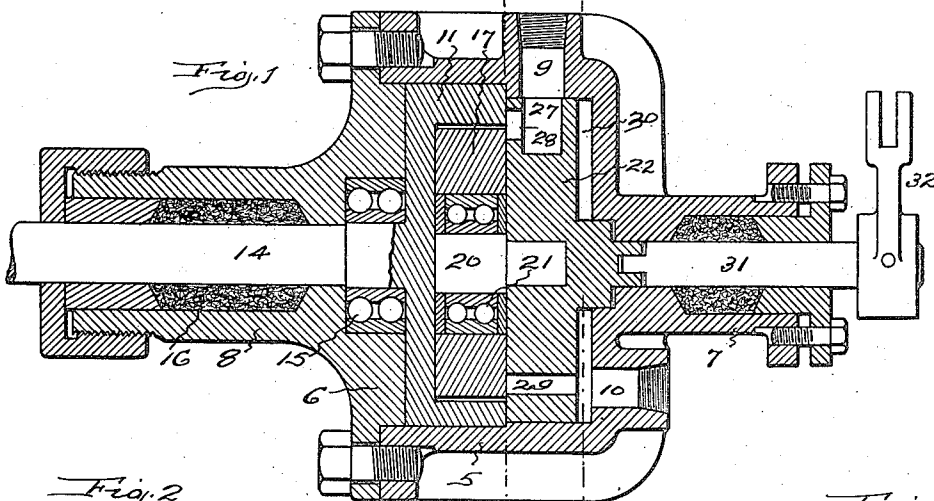
1,486,835

E. HILL

ROTARY PUMP

Filed Oct. 12, 1922

2 Sheets-Sheet 1



INVENTOR

E. Hill
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att'y.

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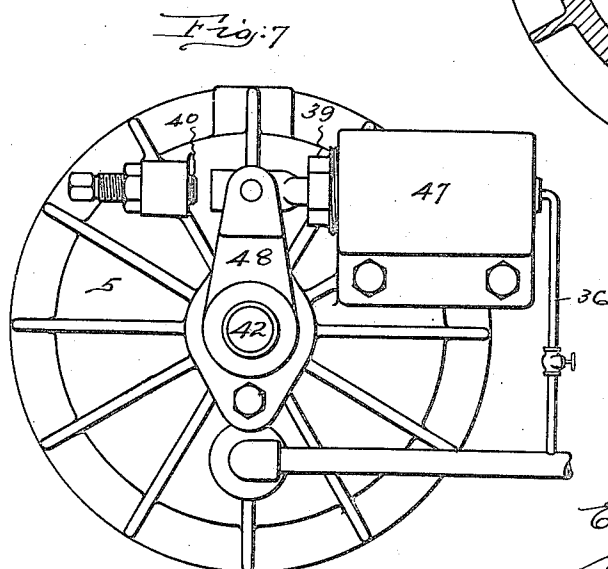
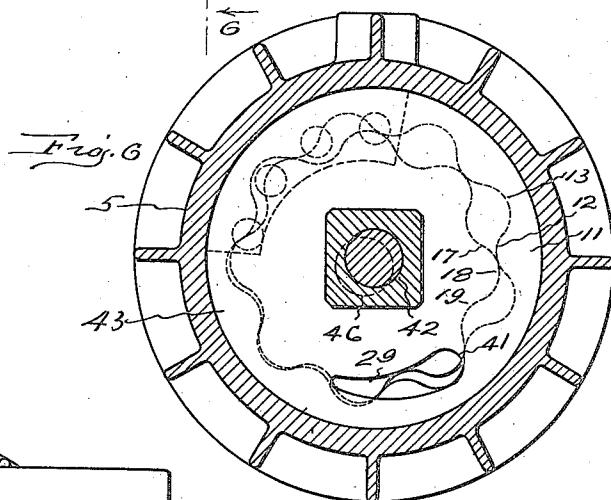
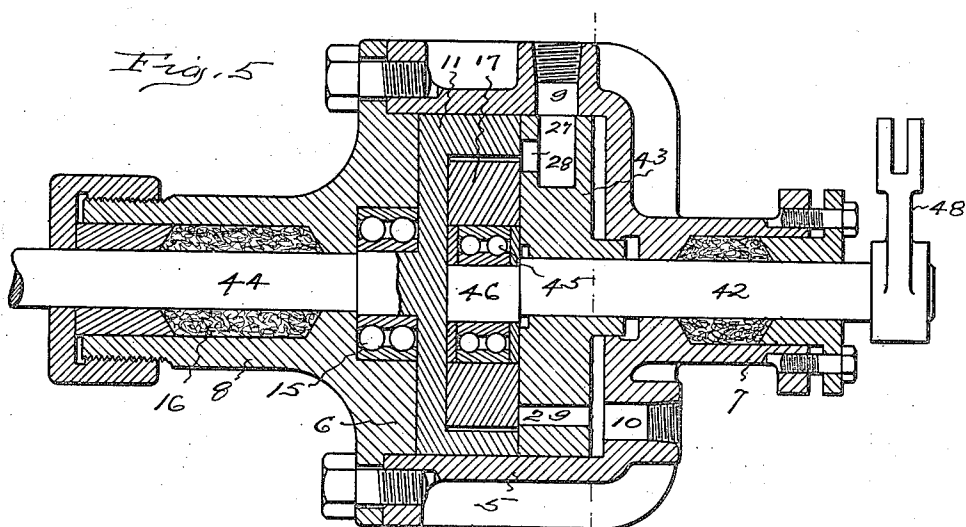
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E. HILL

ROTARY PUMP

Filed Oct. 12, 1922

2 Sheets-Sheet 2



INVENTOR

*Ebenezer Hill by
Harry P. Williams
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UNITED STATES PATENT OFFICE.

EBENEZER HILL, OF NORWALK, CONNECTICUT.

ROTARY PUMP.

Application filed October 12, 1922. Serial No. 594,028.

To all whom it may concern:

Be it known that I, EBENEZER HILL, a citizen of the United States, residing at Norwalk, in the county of Fairfield and State of Connecticut, have invented a new and useful Improvement in Rotary Pumps, of which the following is a specification.

This invention relates to rotary pumps of the gear type, that is, those pumps which have an outer driving gear and an inner driven gear that has a different number of teeth than, and is eccentrically mounted within the outer gear, which pumps are particularly adapted for pumping and compressing gas to relatively high degrees.

A pump of this type is shown and described in my copending application Serial No. 635,372 filed April 28, 1923.

The object of the present invention is to provide a simple valve and governing mechanism for such pumps, which not only controls the discharge pressure and readily admits of an automatic regulation of the pressure but also utilizes the pressure to keep the pump tight and prevent leakage of the gas being compressed across the faces of the gear teeth, no matter to what degree the pressure is raised.

This object is attained by arranging a floating plate that has an intake opening and a discharge port within the pump casing so that it will face the co-operating external and internal gears and be forced against the gear teeth by the gas discharge pressure, thereby preventing leakage across the faces of the teeth, and providing means that may be actuated either manually or by the gas pressure in the receiver into which the gas is pumped by the apparatus, for changing the relation of the discharge port in the plate to the compression spaces between the engaging gear teeth, and thereby controlling the discharge pressure.

In the accompanying drawings Figure 1 shows a longitudinal section of one form of pump which embodies the invention. Fig. 2 is a transverse section of this form of the pump, on the dotted line 2 on Fig. 1, showing the co-operating gears. Fig. 3 is a transverse section on the dotted line 3 on Fig. 1, showing the valve plate. Fig. 4 is a view looking toward one end of the pump with the automatic valve control in section. Fig. 5 is a longitudinal section of a modified form of the pump. Fig. 6 is a transverse section of the modified form, on

dotted line 6 on Fig. 5. Fig. 7 is a view looking toward one end of the modified form of pump.

The pump casing 5 is cylindrical and it has a head 6 secured in such manner that the head may be removed to give access to the interior of the casing. The casing has a hub 7 and the head has a hub 8. In the side of the casing is an intake opening 9 and in the face of the casing is a discharge opening 10.

The outer gear 11 has its periphery shaped so that it will have a close but rotatable fit within the cylindrical casing. The teeth 12 of this gear are curved as are the spaces 13 between the teeth. The outer gear is shown as attached to a driving shaft 14 that extends through the hub 8 of the head. The shaft is mounted on anti-friction bearings 15 in the head and is made tight by an ordinary gland packing 16 in the hub.

The inner gear 17 has curved teeth 18 and curved spaces 19 between the teeth. This gear is mounted on an arbor 20, with interposed anti-friction bearings 21, the arbor extending into the valve plate 22. The axis of the inner gear is slightly eccentric to the axis of the outer gear. The inner gear is of such diameter and its eccentricity is such that when a tooth 23 on one side bottoms closely in a space between teeth 24 of the outer gear, the tooth 25 on the inner gear diametrically opposite this, will just pass by the adjacent tooth 26 of the outer gear, the diameters of the gears, the shapes of the teeth and the amount of eccentricity being designed to permit this. In the pump shown the inner gear has eight teeth and the outer gear has nine teeth. The difference in the ratio of the teeth may be increased or diminished if desired for certain results; this is not material to the invention. It is obvious that with this construction as the gears rotate the spaces between the teeth, from the bottoming teeth to the sealing teeth, increase in capacity while the spaces between the teeth from the sealing teeth to the bottoming teeth decrease in capacity, and that a close seal is made between the adjacent spaces from the sealing teeth around to the bottoming teeth by the facing of the gear teeth on the compression or discharge side under the pressure. Gas is allowed to enter the spaces between the teeth at some point between the bottoming teeth and the sealing teeth, and is discharged from

the spaces between the teeth at some point between the sealing teeth and the bottoming teeth. As the rotation of the gears progresses the volume of gas increases on the entrance side owing to the increase in size of the spaces between the teeth, and decreases on the discharge side owing to the decrease in the size of the spaces on that side. Consequently any gas which is drawn in on the entrance side is compressed on the discharge side. The pressure to which the gas will be compressed depends on the distance on the compression side from the sealing teeth to the discharge port.

The valve plate 22, the circular periphery of which fits a circular wall of the chamber in the casing, has an intake chamber 27 opposite the intake opening through the casing, and holes 28 through the side wall of the intake chamber which holes lie over the pitch lines of the gears on the intake side. The valve plate has a discharge port 29 that is adapted to extend over openings between the gear teeth on the discharge side. The valve plate is made to float in the casing and a space 30 is left between it and the wall of the casing, which space is in communication with the discharge port so that the pressure of the gas which is compressed will be exerted against the outer face of the valve plate and force it tightly against the faces of the gears.

In the form of pump first illustrated the floating valve plate is rotatable in the casing as well as movable toward the gears. In the hub 7 of the casing and suitably packed to prevent leakage is a spindle 31, the inner end of which is connected with this valve plate. The outer end of the spindle is provided with a lever 32 which may be operated manually for turning the spindle and rotatably adjusting the valve plate. It is preferred however to connect this lever by a link 33 with a piston 34 in a cylinder 35 which is designed to be connected by a pipe 36 with the receiver 37 into which the gas is pumped by the apparatus. A spring 38 is placed in the cylinder back of the piston so as to force it against the pressure and a plug 39 is arranged back of the spring so that its tension may be varied. A stop screw 40 is arranged back of the lever in such position that the distance of movement of the lever under the pressure of the gas in the cylinder can be accurately limited.

As stated the pressure to which the gas will be compressed depends on how far around on the compression side from the crest point of the gears the discharge port is adjusted. The further around in the direction of the arrow, Fig. 3, the edge 41 of the discharge port in the valve plate is carried, the greater will be the discharge pressure, for the spaces between the teeth of the gears decrease and the volume of the gas is

consequently reduced until it can escape through the discharge port. The discharge port in the valve plate is made in the shape of an arcuate slot so that any gas in the compression spaces beyond the point at which it is desired to take off the gas may escape, and not be carried to a higher pressure than is desired on account of not being able to get out. The position of the edge 41 of the valve discharge port determines the discharge pressure.

The pressure on the back of the valve plate causes the plate to hug the faces of the teeth and follow up any wear, thus reducing the amount of oil or lubricant necessary for a seal. Turning the valve plate in the direction of rotation of the gears increases the discharge pressure. Turning the valve plate opposite to the rotation of the gears decreases the discharge pressure. In the form of pump described if the pressure in the reservoir into which the gas is pumped is low it is unnecessary to carry the compression in the pump to a higher degree for it merely would take more power and on release through the port the gas would expand into the reservoir at the lower pressure. This in some instances would materially lower the efficiency of the machine. If the discharge port is opened at such a point that the pressure in the pump is equal to the reservoir pressure then the pump will compress to exactly the pressure being used. As the reservoir pressure increases the position of the valve is changed slightly in the direction of rotation of the gears to meet the altered conditions of pressure, so that the pressure in the pump and the reservoir will always be the same. The tension of the spring in the governor cylinder is set to the required degree. When the pressure in the cylinder in front of the piston increases the piston is pushed back against the spring and this through the link and lever turns the valve plate in the direction of rotation of the gears so that the pump discharge pressure will be higher. This can continue until the pressure in the reservoir reaches such a degree that the piston is pushed back far enough for the lever to be obstructed by the stop screw. With this governing arrangement when the pressure in the reservoir is low the pump is only required to deliver gas at a low pressure and consequently will run with a minimum amount of power, but as the pressure builds up in the reservoir the valve is automatically turned so that the pump will deliver gas at a proportionately greater pressure. The result is that a receiver, such as one or more steel bottles can be filled faster with less power expended in the early stages. A number of these pumps can be used in series if desired to obtain a very high pressure.

In the form described the floating valve

plate, which is movable toward the gears for preventing the leakage of gas across the faces of the teeth, is rotatable for permitting a change in the relation of the discharge port to the compression spaces between the gear teeth. The same function can be obtained, as shown in the modified form, by having the valve plate movable toward the gears for preventing leakage but held against rotation, and arranging the governing mechanism in such manner that the point of tangency of the pitch circles of the inner and outer gears may be changed with reference to the discharge port in the valve plate, in other words, the axis of the inner gear is capable of being revolved with relation to the axis of the outer gear.

In the modified form the shaft 42 of the governing mechanism is extended through the valve plate 43, the plate being free to slide on the shaft but held in any suitable manner from rotation in the casing. The outer gear shaft 44 and the governing shaft 42 are in axial alignment. The inner gear bearing 45 is mounted on an eccentric projection or crank extension 46 from the governing shaft. With this construction if the governing shaft is rotated in one direction the inner gear is advanced relatively to the discharge port in the valve plate and if the shaft is rotated in the opposite direction the inner gear is retarded relatively to the discharge port. To accomplish this automatically the governing cylinder 47 is arranged on the other side of the lever 48 that is attached to the governing shaft so as to function oppositely from the governing mechanism previously described.

In the first form of pump if the outer gear is rotating clockwise on turning the valve plate in same direction the discharge port is moved nearer to the point where the gears bottom and thus higher pressure is obtained.

In the second form with the valve plate stationary as far as rotation is concerned, if the governing shaft is rotated counter clockwise the bottoming point of the gears is brought nearer to the discharge port and higher pressure is obtained.

The invention claimed is:

1. A rotary pump comprising a casing having intake and discharge openings, co-acting pump gears rotatable in the casing, a valve plate with intake and discharge ports in the casing, and means for altering the relation of the discharge port to the compression spaces between the gear teeth.

2. A rotary pump comprising a casing having intake and discharge openings, co-acting pump gears and a valve plate located within the casing, one of said gears being mounted eccentric to the other gear and said valve plate having intake and discharge

ports, and means for changing the eccentricity of the gears with relation to the valve ports.

3. A rotary pump comprising a casing having intake and discharge openings, co-acting eccentrically mounted pump gears, a valve plate having a discharge port co-operating with said gears, and means for advancing and retracting said discharge port with relation to the compression spaces between the gears.

4. A rotary pump comprising a casing having intake and discharge openings, intermeshing pump gears rotatable in the casing, and a floating valve plate having intake and discharge ports co-operating with the intake and discharge openings in the casing, located in the casing and facing against both gears, said plate being adapted to be forced by the pressure generated in the pump against the faces of the gears and thus prevent leakage across the faces of the co-acting gear teeth.

5. A rotary pump comprising a casing having intake and discharge openings, co-acting pump gears rotatable in the casing, a rotatable valve plate located at the side of the gears, said valve plate having an intake port communicating with the intake spaces between the gear teeth and having a discharge port communicating with the compression spaces between the gear teeth, and means for rotating the valve plate.

6. A rotary pump comprising a casing having intake and discharge openings, co-acting pump gears rotatable in the casing, a valve plate having intake and discharge ports communicating with the spaces between the gear teeth, said valve plate being adjustable rotatably and also movable toward and from the faces of the gears, and means for rotating the valve plate.

7. A rotary pump comprising a casing having intake and discharge openings, co-acting pump gears rotatable in the casing, a rotatable valve plate located within the casing and facing the gears, said valve plate having an intake port and an arcuate discharge port overlying the pitch lines of the gear teeth, and means for rotating the valve plate in the direction of, and in the direction opposite to, the rotation of the gears.

8. A rotary pump comprising a casing having intake and discharge openings, co-acting pump gears rotatable in the casing, a valve plate with intake and discharge ports rotatable in the casing and bearing against the side faces of the gears, a piston for rotating the valve plate in the direction of rotation of the gears, and a spring for rotating the valve plate in a direction reverse to the direction of rotation of the gears.

9. A rotary pump comprising a casing having intake and discharge openings, co-

acting pump gears rotatable in the casing, a valve plate with intake and discharge ports rotatable in the casing, a cylinder containing a piston and a spring for rotating the valve plate, and a stop for limiting the amount of rotation of the valve plate.

10. A rotary pump comprising a casing having intake and discharge openings, co-acting pump gears rotatable in the casing, a valve plate with intake and discharge ports rotatable in the casing and bearing against the side faces of the gears, a piston for rotating the valve plate in one direction, a spring for rotating the valve plate in opposite direction and a stop for limiting the rotation of the valve plate.

11. A rotary pump comprising a casing having intake and discharge openings, co-acting pump gears, a valve plate having a discharge port co-operating with said gears, and means for advancing and retracting the discharge port with relation to the compression spaces between the gears.

12. A rotary pump comprising a casing having intake and discharge openings, co-acting pump gears rotatable in the casing, a floating valve plate with intake and discharge ports located in the casing and adapted to be forced against the gears by the pressure generated in the pump, and means for adjusting the relation of the valve ports and the compression spaces between the gears.

13. A rotary pump comprising a casing having an intake and a discharge, co-acting pump members rotatable in the casing and having intake and compression spaces between them, a plate having intake and discharge ports communicating with said spaces, said plate being adjustable rotatably and also movable laterally toward and from the side faces of the members, and means for rotatably adjusting the plate.

14. A rotary pump comprising a casing having an intake and a discharge, co-acting pump members rotatable in the casing and

having intake and compression spaces between them, a rotatably adjustable plate having intake and discharge ports in communication with the intake and compression spaces respectively and bearing against the side faces of said members, means for rotatably adjusting the plate in one direction to vary the position of the discharge port for increasing the pressure in the compression space, and means for rotatably adjusting the plate in the opposite direction to vary the position of the discharge port for decreasing the pressure in the compression space.

15. A rotary pump comprising a casing having an intake and a discharge, co-acting pump members rotatable in the casing and having intake and compression spaces between them, a rotatably adjustable and laterally movable plate having intake and discharge ports in communication with the intake and compression spaces respectively and adapted to be forced by the discharge pressure against the side faces of said members, means for rotatably adjusting the plate in one direction to vary the position of the discharge port for increasing the pressure in the compression space, and means for rotatably adjusting the plate in the opposite direction to vary the position of the discharge port for increasing the pressure in the compression space.

16. A rotary pump comprising a casing having intake and discharge openings, co-acting eccentrically arranged internal and external pump gears rotatable in the casing, the engaging faces of the teeth of said gears being formed on epicycloidal and hypocycloidal curves, and a valve plate having an intake port and a discharge port, said valve plate being loosely mounted within the casing and adapted to be forced against the faces of the gears by the discharge pressure.

EBENEZER HILL.