Oct. 18, 1932. L. F. EASTON 1,883,634

DUAL PURPOSE PUMPING APPARATUS

Filed Feb. 7, 1930 4 Sheets-Sheet 1

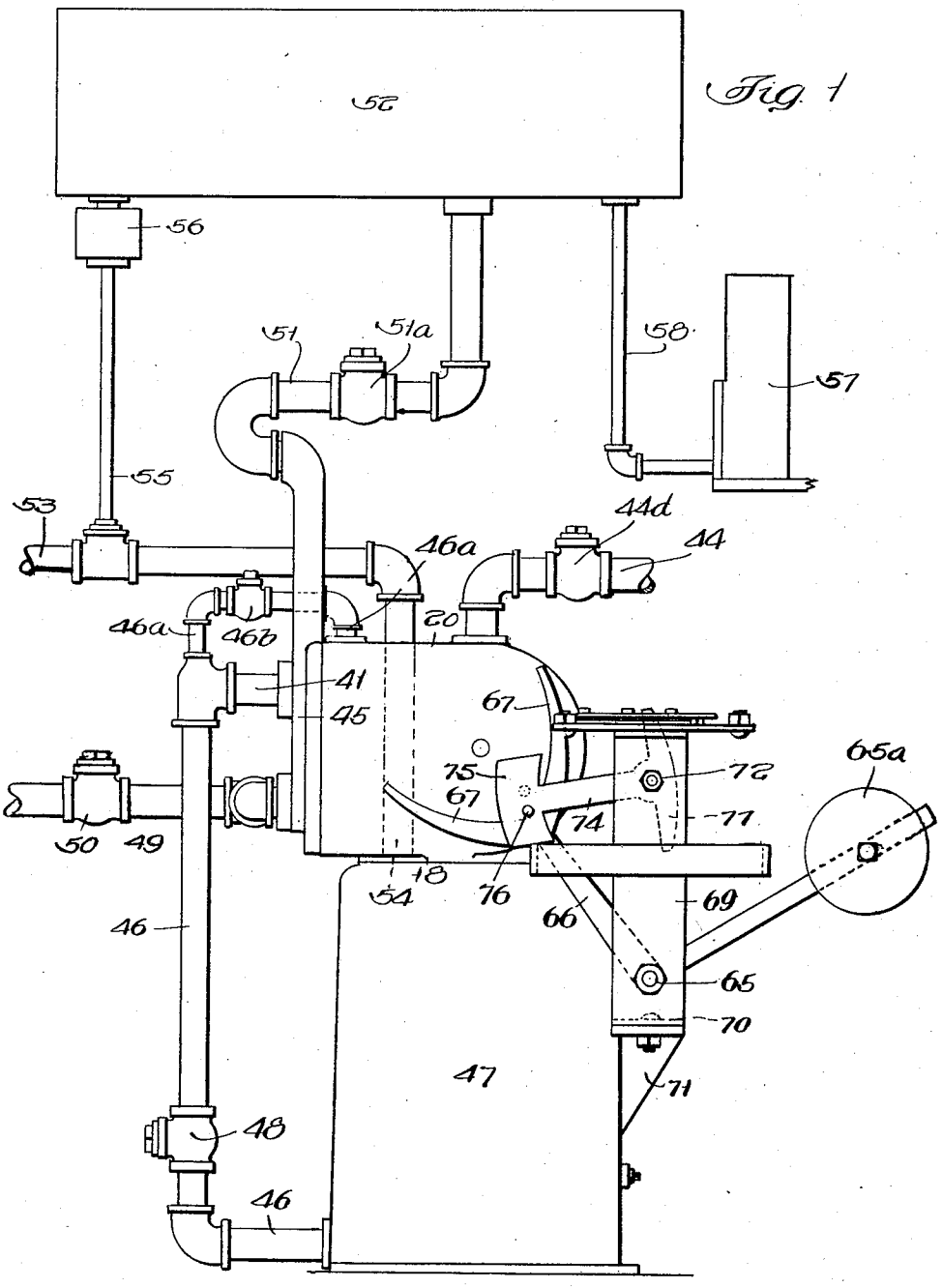


Fig. 1

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DUAL PURPOSE PUMPING APPARATUS

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Fig. 2

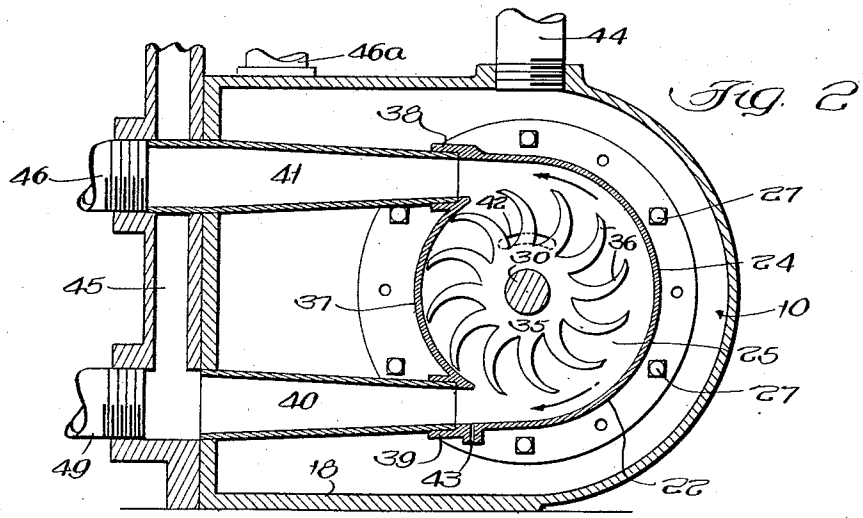
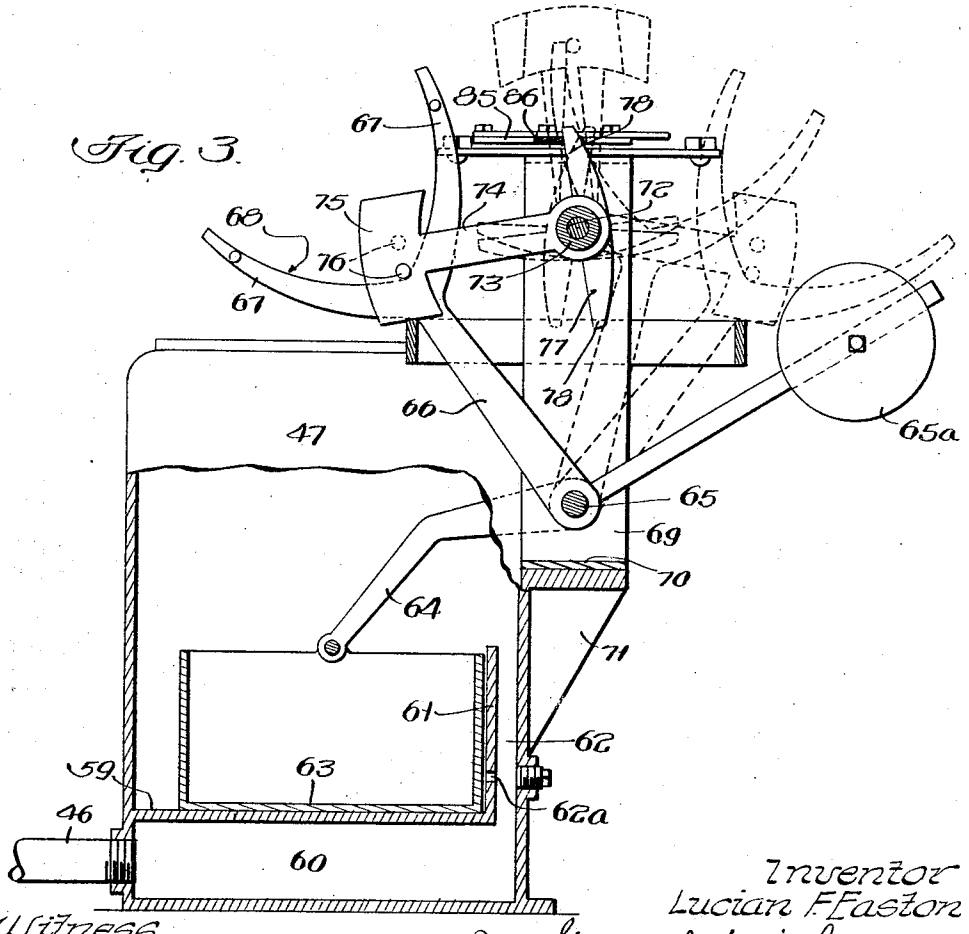


Fig. 3.



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DUAL PURPOSE PUMPING APPARATUS

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Fig. 4

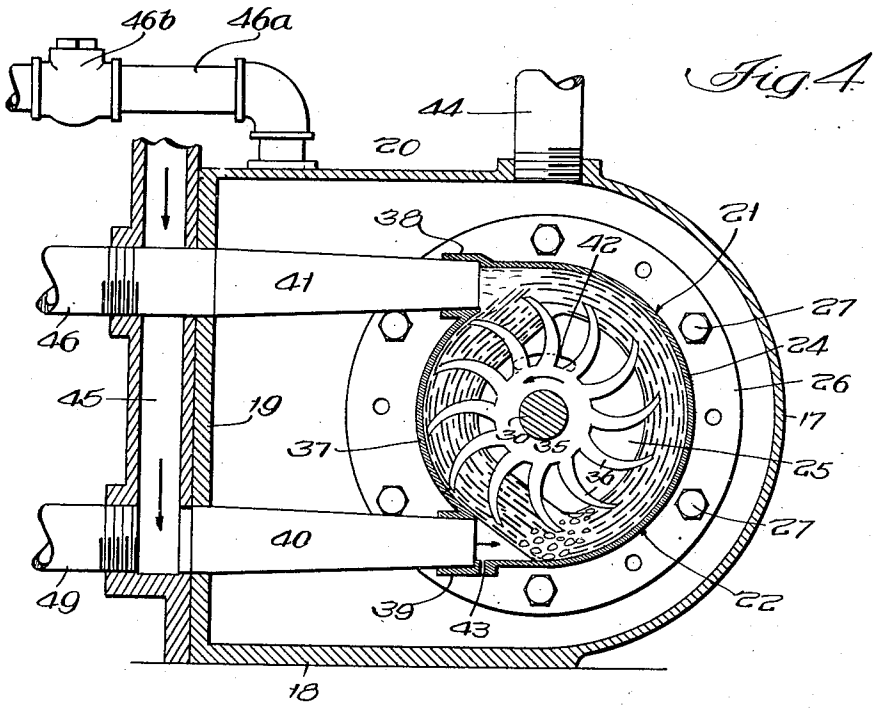
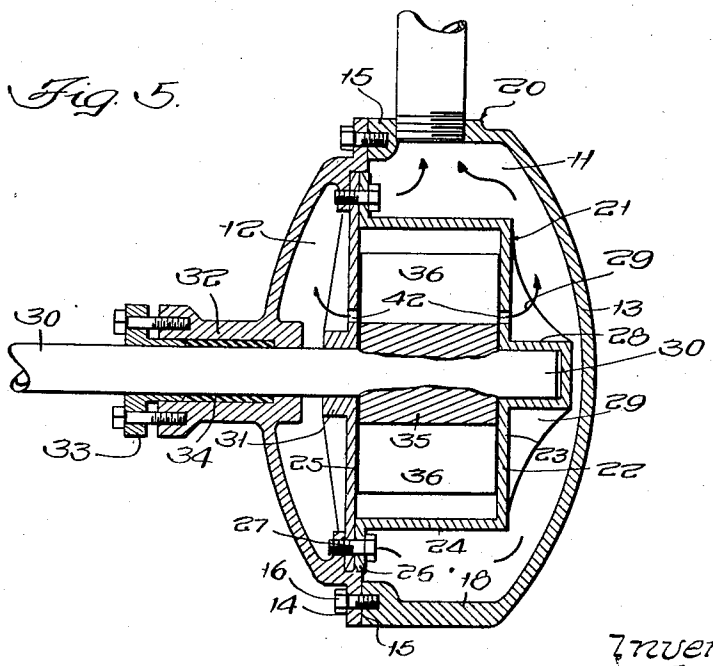


Fig. 5.



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DUAL PURPOSE PUMPING APPARATUS

Filed Feb. 7, 1930 4 Sheets-Sheet 4

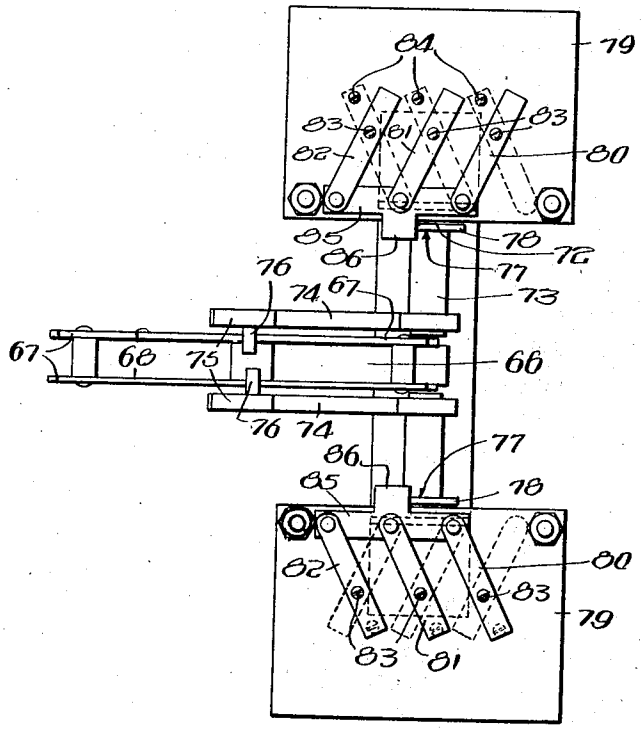
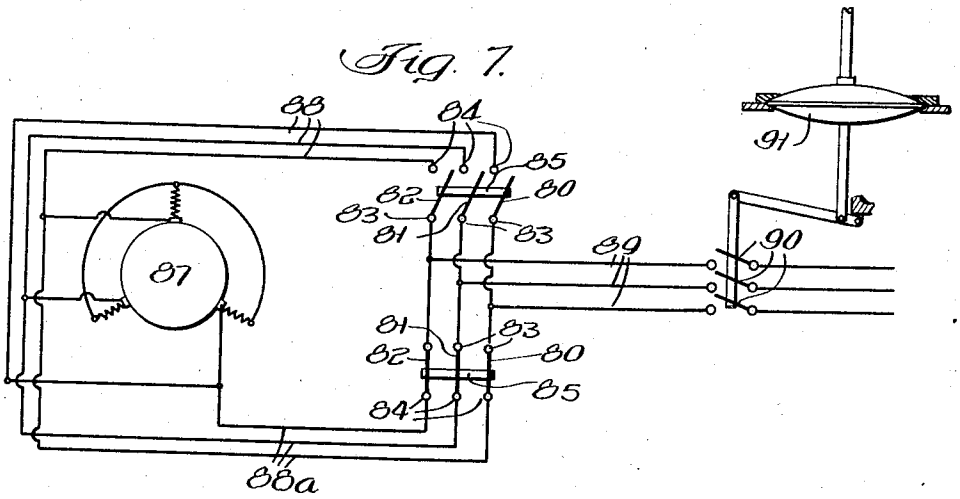


Fig. 6.

Fig. 7.



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Patented Oct. 18, 1932 1,883,634

UNITED STATES PATENT OFFICE

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DUAL PURPOSE PUMPING APPARATUS

Application filed February 7, 1930. Serial No. 426,695.

This invention relates to improvements in dual purpose pumping apparatus.

The pumping apparatus of the present invention is designed primarily for use in exhausting air and water of condensation from a vacuum steam heating system, although it is applicable for use under other conditions in which mechanism must be provided for alternately handling liquids and gases.

The mechanism of the present invention employs a rotary pump having blades so designed as to operate efficiently in the discharge of gas when rotating in one direction, and in the discharge of liquid when rotating in the opposite direction.

In conformity with the design of the rotor, provision is made for reversing the direction of the motor drive in accordance with conditions established within the system with which the pump is associated, so that when an accumulation of fluid in the system necessitates the operation of the pump as a centrifugal liquid pump, the motor will be switched on to rotate the pump in the corresponding direction until the discharge of liquid has continued to a point which necessitates the use of the pump as a vacuum pump, at which time the motor will be automatically switched on to rotate the pump in the opposite direction during the interval when the pump is acting as a vacuum pump.

With these ends in view, provision is made for the actuation of a specially designed switch by means of a float which is responsive to the rise and fall of liquid in the system, so that the ultimate control of the pump will be determined by the accumulation of liquid within the system. In this way it is possible in each instance to rotate the pump in the direction which secures the greatest efficiency in operation commensurate with the design of the rotor blades.

The pump is especially designed for use in connection with a vacuum steam heating system, although it is equally adaptable in use for other purposes, but in order to clearly illustrate the principles of operation, reference will be had in the drawings and description to so much of a vacuum steam heating system as is requisite to a full understanding of the nature of the invention.

For purposes of convenience, it will be assumed that air and water are the fluids being handled by the pump, although it will be understood, of course, that in the use of the terms air and water I have in contemplation the handling of other fluids under analogous circumstances.

Further details of the invention will appear from a description thereof, in conjunction with the accompanying drawings, wherein the apparatus as a whole is illustrated more or less diagrammatically, and wherein,—

Figure 1 is a side elevation of the principal features of the apparatus involved in the present invention;

Fig. 2 is a sectional elevation of the pump, showing the rotor and casing;

Fig. 3 is a view partly in section of the float tank and the switch mechanism involved in the energizing and de-energizing of the motor;

Fig. 4 is a sectional elevation of the pump, showing the pump in use as a centrifugal air or vacuum pump;

Fig. 5 is a sectional view taken at right angles to Fig. 4;

Fig. 6 is a plan view of the switch mechanism; and

Fig. 7 is a diagram of the wiring, motor, switch, and associated parts.

The pump, as best illustrated in Figs. 2, 4 and 5, comprises an outer shell 10 of horizontally elongated formation, as illustrated, which comprises a body portion 11 and a removable head 12.

The side wall 13 of the body portion is outwardly bulged, as shown in Fig. 5, and the head 12 is similarly bulged and provided around its periphery with a flange 14, and secured to a shoulder 15 of the wall of the body portion by means of headed screws 16.

The body portion of the shell is provided with a curving outer end wall 17, a flat base 18, an inner flat end wall 19, and a top wall 20. The configuration of the shell, however, may be varied, or its position otherwise arranged or inverted without departing from the spirit of the invention.

Within the outer shell is located a rotor casing 21, which is drum-shaped and comprises a cup-shaped body portion 22 having a flat side wall 23 and a peripheral wall 24. The body portion is closed by a disk-shaped side plate 25, the outer diameter of which is the same as that of the peripheral flange 26, and so that they will fit snugly into a recess in the head 12, where they are secured by screws 27 in such a manner that the rotor and rotor casing will be in true central alignment with the head 12 and its bearing for the shaft.

The side wall 23 of the cup-shaped body of the rotor casing is outwardly extended at its center to furnish a bearing 28 which may be reinforced by radially extending ribs 29, and the bearing recess receives the end of a rotor shaft 30, which passes through a journal boss 31 formed in the center of the side plate 25 and also through a bearing sleeve 32 outwardly projecting from the head 12 and provided with a gland 33 which is adapted to compress a packing 34 to seal the bearing.

The shaft 30 carries a rotor comprising a hub 35 from which extend a plurality of curving blades 36. The blades all curve uniformly in the same direction, and the side edges of the blades lie in close relation to the opposite sides of the rotor casing, a working clearance only being afforded.

The tips of the blades stand in spaced relation to the curved peripheral wall 24 of the rotor casing, save on the inner side where the wall is formed of a curvature of less radius to bring the wall surface into close proximity to the tips of the blades, in order to afford a block-off wall 37.

Immediately adjacent to each end of the block-off wall, the rotor casing is provided with an outwardly extending tangentially disposed nipple 38 and 39 respectively, into which are entered tapering Venturi tubes 40 and 41 respectively.

In order to provide for the escape of air from the rotor chamber, each of the side walls is provided with an arcuately formed air discharge port 42, the inner edge of which aligns with the adjacent periphery of the hub, and each of the air discharge ports is so disposed as to bring its inner end in substantially radial alignment with the mouth of the adjacent nipple.

Immediately adjacent to the lower nipple 39 is located a small port 43 which serves to provide for the inflow of water from the outer chamber into the rotor chamber at a point adjacent to the inner terminus of the tube 40. Air discharged through the ports 42 into the outer chamber is educted through an air discharge pipe 44.

In order to more fully understand the method of pump control involved in the present invention, it is desirable at this point to give a brief summary of the operation of the pump itself, both when operating as a vacuum pump and when operating as a centrifugal water pump.

It has been shown by demonstration that with the use of curved rotary blades of the character indicated the rotor is enabled to operate efficiently as a centrifugal water pump, when the rotor is rotating in a direction counter to the curvature of the blades, which would be clockwise in Figs. 2 and 4, and also to operate efficiently as a vacuum pump when the direction of rotation is reversed to present the blades in a forwardly curving direction.

In Fig. 4, which illustrates the pump conditioned to operate as a vacuum pump, the lower tube 40 will constitute an inlet for the air, and the upper tube 41 will be closed to prevent the escape of the water ring required in the operation of the pump as a vacuum pump. Under these conditions, with the rotor turning in an anti-clockwise direction, air will be drawn into the rotor chamber at a point immediately below the lower end of the block-off wall 37. At this point, the water ring is suddenly released from the confinement occasioned by the block-off wall and flies outwardly into contact with the more extended circular wall surrounding the remainder of the rotor chamber.

With the water thus agitated by its sudden release, the air admitted through the tube 40 will be drawn inwardly and through the water ring and into the pockets afforded between the rotor blades, and charges of air will thus be carried around until they reach the outlet port 42 which is located at a point adjacent to the upper end of the block-off wall, at which point the water ring is suddenly driven inwardly, which expels the pocketed air through the ports 42 into the outer chamber on each side of the rotor casing, and the air is thence driven upwardly and discharged through the pipe 44.

When the pump is operating as a centrifugal water pump, the water will be admitted through the upper tube 41 and discharged through the lower tube 40, and these conditions will continue until the desired volume of water has been discharged, after which the pump will be re-conditioned to operate as a vacuum pump and its direction of rotation reversed and the passage through the tube 41 closed by automatic means which will now be described in detail.

The lower tube 40 leads into the interior of a header 45 which abuts against the end 19 of the pump shell, and the upper tube 41 extends through the header. The tube 41 communicates with a pipe line 46 which extends downwardly and enters the base of a float chamber 47, upon which the pump and associated mechanisms may be mounted, as shown for convenience and simplicity in the

drawings. Joining the pipe line 46 is a branch 46ª leading to the outer chamber of the pump, with a check valve 46ᵇ interposed in such a manner that liquid may be drawn into the outer chamber.

The pipe line 46 is provided with a check valve 48 near its lower end, which check valve constitutes a closure against the discharge of water through the pipe line 41—46 when the pump is operating as a vacuum pump. The lower tube 40 is aligned with and communicates with a pipe line 49 provided with a check valve 50, which pipe line may lead to the boiler or other point for the discharge of the water.

The header 45 extends upwardly and connects with a vacuum pipe line 51 which, as shown, is connected at its upper end to a vacuum tank 52. A return line from the radiator system is indicated at 53, which return line discharges into the top of the float chamber through the pipe section 54.

A vacuum tube 55 controlled by a thermostatic valve 56 connects the vacuum tank with the return line 53 in the particular embodiment of the invention herein shown, and a vacuum switch 57 connected with the vacuum tank through a pipe or tube 58 serves to cut off power from the motor when the vacuum has reached a predetermined degree.

The water inlet pipe line 41—46 enters the base of the float chamber 47, which is divided by a wall 59 to afford a lower or base chamber 60. The wall 59, on its far side, is separated from the wall of the float chamber and upturned to afford a wier 61 between which and the adjacent wall is a passage 62, while near the base of the wier is a restricted water discharge port 62ᵃ.

A bucket float 63 operates within the space within the wier, and the bucket float has pivoted thereto an arm 64 which connects with a rock shaft 65 which carries a counterweight 65ª and an arm 66 terminating in two pairs of curvedly diverging prongs 67, each pair constituting a yoke 68 for the operation of the switch now to be described.

The rock shaft 65 is mounted within a U-shaped frame comprising upstanding arms 69 and a connecting cross plate 70, which, as shown, is supported upon a bracket 71 outstanding from the wall of the float chamber.

Above the rock shaft 65 and in parallel relation therewith is located a pair of inwardly extending separated stub shafts 72 in aligned relation, the outer ends of which are rigidly secured within the upstanding arms 69 of the U-shaped frame. Each of the stub shafts 72 has journalled thereon a sleeve 73, the inner end of which carries an arm 74 which mounts a weight 75. The two weighted arms are of the same configuration but are operable independently of one another by means of inwardly extending pins 76 which ride upon the edges of the yoke arms 68.

As shown in Figs. 3 and 6, the pins 76 are slightly out of alignment with one another, so that one of the pins will effectively engage the corresponding yoke arm slightly in advance of the other, with the result that as the yoke arm is rocked one of the weighted arms will be lifted and reach the medial point slightly in advance of the other, and will thence fall over into the reverse position indicated in dotted lines in Fig. 3. The result of this arrangement is that switching movements occasioned by the respective arms will occur in succession rather than simultaneously. Each of the sleeves 73 carries at its inner end a cross arm 77 comprising oppositely extending fingers 78.

The upper ends of the upstanding arms 69 of the U-shaped frame carry switch plates 79—79 preferably formed of insulating material, and each of the switch plates has mounted thereon three switch bars 80, 81 and 82, respectively arranged in parallel relation and each pivoted somewhat off center on a pivot pin 83, which pivot pins also constitute terminals for the circuits presently to be described.

Each group of three switch bars coacts with a group of three terminals 84 disposed in parallel alignment with the pivot terminals 83, so that when a group of switch bars is swung, as a unit, from the position indicated at the upper side of Fig. 6, to the dotted line position at the upper side of the same figure, the circuits will be closed through the contacts.

Each group of switch bars is pivoted to a slide bar 85 provided with a lug 86 adapted to be engaged by the fingers 78 of the contiguous cross arm 77; that is to say, as the weighted arm 75 swings past the vertical medial position indicated in Fig. 3, and then falls downwardly toward its reverse position, the previously lowered finger 78 will ultimately be moved sufficiently to engage the lug 86 and shift the slide bar 85 during the final movement of the weighted arm. Upon a reversal of the movement of the weighted arm, the opposite finger 78 will ultimately restore the slide bar with the group of switch arms to the initial position.

These movements of the reversal of the switches are utilized for the purpose of reversing the operation of the motor, which rotates the pump and which is diagrammatically illustrated at 87 in Fig. 7. The illustration and following description serve merely to indicate the principle of operation involved, since the specific construction of the motor forms no part of the present invention, and any type of motor may be employed which can be reversed in direction through the operation of suitably arranged switches.

As shown, a circuit can be established through one of the groups of switches between the corresponding group of pivot con-

tacts 83 and circuit line terminals 84 which connect with wires 88 leading to the motor. The other switch group serves to establish a circuit through wires 88ª which have the effect of energizing the motor in the reverse direction. Current is supplied through line wires 89 controlled by switches 90 which are actuated by a diaphragm 91, which constitutes the active element of the vacuum switch, so that the line wires can be switched off when the vacuum reaches a predetermined degree.

Operation

Where the apparatus is used in connection with a vacuum steam heating system, water of condensation delivered through the return line of the system will accumulate in the float chamber until the water level has risen sufficiently to lift the bucket float, which being counterweighted will rise and fall with the water level. As the float rises, due to an accumulation of water, it will lift the arm 64 and impart a swinging movement to the arm 66 carrying the yokes 68.

The swinging movement of the companion yokes will lift the weighted arms 74, one slightly in advance of the other, until the float has risen sufficiently to bring the weighted arms successively past the medial point, which will cause a dropping of the arms and a reversal of the switch elements. This will actuate the motor in the proper direction to rotate the rotor shaft to cause the rotor to act as a centrifugal water pump, which will serve to draw in water through the water line 46—41 past the check valve 48, so that the pump will begin the discharge of water from the float chamber through the pipe 49 and the check valve 50 to the boiler or other point of delivery. This will lower the water level in the float chamber, and the float will begin to descend, which results in a reverse movement of the switch actuating yokes, but the switches will not be actuated until the water level has been lowered sufficiently to bring the weighted arms in each case beyond the medial point, after which the arms will fall in reverse direction and actuate the switches to cause a reversal of the motor and the operation of the pump as a vacuum pump.

While the pump is operating as a vacuum pump, the outflow of water through the water line 41—46 will be prevented by the action of the check valve 48, so that the proper quantity of water will be retained within the rotor chamber to enable the rotor to act effectively as a vacuum pump and discharge the air through the ports 42 and through the air discharge pipe 44 which is provided with a check valve 44ª to permit discharge of air.

The air will be admitted from the system through the pipe line 51, vacuum tank 52, and vacuum tube 55 which communicates with the return line 53, and the rotor will continue to operate as a vacuum pump until the withdrawal of the air from the return line results in a sufficient degree of vacuum to operate the vacuum switch 57 which shuts off the motor, and the vacuum is maintained temporarily within the system by the provision of a check valve 51ª in the vacuum line 51.

In course of time, water of condensation will accumulate in the float chamber sufficiently to elevate the float to the degree required to actuate the switch mechanism, and the rotor will then begin to rotate in the proper direction to again discharge water of condensation.

The weighted switch operating arms are so arranged that after one has broken the circuits the other does not act until the motor has stopped, but if the motor is so constructed as to be reversed without first being stopped, this successive actuation is not necessary.

When, however, the successive arrangement is employed, it is necessary to so mount the float that it will continue to fall after the pump stops pumping water. This is accomplished by the provision of the weir which affords restricted communication between the upper and lower chambers in the float tank.

When the water level has dropped sufficiently to lower the float below the surface of the weir, it will be buoyed only by the body of water trapped behind the weir, and at this point will descend slowly as the water behind the weir is discharged through the restricted aperture 62ª. This ultimate gradual descent of the float finally causes the second weighted arm to fall and start the motor in the direction to operate the rotor pump until stopped by the vacuum switch.

It will be understood that the float and switch mechanism are so arranged that the first of the weighted arms will fall at proper time to stop the motor, and that the falling of the second arm will be delayed or retarded by the ultimate gradual descent of the float.

The travel of each of the weighted arms is about 210°, or 105° on each side of the upper medial point. If five degrees of travel is allowed past the medial point before the weighted arm drops, and seventy degrees for travel after the finger 78 impinges on the projecting lug of the switch slide bar, it is apparent that there is stored up energy during 70° of falling movement in addition to the actual dead weight of the arms themselves, which energy is relied upon to actuate the switches.

The switch contacts are so placed with reference to each other, as well as to the float, that the first weighted arm moves its switches to break the circuit, and the last fall moves the other switches into contact to close the circuit, and so that when the float again rises,

the motor, after being temporarily stopped, will start the pumping of water. The pumping of gas at the proper time will be established automatically.

The cross arms 77 are so arranged that in each case the edge of the arm that impinges upon the switch lug extends radially through the pivot of the weighted arm, and this edge extends exactly at right angles to the weighted arm.

Although the weighted arm and associated parts are here shown as used to actuate switches for the reversal of a motor, the same mechanism might be advantageously used to control mechanism other than electric switches for reversing the direction of rotation of the rotor, and it is not the intention to limit the present invention to the use of a reversing motor, since other adequate means for accomplishing the same result may be employed without departing from the spirit of the invention.

Furthermore, the use of the control mechanism herein described may be employed for the operation of valves or the like which serve to regulate the inflow and outflow of gases or liquids in such a way as to enable the rotor to operate effectively in the discharge either of gases or liquids, as occasion may require. In this case the motor might not be reversed, and the operation would be similar to that in my copending application, Serial No. 425,087, filed February 1, 1930.

In such copending application the valves shown and described are of a class where the operation of the valve is through a lever handle. If, therefore, lug 86 be considered as attached to the operating end of such lever handle, it is evident that the valve will be opened or closed alternately by the impinging finger 78, thereby operating valves instead of switches in an abrupt and positive manner instead of gradually as shown and described in such copending application. Such a substitution of valves for switches is a mere matter of mechanical detail, and which, while applicant has actually tried it out satisfactorily, requires no further description.

Although as a matter of convenience and simplicity in the drawings, the pump has been shown mounted upon the float chamber, this is not only not necessary but may be undesirable, particularly if curvature of the blades is such as to produce little if any suction when water should be pumped.

The pump may therefore be located at a lower level and in any desirable location with reference to the float chamber. One such location is so that water may flow into the Venturi tube 41 by gravity.

The branch 46^a from the suction line 46 through the check valve 46^b may also be used as a suction supply to the pump, either alone or as an adjunct to the Venturi tube 41. Whether one or both are used will depend upon the liquid pumping requirements.

Other modifications in structure and arrangement may be introduced without departing from the spirit of the invention.

I claim:

1. In apparatus of the class described, the combination of a rotary pump designed to operate as an air pump when rotating in one direction and as a water pump when rotating in the opposite direction, means for admitting air and water to the pump, and means responsive to variations in the quantity of water supplied for effecting rotation of the pump in the desired direction.

2. In apparatus of the class described, the combination of a rotary pump configured to operate as an air pump when rotating in one direction and as a water pump when rotating in the opposite direction, means for admitting air and water to the pump, and means responsive to variation in the level of the water supplied to the pump for actuating the pump in the desired direction.

3. In apparatus of the class described, the combination of a rotary pump configured to operate as an air pump when rotating in one direction and as a water pump when rotating in the opposite direction, means for admitting air and water to the pump, a float chamber with which the water supply line is connected, a float within the chamber, and means controlled by the rise and fall of the float for rotating the pump in the desired direction.

4. In apparatus of the class described, the combination of a rotary pump designed to operate as an air pump when rotating in one direction and as a water pump when rotating in the opposite direction, means for admitting air and water to the pump, a float chamber with which the water supply line is connected, a float within the chamber, a motor adapted to operate in either direction, and switch mechanism actuated by the rise and fall of the float for controlling the operation of the motor in the desired direction.

5. In apparatus of the class described, the combination of a rotary pump designed to operate as an air pump when rotating in one direction and as a water pump when rotating in the opposite direction, means for admitting air and water to the pump, a float chamber with which the water supply line is connected, a float within the chamber, a motor adapted to rotate the pump in either direction, switch mechanism and electrical connections for energizing the motor to operate in the desired direction, and a switch control device operatively connected to the float and adapted when moved by the float to a medial position to automatically move to a reversed position and adapted in so moving to operate the switch mechanism.

6. In apparatus of the class described, the combination of a rotary pump configured to operate as an air pump when rotating in one direction and as a water pump when rotating in the opposite direction, means for admitting air and water to the pump, a float chamber with which the water supply line is connected, a float within the chamber, a motor adapted to rotate the pump in either direction, two sets of switches and circuits adapted respectively to rotate the motor in each of two directions, companion switch operating devices, each operatively connected to the float and adapted to actuate the associated switch in conformity with variations in the rise and fall of the float.

7. In apparatus of the class described, the combination of a rotary pump configured to operate as an air pump when rotating in one direction and as a water pump when rotating in the opposite direction, means for admitting air and water to the pump, a float chamber with which the water supply line is connected a float within the chamber, a motor adapted to rotate the pump in either direction, two sets of switches and circuits adapted respectively to rotate the motor in each of two directions, companion switch operating devices, each adapted to be moved to a medial point and thereafter to automatically move forward to the switch operating position, and means operatively connected with the float for conjointly actuating the two switch operating devices in the desired timed relation to one another.

8. In apparatus of the class described, the combination of a rotary pump configured to operate as an air pump when rotating in one direction and as a water pump when rotating in the opposite direction, means for admitting air and water to the pump, a float chamber with which the water supply line is connected, a float within the chamber, a motor adapted to rotate the pump in each of two directions, two circuit lines and two switches for optionally rotating the motor in either of two directions, companion switch operating arms, each pivoted in proximity to the associated switch and each adapted to be swung upwardly to a medial position and thereafter to fall to the switch operating position, an operating yoke provided with fingers adapted to engage and swing the switch operating arms to a point beyond the medial position, and connections between the float and the operating yoke for swinging the same in either direction in conformity with the rise and fall of water in the float chamber.

9. In apparatus of the class described, the combination of a rotary pump configured to operate as an air pump when rotating in one direction and as a water pump when rotating in the opposite direction, means for admitting air and water to the pump, a float chamber with which the water supply line is connected, a float within the chamber, a motor adapted to rotate the pump in each of two directions, two circuit lines and two switches for optionally rotating the motor in either of two directions, companion switch operating arms, each pivoted in proximity to the associated switch and each adapted to be swung upwardly to a medial position and thereafter to fall to the switch operating position, an operating yoke provided with fingers adapted to engage and swing the switch operating arms to a point beyond the medial position, and connections between the float and the operating yoke for swinging the same in either direction in conformity with the rise and fall of water in the float chamber, the engagement of the switch operating arms with the yoke fingers being such as to actuate one of the arms in advance of the other.

10. In apparatus of the class described, the combination of a rotor casing provided with an inwardly projecting block-off wall, a rotor within the casing having blades adapted to operate as an air pump when rotating in a direction to present the blades forwardly, and adapted to operate as a water pump when rotating in a direction to present the blades rearwardly, passages for admitting air and water to the casing, an air discharge passage in communication with the casing, means for closing the water inlet passage against the escape of water when the pump is operating as an air pump, and means responsive to variations in the amount of water supplied to the pump for varying the direction of rotation of the pump.

11. In apparatus of the class described, the combination of a rotor casing provided with an inwardly projecting block-off wall, a rotor within the casing having blades adapted to operate as an air pump when rotating in a direction to present the blades forwardly, and adapted to operate as a water pump when rotating in a direction to present the blades rearwardly, passages for admitting air and water to the casing, an air discharge passage in communication with the casing, means for closing the water inlet passage against the escape of water when the pump is operating as an air pump, means for supplying rotative power to the pump for rotating the same in either direction, and means responsive to variations in the level of water supplied to the pump for controlling the direction of rotation, said means including a float chamber, a float within the chamber, and connections between said float and said controlling means.

12. In apparatus of the class described, the combination of a pump including a casing provided with a block-off wall, a rotor mounted within the casing and having curving blades adapted to operate as an air pump when the rotor rotates in a direction to present the blades forwardly, and adapted to

operate as a water pump when the rotor rotates in a direction to present the blades rearwardly, air and water supply passages leading into the pump casing at opposite ends of the block-off wall, the pump casing being provided with a laterally opening air discharge port, an air discharge passage in communication with said port, a receptacle adapted to receive water discharged thereinto and having the water supply passage connected therewith, means for rotating the pump in either of two directions, and controlling means responsive to the rise and fall of water within said receptacle for actuating said pump rotating means in the desired direction.

13. In apparatus of the class described, the combination of a pump including a casing provided with a block-off wall, a rotor mounted within the casing and having curving blades adapted to operate as an air pump when the rotor rotates in a direction to present the blades forwardly, and adapted to operate as a water pump when the rotor rotates in a direction to present the blades rearwardly, air and water supply passages leading into the pump casing at opposite ends of the block-off wall, the pump casing being provided with a laterally opening air discharge port, an air discharge passage in communication with said port, a receptacle adapted to receive water discharged thereinto and having the water supply passage connected therewith, means for rotating the pump in either of two directions, and controlling means responsive to the rise and fall of water within said receptacle for actuating said pump rotating means in the desired direction, a vacuum tank with which the air supply passage is connected, a connection between the vacuum tank and the supply line for the water receiving receptacle, a thermostatic valve for controlling the last named connection, a vacuum switch in communication with a portion of the system subjected to vacuum, and connections between said vacuum switch and the means for rotating the rotor for stopping the operation of the rotor when a predetermined degree of vacuum has been secured.

14. In apparatus of the class described, the combination of a rotor casing provided with a block-off wall, a rotor within the casing having curving blades adapted to operate when the rotor is rotated in a direction to present the blades forwardly and adapted to operate as a water pump when the rotor is rotated in a direction to preesnt the blades rearwardly, air and water inlet passages entering the pump casing at opposite ends of the block-off wall, a water discharge passage in communication with the air inlet passage, the latter being adapted on occasion to serve as a water discharge passage, a vacuum tank in communication with the air inlet passage, a water receiving receptacle, and a water supply line leading thereinto, a thermostatically controlled connection between the vacuum tank and the water supply line, a vacuum switch in communication with a portion of the system subjected to vacuum, means for operating the rotor in either of two directions, and control mechanism actuated by the rise and fall of water in the water receiving receptacle for determining the direction of rotation of the rotor, and connections between the vacuum switch and the rotor operating means for starting and stopping the latter in conformity with vacuum conditions.

15. In apparatus of the class described, the combination of a pump designed to operate as an air pump under one set of operating conditions and to operate as a water pump under another set of operating conditions, air and water supply lines leading to said pump, and means controlled by variations in the pressure status of fluids supplied for establishing the desired set of operating conditions for the pump.

16. In apparatus of the class described, the combination of a pump designed to operate as an air pump under one set of operating conditions and to operate as a water pump under another set of operating conditions, air and water supply lines leading to said pump, and means responsive to variations in the volume of water delivered for establishing the operating conditions for the pump.

17. In apparatus of the class described, the combination of a pump adapted to operate as a water pump under one set of operating conditions and to operate as an air pump under another set of operating conditions, means for operating the pump, means for supplying air and water to the pump, and means responsive to variations in the accumulation of water in the water supply means for controlling the operation of the pump operating means to operate the pump either as a water pump or as an air pump.

18. In apparatus of the class described, the combination of a pump adapted to operate as a water pump when water accumulates to a predetermined volume and as an air pump where there is a deficiency in such accumulation, a motor for actuating the pump, means for supplying air and water to the pump, float means responsive to variations in the volume of water supplied, switch mechanism and electrical connections for operating the motor, to actuate the pump either as an air pump or a water pump, and connections between said float and said switch mechanism for operating the latter responsively to variations in the position of the float.

In witness that I claim the foregoing I have hereunto subscribed my name this 14th day of January, 1930

LUCIAN F. EASTON.