J. M. IRVINE.

WAVE MOTOR AND PUMPING SYSTEM.

APPLICATION FILED JUNE 19, 1914.

**1,285,198.**

Patented Nov. 19, 1918.

3 SHEETS—SHEET 1.

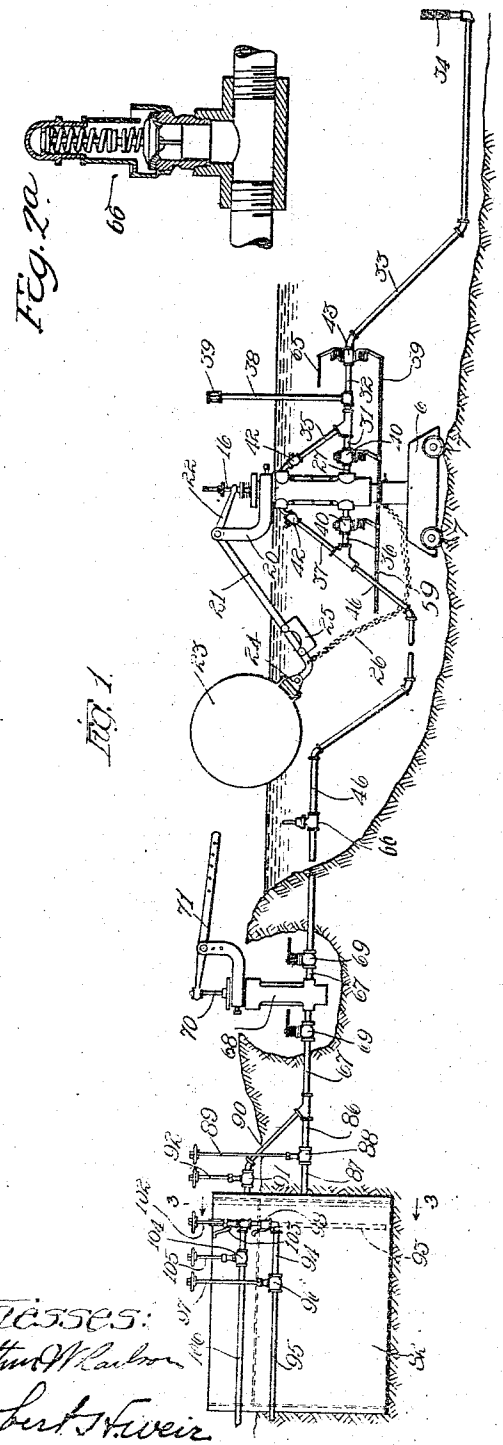


Fig. 1.



Fig. 2a.

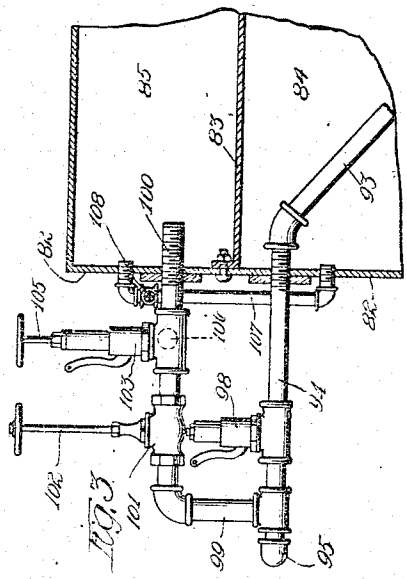


Fig. 3.

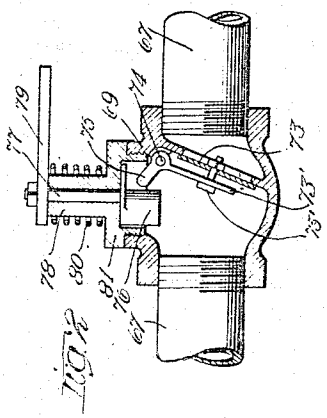


Fig. 2.

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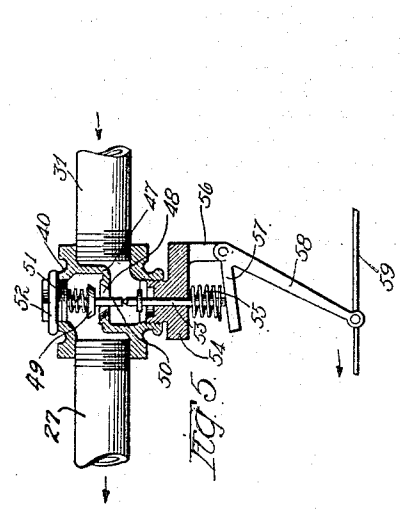


Fig. 5

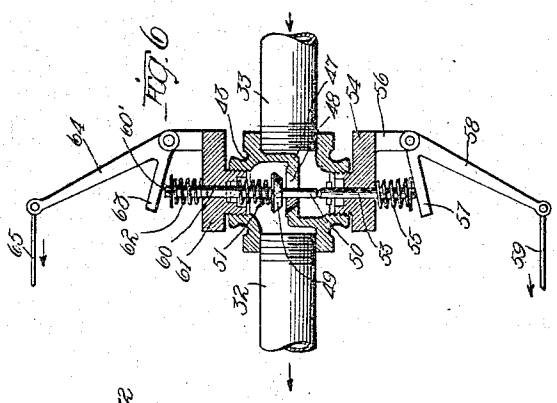


Fig. 6

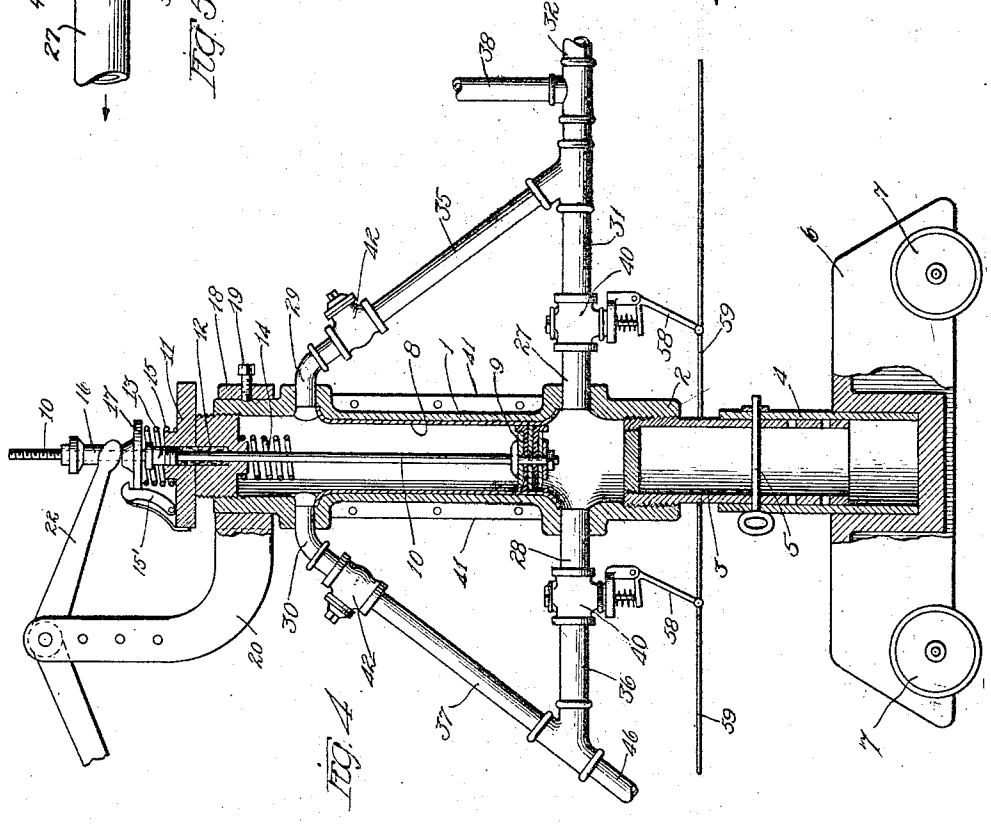


Fig. 4

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3 SHEETS—SHEET 3.

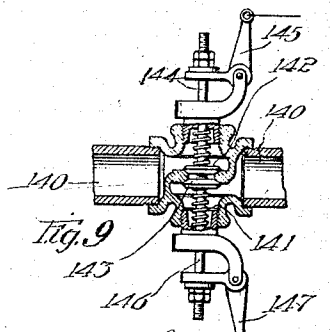



Fig. 9

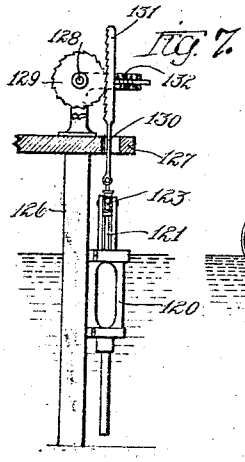



Fig. 7.

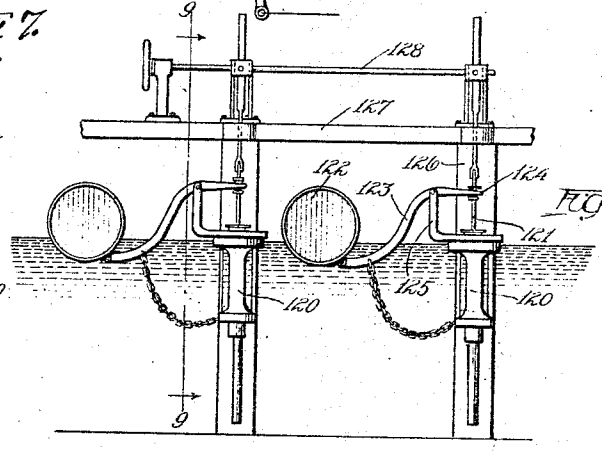



Fig. 8.

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# UNITED STATES PATENT OFFICE.

JOHN M. IRVINE, OF WILLIAMS BAY, WISCONSIN.

## WAVE-MOTOR AND PUMPING SYSTEM.

1,285,198. Specification of Letters Patent. Patented Nov. 19, 1918.

Application filed June 19, 1914. Serial No. 846,066.

*To all whom it may concern:*

Be it known that I, JOHN M. IRVINE, a subject of the King of England, residing at Williams Bay, in the county of Walworth and State of Wisconsin, have invented certain new and useful Improvements in Wave-Motors and Pumping Systems, of which the following is a description.

My invention belongs to that general class of devices known as wave motors, and the like, and relates particularly to an improved wave motor and pumping system for use at such places as are bodies of water upon which there are at times more or less waves. My improved wave motor and system is intended to utilize the waves and operative power therefrom, reducing operating cost to a minimum. My invention has among its objects the production of a motor and system of the kind described that is simple, durable, compact, efficient, and satisfactory, which may be manufactured and installed at comparatively small cost.

To this end my invention consists in the novel construction, arrangement and combination of parts herein shown and described, and more particularly pointed out in the claims.

In the drawings, wherein like reference characters indicate like or corresponding parts,

Figure 1 is a sectional view and side elevation illustrating my invention;

Fig. 2 is a sectional view through one of the valves 69;

Fig. 2ª is a sectional view through the safety valve 66.

Fig. 3 is a sectional view through a portion of the tank, showing the pipes in elevation, the same being taken substantially on line 3, 3 of Fig. 1;

Fig. 4 is a vertical sectional view through my improved motor, the float not being shown;

Fig. 5 is a sectional view through one of the valves 40;

Fig. 6 is a sectional view through one of the valves 43;

Fig. 7 is a sectional view taken substantially on line 9, 9 of Fig. 8, showing the motor used for other purposes than pumping;

Fig. 8 is a side elevation of the same, and

Fig. 9 is a sectional view of a modified valve.

It may first be mentioned that with my improved motor the same is so constructed that it may be turned with either end up, and be supported either from a suitable base, or from a pier, post, or the like. The same motor is also adapted for use in pumping water or converting the wave power into such form that it may be utilized for operating machinery. Referring particularly to Figs. 1 and 4, 1 represents a suitable pump casing, which is extended at one end at 2, and in the figures shown is supported on a standard 3 adjustably and detachably carried by a standard 4. The standard 4 shown may be carried on a movable truck or crib 6, having wheels 7, or by a pile driven in the ground. Where the lake bottom is substantially level or slopes gradually, the truck with broad wheels to prevent sinking in the sand is particularly convenient, as the whole device may be pulled out of the water or pushed in complete. Where the truck 6, and which may be termed a crib, is not portable as shown, the pump may be detached and the pump lifted from the bottom of the lake to prevent injury by the ice in winter. Any adjustable connection may be employed, the pin 5 being a very convenient and simple construction for locking the parts together. The casing 1 is preferably provided with a lining 8 of brass or equivalent material, which may be renewed when worn. Arranged within the pump is a plunger or piston 9, secured to a plunger rod 10, which extends out through a top or cap 11 at the top of the pump casing, suitable packing 12 being arranged as shown. The packing is maintained in place by the plug or stuffing nut 13. The plunger rod 10 is arranged to be operated by an arm 22, as hereafter described. Arranged on the rod 10 is a member 16, which is preferably flanged as at 17, and a spring 15 arranged between the flange 17 and top 11. A spring 14 is also preferably arranged within the motor chamber, the purpose of the two springs being to prevent shocks or jars, particularly during a storm, as will be clear from the operation of the device. Arranged about the casing 1 is a collar 18, which is provided with an arm 20, the collar being rotatable about the casing, if desired. It may, however, be locked against movement by a set screw 19,

or equivalent means for the purpose. Pivotally carried by the arm 20 is a bell-crank lever 21—22, the end 22 being adapted to cooperate with the member 16 on the rod 10, as previously described. Several holes may be provided in the arm 20, so as to afford different adjustments of the arm or levers 21—22. At the free end of the arm 21 is a float 23, the same being preferably secured to the arm or lever 21 by universal coupling or joint 24. The float 23 may be constructed in any desired manner, and may be of any shape most suitable for the purpose. It may be mentioned in this connection that a barrel float is very satisfactory. I preferably adjustably arrange on the lever 21 as a counterbalance a weight 25, and arrange a chain 26, as shown, for limiting the movement of the float. The weight gives a quicker and more positive downward stroke of the arm 21, and holds the arm in its proper position relative to the float. As shown in Fig. 4, a dog 15′ suitably maintained in operative position by a spring or its equivalent, may be provided for positively locking the piston rod in its lowest position, and consequently preventing the dropping of the float.

The pump shown in Fig. 4 is in the form of a compound pump, provided with inlet pipes 27 and 29, and discharge pipes 28 and 30. As shown, pipe 27 is connected through pipes 31 and 32 to an intake pipe 33 (see Fig. 1) to the end of which may be secured a strainer 34. This pipe is arranged so that the strainer or intake end of pipe 33 is below the water level. I have shown pipe 32 connected by a branch pipe 35 to the intake pipe 29, and pipe 30 connected through a branch pipe 37 to the supply or discharge pipe 46, to which pipe 28 is connected through pipe 36. The normal flow of water is through pipes 33, 32 and 31, 27 and 35, 29 through the pump, from whence it is discharged through pipes 28, 36 and 30, 37 to the discharge pipe 46. Of course pipes 35, 29 and 30, 37 may be omitted if so desired. Where it is desired to pump air either simultaneously with the pumping of water, as later described, or only air, I also provide a pipe 38 extending from pipe 32 to above the water level. A valve 39 is preferably provided at the end of this pipe, so that the same may be closed as desired.

I also provide valves 40, 42 and 43 (see Fig. 1) of any suitable construction, preferably of the construction hereafter described. It may be mentioned that I have found it desirable to provide valves 40 of a type that may be opened and maintained open from the shore when desired, and a valve 43 of a type that may be maintained opened or closed, or which operate automatically, the same being arranged to also be controlled from the shore. Valves 42 may be the ordinary form of check valves shown, or they may be similar to valves 40 or 43, if so desired.

While any suitable valves may be employed, I have illustrated my preferred forms in Figs. 5 and 6, the constructions being similar except that valve 43 is arranged for double control. Referring first to Fig. 5, valve 40 consists of a casing having a partition 47 therein, having a port 48 arranged to seat a valve 49, provided with a stem 50. This valve is maintained in position by a suitable guiding cap 52, a spring 51, normally maintaining the valve closed. The valve, however, is free to open under the pressure of the water passing through in the direction indicated by the arrow. It closes, however, and normally checks when the water tends to flow in the opposite direction. A rod 53 is provided for maintaining the same open when desired. This rod passes through a cap 54, and is normally maintained out of operative position by a spring 55. Carried by the cap 54 on the extension 56 is a bell-crank lever 57, 58, to which is secured a rod or cable 59. As is obvious, when the rod or cable 59 is pulled in the direction of the arrow, and held in that position, the valve 49 will be maintained open, so that water may flow in either direction. The valve 43 shown in Fig. 6 is very similar, and I have given similar parts the same reference characters. However, in this case instead of the cap 52, a cap 61 is provided, similar in construction to the cap 54, the same provided with a bell-crank lever 63, 64, arranged to cooperate with the valve rod 60 to coöperate with the auxiliary valve rod 60′, which passes to the exterior of the cap 61. This rod extends into contact with the valve rod 60, so that while a spring 51 normally maintains the valve closed, the same may be locked closed by pulling the cord 65 and operating bell-crank 64, so as to drive the rod 60′ down against the end of the valve rod 60. A spring 62 normally maintains the parts out of operative position. As is obvious, if cable 59 is pulled, the valve is locked open, while if cable 65 is pulled, it is locked closed. On the other hand if neither are pulled, the valve acts as an ordinary check valve, as the water flows in the direction indicated by the arrow.

This part of the apparatus may be utilized in any desired manner. I have, however, shown a complete system, consisting of a suitable pressure tank. Referring to Fig. 1, the pipe 46 is connected through pipes 67 to the tank, as will be hereafter described. In the pipe may be arranged a safety valve 66 of any suitable type. The safety valve prevents the pump from holding up a high pressure in the pipes when the valves at

the tank are all shut. I have also shown pump 68 arranged in the system, provided with a piston rod 70 and operating lever 71. This pump may be similar to that previously described, or, as shown, it may be only single acting. I have not considered it necessary to illustrate the pump in detail, and it may be mentioned that the same may be operated manually, or by suitable motive power. I have also provided valves 69 in the pipe 67, as shown. Any suitable valves may be employed, those shown being illustrated in section in Fig. 2. Referring to this figure, 69 is a casing, within which is arranged a check valve 73, the same being pivotally secured to the casing at 74. In the construction shown I have shown the valve 73 adjustably secured to an arm 73′ by a screw 75′, which arm 73′ is secured to the casing, and which is provided with an extension 75. The extension 75 is arranged to coöperate with a cam member 76 on a shaft 77, extending through the extension 78 of the cap 81. An operating handle 79 is provided, the cam being normally maintained out of operative position by a spring 80 secured to the parts and tending to maintain the handle 79 and shaft 77 against rotation.

The tank is preferably arranged in the ground with the greater portion below the water level of the lake. As shown, 82 is the tank, which is divided by a partition 83 into a water chamber 84 and air chamber 85. The pipe 67 is connected to both of these chambers. Referring to Fig. 1, pipes 86 and 87 connect pipe 67 with the water chamber, 88 being a suitably formed valve provided with a valve handle 89. The air tank or chamber 85 is connected to pipe 67 by pipe 90,—91 being a valve and 92 its controlling rod. I provide supply pipes extending from both chambers 84 and 85, so that either air or water under pressure may be drawn from the tank and utilized as desired. The water supply pipe 95 is connected to pipe 94, which extends within the tank and is provided with an extension 93 to the bottom of the water tank. The air discharge pipe 106 is connected to pipe 100, extending from the air chamber. I have also provided a safety valve 98 in the water pipe, and a pipe 99 connecting the water pipe with the air pipe 100. I have likewise arranged valves 101 in the pipe 99, having an operating rod 102 and a safety valve 103 in the air pipe. The air pipe is also provided with a valve 104 (see Fig. 1) having an operating rod 105 (only the rod being shown in Fig. 3) the water pipe being controlled by a valve 96 with its rod 97. The two tanks may be connected by pipe 107, having a valve 108, as shown.

Having thus described the parts of my system, its operation may be briefly described: Assuming that valves 42 act as ordinary check valves: If there is no water in the water chamber 84, and valve 88 and safety valve 98 are opened, and the cables operated to open valves 69, 40 and 43, owing to the pipes being below the water level of the lake, water will freely flow from the lake into the tank without pumping. If valve 108 is open, air can pass from chamber 84 to chamber 85, compressing the same therein. This permits the filling of the tank or chamber 84 to some extent without operating the pump, and it is a particularly desirable feature at such times when there are no waves on the lake to operate the pump. If there are no waves, more water can be pumped in the tank under a pressure by means of the pump 68 operated on shore. Assume, however, that the pump in the lake is to be operated by its float, there being sufficient waves to raise and lower the float. In this case valves 69, 40 and 43 are released so as to operate as ordinary check valves, check valves 42 being open or in operation. As the float rises and falls, it operates the piston rod 10. However, any shocks at either end of the stroke are relieved by the springs 14 or 15. Water flows then through the intake 34, through pipe 33, 32, and through pipes 31, 27 and 35, 29, through the pump, and out through pipes 37 and 36 to the pipe 46; thence through pipe 67, 86 and 87 to the chamber 84, valve 88 being opened of course. The valves prevent a back flow as the pump is operated. If it is desired to increase the air in the air chamber, that is increase the pressure of the air in the air chamber, valve 43 may be maintained closed and valve 39 opened, so that the air is pumped through pipe 38 and through the several pipes, through pipe 90 into the air chamber 85, valve 91 being open. On the other hand, if it is desired to pump both air and water at the same time, valve 39 may be open and valve 43 released, so that water and air are both pumped by the pump and discharged into the tank. The pressure, of course, may be released at any time, either automatically or manually, by the safety valves 98 and 103, so that there will not be too much pressure in the tank. If at any time there should be any obstruction in any of the pipes, it may be forced backward either by forcing the air or water from the tank back to the intake 34, the valves, of course, being operated or controlled so as to permit the backward flow. The operation of the float on the pump or motor may be varied by shifting the weight 25, or the position of the lever on the arm 20.

In Figs. 7 and 9 the motor is constructed with the casing 120, through which extends a plunger rod 121, the same being guided within the casing. In this case, however, a pump is not required, and the piston may therefore be omitted. The float 122 is con-

nected to the arm or lever 123, having its end 124 arranged to coöperate with the rod 121. To rod 121 is secured a shaft or rod 130. In this case the motor is secured upon the piling 126 below the top of pier 127. The rod 130 is provided with a rack bar 131, arranged to coöperate with ratchet teeth on a ratchet wheel 129, secured to a shaft 128. A spring 132 normally maintains the two in operative relation. As is obvious, as the float is raised, the rod 130 is drawn down, drawing down the rack bar 131, and rotating the ratchet wheel 129, thereby driving the shaft 128. There may be any desired number of floats and motors employed in this construction, so that each wave as it passes on successively raises the floats, so that the rotation of the shaft is substantially continuous. I have not considered it necessary to describe in great detail all the possible variations in my construction, or in my system, or the various uses to which the same may be put. In Fig. 9 a double check valve is shown, which may be used wherever found desirable in the system, the same being arranged to work automatically or to be positively controlled. Referring to this figure, 140 represents a conducting pipe, in which is arranged a valve casing 141, and arranged in the valve casing are valves 142 and 143, the same being provided with valve stems 144 and 146 respectively. The valves are normally maintained on the valve seats by springs, or their equivalents. They are controlled by bell-crank levers 145 and 147 respectively, to which may be secured cables for operating the same from the shore. When both valves are shut the passage of fluid through the pipe 140 is prevented. When one is closed and the other maintained open, backward flow is checked in the usual manner. When both are maintained open the fluid or air is free to pass in either direction. As mentioned, the same may be placed at any point in the supply pipe between the pump and tank.

Having thus described my invention, it is obvious that various immaterial modifications may be made in the same without departing from the spirit of my invention; hence I do not wish to be understood as limiting myself to the exact form, construction, arrangement or combination of parts herein shown and described, or uses mentioned.

What I claim as new and desire to secure by Letters Patent is:—

1. In a device of the kind described and in combination, a casing provided with a separable lining, and having a detachable closure for each end, a plunger arranged within the casing between said closures, a plunger rod secured thereto and extending through one closure to the exterior of the casing, cushioning means arranged on said closure on the interior and exterior sides thereof, a bracket adjustably secured to the casing at said end, a lever arm carried by caid casing bracket having one end coöperating with the plunger rod, a float pivotally connected to the opposite end of said lever arm, and a weight adjustably mounted on said arm, a base for said casing provided with a plurality of supporting wheels, means for adjustably securing the casing on said base, and means for limiting the movement of the float.

2. The combination of a pump, comprising a suitable casing, a lining arranged therein, a closure arranged at each end of said casing, a plunger arranged in said casing provided with a plunger rod extending to the exterior of the casing at one end thereof, means arranged at said end for limiting the movement of said plunger, said casing provided with an inlet at each end and with an outlet at each end, a bracket adjustably carried by said casing, a float arm pivotally secured to said bracket and having one of its ends arranged to coöperate with said plunger rod, a float member pivotally secured to the free end of said arm, a weight adjustably secured to said arm, and means for supporting said casing, comprising a wheel base, and means for adjustably and detachably securing the casing to said base.

3. The combination of a pump, comprising a suitable casing, a lining arranged therein, a closure arranged at each end of said casing, a plunger arranged in said casing provided with a plunger rod extending to the exterior of the casing at one end thereof, resilient means arranged at said end for limiting the movement of said plunger, said casing provided with an inlet at each end and with an outlet at each end, controlling valves for said inlets and outlets, a bracket adjustably carried by said casing, a float arm pivotally secured to said bracket and having one of its ends arranged to cooperate with said plunger rod, a float member pivotally secured to the free end of said arm, a weight adjustably secured to said arm, and means for supporting said casing, comprising a wheel base, and means for adjustably and detachably securing the casing to said base.

4. The combination of a pump, comprising a suitable casing, a lining arranged therein, a closure arranged at each end of said casing, a plunger arranged in said casing provided with a plunger rod extending to the exterior of the casing at one end thereof, means arranged at said end for limiting the movement of said plunger, said casing provided with an inlet at each end and with an outlet at each end, a bracket adjustably carried by said casing, a float arm pivotally secured to said bracket and hav-

ing one of its ends arranged to coöperate with said plunger rod, a float member pivotally secured to the free end of said arm, and means for supporting said casing, comprising a wheeled base, means for adjustably securing the casing to said base, means for controlling the admission of water to the casing inlets, including means extending therefrom to a point remote therefrom.

5. The combination of a pump, comprising a suitable casing, a lining arranged therein, a closure arranged at each end of said casing, a plunger arranged in said casing provided with a plunger rod extending to the exterior of the casing at one end thereof, means arranged at said end for limiting the movement of said plunger, said casing provided with an inlet at each end and with an outlet at each end, controlling valves for said inlets and outlets and means for controlling said valves, a bracket adjustably carried by said casing, a float arm pivotally secured to said bracket and having one of its ends arranged to coöperate with said plunger rod, a float member pivotally secured to the free end of said arm, a weight adjustably secured to said arm, and means for supporting said casing comprising a wheeled base, means for adjustably and detachably securing the casing to said base, means for controlling the admission of water to the casing inlets, including means extending therefrom to a point remote therefrom.

In testimony whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JOHN M. IRVINE.

Witnesses:
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CHARLES I. COBB.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."