

Dec. 6, 1932.

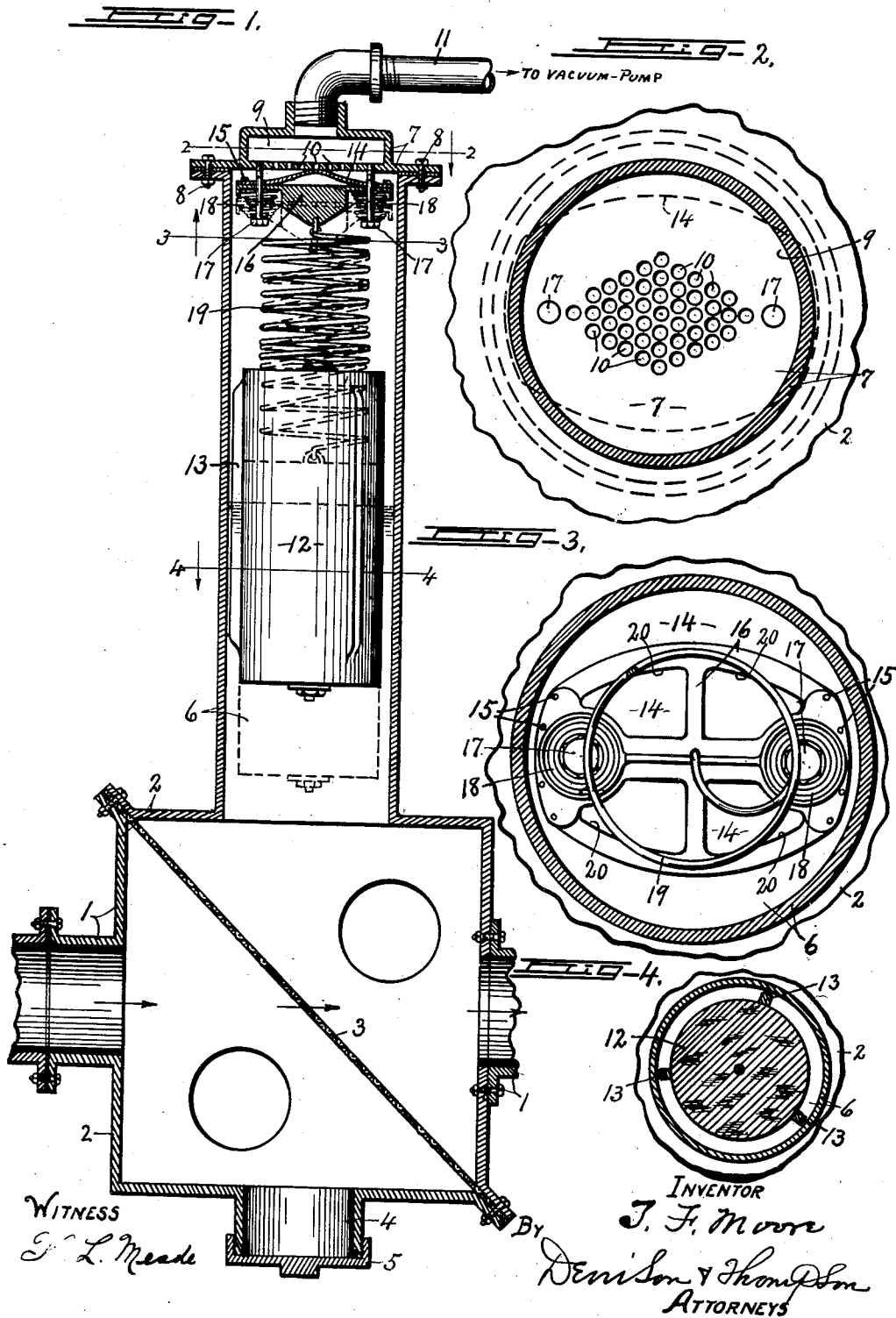
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1,890,126

FLOAT CONTROLLED DIAPHRAGM VALVE FOR HYDRAULIC PUMPING SYSTEMS

Filed Nov. 15, 1930

2 Sheets-Sheet 1



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FIG-5.

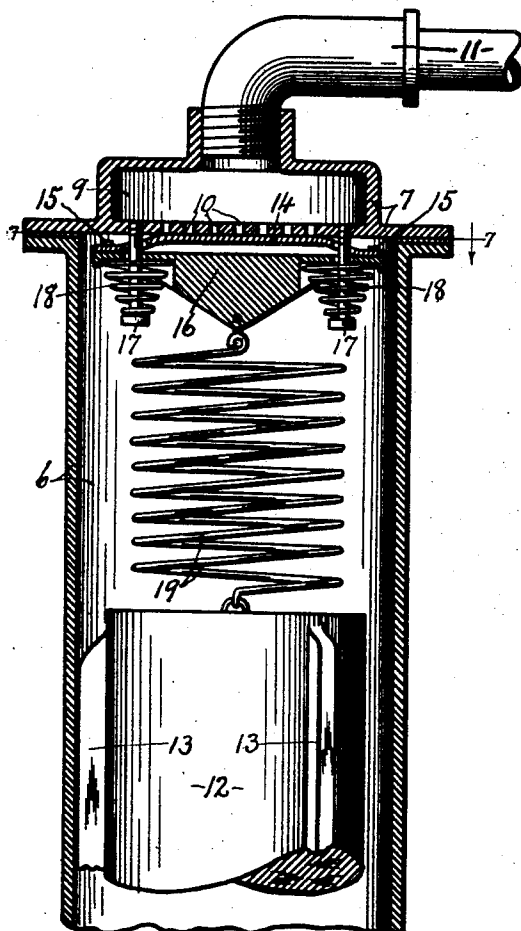


FIG-6.

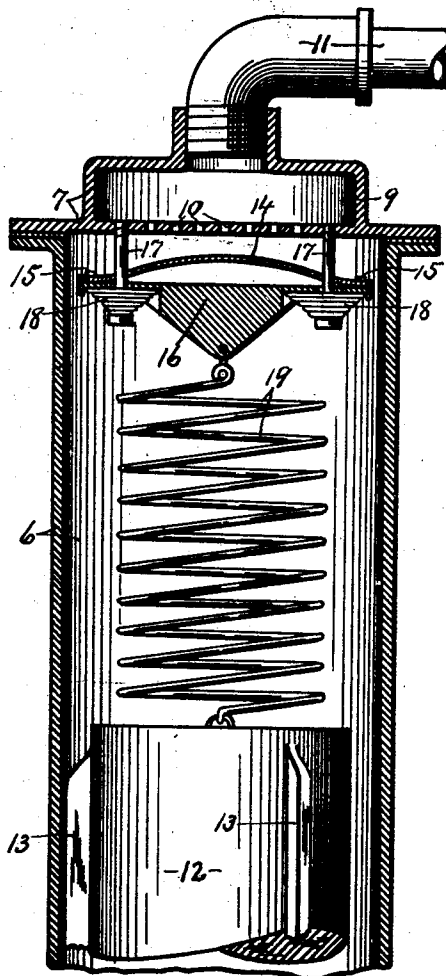
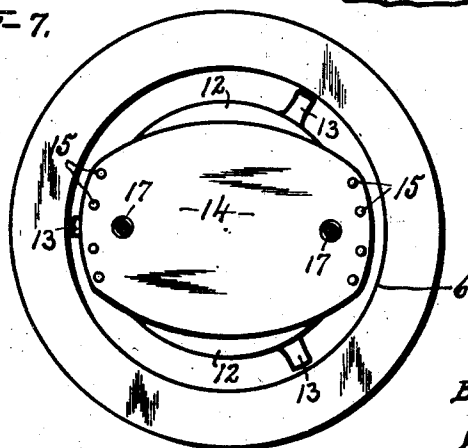


FIG-7.



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FLOAT-CONTROLLED DIAPHRAGM VALVE FOR HYDRAULIC PUMPING SYSTEMS

Application filed November 15, 1930. Serial No. 495,989.

This invention relates to a centrifugal hydraulic pumping system of the class set forth in my pending applications, Serial No. 322,056, filed November 26, 1928 and Serial No. 380,223, filed July 22, 1929, and refers more particularly to a float-controlled means for preventing the entrance of air to and withdrawing of air from the intake side of the pump to prevent the latter from becoming airbound, and incidentally to avoid the necessity of priming the pump when in operation.

These pumps are used extensively for withdrawing water from swamps and other repositories and discharging it into other more or less remote basins to prevent backflow to the source, preparatory to excavations for the reception of masonry or other structures. In many instances the mouth of the intake is only partly submerged in the water, which allows a greater or less quantity of air, sand, chips and other foreign matter to enter the intake with the water and which, if allowed to enter the pump, would be seriously detrimental to the operation and efficiency thereof.

In my pending applications, referred to, suitable means has been provided for reducing this objectionable result by providing the intake conduit with an upwardly extending float chamber adapted to receive a part of the inflowing water therefrom, and having its upper end communicating with a suitable vacuum pump operating simultaneously with the centrifugal pump for pumping or withdrawing air from the intake before entering the centrifugal pump. Communication between the float chamber and vacuum pump is controlled by a float-operated valve within said chamber in such manner that an excess amount of water entering the chamber will effect a gradual closing of the valve and thus prevent the entrance of water to the vacuum pump.

The main object, therefore, is to provide simple, efficient and automatic means for preventing the entrance of air to the centrifugal pump and at the same time preventing the entrance of water to the vacuum pump or other suction device, and incidentally to pre-

vent the passage of chips, gravel and other solid foreign matter from entering the centrifugal pump through the intake.

Owing to the widely varying volumes of water and air admitted to the mouth of the intake it is found that the action of the float and valve controlled thereby is very irregular and consequently under violent reciprocatory motion through widely varying ranges to such an extent as to seriously impair certain parts of the float chamber and movable elements operating therein after a short period of use, unless some means is provided for reducing the shock incidental to the violent operation of said moving parts.

One of the specific objects of the present invention is to reduce to a minimum this liability of impairment of the float chamber and elements moving therein, and thereby to greatly prolong the life of this part of the apparatus by providing yielding connections between the float and valve-supporting member and also between said valve-supporting member and top wall of the float chamber.

Another specific object is to permit the use of a comparatively light-weight valve-controlling float so that it may be instantly responsive to the slightest variations of liquid levels in the float chamber and to connect this float to the diaphragm or strap valve in such manner that the latter will be gradually stripped from the suction ports from one or both ends toward the center during the descent of the float, and also gradually close said ports from the center toward the ends as the float rises.

Another specific object is to provide the top wall of the float chamber with a multiplicity of apertures grouped in the form of a diamond or rhomb as a means of communication between the vacuum pump and upper part of the chamber, and to control such communication by means of a flexible diaphragm valve tending to close under the influence of the partial vacuum but operatively connected to the float in such manner that when the latter descends by the recession of the water in the float chamber the valve and apertures controlled thereby will be gradually opened from opposite ends toward the center thereof,

thereby assuring a more positive, efficient and close control of the inflow of water and outflow of the air to and from the float chamber than has heretofore been practised.

In other words I have sought to provide float-operated means connected to the valve in such manner that when the float is raised by the rise of water in the float chamber the valve will gradually close from the center toward the ends, while on the other hand the descent of the float by the recession of the water in said chamber will cause the valve to gradually open from the ends toward the center, thereby accomplishing the close regulation referred to.

Other objects and uses relating to specific parts of the device will be brought out in the following description.

In the drawings:—

Figure 1 is a vertical sectional view of a portion of the intake conduit of a centrifugal hydraulic pump and a float chamber rising therefrom with the float and valve controlled thereby, together with the intake conduit of a vacuum pump in communication with the upper portion of the float chamber, the float being shown in elevation and in a position for partially opening or closing the valve.

Figures 2 and 3 are enlarged horizontal sectional views taken respectively in the planes of lines 2—2 and 3—3, Figure 1, Figure 3 being inverted.

Figure 4 is a horizontal section view taken in the plane of line 4—4, Figure 1.

Figures 5 and 6 are enlarged vertical sectional views of the upper portion of the float chamber and float therein, the float in Figure 5 being shown in its up position, while Figure 6 shows the float in its lowermost position for fully opening the valve, the valve being closed in Figure 5.

Figure 7 is a horizontal sectional view taken in the plane of line 7—7, Figure 5, showing more particularly the form of the flexible diaphragm valve.

In order that the invention may be clearly understood I have shown an intake conduit —1— of a centrifugal hydraulic pump (not shown) as provided with an enlargement —2— for receiving a diagonal screen —3— between the opposite ends thereof to prevent the passage of chips, gravel and other foreign solids to the pump, and at the same time permitting free passage of the liquid therethrough. The lower wall of the enlargement —2— is provided with a sump —4— having a removable cap —5— to permit the removal of the foreign matter which may be lodged in the inlet end of the enlargement.

The top wall of the enlargement —2— of the intake conduit —1— is provided with an upwardly extending cylindrical float-chamber —6— having its lower end in unobstructed open communication with the interior of

the intake conduit —1—, and its upper end provided with a removable cap plate or partition —7— which is secured by bolts —8— or equivalent releasable means to the adjacent portion of the float chamber to form an air and liquid-tight joint therewith.

The cap plate or partition —7— is provided with a suction chamber —9— in open communication with the upper end of the float chamber through the medium of a multiplicity of apertures or openings —10— formed in the intermediate portion of the bottom wall of the plate —7—.

These apertures —10— are grouped in the form of a rhomb, diamond or oblong around the center of the partition —7— so that the longer and shorter axes of the group will be at substantially right angles to each other and the combined areas of the apertures will be greatest along the shorter axis and will gradually diminish toward the ends of the longer axis for a purpose hereinafter described.

The suction chamber —9— is adapted to be connected by a conduit —11— to a vacuum pump similar to that shown in my pending application, Serial No. 322,056, previously referred to, or any suitable equivalent thereof, for maintaining a partial vacuum in the chamber —9— and apertures —10—, the object of which is to withdraw air from the upper portion of the exhaust chamber and thus prevent such air from entering the centrifugal hydraulic pump.

Both of these pumps are preferably operated simultaneously through the medium of a connecting shaft, shown by dotted lines in my pending application 322,056, and therefore any air which may enter the intake pipe or which may tend to accumulate in the centrifugal pump will collect in the upper part of the float chamber —6— to be withdrawn therefrom by the vacuum pump.

When the pumping system is in operation a part of the water and air drawn into the intake conduit —1— by the centrifugal pump rises in the float chamber —6— aided by the partial vacuum maintained in the upper portion thereof. It will be understood that any air which may enter the intake will assume a position above the level of the water in the float chamber by reason of its lighter specific gravity, and that the water level in the float chamber will vary materially according to the proportionate volumes of water and air which may be taken into the intake —1— from the source of water supply, these proportionate volumes being dependent upon the amount of submersion of the mouth of the intake in the water.

A vertically elongated cylindrical float —12— is arranged within the float chamber —6— for vertical movement by the rise and fall of liquid therein, said float being provided with a plurality of, in this instance

three, external lengthwise ribs —13— cooperating with the inner walls of the chamber —6— for guiding the float in its vertical movement and at the same time to permit the water to pass upwardly from the underside between the ribs.

The float —12— may be of any suitable material, the weight of which will be substantially balanced by the liquid when the level of the latter is about half the height of the float, more or less, as indicated by the dotted line in Figure 1.

The apertures —10— in the top wall of the float chamber —6— are grouped in the manner described around the axis thereof and some distance inwardly from the side walls of the chamber —6—, as shown more clearly in Figure 2, in which the group is somewhat diamond-shaped with one axis longer than the other, for a purpose presently described.

The apertures —10— of the entire group are controlled by an underlying flexible diaphragm valve —14— of somewhat greater area than said group, and is preferably oblong in the direction of length of the longer axis of the group and has its opposite ends secured by rivets —15— or equivalent fastening means to the corresponding ends of an underlying supporting frame —16—, leaving the intermediate portions thereof free to flex vertically and of sufficient area to close all the apertures —10— when the float —12— is in its extreme upper position, as shown more clearly in Figure 5.

The valve-supporting frame —16— is yieldingly supported from the top wall —7— of the float chamber —6— by means of bolts —17— and coil springs —18—, the bolts —17— being passed through registering apertures in the adjacent portions of the frame —16— and valve —14— and being secured at their upper end to the top wall —7— at opposite ends of the group of apertures —10—, said bolts being extended downwardly some distance below the lower faces of the adjacent portions of the frame —16— with their heads at the lower ends thereof.

The coil springs —18— surround their respective bolts —17— and are interposed between the heads of said bolts and the lower faces of the adjacent portions of the frame —16—.

These springs are relatively light and tend to urge the frame —16— and valve —14— upwardly toward the perforated top wall —7— of the float chamber —6— to assist in closing the valve across the undersides of all of the apertures —10— when the float is raised to its extreme upper position, as shown in Figure 5.

The upper end of the float —12— is yieldingly connected to the central portion of the plate —16— by means of a coil spring —19— capable of being placed under compression when the valve —14— is completely closed by

the rise of the float —12— to its extreme upper position, as shown in Figure 5, and also capable of being placed under tension for fully opening the valve against the action of the lighter springs —18— when the float —12— recedes to its lowermost position, as shown in Figure 6.

The portion of the frame —16— underlying the intermediate portion of the valve —10— is provided with openings —20— to allow air to pass from the underside thereof through for slightly inflating the intermediate portion of the valve upwardly, aided by the constant suction maintained in the apertures —10—, so that the intermediate portion of the valve will normally assume an upwardly convex condition, as shown in Figures 1 and 6.

It therefore follows that when the float —12— is moved upwardly by the rise of water in the chamber —6—, the central portion of the valve —14— will first engage the overlying central apertures —10—. As the upward movement of the float continues, the valve will gradually close the remaining apertures from the center outwardly until all of the apertures are closed, as shown in Figure 5; at which time the spring —19— will be placed under compression while the smaller coil springs —18— will be relaxed or extended to further assure the closing of the valve from end to end.

On the other hand, after the valve has been completely closed, as shown in Figure 5, and the float —12— begins to move downwardly by the recession of the water in the chamber —6—, the spring —19— will be placed under tension to draw the frame —16— and opposite ends of diaphragm —14— downwardly against the action of the springs —18—, thereby gradually stripping the valve from the group of openings —10— from the ends toward the center of the group until all, or substantially all, of the openings —10— will be uncovered as shown in Figure 1 or in Figure 6.

Operation

When the centrifugal hydraulic pump and the vacuum pump (neither of which are shown) are in operation and the intake conduit of the hydraulic pump is connected to the body of water to be removed, such water will be drawn through the intake conduit into the pump and discharged from the latter into a suitable basin or other drainage outlet, while at the same time a partial vacuum is maintained in the upper portion of the float chamber, thereby causing more or less of the water to rise from the intake to the float chamber —6—. The screen —3— serves to prevent the passage of chips, gravel and other foreign matter into the pump without retarding the flow of water thereto.

In case the body of water to be withdrawn

is relatively shallow or insufficient to cover the mouth of the intake, it is evident that greater or less volumes of air will be drawn into the intake with the water, under which conditions the float —12— will be more or less violently reciprocated vertically by reason of the rapidly varying volumes of water and air entering the float chamber —6—. The shock of these violent movements of the float is partially absorbed by the springs —19— and —18—, thereby reducing to a minimum the transmission of these shocks or violent motions of the float to the valve —14— and its supporting plate —16—, which greatly prolongs the life of the moving parts of the apparatus and renders its operation more reliable and efficient.

This inflow of external air into the intake may also result from open joints in the intake line which would cause more or less violent action of the float and valve actuated thereby to enable such air to be timely withdrawn from the float chamber.

During this influx of the water and air into the float chamber the air will, of course, collect in the upper end of said chamber above the level of the water therein, due to its lighter specific gravity, and will be immediately withdrawn through the apertures —10— by the action of the vacuum pump.

If, however, an excess quantity of water should be drawn into the float chamber it will immediately cause the valve —14— to close all of the apertures —10— and thus positively prevent the entrance of water into the suction chamber —9— and vacuum pump connected thereto, in a manner previously explained.

It will be evident from the foregoing description that other forms of yielding connections between the float and valve may be used and that the manner of supporting the valve may also be modified without departing from the spirit of this invention.

The diaphragm valve —14— is preferably made of rubber or equivalent air and water impervious material, but may be made of any other equivalent material if desired.

The group of apertures —10— arranged in the manner shown and described constitutes in effect what may be termed an elongated port or opening which is relatively wide at the center and gradually tapers toward the ends. The valve —14— is of somewhat similar form so that when closed it will be gradually stripped from the ports from each end toward the center, thereby establishing a close regulation of the air exit from the float chamber according to the volume of air which may tend to accumulate in the float chamber or any part of the intake of the centrifugal pump,

What I claim is:—

1. The combination with a liquid-receiving chamber and a suction chamber communicat-

ing with each other, a valve controlling said communication, a support for the valve, a float in the first named chamber, and resilient connections between the float and valve support to prevent violent action of the valve under similar action of the float.

2. The combination with a liquid-receiving chamber and a suction chamber communicating with each other, a valve controlling said communication, a float in the first named chamber, and means including a coil-spring for transmitting motion from the float to said valve for opening and closing the same, and yielding means for urging the valve toward its closed position independently of said transmitting means.

3. The combination with a liquid-receiving chamber and a suction chamber communicating with each other, a valve controlling said communication, a support for the valve yieldingly mounted within the first named chamber for relative movement, a float, and yielding connections between the float and valve-support for operating the latter to open and close the valve.

4. The combination with a liquid-receiving chamber provided with a top wall having an apertured portion thereof elongated in one direction, of a flexible valve extending along the underside of said apertured portion, a float in said chamber actuated by the rise and fall of liquid therein, and connections between the float and opposite ends of the valve for gradually opening the valve from its ends toward its center as the float descends and for gradually closing the valve from its center toward its ends as the float rises.

5. The combination with a liquid-receiving chamber and a suction chamber communicating with each other, a valve controlling said communication, a float in said chamber actuated by the rise and fall of liquid therein, a movable support for the valve, and spring connections between the valve-support and float to relieve the valve from excessive shock under violent action of the float.

In witness whereof I have hereunto set my hand this 5th day of November, 1930.

THOMAS F. MOORE.