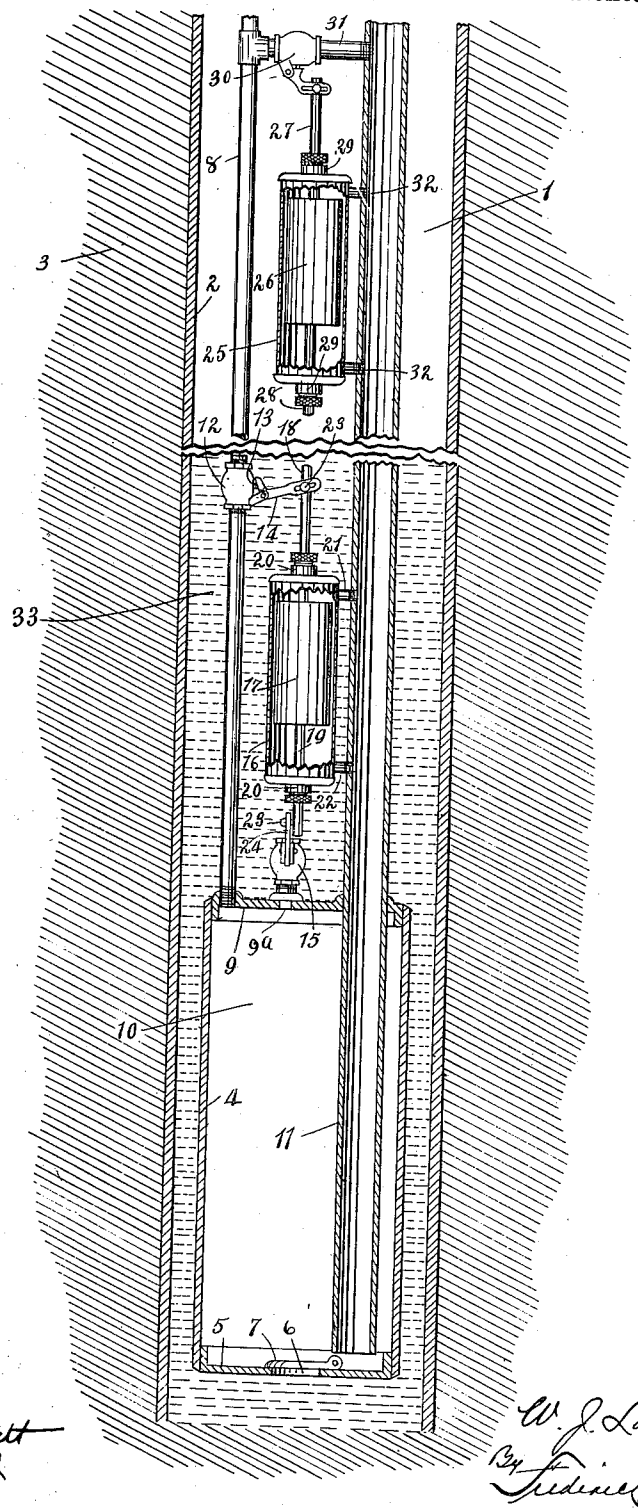
W. J. LAPWORTH.

PUMP.

APPLICATION FILED JUNE 11, 1909.

990,886.

Patented May 2, 1911.



Witnesses

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WILLIAM J. LAPWORTH, OF PITTSBURG, KANSAS.

PUMP.

990,886. Specification of Letters Patent. Patented May 2, 1911.

Application filed June 11, 1909. Serial No. 501,474.

To all whom it may concern:

Be it known that I, WILLIAM J. LAPWORTH, citizen of the United States, residing at Pittsburg, in the county of Crawford and State of Kansas, have invented certain new and useful Improvements in Pumps, of which the following is a specification.

My invention relates to pumps and refers particularly to apparatus employing compressed air as a motive power for lifting water, such appliances being commonly termed pneumatic displacement pumps.

The chief objects of the improvements which form the subject matter of this application are:—to provide a pump that will be efficient and economical in its action, simple in construction, and so arranged that its operation will be entirely automatic and continuous.

A further object of this invention is to provide means whereby air under comparatively low pressure may be used, said means consisting of relay devices arranged at various points along the discharge pipe, and cooperating with the pump to increase the velocity of the stream delivered through the discharge pipe and adding to the efficiency of the apparatus as a whole.

I accomplish the desired results by means of the apparatus illustrated in the accompanying drawing, forming a part of this application, the view showing in vertical section the lower portion of a well and casing in which is arranged a pneumatic pump embodying my improvements.

Referring to the details of the drawing, the numeral 1 indicates a well bore, 2 the casing and 3 the earth rounding and supporting the casing. Submerged at a given depth in the well is located a pump cylinder 4 of suitable capacity, and furnished in the lower head 5 with a water inlet port 6, governed by a check valve 7. An air supply pipe 8, connected at its upper end (not shown) with a supply of air under pressure, extends downward to the said pump cylinder 4, passing through the upper head 9 to communicate with the cylinder cavity 10. The said cylinder is provided with a suitable discharge pipe 11, having its lower end opening near the bottom of the cylinder, and thence extending upward through the head 9 until it reaches the point of discharge at the top of the well. The air supply pipe 8 is furnished with an automatic valve 12, having its stem 13 connected to a bell-crank lever 14, operated by mechanism hereinafter described. The upper pump cylinder head 9 is provided with an opening 9^a guarded by a relief valve 15. This valve and the said air valve 12, are simultaneously operated by an automatic device constructed as follows:—A relief cylinder 16 is arranged between the said valves and contains a float 17, having rods or stems 18, 19, projecting respectively through the upper and lower ends of the float cylinder 16, suitable stuffing boxes 20 being furnished to guard the openings in the cylinder ends through which they pass. The cavity of the float cylinder above and below the float 17 communicates with the bore of the discharge pipe 11 through short pipes 21, 22, arranged near the ends of the cylinder and tapped into the wall of the discharge pipe, thus forming supports for the said cylinder. The upper float rod 18 is operatively connected with the bell-crank lever 14, by a pin 23 which engages a slot in said lever. The lower float rod 19 is operatively connected in the same manner to a bell-crank lever 24, which is attached to the stem of the said relief valve 15.

It will be evident that the reciprocal movement of the float 17 in its cylinder, in a manner to be described, will operate both valves at the same time, and the arrangement of their mechanism and connections is such that when one valve is open the other will be closed.

At suitable intervals along the discharge pipe 11 are arranged automatic relays, whose function is to introduce fresh charges of compressed air into the discharge pipe to supplement the action of the air introduced into the pump cylinder. Only one such relay is shown in the drawing, but as many similar devices may be installed as desired. Each relay consists of a cylinder 25, in which is mounted a float 26 provided with stems 27, 28, projecting upward and downward through stuffing boxes 29, the upper stem 27 being operatively connected with a valve 30, controlling the bore of a short horizontal pipe 31, which connects the air supply pipe 8 with the water discharge pipe 11. The spaces in the cylinder 25 above and be-

low the float communicate with the discharge pipe 11 through short pipes 32, which also serve as supports for the cylinder. It will be observed that the cylinder and attachments in the above described relay apparatus is in nearly all respects similar to the previously described relief cylinder, except that in the former case there is no attachment to the lower stem 28, which has the simple office of a guide for the float, and the action of the float 26 in its ascent is to open the valve 30, while the relief float 17 closes the air valve 12 when moved upward.

To properly operate the apparatus it is necessary to have the pump cylinder 4 and the relief cylinder 16 submerged in the water, which is indicated by the reference numeral 33.

To explain the action of the pump, we will suppose the pump cylinder 4 and the relief cylinder 16 to be filled with water. The float 17 under these conditoins will be at its highest position, with the air valve 12 open and the relief valve 15 closed. If, now, air under pressure is admitted to the pipe 8, the valve 12 being open as stated, the air will displace the water in the pump cylinder, forcing it up through the discharge pipe 11. When the air in the discharge pipe reaches the level of the relief cylinder 16, it will displace the water therein, allowing the float 17 to fall, closing the air valve 12 and opening the relief valve 15, the air in the pump chamber 4 escaping through said valve 15. The pump chamber will then be again filled with water, which rushes in through the inlet port 6, and as soon as the fresh supply of water reaches the relief cylinder 16 it will enter through the lower port 22 and raise the float 17, opening the valve 12 and closing the valve 15, allowing the compressed air to again displace the water which has filled the pump cylinder. As the water passes upward through the discharge pipe it will enter the chamber of each relay cylinder 25 in succession, if there are more than one installed, the action being the same in each case, which is as follows:—the pressure of the water will raise the float 26 and open the air valve 30 connected therewith, admitting a quantity of air under pressure from the pipe 8 which will enter the discharge pipe acting upon the water therein to increase its velocity, thus economically supplementing the energy applied by the air which enters through the pump cylinder at the greater depth. A certain proportion of the air from the pump cylinder 4 will enter the pipe 11 during each cycle of operations and will ascend the said pipe so that during the operation of the appliance the ascending current will consist of portions of water alternating with pockets of compressed air, the latter expanding as higher elevations are reached. When one of these pockets arrives at the relay cylinder 25, the expanding air will drive out the water therefrom, and cause the float 26 to descend, thus closing the air valve 30 to shut off this auxiliary supply of air. The air thus introduced by the action of the relay also forms a pocket or cushion between two portions of water. In deep wells and wherever the water is to be lifted to an unusual height, the air employed as a motive force must be held under a correspondingly high pressure which requires the expenditure of a large amount of initial energy. It is for the purpose of permitting the use of air under comparatively low compression, accompanied by a corresponding reduction in the cost of production that the system of relays is installed, and the advantages of this plan will be particularly evident when air at a sufficient pressure is not available to lift the water to the required height through the medium of the pump cylinder and its immediate attachments.

Having thus described my invention, what I claim as new, is:—

1. In a pneumatic pump including a pump-cylinder having a water inlet port, a water discharge pipe, an air supply pipe and a relief port, the combination of a valve for said water inlet port, a valve for said air-supply pipe and a valve for said relief port, and means operatively connecting the valve in the air supply pipe with the relief port valve, said means comprising a cylinder communicating with said discharge pipe, a float in said cylinder and connections between said float and said valves, whereby the movements of said float will close one of said valves and open the other, and automatically operative means connected with said air-supply pipe for admitting air directly to said discharge pipe.

2. In a pneumatic pump, including a pump cylinder having a water inlet port, a water outlet pipe, and an air supply pipe, the combination of a valve in said air pipe, a relief valve in said pump cylinder, a relief cylinder having a plurality of ports communicating with said outlet pipe, a float in said relief cylinder, operative connection between said float and said valves, a relay cylinder arranged above said relief cylinder and communicating with the said outlet pipe, a passage connecting said air pipe with the outlet pipe, a relay valve in said passage and a float in said relay cylinder operatively connected with the relay valve.

3. In a pneumatic pump, the combination with a pump cylinder having a valve controlled water inlet port, a water outlet pipe and an air inlet pipe, of means for alternately admitting air under pressure to the pump cylinder and removing it therefrom, and a relay for intermittently admitting air under pressure to the water outlet pipe, said

relay comprising a passage connecting the said air inlet pipe with the water outlet pipe, an air valve controlling said passage, a cylinder communicating with the said water outlet pipe, a float in said cylinder, and connection between said float and said air valve.

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

WILLIAM J. LAPWORTH.

Witnesses:
A. H. McCormick,
E. E. Coulter.