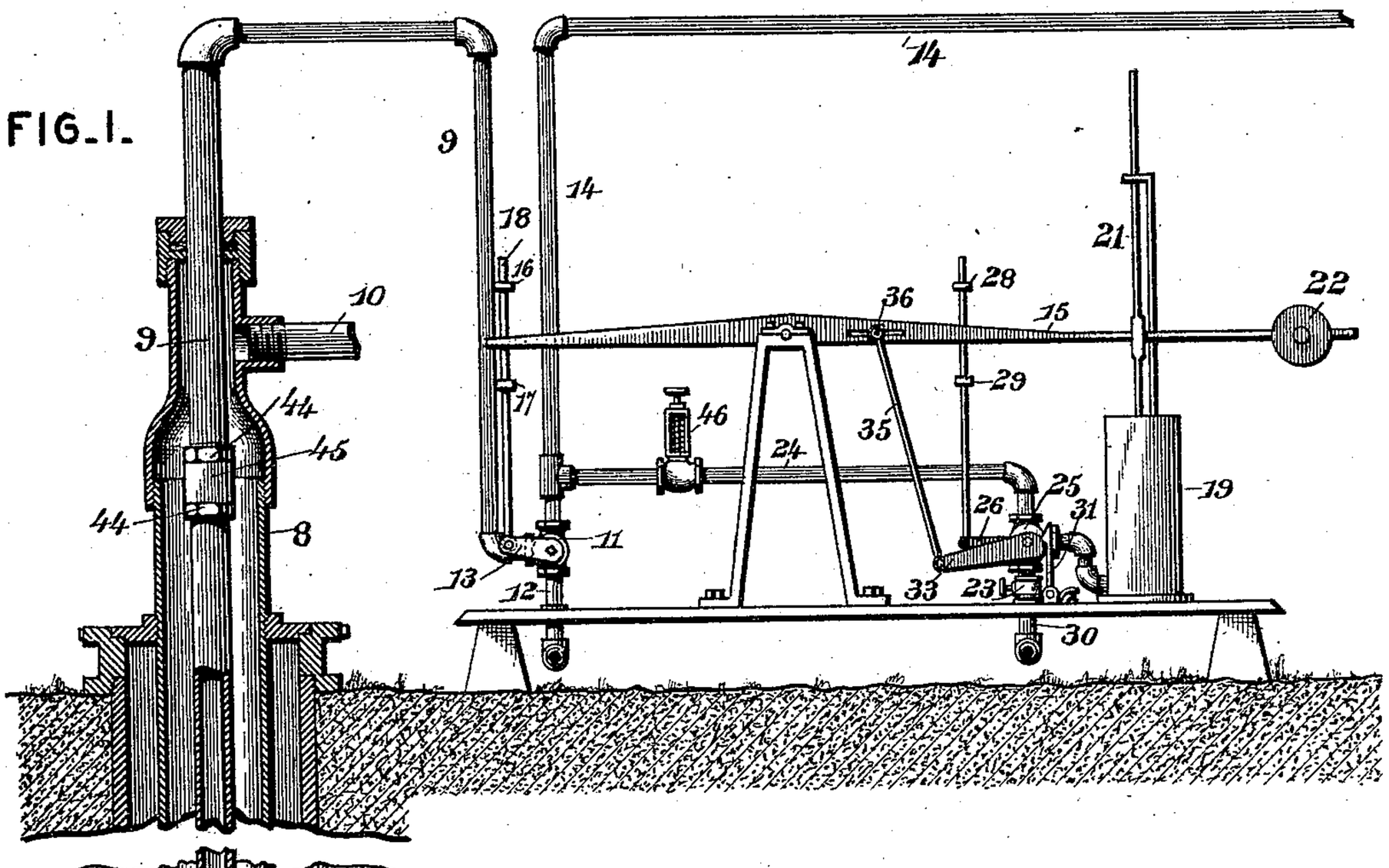
(No Model.) 2 Sheets—Sheet 1.

W. E. KARNS.

AIR FORCE PUMP.

No. 575,117. Patented Jan. 12, 1897.

FIG. 1.



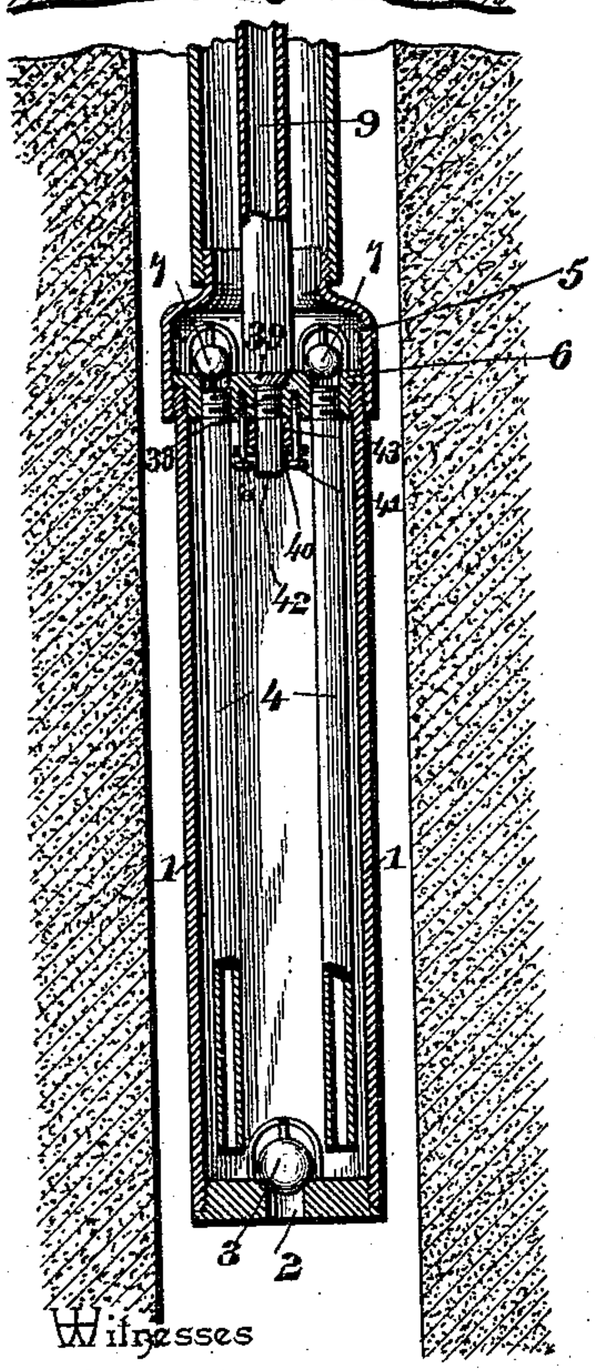


FIG. 3.

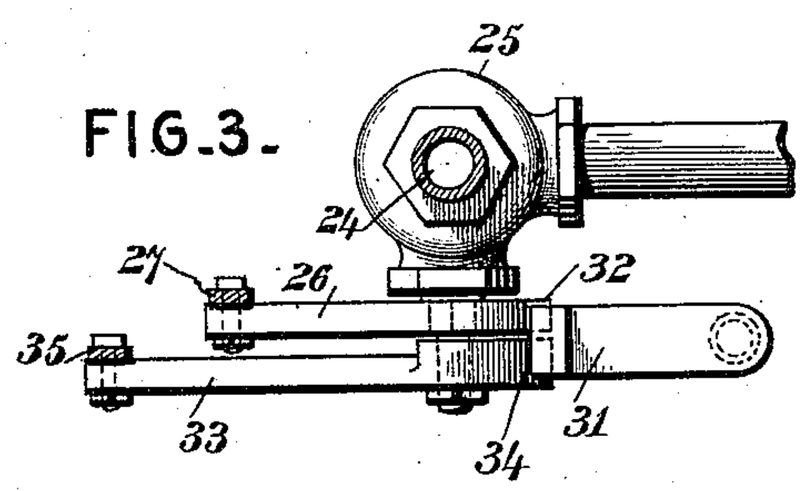


FIG. 4.

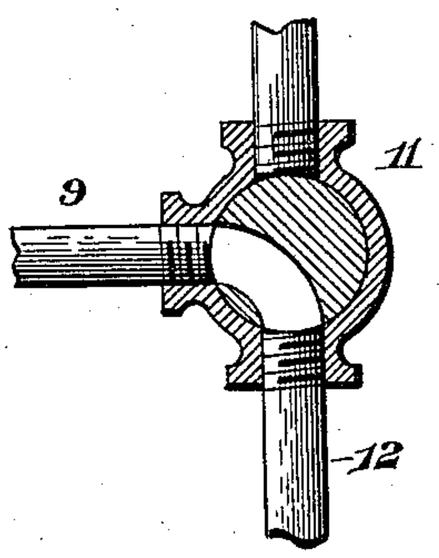
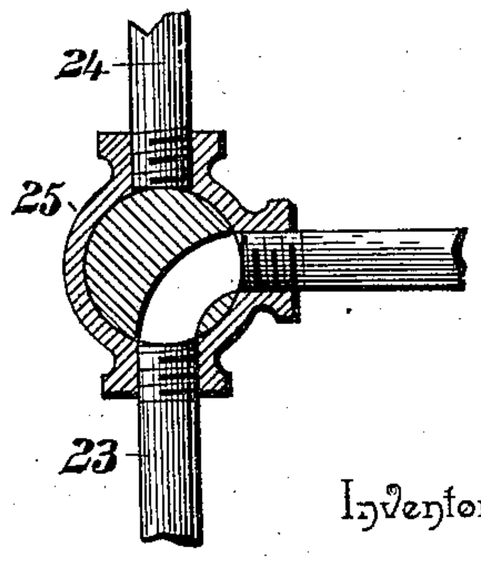


FIG. 5.



Inventor

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By his Attorneys,

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Witnesses

Jas. K. McCathran

O. E. Doyle

(No Model.) 2 Sheets—Sheet 2.

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AIR FORCE PUMP.

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FIG. 6.

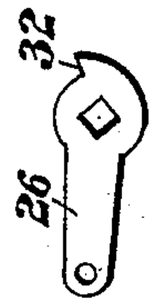

FIG. 2.

Witnesses

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UNITED STATES PATENT OFFICE.

WILLIAM E. KARNS, OF PARKER'S LANDING, PENNSYLVANIA.

AIR FORCE-PUMP.

SPECIFICATION forming part of Letters Patent No. 575,117, dated January 12, 1897.

Application filed May 15, 1896. Serial No. 591,690. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM E. KARNS, a citizen of the United States, residing at Parker's Landing, in the county of Armstrong and State of Pennsylvania, have invented a new and useful Air Force-Pump, of which the following is a specification.

My invention relates to pumps of that class in which liquid is elevated by the direct pressure of air thereon without intervention of plungers or operating mechanism; and the object in view is to provide such an arrangement of parts as to insure the proper application of a heavy fluid-pressure to elevate liquid from any desired depth without the risk of the pressure fluid "blowing through" the liquid; and, furthermore, to provide valve mechanism and operating devices for automatically controlling the application of fluid-pressure to allow intervals of any desired length to give time for the refilling by gravity of the pump barrel or cylinder, the periods of application of pressure being regulated to agree with the rapidity of "flow" of the liquid to be elevated.

Further objects and advantages of this invention will appear in the following description, and the novel features thereof will be particularly pointed out in the appended claims.

In the drawings, Figure 1 is a view of a pump mechanism constructed in accordance with my invention, the pump cylinder or barrel, the lift-pipe, and contiguous parts being shown in section, the valve mechanism being shown in the position assumed thereby while the pump is in operation or during the application of pressure to the contents of the pump-barrel. Fig. 2 is a detail view of the valve-operating mechanism, showing the positions of the parts when the pump is at rest or during the interval allowed between strokes for the refilling of the pump-barrel by gravity, the parts having just reached the positions necessary to close the air-pressure valve. Fig. 3 is a detail plan view of the means for controlling the cylinder inlet-valve. Fig. 4 is a detail sectional view of the fluid-pressure-controlling valve in the position which it occupies in Fig. 2. Fig. 5 is a similar view of the cylinder inlet-valve in the position occupied in Fig. 2. Fig. 6 is a detail view of the operating-arm of the cylinder inlet-valve.

Similar numerals of reference indicate corresponding parts in all the figures of the drawings.

1 designates a pump barrel or cylinder, which is adapted to be of any desired capacity to suit the rapidity of flow of the well, the same having at its outer end an inlet-port 2, controlled by a gravity check-valve 3, which is inwardly opening to allow the entrance of liquid into the barrel. Preferably arranged with their open lower extremities contiguous to the lower end of the barrel are lift-tubes 4, having valved connection with a chamber 5 at the upper end of the barrel and cut off from direct communication with the latter by means of a partition 6. Said lift-tubes are fitted in suitable openings in the partition, and in the construction illustrated are provided with upwardly or inwardly opening check-valves 7.

In communication with the chamber 5 is a lift-pipe 8, and preferably extending axially through the lift-pipe is a fluid-pressure pipe 9. The fluid-pressure pipe communicates directly with the pump-barrel, whereby when the latter has been filled with liquid the pressure is applied directly to the upper surface thereof to force the liquid upwardly through the lift-tubes 4 and into the receiving-chamber 5, from which it passes upwardly through the lift-pipe 8 to the discharge-pipe 10.

After the application of pressure during an interval sufficient to exhaust the pump-barrel by forcing the liquid through the lift-pipe it is necessary to cut off the supply of pressure fluid and allow the same to escape freely from the pump-barrel through the fluid-pressure pipe, and thus permit the inflow of liquid into the pump-barrel, and the means which I employ for controlling the application and reduction of pressure in the barrel includes a fluid-pressure valve 11 of three-way construction, which is introduced at an intermediate point of the fluid-pressure pipe and is in communication with an exhaust-pipe 12, as shown clearly in Fig. 4. In Fig. 1 the crank-arm 13 of the valve is shown in its elevated position, whereby the valve is disposed to open communication through the fluid-pressure pipe,

and thus apply pressure to the surface of the liquid in the pump-barrel, while in Fig. 2 a reversed position of said parts is shown, wherein the arm 13 is depressed to cut off communication through the fluid-pressure pipe and open communication between the same and the exhaust-pipe 12 to allow air to escape from the pump-barrel during the influx of liquid. The supply-pipe 14 is adapted to be connected with a condenser or fluid-pressure-supply apparatus of any desired construction. (Not shown.)

The means which I have illustrated in the drawings for accomplishing the automatic operation of the fluid-pressure-controlling valve 11 includes an operating-lever or walking-beam 15, arranged to coöperate with spaced tappets 16 and 17, arranged upon the valve-rod 18, the engagement of said operating-lever or walking-beam with the tappets at the ends of its swing being sufficient to reverse the position of the valve at intervals corresponding with the period of vibration of the lever. The period of vibration of the lever is controlled by a cylinder 19, in which operates a piston 20, having its rod 21 connected to the other arm of the lever or walking-beam to move said lever in one direction, and a return device, such as a weight 22, to move the lever in the opposite direction and at the same time depress the piston in the cylinder 19. The weight 22 is adjustably mounted upon the long arm of the lever or walking-beam to provide for varying the rapidity of depression of said long arm of the lever, and hence vary the length of the interval during which the fluid-pressure-controlling valve is closed to allow the refilling of the pump-barrel. This interval is regulated to suit the rapidity of flow of the well. In addition to the adjustment of the weight to control the period of rest of the pump mechanism, I employ an adjustable exhaust valve or cock 23 of any desired construction to control the rapidity of exhaust from the cylinder during the downstroke of the piston.

The means which I employ for elevating the piston in the cylinder 19 and thus closing the fluid-pressure-controlling valve are actuated by the fluid-pressure employed for elevating the liquid, and for this purpose a cylinder feed-pipe 24 extends from the fluid-pressure-supply pipe to the cylinder below the piston and is provided at an intermediate point with a cylinder-inlet-controlling valve 25, having an arm 26, to which is connected a stem 27, having upper and lower tappets 28 and 29, between which operates the long arm of the lever or walking-beam 15. When the stem 27 is at the limit of its upward movement, to which it has been elevated by the upward movement of the piston 20, the cylinder-inlet-controlling valve 25 has opened communication between the cylinder and the exhaust 30, in which is arranged the exhaust-controlling cock 23, this position of the parts being illustrated in Figs. 2 and 5, and as the pressure is thereby relieved at the under side of the piston the latter is allowed to be depressed by the return device, which in the construction illustrated consists of the weight 22. The arm 26 is arranged in operative relation with locking devices to maintain it in said elevated position, with the valve open to the exhaust, said locking devices in the construction illustrated consisting of a spring-actuated locking arm or latch 31 for engaging a shoulder or offset 32 on the arm 26, and the parts retain these positions until the piston has reached the limit of its downward movement. In order that the reversal of the cylinder-inlet-controlling valve may be accomplished quickly, I employ trip mechanism consisting of a trip-lever 33, having a cam-face 34 arranged in operative relation with the locking arm or latch 31, and a pitman or connecting-rod 35 between said trip-arm and the long arm of the operating-lever or walking-beam. The connection between the rod 35 and the walking-beam is preferably adjustable, as shown at 36, whereby the tripping of the latch may be accomplished at the desired point in the movement of the walking-beam.

In order to provide for the removal of the fluid-pressure-supply pipe without affecting the tubing, I provide a reduced threaded extension 38 at the lower end of the supply-pipe to fit in the opening in the partition 6, and also provide said pipe with a contiguous ground-surface 39, of conical shape, for fitting in a similar seat in said partition. Under ordinary circumstances this connection is sufficient to prevent leakage, but as an additional safeguard I may employ a packing device including a movable pressure or packing plate 40, arranged below the plane of the partition or head 6 upon guide-pins 41 and around an extension 42 of the supply-pipe below the plane of said partition or head, packing 43 being interposed between the upper side of said packing-plate and the under surface of the partition or head, whereby when fluid-pressure is applied to the interior of the pump-barrel said plate is forced upwardly to compress the packing material. In order to provide for threading the lower extremity into and out of the opening or seat in the partition or head, the couplings between contiguous sections of said pipe are fitted with jam-nuts 44 to bear against the extremities of the coupling-sleeve 45.

This being the construction of the apparatus, it will be seen that the operation, briefly stated, is as follows: With the parts in the positions indicated in Fig. 1, in which the fluid-pressure-controlling valve is open to the supply and the cylinder-inlet-controlling valve is also open to the supply to admit pressure to the cylinder, the air will be applied to the surface of the liquid in the pump-barrel and will force it upwardly through the lift-tubes and pipe. This operation will continue until the piston has reached the limit of its upward movement and has caused the con-

tact of the operating-lever or walking-beam with the tappets 17 and 28, thus closing the controlling-valves to the supply and opening them to the exhaust, the cylinder-inlet-controlling valve being locked in this position by means of the latch 31 to prevent premature movement. This arrangement of parts is illustrated in Figs. 2, 4, and 5. The pump-barrel will now be filled with liquid by gravity, the inflow of liquid forcing the air out through the air-supply pipe 9 and the exhaust 12. During this period of rest of the pump mechanism the piston 20 is descending by gravity or equivalent force, controlled by the amount of discharge permitted through the exhaust-controlling cock 23 and the position of the weight 22, and when said piston has reached the limit of its downward movement the trip mechanism disengages the latch 31 from the cylinder-inlet-controlling-valve mechanism and allows the parts to resume the positions shown in Fig. 1.

Inasmuch as less pressure is necessary for operating the cylinder-piston 20 than is required for the elevation of the liquid, I preferably introduce a pressure-reducer 46 of ordinary construction at an intermediate point of the feed-pipe.

Where a series of wells are arranged for operation from a given supply of fluid-pressure and where the operation of the pumps in connection with the several wells is intermittent owing to the slowness of flow thereinto, the valve mechanism may be dispensed with, in order that the controlling-valve may be adjusted manually at intervals. In other words, where the interval required for filling the pump-barrel is excessive owing to the slowness of flow it is desirable to dispense with the valve mechanism and manipulate the valves as required by hand.

Various changes in the form, proportion, and the minor details of construction may be resorted to without departing from the spirit or sacrificing any of the advantages of this invention.

Having described my invention, what I claim is—

1. Fluid-pressure pumping apparatus having a pump-barrel provided at its lower end with a valved inlet-port and provided near its upper end with a transverse partition forming a superjacent receiving-chamber, valved lift-tubes supported by said partition in communication at their upper ends with the receiving-chamber and at their lower ends with the pump-barrel contiguous to its inlet-port, a lift-pipe communicating with the receiving-chamber, a fluid-pressure-supply pipe removably seated upon the said partition in communication with the pump-barrel and adapted to be unseated to allow the withdrawal of the supply-pipe without disturbing the well-tubing or pump-barrel, said supply-pipe having a conical ground surface to fit a corresponding surface on the partition, and valve mechanism for controlling the application of pressure through the supply-pipe, substantially as specified.

2. Fluid-pressure pumping apparatus having a pump-barrel provided at its lower end with a valved inlet-port and at its upper end with a transverse partition or head forming a superjacent receiving-chamber, valved lift-tubes arranged within the pump-barrel and connecting the interior of the body portion thereof with the receiving-chamber, a lift-pipe in communication with the receiving-chamber, and a fluid-pressure-supply pipe extending axially through the lift-pipe and removably fitted in a seat in said partition to communicate with the interior of the pump-barrel, said supply-pipe being removable from and replaceable in the well without disturbing the lift-pipe or pump-barrel, substantially as specified.

3. Fluid-pressure pumping apparatus having a pump-barrel, lift-pipe, and air-supply pipe through which pressure is adapted to be applied at intervals, and valve mechanism for controlling the application of pressure, said valve mechanism including an air-pressure-controlling valve adapted to open communication with the air supply and exhaust alternately, an operating-lever or walking-beam arranged in operative relation with tappets carried by a stem of the fluid-pressure-controlling valve, and means controlled by fluid-pressure for oscillating said lever or walking-beam, said means including other valve mechanism connected to the walking-beam, substantially as specified.

4. Fluid-pressure pumping apparatus having a pump-barrel, lift-pipe, and air-supply pipe through which pressure is adapted to be applied at intervals, and valve mechanism for controlling the application of pressure, said valve mechanism including a fluid-pressure-controlling valve, an operating-lever or walking-beam arranged in operative relation with tappets carried by the stem of said valve, a cylinder in communication with a feed-pipe connected with the fluid-pressure-supply pipe, a piston operating in the cylinder and connected with the operating-lever or walking-beam, means for depressing the piston, and cylinder valve mechanism operatively connected with the walking-beam and including a valve controlling the cylinder inlet and exhaust, substantially as specified.

5. Fluid-pressure pumping apparatus having a pump-barrel and a lift-pipe, fluid-pressure-supply pipe, a fluid-pressure-controlling valve adapted to connect the pump-barrel with an exhaust, an operating-lever connected with the controlling-valve, a cylinder having a feed-pipe in communication with the fluid-pressure supply, a piston connected with the operating-lever, means for returning the piston to its initial position, and cylinder valve mechanism including a controlling-valve arranged in the feed-pipe and adapted to connect the cylinder with an exhaust, a valve-stem having tappets arranged in the path of

the operating-lever, locking mechanism for securing said valve in one position, and trip mechanism controlled by the operating-lever for releasing a valve, substantially as specified.

6. Fluid-pressure pumping apparatus having a pump-barrel and a lift-pipe, fluid-pressure-supply pipe, a fluid-pressure-controlling valve adapted to connect the pump-barrel with an exhaust, an operating-lever connected with the controlling-valve, a cylinder having a feed-pipe in communication with the fluid-pressure supply, a piston connected with the operating-lever, means for returning the piston to its initial position, and cylinder valve mechanism including a controlling-valve arranged in the feed-pipe and adapted to connect the cylinder with an exhaust, a valve-stem having tappets arranged in the path of the operating-lever, locking mechanism for securing said valve in one position, and trip mechanism controlled by the operating-lever for releasing the valve, said trip mechanism including a cam-lever arranged in operative relation with the locking devices, a connecting-rod between the trip-lever and the operating-lever, and adjustable means for attaching the rod to said lever, substantially as specified.

7. Fluid-pressure pumping apparatus having a pump-barrel and a lift-pipe, fluid-pressure-supply pipe, a fluid-pressure-controlling valve adapted to connect the pump-barrel with an exhaust, an operating-lever connected with the controlling-valve, a cylinder having a feed-pipe in communication with the fluid-pressure supply, a piston connected with the operating-lever, means for returning the piston to its initial position, and cylinder valve mechanism including a controlling-valve arranged in the feed-pipe and adapted to connect the cylinder with an exhaust, a valve-stem having tappets arranged in the path of the operating-lever, locking mechanism for securing said valve in said position and consisting of a spring-latch for engaging a shoulder on the valve, and trip mechanism including a cam-lever arranged in operative relation with the latch and operatively connected with the lever, substantially as specified.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

W. E. KARNS.

Witnesses:
E. G. SIGGERS,
J. H. SIGGERS.