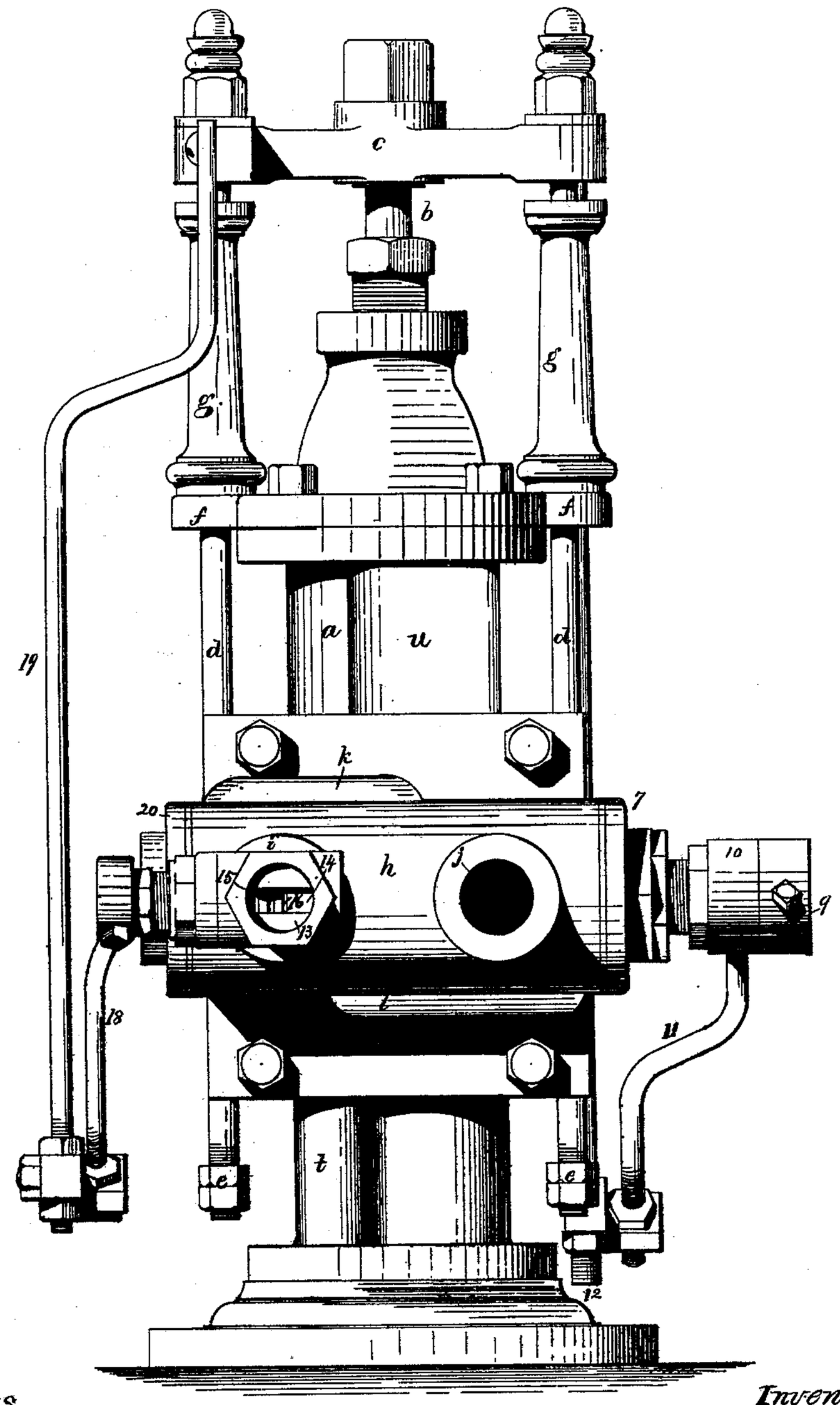
2 Sheets—Sheet 1.

W. O. WAKEFIELD.

HYDRAULIC ENGINES.

No. 195,314. Patented Sept. 18, 1877.

Fig. 1.



Witnesses.
L. H. Latimer.
C. C. Perkins.

Inventor.
William O Wakefield.
per Crosby & Gregory Attys

2 Sheets—Sheet 2.

W. O. WAKEFIELD.

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Fig. 2.

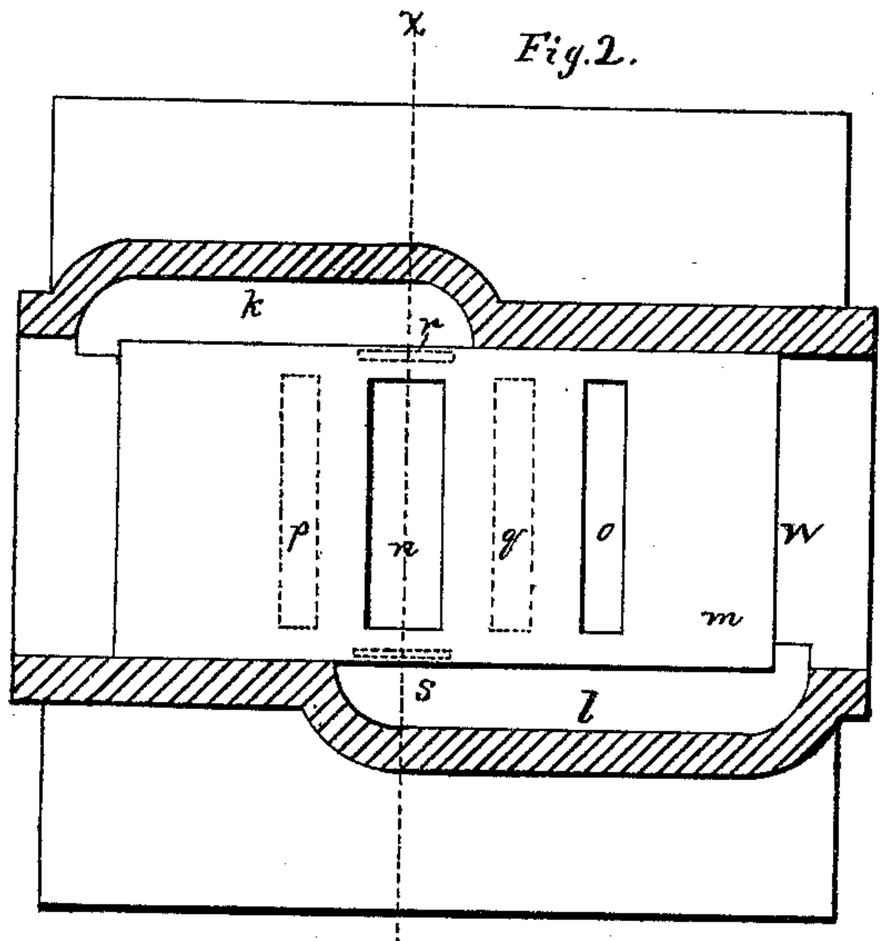


Fig. 3.

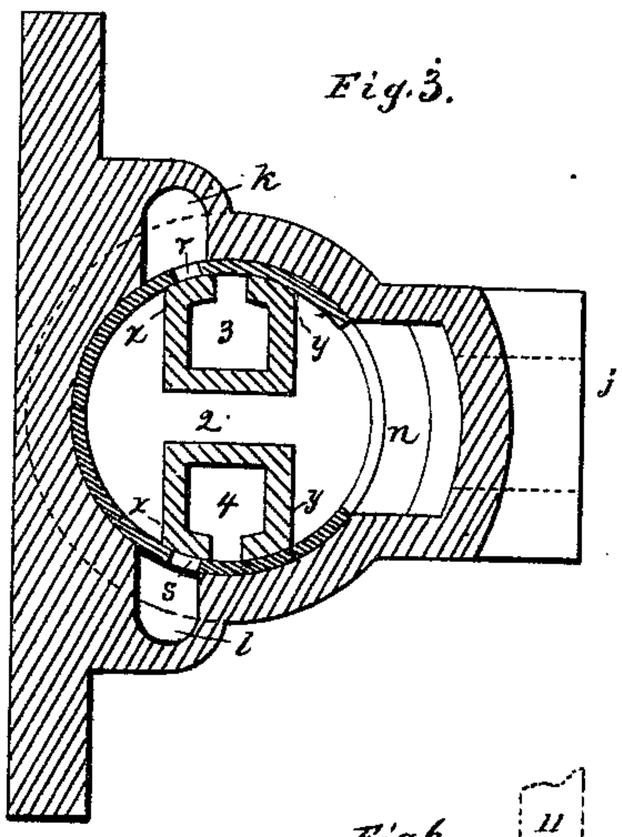


Fig. 4.

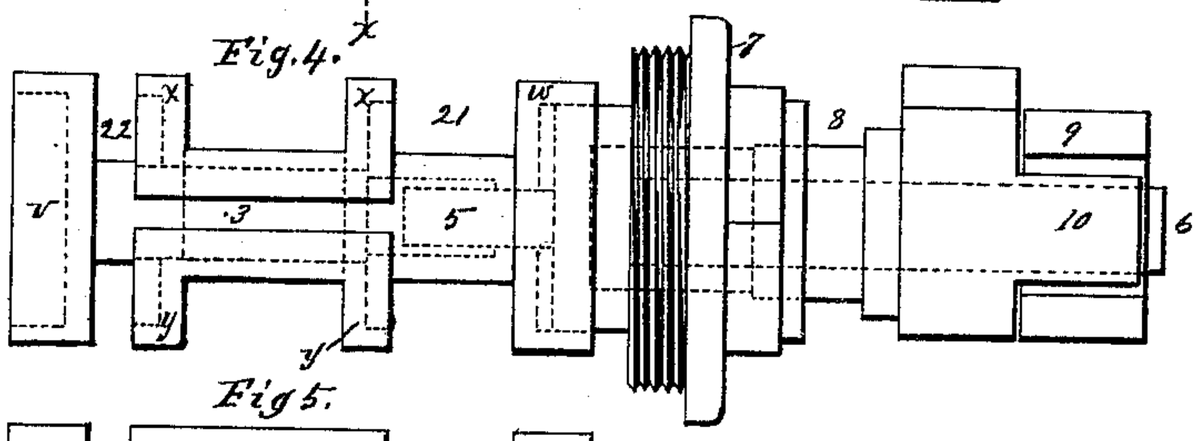


Fig 5.

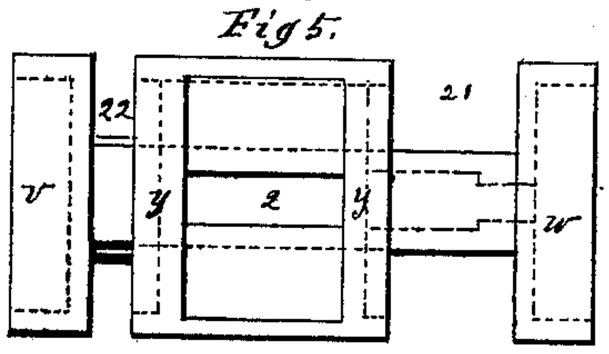


Fig. 6.

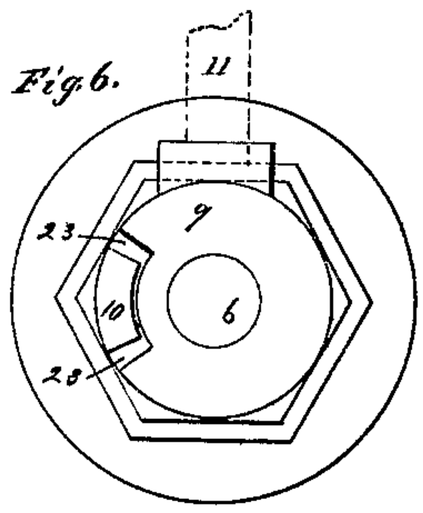


Fig. 7.

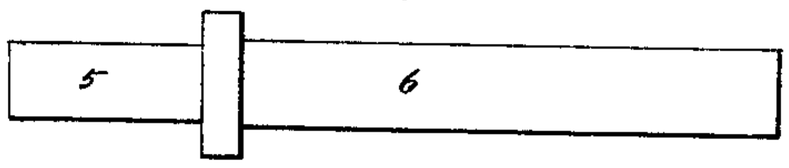
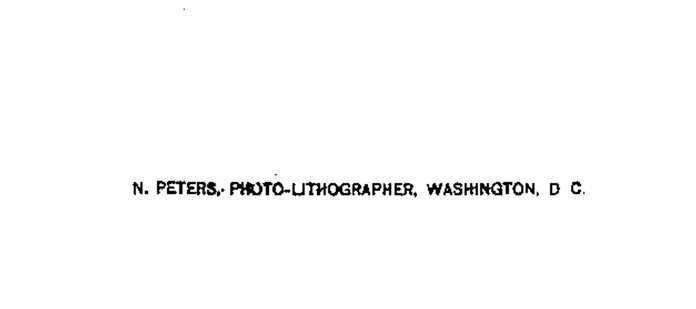


Fig. 8.



Witnesses.
L. C. Latimer.
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Inventor
William O. Wakefield
per Crosby & Gregory. attys.

UNITED STATES PATENT OFFICE.

WILLIAM O. WAKEFIELD, OF BOSTON, MASSACHUSETTS.

IMPROVEMENT IN HYDRAULIC ENGINES.

Specification forming part of Letters Patent No. **195,314**, dated September 18, 1877; application filed May 19, 1877.

To all whom it may concern:

Be it known that I, WILLIAM O. WAKEFIELD, of Boston, in the county of Suffolk and State of Massachusetts, have invented an Improved Hydraulic Engine, of which the following is a specification:

This invention relates to hydraulic engines of the class employing rotary reciprocating valves to control the flow of water to operate the main piston. Such valves are shown in United States Patents Nos. 102,948 and 112,722.

One object of this invention is to so construct a valve of this class that the pressure of the water will cause it to bear equally against the walls of the chamber in which it is moved, instead of unequally, as heretofore. To do this I have provided the valve with a transverse central passage, in order that its pressure may be balanced by the water, and I have also added to it longitudinal passages to convey the exhaust water from below the main piston to an exhaust-port communicating with the main outlet of the machine. I have also placed one of the heads of the auxiliary piston sufficiently far from one end of the valve to thereby form a passage wide enough to remain in constant communication with the exhaust-port of the engine, in order that the exhaust water above and below the main piston may constantly flow from one port.

The water admitted to the valve-cylinder enters through an inlet-valve operated in any suitable way, preferably through an adjustable connection with the main piston, whereby the quantity of water admitted to the engine is gradually increased and diminished, according to the position of the main piston within its cylinder. This construction enables the main piston to be moved faster or slower at portions of its stroke, and permits the piston to be moved rapidly without liability to shock at the ends of its stroke. I have also provided the inlet-valve, operated by the main piston, with a series of grooves or auxiliary water-passages, separate from its main passage, in order that the water shall never be wholly shut off by the opening or closing movement of the inlet-valve. This is done so that should the main piston, which is adjusted to move a certain distance, according to the work to be accomplished, for any cause be moved farther than was intended, sufficient water would enter at the inlet-valve to reverse the main valve, and consequently the main piston.

Figure 1 represents, in front elevation, one of my improved engines; Fig. 2, a longitudinal section through the valve-chamber, looking toward the main piston, but showing the lining in elevation, the ports upon its rear side being shown in dotted lines; Fig. 3, a transverse section of such valve-chamber and valve on dotted lines *x x*, Fig. 2; Fig. 4, an elevation of the top of the valve and auxiliary piston, such figure also showing one of the heads of the valve-chamber and the rocking shaft to move the valve axially; Fig. 5, a front view of the auxiliary piston, showing the valve counterpart; Fig. 6, an end view of mechanism to move the valve axially; Fig. 7, a separate view of the rod which carries the valve; and Fig. 8, a sectional detail, showing the inlet-valve in elevation.

The main cylinder *a* is provided with a piston-rod, *b*, it having at its lower end a piston fitting such cylinder in any usual way. Attached to this piston is a cross-head, *c*, carrying at its outer ends rods *d*, provided at their lower ends with suitable nuts *e*, to check the upward movement of the cross-head and piston in case of obstruction in the valve-chamber, the nuts then striking the ears *f*. These rods are provided with columns *g*, resting on ears *f*, to check the downward motion of the piston under similar circumstances.

The valve-chamber *h* has an inlet, *i*, and an outlet, *j*, and water-passages *k l*. Inside the chamber is a lining, *m*, provided at its front side with an inlet-port, *n*, and with an exhaust-port, *o*, the port *n* communicating with the inlet *i*. At the rear of the lining *m* are ports *p q r s*, port *p* communicating with the main cylinder below the piston-head through a passage, *t*, and port *q* communicating therewith above the piston by a passage, *u*. The passages *t* and *u* are shown as cast upon the main cylinder. The port *r* permits water to pass through it and the passage *k* to the end *v* of the auxiliary piston, and the port *s* admits water through passage *l* to the end *w* of the auxiliary piston. This auxiliary piston is

provided between its heads or ends *v w* with a valve, *x*, and opposite it is a valve counterpart, *y*, the function of the latter being to come in contact with that side of the lining opposite that upon which the valve works, to open and close the ports *p q r s*. This valve is provided with a transverse central opening, 2, to permit the passage of the water from the valve counterpart through to the opposite side of the axis of the valve into the valve proper. The valve and valve counterpart are separated by water-passages 3 4, to permit exhaust water to pass from below the main piston, through port *p* and passages 3 4, to port *o* and outlet *j*.

The auxiliary piston, at the end next head *w*, is provided with an angular opening (shown in dotted lines, Figs. 4, 5) to receive the end 5 of a rod, 6, which extends through the head 7 of the valve-chamber, and through the stuffing-box 8, of usual construction, where it has attached to its end the fixed part 9 of a clutch, the movable part 10 of the clutch also surrounding such shaft, and being connected by arm 11 with a rod, 12, connected with the cross-head, the connection between the arm 11 and rod 12 being adjustable.

Water to drive the engine is admitted through a valve, 13, provided with a plug, 14, having an irregular central passage, 15, and other auxiliary water-passages, 16, in this instance shown as made annularly about the plug. The stem 17 of this plug has attached to it an arm, 18, adjustably connected with a rod, 19, attached to the cross-head.

When the piston is down, as in Fig. 1, water will enter through the partially-closed opening 15, inlet *i*, port *n*, then into the valve counterpart *y* through passage 2, thence into the valve *x* and port *p*. The head *v* of the valve, then being next the head 20 of the outer chamber, (see Fig. 1,) permits the water to pass through passage *t* to the under side of the main piston.

As the piston rises it, through rod 12 and arm 11, rotates the rod 6 and the valve sufficiently far to open port *r*, communicating with passage *k*, and the water then flows to the end *v* of the auxiliary piston, and reciprocates it, so that its end *w* comes to the head 7 just at or about the time that the main piston completes its upstroke. As the piston was raised the water above it was forced downward through the passage *u*, out through port *q* into the wide passage 21 between the valve and head *w*, thence through port *o* and outlet *j*.

The exhaust water between end *w* and head 7, during the before-described reciprocation of the valve, was forced through passage *l*, port *s*, into passage 4, and thence into the wide opening 21, and through port *o*, with the other exhaust water.

The end *w* of the auxiliary piston, having reached the head 7, as described, has uncovered the port *q*, which permits water to pass from the valve through passage *u* to the upper side of the main piston, which then descends, and just before or as it reaches its lowest position it, through its connections, rotates the valve *x*, so as to uncover the port *s*, when water passes therethrough into passage *l*, and, acting against the head *w*, moves the auxiliary piston and valve in the opposite direction, the exhaust water in the valve-cylinder, and in advance of end *v*, passing through passage *k*, and port *r* into passage 3 of the valve and thence into the wide passage 21, where it meets the exhaust water from below the main piston, it flowing through passage *t*, port *p*, opening 22, thence along passages 3 and 4 to the wide opening 21, and out at the port *o* and outlet *j*.

The space 23 between the fixed and movable parts 9 10 of the clutch (see Fig. 6) permits the necessary amount of lost motion to release the valve from being rotated constantly.

The plug 14 of the inlet-valve, through the arm 18 and rod 19, is turned as the cross-head is raised and lowered, the opening 15 being thereby gradually covered and uncovered more or less, to gradually increase and diminish the flow of water, the water moving the piston increasing gradually until the piston approaches the end of its stroke, when it is gradually diminished.

The grooves 16, or equivalent passages in the inlet-valve, provide for the passage of some water, even though the passage 15 was completely closed, such grooves admitting enough water to reverse the valve and start the main piston.

If desired, the so-called inlet-valve may be applied with equal advantage to the outlet, to check the flow of exhaust water, which, in operation, is equivalent to checking the supply.

Instead of this rotating inlet-valve, a reciprocating plate-valve with large and small openings may be employed.

I claim—

1. The combination, with a hydraulic engine, of a valve to gradually check the flow of water, to permit the piston to be operated with a less head of water at the ends of its strokes, substantially as described.

2. The combination, with a hydraulic engine, of a valve provided with grooves or auxiliary water-passages, to permit sufficient water to flow continually therethrough to start the main and auxiliary pistons, substantially as described.

3. The inlet-valve and its arm, in combination with the rod 19, adapted to be raised and lowered by the cross-head to automatically lessen and increase the volume of water admitted to the main piston at each movement, substantially as described.

4. The combination of the valve-cylinder and its ports *o q* with the auxiliary piston and valve, the end *w* of the piston being removed far enough from the valve to provide a passage of sufficient width to communicate with the ports *o q*, substantially as described.

5. The valve *x* and its valve counterpart, constructed substantially as described, and provided with passages 2 3 4 between them, to operate substantially as set forth.

6. The auxiliary piston provided with the rotary reciprocating valve, the valve counterpart, and the passages 2 3 4, in combination with the valve-chamber provided with ports *n o p q r s*, to operate substantially as described.

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

WILLIAM O. WAKEFIELD.

Witnesses:
G. W. GREGORY,
S. B. KIDDER.