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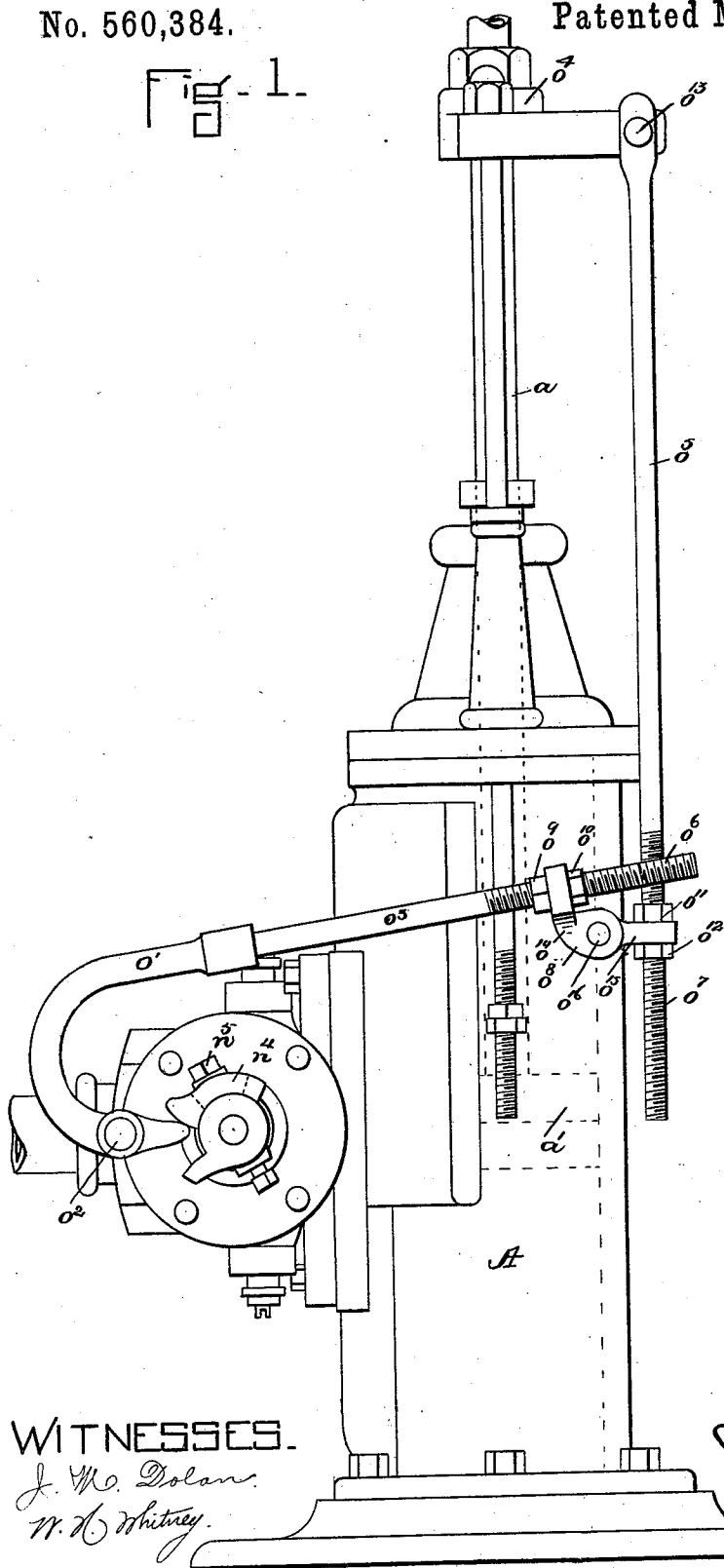
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F. E. WHITNEY.
HYDRAULIC ENGINE.

No. 560,384.

Patented May 19, 1896.

Fig-1-



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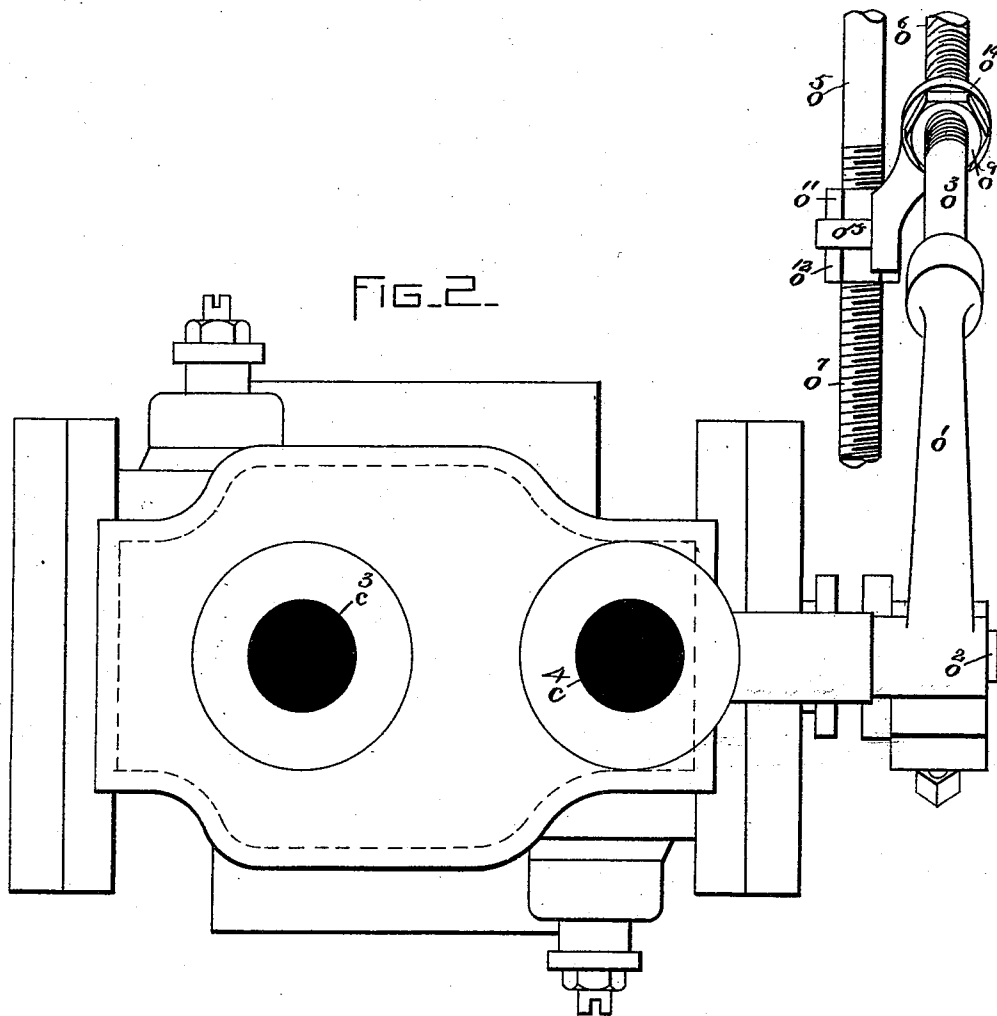
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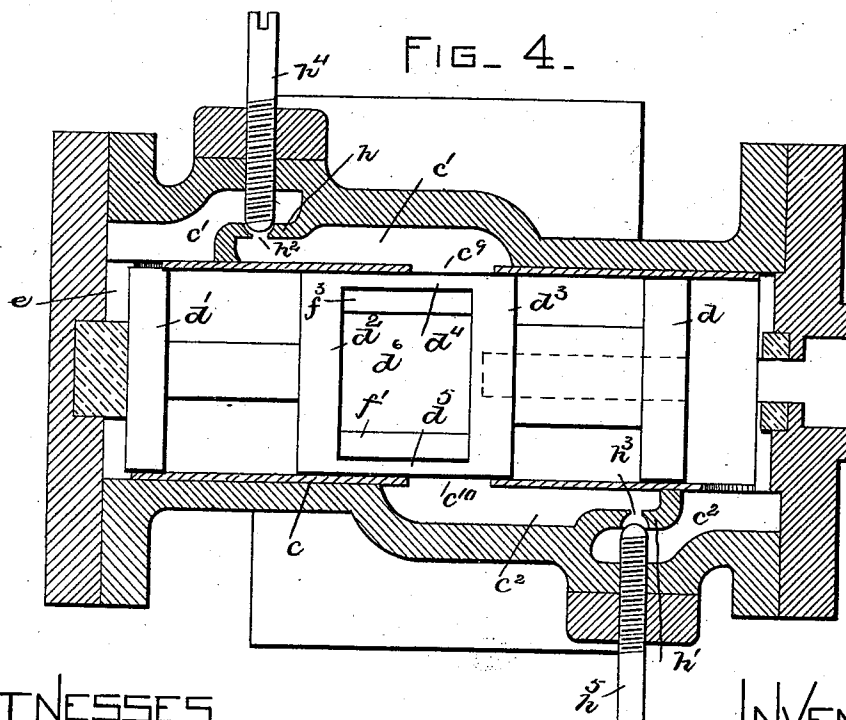
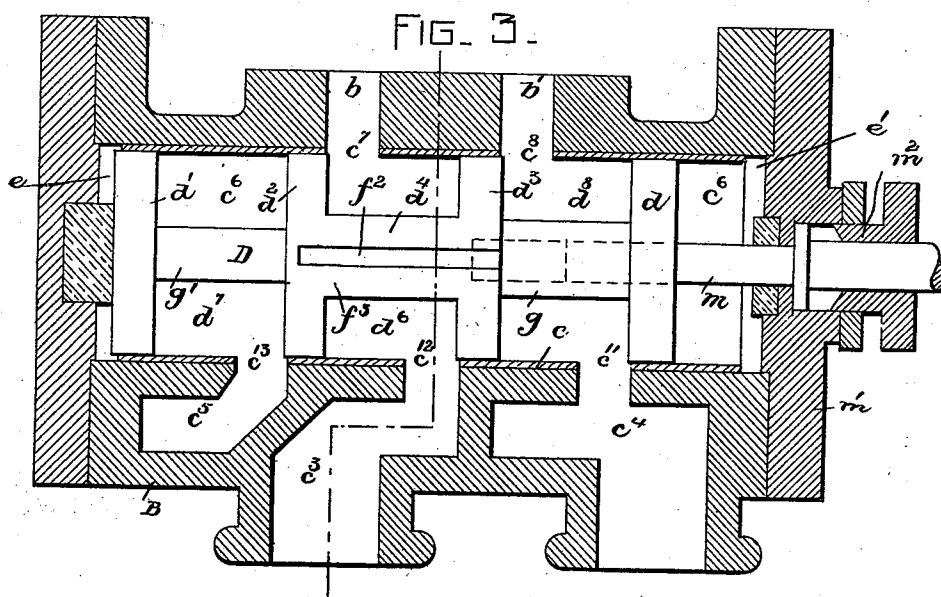
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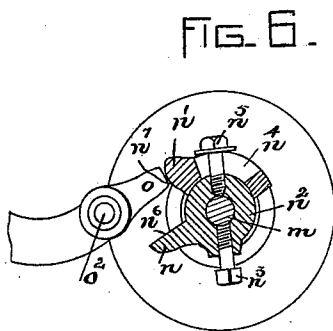
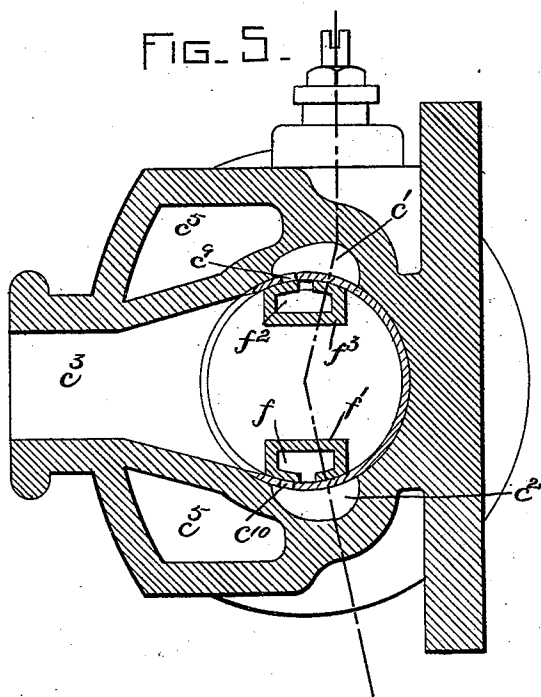
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5 Sheets—Sheet 5.

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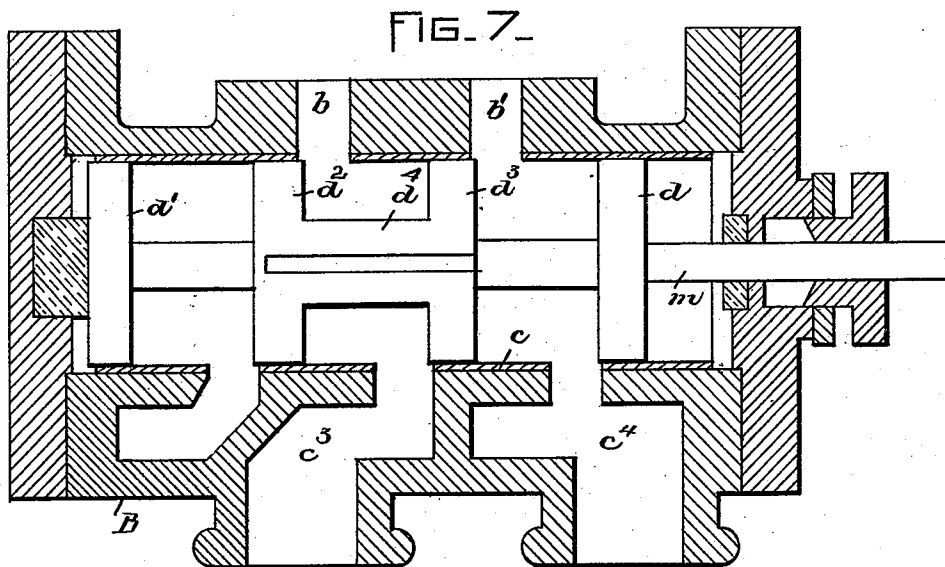
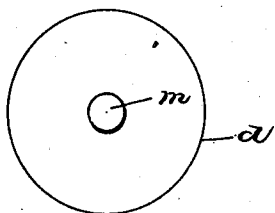


FIG. 8.



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UNITED STATES PATENT OFFICE.

FRANK E. WHITNEY, OF MELROSE, MASSACHUSETTS.

HYDRAULIC ENGINE.

SPECIFICATION forming part of Letters Patent No. 560,384, dated May 19, 1896.

Application filed February 18, 1891. Serial No. 381,901. (No model.)

To all whom it may concern:

Be it known that I, FRANK E. WHITNEY, a citizen of the United States, residing at Melrose, in the county of Middlesex and State of Massachusetts, have invented a new and useful Improvement in Hydraulic Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification in explaining its nature.

The invention relates to various improvements in hydraulic-engine valves, all of which will hereinafter be fully described.

In the drawings, Figure 1 is a view in front elevation of a hydraulic engine having the features of my invention. Fig. 2 is a view in side elevation of the valve-casing and a portion of the valve-actuating mechanism. Fig. 3 is a view in horizontal section, taken through the valve-casing and valve. Fig. 4 is a horizontal section upon the dotted line of Fig. 5. Fig. 5 is a view in horizontal section upon the dotted line of Fig. 3. Fig. 6 is a detail view illustrating in cross vertical section and elevation a portion of the valve-turning mechanism. Fig. 7 is a view in section of the valve-casing and in side elevation of the piston, and Fig. 8 is a view in end elevation of the piston, the said views representing a construction of piston hereinafter referred to.

The invention relates to that class of hydraulic engines having a reciprocating rotary valve.

In the drawings, A represents the engine-casing, *a* the piston-rod of the engine, and *a'* (in dotted outline in Fig. 1) the piston. Passages extend in the casing of the engine to the upper and lower ends of the piston-chamber, and these passages connect with the passages *b* *b'* of the valve-casing B. The valve-casing has a cylindrical hole *c*, extending from end to end, the passages *c'* *c''*, the water-inlet passage *c''*, (see Figs. 2 and 4,) the water-outlet passage *c'*, and the passages *c''*. (See Figs. 3 and 5.) A cylindrical shell *c'* fits the bore of the hole *c*, and this shell has the ports *c''* *c''* *c''* (see Figs. 3 and 4) and the holes *c''*, *c''*, and *c''*. The ports *c''* *c''* communicate, respectively, with the passages *b* *b'*, connecting with the piston-chamber of the engine. The ports *c''* *c''* open into the passages *c'* *c''*, respectively. The piston D has the heads *d* *d'*

and the valves *d''*, *d''*, *d''*, and *d''*. Between the valves *d''* *d''* is a large passage or hole *d''*, extending across the piston. (See Figs. 3 and 4.) The space *d''* between the head *d'* and valve *d''* acts when the piston is in a certain position as a portion of an escape-passage. The space *d''* between the head *d'* and valve *d''* also when the piston is in a certain position acts as an escape-passage. The valve *d''* serves to alternately connect the passage *b* with the inlet *c''* through the inlet-passage *d''* in the valve and the escape-passages *c''* through the piston escape-passage *c''*. In Figs. 3 and 4 the passage *b* is shown connected with the inlet *c''*. If the piston were at the other end of its stroke the valve *d''* would be transferred beyond the port *c'* and an escape-passage then provided for the fluid from the passage *b* through the chamber *c''*, which is then brought in line with the port *c''* into the passages *c''* through the hole *c''*. The passage *b'* is connected successively with the water inlet *c''* and outlet *c''* by the valve *d''*. When the piston is in the position represented in Fig. 3, the passage *b'* is connected with the outlet through the piston-chamber *d''* and hole *c''*. When the piston is at the other end of its stroke, the valve *d''* is transferred to the other side of the port *c''*, and the passage *b'* is then connected by means of the piston-chamber *d''* with the water-inlet *c''*. (See Fig. 4.) To give the valve these movements, the inlet-chamber *d''* is connected alternately with the ends *e* *e'* of the piston-chamber. This result is obtained by rotating the valve sufficiently to open the parts *c''* *c''*. Supposing the valve to be at the end of the stroke, as represented in Figs. 3 and 4, the port *c''* has been open and water flows from the inlet-chamber *d''* through the passage *c'* to the end *e* of the piston, and the movement of the piston is then reversed. The port *c''* is then closed from the chamber *d''*, but is open through the passage *f* in the side of the section *f'* of the piston to the outlet-chamber *d''* and outlet *c''*, so that during the movement of the piston toward the end *e'* the water is discharged from that end of the piston-chamber through the passage *c''* in the casing, ports *c''*, and passage *f* to the outlet *c''*. When the piston reaches the end of its stroke, it is again turned backward to its original position, and this brings the

port c^{10} into operative relation with the inlet-chamber d^6 , so that the water then flows from said chamber through the passage c^2 to the end e' of the piston-chamber, while at the same time opportunity to exhaust water from the end e of the piston-chamber is obtained by the bringing of the passage f^2 in the part f^3 of the piston into line with the port c^9 , so that the water flows through the passage c' , port c^9 , and passage f^2 to the outlet c^4 . (See Fig. 5.) It will be seen that the piston is made up of the heads d d' , the valves d^2 d^3 , and the central connection g between the piston-head d and the valve d^2 and the central connection g' between the head d' and the valve d^3 . It will be observed also that the valves d^2 d^3 are connected with each other by the narrow sections $f'f^3$, connecting the outer edges of the valves, and in which sections are the passages $f'f^2$, closed at the valve end d^2 and extending through the valve d^3 into the chamber d^8 . (See Figs. 3 and 5.) This construction provides a large unobstructed chamber d^6 in the piston for the inflow of the water from the inlet c^3 .

Across the passages $c'c^2$ in the piston-case there are formed the partitions h h' , respectively. (See Fig. 4.) These partitions are in part parallel with the outer surface of the casing, and in such portion of each partition I form a hole h^2 h^3 , respectively, which is tapered or rounded from its outer edge inward. Through these holes the live and exhaust water for actuating the valve passes. The size of these openings is regulated by means of valves h^4 h^5 , respectively, (see Fig. 4,) each of which screws in a threaded hole in the case and has means at its outer end by which it is screwed and the position of its inner end varied in relation to the tapering or conical valve-seat. By this means I am enabled to control the flow of water or fluid to and from the piston-chambers e e' , and thereby cause the valve to operate with any motion and speed required. I would not be understood, however, as limiting myself to this particular valve or means for regulating the flow of fluid through the passages $c'c^2$, as any other device capable of varying the area of these passages or of regulating the quantity of fluid which shall pass through them I consider to be a mechanical equivalent for the specific mechanism which I have herein described. The valve may have a spindle m extending through the end m' of the casing, and a stuffing-box m^2 , detachable from the valve or the spindle, may be cast or formed integral with the piston. I much prefer the latter form of construction. In Figs. 3 and 4 the first-named form is shown; in Figs. 7 and 8, the last-named. As valves of this character have heretofore been somewhat uncertain in their action because the mechanism for turning the same forward and back at the proper intervals has not been so constructed as to insure certainty, I have in lieu of such mechanism arranged upon the outer end of

the valve-spindle m tappet-lugs which are so shaped and located in relation to their actuating mechanism or tappet that they allow it to move them and the spindle a predetermined distance and no more, even if the actuating mechanism shall continue to move, a disengagement between the tappet-lugs and their actuating device taking place if such further movement of the actuating device occurs.

In the drawings, n n' are the tappet-lugs. The tappet-lug n is formed upon the collar n^2 , which is fastened to the valve m by a locking or set screw n^3 . The tappet-lug n' is shaped upon its inner side to turn upon the sleeve n^2 . It has the long slot n^4 and is fastened to the collar n^2 by a set or locking screw n^5 . (See Figs. 1 and 6.) This slot n^4 and screw n^5 provide means whereby the distance between the two faces n^6 n^7 of the tappet-lugs may be varied. The face n^7 of the tappet-lug n' is rounded or curved. Extending into the space between the two tappet-lugs is the tappet end o of a lever o' . This lever is pivoted at o^2 and has the arm o^3 connected with the cross-head o^4 of the engine by a vertical rod o^5 . (See Figs. 1 and 2.) The outer end of the lever o^3 is provided with the screw-thread o^6 , and the lower end of the rod o^5 also has the thread o^7 . These threaded ends are connected with each other by the bent link o^8 , which has at one end a hole through which the end o^6 of the lever o^3 extends and at the other end a hole through which the end o^7 of the rod o^5 extends. The link is secured in place to the rod o^3 by the nuts o^9 o^{10} and to the rod o^5 by the nuts o^{11} o^{12} . The rod o^5 is pivoted at its upper end o^{13} to the cross-head. The link is made in two parts o^{14} o^{15} and pivoted together by the pivot o^{16} . The tappet-lug n' is set to give the valve the desired lead when the tappet-lugs are actuated by the end or point o of the lever. This end, it will be understood, is reciprocated by the movement of the cross-head of the engine, and if its movement exceeds the lead allowed by the tappet-lug n' it then becomes disengaged from the tappet-lug and its movement no longer operates to turn the valve. Therefore the valve is left in a position to be reversed, and it cannot be turned from an operative position in either direction by any irregular action of the actuating-lever. By making the valve-spindle m integral with the piston the movement of the piston is at all times indicated outside its casing by the movement of the spindle, and there is no possibility of a rotary movement being imparted to the spindle which shall not also be imparted to the piston. Of course the tappet-lugs must be of sufficient width, taken in connection with the operating-arm o , to maintain operative contact during the full stroke of the piston when the stem or spindle m moves with it.

It will be understood that the construction represented in Fig. 3, which is the old construction of valve-spindle, represents the

valve-spindle as not reciprocating with the piston, but simply as turning with it, the piston having a long rectangular hole to receive the spindle, which has a rectangular or square end to enter said hole, and the piston reciprocates upon the stem.

It will be understood that while I have described the piston-chamber of the valve and of the engine as receiving water from the inlet c^3 I would say that the inlet may be through the passage c^4 and the outlet by means of the passage c^3 . In other words, the construction of piston-chamber and its ports and passages and valve is such that it makes no difference in the operation of the valves and engine whether the passage c^3 or the passage c^4 be used as an inlet or an outlet.

Having thus fully described my invention, I claim and desire to secure by Letters Patent of the United States—

1. In a hydraulic engine, a valve-casing having the inlet c^3 , the outlet c^4 and the passages b b' and c' c^2 and c^5 and a cylindrical bore, the sleeve fitting said bore and having the ports c^7 , c^8 , c^9 , c^{10} and the holes c^{11} c^{12} and c^{13} , a reciprocating rotary piston having the heads d d' , the valves d^2 d^3 , the cross-passages d^6 d^7 d^8 and the longitudinal passages f f^2 , substantially as described.

2. The combination in a hydraulic-engine

valve having a rotary reciprocating piston, of the valve-casing having the ports c^7 , c^8 , c^9 , c^{10} , and the holes c^{11} , c^{12} , c^{13} , the piston-chamber and the piston D having the ends d , d' , the valves d^2 , d^3 , the sections g , g' and the connecting-sections f' , f^3 with their passages f , f^2 , closed by the valve d^2 and extending through the valve d^3 , as and for the purposes described.

3. The combination in a hydraulic engine of the lever o' , pivoted at o^2 , having the arms o^3 , o^5 screw-threaded at their extremities, the connecting-links o^{14} , o^{15} , pivoted together by the pivot o^{16} and the check-nuts o^9 , o^{10} , o^{11} , o^{12} , as and for the purposes described.

4. The combination of the valve-spindle, a sleeve having a tappet-lug rigidly secured to said spindle and an adjustable tappet-lug carried thereby, the tappet o and devices for connecting it with the cross-head of the engine, as and for the purposes described.

5. The combination of the valve-spindle, the sleeve n^2 having a tappet-lug n fastened to the spindle, the tappet-lug n' fitted to turn on said sleeve having the slot n^4 and locking-screw n^5 and the tappet o , as and for the purposes described.

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Witnesses:

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J. M. DOLAN.