(No Model.) 4 Sheets—Sheet 1.

A. T. BALLANTINE.

RECIPROCATING HYDRAULIC MOTOR.

No. 476,359. Patented June 7, 1892.

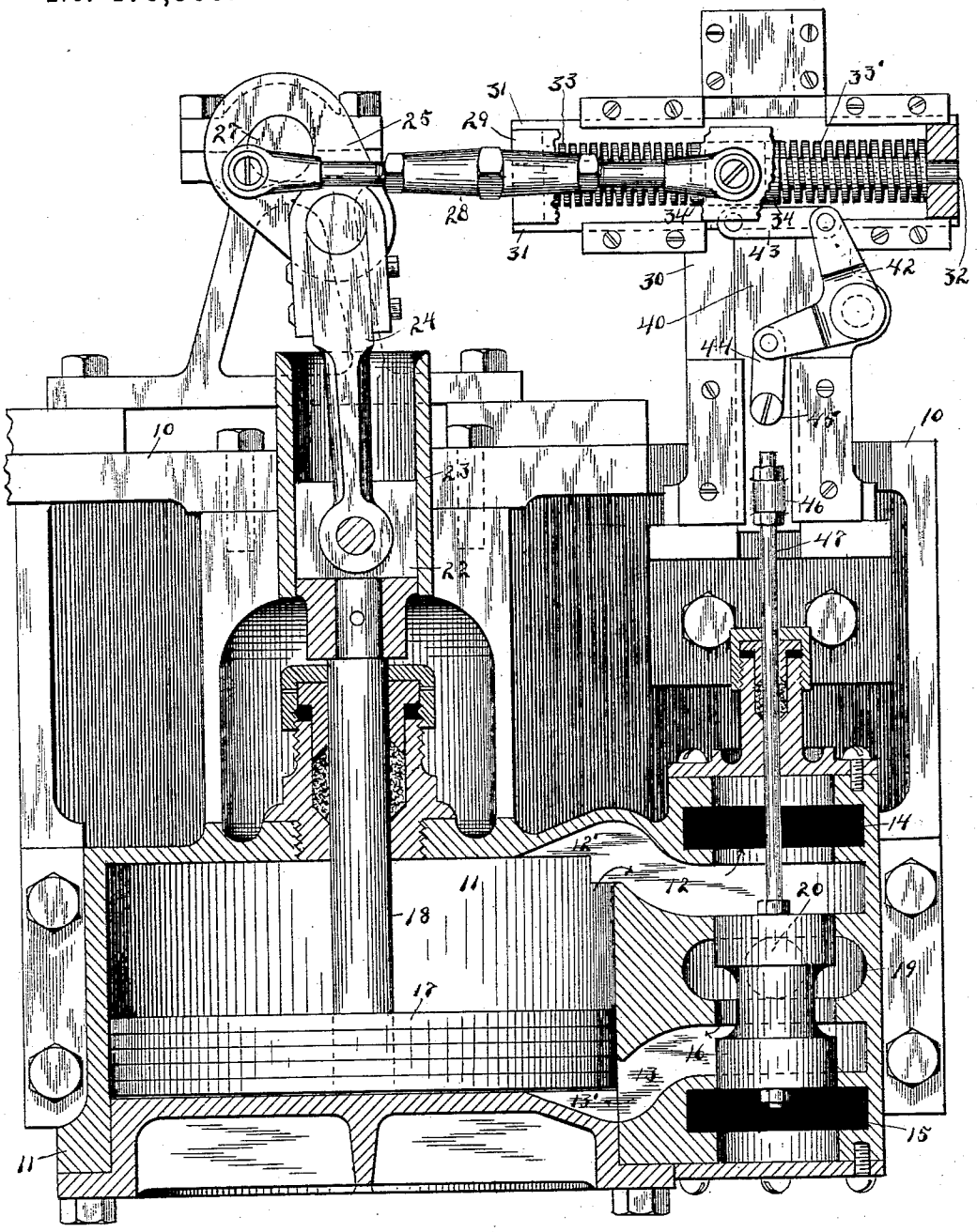

Fig. 1

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(No Model.) 4 Sheets—Sheet 2.

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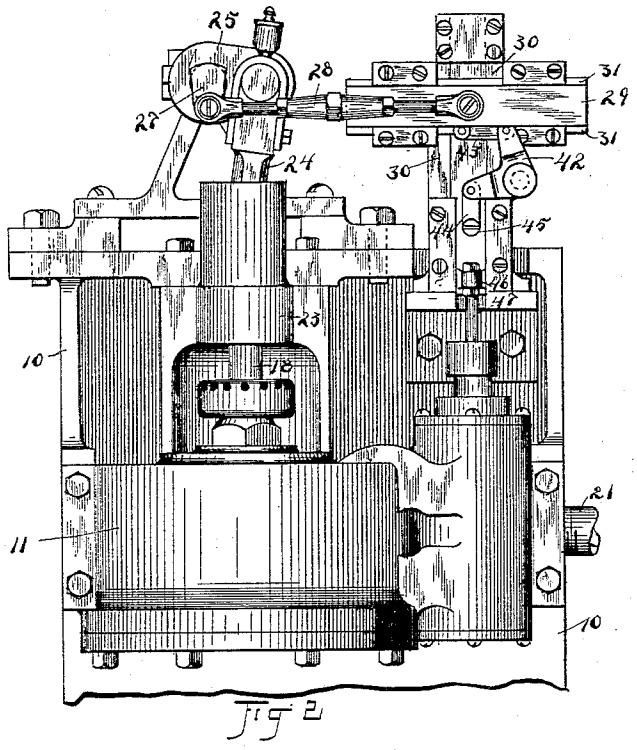
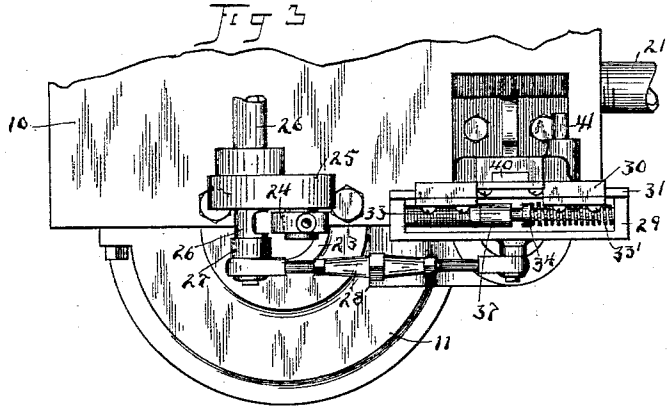


Fig 2

Fig 3



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(No Model.) 4 Sheets—Sheet 3.

A. T. BALLANTINE.

RECIPROCATING HYDRAULIC MOTOR.

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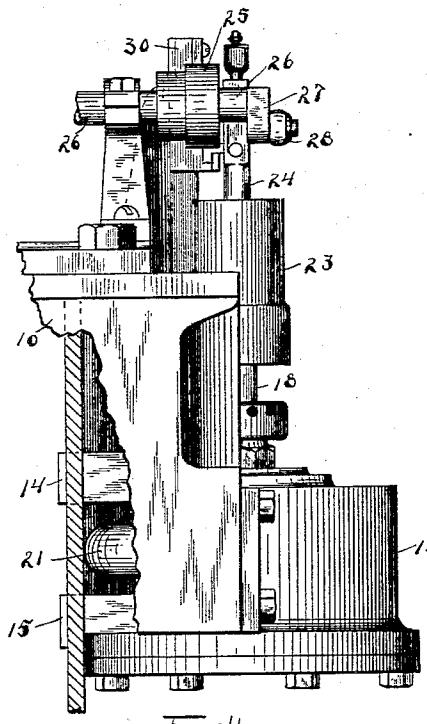

Fig 4

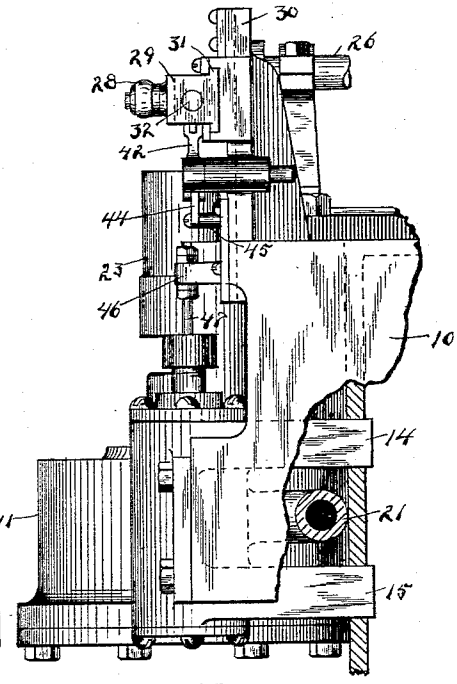

Fig 5

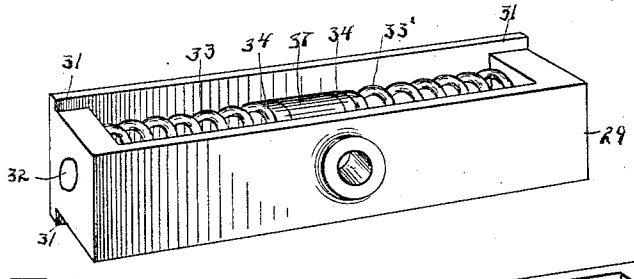

Fig 6

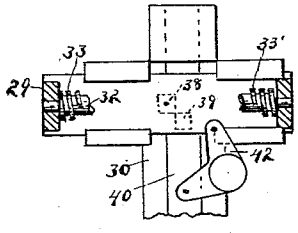

Fig 12

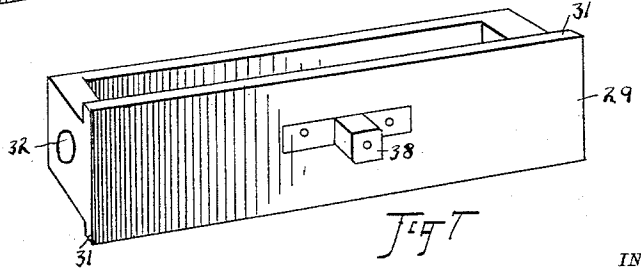

Fig 7

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(No Model.) 4 Sheets—Sheet 4.

A. T. BALLANTINE.

RECIPROCATING HYDRAULIC MOTOR.

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Fig 8

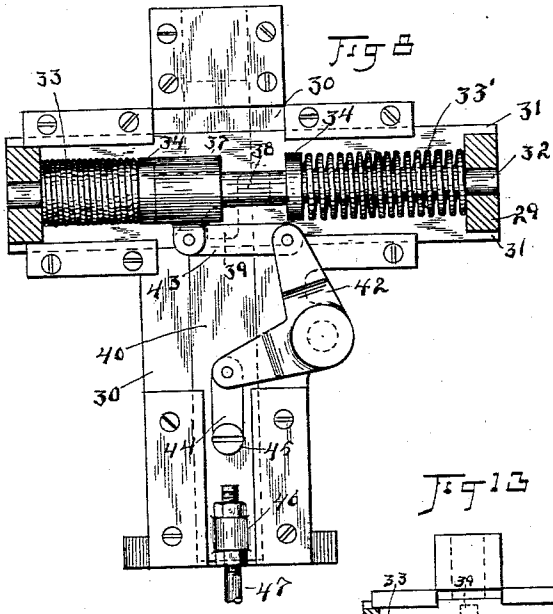


Fig 10

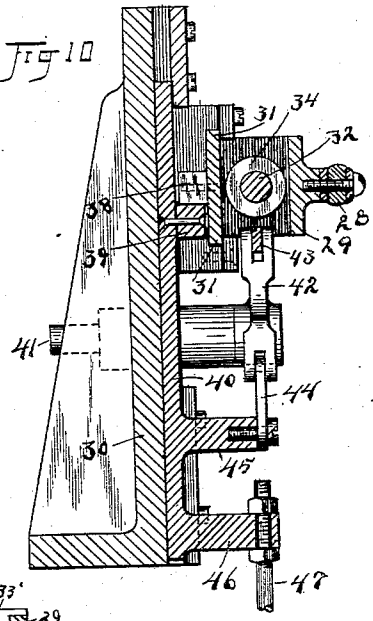


Fig 13

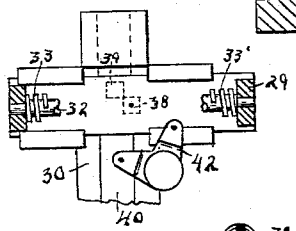
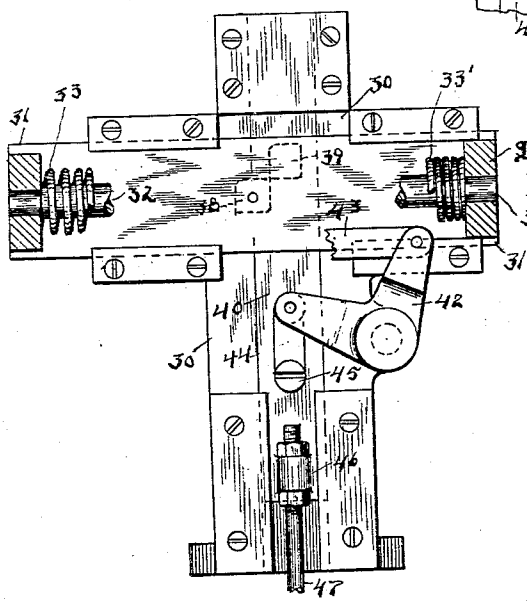
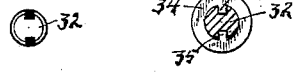


Fig 7





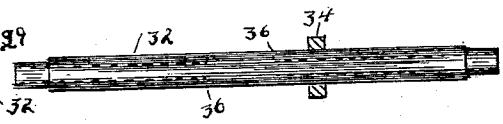
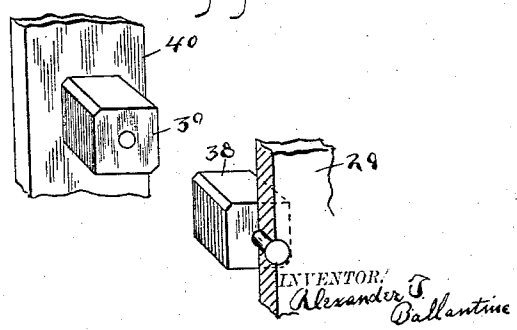


Fig 11



WITNESSES:
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UNITED STATES PATENT OFFICE.

ALEXANDER T. BALLANTINE, OF CLEVELAND, OHIO, ASSIGNOR TO THE DOMESTIFROID COMPANY, OF SAME PLACE.

RECIPROCATING HYDRAULIC MOTOR.

SPECIFICATION forming part of Letters Patent No. 476,359, dated June 7, 1892.

Application filed April 2, 1891. Serial No. 387,364. (No model.)

To all whom it may concern:

Be it known that I, ALEXANDER T. BALLANTINE, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Reciprocating Hydraulic Motors; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to reciprocating hydraulic motors; and it consists in the construction as shown and described, and particularly pointed out in the claims.

In the accompanying drawings, Figure 1 is a vertical sectional elevation of the motor and the valve and valve-operating mechanism, the parts being shown at the completion of the downstroke and just about to reverse. Fig. 2 is a front elevation of the motor and valve mechanism complete and on a somewhat reduced scale from Fig. 1, the parts being on the half-stroke. Fig. 3 is a plan view of motor and valve mechanism. Fig. 4 is a side elevation looking from the left of Fig. 2; and Fig. 5 is a side elevation looking from the right of Fig. 2, the casing in both views being broken away to show the water-supply pipe and the exhaust-ports. Fig. 6 is a front perspective view of the spring-carrying box and carrier through which the valve is operated by the springs, and Fig. 7 is a rear perspective of the box. Fig. 8 is a front elevation of the valve-operating mechanism with the motor connections removed, and Fig. 9 is a similar view in which the actuating-springs also are broken away to disclose the relation of the posts or studs behind the same. Fig. 10 is a vertical central transverse sectional view of the valve-actuating mechanism, including the motor connections. Fig. 11 shows a group of details relating to the valve-operating mechanism, as elsewhere shown and described. Fig. 12, reduced, shows the locking lugs or projections through which the position of the valve is controlled in the positions they occupy when the motor-piston and the valve reach the bottom of their stroke; and Fig. 13 shows the position of said lugs when the piston and valve are at the top of their stroke.

The motor is intended, mostly, for domestic use and has a suitable casing 10, provided with a piston-chamber 11, and inlet and exhaust ports 12 and 13, entering said chamber at the top and bottom, respectively, from one side thereof. Between the outer portions of the said ports and extending above and below the same into the exit-ports is the valve-chamber, containing a valve 16, which controls the flow of pressure fluid to both sides of the motor and exhaust therefrom, the pressure and exhaust of course occurring alternately from opposite sides of the motor-piston.

The motor-piston 17 is of the reciprocating variety and is adapted to slide up and down in its chamber, guided centrally by the shaft 18, rigid therewith and sliding in a suitably-packed bearing above the chamber. A motor of this kind is deemed absolutely essential to the successful operation of the apparatus when hydrostatic pressure proceeding from the usual house-service is employed, because it is the only form of motor that is reliable under all the attending circumstances of such service. Among these circumstances we have the wide fluctuations in pressure due to the opening of faucets or other use of the water throughout the building, which reduces the pressure in proportion to the water thus consumed. The opening of a single faucet will reduce the pressure more or less, and this reduction is perceptible to that degree in the reduced speed of the motor. The opening of several faucets at the same time may lower the pressure so much that the motor cannot overcome the resistance of the machinery or apparatus operated thereby, and hence will stop until sufficient pressure is restored. Now if a rotary motor were used the stopping would occur on the dead-center, as is the usual experience in that class of machines, and therefore it would follow when the water-pressure was sufficiently restored for operation that the motor would not start without personal help. If such help were required to carry it over exigencies liable to arise at any time and to frequently recur dur-

ing the day, the motor would totally fail of its purpose and be practically worthless. Hence in devising the system of power herein employed I have anticipated the difficulties arising from varying motive pressure by providing a motor that has no dead-center point and which must inevitably and automatically start when sufficient pressure recurs and continue to run as long as such pressure remains.

The duration of suspension of pressure sufficient to run the motor is never liable to exceed a few moments for the reason that though several faucets may happen to be opened at the same time they are not all liable to continue open longer than a few moments and the motor will resume work just as soon as sufficient pressure is restored.

The valve 16 may be either of the piston variety shown or of any other variety that will serve the purpose, and the valve-chamber has a central enlargement 19, in which is the fluid-inlet 20. (Shown in dotted lines behind the valve in Fig. 1 and by pipe connection 21 in Fig. 3.)

The valve 16 is operated automatically by the motor-piston through the following mechanism: First there is a head 22, fixed rigidly to motor-shaft 18 and sliding in a suitable guide 23. A pitman 24 connects the head 22 with a crank 25 on the rock-shaft 26, with which a pump or other object to be driven is connected. From this crank-shaft, outside of crank 25, Fig. 3, is a crank 27, of less radius than crank 25 and connected by a rod 28 with a spring containing and compressing box 29, adapted to slide back and forth within given limits in the supporting-frame 30. The box 29 is oblong and has flanges 31 above and below, at its rear sliding in suitable guideways on the fixed frame 30. Supported in the ends of the box 29 and extending centrally through the same is the spring-supporting rod 32, carrying two separate but equal springs 33 and 33′, which at one end bear against the end of the box and at the other against a collar 34, loosely splined on the said rod, so as to slide thereon. The grooves in the rod 32 in which the interior projections 35 of the collars rest terminate at 36 near the middle of the said rod, forming shoulders, beyond which the collars cannot slide, (see details in Fig. 11,) and this middle space on the rod is occupied by a sliding sleeve 37, which fills the said space when the two collars are in their normal position, as seen in Fig. 6. Centrally on the back of the spring-carrying box 29 is a rectangular block or projection 38, rigidly fastened or cast thereon, and this projection is adapted to engage with a corresponding projection or block 39 on a vertically-sliding plate 40, set at right angles to the spring-box 29 and behind the same in frame 30. The engaging edges of the two blocks are beveled or rounded, and the upper and lower surfaces especially should be flat and parallel, so as to ride evenly one upon and over the other alternately from side to side. At one side or edge of the frame 30 and on a pivot pin or bolt 41, extending outward therefrom, is pivoted a bell-crank lever 42, connected at its upper arm by a link 43 to ears on the sleeve 37 and at its lower arm by a link 44 with the vertically-sliding plate 40, the said plate being provided with a projection 45 for bringing such link connection into proper alignment with the other parts. At the bottom of the plate 40 is another forward projection 46, to which is adjustably secured the valve-operating rod 47. This completes the chain of connections extending from the motor to the valve 16, whereby the valve is operated. When the piston is down at the end of its downstroke, as in Fig. 1, the valve 16 also is down and in position to admit pressure fluid beneath the piston, and when the piston is at the end of its upstroke the positions of the valve and the other connected parts are of course reversed.

The operation of this mechanism is as follow: Assuming that the piston is down, as in Fig. 1, the two springs 33 33′ will be under their normal tension and the collars 34 and sleeve 37 will be at the center, as seen in Figs. 1 and 6. In this position of the parts the studs or blocks 38 and 39 are in the relation to one another shown in Fig. 12. Now the valve, the crank-lever 42, and the slide, with stud 39, will remain down, while the motor-piston rises to the limit of its upstroke. As the said piston rises it carries the box 29 to the right, and in so doing compresses spring 33, because the stud 38 at the very outset of the movement begins to ride across upon the lug 39, and thus prevents the bell-crank and the parts to which its arms are connected from moving while the lug 38 thus bears the lug 39 down. The spring 33 therefore compresses against sleeve 37 until the lugs reach the relation shown in Fig. 8, where the lug 38 is shown as just in the act of releasing the lug 39. When this occurs, the slide 40 is unlocked and the parts instantly fly to the opposite position shown in Fig. 13. In this movement, under the pressure of spring 33 the valve 16 is instantly reversed, and the reversal is arranged to come precisely at the time the motor-piston reaches the limit of its upward stroke. Meantime the box 29 is carried to the right and the springs 33 33′ are again under their normal tension and the collars and sleeve are at the center, as before. The studs 38 and 39 have, however, changed position and the stud 39 is above and the stud 38 below and their beveled corners are in juxtaposition. Now as the motor-piston descends it carries the box 29 to the left and at the very outset engages the said lugs, so as to prevent the slide 40 from going down until the time comes to reverse the valve 16. In doing this the lug 38 travels twice its width and until it just clears lug 39 at the left, when said lug and its slide are free to drop and carry all the parts into the lower position, as seen in Fig. 1, from which they originally started. In this instance

the spring 33′ does the work, and the parts resume their normal positions. The box 29 stops first at the left and then at the right of the working center and the lug 39 is first below and then above the lug 38. Both lugs alternate in positions, the lug 38 from right to left and the lug 39 up and down, according as the motor-piston is below or above in its chamber. This construction of valve mechanism does not only produce the desired reversal of the valve at exactly the right times, but it is instantaneous in its operation, so that the moment the motor-piston reaches the end of its stroke it is immediately put under the reverse pressure and its dead-water is exhausted. The exhaust-channels from both sides of the motor-piston are constructed and arranged with especial reference to getting this instantaneous effect on the piston the instant the valve is reversed, and to this end it will be seen that the channels or ports 12 and 13 are so curved and arranged with respect to the exits 14 and 15 that there will be more or less water left therein when the valve is reversed. It will be observed that the lower port has a downward curve from the valve-chamber to the piston-chamber and that the port extends in a short distance at 13′ beneath the piston to make an easy entrance for the water. This space in any event will be filled with water. A like construction, with a reverse curve and inlet 12′, is formed in the upper port 12; but in addition to this construction, which in any event retains more or less water in the ports 12 and 13 to help swell the inlet when pressure is turned on, a material and novel advantage is obtained by the simultaneous movements of the motor-piston and the valve, whereby the instantaneous reverse movement of the piston is produced the instant the valve opens either port to pressure. Thus suppose the piston to have just descended, as in Fig. 1. Its speedy downward movement taxes the exhaust-channel to carry away the dead-water, and said channel consequently is full. Now the instant the piston reaches the bottom the valve is reversed to the position shown in Fig. 1, and the reversal occurs with the space about the valve and the port 13 full of water. Hence there is no void space to be filled before the pressure is communicated to the piston, and hence action on the piston is instantaneous. The effect on the piston and through it to the pumps is equivalent to the constant movement of a rotary motor, and there is no halt or pause at the end of each stroke, as usually occurs when the motor fluid has to fill the ports before it can begin to act. The inlet-pipe 21 of course is provided with a suitable cock or valve (not shown) to turn the water on or off, as well as to control the flow and pressure. The exhaust is through the exits 14 and 15.

Obviously the construction herein shown and claimed, in so far as the details and specific features are concerned, may be considerably varied and yet remain within the spirit of the invention. Thus the compression-box 29 may be any suitable carrier, frame, or support and the springs therein may be of any nature or form and supported in any way that will serve the purpose. The sliding sleeve 37, which operates as a spring-compressor, may be any suitable block or like piece adapted to bear against the springs and to make connection with the crank-lever, as shown, and the plate or bar 40 may be any suitable piece which will answer the purpose of said plate or bar. These and other parts need not necessarily follow the exact form shown here, but may be varied within the spirit and terms of the invention.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination of a reciprocating piston, a shaft driven thereby, a reciprocating valve for controlling said piston, and mechanism for starting the valve and piston and preventing a dead-centering of the same, said mechanism comprising a sliding plate carrying the valve-rod, a box connected to the shaft and arranged to travel crosswise of the sliding plate, springs in said box, a sliding sleeve arranged between said springs for compressing said springs alternately, and projections on the sliding plate and box, which are periodically locked and unlocked, substantially as and for the purposes described.

2. The spring-carrier and a projection thereon, the springs and the spring-compressor supported by said carrier, a valve, a sliding bar connected with the valve and also with the spring-compressor, and a projection on said sliding bar, said carrier and sliding bar moving at right angles to cause their projections to interlock at intervals, substantially as described.

3. A spring-carrier supported in guideways to slide therein and having a lateral projection, a rock-shaft to actuate said carrier, a valve-actuating bar supported in guideways at right angles to the spring-carrier, a projection on said bar corresponding to the projection on the carrier, springs in said carrier, and connections between the valve-actuating bar and the springs, whereby the periodical locking and releasing of said projections is effected, substantially as described.

4. The sliding spring-carrier, the springs therein, and a projection on said carrier, the sliding valve-operating bar at right angles thereto, and a complemental projection on said bar, a spring-compressor in said spring-carrier, and a bell-crank lever interposed between the spring-compressor and the sliding valve-operating bar, whereby said bar and spring-carrier may be locked and unlocked, substantially as described.

5. The spring-carrier and the springs supported on a rod therein, a spring-compressor on the rod between the springs, the valve and valve-operating bar, a link and rocking con-

nection between said bar and the spring-compressor, and locking projections on said compressor and the spring-carrier, substantially as described.

6. A spring-carrier having a projection on its rear, a valve-operating bar at right angles to the carrier and having a projection to engage with the projection in the carrier, separate springs in the carrier, a spring-compressor supported between the said springs, and a link connection between the said compressor and the valve-operating bar, substantially as described.

7. A carrier having a pair of compressible springs and a spring-compressor between the same, in combination with a valve-operating bar, a rocking connection between said bar and the spring-compressor, and projections from the carrier and bar adapted to interlock to hold temporarily the valve-operating bar in raised or lowered position, whereby the spring-compressor is held against the tension of one of the springs, substantially as described.

8. The carrier supported in horizontal guides and having a central rod with springs and a spring-compressor thereon and a projection on its rear, in combination with a valve-operating bar having a projection locking temporarily on said carrier, and link and rocking connections between the spring-compressor and the valve-operating bar, substantially as described.

9. The valve and the valve-operating bar having a projection on its face, and a transverse sliding frame having a projection on its rear, engaging the projection on the valve-operating bar alternately above and below, an elbow-lever, a spring-compressor and springs, and link connections between said compressor and the valve-operating bar and the said elbow-lever, substantially as described.

10. The reciprocating piston, and the rock-shaft, and the valve and the valve-actuating bar, a sliding carrier-frame operated by the rock-shaft and constructed to engage and disengage said valve-actuating bar, springs in said carrier and a spring-compressor between the springs, a rocking lever, and link connections between the lever and the spring-compressor and the valve-operating bar, respectively, substantially as described.

11. The spring-carrier having a central grooved rod, springs on the rod, and collars between the springs, sliding on said grooves, and a sliding sleeve between collars, in combination with a valve-operating bar having a projection to lock on the said carrier and pivoted connections between the said bar and the sliding sleeve between the said springs, substantially as described.

Witness my hand to the foregoing specification this 19th day of March, 1891.

ALEXANDER T. BALLANTINE.

Witnesses:
H. T. FISHER,
N. L. MCLANE.