(No Model.) 2 Sheets—Sheet 1.

F. STARKENBERG.

WAVE POWER MOTOR.

No. 385,327. Patented June 26, 1888.

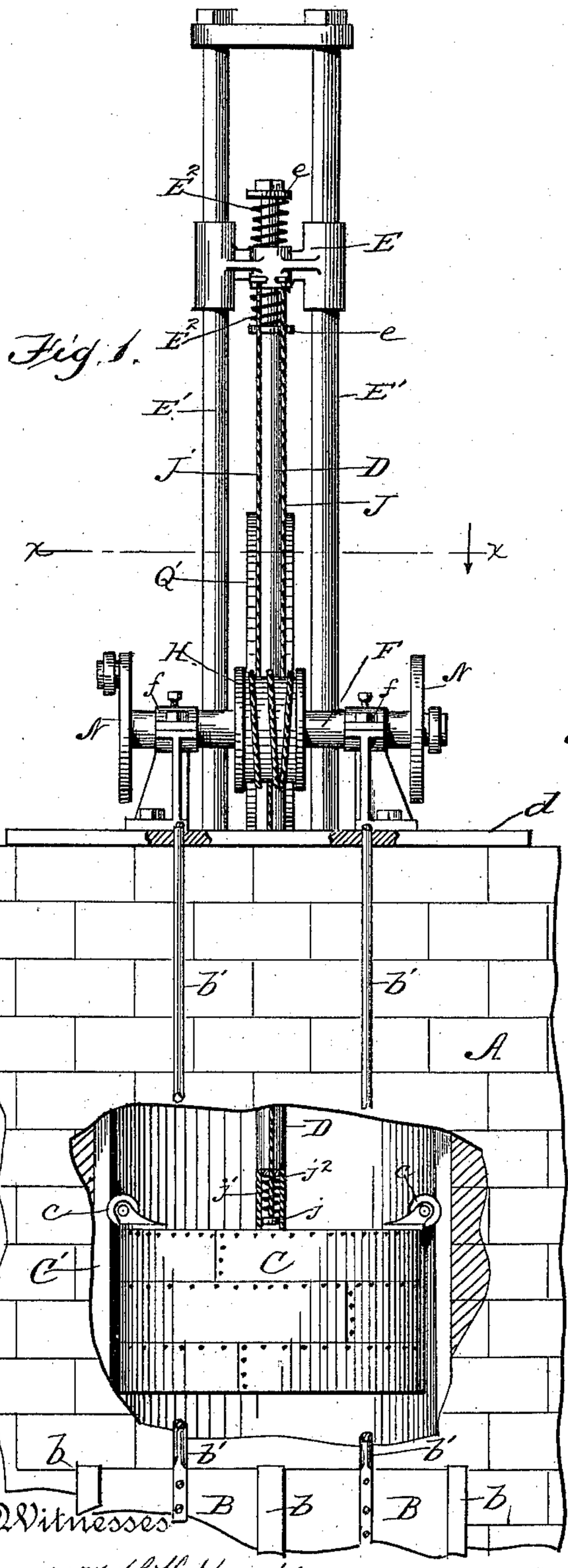

Fig. 1.

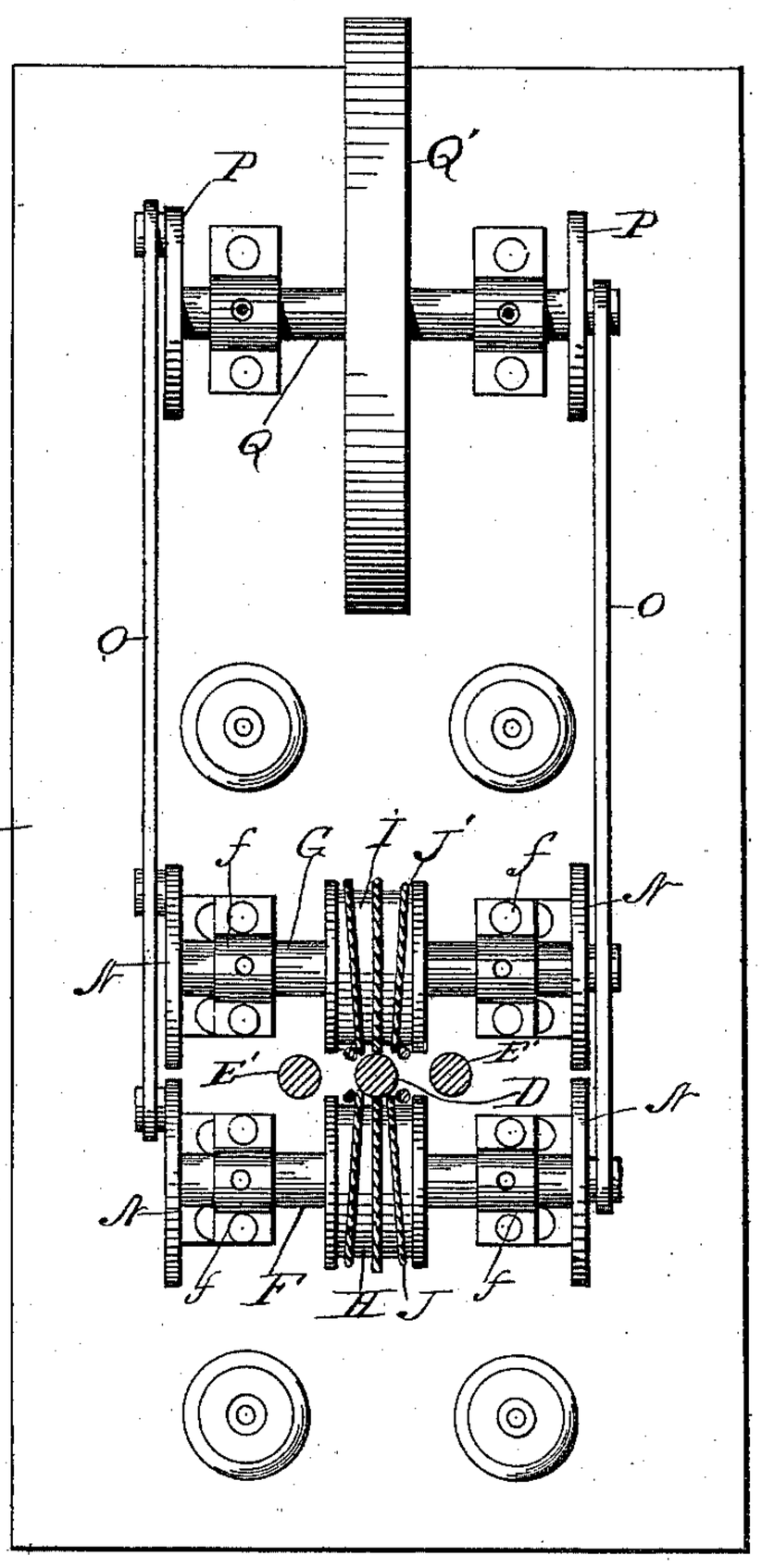

Fig. 2.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 4.

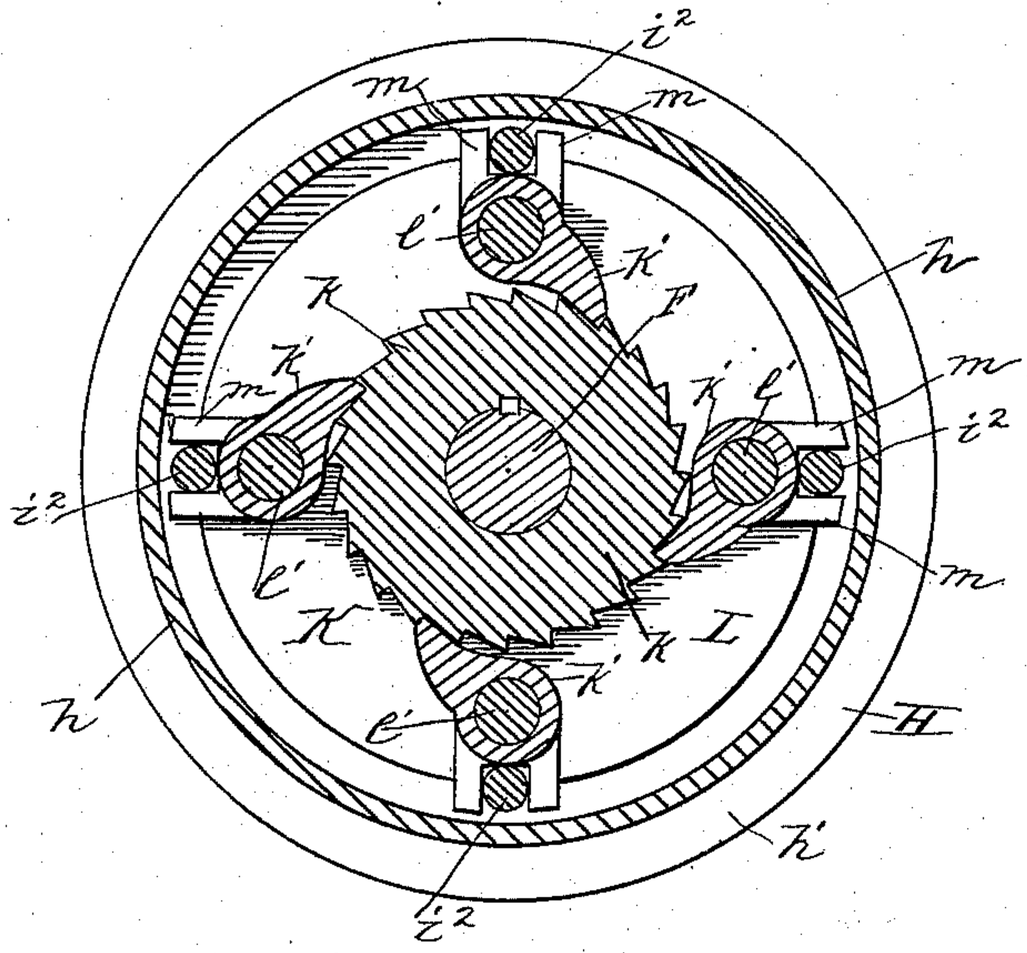


Fig. 6.

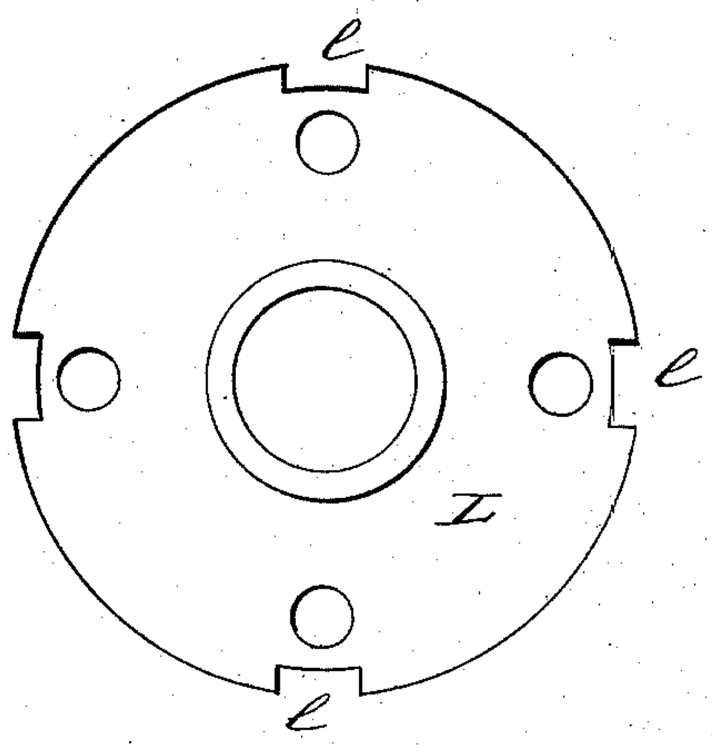


Fig. 3.

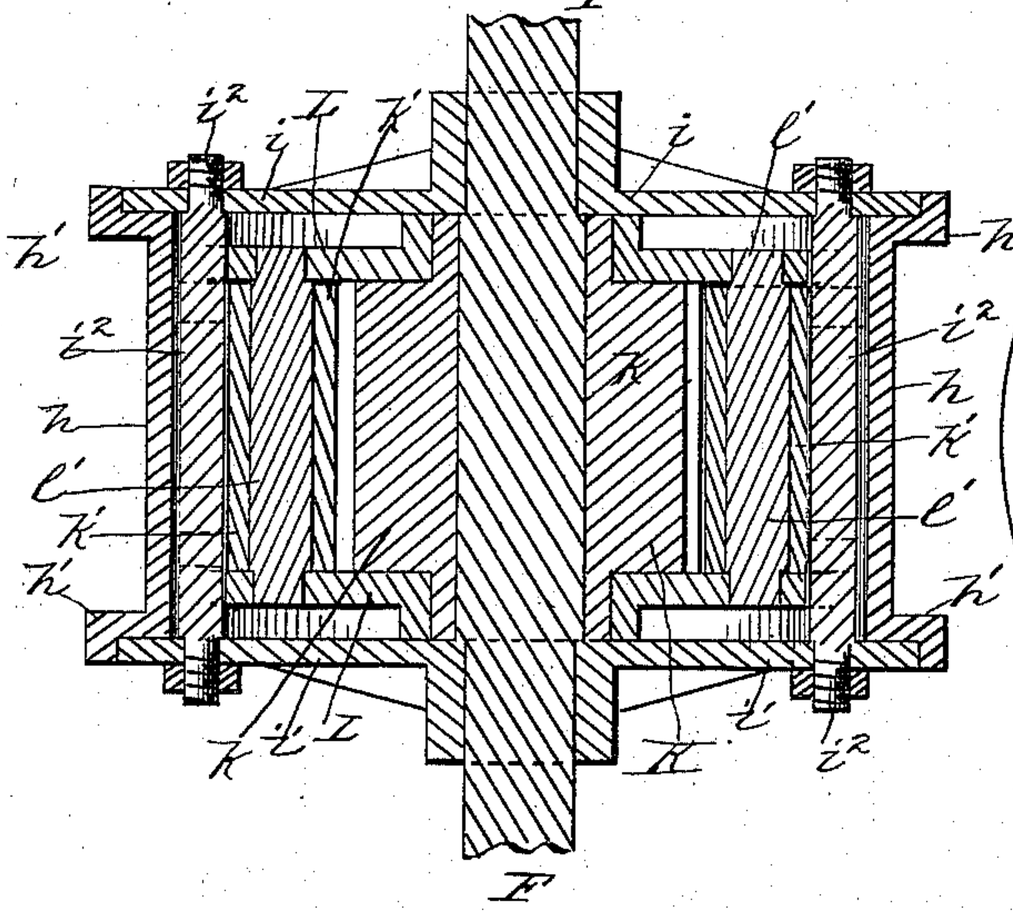
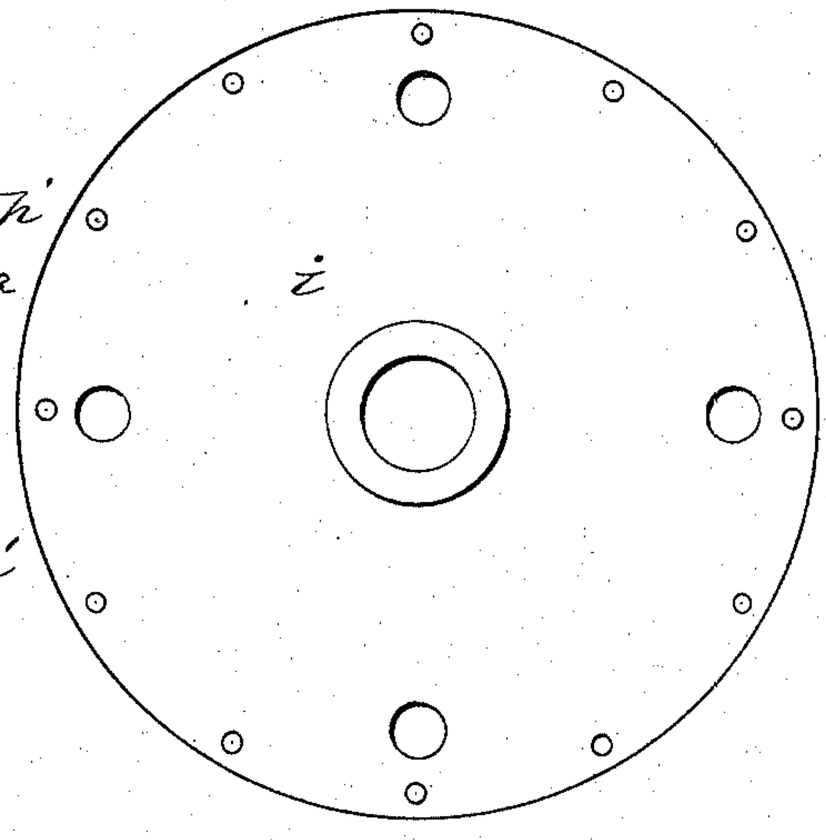


Fig. 5.



Witnesses

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UNITED STATES PATENT OFFICE.

FELIX STARKENBERG, OF MILWAUKEE, WISCONSIN, ASSIGNOR OF ONE-HALF TO HENRY J. DELANEY, OF SAME PLACE.

WAVE-POWER MOTOR.

SPECIFICATION forming part of Letters Patent No. 385,327, dated June 26, 1888.

Application filed January 10, 1888. Serial No. 260,326. (No model.)

To all whom it may concern:

Be it known that I, FELIX STARKENBERG, a citizen of the United States, residing at Milwaukee, in the State of Wisconsin, have invented certain new and useful Improvements in Wave-Power Motors; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My present invention relates to improvements in hydraulic motors of that class wherein the rise and fall of a vertically-movable reciprocating float is utilized to rotate a suitable power-shaft or set in motion other mechanical contrivances for the transmission of power; and it consists of the peculiar combination of devices and novel construction and arrangement of parts, as will be hereinafter fully described and claimed.

The primary object of my invention is to provide simple and effective mechanism for utilizing both the upward and downward movement of a reciprocating float to rotate a shaft and to convert the reciprocating movement of said float into rotary motion to continuously drive such power-shaft in one direction only, the power of which shaft can be communicated by suitable contrivances to various machinery for operating the latter.

A further object of my invention is to provide means for guiding the float in its vertical movements and to cushion or deaden any undue shock or jar which is liable to take place at the termination of the movement of the float in either direction.

A further object of my invention is to provide ratchet mechanism for converting into rotary motion the reciprocating movements of the cables between the float and such ratchet mechanism which will be absolutely noiseless in its operation and automatically controlled or thrown into and out of action by the movement of the float itself, as will be hereinafter more fully described.

In the accompanying drawings, Figure 1 is a side elevation, partly in section. Fig. 2 is a horizontal sectional view on the line *x x* of Fig. 1, looking downward. Fig. 3 is a vertical transverse sectional view through one of the winding-drums and the ratchet mechanism contained therein. Fig. 4 is a sectional view of the same, taken in a plane at right angles to that of Fig. 3. Figs. 5 and 6 are detail views.

Referring to the drawings, in which like letters of reference denote corresponding parts in all the figures, A designates a stationary reservoir or cylinder, which is constructed of masonry or other suitable material and is placed or immersed in tide-water. This reservoir or cylinder is provided in its lower end with suitable ports, through which the waves or tide-water is admitted to the reservoir to alternately elevate and depress a float located therein, and the ports are adapted to be closed by means of valves or gates B B, which work in suitable fixed guideways, *b*, and are operated by vertical rods *b' b'*, which are secured at their lower ends to the valves or gates.

C designates a reciprocating float which is arranged to move freely in the reservoir, and this float is provided with suitable frictional rollers, *c*, that are journaled in fixed supports on the float, at or near the periphery thereof, these frictional rollers riding against fixed guide-rods, C', that are arranged within the reservoir. Any suitable number of guide-rods and rollers may be used to insure the float keeping in its proper position. To the center of the float is fixed or secured a vertical pitman or rod, D, which passes through a horizontal platform, *d*, over the upper open end of the reservoir. A cross-head, E, is secured or connected to the upper extremity of the pitman or rod D, and it is guided in its reciprocating movements on upright ways or posts E', which are erected on the platform *d* and arranged on opposite sides of the pitman or rod D.

F G designate horizontal shafts, preferably arranged on opposite sides of the guide ways or posts E' and the pitman, and which are journaled in suitable bearings, *f*, which are carried or supported on suitable fixed standards. On each of these shafts F G is fitted a winding-drum, H I, respectively, each of which is alternately rotated or driven in re-

verse directions by ratchet mechanism, hereinafter described, according to the rise or fall of the float, with which said drums or shells are connected by cables or other pliable connections, J J'. One end of each of these cables or connections is connected to the float, while the opposite end of each cable is connected to the reciprocating cross-head, and the manner in which the connection of the cable with the float is made is such as to cushion or allow the cable a limited endwise movement when the float reaches its limit of movement, and thereby prevents any undue strain or pull on the cable, and thus obviate any undue shock or jar on the winding-drum over which the cable passes. To the lower end of each cable is secured a follower or disk, *j*, which works in a suitable cylinder, *j'*, that is fixed to the upper side of the float and is carried thereby; and between this follower and the upper head of the cylinder is interposed a coiled cushion-spring, j^2, which is adapted to be compressed and yield to any strain or pull exerted on the same by the follower and cable. The cross-head is also cushioned to prevent any undue pull or strain on the cables and prevent the latter from exerting a shock or jar on the winding-drums. Through a suitable vertical opening in the middle of the cross-head is passed the upper end of the pitman or rod D, and between the cross-head and suitable fixed disks, *e*, on the pitman are interposed coiled cushion springs E^2 E^2, which alternately yield to the pressure exerted thereon by the pitman and cross-head during the reciprocating movements of the same.

One of the cables, J, is wound around the drum H in one direction, and the other cable, J', is wound around the other drum, I, in the reverse direction, so as to alternately rotate the drums in the same corresponding direction as the float rises and falls, one cable being disposed around its drum to rotate it in the proper direction when the float rises and the other cable being arranged to rotate the other drum in the same direction when the float falls.

Each drum is provided with ratchet mechanism K, which is inclosed or contained within the drum, and by means of which the drum is alternately connected to and disengaged from its shaft, according as it is rotated in the proper or retrograde direction. Thus, when the drum is rotated in the proper direction, the ratchet mechanism couples the drum with the shaft to rotate the same; but when the drum is driven in the reverse direction the ratchet mechanism automatically uncouples the drum from the shaft, so that the latter is not rotated in the same direction with the drum, and the drum turns freely on the shaft. The drums are arranged to be alternately coupled with their shafts. Thus, when the float rises one drum is coupled with its shaft to rotate the same, while the other drum is uncoupled from its shaft and rotates freely thereon in the reverse direction, and when the float falls the last-named drum is coupled to its shaft to drive the same in the same direction that the first-named drum drove its shaft, while at the same time the first-named drum is uncoupled from its shaft and turns freely thereon in the reverse direction. The shafts of the two winding-drums are thus alternately rotated and always in the same direction, and these two shafts are coupled to a common power-shaft in any well-known manner, so that the latter shaft is rotated in one direction continuously for driving suitable contrivances or machinery.

I will now proceed to describe my preferred construction of drum and ratchet mechanism.

Each drum consists of a circular peripheral shell, *h*, having an annular flange, *h'*, at each edge to prevent displacement of the cable, and two lateral plates, *i i'*, which are disposed parallel to each other and secured together by through bolts or shafts i^2, the parts being bound and secured together in such firm and rigid manner as to form a light strong drum. The drum is fitted loosely on the driven shaft on which it is mounted, so as to turn freely thereon, and within the drum is contained the ratchet mechanism K for alternately coupling and uncoupling the drum to the shaft. The ratchet *k* of the ratchet mechanism is fixed or keyed to the shaft F or G, so as to rotate or turn therewith, and around this ratchet are disposed a series of pawls, *k'*, which are carried by disks L, and are arranged to simultaneously engage with and be disengaged from the ratchet, in the manner presently specified. Two of these disks L are provided for each drum, which are arranged on opposite sides of the ratchet within the winding-drum, and these disks are loosely mounted on the shaft F or G, so as to turn freely thereon. The disks are of greater diameter than the ratchet, and in their periphery they are formed with coincident notches or slots *l*, which correspond in number to the through bolts or shafts i^2. These bolts or shafts of the winding-drum fit in the notches of the loose disks, and said notches or slots are of greater length than the transverse diameter of the bolts or shafts, so as to permit the shafts to have a limited play or movement in the notches or slots, the bolts or shafts bearing against the shoulders formed by the notches and serving to impel the loose disks to rotate or turn in either direction with the winding-drum. The pawls are each mounted on a separate pivot, *l'*, which is fixed to the loose disk, and each pawl has two extended arms or lugs, *m*, which project toward the periphery of the drum and embrace the through bolts or shafts i^2 of the winding-drum. The functions of these extended arms or lugs of the pawls is to positively force or move the pawls on the pivots *l'* when the drum is rotated in the retrograde direction, so as to elevate the free ends of the pawls from engagement with the ratchet and to positively hold the pawls in such disengaged position to

prevent any clicking noise during the reverse rotation of the drum, and thereby make it absolutely noiseless. It will be understood that the shafts or bolts of the drum are free to move a limited distance in the notches or slots of the pawl-carrying disks, and when the drum is being rotated in the proper direction these bolts impinge against one end of the notches to throw the arms *m* of the pawls forward, and thus positively depress the pawls into engagement with the ratchet, and to hold them in this position as long as the drum is rotating in the proper direction; but when the drum is rotated reversely the bolts or shafts are shifted to the opposite end of the slots or notches in the pawl-carrying disks, to thereby throw the arms *m* of the pawls rearwardly, and thus turn the pawls on their pivots and elevate the free ends thereof out of engagement with the ratchet. The pawls are thus positively and automatically controlled by the rotations of the winding-drum, and they are held in their adjusted positions and prevented from slipping over the teeth of the ratchet, to thereby render the ratchet mechanism absolutely noiseless and reliable in action.

The loose pawl-carrying disks are arranged a short distance from the lateral face-plates of the winding-drum to leave annular spaces or chambers on each side of the same, in which a lubricant can be placed to lubricate the ratchet mechanism.

To the opposite ends of the driven shafts F G are secured crank-disks N, having suitable crank-pins, to which are connected one end of the pitmen O, which are pivotally connected at their opposite ends on suitable crank-pins of similar disks, P, that are fixed to the ends of a common power-shaft, Q, which is journaled in suitable bearings and carries a fly-wheel, Q′.

The operation of my invention will be readily understood from the foregoing description, taken in connection with the drawings. When it is desired to use the motor, the valve-rods are operated by hand to adjust the valves or gates and open the ports to admit the waves or tide-water to the reservoir, and thereby cause the float to reciprocate therein. As the float rises in the reservoir, it operates the pitman D, the cross head connected thereto, and the cables. The cables rotate the winding-drums, one of which is coupled to its shaft by the ratchet mechanism to rotate said shaft in one direction, and the other drum turns freely on its shaft. On the descent of the float the cables again rotate the winding-drums, the first-mentioned drum being automatically uncoupled from its shaft and turning freely thereon, while the last-mentioned drum is coupled to its shaft to turn the latter in the same direction as the first-mentioned shaft was rotated by its drum. The two shafts are thus alternately driven by their drums in one and the same direction, and the common power-shaft is driven continuously in one direction by these alternately-driven shafts.

The valves or gates remain open as long as it is desired to use the motor, and it is only necessary to close said gates in order to prevent the waves or tide-water from influencing or operating the float, the motor being thus placed under the control of the operator, who can stop and start the same by simply adjusting the valves or gates.

Changes in the form and proportion of parts of the devices herein shown and described as an embodiment of my invention can be made without departing from the spirit or sacrificing the advantages thereof.

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

1. In a hydraulic motor, the combination of a reciprocating float, a cross-head guided in suitable ways, a pitman connected to the float and cross-head, the driven shafts each carrying a winding-drum, and cables passed over the drums and connected with the float and cross-head, substantially as described.

2. In a hydraulic motor, the combination of a reciprocating float operating in a suitable reservoir and guided therein, a cross-head guided in suitable ways, a pitman intermediate to the float and cross-head, two driven shafts, each carrying a winding-drum, and cables wound around the drums in reverse directions and connected with the float and cross-head, substantially as described.

3. The combination of a shaft carrying a ratchet, which is fixed thereto, pawl-carrying disks loosely mounted within the drum and having one or more pawls, and a winding-drum mounted on the shaft and connected with the disks and pawls, substantially as described, to adjust and hold the pawls in their proper positions according to the direction in which the drum is rotated, substantially as described.

4. The combination of a shaft carrying a ratchet, a winding-drum mounted on the shaft to turn freely thereon, and a series of pawls carried by an independent support within the drum and connected with the latter, as described, the pawls being constructed to engage the ratchet when the drum is rotating in one direction and to be lifted clear of the ratchet when the drum is turning in the reverse direction, substantially as described.

5. The combination of a shaft carrying a ratchet, a drum loosely mounted on the shaft to turn freely thereon, loose disks mounted on the shaft within the drum, and a series of pawls pivoted on the loose disks and connected with the drum to be controlled thereby, substantially as described.

6. The combination of a shaft carrying a ratchet, the disks loosely mounted on the shaft and having the slots or notches, the pivoted pawls carried by said disks, and a winding-drum having the transverse shafts or bolts

which fit in the notches of the disks and engage the pawls to lift the latter from the ratchet when the drum is rotated reversely, substantially as described.

7. The combination of a shaft carrying a ratchet, the notched or slotted disks mounted thereon, the pivoted pawls carried by the disks and having the extended arms, and a winding-drum inclosing the disks and ratchet and having the transverse shafts or bolts which fit in the notches of the disks and between the lifting-arms of the pawls, substantially as described.

8. In a hydraulic motor, the combination of a reciprocating float, two driven shafts, a winding-drum loosely mounted on each shaft and having ratchet mechanism housed therein for alternately coupling and uncoupling the drum to the shaft, a reciprocating cross-head arranged above the driven shafts and connected with the float by an intermediate rod, cables secured at their ends to the float and cross-head and wound in reverse directions around the drums at an intermediate point of their length, and a power-shaft common to both driven shafts and connected therewith by an intermediate pitman, substantially as described, for the purpose set forth.

9. In a hydraulic motor, the combination of a reciprocating float operating in a reservoir and guided therein, upright ways or guides, a cross-head sliding on said ways or guides, a pitman fixed on the float and passing through the cross-head, cushion-springs interposed between said cross-head and the pitman, the driven shafts each carrying a winding-drum, and the cables passed over the drums and connected at one end to the cross-head and having a spring-connection at their opposite ends with the float, substantially as described.

10. In a hydraulic motor, the combination of a reciprocating float, the two driven shafts having crank-disks at their ends, a winding-drum mounted on each shaft, cables connected with the float and passing over the winding-drums, a power-shaft common to both driven shafts, and pitmen connecting the power and driven shafts, substantially as described.

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

FELIX STARKENBERG.

Witnesses:
HENRY J. KILLILEA,
ANNA O'TOOLE.