No. 626,162. Patented May 30, 1899.

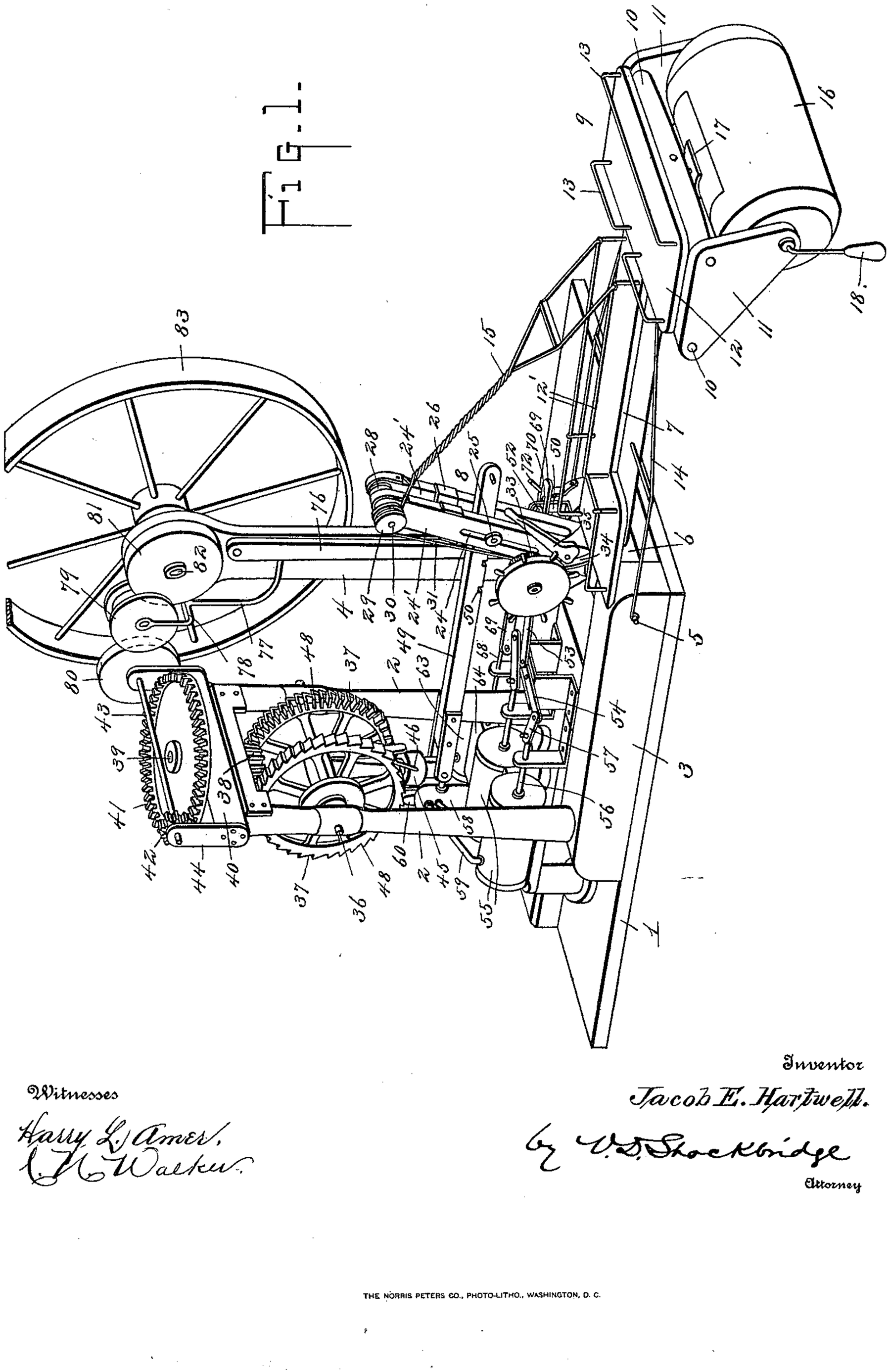
J. E. HARTWELL.

WAVE MOTOR.

(Application filed May 6, 1898.)

(No Model.) 4 Sheets—Sheet 1.

FIG. 1.



Witnesses

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4 Sheets—Sheet 2.

FIG. 5.

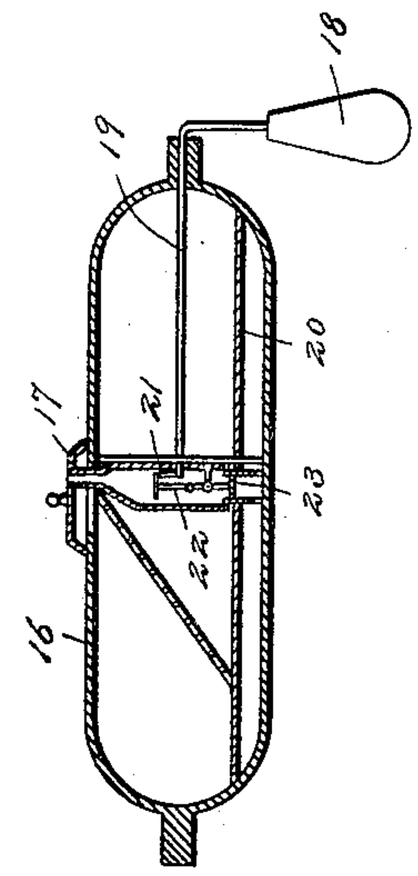
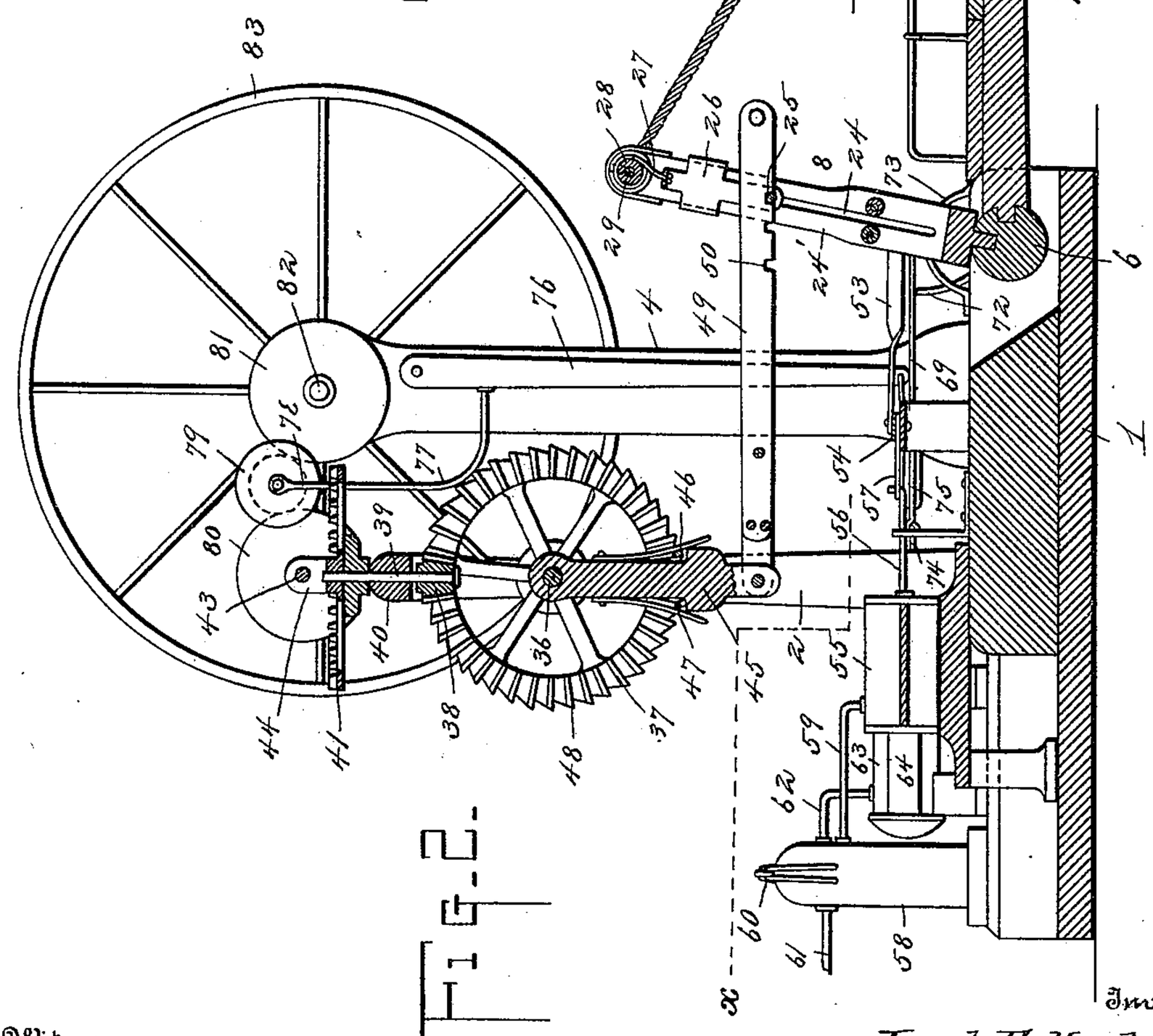


FIG. 2.



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4 Sheets—Sheet 3.

FIG. 6.

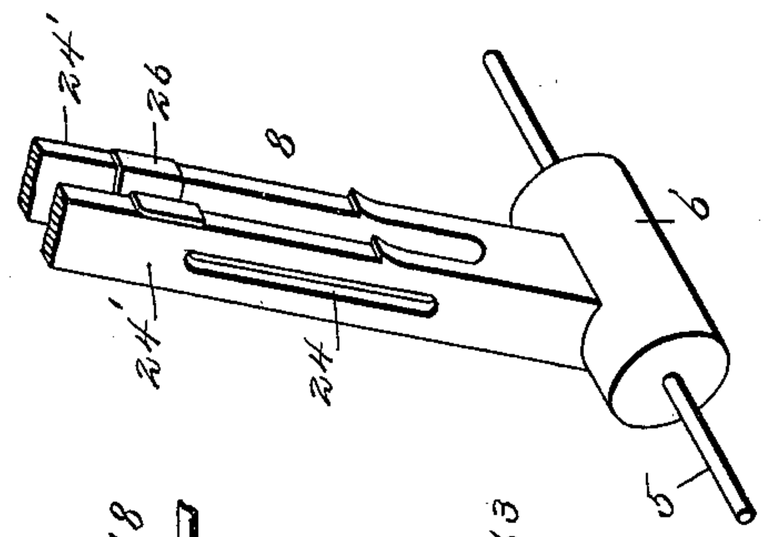


FIG. 9.

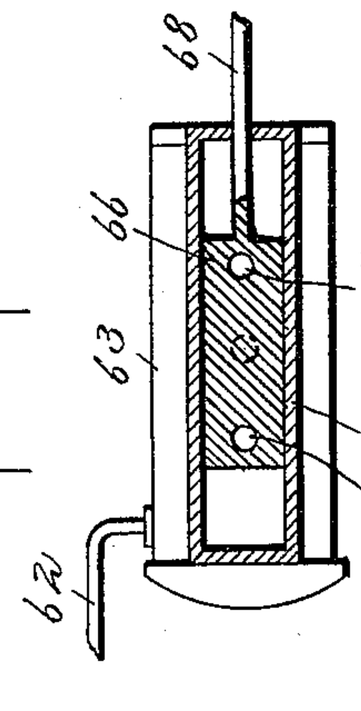


FIG. 10.

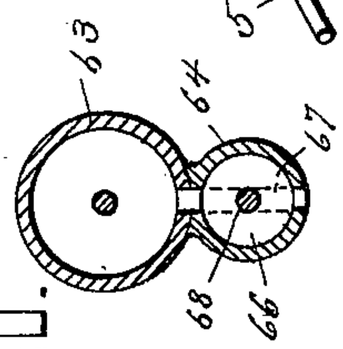
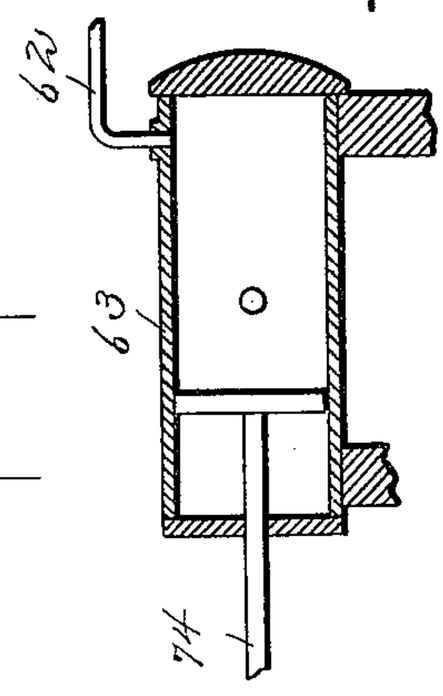


FIG. 7.

FIG. 8.



Witnesses

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4 Sheets—Sheet 4.

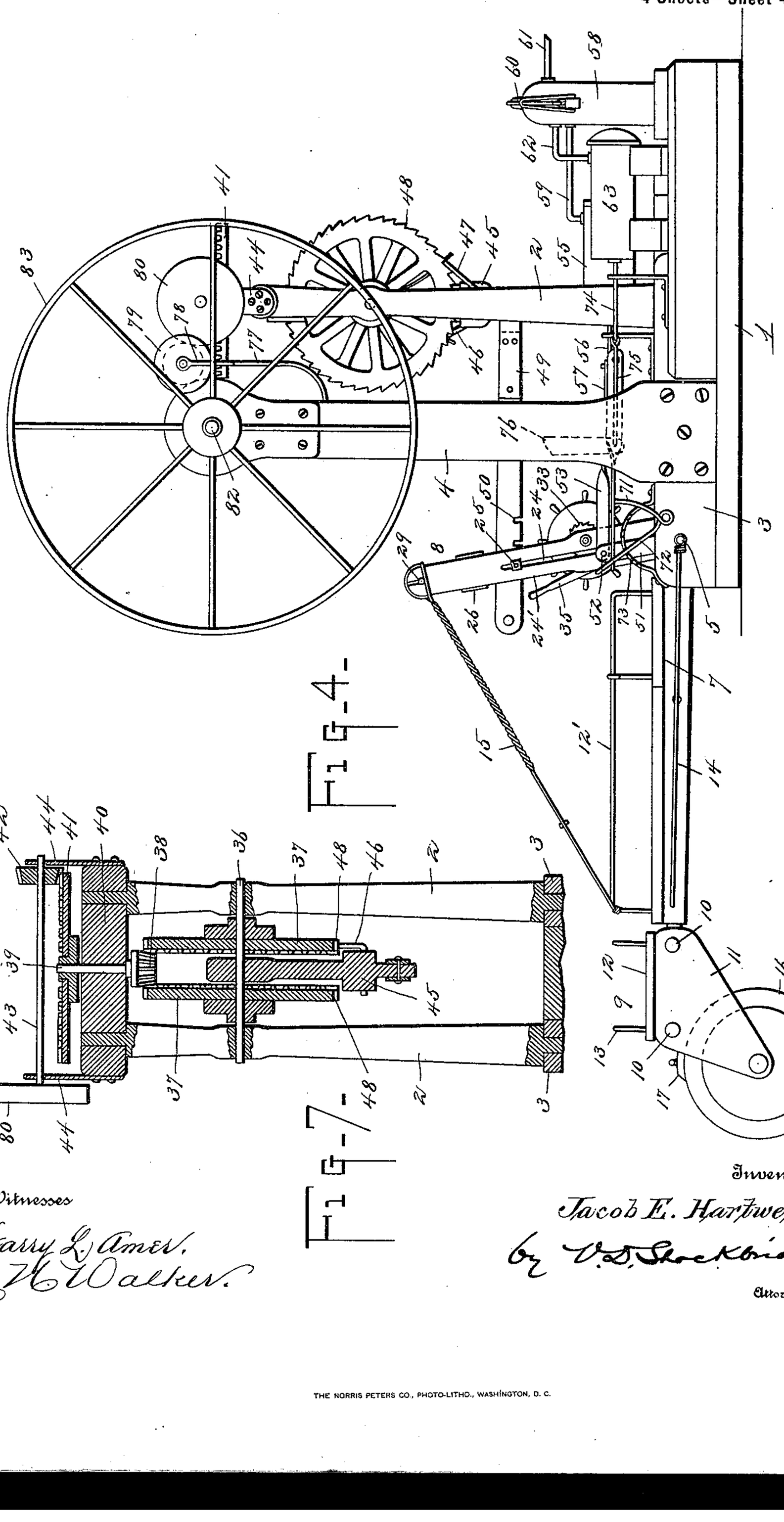

FIG. 4.

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UNITED STATES PATENT OFFICE.

JACOB E. HARTWELL, OF TROY, MONTANA.

WAVE-MOTOR.

SPECIFICATION forming part of Letters Patent No. 626,162, dated May 30, 1899.

Application filed May 6, 1898. Serial No. 679,944. (No model.)

To all whom it may concern:

Be it known that I, JACOB E. HARTWELL, a citizen of the United States, residing at Troy, in the county of Flathead and State of Montana, have invented certain new and useful Improvements in Wave-Motors; and I do hereby 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.

My invention is designed for the production of a wave-motor by means of which the power exerted by the incessant movement of the waves may be utilized.

The primary object of the invention is to provide means in a motor of this character whereby a continuous movement will be imparted to the power-shaft during the upward-and-downward movement of the wave-actuated mechanism.

A further object of the invention is to provide means whereby the position of the float may be regulated according to the condition of the tide and means whereby the length of stroke may be controlled according to the height of the tide and the size of the wave.

A still further object of the invention is to provide means for automatically disconnecting the drive-shaft from the power-transmitting mechanism when a wave of unusual size acts upon the float.

Other objects and advantages of the invention will hereinafter appear.

The invention consists of the construction, combination, and arrangement of parts which will be hereinafter more fully described and claimed.

In the drawings forming a part of the specification, Figure 1 represents a perspective view of my improved motor in operative position. Fig. 2 is a vertical central longitudinal section through the same. Fig. 3 is a horizontal section taken on the line *x x* of Fig. 2, the same extending through the frame, just above the air-pumps thereon. Fig. 4 is an elevation looking from the side upon which the fly-wheel or governor is located. Fig. 5 is a vertical longitudinal section through the main float. Fig. 6 is a detail perspective view, partly in section, of the walking-beam or power-transmitting arm mounted upon the main frame. Fig. 7 is a vertical sectional view through the uprights or standards on the main frame. Fig. 8 is a longitudinal sectional view through the air-compression cylinder, the drum, and the parts connected thereto. Fig. 9 is a similar section through the valve-chest communicating with said cylinder. Fig. 10 is a cross-section through the compression-cylinder and valve-chest.

Like reference-numerals indicate like parts in the different views.

In carrying out my invention I provide a frame which is secured in any suitable manner to the shore adjacent to the beach, the said frame comprising a base 1, a pair of substantially parallel uprights 2 2, longitudinally-extending parallel beams 3 3, and an upright 4, in which the drive-shaft carrying the fly-wheel is mounted. Connecting the outer ends of the beams 3 3 is a horizontally-disposed rod or shaft 5, upon which is mounted a drum or roller 6, to which are secured a float-supporting beam or arm 7 and the walking-beam or power-transmitting arm 8, the float-supporting arm or beam extending outwardly and the power-transmitting arm upwardly, so that they are at substantially right angles one to the other. Pivotally connected to the outer end of the beam 7 is the float-frame 9, comprising the parallel bars 10 10, the downwardly-extending parallel side arms 11, and a platform 12, as clearly shown. The said frame is so connected with the beam 7 that a pivotal movement thereof in a plane at right angles to said beam is permitted. Upon the upper side of the beam 7 suitable hand-rails 12′ are provided, and similar rails 13 are provided upon the platform 12. The outer ends of the shaft 5 project beyond the sides of the beams 3 3, and bracing wires or cables 14 connect said shaft with the outer end of the beam 7. Suitable bracing wires or cables 15 also connect the outer end of the beam 7 with the upper end of the beam or power-transmitting arm 8. The bracing wires or cables 15′ are so located that they will not obstruct the passage along the platform on the beam 7. Pivotally mounted in the float-frame 9 and located between the side arms 11 11 thereof is the main float 16, which is formed hollow and of any suitable material. The opening on the upper side thereof may be closed by a suitable hatch 17, as clearly shown. In con-

nection with the main float 16 I employ an auxiliary or supplemental float 18, the same being connected to the outer end of a shaft 19, which extends longitudinally into the main float 16 and is mounted in suitable bearings therein. Adjacent to its point of connection with the main float the said shaft is bent at right angles, forming two arms, upon the outer of which the float 18 is secured. By this construction it will be seen that a rocking movement will be imparted to the shaft 19 by the action of the waves upon the float 18. The inside of the main float 16 is provided with a false bottom 20, beneath which rocks or other suitable ballasting material may be placed, the object of the ballast being to retain the float at all times in its upright position or, rather, in a position so that the hatch 17 will be at all times uppermost. The ballast is also provided for the purpose of causing the downward movement of the float 16 upon the recession of the waves to exert the same power as the upward movement thereof does. Formed upon the inner end of the shaft 19 is a crank-arm 21, to which is connected a suitable piston-rod 22 of an ordinary pump 23, the object of this pump and its connections with the float 18 being to pump the water from the main float 16 in case any should enter the same.

The walking-beam or power-transmitting arm 8 is formed of two parallel sections, which are suitably connected to the drum 6 and are provided with oppositely-disposed elongated slots 24 24. Within these slots fits and moves a transverse pin 25, connected to the lower ends of guide-plates 26 26, located between the two sections of the beam 8. Connected to the upper end of said guides is a wire or cable 27, which passes around a pulley 28, secured to a transverse shaft 29, connecting the upper ends of the sections 24′ of which the beam 8 is made. Upon the outer end of the shaft 29 is a pulley 30, to which is connected a wire or cable 31, which passes downwardly therefrom and is wound upon a winch or windlass 32, suitably mounted at the lower end of the beam 8. Said windlass is provided with a ratchet-wheel 33, which is engaged by a spring dog or pawl 34 for preventing backward movement thereof. The said dog is controlled by a cam-lever 35, fulcrumed upon the beam 8 at a point near its lower end, said lever being provided for the purpose of throwing said dog out of engagement with said ratchet-wheel when desired. By the mechanism described it will be seen that by turning the winch or windlass 32 in one direction or the other the guides 26, carrying the transverse pin 25, may be raised or lowered for a purpose which will hereinafter appear.

Mounted loosely upon a shaft 36, connecting the uprights 2 2 at points near their upper ends, are two parallel crown-gears 37 37, whose teeth are formed upon their adjacent faces. The said gears mesh with a pinion 38 upon a vertical shaft 39, mounted in bearings in a cross-beam 40, connecting the upper ends of the uprights 2. The upper end of the shaft 39 carries a crown-gear 41, which meshes with a pinion 42, secured to the horizontally-disposed shaft 43, mounted in brackets 44 on the cross-beam 40. Also loosely mounted on the shaft 36 and located between the crown-gears 37 is a ratchet-lever 45, which carries at points near its free end the oppositely-disposed spring-actuated ratchet-blocks 46 47, which are adapted to engage, respectively, ratchet-teeth 48 upon the peripheries of the crown-gears 37. The said ratchet-blocks are so disposed upon the ratchet-lever 45 that upon the movement of said lever in one direction one of said gears 37 will be turned and upon the opposite movement thereof the other will be turned, the action of the gears 37 being to rotate the shaft 39, upon which the pinion 38 is mounted, always in the same direction. The free end of the ratchet-lever 45 is connected through a pitman 49 with the walking-beam or power-transmitting arm 8. The means of connection is through the adjustably-mounted transverse pin 25, which fits within slots or notches 50 upon the under side of said pitman.

From the foregoing description it will be seen that the upward-and-downward movement of the float 16, caused by the waves, will through the float-beam 7 transmit a rocking motion to the drum 6, which motion will be imparted to the power-transmitting arm 8 and thence through the pitman 49 to the ratchet-lever 45, the crown-gears 37, pinion 38, shaft 39, gear 41, and pinion 42 to the shaft 43. As the tide rises and falls the mean level of the float 16 will vary and the stroke of the power-transmitting arm 8 will be lengthened or shortened, according to the height or size of the waves. In order to compensate for these variations, the mechanism heretofore described for connecting the power-transmitting arm 8 with the ratchet mechanism has been designed. For example, when the tide is high the pitman 49 will be connected to the transverse pin 25 in one of the notches nearer its point of connection with the ratchet-lever 46, and when the tide is low the connection will be in one of the notches or slots adjacent to the outer end of said pitman. The length of stroke is controlled by raising or lowering the guides 26, which carry the transverse pin 25, through the medium of the windlass 32 and its connections with said guides, so that the arc of movement of the point of connection between the pitman 49 and the arm 8 will be lengthened or shortened.

It has been the experience of all who have watched the movement of the waves upon a beach that every fourth or fifth wave is larger or higher than the others. Some means must be provided, therefore, for preventing the drive-shaft from being affected by this irregularity in movement of the power-sup-

plying agent. The mechanism I have provided for this purpose is as follows: Secured to the drum 6, preferably at the end opposite that to which the winch 32 is secured, is a short arm 51, which is connected through a pin 52 with a pitman 53, leading rearwardly from the walking-beam or power-transmitting arm 8, the same being connected eccentrically to a horizontally-disposed rocking lever 54, mounted in a suitable bracket upon the base 1. In the rear of said bracket are located twin air compressors or pumps 55 55, whose pistons 56 56 are connected through links 57 57 with the outer ends, respectively, of the rocking lever 54, so that the rocking movement of the power-transmitting arm 8 will transmit to said piston-rods an alternating and reciprocating movement. Leading from the rear ends of the pumps 55 55 to an air drum or dome 58 are suitable pipes or conduits 59. The air-dome is provided with a safety-valve 60 in its upper end, and through the opening therein the escaping air is transmitted through a pipe 61 to a point beneath the surface of the water for the purpose of avoiding the disagreeable noise occasioned by the escape of air from said drum. Said drum communicates through a pipe 62 with an air-compression cylinder 63, having a valve-chest 64 upon one side thereof. A vent-opening leads from the longitudinal center of the cylinder 63 to said chest, and in the latter moves a valve 66, having openings 67 at its opposite ends, adapted to register with said vent-opening when it is in its extreme forward or extreme rearward position. The valve-stem 68 of the valve 66 leads forwardly and is connected to a flat rod or bar 69, having an elongated slot 70 in its forward end, within which fits and moves the short arm 51, heretofore referred to. The end of said flat rod or bar 69 may be raised or lowered for the purpose of increasing or decreasing the leverage between the arm 51 and said bar by means of a crank-lever 71, which is fulcrumed to one of the longitudinal beams 3 and is adapted to bear against the under side of said bar. Said crank-lever is provided with a handle-arm 72, which moves in contact with a toothed sector 73, secured to the beam 3, by means of which the position of the crank-lever may be controlled.

By the construction just described it will be observed that under normal conditions or with waves of normal size the movement of the power-transmitting arm 8 will have no effect upon the bar 69 and the valve 66, connected thereto. Should a wave of unusual size come, however, the arm 8 will be rocked to an unusual degree and the short arm 51, connected thereto, will be brought into engagement with one end or the other of the slot 70 and impart a longitudinal movement to the valve 66, bringing one of the openings 67 therein opposite the vent-opening between the cylinder 63 and the valve-chest 64 thereon. When this takes place, the air within the engine 63 will be released and the pressure on the piston therein relieved. The piston-rod 74 of the cylinder 63 is connected through a link 75 with the lower end of a lever 76, fulcrumed at its upper end to the upright 4 on the main frame. A short distance below the point of connection of said lever with said upright is secured a laterally-extending preferably curved arm 77, carrying a yoke 78, having a flanged friction-wheel 79 mounted in the upper end thereof. The said friction-wheel is adapted to bear against the adjacent edges of two rollers 80 and 81, mounted, respectively, upon the end of the shaft 43 and the end of the drive-shaft 82 upon the upper end of the upright 4. The outer end of the shaft 82 carries a fly-wheel or governor 83, which may also serve as a drive-wheel. The construction just described is provided for the purpose of preventing irregularity of movement in the motor from being transmitted to the drive-shaft 82. The drive-shaft 82 is connected to the shaft 43 by the frictional contact between the friction-wheel 79 and the rollers 80 and 81, the said contact being maintained by means of the pressure exerted on the wheel 79 from the compression-cylinder 63 through the piston-rod 74 thereof, the link 75, and the lever 76, whose upper end carries the wheel 79 and whose lower end is connected to said link. When an unusually large wave strikes the float 16, the power-transmitting arm 8 is rocked beyond its usual extent of movement and the arm 51 will be brought into engagement with one or the other end of the slot 70 in the rod 69, with the result that the valve 66 will be thrown to the limit of its movement in one direction or the other, bringing one of the openings 67 therein opposite the vent-opening in the cylinder 63, thereby relieving the pressure within said cylinder and removing the frictional contact between the wheel 79 and the rollers 80 and 81.

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

1. In a wave-motor, a float, a power-transmitting arm operated thereby, a rod or pitman connected to said arm for transmitting motion therefrom, a transverse pin on said arm by which the pitman is connected thereto, and a windlass and flexible connection for raising and lowering said pin and adjusting it at any point on said arm.

2. In a wave-motor, a float, a power-transmitting arm operated by said float, guides movable longitudinally on said arm, a longitudinally-adjustable pitman connected to said guides for transmitting motion from said arm, and pawl-and-ratchet mechanism for locking said guides at any point on said arm.

3. In a wave-motor, a float, a power-transmitting arm operated thereby and provided with guide-slots, movable guides on said arm, a transverse pin connecting said guides and entering and traversing said slots, means for

raising and lowering said guides, and a pitman connected to said pin for transmitting motion from the power-arm.

4. In a wave-motor, a float, a power-transmitting arm operated by said float and provided with guide-slots therein, guides on said arm, a transverse pin connecting said guides and fitting and moving in said slots, a roller mounted to turn in said arm, a cable connecting said roller with said guides, a windlass on said arm for turning said roller for the purpose of raising and lowering said guides, and a pitman connected to said pin for communicating motion from said arm, as and for the purpose set forth.

5. The combination with a shaft having a pinion thereon, of two oppositely-disposed loosely-mounted gear-wheels meshing with said pinion, and a ratchet-lever carrying dogs adapted to engage ratchet-teeth upon said gear-wheels, as and for the purpose set forth.

6. The combination with a shaft and a pinion thereon, of a pair of loosely-mounted gear-wheels meshing with said pinion and provided with oppositely-extending ratchet-teeth upon their peripheries, a ratchet-lever or pawl-arm mounted upon the same shaft with said gear-wheels, and spring-actuated blocks or dogs adapted to engage respectively the ratchet-teeth on the gear-wheels, as and for the purpose set forth.

7. In a wave-motor, the combination with a hollow float and suitable power-transmitting mechanism connected thereto, of a shaft extending longitudinally of said float and provided with a crank-arm upon its outer end, a supplemental float on said crank-arm, a pump, and connections between the piston-rod thereof and said shaft, as and for the purpose set forth.

8. In a wave-motor, the combination with a hollow float and power-transmitting mechanism connected therewith, the said float being provided with an opening in one side and having a false bottom opposite said opening, beneath which suitable ballast is located for the purpose of holding said float so that the opening therein will be uppermost, of a shaft extending longitudinally of said float having a crank-arm upon its outer end, a supplemental float on said crank-arm, a pump leading to the bottom of the hollow float, and connections between the piston-rod thereof and a crank-arm on said shaft, as and for the purpose set forth.

9. In a wave-motor, a float, a drive-shaft, power-transmitting mechanism between said float and drive-shaft, and means for automatically disconnecting the drive-shaft from said power-transmitting mechanism when a wave of unusual size acts upon the float.

10. In a wave-motor, a float, a drive-shaft, power-transmitting mechanism between the float and the drive-shaft, a friction-coupling between said shaft and said power-transmitting mechanism, and means for automatically throwing said coupling out of operative position when a wave of unusual size acts upon the float.

11. In a wave-motor, a float, a drive-shaft, and power-transmitting mechanism between the float and the drive-shaft, a friction-coupling between the drive-shaft and the power-transmitting mechanism held in operative position by air under pressure, and means for relieving the pressure of the air upon said coupling when a wave of unusual size acts upon the float.

12. In a wave-motor, a float, a drive-shaft, and power-transmitting mechanism between the float and the drive-shaft, a pulley upon the drive-shaft, a similar pulley upon a shaft forming part of said power-transmitting mechanism, a friction-wheel for coupling the pulleys on said shafts, an air-compression cylinder, a lever connected to the piston-rod of said cylinder at one end and supporting said friction-wheel at the other end, and means for automatically discharging said cylinder when a wave of unusual size acts upon the float.

13. In a wave-motor, a float, a drive-shaft, and power-transmitting mechanism between the float and drive-shaft, a friction-wheel for coupling said drive-shaft and said power-transmitting mechanism, a compression-cylinder, a lever connected at one end to the piston-rod of said cylinder and carrying said friction-wheel at its other end, and means for automatically discharging said cylinder when a wave of unusual size acts upon the float.

14. In a wave-motor, a float, a power-transmitting arm, a drive-shaft, and intermediate mechanism between said arm and said drive-shaft, an air-pump operated by the movement of said arm, an air-compression cylinder communicating therewith, a pivoted lever carrying at one end a friction-wheel for connecting the drive-shaft with the mechanism between the power-transmitting arm and said shaft and connected at its opposite end to the piston-rod of said cylinder, a short arm connected to said power-transmitting arm, a valve-chest upon the side of said air-compression cylinder and communicating with said cylinder by a central port in the latter, a valve in said chest having ports at its opposite ends, and a rod or bar connected to the outer end of the stem of said valve and provided with an elongated slot through which the short arm on said power-arm extends, as and for the purpose set forth.

15. In a wave-motor, a float, a power-transmitting arm, a drive-shaft, and intermediate mechanism between said arm and said drive-shaft, an air-pump operated by the movement of said arm, an air-compression cylinder communicating therewith, a pivoted lever carrying at one end a friction-wheel for connecting the drive-shaft with the mechanism between the power-transmitting arm and said shaft, and connected at its opposite end to the piston-rod of said cylinder, a short arm connected to said power-transmitting arm, a

valve-chest upon the side of said air-compression cylinder and communicating with said cylinder by a central port in the latter, a valve in said chest having ports at its opposite ends, a rod or bar connected to the outer end of the stem of said valve and provided with an elongated slot through which the short arm on said power-arm extends, and means for raising and lowering the free end of said rod or bar, as and for the purpose set forth.

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

JACOB E. HARTWELL.

Witnesses:
JOHN D. POSTEN,
C. A. POTTER.