No. 646,199. Patented Mar. 27, 1900.

J. C. WALKER.

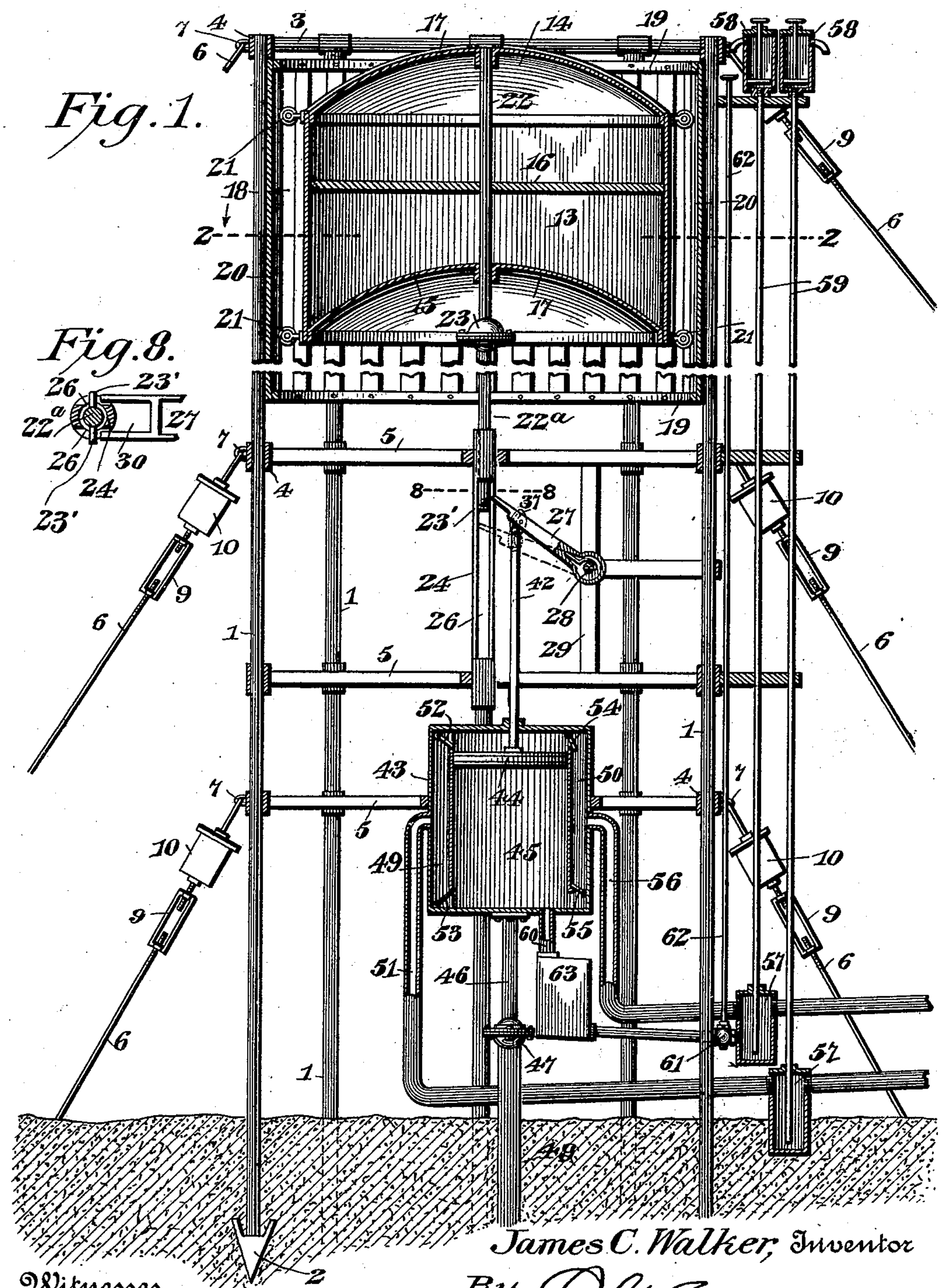
WAVE MOTOR.

(Application filed Oct. 25, 1899.)

(No Model.) 3 Sheets—Sheet I.

Fig. 1.

Fig. 8.



Witnesses
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3 Sheets—Sheet 2.

Fig. 2.

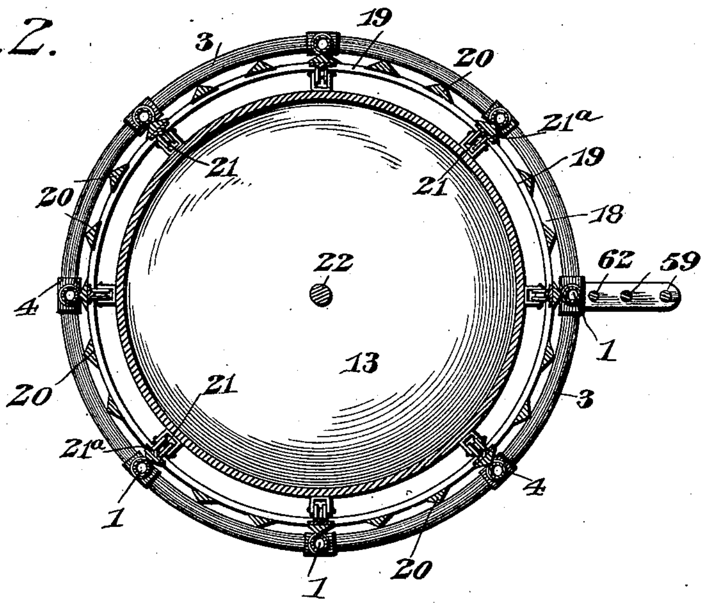


Fig. 3.

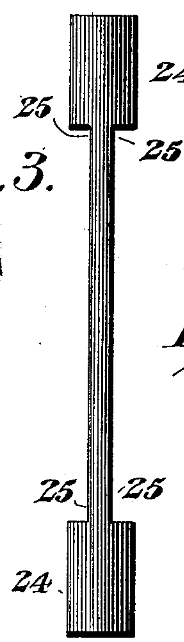


Fig. 4.

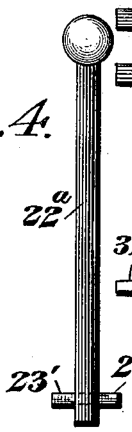


Fig. 5.

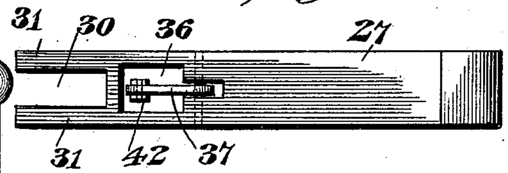
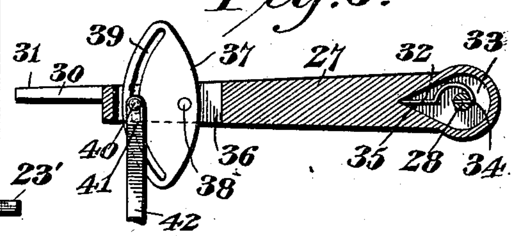


Fig. 6.



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No. 646,199. Patented Mar. 27, 1900.

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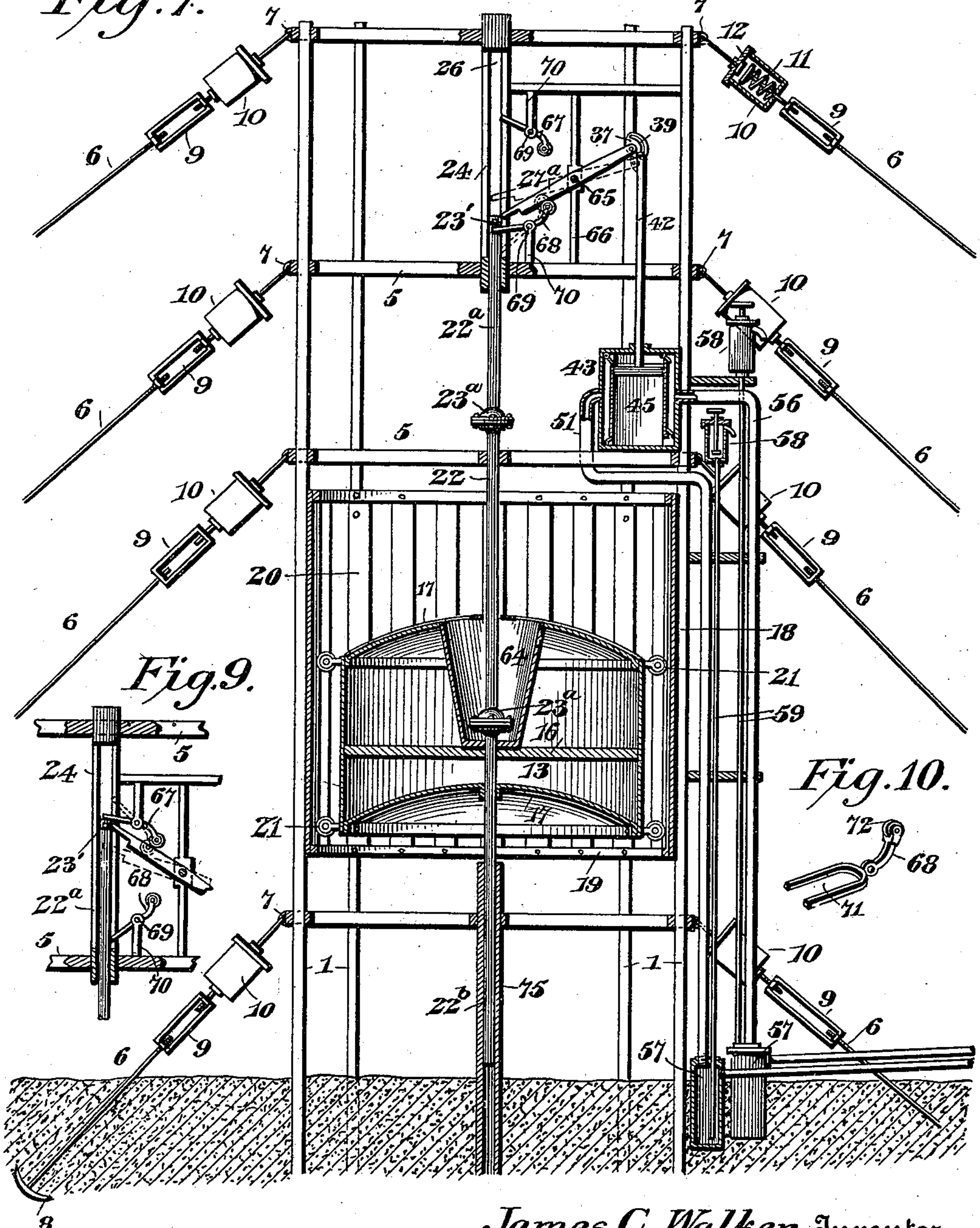
(No Model.) 3 Sheets—Sheet 3.

Fig. 7.

Fig. 9.

Fig. 10.



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UNITED STATES PATENT OFFICE.

JAMES C. WALKER, OF WACO, TEXAS.

WAVE-MOTOR.

SPECIFICATION forming part of Letters Patent No. 646,199, dated March 27, 1900.

Application filed October 25, 1899. Serial No. 734,737. (No model.)

To all whom it may concern:

Be it known that I, JAMES C. WALKER, a citizen of the United States, residing at Waco, in the county of McLennan and State of Texas, have invented a new and useful Wave-Motor, of which the following is a specification.

This invention relates to wave-motors of that type which are designed to utilize the power of the waves by transmitting the motion thereof to any suitable machinery or apparatus to be operated.

The present invention contemplates an improved wave-motor so constructed as to withstand to the greatest possible degree the impact force of the waves, so that the vibration of the working parts of the motor will be reduced to a minimum, thus insuring freedom and accuracy of operation, while at the same time utilizing to the fullest extent the lifting power of the waves. In carrying out this object the different parts of the motor are so constructed as to be practically unaffected by the vibration due to the side thrust or impact force of the waves, and the parts are so arranged as to be afforded the maximum protection.

Heretofore in the construction of wave-motors a great desideratum has been to construct a mechanism that will meet the varying movement and size of the waves induced by ordinary winds as well as by storms, and in order to meet this requirement an important object of the present invention is to equip the apparatus with improved means, whereby the varying height of the waves will be compensated for without affecting the stroke of the machinery being operated, while also providing means whereby the power-transmitting parts of the motor will be automatically thrown out of action at the end of each full stroke of the driven element, thereby permitting the float or buoy to rise to the crest and fall to the trough of the highest storm-wave without straining any of the parts of the machinery or affecting the stroke of the driven element. Each stroke is thus always made uniform and definite, irrespective of the height of the waves.

With these and many other objects in view, which will more readily appear as the nature of the invention is better understood, the same consists in the novel construction, combination, and arrangement of parts hereinafter more fully described, illustrated, and claimed.

The fundamental features of the present invention are necessarily susceptible to a variety of modifications, and various arrangements of the different parts may be resorted to without departing from the spirit and scope of the invention; but the preferred embodiments of the improvements are shown in the accompanying drawings, in which—

Figure 1 is a vertical sectional view of a wave-motor constructed in accordance with the present invention and showing one way of arranging the different parts for securing the desired operation. Fig. 2 is a cross-sectional view on the line 2 2 of Fig. 1. Fig. 3 is a detail elevation of the stationary slotted guide-tube for the stem of the float. Fig. 4 is a detail elevation of a section of the float-stem coöperating with the stationary guide-tube. Figs. 5 and 6 are detail views of the form of power-transmitting lever and the parts connected therewith which are utilized in the form of the invention shown in Fig. 1 of the drawings. Fig. 7 is a view similar to Fig 1, showing a modified arrangement of the working parts of the motor and also illustrating the preferred compensating means for maintaining a uniform stroke for the pump or driven element, irrespective of the amplitude of movement of the float and its stem. Fig. 8 is a detail sectional view on the line 8 8 of Fig. 1. Fig. 9 is an enlarged detail elevation of the power-transmitting or compensating mechanism shown in Fig. 7 of the drawings. Fig. 10 is a detail in perspective of one of the pivotal trip-levers forming a part of the mechanism shown in Fig. 9.

Like numerals of reference designate corresponding parts in the several figures of the drawings.

In carrying out the present invention the supporting frame or framework for the motor is designed to be constructed and braced in such a manner as to provide a structure capable of withstanding the heaviest seas, while at the same time possessing sufficient rigidity to have a minimum amount of vibration, so as not to materially affect the free operation of the working parts of the motor. To secure this necessary result, the supporting-frame for the motor consists of a plurality of upright standards or piles 1, grouped in an annular or circular series and preferably fitted at their lower ends with anchor-points 2, which are firmly embedded in the sea-bottom to provide for securely holding the standards in position. The annular or circular series of frame-standards 1 may extend a sufficient height above the level of the water to accommodate the full movement of the float or buoy of the motor under normal as well as abnormal conditions of the sea and to provide for rigidly joining the several standards to make a structure of sufficient strength for the purpose. The said standards are connected by a plurality of annular braces 3, extending completely around the entire series of standards and fitted thereto by means of suitable couplings 4. In addition to the annular braces 3, encircling the series of standards 1, a number of interior cross-braces 5 may be employed, which are arranged within the framework and have suitable arm connections with the standards. It will of course be understood that any number of interior braces, as well as any number of annular braces, may be utilized in strengthening and rigidly joining together the standards. So it will be understood that the invention is not restricted to the specific arrangement and number of braces illustrated, for instance, in Figs. 1 and 2 of the drawings.

While the braces described firmly couple together the standards 1 and in connection therewith provide a strong rigid framework, it is preferable to make provision for bracing the upstanding framework against the impact force of the waves which strike the same laterally. This may be effectively accomplished by the employment of a series of inclined guy-lines 6 in connection with each of the upright standards 1. A series of the inclined guy-rods or cables 6 are arranged for use with each upright standard 1 and are located at suitable distances apart to properly distribute the strain upon the different lines or cables. Each of the guy-rods or cables 6 is suitably coupled at its upper end, as at 7, to a convenient point of attachment on the standard 1 with which it is associated, while the lower end of said guy-rod or cable has fitted thereto an anchor-point 8, firmly embedded in the sea-bottom, similar to the anchor-points for the standards of the framework. To render the guy-rods or cables 6 effective under all conditions, each of the said rods or cables is provided with a turnbuckle 9, which may be tightened from time to time to take up any slack in the rod or cable which may have been occasioned by the straining of the structure, and in order to compensate for any contraction and expansion that may take place and to assist in always maintaining the guy-rods or cables taut each of the same is further provided with a spring compensating device 10, consisting of a compensating spring 11, fitted on one section of the rod or cable, and a spring-boxing 12, attached to an adjacent section of the rod or cable and housing therein the said spring, while at the same time permitting of the free expansion and contraction thereof.

The open framework just described is of a sufficient size to freely receive therein a vertically-reciprocating float or buoy 13, which rises and falls with the waves and through the medium of the connections to be described is designed to transmit this motion to the machinery to be operated. The vertically-reciprocating float 13 essentially consists of a cylindrical air and water tight body provided with dished or upwardly-concaved top and bottom portions 14 and 15, respectively, and in order that the float-body may be of sufficient strength to resist any lateral strain that may be placed thereon, as well as to meet all conditions required thereof in the operation of the motor, the same may be provided with suitable interior braces 16, extending transversely across the interior thereof, as well as with suitable braces or ribs 17 at the top and bottom thereof; but it will of course be understood that the float-body may be reinforced by means of other braces or reinforcing members should this be found necessary in the practical construction of the machine.

The upright framework, consisting of the standards 1 and the braces associated therewith, is open and allows the waves to freely pass through the same and affect the float or buoy 13 therein; but in order to secure the maximum protection for the said buoy the skeleton protective curb 18 is employed. In the form of the invention shown in Fig. 1 of the drawings the protective curb 18 is arranged inside of the open framework, within the upper end portion thereof, and is of a sufficient length to accommodate the vertical play of the float under all conditions. The said protective skeleton curb for the float is bolted or otherwise rigidly secured to the standards 1 of the framework, so as to constitute an immovable or rigid part of the structure within which the float works, and the said curb essentially consists of a plurality of horizontal concentric annular ribs 19 and a circular series of regularly-spaced upright slats 20, bolted or otherwise suitably fastened to the said ribs. The upright slats 20 of the curb 18 are preferably of a triangular shape in cross-section, with their apices disposed outwardly, as plainly shown in Fig. 2 of the drawings, so as to permit the water to freely enter the spaces confined therein and act upon the float, while at the same time serving to break the impact force of the oncoming wave and reduce the lateral shock or thrust upon the float. Also by reason of the protective curb 18 completely surrounding the space within which the float works the same protection is afforded to the float, irrespective of the angle or direction from which the wave approaches.

To secure a steady reciprocation of the float within the curb or casing with a minimum amount of friction, the float-body has fitted at the upper and lower ends thereof an annular series of grooved antifriction guide-rollers 21, the grooves of which receive and travel upon track-rails 21^a, which are fastened to the inner side of the protective curb, preferably opposite each upright standard 1 of the framework, as illustrated in Fig. 2 of the drawings. On account of the employment of the annular series of the grooved guide-rollers 21 the said rollers not only hold the float to a reciprocation in a fixed path and prevent binding thereof within its curb or casing under the impact or shock of an oncoming wave, but also prevent axial turning or twisting of the float during the operation of the machinery.

In order to transmit the motion of the float to the apparatus or machine to be driven, the same has fitted centrally therein a stem 22. This stem extends vertically through the central portion of the float and is fitted in the dished top and bottom portions thereof by water and air tight joints, and this stem is preferably formed in sections coupled together by a ball-and-socket or equivalent universal joint 23, arranged exterior to and below the float in the form of the invention shown in Fig. 1 of the drawings. Referring particularly to this form of the invention, it will be observed that the float-stem section 22^a below the ball-and-socket or equivalent universal joint 23 is provided at its extremity with tappet-lugs 23′, projecting from opposite sides thereof, and works within an upright stationary guide-tube 24. The upright stationary guide-tube 24 is rigidly fitted to the interior bracing of the framework, so as to always retain a fixed position with reference to the parts associated therewith, and the said stationary guide-tube is of a sufficient bore or interior diameter to freely receive the reciprocating float-stem section carrying the tappet lugs or pins 23′. The end of the float-stem section 22^a playing within the stationary guide-tube 24 has no direct connection with any other part, so that the float can rise and fall on the highest wave without straining any part of the machinery or varying the stroke thereof, as will be hereinafter more fully explained. To provide for transmitting motion from the reciprocatory float-stem to the other parts of the motor, the guide-tube 24 is cut away longitudinally upon opposite sides thereof, as at 25, for the greater portion of its length to produce longitudinal side slots 26, through which the tappet-lugs of the reciprocatory float-stem project. The said longitudinally-slotted side portions 26 of the stationary guide-tube 24 are designed to be of a length equaling the height of the highest storm-waves, and in setting up the form of apparatus shown in Fig. 1 of the drawings for use the guide-tube is arranged in such a position that the upper ends of the side slots 26 thereof will lie in the plane of the crest-line of the highest waves, while the lower ends of said slots will lie in the plane of the trough-line of said waves, thereby permitting the tappet-lugs 23′ of the float-stem to have a free play under normal as well as abnormal conditions of the sea. In connection with the slotted guide-tube and the float-stem section working therein there is used an oscillatory or swinging power-transmitting lever 27. In the form of the invention shown in Fig. 1 of the drawings the power-transmitting lever 27 is arranged at one side of the guide-tube 24 and is pivotally mounted at one end on a fixed axle 28, fitted to suitable frame-supports 29, arranged within the framework of the motor and in the plane of the median line between the upper and lower ends of the slots 26 of the guide-tube. The said swinging power-transmitting lever 27 is provided at its free swinging end with a fork 30, embracing the intermediate reduced portion of the guide-tube 24 at one side thereof and having its side arms 31 working, respectively, at the opposite cut-away sides of the tube, so as to coöperate with the oppositely-projecting tappet-lugs 23′ of the float-stem in the manner to be presently explained. In the operation of the motor it is necessary when the fork 30 of the power-transmitting lever is released or disengaged from the tappet-lugs 23′ to move said lever in a direction toward the horizontal plane of its pivotal support to provide for resetting the lever in a position for being actuated on the reverse movement of the float. Different expedients may be resorted to for accomplishing this result, and in the form of the invention now being described and shown in Fig. 1 of the drawings this expedient consists of a resetting-spring 32. The resetting-spring 32 is housed within a chamber 33, formed within the pivoted end of the power-transmitting lever, and this chamber is made perfectly water-tight to protect the spring from the corrosive action of the water. One end of the resetting-spring 33 is secured fast, as at 34, to the pivoted axle 28 of the lever and is arched over said axle, the opposite end of the spring engaging in a recess 35 at one side of the chamber 33, so that the tension of the spring may be normally exerted on the lever in a direction so as to tend to normally move it toward the horizontal plane of the pivot.

Contiguous to its forked end the power-transmitting lever shown in Figs. 1, 5, and 6 of the drawings is provided with an elongated opening 36, within which is arranged a coupling-link 37. The coupling-link 37 is of an elongated form and extends above and below the power-transmitting lever to which it is fitted, the said link being mounted at a point intermediate its ends on a pivot-pin 38, fitted in the power-transmitting lever. The pivot-pin 38 for the coupling-link 37 is disposed at one side of the longitudinal axis of the latter, and at the opposite side of its axis the said elongated coupling-link is provided with a longitudinally-disposed arcuate slot 39, which loosely receives therein a coupling-pin 40, fitted in the upper bifurcated end 41 of the reciprocating piston-rod 42 of the air-pump 43, which preferably forms a part of the apparatus or motor. The piston-rod 42 of the air-pump 43 carries at its lower end the piston 44, working within the cylinder 45. The cylinder 45 of the air-pump is securely braced in a fixed position within the framework of the motor, and in the arrangement of parts shown in Fig. 1 of the drawings the said cylinder has connected to the lower end thereof a depending pump-foot 46, having a ball-and-socket or other universal-joint connection 47 with the upper end of the anchor-post 48, which is firmly anchored in the sea-bottom. The pump-foot 46 and the anchor-post 48 provide a firm support for the pump-cylinder to obviate the possibility of the same being displaced, and at this point it may be well to observe that the ball-and-socket or other universal-joint connection 47 for the pump-support, as well as the similar joint connection 23 for the section of the float-stem, provide means for insuring an approximately-uniform operation of the pump, irrespective of the irregular lateral strain imposed on the parts of the motor by the impact or side thrust of the waves.

The pump-cylinder 45 is provided at opposite sides of the piston-chamber thereof with the oppositely-located air inlet and outlet chambers 49 and 50, respectively, the air-inlet chamber 49 having connected therewith one end of the air-supply pipe 51, which extends from its connection with the cylinder to a point on the shore to provide means for conducting the necessary supply of air to the pump. At its upper and lower ends the air-inlet chamber 49 of the cylinder is provided with the reversely-operating inlet-valves 52 and 53, respectively, which control the ports or passages leading from the chamber 49 into the main piston-compartment of the pump. The air-outlet chamber 50 of the cylinder is also provided at the upper and lower ends thereof with the reversely-operating valves 54 and 55, respectively, which control the discharge or outlet of air from the piston-compartment of the cylinder into the chamber 50, from which chamber the air is conducted through a delivery-pipe 56 to the storage-reservoir or other desired point arranged on the shore.

Both the air supply and delivery pipes 51 and 56 have interposed in the line thereof at a suitable point a water-trap 57, into which any water will collect that may have worked its way into the pipe.

Inasmuch as the water supply and delivery pipes of the pump are under water and are subject more or less to a constant vibration, there is liability for leakage of water at the joints; but by arranging the water-traps 57 in the line of such piping means are provided for keeping the pipes free of water, and the accumulations of water in the traps 57 may be removed from time to time through the medium of hand-pumps 58, supported at one side of the framework, above the water-line. The hand-pumps 58 are duplicates in construction, and each of the same has a suction-pipe connection 59 with one of the water-traps 57, the suction-pipe for each of said traps extending therein to a point near its bottom to insure the drawing off of substantially all the water therein. To maintain the cylinder and chambers free of accumulation of water, there is associated with the cylinder a water-drain pipe 60. This water-drain pipe 60 is connected at one end with the bottom of the air-pump cylinder 45 and at its other end is conveniently coupled to one of the water-traps 57, said drain-pipe 60 being fitted contiguous to its connection with the water-trap with a cut-off valve 61, having an extended operating-stem 62, leading above the water-line to a point adjacent to the hand-pumps 58 for convenient manipulation, whereby the valve 61 may be opened from time to time to admit of accumulations of water being forced from the air-pump cylinder on the downstroke of its piston through the drain-pipe 60 and into the water-trap 57 with which it is connected. The said drain-pipe 60 also, preferably, has interposed in the line thereof a drain-trap 63, which serves to receive and hold the accumulations of water draining from the cylinder when the cut-off valve 61 is closed.

Referring particularly at this point to the operation of the air-pump, it will be observed that the same is double-acting and provides for the discharge of the air through the delivery-pipe 56 on both the upstroke and the downstroke of the piston 44. On the downstroke of said piston the upper air-inlet valve 52 will open to admit a supply of air within the cylinder above the piston and at the same time the upper air-outlet valve 54 will close to prevent the discharge of air at this point. On the same movement of the piston 44—that is, on its downstroke—the lower of said inlet-valves 53 will close, while the lower air-outlet valve 55 will open to permit the compressed air beneath the piston to pass into the outlet-chamber 50 and thence into the delivery-pipe 56 to the point of discharge. The reverse movement or upstroke of the piston 44 will reverse the positions of all the valves—that is, opening the lower air-inlet valve 53 and closing the lower air-outlet valve 55 and closing the upper inlet-valve 52 and opening the upper air-outlet valve 54—to permit of the discharge of compressed air at the upper end of the cylinder. This operation takes place continuously, and thereby provides means for fully utilizing both the up and down movements of the float 13 as the same rises and falls upon the waves.

The power-transmitting or compensating mechanism of the power, by reason of the construction described, provides a uniform stroke for the piston of the motor irrespective of the amplitude of movement of the float. In order that a clear understanding may be had of the action of this part of the motor, reference is made at this point to the form of the invention illustrated in Fig. 1 of the drawings. Referring to this figure of the drawings, it will be assumed that a wave is just passing through the open framework and lifting the float or buoy 13 to its highest position. This movement of the float draws its stem upward, and by reason of the engagement of the tappet-lugs 23′ with the fork 30 of the power-transmitting lever 27 this lever will be swung in an upward direction, with a consequent upward pull on the piston-rod 42, thereby giving the upstroke to the piston 44 of the air-pump. The parts are so arranged that the power-transmitting lever 27 will only swing a sufficient distance to provide for the full stroke of the piston 44 in both directions, so that by the time the piston reaches its upper limit of movement the forked end 30 of the power-transmitting lever will have swung to one side of the longitudinal center of the stationary guide-tube 24, as shown in Fig. 1 of the drawings, and therefore at one side of the plane of movement of the tappet-lugs 23′. This necessarily causes the disengagement of said tappet-lugs from the forked end of the power-transmitting lever and permits the float to continue to rise if the wave is high enough without further affecting the movement of the said lever. At the moment of disengagement of the forked end of the power-transmitting lever from the tappet-lugs of the float-stem the resetting device, which is in the form of the spring 32 in the construction shown in Fig. 1, comes into play and moves the power-transmitting lever downward to the position shown in dotted lines in Fig. 1. This movement causes the side arms of the fork 30 to be again projected across the slots of the stationary guide-tube 24 and directly in the path of the tappet-lugs 23′ of the float-stem, so that on the downward movement of the latter the said tappet-lugs will again engage with the fork of the power-transmitting lever, but at the upper side of the latter. During the adjustment or resetting of the power-transmitting lever 27 to a normal position with the side arms of its fork projecting across the slots of the guide-tube the longitudinally-disposed arcuate slot 39 in the coupling-link 37 will permit the pivot-bolt 40 for the piston-rod 42 to travel from the lower end of said slot to its upper end without affecting the movement of the piston. In other words, the slot 39 in the coupling-link 37 is of a sufficient length to permit the resetting device for the power-transmitting lever to freely move said lever back to the proper working position ready for the next stroke without affecting the piston of the pump.

After the upstroke of the parts and the resetting or adjustment of the power-transmitting lever 27 to the position with the side arms 31 of its fork 30 projecting across the path of movement of the tappet-lugs 23′ as the float or buoy 13 descends into the trough of the wave the tappet-lugs will engage the fork 30 of the lever at the upper side thereof, and thereby move the same downward, which movement transmits the downstroke to the pump-piston. When the piston reaches the limit of its downstroke, the tappet-lugs 23′ again become disengaged from the fork of the power-transmitting lever and pass beneath the same, thereby freeing the lever, so that it may swing back under the influence of the resetting-spring 32 to a position with its fork lying across the path of and above the tappet-lugs ready to be engaged thereby on the next upward movement of the float or buoy, it being observed in this connection that the slot 39 in the coupling-link 37 will in this operation also permit of the upward movement of the power-transmitting lever under the influence of the spring 32 without affecting the piston of the pump. The two operations described are repeated continuously and automatically during the action of the motor, and it will be observed that while the float or buoy is permitted to rise and fall upon the highest wave still the construction and arrangement of parts is such that a definite and uniform stroke is always imparted to the piston of the pump, thereby providing for a uniform operation of the latter and obviating the possibility of straining or breaking the parts of the motor.

In carrying out the invention various modifications may be resorted to, and it may be found expedient under some conditions to resort to the alternative arrangement of parts shown in Fig. 7 of the drawings, and which alternative arrangement of parts involves a very practical and efficient form of resetting device for the power-transmitting lever. In the alternative or modified form of the apparatus shown in Fig. 7 the distinctive difference between the same and the arrangement shown in Fig. 1 of the drawings is that the main working parts of the motor are arranged in inverted positions. The framework and the bracing therefor undergo no change; but the skeleton curb 18 for the float is arranged within the lower portion of the framework to accommodate therein the vertically-reciprocating float or buoy 13, and the air-pump and the stationary guide-tube are arranged within the upper part of the framework above the plane of the said protective curb. This arrangement of parts disposes the air-pump and the power-transmitting mechanism above the water-line, thereby exposing the same to view and at the same time protecting them from the action of the water.

In the alternative or modified construction shown in Fig. 7 the float-stem 22 is provided with a plurality of ball-and-socket or other equivalent universal joints 23^a, which perform the same function as the similar joints herein referred to—namely, to provide means whereby an approximately-uniform operation can be maintained of the pump irrespective of the irregular lateral strain exerted on the parts by the lateral impact or thrust of the waves. In connection with the construction of the float-stem with a plurality of ball-and-socket or equivalent joints 23^a the float or buoy 13 used in the form of motor shown in Fig. 7 is provided with an inwardly-extending joint-pocket 64. This joint-pocket 64 extends inwardly and downwardly from the top of the float to a point substantially in the plane of the transverse center thereof and is perfectly air and water tight to prevent the leakage of air from the interior of the float and leakage of water into the same. The said joint-pocket 64 is open at the top and is adapted to house within the bottom portion thereof the lowermost joint 23^a of the float-stem, thereby disposing the said joint at about the center of the float, where there is the least oscillation thereof, thereby reducing the oscillation or vibration of the float-stem to a minimum. In other respects the construction is similar to that already described in connection with Fig. 1, and the section 22^a, carrying the tappet-lugs 23′, works within the stationary guide-tube 24, which is rigidly centered within the open framework at the top thereof. In the alternative or modified construction being described the tappet-lugs 23′ of the float-stem coöperate with a slightly-modified form of power-transmitting lever 27^a. This lever 27^a is fulcrumed or pivotally supported intermediate its ends, as at 65, on a suitable supporting-base 66, mounted on interior braces within the framework; but said lever 27^a is provided at the end next to the guide-tube 24 with the fork 30, whose side arms 31 work respectively upon the opposite slotted sides of the tube in the same manner as the fork of the lever 27. (Shown in Fig. 1.) While the fork 30 of the lever 27^a operates in precisely the same manner as the fork of the lever 27 previously described, a slightly-modified arrangement of the coupling-link is resorted to, said coupling-link being pivotally mounted on the end of the lever 27^a opposite its fork, but being connected to and coöperating with the piston-rod 42 in the manner already fully pointed out. In the operation of the form of power-transmitting lever 27^a the use of the spring 32 for resetting the lever is dispensed with, and in place of this spring there is employed a pair of reversely-arranged upper and lower pivotal resetting-levers 67 68, respectively. Each of said levers is pivotally mounted intermediate of its ends, as at 69, on a suitable support 70, fitted to the interior bracing of the framework, and at one end carries a contact-roller 72, adapted to engage against the power-transmitting lever 27^a in its oscillation. The opposite end of each of the resetting-levers 67 68 is provided with a fork 71, similar to the fork of the resetting-lever, and whose side arms are also adapted to work respectively upon the opposite slotted sides of the guide-tube in the path of the tappet-lugs 23′. The roller-carrying end of the upper resetting-lever 67 is heavier than its forked end, so that said lever will normally tend to assume the position shown in full lines in Fig. 7 of the drawings, while the forked end of the lower resetting-lever 68 is the heavier end, so that said lever will normally swing in the position shown in full lines in Fig. 9 of the drawings.

Referring particularly to the operation of the resetting device consisting of the levers 67 68, it will be observed that on the upstroke of the float-stem the tappet-lugs 23′ will engage with the forked end of the lever 27^a at the under side thereof and swing such lever upward until the full downstroke of the pump-piston is made, at which moment the tappet-lugs will pass out of engagement with the fork of the lever. During this upward swing and just prior to its disengagement from the tappets of the float-stem the power-transmitting lever 27^a engages with the contact-roller of the upper resetting-lever 67, thereby swinging the forked end of said lever downward and in the path of the upwardly-moving tappet-lugs 23′, so that when the said lugs become disengaged from the power-transmitting lever the continued upward movement thereof will press the roller-carrying end of the lever 67 against the power-transmitting lever and throw the same back to a position with the side arms of its fork extending across the path of the lugs 23′, when the latter will again engage the power-transmitting lever on the downward movement of the float-stem. Upon this downward movement of the float-stem the power-transmitting lever is carried downward to the position shown in full lines in Fig. 7 of the drawings, and the lower resetting-lever 68 then comes into play similar to the upper lever and forces the power-transmitting lever back to a position with the side arms of its fork extending across the path of the tappet-lugs 23′.

The length of the slot 39 in the coupling-link 37 is sufficient to admit of the resetting of the power-transmitting lever to the positions shown in dotted lines in Figs. 7 and 9 of the drawings, and it will be further observed at this point that when said lever leaves either of the resetting-levers the latter assume the normal positions shown in full lines in Figs. 7 and 9 of the drawings.

By reason of inverting the parts, as shown in Fig. 7 of the drawings, it is necessary to provide for bracing and steadying the float or buoy in its reciprocation independently of the function of the grooved guide-rollers 21, and to provide for this there is employed an anchor-guide tube 75, arranged within the lower part of the framework and anchored firmly in the bed of the sea. This guide-tube slidably receives therein the lower extension 22^b of the float-stem, which is projected beneath the float or buoy.

In further explanation of the function of the water-traps 57, interposed in the line of the air-supply and delivery pipes 51 and 56, it may be stated that the pressure of air in the delivery-pipe 56 and its water-trap 57 is ordinarily sufficiently strong to force the water out of said trap and through the pipe 59, connected therewith; but the hand-pump 58 is associated with said pipe 59 for the trap of the air-delivery pipe 56 in order to meet all possible conditions and insure the removal of accumulations of water from the water-trap. It may also be explained that when the piston for the said hand-pump is forced to the lowest point the same closes the inlet-valve of the pipe perfectly air-tight, so as to not interfere with the action of the apparatus. This applies to both forms of the motor shown in Figs. 1 and 7 of the drawings.

From the foregoing it is thought that the construction, operation, and many advantages of the herein-described wave-motor will be readily apparent to those familiar with the art without further description, and it will be understood that various changes in the form, proportion, and minor details of construction may be resorted to without departing from the principle or sacrificing any of the advantages of the invention.

Having thus described the invention, what is claimed as new, and desired to be secured by Letters Patent, is—

1. In a wave-motor, an upright open framework having a plurality of standards, a series of guy-rods extending from each of the standards, each of said guy-rods having an adjusting and a spring compensating device, a float arranged to reciprocate within the framework, and power-transmitting mechanism associated with the float, substantially as set forth.

2. In a wave-motor, an upright open framework consisting of an annular series of standards, annular braces encircling the series of standards and coupled individually thereto, an open protective curb arranged within the framework, a float arranged to reciprocate within said curb, and power-transmitting mechanism associated with the float, substantially as set forth.

3. In a wave-motor, an upright open framework, a semicylindrical slatted protective curb arranged within the framework, a float arranged to reciprocate within said curb, and power-transmitting mechanism associated with the float, substantially as set forth.

4. In a wave-motor, an upright open framework, a protective curb fitted to the framework, consisting of an annular series of spaced slats, a float arranged to reciprocate within the curb, and power-transmitting mechanism associated with the float, substantially as set forth.

5. In a wave-motor, an upright open framework, a cylindrical protective curbing fitted to the framework and having a series of spaced triangular slats whose apices are disposed outwardly, a reciprocating float, and power-transmitting mechanism, substantially as set forth.

6. In a wave-motor, an upright open framework, a cylindrical protective curbing arranged inside of and fitted to the framework, said curb consisting of a plurality of annular ribs and a circular series of slats secured to said ribs, said slats being regularly spaced apart and triangular in cross-section with their apices disposed outwardly, a float mounted to reciprocate within the curb, and power-transmitting mechanism, substantially as set forth.

7. In a wave-motor, an upright open framework, a cylindrical protective slatted curb mounted within the framework, a plurality of track-rails fitted inside of the curb and extending longitudinally thereof, a reciprocating float carrying interior guide-rollers engaging with said track-rails, and power-transmitting mechanism, substantially as set forth.

8. In a wave-motor, a framework, a reciprocating float supported to work within the framework, a stem connected to and movable with the float, said stem being sectional and having a universal joint or coupling disposed at or about the center of the float, a power-translating mechanism, and a power-transmitting mechanism having a lever associated with the float-stem and operatively connected to a part of the power-translating mechanism, substantially as set forth.

9. In a wave-motor, an upright framework, a vertically-reciprocating float provided with a joint-pocket extending inwardly from the top thereof to a point at or about the center thereof, a sectional stem connected to and movable with the float, said stem having a universal joint or coupling housed within the bottom portion of said pocket, and power-transmitting mechanism associated with said stem, substantially as set forth.

10. In a wave-motor, a framework, a reciprocating float working within the framework and carrying a single stem provided with a trip, power-transmitting mechanism including a lever having a tripping engagement with said stem, and means for automatically resetting the power-transmitting lever into the path of the stem-trip for operation thereby on each stroke of the stem, substantially as set forth.

11. In a wave-motor, the framework, a reciprocating float working within the framework and carrying a single stem provided with a trip, a power-transmitting lever having a tripping engagement with said stem, and also coupled with the driven element, and means for automatically resetting the power-transmitting lever to an operative position after disengagement from the stem on each stroke thereof, substantially as set forth.

12. In a wave-motor, the framework, a reciprocating float working within the framework and carrying a single stem, a power-transmitting lever coupled with the driven element and having a tripping engagement with the float-stem, and means for automatically resetting the power-transmitting lever in operative relation with the stem after it is

released therefrom at the end of each sliding movement in one direction, substantially as set forth.

13. In a wave-motor, the framework, a reciprocating float carrying a single stem having tappets, a power-transmitting lever coupled with the driven element and having a tripping engagement with said tappets, and means for automatically resetting the power-transmitting lever in operative relation to said tappets after disengagement therefrom at the end of each sliding movement in one direction, substantially as set forth.

14. In a wave-motor, the framework, a reciprocating float carrying a stem having tappets, a power-transmitting lever coupled with the driven element and provided with a forked end having a tripping engagement with said tappets, and means for automatically resetting the fork end of the lever in operative relation to said tappets after disengagement therefrom at the end of each stroke of the driven element, substantially as set forth.

15. In a wave-motor, the framework, a reciprocating float carrying a stem having tappets, a forked lever coupled with the driven element and having a tripping engagement with said tappets, and an automatically-adjusted resetting-lever arranged to coöperate with the power-transmitting lever at the end of each stroke of the driven element, substantially as set forth.

16. In a wave-motor, the framework, the reciprocating float carrying a stem, the power-transmitting lever having a tripping engagement with said stem, the driven element having a reciprocating rod, a slotted link connection between said rod and the power-transmitting lever, and means for automatically resetting the power-transmitting lever in operative relation to the stem after disengagement therefrom at the end of each stroke, substantially as set forth.

17. In a wave-motor, the framework, a stationary guide-tube mounted within the framework and having longitudinally-slotted side portions, a float carrying a stem working within the guide-tube and having tappet-lugs, a swinging power-transmitting lever having a forked end working over the guide-tube and having a tripping engagement with said lugs, the driven element having a reciprocating rod, a link loosely mounted on the power-transmitting lever and having an arcuate slot receiving the coupling or pivot pin of said reciprocating rod, and means for resetting the forked end of the lever in operative relation to said lugs after disengagement therefrom at the end of each stroke of the driven element, substantially as set forth.

18. In a wave-motor, the framework, the stationary slotted guide-tube mounted within the framework, the reciprocating float carrying a stem working within said guide-tube and having tappet-lugs, a forked power-transmitting lever coupled with the driven element and having a tripping engagement with the tappet-lugs, pivotal resetting-levers arranged respectively at the upper and lower limit of movement of the power-transmitting lever, each of said resetting-levers being forked at one end for engagement with said tappet-lugs and having their opposite ends arranged for contact with the power-transmitting lever, each of said levers being weighted to dispose their contact ends normally in the path of the power-transmitting lever, substantially as set forth.

19. In a wave-motor, the combination with the float and the power-transmitting mechanism, of the air-pump having air supply and delivery pipe connections therewith, a water-trap interposed in the line of the air supply and delivery pipes for the air-pump, and hand-operated pumps supported above the water-line and having suction-pipe connections with the water-traps, substantially as set forth.

20. In a wave-motor, the combination with the float and the power-transmitting mechanism, of the air-pump having air supply and delivery pipe connections therewith, a water-trap interposed in the line of the air supply and delivery pipes for the air-pump, a valved water-drain pipe leading from the bottom of the pump-cylinder to one side of said water-traps, and a drain-trap interposed in the line of said water-drain pipe, substantially as set forth.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

JAMES C. WALKER.

Witnesses:

J. R. DOWNS,

C. FALKNER.