

(No Model.)

J. H. BUNNELL.
WAVE MOTOR.

3 Sheets—Sheet 2.

No. 601,238.

Patented Mar. 29, 1898.

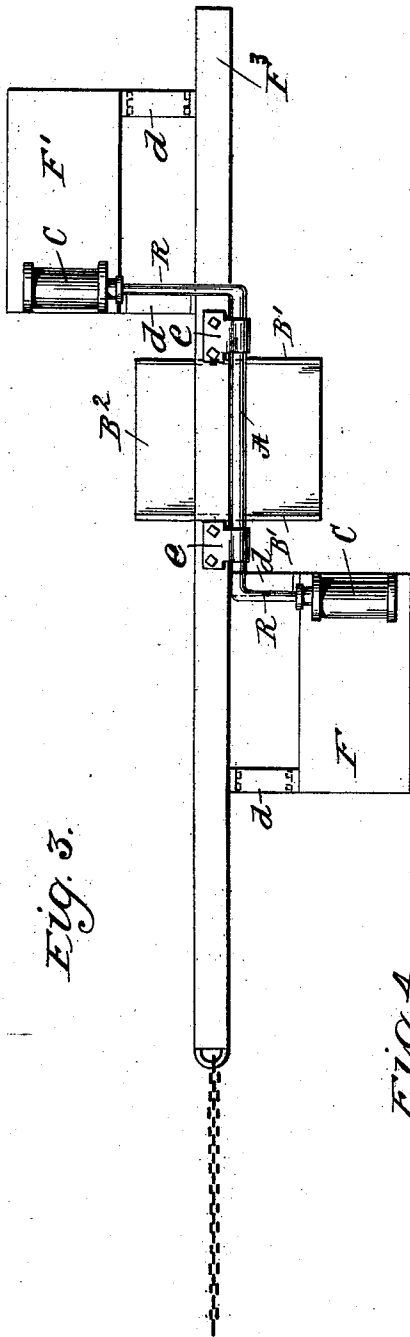


Fig. 3.

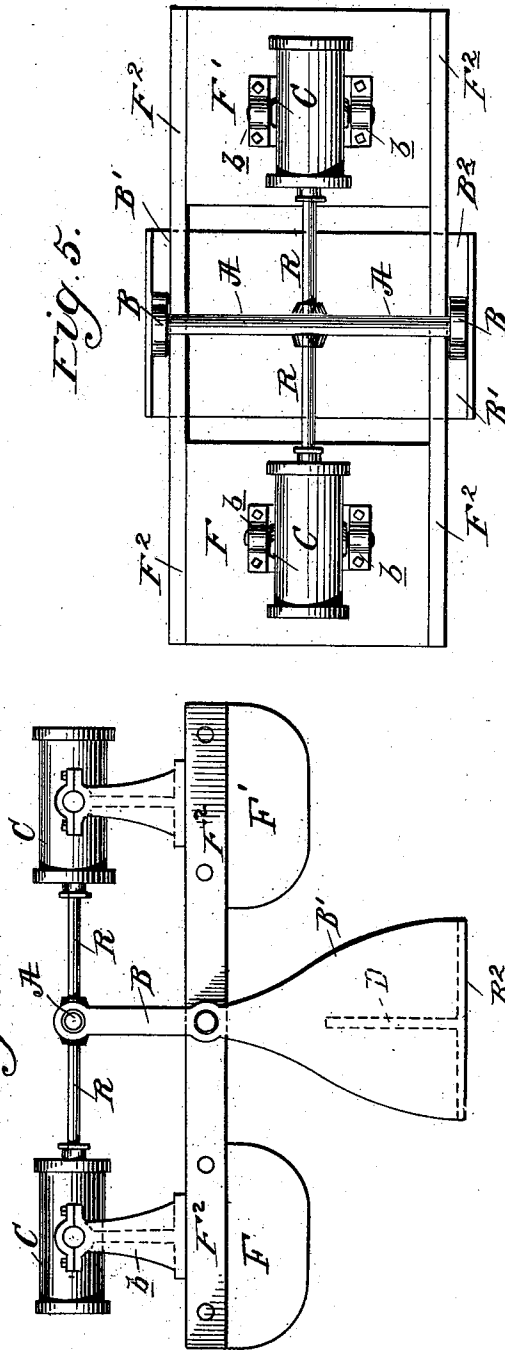


Fig. 4.

Fig. 5.

Witnesses
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Inventor
By his Attorney Jesse H. Bunnell
Charles J. Kistner

(No Model.)

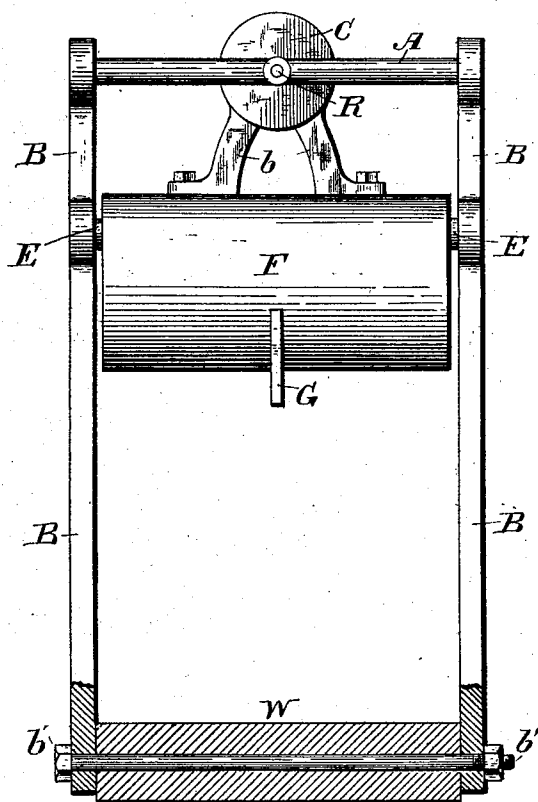
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FIG. 6.



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UNITED STATES PATENT OFFICE.

JESSE H. BUNNELL, OF BROOKLYN, NEW YORK.

WAVE-MOTOR.

SPECIFICATION forming part of Letters Patent No. 601,238, dated March 29, 1898.

Application filed May 18, 1897. Serial No. 637,041. (No model.)

To all whom it may concern:

Be it known that I, JESSE H. BUNNELL, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have made a new and useful invention in Wave-Motors, of which the following is a specification.

My invention is directed to improvements in that type of wave-motors in which motive power is derived by the action of waves upon anchored floats or barges actuated by the rise and fall of ocean waves; and its objects are, first, to combine with a float mechanism which will utilize to the best effect the stored-up energy attributable to the pitching or rolling thereof as it (the float) rides over the incoming waves; second, to adapt the same for use in connection with any type of motive device whereby the stored-up energy may be effectually utilized, and, third, to so arrange all of the apparatus that it will withstand the destructive effects of variable winds and tides.

To this end it consists, broadly, in mechanism for utilizing the pitching or rolling effects of waves upon a float or floats as they pass under it or them and in such manner as to convert said effects into mechanical energy through the agency of one or more pivoted levers carried by or constituting a part of said float or floats and extending downward into the water beneath the same, as will be hereinafter described, the especially novel features of my invention being particularly pointed out in the claims at the end of this specification.

For a full, clear, and exact understanding of my invention, such as will enable others skilled in the art to construct and use the same, reference is had to the accompanying drawings, in which—

Figure 1 illustrates in side elevational view one form of my invention, consisting of a float, pumping mechanism, and attachments, said float being shown as anchored. Fig. 2 is a plan view thereof, the pumping mechanism being illustrated in horizontal sectional view. Fig. 3 is a plan view of a modified form of the invention, consisting of two independent floats located some distance from each other and connected together by a spar or timber, my improved mechanism being attached thereto. Fig. 4 is a side elevational

view, and Fig. 5 a plan view, of a still further modified form, wherein two floats are connected together end to end and provided with my improved apparatus. Fig. 6 is an end elevational view of a modified form of my invention, in which a weight is utilized for maintaining the operating-levers in a vertical position.

Referring now to the drawings in detail and first to Figs. 1 and 2, F represents a float which is constructed, preferably, in the nature of a flat scow or barge having its bottom curved upward near its center, for a purpose which will be hereinafter more particularly described.

G represents a skeg or centerboard for holding the float longitudinally in the direction of the incoming waves.

S S represent two anchor ropes or chains secured at points *a a* on opposite sides near the middle or center of motion of the float and running parallel with the sides thereof to a point some distance in advance of the bow or front end, where they are secured to or passed through the opposite ends of a stanchion *c*, passing thence downward, where they are joined to an anchor-chain, which in turn is attached to an anchor located at any convenient point, as shown, so that the float will ride freely or easily upon the waves W.

B B represent two upright levers pivotally secured upon trunnions E E at or near the center of the float, the upper ends of said levers being pivotally connected to a cross-rod A, which in turn is secured to a piston R, connected with a piston-head adapted to move freely back and forth in a pivoted pumping-cylinder C of sufficient length to admit of free movement of the piston-head to the extreme stroke which may be given to the levers B B. The lower portions of the levers B B are broadened, as shown at B' B', so as to constitute a sufficient support for a base B² and an upright paddle-like portion or surface D, the functions of which parts will be described in connection with the description of the mode of operation, said parts B B, B' B', B², and D constituting, broadly, mechanism for transmitting motion to any motive device carried by the float F.

The cylinder C is pivotally secured to strong metallic standards *b b*, which in turn are at-

tached to the front end of the float by bolts, as shown.

P³ represents an inlet-pipe running from the bottom of the float upward to pivotally-supported branch inlet-pipes P' P', running to opposite ends of the pumping-cylinder C, P² P² being corresponding pivoted branch inlet-pipes running from the opposite ends of said cylinder to a single main supply-pipe P, running forward down the anchor-rope and anchor-chain, to which it is secured in any preferred manner and to a point near the anchor, so as to permit the float to swing freely about the point of anchorage without danger of injuring the pipe, that portion of the pipe P connected to the anchor-rope and anchor-chain being of course of a flexible nature. No valves are shown in connection with the pumping-cylinder C, its inlet and outlet pipes; but it is to be understood that any well-known form of valves used in such pumps may be used, they having been omitted here for the purpose of rendering the drawings more clear.

The modified form shown in Fig. 3 illustrates means for utilizing the rolling effects of waves. Two floats F and F' are secured side by side, but at some distance from each other, through the agency of arms or trusses *d d*, to a spar or timber F³ of sufficient strength to withstand all strains that may be put upon it by the pumping apparatus, there being in this instance two pumping-cylinders C C and two piston-rods R R connected to the cross-rod A, which in turn is secured to the tops of the levers B B (not shown) by journal-bearings *e e*, said levers B B being in turn pivotally secured at a point beneath the spar or timber F³, so that the extended parts B' B' are located at right angles with relation to said timber, the details of the pumping mechanism in this instance being substantially like those shown in Figs. 1 and 2.

In Fig. 4 I have shown still a further modified form of the invention wherein two floats F and F' are secured together end to end by side timbers F² F², the details of the pumping mechanism connected to the pumping-cylinders C C being, as before, substantially like the apparatus illustrated in connection with Figs. 1 and 2.

I wish it understood that my invention is directed, broadly, to mechanism for utilizing the pitching or rolling effects of waves upon one or more anchored floats of any form or construction when so arranged as to transmit, through one or more pivoted levers or equivalent mechanism, movement to a motive device, such as a pump carried by the float or floats.

In the form of my apparatus shown in Figs. 1 and 2 the float F is anchored, as shown, and the incoming waves W are supposed to be moving from left to right in the direction of the arrow. In the position indicated the float is approximately level, the opposite ends thereof resting for the time being upon two adjacent waves. As the waves advance the

front end of the float will descend into the trough between the wave now under it and the next succeeding wave and the rear end thereof will be elevated by the wave which is now under said front end. Consequently there will be a lifting effect upon the rear end of the float and a tendency to lift the levers B and their broadened supporting parts B' B', together with the bottom B²; but this enlarged surface or bottom B² will resist this tendency, owing to the body of water above it. Consequently the upper part of the lever will tend to remain stationary, thus transmitting a movement to the piston-rod R in a direction toward the left. It will be seen that by reason of the curvilinear portion of the float near its center there will be no lifting effect of the waves at that point, the entire lifting effect being by reason of this fact always at the opposite ends thereof. It will also be apparent that the enlarged paddle-like surface D will tend to prevent any movement of the lever B in either direction. The next succeeding wave, therefore, acts in a reverse manner and elevates the front end of the float, thus imparting a motion to the piston R in a direction to the right, there being substantially four complete effects for each wave—to wit, first, a lifting effect on the approach of the wave; second, a depressing effect on its departure from under the front end of the float; third, a lifting effect upon the rear end of the float, and, fourth, a depressing effect as it leaves said rear end.

The action of the pump will be readily understood, inasmuch as it forces water to a source of supply on shore, or the same may be utilized in any desired manner. To illustrate, the pumping mechanism might be connected to a source of fresh-water supply located in a tank within the body of the float and so connected to a compression-chamber that the water might be stored in such compression-chamber under air-pressure and utilized upon a Pelton water-wheel, which in turn might drive a dynamo, the current therefrom being conveyed by insulated cables down the anchor-rope and thence to any desired point on shore, the water as it is utilized being again pumped back into the compression-chamber, or any preferred means of applying the lever or levers B B may be utilized, such matters being well within the skill of those versed in the art of transmitting power.

In the modified form shown in Fig. 3 the spar or timber F³ is of such length as to enable the floats F and F' to be placed at distances substantially equal to the wave lengths from crest to crest, so that the rocking or rolling motion of succeeding waves is felt by the floats in succession, the operation of the pumping apparatus being substantially like that already described.

The operation of the modified form shown in Figs. 4 and 5 will be obvious, it being apparent that the same effects are had with the two floats F and F' as are had with the oppo-

site ends of the single float with the curvilinear bottom illustrated in Fig. 1.

I do not limit myself to the special forms of apparatus herein shown and described for transmitting power by waves, as I believe I am broadly entitled to claim mechanism for utilizing power from one or more anchored floats when the same is effected through the agency of one or more levers pivotally secured to the body of such float or floats and extending downward into the water beneath the same with the upper end or ends thereof attached to a motive device, such as a pump, whereby the pitching or rolling effects of waves is converted into mechanical energy. To make a single illustration, in place of the enlarged surface or bottom B² and paddle or surface D I may substitute a mass of material—such as lead, iron, or the like—so that the weight thereof will maintain the levers B in a vertical position and enable the float to pitch or roll in the manner already described, so that its pitching or rolling motion will impart the necessary reciprocating motion to the piston-rod R, which may be utilized either in driving a pump or a reciprocating or rotary motive device of any preferred form, my claims being directed generically to mechanism for utilizing the motive force of waves in the manner described. Such a modified form of my invention is illustrated in Fig. 6, in which the float F, with its skeg G, are shown in end elevational view and the levers B B pivotally secured thereto upon trunnions E E, as before, W being a cylinder of iron, lead, or any other mass of material secured by a bolt b' or in any preferred manner to the lower ends of the levers B, the arrangement being such that this mass of material will tend to hold the levers in their vertical positions, so that as the float tosses or pitches in the manner already described the pumping action will be effected through the agency of the upper ends of the levers B, cross-rod A, piston-rod R, and pumping-cylinder C.

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

1. In a wave-motor a float provided with means near its center of motion for attaching one or more anchor ropes or chains thereto, in combination with one or more anchor ropes or chains extending forward therefrom and downward to an anchor-ropes, together with means pivotally secured to said float and connected to a motive device adapted to utilize the force imparted to the float by the rise and fall of waves, substantially as described.

2. In a wave-motor a float provided with means for anchoring it, one or more pivoted levers secured to said float and provided with means for maintaining the same in substantially a vertical position, in combination with a motive device as a pump operatively connected to said lever or levers, substantially as described.

3. A wave-motor in the nature of a float pro-

vided with means for holding it at a given point, in combination with one or more pivoted levers secured to said float and provided with means tending to hold said lever or levers in a given position, said lever or levers being connected in turn to a motive device as a pump, substantially as described.

4. A wave-motor consisting of an anchored float having one or more levers pivotally secured thereto, means attached to said lever or levers for resisting the direct lifting effect and mechanical connections between the lever or levers and a motive device, whereby the rolling motion of the float or floats is converted into useful energy, substantially as described.

5. A wave-motor consisting of a float having a lever or levers pivotally secured at or near its middle; said lever or levers being provided with means for maintaining it or them in a substantially vertical position, in combination with a motive device connected thereto and adapted to convert the motion imparted to the float into mechanical energy, substantially as described.

6. A wave-motor consisting of a float having a pivoted lever secured thereto, one end of said lever being provided with means for maintaining it in a substantially constant position and the other connected to a piston-rod having a piston-head adapted to move within a pumping-cylinder pivotally secured to the float with a supply-pipe P connecting the pump with a source of supply located at any convenient point, substantially as described.

7. A wave-motor consisting of a float and a pair of levers pivotally secured thereto and supporting in turn a surface or bottom adapted to resist the direct lifting effort of the float, said levers being connected to a motive device as a pump, substantially as described.

8. A wave-motor consisting of a float, a pair of levers pivotally secured thereto and provided with a surface or bottom and a paddle for maintaining said levers in a given position, said levers being in turn connected to a motive device for transmitting power, substantially as described.

9. A wave-motor consisting of a float provided with means for anchoring it, a pair of levers pivotally secured thereto and provided with a surface or bottom and a paddle beneath the float for maintaining said levers in a given position, connections between the upper ends of said levers and a pump, in combination with a flexible supply-pipe running from said pump to a source of supply located at any convenient point, substantially as described.

10. A wave-motor consisting of two floats rigidly connected together, one or more levers pivotally secured between said floats and extending downward into the water, the lower end or ends of said lever or levers being provided with means for resisting the upward lifting effect of the float and additional means for maintaining said levers in a substantially

vertical position, in combination with means for connecting the upper ends thereof with one or more motive devices carried by said floats, substantially as described.

5 11. A wave-motor consisting of a float and means for anchoring it, in combination with means pivotally suspended from the float but
10 extending downward into the water beneath the same and connected at the upper or free end thereof to a motive device all arranged
so as to utilize the pitching or rolling effect of waves, substantially as described.

12. A wave-motor in the nature of a float pivotally secured by one or more anchor-
15 chains at a point or points near its center of motion, said anchor chain or chains extending forward and downward to one or more anchors located in the bed of the ocean, in combination with one or more levers pivotally se-
20 cured to the body of the float and extending into the water beneath the same, the upper or free end or ends thereof being attached to a motive device, the arrangement being such as to utilize the pitching or rolling effects of
25 the waves, substantially as described.

13. A wave-motor consisting of a float piv-

otally secured at one or more points near its center of motion, in combination with means carried by the float and extending downward
30 into the water, said means being connected with a motive device as a pump, the entire arrangement being such that as the float rolls or pitches about its center of motion mechanical energy is imparted to the motive device,
35 substantially as described.

14. A wave-motor consisting of a float provided with means for anchoring or sustaining
it at a point or points near its center of motion, and means such as a skeg for causing it
40 to head toward incoming waves, in combination with a motive device as a pump carried by the float and operatively connected therewith through mechanism actuated by the rolling and pitching movement thereof, substan-
45 tially as described.

In testimony whereof I have hereunto subscribed my name this 15th day of May, 1897.

JESSE H. BUNNELL.

Witnesses:

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M. M. ROBINSON.