(No Model.)

2 Sheets—Sheet 1.

G. C. HALE & T. R. TINSLEY.

TIDE AND WAVE POWER.

No. 455,616. Patented July 7, 1891.

Fig. I.

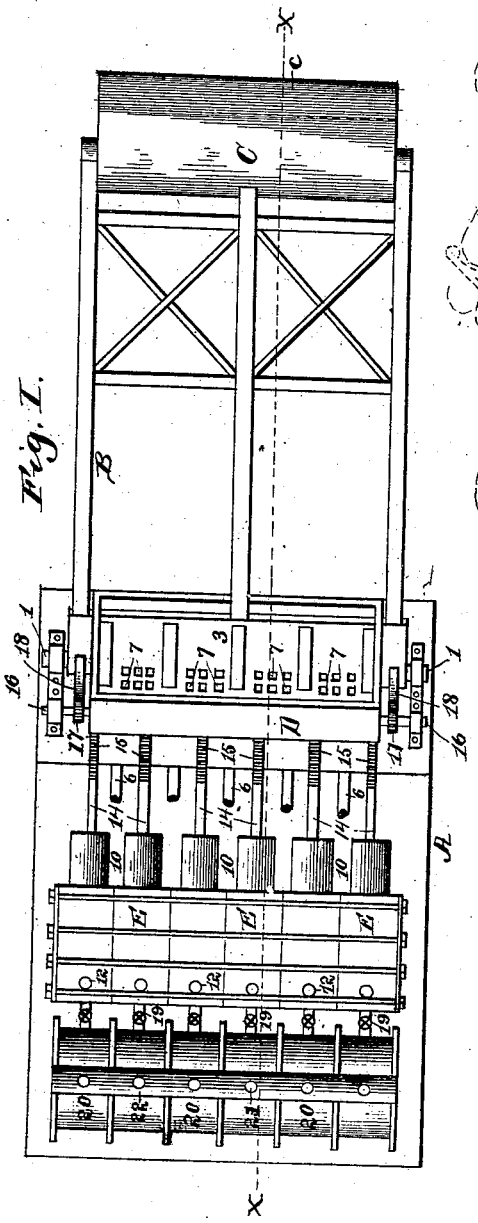
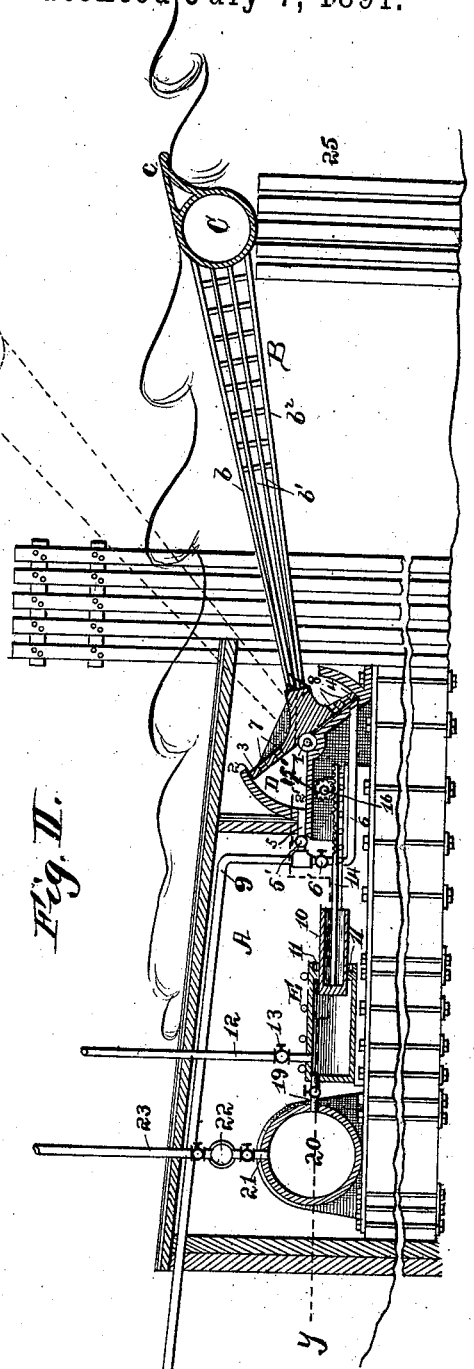


Fig. II.



Witnesses:
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their Attys.

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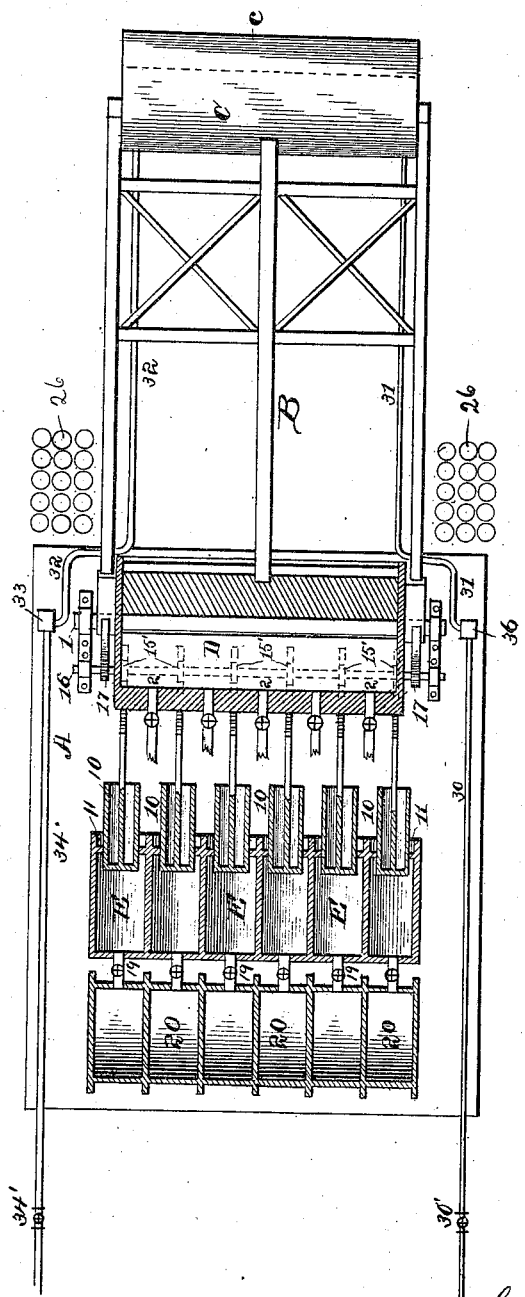
Fig. III.



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UNITED STATES PATENT OFFICE.

GEORGE C. HALE AND THOMAS R. TINSLEY, OF KANSAS CITY, MISSOURI.

TIDE AND WAVE POWER.

SPECIFICATION forming part of Letters Patent No. 455,616, dated July 7, 1891.

Application filed November 3, 1890. Serial No. 370,206. (No model.)

To all whom it may concern:

Be it known that we, GEORGE C. HALE and THOMAS R. TINSLEY, citizens of the United States, of Kansas City, in the county of Jackson and State of Missouri, have invented certain new and useful Improvements in Tide and Wave Powers; and we 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.

Our invention relates to an apparatus for utilizing the power of the tide, waves, and motion of the sea or body of water; and the object of our invention is to provide a simple and substantial motor operated automatically by the motion of water to compress air or elevate water to a height for the purpose of storing energy to be utilized in running machinery for transmission of power and many other uses in the mechanical arts.

With this end in view our invention consists, briefly stated, in a swinging arm or lever fulcrumed at or near one end and carrying a float at its other end, which is influenced by the ebb and flow of the tide, the motion of waves, &c., to rock or swing said lever and its fulcrum, an air-pump operated by connections with said lever or arm to compress air, and a water-pump also operated by said swinging lever or arm to raise or elevate water to a height.

Our invention further consists in the combination of devices and novel construction and arrangement of parts, as will be hereinafter fully described and claimed.

To enable others to understand our invention, we have illustrated the same in the accompanying drawings, in which—

Figure I is a top plan view of a tide and wave power embodying our invention. Fig. II is a vertical sectional view on the plane indicated by the dotted line $x\ x$ of Fig. I. Fig. III is a horizontal sectional view through the air-pumps and the water-pumps on the plane indicated by the dotted line $y\ y$ of Fig. II.

Like letters and numerals of reference denote corresponding parts in all the figures of the drawings, referring to which—

A designates the submerged bed or foundation of our improved tide and wave power, which bed is constructed in a substantial manner of masonry or other material suitable for the purpose. The apparatus or motor is erected near the shore of the sea and a suitable distance out to be acted upon by the ebb and flow of the tide or the motion of the waves, and upon this bed is secured all the working appliances and mechanisms of the motor.

B is the swinging power arm or lever, which is constructed of a number of light steel tubes $b\ b'\ b^2$, each of which comprises a series of small tubes suitably braced or laced. The tubes $b\ b'\ b^2$ are suitably spaced apart in parallel positions in relation to each other, and at the outer ends of said tubes, which constitute the swinging power-arm, is rigidly secured in any suitable manner the hollow float C. This float is formed of a light substantial cylinder and arranged transversely across the series of tubes, and a hood c is secured at the opposite side of the cylinder from the arms, which hood is curved upward and beyond the cylinder to catch or be acted on by the crest of the waves, and thus assist the motions of the float in swinging or rocking the lever. The inner ends of the series of tubes forming the power lever or arm are rigidly fastened to a rock-shaft 1, which serves the purpose of a fulcrum for the lever or arm, and which is rocked or moved by the lever or arm as it rises and falls with the buoyant float, and this shaft extends transversely across the arm or lever and is suitably journaled in suitable fixed bearings on the bed or foundation A.

D designates the water chest or chamber of the pump for raising water to an elevation. This water-chest comprises a single casing or shell, which extends parallel with the rock-shaft or fulcrum-shaft 1 of the power-lever, and this shell is provided with a longitudinal opening or space 2 in one side thereof, said shell or water-chest being arranged concentric with the rocking fulcrum-shaft, so that it partially incloses said shaft. The water-chest is rigidly secured to the bed or foundation between the bearings of the rock-shaft, and it is provided with closed heads at its ends and a longitudinal partition 2′, which divides said chest into two compartments. The rock-shaft carries two abutments or wings 3 4,

which move with said shaft and are arranged at diametric opposite positions in relation thereto, and said abutments are arranged to operate within the non-communicating compartments of the water-chest and act upon the water therein to force the water through the conducting pipes 5 6, which communicate, respectively, with said compartments of the chest.

Water is admitted to the water-chest through valves 7 8, placed in the abutments or wings, and these valves are so placed as to act in opposite directions. Thus when the abutment 3 is forcing water out of one compartment and its valves 7 are closed, the valves 8 in the other abutment are opened to admit water to the other compartment of the chest, and vice versa. The conducting-pipes 5 to one compartment has a check-valve 5′ to prevent backflow of water into said compartment, and the other pipe 6 is provided with a similar valve 6′ for the same purpose, and said pipes are connected to a common eduction-pipe 9, which leads to an elevated tank in which water can be stored for future use.

We also contemplate the provision of air compression adapted for operation by the movements of the swinging power lever or arm, and in this embodiment of our invention we provide a series of water-tight cylinders E, which are firmly secured to the bed or foundation at one side of the water-chest. One end of each cylinder is left open, and in each cylinder operates a hollow cylindrical plunger or piston 10, which is surrounded by a tight packing 11 to exclude water from said cylinder, and to each cylinder of the series is connected an air-supply pipe 12, which extends above the surface of the water for a suitable distance and is provided with an inwardly-opening check-valve 13 to prevent the escape of air being compressed in the cylinder. The series of pistons or plungers 10 have their rods 14 formed with a series of teeth forming racks 15, and with these racks mesh a series of pinions 15′, which are carried by a horizontal shaft 16, suitably journaled in bearings on the bed or foundation A. This shaft 16 is provided at its ends with the pistons 17, which are rocked or operated by toothed quadrants 18, said quadrants being rigid with the rocking fulcrum-shaft of the power arm or lever, whereby said shaft 16 is operated by the swinging movements of the lever or arm, and said shaft in turn reciprocates said racks and the pistons to compress the air admitted to the cylinders.

The compressed air from the cylinders is conveyed through pipes 19 to the storage-reservoirs 20, or to a single reservoir which is common to all of the cylinders, and the air from the several reservoirs is conducted by vertical pipes 21 to a valve-drum 22, arranged above the reservoirs, and from which leads the pipe 23 for conveying the compressed air to mechanical appliances for utilizing the air.

By the use of the hollow steel tubes to form the swinging power arm or lever we are enabled to admit water to the tubes in order to submerge the arm or lever and the attached float in times of storms or gales, and thus avoid the liability of accident and damage to the arm, and when the arm or lever is thus submerged it rests upon and is supported by the piles 25, which are of a height suitable to this purpose. The hollow tubes can be emptied by admitting compressed air to said tubes to force the water out of the same, and thereby render the arm or lever buoyant again.

In Fig. III of the drawings we have illustrated one form of apparatus for submerging the arm or lever and the attached float and for raising the same when submerged, referring to which, 30 designates a pipe which connects the elevated reservoir with a suitable packing-box 36, secured to the bed or foundation A. From this packing-box leads another pipe 31, one end of which enters the float C. From the float C, preferably from the end opposite to the place of entrance of the pipe 31, a pipe 32 leads to another packing-box 33, from which extends a pipe 34 to an air-pump. Both pipes 30 34 are provided with valves 30′ 34′. When it is desired to submerge the float and arm, the valve 30′ is opened, which permits water to pass from the elevated reservoir through the pipes 30 31 into the float C. To raise the float, the valve 34′ is opened and air pumped into the float C through the pipes 34 32 and the water forced back through the pipes 31 30 to the elevated reservoir, and the valve 30′ is then turned to prevent the water entering the pipe 30.

On both sides of the motor are erected guard-piles 26, which are suitably braced together and extend the necessary distance above the motor and the position occupied by the arm or lever when raised, in order to protect the apparatus from floating débris and shield the arm or lever.

The operation of our invention is simple and may be briefly described as follows: The buoyant arm or lever and its attached float are raised and lowered by the action of the waves and the flow or motion of the tide and the motion of the lever or arm is communicated to the rock-shaft. This rock-shaft in turn operates the abutments or wings of the pump to force water continuously through the water-pipe and raise the same to an elevated tank, and at the same time said shaft operates the quadrants and the shaft 16, thus reciprocating the racks and plungers of the air-compressors, which compressed air is stored in the reservoirs or conducted through the pipe to utilize the same in running machinery.

We are aware that changes in the form and proportion of parts and details of construction of the mechanism herein shown and described as an embodiment of our invention can be made without departing from the spirit or sacrificing the advantages thereof, and we

therefore reserve the right to make such alterations as fairly fall within the scope of our invention.

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

1. In a tide or wave power, the combination of a stationary water-chest, the water-eduction pipes leading therefrom, the pivoted power-arm having a float at or near its free end, and the movable valved abutments 3 4, movable with the power-arm and operating in the water-chest, substantially as described

2. In a tide or wave power, the combination of a stationary water-chest, the pivoted buoyant power arm or lever with its pivot concentric with the chest, and the valved abutments movable with said power arm or lever and operating within the water-chest, substantially as described.

3. In a tide or wave power, the combination of the water-chest divided into non-communicating compartments, the pivoted power arm or lever, and the diametric abutments operating in the compartments of the water-chest, and each having the valve for admission of water to said compartments, substantially as described.

4. In a tide or wave power, the combination of a buoyant power arm or lever, which is fulcrumed at one end, the open-sided water-chest arranged concentric with the pivot of said power arm or lever, the valved abutments or wings rigid with the power arm or lever and operating in separate compartments of the water-chest, and the valved eduction-pipes entering said separate compartments of said chest, substantially as described.

5. In a tide or wave power, the buoyant power-lever composed of two or more series of hollow or tubular arms adapted to receive a liquid for submerging said lever, and the float attached to said arms, combined with a pump which is actuated by the power arm or lever, substantially as described.

6. In a tide or wave power, the power arm or lever composed of the hollow or tubular arms and the float attached to said arms and provided with the hood or extension at one side thereof for the purpose described, substantially as set forth.

7. In a tide or wave power, the combination of a pivoted buoyant arm or lever, the pump operated by said lever, the float, and the guard-piles erected on opposite sides of the lever or arm and the pump, substantially as described.

8. In a tide or wave power, the combination of the power arm or lever, the float attached to said arm, a pipe connecting said float with a reservoir, and another pipe connecting the float with an air-pump, substantially as and for the purpose described.

9. In a tide or wave power, the power arm or lever fulcrumed or supported on a pier or foundation and having a buoyant float connected thereto, and means for submerging or sinking the power arm and float, substantially as described.

10. In a tide or wave power, the power arm or lever fulcrumed on a pier or foundation, a buoyant float rigid with said power arm or lever, and means for admitting a fluid to said float to sink or submerge the power arm and float, substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

GEORGE C. HALE.
THOMAS R. TINSLEY.

Witnesses:
CHARLES E. FINLEY,
W. C. ROGERS.