No. 632,826. Patented Sept. 12, 1899.

M. B. RICE.

WAVE MOTOR.

(Application filed Nov. 4, 1898.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

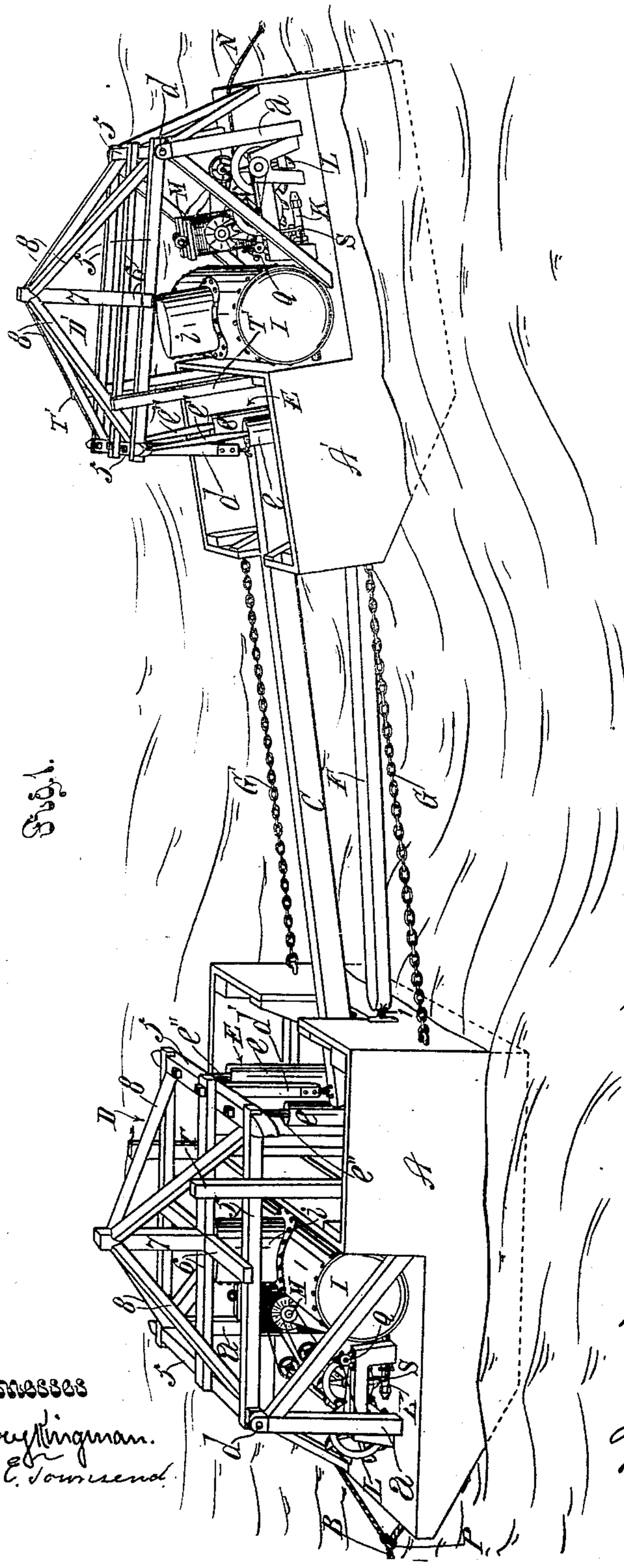
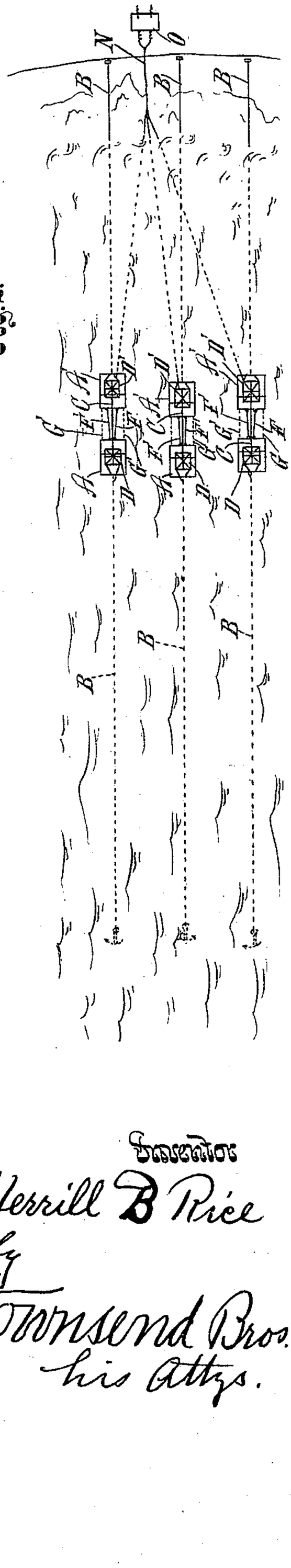


Fig. 2.



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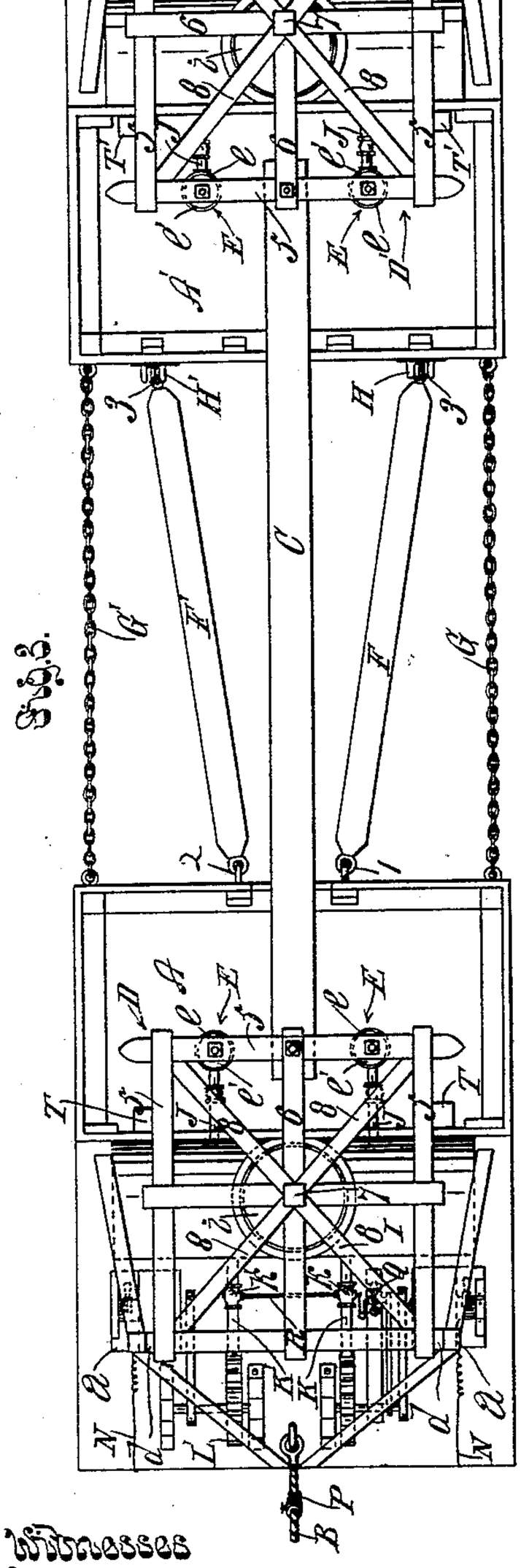

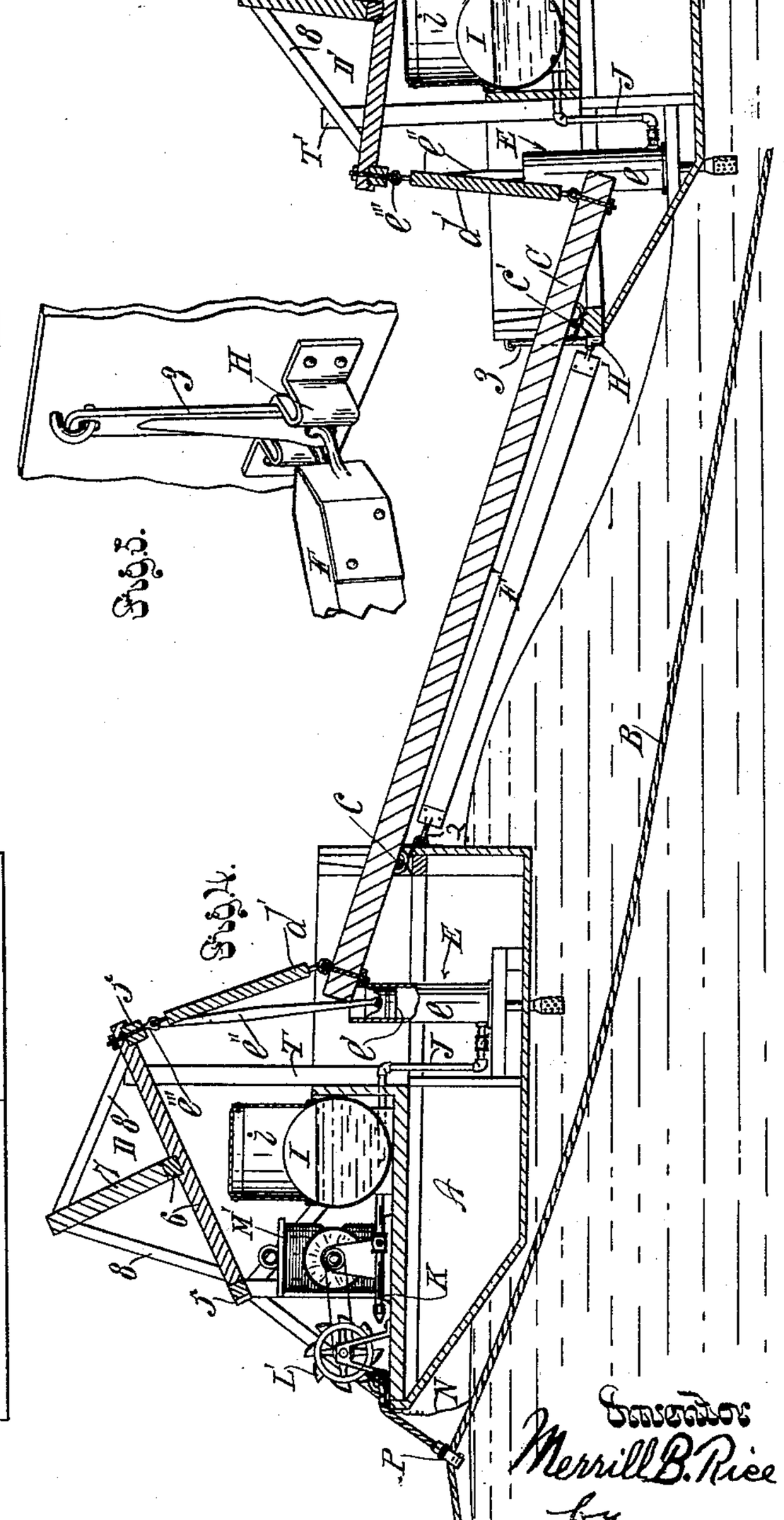

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UNITED STATES PATENT OFFICE.

MERRILL B. RICE, OF TUSTIN, CALIFORNIA.

WAVE-MOTOR.

SPECIFICATION forming part of Letters Patent No. 632,826, dated September 12, 1899.

Application filed November 4, 1898. Serial No. 695,504. (No model.)

To all whom it may concern:

Be it known that I, MERRILL B. RICE, a citizen of the United States, residing at Tustin, in the county of Los Angeles and State of California, have invented new and useful Improvements in Wave-Motors, of which the following is a specification.

The object of my invention is to provide a wave-motor which will be self-contained unattached to any wharf, not subject to the action of the breakers, and which will operate efficiently from the undulatory movement of the swells of an ocean or other large body of water.

A further object of my invention is to provide a very strong wave-motor structure which while allowing flexibility of connection between the floats will hold the floats at a proper distance apart and which will hold two floats in practical alinement, although giving sufficient latitude of movement to avoid danger of breaking, which would result in the case of more rigid connections.

A further object of my invention is to provide means by which to receive the power from waves and transmit it to the shore without danger of any breakage of the connections.

My invention in the various features is capable of adaptation in various ways, which will suggest themselves to mechanics; and I desire it to be understood that I do not limit myself to the particular construction shown, as I regard my invention as a broad departure from wave-motors heretofore known.

The accompanying drawings illustrate my invention.

Figure 1 is a perspective view of my newly-invented wave-motor anchored in place in the ocean near the shore. Fig. 2 is a plan view of a portion of a power plant embodying my invention. Fig. 3 is a plan view of the apparatus shown in Fig. 1. Fig. 4 is a vertical longitudinal section on line 4 4, Fig. 3. Fig. 5 is a detail of the connection between the rear float and the rear end of one of the stays.

My invention comprises the combination of two floats A A′, anchored by a line B and arranged to rise and fall independently of each other, a lever C, fulcrumed to both of the floats by fulcrums *c c′*, and any suitable power receiving and transmitting appliance composed of two movable parts, one of which parts is fastened to and moves with one of the floats and the other of which parts is fastened to and moves with the lever. This lever is connected with a beam D, which is pivotally connected at one end to the float A and pivotally connected at the other end with a movable part of the receiving and transmitting appliance. I prefer to use a pump or series of pumps E for receiving and transmitting the power from the beam D.

e indicates the pump-cylinder fixed to the float, and *e′* the pump-piston, which is preferably a trunk-piston, connected with the beam by the connecting-rod *e″*.

The beam D is preferably formed of a truss-frame pivoted at one end, as at *d*, to the float, and the link *d′* connects the other end of the beam with the lever C.

Any number of pumping-cylinders *e* may be fixed to the float, and their corresponding connecting-rods are pivotally connected with the beam, as at *e‴*.

Each of the floats is provided with a pump-operating beam, and the two beams are connected with the opposite ends of the lever, so that the movement of either of the floats will operate the beam of both floats and the beams will be operated by the movement of both of the floats. The beam D of the forward float A is pivoted at the forward end of its float and the beam D′ of the rearward float A′ is pivoted at the rear of its float. The bow of each of the floats preferably slopes upward and the stern is preferably straight up and down, so that the floats will most readily respond to the waves.

In order to hold the floats apart and in line with each other transverse the line of the waves, I provide two rigid stays F F′, each pivotally connected at one end to one of the floats near the middle of the end thereof and connected at the other end to the end of the other float near the sides thereof, diverging from each other in V shape, as shown in Fig. 3, and two flexible connections G G′ are fastened at the sides of the float and connect the two floats together. These flexible connections are cables or chains, as indicated in the drawings. The stays are pivotally connected to the float A by links 1 2, and the connections between one of the floats and the two stays are preferably formed of two swing-

ing links 3 3′, which are pivoted to their float, one for each of the stays, and pivotally connected at their lower ends with their respective stay. H H′ indicate keepers fastened to the float, one for each of the swinging links to prevent lateral movement thereof, but to allow the lower ends of the swinging links to swing lengthwise of the float, thus to allow a slight movement of the floats to and from each other.

The truss-beam for the pumps comprises a horizontal frame 5, pivoted or journaled at one end thereof to a support *a* and provided with middle cross-bars 6, a post 7, seated on the cross-bars at the center of the frame, and four slanting corner-braces 8, extending from the inside corners of the frame to the center post and secured to the center post. It is necessary that the beam D shall be very strong and rigid, so that it will not be racked in case one or more of the pumps become disabled, thus throwing the strain to one side or the other of the beam, and the form of truss-beam shown affords the required strength.

In order to conduct the power to the shore with the least difficulty and without danger of breakage of the conductors, I propose to provide upon each of the floats an accumulator-tank I (with compressed air-cushion *i*) to receive the water from the pumps and a pipe J, leading from the pumps to the tank. A discharge pipe or nozzle K is arranged to discharge from the tank upon a water-motor L, which is arranged to receive the stream from the nozzle. Any effective form of water-wheel may be used, such as the wheel known as the "Pelton" wheel. M indicates an electrical generator to be driven by the water-wheel, and N an electrical conductor for conducting the electricity to the shore. A water-wheel, with generator and connections, is applied in each of the floats and the electrical energy may be used immediately or stored in storage batteries O, arranged on shore. The floats may be connected with the cable by a suitable clamping appliance P, so that the position of the floats with relation to the shore may be changed.

In practice any number of pairs of floats may be provided for a plant, and the floats may be made of any practicable size and weight and may be open at top or housed in. They are to be securely anchored in line outside the line of breakers, so as to be acted upon by the waves as distinguished from the breakers, so that they are not subject to the destructive force of the waves, but safely ride thereon. In this way it will be possible to so strongly construct and anchor the floats of the plant that the motor will operate effectively during severe storms as well as in calm weather, though with greater effect in the production of power.

The parts of the pumps must be sufficiently long to allow the pumps to operate freely under the action of heavy swells or waves, so that in heavy seas the movement of the float will all be transmitted for pumping the water. The length of pump required will depend upon the proportions of the arms of the lever and also upon the size of the waves. It will also be understood that the diameter of the pump-cylinders must be sufficient to allow the necessary movement of the piston-rod.

Suitable speed-regulating devices and governors may be applied to govern the speed of the dynamos. With this object in view a governor Q may be provided to open and close the discharge pipe or nozzle K. When the speed of the dynamo becomes too great, the governor will close the discharge pipe or nozzle K sufficiently to diminish the stream which operates on the motor L. This will increase the pressure within the storage-tank I, and in order to relieve such pressure a plurality of discharge-pipes may be provided and the governor connected with the second discharge-pipe K′ to open it in proportion to the closing of the discharge-pipe K. Preferably a water-motor L′, with dynamo M′, is provided for the second discharge-pipe, and any required number of discharge-pipes, water-motors, and dynamos can be provided to take care of the power generated, thus to give a large range of capacity to the apparatus. In practical operation when the wave motion becomes so violent as to cause the pressure in the tank to be so great as to drive the motor so fast as to cause the governor to cut down the discharge through K the governor, acting as a safety-valve, opens the discharge-pipe K′, thus to relieve the pressure within the tank and drive the motor L′ and its dynamo M′. This relieves the tank-pressure, and the second dynamos will be driven until the pressure falls again.

k k′ indicate valves in the pipes K and K′.

R indicates a rod connecting the valves *k* and *k′* and operated by connections S, which are connected with and operated by the governor Q.

T T′ indicate vertical ways for the beams D D′ to prevent the beams from moving laterally.

The water is preferably taken by the pumps from the ocean through a pipe U and returned to the ocean from the water-motors L and L′.

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

1. The combination of two floats to rise and fall independently of each other; a lever fulcrumed to both of the floats; a power receiving and transmitting appliance composed of two movable parts, one of which parts is fastened to and moves with one of the floats, and the other of which parts is pivoted to and moves with the lever, substantially as set forth.

2. The combination of two floats to rise and fall independently of each other; a lever fulcrumed to both of the floats; and a pump having one member fixed to one of the floats and its other member pivoted to the lever.

to be operated thereby, substantially as set forth.

3. The combination of two floats to rise and fall independently of each other; a lever fulcrumed to both of the floats; a pump with one member fixed to one of the floats; a pump-operating beam pivotally connected at one end to the float and pivotally connected at the other end with the movable pump member; and a connecting-rod connecting the lever with the bar, substantially as set forth.

4. The combination of two floats to rise and fall independently of each other; a lever fulcrumed to both of said floats; a beam formed of a trussed frame pivoted at one end to the float; a connecting-rod connecting the other end of the beam with the lever; a series of pump members fixed to the float; and a series of pump members to operate therewith operatively connected with the beam.

5. The combination of two floats to rise and fall independently of each other; a lever fulcrumed to both of the floats; a beam pivotally connected at one end with one of the floats; a connecting-rod connecting such beam with the lever; a beam pivotally connected at one end with the other of the floats; a connecting-rod operatively connecting such beam with the lever; and one or more pumps in each of the floats and each pump having one member connected with its float and the other member operatively connected with its beam, substantially as set forth.

6. In a wave-motor, two floats and between the floats two rigid stays pivotally connected at one end to one of the floats near the middle of the end thereof and pivotally connected at the other end to the end of the other float near the sides thereof; and flexible connections fastened at the sides of the float and connecting the two floats together, substantially as set forth.

7. In a wave-motor, the combination of two floats and between the two floats two rigid stays pivotally connected to one of the floats near the middle of the end thereof; two swinging links pivoted to the other float, one for each of the stays and pivotally connected at the lower end with the stays respectively; two keepers, fastened to the float, one for each of the swinging links to prevent lateral movement thereof but to allow the lower ends of the swinging links to swing lengthwise the float; and flexible side connections connecting the floats together.

8. A connection for two floats of a wave-motor, comprising a rigid stay pivoted at one end to one of the floats; a swinging link pivoted to the other float and pivoted at its lower end to the stay; a keeper for the lower end of the link to prevent lateral movement; and a stop to limit endwise movement of the bar.

9. A truss-beam for the pumps of a wave-motor comprising a horizontal frame journaled at one end thereof to a support and provided with middle cross-bars; a post seated on the cross-bars at the center of the frame; and four slanting corner-braces extending from the inside corners of the frame to the center post and secured to the center post.

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