No. 639,734. Patented Dec. 26, 1899.

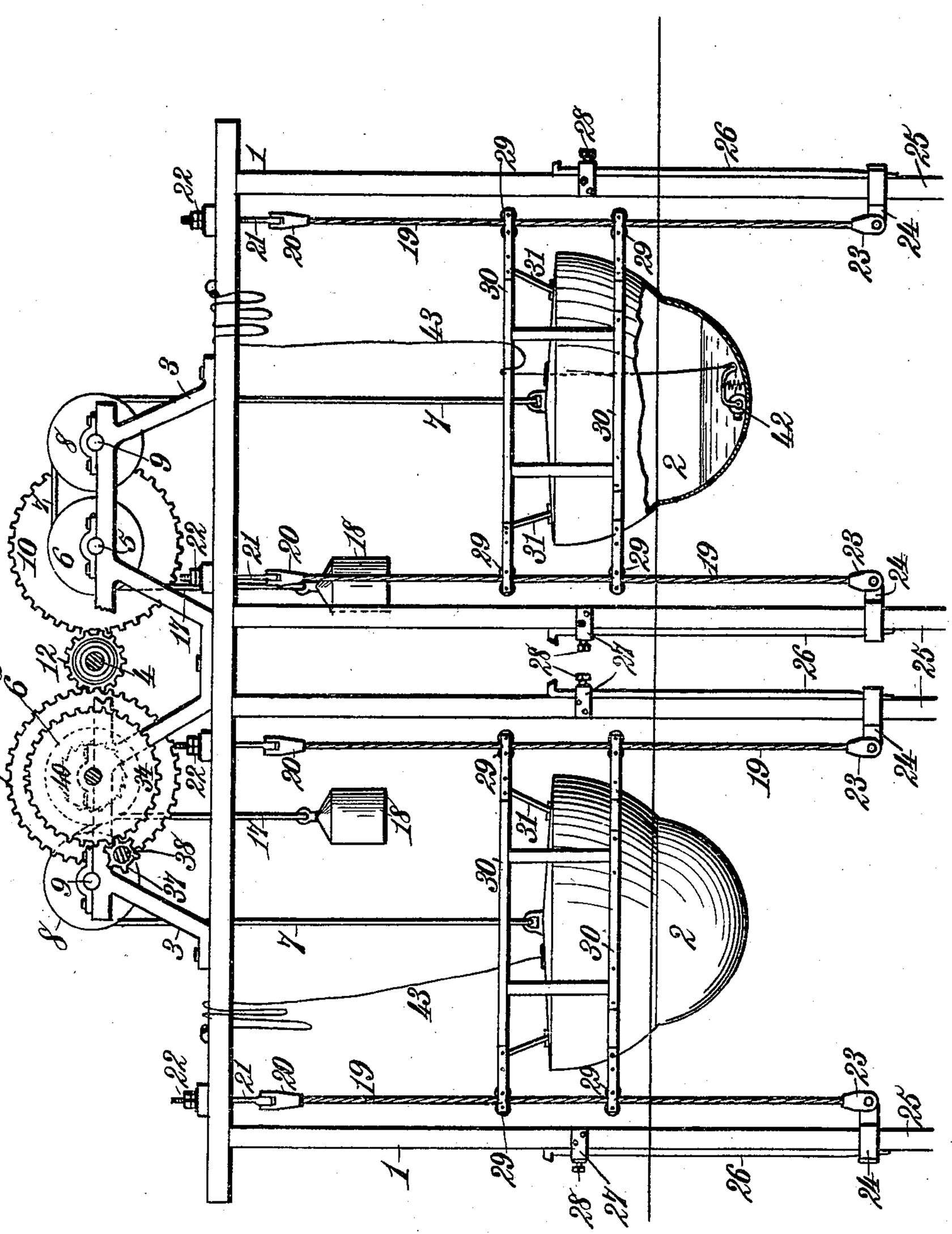
C. M. JOHNSON.

WAVE AND TIDE POWER.

(Application filed July 15, 1899.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.



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(No Model.) 4 Sheets—Sheet 2.

Fig. 2.

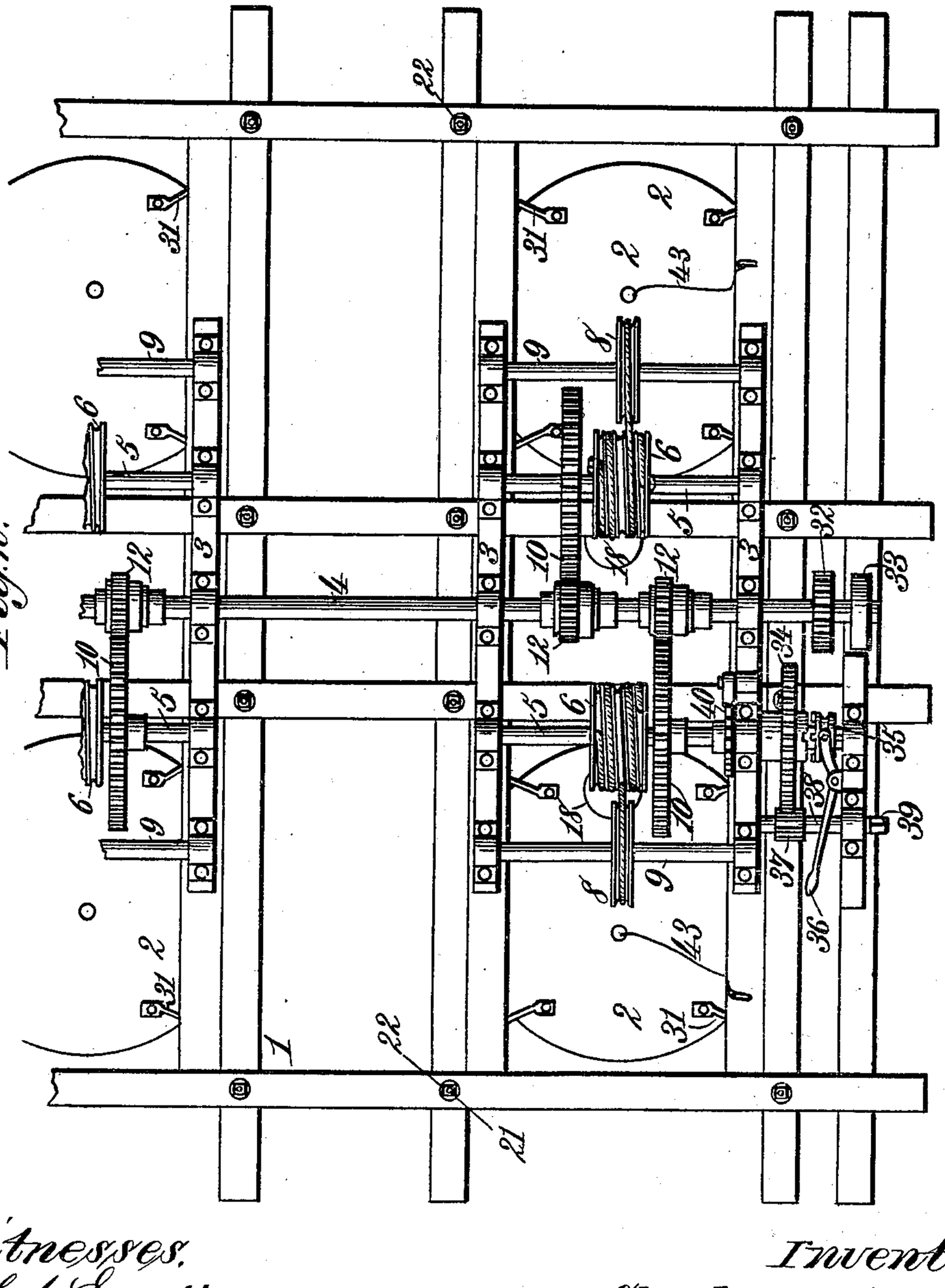

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Fig. 3.

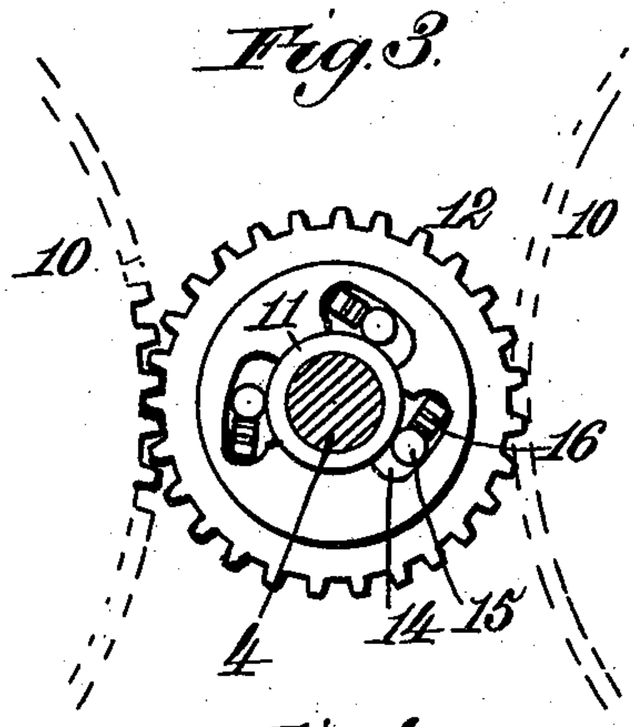

Fig. 4.

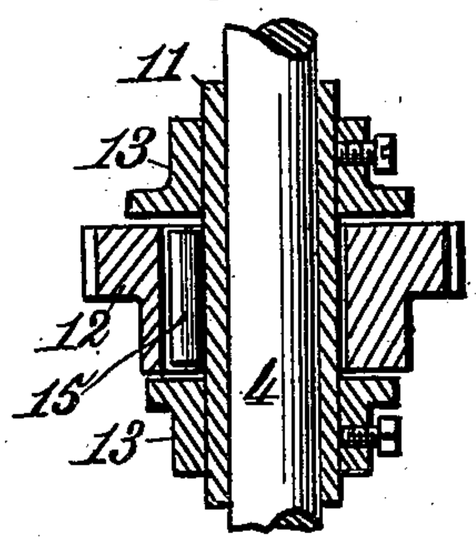

Fig. 5.

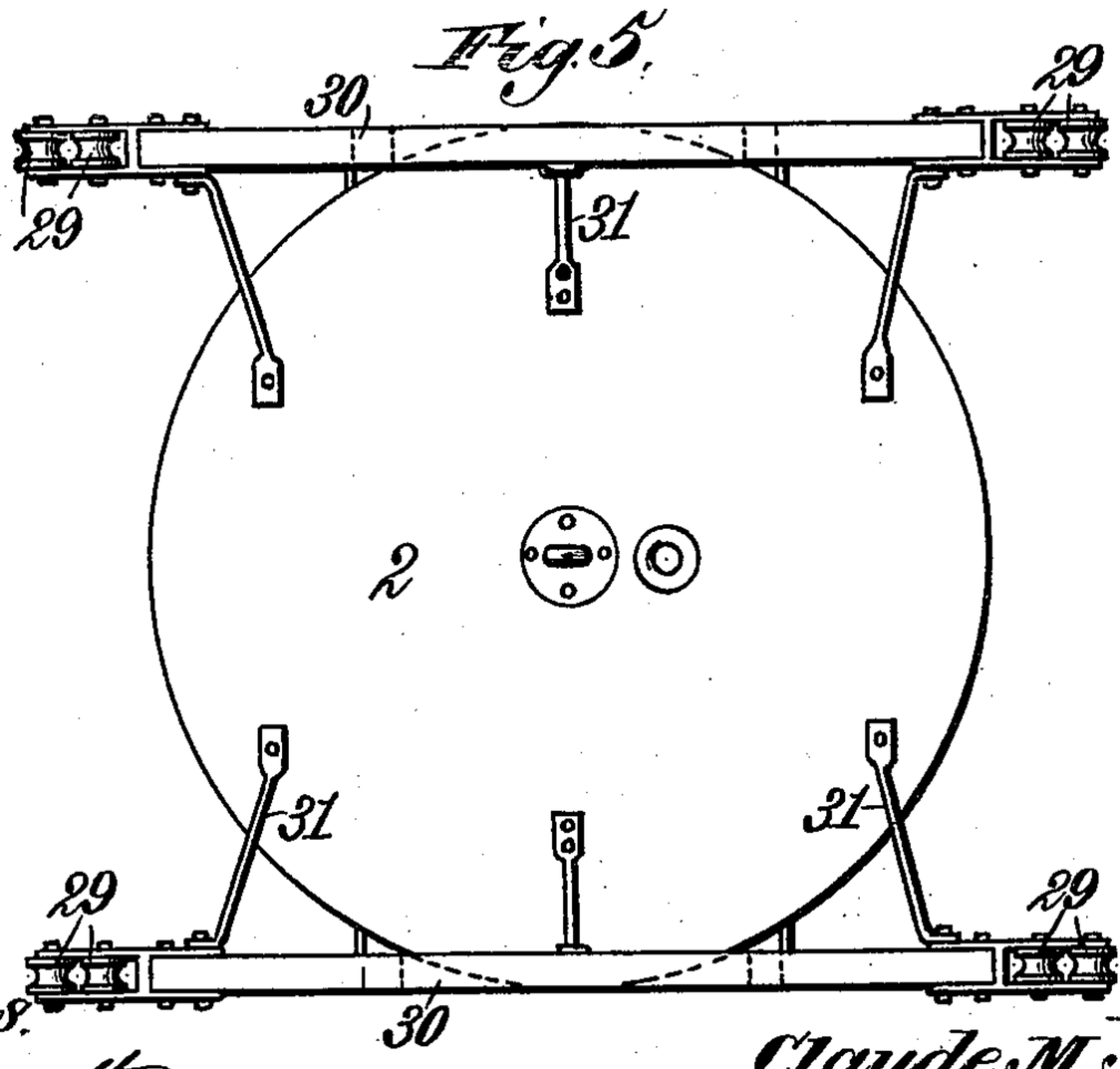

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Fig. 6.

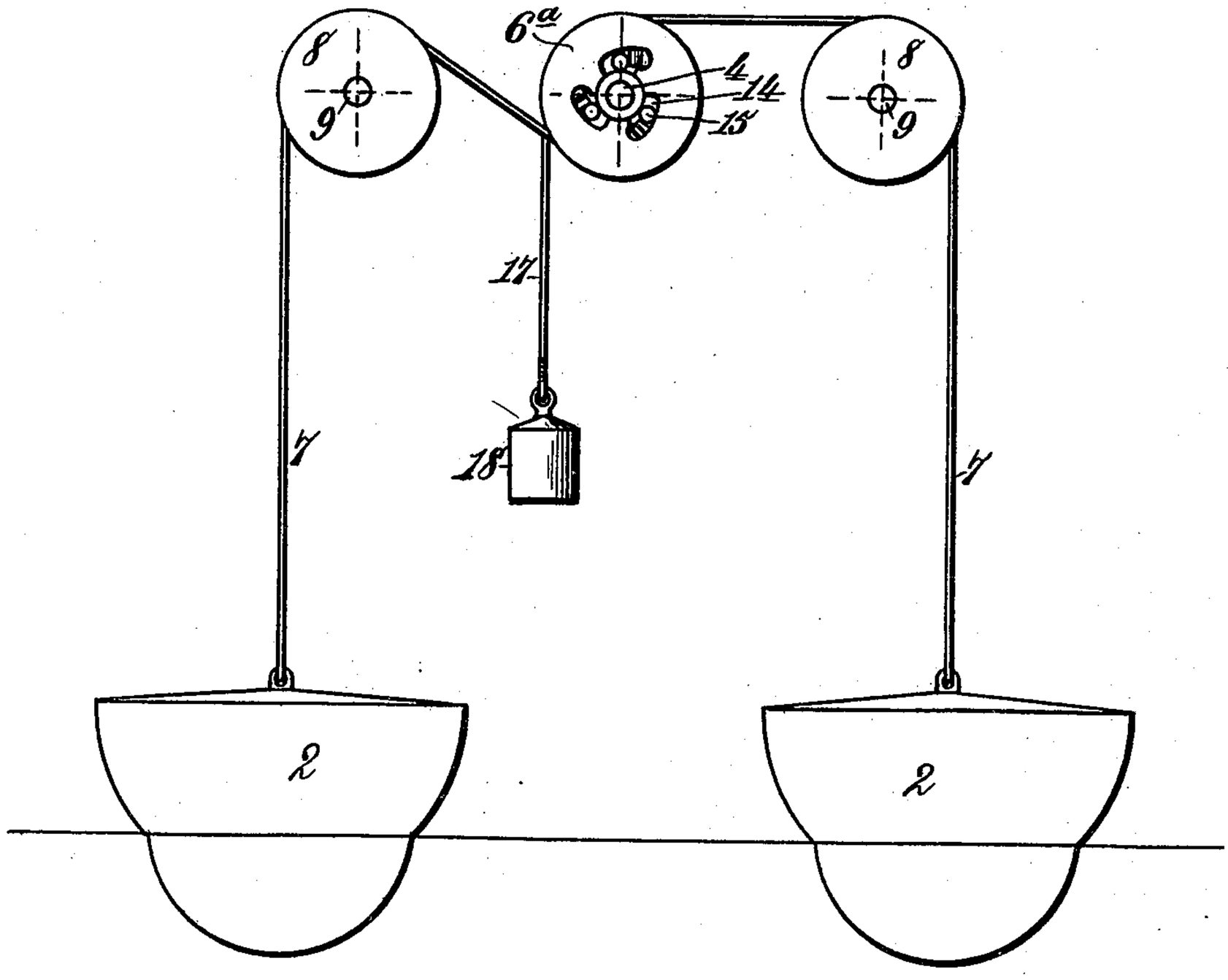
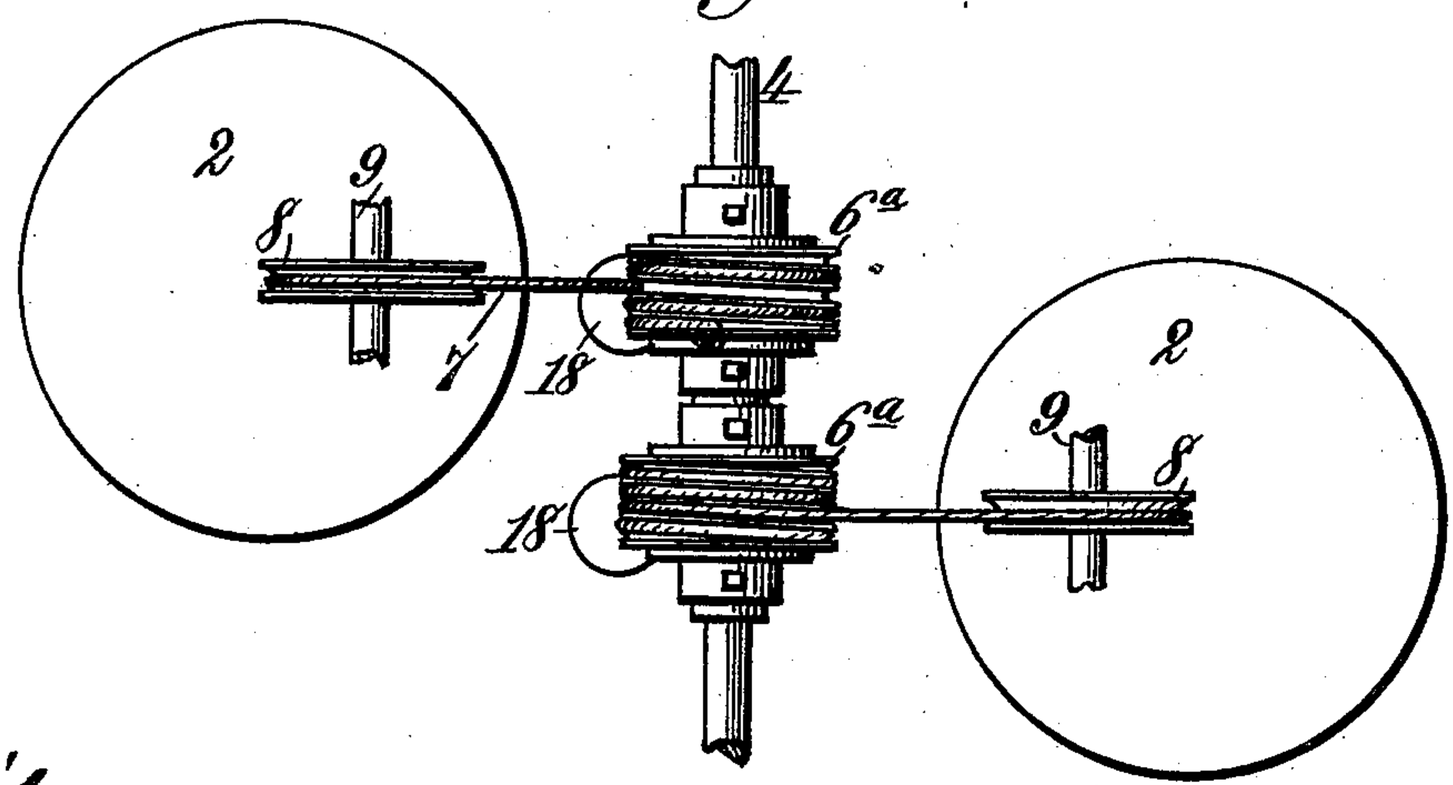


Fig. 7.



Witnesses.
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Inventor:
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Atty.

UNITED STATES PATENT OFFICE.

CLAUDE M. JOHNSON, OF LEXINGTON, KENTUCKY.

WAVE AND TIDE POWER.

SPECIFICATION forming part of Letters Patent No. 639,734, dated December 26, 1899.

Application filed July 15, 1899. Serial No. 723,978. (No model.)

To all whom it may concern:

Be it known that I, CLAUDE M. JOHNSON, a citizen of the United States, residing at Lexington, in the county of Fayette and State of Kentucky, have invented new and useful Improvements in Wave and Tide Powers, of which the following is a specification.

My invention relates to wave and tide powers, and has for its principal object to provide simple and thoroughly efficient means for the direct transmission of power derived from the oscillatory movements of one or more floats or buoys moored in position to be acted on by the rising, falling, rolling, or tumbling motion of the water.

It is the principal purpose of my invention to provide novel, simple, and convenient means for the practically direct application of power to a continuously-driven shaft from a float or floats or buoy or buoys acted on by the waves or tides.

The invention consists in features of construction and novel combinations of devices in a wave or tide power, as hereinafter described and claimed.

In the annexed drawings, illustrating the invention, Figure 1 is a part-sectional end elevation of one form of my improved wave-power. Fig. 2 is a part-plan view of the same. Fig. 3 is a sectional detail view of one of the automatic clutch-gears on a shaft that is to be driven continuously from reversely-rotary shafts on opposite sides. Fig. 4 is a horizontal section of an automatic clutch-gear on the continuously-driven shaft. Fig. 5 is a plan of one of the floats or buoys provided with frames in which guide-sheaves are carried. Fig. 6 shows a modification of the devices through which the continuously-driven shaft is actuated from the floats. Fig. 7 is a plan of the same.

The reference-numeral 1 in Figs. 1 and 2 designates a framework or scaffolding to be erected over the water in a suitable position for the utilization of wave or tide power by means of floats or buoys 2 of any suitable construction. On the scaffolding 1 there are erected at suitable intervals a number of frames 3, provided with suitable bearings for a centrally-located shaft 4, that is to be driven continuously. This continuously-driven shaft 4 is to be extended the entire length of the apparatus. On opposite sides of the continuously-driven shaft 4 and above each float or buoy 2 there is mounted a reversely-rotary shaft 5, having a drum 6 secured thereon. Each drum 6 has secured thereto a cable 7, that passes over a guide-sheave 8 and connects with a central portion of a float or buoy 2 moored beneath. The guide-sheaves 8 may be mounted on shafts 9, supported in the frames 3, as shown in Fig. 2.

By reference to Fig. 1 it will be seen that one of the power-transmitting cables 7 is passed over the sheave 8 to the upper side of the adjacent drum 6, while an opposite power-transmitting cable 7 on the other side of the continuously-driven shaft 4 is passed from the upper side of a sheave 8 to the under side of the adjacent winding-drum. On each reversely-rotary drum-shaft 5 there is secured a spur-gear 10, Figs. 1, 2, and 3. The continuously-driven shaft 4 is provided at suitable points with hardened sleeves 11, Figs. 3 and 4, and these sleeves are surrounded by automatic clutch-gears 12, each of which is in mesh with a spur-gear 10 on one of the reversely-rotary drum-shafts. The automatic clutch-gears 12 are held in place against endwise movement on the sleeves 11 by means of collars 13, Fig. 4, which may be secured to said sleeves in any suitable manner. In each clutch-gear 12 there is provided a series of slots 14, Fig. 3, each of which is widest at one end and has one side formed by the hardened sleeve 11, on which said clutch-gear is mounted. In each of these slots 14 there is placed a friction-roller 15, normally resting against any suitable spring 16, that is so arranged in the wider part of the slot 14 as to hold said rollers in position to enter the narrow end portions of the slots 14 when the gear 12 is rotated in the proper direction to actuate the shaft 4, on which it is mounted. When any automatic clutch-gear 12 is rotated by a spur-gear 10 on descent of the float or buoy 2, the said clutch-gear will receive rotation in such direction as to cause the rollers 15 to enter the narrow ends of the slots 14 and bear therein against the sleeve 11 on the shaft 4, thereby rotating said shaft; but when a clutch-gear 12 is actuated through its intermeshing gear

10 in an opposite direction on ascent of the float or buoy 2 then the rollers 15 will be moved toward the springs 16 in the wider parts of the slots 14 and will cease to bear against the hardened sleeves 11 of the shafts 4, the gear 12 being consequently unclutched, so as to exert at this time no driving action on said shaft.

In order to provide for taking up slack of the power-transmitting cables 7 on ascent of the floats or buoys 2, each drum 6 has attached thereto a rope or cable 17, Fig. 1, with a weight 18 attached to its lower end. The weights 18 are suspended from the several winding-drums 6 in such manner as to cause rotation of said drums and take up slack in the power-transmitting cables 7 when the floats or buoys 2 are moved upward by the action of the tide or waves, and thus these power-transmitting cables 7 are always in condition for actuating the drum 6 and their reversely-rotary shafts 5 on descent of the floats or buoys.

For the purpose of guiding the floats or buoys 2 in their vertical movement and mooring them in a convenient operative position, so that they may have at the same time a sufficient lateral play to avoid undue strain, there are provided a number of vertical guides 19, consisting, preferably, of wire cables of sufficient strength and flexibility and which are attached to the scaffolding 1 in such manner as to provide a necessary degree of rigidity for acting as suitable guides to the vertically-movable floats or buoys. As shown in Fig. 1, these vertically-arranged guide-cables 19 are connected at their upper ends to attaching devices 20, that are flexibly connected with the lower ends of bolts or screw-threaded rods 21, inserted through openings in the upper portions of the scaffolding and secured above the same by nuts 22 or other adjustable fastenings. The lower ends of these vertical guide-cables 19 are each secured in attaching devices 23, that are pivotally connected with straps or clips 24, embracing conveniently-placed uprights 25 of the scaffolding 1, as shown in Fig. 1. These straps or clips 24 are submerged—that is to say, they are placed on the uprights 25 at points below the level of low water, so as to provide a sufficient range of vertical movement for the floats or buoys. Each clip or strap 24 is held in place on the upright 25 by means of the wedging action of a vertically-arranged bar 26, that is long enough to have its upper end above the level of high water when the clips 24 are secured in place. The lower end of each bar 26 is wedge-shaped, as shown in Fig. 1, to more readily engage the clip or strap 24 and confine it to the upright 25, and the upper end of each bar 26 is confined to the upright 25 by means of a strap or clip 27 and a set-screw 28 therein to bind said bar 26 against the upright. It will be readily understood that by loosening the set-screw 28 the bar 26, which has a hooked or shouldered upper end, can be readily lifted from engagement with clips or straps 24 and 27 and then each guide-cable 19 can be withdrawn from the water if desired. Instead of the wire guide-cables 19 it will be obvious that any other suitable guides may be employed; but the wire cables are preferable as affording some degree of flexibility, and at the same time by means of the nuts 22 on the bolts or rods 21 said cables can be strained to have any desired degree of rigidity. The vertical guides 19 are engaged on opposite sides by guide-sheaves 29, carried in the ends or other suitable portion of horizontally-placed frames 30, that are carried on upper and lower portions of each float or buoy 2, as shown in Figs. 1 and 5. Each frame 30 may be connected with the float or buoy 2 by braces or brackets 31 or in any other suitable manner. The vertically-arranged guides 19 and the guide-sheaves 29, carried on the buoys or floats 2, afford very convenient and compact means for mooring the several buoys or floats independent of each other and in such manner that each float or buoy shall be free to have a necessary lateral play, to avoid undue strain, without interfering with the required vertical movements of said floats or buoys under the action of the waves and tide.

It will be obvious that any convenient number of floats or buoys 2 may be arranged in one or more series, preferably in parallel lines, and connected with independent reversely-rotary shafts, as 5, preferably arranged on opposite sides of the lengthened shaft 4, that is to be continuously driven. By gearing each reversely-rotary shaft 5 with the continuously-driven shaft 4, through automatic clutch mechanism of any suitable character the said shaft 4 will receive a continuous rotation derived in part from each reversely-rotary shaft, while the provision of automatic clutch mechanism between the continuously-driven shaft 4 and the several reversely-rotary shafts 5 will permit the necessary rocking motion of the reversely-rotary shafts without acting on the continuously-driven shaft except when the reversely-rotary shafts are moved in the proper direction on descent of each float or buoy. It will be understood that the power for driving the reversely-rotary shafts 5 is derived from the fall of the several floats as the waves and tide recede, the weights 18, connected with the drums 6, being provided merely to take up slack in the power-transmitting cables that connect with the several floats or buoys. The manner of gearing the continuously-driven shaft 4 with the several reversely-rotary drum-shafts 5 is very simple and extremely sensitive, so that it readily responds to every descending movement of each float or buoy. Obviously by employing a sufficient number of floats or buoys 2 and reversely-rotary shafts 5 connected therewith, and each independently geared with the shaft 4 through automatic clutch-gear-

ing, a continuous, uniform, and steady rotation will be imparted to said continuously-driven shaft.

By means of a spur-gear, as 32, or a band-wheel 33, located at any convenient point on the continuously-driven shaft 4, power can be taken from said continuously-driven shaft to actuate various kinds of machinery, such as air-compressors, dynamos, or machines in general. This apparatus for the utilization of wave-power is practical, economical, and comparatively inexpensive, and by employing a suitable number of floats or buoys any required speed and power can be readily obtained.

It may be sometimes necessary to hoist the floats or buoys 2 out of the water, as for purposes of repair or to avoid damage to the apparatus from high or violent storm-waves. For this purpose there may be arranged on each reversely-rotary drum-shaft 5 a loose spur-gear 34, Figs. 1 and 2, adapted to be clutched with said shaft through a clutch-collar 35, arranged to be operated by a lever 36 or otherwise. The spur-gear 34 is in mesh with a pinion 37 on a shaft 38, that may be rotated by any suitable means—as, for instance, by means of a crank or lever attached to a squared end 39 of said shaft 38; or the shaft 38 might be operated by power. Obviously there can be a shaft 38 and its pinion 37 for each winding-drum, or the said shaft 38 could be extended and provided with a number of pinions for the reversely-rotary shafts of the several drums. By unclutching the spur-gear 34 from the drum-shaft it will be unaffected by the oscillations or rocking of said shaft when the wave or tide power is in operation.

Any suitable ratchet mechanism 40 may be provided on each drum-shaft to hold the hoisted floats in an elevated position, the pawl 41 of each ratchet device to be thrown off, of course, when the floats are to be lowered into the water.

It will be obvious that power from any convenient source could be applied to the driven shaft 4 through gearing, such as 32 or 33, to turn said shaft in a proper direction to hoist the floats when necessary.

The floats 2, which are preferably hollow, may be conveniently weighted, as required, by admitting any suitable quantity of water to the interior of each float. When it is desired to hoist these floats, they may be lightened by discharging the water through a valve 42, that can be opened by pulling on a rope 43, extended to a convenient point within reach of an attendant.

Instead of the arrangement of float-actuated reversely-rotary devices shown in Figs. 1 to 4, comprising drums 6, mounted on shafts 5, that are geared with the continuously-driven shaft 4 through automatic clutch-gearing mechanism, I may employ an arrangement of reversely-rotary devices such as shown in Figs. 6 and 7, in which the power-transmitting cable 7 of each float is secured to its appropriate reversely-rotary drum 6^a, that in this case is loosely mounted on the continuously-driven shaft 4 in alternately clutched and unclutched relation therewith through automatic clutch mechanism of any suitable kind, preferably of the character already hereinbefore described. Thus, as shown in Figs. 6 and 7, the shafts 5 and gears 10 and 12 may be dispensed with, the continuously-rotating shaft 4 being then provided with a number of loosely-mounted drums 6^a, corresponding with the number of floats 2 to be employed in the apparatus. Each float 2 will be connected with its drum 6^a, Figs. 6 and 7, by a power-transmitting cable 7, and the slack in each of these cables will be taken up on ascent of the float by means of a weight 18, suspended from a rope or cable 17 on each drum, as before. In the hubs or other suitable part of each loosely-mounted reversely-rotary drum 6^a will be arranged automatic clutch mechanism, preferably comprising the slots 14, rollers 15, and springs 16, already described, said automatic clutch mechanism being so arranged that when the drum 6^a is rotated by descent of the float 2 the said drum will be automatically clutched with the shaft 4, so as to drive the same continuously in one direction, while on ascent of the float the drum will be automatically unclutched and rotated in a reverse direction by action of the weight 18, the continuous rotation of the shaft 4 in its one required direction being meanwhile maintained through the operation of descending floats acting on other reversely-rotary automatic clutching and unclutching drums, as will be readily understood. The several floats 2 may be arranged in parallel series, with their power-transmitting cables 7 passed over guide-sheaves 8 on opposite sides of the continuously-driven shaft 4 and thence in proper direction to drums 6^a on said shaft, as shown in Figs. 6 and 7. Obviously any suitable number of floats and connected drums or other reversely-rotary devices may be employed, according to the speed and power to be developed in the continuously-driven shaft.

As shown in Figs. 1, 2, 6, and 7, the floats 2 are preferably arranged on opposite sides of the continuously-driven shaft 4, thereby obtaining the advantage of applying to said driven shaft the power derived from a large number of floats without involving any necessity of extending a series of floats to a great distance from the shore. Obviously the reversely-rotary devices, through which the power developed by the floats is applied to the continuously-driven shaft, may be mounted on said shaft or at the side thereof, as preferred.

What I claim as my invention is—

1. The combination of a continuously-driven shaft, a plurality of reversely-rotary devices, automatic clutch mechanism intermediate each of said reversely-rotary devices

and the said continuously-driven shaft, a plurality of floats or buoys arranged on opposite sides of the continuously-driven shaft, a power-transmitting rope or cable connecting each float or buoy with a reversely-rotary device, a weight suspended from each reversely-rotary device, vertically-arranged mooring-cables for the several floats or buoys, and means for detachably securing said mooring-cables at points above and below the water-level, substantially as described.

2. The combination of a framework or scaffolding a plurality of floats or buoys acted on by wave-power, vertically-arranged mooring and guide cables for each of said floats or buoys, means for detachably connecting said mooring and guide cables with the scaffolding at points above and below the water-level, a plurality of reversely-rotary devices, means for actuating each of said reversely-rotary devices from a float or buoy, a continuously-driven shaft, and automatic clutch mechanism intermediate each of said reversely-rotary devices and the said continuously-driven shaft, substantially as described.

3. The combination of a plurality of floats or buoys to be acted on by wave-power, a continuously-driven shaft, a plurality of reversely-rotary devices mounted on opposite sides of said continuously-driven shaft, power-transmitting cables connecting each of said floats with a reversely-rotary device, guides for said cables, and automatic clutch mechanism intermediate each reversely-rotary device and the said continuously-driven shaft, substantially as described.

4. The combination of a continuously-driven shaft, a plurality of reversely-rotary devices, a plurality of floats or buoys arranged on opposite sides of the continuously-driven shaft, power-transmitting cables connecting the several floats or buoys with the several reversely-rotary devices, weights suspended from the several reversely-rotary devices, guide-sheaves for said power-transmitting cables arranged on opposite sides of the continuously-driven shaft, and automatic clutch mechanism intermediate each reversely-rotary device and said continuously-driven shaft, substantially as described.

5. The combination of a continuously-driven shaft, a plurality of independent reversely-rotary shafts provided with winding-drums, a plurality of floats or buoys, means for mooring said floats or buoys, power-transmitting cables connecting said floats and drums for actuating each of said reversely-rotary shafts, guide-sheaves for said power-transmitting cables, weights suspended from each of said drums, and gearing connecting each of said reversely-rotary shafts with the continuously-driven shaft and comprising automatic clutch mechanism through which said continuously-driven shaft is actuated from each reversely-rotary shaft, substantially as described.

6. The combination of a framework or scaffolding, a plurality of floats or buoys, vertical mooring-guides for said floats or buoys detachably connected with said scaffolding above and below the water-level, guide-sheaves carried by each float or buoy and engaged with said vertical mooring-guides, a plurality of reversely-rotary devices, means for actuating said reversely-rotary devices from the floats or buoys, a continuously-driven shaft, and automatic clutch mechanism intermediate each reversely-rotary device and said continuously-driven shaft and through which the said continuously-driven shaft is actuated from the several reversely-rotary devices, substantially as described.

7. The combination of a continuously-driven shaft, a reversely-rotary shaft, gearing connecting said reversely-rotary shaft with the continuously-driven shaft and comprising automatic clutch mechanism through which the continuously-driven shaft is actuated from the reversely-rotary shaft, a float or buoy, means for actuating the reversely-rotary shaft from said float or buoy, and vertically-arranged mooring-cables to moor and guide said float or buoy, substantially as described.

8. The combination of a framework or scaffolding, a float or buoy, guide-sheaves carried on said float or buoy, vertically-arranged mooring and guide cables with which said guide-sheaves are engaged, mechanism detachably connecting said vertically-arranged mooring and guide cables with said scaffolding above and below the water-level and for attaching and detaching said cables from above, and power devices actuated from said float, substantially as described.

9. The combination of a framework or scaffolding, a float or buoy acted on by wave-power, guide-sheaves carried by said float or buoy, vertically-arranged mooring and guide cables for said buoy, means for detachably connecting said mooring and guide cables with said scaffolding at points above and below the water-level, and power-shafting actuated from said float or buoy, substantially as described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

CLAUDE M. JOHNSON.

Witnesses:
JAMES L. NORRIS,
F. B. KEEFER.