No. 639,733. Patented Dec. 26, 1899.

C. M. JOHNSON.

WAVE AND TIDE POWER.

(Application filed Apr. 27, 1899.)

(No Model.) 3 Sheets—Sheet 1.

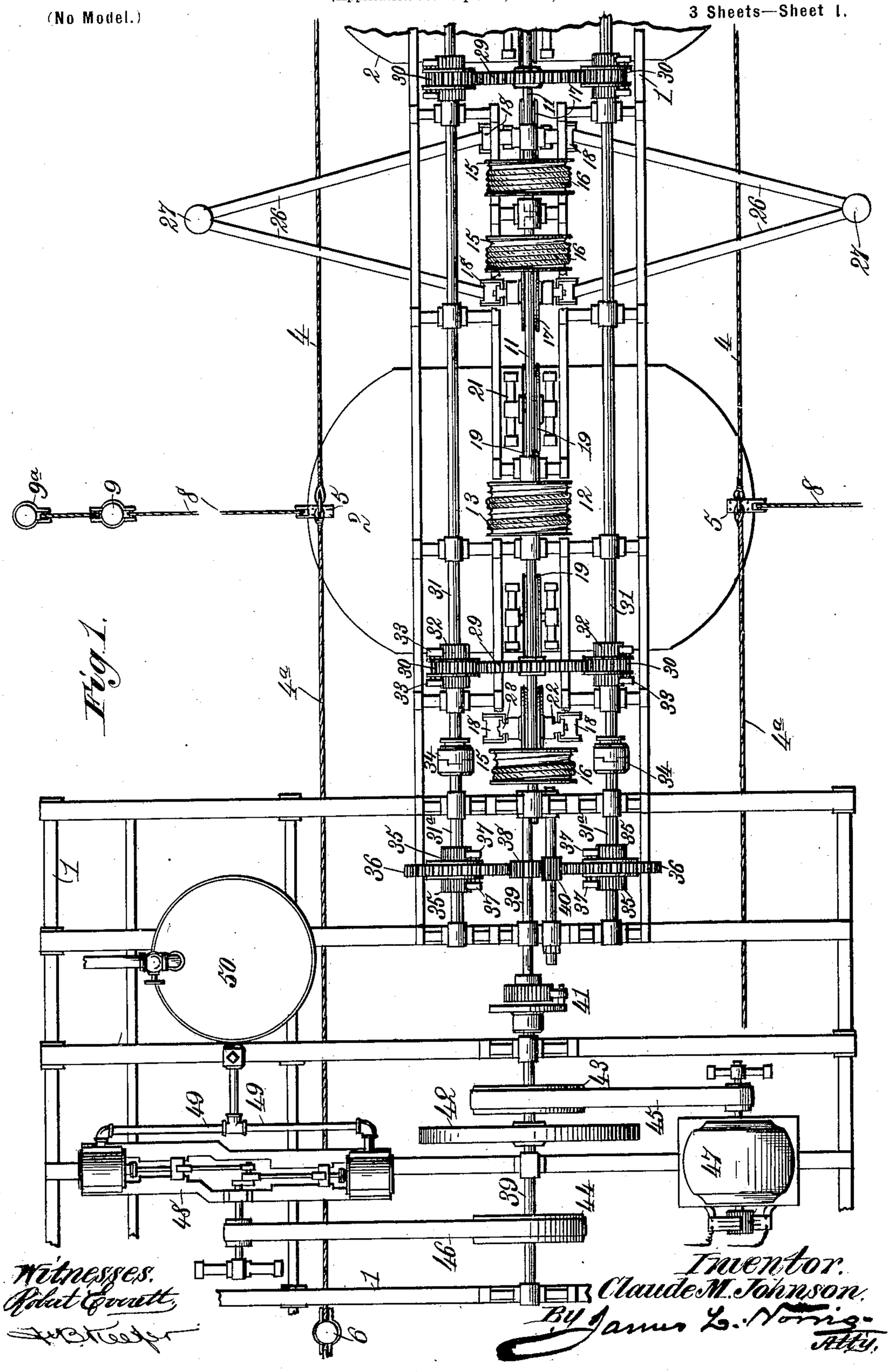

Fig. 1.

Witnesses.
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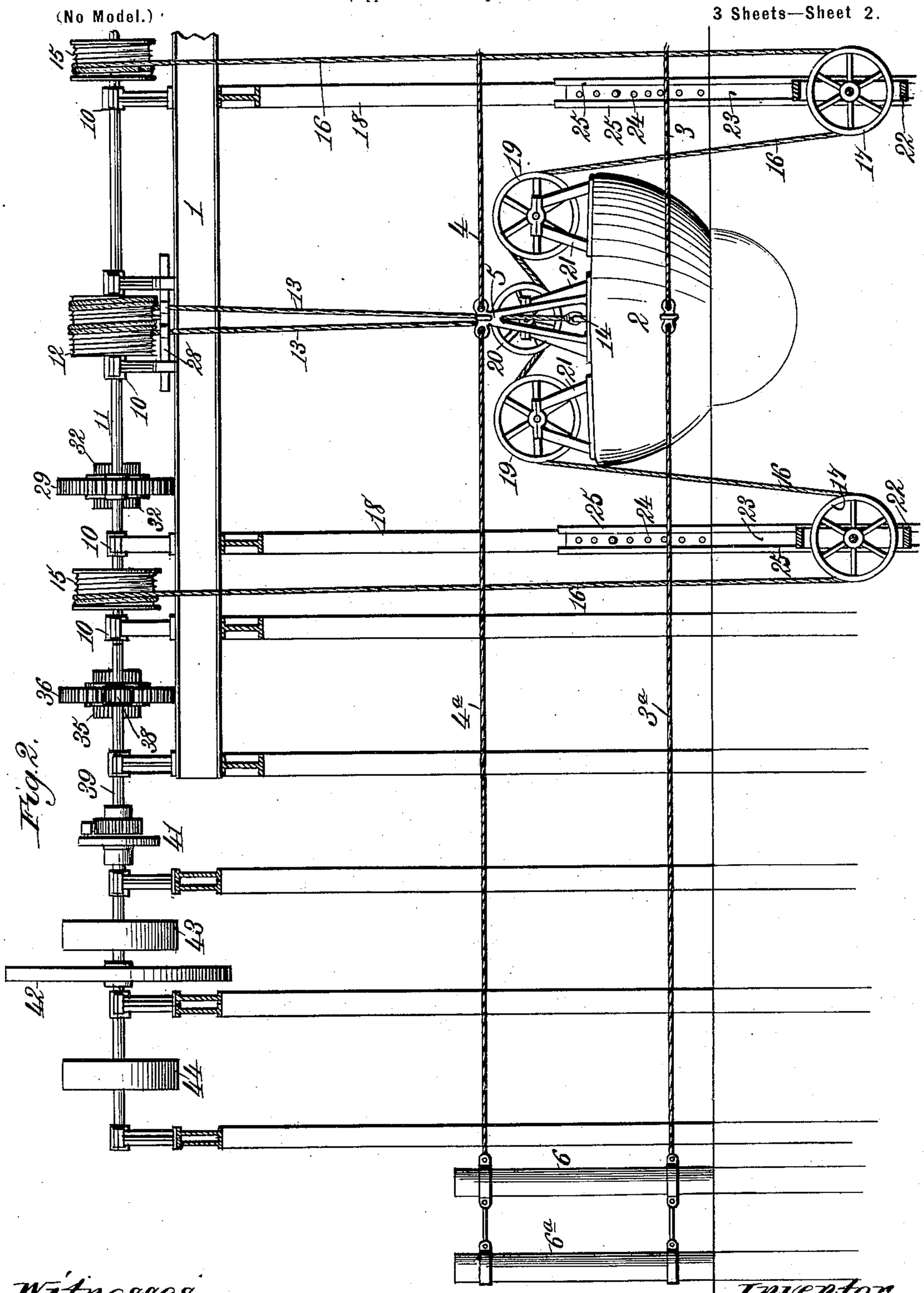

Fig. 2.

Witnesses,
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(No Model.) 3 Sheets—Sheet 3.

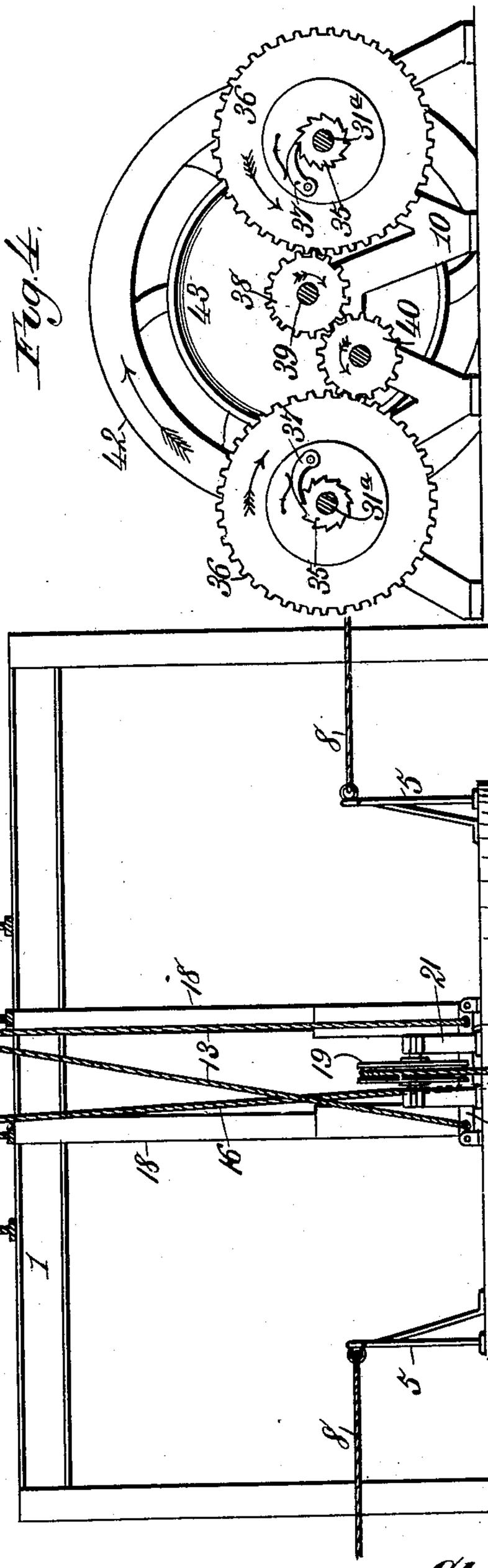

Fig. 3.

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UNITED STATES PATENT OFFICE.

CLAUDE M. JOHNSON, OF LEXINGTON, KENTUCKY.

WAVE AND TIDE POWER.

SPECIFICATION forming part of Letters Patent No. 639,733, dated December 26, 1899.

Application filed April 27, 1899. Serial No. 714,747. (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.

This invention relates to wave and tide powers, and has for its object to provide improved and simple means for the steady, uniform, and economical application of power derived from the oscillatory movements of one or more floats or buoys moored in position to be acted on by the rolling and tumbling motion of the water.

The invention consists in a reversely-rotary shaft, (one or more,) actuated from a float or floats through suitable power-transmitting connections, combined with intermittently-rotating shafts mounted on opposite sides of all the reversely-rotary shafts and parallel therewith, automatic clutch-gearing through which the intermittently-rotating shafts are actuated from the several reversely-rotary shafts, and a continuously-driven shaft geared with and actuated from the intermittently-rotating shafts and from which continuously-driven shaft power may be taken for driving machinery, running dynamos, air-compressors, and other mechanism, and for transmitting power generally.

The invention further consists in features of construction and novel combinations of devices, as hereinafter described and claimed.

In the annexed drawings, illustrating the invention, Figure 1 is a partial plan of a wave-power embodying my improvements. Fig. 2 is a part-sectional elevation of the same. Fig. 3 is a vertical transverse section of the apparatus at a point through one of the reversely-rotary shafts. Fig. 4 is a vertical transverse sectional view at the point where the motion of the intermittently-rotating shafts is transmitted to the continuously-driven shaft.

In the drawings the reference-numeral 1 designates a scaffolding or framework of any suitable construction erected over a sufficient depth of water to provide for an efficient utilization of wave-power through the medium of floats or buoys 2, that are moored beneath said scaffolding in such manner as to rise and fall with the oscillatory movements of the tide and waves. These buoys 2 may be of any suitable form and construction; but obviously they must have sufficient strength to withstand the pressures and strains to which they may be subjected. One or more buoys or floats 2 may be employed, according to the power desired.

When employing a plurality of buoys or floats 2, they may be arranged in a series at suitable distances and be connected by cables 3, secured to said buoys on opposite sides of each at a point below its top, and also by cables 4, secured to stanchions 5, erected on the top of each buoy. The connected buoys are conveniently moored by means of cables 3^a and 4^a, Figs. 1 and 2, extended from the ends of the series of buoys and in line therewith. At one end these cables 3^a and 4^a may be secured to opposite parts of a buoy at the same points as the cables 3 and 4, as shown. The cables 3^a and 4^a may be fifty feet in length, more or less, and are secured to mooring-posts 6 and stay-posts 6^a, placed one behind the other at a distance of, say, forty-eight feet from the nearest buoy. These mooring-posts and stay-posts may be suitably braced or coupled together in any preferred manner. Although only one end of the series of buoys or floats is represented in the drawings, it is to be understood that both ends of the series are moored in substantially the same manner by means such as just described. Each buoy or float 2 is also moored independently of the others by means of cables 7 and 8, Figs. 1 and 3, extended at right angles to the series of buoys. These cables may also be fifty feet in length, more or less. At one end they are secured to the buoys in the manner already described with reference to the mooring-cables 3^a and 4^a and at the other end they connect with mooring-posts 9 and stay-posts 9^a, Fig. 1, placed one behind the other at a distance of, say, forty-eight feet from the buoy. The object of having the several mooring-cables of slightly-greater length than the distance between the buoys and the mooring-posts is to provide for a sufficient play of the buoys to avoid undue strain and yet maintain the position of the several buoys within such limits as are best suited to a steady and uniform development of wave-power.

On the top or upper part of the scaffolding

1 there are bearings 10, in which, above each float or buoy, there is mounted a reversibly-rotary power-shaft 11, that is arranged to be reversibly rotated or alternately revolved in opposite directions by the oscillatory up-and-down movements of the float or buoy with which said shaft is in operative connection. There will be a series of reversibly-rotary shafts 11, corresponding with the number of floats or buoys, and all these shafts are in line with each other, one above each buoy, throughout the series. To each reversibly-rotary shaft 11, at a point above the center of its actuating-buoy, there is secured a winding drum or drums 12, Figs. 1 and 2, preferably a double drum, as shown. These drums 12 are connected directly with the buoy 2 by means of power-transmitting cables 13, having one end secured to the buoy, as at 14, in any suitable manner, the other end of each cable being secured to and wound on its appropriate drum. Each reversibly-rotary shaft 11 has also secured thereto, near each end of said shaft, a winding-drum 15, Figs. 1 and 2, to each of which is secured one end of a power-transmitting cable 16, Figs. 2 and 3, that indirectly connects both drums with the actuating-buoy. This power-transmitting cable 16 is extended beneath submerged guide-sheaves 17, Figs. 2 and 3, that are supported between posts 18, which may form part of the main scaffolding or framework. Between the two submerged sheaves 17 the cable 16 passes over outer sheaves 19 and beneath an intermediate sheave 20, that are all mounted in suitable supports 21 on the top of the buoy. The two submerged sheaves 17 are each mounted in its separate rectangular frame 22, which is provided on opposite sides with vertical arms 23, having series of holes 24 therein, as shown in Fig. 2. These vertical arms 23 are confined laterally by guide-flanges 25, arranged vertically on the posts 18, between which the sheave-frame 22 is placed. The posts 18 may be braced by struts 26, extended to stay-posts 27, or otherwise, as desired. While each sheave 17 is designed to be submerged, the arms 23 are of sufficient length to extend above the water, and thus a suitable pin or bolt inserted through any of the exposed holes 24 will serve to hold the sheave down to a proper depth of submersion to take up any slack in the cable 16 and maintain it in a suitably taut and operative condition with relation to the drums, sheaves, and buoy. The bolt or pin that is inserted through any of the holes 24 to hold down the sheave-frame 22 is readily accessible, being above the surface of the water, and after withdrawing such pin or bolt the sheave-frame and sheave can be readily lifted out of the water to a point above the guide-flanges 25 and be thus disengaged or removed for the purpose of making any needed repairs or for disentangling seaweed or other floating matter that might obstruct the operation of the sheaves and cable.

It will be observed by reference to Fig. 2 that the power-transmitting cables 13 and 16 are arranged on their respective drums 12 and 15 in such manner that when the float 2 descends with a subsiding wave the cables 13 will unwind from the drums 12, and thereby rotate the shaft 11 in such direction as to wind the two ends of the cable 16 on their drums 15, while, on the contrary, as the float 2 ascends with a rising wave or swell the two ends of the cable 16 will unwind from the drums 15, and thus rotate the shaft 11 in the opposite direction, so as to reciprocally wind the cables 13 onto their respective drums. Thus the reversibly-rotary shaft 11 will be rotated in one direction through the cables 13 and in the other direction through the cable 16, in accord with the oscillatory or rising-and-falling movements of the float or buoy 2 as acted on by the waves and tide. It will be observed that the arrangement of the continuous cable 16 with relation to the submerged sheaves 17 and buoy-sheaves 19 20 will permit any swinging or tilting of the buoy without causing slack in either portion of said cable 16 at opposite sides of the buoy. The drums 12 and 15 may be spirally fluted, as shown, and any suitable guide device 28, Figs. 2 and 3, may be provided for laying the cables 13 in the grooves of their winding-drums.

As shown in Figs. 1 and 2, each primary and reversely-rotary power-shaft 11 carries a spur-gear 29, that is in mesh with pinions 30, which are loosely placed on secondary intermittently-rotating shafts 31, Figs. 1 and 3, that are mounted on opposite sides of the reversely-rotary shaft 11 and parallel therewith. Each intermittently-rotating shaft 31 is continuous throughout and is extended to such length as to be in position for receiving power from all the reversely-rotary shafts. To each of these shafts 31 there may be secured ratchet-wheels 32, through which said shafts are actuated by means of pawls 33, carried on opposite sides of the several loose pinions. Obviously any other suitable clutch devices may be provided for automatically clutching and unclutching the pinions 30 and shafts 31, so that said shafts 31 will be alternately and intermittently rotated, one shaft in one direction and the other in an opposite direction, as shown in Fig. 3, according to the reversely-rotary movements of the shaft 11 and gear 29 thereon. Thus when the gear 29 of any reversely-rotary shaft 11 turns in one direction it will actuate one of the intermittently-rotating shafts 31, but will not affect the other shaft 31, owing to slipping of the pawl or clutch devices on one side or the other.

Each intermittently-rotating shaft 31 may be connected at one end to an extension-shaft 31^a by means of any suitable clutch-coupling 34, Fig. 1, with provisions for shifting said clutch to connect or disconnect the shafts 31 and 31^a, as desired. When connected therewith, the extension 31^a constitutes a part of

the shaft 31 and turns with it. On each shaft extension 31ª, or directly on the shafts 31 in case the clutches 34 should be omitted, there are fixed two ratchet-wheels 35, on opposite sides of loose pinions 36, provided with pawls 37 or other clutch devices for transmitting power to a spur-gear 38, that is fixed to a continuously-driven shaft 39, Figs. 1 and 4. Between the gear 38 and one of the loose pinions 36 there is arranged an intermediate gear 40, so that the shaft 39 shall be driven continuously from either one shaft 31ª or the other.

The continuously-driven shaft 39 is preferably made in two sections connected end to end by means of any suitable automatic clutch device 41, the parts of which are so arranged that while both sections of said shaft will normally rotate together one part of said clutch will be free to slip on the other, and consequently permit the speed and uniform motion of the extended portion of said shaft 39 to be maintained by momentum of the flywheel 42 thereon in case the speed of the portion of said shaft to which is attached the spur-gear 38 should be diminished by any irregularity in the movements of the shafts that are more directly actuated from the floats or buoys.

As shown in Figs. 1 and 2, the extended portion of the continuously-driven shaft 39 may carry band-wheels 43 44 for attachment of belting 45 46 to drive a dynamo 47 or an air-compressor 48 or any other machinery. The air-compressor 48 may connect by pipes 49 with a compressed-air reservoir 50, from which the compressed air may be conducted by suitable piping to any required point to be used as a source of power or for other purposes.

Although I have referred to the shafts 11 as being "reversely rotary" and the shafts 31 as "intermittently rotating," it will be obvious that, as actuated by only a slight movement of a buoy, the connected shaft 11 may have only a slight rocking motion at times, while, as geared with and acted on by a plurality of independently-actuated shafts 11, the shafts 31 may rotate continuously, or very nearly so, at certain times, according to the number of floats or buoys included in the apparatus. I would therefore have it understood that the terms "reversely rotary" as applied to the shafts 11 and "intermittently rotating" as applied to the shafts 31 have been adopted for convenience of description and not as imposing any limitation with regard to the degree of movement imparted to these shafts.

What I claim as my invention is—

1. The combination of a reversely-rotary shaft, means for actuating said shaft from a float or buoy acted on by wave-power, intermittently-rotating shafts mounted parallel with said reversely-rotary shaft on opposite sides thereof, gearing connecting said shafts and comprising automatic clutch mechanism through which the intermittently-rotating shafts are alternately actuated from the reversely-rotary shaft, and a continuously-driven shaft geared with said intermittently-rotating shafts and actuated therefrom alternately, substantially as described.

2. The combination of a reversely-rotary shaft, means for actuating said shaft from a float or buoy, intermittently-rotating shafts mounted parallel with said reversely-rotary shaft, gearing connecting said shafts and comprising automatic clutch mechanism through which the intermittently-rotating shafts are alternately actuated from the reversely-rotary shaft, a continuously-driven shaft geared with and actuated from said intermittently-rotating shafts alternately, and means for taking power from said continuously-driven shaft for the operation of machinery, substantially as described.

3. The combination of a reversely-rotary shaft having winding-drums secured thereon, a float or buoy, means for mooring said buoy, power-transmitting cables connecting the buoy with the drums on the reversely-rotary shaft in such manner that rise and fall of the buoy as acted on by wave-power will actuate said reversely-rotary shaft through said cables, intermittently-rotating shafts mounted parallel with said reversely-rotary shaft, gearing connecting said shafts and comprising automatic clutch mechanism through which the intermittently-rotating shafts are alternately actuated from the reversely-rotary shaft, and a continuously-driven shaft geared with and driven from said intermittently-rotating shafts, substantially as described.

4. The combination of a reversely-rotary shaft, winding-drums secured to said shaft, a float or buoy, a power-transmitting cable directly connecting said buoy with a drum centrally located on the reversely-rotary shaft, sheaves mounted on the buoy, submerged sheaves supported independent of the buoy and on opposite sides, and a power-transmitting cable engaged with the buoy-sheaves and with the submerged sheaves and indirectly connecting the buoy with drums located on the end portions of the reversely-rotary shaft, substantially as described.

5. The combination of a float or buoy having sheaves mounted thereon, a reversely-rotary shaft mounted above said buoy, winding-drums secured to said shaft, submerged sheaves supported independent of the buoy and on opposite sides, sheave-supporting frames having arms extended above the surface of the water, posts provided with guide-flanges engaged by said sheave-frames and their arms, means for securing said arms to said posts at a point above the surface of the water to hold down the submerged sheaves and to permit their removal, one or more power-transmitting cables directly connecting the buoy with a winding drum or drums located on a central part of the reversely-ro-

tary shaft, and a power-transmitting cable engaged with the buoy-sheaves and submerged sheaves and indirectly connecting the buoy with winding-drums located on end portions of the reversely-rotary shaft, substantially as described.

6. The combination of a plurality of floats or buoys, means for mooring said buoys, a plurality of independent reversely-rotary shafts provided with winding-drums, power-transmitting cables for actuating each of said reversely-rotary shafts from a float or buoy, continuous intermittently-rotating shafts mounted on opposite sides of and parallel with said reversely-rotary shafts, gearing connecting each of said reversely-rotary shafts with both intermittently-rotating shafts and comprising automatic clutch mechanism through which the intermittently-rotating shafts are actuated from the several reversely-rotary shafts, and a continuously-driven shaft geared with and actuated from said intermittently-rotating shafts, substantially as described.

7. The combination of a plurality of floats or buoys, cables and posts for mooring said buoys, a plurality of independent reversely-rotary shafts, means for actuating said shafts from the float or buoys, continuous intermittently-rotating shafts mounted on opposite sides of and parallel with said reversely-rotary shafts, automatic clutch-gearing connecting each of said reversely-rotary shafts with both intermittently-rotating shafts, and a continuously-driven shaft, geared with and driven from said intermittently-rotating shafts 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,
GEO. W. REA.