N. S. EDENS.

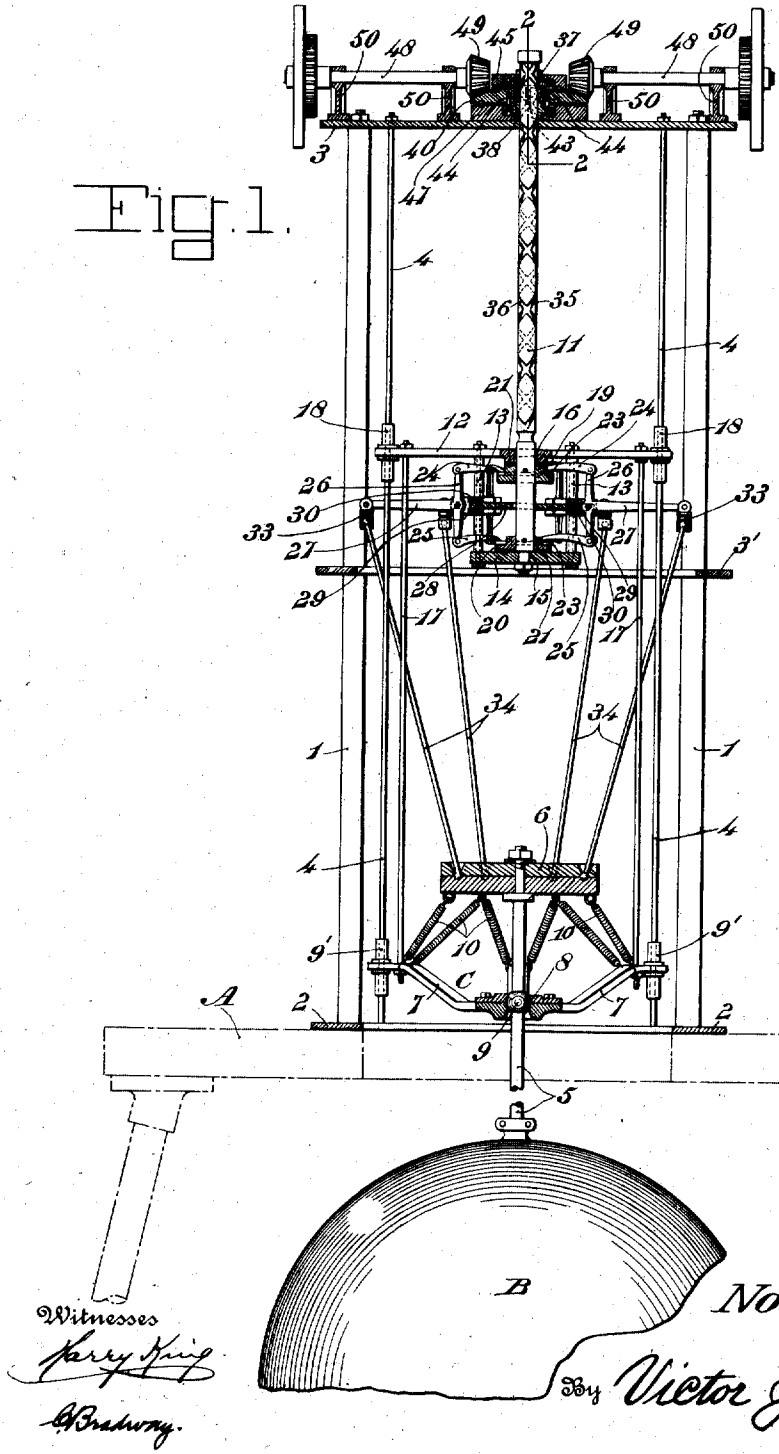
WAVE AND TIDE MOTOR.

APPLICATION FILED SEPT. 7, 1910.

994,728. **Patented June 13, 1911.**

3 SHEETS—SHEET 1.

Fig. 1.



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3 SHEETS—SHEET 2.

Fig. 2.

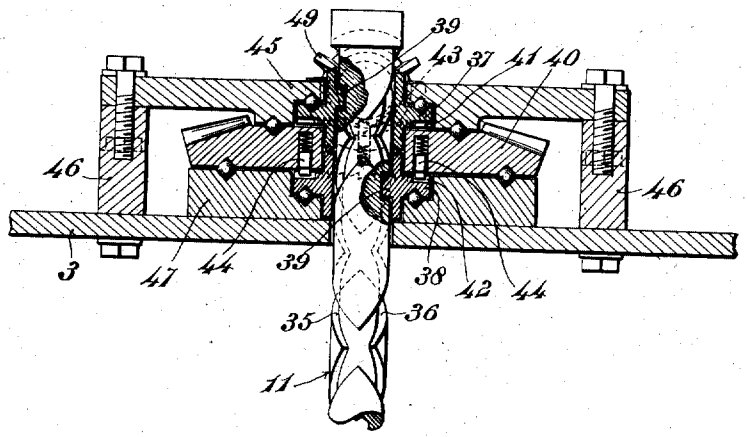
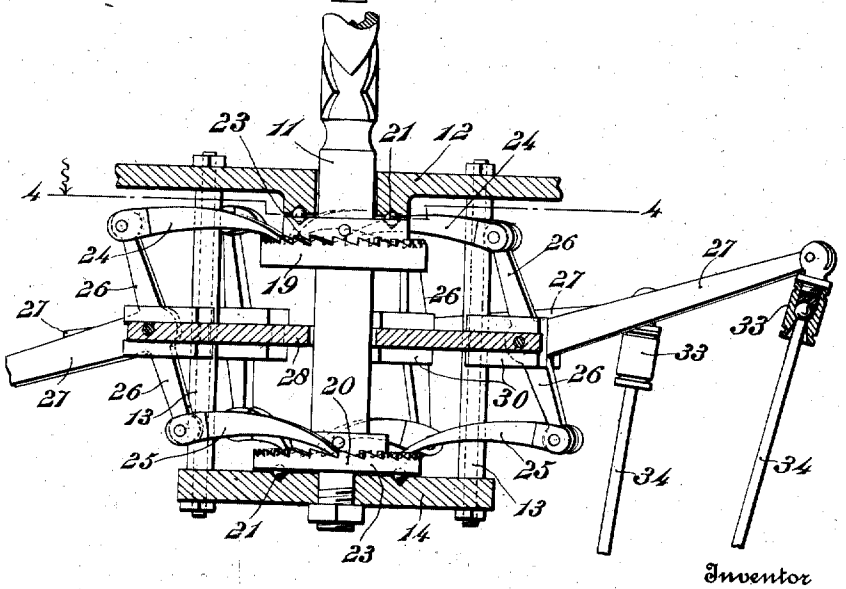


Fig. 3.



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3 SHEETS—SHEET 3.

Fig. 4.

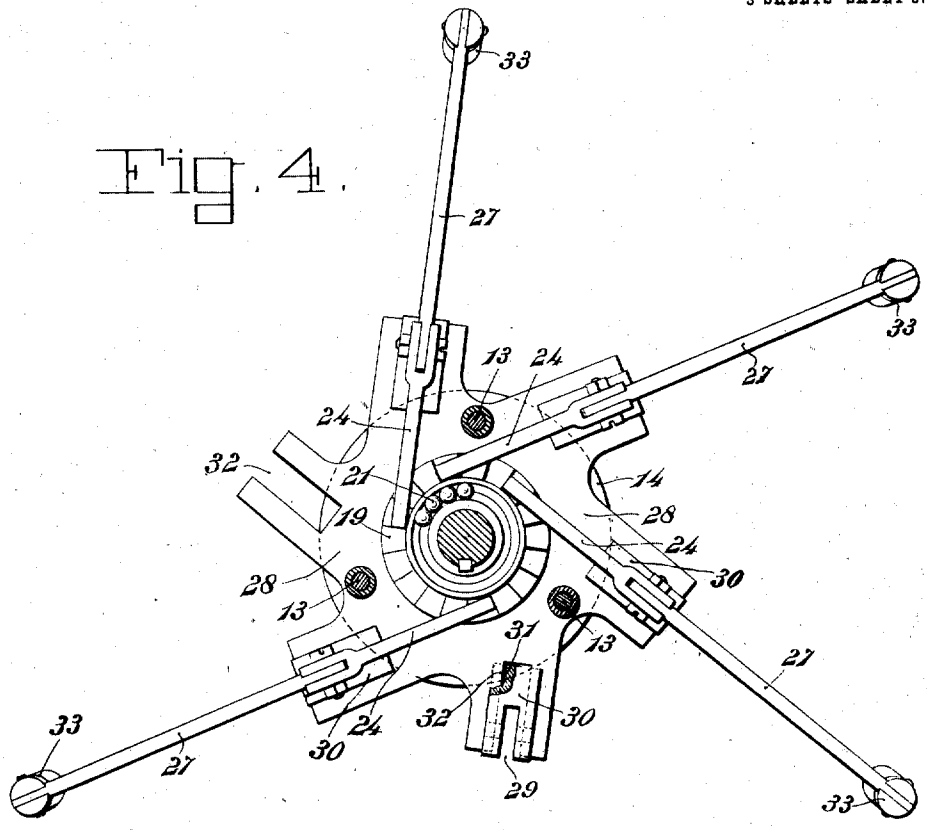
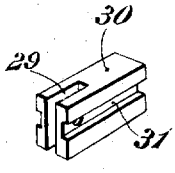


Fig. 5.



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UNITED STATES PATENT OFFICE.

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WAVE AND TIDE MOTOR.

994,728. Specification of Letters Patent. **Patented June 13, 1911.**

Application filed September 7, 1910. Serial No. 580,848.

To all whom it may concern:

Be it known that I, NOAH S. EDENS, a citizen of the United States, residing at Highland, in the county of San Bernardino and State of California, have invented new and useful Improvements in Wave and Tide Motors, of which the following is a specification.

This invention relates to motors of that type in which the varying level and undulations of a body of water are utilized to produce mechanical power, and the present invention is more especially an improvement on the motor disclosed in my prior application for Letters Patent of the United States, Serial No. 481,263, and filed March 5th, 1909.

The invention has for one of its objects to improve and simplify the construction and operation of motors of this character so as to be comparatively simple and inexpensive to manufacture, reliable and efficient in use and of durable and substantial design.

Another object of the invention is the employment of a rotary spiral, which is rotated by separate ratchet mechanisms which utilize the variations of the tide and the lateral impact of waves, so that continuous rotary movement can be obtained, by such motions in a body of water.

With these objects in view, and others as will appear as the description proceeds, the invention comprises the various novel features of construction and arrangement of parts which will be more fully described hereinafter and set forth with particularity in the claims appended hereto.

In the accompanying drawings, which show one embodiment of the invention; Figure 1 is a central vertical section of the apparatus. Fig. 2 is a vertical section on line 2—2 of Fig. 1. Fig. 3 is a sectional view of the ratchet mechanism for operating the spiral shaft by the lateral movement of the float. Fig. 4 is a sectional view on line 4—4 of Fig. 3. Fig. 5 is a perspective view of the connection block for mounting a pawl carrying lever on its support.

Similar reference characters are employed to designate corresponding parts throughout the several views.

Referring to the drawing, A designates a pier, wharf, or other support on which the motor is mounted. The frame of the motor consists of standards 1, secured at the lower ends to a base 2, and at the upper ends to a plate 3, and at an intermediate point on the standards is a horizontal bracing ring 3′, the parts thus forming a skeleton-like frame.

Mounted in the frame are fixed vertically disposed guide rods 4, on which the vertical movable structure of the motor rises and falls through the float B acted on by the tides. The float has a suspending rod 5 that is provided at its upper end with a rigidly secured coupling head 6, and under the head is a spider 7 that is provided with a socket bearing 8 in which is held a ball or enlargement 9 to support the float in such a manner that it can sway in any direction like a pendulum. The spider or base frame 7, together with the coupling element 6 forms a cross head, designated generally by C and the spider is provided with bearing sleeves 9′ which slide on the guide rods 4. The coupling element 6 is capable of changing its position with respect to the spider as the float sways but is held normally in parallelism with the spider by a plurality of extension springs 10 connected with the outer ends of the spider arms and with the under side of the coupling element or head 6, the springs coöperating with the weight of the float to assist in effecting the return movement of the latter.

Mounted above the coupling elements 6 is a vertically disposed rotary and longitudinal movable shaft 11, which is intended to rotate by the lateral or pendulum movement of the float and to move longitudinally by the rise and fall of the float, the movement of the shaft being utilized in any suitable manner for performing work. The lower end of the shaft is mounted in a frame which consists of a cross bar, spider

or the like 12, which is connected by posts 13 with a plate 14 and on this plate 14 is a step bearing 15 for the lower end of the shaft 11, the spider 12 being provided with a bearing 16 for an intermediate portion of the shaft. This frame is connected with the spider 7 by tie rods 17 so that the cross head C is rigidly connected with the frame consisting of the parts 12, 13 and 14 and forms therewith a cross-head structure adapted to reciprocate in the main frame of the machine, the upper portion of the cross-head structure being guided on the rods 4 by sleeves 18.

Secured on the lower portion of the shaft 11 are upper and lower ratchet wheels 19 and 20 that are disposed adjacent the parts 12 and 14, respectively, with bearing balls 21 interposed between the ratchet wheels and said parts. Each ratchet wheel has upwardly facing ratchet teeth 23 and the ratchet teeth of both wheels slant in the same direction, and co-acting with these ratchet wheels are a plurality of pairs of pawls 24 and 25, the pawls of each pair being pivoted to the extremities of the arms 26 of a T-shaped lever 27. In the present instance, six of these levers are shown and hence six sets or twelve pawls engage the ratchet wheels. The levers are mounted on a spider 28, secured to the posts 13 and as shown in Fig. 4, the levers, together with the pawls are disposed in tangential relation to the ratchet wheels. Each lever is fulcrumed in the recess 29 of the connecting block 3, Figs. 4 and 5, which block has grooves 31 at opposite sides so as to fit in the slot 32 of the arm of the spider or support 28. The outer ends of the levers 27 are provided with coupling devices 33 for connection with the upper ends of combined push and pull rods 34, the lower ends of which are connected with the coupling head 6, as clearly shown in Fig. 1, the joints between the extremities of the connecting rods 34 and coupling devices 33 and head 6 being of the ball and socket type. By this ratchet mechanism, the lateral movement of the float will cause rotary movement of the shaft 11, which rotary movement will be continuous in the same direction as long as the pendulum action of the float continues. When the float swings to the right, Fig. 1, the coupling head 6, will tilt in such a direction as to push upwardly the levers 27 at one side of the ratchet mechanism and pull the diametrically opposite pawls down so that the parts will be in the position as shown in Fig. 3 and during this movement, the upper pawls of the levers at one side and the lower pawls of the levers at the opposite side will positively engage their respective ratchet wheels and produce a rotary impulse on the shaft 11, and as the levers tilt in the opposite direction by the return swing of the float, the other formerly inactive pawls will be brought into play to impart an impulse to the shaft for turning the latter in the same direction. By employing a plurality of sets of pawls, it matters not in which direction the float swings, it will always impart rotation to the shaft in one direction.

In order to translate the vertical movement of the shaft 11 into rotary movement of some driven part, the upper portion of the shaft is provided with a pair of crossed spiral, or right and left helical grooves 35 and 36 and at the top plate 3 of the supporting frame are separate ratchet wheels 37 and 38, through the hubs of which the shaft extends. Each wheel is provided with an internal rib or feather 39 for engaging in one of the spiral grooves of the shaft 11, so that when the shaft moves upwardly, one wheel will turn therewith, and as it moves downwardly, the other wheel will be turned. Between the ratchet wheels 37 and 38 is a gear wheel 40, and the inner opposite faces of the wheel are provided with ratchet teeth 41 and 42, respectively, with which coöperate spring-pressed pawls 43 and 44 carried by the gear wheel 40, the pawls 43 being arranged in a plane at right angles to the plane in which the pawls 44 are disposed. The ratchet wheel 37 is held in place by a yoke or cross bar 45 secured to posts 46 on the top plate 3, while the ratchet wheel 38 is set into a bearing plate or disk 47 on the plate 3, there being ball bearings arranged between the relatively movable parts of the ratchet mechanism which converts the longitudinal movements of the shaft 11 into rotary movement of the gear 40. The gear 40 drives one or more shafts 48 which have pinions 49 meshing with the gear, and power can be taken from the shafts 48 in any suitable manner for performing useful work, the shafts being supported in bearings 50 on the top of the main frame. The gear 40 may be driven either by the vertical movement of the shaft 11 as when the water is comparatively smooth but is changing with the tide, or it can be driven by the rotary movement of the shaft 11 incident to the pendulum action of the float, caused by the waves or roughness of the water, or the gear may be rotated by the combined rotary and longitudinal movement of the shaft 11 due to the simultaneous actions of the waves and tide on the float.

From the foregoing description taken in connection with the accompanying drawing, the advantages of the construction and of the method of operation will be readily apparent to those skilled in the art to which the invention relates, and while I have described the principle of operation of the invention, together with the device which I now consider to be the best embodiment

thereof, I desire to have it understood that the device shown is merely illustrative and that such changes may be made when desired as are within the scope of the claims.

What I claim as new and desire to secure by Letters Patent is:—

1. In a wave and tide motor, the combination of a float, a rotary and longitudinal movable element actuated by the float, and means for translating the rotary and longitudinal movement of the element into continuous rotary movement.

2. A wave and tide motor comprising a float, a shaft adapted to rise and fall with the float, means for rotating the shaft by the pendulum movement of the float, and means for converting the rotary and longitudinal movement of the shaft into a single movement.

3. A wave and tide motor, comprising a float mounted for vertical and pendulum movement, a shaft mounted for rotary and vertical movement, means for connecting the shaft with the float to move together, and a ratchet mechanism for rotating the shaft by the pendulum movement of the float.

4. A wave motor, comprising a float mounted for pendulum movement, a rotary shaft, a ratchet wheel connected with the shaft, and a plurality of spaced pawls operatively connected with the float for rotating the wheel and shaft by the back and forth oscillatory movement of the float in any direction.

5. A wave motor comprising a float mounted for universal movement, a rotary shaft and means for rotating the shaft by the oscillation of the float, said means consisting of separate ratchet wheels on the shaft, and a plurality of pawls acting on each wheel and operatively connected with the float for rotating the shaft by the movement of the former.

6. A wave motor comprising a float mounted for oscillatory movement, an element mounted to rotate on a vertical axis, and a plurality of devices operatively connected with the float and co-acting with the element for rotating the same by the oscillation of the float.

7. A wave motor comprising a float mounted for universal movement, a rotary shaft, a pair of ratchet wheels mounted on the shaft, an element moved by the oscillation of the float, and a pawl on the element for each ratchet wheel, one pawl being active while the other is inactive to rotate the shaft.

8. A wave motor, comprising a float mounted for oscillatory movement, a rotary shaft, separate ratchet wheels thereon, levers mounted adjacent the ratchet wheels, a pair of pawls carried by each lever and each engaging a ratchet wheel, and means for engaging the levers with the float.

9. A wave motor comprising an oscillatory float, a rotary shaft, ratchet wheels thereon, pawls disposed in tangential relation with the ratchet wheels, a plurality of lever elements each supporting a plurality of pawls, and means for connecting the lever elements with the float.

10. A wave motor comprising an oscillatory float, a coupling head mounted above the axis of movement of the float, a rotary shaft, and a ratchet mechanism for rotating the shaft and including a plurality of pawl carrying levers independently connected with the head.

11. A wave motor comprising an oscillatory float, a rotary shaft, separate ratchet wheels secured to the shaft, levers fulcrumed adjacent the ratchet wheels and disposed in tangential relation thereto, separate pawls on each lever engaging the respective ratchet wheels, and combined pull and push rods connecting the levers with the float.

12. A wave motor comprising a float mounted for oscillatory movement, a coupling head secured to the float, a plurality of rods connected with the head and extending upwardly therefrom, a T-shaped lever connected with each rod, a pair of pawls connected with each lever and simultaneously moved in opposite direction by the tilting of the lever, separate ratchet wheels engaged with the pawls, and means actuated by the ratchet wheels.

13. A wave motor comprising an oscillatory float, a support for the float, a rotary shaft, ratchet wheels on the shaft, a frame for supporting the shaft, a plurality of levers independently fulcrumed on the frame and disposed in tangential relation, ratchet wheels, pawls on the levers for engaging the ratchet wheels, a coupling head connected with the float, and combined push and pull rods connected by ball and socket joints with the coupling head and with the levers.

14. A wave and tide motor comprising a float, guide rods, a frame movable along the guide rods, means on the lower ends of the frame supporting the float for oscillatory movement, a shaft supported by the frame and movable therewith, a ratchet mechanism between the float and shaft for rotating the same, said ratchet mechanism including a plurality of pawls acting successively by the movement of the float to rotate the shaft, and means rotated by the rotation of the shaft and by the longitudinal movement thereof.

15. A wave and tide motor comprising a supporting frame including guides, a float, a rod suspending the same, a cross head structure movable along the guides, a ball and socket joint between the lower end of the cross head and rod, a coupling head on the rod at a point above the said joint, a

shaft mounted on the cross-head structure for independent rotation and to move bodily therewith, said shaft being disposed above the suspending rod, a ratchet mechanism mounted on the cross-head structure for rotating the shaft, said mechanism including a plurality of independently actuated pawls, independently connected with the coupling head on the upper end of the rod, and a mechanism driven by the rotation and longitudinal movement of the said shaft.

In testimony whereof I affix my signature in presence of two witnesses.

NOAH S. EDENS.

Witnesses:
M. C. TAYLOR,
C. F. LA FOLLETTE.