D. K. BRYSON.

WAVE ENERGY MOTOR.

APPLICATION FILED FEB. 12, 1910.

1,021,572.

Patented Mar. 26, 1912.

2 SHEETS—SHEET 1.

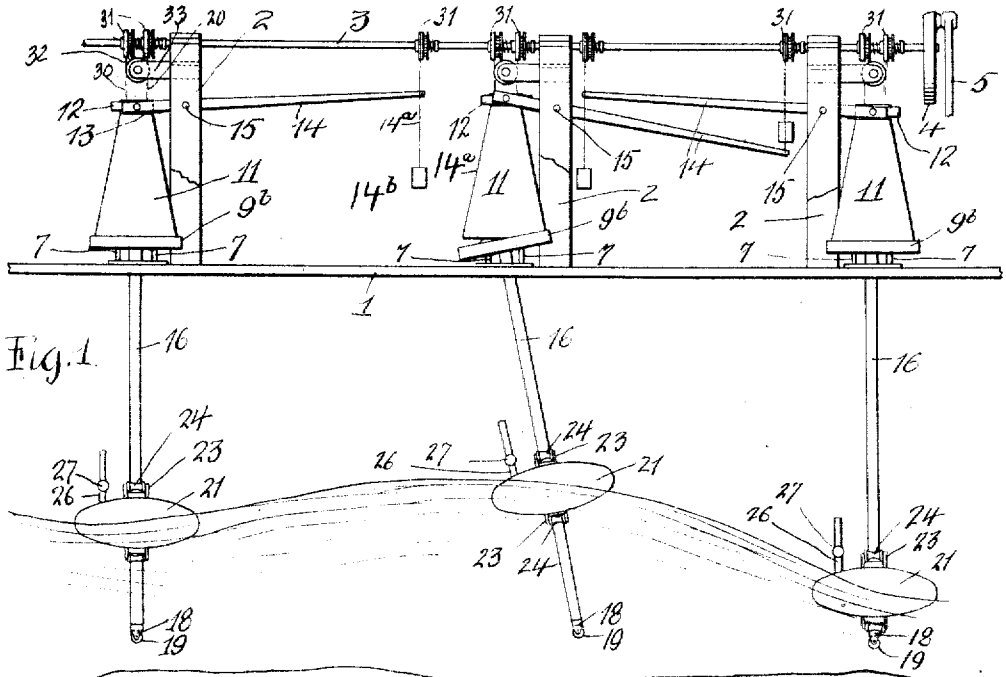

Fig. 1.

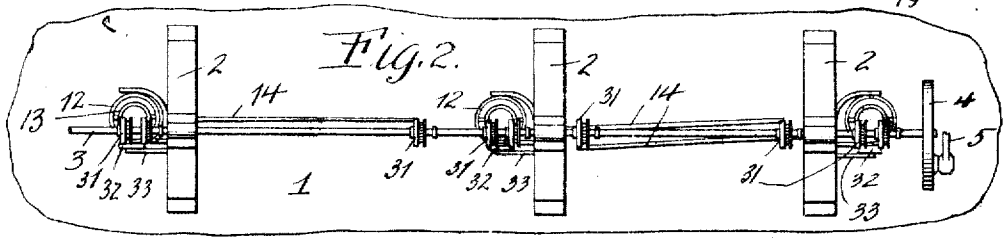

Fig. 2.

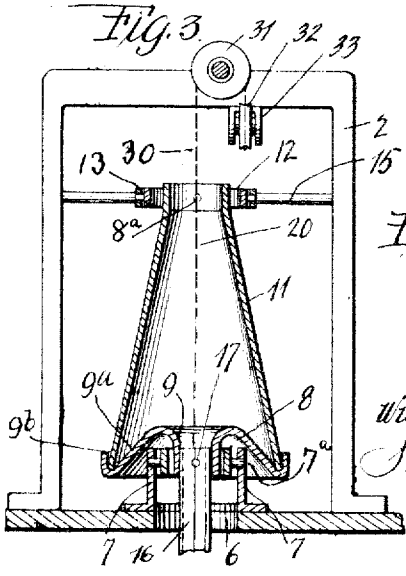

Fig. 3.

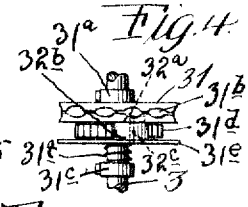

Fig. 4.

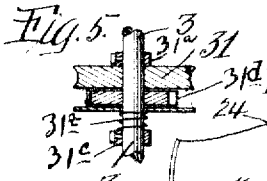

Fig. 5.

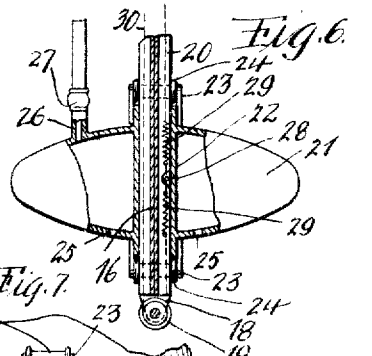

Fig. 6.

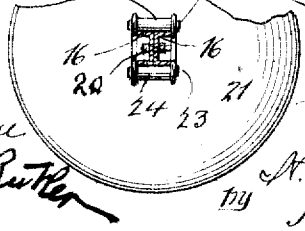

Fig. 7.

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2 SHEETS—SHEET 2.

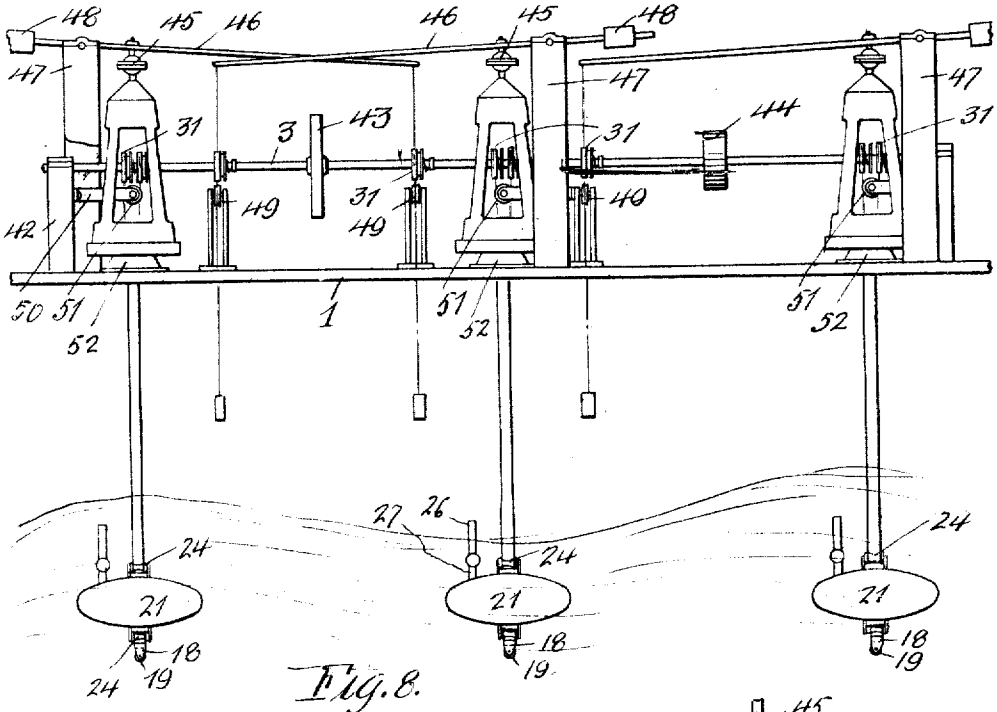


Fig. 8.

Fig. 9.

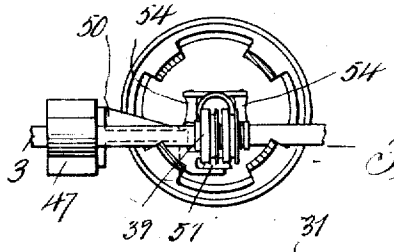


Fig. 11.

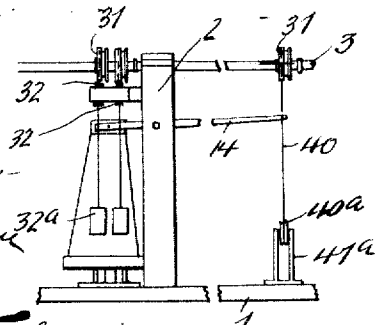
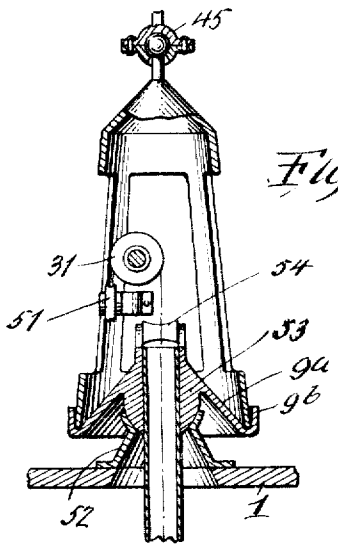


Fig. 10.



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UNITED STATES PATENT OFFICE.

DAVID K. BRYSON, OF PITTSBURGH, PENNSYLVANIA.

WAVE-ENERGY MOTOR.

1,021,572. Specification of Letters Patent. Patented Mar. 26, 1912.

Application filed February 12, 1910. Serial No. 543,461.

To all whom it may concern:

Be it known that I, DAVID K. BRYSON, a citizen of the United States of America, residing at Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Wave-Energy Motors, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention is an improvement upon my United States Patent No. 918,956, granted April 20, 1909.

The present invention aims to provide a wave motor of the "float" type, wherein novel means is employed for obtaining power from ocean waves, the power being obtained by the undulatory movement of floats upon waves, and the present invention resides in providing a machine of the above type with means for imparting a rotary movement to a shaft from the upstroke of a float.

In my prior patent there is shown means whereby power can be derived from the lateral impulse of a wave and from the swell of the wave in one direction, and the principal object of the present invention is to provide means whereby power can be derived from the swell of a wave in either direction.

The present invention will be hereinafter more fully described and then specifically claimed, and reference will now be had to the drawings forming part of this specification, wherein there are illustrated the preferred embodiments of the invention, but it is to be understood that the structural elements thereof can be varied or changed without departing from the spirit and scope of the invention.

In the drawings:—Figure 1 is a side elevation of a portion of the motor illustrating three units thereof, Fig. 2 is a plan of the same, Fig. 3 is a vertical cross sectional view of a rock head and reciprocating cap forming a part of one of the units of the motor, Fig. 4 is a plan of a combined sprocket wheel used for imparting a rotary movement to the main shaft of the motor, Fig. 5 is a horizontal sectional view of the same, Fig. 6 is an elevation, partly broken away and partly in section, of one of the floats, Fig. 7 is a plan of a portion of the same, Fig. 8 is a side elevation of a modified form of wave motor, Fig. 9 is a horizontal sectional view of a modified form of rock head and cap, Fig. 10 is a vertical sectional view of the same, and Fig. 11 is a side elevation of still another modified form of my invention.

In order that those not conversant with my prior Patent No. 918,956, may understand its nature, I quote from the same and will specifically point out the improvements as the various elements are considered.

To put my invention into practice, I use a pier or suitable elevated structure for supporting my motor a desired and safe distance above the ocean waves, said pier or structure being preferably in communication with the ocean shore, whereby power can be easily transmitted to the shore for manufacturing or electric lighting purposes. The motor can be suitably housed upon the pier or structure and protected from destructive forces of nature that might render the motor inoperative.

My motor consists of a plurality of units that are arranged as compactly as possible to coöperate, each unit having mechanism for imparting a revoluble movement to a shaft from a float moved in an undulatory manner. I have only deemed it necessary to illustrate three of these units and would have it understood that an indefinite number can be used according to the power desired. As these units are identical in construction, with only a slight exception on account of the arrangement of the same, I will only describe one of said units.

Referring first to Figs. 1 to 3 inclusive, 1 designates a pier or elevated structure provided with a plurality of longitudinally alining bearings 2 for a longitudinal shaft 3 adapted to be driven by the units of my machine, this shaft having a wheel 4 provided with a pitman connection 5 for driving an engine or a piece of machinery.

My first mentioned improvement is a universal bearing located above an opening 6 adjacent to each one of the bearings 2 upon the elevated structure or pier 1. The universal bearing comprises oppositely disposed bearings 7 and pivotally mounted in these bearings by trunnions 7^a is a ring 8 and pivoted within the ring 8 as at 8^a and at right angles to the trunnions thereof is

the depending neck 9 of a circular rock head 9^a, said head having a peripheral flange 9^b providing an annular seat for the lower edges of a frusto-conical hollow cap 11, some part of said cap always engaging in the rock head 9^a. Upon the upper end of the cap 11 is arranged a universal connection 12 for a yoke 13, said yoke being connected to a walking beam 14 pivotally mounted in the bearings 2, as at 15, and the object of this beam will hereinafter appear.

My second improvement is in connection with the float lever, and instead of making this lever tubular, I make the same of two channel bars 16, arranged back to back and suitably connected together. The upper ends of the bars are fixed and rigidly held in the neck 9 of the head 9^a, as at 17, and the lower ends of the bars are provided with depending bearings 18 for a roller or sprocket wheel 19. This roller or sprocket wheel is adapted to vertically aline with the vertical grooves 20 formed by the channel bars.

My next improvement is in connection with the metallic hollow oval float which is slidably mounted upon the float lever. This float is designated 21 and is provided with a central rectangular sleeve 22 adapted to receive the float lever. The upper and lower ends of the sleeve are provided with bearings 23 for oppositely disposed rollers 24 adapted to guide the float upon the float lever and reduce the friction to a minimum. The float 21 has the bottom thereof provided with openings 25 and the top of said float is provided with a pipe 26 having a conventional form of valve 27, the purpose of which will presently appear.

The sleeve 22 of the float is provided with an inwardly projecting lug 28 and connected to this lug are retractile springs 29, and connected to said springs is an endless sprocket chain 30, said chain passing over the roller or sprocket wheel 19 of the lower end of the float lever and extending upwardly through the grooves 20 provided by the channel bars of said float lever. The sprocket chain 30 is adapted to extend upwardly through the cap 11 and over sprocket wheels 31 mounted upon the shaft 3 and under a roller or sprocket wheel 32 carried by a bracket 33, secured to the bearing 2.

The sprocket wheels are identical in construction and each wheel is loosely mounted upon the shaft 3 between collars 31^a and 31^c fixed upon the shaft. The periphery of the sprocket wheel has sockets 31^b to receive the links of the sprocket chain 30 and interposed between said sprocket wheel and the collar 31^c is a ratchet wheel 31^d and a disk 31^e. The ratchet wheel 31^d is keyed upon the shaft and the disk 31^e is loosely mounted upon the shaft. Encircling the shaft 3 between the collar 31^c and the disk 31^e is a coiled compression spring 31^f adapted to normally hold the disk 31^e in engagement with the ratchet wheel 31. Pivotally connected to the sprocket wheel 31 by a pin 32^a is a pawl 32^b adapted to engage the rachet wheel 31^d. The disk 31^e can be cut away whereby the pawl can be easily connected to the sprocket wheel 31. The pawl 32^b is provided with a pin 32^c adapted to extend through the pawl into a slot provided therefor in the disk 31^e and into a groove provided therefor in the face of the sprocket wheel 31. This mechanism constitutes what may be termed a ratchet mechanism for moving the shaft 3 in one direction, said ratchet mechanism being placed out of operation while the shaft is moved in the opposite direction. Assuming that the sprocket wheel 31 is rotated in one direction, the pawl 32^b is elevated through the medium of the pin 32^c extending into the groove and the slot of the sprocket wheel 31 and the disk 31^e, thereby maintaining the end of the pawl 32^b out of engagement with the ratchet wheel 31^d. Assuming now that the sprocket wheel is rotated in the opposite direction, the coiled spring 31^f holds the disk 31^e in engagement with the keyed ratchet wheel 31^d until the pin 32^c of the pawl 32^b rides downwardly and places the end of the pawl 32^b in engagement with the ratchet wheel 31^d, thereby causing said sprocket wheel and the ratchet wheel to rotate in unison, the disk 31^e remaining stationary. Two sets of ratchet mechanisms are located upon the shaft 3 and they are reversely arranged upon the shaft, whereby the sprocket wheels will be alternately actuated according to the movement of the chain 30 to always rotate the shaft 3 in the same direction. This operation will be better understood when explained in connection with the float 21. Water can be admitted to the float 21 to sink the same a desired depth in a wave, whereby it will positively ride with the wave, also whereby the water within the float will be of sufficient weight to lower the float upon the float lever when a wave recedes. This is accomplished by opening the valve 27 and allowing water to enter the float through the openings 25 and by closing the valve after the desired displacement has taken place, the floats will remain upon the waves with the lower part thereof immersed. The floats are then subjectable to the action of waves and by virtue of their novel arrangement can move to all points of the compass. The action that the float levers receive from the lateral impulses of the waves is disclosed in my prior patent, also the action of the floats reciprocating upon the float levers, but heretofore I only utilized the weight of the floats in descending upon the float levers to impart motion to the shaft 3.

Now, the important improvement in the present invention is to utilize the upward movement of the float upon the float lever and this has been accomplished by the arrangement of the endless sprocket chain 30 and the use of an additional sprocket wheel 31. It is apparent that the sprocket chain 30 must move over the sprocket wheels by any movement of the float upon the float lever, and since the sprocket wheels are reversely arranged, the shaft 3 will be revolved in one direction irrespective of the direction in which the float moves upon the float lever. This can best be understood by reference to Fig. 1 and to the floats or buoys, one of which I have illustrated in action while another is at rest. When a unit is at rest the float lever is perpendicular with the walking beam 14 at approximately right angles to said float lever and the cap 11 resting upon the rock head which is held in a horizontal position. With the unit in action the lateral impulse of a wave to move is entirely free of any reciprocatory movement of the float upon the lever, and a movement of the float lever 16 in transmitting power to the shaft 3 is simply on a principle of leverage.

By reference to the universal bearings shown in Fig. 3 of the drawings, it will be observed that the circular rock-head 9^a will be tilted when the float lever is moved from a perpendicular position, consequently the raised or high edge of the rock-head will elevate the cap 11, and as the upper end of said cap is universally connected to the yoke 13 of the walking beam 14, said walking beam will be rocked in the bearing 2. The other end of the walking beam is adapted to be connected to a sprocket chain 14^a which passes over a ratchet mechanism similar to that previously described, said mechanism being carried by the shaft 3. The end of the sprocket chain is provided with a weight 14^b to normally hold the chain taut whereby it will frictionally engage the sprocket wheel of the ratchet mechanism. This mechanism is adapted to coöperate with one of the other mechanisms in rotating the shaft in one direction.

The number of degrees the float lever 16 swings from the perpendicular is approximately the same number of degrees described by the longer arm of the walking beam 14. This is accomplished by making the distance between the universal connection 12 and the pivot 15 the same as the radius of the rock head 9^a. In other words, every foot pound delivered by a stroke of the lower end of the float lever is transmitted to the power shaft 3, and through the medium of the universal connections the power lost in transmission is not perceptible. Combining the reciprocating movement of the float upon the float lever with the swinging movement imparted to the float by the lateral impulse of a wave, a continuous rotation of the shaft 3 is accomplished.

The universal bearing shown in Fig. 3 eliminates all liability of the float lever being bodily raised when the float is raised and to eliminate stresses and strains upon the sprocket chain 30, I have incorporated the retractile springs 29, these springs compensating for any sudden or jerky movement such as might be imparted to the float by the "breaking" of a wave, and thereby preventing the power shaft and the ratchet mechanisms thereof from being injured. Furthermore, as a safety factor, I provide the float 21 with the pipe 26 and the valve 27. This pipe 26 and valve 27 permit of air exhausting from the float whereby it can be completely filled with water and sunk beneath the surface of the waves as is essential during an unusual heavy storm or extraordinary oceanic conditions. To remove the desired quantity of water from the float, air is injected into the same to expel the desired amount of water, whereby the float will assume its normal position upon the surface. The forcing of air into the pipe 26 can be accomplished by a hose connection, either permanent or detachable, and with the pipe 26 of a sufficient length, always extending above the water, the connection can be made permanent by carrying the air supply pipe upwardly along the float lever to the pier or elevated structure.

In the modification of my invention shown in Figs. 8 to 11 inclusive, these modifications will be best understood by quoting from my prior patent. In the first place, separate bearings 42 are provided with the shaft 3, and said shaft at certain points is provided with balance wheels 43 and pulley wheels 44. The vertically reciprocating caps are of a skeleton form with the shaft 3 extending through said caps, and these caps at their upper ends are provided with ball and socket connections 45, and with walking beams 46, said beams being fulcrumed upon bearings 47 adjacent to the bearings 42. The beams are weighted, as at 48, to properly balance the walking beams, and are provided with cables or chains similar to the beam 14, with the exception that the cables or chains travel under the ratchet mechanisms (of the shaft 3) and over pulleys 49 provided therefor. Instead of locating the ratchet mechanisms directly above the reciprocating caps, as in the preferred form, I locate said ratchet mechanisms in the cap and upon the shaft 3. In order that two sets of mechanisms can be used upon the shaft 3 within the caps and an endless sprocket chain used in connection with said mechanisms, the bearings 42 are provided with brackets 50 that extend into the caps and support a roller or

sprocket wheel 51, similar to the wheels 32 of the preferred form of construction.

In Fig. 10 I illustrated a modified form of bearing for the circular rock head, the bearing comprising a socket 52 and a ball 53 carried by the head 9^a. The ball 53 is provided with an opening for the upper end of the float lever, and the head 9^a is provided at the upper end of the float lever with rollers 54 for the endless sprocket chain adapted to travel in the float lever.

In Fig. 11 of the drawings a slight modification is shown, wherein an additional roller or sprocket wheel 32 is provided and instead of running the sprocket chain 30 around one of said wheels, the sprocket chain is divided with the ends traveling over the wheels 32 and provided with weights 32^a. Furthermore, the walking beam 14 is connected to an endless sprocket chain or cable 40, adapted to travel over the ratchet mechanisms 31 located upon the shaft 3 and over an idler 40^a revolubly mounted in a bearing 41^a carried by the pier or elevated structure 1.

From the foregoing it will be observed that I have devised numerous improvements in my power motor, and all of these improvements contribute to better results and meet with certain conditions that could not be met by the motor disclosed in my prior patent.

Having now described my invention what I claim as new, is:—

1. In a wave motor, the combination with a pier, bearings supported thereby, and a shaft journaled in said bearings, of a plurality of shaft operating units located upon said pier, each unit comprising a universal bearing, a rock head forming part of said bearing, a depending float lever supported by said rock head, a float slidably mounted upon said lever, a lug carried by said float and extending into said lever, a roller carried by the lower end of said lever, a reciprocating cap supported by said rock head, a walking beam pivotally mounted in one of the first mentioned bearings, a universal connection between said beam and said cap, ratchet mechanisms located upon said shaft, a roller revolubly supported adjacent to each mechanism, an endless sprocket chain adapted to travel over said roller and the roller of said float lever and have the ends thereof yieldably connected to the lug of said float, and a sprocket chain connected with said beam and passing over the other of said ratchet mechanisms.

2. In a wave motor, the combination with a pier, bearings supported thereby, and a shaft journaled in said bearings, of a plurality of shaft operating units supported by said pier, each unit comprising a universal bearing, a rock head located thereon, depending channel bars carried by said rock head and constituting a float lever, a float slidably mounted upon said lever, means in connection with said float and adapted to cause a displacement of water therein, a beam pivotally carried by one of said bearings and adapted to be oscillated by a rocking movement of said head, ratchet mechanisms located upon said shaft for rotating the same, a sprocket chain connecting with said beam for actuating one of said mechanisms, and an endless sprocket chain connecting with said float for actuating the other of said mechanisms.

3. In a wave motor, the combination with a shaft, of a plurality of independent mechanisms for rotating said shaft, endless sprocket chains adapted to travel over some of said mechanisms, means adapted to movably anchor one of said chains relative to the swell of a wave, and means in connection with the first mentioned means and adapted to impart a movement to the other of said chains by the lateral impulse of a wave.

4. In a wave motor, the combination with a plurality of float levers, of floats slidably mounted upon said float levers and in conjunction with the movement of said float levers adapted to transmit power, and air connections with said float levers adapted to displace water within said floats by the injection of air.

5. A wave motor comprising a driven element, driving mechanisms therefor, and float mechanisms operated from the swell of a wave in either direction for actuating said driving mechanisms to operate the driven element.

6. In a wave motor, a driven element, driving means therefor, swinging float levers, floats vertically movable upon said levers, means actuated by a swinging movement of said levers for operating said driving means, and means actuated by the vertical movement of the floats upon said levers for operating said driving means.

7. In a wave power motor, a plurality of float levers, floats slidably mounted upon said levers and in connection therewith transmitting power, and means whereby fluid pressure can be supplied to within the floats to regulate the submerged position of the floats.

8. A wave power motor, comprising a driven element, driving mechanisms therefor, float mechanisms operated from the swell of the wave in either direction for actuating said driving mechanisms to operate the driven element, and means for supplying air to the float mechanisms for regulating the submerged position of the float elements of said float mechanisms.

9. A wave motor comprising a driven element, driving mechanisms therefor, float mechanisms including float elements, said

float mechanisms operated from the swell of a wave in either direction for actuating said driving mechanisms to operate the driven element, and means in connection with said float mechanisms for regulating the buoyancy of the float elements upon a wave.

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

DAVID K. BRYSON.

Witnesses:
KARL H. BUTLER,
EVA A. MILNE.