E. W. FAIRBANKS.

WAVE AND CURRENT MOTOR.

APPLICATION FILED MAY 13, 1912.

1,067,722.

Patented July 15, 1913.

2 SHEETS—SHEET 1.

Fig. 1

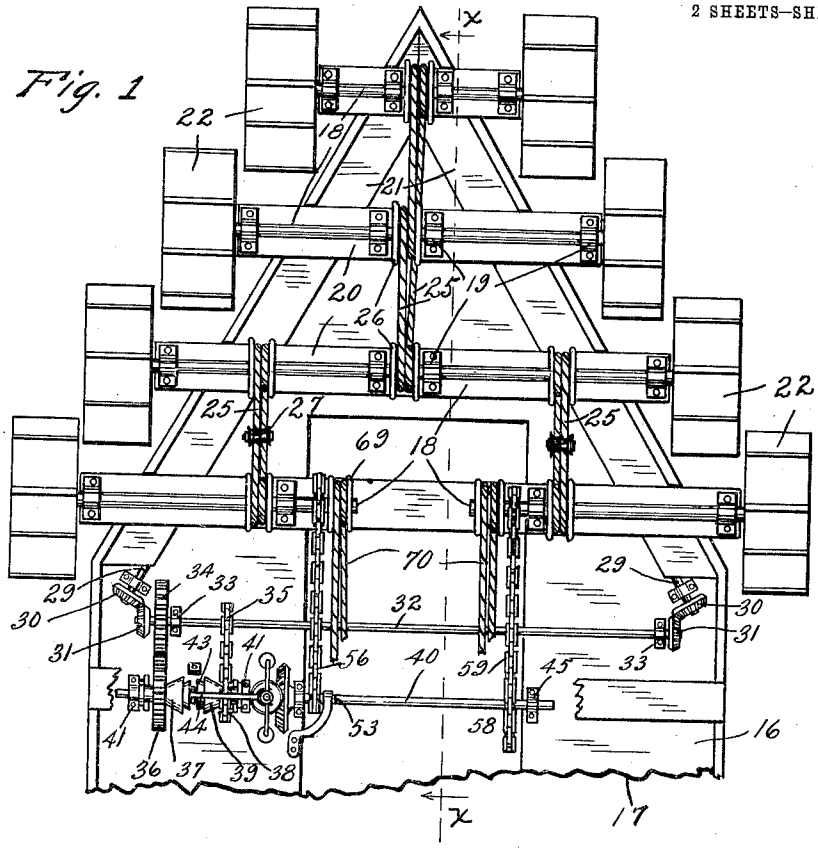
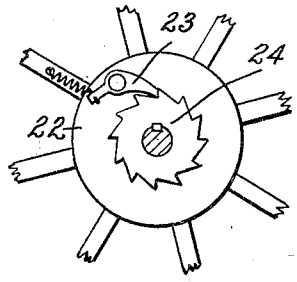


Fig. 4



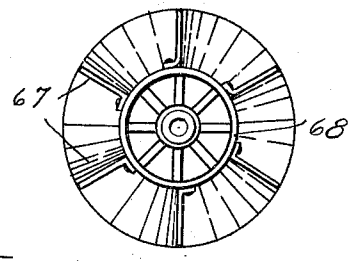


Fig. 3

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2 SHEETS—SHEET 2.

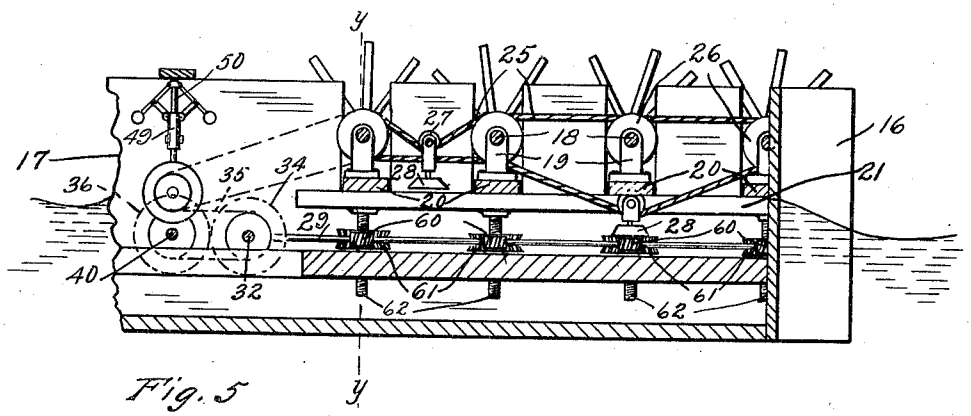


Fig. 5

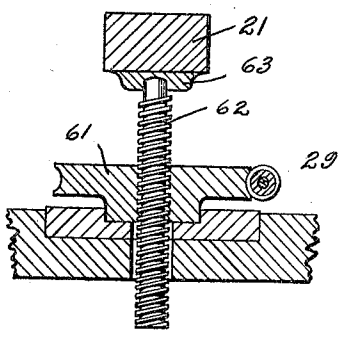


Fig 6

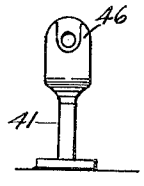


Fig. 8

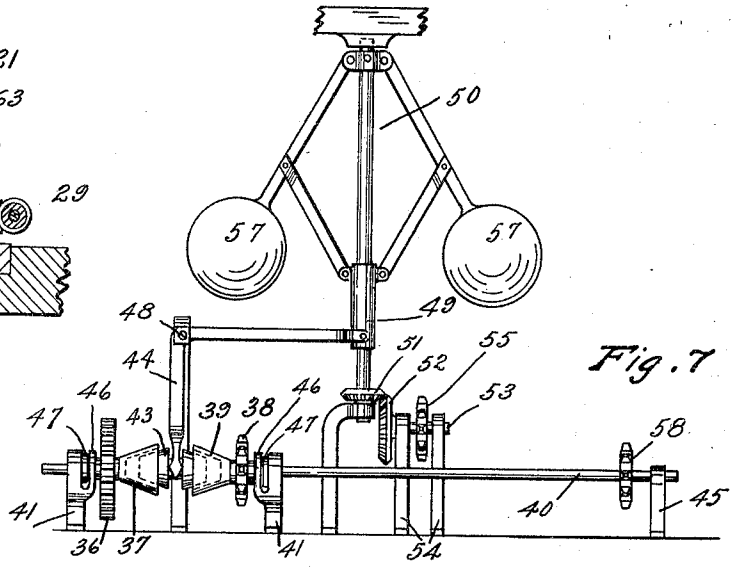


Fig. 7

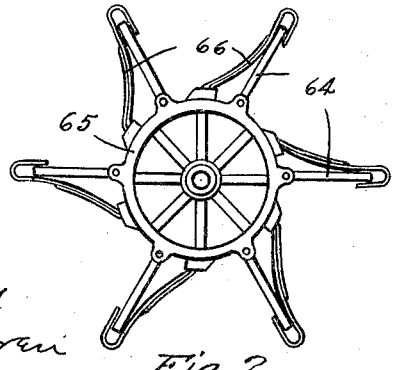


Fig. 2.

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UNITED STATES PATENT OFFICE.

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WAVE AND CURRENT MOTOR.

1,067,722. Specification of Letters Patent. Patented July 15, 1913.

Application filed May 13, 1912. Serial No. 697,076.

To all whom it may concern:

Be it known that I, EPHRAIM W. FAIRBANKS, citizen of the United States, residing at Seattle, in the county of King and State of Washington, have invented a certain new and useful Improvement in Wave and Current Motors, of which the following is a specification.

My invention relates to that class of motors which are adapted to be actuated by the force of a current of water or by the waves of a body of water, and the object of my invention is to provide such a motor as will be simple in construction and efficient in its operation and which shall be adapted to operate either by the action of waves or by the action of a river's current as may be required, and which, further, shall be capable of delivering, in useful form, great and constant power in response to the action of such waves or such current. I attain this object by devices illustrated in the accompanying drawings wherein—

Figure 1 is a plan view of my invention, Fig. 2 is a view in side elevation of a modified form of a part of my invention, Fig. 3 is a view in end elevation of the same part shown in Fig. 2, Fig. 4 is a view partly in cross-section of certain parts associated with the device illustrated in Fig. 1 but not shown therein, Fig. 5 is a view of my invention in longitudinal section on broken line *x*—*x* of Fig. 1, Fig. 6 is a view in vertical section of certain parts of my invention on broken line *y*—*y* of Fig. 5, Fig. 7 is a view in side elevation of some parts of my invention, and Fig. 8 is a view in side elevation of a detail thereof.

Like numbers indicate like parts throughout the drawings.

Referring to Fig. 1 of the drawings, 16 represents the front end portion of a scow or barge upon which one form of my invention may be disposed, the rear portion of which is not shown, being broken off on the irregular line 17. A plurality of shafts 18 are mounted to rotate in bearings 19 which are disposed and securely fastened upon cross-beams 20, which cross-beams 20 are rigidly mounted on timbers 21 extending from the parallel side of the barge 16 to converge and unite at the prow of said barge 16. The shafts 18 project outwardly on each side of the A shaped bow of the barge 16 for a suitable distance and upon such projecting ends of the shafts 18, are freely mounted, to revolve about said shafts 18, the paddle-wheels 22. Associated with each paddle-wheel is a pawl 23 so disposed and swingingly mounted thereon to adapt it to engage with an adjacent ratchet-wheel 24 which is secured to the respective shafts as shown in Fig. 4 whereby the paddle-wheel 22 may force the shaft 18 to rotate only in one direction and whereby, likewise, a shaft 18 may rotate in that same direction while its paddle-wheel is stationary or turning in the opposite direction. All the shafts 18 are connected by cable-belts 25 adapted to engage with and run upon pulley-wheels 26 whereby all the shafts 18 shall always rotate together and at the same speed.

There may be substituted for the cable-belts 25 and the pulley-wheels 26 any of well known equivalent means for communicating motion from one shaft to another, as for instance, chain-belts and sprocket-wheels.

To prevent slackness in the cable-belts 25 I have provided suitably disposed idler-pulleys 27 from which a weight 28 may be suspended as more clearly shown in Fig. 5.

To maintain a constant speed of rotation of the shafts 18, irrespective of variations in the effect of waves or currents of water upon the paddle-wheels 22, I have provided a governor which operates automatically to raise the timbers 21 with all the cross-beams 20, the shafts 18 and the paddle-wheels 22, to such height, when the shafts 18 begin to revolve too fast, that the paddle-wheels 22 will have less contact with the waves or current of water whereby an increase in the speed of the rotary shafts 18 is prevented; while on the other hand if the speed of rotation begins to decrease then the said timbers 21 with their associated parts automatically are lowered to cause the paddle-wheels 22 to be more effectively engaged with such waves or current. One form of such governing mechanism I have illustrated in Figs. 1—5—6 and 7, wherein a governor of the well known centrifugal-ball type is embodied, which comprises a shaft 29 disposed beneath, and parallel with, each of the timbers 21 to revolve in suitable bearings 42. Upon the rear ends of said shafts 29 are securely mounted bevel gear-wheels 30 at such angle as adapts them to engage with other bevel-gear wheels 31 which are mounted securely one on each end of a shaft 32 extending crosswise the barge 16 as shown in Fig. 1,

which shaft 32 is mounted to revolve in bearings 33. At a point on said shaft 32, adjacent to one end thereof, is mounted fast a gearwheel 34 and at another point not far distant on the same shaft 32 is fixed a sprocket-wheel adapted to engage with a sprocket-chain 35. The said gearwheel 34 is adapted to engage with a like gearwheel 36 mounted upon the sleeve portion of a clutch 37 while the sprocket-chain 35 is adapted to engage with a sprocket-wheel 38 upon another clutch 39 both of which clutches 37 and 39 respectively are freely mounted to rotate about a shaft 40 disposed in bearings 41 and 45. The shaft 40 being parallel with shaft 32 and of such distance therefrom as will serve to cause the teeth of gearwheels 34 and 36 properly to engage.

Fig. 7 is an enlarged view more clearly showing the shaft 40, the clutches 37 and 39 respectively and other associated parts. On the shaft 40, at a point between the clutches 37 and 39, is securely fixed a double ended cone-clutch member 43, one cone-like end of which is adapted to engage with clutch 39 while the other cone-like end is adapted to engage with clutch 37. The double ended cone-clutch member 43, midway of its length, is provided with a groove within which may be disposed the end of a lever 44 whereby such lever 44 may be caused to move in either direction to cause the said clutch member 43 to engage, as may be required, with one or the other of clutches 37 and 39 on the shaft 40 upon which said clutch member 43 is fixed, the shaft 40 being adapted to be moved endwise for sufficient distance to permit an engagement between the clutch member 43 and either of the clutches 37 and 39 whereby the clutch 37 or the clutch 39 may be rotated with and by the shaft 40. Upon the end of the sleeve of the clutch 39 and likewise upon the end of the sleeve of the clutch 37 is provided a flange 47 adapted to be disposed each between an upwardly projecting arm 46 and the adjacent bearing 41, said arm 46 being an integral part of said bearing 41. Thus the flange 47, so confined, serves to prevent endwise motion to its respective clutch 37 or 39. Fig. 8 shows by an enlarged view in inside elevation the construction of such bearings 41.

The lever 44 extends upwardly from the clutch member 43 to be fulcrumed by a pivot 48 from which pivot 48 it extends horizontally for a suitable distance to be articulated, in a manner well known, with the sleeve 49 which is slidingly mounted upon the suitably supported vertical shaft 50, of a well known type of centrifugal ball governor as more clearly shown in Fig. 7. Upon the lower end of said shaft 50 is mounted the bevel-gear 51 adapted to engage with a bevel-gear 52 which is mounted upon a shaft 53 disposed to rotate in suitable bearings 54 and upon which shaft 53 is also mounted rigidly a sprocket-wheel 55. Extending from sprocket-wheel 55 to the adjacent paddle-wheel shaft 18 is a sprocket-chain 56 whereby rotary motion may be communicated from said shaft 18 to said shaft 53 thus to cause and maintain a constant rotation of the vertical governor shaft 50, associated with which shaft 50 are the governor balls 57 which, in a manner well known, may govern the position of the clutch member 43 through the sleeve 49 and lever 44 in response to changes in speed. Near the bearing 45, upon the shaft 40 is sprocket-wheel 58, as shown in Fig. 7, from which extends a sprocket-chain 59 leading to a sprocket-wheel upon the adjacent paddle-wheel shaft 18 whereby constant rotary motion may be communicated from said paddle-wheel shaft 18 to shaft 40.

With such association of parts of my invention when the governor balls 57 are properly opposed in a well known manner, by an opposing spring, not shown, for a given speed, then if the paddle-wheels are affected by a current of water or waves whereby they begin to increase the speed of their rotation, the governor balls 57, acting by centrifugal force may serve and act through the sleeve 49 and lever 44 to force the clutch member 43 to engage with the clutch 39 whereby the sprocket-chain 35 will revolve the shaft 32 to impart rotary motion in one direction to the two shafts 29 through the bevel gears 31 and 30, and whereby if the paddle-wheels are affected to begin to decrease the speed of their rotation the governor balls 57, in response thereto will likewise force the clutch member 43 to engage with clutch 37 to cause the gearwheel 36 to communicate rotary motion through gear-wheel 34 to shaft 32 and thence to shafts 29 in an opposite direction.

As shown in Fig. 5 mounted on shafts 29 are worm-screws 60 which engage with worm-gears 61 which have screw-threaded holes in their central portion and which are disposed on vertical jack-screws 62 suitably disposed beneath the timbers 21 at suitable points whereby such jack-screws 62 may raise or lower the said timbers 21 with the cross-beams 20, shafts 18 and paddle-wheels 22, thus the tendency to an increase in the speed of rotation of the paddle-wheels 22 serves to raise such paddle-wheels 22 while a tendency to decrease in speed of the same serves to lower them.

Fig. 6 more clearly shows the disposition of the jack-screw 62, the worm-gear wheel 61, the worm-screw 60 and a seating plate 63 disposed between the timber 21 and the top of jack-screws 62.

Fig. 2 shows one form of paddle-wheel that may be embodied in my invention

wherein the several blades 64 are hinged or pivoted to the rim 65 of the paddle-wheel, which blades 64 are maintained in a normally radial position with respect to the center of the paddle-wheel by means of a spring 66 comprising a plurality of leaves of spring steel secured to the wheel-rim 65 at a point between two adjacent blades 64 whereby the floats in a paddle-wheel of such construction may be resilient to the force of a wave striking a blade.

Contemplating Fig. 1 it will be observed that the paddle-wheels 22 are disposed in echelon formation on each side of the barge 16 whereby each of the paddle-wheels 22 will independently be acted upon by a different portion of the water waves or current of water, thus being more effectively acted upon than if such paddle-wheels 22 be placed one behind another.

In operation by reason of the cable-belt connections 25 between all the shafts 18, all such shafts 18 may revolve at the same rate of speed while the several paddle-wheels 22 may vary in speed with respect to each other by reason of the action of the ratchet-wheel 24 and the pawl 23 as hereinbefore described.

Upon the inner end of the rearmost shafts 18 is fixed on each a pulley 69 from which power may be communicated by the cable-belts 70 to any desired machinery to be operated upon by the power developed by my invention.

Of course many immaterial modifications of the devices herein shown and described may be made without departing from the spirit of my invention.

What I claim is:

1. In a motor of the class described, the combination with a floating support, of a plurality of rotatable shafts of different lengths mounted and associated by suitable means, to rotate together, said shafts being so disposed on said floating support that an end of each shaft projects outwardly over each side of said floating support, a paddle-wheel mounted freely to rotate about each of said projecting shaft ends and associated thereon with a pawl and ratchet mechanism whereby said paddle-wheels may rotate only in one direction with respect to said shaft, and automatic governing means associated with said shafts and paddle-wheels whereby said shafts with said paddle-wheels may be raised and lowered in response to changes in the speed of rotation of said shafts.

2. In a motor of the class described, the combination with a floating support having divergent sides, of a plurality of shafts adapted to rotate in suitable bearings associated with said floating support and disposed thereon so that each of said shafts extends between and projects beyond said divergent sides of said floating support, and a paddle-wheel mounted on each end of said shafts whereby the paddle-wheels on each of the divergent sides shall be disposed to present an echelon formation.

3. In a motor of the class described, the combination with a floating support, of vertically movable cross-beams each disposed with an end projecting outwardly over each side of said floating support, a paddle-wheel disposed adjacent to each of said projecting cross-beam ends and adapted to rotate in suitable bearings associated with said cross-beam, and automatic governing means associated with said cross-beams whereby said cross-beams may automatically be raised and lowered in response to changes in the speed of rotation of said paddle-wheels.

4. In a motor of the class described, a paddle-wheel comprising a wheel-frame, a plurality of blades suitably hinged to the rim of said wheel-frame and adapted normally to extend radially therefrom, resilient means associated with said wheel-frame and with said blades whereby said blades may be maintained in a normally radial position, a shaft upon which said paddle-wheel may be mounted freely to revolve, and a ratchet-wheel mounted rigidly on said shaft, in combination with a pawl mechanism, whereby said paddle-wheel may rotate on said shaft in one direction only.

5. In a motor of the class described, the combination with a floating support, of a plurality of associated paddle-wheels suitably mounted to rotate on said shafts disposed in suitable bearings, said bearings being secured to suitable beam supports, a plurality of jack-screws disposed at suitable points beneath said beam supports and mechanically connected mechanism associated with said jack-screws whereby all said jack-screws may be turned synchronously in either direction as desired to raise or lower said beam supports and the machinery thereon.

In witness whereof, I hereunto subscribe my name this eleventh day of April A. D., 1912.

EPHRAIM W. FAIRBANKS.

Witnesses:

GEORGE BLAIR,

ANNA HASKINS.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."