J. A. KNOWLTON.

TIDE MOTOR.

APPLICATION FILED APR. 7, 1914. RENEWED MAY 11, 1916.

1,209,975.

Patented Dec. 26, 1916.

2 SHEETS—SHEET 1.

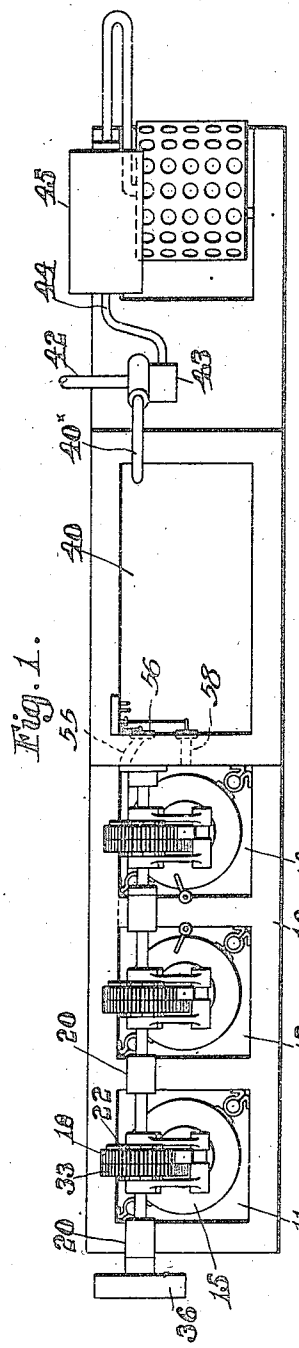


Fig. 1.

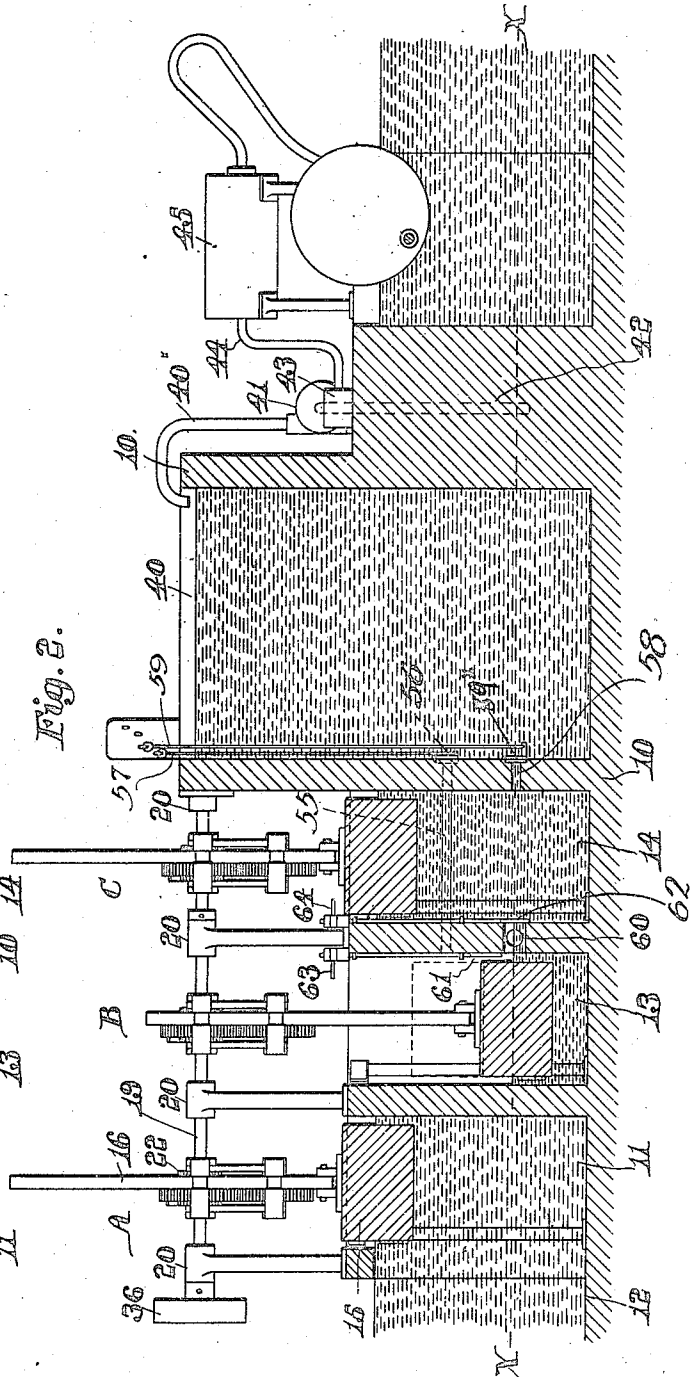


Fig. 2.

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2 SHEETS—SHEET 2.

Fig. 3.

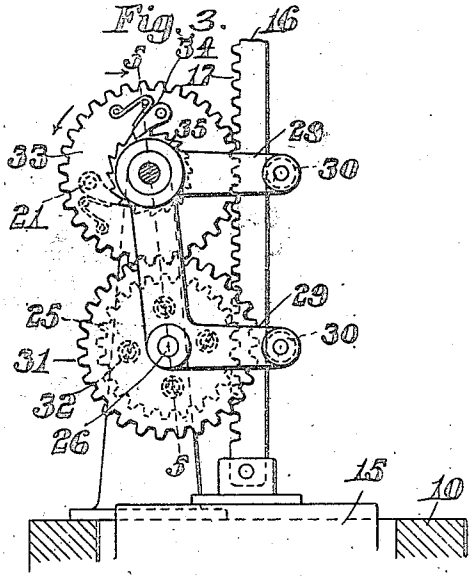
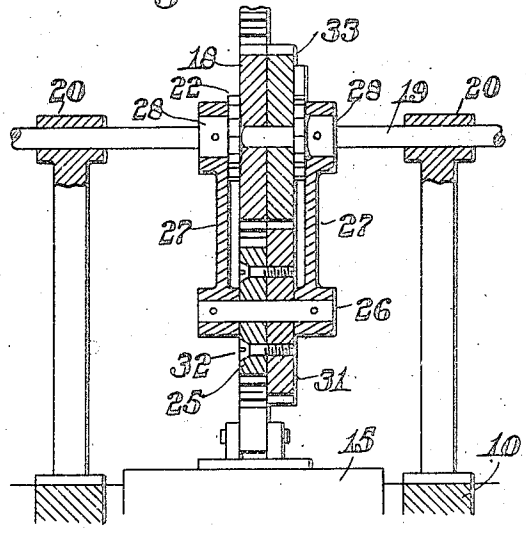


Fig. 4.



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UNITED STATES PATENT OFFICE.

JOHN A. KNOWLTON, OF DORCHESTER, MASSACHUSETTS.

TIDE-MOTOR.

1,205,975. Specification of Letters Patent. Patented Dec. 26, 1916.

Application filed April 7, 1914, Serial No. 830,543. Renewed May 11, 1916. Serial No. 96,946.

To all whom it may concern:

Be it known that I, JOHN A. KNOWLTON, a citizen of the United States of America, and a resident of Dorchester, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Tide-Motors, of which the following is a specification.

This invention is an improvement in tide motors, and the object of the invention is to provide a tide motor which will deliver power continuously, be simple in structure and efficient in operation.

The features of the invention employed to the accomplishment of this object and such others as may hereinafter appear, will best be understood from the following description and accompanying drawings.

Of the drawings: Figure 1 is a plan view of the improved tide motor. Fig. 2 is a central longitudinal section of the motor shown in Fig. 1. Fig. 3 is a detail view on an enlarged scale showing the power transmission mechanism, and Fig. 4 is a section on the line 5—5 of Fig. 3.

Similar characters designate like parts throughout the several figures of the drawings.

In order that a tide motor shall deliver continuous power, it is necessary to provide power delivering means which act during the fall of the tide as well as during the rise. The present invention contemplates the provision of a motor A which delivers power on each tide and two motors B and C which alternate in delivering power during the ebb and slack tide periods.

In the drawings, 10 indicates a wall structure of cement or other suitable material set in the water and having its base below the low water level indicated by the line X X. The structure is arranged to form three tanks or wells, one well 11 always open to the tide through the opening 12, and two closed wells 13 and 14. The well 11 forms a part of the motor A, and as the motors B and C are exactly similar in form except that the last two wells are not always open to the tide, a description of one motor will suffice for all.

The motor A comprises a float 15 having attached thereto a vertical bar 16, one face of which is provided with a rack 17 (Fig. 3). The rack is in mesh with a gear 18 loosely mounted on a shaft 19 carried in journals 20. When the float 15 is rising with the flood-tide, the gear 18 is rotated and its motion is imparted to the shaft 19 through a pawl 21, mounted on the gear, which engages a tooth in the ratchet wheel 22 fixed on the shaft 19. This drives the shaft during the rise of the tide and permits the float to drop with the fall.

In order that the energy of the falling weight may not be wasted, provision is made for utilizing the weight to aid in driving the shaft 19. This is done by providing a gear 25 in mesh with the rack 17, rotatably mounted on a counter shaft 26. The counter shaft is supported at each end by a yoke 27 depending from the shaft 19. The upper ends of the yokes may surround the hubs 28 of the ratchet wheels 22 if desired. The yokes have arms 29 which extend on each side of the bar 16 and carry rolls 30 to retain the rack in engagement with the gears. The gear 25 is rigidly connected with a larger gear 31 by screws 32 and this gear is in mesh with a gear 33 on the shaft 19. The gear 33 is connected to drive the shaft by a pawl 34 and a ratchet wheel 35 in exactly the same way as has been described with relation to the gear 18. By this construction the downward movement of the rack 17 drives the gear 33 in the direction of the arrow on Fig. 3 and the motion is transmitted to the shaft by the ratchet and pawl. It is apparent that the direction of the rotation of the gears 18 and 33 is always opposite so that while one gear is driving the shaft, the other gear is running idly in the opposite direction with its pawl clicking over the ratchet teeth. The shaft 19 is driven continuously by the action of one of the motors as will be hereinafter described, and, as the weight of the float 15 is not sufficient to drive the shaft of itself, the decreasing ratio of the gears 33, 31, and 25 lifts the float slightly out of the water as the tide ebbs and causes the weight of the float to assist in driving the shaft. More briefly stated, the float is allowed to descend by the rotation of the shaft 19, at a slower speed than the fall of the tide. The shaft 19 is provided with means for transmitting power, such as a pulley 36, and extends through the gears 18 and 33 of each of the motors A, B, and C.

The float 15 of the motor A rises and falls with every tide. In order that the motors B and C may work at times not coincident

with the rise of the tide, a reservoir 40 is provided for the storage of a supply of water at a height greater than the highest tide. Water is delivered to the reservoir through a pipe 40× by a pump 41 having a pipe 42 leading into the water to a point below the low water line. The pump may be driven by any suitable means, such as a compressed air motor 43 connected by a pipe 44 with a chamber 45 which is supplied with air from an air compressor actuated by the tide.

In order to operate the motor B from the reservoir 40, the well 13 is connected with the reservoir by a pipe 55 of such size that the water passing through the pipe fills the well at a speed equal to the rise of the tide. The flow through the pipe is controlled by a valve 56 which is opened by a cord 57. A pipe 58 and valve 59×, operated by a cord 59, supply water to the well 14 in the same manner. Water from the outside may enter or leave the wells 13 and 14 by a pipe 60 of suitable size to move the water in the well at tide speed, which may be opened to either of the wells by valves 61 and 62 movable by means of handles 63 and 64.

The valves 61 and 62 are opened when the tide is high and water flows into the wells until the rising water level in the wells and the falling tide level are nearly equal. The valves 61 and 62 are then closed and the valves 56 and 59× are opened to supply water to the wells from the reservoir 40. When the valves 61 and 62 are opened on the falling or low tide, the water level descends at the same speed at which the tide falls. By this construction the floats of the motors B and C have exactly the same movement as though they were acted upon directly by the tide.

The operation of this invention is as follows: Starting with the rise of the tide, the motor A acts until the tide has reached approximately its highest point, as shown in Fig. 2. At this time the valve 61 is opened, which allows water to flow into the well 13 from the outside high water and fill it at the same rate at which the tide rises. At about the time the float reaches dotted line position, the tide will have descended to nearly the same level as the water in the well so that the flow thereto will soon cease. In order to keep the motor B in operation, the valve 61 is now closed and the valve 56 opened which causes the well 13 to be filled with water from the reservoir 40, thus imparting a full movement to the float, which is held in its uppermost position by keeping both valves closed until after motor A has again risen; after which the valve 61 is opened to allow the water to escape from the well 13 and permitting the floats of motors A and B to descend simultaneously. By the time the motor B has completed its upward movement the tide is again at low water so that the motor A again takes up the load and rises to the high tide position. When the motor A completes its second upward movement the valve 62 is opened to allow the water from the outside high tide to flow into the well 14 of the motor C. This motor acts in the same manner as the motor B, the first part of its upward motion being derived from water entering through the valve 62 and the latter part from water entering from the reservoir 40 through the valve 59× the valves being operated in the same timed relation as is described in connection with the motor B. On each ebb tide there are two floats descending, on the first ebb the floats of the motors A and C are dropping, and on the second ebb the floats of the motors A and B. The cycle of the machine is then repeated.

As the weight of the descending floats is not sufficient to turn the shaft 19, the shaft is driven by the float which is rising with the tide or with the water which is admitted at tide speed. Thus the train of gears 25, 31, and 33 act to retard the downward movement of the descending floats, which, of course, causes the weight of the floats to be applied toward driving the shaft. From the foregoing description it is apparent that one of the three floats is always rising at tide speed, either from the direct action of the tide or from water admitted from the reservoir. By this construction the shaft is continuously driven at a constant speed with relation to the movement of the tide. Normal variations in the movement of the tide will naturally produce a corresponding variation in the speed of the shaft.

It is to be understood that this invention is capable of wide variation in structure and arrangement of parts, and the invention is not limited to the specific construction illustrated and described except in so far as is specified in the appended claims.

It is believed that the operation and many advantages of the invention will be fully understood from the foregoing description.

Having thus described my invention, I claim:

1. In a tide motor, the combination with a float of means for transmitting power from the float as the tide rises, means for transmitting power from the float as the tide falls, and means for causing the float to fall at less speed relatively to the speed of the driven mechanism than it rises.

2. In a tide motor, the combination with a float, of means for transmitting power from the float as the tide rises, means for transmitting power from the float as the tide falls, and means for causing the float to fall at less speed than the fall of the tide.

3. A tide motor comprising a float, a rack movable with the float, a shaft having a loosely mounted gear in mesh with the rack,

means for operatively connecting the shaft and the gear when the gear rotates in one direction only, a second gear on the shaft, means for operatively connecting the gear and the shaft when the gear rotates in one direction only, and speed increasing gears connecting the rack and the second gear whereby equal movements of the rack in opposite directions will impart a greater movement to the second gear than to the first.

4. A tide motor comprising a float freely movable with the tide, a second float movable independently of the tide, means for supplying water to the last named float whereby the float is moved at tide speed independently of the movement of the tide and means for transmitting power from the floats.

5. A tide motor comprising a float freely movable with the tide, a float arranged to be lifted at tide speed during an ebb tide, a float arranged to be lifted at tide speed during the next ebb tide and means for transmitting power from the floats to the driven mechanism.

6. A tide motor comprising a float freely movable with the tide, a pair of independently movable floats adapted to be lifted alternately at tide speed during two downward movements of the first float and means for transmitting power from the floats to the driven mechanism.

7. A tide motor comprising a float freely movable with the tide, wells containing additional floats, a reservoir above high tide level, means to admit tide water to the wells, means to admit water from the reservoir to the wells and means for transmitting power from the floats to the driven mechanism.

8. A tide motor comprising a float freely movable with the tide, wells containing additional floats, a valve in each well controlling an opening to tide water below low water level, a reservoir above high water level, a valve in each well controlling the admission of water from the reservoir, all of said valves being arranged so that the water level in the wells is moved at tide speed when any one of the valves is open and means for transmitting power from the floats to the driven mechanism.

9. A tide motor comprising a series of floats, connections between the floats, and a shaft and mechanism whereby power is transmitted to the shaft upon movement of each float in either direction, means to permit some of the floats to be acted upon directly with the tide, and means to control the admission of water to act upon other of the floats independently of the tide.

10. A tide motor comprising a float subject to the action of the tide, wells containing additional floats, means for opening the wells to tide water, a reservoir above high water level, means for admitting water to the wells from the reservoir, an air compressor actuated by the tide, and a pump operated by the air to deliver water to the reservoir.

Signed by me at 4 Post Office Sq., Boston, Mass., this 4th day of April, 1914.

JOHN A. KNOWLTON.

Witnesses:

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