J. ISHII.

TIDE MOTOR.

APPLICATION FILED OCT. 25, 1913.

1,104,510.

Patented July 21, 1914.

3 SHEETS—SHEET 1.

Fig. 6.

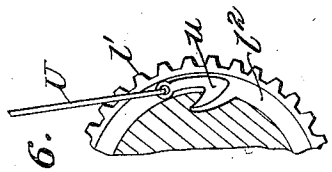


Fig. 1.

WITNESSES

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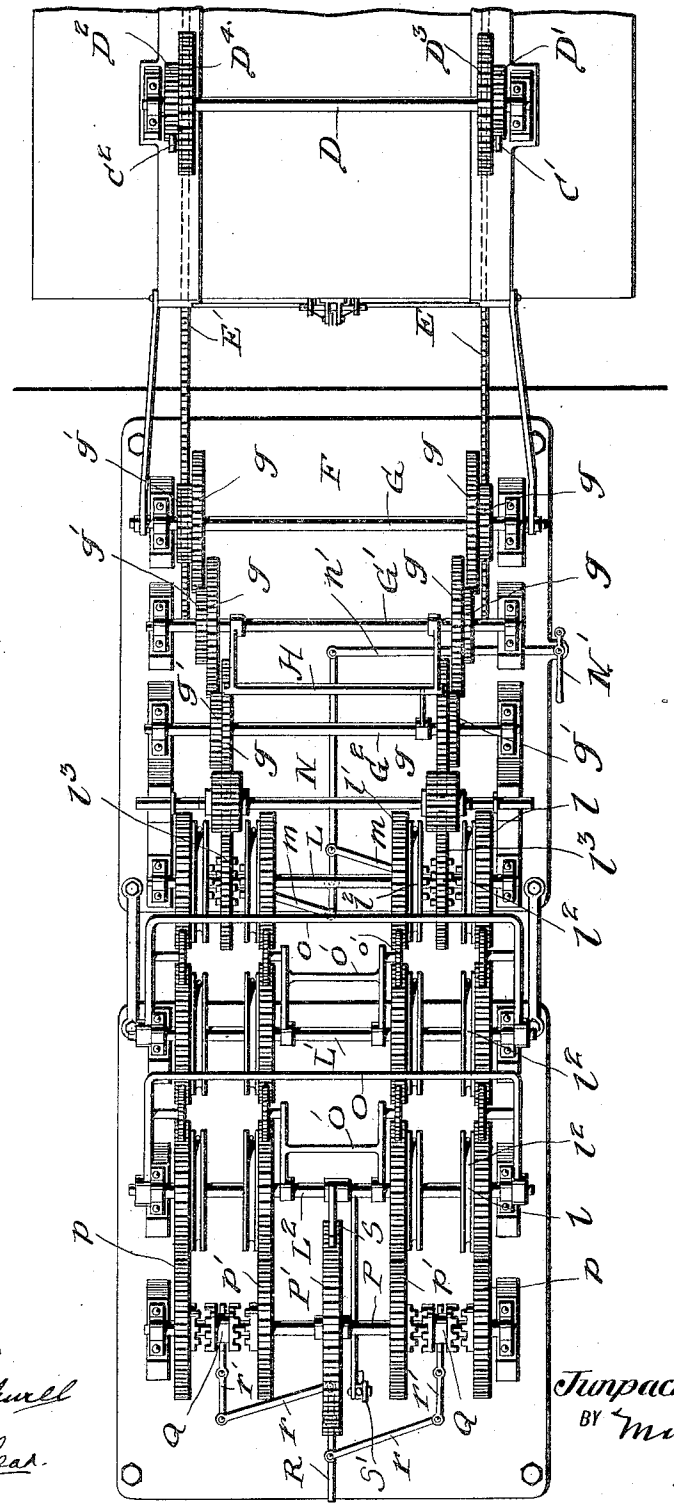


Fig. 2.

WITNESSES

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3 SHEETS—SHEET 3.

Fig. 4.

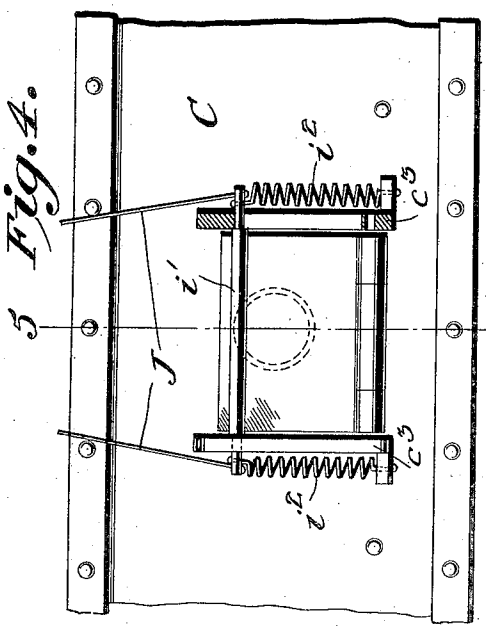


Fig. 5.

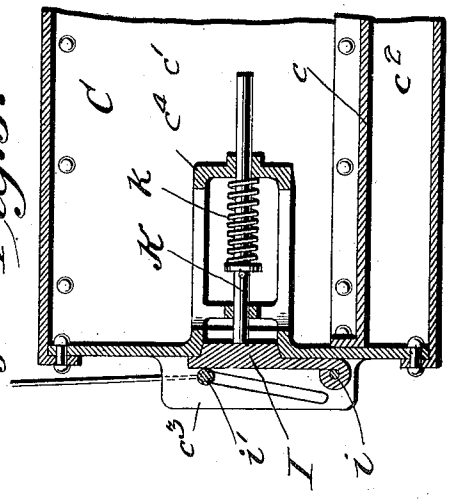
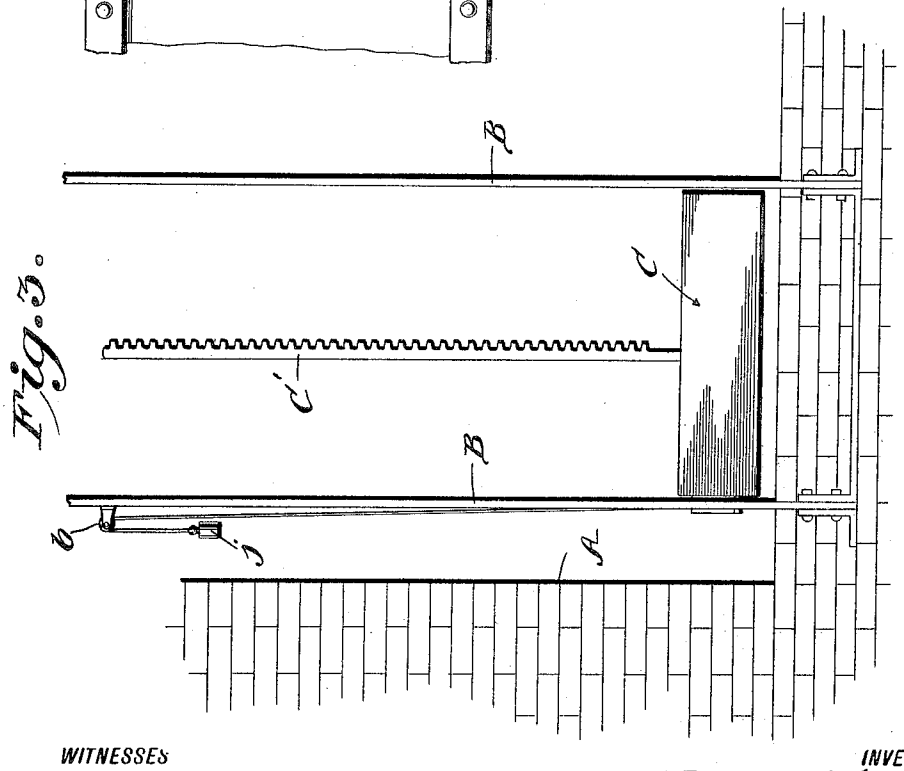


Fig. 3.



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UNITED STATES PATENT OFFICE.

JUNPACHIRO ISHII, OF BOSTON, MASSACHUSETTS.

TIDE-MOTOR.

1,104,510. Specification of Letters Patent. Patented July 21, 1914.

Application filed October 25, 1913. Serial No. 797,195.

To all whom it may concern:

Be it known that I, JUNPACHIRO ISHII, a subject of the Emperor of Japan, and resident of Boston, in the county of Suffolk and State of Massachusetts, have invented an Improvement in Tide-Motors, of which the following is a specification.

My present invention relates to tide motors, and the object of my invention is to provide certain improvements in devices of this character both with respect to the float and its controlling means and the mechanism whereby to transmit and store the power generated by the rise and the fall of the float.

These objects will be made apparent in the course of the following description in which reference is had to the accompanying drawings, forming a part of this specification and in which,

Figure 1, is a side elevation of a portion of the device. Fig. 2, is a plan of that portion of the apparatus shown in Fig. 1. Fig. 3, is a side elevation of the float and the lower portion of its support and controlling parts. Fig. 4, is a face view, partly broken away and in section, illustrating the float valve and that portion of the float immediately surrounding its valve, Fig. 5, is a vertical section through one side of the valve and its float, taken substantially on line 5—5 of Fig. 4. Fig. 6 is a fragmentary detail illustrating the manner of securing one of the flexible weight connections with its respective drum.

Referring now to these figures and particularly to Figs. 1 and 3, A represents the masonry support of suitable character for the transmission and winding mechanisms, the outer face A′ of which is in the nature of a sea-wall along which upstands the supports B for the float C, this float having two upstanding rack bars C′ and C², (see Fig. 2.)

Referring now to Fig. 2, there is mounted across the top of the float supports, a horizontal shaft D, at the outer ends of which are gear wheels D′ and D² with which the rack bars C′ and C² of the float C respectively engage, shaft D also supporting larger gear wheels D³ and D⁴ which respectively engage horizontal rack bars E and E′.

The transmission mechanism is mounted upon a bed plate F supported upon the masonry as particularly shown in Fig. 2 and comprises a plurality of transverse shafts G, G′, and G², each shaft being provided adjacent opposite ends with large and small gear wheels g and g' respectively, the large gear wheel g of the intermediate shaft G′ engaging the small gear wheel g' of the inner shaft G² and the large gear wheel g of the outer shaft engaging the smaller gear wheel g' of the intermediate shaft G′, thus forming a stepped arrangement of transmission gears along the opposite sides of the shafts G, G′ and G², the inner ends of the horizontal rack bars E and E′ being in engagement with the smaller gear wheels g' at opposite ends of the outer transmission shaft G.

A latch bar H, the extensions of which are journaled on the intermediate transmission shaft G′ is adapted for engagement, as will be seen by comparison of Figs. 1 and 2, with the larger gear wheels g of the inner transmission shaft G², for the purpose of locking the transmission mechanism and also the horizontal rack bars E and E′ against movement, thus at the same time locking the float and its rack bars against movement for a purpose hereinafter fully explained.

The float C is divided by a horizontal partition c into upper and lower chambers c' and c^2 respectively, it being noted particularly from Fig. 5 that the upper chamber is considerably greater in proportion than the lower chamber and is provided at one side with an aperture located adjacent to its base and with vertically slotted brackets c^3 arranged upon opposite sides of this aperture. A valve disk I is provided with lower extensions hinged at i below the opening, this disk being controlled by a cross-pin i' movable vertically along its outer face and having the ends thereof extended through the vertical slots of the side brackets c^3. Side springs i^2 connected at their upper ends to the outer ends of the cross-pin i' and secured at their lower ends to laterally projecting portions of the brackets c^3, serve to draw the cross-pin downwardly in order to permit the valve disk I to swing on its hinge away from the opening which leads into the float chamber c', the action of these springs being normally prevented, however, by flexible connections J extending upwardly from the ends of the cross-pin i' and over a pulley b of the float supports B, the free ends of these flexible extensions being connected to a weight j which serves to hold the cross-

pin i' in its upper position and maintain the valve closed.

It will thus be seen that the upper larger compartment c' of the float is adapted to be flooded with water when desired and that the lower smaller float chamber c^2 is permanently closed and contains only air at all times. Thus when the tide rises, the upper chamber c' as well as the lower chamber c^2 is filled with air and the latch bar H is thrown into engagement with the gears g of the inner transmission shaft G^2 so that the float is locked against upward movement until the water rises to approximately the top thereof. The operator then releases the latch bar and does not throw it into engagement again until the upward movement has been completed. In the upper position the operator lifts weight j and the springs i^2 pull the cross-pin i' downwardly. As soon as this action takes place, a valve pin K longitudinally movable within the float chamber c' and guided against the inner surface of the valve I within a cage c^4, moves against the inner surface of the valve under actuation of its spring k and forces the valve off of its seat, permitting the entrance of water for the purpose of flooding the float chamber c'. With the float compartment c' thus heavily weighted, it will descend with the receding tide and both its up and down movement utilized to develop potential power by the means which I will now describe.

The winding and power storing mechanism comprises a plurality of horizontal transverse shafts L, L′, and L^2, the former of which is nearest the inner transmission shaft G^2. Each of these shafts is provided adjacent each end with a pair of facing gear wheels l and l' upon the inner faces of which are winding drums l^2, and the shaft L is provided with a gear wheel l^3 splined between each of its parts of gear wheels l and l' and provided upon opposite sides with clutch faces to engage similar clutch faces upon the inner sides of the drums l^2.

Between the gear wheels l^3 and the larger gear wheels g of the inner transmission shaft G^2 is arranged a pair of parallel shafts M, and M′ provided with intermeshing gears m and m' adjacent opposite ends and having their extremities journaled, through end pieces m^2 provided with central trunnions m^3, these trunnions being journaled in the upper slotted portions of side supporting brackets in such manner that the shafts M and M′ may be held in vertical position with the single gear m' in mesh with the before mentioned larger gear wheel g of the inner transmission shaft G^2 and the adjacent splined gear wheel l^3, the parts being arranged in this position when the float is ascending upon the surface of a flood tide. When, however, the float descends, the shafts M and M′ are raised and moved to horizontal position so that the gear wheel m meshes with the before mentioned gear wheel g and the gear m' meshes with the splined gear wheel l^3, due to which the splined gear wheels l^3 will be turned in the same direction irrespective of the direction of movement of the float.

Inasmuch as each side portion of the apparatus is substantially of the same structure it will be necessary to describe only one, in so far as the particular arrangement of the several gear wheels is concerned, it being noted however, that the outer series of gears of the two sides are utilized in conjunction through the fact that the splined gear wheels l^3 are moved either outwardly or inwardly in unison by means of links m extending from a lever N upon opposite sides of its pivot, the free end of this lever being connected by a connecting rod n' to a side handle or the like N′. The outer series of gears l and inner series l' of each side of the apparatus are spaced apart and arranged to be connected through small connecting gears o and o' journaled upon portions of swinging frames O and O′, these frames being journaled upon the ends of the shafts L′ and L^2 as particularly seen in Figs. 1 and 2. In this manner the drum wheels of shafts L^2 and L′ may be disconnected when desired.

The gear wheels l and l' of shaft L^2 are in mesh with gear wheels p and p' journaled on a driven shaft P, centrally of which is a gear P′ from which the power is taken through suitable means and to suitable purposes, clutch members Q being arranged between the gear wheels p and p' adjacent each end of the shaft P and arranged to clutch either the outer gear wheels p or the inner gear wheels p' in unison as before described with reference to the movements of the gear wheels l^3, clutch members Q being actuated from a single lever R through connecting links r and intermediately pivoted arms r'. When power is being stored up the clutch members Q are moved to intermediate positions as shown in Fig. 2 and the central shaft P′ is latched by means of a latch arm S journaled on shaft L^2 and actuated from a lever S′ through a connecting rod s as best shown in Fig. 1.

Mounted above the shafts L, L′, and L^2, as best shown in Fig. 1, is a frame T, upon the upper portion of which are journaled series of rollers t above the several series of gear wheels l and l', flexible connections U being passed over these pulleys. At one end each of the flexible connections U is provided with a weight U′ and at its opposite end is provided with a hook u or similar means adapted for connection with the respective drum l^2.

In operation with the parts as shown in

Fig. 1 in which the shafts M and M′ are turned to correspond with the upward movement of the float, and with the splined gear wheel l^3 moved outwardly to clutch the outer series of gear wheels l, the flexible connections U of gear wheels l of shafts L and L′ are disconnected in the first instance and frames O are moved to connect the gear wheels l of shafts L, L′ and L^2. Thus with the flexible weight connections of shafts L and L′ disconnected or cast off as above stated rotation is transmitted to the gear wheels l of shaft L^2 and the flexible connections of the drum l^2 of these gears are wound thereon to raise their respective weights U′. As soon as these weights are raised the frame O between the gear wheels l of shafts L′ and L^2 are raised with clutches Q in proper position to prevent unwinding so that these gear wheels are disconnected and the flexible connections U of the gear wheels l of shaft L′ are again attached and these flexible connections are then wound upon their drum l^2 so that their weights U′ are raised. If the raising of the weights just mentioned has not exhausted the upward stroke of the float, the frame O between the gear wheels l of shafts L and L′ is raised, thus disconnecting the shaft L′, the frame O between shafts L′ and L^2 being lower to prevent unwinding and the remaining motion of the float is communicated to raise the weights of shaft L, the flexible connections of which are attached to the respective drums l^2 at each side of the shaft L. Thus it will be seen that each series of gears l and l' must be loose on their respective shafts, and that the two outer series of gears l may be operated independently of the two inner series of gears l' depending upon the positions of the splined gear wheels l^3. This operation is substantially repeated in reverse order when power is taken from the apparatus through the shaft P before mentioned, and it is to be noted that in either operation more than one set of weights may be utilized at the same time if desired.

The apparatus thus described and forming my invention affords an effective means by which power may be derived and utilized from the rise and the fall of tide, and is particularly desirable and advantageous in certain localities where the tides are strong or sufficient rise and fall of water can be effected.

I claim:

1. In a tide motor, the combination of a vertically reciprocatory float, a transmission mechanism including a series of gears whereby to convert the reciprocatory movements of the float into rotary motion, a storing mechanism including series of gears carrying winding drums, vertically movable weights for connection with and disconnection from the winding drums, means for throwing each series of gears into and out of operation, and means for throwing certain of the gears of each series into and out of operation in accord with the connection and disconnection of their respective weights.

2. In a tide motor, the combination of a vertically movable float, a transmission mechanism including a series of gears whereby to convert the reciprocatory movements of the float into rotary motion, a power storing mechanism including winding drums and vertically movable weights, a gear frame between the transmission and storing mechanisms, and a pair of intermeshing gears journaled in said gear frame and movable therewith so that either one or both of the gears form a connection between the transmission mechanism and the storing mechanism.

3. In a tide motor, the combination of a vertically reciprocatory float having a pair of compartments one of which is permanently closed, a transmission mechanism including a series of gears whereby to convert the reciprocatory movements of the float into rotary motion, and means whereby to permit the other float compartment to alternately flood and free itself of water, and including a latch engaging one of the transmission gears whereby to lock the transmission mechanism and the float against movement.

4. In a tide motor, a vertically reciprocatory float having two compartments of which the lower compartment is permanently closed and the upper compartment is provided with an opening in one side wall thereof, a valve disk hinged at its lower edge to the said wall of the float and movable to cover and uncover the opening, a valve controlling member for movement against the valve disk, weight controlled connections for moving the controlling member to hold the valve closed, and springs for moving said controlling member to permit the valve to open when the weight controlled connections are released.

5. In a tide motor, the combination of a vertically reciprocatory float, a transmission mechanism including a series of gears whereby to convert the reciprocatory movements of the float into rotary motion, a power storing mechanism including series of gears carrying winding drums, and vertically movable weights engageable with and disengageable from said winding drums, a pair of intermeshing gears movably mounted so that either one or both of the gears form a connection between the transmission and storing mechanisms, the said storing mechanism including means for throwing each series of gears into and out of operation and means for throwing certain of the gears of each series into and out of opera-

tion in accord with the connection and disconnection of their respective weights.

6. In a tide motor, the combination of a vertically reciprocatory float, a transmission mechanism including a series of gears whereby to convert the reciprocatory movements of the float into rotary motion, a power storing mechanism including series of gears carrying winding drums, vertically movable weights for connection with and disconnected from the winding drums, gears connecting the winding drum gears and movable into and out of engagement therewith to accord with the connection and disconnection of their respective weights, and clutches movable to bring selected pairs of winding drum gears into operation, a gear frame movably mounted between the transmission and storing mechanisms, and a pair of intermeshing gears mounted in said gear frame and movable therewith between the transmission and storing mechanism so that either one or both of said intermeshing gears forms the connection between the said mechanisms, for the purpose described.

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