H. B. FENNER.

CURRENT WATER MOTOR.

APPLICATION FILED SEPT. 15, 1908.

948,544.

Patented Feb. 8, 1910.

3 SHEETS—SHEET 1.

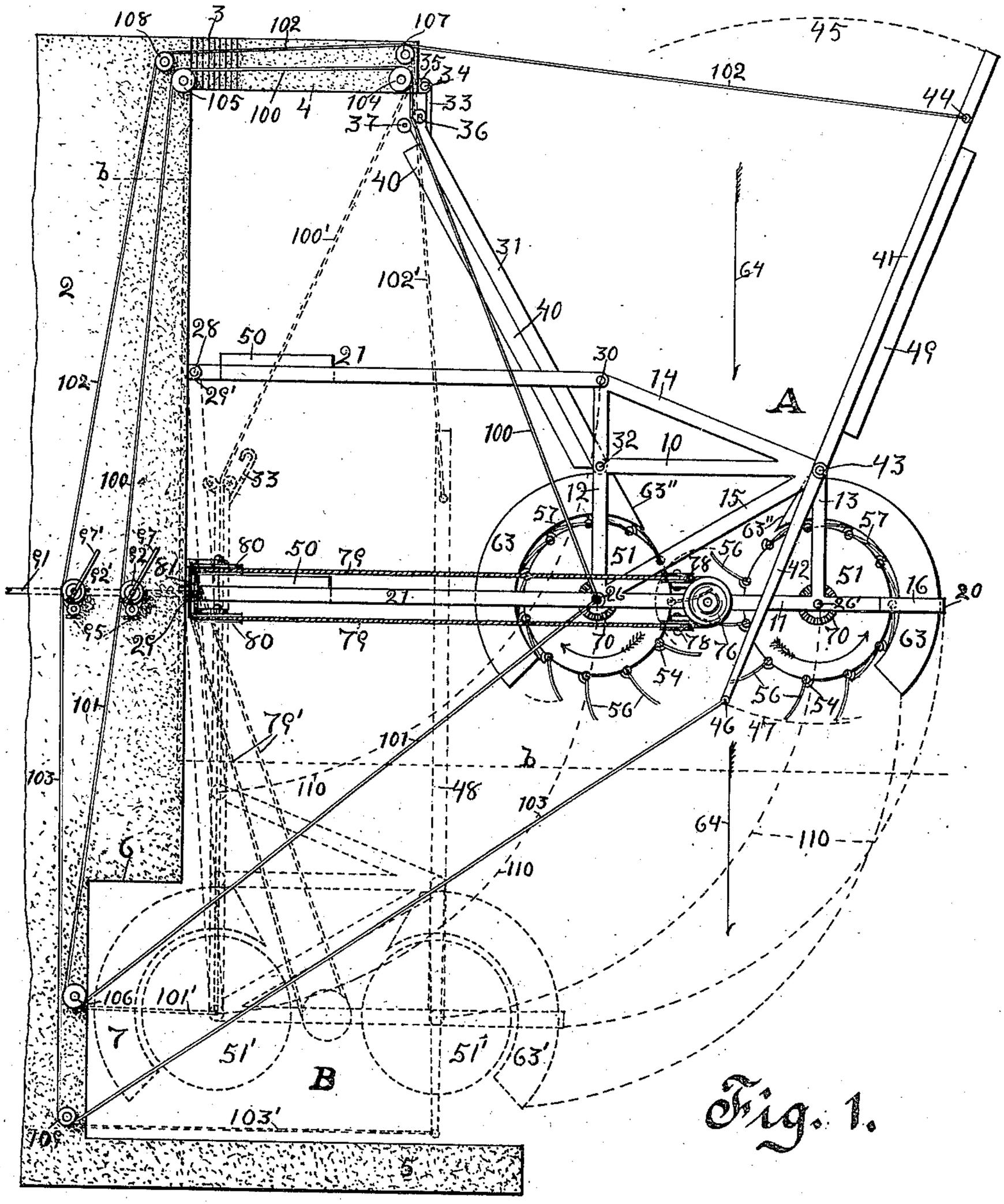

Fig. 1.

WITNESSES:

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F. L. Ass.

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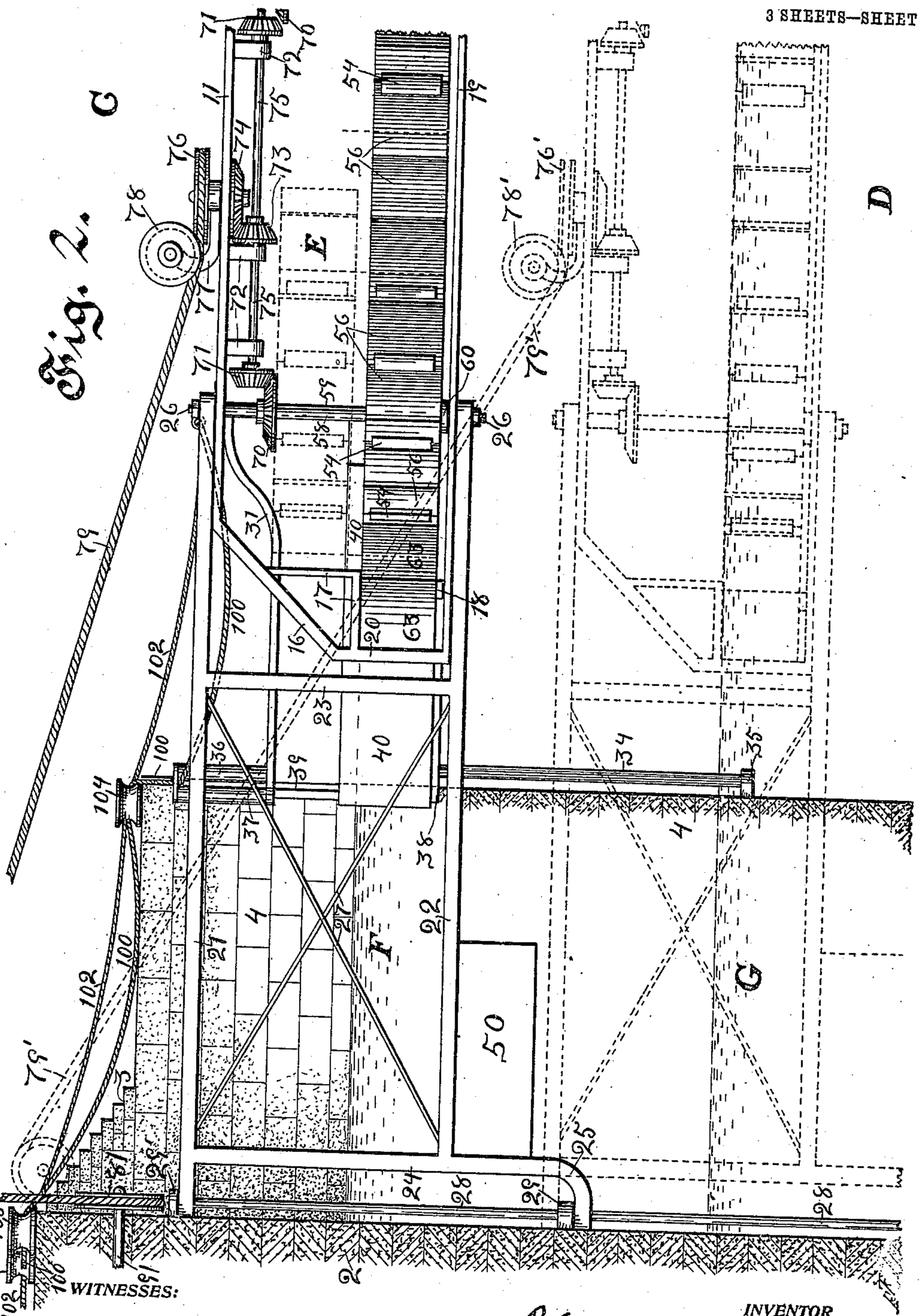

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3 SHEETS—SHEET 3.

Fig. 7.

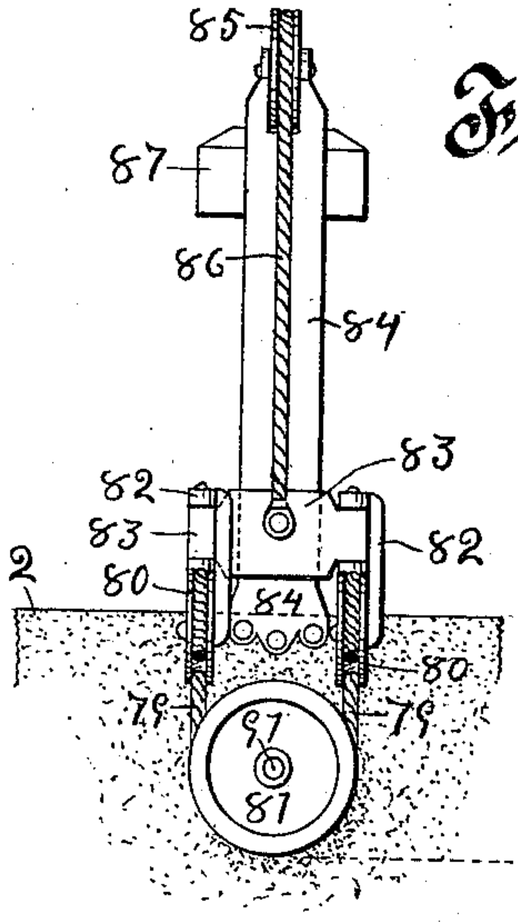

Fig. 6.

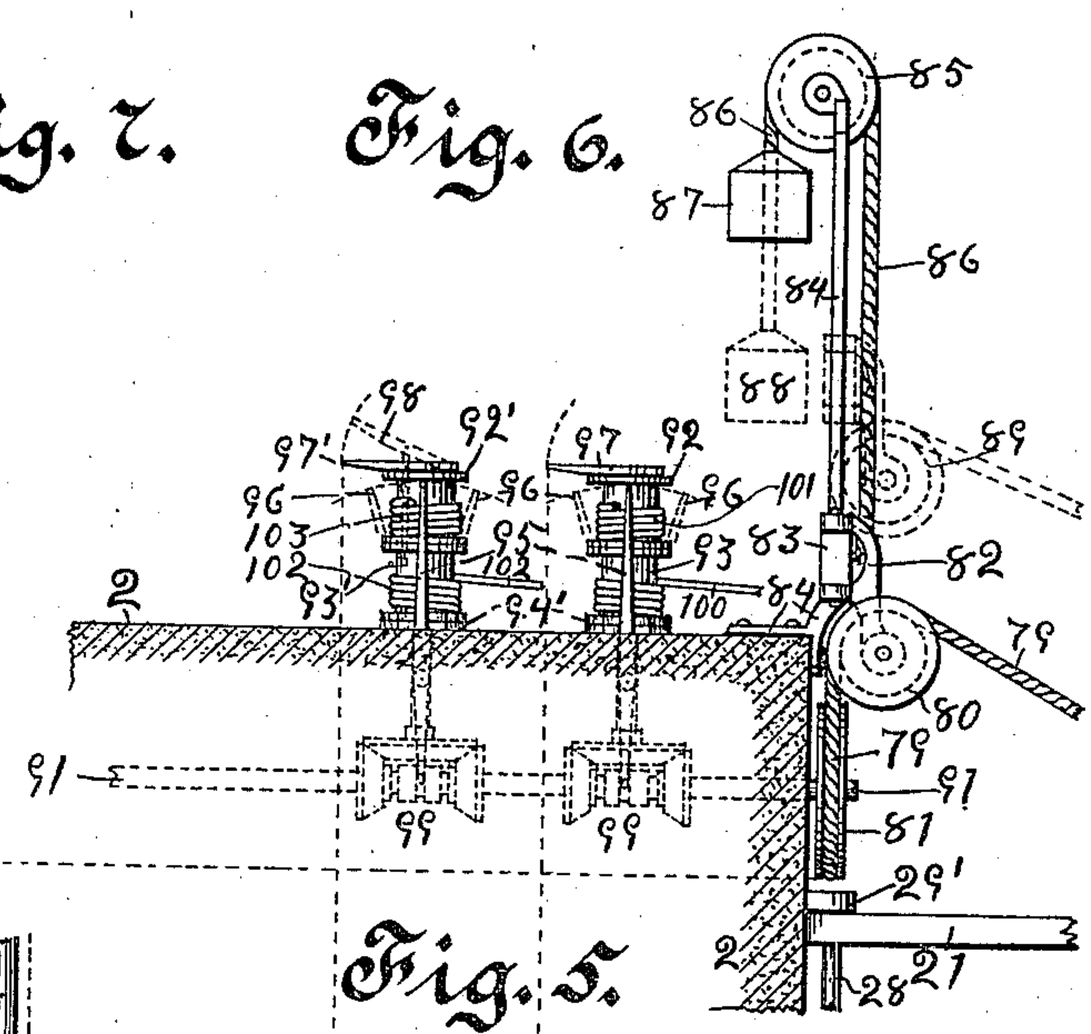

Fig. 4.

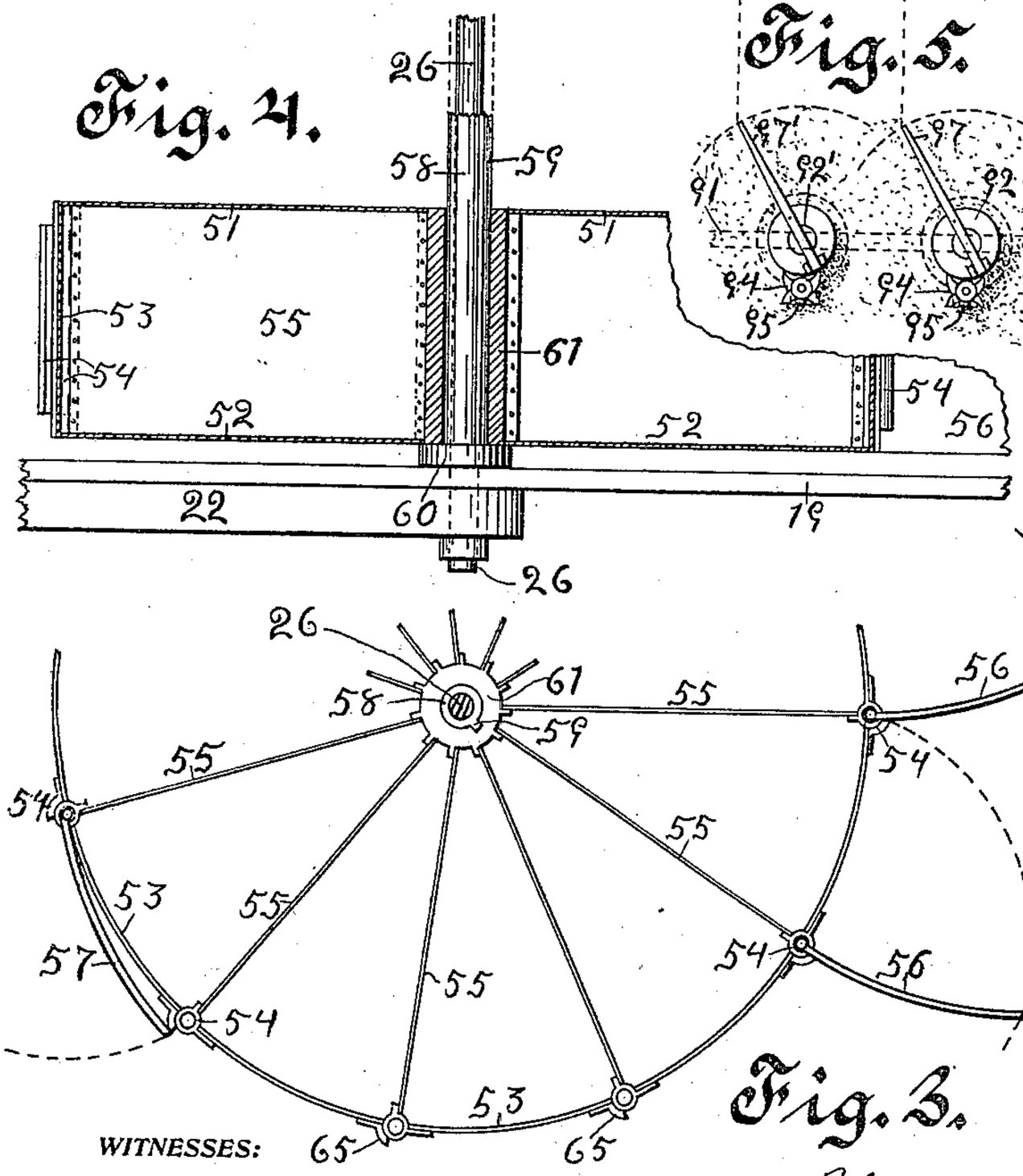

Fig. 5.

Fig. 3.

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UNITED STATES PATENT OFFICE.

HARRY B. FENNER, OF OMAHA, NEBRASKA.

CURRENT WATER-MOTOR.

948,544. Specification of Letters Patent. Patented Feb. 8, 1910.

Application filed September 15, 1908. Serial No. 453,105.

To all whom it may concern:

Be it known that I, HARRY B. FENNER, a citizen of the United States of America, residing at Omaha, in the county of Douglas and State of Nebraska, have invented certain new and useful Improvements in Current Water-Motors, of which the following is a specification.

My invention relates to improvements in water-motors for utilizing the power of running water in streams; and the objects of my improvements are, first, to utilize the most powerful portion of the current of the stream and not obstruct navigation; second, to provide an adjustable retractable dam; third, to connect water-wheels with said dam and facilitate the automatic adjustment of the whole to high and low water of the stream; fourth, to facilitate throughout all the varied adjustments the even transmission to the shore of the power generated by the water-wheels; fifth, to provide connected mechanism whereby the power from the water-wheels is used to throw the dam and water-wheels out across the channel or to withdraw them to clear the stream for navigation; sixth, to support the water-wheels without heavy bearings that carry great weight and soon cut away in turbid sand-bearing streams; and, seventh, to facilitate the utilization of the full force of small streams and the best part of the current of large streams by an improved construction and relative arrangement of two current water-wheels with other minor objects hereinafter more fully set forth. I attain these objects by the mechanism illustrated by the accompanying drawings in which—

Figure 1, is a plan showing the principal parts assembled, the dam and wheels thrown out across the channel at A for service; and by broken lines at B these parts are indicated withdrawn from said channel; Fig. 2, an elevation looking upstream from the broken line *b* in Fig. 1, showing at C the dam and wheels as located and supported for operation at a period of high water F, and indicated by broken lines at D, in working position at a time of low water G; Fig. 3, is a detail plan of the wheel construction, and shows the relative working positions of the two wheels; Fig. 4, is a central vertical section of one of the wheels; Fig. 5, is a detail plan of the driving-cable tightener and guide and the controlling capstans; Fig. 6, is an elevation of said tightener and capstans, showing their connection with the driving-cable and service-shaft and section of the breast-wall as seen looking upstream; and, Fig. 7, a water-front elevation of said tightener and the driven-pulley on the end of the service-shaft with a portion of the shore-end of the driving-cable.

Similar numerals refer to similar parts throughout all of the several views.

A traveling frame to carry the water-wheels and their curved float-shields 63 and 63, is composed of horizontal top beams as follows:—An inner or base-beam 12 is disposed parallel with the current of the stream; a shorter outer beam 13 parallel with the base-beam and connected thereto by the long cross-beams 10 and 11 to form a rectangle of width equal to said short outer beam and leave the excess length of the base-beam projecting upstream. A brace-beam 14 has one end fastened to the projecting end of the base-beam and its opposite end fastened at the outer upstream angle of said rectangle. The brace-beam 15 is disposed and fastened diagonally across said rectangle, oppositely to the brace-beam 14; the whole forming three triangular truss-panels in the same plane, thus producing a horizontally rigid top. A like horizontal bottom, including the beam 19 immediately beneath the wheels and the top-beam 11, is rigidly connected to the top by uprights 20 and 20, and the round uprights 26 and 26′, and like uprights at 30, 32 and 43. This traveling frame at all points in its range of movement, is supported transversely to the direction of the channel current, which is indicated by the arrows 64 and 64. It is supported by two swinging parallel connecting frames of equal length, each consisting of a horizontal top-beam 21 and bottom-beam 22, an intermediate vertical cross-beam 23 and a vertical base-beam 24. This base-beam is of greater length, as shown, having a curve 25 at its lower end which terminates horizontally in an eye to receive and slide loosely on that part of the vertical pivot-rod 28 below the intermediate anchor-stud 29. The anchor-stud 29 and top and bottom anchor-studs 29′ and 29′ are laid in the breast-wall 2 to support said vertical pivot-rod as shown. The top-beam

projects beyond the vertical base-beam to form a like eye to turn and slide on the pivot-rod between the intermediate stud 29 and the top stud 29′, allowing the swinging frames to slide up and down vertically a distance equal to the difference in altitude of high and low water of the stream. Oblique stay-rods 27 truss the swinging frames in their vertical planes. The sweeping ends of these swinging frames are pivoted one at each end of the beams 12 and 12, top and bottom, on the uprights 26 and 30 of the wheel-frame and the two vertical pivot-rods carrying the pivoted bases of the swinging frames are spaced a like distance apart on the face of the breast-wall 2. The breast-wall 2 is disposed parallel with the channel of the stream and the downstream or lower swinging frame is preferably pivoted directly beneath the driven-pulley 81 mounted on the out end of the service-shaft 91; this brings the service-shaft, lower swinging frame and the downstream or lower side of the wheel-frame, where the water-wheels are mounted on the round uprights 26 and 26′, all in transverse line to the channel, when swung fully out as shown at A in Fig. 1.

The breast-wall 2, which may be a part of an adjacent building, has at 6 an offset toward the bank, out of the stream. This with the right-angularly projected pier 5 below, forms the dock or harbor 7, into which the wheels and wheel-frame are swung when not in use or laid by for repairs, as indicated by the broken lines 51′ and 63′ etc., at B. The curved broken lines 110 indicate the sweep of points on the wheel-frame in passing from position A to position B.

At the upstream end of the breast-wall the pier 4 is thrown out toward the channel to supply support for the pulleys 104 and 107 carrying the upper controlling cables 100 and 102, and to provide anchorage for the dam and wheels when in the working position A. To bring said pulleys and controlling cables into a more direct line of service, this pier is of less height than the breast-wall and connected therewith by the flight of steps 3.

The top and bottom beams 11 and 19, of the downstream or lower side of the wheel-frame are extended beyond the end beams 12 and 13, as shown in Figs. 1 and 2. The uprights 20 and 20 have inclined portions 16 and 16 at their tops connecting them with the horizontal beam 11. Beneath these inclined portions are formed the brackets 17 and 17 by which supports and spaces are provided within the frame at its opposite ends for the curved blade-guides, shields and floats 63 and 63. These floats at their upstream ends are fastened to the uprights 32 and 43 and thus serve as strengthening braces and become parts of the wheel-frame. They are made hollow, of sheet metal, air tight and of a size to give displacement more than equal to the weight of the wheel-frame; so as to support said water-wheels little if any more than entirely submerged, as shown in Fig. 2. Their upstream-end vertical surfaces 63″ and 63″ are made inclined and set inclined to the current to serve as continuations of the deflecting faces of the dam-sections 31 and 41, to concentrate and deliver the current at greater head to the receiving parts of the wheels, and to their opening and opened radial blades 56. And their inner curved surfaces serve to guide and retain folded the blades 56, of the water-wheels, during that part of the revolution when the blades are out of commission. They also shield the returning or upstream-moving part of the wheel from the action of the current.

Hollow sheet metal floats 50 and 50 are fastened one at the base of each of the swinging parallel connecting-frames to balance them with the other connected parts: to secure their automatic vertical adjustment on the pivot-rods to varying heights of water and thus carry them level with the floated wheel-frame.

An inner swinging dam-section 31, is hinged to the upright 32 of the wheel-frame and its lower edge set at about equal depth therewith. The free end of this section is provided with the hook 33 to releaseably engage the vertical anchor-rod 34 fastened on the outer end of the pier 4 by anchor-studs 35 laid in the wall. A sheet metal float 40, of air-tight compartments like the other floats, forms a part of this dam-section, so that its buoyancy retains it at an altitude agreeing with the connected wheel-frame. A pair of cylinders 36 and 37 are mounted on vertical stud-shafts to project upward on top of the swinging or free end of this dam-section, as shown in Figs. 1 and 2. These cylinders are revoluble and set sufficient distance apart to allow the controlling cable 100 to pass freely between them.

The controlling cable 100 has one end attached to the wheel-frame at the top of the upright 26; it is then carried between the cylinders 36 and 37, thence to and around the pulley 104 on top of the pier 4, thence to and around the pulley 105 on top of the breast-wall 2, above the base of the pier 4, and thence to the base-barrel 93 of the capstan on which its opposite end is fastened and wound. See Fig. 6. The controlling cable 101 has one end fastened to the wheel-frame, preferably at the same point 26; it is then carried around the pulley 106, thence to the top barrel 92 of the capstan to which it is fastened to wind on in an opposite direction to the winding of the cable 100 on the base-barrel 93. These base and top bar-

rels are parts of the same capstan and normally revolve together in the same direction; so that the cables being wound on in opposite directions one is paid out as the other is wound in.

An out-end or outer swinging dam-section 41, is of construction similar to the section 31. It is similarly hinged to the upright 43 of the wheel-frame and has a float 49 to carry it so that it draws the same depth of water as the other connected parts. This section also has an integral arm or lever 42 projecting from its pivoted base in a direction opposite to its free end and disposed above the wheel-frame. The curved broken lines 45 and 47 indicate the sweep of the free ends of the section and arm respectively with reference to their pivot 43 on the wheel-frame. The principal service of this dam-section is to arrest that part of the current farthest out from the anchorage and deflect it in to the wheels at greater head; while section 31, as set in Fig. 1, deflects the current outward from the shore base or anchorage.

The controlling cable 102 has one end attached at 44 near the free end of the section; said cable is then passed around the pulleys 107 and 108, and the opposite end attached to wind on the lower capstan-barrel 93′. The opposed cable 103 has one end attached at the free end 46 of the arm 42, then passes around the pulley 109 and its opposite end is fastened to the top barrel 92′ of the same capstan to wind thereon in an opposite direction to the cable 102. This capstan—which is constructed geared and operated the same as the one carrying the cables to control section 31,—is connected with the service-shaft 91 by releasing and reversing gear indicated by broken lines 99 in Fig. 6. This releasing and reversing gear is operated by the hand-lever 95 which, when standing perpendicular, as shown in Figs. 1, 5 and 6, leaves the capstan entirely out of gear or released. In this position the oppositely-disposed pawls 94 engage the two oppositely-hooked sets of ratchet teeth 94′ on the base of the capstan and prevent revolution of the capstan in either direction. The capstan may be driven in either direction by throwing the lever to one or the other of the opposite positions indicated by the broken lines 96; such movement of the lever disengages the opposing pawl and simultaneously connects the gearing to drive the capstan in the direction desired; a reverse or opposite movement of the lever producing a reverse revolution of said capstan. The top barrels 92 and 92′ are mounted on concentric stub-axles of the lower barrels and are locked to revolve with said lower barrels. By vertical plunger-bolts having their top ends hinged to the levers 97 and 97′ and their lower ends extending down between teeth or into holes in the top ends of the nether barrels when the levers are depressed. By raising the levers 97 or 97′, as indicated by the broken lines 98, the plunger-bolts are drawn upward out of the lower barrel and thus the connecting locks are released and the top barrels may then be turned by said levers independently of said lower barrels By this means the lengths of the unwound parts of the controlling cables are increased or diminished to adjust them to different heights of the floating parts caused by high and low water in the stream, or by the different positions from A to B at which they may be set.

As shown in Figs. 1, 3 and 4, the water-wheels are constructed with buoyant cores or central floats surrounding the hubs 61. To the periphery of this core the curved folding blades 56 are pivoted. I prefer to construct this core with air-tight compartments as follows:—Between top and bottom plates 51 and 52, the radial partition-plates 55 are disposed with their inner ends riveted to radial flanges on the hub 61. As the strain between partition-plates and top and bottom plates is compression, and galvanized sheets are preferably used, they are connected by plain butt joints soldered to make them air-tight. In exceedingly large wheels where great strength is required and other strains may be developed, flanges are bent on the top and bottom edges of the partition-plates to receive rivets through the top and bottom-plates. The castiron pivot-angles 54 have radial flanges as shown to which the outer ends of the radial partition-plates and the ends of the curved peripheric plates 53 are riveted; thus completing the inclosing walls of the central float. The pivot-angles 54 have vertical central bores through which and through horizontally inwardly projecting eyes at the top and bottom of the inner ends of the blades, rods are loosely disposed and riveted by which the blades 56 are hinged to swing outwardly into working position where their outward swing is limited by their back faces striking the shoulders 65 on the outsides of the pivot-angles.

The wheels are each mounted on a vertical hollow shaft 58 which is mounted to revolve on the stationary round upright 26 of the wheel-frame. The hub is fitted to slide vertically on the hollow shaft and drives the shaft by the spline 29 on the shaft disposed in a corresponding groove in said hub. By this means either wheel may be independently raised out of the water, as indicated by the broken lines at E in Fig. 2, for inspection or repairs. The large washer 60 disposed loosely beneath the hollow shaft 58 and the hub 61, elevates the water-wheel to give it clearance over the beam 19. The buoyant core of the

wheel is proportioned to carry the greater portion of the weight of the wheel leaving little pressure on said washer. In their relation to each other the water-wheels are disposed so that the blades of opposite wheels alternate and interlap across the center of the space between their buoyant cores as indicated at 62 in Fig. 3; thereby utilizing as near as possible the full force of the current passing through.

The gearing to unite the power of the wheels, consists of bevel gear-wheels 70 and 70 mounted on the hollow shafts near their tops to revolve therewith and engage corresponding bevel pinions 71 and 71 mounted on the ends of the horizontal shaft 75. Either of these pinions may be shifted back from the end of the shaft, as one is shown in the drawing, to disconnect either wheel while it is elevated as at E and out of service. An intermediate bevel pinion 73 is mounted on the shaft 75, to engage the bevel gear-wheel 74 mounted below the beam 11 on the lower end of a vertical shaft journaled through said beam. On the top end of said vertical shaft is mounted the driving-pulley 76, grooved to carry and drive the driving-cable 79.

Between the pulley 76 and the beam 11, the base of the forked and curved bracket 77 is mounted to revolve independently and concentrically with said vertical shaft and driving-pulley. At the ends of the forks the grooved guide-pulleys 78 and 78 are mounted to guide the driving-cable into and from the groove of said driving-pulley; as this bracket is freely revoluble in a horizontal plane around the same axis as the driving-pulley, and the bracket arms support the lower edges of the guide-pulleys in tangential line with opposite sides of said driving-pulley, the cable is received and discharged correctly at any horizontal angle from A to B, or any vertical angle caused by movement of the wheel-frame to positions at or between C and D.

Mechanism to guide the driving-cable to and from the driven-pulley at varying angles and to tighten and take up and slacken the driving-cable to adjust its length to the various heights of water in the stream, is illustrated in Figs. 5, 6 and 7. 79 in Fig. 6, and the broken lines 79′ in Fig. 2 show the angle of action of the driving-cable and position of the guide-wheels 80 and 80 at the shore end during a period of low water; while 79 in Fig. 2 and 89 in Fig. 6 indicate the angle of action of the driving-cable and position of shore-end guide-wheels at a period of high water.

Directly above the driven-pulley 81 on the outer end of the service-shaft 91, the upright guide-way 84 is footed and fastened to the face and top of the breast-wall. A cross-block or carriage 83 is fitted to travel up and down on said guideway. At each end of said carriage an arm 82 is hinged to swing in a horizontal plane around an axis tangentially in line with the groove at the side of the driven-pulley 81 directly below. On each arm is mounted a grooved guide-pulley 80 having the groove at its inner edge directly in line with the axis of its supporting arm and the groove of said driven-pulley. See Figs. 6 and 7. The broken lines 90 in Fig. 5 indicate the sweep of these arms and guide-pulleys and illustrate how they deliver the driving-cable to and take it from the driven-pulley at any angle of operation from A to B: That here indicated being equivalent to that indicated by the broken lines 79′ in Fig. 1. At the top of said guide-way the grooved pulley 85 is journaled. A cable 86 has one end attached centrally to the carriage 83, is disposed up over the pulley 85 and the weight 87 attached to the opposite end. In a period of high water the carriage and suspended guide-pulleys are drawn up to the position indicated at 89, the weight descending to 88, taking care of the slack and in no manner interfering with the work of the driving-cable.

In operation it is obvious that the dam-section 31 may be retained at less inclination to the current by not pulling the whole clear out to the anchored position A. And the section 41 may be set at any angle within the range of, and room for, its movement; even to a position to deflect the current away from the water-wheels; which latter is desirable when the capstans,—which are within hand-reach of each other,—are operated conjointly to swing the floating parts to position B, and the action is desired to be slow.

To withdraw from the channel to position B, capstan 93—92 is started to draw on the cable 100; this disengages the hook 33 and the bend in the cable around the cylinder 36 straightens to throw the section out and the hook away from the catch-rod 34. If the capstan is instantly reversed the hook passes the anchor-catch and the whole moves down to B; but if the hook is drawn to near its limit upstream and then slacked back, the current forces the section toward the wall and the hook into engagement with the catch-rod.

In position B with the section 41 drawn parallel with the channel, as indicated by the broken lines 48, it is obvious that the channel is left open for navigation.

Such hoisting machinery as is required to raise the wheels to the position E, is operated from the top of the pier 5.

I claim:

1. A cylindrical core for current water-wheels, consisting of end-plates, a hub having radial flanges, radial partitions fastened to said end-plates, flanged angle-pieces fas-

tened to the outer ends of said radial partitions, and peripheric plates fastened to said end-plates and to said angle-pieces.

2. A current water-wheel having end-plates and peripheric-plates to form a central pneumatic core, flanged joint-pieces to unite said peripheric plates, foldable blades pivoted to said joint-pieces, and shoulders on said joint-pieces to limit the outward swing of said blades.

3. The combination of a wheel-frame, a pair of vertically axled current water-wheels mounted in said wheel-frame to turn toward each other and receive the driving current therebetween, parallel frames pivoted to a stationary support and to said wheel-frame to swing said wheel-frame toward and from and in fixed angular relation to the channel of a stream and support said wheels ranged thereacross, an inner dam-section having one end hinged to the supported side of said wheel-frame and the opposite end suspended upstream from a stationary support, an outer dam-section hinged to the extended side of said wheel-frame and means connected to support and adjust its free end obliquely upstream and outward.

4. The combination of a horizontally-swinging frame, a current water-wheel mounted in said frame, an inner dam-section having its downstream end hinged to said frame to travel therewith, an outer dam-section hinged at one end to said frame, a cable fastened to the free end of said outer dam-section and connected to wind on a capstan, a rigid arm on said outer dam-section disposed oppositely from its hinge, and a cable connected to said arm and to said capstan to wind thereon oppositely to said free-end cable.

5. The combination of a frame mounted to swing horizontally and reciprocate vertically, a float attached to said frame, a splined shaft boxed vertically in said frame, a current water-wheel mounted on said splined shaft to drive the same and slide vertically thereon.

6. The combination of a vertically-reciprocal frame pivoted to swing horizontally, a float attached to said frame, a splined shaft boxed vertically on said frame, a current water-wheel mounted thereon to drive said splined shaft and vertically slidable thereon, and a float in said water-wheel.

7. The combination of, a floating wheel-frame, floating parallel frames hinged at their bases to swing horizontally and mounted to reciprocate vertically on a stationary anchorage and their free ends hinged to said wheel-frame, and current water-wheels mounted in said wheel-frame and ranged transversely to the current of the stream.

8. The combination of a floating wheel-frame, floating frames hinged at one end to swing horizontally and reciprocate vertically on stationary rods and their free ends hinged to said floating wheel-frame to swing said wheel-frame across the current of a stream while retaining it in fixed angular relation to said current, a pair of splined vertical shafts ranged transversely to said current and journaled in said wheel-frame, and buoyant current water-wheels mounted to slide vertically on said splined shafts and to drive the same.

9. The combination of a buoyant wheel-frame, buoyant frames hinged at one end to swing horizontally and slide vertically on stationary rods and their opposite ends hinged to said wheel-frame to retain it in fixed angular relation to the current of a stream and swing it into and out of said current, vertical splined shafts spaced transversely to said current and journaled in said wheel-frame, buoyant current water-wheels mounted to slide vertically on and drive said splined shafts, a driving-shaft journaled on said wheel-frame and connected by gearing with said splined shafts, a driving-pulley mounted on said driving-shaft, a power-transmitting cable carried by said driving-pulley, and a swinging bifurcate arm pivoted concentrically with said driving-pulley and having grooved pulleys journaled on its forks to guide said cable onto and away from said driving-pulley.

10. The combination of a current water-wheel disposed in a wheel-frame mounted to swing horizontally toward and from the channel of a stream, an inner dam-section pivoted to said wheel-frame to swing its downstream end outwardly with said wheel-frame, and an outer dam-section pivoted at its downstream end to said wheel-frame and a cable and capstan connected to throw and sustain said outer dam-section obliquely upstream and outwardly from said wheel-frame.

11. The combination of a buoyant frame connected to a stationary anchorage to slide vertically thereon and swing horizontally toward and from the channel of a stream, a current water-wheel journaled on said frame, a revoluble shaft on said stationary anchorage, a driving cable connected to said water-wheel and to said shaft, a capstan geared to said shaft, a pair of oppositely disposed controlling cables fastened to wind in opposite directions on said capstan and connected to swing said frame.

12. The combination of a buoyant wheel-frame connected to a stationary anchorage to slide vertically thereon and swing horizontally in the current of a stream, a pair of current water-wheels journaled in said wheel-frame and spaced transversely to said current, a revoluble shaft on said stationary anchorage, a driving-cable connected to said wheels and shaft, capstans geared to said shaft, a pair of oppositely disposed con-

trolling cables fastened to wind in opposite directions on one of said capstans and connected to swing said wheel-frame, an inner buoyant dam-section hinged to said wheel-frame and connected to one of said controlling cables, an outer buoyant dam-section hinged to said wheel-frame and having a rigidly attached arm projecting oppositely from its hinged end, a cable one end fastened to said outer dam-section and a cable one end fastened to said oppositely projecting arm and the opposite ends of these cables fastened to wind in opposite directions on one of said capstans.

13. The combination with a current water-wheel journaled in a vertically-slidable and horizontally-swinging frame connected to a stationary anchorage, a driving-pulley geared to said water-wheel, a driven-pulley mounted at said stationary anchorage, and a driving-cable running on said pulleys, of a bifurcate arm its base pivoted concentric with said driving-pulley, and guide pulleys mounted on the forks of said arm to guide said driving-cable to and from said driving-pulley.

14. The combination with a current water-wheel and connected driving-pulley mounted on a frame hinged to swing horizontally and slide vertically on a stationary anchorage, a driven-pulley mounted on a shaft journaled on said stationary anchorage, and a driving-cable disposed on said pulleys, of a reciprocating carriage, arms hinged to said carriage, and pulleys mounted on said arms to guide said driving-cable to and from said driven-pulley.

15. The combination with a vertically-adjustable and horizontally-swinging frame carrying a current water-wheel connected to drive a shaft at a stationary anchorage and oppositely disposed controlling-cables connected to swing said frame, of a capstan having a base-barrel connected to said shaft by releasing and reversing gearing, a top-barrel concentrically journaled on said base-barrel and locked to normally revolve therewith, a lever on said top-barrel to unlock and revolve it independently, and said controlling-cables fastened one to each barrel to wind thereon in opposite directions.

16. The combination of a frame pivotally connected to a support to swing toward and from the channel of a stream, a water-wheel journaled to said frame, a shaft journaled on said support, a driving cable connected to said water-wheel and to said shaft, a capstan having a base-barrel geared to said shaft and an independently revoluble barrel mounted on said base-barrel and releasably locked thereto, and a pair of controlling cables each having an end connected to said frame and then oppositely disposed therefrom and their other ends fastened to wind in opposite directions on different barrels of said capstan.

17. The combination of a breast-wall disposed parallelly adjacent to a stream and its ends angled to form transverse piers to form a harbor, a current water-wheel mounted in a swinging frame pivoted to said breast-wall to swing said wheel from said harbor, and a hook on said frame to engage a catch on the upstream-pier to retain said water-wheel swung outward into the current of said stream.

18. The combination of a breast-wall angled to form a transverse pier and anchorage at the shore of a stream, a current water-wheel mounted in a horizontally-swinging frame hinged to said wall, a catch on said pier, and a hook on said frame to engage said catch.

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

HARRY B. FENNER.

Witnesses:
J. W. MARTIN,
N. M. MARTIN.