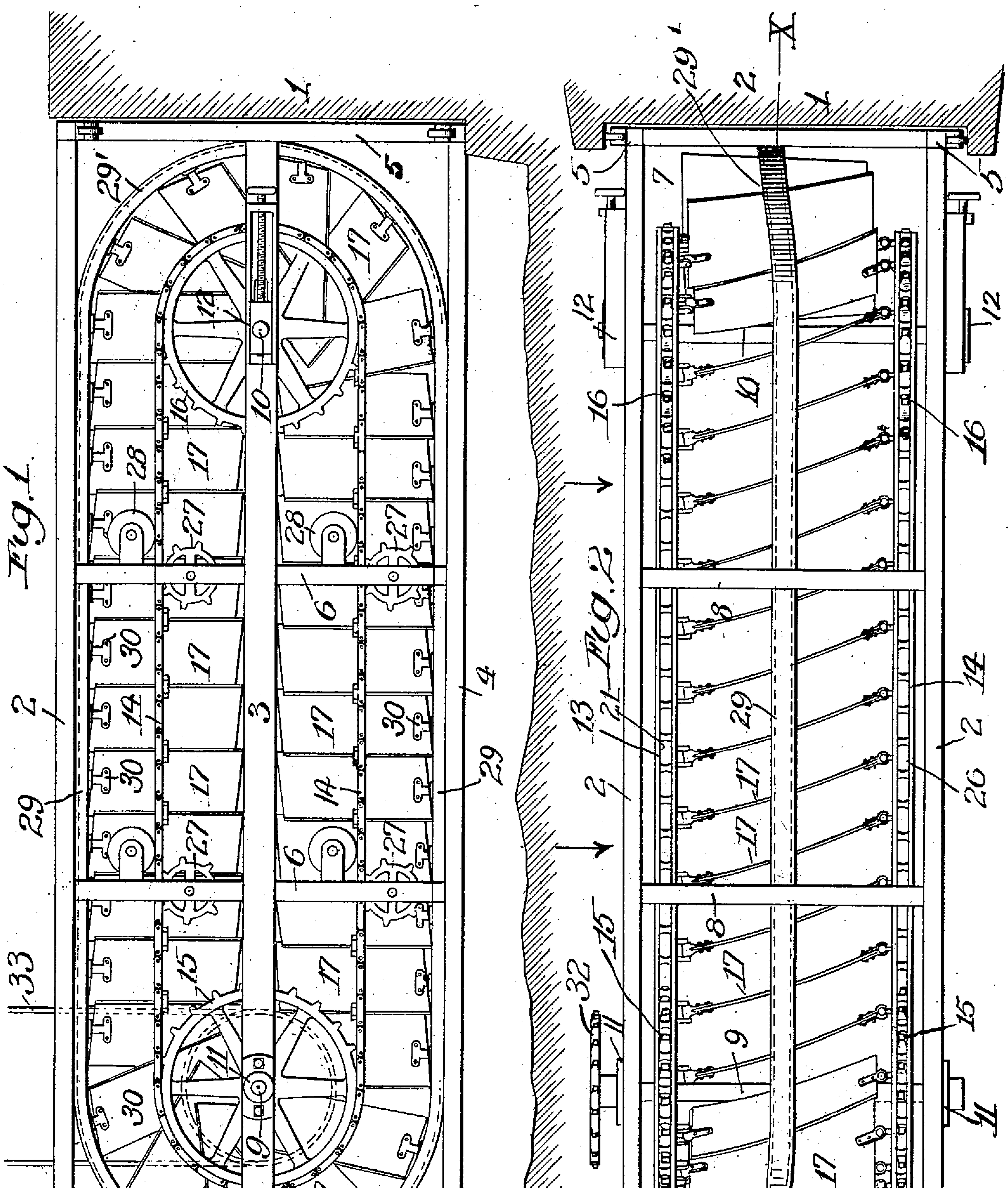
No. 742,529. PATENTED OCT. 27, 1903.

W. H. TRENCHARD & F. HEATH.

CURRENT WATER MOTOR.

APPLICATION FILED JAN. 13, 1903.

NO MODEL. 3 SHEETS—SHEET 1.



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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 4

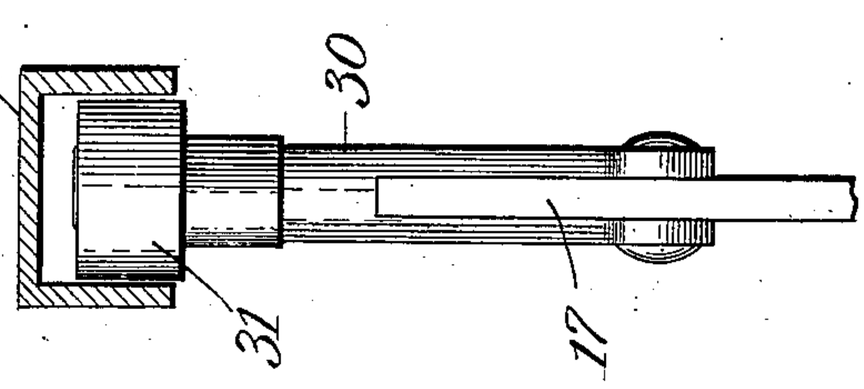

Fig. 5

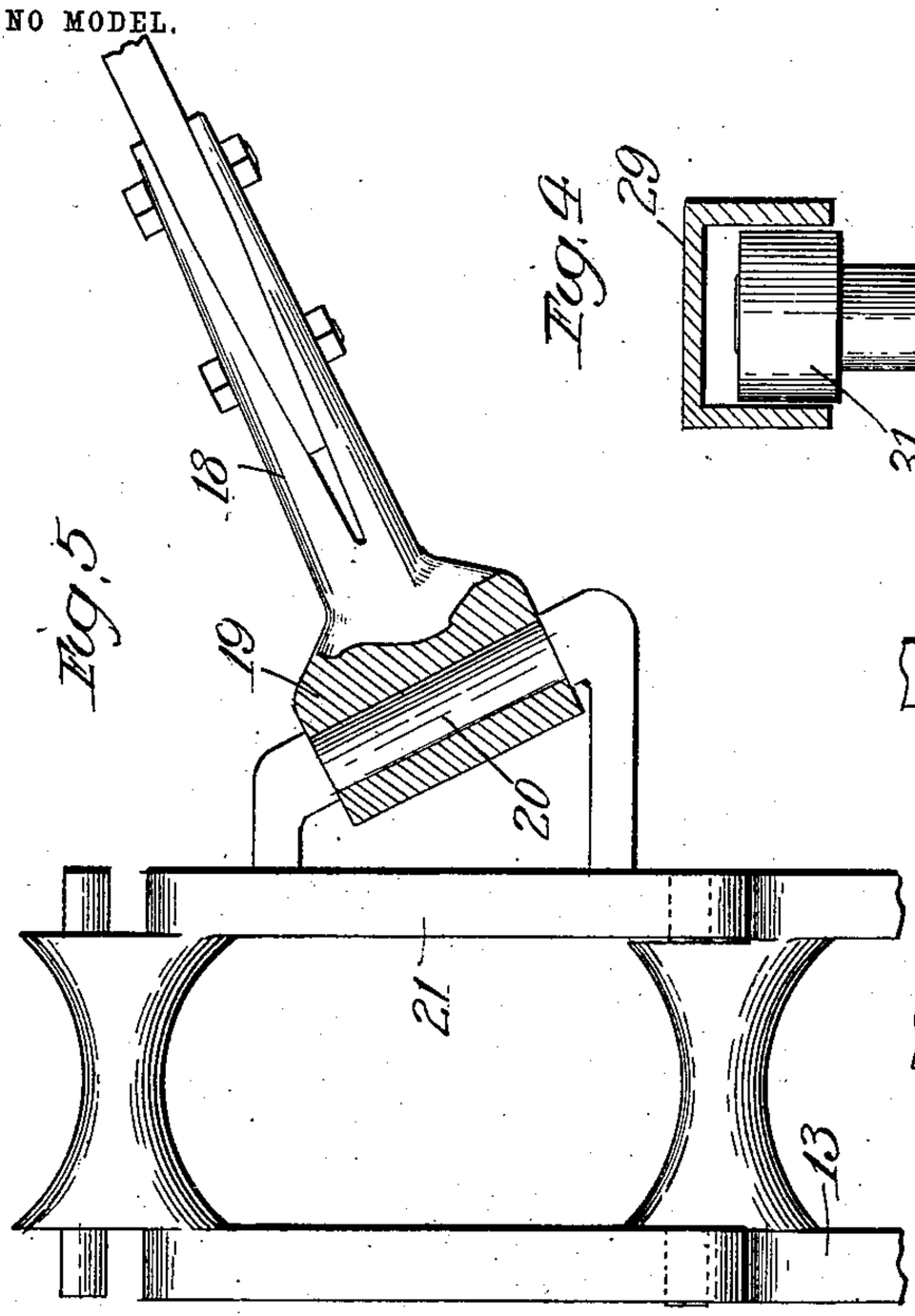

Fig. 6

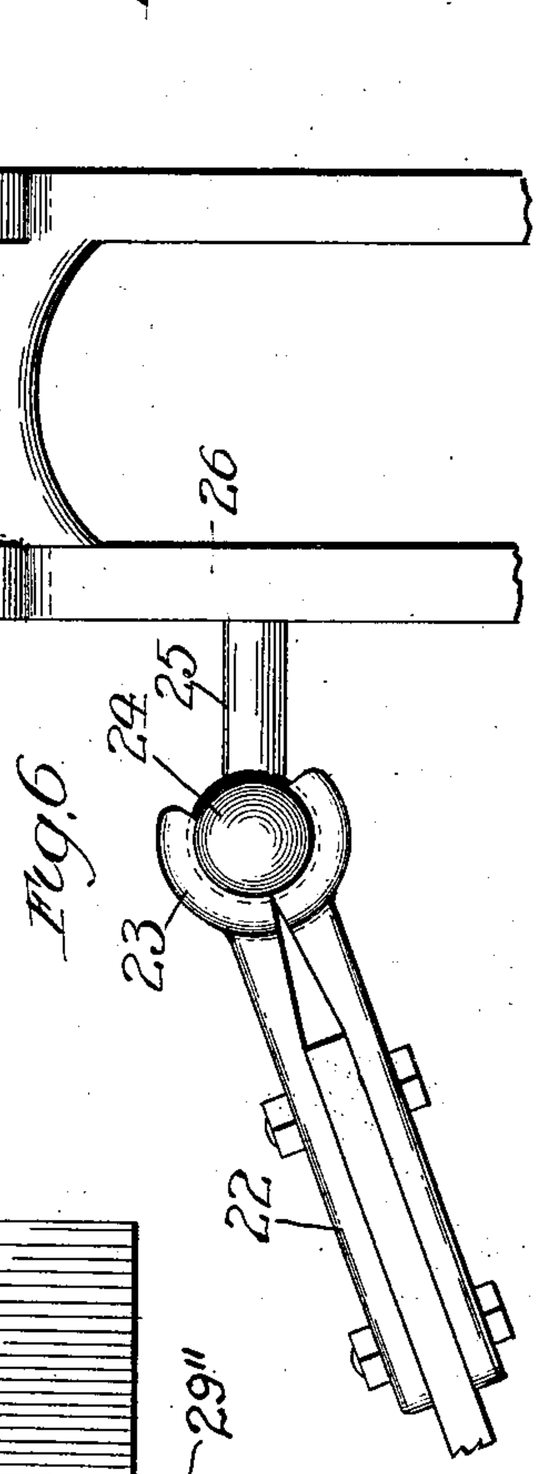

Fig. 3

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APPLICATION FILED JAN. 13, 1903.

NO MODEL. 3 SHEETS—SHEET 3.

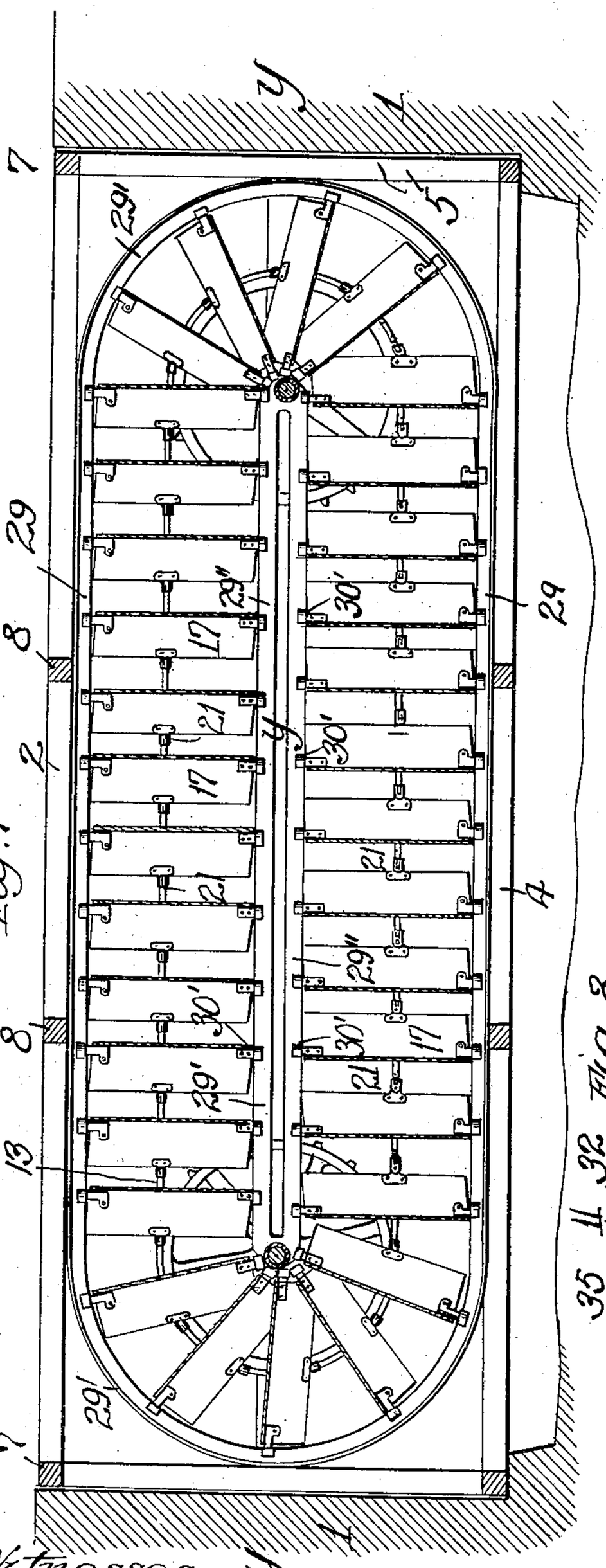

Fig. 7

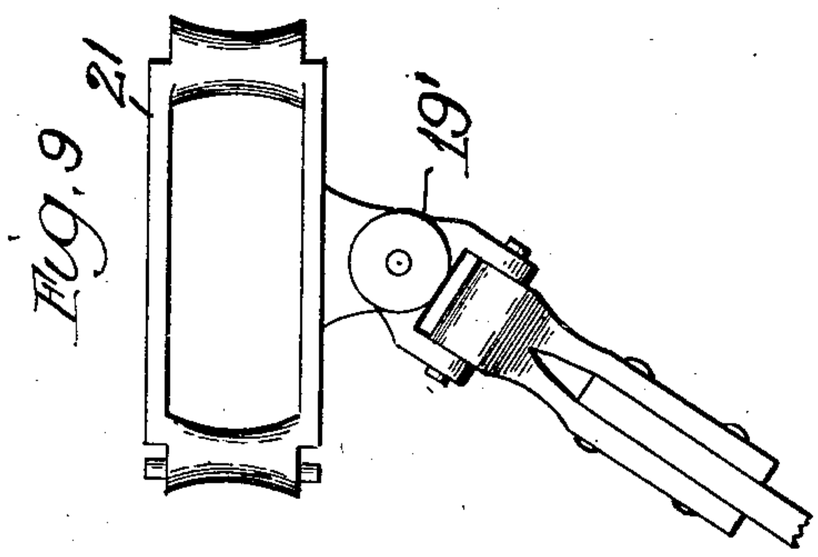

Fig. 9

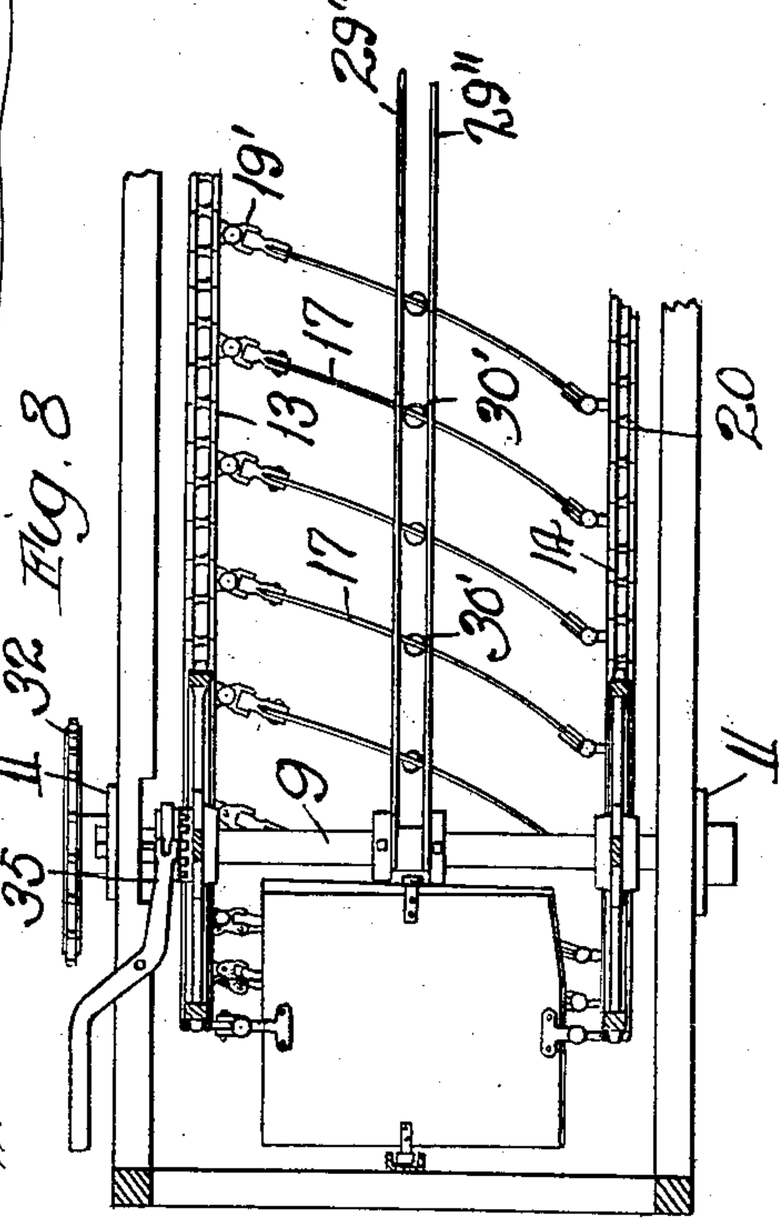

Fig. 8

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No. 742,529. Patented October 27, 1903.

UNITED STATES PATENT OFFICE.

WILLIAM H. TRENCHARD AND FRANK HEATH, OF JAMUL, CALIFORNIA.

CURRENT WATER-MOTOR.

SPECIFICATION forming part of Letters Patent No. 742,529, dated October 27, 1903.

Application filed January 13, 1903. Serial No. 138,871. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM H. TRENCHARD and FRANK HEATH, of Jamul, in the county of San Diego and State of California, have invented a certain new, useful, and Improved Current Water-Motor, of which the following is a specification.

Our invention relates to current-motors by which power is obtained from running streams and from tide-currents.

The object of the invention is to provide a simple, durable, and efficient current water-motor by means of which the maximum of power may be obtained without dams or reservoirs from running streams, rivers, or tide-waters.

A special object of the invention is to improve and cheapen the construction of current-motors, and also to increase the area of the surfaces exposed to the propelling action of the moving water.

Still another object of our invention is to provide a current water-motor which shall be reversible and which may be reversed by a very simple readjustment of its parts.

Our invention consists, primarily, in a motor of the belt type having vanes or blades which occupy substantially vertical planes, but which are pivoted or secured horizontally upon the carrying-belts.

Our invention further consists in a current water-motor comprising parallel belts arranged upon pulleys having horizontal axes in combination with a plurality of regularly-spaced vanes or blades disposed angularly between said belts, whereby movement is imparted to said belts by the flowing water.

Our invention further consists in a current-motor of the class described which is provided with external blade-guides and which is, preferably, also provided with internal guides for the blades; and, further, our invention consists in a current water-motor of the class described wherein the carrying and connecting belt on one side of the machine is movable with relation to the other for the purpose of reversing the position of the blades or adjusting the angularity thereof to reverse or stop the motor; and, further, our invention consists in various details of construction, and in combination of parts, all as hereinafter described, and particularly pointed out in the claims.

The invention will be more readily understood by reference to the accompanying drawings, forming a part of this specification, and in which—

Figure 1 is a rear elevation of a current water-motor embodying our invention. Fig. 2 is a plan view thereof. Fig. 3 is an enlarged view of one of the blades, showing the guide therefor and also the belts in cross-section. Fig. 4 is an enlarged sectional detail of the peripheral guide. Fig. 5 is an enlarged detail of the attachment at the forward end of the blade. Fig. 6 is a similar detail of the attachment between the rear or downstream end of a blade and the belt. Fig. 7 is a vertical section substantially on the line $x\,x$ of Fig. 2. Fig. 8 is a horizontal section substantially on the line $y\,y$ of Fig. 7, and Fig. 9 is a detail of the reversible clip or attachment of one of the blades.

As shown in the drawings, our water-motor is intended to be lowered and used below the surface of the running stream. We prefer to hold the motor in place by masonry 1; but any suitable anchorage may be employed. The mechanism has a long box-like frame composed of the main timbers 2 2, 3 3, and 4 4, which extend across the stream and which are joined by the vertical beams 5 5 5 5 and 6 6 6 6 and the horizontal beams 7 7 7 7 and 8 8 8 8. These do not materially obstruct the flow of water and do provide a strong frame for the rotating members of the mechanism, which frame may be bodily raised to the surface by suitable means (not shown) whenever necessary, as for the purposes of repair.

9 and 10 are the main shafts of the motor. These are held in suitable bearings 11 and 12, respectively, on the forward and rear middle timbers 3 3 of the frame. The bearings 12 are made adjustable, as shown, for taking up of slack in the belts 13 and 14, which carry the vanes or blades. These belts are endless sprocket-chains and are carried by the large sprocket wheels or pulleys 15 15 and 16 16, provided upon the shafts 9 and 10, respectively. The sprockets 15 are secured to the shaft 9, while the sprockets 16 may be loose upon the shaft 10, though we prefer to

key them also. The blades 17 are hung between the belts 13 and 14 and in height are slightly less than twice the radius of the sprocket-pulleys 15—that is, the blades extend both above and below the horizontal plane of the fore and aft belts to which they are connected. The blades are arranged obliquely and are curved in practice even more than indicated in the drawings. Both sprocket-belts are provided with regularly-spaced specially-formed links for connection with the blades. The blades are made of sheet metal and upon their forward edges are provided with the clips 18, riveted or bolted thereto, and each provided with an eye or cross-sleeve 19, that is journaled on the angular pin 20. This pin 20 may be an integral part of the special sprocket-link 21. The angle of the pin conforms to the obliquity of the blade, and the pivotal attachment being in a horizontal plane serves to prevent the twisting of the blade upon the belt or between the fore and aft belts. The rear connection for each blade comprises a two-part clip 22, fastened to the rear edge of the blade and constituting a ball-socket 23, that is journaled on the ball 24, which with its shank 25 is an integral part of the special link 26. This ball or universal-joint connection is rendered necessary by the relative twist or torsion imparted to the blade as it passes around the pulleys 15 and 16. This torsion is due to the fact that the forward end of the blade starts downward over the pulley 15 or upward over the pulley 16 in advance of the rear end of the blade because of the oblique position of the blade. For the same reason it is sometimes necessary to cut away one or more corners 17′ of each blade to prevent the interference of the blade with one another or the wheels while making the turn.

27 27 represent idler-sprockets secured upon the inner sides of the beams 6 and which prevent the sagging of the upper and lower legs of the belts and also assist in preventing lateral motion of the belt, due to the pressure of the water against the blades.

28 28 are smooth pulleys which hold the belts upon the idlers 27.

It is necessary to further counteract the tendency of the current to displace the blades and belts. For this purpose we employ the peripheral guide 29, which entirely surrounds the mechanism and engages with lugs that extend from the outer edges of the blades. This guide comprises a metal channel, (see Figs. 3 and 4,) which is secured within the frame of the motor, and the lugs upon the blades are constituted by the clips 30, each of which is provided with an antifriction-roller 31 to roll between the sides of the channel-guide. To accommodate the twisting movement of the blades as they turn around the pulley-shafts, it is necessary to curve the ends 29′ of the guide, as shown in Fig. 2, whereby the blades are properly reinforced throughout their entire circuit. In addition to the external or peripheral blade-guide we preferably employ an internal guide 29″, which extends between and is supported upon the shafts 9 and 10 and takes the thrust of the inner lugs 30′ of the blades. It is obvious that these two guides prevent longitudinal movement of the blades and relieve the sprocket-belt from lateral strain.

32 represents the power-transmitting sprocket provided on the shaft 9 and from which a belt 33 extends to a power-shaft conveniently located above the surface of the river.

Our motors may be arranged in series across the river or tide current, or the same may be arranged one above the other with respect to the current-flow.

While we have described our motor as though operated by a current flowing constantly in one direction, it should be noted that it is adapted for reversal and will reverse automatically when the direction of flow is altered, as in the case of ebb and flood tides. When the current reverses, the motor operates with slightly less power proportionally by reason of the somewhat less effective curve that each blade presents to the current, the blades being as a rule stiff and inflexible. Such construction is, in fact, preferable for river-motors; but where the motors are to be used in tide-waters the blades are preferably made light, so that the return-tide flow will buckle or reverse the same, in which case the curve of the blades will be the same for both directions, and the motor will be as efficient during the ebb flow as in the flood tide, or instead of employing light blades and relying upon the automatic flexing thereof we sometimes connect the forward wheel or wheels to the shaft 9 by a clutch 35, the movable portion of which is keyed to the shaft. When this clutch is thrown out, the forward belt and wheels may be turned with relation to the rear belt to reverse the positions of the blades. The clutch is then replaced and thereafter the current-motor will rotate in the other direction. This construction of the motor renders it necessary to swivel the forward ends of the blades upon the belt-links, and in such cases we prefer to employ the universal connection or swivel 19′, (detailed in Fig. 9.) A particular advantage possessed by the motor in this form is that the motor lends itself to the regulation by adjustment of the angularity of its blades and may also be stopped by the throwing of the blades into middle or straight positions. Suitable means may be employed for shifting the forward belt automatically or manually, and we believe that this form of regulation and control best adapt the motor for all tide-water uses.

It is obvious that various modifications of our invention will readily suggest themselves to one skilled in the art, and we therefore do not confine the invention to the specific constructions herein shown and described.

Having thus described our invention, we claim as new and desire to secure by Letters Patent—

1. In a current water-motor, the fore and aft belts, in combination with the pulleys and shafts therefor, suitably supported, and the blades swung obliquely between said belts; substantially as described.

2. In a current water-motor, the fore and aft belts, the pulleys and the shafts therefor, in combination with the blades extending obliquely between corresponding legs of said belts and pivotally joined thereto; substantially as described.

3. In a current water-motor, the belts arranged in parallel vertical planes, in combination with the pulleys and shafts therefor, carrying said belts, a suitable frame and the blades arranged between said belts, extending above and below the same and obliquely pivoted thereto; substantially as described.

4. In a current water-motor, the belts arranged in parallel vertical planes, in combination with the pulleys and shafts therefor, supporting said belts, the equidistant blades obliquely arranged between opposite legs of said belts and a peripheral guide for said blades; substantially as described.

5. In a current water-motor, the belts arranged in parallel vertical planes, in combination with the pulleys and shafts, supporting said belts, the equidistant blades obliquely arranged between opposite legs of said belts, the peripheral guide and the inner guide for said blades; substantially as described.

6. In a current water-motor, the vertically-arranged parallel belts, in combination with the horizontal shaft and the belt-pulleys thereon, idler and holding pulleys for said belts and the obliquely-arranged regularly-spaced blades having their ends attached to said belts; substantially as described.

7. In a current water-motor, the parallel belts and the pulleys and shafts therefor, in combination with the oblique curved blades, each provided with universal-joint pivots connecting it to said belts; substantially as described.

8. In a current water-motor, the parallel vertical belts and the pulleys and shafts therefor, in combination with the oblique horizontal blades pivotally arranged between the opposite legs of said belts, the peripheral lugs on said blades and the peripheral guide therefor, curved at its ends; as and for the purpose specified.

9. In a current water-motor, the parallel vertical belts and the supporting pulleys and shafts therefor, in combination with the flexible metal blades obliquely pivoted between opposite legs of said belts; as and for the purpose specified.

10. In a current water-motor, the belts arranged in parallel vertical planes upon suitable carrying-wheels and shafts, in combination, with the flexible blades, the universal joints between said blades and belts, means resisting the longitudinal movement of said blades and mechanism for relatively adjusting said belts to stop or reverse the motor; substantially as described.

11. In a current water-motor, the parallel belts, the wheels and shafts thereof and a suitable frame, in combination with the peripheral guides and the inner guides provided in said frame and the blades, normally oblique, pivotally attached to said belts and held against longitudinal movement by said guides; substantially as described.

12. In a current water-motor, the frame, in combination with the shafts journaled therein, the belt-wheels on said shafts, the parallel belts, a clutch connecting one of said wheels and belts with its shaft and the equidistant oblique, flexible blades arranged between said belts and angularly adjustable by relative movement of the belts; substantially as described.

13. In a current water-motor, the combination, with the fore and aft vertical belts, the horizontal shafts, the belt-pulleys arranged thereon, a suitable frame, the metal blades having their corners cut away as described and the universal belt-pivots for said blades; substantially as described.

14. In a current water-motor, the belts 13 and 14 and the pulleys and shafts therefor, suitably supported, in combination, with the oblique blades 17, the pivots therefor on said belt 13 and the ball-pivots 24 therefor, provided on the belt 14; substantially as described.

15. The current-water-motor blade comprising a sheet-metal plate 17 suitably curved, in combination with the ball-socket clip, the eye-clip and the guide-lug clips; substantially as described.

16. In a current water-motor, the combination, of the frame, with the shafts 9 and 10 journaled therein, the pulleys 15 and 16 on said shafts, the sprocket-belts 13 and 14 provided with special pivot-links, the metal channel peripheral guide 29 and the oblique blades having antifriction-lugs engaged with said guide and having pivot-clips engaged with said special links; substantially as described.

In witness whereof we have hereunto set our hands this 6th day of November, 1902.

W. H. TRENCHARD.
FRANK HEATH.

In presence of—
LEROY A. WRIGHT,
M. SCHAFFNET.