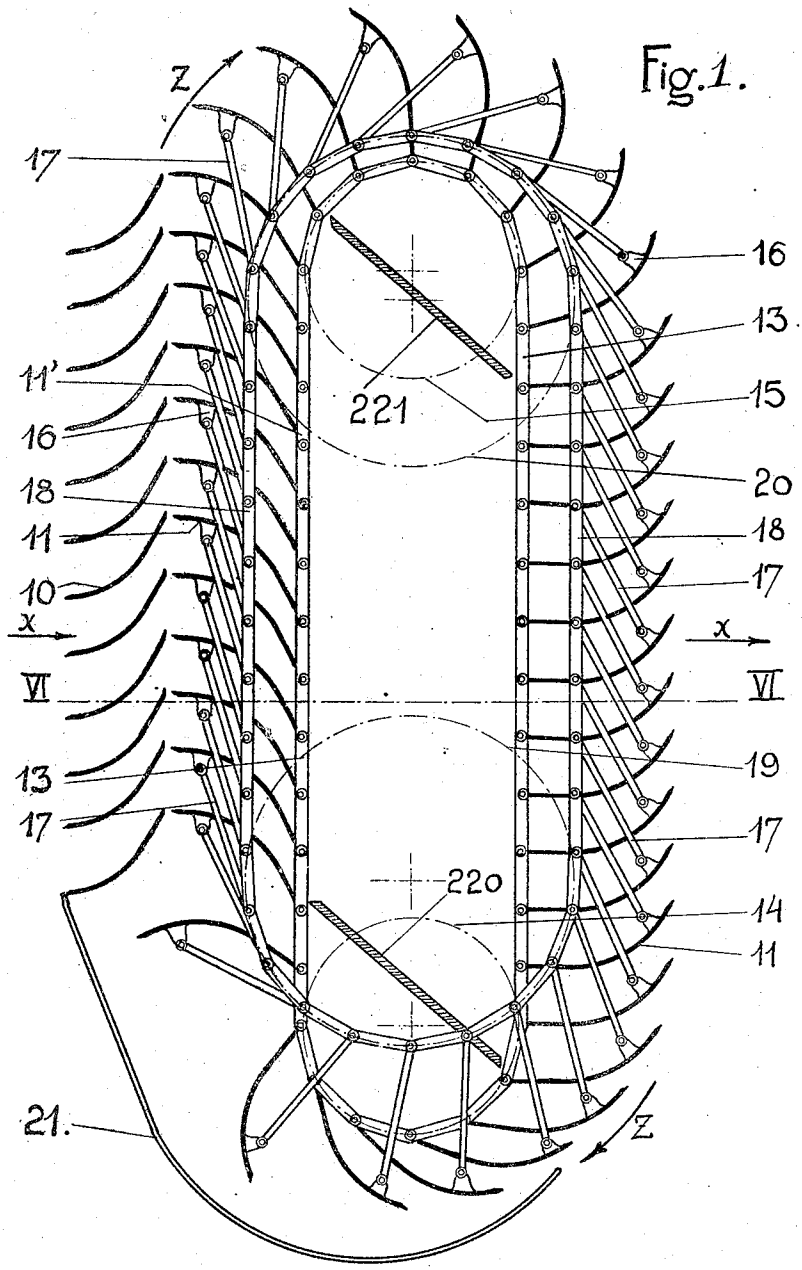
Jan. 22 , 1924. 1,481,397

A. TETETLENI

CHAIN TURBINE

Filed Sept. 30. 1921 4 Sheets-Sheet 1

Fig.1.




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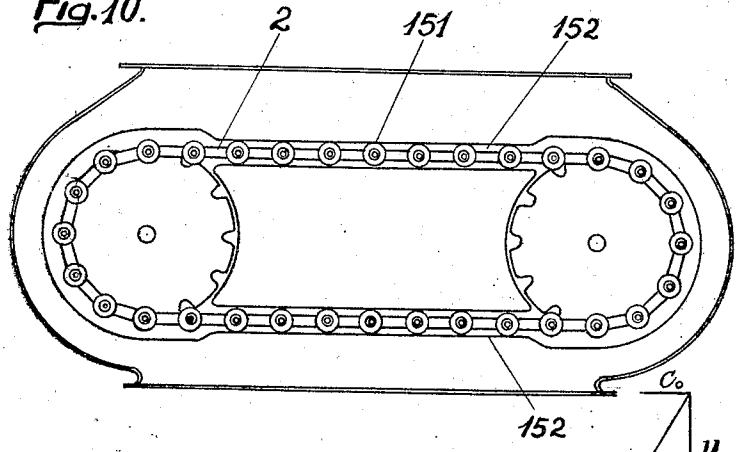
Jan. 22, 1924. 1,481,397

A. TETÉTLENI

CHAIN TURBINE

Filed Sept. 30, 1921 4 Sheets-Sheet 2

Fig. 10.



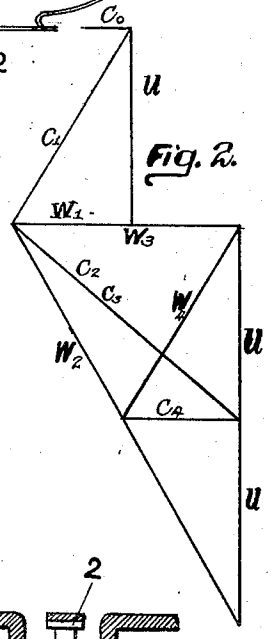




Fig. 2.

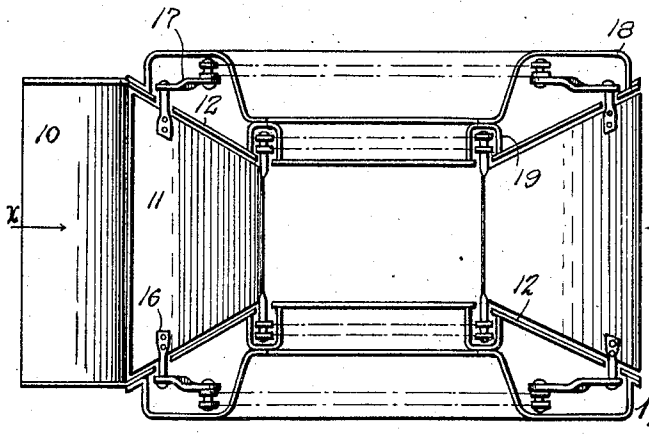



Fig. 3.

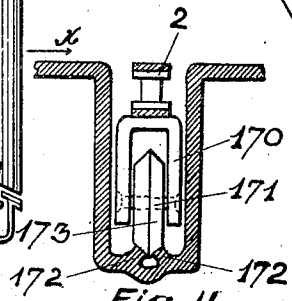



Fig. 11.

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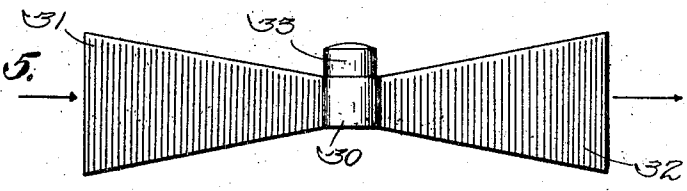
Jan. 22, 1924. 1,481,397

A. TETÉTLENI

CHAIN TURBINE

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Fig. 5.



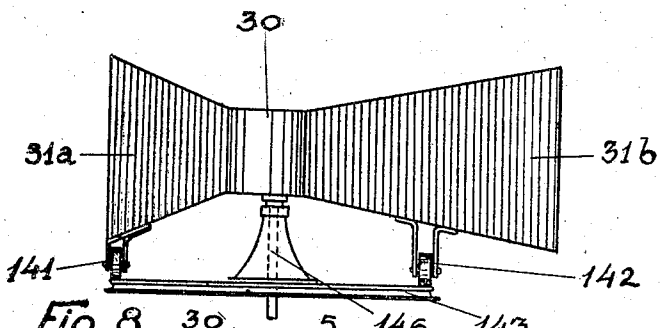




Fig. 8.

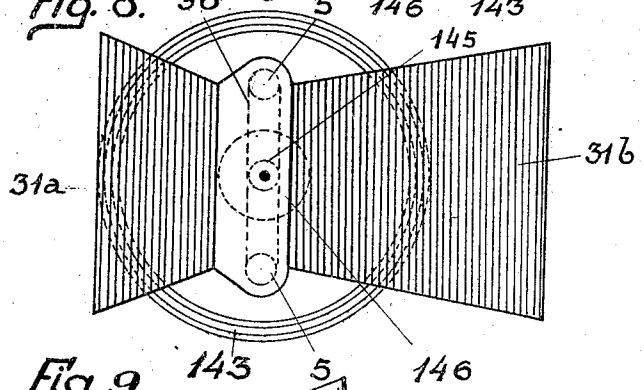



Fig. 9.

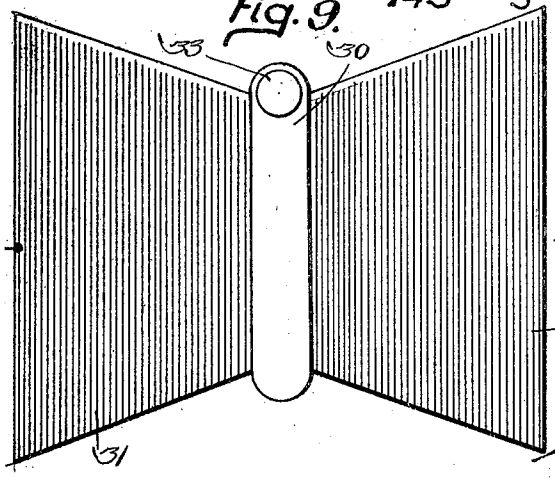



Fig. 4.

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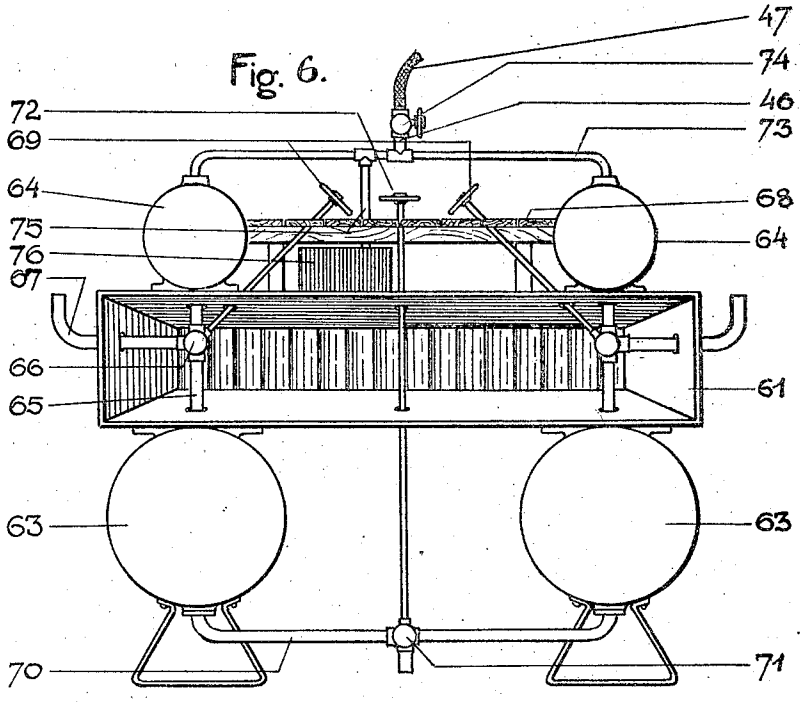
Jan. 22, 1924. 1,481,397

A. TETÉTLENI

CHAIN TURBINE

Filed Sept. 30, 1921 4 Sheets-Sheet 4

Fig. 6.



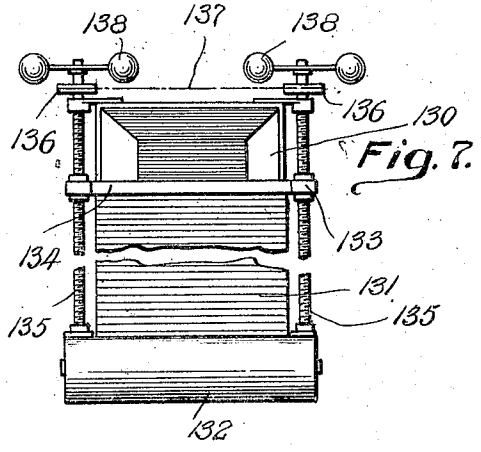




Fig. 7.

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Patented Jan. 22, 1924. 1,481,397

# UNITED STATES PATENT OFFICE.

ARMIN TETÉTLENI, OF BUDAPEST, HUNGARY.

## CHAIN TURBINE.

Application filed September 30, 1921. Serial No. 504,459.

*To all whom it may concern:*

Be it known that I, ARMIN TETÉTLENI, residing at Jozsef-ter 10, in the city of Budapest V., Hungary, and a citizen of Hungary, have invented certain new and useful Improvements in Chain Turbines, of which the following is a specification.

This invention is a structural arrangement by which the velocity of flowing fluids, such as water, air, etc., may be exploited with respect to power.

The basic principle of the invention is the provision of turbine blades carried by an endless chain or chains, which blades, in connection with co-operating guide members, are supported in such manner that the spaces between the blades on both parallel chain sections are smaller at the outflow than at the inflow.

According to another execution of the invention, the turbine is placed in the smallest cross-section of a channel, similar to a Venturi tube.

Finally, the invention extends to the means for connecting floats to the hydraulic motor, whereby the latter may be be elevated out of the water; to the means for regulating and turning off the turbine; and to the serviceable development of the chain guide.

The accompanying illustrations show various possible executions of the invention. Briefly described;

Figure 1 is a horizontal cross-section of an action and re-action turbine;

Figure 2 is a diagram of the velocity ratios of the device of Fig. 1;

Figure 3 is a vertical section on the line VI—VI of Fig. 1;

Figure 4 is a top plan view of a chain turbine placed in a guide-channel which is narrowed toward the center;

Figure 5 is a view in side elevation of the device of Fig. 4;

Figure 6 is a view in front elevation of a submerged chain-turbine, showing, more particularly, means in operative relation thereto for raising the turbine out of the water;

Figure 7 is a view in front elevation of a turbine, showing, more particularly, a revolving-shutter, and shutter-regulating means;

Figures 8 and 9 are views, in side elevation and top plan, respectively, of a device moving on circular rails, furnished with asymmetrical Venturi tube system;

Figure 10 is a longitudinal, vertical, sectional view of certain parts of the turbine, showing, more particularly, a chain-guide for a turbine having horizontal axis;

Figure 11 is a fragmentary sectional detail view of the form of chain-guide for turbines with vertical axes.

Referring, now, in detail, to the drawings,

The chain turbine shown in Figs. 1 to 3 is a turbine with a double flow of water, the first stage being a reaction- and the second stage an action- turbine. As shown, the water flows toward the guide-blades 10, as indicated by the left hand arrow $x$, passes through the guide-blades, and, after leaving the same, strikes the movable blades 11, which are shaped like the blades of reaction turbines. The blades move as shown in Fig. 3, in a channel which is narrowed toward the middle 12, the ratio of its largest and smallest cross-section being the same as that of the largest and smallest of the spaces between the blades. Passing out from between this row of movable blades, the water (without the interposition of other guide-blades) strikes the second row of movable blades. This second row of movable blades also moves in a channel of which the cross section increases in the above indicated ratio toward the edge lying in the direction of the down-current. As this increase just balances the decrease of the space between the blades, the functioning of this row of blades is equivalent to the row of an action turbine or limit turbine. The velocity ratios of these turbines are shown in Fig. 2. The water flowing in the direction of the arrow $x$ enters the guide-blades with the velocity $c_0$ and passes out with the velocity $c_1$. If from this velocity $c_1$ the translation velocity $u$ at the movable blade row be vectorially deducted from the movable blade row, the relative velocity $w_1$ of the water entering the movable blades will be obtained. Here the velocity of the water will be increased to the relative velocity $w_2$, the ratio of the latter to $w_1$ being (in consequence of the above-mentioned narrowing of the cross-section of the channel) the same as that of the square of the space between the blades at the entrance point to the square of this space at the point of exit.

If, to this velocity $w_2$, the velocity $u$ be added by vector addition, the absolute velocity $c_2$ of the water passing out will be obtained. As there is no second arrangement of guide-blades, the absolute velocity $c_3$ of the water entering the second row of movable blades agrees perfectly with the $c_2$ of the rate and direction. From this, it is possible to obtain, by vectorial subtraction of the translation velocity $u$ of the movable blades, the relative velocity $w_3$ of the water entering the second row of blades. Between these blades, which function in the manner of action-turbine blades and limit-turbine blades, only the water direction is changed, but not the relative velocity. Therefore, if the relative velocity $w_3$ is plotted with unchanged, but in the direction of the exit tangent of the curve of the blade, we get the relative velocity $w_4$ of the water leaving the turbine, and from this, by vector addition of the translation velocity $u$, the absolute velocity $c_4$ of the water leaving the turbine. This latter velocity agrees with the absolute entrance velocity $c_0$ with relation to rate and direction.

From this, it may be seen that, in this chain-turbine, the blades of the second row do not rotate at an angle of 180°, but at a much smaller angle, which, under certain circumstances, may even be below 90°. This makes it necessary for the blades to rotate at a much greater angle than 180°,—the angle may even be 270° when passing from the down-stream row to the up-stream row. This lack of symmetry in the blade's angle of rotation may, according to the invention, be accomplished as follows: Instead of using one set of chains for guiding the blades, two sets are used, the length and number of links (also the total lengths of the chains) being exactly the same. These chains, as shown in Fig. 3, are arranged at different levels. The inner edges 11′ of the blades are fastened by hinges to the chain 13, which passes around wheels 14, 15. The ears 16 of the blades, near the other or free edge, are loosely or pivotally connected by means of the rods 17 to the outer chain, which passes around the chain-wheels 19, 20. These wheels have a larger diameter than the wheels 14 and 15. It is understood that, between the chain-wheels 14 and 19, or 15 and 20, suitable gearing is inserted to ensure the same circumferential velocity for both sets of chains. Thus, the relative position of both of the centers of rotation of every blade remains unchanged as long as the chains are moving in a straight line; therefore, their movement through this section is translatory. Now, the inner set of chains and wheels is so placed that one of the smaller chain wheels is inside the chain wheel 20; the result of which is (as the length of the chain is the same) that the smaller of the chain-wheels projects beyond the larger adjacent chain-wheel. The result of this again is that, when the chains rotate, as indicated by the arrow $z$, the circumference centers of wheel 20 are slower than of wheel 15, as they traverse a longer distance at the same rate of speed. From this, it follows that, while traversing the distance from the left side of the figure to the right side of the same, the blades revolve around an angle that is smaller than 180°. From the fact that the circumference velocities agree, it follows that the blades (while traversing the distance from the right side to the left side of the figure with the aid of the chain-wheels 19 and 14) revolve around an angle which, combined with the one formerly mentioned, is 360°. With regard to the size of these angles, the limits at command may be of considerable extent, if a suitable selection is made of the distance between the centers of rotation of the blades, also of the angle embracing the straight line which is described by the blades with the blade brace. At this point, a casing is attached to protect the blades which are worked against the current.

According to the execution of the invention shown in Figs. 4 and 5, these turbines are placed in the narrowest cross-section of a channel shaped like a Venturi tube (or a similar tube-like arrangement). In the illustration, the chain-turbine itself is indicated by 30. The water is conducted to the chain turbine by the collector-tube 31, and leaves the same by means of the diffuser tube 32. The closed case indicated by 33 is the engine installed for the purpose of converting the energy generated by the turbine (dynamo, compressor, etc.) This arrangement makes it possible to make exploitable, by means of the turbine, a portion of the cross-section of the flow which is much greater than its own cross-section of passage.

The turbine of the invention may be used for all flowing water, for small brooks, as well as streams and rivers, for ocean currents and other flowing water. When used in small streams, the turbine may, in certain cases, be permanently installed, but so that it may be raised, after the manner of a sluice, by damming the stream. In this case, a raising device operated either by man power or by hydraulic or electrical means may be employed for the work of lifting it out of the water. The possibility of lifting out the turbine facilitates the cleaning of the same considerably, and also facilitates the execution of repairs that may be necessary from time to time. It furthermore clears the stream for the purpose of floating logs. In larger streams or rivers with a current sufficiently strong, the device is installed on anchored floats. The conducting of the generated energy to the place of consump-

tion can be accomplished by electric or pneumatic means, in which case the cables or pipe conduits, as the case may be, which conduct the power from the generator (or compressor) which is attached to the turbine, are laid along the anchor ropes; or the anchor ropes may themselves be used for this purpose, by employing electric cables or flexible tubing. In places where the direction of the current changes frequently, the lower ends of the anchor ropes should be fastened at one articulated point to the river bed. Fig. 6 shows an installation mounted on floats. This installation may be lifted out of the water for cleaning, or for the execution of repairs. For this purpose, the turbine case 61, that is, the guide-channel, is provided with two sets of floats 63, 64. The lower ones, 63, are made large enough so that, when filled with air, the whole construction is kept at the surface of the water, with the turbine-chamber itself above the water line; while the smaller upper floats 64 maintain the installation in a certain position below the surface. Accordingly, if both sets of floats are filled with water, the whole installation sinks to the bottom of the river. If the water is removed from the upper set of floats, the installation rises to the working position, and, if the water is evacuated from the lower set of floats, also, then the guide-channel and motor-chamber rise completely out of the water, and only a portion of the lower float remains beneath the surface. These operations can be executed in various ways. However, it will be advisable, according to the invention, to make use of the following arrangement for the purpose. The floats of the upper set are connected by tubes 65 with the lower set. A three-way stop-cock, or the like, is attached to the tube at point 66. The third branch 67 of this stop cock connects with the water outside. The cocks can be adjusted by means of the handle or wheel 69 which may be reached from the platform 68. The lower floats 63 are connected with the outlet cock 71 by means of tubes 70. The outlet cock can also be adjusted from the platform 68 by means of a handle or wheel. The upper floats 64 are connected with one another by the pipe 73. The extension piece 46 of the latter is furnished at this point with the cock 74. Tube 75 connects tube 73 with an air pump 76 driven by the turbine. When the arrangement is in readiness for operation, all the cocks are closed. Now, if it is desired to raise the arrangement for cleaning purposes, or for the execution of repairs, then the pump 76 is operated so as to force air into the upper floats. When the pressure is sufficient (the amount necessary being easily calculated) then the cocks 66 must slowly be brought into a position which will connect the upper floats with the lower floats, and the cock 71 is opened. In this way, the compressed air will pass from the upper floats to the lower floats, forcing the water in the latter through tube 70 and out through cock 71, whereupon the turbine proper rises above the water-line and the necessary work of cleaning or repairing can be undertaken.

Now, when the arrangement is once more to be submerged to its normal working position, the cocks 66 must again be so adjusted as to connect the lower floats with the atmosphere. In this case, the air passes out through the cocks 66 and tubes 67, and water passes in through cock 71, filling the lower floats. But none can pass into the upper ones, because of the position of the cocks 66. Thus, the arrangement assumes its normal working position without any further adjustment. If, on the other hand, it is desired to sink the arrangement to the bottom of the river, then the cocks 66 must be so adjusted as to connect the upper floats with tubes 67, and, in this way, with the water outside. The cock 74 is then opened, and the upper floats will fill with water through tubes 67, and the air in the floats will escape through a buoy. When lifting the arrangement out of water, the opposite process takes place. Air is forced into the floats through the buoy and tube 47, and the water thus forced out of the floats escapes through tubes 67.

The centrifugal regulators (which are furnished with a suitable servo-motor) are generally used. If, used as a wind motor, the wind velocity can be used in place of the motor velocity for regulating purposes. The following arrangement is an example of this (Fig. 7). The turbine, or the opening 130 of the Venturi tube of the turbine, is fitted with a revolving shutter 131 arranged to roll upon a cylinder. The latter is inside a box 132, and is fitted with a spring which is arranged so that it is constantly endeavouring to roll up the revolving shutter. Both edges of the end of the revolving shutter are fitted with screw nuts 133, which are connected by a cleat 134. These nuts run on a screw 135 with steep threads. The chain wheels 136 which are connected by chain 137 are fastened with wedges to the screw spindle of the screws, in order to ensure the same twist for both screws. A wind wheel 138 is attached at the end of one or both screw spindles, in this case a Robinson wheel. The arrangement works as follows: When the wind is normal, the wind-wheels are still, and the revolving shutter is in the lowest position. If the velocity of the wind increases, then the wind-wheels overcome the resistance of the springs of the revolving shutter, and, by means of the screws which engage the nuts 133, raise the revolving shutter until the constantly extending spring

of the shutter balances the pressure of the wind against the wind-wheels. Thus, as the wind increases, the revolving shutter rises higher and higher, and the inlet opening is gradually narrowed. In case of a strong wind, such as would be dangerous for the turbine, the opening closes completely. Of course, it is possible to insert some well-known retarding gear between the wind wheel 138 and the screw 135, which would permit the use of smaller wind-wheels.

Where the current direction of the medium is variable (for instance, in the case of atmospheric air-currents), devices are used which turn the turbine automatically in the direction of the current. The wind vane and the little auxiliary wind-wheel are devices of this kind, and are familiar by reason of the wind motor. But an invention shown in Figs. 8 and 9 can also be used for this purpose. It is well known that the inflow section of a Venturi tube through which the fluid always passes in the same manner, is often shaped like a cone with a large opening, and is, therefore, shorter than the outflow section of the same. The reason of this is that the converging of the inflowing portion of the medium can be accomplished through a shorter tube section, whereas, with the outflowing portion of the medium, a certain opening angle may not be exceeded, as, otherwise, the jet of fluid will be separated from the sides of the tube. According to the invention, this asymmetric execution may also at the same time be used for adjusting the device to the direction of the wind. In Figs. 8 and 9. 30 is the turbine casing, to which the shorter tube piece $31^a$ and the longer tube piece $31^b$ are attached. The latter rest on the circular rails, by means of the wheels 141, 142. In addition to the two outer chain wheels 5, 5, there is a third chain wheel in the lower part of the turbine. This chain wheel is fastened by means of wedges to the main axis 146. A downward extension of the latter, into the turbine box, could be made to drive the generator, and would, at the same time, be the axis of rotation for the device running on the circular rails. Now, if the direction of the flowing liquid is changed, the device will always adjust itself so that the shorter of the funnel-shaped tubes $31^a$ will be turned to windward, because the funnel $31^b$ takes the place of the vane. In place of the circular rails, a simple axis of any other arrangement running in a circle may be employed.

Fig. 11 shows a chain-guide arrangement which makes possible the supporting of the chain not only against the forces acting with the direction of the current, but, also, those acting vertically with relation to it. This arrangement can, therefore, also be used for turbines with a vertical axis. The supporting of the chain is accomplished as follows: The journals of chain 2 are provided with forks 170. Around the journal 171 of the forks, rollers, shaped conically at both ends are revolubly attached.

Of course, the invention itself would be in nowise changed should the guide-rollers not be attached to every link in the chain, but, instead, for instance, only to every second or third link.

Various modifications, especially in detail, may be made in my invention, within the scope of the appended claims, without departing from the spirit of the invention, or necessarily sacrificing any of its advantages.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a chain-turbine, an endless chain supported for movement in two reversely-moving parallel sections, spaced turbine-blades pivotally connected to said chain and forming two parallel rows, and means secured to said turbine-blades toward their free ends for supporting them so that the space between the blades on both chain-sections is smaller at the outflow than at the inflow.

2. In a chain-turbine, an endless chain supported for movement in two reversely-moving parallel sections, spaced turbine-blades pivotally connected to said chain and forming two parallel rows, a steering-chain, and connections between said steering-chain and said turbine-blades.

3. In a chain-turbine, an endless chain supported for movement in two reversely-moving parallel sections, spaced turbine-blades pivotally connected to said chain and forming two parallel rows, a steering-chain of the same length as the turbine-blade carrying chain, end wheels around which said steering-chain passes, connections between said steering-chain and said turbine-blades, and end-wheels around which said turbine-blade carrying chain passes and of larger diameter than said first-mentioned end wheels.

4. In a chain-turbine, an endless chain supported for movement in two reversely-moving parallel sections, spaced turbine-blades carried by said chain and forming two parallel rows, and casing plates disposed over the upper and lower edges of said blades, the upper and lower surfaces of the casing plates limiting the blades converging toward the interior of the chain-turbine, in such manner that the ratio of their broadest and smallest interspace is the same as the largest blade interspace to the smallest, in order that the first row of blades shall function as a reaction turbine and the other row as an action turbine.

5. A chain-turbine according to claim 1,

said chain-turbine being arranged in the smallest cross section of a channel which is narrowed in the middle and then broadens out like a Venturi tube.

6. In a chain-turbine, an endless chain supported for movement in two reversely-moving parallel sections, spaced turbine-blades carried by said chain and forming two parallel rows, casing plates disposed over the upper and lower edges of said blades, and floats connected with said casing plates for submerging and elevating said turbine.

7. In a chain-turbine, an endless chain supported for movement in two reversely-moving parallel sections, spaced turbine-blades carried by said chain and forming two parallel rows, casing plates disposed over the upper and lower edges of said blades, upper floats connected with the top casing-plate, lower floats connected with the bottom casing plate, and an air-pump driven by the chain-turbine for compressing air to force the water out of the lower floats.

8. In a chain-turbine, an endless chain supported for movement in two reversely-moving parallel sections, spaced turbine-blades carried by said chain and forming two parallel rows, said chain-turbine being arranged in the smallest cross section of a channel which is narrowed at the middle and then broadens out after the manner of a Venturi tube, and revolving shutters disposed as regulating devices in front of the inlet of said channel.

9. In a chain-turbine, an endless chain supported for movement in two reversely-moving parallel sections, spaced turbine-blades carried by said chain and forming two parallel rows, said chain-turbine being arranged in the smallest cross section of a channel which is narrowed at the middle and then broadens out after the manner of a Venturi tube, revolving shutters disposed as regulating devices in front of the inlet of said channel, and automatically-actuated, wind-controlled mechanism for operating said shutters.

10. In a chain-turbine, a casing having an inlet and an outlet, an endless chain within said casing, oppositely-disposed end-wheels over which said chain passes, said chain being thereby supported for movement in two reversely-moving parallel sections, said casing being provided with oppositely-disposed longitudinally-extending wedge-shaped recesses, supporting-rollers carried by said chain and having wedge shaped peripheries and moving through said recesses, and spaced turbine-blades carried by said chain and forming two parallel rows.

In testimony whereof I hereunto affix my signature.

ARMIN TETÉTLENI.