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TURBINE HAVING ITS ROTATING SHAFT TRANSVERSE  
TO THE FLOW OF THE CURRENT  
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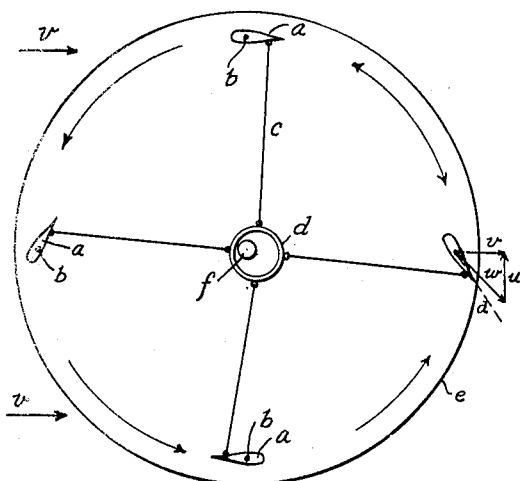


Fig. 1.

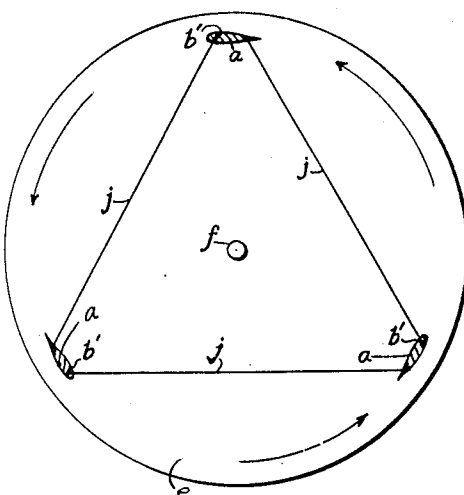


Fig. 2.

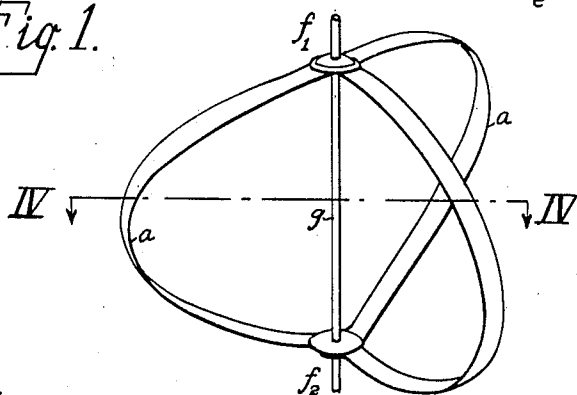


Fig. 3.

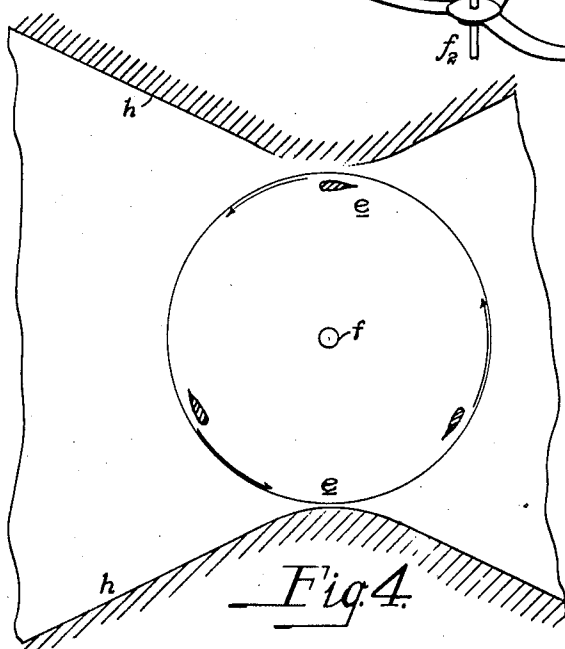


Fig. 4.

Fig. 5.

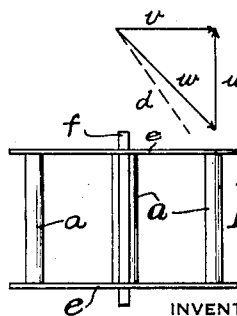


Fig. 6.

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## UNITED STATES PATENT OFFICE

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TURBINE HAVING ITS ROTATING SHAFT TRANSVERSE TO THE FLOW OF THE CURRENT

Application filed October 1, 1926, Serial No. 138,844, and in France October 9, 1925.

Although a considerable number of arrangements have been proposed at different times, particularly for utilizing the force of the wind, which comprise wheels having their shafts transverse to the current, especially vertical shafts, none of these arrangements have been developed for practical use for the following reasons:

1. Their efficiency is as a rule very low, for even when the blades comprising them are not subjected to an adverse effect by the fluid over a part of its course which counteracts the movement, their system of operation in the active part of this course is defective inasmuch as it is inseparable from the formation, down stream of eddies and discontinuities from which the kinetic energy given up to the fluid which has passed through the apparatus, represents an appreciable loss.

2. Their peripheral speed, in almost every case, is at the most equal to that of the wind which entails the provision of large active surfaces and a heavy and costly transmission.

The present invention has for its object a turbine in which the blades which receive the action of the wind always present the same surface to the direction of the relative wind, and furthermore rotate at such a speed that this relative wind only undergoes a limited angular displacement with regard to the tangent of the trajectory of these blades.

It is thus possible to give these blades a stream line section analogous to that of the wings of birds, that is to say, offering the minimum resistance to forward movement and capable of converting into mechanical energy the maximum available amount of energy of the fluid by means of the useful component of the transverse thrust which this section undergoes.

In the particular embodiment illustrated in Fig. 1, the blades *a*, whereof each is pivotally mounted on an axle *b*, are connected with a kinematic device which may consist of the links *c* attached to a common eccentric ring *d* which rotates with the turbine, so that when in rotation, the said blades will oscillate to a moderate degree on either side

of the tangent, with a period equal to that of the rotation. (The axes *b* and *f* may be rigidly positioned in and extend upward from a circular supporting plate *e*.) This inclination thus causes the direction of the blade, irrespective of the leading angle which results in the thrust following the direction of the relative wind, which in turn, is resulting from the absolute speed *v* of the fluid and from the peripheral speed *u* of the blade (see Fig. 5).

Figure 6 is a diminished view in elevation of the preferred embodiment of my invention shown in Figure 2.

My turbine is so constructed as to offer a speed which much exceeds the speed of the current and in this event the ratio  $\frac{U}{V}$  is very great and since the angle between the relative speed *w* and the peripheral speed *u* will in no case exceed the limiting leading angle after which there would be produced a separation of the lines of the current along the profile, I may dispense with the oscillation of the blades and hold them rigidly in position between two supporting discs or plates *e*. The blades *a* may be secured to their supporting disc *e* by any suitable means or method, such as welding or the like.

The blades *a* may be either rectilinear and parallel to the shaft so as to form, when assembled, a cylindrical drum or squirrel cage as shown in Figures 2 and 6, or they may be curved or twisted in the form of a skipping rope substantially a semicircle, in order to reduce or annul the bending stresses due to centrifugal force, as in Fig. 3, where *f*<sup>1</sup> and *f*<sup>2</sup> indicate two hubs suitably attached to the shaft *g* of the turbine. The bearings as well as the transmission devices and means for utilizing the energy do not present any special features, and for the sake of clearness are not shown in the drawings.

In the examples described above the utilization of a fluid current of indefinite dimensions and constant direction, or on the other hand, variable in every direction, has been considered, such as the wind, a river or torrent which is not canalized, rolling or choppy sea, etc.

It is possible, without departing from the scope of the invention, to arrange the above described wheels in channels *h* or tanks of a form suitable for directing the fluid on to the wheel (Fig. 4). Figure 4 shows a diminished top sectional view of the embodiment of my device shown in Figure 2 as properly positioned in the channel *h*. The modern theory of the Lanchester-Prandtl lifting wing allows it to be seen that if the circulation (in a hydrodynamic sense) around each blade retains a constant value but an opposite direction for each of the half-circles which separate the points *e*, the utilization of all the stream lines of the fluid is complete with the exception of course of the friction losses due in particular to the resistance of the blade section and the losses due to leakage through the gaps.

A turbine of this kind, in consequence of its high specific velocity and its simplicity is particularly adapted for utilizing the tides or rivers with a low fall, especially the exceptional quantities available at high water.

What I claim is:

1. The combination in a fluid turbine having a vertically-extending axle shaft, of a plurality of blades of substantially semicircular form, the ends of each blade being rigidly secured to opposite longitudinally-spaced points on said shaft each of said blades having a substantially stream line section.

2. The combination with a fluid turbine having a vertically-extending axle shaft, of a plurality of spaced blades rigidly secured thereto, each of said blades having a substantially semicircular form, each of said blades having a substantially stream line section.

3. The combination with a fluid turbine having a vertically-extending axle shaft, of a plurality of equally spaced blades of substantially semicircular form, the ends of each blade being rigidly secured to opposite longitudinally-spaced points on said shaft, each of said blades having a substantially stream line section.

4. The combination with a fluid turbine having a vertically-extending axle shaft, of a plurality of blades of substantially semicircular form rigidly secured thereto, each of said blades having a substantially stream-line section, said section having a width of a value which is but a small percentage of the diameter of the largest circle described in the rotation of said turbine.

5. The combination with a fluid turbine having a vertically-extending axle shaft, of a plurality of blades, the extreme ends of each blade being rigidly secured to opposite longitudinally-spaced points on said shaft, said blades having a fine-stream-line outline.

6. The combination as set forth in claim 5 provided with means for directing the actuating fluid upon the turbine in such manner

that substantially all of the actuating fluid engages said blades.

7. The combination with a fluid turbine having an extending axle shaft, of a plurality of blades, the extreme ends of each blade being rigidly secured to longitudinally-spaced points on said shaft, each blade having a fine stream-line outline curved in the form of a skipping rope.

8. The combination with a fluid turbine having the form of a squirrel-cage, of a plurality of blades of fine-stream-line outline, the extreme ends of each blade being rigidly secured to longitudinally-spaced points on said shaft.

9. The combination in a fluid turbine having a vertically extending axle shaft, of a plurality of blades of stream-line outline and substantially semi-circular form, the ends of each blade being rigidly secured to opposite longitudinally spaced points on said shaft.

10. The combination with a fluid turbine having a vertically extending axle shaft of a plurality of spaced blades rigidly secured thereto, each of said blades having a stream-line section.

11. The combination with a fluid turbine having a shaft at right angles to the direction of the flow, of a plurality of blades having a substantially semicircular form rigidly secured thereto, each of said blades having a substantially stream-line section, said section having a width of a value which is but a small percentage of the diameter of the largest circle described in the rotation of said turbine.

12. The combination with a fluid turbine having a shaft at right angles to the direction of the fluid, of a plurality of blades, the extreme ends of each blade being rigidly secured to opposite longitudinally-spaced points on said shaft, said blades having a fine stream-line outline.

13. The combination with a fluid turbine having a shaft at right angles to the direction of the fluid, of a plurality of blades having a stream-line section, said section having a width of a value which is but a small percentage of the diameter of the largest circle described in the rotation of said turbine, the longitudinal axis of each section being substantially tangent to the circle described by one of its points.

14. The combination with a fluid turbine having a shaft arranged in a vertical direction, of a plurality of blades having a stream-line section, said section having a width of a value which is but a small percentage of the diameter of the largest circle described in the rotation of said turbine, the longitudinal axis of each section being substantially tangent to the circle described by one of its points.

15. The combination with a fluid turbine

having a shaft at right angles to the direction of the fluid, of a plurality of blades parallel to this shaft having a stream-line section, said section having width of a value which is but a small percentage of the diameter of the largest circle described in the rotation of the turbine, the longitudinal axis of each section being substantially tangent to the circle described by one of its points.

16. The combination with a fluid turbine having a vertically extending shaft of a plurality of blades parallel to this shaft having a stream-line section, said section having a width of a value which is but a small percentage of the diameter of the largest circle described in the rotation of the turbine, the longitudinal axis of each section being substantially tangent to the circle described by one of its points.

17. The combination with a fluid turbine having a shaft at right angles to the direction of the fluid, of a plurality of blades parallel to said shaft having stream-line sections, the longitudinal axes of all these sections being all tangent to a common circle concentric with said shaft, said sections having a width of a value which is but a small percentage of the diameter of said circle.

18. The combination with a fluid turbine having a vertically extending shaft, of a plurality of blades parallel to said shaft having stream-line sections, the longitudinal axes of these stream-line sections being all tangent to a common circle concentric with said shaft, said sections having a width of a value which is but a small percentage of the diameter of said circle.

19. The combination with a fluid turbine having a shaft at right angles to the direction of the fluid, of two discs mounted on said shaft at right angles thereto, a plurality of blades parallel to said shaft having stream-line sections rigidly mounted on said discs, the longitudinal axes of these stream-line sections being all tangent to a common circle concentric with said shaft, said section having a width of a value which is but a small percentage of the diameter of said circle.

20. The combination with a fluid turbine having a vertically extending shaft, of two discs mounted on said shaft at right angles thereto, a plurality of blades parallel to said shaft having stream-line sections rigidly secured to said discs, the longitudinal axes of these stream-line sections being all tangent to a common circle concentric with said shaft, said sections having a width of a value which is but a small percentage of the diameter of said circle.

In testimony that I claim the foregoing as my invention, I have signed my name hereto.

GEORGES JEAN MARIE DARRIEUS.