

Dec. 31, 1935.

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2,026,436

CONTROL DEVICE FOR IMPULSE TURBINES

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2 Sheets-Sheet 1

Fig. 1

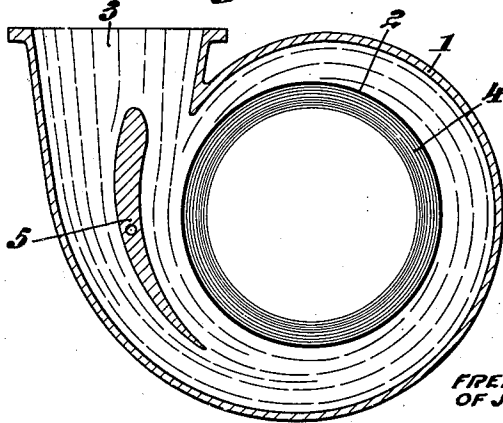


Fig. 2

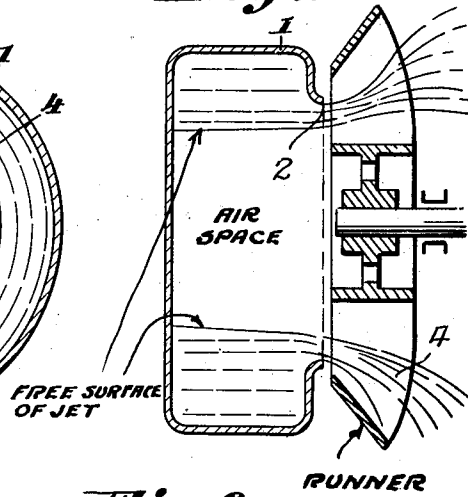


Fig. 3

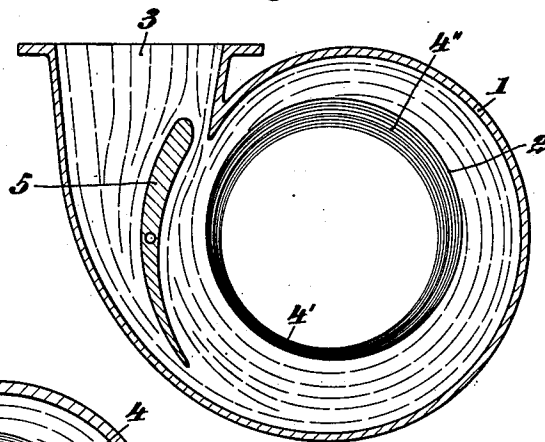
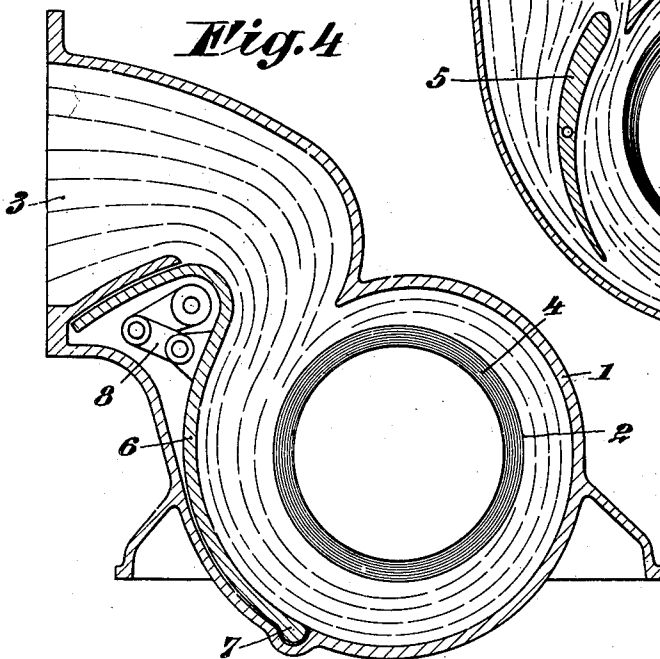


Fig. 4



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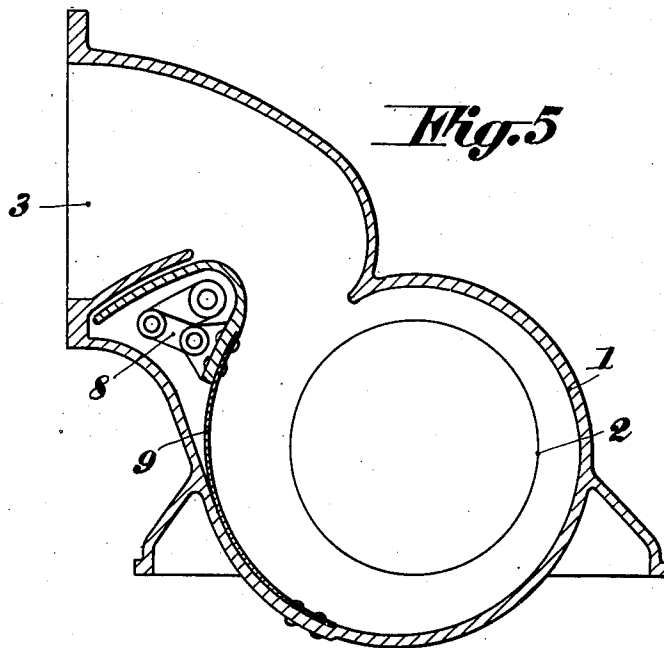
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CONTROL DEVICE FOR IMPULSE TURBINES

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4 Claims. (Cl. 253-124)

In certain hydraulic impulse-turbines known to the art of the type having a spiral case, the runner is actuated by a jet of annular cross section. This annular jet is formed by the overflowing of a rotating mass of water over the edge of a circular orifice located in one of the walls of the scroll case. The jet escaping through the orifice has the proper axial and tangential velocity-components without it being necessary to provide guide blades in the interior of the case. This jet then impinges on the buckets of a runner disposed in front of the orifice and causes it to rotate with a uniform speed. In a turbine of this type as known in the art, the control of the flow is effected by contracting the cross section of the inlet pipe by a needle-shaped device or the like. By this method, however, even when streamlined arrangements are employed, the control is effected chiefly by a throttling action on the water which is unfavorable for maintaining efficiency at part gates.

A perfect control, without losses, would be possible only by means of a scroll case variable in its whole shape. It has been found according to the invention that it is sufficient to vary the shape of a part of the scroll case to influence the whole flow therein. The flow through the orifice is not then perfectly symmetrical around the axis of the turbine but theory and experience have proved that the variations in thickness of the annular ring of water issuing from the orifice has no bad effect on the efficiency of the machine. It is sufficient in practice to use a device, situated not at the inlet proper of the scroll case but in the interior of the case itself in the first part of the spiral path of the water so as to influence both the incoming water and the water already whirling round in the case imparting to the flow the proper directions. The effect is as if the curvature of the whole scroll case itself has been altered. That is, the control is effected by guiding and not by throttling.

A similar regulating device is known for reaction turbines, but its working is quite different from that of the present invention. In reaction turbines where the scroll case runs always full of water, the thickness of the water jet imparting the runner leaves the same and the angles of attack change, whilst in impulse turbines with an annular jet with free internal cylindric surface and formed by diversing of the water over a circular overrunning edge at the regulation with a control device about the present invention the angles of attack rest independent from the degree of regulation and only the wall thickness

of the annular jet varies. Thus it is possible to maintain very good efficiency at part gates.

In Figs. 1 to 5 several modes of execution of the present invention are represented.

Fig. 1 of the drawings is a longitudinal section and Fig. 2 is a section on the axis through the spiral casing of a turbine with a normal flow of water passing through it. Fig. 3 shows the same view as Fig. 1 with the control device in a part gate position. Figs. 4 and 5 represent the longitudinal section of other examples of execution.

In all examples the turbine consists in a spiral-casing 1 with an orifice in the side wall the edge of which is the circular weir 2 over which the jet escapes.

The water entering by the inlet pipe 3 forms in the casing a real whirl or vortex. The flowing over on the circular weir 2 forms a rotating jet of annular cross section 4, which has both axial and tangential velocity components. This jet then impinges on the runner buckets placed in front of the orifice.

In the example of Fig. 1 and efficient streamlined rotatable control device 5 is situated in the first part of the scroll case, and can be considered as a part of the spiral case giving the necessary variable feature that will influence the characteristics of the water whirling round in the case.

If the control device 5 is situated so as not to alter materially the flow distribution that obtains in the plain scroll case (Fig. 1), the flow characteristics will remain as it would be in the plain scroll case and with a proper design the annular jet 4 will have a constant thickness.

If the control device is moved to the position shown in Fig. 3, the flow in the spiral-casing will be influenced in such a manner, as to cause the annular jet to escape from the casing along the circular weir 2 with different thicknesses 4', 4'', without changing materially the axial and tangential velocity components and the angle of the jet defined thereby.

In the example shown in Figs. 4 and 5, a part of the spiral wall of the casing itself is made variable in its shape.

On the wall of the spiral-casing 1 a flap 6 is articulated with the center of rotation at 7 (Fig. 4) or an elastic flexible sheet 9 is provided for (Fig. 5). These devices are on the water-side formed as a part of the spiral and can be actuated by any arrangement 8. They influence the whirling water and the annular jet in the

same manner as the streamlined vane shown in Fig. 3.

5 The scope of the invention covers also the arrangement of the control device at the beginning of the spiral path of the water in the scroll case with other types of construction than those of Figs. 1 to 5. For instance a sliding regulating device could be arranged or others.

10 Having thus fully described the invention what is claimed as new and desired to be secured by Letters Patent is:—

1. In an impulse turbine the combination of a scroll case provided with a circular opening in at least one side wall formed as a circular weir and opening to substantially atmospheric pressure to provide a rotating annular jet having a free inner surface, with a regulating device located in the interior of the scroll case in the first part of the spiral path of the water.

20 2. In an impulse turbine the combination of a scroll case provided with a circular opening in at least one side wall formed as a circular weir and opening to substantially atmospheric pressure to provide a rotating annular jet having a free inner surface, with a regulating device located in the interior of the scroll case in the

first part of the spiral path of the water, said regulating device being a streamlined vane washed by the water on both sides.

3. In an impulse turbine the combination of a scroll case provided with a circular opening 5 in at least one side wall formed as a circular weir and opening to substantially atmospheric pressure to provide a rotating annular jet having a free inner surface, with a regulating device located in the interior of the scroll case in the 10 first part of the spiral path of the water, said regulating device being in the form of a flap hinged on the scroll case.

4. In an impulse turbine the combination of a scroll case provided with a circular opening 15 in at least one side wall formed as a circular weir and opening to substantially atmospheric pressure to provide a rotating annular jet having a free inner surface, with a regulating device located in the interior of the scroll case in the 20 first part of the spiral path of the water, said regulating device being in the form of a flexible elastic sheet forming a part of the internal scroll wall of the scroll case.

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