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TURBINE.

APPLICATION FILED DEC. 4, 1908.

945,742. Patented Jan. 11, 1910.

Fig. 1.

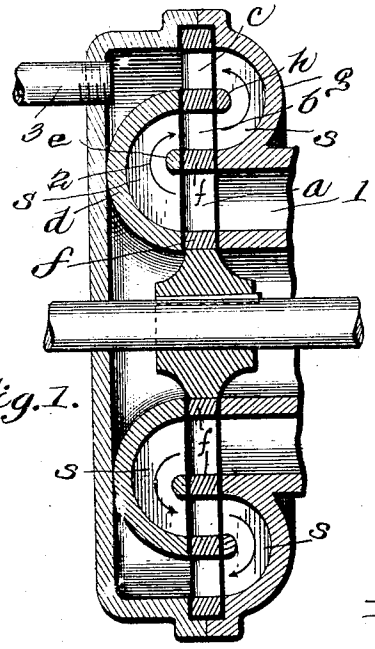


Fig. 2.

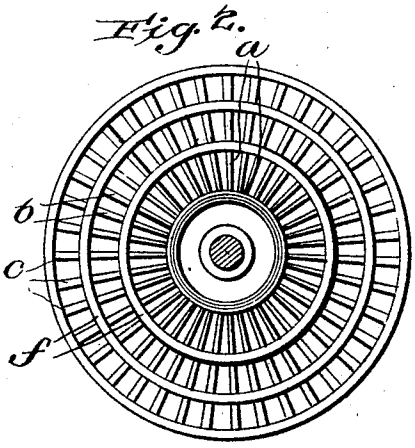


Fig. 3.

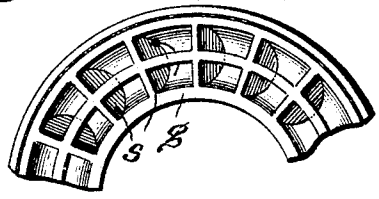


Fig. 4.

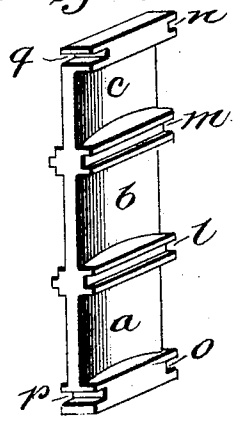


Fig. 5.

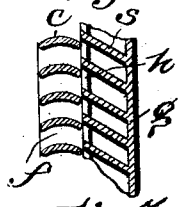


Fig. 6.

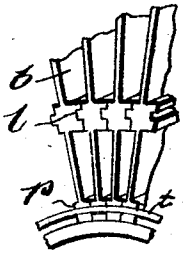
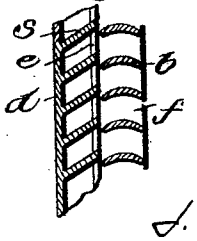


Fig. 7.



Witnesses

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UNITED STATES PATENT OFFICE.

ALEXANDER BOECKEL, OSKAR GRUNBERG, JURI KORWIN-KRUKOVSKY, AND EDOUARD LUXEMBOURG, OF ST. PETERSBURG, RUSSIA.

TURBINE.

945,742. Specification of Letters Patent. **Patented Jan. 11, 1910.**

Application filed December 4, 1908. Serial No. 466,010.

To all whom it may concern:

Be it known that we, ALEXANDER BOECKEL, OSKAR GRUNBERG, JURI KORWIN-KRUKOVSKY, and EDOUARD LUXEMBOURG, subjects of the Czar of Russia, residing at V. O. Kadetskaia Liniya 9, St. Petersburg, Russia, have invented certain new and useful Improvements in Steam or Gas Turbines; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to an axial impulse turbine with several velocity stages in which the steam or the gas passes successively through a number of rings of blades or buckets arranged concentrically around one another, the passage from one ring to the next taking place through all the blades of a given ring simultaneously, and through a suitable guiding means or channel. In such an arrangement the steam or gas leaving the one ring passes to the whole periphery of, and simultaneously through the blades of the next ring so that the turbine does not act as a partial but as a full working-turbine. Furthermore, the number of blades or buckets in all the rings is the same so that said blades for all the rings can be produced from one piece, and all blades can also be secured suitably at the circumference of the wheel.

Referring to the accompanying drawings forming a part of this specification in which like letters refer to like parts in all the views, and in which one form of the turbine with three velocity stages is illustrated:—Figure 1 is a diagrammatic sectional view of a wheel showing the blades and guiding means; Fig. 2 is an elevational view partly in section showing the arrangement of the blades; Fig. 3 is a diagrammatic and partly perspective view of a portion of the guiding means for the steam or gas; Fig. 4 is a perspective view of three of the blades of the turbine made in one piece; Figs. 5 and 7 are detail sectional views of a portion of the wheel and guiding means, and Fig. 6 is a view showing how the blades are attached to the wheel.

The steam or gas enters in the direction Fig. 1, and passes through the ring of blades *a*, and after passing simultaneously through all of the blades of said ring, the said steam flows into the conducting channel *d*. This channel is a circular groove which runs around the entire circumference of the rings of blades lettered *a* and *b* on one side of the wheel, and is intersected by planes or pieces *s*, see particularly Figs. 5 and 7, which planes form tangents to the curves of the blades so that the steam leaving the blades of the ring *a* does not alter its movement in a radial plane but only changes its direction in following the arrow 2, Fig. 1. In order that such a change in direction of the steam may actually take place, opposite the line of separation between the one ring of blades and the next, there is arranged a flat annulus *e* which is secured to the rings *f* on the turbine wheel. The guiding passage *g* is similar to the passage *d*, and is also provided with an annulus *h* in exactly the same manner.

As the blades of one ring form in a radial direction a continuation of the blades of the next ring, the distance between the individual blades becomes greater the greater the distance from the center of rotation. And this distance between said blades is made to correspond exactly with the natural expansion of the fluid, and is governed according to the proximity of the blades to the outlet 3; and in consequence of the resulting diminution of the velocity of the steam, the loss of power in the same is readily compensated for. It is evident that the circumferential velocity of each ring of blades, in other words, must correspond to the length of the radius of its mean periphery.

In order that the volume of the steam or gas passing through any ring of blades, and the size of the opening between the blades may exactly correspond, the latter can be dimensioned correctly by diminishing or increasing the height of the wheel in the direction of its radius.

When the blades *a*, *b* and *c* of the wheel are made in one piece, as illustrated in Fig. 4, projections *l*, *m*, *n*, and *o* are preferably provided between each ring of blades for the purpose of securing contiguous blades together, as illustrated in Fig. 6. By means of suitably shaped ends the blades may be inserted in slots in the hub of the wheel, and then secured with the aid of a ring *t* entering the grooves *p* on the edges of said blades. The grooves *q* and *r* are provided

for the accommodation of a similar ring on the outer ends of the blades. It is evident that both the number of rings of blades, and the velocity blades as well as the blades themselves, can be varied as desired. It is to be noted, however, that with the correct number of stages, the lateral pressure on the wheel can be balanced. Also instead of one wheel two wheels can be used.

What we claim is:—

1. In a multi-stage turbine, the combination of a plurality of concentric rings of curved blades, said blades in the outer rings being successively spaced farther apart than the blades in the inner rings; a port adapted to admit steam to the innermost ring; and a channel opposite said port covering a plurality of rings and provided with separators *s* tangential to said blades, substantially as described.

2. In a multi-stage turbine, the combination of a plurality of concentric rings of curved blades, said blades in the outer rings being successively spaced farther apart than the blades in the inner rings; a port adapted to admit steam to the innermost ring; a channel opposite said port, covering a plurality of rings and provided with separators *s* tangential to said blades; and a second channel provided with like separators located on the same side of the wheel as said port and likewise covering a plurality of rings, substantially as described.

In testimony whereof, we affix our signatures in presence of two witnesses.

ALEXANDER BOECKEL.
OSKAR GRUNBERG.
JURI KORWIN-KRUKOVSKY.
EDOUARD LUXEMBOURG.

Witnesses:
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