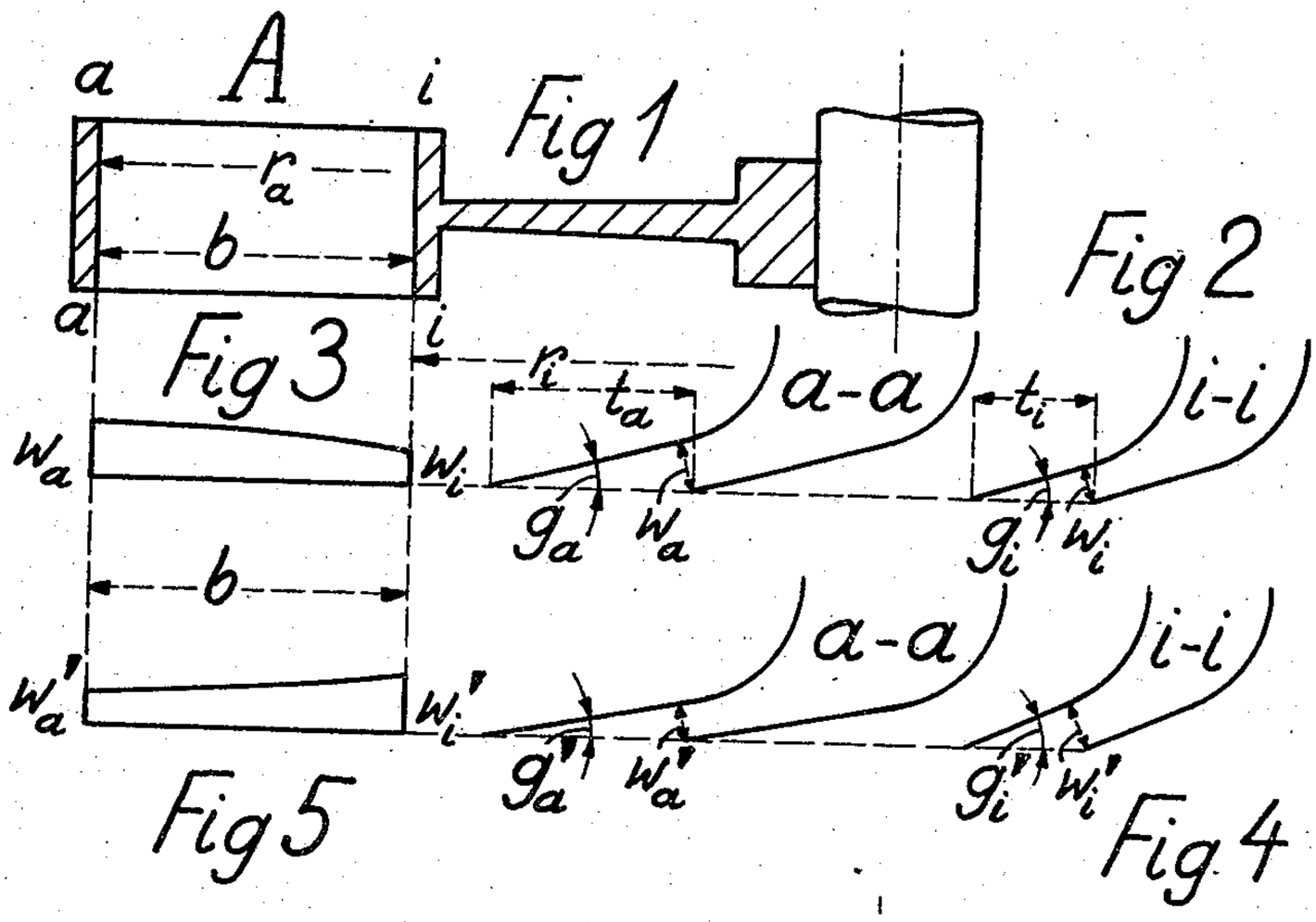
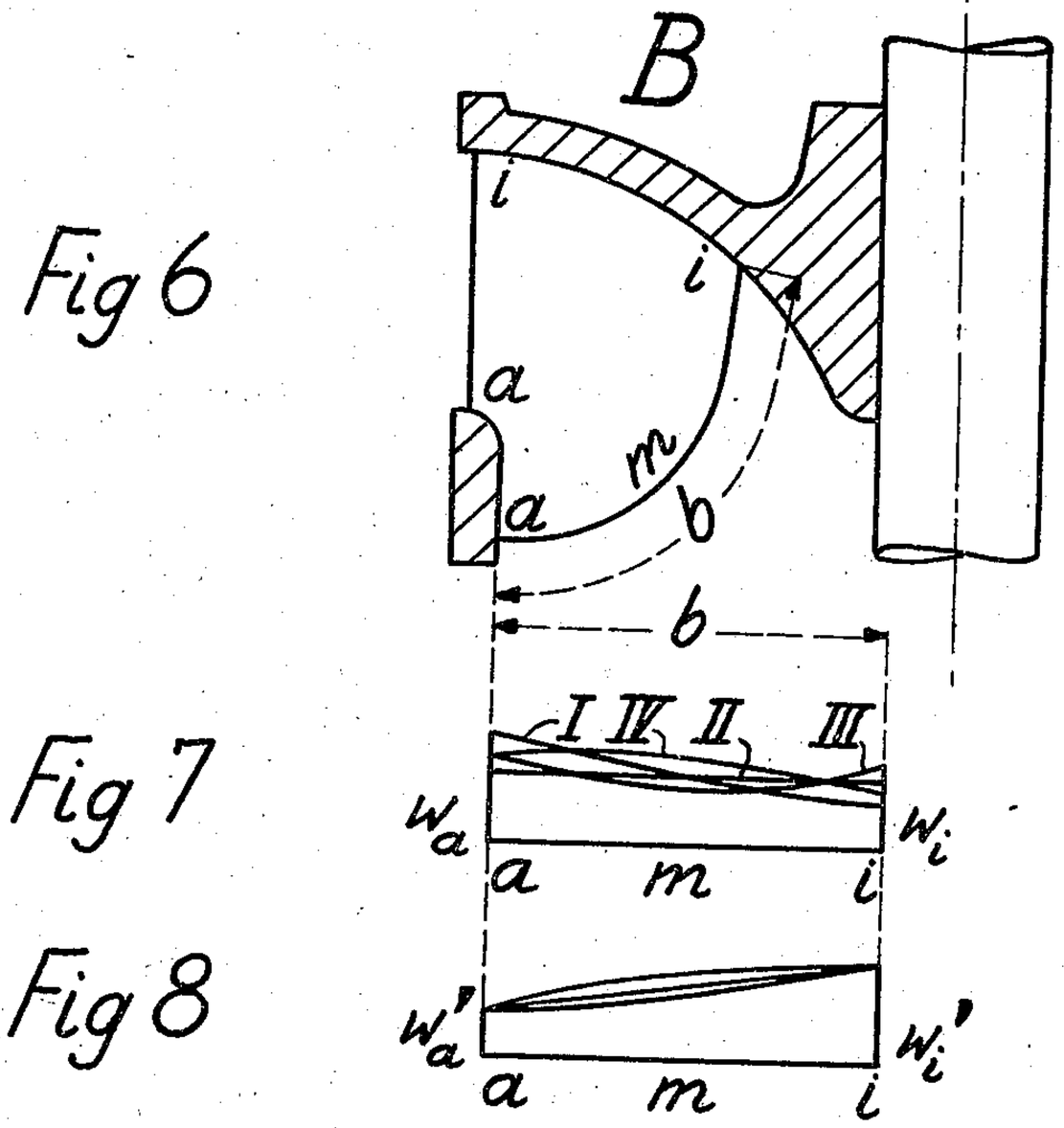
No. 867,566. PATENTED OCT. 8, 1907.

N. BAASHUUS.

TURBINE.

APPLICATION FILED MAY 25, 1907.





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UNITED STATES PATENT OFFICE.

NILS BAASHUUS, OF CHRISTIANIA, NORWAY.

TURBINE.

No. 867,566. Specification of Letters Patent. Patented Oct. 8, 1907.

Application filed May 25, 1907. Serial No. 375,604.

To all whom it may concern:

Be it known that I, NILS BAASHUUS, a subject of the King of Norway, and a resident of Christiania, in the Kingdom of Norway, have invented new and useful Improvements in Turbines, of which the following is a specification.

My invention relates to an improved running-wheel for turbines, whereby the working agent (water, steam, gas) can be very thoroughly utilized with varying discharges.

The invention is illustrated in the accompanying drawing.

Figure 1 is a section through a portion of the running-wheel of an axial turbine. Figs. 2—5 are diagrams explanatory of the nature of the invention with respect to axial turbines. Fig. 6 is a section through a portion of the running-wheel of a radial turbine. Figs. 7 and 8 are diagrams explanatory of the nature of the invention with respect to radial turbines.

Referring more particularly to Figs. 1—5, A is the running-wheel of an axial turbine, *aa* being the outer and *ii* the inner limit of the buckets. r_a and r_i are the corresponding radii. If the wheel A is cut in cylindrical surfaces concentric with the axis of the turbine and these sections are laid out in the plane of the drawing, the bucket curve is arrived at. The bucket sections at *aa* and *ii* of Fig. 1 are represented at *a*—*a* and *i*—*i* in this manner (Fig. 2), the inside widths of exit at the outer and inner limits respectively being seen at W_a and W_i. The angles g_a, g_i are the angles of exit, which determine the loss in outflow. The variation in the inside widths of exit with the radii of the exit edge is seen in the diagram Fig. 3, where the breadth *b* of the buckets is employed as abscissa and the inside widths of exit as ordinates. From Fig. 3 it is obvious that the inside widths of exit increase with increasing radius, which in turbines of prior construction is the case.

According to my invention, by selection of the dimensions of the angles of exit g'_a and g'_i, the inside widths of exit are such that the minimum of the same lies in the outer quarter of the exit edge, as shown in Fig. 4, where *a*—*a* and *i*—*i* represent the bucket sections at *aa* and *ii* of Fig. 1, W'_a and W'_i being the new widths of exit. The variation of these widths of exit with the radii of the exit edge is shown by way of example in the diagram Fig. 5. That such dimensions for the inside widths of exit are possible is clear when it is remembered that the inside width of exit is a product of t_a (or t_i), Fig. 2, and the sine of the angle g_a (or g_i), that is, expressed in general terms

$$W_x = t_x \cdot \sin g_x.$$

The influence of the thickness of the buckets can here be neglected. In this expression the factor t_x with a given number of buckets is to be regarded as given, and the angle g_x may be given various values depending upon the principle of construction. According to my invention the angles g_x are given such values that the inside widths of exit at the outer circumference (W'_a) are smaller than those at the inner circumference (W'_i) and that the minimum of the inside widths of exit lies in the outer quarter of the exit edge.

The principle, above set forth with reference to axial turbines, of the minimum of the inside widths of exit lying in the outer quarter of the exit edge can also be applied to radial turbines. In Fig. 6, B is the running-wheel of a radial turbine, *aa* being the outer and *ii* the inner limit of the buckets. The exit edge is indicated by *b* and one of the center points of the same by *m*. In Fig. 7 the exit edge is shown laid out as a straight line in the plane of the drawing and used as abscissa of a diagram similar to those shown in Figs. 3 and 5. The ordinates are the corresponding inside widths of exit. The curves I, II, III, IV show the variations of the widths of exit as hitherto adopted along the exit edge. Curve I shows that the width of exit from the outer limit (at *a*) decreases inwardly (toward *i*). Curve II shows that it is made constant along the exit edge. Curve III shows that it decreases both from outside and inside toward a point near the middle (at *m*). Curve IV shows that it increases both from the outer limit and from the inner limit toward the middle.

According to my invention the inside exit-widths by selection of the dimensions of the angles of exit are such that the minimum of the same lies in the outer quarter of the exit edge, as shown in the four curves of Fig. 8. That this is possible follows from what has been said in respect to axial turbines. By reason of such distribution of the area of exit the working agent with varying discharges is particularly well utilized. For with a smaller discharge, by reason of the decrease of the degree of reaction and the relative velocity of inflow, the increasing influence of the centrifugal force compels the working agent to flow out chiefly at the places of exit lying radially furthest from the axis of rotation, that is to say, at the places that is, in the

outer quarter of the exit edge, toward *a*. At these places, through the selection of the angles of exit, the inside widths of exit are smaller than with running-wheels as hitherto constructed. In this manner the exit-losses at these parts are rendered smaller, and since with reduced discharge the discharge is principally in this province (in the outer quarter of the exit edge), the running-wheels, according to my invention, within very wide limits of discharge, have a much higher efficiency than those hitherto constructed.

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

In a turbine, a running-wheel in which the minimum of the inside widths of exit lies in that quarter of the length of the exit edge which is most remote from the axis of rotation, substantially as and for the purposes set forth.

In witness whereof I have hereunto set my hand in presence of two witnesses.

NILS BAASHUUS.

Witnesses:

WOLDEMAR HAUPT,

HENRY HASPER.