H. H. WAIT.

TURBINE BLADE.

APPLICATION FILED MAR. 17, 1910.

961,328. **Patented June 14, 1910.**

Fig. 3.

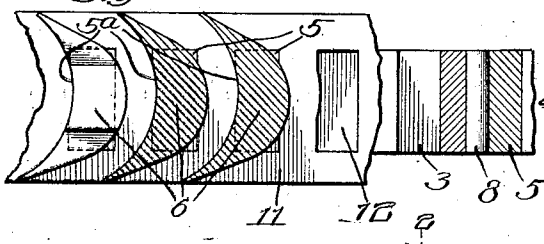


Fig. 5.

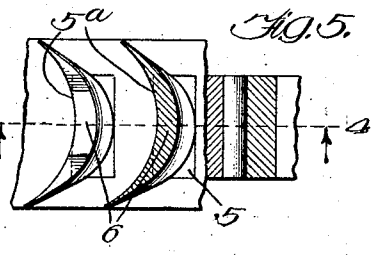


Fig. 1.

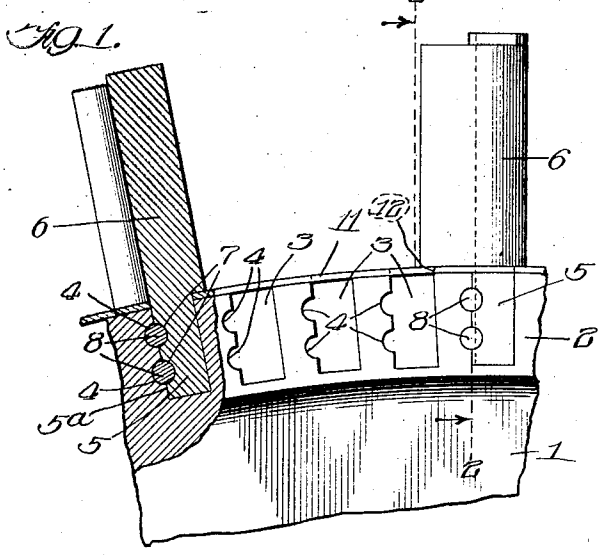


Fig. 2.

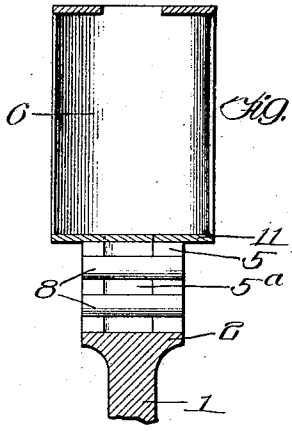


Fig. 4.

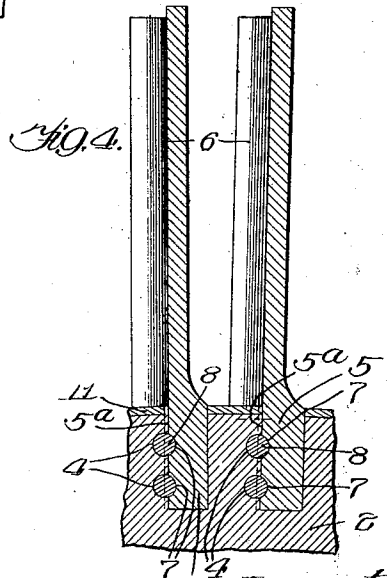
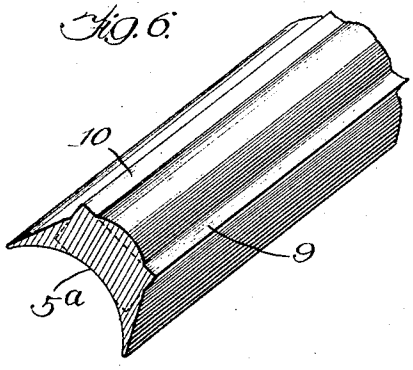


Fig. 6.



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TURBINE-BLADE.

961,328. Specification of Letters Patent. Patented June 14, 1910.

Application filed March 17, 1910. Serial No. 549,868.

To all whom it may concern:

Be it known that I, HENRY H. WAIT, citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Turbine-Blades, of which the following is a full, clear, concise and exact description.

My invention relates to rotary turbine wheels and more particularly to the structure of the blades or vanes and to the method of making the same, and to the manner in which said blades are attached to the turbine disk.

The object of my invention is to simplify and to render more economical the manufacture of turbine blades, and to provide a blade structure which has a strong root adapted to be firmly anchored to the turbine wheel.

The blade of my invention comprises a body portion having the requisite strength and thickness and of the usual shape, that is crescent in cross-section, the root of the blade being substantially of rectangular cross-section and having great thickness and breadth, thereby giving the blade the requisite strength to sustain the severe strain to which, as is well known, the blade is subjected in use. The root of the blade preferably has on its front face a semi-circular groove or grooves adapted to register with a similar groove or grooves in the wall of the blade-receiving slots in the rim of the wheel. The blades are then securely locked to the wheel by means of pins inserted in the circular holes thus provided between the roots of the blades and the walls of the slots in which the blades are inserted.

Another feature of my invention consists in making the felly or rim of the wheel of increased thickness and making the root of the blade of corresponding width.

Still another feature of the invention relates to the stock from which the blades are made, and the manner in which the blades are shaped therefrom, such stock consisting of a drawn bar in the general form of a crescent in cross-section, but provided, preferably upon its convex side, with an angular projection or projections whereby a rectangle of increased width and thickness, corresponding to the desired cross-section of the blade root, can be inscribed within the cross-sectional area of the stock.

These and other features of my invention may be more readily understood by reference to the accompanying drawings, in which,

Figure 1 is a fragmentary view partly in side elevation and partly in section; Fig. 2 is a section on the line 2—2 of Fig. 1. Fig. 3 is a fragmentary view partly in plan, partly in cross-section and with portions broken away; Fig. 4 is a section on the line 4—4 of Fig. 5; Fig. 5 is a view, similar to that of Fig. 3, of the wheel and blades shown in Fig. 4; and Fig. 6 is a perspective view of a portion of the preferred form of stock from which the blades are manufactured.

Similar numerals of reference describe similar parts throughout the several views.

The rotary wheel 1 is provided with a rim or felly 2 of increased axial thickness. Opening outwardly or radially from the periphery of the rim 2, are a series of slots 3 adapted to receive the roots of the turbine blades. The slots 3 are preferably mere channel slots having parallel walls, since said type of slot is more easily and economically provided.

Fitting in the transverse slots 3 are the roots 5 of the turbine blades. The said roots 5 are of approximately rectangular cross-section. However, in order to increase the width and thickness of the blade root, which can be cut from the stock, a slight cavity 5^a may be left in the front wall of the root corresponding to the concavity in the face of the corresponding body portion 6 of the blade. The back of the blade root thus presents a plane surface, and the front face of the root likewise forms a plane bearing surface for said root. The blade roots are thus of substantially rectangular cross-section and are adapted to fit in the channel slots in the rim of the turbine wheel or disk. In the preferred embodiment of my invention the root of the blade is provided with one or more semi-circular grooves 7 which are adapted, when the blade is in position, to register with the corresponding grooves 4 in the walls of the slots 3, thus forming holes into which pins 8 are inserted for locking the blades in said slots. The blades are preferably formed from the stock shown in Fig. 6 which consists of a drawn metal bar of substantially crescent shape in cross-section, the convex surface of said bar being formed, however, with angular, longitudinally extending ribs 9, 10, the vertices of which are right angles. The inner faces of the ribs 9 and 10 are in the same plane.

and the outer faces thereof are in parallel planes. These two ribs form opposite corners of a rectangle which may be inscribed within the cross-section of the blade, as shown in the dotted lines in Fig. 6. By providing such projections on the convex side of the body of the stock, it is obvious that a rectangle can thus be inscribed, corresponding to the desired cross-section of the blade root, having both a greater width and a greater thickness than could otherwise be obtained. In order that the thickness of the rectangle may be made somewhat greater, the front line thereof may be so drawn as to lie at its central portion somewhat outside the body of the stock, thereby leaving a slight concavity 5^a in the front surface of the corresponding blade root, as hereinbefore described.

In the manufacture of the blades from the stock shown in Fig. 6, the body portion of the blade is given the desired configuration by milling off so much of the stock as is not necessary to give the upper contour to the blade, as for example, the ribs 9 and 10 only, in the manufacture of the shorter blades, are milled off so as to give the entire thickness of the stock to such short blades. The structure of such shorter blades is shown in Figs. 1 and 3. In the longer blades illustrated in Fig. 4, the convex surface of the stock is milled down until the desired shape and thickness of the body of the blade is secured. In both cases, however, the ribs 9 and 10 form a portion of the rectangular blade root. It is obvious that a blade can thus be produced, having a very much larger and stronger root, and which nevertheless can be cheaply and quickly made.

The periphery of the felly 2 is covered by the cover plate 11, which is provided with perforations 12 of a contour corresponding to the cross-sectional contour of the root of the blades. These perforations in the cover plate lie immediately over the slots 3, and hence the blades can readily be set in place. The blades are then anchored to the turbine disk by the pins 8.

It will be noted that I preferably make the felly or rim of the turbine disk of increased axial thickness and also provide ribs upon the convex surface of the stock from which the blades are made, thus permitting of a wider and thicker blade root than could otherwise be secured. It will be understood, however, that various modifications of my invention can be made within the scope of the appended claims.

What I claim is:

1. In a turbine wheel, the combination of a wheel disk having a rim of increased axial thickness, said rim being provided with a series of slots in its periphery, turbine blades each having a body portion of crescent shape in cross-section and a root of approximately rectangular cross-section, said roots fitting in the slots of said rim, pins locking the blade roots to the wheel, and a cover plate overlying the periphery of said rim and projecting upon the opposite sides thereof to the tips of the body portion of said blade.

2. In a turbine wheel, the combination with a wheel disk having a rim of increased axial thickness, said rim having in its periphery a series of channel slots provided with parallel walls, of turbine blades each having a body portion of crescent shape in cross-section and a root of approximately rectangular cross-section, said roots fitting in and approximately filling the slots in said rim, the walls of said slots and said blade roots being each provided with semicircular grooves, the grooves in said walls registering with the corresponding grooves in said roots, pins fitting in the circular openings formed by said grooves, and a cover plate surrounding the periphery of said rim and projecting between the opposite sides thereof, said cover plate being provided with perforations overlying said slots and of a contour corresponding to the cross-sectional contour of the roots of said blades.

3. In a turbine wheel, the combination with a wheel disk having a rim of increased axial thickness, said rim being provided in its periphery with a series of outwardly opening, transverse slots, and turbine blades having a body portion of crescent shape in cross-section and a root portion of approximately rectangular cross-section, the front surface of said root having a slight concavity forming a prolongation of the concave face of the body portion of the root, said blade roots fitting in and approximately filling said slots in said rim.

4. In a turbine wheel, the combination with a wheel disk having a rim of increased axial thickness, said rim being provided in its periphery with a series of outwardly opening, transverse slots, turbine blades having a body portion of crescent shape in cross-section and a root portion of approximately rectangular cross-section, the front surface of said root having a slight concavity forming a prolongation of the concave face of the body portion of the root, said blade roots fitting in and approximately filling said slots in said rim, and a cover plate surrounding the periphery of said rim and projecting upon the opposite sides thereof, said cover plate being provided with perforations overlying said slots and of a contour corresponding to the cross-sectional contour of the roots of said blades.

5. As an article of manufacture, a stock for turbine blades consisting of a drawn bar of approximately crescent shape in cross-

section provided with an angular, longitudinally extending rib.

6. As an article of manufacture, a stock for turbine blades consisting of a drawn bar of approximately crescent shape in cross-section provided with angular, longitudinally extending ribs, the vertices of said ribs being right angles.

7. As an article of manufacture, a stock for turbine blades consisting of a drawn bar of approximately crescent shape in cross-section, said bar being provided upon the opposite sides of its convex surface with angular, longitudinally extending ribs having vertices which are right angles.

8. A turbine blade comprising a body portion of crescent shape in cross-section and a root of approximately rectangular cross-section, the front surface of said root having, at its central portion, a slight concavity forming a longitudinal prolongation of the front surface of said body portion of the blade.

9. A turbine blade made from drawn stock, provided with angular, longitudinally extending ribs, said blade comprising a body portion of crescent shape in cross-section and a root corresponding to a rectangle inscribed in the said stock, said ribs forming two of the corners of said rectangle.

In witness whereof, I hereunto subscribe my name this fifteenth day of March, A. D., 1910.

HENRY H. WAIT.

Witnesses:
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