No. 730,362. PATENTED JUNE 9, 1903

H. GEISENHÖNER.

TURBINE BUCKET CUTTING TOOL.

APPLICATION FILED DEC. 23, 1901.

NO MODEL.

Fig. 2.

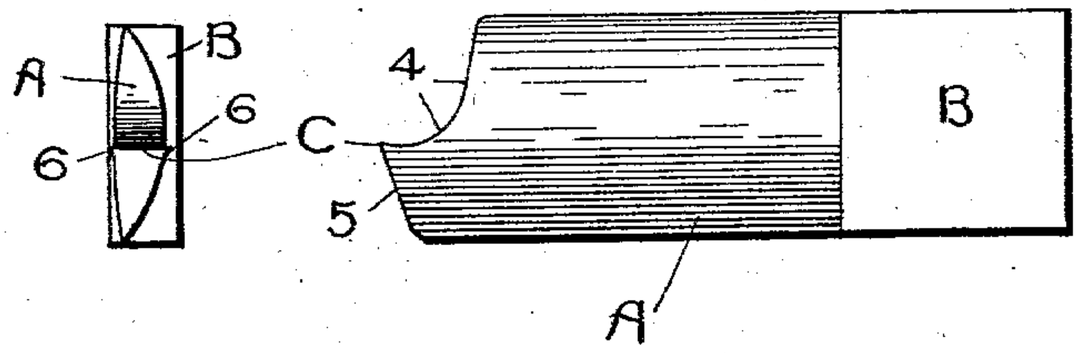


Fig. 1.

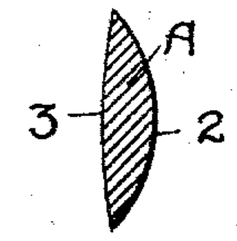


Fig. 3.

Fig. 4.

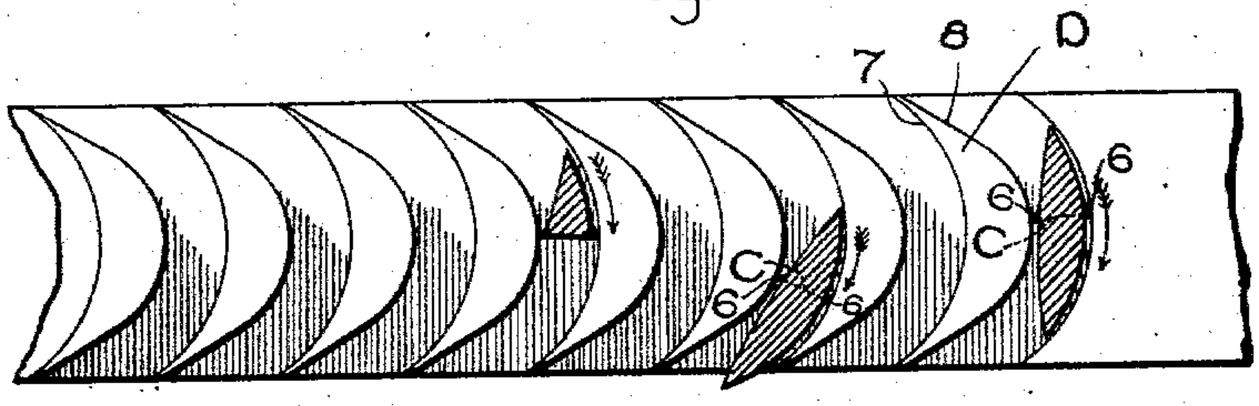
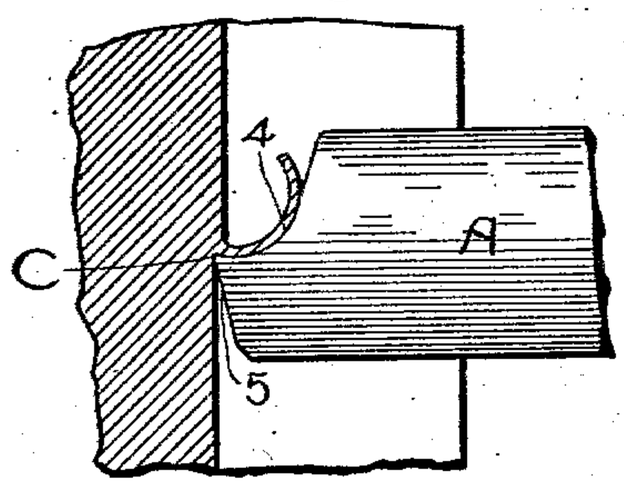


Fig. 5.



Witnesses.
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No. 362. Patented June 9, 1903.

UNITED STATES PATENT OFFICE.

HENRY GEISENHÖNER, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

TURBINE-BUCKET-CUTTING TOOL.

SPECIFICATION forming part of Letters Patent No. 730,362, dated June 9, 1903.

Application filed December 23, 1901. Serial No. 86,931. (No model.)

To all whom it may concern:

Be it known that I, HENRY GEISENHÖNER, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Turbine-Bucket-Cutting Tools, of which the following is a specification.

My invention relates to turbine-bucket-cutting tools—that is, to tools adapted to cut irregular or sinuous channels in a metallic disk or wheel, whereby the integral segments left between such channels will constitute properly-shaped turbine-buckets.

Heretofore it has been impracticable to manufacture steam turbine-wheels with integral buckets for the reason that no cutting-tool known or used prior to my invention was adapted to or capable of cutting the deep, narrow, sinuous channels between the buckets. These channels are often required to be six inches in depth and only a quarter or five-sixteenths of an inch in width, and as a consequence the cutting-tool must be correspondingly long and thin to travel in said channels and to provide for the necessary clearance. Moreover, because of the sinuous form of the channels and the necessity of keeping the cutting edge at right angles to its line of travel the tool must be narrow and further reduced in thickness at its edges to permit it to be turned upon its axis in said channels as it traverses them. Furthermore, steam turbine-wheels are now made of cast-steel, which, as is well known in the art, requires great strength in the cutting-tools.

The object, therefore, of my invention is to provide a bucket-cutting tool which shall operate effectually to cut irregular or sinuous channels of relatively small width and great depth.

The invention will be more readily understood by reference to the accompanying drawings, forming a part of this specification, and in which—

Figure 1 shows in side elevation a short or contracted bucket-cutting tool embodying my invention. Fig. 2 is an elevation of the cutting end of the same. Fig. 3 is a transverse section of the blade of the tool. Fig. 4 is a developed plan of a portion of the face of a steam turbine-wheel, showing the cutting-tool in different positions in the channels thereof; and Fig. 5 is a side elevation of the cutting end of the tool represented as in operation.

As shown in the drawings, my invention consists of a long narrow blade A, the length of which will depend upon the depth of channels required to be cut, provided with a rectangular nib or shank B at one end, whereby the tool is adapted to be engaged and securely held in the tool holder or spindle. The shape of the blade A is substantially uniform in size throughout its length and of a cross-section as indicated in Figs. 2, 3, and 4 of the drawings, with the outer or right-hand side 2 made cylindrical of short radius and the inner or left-hand side 3 made nearly plane or cylindrical with long radius of curvature, the curvature of the outer side 2 being regulated by the greatest curvature or concavity in the face side 7 of the turbine-buckets D and the curvature of the inner side 3 of the tool being regulated by the shape of the back side 8 of said buckets. The convexity of the sides 2 and 3 of the tool is always made somewhat greater to provide for side clearance. The cutting edge C is located at right angles to the blade and at the central axis thereof and is made by grinding off the leading edge 4 of the tool-blade near one end and by slightly swaging the metal of the lower clearance-face 5 in the vicinity of the cutting edge, forming the enlargements 6 6, so that the cutting edge is slightly longer than the greatest thickness of the blade A. As indicated in Fig. 4 of the drawings, the tool at first moves in nearly a straight or slightly-concave path, the direction of which is about thirty degrees to the plane of the turbine-wheel. After moving a certain distance—about one-fourth or less part of its travel—it is turned gradually about its axis and caused to move in a circular path for the larger part of its travel and then moves along another nearly-straight path as it emerges from the channel. It will be observed that the blade of the tool does not interfere with the movement of the tool about its axis, as it is turned to keep the cutting edge C at right angles to its line of travel, and at the same time it will be noted that the

effective width of the tool is nearly equal to the thickness of the turbine-wheel. On account of this large effective width of the blade of the tool I am enabled to take relatively thick chips, as indicated in Fig. 5 of the drawings, from cast-steel without causing the tool to chatter and without danger of breaking it.

Referring to Fig. 3, it is to be noted that the body of the blade has a much greater length than width. In the present instance the length is more than twice as great as the width. This relation is made necessary by reason of the great strength required to cut sinuous passages of the character described. It is also to be noted that the sides of the body of the tool taper from a middle portion toward the front and rear edges, the latter being thin, like a knife-blade, but forming no part of the cutting edge. It is important to have the side wall 2 of the body conform approximately to the curvature of the bucket-wall, because the presence of metal at this point gives strength and rigidity to the tool. Some clearance at this point is permissible, but preferably it should be as small as possible, the particular shape of the bucket and the character of the steel being cut being the principal factors which determine this. The curve of the side 3 is made much flatter than that of the opposite or outer side, the object being to permit the tool to be oscillated slightly on its own center as it follows the sinuous path prescribed for it by the bucket-cutting machine. The thin front and rear edges of the body considered in cross-section are made necessary by the peculiar curvature of the buckets. If these ends were made thicker, they would prevent or largely limit the oscillating of the tool, which is essential to good work. The great length of the body of the tool with respect to its width when viewed in cross-section prevents the chattering of the tool when in use by giving to it a rigidity sufficient to counteract the effect of the cut. The tool is adapted to form the passages by successive cuts, and as the passage gets deeper and deeper the necessity of having an unyielding tool and one which will pass freely through the passage between the buckets becomes more apparent.

While I have restricted the above description to the specific construction shown in the drawings it is evident that other forms may be constructed embodying the essential features of my invention, and while I have in the claims hereto annexed employed the word "central" as expressing the approximate location of the cutting edge of the tool I intend to include a considerable departure from the mathematical center as within the scope and meaning of the said claims.

What I claim as new, and desire to secure by Letters Patent, is—

1. As an article of manufacture, a tool for forming sinuous passages by successive cuts, comprising a body portion having a curved side wall that substantially conforms to the curvature of the passage, and a second side wall that is oppositely curved, the said body portion having, in cross-section, a greater length than width, considered in the direction of the passage, and a cutting edge that extends across the tool in the direction of its width.

2. As an article of manufacture, a tool for forming turbine-buckets by successive cuts, comprising a body portion which, in cross-section, has double convex side walls and, when considered in the direction of the cut, has greater length than width, and a cutting edge centrally located that extends across the body in the direction of its width, and is slightly wider than the body.

3. As an article of manufacture, a tool for forming sinuous passages by successive cuts, comprising a body portion having double convex sides with a greater length than width and thin front and rear edges, when considered in cross-section and in the direction of the cut, and a cutting edge at one end which is centrally located and extending at right angles to the body.

4. As an article of manufacture, a tool for forming sinuous passages by successive cuts, comprising a body portion which in cross-section has a greater length than width, the said body tapering from the middle toward the front and rear, and a cutting edge located centrally with respect to said body and situated at one end.

5. As an article of manufacture, a tool for forming turbine-buckets by successive cuts, comprising a body portion having curved sides 2 and 3 which are formed on different radii, and a cutting edge C located at right angles to the body and at the central axis thereof, and formed by cutting away the leading edge, as at 4, and the heel, as at 5.

In witness whereof I have hereunto set my hand this 14th day of December, 1901.

HENRY GEISENHÖNER.

Witnesses:
ALEX. F. MACDONALD,
ROBT. C. CHAPMAN.