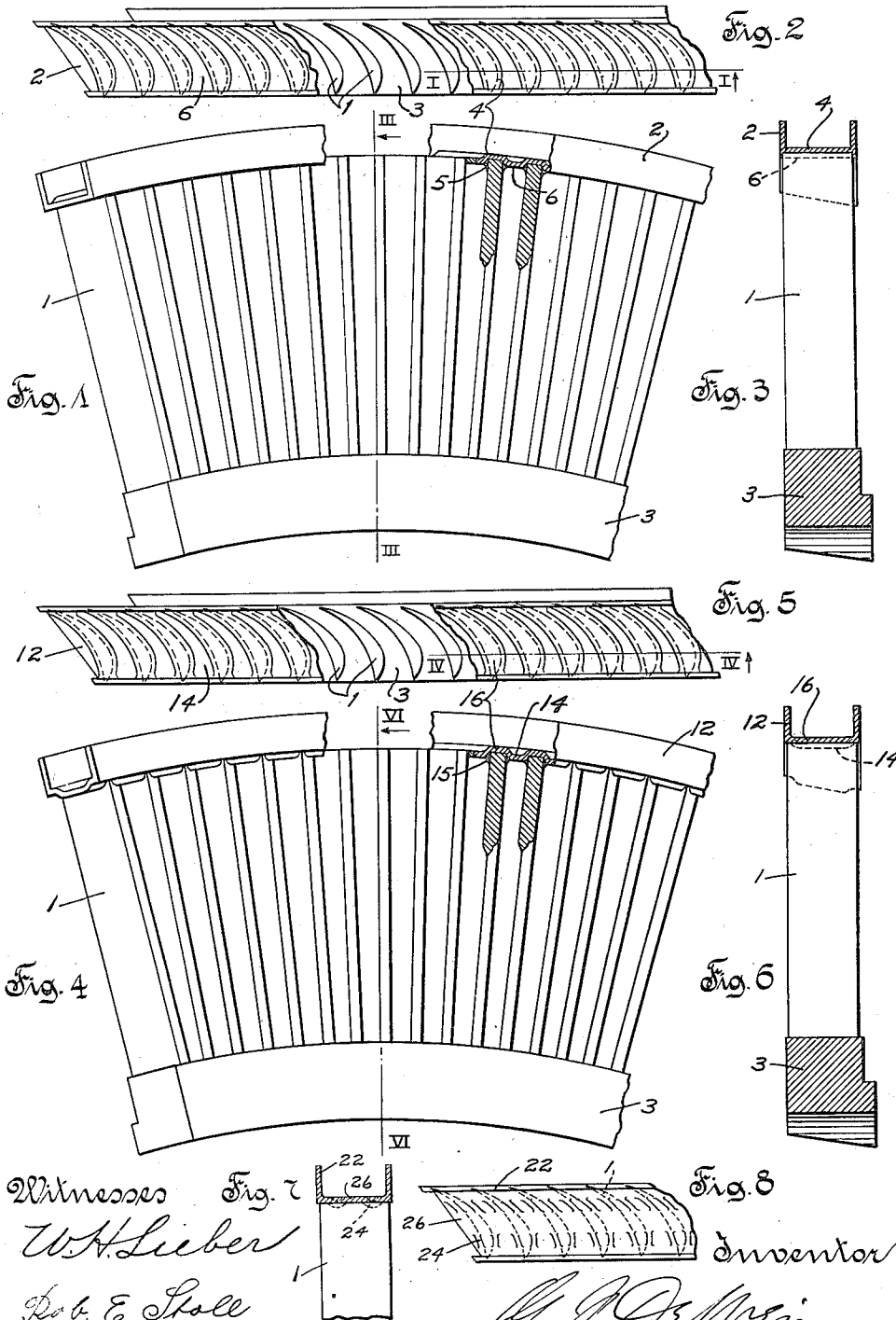


G. F. DE WEIN.
STEAM TURBINE.

APPLICATION FILED FEB. 9, 1914. RENEWED NOV. 26, 1915.

1,187,449.

Patented June 13, 1916.



Witnesses

W. H. Lieber
Robt. E. Hall

Fig. 8

Inventor

G. F. De Wein

UNITED STATES PATENT OFFICE.

GEORGE F. DE WEIN, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO ALLIS-CHALMERS MANUFACTURING COMPANY, OF MILWAUKEE, WISCONSIN, A CORPORATION OF DELAWARE.

STEAM-TURBINE.

1,187,449.

Specification of Letters Patent.

Patented June 13, 1916.

Application filed February 9, 1914, Serial No. 818,153. Renewed November 26, 1915. Serial No. 64,173.

To all whom it may concern:

Be it known that I, GEORGE F. DE WEIN, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented a certain new and useful Improvement in Steam-Turbines, of which the following is a specification.

This invention relates to steam turbines and more particularly to a method of securing the shroud to the blade ends and of properly positioning the blades at one end.

An object of the invention is to provide an assembled blade structure for steam turbines which is simple in construction, efficient in operation, and which possesses the requisite amount of rigidity and strength, especially to withstand vibration.

One of the more specific objects is to provide efficient means for securing a light shroud to the single-surfaced ends of a plurality of blades, this shroud being provided with means for properly positioning the blade ends both as to spacing and angling the same.

Another object is to provide an imperforate shroud with means for positioning the blades at their ends, the blades and shroud being united by fusion of metal.

The expression "single-surfaced end" as used herein is intended to apply to a blade end which is free from any projection or recess abruptly interrupting the continuity of the end surface of the blade. The expression therefore includes blade ends having surfaces which are either plane or curved, these surfaces being either perpendicular or oblique to the edges of the blades.

Heretofore it has been proposed to fasten a shroud to blade ends by means of tenons formed on the blade ends and passing through holes in the shroud, the tenons being riveted over the shroud stock. It has also been proposed to fasten a shroud to the ends of the blades by fusion of metal, for instance by brazing, the blade ends in this case being properly positioned by forming a tenon on each of the blades and inserting the same in correspondingly shaped holes formed in the shroud. The objections to these constructions are, first, that considerable blade stock is wasted in forming the tenons; and, second, that the shroud is weakened at least temporarily, by forming the holes therein for the tenons. With the use of the present

invention these objections are eliminated and a very strong and light shroud structure is produced.

A clear conception of several embodiments of the invention may be had by referring to the drawing accompanying and forming a part of this specification in which like reference characters designate the same or similar parts in the various views.

Figure 1 is an elevation, partly in section and partly broken away, of a fragment of one form of blade segment, the section being taken along the line I—I of Fig. 2 looking in the direction of the arrow. Fig. 2 is a plan view of a fragment of the blade segment shown in Fig. 1, a portion of the shroud being broken away. Fig. 3 is a transverse vertical section through the blade segment and shroud shown in Fig. 1, the section being taken along the line III—III of Fig. 1 looking in the direction of the arrow. Fig. 4 is an elevation, partly in section and partly broken away, of a fragment of another form of blade segment, the section being taken along the line IV—IV of Fig. 5 looking in the direction of the arrow. Fig. 5 is a plan view of a fragment of the blade segment shown in Fig. 4, a portion of the shroud being broken away. Fig. 6 is a transverse vertical section through the blade segment and shroud shown in Fig. 4, the section being taken along the line VI—VI of Fig. 4 looking in the direction of the arrow. Fig. 7 is a transverse vertical section through still another form of shroud attached to a fragment of a blade. Fig. 8 is a fragmentary plan view of a shroud and blades such as are disclosed in Fig. 7.

The figures of the drawing disclose rotor or movable blading of a turbine of the parallel flow Parsons type, but it is to be understood that the invention is equally applicable to stator or stationary blading as well as to other types of turbines. As disclosed in the drawing, the blades 1 have their ends united with foundation segments 3 by fusion of metal, this union of the metals being accomplished by casting the foundation segment 3 directly upon the blade roots. The foundation segments 3 are properly machined for insertion within grooves of the turbine rotor, the segments being secured in place by calking or other suitable means. This portion of the disclosure is, however,

merely illustrative of one form of uniting the blades to the spindle, other well known means being equally feasible.

In each of the forms of the invention illustrated, the blades 1 have single-surfaced ends, the end surfaces being disclosed as planes perpendicular to the working faces of the blades, that is, perpendicular to the blade stock. This formation of the blades with
10 single-surfaced ends permits complete utilization of the blade stock without waste of material such as results when blades are provided with tenons or similar irregularities. As disclosed the shroud is constructed in
15 the form of a channel having parallel outwardly extending side walls, this construction permitting ready machining of the shroud to bring the same in close proximity to the turbine casing. This invention is not,
20 however, limited to channel shaped shrouds.

Referring specifically to Figs. 1, 2 and 3, the channel shaped shroud 2 is provided with a series of pockets or recesses for the ends of the blades 1. The recesses are
25 formed by forcing the portions 4 of the shroud stock in line with the blades 1 outwardly out of the normal cylindrical formation of the base of the shroud 2. The die used in distorting the metal during the operation of forming the recesses, is of the
30 same cross section as a blade, while the backing die is of any suitable shape adapted to prevent distortion of the portion 6 of the shroud between the blades 1. As the blades
35 1 when in normal position are of a projected width greater than the distance between the adjacent surfaces of the side walls of the shroud 2, the blade edges project into these walls and the metal directly in line
40 with these projecting edges which is displaced during the distorting operation, will of necessity have to be forced out of the side walls preferably into previously provided spaces in the backing die. It will be
45 noted that the shroud thus produced is imperforate and has formed directly thereon means for properly positioning, that is spacing and angling, the blade ends. After the shroud 2 has been provided with the
50 pockets or recesses, the shroud is brought in contact with the blade ends, the blade ends being inserted within the successive recesses and being thus properly positioned. With the blade ends thus properly positioned,
55 the blades and shroud are united by soldering, brazing, welding or other method of producing fusion of metal. In the drawing the brazing process is indicated as having been used, the added fusible material being represented as forming a fillet
60 adjacent the blade ends.

Referring specifically to the disclosure in Figs. 4, 5 and 6, the shroud 12 is provided with a series of recesses for positioning the ends of the blades, said recesses having their

bottoms flush with the normal base 16 of the shroud. The recesses in this case are formed by forcing the portions 14 of the shroud stock between successive blades inwardly out of the normal cylindrical formation of
70 the base 16 of the shroud 12. The die used in distorting the metal is of suitable form, the backing die having portions of the same cross section as a blade. After the shroud
75 12 has been provided with the recesses it is brought in contact with the single-surfaced ends of the blades and is united thereto at the recesses by fusion of metal, as indicated above. It will be observed that in
80 the form of the invention shown in Fig. 6, it is unnecessary to disturb the metal in line with the side walls of the shroud 12 as in the form of the invention shown in Fig. 3. In the drawing the means for uniting the
85 shroud 12 and blade 1 is represented by the fillet 15 of added fusible material, see Fig. 4.

Referring specifically to Figs. 7 and 8, the shroud 22 is provided with local projections 24 on the blade side of the shroud,
90 forming positioning means for the blade ends. The recesses between successive projections 24 are created by the forming of the projections 24. The projections are formed by locally forcing metal from the
95 normal base 26 of the shroud stock, between and adjacent successive blades, by means of a movable die having local projections positioned for properly spacing and angling the blades 1. This form of shroud 22 is
100 more specially applicable to the larger sizes of blading because of the increased distance between the limits of transverse contact between the positioning surfaces and one of the faces of the blade. With this form of
105 shroud the recessed projection at a blade is discontinuous with the corresponding recessed projection at an adjacent blade so that there will be less tendency to produce eddying of the steam between the blades. The
110 projections furthermore are located closely adjacent to and conform with the contour of the blade ends thereby tending to permit utilization of the entire working face of the blade.

In each of the forms of shroud disclosed,
115 it will be noted that the shroud is imperforate (the possible shearing in the form shown in Figs. 7 and 8 not being considered as perforating), being at the same time provided with means for properly spacing and
120 angling the blade ends. These features are of importance; the former since it permits production of a very light shroud of great strength, and the latter because the proper spacing and angling of the blades is of great
125 importance in attaining the highest efficiency in the turbine. The formation of the blades with single-surfaced ends permits utilization of the entire blade stock without waste. The distortion of an imperforate shroud pro-

duces a locally arched structure which when united with the blades by fusion of metal forms a completed structure of great rigidity and strength, especially to withstand vibration. It will also be noted that in each case the shroud is provided with recesses adjacent the blade ends, and with positioning surfaces which coact directly with the working faces of the blades. In some cases there are projections on the shroud for positioning the blades. In order to secure proper positioning of the blades, the positioning surfaces should be so formed as to coact with the working faces of the blades both transversely and longitudinally thereof to a considerable extent. This result is more especially easily accomplished in the construction shown in Figs. 1 and 7, although by using excessive pressures on the dies the same result will be attained in the remaining form shown.

It should be understood that it is not desired to be limited to the exact details of construction shown and described except as required by the scope of the appended claims, for obvious modifications will occur to a person skilled in the art.

It is claimed and desired to secure by Letters Patent,—

1. The process of providing a blade with a shroud comprising, forming said shroud

with means for positioning said blade, forming said blade with a single-surfaced end, applying said shroud to have said blade end coact with said means, and uniting said blade and said shroud by fusion of metal.

2. The process of providing a blade with a shroud comprising, forming surfaces on said shroud, applying said shroud to have the extreme end of said blade lie between adjacent surfaces, and uniting said blade and said shroud by fusion of metal.

3. The process of providing a blade with a shroud comprising, forming a recess in the shroud, applying said shroud to have the extreme end of said blade lie within said recess, and uniting said blade and said shroud by fusion of metal.

4. The process of providing a blade with a shroud comprising, forming the shroud with projections, applying the shroud to have the extreme end of said blade lie between successive projections, and uniting said blade and said shroud by fusion of metal.

In testimony whereof, the signature of the inventor is affixed hereto in the presence of two witnesses.

G. F. DE WEIN.

Witnesses:

W. H. LIEBER,
J. J. KANE.