C. E. SEARCH.

BLADE BRACING AND METHOD OF LOCATING THE SAME.

APPLICATION FILED FEB. 16, 1918.

1,309,816. Patented July 15, 1919.

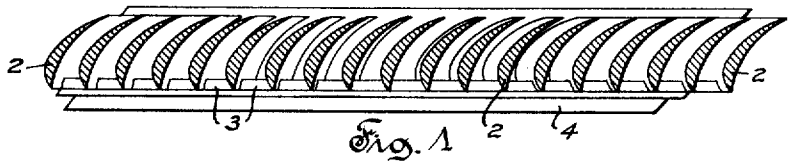


Fig. 1

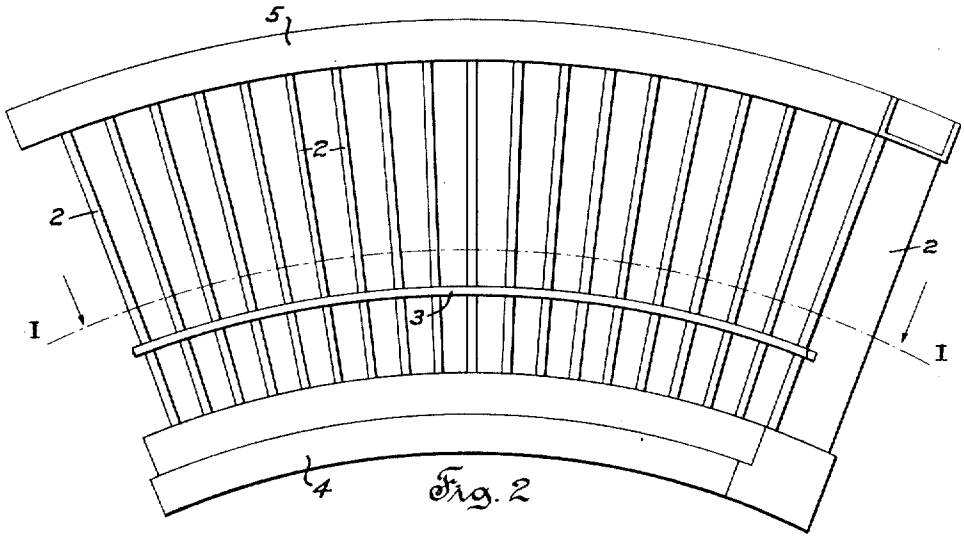


Fig. 2

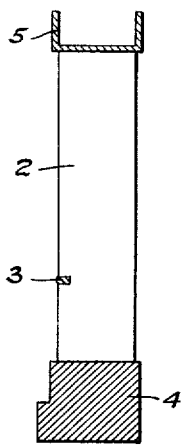


Fig. 3

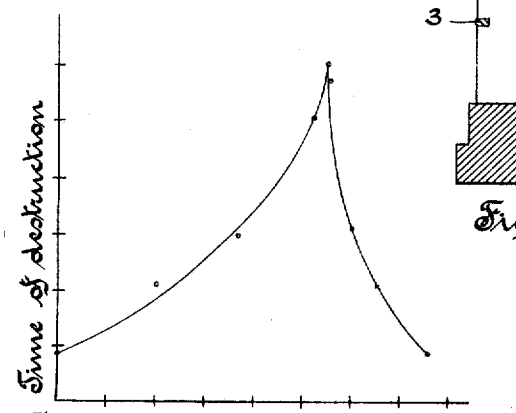


Fig. 4

Inventor
C. E. Search
by
Attorney

THE COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

CHARLES EDWIN SEARCH, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO ALLIS-CHALMERS MANUFACTURING COMPANY, OF MILWAUKEE, WISCONSIN, A CORPORATION OF DELAWARE.

BLADE-BRACING AND METHOD OF LOCATING THE SAME.

1,309,816. Specification of Letters Patent. Patented July 15, 1919.

Application filed February 16, 1918. Serial No. 217,985.

To all whom it may concern:

Be it known that I, CHARLES EDWIN SEARCH, a citizen of the United States of America, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented a certain new and useful Improvement in Blade-Bracings and Methods of Locating the Same, of which the following is a specification.

This invention relates to improvements in the construction of steam turbines and particularly to improved means for bracing relatively long and thin steam turbine blades, and to a method of determining the most efficient location of such means.

An object of the invention is to provide efficient means for bracing turbine blades. Another object is to provide a simple method of determining the most efficient location of the blade bracing means.

It has heretofore been customary to stiffen or brace relatively long turbine blades in order to prevent fracture thereof due to vibration, by connecting the successive blades at points intermediate their ends by means of a strip or ribbon of metal which was secured to the blades either by distorting the bracing strip or by fusion of metal. It has been common practice to arbitrarily position the bracing strips of the prior art, the usual location of the strips being midway between the ends of the projecting portions of the blades. While these bracing strips of the prior art strengthened the blading, it has been found that by positioning the bracing strip at definite points along the lengths of the blades, a structure of maximum rigidity and strength results. The most efficient location of the bracing strip may be definitely ascertained by making break-down vibration tests of similar segments of blades, each having the bracing strip located at a different distance from the blade roots. As an example embodying the results of such test, it has been found that for blades of approximately 7½" length the most efficient location of the strip is between one-fourth and one-third of the blade length, from their roots.

A clear conception of an embodiment 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 a transverse section through a rotor blade segment, the section being taken along the line I—I of Fig. 2 looking in the direction of the arrows.

Fig. 2 is a side elevation of a rotor blade segment showing a segment of a bracing strip properly located.

Fig. 3 is a transverse vertical section through the shroud, bracing strip, and foundation ring segments, the section being taken between two successive blades.

Fig. 4 is a curve adapted for use in determining the most efficient exact location of the bracing strip.

The rotor turbine blading of which a segment only is disclosed in the drawing, comprises a foundation ring segment 4, a shroud ring segment 5, a bracing ring segment 3 and a plurality of radial blades 2 interconnecting the ring segments. The blades 2 are rigidly secured at their roots to the foundation ring segment 4 in any suitable manner, the blade roots in the present case being secured by fusion of metal by casting the metal of the ring segment 4 directly around the blade roots. To the outer opposite ends of the blades 2 is rigidly secured the shroud ring segment 5 in any suitable manner, as by fusion of metal by brazing. The brazing ring segment 3 is rigidly secured to the thicker inlet edges of the blades by first notching these edges and inserting the ring segment within the notches, and then brazing or otherwise securing the ring segment 3 to the blades at their notched portions. The entire blading segment is therefore constructed as an integral, rigid, element which may be secured to the turbine rotor in any suitable manner as by calking, bolting or otherwise securing the same.

In determining the most efficient point of location of the shroud ring, it is desirable

to construct a number of sample blade segments which are of like construction throughout except for the location of the bracing ring segment 3. This bracing ring segment 3 is located at different distances from the blade roots in the various sample segments. The segments are then subjected to like break-down tests by vibrating the segments in a direction approximately perpendicular to the blades, that is, across their thickness. As the blades 2 are set at an angle to the shroud and foundation rings 5, 4, this vibration will also be in a direction at an angle to the plane of these rings. The vibration of the sample segments is continued until the blades 2 break, it being found that the blades generally break at or near the root ends thereof. By comparing the number of vibrations or the length of time necessary to fracture the blades of the various samples, approximately the most efficient point of location of the bracing strip is ascertained.

In order to ascertain exactly the most efficient point of location of the bracing strip other samples having the bracing strip located in the vicinity of the location of the strip producing the best results under the preliminary test, may be subsequently tested and the one selected showing the best results. The same result may also be arrived at by plotting a curve such as shown in Fig. 4, having the time of vibration to break-down as one coördinate and having location of the bracing strip along the blade length in inches as the other coördinate. This curve will rapidly reach a maximum point of time value and as rapidly recede therefrom. The point in question is therefore sharply defined.

It has been found by actual experiment that locating the strip at this most efficient point of location of the bracing strip 3 prolongs greatly the life of the blading. As heretofore stated, it has also been found that the most efficient location of the bracing strip is slightly more than one-fourth the length of the blades from the foundation ring for a given length of blades. In all cases it has been found that the most efficient location of this bracing strip 3 is less than one-half the length of the blades from the foundation ring. While the exact location may differ slightly for different types and shapes of blades, the present invention is applicable in all cases to properly locate the most efficient position of the bracing strip.

It should be understood that it is not desired to be limited to the exact details of construction herein described for various modifications will occur to a person skilled in the art.

It is claimed and desired to secure by Letters Patent:

1. In combination, a plurality of blades rigidly secured at corresponding ends to a foundation element, and bracing means cooperating with said blades intermediate their ends, said bracing means constituting the sole intermediate support and being nearer the fixed blade ends than the opposite ends of said blades.

2. In combination, a plurality of blades rigidly secured at corresponding ends to a foundation element, and bracing means cooperating with said blades intermediate their ends, said bracing means constituting the sole intermediate support and being less than one-third the length of the blades from their fixed ends.

3. In combination, a plurality of blades rigidly secured at corresponding ends to a foundation element, and bracing means cooperating with said blades intermediate their ends, said bracing means constituting the sole intermediate support and being between one-third and one-fourth of the length of the blades from their fixed ends.

4. In combination, a plurality of blades rigidly secured at corresponding ends to a foundation element, and bracing means cooperating with said blades intermediate their ends, said bracing means constituting the sole intermediate support and being between one-third and one-fifth of the length of the blades from their fixed ends.

5. In combination, a plurality of blades rigidly secured at corresponding ends to a foundation element, and bracing means cooperating with said blades intermediate their ends, said bracing means constituting the sole intermediate support and being between one-half and one-fifth of the length of the blades from their fixed ends.

6. In combination, a plurality of blades rigidly secured at their roots, and bracing means cooperating with said blades intermediate their ends, said bracing means constituting the sole intermediate support and being approximately one-fourth the length of the blades from their root ends.

7. In combination, a plurality of blades rigidly secured to each other at their opposite ends, and bracing means rigidly secured to said blades intermediate their ends, said bracing means constituting the sole intermediate support and being approximately one-fourth the length of the blades from their corresponding ends.

8. In combination, a plurality of blades rigidly secured at corresponding ends, and bracing means secured to the inlet edges of said blades intermediate their ends, said bracing means being nearer the fixed blade ends than the opposite ends of said blades.

9. In combination, a plurality of blades rigidly secured at corresponding ends to a foundation element, and bracing means secured to the inlet edges of said blades intermediate their ends, said bracing means be-

ing less than one-third the length of the blades from their fixed ends.

10. In combination, a plurality of radial blades rigidly secured at corresponding ends to a segmental foundation element, and bracing means coöperating with said blades intermediate their ends, said bracing means constituting the sole intermediate support for said blades and being nearer said foundation segment than the opposite ends of said blades.

In testimony whereof, the signature of the inventor is affixed.

C. EDWIN SEARCH.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents. Washington, D. C."