J. F. BRADY.

TURBINE.

APPLICATION FILED JULY 20, 1905. RENEWED JAN. 27, 1908.

1,008,306. Patented Nov. 14, 1911.

Fig. 1.

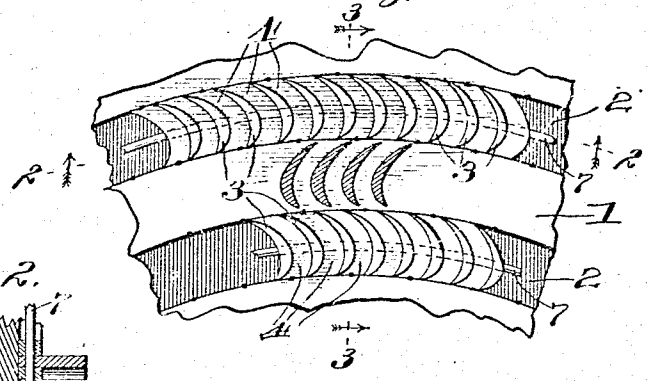


Fig. 2.

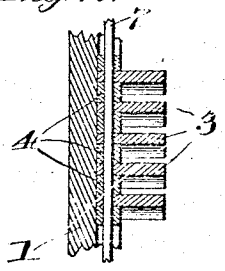


Fig. 4.

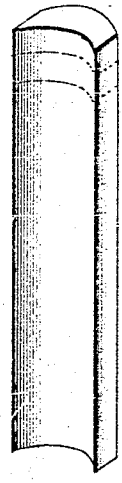


Fig. 5.

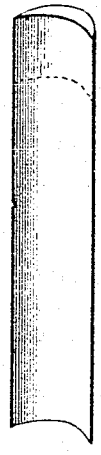


Fig. 3.

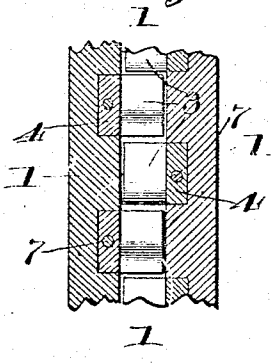


Fig. 7.

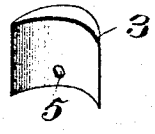


Fig. 6.

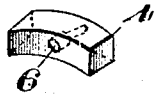
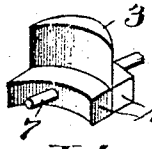


Fig. 8.



Witnesses.

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UNITED STATES PATENT OFFICE.

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TURBINE.

1,008,306. Specification of Letters Patent. Patented Nov. 14, 1911.

Application filed July 20, 1905, Serial No. 270,476. Renewed January 27, 1908. Serial No. 412,804.

To all whom it may concern:

Be it known that I, JOHN FRANKLIN BRADY, mechanical engineer, a citizen of the United States, and resident of Chicago, county of Cook, State of Illinois, have invented certain new and useful Improvements in Turbines, of which the following is a full, clear, and exact description.

This invention relates to blades and vanes for elastic fluid turbines.

In the manufacture of elastic fluid turbines of both radial and parallel flow types, it is now customary to mount the blades for the rotors and the vanes for the stators in annular grooves in the respective elements.

In some turbines with which I am familiar, the blading material is drawn or rolled or otherwise formed into suitable bars of the desired cross-section and the blades or vanes are then cut off of the proper length. These blades and vanes are then mounted in the annular grooves in the turbine elements and are spaced apart in the rows by means of spacing elements. The spacing elements are short lengths of rod made like the blades and of the desired cross-section to hold the blades the proper distance one from the other in the annular rows.

It has been customary in some makes of turbines, such as the "Parsons" turbines, to assemble the blades and vanes and spacing elements separately; that is, one at a time, and thereafter to calk or fuller the spacing elements so that they spread, thereby gripping the walls of the slots or grooves and bases of the blades or vanes. With this method it will be seen that it is necessary first to machine the turbine blade-holding-element, such as the rotor or stator, and to form therein the annular grooves, slots or recesses for the reception of the blades or vanes. The individually formed blades and spacing elements are then mounted separately and individually in the grooves, and, during the mounting, the spacing elements are slightly fullered in order that a complete row, or a desired portion of a row, may be assembled and held in place. After this, it is necessary to go over the row again and again fuller or calk the spacing elements permanently; that is, sufficient pressure must be applied to the upper or exposed portion of each spacing element after the row is completely filled, or a desired portion thereof, to spread the spacing elements transversely to the applied pressure sufficiently to fill the grooves or slots and to grip the walls of the adjacent blades or vanes, so that they will be held firmly against the vibration and centrifugal forces encountered. While this method has been practiced to a large extent, it has been found to be more or less objectionable in the assembling of turbines and it has further been found that repairs in the field, such as the replacement of blades or vanes, are made with great difficulty.

In order to overcome many of the difficulties in practicing the above method and in order to form blade strips or partial rings, semi-circles or segments, Messrs. Parsons, Stoney and Fullagar, as illustrated in United States Patent No. 655,414 utilize a base or foundation ring having teeth milled in one side thereof; blades or vanes are placed within the slots between the teeth and the teeth are bent over to grip the bases of the blades or vanes. These blade strips or assembled groups permit the use of rolled or drawn blading material of the proper cross-section, such as had been used in the method utilizing the separately formed spacing elements and facilitated the manufacture of turbines by permitting the assembled groups of blades or vanes to be finished ready for insertion in the grooves of the blade-holding-elements while said elements were being finished to receive the same.

Since Messrs. Parsons, Stoney and Fullagar made their invention in assembled groups of blades, numerous other attempts have been made to form assembled groups which would be superior to those illustrated in said Patent No. 655,414, but all with which I am familiar have utilized one or more base or foundation strips necessitating accurate and expensive machine work and most of them require the deformation of the blade or vane roots or bases.

An object of this invention is to provide means for uniting separately formed blades or vanes and spacing elements into assembled groups or strips ready for mounting in the turbine elements; and for providing means for anchoring the collectively inserted

blades or vanes forming the groups or strips in place in the blade or vane-holding-elements of the turbine.

With this invention the blades and spacing elements are formed just as they are for the method heretofore largely used in the "Parsons" type of turbines; that is, the blades, vanes and spacing elements are cut from stock which is either drawn or rolled, or otherwise formed, into rods of the proper cross-section. One end of each blade or vane and each spacing element has a hole extending through it from front to back; the hole may be either punched or drilled, as desired. The punched or drilled blades or vanes and spacing elements are then assembled on a rod or wire which, when it contains the desired number to form a group or strip, may have its ends upset or riveted in order that the group or strip will be more or less rigid in its nature.

In the drawings, throughout which like parts are designated by similar characters; Figure 1 is a fragmentary face view of one of the blade or vane-holding-elements of a radial flow turbine taken on line 1—1 of Fig. 3 showing in section the blades or vanes of the other blade or vane-holding-element of the turbine; Fig. 2 is a sectional view on line 2—2 of Fig. 1; Fig. 3 is a sectional view on line 3—3 of Fig. 1; Figs. 4 and 5 are detail perspective views of rod from which spacing elements and blades of the proper lengths may be cut, as shown by dotted lines in said figure; Fig. 6 is a view in perspective of a finished spacing element; Fig. 7 is a view in perspective of a finished blade or vane; and, Fig. 8 is a detail perspective view of a blade or vane interposed between two spacing elements; this view illustrates the manner of assembling the blades or vanes and spacing elements upon a rod or wire to form assembled groups or strips.

In carrying out this invention, the assembled groups or strips may be of any desired length; that is, they may include any desired number of blades or vanes and spacers and may either be formed curved or straight.

As illustrated in Figs. 1, 2 and 3, the invention is shown as applied to a turbine of the radial flow type. It will be understood, however, that I do not wish to be limited to this type of turbine, as the invention is equally applicable to turbines of the parallel flow type. The blade and vane-holding-elements—both being designated by numeral 1—are provided with annular slots or recesses into which the assembled groups, made up of blades or vanes 3 and spacing elements 4, are inserted. Each of the blades or vanes 3 is provided with a punched or drilled hole 5, while the spacing elements are provided with a similar hole 6. The blades or vanes and spacing elements are arranged in alternate order on the rod or wire 7. If desired, the hole through the spacing elements located at opposite ends of a group or strip may be enlarged to receive the upset ends of the wire or rod. In radial flow turbines, after the blade groups or strips have been inserted, I desirably anchor the same in place by the application of a suitable punch which may be applied at the juncture of the margins of the spacing elements and the walls of the slots or recesses, as illustrated in Fig. 1. In parallel flow turbines, the assembled groups may be secured within the grooves in slots of the turbine element in any well-known manner; the spacers may be fullered or calked, or a soft metal strip may be placed alongside the groups in the groove or slot and the strip calked as described in the Parsons, Stoney and Fullagar Patent No. 655,414.

In accordance with the provisions of the patent statutes, I have described one means of carrying out my invention, together with the product which I now consider to represent the best embodiment thereof, but I desire to have it understood that the product shown is only illustrative and that the invention can be carried out by other means. I would further have it understood that the term "blades" is intended to include vanes or similar elements either in the stater or rotor.

What I claim is:

1. An assembled group of blades for use in turbines comprising blades, separate spacing elements and means for uniting the same in alternate order.

2. An assembled group of turbine blades consisting of blades and spacing members mounted and arranged in alternate order upon a rod or wire.

3. An assembled group of turbine blades consisting of blades, a binding member extending longitudinally of said group and to which said blades are attached and means for spacing said blades.

4. A plurality of alternately arranged blades with separate spacing elements in combination with a binding member extending through holes provided in the blades and in the spacing pieces.

5. In combination with a turbine blade holding-element, an assembled group of blades comprising blades, separate spacing elements, means for uniting the same in alternate order and means for anchoring the assembled group to the blade holding-element.

6. In a turbine, the combination of a blade holding-element provided with a recess, a plurality of blades and spacing elements, means uniting the same in alternate order and means for anchoring the united parts in said recess.

7. In a turbine, the combination of a blade

holding-member provided with a recess, a plurality of alternately disposed blades and spacing elements united by a wire or rod and means for anchoring the united parts within said recess.

8. In a turbine, the combination of a blade holding member provided with a recess, a plurality of blades and spacing elements, means uniting said blades or vanes and spacing elements in alternate order and means for anchoring said spacing elements in said recess.

9. In a turbine, the combination of a blade holding-element, a plurality of blades and spacers, means for uniting the blades and spacers into an assembled group independent of the blade-holding element and means for anchoring said assembled group to the blade-holding-element.

10. In a turbine, the combination of a blade holding-member, a plurality of blades and spacing elements, means engaging said spacing elements and said blades approximately at the base thereof for uniting the same into an assembled group and means for securing said group in operative position upon said blade holding member.

11. In combination in a turbine, a blade holding-element, blades comprised in a row, spacing pieces located between the ends of the blades of said row and having faces conforming in contour with the concave and convex faces of the blades and a binding member passing through the blades and spacing pieces.

12. In combination in a turbine, a blade holding-element provided with a recess, blades comprised in a row, spacing pieces located within said recess between the ends of the blades and having faces conforming in contour to the concave and convex faces of the blades and a binding member passing through the blades and spacing pieces and located within said recess.

13. In a turbine, a blade holding-element, blades of vanes extending therefrom, a binder strip passing through the blades and separate spacing elements mounted on said strip between the adjacent blades.

14. An assembled group of turbine blades consisting of blades, spacing means and a wire or rod for locking said blades to said spacing means.

15. An assembled group of turbine blades consisting of blades, spacing means and an agent, independent of said spacing means, for locking said blades to said spacing means.

16. A plurality of alternate blades and intermediate spacing pieces comprised in a row, a binding member projecting through holes provided in the bases of the blades and in the spacing pieces for uniting the blades and the spacing pieces together.

17. A plurality of alternately arranged blades and intermediate spacing pieces comprised in a row and means extending through holes provided in said blades for uniting the blades and the spacing pieces together.

18. A plurality of blades comprised in a row, intermediate spacing pieces located between adjacent blades and provided with faces conforming in contour with the contour of the contacting faces of the blades and means for securing said blades and said pieces into an assembled row.

19. A substantially flexible bladed strip ready for insertion in a turbo-machine groove comprising blades, separate distance pieces and substantially flexible connecting means which are of less width than the roots of the blades.

20. The herein described new article of manufacture comprising a plurality or series of blades spaced apart and fastened together at their bases in such manner as to form a common base, therefor, substantially as described.

21. The herein described new article of manufacture, comprising a plurality of turbine blades and a plurality of spacers arranged in series and permanently secured together in such relation, the base formed by the ends of said blades and said spacers being shaped to fit the groove of a turbine member, substantially as described.

22. A substantially flexible bladed strip ready for insertion in a turbo-machine groove, comprising blades, separate distance pieces and substantially flexible connecting means introduced into the distance pieces and roots of the blades.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN FRANKLIN BRADY.

Witnesses:
CARL H. CRAWFORD,
CLARA HEYMANN.