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BLADING FOR TURBINES.

APPLICATION FILED MAY 26, 1908.

943,347. Patented Dec. 14, 1909.

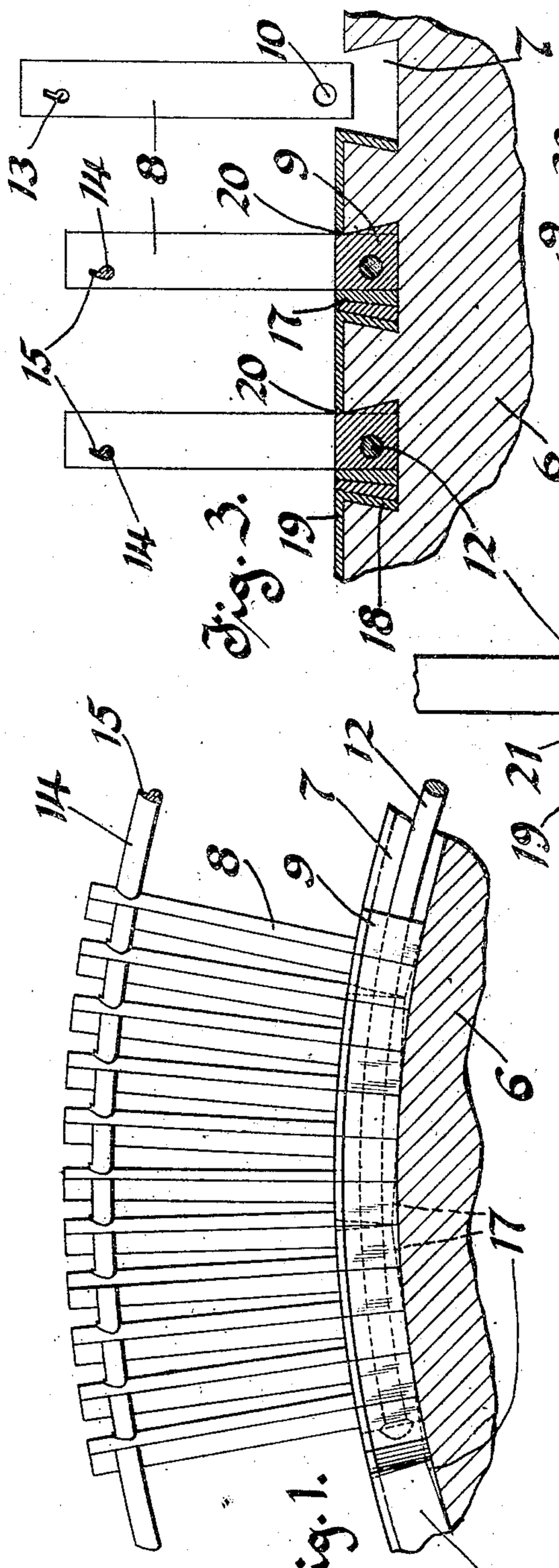

Fig. 1.



Fig. 3.



Fig. 4.



Fig. 5.



Fig. 6.



Fig. 2.

WITNESSES:

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# UNITED STATES PATENT OFFICE.

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## BLADING FOR TURBINES.

943,347. Specification of Letters Patent. Patented Dec. 14, 1909.

Application filed May 26, 1908. Serial No. 435,076.

*To all whom it may concern:*

Be it known that I, FRANCIS HODGKINSON, a subject of the King of Great Britain and Ireland, and a resident of Edgewood Park, in the county of Allegheny and State of Pennsylvania, have made a new and useful Invention in Blading for Turbines, of which the following is a specification.

This invention relates to blading means for elastic fluid turbines and also to means for protecting the working elements of the turbine; that is, the peripheral face of the rotor element and the interior peripheral face of the stator element or stationary blade-carrying element from the corrosive and erosive action of the motive fluid.

An object of this invention is the production of simple and effective means for blading the turbine, which is adapted to effectively secure in place a protective covering for the blade-carrying element of the turbine.

The corrosive and erosive action encountered in elastic fluid turbines may result from chemical impurities in the boiler feed water, such for instance, as acids, or it may result from the corrosive action of distilled water; that is, the water of condensation, and the erosive action of the motive fluid and the water of condensation in their passage through the turbine. Whatever the cause the fact remains that the exposed surfaces of the working elements are at times and under certain conditions badly pitted and corroded. The cast iron casing is usually more actively attacked, but the rotor element is sometimes attacked and I, therefore, contemplate providing a protective covering which may be effectively secured to both the stationary casing and the rotating element.

In the drawings accompanying this application and forming a part thereof: Figure 1 is a transverse section of a fragment of the rotor element of the turbine and discloses in elevation blades and spacing pieces located within a blade-mounted slot; Fig. 2 is a transverse section of a fragment of the stator or stationary blade-carrying element of a turbine and discloses in section an embodiment of my invention; Fig. 3 is a longitudinal section of a portion of the stator element taken at right angles to the section of Fig. 1; Fig. 4 is a plan view of blades and vanes secured to a blade-carrying element and embodying my invention; Fig. 5 illustrates in perspective a detail of my invention; and, Fig. 6 is a partial transverse section of a blade-carrying element and illustrates a detail embodied in my invention.

The blade-carrying element of the turbine is provided with a plurality of blade-mounting slots 7 in which the blades 8 and intermediate spacing pieces 9 are secured. Each blade is provided near its base with a hole 10 which extends transversely therethrough and each spacing piece is provided with a hole 11 which extends transversely through it and which is so located as to register with a hole 10 of an adjacent blade when located in the blade-mounting slot. Blades and alternate spacing pieces are assembled in a segmental strip or section by mounting a number of the blades and the intermediate spacing pieces on a binder wire 12 which is threaded through the holes 10 and 11 respectively of the blades and pieces. Any suitable method may be employed for assembling the blades and pieces on the wire and after they are in place the ends of the binding wire may be riveted over to secure them together and to form a fairly rigid segmental strip. The outer or free ends of the blades are provided with comma-shaped holes 13, through which a binding wire 14 of comma-shaped cross-section extends. The binding wire is secured to the blades and is caused to space the outer or free ends by having the tail-shaped fin 15 sheared and bent over between adjacent blades. After the blades and spacing pieces are assembled in segmental strips, the strips are secured in the mounting slots by means of coöperating wedges which are driven home, one beside the other, between the segmental strips and one wall of the mounting slot. The slots 7 are preferably undercut and one lateral face of each spacing piece 9 is inclined as shown at 16, Fig. 5, to correspond to the inclination of the adjacent undercut wall of the slit. The other lateral face of each spacing piece extends at right angles to the top and bottom faces of the piece. The segmental

strips are preferably secured in the undercut walls by means of double or compound tapered wedges 17. The wedges 17 are also utilized to secure the flange 18 of the L-shaped protective strips 19 into the slots. Each protective strip is so formed that the major portion of the strip lies closely in contact with the peripheral surface of the blade-carrying element when the flange 18 extends into the slot and is in contact with one wall of the slot. The major portion of the strip is of sufficient width to cover the portion of the blade-carrying element intermediate adjacent blade-mounting slots. Each base piece 9 extends beyond the mounting slot an amount equal to the thickness of the protective strip 19 and is provided with a laterally projecting or overhanging lug 20, against which the free edge of the strip 19 abuts and by which it is secured in place.

In mounting the blades and the protective strips to the blade-carrying element the blades 8 and the spacing pieces 9, after they are assembled to form a segmental strip, are introduced into one of the blade-mounting slots 7 and are so located in the slot that the inclined faces of the spacing pieces 9 fit snugly against one of the undercut walls of the slot. The flange 18 of a protective strip is then introduced into the slot adjacent the other undercut wall and the strip and the blades are then secured in place by compound tapered wedges 17 which are introduced into the slot between the vertical faces of the spacing pieces 9 and the inclined flange 18 of the protective strip. The wedges are arranged in pairs and are so constructed that, when driven home, the two wedges of each pair conjointly form a wedge-shaped key which effectively secures the blade strip and the flange 18 of the protective strip in place, and which is prevented by its shape and the shape of its component wedges from being dislodged from the slot by centrifugal or any other dislodging force. The segmental strips are of such lengths that several are required to make up an annular row of blades and they are so arranged at their ends that they may be inserted into the blade-mounting slots 7 end to end without destroying the spacing of the blades. A number of pairs of the compound tapered wedges are employed to secure each segmental strip in a slot. The wedges are preferably so spaced within the slots that the component wedges of one pair abut against the corresponding component wedges of adjacent pairs. Since it is necessary to leave considerable space between the first and last pairs of wedges so introduced into a blade-mounting slot, I have provided special means for securing the component wedges of these pairs in place and I have illustrated the same in Fig. 6. A simple wedge 21 and a rectangular key 22 are cut to such lengths as to fit into the blade-mounting slot 7 between wedges of the first and last pairs introduced into the slot. The wedge 21 is introduced into the blade-mounting slot and is so located within the slot that its inclined face contacts with an undercut wall of the slot, and the key 22 is introduced into the slot between the wedge and the segmental blade strip. The wedge is of such a width that it projects beyond the slot a predetermined amount and the key and wedge are secured in place by peening or calking over the projecting edge of the wedge. Such an arrangement prevents any possibility of the wedges becoming displaced or loosened in the slots. The overhanging lugs 20 of the spacing pieces 9 mounted in the next adjacent blade-carrying slot are effective in securing the free edge of the base strip 9 rigidly in place. This construction holds the outer edge of the strip rigidly in place and prevents a distortion of the strips 19 which might be caused by centrifugal force in case the strips were utilized on the rotor element.

In Fig. 2 I have illustrated blades and vanes in connection with a fragmental section of the stationary blade-holding element, and while I have utilized the term "blade" throughout the specification, I wish it to be understood that I do not wish to limit myself to the moving blades, but wish to include the stationary blades or "vanes" as they are sometimes called.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other means.

What I claim is:

1. The combination of the turbine element provided with a slot, blade securing means in said slot, a protector element for the turbine element having a portion in the slot and wedges interposed between the protector element and the blade-securing means, the wider portion of said wedges being at the bottom of the slot whereby the blade holding means, the wedges and the protector element are held against displacement.

2. A turbine element provided with an undercut slot, blade holding means in said slot, a lining, having a portion extending into the slot, and wedges interposed between the lining and blade holding means.

3. A turbine element having an undercut slot, a plurality of alternately arranged blades and spacing pieces in said slot, said

blades and spacing pieces having an alining opening and binding member passing through said opening, a lining for the turbine element having a portion extending into the slot and wedges interposed between the blades and spacing pieces and the lining member, said wedges being in a slot.

In testimony whereof, I have hereunto subscribed my name this 16th day of May, 1908.

FRANCIS HODGKINSON.

Witnesses:

CHARLES W. MCGHEE,

E. W. MCCALLISTER.