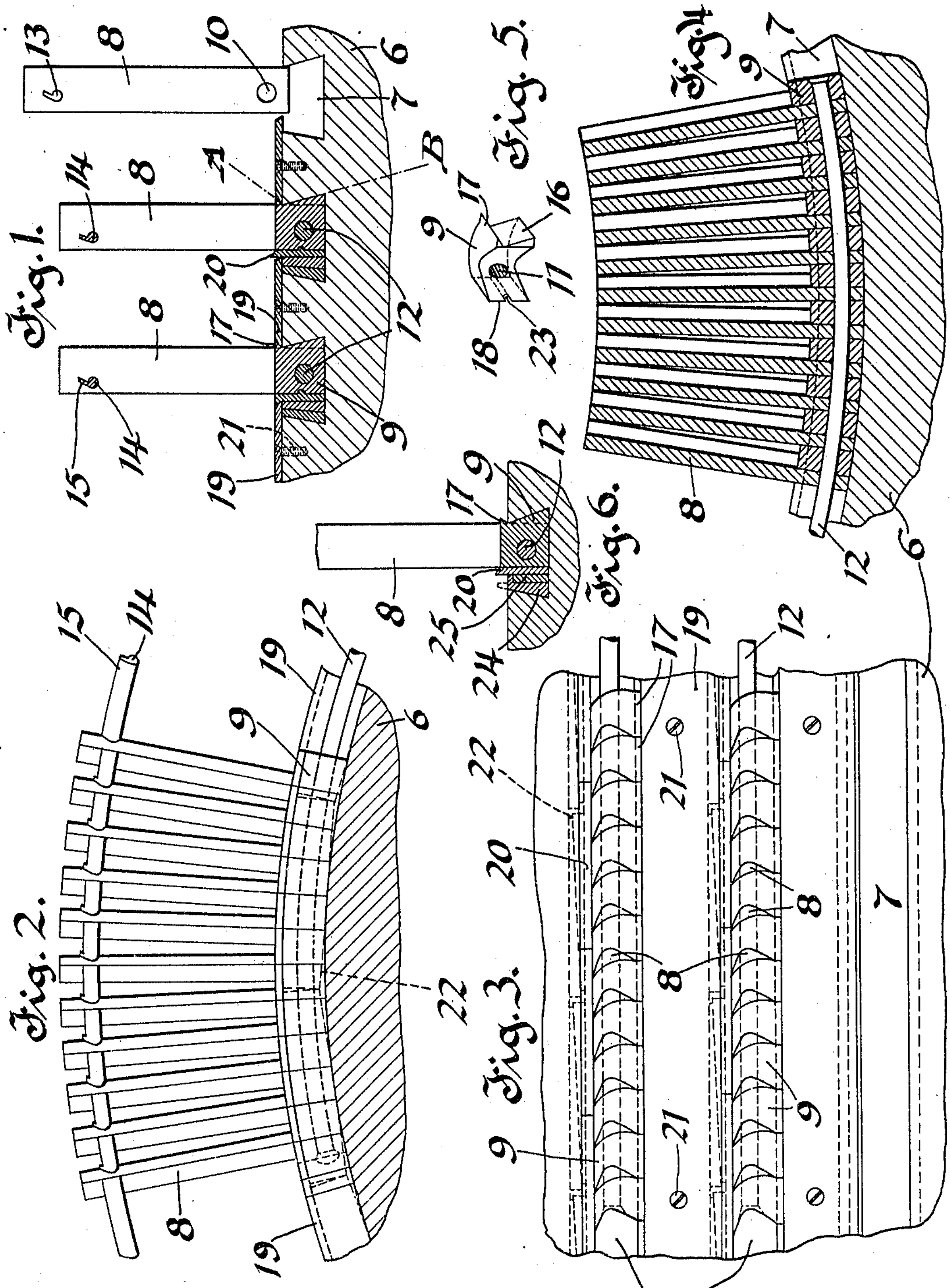
F. HODGKINSON.

STEAM TURBINE CYLINDER LINING.

APPLICATION FILED JUNE 12, 1908.

945,392. Patented Jan. 4, 1910.



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STEAM-TURBINE-CYLINDER LINING.

945,392. Specification of Letters Patent. Patented Jan. 4, 1910.

Application filed June 12, 1908. Serial No. 438,164.

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 Steam-Turbine-Cylinder Lining, 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 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 a turbine in conjunction with means for effectively securing a protective covering for the blade-carrying element in place on the element.

A further object is the production of a simple and effective means for assembling the blades in segmental strips and for rendering the operation of renewing blades in a turbine a simple matter.

The erosive and corrosive action encountered in turbines may result from chemical impurities in the boiler feed water, such, for instance, as organic or inorganic acids, or it may result from the corrosive action of distilled water, that is, the water of condensation, and the erosive action of 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 blade-carrying element of the turbine.

In the drawings accompanying this application and forming a part thereof: Figure 1 is a fragmental section taken longitudinally of the turbine of a rotatable blade-carrying element; Fig. 2 is a partial section taken along the line A—B of Fig. 1; Fig. 3 is a plan view of the rotatable blade-carrying element of a turbine provided with blades and a protective covering secured in place in accordance with my invention; Fig. 4 is a fragmental section, taken longitudinally of the turbine, of a stationary blade-carrying element; Fig. 5 is a perspective view of a spacing piece which forms a detail of my invention; and Fig. 6 is a fragmental section of a blade-carrying element and illustrates a detail of my invention.

My invention contemplates assembling the blades and the intermediate spacing pieces, which are located between the bases or roots of the blades, into segmental strips, and providing means for securing both the blade strips and protective strips for the blade-carrying element to that element.

The blade-carrying element 6 of the turbine is provided with a plurality of under-cut blade-mounting slots 7 in which blades 8 and intermediate spacing pieces 9 are assembled. Each blade is provided near its base with a hole 10, which extends transversely through it, and each spacing piece 9 is provided with a hole 11 which extends transversely through it and which is so located within the piece as to register with a hole 10 of an adjacent blade 8 when the blades and spacing pieces are assembled in a blade-mounting slot. The blades 8 and spacing pieces 9 are, before they are introduced into the blade-carrying slot 7, assembled into segmental strips or sections by threading a number of alternately arranged blades and spacing pieces onto a binder wire 12, which is adapted to be threaded through the holes 10 and 11 of respective 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 wire may be riveted over to secure them together and to form a 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 is adapted to extend. The binding wire is secured in place by shearing, on each side of each blade and bending over between adjacent blades, a longitudinally-extending rib 15 which is formed integrally with the wire 14. The bent-over portion of the rib forms spacing pieces which are secured to the main body portion of the wire 14 and which positively lock the outer ends of the blades permanently in their relative positions. The main body portion of the wire acts as a binder for the outer or free ends of the blades. The lateral

face 16 of each spacing piece is so inclined, relative to the top and bottom faces of the piece, as to conform to the inclination of the undercut walls of the blade-mounting slots 7. A laterally projecting lug 17 is formed at or near the top of the piece and on the same side as the inclined face 16. The lug is so located as to project beyond the walls of the slot and to overhang the adjacent wall when the piece is in place in a blade-mounting slot. The other lateral face 18 of each piece extends at right angles to the top and bottom faces. After the blades and spacing pieces have been assembled in the segmental strips, the strips are secured in the blade-mounting slots by means of co-operating wedges 22 which are driven home in pairs, one wedge beside the other, between the segmental strips and one wall of the mounting slot.

Protective strips 19 are adapted to be secured to the blade-carrying element between adjacent rows of blades. These strips are secured in place by means of the lugs 17 of the spacing pieces 9, located in one blade-mounting slot, and a locking piece 20 which is located and secured in place in the next adjacent blade-mounting slot. The piece 20 is adapted to be peened over and thereby caused to engage one edge of the protective strip 19. Each segmental blade strip is so located within a blade-mounting slot 7 that the inclined face of the base strip, formed by the inclined faces 16 of the intermediate pieces, contacts with one of the undercut walls of the slot. The locking pieces 20, which are cut to about the same lengths as the wedges, that is, to subtend about four spacing pieces, are introduced into the blade-mounting slot adjacent to the vertical faces 18 of the spacing pieces 9 comprised in the assembled blade strip and the wedges are then introduced into the slot between the pieces 20 and the other undercut wall of the slot. The pieces 20 are so constructed that the upper edge of each piece projects beyond the wedges and beyond the walls of the slot. The wedges are preferably compound tapered wedges and are so constructed, that when driven home, the two wedges of each pair conjointly form a wedge shaped key which effectively secures the assembled blade strip into the blade-mounting slot 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. After the assembled blade strips and the locking pieces 20 are secured into the blade-mounting slots the protective strips 19 are then located between adjacent rows of blades. The strips are curved to correspond to the curvature of the peripheral face of the blade-carrying element, and they are cut into convenient lengths for handling and securing in place. Each strip is of sufficient width to cover the portion of the blade-carrying element located between two adjacent blade-mounting slots 7 and also the mounting wedges 22 located in one of the slots 7. One beveled edge of a strip 19 is so placed as to abut against and to be secured in place by the overhanging lugs 17 of one assembled blade strip, mounted in a slot 7, and the other beveled edge of the strip extends into close proximity with the locking pieces 20, located in the next adjacent slot 7. The projecting edge of each piece 20 is then peened or calked over and thereby caused to engage the adjacent beveled edge of the protective strip and lock the strip in place. In addition to the overhanging lugs 17 and the locking pieces 20, the protective strips 19 may, if desired, be secured to the blade-carrying element by means of screws 21, which are spaced along the strip and are secured to the blade-carrying element.

Each spacing piece 9 is preferably provided with a slot 23 which extends longitudinally of the blade-mounting slot 7 across face 18 of the piece. These slots 23 are provided in order that the locking pieces 20 may be positively locked to the spacing pieces 9 and thereby secured in place. The pieces 20 are preferably made of some soft metal that will, under the influence of the lateral pressure exerted by the wedges, when they are driven home, flow into and fill or partially fill the slots 18, and thereby positively lock the pieces 20 to the assembled blade strip.

The blade strips are assembled in 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 compound wedges are employed to secure each segmental strip in a slot. The wedges are preferably so shaped within the slots that the component wedges of each pair abut one against the other. Such an arrangement prevents the component wedges of each pair from moving longitudinally and from thereby being dislodged from the slot.

In Fig. 6 I have illustrated suitable means for securing in place the component wedges of the first and last pairs introduced into a slot. A simple wedge 24 and a rectangular key 25 are cut to such lengths as to snugly fit into the blade-mounting slot between the component wedges of the first and last pairs introduced into the slot. The wedge 24 is so located in the slot that its inclined face contacts with the undercut wall of the slot and the key 25 is then dropped into place between the wedge 24 and the adjacent locking piece 20. The wedge 24 is of such width that it projects beyond the walls of the slot 7. The key and the wedge, after they are in place, are permanently secured in the slot

by peening or calking over the projecting edge of the wedge 24, so that the key 25 is locked in place by being enveloped by the wedge and the adjacent piece 20. Such an arrangement absolutely prevents the wedges from moving longitudinally in the slots and therefore permanently locks them in place. The pieces 20 are preferably spaced to correspond to the spacing of the wedges.

Throughout this specification and in the claims I have utilized the terms "blade" and "blades" in their broadest sense, that is, to mean either the moving or stationary blades or buckets of a turbine. The term "blade-carrying element" is also used in the broad sense and means the stationary or rotating blade or bucket carrying element of a turbine. I, therefore, wish it to be understood that I do not limit this invention to either the stationary or moving blade-carrying element of a turbine and that it is sufficiently broad to include various and different kinds of turbine blades or buckets.

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

What I claim is:

1. In combination in a turbine, a blade-carrying element provided with a plurality of slots, a plurality of blades and intermediate spacing pieces assembled in segmental blade rings and located in the slots of said element, protective strips for said element located between adjacent rows of blades, lugs provided on the intermediate spacing pieces comprised in one blade ring, and a locking piece located in the next adjacent blade mounting slot for securing said protective strip in place, and component tapered wedges located in the slots of said element for securing said blade rings and said locking pieces to said element.

2. In combination in a turbine, a blade-carrying element provided with a plurality of rows of blades secured thereto, a protective strip located between adjacent rows of blades, and screws for securing said strip to said element.

3. In combination in a turbine, a blade-carrying element, a protective covering for said element and screws for securing said covering to said element, means for securing blades and the protective covering to the blade-carrying element of a turbine as herein described and illustrated.

4. In combination in a turbine, a blade-carrying element provided with a plurality of slots, blades and intermediate spacing pieces located in said slots, a protective strip for said element, means comprising lugs formed integrally with said spacing pieces, and a locking piece secured to said element for mounting said strips on said element.

5. In combination in a turbine, a blade-carrying element provided with a plurality of slots, blade strips mounted in said slots, protective strips for said element located between adjacent slots, means comprising lugs formed integrally with said blade strips, and a locking piece secured to said element for mounting said protective strip to said element.

6. In a turbine, a blade-carrying element provided with a slot, means for securing blades in said slot, a protective covering for the blade-carrying element having a portion overhanging the edge of the slot and means for securing the first named means in the slot and for engaging the protective covering.

7. In a turbine, a blade-carrying element provided with a slot, means for securing a plurality of blades together to provide a built-up section, means for securing the built-up section in the slot and terminating in the same plane as a surface of the blade-carrying element, a protective covering for the blade-carrying element and projecting over the securing means and means for securing the protective covering to the blade-carrying element.

8. A spacing piece for turbine blading comprising a body portion having an inclined side and a straight side, the straight side being provided with a groove and an outstanding projection to engage a protective covering.

9. A spacing piece for turbine blading comprising a body portion having an inclined side and a straight side, the straight side being provided with a groove and the body portion having a hole therein.

10. A turbine element having a groove, a blading section made up of blades and spacing pieces, means for securing the spacing pieces and blades together, wedges in the slot the tops of which terminate at a point in line with the surface of the element, a locking piece interposed between the wedges and the blading section and projecting beyond the surface of the element, and a protective covering for the element adapted to lie against the surface thereof, the edge of said covering being engaged when in place by the portion of the locking piece outside the slot.

11. In combination in an elastic fluid turbine, a blade-holding element provided with a blade-mounting slot, alternately arranged blades and spacing pieces located within said slot, means for securing said blades into said slot, a protective strip for said blade-carrying element and means, secured to each spacing piece, for securing said protective strip in place.

12. In combination in an elastic fluid turbine, a blade-carrying element provided with a plurality of blade-mounting slots, alternately arranged blades and spacing pieces located in each slot, protective strips for said blade carrying element, means for securing said blades and said strips in place in said slots and means, formed integrally with each spacing piece, for securing in place the outer edge of the protective strip mounted in the next adjacent slot.

13. In combination in an elastic fluid turbine, a blade-carrying element provided with a blade-carrying slot, blades and intermediate spacing pieces mounted in said slot, a protective strip for said blade-carrying element and means, formed integrally with said spacing pieces, for securing said strip in place.

14. In combination in an elastic fluid turbine, a blade-carrying element provided with blade-mounting slots, a protective strip for said element, blades and intermediate pieces located within said slot, and means formed integrally with said spacing pieces for securing said protective strips in place.

15. In combination in an elastic fluid turbine, a blade-carrying element provided with a blade-mounting slot, a protective strip for said element, alternately arranged blades and spacing pieces located in said slot and an overhanging lug formed integrally with each piece and projecting from said slot to secure said protective strip in place.

16. In combination with a turbine, a blade holding element provided with an undercut slot and a blade strip comprising alternately arranged blades and spacing pieces, said spacing pieces being provided each with one inclined face and three vertical faces.

17. In a blade-mounting strip comprising blades provided at one end with a hole extending transversely therethrough, spacing pieces provided with end faces, conforming in contour with the adjacent faces of said blades, and with one vertical and one inclined lateral face and located between adjacent blades and means extending through holes provided in said end pieces for securing the blades and pieces together.

18. In combination with a blade mounting element provided with blade-mounting slots, blades located within said slots and spacing pieces located between adjacent blades and provided with end faces forming in contour with the adjacent faces of the blades and one inclined and one vertical lateral face.

In testimony whereof, I have hereunto subscribed my name this 4th day of June, 1908.

FRANCIS HODGKINSON.

Witnesses:
CHARLES W. MCGHEE,
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