C. E. SWEET.

BLADING AND LINING FOR TURBINES.

APPLICATION FILED JUNE 25, 1908.

997,216. Patented July 4, 1911.

Fig. 2.

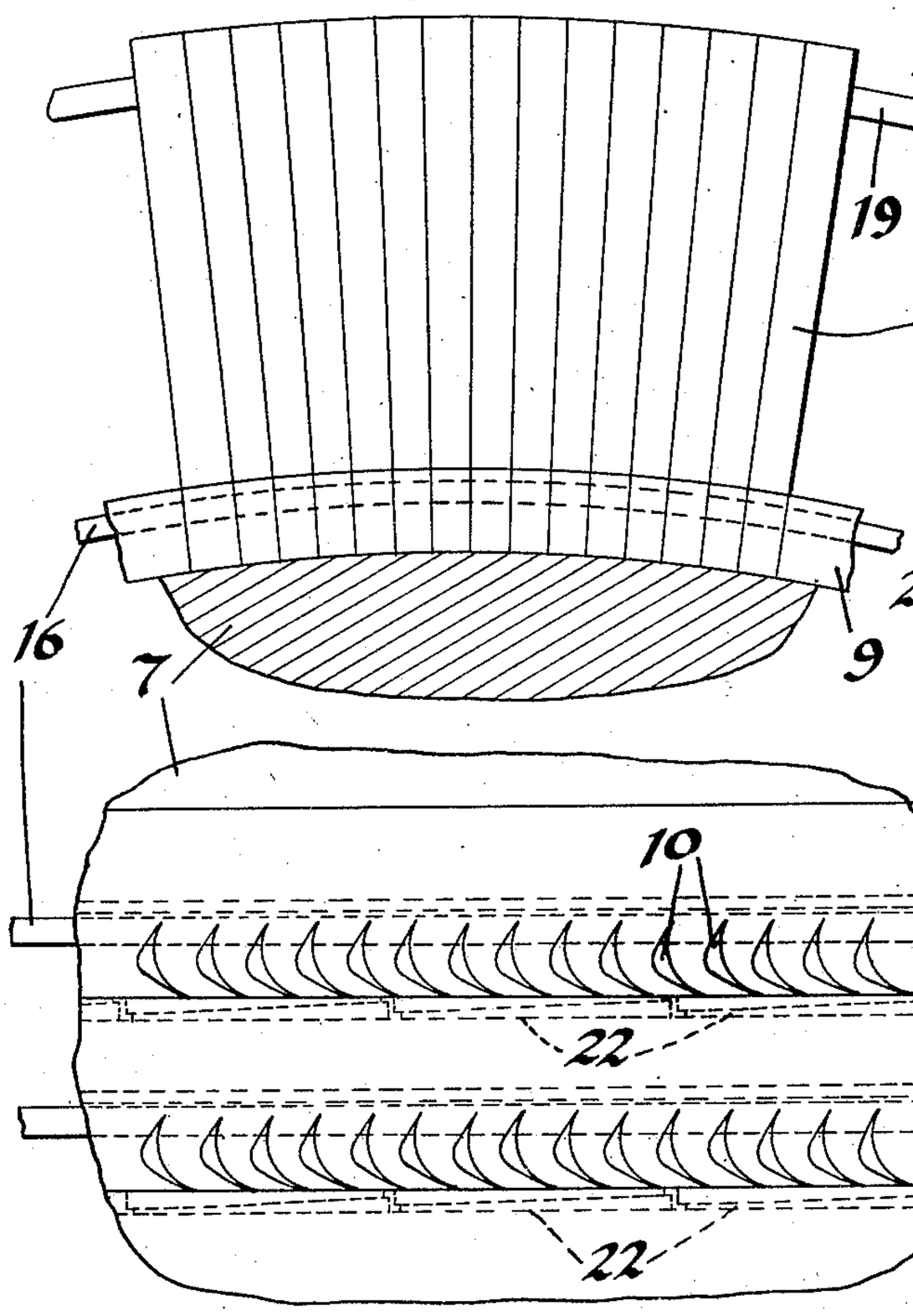

Fig. 3.

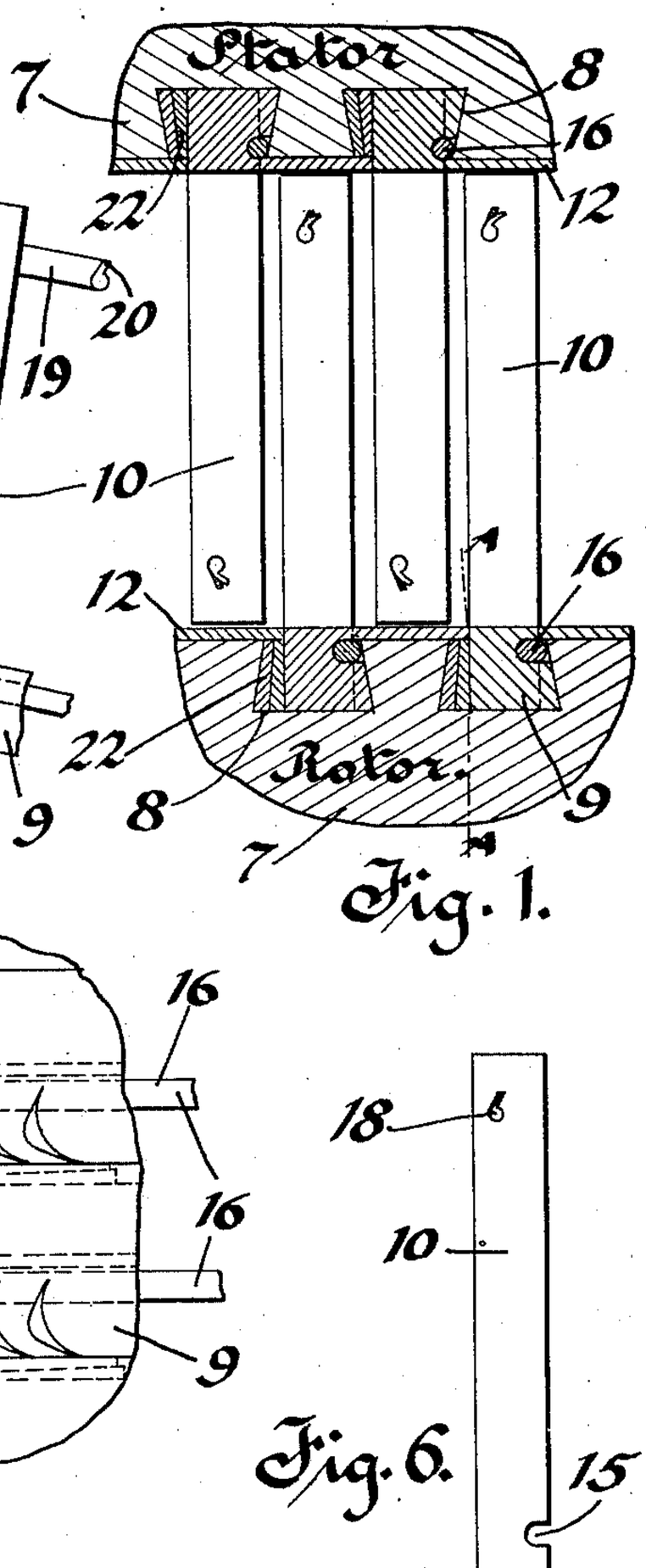

Fig. 1.

Fig. 6.

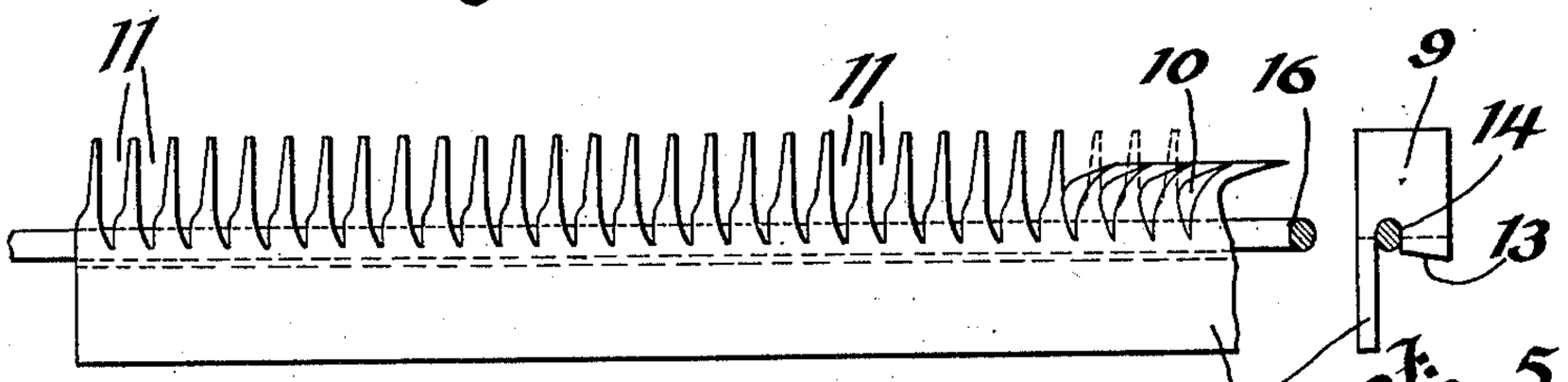

Fig. 4.

Fig. 5.

WITNESSES:

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BLADING AND LINING FOR TURBINES.

997,216. Specification of Letters Patent. **Patented July 4, 1911.**

Application filed June 25, 1908. Serial No. 440,334.

To all whom it may concern:

Be it known that I, CHARLES E. SWEET, a citizen of the United States, and a resident of Wilkinsburg, in the county of Allegheny and State of Pennsylvania, have made a new and useful Invention in Blading and Protective Linings for Turbines, of which the following is a specification.

This invention relates to elastic fluid turbines and has for an object the production of simple and effective means for blading the turbines and for providing a protective covering for the blade-carrying elements of turbines.

The corrosive and erosive action encountered in elastic fluid 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 the distilled water, that is, the water of condensation, and the erosive action of the motive fluid and the water of condensation. Whatever the cause, the fact remains that the exposed surfaces of the blade-carrying elements are at times corroded and even badly pitted. The cast iron casing of the turbine (the stationary blade-carrying element) is usually more actively attacked and for this reason the primary object of my invention is to provide a protective lining for the casing, but I desire it to be understood that I contemplate providing a blading means and a protective cover for turbines, which is equally applicable to the rotor or stator element.

In the drawings accompanying this application and forming a part thereof, Figure 1 is a fragmental transverse section through a turbine and discloses a portion of the rotating blade-carrying element, provided with blades mounted in accordance with my invention, and a portion of the stationary blade-carrying element provided with directing vanes mounted in accordance with my invention; Fig. 2 is a fragmental longitudinal section of the rotor element of a turbine along the line A—A of Fig. 1; Fig. 3 is a fragmental plan view of the rotating blade-carrying element and discloses blades mounted in accordance with my invention; Fig. 4 is a plan view of a portion of a base strip forming a detail of my invention; Fig. 5 is an end view of the strips shown in Fig. 4; and Fig. 6 is an elevation of a blade forming a detail of my invention.

Throughout the remainder of the specification and in the claims, I will designate both the rotating blades and the stationary directing vanes by the broad term "blades", and I will employ the term "blade-carrying element" to include both the rotating and the stationary blade-carrying elements.

My invention contemplates assembling the blades in segmental rings by permanently and positively securing them in place on a segmental base strip which is provided with a flange adapted to form a protective strip for the turbine blade-carrying element, when the strip is mounted in place on the element.

Referring to the drawings: The blade-carrying element 7 of the turbine is provided with a plurality of undercut blade-mounting slots 8, in which segmental base strips 9 are mounted. The base strips are rolled or drawn to the desired section and are formed into semi-circular or smaller segmental sections of the same curvature as the blade-mounting slots in which they are to be mounted. Each strip is provided with a plurality of suitably spaced blade receiving slots 11 which extend radially across one lateral face of the strip 9 and are adapted to receive the bases of the blades 10 and to properly space and gage the blades.

A longitudinally extending and laterally projecting flange 12 is formed on each strip 9 flush with the outer peripheral face and, overhanging the lateral face 13 of each strip, is adapted to project out of the blade-mounting slot in which the strip is mounted, and to lie in close contact with the portion of the peripheral face of the blade-carrying element 7 located between the slot 8 in which the strip is mounted and the next adjacent mounting slot.

The blades 10 are substantially crescent shaped and are of the same cross section throughout their length. Each notch 11 conforms at its inner end to the contour of a portion of each blade and is so constructed as to fit about one-half of the base portion of each blade when one of its walls has been distorted to secure a blade in the next adjacent notch. The bases of the blades are inserted one after the other in consecutive

notches and the projecting wall of each notch, is, after the blade is in place, pressed into engagement with the base portion of the blade to thereby secure it to the base strip. After the blades are in place the walls of the notches, which are then lapped one over the other to inclose the blades, present a substantially plane face, which may be finished and trued up if desired.

In addition to the above described means for securing the blades to the blade-mounting strips, I have provided means for positively locking each blade to its mounting strip.

A longitudinally extending slot 14 is cut across the face 13 of each strip and extends deep enough into the strip to intersect the inner edges of the notches 11. Each blade 10 is provided, at one edge and near its base, with a notch 15, which is so located as to register with the slot 14 when the blade is in place in a blade-mounting notch 11. After all the blades are secured to a blade strip 9 by the frictional engagement of the walls of the mounting slots 11, a locking wire 16 is inserted into the slot 14 and, engaging the notches 15 of each blade, permanently locks each blade to the strip and secures it against longitudinal displacement.

The face 13 of each segmental strip is inclined to correspond to the inclination of the undercut walls of the blade-mounting slots 8. Each wire 16 is of such size that it will be held in place within its mounting slot 14 by contacting with the adjacent face of the blade-mounting slot 8 when the blade strip is located within a slot 8.

Other means may be employed for securing the wires 16 in place in their mounting slots; for example, they may be soldered or pressed into place so as to be permanently secured to the blade-mounting strip before it is located and secured in the blade-mounting slot. The bases of the blades may also be cut or swaged at their mounting ends so as to more readily be secured into the mounting notches 11.

The outer or free end of each blade is provided with a comma-shaped hole 18 through which a binding wire 19, of comma-shaped cross section extends. The binding wire is secured in place by shearing, on each side of each blade, and by bending over, between adjacent blades, a longitudinally extending rib 20, which is formed integrally with the wire 19. The bent over portions of the rib 20 form spacing pieces which are secured to the main body portion of the wire and which positively lock the outer ends of the blades in their proper relative positions, the main body portion of the wire acting as binding element for the blades.

After the blades are in place, the segmental strips are located in the blade-carrying element and secured thereto as follows: Each base strip is introduced into a blade-mounting slot so that its inclined face 13 contacts with one of the undercut walls of the slot, and the projecting flange 12 contacts with the peripheral face of the blade-carrying element.

Any suitable means may be employed for securing the blade strips into the blade-mounting slots, but since each of the lateral walls of each blade-mounting slot is undercut, I preferably employ compound tapered wedges 22 to secure the blade strips into the slots. The wedges are introduced into the slot in pairs, one beside the other, between the blade strip and one undercut wall of the slot. The wedges 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 in place within the slot and which is prevented, by its shape and the shape of its component wedges, from being dislodged from the slot by centrifugal or other dislodging forces.

Each segmental strip is secured in place by a number of pairs of wedges 22 suitably spaced along the strip. It is preferable, however, to so space the wedges that the ends of the component wedges of one pair abut against the ends of the wedges of the next adjacent pair and thereby secure them against longitudinal displacement.

It is necessary on account of the construction of the blade-mounting slots and component wedges to leave considerable space between the first and last pairs of wedges introduced into the blade-mounting slot and for that reason some suitable means is employed for securing the component wedges of the first and last pairs introduced into the slot against longitudinal motion.

In the drawings I have disclosed the blade-mounting strips provided with flanges 12 of such width that the flange of one strip not only covers the portion of the peripheral face of the blade-mounting element intermediate the slot 8, in which the strip is mounted, and the next adjacent slot, but also projects into close proximity with the next adjacent row of blades and covers the wedges 22. It may be found desirable to employ narrower flanges 12 so that the blade-mounting wedges 22 are not covered but are at all times accessible. With either construction the blade-mounting elements are adequately protected from the erosive and corrosive action of the motive fluid and the water of condensation traversing the working passages of the turbine.

I have shown, in the drawings deeper notches 15 in the blades mounted to the rotor of the turbine than in the blades mounted on the stator of the turbine. The depth of these notches, however, may be varied to suit the conditions, provided, of course that

the wire 16 is of such section that it will be held securely in its mounting slot 14 by the adjacent wall of the blade-mounting slot, when the strip is in place in a blade-mounting slot.

In accordance with the provisions of the patent statutes, I have described the principle 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. In a turbine, a blade strip provided with blade-receiving notches, blades in said notches and a longitudinally extending locking means bearing against the blades and against the strip on the side opposite to that on which the notches are provided.

2. In a turbine, a blade-carrying element provided with a slot, a blade-strip provided with blade-receiving notches, the walls of the notches frictionally engaging the blades, and a locking member extending longitudinally of the strip and bearing thereagainst on the side opposite to that on which the notches in the strip are provided.

3. A turbine blade-carrying element provided with a slot, a blade strip having blade-receiving notches on one longitudinal edge, blades in said notches and frictionally engaged by the edges thereof, and a locking wire engaging notches in the blade, said wire being on the side of the strip opposite to that on which the notches are provided.

4. In combination in a turbine, a plurality of blades, a blade strip provided with blade receiving notches, the walls of which are adapted to grip the bases of the blades by being pressed into gripping engagement therewith, a locking member located in a slot provided in the strip and engaging notches provided in each blade, and a laterally projecting flange formed integrally with each strip.

5. In combination in a turbine, a plurality of blades, a blade strip provided with blade receiving notches, the walls of which are adapted to engage the bases of the blades by being distorted, and a wire let into said strip and adapted to positively lock said blades thereto.

6. In a turbine, a plurality of blades, a blade strip provided for said blades, and means for positively locking each blade to said strip and within the free edge of the strip.

7. In combination in a turbine, a plurality of blades, a base strip therefor, to which said blades are adapted to be secured, a protective strip formed integrally with said base strip, and means for positively locking said blades to said base strip.

8. A foundation strip for blading having notches to receive blades on one side and a flange on the opposite side adapted to extend over the turbine element.

9. A foundation strip for blading having notches on one side and a protective element on the opposite side.

10. A base strip for turbine blades having a flange projecting from one longitudinal edge and notches for the reception of blades in the opposite edge.

11. In a turbine, a blade strip, blades, and a wire locked into the blade strip to fasten blades into said blade strip.

12. In a turbine, a blade strip provided with blade receiving notches, blades in the notches, and a locking wire.

In testimony whereof, I have hereunto subscribed my name this 22nd day of June, 1908.

CHARLES E. SWEET.

Witnesses:

CHARLES W. MCGHEE,

E. M. MCCALLISTER.