L. L. SMITH.

TYING MEANS FOR TURBINE BLADES.

APPLICATION FILED MAR. 5, 1914.

1,245,810. Patented Nov. 6, 1917.

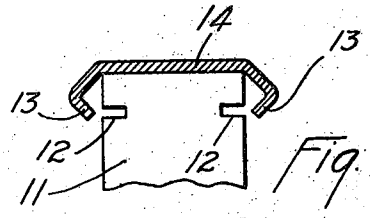


Fig. 1.

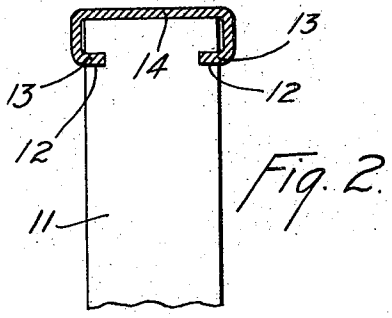


Fig. 2.

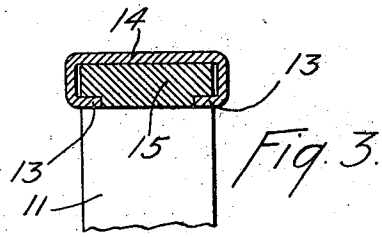


Fig. 3.

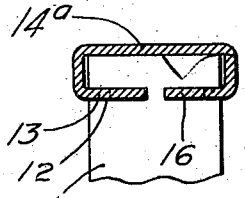


Fig. 4.

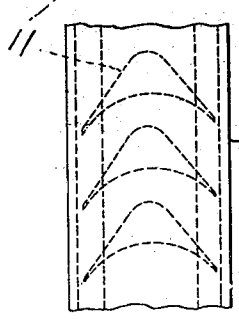


Fig. 5.

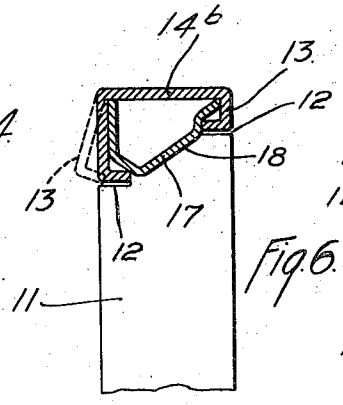


Fig. 6.

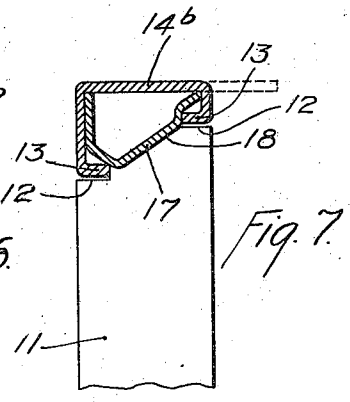


Fig. 7.

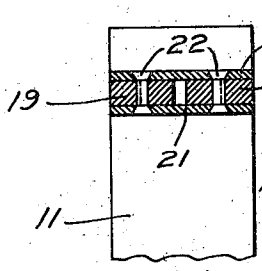


Fig. 8.

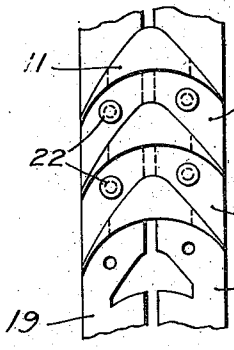


Fig. 9.

INVENTOR

Louis L. Smith

BY

HIS ATTORNEY IN FACT

WITNESSES:

E. M. McCutcheon

UNITED STATES PATENT OFFICE.

LOUIS L. SMITH, OF EDGEWOOD, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

TYING MEANS FOR TURBINE-BLADES.

1,245,810. Specification of Letters Patent. Patented Nov. 6, 1917.

Application filed March 5, 1914. Serial No. 822,697.

To all whom it may concern:

Be it known that I, LOUIS L. SMITH, a citizen of the United States, and a resident of Edgewood, in the county of Allegheny and State of Pennsylvania, have made a new and useful Invention in Tying Means for Turbine-Blades, of which the following is a specification.

This invention relates to blading for elastic fluid turbines and has for an object to produce a new and improved means for securing the outer ends of the blades together and for forming a cover for the fluid passages formed between adjacent blades.

The blades of elastic fluid turbines are subjected to vibration creating shocks during the delivery of motive fluid to the turbine and it is necessary to eliminate the tendency of the blades to vibrate. This is accomplished in my present invention by securing together the outer ends of a number of blades located in one row, so that each blade so secured coöperates with the other blades in resisting vibrations.

With some types of turbine blades it is desirable to provide a cover or shroud member for the outer or free ends of the blades, so that the fluid passing between the blades is confined to a well defined path and is not spilled outwardly past the ends of the blades. For this reason it is customary to provide the outer ends of blades of the impulse type with a cover or shroud member, which is sometimes also employed as a means for tying the outer ends of the blades together.

My invention contemplates a new and improved blade-tie for the outer ends of the blades which also constitutes a shroud or cover for the blades of a row, and is of simple construction and is capable of being easily and quickly secured in place on the blades.

In the drawings accompanying and forming a part of this application:

Figure 1 is a fragmental elevation of a blade shown in connection with a transverse sectional view of a shrouding tie member embodying my invention, as it appears prior to being secured to the blade;

Fig. 2 is a view corresponding to Fig. 1, in which the shrouding tie member has been pressed into engagement with the blade;

Fig. 3 is a view corresponding to Fig. 2 and illustrates an embodiment of my invention in which a spacing piece is employed between adjacent blades and is held in place by the shrouding tie member;

Fig. 4 is a view corresponding to Fig. 2, and illustrates a modified form of shrouding tie member embodying my invention, in which the member is so formed that it of itself operates to secure the outer ends of the blades together and also to positively hold them in definitely spaced positions with relation to each other;

Fig. 5 is a fragmental plan view of a row of blades equipped with a tie member such as illustrated in Figs. 2 and 3;

Fig. 6 is a view corresponding to Fig. 3 and illustrates a modified form of tie member and spacing piece forming a detail of my invention;

Fig. 7 is a similar view and illustrates a different method for securing the tie member in place from that shown in Fig. 6;

Fig. 8 is a view corresponding to Fig. 1 and illustrates still a further modification of my invention; and

Fig. 9 is a fragmental plan view of a row of blades equipped with the tie member and spacing pieces illustrated in Fig. 8.

In Figs. 1 to 7, inclusive, the lateral edges of the blades 11 are shown provided with slots 12, each slot being adapted to receive a flange or projecting edge 13 of a shrouding tie member. As illustrated in Fig. 1, the shrouding tie member 14 is so formed that it may be readily located along the outer ends of a row of blades and then may be permanently and positively secured to the blades by crimping its lateral flanges inwardly so that the edges engage the slots 12 as shown in Figs. 2 and 3. With this arrangement the tie member not only forms a shroud for the blades, but it also rigidly secures their outer ends together and prevents the objectionable vibrations of the blades which are apt to occur during the operation of the turbine. In addition to this, the tie member can be readily removed from the blades by merely withdrawing one or both of its slot engaging lateral edges from the engagement with the blades. This, as is apparent, can be accomplished without mutilating the blades and without rendering the tie member incapable of being subsequently used.

In Fig. 3 I have illustrated means which may be employed in connection with a tie

member for more positively holding the outer ends of the blades in their respective relative positions and of thereby positively overcoming the tendency of the blades to vibrate. The means illustrated also coöperates with the tie member to render it more effective as a shrouding element for the blades, since it eliminates the possibility of eddy currents being set up in the fluid passages between the blades by the exposed ends or edges of the tie member. Between each of the blades in a row, I employ a spacing or filling piece 15 which is so formed that its front and rear faces respectively correspond in contour to the rear and front faces of the blades, and which is of such size that its width corresponds exactly to the desired spacing of the ends of the blades. The pieces 15 are, moreover, so constructed that they fill the spaces between the blades, which are partially surrounded by the substantially U-shape tie member 14, and, with the tie member, present a substantially smooth or unbroken face to the fluid passages located between the blades. It will be apparent that the pieces 15 not only space the ends of the blades and positively hold them in their proper relative positions, but also prevent eddy currents which would probably be occasioned by the shape of the tie member 14.

Any means may be employed for securing the filling piece 15 in place or for mounting it on the tie member. As illustrated, it is secured in place by the inturned edges 13 of the tie member.

In Fig. 4 I have illustrated still another embodiment of my invention in which the shrouding tie member 14^a is so formed that it of itself operates as a spacer for the ends of the blades as well as a tie and shroud member. This is accomplished by increasing the length of the inwardly turned edges of the flanges 13 and by notching the flanges out so that they are capable of engaging the slots 12 formed in the blades and so that extensions 16 are formed on the tie member which extend inwardly with relation to the blades and of engaging their working or curved faces of the blades, when the tie member is in place. The operation of securing the member 14^a to the blades is similar to that illustrated in Figs. 1 and 2 and consists merely in forcing the flanges 13 from a position somewhat similar to that illustrated in Fig. 1 to the position illustrated in Fig. 4. It will be understood, of course, that the blade-engaging edges of the projections or spacing pieces 16, integrally formed on the member 14^a, correspond in contour to the contour of the blade surfaces engaged by them, and that the peripheral or longitudinal length of these pieces is equal to the desired distance between the outer ends of the blades.

In Figs. 6 and 7 I have illustrated a shrouding tie member 14^b which is similar in many respects to the member 14 illustrated in Figs. 1 and 2. It, however, is adapted to be employed in connection with a spacing piece of such form as to provide a divergent fluid passage between the blades with which it is employed. The spacing piece 17 illustrated is of such shape that while its ends engage the blades and correspond in outline to the contour of the engaged faces of the blades, it presents to the fluid passage between the blades a face 18 which is inclined relatively to the outer or peripheral face of the member 14^b, and which, as stated, forms a divergent path for the fluid passing between the blades. In order to accommodate a spacing piece of this shape I have formed one of the flanges 13 of the tie member 14^b so that it is longer than the other flange. The slots 12 on the opposite sides of the blade are, of course, correspondingly spaced from the end of the blade so that they are capable of being engaged by the flanges of unequal length. In Fig. 6 I have shown one method of initially forming the tie member 14^b and of securing it in place on the blades. The longer flange 13 is initially formed so that it is inclined or located at an angle to the peripheral face of the tie member. The shorter flange is then hooked into engagement with the coöperating slots 12 formed in the blades. The spacing pieces 17 are located between the blades and in engagement with the tie member, and then the longer flange 13 is pressed or peened inwardly so that it engages its coöperating slots 12 in the blades and thereby locks the tie member in place on the blades and the spacing piece in place between the blades.

In Fig. 7 I have shown a form of the tie member 14^b in which the shorter flange 13 is formed after the tie member has been located in place on the outer end of the blades with the longer flange in engagement with its coöperating slots 12. The flange 13 is then formed or rolled on the member 14^b so that its edge projects into the adjacent slots 12 formed in the blades. After the shorter flange is forced into engagement with its coöperating slots, the tie member is exactly similar to the member shown in Fig. 6 and is not only positively secured to the blades, but also positively holds the spacing pieces 17 in place between the blades.

In Figs. 8 and 9 I have shown still another modification of the invention. In this modification I employ two tie members 19 which are adapted to be inserted into slots, corresponding to the slots 12 formed in opposite edges of the blades, and which are positively locked in the slots by means of spacing pieces 21 to which they are permanently secured. As illustrated, each spacing piece,

besides operating to hold the blades in their proper relative positions, acts as a tie member for the two members 19, as is clearly illustrated in Fig. 8. Each of the members 19, as shown in Fig. 9, is notched out so that it not only engages the slots 12 cut in the edges of the blades, but also projects inwardly between the blades in the manner described in connection with the disclosure of Fig. 4. In the drawings two sets of spacing pieces are employed for securing the two tie members 19 together, one set being located on one side of, and the other set being located on the other side of the tie members, and, as illustrated, secured to each tie member by means of rivets 22. This construction not only rigidly locks the outer edges of the blades together and holds them in their proper relative positions, but also forms a smooth and unbroken wall of the steam passage between each pair of blades.

In accordance with the provisions of the patent statutes, I have described what I now consider to be the preferred embodiment of my invention, but I desire to have it understood that various changes, modifications and substitutions may be made in the details of construction without departing from the spirit and scope of my invention, as set forth by the appended claims.

What I claim is:

1. In combination with a blade having notches formed in the lateral edges thereof and spaced from the end of the blade, a cover piece engaging the end of the blade, and having its lateral edges bent down along the sides of the blades and distorted and pressed into said notches.

2. In combination with a row of blades, each blade having a notch formed in each lateral edge thereof and spaced from the end of the blade, a cover piece engaging the ends of the blades of the row and bent down along the sides of the blades at its lateral edges so that it envelops the ends of the blades and having the ends of the downward bent portions distorted and moved into locking engagement with the adjacent notches formed in the blades.

3. In combination with a row of blades, each blade having a notch formed in each lateral edge thereof, a cover piece for engaging the ends of the blades and having distortable lateral flanges for engaging the notches in the blades, and separate spacing pieces located between adjacent blades.

4. In combination with a row of blades, each blade having a notch in each lateral edge thereof, a cover piece for engaging the ends of the blade and having lateral flanges capable of being forced into said notches and of projecting between the blades to form spacing pieces.

5. In combination, a row of blades, each blade having a notch in each lateral edge thereof, a cover piece having lateral flanges formed thereon and peened into said notches, and separate spacing pieces located between the blades and held in place by the cover pieces.

6. In combination with a row of blades having flange receiving notches formed therein, a cover piece engaging the ends of the blades and having distortable flanges for engaging the notches in the blades and spacing pieces located between adjacent blades of the row.

7. In combination, a row of blades having opposed flange receiving notches formed therein, a cover piece engaging the ends of the blades and having distortable lateral flanges bent into engagement with said blades, and spacing pieces located between the blades and held in place by said strip.

8. In combination with a blade having notches formed in the lateral edges thereof and spaced from the end of the blade, a cover piece of substantially the same thickness of material throughout engaging the end of the blade, and having its lateral edges distorted and pressed into said notches.

In testimony whereof, I have hereunto subscribed my name this 2nd day of March, 1914.

LOUIS L. SMITH.

Witnesses:
C. W. McGHEE,
E. N. McCALLISTER.

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