J. F. METTEN.

METHOD OF SECURING BLADES OF TURBINES, &c.

APPLICATION FILED FEB. 11, 1907.

**901,115.** **Patented Oct. 13, 1908.**

2 SHEETS—SHEET 1.

fig. 1.

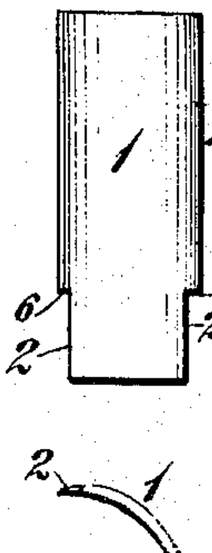



fig. 2.




fig. 3.

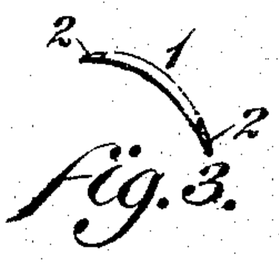



fig. 5.

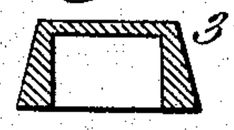



fig. 4.

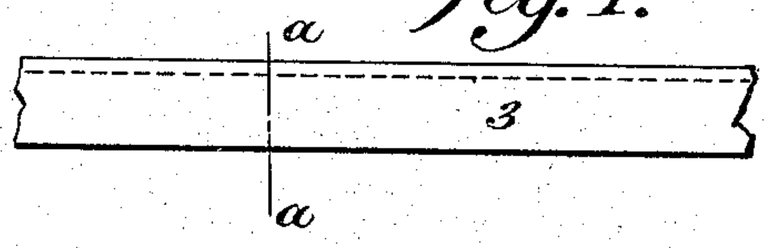



fig. 7.

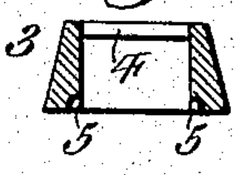



fig. 6.

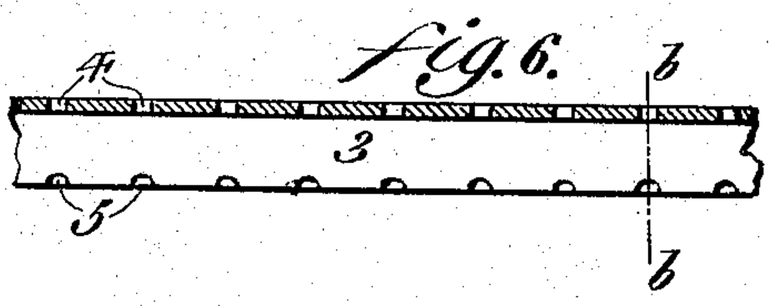



fig. 9.

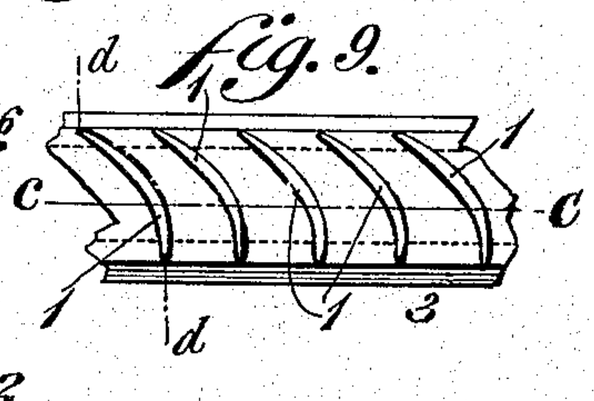



fig. 8.

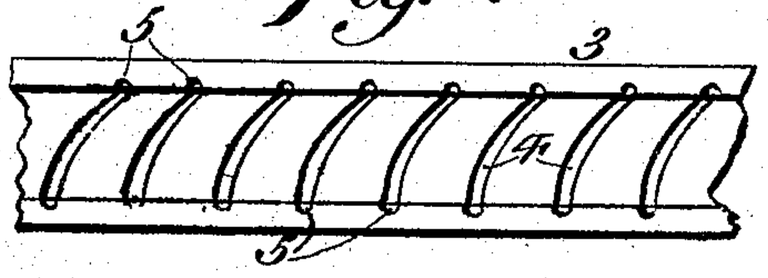



fig. 11.

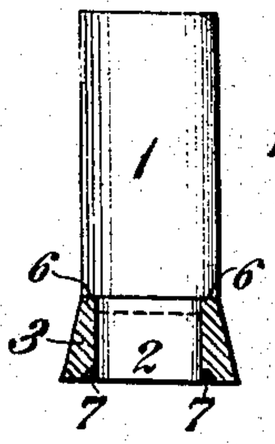



fig. 10.

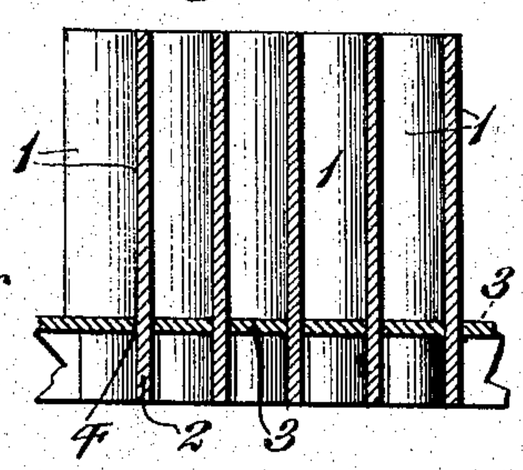



fig. 14.

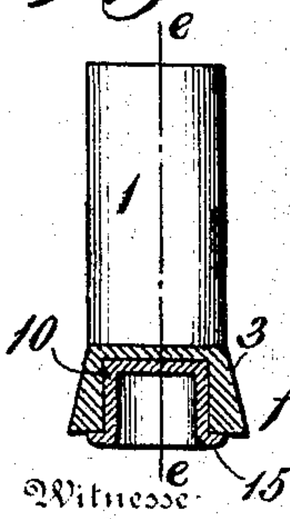



fig. 15.

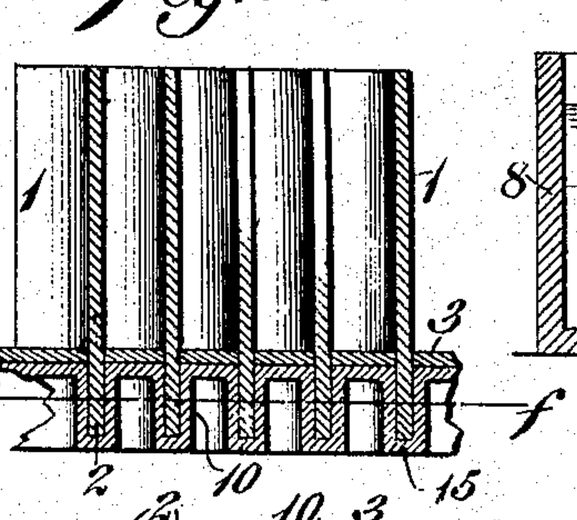



fig. 16.

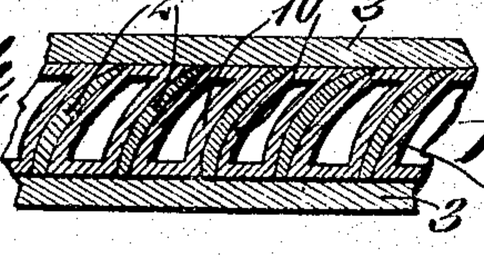



fig. 12.

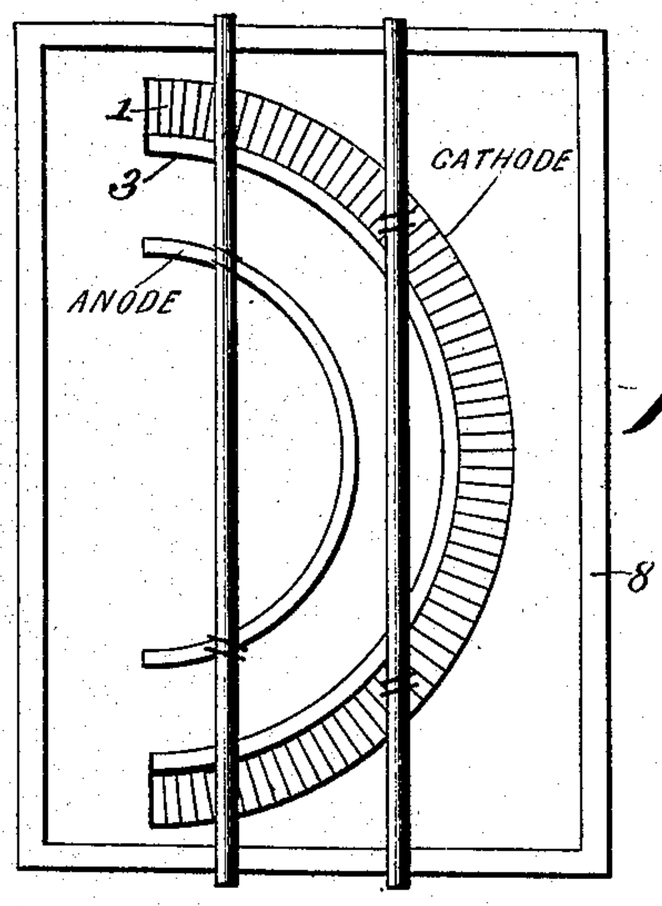
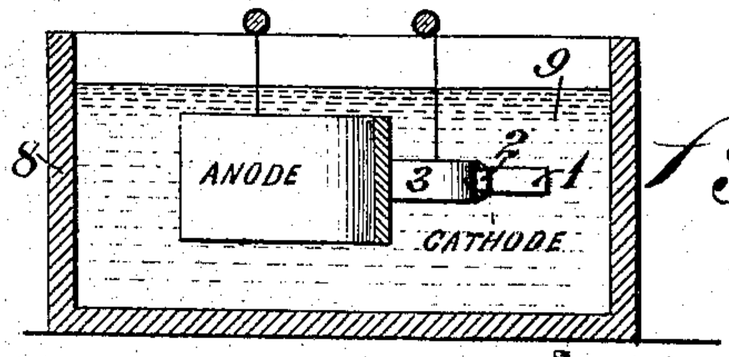



fig. 13.

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METHOD OF SECURING BLADES OF TURBINES, &c.

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2 SHEETS—SHEET 2.

*fig. 17.*

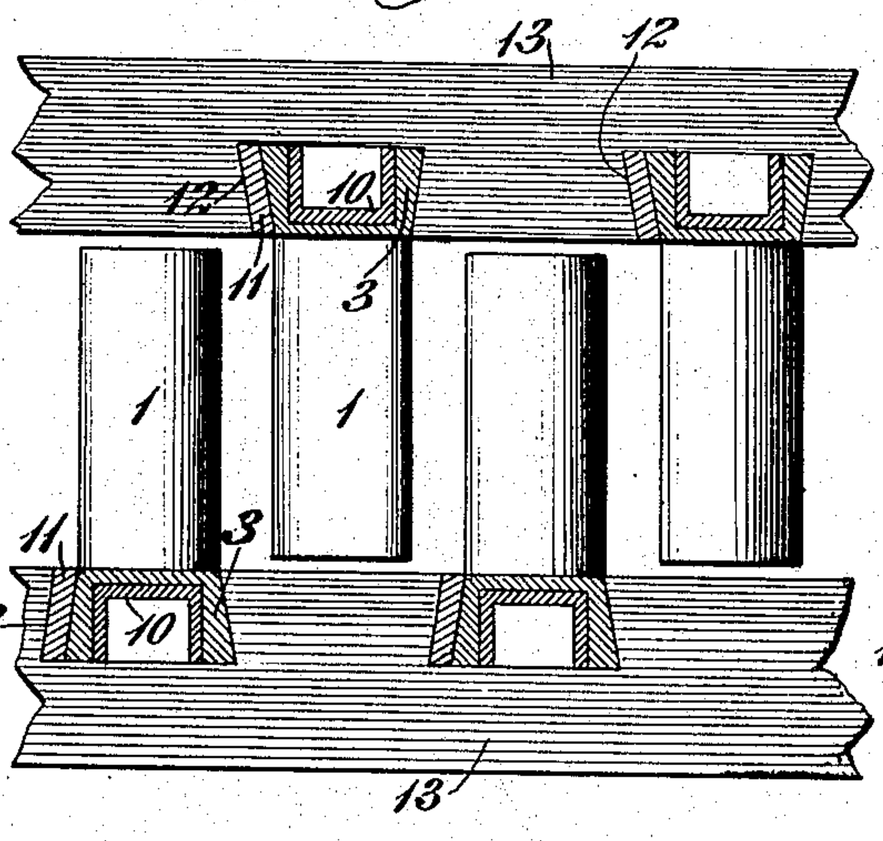



*fig. 18.*

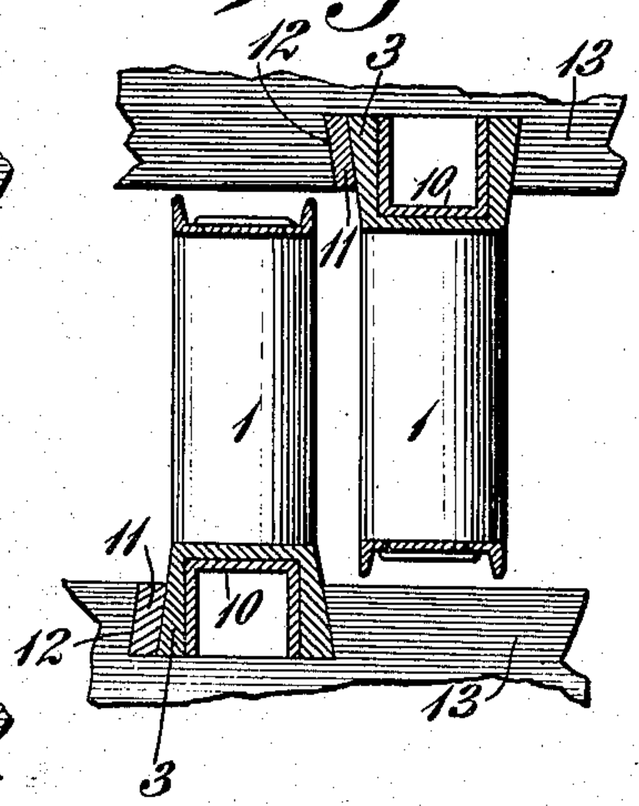



*fig. 19.*

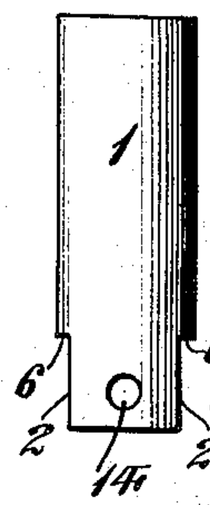



*fig. 20.*

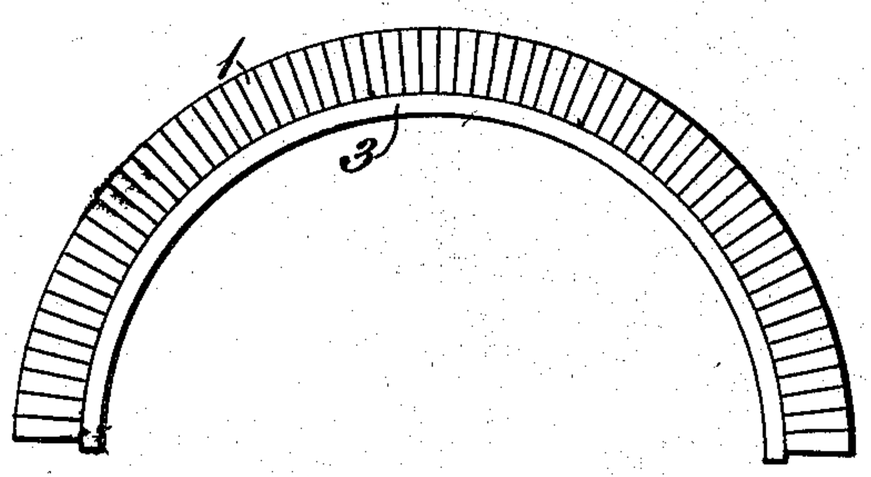
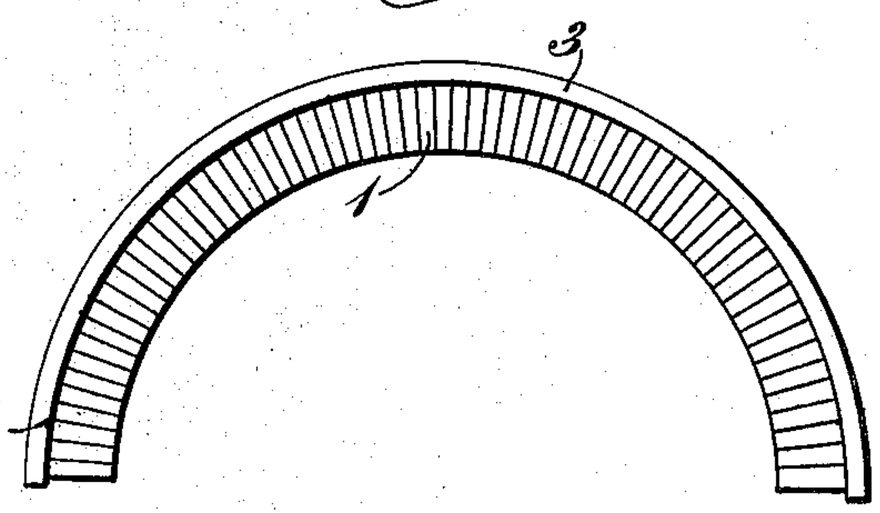



*fig. 21.*

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# UNITED STATES PATENT OFFICE.

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## METHOD OF SECURING BLADES OF TURBINES, &c.

No. 901,115. Specification of Letters Patent. Patented Oct. 13, 1908.

Application filed February 11, 1907. Serial No. 356,830.

*To all whom it may concern:*

Be it known that I, JOHN F. METTEN, a citizen of the United States, residing in the city and county of Philadelphia, State of Pennsylvania, have invented a new and useful Method of Securing Blades of Turbines and the Like, of which the following is a specification.

My present invention consists of a novel method of securing the vanes or blades in steam or gas turbines and I have preferred to show in the present instance, my novel method as applied to turbines of the Parsons' type in which segmental rings carrying the moving and guide vanes are built up separably from the rotor and cylinder, after which said rings are secured in grooves by calking a strip of metal at one side thereof, although my invention is applicable to other forms and types of turbines in which each row of moving or stationary vanes are carried by a separate disk.

To the above end my invention consists broadly in the method of securing vanes or blades to turbines and the like by electrolytically deposited metal.

Any suitable metal or material may be employed for the different blades or rings and the metal or material employed will depend upon the temperature to which the work will be subjected.

In turbines using steam of ordinary pressure and temperatures the blades are usually made of drawn brass, and steel or brass rings would be employed, the electrically deposited metal being copper. In turbines using steam of higher temperatures such as are met with when superheated steam or gas are employed, other materials having a higher heat resistance may be used, such as steel blades and rings, with electrically deposited nickel or iron to secure the same in assembled position.

The composition of the electrolyte would depend upon the metal to be deposited and I have shown, in the present instance, an elementary plating arrangement in order to make clear that my intention is to employ whatever form of electroplating is best suited to the conditions and requirements of the case, it being obvious that in practice the deposition of metal on a large number of rings can be carried on at the same time and the metal is preferably deposited on whatever number of rings is required to make up a complete section in order to secure uniform deposition and perfect balance.

For the purpose of illustrating the manner in which my method can be advantageously carried out in practice, I have shown in the accompanying drawings different stages of the operation and construction, although it is to be understood that the instrumentalities of which my invention consists can be variously arranged and organized and that my invention is not limited to the precise arrangement and organization of these instrumentalities, as herein shown.

Figure 1 represents a top plan view of one of the blades. Fig. 2 represents a side elevation of Fig. 1. Fig. 3 represents a bottom plan view of one of the blades. Fig. 4 represents a side view of a bar for the ring section. Fig. 5 represents a section on line *a*—*a*, Fig. 4. Fig. 6 represents a section of Fig. 4 showing the bar as it appears at a different stage of the operation. Fig. 7 represents a section on line *b*—*b*, Fig. 6. Fig. 8 represents a bottom plan view of the bar seen in Fig. 6. Fig. 9 represents a top plan view of the bar seen in Fig. 6. Fig. 10 represents a section on line *c*—*c*, Fig. 9. Fig. 11 represents a section on line *d*—*d*, Fig. 9. Fig. 12 represents a plan view of one form of an electroplating device which may be employed in carrying out my method. Fig. 13 represents a sectional view of Fig. 12. Fig. 14 represents a sectional view of a blade and ring after the metal coating has been deposited. Fig. 15 represents a section on line *e*—*e*, Fig. 14. Fig. 16 represents a section on line *f*—*f*, Fig. 15. Fig. 17 represents a sectional view of a portion of a completed blade segment calked into grooves in the rotor or cylinder. Fig. 18 represents a sectional view in which the blades are shrouded at their tips. Fig. 19 represents, in elevation, a blade which has been punched or drilled. Fig. 20 represents a side elevation of a half ring for the drum or rotary blades. Fig. 21 represents a side elevation of a half ring for the cylinder or stationary blade.

Similar numerals of reference indicate corresponding parts in the figures.

Referring to the drawings:—1 designates the vanes which are made of extruded or drawn metal of a section suitable for the turbine and are usually made in bars several feet in length. The individual blades or vanes are first cut to the required length and

the end to be fastened is milled on each side for a short distance as seen at 2 in Figs. 2 and 3. An extruded or cold drawn bar of material as is seen in Figs. 4 and 5, is cut to the length required to make the ring section and then bent to form the segment of a circle which has been decided upon. In the present instance I have preferred to show the segments as built up in half circles, as may be clearly understood from Figs. 20 and 21.

4 designates apertures which correspond to the reduced end 2 of the blades and which are punched in the bar 3.

5 designates nicks in the lower edges of the bar 3 for the temporary securing of the blades or vanes.

It will be apparent to those skilled in this art that the punching and nicking of the bars can be done before bending and also that the bars can be turned up in complete rings and afterwards cut to the desired part of a circle, instead of being formed of drawn metal.

The milled portion 2 of the blade 1 is inserted in an aperture 4 until the shoulder 6 abuts against the bar 3 and the corners lightly riveted in the nicks, as seen at 7, in Fig. 11, forming when all the blades are in place, a half ring for the drum or rotating blades, as seen in Fig. 20, or a half ring for the cylinder or stationary blades, as seen in Fig. 21. The built up ring is now pickled in a suitable solution to remove all grease and similar material from the surface after which it is thoroughly dried and all of the exposed portion of the blades and rings with the exception of the reduced portion 2 of the blades 1, and the portion of the bar 3 contiguous thereto, as will be understood from Fig. 11, are given a coat of varnish or other suitable material, which will resist the action of the electrolyte. The segment or segments are next transferred to a tank 8 containing a suitable bath or electrolyte 9 and suspended therein so that the exposed portion above referred to, as seen in Fig. 11, will be in proper relation to the anode of metal desired for deposition. This refers to the ordinary electroplating process and the anode and the built up blade ring are connected to a suitable source of electric current until a layer 10 of electrically deposited metal of sufficient thickness to properly secure the blades 1 in the bar 3 has been formed, as shown in Figs. 14, 15 and 16. After the metal has been deposited the rings are placed in a suitable machine and the inner portion 15 of deposited metal, as seen in Fig. 14, is turned off flush with the faces of the bar. The completed blade segments are calked at 11 into grooves 12 in the rotor or cylinder 13, as seen in Fig. 17. If a slight modification is made in the depth of the bar, as seen in Fig. 18, any of the prevailing forms of shrouding may be used and while in the other figures I have omitted to show the shrouding at the tips for sake of clearness of illustration in said Fig. 18, I have shown a rotor or cylinder rim after insertion, the blades of which are shrouded by the channel section.

The blades or vanes may be punched or drilled before insertion, as seen at 14 in Fig. 19, in which case the deposited metal will extend from each side of the blade through the aperture 14 in order to form a secure fastening for resisting centrifugal forces at high speeds.

In the present instance I have shown my invention as applied to certain classes of turbines, but it is to be understood that I do not confine myself to its application to such classes and that it may be modified to suit other conditions and requirements met with in practice without departing from the spirit or scope thereof.

It will now be apparent that since the blades are formed from a drawn bar without any clamping or distortion of the surface exposed to the flow of steam or gas, that the correct form of blade or vane for maximum efficiency is obtained for the whole exposed length of said blade, which is a very important and valuable feature particularly for short blades in high pressure end, or first stages of expansion. This feature also insures the maximum resistance to bending at the point of support, this giving the greatest possible stiffness to the blades, both collectively and separately.

Under my present method there are no expensive milling or turning operations involved in forming the completed rings since the work is of such a character that drawn or rolled sections may be employed in all cases. The spacing of the blades being fixed by the apertures punched in the ring, absolute uniformity of areas may be attained and the predetermined angles of entrance and delivery will be accurately fixed.

The process of fixing the blades in rings by electrically deposited metal insures each separate blade being rigidly fixed in a socket of homogeneous metal which does away with the possibility of any individual blade becoming loose and since no rivets or screws are employed there are no pieces that can become detached and cause disastrous results.

All of the work is of a character which permits the use of jigs and automatic tools in the production of the blading segments so that the most reliable work can be produced at minimum cost.

The blading rings after completion are not solid, owing to the manner in which the metal is deposited which gives a slight elasticity to the ring and in calking the rings into the rotor or cylinder, this elasticity prevents undue distortion of the parts into which the rings are calked.

It will be further apparent that owing to

the processes to which the blades are subjected there is no necessity for annealing them. The hardness and stiffness of the drawn section is maintained and this is a factor which is not possible with blades which are stamped to a different form at the inserted end or in blades that have the rings cast around the same.

It will now be apparent that my invention in its broad scope comprises a novel method by means of which the vanes or blades may be secured to any desired type of turbine by the employment of electrically deposited metal and that the operation will be the same whether sectional rings are employed or whether blades are fastened to disks, drums, or the cylinders direct.

It will now be apparent from the foregoing that I have produced a new and useful method of securing the blades or vanes of turbines in assembled position in such a manner that there will be no improper movement of the parts and while I have preferred to illustrate and describe a method which gives satisfactory and reliable results in practice it will be apparent that the means employed for carrying out my invention may vary in a large measure without departing from the spirit and scope thereof or sacrificing any of its advantages.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:—

1. The method of securing the blades of turbines which consists of aperturing a disk, inserting in said apertures the ends of the blades and uniting the blades and disks by electrolytically deposited metal.

2. The method of securing the blades of turbines which consists of aperturing the disk members, reducing one end of the blades and inserting said ends in the apertures, and then uniting the blades and disk members by electrolytically deposited metal.

3. The method of securing the blades of turbines which consists of aperturing a disk and nicking the same adjacent the apertures, inserting in said apertures the ends of the blades, and causing them to engage said nicks, and then uniting the blades and disk by electrolytically deposited metal.

4. The method of securing blades of turbines which consists of forming a ring member, aperturing said ring member, inserting one end of the blades in said apertures, and uniting the blades to the ring by electrolytically deposited metal.

5. The method of securing blades of turbines which consists of forming a ring section by bending a bar of metal to the required contour, aperturing such section at predetermined intervals, temporarily securing the blades in place, and then subjecting the contiguous portion of the blade and ring to the electrolyte until a desired thickness thereof is deposited.

6. The method of securing blades of turbines which consists of forming a ring section by bending a bar of metal to the required contour, aperturing such section at predetermined intervals, temporarily securing the blades in place, then subjecting the contiguous portion of the blade and ring to the electrolyte until a desired thickness thereof is deposited, and then removing the surplus of deposited metal.

7. The method of securing the blades of turbines, which consists of bringing the blades into proximity with their support and then uniting them thereto by electrolytically deposited metal.

8. The method of securing the blades of turbines, which consists of bringing the blades into proximity with their support, temporarily securing the blades to said support and then uniting them thereto by electrolytically deposited metal.

JOHN F. METTEN.

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