C. A. PARSONS, J. W. WILSON & J. FORD.

BLADING FOR TURBINES.

APPLICATION FILED JUNE 21, 1907.

1,021,472.

Patented Mar. 26, 1912.

2 SHEETS—SHEET 1.

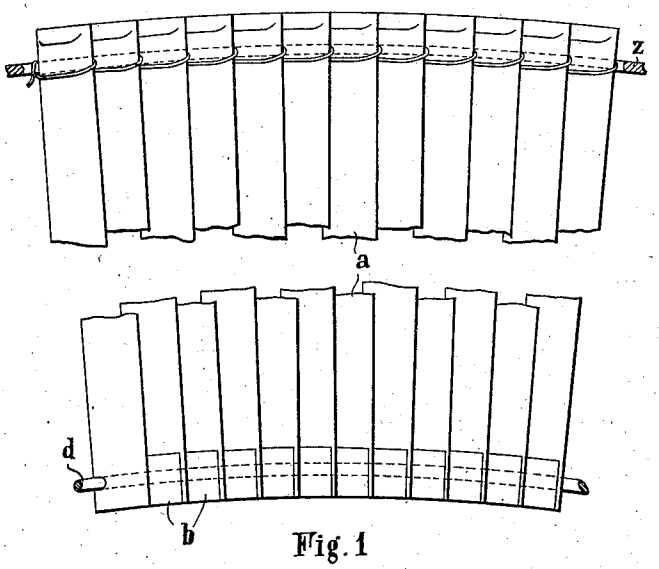

Fig. 1

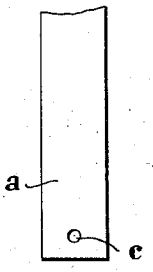

Fig. 3

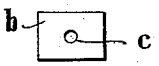

Fig. 4

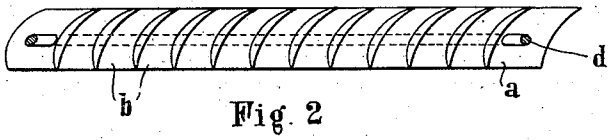

Fig. 2

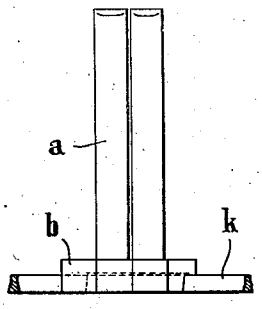

Fig. 5

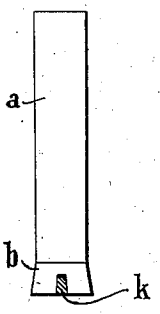

Fig. 6

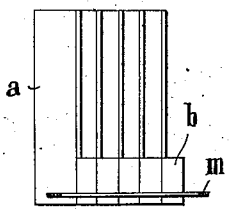

Fig. 8

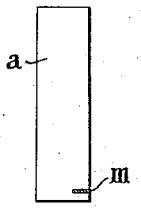

Fig. 9

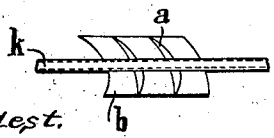

Fig. 7

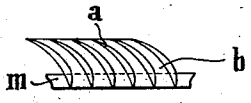

Fig. 10

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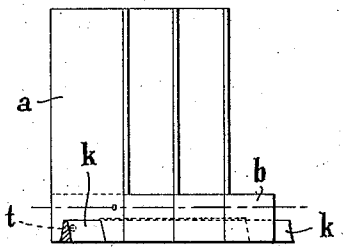

Fig. 12

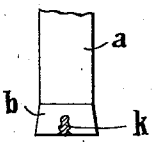

Fig. 11

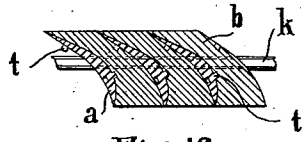

Fig. 13

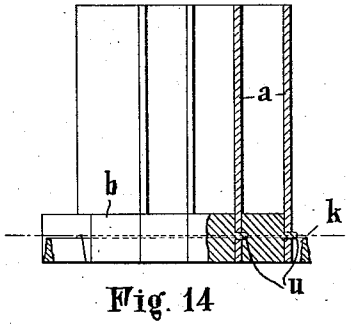

Fig. 14

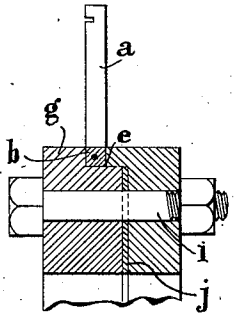

Fig. 17

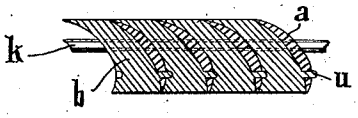

Fig. 15

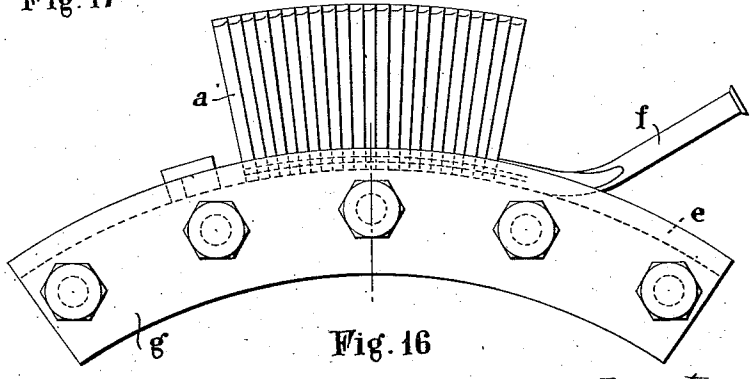

Fig. 16

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UNITED STATES PATENT OFFICE.

CHARLES ALGERNON PARSONS AND JAMES WALTER WILSON, OF NEWCASTLE-UPON-TYNE, AND JOHN FORD, OF WALLSEND, ENGLAND; SAID WILSON AND FORD ASSIGNORS TO SAID PARSONS.

BLADING FOR TURBINES.

1,021,472. Specification of Letters Patent. Patented Mar. 26, 1912.

Application filed June 21, 1907. Serial No. 380,094.

To all whom it may concern:

Be it known that we, CHARLES ALGERNON PARSONS, JAMES WALTER WILSON, and JOHN FORD, subjects of the King of Great Britain and Ireland, residing the two former at Heaton Works, Newcastle-upon-Tyne, in the county of Northumberland, England, and the latter at Turbinia Works, Wallsend, Northumberland county, England, have invented certain new and useful Improvements in and Relating to Bladings for Turbines, Compressors, and the Like, of which the following is a specification.

This invention relates to improvements in blading for turbines, turbo-compressors and the like.

The object of this invention is to effect improvements in the assemblage of blades in segments, complete rings or in plain straight lengths in such a manner that the assembled portions are ready for application in the grooves of the casing and rotor of turbines or turbo-compressors, with or without the use of separate side calking strips.

The invention consists in a method of assembling turbine blades in segment, ring or strip form ready for application to the groove in the drum or casing, which consists in providing the roots of the turbine blades and their distance packing pieces with holes, notches, recesses or the like, and passing the blades and packing pieces over a wire or strip of suitable section, a tube or the like, the blades and distance pieces being then driven one or more at a time, tightly and solidly against each other on a former which prevents the metal from flowing laterally whereby the distance pieces and blades are tightened firmly upon the binding wire, strip or tube and are consequently held together in a manner which permits of transference to the turbine or the store as a bladed ring, segment or strip on removal from the former.

The invention further consists in assembled turbine blading strips in which the roots of the blades and their distance pieces firmly grip a wire, metallic strip or the like serving to hold the blades together so that they may be transferred after calking or staving up as a segment, complete ring or comparatively flexible strip into the groove or drum of the turbine casing.

The invention further consists in serrating milling or notching or otherwise prepairing the wire, strip or tube so as to increase the hold upon it of the blades and distance pieces both in a longitudinal and transverse direction. Such serrations or the like may conveniently be made by passing the strip through milling rollers of suitable form.

The invention further consists in forming the blade or the distance pieces with one or more projections and recesses engaging with each other, or in providing the distance pieces with slots or saw-cuts or stamped projections and recesses, into which said portions of adjacent blades are to enter, the blades and distance pieces being consolidated on a former with the holding wire or strip above referred to and giving a mutual chain grip between the blades and sections.

The invention further consists in the blade segments, rings or strips hereinafter described.

Referring now to the accompanying drawings which illustrate various ways of carrying the invention into effect and form part of the specification, Figure 1 is an elevation of a segment of blades on a binding wire passing through holes in the roots of the blades. Fig. 2 is a bottom view of the same. Fig. 3 is an elevation of the root of one of the blades shown in Fig. 1, and Fig. 4 is a similar view of a corresponding distance calking piece. Fig. 5 is an elevation of a part of a bladed segment or straight length of blades in which a strip is used instead of a wire, the strip being inserted in slots cut in the bottom of the distance pieces and blades. Figs. 6 and 7 are sectional elevation and bottom view respectively of Fig. 5. Figs. 8, 9 and 10 are side and end elevations and plan respectively of a modification in which the strip is in the side of the distance pieces and blades. Fig. 11 is a sectional view showing a form of serrated strip. Figs. 12 and 13 are elevation and sectional plan respectively of the blade roots and distance pieces showing a device in which projec-

tions are formed on the blades and holes in the distance pieces. Figs. 14 and 15 are similar views to Figs. 12 and 13 of a modification in which projections are formed on the distance pieces and holes or slots in the blades. Figs. 16 and 17 are elevation and cross sectional views of a part of a former, in which the calking is effected to consolidate the blades and interlocking links or pieces to form a bladed strip segment or the like.

In carrying the invention into effect according to the manner illustrated with reference to Figs. 1 to 4, ordinary turbine or compressor blades, *a*, and packing sections or distance pieces, *b*, such as those described for example in Parsons' English Patent No. 8698 of 1906 are drilled at about their centers. Through the holes, *c*, in the blades and distance pieces a wire, *d*, is threaded. The blades and distance pieces are placed in the groove, *e*, of a former, *g*, such as that shown in Figs. 16 and 17, and by a suitable calking tool, *f*, are driven up solidly and tightly one or more at a time. The groove, *e*, in the former is slightly narrower than the groove in the turbine or compressor drum or casing and the stemming up action of the calking tool not only forces the blades and distance pieces into intimate contact with each other but also tightens the pieces and blades solidly upon the binding wire, the walls of the former preventing lateral flow of the metal during the operation. One side of the groove of the former is provided with a removable flange, *h*, held firmly by strong bolts, *i*, distance packing, *j*, being interposed to allow adjustability of the width of the groove of the former to suit various desired widths of bladed strips. If desired the terminal blades of the assembled strips or segment may be soldered or otherwise treated to insure their solidity before insertion in the groove of the turbine. Instead of using a solid wire such as that shown at *d*, in Figs. 1 to 4, a tube may be used, or as shown in Figs. 5 and 6, the distance pieces and the roots may have slots cut in their bottoms into which a strip, *k*, is pressed. The strip is preferably slightly wedge-shaped while the sides of the slots in the blades and distance pieces are parallel. The assembling of the blades and distance pieces is done in the former groove when the wedge shaped strip imparts a slightly dovetailed shape to the distance pieces and blade roots. The connecting strip may be serrated as shown in Fig. 11 to increase its hold. When staved up as above described, the blades and distance pieces firmly grip the strip, *k*, which thus acts as an interconnecting means and binds them all together as a segment, straight length or ring of blades. Similarly the wire when used may be serrated, roughened or fluted for the same purpose. A side strip, *m*, (Figs. 8, 9 and 10) may be used instead of a bottom strip.

In cases where the blade is formed with an enlarged root integral with the blade, one or more holes or slots may be formed in it for the purposes above indicated.

When the assembled blades are on the former their tips may be shrouded with any convenient devices or in any suitable manner, as shown for example at *z*, in Fig. 1.

The segments, rings or strip lengths when transferred to their grooves on the drum or casing, may be secured therein in any convenient manner with or without calking strips. The manner of fixing described in English Patent No. 8698 of 1906 may be conveniently adopted. In some cases a holding strip is employed on both sides of the blade roots or a plurality of strips may be used in the bottom or sides of the distance pieces and blades.

In a further modification of the invention shown in Figs. 12 and 13, projections, *t*, are formed on the blades by punching them partially through or by other means, the distance pieces being provided with corresponding recesses so that when the blades and distance pieces are driven together on the former, projections on the one enter the recesses on the other so that the whole is consolidated.

The distance pieces may in some cases (Figs. 14 and 15) be provided with projections, *u*, engaging in corresponding recesses or slots in the blades. When consolidated on a former, the blades make a strip, segment or ring which may be transferred without displacement to the turbine carrying member and then be secured in position in the groove by any convenient means. A strip, *k*, or a wire or tube is preferably used in conjunction with the projection and recess devices shown in Figs. 12 to 15 to increase the rigidity of the bladed segment or the like.

The distance pieces are sometimes treated in dies before or after being cut off from the rod of suitable form or they may be otherwise formed in any well known manner by pressing. These means of forming strips or segments may be used independently of or in combination with the connecting wire, strip or tube before described.

To insure accuracy and reliability of the operations of forming the holes or slots, jigs with suitable attachments are employed. Jigs and blocks carrying the sections can be arranged either singly or in multiple and may be arranged horizontally or vertically or any desired angle to the drilling or shaping machines which are preferably high speed sensitive tools. Suitable feeding attachments are arranged so that the sections to be dealt or shaped are automatically fed

forward to the tool. Ramming of the distance pieces and blades in the former may be effected by means of grooved calking tools or by hydraulic or pneumatically operated means.

Hitherto in strips or the like of blades ready for insertion in the groove of the turbine member it has been usual to make the element which connects the blades and holds them in consolidated form, of a width which is at least equal to the width of the blade measured parallel to the axis of rotation of the turbo machine shaft. According to the present invention however the piece or pieces which effect the actual connection of the separate distance pieces and blades before they are inserted in strip form into the turbine groove consists or consist of pieces of metal which are of much less width than the blade root measured as above indicated and which are of very small cross sectional area in relation to the cross sectional area of the part of the strip which is gripped in the groove. In Figs. 1 to 11 the connecting means consists of the wire like connectors, *d*, *k*, and *m;* in Figs. 12, 13 and 14 the connecting means consists of the tongues, *n*, *p*, and *s;* in Figs. 15, 16, 17 and 18 the connecting means consists of wire like connecting means, *k*, together with projections *t* and *u*.

Having now described our invention what we claim as new and desire to secure by Letters Patent is:—

1. A substantially flexible bladed strip ready for insertion in a turbo-machine groove comprising blades, separate distance pieces and substantially flexible connecting means consolidated therewith.

2. A substantially flexible bladed strip ready for insertion in a turbo-machine groove comprising blades, separate distance pieces and substantially flexible connecting means continuous of a plurality of said blades and distance pieces consolidated therewith.

3. A substantially flexible bladed strip ready for insertion in a turbo-machine groove comprising blades, separate distance pieces and wire like connecting means consolidated with said blades and distance pieces.

4. A substantially flexible bladed strip ready for insertion in a turbo-machine groove comprising blades, separate distance pieces and wire like connecting means passed into openings in the distance pieces and blades, the whole being consolidated.

5. A substantially flexible bladed strip ready for insertion in a turbo-machine groove comprising blades, separate distance pieces and round metallic wire like connecting means passed into holes in the distance pieces and blades, the whole being consolidated.

6. A substantially flexible bladed strip ready for insertion in a turbo-machine groove comprising blades, separate distance pieces and a metallic connecting wire consolidated with said blades and distance pieces.

7. A substantially flexible bladed strip ready for insertion in a turbo-machine groove comprising blades, separate distance pieces and a metallic connecting wire passed into holes in said distance pieces and roots of said blades and consolidated therewith.

In testimony whereof, we affix our signatures in presence of two witnesses.

CHARLES ALGERNON PARSONS.
JAMES WALTER WILSON.
JOHN FORD.

Witnesses:
HENRY GRAHAM DAKYNS, Jr.,
FREDERICK GORDON HAY BEDFORD.