F. HODGKINSON.

BLADE HOLDING MEANS.

APPLICATION FILED MAY 26, 1908.

943,348. Patented Dec. 14, 1909.

2 SHEETS—SHEET 1.

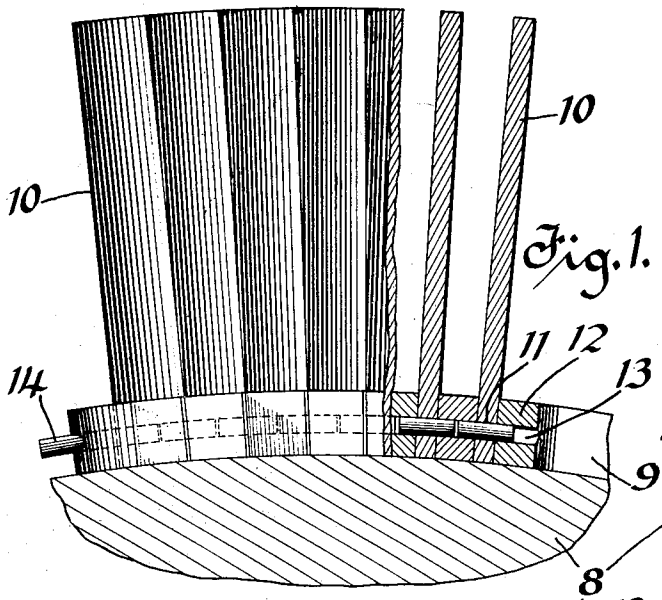

Fig. 1.

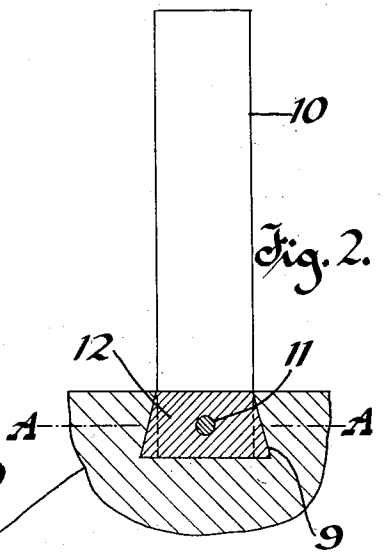

Fig. 2.

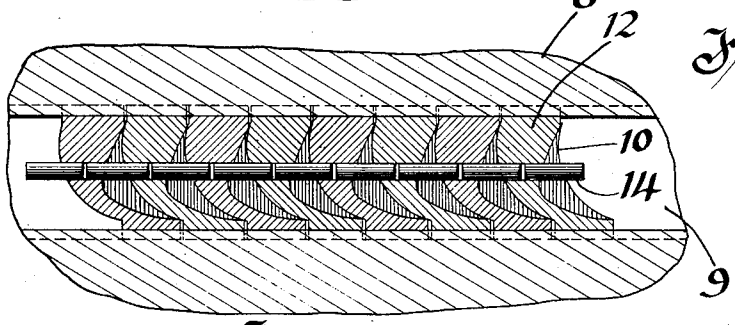

Fig. 3.

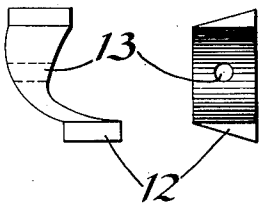

Fig. 4. Fig. 5.

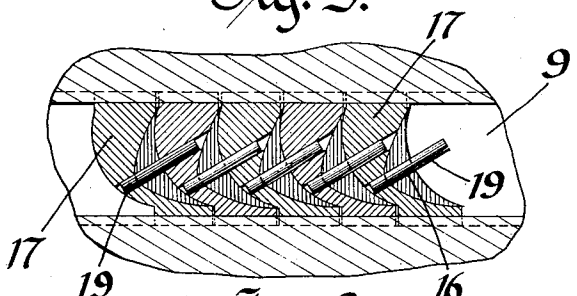

Fig. 6.

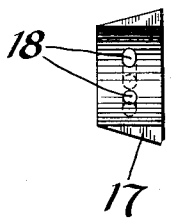

Fig. 7.

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2 SHEETS—SHEET 2.

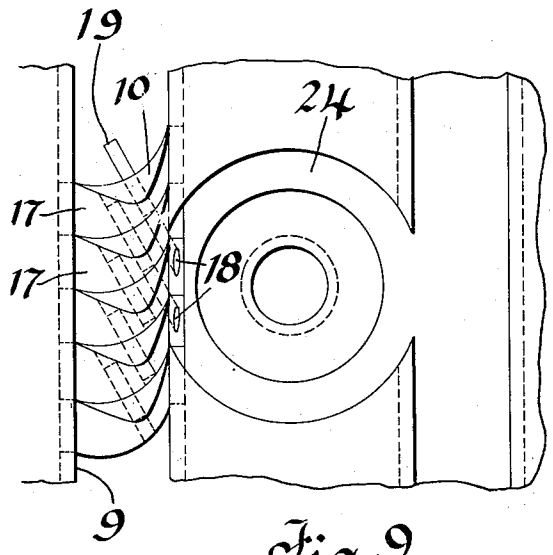

Fig. 9.

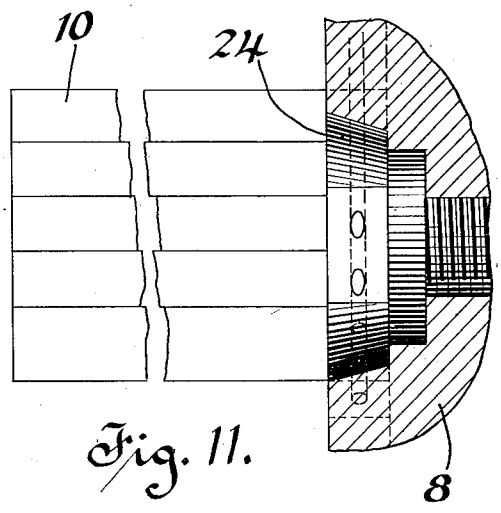

Fig. 11.

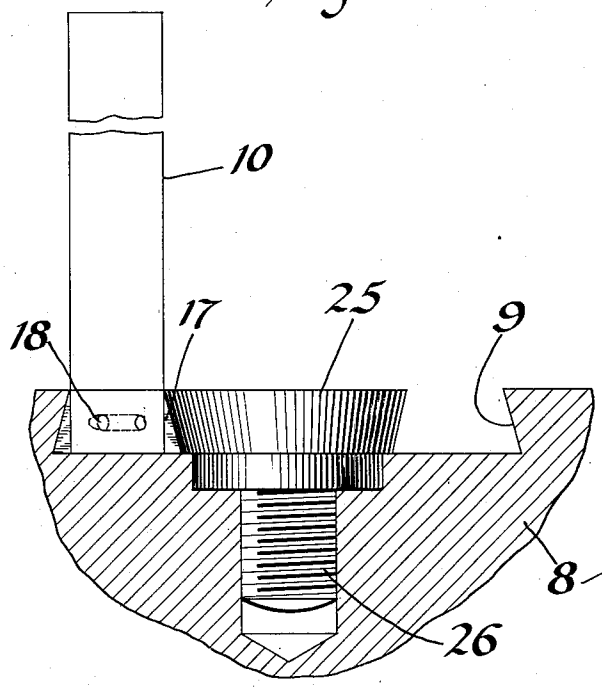

Fig. 10.

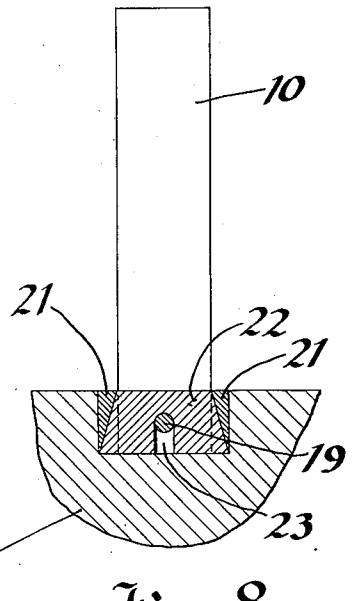

Fig. 8.

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UNITED STATES PATENT OFFICE.

FRANCIS HODGKINSON, OF EDGEWOOD PARK, PENNSYLVANIA, ASSIGNOR TO THE WESTINGHOUSE MACHINE COMPANY, A CORPORATION OF PENNSYLVANIA.

BLADE-HOLDING MEANS.

943,348. Specification of Letters Patent. Patented Dec. 14, 1909.

Application filed May 26, 1908. Serial No. 435,077.

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 Blade-Holding Means, of which the following is a specification.

This invention relates to elastic fluid turbines and more particularly to blading for turbines.

My invention relates specifically, although I do not wish to so limit it, to blades which are secured, by means of separate spacing pieces, into grooves or slots formed in the blade-carrying element of the turbine. By "blade-carrying element" I mean the element carrying the stationary blades or the element carrying the rotating blades.

An object of my invention is the production of a simple and effective means for securing the blades to the blade-carrying elements of the turbine.

A further object is the production of means for securing the blades to the blade-carrying elements, which will positively and effectively lock them in place and resist the dislodging strains encountered by the moving blades and occasioned by centrifugal force.

These and other objects I attain in the apparatus herein described and illustrated as embodiments of my invention.

In the drawings accompanying this application and forming a part thereof: Figure 1 is a fragmental sectional elevation of a turbine blade-carrying element provided with blades mounted in accordance with my invention. A portion of the blades are shown in elevation and a portion in section; Fig. 2 is a transverse section of Fig. 1; Fig. 3 is a section along the line A—A of Fig. 2; Figs. 4 and 5 are respectively plan and side elevation of a spacing piece embodied as a detail in my invention; Fig. 6 is a sectional plan view of a modification of my invention; Fig. 7 is an elevation of a calking piece which forms a detail of the modified embodiment; Fig. 8 is a fragmental elevation of a blade-carrying element and illustrates a detail of my invention; and Figs. 9, 10 and 11 are respectively plan, sectional and side views of a locking key for securing the last blades of a row in place.

Blades have heretofore been secured, by means of spacing or calking pieces, into blade-mounting slots formed in the blade-carrying elements of the turbine and provided with straight walls. The spacing or calking pieces are inserted between the base portions of adjacent blades and are expanded transversely to grip both the walls of the mounting slots and the adjacent faces of the bases of the blades.

My present invention provides means for securing the blades into the blade-mounting slots by means of separate spacing pieces which are located between adjacent blades of a row, and in addition thereto it provides means for positively locking each blade to the two spacing pieces which are located adjacent to it.

Referring particularly to Figs. 1, 2 and 3: The blade-carrying element 8 is provided with an undercut blade-mounting slot 9 which extends circumferentially of the element and in which the bases of the blades 10 are located. Each blade is provided at its mounting end with a round hole 11, which extends transversely through the blade. Separate spacing pieces 12 are mounted between the bases of adjacent blades and each piece is provided with a concave face which conforms in contour to the convex face of the blade, and a convex face which conforms in contour to the concave face of the blade. The lateral faces of the spacing pieces are plain, but are inclined to conform to the inclination of the undercut walls of the slot 9 and consequently each piece is wedge-shaped and fits snugly in the blade-mounting slot between two adjacent blades. A round hole 13 extends parallel to the lateral faces through each spacing piece and is so located in the piece that it registers with the holes 11 formed in the bases of the adjacent blades when the blades and pieces are in place within the blade-mounting slot. Cylindrical plugs 14 fit into the registering holes 11 and 13 of the blades and pieces respectively and each plug is so located relative to each blade that it positively locks the blade to the adjacent pieces located on each side of it. Each plug 14 may be rigidly secured, if desired, in the hole provided in each calking piece 12.

In securing the blades to the blade-carrying element the bases of the blades and alternate spacing pieces 12 are introduced into a blade-mounting slot 9, and each blade

is secured in place between the adjacent spacing pieces by means of the plug 14. The dove tailed or wedge shaped spacing pieces are, therefore, held securely in place by the undercut walls of the slot and the blades are positively locked to the spacing pieces.

In assembling the blades and spacing pieces it may be necessary to notch out a portion of one of the undercut walls of the blade-mounting slot for the purpose of introducing the spacing pieces. If this is the case, the notched out portion may be replaced by a removable key construction hereinafter described in connection with Figs. 9, 10 and 11. The last spacing piece 12 introduced into the blade mounting slot is, as the construction necessitates, constructed in a peculiar manner, and after it is secured into place in the slots acts as a key to lock the remaining pieces and blades in place. In Fig. 8 I have illustrated a preferred construction of the final spacing or locking piece in connection with means for securing it in place. The final piece 22 is in shape substantially the same as the other spacing pieces 12 with the exception that a slot 23 is cut across the bottom face of the piece 22 and is adapted to receive the ends of two adjacent plugs 14. The undercut portions of the wall are cut away so that the piece 22 can be inserted into the slot. The cutaway portions are replaced by calking pieces 21 which are inserted after the piece 22 is in place and which are calked into place. The calking of the piece 22 in the slot holds all spacing pieces and blades located within the slot in place and thereby positively locks them to the blade-carrying element.

In Figs. 6 and 7 I have illustrated a modification of my invention. The blades are, as shown in Fig. 1, locked into the undercut slot 9 by means of separate spacing pieces. Each blade is provided with a hole 16 near its base which extends diagonally through the blade relative to the general direction of the slot 9. Each spacing piece 17 is provided with two parallel holes 18 which cooperate with plugs 19 extending therethrough and into the holes 16 in the bases of the blades in positively locking each blade to the adjacent pieces located on each side of it. Each blade is thereby positively locked to the spacing pieces of each side of it by means of one plug 19, and each piece is positively locked by two plugs 19 to the blades located on either side of it. Each plug 19 may be secured to one of the pieces 17 or to one of the blades 10 or, if desired, it may be loosely mounted in the blade or the calking piece before they are secured into the slot.

The operation of securing the blades into the slot is similar to that described with reference to the other modification of my invention. It is impossible to insert the last few blades and spacing pieces 17 in the blade-mounting slot owing to the fact that the slot is undercut and that the separate spacing pieces and blades are locked together by means of plugs 19. In Figs. 9, 10 and 11 I have shown means whereby the last few blades and spacing pieces may be inserted into the slot and secured in place on the blade-carrying element. I cut away a portion of one of the undercut walls of each blade-mounting slot and replace it by a removable key, and I also provide a special construction for the last few spacing pieces located in the slot. A portion of the blade-carrying element 8 is drilled or otherwise cut away at 24 so as to remove a portion of one undercut wall of each of two adjacent blade-mounting slots 9. The portion of the element removed is replaced by a removable piece 25, which is so constructed as to replace the removed portion of each undercut wall and is secured in place on the carrying element by any suitable means; for example, a screw 26. The piece 25 is removed while the blades and spacing pieces are being introduced into the blade-mounting slot, as shown in Fig. 9. The two spacing pieces 17, located adjacent to the cut-away portion of the slot, are provided with additional walls which extend parallel to the holes 18, and which, with notches formed in the two blades located adjacent to the cut-away portion of the slot, are provided so that the plugs 19 may be introduced through the opening provided by cutting away the portion of the blade-carrying element. After all the blades and spacing pieces are assembled in the two adjacent slots the key 25 is secured to the blade-carrying element and the blades are then positively locked within the slot 9. The blade-mounting slots 9 need not necessarily be undercut, as any suitable means may be employed for securing the spacing pieces in place. The spacing pieces, for example, may be transversely expanded by being calked and thereby caused to grip the walls of the slots, or a separate locking means may be employed between the spacing pieces and the blade-carrying elements.

In accordance with the provisions of the patent statutes, I have described the principle of operation 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. A motor element having a slot, alternately arranged blades and spacing pieces in the slot and a row of staggered fastening devices for securing the blades and spacing pieces together in said slot.

2. A turbine blading comprising a plurality of alternately arranged blades and

spacing pieces and a row of staggered pins for securing said blades and spacing pieces together.

3. A turbine blading comprising a plurality of alternately arranged blades and spacing pieces and a row of staggered pins for securing said blades and spacing pieces together, each spacing piece having two pins passing therethrough and each blade having one pin passing therethrough.

4. A plurality of alternately arranged blades and spacing pieces for turbines, and a staggered row of fastening devices for securing the blades and spacing pieces together, said fastening devices being parallel to each other.

5. Turbine blading, comprising alternately arranged blades and spacing pieces and pins passing through the blades and spacing pieces, each pin being out of line with the pin adjacent to it.

6. Turbine blading comprising spacing pieces and blades and pins extending diagonally through the spacing pieces and blades.

7. Turbine blading, comprising spacing pieces and blades, the spacing pieces having two openings and each blade having a single opening and pins passing through one opening in each blade and engaging the respective openings in the spacing pieces.

In testimony whereof, I have hereunto subscribed my name this 16th day of May, 1908.

FRANCIS HODGKINSON.

Witnesses:

CHARLES W. MCGHEE,

E. W. MCCALLISTER.