G. WESTINGHOUSE.

TURBINE BLADE AND VANE.

APPLICATION FILED JAN. 7, 1907.

953,568. Patented Mar. 29, 1910.

2 SHEETS—SHEET 1.

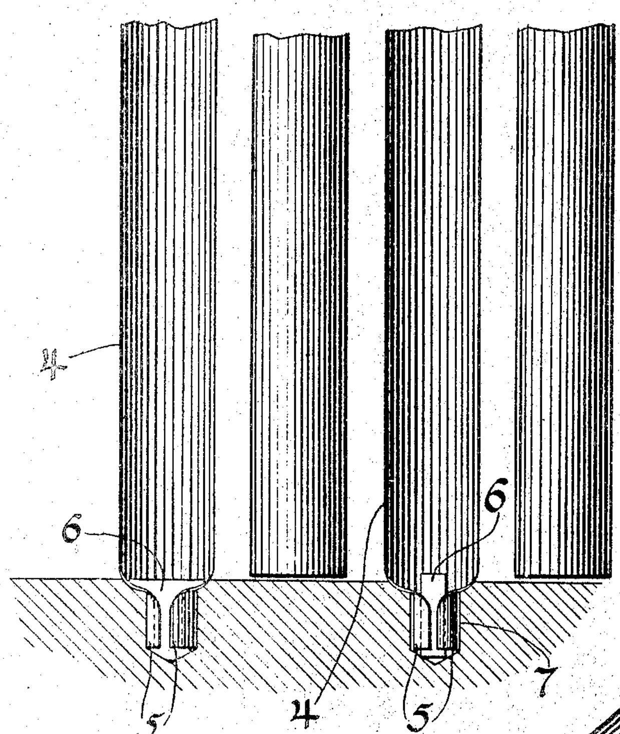

Fig. 1.

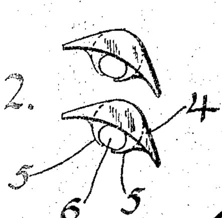

Fig. 2.

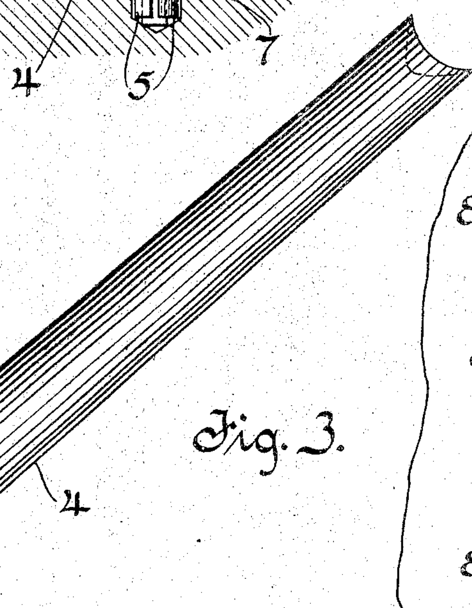

Fig. 3.

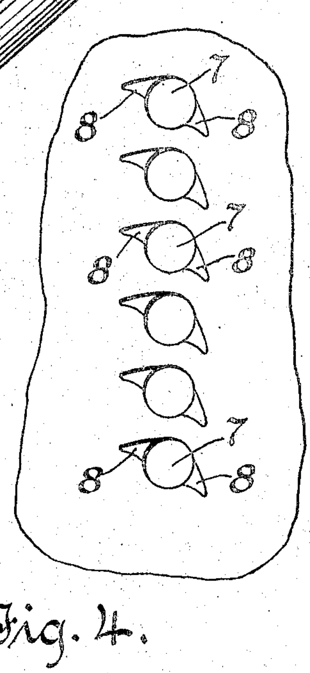

Fig. 4.

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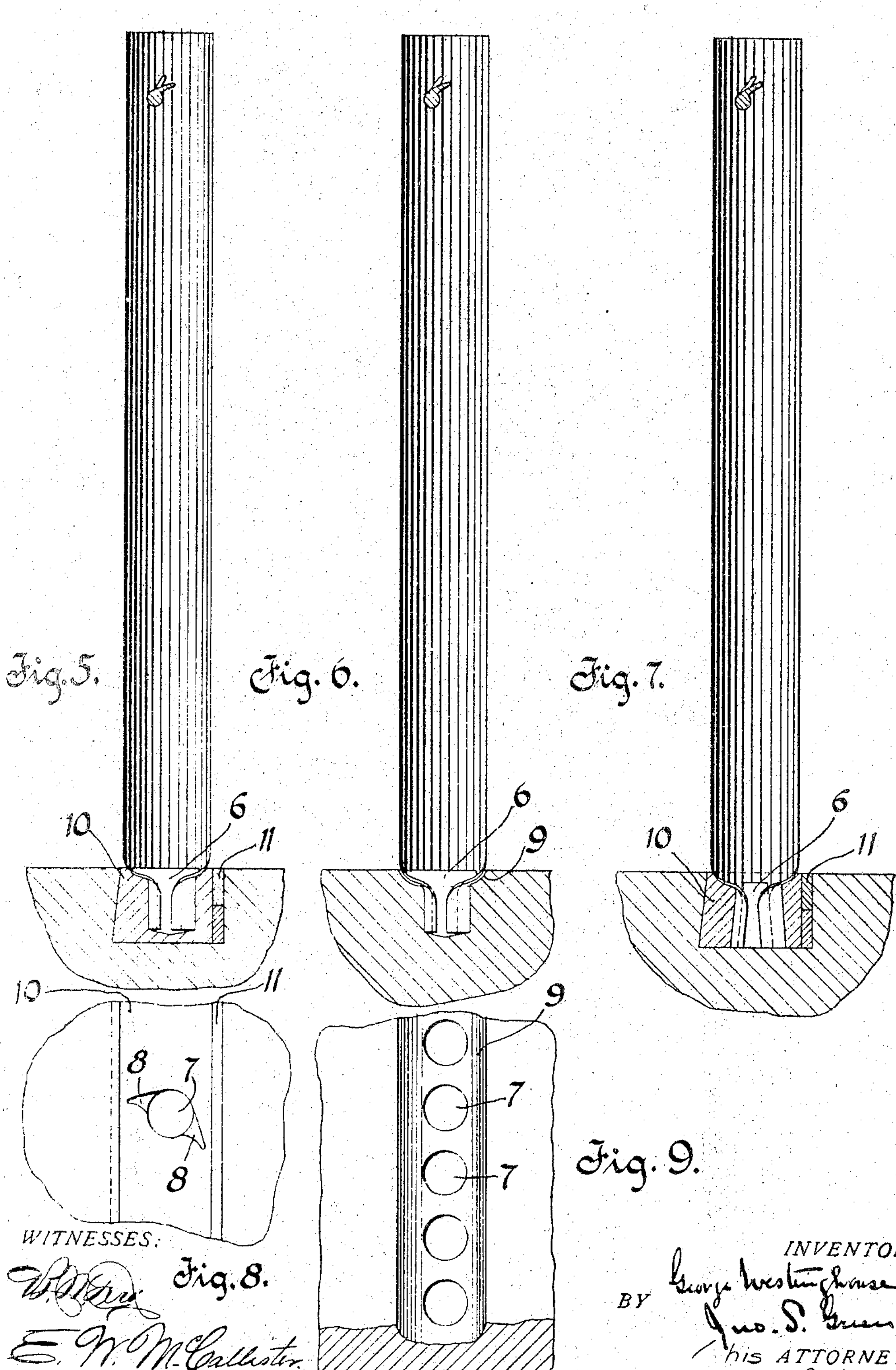

Fig. 5. Fig. 6. Fig. 7. Fig. 8. Fig. 9.

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UNITED STATES PATENT OFFICE.

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TURBINE BLADE AND VANE.

953,568. Specification of Letters Patent. Patented Mar. 29, 1910.
Application filed January 7, 1907. Serial No. 351,181.

To all whom it may concern:

Be it known that I, George Westinghouse, a citizen of the United States, and a resident of Pittsburg, in the county of Allegheny and State of Pennsylvania, have made a new and useful Invention in Turbine Blades and Vanes, of which the following is a specification.

This invention relates to elastic fluid turbines and more particularly to the blades and vanes thereof.

An object of this invention has been to provide simple, relatively cheap and efficient means for securing the blades and vanes to their respective holding elements, such as the rotor and stator of the turbine. This and other objects I attain by means of the construction illustrated in the accompanying drawings and forming a part of this application.

In the drawings, Figure 1 is a fragmentary view in longitudinal section of a portion of a turbine rotor showing two blades of two annular rows secured to the rotor in accordance with this invention; fragments of two vanes secured in two annular rows of stator vanes are shown alternating with the rows of rotor blades; Fig. 2 is a view looking toward the outer ends of two turbine blades for use in this invention; Fig. 3 is a perspective view of a turbine blade or vane with its binder plug in place, as hereinafter described; Fig. 4 is a plan view of a blade holding element showing the arrangement of drilled holes; Figs. 5, 6 and 7 illustrate modifications of my invention; and Figs. 8 and 9 are plan views of the holding element shown in Figs. 5 and 6 respectively.

In carrying out this invention, as illustrated in Figs. 1, 2, 4, 6 and 8, annular rows of holes of the proper size and depth are drilled into the rotor and stator so that their axes extend radially of the turbine axis. One hole is drilled for each blade or vane. After the blade strips, which are substantially crescent-shaped in cross section, have been cut into the desired lengths one end of each blade or vane is swaged or otherwise deformed so that the horns of the crescent are caused to partially encircle and more or less firmly grip a metallic binder block or calking plug. The deformed ends of the blades or vanes are then inserted within the holes drilled in the respective holding elements and pressure is applied to the exposed ends of the calking plugs so that the plugs will expand transversely of the applied pressure and cause those portions of the blades lying within the holes to firmly grip the walls of the holes.

In Fig. 1 of the drawings the right hand blade 4, which has the horns 5 of the base portion deformed to encircle a calking plug 6, has its base end more or less loosely lying within a hole 7 drilled in the rotor to receive the same. As before stated, after the blades or vanes are inserted in the holes drilled for their reception, pressure is applied to the exposed ends of the calking plugs, (preferably by means of a calking tool and hammer) and the plugs are spread transversely of the holes and the blades with their horns are caused to grip the walls of the holes, as illustrated in the left hand blade of Fig. 1. Slots or depressions 8 are cut or punched in the mounting member at each side of the drilled holes 7, as indicated in Fig. 4. These depressions receive the portion of the blade edges which have been distorted by swaging the ends of the blades into a cylindrical form and consequently permit the blade to extend farther into the mounting element, thereby minimizing the leakage of motive fluid since almost the entire face of the blade presented to the working fluid is of the correct contour. The calking plugs 6, moreover, are of such lengths that after being distorted by the calking pressure they entirely fill the depressions and portions of the drilled holes 7 not occupied by the blades and form a surface which is even with the surface of the mounting element. The depressions 8 are so positioned, relative to each hole and to each other, that when the blades and vanes are in place in the drilled holes they are turned to the correct angle for an efficient operation, thereby doing away with the operation of gaging, which consists in turning the blades and vanes to the correct angle after they have been calked or secured in place.

In Figs. 6 and 9 a modification of my invention is shown, the depressions 8 being replaced by an annular groove 9, which is turned in the mounting element and which, like the depressions 8, permits the blades and vanes to extend into the mounting element so that only the undistorted portions of the blade are subjected to the direct action of the working fluid.

In Figs. 5 and 7, modifications of my invention are shown in which the holes 7 are drilled or punched in a separate mounting strip or foundation ring 10, which, after the blades are secured in place, is mounted in a slot formed for its reception in the working element of the turbine and which is secured in place by a calking strip 11. In Fig. 5 the holes 7 do not extend clear through the strip 10 and the blades or vanes, as the case may be, are calked into place by means of the calking plugs or blocks 6, as described in connection with the other modifications. In Fig. 7 the holes 7 extend entirely through the mounting strip 10 and are tapered to a larger diameter on the inner side of the strip; that is, on the side which contacts with the inner surface of the slot. The ends of the blades or vanes are swaged in the same way as described in connection with the other modifications with the exception that the calking plug 6 is not inclosed within the cylindrical or swaged portion of the blade. The calking plugs 6 utilized in connection with this modification are conical in shape and are inserted into the larger side of the drilled hole 7 after the swaged ends of the blades have been inserted into the hole from the other side. The blades are then secured in place by driving the calking piece home, thereby spreading the swaged end of the blade and forcing it into gripping contact with the surface of the hole. The plug 6 may be distorted or not as deemed desirable. After the blades and vanes are secured in place in their respective holding strips 10, the strips are calked into grooves or slots, formed for their reception in the working elements of the turbine, by means of calking strips 11, as before described. The calking plugs or blocks 6 cannot be dislodged after the mounting strips are secured into the slots, since they are locked into place by the inner face of the slot against which they abut. The depressions 8 at either side of the drilled holes 7 may be utilized in connection with the separate mounting strips 10, as illustrated in Fig. 8.

It will be understood, of course, that this invention may be practiced with blades that differ in cross section from the blades shown; that is, the blades may be more nearly crescent shaped than the blades shown, or may be farther from a crescent shape than the blades shown, and so long as the base is deformed to surround a calking plug, either before or after the blades are finally assembled in their holding elements, the structure will fall within the spirit and scope of this invention.

Having thus described my invention, what I claim as new and useful is:

1. In combination in an elastic fluid turbine, a blade or vane holding element provided with a plurality of blade recesses, a blade or vane provided with a mounting portion formed by swaging one end of the blade or vane to encircle a calking plug without fracturing the edges of the blade or vane and a calking plug encircled by said swaged end and which is adapted to be expanded transversely to secure the blade or vane within a recess of said mounting element.

2. A turbine blade or vane, one end of which is deformed, without fracturing the edges of said blade, so as to grip a calking plug, in combination with a calking plug.

3. In combination in a turbine, a blade or vane carrying element provided with a circumferentially extending groove, a mounting strip provided with a plurality of holes extending transversely therethrough, blades or vanes swaged at one end to form mounting portions, a calking piece for securing each blade into one of said holes by expanding the mounting portion to grip the walls of the holes, and means for securing said strip into said slot.

4. In combination in a turbine, a blade or vane carrying element provided with a circumferentially extending slot, a mounting strip provided with a plurality of tapered holes extending therethrough, blades or vanes swaged at one end to enter said holes, separate tapered calking pieces for securing the mounting portions of each blade in one of said holes, and means for securing said mounting strip into said slot.

5. In combination in a turbine, a blade or vane carrying element provided with a slot, a blade or vane mounting strip located in and extending longitudinally of said slot, a row of holes extending through the middle portion of said strip, and blades or vanes, swaged at one end to form mounting portions, which extend into said holes and are secured therein by means of separate calking pieces.

6. A blade mounting strip provided with a tapered blade mounting hole, a blade or vane swaged at one end to form a mounting portion, and a tapered mounting piece for securing the mounting portion of said blade into said hole.

7. The combination of a blade carrying element, a mounting strip provided with a plurality of blade or vane mounting holes extending therethrough, blades or vanes swaged at one end to form mounting portions, which are located within said holes, and separate means for securing each of said blades or vanes to said mounting strip.

8. In combination in a turbine, a blade or vane carrying element provided with a circumferentially extending slot, a blade or vane mounting strip located within and extending longitudinally of said slot, a row of holes extending through the middle portion of said strip, and blades or vanes, swaged

at one end to form mounting portions, which extend into said holes and are expanded transversely to grip the walls of said holes.

9. In combination in a turbine, a blade or vane carrying element provided with a circumferentially extending slot, a mounting strip provided with a plurality of holes extending transversely therethrough, blades or vanes deformed, without fracturing the edges of the blades, so as to form mounting portions, a calking piece for securing each blade into one of said holes by expanding the mounting portion to grip the walls of the holes, and means for securing said strip into said slot.

10. In combination in a turbine, a blade or vane carrying element provided with a circumferentially extending slot, a mounting strip provided with a plurality of tapered holes extending therethrough, blades or vanes swaged at one end, without fracturing the edges of the blades, to form mounting portions, separate tapered calking pieces for securing the mounting portions of each blade in one of said holes, and means for securing said mounting strip into said slot.

11. The combination in a turbine engine of a carrying element having a groove therein, a foundation ring having holes therein, means for holding the ring in the groove, blades having one end engaging with the holes in the ring, and calking blocks also engaging in said holes.

12. In combination with a turbine blade-carrying element having a groove therein, a foundation ring having holes therein of greater width than the thickness of the blades, distortable means located within said holes for securing said blades to said ring and means for securing said ring within said groove.

13. In combination with a turbine blade-carrying element provided with a groove, a foundation ring having holes therein of greater width than the thickness of the blades, means located within each hole and the cross-sectional area of which is adapted to be changed for securing said blades to said ring and a calking strip for securing said ring within said groove.

14. In combination with a turbine blade-carrying element provided with an undercut groove, a foundation ring of less width than said groove and having holes therein of greater width than the thickest portion of the blades, distortable means located within said holes for securing said blades to said ring and a calking strip located in said groove alongside of said ring for securing said ring within said groove.

15. In combination with a turbine blade-carrying element having a groove therein, a foundation ring provided with holes, distortable means located within said holes for securing the blades to said ring and means for securing said ring within said groove.

16. In combination with a turbine blade-carrying element provided with a groove, a foundation ring having holes therein, means located within each hole and the cross-sectional area of which is adapted to be changed for securing the blades to said ring and a calking strip for securing said ring within said groove.

17. In combination with a turbine blade-carrying element provided with an undercut groove, a foundation ring of less width than said groove and having holes therein, distortable means located within said holes for securing the blades to said ring and a calking strip located in said groove alongside of said ring for securing said ring within said groove.

In testimony whereof, I have hereunto subscribed my name this 29th day of December, 1906.

GEO. WESTINGHOUSE.

Witnesses:

CHARLES W. McGHEE,

R. P. McINTYRE.