G. WESTINGHOUSE.

TURBINE BLADE AND VANE.

APPLICATION FILED JAN. 2, 1907.

930,907.

Patented Aug. 10, 1909.

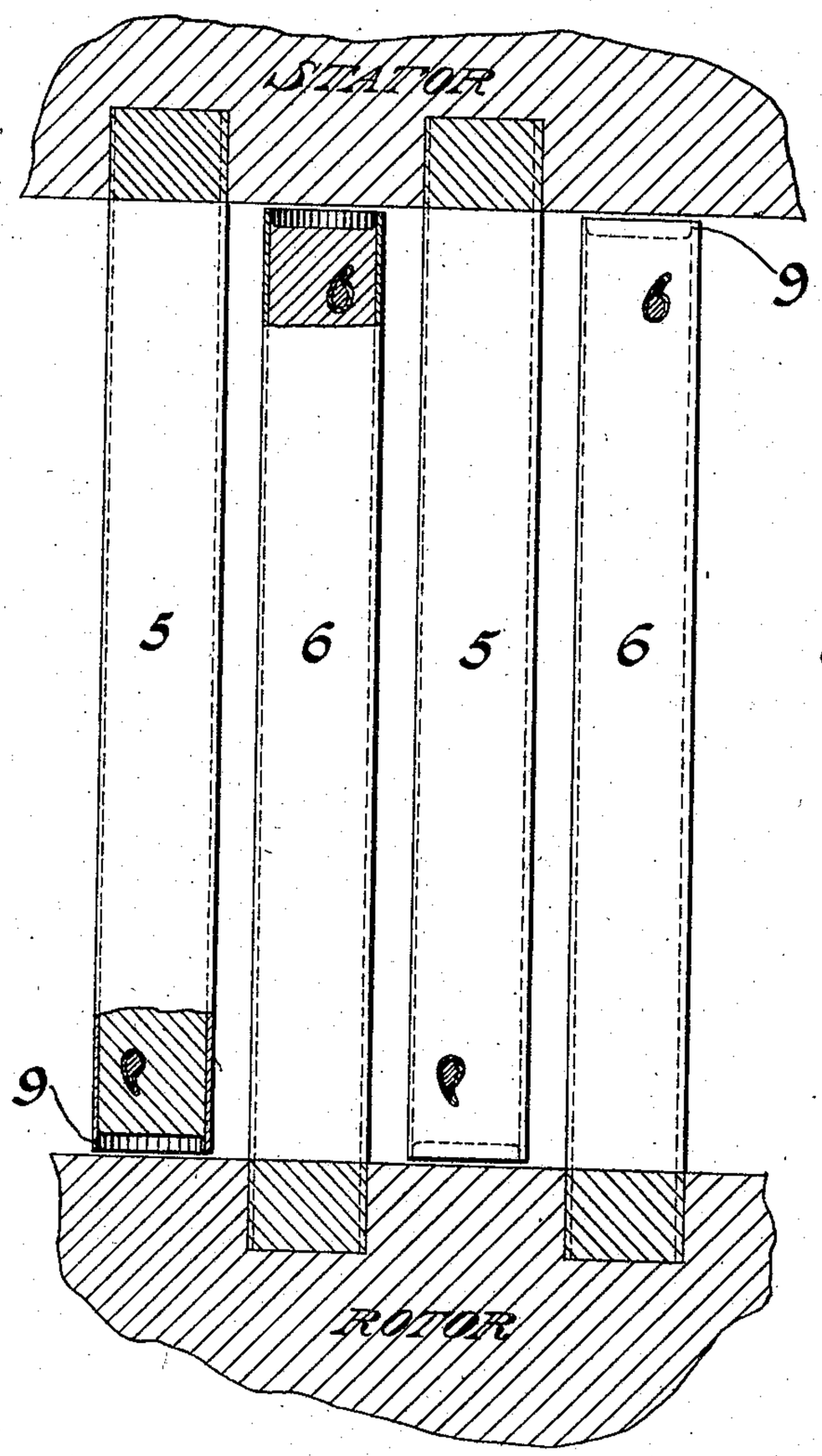

Fig. 1.

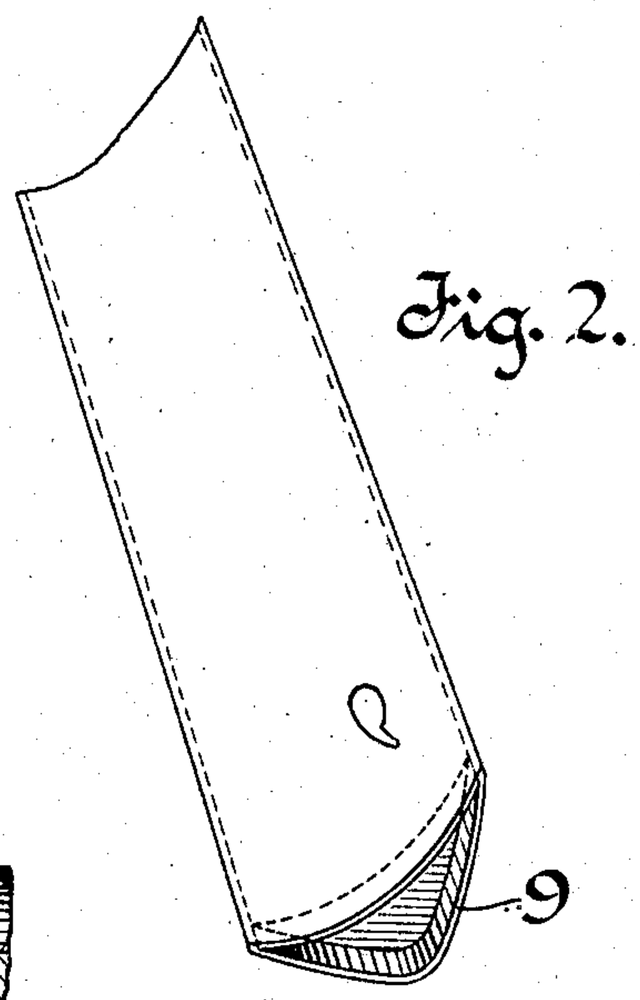

Fig. 2.

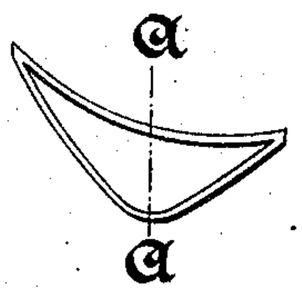

Fig. 3.

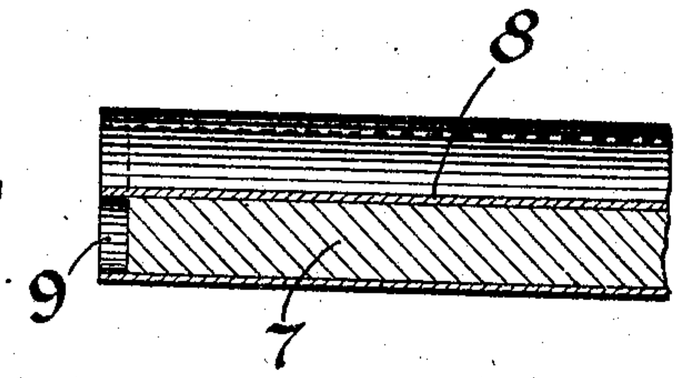

Fig. 4.

WITNESSES:

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UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, OF PITTSBURG, PENNSYLVANIA.

TURBINE BLADE AND VANE

No. 930,907. Specification of Letters Patent. Patented Aug. 10, 1909.

Application filed January 2, 1907. Serial No. 350,406.

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.

It has been found in practice that the rotors and stators of elastic fluid turbines are liable to, and do distort under certain operating conditions. It is essential to the efficiency of such machines to have the clearances between the relatively moving parts (that is, the clearances between the tip ends of the blades and the stator or casing and the tips of the vanes and the rotor or spindle) small, and to overcome the troubles which arise from small clearances and said distortions, has been an object of this invention. I am aware that numerous attempts to this end have been made, but with all of them with which I am familiar fluid eddies resulting from the schemes utilized rendered the same impracticable.

A further object of this invention is to produce a turbine blade or vane which throughout its entire length presents to the working fluid the proper surface contour, and the free end or tip of which, when collision between it and the surface element to which it stands adjacent occurs, may be readily worn away in a predetermined amount whereby the remainder of the blade or vane will be uninjured and safe clearances attained.

These and other objects I attain by means of the blades and vanes illustrated in the accompanying drawings forming a part of this application, and throughout which like elements are denoted by like characters.

In the drawings, Figure 1 is a fragmentary view of a portion of a turbine stator carrying two annular rows of vanes and of a turbine rotor carrying two rows of blades alternating with said vanes; Fig. 2 is a view in perspective of a portion of a turbine blade or vane, as the case may be, constructed in accordance with this invention; Fig. 3 is an end view of a turbine blade or vane, as the case may be, constructed in accordance with this invention; and Fig. 4 is a partial sectional view taken along the line A—A of Fig. 3.

The stator vanes 5, which may be secured to the stator in any desired manner, extend to within close proximity of the rotor in order to maintain the small clearances desirable, while the rotor blades 6, which may be secured to the rotor in any desired manner, extend to within the same distance of the stator. In order to present to the working fluid the proper surface contour throughout the entire length, each blade and vane is properly formed of two parts; a core portion, which is preferably of steel, and an armor or sheath, preferably of copper, which extends beyond the core portion, forming a projecting rim which lies in the planes of the blade faces and forms a hollow tip, which presents to the working fluid a working surface of the same contour as the blade proper. The projecting rim, which is of less cross sectional area than the major portion of the blade, may be readily worn away to the end of the major portion of the blade if collision between it and the element to which it stands adjacent occurs.

In order to protect the blade proper against the erosive and corrosive effect of the fluid encountered, it is preferable to sheath the same with an armor of copper or some other metal equally as efficient as a protector. By thus sheathing the blade with a metal softer than the core portion, I am enabled to form the projecting rim to the tip end of the blade of the same soft metal, thus providing a wearing tip which will be as effective in expanding the working fluid and abstracting the energy therefrom as though formed of the same metal as the core portion, but more effective as a wearing tip.

Blades and vanes constructed in accordance with this invention are preferably formed by welding a copper envelop or sheath to a steel core, after which the whole is drawn to the proper cross section. Each blade then consists of a core portion 7 and a protective armor or sheath 8. After the blade strips are thus formed they are cut into the proper lengths and the individual blades and vanes are then tip immersed in a suitable acid bath (such as sulphuric acid) whereby the core is attacked and removed in a predetermined amount, leaving a projecting rim 9 of the sheathing or armor metal. An acid for the bath, of course, will be chosen which will attack the core portion without touching the sheath or armor and the acid, of course, may be varied to suit the different metals used.

In Fig. 1, one blade and one vane is cut

away near its outer end to illustrate the positions of the several parts of the structure.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the device which I now consider to represent the best embodiment thereof, but I desire to have it understood that the device shown is only illustrative and that the invention can be carried out by other means.

What I claim is:

1. A sheathed turbine blade or vane, the sheath of which projects beyond the sheathed portion at one end of the blade or vane.

2. A turbine blade or vane formed of a core and a protective cover or envelop which projects beyond the core at one end of the blade.

3. A turbine blade or vane formed of a metallic core and a metallic armor welded thereto and which projects beyond the core at one end of the blade.

4. A turbine blade or vane formed of a metallic core and a metallic armor welded thereto and which projects in the planes of the blade or vane faces beyond one end of the blade or vane.

5. In a turbine, alternate annular rows of moving blades and stationary vanes, the blades and vanes of which rows extend to within close proximity of the stator and rotor respectively; the free ends of each blade and vane being hollowed out to form a projecting rim adapted to be worn away when collision between the relatively moving parts occurs.

6. A turbine blade or vane formed of a core portion and a protective sheath or cover which projects beyond the core portion and presents to the working fluid a working surface of the same contour as the blade or vane.

7. A turbine blade or vane provided at one end with a wearing tip welded thereto.

8. A blade or vane provided with a tip portion of metal softer than the major portion of the blade or vane.

9. A turbine blade or vane provided with a tip portion of metal softer than the major portion of the blade or vane and presenting to the working fluid working faces of substantially the same contour as the blade or vane.

10. A turbine blade or vane provided with a wearing tip of soft metal.

11. A turbine blade or vane provided with a soft metal tip welded thereto.

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

GEO. WESTINGHOUSE.

Witnesses:
CHARLES W. MCGHEE,
JNO. S. GREEN.