J. F. JOHNSON.

TURBINE BLADE.

APPLICATION FILED SEPT. 28, 1916.

1,317,707. Patented Oct. 7, 1919.

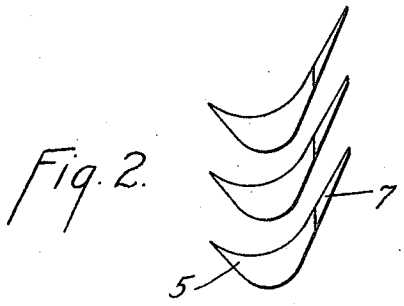


Fig. 2.

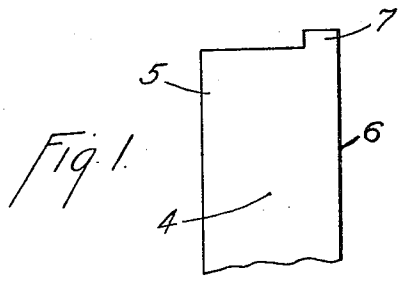


Fig. 1.

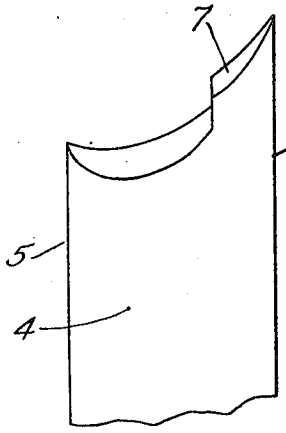


Fig. 3.

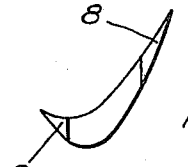


Fig. 5.

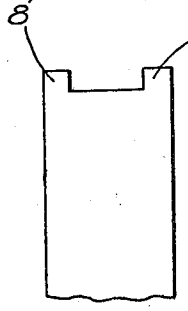


Fig. 4.

INVENTOR.

J. Francis Johnson

BY Green & McCallister

HIS ATTORNEYS IN FACT

THE COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

JOSIAH FRANCIS JOHNSON, OF EDGEWOOD, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

TURBINE-BLADE.

1,317,707. Specification of Letters Patent. Patented Oct. 7, 1919.

Application filed September 28, 1916. Serial No. 122,637.

To all whom it may concern:

Be it known that I, JOSIAH FRANCIS JOHNSON, a citizen of the United States, and a resident of Edgewood, in the county of Allegheny and State of Pennsylvania, have made a new and useful Invention in Turbine-Blades, of which the following is a specification.

This invention relates to improvements in the blades for steam, gas, or air turbines or turbo compressors.

In order to reduce the losses due to leakage around the ends of the blades in turbines or similar machines it is customary to construct these machines with but slight clearances between the ends of the blades and the adjacent relatively moving surfaces, *i. e.*, the casing or rotor. Under some conditions it is difficult to maintain these small clearances, especially in large machines which may be subjected to vibrations or in which warping of the casing or rotor may occur because of unequal heat distribution or other causes. Serious damage to the blades and possibly to the turbine might result in the case of a blade rub, unless some means were provided to minimize the friction created by the blade rub.

The object of this invention is to produce a blading for turbines or similar machines which will reduce the amount of damage occasioned by a blade rub.

A further object is to produce blading in which simple and cheap means are employed for reducing the amount of damage resulting from a blade rub.

A further object is to produce a turbine blade of such a design that the friction due to contact between the ends of the blades and the adjacent surfaces will be greatly reduced.

These and other objects are attained by means of a blade or blading construction embodying the features herein described and illustrated in the drawings accompanying and forming a part hereof.

In the drawings; Figure 1 is a fragmental elevation of a blade embodying a preferred form of my invention.

Fig. 2 is a plan view of a portion of a row of blades which may be mounted on the rotor or the stator of a turbine machine, each blade being equipped with my invention.

Fig. 3 is a fragmental perspective view of a blade embodying my invention.

Figs. 4 and 5 are respectively a fragmental elevation and a plan view of a blade embodying a modification of my invention.

In Patent No. 899,319, issued to Parsons *et al.* on Sept. 22, 1908, a blade construction is disclosed in which the blade is of decreasing cross section toward its free end. Such a blade is expensive and difficult to manufacture and it cannot be cut from a drawn strip in a single operation. The specific object of my present invention is to produce a wearing tip on the end of a turbine blade, which reduces the amount of wearing surface at the end of the blade and is so constructed that the blade may be cut from a drawn blade strip in a single operation, or may be formed after the blades are permanently secured to their mounting element and at the time the blades are being finished to proper working diameters.

In Figs. 1, 2 and 3 I have shown the preferred form of my invention. Each blade illustrated is of a type which may be termed an impact and reaction blade, in that a portion of the working surface of the blade is employed for abstracting the velocity energy rendered available by a previous expansion of the motive fluid, whereas the remainder of the blade is employed for further expanding the fluid and for abstracting by reaction the energy rendered available by the further expansion of the fluid.

Each blade is more or less crescent shape in cross section and is consequently provided with a thickened intermediate or body portion 4, and two wings or horns 5 and 6, each of which is gradually tapered to a thin or knife-like edge. The thickened portion adds strength to the blade and is employed primarily for structural reasons. Both the front and rear surfaces are of course of such contour that they coöperate with the adjacent blades to provide fluid passages of the desired shape. As illustrated, the thickest portion of each blade is located nearer the receiving edge of the blade, and consequently the discharging wing 6 is elongated or more gradually tapered so that it forms, with an adjacent blade, a passage capable of expanding the fluid passing through it and leaving the blade. As illustrated, the free end of the blade is cut so as

to provide a wearing tip 7 which is formed wholly of the elongated or thin wing 6 of the blade. With this arrangement I cut away that portion of the blade which is thickened for the purpose of strengthening the blade and which is in fact the impulse portion of the blade. In this way I reduce the efficiency of the blade an infinitesimal amount, since the greater portion of energy is abstracted from the steam or motive fluid by the reaction or uncut portion of the blade.

A reference to Fig. 2 will show that although a portion of the working face of each blade is cut away, the remaining portion or the projecting tips 7 of all of the blades coöperate to form a barrier for the motive fluid, which prevents it from passing the ends of the blades without delivering up energy to the tips.

Fig. 2 also shows that I have in effect provided each blade with a longitudinally projecting tip 7, which coöperates with the tips on adjacent blades to form expansion nozzles for the motive fluid passing between the tips.

In Figs. 4 and 5 I have shown a modified form of my invention in which the thickened portion only of the blade is cut away. This provides each blade with two longitudinally projecting tips 8, which are formed at the thinned portion of the blade, and consequently are of small sectional area. The blades embodying either modification of the invention may be formed by a single cutting operation, since the blade cutting dies may be so formed that they will form the tips 8 during the operation of cutting the blade from the drawn strip. It will also be apparent that the tips may be formed by turning off the ends of the blades after the blades are permanently secured to the mounting member and during the operation of finishing the blades, so that the working elements are of the proper diameters.

While I have illustrated but two modifications of my invention, it will be apparent that various changes, substitutions, additions and omissions may be made in the apparatus without departing from the spirit and scope of the invention as illustrated.

What I claim is:

1. A blade having one wing extending longitudinally beyond the body of the blade at the free end thereof.

2. A blade having a projecting wearing tip of less width than the blade extending beyond the end thereof in the direction of the length of the blade.

3. A blade having a portion of one wing of the free end extending beyond the remainder of the blade in the direction of the length of the blade.

4. An impact and reaction blade, having the impact portion cut away so as to form a longitudinally projecting reaction tip at the outer or free end thereof.

5. A blade of the type described, having its free or outer end cut to form a relatively thin longitudinally projecting wearing tip, characterized by that the tip forms a continuation of the wing portion of the blade, whereas the body portion is cut away.

6. A blade comprising a body portion and wings of gradually decreasing section located on each side of the body portion, and a longitudinally projecting tip located at the free end of the blade and forming a longitudinal continuation of one wing of the blade.

7. A blade of the impact reaction type comprising a thickened impact portion and a lateral wing forming a reaction portion and gradually decreasing in section toward a lateral edge of the blade, and a longitudinally extending tip at the free end of the blade forming an extension of the reaction portion of the blade and projecting beyond the impact portion thereof.

8. A blade substantially crescent shape in cross section and thickened at a point intermediate the wings to strengthen the blade, and a longitudinally projecting tip forming a continuation of one wing of the blade and located at the free end of the blade.

9. A blade comprising a thickened body portion and a wing formed integrally with the body portion and decreasing in section toward the lateral edge of the blade, characterized by that the free end of the blade is notched to form a longitudinally projecting tip on the wing portion of the blade.

10. A blade having a longitudinally projecting tip of less width than the blade formed on the free end thereof which projects beyond the body portion of the blade and forms with corresponding tips on adjacent blades fluid expanding passages.

In testimony whereof I have hereunto subscribed my name this 26th day of September, 1916.

JOSIAH FRANCIS JOHNSON.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."