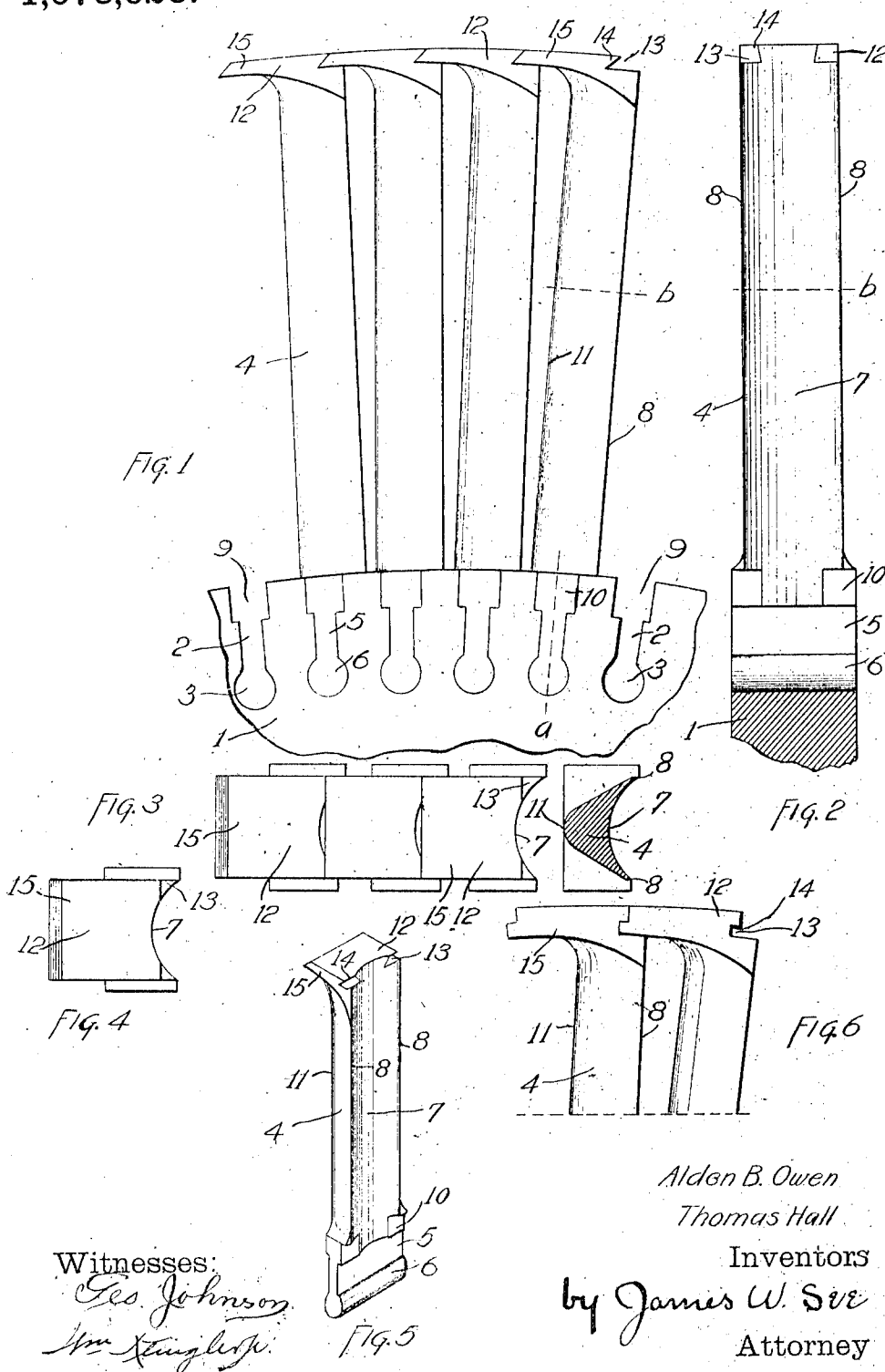


A. B. OWEN & T. HALL.
STEAM TURBINE BLADE.
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1,073,623.

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Witnesses:

Geo. Johnson
Wm. H. Hingle

Alden B. Owen
Thomas Hall

Inventors

by *James W. Sive*
Attorney

UNITED STATES PATENT OFFICE.

ALDEN B. OWEN AND THOMAS HALL, OF RIDGWAY, PENNSYLVANIA, ASSIGNORS TO
THE RIDGWAY DYNAMO AND ENGINE COMPANY, OF RIDGWAY, PENNSYLVANIA.

STEAM-TURBINE BLADE.

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To all whom it may concern:

Be it known that we, ALDEN B. OWEN and THOMAS HALL, citizens of the United States, residing at Ridgway, Elk county, Pennsylvania, have invented certain new and useful Improvements in Steam-Turbine Blades, of which the following is a specification.

The present invention, relating to improvements in the blades or buckets of steam turbines will be readily understood from the following description taken in connection with the accompanying drawings in which:—

Figure 1 is a side elevation of a portion of a rotor of a steam turbine fitted with blades exemplifying our present invention: Fig. 2 a diametrical section, in the plane of line *a* of Fig. 1 of a portion of the rotor, one of the blades appearing in elevation exposing its concave face: Fig. 3 a plan of three of the blades, in conjunction with a fourth blade shown in transverse section in the plane of line *b* of Figs. 1 and 2: Fig. 4 a plan of one of the blades: Fig. 5 a perspective view of one of the blades: and Fig. 6 a side elevation of the outer portion of two of the blades in a somewhat modified form.

In the drawing, ignoring Fig. 6 for the present:—1, indicates a disk of a turbine rotor: 2, radial slots in the periphery of the disk: 3, cylindrical enlargements at the roots of the slots: 4, the blades: 5, tangs on the inner ends of the blades, these tangs fitting the slots 2 in the disk: 6, circular enlargements on the inner end of the tangs, these enlargements fitting the enlargements 3 of the slots: 7, the concave retreating faces of the blades, these concave faces extending the entire length of the blades from the periphery of the disk to the extreme outer ends of the blades and having such contour of cross-section as is usual or proper in turbine blades: 8, the retreating side edges of the blades, at the side extremities of the concave faces, these edges extending from the periphery of the disk to a point inwardly from the extreme outer ends of the blades: 9, widened portions of the slots 2 in the disk: 10, widened portions of the tangs 5 of the blades, to fit the widened portions 9 of the slots: 11, the convex advancing faces of the blades: 12, the heads or outer ends of the blades, these heads having flat side faces, and having preferably a width equal to or greater than that of the concave portions of the blades: 13, recesses in the outer rear-

ward portions of the heads of the blades: 14, inwardly presenting surfaces with which each of the recesses 13 are to be preferably provided: and 15, forward projections from the heads of the blades, the forward extremity of each projection engaging the recess 13 of the head of the blade in advance, and the outer surfaces of the heads being curved to give to the rotor its circular periphery.

Each blade may be milled from a solid piece of metal, steel, bronze, Monel metal or other metal. The cross-sectional form of the blades and the manner in which they are tanged into slots in the rotor-disk is not new. The projections 15 unite the heads of the blades firmly with each other, and the construction is manifestly such that any individual blade of the series may be removed from the disk and from the general series of blades, the tangs of the blade sliding out sidewise from the disk while the head of the blade slides out sidewise from the two contiguous blades. The concave face of the blade may be accurately and economically formed by a straight milling cut extending from tangs 5 to the outer extremity of the blades. In the illustration it will be noted that the recesses 13 are not cut forward as far as the concavities of the blades extend, the result being that the projections 15 do not completely close the outer extremities of the concavities of the blades. This will be understood from Fig. 3 and results from the shortness of projections 15, which shortness is suggested by economy of material, the small openings at the periphery of the rotor not being at all objectionable.

The undercut or hooking feature 14 of the recesses 13, in conjunction with the corresponding fitting forward extremities of the projections of the heads is desirable, but not at all essential as the extremities of the projections 15 may merely overlap the floors of the recesses 13 without any hooking quality. In the figures thus far referred to the undercut or hooking characteristic is produced by an angular formation of the forward wall of the recess, in conjunction with a corresponding angular formation of the forward extremity of the projection of the head, but the same hooking feature may be obtained by the square tonguing and grooving of the heads as illustrated in Fig. 6.

We have illustrated our blade construc-

tion as embodied in the rotor of a turbine and have deemed it unnecessary to explain in detail how precisely the same system of construction may be applied to the stator, as the manner of such application will readily suggest itself to the constructing engineer. Having described the construction in connection with a rotor, and having used such terms as front and rear and forward, etc., which terms might not apply with exactness in cases where our blades are applied to the stator, we wish it distinctly understood that those terms as employed in the claims are to be considered in their relative sense only.

We claim:—

1. A turbine blade comprising, a general blade-portion having in cross-section a concave rear and a convex front, means for securing one end of said blade-portion to a blade-holder of the turbine, a head formed upon the opposite end of the blade-portion in circumferential advance of the concavity of the blade-portion, a recess formed in the rear portion of said head over the edges of the concavity of the blade-portion, and a projection extending forward from said head and engaging the recess of the head of the neighboring blade, combined substantially as set forth.

2. A turbine blade comprising, a general blade-portion having in cross-section a concave rear and a convex front, means for securing one end of said blade-portion to a blade-holder of the turbine, a head formed upon the opposite end of the blade-portion in circumferential advance of the concavity of the blade-portion, a recess formed in the rear portion of said head over the edges of

the concavity of the blade-portion and having a rearward overhang, and a projection extending forward from said head and engaging the recess of the head of the neighboring blade and having its forward extremity engaging under the rearward overhang of said recess, combined substantially as set forth.

3. A turbine blade comprising, a blade-portion having a rearward concavity extending to its free extremity, means for securing one end of the blade-portion to a blade-holder of the turbine, and a head formed upon the free end of the blade-portion and extending forwardly therefrom and adapted to engage with the rear portion of the neighboring blade and over the concavity thereof, combined substantially as set forth.

4. A turbine blade comprising, a general blade-portion having in cross-section a concave rear and a convex front, means for securing one end of said blade-portion to a blade-holder of the turbine, a head formed upon the opposite end of the blade-portion in circumferential advance of the concavity of the blade-portion, a recess formed in the rear portion of said head over the edges of the concavity of the blade portion and a projection extending forward from said head and engaging the recess of the head of the neighboring blade and partially closing the end of the concavity of the succeeding blade, combined substantially as set forth.

ALDEN B. OWEN.
THOMAS HALL.

Witnesses:

JOHN G. HAYES,
CARL A. FAY.