J. F. METTEN.

ELASTIC FLUID TURBINE.

APPLICATION FILED NOV. 9, 1911. RENEWED NOV. 9, 1912.

1,048,564. Patented Dec. 31, 1912.

Fig. 1

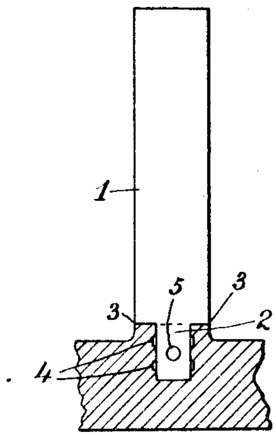


Fig. 2

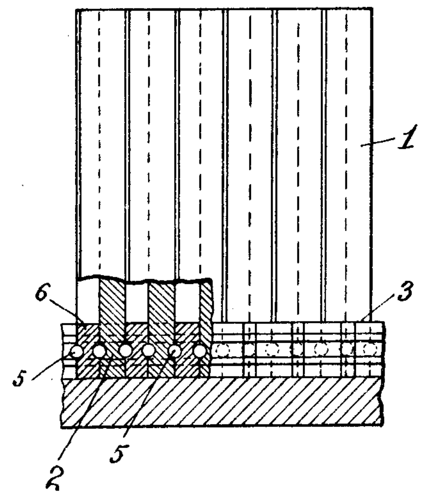


Fig. 3

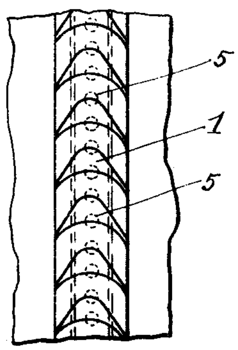
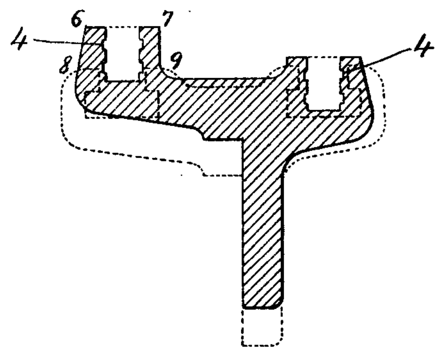


Fig. 4



WITNESSES

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ELASTIC-FLUID TURBINE.

1,048,[illegible]4. Specification of Letters Patent. **Patented Dec. 31, 1912.**

Application filed November 9, 1911, Serial No. 659,339. Renewed November 9, 1912. Serial No. 730,492.

To all whom it may concern:

Be it known that I, JOHN F. METTEN, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Elastic-Fluid Turbines, of which the following is a full, clear, and exact specification.

This invention relates to elastic fluid turbines and has for its object an improved mounting for the blades in the revolving or stationary member of a steam or gas turbine, by means of which they are more securely locked against displacement under centrifugal thrust and torsional strains and may be assembled with greater convenience than by the methods commonly employed, and by which a lighter and stronger structure may be secured.

Various methods of securing the blades to the elements of a turbine have been heretofore employed. In one method, grooves are cut in the drums the full width of the blades, which are held in place by soft metal packing pieces spaced between, and calked so as to be swelled into serrations cut into the grooves and the adjacent sides of the blades. This method, although cheap in construction, is objectionable in that, if any calked section is defective, the blades are liable to strip under the centrifugal strains, which produces disastrous results to the machine. Other methods are to rivet the blade to a strip of metal and bend the latter to fit a groove of the drum; or to provide an undercut groove and mill the roots of the blades of a proper shape to dovetail with the undercut channels. In all of these types a shallow groove is employed so that with weak or careless calking the blades are liable to work loose and become displaced under the combined effort of rotary and centrifugal strain or the blades will lack proper lateral rigidity if the fit in the grooves is not perfectly tight. By reason of their difficult mechanical structure, some of them are, moreover, open to objection on account of manufacturing expense.

By my construction I overcome possibility of damage through defective local calking and secure the blades in position by a structure of great rigidity, at the same time lessening the mass of metal necessary in the cross section of the support. I secure these desirable results by making the root of the blade deep relatively to its width and lock the blades to their support by milling hemispherical recesses on opposite sides of the root to receive steel balls by which the blades are firmly locked against relative slip. Wide shoulders are formed near the junction of the root of the blade which find a secure abutting surface on the face of the drum or disk, and the blades are assembled with intervening soft metal space blocks and then driven into undercut or serrated channels until the shoulders squarely engage the face of the drum, the space blocks thereby extending into the serrations and in conjunction with the steel balls, anchoring the root in two planes against displacement under centrifugal thrust or circumferential strain or flexure.

My invention, therefore, consists in a turbine blade mounted in a deep and relatively narrow recessed groove in the rotary element and locked in place by unyielding walls at all faces of its root.

It embodies also various other more specific features, the novelty of which will be hereinafter more fully described in the specification and definitely indicated in the claims.

In the accompanying drawings which illustrate my invention, Figure 1 is a part sectional view of a blade mounting embodying my invention; Fig. 2 is a similar view on a plane at right angles to that of Fig. 1; Fig. 3 is a top plan view of Fig. 1; Fig. 4 is a sectional view showing my invention as applied to a disk rotor of a turbine.

Referring now to the drawings in detail, 1 represents the turbine blade, the root of which, 2, is milled off with square shoulders 3 to engage corresponding walls on the face of the drum or disk of the rotary element of the turbine. Suitable slots are milled in the face of the drum or disk in which the ratio of the width to the depth is very much less than in the systems of mounting heretofore in vogue. The walls of the slot are grooved or serrated as indicated at 4, to form an anchorage for the soft metal used for calking hereinafter described. The root of the blade is adapted to enter the slot, its lateral faces being milled with a small hemispherical recess 5 adapted to form a seat for a relatively hard ball, such as steel, or other suitable key to lock the blades and the filling pieces in position.

Between each pair of blades is placed a filling block 6 of soft metal, the lateral faces of which are recessed to form a seat for the balls. A group of the blades are assembled in the slot side by side with the intervening packing blocks, steel balls fitting snugly between the corresponding cavities in the block and root of the blade, and the blocks are subjected to pressure by calking the exposed ends so as to cause the soft metal to expand into the serrations or grooves in the walls of the drum. The balls thus form a rigid connection between the block 6 and the root of the blade, and if any packing block should not be calked hard enough to thoroughly fill the serrations in the groove, the balls will form an interlock between it and the adjacent blades, which will prevent the centrifugal force due to the revolution of the cylinder or disk carrying the blades from pulling out the blade without also drawing out the packing block. An important advantage of this form of construction is the great rigidity due to the milled shoulders 2, 3 and the depth of the slot; moreover, as the slots are cut in raised shoulders on the surface of the drum, as indicated in Fig. 1, the thickness of metallic wall between these shoulders can be less than the thickness required if the slots were the full width of the blade, which means a lighter form of construction, the space between the raised shoulders being adapted to provide clearance for the shrouding on ends of adjacent blades.

In assembling, the required number of blades, blocks and balls will be placed closely together, to fill the groove, and the exposed ends of the blocks calked so as to expand into the serrations in side of groove. It will be evident that, by reason of the penetration of the calking material into the serrations of the grooves and by reason of its completely embedding the interlocking balls, the blades are rigidly supported against centrifugal thrust on all sides of the root. Moreover, by reason of the depth of the root, a much more stable construction is provided against circumferential thrust as the distance is greater between the torsional fulcrum on the shoulders 2, 3, and the bottom of the groove. If the blades are mounted on disks, a still greater advantage in saving of weight accrues. This is illustrated in Fig. 4, where the dotted lines show the section of metal required in revolving disks with undercut slots to receive the blade, and the full lines show the section of metal required for the type of blading herein described. It will be noted that the part represented by the reference characters 6, 7, 8, 9 replaces the packing sections or distance pieces between the blades of this type of turbine and that this is not additional weight, as might at first appear.

Having thus described my invention, I declare that what I claim as new and desire to secure by Letters Patent, is:

1. In a turbine, the combination of a blade having a root embedded in a serrated groove in a supporting member, hard metal keys interlocking with sockets in the root, and soft metal packing filling the groove and embedding the keys and serrations.

2. In a turbine, the combination of a series of blades having roots embedded in a serrated groove in a supporting member, a series of steel balls seated in cavities in the roots, and soft-metal compressible packing separating the roots of the blades.

3. In a turbine, the combination of a blade having a root deep relatively to its width with wide bearing shoulders to engage the periphery of the support, and rigid keys interlocking on all sides with the root and its supporting walls to prevent displacement under centrifugal or rotary thrust.

4. In a turbine, the combination of a series of blades with intervening soft metal space blocks at their roots, a serrated groove in the rotary element, and hard metal balls interlocking with the side faces of the roots and embedded within the space blocks.

5. In a turbine, the combination of a series of grooved blades anchored in an undercut groove in one of the elements, space blocks of soft metal compressed in serrations of the grooves, and a series of steel balls interlocking with recessed surfaces of the roots of the blades and with the compressed space blocks.

6. In a turbine, the combination of a series of grooved blades having deep roots with bearing shoulders engaging the face of the rotary element, an undercut groove in the rotary element, a series of steel balls interlocking with the side walls of the roots, and soft metal space blocks partly surrounding each ball and the undercut groove and compacted into tight engagement therewith.

7. In a turbine, the combination of a series of grooved blades having roots relatively deep to their thickness and right angled bearing shoulders engaging the face of the rotary element, an undercut groove in the face of the rotary element, a series of steel balls engaging hemispherical steel recesses in the side walls of the roots, and soft metal space blocks with corresponding hemispherical recesses, the space blocks being

compacted into the grooves to embed the roots and undercut grooves.

8. In a turbine, the combination of a grooved support, a plurality of blades, space blocks and interlocking balls between the blades, whereby the blades are locked in position.

In testimony whereof I affix my signature, in presence of two witnesses.

JOHN F. METTEN.

Witnesses:

ISAAC ARROTT,
CHAS. W WILLIAM.