No. 846,739. PATENTED MAR. 12, 1907.

E. H. FARQUHAR.

BUCKETS FOR ELASTIC FLUID TURBINES.

APPLICATION FILED JULY 21, 1906.

2 SHEETS—SHEET 1.

Fig. 1.

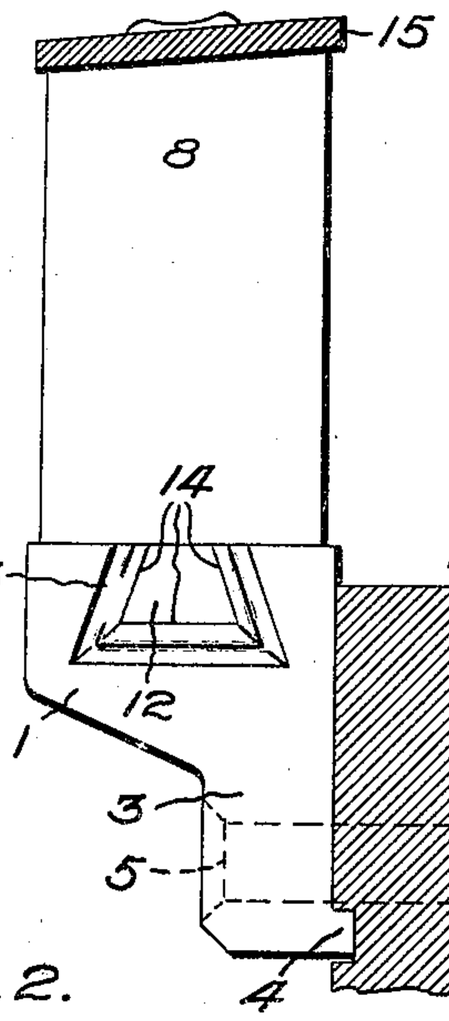


Fig. 4.

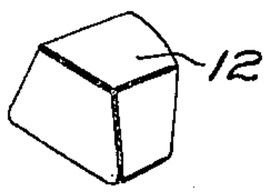


Fig. 5.

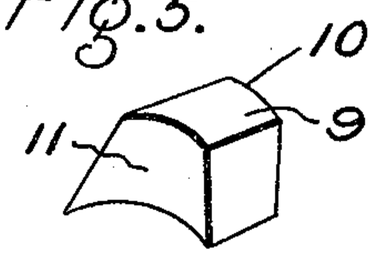


Fig. 2.

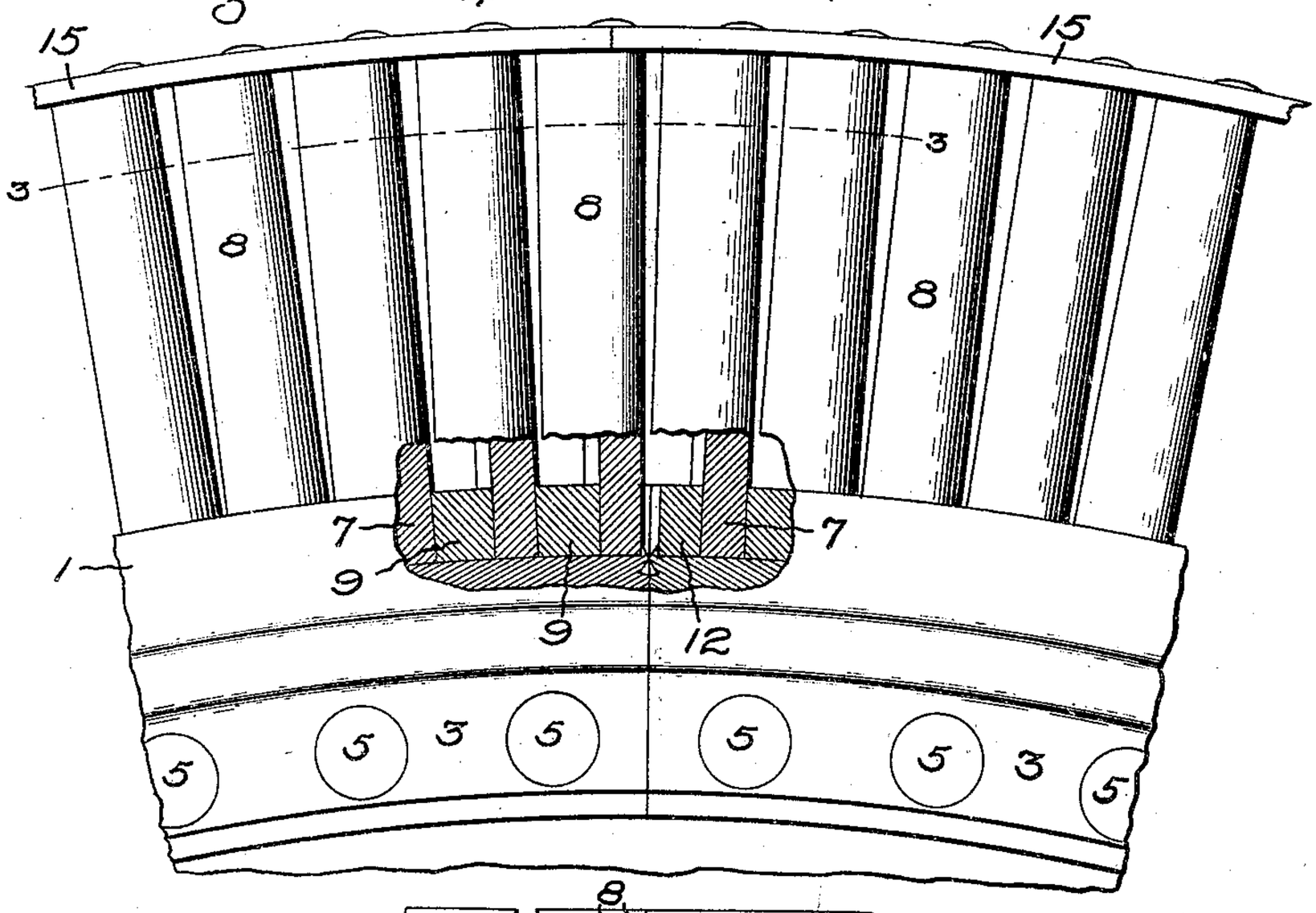
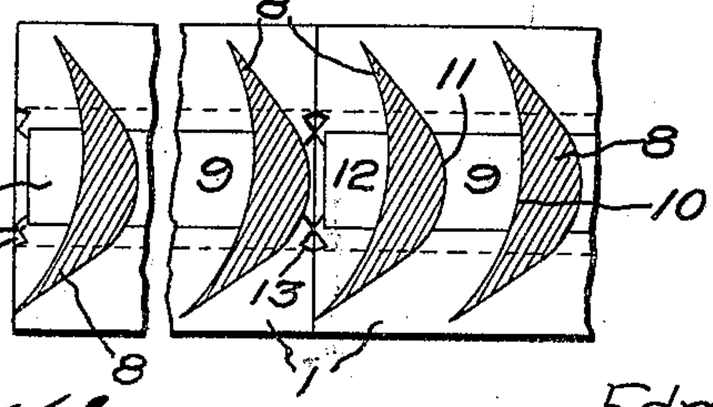


Fig. 3.



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BUCKETS FOR ELASTIC FLUID TURBINES.

APPLICATION FILED JULY 21, 1906.

2 SHEETS—SHEET 2.

Fig. 6.

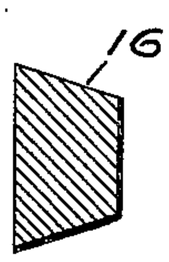


Fig. 7.

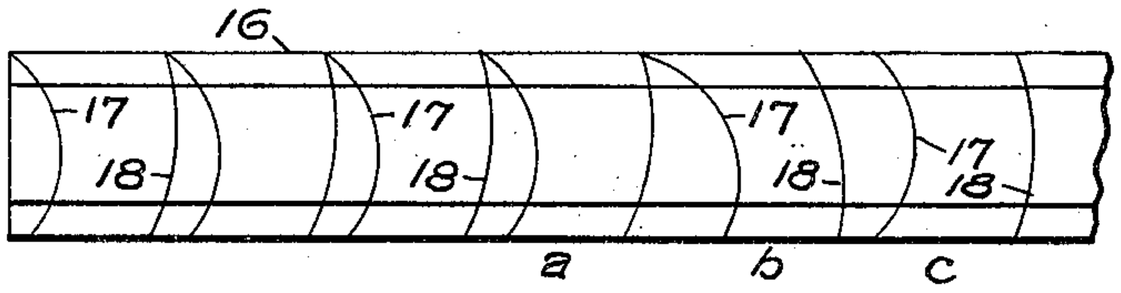
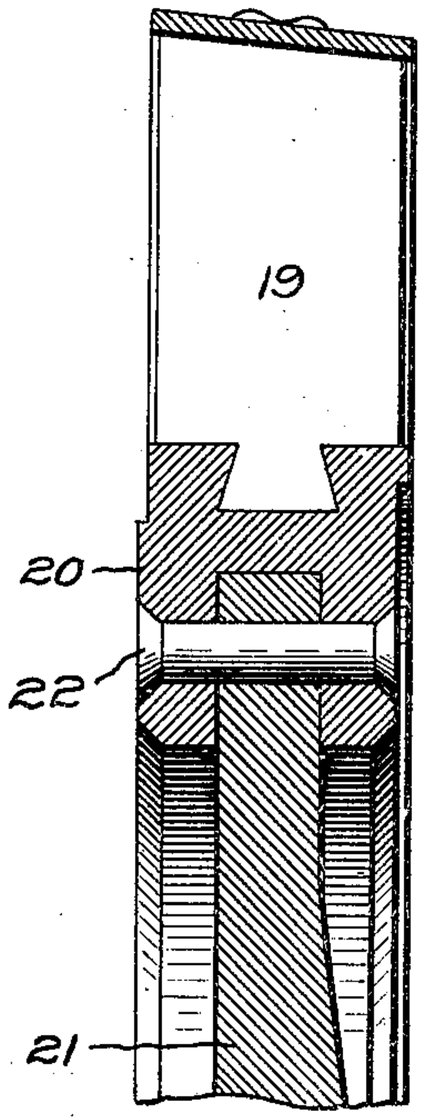


Fig. 8.



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UNITED STATES PATENT OFFICE.

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BUCKET FOR ELASTIC-FLUID TURBINES.

No. 846,739. Specification of Letters Patent. Patented March 12, 1907.

Application filed July 21, 1906. Serial No. 327,177.

To all whom it may concern:

Be it known that I, EDMUND H. FARQUHAR, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Buckets for Elastic-Fluid Turbines, of which the following is a specification.

This invention relates to the buckets, blades, or vanes of elastic-fluid turbines; and its object is to provide an improved mode of securing separately-formed buckets to a segmental or other base or support.

The invention consists in making a dovetail or undercut groove in the base or support and forming each bucket with a dovetail or flanged shank adapted to be slipped into said groove from one end thereof, spacing-blocks being interposed between the shanks on the buckets, and when a section or segment of the entire base is filled with buckets and blocks the metal of the base segment or support is upset or riveted around the ends of the groove to force the buckets and the spacing devices into engagement with each other and secure the parts firmly together.

For convenience I shall show and describe the invention in connection with a bucket-wheel, though it will be understood that it is equally applicable to the securing of intermediate buckets to their supports.

In the accompanying drawings, Figure 1 is a cross-section of a bucket-wheel, showing the ends of two base-segments and the buckets inserted therein. Fig. 2 is a side view, partly in section, showing the joint between two base-segments. Fig. 3 is a cross-section transverse to the axes of the blades on the line 3 3, Fig. 2. Fig. 4 is a perspective view of the filling-block; Fig. 5, a perspective view of a spacing-block. Fig. 6 is a cross-section of the bar from which the spacing-blocks are cut. Fig. 7 is a top plan view of such a bar, and Fig. 8 shows a modified construction of wheel and bucket support.

The base-segments 1 are of any desired length and are curved to fit the periphery of the bucket-wheel 2. Each segment has a flange 3 lying against the face of the wheel and a lip or rib 4 engaging with a groove in the wheel to resist the centrifugal force developed at high speeds. When two base-segments are placed on opposite sides of the bucket-wheel, they are preferably secured thereto by through-rivets 5, passing through the flanges 3 and the wheel 2. The heads of the rivets are countersunk flush with the surfaces of the flanges to reduce rotation losses.

In the peripheral surface of each segment is cut a longitudinal groove 6, which is narrower at the throat than at the bottom and is preferably of a dovetail form, as shown. Into this groove are slid the dovetail or flanged shanks 7 on the inner ends of the independently-formed buckets, blades, or vanes 8. I prefer to make these buckets of extruded metal, so that they are of uniform cross-section and have smooth-finished surfaces. The shank is formed by cutting away portions of the bucket at one end thereof, preferably in such a manner that the buckets stand not quite square across the base-segment, but with one edge in advance of the other, as shown in Fig. 3.

In order to maintain the buckets apart at the proper distance, spacing-blocks 9 are interposed between them. These blocks are trapezoidal or T-shaped in cross-section, so that they fill the groove in the base-segment and lie flush with its top. One end 10 is convex to fit into the curve of the adjacent bucket-shank and the other end 11 is concave to fit the convex back of the next bucket-shank.

At the end of each base-segment a filling-block 12 is inserted, having a flat end to lie nearly flush with the end of said segment. The space-blocks 9 are made, preferably, of the same alloy as the buckets in order that they may have the same rate of expansion and contraction; but the filling-blocks 12 are made of harder metal like the base-segments, (preferably steel,) so as to afford a rigid abutment when the metal around the end of the groove in said segment is upset to secure the buckets and blocks in place. The upsetting is done by means of a suitable punch, which forms deep incisions 13 in the metal on lines parallel with the sides and bottom of the groove 6 and crowds a lip 14, of metal, over and against the flat face of the filling-block 13 at one end of the base-support and against the shank of the end bucket at the other end thereof.

The buckets are provided with the usual cover or shrouding 15.

In Figs. 6 and 7 is shown a convenient and economical manner of making the spacing-blocks 9. A bar 16 is made of extended metal having its cross-section a trapezoid, as shown in Fig. 6. Such a bar is then severed transversely, as shown in Fig. 7, on curved lines 17 18 in a direction perpendicular to the wide and narrow faces of said bar and on such a curvature as to fit the fronts and backs of the buckets. By varying the length of the blocks between the lines 17 18 the distance between the buckets—that is, the pitch of the bucket-wheel—will be varied. By varying the location of the curved lines the blocks will cause the buckets to vary more or less from a position at right angles to the longitudinal axis of the groove 6. Thus the block *a* in Fig. 7 is similar to the ones used in Fig. 3. The block *b* will skew the buckets still further, while the block *c* will cause the buckets to stand square across the grooves should such an arrangement be desired.

Fig. 8 shows a modification in which the buckets 19 are attached to a bifurcated base 20, which straddles the rim of the bucket-wheel 21 and is secured thereto by rivets 22 or otherwise, thus providing for only one row of buckets in the plane of the wheel. The buckets 19 are secured to the base 20 in the same manner as the buckets 8 are secured to the bases 1.

By the construction above set forth the bases or other supports can be made of hard metal, such as steel, which is well qualified to withstand the severe strains to which the wheel is subjected and will not yield or be deflected even when the base-segments are secured to the side of the wheel, as in Fig. 1. Moreover, the radial pull on the buckets, due to centrifugal force, is in direct line with the shanks, and the trapezoidal or undercut cross-section of the groove and shanks distributes this tensional strain equally on both sides, so that the buckets do not have any tendency to tilt edgewise.

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

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The combination with a base having a dovetail or undercut groove, of a plurality of separately-formed buckets having shanks fitting said groove, and spacing-blocks in said groove between said bucket-shanks, the material of the base at the ends of the groove being upset to secure the parts together.

2. The combination with a base having a dovetail or undercut groove, of a plurality of separately-formed buckets of uniform cross-section and cut away at one end to form shanks fitting said groove, spacing-blocks in said groove flush with the surface of the base and having curved ends fitting against the bucket-shanks, and lips upset at the ends of the groove to hold the parts together.

3. The combination with a base having a dovetail or undercut groove, of a plurality of separately-formed buckets of uniform cross-section and cut away at one end to form shanks fitting said groove, spacing-blocks of the same material as the buckets fitted into said groove and fitting the curves of said bucket-shanks, a filling-block at the end of the groove of substantially the same material as the base, and incisions in the ends of the base forming upset lips to hold the parts together.

4. In an elastic-fluid turbine, the combination of a bucket-support having a groove formed therein which is narrower at the throat than at the bottom, buckets having projections thereon which enter the groove and are retained in place by the walls thereof and devices for spacing the buckets apart to preserve the proper pitch, the ends of the support being riveted over to force the buckets and the spacing devices into engagement with each other and also to secure them rigidly in said support.

In witness whereof I have hereunto set my hand this 20th day of July, 1906.

EDMUND H. FARQUHAR.

Witnesses:
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