O. D. H. BENTLEY.

ELASTIC FLUID TURBINE.

APPLICATION FILED MAY 5, 1913.

1,254,465. Patented Jan. 22, 1918.

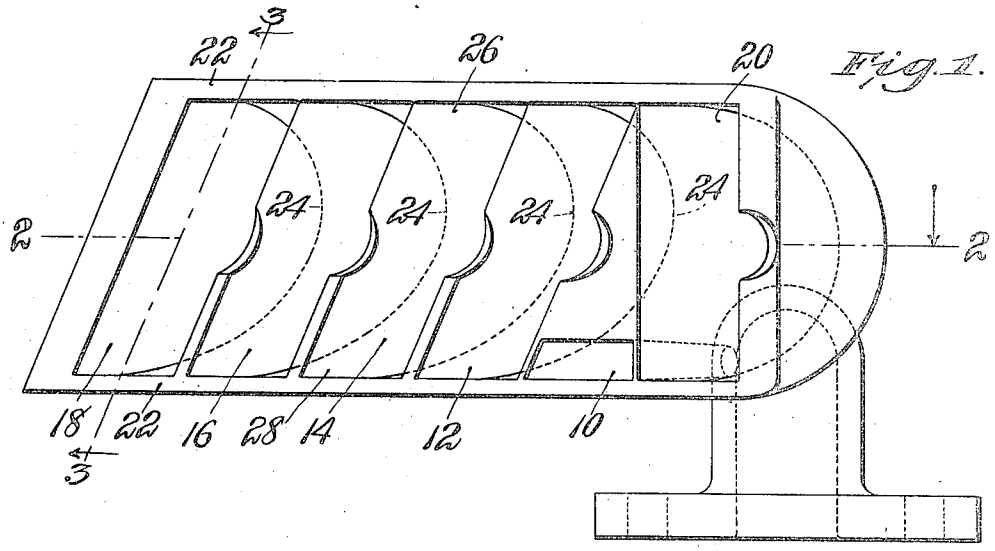


Fig. 1.

Fig. 2.

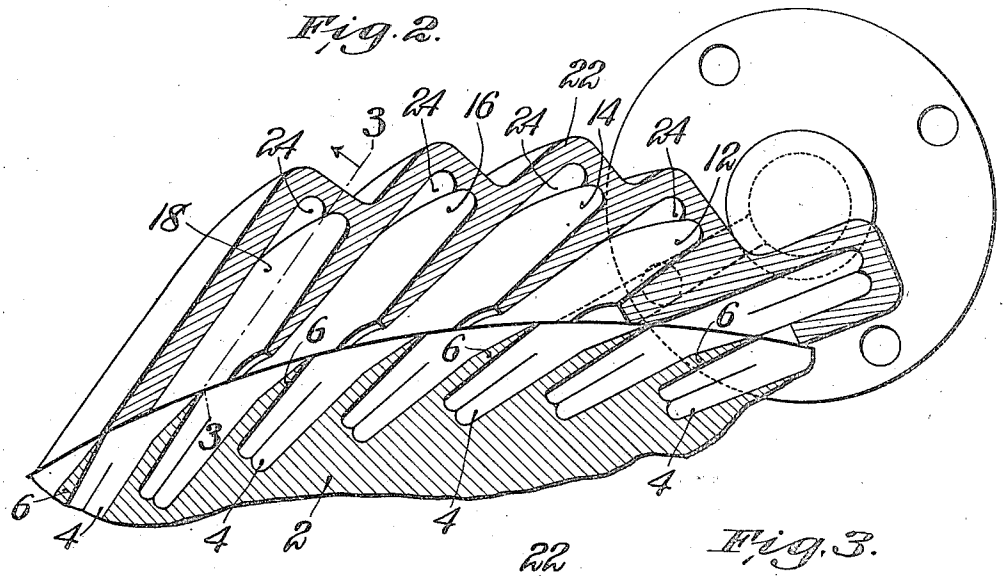
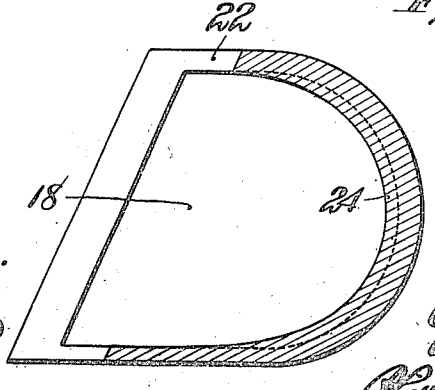


Fig. 3.



Witnesses:

E. W. Wurdeman

Geo. L. Stebbins.

Inventor:

O. D. H. Bentley

by his attorneys

Phillips Van Everen Fitch

UNITED STATES PATENT OFFICE.

OLIVER D. H. BENTLEY, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO B. F. STURTEVANT COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

ELASTIC-FLUID TURBINE.

1,254,465. Specification of Letters Patent. Patented Jan. 22, 1918.

Application filed May 5, 1913. Serial No. 765,552.

To all whom it may concern:

Be it known that I, OLIVER D. H. BENTLEY, a citizen of the United States, residing at Hyde Park, Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Elastic-Fluid Turbines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention relates to elastic fluid turbines, and more particularly to the type of elastic fluid turbine in which the elastic fluid is delivered at high velocity from an expanding nozzle into substantially semi-cylindrical rotor buckets, from which it is discharged into substantially semi-cylindrical stator buckets which redirect the steam into the same set of rotor buckets. The object of the present invention is to reorganize and improve the construction and arrangement of the buckets and the expanding nozzle so as to secure a better and more efficient flow of the elastic fluid through the buckets. The present invention in its narrower aspects is intended more particularly as an improvement upon the stationary reversing buckets disclosed in my prior Patent 1,042,871, dated October 29, 1912.

With the above object in view, the present invention consists in the improvement in elastic fluid turbines hereinafter described and particularly pointed out in the claims.

In the accompanying drawings which illustrate the preferred embodiment of the present invention, Figure 1 is a view of the block or segment in which are formed the stationary or stator buckets and the expanding nozzle, looking into the open mouths of the buckets; Fig. 2 is a section taken along the line 2—2 of Fig. 1, the section being carried down into the rotor or bucket wheel; and Fig. 3 is a section taken on a plane through the steam guiding rib of one of the stator buckets. The plane of the section of Fig. 3 passes through the middle of the inclined stator buckets parallel with the flat end walls thereof and is inclined to the plane of the paper in both Figs. 1 and 2, the line of intersection of this plane and the plane of the paper being indicated by the line 3—3 in Figs. 1 and 2.

Referring to the drawings, 2 indicates a fragment of the rotor or bucket wheel, which is preferably formed of a single steel forging, in the periphery of which are milled semi-cylindrical or U-shaped reversing buckets 4. The flat end walls of these semi-cylindrical buckets are substantially parallel and are inclined to the intersecting radii of the rotor, but are parallel to the axis of the rotor. The partitions 6 between the rotor buckets are beveled at their edges to offer a minimum resistance to the inflowing steam.

The steam is delivered at high velocity into the receiving sides of the rotor buckets by means of an expanding nozzle 10. Forward of the nozzle 10, in the direction of rotation of the rotor wheel, are four U-shaped or substantially semi-cylindrical stator reversing buckets 12, 14, 16 and 18. The mouths of these buckets are inclined to the direction of movement of the periphery of the rotor wheel, the flat end walls of the buckets being substantially parallel with each other and inclined to intersecting radii of the rotor wheel, and also inclined to the axis of the rotor. Back of the nozzle 10, relatively to the direction of rotation of the rotor wheel, is a supplemental U-shaped or substantially semi-cylindrical stator reversing bucket 20. The mouth of this bucket is not inclined like the other stator buckets, the substantially parallel flat end walls being parallel to the axis of the rotor and inclined to the intersecting radii of the rotor. The stator buckets and the expanding nozzle are formed in a one-piece metal block known as a nozzle and bucket segment, and are arranged substantially as in my above-mentioned prior patent. The partitions between the adjacent buckets of both the rotor and the stator are substantially parallel with each other (allowing for the curvature of the rotor), and extend from the bottoms of the buckets flush with the mouths of the buckets. The substantially semi-circular curved peripheral walls 22 of the stator and rotor buckets are all provided with steam guiding ribs or projections 24, as best shown in Fig. 2, the rib 24 of each bucket serving to divide the peripheral wall into a plurality of round-bottomed grooves. The rib serves to guide the steam flowing along the wall 22 in a path lying in a constant plane and to maintain a uniform distribution of steam-flow along the curved

wall of the bucket. Thus the mixing of steam currents is reduced, and eddies and interferences are minimized. At the mouths of the buckets the junctions between the end walls and the peripheral walls 22 are squared, as shown in Fig. 1, and the steam guiding ribs near the mouths of the buckets fade away or merge with the walls 22. This is especially important at the receiving sides 26 of the buckets, as it removes all impediment to the free inflow of steam. It is also important that the ribs 24 should not extend to the mouths of the buckets at the discharge sides 28, in order that the steam may be discharged at the extreme edges of the buckets in position to enter the receiving sides of the opposing buckets at their extreme edges.

This form of bucket may be easily cut with a milling cutter applied twice at each bucket. The milling cutter has flat end faces and its edge is semi-circular in cross section, so that the peripheral wall of the chamber is divided by the rib 24, which is left between the two grooves cut by the two applications of the milling cutter. After the buckets are milled, the mouths are finished by squaring the corners of the mouths and tapering off the ends of the ribs 24. This type of bucket is particularly adapted for the inclined buckets of the stator. As illustrated in the drawings, the stator buckets 12, 14, 16 and 18 are inclined so that they have substantially rhomboidal mouths. This form of bucket cannot be aproximated with a single application of a roughed out cutter, but can be milled with two applications of a milling cutter, as above described.

Another feature of the invention resides in the form of the nozzle mouth, which is trapezoidal, as illustrated in Fig. 1, so as to adapt it to the most economical use of the space between the supplemental stator bucket 20 and the inclined stator bucket 12. The two stator buckets 20 and 12 have their receiving sides 26 in proximity to each other, and their discharge sides 28 located forward and back of the nozzle 10, leaving a triangle within which the nozzle must be placed. The trapezoidal form of the nozzle mouth, therefore, for a given mouth area, permits the steam to be delivered nearer the edges of the receiving sides of the rotor buckets and so insures the more efficient application of the steam jet to the rotor. It is to be recognized that the partition walls between the stator buckets and the nozzle opening should be thin, to the end that the stator buckets and nozzle should deliver a substantially continuous stream of steam into the rotor buckets. The trapezoidal form of nozzle permits the sides of the nozzle mouth to be parallel with and close to the sides of the adjacent bucket mouths, so that the steam coming from the nozzle merges with the reversed steam coming from the discharge sides of the buckets and forms with it a continuous stream of steam issuing from the discharge edge of the nozzle and bucket segment, the thin partition walls forming practically no gap or break in the cross section of the stream.

While the preferred embodiment of the present invention has been specifically illustrated and described, it is to be understood that the invention is not limited to its preferred embodiment, but may be embodied in other constructions of elastic fluid turbines within the scope of the invention as set forth in the following claims:—

1. An elastic fluid turbine having a circularly extending series of deflecting-surfaces, transversely arranged with respect to the plane of rotation of the turbine, the adjacent surfaces being substantially parallel and offset one from another, each of said surfaces being divided into a plurality of parallel channels with intermediate ribs extending above the bottoms of the channels on each side.

2. An elastic fluid turbine having, in combination, a circularly extending series of deflecting-surfaces, transversely arranged with respect to the plane of rotation of the turbine, the adjacent surfaces being substantially parallel and offset one from another, each of which surfaces is divided into a plurality of parallel channels with comparatively shallow intermediate ribs or septa extending above the bottoms of the channels on each side; and comparatively deep septa separating the adjacent deflecting-surfaces.

3. An elastic fluid turbine having, in combination, a rotor having reversing buckets, and a stator comprising an expanding nozzle having a trapezoidal mouth for delivering the elastic fluid at high velocity to the rotor buckets, and two reversing buckets for receiving the fluid from the rotor buckets and redirecting it to the same set of rotor buckets having their receiving sides in proximity to each other and their discharge sides separated from each other and located forward and back of the nozzle, substantially as described.

4. An elastic fluid turbine having, in combination, a rotor having reversing buckets, and a stator comprising an inclined reversing bucket receiving the fluid from the rotor buckets and redirecting it to the same set of rotor buckets and an expanding nozzle having a trapezoidal mouth for delivering the elastic fluid at high velocity to the rotor, the mouth of said nozzle having one of its sides substantially parallel to the mouth of the inclined stator bucket and in proximity to the discharge side of said bucket, substantially as described.

5. An elastic fluid turbine having a substantially U-shaped bucket of which the

curved deflecting-surface extends, in cross-section, in a general direction normal to the plane of flow of the motive-fluid, but is provided with a longitudinally-extending rib which divides the bottom of the bucket into two substantially parallel channels, the rib projecting above the bottoms of the channels on each side thereof.

6. A substantially U-shaped bucket for an elastic fluid turbine having its curved wall provided for the greater part of its length with a steam guiding rib or projection and round-bottomed grooves upon each side of and parallel with the rib or projection, substantially as described.

7. A substantially U-shaped bucket for an elastic fluid turbine having its curved wall for the greater part of its length cardioidally cusped in transverse section, substantially as described.

8. A bucket for an elastic fluid turbine having flat and substantially parallel end walls extending to the mouth of the bucket and having a substantially semi-circular peripheral wall provided with a steam guiding rib or projection, substantially as described.

9. An elastic fluid turbine having, in combination, a plurality of adjacent substantially U-shaped buckets separated by substantially flat and substantially parallel partition walls which extend to the mouths of the buckets, the curved walls of the buckets being provided with steam guiding ribs or projections, substantially as described.

10. An elastic fluid turbine having, in combination, a plurality of adjacent substantially U-shaped reversing buckets separated by substantially flat and substantially parallel partitions extending to the mouths of the buckets, the curved peripheral walls of the buckets being provided with steam guiding ribs or projections, the mouths of said buckets being squared, and the steam guiding ribs or projections being tapered near the mouths of the buckets on the receiving sides of the buckets to gradually merge with the squared mouths of the buckets, substantially as described.

11. A substantially U-shaped bucket for an elastic fluid turbine provided with a steam guiding rib or projection on its curved peripheral wall, said steam guiding rib or projection being tapered to gradually merge with the wall near the mouth of the bucket, substantially as described.

12. An elastic fluid turbine having a substantially U-shaped bucket of which the curved deflecting-surface is divided, at the bottom of the bucket, into a plurality of substantially parallel shallow channels, the bottoms of the channels being, in cross section, in alinement substantially at right angles to the end walls of the bucket.

13. An elastic fluid turbine having a substantially U-shaped bucket of which the curved deflecting-surface is divided, at the bottom of the bucket, into a plurality of substantially parallel channels of curvilinear cross-section transversely arranged with respect to the plane of rotation of the turbine.

OLIVER D. H. BENTLEY.

Witnesses:
H. A. McKENNA,
L. I. SMITH.

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

Correction in Letters Patent No. 1,254,465.

It is hereby certified that in Letters Patent No. 1,254,465, granted January 22, 1918, upon the application of Oliver D. H. Bentley, of Boston, Massachusetts, for an improvement in "Elastic-Fluid Turbines," an error appears in the printed specification requiring correction as follows: Page 2, strike out lines 35–36 and insert the words and syllables *with a single application of a milling cutter, but can be roughed out with two applica-;* and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 26th day of February, A. D., 1918.

[SEAL.]

F. W. H. CLAY,
Acting Commissioner of Patents.

Cl. 253—54.