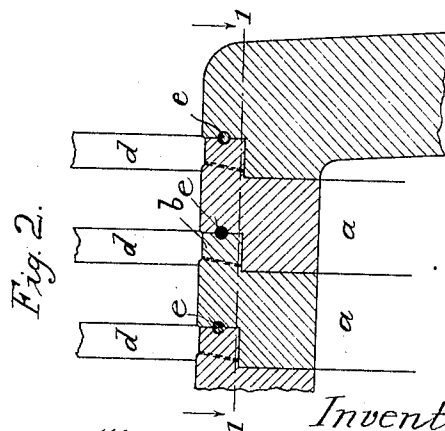
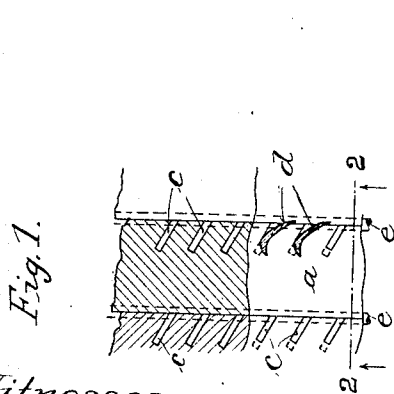
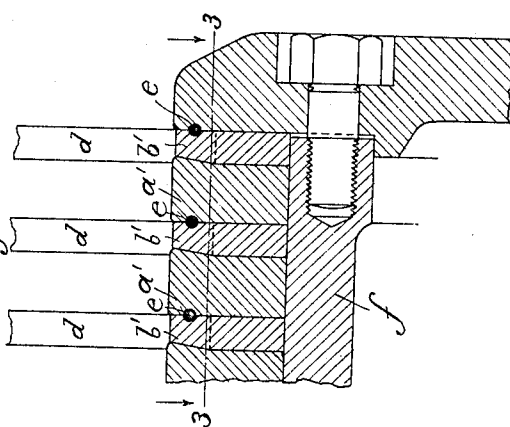
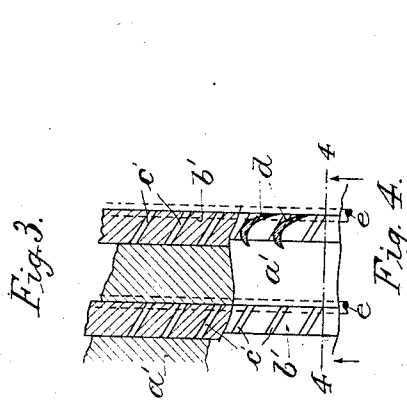
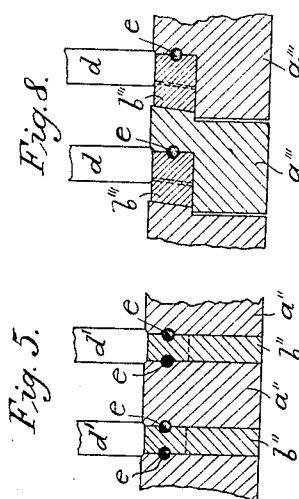
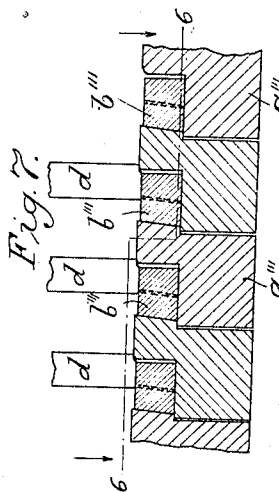
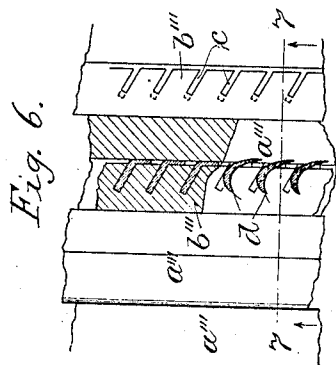


No. 852,030.

PATENTED APR. 30, 1907.

W. A. NUSSBAUMER.
ELASTIC FLUID TURBINE.
APPLICATION FILED SEPT. 8, 1906.



Witnesses:
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UNITED STATES PATENT OFFICE.

WILLIAM A. NUSSBAUMER, OF MILWAUKEE, WISCONSIN.

ELASTIC-FLUID TURBINE.

No. 852,030.

Specification of Letters Patent.

Patented April 30, 1907.

Application filed September 8, 1906. Serial No. 333,839.

To all whom it may concern:

Be it known that I, WILLIAM A. NUSSBAUMER, a citizen of the Republic of Switzerland, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Elastic-Fluid Turbines, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

This invention relates more particularly to the vane supporting and fastening means and is applicable to both the stationary and rotating parts of a turbine. Its main objects are to securely fasten and hold the vanes in place without calking, which is a laborious operation and does not produce a reliable fastening; to facilitate removing and replacing the vanes singly or by rows; and generally to simplify and improve devices of this class.

It consists in certain novel features of construction and in the peculiar arrangement and combination of parts as hereinafter particularly described and pointed out in the claims.

In the accompanying drawing, illustrating several forms in which the invention may be embodied as applied either to the rotating or stationary members of a turbine, like characters designate the same parts in the several figures.

Figure 1 is a partial plan view and section on the line 1 1, Fig. 2, of one form of the device; Fig. 2 is a section of the same on the line 2 2, Fig. 1; Fig. 3 is a partial plan view and section on the line 3 3, Fig. 4, of a modification of the device; Fig. 4 is a section on the line 4 4, Fig. 3; Fig. 5 is a partial section corresponding with that of Fig. 4 and showing a slight modification of the construction thereby illustrated; Fig. 6 is a partial plan view and section on the line 6 6, Fig. 7, of still another modification of the device; Fig. 7 is a section on the line 7 7, Fig. 6; and Fig. 8 is a section corresponding to that of Fig. 7, and showing a slight modification of the construction thereby illustrated.

Referring to Figs. 1 and 2, *a* designates vane supporting rings each formed on one side with an annular flange *b* and on the opposite side with a corresponding recess into which the flange of the adjoining ring fits, thereby centering and securely holding the several rings in place when they are assembled as shown. The laterally projecting

flange *b* of each ring is formed with a circular series of uniformly spaced radial grooves *c*, which open through the inner and outer curved faces and the intervening lateral face of the flange. These grooves are made of dovetail form or their bottoms are inclined, as indicated by dotted lines in Fig. 2.

The vanes *d* have dovetailed shanks fitted in said grooves and clamped in place therein between adjoining rings when the parts are assembled. To equally distribute the pressure upon the vane shanks and to firmly hold the individual vanes securely in place by compensating for any slight inaccuracy in fitting, key pieces *e*, which may be made of copper or soft metal wire bent into annular form, are inserted in annular grooves in adjoining faces of the rings and engage with corresponding notches in the edges of the vane shanks. When the parts are clamped together the notched edges of the vane shanks embed themselves more or less in these key pieces, and any play which they might otherwise have in the grooves *c* is thus taken up.

Referring to Figs. 3 and 4, the dovetailed shanks of the vanes *d* are fitted in grooves *c'* formed in one of the curved faces of each of the rings *b'*. In this case the grooves open on both lateral faces of the rings and the rings in which they are formed are separated by spacing rings *a'*. The adjoining faces of the rings on one side of each row of vanes are beveled to correspond with the inclination or taper of the vane shanks, so as to securely bind and hold the vanes in place and prevent longitudinal displacement thereof when the parts are assembled and clamped together, as shown. The vane supporting rings in this case are centered and held concentric with each other by a drum or cylinder *f*.

Instead of the dovetailed or tapered formation of the vane shanks and beveled faces on the vane supporting rings for holding the vanes in place, the shanks may be made straight and the rings formed with parallel faces as shown in Fig. 5. In this case key wires *e* are inserted in the adjoining grooved faces of the rings *a''* and *b''* on both sides of each row of vanes *d*, and engage corresponding notches in their opposite edges. In other respects the construction is substantially like that shown in Figs. 3 and 4.

Referring to Figs. 6 and 7, the shanks of the vanes *d* are of angular formation, as shown in Fig. 6, and the oblique portions of

the shanks are fitted and inserted in corresponding grooves in rings b''' . These rings are fitted in annular recesses formed in flanged spacing rings a''' , and are clamped
5 with the parts of the vane shanks protruding therefrom between the flanges and the opposing faces of the spacing rings. The lateral faces of the flanges on the spacing rings and the adjoining faces of the grooved rings are
10 beveled or inclined so as to securely bind and hold the grooved rings and vanes in place. The rings b''' are made somewhat narrower than the recesses in the rings a''' , so that the flange on each spacing ring will project into
15 the recess in the adjoining spacing ring and thus center and hold the parts in the proper relation to each other, without a supporting drum or case such as is shown in Fig. 4.

In place of the angular shanks shown in
20 Fig. 6, the vanes may be formed with straight flat shanks, as shown in Figs. 1 and 3, and these may be tightly held between the grooved rings b''' and the spacing rings a''' by key wires e , as shown in Fig. 8.

25 In any of the several forms of the device herein shown and described, the vanes may be easily and quickly removed and replaced either singly or in rows by simply releasing and separating the rings between which they
30 are bound.

I claim:

1. The combination of a number of interlocking selfcentering vane supporting rings having radiating grooves arranged in circular series and vanes having their shanks fitted in
35 said grooves and clamped between adjoining rings, substantially as described.

2. The combination of a number of concentric vane supporting rings fitted together side by side and having radiating grooves arranged in circular series, vanes having shanks fitted in said grooves and clamped between adjoining rings, and a key piece fitted in annular grooves in the opposing faces of adjoining rings and engaging with corresponding
45 notches in the vane shanks, substantially as described.

3. The combination of a number of concentric vane supporting rings having interfitting lateral annular recesses and flanges, and vanes having their shanks fitted and clamped in circular series of radiating grooves between said rings, substantially as described.

In witness whereof I hereto affix my signature in presence of two witnesses:

WILLIAM A. NUSSBAUMER.

Witnesses:

CHAS. L. GOSS,
PAUL G. ROESTL.