Aug. 4, 1925. 1,548,613

W. KIESER

ELASTIC FLUID TURBINE

Filed March 21, 1924

Fig. 1.

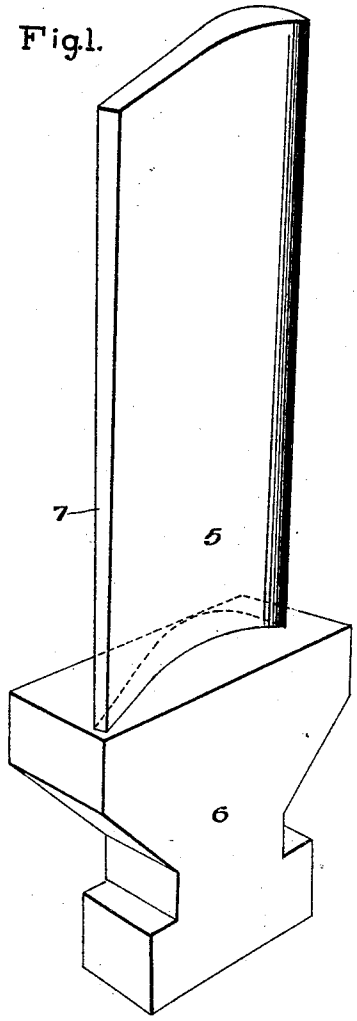


Fig. 2.

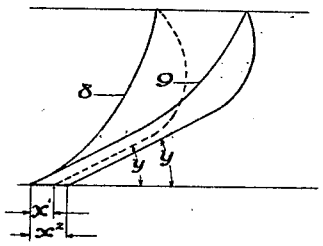


Fig. 3.

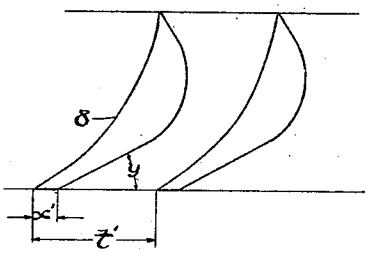
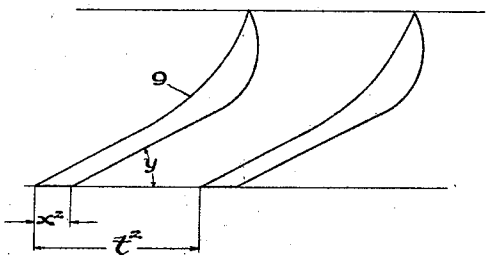


Fig. 4.



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UNITED STATES PATENT OFFICE.

WALTER KIESER, OF CHARLOTTENBURG, GERMANY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO ALLGEMEINE ELEKTRICITÄTS GESELLSCHAFT, OF BERLIN, GERMANY, A CORPORATION OF GERMANY.

ELASTIC-FLUID TURBINE.

Application filed March 21, 1924. Serial No. 700,957.

To all whom it may concern:

Be it known that I, WALTER KIESER, a citizen of Switzerland, residing at Charlottenburg, Germany, have invented certain new and useful Improvements in Elastic-Fluid Turbines, of which the following is a specification.

The present invention relates to axial flow elastic fluid turbines and particularly to the structure of long buckets or blades such as are found in the lower pressure stages of large machines of this type. The buckets in the lower pressure stages of elastic fluid turbines become quite long and it has been found with such buckets when of the usual construction that because of the difference in speed between the roots or radially inner ends of the buckets and the tips or radially outer ends of the buckets that the elastic fluid issuing from the outer ends instead of flowing in a truly axial direction has a radial component which, of course, is not desirable.

The object of my invention is to provide a turbine construction wherein the above mentioned radial component of the elastic fluid issuing from the buckets is eliminated or prevented and for a consideration of what I believe to be novel and my invention, attention is directed to the accompanying description and the claims appended thereto.

Considering a ring or row of turbine buckets, it is clear that because of the thickness of the discharge edges of the buckets, the entire cross sectional passage is not available for the passage of elastic fluid but only a part of the same, there remaining for the passage, if t represents the pitch of the buckets on any circumference and x the thickness of the discharge edges of the buckets, the part

$$\frac{t-x}{t}.$$

This may be written

$$1-\frac{x}{t}$$

and may be termed the passage equation for the turbine buckets. Likewise in the case of the nozzles the same thing applies and the available discharge area for the nozzle passages may be in like manner represented by what may be termed the nozzle passage equation

$$1-\frac{x_1}{t_1}$$

where x_1 is the thickness of the discharge edges of the nozzle partitions and t_1 is the pitch of the nozzle partitions.

I have discovered that the radial component of the elastic fluid issuing from the buckets is eliminated when the buckets are constructed with such a thickness at their discharge edges that the ratio

$$(1)\quad \frac{1-\frac{x}{t}}{1-\frac{x_1}{t_1}} \text{ equals a constant}$$

along the entire bucket length.

This relation applies under the assumption that the relation of the axial speed at nozzle issuance to that of the blade issuance remains constant along the entire bucket length.

If now in the case of the nozzle partitions the discharge edges are made very thin or they are placed a considerable distance apart as compared to the pitch of the buckets, then the value x_1 becomes relatively very small and may be placed equal to zero, and substituting zero for x_1 in equation 1 there is obtained the equation

$$(2)\quad 1-\frac{x}{t} \text{ equals a constant.}$$

From this it follows that under these conditions as to nozzle partition structure, the radial component of the flow of elastic fluid from the discharge edges of the buckets will be eliminated if the buckets are so constructed that the value of $\frac{x}{t}$ remains constant. According to this aspect of my invention, therefore, I construct the buckets so that their discharge edges increase in thickness from the roots to the tips at such a rate that the value of $\frac{x}{t}$ remains constant.

In the drawing, Figure 1 is a perspective view of a bucket embodying my invention; Fig. 2 shows the root and tip profile of the bucket arranged one above the

other, and Figs. 3 and 4 show the roots and tips separately of successive buckets of a bucket row.

Referring to the drawing, 5 indicates a turbine bucket provided with a base 6. The discharge edge of the bucket is designated 7. In Figs. 2, 3 and 4, 8 indicates the profile of the root of the bucket and 9 the profile of the tip of the bucket. x^1 and x^2 indicate the thicknesses of the discharge edge of the bucket at the root and tip respectively and t^1 and t^2 indicate the pitch. In accordance with my invention

$$\frac{x^1}{t^1} \text{ equals } \frac{x^2}{t^2}.$$

My invention has the particular advantages that I eliminate the radial component of the issuing elastic fluid without the necessity of varying the angle of discharge of the buckets from their roots to their tips, the angle of discharge, which is designated y in the drawing, remaining the same throughout the length of the buckets. This means that buckets embodying my invention can be manufactured by the usual methods and at comparatively low cost.

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 may be carried out by other means.

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

1. An elastic fluid turbine wherein the buckets of considerable length are so constructed that the ratio of the bucket passage equation to the nozzle passage equation is substantially equal to a constant along the entire length of the buckets.

2. An elastic fluid turbine rotor elements having buckets the thickness of the discharge edges of which increases from the roots to the tips at such a rate that the ratio of such thickness to the pitch of the buckets is substantially constant along the entire length of the buckets.

In witness whereof, I have hereunto set my hand this 28th day of February, 1924.

WALTER KIESER.