Nov. 27, 1923 1,475,267

O. JUNGGREN

ELASTIC FLUID TURBINE

Filed July 12, 1922

Fig. 1.

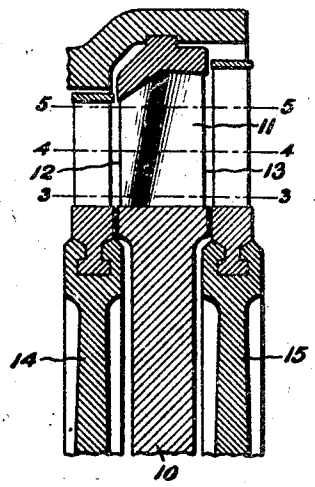


Fig. 2.

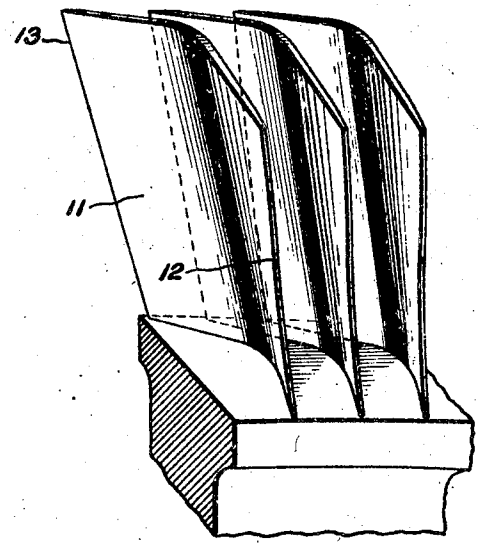


Fig. 3.

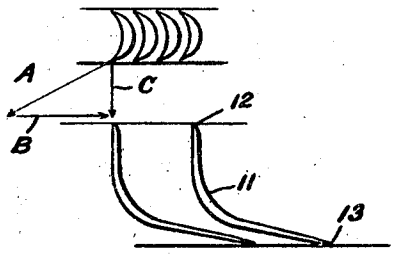


Fig. 4.

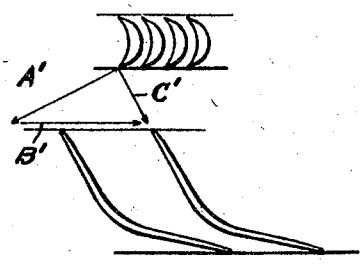
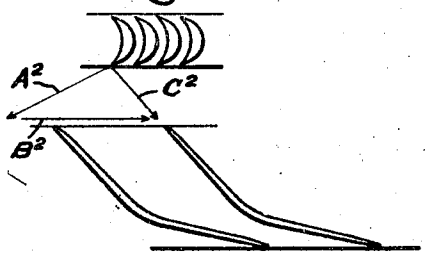


Fig. 5.



Inventor:

Oscar Junggren

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UNITED STATES PATENT OFFICE.

OSCAR JUNGGREN, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELASTIC-FLUID TURBINE.

Application filed July 12, 1922. Serial No. 574,511.

To all whom it may concern:

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

The present invention relates to elastic fluid turbines of the impulse type and particularly to nozzles for such turbines. As is well understood, the nozzles are stationary, fluid-directing elements which serve to expand the elastic fluid, thereby converting pressure into velocity, and direct it against the adjacent bucket ring of the rotating wheel. In general, the nozzles are formed by mounting or arranging guide blades or partitions between two radially spaced concentric rings, the structure as a whole being termed a nozzle diaphragm. The nozzles may extend entirely around the diaphragm providing for complete peripheral admission or they may extend only part way around.

In multistage turbines of considerable size the buckets in the lower pressure stages become quite long so that there is considerable difference in speed between the roots and the tips of the buckets, and as the elastic fluid speed is constant in any particular stage it means that the speed through the tips of the buckets is slower than that through the roots; and since the tips are traveling faster than the roots it follows that the elastic fluid is discharged from the tips of the buckets in a forward direction, i. e. in the direction of motion of the buckets. In fact, as will be apparent from a consideration of the foregoing, the elastic fluid will be discharged from the buckets in a continuously varying direction from the roots of the buckets to their tips.

Prior to my invention, so far as I am aware, it was the practice to make the entrance edges of the nozzle partitions radial and the entrance angle of the nozzle plates the same throughout their length and as the elastic fluid issuing from the adjacent bucket ring strikes them at varying angles the result has been the setting up of eddies in the nozzle passages, water cutting of the nozzle partitions, and improper filling of the nozzle passages, particularly in the case of flared nozzles.

The object of my invention is to provide an improved nozzle or nozzle diaphragm structure and arrangement which will overcome the above difficulties 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.

In the drawing Fig. 1 is a radial sectional view through a nozzle diaphragm and adjacent bucket wheels of an axial flow elastic fluid turbine, the nozzle diaphragm having nozzles embodying my invention; Fig. 2 is a perspective view on an enlarged scale of several adjacent nozzle partitions the outer ring being omitted, and Figs. 3, 4 and 5 are diagrammatic sectional views taken on lines 3—3, 4—4 and 5—5, Fig. 1.

Referring to the drawing, 10 indicates a nozzle diaphragm having nozzle partitions 11. The entrance edges of the nozzle partitions are designated 12 and the discharge edges 13. The bucket wheels of the stages preceding and following diaphragm 10 are indicated 14 and 15, and it will be understood that the elastic fluid leaving the buckets of wheel 14 enters the nozzles of diaphragm 10 and is directed by such nozzles to the ring of buckets on wheel 15. The section of Fig. 1 is taken through one of the lower pressure stages of a turbine and it will be noted that the buckets on wheel 15 are longer than those on wheel 14 and that the diaphragm nozzles flare radially outward so as to direct the elastic fluid from the ring of buckets of smaller diameter to that of larger diameter.

According to my invention I provide the nozzle diphragm with nozzle partitions having warped entrance edges, the edges being so warped that the nozzle walls are parallel to the stream lines of the fluid. This requires that the angle which the entrance edge of each nozzle partition makes with the axial change continuously throughout its radial depth as is best illustrated in Figs. 3, 4 and 5. In Fig. 3, which is a section taken at the roots of the nozzle partitions, the entrance edges of the nozzle partitions are axial, while in Fig. 5, which is a section taken at the tips of the nozzle partitions, the entrance edges of the nozzle partitions extend at an angle to the axial. At intermediate points, such as that shown in Fig. 4, the entrance edges of the nozzle partitions ex-

tend at angles between those of Figs. 3 and 5. The shape of the entrance ends of the nozzle partitions, i. e., the amount they need to be warped, depends upon the bucket angle and speed, and the elastic fluid speed, and in Figs. 3, 4 and 5 I have shown vector diagrams illustrating this. In these diagrams A, A′ and A^2 indicate the elastic fluid speed and direction relative to the bucket, these being approximately the same in each instance; B, B′ and B^2 indicate the bucket speed which increases from the roots to the tips of the buckets, and C, C′ and C^2 indicate the resultant and show the direction of the elastic fluid flow from the buckets into the nozzles. As will be clear from Figs. 3, 4 and 5 the entrance ends of the nozzle partitions are so shaped that they are at every point parallel to the direction of elastic flow as represented by lines C, C′ and C^2.

By this arrangement the nozzle partitions receive the elastic fluid without shock and without the formation of objectionable eddies which disturb the flow and create losses. Also the arrangement eliminates the wearing away of the entrance edges of the nozzle partitions. Furthermore, the arrangement insures that the nozzles are properly filled with elastic fluid throughout their length. This latter is of particular importance in connection with flared nozzle passages of considerable height such as are required in the lower pressure stages of a turbine in order to convey elastic fluid from a shorter bucket ring to a longer one. By my invention the difficulties which have heretofore been experienced in properly filling such nozzles and the losses which have occurred because of this are substantially eliminated. It has been found by experiments and tests that if a diaphragm having flared nozzles is provided with nozzle partitions having warped entrance ends in accordance with my invention, the nozzle passages including the flared portions will be evenly and fully filled and there will be no disturbances or losses due to eddy currents. I regard, therefore, the use of nozzle partitions having warped entrance edges in connection with diaphragms having flared nozzles as being an important feature of my invention.

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

1. A nozzle diaphragm for elastic fluid turbines characterized by the fact that the entrance ends of the nozzle partitions are warped whereby elastic fluid discharged from the preceding bucket ring will enter the nozzles in stream lines parallel to the nozzle partitions.

2. A nozzle diaphragm for elastic fluid turbines characterized by the fact that the entrance angle of the nozzle passages varies continuously throughout their radial depth to such an extent that the elastic fluid will enter them in stream lines parallel to the entrance walls of the nozzle partitions.

3. A nozzle diaphragm having nozzle partitions so shaped that the entrance angle to the nozzle passages varies continuously and in such manner that the elastic fluid will enter them in stream lines parallel to the entrance walls of the nozzle partitions.

4. A flared nozzle having nozzle partitions provided with warped entrance walls whereby elastic fluid discharged from the preceding bucket ring will enter the nozzles in stream lines parallel to the nozzle partitions.

In witness whereof, I have hereunto set my hand this 11th day of July, 1922.

OSCAR JUNGGREN.