No. 735,110. PATENTED AUG. 4, 1903.

O. JUNGGREN.

ELASTIC FLUID TURBINE.

APPLICATION FILED FEB. 10, 1903.

NO MODEL.

Fig. 1.

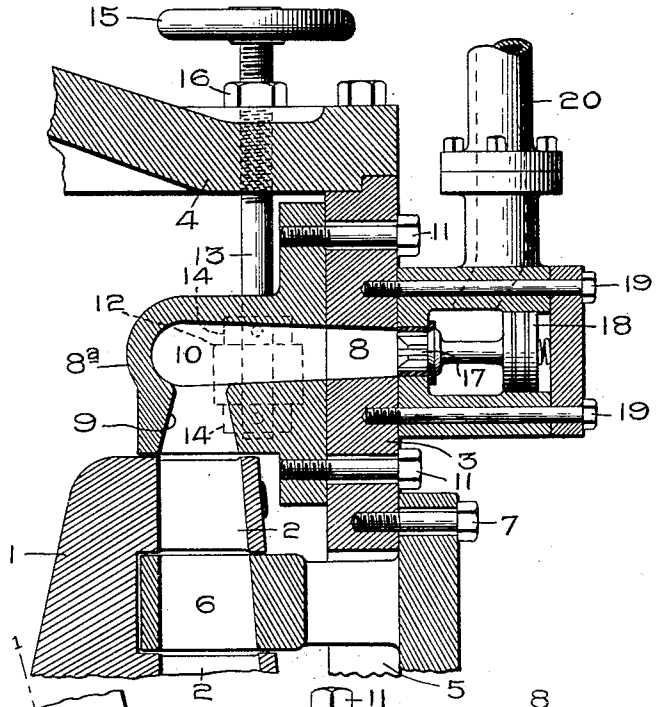


Fig. 2.

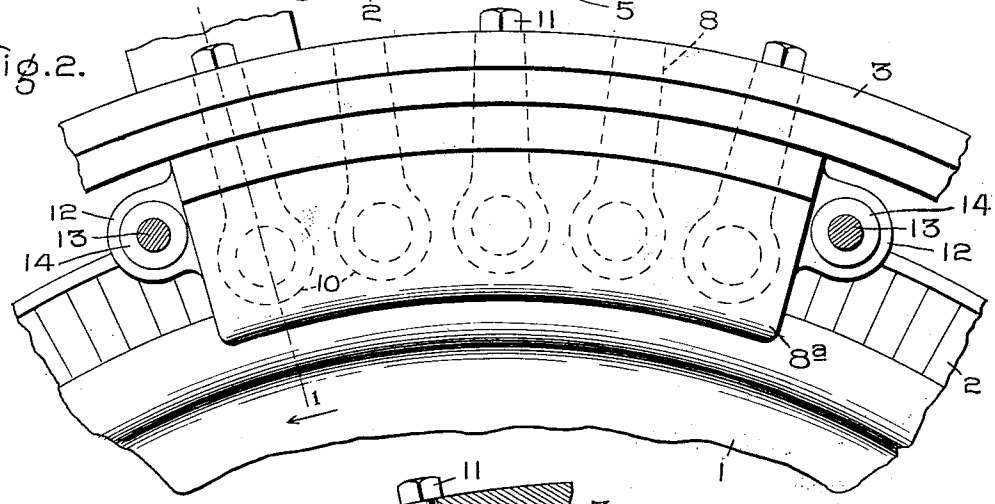
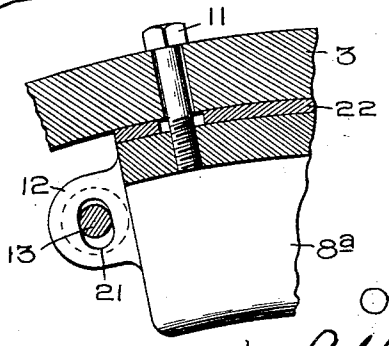


Fig. 3.



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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.

SPECIFICATION forming part of Letters Patent No. 735,110, dated August 4, 1903.

Application filed February 10, 1903. Serial No. 142,786. (No model.)

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 Adjustable Nozzles for Elastic-Fluid Turbines, of which the following is a specification.

Elastic-fluid turbines, and more particularly those of the jet type, are provided with nozzles and wheel-buckets that are arranged for relative movement. It is common practice in certain constructions to have the buckets rotate past the delivery ends of nozzles with a speed of two hundred and fifty feet per second and even higher in others. The efficiency of a jet-turbine is largely dependent upon the clearance between the moving buckets and the nozzles, and for that reason it is made as small as possible, frequently being as small as three one-hundredths of an inch even in very large machines. Owing to the construction and arrangement of the bucket-wheel shaft within the casing, there is a difference in expansion between it and the casing which causes a change in the clearance between the buckets and nozzle when the machine is cold and when it is hot. With some constructions this can be compensated for by having a clearance when the parts are cold that is greater than is desired and depending upon the unequal expansion of the shaft and casing when heated to decrease this clearance to the proper amount; but in other constructions this is out of the question. It sometimes happens that this unequal expansion of the parts of the casing will disturb the proper relation as to clearance between the nozzle and buckets and cause the parts to rub. In certain types of turbines it has been proposed to rigidly attach the intermediate buckets to the casing, the said intermediate buckets being employed to receive the motive fluid from one row of wheel-buckets and discharge it into the next. In cases of this kind it is impractical to set the parts once for all. Hence some sort of adjusting means is necessary.

My invention has for its object to avoid the objections above pointed out and to provide a nozzle which can be adjusted by means located outside of the shell or casing toward or away from the wheel-buckets in a plane parallel with the axis of rotation, even though the latter are revolving at full speed. I also contemplate an adjustment of the nozzle toward or away from the wheel-axis. By reason of my improved construction I am also enabled to compensate for slight inaccuracies in workmanship and also to simplify the question of alinement.

In the accompanying drawings, which represent one embodiment of my invention, Figure 1 is a partial section of a jet-turbine, taken on line 1 1 of Fig. 2. Fig. 2 is a partial cross-section taken at right angles to the first; and Fig. 3 is a detail view of one end of the nozzle, showing means whereby it can be adjusted toward or away from the wheel-axis.

In the drawings, 1 represents a part of a wheel having radially-extending buckets 2, arranged in circumferential rows. Surrounding the wheel is a casing comprising side walls 3 and a horizontal cover 4. The particular illustration shows a part of a vertical machine; but my invention can be used in connection with horizontal turbines. The casing is provided with one or more openings 5, through which extend the supports for the segmental and sectionalized intermediate buckets 6. The intermediate buckets are situated between the rows of wheel-buckets and are designed to receive motive fluid from one row of buckets and after changing its direction deliver it to the second row of buckets. In the present drawings only one row of intermediates is shown; but it is to be understood that as many may be employed as are desired. The segmental buckets extend over substantially the same arc as the nozzle, and the arc varies with the power of the machine and also with the pressure and volume at any given point. In the present illustration the intermediate buckets are adjustable independently of the wheel and nozzle; but, if desired, these buckets may be rigidly attached to the wheel-casing. They are retained in place by the bolts 7, and for the purpose of illustration the hole in the intermediate support is made consid-

erably larger than the body of the bolt. The wall 3 of the wheel casing or shell is provided with as many openings 8 as there are nozzle-sections. In the present instance five of these openings are shown; but it is to be understood that the number can be increased or decreased to meet the conditions of service. Situated on the inside of the cylindrical shell and adjustable with respect thereto is a sectionalized nozzle 8^a, which is designed to deliver motive fluid to the side of the wheel-buckets. The nozzle is divided into sections, and each nozzle-section is provided with diverging walls 9, so as to convert the pressure of the steam largely or wholly into velocity before delivering it to the buckets. The invention is not, however, limited to the particular shape of the nozzle-openings. Each nozzle-section is provided with a bowl 10, which registers with the openings or ports 8 in the side wall of the casing. The inner wall or surface of the casing is turned true at the point where it is designed to receive the nozzle, and the outer face of the nozzle is curved concentric with the surface of the wall. I have shown the meeting faces of the nozzle and shell curved; but the invention in its broader aspects is not limited thereto. This is, however, a good construction, as it simplifies the machine-work. It is secured in place by the bolts 11, which pass through enlarged openings in the wall of the shell. For the purpose of illustration the clearance between the bodies of the bolts and the wall of the shell has been somewhat exaggerated. The ends of the nozzle are provided with projections 12, containing a central opening to receive the adjusting-bolts 13, which are employed to move the nozzle toward or away from the wheel-buckets in a direction parallel to the axis of rotation. The bolts are provided with collars 14, situated above and below the projection 12, so that when the bolt is rotated by the hand-wheel 15 the nozzle as a whole will be moved up or down, it being understood that the bolt is threaded to the cover 4 of the shell. In order to lock the parts in position, a check-nut 16 is provided for each bolt. As shown, both ends of the nozzle are intended to be simultaneously and correspondingly adjusted; but it is possible to adjust the parts so that one end of the nozzle is a trifle higher or lower than the other, the clamping-bolts 11 permitting of this adjustment. In order to regulate the admission of fluid to the nozzle-sections, each of the said sections is provided with a valve 17, which is actuated by a piston 18 in a suitable manner. This valve and the means for operating it form the subject-matter of a separate application and for that reason are not more fully illustrated and claimed herein. The valve is attached to the casing by bolts 19, and steam is admitted thereto by the conduit 20.

When for any reason it becomes necessary to adjust the nozzles with respect to the wheel-buckets, the bolts 11 are slackened slightly and also the check-nuts 16. The hand-wheels 15 are then rotated to the right or left, as the case as may be, until the nozzle has been adjusted to the proper position, after which the check-nuts 16 are seated and also the bolts 11. If for any reason it becomes necessary to adjust the intermediates, the bolt 7 is slackened and the support 5 moved up or down in a direction parallel to the axis of rotation until the buckets 6 occupy a position midway between the wheel-buckets, after which the nuts 7 are seated in place.

In Fig. 3 I have shown a means whereby the nozzle can be adjusted toward or away from the axis of rotation. I may combine this with the means employed to adjust the nozzles in a plane parallel to the axis of rotation, if desired. 3 represents the wall of the casing, 8^a the nozzle, and 12 the projection on the end of the nozzle. This projection is provided with an enlarged slot 21, through which the bolt 13 passes, the latter being provided with collars 14, as before. Between the nozzle and the wall of the casing is located a shim 22, the thickness of which can be varied to suit the conditions. This shim is provided with openings to receive the nozzle-attaching bolts 11. It is also provided with openings which register with the ports of openings 8 in the shell. By providing somewhat-enlarged slots in the projections 12 on the end of the nozzle shims of varying thickness can be employed, whereby the nozzle may be set in the proper position without interfering with the action of the adjusting-bolts 13. It is not intended to adjust the nozzle toward or away from the axis of rotation when the machine is in operation, because this is in the nature of a permanent adjustment and should be taken care of when the machine is assembled.

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. In a turbine, the combination of a bucket-wheel and casing that are relatively movable, a nozzle for delivering motive fluid to the side of the wheel-buckets, and means for adjusting the nozzle toward or away from the wheel-buckets in a plane parallel to the wheel-axis.

2. In an elastic-fluid turbine, the combination of a wheel having rows of buckets, a nozzle, intermediate buckets between the rows of wheel-buckets, and a means for adjusting the nozzle independently of the wheel and intermediate buckets.

3. In a turbine, the combination of a bucket-

wheel, a casing therefor, a sectionalized nozzle located within the casing for delivering motive fluid to the side of the wheel-buckets, means extending outside of the casing for adjusting the nozzle with respect to the wheel in a plane parallel to the wheel-axis, and a means for attaching the nozzle to the casing.

4. In a turbine, the combination of a bucket-wheel, a casing therefor, a nozzle which covers a plurality of the wheel-buckets, and means attached to the ends of the nozzle for adjusting it.

5. In a turbine, the combination of a bucket-wheel, a casing therefor, a nozzle which covers a plurality of the wheel-buckets, screw-threaded means attached to the nozzle for adjusting it, and means for clamping the nozzle to the casing.

6. In a turbine, the combination of a segmental nozzle which covers a plurality of buckets, a bucket-wheel, sectionalized intermediate buckets arranged in the form of a segment of a circle, and means for adjusting the nozzle independently of the intermediate and wheel buckets.

7. In a turbine, the combination of a cylindrical casing, a nozzle having a cylindrical surface that is concentric with the inner wall of the casing, adjusting means engaging the nozzle at opposite points, and nozzle-controlling valves mounted on the casing.

8. In a turbine, the combination of a cylindrical casing having fluid-carrying passages, a nozzle having openings registering with the passages in the casing, a bucket-wheel, and means for adjusting the nozzle toward or away from the wheel-buckets and in a plane parallel to the wheel-axis.

9. In a turbine, the combination of a sectionalized nozzle, projections on the nozzle having slots formed therein, adjusting-bolts which extend through the slots in the projections, means for preventing longitudinal movement of the bolts independent of the nozzle, and locking devices for the bolts.

10. In a turbine, the combination of a bucket-wheel, a shell or casing having a plurality of ports or passages, and a nozzle situated inside of the shell and provided with bowls that register with the ports or passages in the shell.

In witness whereof I have hereunto set my hand this 9th day of February, 1903.

OSCAR JUNGGREN.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.