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O. JUNGGREN.

NOZZLE FOR ELASTIC FLUID TURBINES.

APPLICATION FILED SEPT. 19, 1903.

Fig. 1.

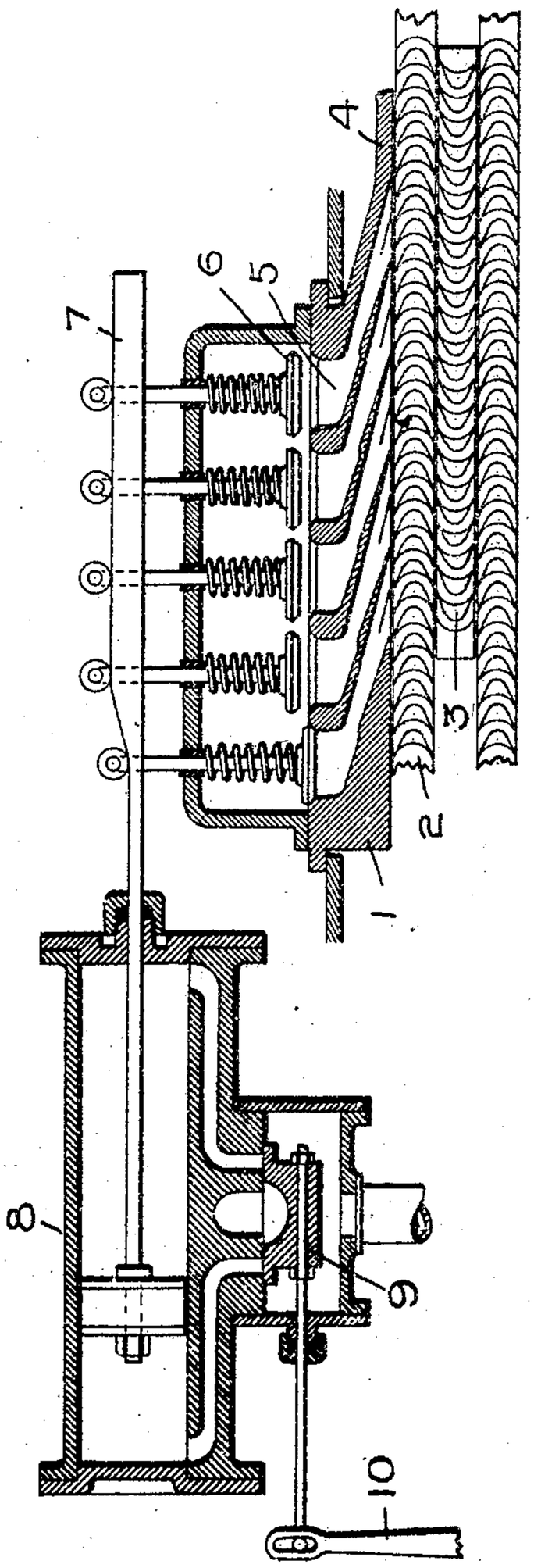
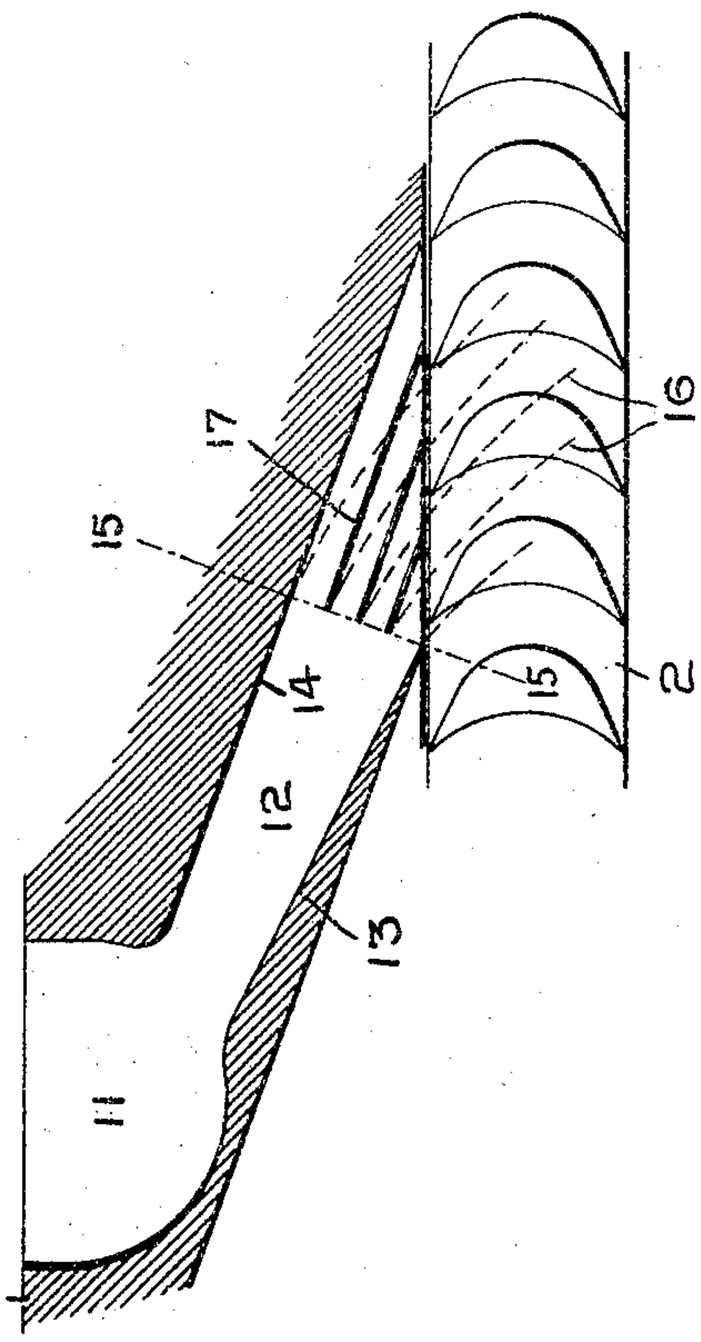


Fig. 2.



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NOZZLE FOR ELASTIC-FLUID TURBINES.

No. 796,432. Specification of Letters Patent. Patented Aug. 8, 1905.

Application filed September 19, 1903. Serial No. 173,842.

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

Nozzles for elastic-fluid turbines are commonly constructed with a relatively thin wall at the trailing end, meaning by "trailing end" the end of the nozzle extending in the direction of revolution of the wheel. The wall is usually so thin that it covers only a fraction of the space between two adjacent wheel-buckets. As the wheel rotates more or less of the motive fluid discharged by the nozzle or the last nozzle-section and confined between the buckets is carried or dragged along, due to the rotation of the wheel. As soon as the particular bucket-space containing the steam or motive fluid passes beyond the thin wall of the nozzle the steam or motive fluid escapes into the wheel casing or shell instead of passing into the intermediate bucket-space and is therefore lost.

One object of the present invention is to utilize the motive fluid which ordinarily escapes without doing useful work by providing a means for confining it until it has given up its energy to the wheel. In carrying out this feature of the invention the sides of those buckets adjacent to the nozzle are covered for a short distance beyond the last discharge-orifice of the nozzle. This covering may be supported in any suitable way. It can with advantage take the form of a plate or extension on the nozzle itself; but the invention is not limited thereto.

The feature of closing in the buckets on the trailing end of a nozzle is shown in connection with an expanding type of nozzle, since it has great utility in connection therewith; but it can also be used with advantage on other types of nozzles.

In controlling a turbine the sections of which the nozzle is composed, and particularly where the above-specified covering is provided, are preferably cut into and out of service from the leading end of the nozzle, thereby effectively confining the motive fluid at all times on the trailing end. In other words, the column of fluid delivered to the wheel remains unbroken, although the total amount of fluid supplied is varied to suit the demand. This is accomplished by means of separately-actuated valves which cut one section after the other into or out of service. The valves may be actuated in any suitable manner. In the present embodiment of the invention each valve is actuated by a cam which in turn is operated by a piston and cylinder.

When the cross-sectional area of the nozzle or nozzle-section assumes substantial proportions, there is a tendency for the motive fluid to distribute itself unequally at different points therein, which means that the bucket-spaces will not receive equal amount of fluid. This is due to the fact that one side of the nozzle-orifice is longer than the other, which is made necessary by the angular relation between the nozzle and the adjacent bucket-wheel. To obviate this objection, I provide one or more directing-plates or partitions for the nozzle or nozzle-section, which begin at a point substantially coincident with the point where the expansion of the side walls ceases and extend therefrom to the end of the nozzle. On the shorter side of the nozzle these partitions are relatively short; but they increase in length proportionally as they occupy positions nearer and nearer the longer wall of the nozzle. The partitions or directing-plates may be made of thin metal coated with enamel or similar material to make them smooth, or they may be made of uncoated metal. These partitions being located at the end of the nozzle and beyond the expanding portion have no effect on the expansion. Their function is to direct the fluid, not to change its character as to velocity or pressure. I have shown this feature of my invention in connection with an expanding nozzle, because it is particularly applicable thereto; but it can be used with other types of nozzles.

In the accompanying drawings, which illustrate one embodiment of my invention, Figure 1 is a sectional detail view of a sectionalized nozzle, valve mechanism, and buckets; and Fig. 2 is an enlarged detail view of an expanding nozzle fitted with partitions or directing-plates.

1 represents a sectionalized expanding nozzle carried by the casing and arranged to deliver steam or other motive fluid to the bucket-wheel 2. Between the rows of wheel-buckets is a sectional row of intermediate buckets 3, which receive fluid from one row of buckets

and after changing its direction discharge it against the adjacent row.

One or more rows of wheel-buckets may be employed, as is desired to meet the conditions of service. On the trailing end of the nozzle, which in the present illustration is the right-hand end, is a plate or extension 4, which has a radial depth equal to or greater than that of the buckets. Its length circumferentially is great enough to cover several of the wheel-buckets, and the steam carried forward by the wheel is thus pocketed in the working passages or bucket-spaces and compelled to pass through the bucket-spaces into the intermediate and perform useful work.

It is impracticable to run the wheel-buckets close to the wall of the surrounding shell or casing, since it would involve finishing the entire wall, an operation which would be very expensive, owing to the size of the parts. Again, there are certain clearances which have to be considered—such, for example, as those between the nozzles and buckets and between relatively moving buckets—and it would greatly enhance the difficulty of construction and adjustment if the clearance between the wheel and the wall had also to be considered. By mounting the nozzles on the casing in such manner that they project well into the casing the difficulties of construction and adjustment are reduced to a minimum.

Each nozzle-section is provided with a bowl 5, and the entrance of fluid thereto is controlled by a puppet type of valve 6. Each valve is normally closed by the coiled compression-spring surrounding its stem and is opened by a cam 7, that is actuated by a motor 8. The motor comprises a piston and cylinder, the former being attached to the cam for moving it longitudinally. The movements of the piston are controlled by a governing-valve 9, that is regulated in its action by a speed-responsive device or other governor through the lever 10. The valve at the leading end of the nozzle is closed, while the others are open. Moving the cam longitudinally acts on the valves successively, beginning with the one at the leading end of the nozzle.

In Fig. 2 a nozzle or nozzle-section is shown on a somewhat enlarged scale. 11 represents the bowl, and 12 the throat, of an expanding nozzle. The side walls 13 and 14 gradually expand from the throat to the point represented by the dotted line 15. At or about the line 15 the shorter wall ceases, while from the said line to the outer end the longer side wall extends parallel with the axis of the nozzle. There is a tendency for the motive fluid in leaving a large nozzle to follow the path indicated by the curved dotted lines 16. For the purpose of illustration this tendency has been somewhat exaggerated. This means that the bucket-spaces opposite the trailing side of the nozzle will not receive their full amount of steam, and consequently will work less efficiently. To obviate this and to direct the fluid properly, partition or division plates 17 are provided, which extend from the beveled end of the nozzle to a point approximately that at which the expansion in the nozzle ceases. These plates may be fastened in slots formed in the casting of which the nozzle is composed, or they may be otherwise secured. In order that they may present smooth surfaces, a coating of enamel or similar substance may be given them.

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. A turbine comprising a bucket-wheel, a nozzle composed of a plurality of sections, and a separately-actuated valve for each section, in combination with means for actuating the valves of the leading sections of the nozzle, one after the other, to regulate the volume of motive fluid delivered to the wheel and to preserve the continuity of the column, and a plate located at the trailing end of the nozzle to prevent the motive fluid from escaping without doing useful work.

2. A turbine comprising a bucket-wheel, a nozzle composed of a plurality of closely-associated nozzle-sections, and an individual valve for each section which is separately operated, in combination with a means for confining the motive fluid within the bucket-spaces after they pass the last discharge-orifice of the nozzle, and a device for cutting the nozzles successively into and out of service from the leading end of the nozzle.

3. A turbine comprising a bucket-wheel and a plurality of closely-associated nozzle-sections arranged to deliver fluid to the wheel, a plurality of separately-actuated valves, and a chest containing the valves, in combination with a covering at the side of the buckets and beyond the last nozzle-orifice on the trailing end and covering a plurality of bucket-spaces to confine the fluid, and a controlling device which actuates the valves successively to cut the nozzles into and out of service beginning with the one at the leading end of the nozzle.

4. A nozzle for a turbine comprising a bowl, walls which connect with the bowl and direct the passage of fluid and present a beveled end to the wheel, and a partition or division plate located between the walls and beyond the bowl which serves to direct the passage of fluid to the wheel without changing its pressure or velocity.

5. A nozzle for a turbine which presents a beveled end to the wheel and comprising a bowl, a long and a short wall, in combination

with a division-plate which occupies a position between the end of the short side and that of the long side for directing the passage of fluid to the wheel without changing its velocity or pressure, and a valve which controls the admission of fluid to the bowl, which has an open and a closed position but no intermediate.

6. A nozzle for a turbine comprising side walls which have a gradual divergence, in combination with a division-plate or partition which extends from the point where the divergence ceases to the discharge end thereof.

7. A nozzle for a turbine comprising a bowl, long and short walls for directing the passage of fluid and which presents a beveled end to the bucket-wheel, and a plurality of partition-plates for directing the passage of fluid without changing its velocity or pressure which gradually increase in length as their location approaches the long wall of said nozzle, in combination with a valve which controls the admission of fluid to the bowl.

In witness whereof I have hereunto set my hand this 16th day of September, 1903.

OSCAR JUNGGREN.

Witnesses:
GEO. P. TOWNSEND,
N. P. ZECH.