No. 866,068. PATENTED SEPT. 17, 1907.

R. H. RICE.

NOZZLE AND DIAPHRAGM FOR TURBINES.

APPLICATION FILED FEB. 8, 1907.

2 SHEETS—SHEET 1.

Fig. 1.

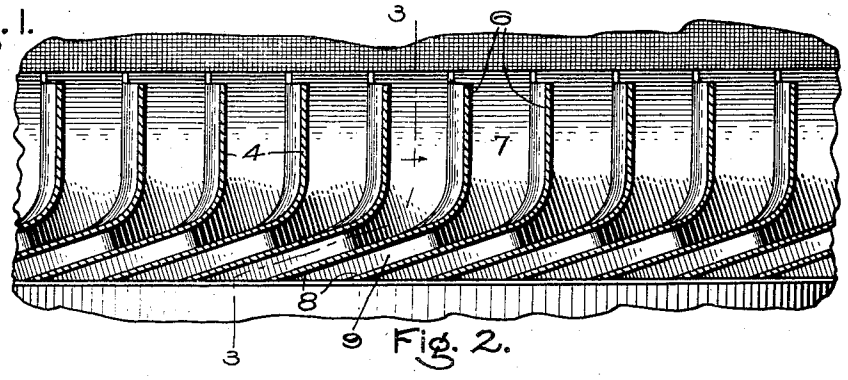


Fig. 2.

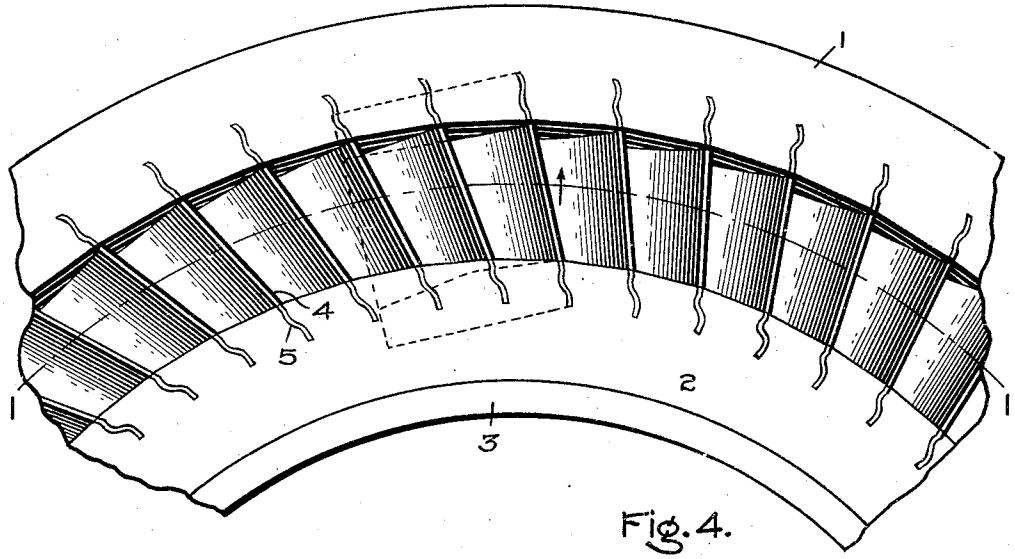
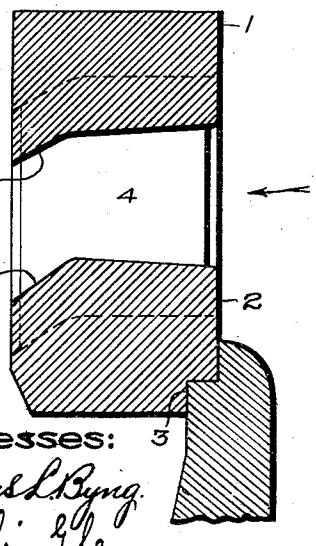
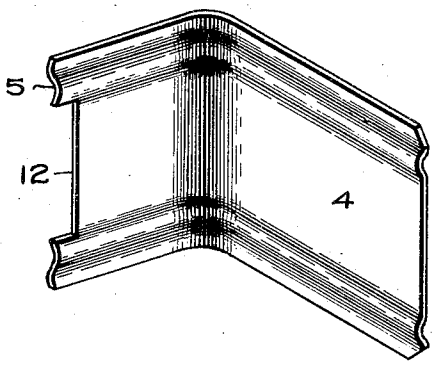


Fig. 4.

Fig. 3.





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2 SHEETS—SHEET 2.

Fig. 5.

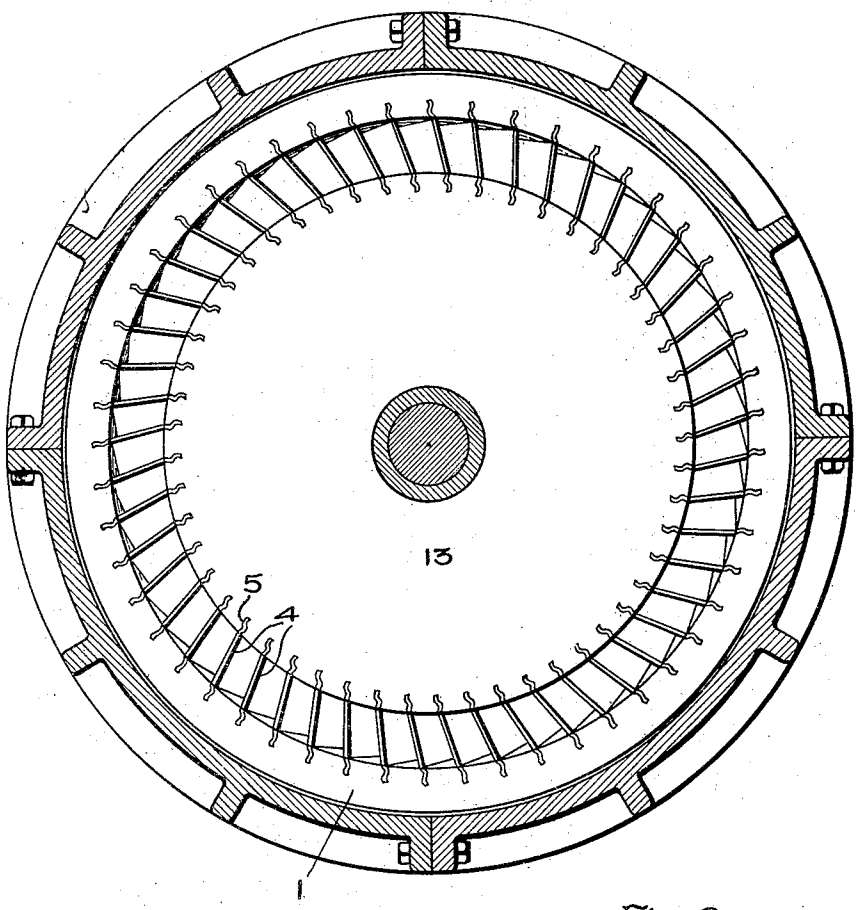


Fig. 6.



Fig. 7.

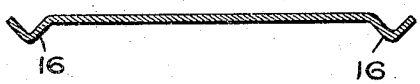


Fig. 8.

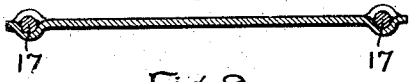
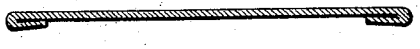


Fig. 9.



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UNITED STATES PATENT OFFICE.

RICHARD H. RICE, OF SWAMPSCOTT, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

NOZZLE AND DIAPHRAGM FOR TURBINES.

No. 866,068. Specification of Letters Patent. Patented Sept. 17, 1907.

Application filed February 8, 1907. Serial No. 356,297.

To all whom it may concern:

Be it known that I, RICHARD H. RICE, a citizen of the United States, residing at Swampscott, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Nozzles and Diaphragms for Turbines, of which the following is a specification.

The present invention relates to nozzles having sheet metal partitions which are cast into the support when the latter is made.

The invention also relates to the construction of diaphragms having a nozzle or nozzle passages which extend entirely around the circumference so that all of the buckets of the adjacent wheel will be active. The latter feature is of the greatest importance in the low pressure stages of a multi-stage turbine where the volume of motive fluid to be handled is large.

The invention has for one of its objects to provide a nozzle of improved construction wherein the nozzle partitions are firmly anchored by mechanical means in the cast metal forming the body of the support.

A further object is to provide a diaphragm of improved construction wherein the nozzle partitions not only serve as such but also act as beams to support the central portion of the diaphragm against the pressure to which it is subjected.

For a consideration of what I believe to be novel and my invention attention is directed to the accompanying specification and claims appended thereto.

In the accompanying drawings which are illustrative of the invention, Figure 1 is a section of a diaphragm and nozzle taken on line 1—1 of Fig. 2; Fig. 2 is a partial plan view of the outer portion of a diaphragm; Fig. 3 is a section taken on line 3—3 of Fig. 1; Fig. 4 is a perspective view of the nozzle partitions clearly showing the corrugated side portions which afford a mechanical union with the cast metal of the diaphragm or other support; Fig. 5 is a plan view of a diaphragm wherein the central portion is supported solely by the partitions; and Figs. 6 to 9, inclusive, show modified forms of the anchoring means.

1 represents the outer portion of the nozzle or the diaphragm as the case may be and 2 the inner portion thereof. The inner portion may take the form of a ring having a shoulder 3 to receive the peripheral portion of the central or inner part of the diaphragm, or it may form an integral portion of the central part of the diaphragm.

4 represents one of the nozzle partitions of L shape in longitudinal section. It is made out of sheet steel, usually by a punching operation. The sides are then corrugated at 5 to afford a mechanicel securing or anchoring means. Stated broadly, the metal forming the sides of the partitions is deflected to a greater or less extent from the plane of the body so that the partition will be firmly anchored against strains tending to pull them out of the metal in which they are embedded. Where the strains are comparatively small on each partition, one deflection on either side of the plane of the body will generally be found sufficient but where they are comparatively large it will be found best to deflect the metal first on one side and then on the other of the plane of said partition.

Attempts have been made heretofore to anchor the partitions in the nozzle support by perforating them at one or more places near the sides to receive molten metal when the casting is made. My experience has demonstrated that this arrangement does not result in a good anchor for the reason that the metal will not always flow into and fill the perforation; second that the small amount of cast metal in the perforation has no particular strength; third that perforating the sheet metal partitions weakens it; and fourth that it is impracticable to increase the width of the partition to give more stock between the perforation and a side of the partition because it makes it more difficult to obtain good castings.

After the partition has been cut to the desired dimensions and the sides corrugated, it is put in a suitable die and bent to the desired shape. One end 6 of each partition forms a part of the throats 7 of two adjacent nozzle sections or passages and the opposite end 8 forms a part of the discharge portion of two nozzle sections or passages 9. The passages may be expanding or non-expanding in character, depending upon the requirements. The portions 8 of the partitions may be parallel to each other or not, the desired relation of throat to discharge area being determined by the opposed side walls 10 and 11 of the nozzle support. The throat ends of the partitions are cut away at 12 so that it will be unnecessary to machine them after the casting is made. I may turn up the upper surfaces of the casting adjacent to the portions or leave them unfinished as desired. The under surface of the diaphragm will be finished where it rests on a shoulder in the wheel casing. Usually the partitions will terminate slightly inside of the bottom surface of the diaphragm to prevent injury either in machining or in handling.

It is important to have the discharge ends of the partitions occupy radial positions because the sharpened edges of the wheel buckets occupy corresponding position and the passages should discharge in a manner to fill the bucket spaces. Owing to the fact that the opposed surfaces of the inner and outer portions of the nozzle support are of different diameters,

the partitions would have to be of a complicated shape if both top and bottom edges were to stand exactly radial. I avoid this objection and also direct the fluid particles in straight lines by making the partitions rectangular with parallel opposing edges and bending them crosswise in a plane perpendicular to the length. The partitions are then inserted in the core in such manner that the lower edges are strictly radial with respect to the axis of the machine, the upper edges coming as they will and occupying non-radial positions. The core determines the radial dimensions of the nozzle passages which is considerably less than the width of the partitions. By reason of this arrangement I am able to get uniformly spaced partitions which direct the motive fluid in the proper direction to fill the bucket spaces, and also to reduce to a minimum the losses due to eddies. A nozzle made in this manner requires no careful finishing of the passages and thus eliminates a very large item of expense in manufacture. Any rough spots can of course be removed by tooling in the usual way.

In Fig. 5 is shown a diaphragm 13, the inner portion of which is supported solely by the partitions 4. In this case the partitions act not only as such but also as beams, of which there are a great many, to transfer the pressure on the inner to the outer portion. Break-down tests made with the construction described show that with abnormal pressure in the central portion of the diaphragm the partitions will yield at a point inside the portion I of the diaphragm without the anchoring means yielding. These break-down tests were made with hydraulic means and the pressures used per square inch were far in excess of those met in operating turbines under prevailing conditions.

Instead of corrugating the side portions of the partitions for anchoring purposes, I may bend or displace the metal in other ways. For example, the sides 15 may be inclined as in Fig. 6. The metal of one side may be deflected in one direction and that of the other side in the opposite direction, or part of the metal of one side may be bent in one direction and the remainder in the opposite. In Fig. 7 the side portions are corrugated to form a V-shaped section 16. In Fig. 8 the side portions are provided with parallel slits and a wire 17 threaded through the slits so that it is exposed first on one face and then on the other of the partitions. In this case as before the sides are bent or deflected from the normal plane of the partition to form an anchoring device. In Fig. 9 the sides are folded back on the main body portion to accomplish the same purpose.

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 it to be 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 nozzle for an elastic fluid turbine comprising a metal support having an orifice and one or more partitions extending across the orifice and entering the support on both sides, and an anchoring device for each partition which is formed integral therewith and is embedded in the support.

2. A nozzle for an elastic fluid turbine comprising a metal support having an orifice with one or more sheet metal partitions extending across the orifice, the sides of which are cast into the said support when the latter is formed, and an anchoring device for each partition which is formed by bending or deflecting the stock of which the partition is composed out of its normal plane.

3. A nozzle for an elastic fluid turbine comprising a metal support having an orifice, and one or more partitions extending across the orifice, the ends of said partition being corrugated and seated in said support.

4. A nozzle for an elastic fluid turbine comprising a cast metal support having an orifice, and one or more partitions which are cast into the support and extend across the orifice, the sides of each partition being corrugated in the direction of their length to form an anchoring means.

5. A nozzle for an elastic fluid turbine comprising a metal support having an orifice, one or more partitions extending across the orifice and anchored in the support, the discharge end of the partition being radial to the axis of the machine and the receiving end non-radial.

6. A nozzle for an elastic fluid turbine comprising a cast metal support having an orifice, one or more partitions which extend across the orifice and are cast into the support, the said partitions having parallel ends and sides, the discharge end occupying a radial position and the receiving end a non-radial position, and anchoring means for the sides of the partitions.

7. A diaphragm comprising outer and inner members separated by a space and partitions which extend across the space and divide it into nozzle passages and form the sole support for the said inner member.

8. A diaphragm comprising an outer and inner member separated by a space through which motive fluid passes, sheet metal partitions which extend across the space, divide the same into passages and form the sole support for the inner member of the diaphragm.

9. A diaphragm comprising an outer and inner member separated by a space through which motive fluid passes, sheet metal partitions which extend across the space, divide the same into passages and form the sole support for the inner member of the diaphragm, and means for anchoring the side portions of each partition in the inner and outer members of the diaphragm.

10. A diaphragm comprising an outer annular member, an inner annular member of smaller diameter, a plurality of partitions which divide the space between said members into passages having the same angle of discharge, the partitions forming the sole support for said inner members, and a diaphragm which is carried by said inner member.

11. As an article of manufacture, a sheet metal nozzle plate having sides that are deflected from the plane of the body to form an anchoring device.

12. As an article of manufacture, a rectangular sheet metal nozzle plate, corrugated in the direction of its length to form anchoring means and L shaped in longitudinal section.

In witness whereof, I have hereunto set my hand this fifth day of February, 1907.

RICHARD H. RICE.

Witnesses:
JOHN A. McMANUS, Jr.,
HENRY O. WESTENDORP.