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O. JUNGGREN.

DIAPHRAGM AND NOZZLE CONSTRUCTION FOR TURBINES.

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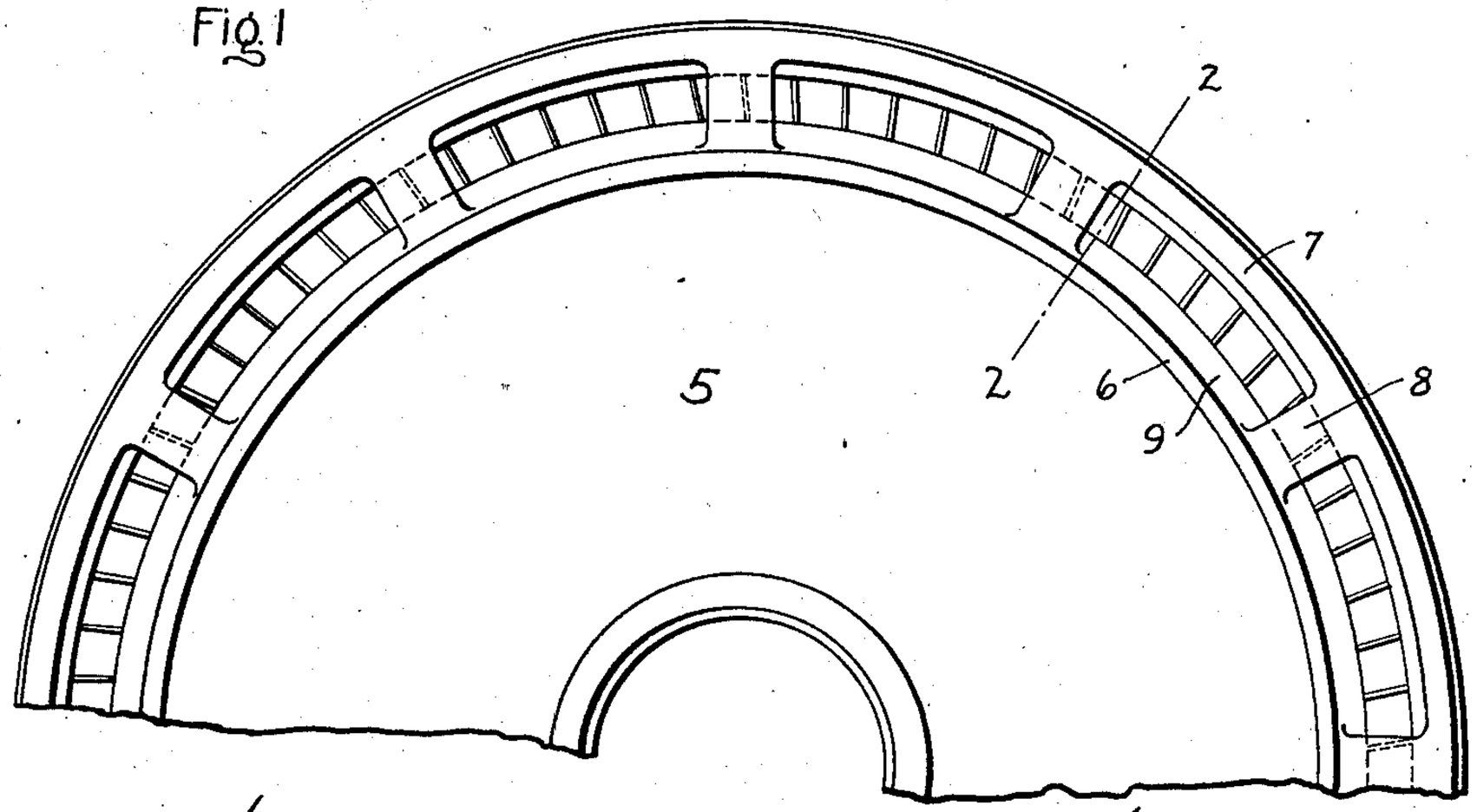
Fig. 1



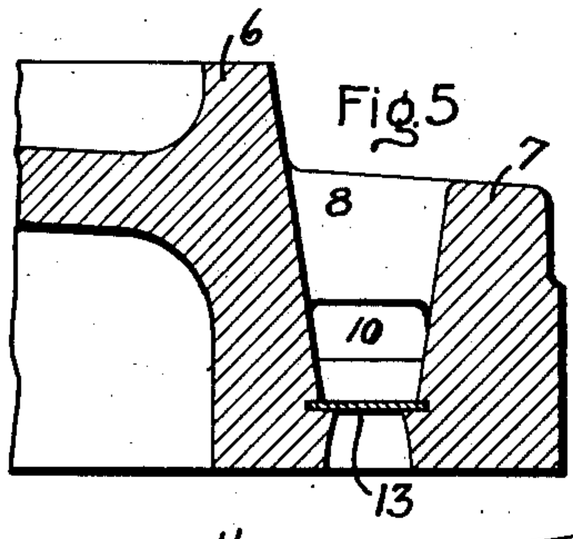


Fig. 5

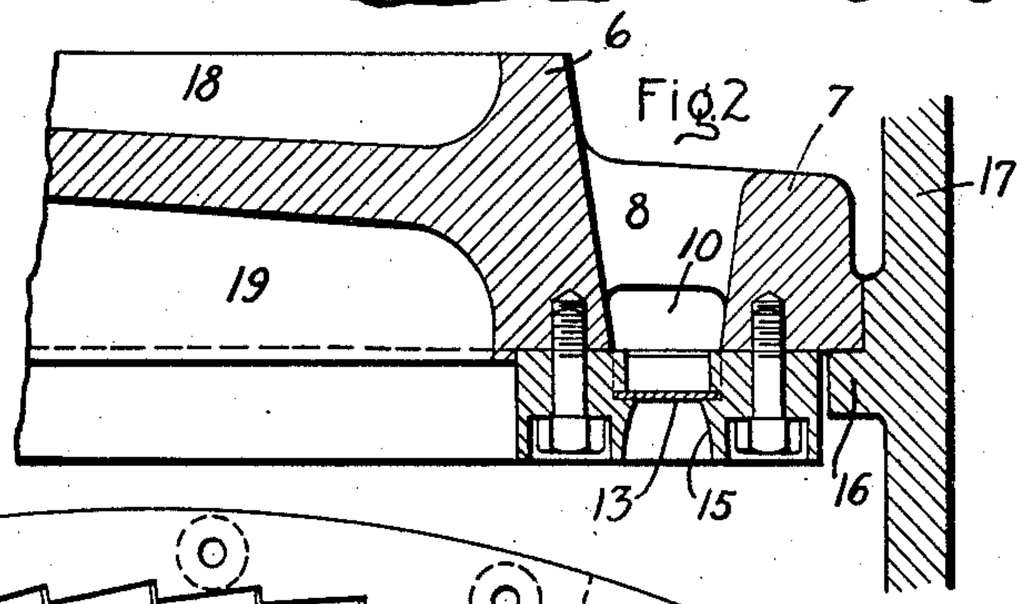


Fig. 2

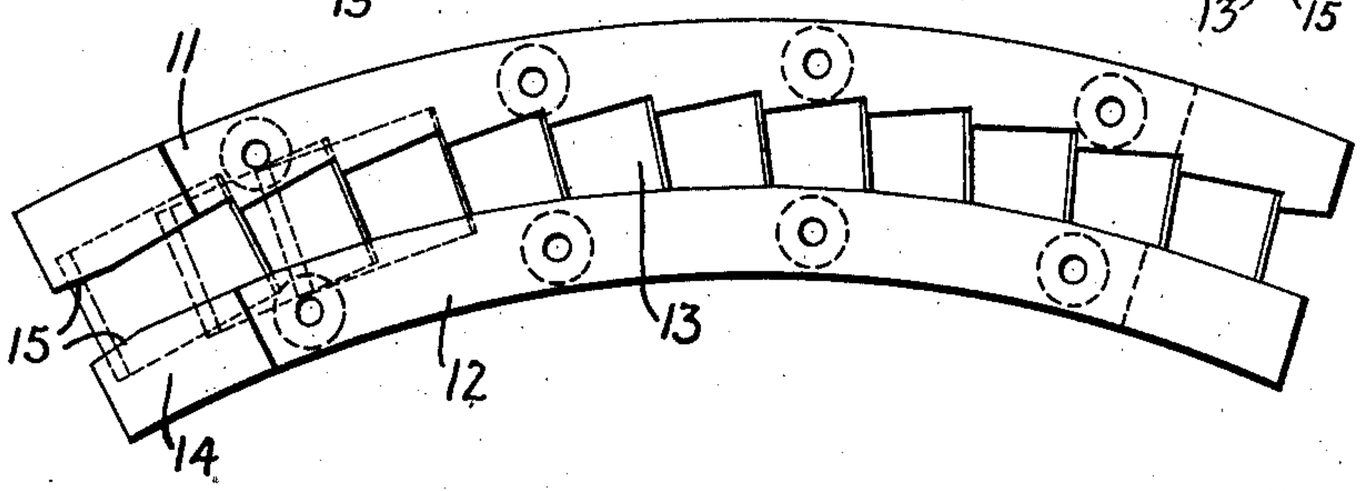
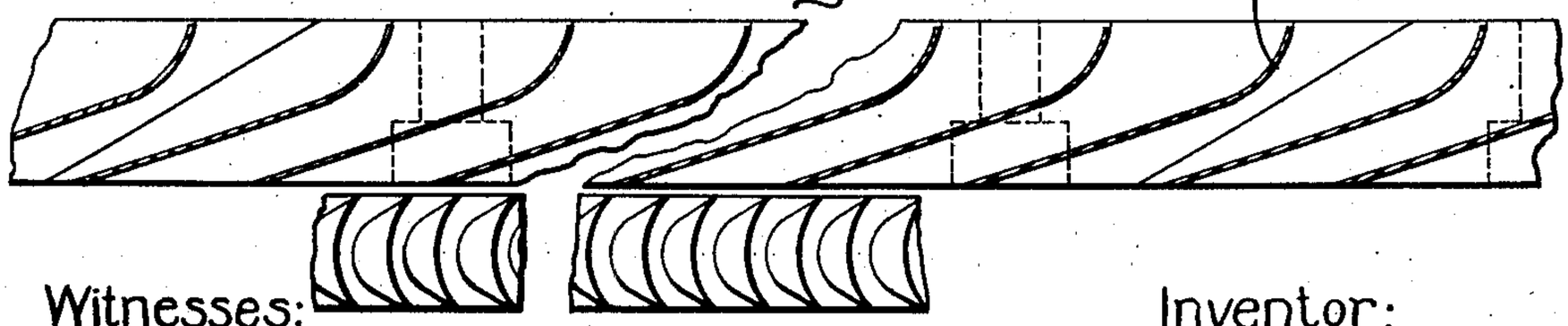


Fig. 3

Fig. 4



Witnesses:
Lloyd C. Buck
Alex. F. Macdonald.

Inventor:
Oscar Junggren
By Albert G. Davis
Atty.

UNITED STATES PATENT OFFICE.

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

DIAPHRAGM AND NOZZLE CONSTRUCTION FOR TURBINES.

No. 840,132. Specification of Letters Patent. Patented Jan. 1, 1907.

Application filed June 5, 1905. Serial No. 263,704.

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 Diaphragm and Nozzle Construction for Turbines, of which the following is a specification.

The present invention relates to the construction of diaphragms and nozzles for elastic-fluid turbines; and it is the object of my invention to improve their construction.

Difficulty is experienced in constructing diaphragms and nozzles for elastic-fluid turbines, and particularly those intended for use in the low-pressure stage or stages of the machine, where it is desirable to have the nozzles extend entirely around the circumference of the bucket wheel or wheels. This is largely due to the heavy pressures to which the diaphragm is subjected. Hence special precautions must be taken to provide a construction which will withstand such pressures and at the same time permit the use of a complete ring or range of nozzles.

In carrying out my invention the main body of the diaphragm, partition, or support is made of suitable diameter and thickness, and extending from the periphery or a point near the periphery are thick radial ribs like the spokes on a wheel. These ribs are connected at their outer ends by a heavy rim which is separated from the main body of the diaphragm by a chamber which is divided by the ribs into a number of segmental chambers which supply steam or other elastic fluid to the nozzles or nozzle-sections. Situated adjacent to or connecting with the inner ends of the radial ribs is or may be a circumferential web for strengthening the main body of the diaphragm. The exhaust side of the diaphragm is provided with a suitably-finished surface to receive the nozzle, and between this surface and the exhaust side of the radial ribs are passages which connect the adjacent segmental chambers. The object of these passages and chambers is to furnish a means whereby a complete range or ring of nozzles can be supplied with motive fluid and also to equalize the pressures to which the various nozzles or nozzle-sections are subjected.

Bolted or otherwise secured to the exhaust side of the diaphragm is a nozzle for supplying elastic fluid to the buckets, which is also of novel construction. The nozzle is made up of concentric rings which form a frame, and this frame is divided into sections having suitably-finished surfaces that engage with corresponding surfaces on the adjacent sections when the nozzle acts on a complete range of buckets. Each nozzle-section is provided with one or more thin partitions which extend radially, or substantially so, and are also inclined at an angle to the plane of the bucket-wheel, so that the fluid will leave the nozzle at the proper angle. The partitions may with advantage be made of sheet metal of uniform or substantially uniform thickness. They may be made and secured to the sections of the frame in any suitable way. I prefer, however, to cast them into the frame, since by so doing all loose pieces are avoided and the machine-work is reduced to a minimum, resulting in a simple and cheap construction which is easily made and replaced. By making the frame in sections if one of them is injured in casting or while in service it can readily be replaced and at a small expense. The nozzle-passages have the same angle of discharge, and the partitions are so thin that the motive fluid enters the buckets in the form of an unbroken cylindrical column.

Owing to the fact that the partitions are inclined to the plane of the wheel and also to the fact that the nozzle extends entirely around the diaphragm partition or support, the form and arrangement of the joint between the sections becomes an important feature. I prefer to make this joint with inclined abutting surfaces, and the plane of division is such that it is confined to a space between adjacent partitions. By means of this construction and arrangement the surfaces of the partitions are unbroken. Each section is a counterpart of every other and the machine-work is reduced to a minimum.

The nozzle may be of the expanding or non-expanding type, as desired. When non-expanding in character, the discharge portions of the partitions will occupy parallel positions, and the opposing walls of the frame will also be made parallel. When of the expanding character, the partitions may be parallel or slightly divergent in the direction of the exhaust and the opposed walls of the frame suitably arranged to give the desired

expansion. These arrangements can of course be suitably modified to suit the conditions of service.

Instead of making the nozzle in sections I can in certain cases make the nozzle in a single structure arranged to cover all of the wheel-buckets. The nozzles or nozzle-sections can in certain instances be arranged to cover less than the full number of wheel-buckets. This will be largely dependent upon the size of the turbine, the diameter of the bucket-wheel, and whether or not the parts are located in the high or in the low pressure stage or stages.

Instead of providing all of the frame-sections of the nozzles with partitions for directing and guiding the motive fluid some of the sections may be made blank—as, for example, where less than the full number of wheel-buckets are active in a given stage. In this case the beveled arrangement of the sections is preferably preserved, as are also the segmental chambers and equalizing and connecting passages adjacent to the active nozzles.

In the accompanying drawings, which illustrate one embodiment of my invention, Figure 1 is a partial plan view of the diaphragm of an elastic-fluid turbine of the jet type. Fig. 2 is a cross-section, on an enlarged scale, taken on the line 2 2 of Fig. 1. Fig. 3 is a plan view of a nozzle-section. Fig. 4 is a longitudinal section of a nozzle, and Fig. 5 is a sectional view of a slight modification wherein the diaphragm and nozzle are formed in a single structure.

5 represents the main body or web of the diaphragm, and 6 a circumferential rib located between the shaft-opening and the outer rim 7. This rib strengthens the diaphragm, acts to cut off the chambers between the shaft and the buckets, and also as a means to prevent the wheel and intermediate buckets from engaging, providing the clearance is less than the bucket clearances.

Extending radially from the web 5 and uniting the rim 7 with it are ribs 8, of which as many may be employed as are necessary to sustain the pressure to which the diaphragm is subjected. Situated between the ribs are segmental chambers 9, that admit steam or other elastic fluid to the nozzles. The segmental chambers are connected by passages 10, which supply steam or other elastic fluid to the nozzle-passages below them. The nozzle, which is bolted or otherwise secured to the exhaust side of the diaphragm, comprises two principal members 11 and 12. These members are curved in the arc of a circle and are separated by a space. This space is divided by thin sheet-metal partitions 13 with nozzle-passages. The ends of the nozzle-sections are beveled, as at 14, and are preferably, but not necessarily, provided with plane surfaces. The adjacent surfaces of adjoining sections should be correspondingly formed so as to make a fluid-tight joint between the sections. The sheet-metal partitions 13 are preferably cast into the members 11 and 12 of the nozzles and are of the general shape shown in dotted and full lines, Fig. 3, and in section, Fig. 4. In the present embodiment of the invention the nozzles have a slight expansion, which is obtained by causing the walls 15 of the nozzle members to diverge.

In Fig. 5 the diaphragm is constructed as before, with the exception that the nozzle-partitions 13 are cast into the main body thereof, and hence are not detachable. This construction possesses certain advantages in that the amount of machine-work is decreased and the chance for errors in alinement reduced to a minimum. The outer rim 7 is finished on the exhaust side and also on its periphery for a suitable portion thereof to insure a good joint with a shoulder 16 on the wheel-casing 17. The peripheral surface engages a finished surface in the casing, which serves to center it.

The nozzle or nozzle-sections discharge motive fluid against the wheel-buckets, and where the turbine is compounded by stages intermediate buckets are provided between adjacent rows of wheel-buckets. Since the diaphragm or partition is intended to divide a turbine into stages, 18 represents one stage-compartment and 19 the adjacent one of lower pressure. The machine may be provided with one, two, three, or more of these diaphragms, depending upon the requirements.

My invention is applicable to horizontal as well as vertical shaft turbines.

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 merely 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 an elastic-fluid turbine, the combination of a casing, a diaphragm or partition which divides the casing into wheel-compartments comprising a central portion, a surrounding rim separated therefrom by a space and connected by ribs, wheel-buckets, a fluid-discharging device comprising passages separated by thin partitions, which discharge motive fluid in an unbroken column to the wheel-buckets, and a chamber that extends under the ribs and receives motive fluid from a wheel-compartment and is in free communication with and supplies motive fluid to all of the nozzle-passages.

2. In an elastic-fluid turbine, the combina-

tion of a casing, wheel-buckets, an annular fluid-discharging device comprising a plurality of closely-associated discharge-passages separated by thin sheet-metal partitions, which discharge motive fluid in an unbroken cylindrical column to all of the wheel-buckets located adjacent thereto, and an annular chamber that receives fluid from a wheel-compartment and is in free communication with and supplies motive fluid to all of the nozzle-passages.

3. In a turbine, the combination of a support having outwardly-extending ribs, a rim surrounding the support and connecting the ribs, segmental chambers between the support and the rim, which are connected on one side of the ribs so as to supply all of the nozzle-passages, and nozzle-passages which receive motive fluid from the chambers and discharge it in an unbroken column against the wheel-buckets.

4. In a turbine, the combination of a support having outwardly-extending ribs, a rim surrounding the support and connecting the ribs, segmental chambers between the support and the rim, passages connecting the chambers for supplying one or more nozzle-passages adjacent to the ribs, and a nozzle structure containing passages which receive fluid from the chambers and passages.

5. In a turbine, the combination of a support having a circumferential strengthening-web, ribs extending outwardly from said support, a rim connecting the ribs and surrounding the support, chambers situated between the support and the rim for supplying fluid to the nozzle, passages connecting the chambers, and a nozzle structure attached to the support and provided with passages which receive fluid from the chambers and the passages.

6. In a nozzle for turbines, the combination of a frame divided into sections and having concentric walls separated by a space, one or more partitions which divide the space into fluid-discharge passages, and inclined abutting surfaces for the sections of the frame.

7. In a turbine, the combination of a support, a nozzle attached thereto comprising a structure curved in the arc of a circle and divided into sections, beveled abutting surfaces between the sections, and partitions carried by the nozzle which with the walls of said structure form fluid-discharging passages.

8. In a turbine, the combination of a support, a nozzle attached thereto comprising a structure curved in the arc of a circle and divided into abutting sections, partitions carried by the said structure which coöperate with the walls thereof to form fluid-discharging passages, the sections being so arranged that the plane of division between them is situated between two adjacent partitions, and means for securing the nozzle-sections to the support and holding the abutting surfaces in contact.

9. In an elastic-fluid turbine, the combination of a support having peripheral ribs thereon, a rim surrounding and connecting the ribs, segmental chambers situated between the ribs, passages extending across the ribs and connecting the chambers, and a nozzle attached to the support and in a position to receive fluid from the chambers and passages, comprising concentric members and transverse partitions, the said nozzle being divided into segmental sections, each section having an inclined surface which abuts on the adjacent sections.

10. As an article of manufacture, a nozzle-section comprising curved walls separated by a space, partitions which are attached to the walls and divide the space between them into fluid-discharging passages, and a finished beveled surface at one end of the section, which is adapted to coöperate with a similar surface on an adjacent section when assembled.

11. As an article of manufacture, a nozzle-section comprising curved walls separated by a space, thin sheet-metal partitions which are cast into the walls and coöperate therewith to form fluid-discharging passages, and finished abutting surfaces on the ends of the section which are adapted to coöperate with similar surfaces on adjacent sections, the said abutting surfaces being located between two partitions when the parts are assembled.

In witness whereof I have hereunto set my hand this 3d day of June, 1905.

OSCAR JUNGGREN.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.