Feb. 10, 1925. 1,525,804

J. H. DORAN

ELASTIC FLUID TURBINE

Filed Nov. 23, 1923

Fig. 1.

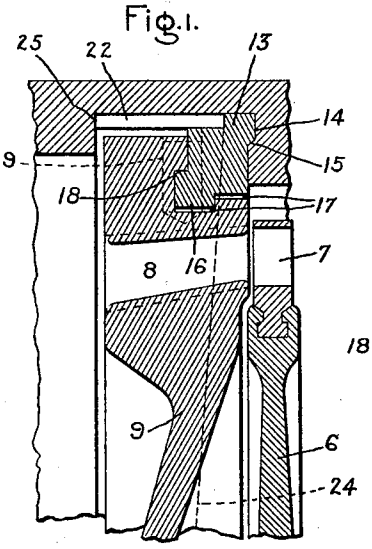


Fig. 3.

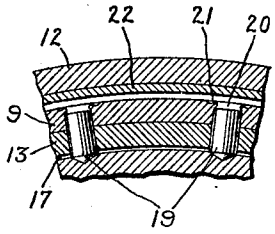


Fig. 4.

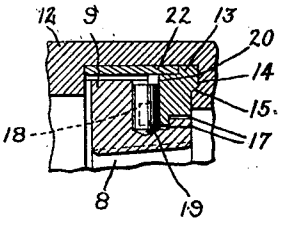


Fig. 2.

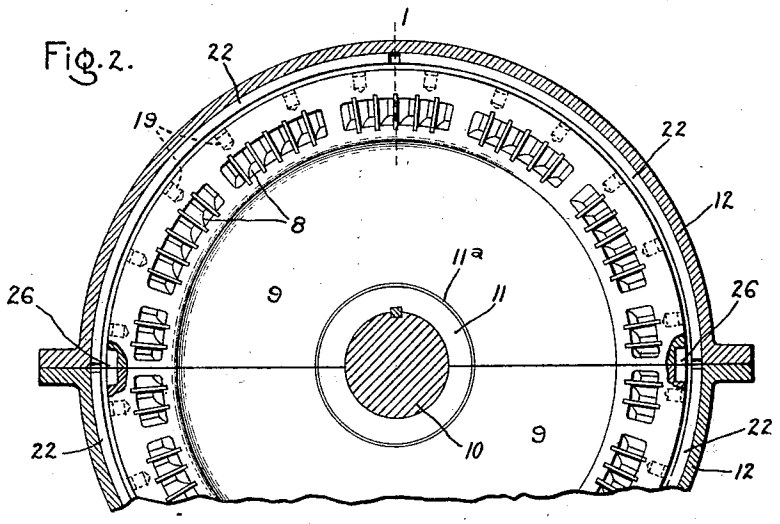
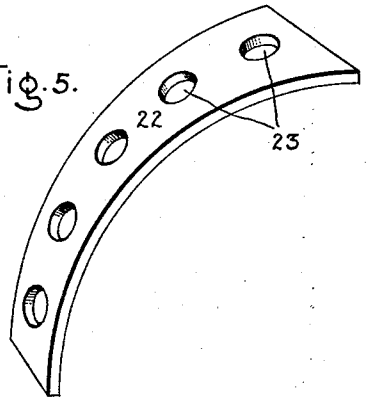


Fig. 5.



Inventor:
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His Attorney.

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UNITED STATES PATENT OFFICE.

JOHN H. DORAN, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELASTIC-FLUID TURBINE.

Application filed November 23, 1923. Serial No. 676,663.

To all whom it may concern:

Be it known that I, JOHN H. DORAN, a citizen of the United States, residing at Schenectady, in the 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 multi-stage elastic fluid turbines and specifically to the means for mounting the nozzle containing diaphragms in the casing of the turbine.

Owing to the fact that the diaphragms and casing do not expand and contract uniformly at the same time, that is to say, one expands or contracts before the other in starting up and shutting down, and to some extent under load variations, the problem of supporting them is a difficult one, and in particular it is difficult to provide an arrangement which will hold the diaphragm central with respect to the axis of the shaft at all times. Various attempts have been made to support diaphragms so as to avoid shaft packing troubles and casing injuries but to my knowledge no entirely satisfactory and simple means has been found heretofore.

My invention has for its object to improve the means for supporting nozzle diaphragms in multi-stage elastic fluid turbines to the end that they may freely expand and contract with respect to their casings without causing leakage between stages around their peripheral portions and at the same time maintain their concentric position or relation with respect to the various shaft packings.

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 attached drawing which illustrates one of the embodiments of my invention, Fig. 1 is a partial axial section of a nozzle diaphragm and its casing, taken on line 1—1 of Fig. 2; Fig. 2 is a partial cross section of a turbine; Figs. 3 and 4 are detail views, and Fig. 5 is a perspective view of a wedge.

6 indicates a wheel for a multi-stage impulse turbine of ordinary axial flow type having a peripheral row of buckets 7. Steam is discharged against the buckets by nozzles 8 which extend around the wheel and may be arranged in groups or otherwise as desired. The nozzles are carried by a diaphragm 9 which is made in halves, the plane of division being diametrical and horizontal. 10 indicates the shaft on which the wheels, of which only one is shown, are mounted. On the shaft is mounted a stage packing member 11 for each diaphragm which cooperates with a suitable packing member 11^a carried by the diaphragm. The particular type of packing is immaterial so long as it is effective to reduce leakage from one stage to another. This of course implies close clearances between the members. Surrounding the diaphragms and wheels is a casing 12 which is divided into an upper and lower part on a horizontal plane.

The inside of the casing is provided with a shoulder or support for each diaphragm. The shoulder is machined on one side to provide a pressure tight seat for the diaphragm supporting ring or intermediate holder 13. The seat instead of being flat over its entire surface is provided with an inset or recess 14, the outer wall of which may be flat or tapered and the inner wall 15 is beveled as shown so as to hold the ring in its central position. The ring is also made in halves and each half is worked into position by a partial rotary motion together with a half of the diaphragm when the casing is open. The inner portion or bore of the ring is provided with a shoulder 16 with the sides of which the diaphragm engages to form a support and also a pressure tight seat, it being noted that radial clearances 17 are provided so that the diaphragm can freely expand and contract independently of the casing in a radial direction. Without such clearances the diaphragm might in expanding crack the casing. The force due to expansion of the ring alone is not so great and hence can be held by the casing. The ring is also provided with an annular shoulder 18 on one side concentric with the shaft axis and on which the diaphragm is seated. The parts are shown in the positions which they occupy when cold. When the diaphragm heats more rapidly than the ring and casing it is free to move outwardly away from said shoulder, the clearances 17 permitting of this.

From the foregoing and from an inspection of the drawing it will be seen that the

intermediate ring or holder 13 is interlocked with the casing and that the diaphragm is interlocked with the ring, and further that the ring is seated pressure tight on the shoulder and the diaphragm pressure tight on the ring.

In order to make sure that the diaphragm will always retain its concentric position with respect to the shaft and especially in cooling so as to avoid injury to the packings, the intermediate holding ring 13 and the diaphragm are united by a relatively large number of radially disposed pins 19. These pins are located in holes or sockets 20 which are half in the diaphragm and half in the ring. The pins are permanently held in their sockets by any suitable means, as for example, by staking over or upsetting the walls as indicated at 21. By reason of the arrangement of these pins the diaphragm is unrestrained as regards expansion but when contraction occurs all parts thereof are constrained to move inwardly in radial planes, and therefore the diaphragm and its packing member are at all times maintained concentric with the axis of the machine. As a result of this small packing clearances can be maintained at all times. It will, of course, be apparent that the total enlargement of the diaphragm due to heat changes is relatively small and is greater for large diameters than small but where packing clearances are only a few thousandths of an inch a very slight displacement of one member from its true position will cause rubbing and wear of the parts and hence an enlargement of the clearance and greater leakage losses.

Due to the fact that the steam pressure on the left hand side of the diaphragm and ring is greater than on the wheel or discharge side and the fact that said ring is fitted in the casing against radial movement, the diaphragm when in service will be held in its proper position. As an additional securing means for the intermediate ring wedges 22 of the character shown in Fig. 5 are provided. These are tapered on one side, are relatively thin and are curved to conform to the inner wall of the casing. They are also provided with one or more holes 23 by which they can be pulled out with a suitable tool. In order that they may be effective for the purpose intended they should bear on relatively large surfaces. To this end the left hand face of the outer part of the intermediate holding ring 13 is beveled to correspond to the wedges. That is to say, the surface is similar to a portion of a large diameter screw thread as indicated by the dotted lines 24. When the wedges are driven home, which is accomplished by a partial rotary movement of the wedge, (the parts of the casing being open) the intermediate ring will be firmly held against its seat, the opposite side of each wedge engaging the abutment 25. Generally it will be found advisable to use four wedges for each diaphragm and to drive two into each half of the casing from its horizontal joint. To enable the wedges to be pulled out small pockets such as 26 are provided on each side the diaphragm at the horizontal joint so that a bar or hook may be inserted in the holes 23. These wedges also serve as means to prevent the diaphragm from turning within the casing.

Aside from the advantages mentioned above in connection with the operation of the turbine, apparatus constructed in accordance with my invention has the very substantial advantage that it can be easily manufactured. The interlocking parts of the diaphragm and ring are first machined to the proper dimensions after which one is slid over the other by relative rotary movement. The holes or sockets for the pins are then bored and the pins inserted in place. The two halves of the diaphragm are then mounted on a boring mill and the entire periphery turned to exact size. To state the matter another way, the pins 19 so unite the parts of each half ring and holder that they can be treated as a solid piece and hence much less difficulty in machining will be experienced than if the work had to be done separately. The fact that the pins are entirely inside of the casing and are not subjected to a difference of pressure means that there will be no leakage due to their use.

In accordance with the provisions of the patent statutes, I have described the principle 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 an elastic fluid turbine, the combination of a casing having an internal support, an intermediate holding ring which is seated pressure-tight on one side of the support, a diaphragm which is seated pressure-tight on one side of the ring, there being provision between the ring and diaphragm for relative movement in a direction perpendicular to the turbine axis, a packing element carried by the diaphragm, and radially extending means between the ring and diaphragm which preserve the concentric relation of the diaphragm and packing element with respect to the turbine axis at all times.

2. In an elastic fluid turbine, the combination of a casing having an internal support, an intermediate holding ring which is seated pressure-tight on one side of the support,

a diaphragm which is seated pressure-tight on the opposite side of the ring, means for holding the ring against turning, a packing element carried by the diaphragm, and radially disposed means which engage both the ring and diaphragm and preserve the concentric relation of the diaphragm and packing element with respect to the turbine axis at all times.

3. In an elastic fluid turbine, the combination of a divided cylindrical casing having an internal support, an intermediate divided ring carried by the support and held in fixed relation with respect to it and the casing, a nozzle-carrying member, a packing element carried by the member, and radially-extending means which engage both the ring and member and maintain the concentric relation of the member and packing with respect to the axis of the turbine at all times.

4. In an elastic fluid turbine, the combination of a divided cylindrical casing having an internal support, an intermediate divided ring which is carried by the support and is held thereon against movement, a divided nozzle-carrying member, a packing element carried by the member, interlocking means between the ring and member which permit the latter to freely expand and contract in a radial direction but hold the member against axial movement, and radial means which unite the ring and member and serve to maintain the concentric relation of the member and packing element with respect to the axis of the turbine at all times.

5. In an elastic fluid turbine, the combination of a casing having an internal support, an intermediate ring which is carried by the support and is held thereon against movement, a nozzle-carrying member, a packing element carried by the member, interlocking means between the ring and member which permit the latter to freely expand and contract in a radial direction but hold the member against axial movement, and a plurality of radial pins which unite the ring and member, said pins being located in sockets which are formed half in the ring and half in the member.

6. In an elastic fluid turbine, the combination of a cylindrical casing having an internal support, an intermediate ring which is carried by the support and is held thereon against movement, a nozzle-carrying member, a packing element carried by the member, interlocking means between the ring and member which permit the latter to freely expand and contract in a radial direction but hold the member against axial movement, radial means which unite the ring and member and serve to maintain the concentric relation of the member and packing element with respect to the axis of the turbine at all times, and means for preventing the ring and member from rotating within the casing.

7. In an elastic fluid turbine, the combination of a casing which is divided in a horizontal plane into two parts each of said parts having an internal shoulder, a two-part intermediate ring which is seated on the shoulder, a two-part nozzle-carrying member, the half portions of the member being carried by like portions of the ring, a divided packing element carried by said nozzle member, and radial pins which are located in sockets inside of the casing and unite each half ring with its cooperating member, one half of each socket being formed in the ring and the other half in the nozzle member.

8. In an elastic fluid turbine, the combination of a divided casing having an internal support, a divided ring which is seated on the support and has shoulders on one side, a divided diaphragm which has shoulders on one side which interlock with the ring, said shoulders holding the diaphragm against axial movement and permitting it to freely expand and contract in a radial direction, there being radial clearances between the ring and diaphragm, a packing element carried by the diaphragm, and radial pins which are located in sockets and unite the parts of the ring with the parts of the diaphragm.

9. In an elastic fluid turbine, the combination of a divided casing having an internal support, a divided intermediate ring which is seated pressure-tight on the support, a divided diaphragm which is seated pressure-tight on the ring, a packing element carried by the diaphragm, radial pins which unite the ring and diaphragm and preserve the concentric relation of the diaphragm and packing element with respect to the turbine axis, and wedges for holding the intermediate ring against the internal support.

In witness whereof, I have hereunto set my hand this 22nd day of November, 1923.

JOHN H. DORAN.