Aug. 18, 1931. D. J. BLOOMBERG 1,819,864

ELASTIC FLUID TURBINE

Filed March 24, 1930

Fig. 1.

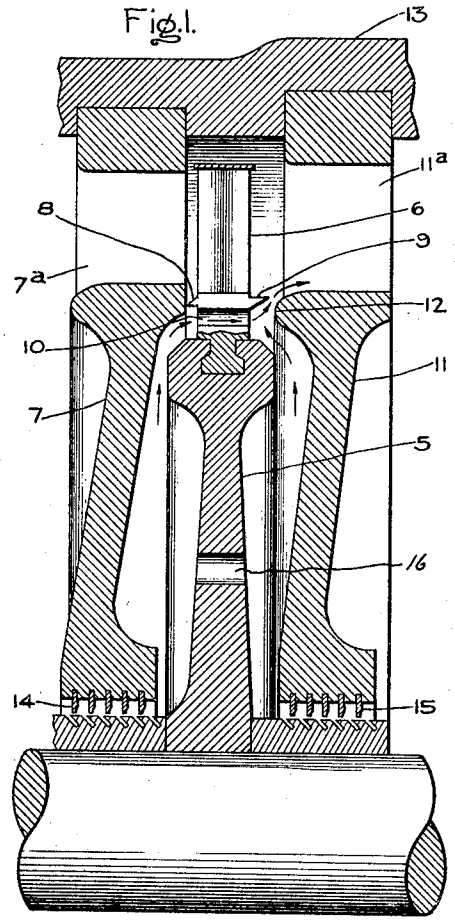



Fig. 3.

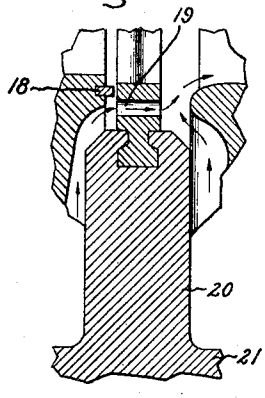
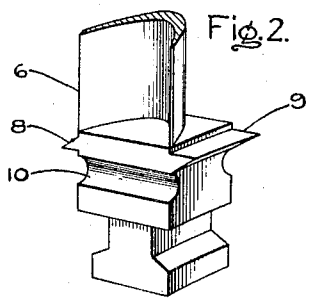



Fig. 2.




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# UNITED STATES PATENT OFFICE

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## ELASTIC FLUID TURBINE

Application filed March 24, 1930. Serial No. 438,311.

My invention relates to elastic fluid turbines and more particularly to elastic fluid turbines of the impulse type, which comprise a series of nozzle diaphragms which divide the turbine into stages and bucket wheels carried by the turbine shaft and located in the successive stages. In such turbines, as is well understood, the nozzles serve to direct the elastic fluid to the buckets of the successive stages.

In the operation of such turbines, leakage elastic fluid, such as that which leaks through the shaft packings, finds its way into the spaces between the diaphragms and the webs of the wheels, which leakage elastic fluid flows radially outward toward the main stream of elastic fluid passing through the nozzles and buckets. The velocity at which the leakage fluid strikes the main fluid flow is increased over its ordinary velocity by frictional contact with the fast moving bucket carrying wheel and, if permitted to flow directly into the main elastic fluid stream, causes disturbances and cross currents, thus tending to decrease the efficiency of the turbine.

The object of the present invention is to reduce to a minimum, or prevent altogether, losses due to the leakage elastic fluid impinging with the main stream and at the same time provide means whereby the leakage fluid is fed into the main stream on the discharge side of the buckets so as to take advantage of the energy stored in the leakage fluid.

In accordance with my invention, the working passages are shielded from all deleterious cross currents, and means are provided whereby the leakage elastic fluid is introduced into the working passage in a path substantially parallel to that of the main fluid flow so that no disturbances in the fluid flow will arise.

I prefer to shield the working passage by forming integral with the bucket bases, skirts on the inlet and outlet sides. By skirts, I means projections formed integral with the bucket bases. These skirts, cooperating with adjacent diaphragms, prevent cross currents from entering the working passage. Just below the skirt means are provided so that the leakage fluid may flow from the inlet side to the outlet side of the buckets. I prefer to cut grooves in the edges of the bucket bases to form this passageway, although it may be formed in other ways. Cooperating with the skirts on the outlet side of the bucket is the adjacent diaphragm which is curved so as to permit the easy entrance of the leakage fluid into the working passage.

For a more detailed description of my invention reference may be had to the drawings in which Fig. 1 is a section of a part of the turbine embodying my invention; Fig. 2 is a perspective view of a single turbine bucket showing a groove cut in its edge just below the skirts; and Fig. 3 is a detail view of a modification.

Referring to the drawings, a bucket carrying wheel is shown at 5, supporting buckets 6 between the diaphragms 7 and 11, the diaphragm nozzle partitions being indicated at $7^a$ and $11^a$. Protection of the working passage is afforded by means of skirts 8 and 9 formed integral with the bucket bases, the skirt 8 being on the inlet side and the skirt 9 being on the outlet side. By the working passage, I mean the passage wherein the fluid reacts on the curved working portions of the buckets.

The diaphragms 7 and 11 are secured to casing member 13 and at the lower ends of the diaphragms a usual form of shaft packing is shown at 14 and 15, and balancing holes for the wheel are shown at 16. A certain amount of elastic fluid will escape and flow into the space between the diaphragms. The pressure of the entering leakage fluid and the pumping action between the elastic fluid and the wheel 5 travelling at a high rate of speed, causes the leakage elastic fluid to flow to the outermost part of the wheel at a considerable velocity. The skirts formed on the buckets prevent these cross currents from impinging on the main fluid flow in the working passage and also prevent the undesirable disturbances which give rise to losses. The bucket efficiency is thus maintained higher than it would be without my invention. In order to permit the leakage

elastic fluid to flow from the inlet side to the outlet side, passages 10, or suitable ventilating openings are provided below the skirts. The outwardly travelling leakage elastic fluid is thus directed by the skirt 8 into the passages 10 and through the passages to the outlet side. The easy entrance of the leakage elastic fluid into the working passage is obtained by slightly rounding the entrance edge of diaphragm 11 as is shown at 12. The rounded edge of diaphragm 11 cooperates with the skirt 9 so that the leakage elastic fluid may enter the main stream substantially parallel thereto as illustrated.

Instead of forming the skirt 8 as a part of the bucket structure, I may form it as a part of the diaphragm structure, and this arrangement I have illustrated in Fig. 3, wherein the skirt is shown in the form of a strip 18 set in a groove in the diaphragm and serving to deflect the leakage elastic fluid to passages 19 which correspond to the passages 10 in Figs. 1 and 2. Otherwise, the structure may be the same as that shown in Figs. 1 and 2. However, in Fig. 3, a skirt corresponding to skirt 9 has been omitted as such a skirt may or may not be used as found desirable. In Fig. 3, the turbine wheel 20 is shown as being formed integral with the shaft 21 and the wheel is not provided with balancing holes. My invention has special utility in connection with a construction of this type, because with such a construction all the leakage steam must find its way from stage to stage by passing around the peripheral portion of the wheel since, due to the absence of balancing holes, none can escape through such holes.

By my invention the damaging cross currents may not cause disturbance in the working passage and at the same time all leakage elastic fluid reenters the main fluid flow on the outlet side of each row of buckets. The leakage elastic fluid enters the main stream substantially parallel to its line of flow and disturbances that occur are negligible.

While I have described the particular embodiment of my invention and certain apparatus for carrying it into effect it will be obvious to those skilled in the art that many modifications may be made without departing from my invention and I therefore aim in the appended claims to cover all such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In an elastic fluid turbine having alternate rows of stationary and movable fluid directing elements providing a working passage for the fluid, skirts formed integral with said elements to substantially shield the working passage from cross currents, means comprising ventilating openings whereby leakage fluid may flow from the inlet side of said movable fluid directing elements to the outlet side, and means permitting the leakage fluid to reenter the working passage substantially parallel thereto.

2. In an elastic fluid turbine, a structure comprising a diaphragm and a rotor having a row of buckets, said buckets having bases attached to the rotor and provided with passages, means forming a part of said structure for directing leakage elastic fluid to said passages, and means forming part of said structure permitting the leakage elastic fluid to reenter the working passage substantially parallel thereto.

3. In an elastic fluid turbine having stationary and movable fluid directing members providing a working passage for the elastic fluid, a skirt on one of said members projecting therefrom in a direction substantially parallel to the flow of the elastic fluid in the working passage, the free end of the skirt being in proximity to the adjacent side of the other member, a ventilating passage in the movable member adjacent said skirt, said skirt preventing leakage fluid from entering said working passage and directing it into the ventilating passage, and means at the outlet side of the ventilating passage for directing the leakage fluid into the working passage in a direction substantially parallel thereto.

4. In an elastic fluid turbine having stationary and movable fluid directing members providing a working passage for the elastic fluid, a skirt provided on one of said members and projecting therefrom in a direction substantially parallel to the flow of the elastic fluid in the working passage, the free end of the skirt being in proximity to the adjacent side of the other member, a ventilating passage in the movable member adjacent said skirt, said skirt preventing the flow of leakage fluid into the working passage and directing it into the ventilating passage, and means provided on said movable member at the outlet side of the ventilating passage for directing the leakage fluid into the working passages in a direction substantially parallel thereto.

5. In an elastic fluid turbine having stationary and movable fluid directing members providing a working passage for the elastic fluid, a skirt on one of said members projecting therefrom in a direction substantially parallel to the flow of the elastic fluid in the working passage, the free end of said skirt being in proximity to the adjacent side of the other member, a ventilating passage in the movable member, said skirt preventing the flow of leakage fluid into the working passage and directing it into the ventilating passage, and means provided on said movable member at the outlet side of the ventilating passage for directing the leakage fluid into the working passage in a direc-

tion substantially parallel thereto, said means comprising a skirt projecting from the movable member and provided with a face inclined in the direction of the flow of the elastic fluid in the working passage.

In witness whereof, I have hereunto set my hand this 21st day of March, 1930.

DAVID J. BLOOMBERG.