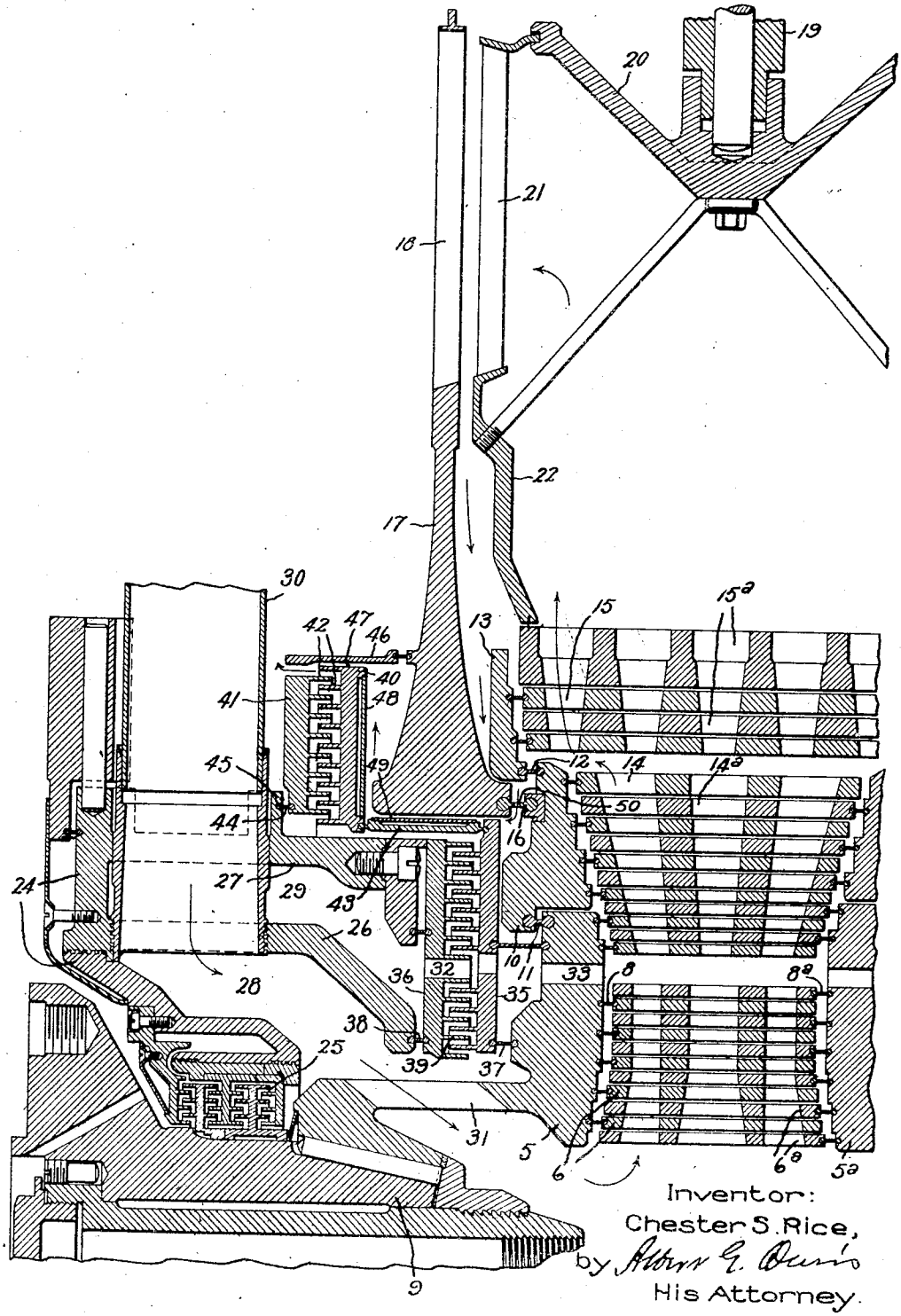
C. S. RICE.

ELASTIC FLUID TURBINE.

APPLICATION FILED SEPT. 8, 1919.

1,337,096.

Patented Apr. 13, 1920.



Inventor:
Chester S. Rice,
by Albert G. Davis
His Attorney.

UNITED STATES PATENT OFFICE.

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ELASTIC-FLUID TURBINE.

1,337,096. Specification of Letters Patent. Patented Apr. 13, 1920.

Application filed September 8, 1919. Serial No. 322,424.

To all whom it may concern:

Be it known that I, CHESTER S. RICE, 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 elastic fluid turbines and specifically to that type having a radial flow high pressure blade system, the parts of which revolve in opposite direction and also an axial flow low pressure blade system, the latter receiving steam from the former. In such a turbine the blades of the radial flow system are mounted on rotor elements and extend axially. The blades of the axial flow system are mounted on separate rotor elements, hereinafter referred to as wheels, which are attached to the inner elements and extend radially.

The wheels are heat-treated to render them very strong and tough and if, in operation, they are subjected to the action of high temperature steam, in such manner that a substantial increase in temperature results, their strength will be materially decreased. It is also important that the entire wheels be maintained at substantially the same temperature to prevent stresses being set up due to undue heating. The object of the present invention is to provide an improved structure and arrangement in a turbine of the character referred to wherein provision is made for effecting a flow of comparatively cool steam over the wheels so as to prevent undue heating of the same and maintain the entire wheels at a substantially constant temperature.

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 drawing the figure is a radial sectional view of a portion of an elastic fluid turbine embodying my invention. The drawing shows the left hand side of a turbine and a part of the right hand side and it will be understood that the two sides are alike, the right hand side being a duplicate of the left hand side.

Referring to the drawing, 5 and 5^a indicate inner rotating elements carrying rings of interleaving blades 6 and 6^a respectively, through which elastic fluid flows radially outward thereby causing elements 5 and 5^a to rotate in opposite directions. Blades 6 and 6^a are connected to elements 5 and 5^a by suitable expansion rings 8 and 8^a, this being now a known form of connection in this type of turbine. Inner rotating element 5 is carried by a stub shaft 9 which in turn is carried by a main shaft (not shown). Inner rotating element 5^a is carried by a similar stub shaft (not shown). In the description following I will describe the left hand side of the turbine only it being understood, as stated above, that the right hand side is a duplicate thereof. Surrounding inner rotating element 5 is an intermediate rotating element 10 fastened to element 5 by an expansion ring 11, and fastened to element 10 by an expansion ring 12 is an outer rotating element 13. Elements 10 and 13 carry axially extending blade rings 14 and 15 with which interleave blade rings 14^a and 15^a of the right hand side of the machine. Connected to intermediate element 10 by an expansion ring 16 is a wheel 17 which carries a ring of radially extending blades 18. Elements 5, 10 and 13 and wheel 17 with their attached rings of buckets form as a whole one rotor of the turbine. Fastened to the surrounding casing wall 19 is a holder 20 which carries a ring of nozzles 21 for directing elastic fluid to blade ring 18 and depending from nozzle ring 21 is an annular wall 22 which defines a passage for directing elastic fluid exhausting from the radial flow blade system to nozzles 21.

The adjacent stationary side wall of the turbine casing is indicated at 24 and between it and stub shaft 9 is a suitable shaft packing 25 to prevent leakage between the shaft and the casing. Projecting from side wall 24 are two concentric annular walls 26 and 27 which define steam chambers 28 and 29. Elastic fluid is admitted to chamber 28 through a supply conduit 30 and from chamber 28 it passes through openings 31 to the radial flow blade system. Chamber 29 may be supplied with elastic fluid from chamber 28 through suitable valves (not shown) and from chamber 29 elastic fluid is supplied through passages 32 and 33 to an intermediate point in the radial flow blade system. The admission of elastic fluid to an intermediate point in the turbine is for the purpose of getting increased power from

the machine as is well understood. Between the rotor and the adjacent casing wall is arranged a packing and axial balancing means comprising an inner portion which is located in the bore of wheel 17 and an outer portion which is located alongside wheel 17. The inner portion comprises disks 35 and 36 connected to inner rotating element 5 and walls 26 and 27 respectively by suitable expansion rings 37 and 38. Between disks 35 and 36 are interleaving packing rings 39 which are carried by such disks. The outer portion comprises disks 40 and 41 between which are interleaving packing rings 42. Disk 40 is carried from disk 35 by a long expansion ring 43, which also forms a guard ring to prevent elastic fluid which leaks through packing 39 from coming into direct contact with wheel 17. Disk 41 is carried by an expansion ring 44 connected to an annular projection 45 on wall 27. Carried by wheel 17 is a ring 46 which closely surrounds the periphery of disks 40 and 41 there being an annular space 47 between them. The elastic fluid leaking through between disks 35 and 36 and disks 40 and 41 will have a comparatively high temperature and to better protect wheel 17 therefrom disk 40 and expansion ring 43 on their sides next wheel 17 are provided with shields 48 and 49. In expansion ring 16 which connects wheel 17 to rotating member 10 are a suitable number of spaced openings 50, and as will be clear, these openings connect the space adjacent the inner side of wheel 17 to the exhaust portion of the turbine casing by way of the annular space between the bore of wheel 17 and expansion ring 43, the space between the outer side of wheel 17 and disk 40 and the space 47 between ring 46 and the peripheries of disks 40 and 41.

The operation of a turbine as shown is well understood, elastic fluid flowing first through the radial flow portion of the machine and then dividing and flowing through the two axial flow portions each of which comprises a ring of nozzles 21 and a wheel 17.

When the turbine is operating elastic fluid leaks through the packing means between disks 35 and 36 and disks 40 and 41 and issues in an annular stream at the periphery of the disks through the space between the periphery of disk 41 and the outer edge of ring 46. The space is suitably shaped so as to create a suction on annular space 47, the action being similar to that of an ejector. As a result, the issuing of elastic fluid from the space between the periphery of disk 41 and the outer edge of ring 46 creates a suction which draws elastic fluid from between nozzles 21 and buckets 18 down along the inner surface of wheel 17 through openings 50 in expansion ring 16, thence through the space between the bore of wheel 17 and expansion ring 43, thence up along the outer surface of wheel 17 as far as ring 46 and out through space 47 to the exhaust shell of the turbine. It will thus be seen that I utilize the leakage of elastic fluid from the packing between the balancing disks to create a suction for drawing cooling fluid over wheel 17. It will also be noted that I utilize as cooling fluid, the motive fluid after it has passed through nozzles 21 and has, therefore, been expanded down to the lowest pressure and temperature which it reaches before passing to the exhaust shell of the turbine. I thus provide a most efficient and economical cooling means for the impulse wheel, and one which maintains the entire wheel at substantially the same temperature since the cooling fluid is of the same temperature as that passing through the buckets of the wheel. In other words, the bore of the wheel is subjected to fluid of substantially the same temperature as that to which the rim of the wheel is subjected.

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 may 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 having a rotor comprising a member having axially extending bucket rings thereon and a wheel carried by said member and having radially extending buckets thereon, means defining a path for conducting elastic fluid from adjacent the entrance side of said radially extending buckets inwardly along the inner surface of the wheel and thence through the bore thereof.

2. In an elastic fluid turbine having a rotor comprising two members connected to each other and carrying bucket elements, one of said members being located to one side of the other and having an enlarged bore, means defining a path for conducting elastic fluid for cooling inwardly along the inner surface of said one member and thence through the bore thereof.

3. In an elastic fluid turbine having a rotor comprising two members connected to each other and carrying bucket elements, one of said members being located to one side of the other and having an enlarged bore, and balancing disk means located in said bore, means defining a path for conducting elastic fluid inwardly along the inner surface of said one member and thence through the bore thereof, the elastic fluid being drawn along such path by the ejector action

of elastic fluid leaking from said balancing disk means.

4. In an elastic fluid turbine having a rotor comprising an inner radial flow portion and an outer axial flow portion, and balancing disks, means actuated by the issuing of elastic fluid from said balancing disks for causing cooling medium to flow over the inner surface of the outer axial flow portion of the rotor.

5. In an elastic fluid turbine, the combination of oppositely rotating elements having interleaving blades, a bladed wheel having an enlarged bore connected to each element, a pair of balancing disks for each element, and means defining a passage along a surface of each wheel and thence through its bore, through which passage fluid for cooling the wheel is drawn by the elastic fluid leaking from said balancing disks.

6. In an elastic fluid turbine, the combination of oppositely rotating elements having interleaving blades, a bladed wheel having an enlarged bore connected to each element, a pair of balancing disks for each element located in the bore of its wheel, and means defining a passage along the inner surface of each wheel and thence through its bore, through which passage fluid for cooling the wheel is drawn by the elastic fluid leaking from said balancing disks.

7. In an elastic fluid turbine, the combination of oppositely rotating elements having interleaving blades, a bladed wheel having an enlarged bore connected to each element, balancing disk means each comprising an inner portion located in said bore and an outer portion located at a side of said wheel, and means defining a passage along the inner surface of the wheel, thence through its bore and thence along the outer surface of the wheel between it and the outer portion of said balancing disk means through which elastic fluid flows to cool the wheel.

8. In an elastic fluid turbine, the combination of oppositely rotating elements having interleaving blades, a bladed wheel having an enlarged bore connected to each element, balancing disk means each comprising an inner portion located in said bore and an outer portion located at a side of said wheel, means defining a passage along the inner surface of the wheel, thence through its bore and thence along the outer surface of the wheel between it and the outer portion of said balancing disk means through which elastic fluid flows to cool the wheel, the elastic fluid being propelled through said passage by the action of elastic fluid leaking from said balancing disk means.

9. In an elastic fluid turbine having a rotor element and a packing means, the combination of means defining a passage along a side wall of said rotor element, and means actuated by elastic fluid issuing from said packing means for causing cooling medium to circulate through said passage to cool the rotor.

10. In an elastic fluid turbine comprising a rotor element having a bore and a packing means, the combination of means defining a passage along a side wall of said rotor element, and means actuated by elastic fluid issuing from said packing means for causing cooling medium to circulate through said passage and the bore of the rotor element.

11. The combination with an elastic fluid turbine having a rotor provided with a ring of blades, of means forming an ejector for causing elastic fluid to flow from adjacent the admission side of said blades over the rotor to cool it.

12. The combination with an elastic fluid turbine having a rotor provided with a ring of blades, said rotor having a bore, of means for causing elastic fluid to flow from adjacent the admission side of said blades over the surface of said rotor and thence through said bore to cool the rotor.

In witness whereof, I have hereunto set my hand this 6th day of September, 1919.

CHESTER S. RICE.