W. E. RICHARDSON & A. WEST.

ELASTIC FLUID TURBINE.

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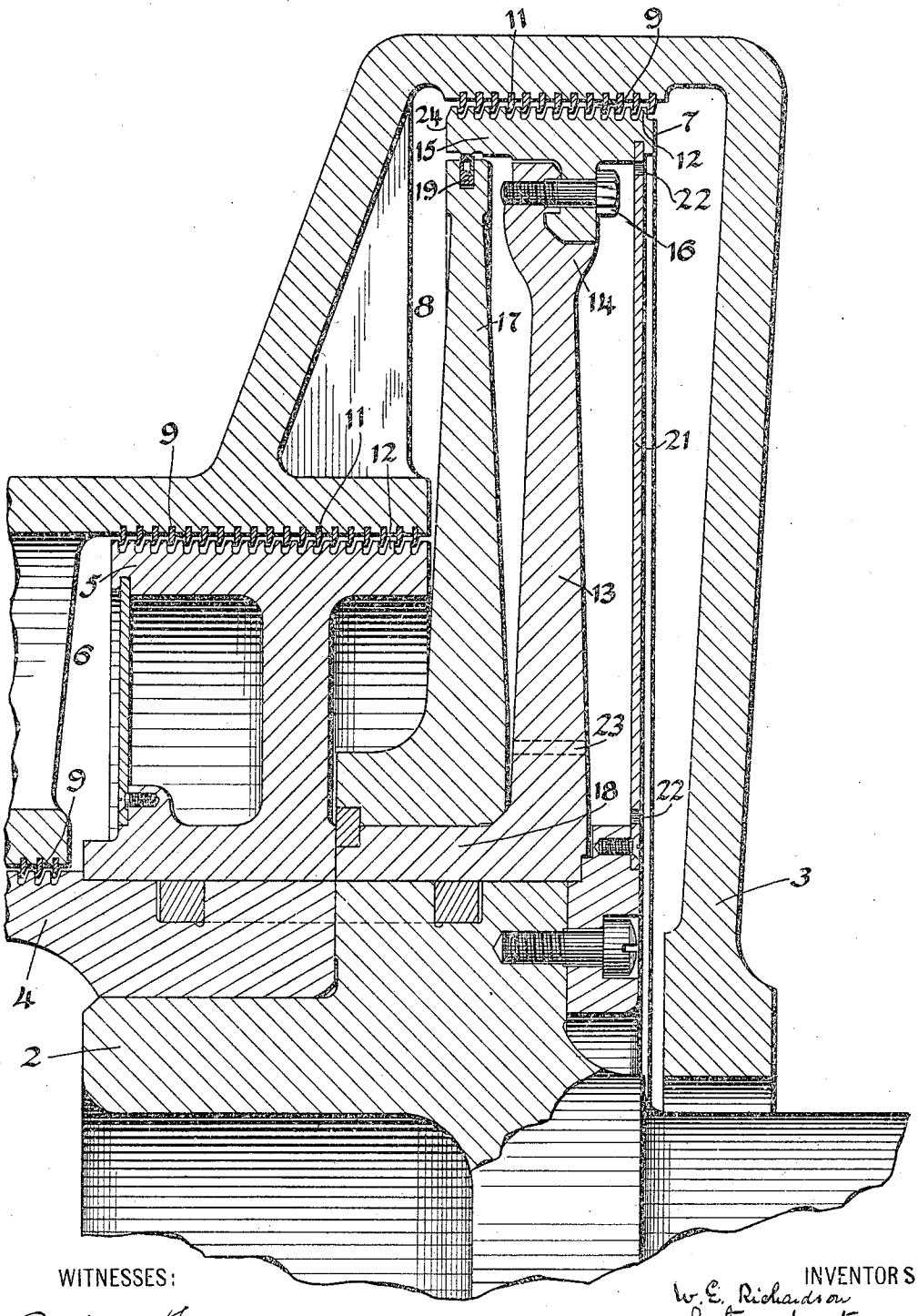
949,440. Patented Feb. 15, 1910.



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ELASTIC-FLUID TURBINE.

949,440. Specification of Letters Patent. Patented Feb. 15, 1910.

Application filed March 1, 1906. Serial No. 303,689.

To all whom it may concern:

Be it known that we, WILBER E. RICHARDSON and ARTHUR WEST, citizens of the United States, and residents, respectively, of Wilkinsburg and Pittsburg, in the county of Allegheny and State of Pennsylvania, have made a new and useful Invention in Elastic-Fluid Turbines, of which the following is a specification.

This invention relates to elastic fluid turbines and more particularly to rotors for such turbines.

In elastic fluid turbines, in which it is necessary to counterbalance the axial or longitudinal thrust by a system of balance pistons or drums and fluid chambers and passages, it is necessary to provide some form of packing between the peripheral faces of the balance pistons and the interior faces of the inclosing casing of the turbine to maintain the proper fluid pressure within the balance passages and chambers. A form of packing known as "labyrinth packing" is ordinarily utilized and comprises a number of annular rings mounted on the interior of the turbine casing and interleaving with a number of annular projections formed on the peripheral surfaces of the rotor element. The interleaving elements of packing do not contact but the flow of motive fluid between them is restricted and checked by limiting the lateral clearances between the individual rings and annular projections. With such a construction it is necessary to maintain accurate longitudinal adjustment of the rotor, and consequently distorting strains or stresses that tend to distort or move the rotor elements, and especially the balance pistons, longitudinally will destroy the fine lateral clearances between the interleaving rims and render the packing ineffective, or will cause the rotor elements of the turbine to collide with the stationary and inclosing casing. The distortions of the rotor elements are due either to lateral fluid pressure, radial stresses, occasioned by the centrifugal force, or inherent strains caused by unequal temperature distribution, or to a combination of the above mentioned causes.

The object of this invention is the production of a rotor for an elastic fluid turbine in which effective means are utilized for overcoming the distorting strains encountered by the rotor elements.

A further object is the production of a balance piston for turbine rotors in which effective means are utilized for overcoming the objectionable results of the distorting strains encountered and which may be utilized as a working drum or blade-carrying piston.

These and other objects we attain in a turbine embodying the features herein described and illustrated.

The single sheet drawing accompanying this application and forming a part thereof is a partial longitudinal section of a turbine; and while we have illustrated our invention as embodied in a balance piston of a turbine rotor, we desire to be understood that we do not wish to limit ourselves to the particular construction shown, or to the peculiar purposes herein set forth.

A turbine spindle 2 is suitably journaled and is inclosed within a stationary casing 3 of the turbine and is provided, at one end, with suitable working drums, not shown, and, at the other, with a high-pressure balance piston 4 inclosed within an annular pressure chamber, not shown, an intermediate balance piston 5 inclosed within an annular pressure chamber 6, formed between the turbine casing 3 and the rotor, and a low-pressure balance piston 7, located in an annular pressure chamber 8, formed between the casing of the turbine and the rotor. Labyrinth packings 9, which consist of a series of rings 11 mounted on the casing 3, and interleaving with a series of annular projections 12, formed on the outer peripheral faces of the balance pistons, are located between the high, intermediate, and low-pressure chambers. The packings are so arranged that the lateral clearances between the individual rotor and stator elements are very small and the flow of motive fluid therethrough is checked by the tortuous passage presented to the motive fluid.

The small clearances necessary to render the packing effective are maintained with little difficulty in the high and intermediate balance pistons; the low-pressure piston, however, because of its greater diameter, is a source of trouble and when constructed to

resist the radial stresses, due to centrifugal force, it will, unless massive and heavy, distort laterally, due to the longitudinal fluid pressure; and when constructed to resist the lateral fluid pressure, it will tend to distort when subjected to the radial stresses occasioned by the centrifugal force. The low-pressure dummy or balance piston herein illustrated consists of a disk 13, mounted on the spindle 2 and provided at its periphery with a suitable mounting flange 14 on which a rim 15, formed integrally or in sections, is mounted by suitable bolts 16. The outer peripheral face of the rim 15 is provided with the annular projections 12 comprising the rotary element of the labyrinth packings 9. A disk 17 is mounted on a laterally-extending hub portion 18 of the disk 13 and is provided at its outer periphery with suitable packing 19, which seals the joint between it and the inner peripheral surface of the rim 15. A disk 21, mounted on the rim portion 15 and the spindle 2 adjacent to the disk 13, are provided with a suitable number of openings 22 arranged to admit fluid pressure into the interior of the drum 7 or into the chamber formed by the disk 17, the rim 15 and the disk 21. Openings 23 are provided in the disk 13 and are of sufficient area to insure an equal distribution of the fluid pressure on either side of the disk, so that the temperature encountered throughout the low-pressure balancing element will be uniform.

The radial strains occasioned by the centrifugal force are resisted by the disk 13 and under such conditions tend to cause no distortion other than a slight radial expansion. The lateral fluid pressure of the chamber 8 is transmitted to the spindle 2, of the turbine rotor, by the disk 17. The forward face 24 of the rim 15 is also subjected to the fluid pressure of the chamber 8, but as the exposed area is relatively small, the disk 13 may be designed to resist the resultant lateral thrust without changing its shape or materially increasing its weight. The tendency of the balancing piston to laterally distort and render the labyrinth packing ineffective, or to cause serious difficulties by colliding with the stationary casing, is overcome since the lateral thrust of the balancing fluid pressure is borne almost entirely by the disk 17, which is so arranged that a lateral distortion will not be objectionable as it will in no way effect the operation of the turbine. With this construction a compact and efficient rotor element is obtained which is easily machined and assembled, and in which the inherent strains, due to unequal expansion, are overcome by equalizing the temperature throughout the rotor element and by dividing it into separate parts.

A similar construction may also be used in the working and balancing drums of the high and intermediate pressure stages and various other arrangements may be utilized and still fall within the limits and spirit of this invention.

What we claim is:

1. In combination with an elastic fluid turbine, a rotor element comprising an agent adapted to resist centrifugal strains and an agent adapted to receive lateral distorting strains.

2. In combination with an elastic fluid turbine, a rotor element comprising a radial disk adapted to resist centrifugal stresses and a disk coöperating therewith to relieve said radial disk of lateral-pressure strains.

3. In combination with an elastic fluid turbine, a rotor element comprising an agent adapted to resist centrifugal stresses and means coöperating therewith to relieve said agent of lateral or longitudinal stresses.

4. In combination with an elastic fluid turbine, a rotor element comprising an agent adapted to resist centrifugal radial stresses and an agent adapted to resist lateral fluid pressure, a packing between said agents adapted to permit of relative lateral motion.

5. In combination with an elastic fluid turbine, a rotor element comprising an agent mounted on the spindle of said turbine, a wheel mounted adjacent to said agent and adapted to relieve said agent of lateral fluid pressure and means for permitting relative motion between said agent and said wheel.

6. In combination with an elastic fluid turbine, a rotor element comprising a wheel mounted on the spindle of said turbine, provided with a removably-mounted rim portion, a disk mounted adjacent to said wheel between which and said rim portion a packing is maintained.

7. In combination with an elastic fluid turbine, a rotor element comprising a wheel mounted on the spindle of said turbine, provided with a removably-mounted and divided rim portion, a disk mounted adjacent to said wheel, a packing strip between said rim portion and said disk and means for circulating motive fluid around said wheel between said disk and said rim portion.

8. In combination with an elastic fluid turbine, a wheel mounted on the spindle of said turbine, a divided rim portion mounted on said wheel, a disk rigidly connected to said rim portion, a second disk adjacent to said wheel, a packing between said second disk and said rim portion adapted to permit of relative motion and means for circulating motive fluid between said disks and around said wheel.

9. In combination with an elastic fluid turbine, a rotor comprising a wheel provided with a laterally-extending rim portion, a disk mounted adjacent to said wheel, forming a fluid-tight fit with said rim portion,

and means for permitting relative motion between said rim portion and said disk and maintaining said fluid-tight fit.

10. In combination in an elastic fluid turbine, a rotor element comprising a wheel rigidly mounted on the spindle of the turbine, a disk rigidly mounted adjacent thereto, and means for permitting relative motion between the periphery of said disk and said wheel and for maintaining a fluid tight fit between said periphery and said wheel.

In testimony whereof, we have hereunto subscribed our names this 28th day of February, 1906.

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ARTHUR WEST.

Witnesses:
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JNO. S. GREEN.