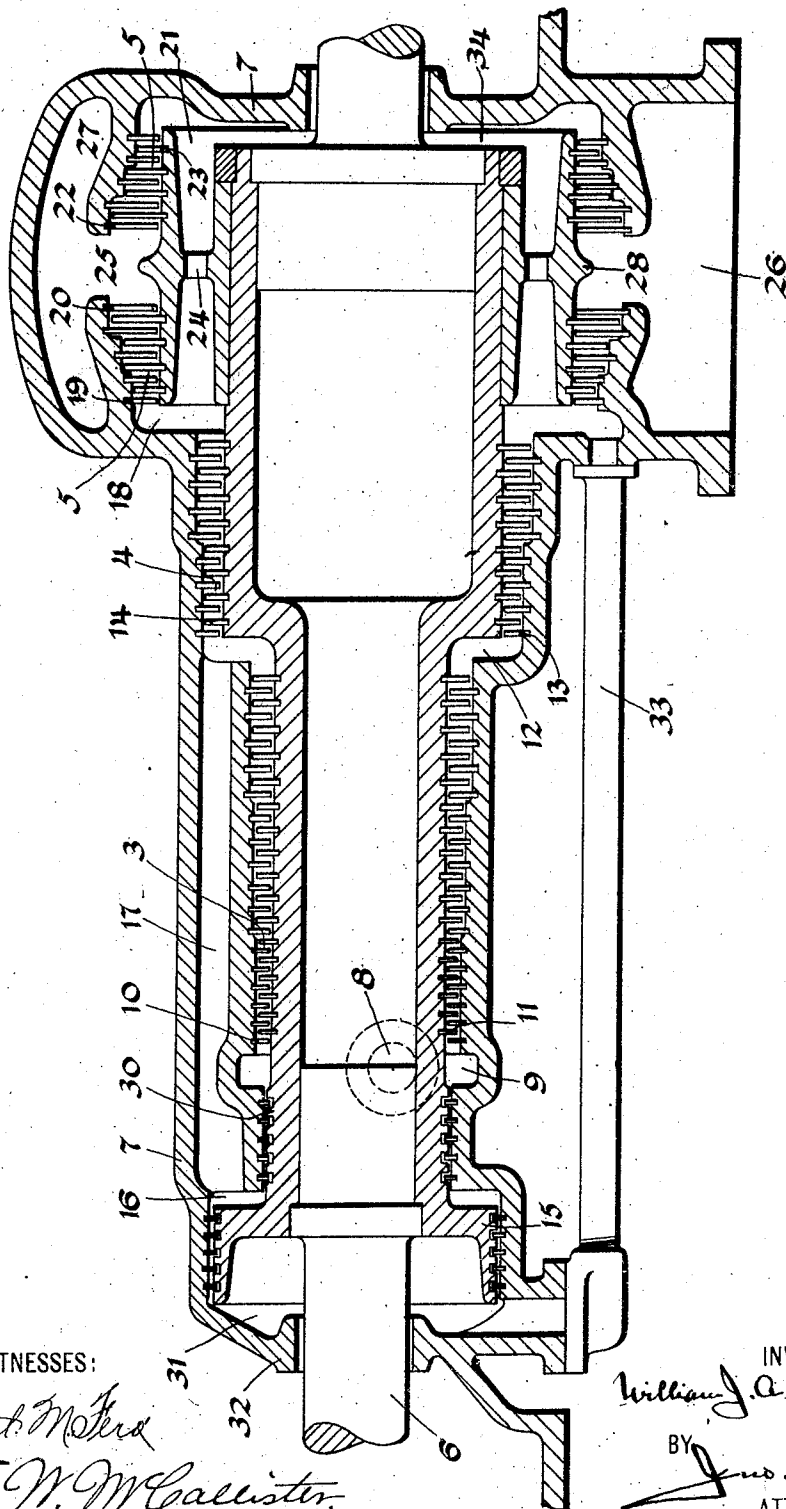


W. J. A. LONDON.
ELASTIC FLUID TURBINE.
APPLICATION FILED MAR. 6, 1906.

1,061,856.

Patented May 13, 1913.



WITNESSES:

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ELASTIC-FLUID TURBINE.

1,061,856.

Specification of Letters Patent.

Patented May 13, 1913.

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To all whom it may concern:

Be it known that I, WILLIAM JAMES ALBERT LONDON, a subject of the King of England, residing at Trafford Park, Manchester, England, have invented new and useful Improvements in Elastic-Fluid Turbines, of which the following is a specification.

This invention relates to elastic fluid turbines and more particularly to balancing means therefor.

In elastic fluid turbines of the axial flow and multi-cellular type considerable longitudinal or axial thrust of the rotor element is encountered, due to the longitudinal pressure of the elastic fluid on the working surfaces of the rotor. Considerable difficulty and expense is encountered in constructing balancing dummies or pistons for the rotor and providing a system of fluid chambers or passages which, in conjunction with the dummies, are arranged to counterbalance the longitudinal thrust of the working parts of the rotor by an equal and opposite thrust of the balancing dummies or pistons.

The object of this invention is the production of an elastic fluid turbine in which effective means are obtained, by proportioning the exposed areas of the working parts and judiciously circulating elastic fluid, for balancing the longitudinal thrust of one working part of the rotor element by an equal and opposite thrust of another working part.

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

According to my invention, the turbine is divided into high and low pressure stages. The blading of the high-pressure stage is mounted on drums or equivalent members in the usual manner; the blading and the fluid passages of the low-pressure stage are, however, so arranged that the fluid exhausted from the high-pressure or initial stage and entering the low-pressure stage is divided into two parts and the separate parts are caused to flow in opposite directions while traversing the low-pressure stage. The fluid passages are so arranged that the axial or longitudinal thrust exerted on the rotor by one part of the fluid in the low-pressure stage is balanced by an oppos-

ing axial thrust exerted by the other part of the fluid in the low-pressure stage.

The drawing accompanying this application and forming a part thereof is a longitudinal section of a turbine embodying my invention.

Referring to the drawing: A turbine rotor, provided with an initial or high-pressure stage 3, an intermediate stage 4 and a final or low-pressure stage 5, is mounted on suitable shafts 6, which are journaled in suitably located standards or bearings not shown. A casing 7, divided on the horizontal plan through its axis, as is now common, surrounds the rotor and has its inner surface so formed that fluid passages of the proper area and extent are provided between it and the turbine rotor.

A motive fluid admission port 8 communicates with an annular passage 9, formed in the casing, which communicates with the initial or high-pressure stage 3 of the turbine. The initial stage comprises alternate rows of directing vanes 10, mounted on the casing, and working blades 11, mounted on the rotor. The blades and vanes are so formed and are so spaced that the fluid in passing therethrough will be fractionally expanded and the resulting kinetic energy of the fluid imparted to the moving blades by impulse and reaction.

The motive fluid discharged from the initial stage 3 enters an annular passage 12 which communicates with the intermediate stage 4. The intermediate stage comprises alternate rows of stationary vanes 13, mounted on the casing, and moving blades 14, mounted on the rotor, which are adapted, as in the initial stage, to fractionally expand the fluid and extract the available energy therefrom by impulse and reaction.

The working drum of the intermediate stage is of larger diameter than the drum of the initial stage and the rotor is, therefore, provided with a balancing piston which is located adjacent to and exposed to the pressure within a chamber 16 formed between the rotor and the stationary casing. The chamber 16 communicates with the passage 12 through a passage 17 and the arrangement is such, that the motive fluid conditioned from the passage

12 will exert a longitudinal thrust on the exposed face of the piston 15 equal and opposite to the axial thrust exerted by the fluid in the passage 12.

5 The motive fluid discharged from the intermediate stage enters an annular passage 18 from which it is let into the final or low-pressure stage 5. The low-pressure stage is divided into two sections, comprising a series of stationary vanes 19, mounted on the casing, and rotating blades 20, mounted on a drum 21, which communicate directly with the passage 18 and a series of vanes 22 and blades 23, which communicate with the passage 18 through a suitable passage 24 arranged in the web portion of the drum 21.

Each section of the final or low-pressure stage is arranged to fractionally expand the motive fluid and abstract the available energy by impact and reaction and the fluid entering the individual sections at opposite ends of the drum is caused to flow in opposite directions while traversing the working passages of each section. Both sections of the low-pressure stage communicate with a passage 25, which communicates with an exhaust port 26, with which the casing 7 is provided, through an annular chamber 27. The drum 21 is provided with a centrally-disposed annular flange 28 which extends into the passage 25 and is adapted to direct the fluid issuing from each section of the low-pressure stage into the annular passage 27.

35 A balance piston 30, located on the rotor between the chambers 9 and 16, is adapted to balance the axial thrust exerted by the motive fluid in the high-pressure stage and is provided with a labyrinth or other packing arranged to restrict and check the flow of live or high-pressure motive fluid from the chamber 9 to the chamber 16.

A chamber 31, located between the end 45 32 of the casing and the balancing piston 15, is connected with the passage 18 by a pipe or conduit 33 and is arranged to balance the axial thrust exerted by the fluid leaving the passage 24 on the end 34 of the rotor. With such an arrangement the longitudinal or axial thrust of the rotor is balanced for all fluid pressure, for all loads and degrees of vacuum without the necessity of utilizing a large balance piston to counteract the axial thrust exerted in the low-pressure stage. Any ordinary packing may be utilized at the joints between the casing and the shaft as the chamber 31 and the passage 24 are each exposed to approximately atmospheric pressure when ordinary fluid pressures usually encountered are utilized.

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 can be carried out by other means.

What I claim as new and useful and desire to secure by Letters Patent is:

1. In combination with one or more high-pressure stages of an elastic fluid turbine through which the fluid flows in one axial direction only, a divided low-pressure stage at one end of said high-pressure stage or stages receiving fluid therefrom and through which the fluid flows in opposite axial directions, and means for counterbalancing the inherent axial thrust of said high-pressure stages.

2. In combination with an elastic fluid turbine one or more stages through which the fluid flows in one axial direction only, means for statically balancing the axial fluid pressure in each stage and a divided and counterbalanced low-pressure stage at one end of said other stages in each division of which the working fluid flows in opposite directions.

3. In an elastic fluid turbine, an axial flow high-pressure stage in which alternate rows of stationary vanes and moving blades are utilized for fractionally expanding the working fluid, and a divided low-pressure stage at one end of said turbine, each division of which receives fluid from said high-pressure stage and through which the fluid flows in opposite axial directions.

4. In combination in an elastic fluid turbine, a rotor element comprising one or more high-pressure drums, a low-pressure drum located at one end of said high-pressure drum or drums and adapted to receive motive fluid therefrom at opposite sides, and means for counterbalancing the axial thrust of said high-pressure drums.

5. In combination with one or more stages of an elastic fluid turbine through which the fluid flows in axial directions only, a divided low-pressure stage or section located at one end of said turbine receiving fluid therefrom and through the divisions of which fluid flows in opposite axial directions, and means for counterbalancing the inherent axial thrust.

6. A turbine having in combination on one shaft a high pressure part, a low pressure part in series therewith and adapted to utilize half the steam from the high pressure part, a further low pressure part utilizing the other half of the steam from the high pressure turbine, a common exhaust chamber for said low pressure parts and means for preventing the collision of the exhaust steam from said turbines.

7. A turbine having in combination on one shaft a high pressure part, a low pressure part in series therewith and adapted to

utilize half the steam from the high pressure part, a further low pressure part utilizing the other half of the steam from the high pressure turbine, a common exhaust chamber for said low pressure parts and a deflecting web (s) for preventing the collision of the exhaust steam from said low pressure turbines.

8. A turbine plant comprising a high pressure part and a low pressure part, said low pressure part being divided into two sections, a hollow drum, means for directing some of the steam direct to one low pressure section, means for directing some through the hollow drum to the other low pressure part and a common exhaust chamber between the two sections.

9. In combination in an elastic fluid turbine, a single-flow stage, a double-flow stage receiving motive fluid therefrom, a common exhaust chamber for the separate sections of the double-flow stage, and means for preventing the collision of the exhaust motive fluid from said sections.

10. In combination in an elastic fluid turbine, a high-pressure stage through which the fluid flows in one axial direction only, a divided low-pressure stage receiving motive fluid from said axial-flow stage, and a common exhaust chamber for the sections of the low-pressure stage, and means for directing the motive fluid discharged from each of said sections.

11. In combination in an elastic fluid turbine, a high-pressure stage, a divided low-pressure stage receiving motive fluid discharged from the high-pressure stage, an exhaust chamber common to each section of the divided stage, and a deflecting flange carried by the turbine rotor for preventing collision of the fluid discharged from the sections of the low pressure stage.

12. In combination in an elastic fluid turbine, a double-flow stage through which the fluid flows in opposite axial directions, an exhaust chamber common to each section of

said stage, and a deflecting flange carried by the turbine rotor for preventing collision of the fluid discharged from each section.

13. In a turbine a single flow stage, a double flow stage located at one end of said single flow stage and a passage through the rotor of the turbine connecting with both of said stages.

14. In a turbine, a single-flow high-pressure stage, a double-flow low-pressure stage, a casing through the opposite ends of which the shaft for said stages passes, an exhaust for said low-pressure stage and means whereby the packing glands of said shaft are subjected to the inlet pressure of said low-pressure stage.

15. A double-flow turbine stage, an inlet at one end of said turbine stage, a hollow drum for placing both ends of said turbine stage in communication with said inlet, an exhaust port and an exhaust chamber extending around said turbine stage.

16. A turbine stage through which the fluid flows in opposite directions toward the center, an inlet at one end, means for placing both ends in communication with said inlet, an exhaust port, an exhaust chamber extending around said turbine stage and means for directing the exhaust from both ends into said exhaust chamber.

17. In combination, a turbine stage through which the fluid flows in opposite directions toward the center, an exhaust chamber extending around said turbine stage, an inlet for said turbine, means for placing said inlet in communication with both ends of said turbine stage and a high-pressure turbine stage.

In testimony whereof, I have hereunto subscribed my name this sixteenth day of February 1906.

WILLIAM JAMES ALBERT LONDON.

Witnesses.

ATHOL DEFRID CLARKE,
J. W. BAILEY.