G. WESTINGHOUSE.

ELASTIC FLUID TURBINE.

APPLICATION FILED FEB. 10, 1908.

935,567.

Patented Sept. 28, 1909.

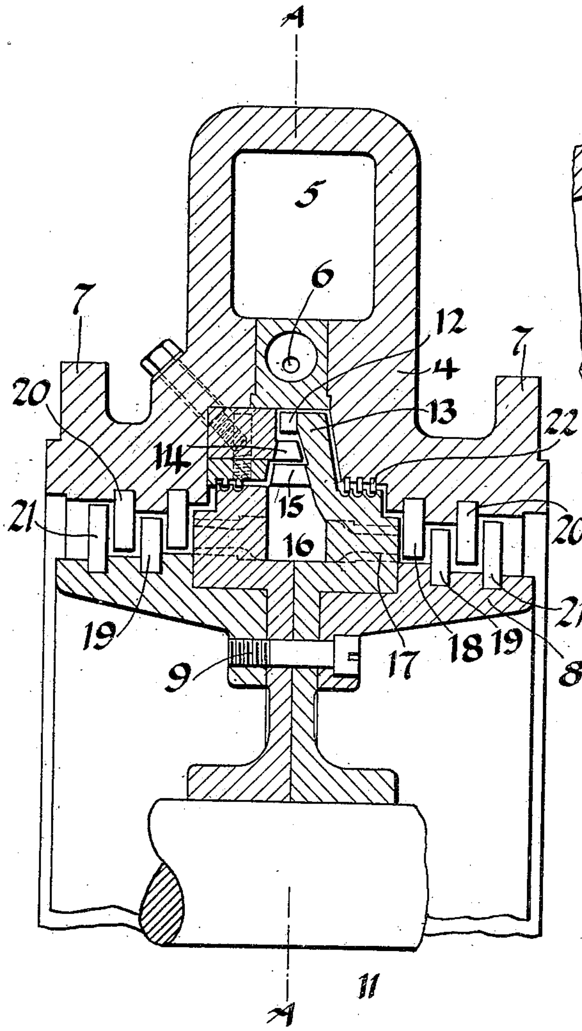

Fig. 1.

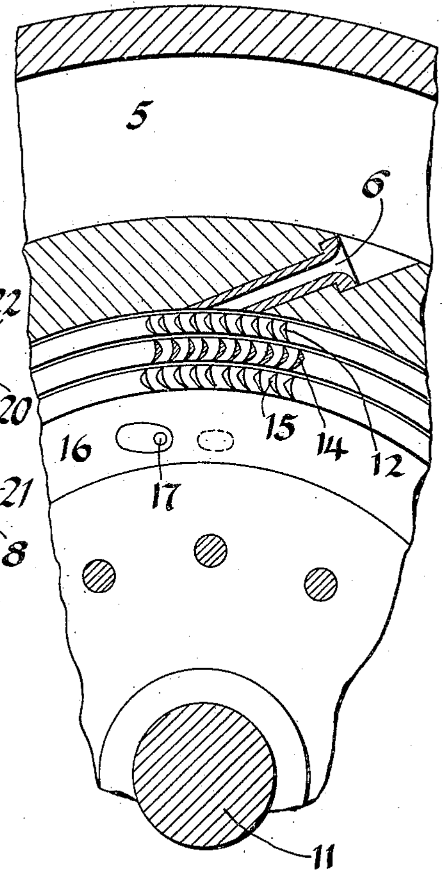

Fig. 2.

WITNESSES:

E. W. McCallister

INVENTOR

George Westinghouse

BY Jno. S. Green

his ATTORNEY

UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR TO THE WESTINGHOUSE MACHINE COMPANY, A CORPORATION OF PENNSYLVANIA

ELASTIC-FLUID TURBINE.

935,567. Specification of Letters Patent. Patented Sept. 28, 1909.

Original application filed June 24, 1903, Serial No. 162,910. Divided and this application filed February 10, 1908. Serial No. 415,088.

To all whom it may concern:

Be it known that I, George Westinghouse, a citizen of the United States, and a resident of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Elastic-Fluid Turbine, of which the following is a specification, this application being a division of an application filed by me on June 24, 1903, Serial No. 162,910.

This invention relates to elastic fluid turbines and has for an object the production of a simple, efficient, compact and relatively cheap turbine of comparatively low speed and having relatively short blades in the low-pressure sections. This and other objects, which will readily appear to one skilled in this art, I attain in the turbine illustrated in the accompanying drawings which form part of this application.

The turbine illustrated comprises a single parallel flow primary stage and a divided secondary or low-pressure stage through the divisions of which the exhaust fluid from the primary stage flows in opposite directions. In the turbine illustrated as embodying my invention the initial or primary stage consists of inwardly-discharging nozzles and alternate rows of rotating blades and stationary directing vanes. The nozzles are adapted to partially expand the motive fluid delivered to them and thereby convert a portion of its thermal and pressure energy into kinetic energy in the form of fluid velocity. The moving blades are so constructed that they fractionally abstract the available kinetic energy of the motive fluid delivered to them. The fluid discharged from the initial stage is delivered to a rest or pressure chamber which is formed in the rotor and located midway between the ends of the turbine. The pressure chamber is provided with two rows of oppositely-discharging reaction nozzles, each row of which delivers motive fluid to a section of a divided low-pressure stage. The reaction nozzles are rearwardly inclined so as to utilize the reactive force of the motive fluid passing through them in imparting energy to the turbine. The longitudinal or axial thrust of one row of nozzles on the rotor occasioned by the longitudinal component of the reactive force is balanced by an equal and opposite thrust of the other row. The separate sections of the divided low-pressure stage are bi-laterally symmetrical and located on opposite sides of the pressure chamber. The fluid discharge from the symmetrical sections of the low-pressure stage is received by exhaust passages which are formed in the turbine casing at each end of the rotor and which connect with a common condenser or the atmosphere, as desired.

In the drawings accompanying this application and forming a part thereof: Figure 1 is a partial section through the turbine, illustrating my invention; and Fig. 2 is a transverse section taken on the line A—A of Fig. 1.

The turbine herein illustrated and described as embodying my invention may be operated by any expansible fluid, but since steam is the fluid ordinarily employed in turbines of this type, the use of this fluid will hereinafter, for convenience, be referred to without any intention of limiting the invention to such specific use.

The casing 4 of the turbine consists of a cylindrical portion, shown in the drawings, and end portions, (not shown) which are secured on each end of the cylindrical portion by means of the annular flanges 7. The casing 4 is provided with an integrally-formed steam chamber 5 which communicates with a source of steam supply and which supplies steam to one or more nozzles 6. A rotor element 8, which consists of a number of parts clamped together by screws 9, is keyed or otherwise rigidly mounted on a shaft 11, which extends through the casing co-axially with the cylindrical portion and is supported by suitable bearings (not shown) located exterior to the casing. The casing 4 entirely incloses the rotor element 8 and is provided with suitable packing glands (not shown) at the joints between it and the shaft 11. The nozzles 6 are adapted to expand the steam supplied to them and thereby convert a portion of the thermal energy into kinetic energy in the form of fluid velocity and are so located that the fluid streams issuing from them are delivered to an annular row of blades 12 which are mounted on a flange 13 of the rotor element. The blades 12 are so formed that they absorb by impact a portion only of the kinetic energy contained in the steam and discharge the steam into a row of adjacent stationary vanes 14 mounted on the stator. The vanes 14 serve to redirect the flow of steam and to deliver it in the most efficient manner to an annular row of blades 15 mounted on the flange 13. The blades 15 abstract the remaining kinetic energy in the steam and deliver the steam into an annular chamber 16 formed in the rotor element 8. Up to this point the steam in traversing the fluid passages of the turbine is directed inwardly or substantially radially, but in its further passage through the turbine it is divided and caused to flow axially and in opposite directions through bi-laterally symmetrical working passages.

Nozzles 17, formed in the rotor element at each side of the chamber 16 and communicating therewith, are adapted to convert a portion of the available thermal energy of the steam contained therein, into kinetic energy in the form of fluid velocity and deliver it to additional working passages of the turbine. The steam discharged from one set of nozzles 17 on one side of the chamber 16 operates in the same manner as that discharged from the oppositely located set and for that reason only one-half of the bi-laterally symmetrical portion of the working passage of the turbine will be described.

The steam discharged by the revolving nozzles 17 is received by an annular row of stationary vanes 18, mounted on the casing, which directs the steam and delivers it to an annular row of blades 19 mounted on the rotor. The blades 19 absorb a portion of the velocity energy of the steam and deliver it to stationary vanes 20 which redirect and deliver the steam to an annular row of blades 21. The blades 21 abstract all the remaining energy of the steam and discharge it into the exhaust passages of the turbine.

The steam discharged from the nozzles 6 in traversing the radially or inwardly-extending passages does not occasion a lateral or longitudinal thrust of the rotor element. The nozzles 17 are rearwardly disposed with reference to the direction of rotation of the rotor and so arranged that the reactive force of the steam is utilized in driving the turbine. The longitudinal or axial thrust on the rotor, caused by the axial component of the reactive force of one row of nozzles, is counterbalanced by an equal and opposite thrust of the other row of nozzles.

Interleaving seals 22, which consist of annular grooves formed in the rotor element, and annular ridges or strips, formed or mounted on the stator or casing, are located between the casing and the rotor at either side of the chamber 16. The seals are provided, one to prevent leakage of the steam from the nozzles 6 around the blades 12 and 15 and the chamber 16, and the other to prevent leakage of steam from the chamber 16 into the fluid passages of lower pressure of the turbine.

The capacity of the turbine may be increased by increasing the number of stationary nozzles 6 and the number of reaction nozzles 17; and various other modifications may be made and still fall within the spirit and scope of this invention.

What I claim is:

1. In an elastic fluid turbine, an impulse stage employing a plurality of rows of moving blades for fractionally abstracting velocity energy and re-action stages on opposite sides of the impulse stage and in open communication therewith.

2. In a fluid-pressure turbine, the combination with a casing having a chamber for the fluid and one or more nozzles leading therefrom to the interior of the casing, of a rotary member mounted within the casing and having an annular chamber, one or more sets of blades interposed between said chamber and the said nozzle or nozzles, a series of expansion nozzles extending laterally from said chamber and one or more sets of alternating blades and guide vanes in position to receive the steam from said nozzles.

3. In a fluid-pressure turbine, the combination with a casing having a chamber and one or more nozzles extending therefrom to the interior of the casing, of a rotary member having one or more sets of blades adjacent to the nozzle outlet or outlets, an annular chamber into which the fluid exhausts from said blades, a series of expansion nozzles leading laterally from said chamber and one or more sets of blades against which the fluid impinges as it leaves said nozzles.

4. In a steam turbine, the combination with a casing having a steam chamber and one or more nozzles leading therefrom to the interior of the casing, of a rotary member having an annular steam chamber, one or more sets of blades between said chamber and said nozzle or nozzles, one or more nozzles leading laterally from said chamber and one or more sets of blades against which the steam impinges as it issues from said lateral nozzle or nozzles.

5. In a steam turbine, the combination with a casing having a chamber and one or more nozzles leading therefrom to the interior of the casing, of a rotary member having a steam chamber, blades between said chamber and said nozzle or nozzles, and nozzles leading laterally from said chamber and sets of blades against which the steam impinges as it issues from said lateral nozzles.

6. In a steam turbine, the combination with a casing having a steam chamber and one or more nozzles leading therefrom to the interior of the casing, of a rotary member having an annular steam chamber, one or more sets of blades between the said annular

chamber and said nozzle or nozzles, nozzles leading laterally from said annular chamber and sets of blades against which the steam impinges as it issues from said lateral nozzles, said casing being provided with guide vanes adjacent to each set of blades with which the rotary member is provided.

7. In a fluid pressure turbine, the combination with a casing having a chamber for the fluid and one or more nozzles leading therefrom to the interior of the casing, of a rotary member mounted in the casing and having a chamber, blades interposed between said chamber and said nozzle or nozzles, nozzles extending from said chamber, the nozzles being at angles to the direction of flow of the steam between the blades, and blades and guide vanes in position to receive the steam from said last named nozzles.

In testimony whereof, I have hereunto subscribed my name this fifth day of February, 1908.

GEO. WESTINGHOUSE.

Witnesses:

GEO. J. TAYLOR,

JNO. S. GREEN.