G. WESTINGHOUSE.

FLUID PRESSURE TURBINE.

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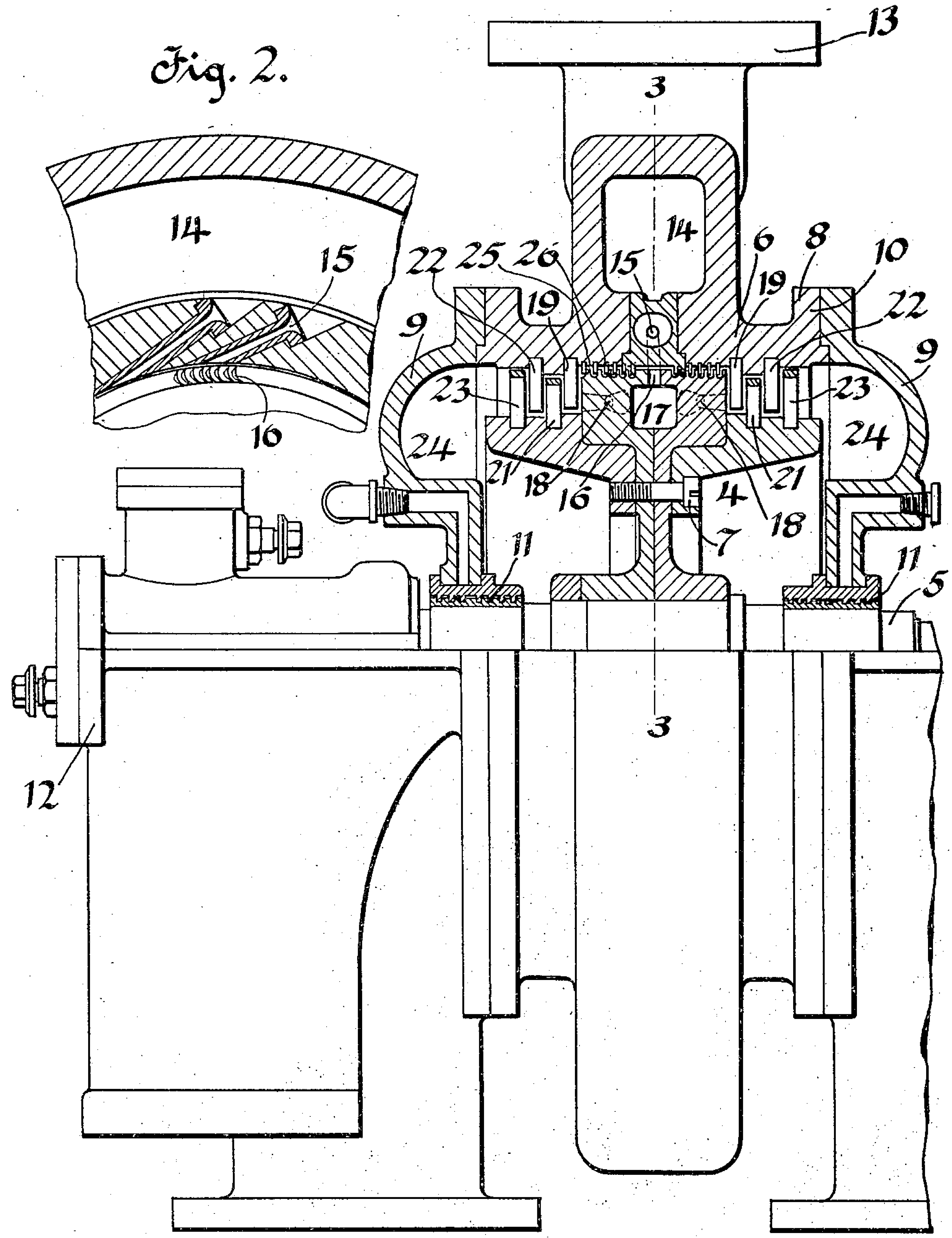
935,438.

Patented Sept. 28, 1909.

Fig. 2.



WITNESSES:

Fig. 1.

INVENTOR

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UNITED STATES PATENT OFFICE.

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

FLUID-PRESSURE TURBINE.

935,438. Specification of Letters Patent. **Patented Sept. 28, 1909.**

Application filed June 24, 1903. Serial No. 162,910.

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 Improvement in Fluid-Pressure Turbines, of which the following is a specification.

This invention relates to elastic fluid turbines and has for an object the production of a turbine which is simple, compact, economical and efficient, and of a relatively great capacity and low speed.

A further object is the production of a multi-stage turbine in which the fluid is so delivered to its separate stages that the endwise or longitudinal thrusts on the turbine rotor are counterbalanced.

The turbine illustrated as embodying my invention is provided with a series of expansion nozzles which direct the flow of motive fluid inwardly and which are forwardly inclined relative to the direction of rotation of the rotor. These expansion nozzles supply the motive fluid admitted to the turbine and partially expand it in its passage through them. The expansion of the motive fluid induces a high velocity of flow which is preferably wholly abstracted by a single row of moving blades mounted on the rotor. The motive fluid discharged from the single row of blades is received by an annular chamber formed in the rotor which is essentially a rest or pressure chamber, since the motive fluid contained therein has practically no inherent velocity. Axially-disposed reaction nozzles communicate with the rest chamber and are formed in the rotor element in symmetrical sets which are located on opposite sides of it. The reaction nozzles are adapted to expand the motive fluid from the pressure encountered in the rest chamber down to exhaust pressure and to deliver it in opposite directions through two bi-laterally symmetrical sections of a low pressure or secondary stage which sections are located on opposite sides of the rest chamber. The reaction nozzles are rearwardly inclined relative to the direction of rotation of the rotor in order that the reactive force of expanding motive fluid may be utilized in driving the turbine. The nozzles are symmetrically and oppositely disposed in order that the axial component of the reactive force of the expanding motive fluid of one set will be counterbalanced by the axial component of the other set.

In the drawings accompanying this application and forming a part thereof: Figure 1 is a view partially in side elevation and partially in section of a turbine embodying the features of my invention, one of the bearing portions being broken away; and Fig. 2 is a partial sectional view on the line 3—3 of Fig. 1.

Referring to the drawings: The turbine comprises a rotor element 4 mounted on shaft 5 and a stationary casing 6, which incloses the rotor element. The rotor is composed of a plurality of parts which are clamped together by bolts or screws 7. The casing 6 comprises a cylindrical portion 8 and portions 9 which are connected thereto by means of flanges 10. The shaft 5 on which the rotor element is rigidly secured extends through the casing 6 coaxially with the cylindrical portion 8 and is provided with fluid packing glands 11 which are located at the joints between the shaft and the end portions 9. The shaft is provided with bearings 12 which are mounted in standards formed integrally with the turbine casing, but which are located exterior to it.

The casing 6 is provided with a fluid inlet port 13 which communicates with a chamber 14 formed in the casing and which preferably extends completely around it. A series of fluid supply nozzles 15 communicate with the chamber 14 and each nozzle is adapted to partially expand the motive fluid passing through it, thereby converting a portion of the pressure and thermal energy of the fluid into kinetic energy in the form of fluid velocity. The nozzles 15 direct the flow of fluid inwardly but are inclined forwardly with reference to the direction of rotation of the rotor element. The fluid discharged from the nozzles is received by a single row of blades 16, which are mounted on the rotor midway between its ends. The blades 16 are impulse blades and are preferably adapted to wholly abstract the available kinetic energy of the motive fluid delivered to them.

The motive fluid issuing from the blades is received by and brought to rest within an annular chamber 17 formed in the rotor and located midway between its ends. Axially-disposed reaction nozzles 18 communicate with the chamber 17 and are arranged to deliver motive fluid from the chamber toward each end of the turbine. The nozzles 18 expand the motive fluid passing through them down to exhaust pressure, thereby converting all of the available pressure and thermal energy of the fluid into kinetic energy in the form of fluid velocity. The nozzles of each row 18 are rearwardly disposed with reference to the direction of rotation of the rotor element and deliver the motive fluid to a row of stationary directing vanes 19 mounted on the casing. The directing vanes redirect the flow of motive fluid and deliver it to rotating blades 21 mounted on the rotor. The blades 21 abstract a portion of the kinetic energy of the fluid stream and deliver the stream to redirecting vanes 22 mounted on the casing, which in turn deliver it to blades 23 mounted on the rotor. The blades 23 preferably abstract all of the remaining kinetic energy in the motive fluid delivered to them and discharge the fluid into exhaust passages 24. Since the turbine is bi-laterally symmetrical, exhaust passages 24 are located in each end of the casing and may either connect with a common condenser or the atmosphere as desired.

The nozzles 18 are so disposed that the reactive force of the motive fluid passing through them assists in driving the rotor of the turbine. The axial thrust of one row of nozzles is counterbalanced by an equal and opposite axial thrust of the other row. Labyrinth packings, which consist of grooves 25 formed in the rotor element and interleaving strips 26 mounted on the casing, are mounted on each side of the blades 16 of the rotor. The interleaving seals present a tortuous path to the motive fluid discharged from the nozzles 15 and, therefore, prevent leakage through the clearance space between the rotor and the casing.

The capacity of the turbine may be increased by increasing the number of stationary nozzles 15 and the number of reaction nozzles 18, 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, the combination with a fixed casing provided with two rows of fixed vanes, of a rotating carrier provided with two rows of nozzles arranged to counteract each the endwise thrust of the other on the carrier and with vanes actuated with fluid from said fixed vanes.

2. In an elastic fluid turbine, the combination of a fixed casing, rows of inwardly pointing vanes connected thereto and oppositely arranged, a rotating carrier having oppositely arranged rows of nozzles discharging endwise of the carrier against said vanes and rows of vanes on said carrier and actuated by fluid from said fixed vanes.

3. In an elastic fluid turbine, a fixed casing, inwardly pointing vanes connected thereto, a rotating carrier having nozzles arranged in a circle of a diameter equal to that of the circle of vanes and discharging against said vanes and other vanes moving with said nozzles and actuated by fluid from said fixed vanes, in combination.

4. In an elastic fluid turbine, a casing, a rotor element located within said casing, means provided in said casing for expanding the motive fluid delivered to the turbine, members mounted on said rotor for abstracting the velocity energy due to said expansion, a collecting chamber provided in said rotor for receiving the motive fluid discharged from said members and instrumentalities communicating with said chamber for expanding the motive fluid contained therein and discharging it in opposite directions toward the ends of said turbine.

5. In an elastic fluid turbine, a casing, a rotor located within said casing, means provided in said casing for expanding the motive fluid delivered to the turbine, members mounted on the rotor for abstracting the velocity energy due to said expansion, a collecting chamber provided in said rotor element for receiving motive fluid from said members, instrumentalities located on each side of said chamber for partially expanding the motive fluid contained therein and alternate rows of stationary vanes and moving expansion elements located on each side of said chamber and receiving the motive fluid discharged from said instrumentalities.

6. In an elastic fluid turbine, a casing, a rotor element, means for delivering motive fluid to said turbine, a collecting chamber provided in said rotor and alternate rows of moving and stationary fluid delivery elements located on each side of said collecting chamber.

In testimony whereof, I have hereunto subscribed my name this 15th day of June, 1903.

GEO. WESTINGHOUSE.

Witnesses:
WESLEY G. CARR,
BIRNEY HINES.