

G. WESTINGHOUSE.
 RE-ENTRANT TURBINE.
 APPLICATION FILED FEB. 26, 1900.

1,031,757.

Patented July 9, 1912.

3 SHEETS-SHEET 1.

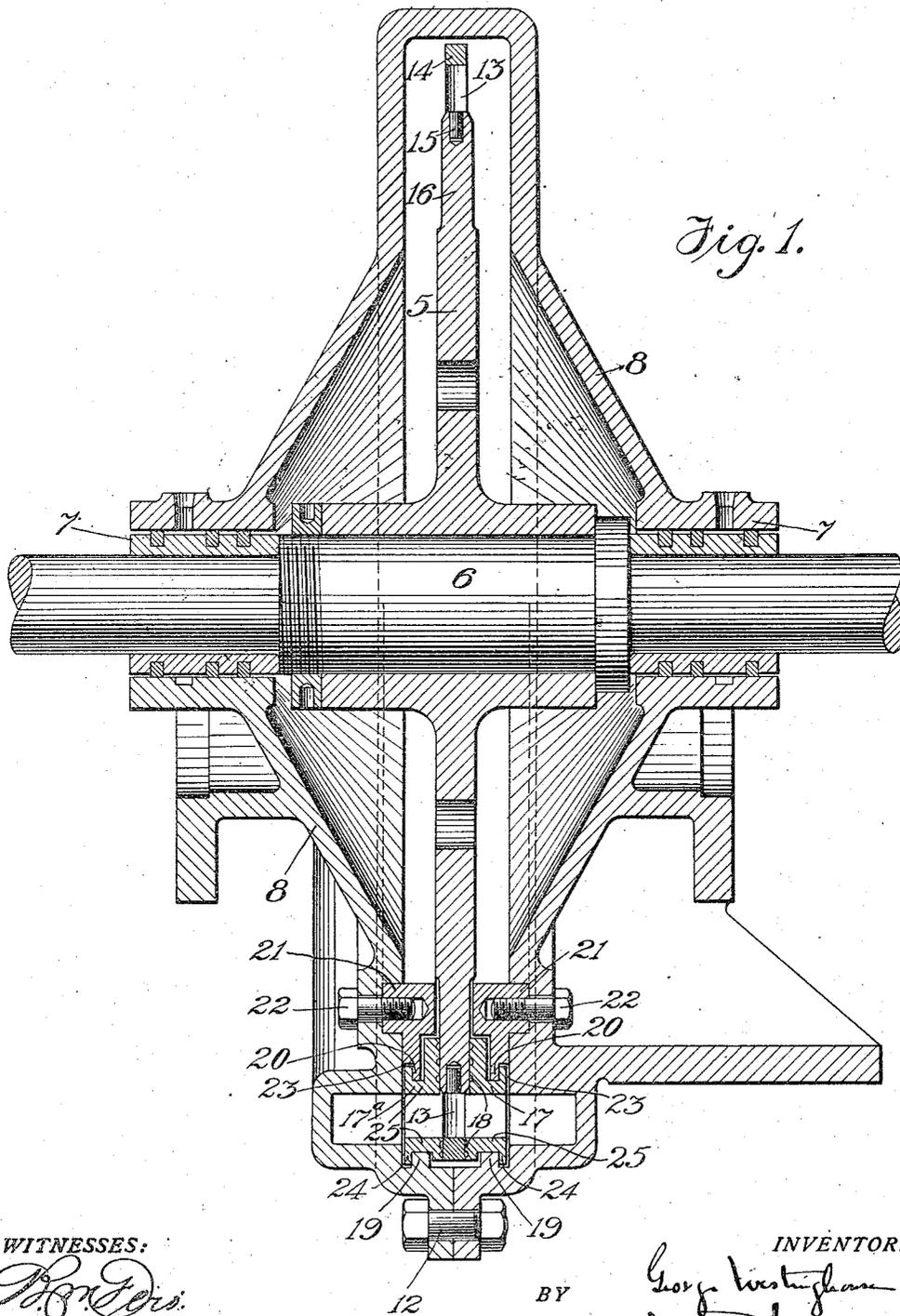


Fig. 1.

WITNESSES:

R. B. Davis
Geodwalter

BY

INVENTOR.

George Westinghouse
per J. W. ...
 ATTORNEY IN FACT.

G. WESTINGHOUSE.
RE-ENTRANT TURBINE.
APPLICATION FILED FEB. 26, 1909.

1,031,757.

Patented July 9, 1912.

3 SHEETS-SHEET 2.

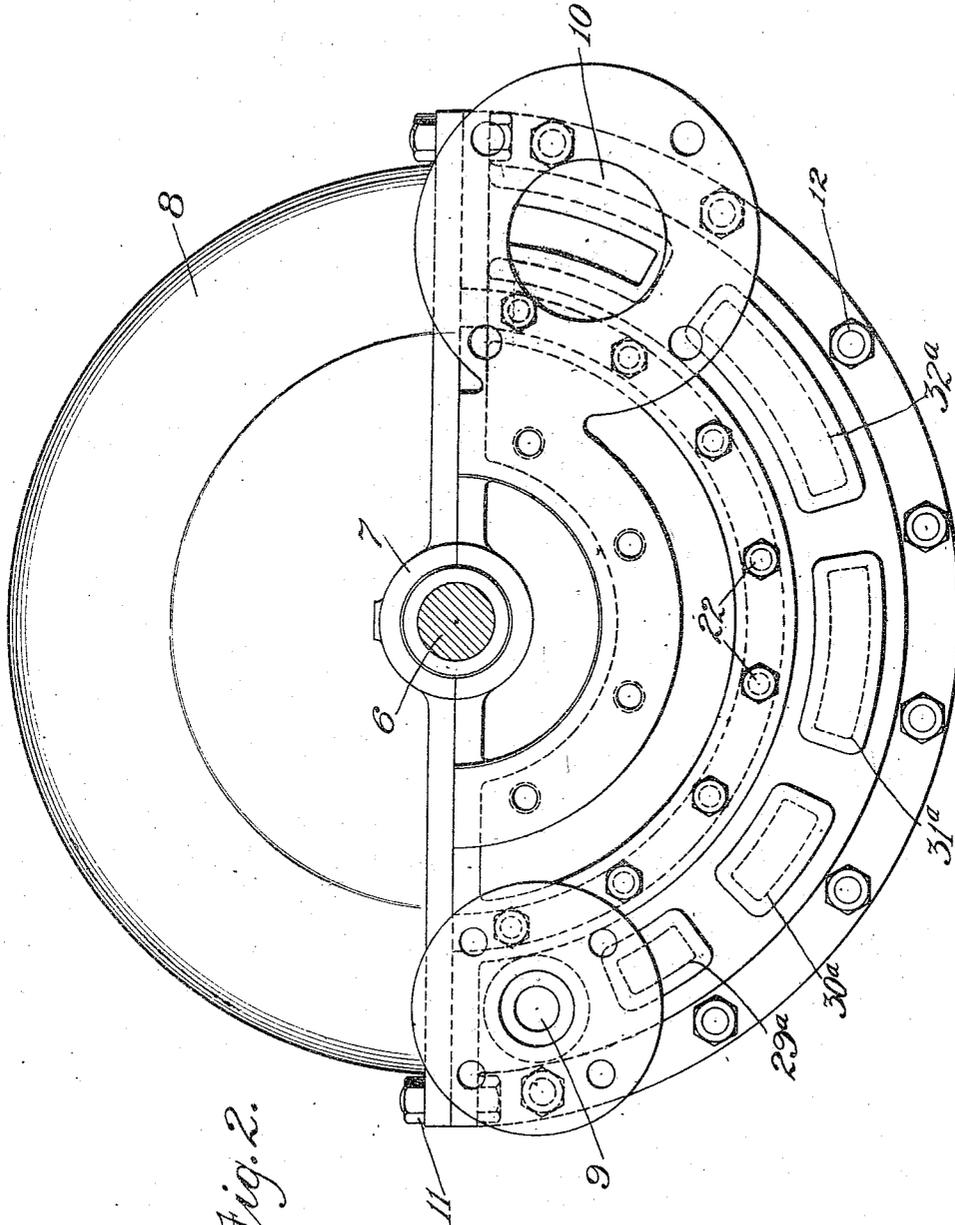


Fig. 2.

WITNESSES:
W. B. D. W.
Geo. H. W. W.

INVENTOR.
BY *George Westinghouse*
John S. Brown
his ATTORNEY IN FACT.

G. WESTINGHOUSE.
 REËNTRANT TURBINE.
 APPLICATION FILED FEB. 26, 1909.

1,031,757.

Patented July 9, 1912.

3 SHEETS—SHEET 3.

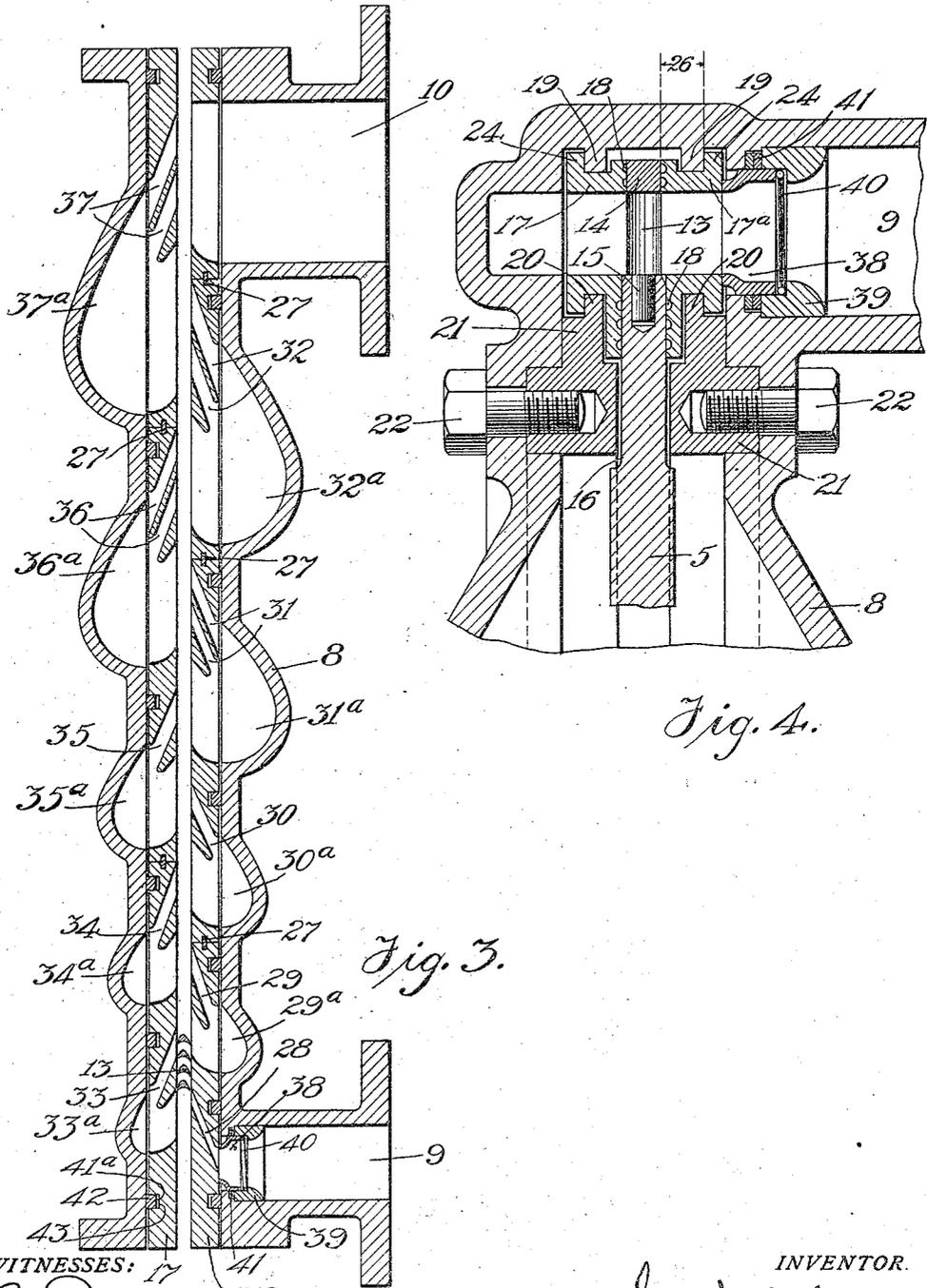


Fig. 4.

Fig. 3.

WITNESSES:
[Signature]
[Signature]

INVENTOR.
George Westinghouse
 BY *[Signature]*
 ATTORNEY IN FACT.

UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, OF PITTSBURGH, PENNSYLVANIA.

REËNTRANT TURBINE.

1,031,757.

Specification of Letters Patent.

Patented July 9, 1912.

Application filed February 26, 1909. Serial No. 480,226.

To all whom it may concern:

Be it known that I, GEORGE WESTINGHOUSE, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have made a new and useful invention in Reëntrant Turbines, of which the following is a specification.

This invention relates to elastic fluid turbines and more particularly to elastic fluid turbines of the reëntrant type.

An object of this invention has been to produce a cheap, efficient, reëntrant turbine.

A further object has been to provide means in a reëntrant turbine for reducing the leakage from stage to stage to a minimum.

These and other objects I attain in the turbine constructed as described in the specification and illustrated in the drawings accompanying and forming a part of this application.

In the drawings; Figure 1 is a longitudinal sectional view of a turbine embodying this invention; Fig. 2 is a view in end elevation of said turbine; Fig. 3 is a development in section of the lower half of the turbine showing the arrangement of nozzles and blades; and, Fig. 4 is a detail view in section of the nozzles and blades and the portions adjacent thereto.

As is now common in reëntrant turbines, the rotor consists of a single wheel 5 mounted upon a shaft 6 mounted in bearings (not shown) and passes through suitable packing glands 7 within a casing 8, which casing surrounds the wheel and is provided with an inlet 9 and exhaust 10.

The casing is preferably divided on its horizontal axis for the purpose of removing the rotor and for accessibility in machining. The upper half of the casing is preferably formed in one casting bolted to the lower half, as at 11, and the lower half is preferably formed in two parts bolted together at 12.

The rotor carries a single row of blades 13, preferably of the impulse type and preferably drop-forged, so that a shrouding 14 is formed as part of the blade forgings. The blades may be assembled in the rotor in any desired manner but are preferably provided with cylindrical base portions 15 secured within holes drilled for their reception in the periphery of the rotor. The side of the rotor or wheel just within the row of blades

is of reduced section and accurately machined, as at 16. Lying within close proximity to the reduced portion 16 of the rotor and on each side thereof is a segmental nozzle-containing member 17, 17^a, provided on its inner face, or that one which lies next adjacent the side of the blade shrouds and the reduced portion of the rotor, with grooves 18 adapted to entrain leakage steam and thereby serve as a packing system. The sectional nozzle members 17, 17^a are yieldingly held toward the sides of the shroud and the faces of the wheel so as to provide the minimum clearances between the grooved faces of the nozzle members and the wheel. Each half of the lower half of the casing is machined so as to form a flange 19 which coöperates with a flange 20 formed on a block 21 secured to the casing by means of bolts 22 to form a recessed portion 23 within which a flanged portion 24 of the nozzle member lies. The waist 25 of the nozzle member fits snugly between the flanges 19 and 20 and is movable between said flanges toward and from the wheel. When the turbine is assembled the distance 26 will be exactly the same as the distance between the inside of flanges 19 and 20 and the faces of the wheel. If collision occurs from any cause the nozzle member will move away and undue heating will be then avoided. It will be seen therefore that the minimum clearance may be maintained. The nozzle members are yieldingly forced toward the wheel by steam pressure acting on their several faces and the members are limited in their inward movement by the flanges 24 which abut against the flanges 19 and 20.

The nozzle members are preferably formed in sections joined together by means of members 27 which serve as packings between the several sections. The nozzle member 17^a is provided with nozzles 28, 29, 30, 31 and 32 for the first, third, fifth, seventh and ninth stages of expansion while the nozzle member 17 is provided with nozzles 33, 34, 35, 36 and 37 for the second, fourth, sixth, eighth and tenth stages of expansion. Nozzle 28, which is the primary inlet nozzle, connects with the inlet 9 through a movable connecting throat member 38, which is provided in order that the area of the nozzle member 17^a acted upon by the inlet pressure, will be reduced to the area of the nozzle 28. In order to do this a block 39 is pressed into the inlet and the movable

throat 38 is yieldingly forced toward and in contact with the nozzle member 17^a by means of a spring 40 inserted between the outer end of the throat member 38 and a shoulder on the block 39. Packing 41 is provided to prevent leakage of steam around the throat member 38. The nozzle members 17 and 17^a are grooved, as at 41^a, to receive packing blocks 42, which snugly fit within the grooves and are pressed by means of springs 43 toward the casing. These springs also tend to move the nozzle members toward the wheel and they are preferably located between the different groups of nozzles in the nozzle members in order to prevent leakage from one series of nozzles to the next. The lower half of the casing is provided with chambers 29^a, 30^a, 31^a, and 32^a as well as 33^a, 34^a, 35^a, 36^a and 37^a, which serve as collecting and supply chambers for the several expansion stages.

If desired the blocks 21 may be formed integrally with the casing castings, for by forming the lower half in two sections the same may be accurately machined.

The interior of the casing, that is, that part lying within the inner groove 18 in the face of the nozzle members, may either be bled to a pressure equalizing the exhaust pressure which may be condenser or atmospheric; or, if desired, this space may connect with the collecting chamber for one of the stages of expansion so that a predetermined pressure will be maintained within the interior of the casing to minimize the leakage.

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 is:

1. In a turbine, a bladed rotor element, a fluid discharging device movable axially of the turbine toward and from said element, and a stop on the turbine stator for limiting the movement toward said element.

2. In a turbine, a bladed rotor element, a fluid discharging device movable longitudinally of the turbine and yieldingly held toward said element, and means limiting the movement of said device toward said element.

3. In a turbine, a running wheel provided with a single row of blades, a casing surrounding said wheel, loosely mounted fluid discharging devices located on opposite sides of said wheel and forming with said wheel, reentrant stages, and stops for limiting the movement of said devices toward said wheel.

4. In an elastic fluid turbine, a rotor element, fluid discharging devices forming in conjunction with said element, reentrant stages and radially extending packing devices located between said stages.

In testimony whereof, I have hereunto subscribed my name this 16th day of February, 1909.

GEO. WESTINGHOUSE.

Witnesses:

CHARLES W. MCGHEE,
JNO. S. GUNN.