

A. PFAU.

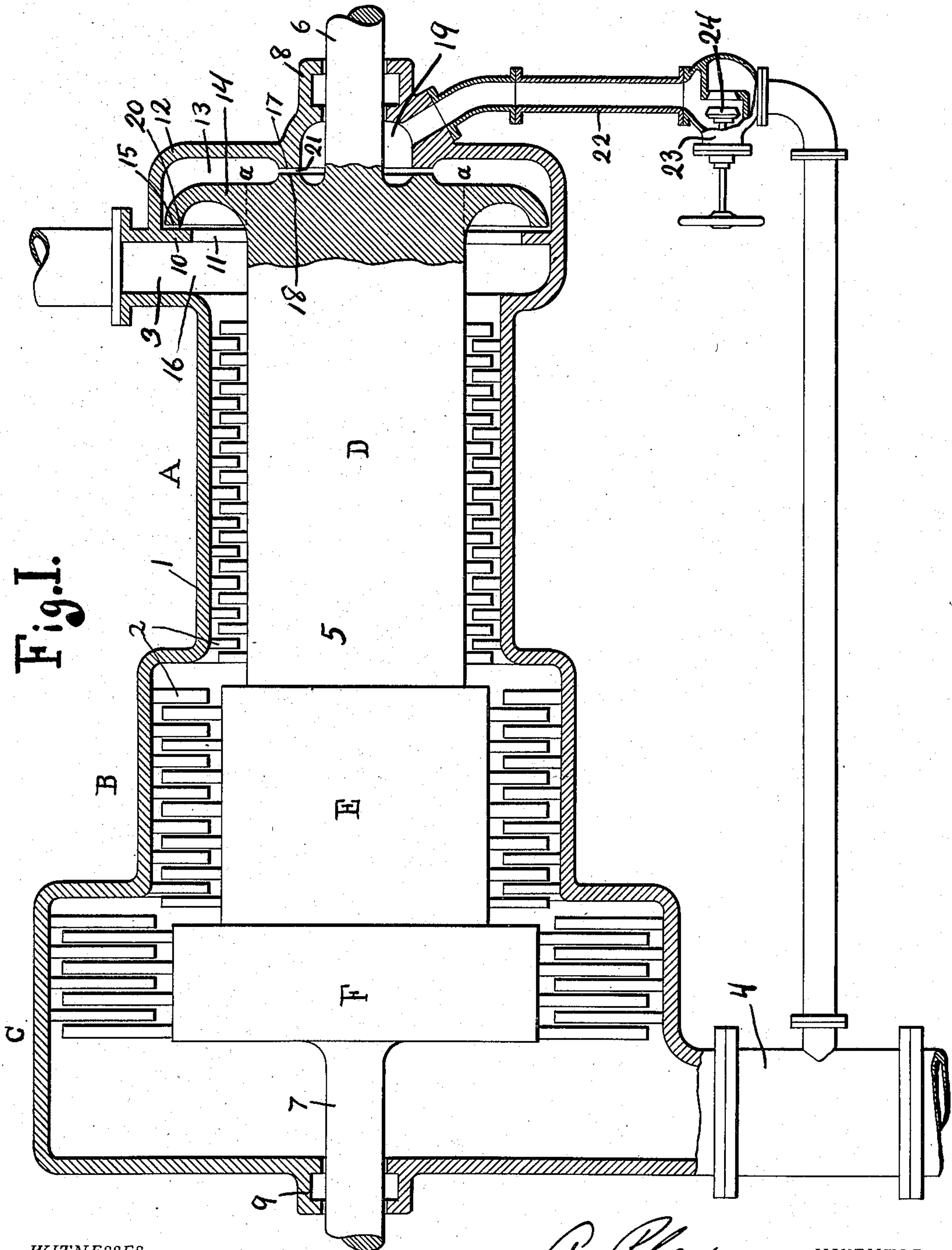
TURBINE.

APPLICATION FILED MAR. 27, 1907.

899,559.

Patented Sept. 29, 1908.

2 SHEETS—SHEET 1.



WITNESSES:
Frank C. Dennett
Ella Brickell

A. Pfau
BY
G. J. DeWitt
INVENTOR
ATTORNEY.

A. PFAU.

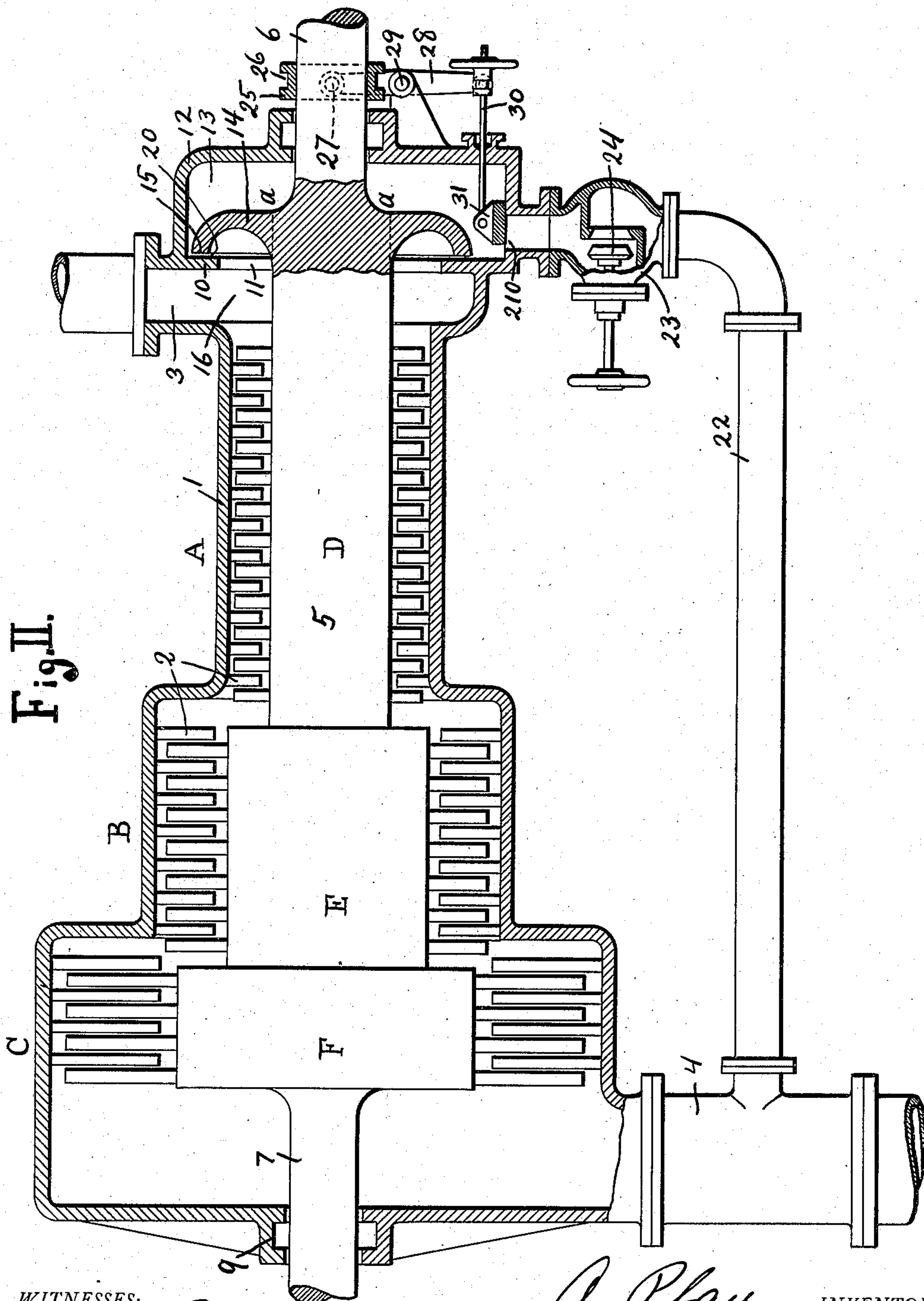
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Ella Brickell

A. Pfau INVENTOR
G. P. Dr. Wein ATTORNEY.

UNITED STATES PATENT OFFICE.

ARNOLD PFAU, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO ALLIS-CHALMERS COMPANY, OF MILWAUKEE, WISCONSIN, A CORPORATION OF NEW JERSEY.

TURBINE.

No. 899,559.

Specification of Letters Patent.

Patented Sept. 29, 1908.

Application filed March 27, 1907. Serial No. 364,789.

To all whom it may concern:

Be it known that I, ARNOLD PFAU, a citizen of the Republic of Switzerland, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented a certain new and useful Turbine, of which the following is a specification.

This invention relates to turbines, fans, pumps and similar apparatus which are actuated by a fluid or which force a fluid, and the purpose of this invention is to provide a structure by which the "end thrust" on the shaft or spindle is automatically balanced by the action of the apparatus itself, whereby damage to the apparatus may be avoided and thrust bearings may be dispensed with. It is immaterial whether such "end thrust" be caused by an application of load to a turbine or the release of the load therefrom, or whether it be caused by static pressure or the kinetic energy of a fluid, by gear connections or otherwise.

Specifically, this invention comprises a structure of apparatus which is provided with a chamber to which fluid under pressure, specifically the fluid which operates the apparatus or the fluid forced thereby, is admitted to act with an endwise thrust against the spindle or a piston thereon, the entrance to and the escape from said chamber being governed by the movements of the spindle itself, the entrance and exhaust passages being opened and closed in inverse order so that the fluid is permitted to accumulate in said chamber under pressure or is permitted to exhaust freely therefrom.

Referring to the drawings which accompany this specification and form a part thereof, and which illustrate embodiments of this invention as applied to an ordinary type of steam turbine, and on which drawings the same reference characters are used to designate the same elements wherever they may appear in each of the several views,—Figure 1 is an illustration in vertical longitudinal section of a steam turbine embodying this invention. Fig. 2 is a similar sectional view showing a modification.

On the drawings, the numeral 1 designates the casing or stator of a steam turbine of the Parsons type provided with the high pressure stage A, the intermediate stage B, and the low pressure stage C, said casing being provided with blades 2 and with a steam inlet port 3, and an exhaust port or pipe 4.

Mounted within the casing 1 is the spindle 5 which is shown more or less diagrammatically by the drawings, this spindle being provided with the several portions D, E, F of different diameters to correspond with the several stages formed by the casing and being supported by the shaft extensions 6 and 7, which pass through the glands 8 and 9 of the casing, and which may be supported in any suitable or preferred way. All of the parts just enumerated may be of any ordinary or preferred construction.

The casing 1 is provided at the high pressure end with the abutment 10 which is in the form of a ring, the inner periphery 11 of which is preferably spaced from the spindle 5 and arranged concentric therewith. Secured to the casing and on the outside thereof with respect to ring 10, is a casing 12 which may be formed as a separate member and attached to the casing 1 or may be formed integral therewith, this casing 12 providing a chamber 13.

A ring or piston 14 is secured to the spindle 5, preferably by being formed as an integral part thereof, and this piston is located within the chamber 13 with a part thereof, as, for example, the face 15, located adjacent the ring 10, the piston 14 forming a division wall between the steam space 16 of the turbine and the chamber 13, and being acted upon by the steam in steam space 16 and by the steam in the chamber 13. The casing 12 is also provided with a projection 17 extending toward the spindle 5, and the spindle 5 is preferably formed with a corresponding projection 18, the casing 12 between the shaft 6 and said projection 17 being provided with a chamber 19, to which steam can flow from the steam space 16 of the turbine by passing through the passageway 20 existing between the ring 10 and the part 15 of the piston 14, through chamber 13 and the passageway 21 existing between the projections 17 and 18. The ring 10 and part 15 of the piston 14, and the projections 17 and 18 form in effect valves which control the flow of steam through the passages 20 and 21 by increasing or diminishing the thoroughfare through said passages respectively.

The numeral 22 designates a pipe or conduit which is in communication with the chamber 19 and serves to connect said chamber either with the atmosphere, or preferably, with the main exhaust pipe 4 of the

turbine, as shown, and the thoroughfare through this pipe is controlled by any preferred form of throttling valve, as the globe valve designated by the numeral 23.

5 The action of the apparatus is as follows: Referring to Fig. 1, if the spindle 5 is thrust to the right, the passageway 20 will be enlarged, steam will pass freely into the chamber 13, but as the movement of the spindle
10 contracted passageway 21, the steam cannot escape from said chamber as readily as it enters it, and the consequence is that the pressures existing in steam space 16 and chamber 13 become substantially equalized, and as
15 the steam in chamber 13 acts upon the end surface of the spindle 5 included between the periphery of the spindle (indicated by dotted lines $a-a$), and the circle formed by projection 18, the spindle 5 will be forced to the
20 left, provided the surface exposed to this pressure is large enough so that the pressure upon it exceeds the force tending to thrust the spindle to the right. Under these conditions the piston 14 projecting outwardly
25 from the periphery of the spindle 5 (indicated by the dotted lines $a-a$), is subjected on each side to substantially the same pressure and does not exert any force in either direction. If, on the contrary, a force is ex-
30 erted now to force the spindle 5 to the left, the thoroughfare 20 will be diminished, thoroughfare 21 will be increased, and the steam cannot so readily pass from steam space 16 into chamber 13, but the steam in
35 chamber 13 can readily expand and escape through thoroughfare 21 and pipe 22, whereby the pressure is reduced in chamber 13, but the full steam pressure in steam space 16 is acting against the piston 14, tending to
40 force the spindle to the right. By suitably adjusting the valve closure 24 of the valve 23 so that the thoroughfare through said valve is more or less throttled, the escape of steam from chamber 13 can be so regulated
45 that the so-called "hunting" of the spindle may be practically avoided. The permissible movement of the spindle 5 is, of course, less than the amount of clearance between the blades which it carries and the blades
50 carried by the casing 1, and as these spindles are comparatively heavy, and the movement required and desired to admit the steam to or release it from the chamber 13 is comparatively slight, excessive "hunting"
55 should be avoided.

The apparatus shown by Fig. 2 of the drawings is in all substantial particulars the same as that shown by Fig. 1, and it does not require explanation except as to the modification shown. The shaft 6 in this construction is provided with a collar 25 secured thereto, within the groove 26 of which are received the pins 27 of a forked lever 28, provided with a suitably supported pivot 29.
60 To this lever 28 is secured the valve rod 30

secured to the slidable valve 31 which controls the port or thoroughfare 210, which thoroughfare corresponds in function to the thoroughfare 21 shown by the apparatus disclosed by Fig. 1 of the drawings, the projec- 70 tions 17 and 18 shown by Fig. 1 being dispensed with in the modification and the valve 31 being substituted therefor. The operation of this form of the apparatus is in all respects similar to that of the preferred 75 form described above, for as the spindle 5 moves to the right, the valve 31 diminishes the thoroughfare 210, and when the spindle 5 moves to the left, the valve 31 enlarges the thoroughfare 210. 80

What I claim is,—

1. The combination with a casing, of a spindle rotatable therein, said spindle being provided with a piston, said casing being provided with a second casing and an abutment 85 whereby a chamber is formed, said second casing being provided with a projection on the interior thereof with which said spindle is adapted to coact to enlarge or diminish a passageway existing therebetween, said piston 90 being located in said chamber and said spindle and piston being adapted to approach said abutment while receding from said projection, or to approach said projection while receding from said abutment, whereby pas- 95 sageways existing between said abutment and said piston, and between said projection and said spindle, are increased and diminished respectively by the movements of said spindle. 100

2. The combination with a casing, of a spindle rotatable therein, said spindle being provided with a piston, said casing being provided with a second casing and an abutment 105 whereby a chamber is formed, said second casing being provided with a projection on the interior thereof with which said spindle is adapted to coact to enlarge or diminish a passageway existing therebetween, said piston 110 being located in said chamber and said spindle and piston being adapted to approach said abutment while receding from said projection, or to approach said projection while receding from said abutment, whereby passageways existing between said 115 abutment and said piston, and between said projection and said spindle, are increased and diminished respectively by the movements of said spindle, a conduit adapted to receive the fluid exhausted from said chamber, and 120 a valve for controlling the thoroughfare through said conduit.

3. The combination with a casing, of a spindle rotatable therein, said spindle being provided with a piston, said casing being provided with a second casing and an abutment 125 whereby a chamber is formed, said piston being located in said chamber and provided with a projection adapted to coact with said second casing to enlarge or diminish a pas- 130

sageway existing therebetween, said piston being adapted to approach said abutment while the projection thereof recedes from said second casing, whereby passageways existing between said abutment and said piston and between said second casing and the projection on said spindle, are increased and diminished respectively by movements of said spindle.

4. The combination with a casing, of a spindle rotatable therein, said spindle being provided with shaft extensions and with a piston, said casing being provided with a second casing and an abutment whereby a chamber is formed, said piston being located in said chamber and adapted to approach or recede from said abutment, whereby a passageway existing between said piston and said abutment may be diminished or enlarged, a second passageway being provided between the spindle and said second casing at a point between the exterior surface of said spindle and said shaft extensions, said second passageway being adapted to be diminished by a movement of said spindle which enlarges said first mentioned passageway, and to be enlarged by a movement of said spindle which diminishes said first mentioned passageway.

5. The combination with a casing, of a spindle rotatable therein, said spindle being provided with a piston, said casing being pro-

vided with a second casing and an abutment whereby a chamber is formed, said piston being located in said chamber and movable to approach or recede from said abutment to permit the steam to act upon one side thereof to force the spindle in one direction or to act upon both sides thereof to equalize the pressures exerted upon both sides of said piston, said spindle being provided with an end surface that may be exposed to steam under pressure when the pressures of the steam on opposite sides of said piston are equalized.

6. In a turbine, the combination of an endwise movable rotor having blades upon which the working fluid causes an end pressure, a casing surrounding said rotor and having blades alternating with the blades of the rotor, said rotor having an end surface exposed to fluid pressure in the same direction as the end pressure caused by the working fluid, and abutment on the rotor at times coacting with the casing to control the exposure of said surface to fluid pressure as required to balance said rotor and also to prevent blowing out of fluid pressure to the exhaust.

In testimony whereof, I affix my signature in the presence of two witnesses.

ARNOLD PFAU.

Witnesses:

G. F. DE WEIN,
JACOB JACOBSEN.