A. BONOM.

STEAM TURBINE.

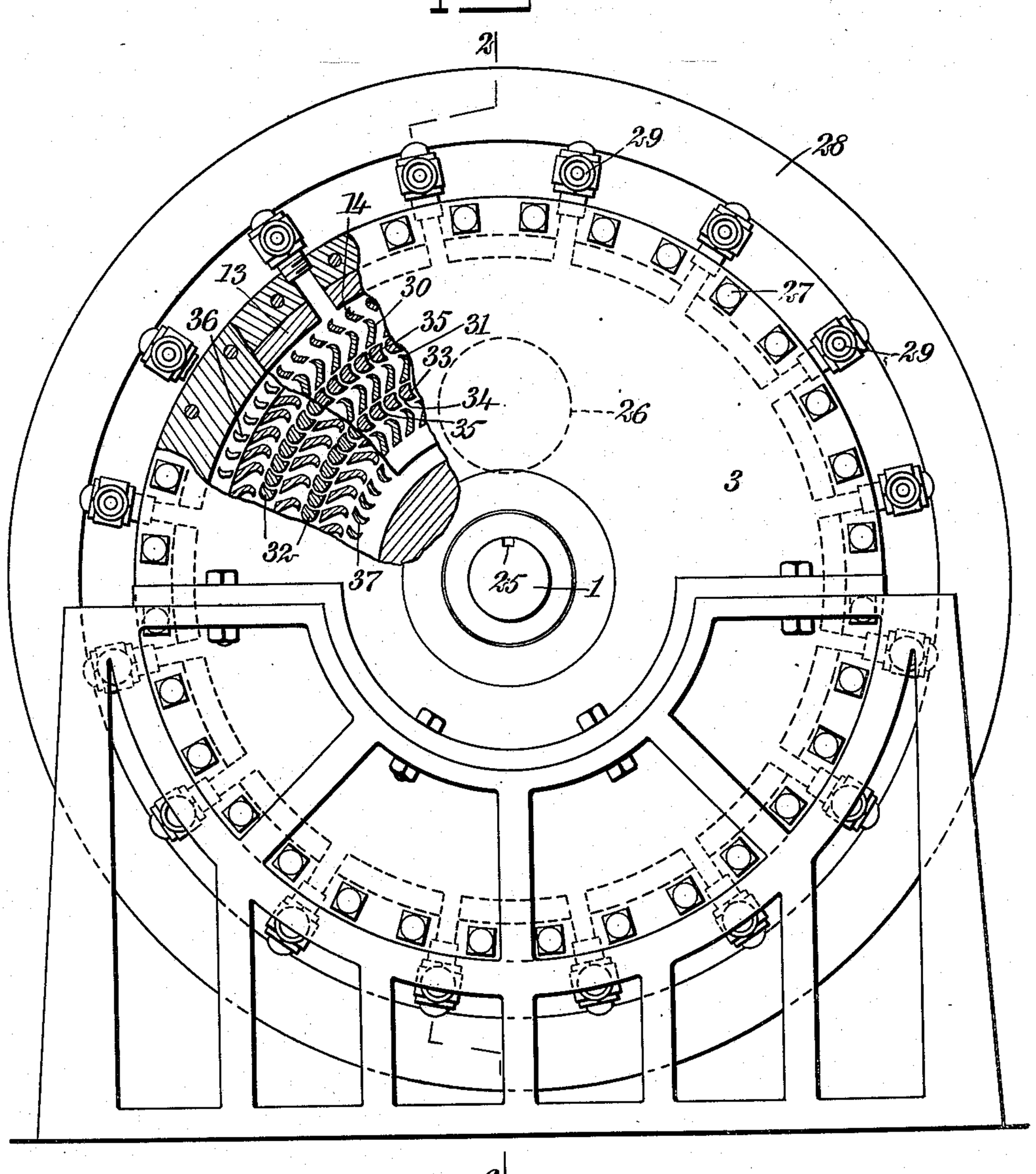
APPLICATION FILED AUG. 4, 1908.

924,309.

Patented June 8, 1909.

2 SHEETS—SHEET 1.

Fig. 1



WITNESSES

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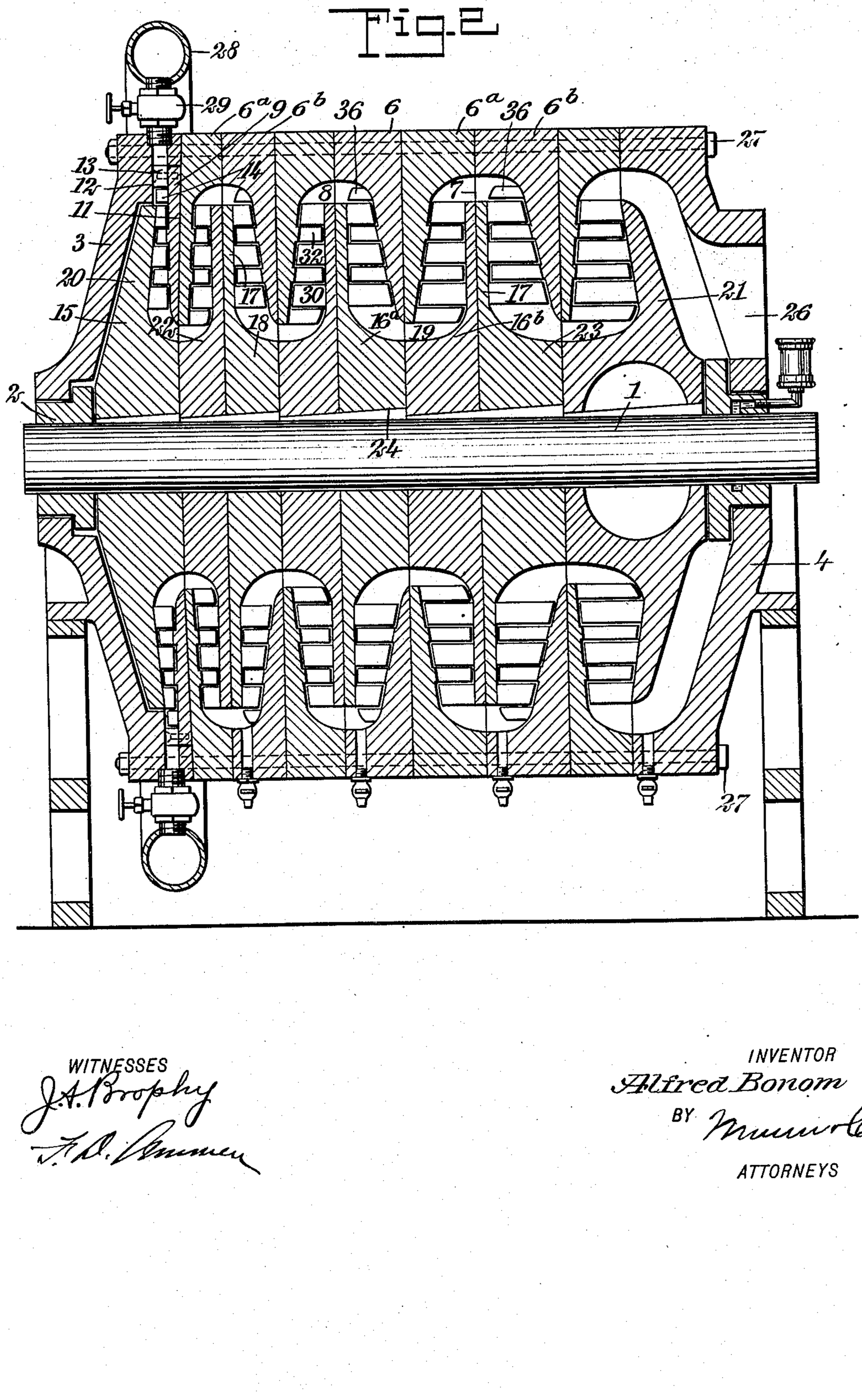
2 SHEETS—SHEET 2.

Fig. 2



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STEAM-TURBINE.

No. 924,309. Specification of Letters Patent. Patented June 8, 1909.

Application filed August 4, 1908. Serial No. 446,911.

To all whom it may concern:

Be it known that I, ALFRED BONOM, a citizen of the Republic of France, and a resident of the city of New York, borough of Manhattan, in the county and State of New York, have invented a new and Improved Steam-Turbine, of which the following is a full, clear, and exact description.

This invention relates to steam turbines and constitutes an improvement on the steam turbine patented to me March 26, 1907, No. 848,432. In this patent there is disclosed a construction in which the steam in passing through the turbine alternately approaches and recedes from the shaft or axis of the rotor. In its passage to and fro it passes in annular conical spaces which enlarge as the steam progresses toward the exhaust end of the turbine. As the steam flows inwardly, although the circumferential area is decreasing, the width of the steam space measured along the axis increases, and vice versa. In this way the increase in volume of the steam space can be readily proportioned, producing a turbine of great compactness and efficiency.

The object of the present invention is to improve the general construction of this type of turbine so as to facilitate its manufacture.

A further object of the invention is to provide an improved arrangement for admitting the steam and for controlling the development of power.

The turbine also presents improvements in the form of the buckets and guide vanes.

The invention consists in the construction and combination of parts to be more fully described hereinafter and particularly set forth in the claims.

Reference is to be had to the accompanying drawings forming a part of this specification, in which similar characters of reference indicate corresponding parts in both the figures.

Figure 1 is an end elevation of the turbine, a portion of the case or stator being broken away so as to disclose the form of the guide vanes and buckets; and Fig. 2 is a longitudinal section on the line 2—2 in Fig. 1, through a turbine constructed according to my invention.

Referring more particularly to the parts, and especially to Fig. 1, 1 represents the shaft of the turbine. The ends of the shaft are suitably mounted in bearings 2 formed in the heads 3 and 4 of the case or stator. The body of this stator is composed of a plurality of rings 6; these rings are of two forms, indicated specifically by the numerals 6^a and 6^b. The rings 6^a and 6^b are arranged in pairs and are oppositely formed, presenting flat or plain outer faces 7 which meet together, as shown. On their adjacent faces the rings 6^a and 6^b are cut away so as to form steam chambers 8, and the faces of the rings which form the side walls of these spaces are inclined, in other words, the inner portions of the rings are tapered in direction of the shaft 1. Adjacent to the head 3, which I shall call the inlet head, I provide a special ring 9. This ring is tapered slightly toward its inner end, and the ring 10 which is adjacent to it has a slightly conical face 11 against which the ring seats, as shown. It will therefore be seen that at this point the meeting faces between the adjacent rings are not flat as are the faces 7, but are slightly conical. The adjacent face of the head 3 is formed with an annular groove 12, and the side face of the ring 9 is formed with projections 13 which extend into the groove and center the ring on the head, as will be readily understood. Just within the groove 12 the face of the head 3 is provided with inlet vanes 14 which are curved so as to direct the steam circumferentially as it flows into the interior of the turbine. In this way the spaces between the vanes 14 constitute inlet nozzles.

The rotor 15 of the turbine is formed of a plurality of sections 16. These sections are of two forms, indicated specifically as 16^a and 16^b. Each section has a disk-shaped body 17 and an enlarged hub 18. The adjacent faces of the sections 16^a and 16^b are cut away so that they form steam chambers 19, said steam chambers constituting continuations of the steam chambers 8 formed in the stator. The end sections 20 and 21 of the rotor are conical in form, as shown, and these end sections unite with the sections 22 and 23 adjacent to the ends of the turbine. The sections 16 of the rotor are attached to the shaft 1 individually by means of keys or cotters 24 which are received in a continuous key seat 25 formed in the shaft, as shown.

The head 4 at the exhaust end of the en-

gine is provided with an exhaust outlet 26 through which the steam finds exit from the engine.

The sections of the stator of the turbine are rigidly held together by a plurality of bolts 27 which are arranged circumferentially in the heads. These bolts firmly clamp all of the sections together and render the joints between them steam-tight.

Disposed around the inlet head 3 there is provided a steam ring 28 in the form of an annular pipe, and this pipe is connected by a plurality of inlet valves 29 with the interior of the turbine. In the illustration shown, I provide sixteen of these valves 29, and they are disposed an equal distance apart, as indicated in Fig. 1. With this arrangement I am enabled to produce a great variety of effects in the steam distribution. Where the engine is to run at low power every fourth one of these valves may be opened, or even fewer of the valves may be opened if desired. The valves which are opened should be disposed substantially an equal distance apart circumferentially so as to produce uniformity in the steam admission or distribution. Where the engine is to run on full power, all of the valves will be opened, and steam will then be admitted at sixteen points on the circumference of the inlet head.

On the sides of the disk body 17 I provide buckets 30. The form of these buckets is very clearly shown in Fig. 1. The body of each bucket is inclined toward the direction in which the rotor turns, and the end of each bucket which receives the steam is curved so as to form a hook 31 against which the steam re-acts as it flows between the buckets. The buckets are disposed in circumferential rows, as shown, and are arranged oppositely so that the steam is effective flowing outwardly and flowing inwardly. Between the rows of buckets 30, guide studs or vanes 32 are attached to the side faces of the sections 6 of the stator. The course of the steam in passing through the engine is alternately inward toward the shaft and outward toward the wall of the stator. As the steam passes from one set of buckets it is directed by the dished faces 33 of the studs onto the next circumferential row of buckets, and so on.

The width of the sections 6 of the stator and the width of the sections 16 of the rotor increase progressively from the inlet end of the engine to the outlet end, from which arrangement the steam spaces 8 and 19 continually enlarge. Attention is called to the fact that as the steam flows inwardly, the reduction in the circumferential area of the current which results is more than compensated for by the increase of width of the steam space in the direction of the shaft. In this way I am enabled not only to increase the steam spaces with respect to each other, but the volume of each steam space increases progressively from the point at which the steam is admitted toward its exit point, for it will be seen that as the steam flows outwardly the width of the steam space is diminished, while the circumferential area of the steam is increasing. In this way by properly constructing the rings 6, a very uniform increase in the volume of the steam space can be effected.

Returning again to a consideration of the form of the guide vanes 32, attention is called to the fact that their rear faces 34 are quite sharply curved, that is, they are convex so that the curved face 34 of each guide vane fits into the dished face 33 of the next guide vane. In this way curved ducts 35 are formed which give the steam the proper direction as it flows from one row of buckets to the next.

It will be seen that the steam spaces through which the steam flows in and out are of substantially conical form and the sides of the cones carry the buckets and guide vanes. At the points where the steam begins to flow inwardly, specially formed guide vanes 36 are provided; and at the points where the steam begins to flow outwardly similar guide vanes 37 are provided as indicated in Fig. 1.

Having thus described my invention, I claim as new and desire to secure by Letters Patent,—

1. A steam turbine having a stator formed of a plurality of ring sections of a width increasing proportionately longitudinally of the axis of rotation, said ring sections having flat abutting faces, and conical faces exposed to the interior of said turbine, the spaces between said conical faces being of increasing volume proportionately with the width of said ring sections, guide vanes carried by said conical faces, a rotor having disks projecting into the spaces between said conical faces and having buckets coöperating with said vanes.

2. A steam turbine having a stator formed of ring sections arranged in pairs, each of said pairs being composed of rings having abutting faces and conical faces exposed to the interior of the turbine, the spaces between said conical faces constituting steam chambers and being of increasing volume longitudinally of the axis of rotation, an inlet ring, a plurality of valves disposed equidistant and admitting steam from said inlet ring to said turbine, a guide vane carried by said conical faces, and a rotor having disks projecting into said steam chambers and having buckets coöperating with said vane.

3. A steam turbine having a stator, a rotor mounted within said stator, said rotor having disks projecting toward said stator carrying buckets, said stator having rings presenting conical faces projecting into the spaces be-

tween said disks and carrying guide vanes coöperating with said buckets, an inlet head, a steam ring mounted at said inlet head, and a plurality of valves disposed circumferentially about said inlet head and affording means for admitting steam thereto from said ring.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ALFRED BONOM.

Witnesses:
F. D. AMMEN,
EVERARD B. MARSHALL.