No. 848,432. PATENTED MAR. 26, 1907.

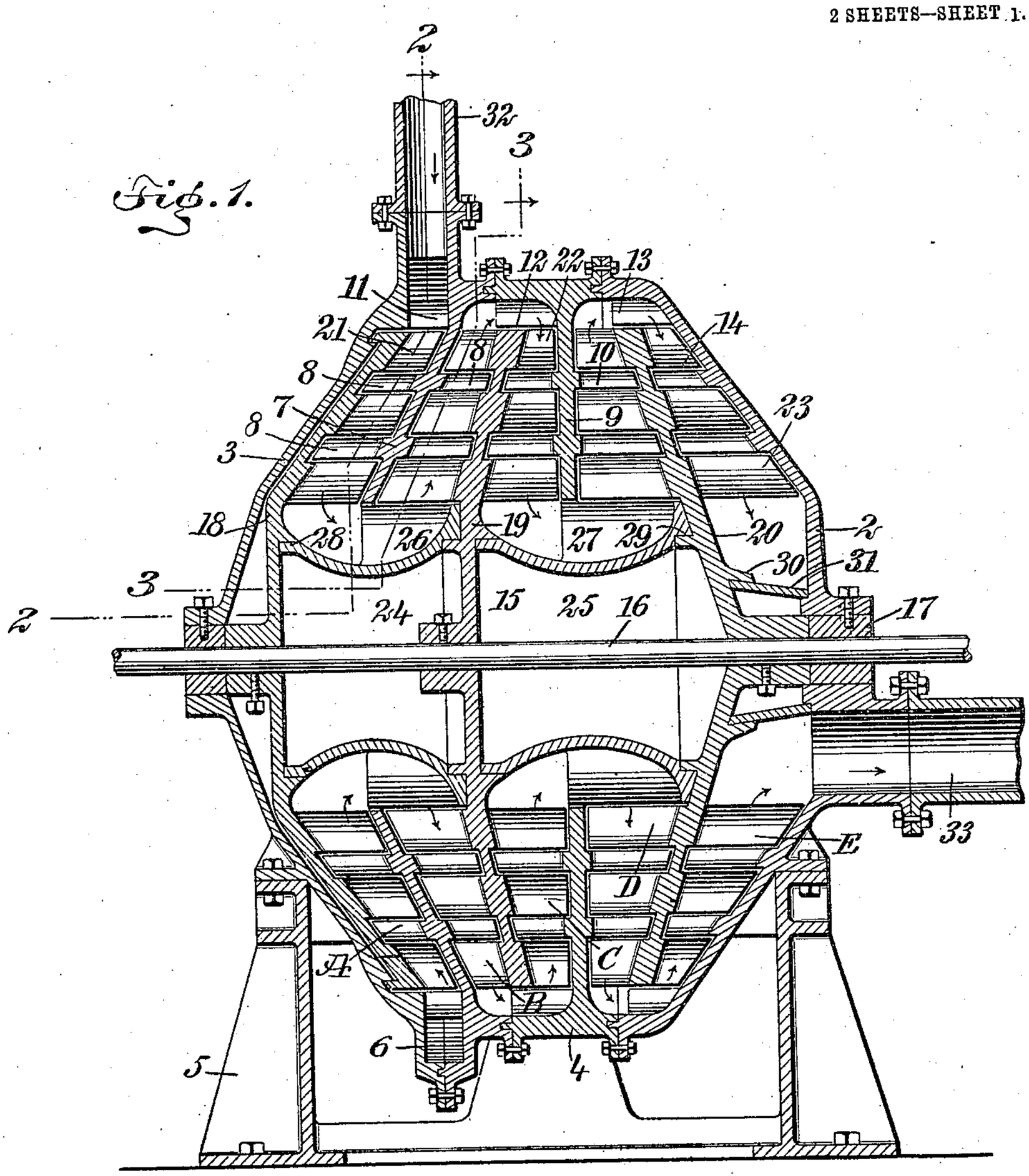
A. BONOM.

STEAM TURBINE.

APPLICATION FILED OCT. 6, 1906.

2 SHEETS—SHEET 1.

Fig. 1.



WITNESSES

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2 SHEETS—SHEET 2.

Fig. 2.

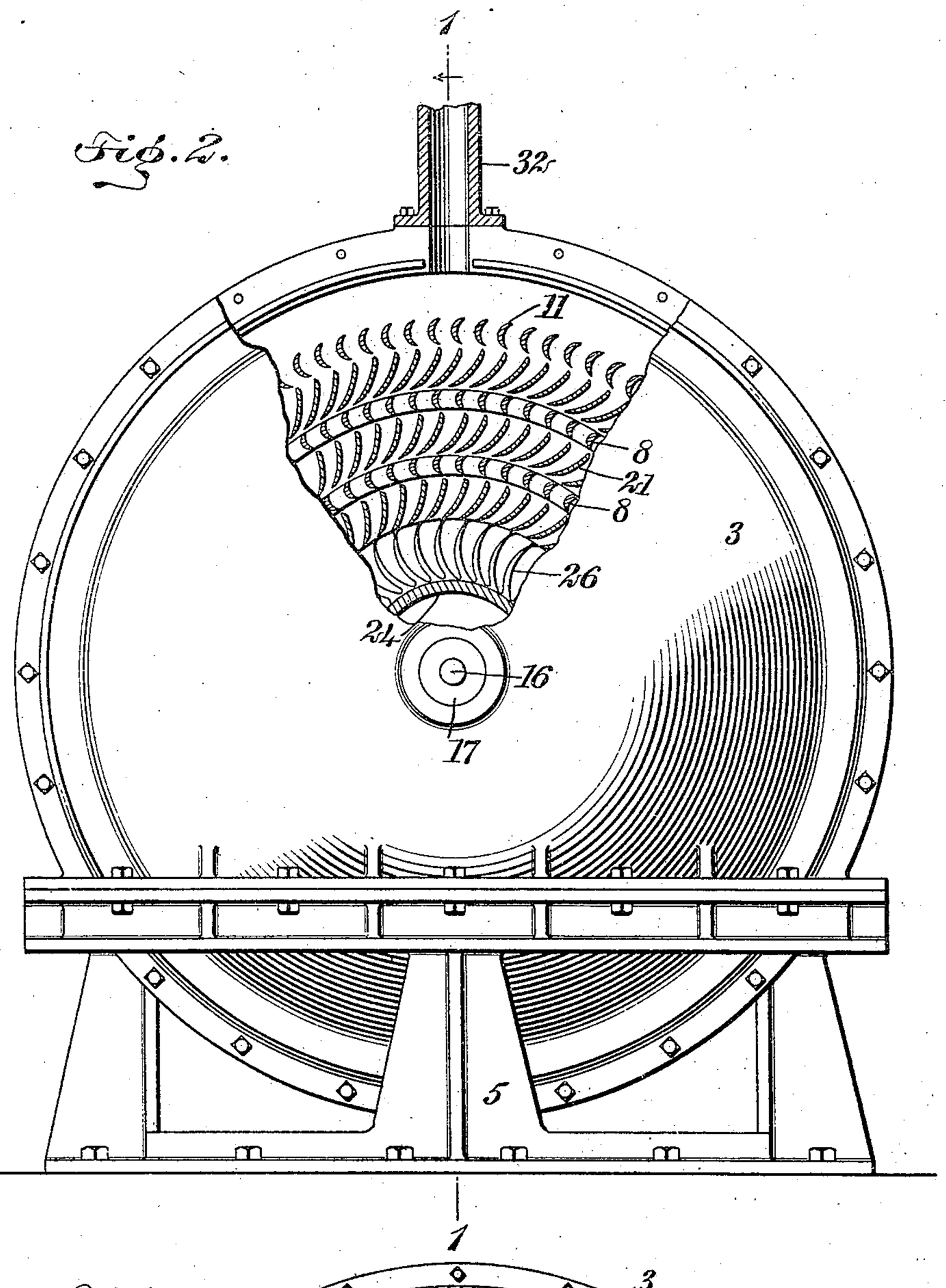
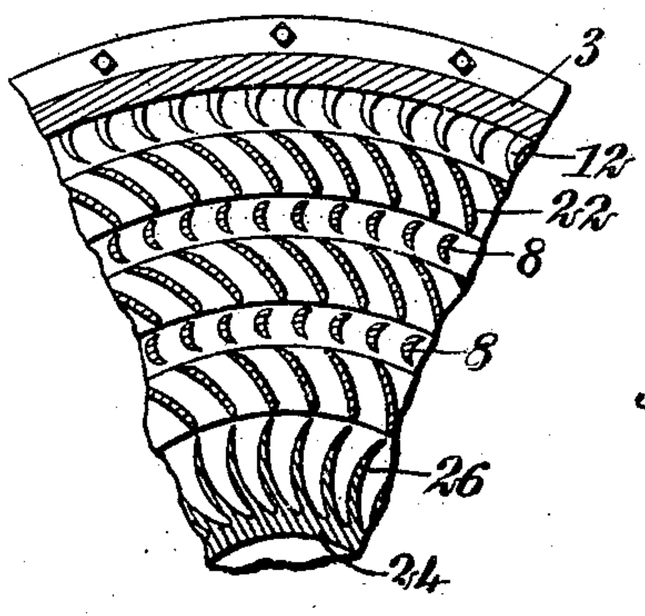


Fig. 3.



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STEAM-TURBINE.

No. 848,432. Specification of Letters Patent. Patented March 26, 1907.

Application filed October 6, 1906. Serial No. 337,727.

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 the general purpose of the invention is to produce a turbine which will be economical in steam consumption and of high efficiency.

More specifically, the object of the invention is to produce a turbine which will be of compact form and in which the steam-space enlarges with the expansion of the steam.

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 all the figures.

Figure 1 is a vertical central section through a turbine constructed according to my invention. Fig. 2 is an end elevation of the turbine, a portion of the same being broken away, so as to show the interior substantially in section on the line 2 2 of Fig. 1; and Fig. 3 is a fragmentary view showing a section through a portion of the turbine on the line 3 3 of Fig. 2.

Referring more particularly to the parts, 1 represents the case of the stator. This case is formed of two head-sections 2 and 3 and an intermediate or ring section 4 and is supported upon a suitable base or frame 5. The arrangement and construction of this base will depend upon the type of turbine adopted, and in this connection it should be understood that the turbine may be set up with a horizontal shaft, as illustrated, or it may be used with a vertical shaft or even mounted in an inclined position. The bodies of the head-sections 2 and 3 of the turbine are substantially conical, so that the side or end walls of the case converge toward their point of attachment to the ring-section or ring 4. The head 3, which constitutes the inlet-head, is provided with an annular inlet-duct or steam-chest 6, and this chest extends continuously around the entire case, as shown. This head 3 is provided with an inwardly-projecting bucket-cone 7, which is preferably formed integral therewith, as shown. This bucket-cone projects into the interior of the turbine, as shown, and is provided on its opposite faces with nozzle-rings 8.

On the inner side of the ring 4 a disk or bucket plate 9 projects into the interior of the case, and this plate is formed on opposite sides into nozzle-rings 10, which are substantially similar to the nozzle-rings 8, referred to above. These nozzle-rings, as illustrated in Fig. 2, are formed by a plurality of crescent-shaped studs or guide-buckets 11, which project parallel to the axis of the turbine, as indicated. On the inner side of the ring 4, or on the left-hand side of the bucket-plate 9 as viewed in Fig. 1, I provide guide-vanes 12, the form and arrangement of which is illustrated in Fig. 3. Their form and purpose will be described more fully hereinafter.

On the inner face of the head 2, near the outer portion of the case, guide-vanes 13 are provided, which are similar in form to the guide-vanes 12, referred to. On the inner face of the head 2 and on the conical portion thereof nozzle-rings 14 are formed, which are provided with nozzles or buckets which are similar in form to the buckets 11, referred to above.

Within the case there is mounted a rotor 15, which is rigidly attached to a shaft 16, which shaft is rotatably mounted in boxes 17, held in the heads 2 and 3, as shown. This rotor is formed of three cones or cone-plates 18, 19, and 20. The cone 18 lies adjacent to the head 3, conforming to the shape of the outer portion of this head, as shown. On the inner face of the cone-plate 18, which lies adjacent to the buckets 11, inwardly-projecting buckets or vanes 21 are carried, and the arrangement of these vanes is very clearly shown in Fig. 2. They are of curved form and incline in an opposite direction, in which the points or lower edges of the buckets 11 project. The cone-plate 19 projects into the space between the bucket 7 and the bucket-plate 9 and its opposite faces are provided with buckets 22, which are substantially similar to the buckets 21, just described. The cone-plate 20 projects into the space between the bucket-plate 9 and the head 2, and its opposite faces are provided with buckets 23, which are similar in form to the buckets 21 and 22. The cones 18, 19, and 20 are rigidly attached to the shaft 16, as stated, and the space between them near their inner portions is occupied by guide-drums 24 and 25.

These drums have concaved faces, as shown, and the face of the drum at one end constitutes a continuation of the faces of the cone-plates adjacent to which the drums terminate. In other words, the face of the drum 24 constitutes a continuation of the face of the cone 18 at its left-hand end, while at its right-hand end it constitutes a continuation of the face of the cone 19. Similarly the face of the drum 25 constitutes a continuation of the right-hand face of the cone 19 and the left-hand face of the cone 20. In this way the drums constitute guides for directing the steam through the turbine in a manner which will be descibed more fully hereinafter. On its outer face the drum 24 is provided with a plurality of guide-vanes 26, the arrangement and form of which is illustrated in Fig. 2. These guide-vanes are formed integrally with the bucket-cone 7, so that the drum 24 is rigidly connected with the case 1 and the head 3. The outer face of the drum 25 is similarly provided with guide-vanes 27, which are similar in form and arrangement to the guide-vanes 26, just described, and these guide-vanes are integral with the bucket-plate 9, so that the drum 25 is also rigid with the case. The ends of the drums 24 and 25 are formed with turned or cylindrical faces 28, which are received against similar faces 29 which are formed on the cones, from which arrangement it should be understood that the rotor rotates freely within the case and around the drums 24 and 25. On the outer face of the cone 20 an outwardly-projecting boss 30 is provided, which is of annular form and which affords means for retaining a conical collar 31, which connects the end head 2 with the cone, as shown. The steam is admitted through an inlet-pipe 32 into the annular steam-chest 6, and it finds exit from the turbine through the head 2 near the shaft 16 at a suitable exhaust-pipe 33.

From the construction described it will be seen that five steam-spaces A, B, C, D, and E are formed. The steam-space A is formed between the cone 18 and the bucket-cone 7, while the space B is formed between the bucket-cone 7 and the cone 19. Between the cone 19 and the bucket-plate 9 the steam-space C is formed, and between the bucket-plate 9 and the cone 20 the steam-space D is formed. At the head 2 the steam-space E is formed on the outer side of the cone 20. These steam-spaces enable the steam to be expanded in a succession of phases or stages. Attention is especially called to the inclination or angular arrangement of the cones of the rotor with respect to the bucket-plate or bucket-cone of the stator. While the cones 18, 19, and 20 converge toward their outer edges, it will be observed that the bucket-cone 7 lies in an intermediate position between the cones 18 and 19. Furthermore, this bucket-cone is nearer to the cone 18 than to the cone 19, so that the volume of the steam-space B is slightly larger than the volume of the steam-space A. Furthermore, it will be observed that the length of all the steam-spaces increases at the inner portion of the steam-spaces—that is, at the nearest point to the shaft 16. The bucket-plate 9 projects into the space between the cones 19 and 20 and is disposed nearer to the cone 19 than to the cone 20, so that the volume of the steam-space D is greater than that of the steam-space C. Furthermore, the steam-space C is of substantially the same volume as the steam-space B, though it may be made greater, if desired. In passing through the turbine steam enters from the steam-chamber 6 into the steam-space A and is guided in its course by the buckets 8, so that it impinges successively upon the vanes of the rotor, always traveling inwardly toward the shaft. It will be observed that the area of the section of the stream toward and from the axis in this manner would decrease contantly if the walls between which the steam flowed were parallel with each other. In order to prevent a contraction of the area and in order to enable the steam-space to actually increase in area as the steam progresses inwardly, I provide the inclined arrangement shown. Thus it will be seen that as the steam flows inwardly and reaches the innermost vanes of the cone 18 the dimension of the current of steam measured parallel with the axis will be greatly enlarged. It will be observed that this principle is carried out throughout the entire turbine. As the steam reaches the annular space which is formed around the drum 24 it passes between the guide-vanes 26 and is deflected by them upon the vanes 22, which are carried by the cone 19. It passes successively through the buckets 8 and is deflected successively upon the vanes as it flows outwardly toward the outer wall of the case. The longitudinal dimension of the current measured parallel with the axis decreases as it approaches the periphery of the rotor; but it will be remembered that this is compensated for by the increased circumferential dimensions at this part. In reaching the ring 4 the steam is deflected by the guide-vanes 12 inwardly, so that it passes successively over the vanes 22 and the buckets 10, which project into the steam-space C. As the steam arrives at the drum 25 it is deflected by the guide-vanes 27 onto the vanes 23, which are carried by the cone 20 and which project into the steam-space D. In this way the steam passes again to the periphery of the rotor, and there it is deflected by the guide-vanes 13 onto the vanes 23 of the cone 20, which project into the steam-space E. In this way the steam is made to pass across a plurality of vanes arranged in each of the steam-spaces, which vanes all incline in the same direction,

so that a rotative force is given to the rotor, and, furthermore, as the steam passes from one steam-space to the next its volume will increase according to the design of the turbine.

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

1. A turbine-engine having a rotor having outwardly-converging cones and vanes carried thereby, and a stator having bucket-plates projecting into the spaces between said cones and carrying buckets adapted to deflect the steam onto said vanes.

2. In a turbine, in combination, a rotor having cones projecting outwardly therefrom and converging toward their outer edges, a stator having bucket-plates projecting into the space between said cones, means for directing the steam inwardly and outwardly with respect to the axis of said turbine and between said plates and said cones, the arrangement being such that the steam-spaces formed between said plates and cones are of increased width near the axis of the said turbine, and buckets and vanes carried respectively by said plates and said cones.

3. In a turbine, in combination, a rotor having outwardly-projecting plates, a stator having a plurality of plates projecting into the spaces between said first plates, buckets and vanes carried by said plates, said plates being inclined with respect to each other whereby courses of enlarging cross-section are presented to the steam, and means for directing the flow of steam inwardly and outwardly between said plates, and buckets and vanes carried by said plates.

4. In a turbine, in combination, a rotor having cones converging toward their outer edges, a stator having plates projecting inwardly between said cones whereby steam-spaces are formed, said plates having buckets, said cones having vanes receiving the steam from said buckets whereby the steam may be directed inwardly and outwardly in said steam-spaces, and guiding means at the inner edges of said plates and directing the steam between said steam-spaces.

5. In a turbine, in combination, a rotor having outwardly-projecting cones, a stator having inwardly-projecting plates forming steam-spaces between said cones, means for causing the steam to flow inwardly and outwardly alternately in said steam-spaces, drums connecting said cones near the axis of said rotor and rigid with said stator, said drums affording means for guiding the steam between said steam-spaces.

6. In a turbine, in combination, a rotor having outwardly-projecting cones, a stator having inwardly-projecting plates forming steam-spaces between said cones, means for causing the steam to flow inwardly and outwardly alternately in said steam-spaces, drums connecting said cones near the axis of said rotor and rigid with said stator, said drums affording means for guiding the steam between said steam-spaces, and guide-vanes on said drums and receiving the steam from a forward steam-space and directing the same toward the rearwardly-disposed steam-spaces.

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

ALFRED BONOM.

Witnesses:
F. D. AMMEN,
JNO. M. RITTER.