R. H. GOLDSBOROUGH.

TURBINE.

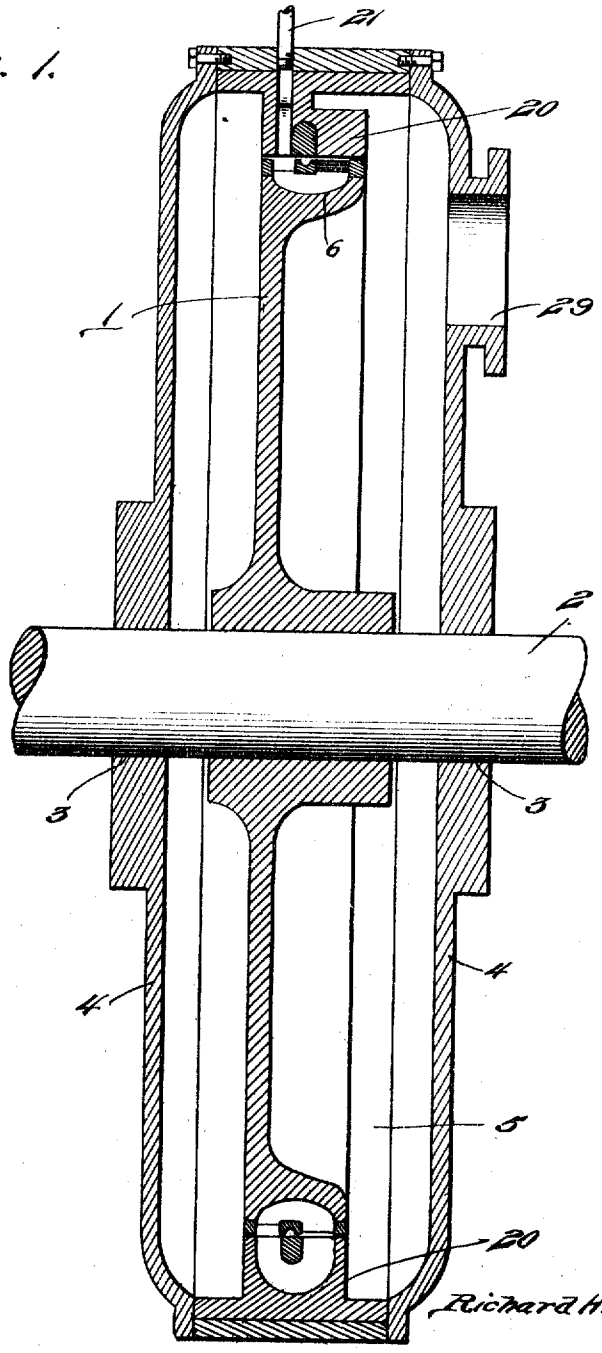
APPLICATION FILED DEC. 4, 1908.

911,492.

Patented Feb. 2, 1909.

5 SHEETS—SHEET 1.

Fig. 1.



Witnesses

B. M. Offutt, Jr.

K. P. McElroy.

Inventor

Richard H. Goldsborough

By

G. Dyrenforth

Attorney

R. H. GOLDSBOROUGH.

TURBINE.

APPLICATION FILED DEC. 4, 1908.

911,492.

Patented Feb. 2, 1909.

5 SHEETS—SHEET 2.

Fig. 2.

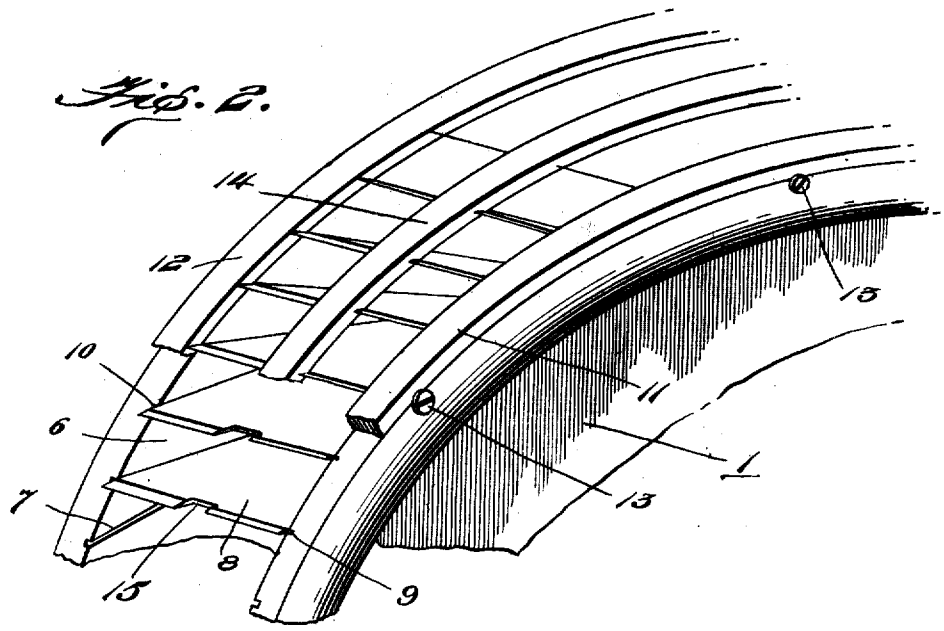


Fig. 4.

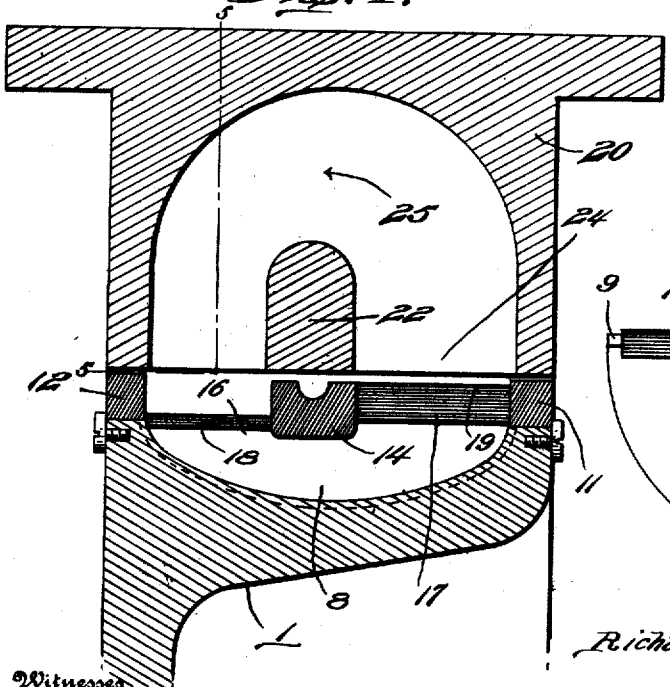
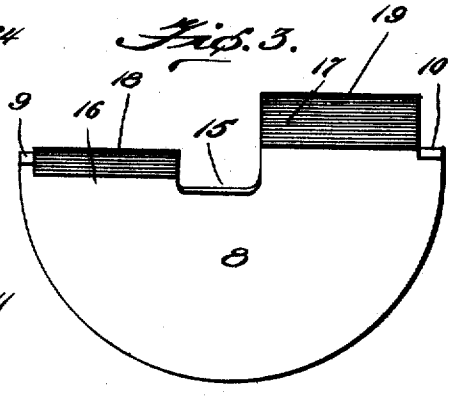


Fig. 3.



Witnesses.

B. M. Offutt, Jr.

K P McElroy

Inventor

Richard H. Goldsborough

By

G. Ayres

Attorney

R. H. GOLDSBOROUGH.

TURBINE.

APPLICATION FILED DEC. 4, 1908.

911,492.

Patented Feb. 2, 1909.

5 SHEETS—SHEET 3.

Fig. 5.

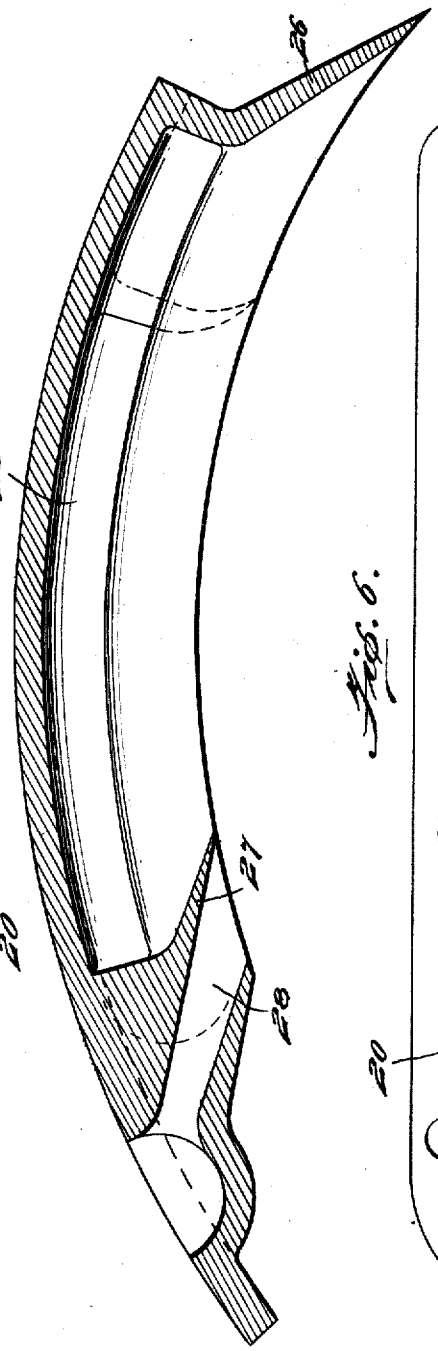
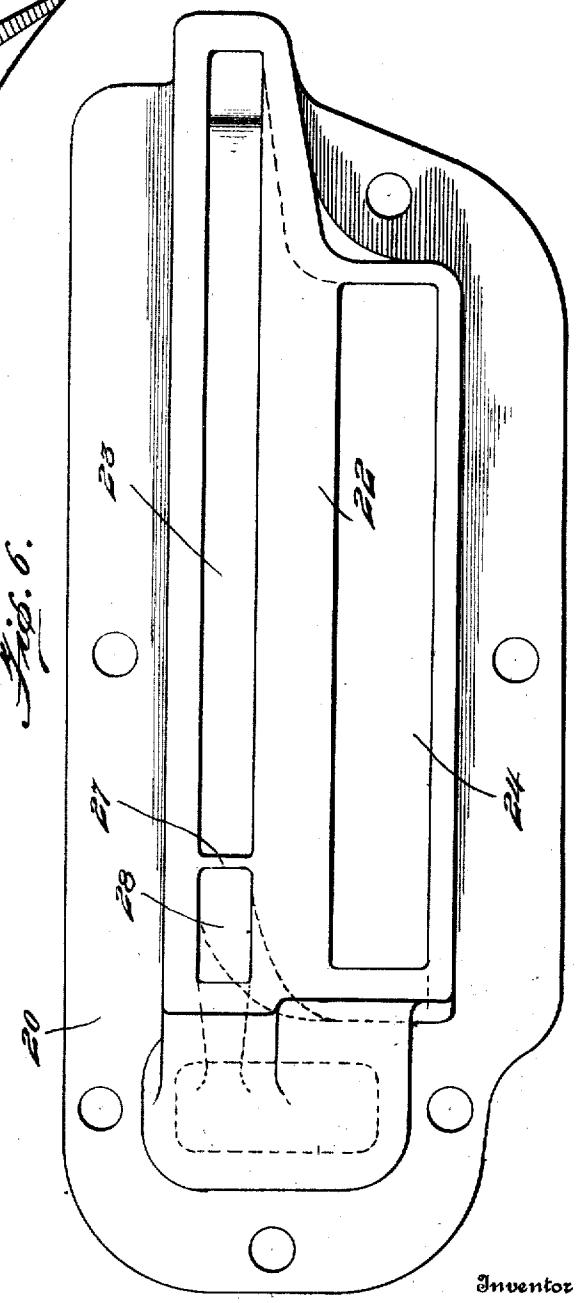


Fig. 6.



Witnesses

B. M. Offutt Jr.

K. P. McElroy

Inventor

Richard H. Goldsborough

By

G. Auer

Attorney

R. H. GOLDSBOROUGH.

TURBINE.

APPLICATION FILED DEC. 4, 1908.

911,492.

Patented Feb. 2, 1909.

5 SHEETS—SHEET 4.

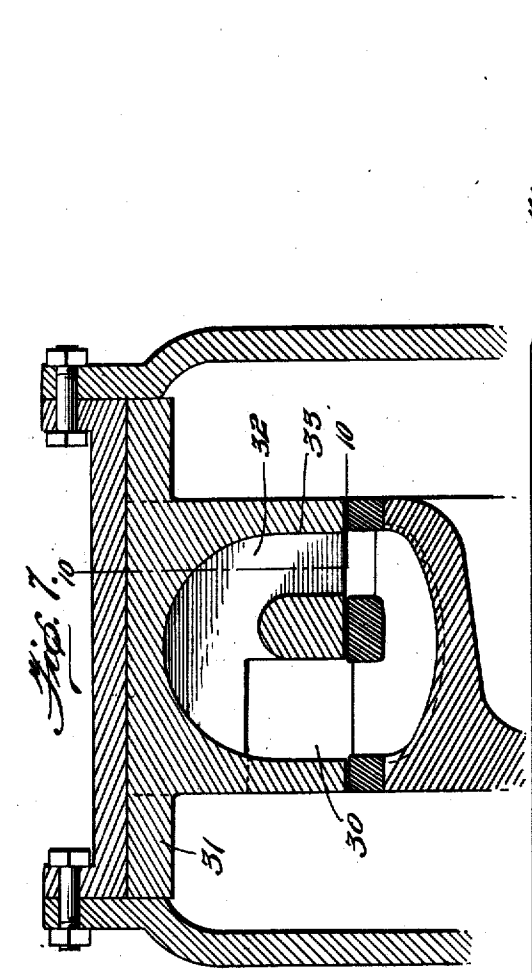


Fig. 7.

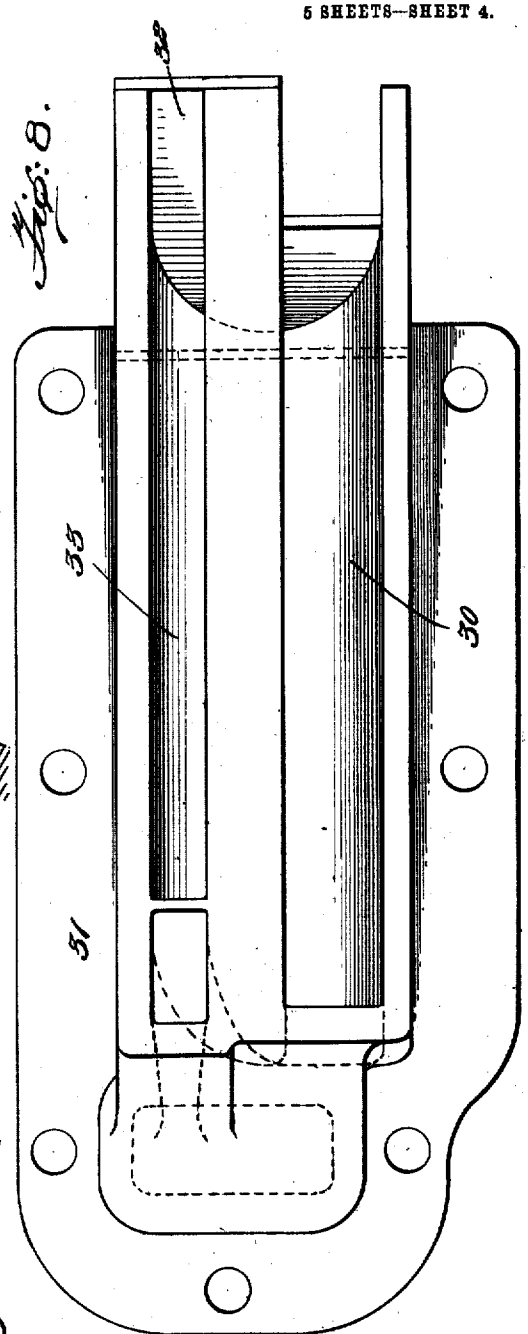


Fig. 8.

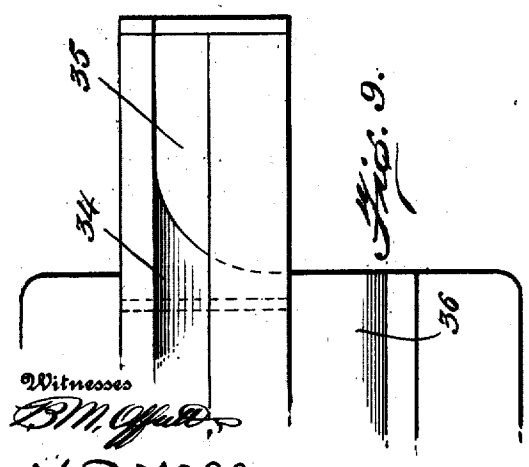


Fig. 9.

Witnesses

B. M. Gluck

K P McElroy

Inventor

Richard H. Goldsborough

By

G. Ayres

Attorney

R. H. GOLDSBOROUGH.

TURBINE.

APPLICATION FILED DEC. 4, 1908.

911,492.

Patented Feb. 2, 1909.

5 SHEETS—SHEET 5.

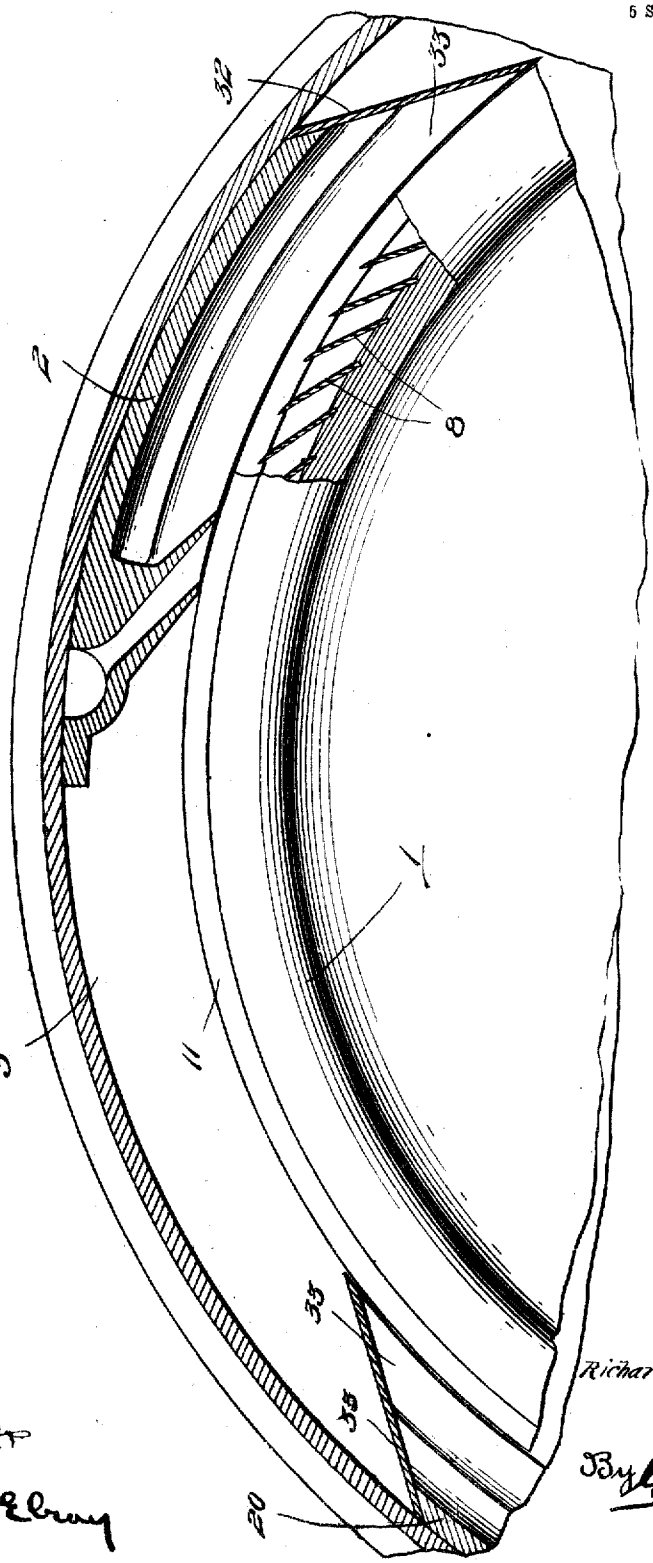


Fig. 10

Witnesses

K. P. McElroy

Inventor

Richard H. Goldsborough,

By H. Ayres

Attorney

UNITED STATES PATENT OFFICE.

RICHARD H. GOLDSBOROUGH, OF WASHINGTON, DISTRICT OF COLUMBIA.

TURBINE.

No. 911,492. Specification of Letters Patent. Patented Feb. 2, 1909.

Application filed December 4, 1908. Serial No. 466,011.

To all whom it may concern:

Be it known that I, RICHARD H. GOLDSBOROUGH, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Turbines, of which the following is a specification.

My invention relates to turbines, and it consists in the constructions, combinations and arrangements herein described and claimed.

An object of my invention is to provide a compact and inexpensive turbine construction, which will have a high efficiency under all operative conditions.

A further object of my invention is to provide an improved repeated-impact turbine, in which the steam between the several impacts will flow upon and be directed by the steam directed between the next preceding impacts.

A further object of my invention is to provide an improved turbine, in which the actuating steam will be directed to and through the rotor vanes in a compact body of greater cross-section than has been possible in previous constructions; thereby practically eliminating the wasteful leakage losses, and permitting the employment of advantageously large rotor clearance.

A further object of my invention is to provide an improved turbine, having radial-flow rotor vanes of greater axial width than is practical in previous constructions, with a resultant minimization of the losses due to fluid and surface friction.

In the accompanying drawings, forming a part of this application and in which similar reference symbols indicate corresponding parts in the several views: Figure 1 is a central, vertical section, illustrating one embodiment of my invention; Fig. 2 is a detail perspective view of the rotor, with the securing and clamping rings partly broken away; Fig. 3 is a face view of one of the rotor vanes; Fig. 4 is an enlarged view of the rotor rim and coöperating stationary section shown at the lower portion of Fig. 1; Fig. 5 is a section on the line 5—5 of Fig. 4; Fig. 6 is an inner plan view of one of the stationary sections; Fig. 7 is a detail axial section, illustrating a modified form of stationary section; Fig. 8 is an inner plan view of the section shown in Fig. 7; Fig. 9 is a fragmentary inner plan view, illustrating a slight modification of stationary section shown in Figs. 7 and 8, and Fig. 10 is a section on the line 10—10 of Fig. 7.

Referring to the drawings, 1 indicates a turbine rotor, secured on a shaft 2 extending through suitable bearings 3 in the heads 4 of a casing 5. The rotor is provided with a peripheral channel 6 having grooves 7 in its walls for positioning at an efficient angle an annular series of vane blades 8. The blades 8 are preferably formed of plates slidably fitting the grooves 7, and provided with shoulders 9 and 10 for engagement by securing rings 11 and 12; said rings being secured to the rotor, as by screws 13, in position to overlap the grooves 7 and firmly engage the peripheral edges of the blade shoulders 9 and 10.

A clamping ring 14 is shrunk, or otherwise suitably secured, about the medial portion of the periphery of the annular series of vane blades; a recess 15 being preferably formed in the peripheral edge of each vane for firmly seating said clamping ring. The ring 14 is shaped to constitute a continuous vane core, for providing the several vanes with U-shaped passages having admission legs 16 and exhaust legs 17.

As shown especially in Fig. 4, the securing rings 11 and 12 constitute the periphery of the assembled rotor, and the admission and exhaust legs of the vanes terminate within such periphery; the admission legs 16 being preferably beveled on both faces to provide a knife edge 18, and the exhaust legs 17 beveled on their front faces to a knife edge 19. This improved vane construction with the securing rings 11 and 12 and clamping ring 14 minimizes the weight of the vanes and the action of centrifugal force thereon during operation. The securing rings positively lock the vane blades to the rotor, and the clamping ring engages the peripheral edges of said blades in the radial plane of their center of gravity to rigidly clamp the blades from bending or distortion under the action of centrifugal force.

This invention provides radial-flow vanes of exceedingly greater axial width than is possible in previous constructions; thereby permitting the actuating steam to be direct-

ed through the vane passages in a volume of sufficiently large cross-section to minimize the losses of fluid and surface friction, and to practically eliminate the wasteful leakage losses.

Any desired number of stationary sections 20 are secured about the rotor for supplying steam to the vanes. As an example, with a rotor thirty inches in diameter provided with my improved vane construction, each section 20 can be conveniently given a capacity of one hundred horse power.

The steam is conducted to the several sections 20 by independent pipes 21, thereby enabling any desired number of said sections to be conveniently cut out for operating the turbine at maximum efficiency at various loads within its capacity. Each section 20 comprises an arc-shaped member provided with an initial port 28 for directing the actuating steam to its first impact on the rotor vanes, and a common chamber for repeatedly directing the steam to successive impacts in a consolidated body of circumferentially-disposed steam layers; said common chamber being provided with a rear guiding surface 27 and a front guiding surface 26 inclined to the periphery of the rotor at a smaller angle than said rear surface 27. The front and rear guiding surfaces confine the consolidated steam body flowing through the common chamber, and guide the successive steam layers thereof at progressively decreased angles to the rotor. A core 22 confines the steam in the common chamber to a U-shaped passage of uniform transverse section; said passage comprising an admission port 23 for directing steam to the rotor vanes, an exhaust port 24 for receiving the exhaust from said vanes, and a deflecting passage 25 connecting said admission and exhaust ports.

In the operation of my invention, the actuating steam is directed by the initial port 28 to the vanes, from which it is discharged into the adjacent rear portion of the exhaust port 24. The steam then flows through the deflecting passage 25, and is directed by the admission port 23 to the vanes; during such travel of the steam between its successive impacts, it impinges upon, and is guided at an efficient angle by, the rear guiding partition 27. The steam thus directed to its second impact with the vanes, is discharged therefrom into the adjacent portion of the common exhaust port 24 in juxtaposition with the steam discharged thereinto from the first impact; the steam discharge from the first impact constituting a fluid cushion for directing the discharge from the second impact. The discharges from the first and second impacts then flow in a consolidated body through the deflecting passage 25, and are directed by the common admission port 23 to the vanes in second and third impacts, respectively. During such flow of the steam discharges in a consolidated body through the ports and deflecting passage, the discharge from the first impact is guided at an efficient angle by the partition 27 and the initial steam supply flowing past the inner edge of said partition, and the discharge from the second impact is guided at an efficient angle by the more rapidly flowing first discharge upon which it impinges. The steam is discharged from the second and third impacts into the common exhaust port 24, simultaneously with the discharge thereinto from the first impact; the several steam discharges flowing through the common chamber in a consolidated body, in which each discharge impacts upon and is efficiently guided by the more rapidly flowing discharge from the preceding impact.

From the above description, it will be seen that a single common chamber can be efficiently employed for any desired number of repeated impacts of the actuating steam; the exhaust from the final impact discharging past the front wall 26 of the stationary section into the turbine casing. Suitable means, such as a conduit 29, is provided for leading the final exhaust from the casing to any desired point.

My invention, thus, provides a construction in which a volume of steam is progressively directed along a helical path to repeated impacts with the vanes; the several steam layers constituting the spirals of such helical flow impinging upon the preceding layers, and being efficiently guided thereby. This provides a highly advantageous construction, in which the surface friction incident to the employment of guiding blades or a multiplicity of nozzles is eliminated, and in which the losses occasioned by dispersion and fluid friction are minimized.

Figs. 7, 8 and 10 illustrate a modification in which the front end of the common exhaust port 30 of the stationary section 31 is open in free communication with the turbine casing which receives the final exhaust. In this modification, I preferably employ a plate 32 for closing the front end of the common admission port 33, and extend said plate across the upper, or outer, portion of the common exhaust port 30. As shown in Fig. 10, the plate 32 is sharply inclined for rearwardly deflecting the relatively slowly flowing discharge impinging thereon from the next to the final impact; thereby causing such discharge to strongly impinge upon the discharge from the preceding impact, and insuring an efficient consolidation of the several steam layers in the common chamber. An important advantage of this modification is that when the velocity of the actuating steam has been so decreased

by repeated impacts that its speed is too low for efficient employment in a further impact, the relatively slowly moving discharge from the vanes will escape through the open end of the common exhaust port 30; thus automatically preventing the loss of power caused by passing steam at an inefficiently low velocity through the rotor vanes.

Fig. 9 illustrates a slight modification, in which the front end of the admission port 34 of the stationary section is closed by an inclined plate 35 similar to that previously described, and the front end of the exhaust port 36 of said section is formed radially and in free communication with the interior of the turbine casing.

I have illustrated and described preferred and satisfactory constructions, but changes could be made within the spirit and scope of my invention.

Having thus described my invention, what I claim as new and desire to secure by Letters-Patent is:

1. In a turbine, the combination of a series of rotor buckets, and a common, curvilinear, inclosed passage or chamber provided with front and rear guide walls and with a working guide bar or core constituting an inner wall of said chamber and dividing the latter into admission and exhaust ports, for receiving and reversing a plurality of steam currents, and for differentially directing such currents along paths of uniform length in a consolidated mass simultaneously into a plurality of said buckets, substantially as described.

2. In a turbine, the combination of a series of rotor buckets, and a common, curvilinear, inclosed passage or chamber provided with a working guide bar or core constituting an inner wall of said chamber and dividing the latter into admission and exhaust ports, for receiving and reversing a plurality of steam currents, and for differentially directing such currents along paths of uniform length in a consolidated mass simultaneously into a plurality of said buckets, said chamber being closed at both ends of its admission or nozzle port, and partially open at the farther end only of its exhaust or receiving port for automatically by-passing or preventing the reentry of any part of such steam currents after the latter have been degraded by loss of velocity into a radial course, substantially as described.

3. In a turbine, the combination of an annular series of vanes, and a common chamber for successively directing a volume of steam along paths of uniform length to progressively advanced portions of said vane series, substantially as described.

4. In a turbine, the combination of an annular series of vanes, and a common chamber for directing a circumferentially-disposed series of abutting steam layers along paths of substantially equal length to said vanes, substantially as described.

5. In a turbine, the combination of an annular series of vanes, and a common chamber having an outer wall parallel to the periphery of said annular vane series for directing a volume of steam along a helical path successively to progressively advanced portions of said vane series, substantially as described.

6. In a turbine, the combination of an annular series of vanes, and a common chamber for directing a volume of steam along paths of substantially equal length to successive impacts on said vane series, substantially as described.

7. In a turbine, the combination of an annular series of vanes, and a common chamber for directing a circumferentially-disposed series of steam layers in a consolidated body to said vanes, said chamber being provided with a rear guiding surface inclined to the periphery of said annular vane series and with a front guiding surface inclined to such periphery at a less angle than said rear surface, substantially as described.

8. In a turbine, the combination of an annular series of vanes, and a common chamber for directing a circumferentially-disposed series of consolidated steam layers to said vanes, said chamber being provided with front and rear guiding surfaces extending at different angles to the periphery of said annular vane series, substantially as described.

9. In a turbine, the combination of an annular series of vanes, and a common chamber for successively directing a circumferentially-disposed series of consolidated steam layers to progressively advanced portions of said vane series, said chamber being provided with a deflecting surface for rearwardly deflecting the several steam layers against the preceding layers, and with front and rear guiding surfaces for directing the consolidated steam layers at an efficient angle to said vanes, substantially as described.

10. In a turbine, the combination of an annular series of vanes, and a common chamber for directing a circumferentially-disposed series of steam layers in a consolidated body to said vanes, said chamber being provided with front and rear guiding surfaces for confining such consolidated steam body and guiding the several layers thereof at an efficient angle to said vanes, substantially as described.

11. In a turbine, the combination of an annular series of vanes, and a common chamber for directing a circumferentially-

disposed series of steam layers of different velocities in a consolidated body to said vanes, said chamber being provided with front and rear guiding surfaces for confining such consolidated steam body and guiding the successive layers thereof at progressively decreased angles to said vanes, substantially as described.

12. In a turbine, the combination of an annular series of vanes, and a common chamber for directing a circumferentially-disposed series of steam layers to said vanes, said chamber being provided with a core extending circumferentially therein parallel to the periphery of said annular vane series for confining the several steam layers, substantially as described.

13. In a turbine, the combination of an annular series of vanes, and a common chamber for repeatedly directing a volume of steam along paths of uniform length to said vanes, substantially as described.

14. In a turbine, the combination of an annular series of vanes, and a common chamber constituting admission and exhaust ports for repeatedly directing a volume of steam along paths of uniform length to said vanes, such admission port being closed at its front and rear ends by guiding surfaces, substantially as described.

15. In a turbine, the combination of an annular series of vanes, and a common chamber for repeatedly directing a volume of steam along paths of uniform length to said vanes, said chamber comprising an admission port closed at both ends by guiding surfaces, and an exhaust port having its front end in free communication with the final exhaust, substantially as described.

16. In a turbine, the combination of an annular series of vanes, and a common chamber for directing a volume of steam repeatedly along paths of uniform length to said vanes, said chamber comprising an admission port closed at its front and rear ends, and an exhaust port having its front end partially closed by a guiding surface, substantially as described.

17. In a turbine, the combination of a rotor provided with a peripheral channel, an annular series of vane blades positioned in such channel and provided with medial recesses in their peripheral edges, securing rings engaging the axial edges of said vanes, and a clamping ring shrunk to a seat in such medial recesses of said vanes, substantially as described.

18. In a turbine, the combination of a rotor, a series of radial-flow vane blades, detachable means for securing the axial edges of said blades to said rotor, and a clamping ring engaging the peripheral edges of said blades at a point intermediate of said securing means, substantially as described.

19. In a turbine, the combination of a rotor provided with a peripheral channel, a series of vane blades extending across such channel, securing rings overlapping the axial edges of said blades, and a clamping ring extending medially about the peripheral edges of said blades, substantially as described.

20. In a turbine, the combination of a rotor provided with a peripheral channel having grooved walls, vane blades extending within such grooves, securing rings overlapping such grooves, and a clamping ring medially engaging the peripheral edges of said blades to constitute a continuous vane core, substantially as described.

21. In a turbine, the combination of a rotor provided with a peripheral channel, vane blades extending across such channel, and a series of spaced detachable rings engaging the peripheral edges of said blades, substantially as described.

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

RICHARD H. GOLDSBOROUGH.

Witnesses:

G. AYRES,

B. M. OFFUTT.