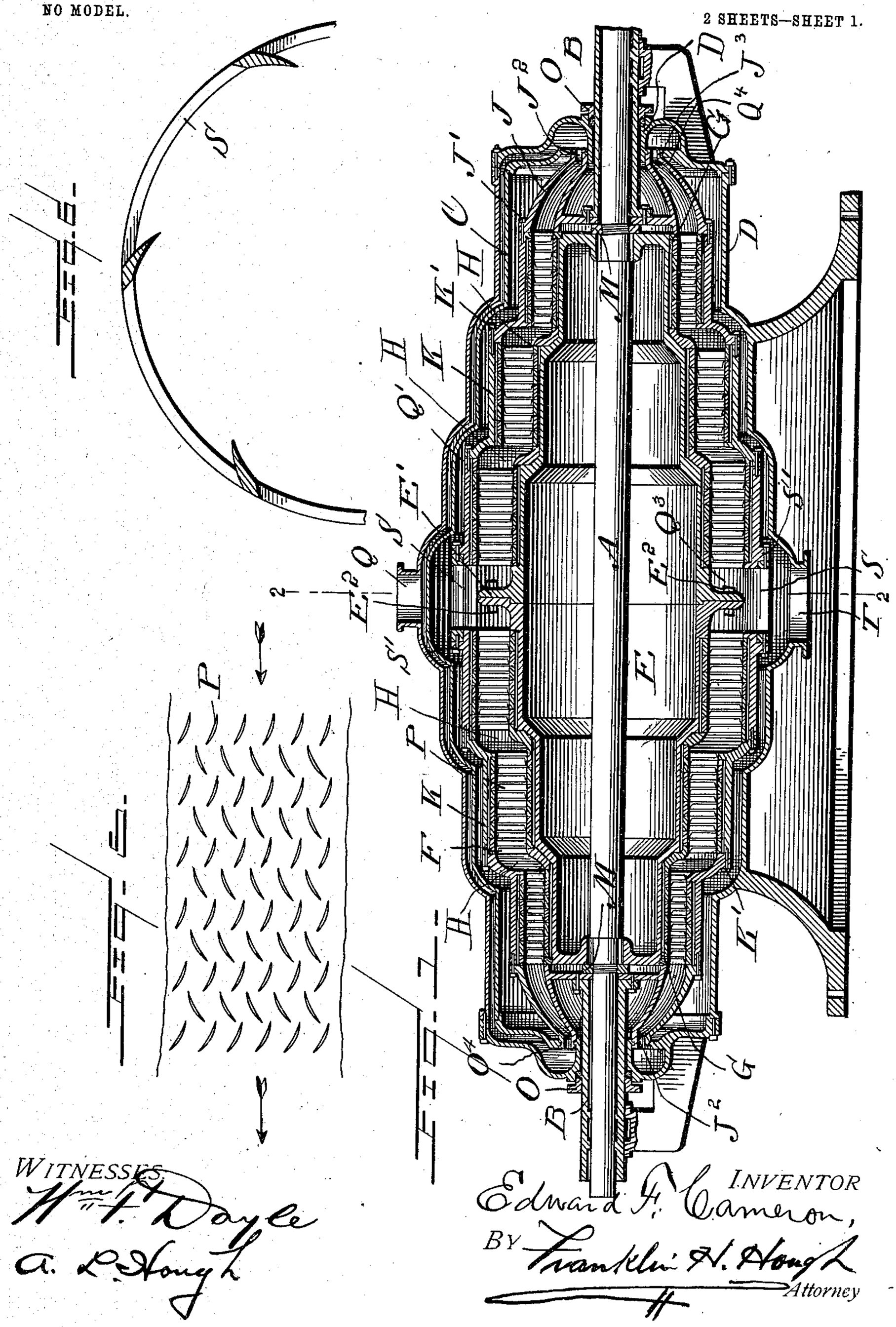
No. 735,341. PATENTED AUG. 4, 1903.

E. F. CAMERON.

STEAM TURBINE.

APPLICATION FILED APR. 11, 1903.

NO MODEL. 2 SHEETS—SHEET 1.



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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 2.

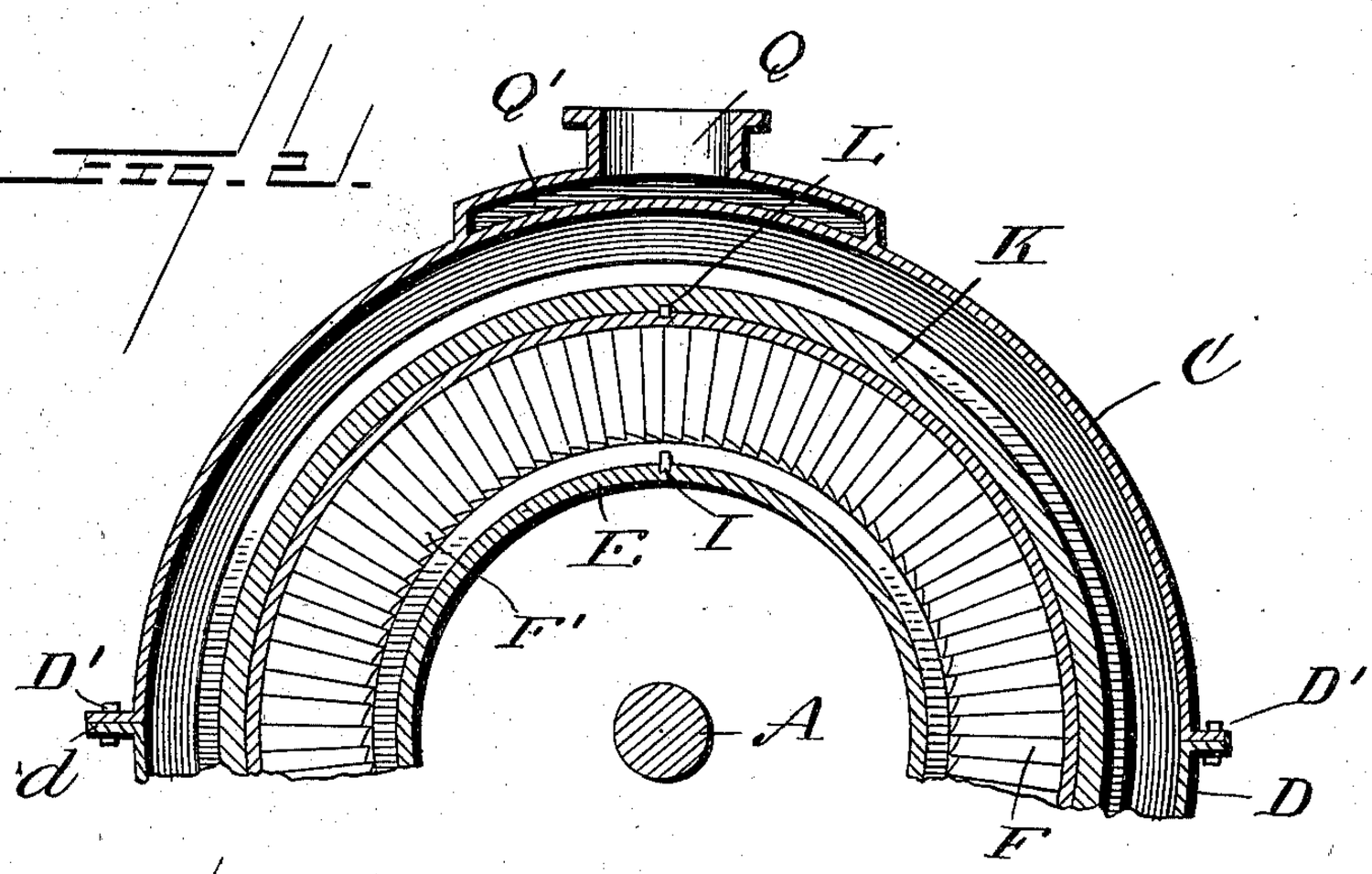


Fig. 3.

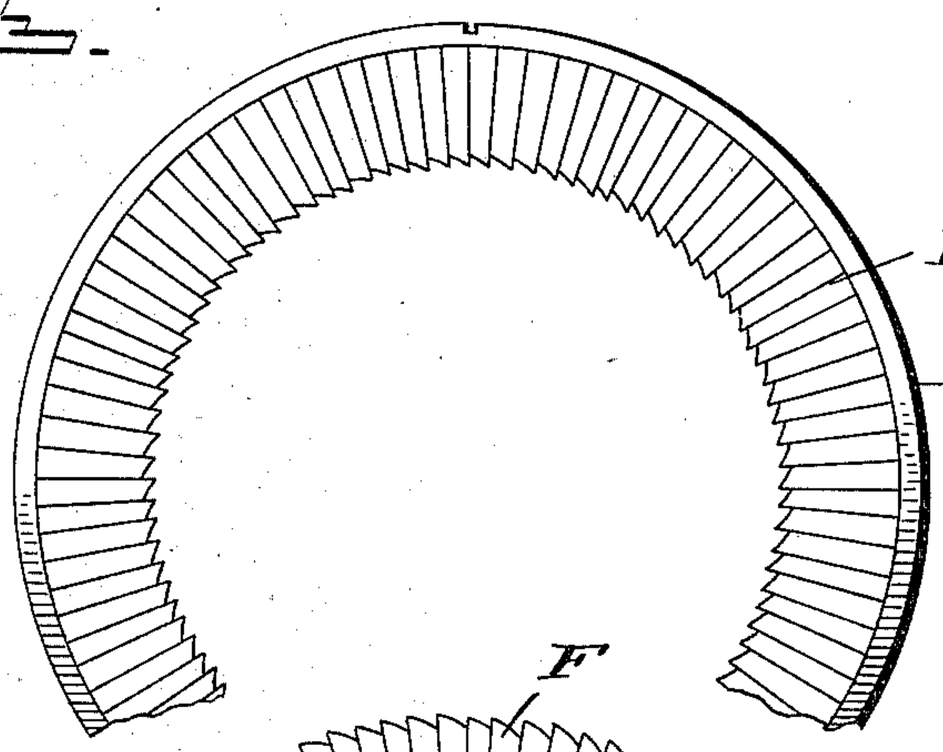
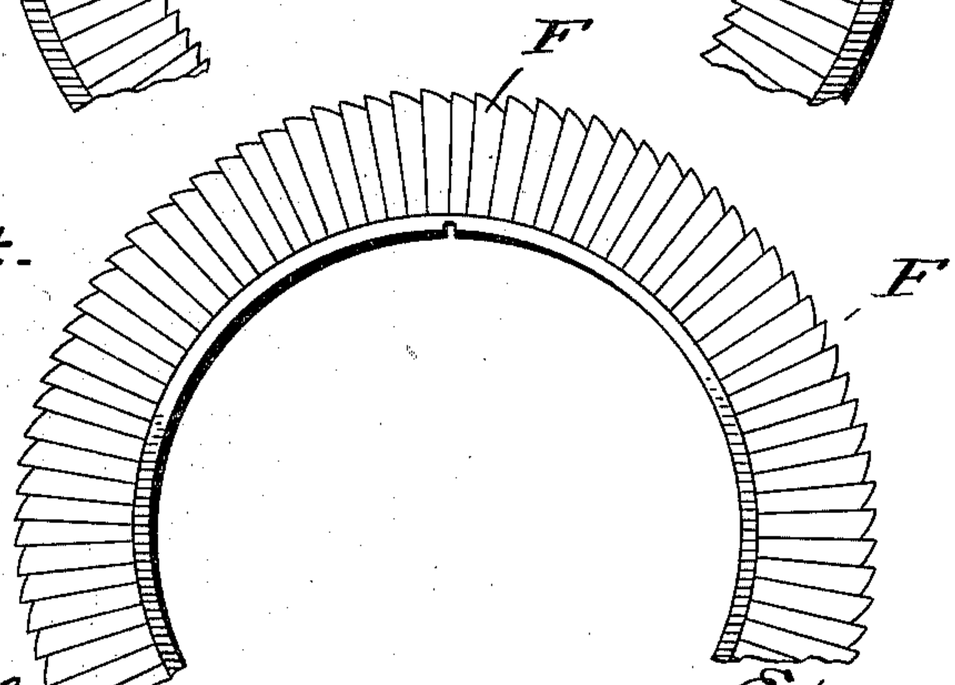


Fig. 4.



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No. 735,341. Patented August 4, 1903.

UNITED STATES PATENT OFFICE.

EDWARD F. CAMERON, OF HELENA, MONTANA.

STEAM-TURBINE.

SPECIFICATION forming part of Letters Patent No. 735,341, dated August 4, 1903.

Application filed April 11, 1903. Serial No. 152,178. (No model.)

To all whom it may concern:

Be it known that I, EDWARD F. CAMERON, a citizen of the United States, residing at Helena, in the county of Lewis and Clarke and State of Montana, have invented certain new and useful Improvements in Steam-Turbines; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to new and useful improvements in turbine-engines, and especially in the provision of an engine comprising series of rotary vane-disks of different diameters affording a multiple expansion to fluid as it passes through the disks.

The invention comprises various details of construction and combinations and arrangements of parts, which will be hereinafter fully described and then specifically defined in the appended claims.

The present invention is clearly illustrated in the accompanying drawings, which, with the letters of reference marked thereon, form a part of this application, and in which drawings—

Figure 1 is a central longitudinal section through my improved turbine-engine. Fig. 2 is a cross-sectional view on line 2 2 of Fig. 1. Fig. 3 is a plan view of one of the vane-disks. Fig. 4 is a similar view of a disk with the vanes disposed at angles to the vanes shown in Fig. 3. Fig. 5 is a detail view showing the relative positions of the vanes in a series of disks, and Fig. 6 is a sectional view through the latticed ring.

Reference now being had to the details of the drawings by letter, A designates an operating-shaft which is journaled in a hollow shaft B, there being two of these hollow shafts, one at each end of the rotary engine and mounted in suitable bearings in the lower portion of the casing D.

C designates the upper portion of the casing, which is fastened to the lower portion by bolts D′, which pass through the flanges *d*, (shown in Fig. 2 of the drawings,) thereby completely inclosing the operative parts of the turbine.

Keyed to the shaft A is a hollow cylinder E, formed in three or more steps or, in other words, having portions thereof of three or more different diameters, as shown clearly in Fig. 1 of the drawings, and to the circumference of said cylinder are fastened the disks F by means of keys I, a detail view of one of said disks being shown in Fig. 4 of the drawings, and each disk of said series comprises an annular flanged ring having radiating therefrom vanes F′, which are inclined and are disposed in substantially parallel planes to one another, as shown clearly in Fig. 5 of the drawings.

Letters P designate the disks of a series, which are grouped together with the disks F and differ from said disks F only in having a peripheral flange P′, which is held to the sectional cylinder K by means of keys L and have the vanes thereof disposed at an angle of substantially forty-five degrees to the vanes of the disks F, as shown in Fig. 5 of the drawings, while the inner ends of the vanes of the disks P are free.

Disks G are provided at the ends of the cylinder E, being threaded thereto, as shown in the sectional view of the drawings, which serves the same purpose as the other disks, with an additional function of holding firmly in place all of the disks of the three series which are illustrated in Fig. 1 of the drawings. Intermediate each series of disks is a circular flange having an ogee face and serving the double purpose of holding in position the series of disks on either side of it, said circular flange being keyed to the cylinder E, as clearly shown, and forming the step from one series of disks to the next. Secured to the ends of the sectional shell K and to the hollow shaft B is a disk J, (shown in the drawings as being held by bolts J′,) and integral with each disk J is an expanding nozzle J^2, which flares toward the opening into the series of disks and diverges toward the outer end of the cylinder and has a suitably packed bearing J^3 with the outer casing D of the engine, and M designates the nut or washer, which is threaded and fitted on threads about the circumference of the main shaft A and holding the cylinder

E securely in position upon the shaft. A suitable packing-gland O, forming a stuffing-box, is shown as intermediate the hollow shaft B and the end of the casing D at each end of the engine, but may be dispensed with, if desired, if the antifriction piping-rings are steam-tight.

The series of sections which make up the shell K are held together by means of bolts K′ and are formed stepped to conform to the stepped outline of the cylinder E, a chamber H being formed intermediate one series of disks and the adjacent series through which steam passes from one series to another.

The steam or fluid entrance to the cylinder is through the port Q, which opens into a passage-way Q′, which surrounds the exhaust-chamber Q^3 and follows a course conforming to the stepped outline of the cylinders within, said passage-way Q′ communicating with the nozzle through an annular opening Q^4 at each end of the engine. The inner ends of the two sections forming the cylinder E have flanges E′, which are secured together by means of bolts E^2, said flanges forming with their outer faces deflecting surfaces and their outer margins being positioned adjacent to a latticed ring S, which is interposed between the adjacent ends of the sections K′ of the shell K, said latticed ring being held securely by means of bolts S′ and through the spaces of which ring the expanded steam passes into the exhaust-chamber Q^3. Said ring S is also provided with blades set parallel to the axis of the turbine and at such angles that the action of the exhaust-steam or other fluid which may be used will tend to exert pressure upon the blades in the same direction as the outer revolving portion of the turbine, thus utilizing from the exhaust-steam such energy as it may contain after expansion in its passage through the various series of disks.

T designates the exit-port through the under side of the casing and has communication with the surrounding exhaust-chamber Q^3.

It will be observed from the foregoing that the diameters of the series of vaned disks increase from the ends of the engine toward the center, the disks of the outer series on each end being of the smallest diameter, thus presenting the smallest area to the steam as it enters from the nozzles and presenting in succession the disks of increasing diameters to the expanding steam as it passes through the engine.

From the above description it will be observed that by the provision of a turbine embodying the principle of my invention two series of disks so combined are provided that no part of the same is stationary when acted upon by the steam or other expansive fluid, hence reducing to a minimum the loss of energy and reducing by one-half the peripheral speed, the number of revolutions to each shaft being one-half what it would be if the outer series of disks were stationary. It will be noticed that the first series of disks when the steam enters the turbine are approximately one-half the diameter and the blades or vanes thereon are substantially one-half the length of the adjacent series where the steam exhausts. This allows for a large measure of expansion. To furnish additional expansion, it will only be necessary to have the first series of disks of less diameter, bringing them nearer the center of rotation, and add as many series of disks as may be necessary, each series increasing in diameter and the blades in length until the expansion is complete.

As the steam-pressure is reduced by expansion in its passage through the turbine, there is presented a greater surface of area of blades or vanes in each series of disks, the last series, on account of the increased diameter and the length of the blades or vanes, presenting a surface area about five times as great as the first series, which, together with the increased distance of the last series from the center of rotation, gives as much power for the low-pressure steam in the last series as was derived from the high-pressure in the first series.

The curved blades or vanes of the revolving disks are set so that they will deflect the steam at an angle of about thirty-five degrees from the axis of the turbine.

It is my purpose to provide the bearings for the engine entirely outside of the casing and consisting of series of loose sleeves, between which will be positioned thin films of oil for forced lubrication, allowing the revolving portions to overcome any slight eccentricity that might exist and revolve around its gravity axis, which might differ from its geometric axis in a very slight degree.

By my arrangement there will be no rubbing surfaces inside the casing excepting the small rings around the nozzle, these consisting of light rings alternately fastened to the nozzle and the casing, and while not in actual contact are so close as to prevent the leakage of steam or other fluid which may be used, and any lubricant that may be necessary can be forced in the rings through the casing by the aid of small ducts.

In the turbine illustrated in the accompanying drawings I have shown one hundred and twenty disks and each disk provided with one hundred blades or vanes, making a total number of twelve thousand blades, and it can be readily understood what an enormous force is accumulated by the action of the steam or other fluid passing through the turbine at a velocity of over two thousand feet per second and acting on six thousand blades in a certain direction and on the same number of blades in the opposite direction.

In operation the steam which enters through the port Q is deflected in opposite directions through the passage-way Q′ and enters the nozzles J^2 and is directed between the outer series of disks P and F, acting upon the blades of the alternate disks of each series in opposite directions, and as the steam issues

from the outer series of blades it goes successively to the other series of gradually-increasing size of blades till it finally makes exit through the ring S of the exhaust-chamber, thus utilizing the full power of the steam.

By delivering the steam at both ends the thrust is entirely overcome, one end balancing the other and avoiding the necessity of thrust collars or rings or other appliances for the same purpose.

While I have shown a particular construction of apparatus illustrating my improved engine, it will be understood that I may make alterations in the detailed construction of the same without departing from the spirit of the invention.

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

1. A rotary turbine-engine comprising a suitable casing, hollow shafts journaled therein, an operating-shaft rotating in said hollow shafts, stepped cylinders secured to and rotatable with said shafts in opposite directions, vaned disks secured to said cylinders and arranged alternately and in series of varying diameters, said disks increasing in diameter from the inlet-port for the expansive fluid toward the exhaust of the engine, as set forth.

2. A rotary turbine-engine comprising a casing, hollow shafts journaled therein, an operating-shaft rotating within said hollow shafts, stepped cylinders fixed to and adapted to rotate with said shafts in opposite directions, series of vaned disks secured to the adjacent circumferences of said cylinders, said disks arranged alternately and in series of varying diameters, the vanes of the two cylinders disposed at angles to each other, the vanes of the different series increasing in diameter from the inlet-port to the exhaust of the engine, as set forth.

3. A rotary turbine-engine comprising a suitable casing, hollow shafts journaled therein, an operating-shaft rotatable within said hollow shafts, stepped cylinders fixed to and adapted to rotate with said shafts in opposite directions, vaned disks having flanges which are secured to said cylinders, the vanes of the disks of the two cylinders arranged alternately and at angles to one another, the disks of the various series increasing in diameter from the inlet-port to the exhaust of the engine.

4. A rotary turbine-engine comprising a suitable casing, hollow shafts journaled therein, an operating-shaft rotatable within said hollow shafts, stepped and concentrically-arranged cylinders keyed to rotate with said shafts in opposite directions, vaned disks keyed to the circumference of the inner of said cylinders, and vaned disks keyed to the inner circumference of the outer cylinder, the vanes of the two cylinders alternately arranged and in series of varying diameters, the disks of the various series increasing in diameter from the inlet-port to the exhaust, as set forth.

5. A rotary turbine-engine comprising a suitable casing, hollow shafts journaled therein, an operating-shaft rotatable within the hollow shafts, concentrically-stepped cylinders keyed to said shafts and adapted to rotate in opposite directions, and series of vaned disks having annular flanges adjacent to the fixed ends of the vanes and keyed to the circumference of the inner of said stepped cylinders, a series of vaned disks having peripheral flanges keyed to the inner circumference of the outer of the stepped cylinders, the vanes of the disks of the two cylinders alternately arranged and disposed at angles to one another, the disks increasing in diameter from the inlet-port to the exhaust of the engine, and spaces intervening between the series of disks, as set forth.

6. A rotary turbine-engine comprising a suitable casing, hollow shafts journaled therein, an operating-shaft rotatable within the hollow shafts, concentrically-arranged stepped cylinders keyed to rotate with said shafts in opposite directions, vaned disks secured to said cylinders and alternately arranged in series, the diameters of the series increasing from the inlet to the exhaust of the engine, a latticed ring through which the expansive fluid passes from the disks to the exhaust-chamber, as set forth.

7. A rotary turbine-engine comprising a suitable casing, hollow shafts journaled therein, an operating-shaft rotatable within the hollow shafts, a stepped cylinder fixed to the operating-shaft, a series of vaned disks keyed to the circumference of said cylinder, a concentric stepped cylinder made up of sections, vaned disks secured to the inner circumference of said sectional cylinder, the disks of the two cylinders having their vanes alternately arranged and in series of varying diameters, increasing in diameter from the inlet to the exhaust of the engine, a latticed ring secured to the inner ends of said sectional cylinder and through which ring the expansive fluid passes to the exhaust-chamber, as set forth.

8. A rotary turbine-engine comprising a suitable casing, hollow shafts journaled therein, an operating-shaft rotatable within the hollow shafts, a stepped cylinder made up of two sections, the inner ends of which are flanged and secured together, said sections being keyed to rotate with the operating-shaft, series of vaned disks keyed to the steps of said cylinder, a concentric cylinder made up of sections and keyed to rotate with the hollow shafts, a latticed ring secured to the adjacent ends of the sectional cylinder, the flanges of the cylinder keyed to the operating-shaft positioned adjacent to the inner circumference of said latticed ring, and vaned disks secured to the inner circumference of the outer of the two cylinders and having vanes

alternately arranged with the vanes of the inner cylinder and of varying diameters in series, as set forth.

9. A rotary turbine-engine comprising a suitable casing, hollow shafts journaled therein, an operating-shaft rotatable within the hollow shafts, a stepped cylinder keyed to the operating-shaft, vaned disks keyed to the circumference of said cylinder, a sectional cylinder having disks secured to its inner circumference and provided with vanes which alternate with the vanes of the inner cylinder, the series of disks increasing in diameter from the inlet to the exhaust port of the engine, a latticed ring secured to the adjacent ends of the sections of the outer stepped sectional cylinder, and wings projecting inward from the latticed ring, and deflecting-flanges on the inner stepped cylinder, as set forth.

10. A rotary turbine-engine comprising a suitable casing, hollow shafts journaled therein, an operating-shaft rotatable within the hollow shafts, a stepped cylinder keyed to rotate with the operating-shaft, vaned disks keyed about the circumference of said cylinder, a sectional stepped cylinder keyed to rotate with the hollow shafts, vaned disks keyed to the inner circumference of the sectional cylinder and having vanes alternately arranged with the vanes of the disks on the inner cylinder, nozzles secured to the ends of the sectional cylinder, inlet-ports communicating with said nozzles, and an exhaust-chamber about the cylinders, and a latticed ring through which the expansive fluid passes to the exhaust-chamber, as set forth.

11. A rotary turbine-engine comprising a suitable casing, hollow shafts journaled therein, an operating-shaft rotatable within the hollow shafts, a stepped cylinder keyed to the operating-shaft, vaned disks keyed to the circumference of said cylinder, a sectional stepped cylinder keyed to rotate with the hollow shafts, a disk keyed to the inner circumference of the sectional cylinder and having vanes which are alternately arranged with the vanes of the disks of the inner cylinder, the vanes of the two series being at angles to each other and the disks arranged in series of varying diameters increasing from the inlet-port to the exhaust of the engine, flanged rings intermediate the series of disks, nozzles secured to the ends of the sectional cylinder, inlet-ports communicating with said nozzles, and an exhaust-chamber about the cylinders, and a latticed ring through which the expansive fluid passes through the disks to the exhaust-chamber, as set forth.

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

EDWARD F. CAMERON.

Witnesses:

ALBAN B. NIXON,

JAS. A. GILLAN.