No. 762,449. PATENTED JUNE 14, 1904.

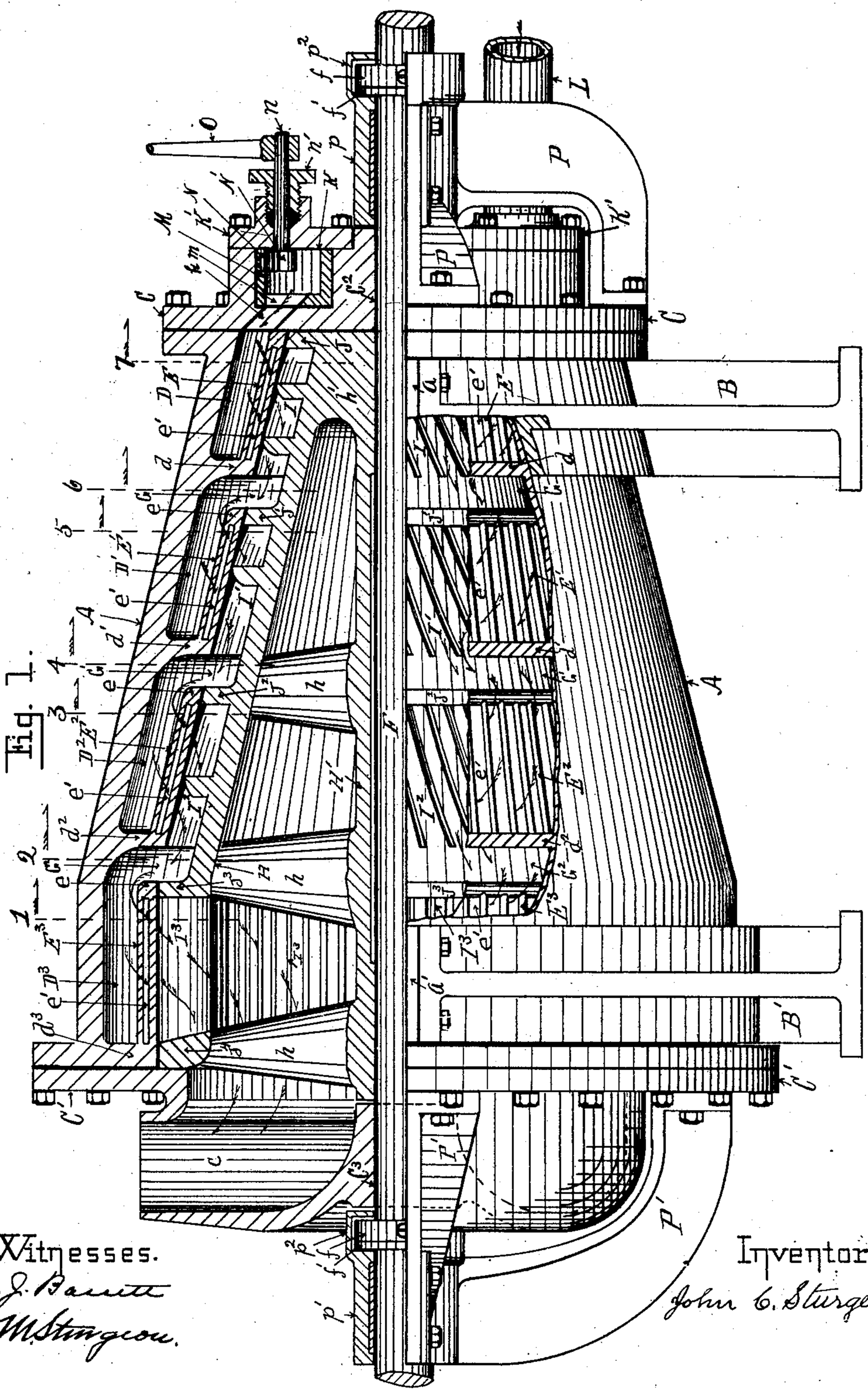
J. C. STURGEON.

ELASTIC FLUID TURBINE.

APPLICATION FILED JUNE 19, 1903. RENEWED JAN. 26, 1904.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.



Witnesses.
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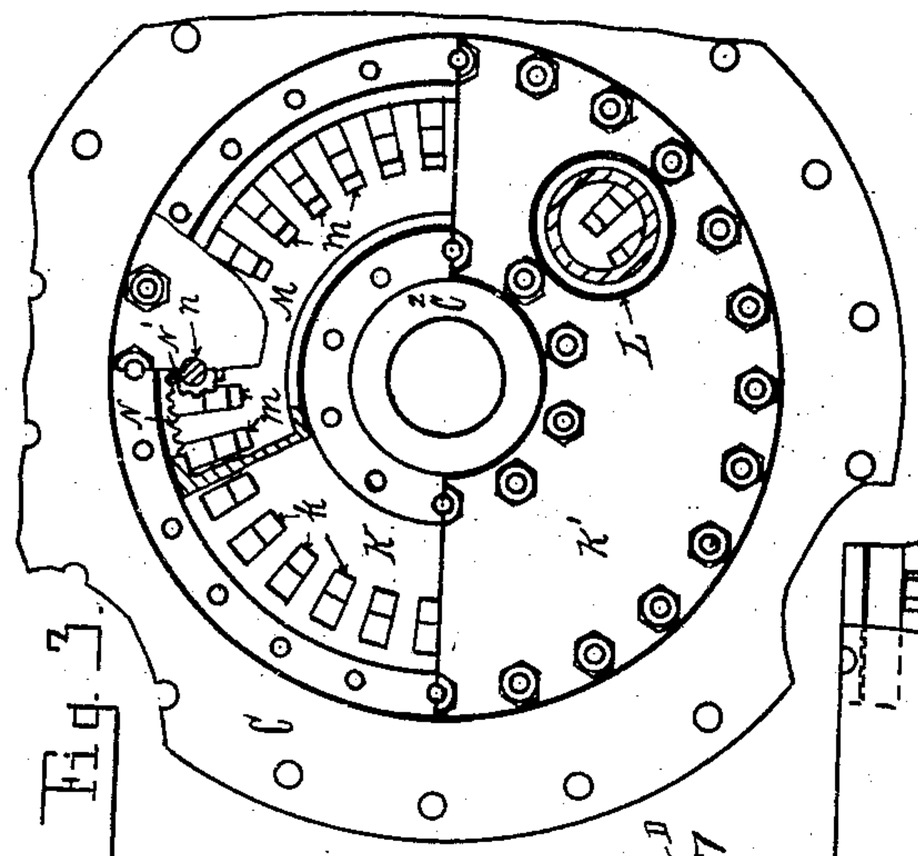
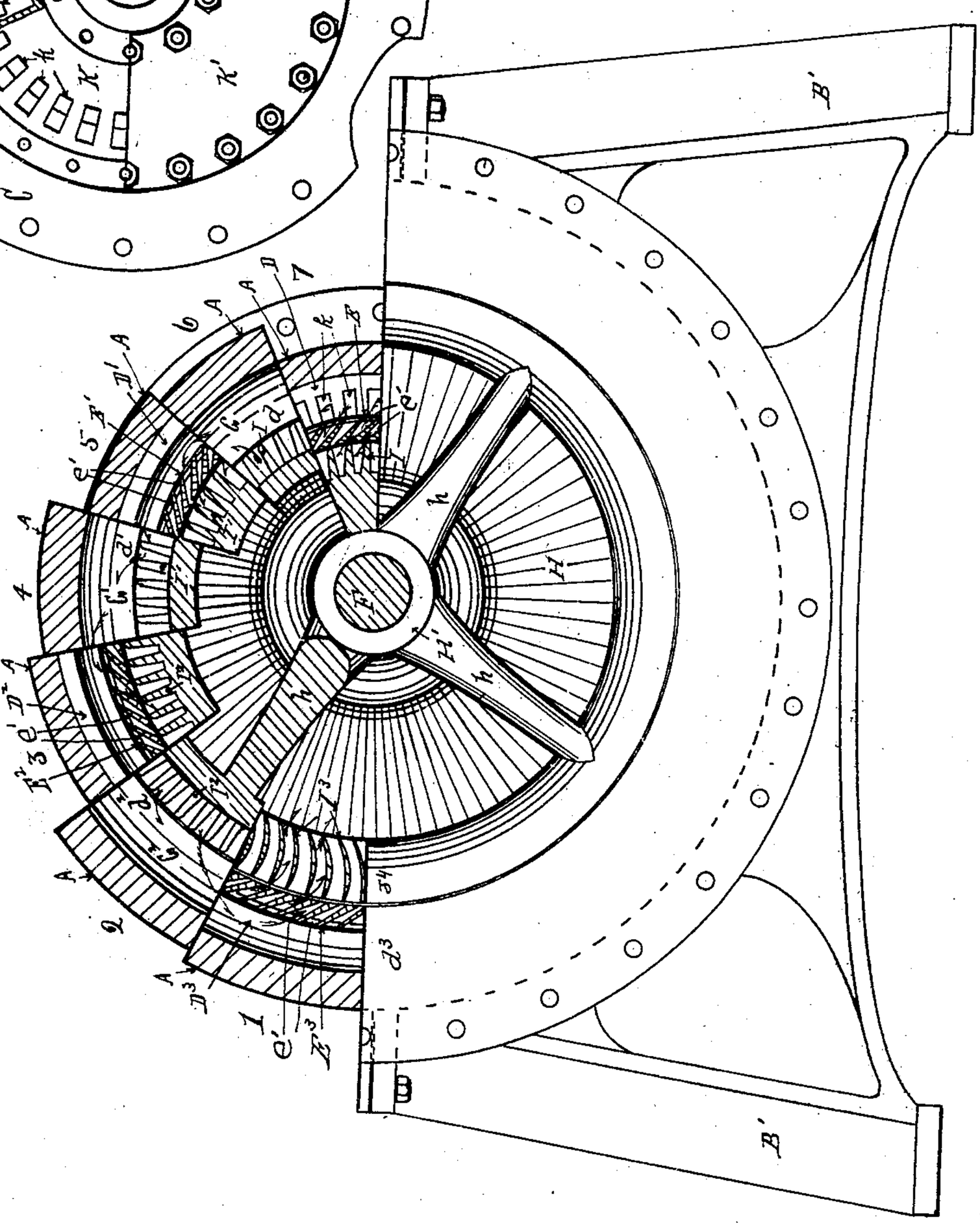


Fig. 2.



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UNITED STATES PATENT OFFICE.

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ELASTIC-FLUID TURBINE.

SPECIFICATION forming part of Letters Patent No. 762,449, dated June 14, 1904.

Application filed June 19, 1903. Renewed January 26, 1904. Serial No. 190,744. (No model.)

To all whom it may concern:

Be it known that I, JOHN C. STURGEON, a citizen of the United States, residing at Erie, in the county of Erie and State of Pennsylvania, have invented certain new and useful Improvements in Elastic-Fluid Turbine-Engines; and I do hereby 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, forming part of this specification.

My invention relates to elastic-fluid turbine-engines, and has for its object the construction of an engine of this type with an annular shell having a series of annular chambers therein the inner walls whereof are provided with the slots or steam-jet openings at angles to radial lines through the axes of said annular chambers, said slots or steam-jet openings being hereinafter designated as "diagonal" slots or steam-jet openings, so that the steam in its passage through the engine enters the first of the series of annular chambers in the shell of the engine and is discharged therefrom through diagonal slots in the inner wall of the chamber against the first of a series of annular rows of vanes on the periphery of the cylinder revolving within said shell, from which vanes it passes to the next chamber of the series and is again discharged therefrom through the diagonal slots in its inner wall against the next annular row of vanes in the series thereof on the cylinder, which operation is repeated by the steam in its traverse until it has passed through the last of the series of chambers and vanes to the exhaust of the engine. To accomplish this result, I construct the engine with a cylindrical shell gradually increasing in diameter from the inlet to the outlet ends thereof and having a head on its inlet end provided with suitable steam-inlet mechanism and a central shaft-bearing and a head on its larger end provided with a suitable exhaust-opening and a central shaft-bearing. This shell is provided with a series of annular chambers, the inner wall of each chamber being provided with diagonal slots or steam-jet openings, through which steam is discharged therefrom against a row of vanes on the cylinder and from the open ends of which it passes through an annular passage into the next succeeding chamber of the series, from which it is again discharged against the next row of vanes on the cylinder, which operation is successively repeated throughout the series of chambers until the steam passes out through the exhaust. In the bearings in the heads of this shell I mount a shaft having a conical cylinder thereon provided with a series of annular rows of preferably spiral vanes on its periphery, the said rows of vanes being so arranged thereon that they coincide with and are in close proximity to the inner walls of the chambers in the shell and will receive the impact of steam discharged through the diagonal jet-openings in the inner walls of said chambers. The smaller end of each row of said vanes is closed by a radial wall on the cylinder, and the larger end of each row of vanes is open, so that the steam after it has been discharged against the vanes passes out longitudinally between the open ends thereof to the passage leading to the next succeeding chamber, from which it is again discharged through the diagonal slots in its inner wall against the second annular row of vanes on the cylinder, which operation of the steam in its traverse through the engine is successively continued until the last set of vanes is reached, which last row of vanes are provided with openings between them through the shell of the cylinder, so that the steam will pass through between them into the interior of the cylinder, and thence out through the exhaust-opening at the larger end of the shell. It will be observed that the conical shape of the engine-shell and cylinder therein gradually increasing in diameter from the steam-inlet to the steam-outlet thereof provides for the gradual enlargement of each succeeding chamber of the series thereof in the shell, thereby providing for the gradually-increasing volume of the steam caused by its expansion during its passage through the engine and at the same time permits of the arrangement of the cham-

bers with relation to each other, so that the steam passing out between the ends of the vanes on the cylinder has comparatively but a short distance to travel before entering the next succeeding chamber, so that there is no room for unnecessary and wasteful steam expansion at any point of its traverse from the inlet of the first chamber to the last row of vanes on the cylinder.

The features of my invention hereinbefore referred to, together with other features thereof, are hereinafter fully set forth and explained, and illustrated in the accompanying drawings, in which—

Figure 1 is a view of my improved elastic-fluid turbine-engine, partially in elevation and partially in section. Fig. 2 is an end view of the shell and cylinder of the same in broken section on the lines 1 2, &c., in Fig. 1. Fig. 3 shows a section of an end view of the smaller shell-head with the steam-chest cover broken away, showing a portion of the steam-chest and of the valve mechanism therein.

In the drawings, A is the conical shell of the engine, and B B′ legs bolted to lugs *a a′* thereon for supporting the same. On the smaller end of the shell A there is a head C, and on the larger end of the shell A there is a head C′, the head C being provided with steam-inlet mechanism and the head C′ with an exhaust-opening *c*, as and for the purpose hereinafter described.

On the inner surface of the conical shell A, I make a series of chambers D D′ D² D³, having annular walls E E′ E² E³, connected at one end with the inner surface of the shell-body A by radial walls *d d′ d² d³*, between which and the ends *e* of the inner walls E′ E² E³ there are annular passages G G′ G², which lead into the chambers D′ D² D³, and through the inner walls E E′ E² E³ of said chambers I make diagonal slots *e′*. (Clearly shown in Fig. 2.)

In bearings C² and C³ in the heads C C′ of the shell A, I mount the shaft F of a conical cylinder H, provided with spokes *h h′*, connecting the shell thereof with a hub H′, by means of which the cylinder is secured to the shaft F. Upon the periphery of the cylinder H, I secure a series of annular rows of vanes I I′ I² I³, which vanes are connected together at their smaller ends by radial walls J J′ J² J³ on the periphery of the cylinder, and the vanes in the rows I I′ I² are preferably arranged spirally on the cylinder, while the vanes in the row I³ are preferably straight and closed at their outer ends by a radial wall J⁴. The shell of the cylinder is cut away between the vanes in the row I³, so that there is a free passage for the steam between them to the interior of the cylinder. The peripheries of the rows of vanes I I′ I² I³ and the radial walls J J′ J² J³ J⁴ are arranged on the cylinder H so that they coincide with the inner faces of the walls E E′ E² E³ of the chambers D D′ D² D³ and so that the open ends of the rows I I′ I² of vanes are directly under the end walls *d d′ d²* of said chambers and so that they are in close proximity with the inner faces of said inner walls, so that the steam entering the first chamber D of the series passes through the diagonal slots *e′* in the inner wall E thereof and impinges against the vanes of the first row I of the series thereof and thence out between the open ends of said vanes under the wall *d* of said chamber and thence through the passage G into the second chamber D′, from whence it discharges against the second row I′ of vanes, as before, thus successively impinging against one row of vanes after another until it impinges against the last row of vanes I³ and passes thence to the exhaust, and though some steam may pass between the peripheries of the radial walls J J′ J² and the inner faces of the end *e* of the inner walls E′ E² E³ any steam so passing will impinge against and expend its force upon the outer edges of the rows of spiral vanes and reduce the loss therefrom to the minimum amount.

For admitting steam to the first chamber D in the smaller end of the shell A in the head C of the shell A there is an annular steam-chest K, having a removable steam-chest cover K′. Through the inner wall of the steam-chest K there are slots or ports *k*, (see Figs. 1 and 3 and section 7 in Fig. 2,) which lead from the steam-chest K to the smaller end of the chamber D, (see Fig. 1,) so that steam will pass therethrough from the steam-chest K into the end of the chamber D, and for supplying steam to said steam-chest I provide a steam-supply pipe L, which enters the steam-chest cover K′. For controlling the admission of steam from the steam-chest K to the chamber D, I provide an annular valve M, adapted to rotate in said steam-chest K. The face of this valve is provided with openings or ports *m*, forming a gridiron valve-face adapted to entirely close, partially open, or entirely open the ports *k*, and for operating this valve I preferably form a section of rack-gear N on the valve M, which rack-gear N is engaged by a pinion N′ on a shaft *n*, extending out through a stuffing-box *n′* in the steam-chest cover K′, and on the shaft *n* I secure a lever O, by means whereof through the shaft *n* and pinion N′ the valve M can be rotated in the steam-chest K as desired.

For supporting the shaft F, in addition to the bearings C² and C³ in the heads C C′, I provide yokes P P′, secured to the heads C C′, which yokes are provided with suitable journal-boxes *p p′*. To secure the cylinder H from end thrust in the shell A, I secure to the shaft F thrust-collars *f f*, adapted to operate against friction-rings *f′ f′* at the ends of the journal-boxes *p p′*, and to provide for proper lubrication of the thrust-collars *f f* and friction-rings *f′ f′* I provide cup extensions *p²*

on one end of each of the journal-boxes, which cup extensions embrace said collars *f f* and rings *f' f'* and retain the lubricating material in contact therewith.

In operation the steam first enters the chamber D and passes through the diagonal jet-openings *e'* in the inner wall E of said chamber against the row I of spiral vanes on the cylinder H and out between the ends of said vanes under the radial wall *d* and thence through the passage G into the chamber D', from whence it passes through the diagonal jet-openings *e'* in the inner wall E' of the chamber against the row I' of the spiral vanes on the cylinder H and out between the ends of the vanes under the radial wall *d'* and thence through passage G' into chamber D^2, from whence it passes through the diagonal jet-openings *e'* in the inner wall E^2 of said chamber against the row I^2 of the spiral vanes on the cylinder H and out between the ends of the vanes under the radial wall d^2 and thence through passage G^2 into the chamber D^3, from whence it passes through the diagonal openings *e'* in the inner wall E^3 of said chamber against the row of vanes I^3 and thence between said vanes into the interior of the cylinder and out through the exhaust-opening *c*, whereby the steam during its traverse acts successively upon the several rows of vanes on the cylinder, as above described, and operates to rotate the cylinder. I have herein shown and described a series of four chambers having diagonal jet-openings in their inner walls and a like number of rows of vanes. It is obvious, however, that I may use a less or a greater number thereof in practice, if desired. I have thus shown and described my invention so as to enable others skilled in the art to which it appertains to construct and utilize the same; but I do not desire to confine myself to the exact construction and arrangement of parts thereof herein shown and described, as it is obvious that many modifications may readily be made therein without departing from the spirit of the invention herein shown and described.

Therefore what I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The combination in an elastic-fluid turbine-engine, of a conical shell having a series of consecutive annular chambers therein, annular inner chamber-walls for each chamber having diagonal slots therein, a conical cylinder within said shell adapted to be rotated therein, and an annular row of vanes on the periphery of said cylinder opposite and adjacent to the inner wall of each chamber in said shell, substantially as set forth.

2. The combination in an elastic-fluid turbine-engine, of a conical shell having a series of consecutive annular chambers therein, conical annular inner walls for each chamber having longitudinal diagonal slots therein, a conical cylinder within said shell adapted to rotate therein, and an annular row of vanes on the periphery of said cylinder opposite and adjacent to the inner wall of each chamber in said shell, substantially as set forth.

3. The combination in an elastic-fluid turbine-engine, of a conical shell having a series of consecutive annular conically-shaped chambers therein, radial walls closing one end of each chamber, and inner annular chamber-walls connected to said radial chamber end walls and having diagonal slots therein, a conical cylinder within said shell adapted to rotate therein, and a series of annular rows of spiral vanes on the periphery of the cylinder opposite and adjacent to the inner walls of the chambers in said shell, substantially as set forth.

4. The combination in an elastic-fluid turbine-engine, of a conical shell having a series of consecutive annular chambers and passages therein, radial walls closing one end of each of said chambers and forming one side of each of said passages, annular inner chamber-walls joined to said chamber end walls and having diagonal slots therein, a conical cylinder within said shell adapted to rotate therein, and an annular row of vanes on the periphery of said cylinder opposite and adjacent to the inner wall of each of said chambers, the last row of which vanes have openings between them through the cylinder-shell, substantially as set forth.

5. The combination in an elastic-fluid turbine-engine, of a conical shell having a series of consecutive annular chambers and passages therein, radial walls closing one end of each of said chambers and forming the wall of one side of each of said passages, conical annular inner chamber-walls joined to said chamber end walls and having diagonal slots therein, a conical cylinder within said shell adapted to rotate therein, a series of annular rows of spiral vanes on the periphery of the cylinder opposite and adjacent to the inner walls of all of the chambers except the last chamber of the series, and an annular row of straight vanes, having openings between them extending through the shell of the cylinder opposite and adjacent to the inner wall of the last chamber in the shell, substantially as set forth.

6. The combination in an elastic-fluid turbine-engine, of a conical shell having a series of consecutive annular chambers therein, heads on the ends of said shell, annular inner walls for each chamber in the shell having diagonal slots therein, a conical cylinder within said shell adapted to rotate therein, an annular row of vanes on the periphery of said cylinder opposite and adjacent to the inner wall of each chamber in the shell, an annular steam-chest in the head on the inlet end of the shell, a rotatable valve in said steam-chest, and means for rotating said valve, substantially as set forth.

7. The combination in an elastic-fluid turbine-engine, of a conical shell having a series of consecutive annular chambers therein, heads on the ends of said shell having central shaft-bearings therein, annular inner chamber-walls for each chamber in the shell having diagonal slots therein, a conical cylinder within said shell mounted in the bearings in the heads thereof so as to rotate within the shell, an annular row of spiral vanes on the periphery of said cylinder opposite and adjacent to the inner wall of each chamber except the last, an annular row of straight vanes on said cylinder opposite and adjacent to the inner wall of the last chamber in the shell having openings between them extending into the interior of the cylinder, an annular steam-chest in the head on the smaller end of the shell having openings or ports therein leading to the smaller end of the first chamber in the shell, a rotatable annular valve in said steam-chest having openings or ports therein, and adapted to be rotated in said steam-chest so that the openings or ports in the valve will partially or wholly coincide with the openings or ports in the steam-chest, and means for rotating said valve, substantially as set forth.

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

JOHN C. STURGEON.

Witnesses:

F. J. BASSETT,

H. M. STURGEON.