No. 762,451. PATENTED JUNE 14, 1904.

J. C. STURGEON.

ELASTIC FLUID TURBINE.

APPLICATION FILED FEB. 9, 1904.

NO MODEL. 2 SHEETS—SHEET 1.

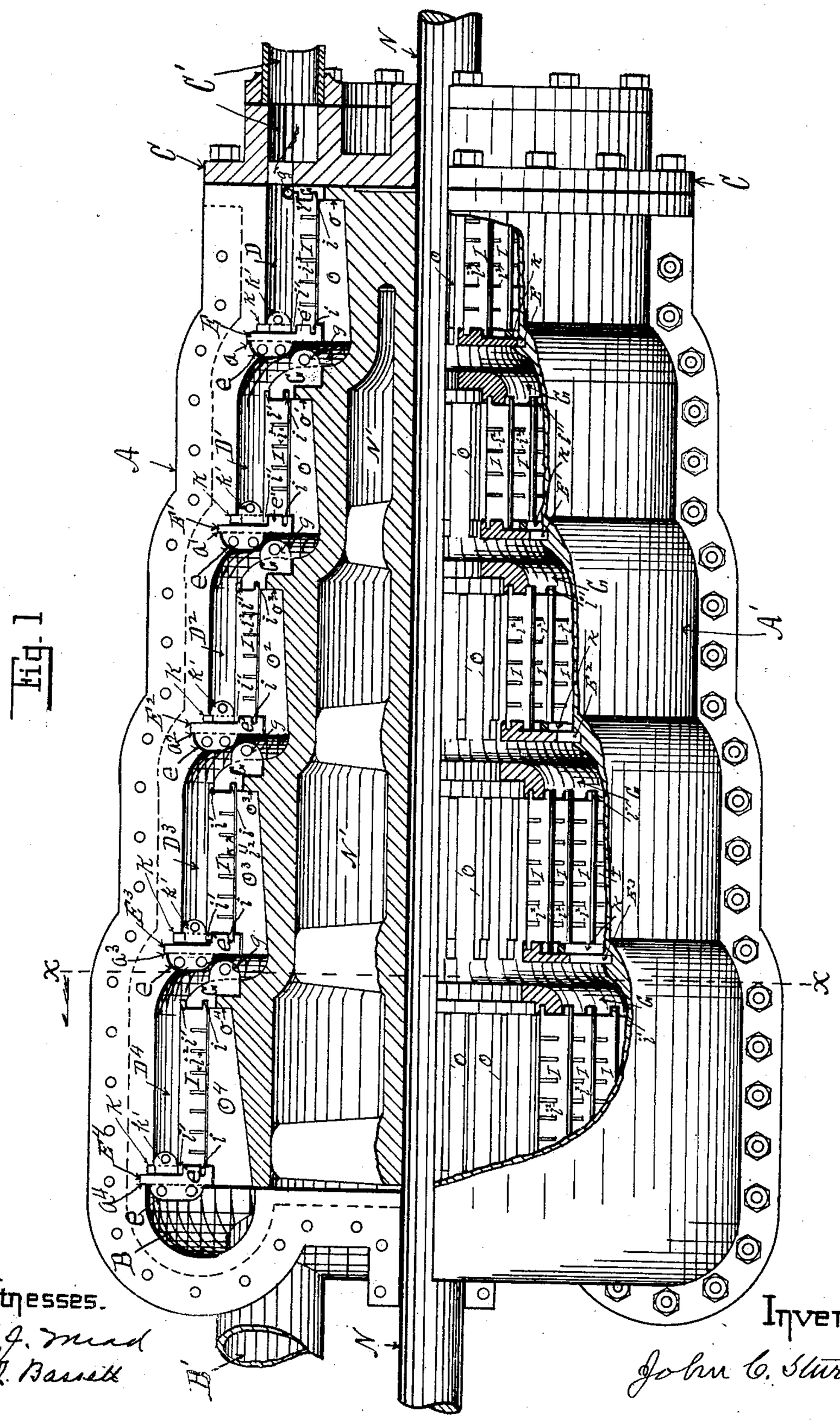

Fig. 1

Witnesses.
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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 2.

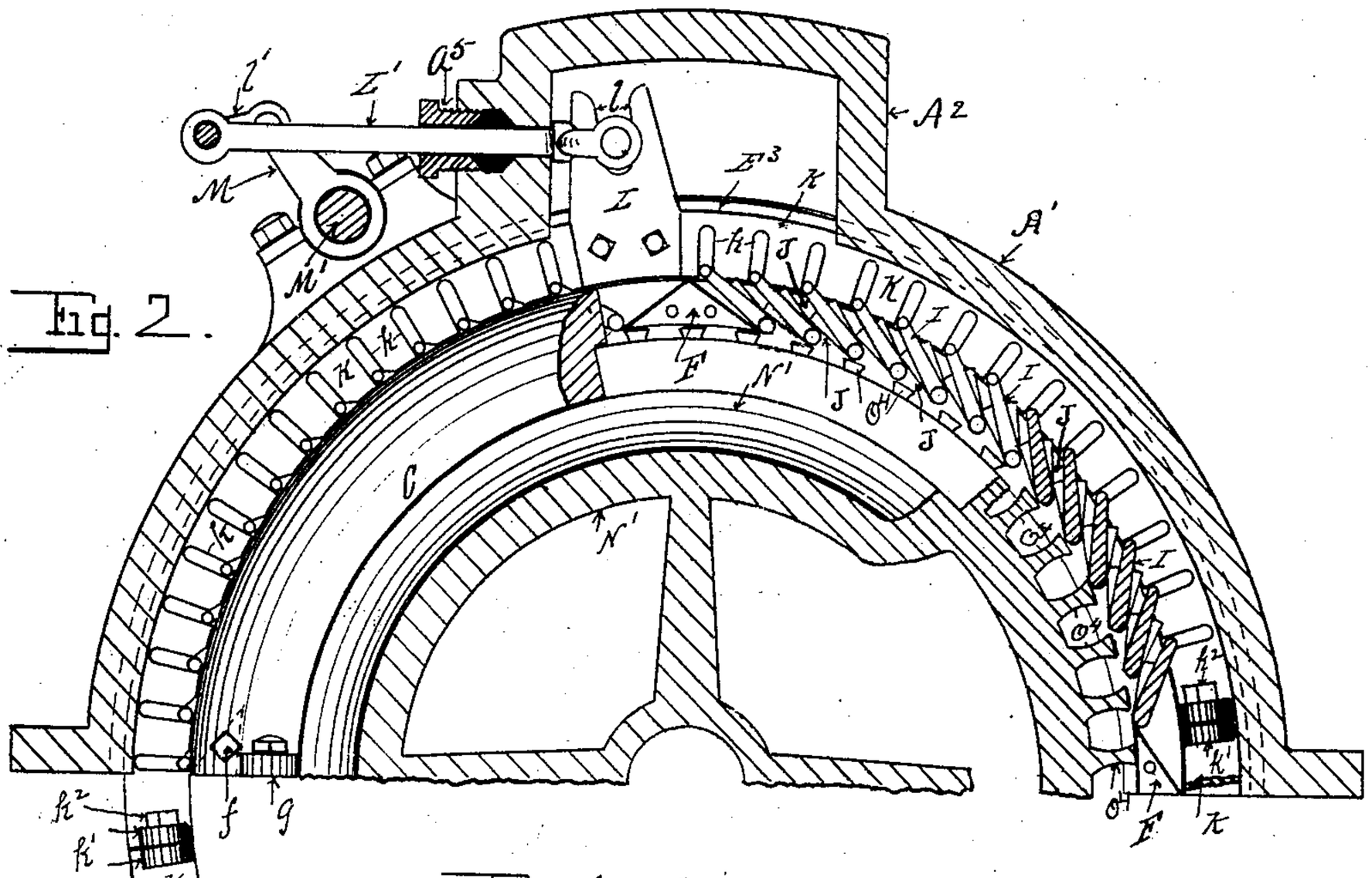

Fig. 3.

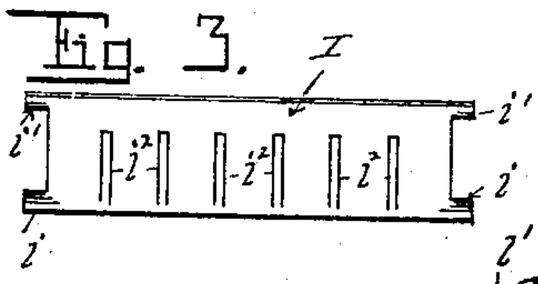

Fig. 4.

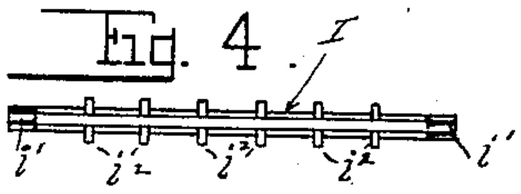

Fig. 6.

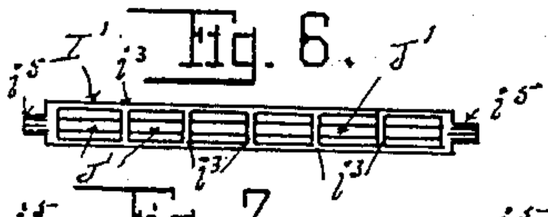

Fig. 7.

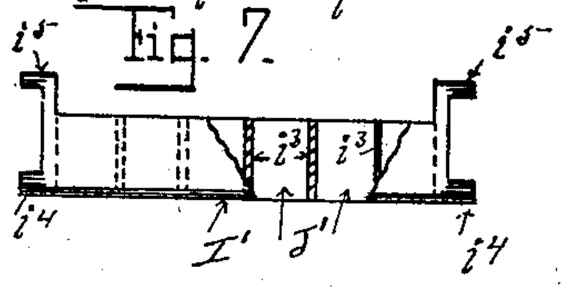

Fig. 5.

Witnesses.

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No. 762,451. Patented June 14, 1904.

UNITED STATES PATENT OFFICE.

JOHN C. STURGEON, OF ERIE, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO ALBERT F. DOBLER, OF GIRARD, PENNSYLVANIA.

ELASTIC-FLUID TURBINE.

SPECIFICATION forming part of Letters Patent No. 762,451, dated June 14, 1904.

Application filed February 9, 1904. Serial No. 192,806. (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 it consists, *inter alia*, substantially in the construction of an elastic-fluid turbine-engine of a cylindrical shell having a series of annular chambers therein the inner walls of which are provided with movable steam-guides which form steam-jet openings therethrough at angles to radial lines through the axes of said annular chambers, hereinafter designated as "diagonal" steam-jet openings, through which the steam is consecutively discharged against rows of vanes on the periphery of a rotatable cylinder concentric with the inner walls of said chambers and coinciding therewith, the movable steam-guides forming the steam-jet openings through the inner walls of said chambers being so constructed and arranged as to be capable of being turned so as to change the direction or angle of the steam-jet openings formed thereby from the right to the left of a longitudinal line through the engine, or vice versa, so as to discharge the steam therethrough from the chambers against the vanes on the cylinder toward the right or left, as may be desired, whereby the direction of the rotation of the cylinder actuated thereby can be reversed, the steam in its passage through the engine from the inlet to the exhaust thereof first entering the first chamber of the series, from whence it is discharged through the diagonal steam-jet openings formed by the movable steam-guides in the inner walls of said chamber against the first row of vanes on the cylinder, from whence it passes out between the open ends of said vanes into the second chamber of the series, from whence it is in like manner discharged against a second row of vanes on the cylinder, this operation being repeated until the steam has consecutively passed into and out of one chamber after the other until it reaches the exhaust of the engine. In the construction of an elastic-fluid turbine-engine embodying these and other features of my invention I preferably make the annular shell of the engine in two parts adapted to be bolted together and provided with a series of removable chamber-walls forming a series of annular chambers therein each of which is provided with an end wall and an annular inner wall, preferably made in half-sections secured together, the end wall of each chamber being preferably secured in an annular groove in the inside of the shell, so that when the two halves of the shell are secured together the end and inner walls of the chambers are held firmly in place in the shell and when it is desired to remove the cylinder the halves of the shell can be detached and the upper half removed. The upper halves of the end and inner walls of the chambers can then be detached from the lower halves thereof and then removed, when the cylinder can be lifted out of the lower half of the shell and the lower half chamber-walls therein. The inner walls of these chambers are made with movable steam-guides pivoted therein in such a manner that they form diagonal steam-jet openings therein and are provided with means for changing the angle thereof, so that the direction of the steam-jet openings formed thereby can be reversed so as to operate against the opposite side of the vanes of the cylinder and cause it to rotate in the opposite direction—that is to say, so as to turn the cylinder either to the right or left, according to the angle of said movable steam-guides. To prevent the steam traveling longitudinally as it passes through the diagonal steam-jet openings instead of squarely against the vanes of the cylinder, I provide partitions in said steam-jet openings whereby they are divided into comparatively narrow openings, through which the steam passes in direct

lines to and against the vanes on the cylinder. These and other features of my invention are hereinafter fully set forth and described, and illustrated in the accompanying drawings, in which—

Figure 1 is a view, partially in elevation and partially in section, of an elastic-fluid turbine-engine embodying the features of my invention. Fig. 2 is a transverse half-section of the same, substantially on the line $x\ x$ in Fig. 1. Fig. 3 is a side view in elevation of one of the steam-guides forming the steam-jet openings in the inner walls of the chambers. Fig. 4 is a top or plan view of the same. Fig. 5 is a transverse half-section substantially on the line $x\ x$ in Fig. 1, showing a modified construction of the steam-guides forming the steam-jet openings in the inner walls of the chambers. Fig. 6 is a top or plan view of one of the modified steam-guides embodied in the construction shown in Fig. 5. Fig. 7 is a side view of the same, partially in elevation and partially in section.

In the drawings illustrating my invention, A A′ are the half-sections of the annular shell of the engine, the lower half to be provided with a suitable base and shaft-bearings. (Not shown.) The rear end of this shell is provided with an exhaust-chamber B and an exhaust-outlet B′, and to the inlet end of the shell A A′ there are secured a suitable head C and a suitable steam-inlet and valve chamber C′. The diameter of the shell A A′ increases from the inlet toward the outlet end thereof. Within this shell I secure the end walls E, E′, E^2, E^3, and E^4 of a series of annular chambers D D′ D^2 D^3 D^4, preferably by turning grooves a, a', a^2, a^3, and a^4 in the shell, into which the peripheries of said chamber-walls E E′ E^2 E^3 E^4 enter, so that when the two halves A A′ of the shell are secured together said chamber end walls are firmly and securely held and retained in place therein. These chamber end walls I make preferably in two half-sections, each of which is provided with ears e, by means whereof they can be bolted together. From these chamber end walls E, &c., the lateral studs F extend, (see Fig. 2,) to the ends of which studs F half-sections of rings G are secured by bolts f, as illustrated in Figs. 2 and 5. The half-sections of the rings G are also provided with ears g, as illustrated in Figs. 1, 2, and 5, whereby they may be secured together, these parts forming the frames of the inner walls of the annular chambers D D′ D^2 D^3 D^4. In these frames I mount movable steam-guides I, hereinafter designated as "reversible steam-guides," which are preferably secured therein by means of lateral-extending studs $i\ i$ on their ends near the inner edges thereof, pivoted in bearings in the inner portions of the chamber end walls E E′, &c., and rings G, as illustrated in Fig. 1. The ends of the upper edges of the reversible steam-guides I are also provided with laterally-extending studs $i'\ i'$, adapted to rest upon shoulders e' on the chamber end walls E E′, &c., and upon the peripheries of the rings G, as illustrated in Figs. 1 and 2, which operate to support the upper edges of the reversible steam-guides I, so that said steam-guides form the inner annular walls of the chambers D D′, &c., and when at rest therein, as illustrated in Fig. 2, form a series of diagonal jet-openings J in each of said chamber inner walls, as illustrated in Fig. 2. These reversible steam-guides I are also provided with transverse ribs i^2 on the sides thereof, as illustrated in Figs. 1, 3, and 4, which ribs i' form transverse partitions in the steam-jet openings J and operate to prevent the lateral traverse of steam passing through said steam-jet openings J. It will be observed from the foregoing that the steam-guides I, being movable on their pivoted bearings $i\ i$, can be swung over or reversed, so as to change their angle of inclination and likewise the direction of the steam-jet openings J; formed thereby, so that the steam will be discharged from the chambers D D′, &c., in one direction or the other, as may be desired.

For reversing the angle of inclination of the steam-guides I, I mount on the shoulders e' of the chamber end walls E E′, &c., annular rings K, provided with radial slots k therein, which slots engage the lateral studs i' of the reversible steam-guides I, resting upon the shoulders e' of said chamber end walls. These rings K are rotatable on said shoulders e', and when in the position illustrated in Fig. 2 the steam-jet openings J discharge toward the right, and when the rings K are moved to the position shown in Fig. 5 the direction of the steam-jet openings are reversed, so as to discharge in the opposite direction. These rings K, it will be observed, are also made in half-sections and are provided with ears k', adapted to be secured together by bolts k^2 therethrough. For moving the rings K, I preferably secure radial arms L thereto, provided with radial slots l, which arms project upward into pockets A^2 in the upper half-section A′ of the shell, where they engage valve-rods L′, which extend outward through stuffing-boxes a^5 and are pivoted to links l', connected with cranks M on a shaft M′, mounted in bearings on the shell-section A′, whereby all of the rings K can be simultaneously moved in either direction, as illustrated in Figs. 2 and 5, and the direction of the steam-guides I, forming the inner walls of the chambers D D′, &c., and the steam-jet openings J therein can be reversed.

In the shell A A′ and concentric with the inner walls of the annular chambers D D′ &c., I mount on a shaft N a cylinder N′, having rows of vanes O O′ O^2 O^3 O^4 on the periphery thereof, the peripheries of which cylinder-vanes coincide with and are adjacent to the

inner faces of the inner walls of the chambers D D′, &c., so that steam passing from the steam-jet openings J in each chamber will be projected directly against the row of cylinder-vanes adjacent thereto, as illustrated in Fig. 2. The ends of the cylinder-vanes O O′, &c., under the open or inlet ends of the chambers D D′, &c., are closed by annular rings o o' o^2 o^3 o^4 on the cylinder, over which the inner edge of the chamber-wall rings G overlap, so as to substantially cut off the passage of steam therethrough, as illustrated in Figs. 1 and 2, while the cylinder-vanes O O′, &c., preferably gradually increase in depth from the rings o o', &c., to their opposite or discharge ends, which are open, thereby forming a free passage for the longitudinal traverse of the steam between the cylinder-vanes and out from the open ends thereof toward the succeeding chambers.

In Figs. 5, 6, and 7 I show a modified construction of the reversible steam-guides forming part of my invention. In this construction the steam-guides I′ are made hollow, having the steam-jet openings J′ through them divided by transverse ribs or partitions i^3, as is clearly illustrated in Figs. 6 and 7. These hollow steam-guides are provided with pivotal studs i^4, which are mounted in the end walls E E′, &c., and in the rings G and with the lateral studs i^5, which operate in the same manner as in the construction shown in Figs. 1 and 2 and hereinbefore described, and are operated by the same mechanism, the only difference in the two constructions being that in Figs. 1 and 2 the steam-jet openings J are between the reversible steam-guides I and in the modified construction the steam-jet openings J′ are directly through the reversible steam-guides I′, the steam-guides I′ being reversible in like manner and with like results as the steam-guides I hereinbefore described.

I have thus shown and described convenient mechanism embodying my invention whereby others skilled in the art to which this invention appertains can readily construct and utilize the same. I do not, however, confine myself to the particular features of this construction of my invention hereinbefore shown and described, as many modifications thereof can readily be made without departing from the spirit of my invention.

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 an annular shell having a series of annular chambers therein into which the steam consecutively enters and from which it is consecutively discharged, movable steam-guides mounted in the inner walls of said chambers and forming diagonal steam-jet openings therethrough, means for moving said steam-guides so as to reverse the direction of the steam-jet openings, a cylinder concentric with the inner walls of said chambers and rotatable therein, and rows of vanes on the periphery of said cylinder coinciding with and adjacent to the inner walls of said chambers, substantially as set forth.

2. The combination in an elastic-fluid turbine-engine of the character described, of an annular shell having a series of annular chambers therein the inner walls of said chambers consisting substantially of movable steam-guides forming diagonal steam-jet openings therein, and mechanism for reversing the direction of said steam-guides, substantially as set forth.

3. The combination in an elastic-fluid turbine-engine of the character described, of an annular shell, a series of sectional chamber end and inner walls removably secured in said shell, movable steam-guides mounted in and constituting part of the said chamber inner walls and also forming diagonal steam-jet openings therein, and mechanism engaging said movable steam-guides operating to reverse the direction thereof and of the steam-jet openings formed thereby, substantially as set forth.

4. The combination in an elastic-fluid turbine-engine of the character described, of a sectional shell, a series of sectional chamber end and inner walls secured therein, and annular flanges on the ends of the inner chamber-walls at the inlet ends of said chambers projecting inwardly and overlapping the closed ends of the cylinder-vanes, substantially as set forth.

5. The combination in an elastic-fluid turbine-engine of the character herein described, of a sectional shell having annular grooves therein, a series of sectional chamber end walls engaging and secured in said grooves in the shell, sectional chamber inner walls joining and supported by said chamber end walls, movable steam-guides mounted in and constituting part of the inner walls of said chambers and also forming diagonal steam-jet openings therethrough, and means for reversing the angle of inclination of said reversible steam-guides whereby the direction of the steam-jet openings is reversed, substantially as set forth.

6. The combination in an elastic-fluid turbine-engine of the character described, of an annular shell, a series of chamber end walls secured therein, annular chamber inner walls joining and supported by said chamber end walls, movable steam-guides constituting portions of the inner walls of said chambers, and and also forming diagonal steam-jet openings therethrough, rotatable rings mounted in said chambers and engaging said movable steam-guides and operating to reverse the angle of inclination thereof and the direction of the

steam-jet openings formed thereby, and mechanism for rotating said rings, substantially as set forth.

7. The combination in an elastic-fluid turbine-engine of the character described, of an annular shell, a series of chamber end walls secured therein, annular chamber-walls for said chambers joining and supported by said chamber end walls, movable steam-guides mounted in and constituting a part of the inner walls of said chambers and also forming diagonal steam-jet openings therethrough, and mechanism engaging and operating to simultaneously reverse the angle of inclination of the movable steam-guides, whereby the direction of the steam-jet openings in all of the inner chamber - walls is simultaneously reversed, substantially as set forth.

8. The combination in an elastic-fluid turbine-engine, of an annular shell increasing in diameter from its inlet end to the exhaust end thereof, a series of annular chambers, consecutively increasing in capacity therein, movable steam-guides mounted in and constituting a portion of the inner wall of each of said chambers and also forming diagonal steam-jet openings therein, mechanism engaging and operating to reverse the angle of inclination of said steam-guides and the direction of the steam-jet openings formed thereby, substantially as set forth.

9. The combination in an elastic-fluid turbine-engine of the character described, of an annular shell having a series of annular chambers therein the inner walls of which are provided with diagonal steam-jet openings therein, and transverse partitions in said steam-jet openings, substantially as set forth.

10. The combination in an elastic-fluid turbine-engine of the character described of an annular shell having a series of annular chambers therein, inner walls for said chamber consisting substantially of movable steam-guides forming diagonal steam-jet openings therein, and transverse ribs on said steam-guides operating to form transverse partitions in said steam-jet openings, 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.