No. 762,452. PATENTED JUNE 14, 1904.

J. C. STURGEON.

ELASTIC FLUID TURBINE.

APPLICATION FILED FEB. 19, 1904.

NO MODEL. 2 SHEETS—SHEET 1.

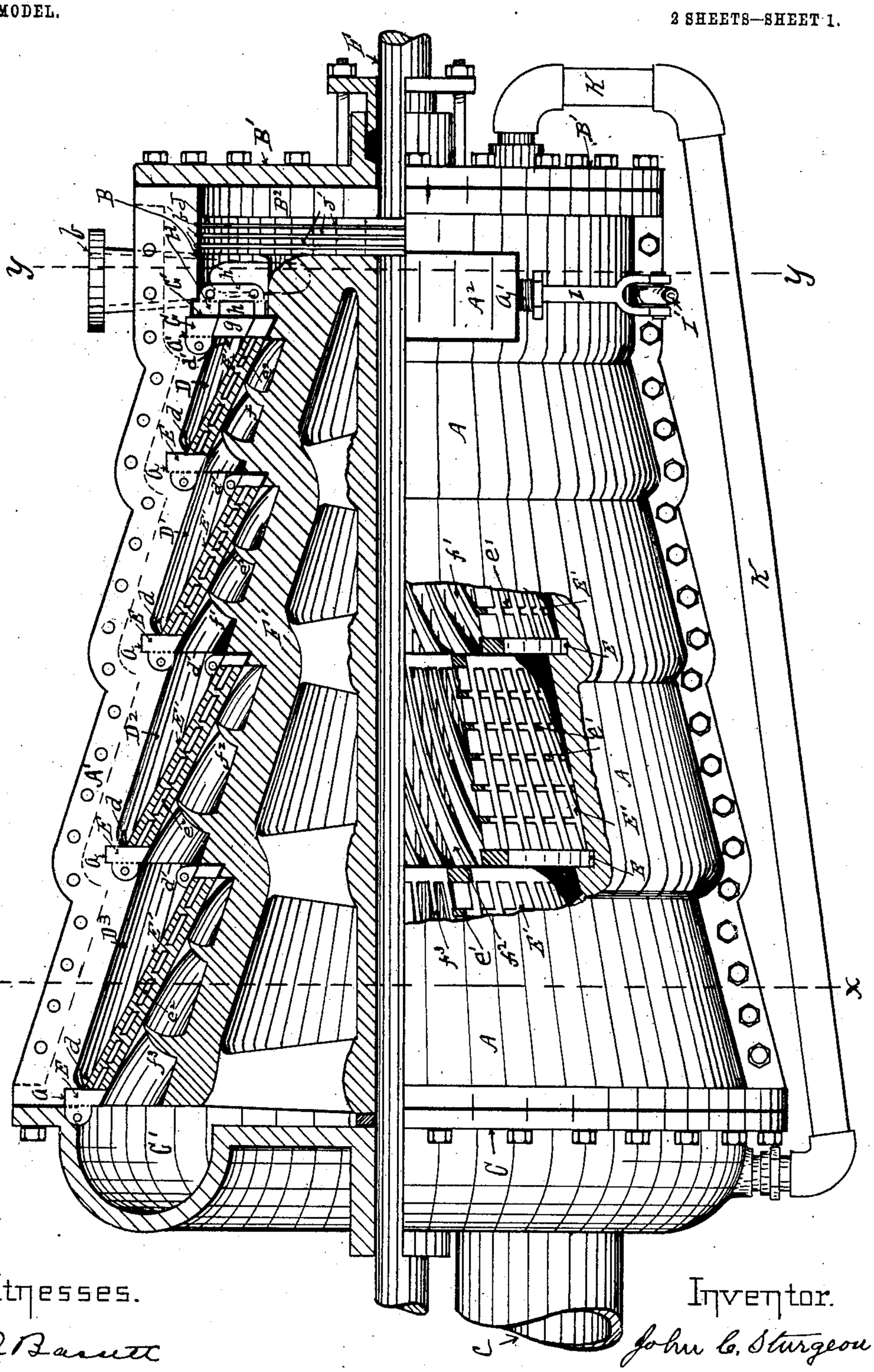

Fig. 1.

Witnesses.

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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 2.

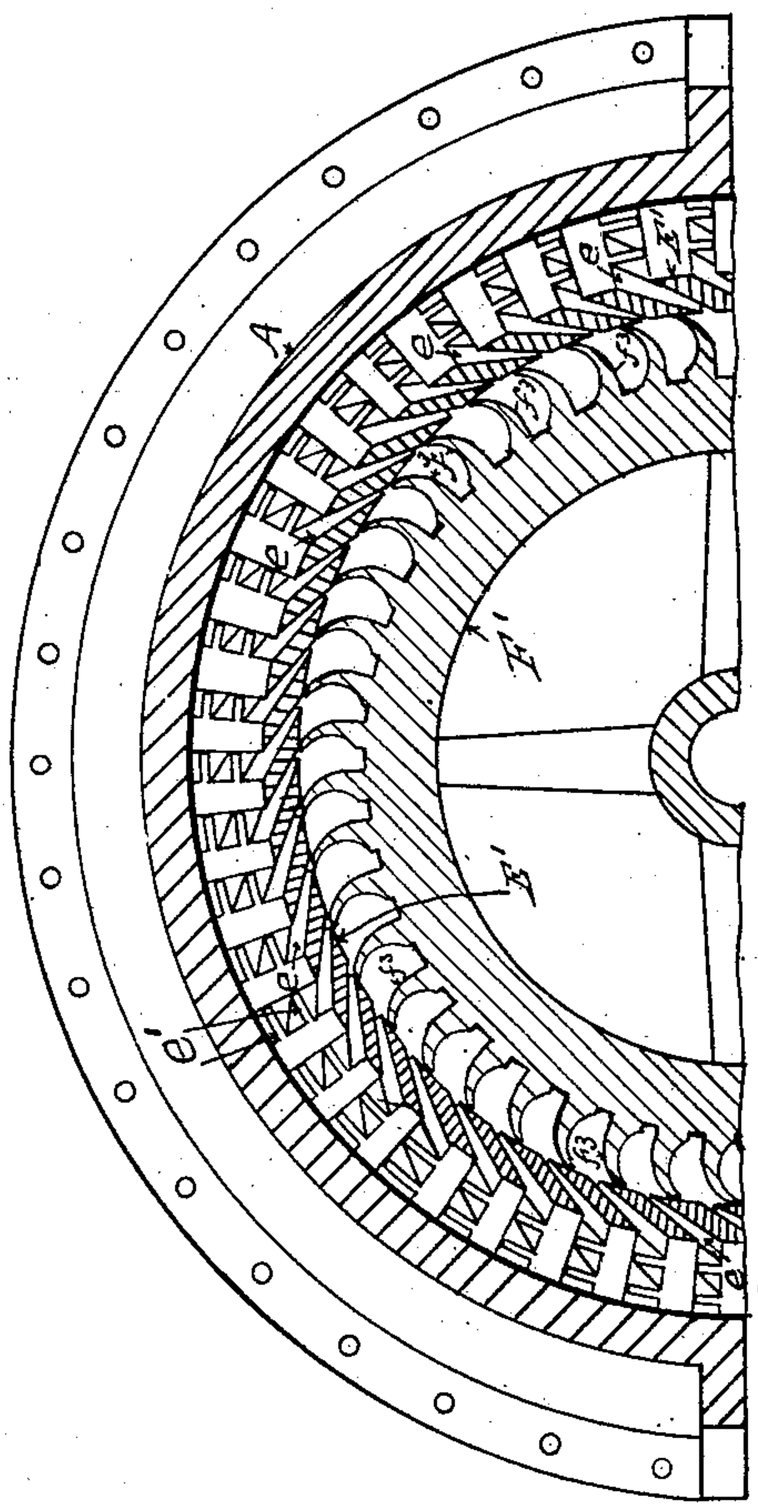


Fig. 3.

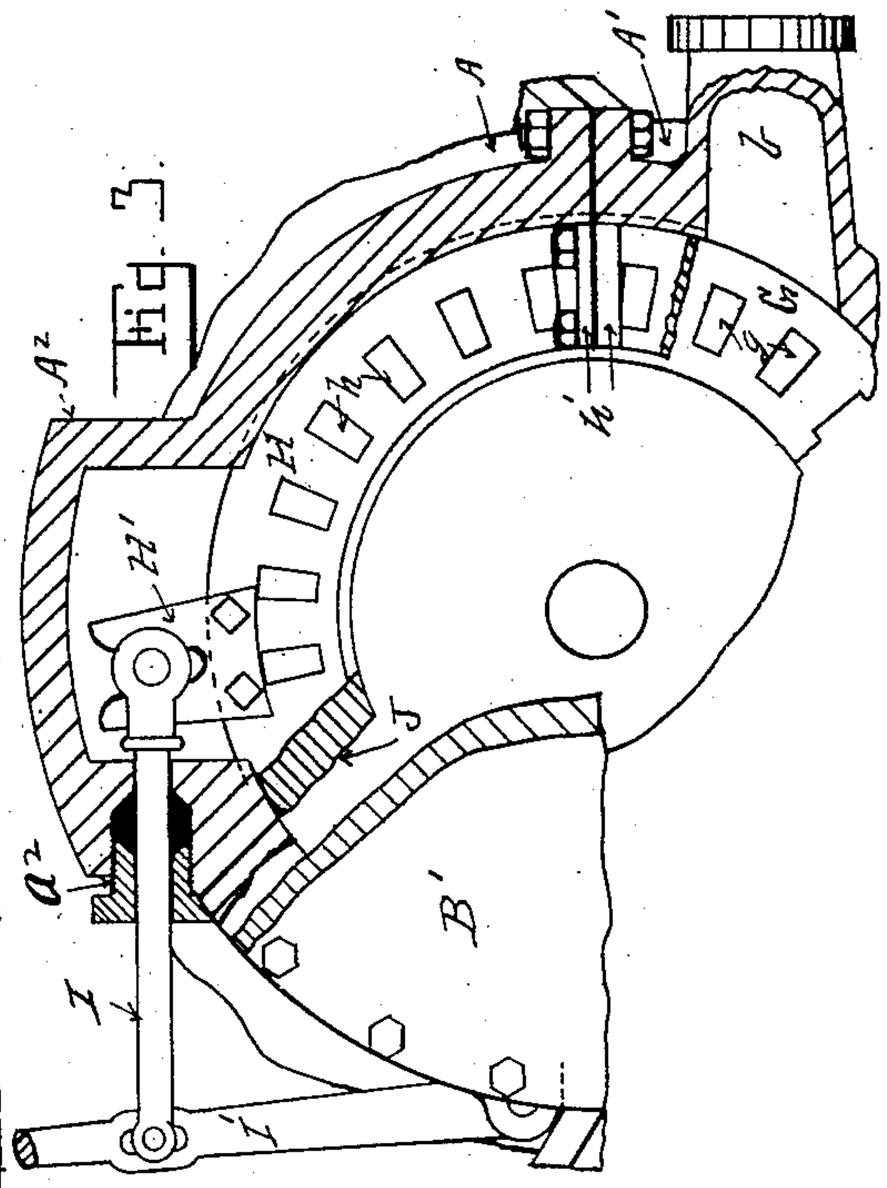
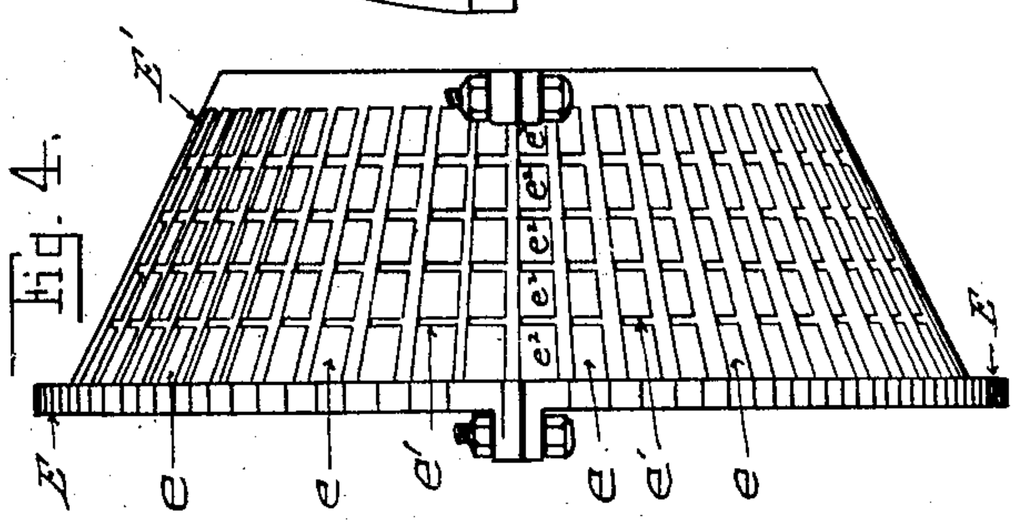


Fig. 4.



Witnesses.
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Inventor.
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No. 762,452. 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. 762,452, dated June 14, 1904.

Application filed February 19, 1904. Serial No. 194,373. (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 objects the combination, in an engine of this character, of a shell having a series of annular chambers therein closed at their rear ends and having their inner walls provided with slots or steam-jet openings therethrough at angles to lines radiating from the axes of said chambers, said slots or steam-jet openings having transverse partition-walls therein and being hereinafter designated as "diagonal" slots or steam-jet openings, and a rotatable cylinder mounted therein concentrically with the inner walls of said chambers and provided on its periphery with rows of vanes coinciding with and adjacent to the inner walls of said chambers, said chambers and vanes being so arranged with relation to each other that the discharge ends of the rows of vanes on the cylinder substantially coincide annularly with the inlet ends of the chambers in the shell, so that the steam passes from the discharge end of each row of said vanes directly into the inlet end of the chamber succeeding thereto in substantially a direct line, so that the steam in its passage through the engine from the inlet to the exhaust thereof enters the first chamber of the series, from whence it is discharged through the diagonal slots or steam-jet openings in the inner wall thereof against the first row of vanes on the cylinder, from whence it passes out of the discharge ends thereof directly into the second chamber of the series, from whence it is in like manner again discharged against the second row of vanes on the cylinder, this operation being consecutively repeated by the steam in its traverse until it has passed successively into and out of one chamber after the other and from the last row of cylinder-vanes to the exhaust of the engine.

Another feature of my invention consists, substantially, in extending the end of the cylinder at the inlet end of the engine into a steam-chest, preferably in the end of the shell, and providing thereon a disk which operates substantially as one end of the steam-chest and receives the steam-pressure therein, and thereby operates to counterbalance the end thrust of the cylinder. In this steam-chest I also provide an annular grid-valve which operates against a grid formed, preferably, on the inlet end of the inner wall of the first chamber, and the valve operating thereon serves to control the admission of steam to the first chamber.

In the construction of an elastic-fluid turbine-engine embodying these and other features of my invention hereinafter described I preferably make the shell of the engine in sections adapted to be secured together, and I secure therein a series of removable chamber rear end and inner walls, so as to form a series of annular chambers in the engine-shell, having their rear ends closed and their front or inlet ends open, each of said inner chamber-walls gradually increasing in diameter from the inlet end to the rear end of the chamber and having therein diagonal slots or steam-jet openings provided with transverse walls therein forming partitions dividing said diagonal slots or steam-jet openings into short sections, so that the steam in passing therethrough is prevented from traveling longitudinally therein instead of directly therethrough. The rear and inner chamber-walls are also preferably made in sections bolted together, and these rear end walls are preferably secured in the shell by being fitted into annular grooves in the inside of the shell-sections, so that when in place and the shell-sections are secured together they are firmly secured therein. Within the shell and concentric with the inner walls of the chambers therein there is mounted a rotatable cylinder,

on the periphery of which there is an annular row of vanes coinciding with and adjacent to the inner wall of each chamber, having the ends thereof under the inlet ends of the chambers closed and the ends thereof under the rear ends of the chambers open, and the chambers and the rows of vanes are so arranged with relation to each other that the open ends of the rows of vanes are directly opposite the open ends of the chambers, so that the steam will be discharged from the open end of each row of vanes directly into the open or inlet end of the chamber next succeeding thereto in substantially a direct line. In the construction of this engine I preferably extend the inlet end of the shell forward far enough to form the outer wall of a cylindrical steam-chest, and on the inlet end of the inner wall of the first chamber I also make an annular grid, the openings or ports in which open directly into the inlet end of the first chamber. I also provide an annular grid-valve which operates against the grid on the chamber and when rotated operates to open and close the ports in the stationary grid, and thereby control the admission of steam from the steam-chest to the first chamber. I also extend the end of the rotatable cylinder into said steam-chest and provide on the outer end thereof a disk, the periphery of which rotates in close proximity to the inner wall of the steam-chest, and annular grooves are provided, preferably both in the inner wall of the steam-chest and in the periphery of the disk, which operate to automatically form a steam-packing for the joint between them, so that said disk substantially forms the outer end wall of the steam-chest and also operates to counterbalance the end thrust of the cylinder caused by the action of the steam thereon. These and other features of my invention are hereinafter fully set forth and explained, 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 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 transverse section of the same substantially on the line $y\ y$ in Fig. 1. Fig. 4 is a view in elevation of one of the rear end and inner walls of the chambers in the shell.

In the drawings illustrating my invention, A A′ are the sections of the shell of the engine, which is to be provided with a suitable base and with cylinder-shaft bearings. (Not shown.) At the inlet end of the engine the shell is preferably extended so as to form a cylindrical steam-chest B, provided with an outer head B′ and a steam-inlet *b*. The rear end of the shell is provided with a head C, having an exhaust-chamber C′ therein and an exhaust-outlet *c*. The shell of the engine increases in diameter from the inlet to the exhaust end thereof and is provided with a series of annular chambers D D′ D^2 D^3 therein, consecutively increasing in capacity, the end and inner walls E E′ of which chambers are made, preferably, in sections bolted or otherwise secured together, as illustrated in Fig. 4, and are secured in the shell, preferably by fitting the end walls E thereof into annular grooves *a* in the shell-sections A A′, so that when they are in place and the shell-sections A A′ secured together they are firmly held in place therein and form the end and inner walls of the chambers D D′ D^2 D^3 with their rear ends *d* closed by the end walls E and their front or inlet ends *d′* open and with the peripheral wall of the front or inlet end *d′* of each chamber substantially coincident with the inner face of the inner walls E at the closed end *d* of the preceding chamber. The inner walls E′ of said chambers flare outwardly, so that they gradually increase in diameter from the inlet ends *d′* to their closed ends *d* and preferably increase in length from the inlet to the exhaust end of the engine, the mean diameter of the chambers D, D′, D^2, and D^3 being successively increased from the inlet to the exhaust end of the shell, whereby the capacities of said chambers are likewise consecutively increased to provide for the normal expansion of the steam passing therethrough.

In the inner walls E of the chambers D, D′, D^2, and D^3, I make diagonal slots or steam-jet openings *e*, (clearly illustrated in Figs. 1, 2, and 4,) and in these diagonal slots or steam-openings *e* I place transverse partition-walls *e′*, thereby dividing said diagonal slots or steam-jet openings into comparatively short sections e^2, as clearly illustrated in Figs. 1 and 4, whereby the steam in its passage therethrough is prevented from traveling laterally therein and is forced to travel in direct lines therethrough.

On a shaft F, I mount a rotatable cylinder F′ concentrically with the inner walls E′ of the chambers D, D′, D^2, and D^3, and on the periphery of the cylinder F′ there are rows of vanes f f' f^2 f^3, coinciding with and adjacent to the inner walls E′ of said chambers. The end of each of said rows of vanes under the inlet ends *d′* of said chambers are closed, and the opposite end of each of said rows of vanes under the closed end *d* of each chamber is open and coincides with the open or inlet end *d′* of the next succeeding chamber, the depth of the vanes f f', &c., gradually increasing from their closed to their open ends, so that their depth at their open ends is substantially the same as the open or inlet end *d′* of the chamber into which the steam from the open ends of the vanes is discharged. The vanes in the rows f, f', f^2, and f^3 thereof on the cylinder F′ are preferably placed spirally thereon, as illustrated in Fig. 1. I can, however, use straight vanes in lieu of spiral ones

with good results. On the end of the inner wall E′ at the inlet end *d′* of the chamber D I make an annular grid-valve seat G with ports *g* therein, which coincide with the inlet of the chamber D. The periphery of said grid G engages in a groove *a′* in the shell A A′, so that said grid G forms an annular grid-valve seat G′, and within the valve-chest B, I place an annular grid-valve H, having ports *h* therein adapted to operate on said valve-seat G′. On said valve H, I secure a slotted arm H′, which extends up into a pocket A^2 in the valve-chest shell, as illustrated in Fig. 3, and engages a valve-rod I, which extends out through a stuffing-box a^2 in one side of the pocket A^2, where it is connected with an operating-lever I′, whereby the valve H can be rotated upon the valve-seat G′ and the ports *g* therein opened and closed, as may be desired. The valve H is preferably made in sections secured together by means of bolts passing through ears *h′* thereon, as illustrated in Fig. 3. The cylinder F is preferably provided with an extension F^2, which extends into the steam-chest B, and on the outer end thereof there is secured a disk J, the periphery of which rotates in close proximity to the inner wall of the steam-chest B, and in the periphery of this disk I make annular grooves J′, and in the inside of the steam-chest B, I also preferably make annular grooves *b′*, coinciding with the grooves J′ in the disk J, which grooves operate to automatically form a steam-packing for the joint between the inner wall of the steam-chest and the periphery of the disk J, so that the disk J substantially forms the outer head of the steam-chest and also operates to counterbalance the end thrust of the cylinder F′, caused by the action of the steam thereon. Between the head B′ and the disk J there is a chamber B^2, into which any steam escaping around the periphery of the disk J passes and from which it is conveyed to the exhaust-chamber C′ of the engine by means of a pipe K.

In operation the steam first enters the chamber D, from whence it is discharged through the diagonal slots or steam-jet openings in the inner wall E′ of said chamber against the first row of vanes *f* on the cylinder F′, and thence passes out from the open ends of said vanes directly into the inlet end of the chamber D′, from whence it is again discharged through the diagonal slots or steam-jet openings in the inner wall E′ thereof against the second row *f′* of the vanes on the cylinder F′, and thence to the chamber F^2, from whence it is again discharged, as before, this operation of the steam being consecutively repeated until it has passed through all of the chambers and acted upon all of the rows of vanes on the cylinder and finally reaches the exhaust-chamber C′ and passes out of the exhaust *c*.

It will be observed that an important feature of this invention is the construction of the chambers and cylinder-vanes and their arrangement with relation to each other, so that the open or inlet ends of the chambers are practically opposite and substantially coincide with the open ends of the cylinder-vanes, together with the gradually-increasing depth of the cylinder-vanes toward their discharge ends, whereby there is a free and direct passage for the gradually-expanding steam therefrom directly into the chambers coinciding therewith. Again, the feature of the partition-walls *e′* in the diagonal slots or steam-jet openings *e* in the inner chamber-walls E′ of the chambers operates to prevent the steam in its passage therethrough from traveling longitudinally in the slots or steam-jet openings toward the vanes of the cylinder instead of directly against the cylinder-vanes at substantially right angles thereto. In my application for patent for an elastic-fluid turbine-engine, Serial No. 192,806, filed February 9, 1904, I have shown and described a method of attaining this result, but do not show or describe the features thereof herein shown and described.

I have thus shown and described a convenient construction of an elastic-fluid turbine-engine embodying the features of my invention which will enable others skilled in the art to which this invention appertains to construct and utilize the same. I do not, however, desire to limit myself to the particular number of chambers and rows of vanes herein shown and described or to any particular construction of the parts of the engine, as these features may readily be considerably modified 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 the character described, of a shell having a series of annular chambers therein, open at their front or inlet ends and closed at their rear ends, the inner walls whereof are provided with diagonal slots or steam-jet openings therein, a cylinder concentric with the inner walls of said chambers. and rows of vanes on the periphery of said cylinder coinciding with and adjacent to the inner wall of each of said chambers, and closed at the front ends thereof and open at the rear ends thereof, the open end of each of said rows of vanes coinciding substantially with the open or inlet end of the chamber succeeding thereto, substantially as set forth.

2. The combination in an elastic-fluid turbine-engine of the character described, of a shell having a series of annular chambers therein of gradually-increasing capacity, open at their front or inlet ends and closed at their rear ends, the inner walls of which chambers flare outwardly from the inlet ends to the closed ends of the chambers and are provided with

diagonal slots or steam-jet openings therein, a cylinder concentric with the inner walls of said chambers, and a row of vanes on the periphery of said cylinder coinciding with and adjacent to the inner wall of each of said chambers closed at its front end and gradually increasing in depth toward the open end thereof, the open end of each of said row of vanes coinciding substantially with the open or inlet ends of the chamber succeeding thereto, substantially as set forth.

3. The combination in an elastic-fluid turbine-engine of the character described, of a shell having a series of annular chambers therein, walls forming the rear ends of said chambers secured in said shell, annular walls joined to said rear end wall and forming the inner walls of said chambers and having diagonal slots or steam-jet openings therein, and transverse partitions in said diagonal slots or steam-jet openings, substantially as set forth.

4. The combination in an elastic-fluid turbine-engine of the character described, of a shell having a series of annular chambers therein, of sectional walls secured in said shell and forming the rear end walls and tapering inwardly therefrom so as to form the inner annular walls of said chambers, said inner annular chamber-walls having diagonal slots or steam-jet openings therein, and transverse partition-walls in said diagonal slots or steam-jet openings, substantially as set forth.

5. The combination in an elastic-fluid turbine-engine of the character described, of a shell having a series of annular chambers therein, of sectional walls removably secured in the shell and forming the rear end and inner annular walls of said chambers, said inner annular chamber-walls having diagonal slots or steam-jet openings therein, transverse partition-walls in said diagonal slots or steam-jet openings, a rotatable cylinder concentric with the inner walls of said chambers, and a row of spiral vanes on the periphery of said cylinder coinciding with and adjacent to the inner wall of each of said chambers and closed at the front end thereof and open at the rear end thereof, the open end thereof coinciding substantially with the open or inlet end of the chamber succeeding thereto, substantially as set forth.

6. The combination in an elastic-fluid turbine-engine of the character described, of a shell having therein a series of annular chambers open at their front ends of consecutively-increasing capacity, of walls removably secured in said shell forming the rear end walls and inner annular walls of said chambers, said inner annular walls tapering inwardly from the closed ends of said chambers to the open or inlet ends thereof and having diagonal slots or steam-jet openings therein, transverse walls in said diagonal slots or steam-jet openings, a rotatable cylinder concentric with the inner walls of said chambers, and a row of spiral vanes on said cylinder coinciding with and adjacent to the inner walls of each of said chambers, closed at the front end thereof and open at the rear end thereof, and gradually increasing in depth from the closed to the open end thereof, and with its open end coinciding substantially with the open or inlet end of the chamber next succeeding thereto, substantially as set forth.

7. The combination in an elastic-fluid turbine-engine of the character described, of a shell having a series of annular chambers therein having diagonal slots or steam-jet openings in the inner walls thereof, a rotatable cylinder concentric with the inner walls of said chambers, a row of vanes on the periphery of said cylinder opposite and adjacent to the inner wall of each of said series of chambers, an annular steam-chest communicating with the inlet of the first chamber of said series, an annular grid-valve seat at the inlet of said chamber an annular grid-valve operating on said grid-valve seat, and means for rotating said grid-valve to open and close the ports in said valve-seat, substantially as set forth.

8. The combination in an elastic-fluid turbine-engine of the character described, of a shell having a series of annular chambers therein, the inner walls of which have diagonal slots or steam-jet openings therein, a rotatable cylinder concentric with the inner walls of said chambers, a row of vanes on the periphery of said cylinder coinciding with and adjacent to the inner wall of each of said chambers, a cylindrical steam-chest at the inlet end of the first of said series of chambers, a disk secured to and rotating with said cylinder the periphery whereof is grooved and operated in close proximity to the inner wall of said steam-chest so as to substantially form one of the end walls thereof, substantially as set forth.

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

JOHN C. STURGEON.

Witnesses:
H. M. STURGEON,
F. J. BASSETT.