No. 803,275. PATENTED OCT. 31, 1905.

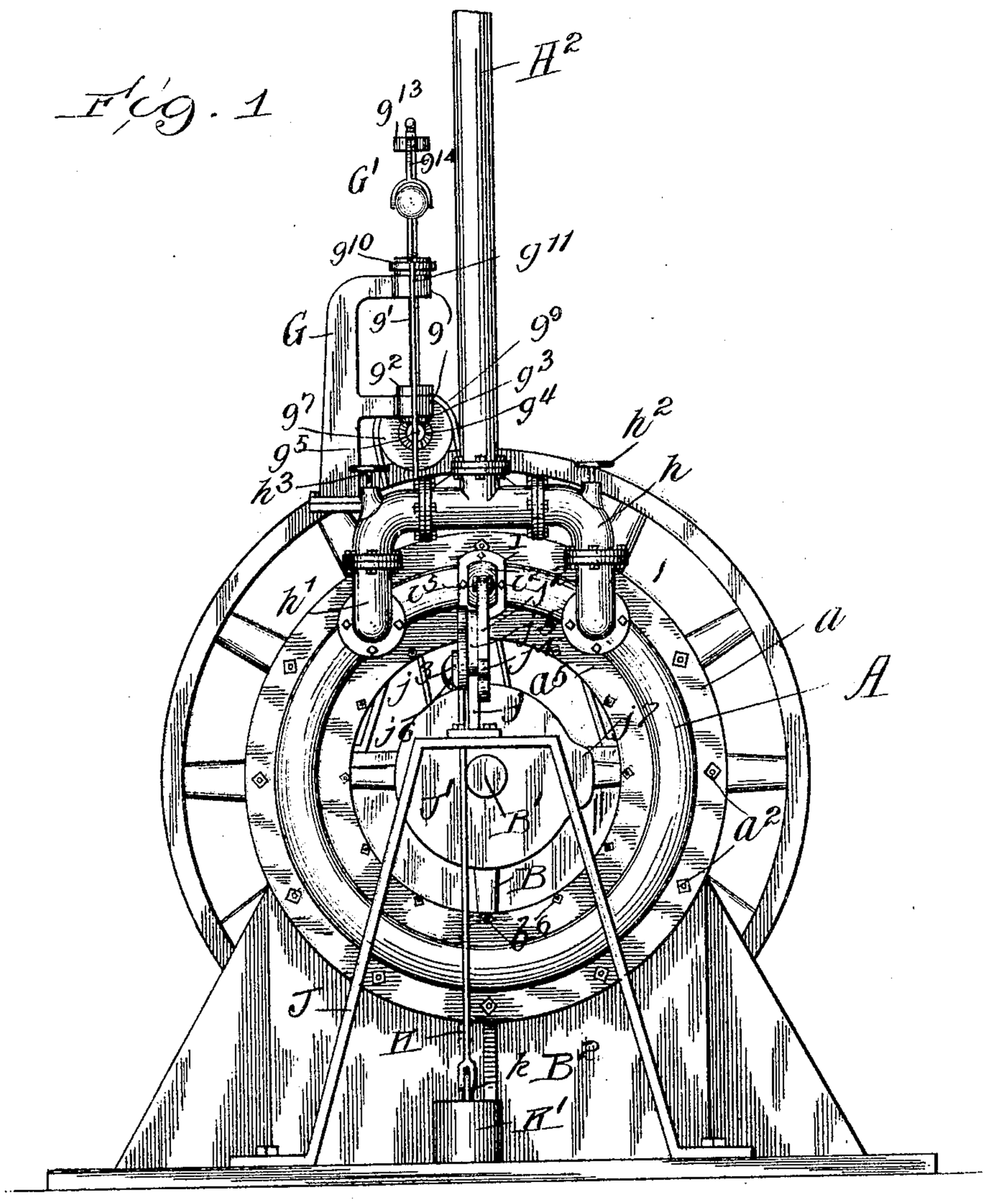
J. A. EATON.

ROTARY ENGINE.

APPLICATION FILED DEC. 4, 1903.

5 SHEETS—SHEET 1.

Fig. 1



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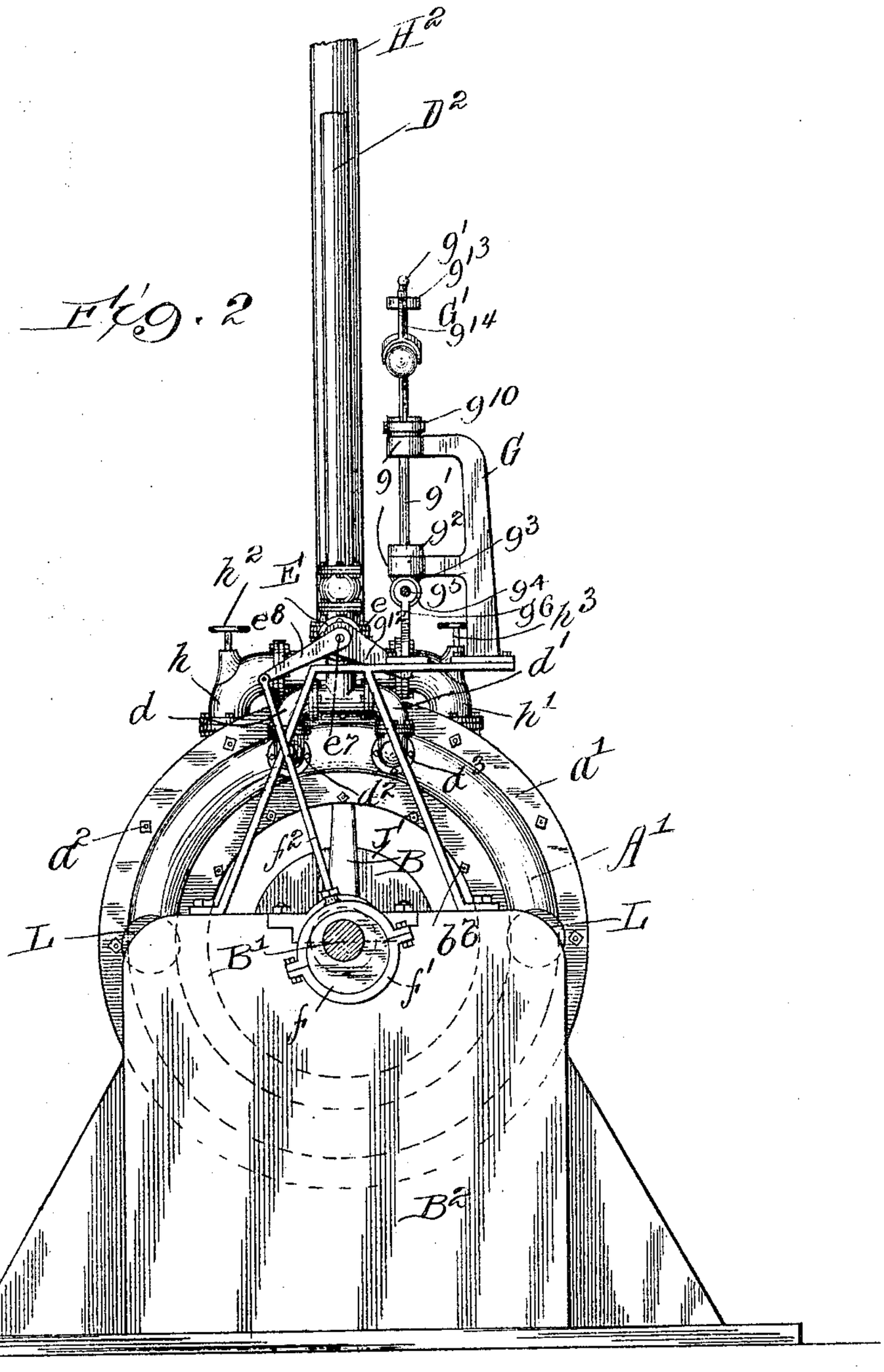
5 SHEETS—SHEET 2.

Fig. 2.



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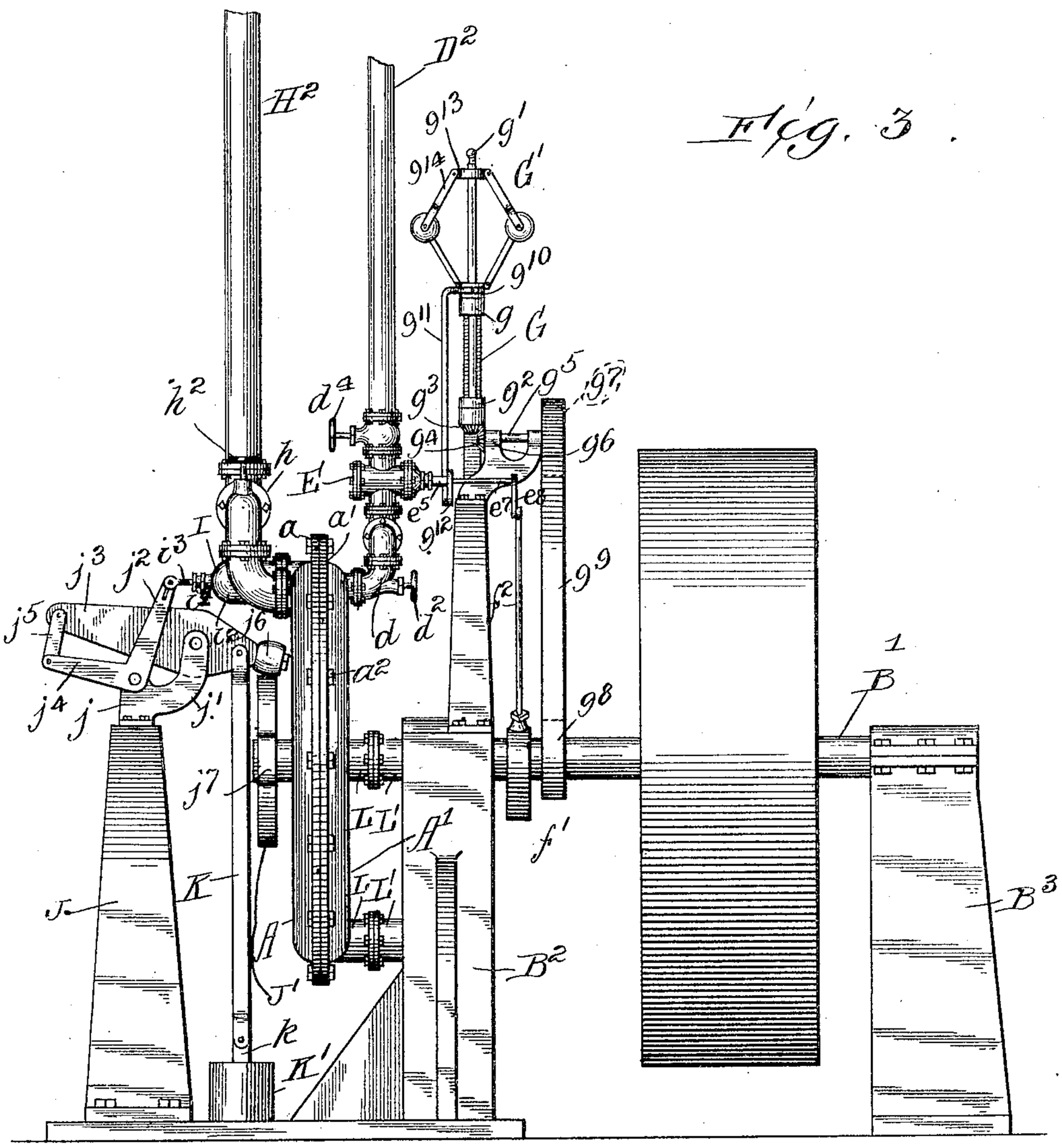
5 SHEETS—SHEET 3.

Fig. 3.



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5 SHEETS—SHEET 4.

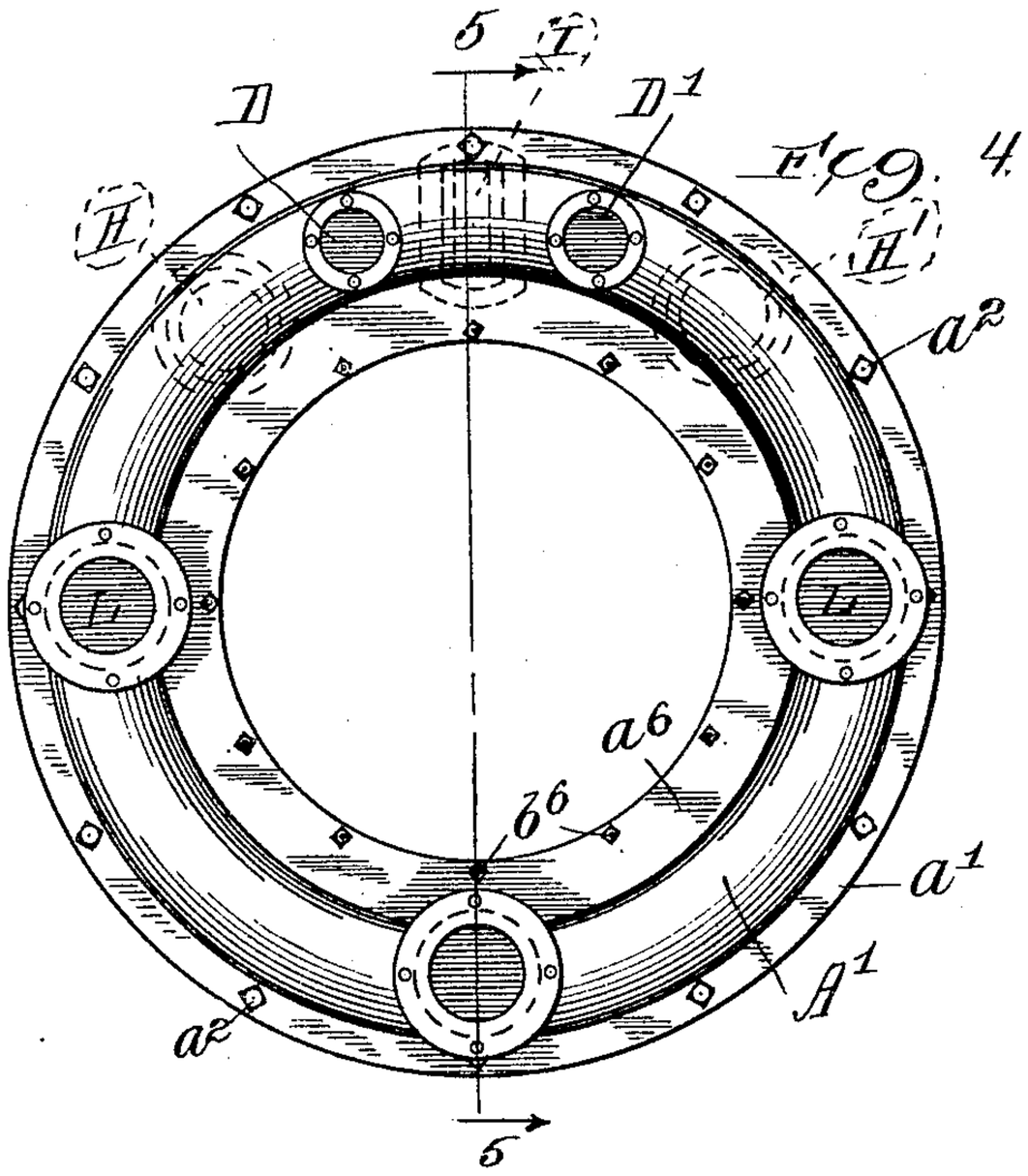

FIG. 4.

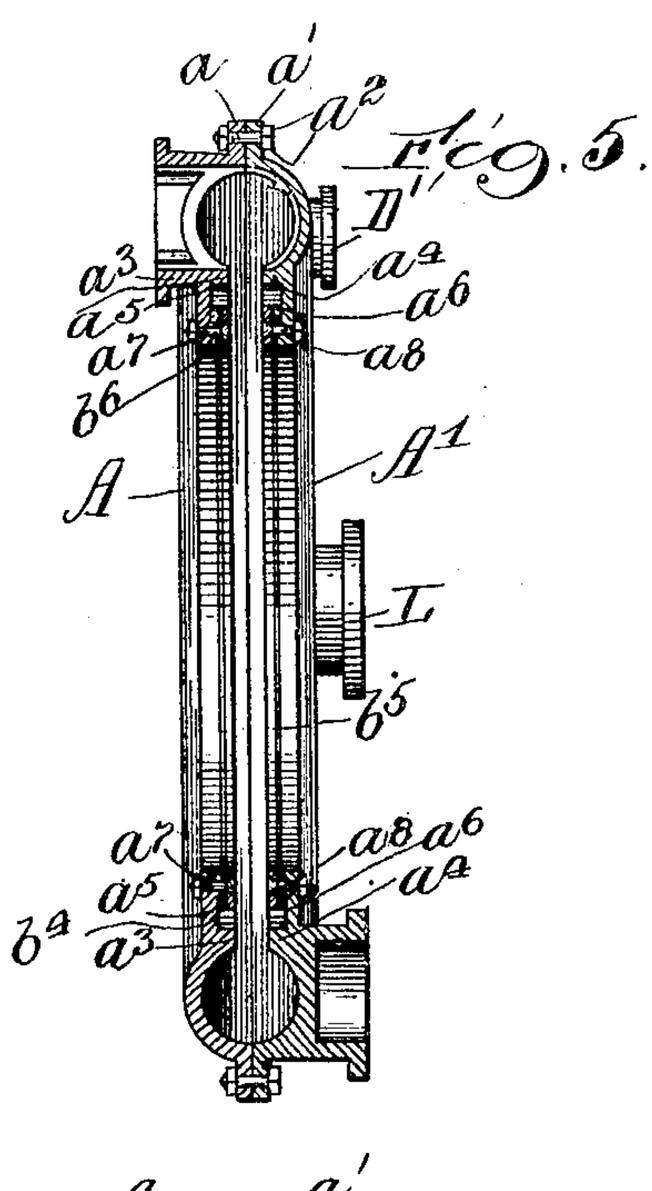

FIG. 5.

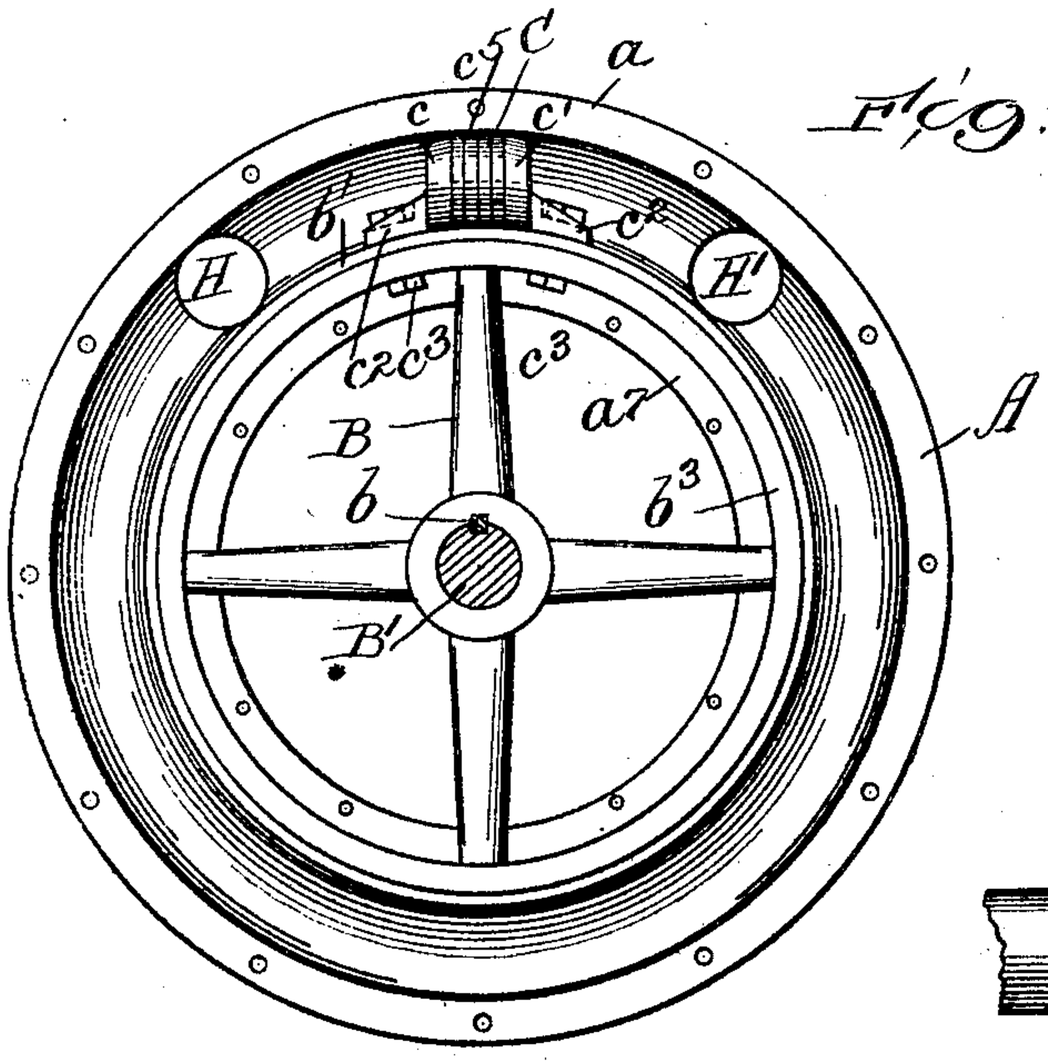

FIG. 6.

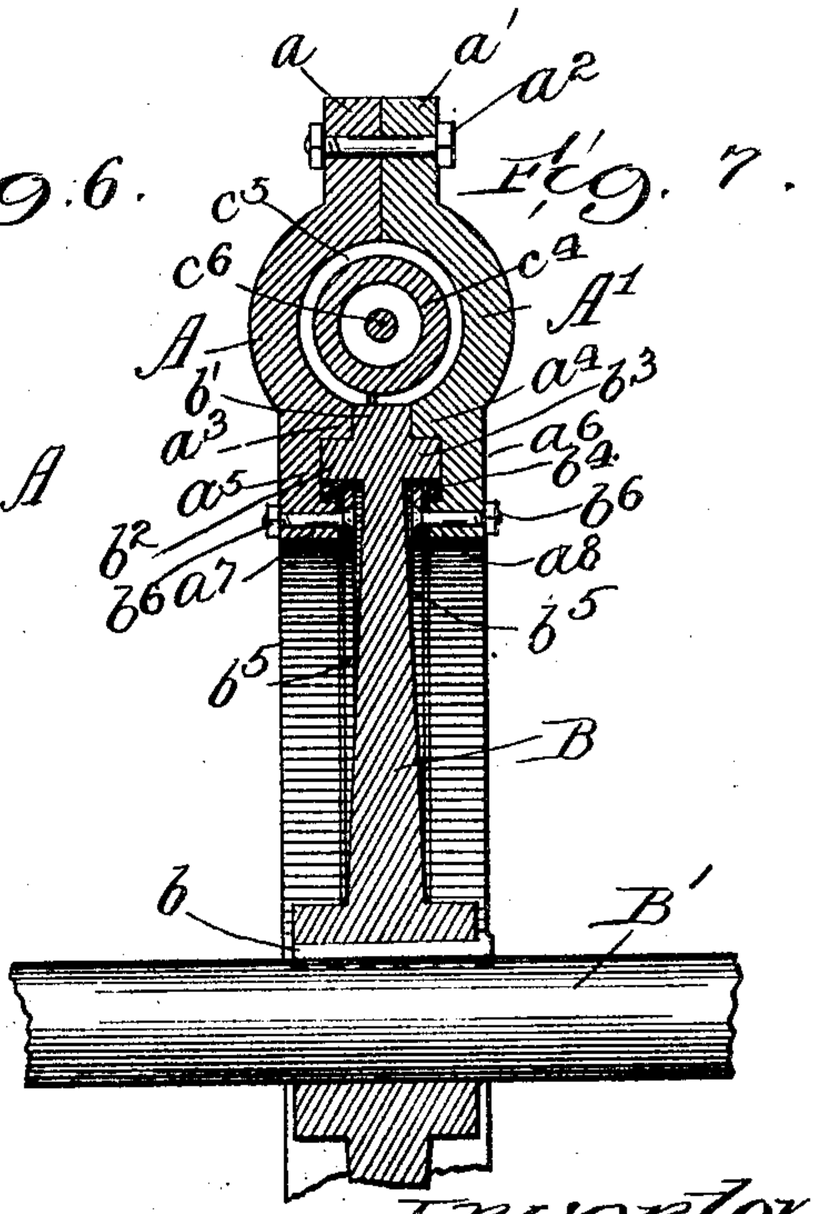

FIG. 7.

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No. 803,275. PATENTED OCT. 31, 1905.

J. A. EATON.

ROTARY ENGINE.

APPLICATION FILED DEC. 4, 1903.

6 SHEETS—SHEET 5.

Fig. 8.

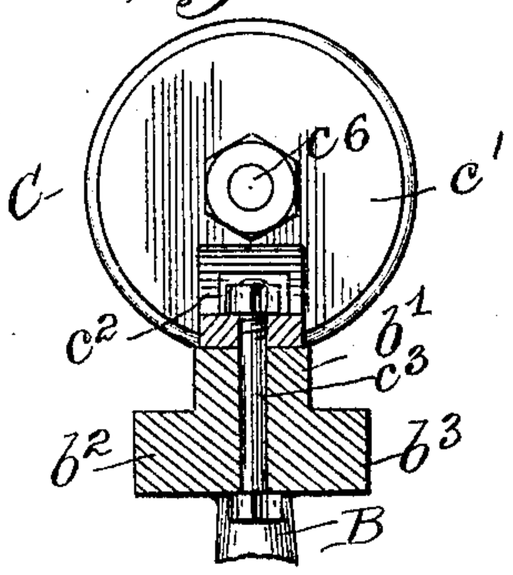


Fig. 9.

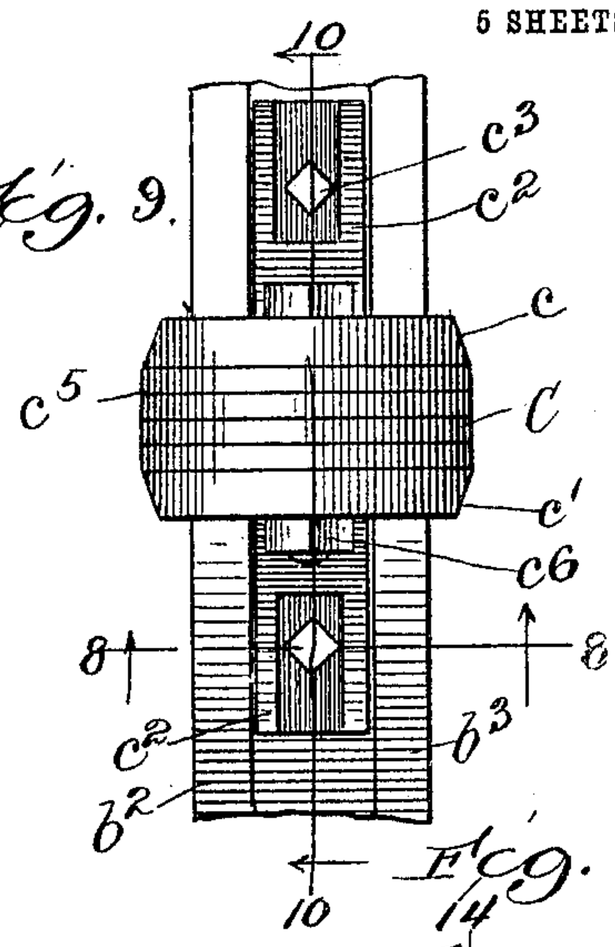


Fig. 10.

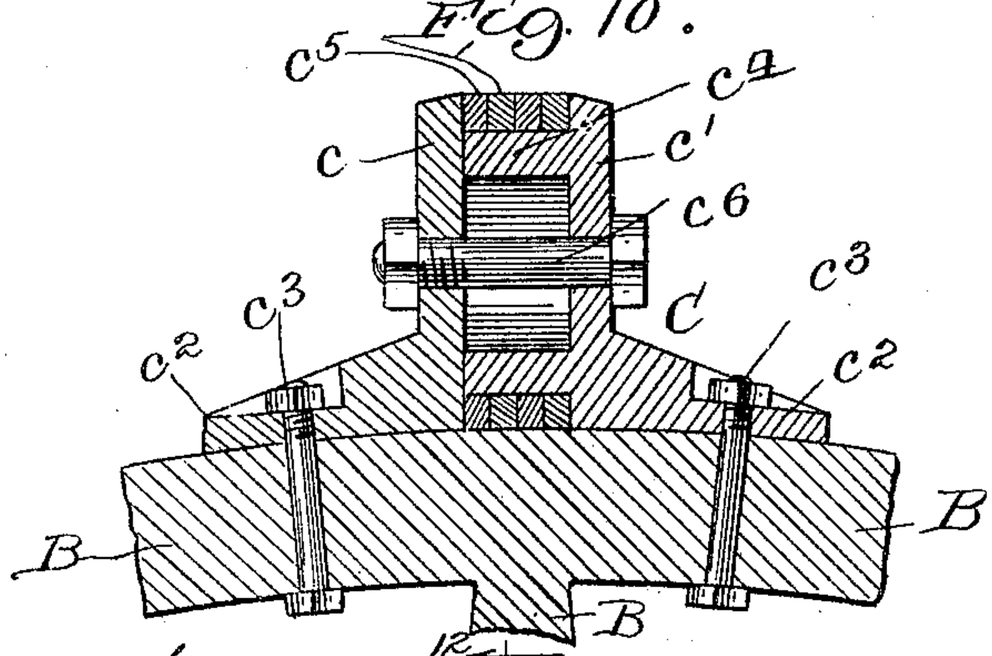


Fig. 13.

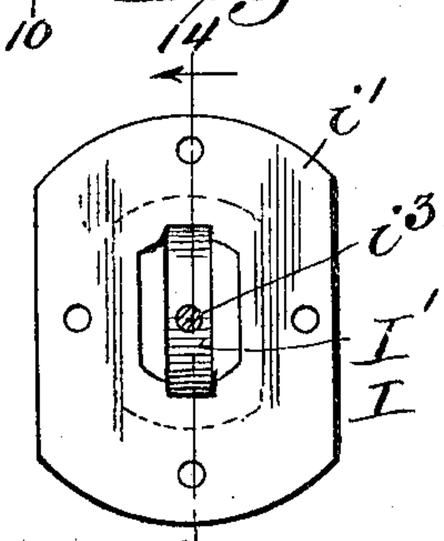


Fig. 11.

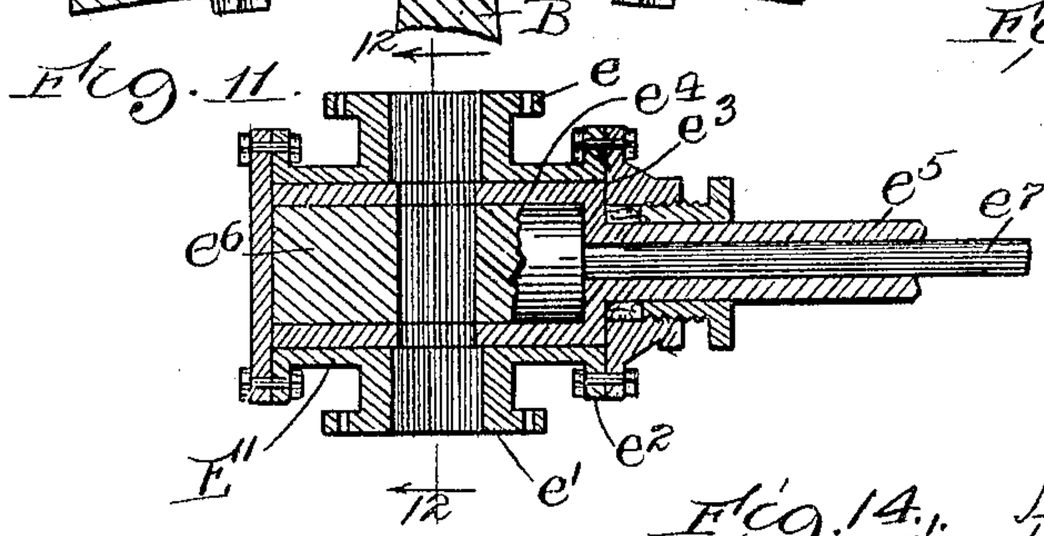


Fig. 12.

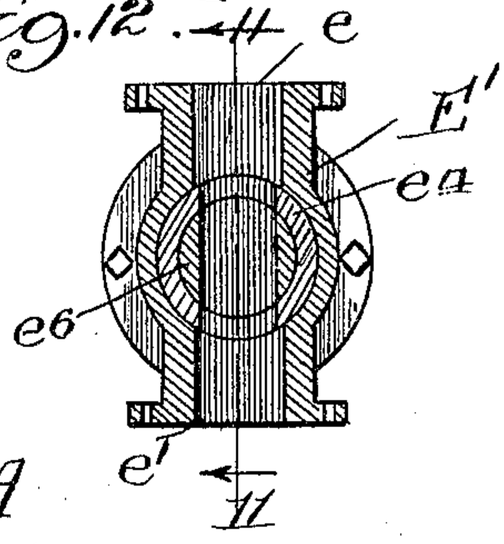
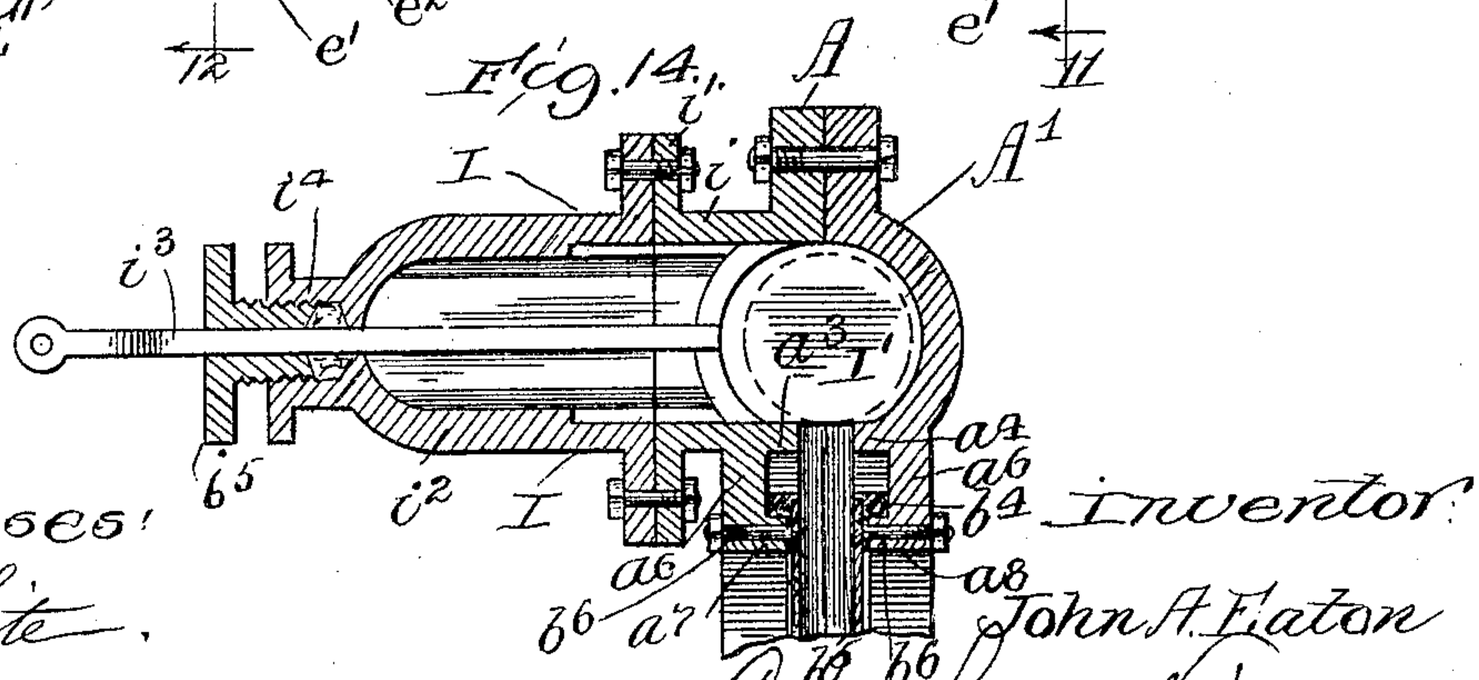


Fig. 14.



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UNITED STATES PATENT OFFICE.

JOHN A. EATON, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO CHARLES M. SECKNER, OF CHICAGO, ILLINOIS.

ROTARY ENGINE.

No. 803,275. Specification of Letters Patent. Patented Oct. 31, 1905.

Application filed December 4, 1903. Serial No. 183,792.

To all whom it may concern:

Be it known that I, JOHN A. EATON, a citizen of the United States, and a resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Rotary Engines; and I do hereby declare that the following is a full, clear, and exact description of 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 improvements in rotary engines of that class provided with a continuously-traveling piston or the like.

Heretofore in many types of engines of the class it has been necessary to provide a separate engine for reverse as well as for direct movement instead of so constructing a single engine as to operate in either direction.

The object of this invention is to provide an engine of strong and durable construction and comparatively light weight and so constructed as to present all the advantages of a reciprocating engine without the disadvantages of the same—namely, the reciprocation of the pistons—and constructed to secure the most effective action of the steam both directly and expansively.

It is also an object of the invention to provide means for readily reversing the engine when desired.

The invention consists in the matters hereinafter described, and more fully pointed out and defined in the appended claims.

In the drawings, Figure 1 is a side elevation of a device embodying my invention. Fig. 2 is an elevation of the opposite side of the engine, showing the main shaft in section and the balance-wheel omitted. Fig. 3 is a front elevation of the same. Fig. 4 is a side elevation of the circular cylinder of the engine, showing the same detached from the frame. Fig. 5 is a section on line 5 5 of Fig. 4. Fig. 6 is a face view of the cylinder and revolving piston, showing one side of the cylinder removed. Fig. 7 is an enlarged fragmentary transverse section of the cylinder and rotating head therein. Fig. 8 is an end view of the revolving head, showing the rim on which the same is carried in section. Fig. 9 is a fragmentary top plan view of the same. Fig. 10 is a section on line 10 10 of Fig. 9. Fig. 11 is a vertical section taken longitudinally through the governing-valve and showing parts in elevation. Fig. 12 is a section on line 12 12 of Fig. 11. Fig. 13 is a transverse section taken through the casing of the cut-off valve at the joint. Fig. 14 is a section on line 14 14 of Fig. 13.

As shown in said drawings, said engine comprises an annular steam-chamber the bore of which describes a true circle and, as shown, is circular in cross-section and of uniform size, though obviously the bore may be of any desired shape in cross-section. Said chamber is formed by rigidly bolting together, as shown, two supplemental shells of cast metal, (indicated by A and A′,) which are provided on their outer periphery with radially-directed flanges a a', ground on their inner faces to afford a tight joint and through which extend the bolts a^2, adapted to secure said shells together. Said shells are provided with oppositely-facing shoulders a^3 a^4, between which, instead of meeting at their inner peripheries, is a narrow passage or channel of uniform width opening into the bore of the chamber. Integral with said shoulders a^3 a^4 are the flanges a^5 a^6, which are directed toward the axis or main shaft, as more clearly shown in Figs. 5 and 7, and are provided on their free edges with inwardly-directed flanges a^7 a^8, respectively, thereby forming an annular recess or channel in each shell-section between said flanges a^7 a^8 and the shoulders a^3 a^4.

Similar uprights or frame members B^2 B^3 are rigidly supported upon any preferred bed, and a main delivery-shaft B′ is journaled thereon concentric with the shell, which, as shown, is rigidly secured to the frame member B^2 by means hereinafter described. Rigidly secured on the shaft B′, as shown by a key b, is a wheel B, provided with a peripheral rib b', fitting closely in and closing the channel between the shoulders a^3 a^4 of the steam-chamber. The rim of said wheel projects laterally beyond said rib into said channels in the flanges a^5 a^6, bearing against said shoulders a^3 a^4 and affording a joint therewith. Said projecting edges of the rim (indicated by b^2 b^3) engage closely between the flanges a^5 a^6 and the contacting faces of the rib and periphery of said wheel, and the shoulders and flanges of said chamber are ground to form true

joints, so as to avoid as much friction as possible. The thickness of the lateral edges b^2 b^3 of the rim is less than the width of the annular recesses in the flanges a^5 a^6 in which they are seated, and the remainder of said recesses form a seat for the packing b^4 of any desired kind. Said packing extends outwardly over the inner faces of the flanges a^7 a^8 and is held in place by compression rings or plates b^5 b^5, which are adjustably secured upon the shoulders a^7 a^8 by means of the bolts b^6 and extend inwardly from said shoulders into close proximity with the rim. Rigidly secured upon the rib b' of the wheel B is the piston-head C, shaped to fit closely within the bore of said steam-chamber and which may be of any desired construction, but, as herein shown, comprises the end sections c and c', each provided with an outwardly-directed base c^2, which fits closely upon the rib b' of the wheel and is rigidly engaged thereon by means of the bolts c^3. The end section c' is provided with an inwardly-directed integral flange c^4, concentric with the bore of said chamber and which affords a seat for the piston-rings c^5. Said piston-rings may be of any desired material and construction. As herein shown, however, they are the ordinary metallic packing-rings and are of a size sufficient to fit closely within the bore of said chamber. A bolt c^6 extends axially through said end sections and rigidly binds them together and holds the piston-ring c^5 rigidly in place. Said piston is adapted to revolve in either direction, and for the purpose of admitting steam at either end of the piston, as may be desired, the shell A' of the steam-chamber is provided with two steam-inlet ports D and D' near the top and a little to one side of the center thereof, into which are respectively connected the supply-pipes d d'. Said supply-pipes lead upwardly and are connected in the main supply-pipe D^2, as shown in Figs. 2 and 3, and provided each with a throttle-valve d^2 d^3, adapted to close either of said ports while the steam is passing through the other. The pipe D^2 for convenience is also provided with a throttle-valve d^4, which for convenience will be called the "main" throttle-valve, by means of which the supply of steam may be cut off should it become necessary. Connected in said pipe D^2 between the main throttle d^4 and throttles d^2 d^3 is a double-acting governing-valve E, comprising, as shown in Figs. 11 and 12, a casing E', closed at the rear and adapted at its sides for connection in said supply-pipe D^2 and the supply-pipes d and d', affording ports e e'. Within said casing E' is a closely-fitting rotative valve-sleeve e^4, provided with a transverse aperture adapted to register with the ports e e' when said sleeve is in one position and to close said ports when in another position. A tubular valve-stem e^5, integral with said sleeve, extends outwardly through a gland e^3 on the end of said casing.

Within the valve-sleeve e^4 is a closely-fitting rotative valve-closure e^6, provided with a transverse aperture adapted when the closure is in one position to register with the ports e e' and with the apertures in the valve-sleeve e^4. Said valve-sleeve e^4 and valve-closure e^6 are adapted to close or partly close said ports by rotation of either the valve-closure e^6 or valve-sleeve e^4 with respect to each other. A valve-stem e^7 is connected with said valve-closure and extends outwardly through the valve-stem e^5 and is provided on its outer end with a crank-arm e^8.

Rigidly secured upon the shaft B' below the crank-arm e^8 is an eccentric f, provided with a yoke f', on which is an upwardly-extending connecting-rod f^2, which is pivotally engaged to the crank-arm e^8, as more clearly shown in Fig. 2, and which acts at each revolution of said shaft to partly rotate the valve-closure e^6, thereby closing the ports e e'. Any desired governing means may be used for automatically operating the valve E to cut off the steam when the engine has reached a predetermined speed of rotation. As shown, however, an upwardly-extending bracket G is rigidly engaged on the frame member B^2 and is provided with suitable bearings g g, in which is journaled an upright shaft g'. Said shaft is provided with a collar g^2, rigidly engaged thereon, which bears on the upper surface of one of said bearings g g and holds said shaft from longitudinal movement. The lower end of said shaft is provided with a beveled gear g^3, which meshes with a similar gear g^4 upon one end of the horizontal shaft g^5, which is journaled in suitable bearing g^6, carried upon said bracket, and provided with a pulley g^7, adapted to receive the driving-belt g^9, trained over a similar pulley g^8, secured on the shaft B'. On the upper end of the shaft g' is a governor G' of any preferred form of construction, but which in the drawings is shown as embracing a fixed collar g^{13}, secured at the top of the shaft g', a sliding collar g^{10}, connected with the collar g^{13} by means of the weighted toggle-arms g^{14} in a familiar manner and comprising a centrifugal governor. Said collar g^{10} is provided with a peripheral groove, in which engages the forked end of the rod g^{11}, which is pivotally connected with an arm g^{12}, rigidly engaged on the valve-stem e^5, so that when the collar g^{10} is raised by the action of the centrifugal governor the valve-sleeve e^4 is partly rotated, with the effect of cutting off the steam in the valve E.

Opening through the shell-section A, as shown, on opposite sides of the inlet-ports D and D' are the outlet-ports H and H', in which are connected the outlet-pipes h h', connected in the main outlet-pipe H^2. Said outlet-pipes

h h' are each provided with a valve h^2 h^3, adapted to close said pipe.

As above described, said engine is adapted to operate in either direction, and for the purpose of turning the steam in the direction of the travel of the piston a cut-off valve I is provided both between the inlet-ports D D′ and the outlet-ports H and H′. Said valve, as shown, is a slide-valve comprising a plate I′, shaped to seat in a complemental recess in said chamber and in its closed position affording a partition between the ports and complete closure for said chamber, as shown in Fig. 14. The shell-section A is provided with an outwardly-opening pipe connection which affords connection with the valve-casing i^2. Said valve-casing, of which the pipe connection i is a part, is provided with oppositely-disposed longitudinal grooves in which said valve-plate I′ reciprocates. The end of said valve-casing is apertured to receive the valve-stem i^3 and is provided with a suitable gland i^5, affording means for packing around said stem. Any desired means may be provided for operating said cut-off valve. As shown, however, a frame or standard J is rigidly secured upon the bed beneath the valve-casing i^2 and is provided with an upwardly-extending arm j, having a laterally curved and upturned arm j''. On the upper end of said arm j is pivotally secured a bell-crank lever, one arm j^2 of which is slotted and is pivotally connected with the outer end of the valve-stem i^3. A lever j^3 is pivotally secured upon the arm j' of the standard, one arm of which is connected with the arm j^4 of the bell-crank by means of a link j^5. The other arm of said lever j^3 is provided with a cam-roller j^6, which is adapted to track upon a cam J′, rigidly secured upon the shaft B′. Said cam J′ is provided with a cam-teat j^7, adapted to engage the cam-roll j^6 and throw the inner end of the lever j^3 upwardly, thereby operating the bell-crank and opening the cut-off valve. The inner end of said lever j^3 is also provided with a downwardly-extending connecting-rod K, pivoted thereon, the lower end of which is pivoted to the stem k of the plunger contained in a dash-pot K′ of any desired construction.

Said steam-chamber may be secured upon the frame in any desired manner. As shown, however, the casing A′ is provided with a plurality of outwardly-directed lugs L, adapted to be rigidly bolted upon similar flanged lugs L′, integral with or secured to the frame member B^2.

The operation is as follows: The valve I being held normally closed by means of the dash-pot K′, steam entering from either of the supply-pipes d d' must travel in a direction away from said cut-off valve, and this determines the direction of travel of the piston. In whichever direction it is desired to operate said engine the supply-pipe d or d', as the case may be, is opened to admit steam behind the piston and the other supply-pipe closed. The outlet-port H or H′ on the side of the valve I opposite from the open inlet is opened, and steam entering behind the piston drives it around the steam-chamber and past the open exhaust-port, where the spent steam escapes. The momentum acquired by the piston carries it forwardly, and the cam J′ is so situated upon the shaft D′ that the teat j^7 operates the lever J^3, the bell-crank, and the attached valve I just before the piston reaches said valve and holds it open until the piston has passed. When the roller j^6 passes from the cam-teat j^7 the valve again immediately closes. The eccentric f is so situated upon the shaft D′ that the valve E is closed while the piston is passing the exhaust-port and until the valve I is closed behind the piston, thereby preventing any waste of pressure through the exhaust-ports. Should the speed at any time become too great, the governor G′ automatically actuates the valve-sleeve e^4 and cuts off the steam.

A suitable drive-wheel M is rigidly engaged upon the shaft B′, by means of which the power generated by said engine may be transmitted to any desired point.

Obviously an engine constructed in accordance with my invention is very simple both in structure and in operation and will not get out of repair as easily as a more complicated device.

Obviously many details of construction may be varied without departing from the principles of this invention.

I claim as my invention—

1. In a device of the class described an annular steam-chamber, a piston therein, a shaft, means operatively connecting said piston with said shaft, a cut-off valve, a cam on said shaft and toggle means connected with said valve and operated by said cam adapted to operate the cut-off valve.

2. In a device of the class described the combination with a rigidly-supported annular steam-chamber having a peripheral opening in the inner periphery thereof, a driving-shaft extending axially of said chamber, a piston engaged thereon and movable in said chamber, inlet and outlet ports, a valve adapted to direct steam in either direction in said chamber, a cam on said shaft and toggle means engaged with said valve and operated by said cam adapted to open and close said valve for the piston to pass.

3. In a device of the class described the combination with a base, of an annular steam-chamber rigidly secured thereon and open at its inner periphery, a shaft journaled in said base and extending axially of said chamber, a wheel thereon closing the opening in said chamber, a piston rigidly engaged on said wheel and fitting in the bore of said chamber, inlet and outlet ports, a valve adapted to in-

termittently close the inlet, means engaging on the shaft adapted to operate said valves a cut-off valve and a bell-crank connected therewith adapted to operate the same.

4. In a device of the class described the combination with a base, of an annular steam-chamber rigidly secured thereon and open on its inner periphery and having two inlet and two outlet ports, a driving-shaft journaled in said base axially of said chamber, a wheel rigidly secured on said shaft and adapted to rotate in the peripheral opening of said chamber, packing means about the periphery of said wheel, a piston shaped to conform to the bore of said chamber and rigidly secured upon the periphery of said wheel, a valve in said chamber positioned with an outlet and an inlet port on each side the same, automatic means for retracting said valve to permit the piston to pass, valves in said inlet and outlet ports adapting said piston to be driven in either direction and a governor acting automatically to cut off the steam-supply.

5. In a device of the class described an annular steam-chamber, a piston shaped to fit in the bore thereof and adapted for continuous travel in either direction therein, a valve adapted to reciprocate through one wall of said chamber, a plurality of valved inlet and outlet ports adapted to admit steam on one side of said valve and discharge it on the other, a lever pivotally engaged on said valve, a cam carried on said shaft and adapted to engage said lever and automatically open the valve to allow said piston to pass, means for automatically closing said inlet during a part of the revolution of said piston, and a governor adapted to cut off the steam at a predetermined rate of speed.

6. In a reversible rotary engine an annular steam-chamber, a closely-fitting piston therein adapted for continuous travel in either direction, means for admitting steam at either end of said piston comprising a reciprocating valve a bell-crank lever engaged thereon and a cam operatively engaged on said lever, a valved inlet and a valved outlet on each side of said valve, automatic means for operating said reciprocating valve, automatically-operated means acting to cut off the steam during a portion of each revolution of the piston and a governor acting to cut off the steam at a predetermined rate of speed of the piston.

7. In a device of the class described the combination with a base, of an annular steam-chamber rigidly engaged thereon and opening at its inner periphery, a radially-directed, and inwardly-recessed flange on each side of said opening, an annular plate partially closing each recess and adapted to engage packing therein, a shaft journaled in said base axially of said chamber, a wheel rigidly engaged on said shaft and adapted to rotate with its periphery seated in said opening and closing the same, means affording a packing, a piston rigidly engaged on said wheel and means for driving said piston in either direction.

8. In a rotary engine a steam-chamber provided with a channel on its inner periphery, flanges thereon having recesses on their inner faces adapted to receive packing material, and annular plates adjustably engaged on said flanges and partially closing said recesses, and adapted to compress the packing therein.

9. In a device of the class described the combination with a base, of an annular steam-chamber rigidly engaged thereon and open at its inner periphery, a shaft extending axially of said chamber, a wheel rigidly engaged thereon with its periphery rotatively engaged in said opening, a piston-head in said chamber rotative with said wheel, a valve in said chamber, a bell-crank lever connected therewith, a cam rigidly engaged on the shaft adapted to operate said lever, a valved inlet and outlet port on each side said valve, and automatic means for cutting off the steam during a portion of the revolution of the piston.

10. In a rotary engine the combination with an annular steam-chamber having inlet and outlet ports, of a piston therein adapted to move in either direction, a shaft extending axially of said chamber, means connecting said piston with said shaft, a valved inlet-pipe, an eccentric connected therewith and adapted to close said valve during part of each revolution of the pistons and a governor also acting to automatically close said valve.

11. In a rotary engine an annular steam-chamber having a plurality of valved inlet and outlet ports, of a piston therein adapted for continuous movement in either direction, a driving-shaft extending axially of said chamber and with which said piston is rigidly connected, a reciprocating valve in said chamber positioned with an inlet and an outlet port on each side thereof and acting to direct the steam in either direction, a cam on said shaft, a pivotally-supported lever in operative engagement therewith and toggle means pivotally engaged on said lever and movably engaged with said reciprocating valve.

12. In a rotary engine the combination with an annular steam-chamber, of a shaft extending axially thereof, a valve adapted to reciprocate transversely of said chamber, a pivotally-supported bell-crank engaged on said valve, a pivotally-supported lever connected at one end with said bell-crank, a cam-follower at the opposite end thereof and a cam rigidly engaged on said shaft adapted to operate said levers and actuate the valve.

13. In a device of the class described, a rigid frame, a steam-chamber rigidly engaged thereon, a shaft journaled on said frame axially of said chamber, a piston, a plurality of

inlet and outlet ports, cut-off valves dividing the chamber with an outlet and an inlet on each side thereof, means for closing inlet as the valve approaches the cut-off and cam-controlled toggle-arms acting to operate said cut-off.

In testimony whereof I have hereunto subscribed my name in the presence of two subscribing witnesses.

JOHN A. EATON.

Witnesses:
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C. M. SECKNER.