(No Model.) 2 Sheets—Sheet 1.

H. HAAB.

ROTARY ENGINE.

No. 404,834. Patented June 11, 1889.

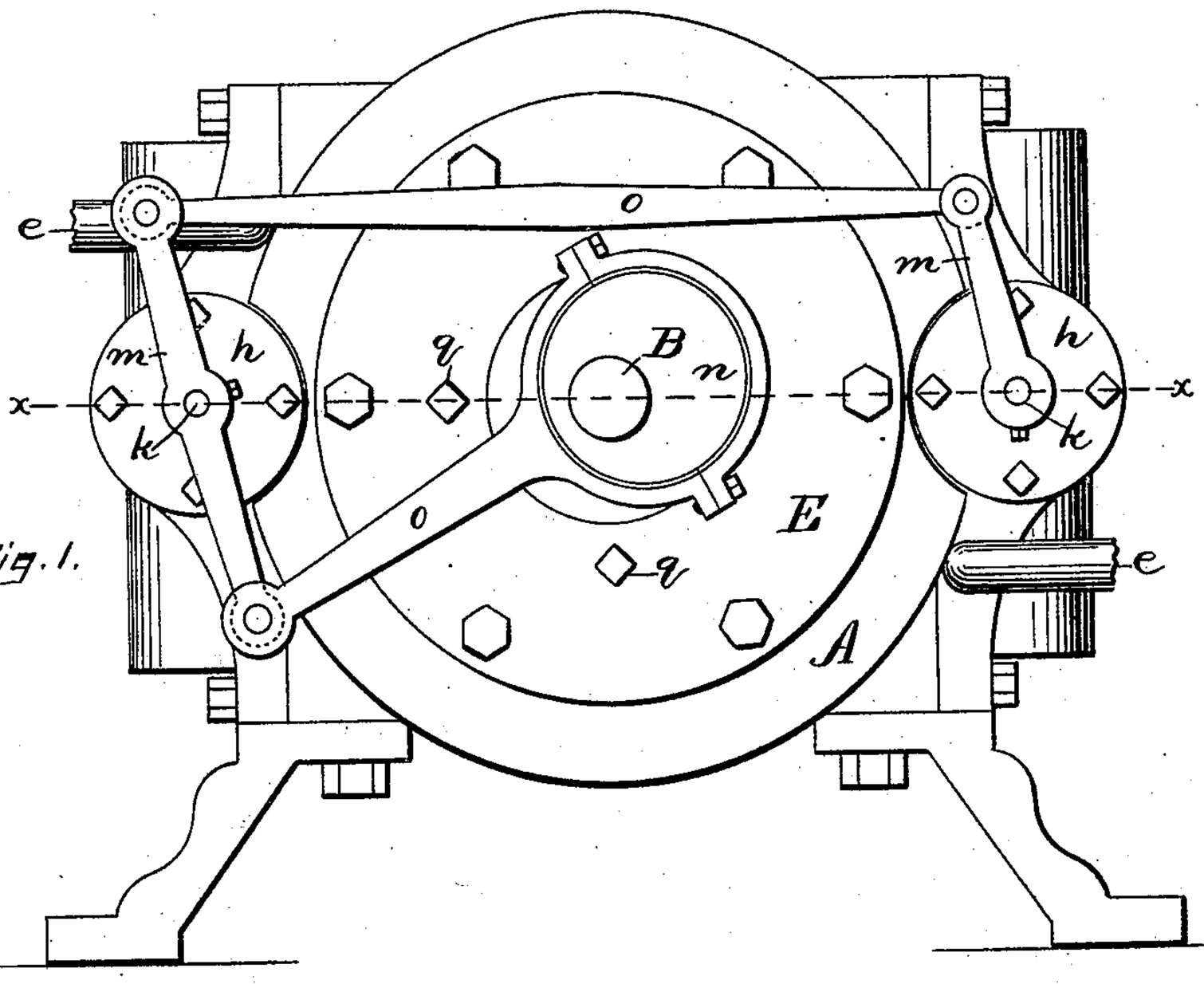

Fig. 1.

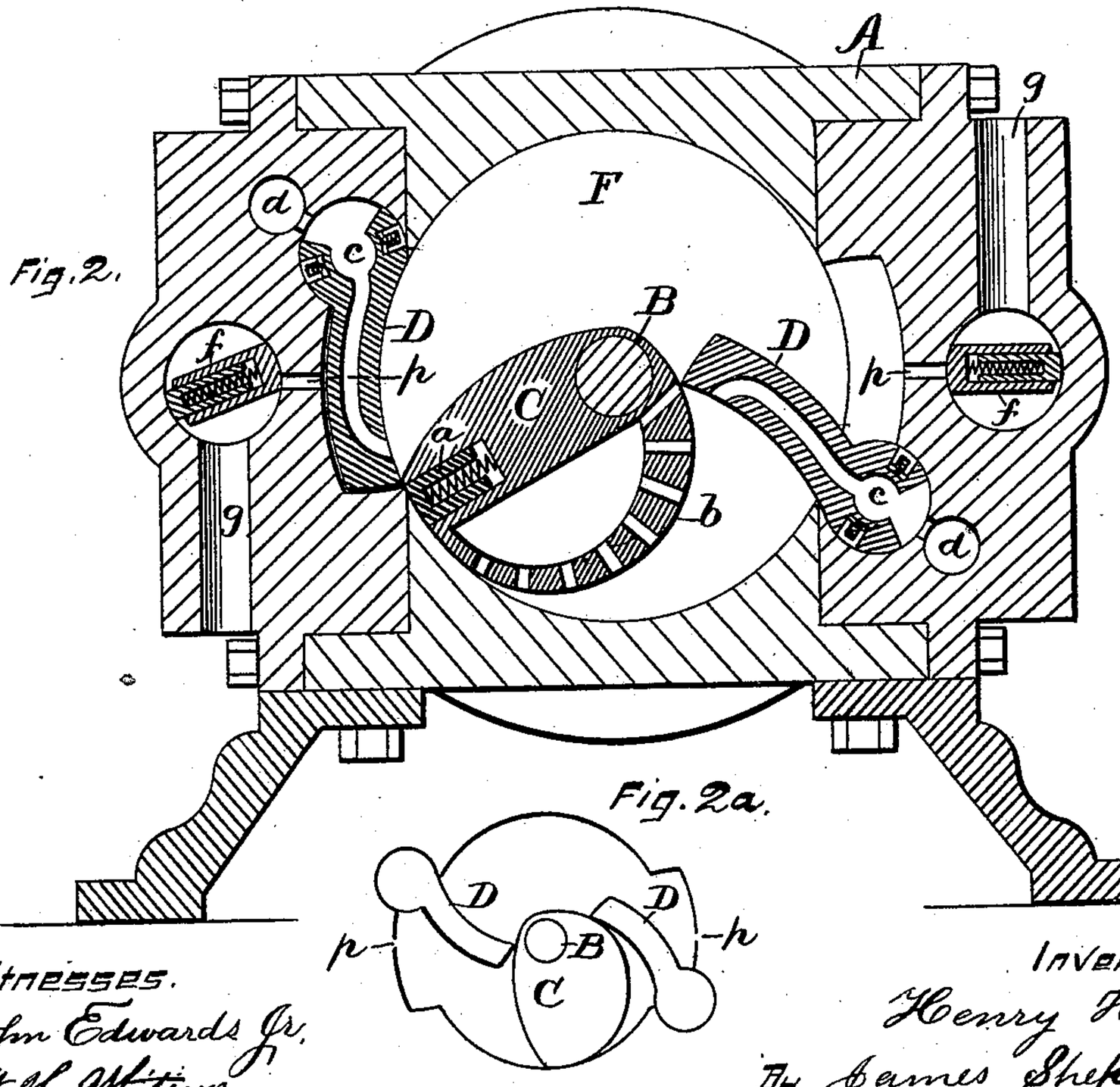

Fig. 2.

Fig. 2a.

Witnesses.
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Inventor.
Henry Haab.
By James Shepard. Atty

(No Model.) 2 Sheets—Sheet 2.

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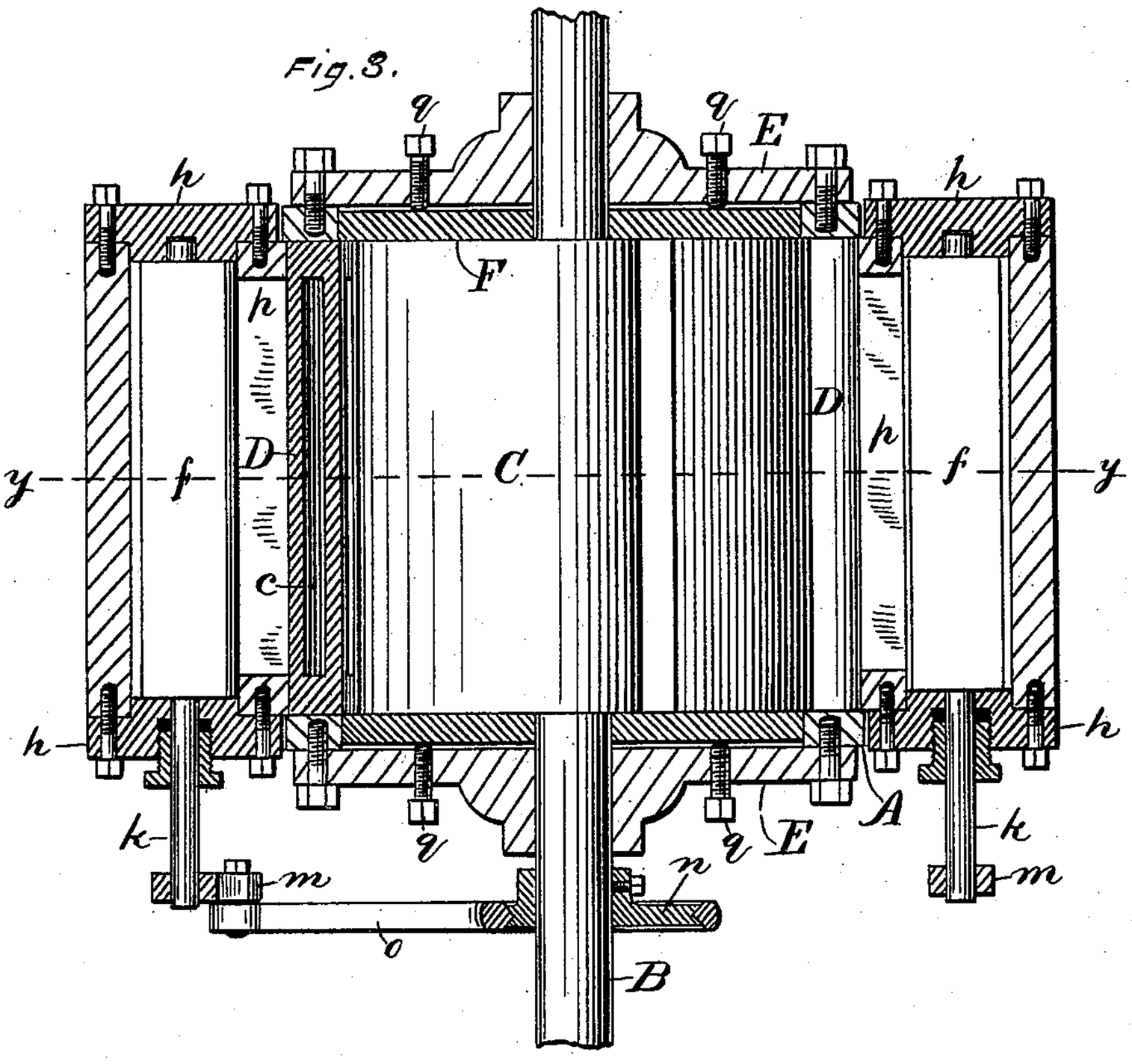
Fig. 3.



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UNITED STATES PATENT OFFICE.

HENRY HAAB, OF BRISTOL, CONNECTICUT, ASSIGNOR OF ONE-HALF TO J. R. HOLLEY, OF SAME PLACE.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 404,834, dated June 11, 1889.

Application filed March 8, 1888. Serial No. 266,466. (No model.)

To all whom it may concern:

Be it known that I, HENRY HAAB, a citizen of the United States, residing at Bristol, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

My invention relates to improvements in rotary engines; and the object of my invention is to increase the efficiency of this class of engines.

In the accompanying drawings, Figure 1 is a side elevation of my engine. Fig. 2 is a vertical section thereof on line *y y*, Fig. 3. Fig. 2ª is a diagram illustrating the main parts at a different point in the revolution of the shaft. Fig. 3 is a horizontal section of my engine, partly in elevation, on line *x x* of Fig. 1.

A designates the case or frame having a cylindrical chamber, through the center of which the shaft B extends. Upon this shaft and within the cylindrical chamber is the revolving piston C, having on its edge a concentric face, which bears against the wall of the cylinder and is provided with an ordinary packing-strip *a*. Said piston is also provided upon its front or exhaust side with a cam *b*, Fig. 2. The pressure-face or rear convex side of said piston—that is, the side opposite the cam *b*—extends from the rear corner of the concentric face at an angle to said face to a point near the shaft B, on which said piston is mounted, said pressure-face being in the arc of a circle whose radius equals the length of the gates D D. Upon each side of the cylindrical chamber I place two oscillating gates D, said gates being pivoted by their enlarged hubs at diametrically-opposite points within a part of the case. The sides of the cylindrical chamber are recessed to receive these gates, said gates at times being forced wholly into said recesses, as shown on the left-hand side of Fig. 2. The gates are so formed upon their inner face that when they are forced back into their recess said inner face is a continuation of the wall of the cylindrical chamber. These gates are each provided with a passage-way *c*, through which the exhaust-steam may pass to the exhaust-passages *d*, Fig. 2, and thence to the exhaust-pipes *e*, Fig. 1, which lead to the free atmosphere.

At each side of the case I place the cut-off valves *f f* within circular valve-chambers which are supplied by steam or other propelling-fluid through the passages *g g*. The valve-chambers are preferably closed by a cap *h* at each end, the valves being pivoted or having their bearings in said caps. The pivotal shaft *k* at one end of said valves projects from the case for the attachment of the operating-levers *m m*, said levers being operated by the eccentric *n* and pitmen *o o*, as in ordinary engines. Ports *p* are formed, which lead from each valve-chamber to the gate-recess and interior of the cylindrical chamber.

The cut-off valves are so timed as that one valve will open just as the point of the piston C passes the end of the gate. Fig. 2 illustrates the piston and left-hand valve as having almost reached this point. The propelling-fluid first acts directly upon the gate D, while the corner or end of the gate bearing on the pressure-face on the rear convex side of the piston will drive the piston, and after the gate has moved far enough to uncover the end of the gate-recess the steam will pass directly upon the piston, the steam pressing also upon the gate, while the gate and piston together divide the cylindrical chamber and confine the steam to one side of the piston until the point of said piston presses the end of the gate upon the opposite side of the engine. The cam acts to press the gates back again to bring them into position for further action. The exhaust-passages are continually open, so that the steam upon one side of the float is being exhausted while steam presses upon its other side for driving said piston. A little before the point of the piston passes the end of the gate on the right-hand side the cut-off valve on the left-hand side is closed, and as soon as the point of the piston passes the end of the gate on the right-hand side the cut-off valve for that side is opened and the piston is driven in the manner before described, the cut-off valves operating alternately to admit and cut off the steam first upon one side and then upon the other, thereby imparting to the piston a continuous rotary movement.

In order to pack the piston and major portion of the gates at their ends, I arrange within the ends of the cylindrical chamber adjusta-

ble packing-disks F F, Figs. 2 and 3, which disks are adjusted by means of the adjusting-screws *q* passing through the caps E, the said caps being bolted to the ends of the case.

For convenience of construction, in making my first engine, I have made the main portion of the frame of three parts bolted together, as shown most clearly in Fig. 2; but I do not wish to confine myself to such construction, nor to the external form of the case, as it is evident that it could readily be made of much less metal by making its exterior conform more closely to the shape of the internal chamber.

I have represented an exhaust-passage leading through and from each gate, which construction I prefer; but this is not necessary, inasmuch as both of these exhausts are always open. Therefore the engine may be successfully operated with an exhaust-passage leading through and from one gate only. In such a case it would be better to perforate the cam, so that steam can pass through from one side to the other of the point where the gate bears against the cam, said cam being illustrated in Fig. 2 as thus perforated. It should be noted that when the steam presses upon one of the gates there is no pressure upon the other gate, and therefore the gate is not held against the cam by pressure, and may yield a little to let the exhaust-steam pass by it to the single exhaust-passage, in case only one passage is used. While I prefer for the sake of economy to arrange this cam on one side of the piston within the cylindrical chamber, as shown, precisely the same result may be accomplished by hanging the two gates D D rigidly upon a shaft, extending said shafts to the outside of the case at one end, and then mounting upon the ends of said shafts and upon the main shaft, respectively, two levers and a cam, shaped in side view like the gates D D and the combined piston C and its cam *b*. The operation of the engine will then be precisely the same as hereinbefore described.

While it is not necessary to perforate the cam *b* of the piston C or to form an exhaust passage-way in both gates, I always prefer to employ both of these features. When there are no perforations and only one exhaust-passage, the gate not pressed upon by steam must necessarily at times be moved away from the face of the cam. Even when there is an exhaust-passage in both gates and the piston advances a little farther than the position shown in Fig. 2ª, a little steam will be inclosed between the cam-face of the piston and the swinging gate, so that the gate will be lifted slightly away from the piston. Whenever it is lifted away from the piston there is likely to be some little jar before it is returned to place, and therefore the engine will run smoother to have both of the gates in contact with the piston at all times. By perforating the cam of the piston as shown, the gates will not be lifted from the piston at any time. It should also be noticed that by forming an inclosed exhaust passage-way through the gates that opens on the concave face at the swinging end, and forming the inlet-ports so as to direct steam upon the opposite side of said gates, the exhaust and inlet ports are brought close together, so that it is not necessary to cut off the steam upon one side until the piston has nearly passed the gate on the opposite side. In other words, the piston has to travel but a very short distance after its pressure-face reaches the exhaust-port before live steam may be again directed upon it, thereby making the action of the steam upon the piston almost continuous.

I have herein shown and described the pressure-face of the piston as extending substantially at right angles to the concentric face at the edge of the piston and in the arc of a circle whose radius equals the length of the gates. By the length of the gate I mean the distance from the axis of the gate to its swinging end. The circle thus described is for an engine moving at the slowest speed; but when a high speed is desired the pressure-face should be on the arc of a circle of a still smaller radius. The greater the speed the smaller should be said radius. For an efficient engine this face should never be on the arc of a circle whose radius is greater than the length of the gate. This form of pressure-face is important, as without it a proper bearing of the gate upon said face cannot always be maintained.

I am aware that prior patents show rotary engines with oscillating gates upon opposite sides, and also with sliding gates, and that in some instances the gates have had substantially the general form of my gates; that in one instance a piston is shown of a form similar to mine, excepting that its pressure-face was in a straight line, and that inlet-passages have been shown as extending through oscillating gates or abutments; but in no such case have they, so far as I know, been made to open upon the side or face which is analogous to the inner concave face of my gate. One patent shows exhaust-grooves in the inner concave face of the gates, which grooves are open to the hinged end of the gates. All of said prior art is hereby disclaimed.

I claim as my invention—

1. The combination of two oscillating gates hung at diametrically-opposite points, the piston mounted on a shaft for revolving in a given direction and having a concentric face at its outer edge and one pressure-face on its convex rear side that extends at an angle to said concentric face from the rear corner thereof to a point near the shaft on the arc of a circle whose radius is not greater than the length of each gate, the case having a cylindrical chamber with live-steam ports located at the back of said oscillating gates, and alternately-acting cut-off valves for said live-

steam ports on opposite sides of said case, substantially as described, and for the purpose specified.

2. In a rotary engine having a case provided with a cylindrical chamber and inlet-ports and having a revolving piston within said chamber, the oscillating gate having an inclosed exhaust passage-way extending lengthwise through said gate, the induction of which passage opens into the cylindrical chamber on the inner concave face of said gate at a point near the swinging end thereof, and the eduction of which passage is at the pivotal end of said gate, substantially as described, and for the purpose specified.

3. In a rotary engine having a revolving piston, the combination of the oscillating gate having an inclosed exhaust passage-way through it that opens on the inner concave face of said gate at a point near the swinging end thereof and extends backward through said gate to its pivotal end, and a case having a cylindrical chamber for said piston with an inlet-port located at the back of said gate, substantially as described, and for the purpose specified.

4. The combination of a case having a cylindrical chamber and inlet-ports, the revolving piston mounted on a shaft within said chamber, the oscillating gates both having a bearing-contact with said piston when it is moving in a forward direction and having an inclosed exhaust passage-way through them that opens on the inner concave face of said gates at a point near the swinging ends thereof, and alternately-acting cut-off valves on opposite sides of said case, substantially as described, and for the purpose specified.

5. The combination of the case having a cylindrical chamber, the oscillating gates hung in the case, each having a concave inner face on the same arc as the wall of said cylinder, and the revolving piston having the cam *b* for acting against the concave inner faces of said gates and provided with perforations for the passage of steam through said cam from one side to the other of the point where the gate bears against it and thereby prevent the gate from being forced out of contact with said cam, substantially as specified.

HENRY HAAB.

Witnesses:
A. F. ATKINS,
GEO. T. STUB.