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A. W. & W. G. BILLINGS.

ROTARY ENGINE.

No. 382,209. Patented May 1, 1888.

Fig. 2.

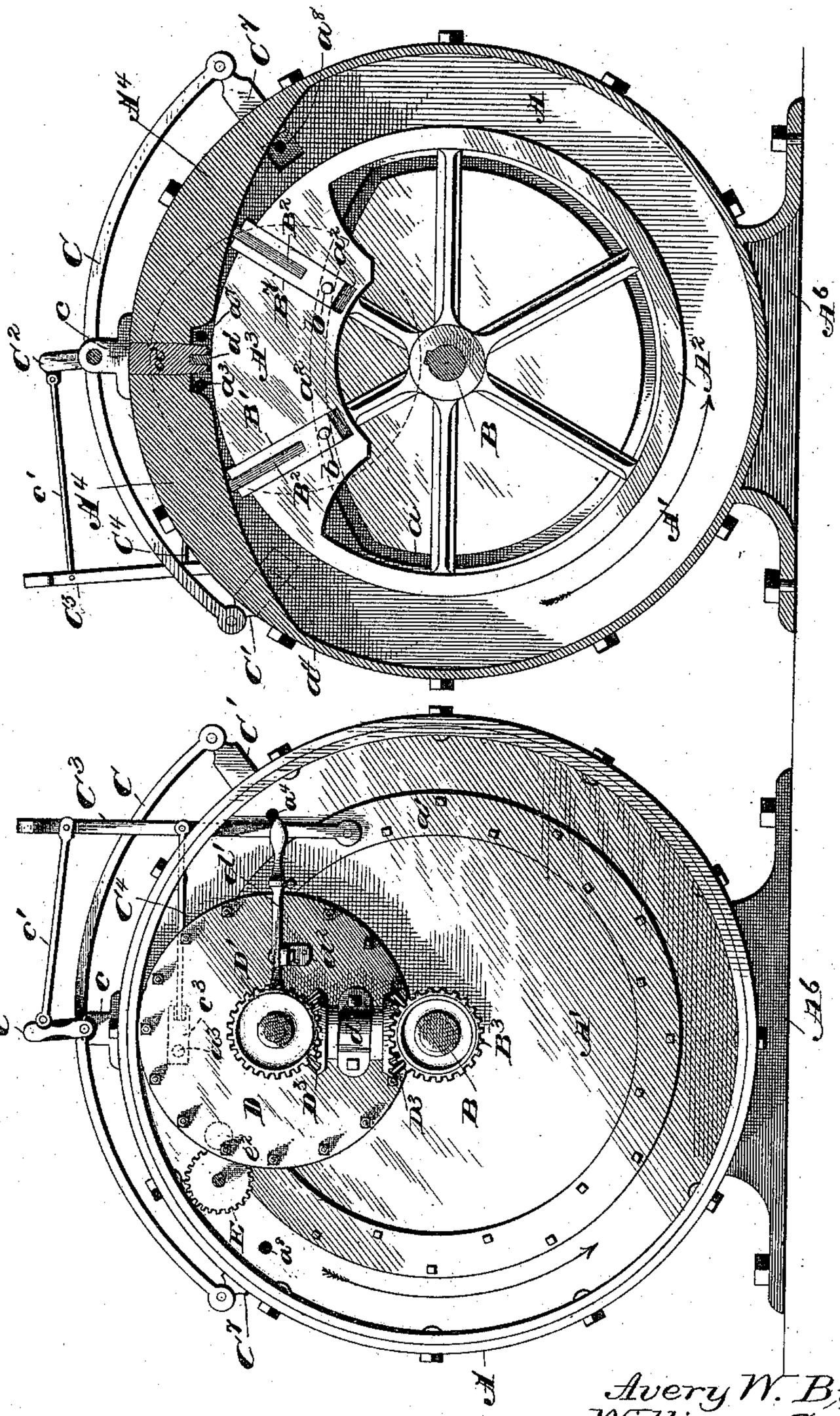

Fig. 1.

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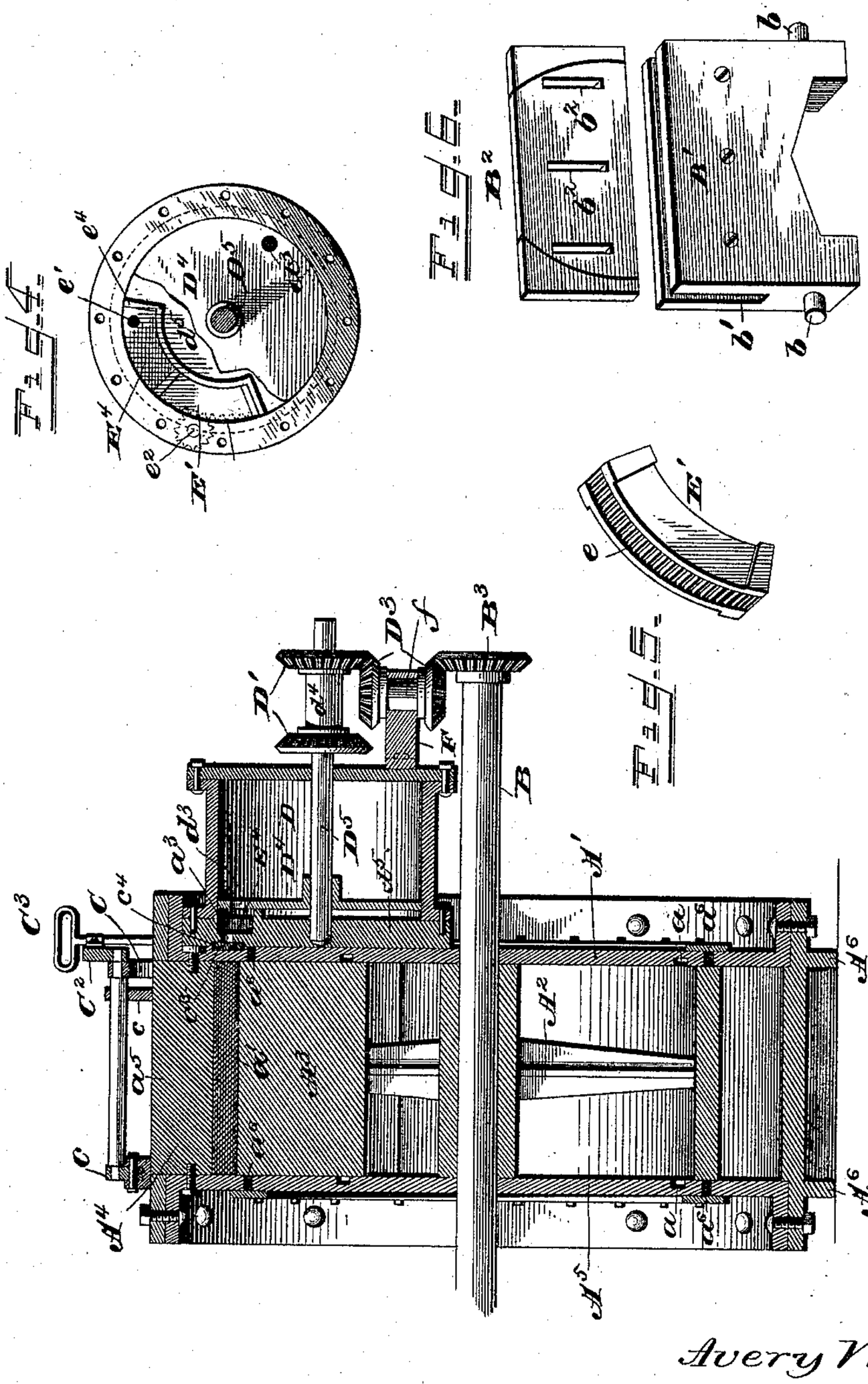

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ROTARY ENGINE.

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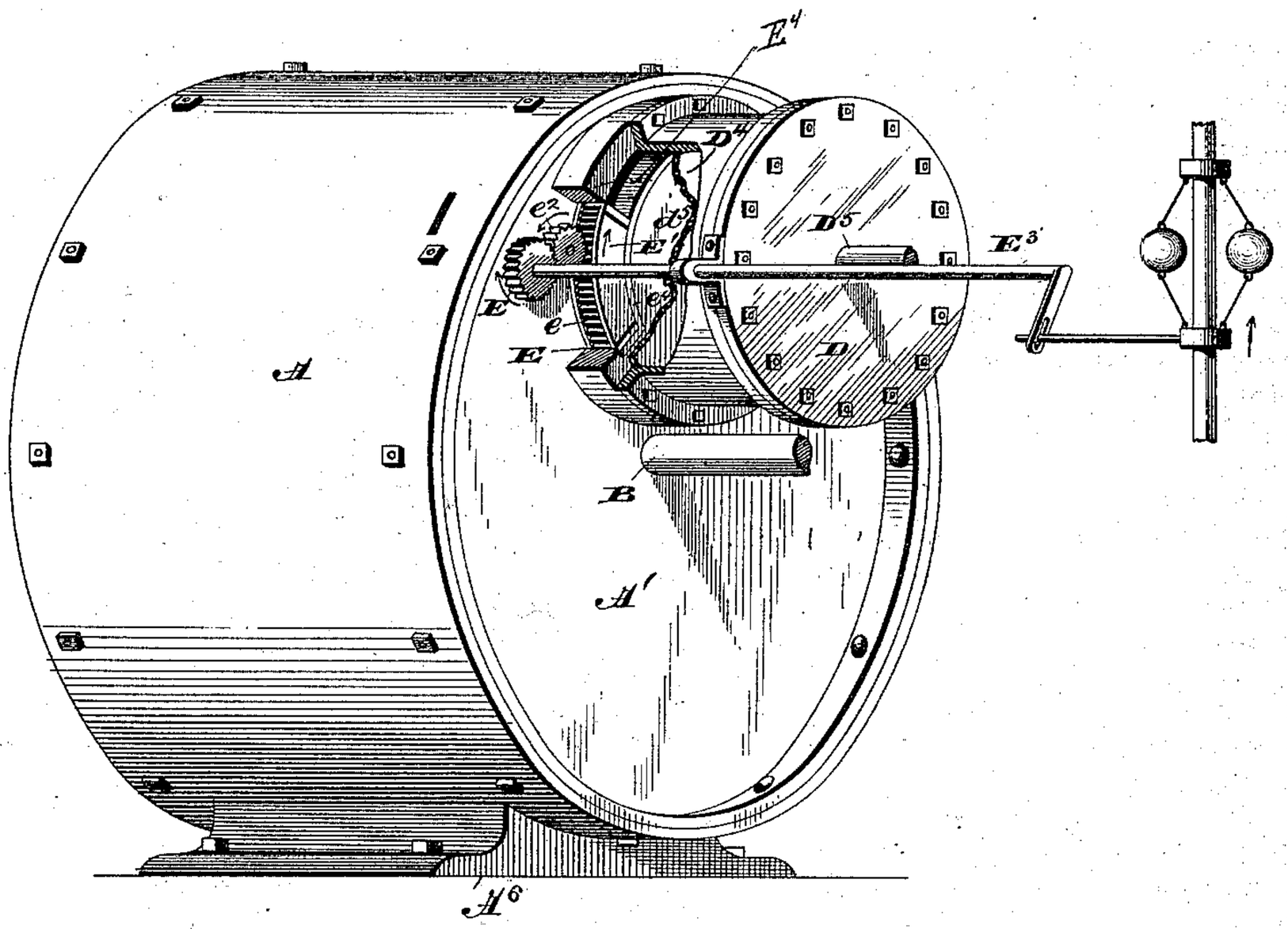
Fig. 3.



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UNITED STATES PATENT OFFICE.

AVERY W. BILLINGS AND WILLIAM G. BILLINGS, OF LARNED, ASSIGNORS OF ONE-THIRD TO ARTHUR T. BILLINGS, OF JETMORE, KANSAS.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 382,209, dated May 1, 1888.

Application filed December 8, 1887. Serial No. 257,327. (No model.)

To all whom it may concern:

Be it known that we, AVERY W. BILLINGS and WILLIAM G. BILLINGS, citizens of the United States of America, residing at Larned, in the county of Pawnee and State of Kansas, have invented certain new and useful Improvements in Rotary Engines; and we 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 letters or figures of reference marked thereon, which form a part of this specification.

This invention relates to that class of rotary engines in which a rotary valve is interposed between the steam-chest or steam-supply and the piston cylinder or chamber.

One object of the invention is to provide an automatic cut-off operating in connection with the rotary valve to control the supply of steam to the engine.

A further object of the invention is to provide means for reversing the engine without affecting the movement of the steam-supply valve.

These and minor objects are attained by the mechanism illustrated in the accompanying drawings, wherein—

Figure 1 is an end elevation of a rotary engine embodying our improvements. Fig. 2 is a similar view with the cylinder-head removed. Fig. 3 is a transverse vertical section Fig. 4 is a detail view in elevation of the steam-chest, the head being partly broken away to expose the cut-off slide. Fig. 5 is a detail perspective view of the cut-off. Fig. 6 is a detail perspective of one of the piston-heads of the engine. Fig. 7 is a detail perspective view, partly in section, illustrating means for connecting the cut-off with the governor of the engine.

The shell A of the piston-cylinder is provided with heads A′ A^5, secured steam-tight, and a base, A^6. In each of the cylinder-heads A′ A^5 is formed a cam-groove, *a*, of irregular circular form, the upper parts of said grooves being parallel with the inner surface of a block, A^4, secured within or forming part of the shell, as shown in Fig. 2. The block A^4 is provided with a transverse slot, in which is seated an abutment-strip, a^5, to the inner edge of which is secured a packing, *a′*, preferably arranged, as shown, within a groove in the edge of the abutment-strip a^5. On each side of the lower projecting edge of the abutment a^5 the block A^4 is provided with a groove, into which the inner ends of the steam-induction ports a^3 a^7, formed in the cylinder-head A′, open. Steam-exhaust ports a^4 a^8 are also formed in the cylinder-head A′ just below and near the ends of the block A^4, as best shown in Fig. 2, and these ports are alternately opened or closed by slide-valves C′ C^7, pivotally secured to the ends of a yoke, C, which in turn is fulcrumed centrally on some fixed point midway between these ports a^4 a^8. A post, C^2, is rigidly connected to yoke C near its fulcrum, said post being in turn connected by a rod, *c′*, to a reversing-lever, C^3, pivoted on a stud projecting from head A′ of the cylinder. Another rod, C^4, is connected to the lever C^3 at a point below the rod *c′*, said rod being provided at its inner end with a slide-valve, c^3, adapted to control the induction-ports a^3 a^7 in the cylinder-head A′. Within the cylinder a piston, A^2, is mounted rigidly upon the central shaft, B, the said piston having a web, A^3, at one side provided with two radial slots, a^2, in which are seated the sliding piston-heads B′ B^7. These piston-heads are each provided with a deep longitudinal groove, *b′*, in which is secured an adjustable packing, B^2, provided with transversely-arranged slots b^2, through which pass the screws which secure the packing within the groove *b′* of the piston-head B′. Each packing B^2 is composed of three sections, the meeting edges of which are so arranged that the outward adjustment of the central section will result in both a longitudinal and radial adjustment of the end sections, thus taking up wear on both the outer edge and ends of the packing.

From the inner corners of the piston-heads B′ project trunnions *b*, adapted to engage the cam-groove *a* of the cylinder-heads and maintain a fixed relation between the outer edges of said piston-heads and the shell A of the cylinder.

One end of the main shaft B is fitted with a bevel gear-wheel, B^3, which meshes with a similar wheel, D^3, secured to the lower end of a short shaft, *f*, journaled in a bearing secured

to a bracket, F, projecting from the outer head of steam-chest D. To the upper end of this shaft *f* is secured another bevel gear-wheel D^3, similar in all respects to the lower one, and this upper gear D^3 is adapted to mesh with one or the other of the gears D′, rigidly secured at the opposite ends of a shifting sleeve, d^4, connected by feather and groove to its supporting-shaft D^5, in order that it will have longitudinal movement on but revolve with said shaft. The shaft D^5 passes centrally through the steam-chest D, its inner end being journaled in a socket formed in the inner head, d^5, of said chest.

In the inner head, d^5, of the steam chest, and concentric with the cylindrical shell thereof, is a segmental recess, E^4, one end of which is connected by a passage, *e*′, with the steam-induction ports a^3 a^7 of the cylinder-head A′, the junction of said passage and ports being intersected by a recess, c^4, in which is seated the perforated slide-valve c^3, adapted to maintain communication between the passage *e*′ and one of the ports a^3 or a^7, while it closes communication with the other of said ports, according as it is shifted to either limit of its movement. This recess E^4 may be formed by a projecting flange, e^4, or by cutting a groove in the metal of the head d^5. I prefer, however, to have it inclosed or surrounded by a projecting flange, for reasons to be hereinafter explained. Within the recess E^4 is seated a sliding cut-off, E′, consisting of a sector-block provided on one side with a rack, *e*, adapted to be engaged by the teeth of a pinion, e^2, which in turn meshes with a pinion, E, secured to a shaft, E^3, which is connected with and actuated by the slide of the engine-governor.

Secured rigidly to the shaft D^5 at a point in proximity to the head d^5 is a disk, D^4, provided at proper points near its periphery with openings d^3, arranged equidistant from each other. The disk D^4 abuts steam-tight against the flange surrounding the recess E^4 in the head d^5 and serves as a valve, which I shall hereinafter term it, and as this is the only point of contact between the valve D^4 and the interior of the steam-chest, and as there will be the same steam-pressure on both sides of the valve, there will be but little friction to oppose the rotation of the valve and its shaft.

Steam may be supplied to the steam-chest through a pipe (not shown) connecting said steam-chest with any suitable boiler.

In operation, the parts being in the position shown in Fig. 2, the slide-valve c^3 will connect steam-passage *e*′ with the induction-port a^3, the slide-valve C′ will close eduction or exhaust port a^4, and slide-valve C^7 will be removed from eduction or exhaust port a^8 to leave the latter open. Steam will now enter the engine-cylinder through induction-port a^3 and be confined between the abutment a^5 and the leading piston-head B′, causing the piston to rotate in the direction of the arrow. When the following piston-head B^7 passes the port a^3, the steam entering will be confined between said head and the abutment a^5, thus continuing the rotary motion of the piston. As the leading piston head B′ passes the exhaust-port a^8, the steam confined between the piston-heads will be exhausted through said port. Thus live steam enters continually through port a^3 and exerts its force on the piston-heads successively, while steam in front of the piston-heads escapes freely through the constantly-open exhaust-port. The rotation of the main shaft impels the valve shaft D^5 through the intermediate gears, D^3, and as one of the apertures in the valve D^4 passes the flange of the recess E^4 steam passes from the chest to the cylinder through that aperture during the time occupied by that aperture in traversing from the upper end of the recess E^4 to the upper end of the cut-off block E′. I prefer that the distance between the upper end of this recess E^4 and the forward or upper end of the cut-off E′ when in its lowest position be equal to the distance between the apertures in the valve-disk, as this insures, when necessary, a constant supply of steam from the steam-chest to the cylinder under normal conditions. Should the engine attain more than the desired rate of speed, the governor (which may be of the well-known ball form and connected to any constantly-moving shaft of the engine) will move the cut-off block E′ nearer to the upper end of the recess E^4, thus limiting time during which steam is supplied to the engine-cylinder through any one of the apertures in the valve-disk and increasing the interval of time during which steam will not pass to the cylinder.

To reverse the engine, the reversing-lever C^3 is shifted to the position shown in Fig. 1. This shifting of reversing-lever C^3 results in moving slide-valve c^3 to close induction-port a^3, open induction-port a^7 on the opposite side of abutment a^5, and also in moving the slide-valves *c* and C^4 at opposite ends of the yoke C to close exhaust-port a^8 and open exhaust-port a^4. Upon reversing the engine, if it is desired that the valve-disk D^4 continue to rotate in the same direction, a hand-lever, *d*′, fulcrumed on a bracket secured to the steam-chest, may be shifted to cause the head-gear at the inner end of the sleeve d^4 to mesh with the gear D^3.

We claim—

1. In a rotary engine, the combination, substantially as before set forth, of the engine-cylinder provided with a cam-block carrying an abutment, the piston, the steam-chest, ports for connecting the steam-chest with the cylinder at opposite sides of the abutment, eduction-ports arranged near the ends of the cam-block, a rotary valve within the steam-chest, and a slide-valve interposed between the rotary valve and cylinder to control the induction-ports for reversing the engine.

2. The combination, substantially as before set forth, of the engine-cylinder and its piston, the steam-chest having a segmental recess in its inner head connected by a passage with the engine-cylinder, a rotary valve mounted within the steam-chest adjacent to its recessed head,

an automatic cut-off mounted to slide within the segmental recess, and mechanism for connecting the cut-off with the engine-governor.

3. The combination, with the engine-cylinder and its piston, of the cylindrical steam-chest having a segmental recess in its inner head, a flange projecting from the edges of said recess, an automatic cut-off mounted to slide in said recess, a rotary disk-valve mounted to move in contact with the faces of the cut-off and flange, but at a little distance from the inner head, and mechanism connecting the cut-off with the engine-governor, substantially as described.

4. In a rotary engine, the combination, substantially as before set forth, of the cylinder provided with a centrally-recessed cam-block, the abutment dividing the recess, ports A^3 A^7, opening into the recess at opposite sides of the abutment, exhaust-ports a^4 a^8, arranged near the ends of the cam-block, the reversing-lever, and slides connected with said lever for simultaneously closing ports A^4 A^7 and opening ports A^3 A^8, or vice versa, by a single movement of the lever.

5. The combination, substantially as before set forth, of the cylinder, the steam-chest connected therewith by a steam-passage and having its inner head provided with a segmental recess communicating with said passage, the sliding cut-off seated in said recess and provided peripherally with a rack, pinions connected with the engine-governor to move said cut-off, a shaft journaled centrally within the heads of the steam-chest, and a disk-valve fixed to said shaft to move in contact with the cut-off.

6. The combination, with the cylinder, its piston and piston-shaft, and the steam-chest with its rotary valve and shaft, of a sleeve mounted to slide upon but rotate with the valve-shaft, a lever to move said sleeve, and a train of bevel-gears, arranged substantially as described, to transmit motion from the piston-shaft to the valve-shaft, whereby the valve may rotate continuously in one direction, notwithstanding the reversal of the piston-shaft.

7. The combination, substantially as before set forth, of the cylinder having induction-ports A^3 A^7 and eduction-ports A^4 A^8, the piston and its shaft, the steam-chest having a passage communicating with the induction-ports of the cylinder, the rotary valve and its shaft, a sleeve mounted to slide upon but rotate with the valve-shaft, a train of gears arranged to transmit motion from the piston-shaft to the valve-shaft, a reversing-lever with its adjuncts to simultaneously open and close two ports of the cylinder at one movement, and a lever to shift the sliding sleeve on the valve-shaft.

8. The combination, substantially as before set forth, of the cylinder having induction and exhaust ports, arranged as described, the pivoted yoke carrying a slide-valve at each end, the slide-valve C^3, the reversing-lever, and rods connecting the reversing-lever with the valve C^3 and with the yoke.

In testimony whereof we affix our signatures in presence of two witnesses.

AVERY W. BILLINGS.
WILLIAM G. BILLINGS.

Witnesses:
JAS. F. WHITNEY,
E. W. BILLINGS.