(No Model.)

J. McCLOSKEY.

ROTARY ENGINE.

No. 554,290. Patented Feb. 11, 1896.

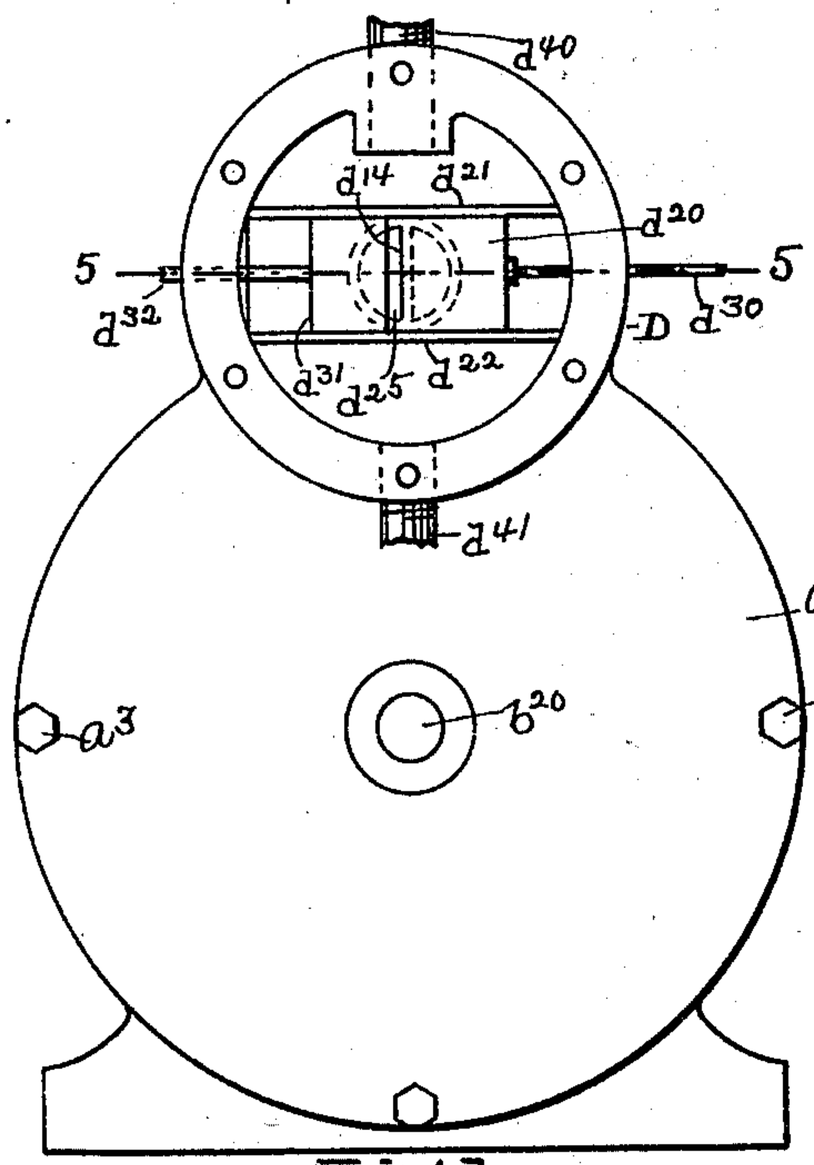

Fig. 1.

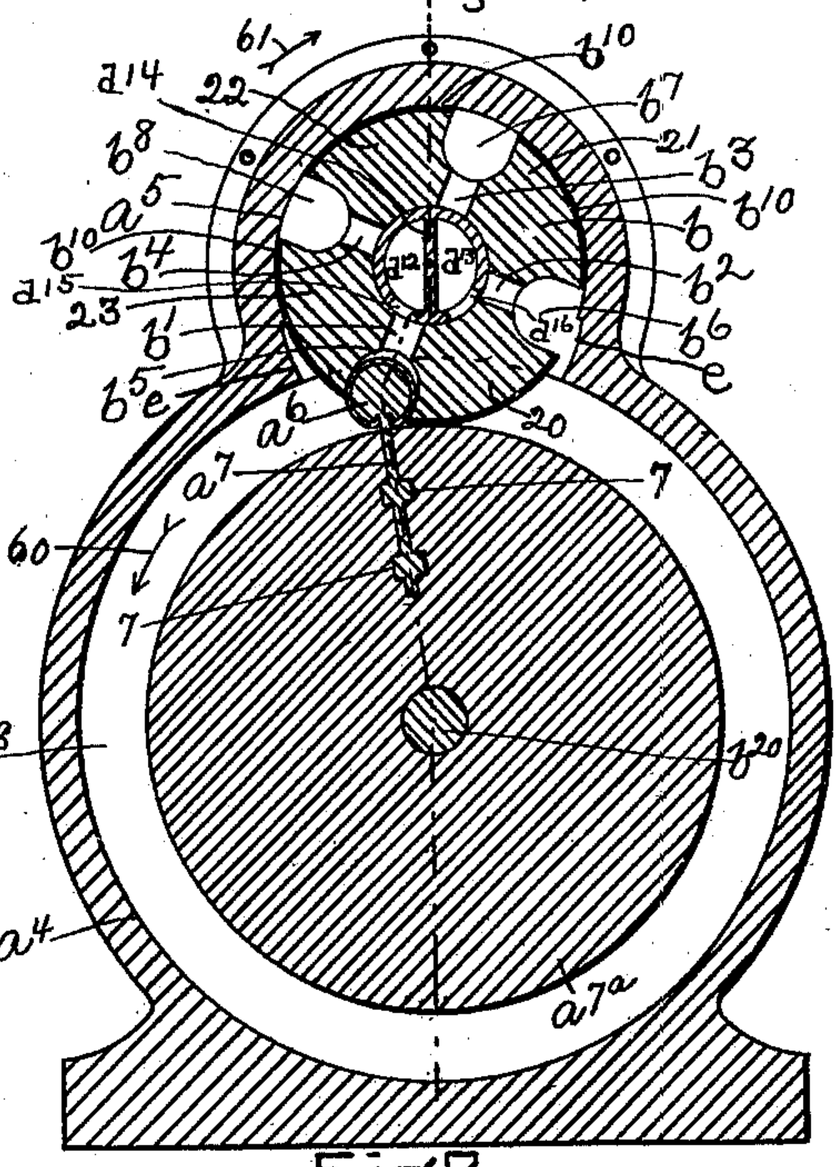

Fig. 2.

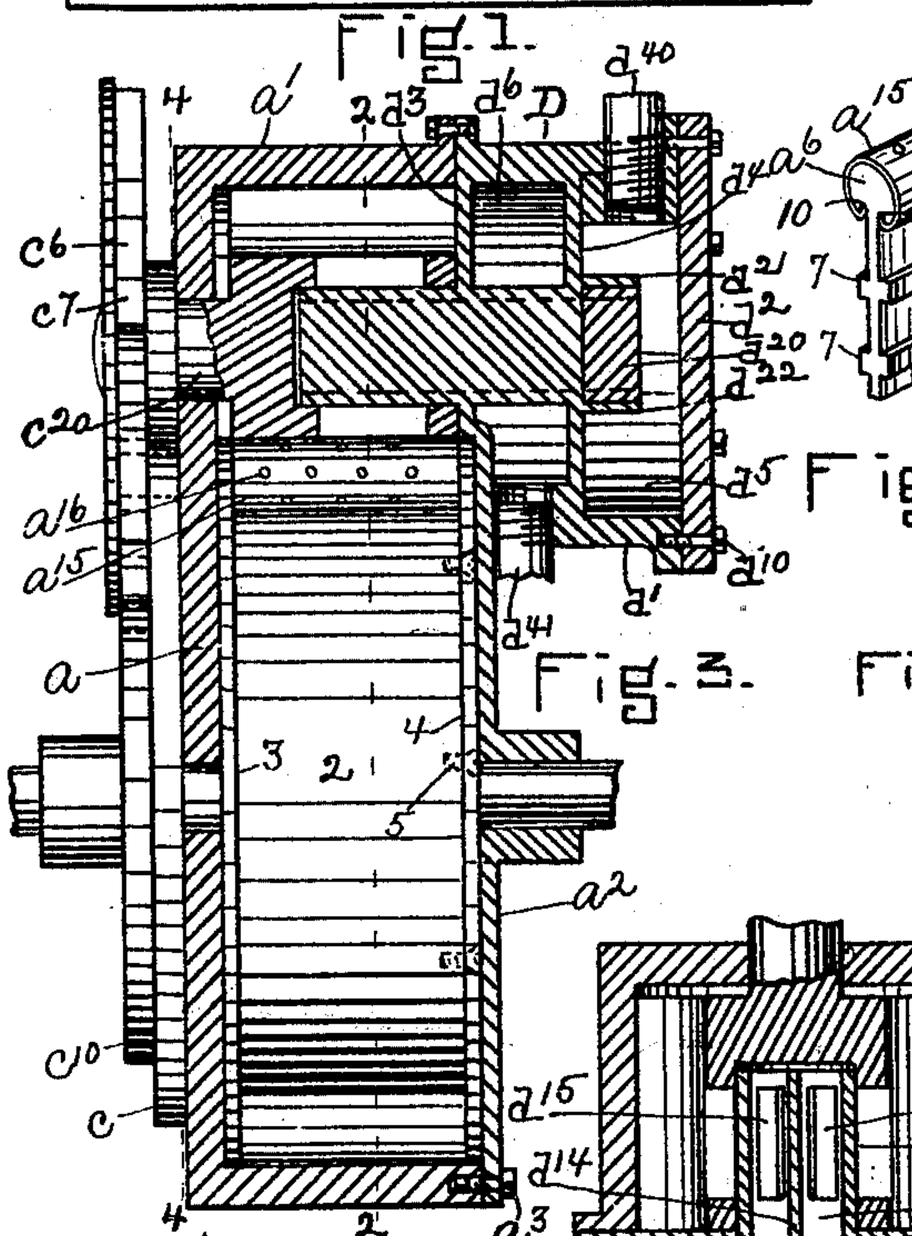

Fig. 3.

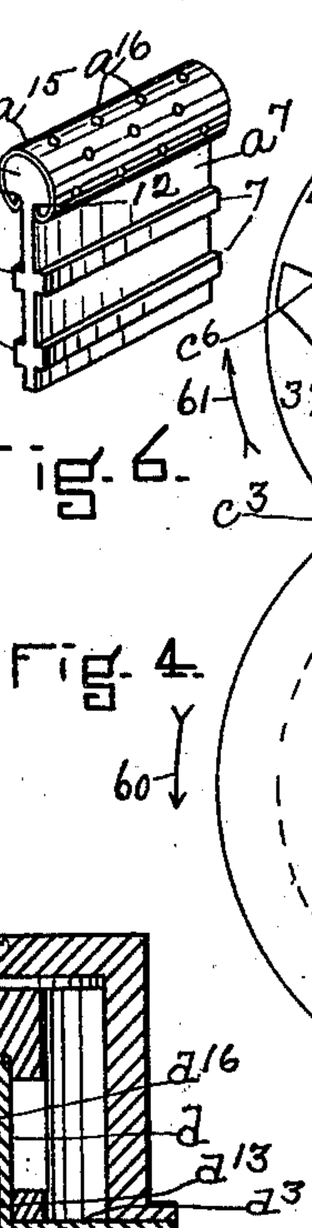

Fig. 4.

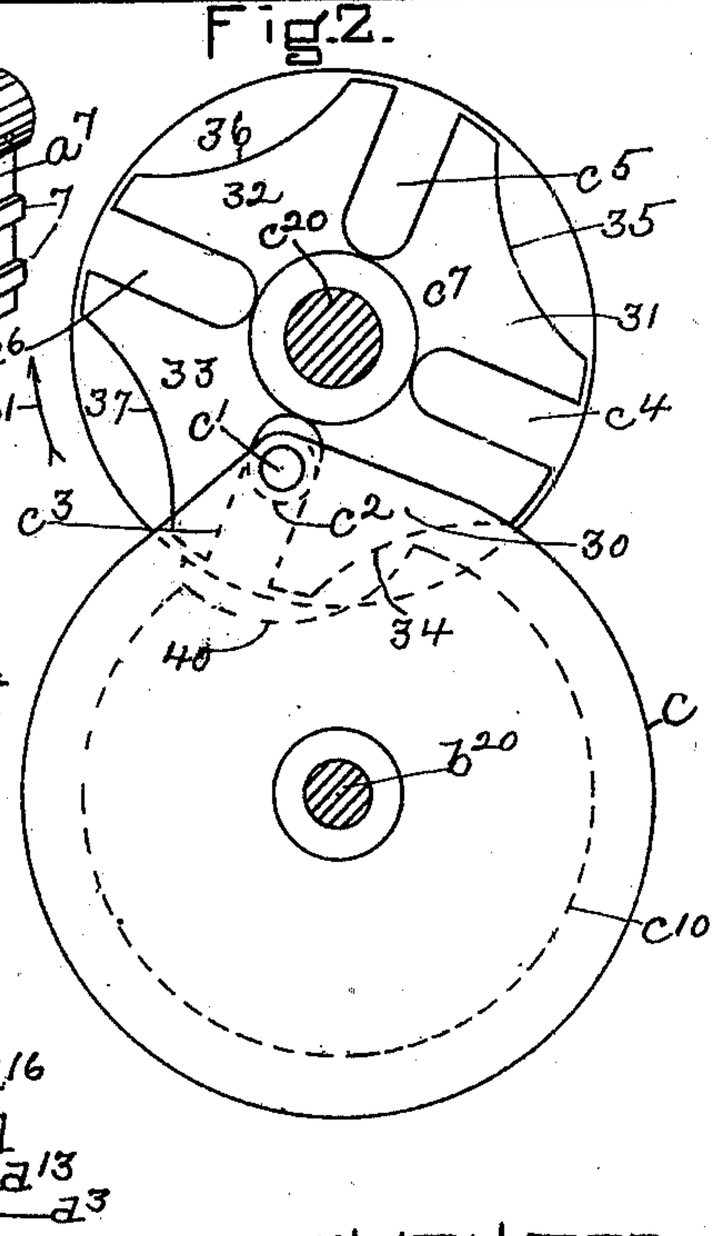

Fig. 6.

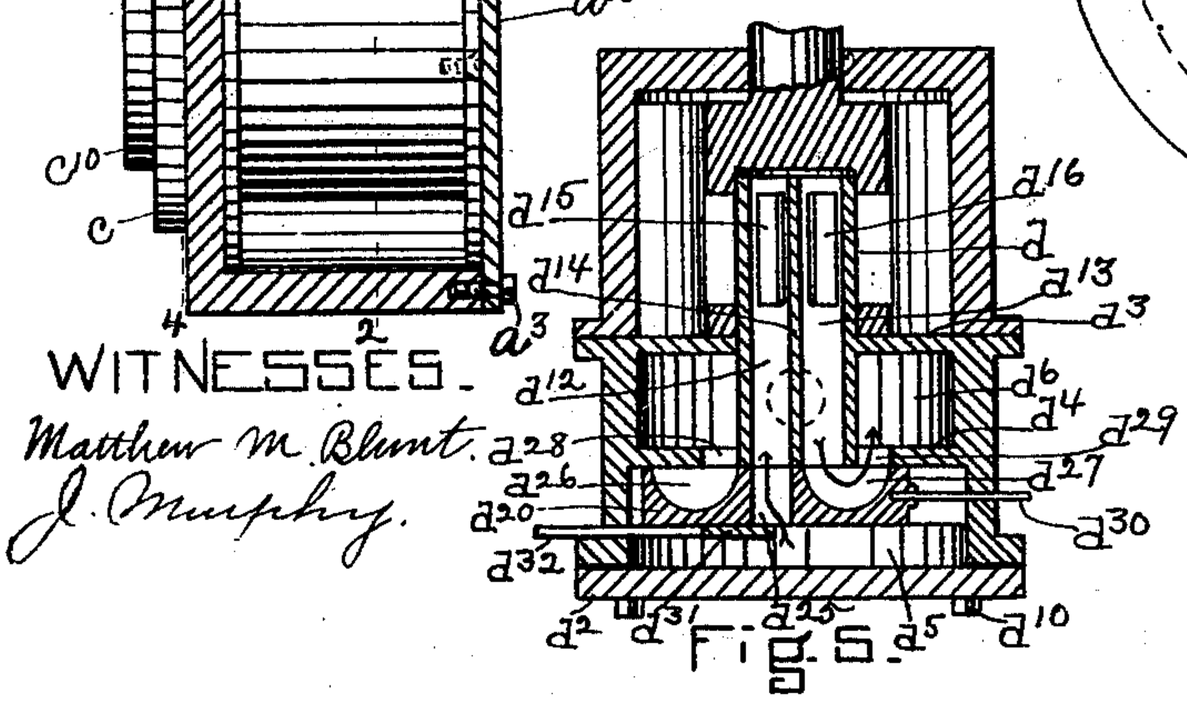

Fig. 5.

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ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 554,290, dated February 11, 1896.

Application filed May 24, 1895. Serial No. 550,516. (No model.)

To all whom it may concern:

Be it known that I, JOHN MCCLOSKEY, a citizen of the United States, residing in Boston, in the county of Suffolk and State of Massachusetts, have invented an Improvement in Rotary Engines or Motors, of which the following description, in connection with the accompanying drawings, is a specification, like letters and figures on the drawings representing like parts.

This invention relates to a reversible rotary engine or motor, which may be actuated by steam, hot air, gas or other suitable medium; but to facilitate description it will be hereinafter referred to as a "rotary" steam engine or motor.

My present invention has for its object to provide a novel construction of rotary engine capable of being reversed, and in which the clearance is reduced to a minimum and is practically nothing.

In accordance with this invention the rotary engine consists essentially of a cylinder or casing provided with a rotatable piston, a rotatable hollow cylinder-head co-operating with the said piston and provided with steam-ports, as will be described, which are adapted to communicate with the steam chamber or passage within the casing, a valve-chest communicating with the hollow rotatable cylinder-head and provided with steam inlet and exhaust ports, and a valve co-operating with said ports to control the direction of rotation of the said piston and cylinder-head, as will be more specifically pointed out hereinafter. These and other features of this invention will be pointed out in the claims at the end of this specification.

Figure 1 is a side elevation of a rotary engine embodying this invention, the cover for the valve-chest being removed; Fig. 2, a vertical section of the engine on the line 2 2, Fig. 3; Fig. 3, a transverse section and elevation of the engine on the irregular line 3 3, Fig. 2, the piston being shown in elevation; Fig. 4, a sectional detail, to be referred to, on the line 4 4, Fig. 3, looking toward the left; Fig. 5, a transverse horizontal section on the line 5 5, Fig. 1, to more clearly show the construction of the rotary cylinder-head and the reversing-valve co-operating therewith; and Fig. 6, a detail to be referred to.

In the construction of rotary engine herein shown as embodying this invention the casing which contains the rotating piston and its co-operating cylinder-head, to be hereinafter referred to, is herein shown as composed of a disk or head a, a rim a', shown as integral therewith, and a removable head or cover a^2, which may be fastened to the rim a' by bolts a^3 or in any other suitable manner.

The casing referred to has its heads and rim so shaped as to form within it a substantially large circular chamber a^4 and a smaller segmental chamber a^5, the walls of the said segmental chamber being preferably greater than a semicircle.

The chamber a^4 contains within it a rotary piston (herein shown as a cylindrical projection a^6 on the end of an arm or vane a^7) secured to or forming part of a crank disk or drum a^{7a}, preferably made as herein shown, it consisting of a center cylindrical portion 2 and sides or heads 3 4, (see Fig. 3,) the side or head 3 being preferably made integral with the center portion 2 and the side 4 being detachably secured to said center portion by countersunk screws 5.

The sides or heads 3 4 are made of a diameter substantially equal to the internal diameter of the casing a and fit therein substantially steam-tight, while the center portion 2 of the crank disk or drum is made of a diameter less than the internal diameter of the casing a to form an annular steam passage or chamber a^8 in which the piston a^6 travels. In the present instance the piston-arm a^7 is shown as provided with side ribs 7, which fit into suitable grooves or channels in the center portion 2 of the crank-disk and lock the piston a^6 to the said crank disk or drum against radial movement; and the detachable head 4, while permitting the insertion of the said ribs in their channels, retains the said piston-arm and piston against axial movement in one direction, while the solid head 3 prevents axial movement in the opposite direction.

The piston a^6 travels in the annular passage a^8 and makes contact with the inner circumference of the rim a' for the greater portion of its rotary movement, and in order to effect a steam-tight joint or fit between the piston and the circumferential wall of the passage a^8 the said piston is provided with packing,

preferably a metal cylinder a^{15} (see Fig. 6) split longitudinally and provided with inturned ends 10 12, which fit into suitable longitudinal slots in the piston a^6 and are retained therein by the spring action of the said packing-cylinder.

The cylinder a^{15} is provided with one or more holes or openings a^{16}, through which steam may pass to act on the under or inner side of the packing-cylinder and force it outward against the rim a'.

The piston a^6 and the crank disk or drum a^{7a} have co-operating with them a rotatable hollow cylinder-head b, which, in the present construction, has the double function of an abutment and valve, as will be described.

The hollow cylinder-head b is provided with a central opening or bore, which, as represented in Fig. 3, extends but partially through the said cylinder, the central bore or opening having extended from it radially a plurality of slots, herein shown as four in number and marked b' b^2 b^3 b^4, (see Fig. 2,) which respectively communicate with or terminate in substantially semicircular axial grooves b^5 b^6 b^7 b^8, made in the periphery of the cylinder-head b. Each of the axial grooves referred to is designed to receive in turn the piston a^6, which fits each groove substantially steam-tight when the groove and piston are in a central line through the crank disk or drum a^{7a} and the center of the head b.

The substantially semicircular axially-disposed grooves b^5 b^6 b^7 b^8 practically divide the circumference of the cylinder b into four circular segments, (marked 20 21 22 23, Fig. 2,) and each segment is provided with a steam-packing, preferably a segmental metal plate b^{10}, (indicated by a heavy black line,) the said plate being fastened to the segments by countersunk screws (not herein shown) or in any other suitable manner, and each plate b^{10} is preferably provided with one or more holes or openings, (not shown,) but similar to the holes a^{16} of the piston-packing, so that steam may pass under the metal plate b^{10} and force it outward into contact with that portion of the rim a' containing the cylinder b, and also forcing the metal packing-plate of one segment into contact with the periphery of the center portion 2 of the crank disk or drum a^{7a}, as shown in Fig. 2, to effect a steam-tight joint between the said segment and the said disk or drum, whereby in the rotation of the crank-disk and its piston the said segment remains in contact with the drum or disk and forms an abutment for the steam which drives the piston.

The cylinder-head b in the present construction of rotary engine is intermittently moved or partially rotated for each complete revolution of the crank disk or drum and its attached piston, and this result may be accomplished by means of the gearing shown in Figs. 3 and 4, or by making the crank disk or drum a^{7a} and the cylinder-head b of a shape to correspond to the said gearing, in which latter case the gearing may be dispensed with.

Referring to Figs. 3 and 4, the shaft b^{20} on which the crank disk or drum a^{7a} is keyed or otherwise secured has fast on it outside of the main casing a disk or plate c, herein shown as substantially heart-shaped and provided at its outer end or apex with a stud or pin c', preferably having loosely mounted thereon a roller or collar c^2, which is adapted to enter one of a plurality of radial slots c^3 c^4 c^5 c^6, made in a disk or plate c^7 and forming four segments 30 31 32 33, having re-entrant or concave circular peripheries 34 35 36 37, made in the arcs of circles having the same or substantially the same radius as a disk or substantially circular plate or ring c^{10} secured to or forming part of the heart-shaped plate or disk c, so that when in the revolution of the disk c the circular periphery of the disk c^{10} engages one of the re-entrant circular portions of the segments 30 31 32 33 the disk or plate c^7 is locked against rotary movement until a concaved or re-entrant circular portion 40 of the periphery of the disk c^{10} co-operates with the re-entrant circular surface of the segment which is in engagement or contact with the circular periphery of the disk or ring c^{10}. When in the revolution of the disks c c^{10}, which are fast to the shaft b^{20}, the surface 40 is brought around, so that a segment of the disk c^7 is released from engagement with the periphery of the disk or ring c^{10}, the disk c^7 is then free to be moved by the passage of the roller c^2 into one of the slots c^3 c^4 c^5 c^6, and in the present construction the disk c^7 will be moved from the time the roller c^2 enters the slot until it leaves it, during which time the disk c^7 is moved one-fourth of a revolution, and as the disk c^7 is fast to a stud or shaft c^{20} of the cylinder-head b the latter is moved coincidently with the disk c^7 and makes a quarter-revolution for each revolution of the crank-disk a^{7a} and its piston a^6.

The cylinder-head b is supported at one end by the stud or arbor c^{20}, and its opposite end is supported by the hollow stationary shaft or tube d, extended into the central opening or bore of the said cylinder-head.

The tube or shaft d is secured to or forms part of a valve-chest D, (see Figs. 3 and 5,) preferably annular in shape and composed of an annular rim d', front and rear walls d^2 d^3, respectively, and a substantially central wall d^4, which divides the valve-chest into two chambers d^5 d^6.

The rear wall, d^3, of the valve-chest D may and preferably will form part of the cover or front head a^2 of the engine-casing, as herein shown, and the front plate or cover, d^2, may be secured to the rim d', as by bolts d^{10}. The tube or shaft d may and preferably will be divided into two passages d^{12} d^{13} by a longitudinal substantially central wall or partition d^{14}, and the said tube is provided in its circumference on opposite sides of the partition

with ports or openings d^{15} d^{16}, with which register the ports or openings in the cylinder-head b, as will be described. The tube or shaft d, as shown in Fig. 5, extends through the partition-wall d^4 in the valve-chest and has co-operating with it a valve d^{20}, herein shown as a substantially rectangular block movable between guiding-flanges or ribs d^{21} d^{22}, (see Fig. 3,) secured to or forming part of the partition-wall d^4. The valve d^{20} is provided, as shown, with a substantially-central slot or port-opening d^{25} and with passages or recesses d^{26} d^{27} made in the rear face of the valve on opposite sides of the port-opening d^{25}, the partition-wall d^4 being provided with ports or openings d^{28} d^{29}, with which the passages d^{26} d^{27} co-operate, for a purpose as will be described.

The valve d^{20} constitutes the reversing-valve of the engine and may be positively operated by hand through the valve-rod d^{30}, connected therewith.

The valve d^{20} may have co-operating with its steam-inlet port d^{25} a cut-off valve of any suitable construction, and which is herein shown as a flat plate d^{31}, (see Figs. 1 and 5,) and the cut-off valve is provided with a stem or rod d^{32}, which in practice may be suitably connected to the shaft b^{20} to automatically operate the said cut-off valve.

The chamber d^5 of the valve-chest D constitutes the steam-inlet chamber and is provided with an inlet-pipe d^{40}, (see Fig. 3,) leading to the boiler or other source of supply, and the chamber d^6 constitutes the exhaust-chamber for the valve-chest and is provided with an outlet-pipe d^{41}.

The operation of my improved rotary engine may be briefly described as follows: Referring to Fig. 2, the piston a^6 is shown as starting on its rotation in the direction of arrow 60, and at such time the said piston and the cylinder-head b have been moved a slight distance beyond the central line through the center of the shaft b^{20} and the center of the cylinder-head b. When the piston a^6 is traveling in the direction of arrow 60 the valve d^{20} occupies the position represented in Fig. 5, with the port d^{25} registering with the passage d^{12}, the passage d^{27} connecting the passage d^{13} with the exhaust-port d^{28}. With the valve d^{20} in the position shown in Fig. 5, the steam or other medium admitted into the chamber d^5 through the pipe d^{40} passes through the port d^{25} into the passage d^{12}, from whence it passes through the port or opening d^{15} into the slot b' and thence into the semicircular groove b^5, wherein it acts upon the exposed surface of the piston a^6 and forces the latter forward in the direction indicated by the arrow 60. The steam in the semicircular passage or groove b^5 abuts against the segment 20, which, at such time, makes a steam-tight joint with the periphery of the crank disk or drum a^{7a}. As the piston a^6 is rotated in the direction indicated by arrow 60, the shaft b^{20} is rotated in the same direction, as indicated in Fig. 4, and the cylinder-head b and the disk c^7 are rotated in an opposite direction, (indicated by the arrow 61, Figs. 2 and 4,) and the rotation of the cylinder-head b and the disk c^7 continues until the roller c^2 has passed out of and away from the slot c^3 in the disk c^7, at which time the disk c^{10} will coincide with and engage the re-entrant circular portion 34 of the segment 30 of the disk c^7, and the cylinder-head b will be locked against rotary movement in the direction indicated by arrow 61 until the piston a^6 has made a complete revolution.

From an inspection of Fig. 2 it will readily be seen that when the piston a^6 and the cylinder-head b are in the central line through the center of the cylinder-head b and of the crank-disk a^{7a} the piston a^6 will fill or substantially fill the semicircular groove b^5, but that as the piston a^6 moves in the direction indicated by arrow 60 it is withdrawn from the groove b^5, and the latter is enlarged so as to receive a greater quantity of steam, until in the movement of the piston and of the cylinder-head the piston is entirely withdrawn from the groove b^5, and at such time the cylinder-head b has been moved so as to open wide the groove b^6 and place it in direct communication with that portion of the passage a^8 in front of the piston a^6, thereby permitting the steam in front of the piston a^6 to pass out through the groove b^6, slot b^2 through the port d^{16}, which, at such time, is uncovered by the cylinder-head b, through the passage d^{13}, valve-passage d^{27} and port d^{29} into the exhaust-chamber d^6 of the valve-casing, from whence it passes out through the exhaust-pipe d^{41}. When the piston a^6 has passed from engagement with the semicircular groove b^5 the cylinder-head b is locked from further rotation in the direction indicated by arrow 61, while the piston a^6 continues its rotation in the direction indicated by arrow 60, and at such time the disk c^7 will have been moved sufficiently far in the direction indicated by arrow 61 to place or move the slot c^4 into the path of movement of the roller c^2, so that when the piston a^6 approaches the completion of its rotary movement or stroke in the direction indicated by arrow 60 the roller c^2 will enter the slot c^4, and at substantially the same time the piston a^6 will begin to enter the groove b^6 in the cylinder-head b, the live steam acting upon the face of the piston a^6 until the latter has been brought onto or about the center line passing through the centers of the cylinder-head b and the piston-crank a^{7a}, and at such time the passage b^7 will have been brought down so as to just open the auxiliary exhaust-passage e, formed by cutting away or enlarging the inner circumference of the rim in which the cylinder-head b is located, the cut e being made substantially equal in length to the width of the passage b^7. This construction affords an exhaust for the steam in the passage a^8 when the piston a^6 and cylinder-head b are passing what may be called the "dead-center," and

as soon as the auxiliary exhaust *e* commences to be uncovered the port d^{15} also commences to be uncovered to admit live steam into the groove b^6, it being understood that the cylinder-head *b* has made a quarter-revolution from the position shown in Fig. 2. It will thus be seen that the piston a^6 during its rotation in the direction indicated by the arrow 60 is acted upon by steam during substantially its entire revolution, and as a result no part of the piston stroke or travel is lost and the clearance in the engine is reduced to a minimum. The engine herein shown is capable of being reversed by simply moving the valve d^{20} from the position shown in Fig. 5 toward the right, so as to connect the passage d^{12} with the exhaust-chamber through the passage d^{26}, and to connect the exhaust-passage d^{29} with the passage d^{27}, while the steam-inlet passage d^{25} is connected with the passage d^{13}.

When the reversing-valve d^{20} is in the position just indicated live steam will pass through the port d^{25} into the passage d^{13} and thence out through the port or opening d^{16}, which produces rotation of the piston a^6 and cylinder-head *b* in the direction opposite to that indicated by the arrows 60 and 61 respectively.

The piston a^6 may be acted upon by full steam-pressure during its entire revolution, or, if desired, it may be expansibly operated upon for a portion of its revolution by cutting off the admission of steam through the inlet-port d^{25} by the valve d^{31}.

It will be noticed that the cylinder-head *b* acts as a valve to close and open the ports d^{15} d^{16}, while at the same time it acts as an abutment for the steam acting against the piston a^6. I have herein shown the cylinder-head *b* as provided with four steam-passages and grooves for the reception of the piston a^6, so that the cylinder-head *b* makes a quarter-revolution for each complete revolution or rotation of the piston a^6, but I do not desire to limit my invention to this particular relative movement of the said parts.

I claim—

1. In a rotary engine or motor, the combination of the following instrumentalities, viz:—a casing provided with an annular passage, a piston movable in said annular passage, a hollow rotatable cylinder-head provided with a plurality of grooves or channels for the reception of said piston and with slots or ports communicating with said grooves or channels, and a shaft upon which said cylinder-head rotates provided with inlet and exhaust passages adapted to be connected with two of the grooves or channels in the cylinder-head by two of its slots or ports, substantially as described.

2. In a rotary engine or motor, the combination of the following instrumentalities, viz:—a casing provided with an annular passage, a piston movable in said annular passage, a hollow rotatable cylinder-head provided with a plurality of grooves or channels for the reception of said piston and with slots or ports communicating with said grooves or channels, a shaft upon which said cylinder-head rotates provided with an inlet and an exhaust passage adapted to be connected with two of the said grooves or channels, and auxiliary inlet and exhaust passages intermediate of the annular passage in the casing and the grooves or channels in the cylinder-head and adapted to establish communication between said annular passage and the said grooves or channels to permit the piston to be acted upon by steam throughout its complete travel or cycle, substantially as described.

3. In a rotary engine or motor, the combination of the following instrumentalities, viz:—a casing provided with an annular passage, a piston movable in said annular passage, a crank disk or drum mounted on a shaft within said casing and to which the said piston is attached, a rotatable cylinder-head intermittently engaging said piston and drum and provided with steam-ports, a divided hollow shaft on which said cylinder-head rotates provided with ports co-operating with the ports of the cylinder-head and intermittently opened and closed by said rotary cylinder-head, for the purpose specified.

4. In a rotary engine or motor, the combination of the following instrumentalities, viz:—a casing provided with an annular passage, a piston movable in said annular passage, a crank disk or drum mounted on a shaft within said casing and to which the said piston is attached, a rotatable cylinder-head intermittently engaging said piston and drum and provided with steam-ports, a divided hollow shaft on which said cylinder-head rotates provided with ports co-operating with the ports of the cylinder-head, and intermittently opened and closed by said rotary cylinder-head, and a reversing-valve controlling the admission of steam into and out of the divided hollow shaft, substantially as described.

5. In a rotary engine or motor, the combination of the following instrumentalities, viz:—a casing provided with an annular passage, a piston movable in said annular passage, a rotatable hollow cylinder co-operating with said piston, and provided with ports or passages, a divided hollow shaft upon which said cylinder is mounted, provided with ports adapted to be connected with the ports of the said hollow cylinder-head by the rotation of the said cylinder-head, substantially as and for the purpose specified.

6. In a rotary engine or motor, the combination of the following instrumentalities, viz:—a casing provided with an annular passage, a rotatable crank disk or drum in said casing provided with a piston extended into the said annular passage, the hollow cylinder-head *b* provided with a plurality of grooves for the reception of the said piston and with slots or ports extended from said grooves, the hollow divided shaft *d* provided with ports d^{15} d^{16}

adapted to communicate with the said slots and grooves, and controlled by the rotatable cylinder-head, a valve-chest provided with an inlet and exhaust chamber, and a valve controlling the communication of said chambers with the said divided hollow shaft, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN McCLOSKEY.

Witnesses:

JAS. H. CHURCHILL,

J. MURPHY.