No. 723,689. PATENTED MAR. 24, 1903.

G. A. L. LIND.

REVERSIBLE ROTARY ENGINE.

APPLICATION FILED AUG. 26, 1901.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 2.

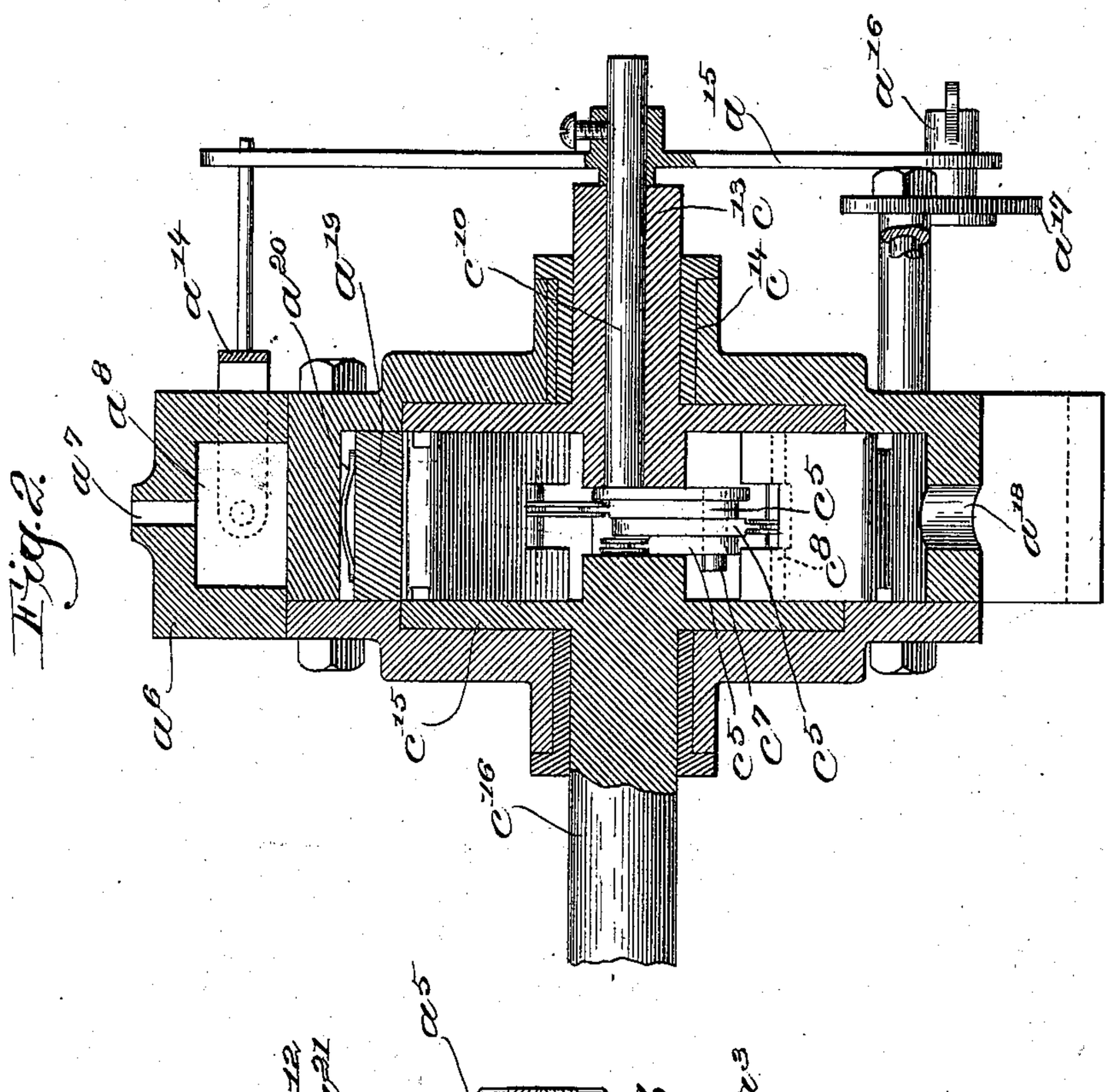
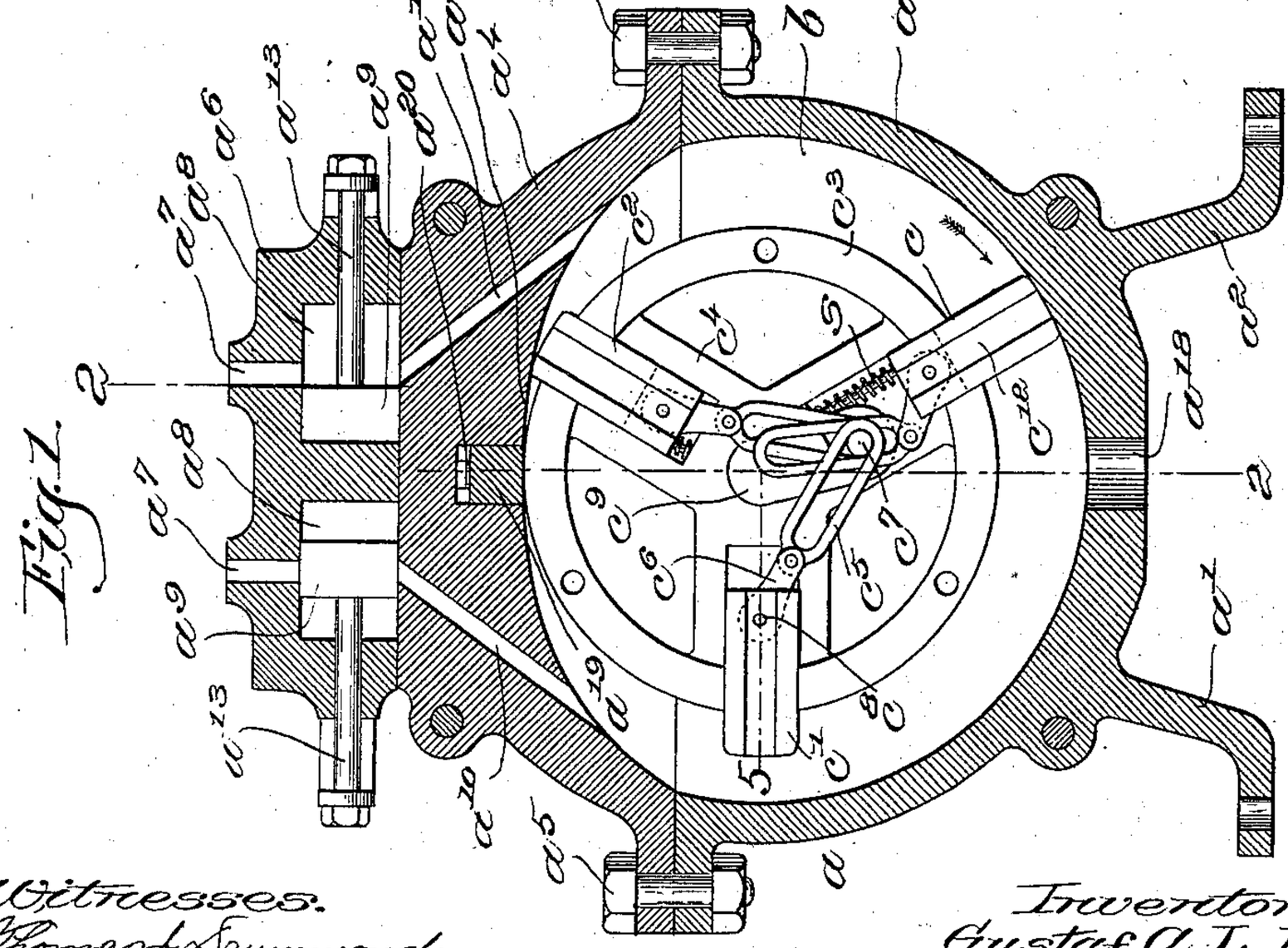


Fig. 1.



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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 3.

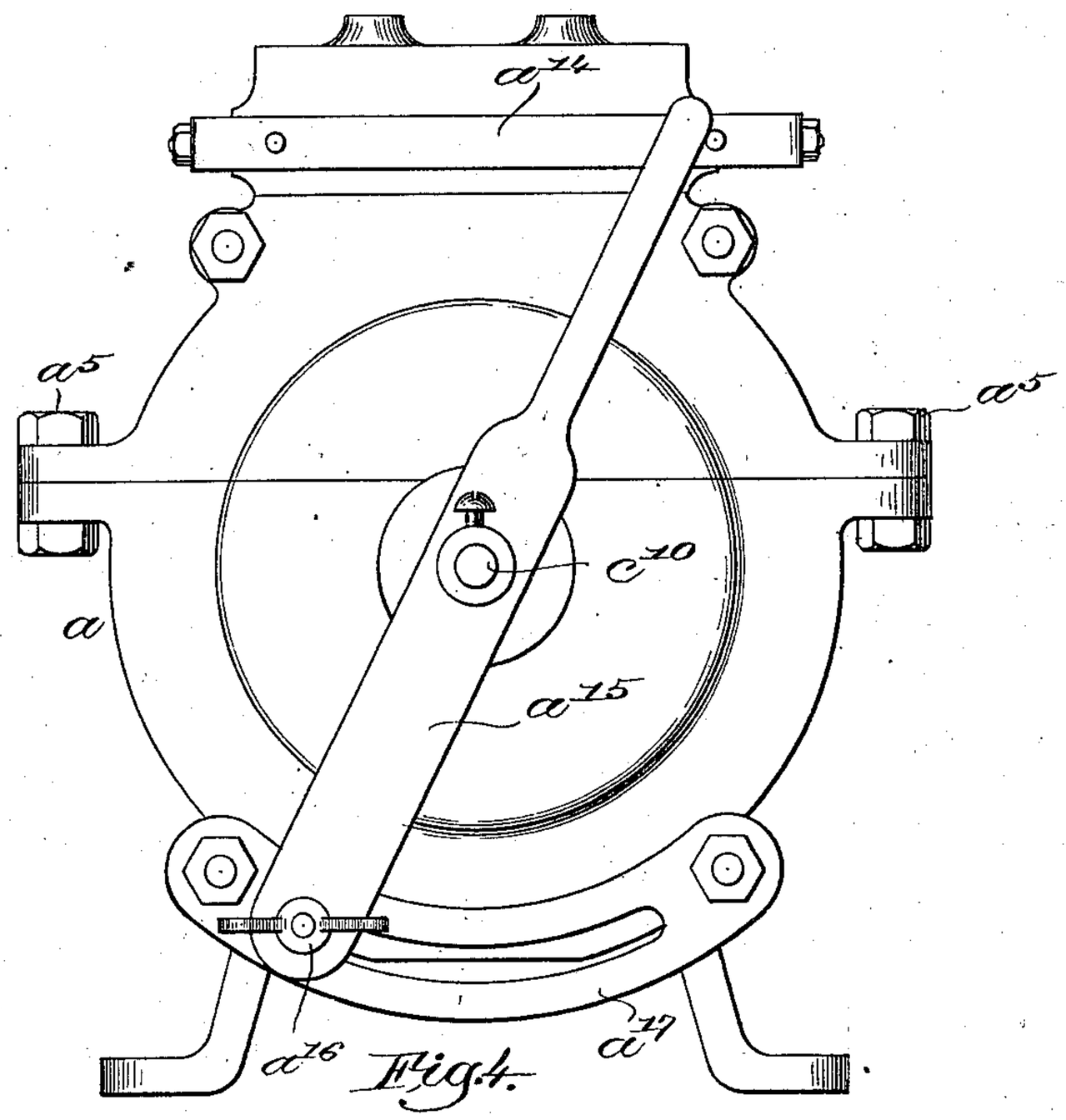


Fig. 4.

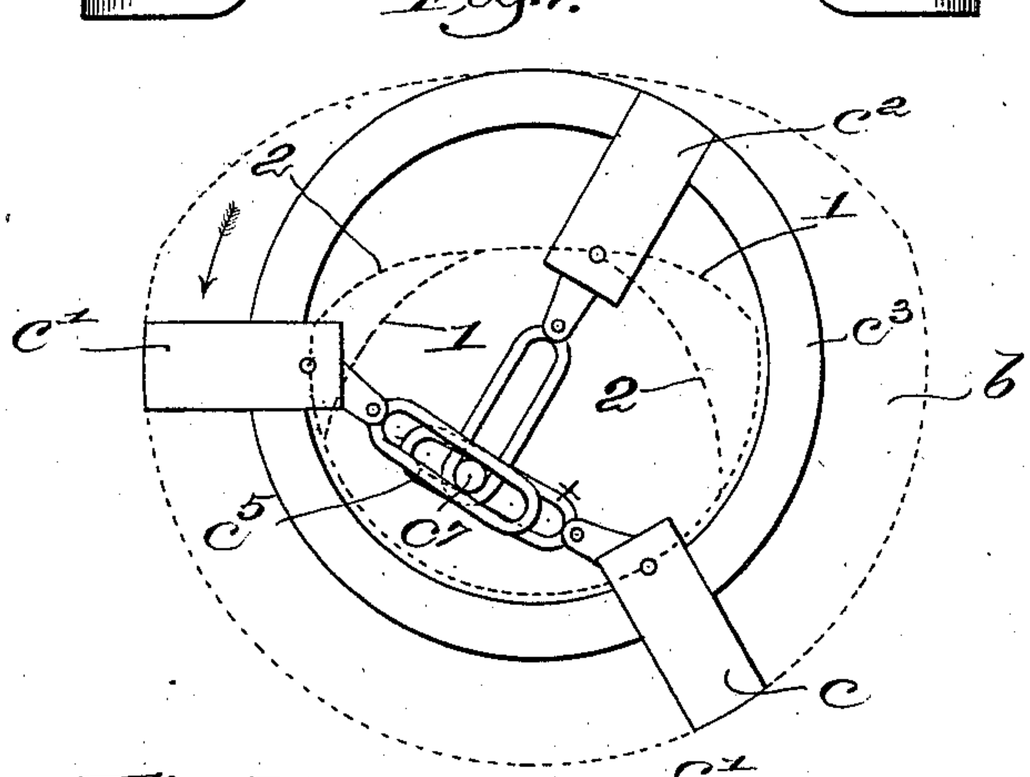
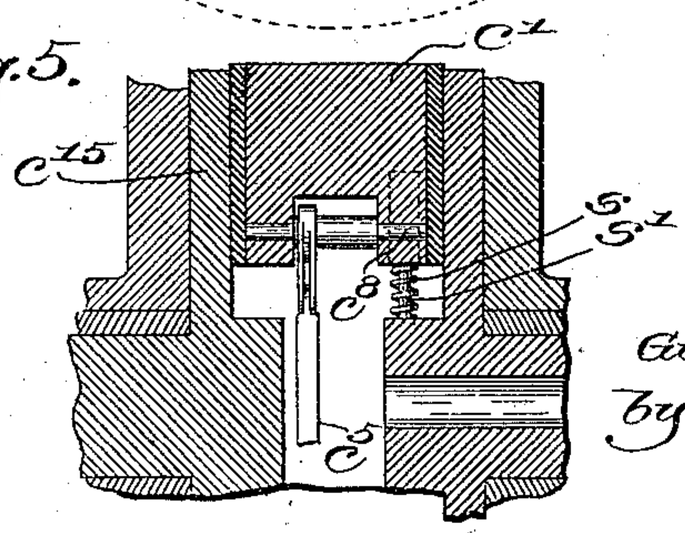


Fig. 5.



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UNITED STATES PATENT OFFICE.

GUSTAF A. L. LIND, OF BOSTON, MASSACHUSETTS, ASSIGNOR OF TWO-THIRDS TO EDWIN A. MASON AND MAX F. KLEINDIENST, OF BOSTON, MASSACHUSETTS.

REVERSIBLE ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 723,689, dated March 24, 1903.

Application filed August 26, 1901. Serial No. 73,353. (No model.)

To all whom it may concern:

Be it known that I, GUSTAF A. L. LIND, a citizen of the United States, residing at Boston, county of Suffolk, State of Massachusetts, have invented an Improvement in Reversible Rotary Engines, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

My invention is a reversible rotary engine, having for its object the provision of simple means for reducing the frictional resistance of the piston or pistons, having at the same time, preferably, all the moving parts rotary about a fixed center of motion.

The constructional details of my invention and further advantages and the operation thereof will be pointed out more fully in the course of the following description, reference being had to the accompanying drawings, in which I have illustrated a preferred embodiment of the invention, and the latter will be more particularly defined in the appended claims.

In the drawings, Figure 1 is a vertical longitudinal section of the machine. Fig. 2 is a transverse section taken on the broken line 2 2, Fig. 1. Fig. 3 is a back side view thereof. Fig. 4 shows in detail a different position of the pistons and connected parts from that shown in Fig. 1; and Fig. 5 is an enlarged sectional detail on the line 5, Fig. 1.

It will be understood that my engine may be mounted in any suitable framework and that many of the constructional details thereof may be varied.

For convenience of illustration I have herein shown the frame a as standing on two legs a' a^2, adapted to be bolted to the floor or other place. Said frame comprises a lower shell a^3 and an upper shell a^4, bolted together at a^5, the upper shell carrying a steam-chest a^6, provided with inlet-ports a^7, communicating with chambers a^8, containing any suitable kind of valves a^9 for controlling the steam-ports a^{10} a^{12}, which admit steam to one side or the other, as desired, of the cylinder or piston-chamber b, said valves a^9 being connected by rods a^{13} to a bar or connecting-piece a^{14}, operated by a reversing-lever a^{15}, which may be locked in adjustment by a thumb-nut or other means a^{16} on a slotted sector a^{17} at the base of the engine.

Within the chamber b is mounted a piston or pistons, three thereof being herein indicated at c c' c^2, carried by a ring or piston-carrier c^3 and movable radially therein, said ring for this purpose being shown as provided with heavy radial slotted arms c^4, one for each piston. Each piston is connected by a flexible link, herein shown as comprising two parts c^5 c^6, pivoted together, the former being slotted and mounted on a wrist-pin c^7 and the link c^6 being pivoted at c^8 to the inner end of its piston. The wrist-pin c^7 projects from a crank c^9 on the end of a shaft c^{10}, which is operated by the lever a^{15} for the purpose of reversing the engine, so that the pistons will properly coöperate with the steam in the steam-chamber, the steam entering at a^{10} or a^{12}, as the case may be, and passing out at an exhaust-port a^{18}.

Preferably at the upper side of the steam-chamber b I provide a packing-block or stop a^{19}, herein shown as held downwardly by a spring a^{20} in constant engagement with the piston-carrier c^3 for the purpose of preventing the passage of steam in the wrong direction, and the top wall of the steam-chamber b is also for the same purpose made eccentric or converging toward the piston-carrier, as indicated at a^{21}, thereby coöperating with the yielding pistons in making it impossible that the steam from either port a^{10} a^{12} shall go backwardly or in a wrong direction.

Preferably each piston is provided at its opposite sides with packing c^{12}, so as to make a close joint against the walls of the steam-chamber b, and is held outwardly by centrifugal force supplemented by springs s, mounted on rods s', said springs bearing at one end against a piston and at the opposite end against the adjacent shaft or a projection therefrom.

The piston-carrier c^3 is connected by the radial arms c^4 to a rotary bearing or shaft c^{13}, mounted in a journal-bearing c^{14} and preferably extending beyond the same for the purpose of receiving a fly-wheel or governing de-

vice, not herein shown, (see Fig. 2,) and within the rotary part c^{13}, as herein shown, is mounted the reversing-shaft c^{10}. At its opposite side or end the piston-carrier is rigidly connected by a plate c^{15} to a power-transmission shaft c^{16}.

In use let it be supposed that the parts are in the position shown in Fig. 1. As shown in this figure, the steam enters freely at the right-hand port a^7, passes through the steam-chest by the port a^{12} to the cylinder or chamber b, and strikes against the piston c, thereby rotating the engine over to the right. As it rotates the piston c^2 is held outwardly into absolutely tight contact with the wall of the steam-chamber by its springs s and the centrifugal force of the engine, and as it comes in range of the steam-jet from the port a^{12} it in turn exerts its leverage by means of the piston-carrier to turn the engine forwardly. Meanwhile the piston c has been automatically drawn inwardly out of frictional engagement with the circumferential wall of the chamber b by the relatively stationary wrist-pin c^7, acting through the links c^5 c^6 in the position shown by the piston c', and the piston so remains withdrawn until it passes the vertical position, whereupon it is permitted to remain in contact with the wall of the steam-chamber, as shown at c^2 and c. Thus as the pistons rotate in the direction of the arrow, Fig. 1, they are held in projected position or driving relation throughout their travel on the right-hand side of the chamber and are retracted as they move upwardly on the left-hand side of said chamber, this movement being automatically accomplished by the releasing of the piston-links during the downward movement of the pistons and the tightening of said links during the upward movement of the pistons, due to having the pivotal point at the wrist-pin c^7 shifted toward the right or located within the right-hand half of the engine. The motion will be more evident viewing Fig. 4, where the dotted circle 1 indicates the path of travel of the point c^8 of each piston when the wrist-pin is in the position shown in Fig. 1, and the dotted line 2 indicates the line of travel thereof when the wrist-pin is reversed, as indicated in full lines, at which time the pistons are traveling in the direction of the arrow, Fig. 4—*i. e.*, opposite to the direction shown in Fig. 1.

The link and wrist-pin mechanism, as shown, reduces the rotary and reversing parts of the engine to extreme simplicity and at the same time makes the operation certain, readily understood, and under the ready control of the operator. This construction also enables me to have everything rotate about a center, being coaxial with the main shaft of the engine.

The carrier and pistons rotate about the center of the engine and the radial movement of the pistons is caused simply by having a fixed connection, which is eccentric thereto.

By transmitting the driving energy from the pistons successively to the very center of rotation I obtain a maximum leverage, while at the same time by withdrawing the inactive pistons I minimize the frictional resistance and other adverse forces.

By my construction the engine operates equally well in either direction.

While I have herein described my invention and all the preferred details of construction, it will be understood that I do not limit myself thereto, excepting in the more specific claims, as certain of the other claims are intended to include various changes and modifications in shape, construction, and arrangement of parts all within the spirit and scope of my invention.

Having described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a rotary engine, comprising an annular steam-chamber, a piston-carrier centrally journaled therein, a piston radially movable in said carrier, a reversing-shaft journaled concentrically of said carrier and provided at its end within the carrier with an eccentric wrist-pin stationary during the operation of the engine and yieldingly connected with said piston for automatically moving the same radially at a predetermined point as the piston revolves by the rotation of the carrier.

2. In a rotary engine, comprising an annular steam-chamber, a piston-carrier centrally journaled therein, a plurality of pistons radially movable in said carrier, a reversing-shaft journaled concentrically of said carrier and provided at its end within the carrier with a stationary eccentric wrist-pin yieldingly connected with all of said pistons for automatically moving the same one at a time radially as the pistons revolve by the rotation of the carrier.

3. In a rotary engine, an annular steam-chamber, a centrally-journaled piston-carrier mounted therein, provided with a radially-movable piston, inlet-ports at the opposite sides of said chamber, exhaust means, a movable stop or packing-block located between said two inlet-ports, the peripheral walls of said steam-chamber converging eccentrically at each side of said block approximately flush with the inner edges of said block, for preventing the backflow of steam from one toward the other, means for positively and automatically maintaining said piston projected in closing position across said steam-chamber during part of its travel from said packing-block and retracted during the remainder of its travel.

4. A rotary engine, having an annular steam-chamber, steam-inlet ports for admitting steam on opposite sides thereof, exhaust means, a piston-carrier centrally journaled in said chamber and provided with a plurality of radially-movable pistons, a rock-shaft provided with a pivot-pin located eccentrically within said carrier, a pivoted connection

between said pin and each piston, a steam-chest provided with valves for controlling the admission of steam to said ports, respectively, and connections between said valves and said rock-shaft for correspondingly reversing the positions of said valves and pin.

5. In a rotary engine, an annular steam-chamber, a piston-carrier centrally journaled therein, a piston radially movable in said carrier, a reversing-shaft extending concentrically within said carrier and provided with an eccentric wrist-pin, a link pivotally connected to said piston and to said wrist-pin, said link being provided with a longitudinal slot for limiting the outward radial movement of said piston away from said wrist-pin and permitting the free movement of the piston toward said wrist-pin as the piston is revolved by said carrier.

6. In a rotary engine, an annular steam-chamber, a piston-carrier centrally journaled therein, a piston radially movable in said carrier, a reversing-shaft extending concentrically within said carrier and provided with an eccentric wrist-pin, a link pivotally connected to said piston and to said wrist-pin, said link being provided with a longitudinal slot for limiting the outward radial movement of said piston away from said wrist-pin and permitting the free movement of the piston toward said wrist-pin as the piston is revolved by said carrier, and a spring for normally maintaining said piston projected across said steam-chamber.

7. A rotary engine, comprising an annular steam-chamber, a piston-carrier provided with a central bearing-shaft mounted at one side of the engine, said carrier comprising a radial part mounted at one side of said steam-chamber and having at its periphery a laterally-extending ring portion, radial slotted arms, pistons mounted movably in said slotted arms, a radial plate at the opposite side of said steam-chamber rigidly secured to said ring portion at the edge thereof opposite to said radial part, a power-shaft extending rigidly from said plate, said bearing-shaft and said power-shaft terminating at their inner ends adjacent the opposite sides of the carrier, leaving an open space between them, and a reversing-shaft coaxially mounted in said bearing-shaft and provided at its inner end in the said open space with operating connections for automatically moving said pistons radially at predetermined points in their travel.

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

GUSTAF A. L. LIND.

Witnesses:
GEO. H. MAXWELL,
WILHELMINA C. HEUSER.