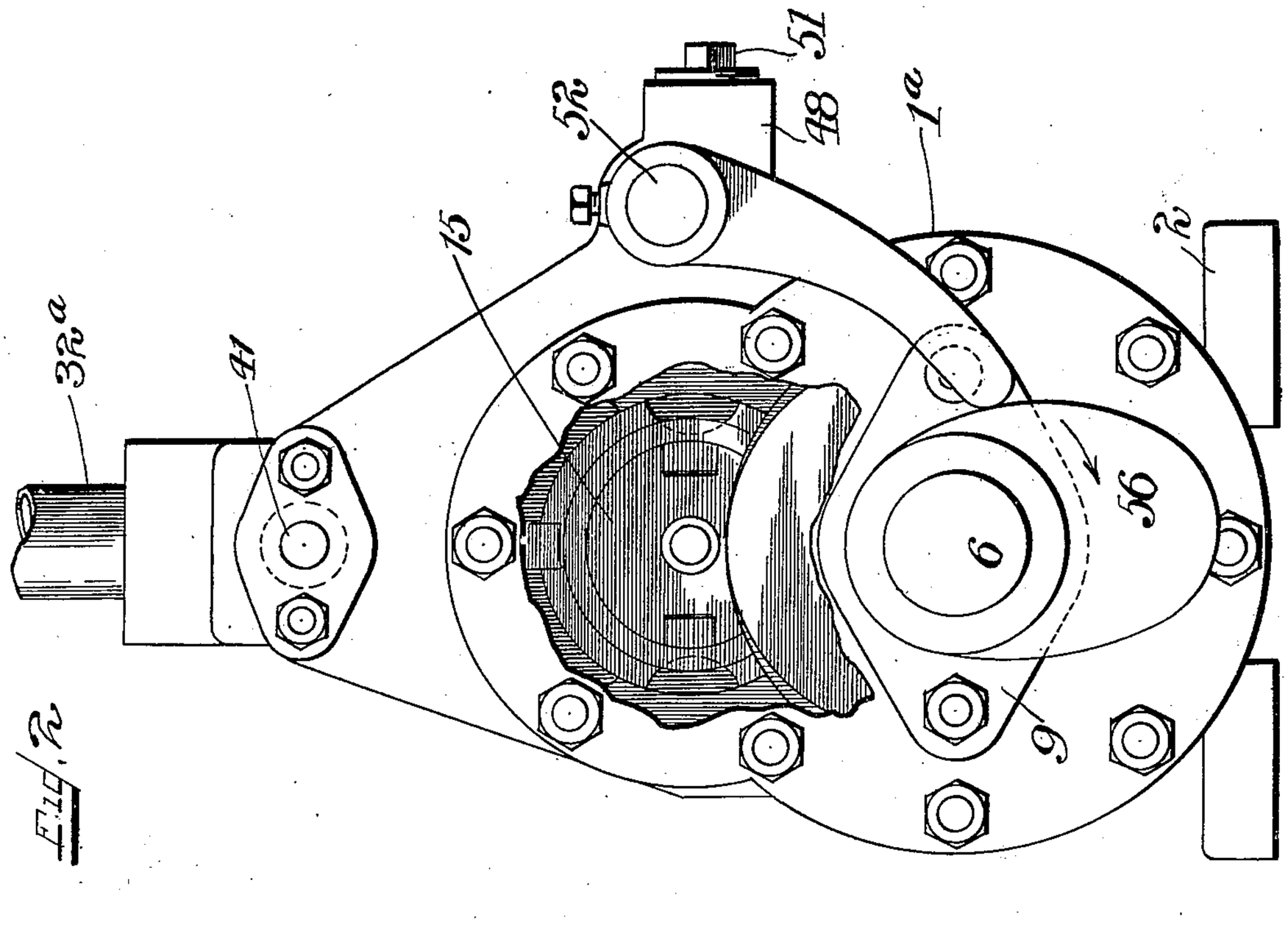
No. 667,323. Patented Feb. 5, 1901.

L. C. KRUMMEL.

ROTARY ENGINE.

(Application filed Dec. 26, 1899.)

(No Model.) 3 Sheets—Sheet 1.



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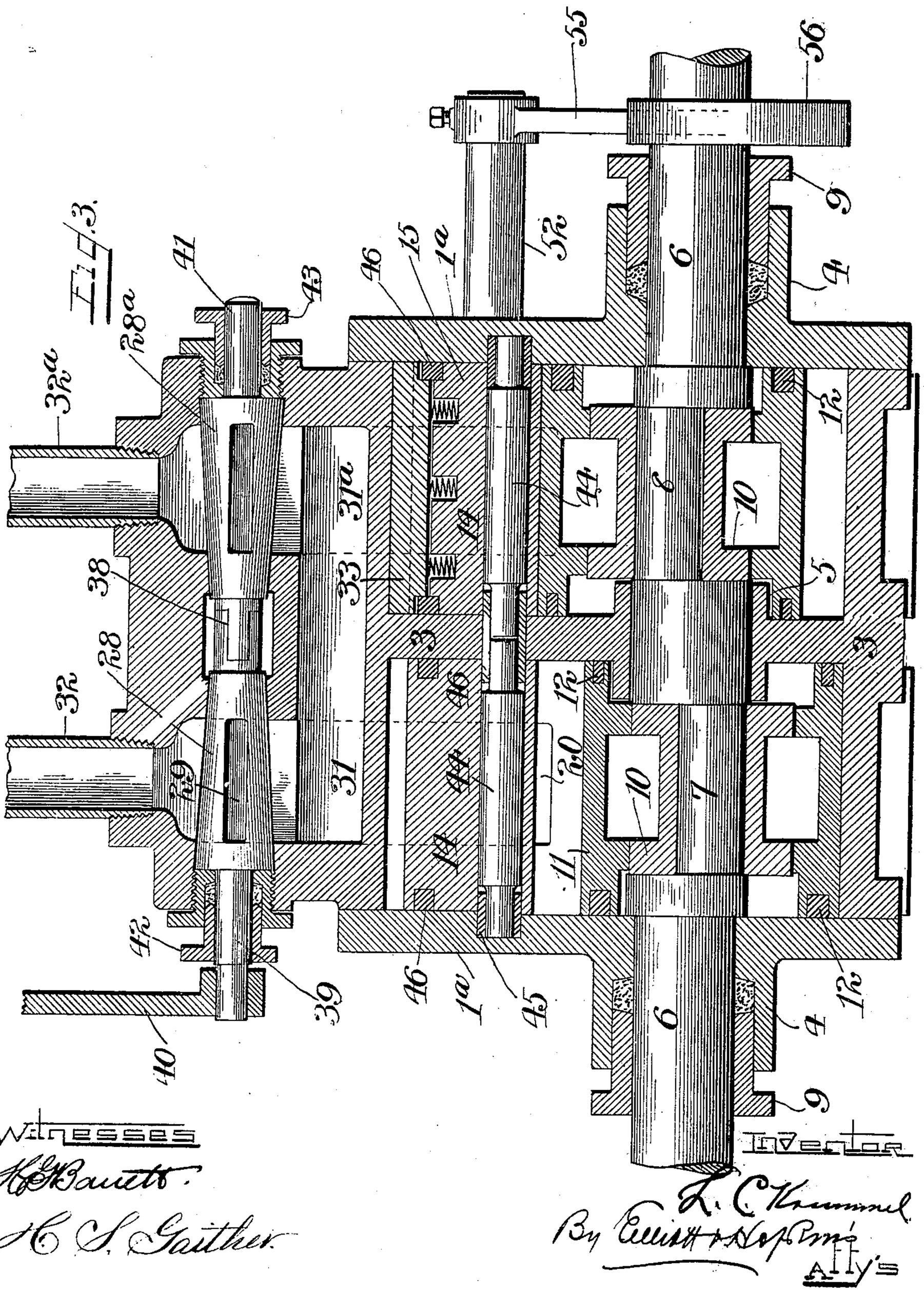
3 Sheets—Sheet 2.

Fig. 3.



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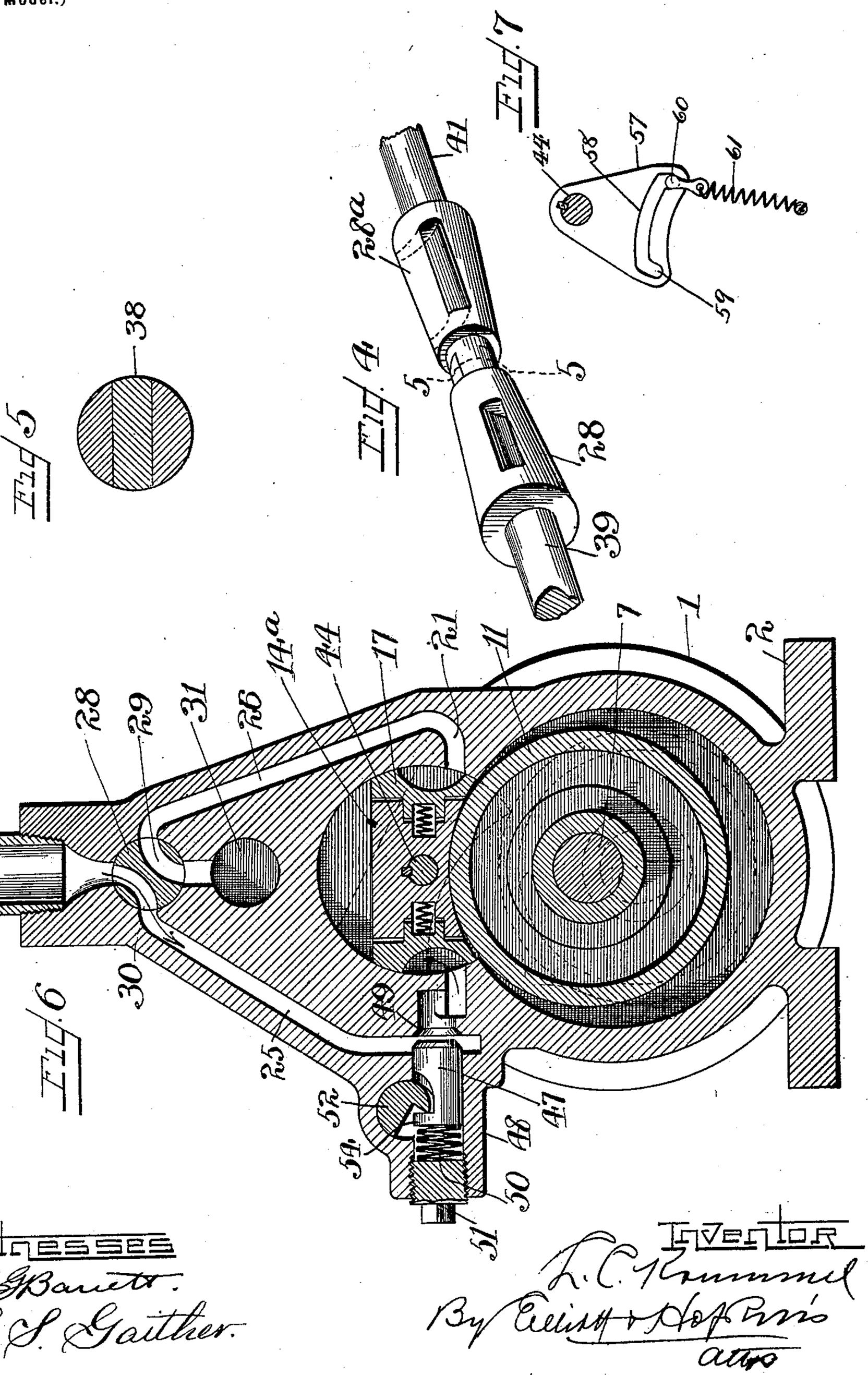

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UNITED STATES PATENT OFFICE.

LOUIS C. KRUMMEL, OF CHICAGO, ILLINOIS.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 667,323, dated February 5, 1901.

Application filed December 26, 1899. Serial No. 741,497. (No model.)

To all whom it may concern:

Be it known that I, LOUIS C. KRUMMEL, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Rotary Engines, of which the following is a full, clear, and exact specification.

My invention relates to rotary engines of that class in which the pressure acts between an abutment and a piston revolving in a cylinder or chamber and contacting with the abutment; and the invention has for one of its objects to provide a port-valve and throttle of such construction that the position of the port-valve may be automatically shifted and the engine thereby reversed by simply shifting or turning the throttle.

A further object of my invention is to provide a combined rocking abutment and port-valve that will be actuated by the movement of the piston and may be tilted into position for having its opposite sides alternately or interchangeably used to govern the inlet and exhaust ports and act as abutments.

With these ends in view my invention consists in certain features of novelty in the construction, combination, and arrangement of parts by which the said objects and certain other objects hereinafter appearing are attained, all as fully described with reference to the accompanying drawings and more particularly pointed out in the claims.

In the drawings, Figure 1 is a vertical transverse sectional view of a rotary engine embodying my invention. Fig. 2 is an end elevation thereof looking from the opposite end to that presented in Fig. 1. Fig. 3 is a vertical longitudinal sectional view taken on the line 3 3, Fig. 1. Fig. 4 is a detail perspective view of the throttle valve or valves hereinafter described. Fig. 5 is a transverse section taken on the line 5 5, Fig. 4. Fig. 6 is a view similar to Fig. 1, showing a slight modification in the combined abutment and port-valve hereinafter described. Fig. 7 is a detail view of a spring arrangement for holding the combined abutment and port-valve in position in lieu of the devices for holding it in position by means of pressure shown in Figs. 1 and 2.

Like signs of reference indicate like parts throughout the several views.

In illustrating my invention in the accompanying drawings I have shown it in the form of a compound engine, one taking its supply from the exhaust of the other; but it will nevertheless be understood that the improvements are equally applicable to a single engine.

In carrying out my invention I employ a cylinder 1, having a suitable base 2 and arranged, preferably, in a horizontal position, with a partition 3 dividing such cylinder into two compartments or cylinders, one of which is the primary and the other the secondary cylinder. Journaled in suitable bearings 4 at the ends of the cylinder 1 and also in a bearing 5, formed in the partition 3, is a crank-shaft 6, having two cranks 7 8, arranged one in each of the cylinder-compartments, the journal-bearing 5 being of sufficient diameter to permit the shaft to be passed through the cylinders endwise and fitted in place. If desired, each of the journal-bearings 4 may be provided or formed with a suitable stuffing-box 9 to guard against leakage of steam or pressure past the shaft.

The shaft 6 is journaled concentrically within the cylinder 1, and arranged on each of the cranks or eccentric portions 7 8 is a piston, which is composed of a revoluble hub 10 and a ring or band 11, secured thereon and being of sufficient diameter to remain in contact with the wall of the cylinder continuously as the shaft revolves and to consequently rotate on an independent axis in the reverse direction of that in which the piston revolves bodily within the cylinder. By this means it will be seen that while the piston remains in firm contact with the wall of the cylinder during its entire travel it nevertheless by virtue of its rolling action moves or walks around the cylinder without producing frictional contact or rubbing therewith, the only friction being that which may be due to the turning of the hub 10 upon its concentric journal or crank and the mere contact at a single point at a time with the wall of the cylinder.

The leakage of pressure past the piston ring or band 11 may be prevented by any suit-

able packing, such as rings 12, let into the ends of the ring 11 and bearing against the partition 3 and end walls of the cylinder, respectively.

The interior of the cylinder 1 is circular, and adjacent to and communicating with the cylinder 1 on each side of the partition 3 is an abutment-chamber 13, also of cylindrical form or at least having a portion of its walls cylindrical, and in these abutment-chambers are journaled abutments 14 15, respectively, which have cylindrical shoes or shoes provided with cylindrical faces 16 17, fitting against the cylindrical walls of these abutment-chambers and serving as port-valves, having valve-cavities 18 19, respectively, which are adapted to alternately connect ports 20 21 with the interior of the cylinder as the abutment is rocked on its axis, thus permitting the exhaust to discharge from the cylinder at either side of the abutment through either of the ports 20 21, according as the engine may be running in one direction or the other. The lower side of each of the abutments 14 15 is cut away, as shown at 22, on an arc of slightly-greater radius than the radius of the cylinder 1, so as to form two projecting edges or corners 23 24, either of which is adapted to be tilted down into contact with the periphery of the piston-ring 11, and thus constitute an abutment closing communication between the two ports 20 21 and compelling pressure to act on the eccentrically-arranged piston and thus impart rotation to the crank-shaft 6. In the position shown in Fig. 1, with the projection 24 of the abutment in contact with the cylinder-ring 1, the engine would be running toward the left or in the direction of the arrow, pressure being admitted at the port 20 and causing the piston-ring 11 to roll around the wall of the cylinder and by contact with the abutment gradually lift it until the top of the ring 11 contacts with a point directly under the center or mid-length of the arc 22, thus raising the valve-cavity 19 and lowering the valve-cavity 18 until the latter covers the port 20 and shuts off the pressure, the exhaust in the meanwhile having taken place while the cavity 19 was passing upwardly over the port 21. Both of the ports 20 21 communicate with pressure-supply passages 25 26, respectively, which lead to a throttle-valve chamber 27, in which is located a two-way throttle-valve 28, having two passages 29 30, one of which is adapted to connect the passage 26 with an exhaust-passage 31, while the other connects the steam-supply pipe 32 with the passage 25, and vice versa when the throttle is rotated in the opposite direction in the act of reversing the engine. In order that the abutments 14 15 may be returned to the position shown in Fig. 1 as the piston revolves, the abutment is provided with means for continuing the pressure of the projecting edge 24 against the piston-ring 11 until such time as it may be desired to reverse the engine, and then such means act to hold the projecting edge 23 against the piston-ring 11 in the same manner. In the form of my invention shown in Fig. 1 this action of the abutment 14 is accomplished by the pressure itself by simply providing the top of the abutment with an auxiliary piston or wing 33, held in contact with the upper wall of a recess 34, produced in the top side of the abutment-chamber, by means of a spring or cushion 35 seated in the abutment, and this recess 34 is connected at each end by passages 36 37 to the pressure-passages 25 26, respectively. Thus it will be seen that when the parts are in the position shown in Fig. 1 the pressure in the passage 25 will hold the abutment 14 tilted to the right in the position shown in said figure and pressure will be admitted between the projecting edge 24 and the piston through the port 20; but should it be desired to reverse the engine it would simply be necessary to rotate the throttle 28 until the passage 30 therein communicates with the exhaust-outlet 31 and the passage 25 and passage 29 with the passage 26 and steam-supply pipe 32, whereupon the pressure predominating in the passage 26 will automatically tilt the abutment 14 to the left by virtue of the pressure against the wing 33, thus bringing the projection 23 down against the piston-ring 11 and causing the exhaust to take place through the cavity 18 and the passages 20 25. When the engine is constructed as a compound engine, these passages 20 21 25 26 and also the throttle 27, with its described two-way passages, are duplicated as often as the piston is duplicated and the exhaust-passage 31 of the primary engine is extended across to the corresponding exhaust-passage 31^a of the secondary engine and serves as the inlet for the latter, the pressure rising in exhaust-passage 31^a and passing through the passages of the throttle 28^a of the secondary engine and into the cylinder of the secondary engine via the passages which correspond with the passages 25 26 of the primary engine already described—that is to say, the exhaust of the primary engine passes into one of the passages 25 26 of the secondary engine, and after acting on the piston of the secondary engine in the manner already described with reference to the primary engine it passes out through the other one of passages 25 26 of the secondary engine and escapes to the atmosphere or other place via the exhaust-pipe 32^a, which corresponds with the steam-inlet pipe 32.

For the sake of convenience in construction and operation the two throttles 28 28^a are coupled together at their inner meeting ends by interlocking portions 38, the throttles being conical plugs tapered inwardly and the throttle 28 having its stem 39 provided with an operating-lever 40, both the stem 39 and the stem 41 of the other throttle 28^a being preferably fitted with stuffing-boxes 42 43, respectively, to guard against leakage.

In compounding the engine the abutments 14 15 are preferably independent of each other, as better shown in Fig. 3, and each is mounted upon a shaft 44, journaled in the partition 3 and the cylinder-heads 1^a in suitable bushings 45, the ends of the abutments being provided with packing-rings 46 to prevent leakage.

If desired, either or both of the ports 20 21 may be provided with means for cutting off the pressure sooner or later from the cylinder, and thus economize pressure. In the accompanying drawings I have shown but one of the ports provided with such means, and from the illustration and description of this one it will be readily understood how the same may be duplicated in the other ports should it be desired, the only object in doing so, however, being to adapt the cut-off for the engine working in either direction. Such a cut-off, however, is of but little importance in a reversing engine, excepting for use in running in one direction, because it is seldom necessary to use engines of this character for any length of time going in a backward direction. The cut-off which I have shown and which I prefer to employ consists of a valve 47, sliding in a socket 48 and having a seat 49 located at a point between the passage 25 and the passage 20, so as to shut off pressure coming through the passage 25, but to permit the escape of pressure from the passage 20 into the passage 25, if necessary. The valve 47 is held to its seat by a coiled spring 50, arranged in the socket 48 between the valve and a screw plug or cap 51. The valve is automatically forced from its seat by means of a rocker-shaft 52, having a finger 53, which engages with a lug 54, formed on the valve 47, and the rocker-shaft is actuated to impart opening movement to the valve by means of an arm 55, arranged against an oval or egg shaped cam 56, secured to the shaft 6, or against a cam of any other form that will open the valve 47 at the proper time and permit it to close before the piston 11 has finished its complete stroke. Should it be desired to reverse the engine when equipped with a cut-off of the described character, the arm 55 may be held back out of the way of the cam 56 in any convenient manner, or, if desired, it may be allowed to remain in place and the valve 47 forced open by the pressure of the exhaust.

In the form of my invention shown in Fig. 6 the construction is the same as that already described, excepting that the abutment 14^a instead of being thrown automatically by the pressure of the steam or other fluid used and held in its tilted position by such pressure its shaft 44^a is carried through the end wall or head 1^a of the cylinder and is provided with an arm 57, having a curved slot 58, provided with a notch 59 at each end and in which slot runs a lug or stud 60, connected to a fixed spring 61. The tension of the spring 61 when the lug 60 is in one end of the slot 58 will hold the abutment 14^a in position, with one of its corners or projections pressing against the piston-ring 11, and when it is desired to reverse the engine the stud 60 is slipped along the slot 58 until it drops into the notch 59 at the opposite end. This action will tilt the abutment 14^a in the opposite direction and hold the other corner thereof in contact with the piston-ring, as before described.

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

1. A rotary engine having its supply-port provided with a valve-seat, a socket, a sliding valve-plug in said socket adapted to fit said seat, a transverse rocker-shaft having tooth-and-notch connection with said plug, an arm on said shaft, a cam for oscillating said arm for withdrawing said plug and a spring for returning said plug, substantially as set forth.

2. In a rotary engine the combination of a piston, a combined rocking abutment and valve, a casing having ports leading to opposite sides of said valve and controlled thereby, a wing or piston on said valve continually exposed on opposite sides to the pressure of both of said ports and means for alternately connecting said ports with the exhaust and supply and thereby rocking or shifting said valve and abutment and reversing the engine by one movement, substantially as set forth.

3. In a rotary engine the combination of a piston, a combined rocking abutment and valve having a wing, a casing having ports leading to opposite sides of said valve and controlled thereby and branch passages from said ports opening against opposite sides of said wing and means for connecting either of said ports with the supply and the other with the exhaust, whereby the pressure in the port connected with the supply will automatically rock said abutment and valve and reverse the engine, substantially as set forth.

4. In a rotary engine the combination of a piston, a combined rocking abutment and valve having a wing, a casing having ports leading to opposite sides of said valve and controlled thereby and branch passages from said ports opening against opposite sides of said wing and a single valve having two passages adapted to alternately connect said ports with the exhaust and supply whereby a single movement of said single valve will reverse the engine, substantially as set forth.

5. In a rotary engine the combination of a bodily-revolving independently-rotatable piston, a combined rocking abutment and valve having two projecting edges either of which is adapted to contact with the periphery of said piston, a wing on said valve, a casing having two ports leading to opposite sides of said valve and controlled thereby and each of said ports having a branch passage opening against opposite sides of said wing and means for directing pressure into either of said ports and connecting the other one with the exhaust, substantially as set forth.

6. In a rotary engine the combination of a casing having a cylinder, a pressure-inlet and an exhaust, a throttle-valve chamber connected with said inlet and exhaust, an abutment valve-chamber, and two passages leading from opposite sides of the latter chamber to opposite sides of the former chamber, a throttle-valve in said first chamber having two ways, both of which are adapted to connect either one of said passages with said inlet and the other with said exhaust; a free, combined rocking abutment and valve located in said second valve-chamber and having two valve-cavities permanently connected with said passages, respectively, and adapted to alternately connect them with the cylinder as the abutment rocks; and a revolving piston, in said cylinder, with which said abutment engages, whereby the turning of the throttle-valve automatically changes the position of the abutment and reverses the engine through the intermediary of the steam-pressure, substantially as set forth.

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