No. 819,638. PATENTED MAY 1, 1906.

E. C. DUNCAN.

ROTARY ENGINE.

APPLICATION FILED AUG. 16, 1905.

2 SHEETS—SHEET 1.

Fig. 1.

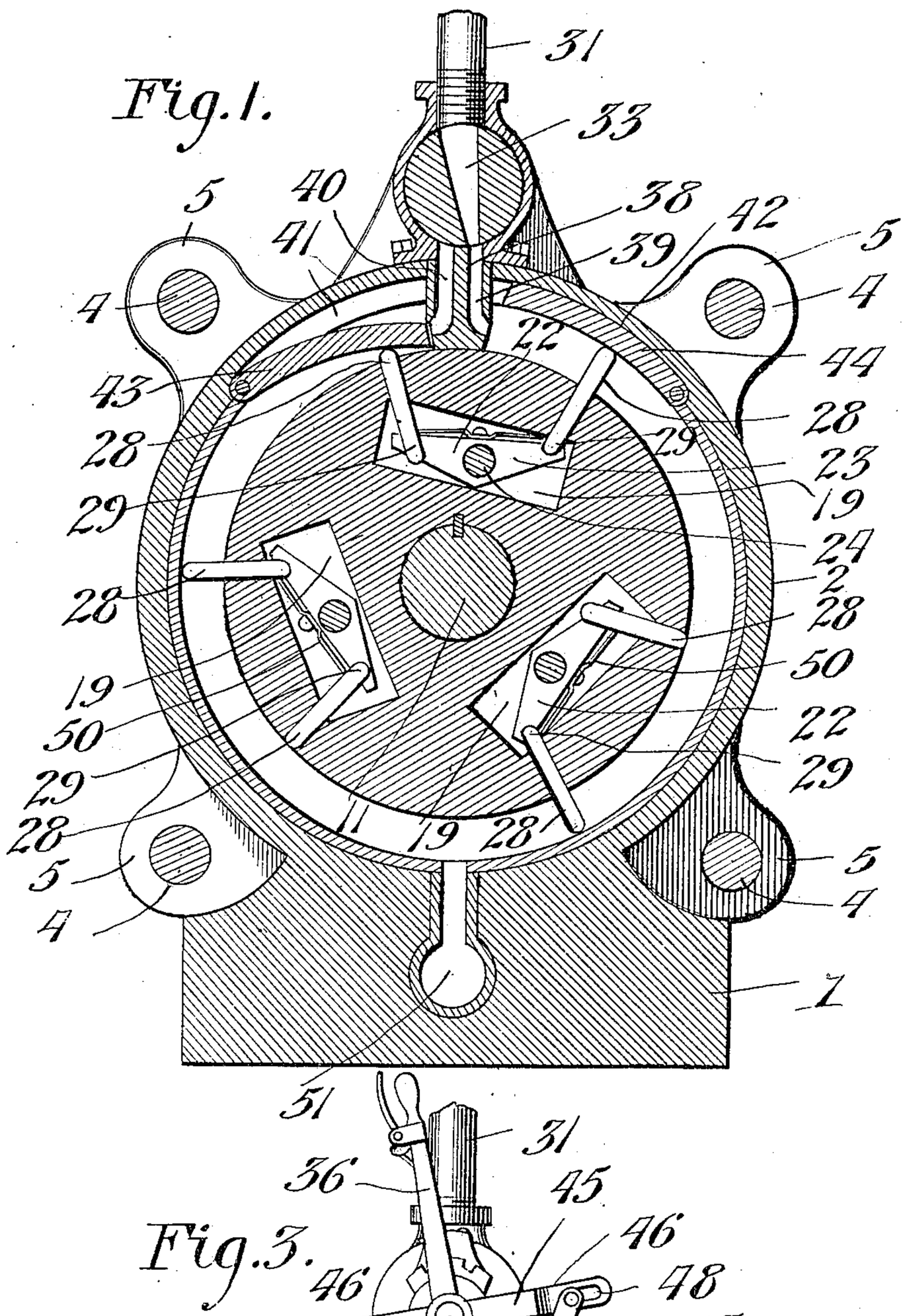
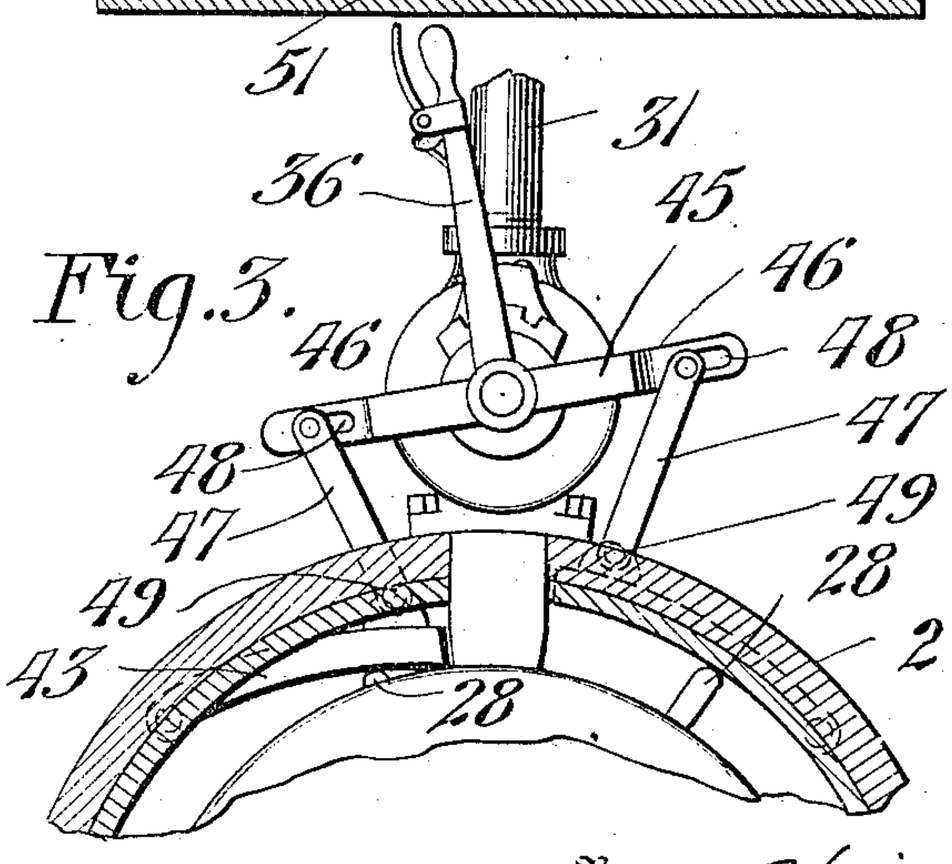


Fig. 3.



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2 SHEETS—SHEET 2.

Fig. 2.

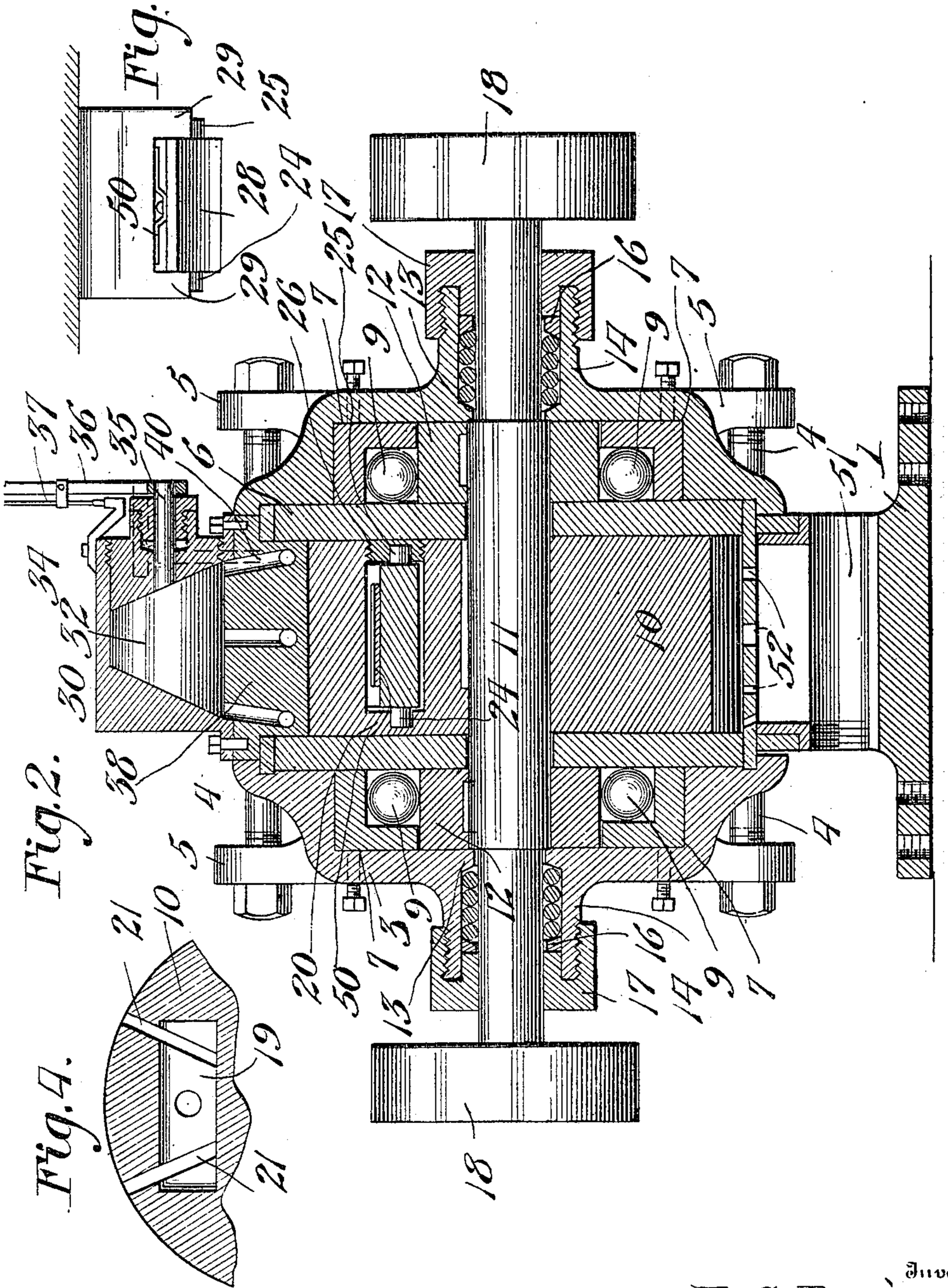

Fig. 4.

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ROTARY ENGINE.

No. 819,638. Specification of Letters Patent. Patented May 1, 1906.

Application filed August 16, 1905. Serial No. 274,453.

To all whom it may concern:

Be it known that I, EDWARD C. DUNCAN, a citizen of the United States of America, residing at Jamaica Plain, in the county of Suffolk and State of Massachusetts, have invented new and useful Improvements in Rotary Engines, of which the following is a specification.

The invention relates to an improvement in rotary engines designed, primarily, for the economic use of steam and for securing the maximum effect from the expansive force thereof.

The main object of the present invention is the provision of movable gates to be carried by the piston, said gates being arranged in connected pairs and automatically operated in reverse direction in the travel of the piston, whereby a simple and convenient means for reversing the engine is provided.

Another object is the provision of duplicate wings carried by the cylinder and adapted for simultaneous operation in the reverse direction, said wings being arranged to operate the piston-gates to insure a steam-tight connection between the ends of said gates and the cylinder-wall.

With these objects in view the invention consists in certain specific details of structure which will be clearly described in the following specification, reference being had to the accompanying drawings, in two sheets, in which—

Figure 1 is a longitudinal section through an engine constructed in accordance with my invention. Fig. 2 is a transverse section of the same. Fig. 3 is a broken elevation, partly in section, illustrating the means for operating the wings. Fig. 4 is a broken vertical section through the piston. Fig. 5 is an end elevation of a portion of the piston.

Referring to the drawings, my improved engine comprises a base 1, upon which is mounted a cylinder 2. The heads 3 are secured in place by tie-bolts 4, connecting ears 5, projecting from the respective heads. The heads are circumferentially recessed on the surfaces next the cylinder to receive disks 6 of a diameter to fit snugly within and close the cylinder ends, as clearly shown in Fig. 2. The heads are further recessed within the plane of the disk-recess, as at 7, to receive ball-cups 8, within which are mounted balls 9 to provide a ball-bearing for the main shaft.

The piston 10, of less diameter than the interior diameter of the cylinder, is supported upon the main shaft 11, which extends laterally of the cylinder in both directions, passing through openings in the closing-disks 6 and being provided immediately beyond said closing-disks with bearing-cones 12, keyed upon the shaft and designed to rest upon and be supported upon the balls 9 within the cups 8. In alinement with the outer surface of the cones the main shaft is reduced and projects through an opening 13, formed in the heads, each of the heads being formed with integral bearing-sleeves 14, concentric with the opening 13. The sleeves are circumferentially enlarged beyond the openings 13 to provide a packing-space in which is mounted the usual ring-packing 15, a gland-ring 16 bearing on the outer ring of the packing and being held in place by a nut 17, arranged for threaded engagement with the end of the sleeve. The main shaft projects through the nut 17, being provided therebeyond with belt-wheels 18, it being understood that the packing 15 may be adjusted as desired to operation of the nut 17.

The piston, which is preferably keyed upon the main shaft, is of less diameter than the interior diameter of the cylinder, thereby providing a steam-space between it and the cylinder. The piston is formed with a series of transversely-arranged recesses 19, preferably rectangular and slightly less in depth than the width of the piston to leave a rear wall 20 of the desirable thickness necessary to revolubly support the gate-operating platforms, to be later described. The piston is also formed with a series of radially-formed slots 21, extending wholly through the transverse width of the piston and terminating coincidently with the periphery thereof and with the inner side wall of the recesses 19, as clearly shown in Fig. 4. The slots 21 are comparatively narrow in cross-section and serve as guideways for the operation of the gates.

22 represents what I term the "operating-platforms," comprising blocks of suitable material which are plain on their operating-faces, the opposite faces being approximately triangular to provide for the necessary movement of the platforms. The platforms are movably supported within the recesses 19 through the medium of journals 23, projecting laterally from the side edges of the platforms and rearwardly supported in suitable bearings, one of the bearings comprising an

opening 24, formed in the rear wall 20 of the recesses, and the opposite bearing comprising an opening 25, formed in a screw-plug 26, which is centrally inserted in a plug 27, designed to fill the mouth of each recess 19 after insertion of the platform, it being understood that the plug is held within the walls of the recess by friction or other suitable means and that the threaded adjustment of the screw-plug 26 in the plug 27 provides for adjusting the bearing of the platforms 22 in an obvious manner.

The gates 28 comprise rectangular body-sections of suitable material arranged to fit snugly in the slots 21, the inner end of each of the gates being bifurcated to provide extensions 29, designed to embrace the ends of the platforms 22. As each recess 19 is in communication with two of the slots 21 and each of said slots is adapted to receive a gate, it will be noted that the single platform in each of the recesses 19 has operative connection with a pair of gates, it being understood that the slots 21 are so arranged with relation to the recess 19 and the platform 22 that the gates 28 contact with the platforms near the respective ends of the latter. The platforms owing to their pivotal mounting are thus converted into levers centrally fulcrumed and supporting a gate at each end.

The valve-chest 30 is mounted for communication with the cylinder, being supplied with a motive fluid, as steam, through a connection 31. The steam-chest, which is preferably cylindrical in section, is cored from one end to receive a cylindrical valve 32, having a transverse and triangular port 33 extending therethrough. The open end of the core within the valve-chest is closed by a plug 34, in which is revolubly supported the valve-stem 35, having direct connection with the valve 32. An operating-lever 36, having the usual ratchet and segment lock 37, is connected to the outer end of the valve-stem and arranged to operate and hold the valve in adjusted position.

A fixed abutment 38 depends within the casing, being preferably formed integral therewith. The free end of the abutment is designed to provide a practically steam-tight connection with the surface of the piston, as clearly shown in Fig. 1. The abutment is formed with a plurality of inlet-ports 39 and 40, each comprising three distinct ports arranged in alinement longitudinally of the abutment and communicating at their upper ends with the interior of the valve-chest and at their lower ends with the steam-space between the cylinder and piston. The ports 39 are formed in the abutment to one side of the longitudinal center thereof and constitute the inlet-ports in the direct operation of the engine, while the ports 40 are formed on the opposite side of the longitudinal center and constitute the inlet-ports in the reverse operation of the engine. By this arrangement the upper ends of each respective set of inlet-ports are spaced apart, and the lower opening of the port 33 in valve 32 is of a size to communicate with but one set of ports at a time, it being understood that the upper or inlet end of the port 33 is of such size and so positioned as to be in open communication with the steam-inlet 31 at all times.

Immediately adjacent the abutment 38 the cylinder 2 is recessed, as at 41 and 42, to provide housings for the gate-operating wings. The recesses 41 and 42 are located on opposite sides, respectively, of the abutment and are coextensive in width with the width of the piston— that is, they extend entirely across the cylinder between the closing-disks 6. In these recesses are mounted wings 43 and 44, respectively, each comprising plate-like sections of solid formation and having a curvature equal to the curvature of the cylinder. The wings are equal in thickness and width to the corresponding dimensions of the recesses, so that they practically fill the recesses when in normal position, the face of the wings thereby providing a surface exactly coincident in plane and in curvature with the interior surface of the cylinder to avoid projection.

The lever 36 is provided at its fulcrum end with a transversely-arranged arm 45, extending in both directions beyond the plane of the lever and having its free ends terminally bent to provide offset portions 46, the extent of the bending at this point being sufficient to arrange the free ends of the portions 46 in a plane above the wings 43 and 44. Rods 47 engage slotted openings 48 in the portions 46 of the arm and depend through the wall of the cylinder and are pivotally connected at 49 to the respective wings 43 and 44. By this construction operation of the lever 36 will elevate one of the wings described, seating the same snugly within its housing-recess, at the same time depressing the other wing until its free end, which is adjacent the abutment, contacts with the surface of the piston.

The wings 43 and 44 are pivotally mounted within the recesses 41 and 42, respectively, said pivotal connection being at the end of the wing remote from the abutment. The wings are of such length that when depressed, as hereinbefore described, their free ends will contact with the abutment at the mouth of the ports 39 or 40, closing said ports, as clearly shown in Fig. 1.

The platforms 23 and the relative arrangement of the slots 21 with relation to said platforms is such that the distance between the gates 28 when in place is considerably greater than the width of the abutment.

To insure positive movement of the platforms and to guard against lost motion, I provide each platform with a leaf-spring 50, secured centrally to the platform with spring-

terminals adapted to contact with the proximate side wall of the recess 19.

An exhaust-port 51 is formed in the base 1 of the engine, being in communication with the interior of the cylinder through a series of openings 52, formed in the cylinder-wall.

In operation, assuming the parts constructed and arranged as described and the valve-port 33 positioned to direct the steam through the inlet-ports 39, the operation is as follows: It is to be understood that the relative movement of the valve 32 and the wings is such that when the lever has been moved to establish communication between the steam-inlet 31 and one set of ports 39 or 40 the wing coöperating with the opposite set of ports is lowered into contact with the piston. The steam passing through the port 39 will be admitted to the steam-space between the cylinder and piston, its expansive force operating between the abutment and the gate 38, immediately forward of said abutment. This gate, as will be noted in Fig. 1, has been projected to contact its free ends with the wall of the cylinder, providing a fixed partition carried by the piston and extending transversely of the steam-space in the cylinder, so that the expansive force of the steam compels a revolution of the piston. As each successive gate or pair of gates moves toward the fixed abutment, the gate elevated, which of course is that gate of the pair in advance in the direction of movement of the piston, will contact with the lowered wing, the surface of which operates to force said projected gate within the body of the piston and project the second gate of the pair by rocking the platform on its pivotal support in an obvious manner. As the distance between the gates of each respective pair is greater than the length of the wings, the gate depressed in traveling beneath the lowered wings will move beneath and beyond the abutment before the second gate of the pair, which of course is projected, rides beneath the wing. As this second gate, however, rides beneath the wing it is depressed in its turn, projecting the first gate of the pair outward into contact with the cylinder; but as this first gate has passed the abutment it provides the partition necessary to utilize the expansive force of the steam admitted through the inlet-ports 39. In reversing the engine the port 33 is positioned to admit steam through the ports 40, this operation of the lever 36 returning the wing 43 to closed position and forcing the wing 44 to open position. The steam now acts against the other gate of the pair in the reverse movement of the piston, as will be evident. As the projected gates pass the exhaust-openings the steam behind them finds its way through the exhaust-port.

It will be noted that the operative gate 28 is projected into operative position immediately beyond the abutment in the direction of movement of the piston, whereby the full expansive force of the steam is utilized against said gate.

The various parts of the engine are of course to be packed in any desired manner, as such details form no material part of the present invention.

Having thus described the invention, what I claim is—

1. A rotary engine including a piston provided with a plurality of gates arranged in pairs, the gates of each pair moving in reverse direction in operation, and manually-controlled means carried by the engine for operating said gates.

2. A rotary engine including a piston provided with a plurality of gates arranged in pairs, and means carried by the piston for supporting each pair of gates to cause reverse operation of the respective gates, and manually-controlled means carried by the engine for operating said gates.

3. A rotary engine including a piston provided with a plurality of gates arranged in pairs, and a platform pivotally supported within the piston and connected with the gate, and manually-controlled means carried by the engine for operating said gates.

4. A rotary engine including a piston provided with a plurality of gates arranged in pairs, and a platform pivotally supported within the piston and connected with the gates, said gates being arranged on opposite sides of the platform-pivot, and manually-controlled means carried by the engine for operating said gates.

5. A rotary engine including a piston provided with a plurality of recesses, platforms pivotally supported within the recesses, and gates supported by the platforms and movable radially through the piston, and manually-controlled means carried by the engine for operating said gates.

6. A rotary engine comprising a cylinder, a piston arranged therein, gates carried by the piston and arranged and operated in pairs, and manually-operable means supported by the cylinder to successively operate each gate of the pair.

7. A rotary engine comprising a cylinder, a piston arranged therein, gates carried by the piston and arranged in pairs, and manually-operable means carried by the cylinder to operate said gates, the movement of one gate in one direction causing a reverse movement of the other gate of the pair.

8. A rotary engine comprising a cylinder, a piston arranged therein, gates arranged in pairs, said gates being movably supported by the piston, and manually-operable wings supported by the cylinder and adapted to operate both gates of a pair in the revolution of the piston, said gates moving in reverse direction in operation.

9. A rotary engine comprising a cylinder,

a concentric piston arranged therein, gates arranged in pairs and movably supported by the piston, wings pivotally supported by the cylinder, an abutment carried by the cylinder and contacting with the piston, said wings being arranged on opposite sides of the abutment and adapted to operate the gates in the revolution of the piston, and means for operating said wings.

10. A rotary engine comprising a cylinder, a concentric piston arranged therein, gates arranged in pairs and movably supported by the piston, wings pivotally supported by the cylinder, an abutment carried by the cylinder and contacting with the piston, said wings being arranged on opposite sides of the abutment and adapted to operate the gates in the revolution of the piston, and means for operating said wings in reverse directions.

11. A rotary engine comprising a cylinder, a concentric piston arranged therein, an abutment projecting from the cylinder and contacting with the piston, said abutment being formed with a plurality of ports, gates carried by the piston, wings pivotally connected to the cylinder on opposite sides of the abutment, an inlet-valve arranged for communication with the ports in the abutment, and means for adjusting said valve and simultaneously operating the wings.

12. A rotary engine comprising a cylinder, a concentric piston arranged therein, an abutment projecting from the cylinder and contacting with the piston, said abutment being formed with a plurality of ports, gates carried by the piston, wings pivotally connected to the cylinder on opposite sides of the abutment, an inlet-valve arranged for communication with the ports in the abutment, and means for adjusting said valve and simultaneously operating the wings in reverse directions.

13. A rotary engine comprising a cylinder, a concentric piston arranged therein, an abutment projecting from the cylinder and contacting with the piston, said abutment being formed with a plurality of ports, gates carried by the piston, wings pivotally connected to the cylinder on opposite sides of the abutment, an inlet-valve arranged for communication with the ports in the abutment, a lever connected to the valve, and an arm connected to the lever and projecting in opposite directions therefrom, the terminals of said arm being respectively connected to the wings.

14. A rotary engine comprising a cylinder open at the ends, heads connected to each other and closing the ends of the cylinder, disks abutting against the ends of the cylinder and fitting within recesses formed in the heads, ball-containing cups seated in recesses in the heads beyond the disks, a shaft revolubly supported by the heads, and bearing-cones keyed on said shaft and bearing on the balls in the cups.

In testimony whereof I affix my signature in presence of two witnesses.

EDWARD C. DUNCAN.

Witnesses:

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