No. 828,712. PATENTED AUG. 14, 1906

H. I. CALL.

ROTARY ENGINE.

APPLICATION FILED JULY 19, 1905.

2 SHEETS—SHEET 1.

Fig. 1.

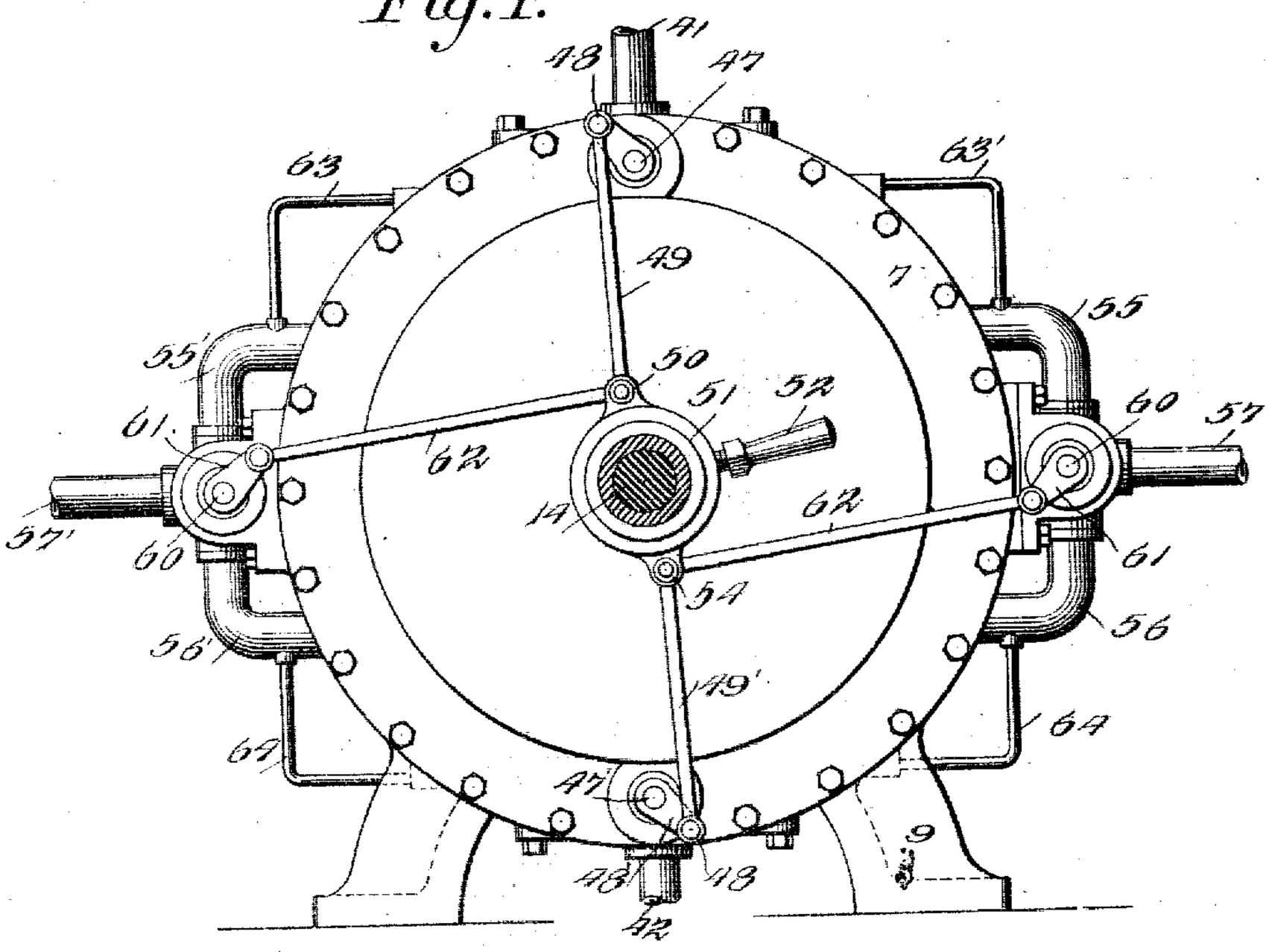
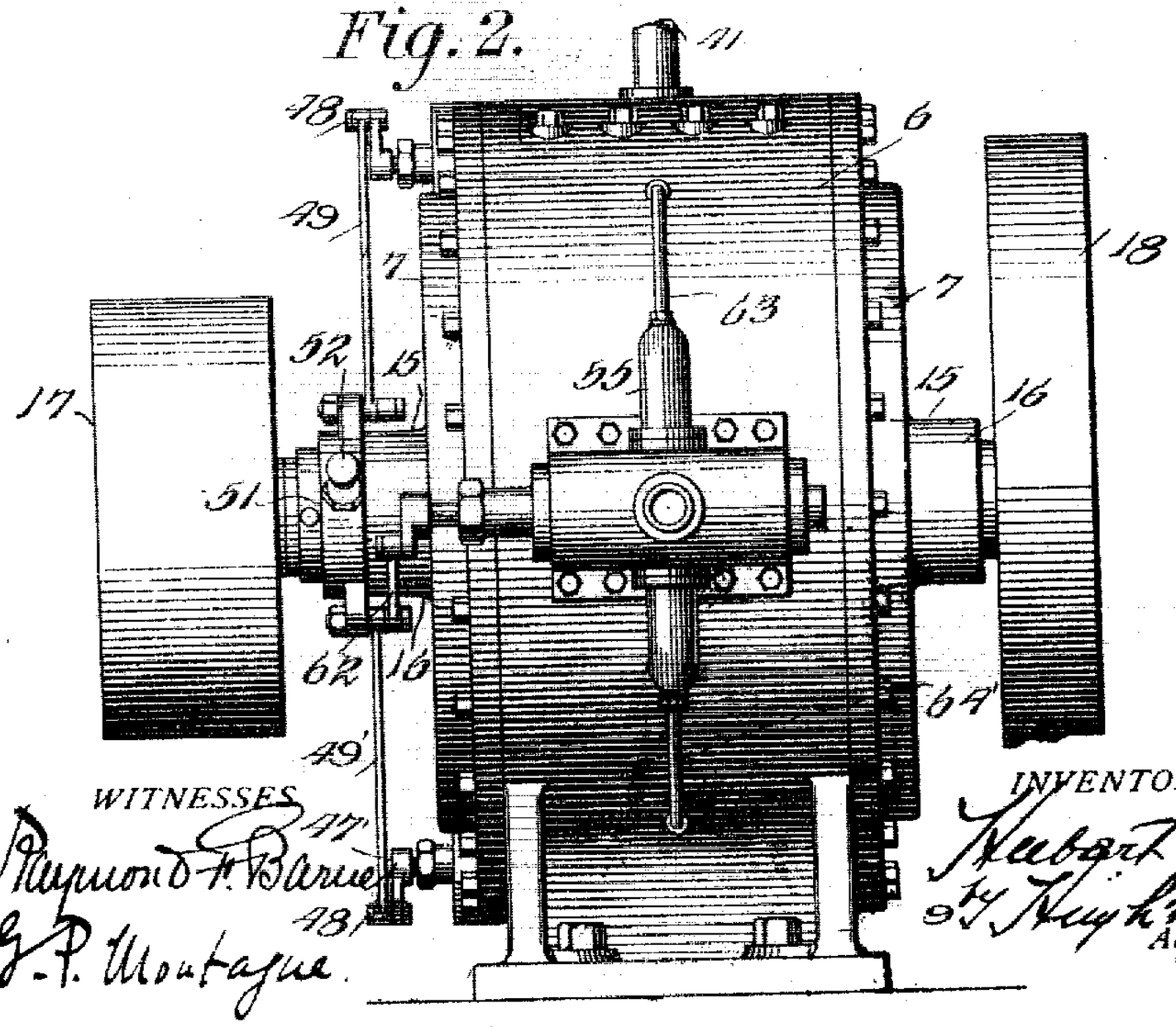


Fig. 2.



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2 SHEETS—SHEET 2.

Fig. 3.

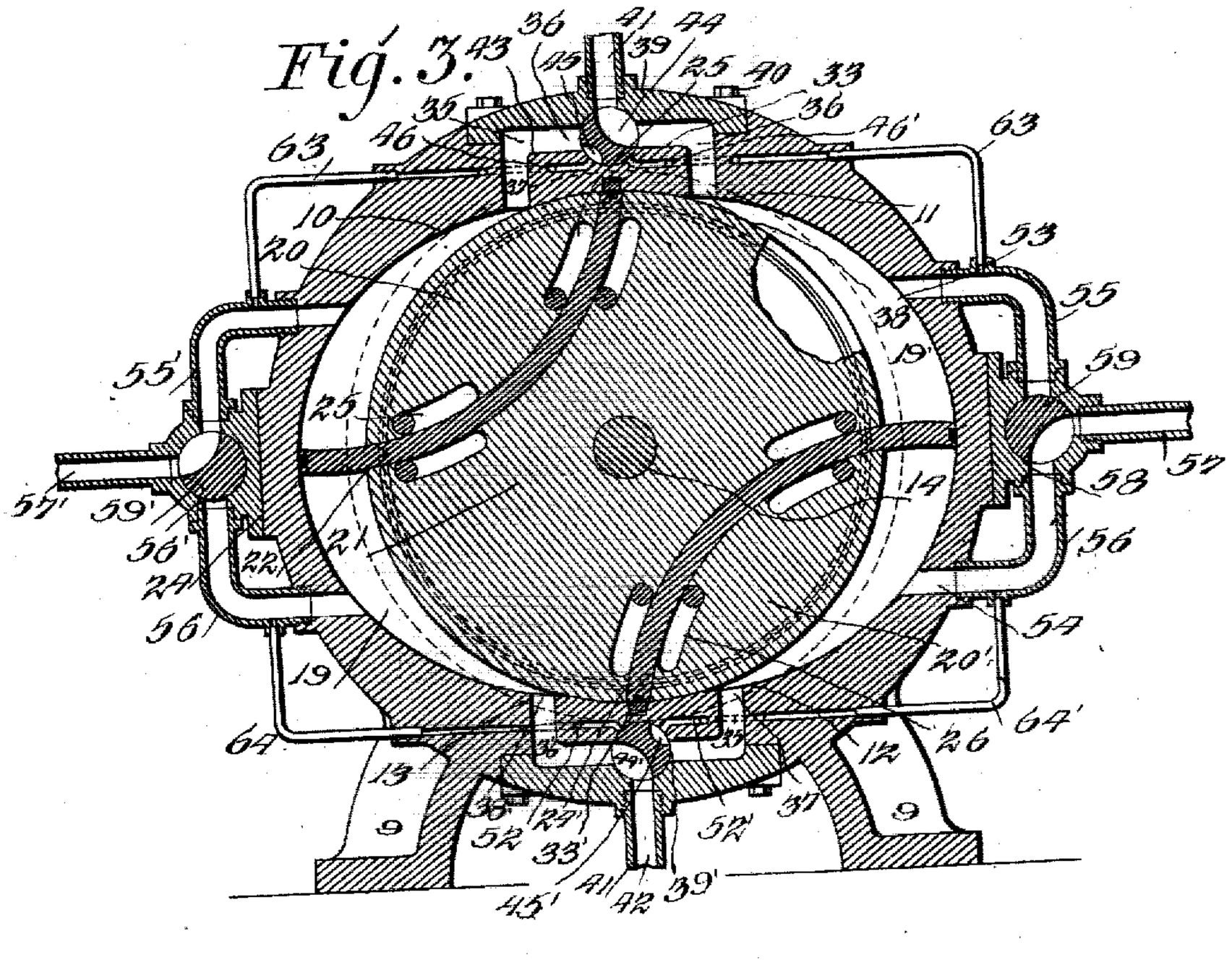


Fig. 4.

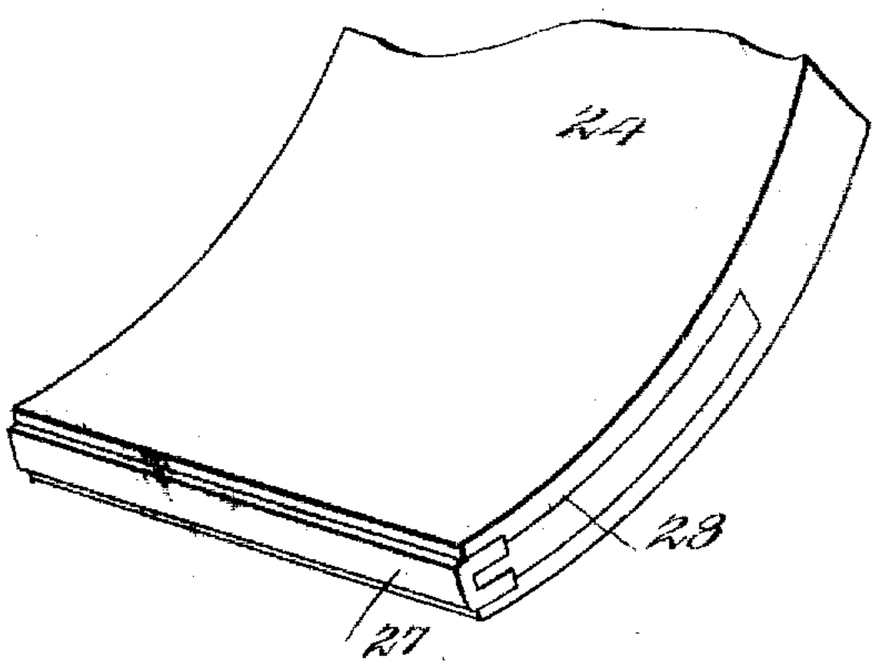
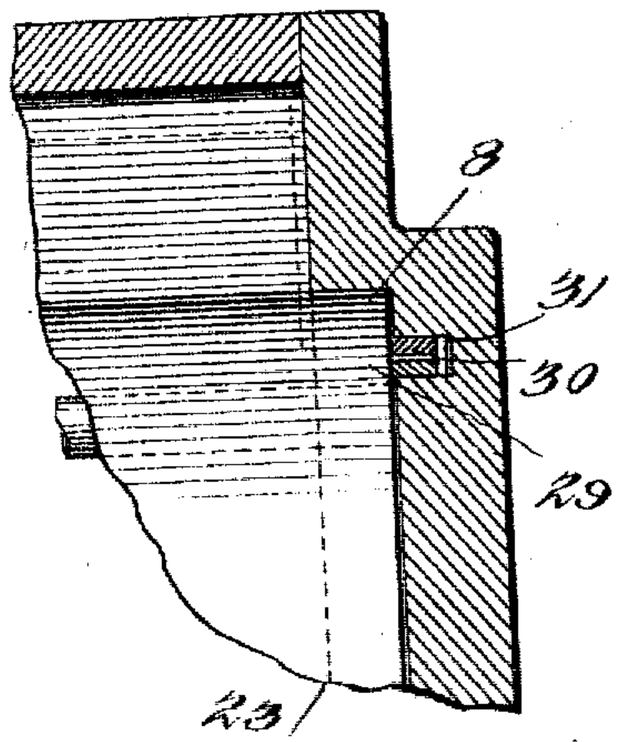


Fig. 5.



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ROTARY ENGINE.

No. 828,712. Specification of Letters Patent. Patented Aug. 14, 1906.

Application filed July 19, 1905. Serial No. 270,396.

To all whom it may concern:

Be it known that I, HUBERT I. CALL, a citizen of the United States, residing at Spokane, in the county of Spokane and State of Washington, have invented new and useful Improvements in Rotary Engines, of which the following is a specification.

The object of my invention is to provide a rotary engine of a type that employs a principle of working the steam expansively with economy and in which the steam enters the cylinder on both sides at the same time and from points opposite each other, the steam issuing from one of the inlets passing upwardly, while that entering from the opposite inlet passing downwardly, thereby imparting by an opposite cycle flow a continuous rotary motion to the rotary drum and shaft with the exertion of equal leverage and double power and in a manner to obtain a dynamic and mechanical balance that eliminates the friction and strains occasioned by taking of steam on one side only.

A further object of my invention is to provide a rotary engine of the above-mentioned type which increases its power and diminishes friction and vibration by avoiding dead-centers.

Another object of my invention is to provide an engine of a rotary type which is capable of having its motion reversed in direction by means of a reversible valve control that is simple in construction and arrangement.

A still further object of my invention is to provide, in addition to the primary exhaust-openings, supplementary or auxiliary exhaust connections arranged in such relation to the primary exhaust-opening and the steam-space as to obtain a continuous exhaust, and thereby more effectually prevent any back pressure.

A still further object of my invention is to provide a method and means of forming steam-tight joints with the least possible friction.

My invention consists, primarily, of a cylindrical piston or rotary drum mounted on a shaft, the same being arranged concentrically within and inclosed by a fixed cylinder having a cross-section of unequal diameter to provide, in conjunction with the steam stops or abutments therein, two oppositely-disposed equal, semilunular steam-spaces between the said drum and cylinder, said cylinder having peripheral steam admission and exhaust passages or ports and said drum having between its opposite segmental portions and its axis two crescentic piston-blade grooves, into which like linearly-curved sliding piston blades or vanes are so fitted that when the drum is rotated the respective ends of the respective sliding blades will be alternately projected inwardly and outwardly under the control of the cylinder-walls with which they are in contact at each end, thereby forming steam-tight partitions that move rotatably in the steam-spaces referred to to form variable steam receiving and discharging spaces therein in which the pressure of steam is exerted on one side and exhausted on the other of the blades to give a continuous rotary motion to the rotary piston and its shaft, while the said blades present effective pistonaries that are limited only by their width, projection, and the sectional area of the steam-spaces through which they travel during each half-revolution.

The invention further consists in providing for the peripheral admission of steam through oppositely-disposed opposing ports in the fixed cylinder, each of which are arranged in open relation, respectively, with its adjacent steam-space for division to cause a circulation of steam in the same direction as the sliding piston-blade revolves past the steam admission ports and the provision for the exhaust of steam from the respective steam-spaces or division by oppositely-disposed outlet-ports positioned at a point intermediate of the steam-admission ports when the sliding piston-blades revolve past the said exhaust-ports.

The invention further consists in providing two sets of admission-ports that connect, respectively, at the upper and lower portions of the cylinder with the adjacent ends of the steam-spaces, each set being governed by a common valve, and means for connecting the said valve, whereby they may be simultaneously actuated to establish or cut off communication of the opposing ports of each set with the opposite steam-space of the cylinder to obtain a reversal of motion of the piston in either desired direction or the stoppage of the same, and the further provision and connec-

tion with the respective steam-spaces for the exhaust of steam therefrom at a point intermediate of said admission-ports, the same comprising the disposition of two sets of exhaust-ports arranged at diametrically opposite points in the periphery of the cylinder, each set being governed by a common valve that is operatively connected to the first-mentioned valve-connecting means.

The invention further consists in providing an auxiliary exhaust connection between the dead admission-passage of each set of steam-admission passages and the active exhaust-passages of each set thereof, which connection is under the control of the governing-valve of the adjacent steam-admission ports.

The invention also consists in certain other novel features in the construction and arrangement of parts, all as hereinafter described, and specifically set forth in the appended claims.

Referring to the accompanying drawings, which form a part of this specification, Figures 1 and 2 represent, respectively, an end and a longitudinal elevation of a complete engine constructed in accordance with the invention. Fig. 3 shows a sectional side elevation of the engine. Fig. 4 is an enlarged view of a fragmentary end portion of one of the sliding piston-blades employed in the engine. Fig. 5 is a fragmentary sectional view of the upper end portion of the cylinder with its attached head.

Like characters indicate corresponding parts in the several figures.

In order to carry out the several features of the invention and to furnish a means for the conversion of the motive power, there is provided a short thick cylinder 6, that is inclosed at each end by a head 7, having on its inner face a centrally-arranged annular recess 8, the said cylinder being mounted at a suitable height upon the standards or pedestals 9.

The interior of the cylinder is elliptical in cross-section, the minor arcs thereof at the top and bottom portions being composed of eighty-degree curves, while the respective longitudinally-extending interior side walls thereof are extended from the points 10, 11, 12, and 13 in parabolic curves, as shown in Fig. 3, to form the major arcs of the ellipsis.

14 represents the axially-arranged longitudinally-extending shaft, which is rotatably mounted in large journal-bearings 15, that are in turn supported within the hollow trunnions 16, that project axially from the respective heads 7 of the cylinder.

The shaft 14 extends outwardly beyond the respective cylinder-heads and their projecting trunnions a sufficient distance to provide for the mounting and support of a pulley 17 at one end and a fly-wheel 18 at its opposite end.

Mounted concentrically within the fixed cylinder upon the shaft 14 is a rotary piston 18, that comprises a drum-like structure having a closed periphery and that is slightly less in diameter than the smaller diameter of the bore of the cylinder and which extends from end to end of said cylinder and presents end projections in a close-spaced relation within the respective centrally-arranged annular recesses 8, formed on the inner faces of the head 7—a construction and arrangement that serves the twofold purpose of providing a steam-abutment and a structural extension of the drum that admits of the formation of the peculiar-shaped slots therein in a manner to be hereinafter referred to and described.

The rotary drum, thus mounted within a cylinder having a bore of the elliptical cross-section described, provides between the periphery of said drum and the interior walls of said cylinder oppositely-disposed equal-sized crescent-shaped steam spaces or divisions 19 and 19′, that are separated by steam-abutment formed by the contour and the close-spaced relationship of the upper and lower inner walls of the cylinder and the revolving-drum periphery, and the resilient bearing projections extending from the walls of the cylinder in vertical alinement, that contact with said periphery, as shown at X, form a dividing-line between said steam-spaces.

The rotary piston thus constructed and mounted is provided within the confines of its periphery between its opposite segmental portions 20 and 20′ and the central portion 21 with curvilinear piston-blade-receiving slots 22, which extend crescent-like between their peripheral terminations.

In order that the formation of the slots 22 within the rotary drum may not destroy or weaken the structural union of the segmental portions 20 and 20′ with its central portion 21, the said slots 22 are not extended longitudinally to the full length of the drum, but terminate at a point indicated by dotted line 23 in Fig. 5, near the respective ends of the rotary drum.

Within the slots 22 thus formed are mounted for veiled reciprocation two similar coöperating sliding piston blades or vanes 24 and 24′, that are each longitudinally curved to form with the curvilinear planes presented by the said slots 22 and that are each of a length to project their ends beyond the peripheral slot terminations into contact in all positions with the inner peripheral wall of the cylinder as they are rotated, thereby forming at four equidistant points on the periphery of the drum a movable peripheral portion the reciprocal movements of which are obtained by the peripheral contact of their respective ends, which by a self-contained cam-like motion alternately projects the heads of each inwardly and outwardly in the direction of the radii of said rotary drum and in radial alinement with the opposite end of the oppo-

site reciprocating piston-blade, thereby forming movable steam-abutments that conform themselves to the irregular path of travel and present effective balanced pistonaries.

It is important that the movements of the sliding piston-blades shall be as far as possible free from frictional hindrance in their contact with the curvilinear faces of the slots 22, and to this end there is provided pairs of roller-bearings 25 and 25′, that are disposed, as shown, in recesses 26.

As the ends of the piston-blades 24 and 24′ are always in sliding contact with the inner walls of the cylinder, and therefore subject to friction and wear, and as it is important to minimize leakage at the points where the steam receiving and discharging spaces are separated by the sliding piston-blades—*i. e.*, at the points of contact of said blades with the walls of the cylinder—there is provided packing-strips 27, that are adapted to fit and fasten themselves within a routed cavity 28, formed in the end portion of the respective blades, as shown in Fig. 4, the outer projecting ends of said strip being scarfed to form a knife-edge contact to obtain a steam-tight joint with a minimum of friction. In order to hold the ends of the rotary drum in steam-tight yielding contact with the head 7 of the cylinder, there are provided the respective ends of the rotary drum with annular grooves 29, within which are fitted and fastened resilient wear-resisting gaskets 30, that project into the annular channel 31, formed on the inner face of the head 7, and that adapt themselves to yieldingly contact with the walls thereof in three planes.

32 and 32′ designate resilient packing-strips that are seated in the channel or recesses 33 and 33′, located, respectively, with the upper and lower inner peripheral wall portions of the cylinder, as shown.

To furnish a means by which the steam may be supplied to the operating steam-spaces 19 and 19′, there is provided in the upper portions of the cylinder casing or walls a steam-admission passage 34, having branches 35 and 36, that terminate interiorly in ports 37 and 38, each of which is arranged in open relation to the adjacent end of the steam space or division with which it is intended to establish communication. The passages thus formed are covered by the centrally-apertured plate 39, which is removably secured to the cylinder by screw-bolts 40.

41 designates a steam-supply pipe that is connected with the apertured plate 39 in a manner to establish communication with the passages 35 and 36.

42 designates a segmental-shaped valve that is shown as being mounted in a tubular seat formed, respectively, by the concave abutments in the removable plate 39 and the portion 43 of the cylinder-casing, the said valve being located at the junction formed by the eduction end of the supply-pipe 41 and the branches 35 and 36 of the passage 34.

In the peripheral surface of the valve-plug is an admission-cavity or passage-way 44, that is concavo in cross-section. On the opposite side of the cavity 44 is arranged a smaller auxiliary exhaust-cavity 45, which is adapted to alternately connect the inactive admission branches, respectively, with the exhaust-cavities 46 46′, formed in the walls of the cylinder.

The valve 42 is provided with a stem 47, on the outer end of which is secured a bell-crank arm 48, which in turn is pivotally connected at its outer end with a rod 49, leading to and pivotally connecting with an ear or lug projection that extends from the wrist-plate or sleeve 51, rotatably mounted on the trunnion 16. The valve 42 is capable of a limited oscillation by the movement of the operating lever or handle 52, which projects from the sleeve 51, and when the valve is turned to the position shown in Fig. 3 the steam will enter through the branch passage 36 and from thence pass through port 38 to the steam-space 19′, while if the valve is rocked to the opposite position the direction of flow of the steam will be through the branch 35, port 37, and from thence into the steam-space 19.

In the lower thickened wall portions of the cylinder there is provided a like system of admission of passages and ports, indicated in the drawings, Fig. 3, as 34′, 35′, 36′, and 37′ and 38′, the latter being covered by a light removable plate 39′ and connected by a steam-supply pipe 41′ and having a light controlling-valve 42′, that is operatively connected, through its stem 47′, bell-crank arm 48′, rod 49′, to the sleeve or wrist-plate 51, whereby the said valve may be simultaneously actuated with its companion valve 42 to coact alternately with the branches 35′ and 37′ for introducing and cutting off steam thereto, but which valve is shown in Fig. 3 as being so set as to provide for an opposing cycle of flow—*i. e.*, through the passages 36′ and 38′ into the opposite steam-space. The valve 42 is likewise provided with an exhaust-cavity 45′, that is adapted to coact alternately with the exhaust-cavities 52 and 52′ and the corresponding inactive steam and admission branches.

To furnish a means by which the steam may be exhausted from the steam-spaces, there is provided exhaust-ports 53 54 in the side walls of the cylinder to the right, to which are connected, respectively, branch pipes 55 and 56, that are joined by a common exhaust-pipe 57. Arranged within the valve-seat 58, formed at the junction of the branches 55 and 56 with the pipe 57, is a segmental-shaped valve 59, that governs the control of said exhaust-passages and which,

as shown in Fig. 3, is positioned to establish communication between the common exhaust-pipe 57 and the branch 56.

Arranged on the opposite side of the cylinder is a like system of exhaust ports and passages and indicated as 53′, 54′, 55′, and 56′, that are governed by the valve 59, the latter being shown in a position to establish an exhaust connection with the branch 51.

The valves 59 and 59′ are likewise connected by their stems 60, bell-crank arms 61, and rods 62 to the ears 50 of the wrist-plate or sleeve 51.

The exhaust branch pipes 63 63′ and 64 64′ connect, respectively, with the cavities 46 46′ and 52 52′ at one end and to the exhaust-pipes 55 55′ and 56 56′ at their opposite ends to provide an auxiliary exhaust system. These auxiliary exhaust connections constitute a feature of special importance in an engine of this type, where it is necessary to obtain a quick and complete exhaustion.

Having thus described the invention, what I claim is—

1. In a rotary engine, a cylinder having a cross-section of unequal diameter, a rotary piston concentric within said cylinder to provide oppositely-disposed equal steam-spaces between the piston and cylinder, peripheral steam-admission and steam-exhaust ports for said steam-spaces, and slidable piston-blades extending through said rotary piston and adapted to be maintained in contact at their ends with the cylinder-wall, substantially as described.

2. In a rotary engine, a cylinder having a cross-section of unequal diameter, a rotary piston concentrically mounted within the same to provide two oppositely-disposed, equal steam-spaces between the piston and cylinder, said cylinder being provided with two oppositely-disposed steam-admission ports, one for each steam-space, and two oppositely-disposed exhaust-ports, one for each steam-space, and slidable piston-blades extending through said rotary piston and arranged to have their ends normally in contact with the walls of the cylinder, substantially as described.

3. In a rotary engine, a cylinder having a cross-section of unequal diameter, a rotary piston concentric within said cylinder to provide two oppositely-disposed equal steam-spaces between the piston-cylinder, slidable piston-blades extending through the rotary piston and adapted to have their ends in operative contact with the wall of the cylinder, said cylinder being provided with two sets of oppositely-disposed steam-admission ports, and two sets of oppositely-disposed exhaust-ports, the admission and exhaust ports of each set communicating with its respective steam-space, and means for controlling the said ports to render one or the other of the set inactive, substantially as described.

4. In a rotary engine, a fixed cylinder having oppositely-disposed steam-spaces, a rotary piston mounted concentrically therein, movable piston-blades, steam-admission ports arranged in the periphery of the cylinder in two opposing sets, those of one set connect each with the end of the adjacent steam-space, exhaust-ports arranged in sets intermediate the steam-admission ports, regulating-valves disposed respectively in said steam admission and discharge ports, auxiliary exhaust connections between the said discharge-ports and each of the steam-admission openings, and means for simultaneously operating said valves whereby one of each set of said admission-ports can be alternately placed in operative sequence with one of the discharge-ports, and the dead admission-ports of each set can be placed in operative connection with one of the active discharge-openings, substantially as described.

5. In a rotary engine, a cylinder, a rotary piston therein adapted to provide two oppositely-disposed steam-spaces between the piston and cylinder, and piston-blades adapted to contact with the wall of the cylinder, said cylinder being provided with two sets of admission and exhaust ports for each steam-space, adapted for alternate operation, said exhaust-ports of each steam-space having a valve adapted to alternately open and close the same, and a secondary exhaust-port for each primary exhaust-port arranged in successive relation thereto and in communication therewith, substantially as described.

6. In a rotary engine, a cylinder having a cross-section of unequal diameter, a rotary piston concentric within said cylinder to provide two oppositely-disposed, equal steam-spaces between the piston and cylinder, slidable piston-blades extending through said piston and adapted to have their ends in operative contact with the walls of the cylinder, said cylinder being provided with steam-admission and steam-exhaust ports for said steam-spaces, and a secondary exhaust-port for each steam-space, adapted to remain open after the primary exhaust has been cut off by one of the piston-blades, substantially as described.

7. In a rotary engine, a cylinder having a cross-section of unequal diameter, a rotary piston concentric within said cylinder to provide two oppositely-disposed, equal steam-spaces between the piston and cylinder, slidable piston-blades extending through said piston and adapted to be in operative contact at their ends with the cylinder-wall, said cylinder being provided with two sets of admission and exhaust ports for each steam-space, valves for controlling said port, and a secondary exhaust-port communicating with each admission-port and controlled by the valves thereof, substantially as described.

8. In a rotary engine, a cylinder having a

cross-section of unequal diameter, a rotary piston concentric within said cylinder to provide two oppositely-disposed equal steam-spaces between the piston and cylinder, slidable piston-blades extending through said piston and adapted to be in operative contact at their ends with the cylinder-wall, said cylinder being provided with two sets of admission and exhaust ports for each steam-space, a valve for each pair of steam-ports connecting opposite steam-spaces and adapted to alternately control the same, and means for controlling said valve to simultaneously throw one set of ports in and the other out of operation, substantially as described.

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

HUBERT I. CALL.

Witnesses:
JNO. A. PIERCE,
J. E. GRIFFITH.