No. 737,853. PATENTED SEPT. 1, 1903.

P. R. MATTOCKS & J. L. GRAFFLIN.

ROTARY ENGINE.

APPLICATION FILED NOV. 17, 1902. RENEWED AUG. 6, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

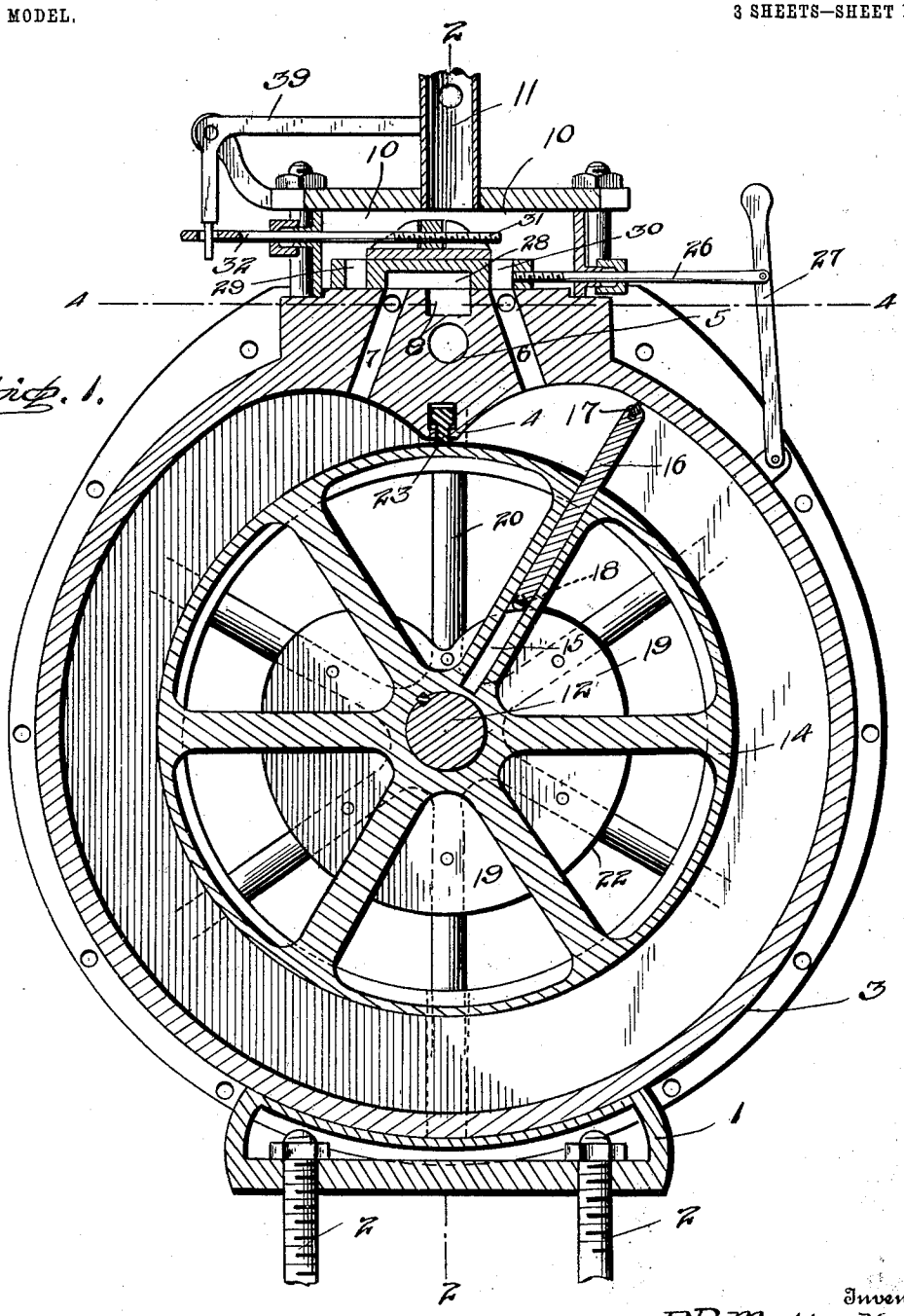

Fig. 1.

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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 4.

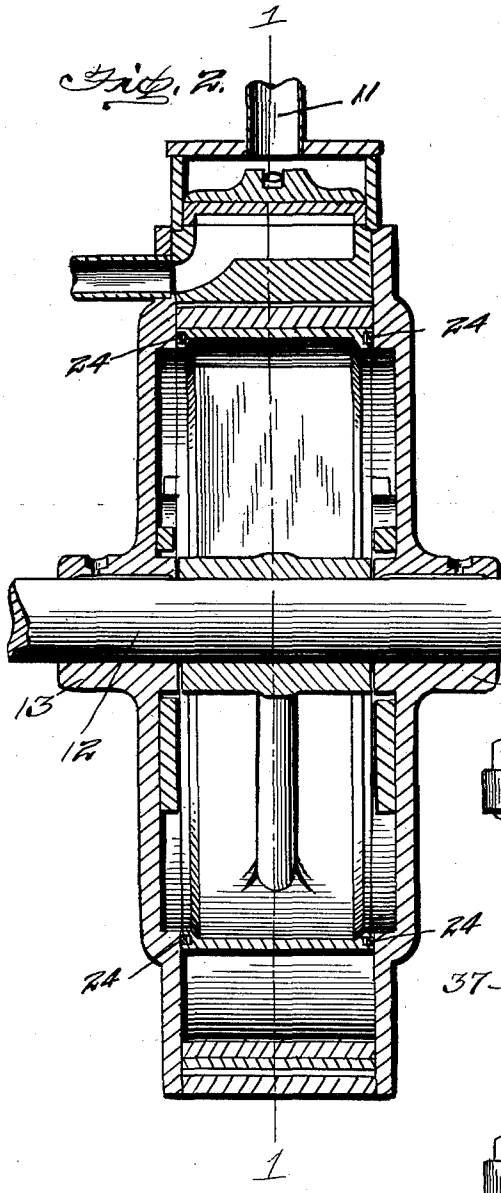
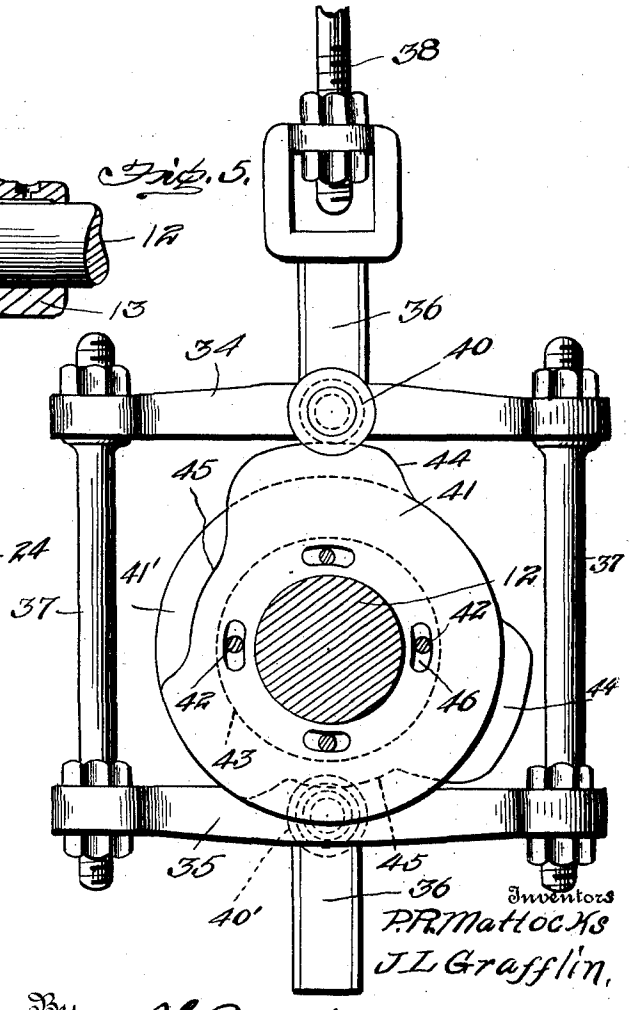


Fig. 5.



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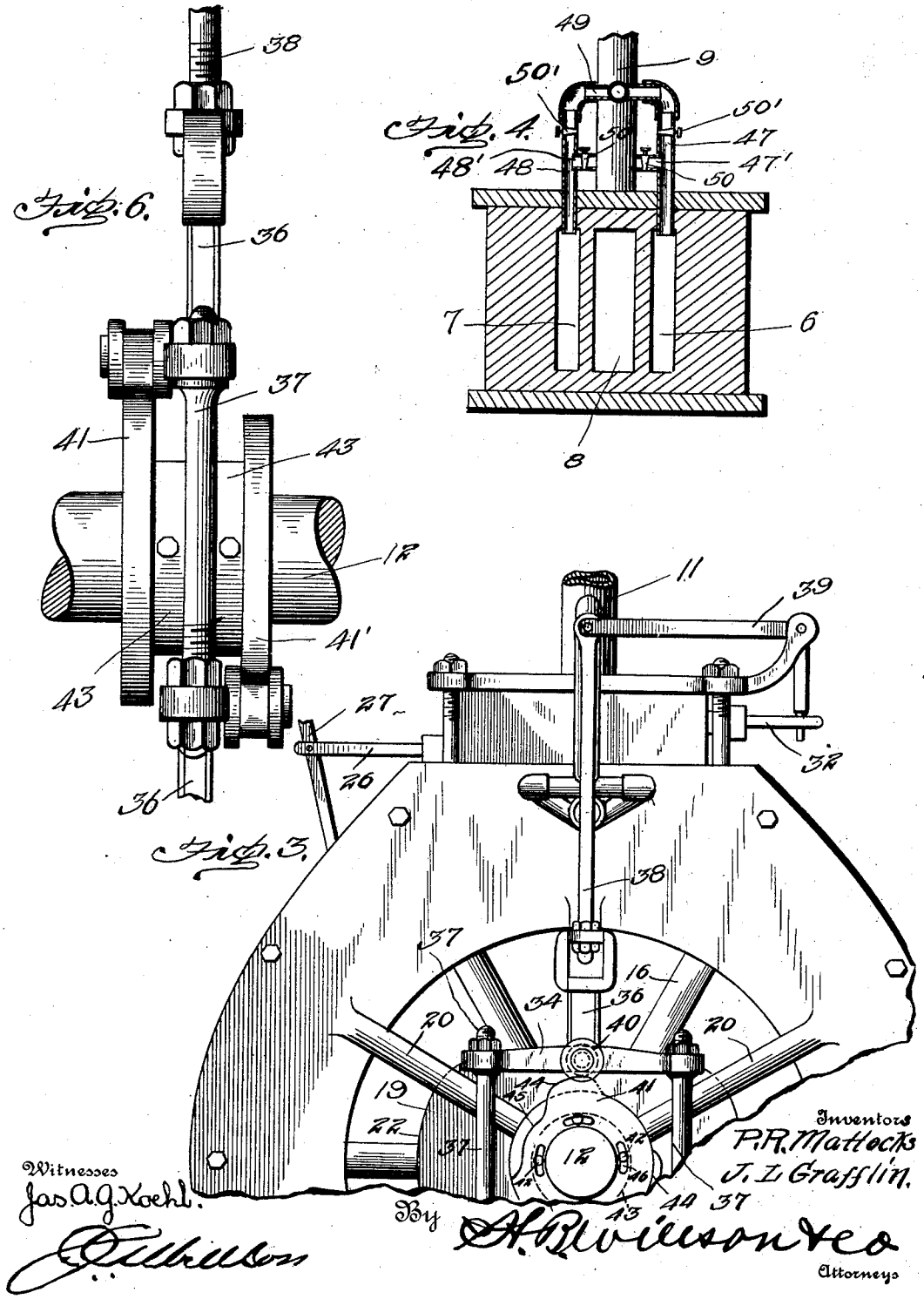
NO MODEL. 3 SHEETS—SHEET 3.



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No. 737,853. Patented September 1, 1903.

UNITED STATES PATENT OFFICE.

PAUL R. MATTOCKS, OF HIGHPOINT, AND JOHN L. GRAFFLIN, OF WILMINGTON, NORTH CAROLINA.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 737,853, dated September 1, 1903.

Application filed November 17, 1902. Renewed August 6, 1903. Serial No. 168,545. (No model.)

To all whom it may concern:

Be it known that we, PAUL R. MATTOCKS, residing at Highpoint, Guilford county, and JOHN L. GRAFFLIN, residing at Wilmington, in the county of New Hanover, State of North Carolina, citizens of the United States, have invented certain new and useful Improvements in Rotary Engines; and we do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to improvements in rotary steam-engines; and its object is to provide a rotary engine which is simple of construction, efficient in use, comparatively inexpensive of production, and adapted to employ steam expansively, and, further, to provide an engine in which the valve mechanism may be quickly changed to adapt the engine to be run only in one direction or to be made reversible at will.

A still further object of the invention is to provide means for starting the engine at any point of position of the piston-wing and for effecting a quick supply of steam to obtain a more efficient action of the same on the piston.

With these and other objects in view the invention consists in certain features of construction and combination of parts, which will be hereinafter fully set forth.

In the accompanying drawings, Figure 1 is a central section through the engine on a line at right angles to the engine-shaft, the plane of section being indicated by the line 1 1 of Fig. 2. Fig. 2 is a section on line 2 2 of Fig. 1. Fig. 3 is a fragmentary side elevation showing the arrangement of the steam supply and exhaust pipes. Fig. 4 is a horizontal section on line 4 4 of Fig. 1. Fig. 5 is a side elevation of the controlling mechanism of the slide-valve. Fig. 6 is an end elevation of the same.

Referring now more particularly to the drawings, the numeral 1 represents the engine-base, which is adapted to be secured to a suitable foundation (not shown) by bolts 2 and which supports the engine-cylinder 3. This cylinder internally is nearly circular in form, the circular formation being broken at one point in the circumference by curving and projecting the central wall of the cylinder inward to form an abutment 4, which constitutes part of an enlargement 5. In this enlargement 5 are formed ports or passages 6 and 7 for the supply and exhaust of steam and an exhaust port or passage 8, which latter communicates with a laterally-projecting exhaust-pipe 9. These ports are in open communication with a steam-chest 10, and the port 8 lies between the said two ports 6 and 7. A steam-supply pipe 11 communicates with the chest and leads in practice from a suitable source of steam-supply. Arranged within the steam-chest is valve mechanism for controlling the supply and exhaust of steam to and from the cylinder, as will be hereinafter described.

The engine-shaft 12 is journaled to rotate in bearings 13, formed on the sides of the cylinder 3 and has keyed thereto a piston-wheel 14, consisting of a hub connected to the shaft, a series of arms radiating from said hub, and a rim or periphery carried by said arms. One of the arms of the wheel is enlarged and recessed to form a radially-extending chamber 15, which opens through the rim or periphery of the wheel and has slidably fitted therein a piston-wing 16, provided at its outer end with a spring-actuated packing-strip 17 for maintaining a steam-tight connection with the internal periphery of the cylinder, and at its inner end with rollers 18, which are engaged by cams 19 to control the sliding movements of said wing. As shown, the cams 19 are bolted or otherwise suitably fastened to arms or bracing-ribs 20, formed on the sides of the cylinder and are formed immediately below the abutment 4 with recesses 21 to allow the piston-wing 16 to move within its chamber 15 to pass said abutment. That portion of the working edge or surface 22 of each cam between the ends of the recess 21 is of such a shape or curvature as to hold the piston-wing 16 projected and in intimate contact with the wall of the cylinder, except at the point where the abutment breaks the circular continuity thereof, the packing-strip 17 serving to take up any clearance-space and to maintain at all times a steam-tight connection. The abutment-point 4 is also recessed for the reception of a packing-strip 23, pressed outward by a

suitable actuating spring or springs to engage the periphery of the piston and prevent the direct passage of steam from one side of the cylinder to the other between the piston and abutment-point. In order to further provide for a steam-tight fitting of the piston, the rim or periphery of the same is formed in its opposite side edges with recesses to receive packing-strips 24, which maintain a steam-tight connection between the piston and side walls of the cylinder. These packing-strips are also preferably pressed outward by the action of suitable springs.

In the operation of the engine it will of course be understood that when steam is admitted through one of the ports 6 or 7 the other becomes the exhaust-port. Assuming that the port 6 is used for the purpose of supply, the piston-wing 16, when passing to the right of the abutment-point 4, will be forced outward gradually by the working edges 22 of the cams 19, forming a pocket between it and the abutment-point, into which the steam from the port 6 enters and which impinges against the piston-wing, thereby propelling the piston-wheel to the right, the impact of the steam being followed by its expansion, whereby both the direct impelling force and expansive action of the steam are utilized to drive the piston, and this action is continuous under the admitted charge until the piston-wing 16 has made one complete revolution and passed the port 7, whereupon the steam exhausts through said port and the port 8 and pipe 9 to the atmosphere and a new supply of steam is admitted through the port 6 and the operation proceeds as before. When the piston is revolving in the opposite direction, steam is admitted through the port 7 and impels the piston-wheel to the left and exhaust takes place through the ports 6 and 8 and pipe 9.

Arranged in the steam-chest 10 is a reversing-valve 24, connected to an exteriorly-projecting stem 26, operated by hand-lever 27. This valve is provided with a central cavity 28, formed in its under side, and with end ports 29 and 30. These ports are so disposed that when the valve is arranged as shown in Fig. 1, in which the piston-wheel is represented as being adapted to revolve to the right, the port 29 will be blank, while the port 30 will connect the port 6 with the steam-chest and the cavity 28 will connect the port 7 with the exhaust-port 8. It will thus be seen that steam entering the ports 30 and 6 will act upon the piston-wheel to rotate the same to the right and will finally exhaust through the ports 7 and 8 and the pipe 9. The valve, however, may be adjusted to the right to move the port 30 out of coincidence with the port 6 and to bring the port 29 into register with the port 7 and connect port 8 with the port 6 through the cavity 28, thus allowing steam to enter the cylinder through port 7 and revolve the piston to the left and the exhaust to take place through ports 6 and 8 and pipe 9, as will be readily understood.

The two ports 29 and 30 of the reversing-valve are controlled by a slide-valve 31, which works upon a seat formed by the upper surface of the reversing-valve. This valve 31 is connected to an exteriorly-projecting stem 32 and is operated through the instrumentality of automatic mechanism to control either port 29 or 30 to regulate the amount of steam-supply to the engine-cylinder.

The mechanism for operating the slide-valve comprises a yoke 33, arranged upon one side of the engine-cylinder and comprising top and bottom bars 34 and 35, vertically movable on guides 36, fixed to the sides of the cylinder and connected by tie-bolts 37. This yoke is carried by an adjustable stem 38, which is connected at its upper end to the short arm of a bell-crank lever or rocker-arm 39, whose opposite or longer arm is attached to the valve-stem 32, so that as the yoke rises and falls reciprocatory movement will be imparted to the valve 31. The yoke carries at its upper and lower ends friction-rollers 40 40′, located on opposite sides thereof and adapted to be respectively engaged by two cams 41 41′, united by bolts 42 to each other and to an interposed collar 43, keyed to the shaft 12. Each of these cams is provided with a projection 44 and a contiguous recess 45, and the projection of the cam 41 is located a distance equivalent to about one-third of the circumference of the cam from the corresponding projection on the cam 41′, so that in the operation of the engine the upward movement of the yoke by the projection 44 of the cam 41 engaging the roller 40 will be quickly followed by the downward movement of the yoke under the action of the projection of the cam 41′ engaging the roller 40′, thus causing a quick movement of the slide-valve to its open position and a reverse action of the same within a definite period to close the supply-port when a sufficient amount of steam has been admitted into the cylinder. Assuming that the shaft 12 is revolving to the right in Fig. 5, it will be apparent that when the projection 44 of the cam 41 comes in contact with the roller 40 the yoke 33 will be lifted, thereby operating the rocker-arm to move the valve in one direction, which in the operation of the engine shown in Fig. 1 will be in the direction to open the port 30, allowing steam to pass through the port 6 into the engine-cylinder, and that at a predetermined time after this action the corresponding projection 44 of the cam 41′ will engage the roller 40′ and force the yoke 33 down, thereby moving the slide-valve in the reverse direction or in a direction to close the port 30 and cut off the supply of steam to the engine. The distance then to be traveled by the projection 44 is approximately equivalent to a two-thirds rotation before said projection engages the

roller 40 again, whereby the steam is allowed to exert an expansive action on the piston-wing for the greater part of the revolution of the piston-wheel. It will be readily understood that when the projection 44 of cam 41 engages the roller 40 the recess 45 of the cam 41′ comes into line with the roller 40′, allowing the yoke to have upward movement, and that when the projection of the cam 41′ comes into engagement with the roller 40′ the recess of the cam 41 comes into register with the pulley 40, allowing the yoke to be forced down. The bolts 42 project through segmental slots 46 in the two cams and permit the latter to be adjusted axially to vary the relation between the two projections 44 of the two cams—that is, to set them closer together or farther apart within a well-defined limit to effect the operation of the yoke in such manner as to adapt the opening and closing actions of the valve to be accurately timed to suit varying conditions which may require changes in the period between the time of admitting and cutting off the supply of live steam. The disposition of the cam projections is such that immediately upon the piston passing the steam-supply port the valve will be quickly opened to admit a full head of steam to the cylinder, which, as the piston-wing does not present its full area at the time of admission of the steam, is advantageous in giving a strong impact or impelling force to move the piston-wing a certain distance in its path of revolution, when expansion of the steam completes the further movement of the piston around its path. As before stated, the cam 41 operates the slide-valve to open port 6 when the piston is revolving to the right, and the action of cam 41′ closes said port. When the reversing-valve 25 is adjusted, however, to make the port 7 the supply-port and the port 6 the exhaust-port, the action of the cams is reversed, the cam 41′ operating the slide-valve to control the supply of steam to the engine through port 7, while the cam 41 effects the reverse movement of the slide-valve to cut off the supply of steam through said port. Thus the mechanism controlling the slide-valve is adapted to perform its function irrespective of the direction of rotation of the piston-wheel.

It will of course be understood that while we have shown in the present case cams for effecting the movements of the slide-valve, eccentrics or other equivalent devices may be substituted therefore, if desired.

When the engine is mounted on a stationary base and does not require movement of the piston in both directions, the reversing-valve may be dispensed with and the slide-valve used to control the three ports 6, 7, and 8. This requires merely the removal of the reversing-valve and the application of the slide-valve to the seat of the reversing-valve. It will thus be seen that we are enabled to use the slide-valve alone or the two valves in combination and that by simply dispensing with one valve the engine may be designed to run in one direction only and then, if occasion requires, may be made reversible by the application of the reversing-valve, such changes in the arrangement of the apparatus requiring no modifications or changes in the construction of the slide-valve-controlling mechanism.

The ports 6 and 7 are in communication with pipes 47 and 48, which are in communication by a union connection 49 with the steam-supply pipe 11, and are also in connection with the exhaust-pipe 9 through branches 47′ and 48′, each of said branches having a controlling-valve 50, while the pipes 47 and 48 have controlling-valves 50′ between said branch pipes and the union 49. It will thus be seen that the pipes 47 and 48 may be independently connected with either the steam-supply pipe or the exhaust-pipe. By this construction upon closing the valve 50 of either pipe and opening the valve 50′ steam may be admitted upon either side of the abutment to start the engine in either direction when the piston is beyond the point of cut-off, and at the same time either port may be placed in communication with the exhaust-pipe 9 by closing the valve 50′ and opening the valve 50, so that when the slide-valve is used without the reversing-valve and either port 6 or 7 is used as the supply-port the other port may be placed in direct connection with the exhaust-pipe 9 for the exhaust of steam from the cylinder.

From the foregoing description, taken in connection with the accompanying drawings, the construction and operation of the invention will be readily understood without requiring a more extended explanation.

Various changes in the form, proportion, and the minor details of construction may be resorted to without departing from the principle or sacrificing any of the advantages of this invention.

Having thus described our invention, what we claim, and desire to secure by Letters Patent, is—

1. In a rotary engine, the combination with a rotary piston provided with a radially-movable piston-wing, of a cylinder having an abutment, a steam-chest, ports or passages communicating with the steam-chest, and an exhaust-port intermediate said passages, of a valve within the steam-chest controlling said ports, a steam-supply pipe, pipes communicating with the steam-supply pipe and the ports on opposite sides of the exhaust-port and provided with valves, and branch pipes connecting said pipes with the exhaust-pipe and provided with valves, the valves in said pipes communicating between the passage-ports and steam-supply pipe being arranged between said steam-pipe and the branch pipes whereby said pipes may be brought into communication with the steam-supply pipe or exhaust-pipe, substantially as described.

2. In a rotary engine, the combination with

the cylinder and its piston, of a controlling slide-valve, an engine-shaft, a yoke connected to actuate the slide-valve, and cams carried by the shaft for reciprocating said yoke in reverse directions, each cam having an operating portion and slots, and bolts passing through said slots and uniting the cams, whereby the cams may be adjusted to set said operating portions at different positions, substantially as described.

3. In a rotary engine, the combination with the cylinder and its piston, of a controlling slide-valve, an engine-shaft, a yoke connected to actuate the slide-valve, and provided with bearing portions, and cams mounted on the shaft and each provided with an operating portion and an adjacent recess, said operating portions being set approximately a third of a revolution apart to first move the yoke in one direction to cause the valve to admit steam to the cylinder, and then to move the valve in the reverse direction to cut off the supply of steam to the cylinder, the arrangement of the cam-operating portions and recesses being such that when the operating portion of one cam engages a bearing portion of the yoke, the recesses in the other cam will receive the other bearing portion of the yoke, and vice versa, substantially as described.

4. In a rotary engine, the combination with the cylinder and its piston, of a controlling slide-valve, an engine-shaft, a yoke connected to actuate the slide-valve, and provided with bearing portions, and cams mounted on the shaft and each provided with an operating portion and an adjacent recess, said operating portions being set approximately a third of a revolution apart to first move the yoke in one direction to cause the valve to admit steam to the cylinder, and then to move the valve in the reverse direction to cut off the supply of steam to the cylinder, the arrangement of the cam-operating portions and recesses being such that when the operating portion of one cam engages a bearing portion of the yoke, the recesses in the other cam will receive the other bearing portion of the yoke, and vice versa, and means for adjusting the cams to set the operating portions at different points in the path of revolution, substantially as described.

5. In a rotary engine, the combination with the cylinder and its piston, and a slide-valve for controlling the passage of steam to the cylinder, an engine-shaft, a reciprocating yoke operatively connected to the slide-valve, and cams carried by the shaft and provided with operating portions adapted to first move the yoke in one direction to cause the valve to open the supply-port, and then move the yoke in the reverse direction to cause the valve to close the supply-port, said cams being axially adjustable to vary the distance between said operating portions, substantially as set forth.

6. In a rotary engine, the combination with the cylinder and its piston, of a controlling slide-valve, an engine-shaft, a yoke connected to reciprocate the slide-valve, and cams carried by the engine-shaft and provided with relatively adjustable operating portions arranged at different points in the path of revolution of the shaft to first move the yoke in one direction to cause the valve to admit steam to the cylinder, and then to move the valve in the reverse direction to cause the valve to cut off the supply of steam to the cylinder, substantially as described.

In testimony whereof we have hereunto set our hands in presence of two subscribing witnesses.

PAUL R. MATTOCKS.
JOHN L. GRAFFLIN.

Witnesses as to Mattocks:
W. R. PEARSON,
J. S. KINDLEY.
Witnesses as to Grafflin:
JAS. H. TAYLOR, Jr.,
H. F. QUINN.