No. 722,086. PATENTED MAR. 3, 1903.

J. F. CRAIG & T. V. FLEMING.

ROTARY STEAM ENGINE.

APPLICATION FILED JULY 31, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

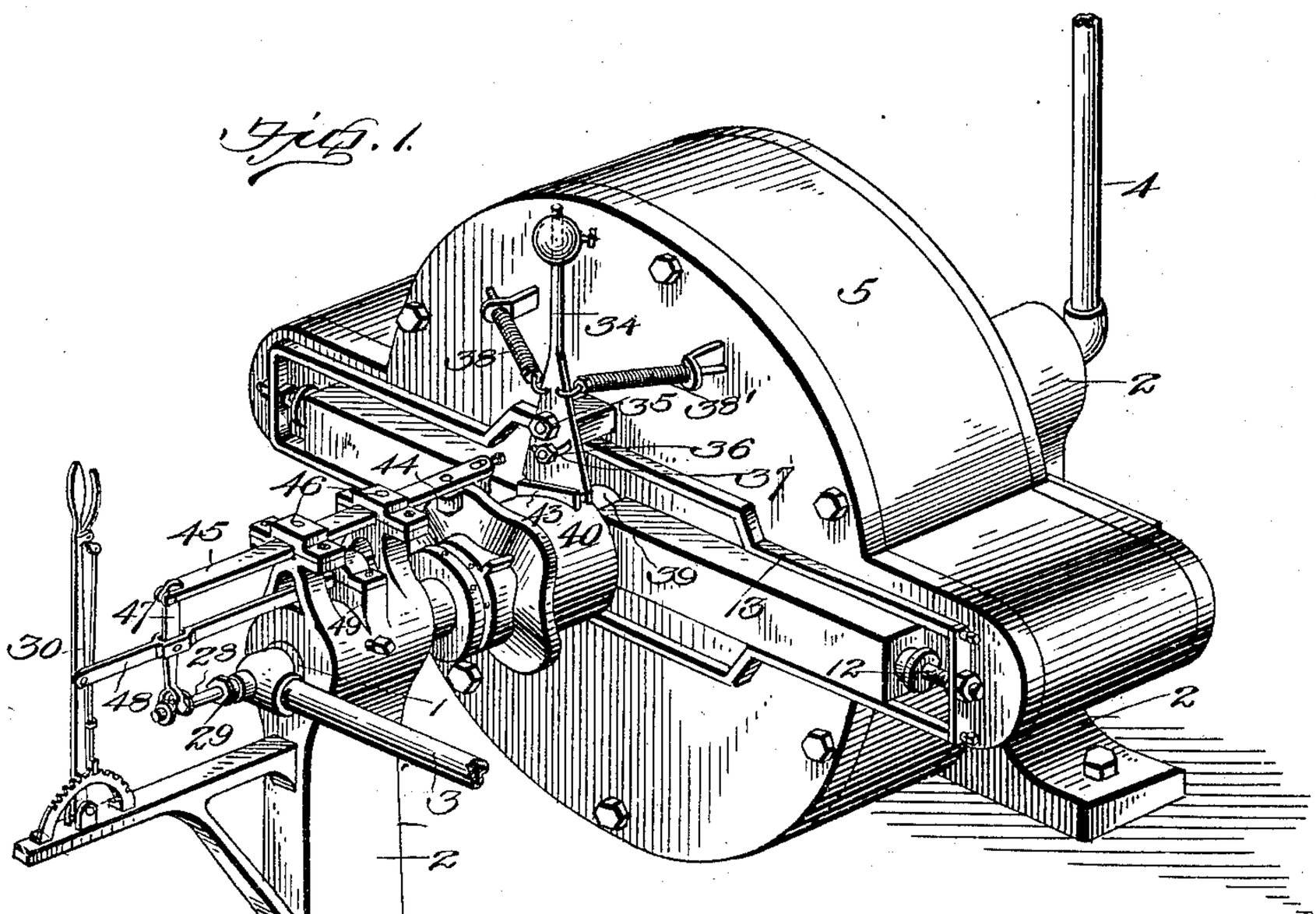

Fig. 2.

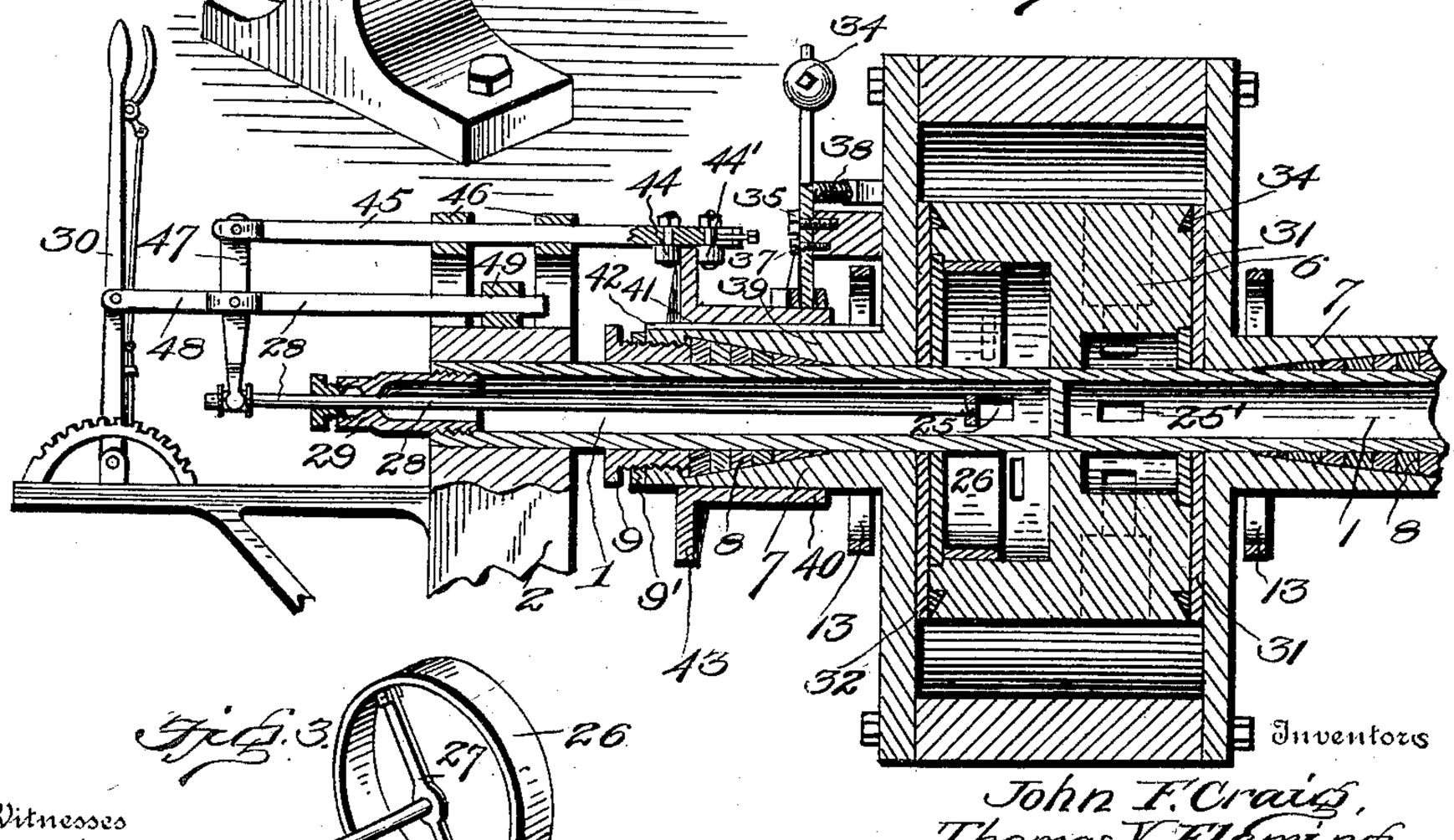

Fig. 3.

Witnesses

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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 9.

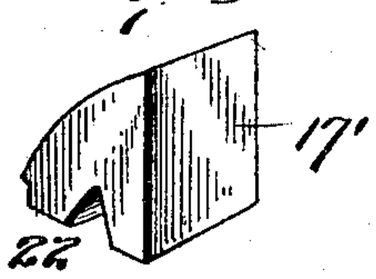


Fig. 4.

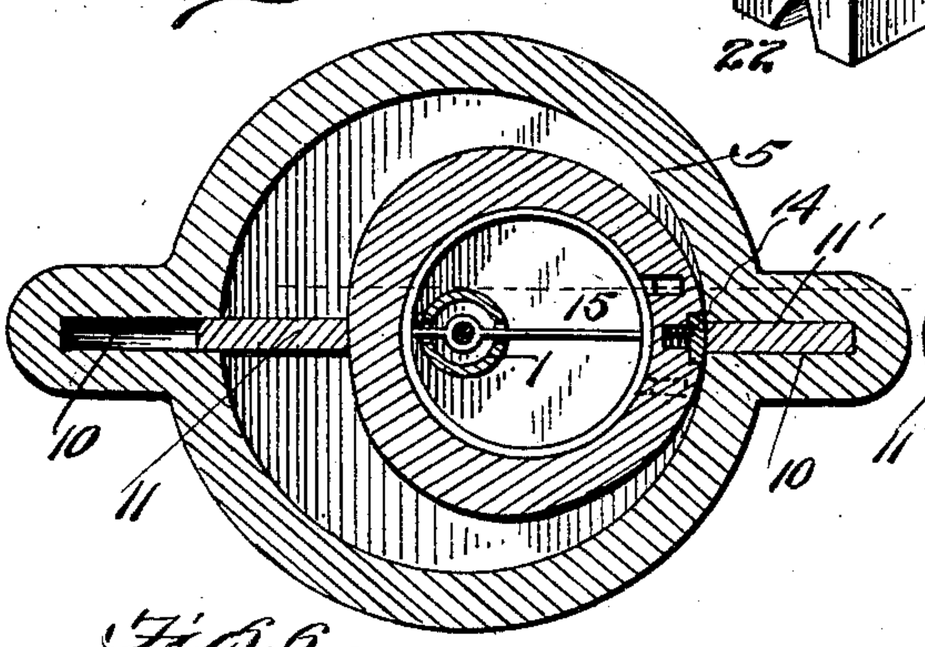


Fig. 5

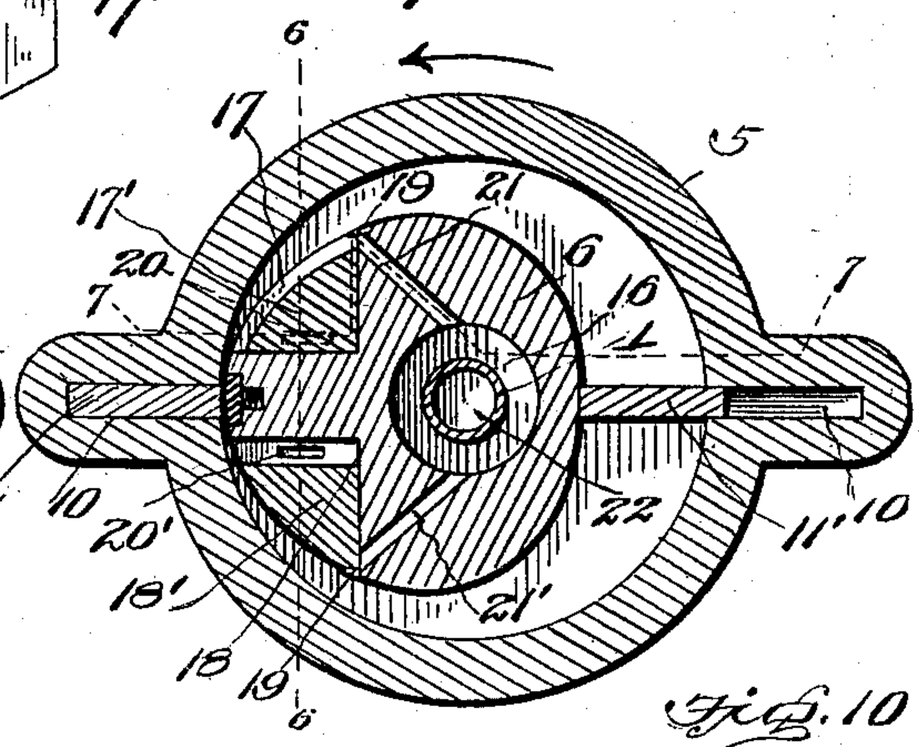


Fig. 6

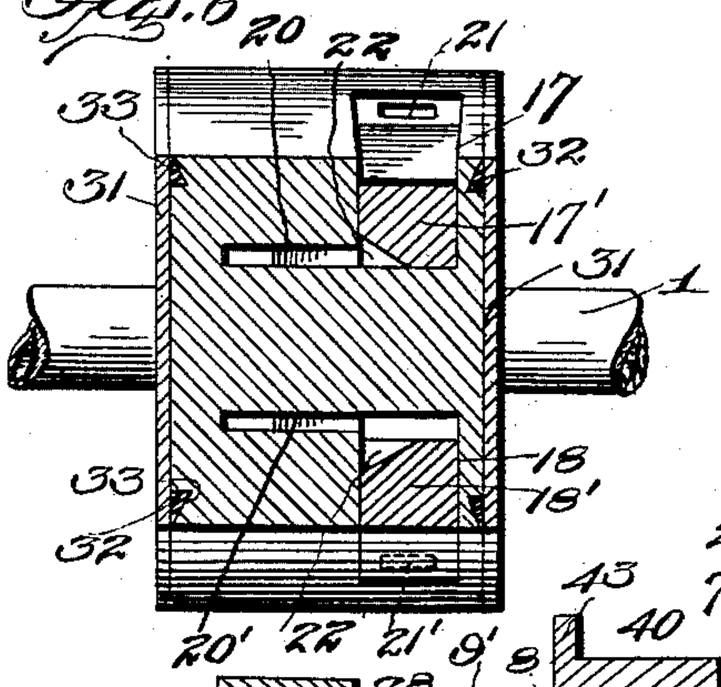


Fig. 8.

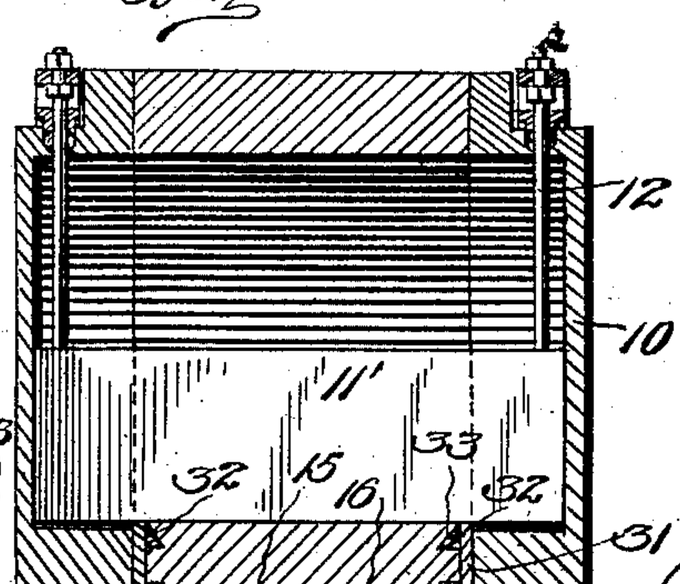


Fig. 10

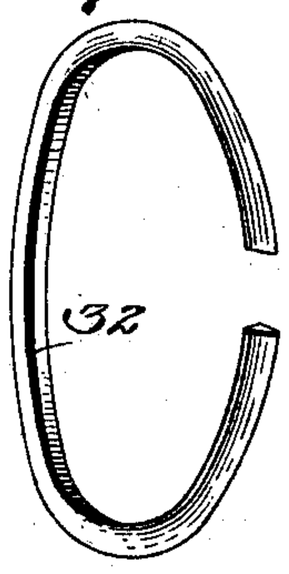
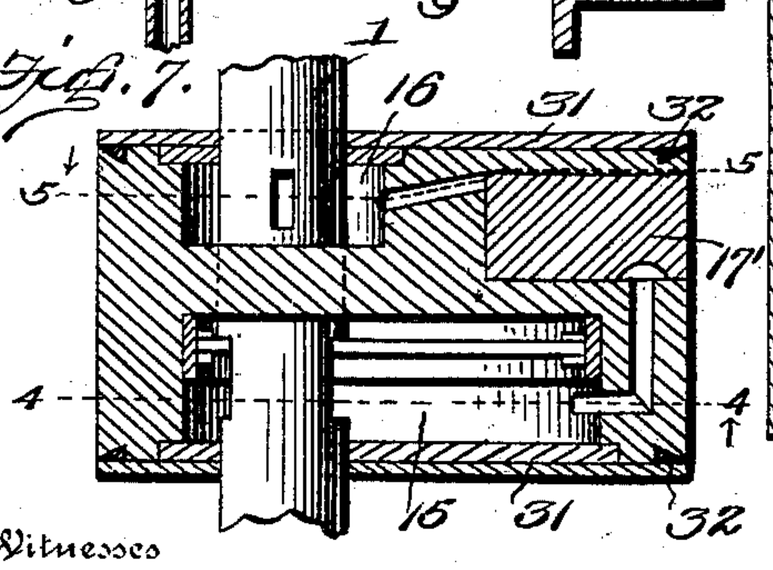


Fig. 7.



Witnesses

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UNITED STATES PATENT OFFICE.

JOHN F. CRAIG AND THOMAS V. FLEMING, OF PARIS, ILLINOIS.

ROTARY STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 722,086, dated March 3, 1903.

Application filed July 31, 1902. Serial No. 117,822. (No model.)

To all whom it may concern:

Be it known that we, JOHN F. CRAIG and THOMAS V. FLEMING, citizens of the United States, residing at Paris, in the county of Edgar and State of Illinois, have invented certain new and useful Improvements in Rotary Steam-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 of that type in which a rotary cylinder revolves upon a stationary shaft and coöperates with a stationary piston fixed to the shaft.

The object of the invention is to provide a rotary engine of this character which embodies certain novel features of construction, combination, and arrangement of parts, hereinafter described and claimed, whereby an engine of superior efficiency in which a maximum amount of power is obtained by the expenditure of a minimum amount of steam is produced and the speed of the engine regulated by the weight of the load upon it; and a further object is to provide an engine which is reversible to operate in either direction of its plane of rotation.

The preferred embodiment of the invention is illustrated in the accompanying drawings, in which—

Figure 1 is a perspective view of a rotary engine embodying our invention. Fig. 2 is a vertical section of the same through the center line of the stationary shaft. Fig. 3 is a perspective view of the throttle-valve. Fig. 4 is a section on the line 4 4 of Fig. 7. Fig. 5 is a section on the line 5 5 of Fig. 7. Fig. 6 is a section on the line 6 6 of Fig. 5. Fig. 7 is an irregular section on line 7 7 of Fig. 5. Fig. 8 is a horizontal section on the central line of the shaft, showing the position of the parts when exhausting steam. Fig. 9 is a detail view of one of the segmental valves. Fig. 10 is a detail view of the piston packing-ring.

1 in the drawings represents a hollow stationary shaft supported by standards 2 and connected at one end to a steam-supply pipe 3 and at the other end to a steam-exhaust pipe 4.

5 is the engine-cylinder revolubly mounted on the shaft, and 6 an eccentric piston keyed to the shaft. Cylindrical sleeves or bosses 7 extend from the sides of the cylinder and surround the shaft, forming extended bearings, and each of these sleeves is flared interiorly to receive a series of graduated packing-rings 8, adjustably confined by a gland-nut 9 and check-nut 9′. The cylinder is provided with diametrically-opposed gate-chambers 10, in which work sliding gates or abutments 11 11′, attached by rods 12 with exterior yoke-frames 13, which connect the gates to operate in unison.

The piston 6 is approximately of ovate form and provides a continuous rounded surface on which the gates may ride, thus adapting the gates to fit steam-tight against the piston. At the point where the piston engages the interior wall of the cylinder it is provided with a spring-pressed packing-brass 14, which maintains a steam-tight connection with the cylinder. The piston is provided on one side with a steam-inlet chamber 15 and on its opposite side with a steam-exhaust chamber 16, and in the periphery of the piston are segmental recesses 17 and 18, in which work segmental valves 17′ and 18′, said valves being of less depth than the recesses to move radially toward and from the periphery of the piston and being limited in outward movement by stops 19. The recesses 17 and 18 are located on opposite sides of the major axial line of the piston adjacent to the packing-brass 14, and formed within the piston are inlet-passages 20 20′ and exhaust-passages 21 21′, operating in pairs, the passages 20 and 21, respectively, connecting the recess 17 with the inlet and exhaust chambers 15 and 16, while the passages 20′ and 21′ connect the recess 18 with said chambers.

The bore of the hollow shaft is divided centrally by a partition 22 to form steam supply and exhaust passages 23 24, the former communicating with the piston-chamber 15 through ports 25 and the latter with the piston-chamber 16 through a port or ports 25′.

The inlet-passages 20 20′ are arranged on opposite sides of the center of chamber 15, and the admission of steam thereto is controlled by a cylindrical valve 26, connected by a bar 27, slidable in the ports 25, with a controlling-rod 28, extending along passage 23 to the exterior through a stuffing-box 29 and connected to a pivoted controlling-lever 30. By means of these operating connections the valve 26 may be adjusted to close or partially close either passage 20 20′ or close both passages at will. When the passage 20′ is in open communication with the chamber 15, steam from the shaft will pass thereinto and, assuming the ports to be in the position shown in Fig. 5, will force the valve 18′ open, thus uncovering passage 20′ and allowing steam therefrom to pass into the cylinder. At the same time valve 18′ closes exhaust-passage 21. The steam will thus discharge into the cylinder at a point between the point of contact of the piston with the wall of the cylinder and the gate or abutment 11′, thereby confining the steam between these two points and causing the same to act upon said abutment 11′ and rotate the cylinder in the direction of the arrow, Fig. 5, until the abutment 11′ comes in line with the exhaust-port 21, when the steam-pressure will force the valve 17′ inward, closing port 20 and opening port 21, and the steam will exhaust to the atmosphere through said port 21, chamber 16, port 25′, and passage 24. The same action ensues when abutment 11 comes into position for action.

The valves 17′ 18′ are controlled by the pressure of the steam, being forced inward by the pressure of the steam in the steam-space of the cylinder and forced outward by the pressure of the steam from passages 20 20′. In order to adapt the valves to open freely under pressure of the steam from the passages 20 20′, each valve is provided with a recess 20^2, which when the valve is seated to close the coöperating passage communicates with said passage, as shown in Fig. 6, said recess allowing the steam to pass under the valve and force it open. When the passage 20 or 20′ is closed by the valve 26, the coöperating valve member 17 or 17′ is forced inward to close the adjacent end of the passage by the pressure of the steam in the steam-space of the cylinder.

To reverse the engine, the valve 26 is shifted to close port 20′ and open port 20, whereupon the steam rushes through passage 20, moves the valve 17′ outwardly to open the adjacent end of said passage, and then passes into the steam-space of the cylinder on the opposite side of abutment 11′ from that previously described—that is, between chamber 17 and abutment 11′—instead of between chamber 18 and abutment 11′, causing the engine-cylinder to rotate in the reverse direction.

Between the piston 6 and the side walls of the cylinder are wear strips or plates 31, which bear upon triangular split packing-rings 32, seated in correspondingly-shaped grooves 33 in the sides of the piston. These rings are made of spring metal, adapting their ends to normally spring apart, and are held contracted by the pressure of the plates 31, which hold them normally seated fully in the grooves 33. By this means the joints or spaces between the sides of the piston and cylinder are closed steam-tight. As the parts become decreased in thickness by wear and the pressure on the rings 32 is relieved the rings expand, and their inclined faces ride outward to a greater or less extent on the inclined walls of the grooves 33, and by this means the rings are at all times caused to bear or impinge firmly on the plates 31 and at the same time close the grooves 33, thus maintaining the joints steam-tight. The chambers 17 and 18 are closed at their outer sides by annular plates 17^2 and 18^2, which inclose the shaft 1 and fit steam-tight against the plates 31.

Governor mechanism is provided for automatically regulating the speed of the engine according to the resistance of the load and comprises a governor-arm 34, weighted at its outer end and pivoted upon a pin or bolt 35 on one side of the cylinder, so as to swing transversely of shaft 1. The inner end of the governor-arm is enlarged and formed with a slot 36, receiving a stop pin or bolt 37, which limits its swinging movement, and connecting the arm beyond its pivot with the engine-cylinder are springs 38 38′, which normally act to hold the arm in a plane at right angles to the shaft 1. The said enlarged inner end of the governor-arm is preferably flat and slants obliquely to its plane of travel and fits within a diagonal groove formed by lugs 39, carried by a sleeve 40, said lugs being arranged at a diagonal or oblique angle to the plane of rotation of the sleeve. The sleeve 40 has a longitudinal groove 41, receiving a key or spline 42, formed on the sleeve 7, whereby it is mounted to rotate positively with the engine-cylinder and slide longitudinally on sleeve 7. At its outer end the sleeve 40 carries an annular cam-flange 43, against the opposite faces of which bear friction-rollers 44 44′ upon the inner end of a reciprocating bar 45, slidably mounted in bearings 46 on the adjacent standard 2 and pivotally connected at its outer end by a lever 47 with the rod 28, whereby the sliding movements of the sleeve 40 will reciprocate said rod 28, and thereby actuate the valve 26. The lever 47 is intermediately pivoted to a bar 48, sliding in a bearing 49 on the standard 2 and pivoted to the controlling-lever 30, so as to guide the latter in its swinging movements.

When the engine is at rest or running at normal speed, the parts stand in the positions

shown in Figs. 1 and 2 with the governor at the neutral point; but when the speed becomes excessive the weighted end of the governor-arm is swung against the resistance of the opposing spring in a direction reverse to the direction of rotation of the engine, thereby forcing sleeve 40 inwardly or outwardly, as the case may be, thus causing the projections of the fluted cam-flange 43 to be brought into engagement with one of the rollers 44 and impart motion thereto to slide bar 45 and reciprocate rod 28 in the proper direction to partially or wholly close valve 26 against the operating inlet-passage 20 or 20′, thereby reducing or wholly cutting off the flow of steam and slowing down the engine. As the engine slows down the governor returns to its normal position and operates valve 26 to open the passage 20 or 20′ wide again. When the speed is too slow, the valve 26, if not set to fully open passage 20 or 20′, is operated to fully open the passage by a swinging movement of the governor in the reverse direction to that previously described, as will be fully understood.

Assuming that the engine is running in the direction of the arrow, Fig. 1, and the passage 20′ is full open, when the speed of the engine becomes too great the weighted end of governor-arm 34 will swing to the right against the resistance of spring 38 and force sleeve 40 outward, thereby partially or wholly closing valve 26 over passage 20′. As the engine slows down the springs 38 38′ restore the governor to its normal position and the governor acts on the diagonal lugs to slide sleeve 40 inward, thereby moving valve 26 to open passage 20′ and again admit steam to the cylinder. It will thus be seen that the valve 26 will be automatically adjusted to regulate the speed of the engine according to the load thereon.

The governor and reversing mechanism are not claimed herein, as they constitute the subject-matter of another application filed July 7, 1902, Serial No. 114,575.

From the foregoing description, taken in connection with the accompanying drawings, it is thought that the construction, mode of operation, and advantages of our improved rotary steam-engine will be readily apparent 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 as new, and desire to secure by Letters Patent, is—

1. In a rotary steam-engine, the combination with a hollow shaft provided with steam inlet and exhaust passages, and a rotary cylinder provided with sliding abutments; of a piston fixed to the shaft and having inlet and exhaust passages communicating with the inlet and exhaust passages of the shaft and with the steam-space of the cylinder, a valve carried by the piston and automatically operated by steam-pressure to alternately open and close said piston-passages, and a valve governing the supply of steam to the inlet-passage of the piston, substantially as described.

2. In a rotary steam-engine, the combination with a hollow shaft provided with steam inlet and exhaust passages, and a rotary cylinder provided with sliding abutments; of a piston fixed to the shaft and having two sets of inlet and exhaust passages communicating with the inlet and exhaust passages of the shaft and with the steam-space of the cylinder, valves carried by the piston and automatically operated by steam-pressure and governing said piston-passages, the valve governing each set of passages being adapted to alternately open and close said passages, and a throttle-valve for governing the supply of steam to either steam-inlet passage in the piston, substantially as specified.

3. In a rotary steam-engine, the combination with a hollow shaft provided with steam inlet and exhaust passages, and a rotary cylinder provided with sliding abutments; of a piston fixed to the shaft and having two sets of inlet and exhaust passages communicating with the inlet and exhaust passages of the shaft and with the steam-space of the cylinder, steam-controlled segmental valves fitting in segmental recesses in the piston and automatically governing said piston-passages, the valve governing each set of passages being adapted to alternately open and close the said passages, and a throttle-valve for governing the supply of steam to either steam-inlet passage in the piston, substantially as specified.

4. In a rotary engine, a cylinder, a piston provided with triangular grooves, a split expansible piston-ring of triangular form in cross-section fitted in said grooves, and wear-pieces between the cylinder and piston and pressing on the rings, substantially as and for the purpose set forth.

5. In a rotary steam-engine, the combination with the hollow shaft provided with steam inlet and exhaust passages and a rotary cylinder provided with abutment-chambers, of diametrically-opposing abutments sliding in said chambers, a yoke connecting the abutments to move in unison, an ovate eccentric piston fixed to the shaft, and adapted to impart positive irregular rectilinear motion to said abutments, said piston having inlet and exhaust passages communicating with the inlet and exhaust passages of the cylinder and with the steam-space of the cylinder, a valve carried by the piston and automatically operated by steam-pressure to alternately open and close said piston-passages, and a

throttle-valve governing the supply of steam to the inlet-passage of the piston.

6. In a cut-off for rotary steam-engines, the combination with a hollow shaft, a rotating cylinder and an eccentric piston fixed to the shaft and having a steam-inlet port communicating with said shaft of a valve controlling said port, a rod connected to the valve, a sliding bar connected to the rod, a cam for operating the rod, and means for operating said cam, as and for the purpose set forth.

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

JOHN F. CRAIG.
THOMAS V. FLEMING.

Witnesses to Craig's signature:
JAMES A. CRAIG,
ELLA M. CRAIG.

Witnesses to Fleming's signature:
JOHN HERRIN,
H. P. LAMASTER.