No. 754,031. PATENTED MAR. 8, 1904.

O. WILLIAMS.

ROTARY ENGINE.

APPLICATION FILED JULY 3, 1903.

NO MODEL. 4 SHEETS—SHEET 1.

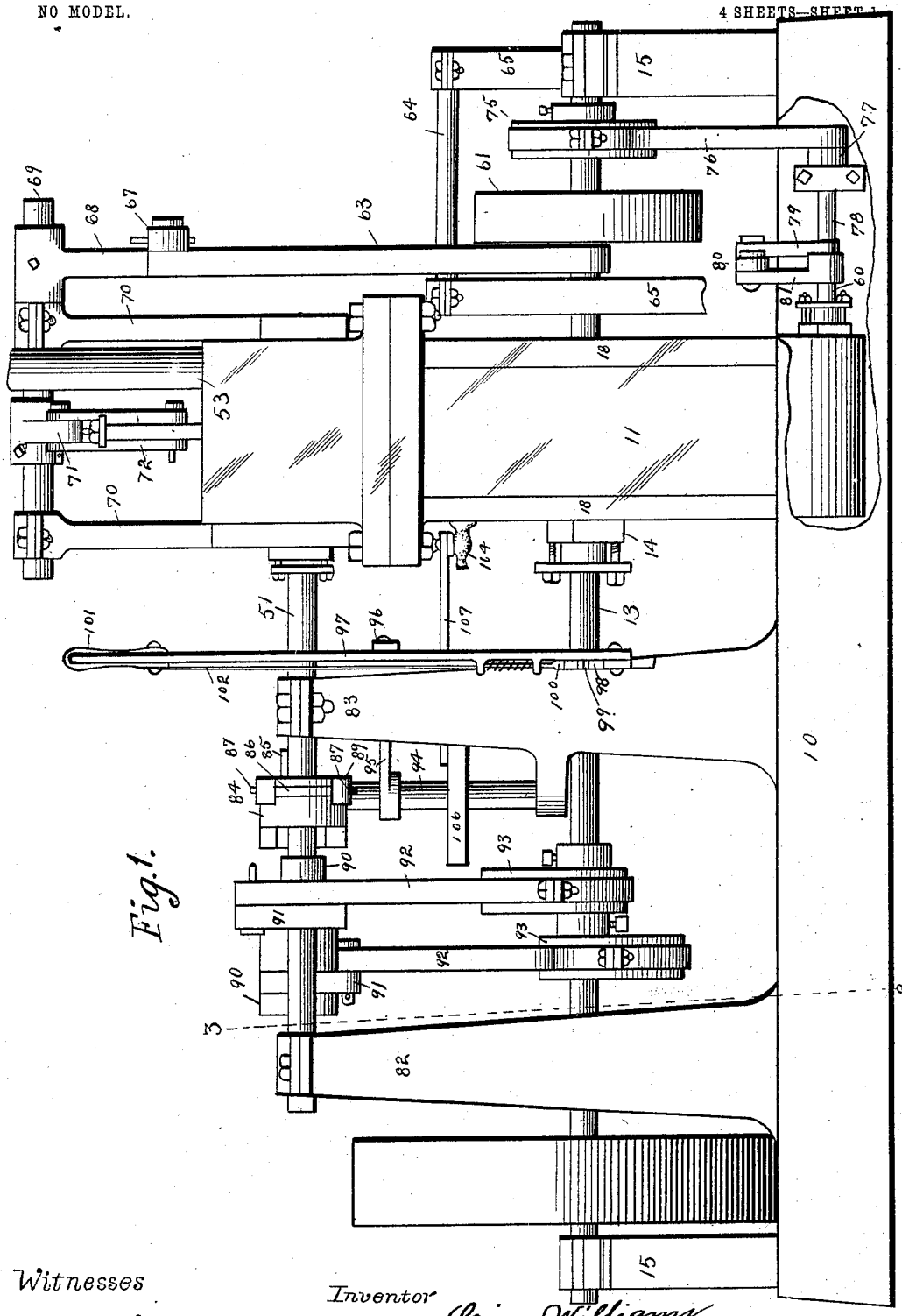

Fig. 1.

Witnesses

A. G. Teague

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NO MODEL. 4 SHEETS—SHEET 2.

Fig. 3.

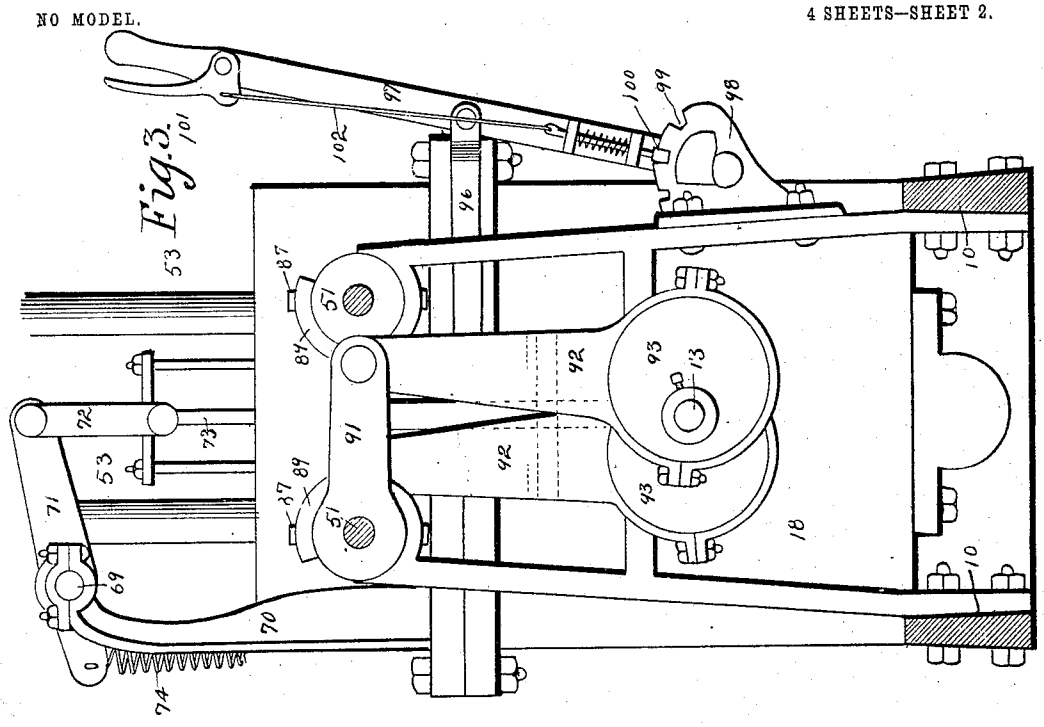
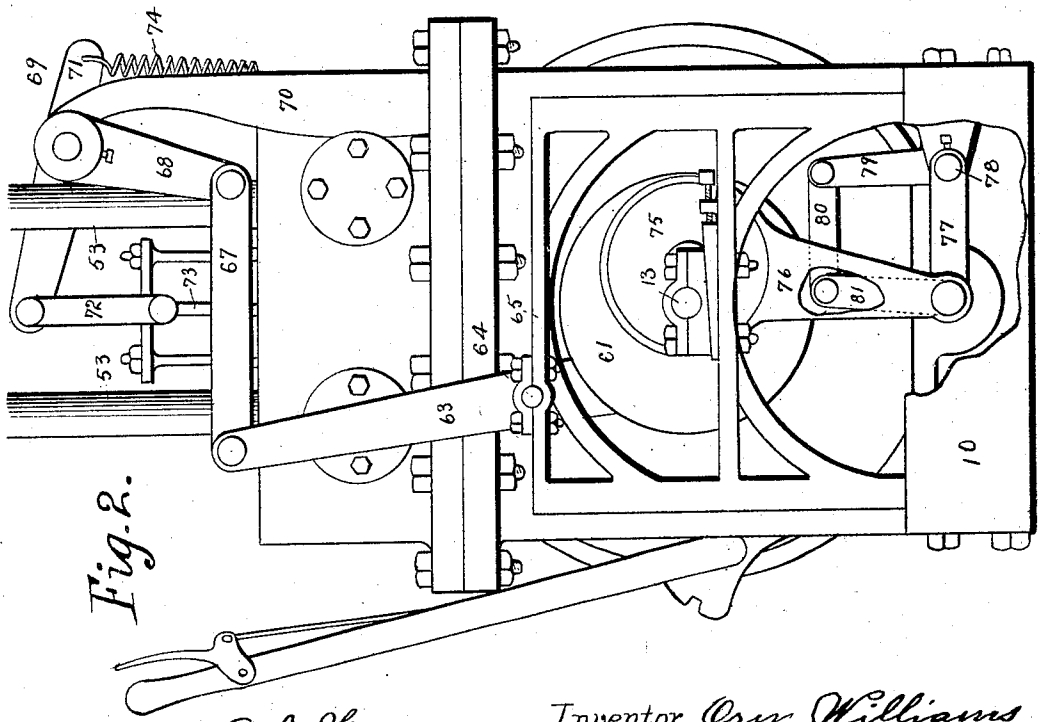


Fig. 2.



Witnesses { A. G. Hagner
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NO MODEL. 4 SHEETS—SHEET 3.

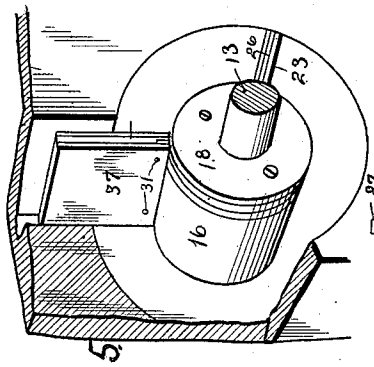

Fig. 5.

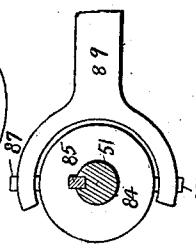

Fig. 6.

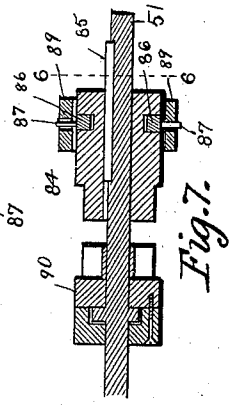

Fig. 7.

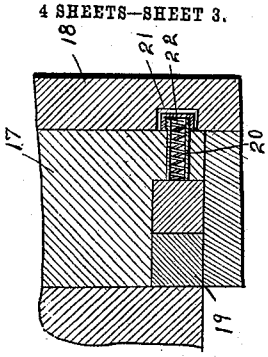

Fig. 8.

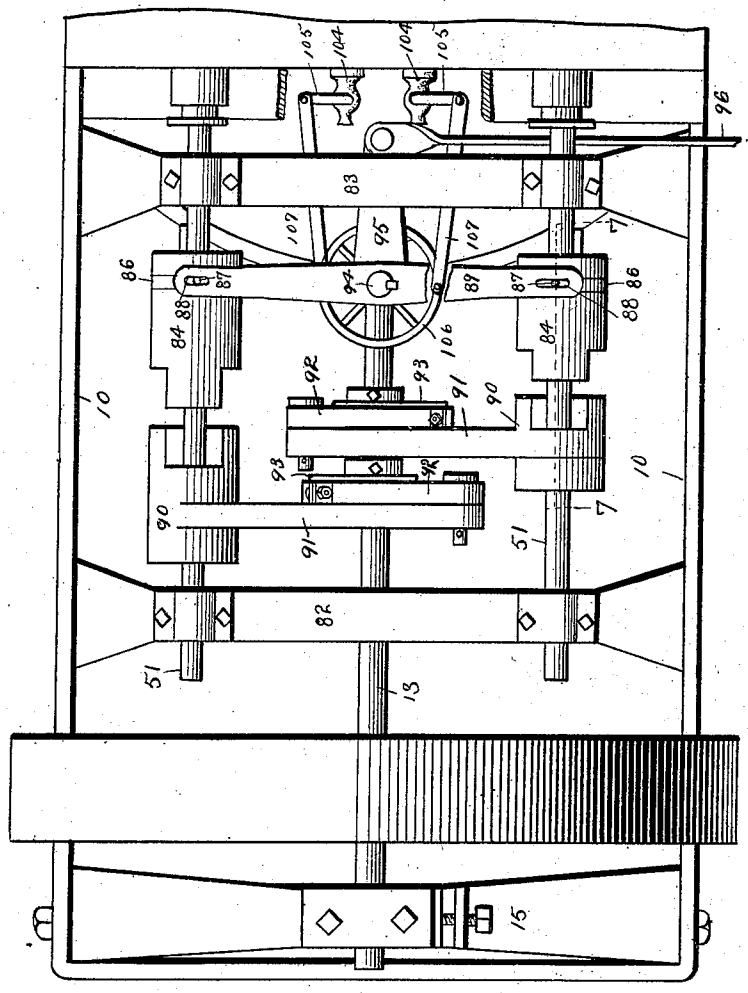

Fig. 4.

Witnesses,

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No. 754,031. PATENTED MAR. 8, 1904.

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ROTARY ENGINE.

APPLICATION FILED JULY 3, 1903.

NO MODEL. 4 SHEETS—SHEET 4.

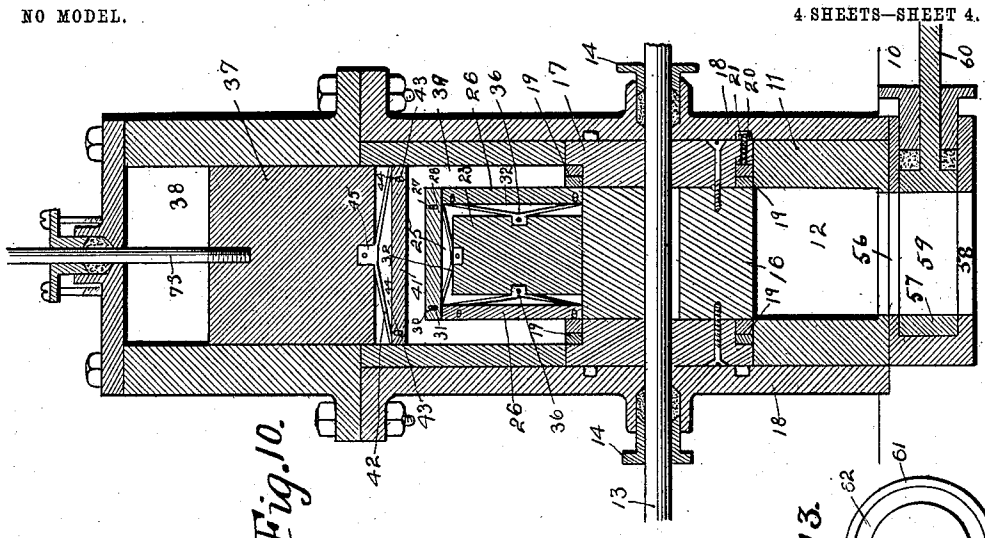

Fig. 10.

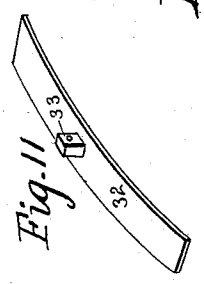

Fig. 11

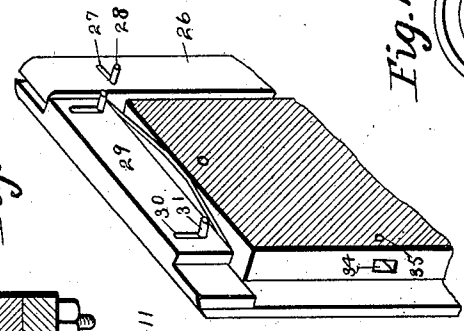

Fig. 12.

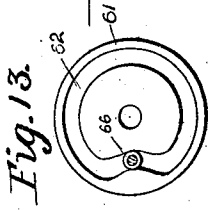

Fig. 13.

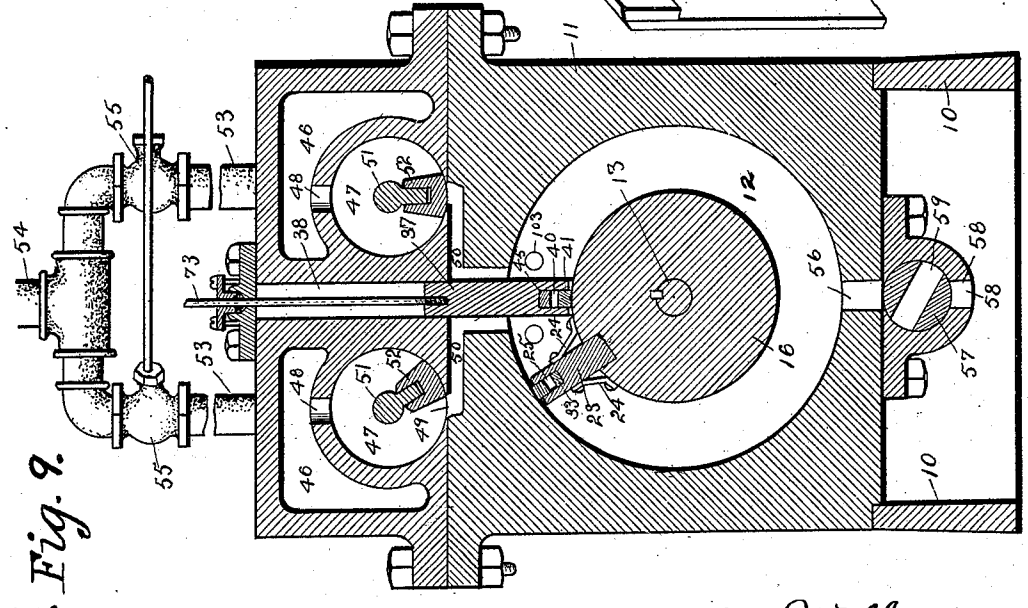

Fig. 9.

Witnesses

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L. R. Leibrock

Inventor Orin Williams.

By Orwig Lane Att'ys.

No. 754,031. Patented March 8, 1904.

UNITED STATES PATENT OFFICE.

ORIN WILLIAMS, OF DES MOINES, IOWA.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 754,031, dated March 8, 1904.

Application filed July 3, 1903. Serial No. 164,138. (No model.)

To all whom it may concern:

Be it known that I, ORIN WILLIAMS, a citizen of the United States, residing at Des Moines, in the county of Polk and State of Iowa, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

The objects of my invention are to provide a rotary engine of simple, durable, and inexpensive construction especially designed to utilize the expansive force of the steam to its maximum capacity.

The invention relates to that class of rotary engines having a rotating piston working in a cylindrical chamber; and my object, more specifically, is to provide packing devices of simple, durable, and inexpensive construction to prevent the leakage of steam around the rotating piston and to take up wear or expansion of the parts, so that the rotating piston may turn freely with a minimum of friction and yet form with the interior of the chamber a steam-tight joint.

A further object is to operate the pressure-plate to accurately coöperate with the rotating piston and to form with the hub of the piston a steam-tight joint, and, further, in this same connection to move the pressure-plate to position in engagement with the rotary hub in such manner that its impact with the hub will be cushioned to prevent excessive wear or pounding and yet said impact and subsequent engagement with the hub will be firm enough to prevent leakage of steam.

A further object is to so arrange the pressure-plate that its sides will be guided and supported throughout its entire stroke to the end that the pressure of steam upon one or the other side of the pressure-plate will not move its lower end laterally nor cause it to bind in its supporting-groove.

In an engine of this class, in which the explosive force of the steam is used to its maximum efficiency, it has been extremely difficult and sometimes impossible to reverse the movement of the rotary piston except when placed at certain predetermined positions on account of the steam necessarily contained in that part of the chamber toward which the rotary piston must advance when its movement is reversed, and in this connection it is my object to provide means for automatically exhausting steam from this part of the chamber when the movement of the rotary piston has been reversed, so that no attention on the part of the operator is necessary for this purpose.

A further object is to provide an engine of this class in which the expansive force of the steam is utilized throughout nearly the entire piston-stroke with an exhaust-opening arranged diametrically opposite from the induction-ports, so that no matter in which direction the engine is running the exhaust-opening will coact with the rotary piston in the same way, and in this connection it is my object, further, to provide an automatically-operating exhaust device entirely independent of the reversing mechanism, so that the operator need pay no attention to the exhausting mechanism and the exhaust will operate perfectly no matter in which direction the engine is running.

My invention consists in certain details in the construction, arrangement, and combination of the various parts of the device whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims, and illustrated in the accompanying drawings, in which—

Figure 1 shows a side elevation of the complete engine. Fig. 2 shows an end elevation of same. Fig. 3 shows a vertical sectional view of same on the indicated line 3 3 of Fig. 1. Fig. 4 shows a top or plan view of a part of the engine, illustrating the reversing mechanism and connected parts. Fig. 5 shows a detail perspective view of a part of the engine-frame, showing the interior of the steam-chamber and the rotary piston and pressure-plate. Fig. 6 shows a sectional view on the indicated line 6 6 of Fig. 7. Fig. 7 shows a longitudinal sectional view through the indicated line 7 7 of Fig. 4. Fig. 8 shows an enlarged sectional view illustrating the device for exerting a yielding pressure on the packing-rings of the rotary hub. Fig. 9 shows a vertical transverse sectional view through the engine-cylinder, the steam-chests, exhaust device, and connected parts. Fig. 10 shows a vertical central sectional view on a line at right angles to the

line on which Fig. 9 is shown and illustrating the pressure-plate in its elevated position. Fig. 11 shows a detail perspective view of one of the springs for controlling the packing-strips, and Fig. 12 shows an enlarged detail perspective view of the rotary piston to illustrate the arrangement of the packing-strips. Fig. 13 shows a face view of the cam-wheel by which the pressure-plate is operated and also showing the roller in position in the cam-groove.

Referring to the accompanying drawings, I have used the reference-numeral 10 to indicate the base of the engine. Supported upon the base is the engine-body 11, having a cylindrical chamber 12 therein.

The numeral 13 indicates a shaft passed through the packing-boxes 14 at the sides of the engine-body and mounted in standards 15 at the ends of the base 10. Keyed to the shaft 13 is a rotary hub 16, arranged concentrically of the engine-chamber 12. This hub 16 is of the same thickness longitudinally of the shaft 13 as the interior of the chamber 12. In order to prevent leakage of steam between the ends of the rotary hub and the sides of the chamber, I have provided two plates 17, connected by screws 18 to the hub 16 and having concentric openings through which the shaft 13 passes. In the inner periphery of each of the plates 17 is an annular groove in which two steel expansion-rings 19 are placed, the inner face of the inner ring resting against the outer face of the hub 16. These plates 17 are set into openings provided for them on the interior of the engine-body 11, and the outer surfaces of the rings engage the inner peripheries of said openings. By this means steam is prevented from leaking from the chamber 12 past said expansion-rings 19. Said rings also perform other important functions, as will hereinafter appear.

I have provided means for applying yielding pressure to the expansion-rings 19 to normally hold them inwardly toward the hub 16, as follows: In Fig. 8 of the drawings the numeral 20 indicates a tube secured in the plate 17 and having a cap 21 screwed to one end thereof. Within the tube 20 is an extensile coil-spring 22, one end of which engages the cap and the other end engages in the packing-ring 19, thus normally forcing the packing-rings inwardly. The head 21 is free to rotate in an annular groove 23, formed in the adjacent portion of the engine-body. Fixed to the hub 16 is a rotating piston, the body portion of which is indicated by the numeral 23. It projects radially from the hub and is firmly fixed thereto by the braces 24, and its inner end is introduced a short distance into the hub. The sides and the outer end of the piston are provided with a groove 25. In the side grooves 25 are the packing-strips 26, accurately fitted in the grooves and capable of movement toward and from the center of the rotary piston. Each of the packing-strips 26 is provided with slots 27, and pins 28 are passed through the sides of the rotary piston and through the slots 27, thus limiting the movement of the packing-strips except in one direction. In the groove 25 at the outer end of the rotary piston is a similar packing-strip 29, having therein the slots 30, through which the pins 31 are passed. The ends of the packing-strips 26 and 29 are cut away to form overlapping joints, as clearly shown in Fig. 12. Each packing-strip is yieldingly held outwardly by means of a leaf-spring 32, having a perforated lug 33 fixed thereto and designed to enter a notch 34 in the rotary piston, said notch being intersected by a pin-opening 35, and a pin 36 is passed through the pin-opening 35 through the perforated lug 33. The outer ends of the spring 32 rest upon the end portions of the packing-strips and force them outwardly. By this means leakage of steam around the rotary piston is prevented, and, furthermore, the inner ends of the side packing-strips 26 rest against the inner faces of the packing-rings 19, and as the packing-rings are yieldingly held inward and the packing-strips are yieldingly held outward there is always a steam-tight joint at this point even if considerable wear has taken place and even if there is considerable expansion and contraction of the metal.

The pressure-plate for coacting with the rotary piston comprises a flat plate 37, moving vertically in a recess 38, formed to receive it directly above the center of the rotary hub. The width of the pressure-plate is considerably greater than the width of the rotary piston, and grooves 39 are formed in the sides of the body portion 11, reaching down to the periphery of the hub 16 and large enough to admit the said pressure-plate. The said grooves 39 are deep enough so that when the pressure-plate moves downwardly its lower edge will strike upon the packing-rings 19, so that a steam-tight joint is thus provided between the packing-rings and the lower end of the pressure-plate. In the lower end of the pressure-plate is a groove 40, in which the packing-strip 41 is held downwardly by a spring 42, and it is this packing-strip that receives the impact when the pressure-plate strikes upon the rotary hub, thus cushioning it and yieldingly holding the packing-strip against the hub. The movement of the strip 41 is limited by the pins 43 in the slots 44, and the spring 42 is held to the body of the pressure-plate by a pin 45. By the arrangement hereinbefore described the expansion-rings 19 are made to serve the following functions: They prevent leakage of steam between the edges of the plates 17 and the adjacent part of the body 11. They also prevent the leakage of steam between the packing-strips 26 of the rotary piston and the rings, and they also serve to cushion the impact of the pressure-plate and to prevent leakage of

steam between the pressure-plate and the rings.

Mounted on top of the engine-body 11 are the two steam-chests 46. These are alike in construction and comprise a cylindrical chamber 47, having an opening 48 at its top and an opening 49 at its lower portion. The opening 49 communicates, by means of a passage-way 50, with the interior of the chamber 12. Passed through each of the chambers 47 is a shaft 51, upon which a valve 52 is mounted, said valve covering the opening 49 when in one position, so that by rocking the shaft 51 the opening 49 is covered and uncovered. Communicating with each of the chambers 46 is a steam-pipe 53. These pipes are united at 54, and each is provided with a valve 55, by which the steam may be cut off.

At the bottom of the chamber 12 is an exhaust-port 56, diametrically opposite from the induction-ports 50. This exhaust-port 56 communicates with a chamber in which is a rotary valve 57 and an exhaust-port 58. The rotary valve is provided with a central opening 59, and the parts are so arranged that when the central opening 59 is in line with the ports 56 and 58 the engine may exhaust, and when the rotary valve is turned at a different angle the passage-way through the valve is closed. This valve is controlled by a shaft 60.

I have provided means for automatically working the pressure-plate in unison with the movements of the rotary piston, as follows: Fixed to the shaft 13 is a cam-wheel 61, having a cam-groove 62 in one of its sides. The numeral 63 indicates a lever fixed to the shaft 64, which is supported upon standards 65 in such a manner that a rocking movement is permitted to the shaft 64. On the lower end of the lever 61 is a roller 66 in the groove 62. Pivoted to the upper end of the lever 63 is a link 67, the opposite end of the link being pivoted to an arm 68, which arm is keyed to a shaft 69, and said shaft is rotatably mounted in the supports 70. Keyed to the shaft 69 is a lever 71, one end of which is connected by a link 72 with the rod 73 of the pressure-plate, and the other end of the lever 71 is provided with a contractile coil-spring 74, the lower end of which is attached to a part of the machine-frame. By the arrangement just described a rotation of the shaft 13 will cause the pressure-plate to move upwardly just as the rotary piston approaches it on account of the arrangement of the cam-groove and other parts, and the pressure-plate will move downwardly immediately after the rotary piston has passed it going in either direction. The function of the spring 74 is to cushion the impact of the pressure-plate upon the rotary hub, and said spring is so arranged that it will exert enough force upon the pressure-plate to cause the pressure-plate to strike gently upon the rotary hub. However, the cam-groove is so arranged that the pressure-plate will be in contact with the rotary hub throughout the effective portion of the piston-stroke.

I have provided means for automatically operating the exhaust device, as follows: Mounted upon the shaft 13 is an eccentric 75, having an arm 76, pivoted at its lower end to a crank-arm 77, keyed to a shaft 78. Keyed to this same shaft 78 is another crank-arm 79, and a link 80 connects the crank-arm 79 with the arm 81, to which the said link is keyed. The lower end of the arm 81 is fixed to the shaft 60 and rocks said shaft in unison with the rotation of the rotary hub. The eccentric 75 is set upon its shaft 13 in such manner that the exhaust-valve 57 will be opened automatically just before the rotary piston reaches the end of its stroke near the pressure-plate. Obviously the eccentric 75 may be set on the shaft 13 in such position that the rotary valve 57 will open when the rotary piston is at any point in its movement. By the arrangement of the parts before described it is to be noted that the rotary valve will exhaust at the same point with relation to the piston-stroke no matter in which way the engine is running, so that the engine may readily be reversed and the operator need pay no attention to the exhausting device.

The means for operating the rotary valves 52 to control the admission of steam to the engine is as follows: As before stated, there are two of these shafts 51, upon which the rotary valves 52 are mounted. These shafts 51 are supported in cross-pieces 82 and 83, fixed to the machine-frame. On each of the shafts 51 is a clutch member 84, capable of longitudinal movement upon the shaft and held against rotary movement thereon by the rib 85. An annular ring 86 is placed in an annular groove in the clutch member 84, and pins 87, attached to the ring 86, are placed in slots 88 of a lever 89, hereinafter described. A movement of this lever 89 tends to force the sliding clutch member 84 into engagement with the mating clutch member 90, and this clutch member is rotatably but not slidingly mounted upon the shaft 51, but held against longitudinal movement thereon, so that the only way a rotary movement can be transmitted to the shaft 51 is by means of the clutch member 84 being placed in contact with the clutch member 90. I provide means for rocking the clutch member 90, as follows: Fixed to said clutch member is an arm 91, the end of which arm is pivoted to the eccentric-strap 92, which strap is mounted upon the eccentric 93 on the shaft 13, so that during a rotation of the shaft 13 the eccentric 93 will be rotated and the eccentric-arm 92 will be moved upwardly and downwardly, thus rocking the clutch member 90 and imparting motion to the clutch member 84 when the said clutch members are in engagement with each other. This rocking motion is sufficient to open and close the valve 52, and in this connection it is to be remem-

bered that the said valves are operated only when one or the other of the clutch members 84 are placed in engagement with its mating clutch, and when both of said clutches 84 are out of engagement then neither of the valves 52 will be rotated.

I have provided means for throwing either one of the clutch members 84 into engagement with its mating member or for placing both of them out of engagement with their mating clutch members, as follows: The numeral 94 indicates an upright shaft mounted upon a support 95 on the base 10. The upper end of the shaft 94 is keyed to the lever 89, so that by rocking the shaft 94 the lever 89 may be operated to draw either of the clutch devices into position or to hold them both inoperative. Attached to the shaft 94 is an arm 95, and a rod 96 is pivoted to said arm and attached to a lever 97. This lever is fulcrumed in a bracket 98 and on top of said bracket 98 is a series of notches 99, designed to receive a spring-actuated pawl 100, mounted on the lever 98 and controlled by the handle 101, which is connected by a rod 102 with the spring-actuated pawl. The parts are so arranged that when the spring-actuated pawl 100 is in the central one of the notches 99, as shown in Fig. 3, the lever will be in the position shown in Fig. 4, and both of the clutches 84 will be in their inoperative positions. When the lever 97 is moved to position where the pawl 100 will stand in one of the outer notches 99, then one of the clutches 84 will be in engagement with its mating clutch 90 and one of the rotary valves 52 will be operated. The other rotary valve will be operated when the lever 97 is reversed.

I have provided means for exhausting from the top of the engine-chamber, which exhaust device is opened automatically upon a reversal of the engine, as follows: Formed in the sides of the chamber 12 on opposite sides of the pressure-plate are the exhaust-openings 103. Each of these exhaust-openings is provided with a petcock 104, controlled by a lever 105. Fixed to the shaft 94 is a rim 106, and links 107 connect said rim with the valve-levers 105. By this arrangement of parts both of the petcocks 104 are closed when the engine is in its inoperative position, as shown in Fig. 4. However, when the reversal lever is operated one or the other of said petcocks is opened. These exhaust-openings 103 are necessary to permit the escape of air in front of the rotary piston after the piston has passed the exhaust-opening 56 and before the pressure-plate is elevated. It is of course essential that the opening 103 on the side in which the steam is being admitted shall be closed to prevent the escape of steam, and when the engine is reversed the petcocks 104 are automatically opened and closed in the manner before described.

In practical use and assuming that the lever 97 is drawn outwardly away from the engine and its pawl 100 is set in the outer one of the notches 99, then the clutch member 84 nearest to the lever 97 will be drawn into engagement with its clutch member 90, and when steam is admitted through the valve 55 then the engine will start to rotate in one direction, and this rotation will turn the shaft 13, and thereby rock the clutch member 90, and as said clutch member is in engagement with the clutch member 84 the said shaft 51 will be rocked and the valve 52 will be operated, as required, to admit steam during a certain portion of the running piston-stroke. In use it is desirable to admit steam for slightly over one-half of the piston-stroke, allowing the steam to expand and force the piston throughout the remainder of its stroke by said expansion. If desired, the eccentrics 93 may be so adjusted relative to the shaft 13 that the valves 52 will cut off at any desirable point. The exhaust-valve 57 is operated from the shaft 13, and hence the engine may exhaust when the piston reaches a certain predetermined point in its revolution. The opening 103 on the side opposite from the point where steam is admitted will have its petcock opened to prevent back pressure or air in the chamber at this point before the pressure-plate is elevated, and as said pressure-plate is operated also from the shaft 13 it will be drawn upwardly just prior to the time the rotary piston approaches it and will be pushed downwardly immediately after the rotary piston has passed it. If it is desired to stop the engine, it is only necessary to move the lever 97 inwardly, so that its pawl will enter the middle notch 99, whereupon the clutch members 84 will both be out of engagement with their mating clutch members, as shown in Fig. 4. Then when it is desired to reverse the movement of the engine the lever 97 is moved to its inner limit and the opposite one of the valves 52 will then be operated, the other one remaining stationary. By thus providing two independent steam-chests the operator may by cutting off the steam from one have access to the one thus cut off, even though the other is working and the engine is running.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States therefor, is—

1. In a rotary engine, a rotary hub, a piston fixed to the rotary hub, expansion-rings on the end portions of the rotary hub and spring-pressed packing-strips on the sides of the piston engaging the inner faces of the expansion-rings.

2. In a rotary engine, a rotary hub, a piston fixed to the rotary hub, expansion-rings on the end portions of the rotary hub and spring-pressed packing-strips on the sides of the piston engaging the inner faces of the expansion-rings, a pressure-plate moving to and from

the hub, and a spring-pressed packing-strip thereon engaging the periphery of the expansion-rings when in its position nearest the hub.

3. In a rotary engine, a rotary hub, a piston fixed to the rotary hub, two expansion-rings arranged side by side and engaging each other at the opposite ends of the hub, spring-pressed packing-strips on the sides of the piston engaging the inner face of the inner expansion-rings.

4. In a rotary engine, a rotary hub, a piston fixed to the rotary hub, two expansion-rings arranged side by side and engaging each other at the opposite ends of the hub, spring-pressed packing-strips on the sides of the piston engaging the inner face of the inner expansion-rings, a pressure-plate moving to and from the hub, and a spring-pressed packing-strip thereon engaging the peripheries of the expansion-rings when in its position nearest the hub.

5. In a rotary engine, a rotary hub, a piston fixed to the hub, two expansion-rings in each end of the hub, spring-pressed packing-strips on the sides of the piston engaging the inner faces of the inner rings, and springs forcing the expansion-rings toward the piston.

6. In a rotary engine, the combination of a shaft, a hub keyed to the shaft, circular plates secured to the ends of the hub and having annular grooves at the inner edges of their peripheries, two expansion-rings in each groove, springs for forcing the expansion-rings toward the center of the hub, a piston fixed to the hub, spring-pressed packing-strips on the sides of the piston, their inner ends bearing against the inner faces of the inner rings.

7. In a rotary engine, a rotary piston, comprising a body portion, having a groove therein, a packing-strip mounted in the groove and having slots therein, pins passed through the body portion and through said grooves to limit the movement of the packing-strips, a flat spring placed in said groove, a perforated block at the central portion of the spring, a pin passed through the body portion and through said perforated block, the ends of the spring engaging the end portions of the packing-strip, for the purposes stated.

8. In a rotary engine, the combination of a rotary hub, a shaft driven by the hub, a cam-wheel fixed to the shaft, a lever, a roller on the lever in the cam-groove, a link attached to said lever, a reciprocating pressure-plate, a rocking lever, a link connecting the reciprocating pressure-plate with one end of the rocking lever, a contractile coil-spring having one end fixed to the opposite end of said lever and the other end held stationary, and an arm on the rocking lever pivoted to the link of the cam-lever, for the purposes stated.

9. In a rotary engine, the combination of an engine-body, a rotary hub, a shaft driven by the rotary hub, two eccentrics on said shaft, two independent steam-chests, a valve for controlling each steam-chest, a shaft fixed to each valve, a clutch member rotatably and non-slidingly connected with each shaft, an arm connecting each of said clutch members with one of the eccentrics, a coacting clutch member on each shaft slidingly, but non-rotatably mounted, a lever connecting said sliding clutches, said lever arranged so that in one position both of the slide-clutches are free and in another position one of the slide-clutches engages its mating clutch, and the other is free, and in a third position of said lever, the opposite clutches are in engagement, arranged and combined substantially in the manner set forth, and for the purposes stated.

10. In a rotary engine, the combination of an engine-chamber, having an exhaust-opening at its lower end and two exhaust-openings near its upper end, two independent steam-chests communicating with the engine-chamber, a valve in each steam-chest, independent means for operating each valve, a lever connected with both valve-operating devices for placing either one in an operative position, two exhaust-ports at the top of the engine-chamber, a valve controlling each, and rods connected with said valves and with the said lever whereby one of said exhaust-ports is closed and the other opened when the said lever is moved to reverse the engine, for the purposes stated.

11. In a rotary engine, the combination of an engine-chamber having an exhaust-port at its bottom and two exhaust-ports near its top, two independent steam-chests communicating with the top of the engine-chamber, a valve in each steam-chest, a shaft connected with each valve, a rotating clutch member on each shaft normally rocking when the engine is running a sliding clutch member on each shaft to coact with the rotating clutch member, an upright shaft, a lever at the top of the upright shaft pivoted to both sliding clutch members, an arm on said upright shaft, and a reversing-lever connected with said arm and means for locking the reversing-lever in different positions, petcocks connected with the exhaust-ports at the top of the engine-chamber, a wheel fixed to the said upright shaft, and links connecting said wheels with the petcocks, substantially as and for the purposes stated.

12. In a rotary engine, the combination of an engine-chamber, a rotary hub in the chamber, a piston on the hub, a shaft driven by the hub, an exhaust-port at the bottom of the engine-chamber, a valve controlling the exhaust-port, means driven by the shaft for controlling said valve, two independent steam-chests communicating with the engine-chamber, independent valves for the steam-chests, shafts for said valves, a reciprocating pressure-plate, means driven by the hub-shaft for reciprocating the pressure-plate, means driven

by the hub-shaft for operating both of the valves in the steam-chests, a reversing-lever controlling said valve-operating means, and two exhaust-ports on opposite sides of the pressure-plate, and means operated by said reversing means for opening and closing said exhaust-ports, for the purposes stated.

13. In a rotary engine, the combination of an engine-chamber, a rotary hub, a piston on the hub, a shaft driven by the hub, an induction-port at the top of the engine-chamber, an eduction-port at the bottom of the engine-chamber diametrically opposite from the induction-port, and a valve controlling the eduction-port, said valve operated automatically from the hub-shaft.

ORIN WILLIAMS.

Witnesses:
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