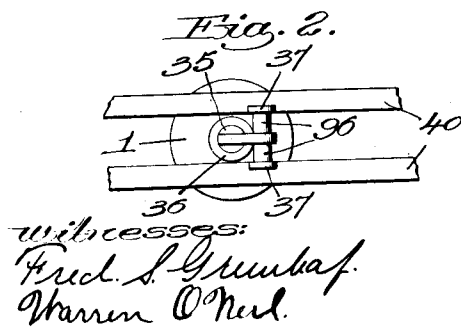
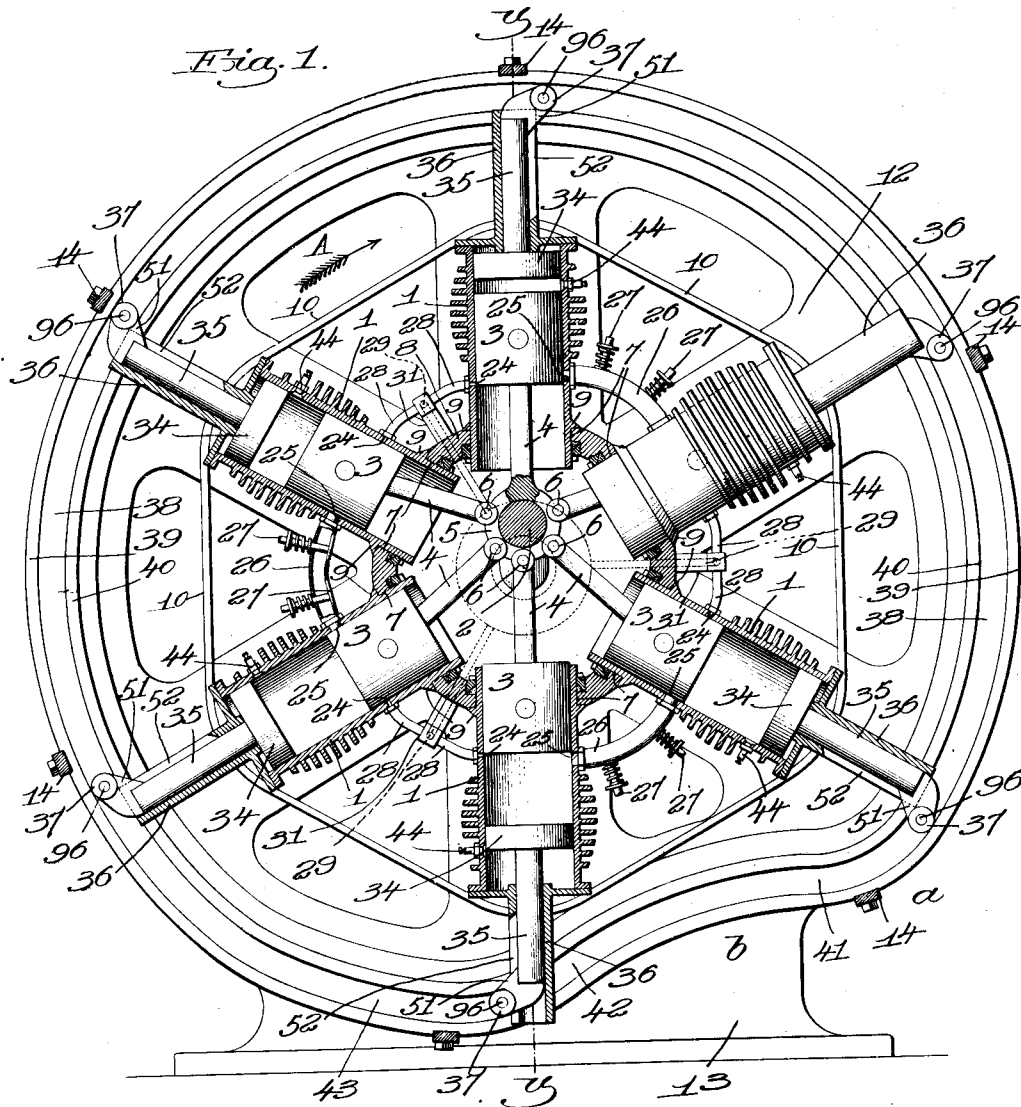


J. A. WALLIS, 2D.
 ROTARY INTERNAL COMBUSTION ENGINE.
 APPLICATION FILED DEC. 11, 1911.

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3 SHEETS-SHEET 1.



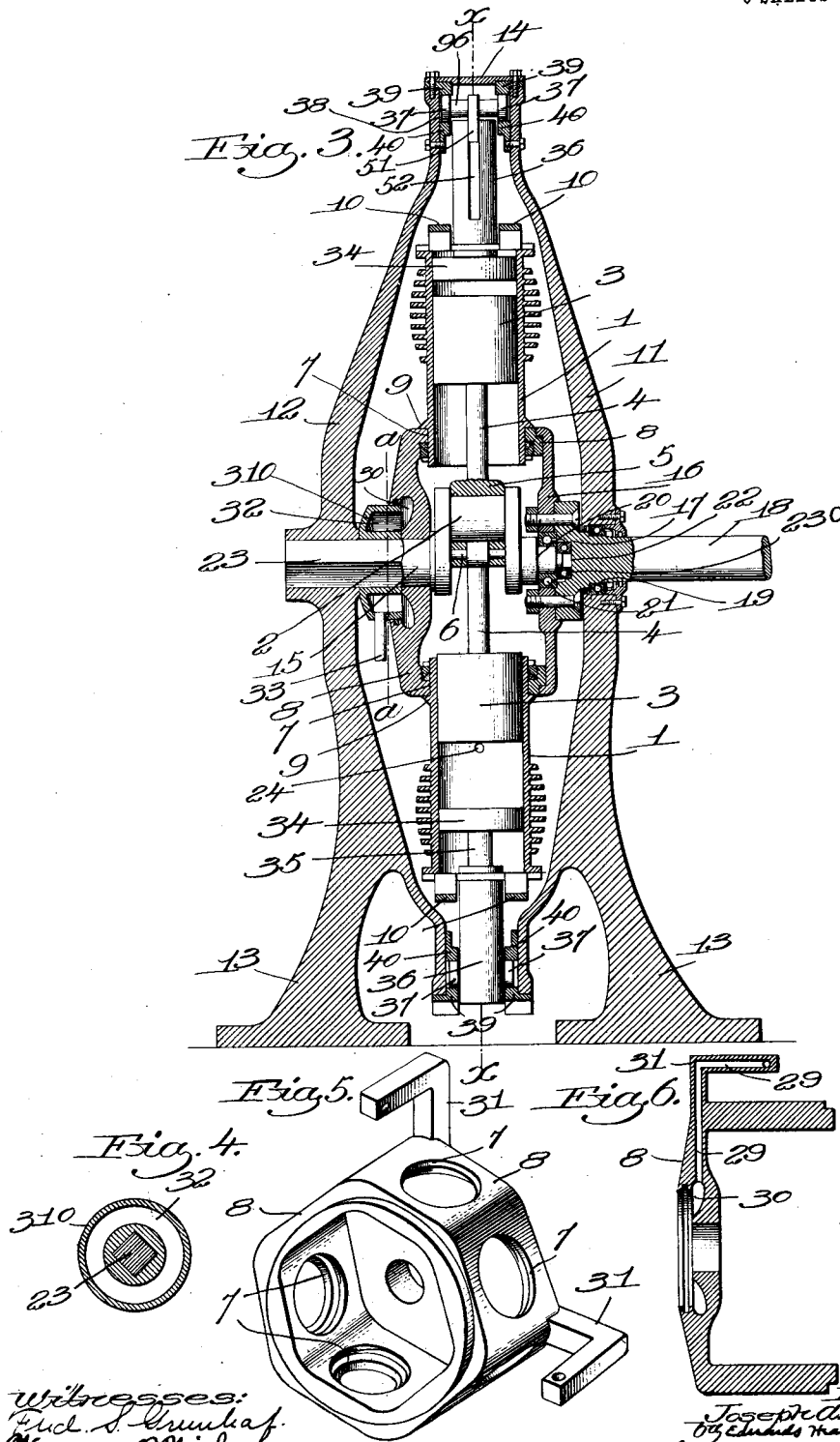
Inventor.
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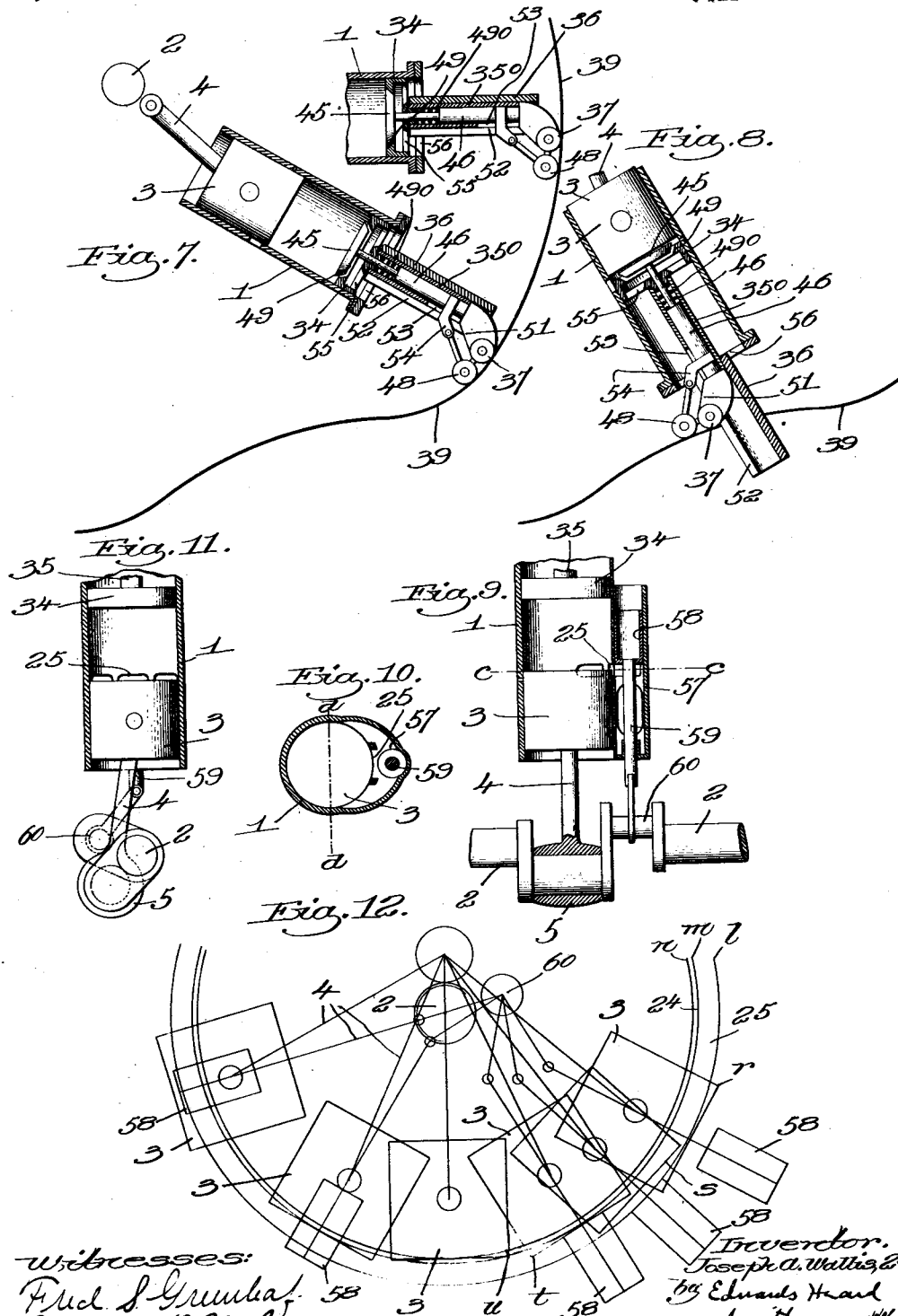
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 3 SHEETS-SHEET 3.

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UNITED STATES PATENT OFFICE.

JOSEPH A. WALLIS, 2d, OF BEVERLY, MASSACHUSETTS.

ROTARY INTERNAL-COMBUSTION ENGINE.

1,109,270.

Specification of Letters Patent.

Patented Sept. 1, 1914.

Application filed December 11, 1911. Serial No. 665,028.

To all whom it may concern:

Be it known that I, JOSEPH A. WALLIS, 2d, a citizen of the United States, residing at Beverly, county of Essex, and State of Massachusetts, have invented an Improvement in Rotary Internal-Combustion Engines, of which the following description, in connection with the accompanying drawing, is a specification, like characters on the drawing representing like parts.

This invention relates to rotary internal combustion engines of that type which embody a plurality of radially-arranged cylinders, the pistons of which are all connected to the same crank shaft and which are arranged to be fired successively.

One of the objects of my invention is to provide an auxiliary or scavenging piston for each cylinder which operates at the proper point in the cycle of operations to scavenge the cylinder and then to draw into it a fresh charge, thus making the engine two-cycle in its operation.

I have illustrated in the drawings some embodiments of my invention which I will now describe, it being understood, of course, that the constructions shown in the drawings are merely selected embodiments of the invention which are sufficient to show the principle thereof.

Figure 1 is a vertical sectional view through an engine embodying my invention taken on the line $x-x$, Fig. 3; Fig. 2 is a detail view of the track for controlling the auxiliary or scavenging piston; Fig. 3 is a vertical section on the line $y-y$, Fig. 1; Fig. 4 is a section on the line $a-a$, Fig. 3; Fig. 5 is a perspective view of the head having the inlet channels for the admission of the explosive charge to the cylinders; Fig. 6 is a vertical section through the head shown in Fig. 5; Fig. 7 is a detail showing a different arrangement of exhaust valve from that illustrated in Figs. 1 and 3; Fig. 8 is a view of the exhaust valve construction shown in Fig. 7 with the parts in different positions; Fig. 9 shows a modified form of exhaust valve; Fig. 10 is a section on the line $c-c$, Fig. 9; Fig. 11 is a section on the line $d-d$, Fig. 10; Fig. 12 is a diagrammatic view showing the relative positions of the working piston and valve at different points in the cycle of operations.

Referring first to Figs. 1 and 3, the cylinders are shown at 1 and are arranged in radial formation surrounding a crank shaft 2. Each cylinder has therein a working piston 3 which is connected by a connecting rod 4 with the crank of the crank shaft 2. While any appropriate manner of connecting the connecting rods to the crank might be employed, I have herein shown one of the connecting rods as having a sleeve 5 integral therewith which surrounds the crank 2 and to which each of the other connecting rods is pivotally connected, as at 6. The crank shaft 2 is stationary and the cylinders 1 are arranged to be rotated about the crank shaft and during such rotation the pistons 3 will have a reciprocating movement in the cylinders, as will be obvious. The cylinders may be supported in any suitable way to permit of their rotation, and as herein shown the inner end of each cylinder is set into an aperture 7 formed in a frame 8 which is mounted to rotate, each cylinder being shown as having a flange 9 to rest against the outer face of the frame 8. For holding the cylinders in their position against centrifugal action, I employ a band or hoop 10 which surrounds the outer ends of the cylinders and holds them firmly seated against the frame 8. The cylinders and frame 8 which constitute the rotating part of the engine are confined between two heads or side pieces 11 and 12 which are provided with feet 13 by which they may be bolted to a floor and which are suitably connected at their peripheries by tie-bars 14. The frame 8 is mounted to turn about the portion 15 of the crank shaft 2, and said frame has associated therewith a head 16 to which is secured the end 17 of a driving shaft 18. This shaft 18 is thus secured to the frame 8 and rotates therewith and it constitutes the shaft from which the power is taken. Said driving shaft 18 extends through the head 11 and is preferably journaled in suitable roller bearings 19 therein. The crank shaft 2 is shown as provided with the extension 20 which is journaled in ball bearings 21 carried by the head 16 and the end 17 of the shaft 18 is provided with a recess 22 which receives a thrust bearing 23 against which the extension 20 rests. The head 16 and shaft 17, therefore, con-

stitute a support for one end of the crank shaft 2. The other end of said crank shaft is made non-circular in cross section, as at 23, and is held in a corresponding aperture in the side piece 12.

In the embodiment shown in Figs. 1 and 3 each cylinder is provided with an inlet port 24 and with an exhaust port 25, said ports being situated to be opened and closed by the piston 3 as it reciprocates. Each exhaust port 25 is shown as leading into an exhaust pipe 26 which is provided with a spring-pressed exhaust valve 27 arranged to open outwardly. Each inlet port communicates with an inlet pipe 28 which has communication with an inlet passage 29 formed in the head 8 and communicating with an annular chamber 30 also formed in said head. The head 8 is formed with L-shaped arms or extensions 31 through which the ports or conduits 29 pass, the ends of said conduits having communication with the inlet pipes 28.

I have shown an arrangement of inlet and exhaust ports in Fig. 1 wherein the two adjacent cylinders have their exhaust ports on adjacent sides thereof so that two cylinders may exhaust into the same exhaust pipe 26. By means of this arrangement one extension 31 and its conduit 29 therein will supply a gaseous charge to two cylinders, each extension 31 having two inlet pipes 28 connected thereto.

Fast on the crank shaft 2 is a member 310 provided with an annular chamber 32 which is open at one side. Said member 310 fits into an opening formed in the side of the head 8, and the chamber 32 has communication with the chamber 30. 33 is a supply pipe to supply a gaseous mixture to the chamber 32. This arrangement is such as to afford a constant communication between the chambers 32 and 30 notwithstanding the rotary motion of the head 8 and the cylinder.

One of the important features of my invention relates to the provision of a scavenging piston in each cylinder, which piston operates at the appropriate time in the cycle of movements to scavenge the cylinder and then to draw thereinto a fresh charge of explosive mixture. These scavenging pistons are shown at 34 and each is provided with a stem 35 which extends through an aperture in the end of the cylinder and through a hollow neck 36 extending from the cylinder head. The position of the scavenging pistons in the cylinders is determined by a stationary guide or track associated with the heads 11 and 12. As shown in Figs. 1, 2 and 3, each stem 35 is provided at its end with laterally-extending arms 37 provided with rolls 37, and these rolls operate in a track 38 formed by two rails 39 and 40

which are spaced apart and are secured to the stationary frame. The rails 39 and 40 are shown as bolted to the heads 11 and 12, as plainly seen in Fig. 3. The track 38 is concentric throughout the greater portion of its extent, but is provided with a cam portion which operates to force the scavenging piston inwardly and then draw it outwardly again at the time when the scavenging is to be done. The concentric portion of the track is situated so as to maintain the scavenging pistons at the outer ends of the cylinders. The arrangement of the crank shaft is such in Fig. 1 that the exhaust and inlet ports of each cylinder are opened by the piston as the cylinder passes through the lower right-hand quarter of its revolution, and I have, therefore, made the track 38 with the inwardly-inclined portion 41 situated to cause the scavenging piston 34 to move inwardly while the cylinder is traveling from the point *a* to the point *b* and with the outwardly-inclined portion 42 which operates to draw the piston back again to its normal position, said outwardly-inclined portion 42 terminating in a gradually-inclined portion 43. The cam portion of the track has such a shape that the movement which is given to the scavenging piston 34 as the cylinder passes from the point *a* to the point *b* is sufficient to cause the scavenging piston to move down into substantial contact with the working piston.

In the operation of the device assuming that the engine is rotating in the direction of the arrow A it will be seen that when each cylinder reaches the point *a* in the track, the scavenging piston will be forced inwardly and at this time the exhaust port 25 is uncovered. This inward movement of the scavenging piston is sufficient to bring it into substantial contact with the working piston, and as a result such movement of the scavenging piston will scavenge the cylinder and force all of the burnt gases out therefrom. After the cylinder is scavenged the outward movement of the scavenging piston due to the shape 42, 43 of the track will create a suction in the cylinder which will draw thereinto a fresh explosive charge. As the cylinder continues its rotation the piston 3 is gradually moved upwardly therein until the cylinder reaches a vertical position over the crank shaft, and during this time the charge is subjected to compression, as will be obvious. When the charge has been thus compressed it is fired by means of a suitable spark plug 44 which may be operated in any suitable way and the explosion will tend to separate the two pistons, the force thus expended resolving itself into one which causes rotation of the cylinders and driving shaft. This operation is repeated for each cylinder. It will be seen,

therefore, that an explosion occurs in each cylinder during each revolution so that my engine works on the two-cycle principle.

During the operation of the engine the scavenging piston is held by centrifugal action in its outward position with the rolls 37 running against the track 39. The track 40 is in the nature of a guard rail which serves to force the scavenging piston outward at the points 42, 43 when the engine is running slowly or is being turned over by hand.

The stem 35 of each scavenging piston is provided with a rib 51 which plays in a slot 52 formed in the tubular neck 36, said rib and slot operating to prevent the scavenging piston from turning and thereby hold the rolls 37 in proper alinement with the track.

In lieu of the exhaust valve arrangement shown in Figs. 1 to 3, I may use that shown in Figs. 7 and 8. In this construction the scavenging piston 34 is provided with a port 49 which is closed by an exhaust valve 45. This exhaust valve is formed with a stem 46 which extends through the stem 350 of the scavenging piston, the latter stem being made tubular for this purpose. The end of the stem 46 is formed with a laterally-extending arm 54 which operates in a slot 53 formed in the stem 350 and also extends through the slot 52 formed in the tubular neck 36 and which carries at its end a roll 48 that operates on the track 39 in advance of the roll 37. Since this roll stands in advance of the roll 37 the roll 48 is so positioned relative to the roll 37 that when the two rolls are passing over the concentric portion of the track 39, as shown at the upper half of Fig. 7, the valve 45 will be held to its seat by the action of the spring 490. When, however, the rolls are passing over the inwardly-inclined portion of the track, as shown in the lower part of Fig. 7 and in Fig. 8, the advance position of the roll 48 will cause the exhaust valve 45 to be opened, thus permitting the gases in the cylinder to be exhausted through the ports 55 in the scavenging piston and through the openings 56 in the end of the cylinder 1.

In Figs. 9 to 12 I have shown still another manner of controlling the exhaust valve. In this embodiment the exhaust port 25 in the cylinder 1 leads to a supplemental cylinder 57 having an exhaust valve piston 58 therein. The latter is connected by a connecting rod 59 with a crank 60 rigid with the crank shaft 2, but arranged at a suitable angle to the crank thereon. With this arrangement the valve 58 will have a reciprocating motion in its cylinder as the engine operates and also will have a motion relative to the working piston 3. In Fig. 12 I have illustrated diagrammatically the operation of this exhaust valve, and in said

figure the circular space between the lines 65 l and m indicates the path of travel of the exhaust port 25 and the circular space between the lines m and n indicates the path of travel of the inlet port 24. The various positions of the working piston are shown diagrammatically at 3 and of the exhaust valve piston at 58. When the piston has reached the position r the exhaust valves and inlet valves are both closed by the working piston. When the pistons reach the position s the working piston has moved inwardly to partially open the exhaust port, and when the position t is reached, the working piston has entirely uncovered the exhaust port. Between the positions s and t , however, the valve 58 has a quick movement inward to close the exhaust port. As the cylinders continue their movement into the position u the inlet port is opened by the working piston 3 to admit a fresh charge of explosive mixture to the cylinder, but this does not occur until after the exhaust port is closed, as above described.

While I have illustrated various ways of operating the exhaust valve I do not wish to be limited to any particular construction, as any suitable method of securing a proper exhaust of the gases of combustion might be adopted without departing from the invention. Neither do I wish to be limited to the particular method of controlling the scavenging piston, nor in any way except by the terms of the appended claims.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. In a rotary internal combustion engine, the combination with a stationary crank shaft, of a plurality of radially-arranged cylinders rotatable about the crank shaft, a working piston in each cylinder connected to the crank shaft, a scavenging piston in each cylinder, and means encircling the cylinders to operate the scavenging pistons thereby to scavenge each cylinder at the proper point in the cycle of operations.

2. In a rotary internal combustion engine, the combination with a stationary crank shaft, of a plurality of radially-arranged cylinders rotatable about the crank shaft, a working piston in each cylinder connected to the crank shaft, a scavenging piston at the outer end of each cylinder, and means encircling the cylinders to move each scavenging piston in the cylinder at the proper point in the cycle of operations thereby to scavenge said cylinder.

3. In a rotary internal combustion engine, the combination with a stationary crank shaft, of a plurality of radially-arranged cylinders rotatable about the crank shaft, a working piston in each cylinder connected to the crank shaft, a scavenging pis-

ton in the outer end of each cylinder, each scavenging piston being provided with a stem extending beyond the cylinder, and means encircling the cylinders acting on the end of the stems to move the scavenging pistons in the cylinders thereby to scavenge the latter.

4. In a rotary internal combustion engine, the combination with a stationary crank shaft, of a plurality of radially-arranged cylinders rotatable about the crank shaft, a working piston in each cylinder connected to the crank shaft, a scavenging piston in the outer end of each cylinder, each scavenging piston having a stem projecting through the cylinder head, and means encircling the cylinders acting on said stems and operating to move each scavenging piston inwardly thereby to scavenge the cylinders and then to move said pistons outwardly thereby to draw in a fresh charge.

5. In a rotary internal combustion engine, the combination with a stationary crank shaft, of a plurality of radially-arranged cylinders rotatable about the crank shaft, a working piston in each cylinder connected to the crank shaft, a scavenging piston in the outer end of each cylinder, each scavenging piston having a stem projecting through the cylinder head and provided with guide rolls, a track exterior to the cyl-

inders and on which said guide rolls operate, said track being shaped to give each scavenging piston an inward movement to scavenge the cylinder and an outward movement to draw a fresh charge of mixture into the cylinder.

6. In a rotary internal combustion engine, the combination with two stationary side pieces, of a stationary crank shaft sustained thereby, a rotatable cylinder-carrying frame situated between said side pieces and sustained thereby, a plurality of radially-arranged cylinders carried by the rotatable frame, a driving or power shaft connected to the frame and extending through and journaled in one of said side pieces, working pistons in the cylinders connected to the stationary crank shaft, a scavenging piston in each cylinder, a cam track carried by the side pieces, and means connecting the scavenging pistons with said track whereby said pistons are operated as the cylinder-carrying frame rotates.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

JOSEPH A. WALLIS, 2d.

Witnesses:

LOUIS C. SMITH,
THOMAS J. DRUMMOND.