No. 822,700. PATENTED JUNE 5, 1906.

W. O. STEELE.

ROTARY ENGINE.

APPLICATION FILED JUNE 21, 1905.

2 SHEETS—SHEET 1.

FIG. I.

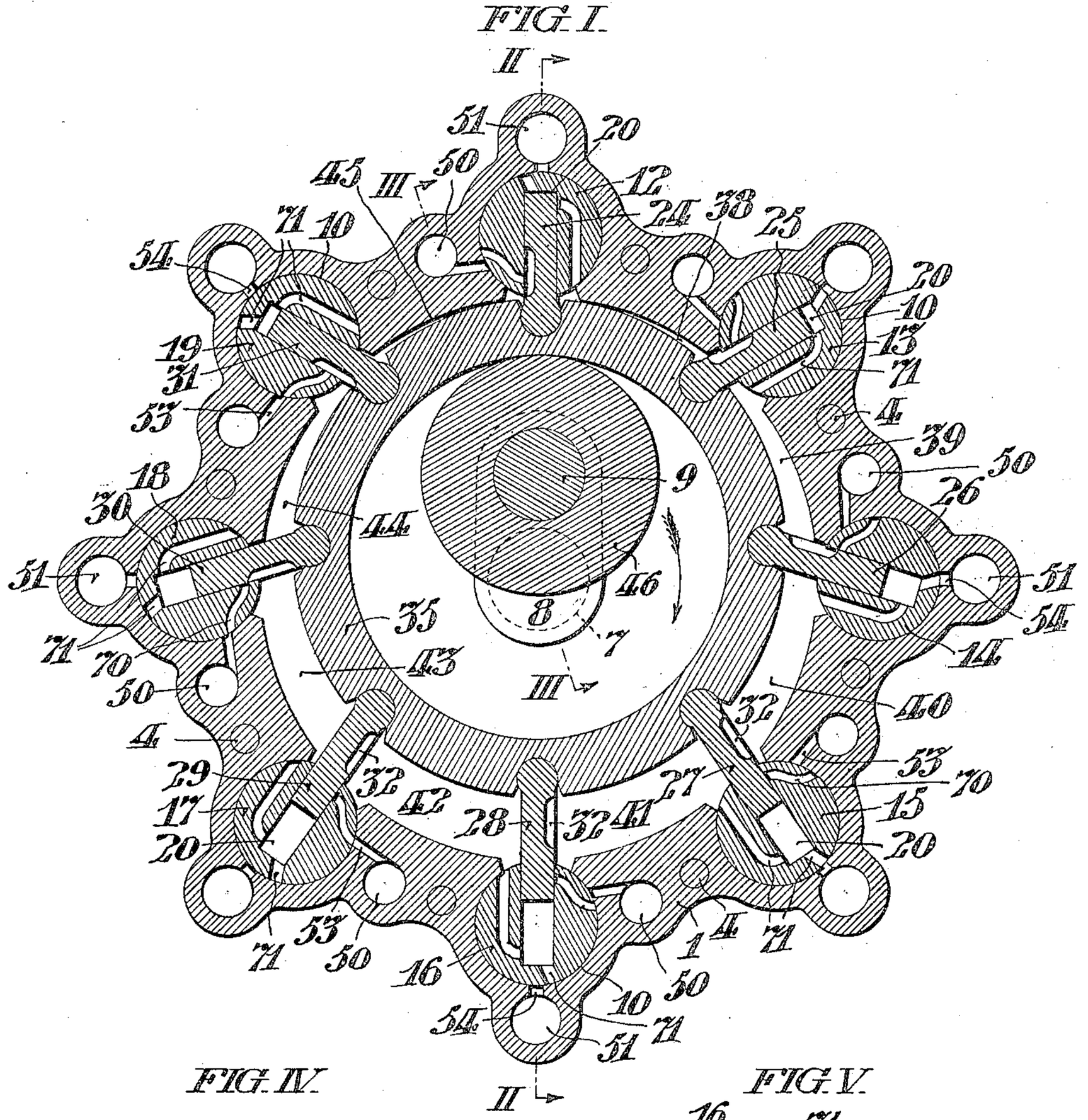


FIG. IV.

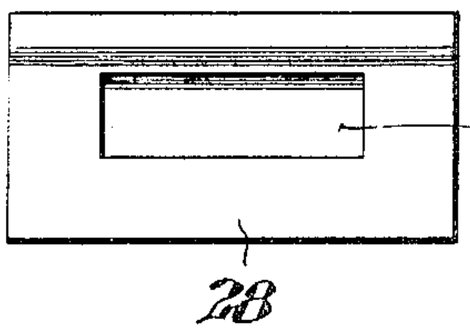
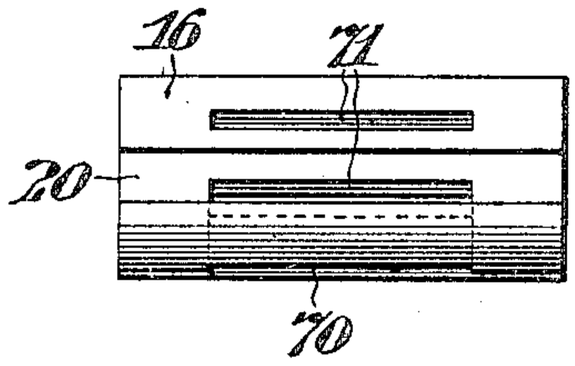


FIG. V.



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2 SHEETS—SHEET 2.

FIG II

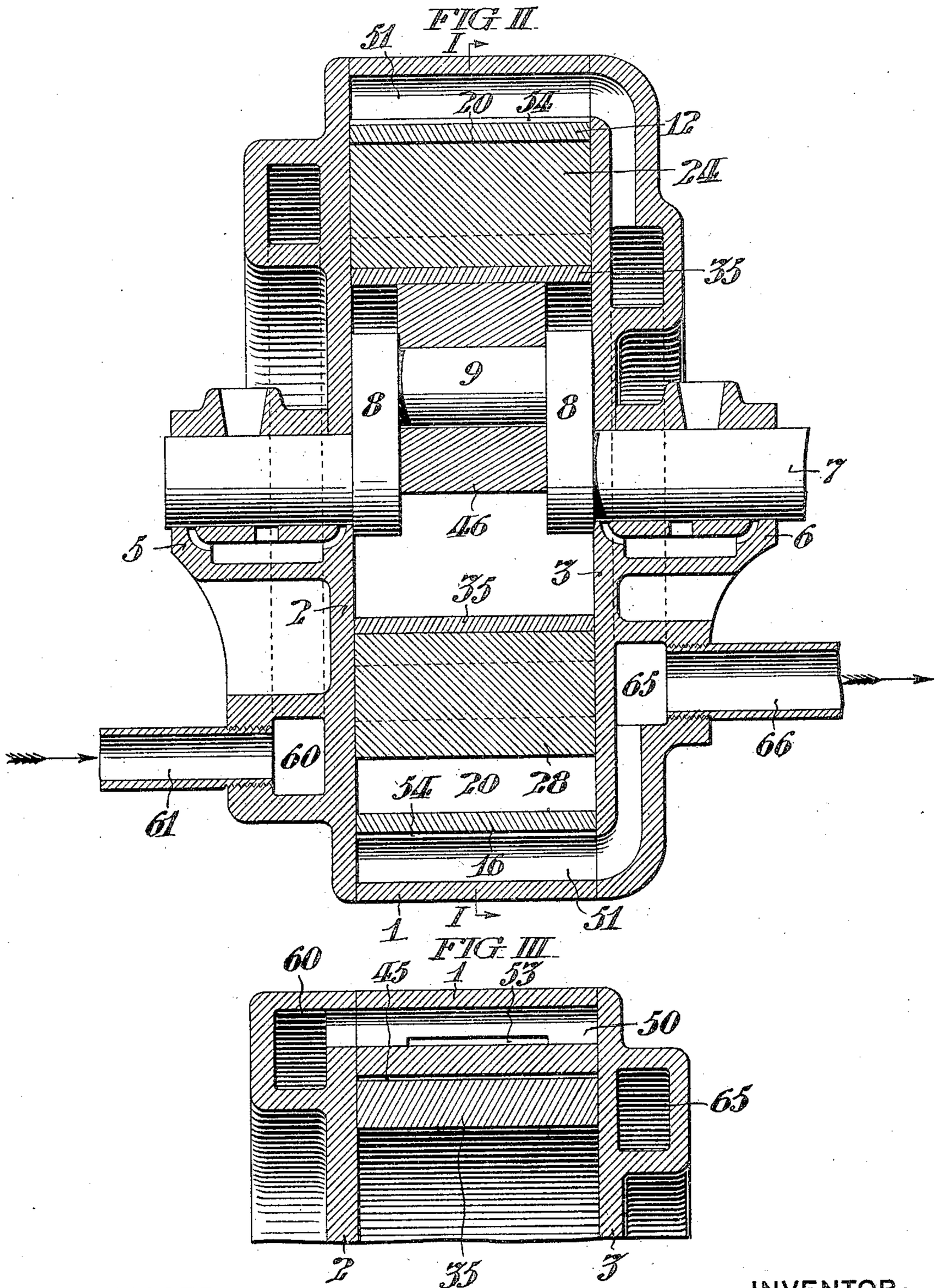

FIG III

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UNITED STATES PATENT OFFICE.

WILLIAM O. STEELE, OF GRENLOCH, NEW JERSEY, ASSIGNOR TO WATSON BIRDSALL RULON, OF PHILADELPHIA, PENNSYLVANIA.

ROTARY ENGINE.

No. 822,700. Specification of Letters Patent. Patented June 5, 1906.

Application filed June 21, 1905. Serial No. 266,209.

To all whom it may concern:

Be it known that I, WILLIAM O. STEELE, of Grenloch, in the county of Camden and State of New Jersey, have invented certain new and useful Improvements in Rotary Engines, whereof the following is a specification, reference being had to the accompanying drawings.

My invention relates particularly to rotary engines comprising a casing inclosing an annular piston surrounding a crank-shaft in operative relation with the latter, said piston being connected with said casing by expansible and contractible connections forming a series of independent compartments between said casing and piston and arranged to receive and emit a motor fluid in definite sequence with respect to said compartments to operate said piston, and thereby rotate said shaft.

It is an object of my invention to so arrange said connections as to thereby control ports for the motor fluid.

A further object of my invention is to so arrange said connections as to afford a series of air-cushions to prevent frictional engagement between said casing and piston.

In the form of my invention hereinafter described said expansible and contractible connections comprise a series of rotary valves whose axes are parallel with the axis of said shaft and which are arranged to be oscillated in accordance with the movement of said piston with which they are connected by slide-valves arranged to reciprocate in sockets in said rotary valves, said sockets inclosing the air-cushions aforesaid.

My invention comprises the various novel features of construction and arrangement hereinafter more definitely specified.

In the accompanying drawings, Figure I is a sectional view of an engine conveniently embodying my improvements, taken on the line I I in Fig. II. Fig. II is a sectional view of said engine, taken on the line II II in Fig. I. Fig. III is a fragmentary sectional view of said engine, taken on the line III III in Fig. I. Fig. IV is a side elevation of one of the slide-valves. Fig. V is a plan view of one of the rotary valves.

In said figures the stationary casing of the engine comprises the cylinder 1, inlet-head 2, and exhaust-head 3. Said heads are secured to said cylinder by the bolts 4 and respectively comprise bearings 5 and 6 for the driving-shaft 7, having the crank-arms 8 and crank 9. Said cylinder 1 comprises a series of circular recesses 10, in which are mounted the rotary valves 12 to 19, inclusive, arranged for oscillation. Said valves have respective sockets 20, extending parallel with their axes, in which the respective slide-valves 24 to 31, inclusive, are arranged to reciprocate. Said slide-valves 24 to 31 each have a recess 32 in one side and are pivotally connected to the annular piston 35, so as to separate the chamber between said casing-cylinder 1 and said piston 35 into a series of compartments 38 to 45, inclusive, with respect to which steam or other motor fluid is alternately admitted and emitted in definite sequence to gyrate said piston in said cylinder, said piston being arranged to transmit rotary motion to the crank 9 and shaft 7.

The piston 35 is of less diameter than the inner circumference of the cylinder 1 and is arranged to be gyrated therein with its periphery in tangential relation to said inner circumference of the cylinder and in eccentric relation to the shaft 7 by the admission of motor fluid to the compartments in succession and by successively exhausting the compartments diametrically opposite thereto, thereby continuously shifting said piston.

The crank 9 carries the wheel 46, arranged to rotate thereon with its periphery in tangential engagement with the internal circumference of the piston 35, so that when said piston is shifted, as above described, the wheel 46 rolls on its inner circumference and imparts rotary motion to the shaft 7.

Referring to Fig. I, it may be noted that the piston 35 has a gyratory motion with respect to the cylinder 1, tending to bring said piston into frictional engagement with the inner circumference in the cylinder 1. However, air-cushioning devices to prevent such engagement are afforded within the rotary valves 12 to 19, inclusive. Referring to the rotary valve 12 in Fig. I, it may be noted that the air confined in the upper end of the socket 20 and the passage leading therefrom tends to hold the piston 35 yieldingly away from said cylinder and each of the slide-valves and rotary valves assume the last-described relation in succession as the piston 35 is shift-

ed. The cylinder 1 is provided with the inlet-passages 50 and outlet-passages 51 local to each of said rotary valves 12, &c., and inlet and outlet ports 53 and 54, respectively, leading from said passages to the recesses 10. Said passages 50 are all in communication with the steam-chest 60 in the inlet-head 2, which is supplied through the pipe 61. The exhaust outlet-passages 51 all communicate with the exhaust-chamber 65 in the exhaust-head 3, which is provided with the vent-pipe 66. Each of said rotary valves comprises an inlet-channel 70 and an exhaust-channel 71, the former being arranged to register with the inlet-port 53 and with the recess 32 in its respective slide-valve, and the exhaust-channel 71 being in communication with the socket 20 and arranged to register with its respective exhaust-port 54 and with the motor-compartment forward of its slide-valve with respect to the rotation of the engine.

The eccentric motion of the piston 35 tends to oscillate the rotary valves 12, &c., and reciprocate the slide-valves 24, &c., to alternately establish and terminate communication, respectively, between the motor-fluid supply and the motor-compartments and between said compartments and the exhaust, the admission and exhaust occurring contemporaneously with respect to compartments at opposite sides of the cylinder 1.

The engine above described operates as follows: With the parts in the position shown in the drawings, the compartments 39, 40, and 41 being in communication with the exhaust-chamber 65 through the channels 71 in the valves 13, 14, and 15 and the compartment 44 in communication with the steam-chest 60 through the channel 70, steam or other motor fluid supplied to said chest 60 is admitted to the compartment 44, where its pressure against the piston 35 causes the latter to shift eccentrically against the wheel 46 on the crank 9, which being thus acted upon by the independent bodies of fluid admitted to the motor-compartments in succession is continuously turned to rotate the shaft 7. For instance, as the motor fluid flows into said compartment 44 the latter expands by the movement of the piston 35 inwardly away from the cylinder 1 and the slide-valve 31 is drawn out of its socket 20 in its coöperative rotary valve 19. The channel 70 is thereby closed (as best shown by the slide-valve 30 and its coöperative rotary valve 18 in Fig. I) and the further movement of the piston 35 oscillates the rotary valve 12 until its channel 70 fully registers with its port 53 to admit motor fluid to the motor-compartment 45 next in succession to said compartment 44. While motor fluid is being admitted to the motor-compartment 44, as above described, the compartments 39, 40, and 41 are being exhausted through the channels 71 in the respective rotary valves 13, 14, and 15. Likewise when motor fluid is admitted to the compartment 45 the compartments 40, 41, and 42 will be in communication with the exhaust through the channels 70 in the respective valves 14, 15, and 16, and so on throughout the entire circular series of compartments.

Although I have referred to steam as a typical motor fluid adapted for employment in an engine constructed in accordance with my invention, it is to be understood that other fluid may be employed—for instance, compressed air or gas, either combustible or otherwise.

I do not desire to limit myself to the precise details of construction and arrangement herein described, as it is obvious that various modifications may be made therein without departing from the essential features of my invention.

I claim—

1. In a rotary engine, the combination with a stationary casing; of a piston in said casing; variable connections between fixed points on said piston and casing separating a series of independent motor-compartments; ports local to and controlled by said connections, whereby motor fluid is admitted to said compartments in definite sequence to operate said connections and said piston; a shaft; and, a transmission device between said shaft and said piston, substantially as set forth.

2. In a rotary engine, the combination with a stationary casing; of a piston in said casing; expansible and contractible connections between fixed points on said piston and casing, separating a series of independent motor-compartments; ports controlled by said connections, whereby pressure fluid is admitted to said compartments in definite sequence to operate said connections and said piston; a shaft; and, a transmission device between said shaft and said piston, substantially as set forth.

3. In a rotary engine, the combination with a casing; of a piston in said casing; oscillatory valves arranged to separate independent compartments between said piston and said casing and to control the supply of motor fluid to said compartments; a shaft; and, a transmission device, whereby said shaft is rotated by said piston, substantially as set forth.

4. In a rotary engine, the combination with a casing; of a piston in said casing; slide-valves arranged to separate independent compartments between said piston and said casing, and to control the supply of motor fluid to said compartments; a shaft; and, a transmission device, whereby said shaft is rotated by said piston, substantially as set forth.

5. In a rotary engine, the combination with a casing; of a piston in said casing; ro-

tary valves mounted to oscillate in said casing; a socket in each of said rotary valves; slide-valves arranged to reciprocate in the respective sockets and to separate compartments between said piston and said casing; means whereby the reciprocatory movement of said slide-valves controls the supply of motor fluid to said compartments; a shaft; and, a transmission device, whereby said shaft is rotated by said piston, substantially as set forth.

6. In a rotary engine, the combination with a stationary casing; of a shaft provided with a crank arranged to rotate in said casing; an annular piston in said casing encircling said crank in operative relation thereto; expansible and contractible connections between fixed points on said piston and said casing, separating a series of independent motor-compartments; and, ports controlled by said connections, whereby motor fluid is admitted in definite sequence with respect to said compartments, substantially as set forth.

7. In a rotary engine, the combination with a stationary casing; of a shaft provided with a crank arranged to rotate in said casing; an annular piston in said casing encircling said crank in operative relation thereto; expansible and contractible connections between fixed points on said piston and said casing, separating a series of independent motor-compartments and comprising a series of rotary valves whose axes are parallel with the axis of said shaft; each of said valves having a socket; slide-valves connected with said piston and arranged to reciprocate in said sockets; and, ports local to said connections, controlled by said valves, substantially as set forth.

8. In a rotary engine, the combination with a stationary casing; of a shaft provided with a crank arranged to rotate in said casing; an annular piston in said casing encircling said crank in operative relation thereto; variable connections between fixed points on said piston and said casing, separating a series of independent motor-compartments and comprising a series of rotary valves whose axes are parallel with the axis of said shaft, each of said valves having a socket arranged to communicate with an exhaust-outlet and the compartment local to said connection; slide-valves connected with said piston and arranged to reciprocate in said sockets; and, ports local to said connections respectively controlled by the oscillatory movement of said rotary valves and the reciprocatory movement of said slide-valves, substantially as set forth.

9. In a rotary engine, the combination with a stationary casing; of a piston in said casing; variable connections between fixed points on said piston and casing, separating a series of independent motor-compartments; and, an air-cushioning device preventing frictional engagement between said piston and casing, substantially as set forth.

10. In a rotary engine, the combination with a casing inclosing an annular piston surrounding a crank-shaft in operative relation with the latter; of expansible and contractible connections between said piston and said casing, separating a series of independent motor-compartments between said casing and piston; and, an air-cushioning device preventing frictional engagement between said piston and casing, substantially as set forth.

11. In a rotary engine, the combination with a casing; of an annular piston in said casing; variable connections between said piston and said casing separating a series of independent motor-compartments; valves arranged to be actuated by said connections; ports arranged to be alternately opened and closed by said valves whereby fluid-pressure is introduced to gyrate said piston; a shaft; cranks on said shaft; a crank-pin; and, a wheel mounted to rotate on said pin in tangential relation to said piston to rotate said shaft, substantially as set forth.

12. In a rotary engine, the combination with a casing; of an annular piston in said casing; variable connections between said piston and said casing separating a series of independent motor-compartments; valves arranged to be oscillated by said connections; ports in said casing; channels in said valves arranged to register with said ports; a shaft; and, a device whereby the movement of said piston rotates said shaft, substantially as set forth.

13. In a rotary engine, the combination with a casing; of an annular piston in said casing; variable connections between said piston and said casing separating a series of independent motor-compartments; valves arranged to be oscillated by said connections; ports in said casing; channels in said valves arranged to connect said ports with said compartments; a shaft; and, a device whereby the movement of said piston rotates said shaft, substantially as set forth.

14. In a rotary engine, the combination with a casing; of an annular piston in said casing; variable connections between said piston and said casing separating a series of independent motor-compartments; valves arranged to be oscillated by said connections; inlet-ports in said casing; a channel in each of said valves arranged to connect one of said ports with a compartment; exhaust-ports in said casing; a channel in each of said valves arranged to connect one of said exhaust-ports with a compartment; a shaft; and, a device whereby said shaft is rotated by said piston, substantially as set forth.

15. In a rotary engine, the combination with a casing; of an annular piston in said

casing; variable connections between said piston and said casing separating a series of independent motor-compartments; valves arranged to be actuated by said connections; a socket in each of said valves arranged to receive one of said connections; inlet-ports in said casing; a channel in each of said valves arranged to connect one of said ports with a compartment; exhaust-ports in said casing; a channel in each of said valves arranged to connect its socket with one of said exhaust-ports and with a compartment; a shaft; and, a device whereby said shaft is rotated by the movement of said piston, substantially as set forth.

16. In a rotary engine, the combination with a casing; of a gyratory piston in said casing; rotary valves mounted to oscillate in said casing; a socket in each of said rotary valves; slide-valves respectively arranged to reciprocate in said sockets and to separate compartments between said piston and said casing; ports in said casing; channels in said rotary valves respectively arranged to register with said ports; a recess in each of said slide-valves arranged to connect the local channel and compartment; exhaust-ports in said casing; a channel in each of said rotary valves arranged to include its socket and to connect one of said exhaust-ports with a compartment; a shaft; and, a device whereby the gyration of said cylinder rotates said shaft, substantially as set forth.

In testimony whereof I have hereunto signed my name, at Grenloch, New Jersey, this 1st day of June, 1905.

WILLIAM O. STEELE.

Witnesses:

JOHN E. KEATING,

ELMER E. WILSON.