No. 690,379. Patented Dec. 31, 1901.

J. W. SUNDERLAND.

ROTARY ENGINE.

(Application filed Mar. 29, 1901.)

(No Model.) 5 Sheets—Sheet 1.

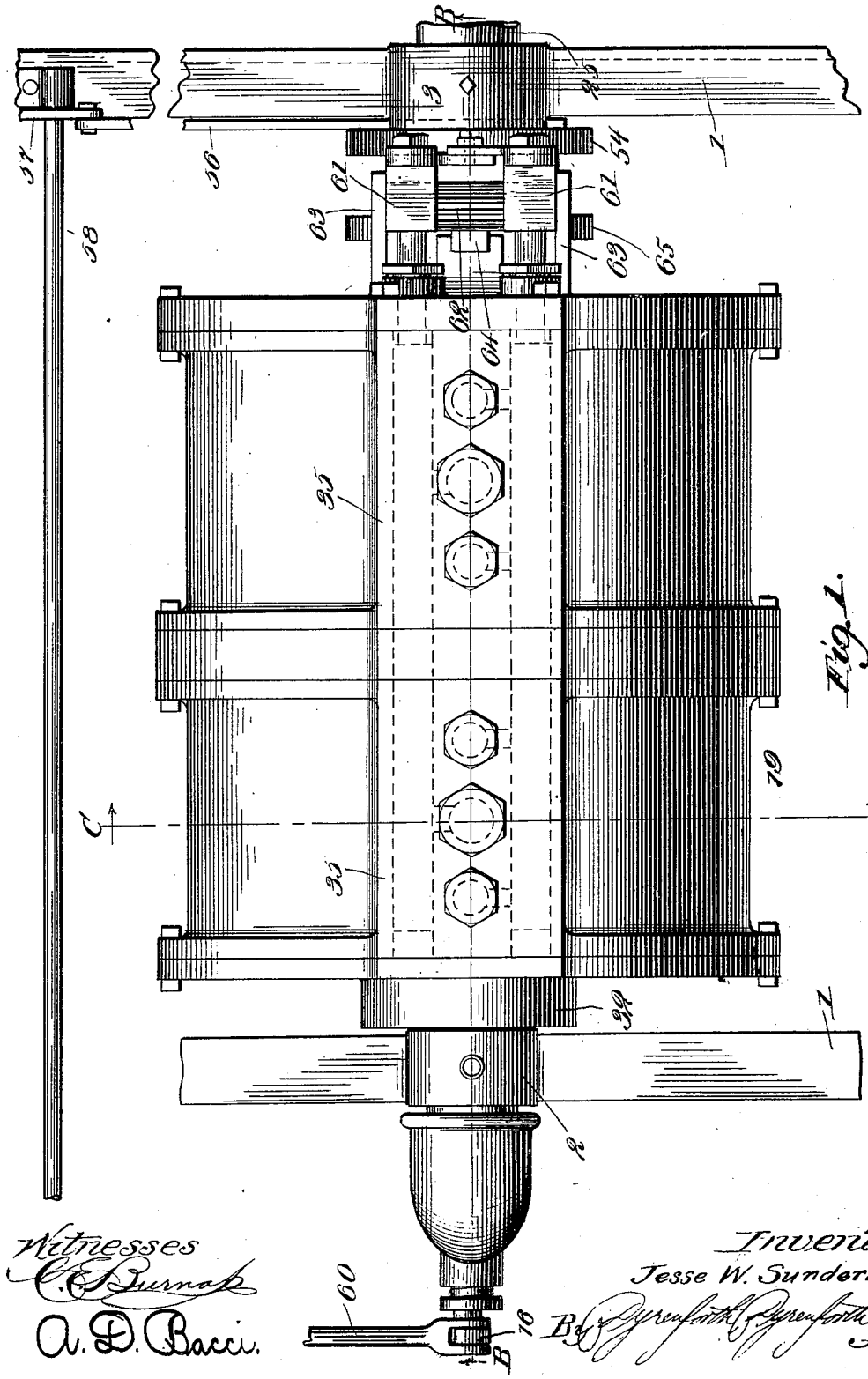


Fig. 1.

Witnesses
C. E. Burnap
A. D. Bacci.

Inventor
Jesse W. Sunderland
By Pyne, Smith & Pyne & Co.
Attys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 690,379. Patented Dec. 31, 1901.

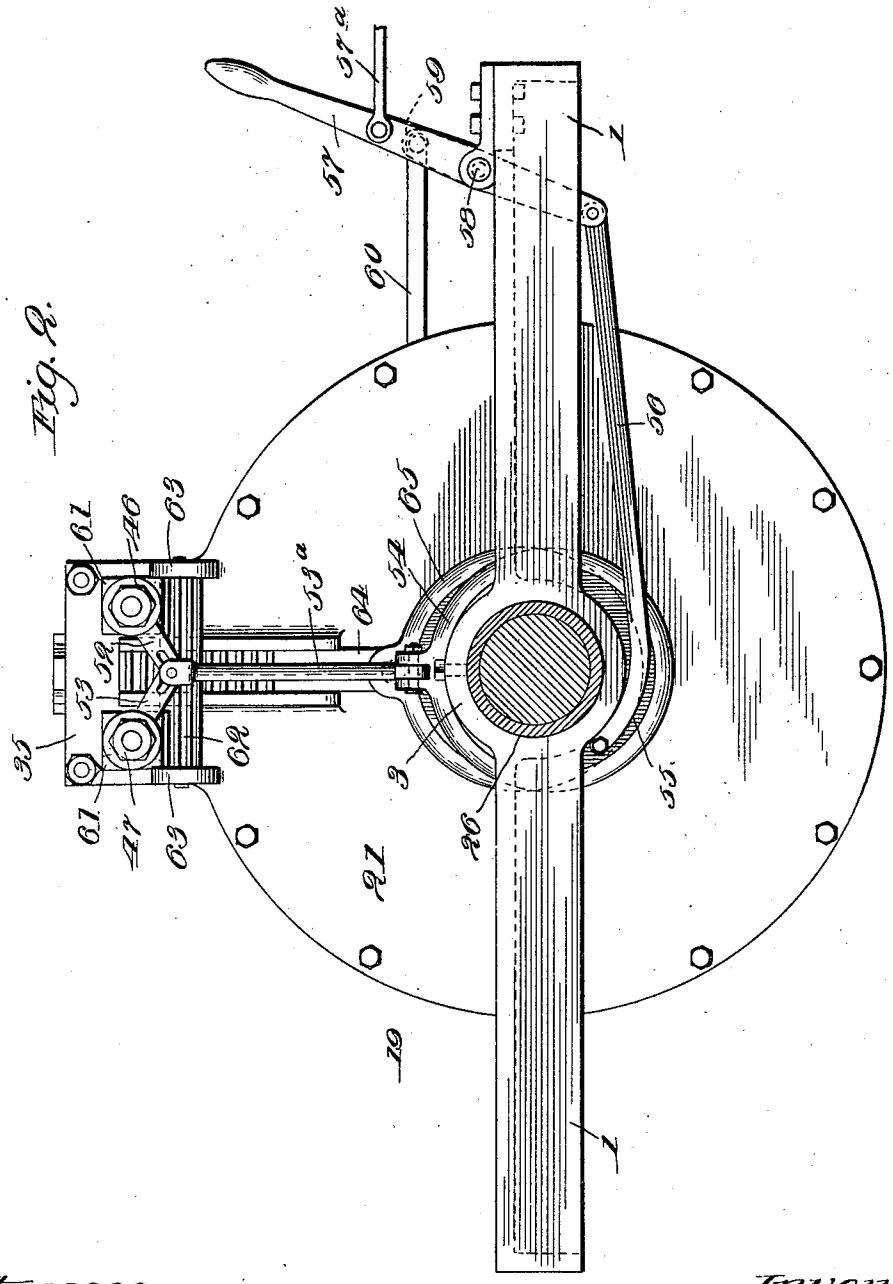
J. W. SUNDERLAND.

ROTARY ENGINE.

(Application filed Mar. 29, 1901.)

(No Model.) 5 Sheets—Sheet 2.

Fig. 2.



Witnesses

C. C. Burnap

A. D. Bacci.

Inventor

Jesse W. Sunderland

By Pyle, Forsyth & Pyle, Forsyth & Lee

Atty's

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 690,379. Patented Dec. 31, 1901.

J. W. SUNDERLAND.

ROTARY ENGINE.

(Application filed Mar. 29, 1901.)

(No Model.) 5 Sheets—Sheet 3.

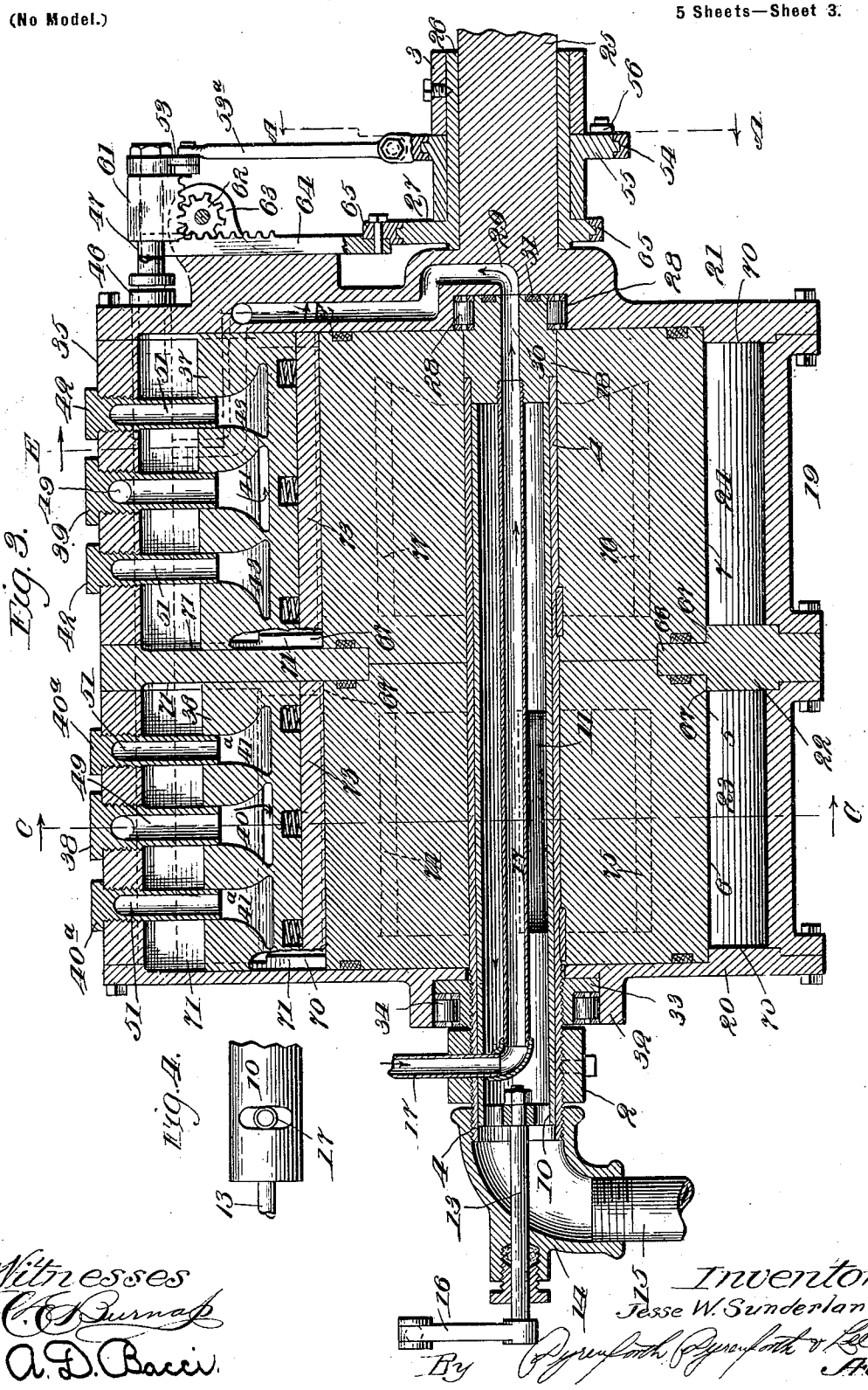


Fig. 3.

Fig. 4.

Witnesses
C. C. Burnap
A. D. Baccus.

Inventor
Jesse W. Sunderland
By Pyne, Smith & Pyne, his Attys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 690,379. Patented Dec. 31, 1901.

J. W. SUNDERLAND.

ROTARY ENGINE.

(Application filed Mar. 29, 1901.)

(No Model.) 5 Sheets—Sheet 4.

Fig. 5.

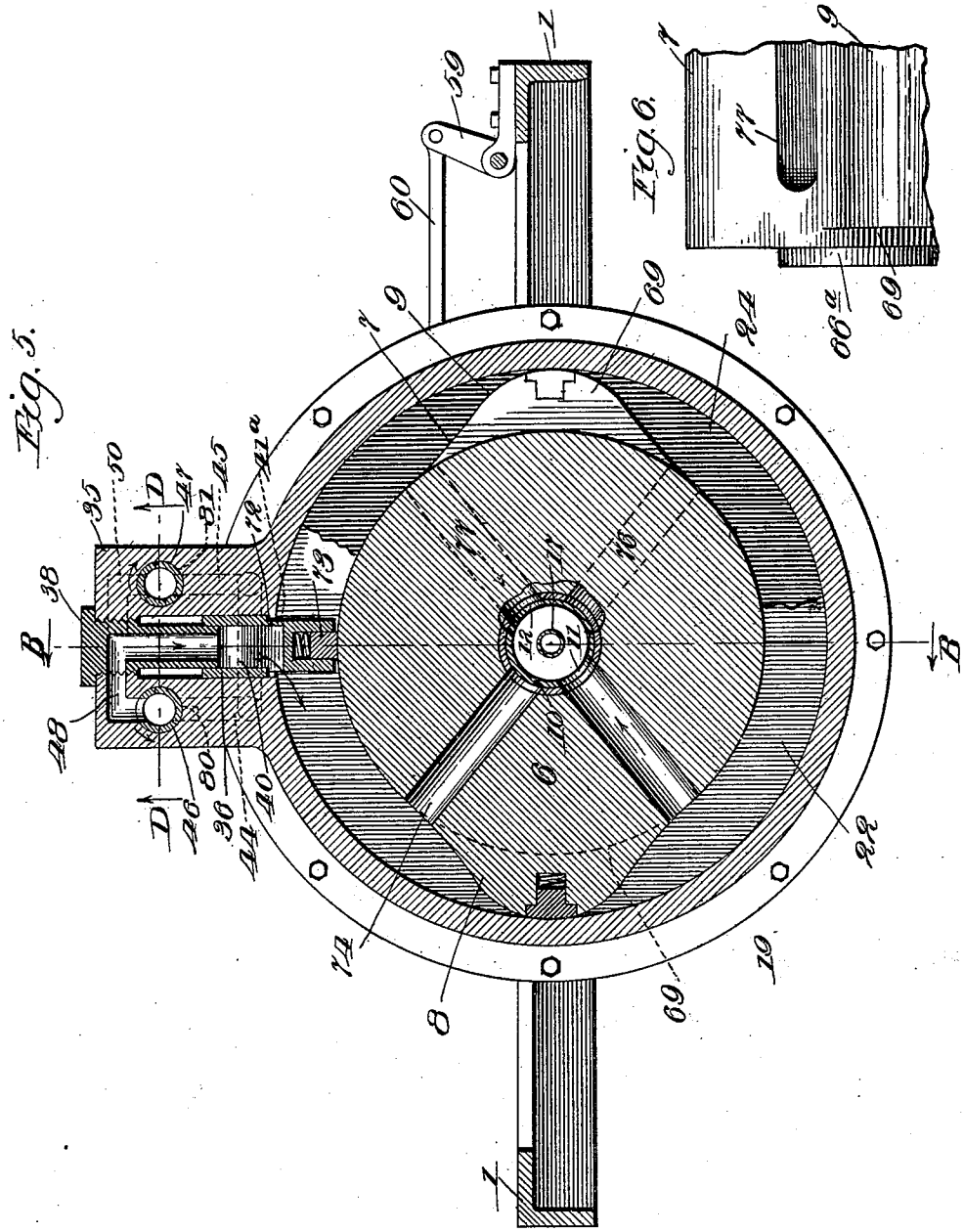


Fig. 6.

Witnesses
C. E. Burnap
A. D. Bacon.

Inventor
Jesse W. Sunderland
By Dyrenforth, Dyrenforth & Lee
Attys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 690,379. Patented Dec. 31, 1901.

J. W. SUNDERLAND.

ROTARY ENGINE.

(Application filed Mar. 29, 1901.)

(No Model.) 5 Sheets—Sheet 5.

Fig. 7.

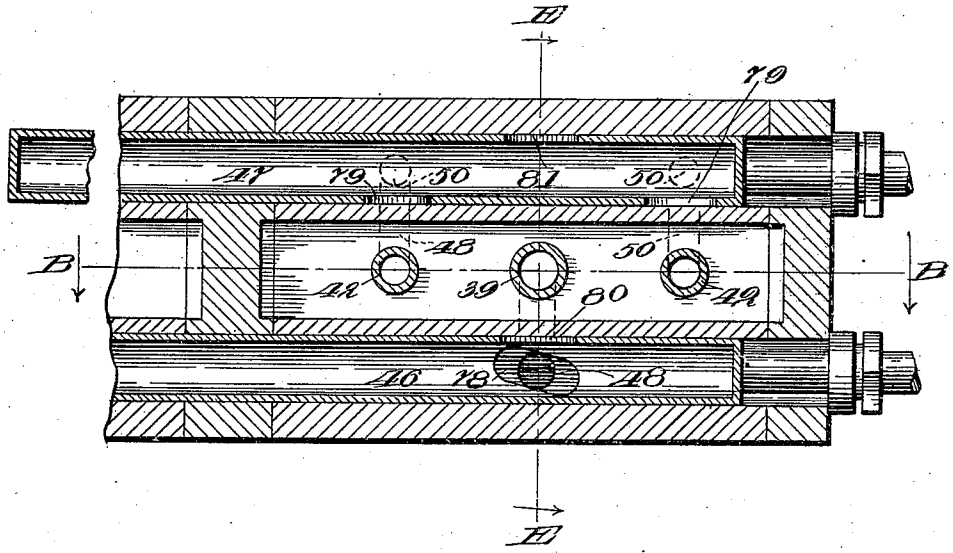
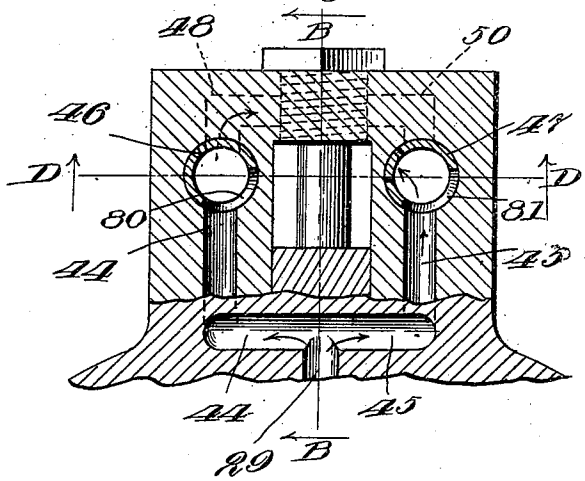


Fig. 8



Witnesses:
C. E. Burnap
A. D. Bacon.

Inventor
Jesse W. Sunderland
By Dyrenforth, Dyrenforth & Lee,
Attys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

JESSE W. SUNDERLAND, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO A. J. McDUFFEE, OF CHICAGO, ILLINOIS.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 690,379, dated December 31, 1901.

Application filed March 29, 1901. Serial No. 53,457. (No model.)

To all whom it may concern:

Be it known that I, JESSE W. SUNDERLAND, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Rotary Engines, of which the following is a specification.

This invention relates particularly to that class of rotary engines in which are employed a central stationary part or core provided with an abutment or abutments confining the steam or fluid in one direction and an inclosing rotary part provided with movable abutments or piston members against which the steam acts to produce rotation.

The primary object of the invention is to provide an engine of this class of improved general construction, particular attention being paid to the features of simplicity, reversibility, and positive control of steam admission, both as to an absolute cut-off for expansion purposes generally and as to automatic regulation of the quantity of steam admitted under varying working conditions where the engine is used for other than traction purposes.

In the accompanying drawings the invention is shown embodied in the form of a reversible double or twin engine, the central stationary core being provided with two peripheral stationary abutments lying between different transverse planes and at an angle of one hundred and eighty degrees to each other and the inclosing rotary cylinder being divided transversely by an internal ring or flange, so as to afford an expansion-chamber corresponding to each stationary abutment. The central core is provided with exhaust-ports and an exhaust-valve, while admission-ports are provided in the rotary cylinder and preferably through the movable abutments carried by said cylinder.

In the drawings, Figure 1 represents a broken plan view of the engine; Fig. 2, a view taken as indicated at line A of Fig. 3; Fig. 3, a longitudinal section taken as indicated at line B of Figs. 5, 7, and 8; Fig. 4, a broken view of the exhaust-valve; Fig. 5, a transverse section taken as indicated at line C of Fig. 3; Fig. 6, a broken view, in side elevation, of one of the two central core-sections employed; Fig. 7, a broken section taken as indicated at line D of Figs. 5 and 8, and Fig. 8 a section taken as indicated at line E of Figs. 3 and 7.

1 represents a frame provided with bearings or shaft-supports 2 and 3; 4, a fixed hollow shaft or trunnion extending through the support 2; 5, a fixed central core comprising sections 6 and 7, keyed to the shaft 4 and provided, respectively, with stationary abutments 8 and 9; 10, a hollow exhaust-valve fitting closely within the hollow shaft 4 and provided with exhaust-ports 11 and 12, corresponding, respectively, with the two expansion-chambers of the engine; 13, a stem for the exhaust-valve, which extends through an elbow 14 of an exhaust-pipe 15; 16, an arm on the valve-stem 13; 17, an admission-pipe extending through the valve 10 and into a fixed plug or stub 18 at the outer end of the core-section 7; 19, a rotary cylinder provided with ends 20 and 21 and provided also with an internal ring or flange 22, which divides the annular space between the core-sections and said cylinder into two expansion-chambers 23 and 24; 25, a shaft rigid with the cylinder end 21 and journaled in a sleeve 26, which is in turn fixed in the bearing or support 3 and is provided at its inner end with an eccentric 27; 28, roller-bearings arranged between the stub 18 of the core and a box or cup with which the inner surface of the cylinder end is provided; 29, a steam-admission port in the head 21, the same communicating with a port 30 in the stub or plug 18 and in communication with the pipe 17; 31, packing between the adjacent surfaces of the head 21 and the plug 18; 32, a cup or bearing on the outer surface of the cylinder end 20; 33, a coacting race member fixed to the shaft 4; 34, roller-bearings between the members 32 and 33; 35, a longitudinal enlargement with which the cylinder 19 is provided; 36 and 37, movable abutments or piston members which correspond, respectively, to the steam-chambers 23 and 24; 38 and 39, plugs connected with the enlargement 35 and extending, respectively, into perforations or ports 40 and 41, with which the piston members 36 and 37 are provided at their longitudinal centers; 40^a 40^a, plugs flanking the plug 38 and extending

into perforations or ports 41ª, with which the piston member 36 is provided; 42 42, plugs flanking the plug 39 and extending into perforations or ports 43, with which the piston member 37 is provided; 44 45, Fig. 8, branch ports communicating with the outer end of the port 29 and leading to valves 46 47, respectively, located in the enlargement 35 flanking the plugs above enumerated; 48 48, ports leading from the valve 46 to ports 49 49 in the plugs 38 and 39, respectively; 50 50, ports leading from the valve 47 to ports 51 51 in the plugs 40ª and 42, respectively; 52 53, rock-arms connected with the stems of the valves 46 47, respectively; 53ª, a connecting-rod through the medium of which said valves are rocked; 54, an eccentric-strap mounted upon a shiftable eccentric 55, which connects through a link 56 with a lever 57 on a rock-shaft 58 external to the cylinder; 59, an arm rigid with said rock-shaft and joined by a link 60 to the arm 16 on the stem of the exhaust-valve; 61 61, racks with which the stems of the admission-valves 46 and 47 are provided; 62, a pinion journaled in brackets 63, projecting from one end of the rotary cylinder; 64, a reciprocable rack meshing with the pinion 62, and 65 an eccentric-strap mounted on the eccentric 27 and serving to actuate the rack 64.

By preference the cylinder 19 is cast in two sections, as shown, with the ring 22 interposed and firmly secured between said sections. The ring 22 is provided with a reduced portion 66, which projects into a suitable recess 66ª, with which the core-sections 6 and 7 are provided, and is flanked by suitable annular packing-rings, as shown. Adjacent to the reduced portion 66 is an enlarged portion affording shoulders 67, which fit about the circular portions of the core-sections. The core-sections are provided with recesses 69, Figs. 5 and 6, at the abutments 8 and 9 for the enlarged portions of the ring 22 to move in. The cylinder ends are provided internally with enlargements or rings 70, which fit about the circular portions of the adjacent ends of the core sections and move in suitable recesses (not shown) provided at the abutments 8 and 9. The piston members 36 and 37 are shown broken away in Fig. 3 to expose the shoulders 67 and 70. Said piston members move in slots 71, provided in the walls adjacent to the ends of said piston members. The piston members are provided with shoulders 72, which engage corresponding shoulders on the cylinder, as shown in Fig. 5, to limit the inward movement of the piston members. Spring-held packing-strips 73 are provided at the inner edges of the piston members to insure close contact with the peripheries of the core-sections. As indicated in Figs. 3 and 5, the ports 40 and 41 of the piston members 36 and 37, respectively, open at one side of the piston to admit steam to the expansion-chambers, and the ports 41ª and 43 open on the opposite side of said piston members to admit steam to said expansion-chambers. In the position shown in Figs. 5 and 7 the valve 46 is in communication with the ports 48, while the valve 47 is out of communication with the ports 50. In this position of the ports steam is admitted through the valve 46 and ports 48 and 40 and 50 and 41 to the expansion-chambers, as indicated by the arrows. The core-section 6 is provided with exhaust-ports 74 and 75, the former of which is represented as closed by the valve 10, while the latter is opened through the port 11. The core-section 7 is provided with ports 76 and 77, the former of which is represented as closed by the exhaust-valve, while the latter is opened through the exhaust-port 12. The ports 76 and 77 are of course in that portion of the core-section 7 which is removed from Fig. 3.

It will be understood from the foregoing description that the valves 46 and 47 are capable of both rotary and longitudinal movement. The valves are formed with closed ends and preferably have elongated eduction-ports 78 and 79, respectively, located and arranged spirally, as shown in Fig. 7. Their induction-ports are numbered 80 and 81, respectively, and these ports are always in communication with the branch admission-ports 45.

The operation will be readily understood from the foregoing detailed description. When the lever 57 is in one position, the valve 46 is open and the valve 47 closed. At the same time the ports 74 and 76 are closed by the exhaust-valve 10, while the ports 75 and 77 are open. By shifting the lever 57 the eccentric 55 is moved, thereby rocking the valves 46 and 47 through the medium of the connecting-rod 53ª and the rock-arms 52 and 53. This closes the valve 46 and opens the valve 47. At the same time the exhaust-valve is rotated through the medium of the rock-shaft 58, arm 59, link 60, and arm 16, thereby closing the ports 75 and 77 and opening the ports 74 and 76. This provides for reversal of the engine. With the valves in the position shown in the drawings steam enters the chambers 23 and 24 through the ports 40 and 41 in the piston members 36 and 37, respectively, thereby causing the rotary cylinder to rotate in the direction indicated by the arrow in Fig. 5. In this position the chamber 23 is exhausted through the port 75, while the chamber 24 is exhausted through the port 77. When the engine is reversed, steam enters the chambers 23 and 24 through the ports 41ª and 43 in the piston members 36 and 37, respectively, the escape of steam from said ports being then in a direction to reverse the movement of the cylinder 19. The abutments 8 and 9 of the stationary core are at an angle of one hundred and eighty degrees to each other, and since each abutment occupies but a small portion of three hundred and sixty degrees it follows that steam will be admitted to one expansion-chamber or the other in any position of the

cylinder. It will be understood, therefore, that the engine will start whenever steam is admitted, regardless of the position of the cylinder. Since the eccentric 27 is fixed, while the eccentric-strap 65 revolves thereon, it follows that the valves 46 and 47 will be reciprocated longitudinally at each revolution of the cylinder. The parts may be so connected that said valves will be caused to close the admission-ports at any portion of a revolution, thereby providing for expansion of the steam. The ports in the movable piston members are so arranged that they start to open soon after the piston members cross the high portions of the stationary abutments, and the admission is increased gradually until the piston members reach the circular portions of the core, when the admission reaches a maximum. Said ports remain open until the stationary abutments are again encountered, when they are gradually closed. A certain amount of steam is trapped in said ports as the piston members are forced outwardly by the stationary abutments, thereby cushioning said piston members. It will be understood, of course, that the admission of steam to the piston members is cut off before the stationary abutments are encountered and the piston members begin their outward movement. It thus appears that the piston members are steam-actuated in one direction of reciprocation and are actuated in the opposite direction of reciprocation by the stationary abutments, both movements being so gradual as to avoid all shock.

When the engine is used for traction purposes, no governor is ordinarily required. When the engine is to be used as a stationary engine, however, any suitable governor may be connected with the lever 57 and through the medium of said lever and of the link 56 caused to automatically actuate the eccentric 55, whereby partial rotation of the admission-valves will be produced and the admission thereby automatically controlled. A link 57^a may form the connecting means between said lever and governor. (Not shown.) It will be understood that by locating the abutments 8 and 9 at an angle to each other not only is provision against a dead-center made, but the forces acting upon the engine are opposed or counterbalanced. In practice the cylinder 19 will be provided with a counterweight located opposite the enlargement 35, though no such counterweight is shown.

Changes in details of construction within the spirit of my invention may be made. Hence no limitation is to be understood from the foregoing detailed description except as shall appear from the appended claims. For instance, it will be readily understood that by suitable arrangement of the cylinder-carried ports one of the admission-valves carried by the cylinder may be omitted.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a rotary engine, the combination with a stationary core provided with an abutment, of an inclosing rotary cylinder provided with a reciprocating piston member and with a fluid-port, and a longitudinally-movable valve carried by said cylinder and controlling said port, substantially as described.

2. In a rotary engine, the combination with a stationary core provided with an abutment, of an inclosing rotary cylinder provided with a reciprocating piston member and with a fluid-port, and a rotary and longitudinally-movable valve carried by said cylinder and controlling said port, substantially as described.

3. In a rotary engine, the combination with a fixed central core having an abutment, of an inclosing cylinder provided with a reciprocating piston member, said piston member being provided with a port and said cylinder being provided with a port communicating therewith, and a valve carried by said cylinder and controlling the port of said cylinder, substantially as described.

4. In a rotary engine, the combination with a stationary core provided with an abutment, of an inclosing rotary cylinder forming with said core a pressure-chamber, a reciprocating piston member carried by said cylinder and provided with a port opening at one side of the piston member to permit fluid to enter said pressure-chamber, and a valved admission-port in the cylinder leading to the admission-port in said piston member, whereby fluid may be admitted to cause rotation, substantially as described.

5. In a rotary engine, the combination with a stationary core provided with an abutment, of an inclosing rotary cylinder forming with said core a pressure-chamber, a reciprocating piston member carried by said cylinder and provided with a port opening at one side of the piston member to permit fluid to enter said pressure-chamber and provided with another port opening at the opposite side of said piston member, and valved admission-ports in the cylinder leading to the admission-ports in said piston member, whereby fluid may be admitted to cause rotation in either direction, at will, substantially as described.

6 In a rotary engine, the combination with a fixed core provided with an abutment, of a rotary cylinder provided with a reciprocating piston member, an admission-valve carried by said cylinder, a fixed eccentric, an eccentric-strap mounted thereon and rotating with said cylinder, and connection between said eccentric-strap and valve, whereby the valve is automatically reciprocated at each revolution, substantially as described.

7. In a rotary engine, the combination with a fixed core provided with an abutment, of a rotary cylinder provided with a reciprocating piston member, an admission-valve carried by said cylinder, a fixed eccentric, an eccentric-strap mounted thereon and rotating with said cylinder, connecting means between said eccentric-strap and valve for effecting a lon-

gitudinal movement of the valve, a shiftable eccentric and connecting means between said valve and last-named eccentric for effecting a partial rotation of the valve, substantially as described.

8. In a reversible rotary engine, the combination with a fixed central core provided with an abutment, of a rotary cylinder forming with said core a pressure-chamber, a reciprocating piston member carried by said cylinder, said cylinder being provided with ports for admitting fluid to opposite sides of said piston member, and a rotary and longitudinally-movable valve carried by said cylinder, one movement of said valve aiding to effect a reversal of the engine, and the other movement thereof to effect a cut-off for the same, substantially as described.

9. In a rotary engine, the combination with a fixed central core provided with an abutment, of an inclosing rotary cylinder forming therewith a pressure-chamber, a reciprocating piston member carried by said cylinder, said cylinder being provided with an admission-port, a valve controlling said admission-port and provided at its stem with a rack, a pinion engaging said rack, a radially-movable rack engaging said pinion, and eccentric means for moving said last-named rack at each revolution of the cylinder, thereby to cause a reciprocation of said valve, substantially as described.

10. In a rotary engine, the combination with a fixed central core provided with an abutment, of an inclosing rotary cylinder provided with an admission-port, a fluid-seated reciprocating piston member carried by said cylinder, said cylinder being provided with a port leading to said piston member, a valve controlling said port, said cylinder and piston member being provided with shoulders for limiting the inward movement of the piston member, and a yieldingly-held packing-strip at the inner end of said piston member and contacting with said core, substantially as described.

11. In a rotary engine, the combination with a fixed central core provided with an abutment and with exhaust-ports, of an exhaust-valve controlling said exhaust-ports, a rotary cylinder forming with said core a pressure-chamber, and a reciprocating piston member carried by said cylinder and provided with ports opening on opposite sides of the piston member into said pressure-chamber, said cylinder being provided with valved ports communicating with the ports in said piston member, substantially as described.

12. In a rotary engine, the combination of a fixed central hollow shaft, a core fixed thereon and provided with an abutment and an exhaust-port, an inclosing rotary cylinder provided with a reciprocating piston member and an admission-port, antifriction-bearing between one end of said cylinder and said shaft, a plug or stub at the opposite end of said core, antifriction-bearing between said stub and the adjacent cylinder end, a central admission-pipe leading through said hollow shaft and communicating with the admission-port of said cylinder, a valve carried by said cylinder and controlling the admission, and a shaft connected with the cylinder end adjacent to said stub, substantially as described.

13. In a rotary engine, the combination of a fixed central core provided with an abutment and with exhaust-ports leading from the periphery of said core at opposite sides of said abutment, a central exhaust-valve, an inclosing rotary cylinder provided with a reciprocating piston member and with two admission-ports opening at opposite sides of said piston member, admission-valve means carried by said cylinder, and a reversing-lever serving to simultaneously actuate said admission and exhaust valves, thereby to effect a reversal of the engine, substantially as described.

14. In a rotary engine, the combination of a fixed core provided with two abutments lying between different transverse planes and at an angle of approximately one hundred and eighty degrees to each other, an inclosing rotary cylinder forming with said core two pressure-chambers, and two reciprocating cylinder-carried piston members, one corresponding to each pressure-chamber, substantially as described.

15. In a rotary engine, the combination of a fixed core provided with two abutments lying between different transverse planes and at an angle of approximately one hundred and eighty degrees to each other, an inclosing rotary cylinder forming with said core two pressure-chambers, two reciprocating cylinder-carried piston members, one corresponding to each pressure-chamber, and valved admission-ports for the two chambers, whereby fluid of the same pressure is received by both chambers from a common source, substantially as described.

16. In a rotary engine, the combination with a stationary core provided with an abutment, of an inclosing rotary cylinder provided with a reciprocating piston member and with a fluid-port, and a longitudinally-movable valve carried by said cylinder and controlling said port, said valve being disposed parallel to the axis of said cylinder, substantially as described.

JESSE W. SUNDERLAND.

In presence of—
D. W. LEE,
ALBERT D. BACCI.