No. 696,926.

Patented Apr. 8, 1902.

F. G. BATES.

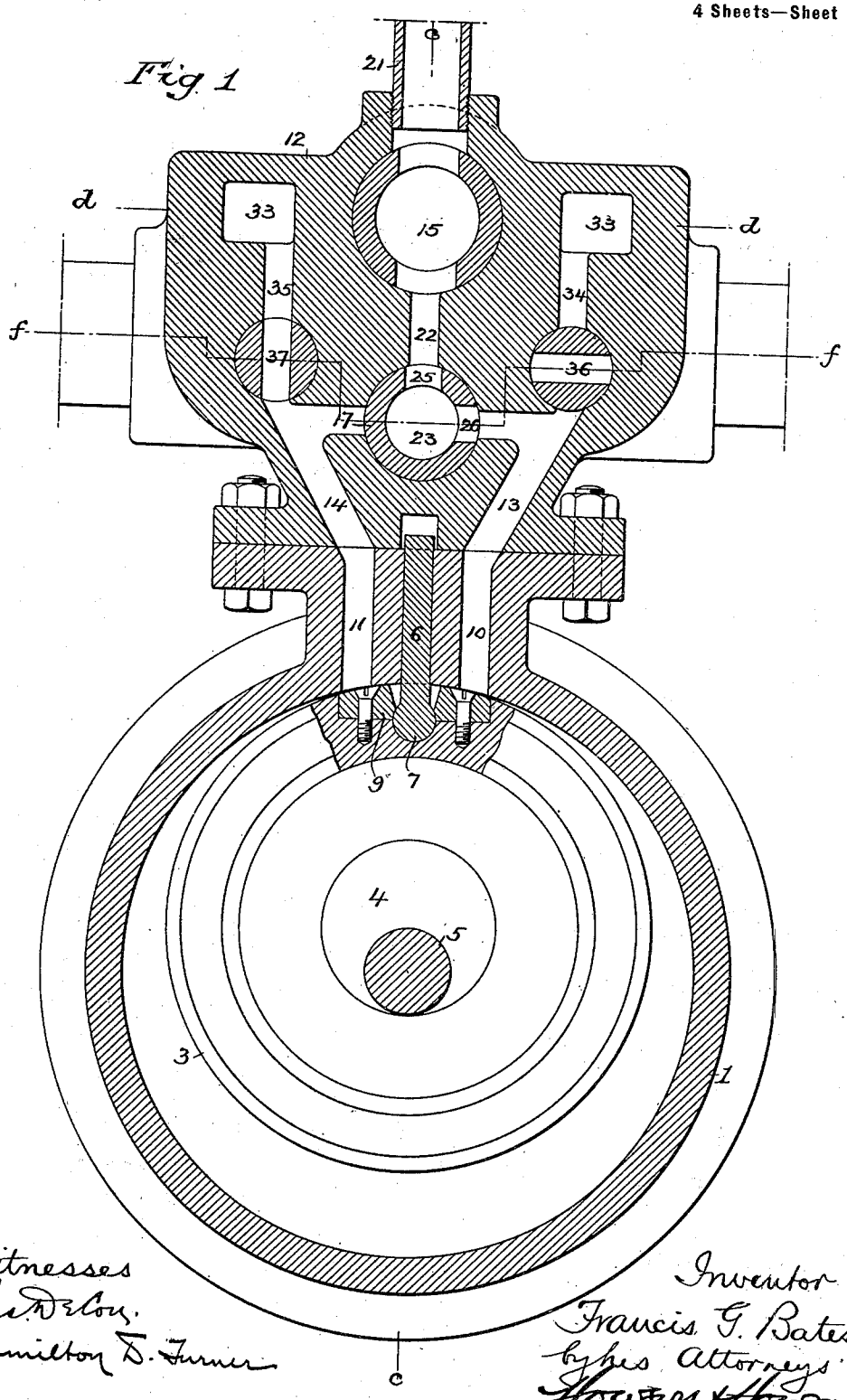
ROTARY ENGINE.

(Application filed May 15, 1901.)

(No Model.)

4 Sheets—Sheet 1.

Fig. 1



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

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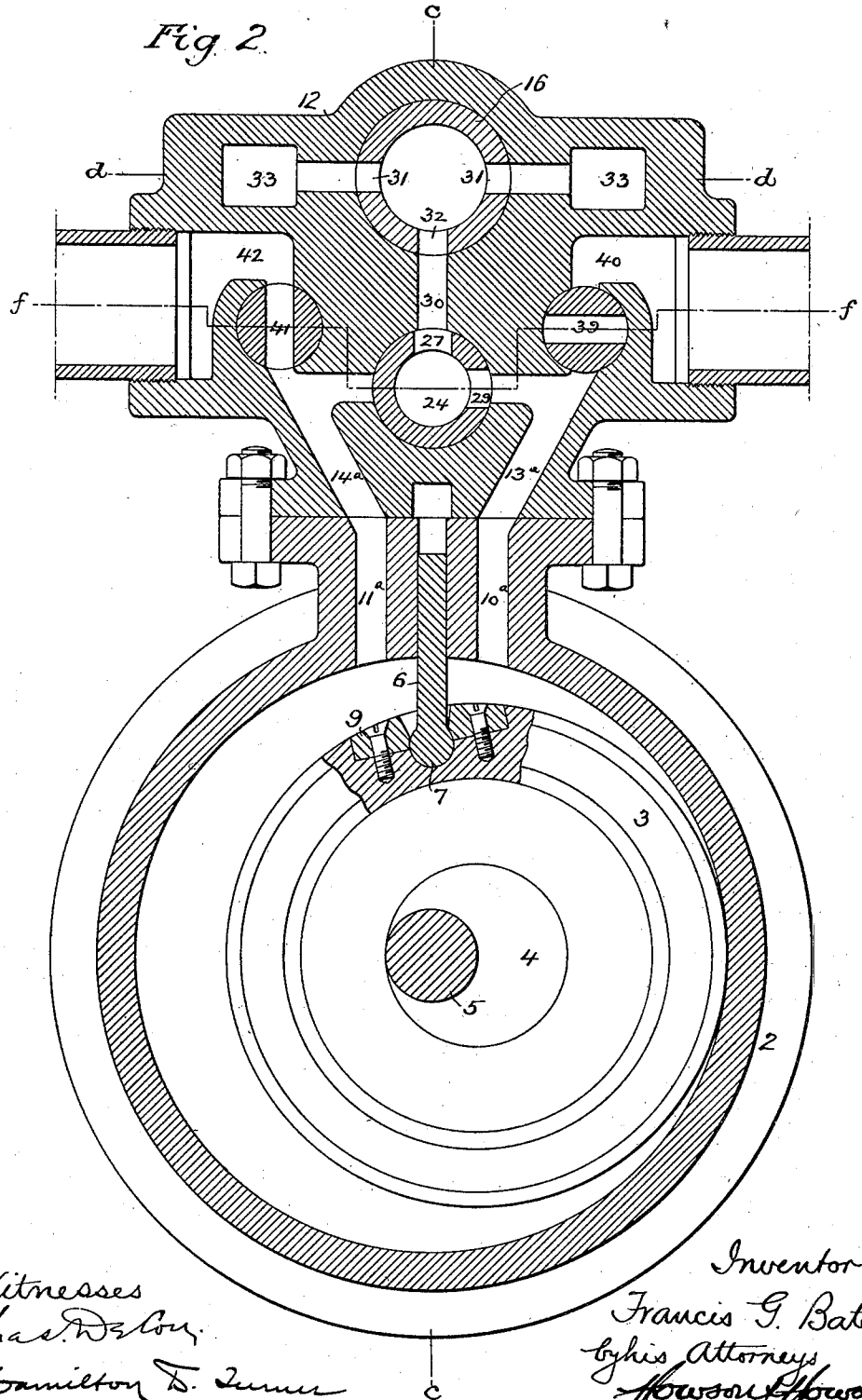
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(No Model.) 4 Sheets—Sheet 2.

Fig. 2.



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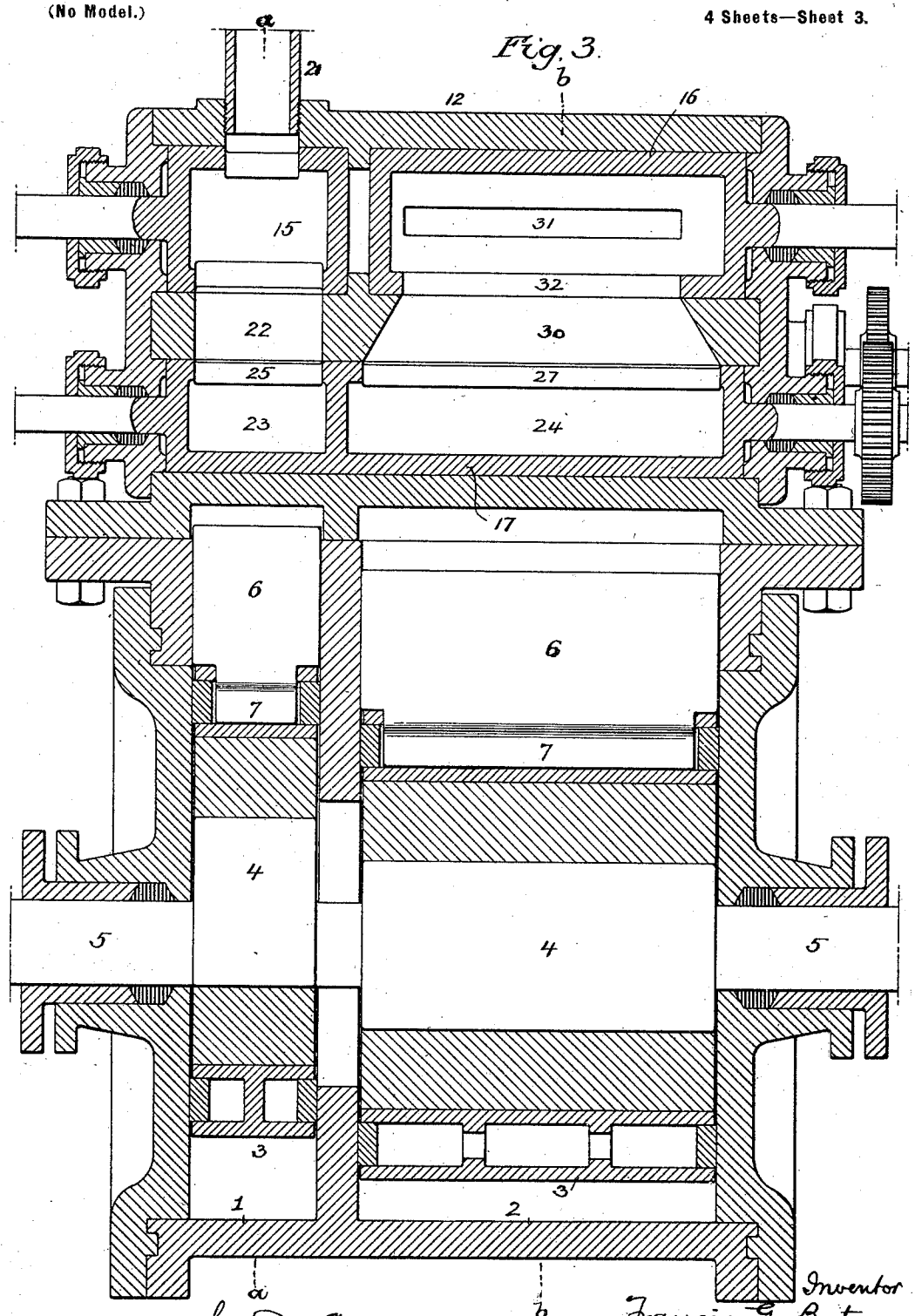
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(No Model.) 4 Sheets—Sheet 3.

Fig. 3.



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No. 696,926. Patented Apr. 8, 1902.

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ROTARY ENGINE.

(Application filed May 15, 1901.)

(No Model.) 4 Sheets—Sheet 4.

Fig. 4.

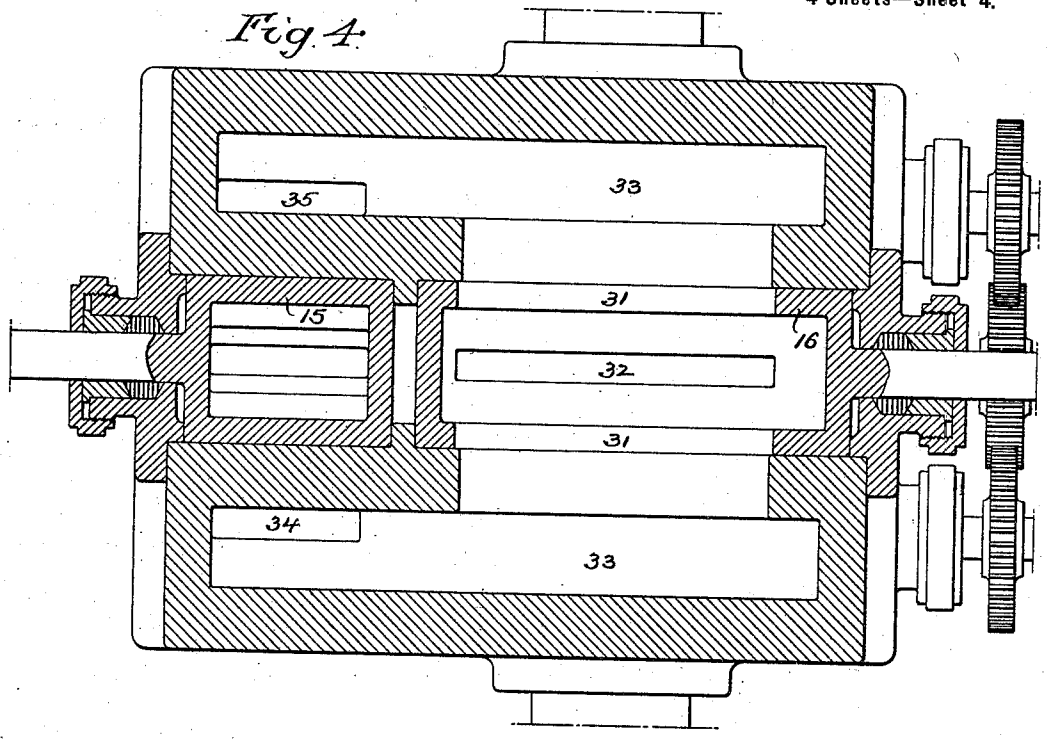
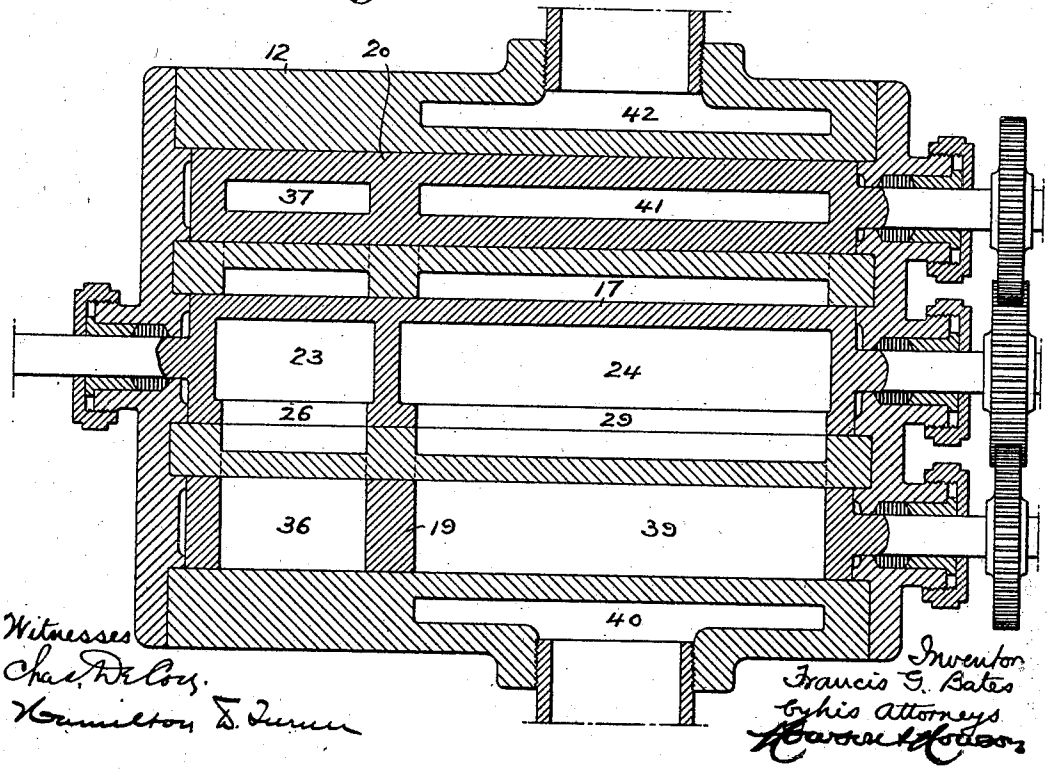


Fig. 5.



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UNITED STATES PATENT OFFICE.

FRANCIS G. BATES, OF PHILADELPHIA, PENNSYLVANIA.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 696,926, dated April 8, 1902.

Application filed May 15, 1901. Serial No. 60,378. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS G. BATES, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented certain Improvements in Rotary Engines, of which the following is a specification.

The object of my invention is to provide a rotary engine with valves and passages whereby the direction of rotation of the engine can be readily reversed and instant stoppage of the engine effected when desired by closing the exhaust, so as to effect compression in front of the piston, this closing of the exhaust being, if desired, accompanied by a simultaneous cutting off of the supply of motive fluid to the space behind the piston.

In the accompanying drawings, Figure 1 is a transverse section of a compound rotary engine constructed in accordance with my invention, the section being taken through the high-pressure cylinder or on the line *a a*, Fig. 3. Fig. 2 is a similar view taken through the low-pressure cylinder of the engine or on the line *b b*, Fig. 3. Fig. 3 is a view of the engine, partly in levation and partly in longitudinal section, on the line *c c*, Fig. 1. Fig. 4 is a sectional plan view on the line *d d*, Fig. 1; and Fig. 5 is a sectional plan view on the line *f f*, Fig. 1.

1 represents the high-pressure cylinder of the engine, and 2 the low-pressure cylinder, these cylinders preferably forming part of the same structure and being proportioned as to width in accordance with the respective areas desired for the high and low pressure pistons.

Each piston consists of a suitably-packed ring 3, mounted upon an eccentric 4 upon the central shaft 5, which is common to both pistons and is adapted to suitable bearings on the opposite heads of the cylinder structure. The piston-ring is combined with a sliding abutment-plate 6, fitting snugly within a central channel at the top of the cylinder and having at the lower end a segmental head 7, which is adapted to a semicircular socket in the ring 3 and is confined thereto by a cap-plate 9, overlapping the upper portion of the segmental head 7 and flared beyond said overlapping portion, so as to permit of the desired swinging movement of the ring 3 in respect to the sliding abutment-plate. The high-pressure cylinder has a passage 10, located on one side of the sliding plate 6, and a passage 11, located on the opposite side of the same and by preference as closely thereto as circumstances will permit, and the low-pressure cylinder has similar passages 10^a and 11^a, and a valve-chest 12, mounted upon the cylinder structure of the engine, has passages 13 and 14, communicating, respectively, with the passages 10 and 11, and passages 13^a and 14^a, communicating, respectively, with the passages 10^a and 11^a. The valve-chest contains five valves 15, 16, 17, 19, and 20 and passages coöperating therewith, as described hereinafter, the valves 17, 19, and 20 being duplex, so as to coöperate with passages corresponding with each of the cylinders of the engine. The valve 15 is a cut-off valve intended to be operated by the governor mechanism of the engine and controlling the flow of motive fluid from the inlet-pipe 21 to a passage 22, leading to the chamber in which the valve 17 works. This valve 17 has two chambers 23 and 24, that portion of the valve which contains the chamber 23 having ports 25 and 26 at right angles to each other, and that portion of the valve which contains the chamber 24 having similar ports 27 and 29. The ports 25 and 26 are in line with the passages 13 and 14 and with the passage 22, while the ports 27 and 29 are in line with the passages 13^a and 14^a and with a passage 30, leading to a chamber containing the valve 16. The valve 16 is a cut-off valve operated in the same manner as the valve 15 and having ports 31 and 32 at right angles to each other and serving to provide communication between the passage 30 and a chamber 33 at the top of the valve-chest, said chamber communicating with passages 34 and 35.

Between the passages 13 and 34 is located the valve 19, and between the passages 14 and 35 is located the valve 20, communication between the passages 13 and 34 being effected by means of a passage 36 in the valve 19, and communication between the passages 14 and 35 being effected by means of a passage 37 in the valve 20. The valve 19 has another passage 39, whereby communication can be established between the passage 13^a and an exhaust-passage 40, and the valve 20 has a passage 41, whereby communication can be es-

tablished between the passage 14ª and an exhaust-passage 42.

The valves 17, 19, and 20 are all connected by means of suitable spur-gearing, so that they can be moved in unison by power transmitted to the shaft or spindle of either of said valves, the effect of their movement being to start, stop, or reverse the direction of movement of the engine and to regulate the speed of the same. As shown in Figs. 1 and 2, the valves occupy the positions assumed by them when the controlling-lever is at one extreme of its movement and the engine is running in one direction—say ahead—at full speed. Under these circumstances the motive fluid passes from the cut-off valve 15, through the passage 22 and port 25 into the chamber 23 of the reversing-valve 17, and thence through the port 26 and passages 13 and 10 into the forward end of the high-pressure cylinder 1, so as to drive the piston forward therein. The rear end of the cylinder 1 communicates, through the passages 11 and 14, through the passage 37 of the valve 20, and through the passage 35, with the chamber 33, and the latter communicates, through the ports 31 and 32 of the valve 16, with the passage 30 and thence through the port 27 of the valve 17 with the chamber 24 of the latter, from which the motive fluid is directed through the port 29 to the passages 13ª and 10ª and thence to the forward end of the low-pressure cylinder 2, so as to drive the piston forwardly therein, the rear end of said cylinder 2 communicating, through the passages 11ª and 14ª, with the passage 41 of the valve 20 and thence with the exhaust-passage 42. No communication can be had between the passages 13 and 34 and the passages 13ª and 40, as the valve 19 closes such communication; but when each of the valves has had a quarter-turn imparted to it by movement of the controlling-lever from the extreme forward to the extreme rearward position the operation of the parts will be reversed, the forward passages 13 and 13ª being now placed in communication with the passages 34 and 40 and the rear passages 14 and 14ª being cut off from communication with the passages 35 and 42, the reversing-valve directing the motive fluid to said rear passages 14 and 14ª and cutting it off from the forward passages 13 and 13ª, so that the engine will now run in a direction the reverse of that in which it formerly ran. The cut-off valve 16 serves to govern the degree of expansion of the motive fluid in the low-pressure cylinder. Movement of the directing-lever from either of its extreme positions to the mid-position will effect a one-eighth turn of each of the valves 17, 19, and 20 and will have the effect of first restricting and then fully cutting off the flow of motive fluid through the passages controlled by said valves. Hence when said lever occupies the mid-position the flow of motive fluid to and the escape of motive fluid from either cylinder is wholly cut off. Hence the escape of motive fluid from either cylinder in front of the advancing piston will be prevented, with the result that said motive fluid will be compressed and the forward movement of said piston arrested, so as to prevent further rotation of the shaft 5, thereby serving as an effectual brake upon the engine, or if the momentum of the shaft 5 is sufficient to carry the piston beyond the center there will be, in addition to the compression in front of the piston, a partial vacuum behind the same to arrest its further forward movement. This provision for effecting starting, stopping, and reversal of the engine and for regulating the speed of the same or for effecting instantaneous stoppage when desired by the manipulation of a single lever renders the engine especially available for use in motor-vehicles, for which use the small size and light weight of the engine and the absence of reciprocating parts, with their attendant vibration, are also desirable qualities.

The retaining-cap 9, let into a recess in the piston-ring 3 and engaging with the segmental head 7 of the sliding abutment 6, provides a ready means of connecting said sliding abutment to the piston-ring.

Although I have shown my invention as applied to a compound engine having two cylinders, it will be evident that it may be applied with equally good results to compound engines having more than two cylinders or, on the other hand, can be used in connection with a simple high-pressure engine having but one cylinder, the valves 17, 19, and 20 in this case being single instead of duplex and the receiving-chamber 33, valve 16, and passages 34 and 35 being dispensed with, the valves 19 and 20 communicating directly with the exhaust-passages 40 and 42, respectively.

Having thus described my invention, I claim and desire to secure by Letters Patent—

1. The combination of a rotary engine comprising a cylinder with eccentric piston, sliding abutment, and inlet and exhaust passages located one on one side and the other on the opposite side of said abutment, with a reversing-valve whereby the motive fluid may be directed to either of said passages, and valves whereby the escape from either passage may be regulated or cut off, the passages of the valves being so disposed that when the reversing-valve is directing steam to either side of the piston, the exhaust-valve on that side will be closed and the exhaust-valve on the other side will be open, and when the reversing-valve is adjusted to cut off the flow of steam, both exhaust-valves will likewise be closed, substantially as specified.

2. The combination of a rotary engine comprising a cylinder with eccentric piston, sliding abutment and inlet and exhaust passages located one on one side and the other on the opposite side of said abutment, with a re-

versing-valve whereby motive fluid may be directed to either of said passages, valves whereby the escape from either passage may be regulated or cut off, and connections between said valves and the reversing-valve whereby conjoint operation of the three valves is effected, the passages of the valves being so disposed that when the reversing-valve is directing steam to either side of the piston, the exhaust-valve on that side will be closed and the exhaust-valve on the other side will be open, and when the reversing-valve is adjusted to cut off the flow of steam, both exhaust-valves will likewise be closed, substantially as specified.

3. The combination, in a compound rotary engine, of the high and low pressure cylinders each with eccentric piston, sliding abutment and inlet and exhaust passages one on one side and the other on the opposite side of said sliding abutment, a reversing-valve having two chambers, one for each of the cylinders of the engine, and ports whereby each chamber may be caused to communicate with either of the passages of its corresponding cylinder, a receiving-chamber in communication with the low-pressure chamber of said reversing-valve, two exhaust-passages, and a pair of duplex valves, one controlling the communication between the forward passage of the high-pressure cylinder and the receiving-chamber and between the forward passage of the low-pressure cylinder and an exhaust-passage, and the other controlling communication between the rear passage of the high-pressure cylinder and the receiving-chamber and between the rear passage of the low-pressure cylinder and an exhaust-passage, substantially as specified.

4. The combination, in a compound rotary engine, of the high and low pressure cylinders each with eccentric piston, sliding abutment and inlet and exhaust passages one on one side and the other on the opposite side of said sliding abutment, a reversing-valve having two chambers, one for each of the cylinders of the engine, and ports whereby each chamber may be caused to communicate with either of the passages of its corresponding cylinder, a receiving-chamber in communication with the low-pressure chamber of said reversing-valve, two exhaust-passages, and a pair of duplex valves, one controlling the communication between the forward passage of the high-pressure cylinder and the receiving-chamber and between the forward passage of the low-pressure cylinder and an exhaust-passage, and the other controlling communication between the rear passage of the high-pressure cylinder and the receiving-chamber and between the rear passage of the low-pressure cylinder and an exhaust-passage, and connections between the reversing-valve and said controlling-valves whereby conjoint operation of the three valves is effected, substantially as specified.

5. The combination in a compound rotary engine, of the high and low pressure cylinders each with eccentric piston, sliding abutment and inlet and exhaust passages, one on one side and the other on the opposite side of said sliding abutment, a reversing-valve having two chambers, one for each of the cylinders of the engine, and ports whereby each chamber may be caused to communicate with either of the passages of its corresponding cylinder, a receiving-chamber, two exhaust-passages, a pair of duplex valves, one controlling the connection between the forward passage of the high-pressure cylinder and the receiving-chamber and between the forward passage of the low-pressure cylinder and an exhaust-chamber, and the other controlling communication between the rear passage of the high-pressure cylinder and the receiving-chamber and between the rear passage of the low-pressure cylinder and an exhaust-passage, and cut-off valves, one controlling the flow of motive fluid to the high-pressure chamber of the reversing-valve, and the other controlling the flow of motive fluid from the receiver to the low-pressure chamber of said valve, substantially as specified.

6. The combination in a rotary engine, of a cylinder having therein an eccentric piston with peripheral ring mounted so as to be free to turn thereon, a sliding abutment with segmental head at its inner end mounted in a semicircular socket of said ring, and a cap-plate let into a recess in the ring and overlapping the segmental head of said sliding abutment so as to confine the same to the ring, substantially as specified.

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

FRANCIS G. BATES.

Witnesses:
F. E. BECHTOLD,
JOS. H. KLEIN.