No. 778,082. PATENTED DEC. 20, 1904.

W. I. SPANGLER.

ROTARY EXPLOSIVE ENGINE.

APPLICATION FILED JULY 13, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

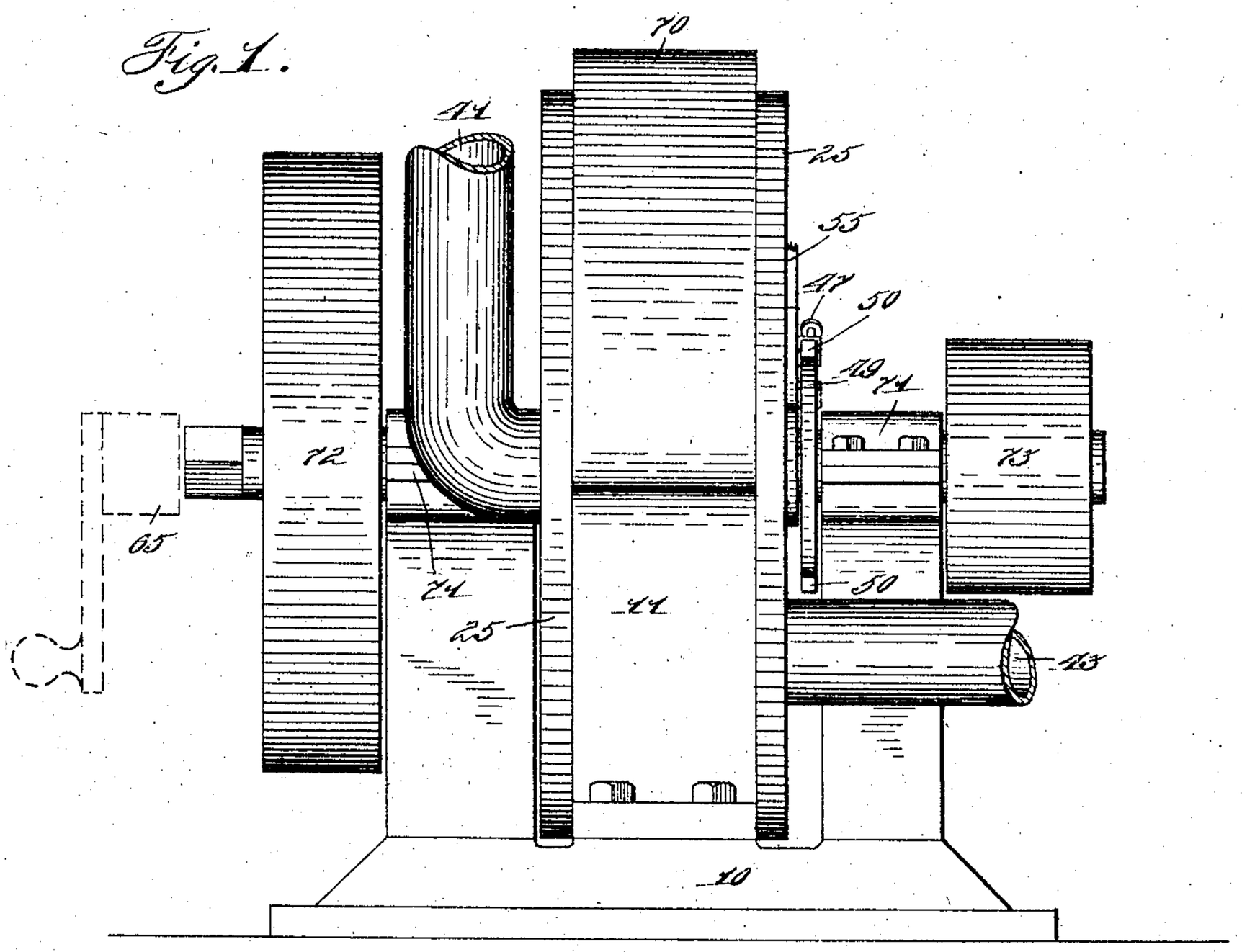
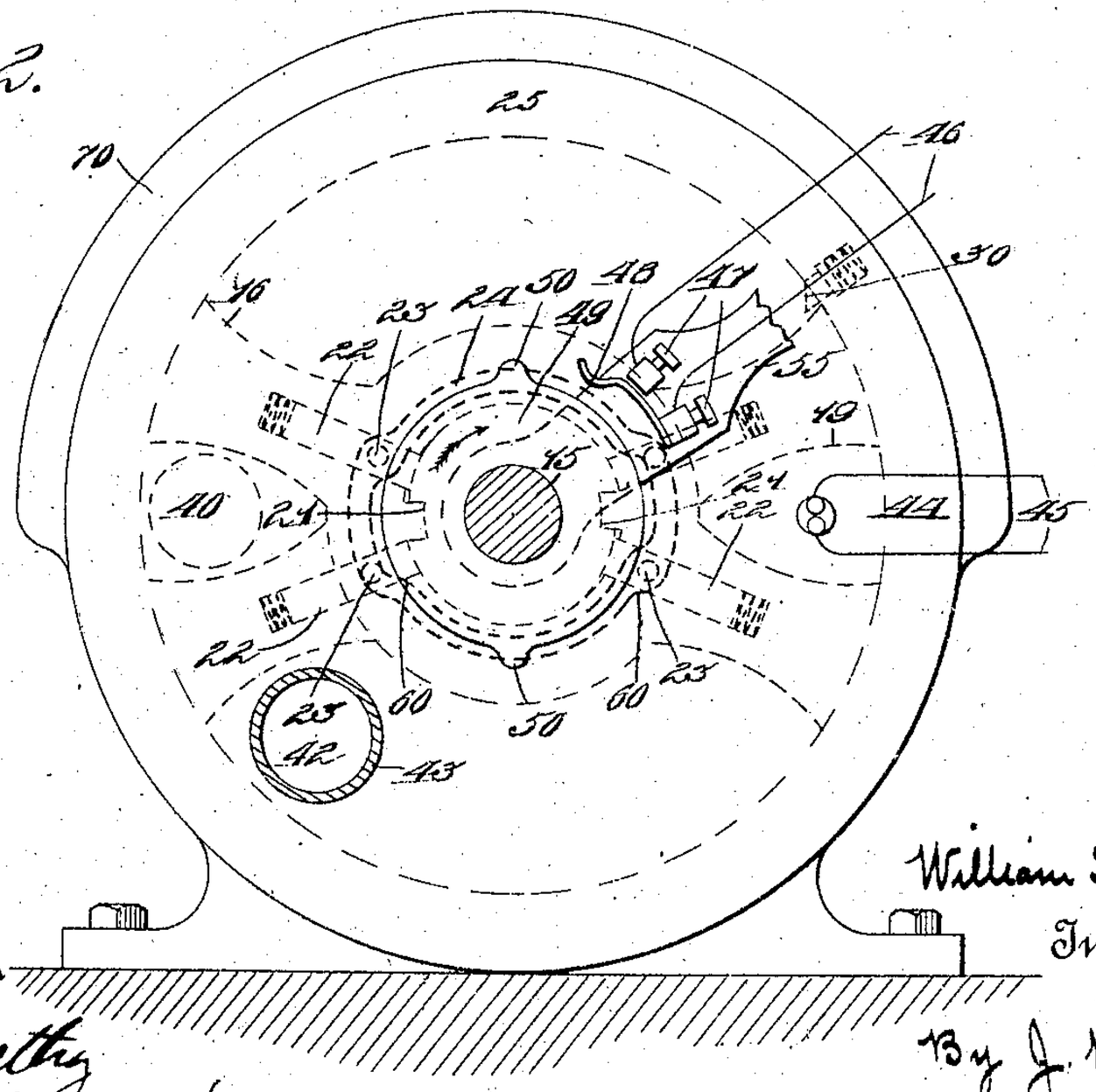


Fig. 2.



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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 3.

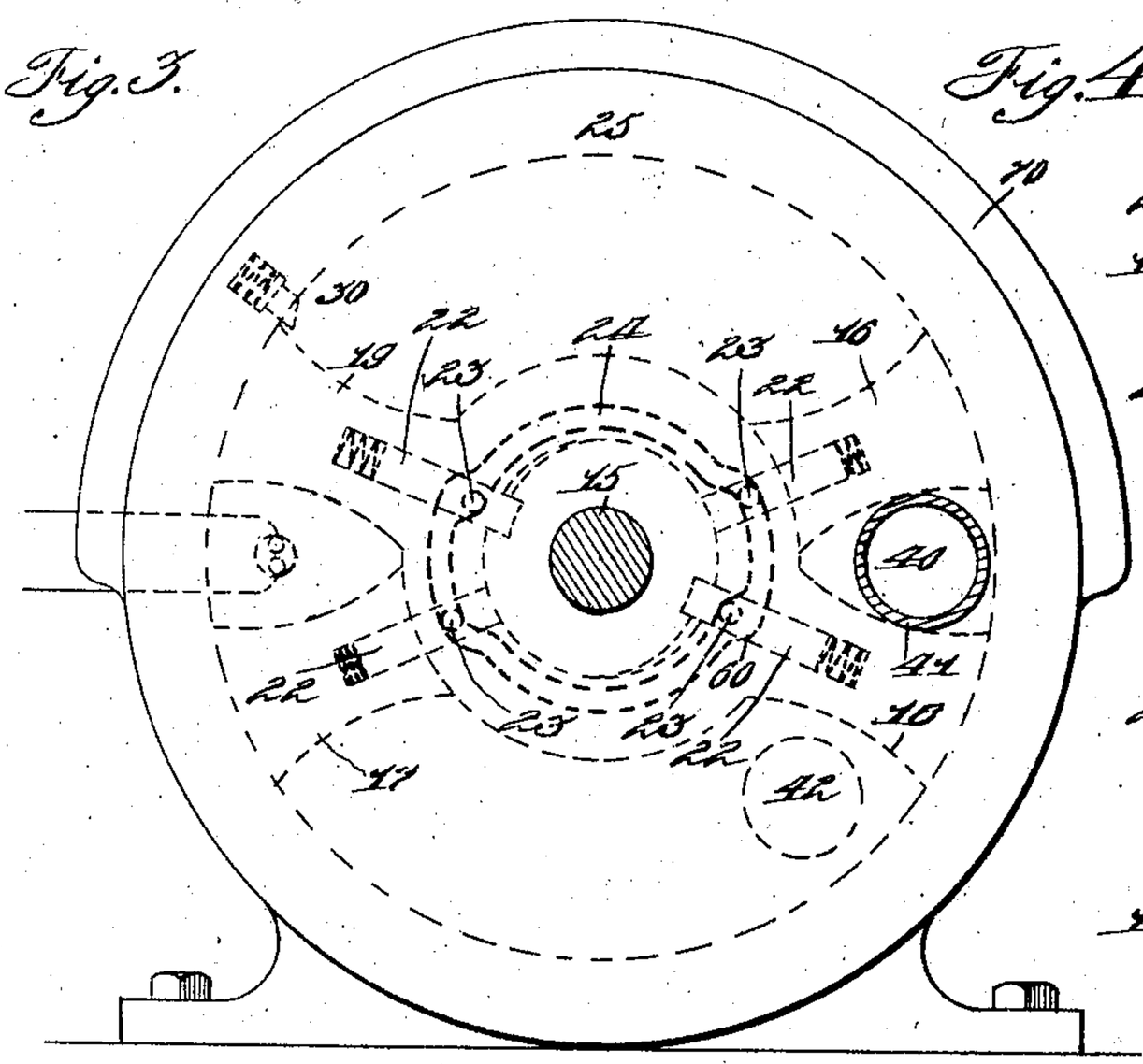


Fig. 4.

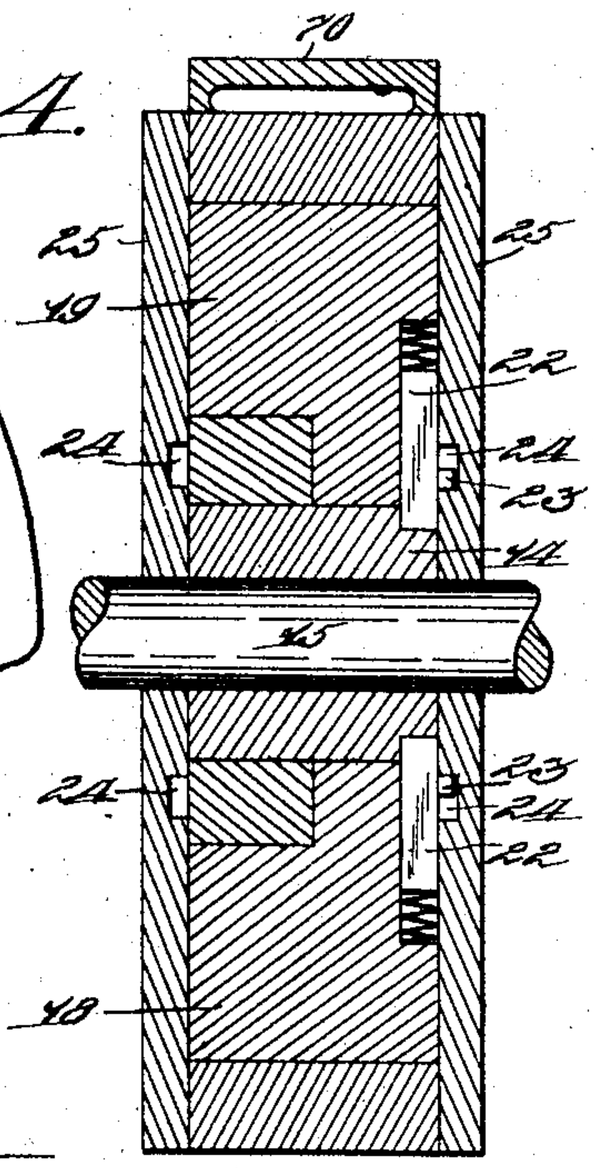


Fig. 5.

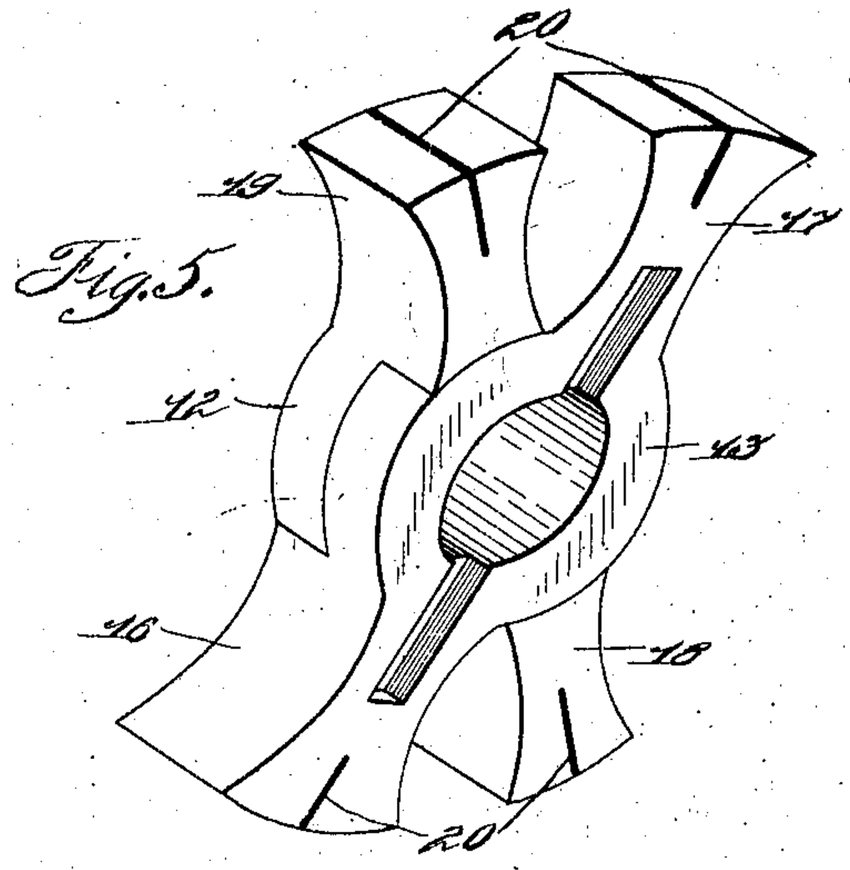
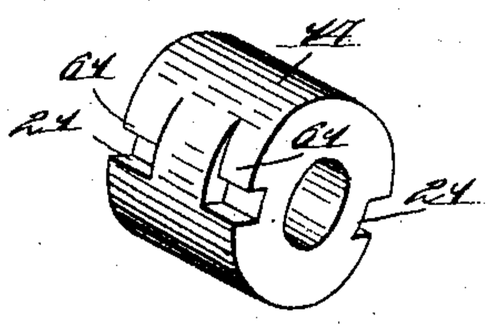


Fig. 6.



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No. 778,082. Patented December 20, 1904.

UNITED STATES PATENT OFFICE.

WILLIAM I. SPANGLER, OF DAYTON, OHIO.

ROTARY EXPLOSIVE-ENGINE.

SPECIFICATION forming part of Letters Patent No. 778,082, dated December 20, 1904.

Application filed July 13, 1903. Serial No. 165,268.

To all whom it may concern:

Be it known that I, WILLIAM I. SPANGLER, a citizen of the United States, residing at Dayton, in the county of Montgomery and State of Ohio, have invented certain new and useful Improvements in Rotary Explosive-Engines, of which I declare the following to be a full, clear, and exact description.

My invention relates to a novel construction of rotary explosive-engine in which any suitable explosive mixture may be used as a propelling medium; and the novelty of my improvement will be more fully set forth hereinafter in the specification and claims.

In the accompanying drawings, Figure 1 represents a front elevation of my machine. Fig. 2 represents a vertical cross-section through the cylinder looking from the right in Fig. 1. Fig. 3 represents a vertical cross-section of the cylinder looking from the left in Fig. 1. Fig. 4 represents a cross-section through the cylinder and pistons, showing the rotary shaft in full. Fig. 5 represents a perspective view of the pistons. Fig. 6 represents a perspective view of the collar which is attached to the rotary shaft.

Referring to the accompanying drawings, 10 represents the base of the machine, upon which is suitably mounted the cylinder 11. Within the cylinder are mounted two similarly-shaped pistons 12 and 13, each of which pistons comprises a body portion which is journaled upon a collar 14, which collar is made fast in any suitable manner to the rotary shaft 15. Each piston has extending outward from opposite sides of its body portion piston-wings 16, 17, 18, and 19. The body portions of these pistons fit closely together upon the collar 14; but the wing portions are made to overlap in the manner shown in Fig. 5, so that these wing portions fill up the entire width of the cylinder, and the cylinder is thus evidently divided into four chambers. The outer portions of these piston-wings are provided with suitable packing 20 to prevent the escape of the gases from one chamber to another. The collar 14 is provided with notches 21, which notches are adapted to be engaged by spring-pressed plungers 22, which are seated one in each piston-wing, there thus being four of these spring-pressed plungers and four corresponding notches in the collar 14. Mounted upon each of these plungers are pins 23, which pins travel in cam-grooves 24, formed in plates 25, fast to the sides of the cylinder, there being a cam-groove plate on one side of the cylinder to engage the pins of the two plungers of one piston and a second cam-groove plate 25 on the other side of the cylinder to engage the pins of the other two plungers of the other piston. (See Fig. 4.) Seated in the circumference of the cylinder is a spring-pressed latch-pin 30, the inner beveled end of which projects through into the cylinder in such manner that the piston-wing may pass in one direction, but will be locked from retrograde movement when the latch snaps in behind the piston-wing.

Entering the cylinder at the induction-port 40 is a suitable induction-pipe 41 to supply the cylinder with explosive gas, and this induction-pipe may be provided with any suitable check-valve. Leading from the cylinder at the exhaust-port 42 is an exhaust-pipe 43. Diametrically opposite the induction-port 40 are suitably-insulated spark-electrodes 44, there being two of these electrodes in an ordinary spark-plug on one side of the cylinder, so that the spark will pass through the gas inside the cylinder, and the electric current for these electrodes is supplied by suitable wires 45, leading from the secondary circuit. The wires 46, leading from the primary circuit, are connected with electrodes 47, which are fast upon an adjustable arm 55, which is pivoted about the rotary shaft 15 and is movable for the purpose hereinafter to be explained. Fast to one of these electrodes is a make-and-break device, consisting of a suitable spring-arm of metal, which is engaged by the cam-plate 49, which is fast to the rotation-shaft 15, there being two projections 50 upon this cam-plate adapted to engage the spring-arm 48.

The principle of operation of the machine is as follows: Assuming that the pistons are in position shown in Fig. 2 and that the explosive gas has been introduced into the chamber between the piston-wings 17 and 19, then if the rotary shaft 15 and collar 14 are rotated slightly in the direction shown by the

arrow in Fig. 2 the notches 21 will be brought opposite the spring-pressed plungers 22 of the piston-wings 16 and 17 and the plungers will immediately be forced down into engagement with the notches, thereby coupling this piston to the rotary collar and shaft. This rotation also carries the cam projection 50 forward and forces the spring-arm 48 upward and makes the current in the primary circuit, whereupon a spark passes between the electrodes 44 and an explosion occurs in the chamber between the piston-wings 17 and 19. The piston-wing 19 is held from reverse rotation by means of the latch-pin 30, but the piston-wing 17 is free to be forced forward under the expansive pressure of the exploded gas, and this piston thereupon rotates, with the pins of its spring-pressed plungers moving within the cam-groove until these pins come in contact with the inclined surfaces 60 of the cam-groove, at which point the pins will be obviously forced outward, carrying the spring-pressed plungers out of engagement with their respective notches. Before reaching this point, however, the piston-wings 17 and 16 would have come in contact, respectively, with the other piston-wings, 18 and 19, and would have carried them forward, so that the piston-wing 16 would pass by the latch-pin 30 and assume the position previously occupied by the piston-wing 19 and the piston-wing 19 would be moved forward into the position of the piston-wing 17, thus leaving the relative positions of the pistons practically the same. However, it will be apparent that while the piston-wing 16 is moving away from the piston-wing 18 more gas will be drawn in through the induction-port 40, and, furthermore, if gas had previously been supplied to the chamber between piston-wings 16 and 19 this gas would now be compressed when the piston-wing 16 is forced forward toward piston-wing 19, and, furthermore, it is obvious that when the piston-wing 17 approaches the piston-wing 18 the air or gases in this chamber will be forced out through the exhaust-port 42. In order to start the machine, then it is necessary to give the rotary shaft a few turns by any suitable means—such as a crank-handle 65, (see Fig. 1)—during which rotation the pistons will be coupled up to the shaft by means of the spring-pressed plungers and successively uncoupled during the successive approach and retreat of one piston-wing from its neighbor, the explosive gas will be drawn in through the induction-port 40, and all four chambers will be supplied with the explosive gas. Of course during this time the spark device will be disconnected in any suitable manner, and then as soon as all the chambers are filled with gas it may be connected, whereupon the operation of the machine will be as heretofore explained—that is, the passage of a spark between the electrodes 44 causes an explosion of the gas between the two piston-wings when the pistons are in the position shown in Fig. 2—and if the rotary shaft is given a slight momentum the notches 21 will be brought opposite the spring-pressed plungers 22, as heretofore explained; but it is obvious that the piston-wing 17 cannot start forward until the notch does come into engagement with the plunger, since the cam-surface 60 of the cam-groove 24 would force the plunger down against the collar 14 and would prevent the forward movement of the piston-wing 17. By this means the full benefit of the explosion is derived, so that the piston-wing does not begin to move forward until a short space of time after the explosion has occurred. However, this relative timing of the explosion and the engagement of the plungers with their respective notches are dependent upon the position of the make-and-break arm 48 with reference to the cam projections 50. Therefore by adjusting the movable arm 55, which carries the electrodes 47 and the make-and-break arm 48, the sparking can be produced sooner or later in the course of revolution of the shaft 15, and the explosion may therefore be made to take place simultaneously with the engagement of the plungers 22 with the notches 21 or before such engagement or after such engagement. It is obvious that when the engine is first starting it would be advantageous to have the explosion take place some time after such engagement, so that the pistons would have already been separated a little distance, and as the speed of the engine increases this spark-setting device may be moved backward, so that eventually the sparking takes place slightly before the coupling of the pistons to the rotary shaft, so that there will be perfect combustion of the gas before the piston begins to move forward under the force of the explosion.

As soon as the piston-wing 17 begins to move forward the gas in the chamber between piston-wings 17 and 18 is driven out through the exhaust, more gas is taken in between the piston-wings 18 and 16, due to the forward movement of the piston-wing 16, and the gas which is between the piston-wings 16 and 19 is compressed, so that when the piston-wing 16 forces forward the piston-wing 19 in the position previously occupied by the piston-wing 17 there is a compressed body of gas now in position to be exploded by another spark, which explosion takes place as soon as the other cam projection 50 makes the contact in the primary circuit by pressing upward the spring-arm 48, and at this point the new gas, which has been drawn in between the piston-wings 16 and 18, is now forced forward by the piston-wing 18 and is compressed, and the piston-wing 18 moves into latched position previously occupied by piston-wing 16, while the gas previously exploded between piston-wings 17 and 19 is driven out through the exhaust-port 42.

In order that the spring-plungers 22 may be sure to engage their respective notches, the collar 14 is cut away slightly at 61, as shown in Fig. 6, so that the spring-pressed plunger may be forced down somewhat before the notch reaches it, and the plunger will therefore engage the wall of the notch upon the opposite side and will be sure to be forced down into the notch. It will be observed from the shape of the cam-grooves 24 that there are four of the inclined portions 60, two of which serve to engage the plungers 22 with their respective notches 21 and the other two of which serve positively to disengage the said plungers from their notches. Furthermore, it will be noted that the cam-groove at the two inclined portions 60, which constitute the point of engagement of the plungers with their notches, as shown in Fig. 3, is slightly enlarged for the purpose of allowing the plungers to drop into their notches under their spring tension.

In order to prevent the heating of that portion of the cylinder which contains the unexploded gas, a suitable water-jacket 70 is provided, which extends only over the upper portion of the cylinder, whereby the gas which is being admitted through the induction-port 40 and which is being compressed by the movement of the piston is kept at a low temperature, whereas the parts of the cylinder where the explosion and expansion are taking place are allowed to remain heated, so as to gain the full benefit of the expansive force of the gas. The rotary shaft 15 is journaled in suitable bearings 71 and has fast upon one side a fly-wheel 72 and on the other side a power-transmission wheel 73. It is thus apparent that by means of these interlapping pistons and by alternately latching one of them from backward movement and coupling the other to the rotary shaft and then automatically uncoupling it I am enabled to produce a continuous cycle of operations, consisting of an explosion, an exhaust, an intake of new gas, and a compression, and thereby by a successive series of explosions impart rotary movement to the shaft to which the pistons are coupled up, and at any instant it will be seen that the cylinder is divided into four chambers, which chambers, however, are merely relative in their position, the end walls of the chambers being formed by the wings of the successively-positioned pistons.

As will be observed in Figs. 2, 3, and 5, the outer walls of the piston-wings are made concave in shape for the purpose of thereby obtaining greater efficiency of the explosive force of the gas against such wall.

Although I have described the starting of my engine, as by rotating the shaft 15 and filling all the chambers with gas, yet it is apparent that it will be sufficient simply to rotate the shaft enough to cause the pistons to move, so as to draw in gas in the two upper chambers in such manner as to bring a body of compressed gas between the pistons 19 and 17 and a body of gas ready to be compressed between the pistons 19 and 16.

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

1. In an explosive-engine, the combination with a cylinder and a rotary shaft, of two pistons arranged to rotate about said shaft and each formed with two diametrically opposite radial wings whereby to divide the cylinder into four chambers, means for effecting an alternate coupling and uncoupling of said pistons to and from said shaft together with means for latching the uncoupled piston against retrograde movement whereby to permit each of said four chambers to alternately expand and contract, means for igniting gas in one of said chambers, an intake-port for introducing uncompressed gas into the diametrically opposite chamber whereby the gas will be sucked into said chamber concurrently with the expansion of said ignition-chamber, and an exhaust-port for the chamber in advance of said ignition-chamber.

2. In an explosive-engine, the combination with a cylinder and a rotary shaft, of two pistons arranged to rotate about said shaft and each formed with two diametrically opposite radial wings whereby to divide the cylinder into four chambers, means for latching the pistons from retrograde movement at one point in their revolution, means for coupling said pistons to said shaft at a point in advance of said latching-point, and means for uncoupling said pistons from said shaft at the latching-point, means for igniting an explosive mixture in the chamber between said latching-point and said coupling-point, an intake-port for introducing uncompressed gas in the chamber diametrically opposite the ignition-chamber whereby the gas will be sucked into said intake-chamber concurrently with the expansion of said ignition-chamber, and an exhaust-port for the chamber in advance of said ignition-chamber.

3. In an explosive-engine, the combination with a cylinder and a rotary shaft, of two pistons arranged to rotate about said shaft and each formed with two diametrically opposite radial wings whereby to divide the cylinder into four chambers, means for latching the pistons from retrograde movement at one point in their revolution, means for coupling said pistons to said shaft at a point in advance of said latching-point, and means for uncoupling said pistons from said shaft at the latching-point, said piston-wings being formed with concave pressure-surfaces whereby to inclose a body of explosive gas between the same when the piston-wings are in contact with each other, and said points of coupling and uncoupling being so constructed that the piston approaching latching position will force the pis-

ton in advance of it into coupling position whereby the latter will be held until after the piston in the rear has been uncoupled from the shaft and the shaft has rotated to the position of coupling to the advanced piston, means for igniting an explosive mixture in the chamber between said latching-point and said coupling-point, an intake-port for introducing uncompressed gas in the chamber diametrically opposite the ignition-chamber whereby the gas will be sucked into said intake-chamber concurrently with the expansion of said ignition-chamber, and an exhaust-port for the chamber in advance of said ignition-chamber.

4. In an explosive-engine, the combination with a cylinder and a rotary shaft, of two pistons arranged to rotate about said shaft, means for introducing an explosive mixture of gas between said pistons, means for igniting the same, means for successively with each explosion locking one of said pistons against retrograde movement and coupling the other piston to the rotary shaft, and means for adjusting said igniting means to cause the ignition to take place at will before or after the coupling of the piston to the shaft.

5. In an explosive-engine, the combination with a cylinder and a rotary shaft, of two pistons arranged to rotate about said shaft, means for introducing an explosive mixture of gas between said pistons, means for igniting the same, means for successively with each explosion locking one of said pistons against retrograde movement and coupling the other piston to the rotary shaft, and means for adjusting said igniting means to cause variations in the interval of time between the moment of ignition and the moment of coupling said piston to said shaft.

6. In an explosive-engine, the combination with a cylinder and a rotary shaft, of two pistons arranged to rotate about said shaft and each formed with two diametrically opposite radial wings whereby to divide the cylinder into four chambers, means for effecting an alternate coupling and uncoupling of said pistons to and from said shaft together with means for latching the uncoupled piston against retrograde movement whereby to permit each of said four chambers to alternately expand and contract, means for introducing an explosive mixture of gas in one chamber, means for igniting said gas in another chamber, means for permitting the expulsion of the exploded gas from another chamber, and means for adjusting said igniting means to cause the ignition to take place at will between or after the coupling of the piston to the shaft, substantially as described.

7. In an explosive-engine, the combination with a cylinder and a rotary shaft, of two pistons arranged to rotate about said shaft and each formed with two diametrically opposite radial wings whereby to divide the cylinder into four chambers, means for effecting an alternate coupling and uncoupling of said pistons to and from said shaft together with means for latching the uncoupled piston against retrograde movement whereby to permit each of said four chambers to alternately expand and contract, means for introducing an explosive mixture of gas in one chamber, means for igniting said gas in another chamber, means for permitting the expulsion of the exploded gas from another chamber, and means for adjusting said igniting means to cause variations in the interval of time between the moment of ignition and the moment of coupling the piston to the shaft, substantially as described.

In testimony whereof I affix my signature in the presence of two witnesses.

WM. I. SPANGLER.

Witnesses:
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L. D. BAKER.