No. 724,606. PATENTED APR. 7, 1903.

J. B. O'DONNELL, DEC'D.

E. M. O'DONNELL, ADMINISTRATRIX.

AIR AND GAS ENGINE.

APPLICATION FILED JULY 24, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 2.

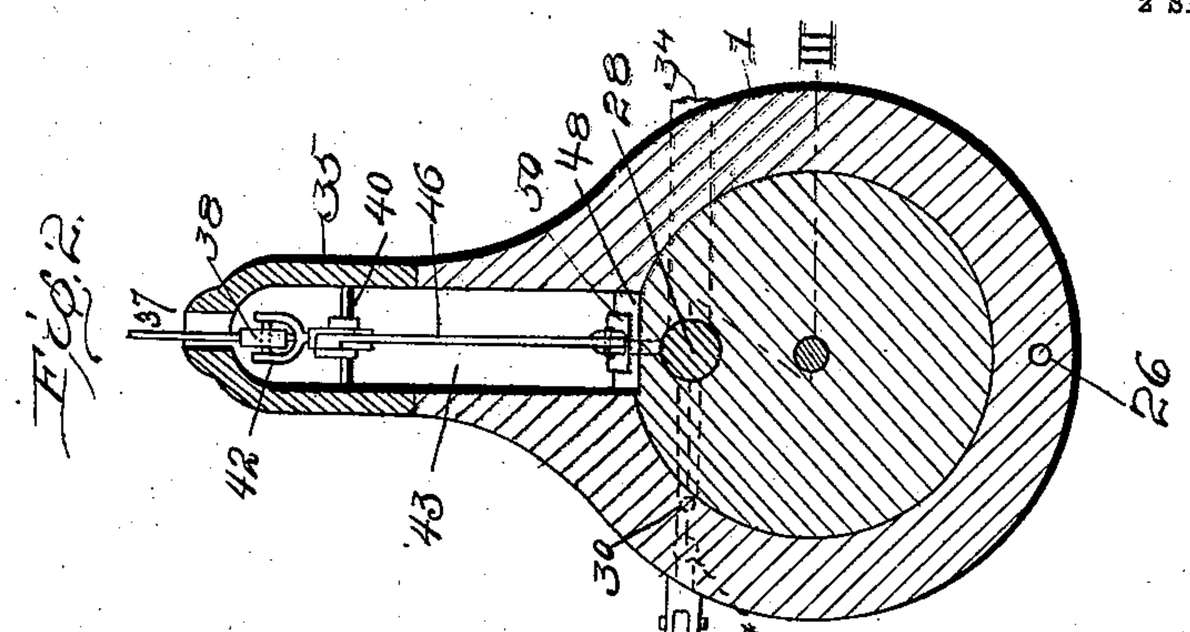


Fig. 1.

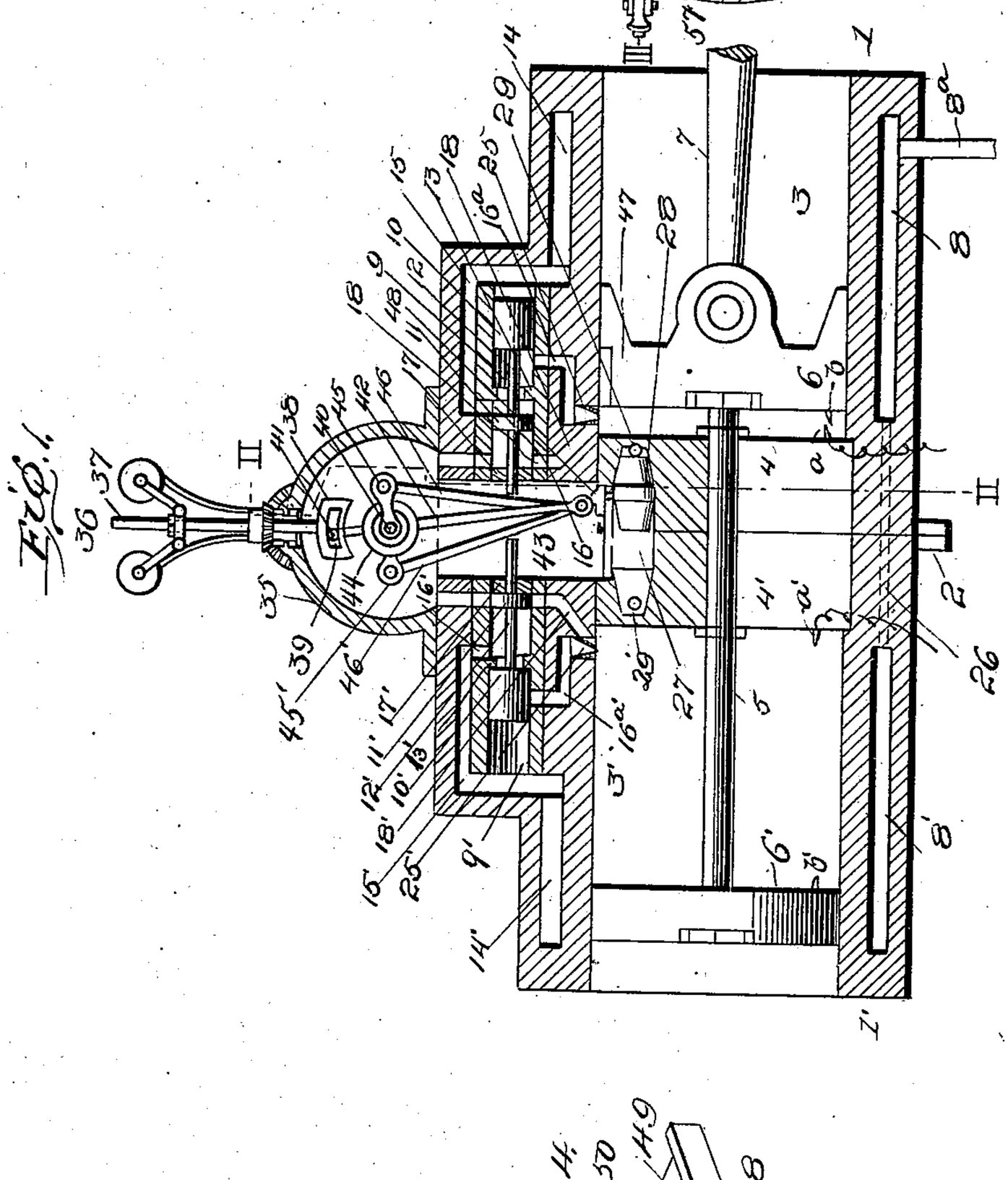
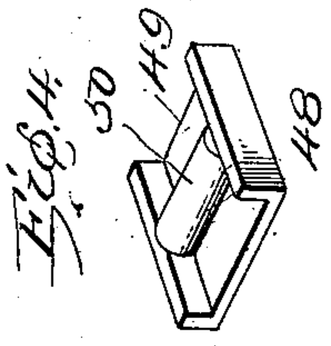


Fig. 4.



Witnesses:
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John B. O'Donnell
By Frank A. Spencer
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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 3.

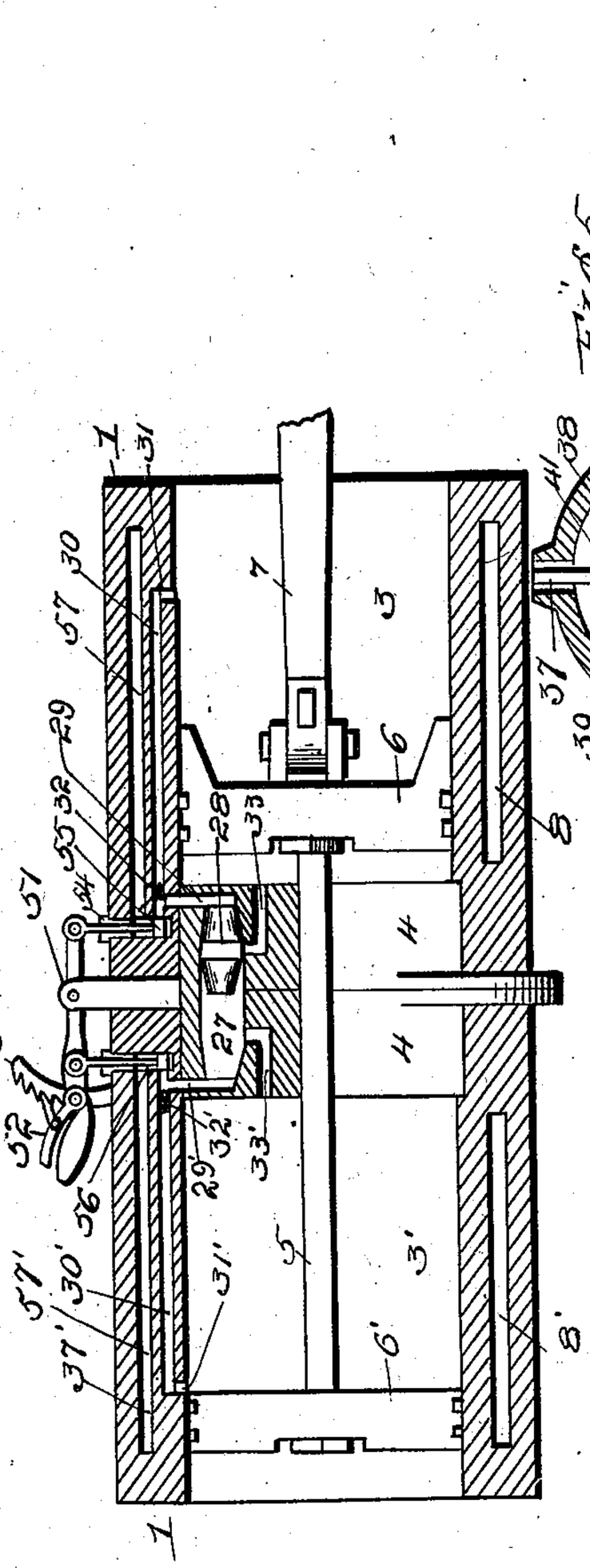

Fig. 5.

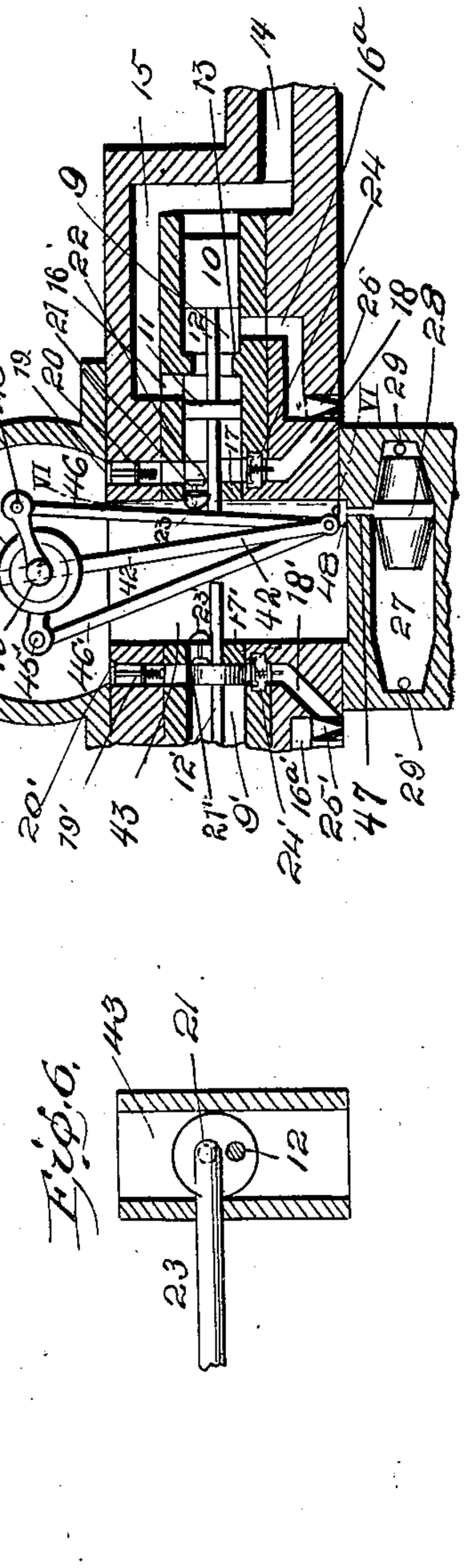

Fig. 6.

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UNITED STATES PATENT OFFICE.

JOHN B. O'DONNELL, OF KANSAS CITY, MISSOURI; ELLA M. O'DONNELL, ADMINISTRATRIX OF SAID JOHN B. O'DONNELL, DECEASED, ASSIGNOR OF ONE-FOURTH TO JAMES R. POLLARD, OF KANSAS CITY, MISSOURI.

AIR AND GAS ENGINE.

SPECIFICATION forming part of Letters Patent No. 724,606, dated April 7, 1903.

Application filed July 24, 1902. Serial No. 116,825. (No model.)

To all whom it may concern:

Be it known that I, JOHN B. O'DONNELL, a citizen of the United States, residing at Kansas City, in the county of Jackson and State of Missouri, have invented new and useful Improvements in Air and Gas Engines, of which the following is a specification.

My invention relates to improvements in air and gas engines of the type in which two cylinders are employed, the same being arranged end to end or "tandem," with the pistons therein operated by a common piston-rod.

The special features of novelty embodied in my engine consist in improved means for operating and regulating the admission-valves whereby the compressed air and gas or other elements composing the explosive mixture are admitted to the cylinders; also, a novel arrangement, construction, and operation of the exhaust-valve. My aim also is to secure the utmost economy and efficiency by using the greatest possible amount of compressed air and the smallest possible amount of gas or gasolene.

In the accompanying drawings, Figure 1 represents a vertical longitudinal section through the cylinders and related parts involved in my invention. Fig. 2 is a cross-section on the line II II of Fig. 1. Fig. 3 is a longitudinal section through the engine on the irregular line III III in Fig. 2, showing the reversing-valve mechanism, exhaust-valve, &c. Fig. 4 is a detached view of a sliding block actuated by the exhaust-valve. Fig. 5 is a vertical section through the admission-valve chamber on the right of Fig. 1 and adjacent parts on an enlarged scale. Fig. 6 is an elevation of one of the side walls of a pendulum-chamber 43 on the line VI VI of Fig. 5, showing, partly in section, a gas-admission pipe and other details.

The two cylinders 1 1′, open at their outer ends, are duplicates of each other, with the positions of their parts reversed, faced together end to end, and secured to each other by bolts passing through flanges 2. These cylinders contain piston-chambers 3 3′ and are provided with heads 4 4′, which abut against each other and form a partition between the piston-chambers. Through said heads passes centrally the common piston-rod 5, connected to the pistons 6 6′, to one of which is attached the connecting-rod 7, leading to the crank, fly-wheel, &c. (Not shown.) The walls of said cylinders contain spaces 8 8′ for compressed air supplied from any suitable source, as 8^a, and in their upper portions valve-chambers 9 9′, in which reciprocate admission-valves 10 10′ 11 11′, mounted on common stems 12 12′ for regulating the admission of compressed air and gas to the explosion-chambers lying between the pistons 6 6′ and heads 4 4′. The valves 10 10′ are adapted to engage seats 13 13′ in said valve-chambers and control the ports 14 14′ 15 15′ 16 16′ 16^a $16^{a\prime}$, through which compressed air passes to the explosion-chambers, and the valves 11 11′ engage the inner ends 17 17′ of valve-chambers 9 9′ and control the ports 18 18′, through which gas passes to said explosion-chambers. It will be observed that on the right-hand side of the engine in Fig. 1 the valves 10 11 are in position to admit both air and gas to chamber 3, while on the opposite side valves 10′ 11′ prevent such admission to chamber 3′.

19 19′ are relief-ports for the escape of waste gases or products of combustion which may remain in valve-chambers 9 9′ after the ignition. Said ports lead to the open air and are each controlled by check-valves 20 20′, opening outward. In the ends 17 17′ of valve-chambers 9 9′ are longitudinal ports 21 21′, controlled by check-valves 22 22′, opening inwardly toward said valve-chambers 9 9′, for the admission of gas supplied through pipes 23 23′. (Shown in Figs. 5 and 6.) Such gas is drawn into the valve-chambers 9 9′ through check-valves 22 22′, on its way to the explosion-chambers, by way of ports 18 18′, by the suction produced by piston-valves 11 11′ as they move away from their seats.

24 24′ are check-valves in the outer ends of gas-ports 18 18′, opening downwardly to admit gas to the chambers at the proper moment, but closing at the moment of explosion.

In the lower ends of the radial air-ports 16^a $16^{a\prime}$, at the points where they open into the

piston-chambers, are located tapering nozzles 25 25′, through which when the valves 10 10′ are open a blast of compressed air is forced, the effect of which is to produce a suction out of gas-ports 18 18′ into the said chambers, thus expediting the entrance of gas thereto and its mixture with the air therein. The inner ends of gas-ports 18 18′ are inclined at an angle to air-ports 16^a $16^{a'}$ and open in immediate juxtaposition to the latter to promote this operation.

The compressed-air spaces 8 8′ are connected with each other by a port 26 (shown in Fig. 2) and are at all times during the operation of the engine filled with compressed air. The abutting center heads 4 4′ contain a longitudinal passage or chamber 27, within which the exhaust-valve 28 reciprocates. Radial exhaust-ports 29 29′ lead from the ends of chamber 27 and are connected by longitudinal ports 30 30′ with radial ports 31 31′, which open into the piston-chambers at points just within the limit of the outstroke of the pistons. In exhaust-ports 30 30′ are located check-valves 32 32′, opening inwardly to permit the passage of the exhaust toward chamber 27, but to resist pressure in the opposite direction. Said exhaust-valve chamber 27 is cylindrical in its central portion, but tapers toward each end to fit the frusto-conical ends of the exhaust-valve 28, which valve is also cylindrical in its central portion to fit the cylindrical portion of said chamber 27. Ports 33 33′ in said center heads extend longitudinally from the inner ends of the piston-chambers 3 3′ and afterward radially to the chamber 27, so that they will be closed by valve 28 when it is at the limit of its throw in either direction. The final-exhaust pipe 34 leads out of the central portion of chamber 27. Said center heads 4 4′ are bored at any suitable point for the admission of the electric wires leading to contact devices of any preferred form, as *a a′*, located at the inner end of the piston-chambers, and the pistons 6 6′ carry similar devices *b b′*, whereby the charge in said chambers is exploded in the usual manner.

The governor-dome 35 is located above the junction of the two cylinders and supports a governor 36 of the ordinary type, having a stem 37, arranged to reciprocate vertically, extending downward into the dome and carrying at its lower end a cross-head 38, containing a curved slot 39, describing an arc having a pin or arbor 40 as its center. Through said slot extends transversely a roller 41, mounted on the upper end of an adjusting-rod 42, which rod extends downwardly, passing loosely through arbor 40 and through a longitudinal slot or opening in the upper wall of the cylinders nearly to the bottom of a chamber 43 in the cylinders, said rod forming the central member of a swinging pendulum device 44 for operating the admission-valves. The arbor 40 is mounted in fixed bearings within the dome 35. To said arbor are pivotally connected links 45 45′, which are also pivoted at their outer ends to arms 46 46′, which extend downwardly, converging toward each other, and are pivoted at their lower ends to the lower end of adjusting-rod 42. Said arms are located in the vertical plane of the valve-stems 12 12′, carrying the admission-valves 10 10′ 11 11′, which stems extend through the side walls of chamber 43 and lie in the path of arms 46 46′, so as to contact alternately therewith when the pendulum device is oscillated laterally in either direction.

The chamber 43, within which the pendulum 44 oscillates, is located immediately above the chamber 27, in which the exhaust-valve 28 reciprocates. Said chambers are connected by a longitudinal slot extending through the floor of chamber 43 and the roof of chamber 27 to provide for the passage and movement of a pin or lug 47, connecting valve 28 with a sliding block 48, which reciprocates longitudinally along the floor of chamber 43 with each throw of the exhaust-valve. Said block 48 (shown in detail in Fig. 4) is of rectangular form, with a flat bottom, and provided, preferably, with a recess 49 in its upper side, in which is located an upwardly-projecting lug 50, having, preferably, a curved upper surface adapted to contact with the rounded lower end of the pendulum device 44, so as to push said pendulum in either direction with each reciprocation of the exhaust-valve 28.

As heretofore stated, compressed air enters the explosion-chambers 3 3′ through the ports 14 14′ 15 15′ 16 16′ 16^a $16^{a'}$ and gas through ports 18 18′. The charge is exploded at the moment when the pistons 6 6′ have completed their instrokes and start on their outstrokes, as shown on the right-hand sides of Figs. 1 and 3. When the piston 6′ reaches the end of its outstroke, having passed the exhaust-port 31′, as shown on the left-hand side in Figs. 1 and 3, expanded gas returns through ports 30′ 29′ and moves exhaust-valve 28 to the opposite end of chamber 27, taking with it block 48, and when the said valve 28 passes port 33′ the exhaust follows through said port to final exhaust through pipe 34. This movement of valve 28 and slide 48 causes lug 50 on said slide to contact with the lower end of pendulum 44 and swings it over for a greater or less distance toward the opposite side of chamber 43, causing arm 46 to contact with the stem 12 of the admission-valves 10 11 upon that side, pushing said valves away from their seats and opening the ports for the entrance of air and gas, as in Fig. 1. The operation described is then repeated at the opposite end of the engine, the charge being exploded with each outstroke of the pistons. When the valve-stems 12 12′ are out of contact with the arms 46 of the pendulum, the admission-ports are entirely closed by the valves 10 10′ 11 11′, owing to air-pressure on valves 11 11′, as seen on the left side of Fig. 1. The quantity of air and gas admitted to the cylinders, and consequently the speed of

the engine, depends upon the distance which the admission-valves are moved outward by contact of their stems with the arms 46 46′ of the pendulum, and consequently the degree to which the admission-ports which they control are open. If said ports are not fully uncovered, the supply of gas and air admitted is diminished and the speed lessened. As the speed increases the balls of the governor are thrown outwardly, raising the governor-stem 37 and adjusting-rod 42, thus lifting the pivoted arms 46 46′ and causing them to approach each other, so that when the pendulum is thrown laterally in either direction by contact with the sliding block 48 it will not push the valve-stems as far as formerly, the admission-valves will be only partially open, and the speed will be diminished. If the speed is so great as to lift the pendulum 44 entirely out of contact with block 48, the admission-valves upon the side toward which said block is moving will remain closed for at least one stroke and the valves upon both sides may remain inoperative, the pendulum returning to vertical position, owing to gravity and air-pressure on valves 11 11′, until the speed diminishes, lowering the pendulum and bringing it again into the path of the block 48. The parts are so adjusted that lug 50 on block 48 will always be carried past the pendulum-point with each throw of said block in either direction, leaving the pendulum free to return to vertical position or make the return stroke.

The device for reversing the engine is shown in Fig. 3. The standard 51 upon the side of the engine supports a reversing-lever 52, provided with a ratchet-and-pawl device 53. To the ends of said lever are pivoted valve-stems 54, operating valves 55 in reversing-valve chambers 56, which chambers connect with the exhaust-ports 29 29′ and also ports 57 57′, leading from the compressed-air spaces 8 8′. The lever 52 is normally adjusted, as shown in Fig. 3, so that the valves 55 will close the entrances of exhaust-ports 29 29′ into the valve-chamber 56; but if by the operation of lever 52 the valve 55, for example, be moved downward, so as to uncover port 29, compressed air from port 57 will pass through chamber 56, along valve-stem 54, enter port 29, and press against valve 28, driving it to the opposite end of chamber 27, and thus reversing the engine. The check-valves 32 32′ in exhaust-ports 30 30′ opening inwardly prevent the passage of compressed air outwardly through those ports during this operation. It will be seen that the radial passages 29 29′ serve a double purpose—as exhaust-passages in the normal working of the engine and as compressed-air passages in reversing.

While I have shown the preferred means of rocking the pendulum device—namely, by means of the block 48, operated by the exhaust-valve—I do not limit my claims to that method of working the device, as the oscillating movement might be imparted to the pendulum by other means than the exhaust-valve or by means of different mechanism connected to the exhaust-valve from that shown without departing from the spirit and scope of my invention.

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

1. An air and gas engine comprising two cylinders disposed end to end, each containing a piston-chamber, with pistons therein mounted on a common piston-rod, center heads through which said rod passes, forming a partition between said chambers, compressed-air ports and gas-ports in the walls of said cylinders, upon each side, leading into said piston-chambers, valve-chambers interposed in the course of said air and gas ports having valves therein mounted on common, inwardly-projecting stems and controlling said ports, a longitudinal exhaust-passage in said partition, an exhaust-valve adapted to reciprocate therein, a governor located above the cylinders and having a depending stem, a cross-head on the lower end of said stem, a pendulum device suspended below said cross-head, having an adjusting-rod supported by said cross-head and mounted to rock thereon, an arbor forming the center of oscillation of said rod and pendulum, lateral arms pivoted at their lower ends to said adjusting-rod, and at their upper ends linked to said arbor, and lying between the projecting ends of said admission-valve stems, and means operated by the exhaust-valve for rocking said pendulum, so as to contact alternately with said stems and regulate the throw of said admission-valves, substantially as set forth.

2. An air and gas engine having two cylinders arranged tandem, piston-chambers with pistons therein mounted on a common piston-rod, a partition between said chambers, air and gas ports leading into said chambers, admission-valves controlling said ports and carried on common valve-stems, a governor mounted above the cylinders and having a depending stem, an arbor mounted below said stem, a pendulum-chamber, a pendulum device suspended therein and mounted to rock on said arbor, between the projecting stems of the admission-valves, an adjusting-rod loosely secured in the lower end of the governor-stem and to said arbor, and pivotally attached to the members of the pendulum-frame, so as to oscillate therewith and also to rise and fall with the vertical fluctuations of said governor-stem, whereby the lateral spread of the pendulum-frame, and consequently the throw of the admission-valves, may be increased or diminished, a longitudinal exhaust-passage below the pendulum-chamber, an exhaust-valve therein, a sliding block in the bottom of said pendulum-chamber, a connection between said block and the exhaust-valve, and a projection on said block adapted to contact with and actuate said pendulum, substantially as set forth.

3. In an air and gas or other engine, two

cylinders in line, pistons in said cylinders mounted to reciprocate simultaneously, admission-ports and admission-valves for each cylinder, said valves having stems projecting inwardly toward each other, in combination with a regulating device comprising a governor, an arbor, a pendulum-frame suspended between said projecting valve-stems and mounted to rock on said arbor, said frame having a central rod engaging said arbor and actuated vertically by the fluctuations of the governor, side arms pivotally connected to said rod and said arbor and adapted to contact with said valve-stems alternately, and means for rocking said frame on said arbor, substantially as set forth.

4. In an air and gas engine, the combination of two cylinders in line, with heads toward each other, piston-chambers and pistons therein mounted on a common piston-rod, air and gas ports leading into said chambers, valves controlling said ports, and means for regulating said valves, a longitudinal exhaust-passage in the cylinder-heads between said chambers, an exhaust-valve adapted to reciprocate in said passage, radial ports leading from the outer ends of said passage, compressed-air ports in the walls of the cylinders, a transverse valve-chamber for each cylinder, with which said air-port and radial port connect, a valve in each of said chambers, normally inoperative, but adapted, when moved, to open connection between said air-ports and radial ports, valve-stems for each of said valves, and a reversing-lever mounted at the side of the engine, for operating said valves, substantially as set forth.

5. In an air and gas or other engine, two cylinders in line, with heads toward each other, and pistons in said cylinders mounted on a common piston-rod, admission-ports and admission-valves for each cylinder, said valves having stems projecting inwardly toward each other, in combination with a regulating device consisting of a governor having a vertically-acting stem, a pendulum-frame suspended midway between said projecting ends of the valve-stems, said frame having a central rod adjustably connected to said governor-stem, an arbor on which said rod and frame oscillate, side members adjustably connected to said rod and said arbor, and lying in the plane of said projecting valve-stems, and means for rocking said frame on said arbor, substantially as set forth.

6. In an air and gas or other engine, two cylinders in line, pistons in said cylinders mounted to reciprocate simultaneously, admission-ports and admission-valves for each cylinder, said valves having stems projecting inwardly toward each other, in combination with a regulating device comprising a governor, an arbor, a laterally-expansible pendulum-frame disposed between said projecting valve-stems and mounted to rock on said arbor, the degree of lateral expansion of said frame, and consequently the throw of said valve-stems, being determined by the fluctuations of said governor, and means for rocking said frame, substantially as set forth.

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

JOHN B. O'DONNELL.

Witnesses:

WINFRED S. PONTIUS,

J. R. POLLARD.