(No Model.)

G. L. THOMAS.

ELECTRICALLY CONTROLLED GAS ENGINE OR MOTOR.

No. 558,749. Patented Apr. 21, 1896.

Fig. 1.

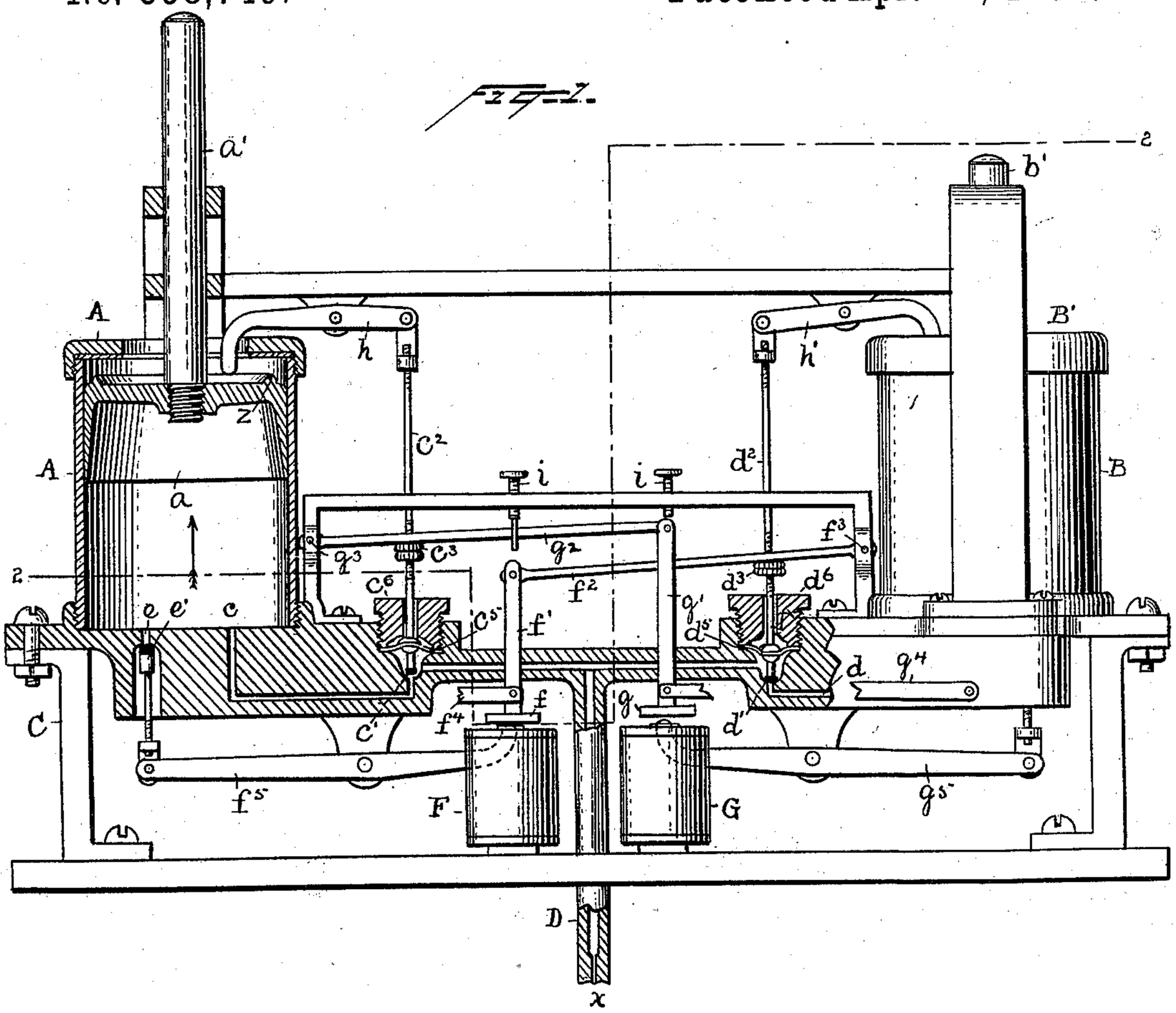


Fig. 2.

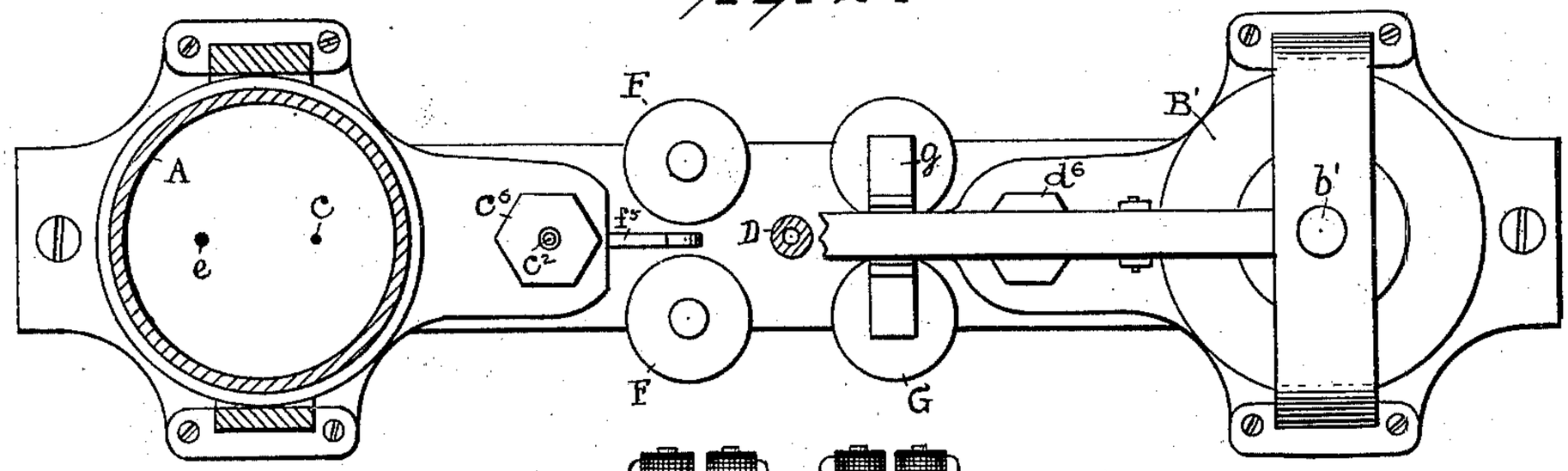
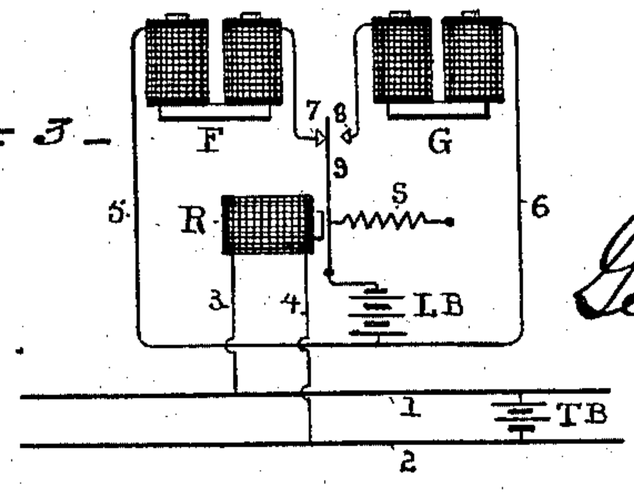


Fig. 3.



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GEORGE L. THOMAS, OF MONTCLAIR, NEW JERSEY.

ELECTRICALLY-CONTROLLED GAS ENGINE OR MOTOR.

SPECIFICATION forming part of Letters Patent No. 558,749, dated April 21, 1896.

Application filed November 11, 1895. Serial No. 568,573. (No model.)

To all whom it may concern:

Be it known that I, GEORGE L. THOMAS, a citizen of the United States, residing at Montclair, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Electrically-Controlled Gas Engines or Motors, of which the following is a specification.

The object of my invention is to produce an engine or motor adapted to be operated by compressed gas, and especially by compressed gas which is formed by allowing the liquid form of a gas such as carbonic-acid gas to expand.

Such gas is comparatively expensive, and it is one object of my invention to economize to as great an extent as possible in the use of such gas. The saving in gas is effected by so constructing the parts that a very small quantity of gas is required to raise the pistons under ordinary conditions. The gas enters the supply-pipe through a contracted passage at a pressure of about two hundred and fifty pounds to the square inch. As the gas enters a cylinder upon the opening of its inlet-valve it expands within the cylinder to a pressure of about twenty-five pounds to the square inch, which pressure under ordinary conditions is sufficient to start the piston upward suddenly and drive it quickly to the end of its stroke. Thus the piston is operated by a small quantity of gas, and to prevent the entrance of more gas into the cylinder I provide a device for closing the inlet-valve when the piston reaches the end of its upward stroke. This device preferably is a pivoted lever having one end connected with the valve-rod of the inlet-valve and the other end curved downward and extending into the cylinder through the cylinder-head. This end of the lever is struck by the piston at the end of its upward movement, whereupon the lever is tilted, which forces the valve-rod downward to close the valve. Thus the inlet-valve is opened and closed within a very short interval of time, and hence a very small quantity of gas will be utilized for each operation. Should the movable parts of my motor or the signaling device become bound by the freezing of moisture, which occurs frequently in the signaling apparatus, the sudden starting of the piston will be a sufficient blow to crack the ice and permit the proper operation of the apparatus. Should a pressure of twenty-five pounds be insufficient to operate the signaling device under the conditions named, then the additional supply of gas which would enter the cylinder so long as the inlet-valve remained open would insure the operation of the apparatus. To facilitate the control of the valves governing the entrance and exit of the gas to the cylinders, I employ electromagnets; and a further object of my invention is to so construct a valve-controlling apparatus that but a comparatively small amount of current will be needed to start the same in operation. This is accomplished by so balancing the gravity of the parts connected with the armature as that the inlet-valve, when its controlling magnet is deënergized, will be held loosely to its seat by the gravity of connected parts, and so that when the magnet is energized the said valve will be held tightly to its seat by the energy of the magnet.

An engine or motor constructed and operating in accordance with my invention is especially useful for operating railway semaphore-signals, although it is evident that such a motor may be employed in many other ways, and particularly in locations where the operation is to be controlled from a distance.

Preferably I arrange my engines in pairs, so that the cylinder of one is operated in alternation with the cylinder of the other, and in order to accomplish this I provide two magnets, one for each cylinder, which are adapted to be alternately energized, and each magnet controlling the inlet-valve of one cylinder and the outlet-valve of the opposite one. In this way I am enabled to operate and control the signaling device in both directions—that is, in setting the signal and returning it to its normal position. I accomplish this by arranging the two piston-rods so that they will engage the signaling device on opposite sides of its pivot, and thus the accidental stoppage of the signal at an intermediate position is prevented.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is a partial elevation and vertical section of a motor and its controlling devices designed especially for operating a railway semaphore-signal. Fig. 2 is a cross-section

on the lines 2 2 of Fig. 1, and Fig. 3 a diagram showing the circuit connections of the controlling-magnets.

Referring to the drawings, A and B are cylinders suitably mounted upon a base C. The cylinder A contains a piston a, preferably of the form shown, and having a rod a'. The cylinder B is likewise provided with a piston and a rod b'. The inlet and outlet passages to the cylinders are shown as formed in the upper portion of the base C. The inlet-passages to cylinders A and B are indicated at c and d, respectively, and are provided with valves c' and d', respectively. The outlet or discharge passage for cylinder A is shown at e, and is provided with a valve e'. The outlet for cylinder B and its valve are not shown, but they are similar to those of cylinder A. The valves for the inlet and outlet passages are preferably provided with elastic tips to effectually close the passages against the passage of gas. The inlet-passages c and d are connected with the supply-pipe D, which has a contracted passage x.

The valves are controlled by two electromagnets F and G. The magnet F has an armature f, carried by a link f', which is hinged to a lever f^2, pivoted at f^3. The link f' is connected to a pivoted arm f^4, which guides the armature f in its movements toward and away from its magnet. The valve-rod d^2 of valve d' passes through the lever f^2, and d^3 are screw-nuts on rod d^2, located under the lever f^2 and through which the valve d' is held to its seat by magnet F. The valve e' for the outlet e of cylinder A is controlled by a pivoted lever f^5, the free end of which curves upwardly and projects into the path of armature f, so that when that armature is moved downward by the gravity of the connected parts the opposite end of the lever f^5 will be tilted upward, closing the valve e'. It will thus be seen that when inlet-valve d' is held to its seat by magnet F the outlet-valve e' will also be held to its seat by that magnet. The valve-magnet G has an armature g, carried by link g', hinged to lever g^2, which is pivoted at g^3. Lever g^2 is operatively connected with valve-rod c^2 through screw-nuts c^3, and g^4 is the guide-link for armature g. The outlet-valve of cylinder B is controlled by the pivoted lever g^5, the free end of which curves upward and projects under the armature g of magnet G.

From the foregoing description of the connected levers and links it will be seen that as the inlet-valve of one cylinder is closed the outlet-valve of the other cylinder is also closed, and it will also be seen that as the inlet-valve of one cylinder is opened upon its controlling-magnet being deënergized the armature of that magnet will be raised through its connection with the stem of the inlet-valve, which will leave the operating-lever of the outlet-valve of the other cylinder free to be tilted, permitting the opening of that valve.

The valve-stems c^2 and d^2 pass through and are secured to diaphragms c^5 and d^5, respectively, located in the valve-chambers, and c^6 and d^6 are screw-plugs screwed into the base and securing the diaphragms at their edges. The diaphragms are employed to open the inlet-valves through the pressure of the compressed gas thereon when the armatures are released by the magnets. The inlet-valves are closed through the tilting of the pivoted levers h and h', connected, respectively, to valve-rods c^2 and d^2. The free ends of these levers are curved downward and extend into the upper parts of the cylinders A and B through their open heads A' B'. The downwardly-extending ends of these levers are designed to be struck by the pistons at the end of their upward strokes to tilt the levers and force their valve-rods downward to close the inlet-valves.

In the operation of my apparatus, when one magnet is deënergized the other is energized, and Fig. 1 illustrates the position of the parts after magnet G is deënergized and magnet F energized, the inlet-valve c' having been opened by the pressure of the gas. When piston a is near the end of its upward stroke, it strikes lever h, tilting the same and closing the inlet-valve c' of its cylinder. The parts will remain in this position, the piston a and valve c' being balanced by the pressure of the gas and outlet-valve e' being held closed by magnet F. When magnet F is deënergized, magnet G is instantly energized, which action releases inlet-valve d', the pressure of the gas opening the same, and inlet-valve c' is held firmly to its seat by magnet G. As the valve d' is opened armature f and its connected parts are raised through the connection with the valve-stem d^2, leaving the lever f^5 free to be tilted and valve e' opened by the pressure of the gas within the cylinder A. The inlet-valve of the cylinder B now being open, the pressure of the gas will raise the piston, and when the piston strikes the pivoted lever h' its inlet-valve will be closed. Simultaneously with the rise of the piston in cylinder B the piston in cylinder A descends, the gas contained therein being free to escape, as before explained. Thus I produce an alternating action of the pistons positively operating and controlling the signaling device in both directions. Two adjustable stops i are provided to limit the upward movement of levers g^2 and f^2.

The heads of the cylinders are provided on their inner sides with rubber or other cushioned surfaces, which coact with the wedge-shaped circular ribs z on the upper sides of the piston-heads to effectively seal the cylinders when the pistons are driven against the cylinder-heads, whereby the escape of gas around the piston-heads and out of the openings in the cylinder-heads is prevented. This is essential because it may be desirable—as, for instance, in the operation of railway-semaphores—to maintain a piston-head in its ele-

vated position for a considerable period of time, and unless the cylinder were effectively sealed to prevent the escape of gas the weight of the piston and of the devices operated by it would force the gas from the cylinder, and the piston would gradually descend, and of course the devices operated by it would move accordingly, rendering the apparatus inefficient for the purpose for which it was designed.

While I have described the two pistons as being alternately operated, which would be the desired way when employed in operating railway-semaphores, it will be understood that they may be operated simultaneously, if desired, by simply opening and closing the circuits to the two magnets simultaneously.

In Fig. 3, which shows the circuit connections, 1 and 2 represent the rails, and to which are connected wires 3 4, leading to relay R, constituting the track-circuit, and T B is the battery for that circuit. The magnets F and G are included in a local circuit having a battery L B, from one side of which the wires 5 6 lead through the magnets to contact-plates 7 8. The other side of the battery is connected to a pivoted contact-arm 9, which makes contact with plate 7 when the armature carried by said arm is attracted by the relay, and with the contact-plate 8 when the battery T B is short-circuited by a train. A spring *s* draws arm 9 against plate 8 when battery T B is short-circuited. The circuit connections, as shown, represent the circuits after a train has left a section, and the positions of the various parts of the motor represent their relative positions just before piston *a* reaches the end of its upward stroke and the piston in cylinder B the end of its downward stroke in lowering the signal.

The next operation of the apparatus will be as follows: A train entering the section will short-circuit the battery of the track-circuit and permit spring *s* to break the local circuit to magnet F and close the circuit to magnet G. The energizing of magnet G will maintain inlet-valve *c'* and the outlet-valve of cylinder B closed, (it being assumed that the tilting of lever *h* effected the closing of said valves, as before explained,) and the deenergizing of magnet F will permit the gas to open inlet-valve *d'*, and the upward movement of the valve-rod will carry the lever f^2 and armature *f* with it, which leaves lever f^5 free to be tilted. The pressure of the gas within cylinder A will force outlet-valve *e'* from its seat, whereupon the gas will escape and piston *a* will descend. By the time the piston of cylinder B will have reached the end of its upward stroke and closed its inlet-valve by the tilting of its lever *h'* the piston *a* will have reached the bottom of cylinder A, and the weight of armature *f* and connected parts will tilt lever f^5 and close outlet-valve *e'*. When the train leaves the section again, the battery T B will be no longer short-circuited, and relay R will draw arm 9 against contact 7 again, thus breaking the circuit to magnet G and again energizing magnet F. The magnet F will then hold its armature and maintain the valves *d'* and *e'* closed. The deënergizing of magnet G will permit the opening of inlet-valve *c'* by the gas in the supply-pipe, and also permit the opening of the outlet-valve of cylinder B by the gas therein, and the apparatus will resume the position indicated in the drawings.

What I claim is—

1. In a motor adapted to be operated by compressed gas, the combination of a cylinder and a piston therein, an inlet-valve held to its seat by an electromagnet and opened by the pressure of the gas when the magnet is deënergized, and an outlet-valve controlled by an electromagnet, substantially as set forth.

2. In a motor adapted to be operated by compressed gas, the combination of two cylinders and pistons therein, inlet and outlet valves therefor, two magnets for controlling said valves, each controlling the inlet-valve of one cylinder and the outlet-valve of the other cylinder, and said inlet-valves being opened by the pressure of the gas when the magnets are deënergized, substantially as set forth.

3. In a motor adapted to be operated by compressed gas, the combination with a cylinder and a piston therein, of inlet and outlet passages for said cylinder, a valve for the inlet-passage controlled by an electromagnet and opened by the pressure of the gas when the magnet is deënergized, a rod on said valve, an actuating-lever connected therewith, said lever being operated by the piston at the end of its stroke to close said valve, and a valve for the outlet-passage controlled by another electromagnet, substantially as set forth.

4. In an engine or motor of the character described, the combination with two cylinders and pistons therein, of inlet and outlet valves for each cylinder, means operated by each piston at the end of its stroke in one direction for automatically closing the inlet-valve of its own cylinder, and mechanism operatively connected with the valve mechanism of each inlet-valve the weight of which closes the outlet-valves, whereby when the inlet-valve of one cylinder is closed, the mechanism connected therewith closes the outlet-valve of the other cylinder, substantially as set forth.

5. In a motor of the character described, the combination with a cylinder and a piston therein, of inlet and outlet valves for said cylinder, mechanism for closing the inlet-valve, a magnet for holding said valve to its seat, and mechanism operatively connecting the armature of said magnet with said inlet-valve, said armature being moved into the field of the magnet by its own gravity and the gravity of the connected parts, substantially as set forth.

6. The combination with two cylinders, of

inlet-valves for said cylinders, independent means for closing said valves, two electro-magnets, one for locking each of said valves in its closed position, the armatures being moved into the field of the magnets by gravity, of an outlet-valve for each cylinder, and means operated by the gravity of the armatures for closing the outlet-valves of opposite cylinders, whereby when the magnet controlling the inlet-valve of one cylinder is de-energized, the outlet-valve of the other cylinder is free to open, substantially as set forth.

This specification signed and witnessed this 7th day of November, 1895.

GEORGE L. THOMAS.

Witnesses:
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W. BELZER.