No. 846,897. PATENTED MAR. 12, 1907.

R. B. BENJAMIN.

GAS ENGINE.

APPLICATION FILED JAN. 2, 1906.

2 SHEETS—SHEET 1.

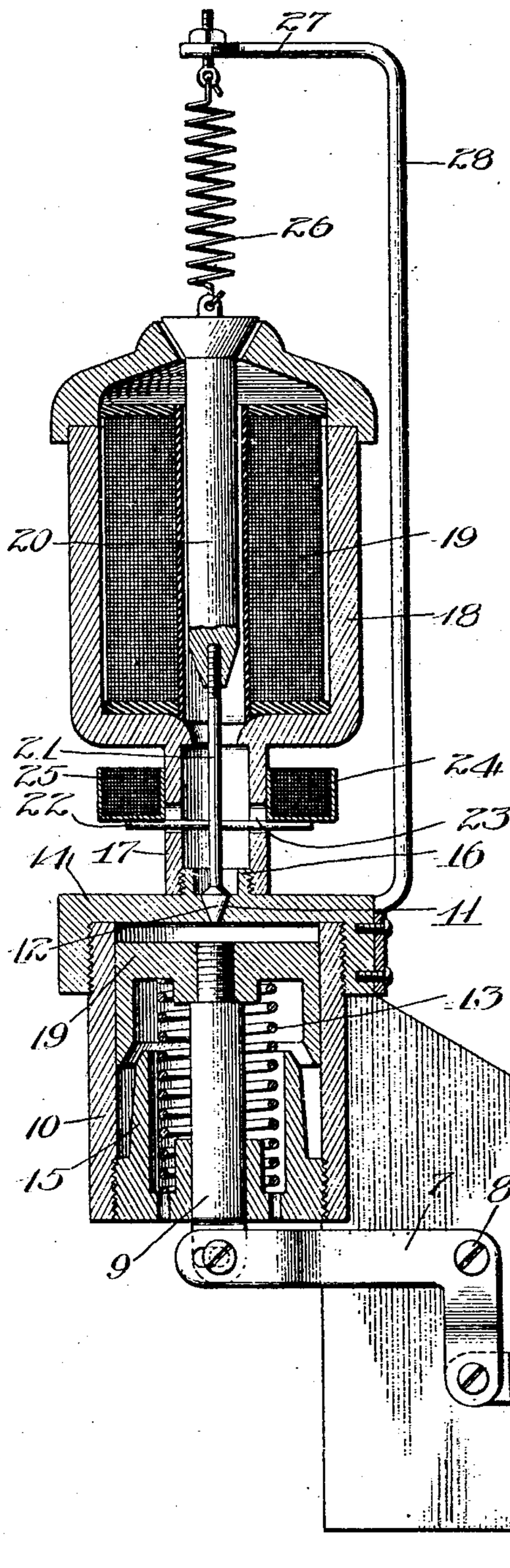

Fig. 1.

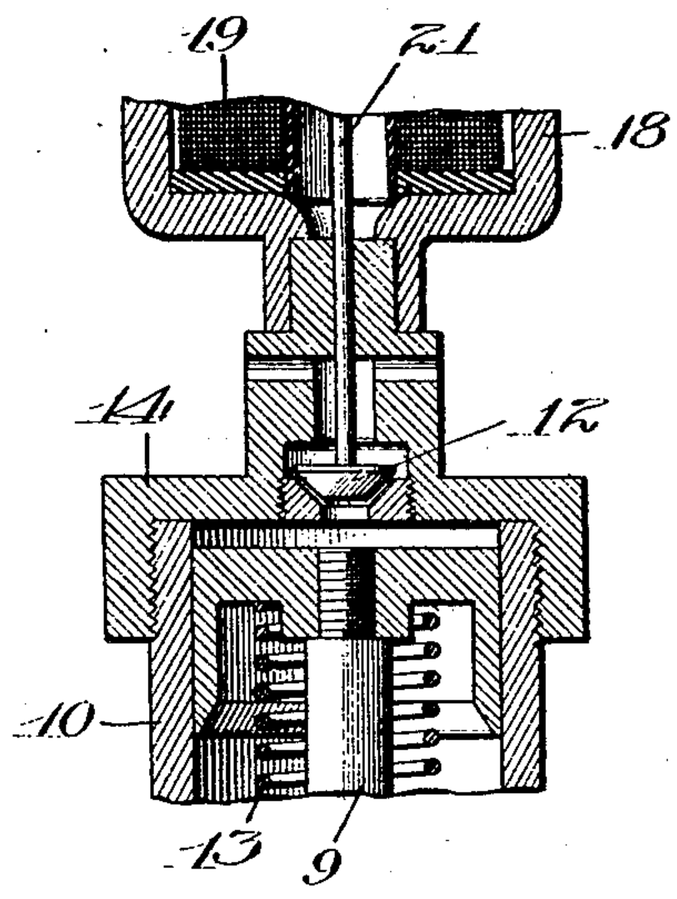

Fig. 2.

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Fig. 3.

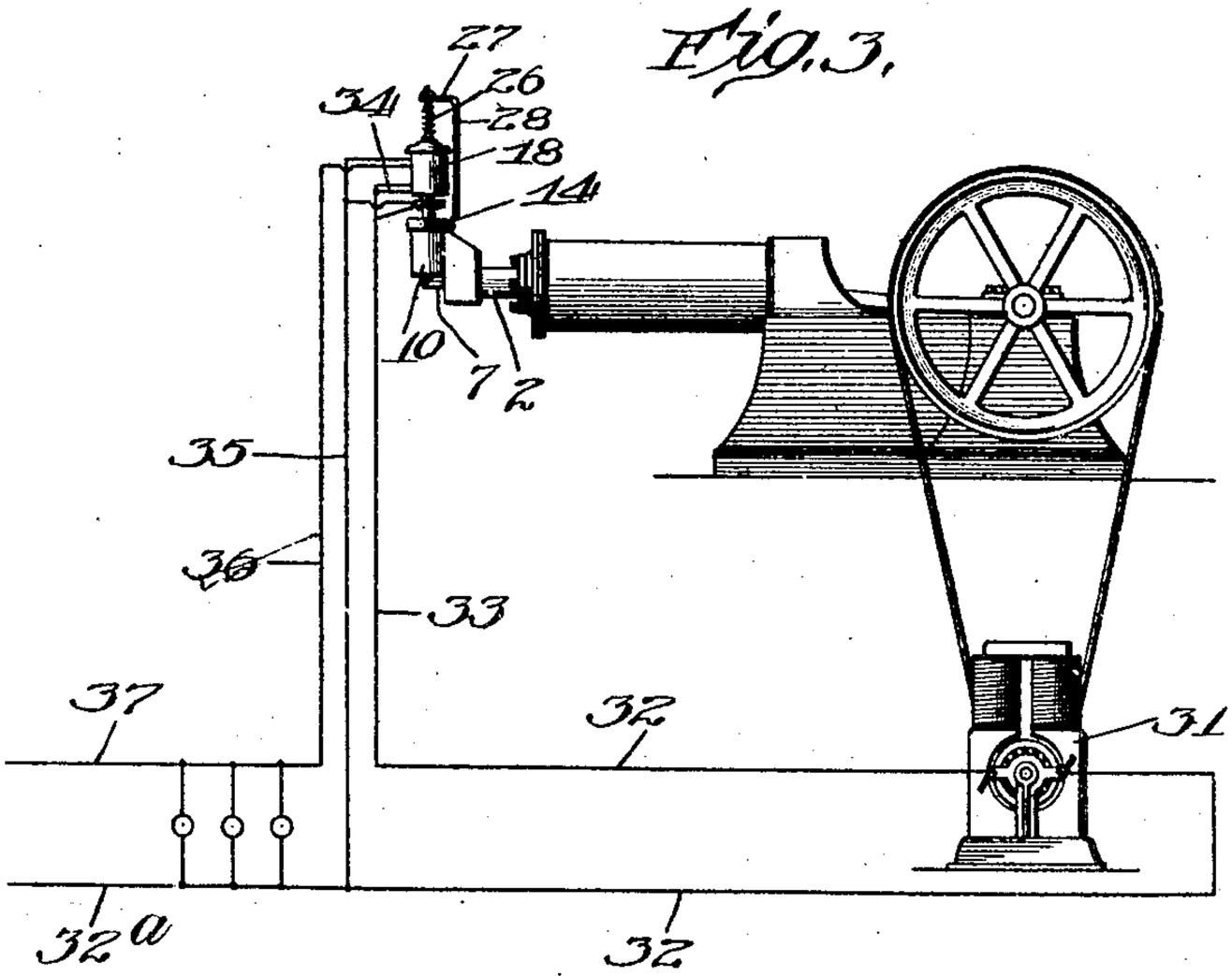


Fig. 4.

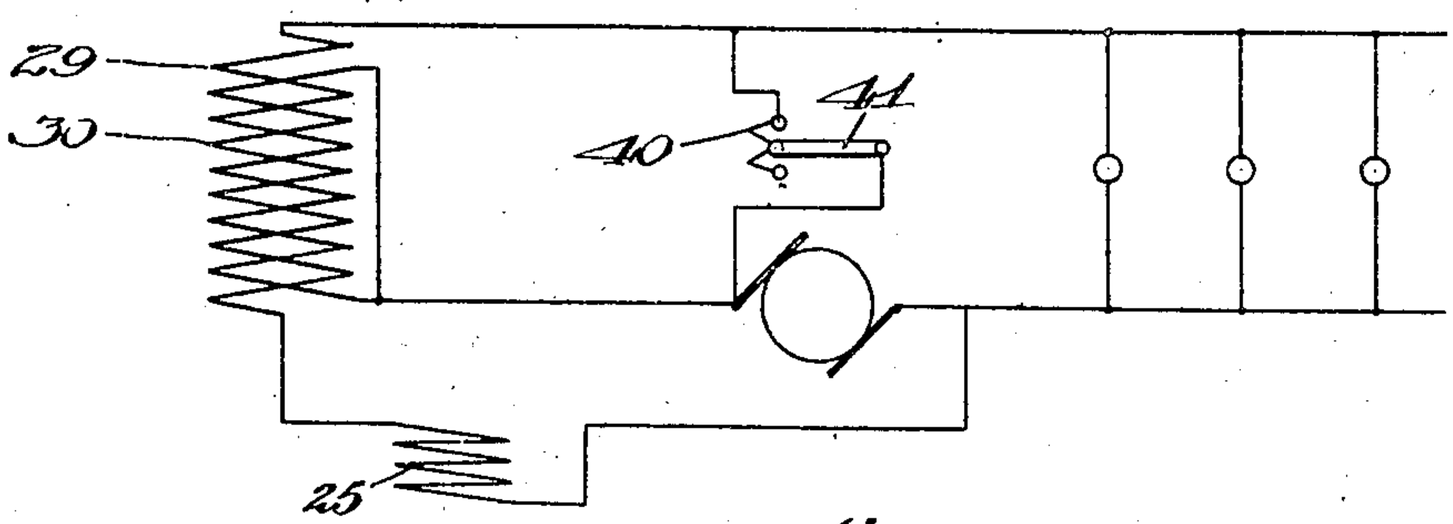
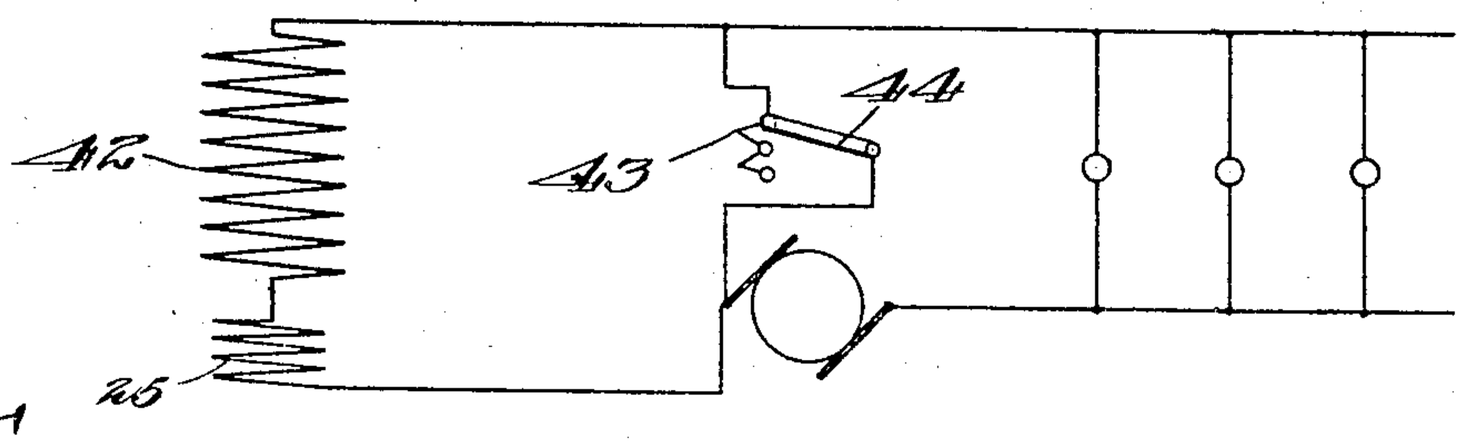


Fig. 5.



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UNITED STATES PATENT OFFICE.

REUBEN B. BENJAMIN, OF CHICAGO, ILLINOIS.

GAS-ENGINE.

No. 846,897. Specification of Letters Patent. Patented March 12, 1907.

Application filed January 2, 1906. Serial No. 294,277.

To all whom it may concern:

Be it known that I, REUBEN B. BENJAMIN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented new and useful Improvements in Gas-Engines, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention relates to improvements in governing means for gas-engines, my object being to provide means whereby the speed of the gas-engine may be controlled in proportion to the load on the engine or according to the speed required of the engine to maintain a certain load on an electric circuit when the engine is driving a generator.

My device is constructed and arranged to regulate the charge admitted to the gasolene-engine by electromagnetic means, and by the construction and arrangement of my device I am enabled to closely regulate the speed of the engine.

I have illustrated my invention in the accompanying drawings, in which—

Figure 1 is a sectional view of my device applied to the gas-inlet of an explosive-engine. Fig. 2 is a modification thereof. Fig. 3 is a diagrammatic view of my device in connection with a gas-engine and an electrical generator. Fig. 4 is a diagrammatic view showing more definitely the manner in which the windings of my governing device are connected in circuit, and Fig. 5 shows a modification of the manner in which the winding of my device may be connected.

In the preferred embodiment of my invention, upon the head or intake end 1 of a cylinder of a gas-engine is mounted a gas-inlet-valve body 2, having a gas-inlet valve 3 opening inward for admitting supply of explosive fluid through the inlet-chamber 4, the port 5 of which is connected with any suitable carbureter. The stem 6 of the inlet-valve extends through the outer wall of the inlet-chamber 4 and is connected by a bell-crank lever 7, pivoted at 8, with an auxiliary piston 9 of an auxiliary cylinder 10, the top of which is provided with a small inlet or vent 11, controlled by a valve 12. A spring 13 is provided, which tends to hold the piston 9 at the upper limit of its stroke in the cylinder 10. The piston 9 when at the extreme upper end of its stroke is close against the inner side of the top cap 14 of the cylinder. I have illustrated in the drawings the preferred arrangement of the auxiliary cylinder and piston with respect to the axis of the inlet-valve and the lever connection between the auxiliary piston and the inlet-valve of the engine. By this lever connection it will be noted an opening movement of the inlet-valve 3 communicates to the auxiliary piston a downward or indrawing movement proportioned to the opening movement of the inlet-valve, as may be determined by the proportions of the lever connection.

When the piston of the engine makes its outward stroke for drawing in the gas-supply, the inlet-valve 3 being pulled off its seat by the suction is resisted in such opening movement to the extent that the resulting movement of the auxiliary piston 9 provides a partial vacuum about it in its cylinder 10. If there were no air-inlet, as would be the case if the valve 12 were closed, it will be necessary that the resistance offered by the auxiliary piston 9 to the opening movement of the inlet-valve 3 would be measured by the area of said auxiliary piston exposed to atmospheric pressure of fifteen pounds to the square inch, because the piston being in contact at its upper surface with the under surface of the cap or upper end of the auxiliary cylinder 10 the slightest movement of said piston away from said surface would produce a total vacuum above it. The valve 12 being open to a slight extent and permitting the entrance of air to a corresponding extent, said vacuum would be prevented to the extent of the air entering, and if the movement of the auxiliary piston is slow the air may enter through a very small opening, pass the valve 12 fast enough to prevent any appreciable vacuum.

For keeping the auxiliary piston 9 lubricated in its cylinder I provide in the cylinder an annular oil-cup formed by the concentric flange 15, and I make the auxiliary piston in the form of an angled cylindrical cup, whose cylindrical wall enters the annular oil-chamber and dipping into the oil at each indrawing stroke carries up enough oil for its lubrication.

The cup 14 of the auxiliary cylinder has immediately surrounding the vent 11 an annular flange 16, over which may be screwed the downwardly-extending cylindrical portion 17 of a frame 18 of a suitable solenoid, comprising a winding 19 and a core 20. The valve 12 is connected with said core by a

stem 21, whereby said valve is raised or lowered by the raising or lowering of the cone of the solenoid. Extending transversely through the stem 21 is a pin 22, which projects through slotted openings 23 in the portion 17, and mounted upon the exterior of the portion 17 is an annular magnet 24, provided with suitable windings 25. The magnet in normal position and when the engine is inoperative rests upon the pin 22. The upper end of the core 20 is connected to the lower end of a coiled spring 26, the upper end of which is connected to a cross-arm 27 of a support 28, secured at its lower end to the auxiliary cylinder or in any other suitable position. By this means the spring tends to open the valve. The weight of the annular magnet 24, however, is great enough to overcome the action of this spring and hold the valve closed. The winding of the magnet is such that the tendency of the same is to act in opposition to the spring 26.

The operation of the device is as follows: The solenoid-winding 19 is connected in any suitable electric circuit, and for the purpose of this description it will be assumed that the winding is connected in the circuit of a generator operated by the gas-engine. Assuming that the parts are in the position illustrated in Fig. 1, in which figure the solenoid is deënergized and the tendency of the spring 26 to raise the core 20 of the magnet 18, and thereby open the valve 12, is overcome by the weight of the annular magnet 24, resting upon the pin 22, in order that the engine may be started the annular magnet 24 is raised by hand, permitting the spring 26 to raise the core 20 and open the valve 12. This destroys the vacuum formed in the cylinder 10, and the engine may be started in the usual manner with gas-engines, the suction caused in the cylinder of the engine opening the valve 3 sufficiently to admit a full charge of gas to the engine-cylinder. Under these circumstances the engine will run at full speed, as there is no restraining action upon the valve 3, and the same may therefore open on each stroke of the engine to its fullest extent. The operation of the engine drives the generator, and as soon as the same commences to deliver current the winding 19 of the solenoid 18 will be energized. The magnetism of the winding 25 will maintain the annular magnet 24 in a raised position and will tend to draw the core 20 downwardly against the action of the spring 26, and the magnetism of the solenoid 19 partially close the valve 12, thereby increasing the resistance offered to the valve 3 of the engine by the piston 9 in the cylinder 10, which prevents said valve 3 from opening to its fullest extent, thereby decreasing the charge admitted to the engine and decreasing the speed of the engine until the generator is running at normal. In event the current delivered by the generator raises the core will be drawn farther downward, thereby lowering the speed of the engine and reducing the current again to normal. If the current falls below normal, the strength of the winding 19 will be reduced, permitting the spring 20 to open the valve 12 wider and permit the engine to speed up until the current delivered by the generator is again normal. It will thus be seen that I have provided an electromagnetic governor which responds to the slightest change and is simple and durable.

The member 24 is provided with the winding 25, which insures the same being maintained in a raised position during the normal operation of the engine. The strength of the magnetic field of the magnet 19 would not be sufficient in itself to maintain the lug 24 in a raised position in event the same was merely formed of metal. Under certain circumstances, however, if the magnet 19 is of sufficient size the windings 25 may be dispensed with and the ring merely formed of iron. In this event the solenoid 19 must be of large size, as otherwise the strength of the same would not be sufficient.

In Figs. 3 and 4 I have shown diagrammatically the preferred manner in which the winding of the solenoid is connected in circuit. The solenoid is preferably a double-wound solenoid, one winding 29 thereof being connected in series with the translating devices connected with the generator, the other winding 30 thereof being connected in multiple with said translating devices. This is illustrated in Figs. 3 and 4. In Fig. 3 one terminal of the generator 31 is connected with the main 32, a branch 33 of said main being connected with one terminal of the series winding and a second branch 34 being connected with one terminal of the multiple winding. The opposite terminal of the series winding is connected by conductors 35 with the branch 32^a of the generator, and the opposite terminal of the multiple winding is connected by conductor 36 with the opposite branch 37 of the generator, the translating devices 38 being connected between the branches 32^a and 37. The diagrammatic view in Fig. 4 illustrates a little more plainly the connection, as in this view the winding is shown diagrammatic. In Fig. 4 I have also shown a resistance 40, controlled by a switch 41, which may be inserted in shunt with the series winding 29, whereby the strength of said winding may be adjusted.

In Fig. 5 I have illustrated a single series winding 42 for the solenoid, having a resistance 43, controlled by a movable arm 44 for controlling the strength thereof.

I have illustrated in the diagrammatic views the translating devices as being connected in multiple. It will be understood, however, that I do not wish to limit myself to connecting translating devices in this man-

ner, as the same may also be connected in series, if so desired. It is also perfectly obvious that, if so desired, the resistance for the windings of the solenoid may be omitted.

By the arrangement of the series multiple windings I am enabled to control the operation of the gas-engine, and thereby regulate the potential of the circuit in which the translating devices are connected to maintain the potential of the same practically constant. By this construction, assuming that there are a number of lamps connected in circuit, as soon as one of the lamps is cut out of the circuit for any reason the strength of the solenoid is increased sufficient to close the intake-valve of the auxiliary cylinder to such an extent as to reduce the speed of the gasolene-engine, and thereby reduce the speed of the generator, which in turn prevents the potential from rising. A corresponding cutting in of one or more lamps would correspondingly decrease the strength of the solenoid-winding, permitting the spring to tend to raise the core thereof, opening the valve in the auxiliary piston, and permitting the engine to speed up, thereby increasing the speed of the generator and preventing the potential of the line from dropping. In this form of winding I preferably construct the device so that the multiple winding is of greater strength than the series winding, and the two windings are wound in opposition to each other, the multiple winding being arranged to draw the core of the solenoid down. By this arrangement I am enabled to more nicely vary the strength of the engine and operate the magnet by smaller variations in the line. Under certain circumstances if such an arrangement of the winding were not provided variations in the potential of the line, while affecting the magnet, would not affect the strength of the same sufficiently to permit the spring to actuate to open the valve. Therefore by providing the oppositely-wound series winding the multiple winding is so nicely balanced that the slightest variation in the potential of the line would affect the same and open or close the valve in accordance with the variations of the load.

While I have described the magnet as controlling the generator through the medium of the vacuum-cylinder it will be understood that I do not wish to limit myself to this particular construction, as there are other positions in which the solenoid may be used—as, for instance, the same may be operated directly to control the machine instead of through the medium of the vacuum-solenoid, as herein shown.

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

1. In a governing device for gas-engines, the combination with an inlet-valve, of an electromagnetically-operated governor for controlling the movement of said valve, and means for preventing said valve from operating until said governor is energized.

2. In a governing device for explosive-engines, the combination with an inlet-valve for the engine, of a resistance device connected with said valve, and an electromagnetic governor for controlling the resistance of said device.

3. In a governing device for explosive-engines, the combination with an inlet-valve for the engine, a vacuum-producing device operated by the opening movement of said inlet-valve, and an electromagnetically-operated governor for controlling the vacuum produced by said device.

4. In a governing device for explosive-engines, the combination with an inlet-valve for the engine, a vacuum-producing device operated by the opening movement of said valve, said vacuum-producing device comprising a chamber having an air inlet or vent, a valve controlling said vent, and an electromagnetically-operated governor connected with said valve.

5. In a governing device for explosive-engines, the combination with an inlet-valve for the engine, of a vacuum-producing device operated by the opening movement of said inlet-valve, an electromagnetic governor for controlling the vacuum produced by said device, and means for preventing the destruction of said vacuum except when said governor is operatively energized.

6. In a governing device for an explosive-engine, the combination with an inlet-valve for the engine, a vacuum-producing device operated by the opening movement of said inlet-valve, said vacuum-producing device comprising a chamber having an air inlet or vent, a valve controlling said vent, an electromagnetically-operated governor connected with said valve, and means for maintaining said vent closed when said governor is inoperative.

7. In a governing device for explosive-engines, the combination with an inlet-valve for the engine, of a vacuum-producing device operated by the opening movement of said inlet-valve and comprising a chamber having an air inlet or vent, a valve controlling said vent, and a solenoid having the core thereof connected with said valve.

8. In a governing device for an explosive-engine, the combination with an inlet-valve for the engine, of a vacuum-producing device operated by the opening movement of said valve and comprising a chamber having an air-inlet, a valve controlling said inlet, a solenoid having the core thereof connected with a valve and tension means for normally holding said valve open.

9. In a governing device, for explosive-engines, the combination with an inlet-valve for the engine, of a vacuum-producing device

operated by the opening movement of said inlet-valve and comprising a chamber having an air inlet or vent, a valve for controlling said vent, and an electromagnetic governor operatively connected with said valve, means for normally maintaining said inlet closed and arranged to be maintained open by said governor when the same is operatively energized.

10. In a governing device for gas-engines, the combination with an inlet-valve for the engine, of means for retarding the action of said valve, and electromagnetic means for governing the action of said retarding means.

In witness whereof I have hereunto subscribed my name in the presence of two witnesses.

REUBEN B. BENJAMIN.

Witnesses:
W. PERRY HAHN,
M. R. ROCHFORD.