J. B. BROWN.

COMPRESSION REGULATOR FOR GAS ENGINES.

APPLICATION FILED NOV. 19, 1908.

970,462. **Patented Sept. 20, 1910.**

3 SHEETS—SHEET 1.

FIG 1

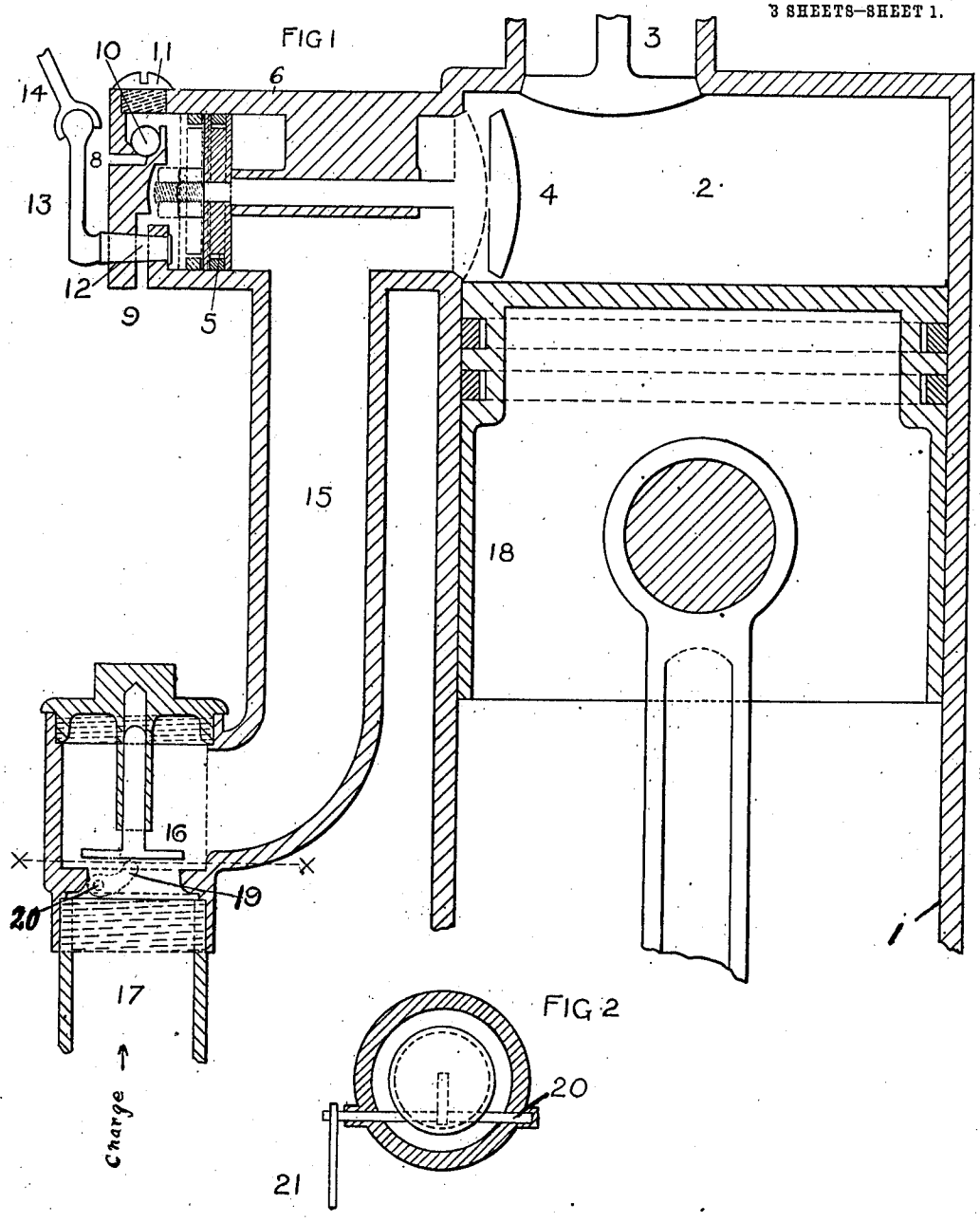

FIG 2

WITNESSES.

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3 SHEETS—SHEET 2.

FIG 3

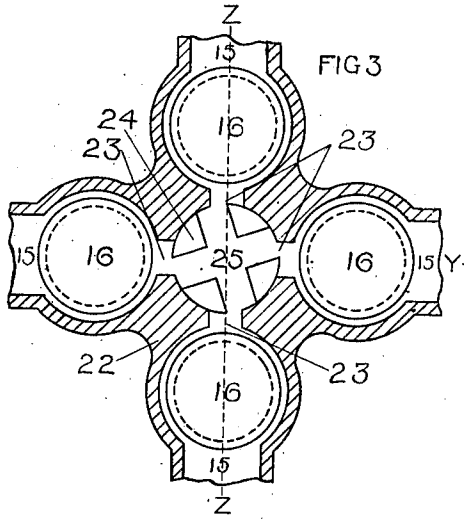


FIG 4

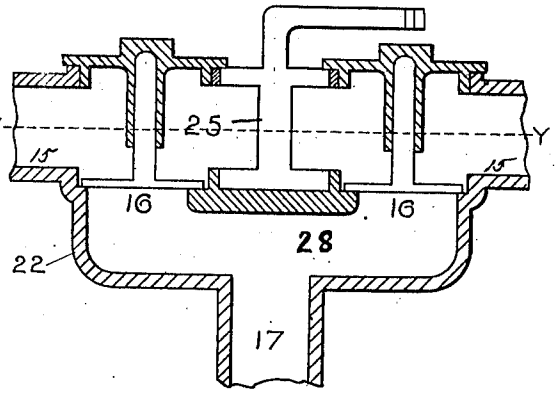


FIG 5

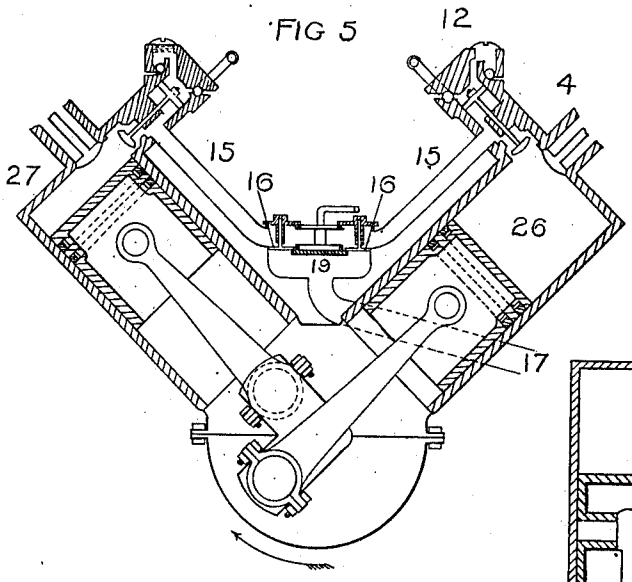
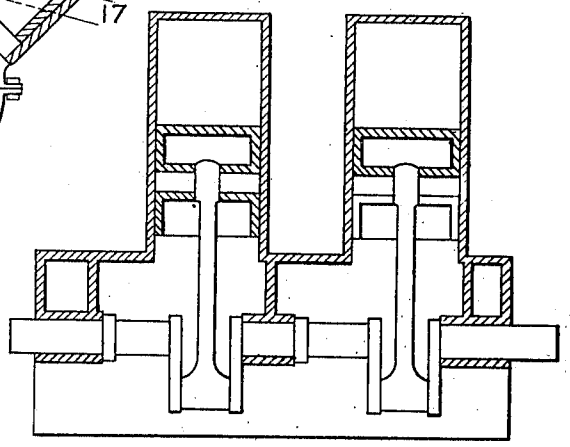


FIG 6



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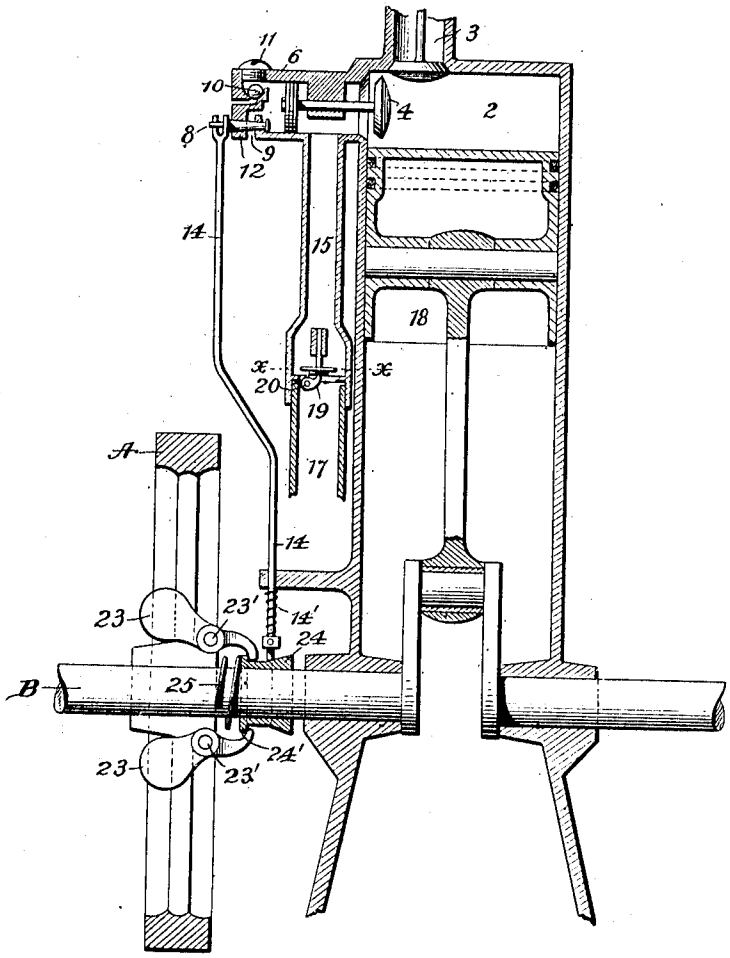
3 SHEETS—SHEET 3.

Fig. 7.



Witnesses:

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Jesse B. Brown

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UNITED STATES PATENT OFFICE.

JESSE B. BROWN, OF LANSING, MICHIGAN.

COMPRESSION-REGULATOR FOR GAS-ENGINES.

970,462. Specification of Letters Patent. Patented Sept. 20, 1910.

Application filed November 19, 1906. Serial No. 344,027.

To all whom it may concern:

Be it known that I, JESSE B. BROWN, a resident of Lansing, in the county of Ingham and State of Michigan, have invented a new and useful Improvement in Compression-Regulators for Gas-Engines, of which the following is a specification.

The object of my invention is to make a simple, practical and cheap device for controlling the degree of compression in a gas or gasolene engine cylinder, thus obtaining at pleasure any of the following results as desired: First, to maintain at all times the highest degree of compression that the mixture employed will bear without ignition, and thus secure the highest economy of operation; second, to automatically control the speed of the engine by controlling the degree of compression in the cylinder; third, to make a device that shall promptly and certainly close the inlet valve without the use of a spring; fourth, to enable any of the above results to be obtained as desired without any change in the device itself. I attain these purposes by means of the mechanism set forth in the accompanying drawings in which—

Figures 1 and 2 show my device as attached to a single cylinder engine. Figs. 3, 4, 5 and 6 show it as modified for application to a four-cylinder engine, such as is ordinarily used in automobiles and Fig. 7 is a view showing the application of a governor. In these figures, Fig. 2 is a cross-section on the line *x*—*x*. Fig. 5 is a vertical section at right angles to the shaft through my device and the axes of two of the cylinders. Fig. 6 is a vertical section on a line parallel to the shaft, and Figs. 3 and 4 are detailed views on an enlarged scale of the controlling device employed in the four-cylinder construction. Fig. 3 is a cross-section on the line *y*—*y*, and Fig. 4 is a vertical section on the line *z*—*z*.

In the drawings, 1 represents a gas engine cylinder which may be of any ordinary type, but in which the compression space 2 is made smaller than usual; 3 is the exhaust valve which may be of any ordinary type; 4 is the inlet valve. To the outer end of the stem of the valve 4 is attached a piston 5 moving freely in a cylinder 6 so as to leave above it when at its highest point a small compression chamber. This cylinder opens into the atmosphere by two passage ways 8 and 9, the former of which is closed by a check valve 10 opening inward. ~~Numeral~~ 11 refers to a screw for the purpose of adjusting or repairing the check valve 10. The port 9 is closed by a cock 12 by means of which it may be regulated to any desired size or may be entirely closed. To handle 13 of cock 12 may be attached, if desired, an extension link 14 for the purpose of connecting it to a governor, or to any other desired means or place of adjustment.

15 is the inlet pipe which is made of such capacity as to serve as an auxiliary compression chamber, the purpose of which will be more fully explained further on.

16 is a check valve located in the inlet pipe to prevent the gases from being forced back through the pipe 17 to the carbureter. The lever 19 revolving on the axis 20, operated by the link 21 operates to prevent the check valve 16 from completely closing, and thus permits a portion of the charge to pass back through said valve into the pipe 17, and thus back to the carbureter, making it possible by this means to secure a lower degree of compression than would be possible with the use of the auxiliary chamber 15 alone. The link 21 may be connected to a governor of any ordinary kind or may be manually manipulated as desired. In this way this lever and check valve alone may be employed as a means for controlling the degree of compression or may be used in conjunction with the cock 12 for that purpose, thus greatly adding to the efficiency and completeness of the control over the degree of compression.

The operation of my device is as follows: Suppose the piston 18 to be at the point indicated, ready to take in a charge; as soon as it begins to move downward, the valves 4 and 16 will open and occupy the position shown by the solid lines. As the valve 4 opens it will carry with it the piston 5, creating a vacuum in the upper part of the cylinder 6, which will be filled by air through the ports 8 and 9. At the same time a charge of mixed gas and air will be drawn into the cylinder through the pipes 15 and 17, and the valves 4 and 16, which will remain open

until the piston 18 has reached the extreme point in its outward travel. As soon as it begins to return, the pressure produced in the cylinder will act on the valve 16 valve 4 and piston 5, and the valves 16 and 10 will close, but the valve 4 will be retarded by the inability of the air to escape rapidly through the port 9 from the upper part of the cylinder 6. It is evident that the larger this port is made by opening the cock 12, the more rapid will be the escape of air and the quicker the closing of the valve 4. Conversely, when the opening 9 is made very small, the valve 4 will close very slowly and a larger proportion of the charge will be permitted to escape from the compression space 2, into the pipe 15. It is thus evident that by moving the cock 12, the closing of the valve 4 can be retarded to any desired degree, and thus the amount remaining in the compression chamber 2, after the valve 4 closes, and the degree of compression may be regulated. By the use of the piston 5, I am also enabled to dispense with the use of a spring for the closing of the valve 4. It will be noted that as soon as compression begins in the cylinder and in the auxiliary chamber 15, it acts upon the piston 5 and produces upon it a direct pressure which tends to close the inlet valve and will do so, more promptly than would be possible by the action of a spring in the ordinary manner; unless retarded by the means employed in my device, as already described. When it is intended to use my device to secure the highest practical degree of compression without preignition, the cock 12 and the lever 19 are directly controlled by the operator, and when any tendency to preignition appears, it can be at once checked by slightly moving the cock 12 so as to decrease the size of the port 9, and thus retard the closing of the valve 4 and permit more of the charge to escape into the auxiliary compression chamber 15, or, by the use of the lever 19, preventing the closing of the valve 16 as already described. In this manner the compression can be constantly kept at the highest practicable point, and thus the greatest economy of operation can be secured, since, if after completely closing the cock 12 to its greatest degree the compression in the cylinder is still too high, it may be still further reduced by operating the lever 19 so as to prevent the complete closing of the valve 16 in the manner already stated. If, however, it is desired to employ the device as a governor, either or both of the levers 14 and 21 are connected by any suitable means to an ordinary governor. If the speed increases, the governor, acting first through the link 14 upon the cock 12, will decrease the size of the port 9 and thus diminish the degree of compression and retard the speed of the engine. Or, conversely, if the speed falls below the required point, the port 9 will be opened wider and the compression increased by the quicker closing of the valve 4. If the pressure is still too high or too low, the governor will then act through the link 21 on lever 19 and complete the regulation by the action of that lever on valve 16, or it is evident that the same effect may be produced by connecting one of these links to the governor and leaving the other for manual manipulation.

When it is desired to employ my device in a four-cylinder engine the valve 16 and its attachments are modified in the manner shown on Figs. 3, 4, 5 and 6. In these figures, where the part is the same as the corresponding one employed in the single cylinder I have employed the same numbers. There being four cylinders, check valves 16 opening through the general chamber 22 into the pipe 17 are employed for each cylinder. The seats for these check valves and the passage 15 are preferably formed from a single piece of metal as shown in Fig. 3. In the central space between the valves 16 is formed a central chamber 22, having passages 23 opening from it into each of the four pipes 15. These passages may be closed to any desired degree by the cock 24 having through it cross passages 25. It is evident the cock 24 will thus perform the function of the lever 19; for example, if it is turned so that passages 23 are entirely closed, none of the charge is permitted to escape from pipe 15, but is all kept compressed in the compression chamber of the engine and in the auxiliary chamber 15, the effect being precisely the same as if the lever 19 were so adjusted as to permit the valve 16 to entirely close. Suppose, however, that it be turned as shown in Fig. 3, so as to partly open the passages 23 and bring them into connection with each other through the cross passages 25, the effect will be as follows: It is a matter of common practice in the building of four-cylinder engines, to arrange the cranks of such engines and the time of the explosions with reference to each other, so that at any time when one of the four cylinders is compressing its charge, one of the remaining cylinders will be taking in a charge, one will be expanding after an explosion and the remaining one will be exhausting. Fig. 5 indicates the position of the piston and valves in the first two cylinders at the moment compression begins in one and the indrawing of the charge in the other. As soon as compression begins, the valve 4 in the cylinder in which the charge is being compressed tends to close, but its closing is retarded by the operation of my device, as already described. The valve 4 of the other cylinder, however, will be kept open by the suction created by the outward movement of its piston; under these condi-

tions, a part of the charge will flow from the cylinder in which compression is taking place, through its pipe 15, the corresponding passage 23 of the cross passages 25, and the pipe 15 of the cylinder that is taking in its charge into that cylinder, thus making of that cylinder an auxiliary compression chamber for the cylinder in which the compression is now taking place. The two pipes 15, the passages 23, the cross passages 25 and the two cylinders thus perform the function that is performed in the single cylinder device, by pipes 15 and 17. It is also evident that the gases from the compression cylinder can only escape into the cylinder that is taking in a charge, since the valves 4, belonging to both of the other cylinders are closed at that time. The cock 24 thus performs the same function precisely, as the lever 19, and like it, is used to control the degree of compression in any of the ways already described in regard to that lever.

Fig. 7, discloses a convenient form of governor means, the same comprising weights 23 pivoted at 23′ to the wheel A, carried by the shaft B. Sleeved upon the said shaft is a conical collar, 24, with a flange, 24′, adapted to be engaged by offset ends of the weights 23. 25 is a spring for normally holding said collar in its outer position. The rod 14 is adapted to normally rest on the collar 24, and is held in this position by a spring 14′. In operation, the weights 23 will be thrown out by the centrifugal force, thus drawing the collar inward against the spring 25. The collar 24 being conical will, by its sliding movement, raise the rod 14, and thereby actuate the cock, 12.

I claim as my invention, and desire to secure by Letters Patent,

1. In combination with an engine cylinder and the piston working therein, a regulating cylinder communicating with said engine cylinder and provided with a vent port, means for regulating the size of said vent port, an inlet valve closing the space between said cylinders, a piston working in said regulating cylinder and connected with said inlet valve, and an auxiliary compression chamber opening into the space between said cylinders.

2. In combination with an engine cylinder and the piston working therein, a regulating cylinder communicating with said engine cylinder and provided with a vent port, means for automatically regulating the size of said vent port, an inlet valve between said cylinders, a piston working in said regulating cylinder and connected with said inlet valve, and an auxiliary compression chamber opening into the space between said cylinders.

3. In combination with an engine cylinder and the piston working therein, a regulating cylinder communicating with said engine cylinder and provided with vent and inlet ports, means for regulating the size of said vent port and a valve closing said inlet port, an inlet valve between said cylinders, a piston working in said regulating cylinder and connected with said last mentioned inlet valve, and an auxiliary compression chamber adjoining the space between said cylinders.

4. In combination with an engine cylinder and the piston working therein, a regulating cylinder communicating with said engine cylinder and provided with vent and inlet ports, a valve closing said inlet port, means for automatically regulating the size of said vent port, an inlet valve between said cylinders, a piston working in said regulating cylinder and connected with said last mentioned inlet valve, and an auxiliary compression chamber opening into the space between said cylinders.

5. In combination with an engine cylinder and the piston working therein, a regulating cylinder communicating with said engine cylinder and provided with a vent port, means for regulating the size of said vent port, an inlet valve between said cylinders, a piston working in said regulating cylinder and connected with said inlet valve, an auxiliary compression chamber opening into the space between the said cylinders, and a check valve adapted to close the opening by which gas enters said auxiliary compression chamber.

6. In combination with an engine cylinder and the piston working therein, a regulating cylinder communicating with said engine cylinder and provided with vent and inlet ports, a valve closing said inlet port, means for regulating the size of said vent port, an inlet valve between said cylinders, a piston working in said regulating cylinder and connected with said inlet valve, an auxiliary compression chamber opening into the space between said cylinders, and a check valve adapted to close the opening by which gas enters said auxiliary compression chamber.

7. In combination with an engine cylinder and the piston working therein, a regulating cylinder communicating with said engine cylinder and provided with a vent port, means for regulating the size of said vent port, an inlet valve between said cylinders, a piston working in said regulating cylinder and connected with said valve, an auxiliary compression chamber opening into the space between said cylinders, a check valve adapted to close the opening by which gas enters said auxiliary compression chamber, and means for permitting the closing of said check valve.

8. In combination with an engine cylinder and the piston working therein, a regulating cylinder communicating with said engine cylinder and provided with vent and inlet

ports, a valve closing said inlet port, means for regulating the size of said vent port, an inlet valve between said cylinders, a piston working in said regulating cylinder and connected with said inlet valve, an auxiliary compression chamber opening into the space between said cylinders, a check valve adapted to close the opening by which gas enters said auxiliary compression chamber and means for preventing the closing of said check valve.

9. In combination with an engine cylinder and the piston working therein, a regulating cylinder communicating with said engine cylinder and provided with a vent port, means for regulating the size of said vent port, an inlet valve between said cylinders, a piston working in said regulating cylinder and connected with said inlet valve, an auxiliary compression chamber opening into the space between said cylinders, a check valve adapted to close the opening by which gas enters said auxiliary compression chamber, and means for permitting the escape of gas from said auxiliary compression chamber.

10. In combination with an engine cylinder and the piston working therein, a regulating cylinder communicating with said engine cylinder and provided with vent and inlet ports, a valve closing said inlet port, means for regulating the size of said vent port, an inlet valve between said cylinders, a piston working in said regulating cylinder and connected with said last mentioned valve, an auxiliary compression chamber communicating with the space between said cylinders, and means for permitting the escape of gas from said auxiliary compression chamber.

11. In combination with engine cylinders and the pistons working therein, an auxiliary compression chamber adjacent to each of said cylinders and communicating with them, inlet valves closing the openings between said cylinders and auxiliary chambers, dash pots, the piston of each of which is connected to one of said inlet valves, and means for permitting the escape of gas from said auxiliary chambers.

12. In combination with engine cylinders and the pistons working therein, an auxiliary compression chamber adjacent to each of said cylinders and communicating with them, inlet valves closing the communication between said cylinders and said auxiliary chambers, dash pots, the piston of each of which is connected to one of said inlet valves, and automatically regulated means for permitting the escape of gas from said auxiliary chambers.

13. In combination with engine cylinders and the pistons working therein, an auxiliary compression chamber adjacent to and communicating with each of said cylinders, inlet valves closing the communications between said cylinders and said auxiliary chambers, dash pots, the piston of each of which is connected to one of said inlet valves, and means for permitting the escape of gas from the auxiliary chamber connected with each of said cylinders into one of the other cylinders.

14. In combination with engine cylinders and the pistons working therein, an auxiliary compression chamber adjacent to and communicating with each of said cylinders, inlet valves closing the communication between said cylinders and said auxiliary chambers, dash pots, the piston of each of which is connected to one of said inlet valves, and automatically regulated means for permitting the escape of gas from the auxiliary chamber connected with any one of said cylinders into one of the other cylinders.

15. In combination with engine cylinders and the pistons working therein, a regulating cylinder communicating with each of said engine cylinders and provided with a vent port, means for regulating the size of said vent ports, inlet valves closing the spaces between each of said cylinders and its corresponding regulating cylinder, pistons working in each of said regulating cylinders and connected with said last mentioned valve, and means for permitting the escape of gas from one of said engine cylinders into another.

16. In combination with engine cylinders and the pistons working therein, a regulating cylinder communicating with each of said engine cylinders and provided with a vent port, means for regulating the size of said vent ports, inlet valves closing the spaces between each of said cylinders and its corresponding regulating cylinder, pistons working in each of said regulating cylinders and connected with said last mentioned valves, and automatically regulated means for permitting the escape of gas from one of said engine cylinders into another.

17. In combination with engine cylinders and the pistons working therein, a regulating cylinder communicating with each of said engine cylinders and provided with vent and inlet ports, means for regulating the size of the vent ports, inlet valves closing the spaces between each of said cylinders and its corresponding regulating cylinder, pistons working in each of said regulating cylinders and connected with said inlet valves, and means for permitting the escape of gas from one of said engine cylinders into another.

18. In combination with engine cylinders and the pistons working therein, a regulating cylinder communicating with each of said engine cylinders and provided with vent and inlet ports, means for regulating the size of said vent ports, inlet valves clos-

ing the spaces between each of said cylinders and its corresponding regulating cylinder, pistons working in each of said regulating cylinders and connected with said inlet valves, and automatically regulated means for permitting the escape of gas from one of said engine cylinders into another.

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

JESSE B. BROWN.

Witnesses:
HARRIET L. LAWRENCE,
MARY S. COBB.