No. 615,393.

Patented Dec. 6, 1898.

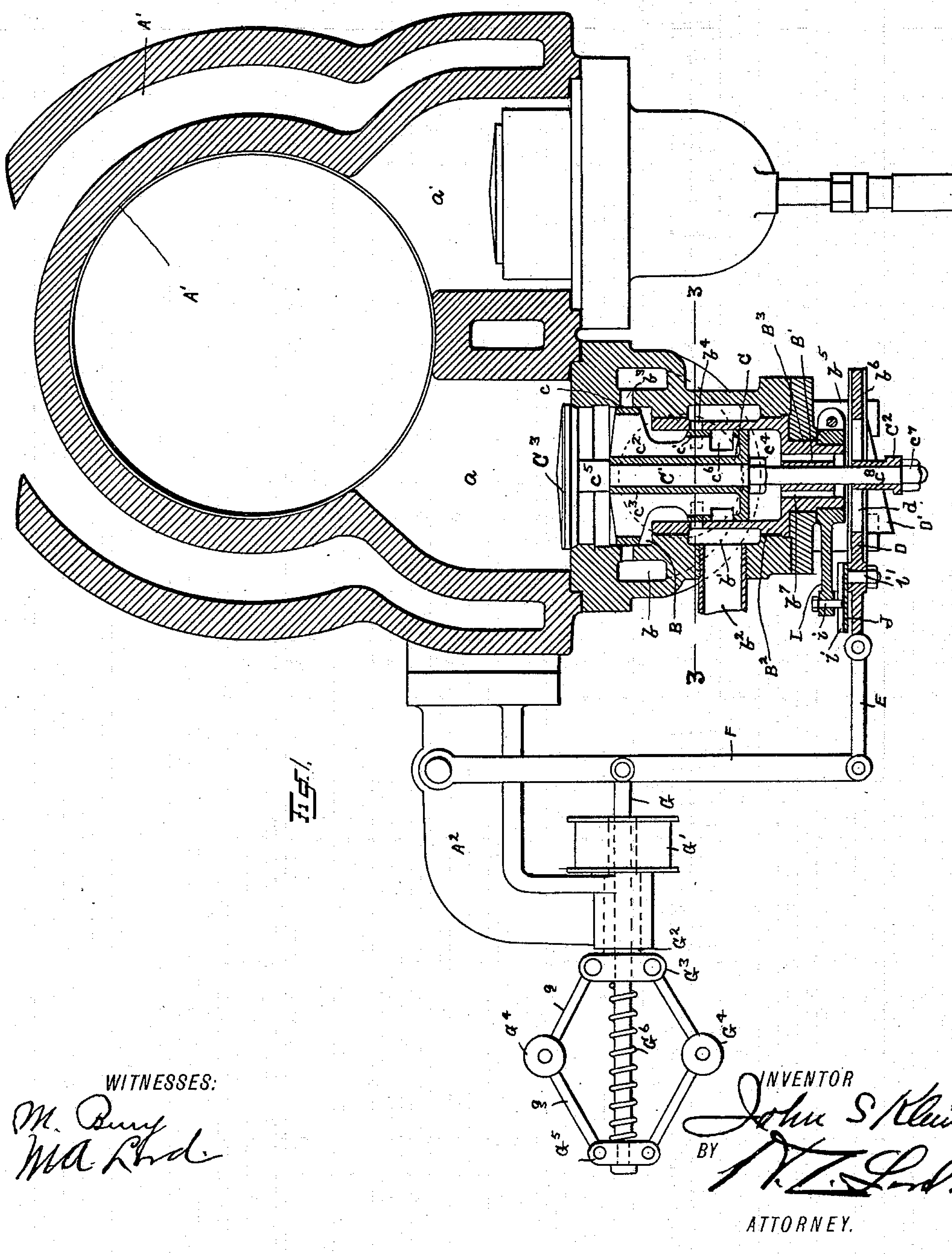
J. S. KLEIN.

SUPPLY CONTROLLING MECHANISM FOR GAS ENGINES.

(Application filed Mar. 1, 1898.)

(No Model.)

4 Sheets—Sheet I.



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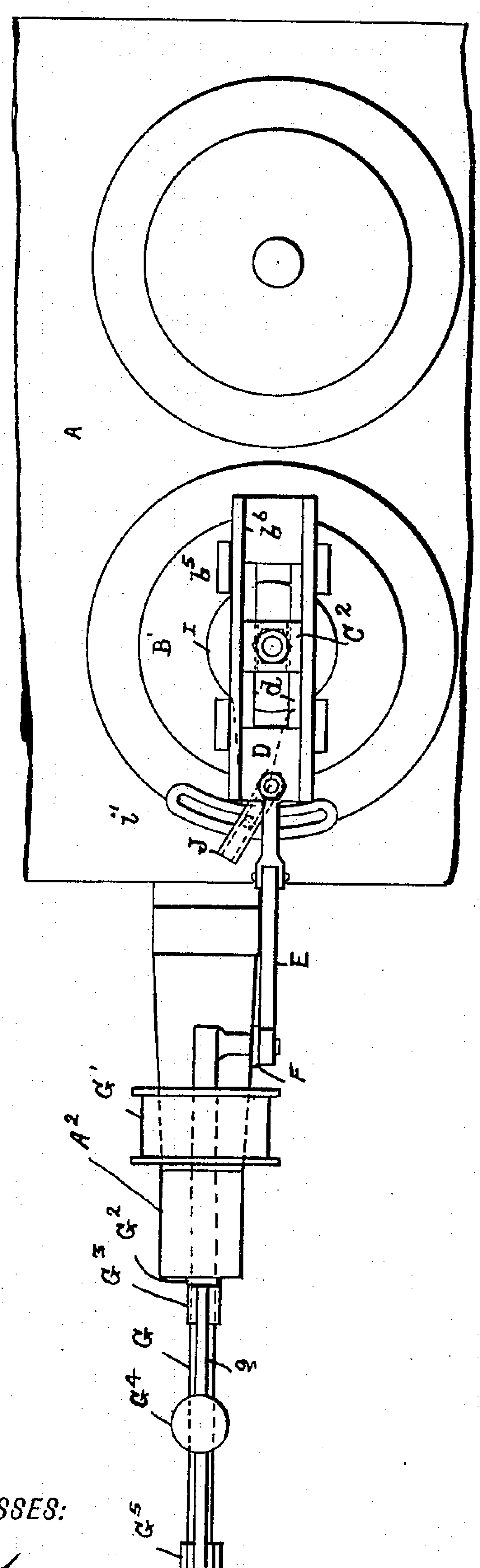
(No Model.) 4 Sheets—Sheet 2.

Fig. 2.



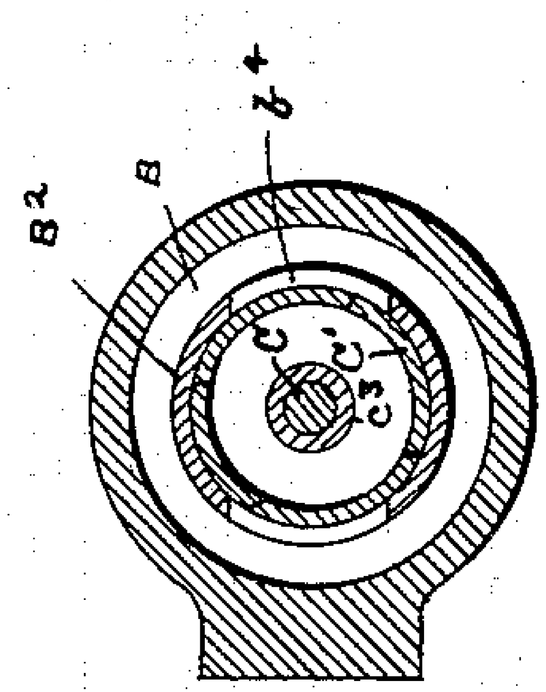


Fig. 3.

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(No Model.) 4 Sheets—Sheet 3.

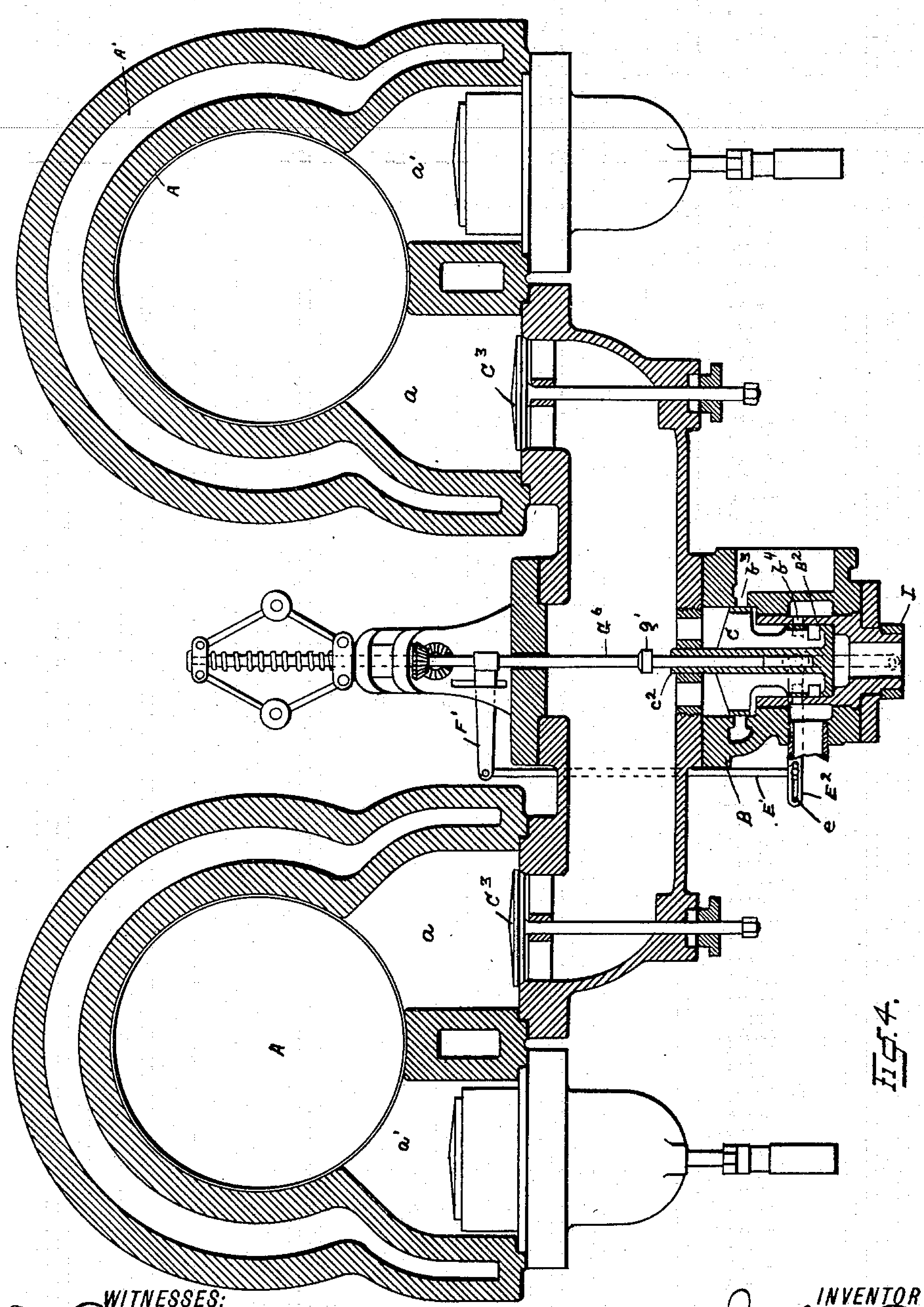

Fig. 4.

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4 Sheets—Sheet 4.

Fig. 7,

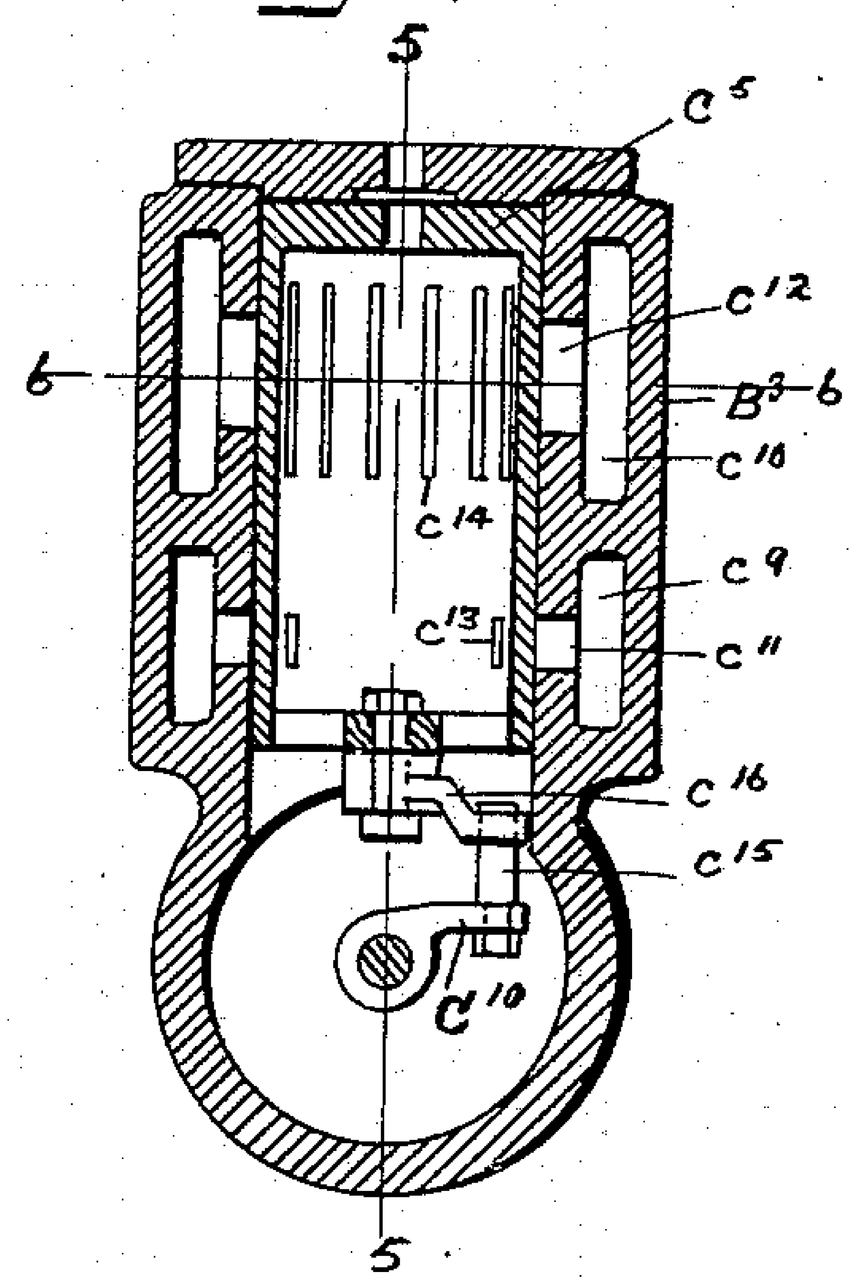


Fig. 5,

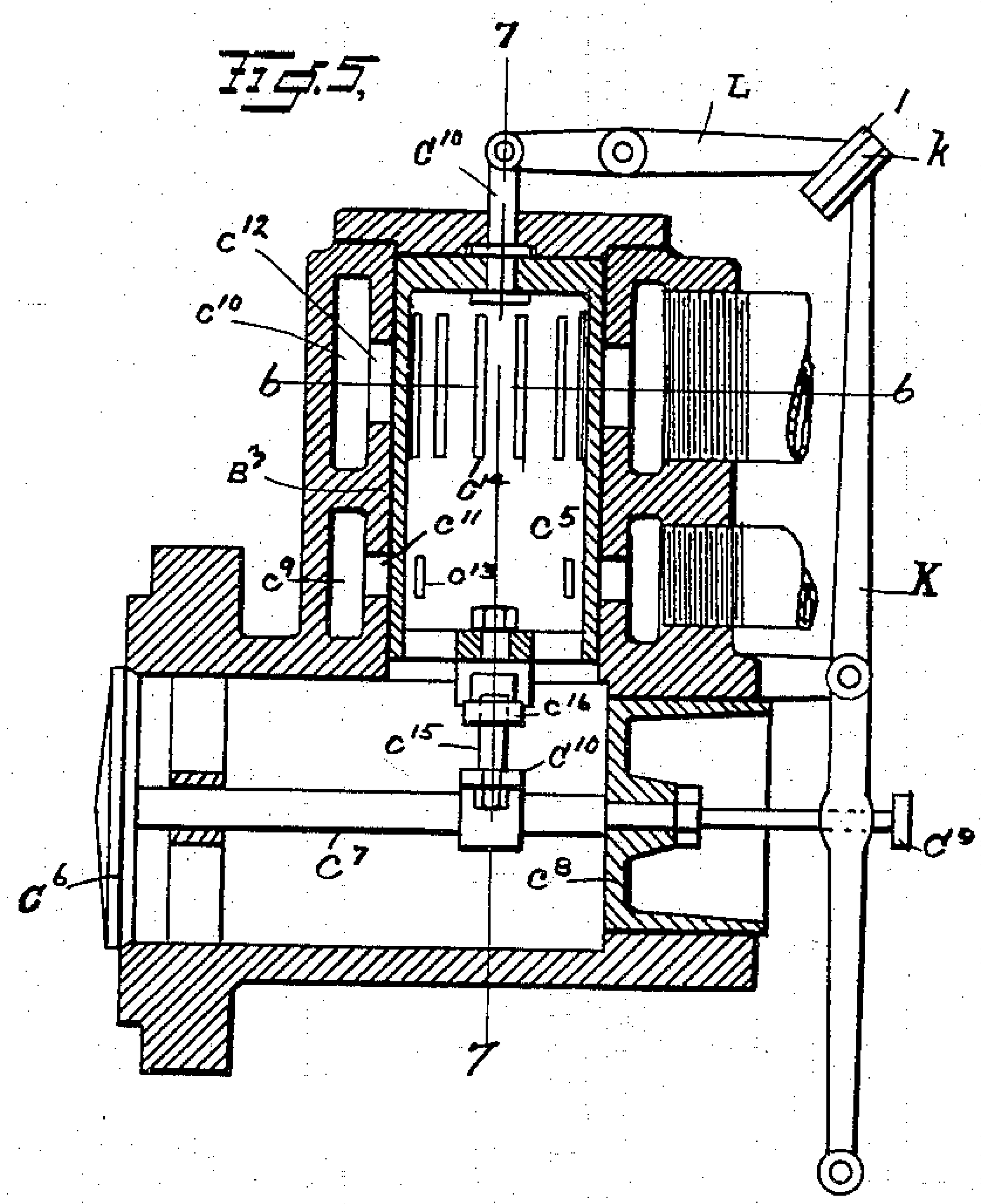
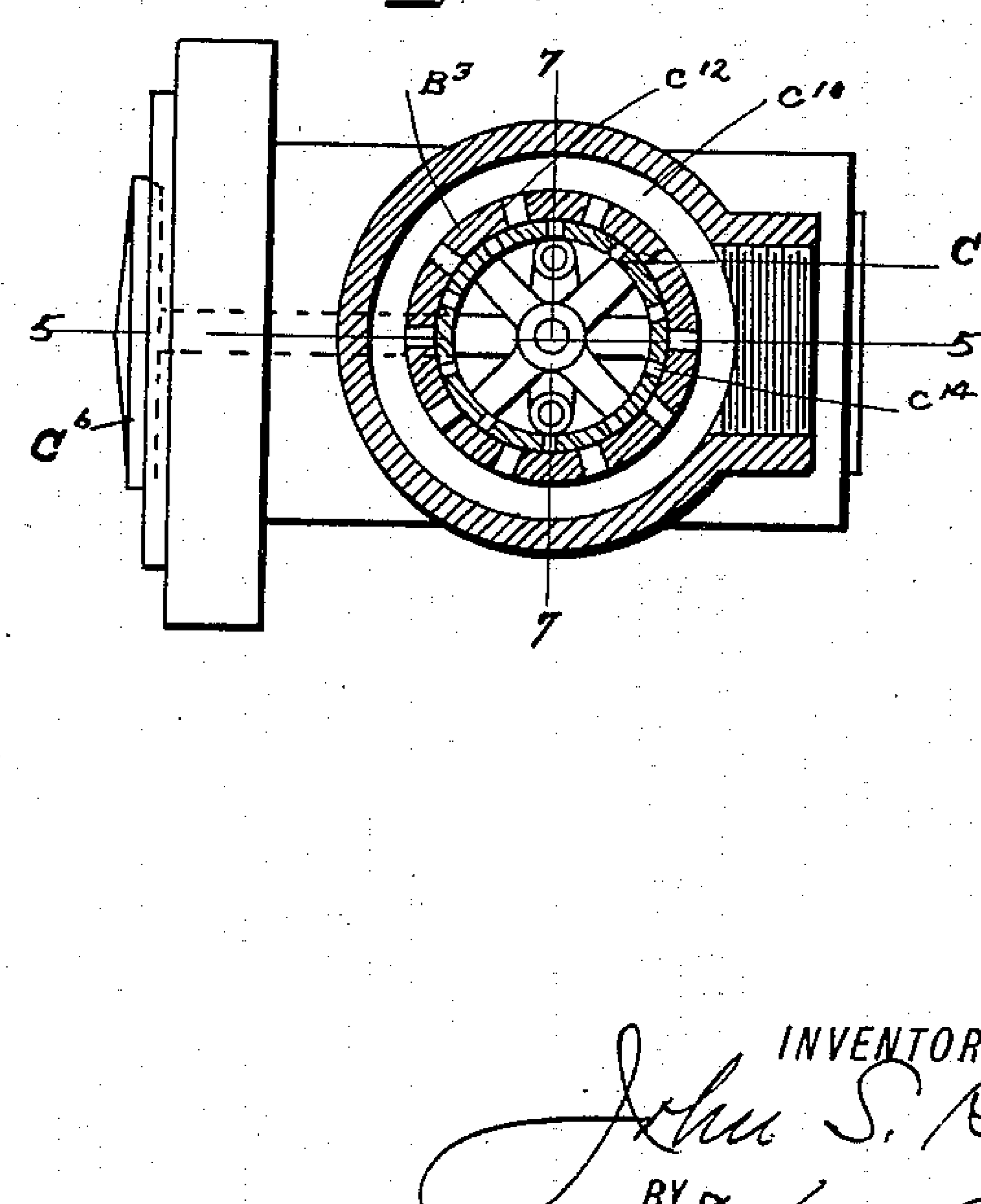


Fig. 6,



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UNITED STATES PATENT OFFICE.

JOHN S. KLEIN, OF OIL CITY, PENNSYLVANIA.

SUPPLY-CONTROLLING MECHANISM FOR GAS-ENGINES.

SPECIFICATION forming part of Letters Patent No. 615,393, dated December 6, 1898.

Application filed March 1, 1898. Serial No. 672,146. (No model.)

To all whom it may concern:

Be it known that I, JOHN S. KLEIN, a citizen of the United States, residing at Oil City, in the county of Venango and State of Pennsylvania, have invented certain new and useful Improvements in Supply-Controlling Mechanisms for Gas-Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to the supply-controlling mechanisms for gas-engines; and it consists in certain improvements in the construction thereof, as will be hereinafter fully described, and pointed out in the claims.

The object of my invention is to provide improvements for controlling the supply of gas and air to gas-engines, and consequently to control the engine.

The invention particularly relates to that class of controlling means that govern the engine by varying the strength of the charges of mixture to effect a change in the power of the engine as distinguished from those that vary the number of charges relatively to the cycles of the engine to effect the same result.

In carrying forward my invention I have found that to obtain the best results a charge for a given power must contain the gas and air in certain proportions, depending upon the quality of the gas and the arrangement of the parts of the engine. I have found also that the best results are not obtained by maintaining constant proportions of gas and air as the strength of the charge is varied, but that a change in the quality (proportion of air and gas) is desirable as well as a change in the quantity of the mixture (air and gas). This is due to the fact that the conditions in the engine remain constant, and such a variation in the quantity as will effect the desired change in the strength of the charge does not give to the lighter charges the compression necessary to maintain a smooth working of the engine.

I have shown and claimed in a separate application, filed December 31, 1897, Serial No. 664,992, a supply-controlling mechanism which will effect the results just hereinabove enumerated as desirable. In the construction shown in this earlier application, as well as in many kindred structures for the same general purpose as known to the art, the air and gas supply ducts leading to the mixing-chamber are kept normally open, so that the ducts for both the air and gas are in communication through the mixing-chamber continuously. With multicylinder-engines, wherein the demand for the explosive mixture is substantially constant and there is in consequence a substantially constant movement of the mixture from the mixing-chamber, such structures operate admirably; but with single-cylinder engines, especially with those running at slow speeds, where the demand for supply is only at intervals, there is between the movements of mixture from the mixing-chamber sufficient time to allow a passage of air into the gas-ducts or a passage of gas into the air-ducts. This takes place if for any cause there is a difference in pressure between the gas in the gas-duct and the air in the air-duct, or, in other words, there is an equalization of pressure by a movement of fluid in one direction or the other, as the case may be. Of course if the pressure in the two ducts can be kept exactly equal this result will not take place, but the fluid in the mixing-chamber will remain substantially stationary during the intervals between the supply strokes; but this condition, even with the best gasometers, is nearly impossible, if not quite so, because there is a reduction of pressure in the supply-ducts induced by the partial vacuum in the cylinder which affects each supply movement of the mixture, and when communication with the cylinder is cut off there is necessarily a necessary movement of fluids to equalize the pressure in the supply-ducts and the mixing-chamber, and this movement may be in one direction or the other, or, in other words, from the air-duct to the gas-duct or the gas-duct to the air-duct, according to the conditions that may exist.

From the foregoing it will readily be seen that it is particularly desirable in supply-controlling mechanisms of this class that the communication between the air and gas ducts should be cut off during the interval of time in which there is a momentary pause in the supply movement of the mixture to the cylinder.

My invention therefore broadly consists in a supply-controlling mechanism arranged to cut off communication between the air and gas supply ducts between each supply-stroke of the engine. The invention further consists in adapting such a supply-controlling mechanism to one wherein there is means for controlling the amount of mixture supplied according to the wants of the engine and also wherein the quality of the mixture is regulated. It has been found desirable also that the mechanism should be actuated by the fluid-pressures operating upon it, so that the ducts will be automatically opened and closed—opened when the pressure conditions of the cylinder are such as to induce a supply movement and closed when said supply movement ceases—and the invention herein also consists of means whereby this result may be attained.

The invention is further carried forward by adapting an automatically-actuated governor mechanism to operate the controlling means.

The invention also consists in the details of construction hereinafter specifically described and claimed.

I have illustrated types of the invention in the accompanying drawings, as follows:

Figure 1 shows a transverse section through the cylinder and supply-valve and mixer mechanisms. Fig. 2 is a plan view of the mixer and supply-valve mechanisms, the point of view being from below. Fig. 3 is a section on the line 3 3 in Fig. 1. Fig. 4 shows my invention adapted to a double-cylinder engine. Fig. 5 shows an alternative construction of the mixing-chamber and supply-valve mechanisms in section on the lines 5 5 in Figs. 6 and 7. Fig. 6 shows the same construction on the lines 6 6 in Figs. 5 and 7. Fig. 7 shows the same construction on the lines 7 7 in Figs. 5 and 6.

A marks the cylinder; A', the water-jacket about the cylinder; a, the supply-port; a', the exhaust-port. The mixing-chamber B has the annular port-cavity b, connected with the air-supply duct, (shown in dotted lines,) and the annular port-cavity b', connecting with the gas-supply duct b^2. Extending from the annular port-cavity b is the annular port b^3, and leading from the annular port-cavity b' are segmental ports b^4. These ports lead into the mixing-chamber and are normally covered by the valve C, which is provided with the closing-surface c for operating over the air-ports b^3 and the closing-surface c' for operating over the gas-ports b^4. These closing-surfaces are connected and supported by a web c^2, which is connected with a central sleeve c^3. The sleeve is secured on a stem C' by means of a nut c^4, which locks the sleeve between said nut and the shoulder c^5. The closing-surface c, operating upon the air-ports, is in the form of an annulus, so that when it is moved off the ports the entire circumferential area of the port is exposed. The closing-surface c' has the segmental valve-openings c^6, which when the valve is moved upwardly are brought into register with the gas-ports b^4.

The stem C' extends out of the mixer-chamber and has at its outer end a stop-shoulder C^2, which is secured on the stem by means of a nut c^7. Secured to the mixing-chamber is a plate B', from which extend hangers b^5. Guides b^6 are supported by these hangers, in which is arranged a slide D. This slide is provided with a slot d, which straddles the stem C'. At each side of the slot is arranged an inclined plate D'. These inclined plates are placed in the path of the stop-shoulder C^2, and this shoulder is inclined so as to be coincident with the top edge of the plates when the shoulder is in contact with the plates. The purpose of the inclined plates, mounted as they are on the slide, is to limit the opening movement of the valve. By moving the inclined plates any variation in the limit of the upward movement may be effected, which will vary the amount of the opening of the valve. The slide D is connected by the link E and rock-arm F with the governor-rod G.

The governor is supported by an arm A^2, extending from the cylinder, and may be of any desired form. As shown, it consists of the drive-pulley G', connected by a sleeve G^2 to one of the blocks G^3 of the governor. The weights G^4 are connected by the links g g with the block G^3 and the second block of the governor G^5. The block G^5 is connected with the rod G, and a spring G^6, supported by the rod G, operates to support the blocks G^3 and G^5, and in consequence exerts a centripetal force which opposes the centrifugal force of the weights. By following the intermediate connection it will be seen that an outward movement of the weights will effect a movement of the slide D in a direction to bring the large end of the inclined plates in the path of the shoulder C^2, so that the movement of the valve will be so limited as to effect a smaller opening of the air and gas ports. On the other hand, when the speed of the engine becomes so reduced that the centripetal action of the spring draws the weights inwardly it will be seen that the slide D will be so moved as to bring the narrower part of the inclined plates in the path of the stop-shoulder, so that the valve will have a longer movement and will in consequence give to the air and gas ports a wider opening.

Secured to the stem C' is the check-valve C^3. It will be readily understood that the device would be operative without this valve C^3, but it is desirable, as it makes the closure between the cylinder and the supply-ports doubly sure and also gives to the device less clearance. The overlap of the closure-surfaces is such that the valve C^3 is opened before the ports b^3 and b^4 are exposed. In order that the valve may be more readily subjected to the entire atmospheric pressure in order to effect a rapid operation when the partial vacuum is effected by the supply-stroke of the engine, I have supplied the ducts b^7, leading from the mixer-chamber below the valve to the atmosphere. As soon, therefore, as the pressure in the cylinder is reduced below atmospheric pressure by the supply stroke of the engine the valve is immediately opened by the pressure of the atmosphere exerted at the bottom of the valve. After the supply stroke has been completed and the pressure in the cylinder approximates that of the atmosphere the valve drops by gravity, thus closing the air and gas ports. The check-valve is securely forced to its seat by the pressure incident to the return of the compression stroke of the piston, so that when the explosion takes place the mixing-chamber valve of the air and gas ports are securely closed.

As before stated, it is desirable that not only the quantity of mixture admitted to the engine should be regulated, but the quality of the mixture should be also controlled. In order that the proportions of gas and air may be varied, I have in the construction shown introduced a bushing B^2, which forms the one annular port-cavity B' and contains the segmental gas-ports b^4. This bushing is so arranged as to be rotative in the gas-chamber. An extension B^3 projects from the bushing through the plate B', and an adjusting-arm I is clamped to this extension. By moving this arm in either direction the bushing may be turned in the mixer-chamber. The valve is locked against rotation by a squared extension c^8 on the stop-shoulder C^2, which plays through the slot d in the slide D. It will readily be seen that by turning the bushing relatively to the valve a greater or less proportion of the segmental ports b^4 will be brought into register with the valve-opening c^6 with each movement of the valve, so that the proportion of gas to air may be thus controlled. Thus the quantity of mixture is controlled by a change of position of the valve in one (longitudinal) direction and the proportion of gas to air is controlled by a relative change of position of the valve and ports in another (circumferential) direction.

As hereinbefore stated, it is further desirable that means should not only be provided whereby the quality of mixture may be varied, but also that the quality of mixture should be varied with the change of quantity of mixture admitted to the cylinder, or, in other words, the best results are obtained by not only changing the quantity of the mixture admitted, but also its quality, so that a change in the power of the engine may be accomplished by a less change in quantity than would be required if the quality were kept constant. To effect this result, I have secured to the slide D a guide-slide J, which is provided with a groove j in its face. This guide is secured to the slide D by means of a bolt j', so that the guide J may be adjusted so as to be in line with the movement of the guide D or may be adjusted at an angle to the line of movement and clamped in any such adjusted position by the bolt j'. A stud i is secured in the arm I and projects into the groove j of the sliding guide J. It will readily be seen that if the sliding guide J is placed in line with the movement of the slide D a movement of the slide D will not effect any movement of the arm I and that if the sliding guide J is placed at an angle to the line of the slide D a movement of the slide D will effect a movement of the arm I, and this effects, as hereinbefore shown, the amount of the opening through the ports b^4 and valve-openings c^6. The result of this construction is that as the slide D is moved to effect a decrease in the quantity of the mixture admitted it will also, if the sliding guide is placed at an angle, vary the proportion of gas to air in the mixture.

The different qualities of gas make it desirable that a different proportion of gas to air be used in the mixture introduced to the cylinder, and in order to adjust the valve mechanism to the different qualities of gas it is desirable that there should be means provided whereby the quality of the mixture with any given valve-opening may be changed. That this may be accomplished I have provided the arc-shaped slot i' in the end of the arm I, so that the arm may be adjusted relatively to the stud i, and therefore to give to the mixture the desired initial quality.

In Fig. 4 the check-valves C^3 are placed between the mixing-chamber and the engine and are independent of the valve C. The operation of and the results attained by this mechanism are substantially the same as that shown in Fig. 1. The valve C, mixing-chamber B, ports b^3 and b^4, and the bushing B^2 are of the same construction as in Fig. 1. The governor-rod G^6 extends directly into the sleeve c^2 of the valve C. A shoulder g' on the rod G^6 acts by its location to limit the opening movement of the valve in substantially the same manner that the inclined plates operate upon the valve in the construction shown in Fig. 1. The mechanism for giving the bushing B^2 the rotative movement consists of the arm F', extending from the governor-rod G^6, and link E', extending from the arm F' to an arm E^2 of a bell-crank lever, (shown in dotted lines.) The bell-crank lever operates upon the arm I, and thus gives to the arm and bushing B^2 a rotative movement. In order to adjust the initial proportions of the gas and air port openings, a slot e is provided in the arm E^2, in which the rod E' may be adjusted in order to shorten or lengthen the arm E^2, and thus control the range movement of the bell-crank.

In the alternative construction shown in Figs. 5, 6, and 7, B^3 marks the mixing-chamber; c^9 and c^{10}, the annular port-cavities for gas and air, respectively, and c^{11} and c^{12}, the gas and air ports, respectively; C^5, the gas and air controlling valve; C^6, the check-valve, which in this construction is placed in a part of the mixing-chamber at right angles to the part containing the valve C^5. The air-ports

c^{12} are arranged in series around the mixing-chamber, and the ports c^{11} are likewise arranged. Valve-openings c^{13} are arranged to be brought into register with the ports c^{11} by a rotative movement, and the valve-openings c^{14} are arranged to be brought into register with the opening c^{12} by a like movement of the valve. The gas-openings c^{13} for gas are of substantially the same length longitudinally as the port c^{11}, so that an axial movement of the valve will bring a less proportion of the valve-openings into register with the port-openings and will constantly reduce the amount of gas admitted through said openings. The valve-openings c^{14} for the air-ports are somewhat longer than the ports c^{12}, so that an axial or longitudinal movement of the valve does not affect the amount of air admitted by said openings. The stem C^7 of the check-valve extends out through a piston C^8 and has at its outer end a stop-shoulder C^9. An arm C^{10} is secured to said stem within the valve-chamber. This arm has the pin c^{15}, which engages a crank-arm c^{16}, which in time is secured to the valve C^5. It will readily be seen that the piston C^8 is exposed to the atmospheric pressure, so that when the pressure in the cylinder is reduced the pressure on the piston C^8 will open the valve C^6, and also that this movement will, by reason of the crank mechanism, cause a rotative movement of the valve C^5 and a consequent admission of air and gas proportional in quantity to the amount of the rotative movement. To limit the movement of the stem C^7, so as to govern the quantity of the mixture admitted, I have arranged the lever K, which is connected to the governor mechanism in the path of the stop-shoulder C^9, so that the movement of the stem C^7 may be regulated by the position of the lever K. In order also that the quality of the mixture may be varied, I have attached to the valve C^5 a stem C^{10}, to which is secured a pivoted lever L, which carries a grooved guide l. It will readily be seen that if the guide l is adjusted at an angle to the lever L a movement of the lever K will produce a movement of the lever L and a consequent axial movement of the valve C^5. This axial movement of the valve C^5, as heretofore explained, will change the area of the gas-port opening, but will effect no change of area of the air-port, so that a change in the quality of the mixture is effected.

By the term "gas-engine" I wish to include all engines operating upon the explosive principle, and by the term "gas" any matter which by union with other gases, as air, and ignition will explode.

What I claim as new is—

1. In a supply-controlling mechanism for gas-engines, the combination with the air and gas supply passages, of a valve device controlling said passages; a means for actuating said valve to automatically cut off the communication between said passages, between those strokes of the engine during which a supply movement of the mixture of air and gas is induced; and means arranged to actuate said valve to vary the quantity and quality of the mixture admitted.

2. In a supply-controlling mechanism for gas-engines, the combination with the air and gas supply ports; of a valve device arranged to control the quantity of mixture admitted by a change of position of the valve device in one direction relatively to said ports, and to vary the quality with each variation of quantity of mixture admitted by a relative change of position of the valve device and ports in another direction.

3. In a supply-controlling mechanism for gas-engines, the combination with the air and gas supply ports; of a valve device arranged to control the quantity of mixture admitted by a change of position of the valve device in a longitudinal direction relatively to said ports and to vary the quality with each variation of quantity of mixture admitted by a change of position of the valve device in a circumferential direction relatively to said ports.

4. In a supply-controlling mechanism for gas-engines, the combination with the air and gas supply passages; of a valve device for controlling said passages arranged to cut off communication between said passages with each stoppage of a supply movement of mixture toward the engine; and a governor arranged to vary the quantity and quality of the mixture admitted to the engine.

5. In a supply-controlling mechanism for gas-engines, the combination with the air and gas supply passages, of a valve device controlling said passages, said device being arranged to normally cut off said passages from the mixing-chamber; and means for varying the ratio of the area of the opening from said gas and air passages by a movement of said normally-closed limits of the valve device.

6. In a supply-controlling mechanism for gas-engines, the combination with the air and gas supply passages; of a valve device controlling said passages, said device being arranged to normally cut off said passages from the mixing-chamber; and means for varying the area of the opening from said passages and the ratio of area of the gas and air opening from said passages by the movement of said valve device.

7. In a supply-controlling mechanism for gas-engines, the combination with the air and gas supply passages, of a valve device controlling said passages, said device being arranged to normally cut off said passages from the mixing-chamber; and means operated by a reduction of pressure in the cylinder for actuating said valve device to open said passages for each supply; and means for controlling movement of said valve device to vary the quality and quantity of mixture passing by said valve device.

8. In a supply-controlling mechanism for gas-engines, the combination with the air and

gas supply passages, of a valve device controlling said passages, said device being arranged to normally cut off said passages from the mixing-chamber; means for varying the ratio of the area of the opening from said gas and air passages by the movement of said valve device; and a governor for automatically controlling the said ratio of the openings at the gas and air ports.

9. In a supply-controlling mechanism for gas-engines, the combination with the air and gas supply passages, and the mixing-chamber; of a valve device controlling said passages, said device being arranged to normally cut off said passages from the mixing-chamber; means operated by a reduction of pressure in the cylinder for actuating said valve to open said passages for each supply; and a governor for controlling said valve device to vary the quantity and quality of the mixture passing by said valve.

10. In a gas-supply-controlling mechanism for gas-engines the combination with the air and gas inlet ports; of a valve arranged to control said ports and having a valve-opening for the gas; a bushing surrounding said valve and carrying the gas-port to the mixing-chamber, said bushing being arranged to rotate to change the extent of the gas-port brought into register with the valve-opening by a longitudinal movement of the valve.

11. In a gas-supply-controlling mechanism for gas-engines, the combination with the air and gas inlet ports; of a valve arranged to control said ports, and having a valve-opening for the gas; a bushing surrounding said valve and carrying the gas-port to the mixing-chamber, said bushing being arranged to rotate to change the extent of the gas-port brought into register with the valve-opening by a longitudinal movement of the valve; and a check-valve carried by said valve and arranged to effect a closure between said valve and the cylinder.

12. In a gas-supply-controlling mechanism for gas-engines, the combination with the air and gas inlet ports; of a valve arranged to control said ports and having a valve-opening for the gas; a bushing surrounding said valve and carrying the gas-port to the mixing-chamber, said bushing being arranged to rotate to change the extent of the gas-port brought into register with the valve-opening by a longitudinal movement of the valve; and a governor connected with said bushing and arranged to automatically turn said bushing.

13. In a gas-supply-controlling mechanism for gas-engines, the combination with the air and gas inlet ports; of a valve arranged to control said ports and having a valve-opening for the gas; a bushing surrounding said valve and carrying the gas-port to the mixing-chamber, said bushing being arranged to rotate to change the extent of the gas-port brought into register with the valve-opening by a longitudinal movement of the valve; and a governor arranged to turn said bushing and to control the longitudinal movement of the valve.

14. In a supply-controlling mechanism for gas-engines, the combination of the mixing-chamber, B, having the gas and air ports, b^3 and b^4; the valve, C, having the closing-surfaces, c c', and the valve-opening, c^6; the bushing, B^3, having the arm, I, carrying the stud, *i*, the slide, D; the adjustable sliding guide, G; and a governor for controlling the movement of the slide, D.

15. In a supply-controlling mechanism for gas-engines, the combination of the mixing-chamber, B, having the gas and air ports, b^3 and b^4; the valve, C, having the governing-surfaces, c c', and valve-opening, c^6; and the bushing, B^3.

16. In a supply-controlling mechanism for gas-engines, the combination of the mixing-chamber, B, having the gas and air ports, b^3 and b^4; the valve, C, having the governing-surfaces, c c', and valve-opening, c^6; the bushing, B^3; and the check-valve, C^3, carried with said valve, C.

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

JOHN S. KLEIN.

Witnesses:
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H. C. COOPER.