No. 812,304. PATENTED FEB. 13, 1906.

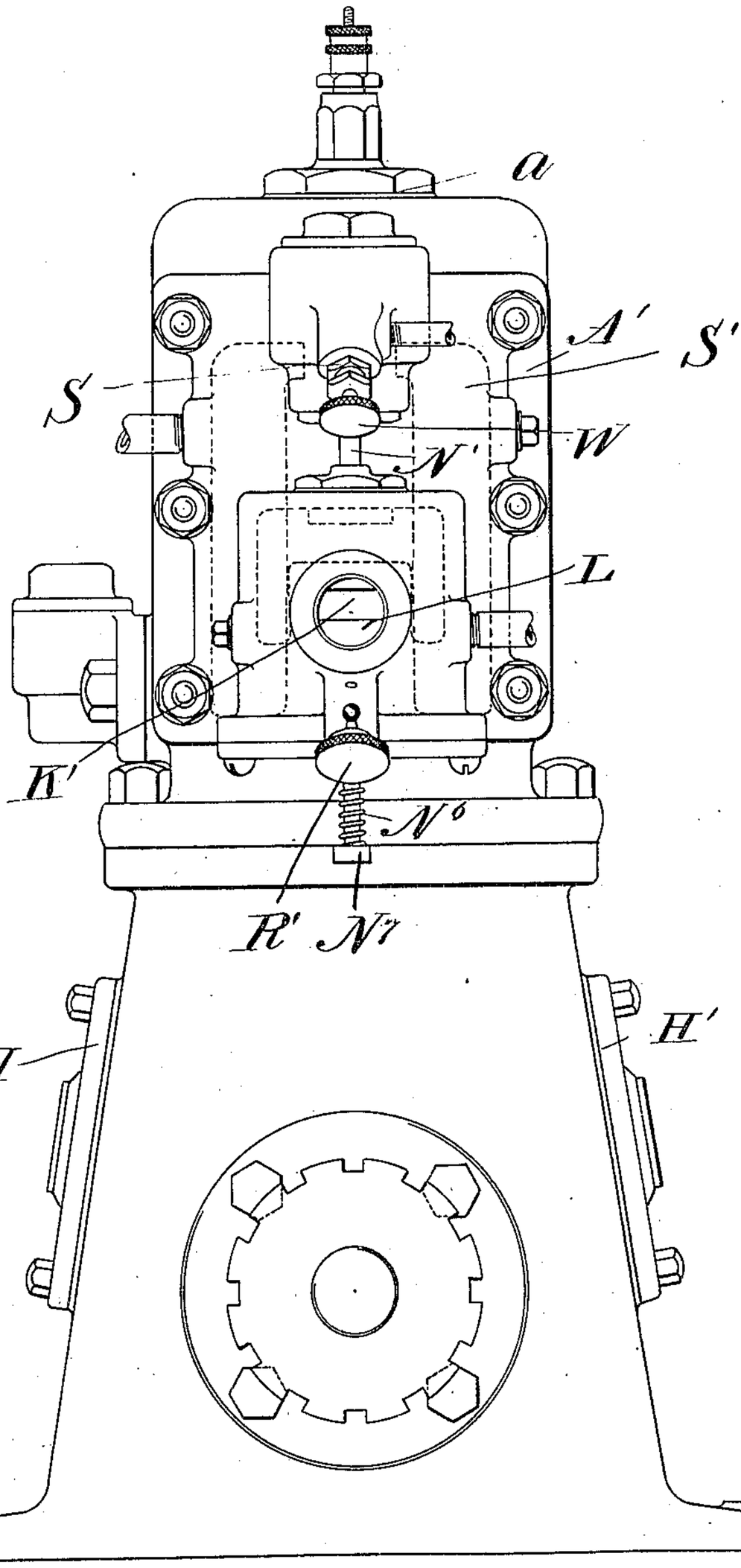
E. G. SHORTT.

EXPLOSIVE GAS ENGINE.

APPLICATION FILED SEPT. 24, 1902.

5 SHEETS—SHEET 1.

Fig. 1.



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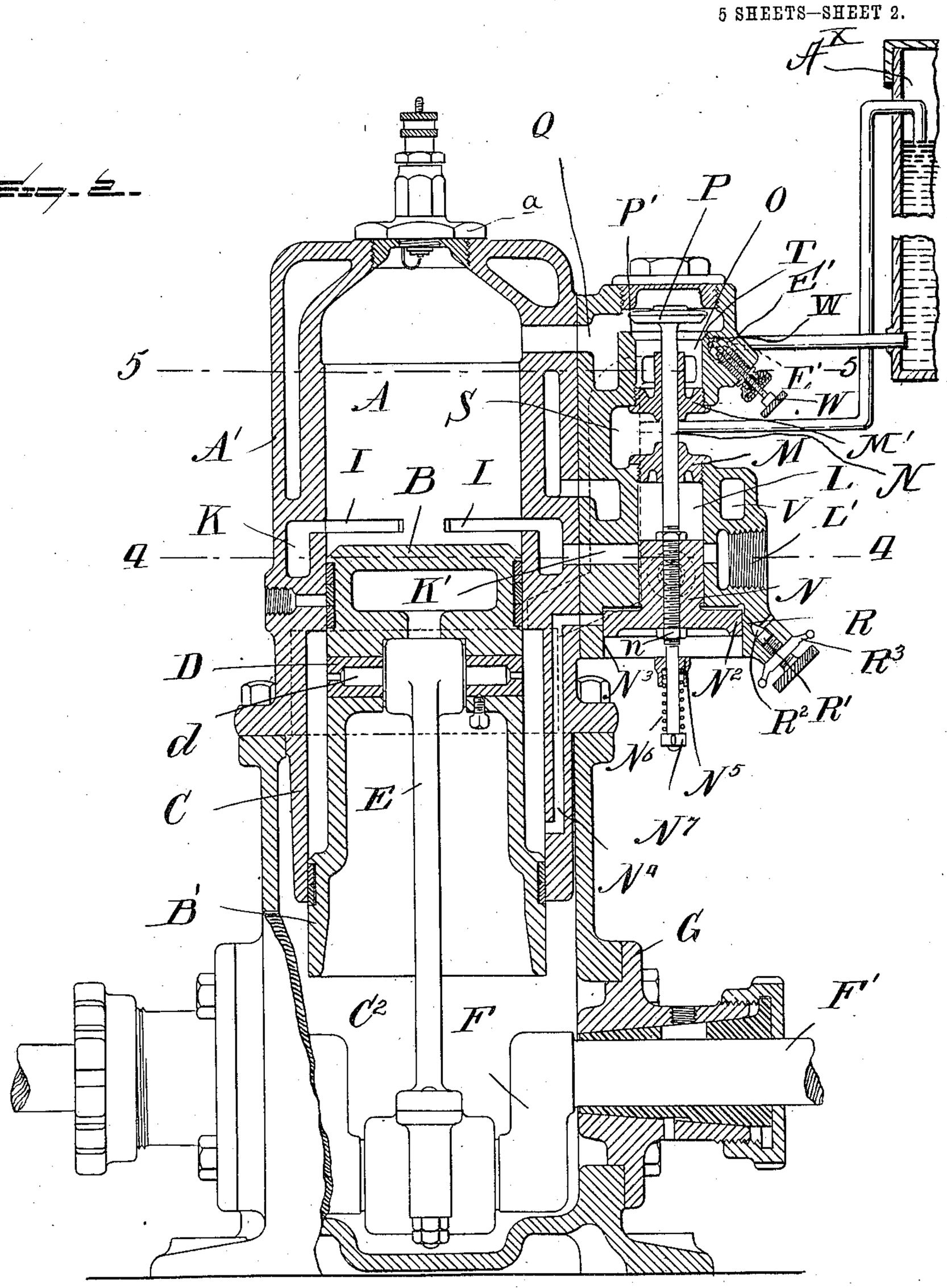
5 SHEETS—SHEET 2.

Fig. 2.



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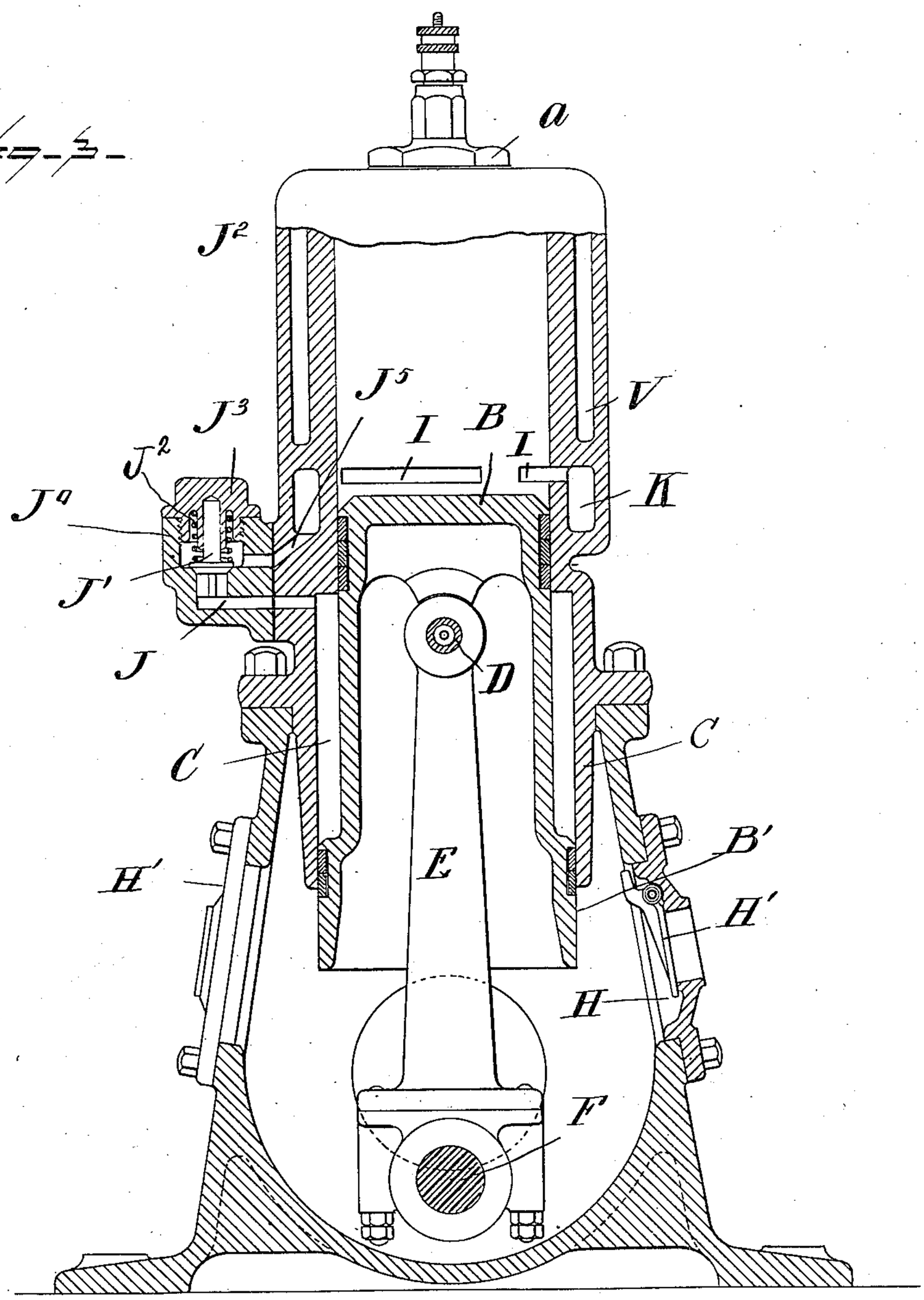
5 SHEETS—SHEET 3.

Fig. 3.



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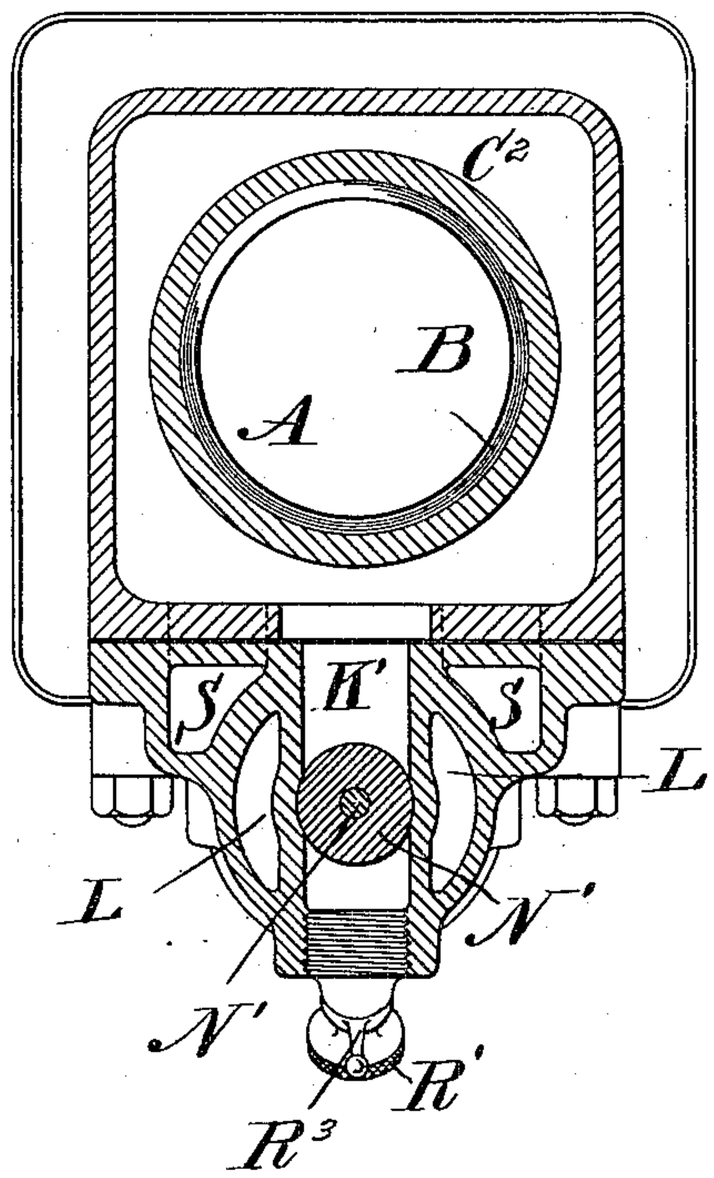
5 SHEETS—SHEET 4.

Fig. 4.



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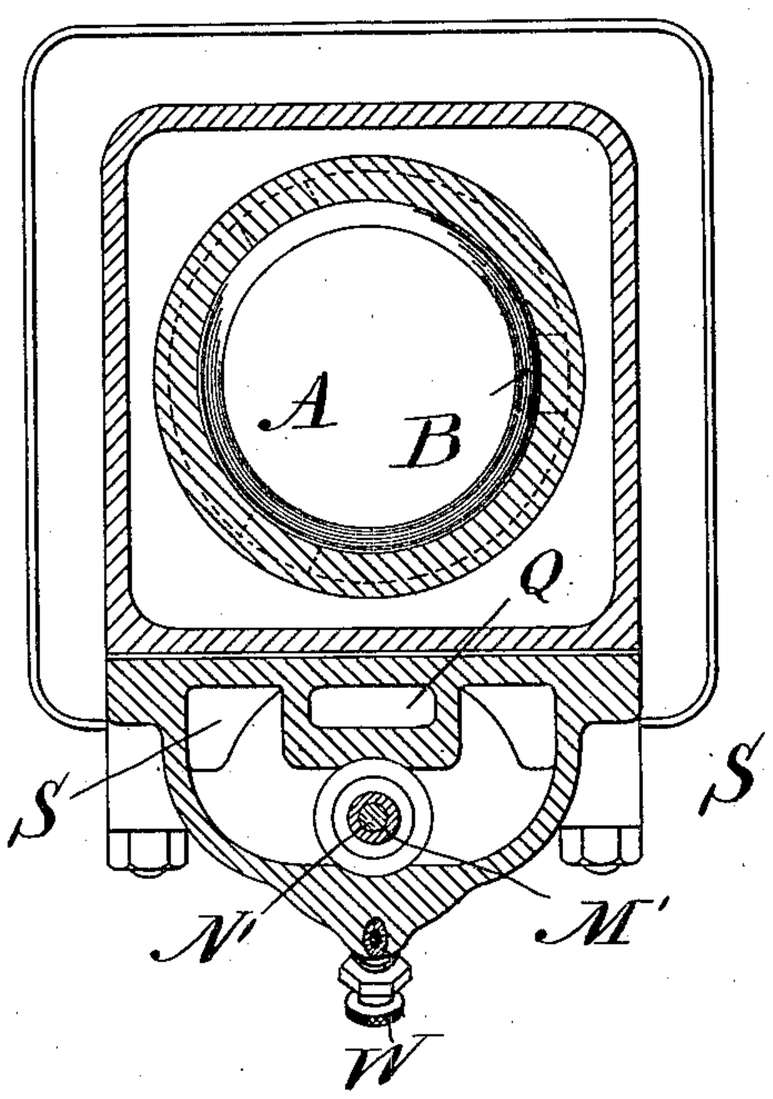
5 SHEETS—SHEET 5.

Fig. 5.



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UNITED STATES PATENT OFFICE.

EDWARD G. SHORTT, OF CARTHAGE, NEW YORK.

EXPLOSIVE-GAS ENGINE.

No. 812,304. Specification of Letters Patent. Patented Feb. 13, 1906.

Application filed September 24, 1902. Serial No. 124,702.

To all whom it may concern:

Be it known that I, EDWARD G. SHORTT, a citizen of the United States, residing at Carthage, in the county of Jefferson and State of New York, have invented certain new and useful Improvements in Explosive-Gas Engines; and I do 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, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to new and useful improvements in gas-engines, and especially to a forced-feed engine in which the supplies of air and fuel are kept separate and normally under pressure until they are fed into the combustion-chamber, at which time the pressure is variable, being greater upon the fuel than upon the air-supply.

The invention consists, further, in the provision of means whereby the amount of fuel being fed to the engine may be automatically regulated by the quantity of air which is allowed to enter a secondary cylinder and break a vacuum, in which a piston works, having a stem which is connected to a valve controlling the admission of fuel and air to the combustion-chamber.

In the present invention a combustion-chamber is provided having valve-regulated communication with a fuel-supply reservoir and with an initial air-compression chamber, whereby at a predetermined moment a forced supply of fuel and air thoroughly atomized may be fed into the combustion-chamber, the residue of the products of combustion being compressed into a receiving-chamber by the impact of the inflow of a forced charge under the initial compression, means being provided for preventing the escape of any of the charge and for maintaining a pressure in the initial supply-chamber and the constant pressure upon the fuel-supply.

Another feature of the present invention consists in the utilization of a single stem, carrying at one end a valve controlling the ingress of fuel and air and at its other end a plunger working in a suitable cylinder adapted to be acted upon by pneumatic pressure to actuate the stem, whereby the valve may be opened and seated at predetermined moments and controlled by the quantity of air which is allowed to enter the secondary cylinder in order to break the vacuum formed therein.

The invention relates, further, to various features and details of construction, which will be hereinafter fully described and then specifically defined in the appended claims and illustrated in the accompanying drawings, which, with the letters of reference marked thereon, form a part of this application, and in which drawings similar letters of reference indicate like parts in the various views, in which—

Figure 1 is a front elevation of my improved engine. Fig. 2 is a central vertical section through the engine. Fig. 3 is a view vertically and centrally through the engine in a plane at right angles to the plane on which Fig. 2 is made. Fig. 4 is a sectional view on line 4 4 of Fig. 2. Fig. 5 is a section on line 5 5 of Fig. 2.

Reference now being had to the details of the drawings by letter, A designates the combustion-chamber of the engine, having a suitable water-jacket A′ about the same, and secured in a threaded aperture at the upper end of said combustion-chamber is a plug *a*, provided with a sparking apparatus of any approved type.

B designates a cylindrical piston which works with suitable packing inside the combustion-chamber. The lower end of said piston is of larger diameter than its upper end and forms a piston-head B′, which works within the hollow shell C′ and fits snugly against the inner wall thereof, said shell C′ extending down into the air-compression chamber C^2. Mounted on a pivotal pin D, which is journaled in an aperture passing through the solid portion of the cylindrical piston, is a pitman E, and said pin is chambered out, as shown at *d*, for the reception of a lubricant. The lower end of said pitman is pivotally connected to a crank F, forming part of a shaft F′, which is journaled in suitably-packed bearings in the casing G. Said casing forms a wall for the air-compression chamber C^2, and on which casing the superstructure of the engine is mounted and securely fastened thereto. Air is drawn into said air-compression chamber by the formation of a partial vacuum therein on the return stroke of the piston, the air entering through the ports H, which are regulated by means of pivoted valves H′. The air, which has been previously drawn into the compression-chamber on the return stroke of the pis-

ton, is compressed slightly on the working stroke of the piston for the purpose of creating sufficient pressure of air to maintain a uniform pressure upon the fuel and also to supply air under pressure to the mixing-chamber preparatory to its entering the combustion-chamber thoroughly atomized with the fuel.

In order to regulate the capacity of the compression-chamber, it is my purpose to utilize oil, which may be poured into the lower portion of the chamber and by so doing increase or diminish the space in which the air is forced and at the same time utilizing the oil for lubricating the crank-shaft, which passes through said chamber.

Leading from the combustion-chamber at locations slightly above the top of the piston B when at its lower limit are formed ports I, that lead into an annular space K of a measured capacity surrounding the lower portion of the combustion-chamber, said annular space K being of sufficient capacity to receive the residue of the products of combustion after the inner end of the piston B opens communication, between the combustion-chamber and the said annular space, through the ports on the outer throw of the piston. Leading from said annular space K is a port K′, through which the residue of the products of combustion pass into and through the cylinder L and thence through the exhaust-port L′ to the atmosphere. Mounted within the cylinder L is a piston N, which is fastened to the piston-stem N′, which stem is adapted to have a reciprocating movement through the threaded plug M, which has threaded connection with threads on the inner wall of the cylinder L and also passing through a head M′, fitted into the lower portion of the air-receiving chamber O. The inner end of said piston N fits snugly the inner wall of the cylinder L and is adapted to open and close the port K′, which leads from the annular space K to the interior of the cylinder L, whereby as said piston N reciprocates at a predetermined moment the residue of the products of combustion may exhaust to the atmosphere and communication with the atmosphere shut off at the proper time to prevent any backflow to the combustion-chamber while a new charge is being fed thereto. One end of said piston N is enlarged, forming a piston-head N^2, which is adapted to fit within the enlarged portion N^3, formed in the wall of the cylinder L and immediately below the same, forming a pneumatic secondary cylinder. A duct N^4 leads from the vacuum-space C at a location a suitable distance above the lower end of the shell about said space through the wall of the secondary cylinder, and through which duct air is exhausted from the latter as the piston B approaches the limit of its outer throw and at the moment that the inner end of the piston-head B′ passes by the entrance into said duct. As the air is exhausted from the secondary cylinder the pressure of the atmosphere upon the outer face of the enlarged portion N^2 of the piston-head will force the same upward, and with it the stem N′, which will cause the valve P to rise from its beveled seat P′, allowing air to pass into the mixing-chamber Q in a manner which will be presently described. As the piston N is driven in by atmospheric pressure the port K′ will be closed, thus shutting off communication between the combustion-chamber and the atmosphere. The lower end of the piston-stem N′ passes through a yoke N^5 on the casing of the engine, and a spring N^6 is interposed between said yoke and a nut N^7, carried on the end of said stem, while an adjusting-nut *n* is mounted on the threaded portion of the stem and bears against the outer surface of the enlarged head N^2 of the piston. This spring is provided for the purpose of assisting in closing the valves after the same have been opened by pneumatic pressure.

Opening into the space forming the interior of the secondary cylinder is a port R, and R′ represents a screw having a threaded connection with the threaded wall of a screw-aperture in the projecting portion of the casing of the cylinder L and is provided with a tapering end R^2, which is adapted to be seated against a tapering wall in the port R, whereby the passage of air through said port R may be regulated. A jam-nut R^3 is mounted upon the threaded portion of said screw, whereby the screw may be held securely in an adjusted position. Said screw mounted as described forms an essential feature of the invention, for the reason that the quantity of air which it is desired to allow to pass through the port R may be regulated, which air is allowed to enter to break the vacuum formed in the secondary cylinder, and accordingly as more or less air is allowed to enter the latter through said port the action of the valve which allows a greater or less quantity of fuel to be fed to the cylinder may be regulated.

Leading preferably from the upper portion of the air-compression chamber is a duct S, through which air under pressure is fed from the air-compression chamber into the air-receiving chamber O preparatory to its being mixed with the fuel which enters through a port T, opening through the inclined wall of the seat P′. The exhaust end of the duct S, through which air under pressure passes from the air-compression chamber into the chamber O, is slightly contracted, as will be observed by the dotted outline of the side wall of said duct designed for the purpose of slightly reducing the pressure of the air which enters the chamber O in order to have a greater pressure upon the fuel which is fed into the mixing-chamber than upon the air-supply.

The fuel, which may be contained within a tank A× at any suitable location, has communication with the air-compression chamber, whereby a constant and uniform pressure is maintained upon the fuel equal to the air-pressure within the air-compression chamber. The supply of fuel from the reservoir is adapted to enter through the port E′, and a thumb-screw W, having a tapering end, is adapted to have a seat W′ formed in the wall of the port P′, whereby the quantity of fuel which it is desired to feed to the mixing-chamber may be regulated.

Water which is provided for the purpose of circulation in the water-jacket enters the spaces V and is adapted to circulate around the combustion-chamber for the purpose of preventing the parts from becoming superheated.

Leading from the upper portion of the vacuum-space C is a port J, the outlet end of which is controlled by means of a check-valve J′, which is held in place by means of a spring J^2, interposed between said valve and a threaded plug J^3, which latter is fitted to the threaded walls of a chamber J^4. This port and check-valve are provided for the purpose of allowing air which is drawn into the vacuum-space to make exit on the inner throw of the cylinder, said air after being forced through the port J and the chamber J^4 passing out through a port J^5 into the chamber K, into which the residue of the products of combustion pass from the combustion-chamber and afterward to the atmosphere.

Upon reference to the sectional view of the drawings it will be observed that the air-compression chamber is substantially square in cross-section, which will allow considerable space about the lower end of the shell in which the piston reciprocates, thus allowing for ample space for the reception of the compressed air, and the apparatus is so regulated that the use of escape-valves to reduce the pressure of the air in the air-compression chamber is dispensed with, and the capacity of said chamber may be regulated, as hereinbefore stated, by the use of oil, which may be poured into the lower portion thereof.

The operation of my invention is simple and will be readily understood and is as follows: A charge of atomized gasolene being forced into the combustion-chamber and ignited, the piston therein is driven outward, and when the inner end of piston B opens communication with the ports I, leading from the lower portion of the combustion-chamber into the exhaust-space K, the residue of the products of combustion will pass through said ports and into the chamber K and to the atmosphere through the ports K and L, the piston N being at this moment in such a position as to open communication between the combustion-chamber and the atmosphere. As the piston is driven outward by the explosion of a charge and reaches its lowest limit a vacuum is formed within the shell C′, and when the inner end of the piston-head B′ opens communication with the lower end of the duct N^4 air will rush from the secondary cylinder in which the piston N^2 is mounted, exhausting the air therein, said air rushing into the vacuum-space C′, and the atmospheric pressure upon the face of the piston N^2 will cause the latter to be forced in, and the stem N′ will raise the valve P from its seat, and air under pressure coming from the port S and fuel under pressure are forced through the feeding-aperture T against the inclined or beveled edge of the valve P, at which location it comes in contact with the supply of air under pressure, which pressure on the supply of air, however, should be slightly less than the pressure upon the fuel which is being fed into the mixing-chamber. As the fuel and air come in contact under pressure, the charge is thoroughly atomized in the mixing-chamber before entering the combustion-chamber. It will be observed that the partial vacuum formed in the secondary cylinder in which the piston N^2 is positioned is broken by means of the adjustment of the valve R′, which allows a greater or less quantity of air to rush through the inlet-duct R to fill the vacuum-space in the secondary cylinder accordingly as it is desired to allow a greater or less quantity of fuel and air to be fed into the combustion-chamber. Simultaneously with the exhausting of the air in the secondary cylinder by the working piston closing communication between the vacuum-space and said secondary cylinder communication between the exhaust-chamber K and the atmosphere is closed by the piston N, at which moment the enlarged end of the piston B will have passed beyond the opening into the duct N^4, leading from the vacuum-space C, and air on the upper surface of the enlarged portion of the piston N will be exhausted into said vacuum-space, and the atmospheric pressure upon the outer face of said piston N overcoming the pressure upon its inner face will cause the valve actuated by said piston to unseat to allow fuel and air to enter the combining-chamber. While said valve is unseated a small quantity of air is allowed to pass through the duct at the inner end of the valve thumb-screw R′ into the space above the enlarged end of the piston N until the vacuum is partially broken, and as pressures upon opposite faces of the enlarged end of the piston equalize the induction-valve will be seated.

From the foregoing it will be observed that the operation of the valve P is automatic in shutting off the supply of fuel the instant the engine is stopped, which shutting off of the supply of fuel is caused by the breaking of

the vacuum in the secondary cylinder, and that as the engine is started a vacuum is created and the valve is automatically opened.

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

1. An explosive-gas engine having a cylinder with a combustion-chamber and a piston working therein, an exhaust-chamber, a fuel-duct, an air and fuel combining chamber, having free and unobstructed communication with said combustion-chamber, an air-compression compartment, and a vacuum-space intermediate the combustion-chamber and the compression-compartment, a valved passage-way leading from the vacuum-space to said exhaust-chamber, valve mechanism for allowing air under pressure from said compression-compartment together with fuel, to simultaneously enter the combining-chamber, and means for actuating said mechanism exposed on one side to the atmosphere and on the other side to the vacuum-space, as set forth.

2. An explosive-gas engine having a cylinder with a combustion-chamber and a piston working therein, an exhaust-chamber, a fuel-duct, an air and fuel combining chamber, having free and unobstructed communications with said combustion-chamber, an air-compression compartment, and a vacuum-space intermediate the combustion-chamber and the compression-compartment, a valved passage-way leading from the vacuum-space to said exhaust-chamber, valve mechanism for allowing air under pressure from said compression-compartment together with fuel, to simultaneously enter the combining-chamber, a pneumatic cylinder positioned in a passage-way communicating with said vacuum-space, a piston in said pneumatic cylinder and adapted to actuate said valve mechanism. and means for regulating the supply of air to said pneumatic cylinder, as set forth.

3. An explosive-gas engine having a cylinder with a combustion-chamber and a piston working therein, an exhaust-chamber, with ports leading thereto from the lower portion of the combustion-chamber, a fuel-duct, an air and fuel combining chamber, having free and unobstructed communication with the combustion-chamber, an air-compression compartment, the lower end of said piston being enlarged and adapted to form, with the adjacent wall of the cylinder in which it works, a vacuum-space, which communicates through a valve-regulated passage-way with said exhaust-chamber, valve mechanism for allowing the air under pressure from said compression-compartment and fuel to simultaneously enter the combining-chamber, and means for actuating said mechanism exposed on the one side to the atmosphere and on the other side to the vacuum-space, as set forth.

4. An explosive-gas engine having a cylinder with a combustion-chamber and a piston working therein, an exhaust-chamber, a fuel-duct, an air and fuel combining chamber, having free and unobstructed communication with said combustion-chamber, an air-compression compartment, a vacuum-space being formed intermediate the combustion-chamber and the compression-compartment, a pneumatic cylinder with a duct leading therefrom and communicating with said vacuum-space, and valve mechanism for regulating the supply of air from the compression-compartment and fuel to the combining-chamber, simultaneously with the closing of the exhaust to the atmosphere, as set forth.

5. In an explosive-gas engine, a combustion-chamber, an air-compression compartment, a piston working in said chamber and having an enlarged end to compress air into said compartment, a vacuum-space being formed intermediate the circumference of said piston and the wall of the compression-compartment, a combining-chamber, having free communication with the combustion-chamber, an exhaust-chamber with ports leading to the combustion-chamber and to the atmosphere, an induction-valve controlling the feeding of air and fuel to the combining-chamber, a stem upon which said valve is mounted, a pneumatic cylinder, a piston mounted in said cylinder and exposed on one side to the atmosphere and on the other side to the vacuum-space, said piston having a contracted portion for controlling the port leading from the exhaust-chamber, as set forth.

6. In an explosive-gas engine, a combustion-chamber, an air-compression compartment and a vacuum-space, a piston working in said chamber, and having an enlarged end adapted to compress air within said compartment, an exhaust-chamber of measured capacity communicating with the combustion-chamber and with the atmosphere, a combining-chamber communicating with the combustion-chamber, a duct leading from said air-compression compartment to convey air from the latter to the combining-chamber, a pneumatic cylinder and piston working therein, a duct leading from said cylinder to said vacuum-space, an induction-valve and stem secured thereto, which is also fastened to said piston in said cylinder, and valve mechanism in connection with said piston in the cylinder, and means for actuating said mechanism exposed on the one side to the atmosphere and on the other side to the vacuum-space, and means for allowing a given quantity of air to enter the pneumatic cylinder to break the vacuum, as set forth.

7. In an explosive-gas engine, a combustion-chamber, an air-compression compartment and a vacuum-space, a piston working in said chamber, and having an enlarged end adapted to compress air within said compart-

ment, an exhaust-chamber of measured capacity communicating with the lower portion of the chamber and with the atmosphere, an induction-valve for regulating the supply of air and fuel to the combustion-chamber, a pneumatic cylinder, a piston having an enlarged head working in said cylinder and provided with a contracted portion regulating the exit passage-way between said exhaust-chamber and the atmosphere, a valve regulating the ingress of air to said cylinder, said induction-valve actuated by said piston in said cylinder, the latter having communication with said vacuum-space, as set forth.

8. An explosive-gas engine comprising a combustion-chamber, a working piston therein, an annular chamber for receiving the residue of the products of combustion, an induction-valve, a pneumatic cylinder, a piston working therein, having a contracted portion regulating the exit passage-way from said annular chamber to the atmosphere, a valve-regulated air-inlet duct leading to the pneumatic cylinder, a stem on which the piston of said cylinder is mounted, an induction-valve mounted on said stem, and opening into a combining-chamber, a shell in which an enlarged portion of the working piston travels forming a vacuum-space, a port leading from said space to the pneumatic cylinder, an air-compression chamber, a crank-shaft mounted therein, and a pitman between said working piston and shaft, and a duct formed in the casing of the engine and leading from the air-compression chamber to said induction-valve, whereby air under pressure may be fed to the combining-chamber as the induction-valve is unseated, as set forth.

9. An explosive-gas engine comprising a combustion-chamber, a working piston mounted therein, a shell extending below the combustion-chamber, an enlarged portion of said piston working therein, an air-compression compartment, an annular chamber for receiving the residue of the products of combustion, a pneumatic cylinder, a piston having an enlarged headed portion working in said cylinder and a contracted portion regulating communication between the exhaust-chamber and the atmosphere, a stem fitted to said piston in said cylinder, and an induction-valve secured to said stem and regulating the flow of air and fuel to the combining-chamber, as set forth.

10. An explosive-gas engine having a combustion-chamber, a receiving-chamber communicating therewith into which the residue of the products of combustion is forced, a working piston mounted in the combustion-chamber, a shell below the combustion-chamber forming a space in which an enlarged portion of the working piston reciprocates, an air-compression compartment, a mixing-chamber into which air is conducted from said air-compression compartment, an induction-valve and stem on which the same is mounted, a pneumatic cylinder, a passage-way leading therefrom to said space, a portion of the piston in said cylinder controlling communication between the receiving-chamber and the atmosphere, a guide-piece through which said stem passes, and a spring for normally holding the induction-valve closed, as set forth.

11. In an explosive-gas engine, a combustion-chamber and an air-compression compartment, a piston in said chamber, a receiving-chamber communicating with the combustion-chamber and into which the residue of the products of combustion is forced, an induction-valve, a stem on which the same is mounted, a shell extending below the combustion-chamber, an enlarged portion of said piston working within said shell, a vacuum-space formed between the enlarged portion of said piston and shell, a pneumatic cylinder, a duct leading therefrom to said vacuum-space, a piston mounted in said cylinder and connected to the induction-valve, and a valve-regulated air-inlet duct leading to said cylinder, a duct leading from the air-compression chamber to the combining-chamber, a valve-regulated fuel-aperture opening to the seat of the induction-valve, and a spring-actuated valve regulating the passage-way between said air-compression chamber and said receiving-chamber, as set forth.

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

EDWARD G. SHORTT.

Witnesses:
H. WARD PEARSON,
GEO. HARVEY TRICKETT.