(No Model.)

J. CHARTER.

HYDROCARBON OR GAS ENGINE.

No. 415,446. Patented Nov. 19, 1889.

Fig. 2.

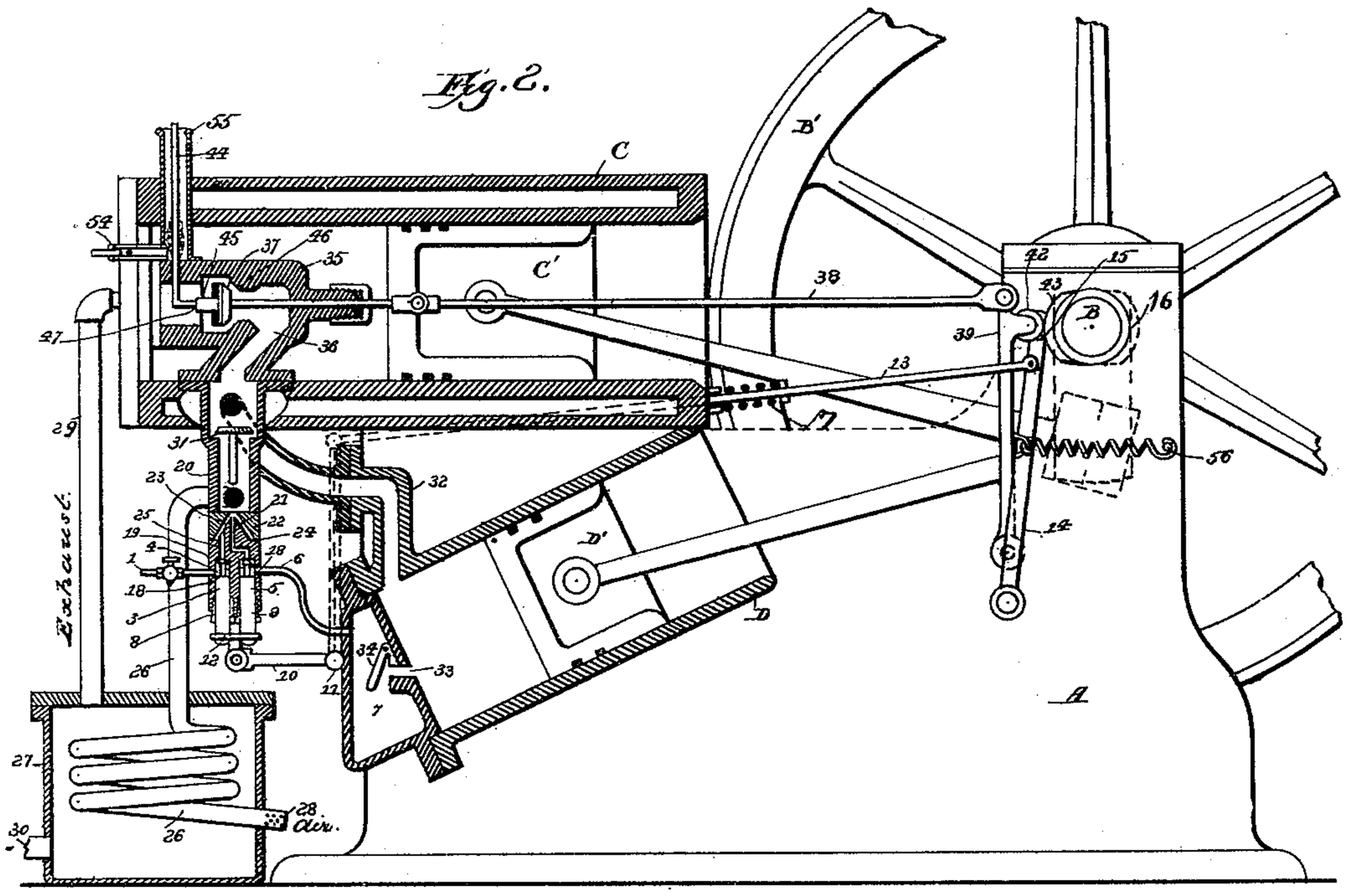


Fig. 1.

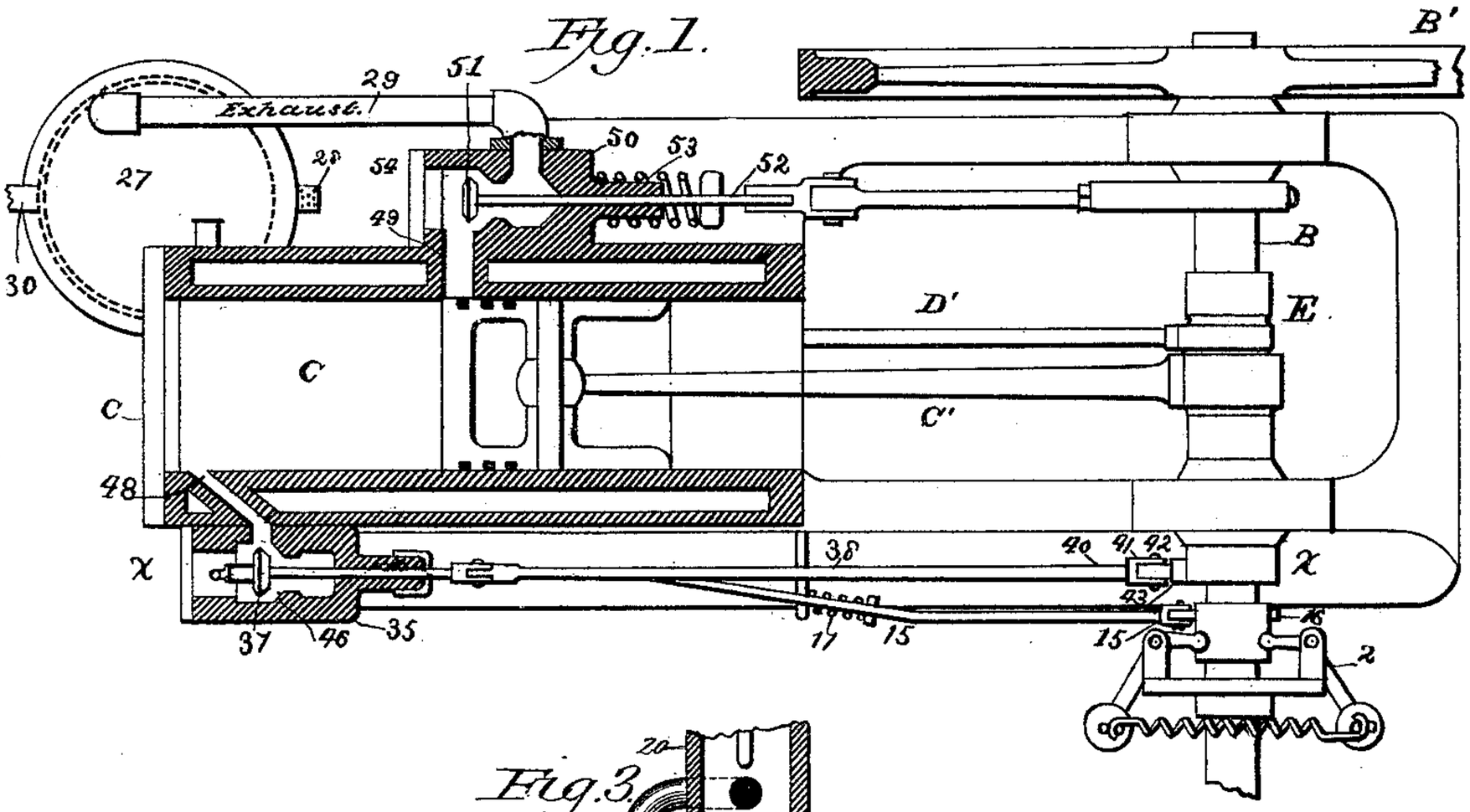
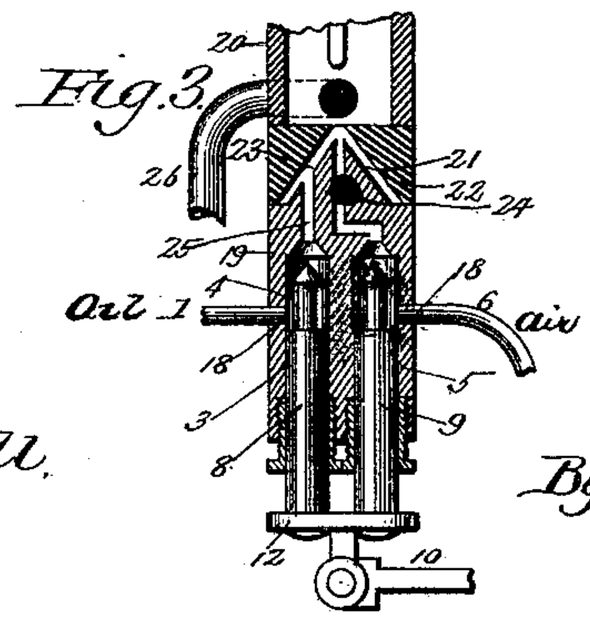


Fig. 3.



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UNITED STATES PATENT OFFICE.

JOHN CHARTER, OF STERLING, ILLINOIS.

HYDROCARBON OR GAS ENGINE.

SPECIFICATION forming part of Letters Patent No. 415,446, dated November 19, 1889.

Application filed September 27, 1888. Serial No. 286,618. (No model.)

To all whom it may concern:

Be it known that I, JOHN CHARTER, a citizen of the United States, residing at Sterling, in the county of Whiteside and State of Illinois, have invented certain new and useful Improvements in Hydrocarbon or 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, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

My invention pertains to certain improvements in hydrocarbon or gas engines; and it consists more especially, first, in certain novel mechanism adapted to vaporize petroleum or its products and intermix the same with heated air for the purpose of making an explosive mixture; second, in mechanism for transferring under proper conditions said mixture to and within the power-cylinder, and, third, in certain mechanism for igniting the explosive mixture within the power-cylinder.

In the drawings, Figure 1 is a plan view of an engine embodying my invention with the power-cylinder, ignition-valve box, and exhaust-chambers connected thereto in horizontal sections. Fig. 2 is a side elevation of the same with the supply and power cylinders and the intermixing and igniting apparatus in longitudinal vertical sections, but in different vertical planes, the section of said apparatus being in the line *x x* of Fig. 1 and in front of the residue of said Fig. 2. Fig. 3 is an enlarged sectional detail of one of the parts of the device.

A is the base of the machine. B is the rotating driving-shaft, suitably journaled in one end of said base and provided with the usual balance-wheel B′. C is the power-cylinder, suitably seated on said base in a horizontal position perpendicularly to the shaft B. D is the supply-cylinder placed on said base beneath the cylinder C, and with its closed end or head projected diagonally downward, as shown. The cylinders C and D are respectively provided with the pistons C′ and D′, the rods of which are pivotally attached at their outer ends to the usual elbow-crank E in the driving-shaft B.

I will now describe the first and second parts of my invention—that is, the vaporizing of the oil, its intermixture with the atmosphere, and the transferring of said mixture to the power-cylinder.

The oil is admitted through the supply-pipe 1, (shown in Fig. 2,) and which is suitably connected at its outer end to the oil-receptacle. (Not shown.) The inner end of the oil-supply pipe 1 communicates with the vertical oil-chamber 3 through the opening 4 in the adjacent wall of the latter. Alongside of and parallel with the oil-chamber 3 is formed a similar preliminary air-chamber 5, into which latter air is forced, as hereinafter described, through the pipe 6, which forms a connection between the chamber 5 and the pocket or chamber 7, formed on the inner end of the supply-cylinder D. Vertical plungers 8 and 9 are fitted to reciprocate, respectively, in the oil and air chambers 3 and 5, and are operated by means of a bell-crank lever 10, pivoted at its angle 11 to the base A, and having its shorter and horizontal portion pivotally connected at its free end to a head 12, to which the lower ends of the plungers 8 and 9 are attached. The lever 10 is actuated by means of a substantially-horizontal pitman 13, pivotally attached at its inner end to the upper end of the vertical portion of said lever 10 and at its outer end to the vibrating vertical arm 14, which latter is pivoted at its lower end to the base A, and is provided at its upper end with the friction-roller 15, adapted to be intermittently engaged by a cam 16, suitably formed upon one side of the shaft B, Fig. 1. In the revolution of the shaft B the cam 16 is intermittently forced against the upper end of the arm 14, oscillating said arm inward, and thereby, through the medium of the pitman 13, forcing the plungers 8 and 9 downward. The roller 15, when not engaged by the cam 16, is held outward and in contact with the normal portion of the shaft B by means of a coiled spring 17, suitably seated on the pitman 13 or in any other obvious mode, and when the friction-roller is in contact with merely the normal periphery of the shaft B the plungers 8 and 9 are held

by spring 17 at the limit of their inward or upward stroke. A portion of the upper ends of the plungers 8 and 9 are cut away circumferentially, so as to form annular shoulders 18 thereon. The plunger 8 performs the function of regulating the supply of oil, the passage of the latter into the chamber 3 being suspended by the spring 17, holding plunger 8 at its instroke whenever roller 15 is drawn out on shaft B by governor 2 far enough to miss cam 16. The operation of governor 2 here is the same as that described in United States Patent No. 356,447, granted to me January 25, 1887.

The cylinder 19, which contains the oil and air chambers 3 and 5, is seated directly under the secondary mixture-chamber 20. In the base of the chamber 20 there is centrally formed the conical-shaped annular opening 21, having its apex upward and communicating with chamber 20. The upper end of the cylinder 19 is also provided centrally with the conical projection 22, conformable to the opening 21, but of a less circumference throughout, so that between the conical upward projection 22 of the cylinder 19 and the opening 21 in the base of the chamber 20 there remains an annular upwardly-converging space or recess 23, which is closed at its lower ends by the outer and horizontal portions of the cylinder 19 and base of chamber 20, being held in close contact.

Admission of the air from the upper end of the air-chamber 5 to the apex of the recess 23 is afforded by a channel 24, which has its entrance in the upper end of the air-chamber 5 and its exit through the top of the cone 22. The oil is drawn into the recess 23 through the channel 25, beginning at the upper end of the oil-chamber 3 and ending in the recess 23, near the adjacent base of the cone 22. The conformation of the upper ends of the plungers 8 and 9, respectively, is such that when said plungers are at the limit of their upward stroke the larger circumferences of said plungers respectively cut off and seal the oil and air entrances to the chambers 3 and 5, and at the same time the upwardly-projecting smaller ends of said plungers respectively seal the entrance of the air and oil channels 24 and 25, thus doubly and more effectually preventing the passage of any air or oil during the interval that said plungers remain at the limit of their upward stroke. The oil and air are preliminarily brought into mutual contact in the conical recess 23, and are then admitted through the conical opening 21 to the secondary air-chamber 20, where they meet the secondary supply of air admitted into said last-named chamber through the main air-supply pipe 26, where said oil is subsequently thoroughly and finally vaporized and by admixture with the air formed into an explosive compound. The upper end of the air-pipe 26 communicates, as aforesaid, with the chamber 20, and is coiled at its lower portion within the air-heating box 27, and its extreme lower end 28 projected through the wall of the box 27 and perforated for the admission of the outside atmosphere. The air is heated during transmission through the box 27 by the products of combustion expelled from the cylinder C through the exhaust-pipe 29 into said box 27 and allowed to escape from the latter through the exit 30. This preliminary heating of the air I find to be very efficient in facilitating the vaporizing of the oil and its thorough mixture with the air. In the upper end of the chamber 20 is seated the automatic valve 31. Communication from the chamber 20 to the supply-cylinder D is afforded through the connecting-tube 32, which communicates at its upper end with the chamber 20 above the valve 31 and at its other end with the cylinder D near the inner end of the latter.

The mixture of the oil and air is accomplished by the following mechanism: A pocket 7 is formed exteriorly on the inner end or head of the supply-cylinder D, and in the head of the cylinder D (which in this case forms a partition between said cylinder and the pocket 7) there is formed a substantially-central opening 33, on the back side of which there is seated the automatic valve 34, opening toward the pocket. The inward stroke of the piston D′ in forcing the explosive mixture into the power-cylinder C also forces a proportion of said mixture through the opening 33 into the pocket 7 with a degree of compression considerably greater than the normal pressure of the atmosphere. During the period that said gaseous mixture is being forced into said pocket 7 communication between the air-pipe 6 and air-chamber 5 is suspended by the air-plunger 9. On the outstroke of the supply-piston D′ the valve 34 automatically closes, and there thereby remains in the pocket 7 and preliminary air-supply pipe 6 a portion of the gaseous mixture under great compression. Immediately after the start of the supply-piston D′ upon its outstroke the oil and air plungers 8 and 9 are withdrawn by pitman 13, and the exit end of the air-tube 6 thereby opened. The compression under which the contents of pocket 7 and air-pipe 6 are held automatically forces, during the initiative of the outward stroke of the supply-piston D′, a sufficient portion of said contents into and through the air-chamber 5 and upwardly through the air-channel 24, conical recess 23, and opening 21 with such force and velocity as to coincidently suck or draw with said air the oil up through channel 25. When the oil is brought in contact with the aforesaid swift current of air, it is by the latter broken into fine particles and carried with and by said current of air and discharged with it through the opening 21 into chamber 20 in the form and character of a fine spray, completely filling chamber 20, where it is thoroughly vaporized and mixed with the heated air delivered through pipe 26, and this prepared mixture is from

thence drawn through the valve 31 and tube 32 into the supply-cylinder D during the residue of the outstroke of the supply-piston D′. The injection aforesaid through opening 21 is with such force that when it meets in chamber 20 the air admitted thereto through pipe 26 there occurs a complete vaporizing of the oil and an instantaneous and thorough mixture of the charge. One important advantage of this mode of taking up the oil consists in the fact that the latter is at no time under any degree of compression. An additional pump or other means may be readily substituted for the aforesaid automatic discharge through pipe 6. Neither is the specific form of recess 23 essential; but my invention in this behalf consists in sucking the oil by and into contact with a swiftly-projected current of air, and thus disintegrating the oil.

As in the operation of the machine, for the purpose of regulating the same, the supply of oil is sometimes entirely suspended, it will result that the contents aforesaid of pocket 7 will at times be substantially pure air, while during the injection of the oil such contents will be a mixture of substantially the same character as that finally driven into the power-cylinder for the purpose of explosion. One prominent advantage of the construction last described arises from the fact that the preliminary contact of the oil and air for the next succeeding charge is effected during the first part of the outstroke of the supply-piston D′, and has its initiative substantially automatically and independent of the action of said supply-piston.

The charge of explosive mixture is compressed in the supply-cylinder D and transferred from the latter to the power-cylinder C, and there ignited by the following-described mechanism: The explosive mixture after being drawn into the supply-cylinder D by the outstroke of the piston therein is partially compressed by the instroke of the latter, and when such compression has advanced to a certain degree the compressed mixture is driven by the further instroke of said supply-piston D′ into the power-cylinder and ignited therein as follows: Above the secondary mixture-chamber 20 there is provided the valve-box 35, with which the upper portion of the mixture-chamber 20 communicates by means of an indirect channel 36. In the valve-box 35 is seated the double-acting valve 37, opened positively and in line with the cylinder C by the valve-rod 38. The outer or actuating end of the valve-rod 38 is pivotally attached to a vertical oscillating arm 39, pivotally attached at its lower end to the base A and provided at its upper end with the friction-roller 42, adapted to be intermittently engaged by a cam 43 on the shaft B, and thereby impart an oscillating movement to said arm 39 and a reciprocal movement to said rod 38. When the valve 37 is driven by the rod 38 toward the head of the cylinder C, entrance 36 to the valve-box 35 is opened and the explosive mixture admitted to said box from the supply-cylinder D. A small ignition-tube 44 is projected from above down through the case of the valve-box 35 to a point opposite the center of the valve 37 and there deflected at right angles toward said valve-box, so as to communicate with the inner end of the horizontal recess 47, formed in the adjacent end of said valve-box. The upper portion of the tube 44 is closed, and about midway of its vertical portion said tube is exposed to the flame of the Bunsen burner 54 and thereby kept at the point of contact with the flame of said burner in a red-hot condition.

On the inner side of the valve 37 there is centrally formed a projection or stopper 45, conformable to recess 47, and adapted to be intermittently driven therein by rod 38 and suspend communication from said ignition-tube 44 to the valve-box 35 when the valve 37 shall have been forced back from the adjacent end of the channel 36, it being understood that at the junction of the channel 36 with the valve-box 35 there is formed a seat 46 for said valve 37, and that valve 37 is held on seat 46 by a coiled draw-spring 56, attached to arm 39 and base A, and that the valve-rod 38 unseats the valve 37 from the seat 46 and seats the stopper 45 in the recess 47, leading from said valve-box into the ignition-tube 44. During the initiative compression of the explosive mixture in the supply-cylinder D the stopper 45 is held in the recess 47 and the transmission of ignition from tube 44 to valve-box 35 prevented. The explosive mixture is meanwhile driven by the instroke of the supply-piston D′ through the tube 32 to valve-box 35, (valve 31 closing,) and through the channel 48 from said valve-box to the cylinder C, and is finally compressed in the latter by the joint action of the incoming pistons C′ and D′. When the charge is sufficiently compressed and ready for ignition, the stopper 45 is withdrawn from the recess 47 and the valve 37 seated oppositely on seat 46 by spring 56. The stopper 45 is fitted into recess 47 sufficiently loose to permit the forcing into said recess and tube 44 of a portion of the explosive mixture during the process of compression of the charge within cylinder C, which portion passes into said recess around the periphery of stopper 45 by the pressure of said compression; but the space between the periphery of the stopper 45 and the walls of the recess 47 is too small to permit the ignition or flame to escape from said recess into valve-box 35 until the stopper 45 is withdrawn from said recess. As said portion of the charge during the loading of cylinder C is forced as aforesaid into recess 47 and tube 44, it is ignited within the latter and ready to follow the withdrawal of said stopper and burst into valve-box 35 and instantly ignite the charge in cylinder C immediately upon the entire withdrawl of stopper 45 from recess 47. As the movement of stopper 45 will

always be proportioned to that of the residue of the engine, I am enabled to positively and accurately fix the instant when the charge in cylinder C shall be fired and prevent premature explosions, however fast or slow the engine may be working. The firing is required to be substantially instantaneous, and the difficulty heretofore has been to have it sufficiently so without experiencing premature firing, particularly in starting the engine, or when the latter should be working slowly. It is obvious that recess 47 may consist of the end of tube 44 and the stopper 45, adapted to reciprocate therein. An opening from ignition-tube 44 into valve-box 35 can be optionally placed in the side or top of the latter and be opened and closed by the periphery of valve 37. A casing 55 is seated on valve-box 35 around the ignition-tube 44 to protect the latter. The exhaust-port 49 on the cylinder C affords an escape for the products of combustion in a manner substantially similar to that described in my United States Patent No. 356,447, granted January 25, 1887, said products of combustion passing through the exit-port 49 into the valve-box 50, and from thence into the communicating tube 29. A positive valve 51 is intermittently seated by the spring 53 on its rod 52 and intermittently opened by the eccentric or cam connection of its rod 52. The spring 53 closes the communication between the exit 49 and the valve-box 50 during the outstroke of the piston C′, and said communication is opened by said rod 52 about the limit of the outstroke of said piston C′, when the instroke of said piston forces the product of combustion out through the valve-box 50 and tube 29 aforesaid.

What I claim as my invention, and desire to secure by Letters Patent of the United States, is—

1. The combination of the cylinder D, provided with the opening 33 in the head thereof, valve 34, pocket 7, piston D′, air-tube 6, air-chamber 5, recess 23, air-channel 24, and air-plunger 9, and means, substantially as shown, for operating said plunger, for the purpose described.

2. The combination of the cylinder D, provided with the opening 33 in the head thereof, valve 34, pocket 7, piston D′, air-tube 6, air-chamber 5, recess 23, air-channel 24, and air-plunger 9, oil-chamber 3, oil-entrance 4, and means, substantially as shown, for operating plunger 9, for the purpose described.

3. The combination of the supply-cylinder D, provided with the piston D′ and opening 33 in the head of said cylinder, the pocket 7, tube 6, air-chamber 5, plunger 9, air-channel 24, recess 23, oil-chamber 3, oil-plunger 8, and means for operating said plungers, tube 29, chamber 20, and tube 32, substantially as shown, and for the purpose described.

4. The combination of the supply-cylinder D, provided with piston D′ and opening 33 in the head of said cylinder, pocket 7, tube 6, air-chamber 5, plunger 9, air-channel 24, recess 23, oil-chamber 3, means for operating said plunger, tube 29, chamber 20, and tube 32, valve-box 35, channel 36, valve 37, recess 47, stopper 45, means for positively actuating said valve 37, ignition-tube 44, and burner 54, substantially as shown, and for the purpose described.

5. In a hydrocarbon or gas engine, the combination of a compressing pump or cylinder, a pocket or reservoir 7, the intercommunicating opening 33, valve 34, mixture-chamber 20, intermittent communication between said reservoir and said chamber, oil-passage opening into said communication, and means for intermitting said communication, substantially as shown, and for the purpose described.

6. In a hydrocarbon or gas engine, the combination of the chamber 20, provided with opening 21, means for injecting therein the oil and air, secondary air-tube 26, and means for intermittingly injecting said oil and air into union with said secondary supply of air, for the purpose described.

7. The combination of the ignition-tube 44, means for heating the same, valve-box 35, provided with valve-seat 46 and recess 47, double-acting valve 37, provided with stopper 45, means for actuating said valve, channels 36 and 48, and cylinder C, substantially as shown, and for the purpose described.

8. The combination of the power-cylinder C, valve-box 35, communicating therewith, induction-channel 36, valve 37, intermittently seated thereon and provided oppositely with stopper 45, ignition-tube 44, recess 47, communicating with said valve-box and adapted to be intermittently plugged by stopper 45, and means, substantially as shown, for operating said valve, for the purpose described.

9. In a hydrocarbon or gas engine, the combination of an ignition-passage provided with an opening or chamber at its communication with the explosive charge, adapted to receive a reciprocating plug or stopper, a stopper adapted to reciprocate in said chamber, an interval between said stopper and the wall of said chamber sufficiently large to permit the passage of the explosive mixture within said chamber while said stopper is seated therein, but too small to allow the flame to escape from said chamber until said stopper is withdrawn therefrom, and means for reciprocating said stopper, for the purpose specified.

10. The combination of the supply-cylinder and piston, the pocket 7, communicating with said cylinder through the opening 33, the valve 34, the plungers 8 and 9, moving, respectively, in the chambers 3 and 5, the bell-crank lever, rod, and cam, whereby said plungers are operated simultaneously at proper times by the rotation of the main shaft, the chamber 20, communicating with the cylinder D, the valve 31, cutting off said communication, the heating-box 27, receiving the pro-

ducts of combustion of the machine, and the hot-air pipe 26, with its lower portion coiled in said box, having the perforated projecting lower end 28, and with its upper end communicating with the chamber 20 below the valve 31, substantially as specified.

11. The combination, with the cylinder C and compressing-piston C′, of the ignition-tube 44, the Bunsen burner 54, valve-box 35, communicating with the cylinder C and having the recess 47, that communicates with the ignition-tube, the valve-seat 46, double-acting valve 37, means, substantially as described, whereby said valve is actuated, and the stopper 45, fitting loosely enough in the recess 47 to permit the gaseous mixture to enter the ignition-tube, but sufficiently tight to prevent the burning gas in said tube from firing that in the cylinder.

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

JOHN CHARTER.

Witnesses:
JOHN G. MANAHAN,
GEO. H. HANNAN.