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W. L. CROUCH & E. E. PIERCE.

GAS ENGINE.

No. 535,815. Patented Mar. 19, 1895.

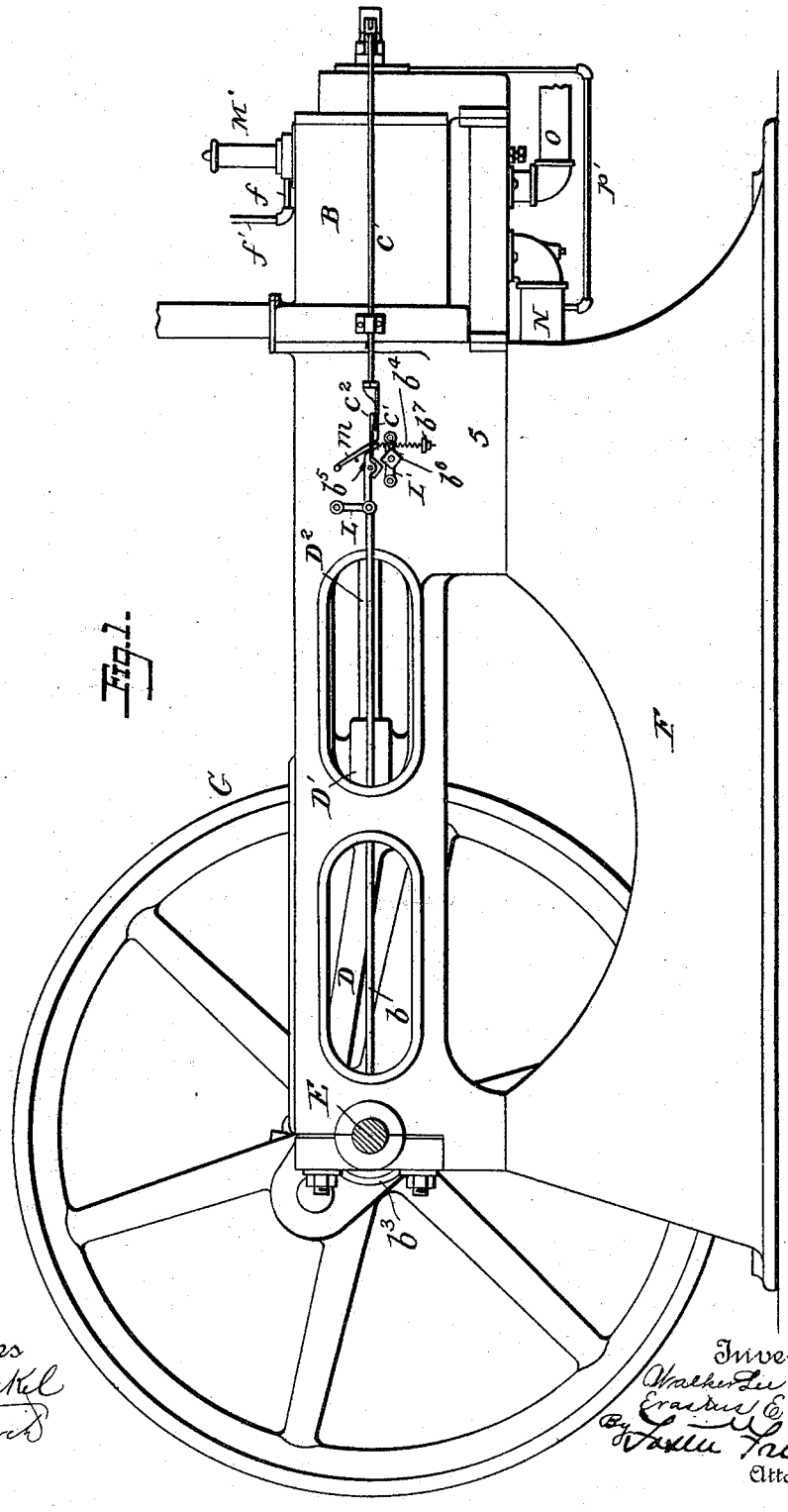

Fig. 1.

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GAS ENGINE.

No. 535,815. Patented Mar. 19, 1895.

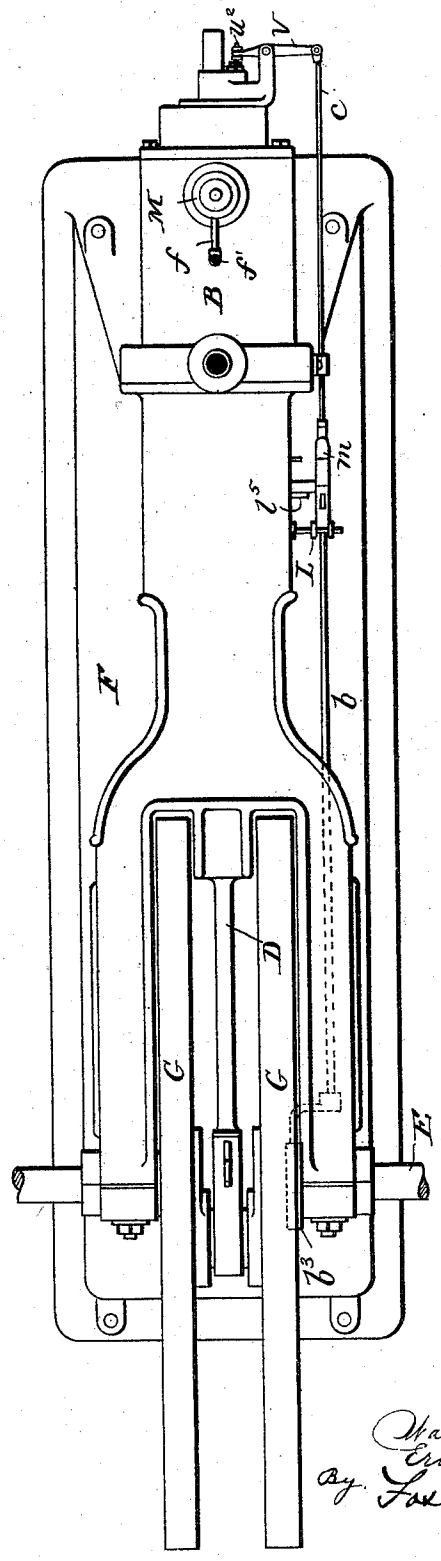

Fig. 2.

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GAS ENGINE.

No. 535,815. Patented Mar. 19, 1895.

Fig. 3.

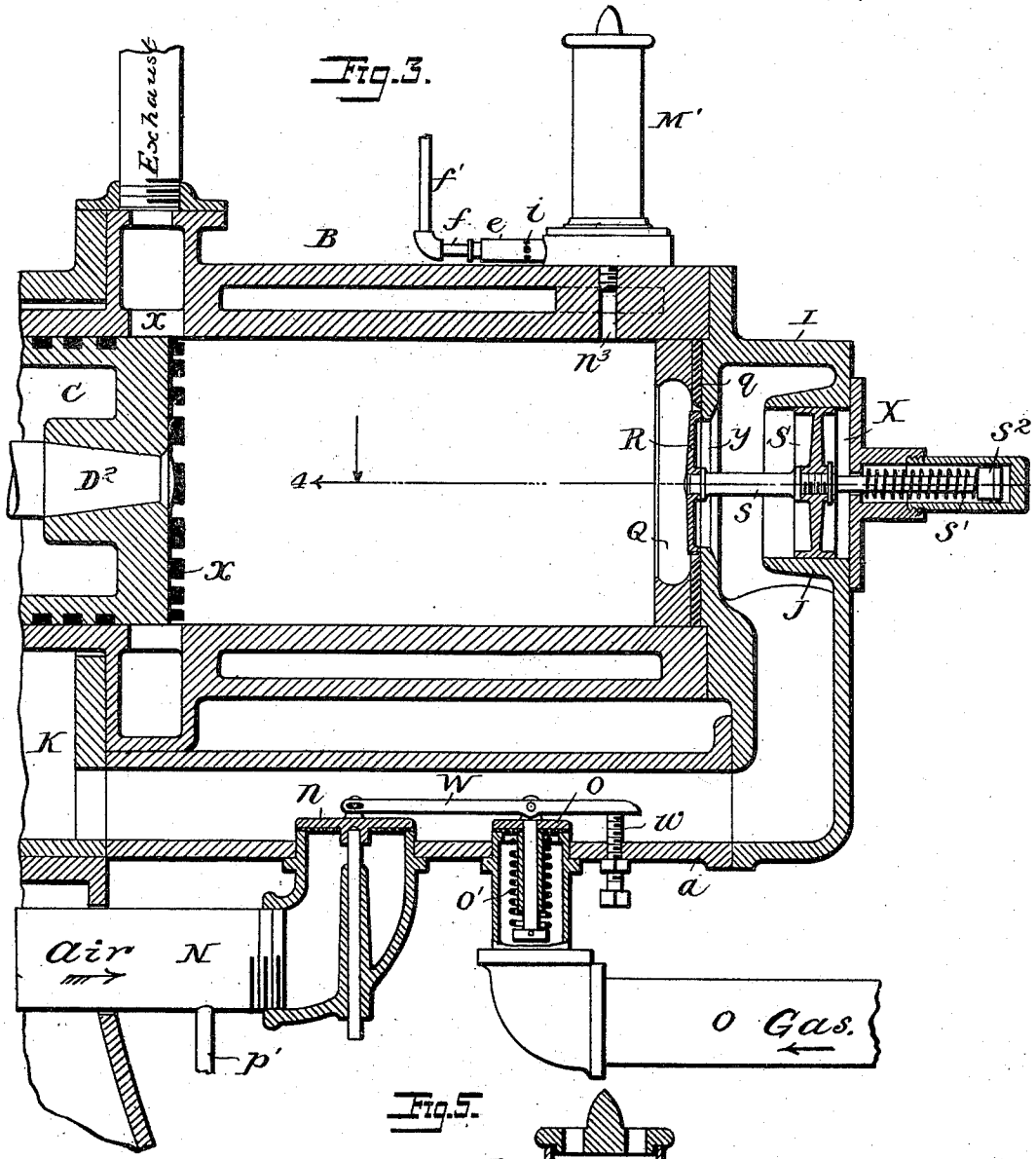
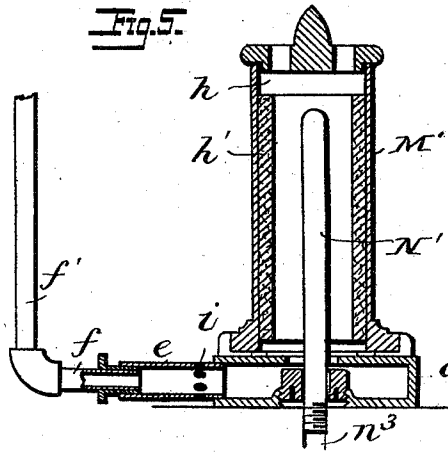


Fig. 5.



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No. 535,815. Patented Mar. 19, 1895.

Fig. 4.

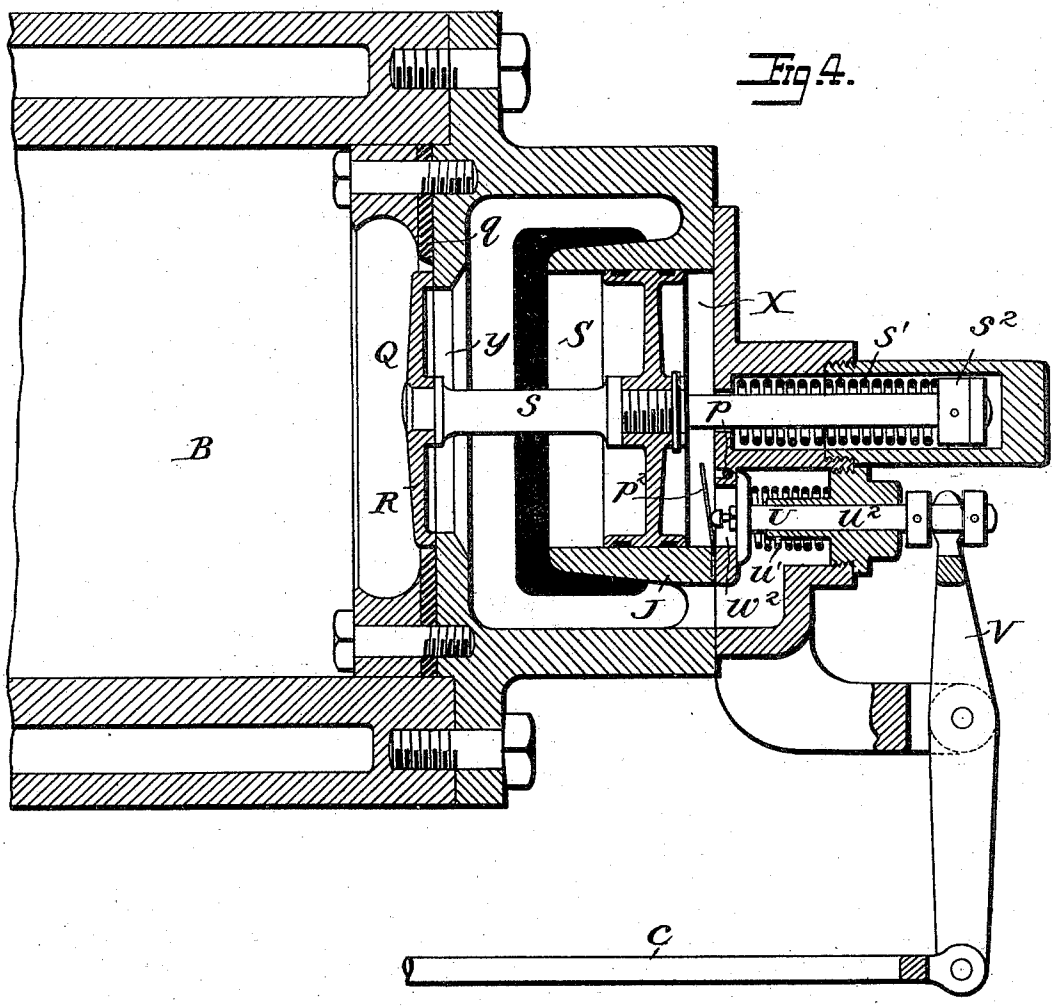
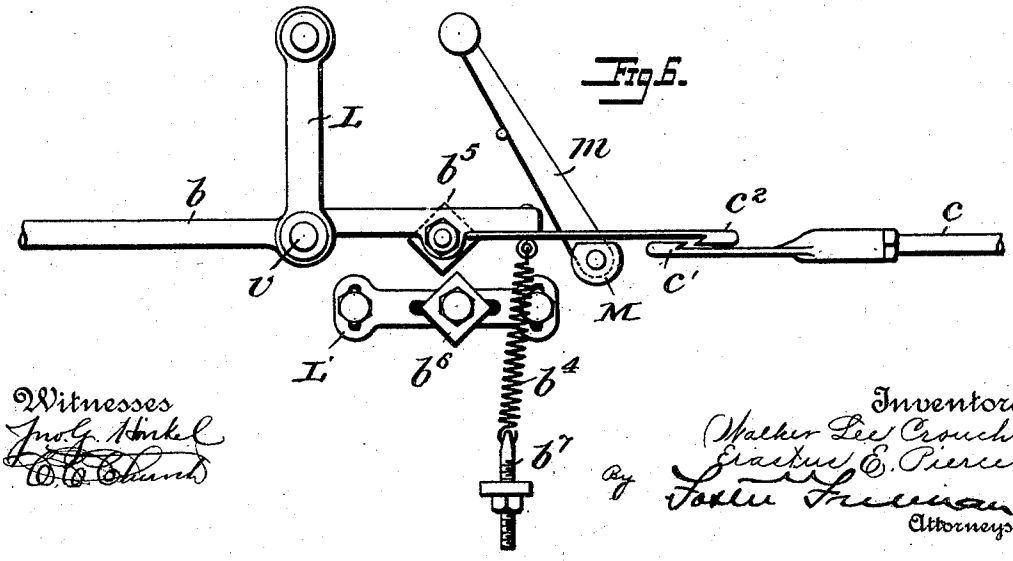


Fig. 5.



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UNITED STATES PATENT OFFICE.

WALKER LEE CROUCH AND ERASTUS E. PIERCE, OF NEW BRIGHTON, PENNSYLVANIA.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 535,815, dated March 19, 1895.

Application filed January 9, 1894. Serial No. 496,274. (No model.)

To all whom it may concern:

Be it known that we, WALKER LEE CROUCH and ERASTUS E. PIERCE, citizens of the United States, residing at New Brighton, in the county of Beaver and State of Pennsylvania, have invented certain new and useful Improvements in Gas-Engines, of which the following is a specification.

Our invention relates to that class of gas engines in which the piston is propelled by the explosions of explosive charges of gas and air successively admitted to the working cylinder and ignited therein; and our invention consists in constructing the engine and in governing and regulating the charges as fully set forth hereinafter and as illustrated in the accompanying drawings, in which—

Figure 1, is a side elevation of a gas engine embodying our improvements. Fig. 2, is a plan view. Fig. 3, is an enlarged sectional elevation. Fig. 4, is an enlarged sectional plan on the line 4—4, Fig. 3. Fig. 5, is a sectional elevation of the igniter. Fig. 6, is an enlarged view of the governing devices.

The foundation F, of any suitable construction supports the frames having bearings for the crank shafts E, supporting the fly-wheel or wheels G, and also having guides for guiding the cross-head D′, to which are connected the connecting rod D, and the piston-rod D^2, and the piston C, which plays back and forth in the water jacketed cylinder B. The forward end of the cylinder B, beyond a series of exhaust ports *x*, constitutes a pump-cylinder, while the rear portion constitutes the working cylinder of the engine, and the pump cylinder communicates in any suitable manner with a chamber K, at the forward end, and at the rear end the said chamber K, has a communication with the working cylinder B, through a central opening *y*, to which is fitted a valve R. As shown the chamber K, is in a casing 5, partly inclosing the cylinder. A gas inlet pipe O, and an air inlet pipe N, communicate with the chamber K, through ports closed by valves *o*, *n*, each opening upwardly and each connected to a lever W, having an adjustable bearing near one end, consisting, as shown, of a threaded pin *w*, extending into the chamber K, through the shell of the casing *a*, inclosing said chamber. The valve *o*, has a downwardly extending stem surrounded by a coiled spring *o*′, which tends to maintain the valve *o*, upon its seat, and the valve *n*, may also have a spring if desired. The gas port is smaller than the air-port and the bearing *w*, is normally set at a short distance below the lower edge of the lever W, so that when the piston C, moves backward the air-valve *n*, will first be lifted to a limited extent, admitting a certain portion of air before the gas valve is lifted, the extent to which the air valve is opened before opening the gas valve depending upon the amount of play permitted by the adjustment of the bearing *w*. By this means we are enabled to regulate the relative proportions of gas and air to any desired extent. The bearing *w*, may if desired, be adjusted so as to cause both valves to open simultaneously.

On its forward stroke the piston C, compresses the mixtures in the chamber K, where it will remain until the piston has passed the exhaust ports *x*, inasmuch as the pressure in the working cylinder, until the exhaust is opened, is much greater than that in the chamber K, and maintains the valve R, upon its seat. When, however, the piston uncovers the exhaust ports the pressure in the working cylinder is at once reduced to about atmospheric pressure, or to such an extent that under normal conditions the pressure in the chamber K, would open the valve R, permitting a new charge to enter the cylinder, which charge is compressed as the piston starts on its backward stroke. It is not always desirable, however, to have a new charge admitted to the cylinder at each outward stroke of the piston as for instance when the engine is running unloaded or at too high a speed, and we therefore combine with the valve R, automatic appliances which will cause it to be either opened or remain closed as may be necessary for the most effective and economical results. To this end we combine with the valve R, a counterbalancing piston S, which may slide in a short cylinder J, as shown, or

the said piston may be in the form of a diaphragm. In the construction shown, the piston S, is arranged within a casing I, constituting a part of the casing that incloses the chamber K, the cylinder J, being open at the forward end or otherwise communicating with the chamber K, and the piston S, being upon the stem s, of the valve R, the said stem extending to the rear and being provided with a collar s^2, against which bears a coil spring s', that tends to carry back the stem and piston and valve to the position shown in Fig. 4.

The chamber X, at the rear of the piston S, communicates with the chamber K, through a port w^2, which is closed by a valve U, so that normally the chambers K, X, do not communicate. With the valve R, thus combined with a piston or diaphragm S, the reduction in pressure in the working cylinder from the uncovering of the exhaust ports will not necessarily cause the valve R, to open the port y, because the pressure in the chamber K, upon the rear face of the valve R, is balanced by the pressure upon the forward face of the piston S, and the latter, if desired, may be of greater diameter than the valve to secure an overbalancing tending to keep the valve closed, and in addition there is the pressure of the spring s'. If, however, the port w^2, is opened the pressure upon one side of the piston S, is counterbalanced by that upon the opposite side, so that there is nothing to longer counter-balance the back face of the valve R, except the spring S', which readily yields to the pressure on the valve permitting the latter to open and a new charge to pass into the cylinder. It will therefore be seen that the valve R, may be caused to open or remain closed by balancing or unbalancing the piston or diaphragm S, and that this may be effected by opening or closing the port w^2, forming the communication between the chamber X, and the chamber K. It therefore becomes necessary to open or close the valve U, accordingly as the variations in the load and of the speed of the engine render adjustments of the valve R, necessary. To this end we combine with the valve U, suitable automatic means for shifting it. As shown, the valve U, is moved in one direction by a coiled spring u', and the stem u^2, extends through the casing and is connected with one end of a lever V, to the opposite end of which is connected a sliding rod c, sliding in guides at the side of the frame and provided at its forward end with an angular projection or hook c'. This hook c', is arranged adjacent to a similar hook c^2, upon the end of a rod b, which extends to a strap upon an eccentric b^3, upon the shaft E, which imparts a reciprocating motion to the rod b, and hook c^2. In connection with these hooks we employ mechanism of any suitable character whereby the hooks are caused to engage each other and open the valve U, when it is required to admit successive charges and to prevent the engagement of the hooks so as to maintain the valve U, closed when it is desired to reduce the speed or power of the engine. The said mechanism may be constructed in different ways but we prefer that which is illustrated in Figs. 1, 2 and 6. As shown in such figures the rod b, is supported near its rear end by a swinging link L, and said rod carries a lug or projection b^5, square or having at the under side two faces at about right angles to each other, and corresponding to the two upper faces of a lug b^6, that is secured in a stationary position at the side of the frame. Preferably, however, one of these lugs, as the lug b^6, is adjustable, and as shown, said lug is carried by a bolt passing through a horizontal slot in a plate L', having also vertical slots for the passage of the bolts that secure it to the frame.

A spiral spring b^4, secured to the rod b, and to an adjustable eye-bolt b^7, tends to draw down the end of the rod b, and this end of the rod is jointed, at v, to the main portion of the rod, as shown, so as to permit a vertical movement of the hook c^2. As the result of this construction, if the engine is moving slowly, and the hook c^2, moving toward the shaft E, the forward face of the projection or toe b^5, will strike the rear face of the opposite toe and the end of the rod and its hook c^2, will be lifted until the points of the toes pass each other after which the end of the rod and the hook c^2, will descend, the hooks will engage and the valve U, will be opened. If, however, the engine is moving so rapidly that it is not desirable to continue the introduction of the charges, the toe b^5, on its forward movement, will be brought so forcibly in contact with the stationary toe that the hook c^2, will be thrown so high that it will not have time to fall low enough to engage with c', till after it has passed the point where it can engage with it and when it does fall it slides on c', but does not move it, and there will therefore be no movement imparted to the hook c', and the valve U, will not be opened.

By the use of a controlling valve U, and mechanism for putting the same into and out of connection with the moving part of the engine, we are enabled to readily start and arrest the movement of the engine by throwing the operating mechanism that moves the valve into and out of operation. Thus, we use a cam M, arranged beneath the hook c^2, and provided with a handle m, which may be shifted so as to lift the hook c^2, out of position to engage with the hook c', or to release it and permit it to engage with the hook c'.

When the engine is to be started the lever m, is thrown to the position shown in Fig. 6, when a single revolution of the crank shaft, by hand or otherwise, will serve to pump a body of mixed air and gas into the chamber K, at one stroke and at the next stroke a charge will be admitted to the cylinder. When it is desired to arrest the movement of the engine the handle is thrown to the right to lift the hook c^2, when it will reciprocate

without engaging the other hook, no further charges will be admitted to the cylinder, and the engine will come to a state of rest.

Any suitable igniter may be employed. We prefer, however, to make use of a tube igniter, the construction of which is best illustrated in Figs. 3 and 5. In said figures n^3, illustrates the ignition port at the top of the cylinder into which is screwed the lower end of igniting tube N′, which is closed at the upper end, and which is surrounded by the heater or furnace M′. This furnace consists of a base *d*, having a chamber communicating with a tube *e*, having air openings *i*, and receiving at its outer end a gas injecting nozzle *f*, communicating with the gas pipe *f′*. The mixed gas and air passes from the chamber in the base *d*, through an annular opening *g*, regulated by an adjustable plug *m′*, surrounding the tube N′, and into a surrounding casing *h*, having a lining of asbestos or other refractory material *h′*, and open at the upper end. We are thus enabled to discharge an annular flame of mixed gas and air against the igniting tube N′, at a point about one-third the length of the tube from its lower end heating it to such a degree as is sufficient to ignite the gases in the working cylinder. After each explosion the tube N′, will be filled with spent gases so that there will be no danger of igniting the fresh charge, when first admitted, when the piston is in its forward position, but as the piston moves to its rear position it so compresses the charge in the working cylinder, as well as the spent gases in the tube N′, that the fresh gases are carried to the ignition point and ignited, and the tube is so proportioned and the heater so arranged that this compression and ignition will only take place as the piston reaches its rear position.

To prevent the gases from leaking into the chamber X, back of the piston S, and thereby balancing the said piston prematurely we provide a contracted passage *p*, communicating through a pipe *p′*, with the air inlet pipe N, and this passage is closed by a flat spring valve p^2, so arranged that when the valve U, is closed a projecting end of the valve stem u^2, will bear against and open the valve p^2, and permit any gas that leaks into the chamber to pass to the air inlet pipe N. Of course the gas might escape into the air or be conducted to any other point, but by passing it into the air inlet pipe the gas is not only utilized, but danger and the objectionable smell that would result from permitting its escape are avoided.

To prevent the gases admitted under pressure into the working cylinder through the port *y*, and laterally from under the valve R, from passing directly to the walls of the cylinder and thence forward along the walls of the cylinder to the exhaust ports, thus enveloping and retaining a large core or plug of spent gases in the center of the cylinder through its whole length, as would be the case, we make use of a curved deflector Q, in the shape of a ring having a circular opening with an inner curved edge against which the gases strike as they flow from the back face of the valve R, and by which they are deflected and thrown inward toward the center of the cylinder, retarded in their forward flow and mixed together in contact with the heated parts of the cylinder so that they are not only prevented from escaping but are retained in contact with the heated surfaces and highly heated previous to ignition which secures a better explosive effect than would otherwise result.

To prevent the rear head of the cylinder from becoming too highly heated we interpose a packing *q*, between the deflector Q, and the cylinder head.

Without limiting ourselves to the precise construction and arrangement of parts shown and described, we claim—

1. The combination in a gas engine, of a cylinder, a reciprocating piston C, exhaust ports arranged to be uncovered by the piston at the end of its forward stroke, a chamber communicating at separate points with the gas and air inlet pipes, a communication between the chamber and the forward end of the cylinder, and a port at the rear end of the cylinder, and a valve closing the latter port, and means for controlling said valve by the action of a governor, substantially as set forth.

2. The combination of the cylinder, piston, independent chamber K, and gas and air inlet pipes, communicating with said chamber, and valves closing said pipes and arranged to open inwardly the said chamber, a port at the rear end of the cylinder communicating with said chamber and a valve closing said port, and means controlled by the governor for opening said valve, substantially as set forth.

3. The combination with the cylinder of a gas engine, chamber K outside of said cylinder and gas and air inlet pipes, of valves *n*, *o*, controlling the flow of gas and air into said chamber K a lever connected to both valves, a bearing *w*, and a spring or springs seating one or both of the valves, substantially as set forth.

4. The combination of a gas engine cylinder, chamber K communicating therewith the air and gas pipes N, O, valves *n*, *o*, for controlling the flow of gas and air into the chamber K spring *o′*, for seating one of the valves, lever W connected with both valves and an adjustable bearing *w*, substantially as and for the purpose set forth.

5. The combination with the cylinder and piston, of a gas engine, of an inlet port and valve, a chamber K, communicating with said port a counter-balancing piston in a cylinder J, communicating with said chamber at one end, and means for putting the opposite end of said cylinder J, into and out of communication with the said chamber, substantially as and for the purpose set forth.

6. The combination with the inlet valve R,

of a gas engine, of a counter-balancing piston connected therewith, a chamber K, containing explosive mixture, and a chamber X, at the opposite side of the piston communicating with the chamber K, through an opening closed by a valve, substantially as set forth.

7. The combination of a gas engine cylinder, a port at the rear end thereof, the valve R closing said port and a piston S arranged between two chambers K and X, the chamber K communicating with said port, a passage between the two chambers, a valve U, controlling said passage, and a governor controlling the position of the valve U, substantially as and for the purpose set forth.

8. The combination of the gas engine cylinder having a port closed by a valve R, a piston S, arranged between chambers K and X, a passage between the said chambers, valve U, controlling said passage, and an escape port p, leading from the chamber X, and provided with a valve substantially as set forth.

9. The combination with a gas engine cylinder, a port, a valve R closing said port counter-balance piston S, valve U, and port p, of a valve p^2, arranged to be struck by a projection on the valve U, when the latter is closed, substantially as and for the purpose set forth.

10. The combination with the controlling valve, of a governor device consisting of two hooked parts c', c^2, two angular engaging pieces b^6 b^5 one carried by the hooked part c^2 and arranged to throw the latter out of engagement with the part c' when the movement is unduly rapid, substantially as described.

11. The combination with the controlling valve of a gas engine, of a rod connected with said valve and provided with a hook, a reciprocating rod also provided with a hook capable of a vertical movement and carrying a toe with reverse double faces, a similar toe in a stationary position on the frame, one of said toes movable longitudinally and vertically, and all arranged substantially as set forth to throw the reciprocating hook out of position to engage the opposite hook when the toes are brought in contact at high speed, substantially as described.

12. The combination of the valve governing the pressure upon the inlet valve R, hook c', connected therewith, reciprocating hook c^2, and contacting toes, one of which is adjustable, substantially as and for the purpose set forth.

13. The combination with the hook c', connected with the governing valve, and reciprocating hook c^2, cam M, arranged to elevate the hook c^3 and means for adjusting the cam, substantially as and for the purpose set forth.

14. The combination with the igniting tube, of a casing, a base supporting the casing and inclosing a gas receiving chamber, and provided with a central opening, and an adjustable plug movable to and from said opening, substantially as set forth.

15. The combination with the inlet port and an inwardly opening valve at the end of the cylinder, of a deflector having a circular opening receiving said valve with a curved edge, arranged to surround the edge of the valve when the latter is open substantially as described.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

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ERASTUS E. PIERCE.

Witnesses:
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