W. J. WRIGHT.

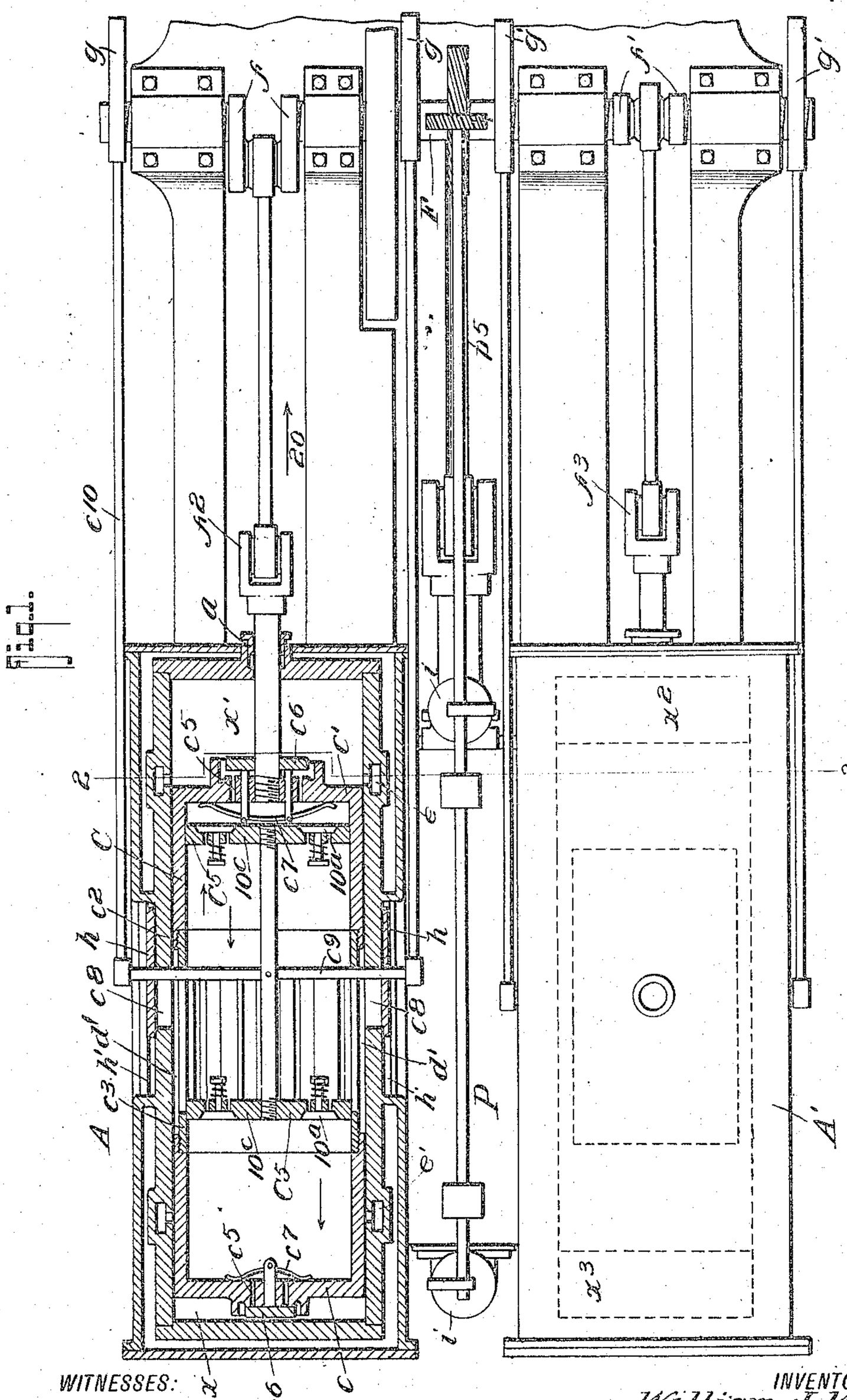
EXPLOSIVE ENGINE.

APPLICATION FILED FEB. 7, 1906.

936,972.

Patented Oct. 12, 1909.

3 SHEETS—SHEET 1.



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3 SHEETS—SHEET 2.

Fig. 2.

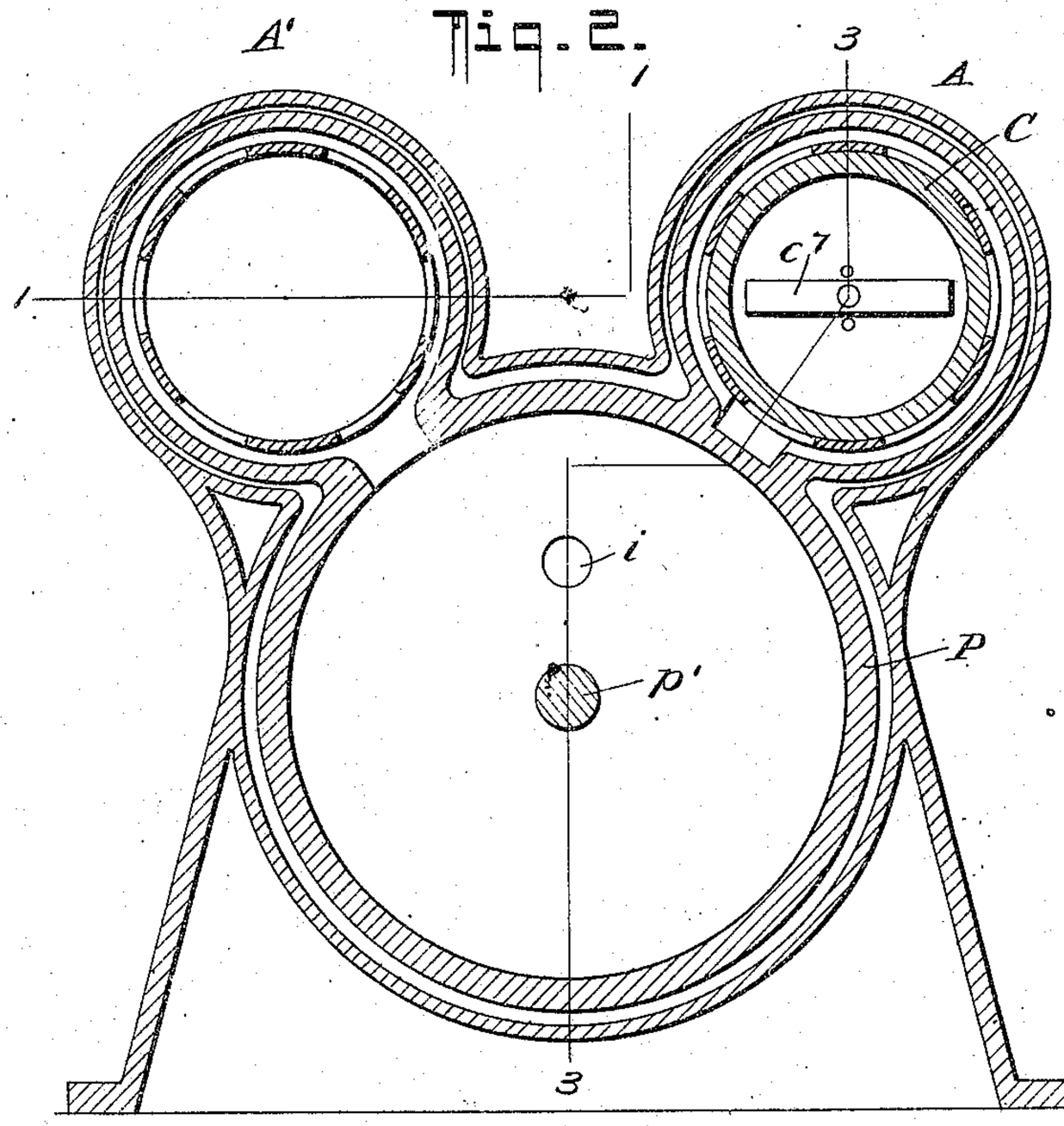
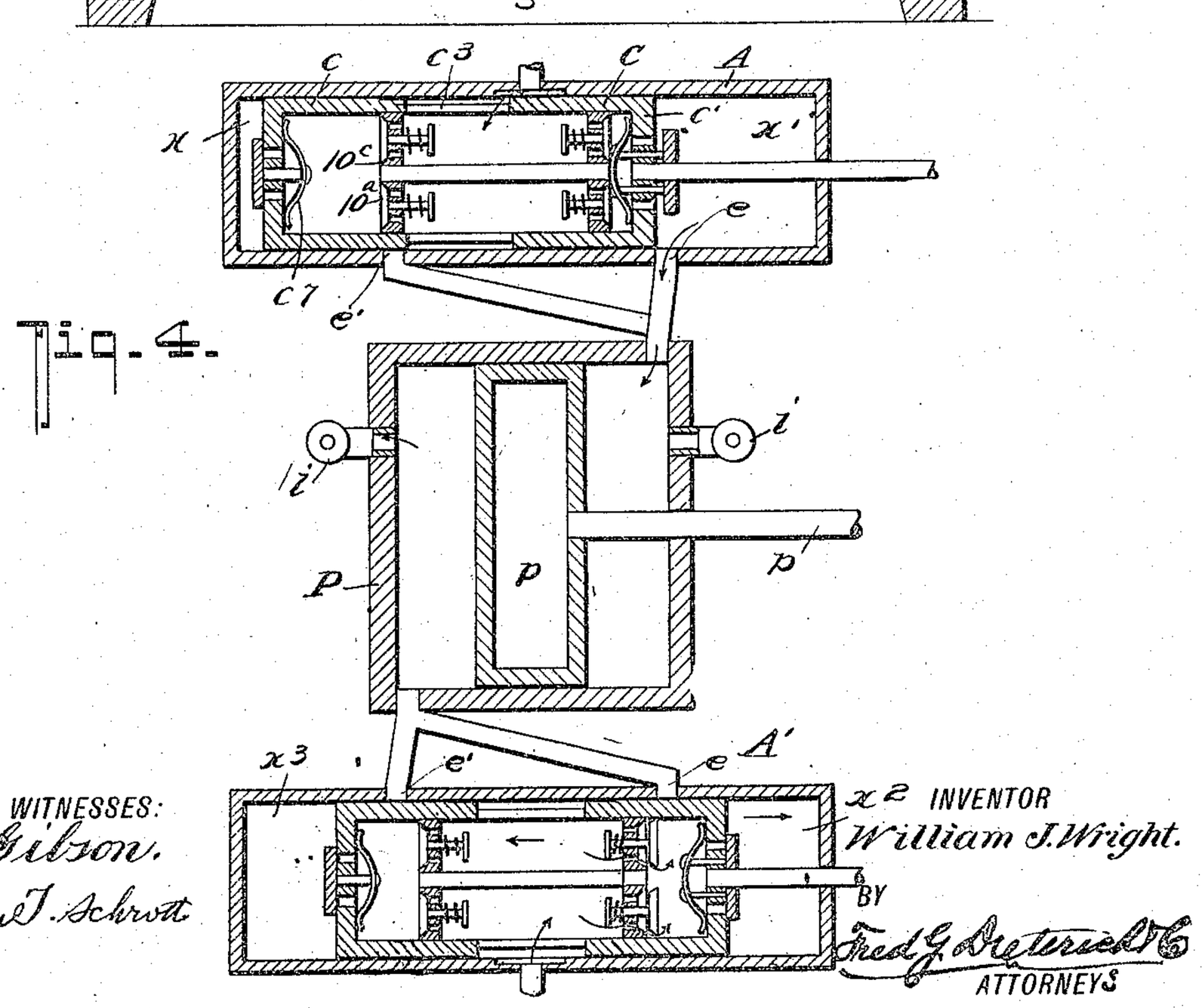


Fig. 4.



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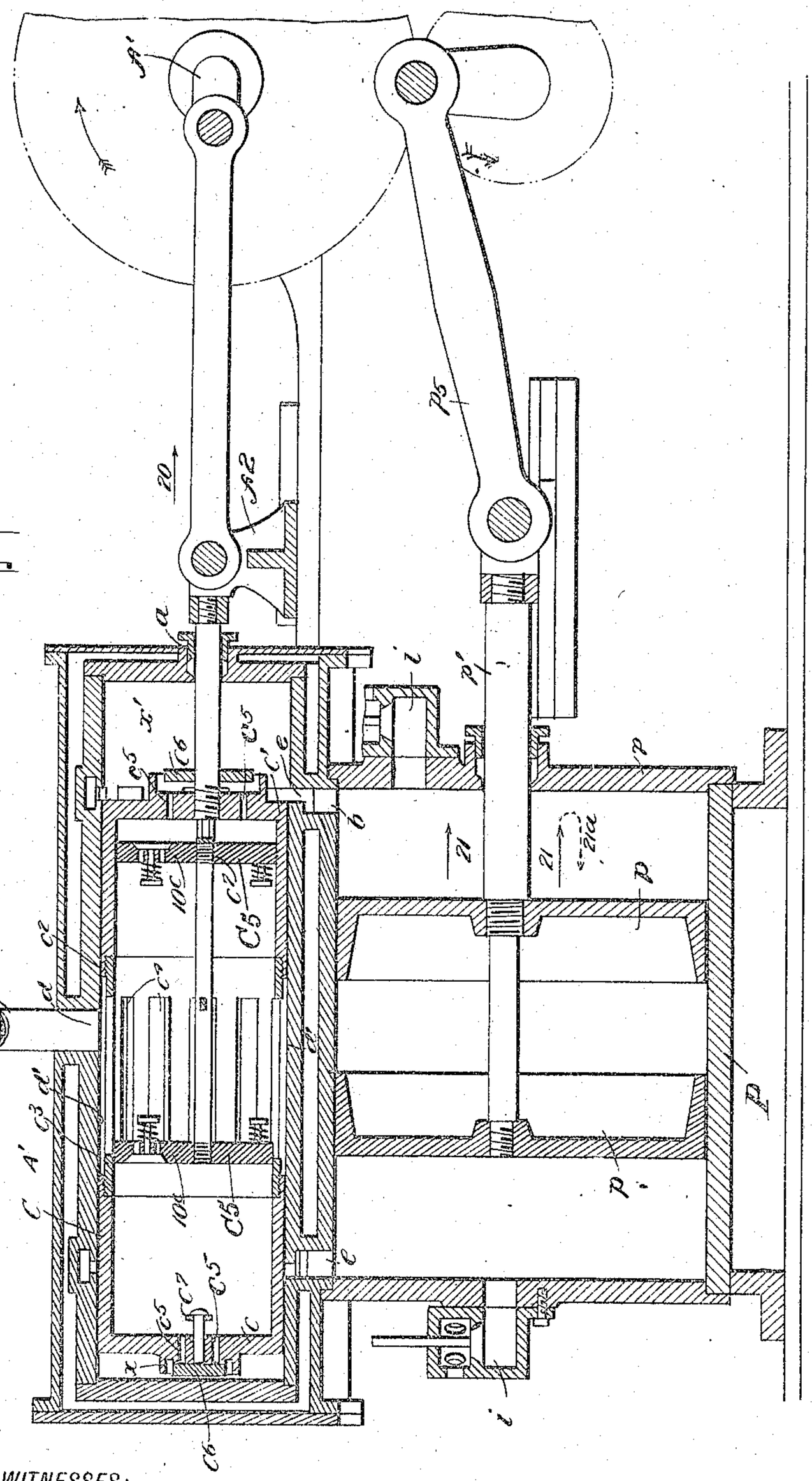
3 SHEETS—SHEET 3.

Fig. 3.



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UNITED STATES PATENT OFFICE.

WILLIAM J. WRIGHT, OF FRANKLIN, PENNSYLVANIA.

EXPLOSIVE-ENGINE.

936,972. Specification of Letters Patent. Patented Oct. 12, 1909.

Application filed February 7, 1906. Serial No. 299,891.

To all whom it may concern:

Be it known that I, WILLIAM J. WRIGHT, residing at Franklin, in the county of Venango and State of Pennsylvania, have invented a new and Improved Construction of Explosive-Engine, of which the following is a specification.

This invention relates to gas engines, and more particularly to that class known as "explosive engines" and the prime object of my present invention is to provide a compound engine of that type stated, which, compared with others of substantially the same type, will be simple and effective in construction, in which the operating parts are so designed and arranged as to provide for a great economy of fuel and for running the engine under such difficulties that in other engines of the type referred to would render their operation impossible, and in which the actuating parts operate in a practically noiseless manner.

Generically, my invention comprises two working cylinders having an explosion chamber in each end, which, with the fuel controlling and compressing means, are so combined that four explosions occur during each complete revolution of the shaft.

In its more subordinate features, my invention embodies a compound engine having two cylinders, each arranged with an explosion chamber at each end, a single intake for each cylinder, a double piston for each cylinder coöperatively combined with a supplemental piston, and an exhaust for each explosion end of the cylinder and a means for coupling the pistons of the two cylinders to a main drive shaft and for effecting reverse directions of movements to the main and supplemental pistons within their respective working cylinders, a single low pressure means including a single piston coupled with the two cylinders, means for effecting two movements of the piston during each stroke of the main and supplemental co-acting pistons within the working cylinder and a means for leading off the exploded charges in the working cylinders after their force has been spent on their respective working pistons to the opposite sides of the piston in the compounding cylinder and for utilizing the remaining force of the said exploded charges upon the said piston, and a further means for creating a vacuum in front of the piston at predetermined times.

In its more subordinate features, my invention consists of certain details of construction and peculiar combination of parts, all of which will be hereinafter fully explained, pointed out in the appended claims and illustrated in the accompanying drawings, in which,

Figure 1, is a horizontal section of my improved compound engine on the line 1—1 on Fig. 2. Fig. 2, is a cross section thereof on the line 2—2 on Fig. 1. Fig. 3, is a vertical longitudinal section thereof on the line 3—3 on Fig. 2. Fig. 4, is a diagrammatic horizontal section of the two working cylinders and the pump or low compression cylinder hereinafter specifically referred to.

In carrying out my present invention, the low pressure cylinder is preferably formed in the bed frame of the machine with the two working cylinders mounted thereon at equal distances from the central or longitudinal axis of the compounding cylinder as best shown in Fig. 2. Briefly stated, the working cylinders and the low pressure cylinder are coöperatively so arranged that an explosion occurs first in one end of one cylinder then in the opposite end of the other cylinder, then in the other end of the first cylinder and then in the other end of the other cylinder and the exhausts from the explosion chambers are drawn off into the low pressure cylinder alternately at one side and then the other side of the piston therein, which cylinder is provided with valve mechanisms arranged to exhaust the charge and form a vacuum in front of it as another charge on the back of the piston therein is being utilized to assist in carrying the said piston forward.

Referring now to the drawings by letters and characters A and A′ designate the two working cylinders which are of like construction and a detailed description of one will therefore suffice for both. The working cylinder A is of a suitable length closed at one end and provided at the other end with an aperture having a suitable stuffing box *a* in which plays the rod for the main working piston C that operates in the said cylinder A. The piston C is forme of two opposing members *c*—*c*′, the adjacent ends of which are separated a predetermined distance and have internal threaded portions c^2 to receive a coupling sleeve c^3, the ends of which are threaded to engage the threaded ends c^2 of

the opposing members of the pistons c—c', and the said internal diameter of the coupling sleeve is the same as that of the internal diameter of the cylinder members c—c' as best shown in Fig. 1, by reference to which it will also be observed that the coupling sleeve has a series of elongated slots c^4 which form the inlets for leading the working agent into the hollow piston C and which is supplied through the feed pipe D that discharges through the aperture d and the annular channel d' on the inside of the cylinder A in line with the elongated slots in the sleeve c^3. Each of the piston sections c—c' at the head ends is provided with outlets c^5 for leading the working agent into the explosive chambers x and x' at each end of the cylinder A and with valves c^6 that usually close the said opening c^5 and which are held closed by a suitably arranged bow spring c^7 located on the inside of the heads of the piston members c—c' and connected to the inwardly projecting stems of the valve c^6 as clearly shown in the drawings. At a point mid-way its length, the cylinder A at diametrically opposite sides, has elongated slots c^8 which are of a length equal that of the elongated feed slots c^4 in the sleeve c^3 and through the slot c^8 passes a cross rod c^9 that couples with the rod c^{10} of a supplemental piston C^5 that works within the hollow main piston C and which consists of the heads 10^c, in each of which is mounted one or more outwardly opening valves 10^a that automatically open in the manner hereinafter explained to lead the working agent charge alternately into the main piston sections c—c'.

e— and e' designate exhausts in the cylinder A, that are located in such a manner to lead off the exploded charge from the opposite ends of the cylinder A when the main piston C reaches the end of its stroke in opposite directions.

F designates a crank shaft having crank members f—f' relatively arranged on quarters, one of which, f, is coupled with the cross head f^2 that connects with the piston rod of the main piston C in the cylinder A, and the other f' of which couples with the cross head f^3 with which the rod of the piston C for the cylinder A′ connects; and g—g—g'—g' designate two pairs of eccentrics mounted upon the crank shaft, to one set of which g—g, the cross bar c^9 operating through the cylinder A connects, whereas the cross rod for the other cylinder A′ is connected by pitman rods with the other set of eccentrics g'—g'.

h—h designate slides that work in suitable guides h' on the outside of the cylinder A and these slides h—h are connected to the cross rod c^9 to move therewith and are so arranged that they will maintain a closure of the slot c^8 in the main cylinder A during all movements of the rod c^9 and the pistons working within the cylinder A, it being understood that like slide members are provided for the cylinder A′.

The operation of the parts, so far as described, is explained as follows: Assuming the hollow piston C to be in the position shown in Fig. 1 and to be traveling in the direction indicated by the arrow 20 on such figure, the said piston C, during such movement, will be compressing a working charge within the explosion chamber x' while a new working charge is being drawn into the section c' of the said hollow piston C by the vacuum created in the said section c opening the valves 10^a in the head 10^c of the supplemental piston which is at this time traveling in the direction opposite to the direction of movement of the hollow piston C, it being understood that the said indicated movement of the hollow piston C is produced by the explosion having taken place in the compartment x' at the other end of the cylinder A. During the stated movement of the hollow piston C, the supplemental piston C^5 that travels within the hollow piston C is now being moved in the opposite direction, by reason of the connection it has with the eccentrics of the crank shaft, and a working charge of explosive mixture in the cylinder between its head and the supplemental piston C^5 will be now compressing, the valve 10^a in the head of the supplemental piston C^5 being at this time held closed by the pressure of the working agent in front of it. At this point it should be stated, that in the practical arrangement of my engine, the correlation of the crank shaft f and the eccentric g, is such, that the main piston C will have partially moved on its return stroke before the head c of the supplemental piston C^5 shall have reached the limit of its forward thrust, such arrangement of parts being provided for two reasons; first, to effect a maximum compression of the charge between the two now opposing heads of the main and the supplemental pistons, and secondly, to cause the approaching head of the supplemental piston to positively engage the spring that holds the valve c^6 closed and thereby move the said valve c^6 to an open position to permit the compressed charge entering into the explosion chamber x', it being understood that this latter operation is effected just after the main piston C shall have uncovered the exhaust e to permit the exploded charge to pass off to the compounding cylinder in a manner presently explained and returning to just cover the said exhaust, it being understood further that when the piston C begins on its return movement the opposing head of the supplemental piston C^5 is still traveling toward the adjacent head of the piston C and by reason of the relative speeds of the two opposing heads referred to, the head of the supplemental piston will now engage and

compress the spring that holds the valve c^6 to its closed position and move the said valve from over the escape valve c^5 and thus permit the compressed charge to enter into the compartment X′ which, at this time, holds the vacuum.

The compound cylinder P has such length and the piston p has its rod p' connected with a driving part of the engine in such manner, that the piston p will make two strokes within the cylinder P during the time that the hollow piston C within the cylinder A is making one stroke, the reason for which is best explained as follows: When the piston C, traveling in the direction before stated and indicated by the arrow 20 on Fig. 1, reaches that point when it begins to uncover the exhaust e for the compartment x', the exploded charge within the chamber x' under the limited expansive force which it still contains, passes out through the exhaust e and through the inlet b of the compounding cylinder P and at the time that the piston C in the cylinder A begins to uncover the exhaust e, the piston p in the compounding cylinder will be in its extreme position in the direction indicated by the arrow 21 within the low pressure cylinder and ready to begin its movement in the opposite direction, it being understood that the exhausted charge just referred to, by reason of its still expansive force, materially aids in carrying the said piston p in the opposite direction indicated by the dotted arrow 21^a, it being also understood that at this time the valve i that controls the port to the vacuum creating means is closed by the pressure of the mixture back of the piston head p.

In the practical application of my invention, the hollow cylinder C and the piston p are so timed, with respect to their reciprocatory movements, that the piston p will travel the full length of its stroke during the time that the hollow piston C in the cylinder A begins to uncover the exhaust e for the chamber x', passes back beyond the said exhaust and returns to almost cover the said exhaust; such correlative positions of the piston C and the piston p being provided to permit of creating a vacuum within the chamber x' prior to the operation of opening the valve c^6 that controls the working agent feed ports c^5 of the chamber x', and such result is obtained by reason of suitable devices connecting with the movable part of the engine which operate to open the valve i of the vacuum producing means the instant that the piston p reaches the limit of its stroke in the direction indicated by the arrow 21, thus creating, as it were, a vacuum back of the piston C as well as back of the piston p, thereby reducing the resistance to the returning movements of the pistons C and p to the minimum. During the time that the piston C is returning in the direction of the compartment x', the working charge in the chamber x^2 in the opposite end of the other working cylinder A′ is being brought into a condition for exploding and the next explosion then occurs in the said chamber x^2, after which an explosion is effected in the same manner in the compartment x in the cylinder A and then in the compartment x^3 in the cylinder A′, it being understood that the several exhausts for the cylinders A and A′ are connected with the inlets b and d in the cylinder P.

To provide for actuating the piston p in the compounding cylinder in the manner hereinbefore stated, that is, at double the speed of that of the pistons within the working cylinders, I connect the rod p^5 of the piston p with the crank of a supplemental shaft, geared with the main shaft, to make two revolutions to one revolution of the said main shaft.

By reason of the peculiar construction of the working charge compression pistons within the cylinders A and A′, to obtain the greatest efficiency of the engine for all kinds of work for which it is adapted, it is necessary to provide for an instantaneous ignition and consumption of the working charges and for such purpose I provide an igniting means for each explosion end of the cylinders, which will produce a flame of such intensity when the charge has been finally compressed within the explosion chamber to its limit, that it will consume substantially every combustible item contained in the charge, thus making it possible to use a working agent consisting of any inflammable substance capable of being fed into the explosion chambers with the air.

In the drawings, I have illustrated the general arrangement of my improved engine and located the coacting parts in such manner that their structure and coöperative relation can be readily seen, but I desire it understood that in the practical application of my invention the working cylinders and the compounding cylinder may be arranged to suit the particular work for which the engine is to be used and the mechanical devices for actuating the several valves may be modified or varied as conditions may make necessary without departing from the scope of the invention.

Having thus described my invention, what I claim is:

1. An explosive engine, comprising a working cylinder, a hollow piston having outlets in the opposite ends thereof, automatically actuated valves for normally closing said outlets, a supplemental piston movable within the hollow piston, a working agent feed in communication therewith, the said supplemental piston having end heads provided with automatically opened and closed

valved apertures for the feed of the working agent to the explosion ends of the cylinder and means for drawing off the burned charge back of the hollow piston, substantially as set forth.

2. In an explosive engine, the combination with a working cylinder having fuel feed inlet, of a hollow piston in said cylinder having longitudinally extended inlet ports in communication with the said feed inlet, a supplemental piston slidably mounted within the hollow piston and having two heads located one beyond each end of the feed slots in the hollow piston, said heads having discharge outlets, valves for closing such outlets that automatically open by suction between the said heads and the hollow piston heads, each of the heads of the hollow piston having a valve discharge which automatically open when the working charge is compressed in the hollow piston to its maximum, the working cylinder having an exhaust in each end, means for drawing off such exhausts and creating a vacuum in the ends of the working cylinder after each exhaust, and means for reciprocating the main and the supplemental pistons in reverse directions, for the purposes described.

3. An explosive engine, comprising a pair of working cylinders, a low pressure cylinder having a single piston and an automatically operating valve in each end actuated at predetermined times, each of the working cylinders having a working agent inlet, a hollow working piston having a discharge port in each end and an automatically operated outwardly opening valve therefor, said hollow piston having elongated inlets centrally thereof, a double headed piston slidably mounted within the hollow piston, each of its heads having a discharge opening and an automatically operating outwardly opening valve therefor, the exhaust port for each end of each of the working cylinders, the oppositely disposed exhausts of the working cylinders discharging into the low pressure cylinder at one side and the other diametrically opposite exhausts of the two working cylinders discharging into the low pressure cylinder at the other side thereof, cross members in each working cylinder that connect with the rods of the supplemental piston, the said cylinders having slots through which the cross members move, slides carried by each cross member for closing said slots, a crank shaft, means for connecting the hollow and supplemental pistons of the two working cylinders to the crank shaft so as to reciprocate the said hollow and supplemental pistons at reverse directions and at different speeds and another means for transmitting two movements of the low pressure cylinder piston to one movement of the piston in the working cylinder, for the purposes specified.

4. In combination with the crank shaft having two cranks set on quarters, two working cylinders and a low pressure cylinder common to both working cylinders, each of the working cylinders having an exhaust for each end that connect with the low pressure cylinder; of a means for delivering a working charge into each working cylinder, another means for compressing the same therein and forcing it alternately into the opposite ends of the cylinder in a highly compressed state, the last stated means being located within the cylinders and connections that join the last said means with the engine crank shaft, and a further means for actuating the low pressure cylinder piston whereby to draw off the burned mixture from each end of the cylinders and creating a vacuum therein prior to entering a new compressed charge therein, as set forth.

5. An explosive gas engine of the character described, which comprises a pair of working cylinders, each having a fuel feed port, a means for each cylinder wholly within the said cylinders for drawing in a working charge, compressing such charge and forcing the compressed charges first into one end and then into the other end of the working cylinders, mechanism connected with the crank shaft for actuating the said charge compressing means and another means for drawing off the burned mixture and creating a vacuum in each end of the working cylinder at predetermined times.

6. In an explosive engine, the working cylinders which include means located wholly within the cylinders for drawing in working charges, compressing the same and alternately forcing it into one explosion end of the cylinders in a highly compressed state and then into the other end of the cylinder to be exploded and means for positively drawing off the burned residuum from each exploded end of the cylinder and creating a vacuum therein prior to recharging said explosive ends and mechanism actuated by the crank shaft for operating the charge controlling and compressing means within the cylinder at predetermined intervals, substantially as specified.

7. In an explosive engine, a working cylinder, a hollow piston therein, said cylinder having a pair of centrally separated exhaust ports controlled by the movement of the piston and having an outlet in each end, means for automatically closing said outlets at predetermined times, means for leading the working charge into the hollow cylinder and another means located within the hollow cylinder for forcing the working agent therein alternately through the valved outlets in the opposite heads of the cylinder all being arranged substantially as shown and described.

8. An explosive engine comprising a work-

ing cylinder having a single feed inlet and an exhaust port at each end, a piston operating in the cylinder that controls the opening and closing of the exhaust ports, and the crank shaft connection with the piston; of a means for initially compressing the working charge mounted within the cylinder before leading it in advance of the piston, and a means for drawing off the burned mixture back of the piston and simultaneously compressing the new charge in front of the working piston, as set forth.

9. As an improvement in explosive engines, a working cylinder having a centrally disposed feed inlet and a pair of exhaust ports one at each end of the cylinder, a double acting pump connected with the exhausts of the working cylinder, the crank shaft and the connections joined therewith and the working piston and pump piston to move the pumping piston twice as fast as the working piston, a hollow piston in the working cylinder having valve controlled outlets in the ends thereof usually closed and a second double headed piston working with the hollow piston, its heads having valved discharges, and a feed port for the cylinder having a feed port that discharges into the hollow piston midway thereof, for the purposes described.

10. In an explosive engine of the character described, the combination with the main cylinder having a centrally disposed fuel inlet and an exhaust port in each end; of a hollow piston that controls the opening and closing of the exhaust ports, said piston having a centrally disposed elongated feed inlet in communication with the feed inlet in the cylinder, the crank shaft that connects with the hollow piston; a mechanism mounted within the hollow piston actuated from the crank shaft for forcing the working charges under pressure alternately through the valved outlets in the ends of the hollow piston and means for drawing off the exhaust, coupled with the crank shaft, as set forth.

11. As an improvement in gas engines, a working cylinder having an exhaust port in each end and a fuel feed inlet midway the exhaust ports and crank shaft; of a hollow double headed piston having a longitudinally elongated inlet that communicates with the fuel feed inlet, and having outlets in each end closed by valves, spring held to their closing position, the piston rod connection that joins with the crank shaft, a double piston working within the hollow cylinder, the heads being separated to straddle the elongated feed opening in the hollow piston, a connection actuated by the crank shaft adapted to impart movement to the said double piston heads of said piston, having outlets provided with outwardly opening valves, as set forth.

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