No. 713,792. Patented Nov. 18, 1902.

J. A. OSTENBERG.

EXPLOSIVE ENGINE.

(Application filed June 1, 1897.)

(No Model.) 3 Sheets—Sheet 1.

Fig: 1.

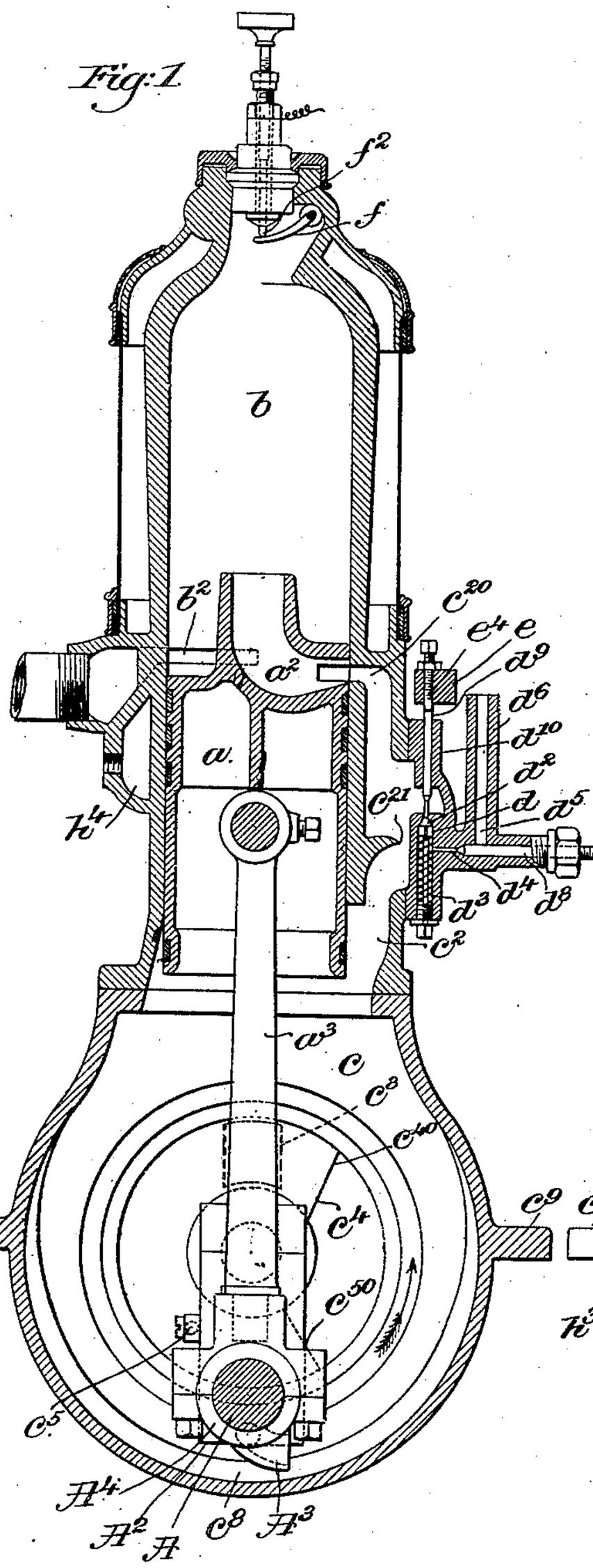

Fig: 2.

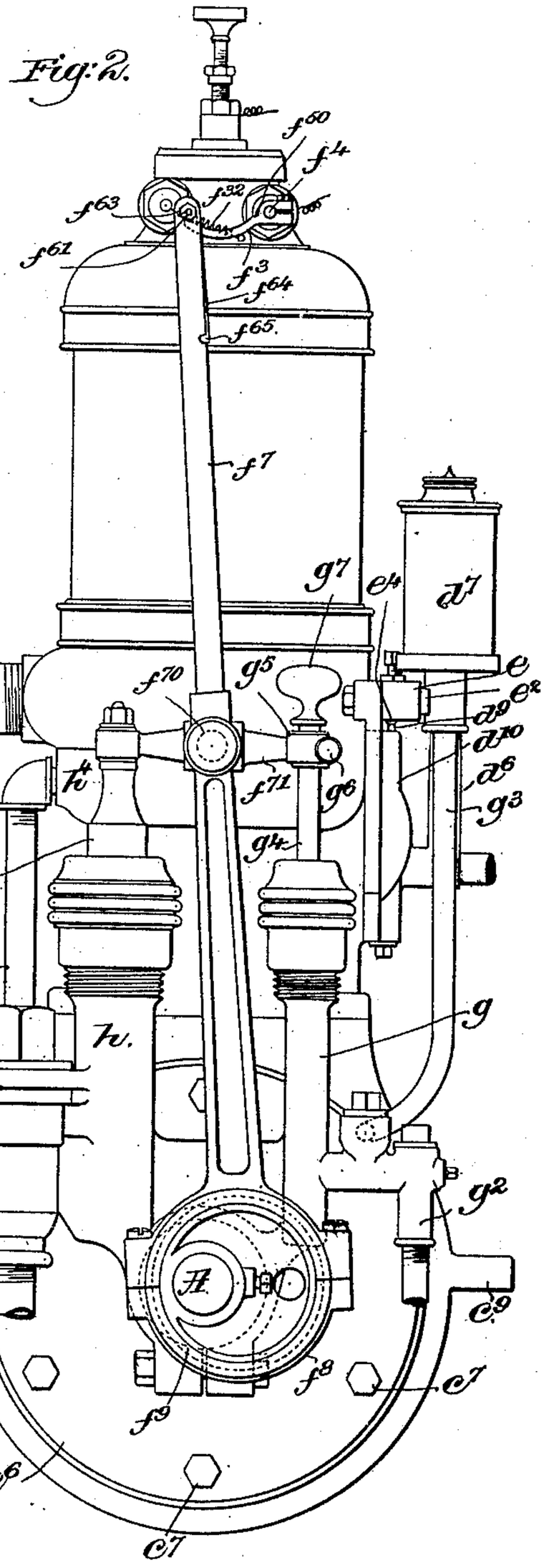

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Fig. 3.

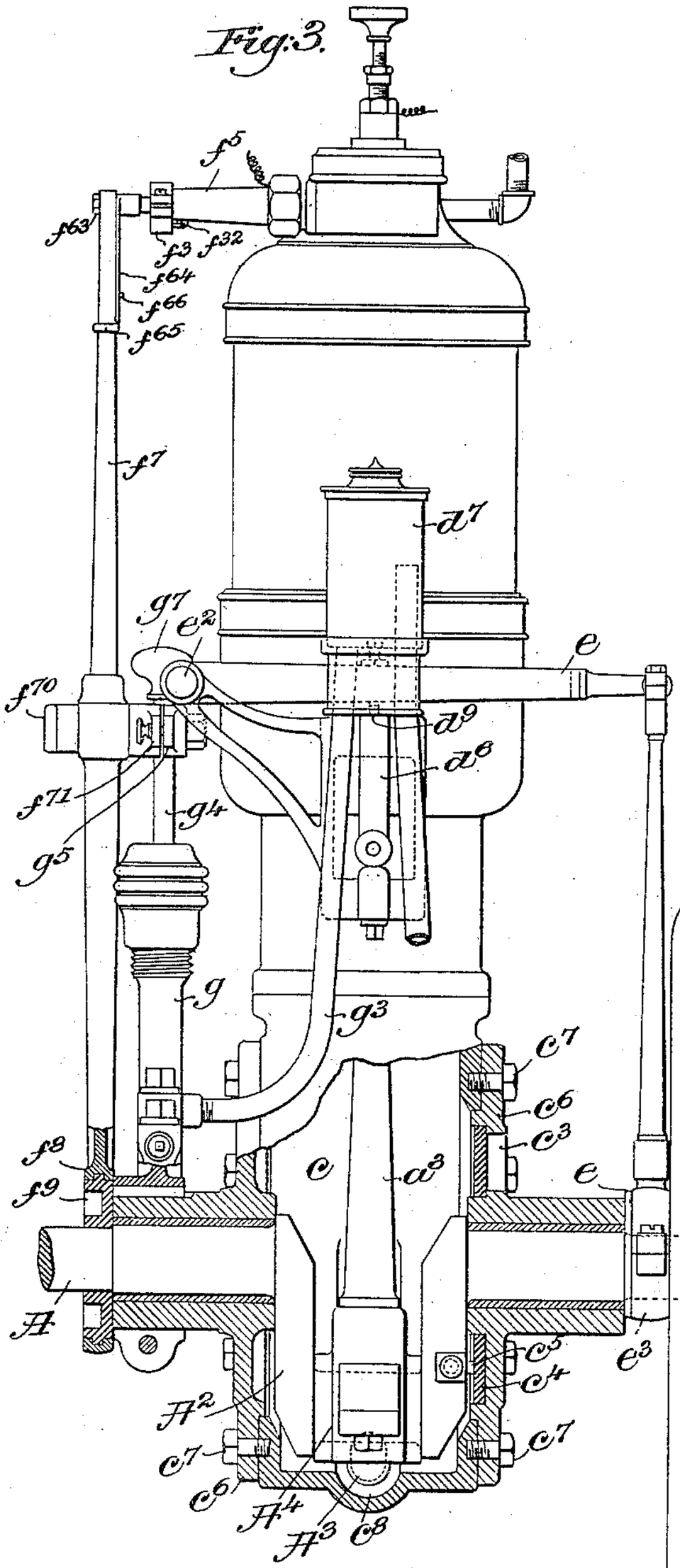


Fig. 4.

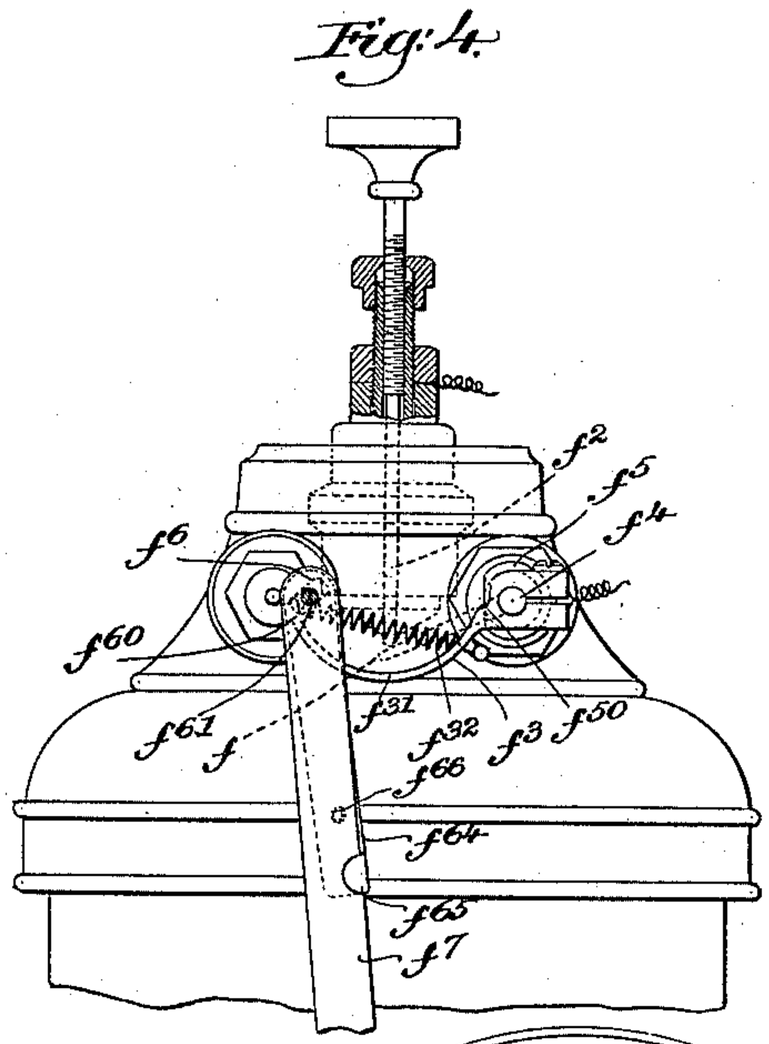
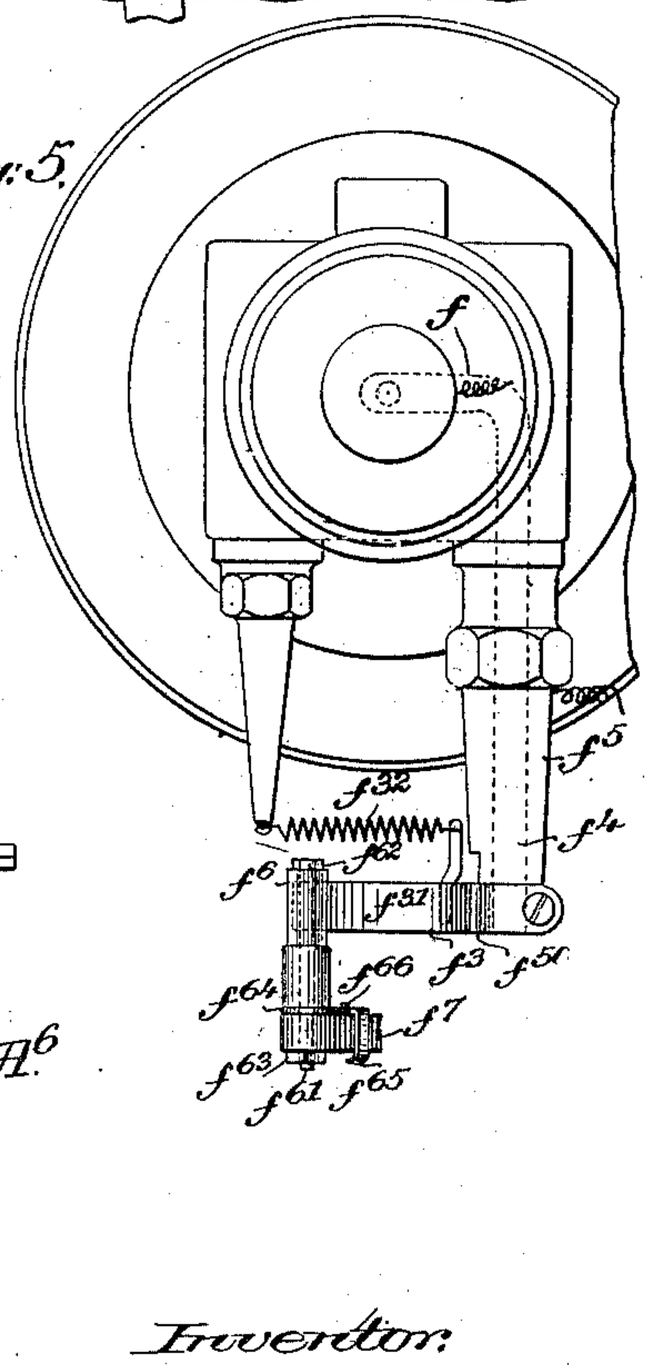


Fig. 5.



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EXPLOSIVE ENGINE.

(Application filed June 1, 1897.)

(No Model.) 3 Sheets—Sheet 3.

Fig: 6.

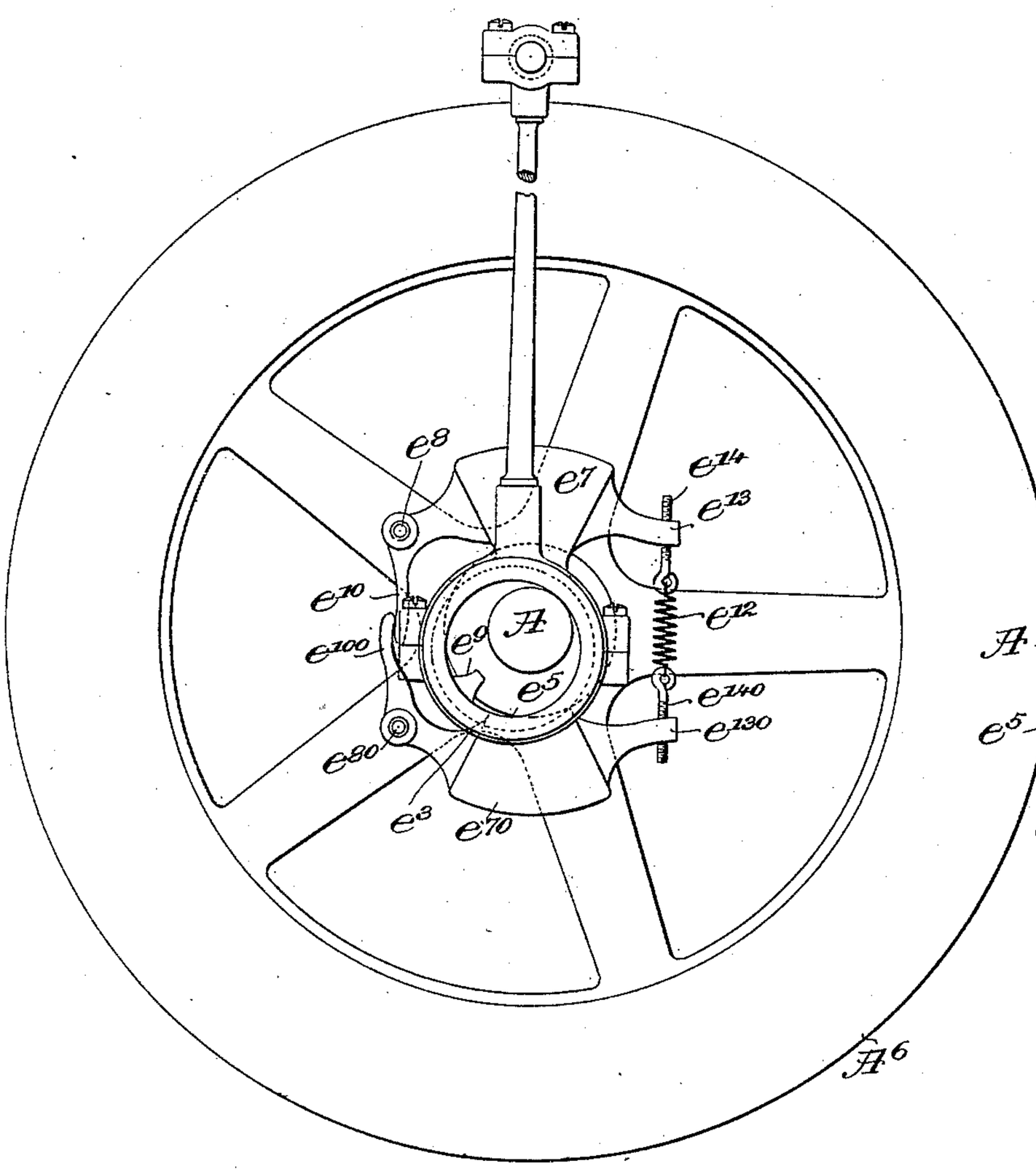
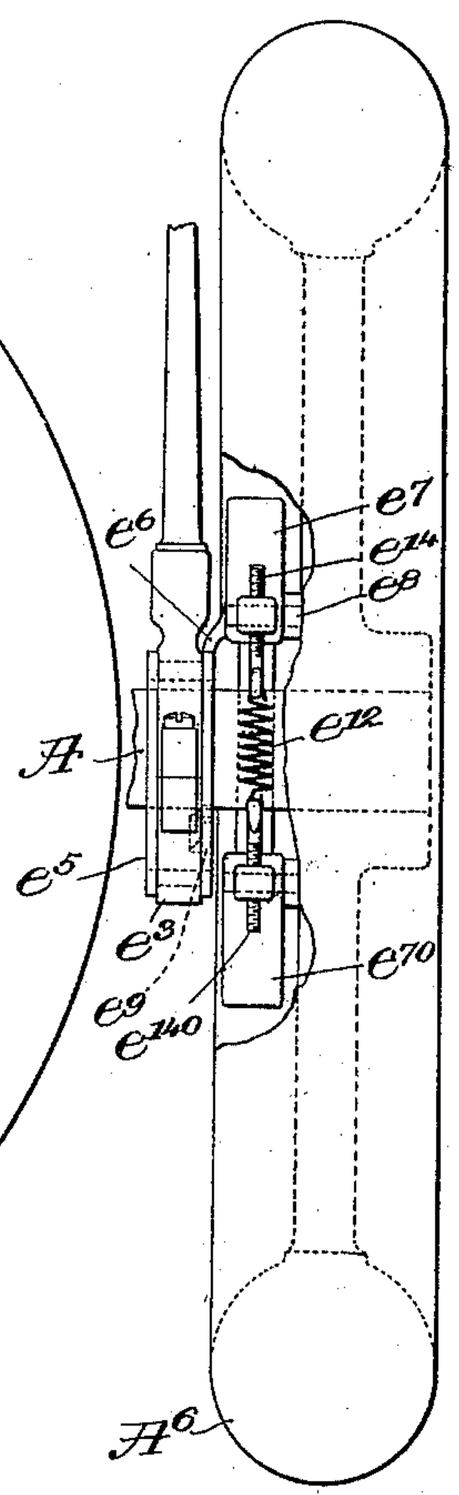


Fig: 7.



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UNITED STATES PATENT OFFICE.

JOHN A. OSTENBERG, OF WESTMINSTER STATION, VERMONT, ASSIGNOR TO FREDERICK M. GILBERT, OF WALPOLE, NEW HAMPSHIRE.

EXPLOSIVE-ENGINE.

SPECIFICATION forming part of Letters Patent No. 713,792, dated November 18, 1902.

Application filed June 1, 1897. Serial No. 638,941. (No model.)

To all whom it may concern:

Be it known that I, JOHN A. OSTENBERG, of Westminster Station, in the county of Windham and State of Vermont, have invented an Improvement in Explosion-Engines, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

The present invention relates to a gas-engine and is embodied in what is known as a "two-cycle" engine or one in which the air which forms part of the explosive mixture is compressed at each stroke and admitted to the cylinder at the end of the stroke, the products of combustion or exhaust being simultaneously driven out and the new explosive mixture taking their place.

The invention is mainly embodied in an improved construction and arrangement of the inlet and exhaust ports, the object being to provide means whereby the incoming charge of compressed air and gas may be suddenly and forcibly injected through the products of combustion toward the closed end of the cylinder or explosion-chamber, which is so shaped as to gather and confine the injected charge after it has penetrated the products of combustion. To this end the charge is admitted through a duct formed in the piston itself and terminating in a nozzle or tube in line with the axis of the cylinder and pointed toward the closed end thereof, the capacity of said tube being no greater than that of any part of the inlet-passage through which the charge is admitted to the cylinder. The said inlet-passage is shown as having an inlet-opening through the side wall of the cylinder, into alinement with which the piston-duct will come at the end of the effective stroke of the piston, the charge being admitted to the inlet-passage and compressed therein during such outward stroke, so that when the piston-duct is momentarily opened the charge is suddenly and forcibly injected through the "injector-nozzle," as it may be termed, and is accumulated and concentrated in the explosion-chamber prior to ignition. The exhaust-port is also arranged in the side wall of the cylinder and is adapted to be opened and closed by the piston itself, the said exhaust-port being preferably opened somewhat in advance of the opening of the inlet, so that the products of combustion of the old charge have already begun to escape when the new charge is injected, as described.

The invention is further embodied in novel means for operating the igniting device, (which device may be of any suitable or usual kind,) the said operating means being such that they can also be utilized for operating the pump to supply a liquid explosive, if such is to be employed, or a pump for circulating cooling fluid around the cylinder, or both, the pump for the explosive being also so arranged that it can be disconnected from the operating means and manually operated to charge a reservoir prior to the starting of the engine or so that it can be permanently disconnected if the pump is not to be used.

The invention further relates to certain details of construction and arrangement, which will be hereinafter more fully described.

Figure 1 is a vertical section of an engine embodying the invention. Fig. 2 is a side elevation of the same; Fig. 3, a sectional elevation taken on a plane at a right angle to that of Fig. 1; Fig. 4, a detail, on a somewhat-enlarged scale, showing the igniting device; Fig. 5, a top plan view of the part shown in Fig. 4; Fig. 6, a side elevation, on an enlarged scale, of the governing device; and Fig. 7, a front elevation thereof, a portion of the fly-wheel being broken away to show the operative parts of the governor.

The piston *a* works in the cylinder *b* to and from an inclosed air-compressing chamber *c* at the mouth of the said cylinder, so that the active or outward stroke of the said piston causes the same to compress the air in the said air-chamber for the next charge, the air compressed as aforesaid being admitted to the cylinder at the end of the stroke through a duct c^2, carrying with it a quantity of gas or gasolene admitted to said duct through a valve *d*, which is operated by the governor-eccentric *e*, as will be hereinafter described. When gasolene or other liquid is used as the explosive, it is desirable that when it is admitted to the duct c^2 it should be finely subdivided or sprayed, so as to thoroughly mix with the compressed air passing through said

duct from the compressing-chamber. For this purpose the said duct is shown as provided with a choked passage c^{21} just below the inlet for the liquid, the said liquid thus meeting a concentrated current of air, which divides it into fine spray and causes it to be thoroughly mixed with the compressed air prior to its being admitted to the cylinder. The passage or duct c^2 is shown as communicating with the interior of the cylinder through a port c^{20}, adapted to be closed by the piston a except at the end of the outstroke thereof, when the said port c^{20} comes in line with a passage a^2 in the piston itself, the said passage opening into the interior of the cylinder, as shown. The said passage a^2 is arranged in accordance with the present invention to constitute an injector-nozzle in line with the axis of the cylinder and directed toward the closed end thereof, where the igniting device ff^2 is located, so that the incoming charge is injected, as it were, in a concentrated jet directed toward the explosion-chamber.

The passage c^2, which receives the explosive from a passage d, controlled by a valve d^2, as will be hereinafter described, communicates directly with the compression-chamber c, in which, as has been stated, the air is compressed during the outstroke of the piston, so that when the duct a^2 comes in line with the duct c^{20} the compressed charge will rush in with considerable force, whereby the jet is caused to penetrate the products of combustion of the last charge, which have already begun to escape through the exhaust-opening b^2, said opening, as shown, being at this period uncovered by the piston in its outstroke.

The upper end of the cylinder or explosion-chamber, where the igniting device is located, is shown as contracted or made smaller than the body of the cylinder, so that the incoming charge, which is centrally directed toward the same, will penetrate the products of combustion and be concentrated and accumulated, as it were, behind the same without any material tendency to mingle with said products of combustion and escape therewith through the exhaust-port.

The air-compressing chamber c is shown as provided with an inlet-port c^3, (indicated in dotted lines, Fig. 1,) the said port being opened and closed by means of a slide-valve c^4, connected, as by a pin c^5, with the crank A^2 on the shaft A, so that in the operation of the engine the said inlet c^3 is opened and closed, being closed during the outstroke of the piston-rod to compress the air, which thus compressed is admitted to the cylinder by the opening of the duct c^{20} at the end of such downstroke. As the piston begins its instroke, however, the end c^{40} of the said slide-valve passes by the port c^3, opening the same and allowing the air to be sucked in behind the piston. As will be seen, the length of the slide-valve is greater than half the circumference of the chamber, so that the end c^{50} thereof passes the port c^3 during the last of the inward movement of the piston, thus closing the port c^3 prior to the beginning of the outward movement, the said port thus being closed and the air confined in the chamber during the whole outstroke of the piston and during so much of the instroke thereof as is necessary to close the port c^{20}.

The compression-chamber c is shown as consisting of a cylindrical shell at the outer end of the cylinder, the said shell being closed at the ends by bonnets c^6, secured, as by cap-screws c^7, to the ends of the cylinder, the said bonnets also containing, as shown, the bearings for the shaft A. The inlet c^3 is shown as an opening in one of the said bonnets, and the slide-valve c^4 travels in an annular guideway formed in the inner surface of that bonnet which has the opening c^3, as best shown in Fig. 3.

Along the lower interior wall of the cylindrical casing which forms the compression-chamber there is an oil-channel c^8, and the crank A^2 is provided at its end with a scoop A^3, adapted to travel along said channel in the rotation of the shaft A and scoop up the oil, so as to lubricate the wrist-pin A^4, which is connected with the piston-rod a^3.

The side walls of the cylindrical casing may be provided, as shown, with lugs or extensions c^9, which are adapted to be secured to a suitable support or base upon which the engine may be mounted.

The gas-valve d is shown as a tapered valve adapted to be seated upon a valve-seat d^2 by means of a spring d^3, the said valve being longitudinally movable to and from its seat through a duct d^4, adapted to receive gas or gasolene from a lateral duct d^5, communicating with the pipe d^6, extending downward from a gasolene-reservoir d^7 when gasolene is used, the said reservoir being adapted to be supplied by means of a pump g, the operation of which will be hereinafter described. The said duct d^4 is shown as provided with a regulating-valve d^8, which may be of any suitable or usual construction. To unseat the said valve at the proper time to admit the gas or gasolene to the passage c^2, which leads from the compressing-chamber c to the cylinder, the valve-actuating device d^9, which is shown as a pin longitudinally movable in a guideway d^{10}, is adapted to be operated upon by the lever e, pivoted at e^2 and connected with the governor e^3, the said lever having an adjustable engaging projection e^4, adapted to engage the end of the valve-actuating device d^9 to unseat the valve.

To govern the engine—that is to say, to prevent the opening of the gas-valve when the speed has risen above the normal—the governing device e^3, which consists of a collar in the nature of an eccentric-strap, is shown as mounted on an annular support or ring e^5, Figs. 6 and 7, adapted to be shifted to and from a position concentric with the axis of the main shaft A, which is shown as provided in the usual way with the fly-wheel

A^6. To thus shift the ring e^5 in response to the changes of speed in the driving-shaft—that is to say, to shift it toward the concentric position when the speed rises and toward the eccentric position when the speed falls—the said ring is shown as connected, by means of an arm e^6, with a weight e^7, pivoted at e^8 in the fly-wheel, the pivotal support being so arranged that the ring e^5 moves on the arc of a circle intersecting the axis of the driving-shaft, so that as the said weight moves on its pivot it will shift the said ring, as is desired. To prevent the said ring from overthrowing or moving beyond a position concentric with its shaft A, it is provided with a projection e^9, adapted to engage the side of the said shaft when the ring is concentric therewith, it being obvious that when it has reached this position there will be no movement of the collar or eccentric-strap e^3, and consequently no movement of the lever e to open the gas-valve.

To balance the weight e^7, so that it will not be affected by the force of gravity in the rotation of the wheel, a corresponding weight e^{70} is arranged opposite to the said weight e^7 and also pivotally connected at e^{80} to the fly-wheel, the said weights being provided with engaging projections e^{10} and e^{100}, whereby a down movement of the lower weight in any position of the wheel in response to the force of gravity will tend to produce a corresponding up movement of the other weight, which will obviously just balance the same, so that the said weights are affected solely by centrifugal force in the rotation of the fly-wheel. To restore the said weights to their normal position—viz., that shown in Figs. 6 and 7—when the normal speed is attained, they are provided with a restoring-spring e^{12}, the said spring shown as secured at one end to one of the said weights and at the other end to the other weight in projections e^{13} and e^{130}, respectively, so that a single spring serves to restore both of the weights.

To set the governor so that it will respond to any desired speed, the spring e^{12} is shown as connected to screw-eyes e^{14} and e^{140}, so that the tension thereof can be regulated by turning one or both of the said screw-eyes.

The igniting device for the explosive may be of any suitable or usual construction and arrangement capable of being mechanically operated and is herein shown as an electric-circuit breaker arranged and constructed substantially as shown and described in another application filed by me November 6, 1897, Serial No. 657,635. The said circuit-breaker comprises the movable and fixed terminals f and f^2, adapted to be separated in response to the movement of an arm f^3, connected to a rock-shaft f^4, having a bearing f^5, the said rock-shaft carrying the terminal f^2 and the said arm having an engaging shoulder f^{50}, adapted to be engaged by a movable actuator f^6 to separate the terminals. The terminals are adapted to be restored to their normal position by means of a spring f^{32} and are controlled in their return movement by the actuator substantially as shown and described in the application above cited. The said actuator f^6 is operated in accordance with the present invention by means of an arm f^7, to which it is connected, the said arm being adapted to receive an oscillating movement from the shaft of the machine, as by means of the eccentric-strap f^8 and eccentric f^9, mounted on the said shaft.

In order that the arm which actuates the igniting device may be controlled in its oscillating movement, so that the actuator for the igniting device will be properly moved to separate the terminals of the igniting device, the said arm is shown as pivoted at f^{70} to a cross-head f^{71}, which is guided so as to have a rectilinear movement, while the end of the arm which carries the actuator for the igniting device will travel in a regular path, so as to properly operate the igniting device. The said arm in accordance with the present invention is also utilized to operate a pump for the explosive, if such pump is needed, and to this end the cross-head f^{71} is shown as connected to the piston g^4 of the pump g, which is adapted to receive the liquid from the pipe f^2 and deliver the same through the pipe g^3 to the reservoir d^7, which has been hereinbefore described. The said piston g^4 is shown as connected to the cross-head f^{71} by means of a screw g^6 in a socket g^5 on the said cross-head, so that by loosening the said screw the piston can be rendered inoperative or operated independently of the cross-head, as by the knob g^7, it thus being practicable to charge the reservoir d by hand before the engine is started. The said arm f may also operate, as shown, a pump h for circulating a cooling fluid around the cylinder of the engine, and when such a pump is utilized the piston h^2 of the same is also connected to the cross-head f^{71}, the two pump-pistons g^4 and h^2, when the engine is provided with both, constituting the guide for the cross-head to cause the same to have a rectilinear movement.

The pump h is herein shown as adapted to pump water from the pipe h^3 into the water-jacket h^4, which is shown as connected to the pump-chamber by a pipe h^5.

It is not intended to limit the invention to the specific construction herein shown and described, since obvious modifications may be made without departing from the invention.

I claim—

1. In a gas-engine, the combination with the cylinder; of an explosion-chamber smaller in diameter than the cylinder; an igniting device for exploding a charge admitted to said explosion-chamber; an inlet-port for the charge and an exhaust-port for the products of combustion; means for opening both of said ports when the piston has reached substantially the end of its outstroke, and for closing the same during the instroke of the piston; a source of

compressed explosive adapted to be admitted through said inlet upon the opening of the same; and a passage through the piston terminating in an injector-nozzle in line with the axis of the cylinder and pointing toward the closed end thereof, whereby the charge admitted is injected in a jet through the spent charge toward the closed end of the cylinder and concentrated in the said explosion-chamber, substantially as described.

2. In a gas-engine, the combination with a cylinder having at its closed end an explosion-chamber smaller in diameter than the cylinder; of an inlet-port for the charge and an exhaust-port for the products of combustion arranged to be substantially simultaneously opened when the piston reaches substantially the end of its outstroke, and to be closed in response to the inward movement of said piston; means for compressing, during the outstroke of the piston, the charge which is to be admitted through the inlet-duct when the same is opened; and an injector-nozzle formed in the piston and in line with the axis of the cylinder through which nozzle the charge is adapted to be injected in a jet directed through the products of combustion and concentrated in the explosion-chamber, substantially as described.

3. The combination with the cylinder having the charge-inlet c^{20} and exhaust-outlet b^2; of the piston a having the duct a^2 adapted to come in line with the inlet c^{20} when the exhaust-outlet b^2 is open; the injector-nozzle at the end of said duct a^2 in line with the axis of the cylinder and directed toward the closed end thereof, whereby the charge is injected through the products of combustion toward the closed end of the cylinder; and the explosion-chamber smaller in diameter than the cylinder in said closed end, substantially as described.

4. In a gas-engine, the combination with the cylinder and piston; of a source of compressed air; a duct leading from said source toward the interior of the cylinder, said duct being adapted to be closed except when the piston is substantially at the end of its effective stroke; an inlet to said duct for admitting an explosive thereto; a choked passage in said duct adjacent to said inlet and between the same and the source of compressed air; and a passage through the piston adapted to communicate with said duct when said piston is substantially at the end of its effective stroke, said piston-passage terminating in an injector-nozzle in line with the axis of the cylinder and directed toward the closed end thereof, an explosion-chamber smaller in diameter than the cylinder at the said closed end and an exhaust-outlet adapted to be opened during the admission of the charge substantially as described.

5. In an explosion-engine, the combination with a mechanically-operated igniting device, of means for operating the same consisting of an arm, a guide for the said arm having a rectilinear movement, the said arm being pivotally connected to said guide, means for connecting one end of said arm to the engine-shaft to produce an oscillating movement of said arm, and a pump for supplying the engine with an explosive, the plunger of said pump being connected with said guide, substantially as described.

6. In an explosion-engine, the combination with a mechanically-operated igniting device, of means for operating the same consisting of an arm, a guide for the said arm having a rectilinear movement, the said arm being pivotally connected to said guide, means for connecting one end of said arm to the engine-shaft to produce an oscillating movement of said arm, a pump for supplying the engine with an explosive, the plunger of said pump being connected with said guide, and means for disconnecting said pump-plunger from said guide, substantially as described.

7. In an explosion-engine, the combination with a mechanically-operated igniting device, of means for operating the same consisting of an arm, a guide for the said arm having a rectilinear movement, the said arm being pivotally connected to said guide, means for connecting one end of said arm to the engine-shaft to produce an oscillating movement of said arm, and a pump for circulating cooling fluid around the cylinder having its plunger connected with said guide, substantially as described.

8. In an explosion-engine, the combination with a pump for supplying an explosive to the cylinder and a mechanically-operated igniting device for the said explosive, of a common actuating device for said pump and igniting device comprising an arm pivotally connected at a point intermediate between its ends with the pump-plunger, the said arm being adapted at a point near one end thereof to engage and operate the igniting device, and means for producing an oscillating movement of said arm at the other end thereof, substantially as and for the purpose described.

9. In an explosion-engine, the combination with a gasolene-pump provided with a reciprocating plunger, of a water-pump for circulating water through a water-jacket, the said water-pump also having a reciprocating plunger, the cross-head connecting said plungers, an arm pivotally connected with said cross-head and provided at one end with an eccentric-strap adapted to coöperate with an eccentric operated by the engine-shaft, an igniting device for the engine, and an actuator for said igniting device at the other end of said arm, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN A. OSTENBERG.

Witnesses:
H. J. LIVERMORE,
NANCY P. FORD.