No. 607,580. Patented July 19, 1898.

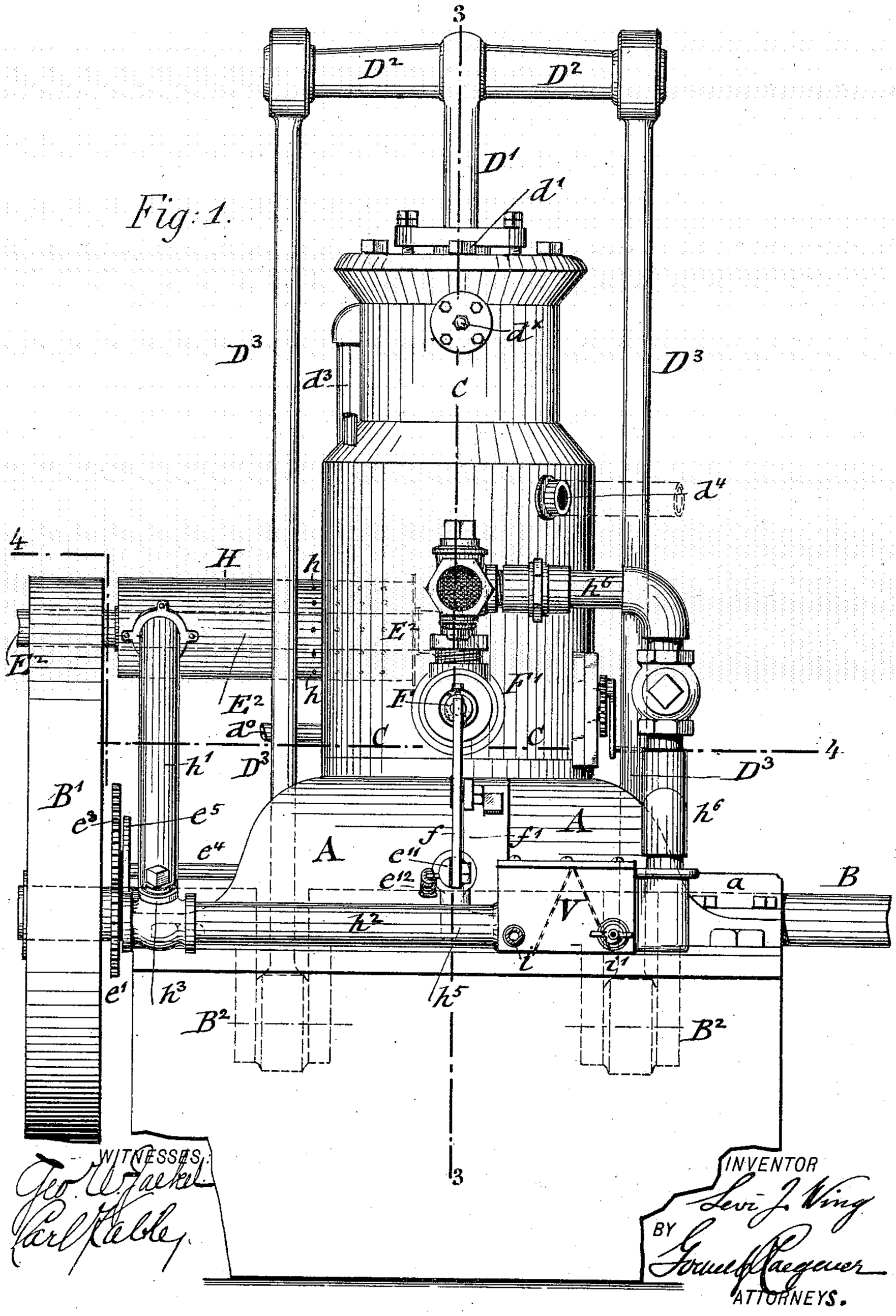
L. J. WING.

GAS ENGINE.

(Application filed Dec. 22, 1896.)

(No Model.) 5 Sheets—Sheet 1.

Fig: 1.



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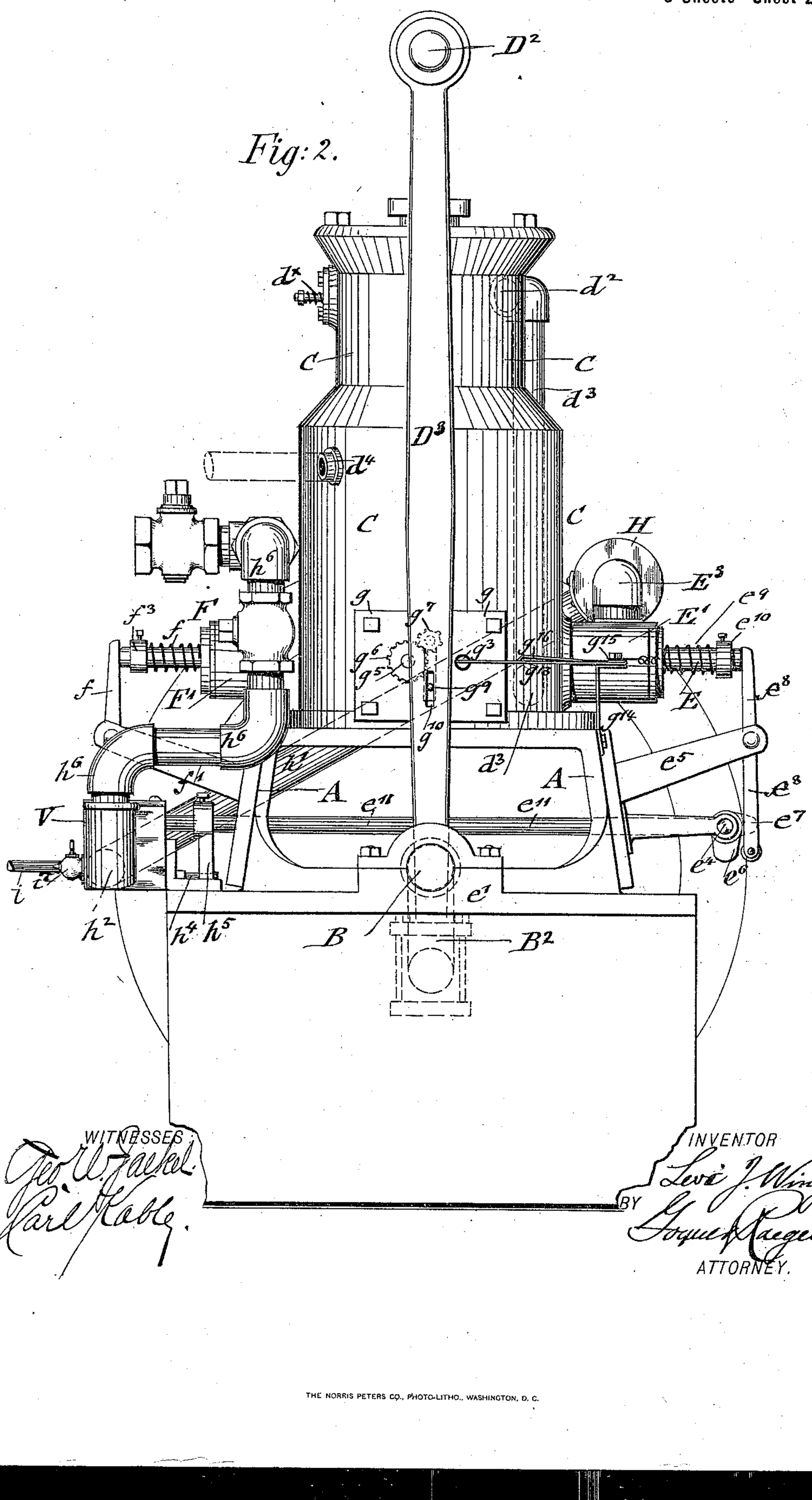
(No Model.) 5 Sheets—Sheet 2.

Fig: 2.



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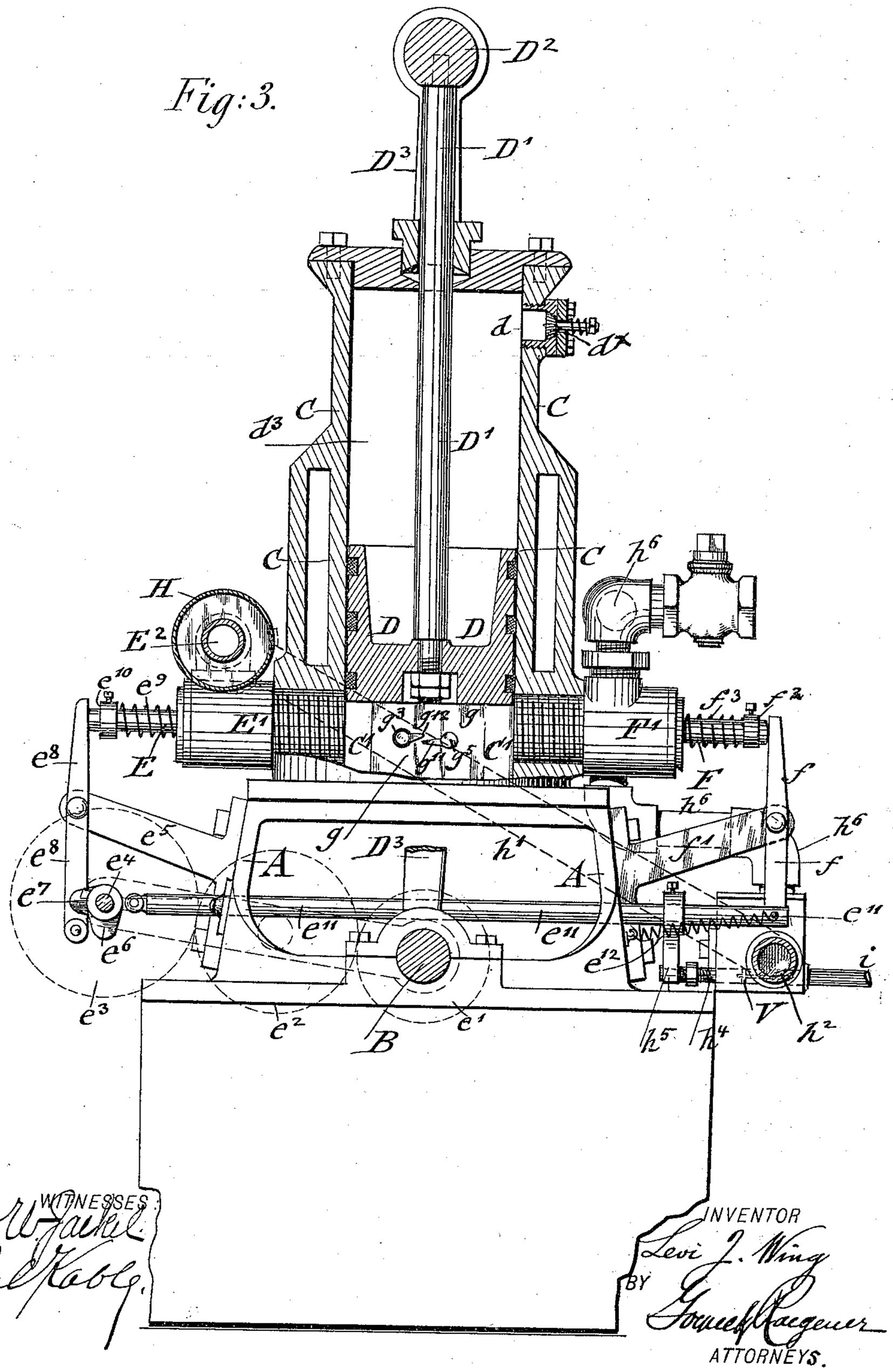
(No Model.) 5 Sheets—Sheet 3.

Fig: 3.



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(No Model.) 5 Sheets—Sheet 4.

Fig: 4.

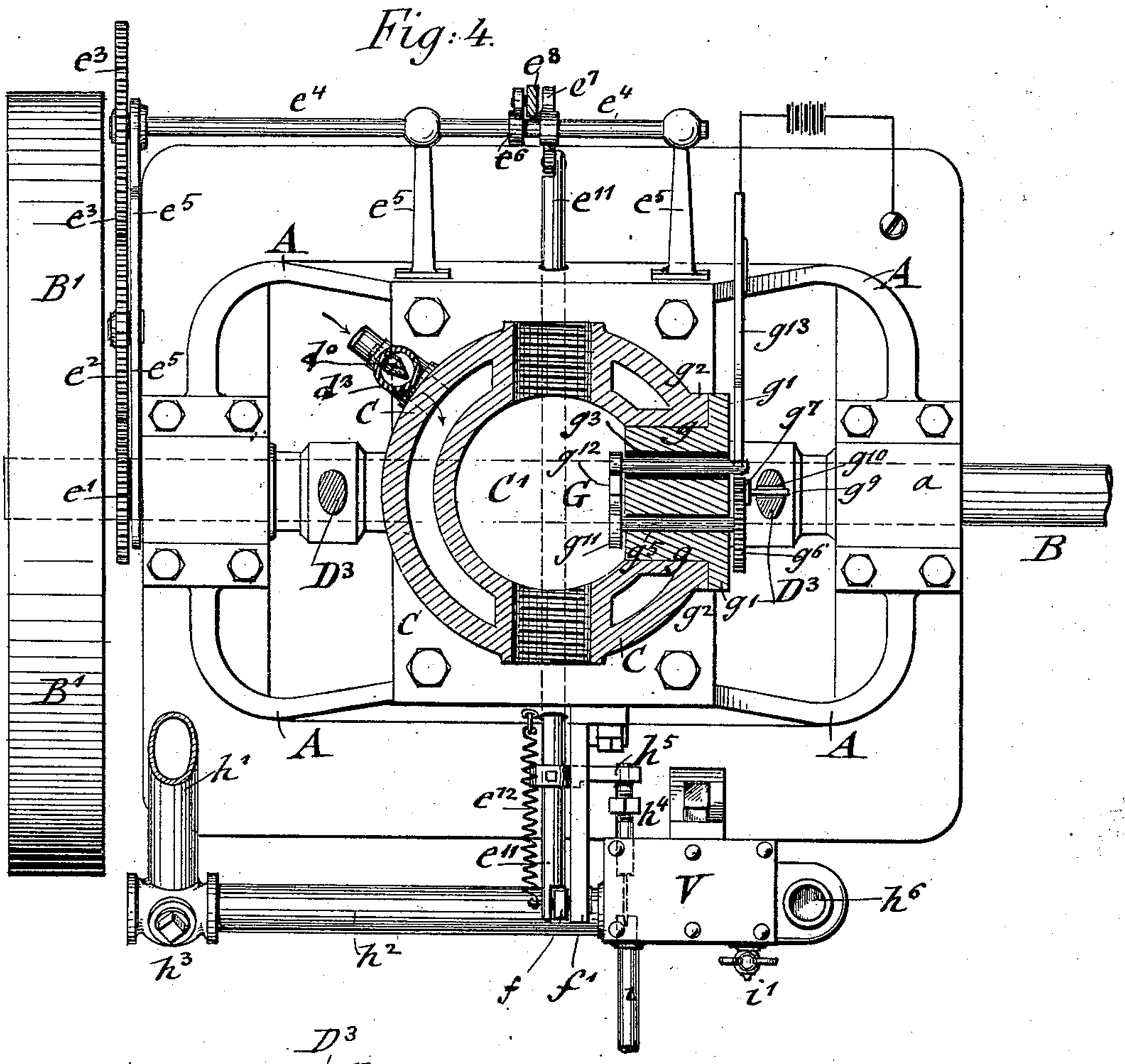
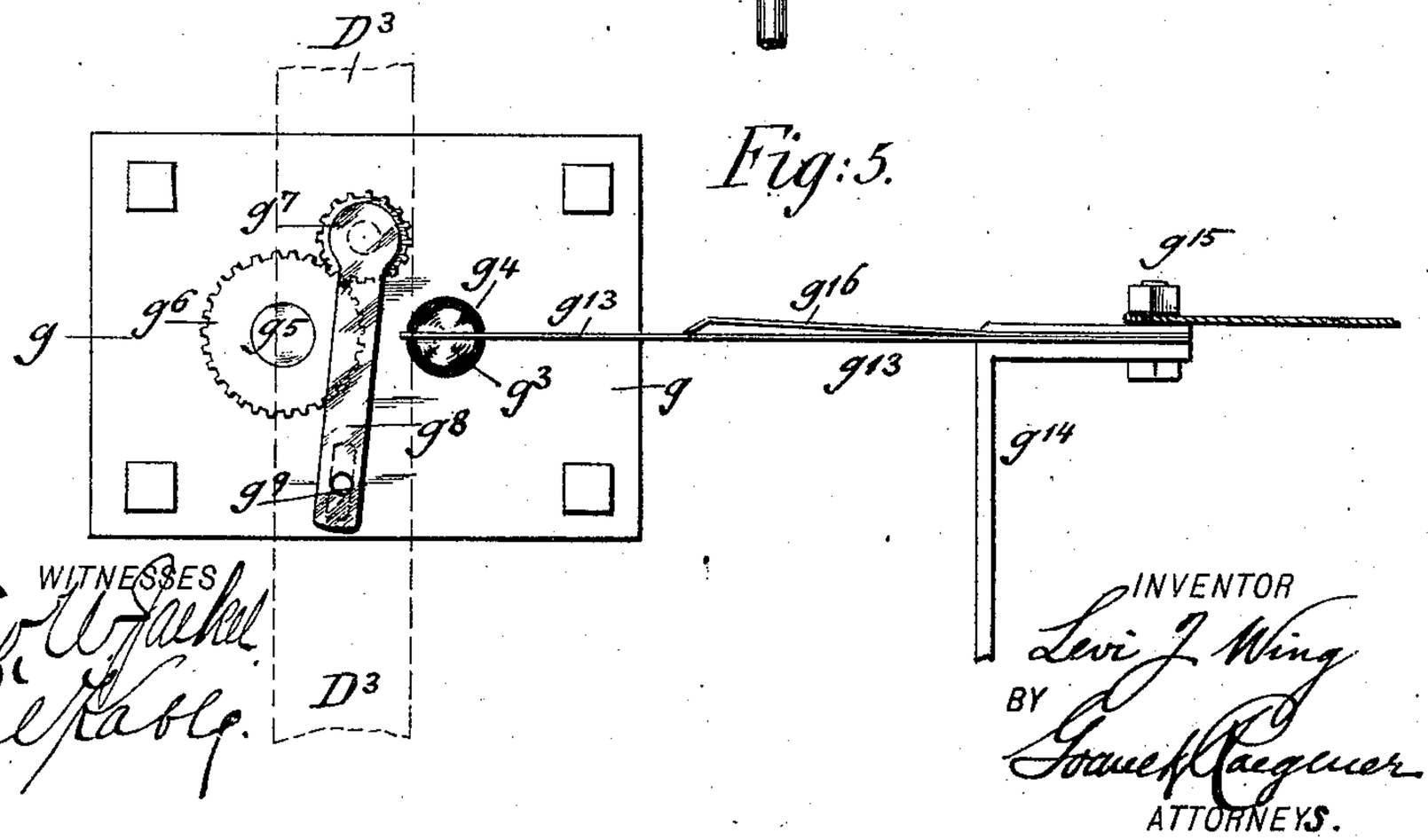


Fig: 5.



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GAS ENGINE.

(Application filed Dec. 22, 1896.)

(No Model.)

5 Sheets—Sheet 5.

Fig: 6.

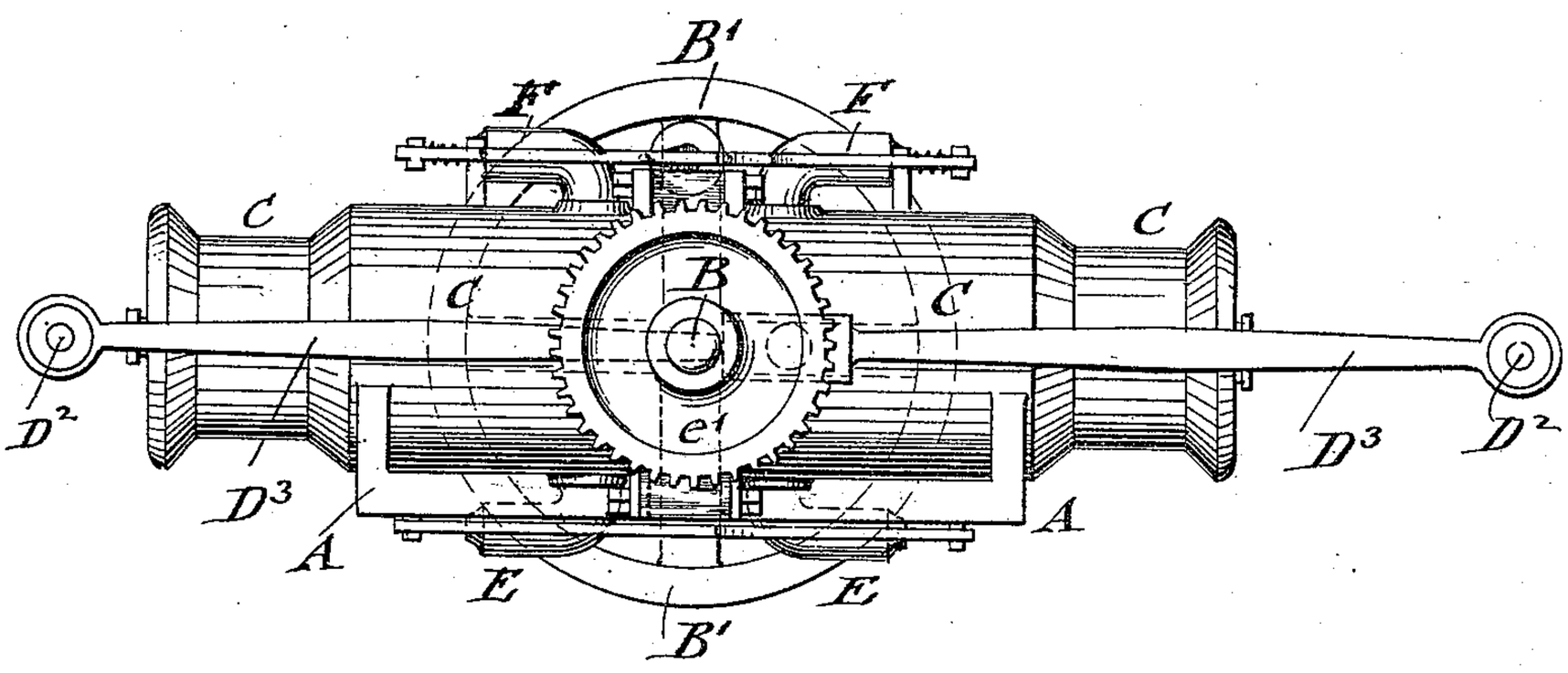
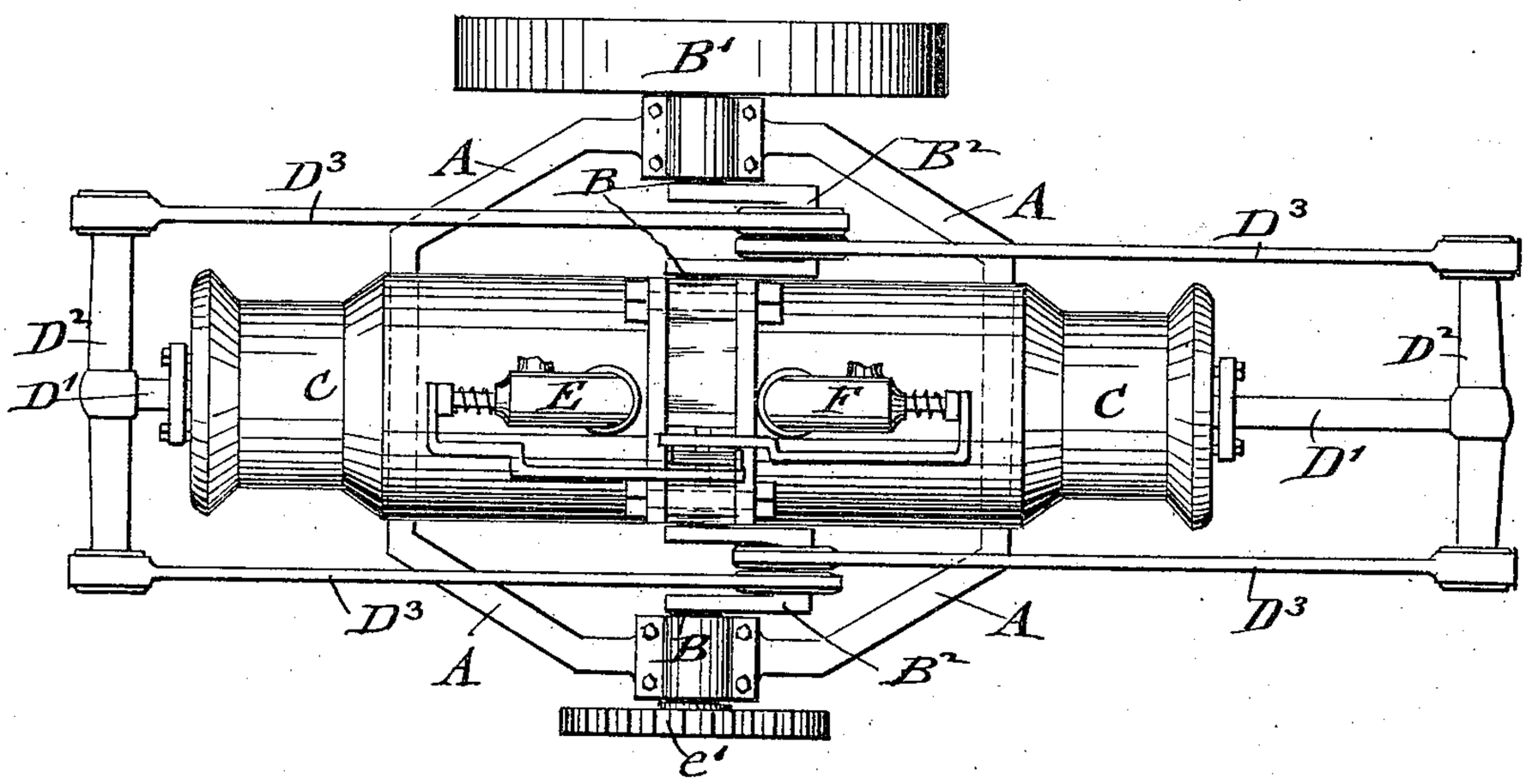


Fig: 7.



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UNITED STATES PATENT OFFICE.

LEVI J. WING, OF NEW YORK, N. Y.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 607,580, dated July 19, 1898.

Application filed December 22, 1896. Serial No. 616,599. (No model.)

To all whom it may concern:

Be it known that I, LEVI J. WING, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Gas-Engines, of which the following is a specification.

This invention relates to certain improvements in gas-engines of that class in which an impulse is given at every second rotation of the crank-shaft, said gas-engine being adapted for stationary and marine purposes when used as an upright engine and for motor-wagons when used in a horizontal position and arranged in such a manner that two engines are connected end to end.

The invention consists of a gas-engine which comprises a jacketed cylinder closed at both ends, a reciprocating piston, a piston-rod provided with a cross-head at its outer end, connecting-rods between said cross-head and the crank-shaft, an inlet-valve for the explosive gas-and-air mixture, an outlet-valve for the products of combustion, a valve-gear for operating said inlet and exhaust valves from the crank-shaft, and an electric igniter located in the combustion-chamber and operated by one of the connecting-rods of the piston cross-head.

The invention consists, further, of certain details of construction, such as the combined air-and-water cooling of the cylinder, the igniter, vaporizer and air-heater, &c., which will be fully described hereinafter and finally pointed out in the claims.

In the accompanying drawings, Figure 1 represents a front elevation of my improved gas-engine. Fig. 2 is a side elevation of the same. Fig. 3 is a vertical transverse section on line 3 3, Fig. 1. Fig. 4 is a horizontal section on line 4 4, Fig. 1. Fig. 5 is a detail outside side elevation, drawn on a larger scale, of the electric igniter; and Figs. 6 and 7 are respectively a side elevation and a plan view of two gas-engines coupled together and arranged in horizontal position for use on motor-wagons.

Similar letters of reference indicate corresponding parts.

Referring to the drawings, A represents the supporting base-frame of my improved gas-engine, which is provided at its open opposite ends with pillow-blocks *a* for the crank-shaft B, to one end of which the fly-wheel B′ is applied. On the base-frame A is supported a cylinder C, which is closed at both ends, the closed upper end being provided with a stuffing-box *d′* for the piston-rod D′ of the piston D. To the outer end of the piston-rod D′ is attached a cross-head D^2, to the opposite ends of which are strapped the connecting-rods D^3, which are fitted at their lower ends to the cranks B^2 of the crank-shaft B. The connecting-rods D^3 are arranged at opposite sides of the cylinder and are rotated in the open space arranged in the ends in the supporting base-frame A, adjacent to the pillow-blocks *a a*.

The cylinder C is jacketed at its lower portion, the upper third of the cylinder being not jacketed and provided with air inlet and outlet openings *d* d^2. The openings *d* d^2 are preferably arranged at diametrically opposite points of the upper non-jacketed portion of the cylinder C, the opening *d* being provided with a check-valve $d^\times$, through which the air is drawn to the interior of the closed cylinder C at every downstroke of the piston D. The opposite opening d^2 is connected by a pipe d^3 with the lower part of the jacketed portion of the cylinder C, the lower end of said pipe being provided with a spray-nozzle d^0 for admitting a small quantity of water, which is taken up by the air that is forced through the connecting-pipe d^3 at each upstroke of the piston, so that a body of air mixed with a spray of water is forced into the jacket for cooling the walls of the cylinder C at each upstroke of the piston D. This arrangement is of special advantage whenever a full supply of cooling-water that is forced through the jacket by direct pressure or by a pump is unavailable, as it permits the cooling of the cylinder for a considerable length of time with a comparatively small quantity of water.

The cooling arrangement described is of special advantage when the engine is used for motor-wagons in which only a limited amount of water can be carried for cooling purposes. The jacketed portion of the cylinder is provided at its upper part with an

outlet-opening d^4, to which a pipe is connected, by which the air and the small quantity of water used for cooling at each upstroke of the piston is conducted off. As the body of cooling-air is supplied at each upstroke of the piston and as the explosion takes place at every second rotation of the crank-shaft, two bodies of air and water are forced through the jacketed portion of the cylinder, one at each rotation of the crank-shaft, so that thereby the cylinder can be kept cool for a considerable length of time with a comparatively small quantity of water. In stationary and marine engines a larger body of water may be supplied to the air forced to the jacketed portion of the cylinder or the latter cooled entirely by means of water in the usual manner.

The piston D is provided with suitable packing and is reciprocated in the cylinder, the reciprocating motion of the piston corresponding to the stroke of the cranks B^2. The combustion-chamber C′ is located in the lower part of the cylinder C, adjacent to the supporting-frame A, and is provided at diametrically opposite sides at right angles to the crank-shafts with an inlet-valve E and an exhaust-valve F. Intermediately between said inlet and outlet valves E and F is arranged the electric igniter G. The valve-gear of the inlet and exhaust valves E and F is actuated by a gear-wheel transmission e' e^2 e^3 from the crank-shaft B, the gear-wheel e' being applied to the crank-shaft, the gear-wheel e^2 to a short intermediate shaft on the supporting-frame A, and the gear-wheel e^3 to an auxiliary shaft e^4, which is supported in bearings of inclined bracket-arms e^5, that are bolted to the side and rear parts of the supporting-frame A. The auxiliary shaft e^4 is provided with two cams e^6 e^7, of which the cam e^6 acts on an antifriction-roller at the lower end of a valve-lever e^8, which is fulcrumed to one of the bracket-arms e^5, while the upper end presses on the outer end of the stem of the exhaust-valve E, which latter is opened against the tension of a helical spring e^9, that is interposed between the casing E′ of the exhaust-valve E and a collar e^{10} on the valve-stem, as shown in Fig. 3. The cam e^7 on the auxiliary shaft e^3 acts at each rotation of the shaft e^4 on the end of a rod e^{11}, that is guided in openings of the base-frame A and held in contact with the actuating-cam e^7 by a helical spring e^{12}, attached to the end of the rod f and the base-frame A, as shown in Fig. 3. The opposite end of the reciprocating guide-rod e^{11} is pivoted to the lower end of a lever f, that is fulcrumed to a bracket-arm f' at the front of the base-frame A, and the upper end of which presses on the outer end of the stem of the inlet-valve F. Between the casing F′ of the inlet-valve F and a collar f^2 on its valve-stem is interposed a helical spring f^3, against the tension of which the inlet-valve is opened and which serves to return the inlet-valve F into closed position. The valve-casings E′ F′ of the exhaust and inlet valves E and F are provided with threaded shanks that are screwed into threaded openings located at diametrically opposite points of the combustion-chamber C′, as shown in Fig. 3.

The products of combustion are exhausted through a pipe E^2 on the casing E′ of the exhaust-valve E, around which exhaust-pipe is arranged a cylindrical shell H, which is closed at both ends and provided at that end adjacent to the exhaust-valve with a number of air-openings h, through which the air is drawn into the shell, so as to be heated by the heat of the products of combustion which are forced through the exhaust-pipe E^2. The opposite end of the air-heating shell H is connected by a downwardly-extending pipe h' with a horizontal pipe h^2, that leads to a vaporizer V, which is supported on the base-frame A of the engine. The horizontal pipe h^2 is provided at its point of connection with the upwardly-inclined pipe h' with a stop-cock h^3, through which a certain quantity of air of ordinary temperature can be drawn in when it should be required for producing the mixing of the air in proportions with the gas or vapors supplied to the combustion-chamber of the cylinder. The vaporizer V is connected by a pipe i with a suitable reservoir containing the hydrocarbon oil and with a petcock i' for draining off the surplus oil from time to time from the reservoir. The oil-supply pipe i of the vaporizer V is provided with a needle-valve h^4, which is actuated by an elbow-shaped arm h^5, that is attached to the reciprocating guide-rod e^{11}, so that at every second rotation of the crank-shaft the valve is operated and a certain quantity of oil injected into the vaporizer, evaporated by the hot air drawn into the vaporizer, mixed with the air in the required proportions, and supplied by a pipe h^6 to the inlet-valve F, and thence to the combustion-chamber of the cylinder C. Any approved construction of vaporizer may be used, as I do not desire to confine myself to any special construction of the same.

The igniter G is formed of a casing g, having an exterior flange g', that abuts against a corresponding seat g^2 at the lower part of the cylinder C. The casing g is inserted into a corresponding opening of the combustion-chamber C′ and attached to the seat g^2 by fastening-bolts. It is provided with a straight interior face and with two parallel bore-holes, one for a spindle g^3, that is insulated from the casing g by a sleeve g^4, of insulating material, the other for a shaft g^5, which carries at its outer end a gear-wheel g^6. The gear-wheel g^6 meshes with a pinion g^7, which is pivoted to the casing g and provided with a crank-arm g^8, having a pin g^9 at its outer end that engages a slot g^{10} in one of the connecting-rods D^3, adjacent thereto, as shown in Figs. 4 and 5. The oscillating motion of the con-

necting-rod D^3 imparts a rotary motion to the crank-arm g^8 and by means of the pinion g^7 and gear-wheel g^6 rotary motion to the shaft g^5. At the inner end of the shaft g^5 is arranged a wing g^{11}, which engages at every second rotation of the crank-shaft a projection g^{12} on the pin g^3 for the reason that the gear-wheel g^6 has twice the number of teeth as the pinion g^7. The outer end of the pin g^3 is connected with a spring g^{13}, that is attached to a binding-post g^{15} on a bracket g^{14}, attached to the base-frame A, (shown in Figs. 4 and 5,) said spring g^{13} "giving" sufficiently for permitting the wing g^{11} to pass the wing g^{12} at every rotation of the shaft g^5 and returning the wing g^{12} into its normal position as soon as the wing g^{12} has passed beyond the same. The spring g^{13} is held in contact with a contact-spring g^{16} by the binding-post g^{15} and in electric circuit with a battery the opposite pole of which is connected with a binding-post on the base-frame A, as shown in Fig. 4.

At every rotation of the gear-wheel g^6 and its shaft g^5 the wing g^{11} forms contact with the wing g^{12} on the insulated pin g^3 and moves past said wing against the tension of the spring g^{13}, which slides sufficiently for this purpose in the slitted outer end of the pin. As soon as the contact between the wing g^{11} and the projection g^{12} is interrupted a spark is produced by which the explosive gas-and-air mixture compressed in the combustion-chamber by the downward stroke of the piston is ignited. This ignition of the charge takes place at every second downstroke of the piston, the engine being operated in the well-known manner of gas-engines of this class, in which the explosive gas-and-air mixture is drawn in by the upstroke of the piston, compressed by the downstroke of the same, and then ignited, the force of the explosion moving the piston in upward direction, while the downward stroke of the piston forces the products of combustion through the exhaust-valve to the outside. The regular rotation of the crank-shaft is kept up by the momentum imparted to the fly-wheel, while the proper motion of the inlet and exhaust valves is so timed that the different operations take place at the proper time. The location of the combustion-chamber next to the crank-shaft and the connection of the piston-rod by a cross-head and connecting-rods with said crank-shaft moves the piston away from the shaft and produces the drawing up of the cranks instead of pushing them up, as heretofore, so that a small and compact engine with long connecting-rods and small angle of oscillation is obtained.

When the engine is intended to be used for motor-wagons, it is preferable to combine two engines and support them in a horizontal position below the wagon-body, so that their cylinders are in line with each other, while the base-frames are coupled together so as to form the connection between the cylinders. This arrangement is shown in Figs. 6 and 7, in which the connecting-rods of both cylinders are applied to the same crank-shaft from which rotary motion is transmitted to the driving-axle of the motor-wagon by any suitable transmitting mechanism. This arrangement requires a slight change in the disposition of the inlet and exhaust valves and requires that the explosion in one cylinder alternates with the explosion in the other cylinder, which permits the large fly-wheel to be dispensed with and a smaller fly-wheel substituted in place thereof, as the cranks of the crank-shaft are moved over their dead-points by the momentum imparted thereto alternately by the force of the explosions. The cylinders are cooled in the manner before described by injecting a quantity of air mixed with a spray of water at each upstroke of the piston into the jacketed portion of the cylinder. By coupling two engines together in the manner described the valve-gear of the inlet and exhaust valves can be simplified and a very effective motor for vehicles supplied that takes up a comparatively small space only and can be run with a small quantity of cooling-water.

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

1. In a gas-engine, the combination, with a single cylinder closed at both ends and having a jacketed portion, of a piston in the cylinder, a valved air-inlet opening in the unjacketed portion of the cylinder, an air-outlet opening in the unjacketed portion, a pipe connecting said air-outlet opening with the jacketed portion of the cylinder, a water-supply nozzle in said connecting-pipe, and an outlet-pipe for said jacketed portion, substantially as set forth.

2. In a gas-engine, the combination with a single cylinder closed at both ends and having a jacketed portion, of a piston in the cylinder, a piston-rod provided with a cross-head at its outer end, connecting-rods between said cross-head and the crank-shaft, an inlet-valve for the explosive air-and-gas mixture, an outlet-valve for the products of combustion, a valve-gear for operating said inlet and exhaust valve from the crank-shaft, and an electric igniter located in the combustion-chamber and operated by one of the connecting-rods of the piston cross-head, substantially as set forth.

3. In a gas-engine, the combination, of a cylinder having a combustion-chamber at one end, an igniter in said combustion-chamber, an insulated pin passing through the casing of the igniter and being connected at its outer end with a source of electricity and provided at its inside with a wing or projection, a rotary shaft in said casing provided with a wing at the inner end that forms intermittent contact with the projection on said pin, a crank-arm pivoted to the igniter-casing and connected by a pin with a slot in one of the connecting-rods of the engine, a pinion on the

pivot of said crank-arm, a gear-wheel on the rotary shaft meshing with said pin, said gear-wheel having twice the number of teeth as the pin so as to produce one rotation of the wing for every two rotations of the crank-arms, substantially as set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

LEVI J. WING.

Witnesses:
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