(No Model.) 3 Sheets—Sheet 1.

R. F. SMITH.

GAS ENGINE.

No. 345,998. Patented July 20, 1886.

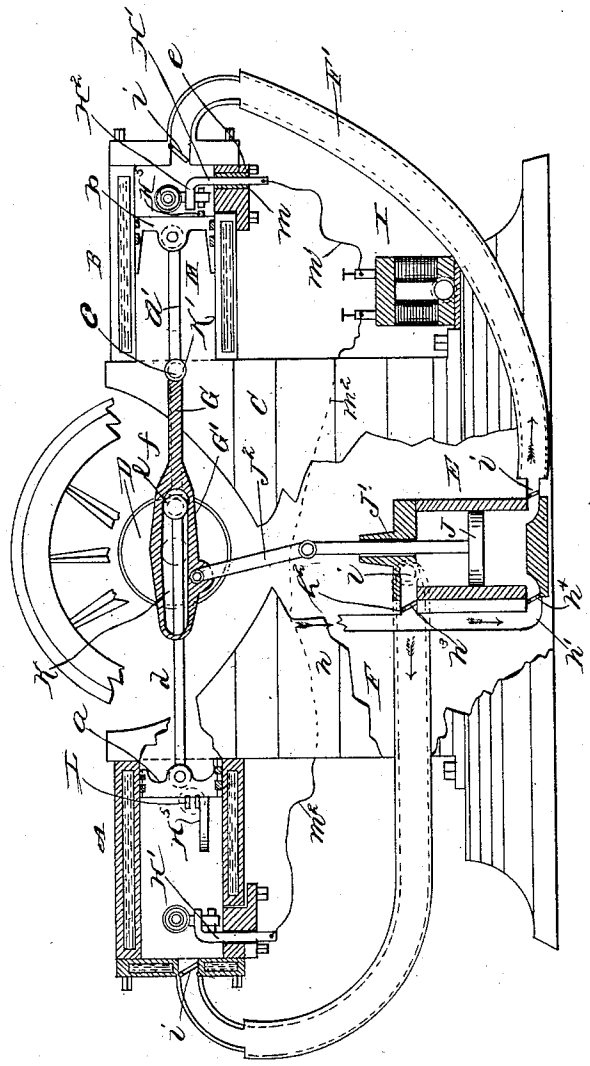

Fig. 7.

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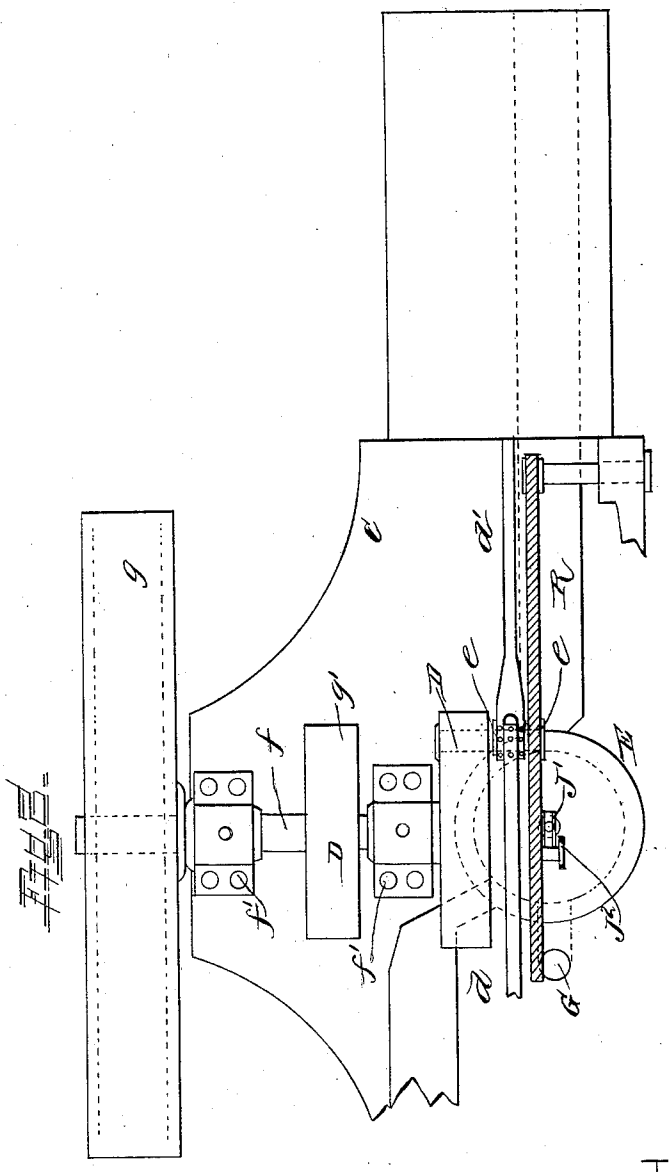

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Fig. 3.

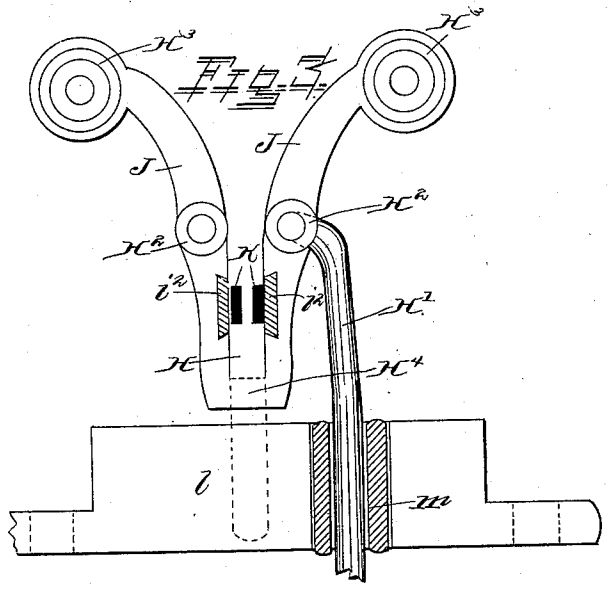
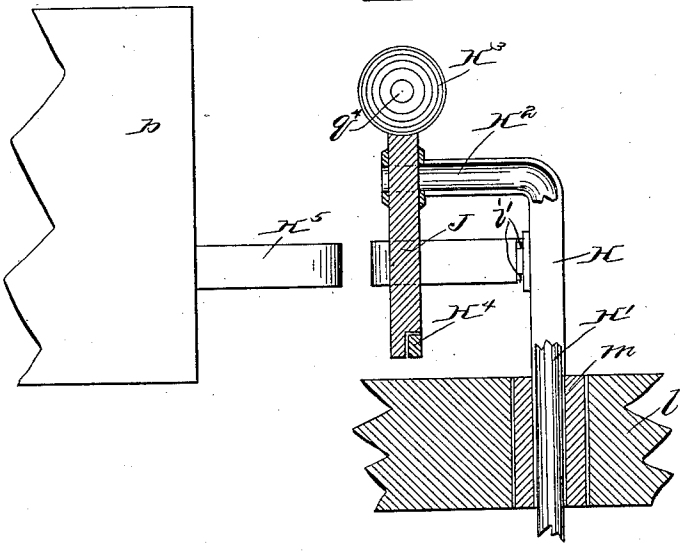


Fig. 4.



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UNITED STATES PATENT OFFICE.

REUBEN F. SMITH, OF ATCHISON, KANSAS.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 345,998, dated July 20, 1886.

Application filed October 27, 1885. Serial No. 181,074. (No model.)

To all whom it may concern:

Be it known that I, REUBEN F. SMITH, a citizen of the United States of America, residing at Atchison, in the county of Atchison and State of Kansas, have invented certain new and useful Improvements in Gas-Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention pertains to improvements in gas-engines, having in particular for its object to produce two explosions, and thus secure two effective strokes, at each revolution of the fly-wheel; and to this end the invention consists of sundry combinations of parts, substantially as hereinafter set forth, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a sectional and partly side elevation of my invention. Figs. 2, 3, and 4 are detail views thereof, the first-named view being taken partly in section and plan, while the two latter are partly in section and side elevation.

In the embodiment of my invention I employ two power-cylinders, A B, which are suitably mounted and secured upon a frame or support, C, one at each end of the latter and in alignment with each other. These cylinders are fitted, one with a piston, *a*, and the other with a piston, *b*, whose construction is obvious from Fig. 1, and which pistons are pivotally connected to the rods *d d'*, respectively, the latter being similarly connected to the wrist-pin *e* of the crank, disk, or eccentric D, its said pin or point of application of its action being eccentric to its axis. The inner or wrist-pin end of the piston-rod *d'* is forked, so as to receive the same end of the piston-rod *d*. The eccentric or crank D is secured upon one end of a shaft, *f*, suitably journaled in boxes or bearings *f'*, secured upon the support C, and which shaft carries a fly-wheel, *g*, and a driving-pulley, *g'*, all of any approved form of construction.

E is the barrel or cylinder of the double-acting pump, suitably disposed with relation to the aforesaid parts, and which is supplied with air and gas by a pipe, *h'*, (the gas-pipe connection not shown,) and with said cylinder or barrel at the upper and lower ends by arms *h' h²*, the feeding of which gas and air is controlled by any suitable form of governor. The arms *h' h²* of the pipe *h* are provided with check-valves *h³ h⁴*, respectively, one, *h³*, admitting air and gas into the cylinder or barrel above the piston (presently described) during its downstroke, and the other, *h⁴*, admitting air and gas into the cylinder or barrel below the piston during its upward stroke.

The cylinder or barrel E is connected at its upper end by a pipe, F, with the cylinder A, said pipe connecting with the latter at its outer closed end, while the lower end of the said cylinder is connected by a pipe, F', with the cylinder B, said pipe F' also connecting with the outer closed end of the cylinder B. The upper and lower ends of the pipes F F' are each provided with a check-valve, *i*, those at the upper ends of the pipes F F' opening into the cylinders A B, and those at the lower ends of said pipes opening into the said pipe.

The cylinder or barrel E is fitted with a piston, *j*, which is provided with a rod, *j'*, fitted air-tight in the upper end or head of the cylinder or barrel, and pivoted to a link, *j²*, in turn pivotally connected to the lower side of and about midway an enlargement, G', of the lever G, which enlargement is provided with a slot, *k*, which receives and within which works the wrist-pin *e* of the crank or eccentric D, in order to actuate the pump-piston. The opposite or outer end of the lever or pitman G is pivoted to the support C at *k'*. The exhaust-ports L are on the sides of the power-cylinders, and uncovered by their pistons at end of power-stroke.

Within each of the cylinders A B, near the receiving end—*i. e.*, that end at which the air and gas are supplied to said cylinders by the pipes F F'—is disposed an igniting apparatus, the construction of which is as follows:

H H' are two uprights or supports for levers, (presently described,) one, H, being let into a socket, as seen in dotted lines in Fig. 3, in a block or base, *l*, with its greater or upper reduced portion let into an opening in the bottom of each of the cylinders A B, the lesser portion being extended and forming a flange around the lower edge of the upper portion, for the reception and passage through it of fastenings or bolts to permit of the bolting or securing of the same to the cylinder. The

other upright or support, H′, is passed through and held in an insulator, *m*, secured in an aperture of the block *l*. One bar or support, H′, of one cylinder is connected by a wire, *m′*, to one pole of a dynamo-electric machine, I, while the bar or support H′ of the other cylinder, A, is connected by a wire, m^2, to the other pole of the said machine. The upper ends of the supports or uprights H H′ are provided with arms H^2, formed at about right angles to their lower vertical portions and arranged about parallel to each other, as shown in Figs. 3 and 4.

J J are two levers, fulcrumed at about their middles, one upon each of the arms H^2 of the supports or uprights H H′, said levers being curved at their upper portions outwardly away from each other and weighted at their extreme upper ends, as at H^3, while their lower ends are formed with lapping projections H^4, one of which latter abuts against the lower end of the opposite lever to form a contacting surface between said levers. To the upright or support H are hinged at *i′ i′* two parallel plates, K K, which are so arranged as to extend intermediately of the levers J J at their forward ends, the points of contact between said levers and plates being insulated by means of pieces of porcelain, i^2 i^2, or other electrical non-conductor. The outer free ends of these plates K are relatively divergent to permit of ready access between the same.

Fixed to the opposite surface or face of each of the pistons *a b* is a beveled finger or projection, H^5, which is arranged in a plane passing between said plates K, to enable, as the finger or projection is moved by the action of the piston between said plates, the separation of the abutting and lapping lower ends, H^4, of the weighted levers J, in order to effect the breaking of the circuit, and thus generate a spark in the explosion-chambers of the cylinders A B, to ignite the charge, which will result in an explosion, one in each cylinder, whereby two effective strokes of the pistons *a b* will be obtained at one complete revolution of the fly-wheel upon the driving-shaft *f*.

The operation is as follows: Assuming a charge of air and gas to be in front of the piston *b* of cylinder B under compression and the finger or projection H^5 separating the contacting points H^4 of the levers J, an explosion, as above stated, will occur, when the piston *b* will begin to move on its power stroke. At the time of the explosion or ignition of the air and gas in front of the piston *b* of cylinder B the piston *a* of cylinder A will be at the extreme end of its stroke, allowing the exhaustion of the products of combustion arising from the explosion previous, which occurred in the latter cylinder, through the port L. During the latter part of this stroke, and while the products of combustion are being exhausted, the pump-piston is forcing a charge of air and gas through the pipe F into the cylinder A. Upon the return-stroke of the piston *a*, closing the exhaust-port L and compressing the charge in the cylinder A, the pump-piston is delivering a previously-received charge of air and gas through the pipe E and past the valve *i*, which is to enter the cylinder B the instant the piston *b* uncovers the exhaust-port M. Of course, as soon as the finger H^5 of the piston *a* or *b* is withdrawn from between the plates K K the weights H^3 at the upper ends of the levers J will instantly bring or swing the lower contacting ends, H^4, of said levers together, and thus re-establish the circuit of electricity, which will be broken in the other cylinder in the manner above described, the circuit thus being alternately broken and established in the two cylinders. It will be here remarked that the pump-piston *j* is about one-quarter stroke in advance of the power-pistons of the cylinders A B—*i. e.*, the pump-piston commences to deliver its charge of air and gas into the pipe F or F′ about when the power-stroke of the piston *a* or *b* is half completed, thus securing sufficient pressure in the pipes to deliver the charge into the cylinder as soon as the exhaust-port is open or uncovered. The downstroke of the pump-piston *j* delivers a charge into pipe F′ for cylinder B, and draws in a charge from above to send to the cylinder A during the upward stroke of the piston *j*. It will be further seen that the insulated uprights or supports H′ of the one lever J of each pair of said levers being connected by the conductors to the two poles of the dynamo-machine, the electric current flows from the latter along one of the said conductors and through one of the said insulated bars or supports and through the two levers in one cylinder, the current passing through the contact-points of said levers. It then passes through the engine to and through the levers and their contact-points and supports in the other cylinder, and to and along the conductor connecting the same with the other pole of the dynamo, thus forming the circuit.

Having thus fully described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In an air and gas engine, the combination of the two cylinders, their pistons, a double-acting air and gas pump adapted to alternately charge each cylinder, and the igniting apparatus, the same being arranged in an electric circuit, substantially as and for the purpose set forth.

2. In an air and gas engine, the combination, with the engine-cylinders, the piston-rods, and their pistons, of the air and gas pump connecting by valved pipes with said cylinders, the pump-piston rod, and the link connected to said pump-piston rod and to a lever or pitman pivoted to a fixed point, and having a slot which receives the wrist-pin of the driving-shaft eccentric or crank, substantially as and for the purpose specified.

3. In an air and gas engine, the combination, with the engine-cylinder and its piston, of the igniting apparatus comprising the levers having weighted upper ends and lower contacting

ends, said piston being adapted to separate said levers at their contacting points, the same being arranged in an electric circuit, substantially as and for the purpose specified.

4. In an air and gas engine, the combination, with the engine-cylinder and its piston carrying a projection or finger, of the igniting apparatus carrying the weighted levers having contacting points, and the insulated lever-support having the hinged parallel plates, the same being arranged in an electric circuit, substantially as and for the purpose specified.

5. In an air and gas engine, the combination, with the engine-cylinders and their pistons having projections or fingers, of the weighted levers having lower contacting points and the lever-supports, one having hinged parallel plates insulated from the levers, one of a pair of the supports of said levers in one cylinder having connection with one pole of a dynamo-electric machine, and the one of a pair of the lever-supports in the other cylinder having electrical connection with the other pole of said machine, substantially as and for the purpose set forth.

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

REUBEN F. SMITH.

Witnesses:
B. F. TALBOTT,
W. W. A. SMITH.