(No Model.)

3 Sheets—Sheet 1.

H. S. MAXIM.

GAS MACHINE.

No. 250,561. Patented Dec. 6, 1881.

Fig 1.

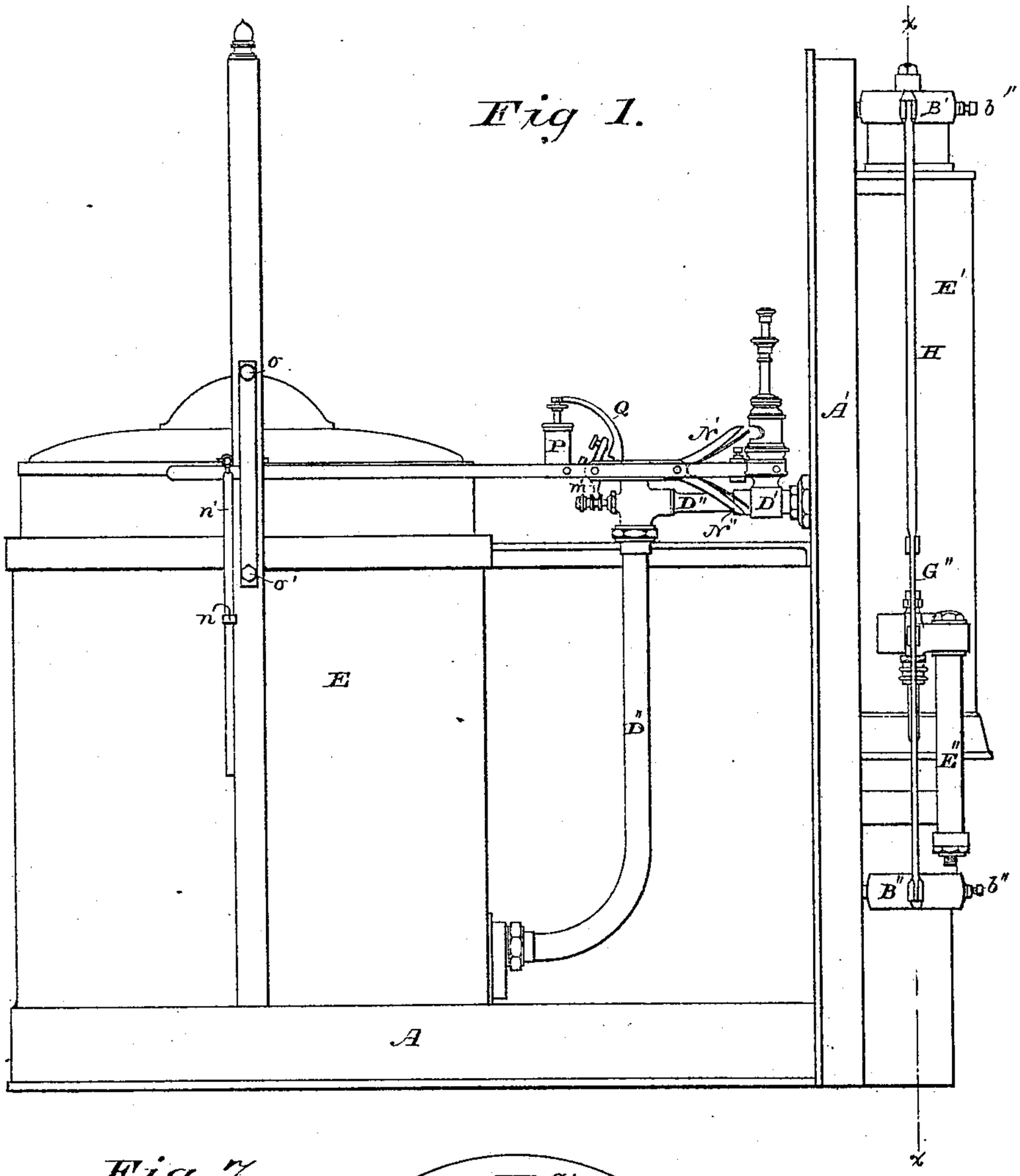
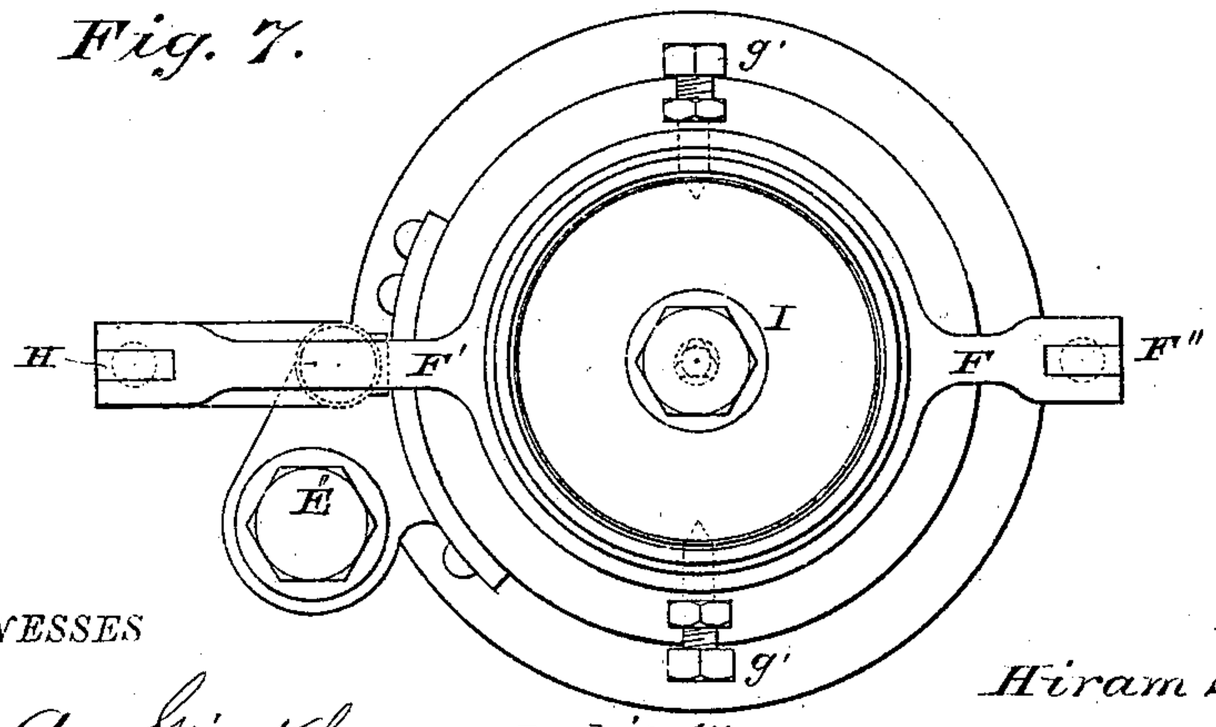


Fig. 7.



WITNESSES

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(No Model.) 3 Sheets—Sheet 2.

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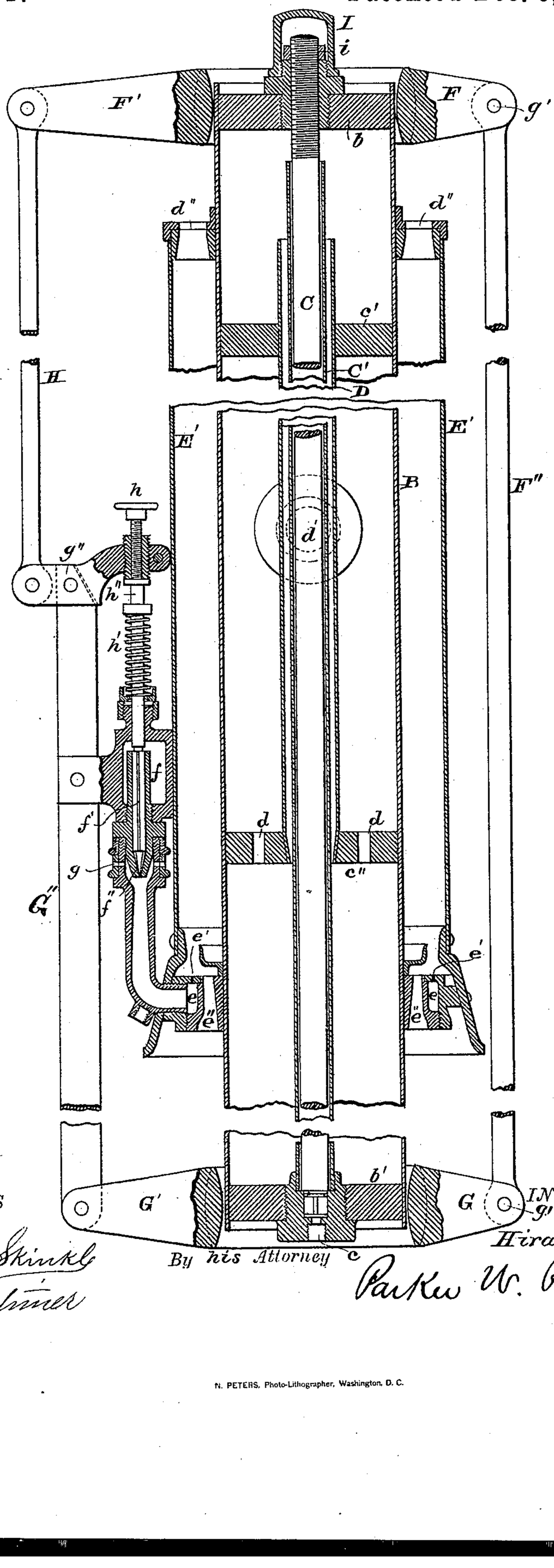
Fig 2



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(No Model.) 3 Sheets—Sheet 3.

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Fig. 3.

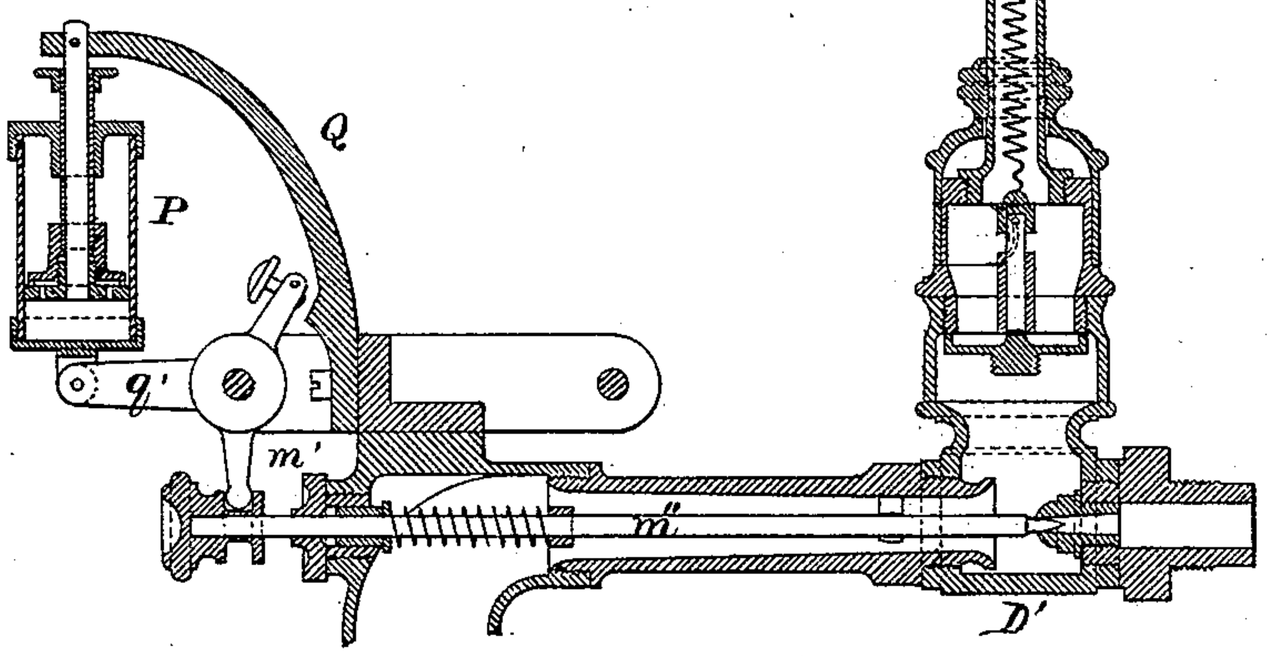


Fig. 4.

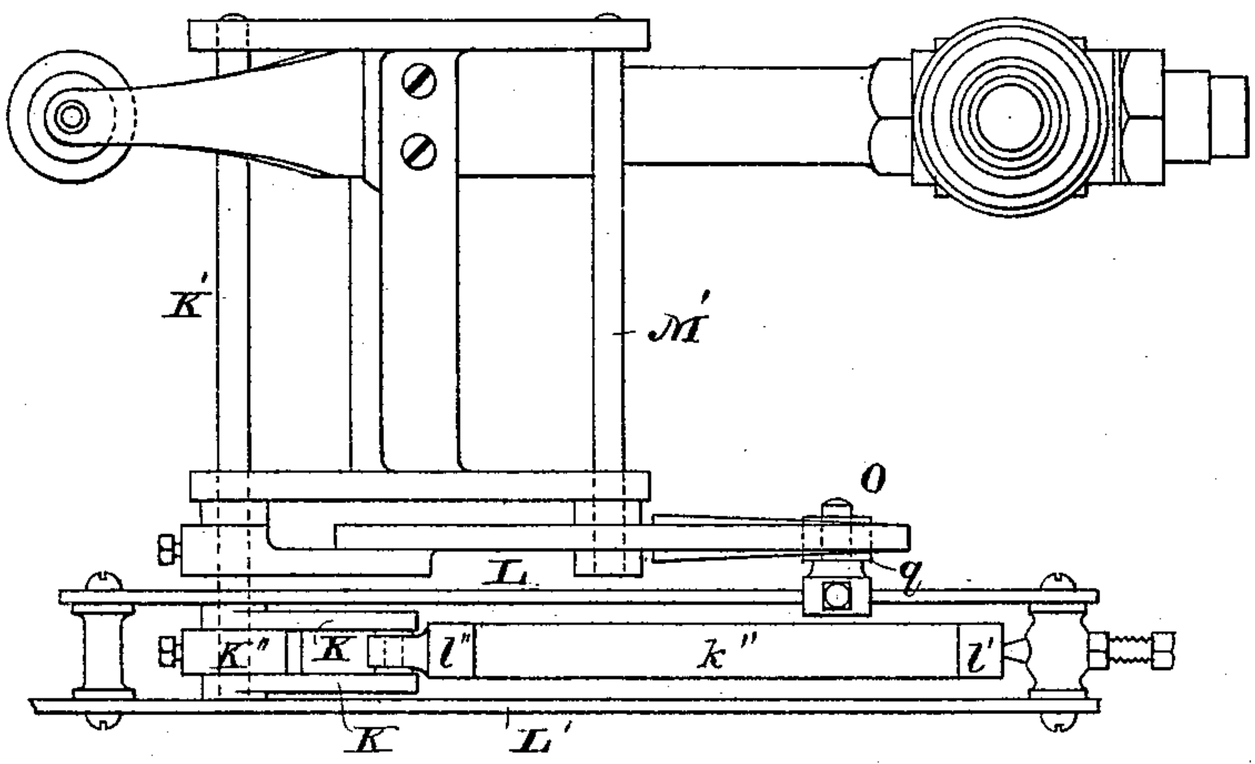


Fig. 5.

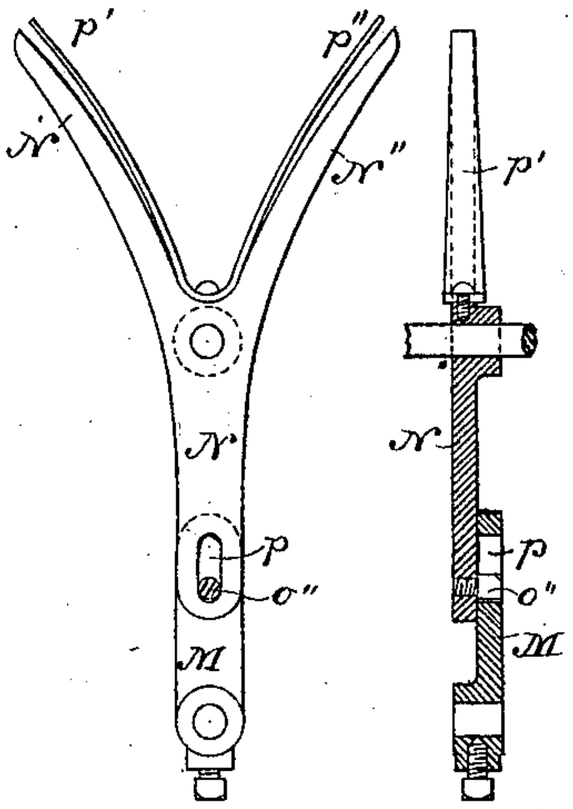
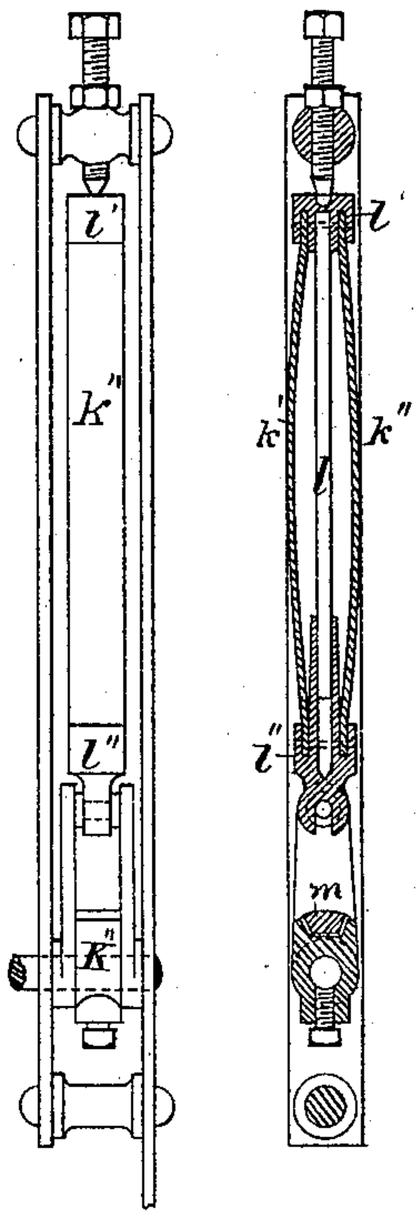


Fig. 6.



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UNITED STATES PATENT OFFICE.

HIRAM S. MAXIM, OF BROOKLYN, NEW YORK, ASSIGNOR TO THE MAXIM MANUFACTURING COMPANY, OF NEW YORK, N. Y.

GAS-MACHINE.

SPECIFICATION forming part of Letters Patent No. 250,561, dated December 6, 1881.

Application filed August 20, 1881. (No model.)

To all whom it may concern:

Be it known that I, HIRAM S. MAXIM, of Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Gas-Machines, of which the following is a specification, reference being had to the drawings accompanying and forming a part thereof.

My invention relates to machines in which a hydrocarbon fluid—such as gasoline or naphtha—is volatilized and then mixed with a definite proportion of air to form a gas of uniform density suitable for general purposes of heating or illumination. In numerous patents granted to me machines of this character are shown and described, which, while differing in many particulars with respect to the details of construction, involve alike certain characteristics that may be described in general terms as consisting of a vaporizing-tank, a device whose functions are to mix the pure hydrocarbon vapor with air, and by regulating the amount of air admitted to the mixing-chamber to maintain the proportions constant, mechanism operating to open or close the valves at the proper time, and a reservoir for containing the gas when made.

The present invention embraces certain devices, automatic in their action, that are applicable to machines of this kind, said devices consisting, in the main, first, of mechanism for shutting off the supply of the liquid hydrocarbon at the proper time to prevent flooding of the apparatus; second, of an improved heating apparatus for effecting the vaporization of the liquid; third, devices for regulating and controlling the heat so applied.

The invention involves, further, certain improvements in the construction of the apparatus and the various devices used in connection therewith, the nature of which will be more fully explained hereinafter.

In the accompanying drawings, Figure 1 is a side view, in elevation, of my improved apparatus complete; Fig. 2, a sectional view of the same on line *x x* in Fig. 1; Fig. 3, a vertical sectional view of the devices for mixing the gas with air, with portions of the valve mechanism employed therewith. Fig. 4 is a plan of the same, with the addition of a safety device for operating the valves; Fig. 5, side and sectional views of a detached portion of the said valve mechanism; Fig. 6, plan and sectional views of details included in the valve mechanism; and Fig. 7 is a plan view of the heating apparatus.

In all previous instances of gas-machines in which a liquid hydrocarbon is volatilized and stored, as in the present case, the apparatus for effecting the vaporization and for storing the gas have been, so far as I am aware, constructed without regard to the relative positions in which they are designed to be used, except in so far as provision is always made for their location in separate apartments, or for the intervention of a wall between the two, this being a matter of great importance, as the storage apparatus should, as far as is practicable, be isolated from the heater, as a matter of precaution in the event of leakage, or the water in the reservoir becoming exhausted. For these reasons it has been necessary, in constructing a partition between the gas-containing reservoir and the heating apparatus, to wall up around the large pipe or tube serving as a means of communication between the two. My present machine is constructed with special reference to avoiding the difficulties which this entails, and for this purpose I secure the gas-reservoir to a bed-plate or base, A, to the end of which is fixed an upright plate of iron, A′, having the central portion of a thickness equal to that desired for the wall. Through the plate A′ the connecting-tube passes, so that in separating the two parts by a wall or partition the bricks or stone are laid directly against the even edge of the thick portion of the plate. By this means the plate forms a portion of the partition, and the difficulties of walling-up around a circular pipe are avoided.

The devices for effecting the vaporization of the liquid hydrocarbon are as follows:

B is a cylindrical copper tank, which, for convenience, will be called the "heater," closed at both ends by heads *b b′*. The heater is supported by the plate A′, and has attached to its ends metallic rings B′ B″, by means of pivoting-screws *b″*, as shown in Fig. 1. In the bottom of heater B is an inlet, *c*.

C is a steel rod, secured to the head *b* of the

heater, and extending downward over inlet *c*, closing the same when the apparatus is cool.

C′ is a brass tube, secured to head *b′*, and surrounding the rod C, a space of about one-sixteenth of an inch intervening between the two. The tube C′ extends nearly to the top of the heater, or to within a short distance of the head *b*. The heater B is divided by partitions *c′ c″* into three compartments, the partition *c′* being near the top, and that designated *c″* being near the bottom of the same.

D is a copper tube surrounding the tube C′, and forming a communication between the upper and lower compartments of the heater. Tube D extends for a short distance above the partition *c′*, for purposes hereinafter set forth. The lower partition, *c″*, contains a number of perforations, *d*. An outlet-tube, *d′*, communicates from the central compartment of the heater with the mixing-chamber D′. This latter is of the usual construction and contains a needle-valve, through which the gas is forced into the chamber, where it is mixed with air drawn down through a spring-valve and forced onward through a pipe, D″, to the reservoir E.

E′ is a metal case surrounding the heater, provided at the bottom with a circular burner, and at the top with apertures *d″*, for allowing the heated air and products of combustion to escape. The base of said casing contains a circular tube or chamber, *e*, having perforations *e′* and air-spaces *e″*, for supplying air to the burners. The chamber *e* communicates by a tube with devices for supplying an inflammable gas, said devices consisting of the following parts: A cylinder, E″, for containing and heating naphtha or some equivalent liquid, the interior of which cylinder communicates, by means of a passage, *f*, with an apparatus for mixing the gas given off from the naphtha when heated, the construction of said apparatus being similar in principle to that of the mixing-chamber D′, and consisting of a valve-stem, *f′*, and needle-valve *f″*, immediately over which are a number of perforations, *g*, for the admission of air.

F F′ and G G′ are arms projecting from the rings B′ B″ at points about midway between the pivoting-screws *b″*.

F″ is a bar or rod of iron connecting the ends of arms F and G, the connections being formed by pivoting-pins *g′*. G″ is a similar bar connected to the end of arm G′, and rigidly secured to the heater or its inclosing-case, and to the plates A′, as shown in Fig. 2.

H is a rod hinged to the end of arm F′ and connected to the end of rod G″ by a hinged lever, *g″*. The end of said lever *g″* is provided with an adjusting-screw, *h*, against the end of which is caused to bear, by the spiral spring *h′*, a stem, *h″*, passing down into the gas-chamber *f* through an air-tight gland, and forming a prolongation of valve-stem *f′*.

The operation of the above-described devices constituting the gas-generating apparatus proper is as follows: Assuming, primarily, that the burners around the heater are lighted, the tube or heater is expanded, and as its temperature is higher than the more protected rod C, besides being composed of a metal having a greater rate of expansion than the said rod, the inlet *c* is opened, and gasoline, under a pressure of about fifteen pounds, is introduced. The liquid passes up through the tube C′, around the rod C, and into the upper compartment of the heater. Here it is boiled and driven up by the heat to the mouth of the tube D, down which it passes to the lower compartment, above described. The portions which reach this point in liquid form are retained in the bottom of the tank until volatilized, the remainder, in the form of gas, being forced up through perforations *d* into the central compartment of the heater, from whence it is forced out through tube *d′* to the mixing apparatus and the reservoir. The gas for supplying the burners is obtained in a somewhat similar manner. Naphtha is introduced into cylinder E″ under a light pressure. Here, by the proximity of the cylinder to the burners, or by means of an external source of heat, the naphtha is boiled and vaporized. The vapor is driven out into chamber *f* and then down around the valve-stem *f′* through valve *f″*, taking up in its passage an admixture of air through the ports *g*. From the valve *f″* the mixed gases pass to the chamber *e* and up through the perforations *e′*, where they are ignited. Assuming, now, that the apparatus is in operation and that all the parts in action are performing their alloted functions under normal conditions, no movement of the said parts is taking place while the supply of gasoline through the valve *e* and of naphtha-vapor to the burner is continuous. Should the burner impart too high a temperature to the heater, or the supply of naphtha-vapor be at all in excess of the requisite amount, the tube or heater B is expanded, so as to raise the arm F′ and rod H and depress the end of lever *g″* until the screw *h* forces down the stem *h″*, thus closing more or less the valve *f″* and limiting the supply of naphtha-vapor passing to the burner. In this way the heat imparted by the burner is utilized as its own regulator, causing, through the action of the above-described devices, the valve *f″* to close as the heat rises above a certain point, and allowing it to open as the temperature is too much reduced. The screw *h* is employed to adjust the position of the valve-stem and regulate the supply of gas for any given temperature, and also for controlling the supply of the same when the burner is first lighted.

It will be observed that the above results are due to the unequal expansion of the copper tank B and the rod F″. The former in all cases should be made of a metal having a greater coefficient of expansion than the latter, and when, in addition to this, it be remembered that the rod F″ is less exposed to heat than the tube B, it is plain that a considerable range of motion will be given to the arm F′ and rod H.

When the burners are extinguished, either

by accident or design, it is essential that the supply of gasoline be stopped. This is effected by the steel rod C, which closes the aperture *c* when the copper tube cools.

It will be observed that the rod C′, from the construction and arrangement of the parts described, is prevented from being heated or expanded at any portion of its length by the surrounding stream of cool gasoline which is forced up around it. From this it follows that the supply of gasoline can never be shut off, except in the event of the apparatus cooling down to a certain point. To determine this point the rod C is made adjustable in the head *b*, through which its threaded end passes. For additional protection against leakage or the escape of gas the protruding screw-head of the rod C, with its clamping-nut *i* attached, is inclosed by a screw-cap, I, which may be readily taken off when it is desired to gain access to the rod C for the purpose of adjusting it. The gas, after being forced from the heater, and receiving its admixture of air, is carried, as above stated, through pipe D″ to the reservoir or containing-tank E. The pipe D″ extends out for some distance from the plate A′ at right angles, and forms a support for the valve-gear, which in its mode of operation is similar, in many respects, with those described in my former patents.

K is a lever swinging freely on the end of a rock-shaft, K′, and carrying at its end a frame, L L′. Between the two sides of said frame, on the rock-shaft K′, is a short arm or stop, K″, between a shackle, *k*, that forms one part of a toggle, the other part of which is formed by the flat steel springs *k′ k″*, and brass rod *l*, attached to head *l′*, and arranged to slide in the opposite head, *l″*. The end of the stop K″ has two forks at the end, between which works a lug or cross-piece, *m*, so that as the toggle passes the center it will act upon the stop or arm K″ with a slight blow, thus rendering more certain the moving of the same, the turning of the rock-shaft, and the consequent closing of the valves through the intervention of a toe, *m′*, fixed to said shaft and engaging with the end of a spring valve-stem, *m″*. As the gas-reservoir E rises or falls the lever K is moved at a point determined by the position of an adjustable stop, *n*, on a rod, *n′*. The movement of lever K causes the end of L L′ to rise or fall, thus compressing the springs *k′ k″* and forcing them apart. As soon as the parts pass the center line, however, the springs straighten, bend the toggle in the opposite direction to the movement of lever K, and turn the rock-shaft K′, thereby opening or closing the valves, as the case may be. The extremes of motion of the lever K are determined by a guide fixed to a stationary part of the gas-reservoir and containing stops *o o′*.

It sometimes happens that the toggle alone is not sufficient to operate the valves, and to provide against such contingencies I employ supplementary devices for insuring the proper action of the valves, the general character of which has been illustrated in a former patent. The devices employed in the present instance, however, are an improvement on those hitherto employed, and consist of an arm, M, fixed to a rock-shaft, K′, and a forked lever, N, having arms N′ N″, which swing freely on a shaft, M′, in a light frame supported by pipe D″. The lever N connects with arm M by a pin, *o″*, that works in a slot, *p*, as shown in Fig. 5. Between the arms N′ N″ are arranged flat springs *p′ p″*.

To the bar L, forming one side of frame L L′, is adjustably secured, by a screw or clamp, a pin, O, projecting out between the arms N′ N″ and carrying a small roller, *q*. As the frame L L′ is raised or depressed it brings the roller *q* toward one or the other of arms N′ N″, and should the toggle for any cause fail to operate the roller effects the requisite movement in the rock-shaft by raising or lowering the lever N. The purpose of the springs *p′ p″* is to prevent a too sudden movement of the lever N, the pressure exerted by the roller being gradual and even.

Fixed to the pipe D″, or the frame supported thereby, is a standard, Q, to the end of which is connected a piston-rod of a dash-pot, P. The dash-pot is carried by an arm, *q′*, on the rock-shaft K′, and is raised or lowered by the movement thereof, the piston remaining stationary. This prevents too sudden movement of the rock-shaft and valve mechanism, and avoids any jarring or concussion of the parts.

In many respects the devices composing the above-described apparatus may be varied and the old forms substituted for those shown. Possible modifications are not, however, described, as their number is very great. I would also state that several parts of the apparatus have been described only so far as is necessary to an understanding of the present case, for the reason that they form already the subject-matter of patents heretofore granted to me.

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

1. In an apparatus for the manufacture of gas from volatile oils, the combination, with a cylindrical retort for vaporizing the liquid, of a burner or burners for heating the same, a system of levers connected with the opposite ends of the retort, and arranged to operate by the longitudinal expansion and contraction of the same, and valve mechanism, in conjunction with and controlled by the said system of levers, whereby the supply of inflammable material supplied to the burners is regulated substantially in the manner set forth.

2. In an apparatus for the manufacture of gas, the combination, with an expansible retort and devices for vaporizing, mixing with air, and storing a volatile oil, of a burner or burners communicating with a supplementary gas-producing apparatus, and a system of levers connected with the said retort and adapted to

operate by the expansion and contraction of the same to regulate the supply of gas to the burners, as set forth.

3. The combination of a cylindrical vaporizing-retort, a burner or burners for heating the same communicating through suitable valve mechanism with a receptacle containing gas, arms or levers pivoted to the ends of the retort, a rod or bar connecting the ends of said levers on one side of the retort, and rods connecting the other ends to a stationary support and to a lever adapted to control the action of the valve mechanism respectively, these parts being combined and arranged for mutual operation substantially as and for the purpose set forth.

4. In a gas-machine of the kind described, the combination, with a vaporizing-retort having an inlet for the admission of fluid at one end, of a metal rod having a smaller rate of expansion under high temperature than the retort attached to the opposite end, and closing the inlet when the retort is cool, and opening the same when the retort is heated, as described.

5. The combination, with a retort for the vaporization of hydrocarbon fluids, having at one end an inlet for the admission of the fluid, of a metal rod attached to the opposite end and adapted to open or close the said inlet, according to the relative degrees of expansion of the rod and the retort, and a tube extending up from the inlet and inclosing the rod, as and for the purpose set forth.

6. In an apparatus for the vaporization of liquid hydrocarbons, as described, the combination, with bed-plate A and upright partition or plate A′, of a volatilizing-retort and a storage-reservoir located on opposite sides of the said upright plate, and communicating by means of a pipe which passes through or forms a part of the plate or partition, substantially as set forth.

7. The combination, with lever K, rock-shaft K′, and arm K″, of a toggle composed of frame L L′, shackle *k*, springs *k′ k″*, attached to heads *l′ l″*, and rod *l*, fixed to one of the said heads and sliding freely in the other, substantially as described.

8. The combination, with lever K and rock-shaft K′, of an arm, M, pivoted lever N, having forks or branches N′ N″ and roller *q*, adjustably secured to the lever K, as set forth.

9. The combination, with lever K and rock-shaft K′, of arm M, pivoted lever N, having branches N′ N″ and springs *p′ p″*, and roller *q*, adjustably secured to the lever K, as and for the purpose set forth.

10. The combination, with retort B, of a valve-rod, C, extending through the head *b*, and a screw-cap, I, covering the projecting end of the said rod, for the purpose specified.

In testimony whereof I have hereunto set my hand this 29th day of July, 1881.

HIRAM S. MAXIM.

Witnesses:

CLAYTON KNEELAND,

PARKER W. PAGE.