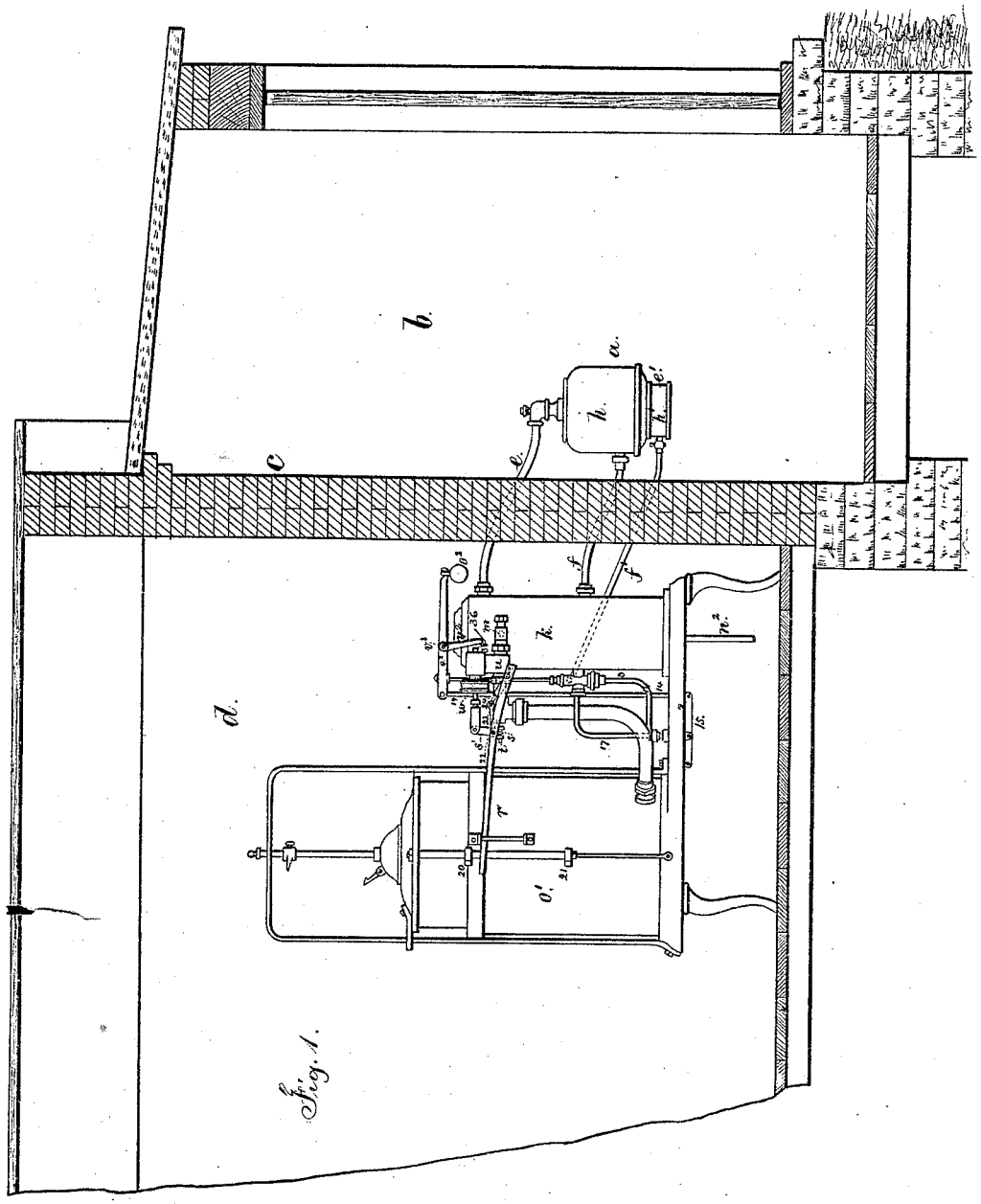
3 Sheets--Sheet 1.

H. S. MAXIM.

Apparatus for Manufacturing Illuminating-Gas from Liquid Hydrocarbon.

No. 160,216. Patented Feb. 23, 1875.



Witnesses

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atty.

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Fig. 2.

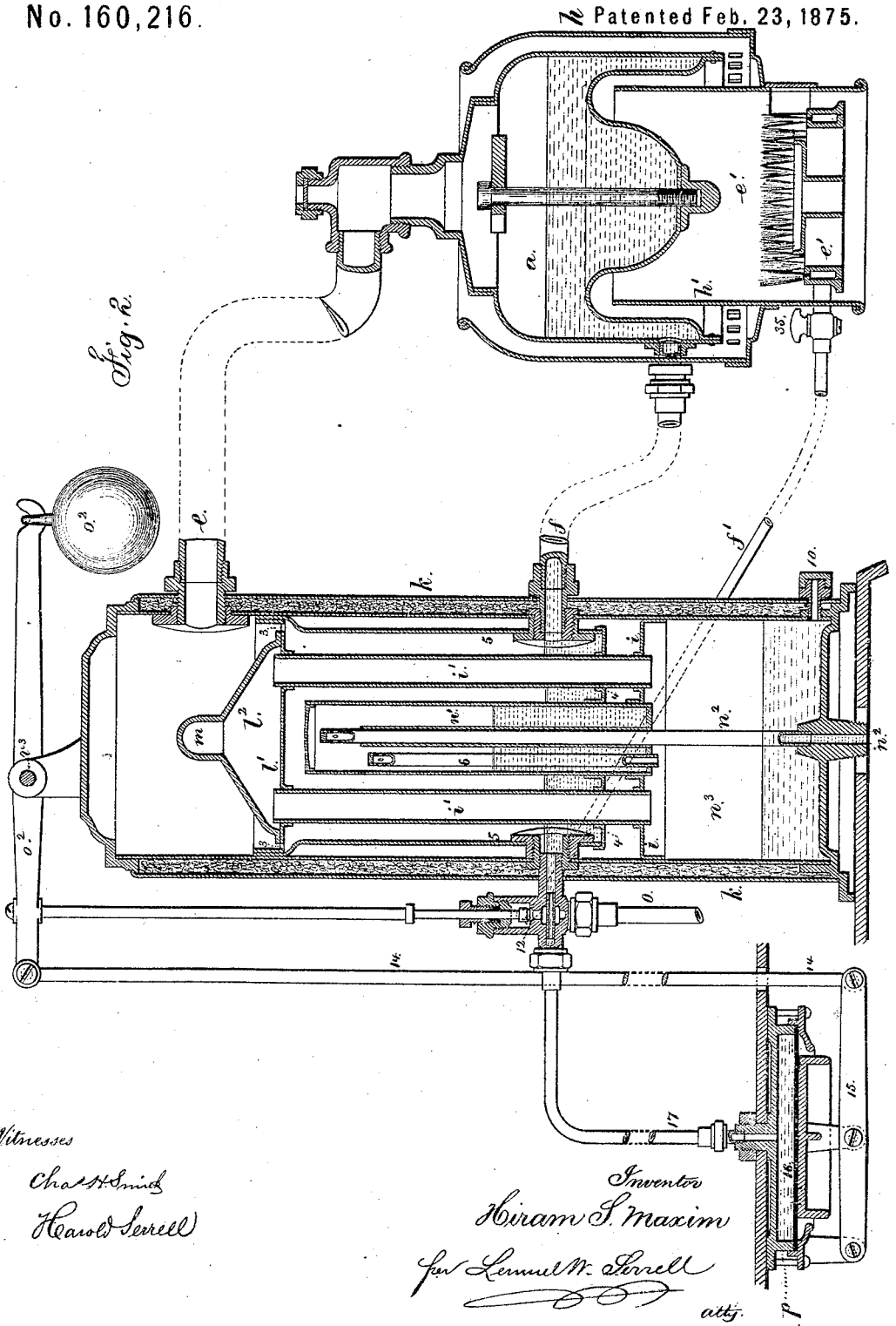

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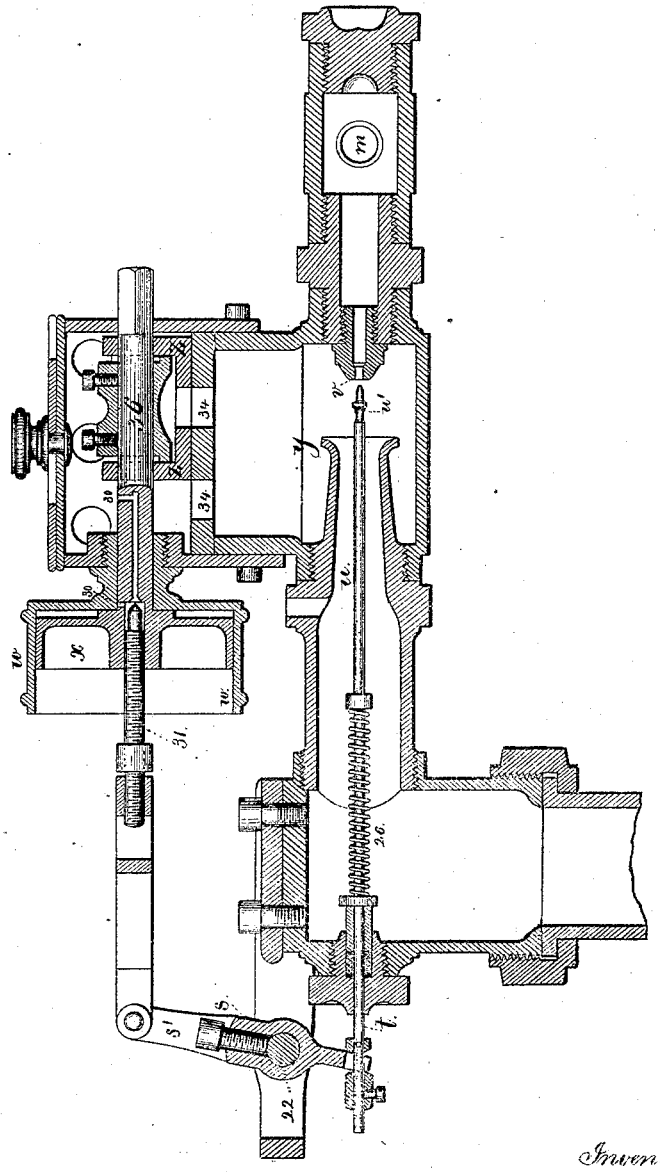
Fig. 3.



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UNITED STATES PATENT OFFICE.

HIRAM S. MAXIM, OF BROOKLYN, NEW YORK, ASSIGNOR TO THE MAXIM GAS-MACHINE COMPANY OF NEW YORK.

IMPROVEMENT IN APPARATUS FOR MANUFACTURING ILLUMINATING-GAS FROM LIQUID HYDROCARBON.

Specification forming part of Letters Patent No. **160,216**, dated February 23, 1875; application filed December 5, 1874.

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 an Improvement in Manufacturing Illuminating-Gas from Liquid Hydrocarbon, of which the following is a specification:

The liquid hydrocarbon is introduced into a vaporizing-vessel, heated by steam from a boiler in a separate apartment. The water of condensation runs back to the boiler. The burner that is used to heat the boiler is supplied with more or less inflammable material, according to the pressure of the steam. The vaporizing-vessel is constructed so that the hydrocarbon vapors are exposed to a superheating operation, to prevent the escape of any liquid to the air-mixing chamber, and the jet-valve is opened fully or entirely closed, so that the proper proportion of vapor and atmosphere will be maintained; but the movement is so controlled that the lights are not made to vary by suddenly opening or closing the jet.

In the drawing, Figure 1 is a general elevation. Fig. 2 is a section of the vaporizing-vessel and boiler, and Fig. 3 is a section of the valve.

The boiler *a* is in the apartment *b*, that is separated by the wall *c* from the apartment *d*, in which the gas holder and generator are located, and the wall is entirely closed, so that there is no possibility of fire passing from one apartment to the other, the only connections being the steam-pipe *e*, return water-pipe *f*, and vapor-pipe *f'*, for the burner *e'*. The boiler, by preference, is made with a surrounding-jacket, *h*, to retain the heat, and with a vertical case, *h'*, around the burner, so as to cause a circulation of the heat within the annular-recessed bottom of the boiler. The generating-vessel *k* is preferably made double, and packed with felt or other non-conducting material, as seen in Fig. 2, and the steam enters this vessel from the pipe *e;* and within this vessel is a diaphragm, *i*, through which vertical tubes *i'* pass to the diaphragm l^1, above which is the dome l^2, that terminates in the vapor-delivery pipe *m*.

The steam passes the diaphragm l^1 through the holes 3, and surrounds the tubes *i'*, and the central gasoline-vessel n^1, and the water of condensation remains above the diaphragm 4, and within the case 5, and the overflow runs back to the boiler by the pipe *f*. The gasoline or similar volatile liquid hydrocarbon is supplied through the pipe n^2, and it is preferable that this liquid be under a sufficient head or pressure to run into the vessel n^1 when the pressure therein lessens in consequence of the evaporization of the contents thereof.

The vapors from n^1 pass down through the pipe 6 into the chamber n^3; thence up through the pipes *i'* to the dome l^2, and in so doing are thoroughly heated and superheated by passing through the hottest portion of the steam. If the vessel n^1 becomes too full it overflows through this pipe 6 into the chamber n^3, and may be withdrawn at the plug or cock 10. This, however, will only be the portions that are not easily volatilized.

A pipe, *o*, from the gas-holder o^1, leads to a valve-seat and valve, 12, that regulates the supply of gas to the pipe *f'*, and burner *e'*, and this valve 12 is regulated according to the pressure in the boiler and generator, through the agency of the lever and weight o^2, connecting-rod 14, lever 15, diaphragm 16, in the vessel *p*, to which the pipe 17 is connected, leading to the water-vessel of the generator, and these parts are so adjusted that the steam cannot accumulate beyond a given pressure; otherwise the pressure, acting upon the diaphragm 16, will close or partially close the supply of gas to the burner, and lessen or extinguish the flame.

By this construction the diaphragm 16 is acted upon by water only, that is at or about the temperature of the atmosphere, and the diaphragm is moved according to the pressure of steam in the vaporizing-vessel, instead of being exposed to the heat and pressure of the steam-generator, as heretofore.

The gas-holder o^1 is constructed in any desired manner, and provided with the tappets 20 and 21, that move the lever *r* at the extreme elevation and depression, and this lever

r swings loosely on the shaft 22, and upon this shaft 22 is an arm, 23, fastened, and a spring-toggle, 24, intervenes between the end of the lever r and the arm 23, similar to that shown in Letters Patent No. 120,302, in order that the shaft 22 may be partly turned suddenly one way at one extreme movement of the gas-holder, and the other way at the extreme movement of the gas-holder.

Upon this shaft 22 is a lever, s, one end of which operates the valve-rod t that passes through the mixing tube u, and is opposite the nozzle or jet-tube v, to which the gasoline vapors are supplied by the pipe m. The spring 26 serves to hold the valve w' to its place when the apparatus is not in use; but when the gas-holder falls the valve would be opened suddenly, and when it rises it would be closed suddenly, and produce flickering and unsteadiness in the light if the devices thus far described only were used. I therefore prevent the sudden movement or concussion of the valve in opening and closing, by employing a compression-cylinder, w, and piston x, that are moved back and forth by the upper arm s' of the lever s, and the air is allowed to pass into or out of the space of the cylinder through the holes 30, and the end of the screw-stem 31 forms a valve to regulate the opening and the consequent speed of movement. The rod 36 of the piston x is also availed of, for opening and closing the air-inlets 34 to the mixing-chamber y and tube u. Said openings are closed by the valve z, that is moved by the piston-rod 36, to cover such openings 34 when the flow of gasoline vapors is stopped by the valve w'.

When the apparatus is not in use the cock 25 at the burner e' should be turned, to prevent the escape of any gas; and as the pressure in the boiler is relieved at this time, I employ an arm, v^2, Fig. 1, on the shaft v^3, actuated by the lever o^2 and weight, to press the end of the piston-rod 36, and hold the parts with the air-openings 34 closed, and the nozzle v stopped by the valve w', so that there is not any risk of their being accidentally moved or left open.

I claim as my invention—

1. The piston x, upon the stem 36 of the air-inlet valve z, and acting within the cylinder w, in combination with the stationary jet-tube v, valve w', and lever s, connecting the rock-shaft 22 to the valve w', and rod 36, respectively, in the manner and for the purposes set forth.

2. The boiler a and heating vapor-burner e' within the apartment b, that is separated from the vapor-generating apparatus in the compartment d by a fire-proof wall, said vapor-generating apparatus being connected to the boiler by the steam-pipe e, and return water-pipe f, and to the burner by the gas-pipe f', substantially as and for the purposes set forth.

3. The diaphragm 16, in a vessel that is separate from the steam-generating vessel, and connected by a pipe leading from the water-space of the vaporizing-vessel, in combination with the lever and valve for regulating the supply of hydrocarbon to the burner of the generator, whereby the supply to the burner will be proportioned to the pressure of steam in the vaporizing-vessel, substantially as set forth.

4. The vessel n^1, into which the gasoline or volatile liquid hydrocarbon is supplied by the pipe n^2, and the tube 6, chamber n^3, pipes i', and dome l^2, in combination with the surrounding vaporizing-vessel 5, connected to the steam boiler or generator a, substantially as set forth.

5. The lever o^2, diaphragm 16, and connections, in combination with the arm v^2, rod 36, lever $s\ s'$, valve w', and heating and gas-generating apparatus, substantially as set forth, for holding the jet-valve closed when the pressure in the boiler is reduced, substantially as set forth.

Signed by me this 10th day of July, A. D. 1874.

HIRAM S. MAXIM.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.