



(No Model.)

2 Sheets—Sheet 2.

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APPARATUS FOR GENERATING GAS FROM HYDROCARBONS AND  
UTILIZING THE SAME IN FURNACES.

No. 274,597.

Patented Mar. 27, 1883.

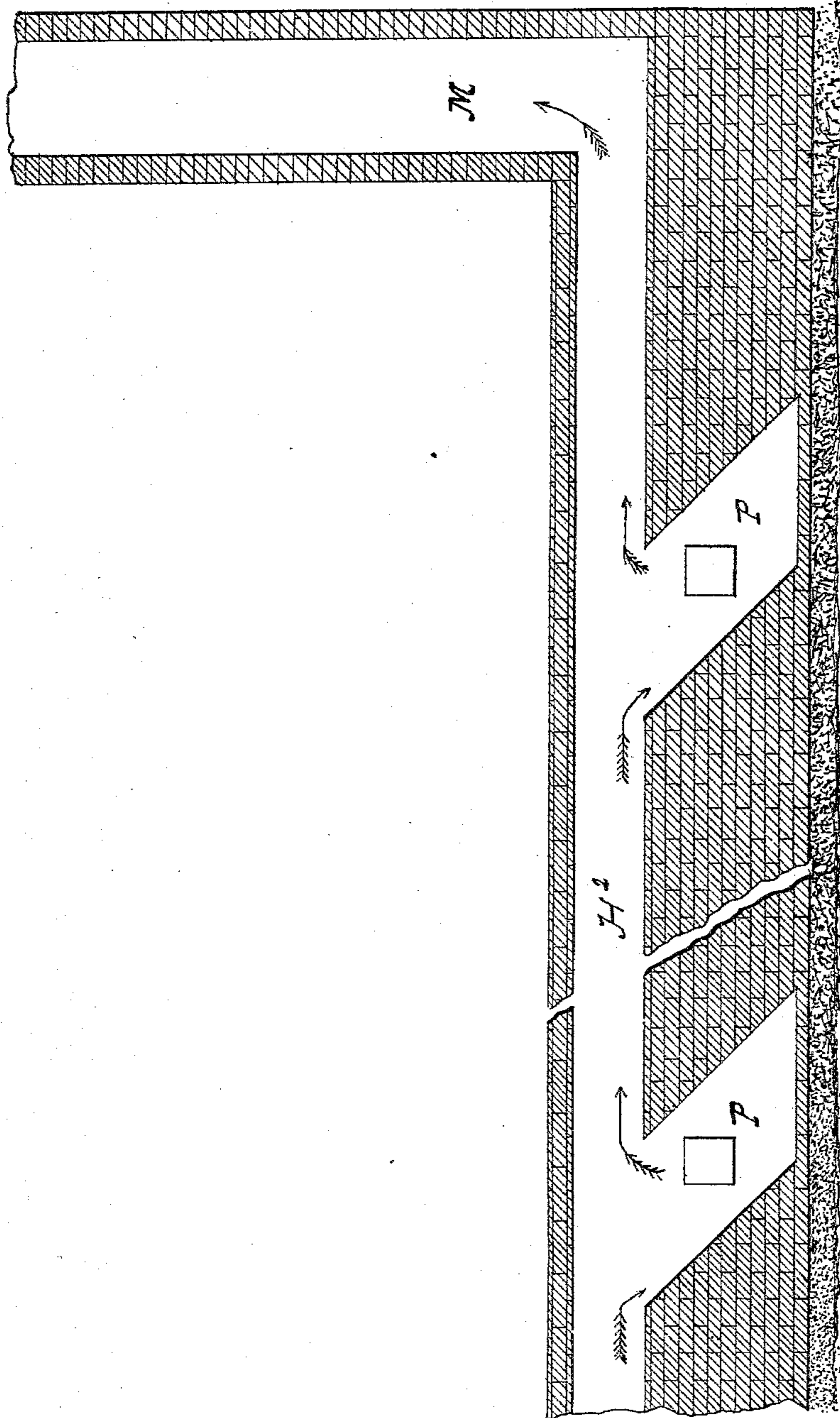


Fig. 2.

Witnesses

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# UNITED STATES PATENT OFFICE.

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APPARATUS FOR GENERATING GAS FROM HYDROCARBONS AND UTILIZING THE SAME IN FURNACES.

SPECIFICATION forming part of Letters Patent No. 274,597, dated March 27, 1883.

Application filed February 8, 1883. (No model.)

*To all whom it may concern:*

Be it known that I, HENRY F. HAYDEN, a citizen of the United States, residing at Washington city, in the District of Columbia, have  
5 invented certain new and useful Improvements in Apparatus for Vaporizing Hydrocarbon and Generating Gas and for Utilizing the Same in Metallurgic and other Processes; and I hereby declare the following to be a full, clear, and  
10 exact description of the same, reference being had to the accompanying drawings, in which—

Figure 1 is a vertical central section of devices embodying my invention, and Fig. 2 is a similar section of the flue for escape of waste  
15 products.

Like letters refer to like parts wherever they occur.

My invention relates to the construction of apparatus adapted either, first, to the simple  
20 vaporization of liquid hydrocarbons in the formation of a temporary gas for immediate use, or, secondly, to the production of a permanent or fixed gas, when such is desired; and while in many particulars the devices are of general  
25 utility for the purposes specified, they are pre-eminently fitted for conducting metallurgic processes—such as reducing ores, refining metal, &c.—for melting glass, and many like manufacturing processes.

30 The main objects in view are, first, such a relative arrangement of the generator and working-chamber that the full heating effect of the combustion of the gas shall be utilized in the generation thereof; secondly, such relative arrangement of the parts that the waste  
35 heat of the escaping products shall be utilized in the preliminary or primary steps of generating the gas by heating the air and steam which are to be combined with the hydrocarbon; and  
40 thirdly, such a construction of the generator as will avoid the deposit of carbon therein and facilitate the cleaning of the generator; and, finally, to obtain so simple a construction as shall render the apparatus comparatively inex-  
45 pensive, durable, and readily repaired. There are minor objects and points of construction, which will hereinafter more fully appear.

I have elected to show the devices in connection with a metallurgic furnace for reduc-  
50 ing ores, but disclaim any limitation thereto.

I will now proceed to describe my invention more fully, so that others skilled in the art to which it appertains may apply the same.

In the drawings, A indicates a stack suit-

able for reducing ores, and which in general  
55 exterior construction may correspond with those in ordinary use, or be of any approved construction. Arranged vertically and centrally thereof is the generator-chamber B, supported below by a water-chamber, C, which  
60 converts the hearth into an annular crucible, *a*, provided with suitable tap-holes, *a'*, and slag-ports *a''*.

In constructing the generator-chamber B, I prefer to arrange in the upper three-fourths  
65 (more or less) a central or inner tube, *b*, which forms the lining of the air-chamber, said tube having a flange, *b'*, above, by which it is suspended or supported from the top of the stack, and a flange, *b''*, below, which supports the  
70 surrounding or inclosing fire-brick or equivalent refractory covering. The generator-chamber B can be made in one piece (without joint) by ramming the material around a core, and a water-jacketed tube, *b'*, may be employed, if  
75 desired.

The water-chamber C (may be metal-lined, if desired, best boiler-iron being preferable) occupies the center of the crucible, and is provided with a supply-pipe, *c*, which delivers into  
80 the upper portion of the chamber, and a valved waste-pipe, *c'*, the valve (*c''*) of which is so set as to insure a constant and uniform flow of the water through chamber C.

*c''* indicates supports or pillars arranged in  
85 the water-chamber C to assist in supporting the superimposed column.

The section D of the generator-chamber, wherein are four or more inclined gas-ports, *d*, (or burners,) is built up of fire-brick, and as this  
90 is the portion of the generator-chamber (or of the furnace) which most frequently requires repair I have suspended the section B, as before specified, and provided a series of doors, *d'*, so that the section D can be torn out and  
95 rebuilt without disturbing the rest of the stack.

E E indicate hoppers provided with valves *e*, through which the ore to be reduced is charged into the furnace. Instead of the common hopper and valve, (shown for purposes of  
100 illustration,) any of the well-known or approved forms of trap feed devices may be substituted.

G indicates the generator, which is composed of a series of flanged funnels or hollow  
105 frusta, *g*, which decrease in size from above downward, so that the vapors, &c., in their passage through the generator must impinge on the inner surface of each cone. This in-

5 sures the thorough intermingling of the steam  
 and hydrocarbon, and prevents any deposit of  
 carbon in the generator. It is desirable that  
 the opening at the apex of the final cone should  
 10 correspond with that of the outlet-pipe, so that  
 any possible deposit may be driven into and  
 through the exit-pipe to the nozzle. These  
 flanged frusta  $g$  are arranged one above an-  
 other in the generator  $G$ , and above the upper  
 15 frusta is a perforated deflecting-disk,  $g'$ , ar-  
 ranged under the inlet-pipe  $g^2$ , to break up and  
 disseminate the incoming vapors. This gen-  
 erator  $B$  is suspended centrally of the air-cham-  
 ber  $F$ , and is provided with an exit-pipe,  $g^3$ ,  
 20 that terminates in a coniform nozzle or burner,  
 $g^4$ , having a series of openings which corre-  
 spond in number and position with the in-  
 clined gas-ports  $d$ .

25 With relation to the working-chamber  $A$ , I  
 have described the preferred construction, not  
 for purposes of limitation, as the only essen-  
 tial is the vertical central position of the gen-  
 erator-chamber, but in order to indicate what  
 I deem to be the best manner of carrying out

the invention.  
 In connection with or at one side of the work-  
 ing-chamber or stack  $A$ , I erect a tower,  $H$ ,  
 which I connect above with stack  $A$  by a flue,  
 $H'$ , and below with a chimney by a flue,  $H^2$ ,  
 30 which may be guarded by a suitable damper,  
 and at the base of tower  $H$ , I place a furnace,  
 $I$ , which delivers into tower  $H$ . This furnace  
 $I$  is only employed for the preliminary heating  
 of the tower, &c., in starting the generator.

35  $K$  indicates the air or blast pipe, provided  
 with a valve,  $k$ , and connected with a suitable  
 blast engine or fan. This pipe enters the tower,  
 preferably at its upper part, and after being  
 coiled therein, as at  $K' K'$ , extends through  
 40 flue  $H'$  and connects with air-chamber  $F$ , sur-  
 rounding generator  $B$ . The coils  $K' K'$  may,  
 if it is found necessary, be covered with fire-  
 clay, or any composition which will protect  
 them from injurious effects of waste gases.  
 45 Such a covering is indicated by the outer cir-  
 cle.

Arranged centrally within the tower  $H$  is a  
 superheating-coil,  $L$ , which receives steam  
 through an inlet-pipe,  $l$ , provided with a valve,  
 50  $l'$ , and delivers the superheated steam through  
 pipe  $l^2$ , which is also provided with a valve,  
 $l^3$ , and connects with the pipe  $g^2$ , which deliv-  
 ers into the generator  $G$ . Within and at the base  
 of tower  $H$  a water or drip tank,  $t$ , may be  
 55 placed, if desired, to hold water or catch any  
 vapors which may condense within the tower,  
 and just above the same is a small door,  $h$ ,  
 which may be used when access to the tower  
 is necessary. The base of tower  $H$  is connected  
 60 with a suitable chimney,  $M$ , by the horizontal  
 flue  $H^2$ , (see Fig. 2,) which is provided at suit-  
 able intervals with floor-pockets  $P$ , inclined  
 toward the line of draft to induce an eddy in  
 the current, and cause the deposit of any fine  
 65 particles of metal which might otherwise be  
 carried off with the escaping waste products.  
 This flue  $H^2$  should be sufficiently long to per-

mit the cooling of the waste products and the  
 condensation and deposit of any vaporized  
 metals.

70  $O$  indicates an oil-pipe which connects with  
 a suitable reservoir, whence the hydrocarbon  
 is pumped or otherwise forced to the gener-  
 ator. This pipe is provided with a suitable  
 valve,  $o$ , and connects with the pipe  $g^2$ , which  
 75 delivers into generator  $G$ .

The construction of the apparatus being  
 substantially such as hereinbefore specified,  
 the process of vaporizing hydrocarbons, gener-  
 ating gas, &c., will be conducted therein as  
 80 follows: For the preliminary heating of the  
 apparatus a fire, preferably of wood or coke,  
 (so as to avoid sulphur and other deleterious  
 gases,) is lighted in furnace  $I$ , and the valves  
 $e e$  of hoppers  $E E$  are opened, so that the  
 85 products of combustion from furnace  $I$  will  
 pass through tower  $H$ , around the air-pipes  
 $K'$  and superheater  $L$ , through flue  $H'$ , and  
 out of the stack  $A$ . As soon as the air-blast  
 and steam have reached the required tem-  
 90 perature the valve  $o$  of the oil-pipe  $O$  is opened  
 and the requisite quantity or stream of hydro-  
 carbon oil is forced into pipe  $g^2$ . The valve  $l^3$   
 is then opened sufficiently far to deliver the  
 requisite quantity of superheated steam, which  
 95 mingles with and vaporizes the oil, and the  
 whole mixture passes into the generator  $G$ ,  
 where a thorough admixture takes place by  
 the passage of the vapors, under pressure,  
 through the series of conical frusta. In the  
 100 meanwhile, the valve  $k$  of the air-pipe  $K$  hav-  
 ing been opened, the highly-heated air-blast  
 passes from coil  $K'$  into air-chamber  $F$ , and  
 thence down to the coniform nozzle or burner  
 $g^4$ , where it mingles with the issuing admixture  
 105 of oil and steam, and is ignited at the mouth  
 of the inclined passage  $d$ . The downward in-  
 clination of passages  $d$  projects the flame into  
 the crucible in the most advantageous manner.  
 The admixture of hydrocarbon vapor, steam,  
 110 &c., having been ignited at the ports  $d$ , the  
 central generator-chamber, as well as the sur-  
 rounding furnace, will soon become so highly  
 heated that the fire in preliminary furnace  $I$   
 can be dispensed with. When this time ar-  
 115 rives the valves  $e e$  of hoppers  $E E$  are closed,  
 the fire in furnace  $I$  allowed to go out, and the  
 products of combustion will then rise in the  
 working-chamber or stack  $A$ , pass through the  
 flue  $H'$ , descend in tower  $H$ , and escape through  
 120 flue  $H^2$  to the chimney. When the stack  $A$   
 or working-chamber has been brought to the  
 desired temperature, the fire to be reduced,  
 the metal to be treated, or whatever is to be  
 operated upon may be charged into the fur-  
 125 nace through hoppers  $E E$ , doors  $d'$ , or other-  
 wise, and will be acted on by the flame is-  
 suing through ports  $d$ , while the waste pro-  
 ducts so rising in the stack and passing  
 through tower  $H$  will supply all the heat nec-  
 130 essary to render the vaporization of the hy-  
 drocarbon or the generation of the gas con-  
 stant and automatic. By properly propor-  
 tioning and regulating the admission of super-

heated steam and hydrocarbons, which can be done by means of valves  $l^3$  and  $o$ , either a simple vapor-gas or a permanent fixed gas may be obtained at will. When ores or metals are treated, as in the reduction of ores, the products of combustion, after leaving tower H, are conducted through a flue,  $H^2$ , having pockets P, wherein any fine particles of metal carried by the current will be deposited, and if the flue H is made sufficiently long to permit the cooling of the waste products, any vaporized matters which are condensable will also be deposited in pockets P and may be recovered. In case it should be necessary at any time to clear the generator G, the valve  $o$  of the oil-pipe may be closed to shut off the oil-supply, and the valve  $l^3$  of the superheated-steam pipe opened full head, so as to cause a blast of steam to pass through the generator, which will at once remove any carbon or other obstructing matter.

I am aware that in reducing ores in the blast-furnace it has been proposed to introduce hydrocarbon liquids, vapors, and gases into the reducing-zone of the furnace or stack, and that for such purposes an oil or vapor pipe surrounded by an air-pipe has been inserted in the upper part of the stack and extended down through the charge to the reducing-zone of the blast-furnace; and I do not herein claim such devices, first, because the pipe and air-jacket do not constitute a vaporizer or generator, and could not so operate; secondly, because the relative arrangement of the devices with respect to the hearth is not such as will enable the parts to coact in the generation and utilization of gas for general manufacturing purposes, as hereinbefore set forth.

I am also aware that condensing and collecting pockets have heretofore been employed—as, for instance, in the manufacture of white zinc, and therefore do not broadly claim such devices.

Having thus fully described my invention and the advantages to be derived therefrom, what I claim, and desire to secure by Letters Patent, is—

1. In apparatus for vaporizing hydrocarbons and generating gas and utilizing the same for manufacturing purposes, the combination, with the furnace or working-chamber, of a centrally-arranged generating-chamber, and a generator or vaporizer suspended therein, substantially as and for the purpose specified.

2. In apparatus for vaporizing hydrocarbons, generating gases, &c., and utilizing the same for manufacturing purposes, the combination of a working-chamber provided with a centrally-arranged generator-chamber, a generator or vaporizer suspended in the generator-chamber, a blast-pipe communicating with the generator-chamber, a chamber which incloses the blast-pipe and communicates with the working-chamber, and a supplemental furnace which communicates with the blast-pipe

chamber, substantially as and for the purpose specified.

3. In apparatus for vaporizing hydrocarbons, generating gas, &c., and utilizing the same for manufacturing purposes, the combination of a working-chamber provided with a central or inclosed generator-chamber, a generator suspended therein, a blast-pipe communicating with the generator-chamber, a superheater communicating with the generator, a chamber which incloses the blast-pipe and superheater, an oil-supply pipe, and a supplemental furnace, substantially as and for the purpose specified.

4. In apparatus for vaporizing hydrocarbons, generating gas, &c., and utilizing the same for manufacturing purposes, the combination of a working-chamber provided with a centrally-arranged or inclosed generator-chamber, a generator suspended therein, a blast-pipe communicating with the generator-chamber, a superheater communicating with the generator, an oil-supply pipe communicating with the steam-pipe, a chamber inclosing the blast-pipe and superheater and communicating with the working-chamber, and a suitable chimney, substantially as and for the purpose specified.

5. In apparatus for vaporizing hydrocarbons and generating gas, and for utilizing the same for manufacturing purposes, the combination, with a working-chamber, of a centrally-arranged generator-chamber, a generator suspended therein, so as to form a surrounding air-heating chamber, a series of air-ports connecting the base of the generator-chamber with the working-chamber, a gas or vapor pipe which communicates with the generator, and a delivery-nozzle arranged within the generator-chamber in the plane of the air-ports thereof, substantially as and for the purpose specified.

6. In combination with the working-chamber, the generator-chamber composed of a flanged suspended pipe inclosed by fire-brick or refractory material supported on the flange of the flanged pipe, substantially as and for the purpose specified.

7. The horizontal escape-flue having a series of drift-pockets in the floor thereof, the rear walls of said pockets inclined at an angle to the line of draft, to arrest and retain matters deposited from the waste products, substantially as and for the purpose specified.

8. The combination, with a working-chamber or hearth, of a centrally-arranged generator-chamber having the downwardly-projecting gas-delivery ports, which deliver the gas into the crucible and in a direction away from the generator-chamber, substantially as and for the purpose specified.

In testimony whereof I affix my signature, in presence of two witnesses, this 7th day of February, 1883.

HENRY F. HAYDEN.

Witnesses:

F. W. RITTER, Jr.,

H. B. MOULTON.