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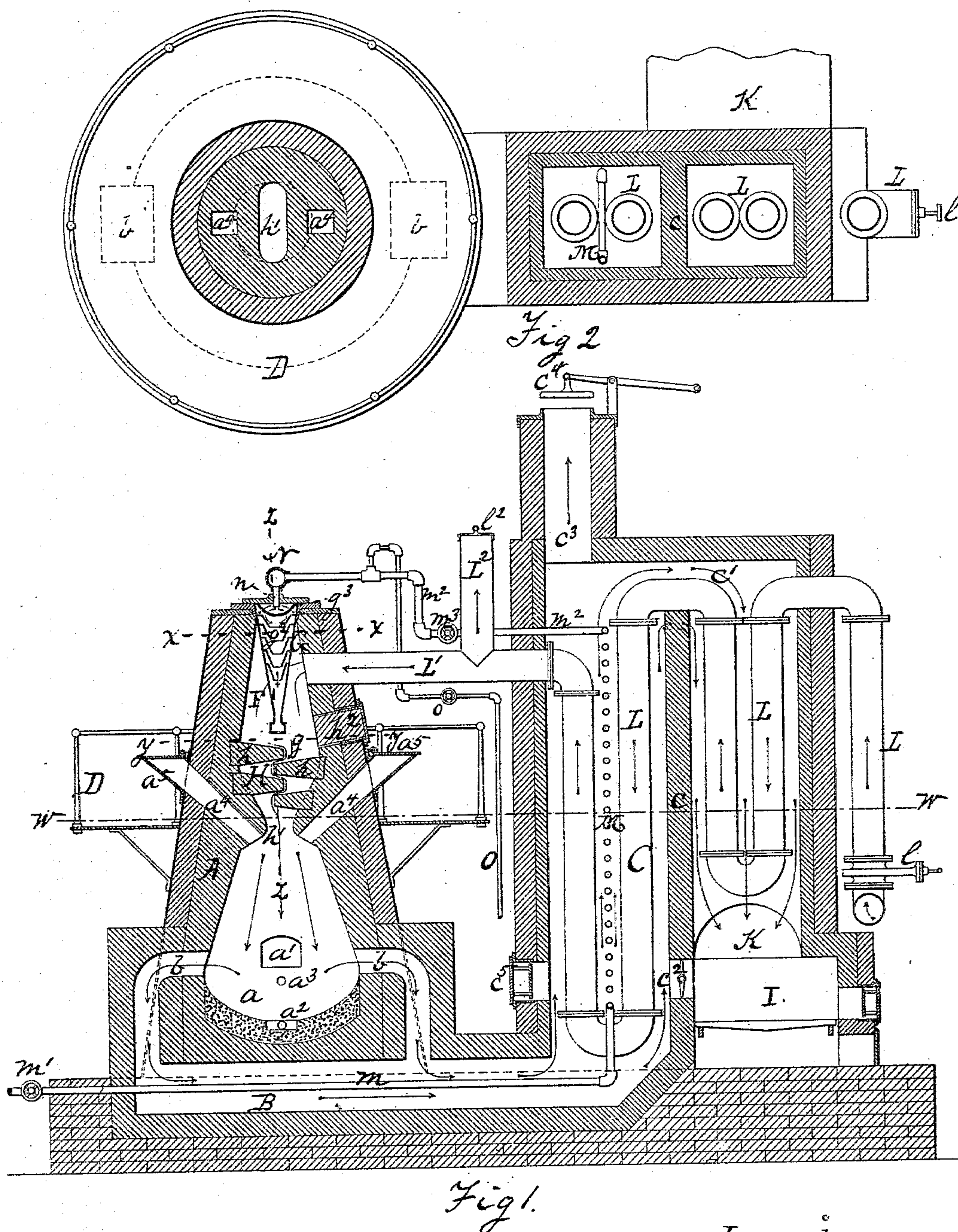
H. F. HAYDEN.

2 Sheets—Sheet 1.

GAS FURNACE.

No. 274,598.

Patented Mar. 27, 1883.



Witnesses:

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Inventor:

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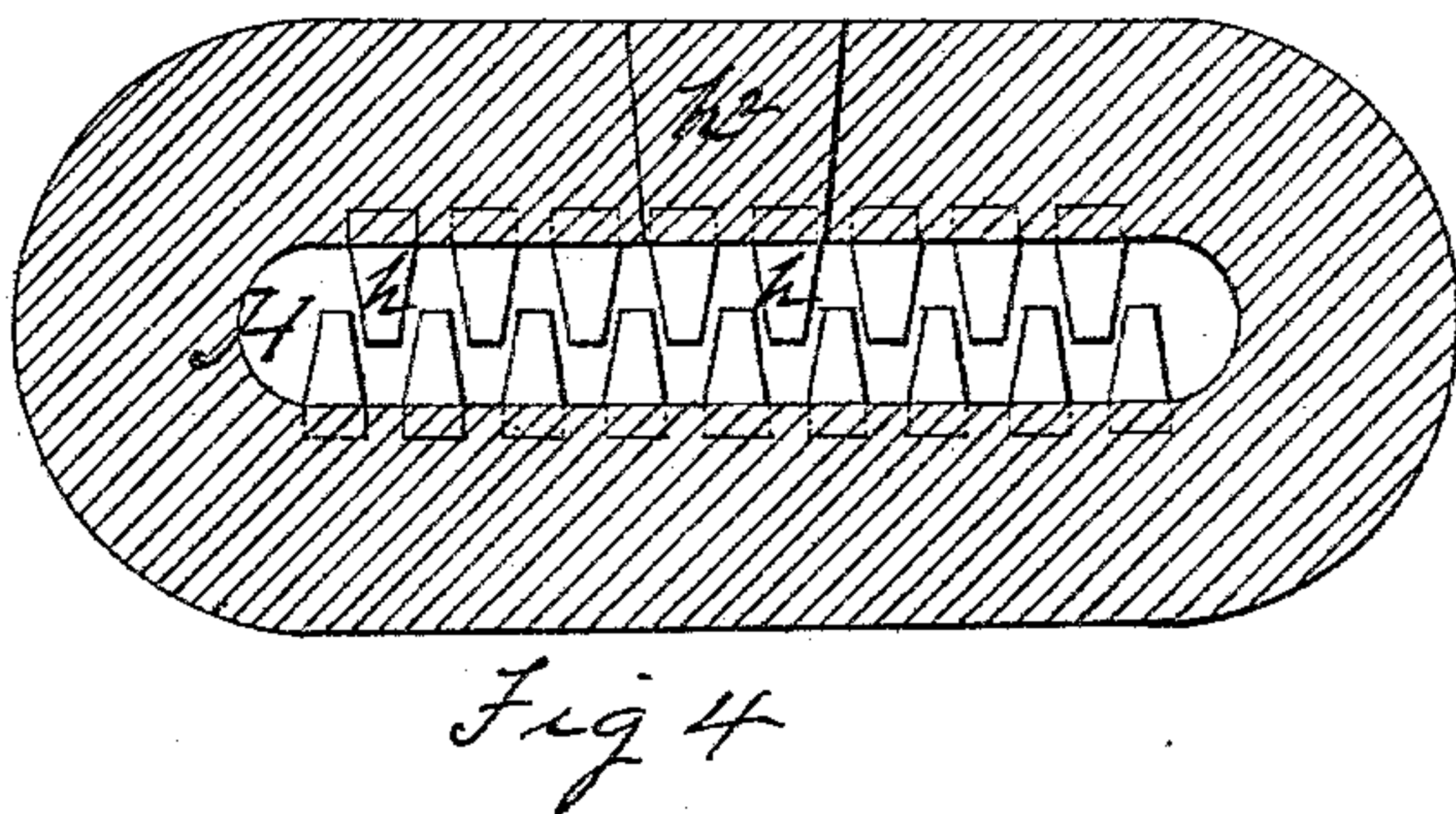
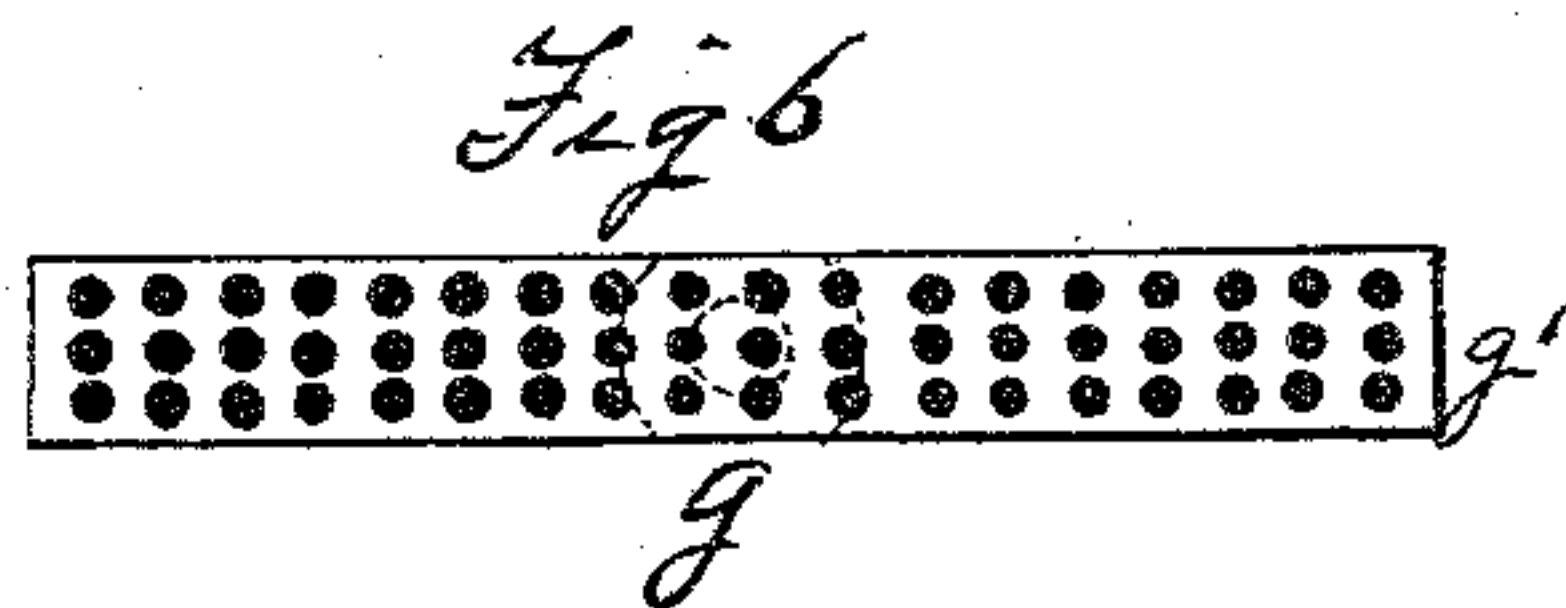
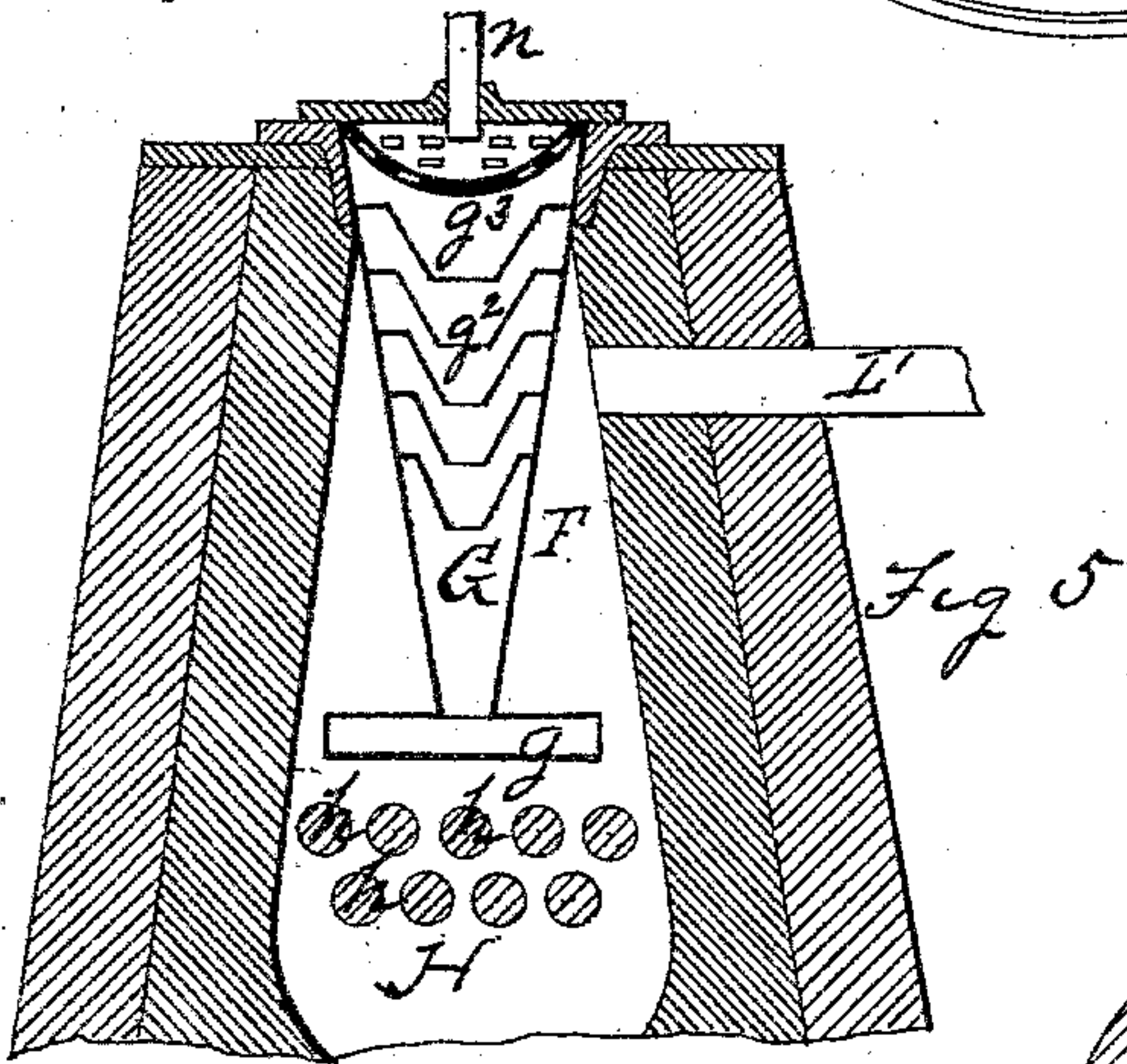
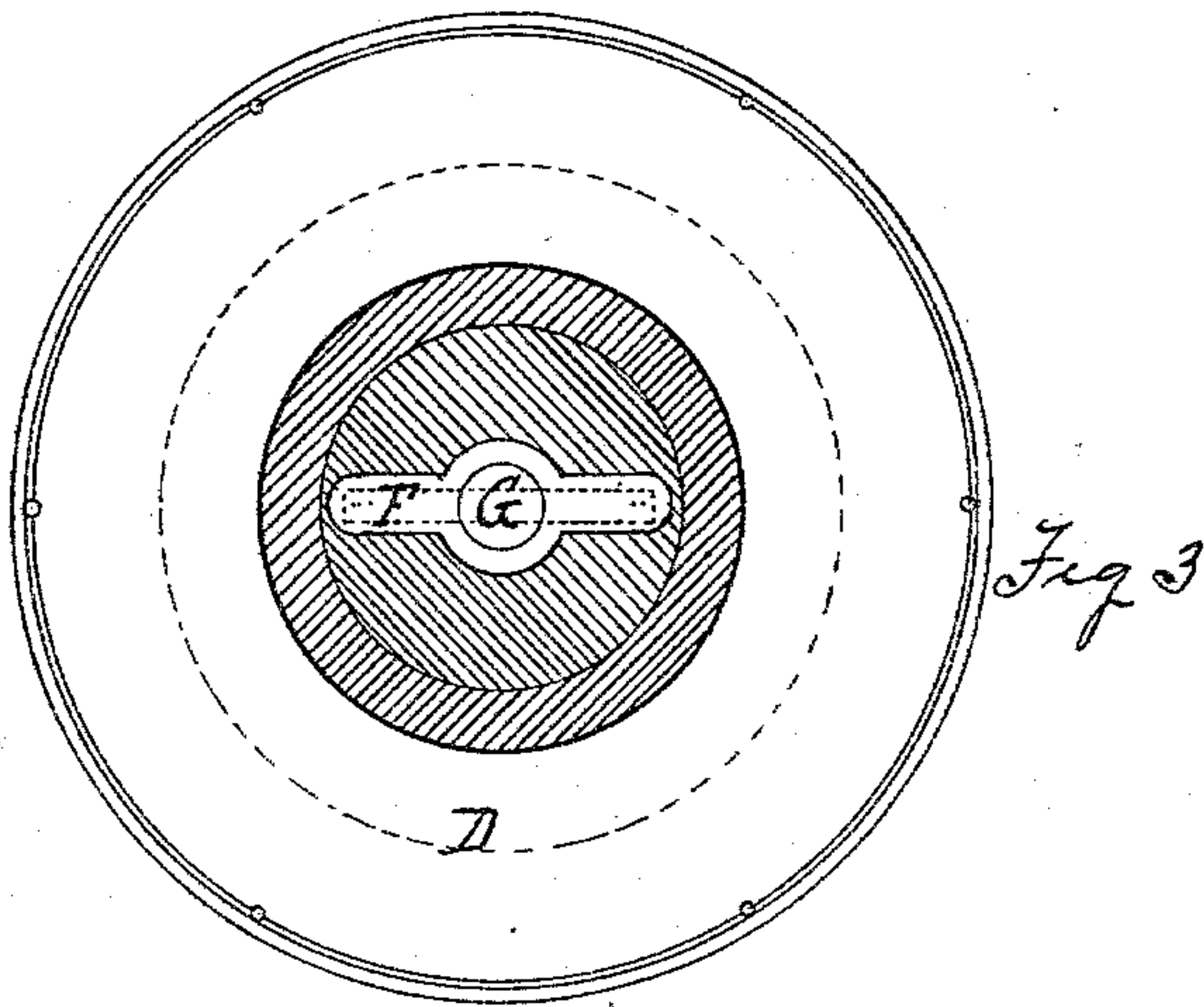
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2 Sheets—Sheet 2.

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Witnesses

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UNITED STATES PATENT OFFICE.

HENRY F. HAYDEN, OF WASHINGTON, DISTRICT OF COLUMBIA.

GAS-FURNACE.

SPECIFICATION forming part of Letters Patent No. 274,598, dated March 27, 1883.

Application filed February 15, 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 invented certain new and useful Improvements in Gas-Furnaces for Metallurgic and other Purposes; and I hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, in which—

Figure 1 is a vertical longitudinal section of devices embodying my invention. Fig. 2 is a horizontal section of the same on the line W W at the throat of the furnace and below the mixing-chamber. Fig. 3 is a horizontal section on the line X X of Fig. 1. Fig. 4 is a similar section on the line y y of Fig. 1. Fig. 5 is a vertical detailed section on the line z z of Fig. 1. Fig. 6 is a detached view of the burner.

Like letters refer to like parts wherever they occur.

My invention relates to the construction of that class of gas-furnaces adapted for manufacturing purposes—such as the reduction of ores, smelting and refining of metals, melting glass, and like processes—where it is desirable to employ liquid fuels and to utilize the heat of combustion and the heat of the waste products for vaporization of the fuel and generation of the gas.

The main features of the present invention are, first, the arrangement of the generator over the crucible or working-chamber, in connection with an interposed mixing-chamber, whereby the gas and air are intimately intermingled and projected directly on the material in the crucible or working-chamber; secondly, the relative arrangement of the generator and flame-throat (or burner) with the feed-hoppers, whereby the material to be treated, (ore, &c.,) in falling, is subjected, while in a divided state, to the direct action of the flame, &c.; thirdly, the relative arrangement of the waste-flues leading from the working-chamber and the throat or gas-inlet, whereby a pressure is maintainable in the working-chamber; and, finally, in specific combinations and in details of construction, which will herein-after more fully appear.

I will now proceed to describe my invention

more specifically, so that others skilled in the art to which it appertains may apply the same.

In the drawings, A indicates a stack or furnace with which the vaporizer or generator may be employed, the exterior walls of which may be of any suitable construction. The interior is divided into a crucible or hearth below, a generator-chamber above, and an intermediate mixing-chamber.

a indicates the crucible or hearth, which occupies the lower part of the stack, and is preferably oviform, being provided with a charging-door, a', suitable trapping-holes, a², and a slag-port, a³. From each side of the crucible or hearth a waste-product flues b b extend, and, dipping down, unite with the main waste-flue B, which delivers into the hot-blast oven C. At the upper part of the crucible or working-chamber, and near the contracted flame-throat or gas and air port, are inclined channels a⁴, terminating on the exterior in hoppers a⁵. These inclined channels and hoppers may be (and are) employed for the introduction of ore and like matter when the furnace is used as a reducing-chamber. When the crucible or hearth is used for other purposes—as, for instance, melting metals—the charge may be introduced through door a'. For convenience in charging the furnace and for like reasons a gallery, D, may be erected around the furnace at the zone of the mixing-chamber.

The upper part of the stack A is occupied by the generator G and air-chamber F. This section of the chamber is preferably a flattened ovoid, the greatest swell or widest portion being at or near the lower end of the generator or opposite the burner, and where the mixing-chamber H commences. The chamber contracts thence down to its junction with the working or crucible chamber, where it forms a narrow and flattened flame-throat, h'. Such a form assists in maintaining pressure in the mixing-chamber and a forcible projection of the mixed air and gas through the throat.

G indicates the generator, which in general construction may have the form of a cone suspended by its base and terminating in a T-burner, g, which extends across the flattened air-chamber F at its juncture with the mixing-chamber H. The lower face of the burner is

pierced by a series of fine jet-holes, g' . (See Fig. 6.) The interior of the generator is provided with a series of flanged conical frusta, g^2 , which decrease in size from above downward, and are arranged one above another, so that the vapor, &c., in its passage through the generator, must impinge on the inner surface of each frustum. Over the upper frustum, g^2 , and directly under the inlet-pipe, a perforated receiving-disk, g^3 , is placed, which receives and nebulizes the incoming vapors or fluids. This generator G is suspended centrally of the air-chamber F , as shown in Figs. 1 and 5, and the annular air-chamber thus formed connects with the hot-blast pipe L' . Between the generator and air-chambers (G F) and the crucible or working-chamber a , and connecting the same, is the mixing-chamber H . The general form of this chamber is a flattened frustum with base above, and arranged in the side walls thereof, so as to project across the chamber and overlap, are a series of tapering blocks, h , of suitable refractory material, which divide the mixing-chamber into zigzag passages and obstruct the same, so as to detain the mixed gases under pressure, which insures thorough admixture and perfect combustion at the throat h' . The tapering blocks h are preferably formed detachable and inserted in holes in the side walls, and just above the mixing-chamber is provided a door, h^2 , which serves a double purpose—viz., to remove and replace the refractory blocks h in repairing the mixing-chamber, and to ignite the gases, &c., at burner g . At or near the working-chamber or stack A is erected a hot-blast oven or tower, divided by a vertical wall, c , into two chambers, which are connected above by the open flues c' and below by the dampered flue c^2 . This tower or hot-blast oven is provided at the bottom of one chamber with a preliminary furnace or fire-chamber, I , and with a flue, K , that leads by way of a pocket-flue (fully described in a former case) to a suitable chimney, and at the top of the opposite chamber with a chimney, c^3 , provided with a suitable damper, c^4 . Near the base of the tower or hot-blast oven O is a door, c^5 , by means of which access may be had to the tower and the air and steam pipes arranged therein.

L indicates the hot air or blast pipe leading from a fan or blast-engine and provided with a valve, l , by which the volume of air entering the pipe is controlled. This pipe enters the hot-blast oven, preferably at or near the top of the first chamber, and after taking a U form in the first chamber passes through flue c' into the second chamber, where it again dips and rises, forming a second U , the upper end of which extends through the walls of the blast-oven O , as at L' , and connects with the air-chamber F , surrounding the generator G . On the horizontal arm or branch L' of the hot-blast pipe is a short stand, L^2 , provided with a detachable cap or valve, l^2 . The function of this pipe L^2 is to serve as a chimney for the

stack A or working-chamber a at the time of the initial heating of the same, as will hereinafter more fully appear.

M indicates a steam-superheater composed of vertical coils arranged in one chamber of the hot-blast oven. Steam is supplied to the superheater below by a steam-pipe, m , which extends through the main waste-product flue B , below the working-chamber a , and which is provided with a suitable valve, m' , and from the superheater the steam is conducted through a pipe, m^2 , to a globe, N , placed over the generator and connected therewith by a tube or tubes, n . In this pipe m^2 , which leads from the superheater, is a valve, m^3 , for controlling the amount of steam which shall pass to the generator G .

O indicates the oil-supply pipe leading from a suitable reservoir or source of supply, provided with a valve, o , for regulating the supply, and connected with the steam-pipe m^2 , into which it delivers, as at o' . Through this pipe O oil is pumped or otherwise forced to the generator G in the required quantities.

The furnace and its adjuncts, being constructed substantially as hereinbefore specified, will operate as follows: The damper in flue K being closed and those at flue c' and chimney c^3 being opened, a fire is started in the auxiliary fire-chamber I , the products of combustion and heat from which divide and pass part through one and part through the other chamber of the hot-blast stove O to the chimney c^3 . This preliminary fire is maintained until the air-pipes L and superheater M have been raised to the required temperature. In the meantime a fire of wood, coke, charcoal, or like material has been started in the crucible or working-chamber a of the stack, and the cap or damper l^2 of stand-pipe L^2 having been removed, the products of combustion, &c., from crucible or hearth a will pass through the mixing-chamber H and air-chamber F , around generator G , and through pipes L' L^2 . This fire is also maintained until the brick-work of the furnace and mixing-chamber have been raised to the desired temperature. When such time has arrived, the damper or cap is placed on stand-pipe L^2 , the damper c^4 of chimney c^3 is closed, as also the damper in flue c' , and the damper in flue K is opened, so as to establish communication through flue K with the main chimney. The valve o of the oil-pipe O is opened, and also the valve m^3 of steam-pipe m^2 , to supply the generator with the requisite quantities of oil and steam. The steam seizes upon the oil as it enters pipe m^2 , vaporizes the same, and the mixture then enters generator G , where it is thoroughly mixed by frictional contact with the inner surfaces of the gradually-decreasing conical frusta g' . This gas, composed of steam and hydrocarbon vapors, is then ignited at the T -burner g through the door h^2 . The valve l of air-pipe L is then opened, and the highly-heated air from the pipes of the hot-blast oven enters the air-cham-

ber F, surrounding generator G, through pipe L', passes to the T-burner g, and the steam and hydrocarbon gas and air are thus united or combined just at the mixing-chamber H, developing high pressure in chamber F. The pressure from behind thus forces the ignited gases through the obstructed mixing-chamber H, and causes such a thorough and intimate admixture of the air with the combustible gases that perfect combustion is obtained, and a clear smokeless flame will be projected forcibly through the contracted throat h' upon the working-hearth a. The products of combustion from the hearth a will pass out through the contracted side flues, b b, into the main waste-product flue B, thence up one compartment or chamber of tower or hot-blast oven C, and down the other to the outlet-flue K, giving up their waste heat to the air-pipes and superheater which are arranged in the hot-blast oven C. As soon as this circulation of the waste products is established the auxiliary fire in furnace I is drawn, and the furnace will become automatic, the waste heat from the working-chamber a serving to heat the air and steam in the preliminary steps, while the radiated heat from the initial combustion in the working-chamber a will maintain the generator at the proper temperature for the effective generation of gas. Where metal is to be melted or refined, it can now be charged onto hearth a through door a'; or if ore is to be reduced it can be fed in a divided state through hopper a⁵, and will thus, in falling, be exposed to the direct action of the reducing-flame before it reaches the bath in the crucible.

It will be observed that the construction herein described is particularly well adapted to the melting of glass, the only change that would be necessary being to place the door a' a little higher up, so as to obtain a deeper crucible or pot. The molten bath, having been established in the pot or crucible, could then be renewed or maintained by gradually introducing the fresh batch or mixture through the hoppers a⁵. The clear smokeless flame that can be obtained would be a great desideratum in working the glass, and the molten glass could, for convenience of working, be trapped out into a side pocket or fountain, where a uniform depth of the metal would be obtained and ropiness be avoided.

The advantages of my invention are, first, the complete utilization of the waste and radiated heat in the generation of the gas; second, the intimate intermingling and combining of the air with the superheated steam and hydrocarbons, whereby complete combustion and a smokeless flame is obtained; and, thirdly, the forcible projection of the flame upon the hearth, whereby any desired pressure may be obtained in the working-chamber.

Wherever hereinbefore or hereinafter the term "mixing-chamber" occurs I wish to be understood as meaning a chamber having interrupted or broken channels, which retard

and cause the thorough intermingling of the air and gas.

Having thus set forth the nature and advantages of my invention, what I claim, and desire to secure by Letters Patent, is—

1. The combination, with a working-hearth or crucible, of a gas-generator located over the same, and an interposed mixing-chamber, substantially as and for the purpose specified.

2. The combination of a working-hearth, a gas-generator located over the same, and an interposed mixing-chamber having a contracted throat at its juncture with the working-chamber, substantially as and for the purposes specified.

3. The combination of a working-chamber, a gas-generator, an interposed mixing-chamber, and a series of feed-chutes arranged at or near the juncture of the mixing and working chambers, substantially as and for the purpose specified.

4. A gas-furnace having a working-chamber below, with waste-product flues leading therefrom, an air-chamber above, a gas-generator suspended in the air-chamber, and an interposed mixing-chamber provided with zigzag projections to insure the intermingling of the gas and air, substantially as and for the purpose specified.

5. A mixing-chamber for gas-furnaces, having a series of detachable overlapping bricks of refractory material, having free ends arranged in and projecting from its side walls, substantially as and for the purpose specified.

6. A hot-blast oven divided into two compartments by a vertical wall, said compartments communicating above and below, an auxiliary furnace; and two waste-product flues communicating with said blast-oven, and a hot-air pipe and superheater arranged in said oven, substantially as and for the purpose specified.

7. In a gas-furnace for metallurgic and like purposes, a stack having a crucible or hearth, an air-chamber arranged over the same, a generator suspended in the air-chamber, and an interposed mixing-chamber, in combination with a hot-blast oven having a hot-air pipe which communicates with the air-chamber over the crucible, a steam-superheater which communicates with the generator, and a flue which connects with the waste-product flue leading from the crucible or hearth, together with an oil-supply pipe leading to the generator, substantially as and for the purpose specified.

8. In a furnace, the combination, with the working-hearth or crucible, of an air-chamber located above the same, a generator suspended therein, and an air-supply pipe communicating with the air-chamber and provided with a valved stand or exit pipe, substantially as and for the purpose specified.

9. The combination of a crucible or hearth, an air-chamber located over the same, a generator suspended in the air-chamber and pro-

vided at its lower extremity with a nozzle or
burner, an interposed mixing-chamber hav-
ing detachable projecting fire-brick, and a
door located in the side wall of the air-cham-
5 ber at its juncture with the mixing-chamber
and opposite the burner, substantially as and
for the purpose specified.

In testimony whereof I affix my signature, in
presence of two witnesses, this 14th day of
February, 1883.

HENRY F. HAYDEN.

Witnesses:

F. W. RITTER, Jr.,
C. A. NEALE.