

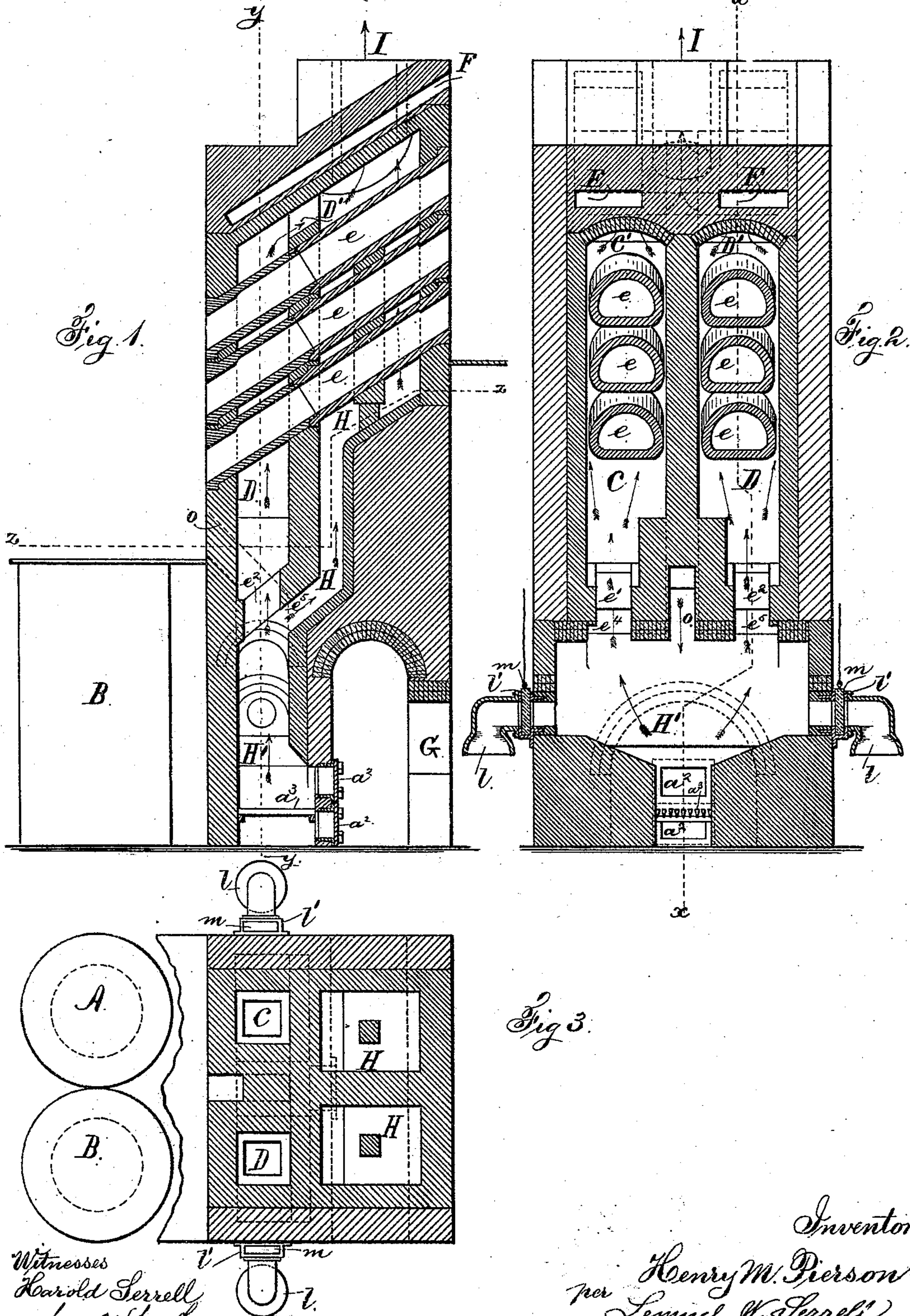
(No Model.)

4 Sheets—Sheet 1.

H. M. PIERSON.  
APPARATUS FOR MANUFACTURE OF GAS.

No. 549,657.

Patented Nov. 12, 1895.



Witnesses  
Harold Terrell  
Chas. H. Smith

Inventor  
Henry M. Pierson  
per Lemuel W. Terrell  
att'y.



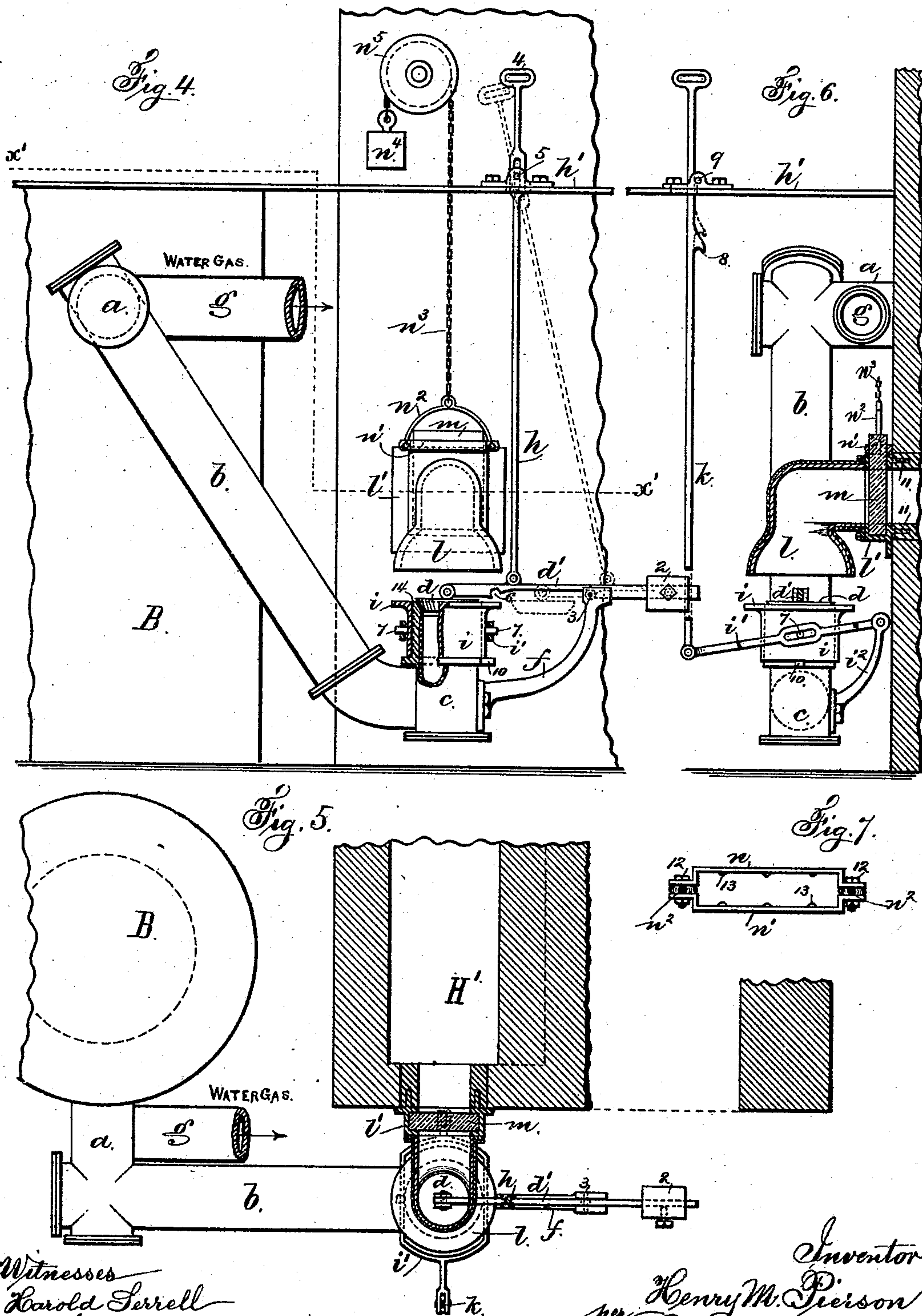
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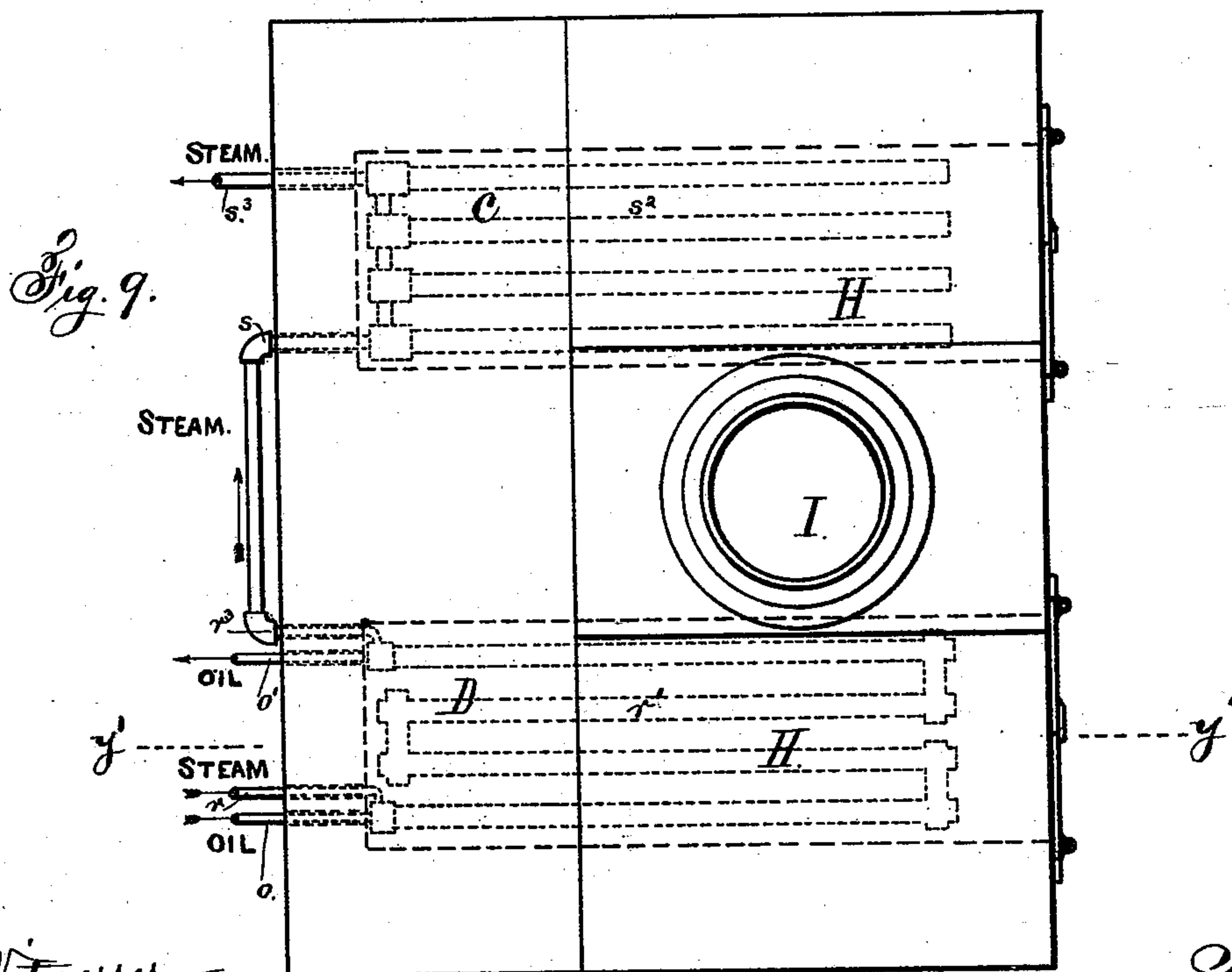
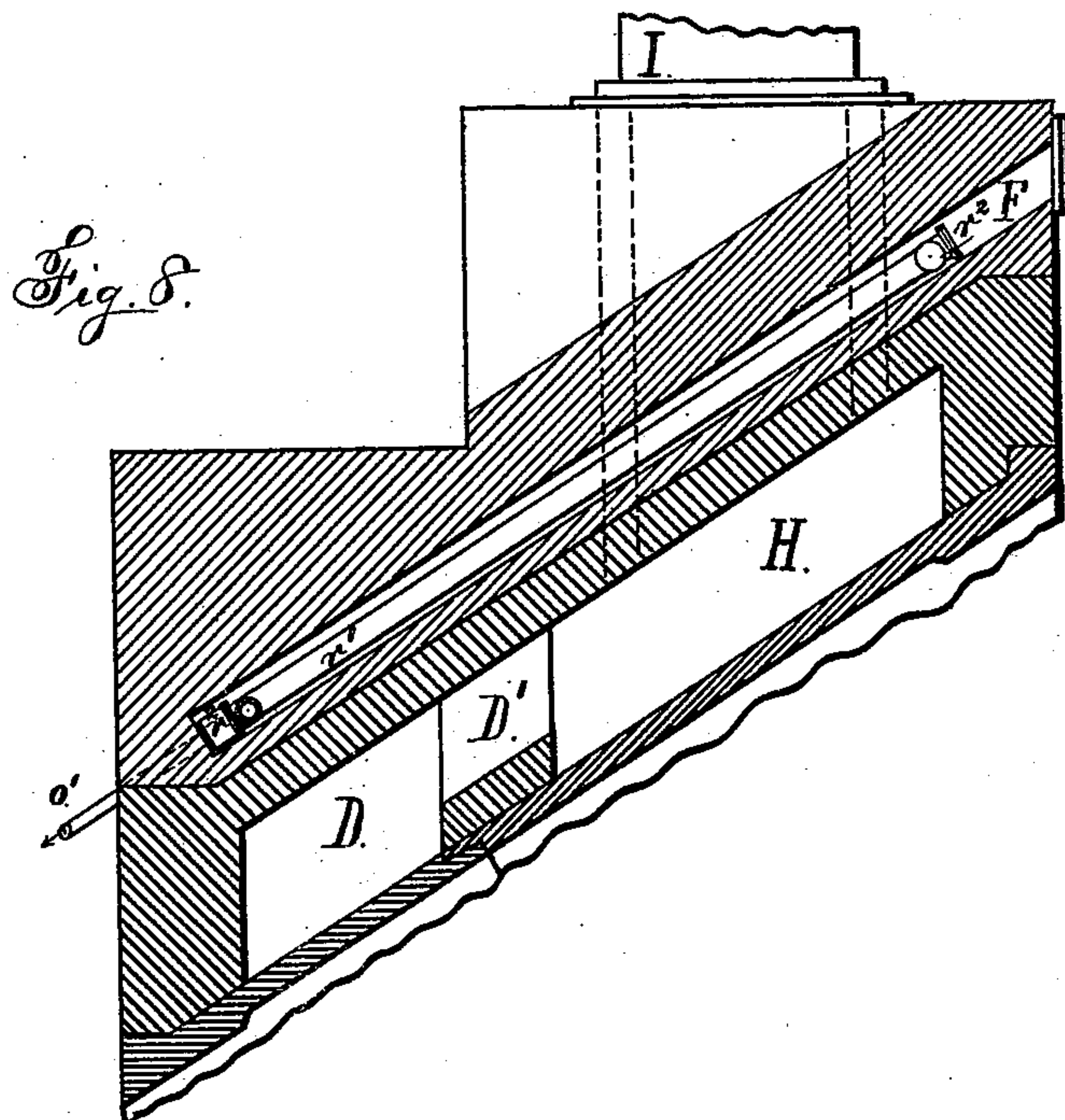
Witnesses  
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(No Model.)

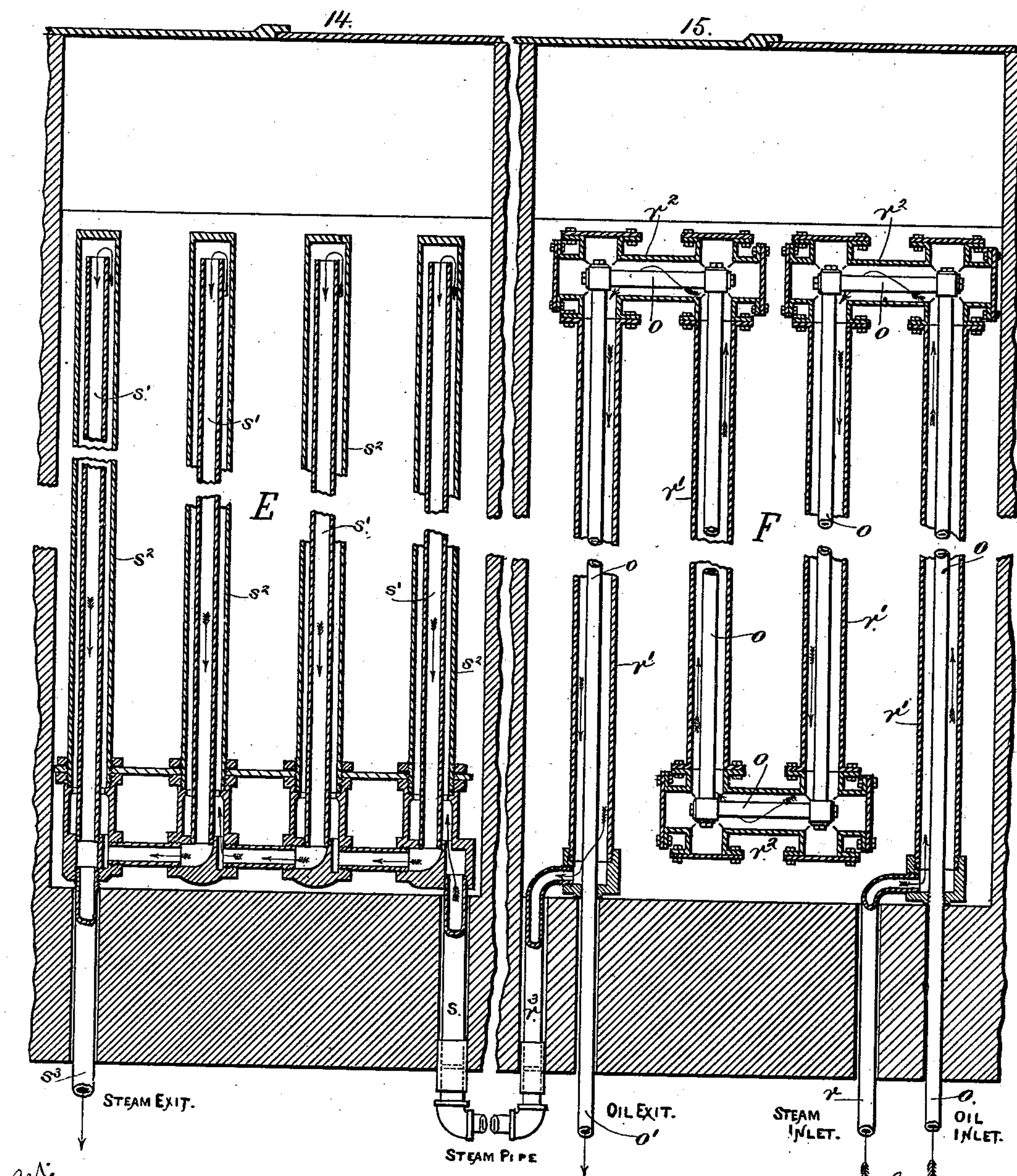
4 Sheets—Sheet 4.

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Fig. 10.



Witnesses  
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# UNITED STATES PATENT OFFICE.

HENRY M. PIERSON, OF BROOKLYN, NEW YORK.

## APPARATUS FOR MANUFACTURE OF GAS.

SPECIFICATION forming part of Letters Patent No. 549,657, dated November 12, 1895.

Application filed June 25, 1894. Renewed May 4, 1895. Serial No. 548,166. (No model.)

*To all whom it may concern:*

Be it known that I, HENRY M. PIERSON, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented a new and useful Improvement in Apparatus for the Manufacture of Gas, of which the following is a specification.

My present invention is designed as an improvement upon the method and apparatus described and shown in Letters Patent granted to me July 5, 1892, No. 478,459, and June 27, 1893, No. 500,424, which patents describe peculiar methods and apparatus for the manufacture of coal-gas, water-gas, and oil-gas, which gases are commingled to form a permanent compound gas as a substitute for natural gas; and the object of my present invention is to render more perfect, efficient, economical, and productive the methods and apparatus therein set forth.

My present invention relates particularly to improvements in blowing up the generating-furnaces and heating inclined coal-gas retorts and in the admission of air to effect complete combustion; also, in the economical treatment of the steam and liquid hydrocarbons preparatory to their utilization in the manufacture of the water-gas and the oil-gas.

In my present invention, as in my former patents herein mentioned, the generating-furnaces are blown up and the products of combustion are employed to heat the lower ends of inclined coal-gas retorts to a high intermittent heat, and in connection with an additional fire to heat the higher ends of said inclined coal-gas retorts to a steady but relatively low heat, while bituminous coal in said inclined coal-gas retorts is being continuously distilled for the production of coal-gas and coke.

The water-gas is made in the generating-furnaces and conducted therefrom to the higher cooler ends of the inclined coal-gas retorts down through said retorts to become enriched by taking up the light tarry matters, the water-gas and the coal-gas then passing together from the lower outer ends of said retorts through the hydraulic main and to a holder. The oil-gas is also made in the generating-furnaces after the fuel therein ar-

rives at a lower temperature, the oil-gas being conducted down through the bed of fuel in the generating-furnaces, which bed of fuel becomes a fixing-chamber, transforming the oil-vapors into a fixed gas, which is thereafter conveyed away to the same holder in which all three gases commingle to form a permanent compound gas.

In my present invention the products of combustion resulting from starting under natural draft and from blowing up the generating-furnaces to incandescence are conveyed by a pipe outside said generating-furnaces into the side of the retort combustion-chamber, and said pipe is provided with a valve adapted to shut off the same completely, and the sides of the retort combustion-chambers are each provided with an opening, a lined bonnet, and with a vertically-movable tile, and the end of the aforesaid pipe is provided with a flanged sleeve, which is adapted to be moved up toward or against the end of the bonnet after the valve has been unseated, and when these parts are brought together and the tile elevated a direct opening is established between either generating-furnace and the retort-furnace and retort combustion-chambers. The generating-furnaces are started under natural draft with the sleeve drawn up tightly against the under side of the bonnet. When the generating-furnaces are being blown up to incandescence, the sleeve is partially or entirely lowered to admit air to the desired extent with the products of combustion to insure perfect combustion of the gases in the retort-furnace and combustion-chambers. The products of combustion pass up through the retort combustion-chambers, the majority of said products passing directly vertically and by their high heat heating the lower ends of the inclined coal-gas retorts to a high heat, and the smaller proportion of said products of combustion pass to the higher ends of said coal-gas retorts, heating them to a lesser degree. There is also a fire burning constantly beneath where the products of combustion enter said chamber, so that a constant heat is maintained which passes upwardly in a similar ratio to the respective ends of said retorts. When the flanged sleeve is lowered and the valve put in position and the tile lowered, the mouth of the bonnet is open and atmospheric



air can enter and surround the exposed parts to keep them all cool, and also while either tile is lowered all access to the retort combustion-chambers at that side is shut off. The  
 5 pipes for the water-gas from the upper ends of said generating-furnaces are connected to the pipes that pass off for the products of combustion, and when the valve heretofore  
 10 spoken of is in place on its seat the water-gas is forced to pass off in the appointed channel, which channel is the same, and through the same means as were described and shown in my aforesaid patents.

I utilize the heat produced in the retort combustion-chambers for increasing the heated  
 15 condition of the steam employed in the manufacture of the water-gas and the oil employed in the manufacture of the oil-gas by causing the same to pass through series of pipes that  
 20 are located in cavities or pockets formed in the brickwork above the retort combustion-chambers. This location is exceedingly convenient, because directly above the arch of said combustion-chambers there is a great  
 25 amount of heat that would otherwise go to waste, and as it is essential to bring the steam to the highest condition of heat before separating its constituent elements and to bring the oil to as high a heat as is safe before trans-  
 30 forming it into oil vapor I employ pipes placed in these pockets and arranged in the peculiar manner hereinafter set forth.

In the drawings, Figure 1 is a vertical longitudinal section and partial elevation at the  
 35 line  $x x$  of Fig. 2. Fig. 2 is a vertical cross-section at the line  $y y$  of Fig. 1, and Fig. 3 is a sectional plan at the line  $z z$  of Fig. 1. These figures show the general location and construction of the respective parts. Fig. 4 is a  
 40 side elevation of the pipe, valve, and bonnet connecting the generating-furnace and the retort combustion-chamber. Fig. 5 is a sectional plan at the line  $x' x'$  of Fig. 4. Fig. 6 is a partial elevation and vertical section of the  
 45 same parts, and Fig. 7 is a plan of the band for holding the tile. Fig. 8 is a vertical section at the line  $y' y'$  of Fig. 9 of the upper end of the retort combustion-chambers, showing the pipes for steam and oil and their respective  
 50 pockets; and Fig. 9 is a plan view of the same. Fig. 10, in larger size, represents the particular construction of the series of pipes for steam and oil.

A B represent the companion generating-  
 55 furnaces.

C D represent the retort combustion-chambers surrounding the lower ends of the inclined coal-gas retorts  $e$ .

H represents the combustion-chamber surrounding the higher ends of the inclined coal-gas retorts, and H' the retort-furnace beneath  
 60 said combustion-chambers, and this retort-furnace H' has entrance-doors  $a^2$ , grate-bars  $a^3$ , and ash-pits, and a chimney I connecting  
 65 with the combustion-chamber H carries the products of combustion away.

There are uptakes or throats  $e' e^2$ , that con-

nect the retort-furnace with the retort combustion-chambers C D, and there are uptakes  
 70  $e^4$  and  $e^5$ , that connect the retort-furnace H' with the combustion-chamber H. The uptakes or throats  $e' e^2$  are properly of at least three or four times the area of the uptakes  
 75  $e^4 e^5$ , the uptakes  $e' e^2$  being directly vertical and the uptakes  $e^4 e^5$  being inclined to the combustion-chamber H, and at the upper end of the retort combustion-chambers C D there  
 80 are openings C' D', which connect the retort combustion-chambers with the combustion-chamber H, so that the products of combustion may pass over the intervening wall and  
 away by the chimney I.

In the upper portion of the brickwork above the combustion-chambers C, D, and H are the  
 85 pockets or receptacles E F for the pipes for steam and oil, hereinafter described. The retort-furnace H' is arranged slightly differently from what is set forth in my former patents,  
 90 in that the fire is central and the entrance thereto through the doors  $a^2$  is beneath the brickwork through the arch G at the back, and this fire is fed by red-hot coke taken out  
 95 of the inclined coal-gas retorts  $e$ , which is passed down the central opening or chute  $o$  from the platform above the generating-furnaces.

The pipe  $a$  extends out from the upper portion of the generating-furnace B, and the pipe  
 100  $b$  connects therewith and extends downwardly to the upright pipe  $c$ . The pipe  $g$  extends off from the pipe  $a$  to convey the water-gas, as set forth in my former patents. These pipes  
 105 are lined with tiling and are duplicated upon the opposite side of the generating-furnace A, and as both sets are alike one only will be particularly described.

The upper end of the pipe  $c$  is made with a conical seat for the valve  $d$ . The valve  $d$  is  
 110 hung upon the end of an arm  $d'$ , upon whose back end is an adjustable weight 2. An arm  $f$ , connected to the pipe  $c$ , carries a roller 3 at its upper end, and said upper end is grooved to receive the arm  $d'$ , which rests upon said roller.  
 115 Pivoted to this arm  $d'$  is a rod  $h$ , which passes through the platform  $h'$  and is provided with a handle 4 at its upper end. This rod is slotted for a pin 5 in a bearing-block fastened to said platform  $h'$ . The under surface of the arm  $d'$  is cut away and by preference is  
 120 notched at 6.

In the position shown the valve  $d$  rests in  
 125 its seat at the upper end of the pipe  $c$  and the back end of the undercut portion of the arm  $d'$  comes against the roller 3. Now if it is desired to remove said valve, the attendant upon the platform  $h'$  pulls upon the handle 4 of the  
 130 rod  $h$ , raises the valve off its seat and swings the rod  $h$  to carry the valve backwardly. This movement brings the valve over into the dotted position shown in Fig. 4, wherein the notch 6 engages the roller 3 and the downward movement of the rod  $h$  is arrested by the end of the groove in the rod  $h$  stopping against the pin 5. The valve is thus supported out of



the way until again required. When the valve is returned to its normal position, the end of the undercut portion of the arm  $d'$  comes against the roller 3 and insures the valve dropping into place.

A flanged sleeve  $i$  surrounds the upper end of the pipe  $c$  and pins 7 project from opposite sides of said sleeve. These pins are engaged by a slotted yoke-frame  $i'$ , one of whose ends is pivoted to the arm  $i^2$ , secured to the pipe  $c$ , and the other end of the slotted yoke-frame  $i'$  is pivoted to a vertical rod  $k$ , with a handle at the upper end and with one or more hooking projections 8. This rod passes up through the platform  $h'$  and through bearing-blocks therein which are provided with a pin 9. In the position shown in Figs. 4 and 6 the sleeve is down at its lowest point at rest upon the projections 10 of the pipe  $c$ . The attendant to elevate the flanged sleeve raises the arm  $k$  to bring its projection 8 over the pin 9 to hold the sleeve in its elevated position. The lined bonnet is secured to a frame  $l'$ , which in turn is fastened to the side of the retort-furnace  $H'$  at the opening therein, and I prefer to make this frame  $l'$  with an annular flange 11, that sets into the brickwork. This frame  $l'$  is open at its upper end and is made with an annular recess to receive the tile-slab  $m$ . This tile-slab is provided with a metal band near the top, which band is preferably composed, as shown in Fig. 7, of the two parts  $n$  and  $n'$  and the bale  $n^2$ , bolts 12 holding the bands together and to the bale, there being small projections 13 on the innerfaces of said bands that take into openings formed in the tile-slab  $m$ , so as to insure the lifting of the tile-slab by the bale and bands, and I employ a chain  $n^3$  with a weight  $n^4$  at its end passing over the pulley  $n^5$ . This weight is equal to the weight of the tile-slab, so that whether the tile be down or be raised the parts are balanced and remain fixed.

I prefer to form annular surface recesses around the upper end of the pipe  $c$  at 14 beneath the surface of the flanged sleeve, so as to provide for the ready up-and-down movement of the sleeve and prevent the risk of the same sticking or working too tight.

In the operation of the parts just described, when it is desired to blow up the generating-furnaces to incandescence, the valve of the water-gas pipe, as shown in my aforesaid patents, is closed, and the valve  $d$  is thrown open, and the flanged sleeve  $i$  is untouched or is partially raised toward the under edge of the lined bonnet, and the tiled slab  $m$  is raised, so that an opening is formed through the frame  $l'$  without raising the slab out of the frame, its under edge being approximately up to the upper edge of the opening. Thus a free passage is provided for the products of combustion from the generating-furnaces to the retort-furnace  $H'$  and upwardly to the retort combustion-chambers  $C D$  and combustion-chamber  $H$ , so that with the blowing up of the generating-furnaces the lower ends of the in-

clined coal-gas retorts are heated to the highest heat and the upper ends to the lowest heat, the products of combustion all passing away by the chimney  $I$ .

In blowing up the generating-furnaces to incandescence, as heretofore stated, air is to be admitted with the products of combustion through the lined bonnet by either leaving the flanged sleeve entirely down or by slightly elevating it to the desired extent, so as to produce an annular opening around the bonnet and between its edge and the edge of the sleeve. This can be done to the extent desired by the operation of said sleeve by the rod  $k$  and yoke-frame  $i'$  and the parts be so held. In this manner perfect combustion is insured in the retort-furnace and combustion-chambers, and the parts of the apparatus are not injured by the heat produced. If now it is desired to make water-gas, flanged sleeve  $i$  is dropped, the valve  $d$  replaced, the tile  $m$  dropped into the frame  $l'$ , and the valve of the water-gas pipe of my former patents opened. The steam is then admitted to the generating-furnace to produce the water-gas, which is conveyed away, as heretofore set forth.

The series of pipes employed for increasing the heat of the steam and the oil, and which pipes are located in the pockets or openings  $E F$  directly above the combustion-chambers  $C, D$ , and  $H$ , are preferably made as follows: Care must be exercised in heating the oil or liquid hydrocarbons so as not to raise the same to too high a degree of heat, but the steam is not subject to such risk. Therefore in heating the liquid hydrocarbons I prefer to pass the same in pipes through a steam-jacket, whereby the heat above these combustion-chambers will not only increase the heat of the steam, but will also highly heat the oil. This same steam is then taken through a second set of pipes back and forth and heated to a very high heat.

In Fig. 10 I have illustrated two sets of pipes for these purposes, and I might here remark that the pockets or openings  $E F$  in the brickwork open at the upper higher end and are provided with closing doors 14 15 and the oil and steam are conducted into and away from said series of pipes from the lower end, which lower end is nearer and more convenient for the utilization of said steam and oil in the generating-furnaces.

The oil or liquid hydrocarbons pass by a pipe  $o$  into and through steam-pipes  $r'$ , the steam passing into said pipes by the inlet  $r$ , the oil passing on back and forth through the series by the pipes and the exit-pipe  $o'$ , the steam also passing on back and forth through the pipes  $r'$  and the return bends  $r^2$  to the exit-pipe  $r^3$ . I have shown a series of pipes and their connecting ends as suitable for conveying the liquid hydrocarbons through the steam; but do not limit myself to this precise construction, as the same is not essential, the object to be attained is, as stated, in carrying the liquid hydrocarbons through steam-pipes, the steam being subject to the



heat above the retort combustion-chambers and in turn heating the liquid hydrocarbons. The steam from the pipe  $r^3$  passes over into the second series of pipes, which, as shown in the drawings, Fig. 9, is located above the retort combustion-chamber C and one combustion-chamber H. This series is one pipe  $s'$  within another and outer pipe  $s^2$  with suitable connecting-heads, so that the steam passes through each length of pipe  $s^2$  into the open end of the inner pipe  $s'$ , back there-through, crosses over to the next set, passes through the outer pipe  $s^2$ , and returns back through the smaller inner pipe  $s'$ , and so on through the series, and finally emerges by the exit-pipe  $s^3$ , and therefrom branches extend down to the generating-furnaces. In this way the liquid hydrocarbons are heated to such an extent that upon coming into the generating-furnaces they are in a greatly-advanced condition to be transformed into a fixed gas by being conducted down through the fuel in the generating-furnaces, which become the fixing-chamber, and the steam employed in the manufacture of the water-gas is heated to such an extent that it is more readily and economically separated into its component parts in the manufacture of water-gas when passed into the generating-furnaces. By the means heretofore described my improved apparatus for the manufacture of gas is rendered more efficient and economical, and the operations performed are carried out with the greatest amount of safety and security and with the greatest rapidity and consequent economy of operation.

I claim as my invention—

1. In an apparatus for the manufacture of gas, the combination with companion generating furnaces and inclined coal gas retorts, a chimney I and the retort furnace H', of the companion retort combustion chambers C D and the combustion chamber H through which chambers pass the inclined coal gas retorts, throats or uptakes connecting the respective lower ends of said retort combustion chambers C D and H directly with the retort furnace H', and throats or openings C' D' connecting the upper ends of said retort combustion chambers C D with the chimney I, substantially as set forth.

2. In an apparatus for the manufacture of gas, the combination with companion generating furnaces A B and inclined coal gas retorts, a chimney I and a retort furnace H', of the companion retort combustion chambers C D through which pass the lower ends of the inclined coal gas retorts and the smaller proportion thereof, the combustion chamber H through which pass the upper ends of said inclined coal gas retorts and the greater proportion thereof, the openings or throats C' D' connecting the retort combustion chambers with the chimney, the throats or uptakes  $e'$   $e^2$  connecting the lower ends of the retort combustion chambers with the retort furnace H', and the throats or uptakes  $e^4$   $e^5$  con-

necting the combustion chamber H with the retort furnace H', the throats or uptakes  $e'$   $e^2$  being of considerably greater area than the throats or uptakes  $e^4$   $e^5$ , substantially as and for the purposes set forth.

3. In an apparatus for the manufacture of gas, the combination with companion generating furnaces and inclined coal gas retorts, of the companion retort combustion chambers C D, the combustion chamber H, the retort furnace H' located centrally beneath said retort combustion chambers, throats or uptakes directly connecting the lower ends of the respective chambers C D and H with the furnace H', and a central downtake  $o$  through which the red hot coke from the inclined coal gas retorts is delivered directly upon the fire in the retort furnace H', substantially as set forth.

4. In an apparatus for the manufacture of gas, the combination with a generating furnace and means for firing its fuel, of the pipe  $a$  passing off from the upper end of the generating furnace, the pipes  $b$   $c$  connected therewith and provided with a valve, a lined bonnet and open frame connecting the same to the open side of the retort furnace and a valve in said frame, and a sliding sleeve closing up against the under side of the bonnet, whereby the products of combustion from the generating furnace under natural draft are conveyed therefrom into the retort furnace, substantially as set forth.

5. In an apparatus for the manufacture of gas, the combination with a generating furnace and means for blowing up its fuel to incandescence, of the pipe  $a$  passing off from the upper end of the generating furnace, the pipes  $b$   $c$  connected therewith and provided with a valve, a lined bonnet and open frame connecting the same to the open side of the retort furnace and a valve in said frame, a sliding sleeve adapted to be moved up toward the under side of the bonnet, whereby the products of combustion from the blowing up of the generating furnace are conveyed therefrom into the retort furnace and whereby air is admitted to any desired extent through the bonnet with the products of combustion by regulating the flanged sleeve, substantially as set forth.

6. In an apparatus for the manufacture of gas, the combination with a generating furnace and means for blowing up its fuel to incandescence and means for conveying the products of combustion from the generating furnace into the retort combustion chamber, of a lined bonnet, a frame connected therewith and by which the bonnet is secured to the open side of the retort furnace, a tile fitting in said frame, and a counter or balance weight for holding the tile in either of its positions, substantially as set forth.

7. In an apparatus for the manufacture of gas, the combination with the pipes  $b$  and  $c$ , of the flanged sleeve  $i$ , the yoke frame  $i'$ , the pivots 7, the arm  $i^2$  to which the yoke frame



is pivoted, the rod *k* and means for operating the rod vertically and raising the flanged sleeve and for holding the same in any desired position, substantially as set forth.

5 8. In an apparatus for the manufacture of gas, the combination with the pipes *b* and *c*, of the valve *d* adapted to fit a conical seat in the upper end of the pipe *c*, the arm *f* connected to the pipe *c* channeled at its upper  
10 end and provided with a roller 3, the arm *d'* pivoted to the valve *d* and having an adjustable counterweight 2 at its other end, the rod *h* pivoted to the arm *d'* and adapted to raise the valve and spring the same back off  
15 its seat, and means substantially as specified for holding and securing said valve, substantially as set forth.

9. In an apparatus for the manufacture of gas, the combination with the generating furnace, companion retort combustion chambers  
20 C D and the combustion chamber H, of the pockets or chambers E F located directly above the arches of the aforesaid chambers but not in communication therewith, series  
25 of pipes arranged and located entirely within the pockets or chambers E F through which pipes pass steam and liquid hydrocarbons to be heated by radiation of the excess heat of the companion retort combustion chambers  
30 before their utilization in the process of making gas, substantially as set forth.

10. In an apparatus for the manufacture of gas, the combination with the combustion chambers surrounding and extending above  
35 the inclined coal gas retorts, of the pockets or chambers E F located within the brickwork and above the arches of said combustion chambers, pipes in sets in the respective pockets E F, the first for steam and liquid hydrocarbons and the other for steam alone so  
40 arranged that the liquid hydrocarbons in the first set pass through inner pipes surrounded by steam, and the steam passing around the liquid hydrocarbons of the first set passes to  
45 the second set and back and forth through the same to be highly heated before utilization, substantially as set forth.

11. In an apparatus for the manufacture of gas the combination with retort combustion  
50 chambers and pockets or chambers located directly above the arches of the said chambers, but not in communication therewith, of a series of pipes and return bends connecting said pipes together at their respective  
55 ends and located within said pockets, a pipe for conveying steam into one end of the series and a pipe for conveying steam away from the other end of the series, a pipe for supplying liquid hydrocarbons passing within one  
60 end and continuously back and forth through the series of steam pipes, and a pipe for conveying the liquid hydrocarbons away at the other end of the series, whereby heat is imparted to both the steam and liquid hydrocarbons by the excess of heat of the retort combustion chambers, substantially as set  
65 forth.

12. In an apparatus for the manufacture of gas, the combination with retort combustion chambers and pockets or chambers located  
70 directly above the arches of said chambers, but not in communication therewith, of a series of pipes and heads to which said pipes are connected and located within said pockets, an inner pipe within each pipe of the series  
75 also connected to and passing through said heads, and short pipes connecting the heads and connecting one inner pipe with the adjacent outer pipe, an inlet pipe connecting with the first outer pipe, and an exit pipe extending away from the last inner pipe, where-  
80 by the steam is caused to flow back and forth through the outer and return through the inner pipes, and is superheated by the excess heat of the retort combustion chambers, substantially as set forth. 85

13. In an apparatus for the manufacture of gas the combination with a generating and a retort furnace of a pipe *a* passing off from the upper end of the generating furnace for  
90 conveying away therefrom both the products of combustion and the water gas, the water gas pipe *g* passing out and away therefrom, the pipes *b* and *c* continuations of the pipe *a* for the products of combustion, means for  
95 forming a connection between the free end of the pipe *c* and the side of the retort furnace, and a valve *d* to close the free open end of the pipe *c* during the process of making the water gas, substantially as specified. 100

14. In an apparatus for the manufacture of gas the combination with companion generating furnaces, and means for blowing up the fuel therein to incandescence alternately, inclined coal gas retorts, combustion chambers  
105 through which said retorts pass, the retort furnace H' having openings in its opposite sides and connections between the said chambers and furnace, of pipes from the said generating furnaces toward the retort furnace for  
110 the products of combustion, frames connected to the sides of the retort furnace around the openings therein, connections between said pipes and frames, and sliding tiles within said frames for establishing or shutting off com-  
115 munication with the retort furnace and means for moving and holding said tiles in either of their positions, whereby when one tile is raised with the blowing up of one generator, the other and opposite tile is lowered to place to  
120 protect the connections of the other generator, substantially as specified.

15. In an apparatus for the manufacture of gas, the combination with generating furnaces, the retort furnace having side open-  
125 ings, and pipes from the generating furnaces for the products of combustion, of valves in the ends of said pipes adapted to shut them completely, movable sleeves around the ends of said pipes, adjacent bonnets connected to  
130 the open sides of the retort furnace, and tiles between the bonnets and said openings whereby when the tiles are closed and the valves in place and the sleeves depressed the



parts are exposed to be kept cool by free circulation of air, substantially as specified.

16. In an apparatus for the manufacture of gas, the combination with a generating furnace and means for blowing up its fuel to incandescence, of inclined coal gas retorts, retort combustion chambers surrounding the lower ends and smaller portion of said retorts, combustion chambers of greater area surrounding the upper ends and greater portion of said retorts, a chimney and connections thereto from said chambers, a retort furnace beneath said chambers, uptakes of large area connecting the retort furnace with the chambers surrounding the lower ends of the retorts, uptakes of small area connecting the retort furnace with the chambers surrounding the higher ends of said retorts, and a pipe connecting the generating furnace with the retort furnace for conveying the products of combustion from the blowing up of the generating furnace into the retort furnace to pass upward around the retorts in volumes regulated by the areas of the respective uptakes for heating the lower ends of the retorts to a greater extent than the upper ends, substantially as set forth.

17. In an apparatus for the manufacture of gas, the combination with a generating furnace and means for blowing up its fuel to incandescence, of inclined coal gas retorts, retort combustion chambers surrounding the lower ends and smaller portion of said retorts, combustion chambers of greater area surrounding the upper ends and greater portion of said retorts, a chimney and connections thereto from said chambers, a retort furnace beneath said chambers, uptakes of large area connecting the retort furnace with the chambers surrounding the lower ends of the retorts, uptakes of small area connecting the retort furnace with the chambers surrounding the higher ends of said retorts, and a pipe connecting the generating furnace with

the retort furnace for conveying the products of combustion from the blowing up of the generating furnace into the retort furnace to pass upward around the retorts in volumes regulated by the areas of the respective uptakes for heating the lower ends of the retorts to a greater extent than the upper ends, and with means for admitting a supply of air in a regulatable quantity with the products of combustion into the retort furnace to insure perfect combustion, substantially as set forth.

18. In an apparatus for the manufacture of gas, the combination with a generating furnace and means for blowing up its fuel to incandescence, of inclined coal gas retorts, retort combustion chambers surrounding the lower ends and smaller portion of said retorts, combustion chambers of greater area surrounding the upper ends and greater portion of said retorts, a chimney and connections thereto from said chambers, a retort furnace beneath said chambers, uptakes of large area connecting the retort furnace with the chambers surrounding the lower ends of the retorts, uptakes of small area connecting the retort furnace with the chambers surrounding the higher ends of said retorts, and a pipe connecting the generating furnace with the retort furnace for conveying the products of combustion from the blowing up of the generating furnace into the retort furnace to pass upward around the retorts in volumes regulated by the areas of the respective uptakes for heating the lower ends of the retorts to a greater extent than the upper ends, and with means for stopping off the said pipe and closing its opening into the retort furnace, substantially as set forth.

Signed by me this 22d day of June, 1894.

H. M. PIERSON.

Witnesses:

GEO. T. PINCKNEY,  
HAROLD SERRELL.