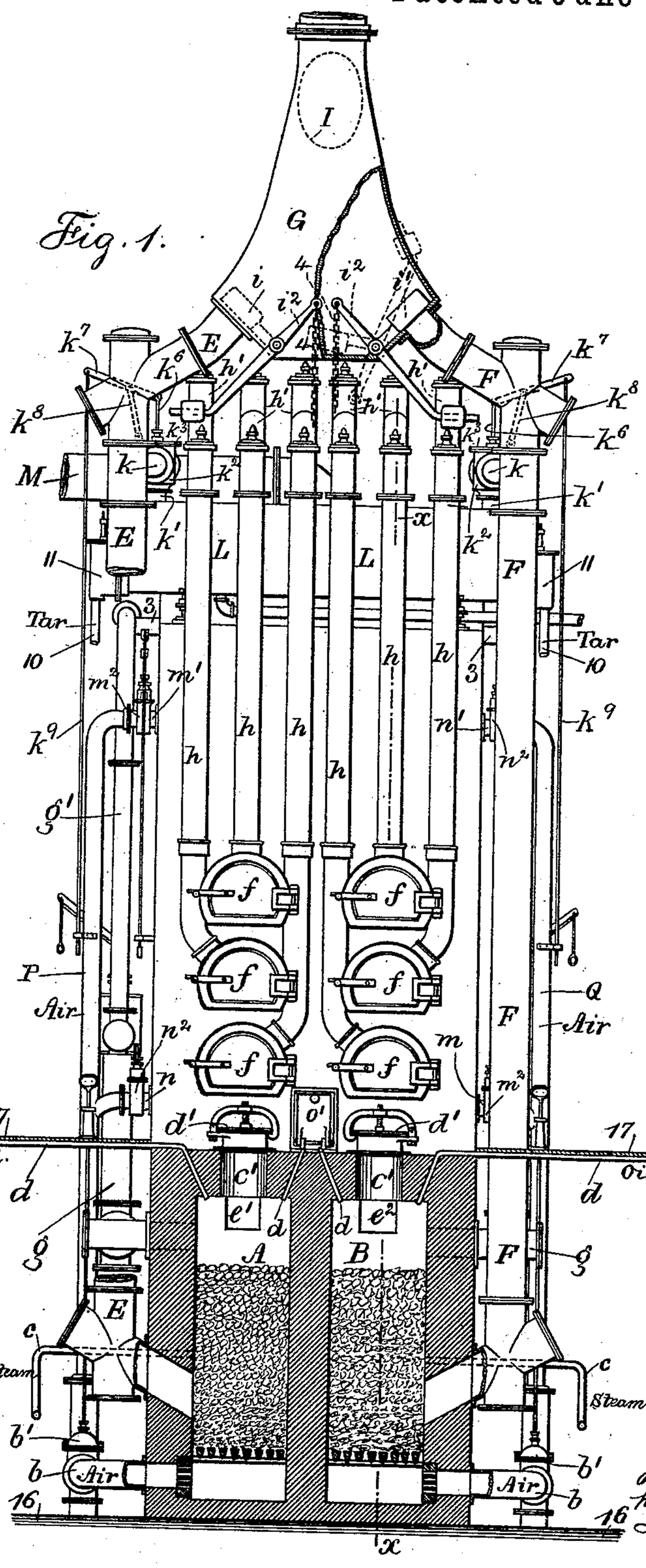
(No Model.) 4 Sheets—Sheet 1.

H. M. PIERSON.

APPARATUS FOR THE MANUFACTURE OF GAS.

No. 500,424. Patented June 27, 1893.

Fig. 1.



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Atty

(No Model.) 4 Sheets—Sheet 2.

H. M. PIERSON.

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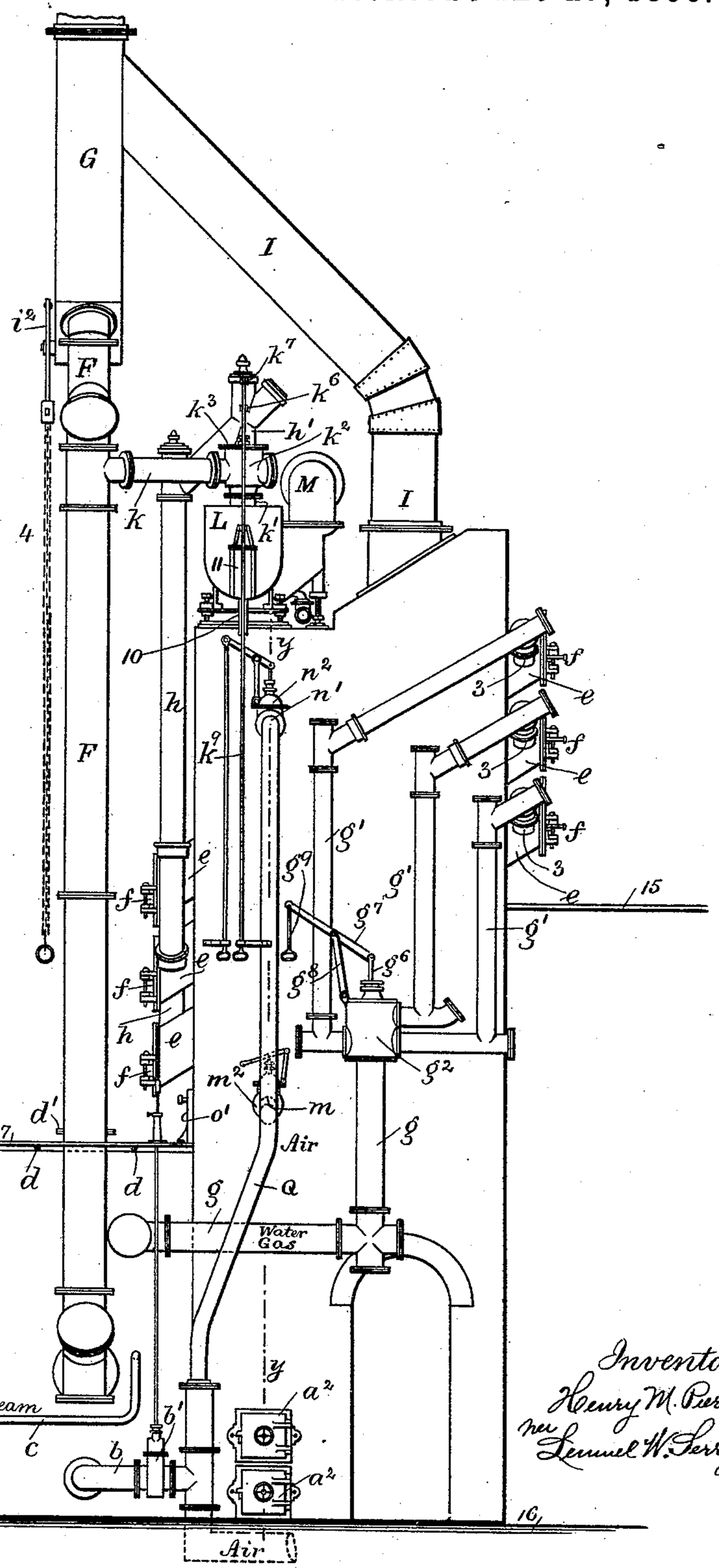
Fig. 2.



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H. M. PIERSON.

APPARATUS FOR THE MANUFACTURE OF GAS.

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Fig. 3.

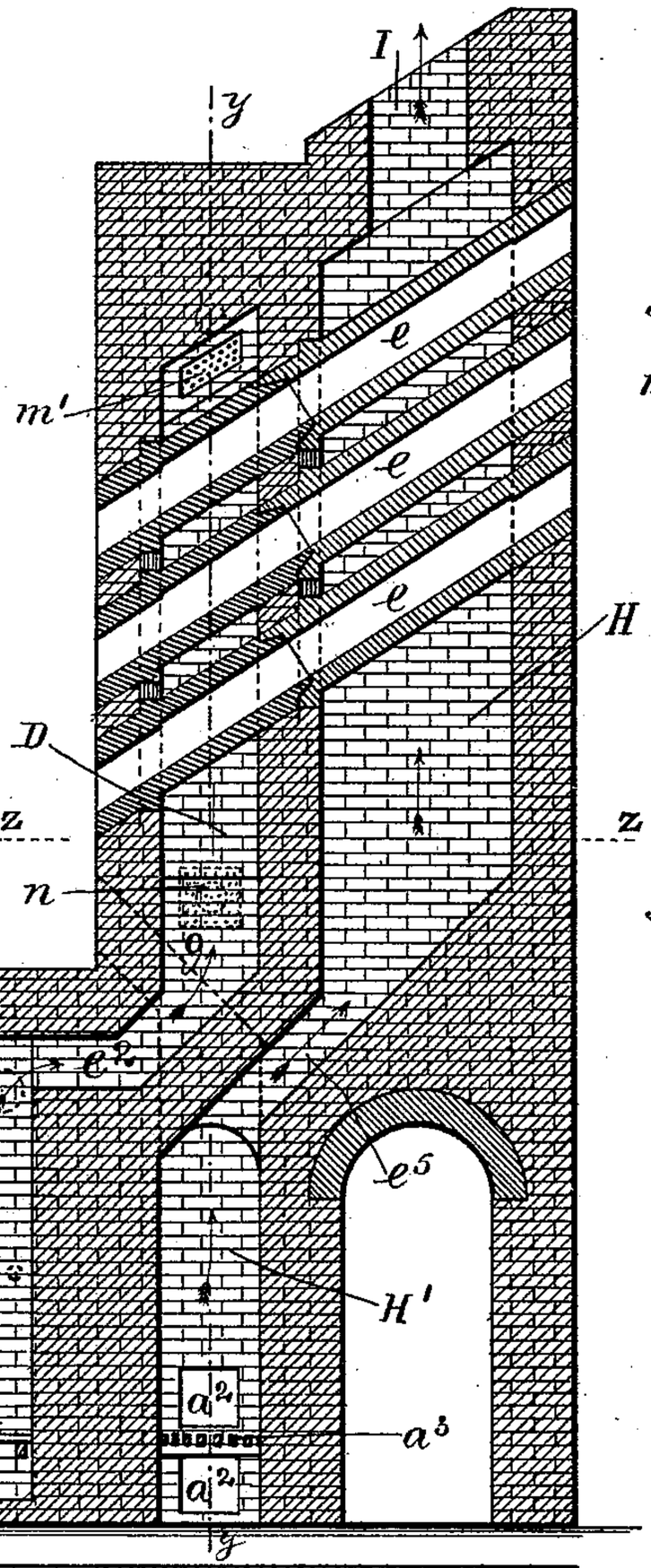


Fig. 4.

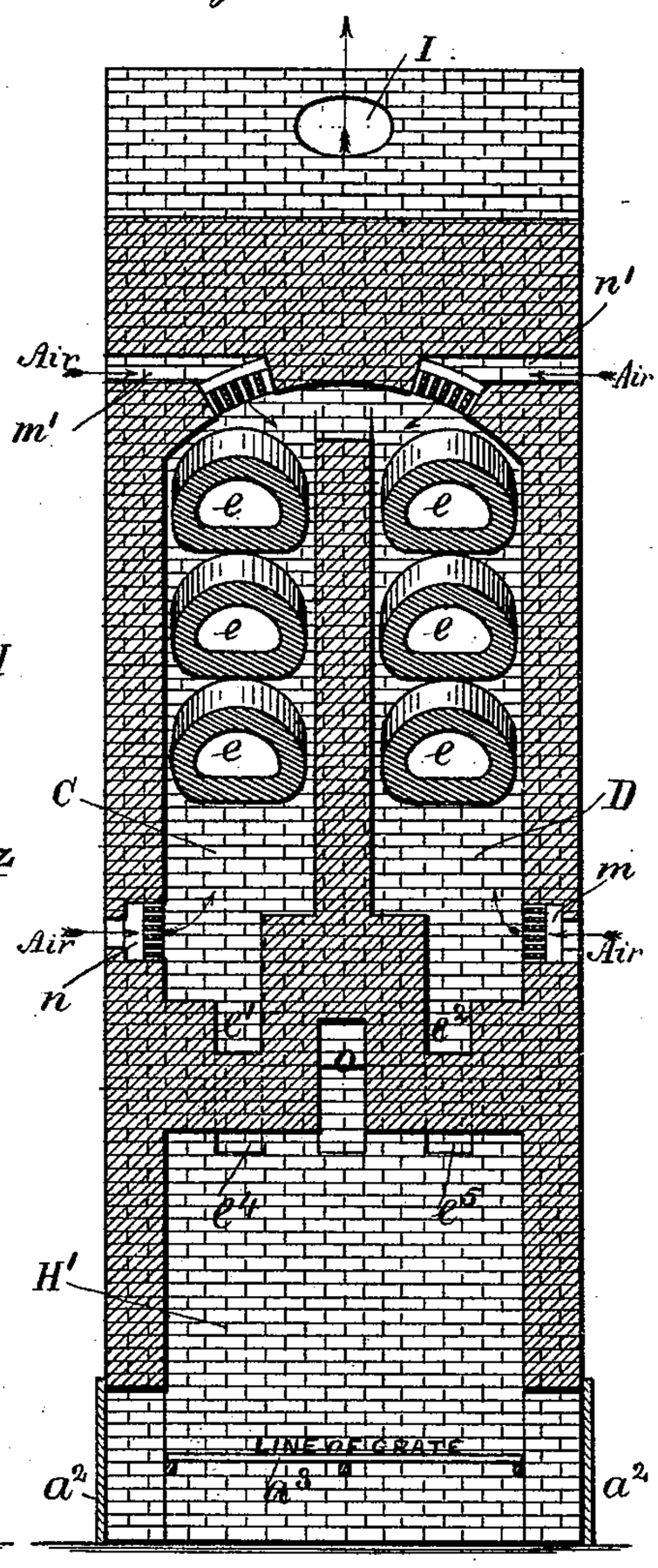
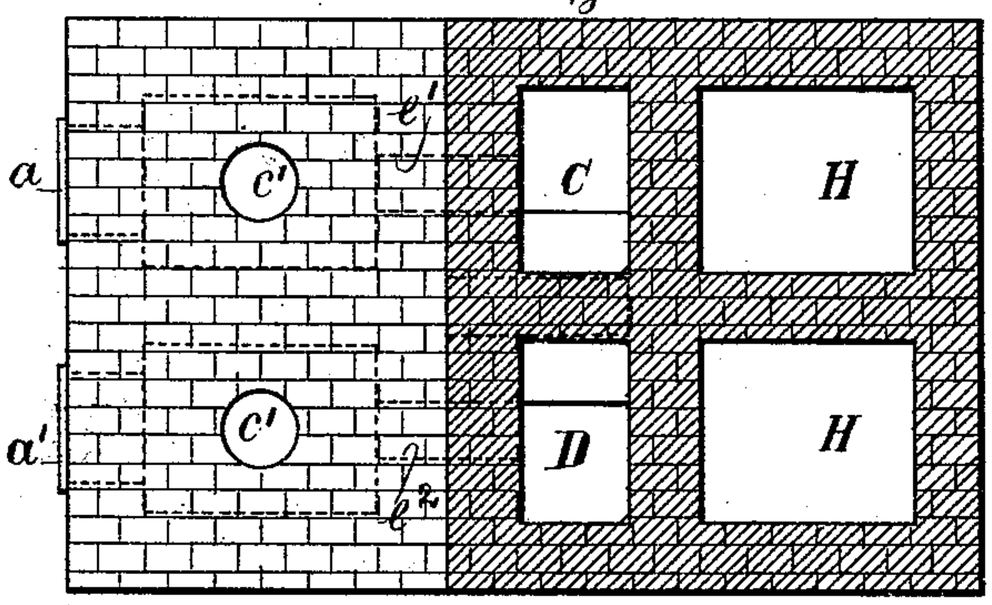


Fig. 5.



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APPARATUS FOR THE MANUFACTURE OF GAS.

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Fig. 6.

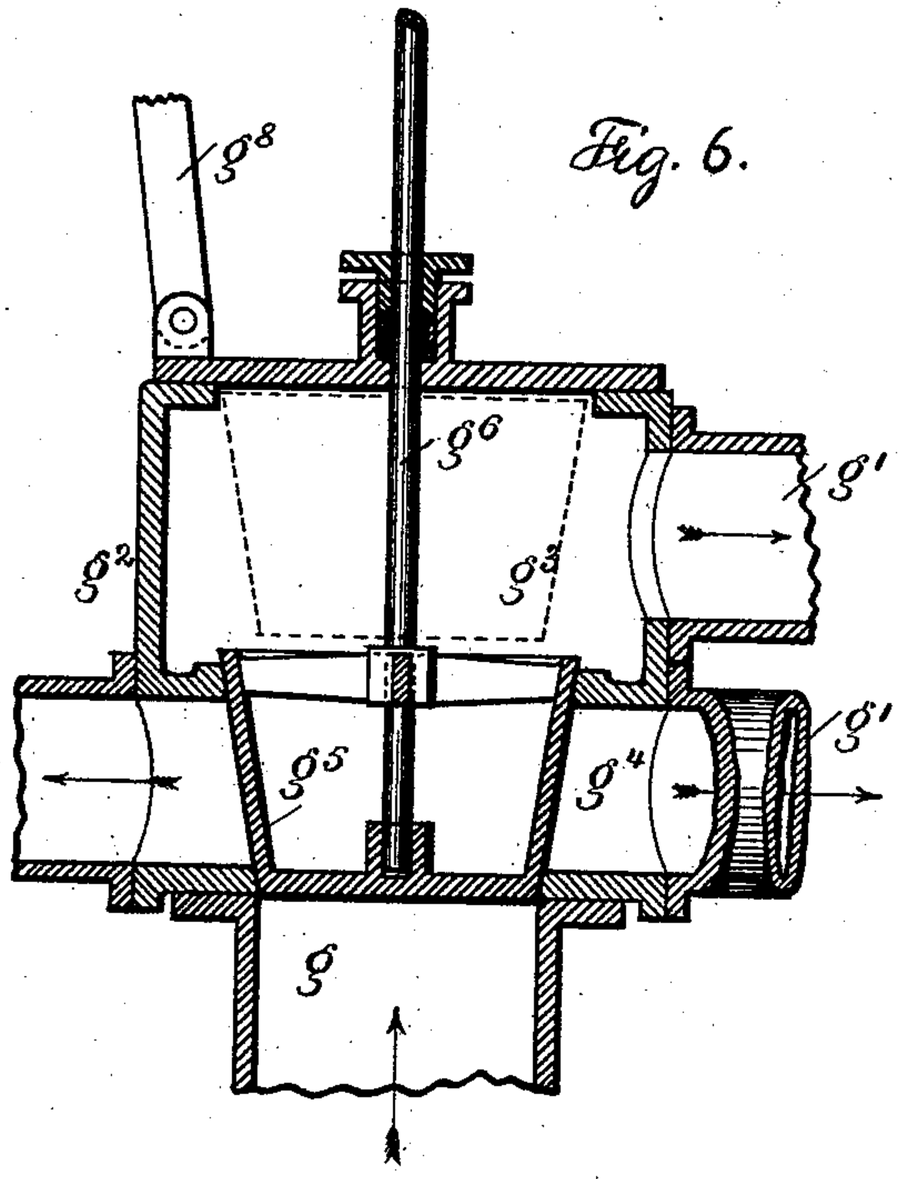


Fig. 8.

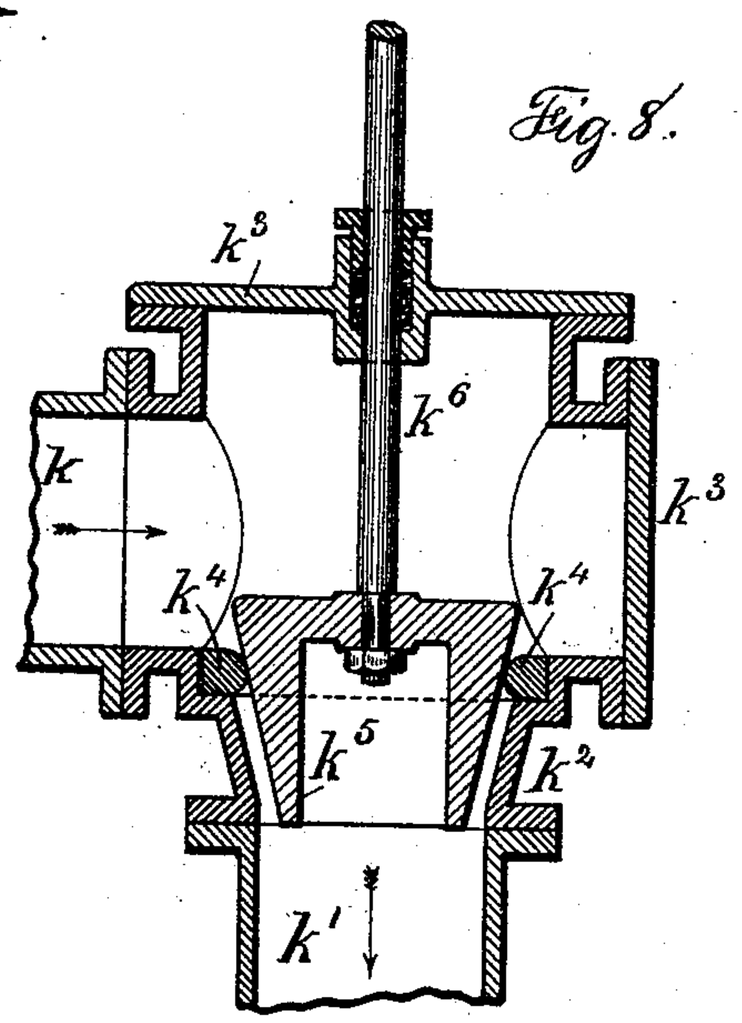


Fig. 7.

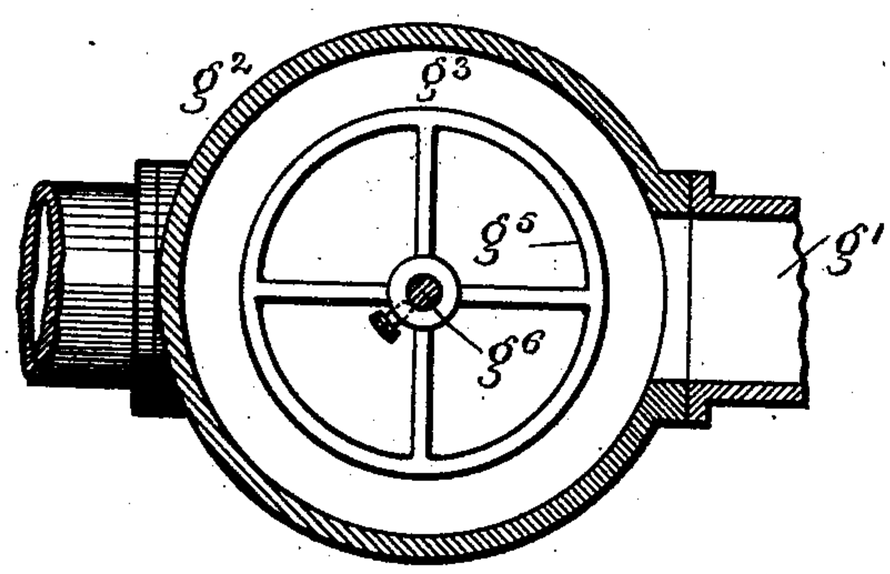
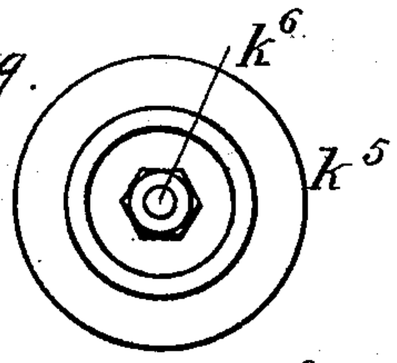


Fig. 9.



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UNITED STATES PATENT OFFICE.

HENRY M. PIERSON, OF BROOKLYN, NEW YORK.

APPARATUS FOR THE MANUFACTURE OF GAS.

SPECIFICATION forming part of Letters Patent No. 500,424, dated June 27, 1893.

Application filed August 6, 1892. Serial No. 442,311. (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 full, clear, and exact description.

Natural gas, the hottest gas extensively used for manufacturing purposes, is fast becoming exhausted; and the object of my present invention is to produce an artificial gas to replace natural gas, and a gas to replace natural gas must be a combination of the hottest known manufactured gases produced cheaply and in a simple apparatus.

My present invention relates to the methods of manufacturing a permanent compound gas and the gases comprising the same, which gases are made in part continuously and in part alternately without the use of the usual refractory material mixing-chamber, and in carrying out my invention I employ coal gas which contains marsh gas and hydrogen, water gas which contains carbonic oxide and hydrogen, and oil gas which contains olefiant gas, as these are the hottest known manufactured gases, and I manufacture these three gases in a peculiar and especially designed apparatus herein set forth and commingle said gases to form the desired permanent compound gas which is my substitute for natural gas. In order to have this gas, which is a combination of the before named gases, of the highest heating power, the same must be of a high candle power, and the gas resulting from these gases commingled fills these requirements, which being the case allows the one gas to be used for both heating and lighting purposes delivered through one set of pipes, and as it has been found expensive to double pipe for the purpose of delivering the gases separately my improvement overcomes this objection.

I employ mechanical devices as far as possible in connection with my apparatus in carrying out my process for making these gases economically and continuously and commingling the same for use.

The coal gas I make continuously from coal delivered into the high upper ends of inclined retorts externally heated, the gas passing from said retorts by stand-pipes through a hydraulic main and by pipes to and through washers, scrubbers, and purifiers to a holder.

The red hot coke made in the inclined coal gas retorts is removed from the lower ends and is employed and at once utilized as hereinafter described for carrying out the process in my improved apparatus.

The washers, scrubbers, purifiers, and holder are well known devices and form no necessary portion of my invention, and consequently are not illustrated or described herein.

The water gas I make by passing steam in the usual manner through a bed of incandescent combustible material in a generator, the resultant gas being conveyed through the hot coal gas retorts during the process of distillation to become enriched by combining with the light tarry matters that usually pass over into the hydraulic main and are lost by commingling and passing off with the tar. This enriched water gas is permanently fixed by passing through the lower and hotter ends of said retorts and it then passes from the lower or delivery end of said retorts, with the coal gas, through the hydraulic main, through washers, scrubbers, and purifiers to a holder.

The oil gas I make by delivering liquid hydrocarbons onto a bed of red hot combustible material in a generator and passing the resultant vapors down through said red hot combustible material in said generator, thereby transforming said vapors into the desired fixed oil gas, said gas then passing into the hydraulic main and through the same with the coal gas and on through the washers, scrubbers, and purifiers to the holder, wherein all three gases inseparably commingle, forming the desired permanent compound gas—a substitute for natural gas.

In carrying out my process I employ an apparatus especially arranged with reference to completeness, compactness, convenience and efficiency wherein two generating furnaces for alternate use are set side by side. These furnaces are arranged in front of the retort furnace and form part of the structure containing the inclined coal gas retorts and in which is a dividing wall forming combustion

and heating chambers at the respective ends of said retorts and into which chambers uptakes extend from both the generating furnaces and the retort furnace, all of which together with the arrangement of pipes, valves and all parts and their functions are hereinafter more particularly described.

In the drawings, Figure 1 is an elevation and partial cross section of my improved apparatus. Fig. 2 is an elevation of the same at one side. Fig. 3 is a vertical section on the line $x\ x$ of Fig. 1. Fig. 4 is a vertical cross section on the line $y\ y$ of Figs. 2 and 3. Fig. 5 is a sectional plan on the line $z\ z$ of Fig. 3, and Figs. 6, 7, 8, and 9 are detailed views of parts hereinafter more fully described.

A, B, are the companion generating furnaces, which are of the usual character and constructed side by side and in which there are self-sealing doors a, a', ash-pits provided also with self-sealing doors (not shown) air-blast pipes b, with regulating gates b' for the inlet of air, steam pipes c for the inlet of steam, oil pipes d for the inlet of oil at various places, throats c', and gas-tight covers d', providing for the admission of fuel to the generating furnaces. The walls of the companion generating furnaces are continued backwardly and upwardly and with an inclined top to form the companion retort combustion chambers C D and the retort furnace combustion chamber H, between which there is a dividing wall, through which the inclined retorts pass. The retort combustion chambers C D are connected with the generating furnaces A B by uptakes or throats e' e^2, and they are separated by a wall parallel with the retorts that does not reach quite to the top of the chambers C D. The retort furnace H′ is preferably placed on a level with the fires of the generating furnaces and uptakes e^4 e^5 connect the space directly above the fire with the combustion chamber H which embraces the upper higher ends of the inclined retorts. The retort furnace H′ has entrance doors a^2 at each side and grate bars a^3 and ash pits and a chimney I connecting said combustion chamber H with the chimney G; and smoke pipes E F also open into said chimney G, and their lower ends are connected to and open into the said generating furnaces A B above the grate bars and adjacent to the fire-zone. I provide a downtake at o through the main wall, and the same is shown by dotted lines in Fig. 3 and full lines, Fig. 4. This downtake is provided with a door o', and the object of said downtake is to supply the furnace H′ with red hot coke as taken from the coal gas retorts as fuel for said furnace fire. The retorts e are of usual character and extend through the combustion chamber H and chambers C D and they are set at an angle of about thirty degrees, the inclination being toward the generating furnaces, so that the lower ends come above the throats c' of the generating furnaces. The respective ends of these retorts are made with metal ends or sleeves conforming in shape to said retorts and forming continuations thereto outside the main brick-work, and these ends have gas tight covers f to close the same. I prefer to make the fire clay portion of the inclined retorts e in two parts joined together at the division wall support as shown in Fig. 3.

Pipes g rise from each side of the generating furnaces A B and extend up outside the same to the valve case, g^2 and from said valve case g^2 pipes g' rise and extend over toward the upper higher ends of the coal gas retorts and said pipes g' terminate in branches 3 which enter the metal ends of said retorts. There are three pipes g' and three branches 3 one for each of the three retorts in one bench and these pipes and branches together with the pipe g and valve case g^2 are duplicated at the opposite side of the apparatus extending from the other generating furnace to the other bench of retorts.

The valve case g^2 shown in the vertical section Fig. 7 and sectional plan Fig. 8, has divided upper and lower chambers g^3 g^4 and the valve g^5 is cup shaped and sets in the divisional wall between the chambers and at the upper end of the pipe g so that when the valve is down and closed the end of the pipe g and the exit therefrom to the pipes g' is completely shut off and each pipe g' is also completely shut off from each other pipe g' therefore there is no communication from any one retort to another when this valve is closed as this is essential in charging or discharging the retorts, and when said valve is raised to the dotted position, free communication is established between the pipe g and pipes g' through said valve case g^2. This valve has a stem g^6, and I provide a lever g^7, link g^8, and rod and handle g^9 for raising the valve, and these parts are so made and proportioned that when the valve g^5 is raised the link g^8 has passed to the other side of a vertical line and holds the valve in its elevated position. These valves are alike on both sides of the apparatus. No valves are employed on said branch pipes 3, for the reasons hereinafter stated in the description of the process. From the lower ends of said retorts e vertical stand pipes h rise and dip pipes h' extend over therefrom into the hydraulic main L, and a pipe M passes from the hydraulic main L away to the washers, scrubbers, and purifiers and to the holder. The tops of the smoke pipes E F are fitted with weighted and tight fitting valves i i', and I provide levers i^2 and depending chains or rods 4 for operating said valves and removing from or replacing the same upon the upper ends of said stand pipes, or in other words, for opening and closing said valves. The valves i i' are heavy and fit gas tight against the ends of the stand pipes and they are assisted in this because the levers i^2 are provided with adjustable weights. The valves are alternately held open by securing the chains or rods 4 and are self closing when released. Near the upper ends of said smoke

pipes E F are branch pipes k and dip pipes k' from the same entering the hydraulic main L.

Between the branch pipes k and dip pipes k' I place valves of improved form which I design to supersede the usual sealing cups. These valves consist each of a case k^2, covers k^3 and an internal ring seat k^4 having a curved convex or conoidal inner edge, and I provide a valve k^5 of inverted cup shape having a conical or tapering exterior. This valve passes into the ring seat k^4 and when the parts come together as shown in the vertical section Fig. 9, there is a nipping and sealing action that is effectually operative even if the ring seat be covered with tar or carbonaceous deposit. Fig. 9 is a vertical section of this valve and case in large size, and Fig. 10 an inverted plan of the valve. This valve has a stem k^6, lever k^7, link k^8 and operative handle k^9 to raise the same as desired. The tar passes constantly from the hydraulic main L by pipes 10 having regulating gates 11 away to the tar well. I have not shown the tar well, because it is a well known device. The respective ends and elbows of all these various pipes are shown with caps for the thorough cleaning and care of such pipes. The upper ends of said retorts are constantly heated by the fires of the retort furnace H', the products of combustion passing off by the chimney pipe I and chimney G, and the lower ends of said retorts are intermittently heated by the high heat produced by the firing up of the generating furnaces.

I have represented floors at 15, 16, 17, for the attendants, which floors are conveniently placed for operating the mechanism in the way of filling the coal chutes l, firing the retort furnace H, and working the smoke pipe valves $i\,i'$ by the chains or rods 4 and the air valves b' by the operating rods, &c.

I provide pipes $m\,m'$ and $n\,n'$, extending into the walls of the chambers C D, and the object of these pipes is to admit air within the chambers, so that the products of combustion in blowing up the generating furnaces may be completely consumed by the addition of sufficient air for that purpose. These pipes $m\,m'$ and $n\,n'$ are each provided with a valve m^2 and n^2 opened and closed in the usual manner. Pipes P and Q rise from the main source of air supply and pressure entering the generating furnaces at each side of the apparatus and these pipes connect with the pipes $m\,m'$ and $n\,n'$.

The operation of carrying on the manufacture of my permanent compound gas is as follows:—The generating furnaces are first charged with coke or other fuel and fired, and the retorts e are charged with bituminous coal, and the fires in the retort furnace H' are lighted and the upper ends of the retorts heated by a steady heat. The smoke pipe valve i' is now opened and the air blast is admitted into the generating furnace A and passes through the fuel therein, raising the same to incandescence, and the gases pass up the throat or uptake e' into the retort chamber C and around the retorts e, over the dividing wall and down the retort chamber D, and around the retorts therein, down the throat e^2, and down through the fuel in the generating furnace B, raising the same to a dull red hot condition, and then up the smoke pipe F and away by the chimney G. In this manner the lower ends of the retorts e are heated by a high heat, which is intermittent with the blowing up of the generating furnaces in alternate directions. During this firing up operation air is admitted by the pipes $n\,n'$ into the chambers C D to completely burn the resulting gases into carbonic acid (complete combustion) before reaching and passing down through the second generating furnace B, thereby only heating, but not consuming the fuel in this furnace. This is necessary, so that the fuel in the second generating furnace is not heated above a dull red heat, which is the required heat to effectually make the oil gas in my process. The air pipes $m\,m'$ and $n\,n'$ in the chambers C D are operated alternately in pairs with the firing of the generating furnaces by opening their valves, and according to the direction of the firing, the pipes $n\,n'$ being used in firing the furnaces A B and the pipes $m\,m'$ in firing the furnaces B A. During this heating operation and together with the heat of the retort furnace H' the bituminous coal in the retorts e is being distilled and converted into red hot coke and giving off coal gas, which contains marsh gas and hydrogen, and said coal gas passes by the stand pipes h from the lower hot ends of the retorts and dip pipes h' into and through the hydraulic main and by the pipe M to the washers, scrubbers and purifiers and to the common holder.

The process of making coal gas from bituminous coal in the retorts e and making red hot coke is continuous, the movement of the coal down the inclined retorts being accomplished steadily by the delivery of coal at the upper ends and the removal of red hot coke from the lower ends through the covers f. This red hot coke is delivered from the retorts periodically through the throats c' into the generating furnaces A B, as desired, for fuel, and the surplus is conveyed by the downtake through the door to the retort furnace H' for use there as fuel. After the generating furnace A has been raised to incandescence the smoke pipe valve i' is closed and steam under pressure is admitted by the pipes c into the generating furnace A for the production of water gas by passing said steam up through the bed of incandescent fuel in said furnace, and the resultant gas passes by one of the pipes g through the valve case up the pipes g', and by the branch pipes 3 into the upper ends of all the retorts e. The gas then passes down through these coal gas retorts e during the process of distillation and in transit becomes enriched by taking up and combining with light tarry matters or hydro-

carbons, such light tarry matters as have heretofore usually passed over into the hydraulic main and are lost by commingling and passing off with the tar. The coal gas is about eighteen candle power and can carry only a certain per cent. of light tarry matters, and the surplus has heretofore been lost in the hydraulic main. By passing my water gas through these retorts during the process of distillation and taking up these surplus matters, I do not rob the coal gas of its light giving qualities, but I do effect a saving and economically enrich the water gas. I have discovered that no valves are needed in the pipes *g'* or in the branch pipes 3 to the retorts *e*, because the retorts which are the hottest repel the entry of the water gas to a great extent and the retorts that are the coolest admit said water gas, and that nearly the entire volume of said water gas passes through the retort most recently charged with bituminous coal, and which coal is directly after charging giving off the light tarry matters that I wish absorbed by the water gas. The said retorts are charged in rotation at stated intervals of about a half hour, so that each particular retort is recharged about every three hours—that is, where six retorts are employed, as shown in the drawings. This enriched water gas then passes through the hot ends of said retorts and becomes fixed therein and then passes from the retorts *e* by the stand pipes *h* and dip pipes *h'* to and through the hydraulic main L by the pipe M to the washers, scrubbers, and purifiers to the common holder, and this occurs simultaneously with the manufacture and delivery of the coal gas. The steam is shut off and the manufacture of water gas is stopped in the furnace A after running the desired time, and one valve g^5 in the valve case, g^2 at the junction of the pipes *g* and *g'* is closed, shutting off the passage from the furnace A to the connected bench of retorts; the valve *i'* at the top of the smoke stack F remains closed and the generating furnace A is not again used until after the next blowing up operation.

I now open one valve k^5 in the valve case k^2 and manufacture oil gas in the generating furnaces B, containing the fuel at dull red heat, and previously unused, by delivering liquid hydrocarbons through the pipes *d* onto this bed of fuel. The resulting vapors are made to pass down through this said bed of fuel, which changes the vapors into a fixed gas, and the gas passes by the smoke pipe F and its branch pipe *k* through the valve case k^2 and dip pipe *k'* into and through the hydraulic main L, and by the pipe M to the washers, scrubbers, and purifiers to the common holder.

The manufacture of coal gas in the retorts *e* is simultaneous with the manufacture of the oil gas; and the operations of alternately blowing up the generating furnaces, and making water gas and oil gas follow one another are repeated in rotation; and the manufacture of coal gas is carried on continuously with these operations.

Heretofore in the manufacture of olefiant gas it has been usual to convey the vapors away from the upper part of the generating furnace into a fixing chamber filled with checker brick previously heated by internal combustion to produce the oil gas; but I have discovered that by passing said oil gas vapors down through a body of fresh unused fuel—such as that already heated to a dull red heat in the generating furnace in which the said vapors are made—the results in this case are far superior to the results heretofore obtained by passing said vapors through the fixing chamber, as formerly employed. In this manner the said fuel is gradually and thoroughly charged with a carbonaceous deposit that materially assists combustion in again blowing up the fuel in said generating furnace in repeating the operations. I have also discovered that because of passing these oil vapors down through the fire I am enabled to use the most common, crude, and inexpensive hydrocarbon oils or their residuums, as the same will make as much gas as more expensive oil, and the fire removes as a deposit in it the impurities which assist as fuel in the reheating of the generator. In the common holder the coal gas, water gas enriched, and the oil gas all inseparably commingle to form the desired permanent compound gas, adapted for both heating and lighting purposes, and to be delivered through one set of pipes for these purposes as a substitute for natural gas. After sufficient oil gas has been made one valve k^5 is closed or dropped to tightly seal the dip *k'* above the hydraulic main, and the valve *i* is opened from the top of the smoke pipe E, and the cover *d'* is removed from the top of the furnace B, and coke in sufficient quantity is drawn from the retorts *e* and delivered into the furnace B as fuel therefor and the cover *d'* closed. The air blast is now turned on into the generating furnace B, and the fuel therein is raised to incandescence, and the retort chambers D and C together with the lower ends of the retorts *e* are heated all at once by the completely consumed products of combustion as well as the fuel in the generating furnace A, which latter fuel is raised to dull red heat, the products of combustion passing by the smoke pipe E to the chimney G. After this the valve *i* is closed and water gas is made in the generating furnace B, now filled with incandescent fuel, and then oil gas is made in the furnace A now filled with fuel at a dull red heat in the manner herein described, and the operations back and forth with these generating furnaces and attendant apparatus are constantly and intermittently repeated as herein described while the manufacture of coal gas and coke is going on continuously.

I would remark that during the operation of firing up the generators and afterward

making water gas the valves k^5 are closed to their seats against the upper ends of the dip pipes k' to effectually seal the same, so that nothing enters the hydraulic main through the pipes k, and that during the making of oil gas one valve k^5 in the valve case k^2 is raised according to the generating furnace in use for the purpose of making oil gas. I would also remark that during the manufacture of oil gas in either generating furnace no gas can pass the valve g^5 of that furnace, because the same is closed tightly, and in carrying out the processes herein specified by the peculiar apparatus described I do not employ the usual refractory material fixing chambers, but fix the gases as made in the manner described, and commingle them and form a permanent compound gas.

In my Patent No. 478,459, granted July 5, 1892, some features are set forth but not claimed. Those features correspond to features herein contained and claimed, the same having been eliminated from the application for said patent for the purpose of being included in the present case.

I claim as my invention—

1. In an apparatus for the manufacture of gas, the combination with companion generating furnaces for alternate use and means for blowing up their fuel; of means for conveying steam thereinto for the formation of water gas, retorts for receiving bituminous coal and means for heating the same for making coal gas, connections between the cooler feeding ends of said retorts and said generating furnaces for conveying the water gas to the retorts, a hydraulic main and connections thereto from the hotter ends of said retorts for conveying away the gases from the retorts, means for delivering oil within said furnaces, pipes to the hydraulic main from the generating furnaces above the grates and ash lines and by which the oil gas is conveyed away after passing down through the bed of fuel, and a common delivery for the gases, substantially as and for the purposes herein set forth.

2. In an apparatus for the manufacture of gas the combination with a generating furnace and means for blowing its fuel to incandescence, and means for conveying steam thereinto for the formation of water gas; of retorts for receiving bituminous coal and means for heating the same for making coal gas, connections between the cooler feeding ends of said retorts and said generating furnace for conveying the water gas to the retorts, a hydraulic main and connections thereto from the hotter ends of said retorts for conveying away the gases from the retorts, substantially as and for the purposes herein described.

3. 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 steam thereinto for the formation of water gas; of inclined retorts for receiving bituminous coal at their higher and cooler ends, and means for heating the same for making coal gas, connections between the higher cooler feeding ends of said inclined retorts and said generating furnace for conveying the water gas to the retorts, a hydraulic main and connections thereto from the hotter and lower ends of said retorts for conveying away the gases from the retorts, substantially as and for the purposes herein described.

4. In an apparatus for the manufacture of gas the combination with a generating furnace and means for blowing up its fuel to a dull red heat and for delivering oil upon its bed of fuel for making oil gas; of a hydraulic main and a pipe to the same from the side of said generating furnace above its grate and ash line and by which the oil gas is conveyed away after passing down through the bed of fuel, substantially as and for the purposes herein described.

5. In an apparatus for the manufacture of gas the combination of a generating furnace and means for blowing up its fuel, a pipe entering the upper end of said furnace for delivering hydrocarbon oil upon the bed of fuel to become vaporized, means for compelling the oil vapors to pass down through the bed of fuel in said generating furnace which becomes a fixing chamber for transforming said vapors into a fixed gas, and a pipe passing out from the said generating furnace near the lower end and above the ash line by which the oil gas is conveyed away, substantially as and for the purposes set forth.

6. In an apparatus for the manufacture of gas, the combination with a generating furnace and inclined coal gas retorts; of a combustion chamber embracing the lower ends of said retorts and communicating with said generating furnace, whereby the lower ends of said retorts are heated to a high heat with each blowing up of the generating furnace, the retort furnace H′ and combustion chamber H beneath and around said gas retorts for heating their upper ends by a steady heat, substantially as and for the purposes set forth.

7. In an apparatus for the manufacture of gas, the combination with a generating furnace, the inclined coal gas retorts and the hydraulic main, of a pipe g' rising from the generating furnace, a valve case and valve to which such pipe is connected, pipes g' rising from the said valve and extending over to the higher ends of said retorts, said pipes g' terminating in branches 3 opening into said retorts, and the stand pipes h and their dip pipes h' connecting the lower ends of said retorts with the hydraulic main, substantially as and for the purposes set forth.

8. In an apparatus for the manufacture of gas, the combination with companion generating furnaces A B and inclined coal gas retorts, of the companion retort combustion chambers C D connecting at their upper ends

and embracing the lower ends of said retorts, the throats e' e^2 connecting the lower ends of said chambers with the generating furnaces, substantially as and for the purposes set forth.

9. In an apparatus for the manufacture of gas, the combination with companion generating furnaces A B and inclined coal gas retorts, of the companion retort combustion chambers C D connecting at their upper ends and embracing the lower ends of said retorts, the throats e' e^2 connecting the lower ends of said chambers with the generating furnaces whereby the lower ends of said retorts are heated to a high heat with each blowing up of the generating furnaces, and the retort furnace H′ and combustion chamber H beneath and for heating the upper ends of said gas retorts, substantially as and for the purposes set forth.

10. In an apparatus for the manufacture of gas, the combination with companion generating furnaces A B and inclined coal gas retorts, of the companion retort combustion chambers C D connecting at their upper ends and through which the coal gas retorts pass, the throats e' e^2 connecting the lower ends of said chambers with the generating furnaces and pipes m m' and n n' entering opposite ends of the chambers C D for conveying air into said chambers for producing complete combustion, substantially as and for the purposes set forth.

11. In an apparatus for the manufacture of gas, the combination with a hydraulic main and a pipe therefrom to a holder, of companion generating furnaces with an upper chamber by which they are connected and are adapted to be employed alternately, the pipes E F passing off from the companion generating furnaces above the grate bars and rising to the hydraulic main, branch pipes from the pipes E F dipping into the hydraulic main, and oil pipes in the upper part of said generating furnaces for delivering hydrocarbon oil for the manufacture of oil gas, and valves in the passages above said generating furnaces, substantially in the manner and for the purposes set forth.

12. In an apparatus for the manufacture of gas, the combination with the generating furnace, of the pipe g therefrom for the water gas, the pipes g' and their branches 3 extending to the upper higher ends of the coal gas retorts, a valve case connecting the pipe g and pipes g', a valve within said case adapted to close and to shut off when closed the passage between the pipe g and all the pipes g' and also the passage from any one pipe g' to any other, and when lifted to throw open freely the passages between all the pipes, substantially as set forth.

13. In an apparatus for the manufacture of gas the combination with a generating furnace, a pipe g therefrom for water gas, pipes g' and branch pipes therefrom to the higher ends of coal gas retorts, of a valve case g^2 connecting the upper end of the pipe g and the lower ends of the pipes g', a vertically movable cup-shaped valve within said case having two seats closed simultaneously and when closed shutting off the pipe g from all the pipes g' and also any pipe g' from all the other pipes g', and when raised and open providing a free passage between all of said pipes, substantially as set forth.

14. In an apparatus for the manufacture of gas, the combination with a generating furnace, a hydraulic main and a stand pipe rising from the generating furnace, of a pipe k from the stand pipe and a pipe k' to the hydraulic main, a valve case connected respectively to the pipes k and k' and through which the gas passes to the hydraulic main, a curved or conical seat within said valve case and a tapering or conical valve adapted to fit said seat and by its form and weight to be wedged to place, substantially as set forth.

15. In an apparatus for the manufacture of gas, the combination with a generating furnace, a hydraulic main and a stand pipe from the generating furnace toward the hydraulic main, of the pipes k k' and valve case k^2 connected at the respective ends of the pipes k k' and forming a passage for the gas from the stand pipe to the hydraulic main, a seat within said valve case formed of a ring k^4, the edge of whose opening is curved or conical, an inverted cup-shaped valve k^5 of inclined or conical exterior adapted to fit and tightly wedge within the ring seat, substantially as and for the purposes set forth.

Signed by me this 4th day of August, A. D. 1892.

H. M. PIERSON.

Witnesses:
GEO. T. PINCKNEY,
WILLIAM G. MOTT.