

(No Model.)

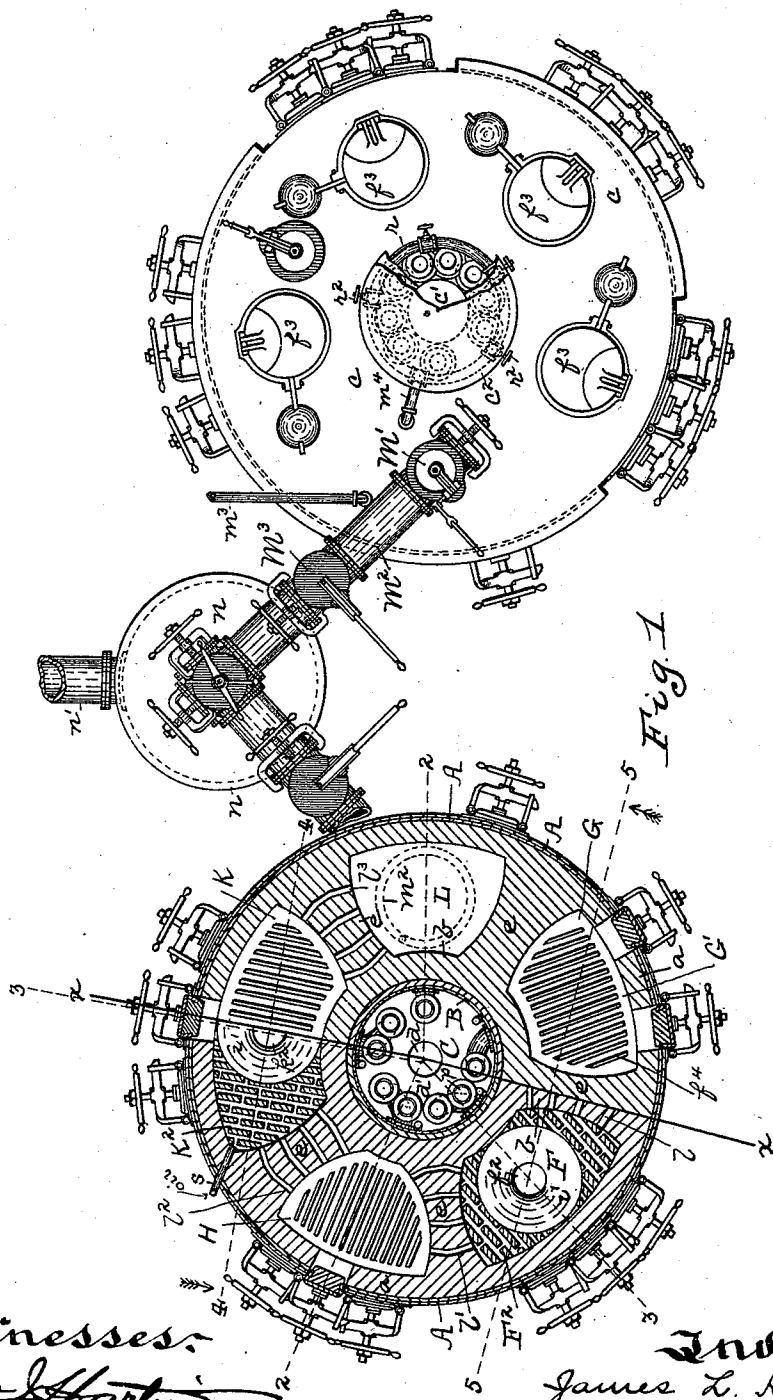
3 Sheets—Sheet 1.

J. L. HASTINGS.

GENERATOR FOR THE MANUFACTURE OF GAS.

No. 530,944.

Patented Dec. 18, 1894.



Witnesses,

Geo. J. Hartman,
 Luella H. Knox.

Inventor:

F. L. **Inventor**
 James L. Hastings.
 By Kay, Totten & Cooke,
 Attorneys.

(No Model.)

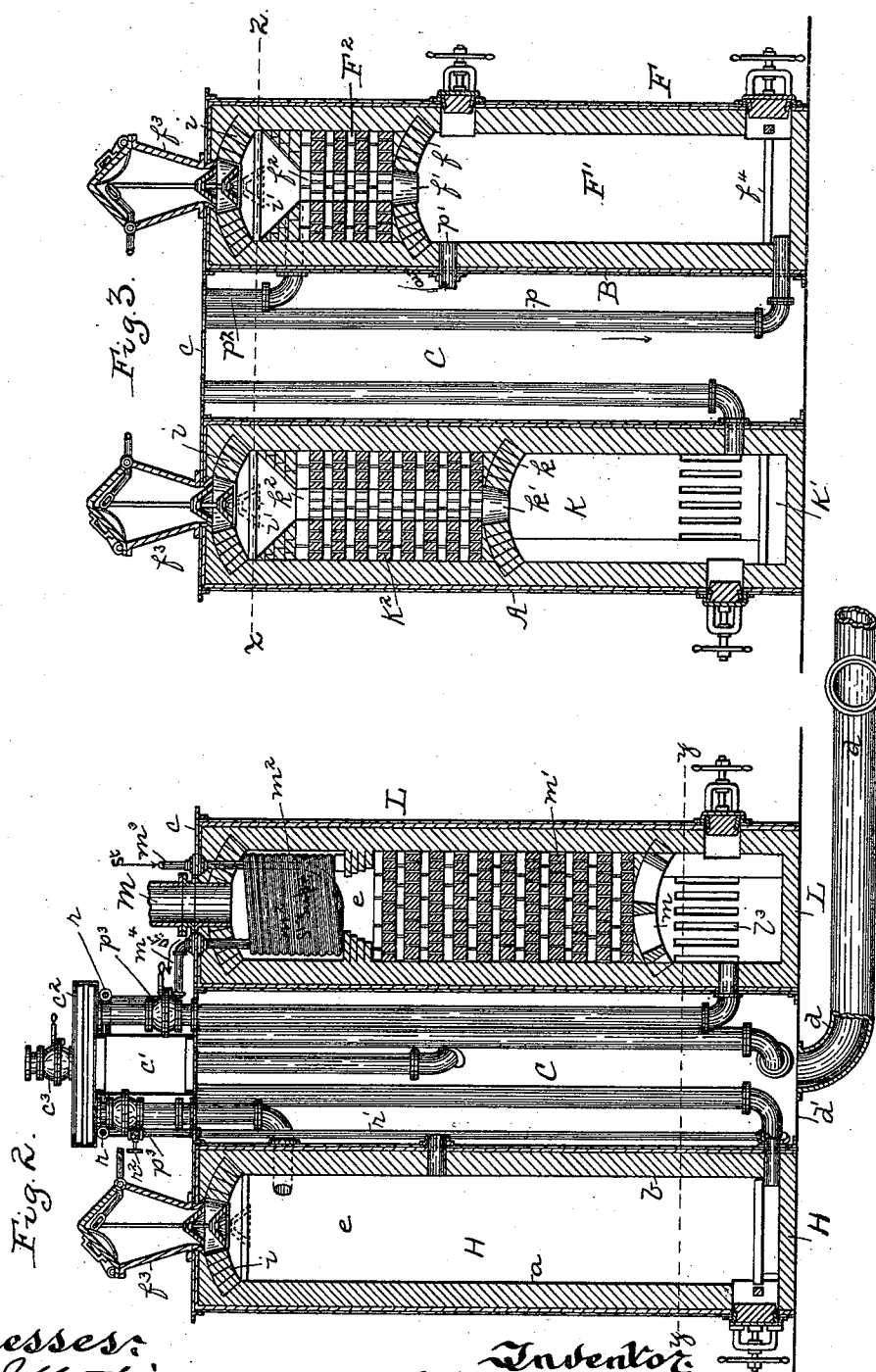
3 Sheets—Sheet 2.

J. L. HASTINGS.

GENERATOR FOR THE MANUFACTURE OF GAS.

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Patented Dec. 18, 1894.



Witnesses:
E. J. Martin.
Luella H. Knox.

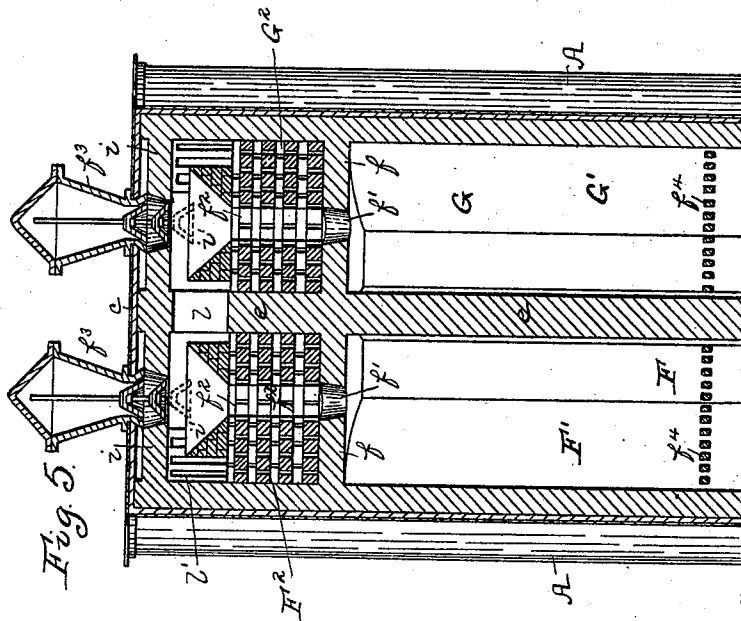
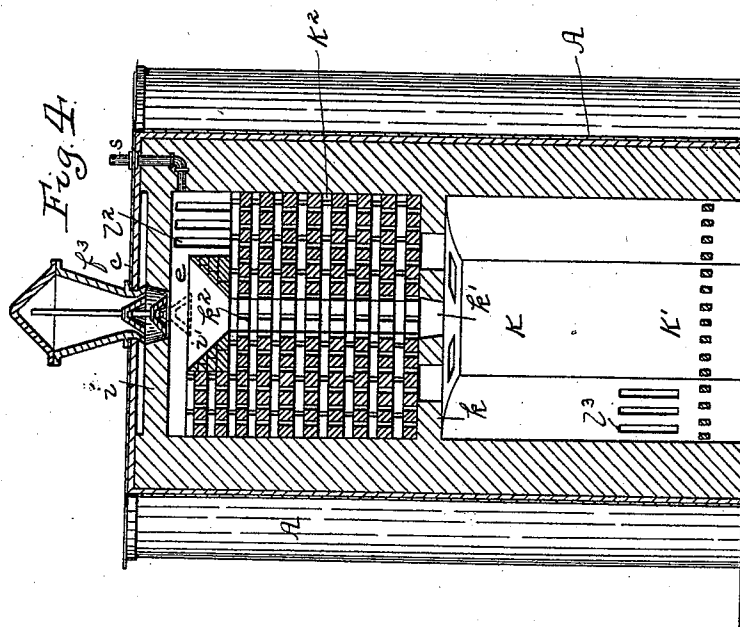
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Witnesses:
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Luella H. Knox.

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UNITED STATES PATENT OFFICE.

JAMES L. HASTINGS, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO THE
NATIONAL HEAT AND POWER COMPANY, OF SAME PLACE.

GENERATOR FOR THE MANUFACTURE OF GAS.

SPECIFICATION forming part of Letters Patent No. 530,944, dated December 18, 1894.

Application filed June 14, 1893. Serial No. 477,566. (No model.)

To all whom it may concern:

Be it known that I, JAMES L. HASTINGS, a resident of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have
5 invented a new and useful Improvement in the Manufacture of Gas; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to the manufacture of
10 gas, and has special reference to gas apparatus adapted, among other things, to practice the method of making gas described in Letters Patent granted to me September 26,
1893, No. 505,525, in which the gas is made
15 by practically the following steps:—Two or more generators are blasted up so as to form generator gas and bring the coal or like carbon therein to the proper heat for making water gas, the generator gas so formed being
20 burned to heat the bodies of refractory material and carbon for superheating and for fixing purposes. Steam is then introduced into one of the generators and the gas so formed is immediately carried into a fixing chamber and hydrocarbons introduced into
25 the same, and the combined water gas and vapor fixed within said fixing chamber and within the body of heated carbon through which it is caused to pass; and at a later part of the run
30 steam is introduced into the other generator and the gases formed carried through a superheater so as to superheat the same before the introduction of hydrocarbons into the same, the hydrocarbons being introduced into the
35 superheated gas and the gases carried in the same course, the result being a more regular and even manufacture of gas, the maintenance of the necessary heat within the apparatus for a longer period, and the consequent
40 longer runs in gas manufacture, and other advantages not necessary here to be stated.

One of the objects of the present invention is to provide a compact and cheap apparatus for the practice of this method of making gas, as well as other methods, so that the apparatus can be constructed at comparatively low cost, and it will not occupy a large space, while all the parts thereof are properly utilized for gas making purposes. This part of
45 my invention comprises, generally stated, a gas apparatus formed of a central circular air tank, a circular casing around the same,

the space between the tank and casing containing suitable gas generating and fixing chambers, and having air pipes leading from
55 said air tank to the gas generating chambers; such construction providing for the heating of the air by the heat radiated through the walls of the generating and fixing chambers into this air tank, so that the air is raised to a
60 considerable heat before it is introduced into the apparatus; while at the same time, in the preferred construction, the air pipes lead within said tank to the points at which the air is introduced into the different chambers,
65 and said air pipes have their valves exposed, and a compact form of apparatus is thus provided and the circular space within the annular body of the gas apparatus is so utilized for the heating of the air.
70

It also consists in such gas making apparatus having two circular casings forming an annular structure and having formed therein a series of cupola generators communicating with each other and with the fixing chamber,
75 as hereinafter described, so as to form a compact gas generating apparatus having several cupola generators from which the gas can be carried to the single fixing chamber, and in which all of the gases can be utilized for the
80 superheating of the steam.

It also consists in certain other improvements in the apparatus which will be particularly set forth and claimed.

To enable others skilled in the art to make
85 and use my invention, I will describe the same more fully, referring to the accompanying drawings, in which—

Figure 1 is in part a plan view and in part a section of the apparatus, one set of the ap-
90 paratus being shown in the plan view and the other in the section, the sections being divided on the line $x-x$, and the section to the right being taken on the line $y-y$, Fig. 2, while the section to the left is taken on the line $z-z$,
95 Fig. 3. Fig. 2 is a vertical section of the apparatus on the line 2-2, Fig. 1. Fig. 3 is a vertical section on the line 3-3, Fig. 1. Fig. 4 is a vertical section on the line 4-4, Fig. 1; and Fig. 5 is a vertical section on the line
100 5-5, Fig. 1.

Like letters of reference indicate like parts in the several figures.

The apparatus is inclosed primarily in the

outer casing A and inner casing B, the two casings forming together the annular body portion of the gas apparatus, and the said inner casing B being closed at the bottom by the base d' , with which the air supply pipe d leading from a suitable air compressor communicates, and closed at the upper end by the annular plate c , the box c' forming an extension from the plate and the enlarged head c^2 of said box forming a circular extension from the box of practically the same diameter as the main body of the tank C which is formed by the circular plate B and the parts above described. The circular body portion is lined by two annular walls a b , said walls being supported by the circular plates A B; and it is divided into a series of chambers by the vertical arches e , which arches extend from the walls a to the walls b and so forming the end walls of the chambers, the crowns of the arches of the two adjoining chambers either bearing on each other or being close to each other so as to form proper braces for the pressure from the generators within the chambers. The body portion as thus shown is divided into several chambers which may be designated as follows:—The cupola generator F, the cupola generator G, the cupola generator H, fixer K, and steam superheater L. By the location of the several walls the sizes of these chambers can be varied as desired, it being desirable to provide a large fixing surface within the fixer K, and it not being necessary to have the cupola generators of as great section or capacity.

The construction of the cupola generators F G is shown to the right of Fig. 3, (and in Fig. 5) said chambers having the coal space $F' G'$ in the lower part thereof, and the superheating chambers $F^2 G^2$ in the upper part thereof, the two chambers being separated by the arch f with the central port f' through which the fuel may be introduced into the coal chamber, a passage f^2 being formed through the checker work of the upper chamber to permit the coal to pass directly through the same into the lower chamber F' . Directly above said passage f^2 is the coal feeder f^3 which opens into the chamber through the roof i thereof and below which is the feeding chute i' which is built of solid brick work resting upon the checker work of the upper chamber, so that the coal or like fuel can be directed by the funnel i' into the passage f^2 and thence into the lower chamber. This solid brick funnel, as shown in Fig. 1, does not extend entirely over the surface of the checker work, but the said checker work extends to the upper part of the chamber around the sides of the funnel i' , and in this way the gases generated in the lower chamber, either in blowing up or in the making of water gas, will pass into the body of checker work in the upper chamber or superheater. The lower chamber has also the grate bars f^4 , and it is arranged to be fed with air and steam as hereinafter described. The cupola generator G

has the coal chamber G' and the superheater G^2 filled with checker work, and is of exactly the same construction as the cupola generator F.

The cupola generator H, which is next to the fixing chamber K, is of the same form as the generators F G but has no superheater located therein, being simply a long coal chamber having the coal feeder at the upper end and being so constructed because the gases formed therein do not require to be superheated in their course to the fixing chamber, as described in said Patent No. 505,525.

The fixer K is made of greater superficial area than the several cupola generators, and is constructed as shown in Figs. 1, 3 and 4, having substantially the same width as the several generators and arranged concentric with the air reservoir C, but being of greater length, that is, occupying a greater portion of the space around the air reservoir, this being desirable as it is desired both to introduce the oil or other hydrocarbons into the same and to fix the gases generated in the several chambers. It is provided with the coke chamber K' in the lower part thereof and the fixing chamber K^2 in the upper part thereof, said fixing chamber being composed of checker work and being supported on the perforated arch k extending across above the coke chamber and having the ports k' therein, the fixing chamber having the same form of coal feeder f^3 at the upper end and having formed through the checker work the central passage k^2 above the port k' with the solid funnel i' above said chute or passage k^2 , such funnel being of the construction above described in connection with the cupola generator F and extending over a portion only of the checker work within the fixing chamber K^2 .

The passages for the gas are arranged in the upper parts of the chambers by means of the ports l between the cupola generators F and G at the upper ends of the superheaters thereof, and the ports l' between the cupola generators F and H in the upper parts of such cupola generators in about the same line as the ports l and the ports l^2 leading from the cupola generator H into the upper part of the fixing chamber K and in about the same horizontal plane as the ports l . The gases are carried from the base of the coke chamber K' into the steam superheater L through a series of ports or passages l^3 which extend through the division wall between the chambers K L opening into the base of the chamber L and rising through a perforated arch m therein. Above this arch is supported the mass of checker work m' , and above the checker work in the upper part of the superheater is the steam superheating coil m^2 , a pipe m^3 leading to such steam superheater and the pipe m^4 leading from the same into the proper position for carrying the superheated steam into the several chambers. The exit pipe M leads from the upper end of said steam superheater L and has at the up-

per end thereof the valve M' through which the heated products of combustion can escape into the atmosphere, while below said valve is the gas eduction pipe M^2 through which the

5 gas escapes, passing into the scrubber, feed water heater, or into any other suitable chamber n , the gas eduction pipe M^2 having the valve M^3 located therein.

The several chambers in the apparatus 10 have suitable doors which may be employed either for feeding the fuel, the withdrawal of ashes, or to obtain access to the different parts of the furnace, which are illustrated in the drawings and which it is not deemed 15 necessary to refer to specifically.

Having now described the different chambers in the apparatus, and the construction of the same, I will proceed to describe the arrangement of the pipes for feeding the steam 20 and air into the several chambers.

As above stated, the air tank C is formed of a circular plate metal body closed at one end by the base d' and at the upper end having the neck c' and the enlarged head c^2 which 25 extends out beyond the neck, as clearly shown in Fig. 2 and the top view of which is shown to the right of Fig. 1. The purpose of this enlarged head c^2 of the tank is to provide for the feeding of air to the different air pipes, 30 and for the location of the valves of such pipes in position for easy access. It will be seen that several air supply pipes lead downwardly from this head c^2 around the neck c' and extend through the plate c into the tank C , leading through the walls of the furnace body into the several chambers at the points desired. For example, the pipe p leads to the base of the chamber F' , the pipe p' leads into said chamber F' at the top thereof under the arch f , and the 40 pipe p^2 leads into the upper end of the superheater F^2 . The pipe p' is broken off in Fig. 3, but is shown in Fig. 2, and like pipes are carried into the several cupola generators at approximately the same points so that in the 45 heating up of the apparatus the air may be fed to the base of the coal chambers, and to the upper ends of the coal chambers, and to the upper ends of the superheaters. As shown in Fig. 2, the valves in these several pipes are 50 arranged around the top of the apparatus outside of the neck c' , as at p^3 , it not being considered necessary to refer to each valve by a reference letter. The supply of air to the apparatus is thus received entirely through the air tank C , the air being delivered by the 55 compressor into that tank and passing up within the body of the apparatus and being heated as it rises therein and being delivered through the neck c' to the head c^2 and thence 60 to the several air pipes leading to the several parts of the apparatus. The pipe m^4 , which carries the superheated steam from the superheating coil m^2 , communicates with the ring pipe r which extends around the neck c' and 65 is preferably located just below the head c^2

of the air tank; and leading from said ring pipe r are the necessary steam supply pipes r' which communicate with the several cupola generators at suitable points as found 70 necessary, these separate steam points leading down through the plate c of the air tank and opening into the bases of the cupola generators, and the pipes being controlled by the valves r^2 which valves are also exposed around 75 the upper part of the tank in the position of easy access.

As above stated, I prefer to employ two sets of apparatus which can either be operated alternately or simultaneously, as found desirable, and both of which communicate with 80 the same storage tank by suitable valve connections, the preferred construction being that both the eduction pipes shall lead into a single scrubber or other form of apparatus in which the gases are cooled, and, if neces- 85 sary, the heat utilized for the heating of the feed water or generation of steam. For example, these pipes may lead through the scrubber by a pipe entering at the top of the same and opening into the water seal at the 90 base of the same, as described in said Patent No. 505,525, or may lead into a suitable feed water heater or boiler, whichever apparatus desired being shown at n in the drawings, the gas then being carried through the pipe 95 n' to scrubbers or purifiers, as found necessary.

The apparatus may either be employed in making fuel gas, which also forms a part of the subject matter of the present application, 100 or in making illuminating gas, such as described in said Patent No. 505,525, or for practicing other gas making methods, as found desirable.

I will first describe the apparatus in con- 105 nection with the manufacture of illuminating gas, such as that described in the patent above referred to. The coal is fed to the several cupola generators which are gradually heated either by the ordinary air current by 110 opening the doors at the base thereof, and the opening of the coal feeders or outlets at the tops of the several chambers, or by air through the pipes above described, as found desirable, this being continued until a body 115 of heated coal is formed in each cupola generator and it is desired to heat up the rest of the apparatus; in which case the doors are closed and the blast continued at a proper 120 pressure, the air being fed to the different chambers at suitable points so that the generator gas formed in the coal chambers is ignited and burned within the checker work of the superheaters of the cupola generators FG and passes through the ports $l'l'$ over the cupola 125 generator H , the gas formed in this chamber also being burned by the admission of air at the upper end thereof, and coal being fed through the coal feeders f^3 to the several coal chambers until the proper bodies of ignited 130

and heated coals are formed in the same. Meanwhile, the gases so generated pass over into the fixer K and are burned within the checker work in the chamber K² in the upper part thereof passing down from the same into the coke chamber K' in the lower part thereof which has been previously filled with coke through the coal feeder f³ above the same, and the heated products passing down through the body of coke and raising the same to the proper heat for gas making (approximately a red heat). The heated products then pass over into the chamber L' and any unconsumed portions of the products of combustion are consumed therein by an air blast and rise through the checker work m' and circulate around the steam superheating coil m² and finally escape through the outlet pipe M. This is continued until the whole apparatus is brought to the proper condition for gas making, the coal in the several coal chambers of the cupola generators F G H being brought to a high state of incandescence, the checker work in the gas superheaters F² G² and in the chamber K² and the checker work m' being raised to a high heat, while the coal in the coke chamber K' is brought to the proper condition for fixing the gases. Steam is then admitted to the cupola generator H, and passing up through the body of incandescent fuel therein unites therewith to form water gas, and this water gas without superheating passes over into the fixer K, and the oil or other hydrocarbon is introduced through the pipes s into the upper part thereof above the checker work, the oil being vaporized, (being introduced, if desired by a steam jet) and uniting with the water gas formed in the cupola generator H and being fixed primarily in the checker work of the chamber K² and passing thence into the coke chamber K' and being fixed within the body of heated coke therein, the making of the gas being completed in this chamber, and the gas flowing thence into the steam superheater L and passing first into the pipe M and thence into the eduction pipe M², and finally into the scrubber or feed water heater and thence to the tank. This is continued for a considerable time, and a large body of gas can be formed in the cupola generator H because of the deep body of coal which it is adapted to hold; and steam may, if desired, be admitted to this generator at different points in the height thereof on account of the deep body of coal therein. At the proper time steam is admitted to the coal chamber F' and combines with the incandescent coal to form water gas, and this water gas rises into the gas superheater F² and is superheated therein and then passes through the ports l' through the upper end of the cupola generator H into the fixing chamber K, the gas being thus superheated before the oil is introduced into the same through the pipe s and the super-

heated gas acting largely to fix the gases by its own heat, as described in said Patent No. 505,525. At the proper time steam is also admitted to the coal chamber G' and the cupola generator G, and the gases formed superheated in the superheater G², and flowing through the upper part of the cupola generators F H into the fixing chamber K, the gases being superheated as above described before the oil is introduced into the same and so aiding in the fixing of the gases as described in said patent. By the superheating of the gases made in the latter part of the run the heat of the apparatus for fixing purposes is thus maintained through the heat of the gases themselves, and, as described in said patent, the gases can be made for a much longer period than where such gases are not superheated, and a much more even and regular body of gas obtained. During all this operation the gases flow through the steam superheater and the heat necessary to properly superheat the steam is maintained by the re-heating of the gases in the mass of checker work m' which had been previously heated as above described, so that the proper heat for maintaining a body of highly superheated steam is always maintained.

When the apparatus is cooled below the proper point for gas making, the steam is cut off, the valve M³ closed, the escape valve M' in the pipe M opened and the apparatus is heated up by the admission of air to the several cupola generators and superheaters as above described.

In the heating up of the apparatus, as the air is introduced into the air tank C it circulates within the main body of the apparatus and is brought into close contact with the walls thereof, and in this way it is raised to a considerable heat before it is introduced into the several chambers, and the air thus heated aids in the more rapid heating up of the several chambers through the heated air causing a higher combustion both of the coal and of the gases generated, this being of considerable importance in the saving of time in the rapid heating up of the apparatus for the next run in the making of gas. At the same time the several valves for the control of air and steam are located at one point where they are easy of access and can be controlled without difficulty by the operator. During the gas making step the escape valve c³ in the air tank may be opened to prevent excess of pressure or overheating therein.

In making fuel gas in accordance with the present invention and with the apparatus above described, after the proper heating up of the several chambers of the apparatus, as above described, the air blast is continued to two of the cupola generators and the gases in rising from the same act to heat up the gas superheaters in the upper parts thereof, such as the superheaters F² G², while steam is ad-

mitted to the other cupola generator, such as the generator H, and the combined water gas and generator gas flow together into the fixing chamber K² into which the oil is introduced through the pipe s in the desired quantities for carbureting the gases, if a carbureted fuel gas is to be formed. The gases are passed down through the checker work and through the body of coke and carried through the steam superheater L and thence to the eduction pipe M². At intervals where one of the cupola generators is raised to too high a heat, steam is admitted to that cupola generator and cut off from the cupola generator through which it has been passing, air being admitted to that cupola generator and the operation continued, the air being admitted to two of the cupola generators while steam is admitted to another one, (this being changed as found necessary) and the water gas generated passing in its course through the gas superheater in the upper part of that cupola generator so as to be superheated in its course and so that all the gases pass into the fixing chamber at a high heat, a heat sufficient to aid in the fixing of the gases, because the generator gases are naturally at a high heat while the water gas is superheated, and it being found that the high heat of the gases will maintain the fixing chamber at the necessary temperature for the fixing of the hydrocarbons introduced into the gases for a long period. In the making of this fuel gas the cupola generator H also has the superheater similar to that in the cupola generators F and G which will be heated by the generator gas and superheat the water gas formed therein.

The apparatus above described has the advantages of compactness of form so that a large body of gas can be generated in a very small space, it being found that two sets of apparatus can be arranged in practically the same space as the one set of apparatus described in said Patent No. 505,525, and that the several cupola generators and fixing chamber, &c., can be made of larger area than shown in said patent. At the same time the apparatus can be constructed at a very much lower cost, as it has two circular plate metal cylinders forming the supporting structure for the whole apparatus, and the central cylinder forms the outer portion of the central air tank, and these parts can be constructed at much less cost than where the cupola generators and other parts are each inclosed in a separate plate metal cylinder. In addition to this provision is made for the heating of the air, and all the necessary valves for the operation of the several chambers are brought within a small space convenient for handling, so that there is but little labor in the running of the plant. In addition to this, in the making of fuel gas a large body of fuel gas of even quality can be obtained, and this gas

can be properly carbureted and the apparatus run without the necessity of heating up for a considerable period. The same method of making fuel gas can be employed with the apparatus described in said Patent No. 505,525.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. A gas apparatus formed of a central circular air tank, and a circular casing around the same, the space between the tank and casing having suitable gas generating and fixing chambers formed therein, and having air pipes leading from the upper part of said air tank through the tank to the gas generating chambers, substantially as and for the purposes set forth.

2. A gas apparatus formed of a central circular air tank, and a circular casing around the same, the space between the tank and casing having suitable gas generating and fixing chambers formed therein, and having air pipes leading from said air tank to the gas generating chambers, said air pipes having valves outside of said air tank and leading thence through the tank to the gas generating chambers substantially as and for the purposes set forth.

3. A gas apparatus formed of a central circular air tank, and a circular casing around the same, the space between the tank and casing having suitable gas generating and fixing chambers formed therein, the upper end of said tank having a neck of less diameter than the tank, and a hollow head of greater diameter than the neck, and an air pipe communicating with the hollow head and leading outside of the hollow neck into the tank and to one of the gas generating chambers, the valve for controlling the air pipe being located outside of the tank, substantially as and for the purposes set forth.

4. A gas apparatus formed of a central circular air tank, and a circular casing around the same, the space between the tank and casing having suitable gas generating chambers, one or more air-pipes leading to one or more of the generating chambers, and a steam superheater in the course of the gases, and having a pipe leading from said steam superheater to a ring pipe around the tank, and valve controlled pipes leading from said ring pipes within the tank to the gas generating chambers, substantially as set forth.

5. A gas making apparatus formed of two circular casings forming an annular structure and having formed therein a series of cupola generators communicating with each other at the top, and air and steam supply pipes communicating with the regenerators, and a gas fixer with the upper end of which the adjoining cupola generator communicates, said fixer having in the upper part thereof a mass of checker work and an oil entrance pipe, and in the lower part thereof a coke chamber, and

having an eduction port leading from the base thereof, substantially as set forth.

6. A gas making apparatus having in the lower part thereof a coal chamber and in the
5 upper part thereof a mass of checker work, a central passage through the checker work communicating with the coal chamber, and a solid brick work funnel above said central
10 passage, but within the chamber and not extending to the top wall so that the gases may

circulate around and pass down through the same, and having a coal feeder in the top wall above said furnace, substantially as and for the purposes set forth.

In testimony whereof I, the said JAMES L. HASTINGS, have hereunto set my hand. 15

JAMES L. HASTINGS.

Witnesses:

J. B. GRAY,

JAMES S. PHILLIPS.