(No Model.) 3 Sheets—Sheet 1.

E. R. ELLSWORTH.

APPARATUS FOR MANUFACTURING GAS.

No. 522,687. Patented July 10, 1894.

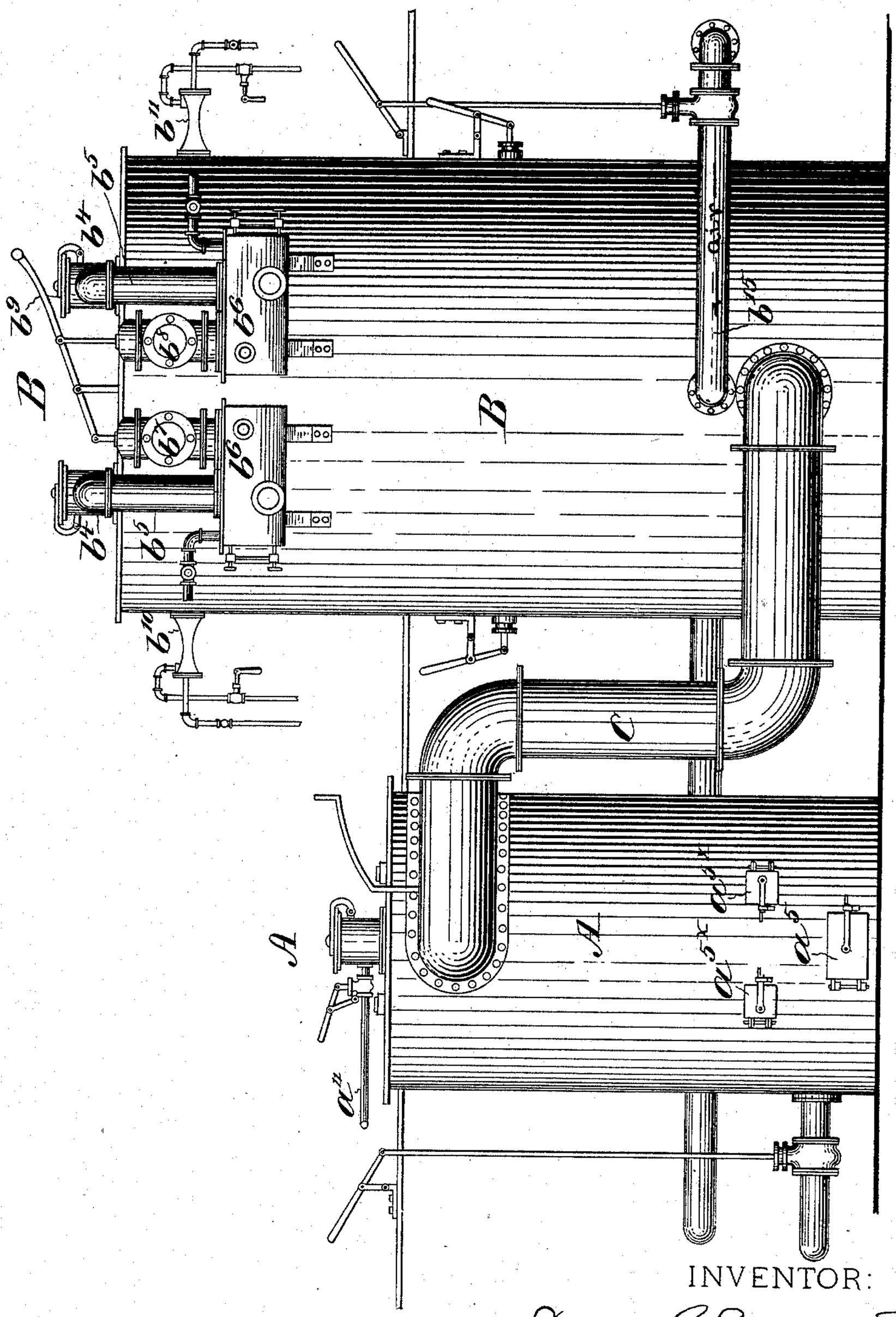

FIG. 1

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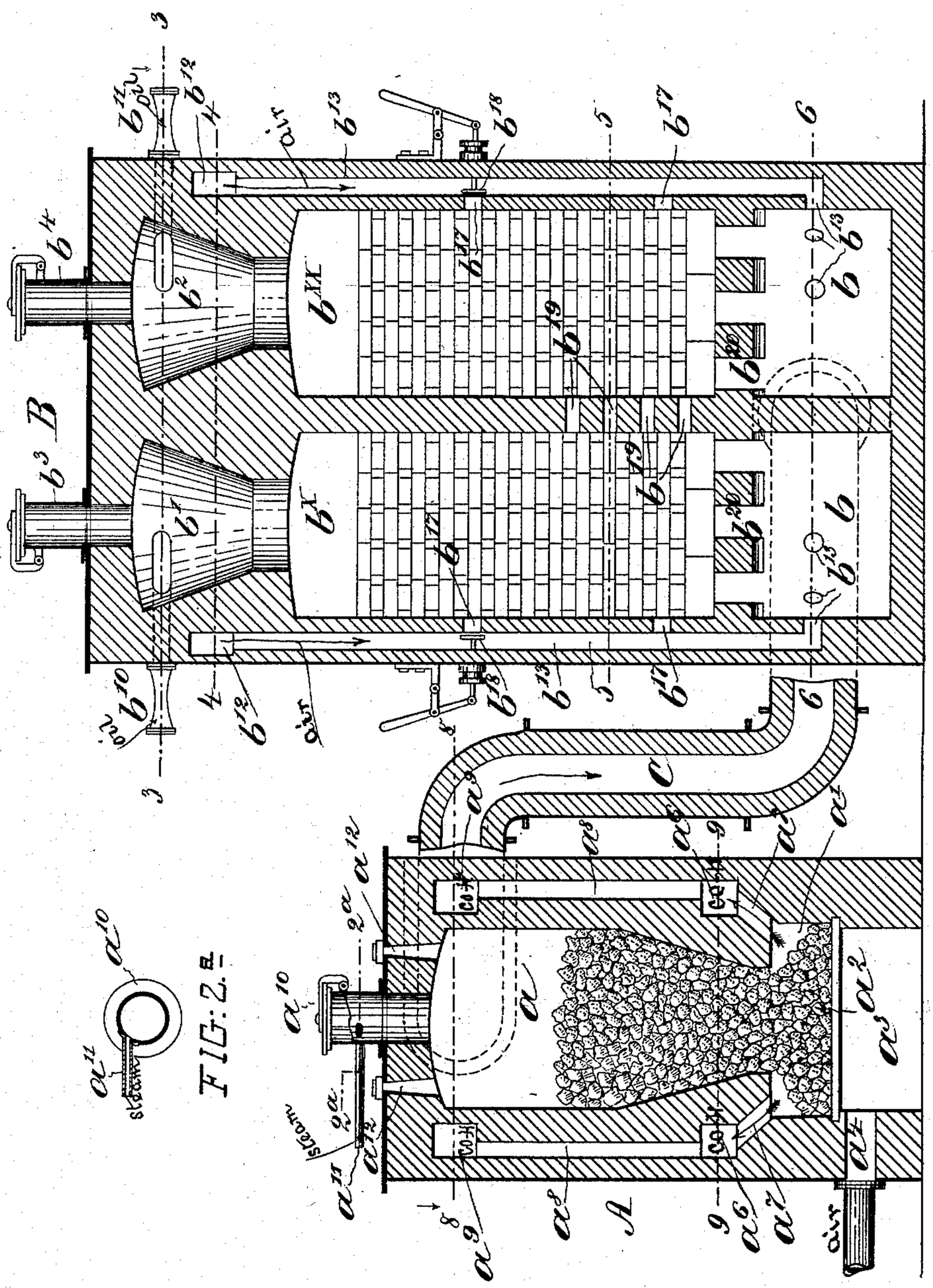

FIG. 2.

FIG. 2a.

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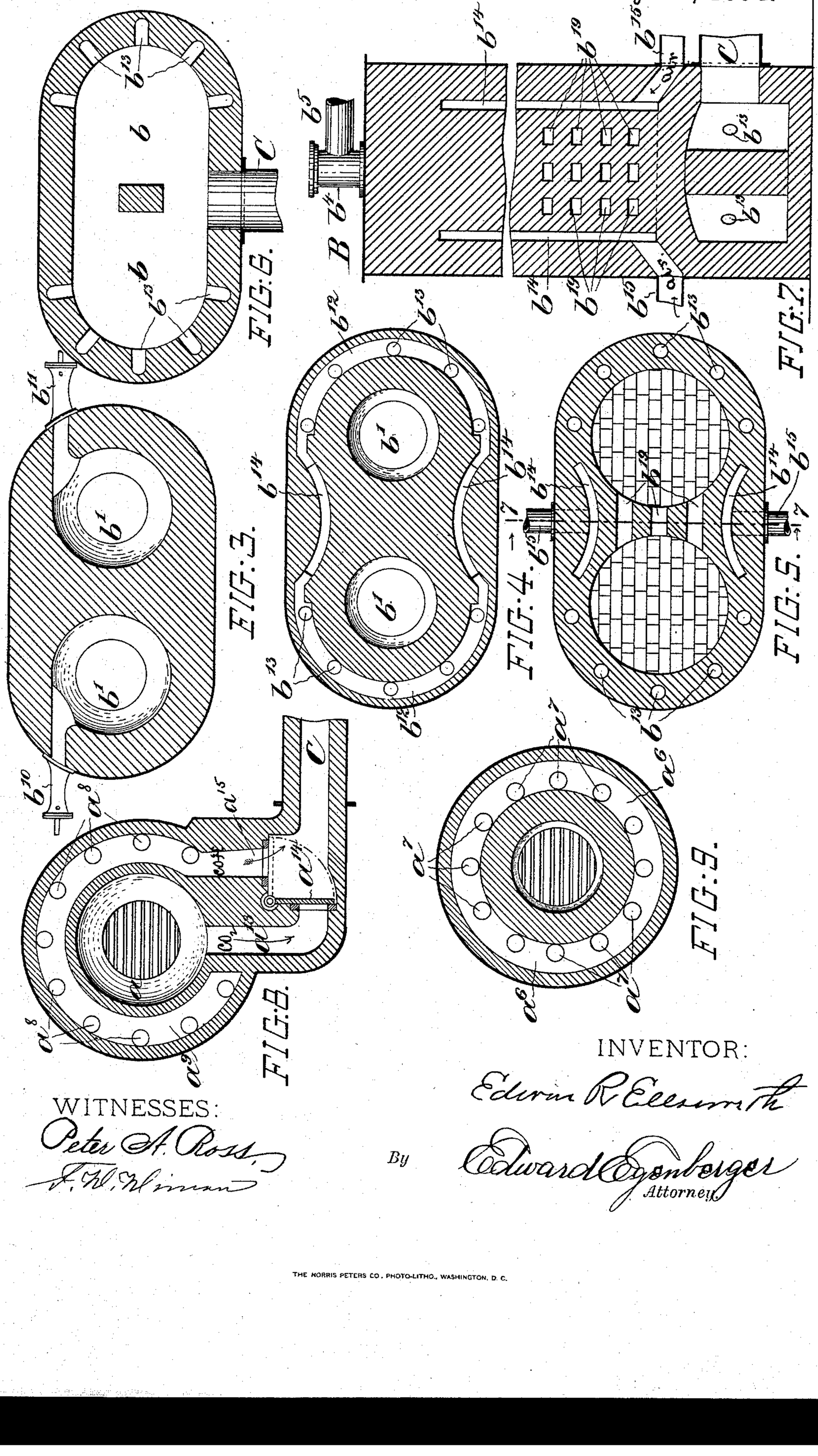

FIG. 6.

FIG. 3.

FIG. 7.

FIG. 4.

FIG. 5.

FIG. 8.

FIG. 9.

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR MANUFACTURING GAS.

SPECIFICATION forming part of Letters Patent No. 522,687, dated July 10, 1894.

Application filed October 31, 1893. Serial No. 489,638. (No model.)

To all whom it may concern:

Be it known that I, EDWIN RUTHVEN ELLSWORTH, a citizen of the United States, residing in Brooklyn, Kings county, New York, have invented certain Improvements in Apparatus for Manufacturing Gas, of which the following is a specification.

My invention relates to the manufacture of heating and illuminating gas and particularly to that type of manufacture wherein steam is decomposed with the aid of incandescent fuel and the gas, commonly called "water gas," afterward fixed by heat. If the gas is to be used as an illuminant, it is carbureted by admixture with some more or less volatile hydrocarbon before fixing or simultaneously therewith.

The object of the invention is in the main, to effect an important economy in the cost of manufacture of gas.

The invention will be fully described hereinafter and its novel features carefully defined in the claim.

In the accompanying drawings I have illustrated an apparatus adapted for use in carrying out my improved process of making gas.

In the drawings—Figure 1 is a side elevation of the apparatus, and Fig. 2 is a vertical longitudinal mid-section of the same. Fig. 2^a is a horizontal section of the charging inlet of the generator, showing the arrangement of the steam inlet. Figs. 3, 4, 5 and 6 are horizontal sections of the superheater taken in the planes indicated, respectively, by the lines 3, 3; 4, 4; 5, 5, and 6, 6, in Fig. 2. Fig. 7 is a vertical transverse section of the superheater taken in the plane indicated by the line 7, 7, in Fig. 5. Figs. 8 and 9 are horizontal sections of the generator taken in the planes indicated respectively by the lines 8, 8, and 9, 9, in Fig. 2.

The apparatus comprises two main features, a generator, A, and a superheater, B. These are connected by a gas conduit, C, as will be hereinafter explained.

The generator, as herein shown, is constructed of fire brick, or other suitable refractory material, and is provided with an exterior casing or jacket of sheet metal. It will be circular in plan by preference, but this circular form is not essential. Within the generator is formed a generating or decomposing chamber, a, which is contracted, or conical, at its lower part where it opens into a combustion chamber, a'. This combustion chamber extends laterally beyond the open, lower end of the decomposing chamber, as seen in Fig. 2, being of greater diameter, and it may, in practice, be about two feet in depth. A grate, a^2, forms the bottom of the combustion chamber and below this grate is the ash pit, a^3.

In the wall of the ash pit is an air-inlet, a^4, to admit air from a blower, not shown.

a^5 is the door of the ash pit, adapted to be tightly closed, and $a^{5\times}$, in Fig. 1, are clinker doors.

In the wall about the decomposing chamber a, is a lower annular flue, a^6, and oblique flues, a^7, lead to this flue from the outer margin of the roof of the combustion chamber a'. Vertical flues, a^8, lead from the annular flue a^6, up to another upper annular flue, a^9, which surrounds the upper part of the chamber a. This upper annular flue a^9, connects with the conduit C, as seen in Fig. 8, and as will be hereinafter explained in detail.

In the top of the generator is the cylindrical charging inlet, a^{10}, for supplying fuel to the decomposing and combustion chambers. This inlet, which projects above the top-plate of the generator, has a cover adapted to be tightly closed; a steam pipe, a^{11}, enters this inlet at its side and tangentially thereto as indicated in Fig. 2^a. Capped holes, a^{12}, for inserting a poker, are arranged in the top of the generator, as shown in Fig. 2.

Before describing further the construction of the generator A, I will describe the construction of the super-heater B, wherein the gas is carbureted and fixed. This superheater is built of fire brick, or like refratory material, inclosed in a jacket of sheet metal. As here shown it is oblong in plan (see Figs. 3 to 6), having within it a double set of chambers as will be explained. In its base is a receiving chamber, b, which receives the gas from the generator by way of the conduit C. Over the chamber b, is a skeleton arch, b^{20}, which forms a bottom for two like fixing chambers, $b^{\times}$ and $b^{\times\times}$, filled or partly filled with what is called checker-work; that is bricks or blocks of some refractory material laid up loosely. Above the respective fixing

chambers are the vaporizing chambers, b' and b^2. These are alike and each is in the form of an inverted frustum of a cone with a cylindrical neck which opens into the crown of the fixing chamber below. In the tops of the respective vaporizing chambers are gas outlets, b^3 and b^4. These are provided each with a tightly closing cover at its top which, when removed, permits the escape of products of combustion during the "blowing up" operation, and each is also provided with a lateral outlet, b^5, which leads the gas generated to an ordinary hydraulic seal, b^6, seen in Fig. 1. From the seals the gas flows to the holder by way of the outlets, b^7 and b^8, of the seals. These outlets have cut-off valves of the usual kind operated by a lever, b^9. The injecting nozzles, b^{10} and b^{11}, for vaporizing the liquid hydrocarbon, enter the respective chambers b' and b^2, tangentially, as seen in Fig. 3, so as to impart a gyratory motion to the vapors in the chambers and thus effect a more thorough atomization of the liquid.

In the upper part of the wall of the superheater A, is an annular flue, b^{12}, and in the side walls of the same are upright flues, b^{13}, which open in the chamber b, at their lower ends (see Figs. 2 and 6) and into the flue b^{12}, at their upper ends. There are two other flues, b^{14}, which are seen in Figs. 4, 5 and 7, which extend from the annular flue b^{12}, down to the skeleton arch b^{20}, or thereabout, and connect thereat with air-inlet pipes, b^{15}, (see Figs. 1 and 7.)

The operation of the apparatus is as follows: A fire is built on the grate in the generator A, and the covers on the gas outlets b^3 and b^4, are thrown open. The fire is ignited and a moderate blast turned on at the inlet a^4 in the ash-box. Coal is fed into the generator at the charging inlet a^{10}, in suitable quantity until the generating and decomposing chambers are filled say to about the extent indicated in Fig. 2. The products of combustion rise directly through the mass of fuel in the generator chambers and pass to the conduit C, by the outlet a^{13}, seen in Fig. 8, the valve or damper a^{14}, seen in this figure being then turned to the position indicated in dotted lines therein, so as to cut off the upward flow of the gases from the chamber a', by way of the flues a^7, a^6, a^8, a^9 and a^{15} (see Fig. 8). The hot gases enter the superheater B, and pass up through the chambers in the same, raising the temperature to a red heat. During this operation, which is termed "blowing up", a blast of air is admitted at the air-inlets b^{15}, the air passing upward through the flues b^{14}, to the annular flue b^{12}, and thence down to the chamber b, through the flues b^{13}. When the proper temperature is attained in the superheater B, the blowing up process is finished. The air blast is shut off from the inlet a^4, under the grate of the generator; and at the inlets b^{15}, the valve a^{14} is turned to the position seen in full lines in Fig. 8; the covers of the outlets b^3 and b^4, of the superheater B, are closed, and the lever b^9, so shifted as to close the valve controlling the gas outlet b^8, if this has not before been attended to. Steam is admitted to the generator A, at the pipe a^{11}, and passes down through the mass of incandescent fuel in the chamber a, where it is decomposed and combines with the carbon of the fuel to form crude "water gas", which is a mixture of carbon monoxide and hydrogen. This gas enters the combustion chamber a', but immediately turns upward in the open spaces (see Fig. 2) above the fuel therein and enters the flues a^7; thence it flows into the annular flue a^6, thence upward through the flues a^8, into the annular flue a^9, and thence (see Fig. 8) into the conduit C. From the conduit C, it flows into the chamber b, of the superheater B. As soon as the process of making a "run" as it is called, has begun as above described, steam and oil are admitted to the atomizer b^{11}, and the atomized hydrocarbon descends into the chamber $b^{\times\times}$, and through the checker work therein, where it becomes heated to the same extent as the gas entering the chamber b, below. The mingled hydrocarbon and gas now pass upward through the checker work in chamber $b^{\times}$, where they are thoroughly combined and fixed. From this chamber the fixed gas rises through the chamber b', and passes off through the outlet b^3, to the seal, and thence by way of outlet b^7, to the holder for storage. This run is continued until the superheater is cooled down to a temperature too low to do the work effectively, when the apparatus is heated up again as at first described. After this second heating, the valves at the gas outlets of the superheater are shifted so as to close the outlet b^7, and open the outlet b^8, and when the water gas enters the chamber b, the atomizer b^{10}, is set to work and the gas is fixed in passing up through chamber $b^{\times\times}$, to the outlet b^8. This reversal of the operation in the superheater at each alternate run equalizes the heat in the superheater and this is very important in the continuous daily operation of the apparatus.

In the operation of "blowing up," the air entering at the lateral inlets b^{15}, may, on its passage down the flues b^{13}, be admitted to the chambers $b^{\times}$ and $b^{\times\times}$, wholly or in part, at apertures, b^{17}, seen in Fig. 2, and these apertures,—or the upper ones—may have valves, b^{18}, to control the influx of the air.

It will be understood that the checker-work placed in chambers $b^{\times}$ and $b^{\times\times}$ is composed of bricks or the like laid in loosely; in placing the bricks care will be taken not to obstruct the inflow of air at the inlets b^{17}. In Fig. 2 this checker-work is merely represented in a diagrammatic manner.

As the atomized and vaporized hydrocarbon descends through the checker work in the fixing chamber it will break up and the vapor of higher volatility may pass into the adjoining fixing chamber through apertures, b^{19}, in the partition wall (see Figs. 2, 5 and 7) and at different levels. With this arrange-

ment only the vapor of lowest volatility will descend through the skeleton arch into chamber *b*.

In preparing for a "run" after the "blowing up," the fire is sliced and fresh coal put on before the steam is admitted for decomposition, and the steam admitted carries down with it through the mass of incandescent fuel below, the gaseous products driven off from the fresh coal. The steam is decomposed and the crude gases from the coal precipitate their heavier elements, the lighter combining with the gases from the steam. These lighter gases from the coal are illuminants, and their utilization effects a very important saving in the amount of liquid hydrocerbon necessary to provide the non-illuminating water gas with illuminants.

Among the advantages arising from my method of operating and from the special apparatus employed, are the following:

I am able to employ the cheapest quality of coal such as the waste from the mines with just enough coke to hold it up loosely. Or lump anthracite coal may be used in lieu of coke. Before the fresh charge of coal is admitted, the fuel in the generator will be incandescent nearly to the top.

All of the gaseous products of the fuel are utilized only clinker and ash falling into the ash-box.

The steam is introduced into the charging inlet of the generator tangentially so that it has a gyratory movement. This causes the steam to abstract the heat from the coal inlet tube, which is of metal and cylindrical, and this motion atomizes the steam and causes it to be highly heated before it reaches the fuel in the generator. This mode of admitting the steam also prevents the disturbance of the mass of fuel by the passage of the steam directly into the same. The grate is also preserved as the steam does not reach it.

The peculiar arrangement of the combustion chamber prevents the fuel from reaching up to the lower ends of the oblique flues a^7, and therefore these flues do not become choked with clinker and cinders.

By passing the air from the inlets b^{15}, upward through flues in the hot walls of the superheater and thence down through another set of flues in the same, the air is heated by what would otherwise be waste heat and when it reaches the chamber *b*, the air is at the proper temperature to mix with the gases from the generator and promote perfect combustion in the superheater.

Another important feature is the mode of atomizing the liquid hydrocarbon in the vaporizing chambers whereby I avoid precipitating the same in liquid form into the chamber below. The vaporizing chambers being circular in plan and the jet being admitted tangentially, the atomized liquid has a gyratory motion and descends in the funnel shaped chamber, meeting with a higher temperature as it descends, until it passes through the contracted neck of the chamber into the fixing chamber. This prevents the deposition of free carbon such as would occur if the liquid were discharged directly onto a highly heated surface.

I am well aware that it is not new to employ two fixing chambers furnished with checker work, but I am not aware of such having been constructed and operated as herein described.

Having thus described my invention, I claim—

In a gas apparatus, a generator having a decomposing chamber *a*, a combustion chamber *a'*, arranged below the chamber *a*, an ash-box and grate, an inlet for an air-blast below the grate, an annular flue a^9, near the upper part, flues leading from the top of the combustion chamber to said flue a^9, a conduit for leading off gases from the upper part of the generator and connected both with the chamber *a*, and the flue a^9, a valve a^{14}, adapted to control the flow of gases from the generator to the conduit, and a charging inlet in the top of the generator.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

E. R. ELLSWORTH.

Witnesses:
DANIEL ROTHSTEIN,
HENRY J. MOORE.