No. 626,866. Patented June 13, 1899.

R. H. LAIRD.

PROCESS OF AND APPARATUS FOR MANUFACTURING GAS.

(Application filed May 13, 1898.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 6.

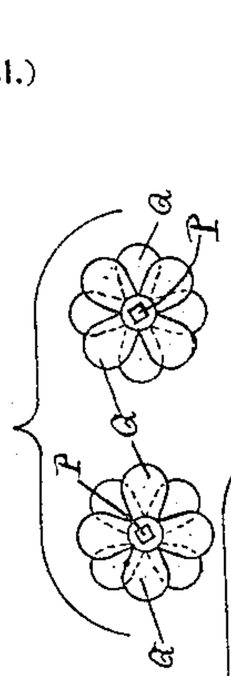

Fig. 1.

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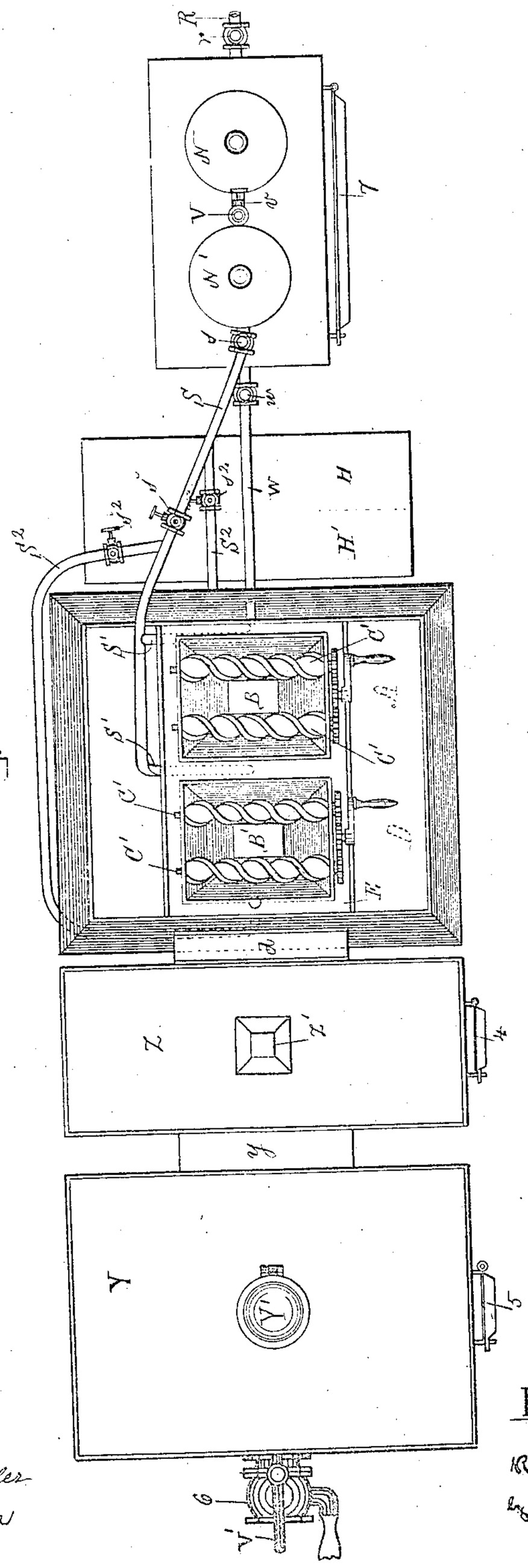
(No Model.) 4 Sheets—Sheet 2.

Fig. 2.



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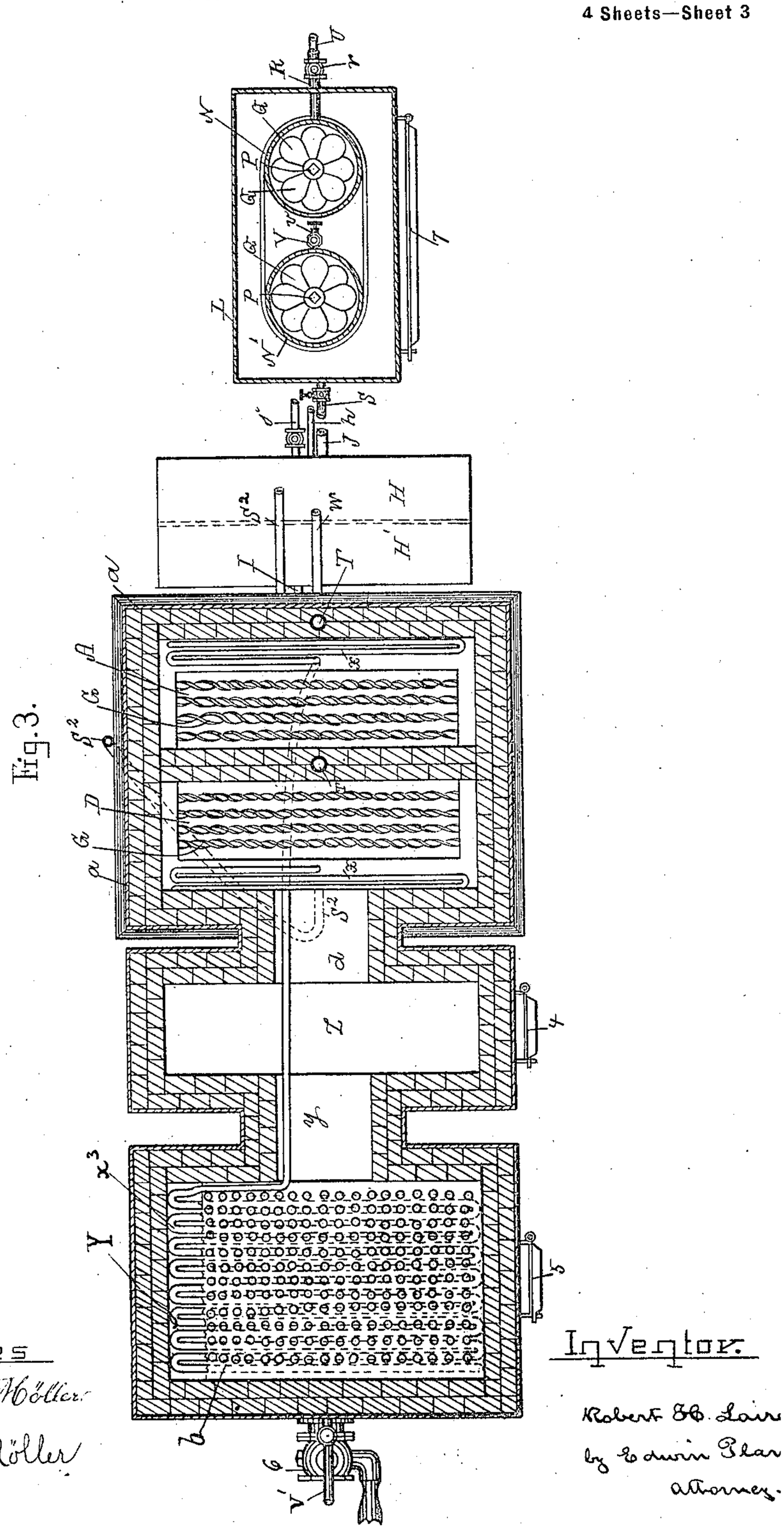
(No Model.) 4 Sheets—Sheet 3

Fig. 3.



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(No Model.) 4 Sheets—Sheet 4.

Fig. 4.

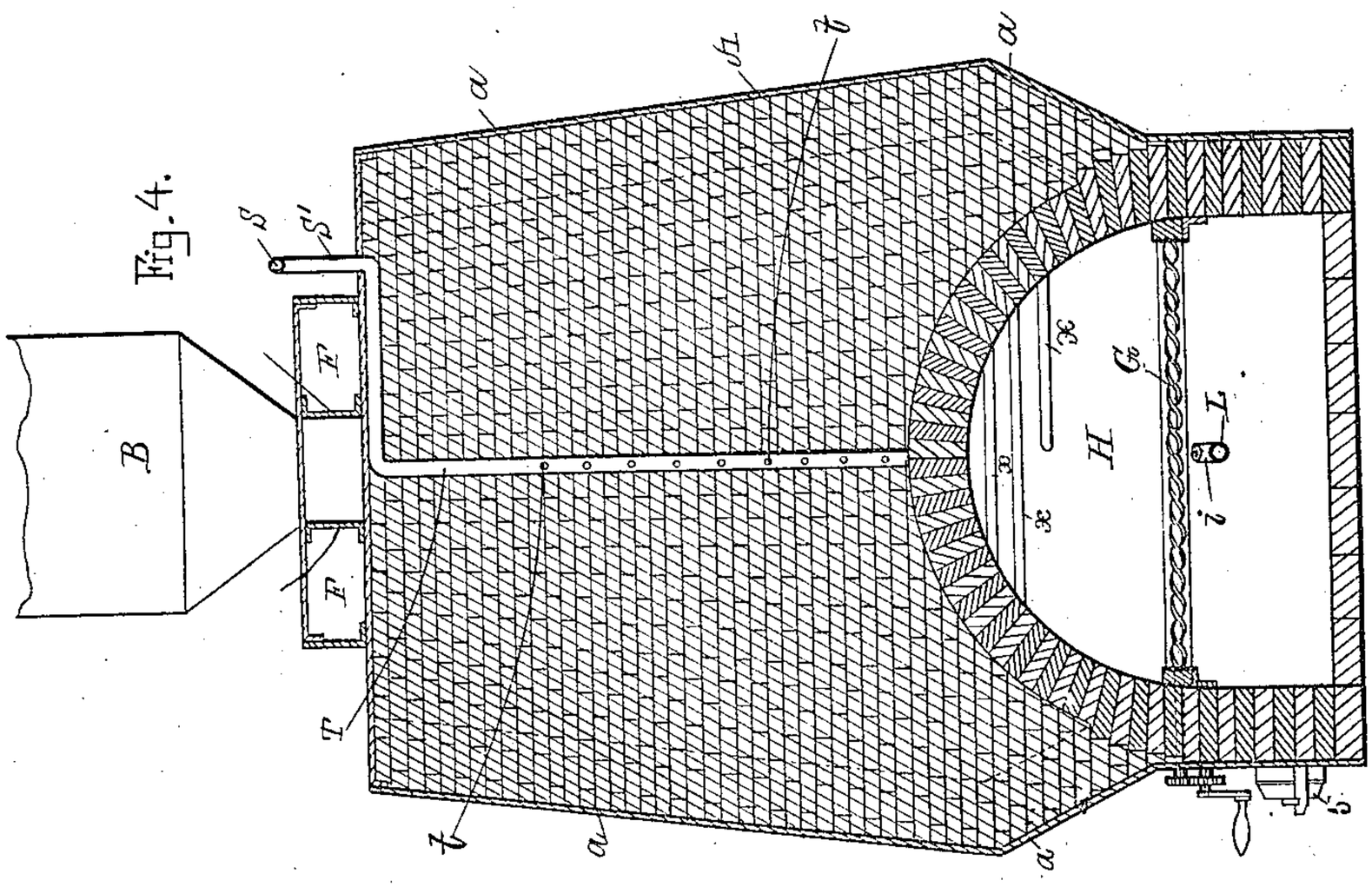
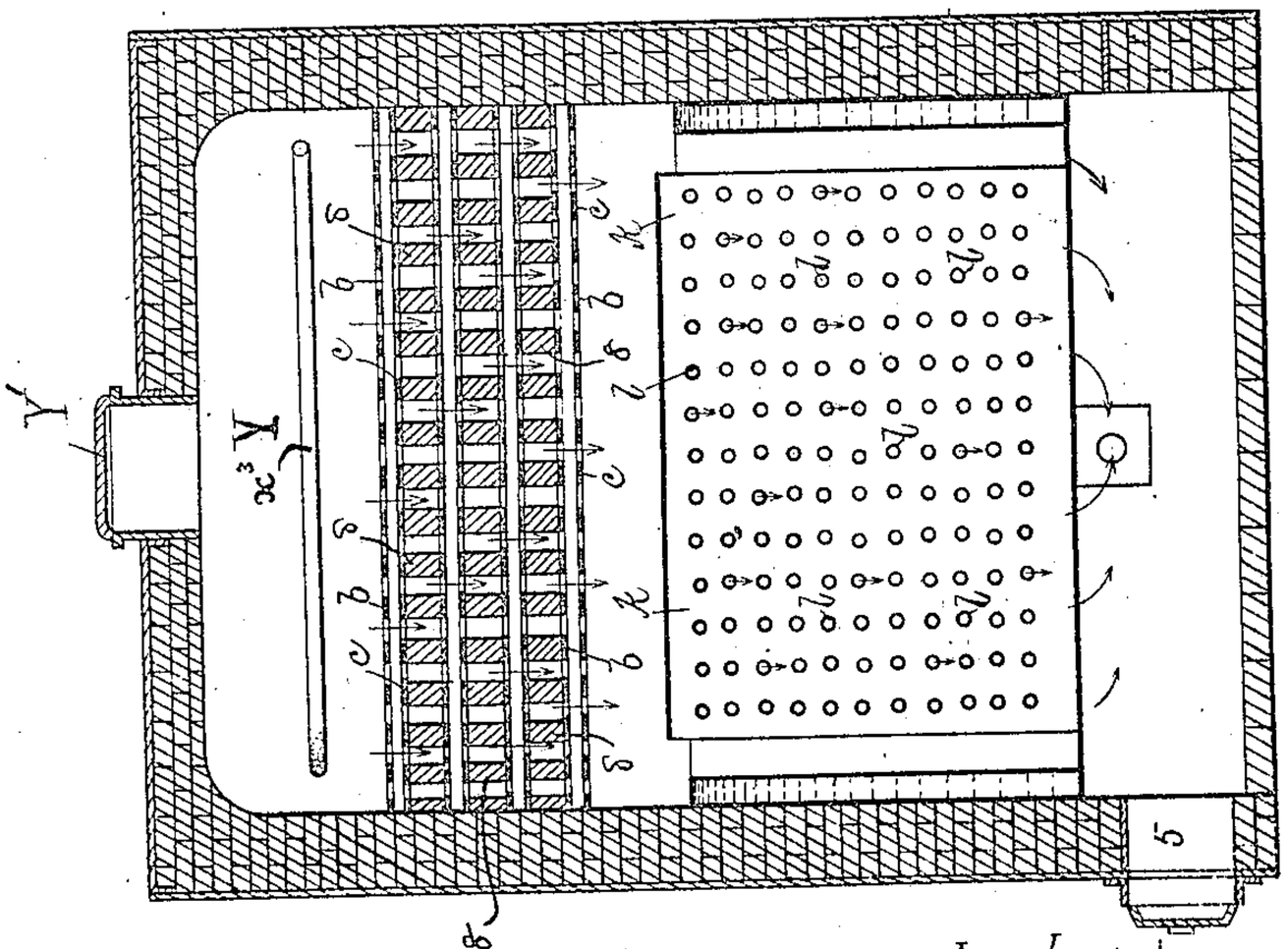


Fig. 5.



Witnesses.

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UNITED STATES PATENT OFFICE.

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PROCESS OF AND APPARATUS FOR MANUFACTURING GAS.

SPECIFICATION forming part of Letters Patent No. 626,866, dated June 13, 1899.

Application filed May 13, 1898. Serial No. 680,635. (No model.)

To all whom it may concern:

Be it known that I, ROBERT H. LAIRD, a subject of the Queen of Great Britain, and a resident of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Processes of and Apparatus for Manufacturing Gas, of which the following, taken in connection with the accompanying drawings, is a specification.

My invention relates to the manufacture of gas for illuminating and heating purposes from coal and oil or other carbonaceous material, air, and steam; and the invention consists in the process and apparatus therefor, as hereinafter described, and set forth in the claims.

Referring to the accompanying drawings, Figure 1 represents a vertical section through an apparatus embodying my invention for producing gas for illuminating and heating purposes. Fig. 2 is a plan or top view of same, showing the upper portion of the converters in section. Fig. 3 is a horizontal section of the entire apparatus, taken on line *x x* of Fig. 1. Fig. 4 is a longitudinal section taken through one of the generators. Fig. 5 is a longitudinal section taken through the fixing-chamber. Fig. 6 is a detail.

In the apparatu I employ two generators communicating with each other at their lower ends.

A represents the first generator, which is supplied with coal from a hopper B and fed into said generator in regular quantities by means of spiral feeding-rolls C, to which motion is imparted by any suitable means.

D is the second generator, that is supplied with cannel-coal or coke from a hopper B′ by means of spiral feeding-rolls C′, as before described.

The hoppers B B′ are supplied with coal or coke by any suitable means.

The generators A D are preferably formed of ordinary brick and lined with any suitable refractory material, or they may be formed entirely of or lined with fire-brick, the whole being inclosed within an iron casing *a*, the first generator A communicating with the second generator D by means of an arch E, so that the products of combustion in the first generator A will pass into the second generator D by means of said arch E. Over the top of these generators is arranged a water-tank F, through which water circulates by means of pipes *f f′* in order to keep the upper surface of the generators cool.

One or both of the generators is provided with a manhole A′ for the purpose of cleaning or repairing the inside of said generators when required, and the ash-pits are fitted with doors 1, as shown in dotted lines, for the purpose of cleaning out same. The upper part of each generator may also be formed with doors 2, as shown in dotted lines, and also with peep-holes 3 in order that the operation in said generator may be inspected, if desired.

The coal or coke in the generators is supported by grates G, the bars of which are capable of being rotated in order to break up clinkers and keep the fire clean.

In order to sustain combustion of the fuel in the generators A D, I employ a tank divided into two compartments H H′ and containing a liquid (as water) solution having the property of absorbing nitrogen, said liquid or solution being supplied to the tank through a pipe J. The first compartment H is supplied with air under pressure through a pipe *h*, said pipe being bent down, so as to deliver the air into the liquid or solution, after which it passes from the top of the first compartment H into the lower portion of the second compartment H′ by means of a bent pipe *h′* and after passing through the liquid or solution in said compartment is conducted to the under side of the grates G G by a pipe I, provided with nipples *i*, and delivered in the form of spray or vapor.

j j′ are pipes fitted with suitable valves by which the contents of the compartments H H′ may be drawn off when desired. The pipe I is also supplied with heated gas from any suitable source through a pipe K, that commingles with the air in pipe I. Thus combined air and gas will be delivered through the nipples *i* directly under the grates G.

The generators A D are supplied with superheated steam from a superheater of the following construction: L is an outer casing provided with a horizontal shelf or partition

M, upon which are arranged two upright cylinders N N', the upper ends of which pass out through the upper wall of the casing L. Each of these cylinders is preferably fitted with an upright stationary rod or shaft P, upon which is mounted a number of disks Q, (preferably of the form shown in Fig. 6, so as to leave passage-ways therethrough,) of iron or copper or iron and copper or other suitable metals, arranged alternately, which plates are heated to a sufficient degree to take up the oxygen, and thus liberate the hydrogen from steam admitted to said cylinders N N' (from any suitable source) through pipes R, which are fitted with valves *r* to regulate the amount of steam admitted. A door 7 is provided in the lower part of the casing, so that the same may be cleaned or repaired.

The hydrogen liberated in the superheater-chambers N N' is by a pipe S conducted by pipes S' to pipes T, built in the walls of the generators, and is then supplied through nozzles *t* or other suitable openings onto or above the surface of the coal or coke in said generators, and, if desired, it can also be delivered by pipes S^2 into the fuel, the pipes S S^2 being fitted with suitable valves *s* s^2 to direct the steam in the desired direction.

The steam admitted into the cylinders N N' by the pipes R is superheated by means of a perforated gas-supply pipe U, provided with a number of jets *u*, which when ignited will throw up jets of gas under the cylinders N N', as shown. Said pipe is fitted with a valve U', by which the supply of gas is regulated.

The steam that passes through the cylinder N may be conducted from the upper end of said cylinder to the lower portion of the cylinder N' by a pipe V, fitted with valves *v v'*, so that when the valve *v* is open and valve *v'* is closed the steam will pass from the cylinder N into the cylinder N'; but when the valve *v* is closed and the valve *v'* is open the superheated steam from the cylinder N will be carried over by a pipe V' to a fixing-chamber Y, hereinafter described.

The space in the superheater around the cylinders N N' becomes filled with the products of combustion of the gases that have passed through the pipe U, and said products become heated to a high degree and are then carried over by a pipe W to the lower end of the generator A and delivered above the coal or coke within same, said pipe being fitted with a valve *w* to regulate the quantity admitted from the chamber L to the generator A.

Within the generators A D are arranged coils of pipes *x*, connected by pipes *x'* to a suitable oil or other hydrocarbon supply. The oil in the coils becomes heated to a high degree and is then carried over by a pipe x^2 to a perforated coil of pipes x^3, situated at the upper portion of what I term a "fixing-chamber" Y—that is to say, a chamber in which the gases liberated from the coal or coke, hydrocarbons, superheated steam, free hydrogen, and air in varying proportions required in manufacturing various kinds of gases become mixed, as hereinafter described.

Z is a dust or ash chamber arranged between the generator D and the fixing-chamber Y. This dust or ash chamber is in connection with the generator D by a passage *d* and to the fixing-chamber Y by a passage *y*, arranged above the passage *d*, so that all dirt, dust, and other heavy particles will fall down in said chamber Z, and the gases carried over through the passage *y* pass into the fixing-chamber Y comparatively free from ashes or other deleterious matter. If desired, to prevent any dirt or dust that may have entered the chamber Z from rising and passing into the fixing-chamber Y, a deflector *z* may be arranged just below the passage *y*, leading into the fixing-chamber Y, as shown in dotted lines.

The fixing-chamber Y is fitted with a series of perforated metallic plates of dissimilar metals, electrically connected and forming a thermopile, (the space between each pair being filled with perforated plates 8, of silica, porcelain, glass, or equivalent material,) that are connected to a dynamo or battery by wires *e*. Just below these plates *b c* the pipe V' enters, by which free hydrogen may be admitted from the superheater L into said fixing-chamber Y, and below said pipe is a series of vertical plates *k*, arranged in pairs, each pair being connected at their upper ends by an insulating material, so as to form, as it were, long flat tubes open at their lower ends, which are supported by a plate *m*, attached to the side walls of the chamber. Each of these plates *k* is fitted with a series of inwardly-projecting hollow teats *l*, that are electrically connected by wires *m m'*, so that the teats in one plate will be of an opposite polarity to those of the opposite plate. Each plate, with its teats, are connected in themselves and to one pole of a dynamo or battery. Thus when in operation an electric arc will be formed between each pair of teats that are opposite one another and the deleterious matter eliminated therefrom and the gases decomposed and recombined.

In order to reduce the temperature around the plates *k*, I line the inside of the chamber Y with a water-jacket 9 and between the said plates *k* place a coil of pipes 10, through which cold water flows, so that the surfaces of the plates *k* will not be overheated. 11 is a pipe for supplying cold water both to the jacket 9 and the pipes 10. 12 is a discharge-pipe from the water-jacket, and 13 a discharge-pipe from the coil 10. These pipes are fitted with suitable valves, as shown.

The heated oil or hydrocarbons from the coils *x* in the converters A D, being supplied to the coil x^3 in the fixing-chamber Y, are delivered unto said chamber through small perforations in said coil x^3 and commingle with the gases from the generating-chambers A D and then first pass through the series of perforated plates *b c*, as before described, by

which the said gases are decomposed and separated, after which they pass through the teats *l* in the plates *k*, where all the deleterious substances are eliminated and the gas passes off to the holder in almost a pure state.

The dust-chamber Z and the electrochamber Y are fitted at their upper ends with manholes Z′ and Y′ and at their lower ends with doors 4 5, in order that they may be cleaned out when required.

In order to create a draft through the apparatus to cause the gases to pass in the desired direction and force said gas into the gas-holder, an exhauster is connected to the outlet-valve 6, leading from the fixing-chamber Y to the gas-holder. The exhauster and gas-holder being of ordinary construction are not shown in the drawings.

In order to make clear the process and mode of operation of the apparatus, I introduce the following general description. The apparatus being constructed and arranged after the manner described in the specification, the generators are just charged with coal, coke, or other carbonaceous matter and then combustion started. The combustion of the carbonaceous matter in the generators is aided by the air, partially freed from nitrogen, as described, by the hydrogen liberated in the superheater, and by the superheated steam, all being fed into, through, or onto the burning fuel of the generators in the manner described. The gaseous products of combustion, together with hydrogen, superheated steam, are then led or forced in the manner described through the dust or ash chamber and thence into the fixing-chamber, where they commingle with the vaporized oil or hydrocarbons delivered from the heated coils of the generators. The action in the fixing-chamber is chiefly that of the action of the electric arcs on the above-mentioned gaseous products and is briefly that of decomposition of some of said gaseous products and a recombination of these decomposed gases with the supplied hydrogen to yield greatly-larger percentage of suitable gaseous hydrocarbons for illuminating purposes. The action of the exhauster is simply to cause the gas to pass in the right direction and to deliver the purified gas to the gasometer.

What I claim is—

1. The process of making gas for illuminating or heating purposes, consisting in burning carbonaceous fuel, supplying air, from which a portion of the nitrogen has been extracted, beneath said fuel and superheated steam and free hydrogen into and above said fuel, in the form of spray, removing the dust from said gas and then passing the gas through an electrochamber, in spraying into said chamber heated oil in commingling said heated oil and generator-gas, then subjecting the same to the action of an electric current and finally in passing the resultant gases through a series of electric arcs to fix the same and eliminate any deleterious matter therefrom as set forth.

2. A process of making gas for illuminating or heating purposes, consisting in burning carbonaceous fuel, supplying superheated steam and free hydrogen into and above said fuel, supplying air, under pressure, having a large portion of the nitrogen extracted therefrom, beneath the fuel, heated gas supplied to commingle with said air, removing the dust from said gas and eliminating any remaining deleterious matter therefrom by means of electricity as set forth.

3. A process of making gas for illuminating or heating purposes, consisting in burning carbonaceous fuel, supplying steam and free hydrogen into and above said fuel, supplying air, under pressure, having a large portion of the nitrogen extracted therefrom, beneath the fuel, and heated gas supplied to commingle with said air substantially as set forth.

4. In an apparatus for making gas for illuminating or heating purposes the combination of one or more generating-chambers, a vessel arranged near same and containing a suitable liquid through which air is passed to extract the nitrogen and then delivered under the grates of the generators, a superheater in advance of the generators for supplying superheated steam to the generators, an ash or dust chamber connected to the exit of the generating-chamber through which the products pass from the generating-chambers, an electrochamber to receive the products from the dust-chamber to extract deleterious matter and an exhauster at the rear of the electrochamber to create a draft through the apparatus all arranged and combined as set forth.

5. In an apparatus for making gas for illuminating or heating purposes the combination of one or more generating-chambers connected together and constructed so as to produce a downward draft, a vessel arranged near same containing a suitable liquid through which air is passed to extract the nitrogen and then delivered under the grates of the generating-chambers, a superheater arranged in advance of the generators for supplying superheated steam to said generating-chambers, an ash or dust chamber connected to the gas-exit of the generating-chambers through which the products pass from the generating-chambers, an electrochamber to receive the products from the dust-chamber to extract deleterious matter and an exhauster at the rear of the electrochamber to create a draft through the apparatus all arranged as set forth.

6. In an apparatus for making gas for illuminating or heating purposes the combination of one or more generating-chambers connected together and constructed so as to produce a downward draft, a vessel arranged near same and containing a suitable liquid through which air is passed to extract the nitrogen and which is then delivered under the grates of the generating-chambers, a superheater in advance of the generators for supplying superheated steam to the generating-chambers,

an ash or dust chamber connected to the gas-exit of the generating-chambers through which the products pass from the generating-chambers, an electrochamber to receive the products from the dust-chamber to extract deleterious matter and an exhauster at the rear of the electrochamber to create a draft through the apparatus as set forth.

7. In an apparatus for making gas for illuminating or heating purposes the combination of one or more generating-chambers, a vessel arranged near same and containing a suitable liquid through which air is forced to extract the nitrogen and then delivered under the grates of the generating-chambers, a superheater in advance of the generators for supplying superheated steam to the generating-chambers, an ash or dust chamber connected to the gas-exit of the generating-chambers and having a deflector said dust-chamber being arranged between the generators and an electrochamber to receive the products that pass through the dust-chamber, said electrochamber extracting the deleterious matter from the gas and an exhauster at the rear of the electrochamber to create a draft through the apparatus as set forth.

8. In an apparatus for making gas for illuminating or heating purposes the combination of one or more generating-chambers, a vessel arranged near same and containing a suitable liquid through which air is forced to extract the nitrogen and then delivered under the grates of the generating-chambers, a superheater in advance of the generators for supplying superheated steam to the generating-chambers, an ash or dust chamber at the delivery end of the generating-chamber, an electrochamber to receive the products that pass through the dust-chamber and having a perforated coil of pipe for delivering carbonaceous matter into same and a number of perforated plates arranged in pairs but insulated from each other said plates being electrically connected and provided with teats, the teats of one plate being of opposite polarity to those of the opposite plate whereby electric arcs are formed, and an exhauster to create a draft through the apparatus as set forth.

9. In an apparatus for making gas for illuminating or heating purposes the combination of one or more generating-chambers, a vessel arranged near same and containing a suitable liquid through which air is forced to extract the nitrogen and then delivered under the grates of the generating-chambers, a superheater in advance of the generators for supplying superheated steam to the generating-chambers, an ash or dust chamber at the delivery end of said generating-chambers, an electrochamber as described to receive the products that pass through the dust-chamber and an exhauster arranged between the apparatus and gas-holder to cause the gas to pass in the right direction substantially as set forth.

10. In an apparatus for making gas for illuminating or heating purposes, an electrochamber into which the gas is delivered from the generator, a coil of pipe situated near its upper end and perforated to deliver carbonaceous matter preferably vaporized, into said chamber, and a number of perforated plates arranged in pairs (the space between said elements or pairs being filled with perforated plates of silica, porcelain, or equivalent material) as thermo-electric elements, through which the gas and vaporized carbonaceous matter passes to be further decomposed and recombined into fixed gas, substantially as set forth.

11. In an apparatus for making gas for illuminating or heating purposes, an electrochamber having a number of plates arranged in pairs, electrically connected, and provided with a number of teats, the plates and teats in one plate being of an opposite polarity to those of the opposite plate, whereby an electric arc is formed between each pair of teats, the same being surrounded by a water-jacket and water-tubes placed between said plates, substantially as set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, on this 10th day of May, A. D. 1898.

ROBERT H. LAIRD.

Witnesses:
CALEB H. SWAN,
EDWIN PLANTA.