(No Model.)

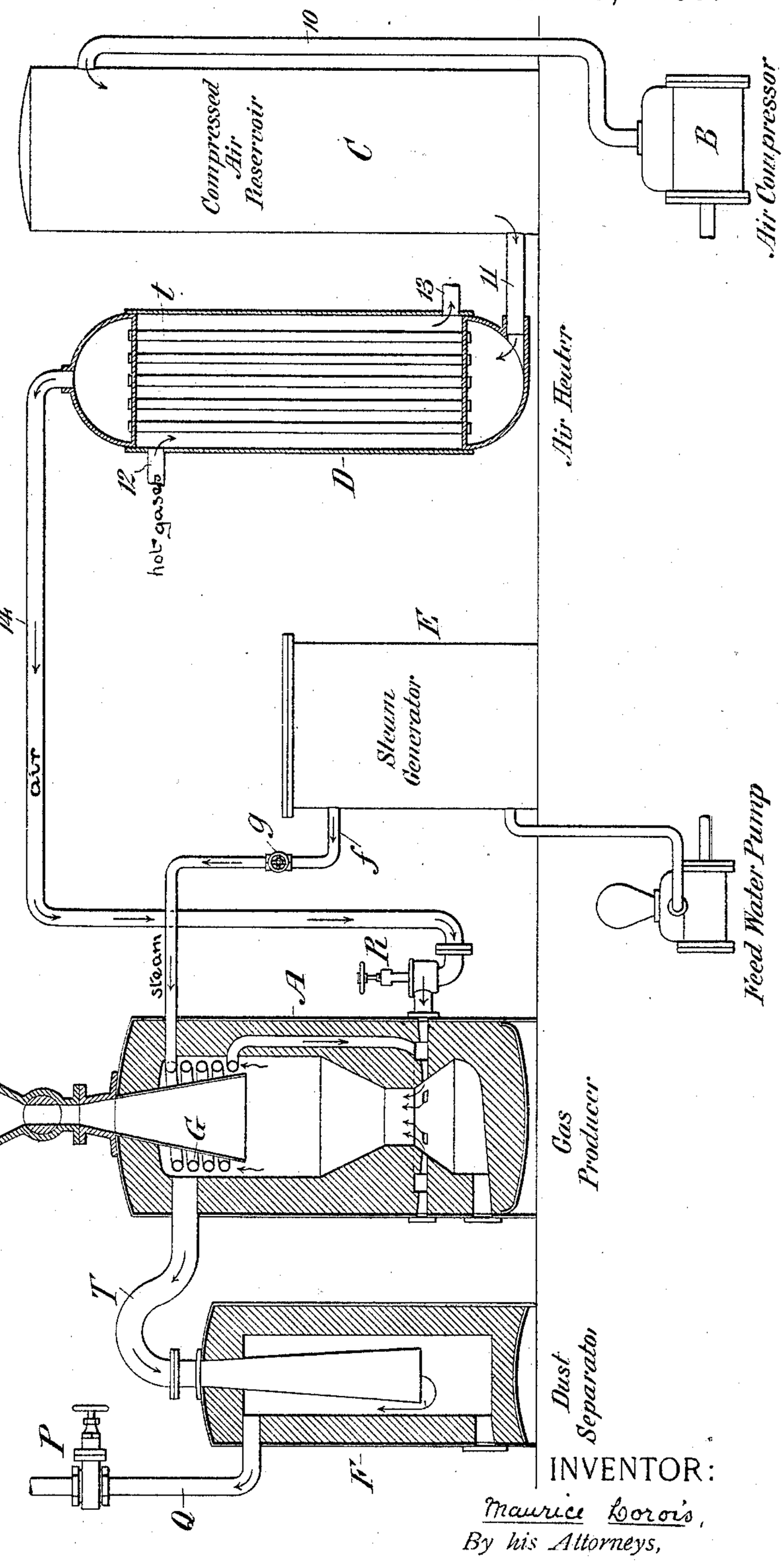
2 Sheets—Sheet 1.

M. LOROIS.

APPARATUS FOR PRODUCING GAS.

No. 584,513. Patented June 15, 1897.

FIG. 1.



WITNESSES:

C. E. Ashley

H. W. Lloyd.

INVENTOR:

Maurice Lorois,

By his Attorneys,

Arthur G. Draper & Co.

(No Model.) 2 Sheets—Sheet 2.

M. LOROIS.

APPARATUS FOR PRODUCING GAS.

No. 584,513. Patented June 15, 1897.

FIG. 3.

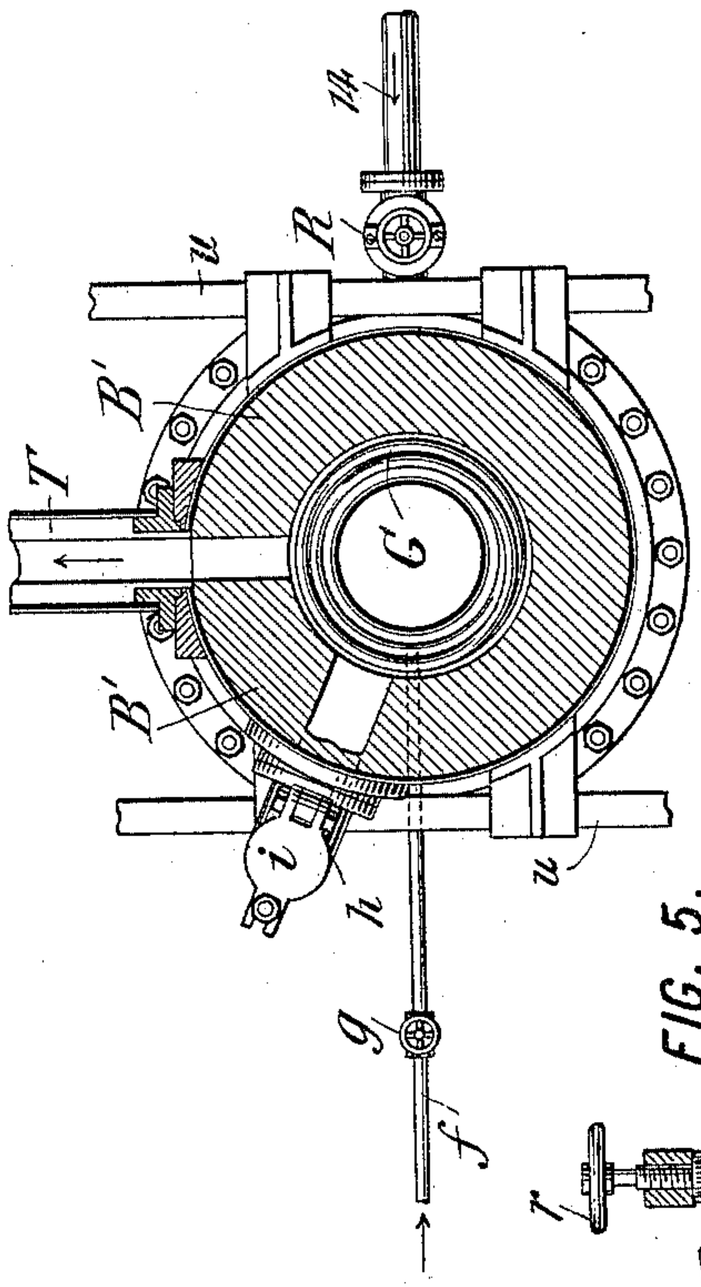


FIG. 4.

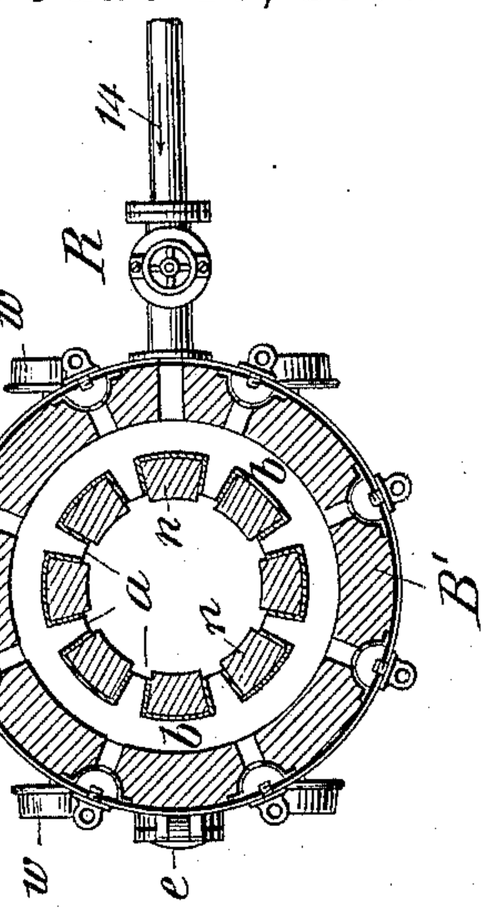


FIG. 5.

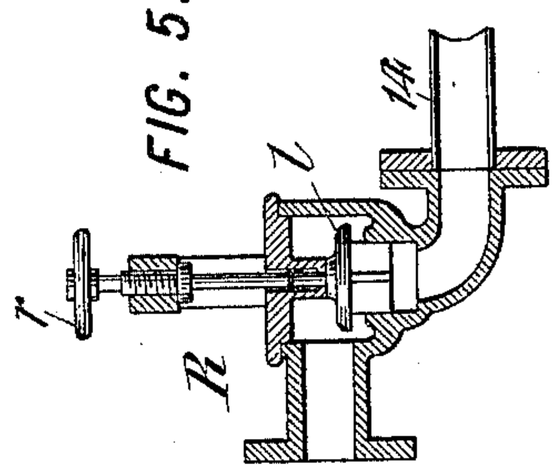
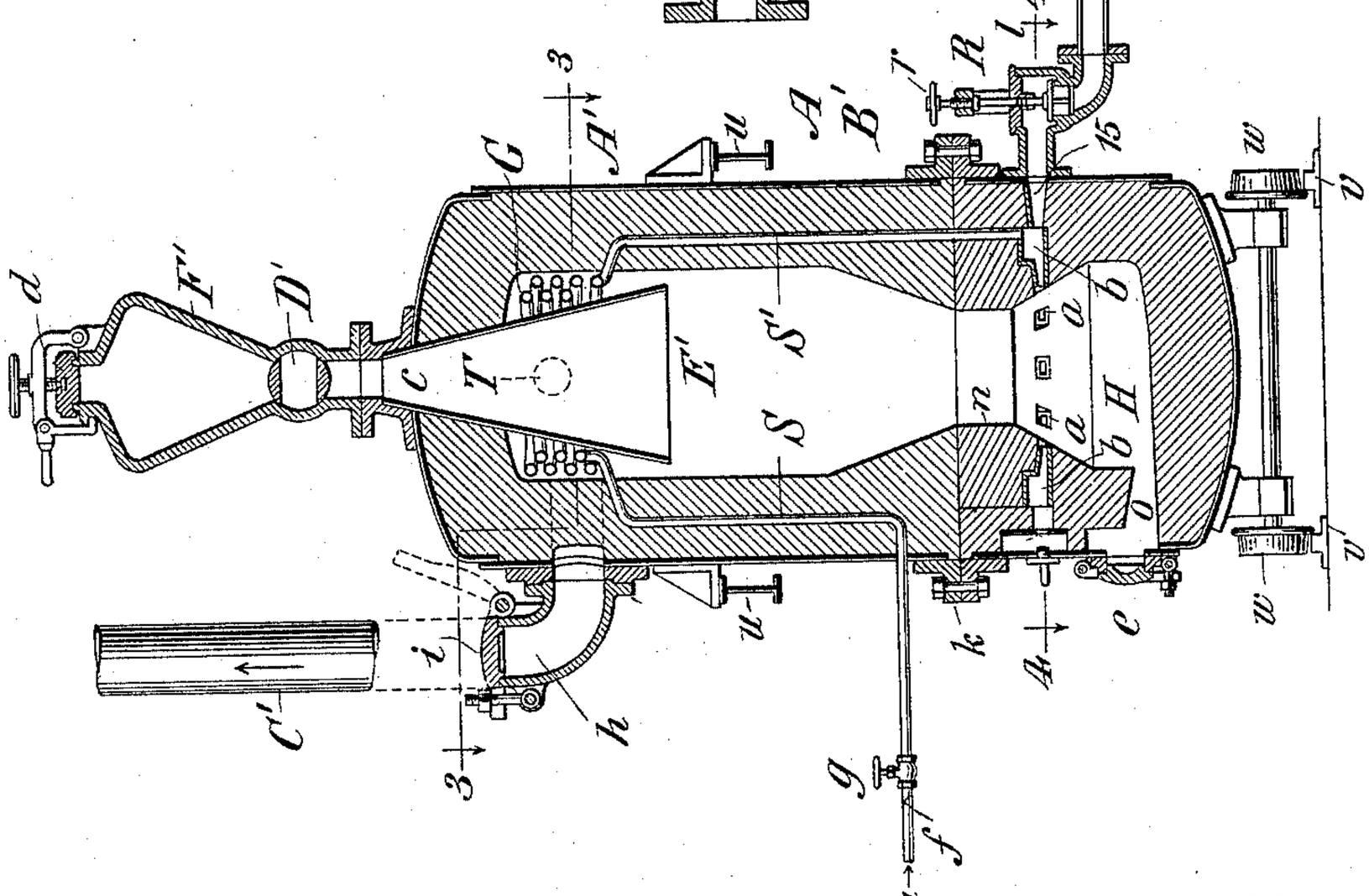


FIG. 2.



WITNESSES:

C. E. Ashley

H. W. Lloyd

INVENTOR:

Maurice Lorois.

By his Attorneys,

Arthur G. Fraser & Co

UNITED STATES PATENT OFFICE.

MAURICE LOROIS, OF NANTES, FRANCE.

APPARATUS FOR PRODUCING GAS.

SPECIFICATION forming part of Letters Patent No. 584,513, dated June 15, 1897.

Application filed September 4, 1894. Serial No. 522,006. (No model.) Patented in France July 30, 1892, No. 223,360; in India September 9, 1892, No. 2,579; in England September 13, 1892, No. 16,413; in Belgium September 26, 1892, No. 101,511; in Switzerland September 26, 1892, No. 5,877; in Luxemburg September 27, 1892, No. 1,696; in Italy September 27, 1892, XXVII, 32,757; in Cape Colony October 11, 1892, No. 268; in Norway October 11, 1892, No. 3,055; in Victoria October 21, 1892, No. 10,073; in New South Wales October 24, 1892, No. 4,066; in Spain November 24, 1892, No. 13,850, and in Canada December 19, 1893, No. 44,918.

To all whom it may concern:

Be it known that I, MAURICE LOROIS, a citizen of the Republic of France, residing in Nantes, (Loire-Inférieure,) France, have invented certain new and useful Improvements in Apparatus for Producing Gas, of which the following is a specification.

This invention is in part patented in the following foreign countries, namely: in France, No. 223,360, dated July 30, 1892; in England, No. 16,413, dated September 13, 1892; in India, No. 2,579, dated September 9, 1892; in New South Wales, No. 4,066, dated October 24, 1892; in Cape of Good Hope, No. 268, dated October 11, 1892; in Victoria, No. 10,073, dated October 21, 1892; in Belgium, No. 101,511, dated September 26, 1892; in Luxemburg, No. 1,696, dated September 27, 1892; in Italy, Vol. 27, No. 32,757, dated September 27, 1892; in Spain, No. 13,850, dated November 24, 1892; in Switzerland, No. 5,877, dated September 26, 1892; in Norway, No. 3,055, dated October 11, 1892, and in Canada, No. 44,918, dated December 19, 1893.

This invention provides an improved apparatus for producing combustible gas by passing air and steam in contact with incandescent carbonaceous matter.

In my patent for process for manufacturing combustible gas, No. 529,423, issued November 20, 1894, I have described and claimed a process consisting in passing heated air and superheated steam in contact, together with ignited carbonaceous fuel at an exceedingly high temperature in a gas-producer, while maintained under a pressure of three kilograms per square centimeter or upward. My present invention provides apparatus for carrying out such process.

My improved apparatus is shown in the accompanying drawings, wherein—

Figure 1 is an elevation of the entire apparatus, portions thereof being shown in vertical mid-section. Fig. 2 is a vertical mid-section of the gas-producer. Fig. 3 is a horizontal section thereof, cut on the plane of the line 3 3 in Fig. 2. Fig. 4 is another horizontal section on the plane of the line 4 4 in Fig. 2. Fig. 5 is an enlarged fragmentary view showing the construction of the regulating check-valve.

Referring to the drawings, let A designate a gas-producer of special construction. (Shown in detail in Figs. 2, 3, and 4.) In operation this gas-producer is connected with other accessory apparatus, as shown in a somewhat diagrammatic manner in Fig. 1. This accessory apparatus consists of an air-compressor B, a compressed-air reservoir C, an air-heater D, a steam-generator E, and a dust-separator F. All of these apparatus are constructed of such strength as to enable them to sustain an internal pressure of at least three kilometers per square centimeter, (about forty-three pounds per square inch.) In practice a pressure two or three times greater than this is found to be desirable, and the apparatus, consequently, are constructed to withstand such higher pressure.

The air-compressor B may be of any known or suitable construction. From its discharge the compressed air is conducted by a pipe 10 into the compressed-air reservoir C. If water or other liquid has been employed for cooling the air-compressor, such liquid will be separated from the water in this reservoir. From the reservoir the compressed air is conducted by a pipe 11 to the air-heater D, in which the compressed air is heated by any suitable source of heat. For the purpose of this heater it is preferable to utilize the otherwise waste heat contained in gaseous products of combustion. Such spent gases may be introduced into the air-heater by a pipe 12 and discharged therefrom by a chimney or stack 13. The air-heater may be variously constructed, it being only essential that the compressed air in passing through it shall come in contact with heated surfaces from which it may abstract heat. When the source of heat is spent gases of combustion, metal partitions or pipes are employed to separate the compressed air from the hot gases. In the construction shown in Fig. 1 the compressed

air passes upwardly through tubes *t*, while the hot spent gases circulate around these tubes. The hot compressed air is conducted from the air-heater by a pipe 14 to the gas-producer A.

This gas-producer is constructed with a cylindrical shell A′, of steel or iron, built of sufficient strength to withstand the heavy pressure required, and within this shell is a thick lining B′, of fire-brick or other refractory non-conducting material. For feeding fuel into the gas-producer an opening *c* is formed at the top, connecting with a feeding-hopper F′ through the medium of the valve D′, which may be turned to open or close communication between the hopper and the interior chamber of the gas-producer. The top opening of the hopper is provided with a cap *d* for hermetically closing it against pressure. By means of this construction the gas-producer can be supplied with fuel without interrupting the operation or permitting the pressure to escape. The valve D′ being closed and the cap *d* open, the hopper F′ is filled with fuel, after which the cap *d* is tightly closed and the valve D′ then opened to permit the fuel to fall through the opening *c* into the gas-producer. The fuel falls through an inverted funnel or magazine E′, made of metal plate, which keeps it piled at a uniform level at the lower end or mouth of this funnel. It also prevents the choking up with fuel of the upper space in the gas-producer around this funnel.

In the lower part of the fire-brick lining of the producer is formed an annular passage or channel *b*, from which a series of radial twyers extend and open into the producer-chamber near the lower portion thereof. The portion of this chamber beneath the twyers serves as an ash-pit H, from which the ashes may be removed through an opening O, which ordinarily is closed by a hermetically-sealed door *e*. Preferably the producer-chamber is contracted just above the twyers to form a throat after the manner of cupola-furnaces.

Compressed air from any available source, such as the reservoir C direct or preferably through the heater D by the arrangement of pipes shown, enters through the pipe 14 into an air-inlet 15, which admits it into the annular passage *b*. The flow of air can be controlled by a valve R, introduced in the pipe 14 and constructed to serve both as a check-valve for preventing any backflow of gas from the producer into the pipe 14 and as a regulating-valve to choke back or control the admission of compressed air. The construction of this valve is shown best in Fig. 4. The valve-disk *l* closes to its seat against the flow of the compressed air, so that normally it is held lifted by the current of air. The screw-stem *r* serves normally as a stop to limit the opening movement of the valve-disk, and by screwing down this stem the valve-disk may be pressed more or less toward its seat to more or less restrict the flow.

Steam from the generator E or any other source of steam flows through a pipe *f*, being controlled, if needful, by a valve *g*, and is thus conducted to the gas-producer. Preferably the steam-pipe is led through the fire-brick lining B′, as shown at S* in Fig. 2. In the free upper part of the producer-chamber is a coil of pipe G, constituting a steam-superheater. The steam-pipe S connects with one end of this coil, while from the other end thereof the pipe S′ extends downward, preferably through the fire-brick lining, and enters the annular channel *b*. Thus the entering steam circulates through the coil G, wherein it is highly superheated, since this coil is exposed to the extreme heat of the newly-produced gas in the upper part of the producer. The superheater might be otherwise located in any position where it would receive sufficient heat either from the newly-produced gas or from any other sufficient source of heat, but its location in the position shown is advantageous, since the heat which is utilized for superheating the steam is abstracted from the newly-generated and excessively hot gas, so that it has the advantageous result of slightly cooling this gas.

The hot compressed air and the superheated steam, both of which are introduced into the passage *b*, are commingled therein and flow around through this passage, being thereby distributed to the various twyers, through which the air and steam are injected into the producer-chamber, entering it at an extremely high temperature and coming immediately into contact with the incandescent mass of ignited fuel in the producer. While passing up through this mass of fuel they become converted in a manner well understood into a fixed gas, consisting, chiefly, of carbon monoxid and hydrogen diluted by nitrogen gas. The combustible gas thus produced passes up and around the funnel E′, and after giving up part of its excessive heat to the superheater G it flows out through a gas-outlet pipe T, Fig. 3, which pipe is lined with fire-brick or other refractory material to protect it against the hot gas.

As some dust or ashes are liable to be carried out from the gas-producer with the stream of gas it is preferable to employ a dust-separator, such as the separator F. (Shown in Fig. 1.) This consists of an upright chamber lined with refractory material and inclosed by a jacket or shell of steel. The gas enters at the top and passes down through an inverted funnel, so as to direct the dust toward the bottom of the chamber, the gas flowing abruptly upward around the funnel and passing out at the top through a discharge-pipe Q.

It is necessary to in some manner obstruct or confine the outflow of gas in order to maintain the stated pressure in the gas-producer. As one means for maintaining this pressure I have shown in the drawings a gate-valve P, which may be adjusted so as to choke back

the flow sufficiently to maintain the required pressure. Ordinarily, however, the gas will be conducted under full pressure to the point where it is required to be used—as, for example, to the inlet-valve of a gas-motor engine or to the injector-nozzle for throwing a blast of gas and air into a glass-furnace, for example, or other furnace or thing to be heated by the combustion of gas. Any such means by which the gas is maintained under pressure for a lesser or greater time after passing out of the gas-producer in order to maintain the required pressure in the gas-producer is within my invention and an equivalent of the valve P shown.

For starting the fire a chimney or stack C′ is provided, detachably connected to an elbow or flue *h*, the valve *i* being thrown back, as shown in dotted lines. This valve is adapted upon the removal of the chimney C′ to be turned down and fastened hermetically over the opening *h*, as shown in Fig. 2.

The operation of the apparatus is as follows: In starting the producer-chamber is filled with fuel introduced through the funnel F′ and valve D′, the chimney C′ is put in place, the fuel is lighted, and air is admitted either by partly opening the valve R or by admitting air through the opening O. When the mass of fuel is well lighted, all the openings are closed, the chimney C′ is removed, the valve *i* closed tightly, and the air-valve R and steam-valve *g* are opened for the admission of compressed air and steam. The steam is superheated in coil G and mingles in the passage *b* with the heated compressed air and the mixture emerges through the twyers *a a* into the chamber, where it it passes up through the mass of fuel. By its passage through the incandescent coal or fuel it is converted into a combustible gas, which is free from considerable carburets and ammoniacal products, the gas being ready to be taken off to be used directly without any purifying process or storage in a gas-holder. The gas thus produced is conducted off through the pipe T to any desired place of utilization—as, for example, to a gas-motor engine. The character of the gas is fully set forth in my said application filed May 23, 1894.

My invention is not limited to all the details of construction shown and described nor to the precise combination and arrangement of apparatus that I have devised for best carrying it into effect. My invention is, in fact, susceptible of considerable modification without departing from its essential features. For example, the employment of a separate air-heater is not absolutely essential, as the compressed air may be heated in other ways. Preferably some otherwise waste heat should be utilized in heating the air, and to this end more or less of the heat otherwise given off from the gas-producer might be availed of for this purpose.

I claim as my invention the following-defined novel features and combinations, each substantially as and for the purpose hereinbefore specified, namely:

1. The combination of a gas-producer constructed with a metallic shell and a refractory non-conducting lining, and having air and steam inlets, and a gas-outlet, an air-compressor, a pipe leading from the compressor to the air-inlet of the producer, means for heating the compressed air before its admission to the chamber of the producer, a steam-generator, a steam-pipe leading thence to the producer to introduce steam thereto, and a gas-discharge pipe leading from the gas-outlet of the producer, with means for restricting the discharge of gas, all said apparatus adapted to maintain a pressure of three kilograms per square centimeter whereby to maintain such pressure in the producer.

2. The combination of a gas-producer, constructed with a metallic shell and a refractory non-conducting lining, and having air and steam inlets, and a gas-outlet, an air-compressor, a pipe leading from the compressor to the air-inlet of the producer, means for heating the compressed air before its admission to the chamber of the producer, a steam-generator, a steam-superheater, a steam-pipe leading from said generator to the superheater and thence to the steam-inlet of the producer, and a gas-discharge pipe leading from the gas-outlet of the producer, with means for restricting the discharge of gas, all said apparatus being adapted to maintain and withstand a pressure of three kilograms or upward per square centimeter.

3. The combination of a gas-producer, constructed with a metallic shell and a refractory non-conducting lining, and having twyers for admitting commingled air and steam and an outlet for the generated gas, an air-compressor, an air-heater, a compressed-air conduit leading from said compressor to said heater and thence to the producer and communicating with said twyers, a steam-generator, a steam-superheater, and a steam-pipe leading from said generator to the superheater and thence to the producer and entering said compressed-air conduit, whereby the superheated steam and preheated air are caused to flow together through said conduit and are thereby commingled and then introduced into the producer-chamber.

4. The combination of a gas-producer, an air-compressor, a steam-generator, and connecting-pipes, the gas-producer constructed with a metallic shell and a refractory non-conducting lining, with twyers for admitting commingled air and steam into the producer-chamber beneath, with a gas-outlet from the upper part of said chamber, with a superheating-coil exposed in the upper part of said chamber to the heat of the newly-generated gas, and with passages for superheated steam and for air formed within the lining and communicating with said twyers.

5. The combination of a gas-producer, an air-compressor, a steam-generator, and con-

necting-pipes, the gas-producer constructed with a metallic shell and a refractory non-conducting lining, with a succession of twyers opening into the producer-chamber, with a conducting-passage formed in said lining and communicating with said twyers, with a steam-superheating coil exposed within said chamber and with steam and air conduits extending respectively from said coil and from the compressed-air-admission pipe within the lining and communicating with said passage, whereby compressed air and superheated steam are united and commingled in said passage while highly heated by the lining, and then introduced through said twyers into the producer-chamber.

6. The combination with an air-compressor and steam-generator of a gas-producer constructed with a metallic shell and a refractory non-conducting lining, having a feeding-hopper for introducing fuel, a magazine or funnel projecting down from said hopper within the producer-chamber, a superheating-coil arranged in the upper part of said chamber around said funnel, a gas-outlet from said chamber communicating with the space around said funnel, and connecting-pipes leading from the air-compressor to the gas-producer and from the steam-generator to said superheating-coil and thence to the steam-inlet of said gas-producer.

7. A gas-producer consisting of an outer metallic shell, a refractory non-conducting lining, both divided transversely into two sections with flanges and fastening devices on the shell for uniting them, a series of twyers entering the producer-chamber beneath the division of the sections, and a separable section of said lining in the space between said division and the twyers where it is exposed to the greatest heat, whereby when the section is burned out it may be renewed by separating the two sections of the producer.

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

MAURICE LOROIS.

Witnesses:
G. DAVAULT,
T. AESPECHE.