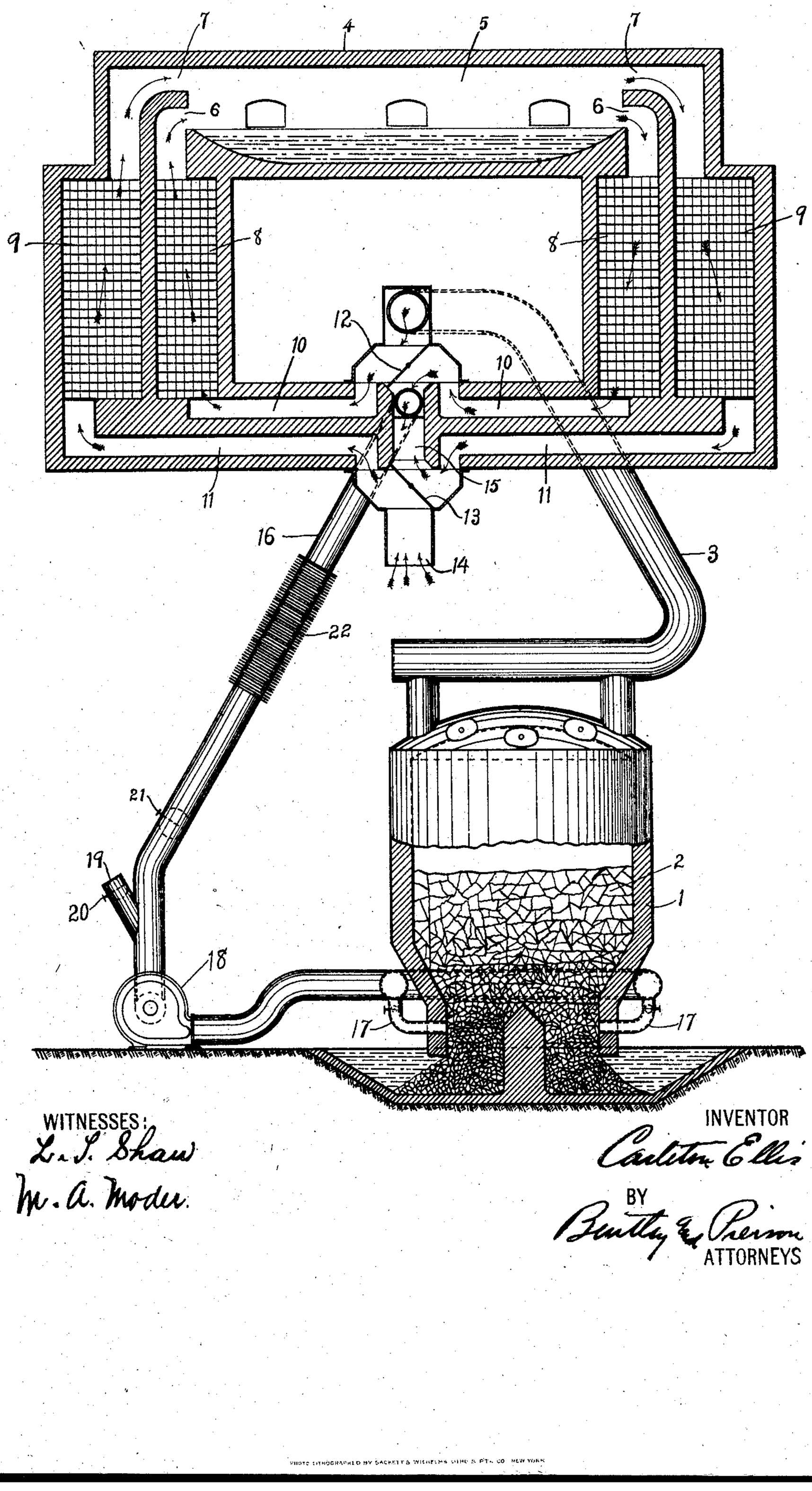
No. 790,253. PATENTED MAY 16, 1905.

C. ELLIS.

GAS PRODUCING AND CONSUMING APPARATUS.

APPLICATION FILED NOV. 22, 1904.



WITNESSES:
L. L. Shaw
M. A. Moder.

INVENTOR
Carleton Ellis
BY
Bentley & Pierson
ATTORNEYS

No. 790,253. Patented May 16, 1905.

UNITED STATES PATENT OFFICE.

CARLETON ELLIS, OF NEW YORK, N. Y., ASSIGNOR TO ELDRED PROCESS COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

GAS PRODUCING AND CONSUMING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 790,253, dated May 16, 1905.

Original application filed October 18, 1904, Serial No. 228,915. Divided and this application filed November 22, 1904. Serial No. 233,300.

To all whom it may concern:

Be it known that I, CARLETON ELLIS, a citizen of the United States, residing at New York city, county and State of New York, have invented certain new and useful Improvements in Gas Producing and Consuming Apparatus, of which the following specification and accompanying drawing disclose as an illustration one embodiment thereof which I now regard as the best out of the various forms in which the principles of my invention may be applied.

This apparatus is especially intended to carry out the method of making weak gas by the producer process as described in my copending application, Serial No. 228,915, of which the present application is a division. Its main object is to dispense with the use of steam as a cooling agent within the producer, to secure a better quality of gas, to permit the employment of accelerated draft without incurring excessive temperatures, and to permit the producer to be operated at a lower temperature, as well as to secure a greater operative range and increased flexibility of adjustment to meet the varying conditions arising with different grades and kinds of fuel. To this end I employ a draft-current composed in part of a neutral endothermically-reacting fixed gas, such as carbon dioxid which may conveniently be derived from the stack-gases of a furnace or other available source.

Prior attempts have been made to devise a system for utilizing the gasified carbon of the waste stack-gases and secure the benefits of that economy in fuel consumption which theoretically results from the fact that less heat is required to reduce CO_2 to CO than is needed in first gasifying solid fuel and then reducing the CO_2. Such systems have necessitated the employment of steam as a cooling agent. The failure to devise a practical system for utilizing the waste gases without using steam to cool the producer has, I apprehend, been due to the following principal causes: first, the employment of the furnace-gases at an extremely high temperature; secondly, the use of gases deficient in carbon dioxid without substantial cooling; thirdly, the employment of draft-accelerating means having inadequate provisions for regulating the oxygen and endothermic constituents of the draft-current independently and in the correct proportions.

I find that the ordinary run of furnace-gases, especially when the furnaces are operated, as usual, with a large excess of air in order to secure complete combustion, are so weak in carbon dioxid that their endothermic action within the fuel-bed of the producer is insufficient to overcome the high temperature at which it has been proposed to introduce them, and as a consequence the producer either runs so hot as to produce large quantities of soot, melted slag or clinkers, and carbon dioxid, or it becomes necessary to employ steam in large quantities in an effort to reduce the temperature to a practical working point. These devices have also suffered from the inflexible control afforded by a jet of air or steam which they were compelled by their high temperature to employ as a draft-accelerator in lieu of a fan or equivalent mechanical device, since such a jet adds its own quota of reacting fluid to the draft-current, and when used in the way proposed a variation in the propelling power of the jet fails to result in maintaining the composition of the draft-current in the correct proportions with reference to the temperature of the stack-gases and their richness in carbonic acid. It is also necessary to take into account the velocity reactions on account of which the fuel under forced draft will slag even with stack-gases theoretically rich enough in CO_2 to maintain a non-slagging temperature, because probably of the fact that at high temperatures carbon manifests a selective affinity for oxygen in preference to carbon dioxid, which is not so apparent when the draft-current is cooled, the exothermic and endothermic reactions in the latter case occurring at speeds more nearly approximating each other.

My invention involves control of the temperature and proportions of the cooling agent with reference to its richness in endothermic constituent, and for the practice of said invention the following conditions are essential—namely, supplying the diluent gas in such a condition, effected either by cooling it or deriving it of a composition sufficiently rich in endothermic constituent, as to maintain the temperature of the producer below the point at which soot, slag, or clinkers form in objectionable quantities and the predetermined independent regulation or adjustment of the respective proportions of free oxygen and neutral or endothermic gas in the draft-current. For the latter result I prefer to employ a mechanical draft-accelerator, such as a fan-blower, combined with a suitable damper or dampers enabling the ratio of air and diluent to be adjusted at will. The cooling of stack-gases prior to their passage through the blower serves to protect the latter from injury.

Cooling of the products of combustion may be conveniently effected in regenerative furnaces by taking them from the discharge end of the regenerator through which they have passed and to which they have yielded up a portion of their heat. In other furnaces the gases may be cooled by leading them to the producer through a long pipe subject to radiation and convection of heat or subjected to artificial cooling by deportation of heat from its surface or contents. Both methods may be employed in conjunction for very weak products of combustion, small regenerators, &c., and I have shown both in the drawing.

I am aware of patent to Eldred, No. 692,257, in which the employment of neutral stack-gases cools the fuel-bed; but I do not claim that feature generically. My present invention relates specifically to the production from a thick bed of fuel of combustible gas, which, owing to the potential properties of its heat-giving constituents, may, if desired, be carried to a distance from the producer and burned at any desired point.

My invention is particularly adapted, though not necessarily confined, to an organization in which the gas-producer is functionally and structurally remote from the consuming apparatus, because from the fact that I operate the producer at a low temperature there is little need of attempting to utilize the sensible heat of the producer-gas, and the necessary length of the return-conduit for the products of combustion in many cases may dispense with other special provisions for cooling these products.

The accompanying drawing represents a sectional view of an apparatus constructed and arranged in accordance with my invention and embodying a gas-producer and a regenerative furnace, together with other features necessary to effect the object above stated.

1 indicates the gas-producer, comprising a generating-chamber adapted to contain a deep bed of fuel 2 and having suitable inlet-apertures for feeding fuel from the top and a water seal at the lower end, from which the ashes are removed.

3 is a gas-pipe connecting the upper end of the producer with a reverberatory furnace 4, of which 5 is the hearth-chamber, and 6 7 the gas and air entrances in pairs at each end, the air-entrance being superimposed upon the gas-entrance.

8 and 9 are respectively the gas and air regenerators, two of each connected with the entrances 6 7 and containing brick checker-work. Their lower ends connect by passages 10 11 with the reversing-valve mechanism embodying valves 12 13, whereby the regenerators are alternately placed in the air and gas lines leading to the furnace and in the path of the products of combustion leading from the furnace to a stack-passage 15.

From a point between the gas-regenerators and the trunk of the stack-passage 15 a pipe 16 leads back to the boshes of the producer 1 and enters the same by twyers 17, whereby products of combustion may be returned from the furnace to the hottest part of the fuel-bed and passed therethrough. This conduit contains a fan-blower 18, and back of said blower there is an air-inlet 19 to the conduit for supplying air to the stack-gases for supporting combustion and cooling the gases. The air-inlet and the trunk of the pipe 16 are equipped with valves or dampers 20 21, whereby the proportions of air and products of combustion in the draft-current may be accurately and independently regulated with especial reference to the temperature of the stack-gases and their richness in CO_2 and the slagging-point of the particular fuel which is being burned, so as to give the desired results in maintaining combustion within the producer at a temperature below the slagging and sooting points. These valves are adjusted to provide an air-supply insufficient for the combustion of the gas after it emerges from the bed of fuel, so that the output of the producer shall be a combustible gas which may be conducted to any desired point of use and there burned with oxygen. The pipe 16 also has a series of heat-radiating fins 22 for reducing the temperature of the gases.

The furnace 4 is operated in the usual way, the products of combustion passing out to the regenerators from one end of the laboratory and yielding their heat to the checker-work, while producer-gas and air are passed in at the opposite end through the other pair of regenerators, from which they absorb

heat. Upon reversal of the valves 12 13 the air and gas pass through the first said regenerators and the products of combustion through the last said pair. A portion of the products is drawn from the discharge end of the regenerator through the pipe 16 by the fan 18 and forced through the producer under accelerated draft in company with free oxygen, which is supplied through the inlet 19 and may be furnished in part from the excess of uncombined oxygen in the furnace 4. The remaining portion passes out through the stack-passage 15. That part of the products which goes through said pipe to the producer is cooled in passing through the regenerators in common with the rejected products, and the cooling action is supplemented by dissipation of heat to the atmosphere from the surface of the pipe 16 and the radiating-fins 22 thereon. These fins may, however, be omitted where the regenerators themselves or the length of the return-pipe afford a sufficient diminution in the temperature, and either the pipe alone or the regenerator alone may effect the required cooling. The regenerators when used may be relied on to cool the gases to a temperature of from 500° to 800° Fahrenheit, or thereabout. It will be noted that owing to the location of the inlet of pipe 16 between the gas-regenerators 8 and the stack-passage 15 the waste gases are taken mainly or wholly from said gas-regenerators, where the products of combustion are richer in carbonic acid, owing to the superincumbency of the air within the furnace and the preponderence of carbonaceous gases in the lower portions thereof. The endothermic reaction of this ingredient with the incandescent fuel, consisting in its conversion into carbon monoxid, exerts an important influence in maintaining the temperature of the producer at a point low enough to avoid the production of soot and clinkers and clogging of the producer from the latter cause.

It will be observed that this apparatus avoids the use of steam, which has heretofore been a requisite in keeping down the temperature, especially with forced draft. Besides the other advantages enumerated a very considerable saving is effected in the consumption of fuel hitherto required to make steam for cooling the producer. The quantity of steam needed to run the engine for driving the fan is a very small proportion of that heretofore used for cooling. The presence of steam in moderate amounts would not interfere with the continuance of my process; but the necessity of employing it as a primary cooling agent is entirely done away with.

It is to be noted that the heat abstracted in the regenerator from that portion of the products of combustion which goes to the producer is shunted or side-tracked around the producer and returned to the furnace by way of the entering producer-gas. In this way I am enabled to save a large part of the heat resulting from the cooling of the producer-draft when the invention is applied to a reverberatory furnace.

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

1. In an apparatus of the character specified, the combination of a gas-producer, a gas-furnace having a regenerator heated by its waste gases, and a conduit for products of combustion connecting the waste-gas outlet of said regenerator with the producer.

2. In an apparatus of the character specified, the combination of a gas-producer, a gas-furnace having a regenerator, a discharge-passage therefrom for the waste gases, a conduit for products of combustion connecting said discharge-passage with the combustion zone of the producer, and draft-accelerating means in said conduit.

3. A gas producing and consuming apparatus comprising a gas-producer, a regenerative furnace supplied thereby and having checker-work, means to intermittently pass the products of combustion from said furnace through the checker-work, and means for returning the products of combustion which have passed through the checker-work to the combustion zone of the producer for cooling the latter.

4. The combination of a regenerative furnace having two regenerators, means to alternately pass combustion-supplying fluid and products of combustion through said regenerators, a gas-producer connected to supply combustible gas to said furnace, and means to return to said gas-producer the cooled products of combustion which have traversed one or the other of said regenerators.

5. The combination of a furnace having regenerators one of which is so located as to receive products of combustion containing a larger proportion of carbon dioxid than another, a gas-producer supplying said furnace, and means for returning to said producer waste gases from the first said regenerator.

6. The combination of a furnace having at each end a gas-entrance and an air-entrance, air and gas regenerators connected with said entrances, an outlet-passage for products of combustion which have traversed said regenerators, reversing-valve mechanism for alternately directing products of combustion and air and gas through said regenerators, a gas-producer connected to furnish gas to the furnace through the gas-regenerators, and a return-conduit for products of combustion connecting said outlet-passage with the combustion zone of the gas-producer.

7. The combination of a furnace having at each end a gas-entrance and a superior air-entrance, air and gas regenerators connected

with said entrances, valve mechanism for alternately directing products of combustion and air and gas through said regenerators, a gas-producer connected to supply gas to the furnace through said gas-regenerators, and a return-conduit connected to receive products of combustion from the gas-regenerators and supply the same to the producer.

In witness whereof I have hereunto set my hand, before two subscribing witnesses, this 18th day of November, 1904.

CARLETON ELLIS.

Witnesses:
M. F. MANGELSDORFF,
W. E. DIXON.