No. 791,461. PATENTED JUNE 6, 1905.

C. ELLIS.

GAS PRODUCER APPARATUS.

APPLICATION FILED DEC. 12, 1904.

3 SHEETS—SHEET 1.

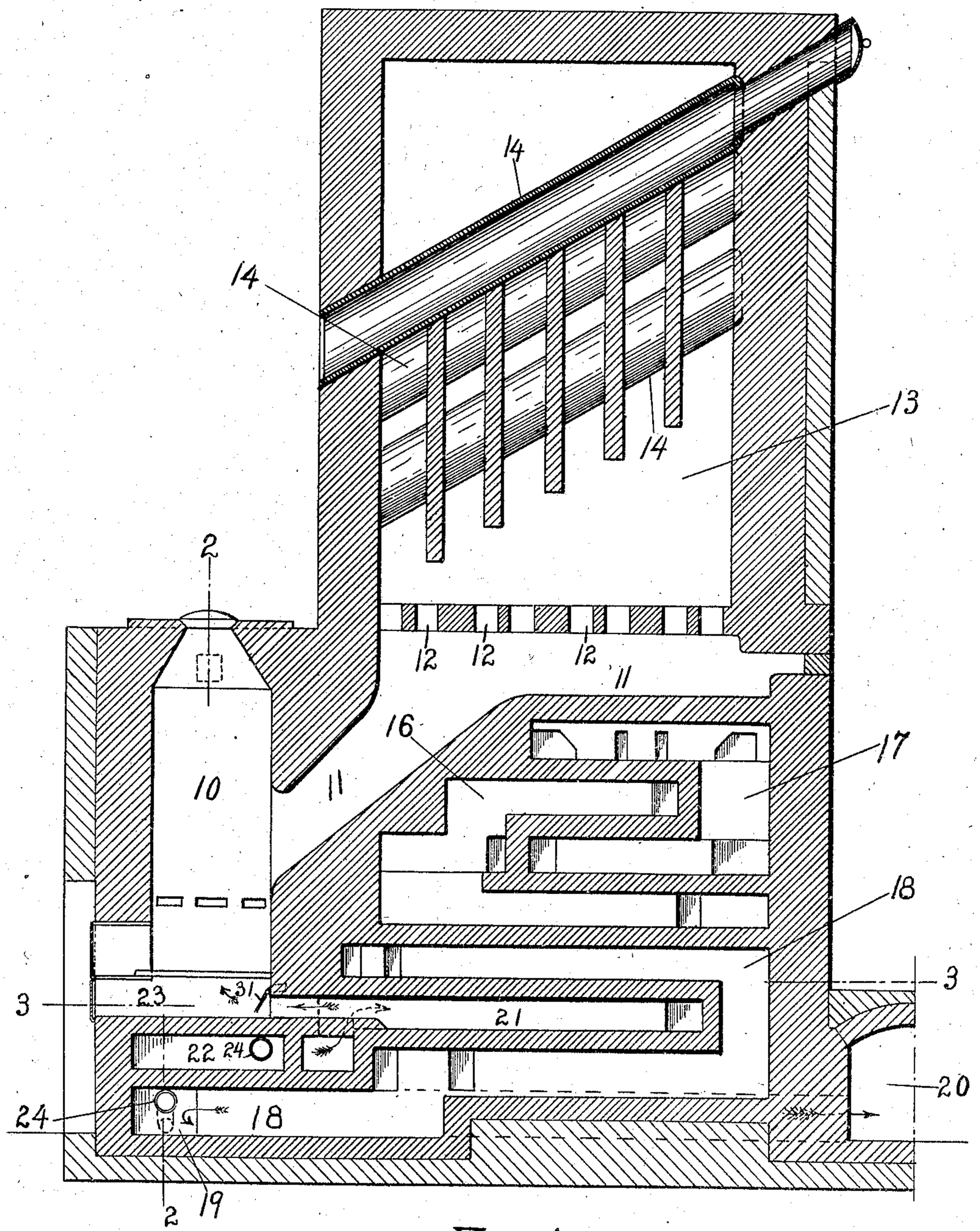

Fig. 1.

WITNESSES:
L. L. Shaw
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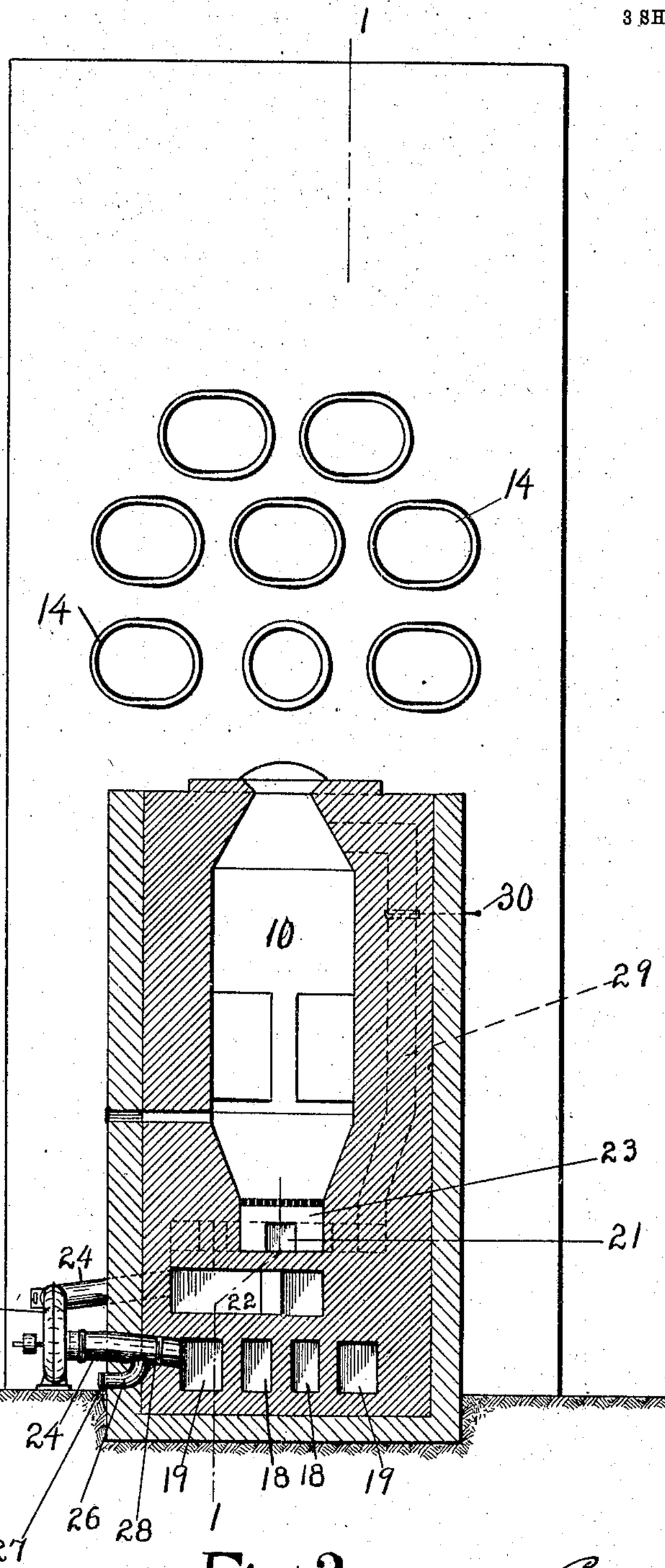

Fig. 2.

WITNESSES:

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3 SHEETS—SHEET 3.

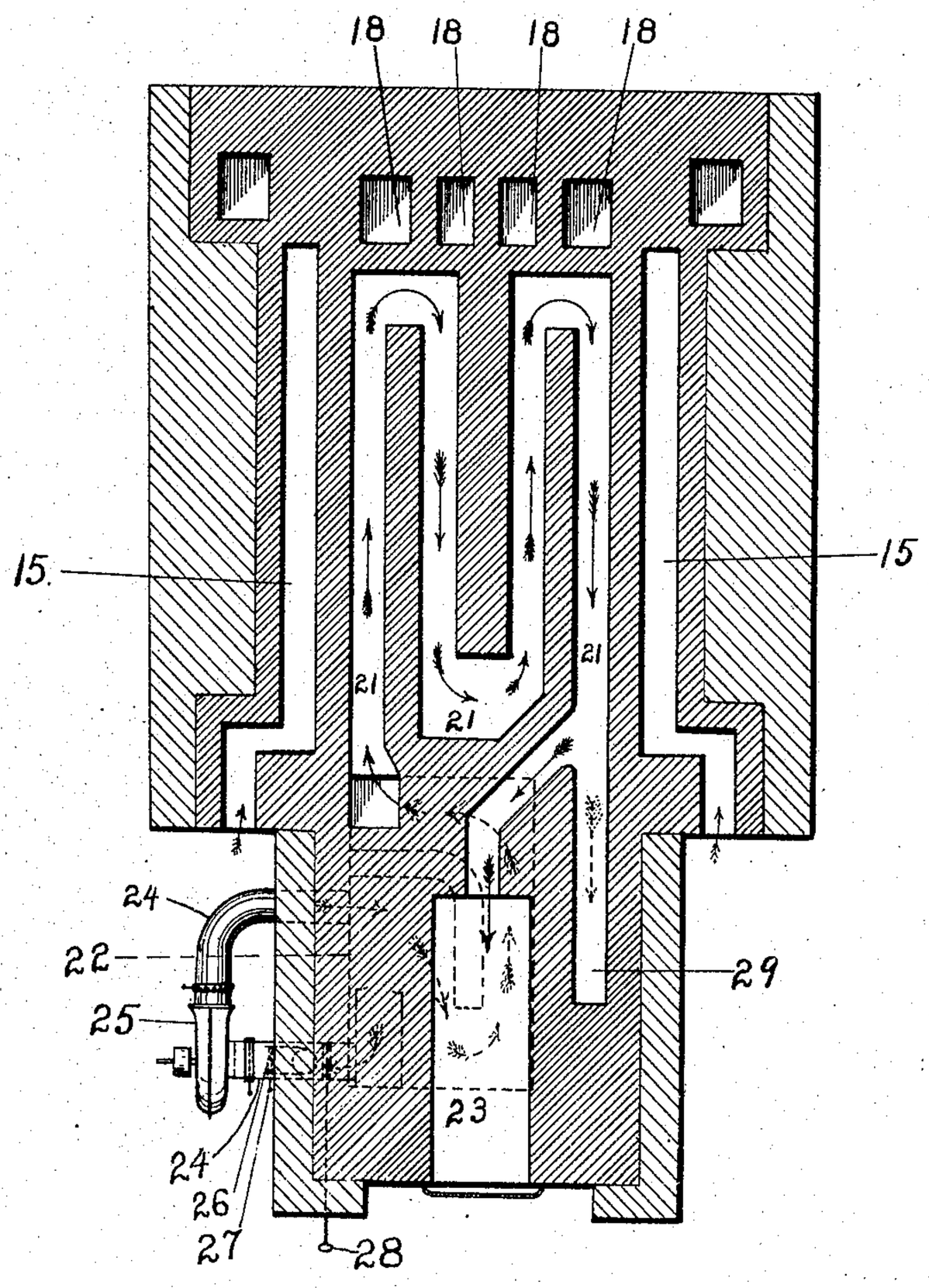

Fig. 3.

WITNESSES:
L. L. Shaw
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No. 791,461. Patented June 6, 1905.

UNITED STATES PATENT OFFICE.

CARLETON ELLIS, OF NEW YORK, N. Y.

GAS-PRODUCER APPARATUS.

SPECIFICATION forming part of Letters Patent No. 791,461, dated June 6, 1905.

Application filed December 12, 1904. Serial No. 236,452.

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-Producer Apparatus, of which the following specification and accompanying drawings 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 invention relates to gas-producer apparatus, and especially those in which a portion of the products of combustion from the furnace in which the producer-gas is burned or from other convenient source is returned to the producer and passed through the bed of fuel therein. I have discovered that these products, owing to their neutral character and to the presence of carbonic acid, may, by properly regulating their temperature, be made the means of keeping down the temperature of the producer and avoiding the production of soot and slag or clinkers in objectionable amounts without requiring the use of steam as a cooler. It is well known that steam has heretofore been largely utilized for that purpose, but is open to serious objections, principally due to the imperfect decomposition which the steam undergoes in passing through the fuel-bed. It also requires a much higher temperature for its decomposition—namely, about 1,900° Fahrenheit and above—than CO_2, which splits up at about 1,200°, and I can therefore not only run the producer cooler, but obtain a range of operation some 700° greater than with steam. This discovery whereby I substitute neutral stack-gases for steam and regulate the temperature of the draft with reference to its composition and the slagging-point of the particular fuel used is not broadly claimed herein, being made the subject of copending applications, Serial Nos. 228,915 and 233,800.

The present invention relates especially to gas-furnaces whose products of combustion contain a large constituent of carbonic acid whose endothermic reaction with the contents of the gas-producer is made the basis of the cooling action above referred to. An example is found in gas-benches for making retort-gas with a distilling-flame of producer-gas, and particularly those in which coke fuel is burned in the producer. A furnace of this kind is shown in United States Patent No. 274,829. In furnaces of this character various influences combine to render it feasible to burn the fuel-gases with oxygen little, if any, in excess of their theoretical requirement. The flame travels for a long distance through a refractory heat-retaining region. Secondly, the coke-producer affords gases consisting largely of carbon monoxid, with little, if any, of the smoky gases of distillation, which require an excess of oxygen for their complete combustion, and, thirdly, the practice of preheating the furnace-air on the regenerative plan reduces the requirement for an excess quantity. I find it possible with products of combustion of the aforesaid character rich in carbon dioxid to rely largely upon the heat-absorbing or endothermic reaction of this ingredient with the incandescent carbon of the producer to maintain the combustion process of the producer on a low-temperature plane.

The present application relates to improvements in apparatus for carrying into effect a process of the aforesaid character and includes certain useful arrangements of conduits, regenerators, and mechanical draft-producing means, such as a fan, whereby a portion of the stack-gases may be diverted from the stack into the producer and whereby protection is afforded to the fan by the cooling undergone by the stack-gases before reaching the fan.

The construction which I provide enables me to cool the draft mixture for the producer sufficiently to protect the fan and avoid objectionable slagging and yet introduce it at a sufficiently high temperature (permissible by reason of the high endothermic capacity of the particular stack-gases) as to secure the benefits of the increase in furnace temperature due to a comparatively high initial temperature of the draft mixture.

In the accompanying drawings, Figure 1 represents a vertical section of a producer-heated retort gas-bench embodying my improvements. Fig. 2 represents a section on

the line 2 2 of Fig. 1. Fig. 3 represents a section on the line 3 3 of Fig. 1.

The same reference characters represent the same parts in all the figures.

In the drawings, 10 is the producer, connecting by a gas-conduit 11 with the burners 12, above which is the furnace or combustion chamber 13, containing the refractory gas-retorts 14 and suitable refractory baffles and walls, whereby the flame is caused to proceed through an extensive heat-retaining region whose reverberatory or radiative properties materially aid in dispensing with excess air and affording products of combustion rich in carbonic acid. These products frequently contain as much as twenty per cent. of carbonic acid in a furnace of the kind illustrated, which means that practically all of the twenty-one per cent. of oxygen in atmospheric air has been combined with carbon in the form of CO_2.

The passages for furnace-air and for products of combustion are not fully illustrated in detail, being familiar in the art. Reference may be had to the aforesaid patent, No. 274,829, for a more complete illustration. I do not, of course, confine myself to constructional details, but may embody in various constructional forms the idea herein illustrated.

The furnace or secondary air enters the combustion-chamber 13 through the burners 12 in a plane alongside of the gas-conduit 11 and is preheated on the continuous plan by the spent gases in passing through a regenerator. The entrance portion of the regenerative passages for furnace-air is shown at 15 15 in Fig. 3, and a portion of these passages at 16 in Fig. 1. A portion of the passages for products of combustion through which the said products pass from the furnace downwardly in a direction opposite to the furnace-air is shown at 17 and 18. The final exit is through a passage 19, Fig. 1, and the stack-tunnel 20. Thereby a considerable portion of the heat of the stack-gases is abstracted and added to the furnace-air by conduction through the walls of the passages. 21 represents passages likewise heated by the products of combustion and having an antechamber 22 and an exit-chamber or ash-pit 23 under the grate of the producer 10. From one of the stack-gas passages 19 a pipe 24 leads to the antechamber 22 and contains a fan-blower 25, whereby a portion of the products of combustion may be diverted into the passages 21. The pipe has an air-inlet 26 anterior to the fan for admitting air to support combustion in the producer, and the relative proportions of air and products of combustion are regulated by dampers 27 28 in the pipe and air branch.

From the passage 21 a branch 29, containing a valve or damper 30, leads to the top of the producer 10. By suitably adjusting this valve and a valve 31, controlling the passage under the grate, a downdraft may be created through the fuel-bed either to the exclusion of the updraft or in conjunction therewith. If the current be divided and the draft proceed both ways and issue from the middle of the fuel-bed, the velocity of each portion is less than that of a single draft of equal volume and more time is given for the reactions within the fuel body.

It will be observed that the products of combustion are considerably cooled before passing through the pipe 24 and the fan 25, thus affording protection to the mechanism and materials of the fan and creating a temperature-repressing influence of marked benefit in keeping the heat of the producer below the slagging-point of the fuel. By mixing with air these products are still further cooled and the air preheated by any residue of temperature in the gases. In the passages 22 21 the temperature of the mixture is raised by regenerative action, so that the mixture may enter the producer quite hot, though at a considerably lower temperature than the original temperature of the stack-gases, because of the relatively small surface of the passages 21 22, the comparative coolness of the stack-gases by the time they have reached the channels in heating relation to these passages, the loss of heat in transmission through the intervening walls, and the admixture of cold air with the stack-gases. If necessary, the delivery-pipe 24 of the fan could of course be connected directly to the ash-pit 23 of the producer. This partial reheating is permissible, owing to the large proportion of carbonic acid available for endothermic action. I find it possible to conduct the producer process under temperature conditions comparable to those existing when steam is used or even at a lower temperature. If the products of combustion are abstracted at an earlier point in their travel and mixed with the air, less preheating of the air by conduction is necessary.

A considerable saving in fuel is effected by my invention, and the gas is cooler and contains a larger proportion of combustible. Bituminous or other fuel may also be employed, in which case, although the products of combustion in general will contain less carbonic acid than with a coke fire, the producer naturally runs cooler, owing to the character of the fuel.

The independent regulation of the composition of the draft-current to the producer afforded by a mechanical draft-accelerator, such as a fan in combination with dampers in the air and stack-gas inlets to the fan, is a very important matter, inasmuch as it enables the composition of the draft-current to be varied with reference to the temperature of the stack-gases, their richness in CO_2, and the slagging-point of the particular fuel employed. Some fuels slag at as low a temperature as 1,400°

Fahrenheit, while others do not slag objectionably below 2,200°. Between these two points there is a wide range of conditions, which are met by the effective control of the various factors relating to the draft, as described. Moreover, the furnace will sometimes be run so as to produce a smaller percentage of CO_2 than at other times. I have found that jet propulsion of the stack-gases as sometimes proposed in gas-producer practice is unsatisfactory on account of the difficulty or impossibility of attaining satisfactory regulation under the varying conditions above mentioned, and I therefore prefer to employ a fan or equivalent mechanical accelerator. I may add that the necessity for cooling the stack-gases before their introduction into the producer arises even with some gases apparently rich enough in CO_2 to suppress producer temperatures to a practical working point, since at high temperatures, and especially under forced draft, carbon appears to manifest a selective affinity for oxygen in preference to carbon dioxid, which is not so apparent when the gases are cooled. The result, as shown by test, is the projection of clinker formations from the twyers into the producer, which eventually clogs the latter and stops the process. With rich gases the cooling required is of course less than with poor furnace-gases containing much free oxygen. Such partial cooling suffices for furnaces such as I have described, where practically all oxygen is burned to CO_2, and for this purpose the continuous regenerator of the gas-bench affords a sufficient cooling, where in other furnaces it would answer not so well or not at all.

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

1. In gas producing and consuming apparatus the combination of a furnace combustion-chamber having extensive refractory baffling-surfaces including one or more refractory receptacles for the materials under treatment, a gas-producer connected to supply combustible gas thereto, a regenerator heated by the waste furnace-gases for imparting heat to the furnace combustion fluid, and a waste-gas passage connecting the waste-gas outlet of said regenerator with the generating-space of the producer.

2. In gas producing and consuming apparatus the combination of a gas-burning furnace, a gas-producer connected therewith, a return-conduit for products of combustion connected with the generating-space of the producer, a mechanical draft-accelerator in said conduit, a heat-removing cooler in said conduit on the suction side of said draft-accelerator, and a reheater in the conduit between the draft-accelerator and the gas-producer.

3. In gas producing and consuming apparatus the combination of a gas-burning furnace, a gas-producer connected therewith, a regenerator heated by the waste furnace-gases, a waste-gas passage connecting the waste-gas outlet of said regenerator with the producer, a fan-blower in said passage, and means for reheating said passage between the fan-blower and the producer by means of waste furnace-gases.

4. In gas-producer apparatus, the combination of a furnace having extensive refractory baffling-surfaces, a gas-producer connected to supply combustible gas to said furnace, a return-conduit for waste furnace-gases connecting said furnace with the generating-space of the producer, a continuous regenerator in the line of said conduit, and means whereby the furnace combustion fluid is continuously heated by conduction through the walls of said regenerator.

5. In gas-producer apparatus, the combination of a gas bench-furnace having extensive refractory baffling-surfaces including one or more refractory retorts, a gas-producer connected to supply combustible gas to said furnace, a return-conduit for waste furnace-gases connecting the furnace with the producer, a fan-blower in said conduit, means between the fan-blower and the furnace for cooling the contents of the conduit by removal of heat therefrom, an air-inlet on the suction side of the fan, and means for independently regulating the proportions of air and furnace-gases in the draft-current supplied to the producer by said fan.

6. A gas producing and consuming apparatus comprising a furnace such as a retort gas-generator, having extensive heat-retaining surfaces in the path of the flame, whereby fuel-gases are burned with a minimum of excess oxygen, a gas-producer for supplying gas to heat said furnace, a continuous regenerator having passages in heat-transferring relation for the products of combustion and the supply-current respectively, a conduit connecting the stack-gas passage with the producer supply-passage and having mechanical draft-producing means such as a fan whereby a portion of the products of combustion may be diverted from the stack and supplied to the regenerative passage, means for supplying air to said conduit, and means for regulating the relative proportions of air and products of combustion in the producer-draft.

7. A gas producing and consuming apparatus comprising a furnace having extensive refractory surfaces in the path of the flame, a gas-producer for supplying said furnace, a continuous regenerator comprising the passages 17, 18, 16 and 21 in heating relation, for products of combustion, furnace-air and producer supply-current respectively, the pipe 24 connecting the passages 18 and 21 and having an air-inlet, whereby products of combustion and air are supplied to the producer and the mixture preheated, means for pro-

pelling the producer-current, and means for regulating the relative proportion of air and products of combustion in the mixture.

8. In gas-producer apparatus, the combination of a source of neutral products of combustion, a gas-producer having a generating-chamber adapted to contain a deep bed of fuel, a combustible-gas outlet from said chamber at an intermediate point in the length of its fuel-containing portion, and a conduit structure for products of combustion leading from said source and having portions opening into said generating-chamber respectively at opposite ends of said portion and adapted to carry a divided draft-current.

In witness whereof I have hereunto set my hand, before two subscribing witnesses, this 10th day of December, 1904.

CARLETON ELLIS.

Witnesses:
A. M. HYATT,
WARREN E. DIXON.