No. 885,740 PATENTED APR. 28, 1908

O. H. ELIEL.

REGENERATIVE RETORT FURNACE.

APPLICATION FILED FEB. 16, 1907.

2 SHEETS- SHEET 1

Fig. 2a.

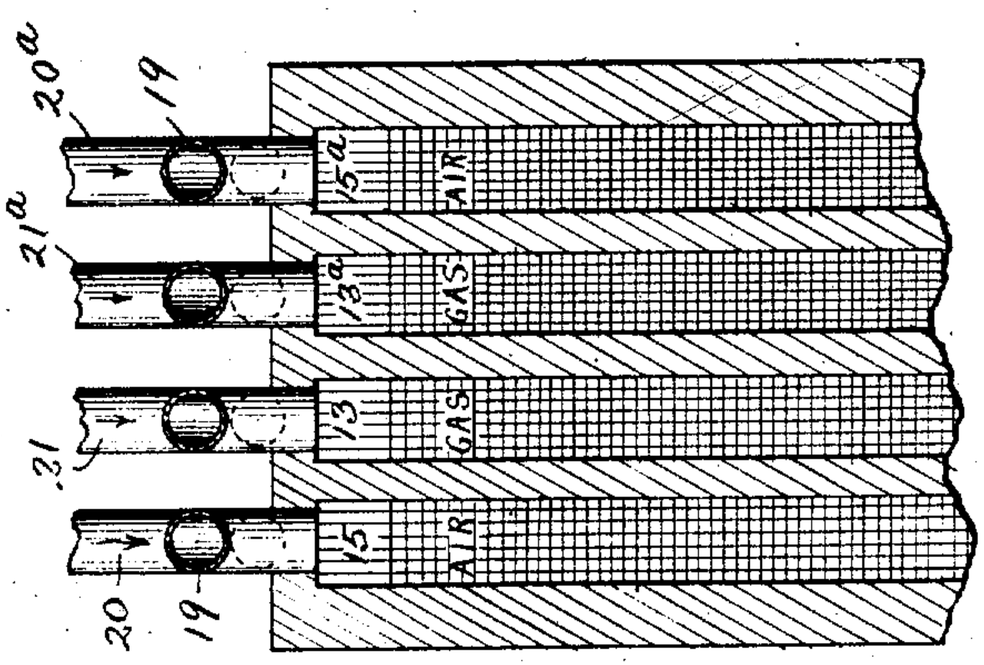
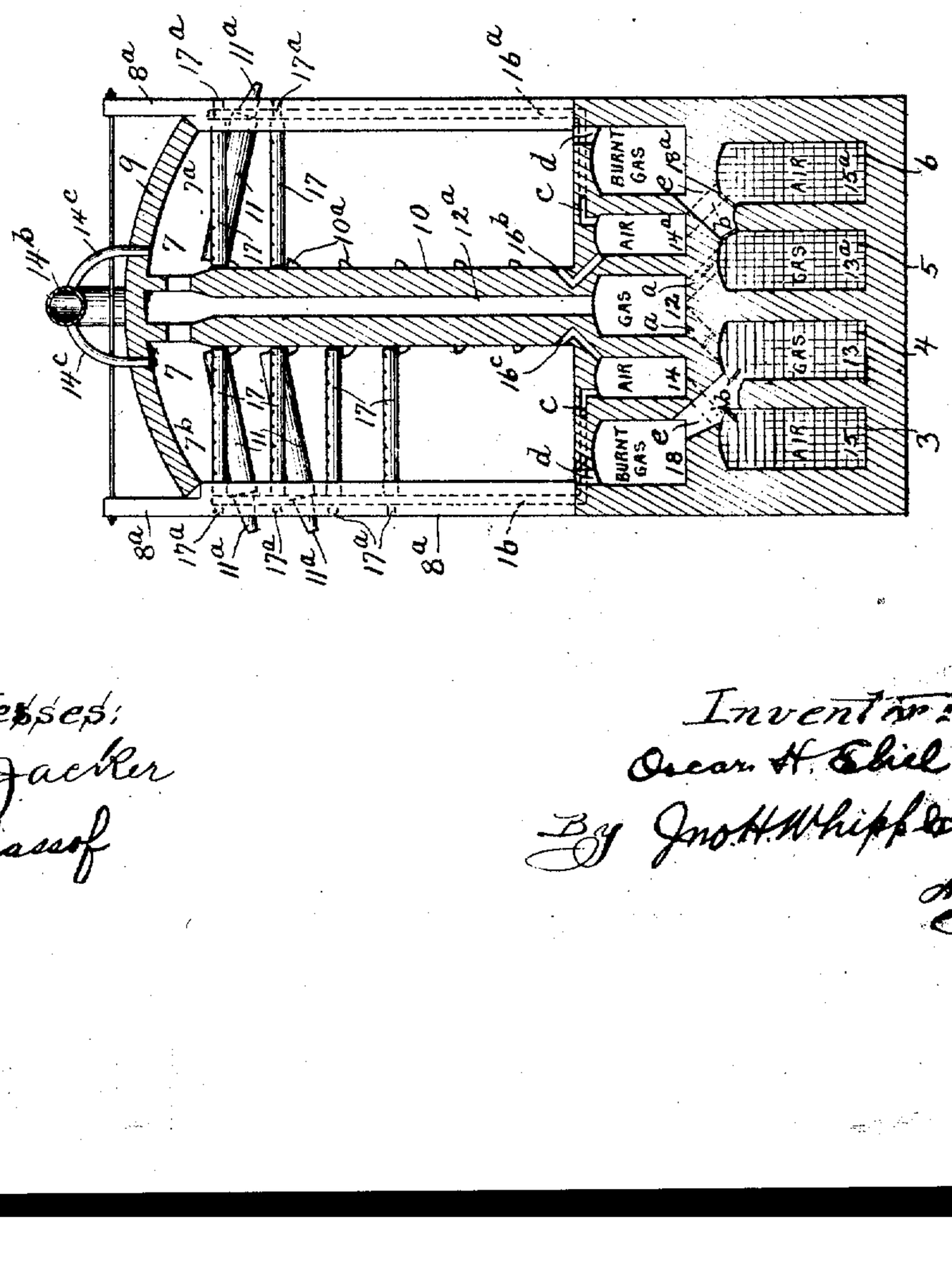


Fig. 1.



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2 SHEETS—SHEET 2.

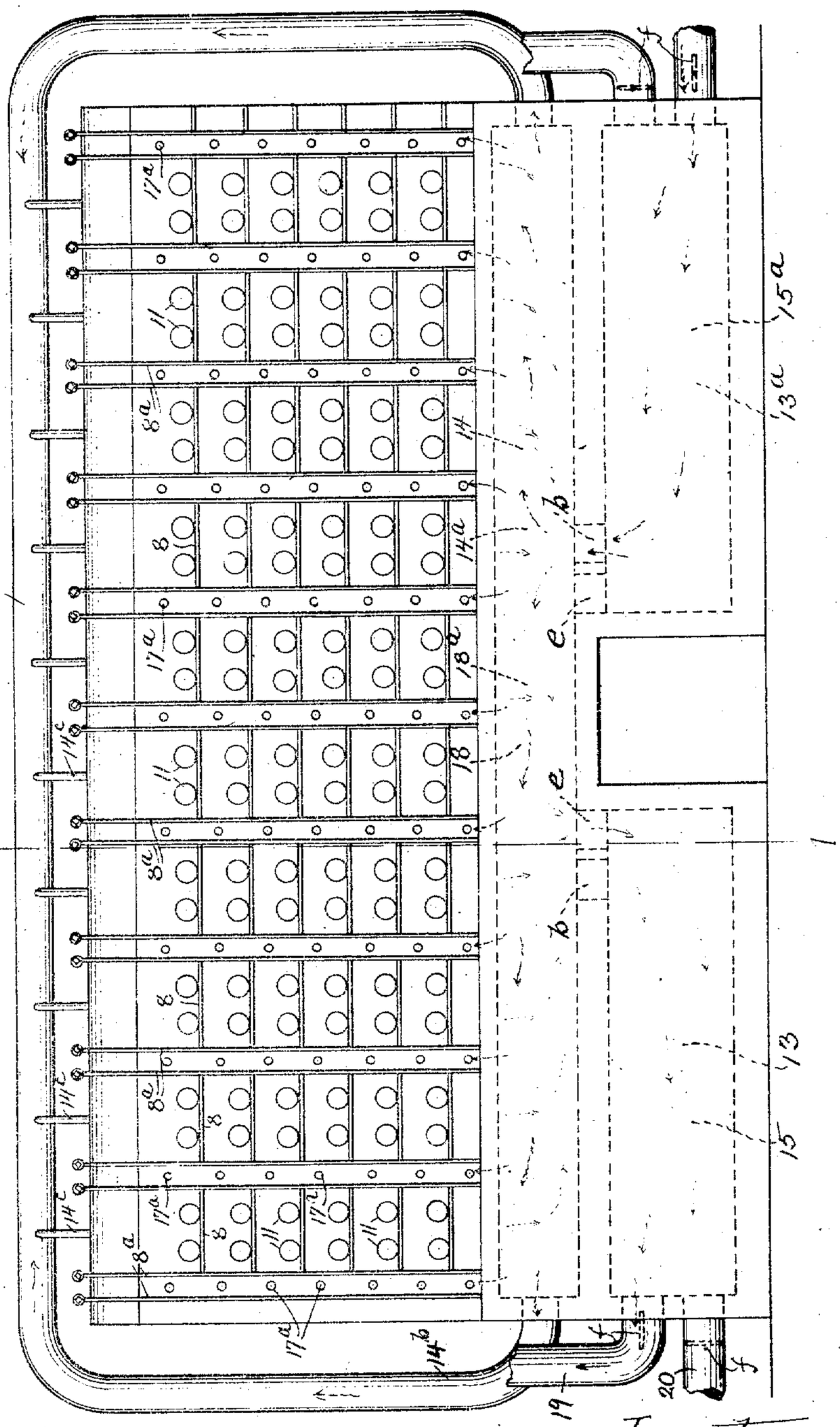

Fig. 2.

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UNITED STATES PATENT OFFICE.

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REGENERATIVE RETORT-FURNACE.

No. 885,740. Specification of Letters Patent. Patented April 28, 1908.

Application filed February 16, 1907. Serial No. 357,688.

To all whom it may concern:

Be it known that I, OSCAR H. ELIEL, of La Salle, in the county of Lasalle and State of Illinois, have invented certain new and useful Improvements in Regenerative Retort-Furnaces, of which the following is a specification.

My invention relates to improvements in regenerative furnaces for heating zinc-distilling retorts or the like; and the object of the improvements is to provide means for producing a continuous and better circulation and mixing of the recuperated oxygen and gases within the retort chambers for the purposes of combustion and heat production. I attain this object by the construction of furnace illustrated in the accompanying drawing, wherein provision is made for introducing the combustible gases at the top of the retort chambers and causing them to pass downward through the same, and provision for introducing air containing oxygen for burning such gases at the bottom, and at intervals between the bottom and top and causing the same to take upwardly inclined courses in order to meet the descending gases and be the better mixed therewith in combustion.

Figure 1 of the drawing is a transverse vertical section on the line 1—1 of Fig. 2 of a regenerative retort furnace containing my improvement. Fig. 2 is a side elevation of the same. Fig. 2ª is a detail showing a fragment of a horizontal section at one end of the furnace.

Similar numerals and letters refer to similar parts throughout the several views.

The regenerators 3, 4, 5 and 6 are located under the combustion chamber 7. The chamber is composed of side walls having cast iron frames with horizontal plates 8 supported by buck staves 8ª which also support an arched roof 9, the side walls being closed with end walls. The chamber is divided by a central division wall 10, which is provided with ledges 10ª for supporting the inner ends of the retorts 11 which have their outer or front ends rested upon fire clay bricks placed upon the horizontal plates 8. The division wall extends up to the arched roof and so divides the chamber into two compartments 7ª and 7ᵇ. Each compartment contains several tiers of retorts 11 arranged in vertical rows along the horizontal extension of said compartments and provided with condensers 11ª of ordinary construction, the space around the outer end of the retorts and between the buck staves and plates being filled with brick or fire clay in the usual way.

Extended along the horizontal extension of the furnace under the division wall 10 is a gas flue 12 which communicates with a series of vertical flues 12ª in the division wall that open or discharge just under the arched roof 9 into the top part of the compartments 7ª and 7ᵇ. Below the gas flue 12 are two gas regenerators 13 and 13ª which communicate with the said gas flue by means of short flues *a*, as shown by dotted lines in Fig. 1.

Along on opposite sides of the gas flue 12 are air flues 14, 14ª which communicate with air regenerators 15 and 15ª by flues *b*, as is also shown by dotted lines in Fig. 1. The air flues 14 and 14ª, respectively, communicate by means of a series of flues *c* with a series of vertical flues 16 and 16ª, arranged in the front side walls between every two rows of retorts and extended up as high as the top tier of retorts. The air flues, 14 and 14ª, also communicate through small flues 16ᵇ and 16ᶜ with the chamber space at the bottom. The series of vertical flues 16 and 16ª, have horizontal branches 17 made of fire clay and extended back from the front at both sides to the central division wall. They also have openings 17ª opposite the branches, affording access to the latter for more or less choking of them with clay or the like to regulate the admission of air into them. The branches are provided with a series of perforations in their upper side, sufficient to let into the chamber the required amount of air in jets directed preferably upwardly at an angle to the upright. The vertical arrangement of the branches is such that their front ends come in the planes between the horizontal tiers of retorts.

Extended along over the top of the retort chamber is an air flue 14ᵇ which is connected in the system with the air flues 14 and 14ª and with the same source of supply. This has small flues 14ᶜ communicating with the compartments 7ª and 7ᵇ at the top.

At the bottom of the retort chamber compartments communicate with flues 18 and 18ª through short flues *d* which carry the products of combustion down from said compartments into said flues 18 and 18ª and from there said products can pass through short flues *e* into the gas and air regenerators 13 and

15 and 13ª and 15ª, respectively, on each side as indicated in Fig. 1.

The gases under pressure pass from the source of supply to the gas regenerators and thence into the gas flue 12 and thence up through the vertical gas flues 12ª into the top of the compartments 7ª and 7ᵇ, thence down through the spaces between and around the retorts 11 and branch air flues 17 where they are burned completely, and pass on to the gas and air regenerators on the same side, and thence on to and out through flues 19 leading to a common exit. The air, or oxidizing gas, under pressure passes in chiefly through the flues 14, 14ª, 14ᵇ, and their branches 16, 16ª and 17, a small amount coming in at the bottom and top through the flues 16ᵇ, 16ᶜ and 14ᶜ. The admission of air to the several branches 17 may be regulated by choking the entrances thereof more or less with clay or the like, for producing the requisite uniform heating of the retorts throughout the entire furnace.

The air and gas flues and the flues for the products of combustion (12, 14, 14ª, 18 and 18ª) are extended horizontally the entire length of the furnace and the short flues *a*, *b* and *e* connect therewith near their mid-length. The air and gas regenerators are made in sections extended each from opposite ends to near the mid-length of the furnace, and connect, respectively, with the said short flues at their inner ends. This leaves open space between the sectional regenerators and under the furnace which renders the regenerators more accessible to be easily cleaned and decreases the resistance to the passage of the air and gas through them.

Air induction or eduction pipes 20, 20ª are provided for taking fresh air into the air regenerators, or allowing the products of combustion to escape, at either end of the furnace, and gas induction or eduction pipes 21 and 21ª, likewise, for taking fresh gas into the gas regenerators. These induction or eduction pipes are provided with reversing dampers *f*, so that by a proper manipulation of the dampers, gas taken in at either end, will be passed through the gas regenerators under that end, thence to the gas flue 12, and along the entire length thereof, thence up through the series of flues 12ª to the compartments 7ª and 7ᵇ, thence downward through said compartments, thence to the flues 18 and 18ª and thence to the air and gas regenerators under the other end of the furnace and out through the exit flues there; and air, similarly taken in at the same end, will be passed from the air regenerators at that end to the air flues 14 and 14ª, and along the entire length thereof, and thence upwardly through the vertical flues and out through the perforations of the horizontal branches to meet the gases descending in the retort chambers and be mixed and burned therewith and discharged at the other end with the products of combustion as before described.

The short flues *a*, *b*, and *c*, being connected respectively with the flues 12, 14, 14ª, 18, 18ª, near the mid-length of the furnace, and with the sectional air regenerators and sectional gas regenerators near their inner ends, operate alternately in conjunction with the valved induction and eduction pipes (19, 20, 20ª, 21, 21ª,) to feed the combustion compartments of the furnace with the regenerated gas and air continuously in the same direction and to exhaust from them the products of combustion continuously in the same direction, the arrangement being such that the reversing of the movement of the air, gas, and products of combustion is confined to the flues and does not occur above the horizontal plane of the flues 12, 14, 14ª, 18, 18ª.

As I am aware, the regenerative retort furnaces having duplicate combustion chambers in use are limited in height to five tiers of retorts in each chamber. The air and fire gases enter at the bottom of one chamber and the products of combustion pass over to the other, and out at the bottom thereof, the course being reversed at intervals, which interferes with the constancy of the temperature. The air is introduced through ports in the central division wall, which are difficult of access for regulation. Even with such limited height, the lower tiers of retorts receive greater heat than the upper ones, and it is impossible to heat the upper and lower retorts evenly, or to have the same temperature in both the chambers simultaneously.

Some of the differences in operation and advantages of my regenerative furnaces over the previous ones are: That the air and fire gases enter into and pass out of both of the retort chambers in the same manner; that the fresh gases enter the chambers at the top and descend therein; that the air enters, some at the bottom, some at the top, and some at intermediate intervals, its course chiefly in opposition to the course of the gases, the flow of air and gases being constant in both chambers; that the products of combustion pass out in front at the bottom of each chamber alike which aids in keeping the open or front ends of the retort hotter and prevents in a high degree the formation of oxids; that the regulation of the admission of air is facilitated by the flues 16, 16ª and ports 17ª at the front; that the course of the air and the gases in the combustion chambers is not reversed, and the temperature conditions can be maintained constant; that a much lower velocity of the gases can be produced in the combustion chambers, which is highly beneficial to perfect reduction and the complete combustion of the gases; that the horizontal position of the air pipes 17 relatively to the inclined angle of the retorts tends to cause a better mixing of the air

and gases than the parallel relation of these parts would; that the sectional regenerators at the ends of the chambers with open space between them offer less resistance to the passage of air and gas through them and makes it easier to clean them; that the reversing of the air and gas is in the regenerators and flues only and does not extend to the combustion chambers wherein the resultant flow remains constant in a downward course.

By means of my improvements a uniform temperature can be produced and maintained in all parts of the combustion chamber of any practical height, and containing many more than five tiers of retorts. Also the air may be introduced in regulated quantity at any of the several ports in front when desired to increase or vary the temperature in any part where it may be found to be too high or too low.

What I claim is—

1. In a furnace of the class described, the combination with a centrally divided retort chamber, of gas ar air regenerators placed beneath the retort chamber compartments, gas flues communicating with the gas regenerators and with the retort chamber compartments at the top, air flues communicating with the air regenerators and with the retort chamber compartments at the bottom and at various intermediate points, the relative arrangement of the gas flues and air flues being such that the gas and air respectively, passing therefrom into the compartments shall move in opposite directions and flues for the products of combustion leading from the retort chamber compartments to the regenerators.

2. In a furnace of the class described, the combination with a centrally divided retort chamber of gas regenerators and air regenerators placed beneath the retort chamber compartments, gas flues communicating with the gas regenerators and with the retort chamber compartments at the top, air flues communicating with the air regenerators and with the retort chamber compartments at various points, flues for the products of combustion arranged beneath the retort chamber compartments at the front parts thereof, and communicating with the same, and flues connecting the said flues for the products of combustion with the gas and the air regenerators.

3. In a furnace of the class described and in combination, a centrally divided retort chamber, sectional gas regenerators and air regenerators placed beneath the retort chamber compartments and at the ends thereof with intervening space between them near the mid-length of the furnace, a centrally located horizontal gas flue extended beneath the retort chamber compartments and having communication with the sectional gas regenerators at each side of the open space between them and communicating with the chamber compartment spaces at the top, horizontal air flues extended beneath the retort chamber compartments and having communication with the sectional air regenerators at each side of the open space between them and with the chamber spaces at the bottom and top and at various other points between the bottom and top, horizontal flues for the products of combustion extended beneath the retort chambers and having communication with the chamber spaces at the bottom and with the sectional gas and air regenerators at each side of the space between them, and reversing dampers for alternating the flow of gas and air in the sectional regenerators.

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