No. 750,868. PATENTED FEB. 2, 1904.

P. A. MacKAY & W. E. MOORE.

FURNACE.

APPLICATION FILED JUNE 9, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

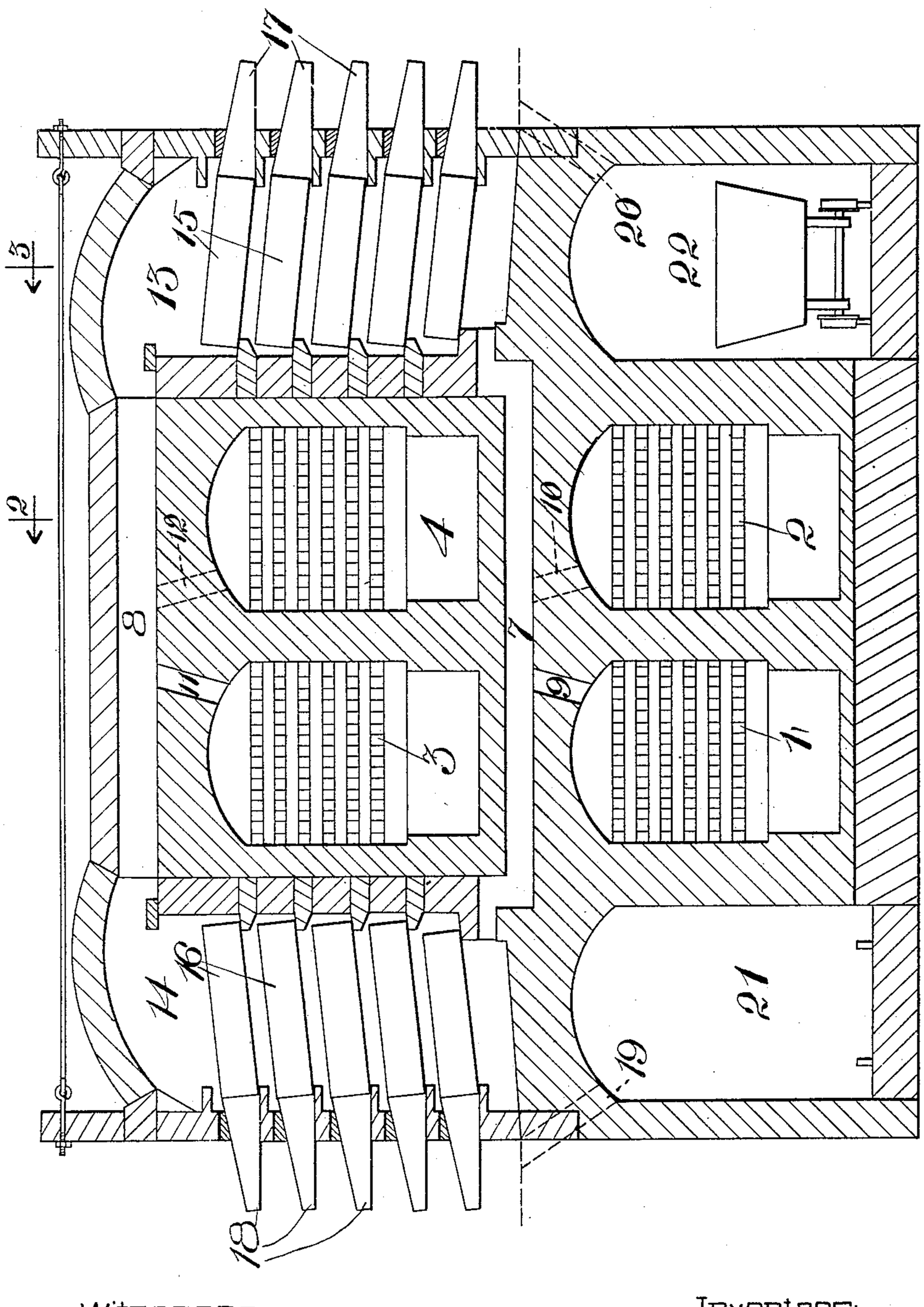

Fig. 1.

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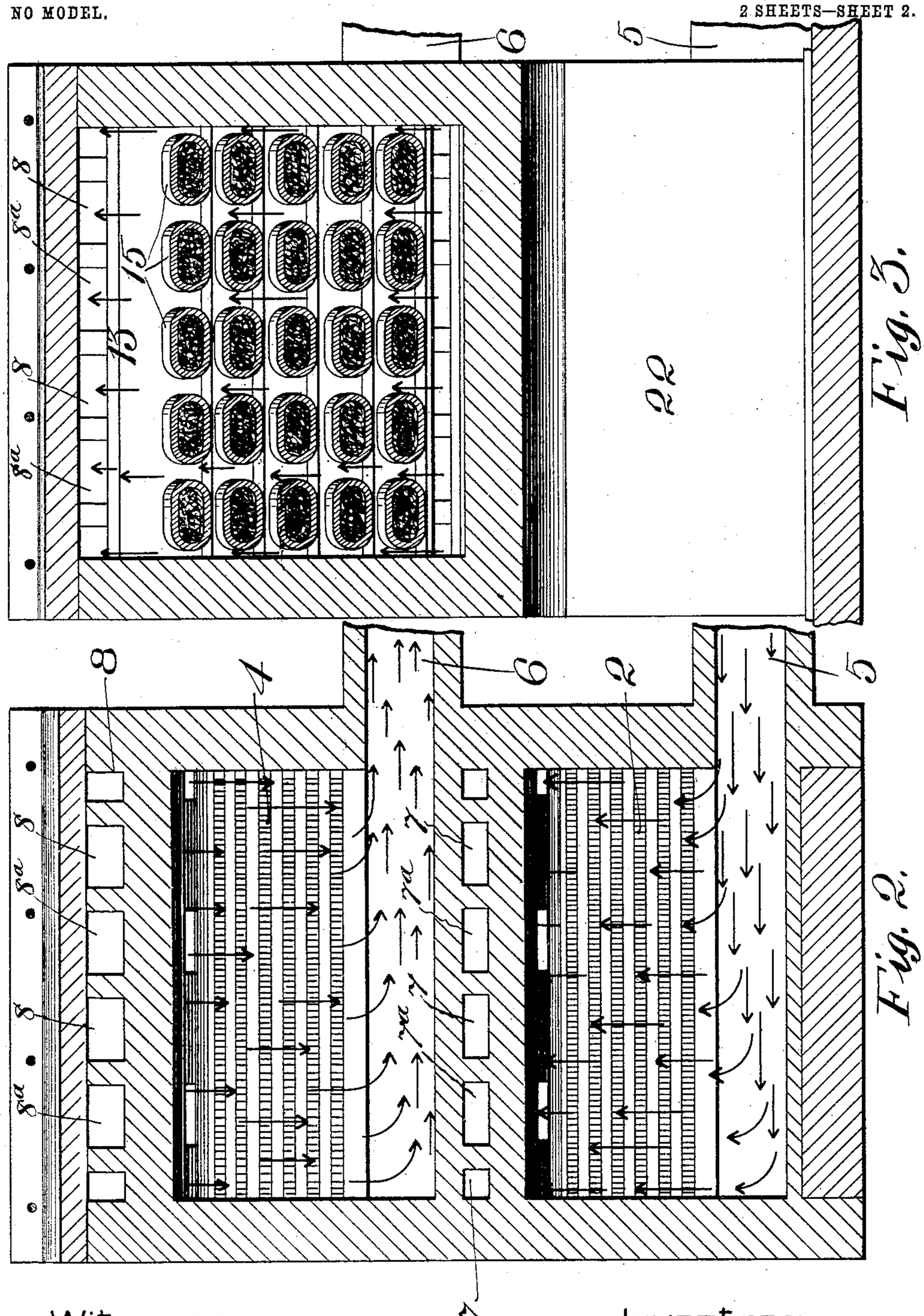

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UNITED STATES PATENT OFFICE.

PHILIP A. MACKAY, OF WENONA, AND WILLIAM E. MOORE, OF PERU, ILLINOIS.

FURNACE.

SPECIFICATION forming part of Letters Patent No. 750,868, dated February 2, 1904.

Application filed June 9, 1902. Serial No. 110,818. (No model.)

To all whom it may concern:

Be it known that we, PHILIP A. MACKAY, residing at Wenona, in the county of Marshall, and WILLIAM E. MOORE, residing at Peru, county of Lasalle, State of Illinois, citizens of the United States, have invented a certain new and useful Improvement in Furnaces, (Case No. 1,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

Our invention relates to furnaces, and is of particular utility in connection with regenerative furnaces, and has for its object the provision of improved furnaces whereby improved operation and construction thereof may be effected.

Our invention is peculiarly designed for use in connection with retorts for reducing ores, though it is not to be limited to any particular adaptation.

Hitherto it has been customary to employ two regenerators, each regenerator including two sets of checker-work, one regenerator being active when the other is passive, the products of combustion of one passing through the checker-work of the other, so as to heat the same. One of the sets of checker-work of the active regenerator has the gas or fuel that is to be ignited passed therethrough, while the air that is to be intermixed with the gas is passed through the companion set of checker-work, the air and gas thereafter intermingling to cause combustion. The products of combustion after passing by the elements to be heated then pass through the checker-work of the idle regenerator, which thereafter may have gas and air passed through its sets of checker-work to be heated and merged to effect combustion, whose products are passed through the checker-work of what has now become the passive furnace after the elements that are to be heated are subjected to the heat action of the passing products of combustion.

In apparatus of the prior art the regenerators and their checker-work have been located abreast, the elements, such as ore-reducing retorts, that are to be heated by the flowing products of combustion being interposed in that path through which the products of combustion must pass, the regenerators and such elements being thus, as it were, included in series. According to this arrangement of the prior art the ore-reducing retorts are arranged one after the other, so that in order that the last retort of the series may receive that degree of heat required to properly roast its contents the initial retort of the series must be heated to too great a temperature to secure desirable results, or if the first retort of the series is to be subject to that degree of temperature sufficiently low to secure the required results there will be too great a drop in temperature to secure proper results at the last retort or retorts of the series. In addition to this disadvantage a disadvantage is had in the arrangement of the regenerators abreast where there is but one series of retorts, due to the fact that the products of combustion in their course between the regenerators are during a large part of such course performing no useful work, in that for a considerable fraction of this course the retorts are not subject to the heat of such products.

We obviate the first difficulty by dividing the products of combustion into two or more streams corresponding to the number of elements or groups of elements that are to be subjected to heat, these streams after having performed their work being preferably converged, so as to pass through the idle or passive sets of checker-work—that is, the elements that are to be subject to heat are arranged in "parallel," so to speak, by which arrangement it is obvious a much less drop of temperature is had with a given total number of elements than if a corresponding number of elements were arranged in series in accordance with the method of the prior art.

We obviate the second difficulty by placing one regenerator above the other, the products of combustion issuing from the top of an active regenerator into the top of a passive regenerator, either upwardly or downwardly, according to which of these two regenerators is active, the element or elements to be heated being interposed in the path of the products of combustion issuing from the regenerators,

which path is thus a shorter or more effective one than has been the case with apparatus of this kind of the prior art, the products of combustion in transit between the regenerators being constantly in contact with the element or elements to be heated, rather than having to pass through a considerable space containing no element or elements to be heated. The latter characteristic of our invention is particularly designed for use in connection with what are termed "one-sided" furnaces; but we prefer to organize the structure of our invention in a two-sided furnace, each side having a set or group of elements or retorts to be heated.

We will explain our invention more fully by reference to the accompanying drawings, illustrating the preferred embodiment thereof, in which—

Figure 1 is a cross-sectional view of a two-sided or double furnace equipped in accordance with our invention. Fig. 2 is a sectional view on line 2 2 of Fig. 1; Fig. 3, a sectional view on line 3 3 of Fig. 1.

Like parts are indicated by similar characters of reference throughout the different figures.

In the apparatus shown there are employed two regenerative furnaces, the lower having chambers 1 and 2 containing checker-work, while the upper has chambers 3 and 4 containing checker-work. One set of checker-work of each furnace—as, for example, the sets in the chambers 2 and 4—may, under conditions of operation to be set forth, have gas that is to be passed through the same, while the companion sets of checker-work in the chambers 1 and 3 may have air that is to promote the combustion of the gas passed therethrough, there being clearly indicated in Fig. 2 ducts or passageways 5 and 6 for conveying the gas to the corresponding sets of checker-work or to convey products of combustion therefrom. Parallel passages 7 and 7ª and 8 and 8ª are provided above the lower and upper furnaces, respectively. Passages 9 10 11 12, communicating between the passages and the chambers containing the checker-work, afford passage for air, gas, and the products of combustion. The passages 7 and 7ª and 8 and 8ª are united on the right by means of a chamber 13 and on the left by means of a chamber 14, in which chambers are located the elements to be heated—as, for example, the clay retorts 15 and 16, containing ores that are to be reduced and which terminate in condensers 17 and 18 for receiving the metal secured in the reducing process, these condensers, as is well understood by those skilled in the art, being adapted for removal from time to time to permit of the discharge of their contents and the contents of the clay retort, there being illustrated passages 19 and 20, communicating with the tunnels 21 and 22, within which vehicles may be wheeled to receive the substance discharged from the retorts through the passages 19 and 20.

Assuming the lower regenerator to be in operation, gas is passed into the chamber 2 and air is passed into the chamber 1, the air and gas being heated by the residual heat contained in the checker-work in these chambers, the heated air passing through the passage 9 into the passage 7 and the heated gas passing through the passage 10 into the passage 7ª. The heated air and gas pass to the right and left through passages 7 and 7ª and commingle in the lower parts of the chambers 13 and 14, where combustion takes place and heats retorts 15 and 16. The products of combustion pass upwardly through these chambers and then through the passages 8 and 8ª to the passive regenerators 3 and 4. The products of combustion after passing through the checker-work in the chambers 3 and 4 are passed out through passage 6 and a similar passage communicating with chamber 3 to a chimney. After this run has been completed the connection of the chambers 3 and 4 with the chimney is cut of, while the connection of the chambers 1 and 2 with the supply of air and gas is also cut off, gas being now forced through the chamber 4, while air is forced through the chamber 3, the air and gas passing through the regenerator and passages 11 and 12 into the passages 8 and 8ª and thence to the upper parts of chambers 13 and 14, where combustion now takes place, the products of combustion passing downwardly between the retorts and in through the passages 7 and 7ª and 9 and 10 to the chambers of the lower regenerator and thence from these chambers 1 and 2 into the chimney, communication with which has now been effected.

It will be seen that greater economy is secured in heating the total number of retorts illustrated when they are arranged thus in parallel than if they were arranged in series and that a much better operation is secured. The advantage of arranging one regenerator above the other will also be apparent. Even though there is but one set of retorts (as in a one-sided furnace) interposed between the regenerators, there is an apparent advantage over the former style of Belgian furnace adapted to use the Siemens regenerative process, where the regenerators are arranged side by side, necessitating a comparatively long transit of the products of combustion between the regenerators, the products of combustion in their passage thus accomplishing less effective work in heating the elements.

It is obvious that many changes may be made from the apparatus of our invention herein shown without departing from the spirit of the invention, and we do not, therefore, wish to be limited to the precise disclosure illustrated; but,

Having thus described our invention, we

claim as new and desire to secure by Letters Patent—

1. In a furnace construction of the class described, the combination with two regenerators, one placed above the other, of a passage-way affording communication between the regenerators for conveying the products of combustion of either to the other to heat such other, said passage-way including a chamber adapted to contain matter to be subject to the action of heat, substantially as described.

2. In a furnace construction of the class described, the combination with two regenerators, one placed above the other, of a passage-way between the top of the upper regenerator and the lower regenerator, whereby the products of combustion of either regenerator may heat the other, said passage-way including a chamber adapted to contain matter to be subject to the action of heat, substantially as described.

3. In a furnace construction of the class described, the combination with two regenerators, one placed above the other, of a passage-way between the top of the lower regenerator and the upper regenerator, whereby the products of combustion of either regenerator may heat the other, said passage-way including a chamber adapted to contain matter to be subject to the action of heat, substantially as described.

4. In a furnace construction of the class described, the combination with two regenerators, one placed above the other, of a passage-way between the tops of the regenerators, whereby the products of combustion of either regenerator may heat the other, said passage-way including a chamber adapted to contain matter to be subject to the action of heat, substantially as described.

5. In a furnace construction of the class described, the combination with two regenerators, one placed above the other, of parallel passages for conveying the products of combustion in diverging paths from the active regenerator and converging paths toward the passive regenerator, each of the said passages including a chamber adapted for the reception of matter to be subject to the action of heat, substantially as described.

6. In a furnace construction of the class described, the combination with two regenerators, one placed above the other, of parallel passages for conveying the products of combustion in parallel paths between the top of the upper regenerator and the lower regenerator, whereby the products of combustion of either regenerator may heat the other, each of the said passages including a chamber adapted to contain matter to be subject to the action of heat, substantially as described.

7. In a furnace construction of the class described, the combination with two regenerators, one placed above the other, of parallel passages for conveying the products of combustion in parallel paths between the top of the lower regenerator and the upper regenerator, whereby the products of combustion of either regenerator may heat the other, each of the said passages including a chamber adapted to contain matter to be subject to the action of heat, substantially as described.

8. In a furnace construction of the class described, the combination with two regenerators, one placed above the other, of parallel passages for conveying the products of combustion in parallel paths between the tops of the regenerators, whereby the products of combustion of either regenerator may heat the other, each of the said passages including a chamber adapted for the reception of matter to be subject to the action of heat, substantially as described.

9. In a furnace construction of the class described, the combination with two regenerators, of parallel passages for conveying the products of combustion in diverging paths from the active regenerator and converging paths toward the passive regenerator, each of the said passages including a chamber adapted for the reception of matter to be subject to the action of heat, each of said chambers having but two openings, one at the top and one at the bottom thereof, through which openings all the products of combustion passing through the chamber are adapted to pass, substantially as described.

10. In a furnace construction of the class described, the combination with two regenerators, of a plurality of passage-ways extending parallelly between the regenerators, each passage-way conveying approximately an equal portion of the products of combustion passing between the regenerators, the products of combustion after leaving the active regenerator dividing and passing parallelly through said passage-ways to meet again upon entering the passive regenerator, and a chamber included in each of said passage-ways for the reception of matter to be subjected to the action of heat, substantially as described.

11. In a furnace construction of the class described, the combination with two regenerators, of a plurality of passage-ways extending parallelly between the regenerators, each passage-way conveying approximately an equal portion of the products of combustion passing between the regenerators, the products of combustion, after leaving the active regenerator, dividing and passing parallelly through said passage-ways to meet again upon entering the passive regenerator, a chamber included in each of said passage-ways for the reception of matter to be subjected to the action of heat, and two openings in each of said chambers, one at each end thereof, to allow passage of all the products of combustion passing through a chamber, substantially as described.

12. In a furnace construction of the class described, the combination with two regenera-

tors placed one on top of the other, of a plurality of passage-ways extending parallelly between the regenerators, each passage-way conveying approximately an equal portion of the products of combustion passing between the regenerators, the products of combustion, after leaving the active regenerator, dividing and passing parallelly through said passage-ways to meet again upon entering the passive regenerator, and a chamber included in each of said passage-ways for the reception of matter to be subjected to the action of heat, substantially as described.

13. In a furnace construction of the class described, the combination with two furnaces, of means for taking products of combustion from one furnace to the other, said means affording diverging paths for products of combustion to heat a plurality of elements simultaneously and substantially equally with the initial heat of the products of combustion, substantially as described.

In witness whereof we hereunto subscribe our names this 28th day of May, A. D. 1902.

PHILIP A. MacKAY.
WILLIAM E. MOORE.

Witnesses:
JEROME HOWE,
JOE BREMER.