J. D. BLACK.

CELL FOR RING FURNACES.

APPLICATION FILED FEB. 9, 1920.

1,383,378.

Patented July 5, 1921.

3 SHEETS—SHEET 1.

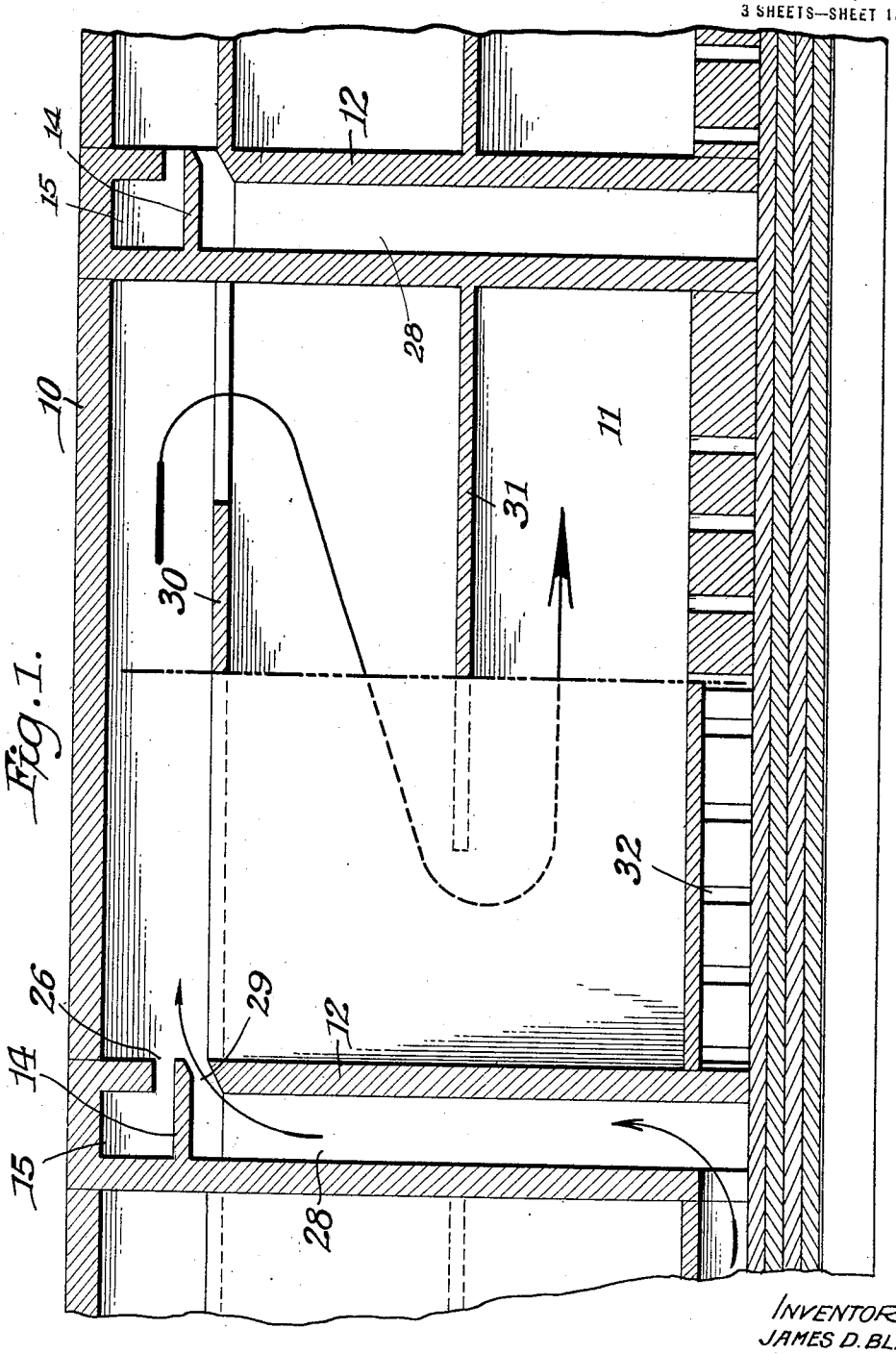


Fig. 1.

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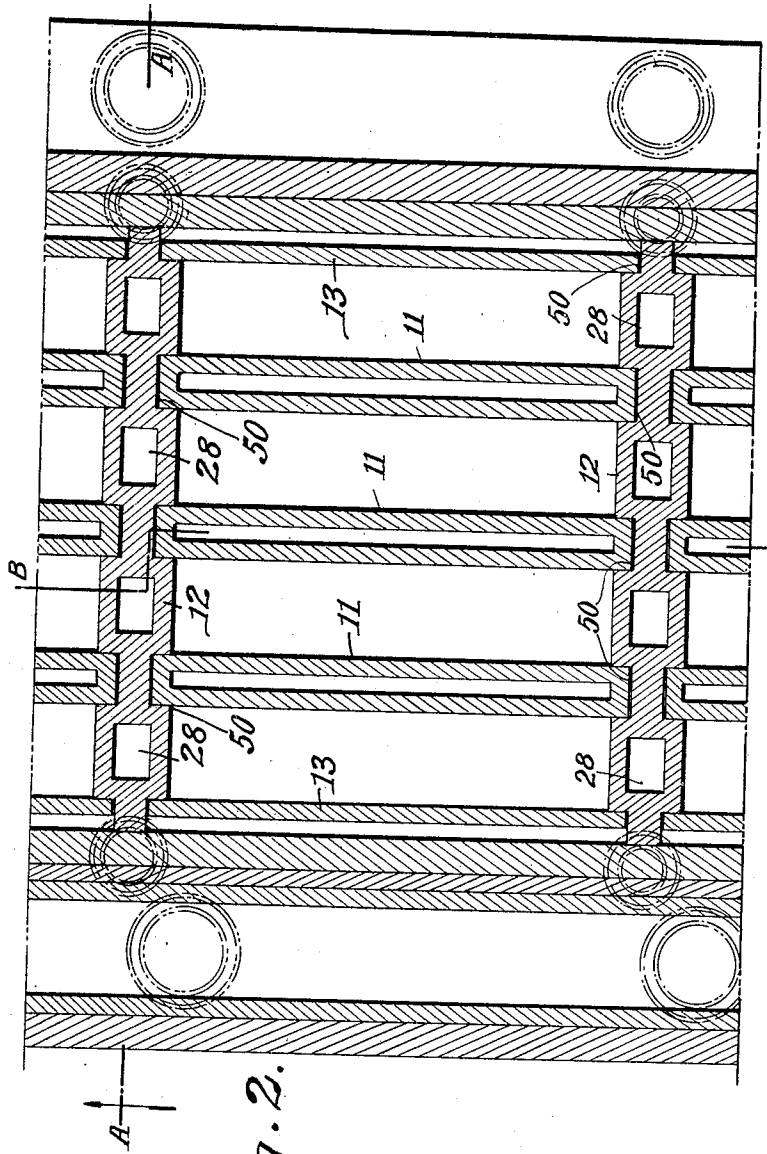


Fig. 2.

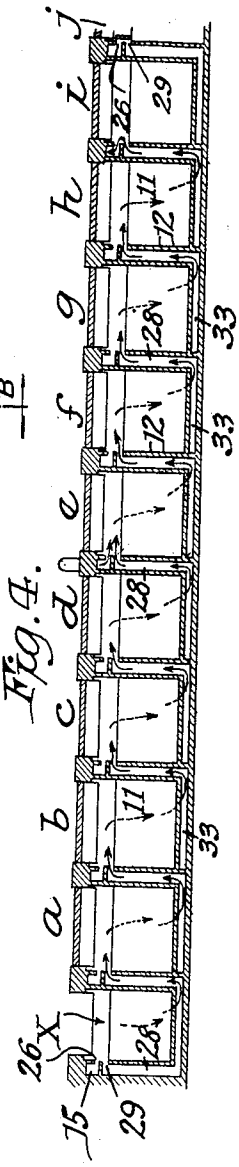


Fig. 4.

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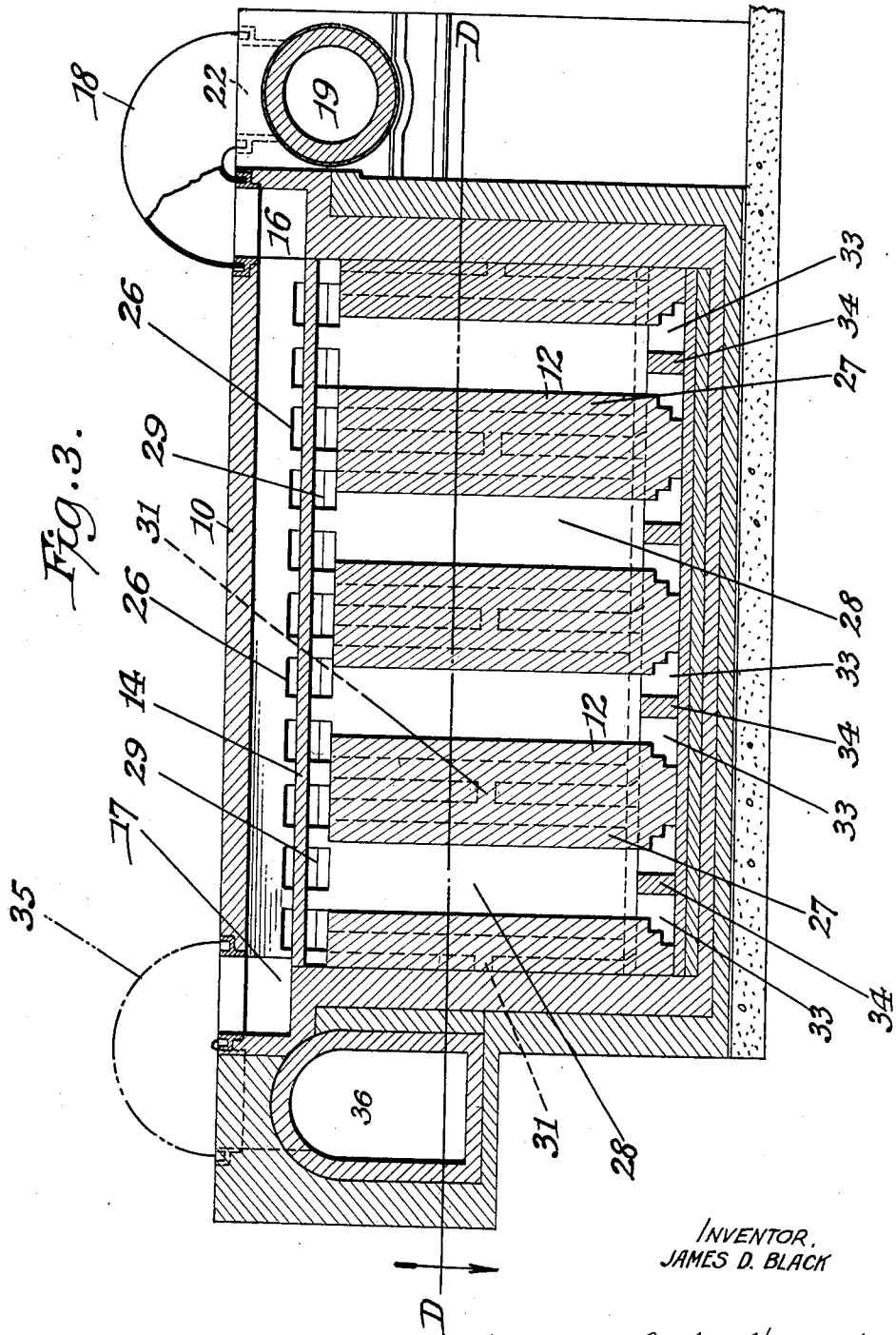


Fig. 3.

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UNITED STATES PATENT OFFICE.

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CELL FOR RING-FURNACES.

1,383,378. Specification of Letters Patent. Patented July 5, 1921.

Application filed February 9, 1920. Serial No. 357,133.

To all whom it may concern:

Be it known that I, JAMES DUNCAN BLACK, a citizen of the United States, residing at Badin, in the county of Stanly and State of North Carolina, have invented certain new and useful Improvements in Cells for Ring-Furnaces, of which the following is a full, clear, and exact description.

This invention relates to so-called "ring" furnaces, for heating or baking articles of various kinds, as for example carbon electrodes for arc-lighting, for electric furnaces, for electrolytic processes, etc. In furnaces of this type as usually constructed at the present time, two parallel rows of heating chambers are constructed, preferably under ground and with the tops of the chambers flush with or extending slightly above the surface of the ground. When the furnace is in operation all the chambers are in use in such manner that one or more chambers containing articles already heated or baked (and still hot) are being cooled by air drawn in from the outside. This air, preheated by absorption of heat from the previously fired chambers, is delivered to the next chamber and there supports combustion of the producer gas or other fuel with which the furnace is fired. From the furnace under fire the products of combustion pass through the next section or sections, and, in doing so, give up heat to the articles therein, thereby preheating such articles. When the articles in the chamber or section under fire are sufficiently heated or baked the supply of fuel is diverted therefrom to the next chamber, that is, the first of the chambers in which articles are being preheated. At the same time cooled articles from the first of the previously fired chambers are being removed, and fresh unheated or unbaked articles are being placed in the first empty chamber beyond those containing articles which are being preheated. In this way the fire proceeds down one row or series of chambers, then crosses over to the adjoining row, passes up the latter row to the end, and then over to the first row again, and so on. Hence the name "ring" furnace.

The present invention relates to furnaces of this general type, and its object is to provide an improved furnace in which distortion and breakage of the compartment parts is minimized and in which renewal and replacement of either vital elements are facilitated. To this and other ends the invention consists in the novel features of construction and combinations of elements hereinafter described.

Referring now to the drawings, in which a furnace embodying the present invention is illustrated:

Figure 1 is a fragmentary longitudinal sectional elevation on line B—B of Fig. 2.

Fig. 2 is a sectional plan view on the plane indicated approximately by the lines D, D of Fig. 3.

Fig. 3 is a cross-section, on line A—A of Fig. 2.

Fig. 4 is a diagrammatic longitudinal section illustrating the course of air and gases through the flues of the furnace.

Referring now to Fig 4, X indicates a chamber which has been opened to permit the removal of heat-treated and thoroughly cooled articles, for instance carbon electrodes, hereinafter referred to simply as "carbons." One or more succeeding chambers, for example three, indicated by *a*, *b*, *c*, contain carbons that have been baked. Outside air enters the channeled or hollow walls and partitions of chamber X, flows through the similar walls, partitions and bottoms of chambers *a*, *b*, *c*, absorbing more heat from said walls and bottom and from the freshly baked (and therefore highly heated) carbons in *d*, and unites with the fuel gas burning under the cover of chamber *e*. In the meantime, chamber X has been emptied and is being refilled; chamber *a* has been cooled sufficiently to permit removal of its cover and the carbons in the chamber; and chamber *i*, through which outside air was being admitted to chamber *j* and others beyond, has been loaded, so that the products of combustion from chamber *f* (now being fired) pass through the walls of chambers *g*, *h*, *i*, and pass to the waste-gas flue. In like manner chamber *g* is next fired, chamber *b* being opened for removal of carbons, chamber *a* being refilled, etc., the firing taking a progressive course down the first row, then across to and up the second, then across to and down the first again, continuously.

In the procedure specifically outlined above (merely to illustrate and explain the operation of the furnace), nine chambers, for instance chambers X, *a*, *b*, . . . *h*, constitute what may for convenience of description be termed a "group." Of these

the first (X) is open and is being unloaded and, later, reloaded. The next four (*a*, *b*, *c*, *d*) contain baked carbons which are being cooled by air admitted through the open chamber (X). The next (*e*) is being fired, and the next three (*f*, *g*, *h*) are being preheated by products of combustion from *e*. If, as is usually the case, there are in the entire furnace more chambers than enough for a single group, one or more other groups are in operation at the same time. Hence, it is customary to make the total number of chambers an even multiple of the number of chambers in a single group. Thus with thirty-six chambers, four groups of nine each can be operated simultaneously. A more complete general description of a complete furnace will be found in the United States application of Bartley E. Broadwell, Serial No. 321,962, filed January 22, 1918, renewed September 5, 1919, now U. S. Patent No. 1,330,164 to which reference is hereby made.

The chambers comprising the furnace, which are closed by means of removable covers 10, are all exactly alike save for certain slight modifications in the end chambers, entailed by their positions, and which need not be specifically disclosed in this application. Each chamber is divided by longitudinal walls or partitions 11 into cells or compartments (four in the present embodiment of the invention). These partitions, the bottoms of the chambers, the end walls 12, and the side walls 13, are all hollow, providing channels, passages or flues, for the gaseous fuel, the air to support combustion, and the waste gases or products of combustion. Across the top of each hollow end wall is a horizontal partition 14, Figs. 1 and 3, leaving a transverse passage 15 above it, which is provided at its inner end with an inlet opening 16 and at its outer end with an outlet 17. This passage or conduit 15 can be connected by means of a connector 18 to a gas manifold 19 extending lengthwise of the furnace and supplied with combustible gas. The connecter 18 fits down upon the inlet 16 and upon the appropriate one of a series of outlets 22 individual to the several chambers, and is removable so that it may be shifted from chamber to chamber as the firing progresses around the furnace in ring-fashion as already mentioned. Such outlets as are not in use are closed by removable covers and the corresponding out-of-use inlet openings 16 of the passages 15 may be closed by similar covers. The outlet openings 17 may also be provided with covers.

Along and just above the horizontal partition 14 (Figs. 2 and 3) each end-wall 12 is formed with a series of burner-openings or ports 26, leading from the adjacent transverse gas-passage or conduit 15 which, it will be remembered, receives combustible gas from the manifold 19 by way of the connector 18. This gas burns at the openings or burners 26, the flames extending out under the covers 10 and over the cells containing the carbons or other articles which are to be heated.

Below the horizontal partitions 14 the passages in the hollow end walls 12 are divided into up-flues 28 and just below the said horizontal partitions the said end walls are provided with a transverse series of outlet apertures 29 which are in vertical alinement with the burner-openings 26. Air rising in the up-flues 28 issues from the apertures 29 and supports the combustion of the gas at the burners 26.

The down-flues, in the hollow longitudinal partitions 11 and the hollow side walls 13, Figs. 1 and 3, are provided with horizontal baffles 30, 31, producing tortuous passages through which pass the products of combustion from the burning of the gas and air issuing from the apertures 26 and 29 respectively. The aforesaid hollow walls 12 are continued downwardly into and through the hollow floor or bottom of the furnace chamber, and the flues 28 each communicate at the bottom with the hollow bottom of the next preceding chamber. The chamber bottoms are provided with transverse openings 32 which connect the down flues in the partitions 11 and side walls 13 with the passages in the hollow bottoms. Between the partitions 11 and side walls 13 the hollow bottom of the chamber is divided into longitudinal passages or flues 33 by longitudinal partitions 34. The products of combustion therefore flow downwardly between the baffles 30, 31, in the down-flues and side walls, laterally through the apertures 32 in the bottoms, and thence longitudinally through the ducts 33 to the vertical passages or up-flues 28 in the next end wall 12. Rising in the latter wall (which separates the chamber which is being "fired" from the next, which latter contains carbons in process of being pre-heated) the products of combustion issue from the openings 29 in the end-wall last referred to, and thereafter pursue a course like that already described, through the hollow walls, bottom, and partitions of the chamber next succeeding the firing chamber. For instance, assuming that chamber *e*, Fig. 4, is being fired, the products of combustion or waste gases flow through passages or flues 28 and 33 of chambers *f*, *g*, and *h* in succession. It will be understood that in chambers *f*, *g*, and *h* the gas-inlet openings 16 (not shown in Fig. 4) are closed by their covers 24. Likewise, the outlet openings 17 of chambers *e*, *f*, *g* and *h* are closed by covers (not shown). The outlet 17 of chamber *i*, however, is connected by a siphon-shaped pipe or connector 35 to the adjacent waste-gas

flue 36 running parallel to the adjacent side of the furnace. At a suitable point, say about the center, the flue 36 may be provided with an exhauster for drawing off the waste gases.

As previously explained, the chambers *d*, *c*, *b* and *a*, in rear of firing chamber *e*, contain carbons already fired and now being cooled,—chamber *d* having been fired just before chamber *e*,—while chamber X is empty, or is being emptied. Cold air enters chamber X and flows through openings 29, then down, under, and around the chambers *a*, *b*, *c*, *d*, absorbing heat from the walls, bottoms, and partitions of the chambers, thereby cooling the chambers and their contents. The air thus preheated finally reaches the firing chamber and issues from the ports 29 to support combustion of the gas at the burners 26 as already described.

From the foregoing it will be seen that in each chamber the combustible gas issues from a transverse duct or passage in the top of the first transverse end-wall and burns forwardly in the combustion space or flue over the carbons piled in the cells into which the chamber is divided; it being understood, of course, that the carbons are covered with fire-brick dust or other inert non-combustible material to protect them from contact with the flame and possible injury by oxidation or otherwise. The preheated air to support combustion rises through the up-flue in the first hollow end wall and is discharged forwardly under the burning gas. At the far end of the chamber the products of combustion pass downwardly into the down-flues in the hollow side walls and longitudinal partitions, through the tortuous passages formed by the baffles in said walls and partitions. Reaching the hollow bottom of the chamber the products of combustion flow laterally to right and left into the longitudinal passages or flues in said bottom, then longitudinally to the bottom of the up-flue in the next transverse end-wall. The latter is the front end-wall of the next chamber, which, when the furnace is in operation, contains unfired carbons. Passing up this wall the gases are discharged under the cover of the said chamber, which is the first chamber undergoing preheating, and pass down through the hollow partitions and side walls and through the bottom of the chamber, and so on, exactly as in the firing chamber, through as many chambers as contain unfired carbons. Finally the waste gases, most of whose heat having been given up to the carbon preheating chambers and contents, are delivered to the waste-gas flue. The air to support combustion in the firing chamber, as described, flows through the passages in the walls, partitions and bottoms of one or more chambers in rear of the firing chamber, following like paths to those pursued by the products of combustion, already described. These rear chambers are hot from previous firings and fired carbons, so that the air, taking heat therefrom, cools the chambers and their contents and is thereby preheated before it is discharged into the firing chamber to support the combustion of the full gas delivered thereto.

It will be noted that the partitions 11 are subjected to intense heat when the particular chamber containing them is being fired. Then when the next succeeding chamber is being fired the partitions are subjected to a cooling draft of air. This repeated heating and cooling causes the said partitions to expand and contract respectively. If no provision were made to permit such expansion and contraction the partitions as well as other parts of the chamber would be subjected to stresses which would lead to distortion and fractures and thereby reduce the efficiency and life of the furnace. In accordance with my invention I provide an expansion joint between the partitions 11 and the end walls 12. While only one of such joints may be provided for each of said partitions I prefer to provide an expansion joint at each end of each partition. Referring more specifically to Fig. 2 it will be noted that each end wall is provided with a plurality of vertical slots each adapted to receive one end of a corresponding partition. Sufficient clearance is provided at 50 between the end walls 12 and the ends of partitions 11 to permit substantially unrestricted expansion of the latter when subjected to firing. The inner plates 13 of the side walls of the chambers are mounted in substantially the same way as the partitions 11 as will be apparent on inspection of the drawings.

Besides the advantage set forth above it should be noted that the walls 12, partitions 11 and plates 13, which are most likely to break or become otherwise unfit for efficient use, may readily be withdrawn by lifting them vertically upward and new elements inserted. Replacements are thereby facilitated and the use of the furnace may be practically uninterrupted.

In order properly to assemble the chamber; *i. e.*, to insure that the various elements 11, 12 and 13 shall bear the proper relative position and alinement when assembled, I prefer to employ the following process: Between each end of each of the members 11, 13 and its corresponding slot in the walls 12 (*i. e.*, in clearance spaces 50) I place spacing means which on subjection to the firing heat of the furnace, will be automatically removed from between the adjacent surfaces of the ends of members 11 and 13 and the slots in walls 12. Among other materials corrugated paper may be utilized for this

purpose as combustion of this material will lead to its removal or disappearance when firing of the chambers takes place. It will be understood that other materials may be employed such for example as substances which at normal temperatures are substantially solid but dissolve or volatilize when subjected to the firing temperature of the furnace.

What I claim is:—

1. The process of assembling a furnace having end walls and longitudinal partitions, which comprises interposing solid material between the ends of said partitions and said end walls, and removing said material by the application of heat.

2. The process of assembling a furnace having end wall members and longitudinal partition members, which comprises interposing solid material between one set of said members and the ends of the other set of members, and removing said material by the application of heat.

3. A furnace comprising a plurality of cells, means for conveying heating gas from each of said cells to another cell, each of said cells having transverse walls, longitudinal side walls and longitudinal partitions, and expansion joints between said transverse walls and partitions.

4. In a furnace of the type described, in combination, a plurality of chambers each having transverse walls and hollow longitudinal partitions, expansion joints between said partitions and walls, and means for conducting hot gases from the hollow portions of the partitions of each of a plurality of chambers to the hollow portions of the partitions of a succeeding chamber.

5. In a furnace of the type described, in combination, a plurality of chambers each having hollow transverse walls and longitudinal partitions, expansion joints between said partitions and walls, and means for conducting hot gases from the hollow portions of each of a plurality of said transverse walls to the hollow portions of succeeding transverse walls.

In testimony whereof I hereunto affix my signature.

JAMES D. BLACK.