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Manufacture of Iron and Steel.

No. 149,240. Patented March 31, 1874.

Fig. 1.

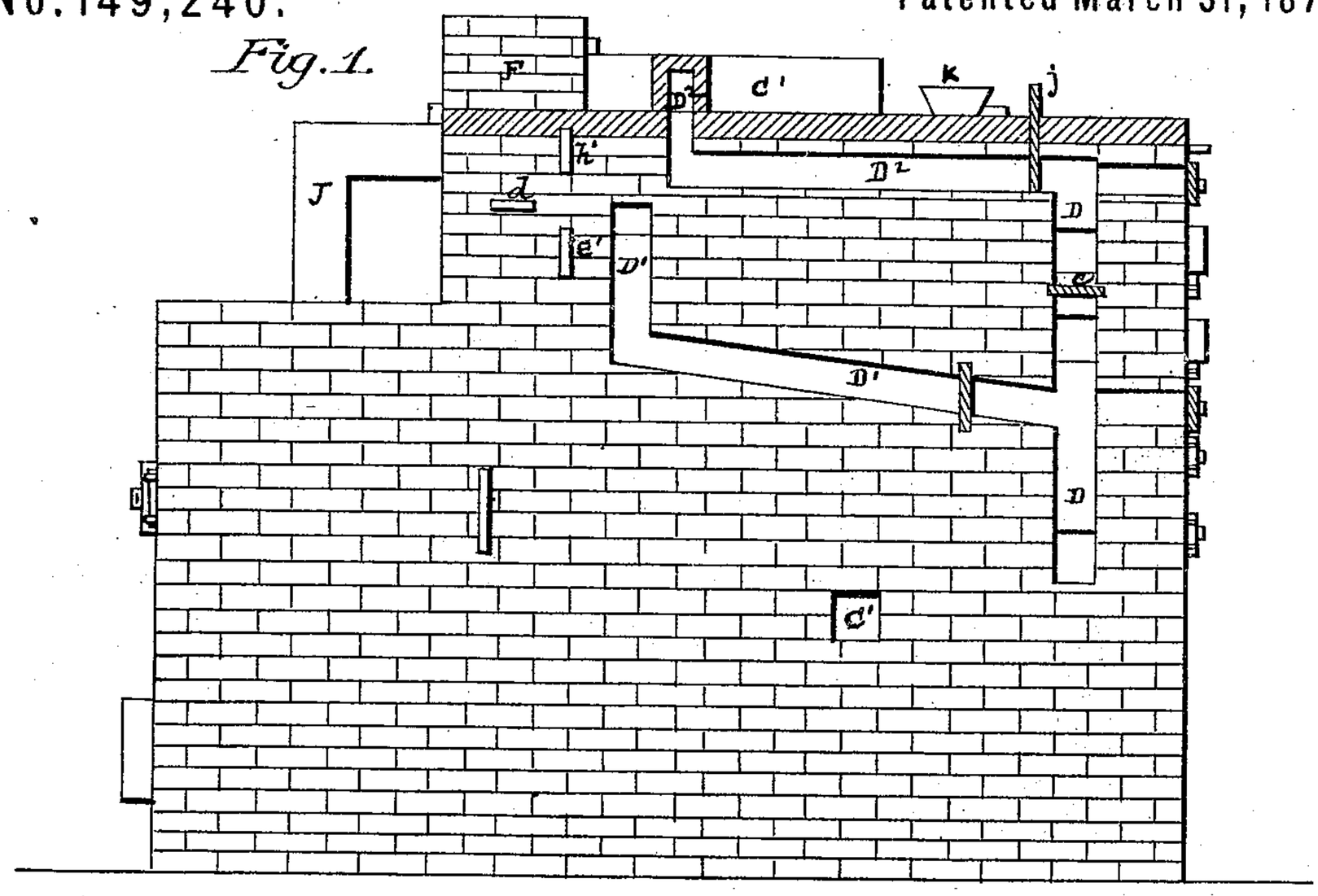

Fig. 2.

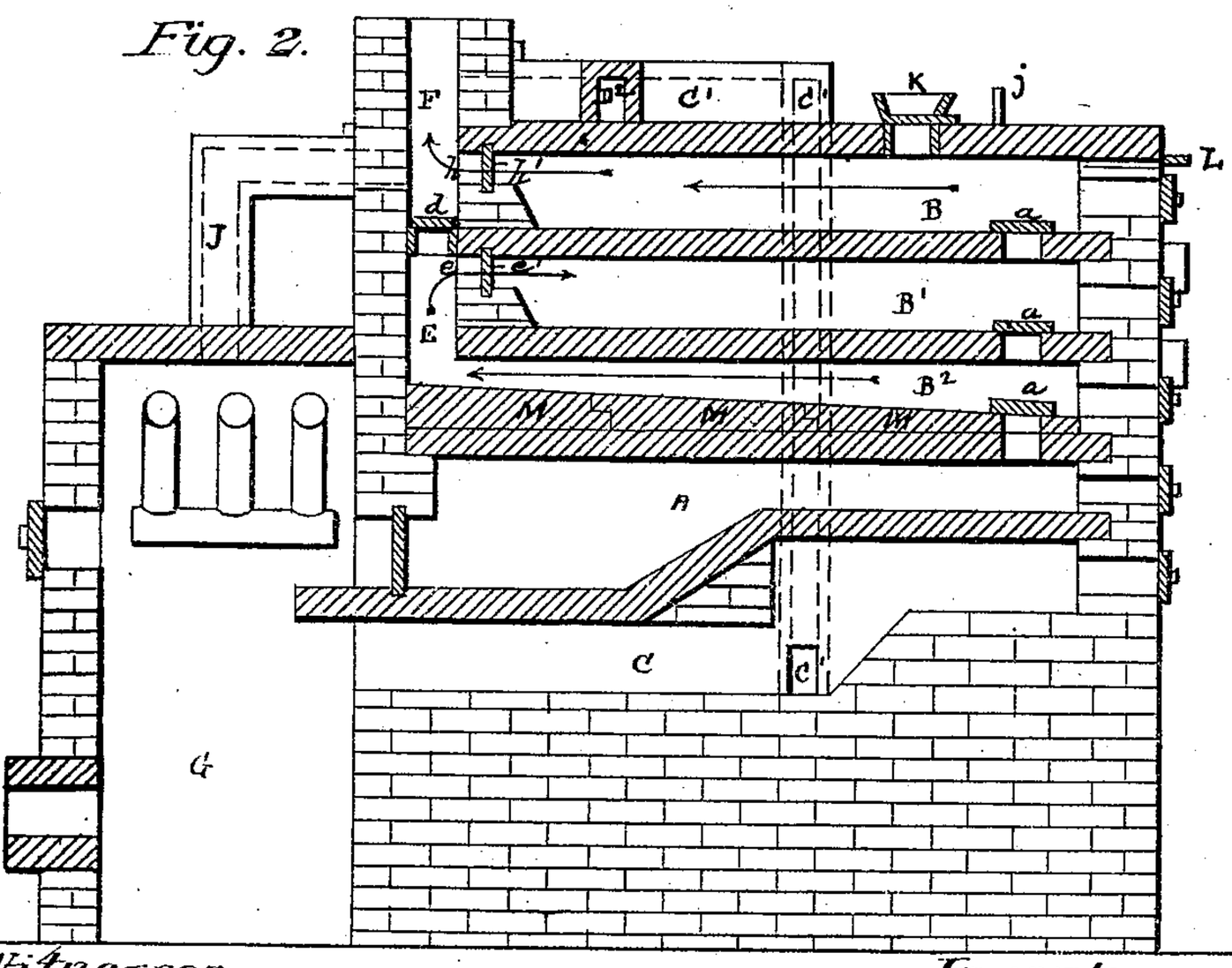

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Fig. 3

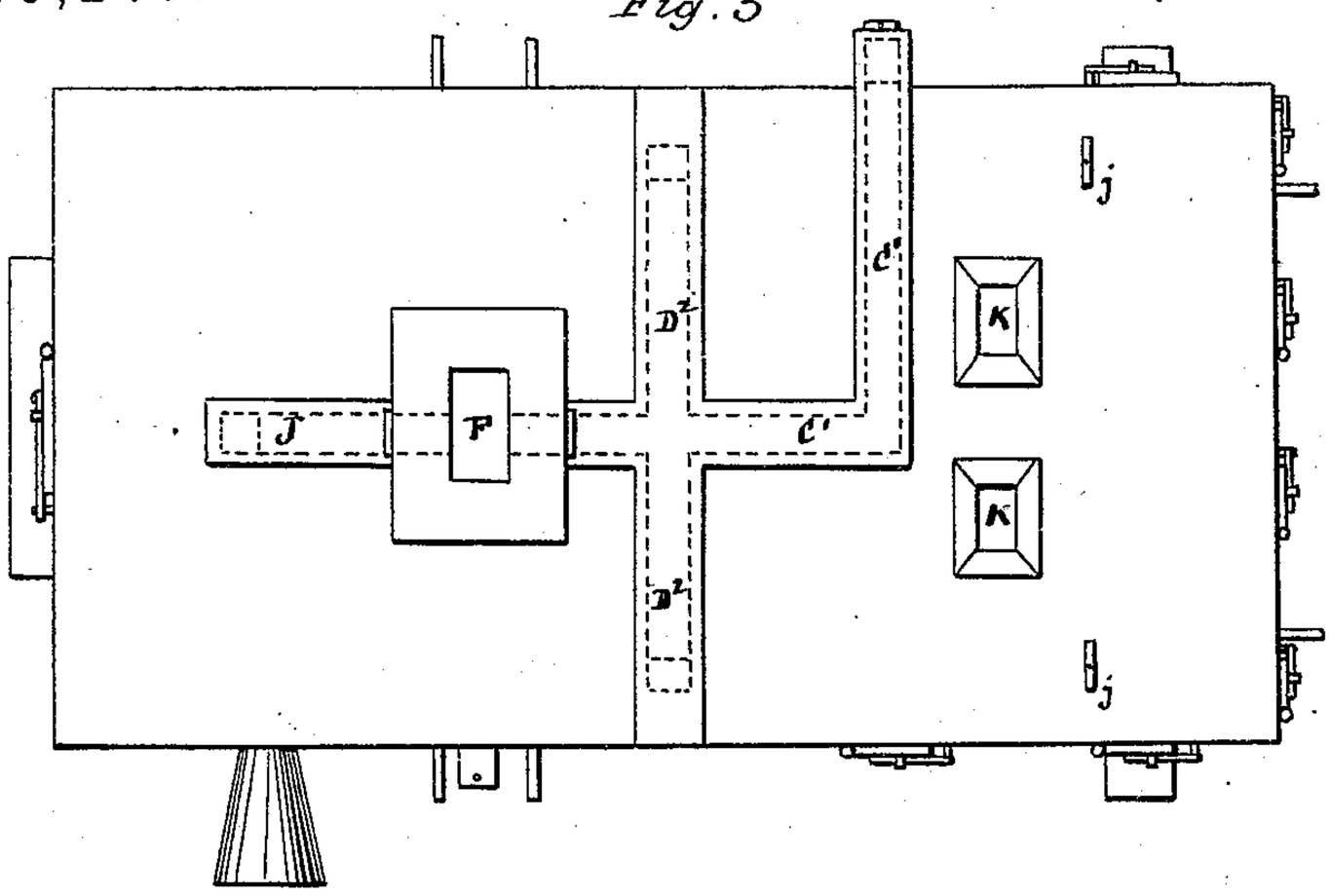


Fig. 4.

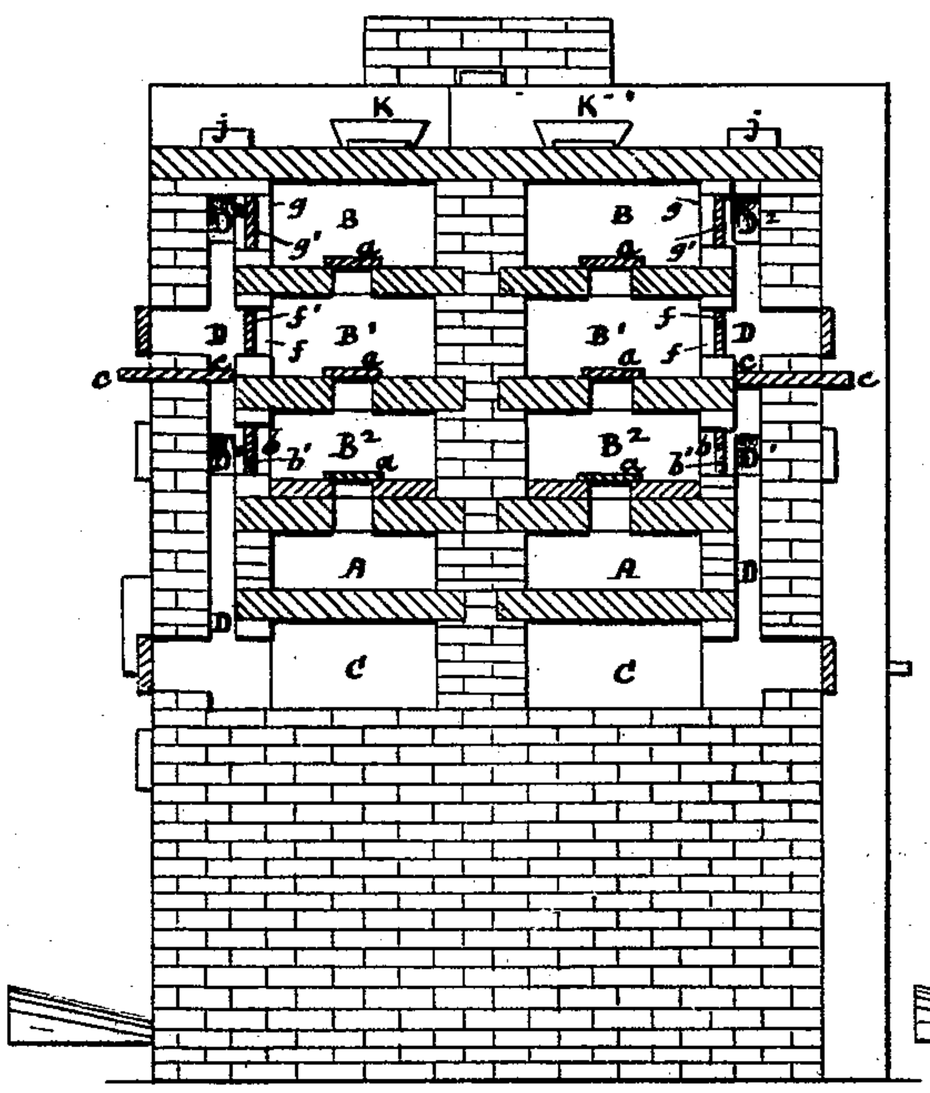
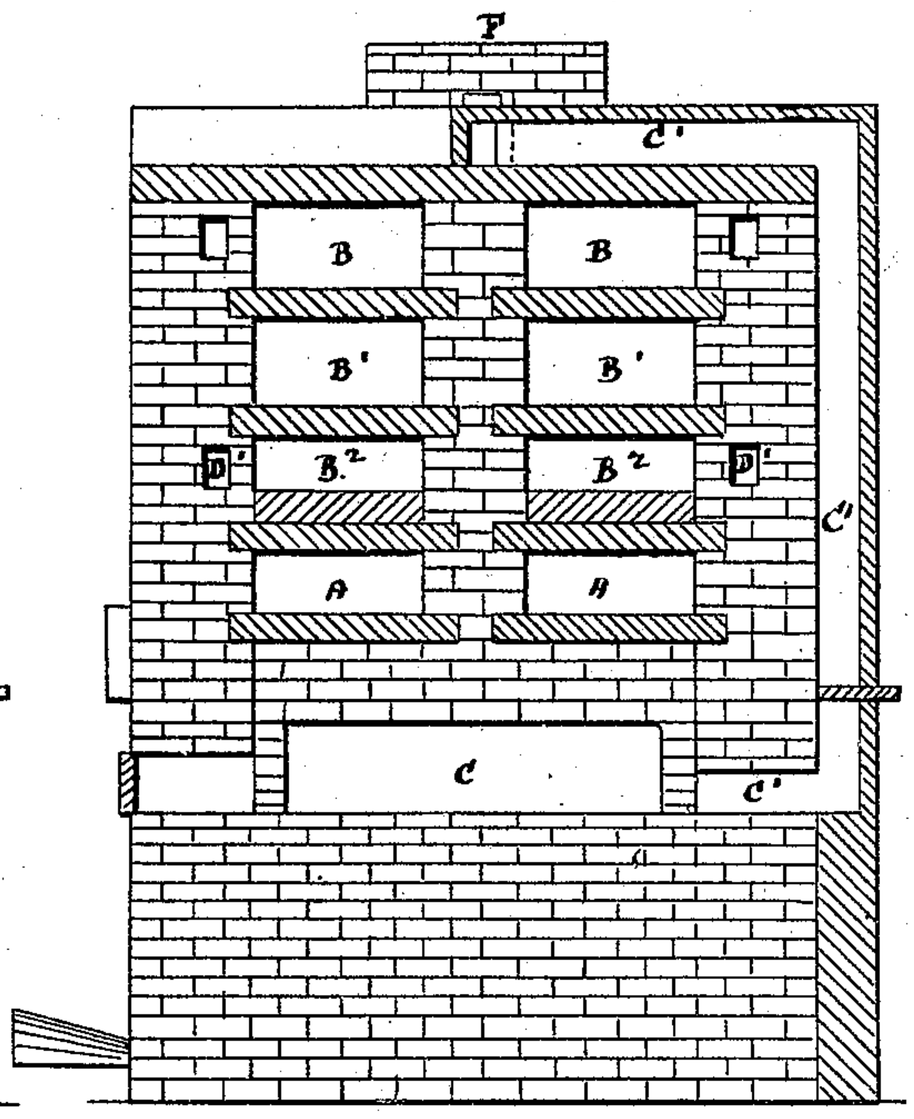


Fig. 5



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3 Sheets--Sheet 3.

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Manufacture of Iron and Steel.

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Fig. 6.

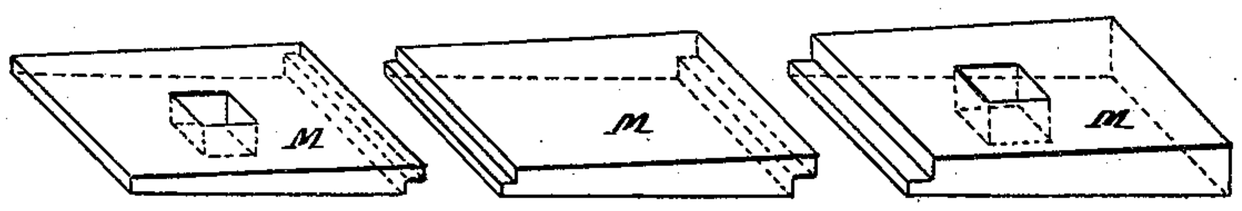

Fig. 7.

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UNITED STATES PATENT OFFICE.

EDGAR PECKHAM, OF ANTWERP, NEW YORK.

IMPROVEMENT IN THE MANUFACTURE OF IRON AND STEEL.

Specification forming part of Letters Patent No. **149,240**, dated March 31, 1874; application filed March 11, 1874.

To all whom it may concern:

Be it known that I, EDGAR PECKHAM, of Antwerp, Jefferson county, New York, have invented certain new and useful Improvements in the Manufacture of Iron and Steel, and in Furnaces to be used therein, of which the following is a specification:

This invention is directed to the production of iron and steel direct from the ore; and it relates, principally, to the treatment of the ore for the purpose of desulphurizing and deoxidizing, and, if need be, carbonizing it prior to its working in the forge-fire, puddling, or reducing furnace, or other apparatus for its after working.

Under my present invention I treat the ore at different temperatures, as hereinafter specified, by the direct action or contact of a reducing-flame, preferably from the waste heat of the forge-fire or puddling-furnace, used in connection with my converting apparatus. The ore is thus treated in distinct chambers, which, however, may be, at proper times, thrown into communication, so that the ore may be transferred from one to the other in succession; and these chambers are combined with a system of flues communicating with the source of heat-supply, and provided with dampers in such manner that any one chamber may be uniformly maintained at any required and predetermined heat, irrespective of, and without interference with, the other chambers.

To carry out my improved process of treating the ore, at different temperatures, by direct contact with the flame, I employ three chambers, in the first of which the ore is deprived of its moisture, and "slaked," so to speak, and, if need be, desulphurized. The flame in this chamber should be a dark cherry-red. If the ore is of such nature that it must be desulphurized, cold air is admitted to the chambers, so as to create an oxidizing-atmosphere therein so long as needed, and, during this desulphurizing operation, the heat must not rise above the fusing-point of sulphuret of iron. In the second chamber, to which the ore is transferred after treatment in the first chamber, the flame is maintained at a deep, full, cherry red, for the purpose of deoxidizing the ore. In the third chamber, if steel is to be made from the ore, the flame is maintained at a bright cherry-red, and the ore, transferred from the second chamber, is subjected to this heat for a time more or less prolonged, according to the degree of carbonization desired. If, however, iron is to be made from the ore, the heat in this third chamber should be the same as that in the second.

When treating the ore for steel, I contract gradually the third chamber in the direction of the end from which the flame escapes, so as to concentrate the draft in the chamber, and obtain a more powerful action of the flame on the ore; but for making iron this contraction of the chamber is not necessary.

The manner in which my invention is or may be carried into effect can best be understood by reference to the accompanying drawings, in which—

Figure 1 is a longitudinal vertical section of a furnace made in accordance with my invention, on line 1 2, Fig. 3. Fig. 2 is a like section on the line 3 4, Fig. 3. Fig. 3 is a plan view of the furnace. Fig. 4 is a transverse vertical section on line 5 6, Fig. 3. Fig. 5 is a like section on line 7 8, Fig. 3. Fig. 6 is a view of the tile-sections, which I use in order to gradually contact the carbonizing or lower ore-chamber, when used to prepare the ore for steel. Fig. 7 is a longitudinal central section of a furnace combining my improved converting apparatus and a puddling-furnace, instead of a forge-fire, as shown in the preceding figures.

The ore-chambers are shown at B B^1 B^2. In this instance three superposed chambers constitute a series, and in the furnace there are two such series, side by side. Each chamber is provided with an opening in its bottom, closed by a slide, *a*. Through these openings the ore is transferred from each chamber to the one beneath it, and from the lower chamber into the receiver A, one of which is provided for each series of ore-chambers. Beneath each receiver is a main gas-chamber, C, in which the blast and products of combustion are mingled, so as to form a reducing-flame; and, leading from each gas-chamber, is a main supply-flue, D, from which the reducing-flame is supplied to the ore-chambers. In order that the heat in each of the chambers may be regulated without interference with the heats in the others, it is desirable that, while they are

in communication, so that the flame may pass through each in succession, they shall, at the same time, have individual and distinct connections with the source of heat-supply and with the stack, so that the draft and heat in each may be regulated and controlled independently of the others.

One arrangement of flues and dampers for this purpose is shown in the drawings.

The chamber B^2 opens into flue D at *b*, a damper, *b'*, being provided for this opening. Under ordinary conditions, the heat should not directly ascend higher in flue D than chamber B^2, and, therefore, I provide in flue D, at that point, a damper, *c*, as seen in Fig. 4. By closing this damper, the flame will be forced to pass through chamber B^2 in the direction of the arrow, Fig. 2. Thence, passing out through the open front end of the chamber, it passes upward through the flue E, which leads to the chimney-stack, and which is provided with a damper, *d*, the closing of which causes the flame to enter the chamber B^1 through its flue-opening *e*, regulated by damper *e'*. The flame, passing through this chamber in the direction of the arrow, leaves it through the flue-opening *f*, regulated by damper *f'*, and again enters flue D, but at a point above damper *c*. The flame, passing up through the flue D, enters chamber B through flue-opening *g*, regulated by damper *g'*, and, traversing this chamber in the direction of the arrow, leaves it through the flue-opening *h*, regulated by damper *h'*, and escapes into the chimney-flue F. It will thus be seen that there is such communication between the ore-chambers that the flame may be caused to pass continually from one to the other, in succession, before escaping to the chimney.

It will be noted that the draft in the lower chamber can be regulated independently of the others by either of the dampers *c d*.

In order to give an independent supply of flame to the chamber B^1, there leads from the main flue D a branch flue, D^1, governed by a damper, *i*, and opening into chamber B^1 near its front end, as indicated in Fig. 1. Therefore, the heat-supply in this chamber is obtained either from the lower chamber B^2, or from the branch flue D^1, or from both in conjunction.

The draft in chamber B^1 is regulated either by the dampers in chamber B^1, or by a damper, *j*, in a waste-flue, D^2, connecting the upper end of the flue D with the chimney-stack.

The top chamber B obtains its heat either from the lower chamber B^1 or directly from the main gas-chamber, this latter being effected by opening damper *c*, which will permit heat to ascend flue D and pass directly to chamber B. The draft and heat in this chamber are regulated by its damper independently of the others.

Each chamber thus has an independent and distinct connection with both the chimney and the source of gas-supply, and, consequently, each may be uniformly maintained at any desired heat, irrespective of, and without interference with, the others.

From the main gas-chamber C leads a waste-flue, C', directly to the chimney-stack. This flue is provided with the proper damper, by which it may be closed or opened at pleasure.

In the furnace shown in Figs. 1 to 5, inclusive, the converting apparatus is heated by the forge-fire G, which discharges its waste heat in the gas-chambers C. The front ends of the receiving retorts or chambers A communicate with the forge-fire, being closed by dampers or slides *k*, which can be withdrawn whenever it is desired to obtain a fresh charge of the prepared ore from the receiving-chambers.

In Fig. 7, the converting apparatus is represented as combined with a puddling-furnace, H, one on each side of the furnace, and for each series of ore-chambers. The receiving-chamber in this case has a sloping or funnel-shaped bottom, at the lowest point of which is an air-tight inclined chute, I, leading to the hearth of the furnace, and provided with a regulating valve or damper, *l*, by means of which the discharge of ore into the puddling-chamber can be effected whenever desired. The flue J leads directly from the blast-chamber of the forge-fire, Figs. 1 and 2, to the chimney-stack. It is provided with a damper, and serves to regulate the temperature of the blast-chamber. The several ore-chambers and the receiving chambers or retorts are provided with doors of suitable construction, any one of which can be opened whenever it becomes necessary to manipulate the ore in the chamber to which the door belongs. The flues are also provided, at suitable points, with doors, through which access may be had to them for the purpose of removing the ashes and emery, and of cleaning them. Above the upper chamber B is a hopper, K, (provided with a suitable door or damper,) through which the ore is fed to the furnace. L is a passage in the upper chamber B, through which, when necessary for desulphurizing, cold air may be introduced into the upper chamber, so as to maintain an oxidizing-atmosphere therein.

In order to prepare the ore for making steel, it becomes necessary to contract gradually the lower chamber, as hereinbefore specified, the extent of contraction being governed by the degree of carbonization desired. For this purpose I provide removable wedge-shaped tile, M, shown separately in Fig. 6, which can be put together so as to form a sloping bottom for the lower chamber, as shown in Fig. 2, when the chamber is to be used for carbonization. But when the ore is to be prepared for the manufacture of iron only, the tile M can be removed, and the chamber used like the chamber B' for deoxidation only.

The ore to be treated is properly cleaned, and reduced to about the size of coarse shot. It is then fed into the upper chamber B, where it is treated with a dark cherry-red flame, a sufficient time according to the nature of the

ore to be treated, say, from six to twelve hours. The ore charge is of quantity sufficient to cover the floor of the chamber to a depth of from two to six inches. After treatment in this chamber, the ore is transferred down through the opening in the bottom of the same into the second chamber B′, where it meets a reducing-flame maintained at a full deep cherry-red, and is subjected to the action of that flame for a sufficient time—say, from eight to twelve hours—to remove the greater portion of its oxygen. From this chamber it then passes or is transferred down into the lowest chamber B^2 of the series, in which, if designed for making iron, it is treated by a flame of the same intensity as that of the flame in chamber B^1. Under these conditions the chamber B^2 is not contracted. But when steel is to be made from the ore, then, by a proper regulation of the dampers, the flame in B^2 should be brought to and maintained at a bright cherry-red, and the chamber should be contracted by means of wedge-shaped tile M, the degree of contraction being governed by the extent to which the carbonization is to be carried. For this purpose several sets of tile may be provided of different degrees of inclination, so that any required contraction of the mouth or escape end of the said chamber may be effected. In the lower or carbonizing-chamber the ore is treated for about the same length of time as in the upper two, and is thence discharged into the receiver, whence it may be transferred to the puddling-furnace or forge-fire. As soon as one chamber is emptied, it is again filled from the chamber above, so that the operation may be made continuous.

In transferring the ore from one chamber to the other, the draft-dampers in the chamber which is opened, in order to permit the workman to effect the transfer, should be closed, so as to prevent possibility of oxidizing action.

One, two, three, or more, series of ore-chambers may be combined in one furnace. Each series is entirely independent of the others, so that the one may be used for steel, while the other is used for iron.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The process of subjecting the ore to the direct action of a reducing-flame in successive chambers, at successively increased but uniformly maintained temperatures, substantially as herein shown and set forth.

2. In a converting-furnace, the combination of a series of ore-chambers, through which the ore passes in succession, the same being combined with a system of flues and regulating-dampers, arranged and operating substantially as described, so that while the flame may pass from one chamber to the other, yet each chamber has its own independent connection with the chimney and the source of heat-supply, whereby the heat or intensity of the flame in each chamber may be regulated and maintained irrespective of and without affecting the others.

3. The gradual contraction of the ore-carbonizing chamber in the direction of its flame-escape opening, substantially as and for the purposes shown and set forth.

4. The combination, with a chamber for treating ore by direct contact with a reducing flame, of wedge-shaped or sloping tile fitted to the floor of and removable from said chamber, whereby the said chamber may be used at will either for carbonization or deoxidation of the ore, substantially as shown and set forth.

5. The combination with a converting furnace, constructed and operating substantially as described, of an independent fire or a forge-fire, puddling or reducing furnace, or other apparatus, for the after working of the ore, substantially as shown and set forth.

In testimony whereof I have hereunto signed my name this 11th day of March, A. D. 1874.

EDGAR PECKHAM.

Witnesses:
HENRY R. ELLIOTT,
EWELL DICK.