

E. PECKHAM.

Manufacture of Iron and Steel and Furnaces Therefor.

No. 149,242.

Patented March 31, 1874.

Fig. 1.

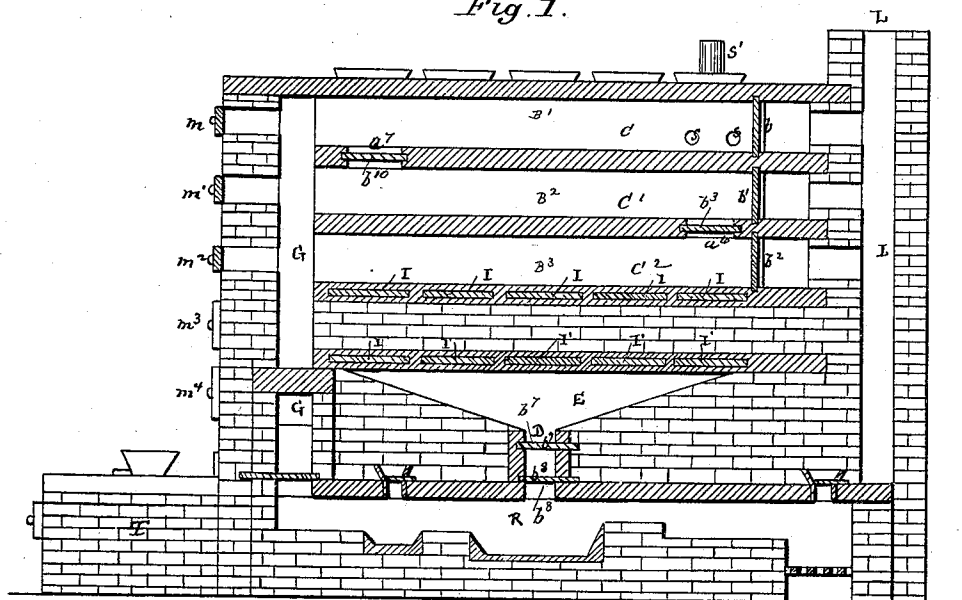
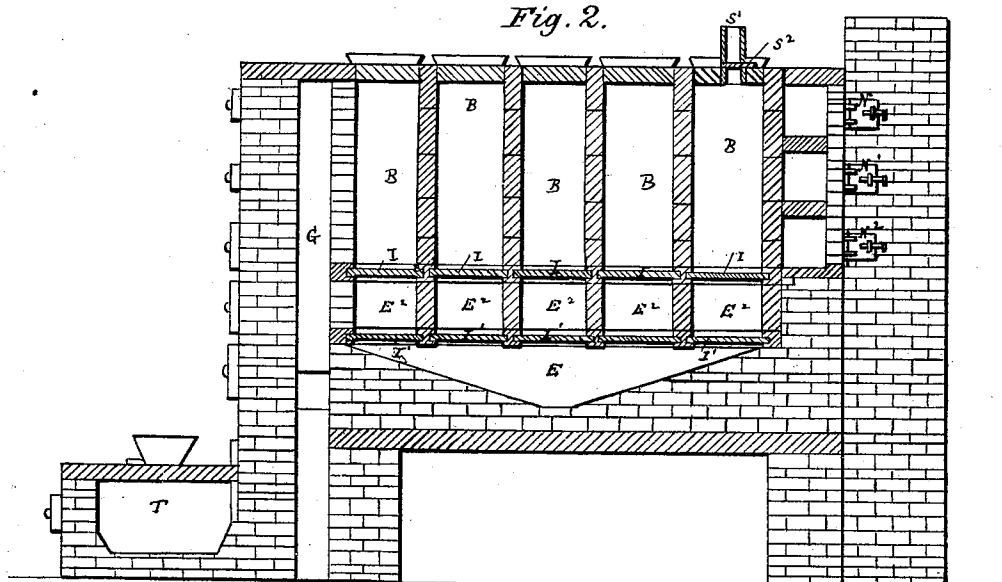


Fig. 2.



Witnesses.

Ewell Drexel
W. E. Chaffee.

Inventor

Edgar Peckham
by atty. Shook,

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Fig. 3.

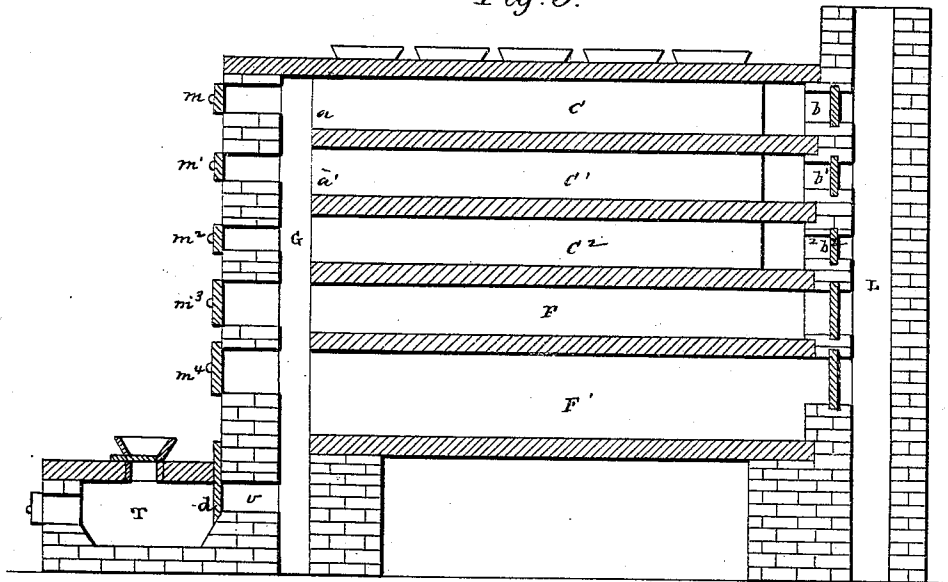
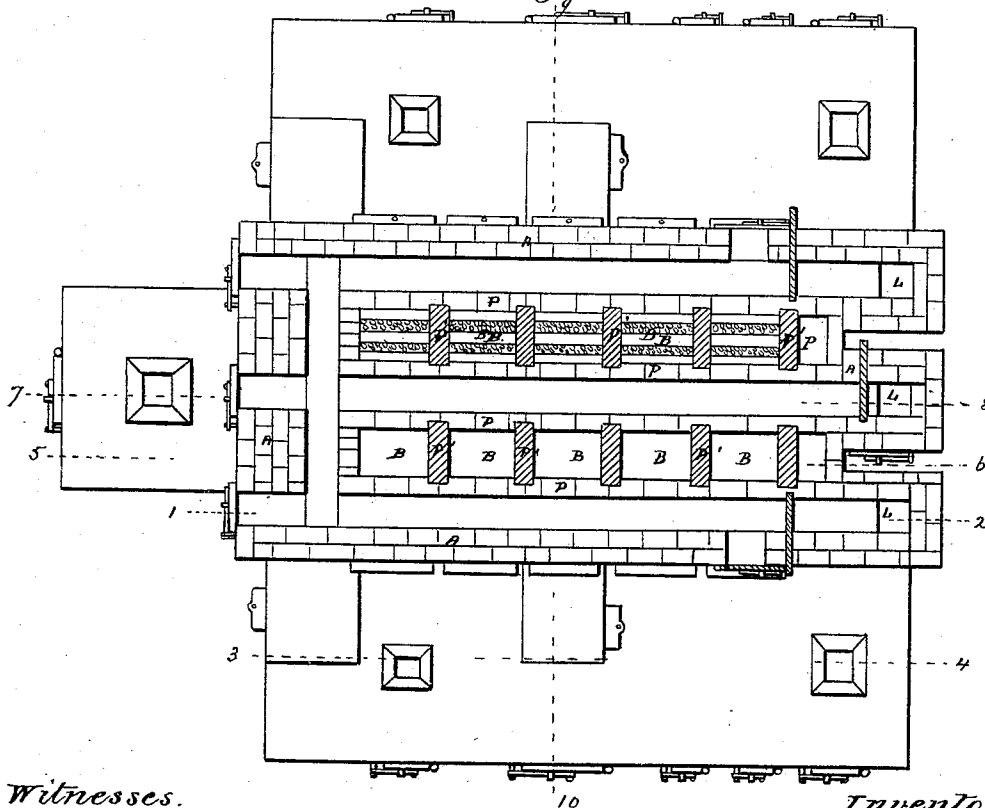


Fig. 4.



Witnesses.
Ewell
W. B. Chapin

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Fig. 5.

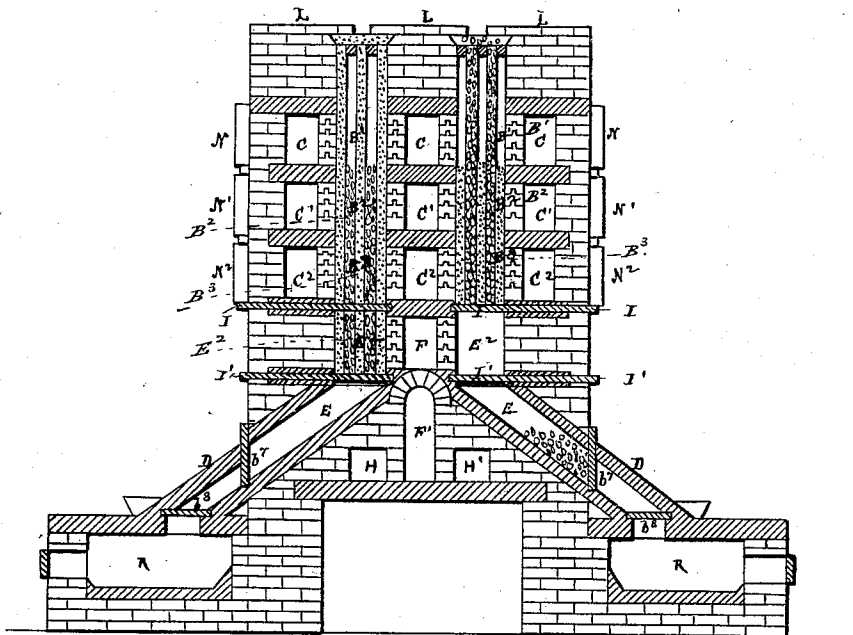
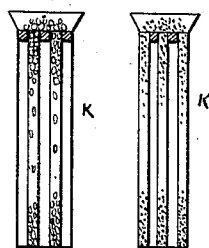


Fig. 6.



Witnesses.

Evellrich
W. B. Chaffee

Inventor.

Edgar Peckham by
att. Atollor

UNITED STATES PATENT OFFICE.

EDGAR PECKHAM, OF ANTWERP, NEW YORK.

IMPROVEMENT IN THE MANUFACTURE OF IRON AND STEEL AND FURNACES THEREFOR.

Specification forming part of Letters Patent No. **149,242**, dated March 31, 1874; application filed March 9, 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 relates, principally, to the treatment of ores in a converting-furnace preliminary to their after-working in a forge-fire, puddling or other reducing furnace or apparatus, for conversion into iron or steel direct from the ore. My present improvements are based upon a process involving the preliminary treatment of the ore in air-tight, or practically air-tight, retorts at different temperatures, whereby the ore is first deprived of its water, and, as it were, slaked, then deoxidized, and then carbonized, each of these several steps requiring a different temperature, beginning at the lowest temperature for the first stage, and then working up to successively higher temperatures in the succeeding stages. In another pending application I have described one way of doing this by successively heating the whole of each retort at the requisite different temperatures. In the present case I accomplish the same result by dividing each retort into different zones or belts, whereby the ore contained in one retort may be subjected to different, but exactly determined, heats, according to the zone in which it is situated, all the ore passing through these several zones, and being subjected successively to the predetermined and ascertained heats, which are imparted to said zones severally.

The nature of my improvements, and the manner in which the same is or may be carried into effect, can best be explained and understood by reference to the accompanying drawings, in which—

Figure 1 is a longitudinal vertical section on the line 1 2, Fig. 4, for the converting-furnace, and the line 3 4, same figure, for the puddling-furnace. Fig. 2 is a like section on line 5 6, Fig. 4. Fig. 3 is a like section on line 7 8, Fig. 4. Fig. 4 is a plan of the apparatus, with the top of the converting-furnace removed. Fig. 5 is a transverse vertical section on line 9 10, Fig. 4. Fig. 6 represents the charger for fill-

ing the retorts with coal and ore in proper proportions.

A A represent the main walls of the converting-furnace, which may be constructed of brick or stone; P P, the horizontal main partition-walls, which, in this furnace, are constructed of fire-brick having tongues on their upper and grooves in their lower sides to correspond with the tongues. They also have grooves in their sides, corresponding with the thickness of the tiles used for the cross-walls separating the retorts, constituting vertical guides or grooves, into which the said tiles P' are fitted, as indicated in Fig. 4. B B B are perpendicular retorts for treating the ore, which are divided, by means of the external horizontal heating-flues C, C¹, and C², into sections or zones B¹, B², and B³. The horizontal flues C, on each side of the retorts B B, correspond with the sections or zones B¹ B¹. C¹ C¹ C¹ correspond with the sections or zones B² B². C² C² C² correspond with the sections or zones B³ B³. The first or upper sections or zones B¹ of the retorts are designed as zones of preparation and desulphurization, in which the ore is treated at a very low heat, (a very dark cherry-red,) to remove its water and sulphur and open its pores preparatory to its passing to the next lower zones, B². When treating ores containing sulphur they (sections B¹) are constructed with air-openings S S at their bottoms, having pipes or tubes leading to the outside of the furnaces, through which cold air may be admitted as desired. In connection with the air-passages S, I employ on top of the retorts small chimneys S¹, having regulating valves or dampers S². By the means described a sufficient quantity of cold air can be drawn into zones B¹ to create an oxidizing atmosphere therein when treating ores containing sulphur. The second or middle sections or zones B² of the retorts are designed for reduction, where the ore, after having been treated in zones B¹ B¹, is precipitated, and there treated at a full cherry-red heat a sufficient time to eliminate the oxygen contained in it preparatory to its passing to the next lower zones B³. The last-named lower sections or zones of the retorts are designed for carbonization, where the ore passing from the zones B² B² is treated at a

bright cherry-red a sufficient time to carbonize it to the desired extent. The horizontal flues C, C¹, and C² communicate with the gas or distributing heat-supply chamber G, and also with the main stacks or chimneys L, L, and L; and b, b¹, and b² are dampers to regulate the draft and heat in said flues, and by which the heat in each flue may be exactly regulated independently of the others. a⁶ and a⁷ are openings having dampers b³ b¹⁰, connecting said flues C, C¹, and C² with each other, by means of which the heat, instead of passing directly to the main stacks, may be made to pass into flues C² C², to flues C¹ C¹ and C C, and from thence to the stack L, traversing in its passage the length of the flues C², C¹, and C. In this manner the heat may be economized. F and F' are horizontal flues or chambers situated between the receiving-chambers E E and the transfer-chambers E² E², and connected with the distributing gas-chamber G and the stack L, and serve the double purpose of conveying direct to the main stack any and all surplus heat not required to heat the retorts B B B, and also to heat the transfer-chambers E² E² and the receiving-chambers E E. E² E² are transfer or discharging chambers situated underneath the retorts B B and over the main receiving-chambers E and E, being separated from the retorts B B by the slides or dampers I I, and from the receiving-chambers E and E by the slides or dampers I' I'. They are used for transferring the prepared ore from the retorts B B to the main receiving-chambers E E. By their use the same amount of prepared ore can be removed from the retorts at each operation, which is essential to a uniform treatment of all the ore. Each retort has one of these transfer-chambers, into which the ore, when properly treated, is first transferred, and from thence to the main receiving-chambers E and E underneath. The capacity of each transfer-chamber should be the same as the last section or zone of the retort. E E are main air-tight horizontal receiving-chambers, situated underneath the discharging or transfer chambers E² E², into which the prepared ore is transferred or discharged from the said chambers E² E², and there retained until required by the forge-fire or puddling-furnace attached thereto. When the forge-fire is used to manipulate the prepared ore into iron or steel, this main receiving-chamber is constructed with a depression in one end, into which the prepared ore is collected and retained for the use of the forge-fire. It has an opening at the lowest part of the depression, connecting it with, and through which the prepared ore is transferred, as required, to the forge-fire. When the puddling-furnace is used to manipulate the prepared ore into iron and steel, this main receiving-chamber is constructed as shown in Figs. 1, 2, and 5, having a depression in the center, with its sides sloping into the depression, into which the prepared ore is collected and retained for the use of the puddling-

furnace. At the lowest part of this depression is an opening, connecting the receiving-chamber with an air-tight inclined passage, D, through which the prepared ore is transferred, as required, direct to the puddling-furnace R. b⁷ and b⁸ are valves or dampers in said inclined passages D, which serve to regulate the flow of prepared ore from the receiving-chambers to the puddling-furnaces, and to close the openings leading into said passages when not transferring ore. The waste heat from the puddling-furnaces is conveyed to the gas-distributing chamber G in any suitable way. T is an independent fire-place, connected with said converting-furnace A A by the opening v, having the damper d. Said fire-place may be used when it is desired to keep up the heat in the converting-furnace, while one or both of the puddling-furnaces are not in operation. In case a forge-fire in lieu of a puddling-furnace is to be combined with the converting-furnace, the forge-fire, or two or more of them, as required, can be arranged at the front of the converting-furnace, where the fire-place T is represented, and in that case the receiving-chambers will be properly shaped and located, so as to communicate with said fires, the arrangement being similar to that shown in another pending application of mine for Letters Patent. H and H' are chambers situated underneath the receiving-chambers E and E, and serve to heat said receiving-chambers. They are connected with the flue F', from which they receive their heat. M, M¹, M², M³, and M⁴ are doors, corresponding with and leading into flues C, C¹, C², F, and F', and through which any and all ashes or emery collecting in said flues may be removed.

In Figs. 5 and 6 I have indicated at K the charging apparatus which I use in order to charge the retorts with alternate vertical layers of coal and ore. This apparatus, however, I do not here particularly describe, as I have made it the subject in part of another application for Letters Patent.

The retorts of the converting-furnace being properly constructed and divided by external flues into zones corresponding with the character of the ore to be employed and quality of metal desired, as previously described, the operation of treating the ore and manufacturing the same into iron or steel is conducted in the following manner, viz: The ore to be used should be separated from all earthy matter and reduced to a uniform size, (or as near as may be,) the size to depend upon the character of the ore. If the ore is of a soft nature—a hematite ore—the particles may be as large as chestnuts, but if the ore is a hard magnetic ore it should be reduced to about the size of coarse shot. The retorts B B B being empty, (presuming this to be the first operation of the furnace,) they are filled to the extent of the two lower zones, B² and B³, with coal. The remainder of the retort, which consists of the top section B¹, is then charged,

by means of charger K, with alternate vertical layers of coal and ore, after which the charger is withdrawn and the retort closed. The remaining retorts should be charged with ore and coal in the same manner. The retorts B B B being full, and the upper sections or zones B¹ B¹ B¹ being charged with alternate layers of ore and coal, fire should be made in the fire-place or furnace attached to the converting-furnace, and the dampers *bbb* to the flues C C C on each side of the retorts, and corresponding with the zones of preparation B¹ B¹, opened sufficient to heat the said horizontal flues C C C to a dark cherry-red, which is the temperature that should be constantly and uniformly maintained in the said flues C C C. When the ore has been treated in the zones B¹ B¹ B¹ a sufficient time to remove its water and sulphur (cold air being introduced into these zones to remove sulphur, as previously described) and open its pores, it is precipitated to the next lower sections or zones B² B² B² by opening or withdrawing the dampers *III* at the bottom of the retorts, and allowing the coal to fall into the transfer-chambers E² E². When the transfer-chambers E² E² are filled, the dampers *II* should be closed and fresh charges of coal and ore again charged into the retorts. This being done, the dampers *b¹ b¹ b¹* to the flues C¹ C¹ C¹, corresponding with the zones of reduction B² B², should be opened sufficiently to heat the flues to a full cherry-red heat, which is the temperature that should be constantly and uniformly maintained in the said horizontal flues C¹ C¹ C¹. When the ore has been treated in zones B² B² a sufficient time to remove its oxygen, the coal in the transfer-chambers E² E² should be transferred to the main receiving-chambers E and E by withdrawing the dampers *I' I'* at the bottom of said transfer-chambers. This being done, the dampers *I' I'* should again be closed, and the dampers *II*, separating the chambers from the retorts opened, and the coal in the retorts allowed to fill the transfer-chambers E² E², when the dampers *II* should again be closed and a fresh charge of ore and coal charged into the retorts. This being done, the dampers *b² b² b²* to the horizontal flues C² C² C², corresponding with the zones of carbonization B³ B³, should be opened sufficiently to raise the heat in the flues C² C² C² to a bright cherry-red, which is the temperature that should be constantly maintained in the flues C² C² C². When the ore has been treated in the sections or zones of carbonization B³ B³ a sufficient time to carbonize it to the desired extent it should be transferred to the transfer-chambers E² E² in the manner previously described, and the dampers *II* closed and a fresh charge of ore charged into the retorts. This being done, the prepared ore in the transfer-chambers E² E² should be precipitated to the main receiving-chambers E and E, ready to be transferred to the forge-fire or puddling-furnace as required, and so on, the ore being charged into the retorts

and precipitated from zone to zone, and from retorts to the receiving-chambers, in the manner described. The temperature of the flues C, C¹, and C² can be determined by the small doors N, N¹, and N², placed in the side of said flues; or a heat-gage, if desired, may be placed in each flue. The retorts should be emptied and recharged alternately, so as to make the operation a continuous one, and to keep constantly on hand in the receiving-chambers E a supply of prepared ore for the reducing-fire or furnace attached thereto. The prepared ore is transferred from the main receiving-chambers E and E to the forge-fire or puddling furnace or furnaces attached thereto, as required, and these manipulated into iron or steel, the quantity of the metal produced depending upon the length of time the ore was under treatment in the retorts, and the percentage of carbon mixed therewith. When manipulating the prepared ore in the forge-fire or puddling-furnace, it should preferably be fluxed and purified according to my improved method of purifying iron or steel during its manufacture in the forge-fire or puddling-furnace, patented October 14, 1873, No. 143,637.

When it is desired to economize the heat, the openings leading from the flues C¹ and C² into the stack or chimney may be closed by the dampers *b¹* and *b²*, and the openings *a* and *a¹*, leading from gas-chamber G into flues C and C¹, closed by suitable dampers provided for the purpose, and the openings *a²* and *a¹*, connecting flues C², C¹, and C, opened, and the heat or flame made to pass from chamber G through openings *a²* to flue C², and from flue C² through openings *a²* to flues C¹, and from flues C¹ through openings *a¹* to flues C, and from thence to the stack or chimney. Thus the whole length of the flues C², C¹, and C, or a portion of the heat, may be made to pass direct to the stack, and the remainder through all the flues, as described.

It is not desirable to use, in general, the last above arrangement, which is simply provided in case it becomes absolutely necessary to so economize the heat. I much prefer, and shall in practice use, the arrangement of independent heat-flues, the heat of each of which can be regulated independently and irrespective of the others.

The movement of the ore through the retorts is dependent upon the length of time it remains in the zone of carbonization; and, likewise, the dimensions of the upper two zones are dependent upon the dimensions of the lower zone, inasmuch as their capacity should, in order to insure uniformity, be either the same as or a multiple of that of the lower zone.

If it should be desired for any purpose to heat the ore only to the extent of deoxidation, then the lower zone may be heated only to the deoxidizing temperature, while the upper zone or zones may be simply zones of preparation. If bituminous or anthracite coal be employed

as fuel, I use the puddling-furnace in connection with my converting apparatus; if charcoal or coke be the fuel, I use with the converting apparatus one or more forge-fires.

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

1. The mode herein described of treating iron ore in upright retorts divided into zones of different but uniformly-maintained heats, through which the ore descends, substantially as and for the purposes set forth.

2. The introduction, substantially in the manner and by the means described, into the upper zone of the retort or retorts, of external air, in order to produce therein an oxidizing draft or atmosphere when needed for desulphurization of the ore, substantially as set forth.

3. The combination, in a converting-furnace for treating ore, of one or more upright retorts and horizontal independent heating-flues, dividing said retort or retorts into zones or belts, in each of which the heat may be regulated and kept at the required degree, irrespective of and without interference with the others, substantially as shown and set forth.

4. The combination, with the upright retorts and external flues dividing said retorts into zones or belts, as specified, of transfer-cham-

bers, one for each retort, located below their respective retorts, and communicating with the same through openings closed by slides or dampers, substantially as shown and described.

5. The combination, with the upright retorts, external flues dividing the same into zones or belts, and transfer-chambers, of main receiving-chambers, one for each set of transfer-chambers, located below said transfer-chambers, and adapted to be thrown into communication with the same at proper times, substantially as described.

6. The combination of the main gas-chamber, the retorts, transfer and receiving chambers, and system of flues for heating said retorts and chambers, and conveying the heat to the chimney or chimneys, the said flues being provided with regulating-dampers, and the said gas-chamber receiving the heat from a forge-fire, independent fire, puddling or other reducing furnace, substantially as shown and set forth.

In testimony whereof I have hereunto signed my name this 9th day of March, A. D. 1874.

EDGAR PECKHAM.

Witnesses:

EWELL DICK,
M. BAILEY.