E. V. LANYON & F. A. CURNOW.

SMELTING FURNACE.

APPLICATION FILED APR. 11, 1914.

1,127,264.

Patented Feb. 2, 1915.

5 SHEETS—SHEET 1.

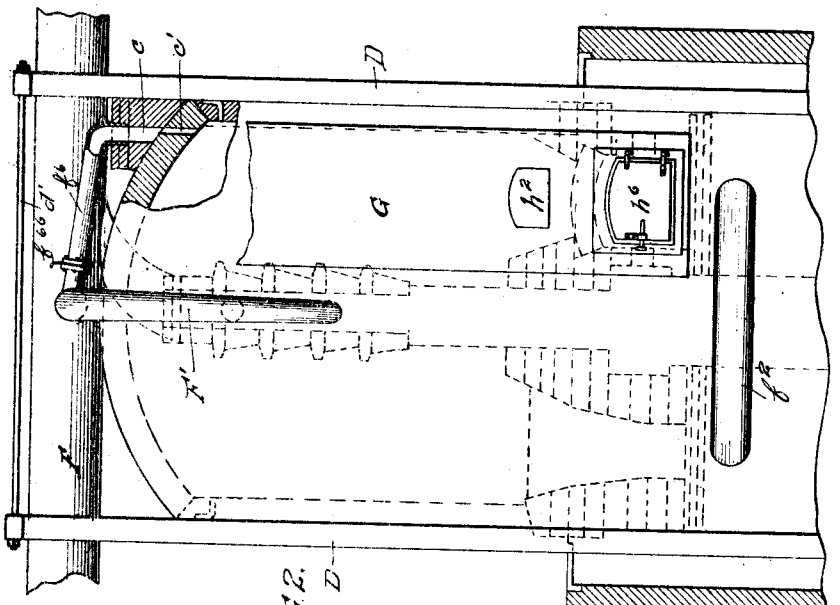


FIG. 2.

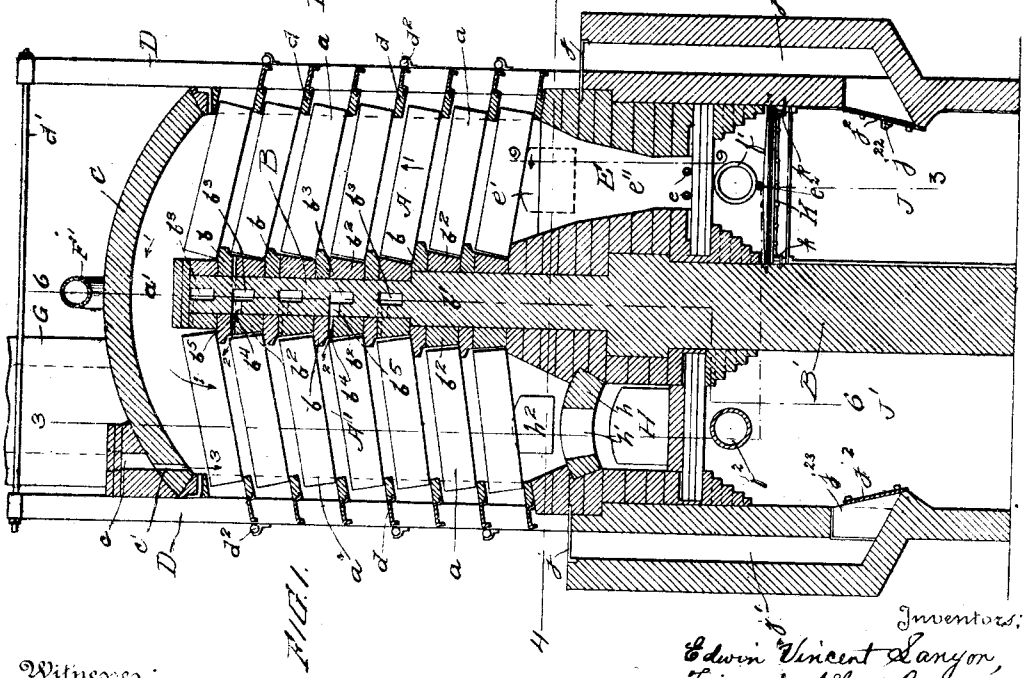


FIG. 1.

Witnesses:

R. S. Troyner.

E. A. Liedebrand

Inventors:

Edwin Vincent Lanyon,

Francis Albert Curnow,

By

their Attorney.

E. V. LANYON & F. A. CURNOW.

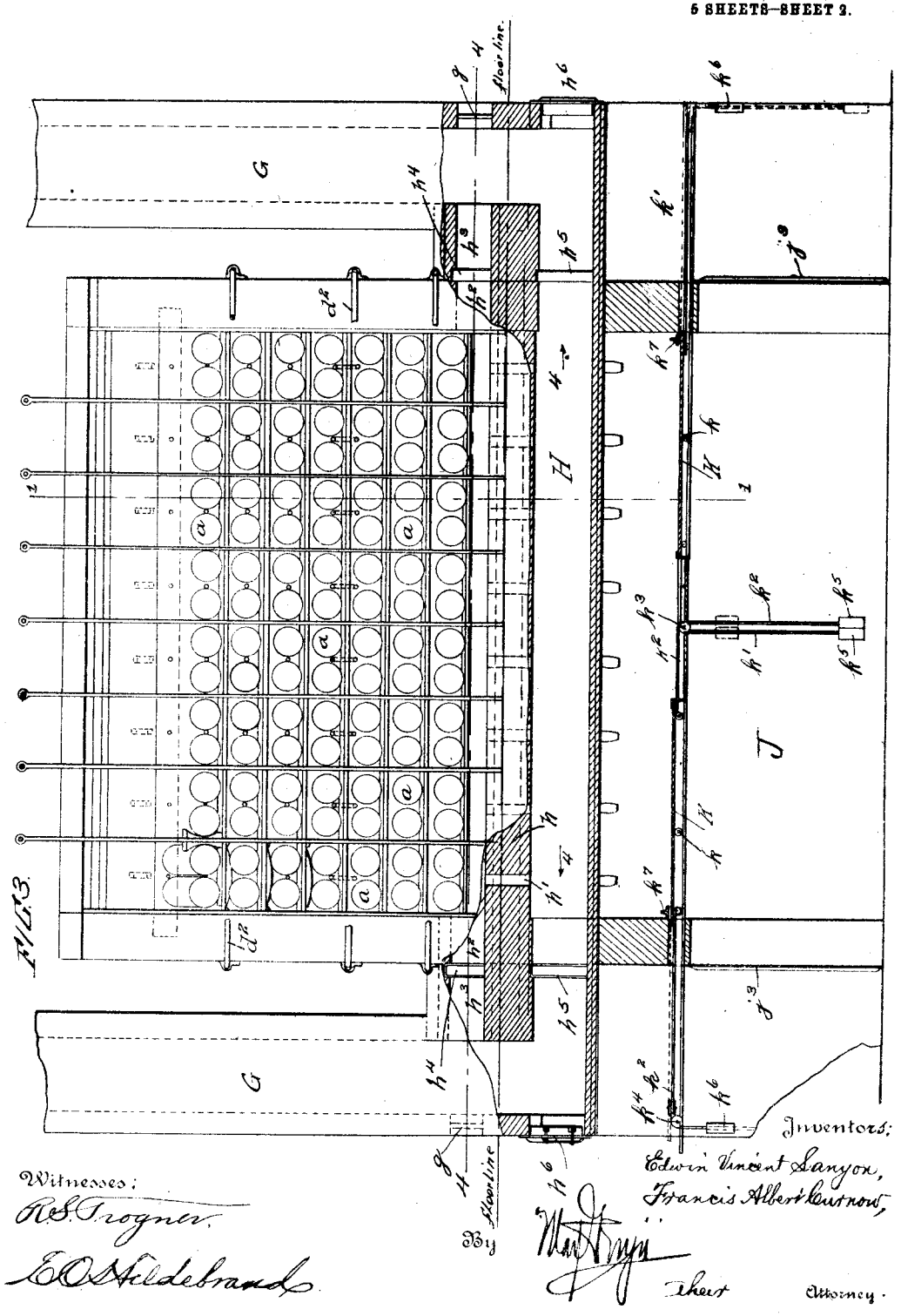
SMELTING FURNACE.

APPLICATION FILED APR. 11, 1914.

1,127,264.

Patented Feb. 2, 1915.

5 SHEETS—SHEET 2.



Witnesses:
R. S. Trogner
E. O. Hildebrand

Inventors:
Edwin Vincent Lanyon,
Francis Albert Curnow,
By Their Attorney.

E. V. LANYON & F. A. CURNOW.

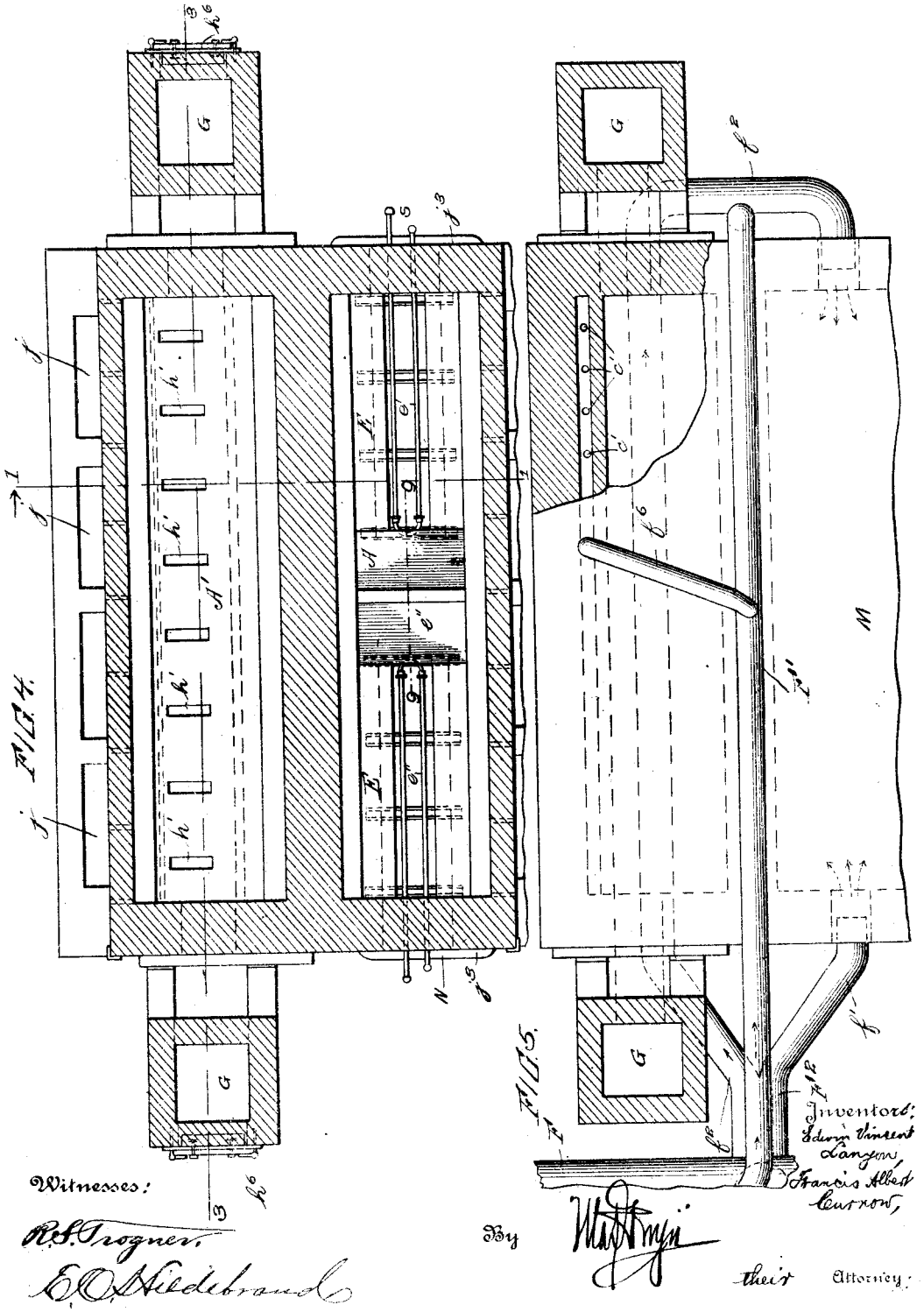
SMELTING FURNACE.

APPLICATION FILED APR. 11, 1914.

1,127,264.

Patented Feb. 2, 1915.

5 SHEETS—SHEET 3.



E. V. LANYON & F. A. CURNOW.

SMELTING FURNACE.

APPLICATION FILED APR. 11, 1914.

1,127,264.

Patented Feb. 2, 1915.

5 SHEETS—SHEET 4.

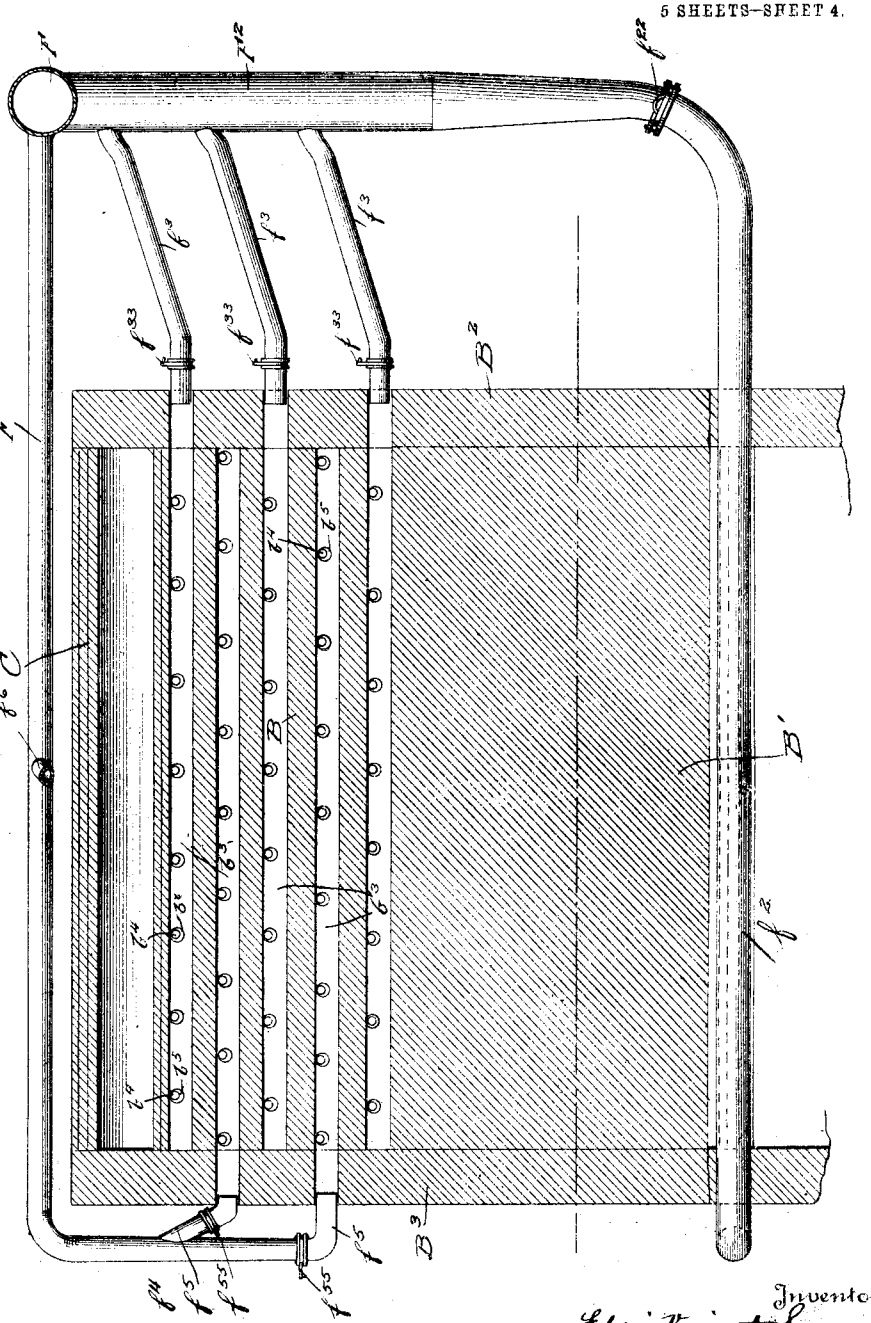


FIG. 6.

Witnesses:

R. S. Trogner.

E. O. Hildebrand

Inventors:

Edwin Vincent Lanyon,

Francis Albert Curnow.

By

their Attorney.

E. V. LANYON & F. A. CURNOW.

SMELTING FURNACE.

APPLICATION FILED APR. 11, 1914.

1,127,264.

Patented Feb. 2, 1915.

5 SHEETS—SHEET 5.

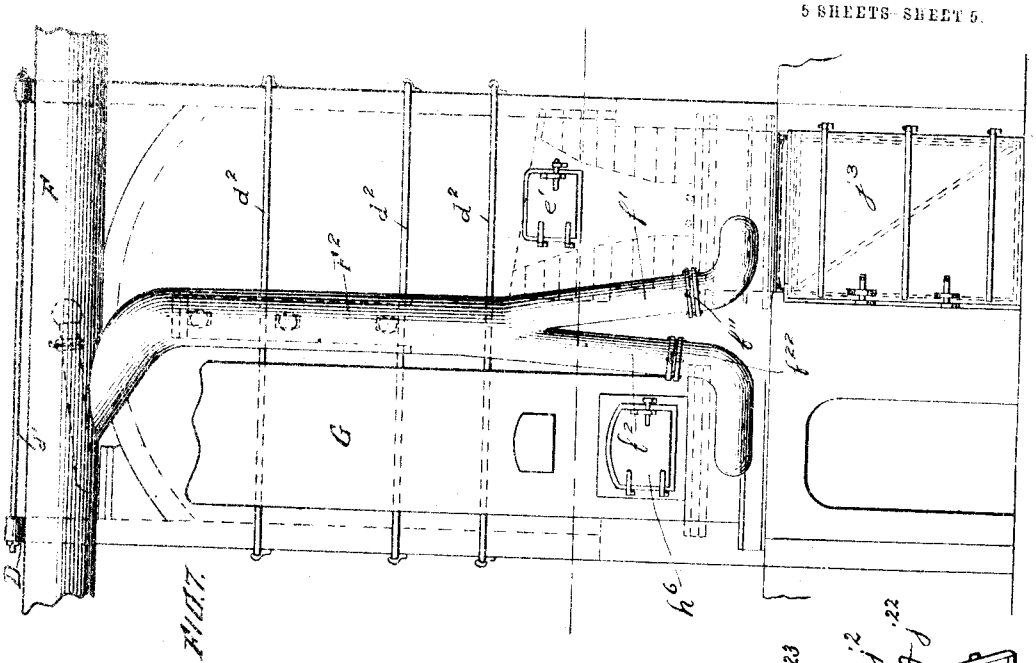


FIG. 7.

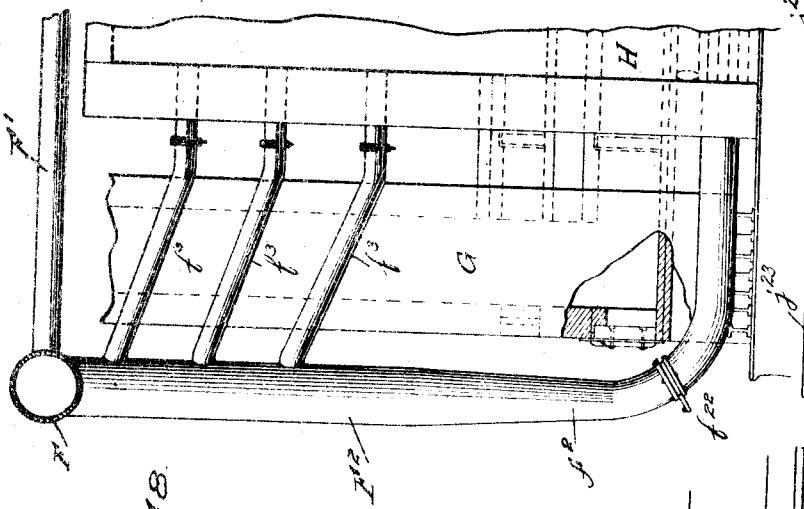


FIG. 8.

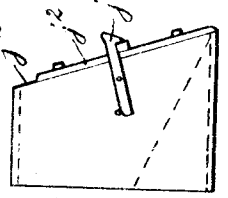


FIG. 11.

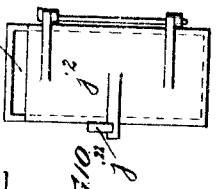


FIG. 10.

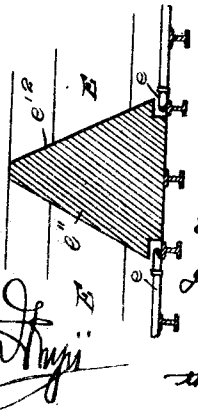


FIG. 9.

Witnesses:

R. S. Wagner.

C. O. Hildebrand.

Inventors:
Edwin Vincent Lanyon,
Francis Albert Curnow,

By Wm. Knight

their Attorney.

UNITED STATES PATENT OFFICE.

EDWIN VINCENT LANYON AND FRANCIS ALBERT CURNOW, OF PITTSBURG, KANSAS.

SMELTING-FURNACE.

1,127,264. Specification of Letters Patent. Patented Feb. 2, 1915.

Application filed April 11, 1914. Serial No. 831,148.

To all whom it may concern:

Be it known that we, EDWIN VINCENT LANYON and FRANCIS ALBERT CURNOW, citizens of the United States of America, residing at Pittsburg, Crawford county, Kansas, have invented certain new and useful Improvements in Smelting-Furnaces; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to furnaces for smelting ore or other metalliferous materials and has special reference to spelter furnaces or furnaces for reducing zinc ores, although the same may be useful also in connection with other styles of furnaces, and furnaces for the reduction of other materials.

The said invention has been designed in particular to increase the efficiency and output of what is known in the art as the Belgian zinc furnace, that is to say, a furnace in which the retorts of elongated form are stacked in the furnace chamber in superimposed more or less approximately horizontal rows or tiers.

In recent years the Belgian type of furnaces has been to a great extent superseded by furnaces adapted to be operated with cheap fuel, such as natural gas, and by more modern types of furnaces adapted to be fired with producer gas, which furnaces have proved more economical and have led to a greater yield per unit of time or per unit of expense, or both.

By applying our invention we have succeeded in making the Belgian furnace easy to fire and to maintain in operation, and economical, both as to fuel consumed and labor required and adapted to give a steady and uniform heat throughout the fire-space, such as could not be obtained under the old forms of Belgian furnaces. Thereby we have been enabled to combine the known advantages of this furnace with those of the more recent types of spelter furnaces. While thus of particular utility in connection with spelter furnaces, it is to be understood that our improvements are also applicable to other classes of metallurgical furnaces, as will be readily appreciated.

The objects thus set forth we attain by the means, features and combinations of parts hereinbelow described and more particularly pointed out in the claims.

In the accompanying drawings we have represented, in illustration of our invention, a zinc or spelter furnace which we consider the preferred embodiment of said invention.

In these drawings—Figure 1, represents a vertical transverse section, on line 1—1, Figs. 3 and 4, of a Belgian smelting furnace embodying our invention; Fig. 2, a side elevation partially in vertical section of the same, looking toward furnace from the end opposite to that from which Fig. 1 is taken; Fig. 3, a side elevation of the same, partially in vertical longitudinal section on line 3—3, Figs. 1 and 4; Fig. 4, a sectional plan thereof, on line 4—4, Figs. 1 and 3; Fig. 5, a top plan view thereof; Fig. 6, a vertical section thereof on line 6—6, Fig. 1, showing the air blast pipe arrangement; Fig. 7, an end elevation showing said air-blast pipe arrangement, and looking in the same direction as for Fig. 1, Fig. 8, a side elevation at one end of the furnace; Fig. 9, a detail sectional view on line 9—9, Fig. 1 and Fig. 4, and Figs. 10 and 11, a detail front and a detail side elevation of the chute door.

In all of the figures the same parts are designated by the same reference characters.

As shown in this drawing, the smelting furnace comprises two retort heating chambers A A′ designed for receiving the usual or any suitable number of retorts *a* of any well-known or suitable arrangement and construction in the art of reducing metalliferous material containing zinc, or other similar metal or metal which may be distilled in retorts, said retorts being arranged in the usual manner in superimposed tiers. The chambers A A′ are separated by a continuous partition-wall B of suitable thickness and strength, said partition-wall rising from the foundation wall B′, but stopping short of the arch-roof, C, of the furnace and being separated therefrom sufficiently to leave a continuous unbroken throat or communication *a′* between the chambers A and A′, as shown. The retorts *a* are supported in an approximately horizontal or somewhat inclined position on ledges *b* at their rear and on supporting plates *d* of the usual or any suitable form and construction at their forward ends, said plates *d* being mounted on buckstaves D, rising from the bottom masonry of the furnace, and main-

tained in position so as to occupy a vertical position and to support the front walls by the usual tie-rods, d'. For further bracing the furnace, encircling braces or hoops d^2, arranged as shown in Figs. 1, 3 and 7, are provided, said braces or hoops surrounding the entire furnace, inclusive of the buck-staves, D.

The furnace is so arranged that hot gases of combustion in a partially burnt or consumed condition are delivered to the heating chamber A at its bottom, said gases passing in the direction of the arrows 1 upward through chamber A, through the throat or communication a' and thence downward through the chamber A', said gases being mingled, as they emerge from the throat a', and within the chamber A', with air for the purpose of more perfect combustion and raising their temperature to that required in the chamber A'. In the furnace shown in the drawings the heating gases are produced in the hearths or fire boxes E E arranged below the heating chamber A at each end of the furnace, said fire boxes and gas producers being provided at the bottom with water-cooled grate-bars e, e, and fire-stoking openings provided with doors e' e', one arranged for each of the said fire boxes. The fire boxes are separated by a fire back e'' having sloping faces e^{12} as shown in Fig. 9.

For delivering the air to be mingled with the gases of combustion and also for supporting the combustion in the fire box, the furnace is provided with an air-blast system whose arrangement and disposition will best be understood from an inspection of Figs. 5 to 8. This air-blast system comprises a main-pipe F arranged to receive air from a fan or other air-forcing or air-compressing source, said main-pipe extending along one end of the furnace and in sufficient proximity to its walls to receive heat radiating therefrom. Communicating with the main-pipe F and running longitudinally over the top of the furnaces at an intermediate part of the same is arranged the horizontal feed-pipe F', (see particularly Figs. 5 and 6). Another feed-pipe F^2, also communicating with the main-pipe F, descends vertically in front of one end of the furnace, (Figs 6, 7 and 8), said vertical feed-pipe branching off near the bottom to form two branch pipes f' f^2, one of these branch-pipes f' being connected to the masonry of the furnace beneath one grate e so as to feed the air thereto, as shown in Figs. 5 and 7, while the other, f^2, passes longitudinally and horizontally beneath the smoke-tunnel H (Figs. 1, 5 and 6) and through the furnace, by way of the residue-chamber J', below described, and thence in front of the farther end of the furnace, its end being connected to the furnace-wall beneath the other grate e so as to feed air thereto, (Figs. 2 and 5). The vertical feed-pipe F^2 is tapped at a number of points in its length to feed air to a number of branch-pipes f^3 f^3 f^3, (Figs. 6 and 8), connected thereto, and the horizontal feed-pipe F', as shown in Figs. 2 and 6, after having traversed the entire length of the furnace, descends to form a vertical arm f^4, from which extend the branch pipes f^5 f^5 which communicate with said vertical arm f^4. The branch pipes f^3 and f^5 serve to deliver the air from the main blast-pipe to the heating-chamber A', and for this purpose the partition wall B is constructed and arranged in the following manner: The said partition wall B consists of an interior portion b' and of a lining built up of the ledge blocks b and the intermediate blocks b^2. These lining or coating blocks b and b^2 are made of heat refractory material such as fire-brick, as are all the other parts of the masonry and inclosure of the furnace exposed to the action of the heating gases, such as the arched roof C, the fire-box E and the other masonry of the chambers, A and A'. In the body of the interior portion b' of the partition wall B is arranged a series of horizontal flues b^3 b^3 b^3, etc., (see Figs. 1 and 6) which flues extend horizontally through the furnace, as best shown in Fig. 6, where it will be seen that each of these flues pierces also one of the end walls, B^2 and B^3 of said furnace in alternate order, so as to communicate alternately, with one of the branch pipes f^3, f^5 at the two ends of the furnace, of which branch pipes said flues b^3 b^3, etc., constitute continuations. From Figs. 1 and 6 it will be seen that these flues b^3 b^3, etc., communicate with the heating chamber A' by orifices b^4 b^4 b^4, etc., said orifices passing through the interior portion b' of the partition wall from the flues b^3 and through the lining blocks b^2 as best seen in Fig. 1. As shown in Fig. 6, these orifices are preferably staggered in arrangement so as to provide for as uniform as possible a distribution of the air to the chamber A'. From an inspection of Fig. 1 it will be noted that the portion b^5 of these orifices is considerably enlarged in cross-section so as to assure the register of the part of the orifices in the lining with the said inner part b^5 of the orifices when the said lining settles under the influence of heat.

The arrangement so far disclosed serves to feed air to the heating gases as they descend in the chamber A' along the inner wall of the said chamber. In order to direct air into contact with said gases along the surface of the outer wall or inclosure, the following arrangement is provided: Referring to Figs. 2, 5 and 6, it will be noted that the horizontal feed-pipe F' is tapped at an intermediate portion of its length, a branch pipe f^6 being connected at this point to said feed-pipe, said branch pipe f^6 leading to a longitudinal air-chamber or trough c run-

ning the entire length of the furnace as seen in Fig. 5. The air-chamber c is provided at suitable intervals along its length with downwardly directed perforations or ducts c' c' c', etc., through which streams of air flow downward into the chamber A′ along the outer inclosing wall thereof. For regulating the amount of air to be delivered to the flues b^3, the air-chamber c, and under the grates e e, the branch-pipes f' and f^2, f^3 and f^5, and f^6 are provided with valves or dampers f'', f^{22}, f^{33}, f^{55} and f^{66}, respectively.

To carry off the heating gases and vapors after passing downward through the heating chamber A′, said chamber communicates with the stacks or chimneys, G, G, by a smoke-flue or tunnel H extending longitudinally through the furnace, beneath the chamber A′ and connecting the two stacks as best shown in Figs. 1, 3, 4 and 5, the arch h over said tunnel being provided at suitable intervals with slots or perforations h' of sufficient size to permit of the ready passage therethrough of the gases and vapors of combustion from the chamber A′ to said tunnel. By referring particularly to Figs. 1 and 3 it will be seen that, for a purpose to be hereinafter stated, a second communication to the stacks from the chamber A′ is established by openings or ports h^2 h^2 opening into the short passages h^3 h^3 leading to the interior of the stacks G G. Both these openings and the extreme ends of the tunnel H are provided with dampers h^4 h^4 and h^5 h^5, respectively, made of suitable material, such as fire refractory brick, and preferably they are made in the shape of sliding dampers. As shown in Figs. 2, 3 and 4, the ends of the tunnel H are provided with doors h^6 h^6, which may be opened for giving access to the said tunnel for cleaning the same or for other purposes, and which are adapted to be tightly closed when the gases and vapors are passing through the tunnel. The stacks or chimneys G G are provided opposite the passages h^3 h^3 with openings g g which permit access to the said passages and which are normally closed by masonry or by luting in any suitable or convenient way. As shown, the tunnel H and the doors h^6 h^6 are, in the example given in the drawings, below the floor-line, while the openings h^2 and passages h^3 are above the said line.

The working floor at both sides of the furnace is provided with openings j j, etc., placed at suitable intervals apart and in close proximity to the side-walls, as seen best in Figs. 1 and 4, said openings leading to the chutes j' j', for the reception of the ashes and residues that are periodically raked or blown out and removed from the retorts, said residues passing down through the chutes j' j' into the residue chambers J J′, which extend longitudinally under the grates e e and the tunnel H. The chutes j' j' are closed at the bottom by any suitable doors, such for example as the doors j^2, j^2, shown in Figs. 1, 10 and 11, which are provided with latches j^{22}, j^{22}, as shown, to hold the residues in the chutes and prevent their dropping out until the residue-removal cars are in position under the chutes, to hold the blast under the grates and prevent air-drafts through the chutes. When these doors are opened, they allow the residue material to pass down and to be discharged into the cars in the chambers J J′, for removal. After the removal of the residues, the doors are again closed and thus prevent the suppression of the blast and also the access of air-drafts through the chutes j', which might chill the outer walls or fronts of the furnace by delivering to the same cold air. In order to permit the gases from the residues to escape into the residue chambers instead of backing up to the working floor, the doors j^2 of the chutes leading to the chamber J′ may be arranged so as not to close the chutes entirely but to leave a small opening j^{23} at the top as shown in Figs. 1, 10 and 11. The doors j^2 for the other residue chamber J are similarly arranged except that they entirely close the chutes, leaving no opening at the top. Below the grates e e is arranged means for feeding steam or water to the fires, such as a perforated steam pipe or water-sprayer e^2; Fig. 1.

The residue chamber J is provided at each end of the furnace with a door j^3 to permit access to the same for cleaning out the residues from the retorts and the ashes and clinkers from the fire-box grates at each end, and for other purposes. As the opening of said doors j^3 would result in sending a stream of cold air into the fires and thus interfere with the blast from the air-pipes f' and f^2, and otherwise with the operation of the furnace, we provide movable means for closing the fire-place E against such drafts or interference with the blast while said doors j^3 are open for cleaning out the chamber J. In the example shown in the drawings these means consist in two horizontal sliding doors K, K, shown in Figs. 1 and 3, arranged below the grates e e, guided in the masonry of the furnace and resting on anti-friction rollers k. At each end the doors K, K, are provided with cords, cables, or chains k' k^2, running over loose pulleys k^3 at the interior of the chamber J and loose pulleys k^4 outside of said chamber, said cords being provided with weights k^5 at their inner ends, and weights k^6 at their outer ends, all as shown in Fig. 3. Scraper-bars k^7, k^7, serve to remove ashes and clinkers which may have dropped on the doors from the grates, as the said doors are drawn outward into their open position.

From the above description the operation of the furnace will be readily understood.

The retorts *a*, being charged in the usual manner with the metalliferous material, such as zinc-ore or other zinc bearing material, and with the proper quantity of coke or any suitable coke or coal-mixture and the fires being in operation in the fire-boxes or gas producers E, the gases and products of combustion therefrom pass through the retort-heating chamber A in the direction of the arrows 1, around the said retorts, said gases then passing through the throat *a'* and descending down through the retort chamber A', where these gases are met by the currents of air issuing through the perforations b^4, on the inner wall of the said chamber A' in the direction of the arrows 2, and from the perforations *c'* in the direction of the arrow 3. The gases then pass through the slots *h* into the tunnel H, through which they pass in the direction of arrows 4 to the stacks G G, and into the air. By suitably adjusting valves *f''* and f^{22} the amount of air admitted under the grates *e* can be regulated to the necessary extent to support the proper degree of combustion, the proper amount of steam or water-spray for this purpose being also introduced under the grates by means of the perforated steam or water-pipe e^2. By introducing the air both from the orifices b^4 and the ducts *c'*, the products of combustion and gases as they enter through the throat *a'* are properly and uniformly mixed so as to secure a uniform degree of heat, both at the outer and inner wall and in the interior of the chamber A'. The supply of air to the flues b^3, with which the orifices b^4 communicate, and to the air-chamber *c* leading to the perforations *c'*, is regulated by the dampers f^{33} f^{55} on the one hand, and the damper f^{66} on the other. The ashes and cinders from the fire-boxes E, as they drop, are collected in the chamber J, and the residues from the retorts *a*, as they are raked or blown out prior to replenishing, drop into the chutes *j'* and when the doors j^2 are opened, they pass into both the chamber J and the chamber J'. When it becomes necessary to clean out the smoke tunnel H, the slots or perforations *h'* in the arch *h*, (see Figs. 1 and 3) are closed with fire-brick, and the dampers h^4 are opened so as to permit the chamber A' to communicate through the passage h^3 h^3 with the stacks G. Thereupon the tunnel H may be cleaned out without interrupting the operation of the furnace, admission to said tunnels being permitted by opening the doors h^6 h^6. In order to evacuate the chamber J without interfering with the blast under the grates or admitting cold air from the exterior to the fire in the fire-boxes E, and thereby chilling the same and the chambers A A' when the doors j^3 are open, the horizontal doors K K which, in the normal operation of the furnace, are drawn out in the dotted position indicated in Fig. 3, are drawn inward to the full extent as indicated in full lines in said Fig. 3, thereby closing off the fires and the chambers A A' against the outer air and forming a secondary blast chamber. The residues, ashes and clinkers can then be removed from the chamber J. As soon as this is done the doors j^3 are closed and the horizontal doors K K are returned to their outermost positions as indicated in dotted lines. As the residue chamber J' is permanently closed off against the heating chamber A' it may be cleaned out at any time without interfering with the blast or the operation of the furnace.

Our improvements as above described may be applied to the old type of Belgian furnaces, or they may be embodied in entirely new Belgian furnace structures.

A furnace embodying or having applied to it our improvements not only saves fuel and labor, but leads to a better yield or recovery of metal from the ores or other metalliferous material treated, by reason of the uniform heat which it enables us to apply continuously to all of the retorts throughout the heating chambers, the lowermost retorts in the first chamber receiving substantially the same amount of heat as the uppermost retorts therein, or the lowermost retorts in the second chamber, and the number of retorts in the chambers or the capacity of said chambers may be increased or diminished without modifying this uniformity of heat.

In the old form of Belgian furnace the fires depended to a material extent on the "stack pull" or draft of the chimneys and the building of heavy fires which have a tendency to cool the furnace for a time, to be followed by the danger of excessively heating the furnace after the green fires have burnt down, such excessive heating being greatest near the fire-box, the heating of the various retorts being moreover very uneven throughout the heating chambers, either the lowermost retorts being excessively and injuriously heated, or the heating of the retorts remote from the fire being inadequate. On the other hand, in a furnace arranged and constructed under our invention, involving the delivery of a preheated blast to the grate and to the gases of combustion at the points where a lowering of their temperature is likely to occur and to the fires themselves, and also means for controlling such blast delivery at the different points, full and small fires can be employed continuously. By this arrangement it is also possible to prolong the life of the furnace by preserving the fire-brick linings against damage, since they are not exposed to the intense heats due to "holes" burning into the fire. A considerable source of economy also resides in the fact that the air blast is preheated by the radiated heat

from the furnace, and also in the arrangement, in addition to the tunnel H, of the means for establishing communication between the stacks G, G and the heating chamber A' above said tunnel, when said tunnel is being cleaned, and of the horizontal doors K, K which permit the residue and ash chamber J to be closed off from the fire-boxes E, E, when cleaning out said chamber. Thereby no interruption in the working of the furnace is necessitated by those operations. In fact the efficiency and output of the coal-fired Belgian furnace has been so materially increased by our improvements as to place a new value on this type of furnaces, and to adapt it to successfully compete with spelter plants employing gas and cheap fuel, and furnaces of modern construction used in connection with gas-producers of various descriptions, which have had a tendency to take the place of the former, notwithstanding the advantages inherent in the same. While particularly adapted to such Belgian furnaces, our improvements, singly or in the aggregate, may be with advantage employed in other furnaces for smelting and treating metalliferous material. The grates employed may be of various descriptions, in the form of stationary or shaker grates. However, the form shown and described above, we find the most suitable in connection with the other parts, as shown.

What we claim and desire to secure by Letters-Patent is:

1. In a smelting furnace, a pair of heating chambers, communicating with each other at their tops, means for delivering heating gases at the lower part of one heating chamber and means for carrying-off the gases from the other heating chamber in combination with a partition wall between the chambers, said partition wall being provided with air-flues and openings leading from the same into the second heating chamber along the surface of said wall, and an air-chamber arranged at the top of the said second heating chamber substantially at the outer portion thereof and arranged to deliver air to said chamber at the outer portion of said chamber.

2. In a smelting furnace, a pair of heating chambers, communicating with each other at their tops, means for delivering heating gases at the lower part of one heating chamber and means for carrying-off the gases from the other heating chamber, in combination with a partition wall between the chambers, said partition-wall being provided with air-flues and openings leading from the same into the second heating chamber along the surface of said wall, and an air-chamber arranged at the top of the said second heating chamber substantially at the outer portion thereof, said air chamber being provided with downwardly directed air outlets substantially along the outer wall of said chamber.

3. In a smelting furnace, a pair of heating chambers, communicating with each other at their tops, means for delivering heating gases at the lower part of one heating chamber and means for carrying-off the gases from the other heating chamber in combination with a partition wall between the chambers, said partition wall being provided with air-flues and openings leading from the same into the second heating chamber along the surface of said wall, and a longitudinal air-chamber extending along the roof and the outer portion of the said second chamber and provided with downwardly directed air outlets along the inner face of the outer wall of said second chamber.

4. In a smelting furnace, a pair of retort heating chambers communicating with each other at their tops, a fire-box at the bottom of one heating chamber and means for carrying off the gases from the bottom of the second heating chamber, in combination with an exterior air-pipe system arranged in heating proximity to the furnace and provided with branch pipes for delivering air under the fire-box and to the inner sides and the top of the second heating chamber.

5. In a smelting furnace, a heating chamber, a stack or chimney, and a communicating passage connecting the chimney with the heating chamber, in combination with a second communicating passage between the chimney and the heating chamber arranged above the first communicating passage, and means for interchangeably closing or opening the opening or openings leading from the heating chamber to the first or second communicating passage.

6. In a smelting furnace, a fire-box and a chamber for collecting ashes, residues and cinders, arranged below said fire-box and provided with a door to give access thereto, in combination with means for cutting off the communication between said chamber and the fire-box, when the door of the chamber is opened.

7. In a smelting furnace, a fire-box and a chamber arranged below the fire-box for collecting ashes, residues and cinders, said chamber being normally closed against access of air and provided with a door, in combination with a horizontal door arranged below the fire-box, and means for opening or closing said door, as the chamber below the fire-box is closed or opened respectively.

8. In a smelting furnace, a fire-box and a chamber for collecting ashes, residues and cinders, arranged below said fire-box and provided with a door to give access thereto and arranged to be closed so as to form a blast chamber and to produce pressure below

the fire-box, and chutes leading from the working floor at the front of the furnace into the chamber and provided with doors at their bottom, in combination with means for cutting off the communication between said chamber and the fire-box, when the door of the chamber is opened.

9. In a smelting furnace, a pair of heating chambers communicating with each other at their tops, means for delivering heating gases at the lower part of one heating chamber and means for carrying off the gases from the other heating chamber at the bottom thereof, in combination with a partition-wall between the chambers, said partition wall being arranged with longitudinal air-flues and openings leading from the same into a second heating chamber along the surface of said wall, a pipe for delivering air to said air-flues, and connecting pipes from the air delivery pipe communicating alternately with the opposite ends of the air-flues.

10. In a smelting furnace, a pair of heating chambers communicating with each other at their tops, means for delivering heating gases at the lower part of one heating chamber, and means for carrying off the gases from the other heating chamber, in combination with a partition wall between the chambers, said partition-wall being provided with air-flues and openings leading from the same into the second heating chamber along the surface of said wall, and an air-chamber arranged at the top of the second heating chamber substantially at the outer portion thereof, said air-chamber being provided with air-outlets leading into the said chamber, and an air-delivery pipe and branch pipes connecting the said air delivery pipe with the air-flues and the air-chamber, and valves arranged in the said branch pipes for controlling the supply of air to the said air-flues and air-chamber.

11. In a smelting furnace, a pair of heating chambers in communication with each other, means for delivering heating gases to one heating chamber, and means for carrying off the heating gases from the second heating chamber, in combination with a partition wall between the chambers, said partition wall being formed of an interior portion and a lining, the interior portion of the partition wall being provided with air-flues and with openings leading from the air-flues outward, the lining being also provided with openings adapted to register with the openings in the interior wall portion and leading into the second heating chamber, one set of openings being smaller in cross-section than the other.

12. In a smelting furnace, a pair of heating chambers, communicating with each other at their tops, means for delivering heating gases at the bottom of one heating chamber and means for carrying off the heating gases from the bottom of the second heating chamber, in combination with a partition-wall between the chambers, said partition-wall being formed of an interior portion and a lining, the interior portion of the partition-wall being provided with longitudinal horizontal air-flues and with openings leading from the air-flues toward the second heating chamber, the lining being also provided with openings leading to the second chamber, adapted to register with the openings in the interior wall portion and being smaller in cross-section than the openings in the interior wall-portion.

13. In a smelting furnace, a pair of fire-boxes, a retort-heating chamber arranged over the said fire-boxes and a chamber for collecting ashes, residues and cinders, arranged below said fire-boxes and provided with a door at each end adapted to be closed so as to form a blast chamber and to produce a pressure and to give access thereto, in combination with means for cutting off the communication between said chamber and the fire-boxes when the doors of the chamber are opened.

14. In a smelting furnace, a pair of fire-boxes and a chamber for collecting ashes, residues and cinders, arranged below said fire-boxes and provided with doors at each end to give access thereto, so as to form a blast chamber, and chutes leading from the working floor at the front of the furnace into the chamber and provided with doors at their bottom, in combination with means for cutting off the communication between said chamber and the fire-boxes when the doors of the chamber are opened.

15. In a smelting furnace, a chamber for collecting residues arranged below the furnace, in combination with chutes leading from the working floor at the front of the furnace into the chamber and provided with doors at their bottom, said doors not entirely closing the opening at the bottom of the chutes and leaving a vent opening for the residue gases.

In testimony whereof we hereunto affix our signatures in the presence of two witnesses.

EDWIN VINCENT LANYON.
FRANCIS ALBERT CURNOW.

Witnesses:
A. H. LANYON,
WM. LANYON, Jr.