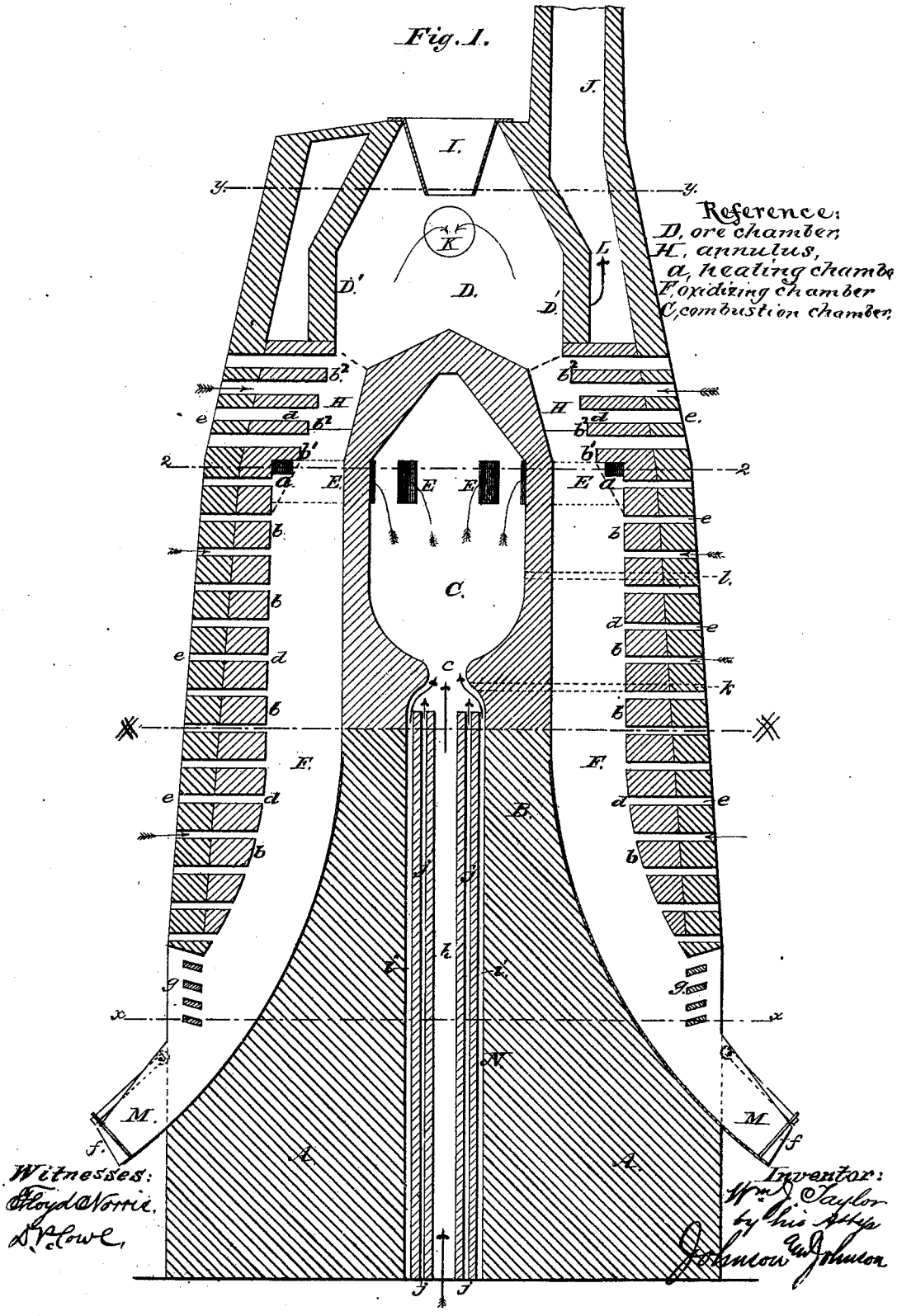
4 Sheets—Sheet 1.

W. J. TAYLOR.

Ore-Roasting Furnace.

No. 196,056. **Patented Oct. 9, 1877.**

Fig. 1.



Reference:
D, ore chamber,
H, annulus,
a, heating chamber,
F, oxidizing chamber,
C, combustion chamber.

Witnesses:
Floyd & Norris.
D. P. Lowe.

Inventor:
Wm. J. Taylor
by his Attys
Johnson & Johnson

4 Sheets—Sheet 2.

W. J. TAYLOR.

Ore-Roasting Furnace.

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Fig. 2.

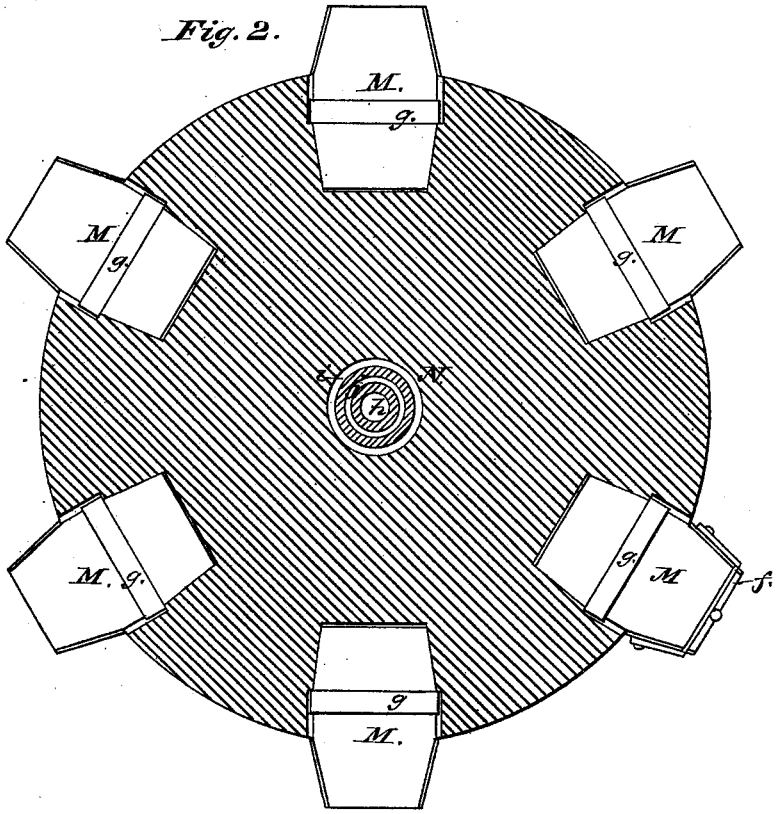
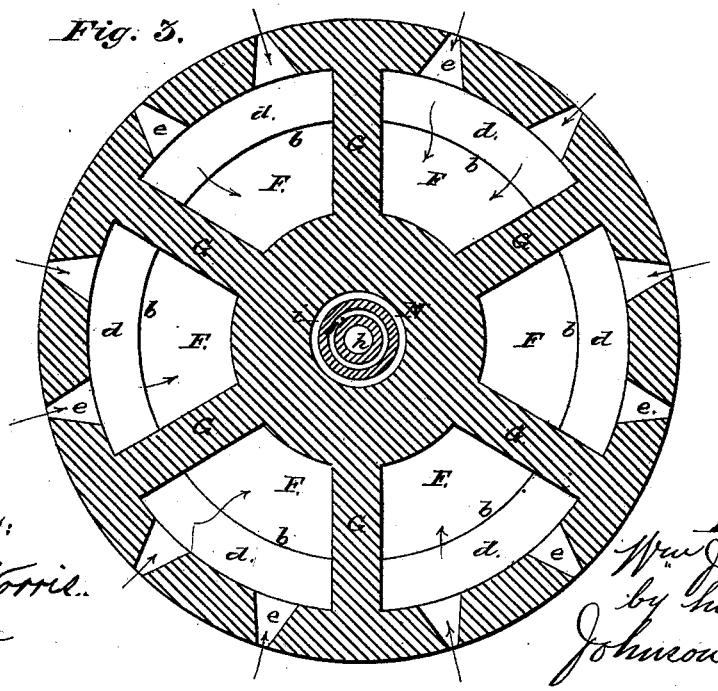


Fig. 3.



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4 Sheets—Sheet 3.

W. J. TAYLOR.

Ore-Roasting Furnace.

No. 196,056. Patented Oct. 9, 1877.

Fig. 4.

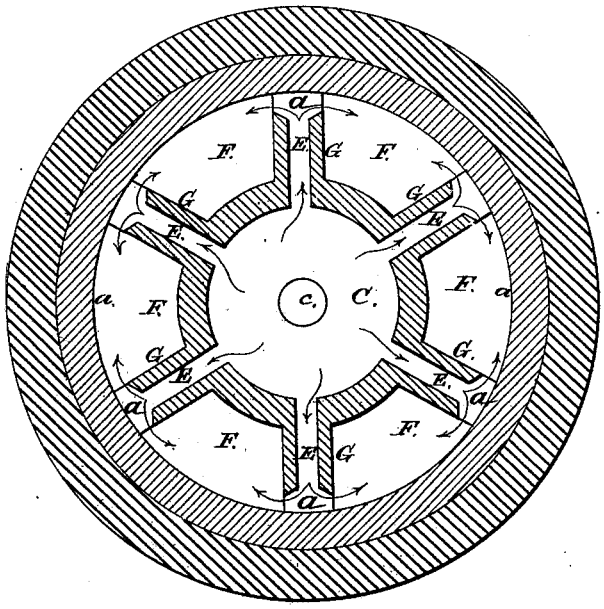


Fig. 6.

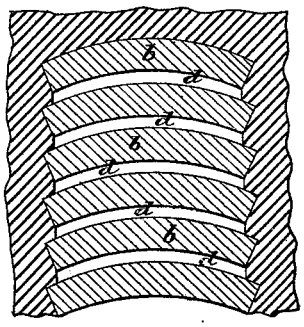


Fig. 5.

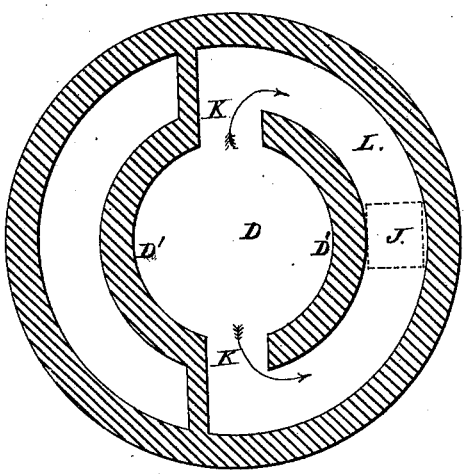
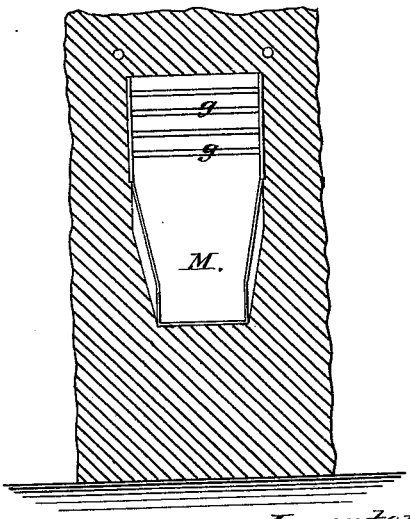


Fig. 7.



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4 Sheets—Sheet 4.

W. J. TAYLOR.

Ore-Roasting Furnace.

No. 196,056. **Patented Oct. 9, 1877.**

Fig. 8.

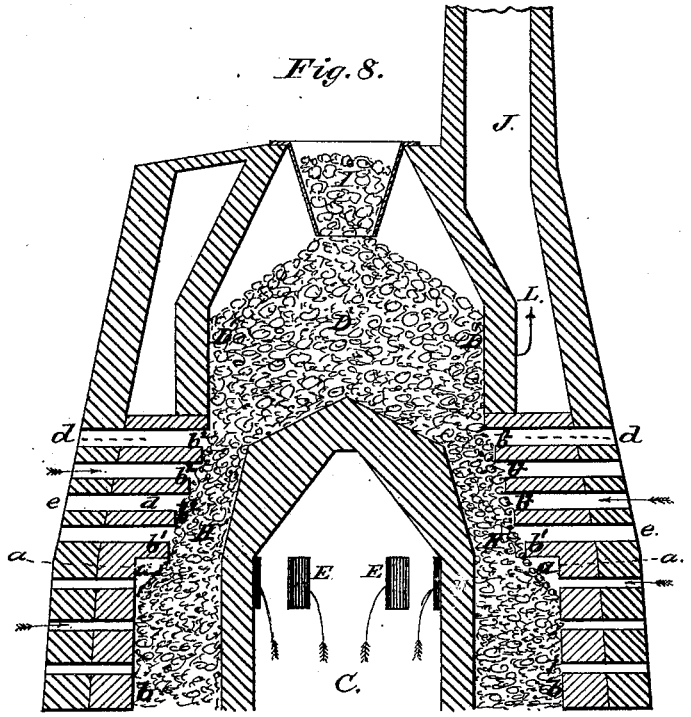


Fig. 11.

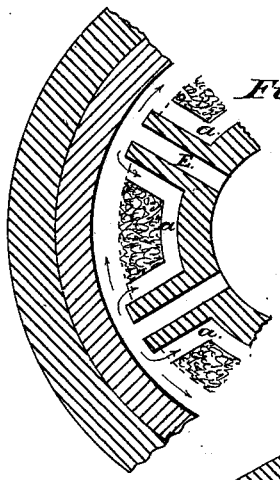


Fig. 10.

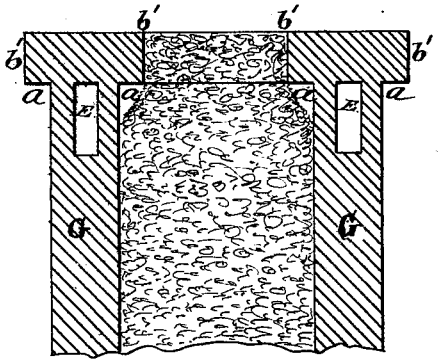
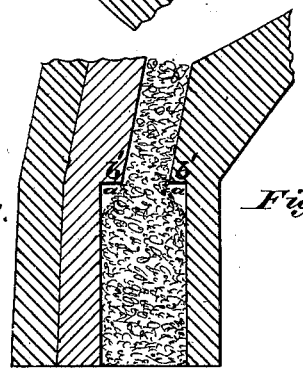


Fig. 9.



Witnesses:
Floyd Norris.
D. P. Lowe.

Inventor;
Wm. J. Taylor
by his Attys
Johnson & Johnson

UNITED STATES PATENT OFFICE.

WILLIAM J. TAYLOR, OF CHESTER, NEW JERSEY.

IMPROVEMENT IN ORE-ROASTING FURNACES.

Specification forming part of Letters Patent No. **196,056,** dated October 9, 1877; application filed March 13, 1877.

To all whom it may concern:

Be it known that I, WILLIAM J. TAYLOR, of Chester, in the county of Morris and State of New Jersey, have invented certain new and useful Improvements in Calcining-Kilns, which improvements are fully set forth in the following specification and accompanying drawings.

Roasting or calcining iron or other ores for eliminating the sulphur is the design of my invention.

The chemical process by which this is effected is explained in a patent granted to me July 27, 1875, No. 166,159, and, besides, is well understood by experts.

I have, however, made a departure from the method hitherto practiced in calcining ores in the particulars of conducting the operation under two separate and distinct conditions—that is to say, the operations of heating and opening the ore, by which a partial elimination of the sulphur is effected, and the ore prepared for the second operation is made separate and distinct from the final process of oxidizing and eliminating the sulphur.

I find by practice that if pure atmospheric air only can be admitted to the ore when it has attained a high heat, the process is much more rapid than if the air is diluted with the gases of combustion.

In the organization of this new kiln only pure atmospheric air enters the oxidizing chamber or chambers from the open chutes and clinker-holes, while the hot gases of combustion pass into and through the ore immediately above said chamber or chambers, thus making a direct contact between the oxygen from the air as it passes upward and the sulphur in the ore as it passes downward through the oxidizing chamber or chambers, whereby a rapid oxidation of the sulphur takes place.

In carrying out this principle, I transfer the combustion-chamber from the base to a point at or near the top of the kiln, and from which the products of combustion pass through a circulating flue or space formed beneath an inner wall offset into the ore at a point to bring the ore to an intense heat just before it enters the oxidizing-chamber.

A hopper effects the even distribution and charging of the ore to a top chamber, while a side chimney or chimneys carries off the sulphur and other gases.

The oxidizing-chamber is divided by vertical piers into a series of chambers for the better working of the kiln, and they are provided with wall-holes for supplying air, breaking clinkers, and watching the heat, while the lower portion of such chambers curve outward and terminate in chutes, in a manner to be most favorable to the regular and even drawing of the ore. In the descent of the ore through these chambers it becomes cooled, and it is prevented from overflowing the outlets of the chutes by means of a grating of plates or bars, and which afford access for breaking up any clinkers which may reach this point as the cold ore is drawn down.

Gaseous fuel is supplied to the combustion-chamber by means of an Argand or other suitable burner, or by other means, the bottom of the combustion-chamber having a construction adapted for such fuel.

Referring to the drawings, Figure 1 represents a vertical central section of a calcining-kiln embracing my invention; Fig. 2, a horizontal section, taken through the discharging ends of the oxidizing-chambers, on the line *x x* of Fig. 1; Fig. 3, a similar section, taken at a point just below the inlet to the combustion-chamber, on the line * * of Fig. 1; Fig. 4, a similar section, taken through the outlet-openings of the combustion-chamber, on the line 22 of Fig. 1, showing the circulating offset-flue; Fig. 5, a similar section, taken through the chimney-flue at the top of the kiln, on the line *y y* of Fig. 1; Fig. 6, a view showing the arrangement of the arches and the spaces between them on the inner sides of the outer walls of the oxidizing-chambers; Fig. 7, a front sectional view of the grated termination of one of the oxidizing-chambers; Fig. 8, a section of the top portion, like Fig. 1, showing more clearly the manner in which the circulating offset-flue is formed; and Figs. 9, 10, and 11, sectional views, showing the circulating offset-flue also arranged around the outer walls of the combustion-chamber and its radial flues.

The kiln is made of any form, dimensions, and material which may be deemed best.

The base A is free from any heating appliances, and the central portion B rises therefrom, and is of such dimensions as to leave an intermediate space between the exterior of the central portion and the outer walls of the kiln.

The combustion-chamber C is formed within and upon the central rising B, as shown. The top of this combustion-chamber is closed, and forms the bottom of an ore-chamber, D, at the top of the kiln. The combustion-chamber is adapted for gaseous fuel, which enters through a bottom neck or opening, *c*, and after combustion passes out at the outer terminations of radial flues E a suitable distance below the top.

The oxidizing-chamber is divided into six (more or less, as may be desired) chambers, F, by radial piers or partitions, G, Figs. 3 and 4, which constitute the oxidizing, cooling, and ore-discharging chambers, and which extend from near the bottom of the kiln to the radial flues E, which are formed in the top of said piers and pass through the walls of the combustion-chamber, as shown in Figs. 1 and 4.

The radial piers not extending to the top of the dome of the combustion-chamber leave an annulus, H, Fig. 1, around the upper part of the combustion-chamber, into which the flues E open by means of a circulating offset-flue, *a*, encircling the inner side of the outer wall, as shown in Figs. 1, 4, 8, 9, 10, and 11.

This flue or space *a* is formed by the drawing in or offset b^1 of the outer wall for a top or covering, and the ore in the annulus H, on passing below this offset, assumes a slope of about forty-five degrees, thus making a triangular flue or space, *a*, of which one side is formed by the ore, as shown in Fig. 8. This circulating offset-flue or heating-space is an important element in the operation of the kiln, as by it a large area of ore is presented for the action of the hot gases and space for their escape into the annulus H and the body of ore in the top chamber, and it is at this circulating offset-flue that the ore is brought to an intense heat, and opened and made porous before it enters the oxidizing chamber or chambers, so that the oxygen from the ascending air and the sulphur in the descending ore form a contact in the oxidizing-chambers under circumstances most favorable for producing the best results.

The top ore-chamber D is formed by an inner wall, D′, contracting at the top to receive a funnel-hopper, I, depending in said chamber, and through which the ore is introduced into the kiln, and an even distribution obtained in charging.

The sulphur-charged gases do not pass out through the hopper, but escape through a side chimney or chimneys, J, by means of openings K below the hopper, which communicate with the chimney by a flue, L, formed between the top chamber D and outer wall, as shown in Fig. 5.

In this construction the hot gases from the circulating offset-flue pass through the body of the ore in the top chamber, imparting most of their heat to the ore, and pass off without extracting much heat from the kiln, while the ore enters the oxidizing-chamber at a high heat, and leaves it entirely cooled off without extracting any appreciable degree of heat from the kiln.

The inner side of the outer wall is formed of a series of arches, *b*, Figs. 1 and 8, one above the other, leaving spaces *d* between them, which communicate with openings *e* in the outer wall, which enlarge or flare inward, as shown in Fig. 3. These holes are for working and punching the ore, and admit air for oxidation. They also form peep-holes, by which to observe the process of roasting.

The several oxidizing-chambers F terminate in outside chutes M at the bottom, provided with hinged drop-gates *f* to hold the ore when not required to be drawn down. These chambers are open some little distance above the chutes, and flat or other shaped bars *g* are placed across these openings, by which ready access is given for breaking up clinkers which may reach and clog the outlet, while at the same time the grating prevents the ore overflowing the chutes.

The curved formation of the lower portion of the oxidizing-chambers F (shown in Fig. 1) prevents the sticking and hanging of the ore or clinkers, and affords facility for the dropping down and even drawing of the ore. For this purpose the back of the curved portions of these chambers are lined with metallic plates.

Passing through the base A, and extending up to the combustion-chamber C, is a central opening, N, large enough to receive an Argand burner, consisting, in the example shown, of a central air-flue, *h*, an outer air annulus or flue, *i*, and an intermediate gas annulus or flue, *j*, terminating below an impingement or neck, *c*, of the combustion-chamber, whereby the air and gases are brought more fully in contact at the point of entrance into the combustion-chamber.

A hole, *k*, (shown by dotted lines in Fig. 1,) extends through the walls into the burner at the point of impingement, by which to light the gas. A similar hole, *l*, (shown by dotted lines in said figure,) also extends into the combustion-chamber C, for observation. The circulating or offset heating-flue can, if desired, be made to extend all round the ore at the heating-annulus by making an offset, *b*′, outward in the combustion-chamber wall and the piers, as shown in Figs. 9, 10, and 11, Sheet 4. This gives a greater extent of said flue or space, and it would then be covered by an arch offset all round and at the sides of the radial piers, as shown in Figs. 9 and 10, which are partial vertical sectional views, and in Fig. 11, which is a partial horizontal section, taken through a portion of said flue. The outlets of the radial flues are directly under the arches or offset in the outer wall, and the ore is there-

by prevented from running into and clogging them.

As shown in Figs. 1 and 8, the circulating offset-flue extends all round on the inner side of the outer wall, thus encircling the ore; but by extending the offset all round the outside wall of the combustion-chamber, as stated and shown, the hot gases from the combustion-chamber have access to two sides of the ore—that is, all round on both sides of the annulus walls and along the sides of the piers. The continuous flues for this purpose communicate with the outlets of the radial flues, as shown in Fig. 11.

The Argand burner is not essential to the proper working of the kiln, as any other mode of admitting gas and air can be used, but the plan shown is found in practice to be economical, simple, and effective.

The gaseous fuel may be taken from a blast-furnace, or made in generators or producers.

In starting, the kiln is filled with ore up to the hopper, and the gas admitted and lighted in the combustion-chamber, the hot gases passing out into the circulating offset-flue, at which point the ore is evenly heated to an intense temperature, say a welding-heat. As soon as this is done the ore can be dropped out of this heating zone or chamber into the oxidizing-chamber, by drawing the ore from the chutes at the bottom. In this way the operation of roasting or calcining ore is continued, the roasted ore being delivered from the chutes at the bottom of the oxidizing-chambers, and the raw ore supplied through the hopper at the top of the kiln.

I do not confine myself to the particular construction of the combustion-chamber; nor to the particular position or location of such chamber shown, as these matters may be varied without departing from the principle and spirit of my invention, which embraces, broadly, the combination and operation in a calcining-kiln of a central combustion-chamber, a circulating offset-flue, from which the hot gases enter the ore, and forming the heating offset flue or space, located at the proper distance from the top of the kiln, and an oxidizing chamber or chambers, in such manner that while the products of combustion pass into and through the ore from the heating-chamber or circulating-flue atmospheric air only is brought in contact with the ore, which has been brought to a high temperature in passing through the heating-chamber, and after the ore has entered the oxidizing-chamber.

The oxidizing-chamber may be uninterrupted by divisions or piers, if found desirable, in which case the radial flues are formed in crossings between the two walls, in any suitable manner.

The space between the inner and outer walls at the top of the kiln, except the flue L, is filled with loam; or it may be made solid.

It will be observed that the annulus H is formed by the sloping arch-offsets b^2, and the sloping of the upper portion of the combustion-chamber, and that the separate horizontal circulating offset flue or space a is formed by the lower offset or offsets b^1 at the base of the annulus, and between the latter and the oxidizing-chamber, so that while the circulating heating flue or space opens into the annulus it is a free and uninterrupted space, communicating by the radial flues with the combustion-chamber.

I claim—

1. The combination, in a calcining-kiln, of a central combustion-chamber with the outer furnace-wall, having an inwardly-projecting circumferential offset, and a series of radial flues which discharge the combustion products from the central chamber into the flue or space formed by said offset, as set forth.

2. The combination, in a calcining-kiln, of a central combustion-chamber, a series of radial conveying-flues, and the outer furnace-wall, provided with an inwardly-projecting circumferential offset, forming an under flue or space into which the flues discharge, with an oxidizing chamber or chambers, adapted to receive the hot ores, as set forth.

3. The combination, with a central combustion-chamber, of a series of radial flues, the outer wall provided with the inwardly-projecting circumferential offset, forming the under space a into which the flues discharge, and the sloping offsets b^2, of a top ore-feeding chamber D, substantially as and for the purpose herein set forth.

4. In an ore-roasting kiln, the central combustion-chamber, the outer furnace-wall constructed with interior offsets b^1 b^2, to form an ore-roasting annulus, H, between said offsets and the upper portion of the combustion-chamber, and above the offset flue or space a, and the heat-conveying radial flues E, whereby the roasting of the ore is concentrated at a point above the oxidizing-chamber.

5. The outer wall of the kiln, the outer wall of the combustion-chamber, and the outer sides of the radial flues E, constructed with offsets b^1, adapted to form continuous flues or spaces a, having communication with the combustion-chamber, for the purpose set forth.

6. In an ore-roasting kiln, the combination, with the central combustion-chamber and the circulating space a, formed by the offset b^1, of the oxidizing chamber or chambers, provided with suitable air-inlets, the several chambers arranged relatively, whereby the heated ore is subjected to the action of atmospheric air free from the products of combustion.

7. The combination, with a central combustion-chamber at or near the top of the kiln, of a series of piers or walls, G, extending from the outlet-chutes M to the radial flues E of the central combustion-chamber, and forming between them the separate and distinct oxidizing and cooling chambers F, as set forth.

8. The inner facing of the outer wall, constructed with long narrow openings d, in com-

bination with the outer walls, provided with inwardly-flaring openings *e*, as and for the purpose described.

9. The oxidizing-chambers F, curved or inclined outward, in combination with the outer wall-grating *g* and the chutes M, having free delivery beneath said wall-grating, whereby to prevent the overflowing of the chutes, and afford access for breaking up clinkers as the cold ore is drawn down.

10. The combination, with the oxidizing chamber or chambers F and the outer-wall grating or bars *g*, of the chutes M and the outside end gates *f*, adapted thereto for the purpose stated.

11. The combination, in calcining-kiln, of a central combustion-chamber, with an Argand or other burner, substantially as herein set forth.

12. The combustion-chamber provided with an impingement inlet-neck, *c*, in combination with an Argand or other burner adapted thereto, substantially as herein set forth.

13. The process of roasting iron and other ores, which consists in subjecting the mass of ore to the calcining action of flame and hot combustion products, and finally to the regulated roasting action of atmospheric air free from the presence of the combustion products, as herein set forth.

In testimony whereof I have hereunto set my hand in the presence of two witnesses.

WILLIAM J. TAYLOR.

Witnesses:
A. B. DICKERSON,
ZERMAN NORMAN.