(No Model.)

C. SIEMENS.

METALLURGICAL FURNACE.

No. 470,712. Patented Mar. 15, 1892.

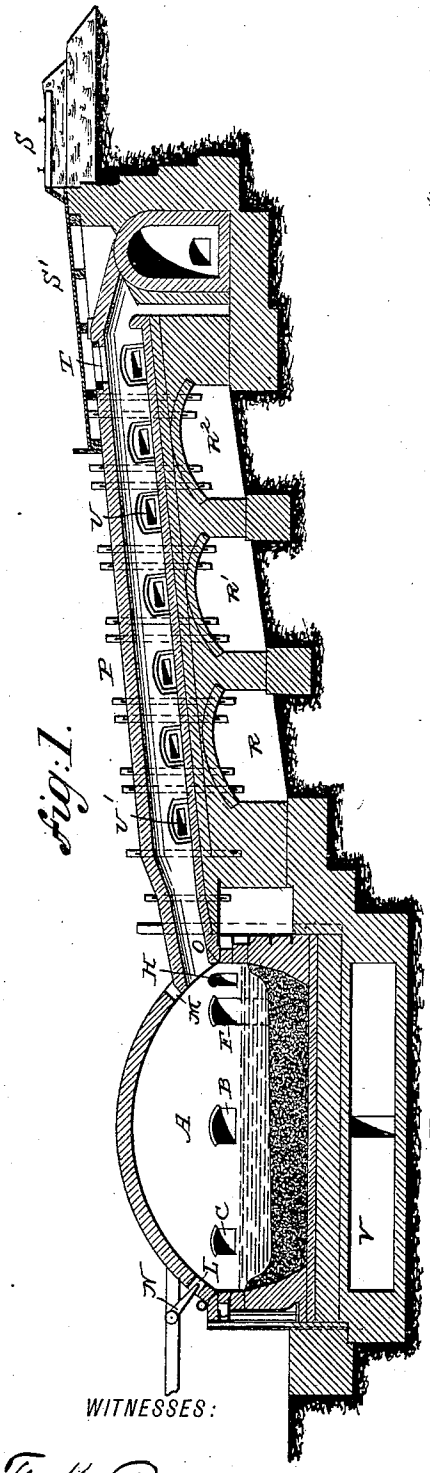

Fig. 1.

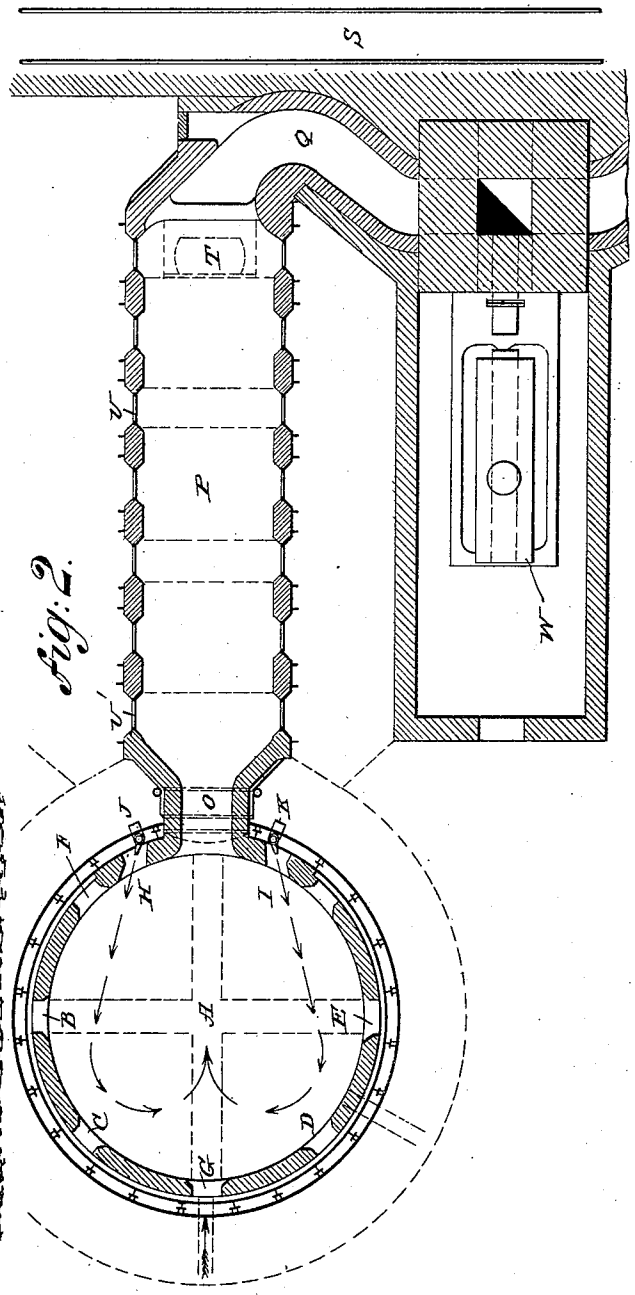

Fig. 2.

WITNESSES:

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CARL SIEMENS, OF ST. PETERSBURG, RUSSIA.

METALLURGICAL FURNACE.

SPECIFICATION forming part of Letters Patent No. 470,712, dated March 15, 1892.

Application filed December 5, 1890. Serial No. 373,710. (No model.)

To all whom it may concern:

Be it known that I, CARL SIEMENS, a subject of the Emperor of Russia, and a resident of St. Petersburg, Russia, have invented certain new and useful Improvements in Metallurgical Furnaces, of which the following is a specification.

My invention relates to a furnace which is adapted to both roast and melt ore for its conversion into pig metal.

My invention further relates to a furnace in which the gaseous fuel used is produced by the decomposition of a hydrocarbon oil, such as petroleum, naphtha, or any residuum due to the distillation of petroleum.

In the treatment of many ores, especially copper, for their reduction to pig metal I have found that a large saving in the cost of reduction could be effected if the whole or a portion of the products of combustion passing from the melting-furnace were employed to heat and roast the ores prior to their being mixed with the required flux and charged into the melting-furnace. When the gaseous fuel employed in melting-furnaces is derived from the decomposition of a hydrocarbon oil, only a portion of the products of combustion are employed to heat the air used in supporting combustion. The balance of the products of combustion have hitherto been employed to fire the boilers and are then carried directly to the chimney.

In my improved furnace I carry the highly-heated products of combustion from the melting-furnace over the ores in a suitable roasting-chamber prior to the admission of such products of combustion into the chimney-stack, and am thus enabled to utilize the heat, which would otherwise be wasted in roasting the ores.

I will now proceed to describe the furnace which I have designed for the above purpose and the method which I employ in operating the same.

In the drawings similar letters of reference indicate like parts.

Figure 1 is a longitudinal vertical section through a melting-furnace and a roasting-chamber connected thereto. Fig. 2 is a sectional plan view of the furnace and roasting-chamber and also shows in plan a gas-fired boiler.

A represents a melting-chamber provided with an arched roof. The melting-chamber I prefer to make circular in section, though it may be elliptical or of any other desired shape. The object of making the chamber circular in section is to prevent any contact between the flame and the walls of the chamber or the material on the furnace-bed, and thereby obtain a better heating effect due to a radiation flame, as fully set forth and described in United States Letters Patent No. 341,285, granted May 4, 1886, to Frederick Siemens, of Dresden, Germany.

The furnace is provided with the working doors B, C, D, and E, through which the roasted and fluxed material may be charged upon the hearth.

F is a tap-hole which is cut lower than the other ports and by which the molten metal is drawn from the lower zone of the melting-chamber.

G is a tap-hole through which the slags are drawn off.

H and I are ports in which are located the hydrocarbon-burners J and K.

L and M are ports in the roof of the furnace through which steam or air blasts may be directed upon the molten metal on the hearth from the jets N.

The hydrocarbon-burners J and K are located so as to direct a spray of diffused fuel toward the sides of the furnace in the direction shown by the arrows.

O is the port through which the products of combustion leave the furnace.

It will be understood that the fuel directed into the melting-chamber A from the burners J and K enters with considerable velocity and traverses the greater part of the body of the chamber and then turns back to leave the melting-chamber by the port O.

P is the roasting-chamber, which is inclined from the melting-chamber upward and supported upon a series of arches R R′ R^2.

Q is a flue leading to the chimney-stack.

S is a railway upon which the ore is car-

ried to the roasting-chamber, S′ a platform, and T the opening through which the ore is charged into the roasting-chamber.

U are working doors in the sides of the roasting-chamber, through which the ore may be stirred and turned over and moved down toward the melting-chamber.

My method of working the furnace is as follows: A charge of four (4) tons of ore at a time is introduced into the roasting-chamber through the opening T. The ore is allowed to remain about twelve (12) hours in the roasting-chamber and is gradually worked down during that time toward the melting-chamber A. At the lowest working door U′ of the roasting-chamber P the ore is taken out and while still red-hot mixed with the required flux and charged into the melting-chamber A through the working doors B C D E. It would be preferable to work the ore directly from the roasting-chamber through the port O into the melting-chamber; but this with certain ores is difficult to accomplish, as the heat near the melting-furnace is so great as to conglomerate the metal, and, further, it is not possible to effect such a thorough admixture with the necessary flux as is now accomplished by the method which I have described. Each charge introduced into the melting-chamber consist of approximately two (2) tons of ore to which the necessary flux has been added. As soon as the first charge has properly melted it is stirred up and a new charge put in. These charges are repeated until the furnace-bed is filled. After the furnace is fully charged as great a heat as possible is maintained in the furnace. For this purpose, in addition to the gaseous flame burning in the furnace, an air-blast is turned on from the jets N through the openings L and M, which materially aids in the formation of slag. The formation and separation of slag from the metal requires considerable time, which is due to the large surface of the hearth. The heat is continued from two (2) to three (3) hours, after which the slag is drawn out through the opening G, and subsequently the molten metal is tapped out through the tap-hole F into ladles or to the casting-pit, as desired, leaving in the furnace a portion of the coarse metal, which serves as a heat-reservoir and materially aids in the reduction of the material subsequently charged over it.

In place of employing jets of air N for aiding in the formation of slag and increasing the heat of the mass of molten metal on the hearth, I may use jets of steam, which serve to heat the molten metal by their oxidizing action and also aid in promoting the formation of slag.

In Fig. 2 of the drawings I have shown a boiler W, which may be fired by a portion of the products of combustion after passing through the roaster P.

In the drawings I have not shown any means of admitting regenerated heated air into the furnace for promoting combustion, as such means are well known and form no part of my invention. It is my practice to place the hydrocarbon-burners about three (3) or four (4) inches from the port-opening of the melting-chamber and to allow the heated air to enter the furnace over the burner, and being heavier than the gas set free from the decomposition of the liquid fuel used in the burners settles through and mingles with it, producing the flame employed in the furnace.

Any suitable hydrocarbon-burner may be employed with a furnace such as described. I, however, prefer to use a hydrocarbon-burner similar to that described in application filed simultaneously herewith of January 28, 1891, Serial No. 379,366.

I do not limit myself to the use of a hydrocarbon-burner with a furnace constructed as described, as it is evident that any gaseous fuel may be employed—for instance, such as that produced in any ordinary "gas-producer" when mingled with regenerated air. Neither do I limit myself to the construction of a roasting-chamber, as shown in the drawings, as this chamber may be given different shapes. With some ores it is preferable to expose them to a high temperature for a short time and with others a low temperature for a greater period. The form of the roasting-chamber may therefore be changed to meet the different conditions required in practice.

I lay no claim herein to the method of working open-hearth furnaces by two horseshoe flames, as herein set forth, but embody it in an application pending herewith and filed in the United States Patent Office December 5, 1890, Serial No. 373,711.

Having thus described my invention, I claim—

1. In a furnace for roasting and melting ore, the combination, with a melting-chamber provided with charging-doors, of an exit-port by which the products of combustion leave the chamber, gas and air ports located on each side of the exit-port in proximity thereto, and an inclined roasting-chamber provided with working doors, one end of said chamber connected directly to the exit-port and the other end to the chimney-stack, substantially as described.

2. In a furnace for roasting and melting ore, the combination, with a melting-chamber provided with charging-doors, of an exit-port by which the products of combustion leave the chamber, hydrocarbon-burners and air-ports arranged on each side of and in proximity to said exit-port, and an inclined roasting-chamber provided with working doors, one end of said chamber connected directly to the exit-port and the other end to the chimney-stack, substantially as described.

3. In a furnace for roasting and melting ore, the combination, with a melting-chamber provided with charging-doors, of an exit-port for the products of combustion, hydrocarbon-burners and air-ports arranged on each side of

said exit-port in proximity thereto, steam or air blast pipes projecting through the roof of said furnace, and an inclined roasting-chamber, one end of which is connected directly to the exit-port and the other end to the chimney-stack, substantially as described.

4. The herein-described method of reducing ores for their conversion into pig metal, which consists in first roasting the ore by subjecting it to a gradually-increasing temperature, subsequently removing said ore from the roasting-chamber and mixing it with the required flux, then charging said roasted and fluxed mass upon a body of melting ore, and finally subjecting it to the reducing action of radiated heat from a freely-developed flame, substantially as described.

5. The herein-described method of reducing ores for their conversion into pig metal, which consists in first roasting the ore by subjecting it to a gradually-increasing temperature, subsequently removing said ore from the roasting-chamber and mixing it with the required flux, then charging said roasted and fluxed mass upon a body of melting ore, and finally subjecting it to the reducing action of radiated heat from a freely-developed flame and to the action of steam or air blasts, substantially as described.

6. The herein-described method of reducing ores for their conversion into pig metal, which consists in first roasting the ore by subjecting it to a gradually-increasing temperature, subsequently removing said ore from the roasting-chamber and while at a high temperature mixing it with the required flux, then charging said roasted and fluxed mass upon a body of melting ore, and finally subjecting it to the reducing action of a gaseous flame, substantially as described.

In witness whereof I have hereunto set my hand and affixed my seal this 3d day of November, 1890.

CARL SIEMENS. [L. S.]

Witnesses:
ALFRED KROEGER,
Commoner of Pernau.
ROBERT LELLEKEN,
Commoner of Narva.