A. W. & C. W. CATTON.

REGENERATIVE FURNACE.

APPLICATION FILED AUG. 10, 1909.

979,647. Patented Dec. 27, 1910.

2 SHEETS—SHEET 1.

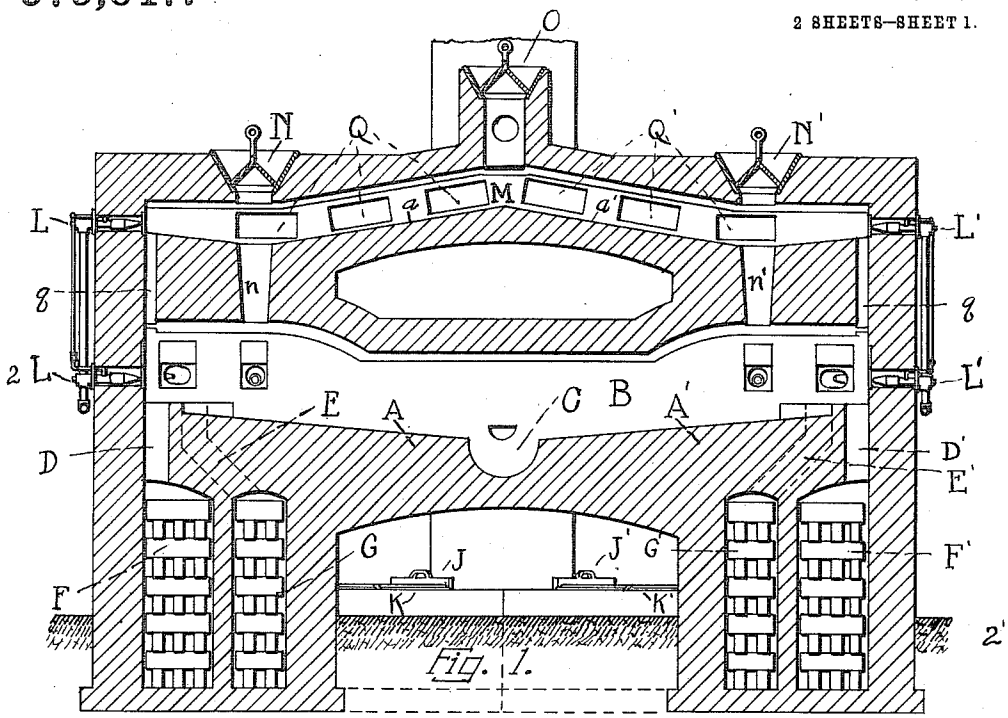

Fig. 1.

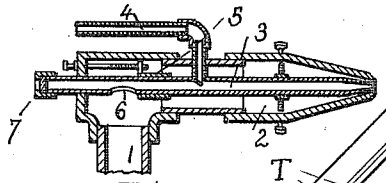

Fig. 3.

Fig. 2.

Witnesses

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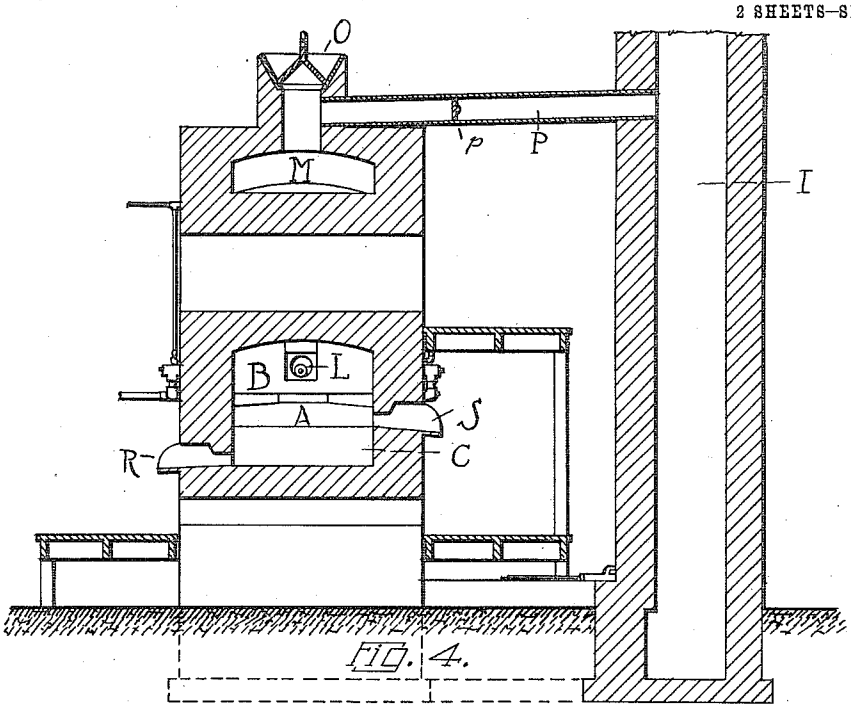

FIG. 4.

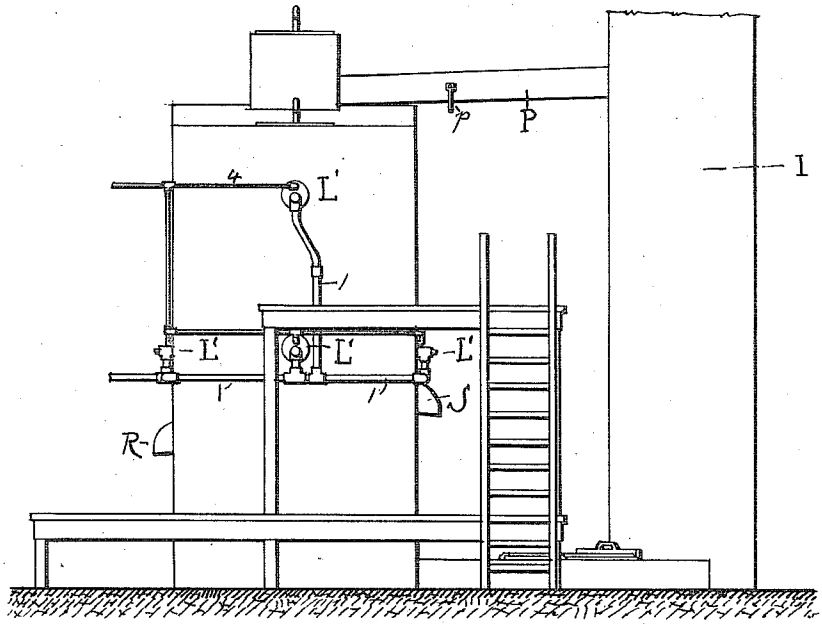

FIG. 5.

Witnesses

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UNITED STATES PATENT OFFICE.

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REGENERATIVE FURNACE.

979,647. Specification of Letters Patent. Patented Dec. 27, 1910.

Application filed August 10, 1909. Serial No. 512,155.

To all whom it may concern:

Be it known that we, ARTHUR W. CATTON and CHARLES W. CATTON, citizens of the United States, residing at the city of West Seattle, in the county of King and State of Washington, have invented certain new and useful Improvements in Regenerative Furnaces, of which the following is a specification.

Our invention pertains to improvements in reverberatory regenerative furnaces designed for the roasting and smelting of ores.

The objects of our invention are: First—to provide a reverberatory furnace in which ores may be roasted and smelted at one and the same time. Second—to provide a furnace in which liquid fuel in the form of crude oil may be used to completely roast and smelt the most refractory ores; and third—to provide a liquid hydrocarbon or crude oil burner to be used in combination with our newly devised roasting and smelting furnace, and with which we are enabled to generate, control and apply an intensely high heat within the furnace, as the character of the ores may require. We attain these objects by means of the contrivance illustrated in the accompanying drawing, in which—

Figure 1 is a vertical section lengthwise through our invention. Fig. 2 is a horizontal section on the line 2—2. Fig. 3 is an enlarged section of one of the crude oil burners, showing its construction. Fig. 4 is a central vertical section of our invention from front to rear, and Fig. 5 is a side elevation of the same.

Similar letters refer to similar parts in the several views.

The general form of our newly improved furnace is constructed on lines similar to the usual form of reverberatory furnaces designed for smelting ores. The hearths A—A′ of the smelting chamber B are inclined to a central lead well C. The ends of the smelting chamber have flue connections D—E and D′—E′ through superheating chambers F—G and F′—G′ and flues H and H′ with the smoke stack I. These flues and chambers are designed to be used alternately to carry off the waste products of combustion and to supply drafts of heated air as the operation of the furnace is changed or reversed from side to side. The draft to the smoke stack I is reversed and controlled by the dampers J—J′ and the intake of fresh air is reversed and governed by the dampers K—K′. The fuel in combustion is supplied alternately through the liquid hydrocarbon burners L—L and L′—L′ located in the walls around each end of the smelting chamber, as shown in Figs. 1 and 2.

The roasting chamber M is located directly above the smelting chamber B and is of equal width and length, with hearths *a*—*a*′ inclined from the center to the charging holes *n* and *n*′ under the charging doors N and N′, the latter designed to receive ores that can be smelted without roasting. The central charging door O is designed to receive highly refractory ores that require roasting before smelting. A smoke pipe P having a damper *p* extends from under the door O to carry smoke and fumes from the roasting chamber M to the smoke stack I. At each end of the roasting chambers are down draft flues *q*—*q*′ designed to convey sulfurous fumes to the smelting chamber to be consumed therein when desired. This is accomplished by closing the damper *p* in the smoke pipe P. In each end wall of the roasting chamber is located a liquid hydrocarbon burner L—L′ to provide the fuel for combustion. The doors Q—Q′ located in the walls of the roasting chamber M are to permit the ore to be turned and worked from the charging door O alternately along the hearths *a* and *a*′ and finally down the openings *n* and *n*′ into the smelting chamber B.

It is to be observed that when in operation, the end of the roasting chamber opposite from that of the smelting chamber is under heat.

Having thus briefly described our newly improved furnace, the operation is as follows:—To charge the roasting chamber M, refractory ore is deposited through the door O and spread over the hearth *a*′ toward the right. If easily smelted ores are available, the smelting chamber B is charged through the door N and opening *n*. The liquid hydrocarbon burner L′ at the right end of the roasting chamber and similar burners L in the walls of the left end of the smelting chamber are turned on until a heat of sufficient intensity to roast the ores on the hearth *a*′ and smelt those on the hearth A is obtained. If the ores in the roasting chamber contain sulfur, the damper *p* in the pipe P is closed and the sulfurous fumes pass down the flues *q* into the smelting chamber where

they are consumed in the more intense heat. The products of combustion from over the hearth A pass to the right over the hearth A′ and still further roast ores that may be worked down through the opening n' from the hearth a'. The waste products of combustion now pass down through the flues D′ and E′, the superheating chambers F′—G′ and out through flue H′ to the smoke stack I, the damper J′ being open and damper J closed. When the ores on hearth A are reduced and run into the lead-well C in the form of slag and molten metal, the furnace is reversed to allow hearth A to be recharged. In the meantime hearth A′ has been charged with ore worked down from hearth a' and with available smelting ores through the door N′. The ores in the roasting chamber are now worked onto the hearth a. The burner L′ of the roasting chamber M and burners L of the smelting chamber B are turned off and burner L of the former and burners L′ of the latter are turned on, the damper J′ is closed and J opened, all of which reverses the working of the furnace from right to left. The air intake damper K is closed and damper K′ opened sufficiently to allow air to pass in through H′ and up through chambers F′—G′, where it becomes highly superheated on entering the smelting chamber B through flues D′—E′ adds much to the combustion of the burners L′. The supply of air is controlled by the damper K′ and the supply of oil is governed by suitable valves in the supply pipes of the burners L′ and L. By this briefly described mode of operation the furnace can be run for an indefinite period, the same being reversed at suitable intervals as conditions may require. The molten metal is drawn off through the lower tap hole R and the slag through the upper tap hole S.

In each of the flues H and H′ side extensions T—T′ are located on the sides at suitable intervals to give the fumes a zigzag course to the smoke stack. A steam pipe U and U′ made to discharge into the flues H and H′ respectively and alternately is designed to be used to precipitate volatilized arsenic from the fumes as they pass therethrough and thus cause them to settle on the floor of the flue. The arsenic thus precipitated can be collected and saved for commercial purposes. Access to the flues for collecting the arsenic can be had through dampers K—K′.

The construction of the liquid hydrocarbon burners L—L′ comprises a novel and essential part of our newly improved furnace and has much to do in its effectiveness and success. This can be understood by referring to Fig. 3. With this burner the oil is delivered into the furnace in a fine spray by means of compressed air supplied by pipe 1 into the outer nozzle 2 and the inner nozzle 3. The crude oil is supplied to the inner nozzle through the pipe 4, while the supply of compressed air is controlled by the sliding sleeve valve 5 made to operate over the intake opening 6. By this means the supply and force of the spray of oil can be varied to meet requirements. The supply of air and oil can be further controlled by means of suitable valves in the pipes 1 and 4, as common with all supply pipes of this character. On the outer end 7 of the inner nozzle pipe is fixed a glass sight hole through which the operator can look to determine the perfection of combustion and the progress of the smelting operation.

Suitable means common to burners of this character will be used to properly adjust them for applying the heat most effectively, and to properly protect them from the heat of combustion within the furnace.

It is to be understood that we do not limit ourselves to proportions and exact dimensions, but reserve the right to change and vary the same as conditions and circumstances may require.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is:—

1. In reverberatory type of regenerative furnace the combination of an upper roasting chamber and a lower smelting chamber, each of said chambers having two hearths oppositely inclined and means for using one of each of said two hearths alternatively, the upper hearth for roasting and the lower hearths for smelting ores substantially as shown and described, and for the purposes set forth.

2. In a reverberatory type of regenerative furnace, the combination of an upper roasting chamber and a lower smelting chamber, each of said chambers having oppositely inclined hearths, and liquid hydrocarbon burners located in the end walls of each of said roasting and smelting chambers, said burners being adapted to furnish liquid hydrocarbon or crude oil for combustion from each end of said chambers alternately, and thus generate the heat required to roast and smelt the ores on the hearths of said chambers, as shown and described and for the purposes set forth.

3. In a regenerative furnace the combination of an upper roasting chamber and a lower smelting chamber, said smelting chamber being located below the roasting chamber, each of said chambers having oppositely inclined hearths designed to be used alternately in roasting and smelting ores in the respective chambers, liquid hydrocarbon burners in the end walls of said roasting and smelting chambers to supply the necessary heat alternately in each end thereof, and said burners being constructed with an outer nozzle to receive and discharge the

compressed air and an inner nozzle to receive and discharge the fuel oil, a sleeve valve intake in said inner nozzle to receive compressed air from the outer nozzle and back of the oil intake, to spray the oil within the furnace for combustion substantially as described and shown.

4. In a reverberatory furnace the combination of a roasting chamber and a smelting chamber, each of said chambers having two oppositely inclined hearths, to be used alternately and simultaneously, each of said chambers being provided with liquid hydrocarbon burners, and each of said burners having a sight hole in the tube of the inner nozzle, as described and shown and for the purposes set forth.

5. A reverberatory furnace having an upper roasting chamber with hearths oppositely inclined toward the end of said chamber, and a lower smelting chamber with hearths oppositely inclined toward a central lead well, each of said roasting and smelting chambers being provided at opposite ends with liquid hydrocarbon burners, as described and shown, and suitable flues and superheating chamber connections with the smokestack whereby from each end of the furnace the draft may be changed alternately from end to end, and superheated air furnished alternately therethrough to aid in the combustion of the fuel oil as described and shown.

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

ARTHUR W. CATTON.
CHARLES W. CATTON.

Witnesses:
M. A. BUTLER,
THOMAS A. MEADE.