No. 726,861. PATENTED MAY 5, 1903.

A. W. CATTON.

FURNACE FOR ROASTING AND SMELTING ORES.

APPLICATION FILED MAR. 11, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

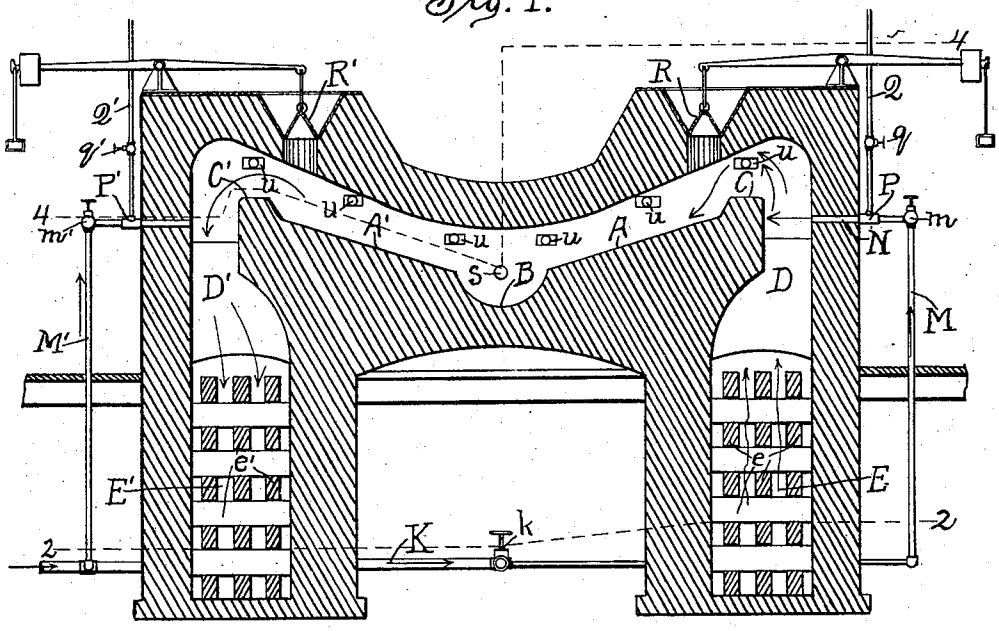
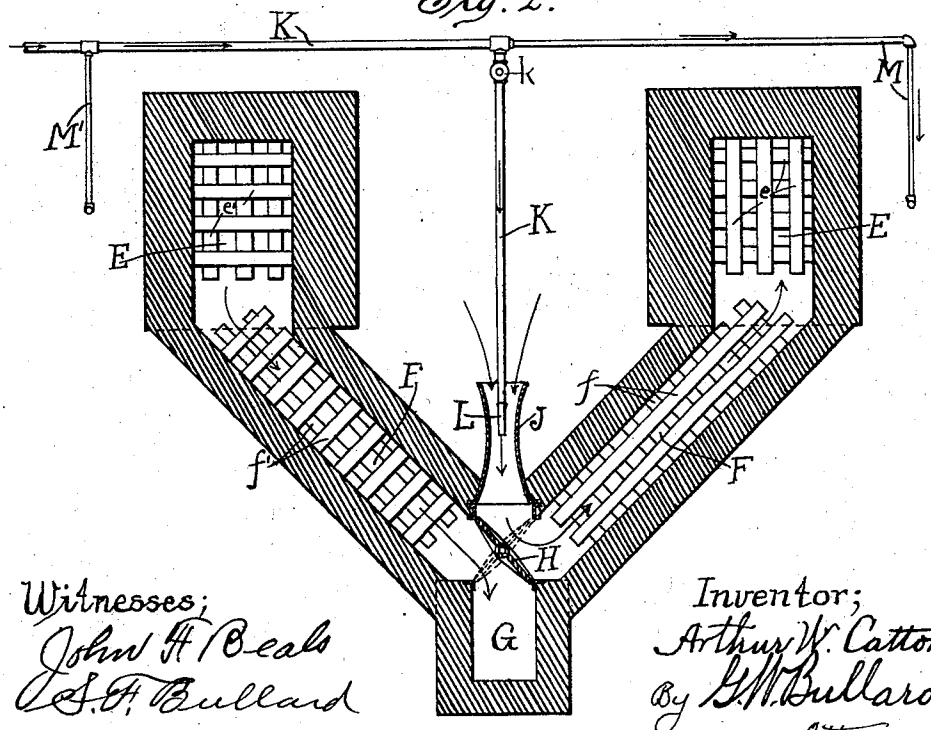


Fig. 2.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 3.

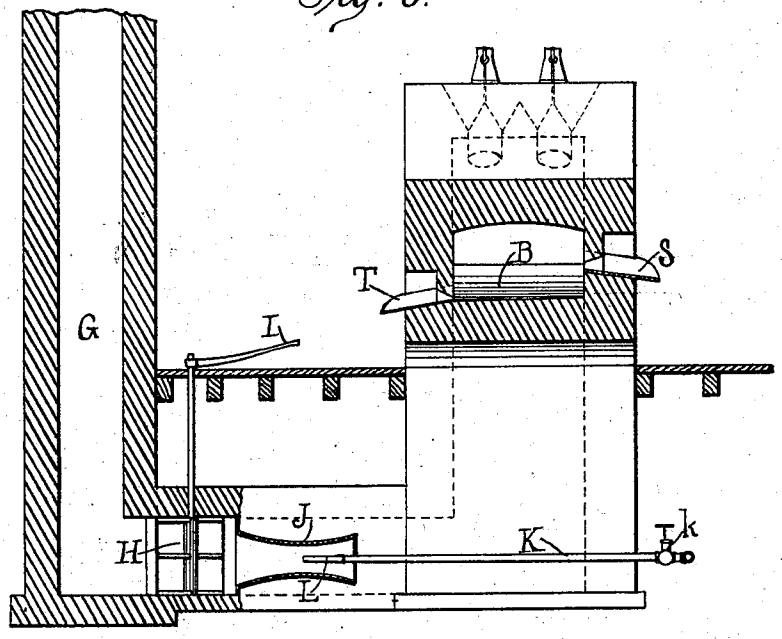
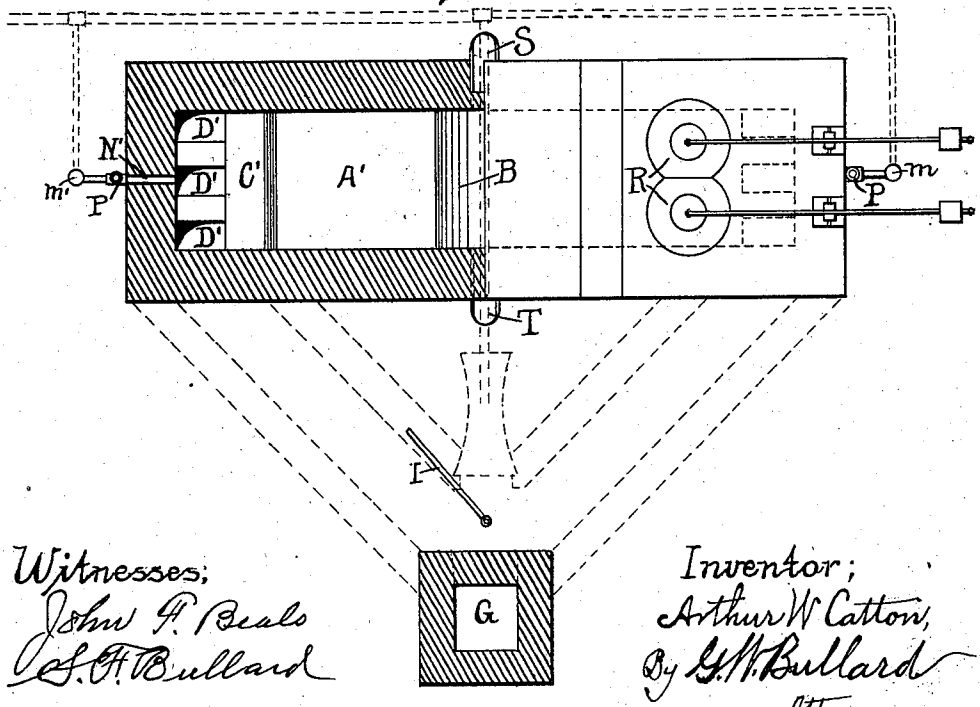


Fig. 4.



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UNITED STATES PATENT OFFICE.

ARTHUR W. CATTON, OF WEST SEATTLE, WASHINGTON.

FURNACE FOR ROASTING AND SMELTING ORES.

SPECIFICATION forming part of Letters Patent No. 726,861, dated May 5, 1903.

Application filed March 11, 1902. Serial No. 97,697. (No model.)

To all whom it may concern:

Be it known that I, ARTHUR W. CATTON, a citizen of the United States, residing at West Seattle, in the county of King and State of Washington, have invented certain new and useful Improvements in Furnaces for Roasting and Smelting Ores, of which the following is a specification.

My invention relates to furnaces for roasting and smelting ores and in which gaseous fuel is used, said gaseous fuel being generated within the furnace from liquid hydrocarbons.

The objects of my invention are, first, to so generate and combine the hydrocarbons in a manner that will prevent explosion and waste of fuel, and, second, to produce a furnace of such form that the highest combustion and heat is produced and applied directly on the ores, and thus prevent the burning of the lining of the furnace unnecessarily, as is commonly done in furnaces of this kind when hydrocarbon gases are used. I attain these objects by means of the form of furnace illustrated in the accompanying drawings, in which—

Figure 1 is a vertical section lengthwise of my invention, showing the form of the furnace. Fig. 2 is a plan section at 2 2 and shows the arrangement of the alternating flues and superheating-chambers and the means for applying and reversing the forced draft. Fig. 3 is a central vertical cross-section of my invention, and Fig. 4 is a half plan section and half top view of the furnace on line 4 4.

Similar letters refer to similar parts in the several views.

My invention comprises a roasting and smelting furnace, as illustrated in Fig. 1. It has a hearth A A′, inclined to a central bullion-well B. At each end of the hearth is a bridge-wall C C′ of suitable height and width and over which the fuel gases and vapors pass as they unite in combustion. Outside of each bridge-wall are flues D D′, connecting the furnace with superheating-chambers E E′, and these chambers are each connected, by means of the horizontal flues F and F′, with the smoke-stack G. A gate-damper H, pivotally mounted at the junction of F and F′ with G and operated by the lever-arm I, provides a means for connecting and disconnecting the flues F and F′ with the smoke-stack G alternately. The flues F and F′ and the chambers E and E′ are each filled with a checker-work of suitable refractory materials to alternately receive heat from the waste products of combustion passing therethrough and to alternately impart the heat thus received to the air and steam forced therethrough. These refractory materials are designated by *e e′* and *f f′*, respectively, and are means commonly used in alternating furnaces where the air and fuel-gases are to be superheated before combustion.

Prior to my invention furnaces designed to generate and use hydrocarbon gases for fuel have been so constructed as to mix the steam and liquid carbon within the chambers and flues of refractory material, and thus generate the hydrocarbon gas therein before reaching the furnace and mixing with the heated air from a separate chamber at the bridge-wall or port to the furnace. This manner of generating the fuel-gases is accompanied with more or less danger from explosion, and difficulty in controlling the heat is also experienced. The application of the greatest heat to the ore is not obtained steadily, often resulting in the damaging of the furnace and a failure to obtain the desired result on the ore under treatment. I obviate these difficulties by a different and more simple method of generating and applying the fuel-gases and liquid carbons, as indicated by the improvements shown in the drawings and as herein described.

Between the alternating flues F and F′ and adjoining the gate-damper H is located a sleeve-shaped air-intake J, designed to supply air alternately to the opposite ends of the furnace. A steam-pipe K, connected with a steam-boiler near by, supplies steam at any desired pressure through a nozzle-outlet L at the center of the sleeve-shaped intake J. By this means a forced draft of live steam and fresh air can be put through the furnace and alternated from side to side at suitable intervals by means of the gate-damper H. The supply and force of the steam can be so controlled by the valve K as to secure any desired force in the draft. The steam and air is forced through the checker-work of refractory materials of the superheating flues and chambers and through the furnace, as indicated by the arrows.

The liquid carbon is introduced alternately at the sides of the furnace at a suitable point below the top of the bridge-wall. To do this, I add branch pipes M and M′ to the steam-pipe K, with valves *m* and *m′* and connections to discharge through the furnace-walls at N and N′. With these connections, by means of suitable injectors P and P′, I connect oil-supply pipes Q and Q′, each provided with a valve *q q′*, respectively. By this means I introduce liquid hydrocarbon, preferably coal-oil in the crude state. The supply of oil and steam is controlled by means of the valves on the respective pipes.

The feed-hoppers R R′, the slag-port S, and the bullion-port T complete my furnace for operation. The eyeholes *u* enable the operator to inspect the interior of the furnace while in operation.

Preparatory to operating my invention the furnace is first heated by placing suitable fuel through the feed-hoppers into the furnace and firing the same till the furnace and checker-work become red-hot. This can be done by reversing the draft at suitable intervals by means of the gate-damper H. When the furnace is sufficiently heated, the valve K is opened and live steam is discharged through the nozzle L into the sleeve-intake J. This discharge of steam draws air into the sleeve-intake and forces the same through the flue F and chamber E, where both steam and air coming in contact with the refractory materials located therein become highly superheated, suitable for combustion. At the same time steam and oil is turned on at *m* and *q*, the force of the steam driving the oil through the hot draft of steam and air now coming up through the flues D. The steam and oil striking the face of the hot bridge-wall C at once vaporizes and rises with the draft of steam and air and unites in combustion therewith. The heated gases and vaporized hydrocarbon thus united in combustion strike the curved angle and roof of the furnace and are abruptly turned downward against the hearth A at a time when the combustion is most complete and the heat is at the highest degree of intensity. This places the ore deposited on the hearth directly under this high heat, which reduces them to slag and bullion at the shortest time practicable. The products of combustion pass through the furnace and out the opposite flues D′, through the chamber E′, the flue F′, and up the smoke-stack G, and thus heat the checker-work of refractory materials to a high degree preparatory for a change of the draft to the opposite side of the furnace.

When the checker-work in the right side of the furnace becomes partly cooled, the draft is reversed by means of turning the gate-damper H. The oil-supply is shut off at *q* and turned on at *q′*, and the fuel combustion is put in operation at the opposite side of the furnace. The refractory materials in the right side of the furnace are now reheated for the next alternate change. In this way the furnace heat will be produced alternately in the two sides of the furnace and the operation continued indefinitely.

It is to be observed that ore is to be kept on both hearths of the furnace in order to utilize the full capacity of the furnace. I preferably purpose charging the furnace alternately at the end opposite the heat combustion. By so doing the ores will become well heated and roasted before being directly exposed to the intense heat of the flames when the furnace is reversed. The furnace can thus be charged without chilling the mat or the hearth and the best results be obtained. As the ore becomes reduced, the bullion collects in the well B and is drawn off at the tap-hole T and the slag at the tap-hole S.

My furnace, as herein described, I have found to produce highly-satisfactory results and to attain the objects desired. With my improvement I can control the heat and apply it directly on the ores without injury to the furnace from the intense heat. I also produce a maximum amount of heat out of the fuel used and avoid liability of waste or explosion.

It is to be observed that my invention is susceptible to modifications and that I have not limited myself to details of construction, but have briefly outlined the ideas involved, so as to set forth in a clear and concise manner the novelty of my invention. I reserve the right to construct the furnace of such proportions and with minor details commonly in use as prevailing circumstances and conditions may require.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A furnace for roasting and smelting ore having hearths and a central bullion-well, the hearths of said furnace sloping toward the central bullion-well and having bridge-walls at their outer sides, the top of said furnace being curved above said hearth and above flues leading upward from side superheating-chambers so as to deflect and direct the flames against the ores on the hearths, charging-hoppers at the point where the flames are directed from the flues to and over the hearths, superheating-chambers at each side of the furnace, superheating-flues leading from said chambers and forming a junction with a smoke-flue, a pivoted gate-damper at the junction of said flues to change the draft alternately from one side of the furnace to the other, and a steam-nozzle within a sleeve-shaped air-intake discharging against said gate-damper and imparting a forced draft to said furnace substantially as described and shown.

2. A furnace for roasting and smelting ores, said furnace having flues and chambers connecting its two sides with a smoke-stack, said flues and chambers having checker-work of re-

fractory materials therein, a steam-nozzle surrounded with a sleeve-shaped air-intake imparting a forced draft of steam and air through said flues and chambers alternately, said steam and air being highly superheated while passing through said flues and chambers containing checker-work of refractory materials, bridge-walls at the side of the furnace, and means for injecting a spray of steam and oil against the bridge-walls at the side of the furnace, said spray mingling with and combining in combustion with said highly-heated draft of steam and air as all come in contact with the ores on the hearths of said furnace alternately, substantially as described, and for the purposes set forth.

3. In a furnace for roasting and smelting ores, the combination of oppositely-disposed chambers containing heat-absorbing refractory material, a hearth interposed between and in communication with said chambers at one end thereof and provided with bridge-walls at opposite ends, a curved deflecting wall at the ends of the oppositely-disposed chambers where they communicate with the hearth, means for projecting a heat-producing agent against the bridge-wall, a stack, flues connecting the stack with the oppositely-disposed chambers, a valve located at the junction of the stack and flues, and means for injecting steam and air into said flues at their junction and impelling it into the chambers, substantially as described.

4. In a furnace for roasting and smelting ores, the combination of oppositely-disposed chambers containing heat-absorbing refractory material, a hearth interposed between and in communication with said chambers at one end thereof, a stack in communication with both of said chambers, a valve for alternately closing communication between said stack and one of said chambers and opening communication with the other chamber, means for injecting steam and air into one end of the chambers containing the refractory material, and means for injecting oil and steam into said chamber at the end where the steam and air admitted at the opposite end pass to the hearth, substantially as described.

5. In a furnace for roasting and smelting ores, the combination of oppositely-disposed chambers containing heat-absorbing refractory material, a hearth interposed between and in communication with said chambers at one end thereof, a bridge-wall at opposite ends of the hearth at the point where the oppositely-disposed chambers communicate with the hearth, flues in communication with the oppositely-disposed chambers at the other end thereof, a stack in communication with said flues, an air-intake in communication with said flues at the junction thereof with the stack, a valve located at the junction of the stack with the flues which communicate with the oppositely-disposed chambers, said valve being adapted for alternately opening communication between one of the flues and stack and closing communication between the stack and other flue and air-intake, a steam-jet pipe located in the air-intake and adapted to draw air into the intake and impel it into and through one of the oppositely-disposed chambers, and means for injecting steam and oil against the bridge-wall at the point where the steam and air pass from the chamber to the hearth, substantially as described.

6. In a furnace for roasting and smelting ores, the combination of oppositely-disposed chambers containing heat-absorbing refractory material, a hearth interposed between and in communication with said oppositely-disposed chambers at one end thereof, flues in communication with the other end of said oppositely-disposed chambers, a stack in communication with said last-mentioned flues, a valve located at the junction of said stack and the flues in communication therewith for cutting off communication between the stack and one of said flues and establishing communication between the stack and the other flue, in alternation, means for impelling air and steam through the oppositely-disposed chambers, a heat-absorbing wall at one end of each of the oppositely-disposed chambers at or adjacent to the point where the chambers communicate with the hearth, and means for impelling steam and oil against said wall for vaporizing the oil, substantially as described.

7. A furnace for roasting and smelting ores comprising oppositely-disposed chambers containing heat-absorbing refractory material, a hearth interposed between and in communication with said oppositely-disposed chambers at one end thereof, flues in communication with the oppositely-disposed chambers at the other end thereof, a stack in communication with said last-mentioned flues, an air-intake in communication with said flues at the junction thereof with the stack, a valve located at the junction of the stack with the flues which communicate with the oppositely-disposed chambers, said valve being adapted to alternately open communication between one of the flues and stack and close communication between the stack and other flue and air-intake, a steam-jet pipe to draw air into the intake and impel it into one of the oppositely-disposed chambers through the flue in communication therewith, a heat-absorbing wall at one end of each of the oppositely-disposed chambers at or adjacent to the point where the chambers communicate with the hearth, and means for injecting steam and oil against said wall for vaporizing the oil, substantially as described.

In testimony whereof I affix my signature in the presence of two witnesses.

ARTHUR W. CATTON.

Witnesses:
J. F. DOUGLAS,
NEVA B. DOUGLAS.