Feb. 16, 1932. C. LEGRAND 1,845,503

PYRO-METALLURGICAL PROCESS AND APPARATUS

Filed May 15, 1928 2 Sheets-Sheet 1

Fig. 1.

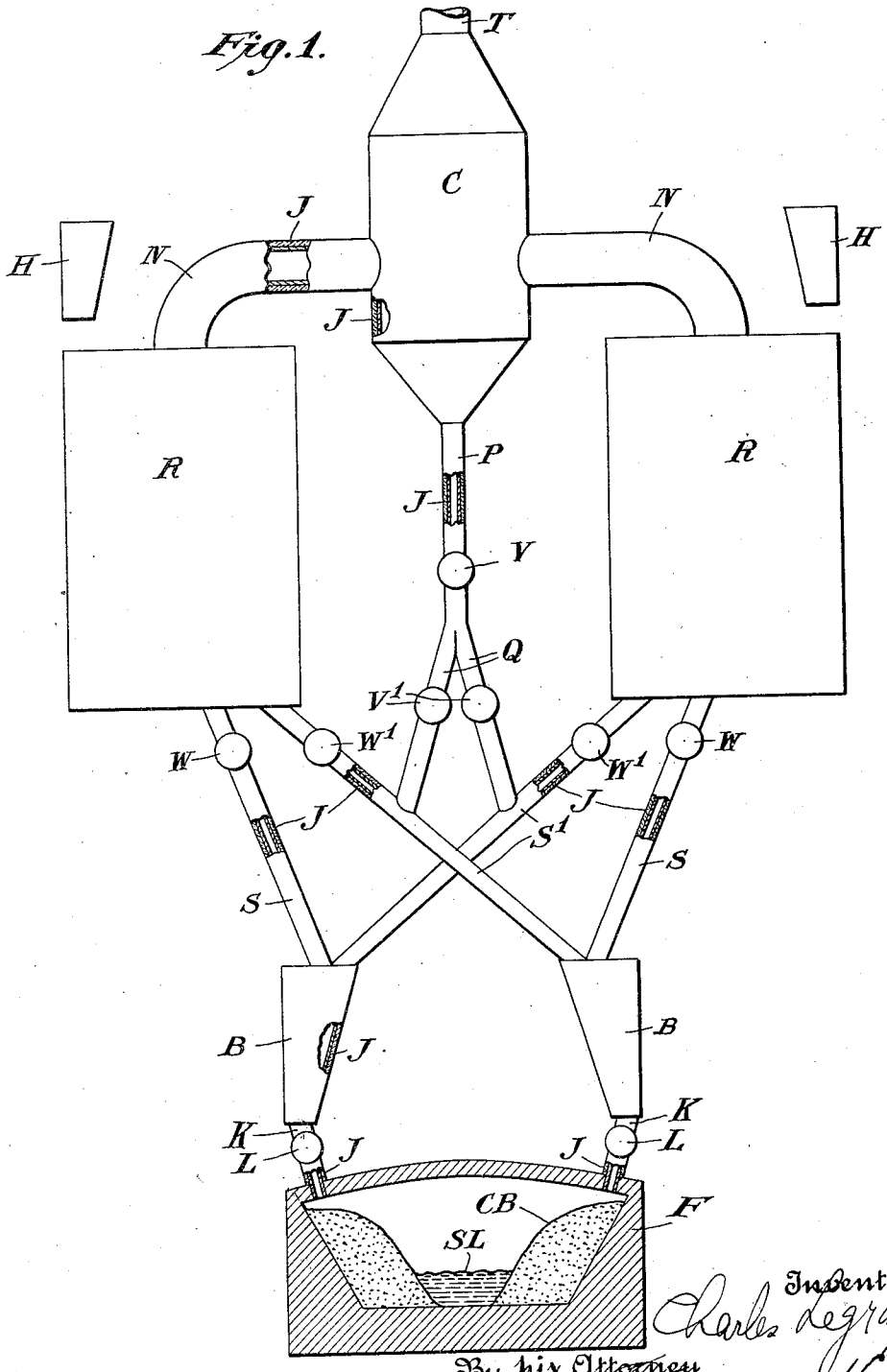

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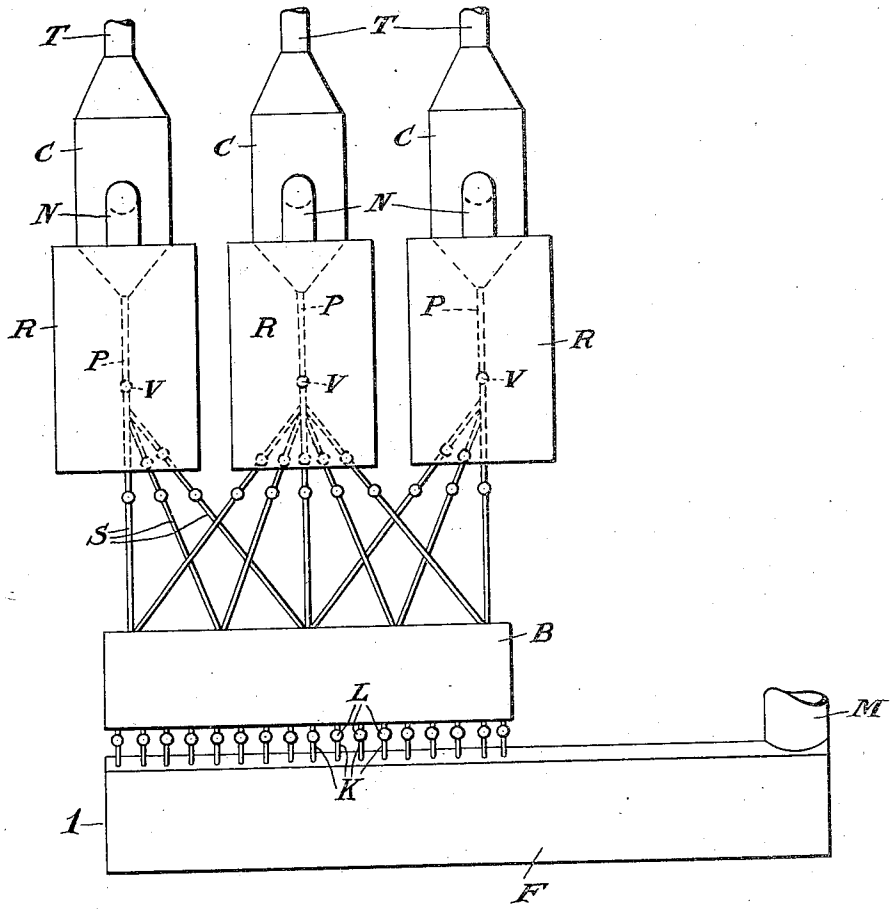
Fig. 2.



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UNITED STATES PATENT OFFICE

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PYRO-METALLURGICAL PROCESS AND APPARATUS

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My invention relates to pyro-metallurgical apparatus including a smelting furnace, roasters and Cottrells, or other dust-collecting devices, and has for its principal object the arrangement of the Cottrells and roasters in relation to the furnace to provide improved distribution of Cottrell dust, and calcines from the roasters, in such manner that the different materials are properly mixed or averaged, and collected for supply to the furnace.

The invention was developed with especial reference to smelting copper ores, and the apparatus chosen for illustration therefore includes a reverberatory copper matting furnace of any known or suitable design; but the invention is not necessarily limited as to the type of furnace or the character of ore.

In study and experiments directed to increasing the efficiency of smelter plants of this class, I have discovered and demonstrated that improved results and especially a great increase in furnace tonnage with relatively low fuel ratio is obtained by securing a thorough distribution and mixture of the calcines from a plurality of roasters, and also similarly distributing the dust from a plurality of Cottrells or other dust collectors, and associating or mixing it with the calcines so that varying characteristics of the materials, such, for example, as different degrees of oxidation of the iron content in the calcines or Cottrell dust, either or both, may be compensated for by the thorough distribution, mixing or averaging of the different materials, and that further, by practically-continuously charging the mixed material into the furnace at frequent intervals along its length to maintain the charge bank therein at proper maximum, proper slag formation is greatly facilitated, and other improved results obtained, as sufficiently understood by persons skilled in this art.

To these and other ends, the invention, as embodied in an apparatus, comprises a suitable furnace, one or more receiving or storage bins, a plurality of Cottrells, or other dust collectors, and a plurality of roasters located above the furnace at suitable elevations to provide for proper supply and distribution of the different materials to different locations in the bin or bins, with means for quickly and frequently supplying the material from the bins to the furnace. While in a broader aspect of the invention various means may be provided for securing the proper supply or distribution of the various materials from Cottrells and roasters to the storage bins, gravity flow or supply is preferable for many reasons, and therefore the Cottrells and roasters are at sufficient elevation above the furnace to provide for gravity flow of the materials through conduits under control of valves to the bins, and for the gravity flow of the mixed and "averaged" materials from the bins to the furnace through a plurality of closely-spaced conduits, under the control of valves, so that while the charging of the furnace is actually intermittent the effect is practically that of continuous charging.

Considered as a method, the invention consists, as broadly described, in controllably supplying dust from a plurality of Cottrells and/or calcines from a plurality of roasters, and mixing or averaging the materials, collecting them and then supplying the mixed materials in properly distributed manner to the charge banks in the furnace.

The roasters for each furnace may be arranged in one or two rows; the distributing means or conduits are preferably arranged for supply or distribution of the calcines from each of the roasters to the storage bin or bins, both longitudinally and laterally with respect to the furnace; and for similar supply or distribution of the dust from each of the Cottrells, particularly with respect to the furnace length or length of the charge banks therein; and in a battery of furnaces provision may be made for lateral distribution of the respective materials for supply to one or more adjacent furnaces.

The characteristics and advantages of the invention are further sufficiently explained in connection with the following detail description of the accompanying drawings, which shows one representative embodiment. After considering this example, skilled persons will understand that many variations

may be made without departing from the principles disclosed, and I contemplate the employment of any methods or structures that are properly within the scope of the appended claims.

The drawings are substantially diagrams showing only structures and arrangements essential to the invention, other parts or mechanisms commonly used in such apparatus being omitted for the sake of simplicity and clearness of illustration.

Fig. 1 is a view, partly in end elevation and partly in section, of apparatus embodying the invention in one form.

Fig. 2 is a side elevation on a smaller scale.

In the form chosen for illustration, the furnace F is a reverberatory copper matting furnace in which a charge bank CB is to be maintained at either side at as high a level as possible without touching the roof. These charge banks extend from the firing end 1, Fig. 2, toward the stack M, and provide between them a trough or slag channel in which the slag level SL is preferably maintained about as shown in Fig. 1.

At a suitable elevation above the furnace are any suitable number of roasters R, arranged in the present instance in two rows, one toward each side of the furnace, although in some cases there may be a single row located directly above the furnace. Also located at a suitable height above the furnace and preferably somewhat above the roasters are any suitable number of dust collectors, such as Cottrells C. The Cottrells may be arranged in a single row between the rows of roasters, or if the roasters are in a single row may be interspaced with them. Gases discharged from the roasters are conveyed to the Cottrells through flues or conduits N. Hoppers H are arranged above the roasters to receive the ore or ore mixture, for supply to the roasters. A storage or receiving bin B is located above and along each side of the furnace, to correspond with the present charge bank arrangement, that is, for side feed to the furnace. The lengths of the bins are coextensive, substantially, with the lengths of the charge banks. Each long bin may be considered equivalent to a plurality of separate bins, arranged in a row.

A plurality of calcine conduits S and S^1 lead downward from each roaster for the discharge therefrom of the calcined material under control of valves W and W^1 respectively. These conduits are arranged to provide for distribution of the calcines from each roaster to each of the receiving or storing bins and to a plurality of points or locations lengthwise of each bin; thus the conduits S as shown in Fig. 2 are arranged vertically or angularly in relation to the length of the bin at the corresponding side of the furnace to effect the desired longitudinal distribution therein of the material from each roaster, and conduits S^1 are similarly arranged for a similar distribution of material lengthwise of the bin at the opposite side of the furnace.

Dust conduits P extend downward from the bottom of the Cottrells for the discharge therefrom of dust under control of valves V. Provision is made for distribution of the dust from each Cottrell to the different bins and also for distribution longitudinally of each bin, and this may be done in different ways. In the arrangement shown each conduit P is branched or connected to other conduits Q, each of which connects to one of the conduits S^1 from an adjacent roaster, valves V^1 being provided to control flow through the branch conduits Q.

The Cottrells are of any known or suitable type in which dust carried by gases from the roasters is precipitated by high tension electrical discharge. The roasters also may be of any known or suitable type, usually a type having a plurality of superposed hearths and mechanical means for moving the ore, showing of such mechanism being omitted for the sake of simplicity. Air for oxidation is admitted to the roasters (through conduits not shown) at the lower hearth and thence flows through the roasters, and passes out of the roasters into the corresponding Cottrell through the conduits N. The upper ends of the Cottrells are connected to the stack by flues or conduits T.

In order to obtain the highest furnace tonnage with low fuel ratio the roasters are desirably operated at the highest temperature which is practicable without sintering; and for the greatest practical heat economy the principal parts of the apparatus and especially the Cottrells, roasters, storage bins and the various conduits are heat-insulated as by sheathing or jackets J of suitable heat-insulating materials.

The bottoms of the storage bins are connected at frequent longitudinal intervals with ports in the upper wall or roof of the furnace near the sides thereof, by charge-supply conduits K under control of valves L.

In operation, the various valves are operated to obtain an approximately uniform distribution and mixture of the dust and calcines to the different storage bins, and also to different points through the lengths thereof. Thus by operation of valves W the flow of calcines from any roaster R may be directed through the various conduits S to any of several different points longitudinally of the bin B at the corresponding side of the apparatus, and by operation of valves W^1 a similar distribution may be obtained to the bin at the opposite side. The calcines from the various roasters are therefore distributed to each of several different points throughout the lengths of the bins and substantially thoroughly mixed, or in other words the calcines from the different roasters are substantially

averaged to provide a very uniform accumulation of calcined material for feeding to the charge banks by manipulation of valves V and V^1. The dust from each Cottrell is supplied to each of the bins and distributed longitudinally thereof, this distribution being effected in the present example by connecting the discharge ends of the branch conduits Q to the calcine conduits S^1. The arrangement also provides for the thorough mixing of the Cottrell dust with the calcine and more effective charging of the dust into the furnace along with the calcine. Otherwise if the dust were fed directly to the furnace a large part of it would be blown out of the furnace without fusing, requiring re-collection of the dust from the flue gases, and causing accretions between the tubes of the furnace waste-heat boilers, etc.

The thoroughly mixed and distributed or averaged materials collected in the storage bins are fed to the charge bank at frequent intervals through the closely spaced conduits K under control of valves L so that the charge banks may be kept practically constantly replenished up to the desired maximum height and throughout their lengths; and while the feeding of the mixed or averaged material to the furnace is actually intermittent it is in effect practically continuous in that the charge banks may be maintained substantially-constantly at proper maximum height or volume for maximum furnace tonnage.

When a battery of furnaces is provided, a similar lateral and longitudinal distribution of material from each set or row of roasters and Cottrells may be made to storage bins of adjacent furnaces.

It is evident that in its preferred form, providing for gravity feed of all the materials, the invention dispenses with relatively complicated conveyors or other mechanical devices, and practically eliminates the necessity for shut-downs which would occur frequently if such mechanism were employed for analogous purposes.

The gravity feed arrangement does not require an excessive overall height of the plant or installation, since I have demonstrated that the materials and especially the calcines, when the roasters are properly operated, will in some cases flow through the conduits without clogging or sintering therein when the conduits have an inclination of only 30° from the horizontal; and a 38° inclination is ample to provide for proper flow of all calcine mixtures.

I claim:

1. Pyro-metallurgical apparatus comprising a furnace, a plurality of roasters and a plurality of Cottrells all located at a substantial height above the furnace, and means comprising closed conduits between the roasters the Cottrells and the furnace for controllably flowing by gravity the calcines from each of the roasters and dust from each of the Cottrells, mixing the different materials thus forming a furnace-charge supply-mixture in which the variations in characteristics of the respective materials are substantially averaged, and distributively feeding the mixed material to one or more charge banks in the furnace.

2. Pyro-metallurgical apparatus comprising a furnace in which charge banks of substantial length are maintained along its sides, roasters located at substantial elevations above the furnace, valved conduits leading from each of the roasters and arranged for gravity distribution and mixing of the calcines from the roasters both longitudinally or laterally of the furnace, and means for controllably feeding the mixed calcines to the charge banks throughout their lengths.

3. Pyro-metallurgical apparatus comprising a furnace in which charge banks of substantial length are maintained along its sides, roasters located at substantial elevations above the furnace, valved conduits leading from each of the roasters and arranged for gravity distribution and mixing of the calcines from each roaster both longitudinally or laterally of the furnace, and means for controllably feeding the mixed calcines by gravity-flow to the charge banks throughout their lengths.

4. A smelting plant of character described, comprising a reverberatory copper matting furnace in which a longitudinal charge bank is maintained, an elevated collecting bin substantially paralleling the furnace, a plurality of roasters elevated above the bin, a plurality of valved conduits leading from each roaster to different locations longitudinally of the bin, for gravity supply of the calcines from the various roasters and collection of the mixed and averaged material throughout the bin length, and valved conduits arranged for gravity supply of the mixed material from the bin to the charge bank throughout its length.

5. A smelting plant of character described, comprising a reverberatory copper matting furnace in which a longitudinal charge bank is maintained, an elevated collecting bin substantially paralleling the furnace, a plurality of roasters elevated above the bin, a plurality of valved conduits leading from each roaster to different locations longitudinally of the bin, for gravity supply of the calcines from the various roasters and collection of the mixed and averaged material throughout the bin length, a plurality of Cottrells elevated above the bin, and a plurality of valved conduits leading from each Cottrell and arranged for gravity supply of dust from each Cottrell to a plurality of locations longitudinally of each bin and mixture of the dust with the calcines therein.

6. A smelting plant of character described, comprising a reverberatory copper matting furnace in which charge banks are maintained along the sides, elevated collecting bins substantially paralleling the furnace sides, a plurality of roasters elevated above the bins, the roasters being arranged in rows in lateral relation to the furnace, a plurality of valved conduits leading from each roaster to different locations longitudinally of each bin, for gravity supply of the calcines from the various roasters and collection of the mixed and averaged material throughout the bin lengths, and valved conduits arranged for gravity supply of the mixed material from the bins to the respective charge banks throughout their lengths.

7. A smelting plant of character described, comprising a reverberatory copper matting furnace in which charge banks are maintained along the sides, elevated collecting bins substantially paralleling the furnace sides, a plurality of roasters elevated above the bins, the roasters being arranged in rows in lateral relation to the furnace, a plurality of valved conduits leading from each roaster to different locations longitudinally of each bin, for gravity supply of the calcines from the various roasters and collection of the mixed and averaged material throughout the bin lengths, a plurality of Cottrells elevated above the bins, a plurality of valved conduits leading from each Cottrell and arranged for gravity supply of dust therefrom to a plurality of locations longitudinally of each bin and mixture of the dust with the calcines therein.

8. A smelting plant of character described, comprising a reverberatory copper matting furnace in which charge banks are maintained along the sides, elevated collecting bins substantially paralleling the furnace sides, a plurality of roasters elevated above the bins, the roasters being arranged in rows in lateral relation to the furnace, a plurality of valved conduits leading from each roaster to different locations longitudinally of each bin, for gravity supply of the calcines from the various roasters and collection of the mixed and averaged material throughout the bin lengths, a plurality of elevated Cottrells, a plurality of valved conduits leading from each Cottrell and connected to different conduits leading from the roasters, for gravity supply of Cottrell dust and mixing thereof with the calcines in the calcine conduits.

9. A method of supplying calcines from a plurality of roasters to a furnace, comprising controllably discharging the calcines from each of the roasters, mixing the respective materials, supplying the mixed and averaged materials controllably to the charge bank in the furnace, and retaining said materials in closed conduits from the roasters to the furnace.

10. A method of supplying calcines from a plurality of roasters to a furnace, comprising controllably discharging the calcines from each of the roasters, mixing the respective materials, supplying the mixed and averaged materials controllably to the charge bank in the furnace at frequent intervals throughout its length, and retaining said materials in closed conduits from the roasters to the furnace.

11. A method of supplying calcines and dust, respectively, from a plurality of roasters and a plurality of Cottrells to a furnace charge bank, comprising controllably discharging the calcines from each of the roasters and dust from each of the Cottrells to each of a plurality of locations relative to the charge bank, and substantially mixing and averaging the different materials, controllably feeding the mixed material to the charge bank at frequent intervals throughout its length, and retaining said materials in closed conduits during the feeding operation to the furnace.

12. A method of supplying calcines from a plurality of elevated roasters to a furnace, comprising controllably discharging the calcines by gravity flow, from each of the roasters, and mixing the respective materials and supplying the mixed materials controllably to the charge bank in the furnace.

13. A method of supplying calcines and dust, respectively, from a plurality of elevated roasters and Cottrells, comprising controllably discharging the materials by gravity flow from each of the roasters and Cottrells, mixing the respective materials in a charge-mass of substantial uniformity, and feeding the mixed material controllably to the charge bank in the furnace at frequent intervals throughout its length.

14. In an ore reducing plant, the combination with a reverberatory furnace, of a group of roaster furnaces disposed over said reverberatory furnace, said roaster furnaces having a plurality of openings in their bottoms, and a plurality of pipes or chutes for delivering the product of said roaster furnaces, passing through said openings, to said reverberatory furnace by gravity.

15. In an ore reducing plant, the combination with a reverberatory furnace, of a group of roaster furnaces disposed over said reverberatory furnace, said roaster furnaces having a plurality of openings in their bottoms, a plurality of pipes or chutes for delivering the product of said roaster furnaces, passing through said openings, to said reverberatory furnace by gravity, and hoppers interposed between the roaster furnaces and said reverberatory furnace and into which hoppers the product of said roaster furnaces is delivered during its travel from said roaster furnace to said reverberatory furnace.

16. In an ore reducing plant, the combination with a reverberatory furnace, of a group

of roaster furnaces disposed over said reverberatory furnace, said roaster furnaces having a plurality of openings in their bottoms, a plurality of pipes or chutes for delivering the product of said roaster furnaces, passing through said openings, to said reverberatory furnace by gravity, hoppers interposed between the roaster furnaces and said reverberatory furnace and into which hoppers the product of said roaster furnaces is delivered during its travel from said roaster furnaces to said reverberatory furnace, and manually controlled gates in the said pipes or chutes whereby the delivery of the product of the roaster furnace may be distributed as desired.

17. In an ore reducing plant, the combination with a reverberatory furnace, of a group of roaster furnaces disposed over said reverberatory furnace, said roaster furnaces having a plurality of openings in their bottoms, a plurality of pipes or chutes for delivering the product of said roaster furnaces, passing through said openings, to said reverberatory furnace by gravity, and hoppers interposed between the roaster furnaces and said reverberatory furnace and into which hoppers the product of said roaster furnaces is delivered during its travel from said roaster furnaces to said reverberatory furnace, said hoppers being arranged over the side walls of said reverberatory furnace.

18. In an ore reducing plant, the combination with a reverberatory furnace, of roaster furnaces disposed above said reverberatory furnace, and a dust-collector above and communicating with said roaster and reverberatory furnaces; whereby calcine dust carried from said roaster furnaces may be discharged into said reverberatory furnace.

19. Pyro-metallurgical apparatus comprising a furnace, a plurality of roasters located a substantial height above the furnace, and means comprising closed and separately valved conduits between the roasters and the furnace for controllably flowing by gravity the calcines from each of the roasters, mixing said calcines and distributively feeding the mixed material to the charge bank in the furnace.

In testimony whereof I affix my signature.

CHARLES LEGRAND.