Dec. 1, 1925. 1,563,616

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PROCESS AND APPARATUS FOR ROASTING ORES

Filed Jan. 16, 1924 2 Sheets-Sheet 1

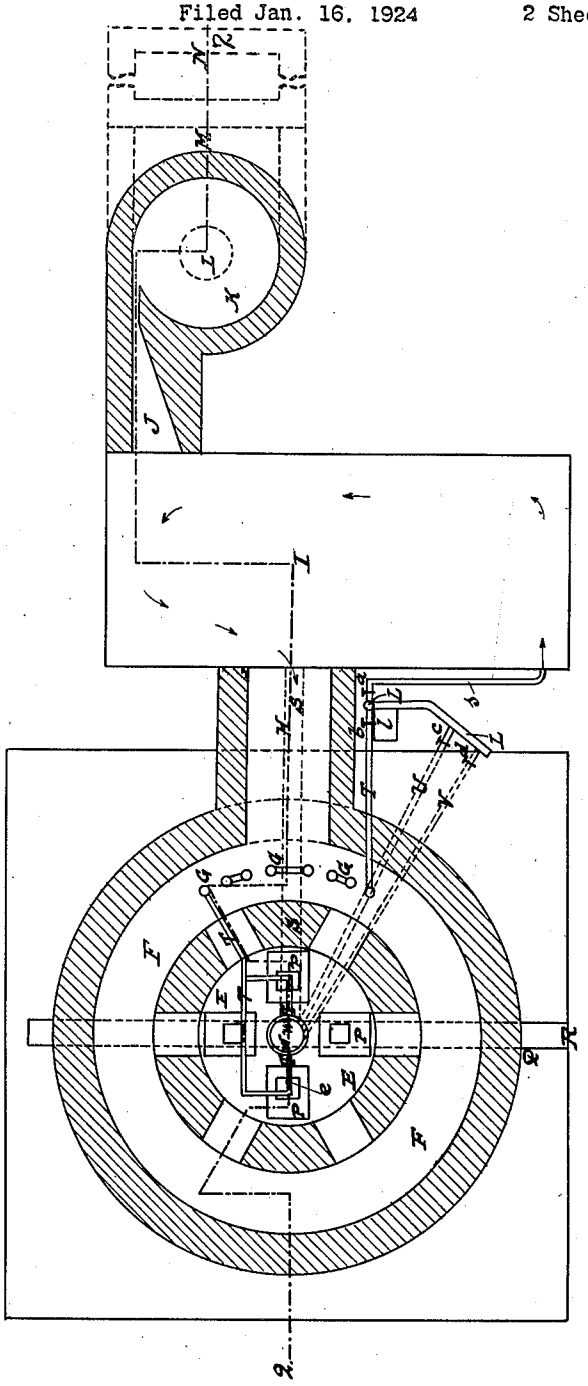


Fig. 1.

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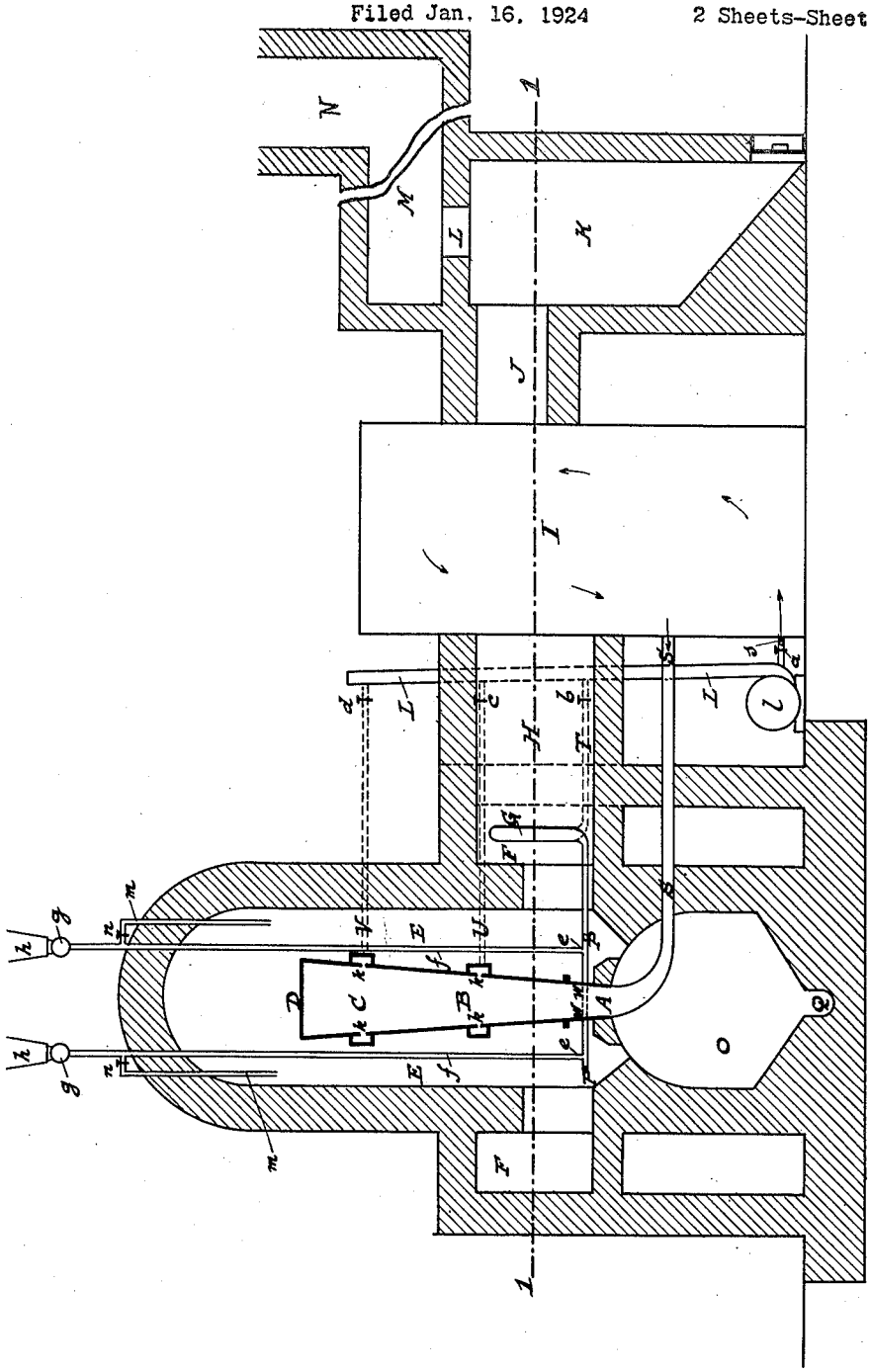


Fig. 2.

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UNITED STATES PATENT OFFICE.

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PROCESS AND APPARATUS FOR ROASTING ORES.

Application filed January 16, 1924. Serial No. 686,553.

To all whom it may concern:

Be it known that I, ADOLPHE DENIS HENRI LÉON FASSOTTE, a subject of the King of the Belgians, residing at Villa Leman, Lommel Usines, Belgium, have invented new and useful Improvements in Processes and Apparatus for Roasting Ores, of which the following is a specification.

The present invention relates to a process for roasting sulfurous, arsenious or other ores, of the kind wherein the temperature required to obtain the combination of the sulphur, arsenic or the like of the ore with the oxygen of the air is derived from and maintained by the reaction itself, and further to an improved apparatus for carrying out the said process, of the type wherein the roasting chamber is composed of two concentric compartments communicating at the top, and of which the first forms a central column or flue in which the ore-particles to be treated and the necessary air are introduced and through which the gaseous current containing the said particles in suspension is caused to pass upwardly, while the second or outer of such compartments forms an annular space round the first and is crossed by the aforesaid gaseous current in a downward direction previous to the extraction from such current of the roasted particles contained therein by suitable means.

The invention is applicable to all kinds of ores and to mixtures of various kinds of ores between them or with other substances, capable of combining with oxygen while developing heat, and more particularly to the roasting of blende or zinc ore, of galena or lead ore, of iron pyrites or iron bisulphide, and of speiss or other arsenious ores.

The said invention mainly has for its object:

(1) To secure an instantaneous ignition of the material to be roasted as soon as it enters the roasting chamber;

(2) To bring within a minimum amount of time the gas and the ignited ore to the optimum temperature of reaction;

(3) To maintain such temperature constant until the reaction is completed; and

(4) To secure a good and uniform suspension and distribution in the mass of the gaseous current of the ore to be roasted, and to maintain same for the whole duration of the upward passage of the ore-particles through the roasting chamber, without it being possible for any particle which might tend to drop owing to a whirl or the like causing said particle to escape temporarily the lifting influence of the air current, ever to reach again the base of the central column.

With this and other objects of lesser importance in view, one feature of the invention consists in pre-heating the ore to be roasted up to a point nearing the point of ignition by feeding the said ore through a tube extending down the roasting chamber. This tube may itself be crossed in a direction opposed to that of the falling ore-particles by an upward air current, of which the velocity is adjusted so as to increase the duration of the fall of the particles, and which eliminates in the shape of steam the small quantity of moisture which the ore might still contain notwithstanding preliminary drying, and of which the presence would tend to retard the ignition. A further feature of the invention consists in initially admixing to the totality of the material to be treated the main portion only of the total quantity of air necessary for the roasting, after having previously heated such air to a temperature equal to or slightly lower than the temperature of ignition in an economizer crossed by the hot spent gases issuing from the roasting chamber, and in injecting the remainder or complement of the necessary air in successive fractions at different points of the upward path of the suspended particles, such injection being effected by means of hollow annular distributing crowns surrounding the central flue and in communication with the latter by sets of upwardly inclined admission ports. Finally another feature of the invention consists in constituting the central flue between the various points of injection of complementary air, of conical sections having a cross section determined according to the gradually increasing volume of the gaseous current passing therethrough, each section being proportioned in such manner that the gaseous current will have at the base a greater velocity than at the top, the velocity at the top being itself slightly superior to that theoretically required to maintain in suspension the largest

of the particles admitted to the roasting chamber. As a consequence, any particle which, from the zone of reduced velocity, would tend to drop back on finding itself in a zone of unsufficient velocity due to a whirl or to the retarding influence of the wall of the flue, will automatically be sent back in an upward direction as soon as it will reach the lower zone where the velocity is greater.

In order that the invention may be readily understood, an embodiment of ore-roasting apparatus constructed in accordance with the said invention is diagrammatically illustrated by the accompanying drawing, wherein Fig. 1 is a horizontal section of said apparatus, taken on the line 1—1 of Fig. 2, while Fig. 2 is a vertical section taken on the line 2—2 of Fig. 1.

The apparatus illustrated is more particularly intended for roasting blende, but may also be used for roasting galena, pyrites, speiss and certain other ores, provided the dimensions are appropriately determined for the purpose.

Referring to the said drawing, A, B, C, D is the central roasting compartment or flue, through which the ore-particles taken up by and maintained in suspension in the air current passes upwardly, and which is of a cross section increasing gradually from the base towards the top. E is the outer annular compartment of the roasting chamber, which communicates at the top with the central flue and through which the gaseous current with the particles in suspension passes downwardly. F is an annular collecting chamber for the gases, which are therein brought into contact with bent or coiled piping G forming a first economizer. H is a flue leading the spent gases from the collecting chamber F to a second economizer I, which the said gases cross before reaching by way of a passage J of gradually decreasing cross section a centrifugal dust-extraction chamber K in which the gases enter tangentially with great velocity and are deprived of the dust which they contain before leaving at a reduced velocity through an upper central outlet L, whence they go via the flue M to apparatus for their utilization such as for instance a Glover tower N.

O is an entirely closed chamber built under the roasting chamber and in which the larger portion of the roasted particles are deposited. An Archimedean screw Q is provided along the bottom of the said chamber O to bring the roasted ore to a point such as R where it can easily be removed manually or otherwise. A fan *l* blows air under pressure through the economizer I in quantities which may be regulated by means of a valve or the like *a*, and also supplies air under pressure to a main air supply pipe L. S, T, U and V are four different air supply pipes of which the first leads from the economizer I while the three others are branched on the main air supply pipe L and are fitted with valves or the like *b*, *c* and *d* respectively for regulating the quantity of air supplied therethrough.

The air blown via *s* through the economizer I is heated therein by absorbing heat from the hot spent gases, and is then fed via the pipe S to the point A at the base of the central roasting flue, in which it penetrates with a velocity much above that necessary to maintain in suspension the largest ore-particles admitted, and which velocity is maintained up to the point W.

The air supplied by the pipe T passes via the coil G and thus becomes heated to a temperature nearing the temperature of ignition of the ore, and the said air, which represents a small portion only of the total air necessary, then penetrates horizontally into the base of the central roasting flue by way of two diametrally opposed inlets or admission nozzles W, after having taken up at *e* the ore-particles falling down the vertical pipes *f* extending through the annular compartment E and to the upper end of which they are fed from two supply hoppers *h* by means of distributing devices *g*, the ore-particles thus being quickly brought to a high temperature owing to the pipes *f* extending through the annular compartment E through which the hot gaseous current passes downwardly. The two jets from the nozzles W meet one another and cause the ore-particles to be thoroughly mingled with the air supplied via S, by which they are conveyed upwardly. A valve *n* on a branch-pipe *m* provided on each of the pipes *f* and opening out into the top of the roasting chamber permits when opened of small quantity of air from the supply pipe T being by-passed via the pipes *f*, in which the said air by forming an upward current meeting the falling particles increases the duration of the fall of the said particles so as to allow them more time to become heated and eliminate any moisture which they might still contain in the shape of steam which escapes via *m*. The cold air supplied by the branch pipes U and V is admitted successively into the central flue by way of hollow annular ducts *i* and *j* and of the upwardly inclined admission ports *k* by which the said crowns communicate with the central flue.

The cross sections of the central flue A, B, C, D at the different levels are proportioned in the following manner:

The cross-section A is such that the quantity of air supplied by S brought to the temperature of ignition of the ore, will at such point have a velocity much superior to that necessary to put into suspension the totality of the ore-particles to be treated.

Consequently none of the particles injected via W can, in view of the agitation produced, escape being put into suspension.

The cross-section at the level of the nozzles W is equal to the cross section at A.

The cross section just below B is such that the quantity of air supplied by S, with the quantity of air injected by the nozzles W added thereto, brought to the roasting temperature, will have a velocity slightly superior to that required to maintain the ore-particles in suspension. Consequently, immediately after the admission of the further quantity of air supplied by U, the velocity of the upward gaseous current becomes much superior to that required for maintaining the ore-particles in suspension.

Again the cross section immediately below C is such that the combined quantities of air supplied by S, W and U, brought to the roasting temperature, will have a velocity slightly superior to that required to maintain the ore-particles in suspension, so that the second injection of cold air, supplied by V, will play the same part as the injection of the air supplied by U.

Finally, the cross section at D is such that the total air necessary for roasting will at such point still have a velocity slightly superior to that required to maintain the ore-particles in suspension. The quantities of air supplied by S, T, U and V, and regulated by means of the valves *a* (on *s*) *b*, *c* and *d* respectively, are rigorously controlled by means of suitable devices such as anemometers or the equivalent, and while the air necessary for roasting may be supplied under pressure by placing the fan *l* in the position illustrated, it may also be employed under suction by placing a suitable fan at a point further on along the path of the spent gases.

It should be understood that the method and means adopted to effect the extraction of the dust or fine roasted particles contained in the spent gases will vary according to the economic value of the roasted particles: If for instance they are particles of valuable ores, it will be advantageous to subject them to repeated treatment in order to obtain a practically perfect separation, and it may be worth while to provide a device for the electrical precipitation of the mineral dust, whereas if they are particles of relatively small value, it will be less important to obtain a final gas entirely free from suspended particles.

It will be observed that the particular arrangement of the concentric roasting compartments ensures an important reduction of heat losses and a particularly resisting and economical construction.

I claim:

1. A process of roasting ores, of the kind wherein the required temperature is derived from the reaction itself and the gaseous current with the ore-particles in suspension is caused to travel first upwardly in a central column and then downwardly in an annular column surrounding said central column, consisting in pre-heating the ore-particles by causing same to absorb heat developed in the annular column, in pre-heating the major portion of the necessary air by means of heat recovered from the spent gases, in feeding the particles together with a small quantity of such pre-heated air horizontally to the base of the central column and causing the main portion of said pre-heated air to meet the mixture at right angles, in bringing about a gradual reduction of the velocity of the gaseous current during its upward travel, in injecting the non-preheated remainder of the necessary air in successive fractions at different points of the height of the central column and from the periphery towards the centre thereof, and finally in removing from the gaseous current after its subsequent downward travel the roasted ore-particles contained therein, substantially as described.

2. A process for roasting ores, of the kind wherein the required temperature is derived from the reaction itself and the gaseous current with the ore-particles in suspension is caused to travel first upwardly in a central column and then downwardly in an annular column surrounding said central column, consisting in pre-heating the ore-particles by causing same to fall vertically through but independently from the said gaseous current travelling in an annular column and thereby to absorb the heat developed in such annular column, in injecting said particles horizontally into the base of the central column by means of a small quantity of air under pressure previously heated by means of heat recovered from the hot spent gases, in feeding at the same time vertically to the base of said central column air under pressure also previously heated by means of heat recovered from the hot spent gases, in suitably adjusted quantities to form with the air used for injecting the particles the major portion of the total necessary air, in injecting the remainder of such total necessary air in successive fractions at different levels of the central column and round the periphery thereof, in bringing about a gradual reduction of the velocity of the gaseous current during its passage through said central column notwithstanding its increasing volume, and finally in removing the roasted ore-particles from the gaseous current subsequently to its downward travel in an annular column, substantially as described.

3. In a process for roasting ores as claimed in claim 2, retarding the fall of

the particles to be treated through the annular column by causing them to be met by an upward current of heated air formed by by-passing into the upper section of the annular column a portion of the pre-heated air used for injecting said particles into the base of the central column, for the purpose described.

4. In apparatus for roasting ores, of the type wherein the roasting chamber comprises two concentric compartments in communication at the top forming respectively a central column and an annular column surrounding said central column, the combination of: a central compartment having a gradually increasing cross-section from the base towards the top; a plurality of hollow annular distributing ducts formed at different levels round said central compartment and each in communication therewith by means of a set of upwardly inclined admission ports provided through the wall of the said compartment; means for supplying a regulated quantity of air under pressure to said distributing ducts; means for feeding the particles to be treated, including a pair of feeding pipes extending vertically through the annular compartment and two opposed horizontal nozzles for the injection of the particles dropping through said pipes into the base of the central compartment; means for blowing a regulated quantiy of pre-heated air through said nozzles; means, including an economizer, for supplying a regulated quantity of pre-heated air under pressure in an upward direction to the base of the central compartment; and means for extracting the roasted particles contained in the gaseous current and for exhausting the spent gases; all substantially as described.

In testimony whereof I signed hereunto my name.

ADOLPHE D. H. L. FASSOTTE.