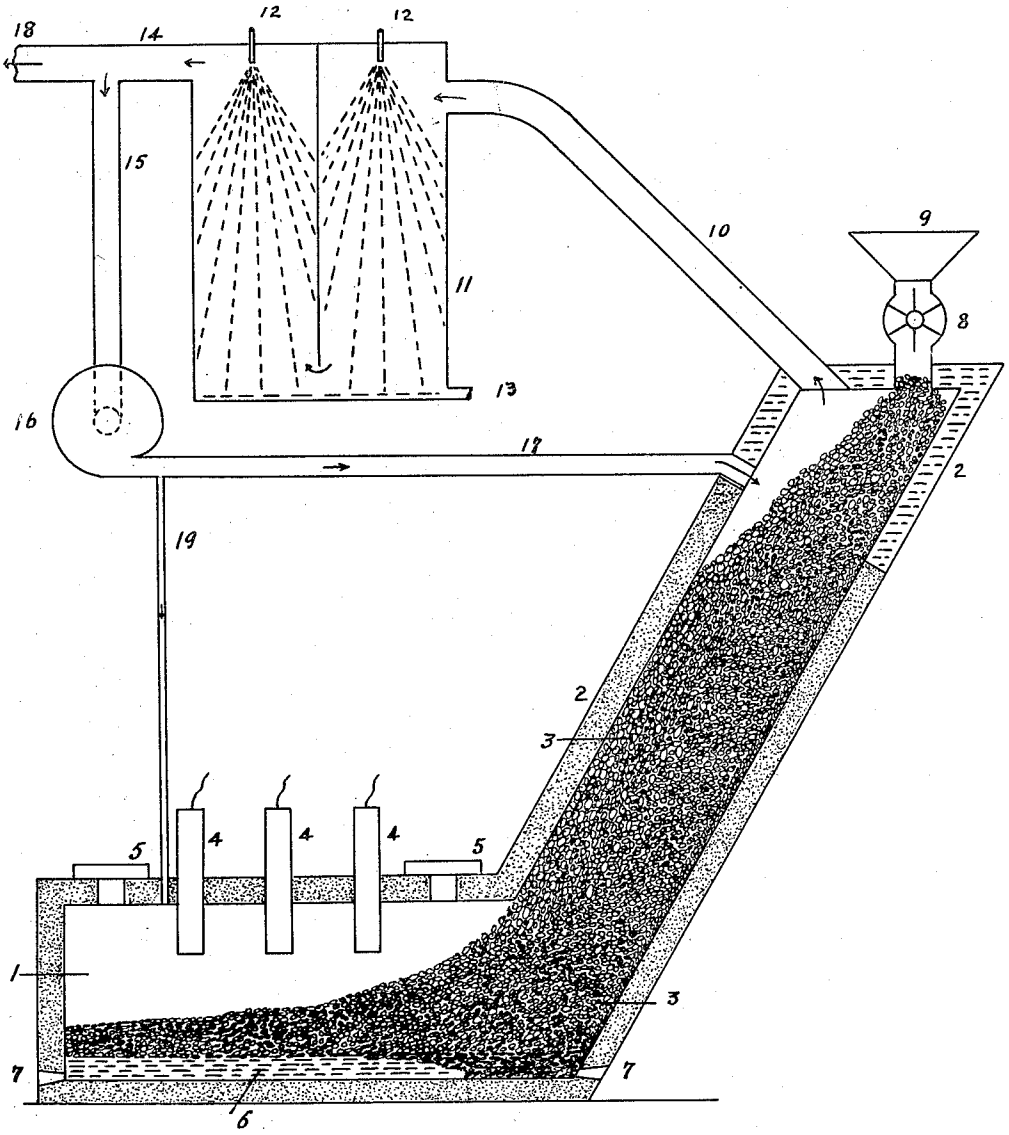
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METHOD OF BRASS SMELTING

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METHOD OF BRASS SMELTING

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If, at first thought, it appears that the expression "brass smelting" is improper I wish to call attention to the fact that the discovery of the alloy was due to its accidental production in the reducing smelting of copper-zinc oxidized ores. It is true that the entirely distinct methods whereby copper and zinc are now won from their ores makes any such production impossible. It is the aim of my process to produce both constituent metals in one operation and thus to have discharged from a furnace an alloy of copper and zinc. The expression "brass smelting" will thus be found to be technically correct.

However, unlike most smelting I do not intend to work upon the crude ore but rather upon intermediate products produced in hydro-metallurgy. In this manner, copper and zinc as oxides of great purity, can be made the starting point for my process, though I do not specifically limit myself to such material, although it is obvious that the production of slag is thus entirely avoided. Upon the drawing I have indicated the type of a furnace I require to carry out my process as no existing type of furnace with which I am acquainted can be used.

In said drawing I have represented in a somewhat diagrammatic manner the various items that make up my apparatus as well as the functions served thereby. Number 1 is a horizontally disposed heating chamber ending in a steeply inclined feed-chute 2, within which the charge 3 is contained. Heat is furnished by the electrodes 4 and supplementary openings 5 into the heat chamber permit of the introduction of additional materials not furnished through the feed-chute 2.

Number 6 is a pool of reduced metal, in this case brass, upon which floats a portion of the smelting charge which thus shields it from the fierce heat of the electric arcs and decreases the volatilization of the contained zinc. Excess metal over and above that which it is desired to retain permanently within the furnace is removed by the tap holes 7 and parenthetically can serve to remove any slag formed from impurities other than the principal metals involved. The charge to be smelted is introduced into the feed-chute by the feeder 8 which forms a gas seal between the feed hopper 9 and the interior of the furnace.

The gases produced in the operation within the furnace, chiefly CO, but still carrying considerable finely divided metallic zinc escape by the pipe 10 into the scrubber 11, where they are washed with a spray of a liquid hydrocarbon, which also serves as a cooling medium, introduced by the spray pipes 12. The cold, washed gas escapes by the pipe 14 and a portion of same is vented at 18. By means of the pipe 15, the blower or fan 16, and the pipe 17, the portion not thus vented is recirculated to the furnace to control the temperature above the charge in the feed chute 2, the top of which is represented as cooled by a water jacket, the rest of chute and furnace being constructed of refractory and insulating material. The number 19 represents a supplementary pipe whereby the cooled furnace gas can be introduced

into the heating chamber itself, the reason being given at a later time in my disclosure.

Before describing the functioning of this furnace I wish to call particular attention to the composition and mechanical characteristics of the smelting charge. As a preferred version I shall confine myself to the behavior of a mixture of the pure oxides of copper and zinc, as implied in a previous paragraph.

It is essential that the charge be in the form of a mass of pebbles, or its equivalent, and that the carbon needed for the reduction of the oxides be in intimate contact with the reacting oxides. These diametrically opposed conditions are met if the carbon itself be the cementing material which bonds the oxides together. Such material is produced if the oxides are commingled with a hydrocarbon or carbohydrate which will leave a coherent coke on carbonization. Manifestly a part of the requisite carbon can be in the form of a fine powder commingled with the oxides before the introduction of the bonding carbon. Preferred forms of carbon would be wood charcoal and sulphur-free petroleum coke. Heavy, low-sulphur mineral oils or residuals are acceptable as bonding materials but wood tar and such carbohydrates as sugars and ammonia compounds of lignin are to be preferred. In any event, the mixture of solids and liquid is made and the result carbonized.

Inasmuch as the material needs but little strength it can be conveniently made in a rotary kiln, mixing and nodulizing being effected in the cool part, before passing down into the hotter part where it becomes carbonized. By screening out fines and recycling these to the mixing operation once more the charge can be made as open as desired. In the event that no distinction is made between carbon that serves simply as a reducing agent and a bonding carbon, then a carbonized mixture, too low in carbon, can manifestly be produced by saturating such a char with fresh liquid carbohydrate or hydrocarbon and recarbonizing until a satisfactory ratio is obtained.

Of course, any other type of agglomeration suited to a mixture of metallic oxides and carbon such as "pelletizing," "briquetting," etc., can be substituted for my preferred version without diverging from the theme of my disclosure. In any event the over-all result is an intimate mixture of the reacting substances while the charge remains so open that a free passage of gas and vapors is assured.

I will now describe the actual operation of the furnace. In the heating chamber 1, beneath the fierce heat of the arcs, complete reduction of the metallic oxides takes place. The copper component, alloyed with more or less zinc, sinks forthwith to the bottom of the chamber where it remains until tapped. The zinc component will in part alloy with said copper and the part not thus accounted for will be volatilized, and, together with the carbon monoxide formed in the reaction, will ascend through that part of the charge retained within the feed-chute 2, passage being assured by the open structure of the charge 3.

It is the nature of such a charge that it will stratify somewhat from the moment it enters through the feeder until it reaches the heating chamber, the coarser material tending to hug the upper wall of the feed chute. Simultaneously the height of the charge will be greater directly under the feed chute and thus along the lower or right hand wall of said chute impeding the gas flow thru that part of the charge directly beneath it. The combination of these items will produce a tendency for the gases and vapors to favor a passage through the portion of the charge in direct contact with the left hand or upper wall of the chute which thus becomes heated to a somewhat greater degree than the remainder of the charge retained

within said chute. Conversely, the portion of said charge in closer juxtaposition to the right hand or inferior wall is relatively cooler due to said impeded gas traverse, thus permitting the downward passage of condensed zinc, or brass, which in turn induces further cooling of said zone. Inasmuch as said terminology requires reference to the drawing to be intelligible I have used in the claims the clause "relatively cooler portion of said inclined column of charge forming the supporting, inferior portion of said column" to designate this zone along the right hand wall of the feed chute through which condensed zinc, or brass, can travel downward without interfering with the upward traverse of volatilized zinc in the remainder of said column. Any portion of the charge which thus becomes heated to reaction temperature before entering the heating chamber, per se, will manifestly react in exactly the same manner as that already described as being "below the arcs," both liquid and volatile products resulting.

The volatile products will manifestly ascend the chute as heretofore and the liquid portion will sink with a tendency to take a path directed towards the lower or inferior wall of the chute, ultimately reaching and becoming a part of the pool of molten metal in the bottom of the heating chamber, but protected somewhat from volatilization by the decrease in temperature as well as by the protective effect of the alloyed copper.

The ascending carbon monoxide will, of course, reduce metallic oxides in accordance with its temperature and the vapor of zinc will reduce copper oxide likewise but in the main said zinc vapor will alloy with copper and liquate out of the charge as previously described. The chute thus becomes the condenser for the volatilized zinc and the major part of the volatilized zinc will be thus returned, with its copper addition, to the molten pool in the heating chamber.

However, though the zinc may be actually condensed within the chute much will still reach the surface of the charge in the form of finely divided fume and as such will leave the furnace by the pipe, **10**, but it will be caught in the scrubber by thorough washing with a mobile hydrocarbon, such as kerosine, which is kept cold by any desired means though this is not shown upon the drawing. The scrubbing medium thus would function both as a cooling and as a scrubbing medium.

The zinc thus washed out of the gas stream is returned to the charge. It may be commingled directly with the metallic oxides or it may be agglomerated and charged by itself. Manifestly when such recovered zinc reaches the zone where fusion is possible it will simply liquate out of the charge and gradually find its way downward in the cooler part of the chute until it reaches its pre-determined locus in the pool in the bottom of the heating chamber.

While I have thus far indicated only a scrubber with a hydrocarbon fluid as a scrubbing medium I do not confine myself to this limitation. It is obvious that water could be substituted if allowance be made for the oxidation of the zinc fume which would result if this practice were followed. It is also obvious that electro-static precipitation or centrifugal force or filtration could be used on the gas stream for the removal and recovery of the solid component of said gas stream. At best, the removal of the fume by scrubbing would be but partial but as a substantial portion of said scrubbed gas would be recycled total extraction would be of no moment. That portion of the gas vented is another matter and obviously the gas vented at **18** should be cleaned as thoroughly as economically possible before its ultimate use as fuel. Even after such use, any zinc fume would be converted to oxide and even this would be recoverable if in sufficient amount to make it commercially desirable.

Another item that can be widely varied is the actual point of re-entry of the cooled gas from the scrubber. On the drawing I have shown this point of entry as above the charge, but this is optional. It is self-evident that it could be lowered below this point and would thus aid in cooling the charge, or it could enter at two or more points as operation might dictate. Manifestly such details will suggest themselves to any operator.

A valuable function served by said returned fume is to increase the weight and volume of the charge as compared with the actual amount of zinc recovered in the form of the metal from the heating chamber and thus raise the efficiency of the charge retained within the chute in its double character as both a condenser and a collector of the zinc volatilized elsewhere. Such a flow of returned zinc might be of enough importance to suggest that it be bled from the chute itself and not be allowed to enter the heating chamber at all. A shallow baffle on the lower wall of the feed chute, not shown in the drawing, would serve this purpose.

Another valuable regulator of temperature within the furnace is supplied by the re-entry of gas, made in the operation, into the heating chamber itself as shown by the pipe, **19**. By judicious use of this device it will manifestly be possible to transfer any unwanted intensity of heat into the interstices of the charge itself as it is approaching said heating chamber and thus permit the smelting zone to extend far above where it would otherwise terminate.

So far I have made no mention of the actual percentage of carbon which should be incorporated in the charge as it will be governed by sundry variables which I wish first to described. It is obvious that the very hot gas and vapor ascending the chute will have a reducing effect upon the metallic oxides. Carbon dioxide and zinc oxide will thus be formed but in the hotter zone such will again be reduced by an excess of carbon, if present. Manifestly, such an action cannot be calculated but there will be a cooler zone where zinc is not reduced from its oxide and where a portion of carbon dioxide will remain as a more or less permanent item in the gas stream. This will depend altogether too much upon furnace practice to prescribe any definite proportion for the reducing carbon, except to say that it will not exceed and doubtless will be somewhat smaller than the calculated amount based upon mixture of metallic oxides undergoing reduction.

In practice, therefore, approximately the calculated amount will be used and this will then be corrected by the behavior of the furnace. As the oxides are called "pure" it follows that they should leave no residue that is not either volatilized or fused so if the carbon were the correct amount then nothing solid should be left. This is manifestly an impossible situation but the aim will be to approach it as nearly as possible. There will always be a residue left, in one case of excess carbon, or conversely, of unreduced oxides.

Manifestly, over a long time of operation these excesses will finally adjust themselves under the heat of the arcs, but pending such adjustments I have provided apertures in the roof of the heating chamber **5**, whereby the required amount of metallic oxide or carbon, as the case may be, can be added to said heating chamber and thus correct any error of feeding technique. With such a description to guide him the operator should soon be able to determine the correct ratio of carbon to oxides.

So far I have confined myself to the actual production of brass such as will result from the use of a mixture of copper and zinc oxides in the manner above described. It is obvious that the composition of said "brass" will be determined by the ratio of copper to zinc in the charge. It is equally obvious that any additional metal which it is desired to introduce into said brass can be added, either as metal or as oxide, to said charge without deviating in any respect from the theme of this disclosure.

What has thus been said for additions to said charge holds equally true for subtractions. If copper be eliminated and the reacting oxide be that of zinc, then, mani-

festly, only zinc would be obtained from the tap holes of the furnace. It is true that a greater portion of zinc would be re-volatilized in its downward course through the charge, if the protecting copper be absent, but in spite thereof, and with the aid of a lowered temperature in the heating chamber, all the zinc charged as oxide will ultimately be obtained as metal at the tapholes. However, it must also be considered that such zinc will be in contact with any impurities of the charge that will remain along with said zinc so it will be all the more imperative to operate upon a very pure zinc oxide such as I prescribed at the start of this disclosure.

In spite of this proviso for purity in the reacting materials the use of my process and apparatus upon natural ores if these be but pure enough and rich enough in metals is not excluded. If such impurities were so adjusted that they would form a fusible slag then such slag would float upon the surface of the metal in 1, and could be tapped periodically by removing all the fused material in the chamber, or another tap hole at a higher level could be provided. Of course, the fusion point of said slag would have to be substantially below the volatilizing point of the reduced zinc. While such things are possible I believe that, in general, the object of the operator should be to use only the purest of materials in carrying out my process.

Having thus fully described my process,

I claim:

1. The method of smelting zinc oxide which comprises; the smelting, with electrically generated heat of an agglomerated, carbonaceous charge consisting of zinc oxide and carbon by passing said charge downwards as a column in a position inclined from the vertical while approaching the heat source; passing the gases and vapors generated in said smelting upwards through the inclined column of charge to condense within said charge a substantial portion of the zinc volatilized in the smelting zone of said column, said condensed zinc finding its way downwards through the relatively cooler portion of said inclined column of charge forming the supporting, inferior portion of said column; and removing said melted zinc from the unmelted components of said charge.

2. The method of smelting zinc oxide, set forth in

claim 1, with the added step that zinc as fume resident in the gases escaping from the inclined column of charge be recovered and restored to the operation as an ingredient of said charge.

3. The method of smelting zinc oxide set forth in claim 1, with the added step that the temperature of charge be lowered by the recirculation of a portion of the gases produced in the smelting operation, after such gases have been cooled and freed from a portion of their resident zinc fume.

4. The method of smelting zinc oxide set forth in claim 1, with the added step that the gases escaping from said charge be cooled by commingling with a cooled portion of said gas from which resident zinc fume has been partially removed prior to such commingling.

5. The method of brass smelting which comprises; the smelting with electrically generated heat of an agglomerated, carbonaceous charge consisting of zinc and copper oxides and carbon by passing said charge downwards as a column in a position inclined from the vertical while approaching the heat source; passing the gases and vapors generated in said smelting upwards through the inclined column of charge to condense within said charge a substantial portion of the zinc volatilized in the lower part of said column, said condensed zinc together with alloyed copper finding its way downwards through the relatively cooler portion of said inclined column of charge forming the supporting, inferior portion of said column; and removing the resultant melted brass from the unmelted components of said charge.

References Cited in the file of this patent

UNITED STATES PATENTS

397,025	Rigaud	Jan. 29, 1889
645,179	Miles	Mar. 13, 1900
1,299,337	Hechenbleikner	Apr. 1, 1919
1,921,820	Handwerk	Aug. 8, 1933

OTHER REFERENCES

"A Comprehensive Treatise on Inorganic and Theoretical Chemistry," by Mellor, vol. IV, 1923, pages 398 and 399.