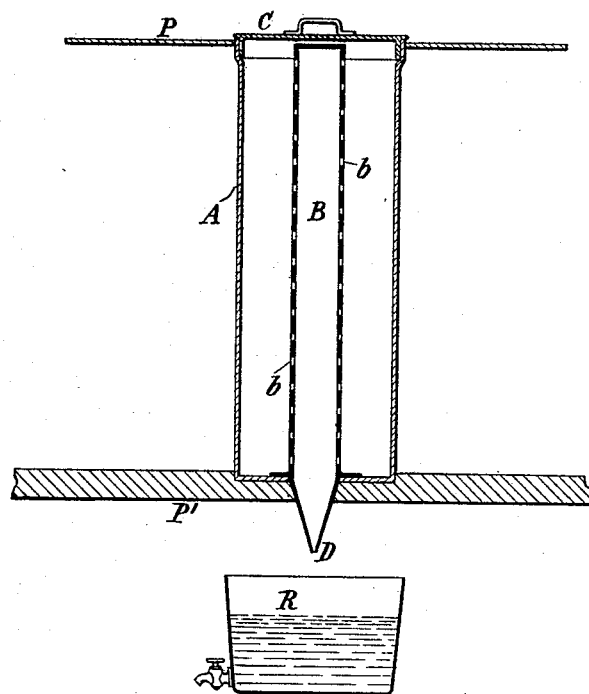


(No Model.)

P. C. CHOATE.
METHOD OF PRODUCING METALLIC ZINC.

No. 489,460.

Patented Jan. 10, 1893.



Witnesses:

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UNITED STATES PATENT OFFICE.

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METHOD OF PRODUCING METALLIC ZINC.

SPECIFICATION forming part of Letters Patent No. 489,460, dated January 10, 1893.

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To all whom it may concern:

Be it known that I, PARKER C. CHOATE, a citizen of the United States, residing in the city of New York, in the county and State of New York, have invented certain new and useful Improvements in Methods of Producing Metallic Zinc, of which the following is a specification.

My invention relates to the production of metallic zinc from its ores and the object of my improvements is to provide an economical method of producing a commercial brand of spelter substantially free from impurities.

While my process may be used in producing metallic zinc from any of its ores, it is more particularly intended to be used in connection with an ore carrying both lead and zinc and is especially valuable as applied to that large class of ores known as "complex" or "blendous galena" which carry zinc, iron, sulphur, lead, gold, silver, copper and gangue matter and usually also varying percentages of other metals such as antimony, cadmium, selenium, arsenic, bismuth, &c. and which on account of the difficulty of working them economically have heretofore been discarded at the mines in great quantities as waste products. In working such ores by the processes heretofore employed, there has been a total loss of the zinc, except where utilized as a pigment, and all attempts to produce a commercial brand of the metallic zinc therefrom, even at the expense of sacrificing the other constituents of value, have resulted in failure.

As is well known to the art, zinc of commerce has heretofore been produced only by distilling it directly from the ore in retorts or muffles, the ore when necessary being desulphurized prior to distillation. In all the processes of distillation heretofore employed, very considerable percentages of the other metals associated with the zinc in the ore appear in the zinc product. Thus such metals as iron, copper &c., which are charged into the retort or muffle with the zinc ore, although not volatile, will always be found in the distilled zinc. The more volatile constituents of zinc ores such as sulphur, arsenic, antimony, cadmium &c. are to a certain extent driven off by the desulphurizing roast above referred to. They cannot, however, be wholly removed by any roasting treatment of the body of the ore, but

when present in the ore will always appear in the distilled product. For these reasons distillation as a method of producing metallic zinc has not heretofore been applicable to the impure blendous ores of zinc, but has only been employed to treat ores rich in zinc, and comparatively free from impurities. Even as produced from such ores by distillation zinc of commerce is universally impure, the nature and amount of the impurities being dependent upon the character of the ore.

Lead, iron and cadmium are the impurities most commonly found in commercial zinc, while antimony, copper, tin, arsenic, bismuth &c. also occur.

Another serious trouble heretofore met with in treating the body of an ore directly in retorts or muffles is that the metallic oxides present in zinc ores form fusible, slags with the body of the retort or muffle at the high degree of heat required for distillation and thus soon destroy the vessel involving heavy loss and expense. An attempt has been made to remedy this by volatilizing the zinc before distillation leaving behind in the furnace the gangue or earthy matter contained in the ore and charging the muffle or retort with the volatilized and condensed product. This process has only been applied to ores containing no appreciable quantity of lead and it was found that the use of the volatilized zinc product in the retorts gave rise to so large a proportion of "blue powder" or oxidized zinc which required further distillation to give it metallic consistency as to render the process undesirable. In this process also the volatile constituents of the ore which would be carried over with the volatilized zinc were charged with it into the retorts or muffles and necessarily appeared in the metallic product. By means of my invention I am enabled to obviate all these difficulties and to produce a commercial brand of metallic zinc from the most complex ores in an economical manner.

To this end, my invention consists in separating the zinc from the other constituents of the ore (except lead) by first heating the ore in the presence of a reducing agent to decompose it and reduce the zinc compounds, volatilizing the zinc and other readily volatile constituents leaving behind in the furnace those constituents which are non-volatile or

less volatile than zinc, and condensing and collecting the volatilized products in the shape of fume, and second, reheating the fume to drive off those constituents more volatile than zinc; then reducing and distilling the purified fume in the presence of lead, thereby preventing the formation of an undue proportion of blue powder, and finally separating the lead from the zinc while in the molten state by gravity.

The accompanying drawing shows a sectional elevation of a form of muffle or retort which may be used with advantage in the distilling part of the process.

By preference I apply my process to ores carrying together with zinc such an amount of lead that it will enter the volatilized zinc fume to the extent of at least five per cent. of such product.

In carrying my invention into effect as applied to such ores, the ore should be first crushed and then, when it contains an excess of sulphur, it may be subjected to the ordinary desulphurizing roast. The ore is then mixed with carbonaceous fuel such as coal screenings roasted in any well known type of furnace in which air is admitted underneath the grate at a temperature sufficiently high to volatilize the zinc until the zinc contents of the ore are driven off. With the zinc will also pass off the lead and the more volatile constituents such as arsenic, cadmium &c. The volatilized zinc and other volatilized bodies are then caught and collected in a bag room in the ordinary manner in the shape of "fume." The non-volatile matter will be left behind in the furnace and will carry all the copper and gold and most of the silver contained in the ore, and the whole mass will be left in an oxidized and semi-fused condition highly suitable for smelting, whereby the above mentioned metals may be saved. The object of this first step is three-fold, since it separates the zinc from the metallic oxides which would destroy the retorts, enables the copper, silver and gold to be saved, and yields a zinc product from which all metallic compounds more volatile than zinc such as cadmium, arsenic, antimony, bismuth &c. can be separated. The collected fume, which will be in a very soft, flocculent form, is then reheated in any suitable form of muffle furnace at a temperature of from 300° to 800° Fahrenheit or sufficient to drive off the compounds more volatile than zinc, care being taken not to revolatilize any of the zinc. The mass should preferably be agitated while heating, in order that it may all receive the required degree of heat. As a result of this the mass will not only be freed from the metals more volatile than zinc such as antimony, arsenic, bismuth, cadmium &c., but will assume entirely different physical characteristics, becoming contracted in bulk and granular in form, the latter result being more particularly due to the cinder of the lead present and being of material advantage, since it facilitates the distillation of the

fume and assists in preventing the formation of "blue powder."

The next step in the process is the reduction of the zinc fume to metallic form by distillation. For this purpose the mixed zinc and lead fume, preferably slightly moistened, is mixed with carbon in the form of crushed coal, and charged into a retort or muffle which may be of the form shown in the drawing at A. It is placed upright in the furnace and is provided with an inner perforated tube B having an opening D at the bottom. The retort having been compactly filled with fume and the cover C luted on, heat is applied and when a temperature sufficient to volatilize zinc is reached, a current of gas and zinc vapor is established passing through the perforations in the tube B and down the interior of the tube. The gas will pass off as such while the zinc vapor condenses into molten zinc at the mouth of the tube and is caught in a suitable vessel underneath. The lead as reduced melts and trickles down the inside of the tube B with the zinc vapor and is caught with the condensed zinc in a vessel underneath. The process of reduction is facilitated by placing a stick of carbon, or of wood, which will carbonize, in the central flue B which will clear the reduced zinc and lead of any oxidized film. The presence of the lead in the retort operates to prevent the formation of an undue proportion of "blue powder." It seems to act as a nucleus and to liquefy and amalgamate with itself such powder of zinc as may be formed, which would otherwise become condensed in a pulverulent non-liquid form and which as is well known resists all attempts to melt and reduce it to liquid form. The mixed zinc and lead is allowed to stand in a suitable vessel, being kept in the molten state, until the lead settles out by gravity, when the lead may be drawn off by means of a cock at the bottom of the vessel, and the zinc may be dipped or run off from the top. The zinc cannot be entirely freed from lead by this process since it will dissolve and carry a percentage of the lead varying in amount from one and one-fourth to one and three-fourths per cent. of the zinc. If the process be carefully carried out and the tools and vessels used are not allowed to contaminate the molten product, this percentage of lead will be the only impurity contained in the zinc.

While I prefer to apply my invention to those ore of zinc of which lead is a constituent, it will be evident that it may, if desired, be applied to zinc ores not containing lead by mixing lead fume or pulverized metallic lead with the zinc fume in the distilling retort.

Instead of limiting myself to the use of the volatilized product collected in the bag-room for subsequent purification and distillation, I may also use the so-called "flue dust" incident to the manufacture of a zinc-lead fume, which may carry, beside the zinc and lead and the more volatile impurities, from three to

five per cent of iron oxide or silica, mechanically carried over from the furnace. This is non-volatile and in the process of distilling will remain with the coal ash in the retort 5 and not appreciably affect the purity of the distilled zinc.

While I do not limit myself in any part of my process to the use of any particular form of apparatus, I prefer to use for distilling the 10 fume the form of muffle or retort described above, since it facilitates the action of the lead in preventing the formation of "blue powder" by bringing the melted lead into intimate contact with the zinc fume and zinc 15 vapor, and also by reason of its upright position in the furnace is more durable than a horizontally placed retort since it is subjected to less strain by the weight of the charge.

The advantages of my invention will be 20 readily apparent to those skilled in the art, since it provides an economical method of producing from impure ores of zinc a commercial metallic zinc carrying lead as its only impurity. While such a brand of zinc is ap- 25 plicable to numerous purposes, its most advantageous use will be in the desilverizing of lead bullion as universally practiced. It may also be refined to great purity by means of the electric current, which is not the case 30 with brands of zinc carrying cadmium, copper, tin, &c.

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

35 1. The hereinbefore described process of producing metallic zinc which consists in heating an ore of zinc carrying lead in the presence of a reducing agent in a furnace to which air is admitted so as to volatilize the 40 zinc and lead and those constituents of the ore more volatile than zinc, thereby obtain-

ing a zinc lead fume free from the less volatile constituents of the ore; reheating the fume to drive off the constituents more volatile than zinc; subjecting the fume mixed 45 with carbon to heat in a retort; thereby obtaining molten lead and zinc vapors; condensing the zinc vapors in the presence of the molten lead; drawing off the resulting molten alloy, permitting the lead to settle under the 50 action of gravity and drawing off the superincumbent zinc substantially as set forth.

2. The hereinbefore described process of producing metallic zinc which consists in 55 mixing zinc fume, lead fume and carbon, subjecting the mixture to the action of heat in a retort thereby obtaining molten lead and zinc vapors, condensing the zinc vapors in the presence of the molten lead thereby obtain- 60 ing a molten alloy of lead and zinc; drawing off the alloy and permitting the lead to subside under the action of gravity, and finally removing the superincumbent zinc substantially as set forth.

3. The hereinbefore described process of 65 producing metallic zinc which consists in heating zinc fume mixed with carbon in a retort to distill the zinc; condensing the resulting zinc vapors in the presence of molten lead thereby obtaining a molten alloy of zinc 70 and lead; and finally allowing the lead to subside under the action of gravity and removing the superincumbent zinc substantially as set forth.

In testimony whereof I have hereunto subscribed my name this 7th day of December, 75 A. D. 1891.

PARKER C. CHOATE.

Witnesses:

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CLARKSON A. COLLINS.