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PROCESS FOR PRODUCING ZINC OXIDE

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Fig. 1.

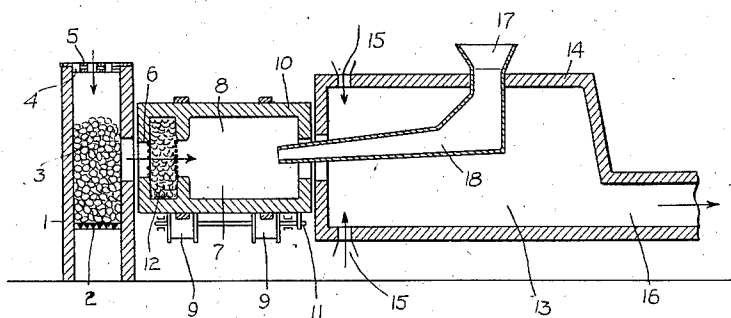
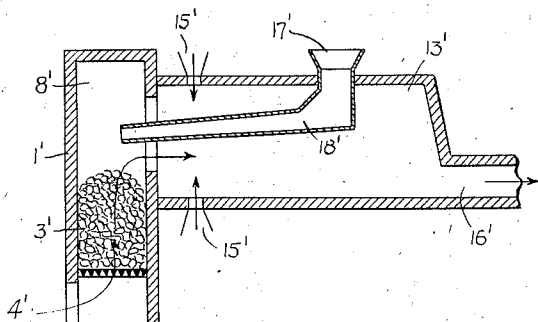


Fig. 2.



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## PROCESS FOR PRODUCING ZINC OXIDE

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5 Claims. (Cl. 23—148)

Our invention relates to a process of and appa-  
ratus for producing zinc oxide from metallic  
starting materials.

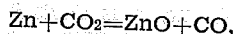
The indirect process for producing zinc oxide,  
although it starts with expensive raw material  
such as metallic zinc or zinc alloys, compares  
favorably with the direct process which in a single  
operation reduces the zinc from ores and immediately  
burns the zinc, because the product of the indirect  
process presents a number of properties adapting it  
for use as a coloring material and vulcanization  
accelerator greatly excelling the like properties of  
the product resulting from the direct process. Nevertheless,  
in order that the indirect process may compete in  
practice with the direct process, the former must be  
operated at low cost so that the advantage which is  
gained in the direct process by starting with cheap  
raw materials is balanced, and consequently, many  
attempts at improving the indirect process have  
been made.

Until recently, the zinc was exclusively distilled  
out of muffles and owing to the wear of the muffles  
and the intermittent character of the operation,  
as well as the high consumption of fuel, the cost  
of operation was great. Although experiments  
with directly heated furnaces were made, the  
quality of the product was unsatisfactory and  
these attempts were discontinued. It was pro-  
posed to pass a masut flame (a residual distilla-  
tion product of petroleum) over the zinc bath  
and agitate the latter, for the purpose of secur-  
ing improved results, but it was found that the  
resulting product had a gray tinge instead of  
being white and could only be made white by sub-  
sequent thorough roasting. Such subsequent  
roasting, however, very materially reduces the  
utility of the product in many respects.

Certain other processes have been proposed in  
which the main body of the zinc is treated in  
the furnace either by blowing air through the  
zinc after the manner of the converter process or  
by conducting combustion gases over the zinc.  
While these processes may have certain heat  
economy advantages over others, it has proven  
impossible to equal qualitatively the muffle prod-  
uct because a light yellow tinge of the zinc oxide  
cannot be avoided. The reason for this may be  
explained as follows:—It is well known that when  
ZnO is heated it is colored yellow but again be-  
comes white upon cooling. At temperatures up to  
about 800° C. the duration of the heating is  
not of material importance but if ZnO is heated  
to very high temperatures, its yellow color cannot

be made to disappear even after cooling, and this  
fact was not heretofore recognized in the art of  
zinc oxide production.

In consequence of the strongly positive heat  
tone of the reaction  $\text{Zn} + \text{O} = \text{ZnO}$ , or



the resulting ZnO is at first exposed to an ex-  
traordinarily high temperature which, in the  
muffle process, is however almost immediately  
lowered by the presence of oxidizing gases in ex-  
cess. It is otherwise in the case of directly heated  
furnaces, because here the ZnO formed at the  
beginning of the furnace flows over the entire  
metal bath surface, along which further combus-  
tion constantly occurs, so that the high tempera-  
ture—dependent on the construction of the fur-  
nace—is maintained for a longer or shorter period  
before cooling can occur. Even with the use of  
highly efficient suction devices, it may only re-  
quire the fraction of a second under certain cir-  
cumstances to impart a permanent yellow tinge  
to the material.

In this process, moreover, the saving in fuel  
is more than offset by the materially poorer yield,  
because in all of these cases substantial incinera-  
tion, due to direct action of oxidizing gases on the  
molten zinc, cannot be avoided. This factor re-  
sults in the necessity of burning the zinc vapors  
only after they no longer have any connection  
with the zinc bath, as is in fact done in the case  
of the muffle process. But to do this involves a  
difficulty which had heretofore not been satis-  
factorily overcome and by reason of which the  
process operating with direct heating of the fur-  
nace was not comparable in all respects with the  
muffle process.

By means of our invention, the difficulty above  
referred to is completely obviated and a zinc oxide  
fully equivalent in all respects to that obtained by  
the muffle process is secured in a directly heated  
furnace, by effecting vaporization of the zinc by  
the direct action on the zinc melt of gases or  
vapors (passed over or through the melt) which  
contain no constituents that react with or oxidize  
the zinc. For the purpose of vaporizing the  
zinc, we preferably use heating gases from any  
suitable source, such as from a generator, grate  
fire, oil fire and the like. Before the gases come  
into contact with the zinc bath they are purified  
in such manner that any constituents thereof,  
notably  $\text{O}_2$  and  $\text{CO}_2$ , which might modify or  
oxidize the zinc, are removed. The gases may  
be thus purified by passing them through a re-

ducing substance, as for example a bed of incandescent coke. Such purified gases may not only be passed over the surface of the bath, but may be passed through the bath, whereby maximum heat efficiency is obtained without danger of incineration, which is unavoidable with normal heating gases.

In the practice of the process, the vaporization of the zinc melt is effected in one chamber and the combustion of the evolved vapors takes place in a second chamber into which the gases, for example air, necessary for combustion are introduced. If coke firing be used, the same may simultaneously serve as a filter for the heating gases, the raw material being placed on the bed of incandescent coke and vaporized thereon. In lieu of the incandescent bed of coke through which the heating gases are passed, the zinc bath may be kept covered with coal or coke; the covering layer again reduces the gases before they come into direct contact with the melt.

Inasmuch as the reduction of the heating gases proceeds endothermically and excessive cooling with consequent unavoidable retardation of zinc vaporization may occur unless the operation is properly carried out, it is advisable to operate in such manner that a preponderance of CO is produced in the gas producer. The removal of the slight residues of CO<sub>2</sub> and O<sub>2</sub> then, has but a very minor adverse effect on the temperature of the heating gases.

Production costs may be reduced by increasing the quantities treated. Inasmuch as the speed of vaporization is in direct ratio to the area of the metallic surface whereby the output increases proportionately to an increase in the area of the free metallic surface, the furnace efficiency may be increased by suitably moving or agitating the zinc bath, the movement being either intermittent or continuous. Rotary furnaces have proven very advantageous for this purpose.

The process of our invention also involves a material saving of fuel in that the heat liberated in the combustion of the zinc vapors is used for melting the zinc, this being accomplished by placing the zinc melting apparatus directly on the combustion chamber, whereby excellent heat transfer is achieved. This arrangement obviates all danger that, by direct melting of the zinc in the oxidizing atmosphere of the combustion chamber, incineration or contamination of the formed zinc oxide occurs.

Another advantage of the process lies in the fact that the secondary ingredients of the treated zinciferous metals, which otherwise would also be oxidized and be contained in the zinc ash and thus rendered completely valueless, remain in metallic form as valuable by-products in the furnace and may be thence removed for further use.

We have shown two forms of the apparatus of our invention in the accompanying drawing, in which, Figure 1 is a vertical sectional view of one form, and Figure 2 is a similar view of the second form.

Referring to Figure 1, 1 denotes a stack containing a grate 2 adapted to receive a charge of coke 3. The upper end of the stack is provided with air passages 4, the area of which may be varied by a damper or valve 5. The stack 1 communicates by means of a lateral opening 6 with the zinc bath 7 in the vaporization chamber 8 contained in the rotary drum 10 mounted on rollers 9. The rollers may be driven by worm gearing 11. The end of the drum adjacent the

stack is provided with a chamber 12 filled or substantially filled, with a charge of coke.

A housing 14, containing the combustion chamber 13, is provided with air nozzles 15 and a channel or passage 16, which leads to a suction device (not shown) designed to draw air in the direction of the arrows through the openings 4, the bed of coke in the chamber 12, the vaporization chamber 8 and combustion chamber 13.

17 is a hopper through which the raw material is charged; the material descending through the slightly inclined chute 18 into the bath 7. The gases of combustion from the source thereof are reduced by the coke bed in the chamber 12 and effect vaporization of the bath 7 which is agitated by movement of the drum 10. The zinc vapors flow into the combustion chamber 13 and are there burned with the coaction of the air drawn in at 15. The air and gas mixture flows through the channel 16 to an ordinary condensing plant (not shown) in which the resulting zinc oxide separates. The heat of reaction evolved in the combustion chamber 13 heats the chute 18 so that the raw material melts therein.

In the modified form of the apparatus shown in Figure 2, the coke only fills the lower part of the stack 1' which is closed above. The charging chute 18' terminates above the coke bed 3', so that the zinc which melts in the chute 18' drops on the coke and is there vaporized. It will thus be apparent that the upper part of the stack forms, at the same time, the vaporization chamber 8' from which the zinc vapors pass directly into the combustion chamber 13'. In this modified form of the apparatus, the reduction of the heating gases is effected by the coke charge itself, in that the air is drawn through the bottom air passages 4' and the coke bed 3'. In other respects, the operation is like that of the form of Figure 1.

We claim:

1. The process for producing zinc oxide which comprises charging metallic zinc into a vaporization chamber containing an atmosphere of hot gases substantially free of all constituents capable of reacting with or oxidizing the metallic zinc whereby the latter is vaporized, and effecting combustion of the evolved zinc vapors in a chamber contiguous to the said vaporization chamber.

2. The process for producing zinc oxide which comprises charging metallic zinc through a conduit in a combustion chamber into a contiguous vaporization chamber containing an atmosphere of hot gases substantially free of all constituents capable of reacting with the metallic zinc whereby the latter is vaporized, and passing the evolved vapors through and effecting combustion thereof in said combustion chamber.

3. The process for producing zinc oxide which comprises passing hot gases through reducing material to substantially free said gases of all constituents capable of reacting with metallic zinc, introducing said hot reduced gases into a vaporization chamber, charging metallic zinc into said chamber into direct contact with said hot reduced gases to evolve zinc vapors and passing said vapors through and effecting combustion thereof in a combustion chamber contiguous to said vaporization chamber.

4. The process for producing zinc oxide which comprises passing hot gases through reducing material to substantially free said gases of all constituents capable of reacting with metallic zinc, introducing said hot reduced gases into a vaporiz-

ing chamber, passing a charge of metallic zinc through a conduit in a combustion chamber heated by the burning gases from the vaporizing chamber into direct contact with the hot reduced  
5 gases in said vaporizing chamber, to evolve zinc vapors from said charge, passing said zinc vapors into and through said combustion chamber and introducing air into said combustion chamber to effect combustion of said vapors.  
10 5. The process for producing zinc oxide which comprises continuously introducing into a chamber hot gases or vapors substantially free of all

constituents capable of reacting with metallic zinc, continuously introducing an oxidizing atmosphere into a chamber contiguous to the first mentioned chamber, continuously introducing  
5 metallic zinc into the first mentioned chamber into direct contact with the hot gases to vaporize said metallic zinc and continuously drawing off the vapors from said first mentioned chamber through said second mentioned chamber to oxidize said vapors. 10

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