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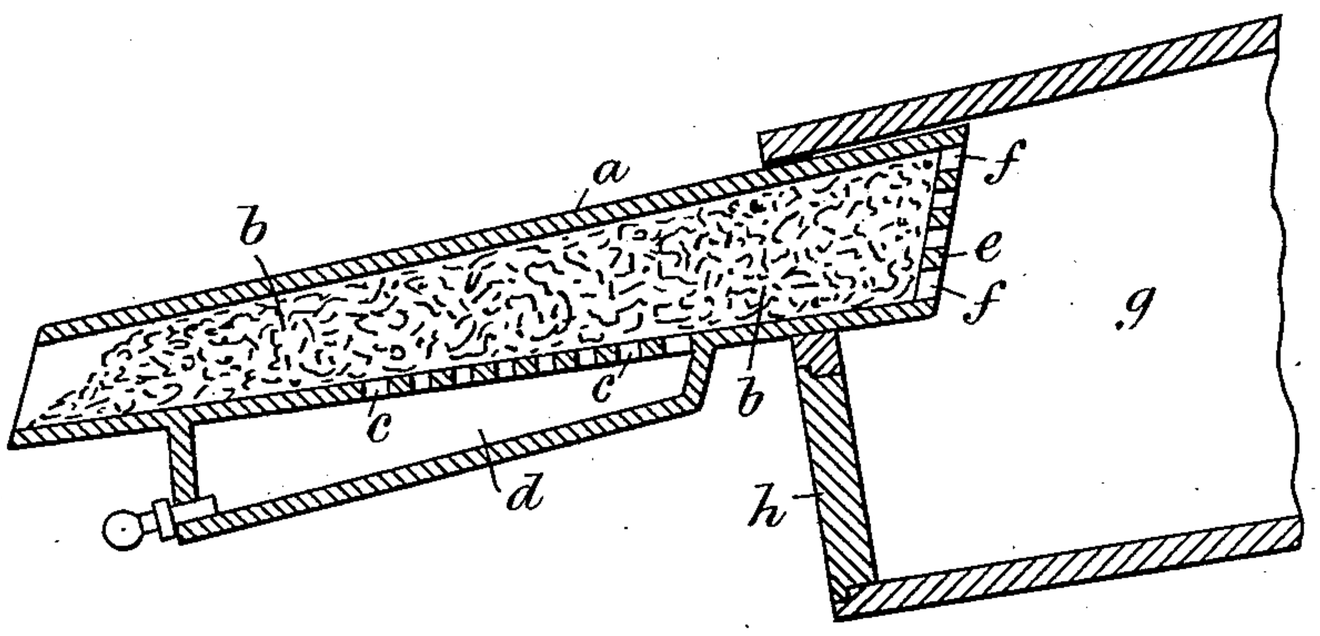
E. H. HOPKINS.

PROCESS OF OBTAINING ZINC.

APPLICATION FILED JUNE 16, 1902.

NO MODEL.



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UNITED STATES PATENT OFFICE.

EVAN HENRY HOPKINS, OF LONDON, ENGLAND.

PROCESS OF OBTAINING ZINC.

SPECIFICATION forming part of Letters Patent No. 731,184, dated June 16, 1903.

Application filed June 16, 1902. Serial No. 111,894. (No specimens.)

To all whom it may concern:

Be it known that I, EVAN HENRY HOPKINS, clerk in holy orders, a subject of the King of Great Britain, residing at 32 Redcliffe Square, South Kensington, London, England, have invented an Improved Process of Obtaining Zinc, of which the following is a specification.

My invention relates to a process of obtaining metallic zinc in mass from zinc oxid, either as contained in ore or as formed as a by-product in other processes.

In the reduction of zinc oxid and obtaining the metal therefrom a number of difficulties are experienced. Zinc oxid can be reduced only at a high temperature by carbon monoxid or solid carbon, a temperature at which metallic zinc is a vapor, and at a somewhat lower temperature, but one above the boiling-point of zinc it is capable of oxidation in the presence of carbon dioxid. It will also readily oxidize in the presence of air or watery vapor. It has also been found that zinc-vapor, if much diluted with non-oxidizing gases or if the temperature at which condensation is effected be relatively low, will condense into metallic zinc in the form of a powder. These difficulties, which are well known to exist, prescribe the following conditions in the reduction of zinc oxid and the collection of the metal: The zinc oxid must be heated to the reducing temperature in the presence of a reducing agent. The metallic vapor thus formed must not be much diluted with even inert gases nor must the vapor be condensed at a low temperature, since under either of these conditions zinc powder will be formed, and, lastly, the zinc-vapor must be condensed to liquid zinc without being in contact with any oxidizing agent—such as carbon dioxid, air, or watery vapor—since if the oxid be formed it can only be again reduced by heating to the initial temperature in the presence of a reducing agent.

My improved process meets the above requirements, and by it I am enabled to separate zinc from a body formed of or containing zinc oxid and collect it in a liquid state with the formation of little or no zinc oxid or zinc-dust.

In carrying out my improved process the usual proportion of zinc oxid and reducing material, such as coal or coke, are charged into the usual or any desired form of retort or muffle. Heat is applied externally to the retort until its contents are raised to the reducing temperature of zinc oxid and thereafter maintained at that point, air being of course excluded from the interior of the retort. The vapor of metallic zinc formed within the retort is then conducted into a mass of highly-heated carbon from which air is excluded and condensed therein, and in or beneath which it is collected in a liquid form. It will be seen that by my process the only air in the retort is that necessarily found in the interstices of the charge, and this will combine with carbon before the zinc oxid is affected. Thereafter the reducing temperature having been attained the zinc oxid is reduced by the carbon of the charge with the formation of metallic zinc-vapor and carbon monoxid. In this respect the process does not differ from ordinary reduction and distillation of zinc in retorts. The zinc-vapor, carbon monoxid, and any carbon dioxid which may form by chance in the retort pass directly to and into a mass of heated carbon. The zinc-vapor on reaching the carbon is only diluted by the oxygen products formed by the deoxidation. It will therefore not condense in particles so small as to be carried forward in the current of gases. On reaching the highly-heated carbon any carbon dioxid which may have formed will be reduced to the monoxid, the carbon monoxid will pass through unchanged, and the metallic vapor will be condensed. It is necessary in order to accomplish the last-named result that the mass of carbon or at least that portion last reached by the gases shall not be heated above the vaporizing-point of zinc, as otherwise the zinc-vapor will pass through it without being condensed and collected. The carbon should also preferably be heated in whole or in part above the temperature at which zinc solidifies, which will insure the collection of the zinc in a liquid mass and not in the condition of zinc powder. The zinc condensed in the heated carbon will trickle down through and will collect beneath it, and if collected in a cavity or receptacle may be drawn off from time to time or as desired. The remaining gas (carbon

monoxid) passes through the carbon to an outlet, at which it may pass into the atmosphere or be burned.

This invention is especially applicable to the condensation of the zinc-vapors obtained from the distillation of the oxids of lead and zinc, as is described in my Patent No. 708,044, of September 2, 1902.

The accompanying drawing shows in vertical section so much as is necessary of apparatus in which my process may be carried out.

The retort *g* may be the usual zinc retort, or it may be any other desired form of retort or muffle adapted to exclude air and the products of combustion. It is mounted in any desired form of furnace (not shown) for heating it externally. It may be provided with a door *h* for charging, or it may be charged in any usual or desired way. Mounted in the front wall of the retort is a condenser *a*, provided with preferably a rear wall *e*, having perforations *f* to retain the carbon *b* in place, while permitting free passage of the distilled gases, and perforations *c* in its bottom communicating with a receptacle *d* beneath to collect the condensed zinc. The carbon with which the condenser is filled is preferably in small lumps; but a porous block may be used, and it must be so arranged in the condenser that the gases from the retort are compelled to pass through it. If the rear wall of the condenser is formed sloping, as shown, it will be found that lead, if any be contained in the material treated, will not collect on it. In the construction shown the heat of the furnace will be found sufficient to heat the carbon contained in the condenser to the requisite temperature. That portion of the carbon inside the retort is heated to a temperature above the volatilizing-point of zinc, and the carbon is kept above the solidifying-point for a short distance beyond the perforations *c* in the receiver.

The zinc-vapor is completely condensed in the carbon before it reaches the outer end of the condenser, and no air can pass from the outside far enough into the carbon to come in contact with the zinc. The zinc is condensed before passing to the receptacle *d*, this receptacle being always tightly closed during the process, being opened from time to time only for the purpose of drawing off the metallic zinc. If there may be any tendency of a "back draft" of air through the outlet of the condenser, such air will be deoxidized by the carbon with which it first comes in contact. This air is effectually excluded from at least that part of the apparatus where the zinc is condensed, which is all that is required.

I claim—

1. The process of reducing and collecting zinc which consists in subjecting a material containing zinc to heat in the presence of a reducing agent, excluding air and the heating-flame therefrom, and in conveying the zinc-vapors into and condensing all of them in a mass of heated carbon from which air is excluded, substantially as described.

2. The process of reducing and collecting zinc, which consists in subjecting a material containing zinc to heat in the presence of a reducing agent, excluding air and the heating-flame therefrom, and in conveying the zinc-vapors into and condensing all of them in a mass of carbon from which air is excluded and which is heated to a temperature above that at which zinc solidifies, substantially as described.

3. The process of reducing and collecting zinc which consists in subjecting a material containing zinc to heat in the presence of a reducing agent, excluding air and the heating-flame therefrom, and in conveying the zinc-vapors into and condensing all of them in a mass of carbon from which air is excluded and which is heated to a temperature below that at which zinc vaporizes, substantially as described.

4. The process of reducing and collecting zinc which consists in subjecting a material containing zinc to heat in the presence of a reducing agent, excluding air and the heating-flame therefrom, and in conveying the zinc-vapors into and condensing all of them in a mass of carbon from which air is excluded and which is heated to a temperature between those at which zinc solidifies and volatilizes, substantially as described.

5. The process of reducing and collecting zinc which consists in subjecting a material containing zinc to heat in the presence of a reducing agent, excluding air and the heating-flame therefrom, conveying the zinc-vapors into and condensing all of them in a mass of heated carbon from which air is excluded, and collecting the condensed metal as a liquid beneath the carbon, substantially as described.

EVAN HENRY HOPKINS.

Witnesses:
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