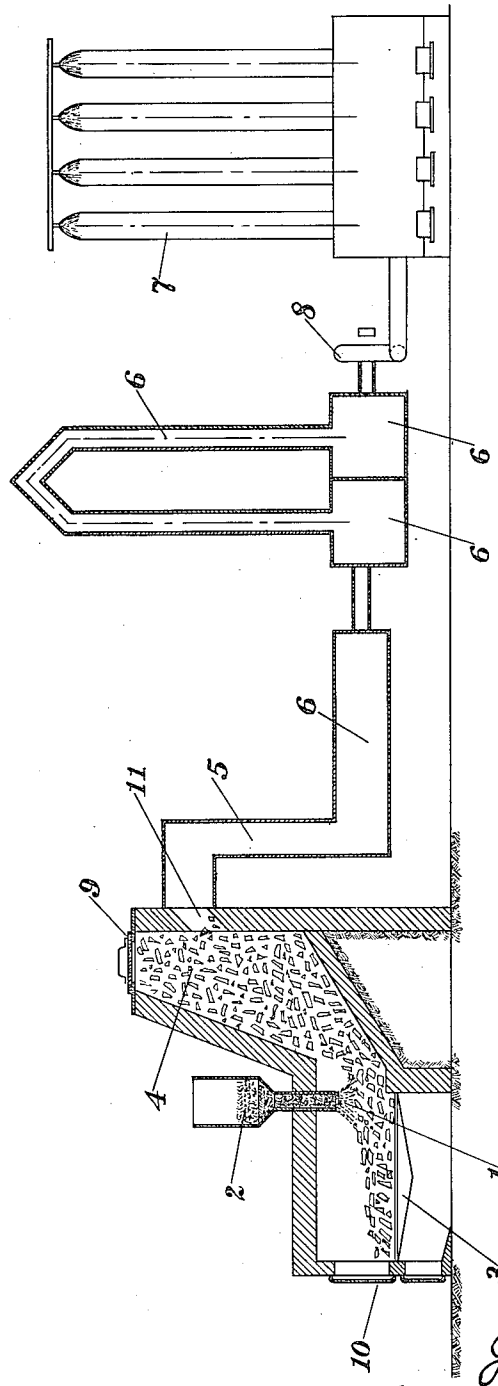
J. F. CULLEN.

PROCESS OF PRODUCING ARSENIC.

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1,433,533. Patented Oct. 31, 1922.



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UNITED STATES PATENT OFFICE.

JOSEPH F. CULLEN, OF MIDVALE, UTAH, ASSIGNOR TO UNITED STATES SMELTING, REFINING & MINING COMPANY, A CORPORATION OF MAINE.

PROCESS OF PRODUCING ARSENIC.

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To all whom it may concern:

Be it known that I, JOSEPH F. CULLEN, a citizen of the United States, residing at Midvale, in the county of Salt Lake and State of Utah, have invented certain new and useful Improvements in Processes of Producing Arsenic; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The invention relates to the manufacture of elementary arsenic, commonly known as metallic arsenic.

Metallic arsenic of commerce is commonly produced by the distillation of mispickle ore in clay retorts. This method of manufacture involves the filling and emptying of the retorts by hand, which is not only a disagreeable operation, but also exposes the workman to the injurious arsenical fumes. Moreover the cost of manufacture by this method is so high as to preclude the application of the product to many of the uses for which it is peculiarly well adapted.

The object of the present invention is to provide a method by which elementary arsenic may be economically manufactured, and which is free from the objections outlined above. To these ends the invention consists in causing vaporized arsenic oxide to traverse a mass of reducing material which is heated to the temperature requisite for reducing the oxide to elementary arsenic. A carbonaceous reducing material, such as coke or charcoal, is preferably employed, and it is heated to a temperature above red heat, so that the carbon will rapidly reduce the vaporized arsenic oxide to elementary arsenic, which, whether in a gaseous or solid state, is not reoxidized by the carbon dioxide produced, and may be recovered by condensation or otherwise.

The invention is applicable to the manufacture of metallic arsenic from various oxygen compounds of arsenic, and may be utilized with special advantage in the commercial manufacture of metallic arsenic from the arsenic oxides which occur in the waste or by-products of metallurgical plants, as for instance in the bag-house dust of smelting plants operating on ores containing arsenic. These oxides consist principally of trioxide mingled with more or less pentoxide, both of which may be vaporized and subsequently reduced to elementary arsenic by contact with a mass of hot reducing material.

In the drawings a simple form of apparatus suitable for the manufacture of metallic arsenic by the above method is shown. As here shown, the arsenic oxide, such for instance as the trioxide recovered from the bag-house dust of a smelting plant, is fed to a furnace 1 from a hopper 2 located substantially at the bridge wall. The oxide is vaporized by the hot gases from the coke or charcoal which is burned on the grate 3, and the vapor passes into the column of hot coke or charcoal in the shaft 4, and during its passage through this hot reducing material it is reduced to elementary arsenic. The arsenic will be in the gaseous state, and will pass with the other hot gases from the column of reducing material through the downtake 5 and into the cooling and condensing chamber and pipe 6, where the major part of the metallic arsenic will be condensed into solid form. Any fine metallic arsenic powder which may remain in the gases may be removed by the use of bags 7 or other fume collecting device, through which the gaseous products from the furnace and reducing column pass before being discharged into the atmosphere. A fan 8 may be utlilzed to secure draft at the grate, and to maintain a continuous flow through the system. The coke or other reducing material is charged to the shaft through the top, which is closed at other times by the cover 9. The fuel is charged to the grate and the clinker removed through the fire-box door 10. By far the greater part of the coke or charcoal used is burned on the grate for the vaporization of the oxide. The amount consumed in the shaft for the reduction of the oxide is comparatively small, and consequently the reducing material need be fed at the top of the shaft, only at long intervals.

It is important that the cooling and condensing sections of the system be air-tight, to prevent filtration of air and consequent oxidation of the product before the latter is cool enough to withstand contact with air. A considerable depth of hot reducing material should be maintained above the down-

take inlet 11 in order to prevent contact of free oxygen with the metallic arsenic vapor, in case of air leakage around the cover 9.

Although the foregoing is a simple form of apparatus for manufacturing metallic arsenic by the present method, it will be understood that it is not the sole form, nor the form which would necessarily be preferred under all conditions. For example, the operations can be performed in muffled or externally heated compartments, or the oxide can be vaporized and the column of coke or other reducing material be maintained at the desired temperature by heat from electrical energy.

The form in which the product is obtained may be varied by the adjustment of the various conditions, such as the rate of cooling, character and area of cooling surfaces, concentration of elementary arsenic vapor in the gases, etc. By proper regulation the product may be obtained as a fine powder or to some extent in crystalline masses. It is suitable for all uses to which metallic arsenic of commerce is put, such as the hardening of lead and lead alloys, the manufacture of arsenic trichloride, arsenic disulfide and other arsenic compounds, and the manufacture of fireworks, smoke signals, etc.

What is claimed is:—

1. The process of manufacturing elementary or metallic arsenic which consists in feeding solid arsenic oxide to an incandescent mass of carbonaceous material within which a reducing atmosphere is maintained to vaporize the arsenic oxide and reduce it to metallic arsenic in a gaseous state, withdrawing the gaseous arsenic with the fixed gases from the carbonaceous mass and subsequently condensing and removing the solid metallic arsenic from the gases in a substantially pure state.

2. The process of manufacturing elementary or metallic arsenic which consists in vaporizing arsenic oxide in a reducing atmosphere substantially free from vapors of other elements to reduce the oxide to metallic arsenic in a gaseous state, withdrawing the gaseous arsenic with the fixed gases, and separating the arsenic in a solid substantially pure state.

JOSEPH F. CULLEN.