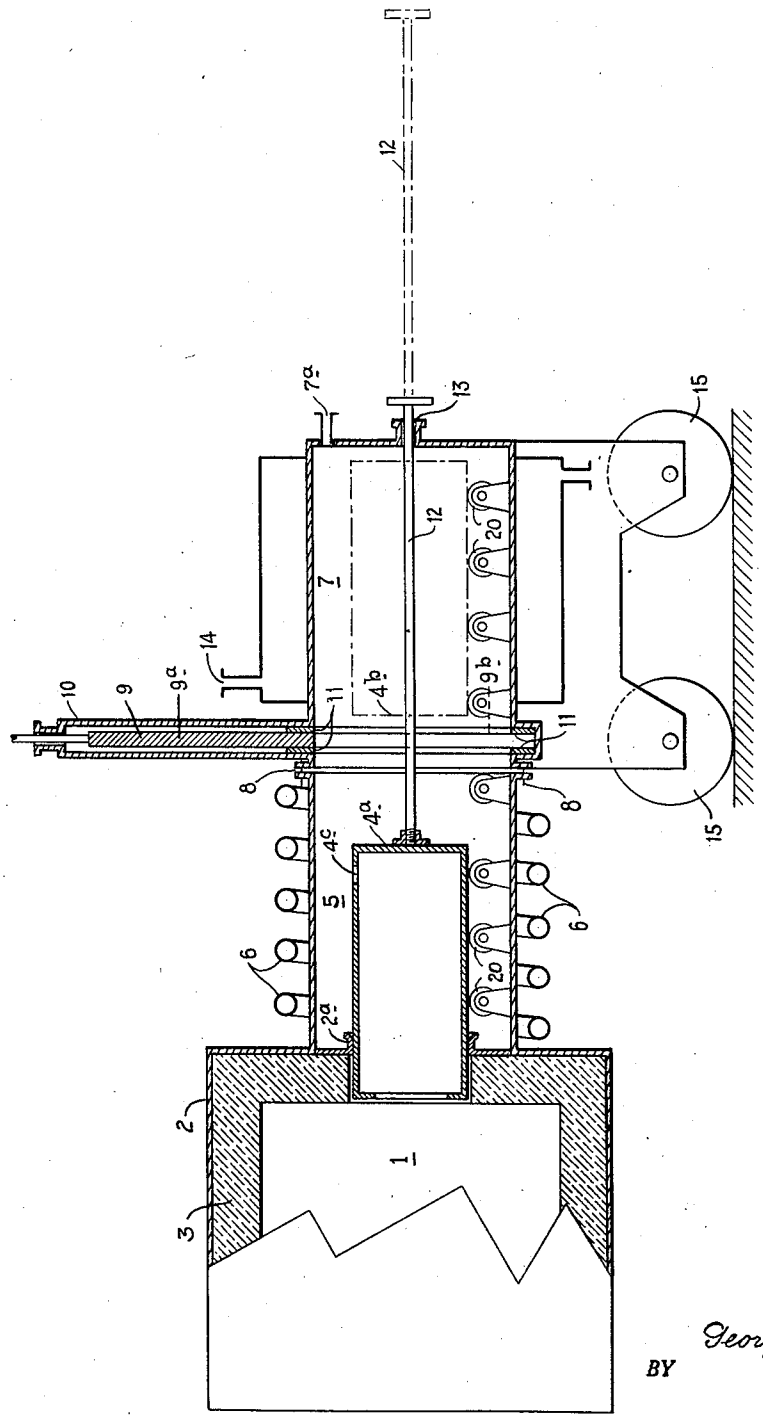
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PROCESS AND APPARATUS FOR THE VACUUM PRODUCTION OF MAGNESIUM

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PROCESS AND APPARATUS FOR THE VACUUM PRODUCTION OF MAGNESIUM

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1

The present invention relates to the treatment of metals in which the metallic vapors are condensed. It refers particularly to the manufacture of magnesium which is obtained by reduction of the ore and condensation of the metallic vapors which are thereby produced. Such operations have to be carried out under vacuum. When they are finished, the atmospheric pressure is reestablished in the furnace, with the object of effecting a fresh charging of the ore, and the condenser is withdrawn for collection of the metal which is deposited therein. The furnace is then again charged and a fresh operation of reduction is commenced after an empty condenser has been put in place.

However, if special precautions are not taken, several disadvantages result from this mode of operation.

At the end of the reduction operation, the metal gathered in the condenser is at a high temperature, which can attain 650° C. in the case of magnesium, and if the vacuum is broken at this moment, the metal is easily oxidised and even nitrided, particularly in those parts of it deposited in the pulverulent state.

If, on the contrary, it is desired to wait, before breaking the vacuum, until the metal has cooled to a temperature at which it will no longer oxidise in air (50°–100° for example, in the case of magnesium), the reduction furnace is uselessly immobilised and moreover is allowed to cool, which increases the expenditure of heat for a latter operation.

On the other hand, the introduction of air at the movement when the furnace is opened produces a movement of dusts towards the condenser.

The present invention has for an object to remedy these disadvantages, among others.

The invention consists in transferring the condenser, at the end of the condensation operation, from the position which it occupies in the furnace enclosure during this operation into an auxiliary chamber constituting a sealed prolongation of said enclosure, this transfer taking place while leaving under vacuum the common enclosure of the furnace and the auxiliary chamber, and in cutting off communication between the chamber and the furnace by sealing means without opening the enclosure.

The furnace may then be opened and charged again, while maintaining under vacuum the auxiliary chamber and consequently the condenser itself. Moreover, the condensed metal may be subjected to any appropriate thermal treatment that may be desired. It is possible particularly

2

to effect under vacuum the cooling of the metal, for example until the chamber can be opened and the vacuum within it broken without danger of alteration of the metal. An operation of fusion and refining of the condensed metal may also be effected.

According to one mode of carrying out the method according to the invention, these different thermal treatments to which the condensed metal is subjected may be effected without separating the auxiliary chamber from the furnace. They may alternatively be advantageously effected by displacing the chamber after the condenser has been transferred into it, for example, in such manner as to enable the condenser to be brought into other apparatus where the condensed metal can be subjected, in the most favourable conditions, to the desired thermal treatment.

The means used for the regulation of the temperature, in the thermal treatment to which the metal is subjected after its condensation, may be mounted on the auxiliary chamber itself or mounted on apparatus into which the condenser is to be brought, while remaining under vacuum, by the displacement of the auxiliary chamber.

In practice, the condenser in position in the furnace may be surrounded by a hood, the auxiliary chamber constituing a prolongation of this hood. The auxiliary chamber may be either connected in a permanent manner to the hood or, preferably, be secured to it in a removable manner in order to be separable from the furnace, as required. In the latter case, the sealing means is mounted on the chamber itself, at the inlet of the latter, in order to accompany this chamber when it is separated from the furnace and to enable it to remain under vacuum during this displacement and the subsequent operations.

In all cases, the sealing means is preferably placed beyond range of the vapors and is not exposed to deterioration by these vapors and metallic deposits. Further, due to its spacing apart from the flow of metallic vapors, the sealing means may easily be cooled and may consequently comprise materials suitable for ensuring complete fluid-tightness, but which would not resist high temperatures.

The condenser, when it is located in the auxiliary chamber, is subjected to a state of pressure or vacuum which at all times is the same internally and externally of the condenser. The latter thus has not to support any pressure stress and can be a simple member easy to displace, to cool, or to subject to other operation.

When the auxiliary chamber is left connected permanently to the furnace, the cooling of the condenser is effected while the furnace is being recharged. Before beginning the treatment of the new charge it is required simply to wait until the condenser of the preceding operation is sufficiently cooled to permit opening of the auxiliary chamber, to remove the full condenser and insert an empty condenser. This requires only a short time in view of the possibility of having, on the auxiliary chamber, intensive cooling means, capable particularly of ensuring a more rapid cooling than that which might be obtained with the aid of temperature regulation means mounted on the furnace itself, about the condensation chamber.

When the auxiliary chamber is to be separated from the furnace after the condenser has been transferred into it and the sealing means closed, another chamber provided with an empty condenser can immediately be substituted for it and a new reduction operation then begun. The auxiliary chamber, holding its condenser and maintained under vacuum can then be brought for the subsequent treatment of the condensed metal to apparatus equipped for this treatment.

Particularly, the auxiliary chamber may be brought into an apparatus fixedly located, comprising especially intensive cooling means—which would have been difficult to mount on the chamber itself—and presenting moreover the advantage of being adapted to serve for the cooling of several auxiliary chambers.

If the treatment to which the metal is to be subjected (for example, a further fusion) requires that the condenser should be transferred from the auxiliary chamber into an apparatus where this treatment is to be effected, this transfer may be effected under vacuum by an analogous manipulation to that which enabled the condenser to be passed from the reduction furnace into the auxiliary chamber, without breaking the vacuum, but for this manipulation effecting the different operations in reverse order.

The invention, which has been described above more particularly in the case where the vapors to be condensed are produced by the reduction of an ore, is applicable, in a general manner, to all cases where the treatment of a metal results in the production of vapors to be condensed either under vacuum or in an atmosphere of predetermined nature and/or pressure. Similarly, the invention is applicable where it is required only to effect a simple operation of distillation.

The foregoing and other advantageous features of the invention will appear more clearly in the following description, with reference to the attached drawing, showing, by way of example and without limitation, apparatus for carrying out the method according to the invention.

The drawing shows diagrammatically, in section, a reduction furnace provided with a hood and auxiliary chamber. The furnace **1** is constituted by a metallic envelope **2** provided with an insulating lining **3**, and heating means not shown. The condenser, constituted by a cylinder of sheet metal open on the furnace side and closed on the opposite side, is shown at **4***a*, in the position which it occupies during the condensation. A hood **5** provided with temperature regulating means **6** surrounds the condenser. The hood is prolonged by an envelope **7** forming the auxiliary chamber. Fluid-tight connecting means, diagrammatically indicated at **8**, permit the chamber **7** and the hood **5** to be connected in a fluid-tight manner or separated from one another at will. Sealing of the chamber **7** is effected by a movable closure plate **9**, housed in the interior of a fluid-tight compartment **10** adjoining this chamber, this plate being capable of ensuring by means of packings **11** the tight closure of said chamber **7**, upon being moved, from the position **9***a*, to the position **9***b*, shown in dotted lines.

In order to facilitate the movement of the closure **9** at the same time as to ensure the satisfactory operation of the packings **11**, some play is left between the closure and its packings until the closure occupies its position **9***b*. The grip of the packings on the closure is effected when the closure has been brought to **9***b*, for example by means of screw clamps, not shown, operated from outside and causing the closure to bear on its seat or clamping it between the packings.

The closure, when it is placed in the position **9***a*, allows free displacement of the condenser at the end of the condensation period, and without affecting the state of vacuum of the furnace and the chamber, this displacement being effected, for example by means of the rod **12**, extending through the end of the chamber **7** by way of an orifice **13** provided with tightening means. The furnace **2** has an annular flange **2***a* with an outwardly peened edge that serves to guide the end of the condenser **4***a* into the furnace opening. An opening **4***c* in the condenser permits the pressure within and outside the condenser to be balanced, and an outlet **7***a* permits the chamber **7** and the chambers conjoined to be evacuated. Rollers **20** mounted in the hood **5** and chamber **7** support the condenser in proper relation to the opening in the furnace.

After the condenser has been transferred into this chamber so as to occupy the position **4***b*, the closure is moved into the position **9***b* and atmospheric pressure can again be admitted to the furnace without modifying the state of vacuum existing in the chamber **7**.

By way of example, cooling means for the auxiliary chamber **7**, constituted by a chamber for the circulation of water, are shown at **14**.

The whole of the auxiliary chamber can be displaced by means of rollers **15** after having been disconnected from the furnace by disengagement of the connecting means **8**.

In the case where the cooling of the auxiliary chamber is effected by cooling apparatus (not shown) serving several chambers and placed at some distance from the furnace, the cooling means **14** may be omitted.

What is claimed is:

1. Apparatus for the manufacture of magnesium or the like that includes three chambers of which the second is constructed to be conjoined and sealed to the first and moved into the third, evacuating means to evacuate the three chambers, heating means to maintain the first chambers at a temperature at which the metal is vaporized, cooling means to maintain the second and third chambers at a temperature at which the metal is condensed, transport means to move the second chamber within the third, and a closure to seal the second within the third.

2. A method of producing magnesium that includes vaporizing magnesium in one of two conjoined zones free of reactive oxygen, condensing the vapors of magnesium under vacuum in the second of the two conjoined zones until it is charged with condensed magnesium, establishing vacuum and a cooling temperature in a third zone conjoined in sealed relation to the first and com-

municating with the second, and then moving and sealing the second zone within the third zone and cooling it there until it may be exposed to the air.

3. Apparatus for the manufacture of magnesium that includes a furnace wherein magnesium ore is reduced and the metallic magnesium is vaporized, an opening in one end of the furnace providing for the escape of magnesium vapors therefrom, a condenser constructed and arranged to fit into the opening in the furnace and to seal the said opening so that magnesium vapors escaping from the furnace pass into the condenser, said condenser projecting outwardly from the wall of the furnace and being surrounded by an extension on the furnace, cooling means surrounding the extension, a wagon having a chamber open at one end and constructed and arranged to make sealing engagement with said extension at said open end, closure means for the wagon chamber constructed therein near the open end thereof, said wagon chamber having an outlet for evacuation, said condenser having an outlet for evacuation of its own interior and that of the furnace, and supporting means on which the condenser may be moved into the wagon chamber for sealing under vacuum prior to the breaking of the seal between the said extension and the said chamber.

4. Apparatus for the manufacture of magnesium or the like that includes three chambers of which the first is a metal vaporizing furnace having an extension, the second is constructed to be conjoined to and open into the first within the extension, and received within the third, and the third is constructed to be sealed to the extension and separable from it, evacuating means including a single outlet in the third chamber for evacuating the three chambers, cooling means to maintain the second and third chambers at a temperature at which the metal is condensed, motion imparting means to move the second chamber into the third, a closure to seal it therein, and transportation means supporting the third chamber for movement away from the second.

GEORGES BASSEREAU.

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The following references are of record in the file of this patent:

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Certificate of Correction

Patent No. 2,446,403. August 3, 1948.

GEORGES BASSEREAU

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows: Column 1, line 32, for the word "latter" read *later;* line 35, for "movement" read *moment;* column 4, line 62, for "chambers at" read *chamber at;* and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 30th day of November, A. D. 1948.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.