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M. D. GIRVIN ET AL
SUBLIMATION APPARATUS

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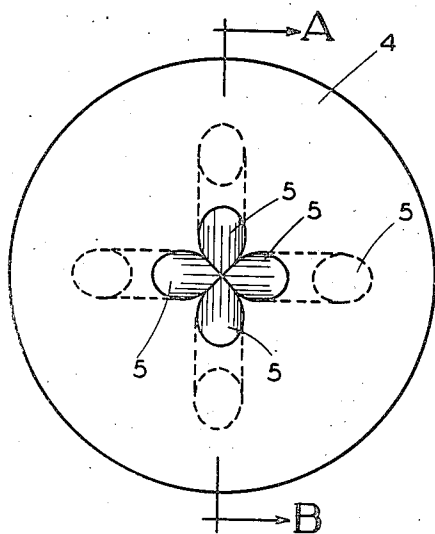


Fig. 1

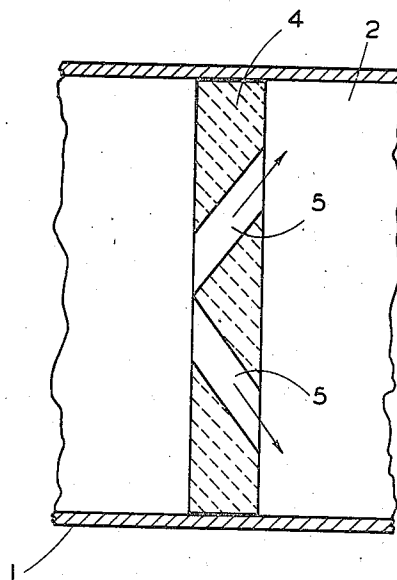


Fig. 2

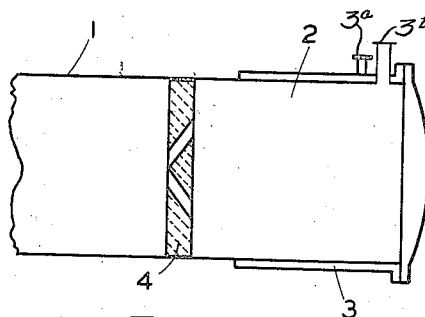


Fig. 3

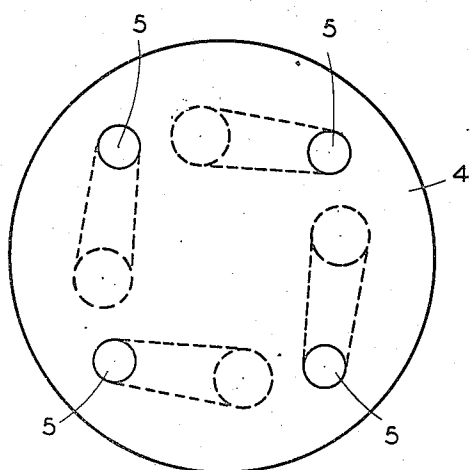


Fig. 4

INVENTOR.
Murray D. Girvin
Leo Alfred Dentone

BY

Murray D. Girvin & Leo Alfred Dentone

UNITED STATES PATENT OFFICE

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SUBLIMATION APPARATUS

Murray D. Girvin, Manteca, and Leo Alfred Dentone, Stockton, Calif., assignors, by mesne assignments, to The Permanente Metals Corporation, a corporation of Delaware

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4 Claims. (Cl. 266—22)

This invention relates to an apparatus for subliming metals from their ores and for refining impure metals by sublimation and has particularly in view an apparatus adapted for the reduction of magnesium-oxide containing raw material with the aid of reducing agents that do not form gaseous products of oxidation, for instance with the aid of silicon or alloys thereof, especially ferro-silicon, aluminum or a mixture of both, silicides, and carbides.

If it is intended to recover magnesium from its ores by reduction at a temperature above the boiling point of the metal, which requires even under very low absolute pressures relatively high temperatures, and by causing the vapor evolved to condense directly from the vapor state in the solid state, without intermediate liquefaction, the rate of sublimation, within limits, will depend under appropriate temperature and pressure conditions upon the quantity of heat applied to the initial material; hence, in the parts of the apparatus forming the reduction chamber a material with high thermal conductivity will be necessary. On the other hand, it is necessary that the temperature in the condensing area should be markedly below that of the metal being sublimed since the difference in the vapor pressure due to this difference in temperature is the driving force causing the rapid transfer of the magnesium vapor from the subliming to the condensing end of the system; hence, a minimum transmission of heat from the subliming to the condensing area is desired. This problem is further complicated by the necessity of disposing the condenser in near proximity to the heated part of the apparatus for the purpose of causing the crystalline condensate to be densely deposited on restricted sections of the condenser area; hence the type of sublimation apparatus employed for the purpose usually consists of an elongated retort a portion of which is kept cool to serve as a condenser, or within which a condenser with internal cooling is suspended so as to extend downward closely to the heated part of the retort. It is the main object of the invention to satisfy these partially conflicting conditions by providing a retort in the heated part of which the evolution of vapor will be rapid enough to allow industrial application and in the condenser part of which there is, in spite of the close proximity of the heated and cooled areas in the apparatus, the possibility of establishing a very satisfactory temperature control.

To this end, there is according to the invention between the heated part and the condenser part of the sublimation apparatus a partition body in-

serted, which is made of a material of low heat conductivity and provided with one or more, preferably a plurality, of ducts which are fairly large and form together a large-diameter communication capable of allowing the free passage of vapor, the said partition being however adapted to prevent the vapor from proceeding in perpendicular direction from the retort side to the condenser side thereof. According to a preferred embodiment of the invention the holes of the partition are arranged to run in diagonal direction across the partition body. The said partition is preferably made of a refractory material of high temperature resistivity.

In this manner a very satisfactory quantity of heat can be applied to the heated parts of the apparatus, without provoking an undesired rise in temperature within the condenser. This is of crucial importance since if the condenser is run at too high a temperature this results in considerable loss of metal through burning. Moreover by the use of a partition of such kind the loss of heat due to transmission of heat from the retort side to the condenser side is minimized. Besides, in this manner a very exact temperature control by appropriate means can be accomplished in the condenser. This is desired since the condensation of the metal should be performed within narrow temperature limits in order to obtain a well-crystallized condensate fit for being discharged without undergoing undesired alterations. If the condenser is kept too cool the metal condenses in a micro-crystalline condition and the crystals catch fire or combine slowly with the oxygen and the nitrogen of the air on being discharged.

In the drawing there is a concrete exemplification of the invention diagrammatically illustrated showing, by way of example, a sublimation apparatus of the horizontal retort type destined for batch or discontinuous operation. Figure 1 is a top view of the partition according to the invention on the retort side thereof, Figure 2 a vertical section on line A—B in Figure 1; Figure 3 is a sectional view of a retort equipped with the partition, Figure 4 a top view of a slightly modified form of the partition on the retort side thereof.

1 designates part of the retort which is made from heat-resisting metallic material, preferably steel, and comprises an elongated receptacle of substantially tubular shape, hermetically closed at the bottom end and provided with a removable cover on the opposite end (Fig. 3). The said retort is adapted to be heated by means of any convenient kind, for instance horizontally supported within an appropriate furnace structure

(not shown in the drawing) at full length except the head part that extends through the front wall of the furnace to serve as a condenser 2 and is therefore provided with external cooling devices, for instance coated by a condenser jacket 3 having an inlet 3a for the introduction of a coolant as shown in Figure 3. Alternatively the condenser may be joined to the open end of the retort, e. g. be welded thereto, in the form of a separate tube. In any case the apparatus is equipped with appropriate means (not shown) adapted to be connected with a conduit 3b for creating and maintaining during operation a suitably reduced absolute pressure within the system.

The retort 1 and the condenser 2 are separated, for the purpose of thermal insulation, by a transverse vertically-disposed partition 4 made from refractory material in which holes 5 are arranged so as to run in a diagonal direction from the retort side to the condenser side of the partition. In the embodiment shown in Figures 1 and 2 of the drawing there are four of such holes 5 provided that form ducts starting adjoined at the center of the retort side, running across the depth of the partition in a diagonally-inclined arrangement, and opening on the condenser side of the partition dispersed at regular intervals around the periphery thereof. According to the alternative embodiment shown in Figure 4 the ducts 5 start on the retort side of the partition body disposed at regular intervals near the periphery thereof, proceed, regularly widening, in an oblique direction but substantially straight-lined to the condenser side and terminate there with openings symmetrically arranged along the periphery thereof.

Refractory materials well adapted for the purpose are firebricks, magnesite refractories, carbon stones and the like materials inert to magnesium vapors and capable of enduring high temperatures without damage.

It is self-evident that less or more than four ducts for the passage of the vapor can be provided, but it has been found that four holes give advantageous results under otherwise favorable conditions. The partition can be situated either in the condenser part 2 adjacent to the retort part 1 or in the head end of the retort part 1 (Fig. 3). In the former embodiment the partition may be fixed in its position with the aid of a heat resistant cement. If the partition is placed in the retort part, it suffices to arrange the outer diameter of the partition so that the partition body closely fits the retort tube and no uniting by cement is needed. It would appear as if a partition body of 2 to 3 inches thickness gives the most satisfactory results.

The securing of a minimum loss of heat by heat exchange on the one hand and of a minimum loss of metal by burning, oxidation and nitridation on the other hand, results in obtaining a higher yield, which increase may amount to from 5 to 8 pounds of metal per unit.

Though specifically described in connection with the recovery of sublimable metals, such as in particular of magnesium, from their ores, the present apparatus is equally applicable to the refining of crude metals, particularly magnesium, by sublimation.

We claim:

1. Sublimation apparatus comprising in combination a retort part and a condenser part adjacent to the retort part, which parts are separated, by thermal insulation, and connected, by vapor passages, through a partition body made of a material with low heat conductivity and provided with a plurality of ducts forming together a large-diameter communication capable of allowing free escape of vapor from the retort part of the condenser part, the said ducts being so arranged that they start adjoined at the center of the retort side of the partition body, run across the depth of the said body in a diagonally inclined direction and open on the condenser side of the said body dispersed at regular intervals around the periphery thereof.

2. Sublimation apparatus comprising in combination a retort part and a condenser part adjacent to the retort part, which parts are separated, by thermal insulation, and connected, by vapor passages, through a partition body made of a material with low heat conductivity and provided with a plurality of ducts forming together a large-diameter communication capable of allowing free escape of vapor from the retort part to the condenser part, the said ducts being so arranged that they start on the retort side of the partition body disposed at regular intervals near the periphery thereof, run regularly widening in an oblique direction across the partition body, and terminate on the condenser side of the partition body with openings symmetrically arranged along the periphery thereof.

3. Sublimation apparatus comprising in combination a retort part, a condenser part, and a member of heat insulating material forming a partition between said parts, said partition member having a plurality of ducts providing for the free passage of vapor from the retort part to the condenser part and arranged to extend regularly, widening in an oblique direction through the partition member to prevent direct transmission of heat from the retort to the condenser part.

4. Sublimation apparatus comprising in combination an elongated tubular inclosure, a partition of heat insulating material disposed transversely within the inclosure to divide the same into a retort part and a condenser part, said partition having a plurality of openings to permit the free passage of vapor from the retort to the condenser part and said openings extending obliquely through the partition to prevent the direct transmission of heat from the retort to the condenser in a direction parallel to the length of the inclosure.

MURRAY D. GIRVIN.
LEO ALFRED DENTONE.