

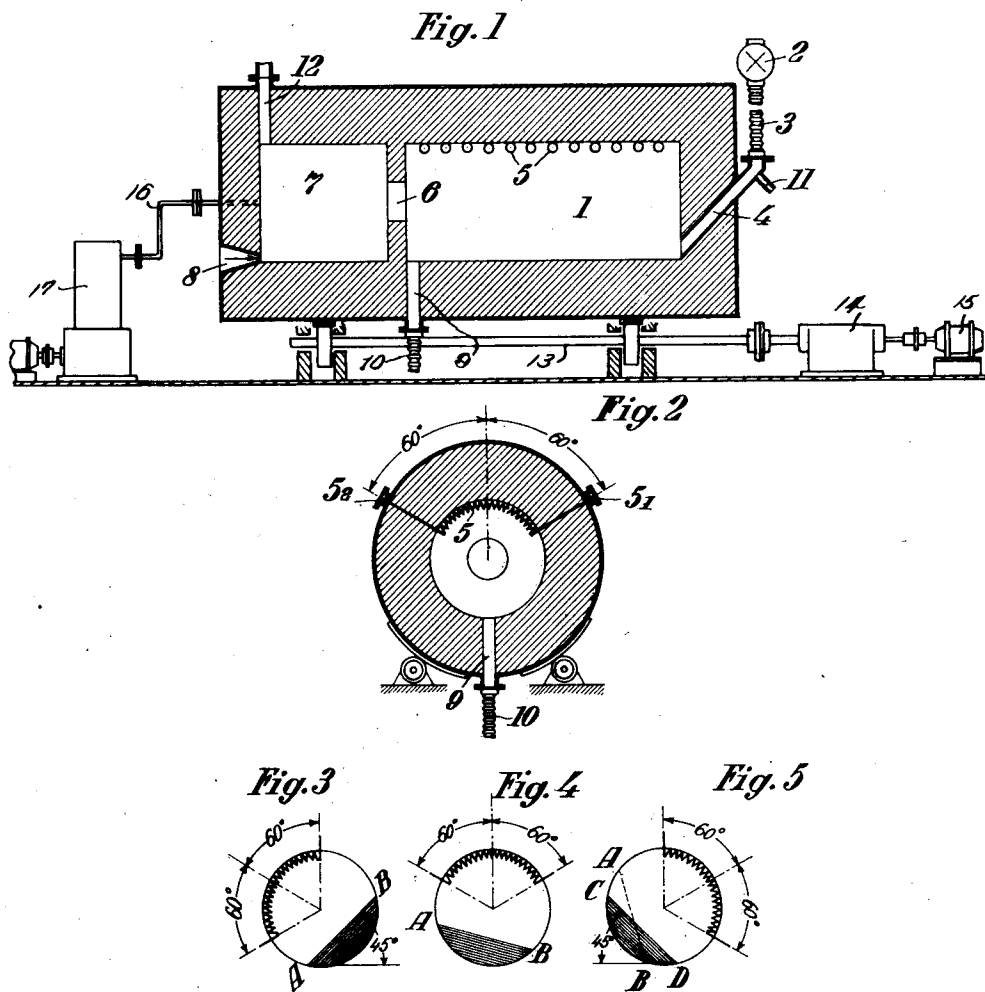
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APPARATUS FOR THE CONTINUOUS PRODUCTION OF METALLIC MAGNESIUM

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APPARATUS FOR THE CONTINUOUS PRODUCTION OF METALLIC MAGNESIUM

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1 Claim. (Cl. 13—21)

The present invention relates to improved apparatus for the continuous production of metallic magnesium which is particularly adapted for a method of continuous production of metallic magnesium by the thermal reduction of raw materials containing magnesia, such as dolomite or the like, in which the reduction is effected at a temperature substantially below the melting point of the reaction residue.

In copending application Ser. No. 758,636 filed by one of us on December 21, 1934, and entitled "Process for the production of magnesium" it was proposed, in reducing magnesiferous raw materials with such reducing agents as calcium carbide, silicon, aluminium and the like, to heat the reaction mixture by direct radiant heat, by continuously leading said reaction mixture past resistors, i. e. electric heating resistances. The attempt to apply this method of operation to rotary-tube furnaces, with a view to improving the thermal economy thereof, is however attended with difficulties, inasmuch as the consequent necessity of disposing of the resistors longitudinally of the furnace, imposes an upper limit on the length and consequently on the capacity of the furnace which results in a furnace output which falls short of the requirements of large-scale operation. Moreover, the reaction mixture, especially in the case of occasional incrustation, is partly carried upwards by the rotating furnace and in descending from the ceiling is liable to damage the axially disposed resistors, which are extremely sensitive to impact and may, in some cases, also be chemically reactive.

The present invention is based on the consideration that, in order to effect the continuous advance of the reaction material in a rotary-tube furnace, there is no need for the furnace to describe complete revolutions, and that it is in fact sufficient for this purpose if the shell of the furnace executes a rocking movement about its axis. This restriction of the movement of the furnace obviates the risk of damage, by down-dropping portions of the charge, to the resistors located within and fixed to the shell of the furnace tube, and especially when the resistors are located considerably above the longitudinal axis of the furnace, for example, in the vicinity of the ceiling of the tube. Incidentally it is possible to dispense with sealing and contact surfaces executing a movement relatively to the furnace, by introducing the charge, and also removing the reaction residues, by means of flexible intermediate members sharing the rocking movement of the furnace, and also of supplying the heating cur-

rent through simple flexible cables. Moreover these advantages impose no constructional limit to the size of the furnace. At the same time, the chamber for the condensation of the distilled magnesium can advantageously take the form of an extension of the furnace space and be integrally connected with the latter. The accumulated metal can be removed from said chamber at intervals during which the movement of the furnace may be temporarily suspended if desired.

It has been found that, in consequence of the friction between the, preferably briquetted, reaction mixture and the furnace walls during the pendulating movement, the lateral amplitude of the charge lags slightly behind the angular deflection of the furnace, so that the latter may have a value of $\pm 60^\circ$ to $\pm 90^\circ$, whilst the resistors can, nevertheless, be distributed over a sector of about $\pm 60^\circ$ from the crown of the furnace, without any risk of their being damaged by the moving mass of reaction material.

In contrast to the ordinary rotary-tube-furnace, in which axial admission of the charge material is necessary, in view of the requisite gas-tight sealing, the present invention affords the possibility of introducing the charge at any convenient part of the furnace. For example, it is advisable to locate the charging opening in the lower sector of the front wall of the furnace (i. e. in that sector of the furnace cross-section which is diametrically opposite to that containing the resistors). In this manner, any disturbing formation of dust can be prevented in charging.

The abolition of all relatively moving sealing surfaces not only substantially simplifies the sealing of the reaction chamber in relation to the atmosphere, but also affords the possibility of running the furnace under reduced pressure or vacuum in case of need, by providing suitable means therefor, when an inert gas, such as hydrogen, is present, in order to produce the magnesium at lower working temperatures.

In order more clearly to understand the invention, reference is made to the accompanying drawing which illustrates diagrammatically and by way of example, one embodiment of furnace in accordance therewith, and in which:

Fig. 1 is a longitudinal section; and

Fig. 2 is a cross-section of the furnace.

Figs. 3, 4 and 5 show the position of the charge in the furnace in various phases of the movement of the latter, it being assumed that the natural angle of repose of the charge is about 45° .

With reference to Figs. 1 and 2, 1 denotes the tubular reaction chamber or furnace into which

the charge is fed through a lock chamber 2, flexible pipe 3 and feed pipe 4 opening into the lower part of the front wall of said reaction chamber 1. Electrical heating resistance coils or resistors 5 are mounted in the ceiling of the reaction chamber, whilst the current is supplied to said resistance coils 5 through radial lead-in members 51 and 52. Under the effect of the heat radiated by the resistors 5, the magnesiferous raw materials are reduced, and the magnesium is distilled over, through an opening 6 located at the other end of the reaction chamber, into a condensing chamber 7, in which the vapours are condensed to liquid magnesium in known manner. The metal is tapped off, from time to time, through a tap notch 8, whilst the solid reaction residues are discharged through a tube 9 and flexible pipe 10, the lower end of which is provided with a lock chamber (not shown).

Suitable means are provided beneath the tubular reaction chamber 1 for oscillating the same. This means is best illustrated in Fig. 1 and comprises a longitudinal shaft 13 controlled through a suitable reversing gear mechanism 14 and directly connected to a prime mover or motor 15. Instrumentalities secured to the shaft 13 and associated with the exterior shell of the reaction chamber 1 constitute positive driving means for actuating the reaction chamber. Furthermore, means for maintaining a reduced pressure in the reaction chamber 1 is provided in the form of a suitable motor-driven exhaust or vacuum pump 17 connected in exhaust relationship with the reaction chamber through the medium of a tubular conduit 16.

When carrying out the hereindescribed process in an inert atmosphere, an inert gas (such as hydrogen) is supplied at 11, to the charge entering the furnace, a discharge pipe 12 being provided, for the removal or circulation of the gas, in the condensing chamber.

Fig. 3 shows the furnace tilted towards the left through an angle of 60° from the normal position.

In so tilting, the surface A—B of the charge material assumes an angle of about 45° and there is therefore still a sufficient distance between the resistors and the charge. If now, as shown in Fig. 4, the furnace be swung back into its normal position, there is at first no change in the position of the charge in relation to the furnace wall. Finally however, when, as shown in Fig. 5, the furnace is tilted towards the right, through an angle of 60° from its normal position, the charge material, assuming it to remain in the position shown in Fig. 3, would lie on the dotted line A—B, but, since its angle of repose is 45°, it will assume the position indicated by the line C—D, in which it is also still sufficiently remote from the resistors.

I claim:

Apparatus for the electrothermal reduction of magnesiferous material by means of reducing agents at temperatures below the melting point of the reaction residue, which comprises an air-tight reaction chamber of tubular cross-section, electrically heated resistors disposed in the ceiling and attached to the shell of said reaction chamber, lead-in members radially disposed in said shell for supplying heating current to said resistors, means for supplying an inert or reducing gas to said chamber, a condensing chamber coaxially disposed in line with said reaction chamber and separated from said reaction chamber by a partition having an opening for the passage of volatilized magnesium therethrough, said opening being so disposed in said partition as to prevent the solid charge in said reaction chamber from entering said condensation chamber, means disposed in said condensation chamber for withdrawing said inert or reducing gas, and means for periodically oscillating said chamber about its longitudinal axis, whereby said charge within said chamber is continuously agitated and different portions of said charge are exposed to the action of the radiant heat.

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