Dec. 29, 1936. F. R. KEMMER 2,065,709

APPARATUS FOR CONDENSING MAGNESIUM

Original Filed April 7, 1933

Fig. 1.

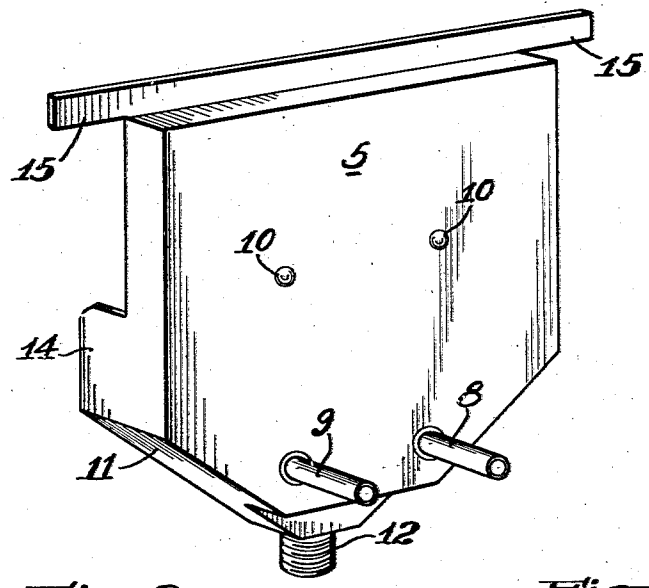


Fig. 2.

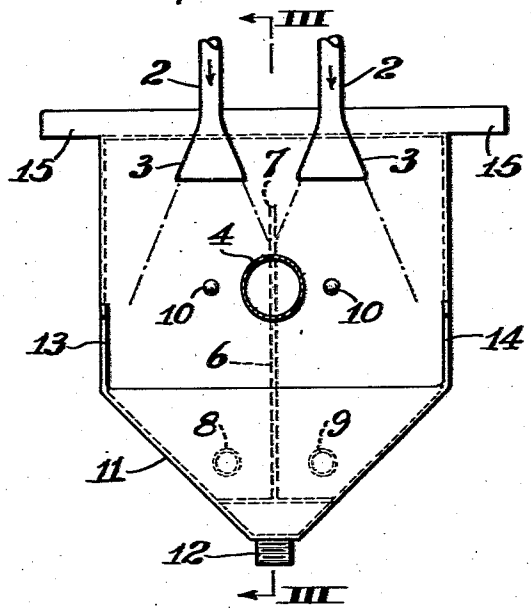
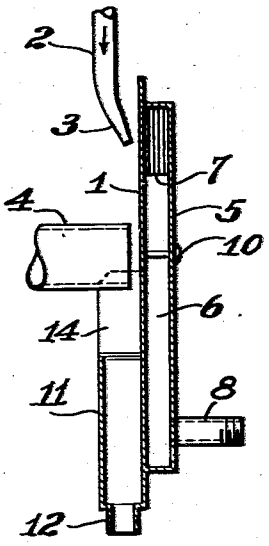


Fig. 3.



WITNESSES

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APPARATUS FOR CONDENSING MAGNESIUM

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Original application April 7, 1933, Serial No. 664,932. Divided and this application November 20, 1934, Serial No. 753,882

4 Claims. (Cl. 266—15)

This invention relates to an apparatus for condensing magnesium vapors.

More particularly the present invention may be combined with the process set forth in my copending application, Serial No. 542,104, filed June 4, 1931, and entitled "Method of producing magnesium", the present application being a continuation in part thereof. In said application I have set forth a process for electrothermally producing magnesium vapors in a furnace and I have furthermore stated that in order to obtain the best results, it is necessary that the mixture of magnesium vapors and CO issuing from the furnace be quickly cooled. The quick cooling is absolutely essential because the reaction between magnesium oxide and carbon to produce the gaseous mixture while proceeding to the right as shown in the following equation:

$$MgO+C=Mg+CO$$

above a temperature of 1,100 to 1,200 degrees C. reverses itself and goes to the left below these temperatures. The reverse reaction is extremely rapid and unless the exit gases are quickly and effectively cooled it is impossible to obtain a major portion of coherent metal from said gases.

This invention therefore resides in an apparatus for condensing the gases issuing from the furnace at the maximum possible speed and as nearly instantaneously as possible to prevent the reversion reaction. The invention also contemplates the protection against chemical reactions of the finely divided magnesium powder formed by the rapid cooling, principally oxidation or nitrification, in the later stages of the process.

The present invention preferably seeks to avoid dilution of the magnesium vapors as they issue from the furnace. A relatively large amount of dilution not only interferes with the condensation of the vapors, but also tends to induce chemical reactions by reason of the presence of the diluting gases. Hydrogen and the like may form water with CO and this may react with the finely divided magnesium forming an oxide coating which would interfere with subsequent recovery of the metal, even if present only in small amounts. If the dilution is large, difficulty arises in the handling of the large volume of gases, and in condensing the magnesium in desirable form.

In practicing this invention the mixture of gases issuing from the furnace is cooled from above the maximum reversion point to a very low temperature by causing the same to impinge upon or into a curtain or film of hydrocarbon oil or other liquid which is non-reactive with magnesium metal. The liquid need not necessarily be non-volatile at said temperature, but preferably so. The liquid should be such as will wet the magnesium powder and thus form a film thereover and protect the powder from oxidation. At the same time the liquid should permit the escape of CO gas. The liquid should be capable of carrying the magnesium powder to a collecting apparatus. While it is not at all essential, it is preferred to cool the liquid so as to maintain its temperature as near normal as possible thus increasing the efficiency of the operation.

As a specific example there was used a kerosene oil at a temperature of 8° C. which was allowed to flow in a thin film over a water cooled plate. The hot magnesium vapors impinging upon this moving film was instantaneously cooled to about 31° C. while the oil was simultaneously heated to the same temperature. Any vapors produced may be recovered, as is well known. The magnesium powder mixed with oil may then be taken to a storage bin and then utilized for further operations. The use of the oil or other liquid has the effect of not only quickly cooling the magnesium but also of separating it from the CO which is not soluble in, nor is held by the oil. The oil furthermore protects the magnesium so that is may be kept in storage for as long a time as desired without danger of oxidation by air. Such oxidation proceeds with a fair degree of rapidity when the magnesium powder is not so protected and is exposed to air at ordinary temperatures. The oil further has an important function in the subsequent treatment of the magnesium powder to produce coherent metal as described in Patent No. 1,964,853, issued July 3, 1934, on an application Serial No. 664,933, filed by me on April 7, 1933, entitled "Method of making liquid magnesium," and which was copending with another application filed by me on April 7, 1933, Serial No. 664,932, of which the present application is a division. The oil in this operation provides a neutral or slightly reducing atmosphere and also provides a slight pressure to keep out air and thus facilitates the production of liquid metal in the stated apparatus.

In the accompanying drawing constituting a part hereof and in which like reference characters indicate like parts, Fig. 1 is a perspective view of a suitable apparatus; Fig. 2 a front elevational view of the apparatus made in accordance with the present invention; and Fig. 3 a side elevational view thereof.

The apparatus consists essentialy of a plate 1, held in a substantially vertical position. At the

upper end thereof are a series of pipes 2, the open ends 3 of which are compressed and flattened as shown in Figs. 1 and 2 to provide nozzles giving a thin, widely spread film of oil over the surface of the plate 1. A pipe 4 leading from the furnace and containing hot magnesium vapors mixed with CO terminates in close proximity to the plate 1. A jacket 5 secured to the back of plate 1 and of relatively narrow cross-section has a baffle 6 therein terminating at point 7, below the top of the water jacket. An inlet pipe 8 is provided on one side of the baffle 6 near the bottom of the jacket for the entrance of water, and a similar pipe 9 on the opposite side of the baffle 6 for the outflow of water. Rivets 10 are provided at various points to hold the jacket and the plate in fixed relative positions and to prevent warping or distortion of the plate. The lower end of the plate and jacket is tapered as shown in Fig. 1, and is provided with walls 11 constituting a receptacle to catch the mixture of oil and magnesium, which flows out through opening 12 and into a suitable storage bin. Wings 13 and 14 along the sides of the plate, and constituting an extension of the side walls 11, act as guards to prevent splashing of oil and thus loss of material. Extensions 15 on the top of the apparatus provide means for holding the same in the proper position.

In operation of the invention kerosene oil is caused to flow through pipes 2 and through the nozzles 3 which cause the oil to spread over substantially the entire surface of plate 1 and to flow down the plate. Hot magnesium vapors mixed with CO from pipe 4 impinge upon the film of oil and the particles of magnesium are instantaneously condensed and are surrounded by films of oil. The CO gas escapes from the surface of the plate and may be removed as desired. The oil flows into the container at the bottom of the plate and through opening 12 to storage. There is no necessity for any rapid recovery of the magnesium from the storage liquid nor is it necessary to take any precautions against oxidation thereof as the magnesium powder is perfectly preserved in the oil.

By this treatment it is possible to place the condenser arrangement close to the furnace and therefore the gases issuing from the furnace impinge upon the same at a relatively high temperature which decreases further the danger of reversion. There are no difficulties introduced as occurs in other proposed methods wherein clogging of the exit pipe by condensed and reverted magnesium causes considerable difficulty. By reason of this method of condensation the eventual recovery of metal from the powder is very materially increased.

Although I have described my invention setting forth a single embodiment thereof and indicating a type of apparatus which I have found to be useful in this operation, my operation is not at all limited to the details herein set forth, but is to be broadly construed. The invention is directed primarily to the extremely rapid cooling of vapors from high temperatures to below a reactive point and is also directed to the preservation of the condensed material against subsequent reactions. It will be apparent to those skilled in the art that various changes, omissions, additions and consolidations of method and apparatus may be made and still carry out the objects of this invention. For instance, other means for cooling the plate may be used. The plate may be omitted and the magnesium vapors may flow into a freely falling curtain of oil or the like. Or the oil may be atomized or injected in finely divided form into the said vapors. In these cases the oil may or may not be previously cooled, as desired. I, therefore, contemplate such changes as may be made for the carrying out of the present invention, the scope of which is not to be limited except by the claims appended hereto.

I may even substitute for the oil, a liquid or fusible solid at a high temperature, as a metal or alloy, or I may use water, preferably cooled, as a means of collecting the magnesium while preventing combination from taking place.

What I claim is:

1. Apparatus for treating highly heated magnesium vapors in admixture with gas, comprising a substantially vertical plate, a spray device for forming on said plate a film of liquid inert to magnesium, a conduit with an end portion extending at substantially right angles to the plate and having a discharge opening of less area than the plate and spaced closely adjacent the plate for transferring the vapors to and causing them to impinge on the film, a funnel secured to the plate and positioned vertically below the discharge opening of the conduit and receiving the mixture of condensed magnesium and liquid, and means for cooling the plate from the side opposite that carrying the film.

2. Apparatus for treating highly heated magnesium vapors in admixture with gas, comprising a plate, a spray device for forming on said plate a film of liquid inert to magnesium, a conduit having a discharge opening of less area than the plate and spaced closely adjacent the plate for transferring the vapors to and causing them to impinge on the film, means positioned adjacent the discharge opening of the conduit for receiving the mixture of condensed magnesium and liquid, and means for cooling the plate.

3. Apparatus for treating highly heated magnesium vapors in admixture with gas, comprising a substantially vertical plate, a spray device for forming on said plate a film of liquid inert to magnesium, a conduit with an end portion extending at substantially right angles to the plate and having a discharge opening of less area than the plate and spaced closely adjacent the plate for transferring the vapors to and causing them to impinge on the film, and means for cooling the plate.

4. Apparatus for treating highly heated magnesium vapors in admixture with gas, comprising a plate, a spray device for forming on said plate a film of liquid inert to magnesium, a conduit having a discharge opening of less area than the plate and spaced closely adjacent the plate for transferring the vapors to and causing them to impinge on the film, said plate extending in all directions away from said opening, and means for cooling the plate.

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