UNITED STATES PATENT OFFICE

2,004,689

MELTING AND/OR REFINING OF MAGNESIUM AND MAGNESIUM ALLOYS PRIOR TO CASTING, AND FLUX THEREFOR

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No Drawing. Application September 22, 1934, Serial No. 745,044. In Great Britain September 21, 1933

12 Claims. (Cl. 75—17)

This invention relates to the melting and/or refining of magnesium and magnesium alloys prior to casting.

It is well known that the refining and preparation for casting of magnesium and its alloys present various difficulties which are mainly associated with the necessary fluxes and refining agents.

Fluxes of low melting point such as carnallite, or mixtures of magnesium chloride and sodium chloride are eminently suitable for covering and protecting the metal during and after melting, but their separation from the molten metal is very difficult and troublesome.

Fluxes of high melting point, for instance, mixtures of anhydrous magnesium chloride with substances which do not form with magnesium chloride eutectic mixtures of low melting point (compare English Patent No. 219,287) are not capable of protecting the metal from oxidation during the temperature interval between the melting point of the metal and that of the flux which is higher.

Further with such high melting point fluxes a refining temperature exceeding, and in some cases considerably exceeding 800° C. is used (compare English Patent No. 182,948).

Since the best pouring temperature for magnesium and alloys composed mainly of magnesium is in the neighbourhood of 740° C., the use of refining temperatures of 800° C. and upwards does not represent the best economy.

The properties of a flux suitable for the most economical preparation of the metal may be summarized as follows:

(1) The flux should melt at a temperature lower than the melting points of the metals or alloys under consideration, which in the present instance are of the order of from about 630° C. to about 650° C., in order to prevent the energetic oxidation which would otherwise occur at the surface of the molten metal.

(2) The flux should be capable of cleaning and refining the metal by separating out with the impurities at a temperature not materially exceeding the optimum pouring temperature of the metal, this latter temperature being of the order of 740° C., but varying according to the composition of the metal and the shape and size of the required casting.

(3) The flux should be capable of completely protecting the metal in the crucible or the like from oxidation when cleaned, and until it is ready for pouring.

The object of the present invention is to provide a flux, or an improved or modified flux, having the above features.

It is stated in the English Patent No. 375,743 and in British Patent 401,672 and in U. S. Patent 1,935,284 that in practice no flux composed exclusively of anhydrous magnesium chloride with sufficient quantities of magnesium fluoride to act as an efficient refining agent will melt at a sufficiently low temperature to allow of refining being carried out below 800° C. The flux with which that specification dealt departed from the stated prior knowledge in the direction of employing hydrous magnesium chloride.

The present invention reverts to the use of anhydrous magnesium chloride, which I have now found can be made with magnesium fluoride into a flux which will melt at a temperature considerably below the melting point of magnesium and its usual alloys, and thus enable the melting and refining of magnesium and such alloys to be carried out at temperatures considerably below 800° C., with adequate protection of the metal during melting, provided that the two salts are present in certain proportions, and that the salt mixture is reduced to the molten state prior to its use as a flux.

The invention consists in a flux for the melting or refining of magnesium, or both melting and refining of magnesium and magnesium alloys prior to casting, comprising anhydrous magnesium chloride and magnesium fluoride melted together in proportions from about 50 to about 80 per cent, by weight of anhydrous magnesium chloride, and about 50 to about 20 per cent, by weight of magnesium fluoride. The fused material may be cooled and more or less finely divided prior to use or it may be applied to the heated or unheated metal to be refined whilst still retaining part at least of the heat employed for fusing the flux.

The invention also consists in fluxes substantantially as herein described.

In carrying the invention into effect in one form, by way of example, the flux contains about 60 per cent, of anhydrous magnesium chloride and 40 per cent, magnesium fluoride. The latter flux, after the intimate contact of its constituents afforded by the initial fusion, melts at a temperature in the neighbourhood of 610° C.

As previously mentioned, the melting points of the metal and alloys under consideration are of the order of 630° C., to 650° C., so that the flux prepared according to the present invention will fuse and cover the metal before the latter assumes the molten state. The flux has excellent refining properties and forms, when suitably applied, a solid crust which not only effects a complete separation of the flux and impurities from the metal, but also serves to protect the molten metal after the refining stage of the process has been completed, and until the metal is in the correct condition for pouring into the mould.

The invention may be carried into effect by way of example in the following manner: A steel or cast iron crucible is preheated, and the metal to be melted placed in it. At the first signs of melting a small quantity of the previously melted and crushed flux, just sufficient to prevent oxidation, is sprinkled over it. If more metal is added in the crucible, additional flux should again be sprinkled over this added metal.

When the metal is completely molten, the temperature is allowed to rise to the region of 680° C.–700° C., and a sufficient quantity of the flux added to deoxidize and refine the metal. This flux again melts in a few minutes, and is vigorously stirred into the molten metal. After sufficient stirring, the flux rises to the surface of the metal, completely covering the melt, and having an appreciable thickness. The crucible and its contents are then raised to and maintained at a temperature of 760° C. for a short period during which the covering flux completely hardens and separates effectively, together with the entrained impurities from the molten metal beneath. The temperature of the metal is then adjusted to a desirable pouring temperature, and the metal is poured into the mould by making a small aperture in the crust, or other convenient method of tapping, leaving the hard crust in its original position in the crucible.

The invention is not limited to the use of a flux of 60 per cent of anhydrous magnesium chloride and 40 per cent magnesium fluoride, but extends to the range from about 50 to about 80 per cent of anhydrous magnesium chloride, and about 50 to about 20 per cent of magnesium fluoride.

In the appended claims, the term "magnesium metal" is intended to embrace pure magnesium and alloys of the types referred to above.

I claim:—

1. In the process of treating magnesium metal, the improvement which comprises forming a flux by melting together about 50 to 80 parts of anhydrous $MgCl_2$ and about 50 to 20 parts of MgF_2, solidifying the melt so obtained and breaking it, all prior to use of said material as a flux.

2. Process of treating magnesium which comprises placing the metal to be melted in a container, heating the said container and adding to it prior to the melting of the metal, a flux prepared according to claim 1.

3. Process of treating magnesium which comprises heating the container serving to melt the metal, adding to the metal as soon as this melts, a small quantity of flux obtained according to claim 1, subsequently adding to the metal when this is completely molten a larger quantity of the said flux sufficient to deoxidize and refine the said metal, stirring the flux into the molten metal, heating the metal to a temperature of about 760° C. leaving the metal and flux in repose for a short period, and finally separating the metal and the solidified flux so formed.

4. In the process of treating magnesium metal, the improvement which comprises forming a flux by melting together about 50 to 80 parts of anhydrous $MgCl_2$ and about 50 to 20 parts of MgF_2, and thereafter applying said flux in the treatment of magnesium metal at temperatures substantially below that necessary for said initial melting step.

5. In the process of treating magnesium metal, the improvement which comprises forming a flux by melting together about 60 parts of anhydrous $MgCl_2$ and about 40 parts of MgF_2, cooling the melt to solidification and comminuting the same, and adding said material as a flux in the melting of magnesium metal.

6. In the process of treating magnesium metal, the improvement which comprises forming a flux by melting together about 50 to 80 parts of anhydrous $MgCl_2$ and about 50 to 20 parts of MgF_2, and applying said mixture as a flux in the treatment of magnesium metal.

7. In the treatment of magnesium metal, the herein described process which comprises forming a flux as set forth in claim 4, placing the magnesium metal in a container and heating said metal, adding a small quantity of the above mentioned flux before any considerable amount of melting of the said metal has occurred, adding a much larger quantity of the flux when the metal has melted, applying heat to melt said added flux, agitating the metal and flux together sufficiently to refine the metal and allowing separation of said metal and flux from each other by gravity.

8. In the process of treating magnesium metal, the improvement as described, which comprises forming a flux by melting together about 50 to 80 parts of $MgCl_2$ and 50 to 20 parts of MgF_2, said materials being substantially anhydrous, and applying said flux to magnesium metal under treatment while at below the melting point of anhydrous $MgCl^2$.

9. In the treatment of molten magnesium metal, the herein described method which comprises forming a flux as in claim 8, and bringing the said flux and magnesium metal into a receptacle, adding enough heat to the magnesium metal and flux, at some stage of the treatment to liquefy both said metal and flux, and agitating the liquefied flux and liquefied metal together, while in a liquid state to refine said metal, and thereafter allowing separation of said metal and flux from each other while in a liquefied condition, whereby it becomes unnecessary to heat said metal to the melting point of anhydrous magnesium chloride.

10. In the process of treating magnesium metal, the improvement as described, which comprises forming a flux by melting together about 50 to 80 parts of $MgCl_2$ and 50 to 20 parts of MgF_2, said materials being substantially anhydrous.

11. Product for the treatment of magnesium which comprises a substantially anhydrous, intimate and homogeneous mixture consisting essentially of about 50 to 80 parts of magnesium chloride and about 50 to 20 parts of magnesium fluoride, and which mixture will melt at a temperature below 630° C., said mixture being in a comminuted condition.

12. A fluxing material suitable for use in melting and refining metallic magnesium and its alloys, which consists essentially of an intimate and homogenous substantially anhydrous eutectic composed essentially of about 60 parts of magnesium chloride and about 40 parts of magnesium fluoride, which eutectic has a melting point below 630° C.

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