Patented Sept. 9, 1947

2,426,987

UNITED STATES PATENT OFFICE

2,426,987

MOLD COATING

Walter A. Dean, Lakewood, Ohio, assignor to Aluminum Company of America, Pittsburgh, Pa., a corporation of Pennsylvania

No Drawing. Application November 13, 1942, Serial No. 465,483

3 Claims. (Cl. 22—189)

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This invention relates to the casting of magnesium and magnesium base alloy and is directed to the problems encountered when that molten metal, or such alloys, is poured into contact with coatings provided on the surfaces of a mold cavity. While the invention has useful aspects in connection with any mold where such coatings are desirable, it is specifically concerned with the problem of molds of the permanent or semi-permanent type in which at least a portion of the surfaces of the mold cavity are composed of a relatively permanent material such as, for example, a metal. Such surfaces are usually composed of mold wall, cores and, perhaps, chills cooperating to form and define a cavity in the mold.

Coatings are usually applied to the walls of a mold cavity, prior to casting molten metal therein, to prevent a sudden chilling of that portion of the metal which contacts the surfaces of the mold cavity, to prevent reaction between mold material and molten metal, to prevent cavity wall erosion and sticking of the metal casting to the mold wall, and to serve other purposes, all of which are well known in the foundry art. For successful operation the coating should have the required thermal characteristics, should provide a surface from which a casting of smooth clean surface may be obtained, should promote ready and exact filling of the mold cavity by the molten metal and should be resistant to the erosive or abrasive action of the incoming metal, as well as capable of preserving its physical integrity under the varying thermal conditions to which it is necessarily subjected during repeated casting operations. It is desirable that a balance of all of these qualities be obtained with the end in view of producing a sound satisfactory casting without constant expensive interruption of the casting process to renew the coating on the casting cavity.

Heretofore in the casting of magnesium and magnesium base alloys thereof the desirable qualities above mentioned have not been achieved in the mold coatings used. Magnesium is, in molten form, a highly reactive metal, and the mold coatings with which it comes in contact often fail after just a few castings are made in the mold cavity. This necessitates interruption of the casting procedure while the coating is renewed and this adds materially to the cost of a casting process, particularly where a permanent or semi-permanent mold is being used and costs are based upon the number of castings which can be produced from said mold in a given period. Moreover, undue reaction between mold

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coating and molten metal causes surface stains and other defects in the casting produced. These difficulties are, in part, encountered in the casting of any alloy containing such amounts of magnesium as lend to the alloy some of the reactive characteristics of that metal. However, those alloys containing about 70 per cent or more by weight of magnesium have, substantially and for practical purposes, the reactive characteristics of magnesium, and it is those alloys which are herein referred to as magnesium base alloys.

The object of this invention is to provide a method of coating molds which will meet the peculiar problems encountered in the casting of magnesium and magnesium base alloy.

A further object of the invention is to provide coated molds and methods of casting which will improve commercial casting conditions in the casting of light metals such as aluminum and its alloys and magnesium and its alloys.

The coatings of this invention are comprised of two general elements—binder and insulator or body material. The coatings are applied to the mold cavity surfaces by means of a carrier, liquid in character, which is usually water, although other liquids may be used. The proportions or concentration of this carrier with respect to the coating will depend upon the operator's needs and the manner in which the coating is to be applied, for instance, by spraying, brushing or the like. The insulator or body material may be one or more of many inorganic materials which are used to perform this function in mold coatings. Their specific selection may depend upon several factors, including their relative chemical inertness, the temperatures involved, the thermal characteristics required, the nature of the desired surface of the casings to be produced (smooth or rough) and, with regard to obtaining optimum coating quality and performance under particular molding conditions, the binder employed. As is later specifically noted, colloidal graphite, furnace slag and vermiculite are particular insulators which are adapted to achieve optimum benefits and specific results in the practice of this invention, but other inorganic materials such as, for instance, other forms of graphite, magnesium oxide, diatomaceous silica, asbestos, soapstone, china clays, and the like, may also be used toward the obtainment of the general objects above stated. Any one or more of these and other insulators may be used in one coating. The proportion of insulator to binder in the final coating is governed by considerations specific and immediate to the

foundry conditions faced by the operator, and selection of specific proportions is governed by the intricacy and size of the mold cavity, the particular alloy being handled, the relative binding quality of the binder, the bulk and covering power of the insulator, the thickness of coating desired and other well known factors. In any event, absolute proportions are a matter of simple and routine selection.

The binder promotes adherence of the particles of the insulator or body material to the mold wall and forms a matrix which gives continuity to the coating and may also serve to protect the insulator particles against erosion or attack of the molten metal. Binders previously used for this purpose have not been entirely satisfactory in the casting of magnesium and its alloys. The problem has been to provide a binder which is not subject to attack by that highly reactive metal and which would also bind the insulator particles to the mold in the form of a continuous coating. Binders, such as sodium silicate, which have previously been used for this purpose have often been found to be inadequate, particularly as regards resistance to attack by the molten metal at elevated temperatures. The result has been that the coatings failed within a relatively short time, thus necessitating frequent interruption of the casting process in order to renew the coating.

According to this invention I provide a binder selected from the class of soluble sulphates consisting of magnesium sulphate and the alkali metal sulphates. Where, as in the case of sodium, more than one soluble sulphate exists, I intend to include in such group all such sulphates of that metal which are soluble in the water, or other carrier. It will be apparent that once the coating is upon the cavity surface solubility of the sulphate becomes unimportant, and indeed the action of the heat of casting upon the coating may alter the solubility of the sulphate of the coating. Of the sulphates in the class just described I prefer to use magnesium sulphate ($MgSO_4.7H_2O$), but all such sulphates have the common property of withstanding the action of the molten magnesium or magnesium base alloy and of also performing the other functions desirable in a binder to produce with the insulator material a relatively hard, adherent and continuous coating upon the mold cavity surfaces. The practice of this invention will therefore comprise the use of a coating containing at least one of these sulphate binders, and insulator or body material. While the insulator or body material may be chosen from the wide range of materials which are available, I have found that certain of these cooperate with the named sulphate binders to form coatings which are particularly superior and, therefore, I prefer to use these substances, which are black iron oxide, vermiculite, and furnace slag.

Examples of mold coatings compounded in accordance with the principles of this invention are the following:

Coating A

Magnesium sulphate ($MgSO_4.7H_2O$)-grams-- 25
Vermiculite ----------do---- 25
Carrier, 100 cubic centimeters of water.

Coating B

Magnesium sulphate ($MgSO_4.7H_2O$)-grams-- 25
Iron oxide (Fe_3O_4) ----------do---- 25
Carrier. 100 cubic centimeters of water.

The proportions of binder and insulator above given form no part of this invention and will be varied by the operator to meet specific conditions. Usually I prefer to add the sulfate binder in an amount not less than about 25 per cent by weight of the total weight of binder and insulator, but percentages expressed by weight are not necessarily significant since some insulators, such as asbestos, diatomaceous silica such as Silocel, and others, have a low weight per unit volume. Simple trial will indicate the amount of the described sulphate necessary to bind the insulator to the mold and to produce the coating continuity desired.

The mold coatings herein described may be applied directly to the surfaces of the mold cavity. In some instances it may be desirable to first wash the mold cavity surfaces with a preliminary wash or coating to obtain a surface to which the mold coating will more readily adhere. Such preliminary washes or base coatings are well known. Their use is, of course, no part of this invention, and since they are completely covered by the mold coating applied thereon, they do not contact the molten metal poured into the mold cavity. Other similar steps such as are normally used in foundry practice may be undertaken in connection with the practice of the present invention.

While the desirable property of these sulphate-bound coatings is their relative permanence as compared with coatings previously used in the casting of magnesium, neither these new coatings, nor the previously used coatings, are, in any relative sense, as permanent as many of the mold cavity surfaces to which they are applied. In large modern foundries permanent mold casting is a relatively continuous operation in which costs depend, to a substantial extent, upon lack of interruption of the casting routine. The molds used are, through one or more production days, permanent, and a continuous supply of molten metal to such molds is merely a matter of arrangement. Given good foundry conditions the casting routine can therefore proceed uninterrupted provided the coating on the mold cavity does not fail and thus necessitate interruption of foundry procedure in order that it may be renewed.

Another aspect of my invention is based on my discovery that in the casting of light metals, such as aluminum and its alloys and magnesium and its alloys, the longevity of any mold coating may be increased if there is provided on the mold coating a superficial layer selected from the class consisting of soluble magnesium sulphate and soluble alkali metal sulphates. Such a layer, applied in any convenient manner as by spraying in solution forms a hard layer on the coating which adds to the effective life of the mold coating without materially altering the functional characteristics thereof. This layer prevents severe erosion, minimizes reaction and generally increases the longevity of the coating to which it is applied. In applying such a superficial layer, neither the manner of application nor the concentration of sulphate compound is a critical factor. The concentration employed will govern the applications necessary to produce a superficial layer of a given thickness. I have used, with good results, a solution containing 25 per cent by weight of magnesium sulphate ($MgSO_4.7H_2O$) and applied this solution by spraying. The desirable result is a well-dried continuous superficial hard layer of magnesium sulphate or alkali metal sulphate imposed on the mold coating.

Where the mold cavity is, at least in part, defined by a non-permanent material, such as a sand core, no problem of permanence arises since the cavity is, to that exent, destroyed after each casting operation. However, the value of the superficial layer in decreasing the reaction of the molten metal on the core coating and in preventing erosion during casting is sufficiently great as to justify its use in many cases.

While certain preferred embodiments of the invention, and specific examples thereof, have been described, it will be understood that such are by way of example only and that the invention may be otherwise practiced within the scope of the appended claims. It will also be understood that the mold cavity "surfaces" referred to in the appended claims may be originally bare or originally provided with a preliminary or base coating.

I claim:

1. In the method of casting light metal into mold cavities at least a portion of the surfaces of which are provided with a coating containing a binder and inorganic insulator material, the improvement consisting in facing the coating with a layer of a compound selected from the class consisting of magnesium sulphate and alkali metal sulphate.

2. In the method of casting light metal into mold cavities at least a portion of the surfaces of which are provided with a coating containing a binder and inorganic insulator material, the improvement consisting in facing the coating with a layer of magnesium sulphate.

3. In the method of casting magnesium and magnesium base alloy in molds having mold cavity surfaces coated with a coating containing a binder and inorganic insulator material, the improvement consisting in forming the coating with a binder which is composed of a substance selected from the class consisting of magnesium sulphate and alkali metal sulphate and in facing said coating with a layer of a substance selected from said class.

WALTER A. DEAN.

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Certificate of Correction

Patent No. 2,426,987. September 9, 1947.

WALTER A. DEAN

It is hereby certified that the error appears in the printed specification of the above numbered patent requiring correction as follows: Column 2, line 39, for "casings" read *casting*; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 25th day of November, A. D. 1947.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.