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ROBERT T. WOOD, OF LAKEWOOD, OHIO, AND FRANCIS C. FRARY, OF OAKMONT, PENNSYLVANIA, ASSIGNORS, BY MESNE ASSIGNMENTS, TO MAGNESIUM DEVELOPMENT CORPORATION, A CORPORATION OF DELAWARE

CASTING EASILY OXIDIZABLE METALS

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This invention relates to the casting of the easily oxidizable metals, such as magnesium, in sand molds or molds made of similar agglomerated substances. The invention is particularly directed toward processes and means by which the casting of these metals may be accomplished without the attendant well known difficulties heretofore encountered.

The propensity of the easily oxidizable metals to react violently with moisture and to combine with oxygen, nitrogen and other gases in the atmosphere has been a serious obstacle to their successful casting in sand molds. In accepted foundry practice there is generally added to the sand or other similar molding materials a tempering medium, usually water, which imparts to the sand the properties necessary to satisfactory molding. Heretofore it has been considered that for successful casting of magnesium and similar metals in such molds, the mold must be carefully heated and the moisture contained therein driven out in order to prevent attack of moisture on the molten metal.

To overcome these well known difficulties, several methods have been suggested. For example it has been proposed to dry the molds carefully and to incorporate in the molding material a substance which, when the mold becomes heated, will produce a vapor which will surround the metal cast therein and protect it from the atmosphere. Such "protective substances", as they are termed hereinafter, must necessarily have the property of producing a protecting vapor which in itself has little or no harmful effect on the magnesium or similar metal.

The principal object of our invention is to provide a protective substance which may be used to advantage in molding mixtures which form the sand molds into which the easily oxidizable metals are cast. The invention has as a further object the production of sound commercial castings of magnesium and similar metals in sand molds.

We have discovered that the compound ammonium phosphate, when incorporated in sand molds and heated by the casting of molten easily oxidizable metals therein, has the effect of protecting such metals from the action of the other constituents of the molding mixture as well as from the action of the surrounding atmosphere. We have further discovered that this compound exerts such a protective action in either dried or undried molds.

In the copending applications of R. T. Wood, filed concurrently herewith, Serial Nos. 410,957, 401,958, 401,959, 401,960, and 401,961, to which reference is made for a more detailed disclosure, there is described a novel process which in its peferred practice involves the use of a plurality of protective substances, capable of producing metal-protecting vapor at variant temperatures and of collectively producing a more or less continuous emission of protective vapors as the temperature of the mold rises, thus insuring the presence of such vapor in the mold and around the casting, regardless of the temperature to which the mold is brought by the hot metal poured therein. While we have found that ammonium phosphate when employed alone in a molding mixture exerts a very favorable protective effect upon magnesium and its alloys and similar metals, we have also found that ammonium phosphate may be used with advantage as one of a plurality of substances added to the molding mixture in accordance with the aforesaid method.

Our experience with various molding sands containing ammonium phosphate singly or in combination with other protective substances, has shown that for the production of small size castings the addition of ammonium phosphate alone, in amounts of 1 to 3 per cent by weight of the sand produces a mixture having a sufficient protective action to allow the production of satisfactory castings. In this connection it is not necessary that the mold be dried before use to remove the aqueous tempering medium for we have found that the protective effect produced under these circumstances is in most cases adequate even in undried molds.

However, in the production of commercial castings of large size we have found that the aforesaid method of R. T. Wood, in which

two or more protective substances are employed, is productive of the best results. Consequently when making castings of an average commercial size or of a large size, we prefer to use with the ammonium phosphate one or more other protective substances, as for instance sulfur, ammonium fluorid, naphthalene, glycerin, ethylene and di-ethylene glycol, and other polyhydric alcohols, boric acid, ammonium bisulfate, anthracene, potassium sulfid, the compound (which we term "organic borate") formed by reaction of boric acid and a polyhydric alcohol, borax and a mineral acid, as sulfuric or hydrochloric, urea, magnesium oxalate, magnesium fluorid, ammonium chlorid, and ammonium borate.

We prefer, however, to use what we believe to be the best combination comprising our new compound, namely a combination of a polyhydric alcohol, boric acid, and ammonium phosphate. The polyhydric alcohol, preferably di-ethylene glycol, may be added to the sand in the form of an aqueous solution containing 25 to 75 per cent of the alcohol, and the boric acid may be added in amounts of 1 to 3 per cent by weight of the total mixture, all of which has been described in the copending applications of R. T. Wood aforesaid. The ammonium phosphate under these conditions is best added in amounts of 1 to 3 per cent by weight of the total mixture and usually 2 per cent is found to be adequate.

We have also found that with sand containing only a polyhydric alcohol and ammonium phosphate an excellent protective action on the molten magnesium or similar metal cast therein is obtained. In this instance we ascribe the protective action to the formation of a compound between the polyhydric alcohol and the ammonium phosphate, which is presumably an organic phosphate. The existence of this compound in the heated sand has not been confirmed by us and therefore we suggest it only as a possible explanation of the beneficial effect produced.

Other protective substances such as naphthalene, sulfur, ammonium fluorid and other well known substances as well as ammonium bisulfate and potassium sulfid, the properties of which have been described in the copending applications aforesaid, may be incorporated with good results in the molding mixtures described above or one or more of these substances may be added to other molding mixtures, in which ammonium phosphate is present, with beneficial results.

Following are examples of a number of molding mixtures comprising our new compound which may be used with good results in the commercial founding of magnesium and its alloys or other easily oxidizable metals. In these examples and in the appended claims, the term "sand" is intended to include and describe not only that particular substance but similar inactive materials which in commonly accepted molding practice are used to form molds of the agglomerated or non-permanent type.

Example 1

A molding mixture consisting of 1 to 3 per cent by weight of ammonium phosphate and sufficient water to lend the proper molding properties to the mixture, the balance being sand.

Example 2

A molding mixture consisting of 2 per cent by weight of ammonium phosphate and sufficient of an aqueous solution of di-ethylene glycol containing 25 per cent di-ethylene glycol to lend the proper molding properties to the mixture, the balance being sand.

Example 3

A molding mixture consisting of 2 per cent by weight of ammonium phosphate and sufficient of an aqueous solution of glycerin containing 50 per cent glycerin to lend the proper molding properties to the mixture, the balance being sand.

Example 4

A molding mixture consisting of 2 per cent by weight of ammonium phosphate, 2 per cent by weight of boric acid, and sufficient of an aqueous solution containing di-ethylene glycol to lend the proper molding properties to the mixture, the balance being sand.

Example 5

A molding mixture consisting of 2 per cent by weight of ammonium phosphate, 2 per cent by weight of boric acid, 2 per cent by weight of sulfur, and sufficient of an aqueous solution containing 40 per cent di-ethylene glycol to lend the proper molding properties to the mixture, the balance being sand.

It is to be understood that the invention is not limited to the forms herein specifically described but can be carried out in other ways without departure from its spirit as defined by the following claims.

We claim:—

1. The method of casting magnesium and other easily oxidizable metals in sand molds, comprising incorporating in the molding material ammonium phosphate, forming a mold of the mixture, and casting the metal in the mold.

2. The method of castng magnesium and other easily oxidizable metals in sand molds, comprising incorporating in the molding material 2 per cent of ammonium phosphate, forming a mold of the mixture, and casting the metal in the mold.

3. The method of casting magnesium and other easily oxidizable metals in sand molds, comprising incorporating in the molding ma-

terial ammonium phosphate and a polyhydric alcohol, forming a mold of the mixture, and casting the metal in the mold.

4. The method of casting magnesium and other easily oxidizable metals in sand molds, comprising incorporating in the molding material ammonium phosphate and an aqueous solution of a polyhydric alcohol, forming a mold of the mixture, and casting the metal in the mold.

5. The method of casting magnesium and other easily oxidizable metals in sand molds, comprising incorporating in the molding material ammonium phosphate and di-ethylene glycol, forming a mold of the mixture, and casting the metal in the mold.

6. The method of casting magnesium and other easily oxidizable metals in sand molds, comprising incorporating in the molding material ammonium phosphate and an aqueous solution containing 25 to 75 per cent of di-ethylene glycol, forming a mold of the mixture, and casting the metal in the mold.

7. The method of casting magnesium and other easily oxidizable metals in sand molds, comprising incorporating in the molding material ammonium phosphate, di-ethylene glycol and boric acid, forming a mold of the mixture, and casting the metal in the mold.

8. The method of casting magnesium and other easily oxidizable metals in sand molds, comprising incorporating in the molding material ammonium phosphate, di-ethylene glycol and 1 to 3 per cent of boric acid, forming a mold of the mixture, and casting the metal in the mold.

9. The method of casting magnesium and other easily oxidizable metals in said molds, comprising incorporating in the molding material ammonium phosphate, di-ethylene glycol, boric acid and sulfur, forming a mold of the mixture, and casting the metal in the mold.

10. The method of casting magnesium and other easily oxidizable metals, comprising casting the metal in a mold made of sand containing in admixture therewith a plurality of protective substances of variant vaporizing temperatures, including ammonium phosphate.

11. A mold for casting magnesium and other easily oxidizable metals, made of sand containing ammonium phosphate in admixture therewith.

In testimony whereof we hereto affix our signatures.

ROBERT T. WOOD.
FRANCIS C. FRARY.