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CASTING READILY OXIDIZABLE METAL

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The present improvements relate more particularly to the casting of magnesium and alloys thereof in which magnesium predominates, but the improved method may also be used for casting other readily oxidizable metals.

Magnesium and its alloys, as is well known, have a high affinity for oxygen which is very pronounced when the metal is hot. The casting of this metal in molds of the ordinary porous type used in casting other metals, such as iron, is unsatisfactory since the oxygen in the mold acts to oxidize or burn the metal, and where the mold is water bound, as in conventional practice, the metal will decompose the water and combine with the oxygen thereof to such an extent that if the casting is of relatively heavy section it may be severely damaged or completely spoiled. Many attempts have been made to discover ways of overcoming this oxidation and burning difficulty, particularly in an effort to find suitable agents that could be added to molding compositions, such as water-bound green sand, which would prevent or counteract this tendency of magnesium and its alloys to oxidize and burn. However, in spite of the extensive work done in this field, there are very few agents known that can be so used with any degree of satisfaction, examples of which are boric acid and sulphur. My experimental work in connection with boric acid and sulphur, however, shows that they are not completely satisfactory. For instance, if a casting should be made having both very thin and very thick sections, then, if one of such agents is used in amount which approaches the minimum that will protect the thin section, the thick section will burn. On the other hand, if the amount of agent used is increased to a point where the thick section will be protected, then the thin section will be damaged by pits, surface depressions, and the like.

I have now made the discovery that borofluohydric acid, HBF_4, and certain of its salts, specifically ammonium borofluoride, NH_4BF_4, are distinctly satisfactory materials for use as oxidation inhibitors in the casting of readily oxidizable metals, such as magnesium and its alloys. Numerous tests with water-bound green sand treated with these agents definitely show that castings having very thin and very thick sections and which cannot be cast without injury where such agents as sulphur and boric acid are used can be satisfactorily cast where my aforementioned agents are used, as hereinafter set forth. Such new agents, moreover, act very efficiently either in admixture with molding compositions, in facings, on the mold surface, or combinations of such procedures.

Accordingly, among the objects of the present invention is the provision of an improved procedure for casting readily oxidizable metals. Another object of the invention is to produce a satisfactory mold for use in the casting of readily oxidizable metals, such as magnesium or alloys thereof, wherein the magnesium predominates. Other objects and advantages will appear as the description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, consists of the methods, steps, and molds hereinafter fully described and particularly pointed out in the claims, the following description setting forth in detail several forms of molds and modes of carrying out the invention, such disclosed forms and modes illustrating, however, but several of the various ways in which the principle of the invention may be used.

While the present invention is applicable for use in connection with molding compositions (sand, carbon, graphite, etc.) for metal casting in general, I will, for simplicity, describe the invention as applied to water-bound green (plastic) sand molding composition. Where borofluohydric acid is used, it may be admixed in amount from 0.5 to 6.0 per cent (based on the 100 per cent acid) with the molding sand. Under ordinary conditions, unless the casting to be made is of relatively thin section throughout, an amount of acid in excess of the minimum noted should be used. The maximum percentage noted may be used to best advantage in connection with the production of castings that are of very heavy section throughout. The preferable amount to use under ordinary conditions where both moderately thick and thin sections are to be cast is from 1 to 3 per cent, and, specifically, 1½ per cent has been found satisfactory for most purposes.

Where ammonium borofluoride is used, it may be admixed in amount from 0.5 to 10 per cent with the molding composition which may, for instance, be molding sand. Under ordinary conditions, however, an amount of

such agent greater than the minimum noted should be used unless the casting to be made is of relatively thin section throughout. The maximum noted, on the other hand, is adapted for use to best advantage in the production of castings that are of exceptionally heavy section throughout. The preferable amount to use under ordinary conditions where castings having both moderately thick and thin sections are to be made is from 2 to 6 per cent, and, specifically, 4 per cent is ample under most conditions substantially or completely to prevent the oxidation and surface injury of magnesium or its alloys when cast in water-bound green sand molds.

The use of my improved agents which may be admixed with a molding composition or produced therein by the use of suitable chemicals or otherwise, is not limited to their use alone, but such agents may be used in combination with other agents which will act at least to give a substantial amount of protection, and at the same time reduce the cost of satisfactorily treating a given quantity of molding composition. Among the agents that can be so used are ammonium sulphate, ammonium fluoride, ammonium chloride, ammonium bromide, ammonium sulphite, ammonium bisulphite, boric acid, and sulphur.

Other modes of applying the principle of my invention may be employed instead of those explained, change being made as regards the means and steps herein disclosed, provided those stated by any of the following claims or their equivalent be employed.

I therefore particularly point out and distinctly claim as my invention:—

1. The method of producing castings of readily oxidizable metals such as magnesium or an alloy thereof which comprises interspersing through a molding composition at least one of the compounds borofluohydric acid, ammonium borofluoride, forming the so treated composition into a mold, and casting the molten metal therein.

2. The method of producing castings of readily oxidizable metals such as magnesium or an alloy thereof which comprises interspersing 0.5 to 6.0 per cent of borofluohydric acid in the molding composition, forming the so treated composition into a mold, and casting the molten metal therein.

3. The method of producing castings of readily oxidizable metals such as magnesium or an alloy thereof which comprises interspersing 1.0 to 3.0 per cent of borofluohydric acid in the molding composition, forming the so treated composition into a mold, and casting the molten metal therein.

4. In the method of forming a green sand mold for use in the casting of readily oxidizable metals such as magnesium or an alloy thereof, the step which consists in impregnating at least the inner surface of the mold with borofluohydric acid.

5. In a method of forming a green sand mold for use in the casting of magnesium or an alloy thereof, the step which consists in mixing with the molding composition approximately 1.5 per cent of borofluohydric acid.

6. The method of producing castings of readily oxidizable metals such as magnesium or an alloy thereof which comprises interspersing 0.5 to 10 per cent of ammonium borofluoride in the molding composition, forming the so treated composition into a mold, and casting the molten metal therein.

7. The method of producing castings of readily oxidizable metals such as magnesium or an alloy thereof which comprises interspersing 2 to 6 per cent of ammonium borofluoride in the molding composition, forming the so treated composition into a mold, and casting the molten metal therein.

8. In the method of forming a green sand mold for use in the casting of readily oxidizable metals such as magnesium or an alloy thereof, the step which consists in impregnating at least the inner surface of the mold with ammonium borofluoride.

9. In the method of forming a green sand mold for use in the casting of magnesium or an alloy thereof, the step which consists in mixing with the molding composition approximately 4 per cent of ammonium borofluoride.

10. A mold for casting metal formed from a molding composition through which has been interspersed at least one of the compounds borofluohydric acid, ammonium borofluoride.

11. A mold for casting readily oxidizable metals such as magnesium or an alloy thereof formed from a molding composition through which has been interspersed 1.0 to 3.0 per cent of borofluohydric acid.

12. A mold for casting readily oxidizable metals such as magnesium or an alloy thereof formed from a molding composition through which has been interspersed 2.0 to 6.0 per cent of ammonium borofluoride.

13. The method of preventing excessive oxidation of magnesium and alloys thereof when cast in sand molds which comprises casting the molten metal in such mold wherein the sand, at least for the parts with which the metal comes into contact, is mixed with ammonium borofluoride.

Signed by me this 1st day of March, 1932.

JOHN A. GANN.