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PROTECTIVE MATERIAL FOR MOLDS AND METHOD OF FORMING THE SAME.

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To all whom it may concern:

Be it known that we, HUBERT A. MYERS and ARTEEMES D. STRAW, citizens of the United States, and residents of Toledo, Lucas County, Ohio, and Wauseon, Fulton County, Ohio, have made an Invention Appertaining to Protective Material for Molds and Methods of Forming the Same; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The purpose of our invention is to provide a protective material for articles of different kinds used in handling or manipulating hot molten material. It particularly has for its object to enable the rapid production of castings of metals having relatively high melting points in permanent molds, especially the formation of ferrous metal castings in iron molds. The protective materials embodying our invention may form alloys or mixtures within the articles with which they are used, and at the same time produce coatings on the articles that will form hard smooth surfaces. The protective materials or portions thereof may have an affinity for and form alloys or mixtures with the material or materials of the articles to which they are applied, which will produce exceedingly durable surfacing materials that will withstand a large number of applications of the heated metal without deterioration of the surfacing materials, and without injury to the article. In case of molds it will permit the rapid and continuous formation of smooth, substantially perfect castings.

The composition of materials utilized will fill the pores of the mold, particularly of iron molds, and will form a coating having a hard, compact, smooth surface that will resist erosion and will prevent pitting and blistering of the casting and pitting or segregation of the materials of which the mold is composed.

The alloying material slightly penetrates the molding surface and the coating produced is an exceedingly thin layer, about one-hundredth of an inch thick. The alloy and coating may be formed or built up in the use of the article by frequent applications of a suitable material or suitable materials between the applications of the molten metal to the article, such as, in the case of a mold, between casting operations, utilizing the heat and the pressure of the molten metal that form the castings to heat compress and perfect the mixture and produce its final protective condition, or the protective material may be applied in any manner and with the use of heat and pressure such as the heat and pressure produced by the molten metal of one or more castings.

The protective material embodying our invention contains a metal having a low vaporizing or boiling point, that is, broadly, a low gasifying point, such as zinc, zinc chloride, cadmium, barium, or bismuth, a carbonaceous material and iron, from which may be formed, first, alloys or mixtures of the metal with the iron and the carbon within the surface of the article, and, secondly, coatings that contain mixtures of the oxide of the metal selected, carbon and iron, and a small amount of the metal that may alloy with the iron. The proportions of the ingredients of the materials may be varied according to the composition of the mold, the metal or alloy that is to be cast therein, and the physical and chemical characteristics to be produced in the casting. Particularly advantageous results are obtained when the protective material contains zinc and is deposited on iron articles, since zinc is readily formed from its compounds and will adhere to or alloy with the iron and in the presence of air readily forms a coating containing zinc oxide on the surface of the articles. To cast ferrous metals in ferrous molds we find it preferable to place a layer containing zinc oxide and carbon over the parts of the mold to be protected from the molten metal and to utilize the iron of the mold or of the casting, or both, to produce an alloy or mixture containing iron, zinc and carbon that is formed within the surface of the mold and a hard coating of iron, zinc oxide and carbon on the surface of the mold. The alloy or mixture that penetrates or is formed within the surface of the mold and the coating on the mold may contain these ingredients in various proportions. The alloy or mixture within the surface of the mold contains, not considering impurities, about 3% to 5% of carbon, about 50% to 60% of iron, and about 30% to 40% of zinc,

and a small amount of zinc oxide. A sample mixture runs about 4% of carbon, 50% of iron, 44% of zinc and a small amount of zinc oxide. The coating mixture contains about 5% to 15% of carbon, 8% to 14% of iron, and the balance of zinc oxide, with a small amount of zinc, ordinarily about 8% of carbon, 12% of iron, 75% of zinc oxide, and the balance of zinc. The amount of the zinc varies, it being probably located at the point of union between the coating and the mold and indistinguishable between the coating and the alloy in the mold. It possibly forms a sub-layer between the two and constitutes a part of the alloy formed in the mold as much as it does of the coating.

To produce the protective material, the matrix of the mold, whatever the composition of the mold may be, is preferably covered with a molten metal having a relatively low melting point and the surplus metal, that may be removed by wiping, is removed as by the use of a wire brush. The surface of the matrix is then covered with the oxide of a metal. The metal may be the same as the metal with which the mold was coated, as just described, or it may be any other suitable metal having vaporizing and boiling points lower than that of the metal to be cast in the mold, and preferably one having an oxidizing point in atmospheric oxygen below the melting point of the metal to be cast. A layer of carbonaceous material, such as the products of an incomplete combustion flame produced from a hydrocarbon fluid fuel, such as acetylene or ordinary fuel gas or carbureted gasolene or oil, is deposited over the oxide. The mold is then filled with the molten metal from which the castings are to be formed. After the removal of the casting a succeeding layer of the metal oxide and carbon is again formed over the matrix and another casting is made. Upon removal of the casting another layer of the metallic oxide and a layer of carbon is formed, and so on repeatedly until the protective material is sufficiently built up on and formed in the mold. This is accomplished ordinarily after ten or twelve castings have been made in the mold.

In forming the protective material, deposits of carbonaceous materials may be omitted. If desired, layers of any well-known heat insulating material, such as magnesia, may be deposited over the layers of metallic oxide, between each of the castings in the preparation of the mold. Also the preparatory dipping or impregnation may be omitted, since the oxide may be reduced by the iron or carbon or a reducing flame, and the metal thus released from its oxygen will alloy with or penetrate the mold.

The deposition of the protective material on the mold may be accomplished in various ways, such as spraying the metal or one of its oxides or salts on the mold. Also the material may be deposited by painting and, if need be, mixtures with vehicles may be used. If desired, the mold may be heated during the application of the metal. Also the metal or its oxide or its salt may be deposited in a mixture of carbonaceous material on the mold in any suitable way, such as painting or spraying or dipping. The oxide, if used, may be subsequently reduced by heating the mold either by a suitable heater or by casting molten metal in the mold and the desired alloy or mixtures formed at or within the surface of the mold. Also the preparatory impregnation of the mold may be accomplished by inserting the mold in a container of metal gas or directing gas of the metal against the mold. If this is done in the presence of oxygen, oxide of the metal will be deposited. The amount of the oxide thus produced will vary according to the amount of concentration of the oxygen.

Inasmuch as the protective substances prevent adherence of metal to metal and to aluminous and cementitious materials, the protective composition may be formed on or incorporated in ladles, pots, troughs, or other articles formed of metal or of the said materials, or both, and used in handling or manipulating molten iron.

The term "mixture" as used in the claims, covers broadly both alloys and mixtures.

We claim:

1. A container having metal incorporated therein and for containing molten metals, and having a protective coating comprising carbon, iron, and an oxide of a metal gasifiable below the melting point of iron.

2. A container having metal incorporated therein and for containing molten metals, and having a protective coating comprising carbon, iron, and zinc oxide.

3. A container having metal incorporated therein and for containing molten metals, and having a protective coating comprising from about 5% to 15% of carbon, 8% to 14% of iron, and zinc oxide.

4. A container having metal incorporated therein and for containing molten metals, and having a protective coating comprising about 8% of carbon, 12% of iron, and 75% of zinc oxide.

5. A container having metal incorporated therein and for containing molten metals, and having a protective coating comprising from about 5% to 15% of carbon, 8% to 14% of iron, and an oxide of a metal, the gasifying point of the metal being below that of the melting point of iron.

6. A container having metal incorporated therein and for containing molten metals, and having a protective coating comprising about 8% of carbon, 12% of iron, and 75% of the oxide of a metal, the gasifying point

of the metal being below that of the melting point of iron.

7. A container having iron incorporated therein and for containing molten ferrous metals, and having a protective coating comprising carbon, iron, and an oxide of a metal gasifiable below the melting point of iron.

8. A container having iron incorporated therein and for containing molten ferrous metals, and having a protective coating comprising carbon, iron, and zinc oxide.

9. A container having iron incorporated therein and for containing molten ferrous metals, and having a protective coating comprising from about 5% to 15% of carbon, 8% to 14% of iron, and zinc oxide.

10. A container having iron incorporated therein and for containing molten ferrous metals, and having a protective coating comprising about 8% of carbon, 12% of iron, and 75% of zinc oxide.

11. A container having iron incorporated therein and for containing molten ferrous metals, and having a protective coating comprising from about 5% to 15% of carbon, 8% to 14% of iron, and an oxide of a metal, the gasifying point of the metal being below that of the melting point of iron.

12. A container having iron incorporated therein and for containing molten ferrous metals, and having a protective coating comprising about 8% of carbon, 12% of iron, and 75% of the oxide of a metal, the gasifying point of the metal being below that of the melting point of iron.

13. A metal-containing mold for metal castings, and having a protective coating comprising carbon, iron, and an oxide of a metal gasifiable below the melting point of iron.

14. A metal-containing mold for metal castings, and having a protective coating comprising carbon, iron, and zinc oxide.

15. A metal-containing mold for metal castings, and having a protective coating comprising from about 5% to 15% of carbon, 8% to 14% of iron, and zinc oxide.

16. A metal-containing mold for metal castings, and having a protective coating comprising about 8% of carbon, 12% of iron, and 75% of zinc oxide.

17. A metal-containing mold for metal castings, and having a protective coating comprising from about 5% to 15% of carbon, 8% to 14% of iron, and an oxide of a metal, the gasifying point of the metal being below that of the melting point of iron.

18. A metal-containing mold for metal castings, and having a protective coating comprising about 8% of carbon, 12% of iron, and 75% of the oxide of a metal, the gasifying point of the metal being below that of the melting point of iron.

19. A mold containing iron for metal castings, and having a protective coating comprising carbon, iron, and an oxide of a metal gasifiable below the melting point of iron.

20. A mold containing iron for metal castings, and having a protective coating comprising carbon, iron, and zinc oxide.

21. A mold containing iron for metal castings, and having a protective coating comprising from about 5% to 15% of carbon, 8% to 14% of iron, and zinc oxide.

22. A mold containing iron for castings, and having a protective coating comprising about 8% of carbon, 12% of iron, and 75% of zinc oxide.

23. A mold containing iron for castings, and having a protective coating comprising from about 5% to 15% of carbon, 8% to 14% of iron, and an oxide of a metal, the gasifying point of the metal being below that of the melting point of iron.

24. A mold containing iron for castings, and having a protective coating comprising about 8% of carbon, 12% of iron, and 75% of the oxide of a metal, the gasifying point of the metal being below that of the melting point of iron.

25. An iron mold for casting ferrous metals, and having a protective coating comprising carbon, iron, and an oxide of a metal gasifiable below the melting point of iron.

26. An iron mold for casting ferrous metals, and having a protective coating comprising carbon, iron, and zinc oxide.

27. An iron mold for casting ferrous metals, and having a protective coating comprising from about 5% to 15% of carbon, 8% to 14% of iron, and zinc oxide.

28. An iron mold for casting ferrous metals, and having a protective coating comprising about 8% of carbon, 12% of iron, and 75% of zinc oxide.

29. An iron mold for casting ferrous metals, and having a protective coating comprising from about 5% to 15% of carbon, 8% to 14% of iron, and an oxide of a metal, the gasifying point of the metal being below that of the melting point of iron.

30. An iron mold for casting ferrous metals, and having a protective coating comprising about 8% of carbon, 12% of iron, and 75% of the oxide of a metal, the gasifying point of the metal being below that of the melting point of iron.

31. A container having metal incorporated therein and for containing molten metals, and having a subsidiary protective material comprising carbon, iron, and zinc.

32. A container having metal incorporated therein and for containing molten metals, and having a subsidiary protective material comprising from about 3% to 5% of carbon, 50% to 60% of iron, and 30% to 40% of zinc.

33. A container having metal incorporated therein and for containing molten metals,

and having a subsidiary protective material comprising about 4% of carbon, 50% of iron, and 44% of zinc.

34. A container having metal incorporated therein and for containing molten metals, and having a subsidiary protective material comprising from about 3% to 5% of carbon, 50% to 60% of iron, and a metal having a gasifying point below that of the melting point of iron.

35. A container having metal incorporated therein and for containing molten metals, and having a subsidiary protective material comprising 4% of carbon, 50% of iron, and 44% of a metal having a gasifying point below that of the melting point of iron.

36. A metal containing mold for metal castings, and having a subsidiary protective material comprising from about 3% to 5% of carbon, 50% to 60% of iron, and 30% to 40% of zinc.

37. A metal containing mold for metal castings, and having a subsidiary protective material comprising about 4% of carbon, 50% of iron, and 44% of zinc.

38. A metal containing mold for metal castings, and having a subsidiary protective material comprising from about 3% to 5% of carbon, 50% to 60% of iron, and a metal having a gasifying point below that of the melting point of iron.

39. A metal containing mold for metal castings, and having a subsidiary protective material comprising about 4% of carbon, 50% of iron, and 44% of a metal having a gasifying point below that of the melting point of iron.

40. A mold containing iron for metal castings, and having a subsidiary protective material comprising carbon, iron, and a metal gasifiable below the melting point of iron.

41. A mold containing iron for metal castings, and having a subsidiary protective material comprising carbon, iron, and zinc.

42. A mold containing iron for metal castings, and having a subsidiary protective material comprising from about 3% to 5% of carbon, 50% to 60% of iron, and 30% to 40% of zinc.

43. A mold containing iron for castings, and having a subsidiary protective material comprising about 4% of carbon, 50% of iron, and 44% of zinc.

44. A mold containing iron for castings, and having a subsidiary protective material comprising from about 3% to 5% of carbon, 50% to 60% of iron, and a metal having a gasifying point below that of the melting point of iron.

45. A mold containing iron for castings, and having a subsidiary protective material comprising about 4% of carbon, 50% of iron, and 44% of a metal having a gasifying point below that of the melting point of iron.

46. A container having metal incorporated therein and for containing molten metals, and having a protective mixture incorporated within the surface of the container comprising carbon, and a metal gasifiable below the melting point of iron.

47. A container having metal incorporated therein and for containing molten metals, and having a protective mixture incorporated within the surface of the container comprising carbon and zinc.

48. A container having metal incorporated therein and for containing molten metals, and having a protective mixture incorporated within the surface of the container comprising from about 3% to 5% of carbon, 50% to 60% of iron, and 30% to 40% of zinc.

49. A container having metal incorporated therein and for containing molten metals, and having a protective mixture incorporated within the surface of the container comprising about 4% of carbon, 50% of iron, and 44% of zinc.

50. A container having metal incorporated therein and for containing molten metals, and having a protective mixture incorporated within the surface of the container comprising from about 3% to 5% of carbon, 50% to 60% of iron, and a metal having a gasifying point below that of the melting point of iron.

51. A container having metal incorporated therein and for containing molten metals, and having a protective mixture incorporated within the surface of the container comprising 4% of carbon, 50% of iron, and 44% of a metal having a gasifying point below that of the melting point of iron.

52. A container having iron incorporated therein and for containing molten ferrous metals, and having a subsidiary protective mixture incorporated within the surface of the container comprising about 4% of carbon, 50% of iron, and 44% of a metal having a gasifying point below that of the melting point of iron.

53. A metal-containing mold for metal castings, and having a protective mixture incorporated within the surface of the mold comprising from about 3% to 5% of carbon, 50% to 60% of iron, and 30% to 40% of zinc.

54. A metal-containing mold for metal castings, and having a protective mixture incorporated within the surface of the mold comprising about 4% of carbon, 50% of iron, and 44% of zinc.

55. A metal-containing mold for metal castings, and having a protective mixture incorporated within the surface of the mold comprising from about 3% to 5% of carbon, 50% to 60% of iron, and a metal having a gasifying point below that of the melting point of iron.

56. A metal-containing mold for metal

castings, and having a protective mixture incorporated within the surface of the mold comprising about 4% of carbon, 50% of iron, and 44% of a metal having a gasifying point below that of the melting point of iron.

57. An iron mold for casting ferrous metals, and having a protective mixture incorporated within the surface of the mold comprising carbon, iron, and a metal gasifiable below the melting point of iron, and a protective coating comprising carbon, iron and an oxide of a metal gasifiable below the melting point of iron.

58. An iron mold for casting ferrous metals, and having a protective mixture incorporated within the surface of the mold comprising carbon, iron, and zinc, and a protective coating comprising carbon, iron and zinc oxide.

59. An iron mold for casting ferrous metals and having a protective coating comprising from about 5% to 15% of carbon, 8% to 14% of iron and zinc oxide and a protective mixture incorporated within the surface of the mold comprising from about 3% to 5% of carbon, 50% to 60% of iron and 30% to 40% of zinc.

60. The process of forming a protective material for molds for casting metals, which comprises depositing on the mold layers of the oxide of a metal that has a gasifying point below the melting point of the metal of the casting, and of a carbonaceous material, and heating and compressing the coating materials.

61. The process of forming a protective material for molds for casting metals, which comprises depositing on the mold layers of the oxide of a metal that has a gasifying point below the melting point of the metal of the casting, and the products of an incomplete combustion flame produced from a hydrocarbon fuel, and heating and compressing the coating materials.

62. The process of forming a protective material for molds for casting metals, which comprises depositing on the mold layers of the oxide of zinc and the products of an incomplete combustion flame produced from a hydrocarbon fuel.

63. The process of forming a protective material for molds for casting metals, which consists in depositing on the mold a metal gasifiable at a temperature below the melting point of the metal of the casting, and depositing on the previously deposited metal a layer of the oxide of a metal that has a gasifying point below the melting point of the metal of the casting.

64. The process of forming a protective material for iron molds for casting ferrous metals, which consists in depositing zinc on the mold, and depositing on the mold layers of the oxide of zinc and of a carbonaceous material, and heating and compressing the coating materials.

65. The process of forming a protective material for iron molds for casting ferrous metals, which consists in depositing zinc on the mold, and depositing on the mold layers of zinc oxide, and the products of an incomplete combustion flame produced from a hydrocarbon fuel, and heating and compressing the coating materials.

66. The process of forming a protective material for iron molds for casting ferrous metals, which consists in depositing zinc on the mold, and also depositing on the mold layers of zinc oxide, and the products of an incomplete combustion flame produced from a hydrocarbon fuel, and casting ferrous metals in the molds.

67. In the process of forming a protective material for iron molds for casting ferrous metals, which consists in depositing layers of the oxides of a metal and of a carbonaceous material on the molds.

68. The process of forming a protective material for iron molds for casting ferrous metals, which consists in depositing layers of the oxides of a metal and of a carbonaceous material on the molds and heating and compressing the coating materials.

69. The process of forming a protective material for iron molds for casting ferrous metals, which consists in depositing layers of the oxides of a metal and of a carbonaceous material on the molds and heating and compressing the coating materials by casting metal in the mold.

In testimony whereof, we have hereunto signed our names to this specification.

HUBERT A. MYERS.
ARTEEMES D. STRAW.