United States Patent Office 3,116,524 Patented Jan. 7, 1964

3,116,524

MOLD COATING

John G. Royal, Kokomo, Ind., assignor to Union Carbide Corporation, a corporation of New York

No Drawing. Filed Sept. 1, 1960, Ser. No. 53,362
8 Claims. (Cl. 22—139)

This invention relates to a method of casting metal in molds and, more particularly, to a method of casting ingots in a protectively-coated ingot mold.

Ingots cast in large metal ingot molds generally have many surface defects resulting from the rough surface of the interior of the ingot mold. Such surface defects on ingots as scabs, pits, blowholes, and inclusions must be removed from ingots by grinding before the ingot is subjected to rolling, forging, or other processing. If not first removed, these defects will carry over into the finished product.

To overcome the expense of the surface finishing operations, various linings and coatings have been used on the interior surfaces of ingot molds. The liners generally suffer from the defects of tearing if fixed in the mold too rigidly; or buckling into the metal if fixed too loosely in the mold.

The ingot mold coatings used very often appear as inclusions in the cast ingot because of their reactivity with the molten metal.

There is a special need for a protective ingot mold coating in those industries casting and fabricating the expensive nickel-, cobalt-, and high alloy iron-base alloys. Many users of these alloys, such as the aircraft industry, have stringent requirements as to surface condition and freedom from inclusions of foreign bodies.

It is the primary object of this invention, therefore to provide a method of casting metals in a protectively-lined molds.

It is another object of this invention to provide a method of casting ingots in protectively-lined ingot molds.

It is another object of this invention to provide an ingot mold coating which is effective, simple to use, and which adds little to the cost of the ingot.

Other aims and advantages of the invention will be apparent from the following description and the appended claims.

In accordance with these objects a method is provided for casting metal in molds comprising preparing a slurry of glass particles mixed with water, applying said slurry to the interior surfaces of a mold, drying the slurry to form a continuous film of discrete glass particles, pouring molten metal into the so-lined mold, and solidifying the molten metal in the mold.

The slurries are generally prepared by mixing the glass particles with enough water to give a watery slurry suitable for brush or spray application to the walls of the mold. The thickness of the coating should be from 0.005 to 0.125 inch and more preferably from 0.025 to 0.050 inch.

The term "glass" as used herein includes any fused metal oxides such as silicates, borates, phosphates, or lead oxides that are supercooled into an amorphous substance that is rigid at room temperatures and soft at high temperatures. Examples of such materials are commercial and industrial glasses, frits, glass cullets, fused silica, mullite, etc.

The small particles of glass may be prepared by crushings or grinding or by fritting. The particle size of the glass should be relatively uniform and have an average size of from 0.0001 inch to 0.01 inch in maximum dimension. The preferred shape is spherical, or nearly so, with a diameter of about 0.001 inch for the average particle.

The vehicle used in preparing the slurry may be water

or another substance; but should not be such that it forms a "binder" for the glass particles. It is critical to the successful practice of this invention that the glass particles, even after coating and drying on the mold, remain discrete and free to move in relatively small groups or sections in accordance with the stresses and strains generated by the hot surging pool of molten metal.

It was the defect of prior art mold coating methods that a binder was used when particulated substances were applied to the interior of a mold. Because the binder cemented, in effect, the particles together into a rigid, unyielding film which was unable to accommodate itself to the forces and heat of the molten metal, whole sections of the coating fell from the mold walls into the molten metal forming inclusions. Coating slurries containing reactive materials which tend to bind or cement together or of unreactive materials held in a binder are unacceptable and to be avoided.

According to the present invention when a slurry of glass particles and ordinary water is applied to the interior of an ingot mold, a thin continuous film of discrete particles forms. The small particles of glass are held together only by a packing and keying effect to produce a macroscopically continuous film of macroscopically discrete particles. The coating is thus able to accommodate itself to the forces of the molten metal. For example, when a droplet of molten metal hits the coating, the droplet falls away carrying a small portion of the glass particles with it. In an uncoated mold, or mold coated with a strongly cohering film of materials, the droplet will freeze to the mold walls or drop into the metal pool carrying a much larger portion of the coating with it than when a film of discrete particles is used. A much larger inclusion is formed when such a cohering coating is used.

Additionally when a droplet of molten metal hits the film of discrete glass particles of this invention, only the outer layer of particles falls away and a thin film of particles is left on the mold wall to provide additional protection to the wall.

Furthermore as the molten metal rises in a mold coated with a film of cohering particles bound by a binder, the stresses caused by the heat and pressure of the metal cause large sections or scabs of the coating to fall off into the molten metal causing inclusions. With a film of unbonded, discrete particles, there is no danger of this breaking away or caking because the film is not subject to internal stresses and strains.

In operation the film of glass particles fills any voids, pits, or cracks in the mold surface to form a smooth surface for the metal ingot. As the pool of molten metal rises, the glass particles fuse into a continuous sheath and remain on the wall as a protective buffer between the mold and cast metal. This buffer acts as a lubricant to the mechanical action of the surging metal, promotes a desirable smooth surface on the casing, protects the surface of the mold, and facilitates the removal of the ingot from the ingot mold.

The glass particle coating is inert and therefore forms no decomposition products when the metal hits it. The glass coating further promotes fluxing action on the surface of the ingot, thereby improving the casting surface by eliminating undesirable solid or gaseous inclusions that otherwise would form on the surface of the ingot.

As an example of the practice of this invention, a 42 inch deep ingot mold of 22 inch diameter was coated with a slurry of water and glass particles or beads of a spherical shape and average particle size of 0.0011 inch diameter. The coating was dried on the mold walls to form a continuous film of discrete glass particles. An ingot of a nickel-base alloy was cast in the mold. The solidified ingot was easily removed from the mold and

had a surface free of defects. No grinding or surface finishing was necessary.

It is to be noted that the slurry of water and glass particles may be brushed on a hot mold whereupon the coating material dries rapidly to give the continuous film of discrete glass particles. It is also to be recognized that this method may be used in other metal molds of any size, such as in permanent mold casting, die casting, etc.

What is claimed is:

1. A method for casting metal in a protectively-lined metal mold comprising preparing a binder free coating slurry of glass particles and water, coating the interior surfaces of a mold with said slurry, drying said coating to form a macroscopically continuous film of macroscopically discrete glass particles on the mold surfaces, pouring molten metal into the so-lined mold, and solidifying the molten metal in the mold.

2. A method for casting metal in a protectively-lined metal mold comprising preparing a binder free coating slurry of glass particles having an average particle size of from 0.0001 to 0.01 inch and water, coating the interior surfaces of mold with sufficient slurry to give a coating thickness after drying of from 0.005 to 0.125 inch, drying said coating to form a macroscopically continuous film of macroscopically discrete glass particles on the mold surfaces, pouring molten metal into the so-lined mold, and solidifying the molten metal in the mold.

3. A method for casting metal in a protectively-lined metal mold comprising preparing a binder free coating slurry of glass particles having an average particle diameter of about 0.001 inch and water, coating the interior surfaces of mold with sufficient slurry to give a coating thickness after drying of from 0.025 to 0.050 inch, drying said coating to form a macroscopically continuous film of macroscopically discrete glass particles on the mold surfaces, pouring molten metal into the so-lined mold, and solidifying the molten metal in the mold.

4. A method for providing a casting metal mold with a protective lining comprising preparing a binder free coating slurry of glass particles and water, coating the interior surfaces of said mold with said slurry and drying the coating to form a macroscopically continuous film of macroscopically discrete glass particles on the mold surfaces.

5. A method for providing a casting metal mold with a protective lining comprising preparing a binder free coating slurry of glass particles having an average particle size of from 0.0001 to 0.01 inch and water, coating the interior surfaces of said mold with sufficient slurry to give a coating thickness after drying of from 0.005 to 0.125 inch and drying said coating to form a macroscopically continuous film of macroscopically discrete glass particles on the mold surfaces.

6. A method for providing a casting metal mold with a protective lining comprising preparing a binder free coating slurry of glass particles having an average diameter of about 0.001 inch and water, coating the interior surfaces of said mold with sufficient slurry to give a coating thickness after drying of from 0.025 to 0.050 inch, and drying said coating to form a macroscopically continuous film of macroscopically discrete glass particles on said mold surfaces.

7. A protectively-lined casting metal mold having as a binder free coating on its interior surfaces a macroscopically continuous film of macroscopically discrete glass particles.

8. A protectively-lined casting metal mold having as a binder free coating on its interior surfaces a macroscopically continuous film of macroscopically discrete glass particles having an average particle diameter of about 0.001 inch, said film having a thickness of from 0.025 to 0.050 inch.

References Cited in the file of this patent

UNITED STATES PATENTS

1,325,725	Kohler et al.	Dec. 23, 1919
1,331,816	McKnight	Feb. 24, 1920
1,662,354	Williams	Mar. 13, 1928
1,770,684	Dewitt	July 15, 1930
1,982,763	Russell et al.	Dec. 4, 1934
2,623,809	Myers	Dec. 30, 1952