METHOD OF FORMING A PROTECTIVE, FLEXIBLE, INSULATING COATING FOR COVERING THE METAL CASTING SURFACE OF A FLEXIBLE CASTING BELT

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ABSTRACT
A method of forming a protective thermally insulating coating for use on a moving flexible surface for casting molten metal, such as flexible metal belts used in continuous metal strip casting machines and processes, this coating having two layers, the first layer comprising finely divided insulative material, for example, diatomaceous earth in a thermostetting resin, which also includes finely divided graphite mixed with the diatomaceous earth and the second layer comprising amorphous carbon and a small amount of resin binder. The coatings are applied to the casting surface in solution with the first coating, applied to a metal surface that has been pre-treated by roughening.

1 Claim, 1 Drawing Figure
METHOD OF FORMING A PROTECTIVE, FLEXIBLE, INSULATING COATING FOR COVERING THE METAL CASTING SURFACE OF A FLEXIBLE CASTING BELT

BACKGROUND OF THE INVENTION

1. Field of the Invention
This invention relates to flexible steel belts used in continuous metal strip casting machines and processes. More particularly, this invention is directed to a method of applying to casting belts a protective and thermally insulating coating and the compositions of such method.

In the Hazelet process for the continuous strip casting of metal, molten metal, such as aluminum, zinc, or the like, is introduced between two synchronously moving endless metal belts which serve as a mold for the solidification of the molten metal. The outer surfaces of these moving casting belts are cooled by rapidly moving layers of coolant, such as water. It is important, in successful operation of the Hazelet process, that heat be extracted uniformly from the molten metal across the widths of the belts and therefore uniform contact between the surface of the solidifying metal and the surfaces of the belts is desirably maintained.

In the past, it has been found beneficial to provide some type of thermally insulative coating on the belt surfaces in order to minimize difficulties arising from casting directly on uncoated belts. That is, too rapid freezing of the casting metal and resultant irregularities responsible for lack of uniform contact and heat extraction are desirably avoided.

2. Description of the Prior Art
In Canadian Patent No. 791,201, based on U.S. Patent application Ser. No. 415,436 filed Dec. 2, 1964, there is disclosed a casting belt coating or dressing composition comprising finely divided carbon, such as graphite or acetylene black, admixed with water-soluble and/or alcohol-soluble organic resin. Also disclosed as an insulative coating is an aqueous dispersion of finely divided acetylene black or graphite and diatomaceous silica, or similar finely divided refractory powder, together with polyvinyl pyrrolidone resin. Although these coatings are said to have a service life which may approximate the mechanical service life of the belt itself, the dressing compositions are said to be capable of application while the belts are on the machine, normally between runs and also during operation if required, so that damaged or excessively worn dressings can be restored.

Other coatings, known as soot washes, have been generally applied after the casting belt is installed on the caster and are maintained or reapplied during casting or between casts. Such coatings consist of amorphous carbon in a quick drying solvent and may include a small amount of resin binder. The life of such a coating is very short.

I have found that a coating, according to the Canadian Patent, comprising finely divided carbon and finely divided insulative refractory material in an aqueous or alcoholic medium containing organic resin binder wears down during casting, undesirably changing the heat transfer characteristics. Since the coating wears down during operation, the thermal conductivity over the coating and metal casting surface varies from run to run, so that the machine operation must be almost constantly observed and adjusted to accommo-
BRIEF DESCRIPTION OF THE DRAWING

The accompanying drawing shows in its sole figure a cross section, taken parallel to the direction of travel, of two coated casting belts having molten metal being cast therebetween as is common in the Hazlett continuous metal strip casting process and machine. The legends on the drawing aid in understanding thereof and characterize the casting belts with their two-layer coating, the molten metal, the solidified metal in the vicinity of the casting belts and the cooling medium applied to the casting belts.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the figure, there is shown a cross section through parallel continuous casting belts, as used in the Hazlett process and apparatus for the continuous strip casting of metal. The direction of travel of the belts and casting is to the right, as indicated by the arrow at the right of the figure.

The casting belts 2 are fabricated from steel, or other alloys, which provide toughness and resistance to abrasion and physical damage as well as resistance to the temperature shocks and heat differential stresses undergone during casting. These flexible metal casting belts can be made in various widths depending upon the desired width of the continuously cast product to be made thereby, for example some are as narrow as eight inches and others have a width up to approximately one hundred inches. Their thicknesses lie in the range of 0.015 to 0.060 of an inch and, therefore, these belts are quite flexible. The belts are cooled on their outer surfaces by rapidly moving layers of coolant 1 created and maintained traveling along the outer surfaces of the belts 2. The coolant may be water in which case suitable corrosion inhibitors are added.

The molten metal 6 is introduced between the continuously moving belts and as the heat is uniformly extracted from the molten metal, it begins to solidify in the area adjacent to the cooled casting belts. The gradual solidification of the process is indicated at 7 where is seen solidified metal increasing in thickness as the belt progresses down stream to the right. The degree of gradual solidification shown in illustrative only and not necessarily to scale.

The belts are provided with a two-layer coating 5 which protects the belts from mechanical damage and wear and deterioration in use arising from physical impingement and thermal shock. Because the belts are flexible and the coatings must flex with the belt, they are preferably thin and must adhere to the belt surface firmly. The belt surface is shown to be etched and/or oxide blasted at 8. Such surface treatment assists in assuring that the bond between the coating and the belt is securely maintained. The coating thickness of the two layers 5 is of the order of 0.001-0.004 inch depending upon the insulating capacity of the materials used.

The figure, while not to scale or accurate proportion, presents an approximate relationship between the thicknesses involved when one considers that the casting belt may be 0.060 inch thick, the two-layer coating 0.0030 inch and the casting metal 0.50 inch, as typical.

The first layer 3 of the two-layer coating 5 preferably comprises finely divided insulative material carried in a thermosetting resin and organic solvent, for example, this insulative material is diatomaceous earth, which may also be mixed with finely divided graphite. This material is sprayed on the etched and/or oxide blasted belt surface 8 and then cured by heating for approximately one hour at a temperature of 450°F. The heat treatment time and temperature is dependent upon the resin used and readily ascertainable. The time can be shortened by adding catalysts to the mixture. The use of thermosetting resin in contact with a roughened belt surface assures good adhesion of the coating and high bond strength contributing to long useful life of the belt coating.

Alternatively, this first layer can be comprised of diatomaceous earth and resin only, eliminating the finely divided graphite. However, when the finely divided insulative material in this first layer is diatomaceous earth, it has been found the addition of graphite gives added strength and durability to the coating. Other finely divided heat insulative refractory materials, such as inorganic, particle form refractory material, such as pumice, asbestos, alumina, talc and the like, may be used. When diatomaceous earth is used, an advantageous form of use herein is diatomaceous silica, such as that sold by Snowfloss by Johns-Manville Company.

The finely divided graphite can be replaced by any finely divided carbon particle in an organic or other solvent suitably selected to form a solution with the thermosetting resin chosen.

The second layer 4 is similar to those beltings known as soot washes and comprise amorphous carbon in a quick-drying solvent and a small amount of resin binder. It may be applied after the belt is installed on the casting machine and maintained or reapplied during the casting process or between casts. It is important that this second layer have maximum non-wettability by the molten metal and thus preserve the integrity of the first layer. The second layer eliminates contact between the insulating layer 3 and the casting as long as it is maintained and contributes to its durability and long life.

The unique association of the two layers results in a casting belt coating which protects the belt against physical wear due to contact with the metal being cast and insulates it from the thermal shocks present during the casting process. Thus, a belt service life, longer than heretofore practicably attainable, is obtained. Improved castings free from quality defects arising from worn belts which have been inadequately protected and insulated are also obtained with the coated belts of this invention.

1. A method of forming a protective, flexible, insulating coating for covering the metal casting surface of a flexible casting belt used for confining molten metal during a continuous metal casting operation, comprising roughening the metal casting surface, applying a first coating comprising finely divided carbon and finely divided refractory material carried in a thermosetting resin and organic solvent to the roughened metal casting surface, heat curing the first coating to form a thermally insulative uniform first layer adjacent to the metal casting surface, and applying a second coating covering the first coating comprising amorphous carbon and a resin binder in a quick-drying solvent to form a second layer to be adjacent to the metal being cast and serving to eliminate contact between the first layer and the metal being cast.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,871,905 Dated March 18, 1975

Inventor(s) CHARLES J. PETRY

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the Cover Page of the Patent, Item 22, the filing date

"November 16, 1972" should read -- November 17, 1972 --.

Signed and Sealed this Twentieth Day of July 1976

[SEAL]

Attest:

RUTH C. MASON
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