Patented Jan. 1, 1952

2,580,524

UNITED STATES PATENT OFFICE

2,580,524

PRODUCTS FOR COATING MOLDS AND INGOT MOLDS

Henri Jean Daussan, Metz, France

No Drawing. Application January 25, 1949, Serial No. 72,740. In France January 29, 1948

2 Claims. (Cl. 22—189)

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It is known that in metallurgy it is necessary to protect the moulds or ingot moulds from the effects of heat and particularly to prevent the fluctuations of the level of the molten metal or the splashes due to the runner from causing the molten metal to adhere to the walls of the ingot mould, and thereby producing the known defects in the surface of the ingots, such as flaws, cold shot, and the like. Consequently various mould dressings have been proposed or used which have, in various degrees, either the drawback of providing a poor protection for the ingot moulds or moulds, or that of not sufficiently eliminating the casting defects that more especially affect the "skin" of the ingot, or even that of actually producing such surface defects.

The present invention has chiefly for its object, by way of a new industrial product, a product for coating the inner surfaces of the moulds and ingot moulds, in particular for cast-iron and steel, that enables the aforesaid drawbacks to be eliminated. Said product is remarkable in that it is in the form of a powder which essentially comprises a mixture of powdered carbon and an alkali metal hydroxide.

This mixture has the following advantages: the carbon forms a sufficiently stable support for the alkali hydroxide to be disseminated therein and remain disseminated therein until it is used. At the instant when it is being used, the carbon, owing to the small size of its particles, penetrates into the pores of the cast-iron of the ingot moulds and prevents the migration of the carbon of said cast-iron towards the less carburized molten metal. On the other hand, the hydroxide (NaOH or KOH) acts on the molten metal which has been cast and purifies same while producing a slight peripheral turbulence at the level of the metal, thereby preventing the non-metallic inclusions from adhering to the walls of the ingot mould.

Preferentially, a sufficiently small quantity of hydroxide is taken (3 to 10% by weight for example) so that, by deliquescence by contact with the moisture of the carbon or of the atmosphere, there is no danger of the mixture's losing a minimum of stability compatible with the manipulation of the product and the packing thereof in paper bags for example.

Preferentially, the product comprises a mixture of a powdered carbonaceous substance containing various oxides or other impurities, for example a natural graphite or an anthracite, the carbon content of which may be of the order of 40 to 85% by weight, and an alkali metal hydroxide, caustic soda or potash, for example in the form of grains, fine strips called "scales" or of a very concentrated lye.

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In this case, in order to have the aforesaid proportion of hydroxide (3 to 10% by weight, for example), supported by the grains of carbon it is obvious that the proportion of hydroxide may be increased owing to the fact that a portion of said caustic soda combines with the impurities when the product is being used: said proportion may be between 5 and 25% by weight.

For use, the powder solely comprising powdered carbon and hydroxide, or the powder containing oxides and other impurities, is mixed with water, for example in the proportion by weight of 1 to 2 parts of water to one part of powder.

The wash thus prepared can be applied to the surfaces of the moulds or ingot moulds, preferably by means of a spray-gun or in any other manner, the film obtained quickly loses, by evaporation, the water with which it was mixed and then no longer contains anything but the useful elements of which the original powder was composed.

In the case in which the mixture contains oxides or other impurities, the alkali hydroxide reacts, in particular when the thinning water is added, on said oxides and other impurities contained in the tiny conglomerates that composes the substance used in the form of a more or less fine powder and thereby produces a disintegration of said conglomerates. This produces the following extremely important result, viz. that, starting from a powder, the fineness of which corresponds to that of a sieve of 6000 meshes per sq. cm., or 77.4 meshes per lineal centimeter, substantially equivalent to U. S. Sieve No. 200, Standard Screen Series 1919, U. S. Bureau of Standards, which has 200 meshes per lineal inch and a sieve opening of 0.0029 inch; and after mixing with water and drying the film of wash by evaporation, carbon grains of extreme fineness, about the size of colloidal micellae, are obtained without its being necessary to effect an extremely thorough mechanical crushing which is often imperfect and is always very costly. These grains lie adjacent, on the surface of the ingot mould, the dried solutions of the alkali salts or other compounds due to the direct or indirect effect of the alkali hydroxide on said oxides or impurities. The carbon particles thus obtained penetrate more readily into the pores of the cast-iron of the ingot mould as they are of smaller size, thereby preventing the migration of the carbon

of the cast-iron itself towards the less carburized molten metal as hereinbefore stated, and so eliminate one of the chief causes of rapid damage to the ingot moulds.

As regards the constituents of the coating that comes into contact with the molten steel as it rises in the mould or the ingot mould, they participate in the purifying reactions of the molten steel at the periphery thereof and furthermore prevent the hereinbefore mentioned surface defects of the ingot or of the casting.

The hydroxide and the alkali salts or various chemical compounds hereinbefore mentioned that form, due to the reaction of said hydroxide with the oxides or impurities, together with the carbon, the coating film, produce on contact with the molten metal highly fusible compounds and a slight surface turbulence at the periphery of the surface of the molten metal. Consequently, the impurities of the molten metal which might become embedded in the skin of the ingot by adhering to the walls of the ingot mould while the metal is rising, are very quickly decanted upwards, carrying with them the dissolved or occluded gases and also, moreover, the constituents of the coating film, other than the carbon. For the same reasons, the projections or splashings of metal on the walls, due to the runner of molten metal, return to the bath. The known surface defects, such as non-metallic inclusions, surface blow-holes, pits, flaws, cold shot and the like, are definitely eliminated.

Thus, in the case in which use is made of sodium hydroxide and a natural graphite containing silica, alumina and various other impurities, the NaOH combines in the form of Na_2SiO_3 in each grain of the powder, either partly or completely with the SiO_2 owing to its affinity for that constituent, which explains the disintegration of each grain at the instant, in particular, when it is mixed with water.

When it comes into contact with the molten casting metal, in the case of steel for example, the Na_2SiO_3 is dissociated into SiO_2 and Na_2O and even if the steel tends to adhere to the walls of the ingot mould a film of $FeSiO_3$ or $MnSiO_3$ is definitely formed which becomes detached from the surface of the mould and thus prevents the molten metal from adhering and assists in forming the very fluid and highly fusible slag at the periphery of the level of the bath, that also contains the other impurities which are decanted right at the top of the ingot, in the portion thereof which must necessarily be cropped.

As regards the carbon of the coating which has not penetrated into the walls of the ingot mould, its presence causes the formation of CO which increases the slight peripheral turbulence hereinbefore mentioned, the reactions being as follows:

(1) $$C+Na_2O=2Na+CO$$

or

(2) $$Fe_3C+Na_2O=2Na+3\ Fe+CO$$

These reactions are followed by the following desulphurizing reactions (3) and (4) in the case in which sulphur is present:

(3) $$FeS+2Na=Na_2S+Fe$$

(4) $$MnS+2Na=Na_2S+Mn$$

The Na_2S which is insoluble is carried away in the purifying slag hereinbefore mentioned which is decanted upwards.

To this desulphurizing action there may if necessary be added a dephosphorizing reaction due to the NaOH in contact with the molten steel.

The following are a few examples of compositions of the product according to the invention.

Example I

Pure carbon, for example electrode scrap, is very finely ground so that the ground product passes through a 10,000 mesh per sq. cm. sieve which substantially corresponds, on the basis previously set forth, to U. S. Sieve No. 270, having a sieve opening of about 0.0021 inch, then the carbon thus ground is intimately mixed with fine or already powdered caustic soda scales, in the following approximate proportions by weight:

C=95
NaOH=5

When it is to be used, the powdered product thus obtained is mixed with water in the proportions of one part by weight of the mixture to one to two parts of water, so as to obtain a sufficiently fluid wash to enable it to be applied for example with a compressed air spray-gun.

Example II

The carbonaceous starting material is a graphitic anthracite of approximately the following composition by weight:

C	80
SiO_2	12
Al_2O_3	5
Iron oxides, TiO_2, CaO, MgO, Na_2O, K_2O	3
Total	100

This graphitic anthracite is ground until it passes through a 6,400 mesh per sq. cm. sieve which substantially corresponds, on the basis previously set forth, to a sieve opening of about 0.0028 inch. 93 g. of the powder thus obtained are thoroughly mixed in a mixer with 7 g. of caustic soda dissolved in a minimum quantity of water, in practice in substantially the same weight of water, the soda solution falling, for example, in a fine spray into the moving powder. The soda is dissolved just before it is introduced into the mixer so that the heat of solution produced sufficiently dries the mass of the mixture obtained, to enable said mixture to be manipulated, stored and packed, even in paper bags, without any danger.

It should be noted that in this embodiment of the invention, the proportions of soda used are such that the coating obtained is friable and not very fusible and the peripheral surface turbulence is comparatively slight.

This coating is therefore particularly suitable for the case of top-casting an effervescent mild steel, or for casting pig, as foundry black, either for incorporating in "green sand" or in "stoved sand" or as liquid washes called "blackwash" or "wet blacking."

Example III

The same starting materials are used as in Example II and the operation is carried out as in said example, using this time 85 g. of the carbonaceous substance indicated to 15 g. of caustic soda dissolved in a minimum quantity of water,

Under these conditions, the silica and the oxides contained in the graphitic anthracite powder are for the greater part combined with the soda without however there remaining much excess alkali when the molten metal comes into contact with the coating film. Said film therefore adheres more firmly to the surface and is more strongly bonded, and this wash should be used more particularly in a thin layer in the case of a bottom-cast killed steel or for coating the surface of moulds intended for casting steel.

Example IV

The same starting materials are used as in Example II, but 80 g. of graphitic anthracite powder are taken to 20 g. of caustic soda dissolved in the minimum quantity of water.

The product obtained contains, in addition to the various impurities, silica and oxides completely combined with the soda, and an excess of alkali. The washes obtained by diluting this product have in particular, owing to their excess of alkali, excellent dephosphorizing and desulphurizing properties which have a favourable effect at the periphery of the ingot, particularly in the case of killed steels of high viscosity.

Example V

A graphitic anthracite of the following approximate composition is taken as a carbonaceous starting substance:

C	70
SiO_2	17
Al_2O_3	8
Iron oxides, TiO_2, CaO, MgO, Na_2O, K_2O	5
Total	100

92 g. of this substance are ground in the same manner as the graphitic anthracite of Example II and 8 g. of caustic soda dissolved in the minimum quantity of water are added thereto.

The wash obtained by dilution contains, besides the carbon and various impurities, a portion of the silica and the oxides combined with the soda and a portion of the silica and the oxides in an uncombined state.

As in all the foregoing examples, this wash has the property of forming a layer to which the molten metal cannot adhere and can be used advantageously for preventing the so-called "bottom crop" due to splashes of the runner and are consequently particularly advantageous for the top-casting of an effervescent steel, by increasing the thickness of the coat at the lower part of the ingot mould.

Example VI

The same graphitic anthracite as in the case of Example V is used as a starting material, but 80 g. of that substance are mixed with 20 g. of caustic soda diluted in a minimum quantity of water. This proportion of soda corresponds to a more complete reaction with the silica and the oxides contained in the carbonaceous starting material. Consequently, the wash obtained has the same properties after dilution as in Example III; however, the surface turbulence produced on contact with the molten metal is slighter and the purifying effect more marked. The wash is suitable in particular in the case of a top-cast killed steel ingot.

Example VII

75 g. of the graphitic anthracite of Example V are mixed with 25 g. of caustic soda diluted in a minimum quantity of water. After a thorough mixing, followed by dilution in an equal weight of water, a wash is obtained that contains an excess of alkali and consequently has, inter alia, excellent desulphurizing and dephosphorizing properties due to the excess of alkali.

The powder prepared according to any of the foregoing examples is mixed at the instant when it is to be used with one or two parts of water to one part of powder. As hereinbefore mentioned, the grains of graphite are extremely fine owing to the fact that the carbon-silica-oxide conglomerate is attacked by the soda, so that the decantation of said grains of graphite takes place very slowly, and when the product thus obtained has been sufficiently triturated, the coat is very homogeneous. The application of the wash with a spray-gun to the walls of the ingot mould can be effected very quickly and enables a homogeneous film without a break to be obtained which dries very quickly. The ingot moulds thus coated withstand a larger number of casting operations without damage and since the ingot mould is dressed with a continuous film, ingots with a smooth "skin" are obtained that contain the smallest practicable number of surface defects.

Of course, the invention is in no way limited to the examples hereinbefore described.

Thus, in particular, it is possible to replace the soda lye by potash lye or by a concentrated solution of a hydroxide of another alkali metal in a stoichiometrically equivalent quantity. It would even be possible to use a hydroxide of an alkali metal in solid form, in grains or in scales, without the addition of water. The operational procedure would remain unchanged. On the other hand, the carbonaceous starting substance need not be graphite or graphitic anthracite. It is possible, for example, to start with any coal or wood-charcoal.

Having now described my invention what I claim as new and desire to secure by Letters Patent is:

1. A product for coating metallic moulds and ingot moulds, adapted to protect the walls of the moulds and the molten metal core being processed in said moulds against migration of carbon from said walls to said core, which consists essentially of a mixture of pulverulent carbon grains capable of passing through a sieve opening not in excess of about 0.003 inch and adapted to enter the pores of the mould walls; and of an alkali metal hydroxide, at least a portion of said hydroxide being unreacted and free and being disseminated among and supported by said carbon grains, said portion amounting to between 3% and 10% of the weight of said mixture, and being adapted to create a protective zone of mechanical turbulence peripherally between said core and said mould walls.

2. A coating for moulds and ingot moulds which comprises by weight one part of the product claimed in claim 1 and about one to two parts of water.

HENRI JEAN DAUSSAN.

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