

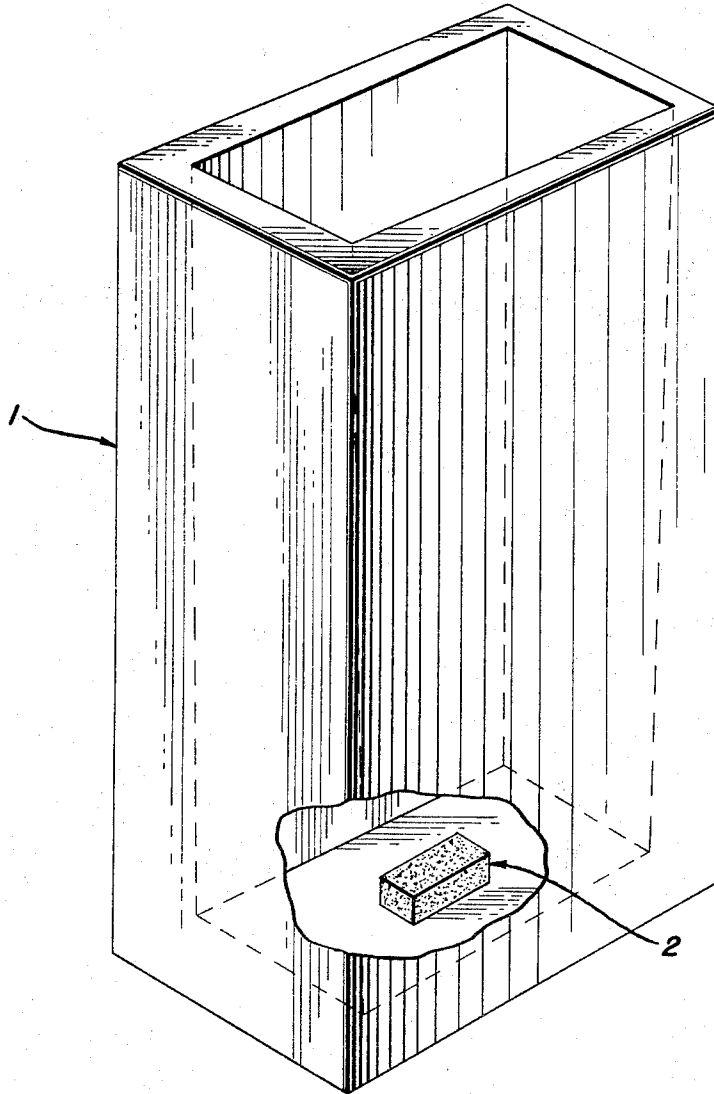
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METHOD OF COATING METAL MOULD WALLS

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INVENTOR.

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**METHOD OF COATING METAL MOULD WALLS**

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Original application July 21, 1965, Ser. No. 473,816, now Patent No. 3,322,518, dated May 30, 1967. Divided and this application Oct. 26, 1966, Ser. No. 608,239

Claims priority, application Great Britain, Nov. 2, 1964, 44,596/64

7 Claims. (Cl. 164-67)

**ABSTRACT OF THE DISCLOSURE**

A method is provided for applying a coating to metal mould walls and for simultaneously generating a non-oxidizing non-corrosive atmosphere within the mould. A small quantity of an ignitable gel composition is placed near the bottom of the mould and is ignited to deposit carbon on the walls of the mould and to generate the desired atmosphere. The gel comprises (1) certain carbocyclic compounds, (2) an inflammable liquid solvent, and (3) a gelling agent for the solvent.

This is a division of application Ser. No. 473,816, filed July 21, 1965, now U.S. Patent No. 3,322,518.

This invention relates to the production of ingots by the method in which molten metal is poured into metal moulds and is particularly concerned with the production of ingots of steel or of slabs or billets of copper, nickel or alloys of either of these. The invention is depicted schematically in the annexed drawing showing an ingot mould 1 containing the three-component gel composition 2 as a discrete mass therein.

When pouring molten steel into metal ingot moulds there is a tendency towards the formation of an oxide skin on the surface of the stream of molten metal which is exposed to the atmosphere. Such oxide formation is more prevalent in the case of top-poured ingots since on striking the bottom of the ingot mould, or the rising surface of the poured metal, splashed metal impinges on the side walls of the mould and remains as flattened droplets with oxidised surfaces. Most of these oxidised droplets cannot be re-dissolved into the body of the molten metal and remain to form defects and blemishes on the ingot skin and, possibly, inclusions in the body of the ingot. Similarly, oxide floating on the surface of the rising metal as the molten metal is poured into the mould may become trapped between the molten metal and the mould walls, giving rise to similar defects.

It is known to use mould dressings or mould additives which reduce oxidation of the molten metal by their fluxing or reducing action and thus help to prevent the above defects. For example, there are, on the one hand, slags, with a melting point considerably lower than that of the metal being cast, which form a molten fluxing layer on the rising surface of cast metal and, on the other hand, there are the commonly used types of mould dressing including those based on tar, pitch or heavy oil compositions. These latter produce the required reducing atmosphere but they give rise to the production of large quantities of smoke and soot during casting, besides being unpleasant and dirty in their application.

Analogous difficulties arise in the production of slabs and billets of copper-based and nickel-based alloys.

It is an object of the present invention to provide means whereby excellent protection, and in some cases complete protection, against the formation of oxidation defects in steel ingots, and copper-based and nickel-based slabs and billets can be achieved.

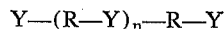
According to the present invention, therefore, there is provided a method for the production of ingots of steel or slabs or billets of copper, nickel or alloys of either which comprises pouring the said molten metal into a metal mould, characterized in that there is placed in the mould a mixture of (1) a carbocyclic chemical substance which contains carbon, hydrogen and optionally also oxygen and/or nitrogen and which will on burning cause a deposit of carbon particles on the walls of the mould, the said particles being adherent to the said walls by reason of the adhesive action of a portion of the said substance or of a combustion product of said substance which deposits on the walls of the mould by sublimation or condensation, or which exists as a coating on the carbon particles, (2) an inflammable liquid and (3) a gelling agent in a quantity sufficient to render the mixture of said constituents into gel form, the said constituents in vapour form, and the gaseous products of combustion thereof, being non-oxidising and non-corrosive, and igniting the gel to cause it to burn and establish a said deposit prior to or simultaneously with the pouring of the said molten metal into the mould.

The invention further includes, as new compositions of matter the gel compositions as aforesaid.

The substance (1) may be a single organic chemical compound or mixture of such compounds. The selected carbocyclic substance should preferably not be deliquescent or hygroscopic since such substances have a tendency to introduce water vapour into the mould. It is generally found preferable to employ an aromatic compound with a high proportion of carbon in the molecule.

A wide variety of compounds are suitable for use in carrying out the method of the invention. These include carbocyclic hydrocarbons such as naphthalene, phenanthrene, anthracene, biphenylene, naphthacene, rubrene, pentacene, heptacene, pyrene, perylene and acenaphthene. Other suitable substances are phenolic compounds (e.g. resorcinol, hydroquinone, alpha and beta-naphthol, anthraquinone quinol), esters of carbocyclic acids (e.g. pentaerythritol and glycerol esters of resins, such as ester gum), terpene compounds (e.g. camphor, borneol, pinene or abietic acid), or certain natural or synthetic resins containing carbocyclic groups (e.g. phenolformaldehyde, copal, terpene resins and alkyd resins) may be used. Nitrogenous compounds may also be used, e.g. alpha-naphthylamine and the aminoanthraquinones. Halogen-containing substances, aromatic acids and anhydrides are not preferred substances since they tend to cause corrosion.

A particularly useful substance is a mixture of mononuclear and polynuclear aromatic alkyl hydrocarbons of the generalised structure R—Y for the lower molecular weight members of the mixture, and



for the higher molecular weight members, where Y is an alkyl residue of up to 8 carbon atoms and R represents a mononuclear or polynuclear aromatic residue (e.g. phenyl, naphthyl and anthracyl). A said mixture having ingredients ranging in molecular weight from about 180 to about 3000 and an average molecular weight of about 315, and having a net carbon content of about 90% by weight, is commercially available (Reichold Chemicals, Inc., U.S.A.) under the name Petrosyn C-2. Analogous mixtures, obtained by a high temperature Friedel-Crafts reaction, can also be employed.

The list of substances for use in the invention just set forth is not to be regarded as exhaustive since any organic carbocyclic substance which affords the desired coating of carbon particles and other effects as set forth may be employed. The efficiency of any compound can be readily ascertained by simple test.

The second ingredient, the inflammable liquid, may be

any such but it is preferable to avoid the use of solvents which contain elements such as halogen or sulphur since these may tend to be corrosive. From the standpoints of cheapness and availability the common inflammable solvents such as solvent naphtha, mineral spirits, turpentine, white spirit and isopropyl alcohol are preferred. Other inflammable solvents such as toluene may be used or mixtures of any of the named solvents may be used. Basically it is only necessary that the liquid should be capable of ready ignition and, when burning, should ignite the said organic carbocyclic substance.

Any gelling agent which will gel in the liquid used may be employed but it is preferred to select such as will leave no, or very little residue, which might contaminate the cast metal. Metal soaps, especially aluminium soaps are very suitable, e.g.:

Aluminium stearate: gels in solvent naphtha and kerosene.

Aluminium naphthenate: gels in white spirit, kerosene, turpentine and isopropyl alcohol.

Aluminium octoate: gels in white spirit, kerosene and turpentine.

Aluminium salt of 2-ethyl hexoic acid: gels in kerosene and other liquid hydrocarbons.

Among other gelling agents of value there may be mentioned alkyl ammonium montmorillonite: gels in aromatic hydrocarbons and alcohols.

It has been found that extremely small amounts of the substances (1) are sufficient to give the desired effect. It is to be noted in this connection that when the same substances (1) are included in sand moulds used for making castings an improvement in fluidity of the molten metal is achieved. This however usually requires a minimum proportion of the volatile substance of the order of 0.01% based on the molten metal being cast. In the present invention, which is concerned only with the casting of steel or copper based or nickel based metal, into metal chill moulds, still smaller quantities may be employed, i.e. quantities less than 0.01% and frequently as low as 0.002% or even less. Thus, in the production of steel ingots a quantity of the gel sufficient to provide the substance at the rate of 2 ounces per ton of metal cast may be sufficient.

The gel additives of the present invention may be employed as such but it is usually convenient to employ them in combustible containers, e.g. of cellulose nitrate film or of paper coated with a plastic or wax layer. Suitable containers are cardboard containers of the general character employed for packing pills and tablets in the pharmaceutical industry. It is of course important that the container should burn away to leave little or no residue which might contaminate the cast metal.

The following are examples of gel additives for use in the method of the invention. Percentages given are by weight.

#### Example I

	Percent
Naphthalene -----	19.3
White spirit -----	77.0
Aluminum naphthenate -----	3.7

#### Example II

Naphthalene -----	45
Kerosene -----	45
Aluminium naphthenate -----	10

#### Example III

Naphthalene -----	40
Turpentine -----	55
Aluminium naphthenate -----	5

#### Example IV

Naphthalene -----	15
Petrosyn C-2 -----	8
Kerosene -----	71

Aluminium octoate -----	3
Aluminium salt of 2-ethyl hexoic acid -----	3

#### Example V

Petrosyn C-2 -----	14
Solvent naphtha -----	80
Kerosene -----	2
Aluminium stearate -----	4

Recommended additions are as follows: for ingots up to 500 lbs. 2-4 oz. per ton; for ingots of 500 lbs. to 5 tons, 4-10 oz. per ton.

In carrying out the method of the invention the required quantity of the gel composition is placed in the bottom of the metal ingot mould and ignited. It is immaterial whether the mould is cold or warm at this time. The ignition may be effected before the molten metal is poured into the mould so that the mould, when the metal is tapped, already has the required carbon deposit, and this method of procedure is generally preferable. However the ignition of the gel composition may, in an alternative procedure, be effected by the molten metal itself in the pouring operation. As the gel composition burns the mould is filled with its vapours and/or the vapours of its decomposition products and an adherent carbon deposit is formed on the walls. By appropriate selection of the constituents, as set forth above, the disadvantages peculiar to the previously known dressings are avoided, i.e. there is no possibility of inclusions in the cast steel deriving from the additive and there is no slag of any sort remaining on the surface of the cast metal. There is little or no fume problem. Furthermore, the simplicity of application compared to normal methods of applying mould dressing is a distinct advantage; thus there is no equipment needed to apply the product, thus avoiding capital cost and maintenance, and there is a reduction in labour costs. Moreover the surface quality of the ingot obtained is much less dependent on human factors. Finally, it may be noted that the coating applied to the mould surface by the method of this invention also functions as a mould release agent and it preserves the surface of the mould thus prolonging its active life.

I claim as my invention:

1. In a method for the production of ingots of steel and slabs and billets of copper, nickel and their alloys by pouring the said metal in molten condition into a metal mould, the improvement which comprises locating near the bottom of said mould a quantity of a gel composition comprising three ingredients (1) a material in an amount effective upon being burned in the mould to generate a non-oxidising non-corrosive atmosphere in the mould and a protective carbon deposit on the walls of the mould, said material being selected from the group consisting of polynuclear hydrocarbons, resorcinol, hydroquinone, alpha-naphthol, beta-naphthol, anthraquinone, quinol, pentaerythritol, glycerol esters of resins, terpenes, phenol-formaldehyde resins, copal, alphenaphthylamine and aminoanthraquinones, (2) an inflammable liquid solvent, and (3) a gelling agent for said inflammable liquid solvent in a quantity sufficient to render said composition into gel form, and igniting the said gel composition to cause it to deposit carbon on the walls of the mould and generate in the mould a non-oxidising non-corrosive atmosphere, said gel composition being placed in the mould in a discrete mass other than a mould coating.

2. A method for applying a coating to metal mould walls which comprises igniting near the bottom of said mould a quantity of an ignitable gel composition comprising three ingredients, (1) a material in an amount effective upon being burned in the mould to generate a non-oxidising non-corrosive atmosphere in the mould and a protective carbon deposit on the walls of the mould, said material being selected from the group consisting of polynuclear hydrocarbons, resorcinol, hydroquinone, alpha-naphthol, beta-naphthol, anthraquinone, quinol, pentaerythritol, glycerol esters of resins, terpenes, phenol-

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formaldehyde resins, copal, alpha-naphthylamine and aminoanthraquinones, (2) an inflammable liquid solvent, and (3) a gelling agent for said inflammable liquid solvent in a quantity sufficient to render said composition into gel form, to thereby deposit carbon on the walls of the mould and generate in the mould a non-oxidising non-corrosive atmosphere, said gel composition being placed in the mould in a discrete mass other than a mould coating.

3. A method according to claim 1 wherein the inflammable liquid is mineral spirits.

4. A method according to claim 1 wherein the inflammable liquid is solvent naphtha.

5. A method according to claim 1 wherein the gelling agent is a metal soap.

6. A method according to claim 1 wherein the gelling agent is selected from the class consisting of aluminum stearate, aluminum naphthenate, aluminum octoate and aluminum 2-ethyl hexoate and alkyl ammonium montmorillonite.

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7. A method according to claim 1 wherein the composition is ignited by pouring said molten metal into said mould.

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