METHOD FOR PROTECTING HOT METAL SURFACE

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The reducing agent may be applied as a cloud of fine particles, as a solution, or as vapors.

3 Claims, No Drawings

ABSTRACT

Process for preventing the oxidation of hot metallic surfaces comprising coating the surfaces of the hot metal with a reducing agent which forms a protective pellicle, i.e., a thin skin or film, through which the state of the metal surface can still be observed during fabrication. The pellicle or film inhibits the formation of an oxide crust. The metal may be in solid or molten condition. The pellicle is formed by applying a reducing agent to the metal surface. The reducing agent may be applied as a cloud of fine particles, as a solution, or as vapors.

5 Claims, No Drawings
METHOD FOR PROTECTING HOT METAL SURFACE

CROSS REFERENCE TO OTHER APPLICATIONS

This application is a continuation-in-part of U.S. application Ser. No. 640,816, filed May 24, 1967 and now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention
The present invention concerns a new process for the protection of solid or liquid hot metallic surfaces.

2. Description of the Prior Art
It is known that surfaces of the type which are treated in the iron and steel industry have a tendency to oxidize, the more so the higher their temperature.

This oxidation generates internal and surface faults. Moreover, it constitutes an unfavorable economic element since in the dressing and transformation of steel it can represent the generation more than 20 kilograms of unusable material per ton of metal.

Processes are known which protect iron and steel parts by applying a protective or reduction layer before submitting them to treatment. However, on the one hand, these known layers are applied cold on the part which must subsequently be heated, and on the other hand, the known processes form a crust which masks the surface of the part.

An object of the present invention is to protect not only solid but also liquid hot metallic surfaces from oxidation. A further object is simultaneously to minimize the formation of oxides.

SUMMARY OF THE INVENTION

The process in accordance with the invention comprises applying, to the metallic surface to be protected, a product possessing reduction properties, which gives rise to a protective pellicle and can, as a result, be introduced and continuously applied, without modification of the manufacturing procedure already existing in the works of shop floors of the iron and steel industry, in forging or in foundry work.

Contrary to the prior art, the process in accordance with the present invention is applicable to a metallurgical part in the course of transformation or working, for example, in the course of a rolling operation, without it being necessary to heat the part solely and separately before the application of the coating. On the other hand, the protected pellicle, in accordance with the invention, reduces the oxides and minimizes the formation of calamine and leaves the hot surface visible so that one can observe with the naked eye the quality and state of the surface of the part in the course of lamination. As soon as a fault appears on the surface, it can be seen with the naked eye, since it is not masked by a crust of oxides, as in the case of known prior art processes.

DETAILED DESCRIPTION OF THE INVENTION

The protective composition of the present invention has particular applicability to cleaning and protecting of steel, which is subjected to temperatures of between 900°C and 1,200°C during the usual rolling operation on a rolling mill. Steel bars being rolled frequently circulate at a speed of about 50 meter per second and their cross-sectional surface can be reduced from 3 feet\(\times\) 3 feet to a one-sixth inch diameter wire after 25 passages between the cylinder.

Protective coatings of the prior art applied before passing in the rolling mill become rapidly inefficient after a few passages, because of the enormous difference of the cross-sections. If these coatings are applied after the rolling operation, they are no longer useful. Furthermore, the metal would have to be reheated in order to form a protective pellicle.

On the contrary, applicant’s composition applied to a steel surface is able to permanently protect the metal surface throughout the rolling operation, no matter how great the cross-section reduction. Furthermore, using the heat produced in the rolling operation, it is not necessary to employ any exterior heat source in order to form the pellicle.

The materials of this invention may be easily applied to the metal surface using already existing rolling mill equipment, without any other construction than mounting a transverse tube about 5 feet in length and an aerosol producing apparatus (such as a hopper, turbine, venturi or the like). No other special preferential circuit or general installation is required. The surface defects of the steel bar may be viewed as soon as they appear during the rolling operation, as the steel surface is kept permanently clean and protected against oxidation.

The chemical forming materials of the present invention may be selected from a wide variety of materials which possesses the necessary chemical and physical properties required to insure the desired protective and reducing rolls of the present invention. That is, the materials to be employed in the process of the present invention are those which form a pellicle when heated, suppress oxide formation on the surface of the metal to be protected and which form a film through which the surface of the metal can be observed. Such materials can comprise either mineral or organic components.

As mineral compositions which have been found to be suitable for use in the process of the present invention, there may be mentioned:

a. \(\text{SiO}_2\), \(\text{Al}_2\text{O}_3\), \(\text{CaO}\), \(\text{MgO}\), \(\text{Na}_2\text{O}\), \(\text{K}_2\text{O}\), and \(\text{B}_2\text{O}_3\);
b. \(\text{SiO}_2\), \(\text{KBO}_2\), \(\text{Na}_2\text{CO}_3\), and \(\text{B}_2\text{O}_3\);
c. \(\text{SiO}_2\), \(\text{KBO}_2\), \(\text{Na}_2\text{CO}_3\), \(\text{NaHCO}_3\), \(\text{NaHCO}_3\), and \(\text{HPO}_4\);
d. \(\text{SiO}_2\), \(\text{Al}_2\text{O}_3\), \(\text{CaO}\), \(\text{MgO}\);
e. \(\text{Na}_2\text{B}_4\text{O}_7\), \(\text{SiO}_2\), and \(\text{CaO}\).

The above mixtures, as well as those of the following examples, have been found to be absolutely non-toxic and very efficient in the protection of steel at forging temperatures of between 900°C and 1,200°C.

As organic compositions which have been found to be suitable for use in the process of the present invention, there may be mentioned mixtures of cellulose, a vegetable oil, such as palm nut oil, arachis oil, sunflower oil or the like, together with at least one material selected from among bentonite clay, chalk or carbon black.

The following illustrative examples will more clearly indicate the nature of the composition of the present invention. The compositions illustrated in Examples 1-5, inclusive, represent the initial compositions as applied to the hot metal surface, and not the final makeup of the coating.

EXAMPLES 1-3

The following table illustrates three compositions which are particularly suitable for application to fer-
rous metals during a foundry rolling operation. In claims 1-5, all proportions are set forth in parts by weight.

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<th>TABLE 1</th>
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<td>Example</td>
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The above compositions are applied to the hot metal surface in the form of finely divided powder which is brought into contact with the surface, thus depositing the protective pellicle. They are also employed in a liquid medium, in which case they are sprayed onto the surface of the hot metal or contacted with such surface in the form of a fog.

EXAMPLES 4 & 5

The following table illustrates two compositions which are particularly suitable for application to non-ferrous metals during foundry rolling operations.

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<th>TABLE 2</th>
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<td>Example</td>
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<td>4</td>
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<td>5</td>
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These materials are contacted with the hot metal surface in the same manner as described for the compositions of Examples 1-3.

EXAMPLE 6

An organic composition particularly suitable for spraying onto metal billets during foundry rolling operations was prepared by mixing the following ingredients:

- Ingredient: Proportion (weight percent)
  - Cellulose: 30
  - Palm nut oil: 24
  - Bentonite clay: 21
  - Carbon black: 25

In use, the above composition is mixed with alcohol to obtain a sprayable paste which is then sprayed onto a metal billet during rolling. This composition provides an excellent protective coating which can be easily removed, if desired, when the metal has cooled.

As indicated in the above examples in accordance with the process which is the subject of the invention, the reducing, pellicle-forming materials are generally solid and may be used in the form of a cloud of very fine powder, the particles of which melt upon contact with the hot part of the liquid metal. As a result there is deposited a pellicle which ensures rigorous protection, whilst exercising a chemical energy reduction. The compositions of this invention may also be employed in conjunction with a suitable liquid carrier, for example, as a dispersion, in the form of a fog which also gives rise, on contact with the hot surface part or the liquid metal, to a protective reducing pellicle. The reducing agents can also be directly gasified so as to constitute an atmosphere which possesses the property of reducing oxides, and which is contacted with the hot metal surface in a reducing atmosphere to form a protective pellicle.

It will be understood that the process which has been described can be used in all industries which put into use oxidizable metals and especially in the iron and steel industry, in forges or in foundries.

For example, in the case of a lamination, it will be seen that the application of a process in accordance with the invention can be effected without having to modify the lamination train, i.e., the mechanical treatment applied to the parts in the course of transformation, when the parts are at the desired temperature.

The protective and reducing pellicle in accordance with the invention, maintains the surface of the part substantially free of oxides, leaving any possible superficial fault exposed to the naked eye and this, in spite of the large increase in surface observed in the course of lamination. The operation in accordance with the invention is thus comparable to sanding, grinding or chemical removal which permits suppression of masking or observation of surface faults. On the contrary, it has nothing in common with the known processes of thermal treatment which consists in applying a coating on the final cold part before passing it to an oven or a vat.

The process possesses the following principal advantages:

a. complete or substantial obviating of faults which may result from hot oxidation,
b. elimination of a large part of oxides which increase the manufacturing costs of oxidizable metals,
c. protection of metallic parts which can thus be stocked in the atmosphere without fear of attack. The protection obtained in accordance with the invention can possibly be used to form a marine coating,
d. since the treatment is effected continuously, it does not limit the production capacity in existing installations in which one puts it into practice. More especially, this treatment does not necessitate any special procedure, and

e. the treatment in accordance with the invention can be effected automatically without the intervention of a workman and it can be incorporated conveniently in existing manufacturing procedures without having to modify them. In particular, since the treatment is applied to a part in the course of hot working or transformation and not on the cold part, it does not necessitate subsequent heating of the part, for example, by passing it through an oven as a separate treatment step.

What is claimed is:

1. A continuous process for forming a protective coating on hot ferrous metals during a hot foundry rolling operation comprising continuously contacting the hot ferrous metal, during hot rolling thereof, with a chemically reducing composition which forms a pellicle when heated, suppresses oxide formation on the surface of the ferrous metal being coated and forms a film through which the surface can be observed, whereby said protective coating is formed upon contact of said composition with said ferrous metal, said chemically reducing composition having the following initial composition, in parts by weight, 17.5 parts CaO, 5.5 parts SiO₂, 1.4 parts Al₂O₃, 0.5 part Fe₂O₃, 1.6 parts MgO, 14 parts B, 0.5 part K and 0.3 part Na.

2. A continuous process for forming a protective coating of hot ferrous metals during a hot foundry rolling operation comprising continuously contacting the hot ferrous metal, during hot rolling thereof, with a chemically reducing composition which forms a pell-
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cle when heated, suppresses oxide formation on the surface of the ferrous metal being coated and forms a film through which the surface can be observed, whereby said protective coating is formed upon contact of said composition with said ferrous metal, said chemically reducing composition having the following initial composition, in parts by weight, 16.0 parts CaO, 4.5 parts SiO₂, 3.6 parts Al₂O₃, 0.8 part Fe₂O₃, 2.4 parts MgO and 17 parts B.

3. A continuous process for forming a protective coating of hot ferrous metals during a hot foundry rolling operation comprising continuously contacting the hot ferrous metal, during hot rolling thereof, with a chemically reducing composition which forms a pellicle when heated, suppresses oxide formation on the surface of the ferrous metal being coated and forms a film through which the surface can be observed, whereby said protective coating is formed upon contact of said composition with said ferrous metal, said chemically reducing composition having the following initial composition, in parts by weight, 25.0 parts CaO, 7.0 parts SiO₂, 4.2 parts Al₂O₃, 1.2 parts Fe₂O₃, 3.2 parts MgO and 17 parts Na.

4. A continuous process for forming a protective coating of hot ferrous metals during a hot foundry rolling operation comprising continuously contacting the hot ferrous metal, during hot rolling thereof, with a chemically reducing composition which forms a pellicle when heated, suppresses oxide formation on the surface of the ferrous metal being coated and forms a film through which the surface can be observed, whereby said protective coating is formed upon contact of said composition with said ferrous metal, said chemically reducing composition having the following initial composition, in parts by weight, 17 parts CaO, 5 parts SiO₂, 5 parts Al, 2 parts Fe₂O₃, 1.8 parts MgO, 37 parts TiO₂ and 2.1 parts Na.

5. A continuous process for forming a protective coating of hot ferrous metals during a hot foundry rolling operation comprising continuously contacting the hot ferrous metal, during hot rolling thereof, with a chemically reducing composition which forms a pellicle when heated, suppresses oxide formation on the surface of the ferrous metal being coated and forms a film through which the surface can be observed, whereby said protective coating is formed upon contact of said composition with said ferrous metal, said chemically reducing composition having the following initial composition, in parts by weight, 22 parts CaO, 4 parts SiO₂, 4 parts Al, 1.5 parts Fe₂O₃, 1.8 parts MgO, 12 parts TiO₂, 10 parts Be and 1.7 parts Na.

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