

Patented Oct. 18, 1949

2,485,061

UNITED STATES PATENT OFFICE

2,485,061

METHOD OF PROTECTING METALLIC SURFACES

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No Drawing. Application March 8, 1946,
Serial No. 653,174

1 Claim. (Cl. 148-6)

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This invention relates to an improved annealing box, and more particularly to inner covers used in connection with hood type annealing furnaces, and still more particularly to a coating composition for such covers.

Annealing boxes formerly used in steel and other metal manufacturing industries usually were in the form of containers employed for the express purpose of preventing direct contact between oxidizing gases of the heating means and the stock being annealed. Two principal types of design were commonly employed: one represented by an upwardly opening box requiring a special lid for closure thereof; and the other substantially resembling a hood which was lowered over the stock to be annealed and rested on a base commonly through the medium of a sand seal or its equivalent.

The above boxes were used principally in connection with stationary annealing furnaces equipped with separate grates for fuel consumption in which the loaded boxes were placed and removed intermittently. Wide temperature variations encountered in this practice, together with the deleterious effect of the highly oxidizing atmosphere of the open flame upon the boxes, caused almost universal adoption to use of heavily ribbed and massive cast iron boxes to provide the necessary strength to resist high temperatures and oxidation or scaling.

Contemporary development of furnace design brought with it a radical departure from the above described method of annealing. The basic difference between the old and new practice consisted in making the annealing charge stationary and moving the furnace proper over it. In this manner it became possible to support enormous loads on a heavy permanent base, protect them from the harmful effects of furnace atmosphere with a comparatively lightweight cover or box subjected to no loads, and place the movable furnace over the whole assemblage.

Seeking further to improve annealing practices the so-called radiant tube type heater has become almost universally adopted as a means of furnishing the desired annealing temperatures and has largely supplanted the older type of open flame heat. However, even with the adoption of the radiant tube heaters, which in a sense eliminated to a certain degree the harmful effects previously encountered from open flame heating, it was found necessary to still use inner covers to maintain a sealed atmosphere around the annealing charge for the purpose of introducing deoxidizing gas therein.

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As a result, the changed function of the annealing cover introduced pronounced changes in design thereof. The new design primarily tended to lighten the cover structure to the utmost in order to secure more rapid transfer of heat to the charge. As a result, today the accepted practice is to fabricate covers from welded together steel sheets which are corrugated for stiffness. Gratifying results are attained by use of the new lighter covers as reflected in increased tonnage annealed and more rapid annealing cycles.

As mentioned previously, adoption of radiant tube type heaters lessened materially the scaling of inner covers, but scaling still occurs and is quite detrimental to the life of the new lightweight covers. Resort has been made to innumerable changes in design including among others the substitution of alloy heat resisting steel portions, and also covers constructed entirely of heat resisting alloys. The extremely light weight of the covers however generally causes them to become deformed when exposed to intensely concentrated heat which requires that they be frequently straightened. All of these facts are detrimental to the life of the covers as reflected in increased operating costs and unsatisfactory performance.

The present invention embodies the discovery that oxidation resistance of inner covers constructed from thin, lightweight ordinary carbon steel sheets is greatly increased by applying to their outside surfaces, i. e., those in contact with heat radiating from the radiant tubes, a mixture composed of graphite and water glass having a definite composition, and applied in a specific manner. When covers so treated are subjected to heat of the annealing process, the applied mixture assumes jet black color and a glaze-like finish apparently entirely impervious to oxidizing gases, thus materially prolonging their useful life.

Practical experience demonstrates the need for maintaining a certain minimum concentration of graphite for any selected combination of sodium silicate and water, depending to some extent upon operating conditions of the annealing furnace. For average temperatures ranging between 1400° F. and 1600° F. in a radiant tube type furnace for instance, a coating mixture containing 18 to 25 pounds of powdered graphite, five gallons of commercial sodium silicate, and five gallons of water, applied to the outer surface of the covers meets the requirements. Lower graphite concentrations lead to an undesirable

light color which the coating mixture assumes when subjected to heat and this impedes heat transfer. Greater concentrations of graphite than the aforementioned 25 pounds interfere with the ease of application of the prepared mixture, is objectionable economically, and leads to the formation of a coating on the treated surfaces of the cover which resists the transfer of heat from the radiant tubes through the cover walls to the charge.

The above specified mixture of the present invention can be applied in any desired manner conducive to a uniform and continuous layer, but preferably it is applied by means of spraying. It has been found that coatings which are too thin do not offer sufficient protection, while excessively heavy coatings will peel off and tend to interfere with evenly distributed and efficient heat transfer. In this respect the covers are sprayed preferably at the rate of substantially one gallon of prepared mixture to each one thousand square feet of cover surface.

Observations leading in part to the presently developed stage of the present invention indicate furthermore that better cover protection is obtained when the mixture is sprayed on a warm cover surface within a temperature range of 400° F. to 700° F. which is representative of the desired temperature. On this account the use of a brush for applying the mixture causes uneven distribution and as a result full benefit is not derived and ultimate cover life will not be secured. The process of dipping covers in the prepared mixture is obviously associated with pronounced mechanical difficulties and is unattractive from a cost standpoint.

Accumulated data support the result that a much better coating adherence and more effective protection is obtained when the graphite bearing film is sprayed on a slightly oxidized surface, in preference to clean metal. In this respect it is preferred to treat covers which have first undergone a weathering period during which a thin oxide film has formed as a natural result of being exposed to the elements.

In introducing the invention to practice there preferably are mixed together thoroughly 20 pounds of powdered graphite and five gallons of water and then while the graphite is still in suspension, there is added five gallons of commercial sodium silicate exemplified by that having a specific gravity of 40° Bé. and a relatively low alkalinity (SiO₂:Na₂O ratio approximately 3.25). While still maintained in an agitated state the mixture described is applied with a spray gun at the rate of one gallon per one thousand square feet of surface to an inner cover heated to a temperature of from 400° F. to 700° F. After water contained in the mixture has evaporated, the sprayed inner cover is placed over the charge and annealed with it, and as a result the sprayed on mixture is transformed into a jet black, glaze-like, tightly adhering coating, and the so treated

cover possesses the inherent qualities of long life and performance of the present invention.

To take fullest advantage of the benefits of the present invention it is preferable to coat inner covers by the method as described immediately after their initial trip to the annealing furnace as this obviously prolongs their life for a greater period of time. Also, in this connection it is more feasible to secure the desired temperature of 400° F. to 700° F. in the covers prior to the spraying operation, as residual heat remaining after the annealing operation is quite sufficient to obtain the ultimate required for spraying.

Plant records have definitely demonstrated that inner covers treated according to the present invention deteriorate at an extremely retarded rate under conventional annealing conditions and can be efficiently utilized for at least twice the length of time as compared to conventional untreated covers, provided the coating is not mechanically injured by careless handling.

I claim:

A method of protecting plain carbon steel inner covers of annealing boxes from oxidation when such covers are heated to annealing temperatures of 1400° to 1600° F. comprising weathering a cover and thereby forming a thin iron oxide film on its surface, heating the cover to an annealing temperature, cooling the cover to a temperature of 400° to 700° F., spraying on the cover surface while at this latter temperature a coating composition consisting of a suspension of powdered graphite in an aqueous solution of sodium silicate, the proportions being 20 to 25 pounds of graphite for each five gallons of sodium silicate and each five gallons of water, the composition being applied approximately in the amount of one gallon per 1000 square feet of cover surface, and re-heating the cover to an annealing temperature.

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