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DRAWING COMPOUND AND METHOD

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This invention relates to the drawing of ferrous metal articles and in particular to a composition for coating the articles to enable them to be drawn. More particularly, it relates to the drawing of articles such as wire, tubing, rod or other stock of variously shaped section.

Heretofore in drawing mills it has been a prerequisite to drawing that the metal be clean, as by being subjected to a conventional acid cleaning or pickling step, the effect of which is to descale the metal. Usually, too, the metal is coated with lime, and in many mills a "sull" coat is applied. For alloy steels, still other steps and coatings have been used.

It is one of the principal objects of this invention to prepare for drawing ferrous metal articles of the kind described and, in so doing, to eliminate the pickling step and all its accompanying disadvantages, such as its expense, difficulty, danger, time consumption, and the serious problem of waste acid disposal. A further significant result of eliminating the pickling step is that hydrogen embrittlement of the metal, an unavoidable effect of pickling, is no longer a problem. Closer control of the tensile strength and torsion of the metal is thus made possible by virtue of the absence of hydrogen embrittlement. The invention, moreover, renders unnecessary the use of lime and "sull" coats and sundry other treating steps.

According to the invention, a ferrous metal article may be prepared for drawing by immersing the undescaled, unlimed article in an aqueous bath comprising about 8% to the saturation percentage of alkali metal borate, by weight, based on the bath, and about 1 to about 20% by weight of titanium dioxide, based on the borate. By "saturation percentage" is meant that amount of borate above which the borate precipitates from the bath. Following such immersion, the article is removed from the bath and dried. Lubricant may then be applied to the article, after which it is subjected to a drawing operation.

The invention further comprises the aqueous bath itself, which contains the foregoing amounts of alkali metal borate and titanium dioxide, the former being dissolved in the bath while the latter is suspended in the same. Still further, the invention comprises the mixture of alkali metal borate and about 1 to about 20% by weight thereof of titanium dioxide, which mixture represents the composition of the coating formed on the surface of the metal article by immersion in the bath and drying.

Considering the invention in greater detail, the ferrous metal that may be treated preferably has a carbon content ranging from about 0.05 to about 0.15%, and may include stainless steel, chrome steel, chrome nickel steel, and other alloy steels. It will be appreciated that the metal is of the kind usually employed in drawing operations.

The alkali metal borates comprise the borates of sodium, potassium, lithium, and ammonium. These borates may be in various forms, as follows: sodium

metaborate, sodium tetraborate, sodium perborate, potassium metaborate, potassium tetraborate, potassium pentaborate, potassium perborate, lithium metaborate, lithium tetraborate, ammonium perborate, ammonium tetraborate, ammonium pentaborate, etc. The amount of chemically bound water which may be associated with these various borates is immaterial so far as the invention is concerned. The preferred borate is sodium tetraborate decahydrate, or borax. The amount of borate which may be employed in the aqueous bath may range from about 8% by weight or lower to the saturation percentage, and preferably from about 8 to about 12% by weight. Amounts above 12% give satisfactory results, but since such results may be obtained by lesser amounts, it is not usually economical to employ more than about 12%. In some cases satisfactory results may be obtained with amounts less than 8%. For titanium dioxide the preferred amount is about 8 to about 10% by weight of the borate.

The bath is prepared by simply adding the borate and titanium dioxide to water. The borate dissolves, while the titanium dioxide forms a suspension which may be maintained by agitation. For satisfactory operation the titanium dioxide should be in a fine state of subdivision prior to introducing it into the bath. The bath may be kept at any suitable temperature, and the metal article is immersed in it for a suitable time, generally for a sufficient time to let the article attain the temperature of the bath, after which the article is removed from the bath and allowed to dry. Desirably, the temperature of the bath is maintained between room temperature or a point just above room temperature, say about 35° C., and the boiling point of the bath solution, and preferably from about 200° F. to the boiling point. A hot bath has the effect of heating the immersed article so that when the article is removed, it tends to dry quickly without need of special equipment; i. e., it is "self--drying." If a hot bath is not desirable for any reason, the article may be immersed in a cooler bath and subsequently dried as by using an air stream, oven or by other suitable means.

As will be understood, the bath solution may also be sprayed or flowed onto the article and drying accomplished as by hot air blasts, infra-red lamps, ovens, etc.

After the article has been dried it has a coating comprising alkali metal borate and 1 to 20% of titanium dioxide, based on the borate. The article may then be coated with a lubricant and cold drawn. As will be understood, the lubricant may be applied to the article while the latter is in the die, or prior thereto. Conventional lubricants may be used such as powdered or granulated, substantially anhydrous, sodium soaps of fatty acids; powdered or granulated soaps of calcium, magnesium or zinc; mixtures of the foregoing soaps with or without powdered lime as a diluent; or similar soaps containing powdered lead. Greases or oils may also be used as lubricants.

In the case of a rod or wire, for example, the drawn product comes through the first die with a smooth, shiny and adherent film. This film, which is usually dark in color, is continuous and permits further continuous multiple drawing without the aid of an additional coating or other treatment. This film is not only a coating which cooperates with the drawing lubricant to promote the progress and efficiency of the drawing operation, but such coating is also a film which becomes attenuated with the work as the drawing progresses and insulates the surface thereof from metal-to-metal contact with the die, preventing damage to the latter and to the work.

If desired, an alkali metal phosphate, alkali metal silicate or alkali metal carbonate may be added to the bath, it having been found that these compounds may have

the effect of a diluent or extender on the resultant coating. Any one or two, or all three of these compounds may be introduced to the bath. Wetting agents in conventional amounts, say up to 1% by weight of the bath, may also be added, if desirable, to aid the action of the bath solution. Such agents may be of the conventional type such as polyethylene fatty esters, polyethylene phenol ethers, fatty acid amides, higher aliphatic and mixed aliphatic-aromatic quaternary ammonium halides; higher aliphatic amines and derivatives of the same, etc.

As an example, an aqueous bath was prepared containing 12% by weight of dissolved borax and 20% by weight of dispersed titanium dioxide, based on the borax (0.6% based on the bath). The bath was heated to boiling, agitated to maintain the suspension, and rod and wire stock were immersed in it for sufficient time to allow the articles to come to the temperature of the bath. The articles were then removed and allowed to air dry without rinsing. In this condition they had a light dry film or coating and were cold drawn directly with a suitable soap lubricant according to normal practice.

It may be stated that both the borate and titanium dioxide are requried in the coating to give satisfactory results. Although borates have heretofore been proposed as coating agents for drawing, it has been found that if the titanium dioxide is not present with the borate, the metal article cannot be drawn successfully; there is scratching and breaking of the article, rapid die wear, die "squealing," and extensive heating of the die. With both borate and titanium dioxide in the coating, the article draws smoothly, quietly, without breakage, and with greatly increased die life. If the article is not drawn immediately after being coated, it may be stored, because the coating will protect it against rusting. It has further been found, in the drawing of stainless steel wire, that the above described method may successfully supplant a previously used method compirsing treatment with sodium hydride, pickling, nitric acid dip, rinsing and drying, followed by a lead or copper coating.

Other advantages are inherent in combining the ingredients of the novel coating. Thus, the borax solution is an efficient vehicle or carrier for the titanium dioxide by procuring its uniform dispersion and deposit on the work. When the coating has been deposited, the ingredients are in a commingled state and coact in response to the pressure in the drawing die to produce a finishing film which has two factors of affinity for the work. First, the latter being mechanically scaled is harder than the acid cleaned or affected type and therefore more difficult to draw. Yet the coaction of the ingredients of the coating under drawing pressure fuses them into a hard film which adheres to the work like an integral part. Second, titanium dioxide is known to contain metallic elements, such as antimony, chromium, columbium, manganese, copper and barium, and these or some of them undergo a flowing or fusing action under the heat and pressure of the drawing operation conducive to the penetration of the coating into the pores of the work and the formation of a coating which is metallic in hardness, black in color and plastic or enamel-like in finish; and the coating is immune to chipping, scraping or checking influences, constituting a hard and protective finish for the work.

In the light of the foregoing description, the following is claimed:

1. The method of treating a ferrous metal article consisting of a rod or wire to condition the same for drawing with the aid of a lubricant, which comprises immersing said article in an aqueous bath containing an alkali metal borate in solution and titanium dioxide in suspension, removing the article from the bath, and drying the article, thereby producing an article coated with a uniformly dispersed solid mixture of alkali metal borate and titanium dioxide.

2. The method of treating a ferrous metal article consisting of a rod or wire to condition the same for drawing with the aid of a lubricant, which comprises immersing said artcle in an aqueous bath containing borax in solution and titanium dioxide in suspension, removing the article from the bath, and drying the article, thereby producing an article coated with a uniformly dispersed solid mixture of alkali metal borate and titanium dioxide.

3. The method of treating a ferrous metal article consisting of a rod or wire to condition said article for drawing with the aid of a lubricant, which comprises immersing said article in an aqueous bath containing an alkali metal borate in solution in an amount between 8% and the saturation percentage of alkali metal borate, based on the bath, and titanium dioxide in suspension in the bath in an amount of 1 to 20%, based on the alkali metal borate, removing the article from the bath, and drying the article, thereby producing an article coated with a uniformly dispersed solid mixture of alkali metal borate and titanium dioxide.

4. In a process for treating an article consisting of stainless steel rod or wire preliminary to drawing with the aid of a lubricant, the improvement which comprises immersing the article in an aqueous bath containing borax in solution and titanium dioxide in suspenson, removing the article from the bath and drying the article, thereby producing an article coated with a uniformly dispersed solid mixture of alkali metal borate and titanium dioxide.

5. A process for treating and drawing with the aid of a lubricant a ferrous metal article consisting of a rod or wire, which comprises immersing the same in an aqueous bath containing an alkali metal borate in solution and titanium dioxide in suspenson, removing the article from the bath, and drying the article, thereby producing an article coated with a uniformly dispersed solid mixture of alkali metal borate and titanium oxide, applying lubricant to the coated article, and subjecting the lubricated coated article to a drawing operation, thereby producing a drawn article with a hard coating having an enamel-like finish.

6. The method of treating a ferrous metal article consisting of a rod or wire to condition the same for drawing with the aid of a lubricant and to insulate the article against metal-to-metal contact with the die in the drawing operation, comprising immersing the article in an aqueous bath containing an alkali metal borate in solution and titanium dioxide in suspension, removing the article from the bath, and drying the article, thereby producing an article coated with a uniformly dispersed solid mixture of alkali metal borate and titanium dioxide.

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